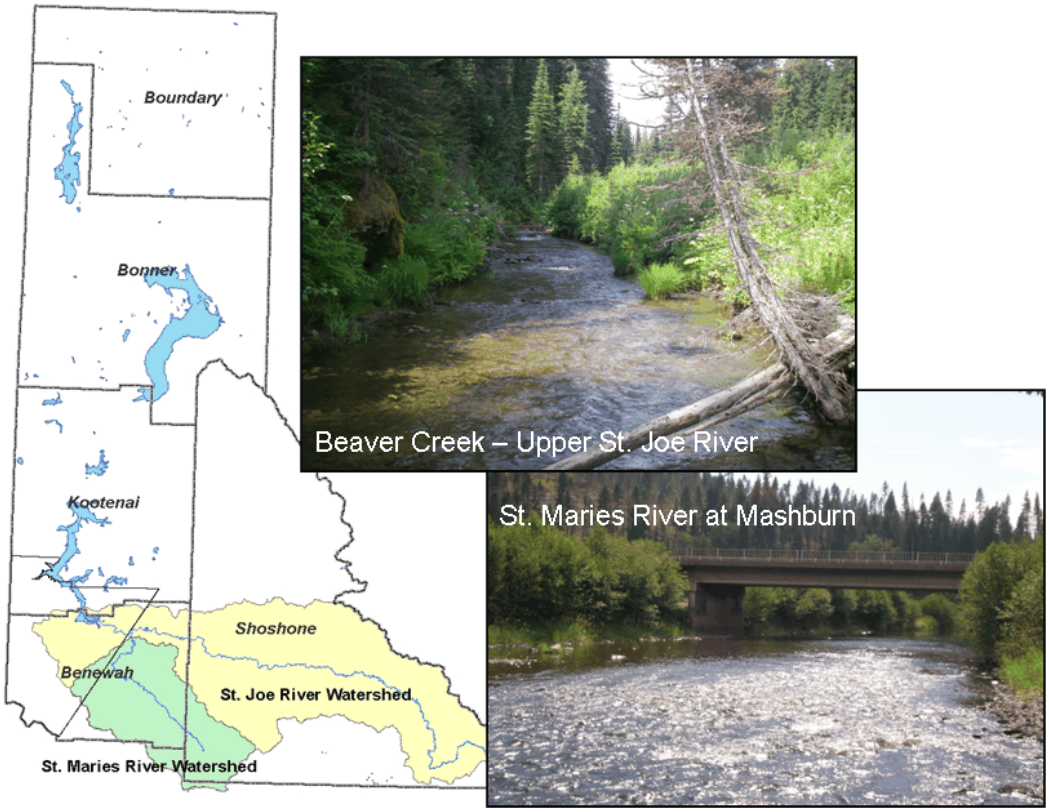
St. Joe River Subbasin
Temperature Total Maximum Daily Loads

Addendum to the
St. Joe River Subbasin Assessment and Total Maximum Daily Loads and
St. Maries River Subbasin Assessment and Total Maximum Daily Loads



Idaho Department of Environmental Quality
September 2011

St. Joe River Subbasin
Temperature Total Maximum Daily Loads

September 2011

Idaho Department of Environmental Quality
Coeur d'Alene Regional Office
2110 Ironwood Parkway
Coeur d'Alene, ID 83814

Idaho Department of Environmental Quality
Technical Services Division
1410 N. Hilton St.
Boise, ID 83706

Acknowledgments

The cover photographs were taken by Tyson Clyne (Idaho Department of Environmental Quality [DEQ]) during field verification of existing shade estimates of Beaver Creek and during a Beneficial Use Reconnaissance Program survey of the St. Maries River at Mashburn.

The completion of this document wouldn't have been possible without help from Mark Shumar from DEQ's Technical Services Division and staff from the DEQ Coeur d'Alene Regional Office. Existing shade estimates in the St. Joe River watershed were field verified with assistance from Valena Berry, Ben Carlson, Kristin Keith, and Kajsa Stromberg. Field verification of shade estimates in the St. Maries River watershed was completed by Mark Shumar and Jennifer Cole (DEQ Technical Services Division).

During the development of this document a watershed advisory group was convened. The St. Joe and St. Maries Rivers Watershed Advisory Group (WAG) provided DEQ with local knowledge of the watersheds, pertinent water quality data, reviewed beneficial uses designations and applicable surface water standards, and also provided comments on draft documents. Public meeting were held every third Friday of the month and were open to the public. Meetings were advertised in local papers and posted to the DEQ webpage. Fourteen (14) meetings have been held to date and meetings will continue into the future to discuss TMDL implementation.

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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
CFR	Code of Federal Regulations
CGP	Construction General Permit
CWA	Clean Water Act
CWE	cumulative watershed effects
DEQ	Idaho Department of Environmental Quality
DMA	designated management agency
EPA	United States Environmental Protection Agency
F	Fahrenheit
ft	feet
GIS	geographic information systems
HUC	hydrologic unit code
IDAPA	Refers to citations of Idaho administrative rules
IDL	Idaho Department of Lands
IPNF	Idaho Panhandle National Forests
kWh	kilowatt hour
LA	load allocation
LC	load capacity
m	meter
MDAT	maximum daily average temperature
MDMT	maximum daily maximum temperature
mi	mile
mi^2	square miles
MOS	margin of safety
MWMT	maximum weekly maximum temperature
n.a.	not applicable
NB	natural background
NPDES	National Pollutant Discharge Elimination System
NREL	National Renewable Energy Laboratory
NSDZ	near stream disturbance zone
PNV	potential natural vegetation
SWPPP	Stormwater Pollution Prevention Plan
TMDL	total maximum daily load
U.S.C.	United States Code
USFS	United States Forest Service
USGS	United States Geological Survey
VRU	vegetation response unit
WAG	watershed advisory group
WLA	wasteload allocation
WWTP	wastewater treatment plant

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 TMDL analysis has been developed to comply with Idaho's TMDL requirements. The TMDL analysis quantifies pollutant sources and allocates the responsibility for load reductions needed to return §303(d)-listed waters to a condition that meets water quality standards. Within the St. Joe River subbasin (hydrologic unit code [HUC] 17010304), water temperature standards were exceeded in 16 assessment units (AUs) in the St. Joe River watershed and 18 AUs in the St. Maries River watershed. TMDLs were developed for these 34 AUs in 2003 (*St. Joe River Subbasin Assessment and Total Maximum Daily Loads* [DEQ 2003a] and *St. Maries River Subbasin Assessment and Total Maximum Daily Loads* [DEQ 2003b]). Following the U.S. Environmental Protection Agency's (EPA's) approval of the TMDLs in 2003, 15 additional AUs were assessed and determined to be exceeding Idaho water quality temperature standards.

This document reviews water bodies in the St. Joe River subbasin that were addressed in the 2003 TMDLs (DEQ 2003a,b) and streams that were identified as exceeding Idaho water quality temperature standards following the completion of TMDLs in 2003. For more information about St. Joe River subbasin characteristics, see the *St. Joe River Subbasin Assessment and Total Maximum Daily Loads* and *St. Maries River Subbasin Assessment and Total Maximum Daily Loads* (DEQ 2003a,b). More information about the water quality listing history, data collection, and impacts to beneficial uses can be found in the Background section of this document.

AUs addressed by an EPA-approved TMDL are reevaluated in this analysis because of new techniques in temperature TMDL development. TMDLs developed in 2003 relied on a mathematical equation to prescribe shade based on elevation to achieve a desired stream temperature. Due to the elevation of the watersheds analyzed, the shade requirements in most locations exceeded 100%. Complete stream shade is not achievable in a natural setting, so those streams addressed by the 2003 TMDLs were reevaluated in this document using potential natural vegetation (PNV) methods (Shumar and de Varona 2009).

Subbasin at a Glance

The St. Joe River subbasin (HUC 17010304) is located in northern Idaho and is the largest tributary to Lake Coeur d'Alene. The majority of the watershed is located in

Benewah and Shoshone Counties, with small portions in Latah, Clearwater, and Kootenai Counties (Figure A). The subbasin contains the towns of St. Maries, Plummer, Santa, Emida, Fernwood, St. Joe City, Calder, Avery, and Clarkia. The subbasin primarily contains two large watersheds, the St. Joe River watershed, above the confluence with the St. Maries River, and the St. Maries River watershed. The watershed sizes are 1,849 and 490 square miles, respectively.

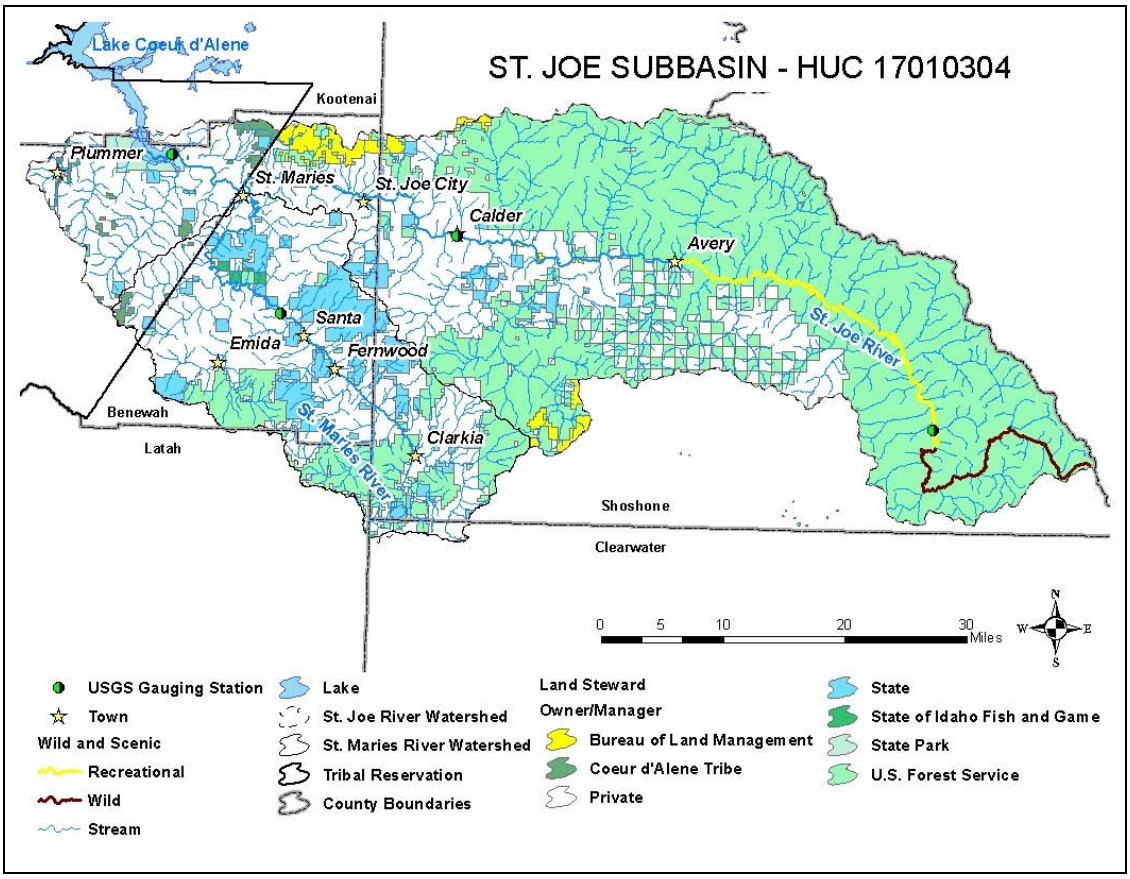


Figure A. St. Joe River subbasin at a glance

The Coeur d'Alene Tribe (Tribe) has CWA authority over a portion of the St. Joe River subbasin (Figure A). The 2001 Supreme Court decision in *Idaho vs. United States* affirmed the Unites States, as trustee, and the Tribe, as beneficiary, hold title to the bed and banks of all the navigable waters lying within current boundaries of the Coeur d'Alene Indian Reservation, which includes portions of the Coeur d'Alene Lake and the St. Joe River, and they are entitled to the exclusive use, occupancy, and right to the quiet enjoyment of those submerged lands (LMP 2009). This court decision gave the Tribe authority to develop water quality standards and other activities associated with implementing the CWA under Tribal law. This document recognizes this ruling and subsequently TMDLs and the associated load allocations were developed only for state waters.

Key Findings

Streams were added to the 1998 §303(d) list of impaired waters by DEQ and EPA for reasons associated with temperature criteria violations. Following completion of the 1998 §303(d) list, Idaho continued to monitor water temperature and, as a result, identified additional streams in the St. Joe River subbasin as failing Idaho water quality temperature standards. DEQ included these additional streams on subsequent §303(d) lists (i.e., in the 2002 and 2008 Integrated Reports).

This TMDL analysis addresses streams included in category 5 (impaired AUs not addressed in a TMDL) of the 2008 Integrated Report (Table A) and streams covered by the 2003 St. Joe River and St. Maries River TMDLs (DEQ 2003a,b) (Table B). These AUs are included in category 4a (streams with an approved EPA TMDL) of Idaho's 2008 Integrated Report.

Table A. Streams evaluated for temperature in the St. Joe River subbasin following completion of the 2003 TMDLs and assessed in this TMDL analysis. (All streams are included in category 5 of the 2008 Integrated Report.)

Stream Name	Assessment Unit
St. Joe River Watershed	
St. Joe River	ID17010304PN027_05
Marble Creek	ID17010304PN031_04
California Creek	ID17010304PN041_02
Medicine Creek	
St. Joe River	
Yankee Bar Creek	
Slate Creek	ID17010304PN062_03
Big Creek	ID17010304PN063_03
East Fork Big Creek	ID17010304PN063_02
St. Maries River Watershed	
Merry Creek	ID17010304PN020_03
Ohlson Creek	ID17010304PN022_02
Gold Center Creek	ID17010304PN019_03
Tyson Creek	ID17010304PN013_03
Carpenter Creek	ID17010304PN014_02
	ID17010304PN014_03
Thorn Creek	ID17010304PN026_03
	ID17010304PN026_02
John Creek	ID17010304PN009_02

Table B. Streams addressed in the 2003 TMDLs and reassessed in this TMDL analysis. (All streams are included in category 4a of the 2008 Integrated Report.)

Stream Name	Assessment Unit
St. Joe River Watershed	
Tank, Harvey and Blackjack Creek	17010304PN027_02
Bear and Little Bear Creek	17010304PN033_02
Fishhook Creek	17010304PN039_03
	17010304PN039_04
Heller Creek	17010304PN041_02 [a]
Sherlock Creek	17010304PN041_02a
East Fork and West Fork Bluff Creek	17010304PN045_02
Bluff Creek	17010304PN045_03
Mosquito Creek	17010304PN046_02
Fly Creek	17010304PN047_02
	17010304PN041_02 [a]
Beaver Creek	17010304PN048_02
Simmons Creek	17010304PN052_02
	17010304PN052_03
Gold Creek	17010304PN053_02
Loop Creek	17010304PN060_02
	17010304PN060_03
St. Maries River Watershed	
St. Maries River—Santa Creek to mouth	17010304PN007_05
St. Maries River—Carpenter Creek to Santa Creek	17010304PN012_05
St. Maries River—confluence of West Fork and Middle Fork St. Maries River to Carpenter Creek	17010304PN015_05
Santa Creek	17010304PN010_02
	17010304PN010_03
	17010304PN010_04
Charlie Creek	17010304PN011_03
Emerald Creek	17010304PN016_02
	17010304PN016_03
West Fork St. Maries River	17010304PN017_02
	17010304PN017_03
	17010304PN017_04
Middle Fork St. Maries River	17010304PN018_02
	17010304PN018_03
	17010304PN018_04
	17010304PN018_05
Gold Center Creek	17010304PN019_02
	17010304PN019_03

[a] AU represents multiple named stream segments.

In this analysis, DEQ established effective shade targets for streams in the St. Joe River subbasin based on the concept of maximum shading under PNV resulting in the lowest possible natural stream temperatures. Shade targets were derived from effective shade curves developed for similar vegetation types in the St. Joe River subbasin. DEQ estimated existing shade from aerial photograph interpretation and performed field verification using a Solar Pathfinder to measure shade at specific locations. Comparing shade targets to estimates of existing shade results in estimates of shade deficits and the amount of shade that must be restored to individual stream reaches.

Five subwatersheds within the St. Joe River watershed were found to be, or assumed to be, meeting TMDL shade targets (Appendix A). Beaver Creek (ID17010304PN048_02), Mosquito Creek (ID17010304PN046_02), Fly Creek (ID17010304PN041_02/ID17010304PN047_02), Heller/Upper Sherlock Creeks (ID17010304PN041_02), and the upper St. Joe River watershed (ID17010304PN041_02) exhibit riparian vegetation communities at or near PNV. These watersheds are relatively unentered and have land-use practices (e.g., lack of roads, timber harvest, or other anthropogenic removal of riparian vegetation) consistent with the development and maintenance of full PNV.

As a result of this temperature TMDL assessment, changes to the listing status of some streams addressed in this report are recommended (Table C). These changes should be reflected during the development of Idaho's next Integrated Report. Six AUs (in five subwatersheds) are meeting TMDL targets and are recommended to be removed from the list of impaired water bodies: Beaver Creek (ID17010304PN048_02), Mosquito Creek (ID17010304PN046_02), Fly Creek (ID17010304PN041_02/ID17010304PN047_02), Heller/Upper Sherlock Creeks (ID17010304PN041_02), and the upper St. Joe River watershed (ID17010304PN041_02). In these AUs, TMDL targets are being met and biological data collected within these watersheds show the attainment of beneficial uses. When assessing new data that indicate full support, only the AU that the monitoring data represents will be removed (de-listed) from the §303(d) list (i.e., removed from category 5 of the Integrated Report).

Table C. Summary of assessment outcomes for temperature-listed assessment units

Water Body Segment	Assessment Unit	Recommended Changes to Integrated Report	Justification
St. Joe River Watershed			
Bear/Little Bear Creek	17010304PN033_02	No change	Not meeting TMDL target
Beaver Creek	17010304PN048_02	Move to category 3	Riparian vegetation is at target
Big Creek and East Fork Big Creek	17010304PN063_02	Move to category 4a	TMDL completed
	17010304PN063_03	Move to category 4a	
Bluff Creek	17010304PN045_02	No change	Not meeting TMDL target
	17010304PN045_03	No change	Not meeting TMDL target
Fishhook Creek	17010304PN039_03	No change	Not meeting TMDL target
	17010304PN039_04	No change	Not meeting TMDL target
Fly Creek	17010304PN047_02	Move to category 2	Riparian vegetation is at target
	17010304PN041_02[a]	Move to category 2	
Gold Creek	17010304PN053_02	No change	Not meeting TMDL target
St. Joe River watershed above Yankee Bar Creek including Neversweat, Yankee Bar, California and Medicine Creeks	17010304PN041_02[a]	Move to category 2	Riparian vegetation is at target
Heller and Sherlock Creek	17010304PN041_02[a]	Move to category 2	Riparian vegetation is at target
	17010304PN041_02a	Move to category 4a	TMDL completed
Loop Creek	17010304PN060_02	No change	Not meeting TMDL target
	17010304PN060_03	No change	
Marble Creek	17010304PN031_04	Move to category 4a	Not meeting TMDL target
Mosquito Creek	17010304PN046_02	Move to category 2	Riparian vegetation is at target
Simmons Creek	17010304PN052_02	No change	Not meeting TMDL target
	17010304PN052_03	No change	

Water Body Segment	Assessment Unit	Recommended Changes to Integrated Report	Justification
Slate Creek	17010304PN062_03	Move to category 4a	Not meeting TMDL target
Tank, Harvey and Blackjack Creek	17010304PN027_02	No change	Not meeting TMDL target
St. Joe River—North Fork St. Joe River to St. Joe City	17010304PN027_05	Move to category 4a	Not meeting TMDL target
St. Maries River Watershed			
John Creek	17010304PN009_02	Move to category 4a	TMDL completed
Santa Creek	17010304PN010_02	No change	Not meeting TMDL target
	17010304PN010_03	No change	
	17010304PN010_04	No change	
Charlie Creek	17010304PN011_03	No change	Not meeting TMDL target
Tyson Creek	17010304PN013_03	Move to category 4a	TMDL completed
Carpenter Creek	17010304PN014_02	Move to category 4a	TMDL completed
Emerald Creek	17010304PN016_02	No change	Not meeting TMDL target
	17010304PN016_03	No change	
West Fork St. Maries River	17010304PN017_02	No change	Not meeting TMDL target
	17010304PN017_03	No change	
	17010304PN017_04	No change	
Middle Fork St. Maries River	17010304PN018_02	No change	Not meeting TMDL target
	17010304PN018_03	No change	
	17010304PN018_04	No change	
	17010304PN018_05	No change	
Gold Center Creek	17010304PN019_02	No change	Not meeting TMDL target
	17010304PN019_03	No change	
Merry Creek	17010304PN020_03	Move to category 4a	TMDL completed
Thorn Creek	17010304PN026_02	Move to category 4a	TMDL completed
	17010304PN026_03	Move to category 4a	
St. Maries River—Santa Creek to mouth	17010304PN007_05	No change	Not meeting TMDL target
St. Maries River—Carpenter Creek to Santa Creek	17010304PN012_05	No change	
St. Maries River—confluence of West and Middle Fork St. Maries River to Carpenter Creek	17010304PN015_05	No change	

[a] AU represents multiple named stream segments.

During this TMDL effort, we also evaluated 20 AUs (15 in the St. Joe River watershed and 5 in the St. Maries River watershed) that are tributaries to stream segments identified as exceeding Idaho water quality temperature standards. The goal of this TMDL and the resulting implementation plan is to achieve natural stream temperatures by restoring or protecting natural stream shading. To achieve natural stream temperatures in the lower stream reaches, tributaries need to exhibit natural stream shade. These 20 AUs lacked stream temperature data to evaluate against Idaho water quality standards and are currently not identified as temperature limited. Modeling of these 20 AUs was done in

this TMDL to help evaluate the watershed as a whole and to help direct implementation actions most likely to reduce stream temperatures (Table D).

Table D. Streams assessed lacking stream temperature data to evaluate Idaho water quality standards

Stream Name	Assessment Unit
St. Joe River Watershed	
Slate Creek—Tributaries to Slate including Dam, Flume, Red Top, Corvus, Fisher, Caim, Binney, Cedar, Fume, Marion, Lumberjack, Fritz, and West Fork Slate Creeks and other 1st- and 2nd–order tributaries	ID17010304PN062_02
Fishhook Creek—Tributaries to Fishhook including Middle, Outlaw, Lick, Wawa, and Horsecamp Creeks and other 1st- and 2nd-order tributaries	ID17010304PN039_02
Tributaries to Marble Creek above Hobo Creek	ID17010304PN035_02
Marble Creek—Delany Creek to Hobo Creek	ID17010304PN035_03
Homestead Creek watershed	ID17010304PN036_02
Hobo Creek—West Fork Hobo and Hobo Creek	ID17010304PN034_02
Marble Creek—Hobo Creek to Bussel Creek	ID17010304PN031_03
Bussel, Toles, Norton, and Lines Creeks	ID17010304PN033_02a
Bussel Creek—Norton Creek to St. Joe River	ID17010304PN033_03
Eagle Creek—North Fork Eagle and Grouse Creek	ID17010304PN032_02
Marble Creek tributaries from Hobo Creek to St. Joe River including Davies, Cranberry, Donkey, and Canyon Creeks	ID17010304PN031_02
Daveggio Creek watershed	ID17010304PN037_02
	ID17010304PN037_03
Boulder Creek watershed	ID17010304PN038_02
	ID17010304PN038_03
St. Maries River Watershed	
Charlie Creek—tributaries including Lemoosh, Lacy, Fagun, Preston, Hume, Ellis, Short, Pumas, Brown, Moolock, Elip, Katsuck, Kimta, and Eena Creeks	ID17010304PN011_02
Carpenter Creek	ID17010304PN014_03[a]
Olson Creek	ID17010304PN022_02[a]
Tyson Creek—North Fork Tyson Creek including other 1st- and 2nd-order tributaries	ID17010304PN013_02
Merry Creek—Mann, Corbett, and Ashenfelter Creeks including other 1st- and 2nd-order tributaries	ID17010304PN020_02

[a] Assessment unit is included in category 5 of the 2008 Integrated Report but is lacking temperature data to determine an exceedance of Idaho water quality criteria; thus, temperature should be removed as a pollutant.

Background

The St. Joe River subbasin (hydrologic unit code [HUC] 17010304) is located in northern Idaho and is the largest tributary to Lake Coeur d'Alene. The majority of the watershed is located in Benewah and Shoshone Counties, with small portions in Latah, Clearwater, and Kootenai Counties (Figure 1). The subbasin contains the towns of St. Maries, Plummer, Santa, Emida, Fernwood, St. Joe City, Calder, Avery, and Clarkia. The subbasin is primarily comprised of two large watersheds, the St. Joe River watershed, above the confluence with the St. Maries River, and the St. Maries River watershed. The watershed sizes are 1,849 and 490 square miles, respectively.[1] Most of the St. Joe River watershed is managed by the U.S. Forest Service (USFS). The St. Maries River watershed has a mix of land owners and managers.

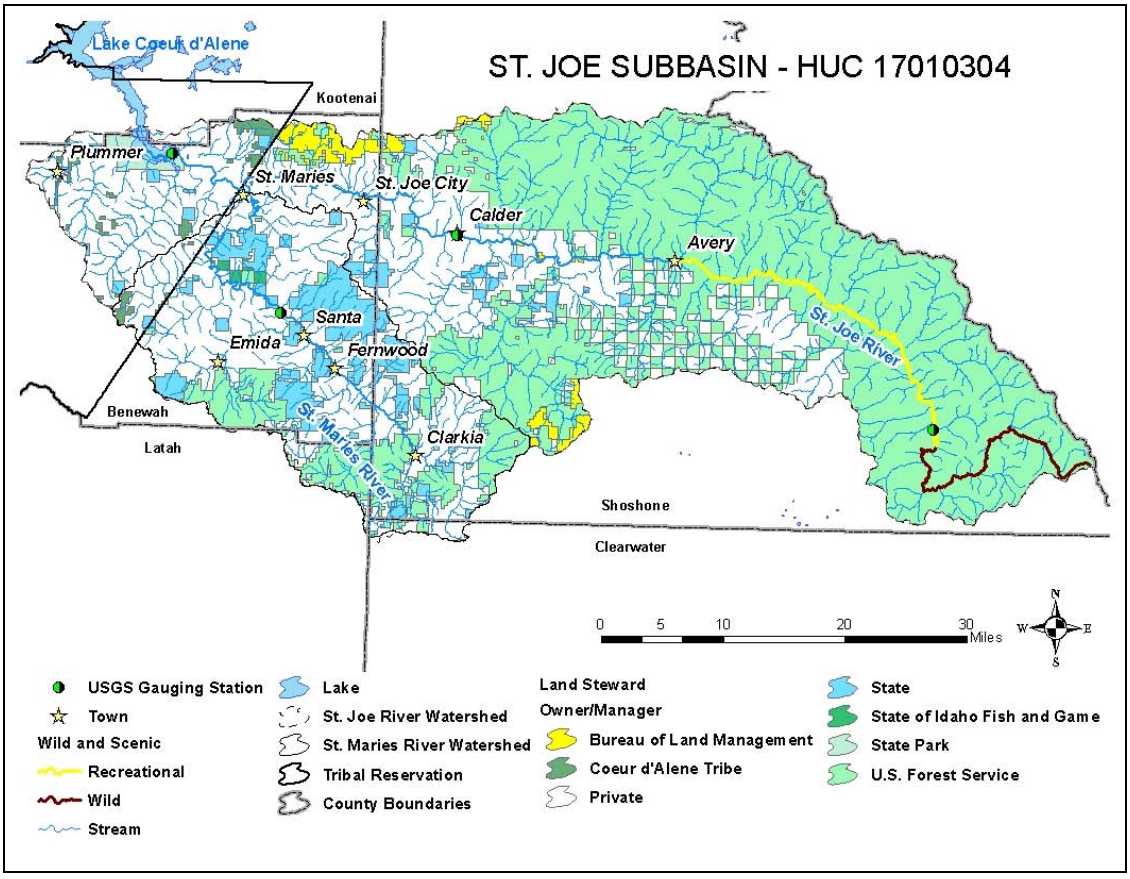


Figure 1. St. Joe River subbasin and landownership

In 2003, the Idaho Department of Environmental Quality (DEQ) conducted subbasin assessments and developed total maximum daily loads (TMDLs) to address sediment, temperature, habitat alternation, nutrient, bacteria, and dissolved oxygen impairments in both watersheds of the subbasin. Those documents, the *St. Joe River Subbasin*

[1] For a unit conversion chart, see Appendix B.

Assessment and Total Maximum Daily Loads and *St. Maries River Subbasin Assessment and Total Maximum Daily Loads* (DEQ 2003a,b), contain full subbasin assessments and details on water quality conditions. This addendum contains updated information on temperature conditions in streams of the St. Joe River subbasin, beneficial use support and status related to temperature, and TMDLs for temperature. Following the background information in this section, the temperature TMDLs are presented in section 5. Section 5 is the typical section number reserved for the actual TMDLs within subbasin assessment and TMDL documents. As such, the section numbering has been retained in this addendum.

The St. Joe River above the town of Avery (confluence with North Fork St. Joe River) was designated as Wild and Recreational by the National Wild and Scenic Rivers System on November 10, 1978; 39.7 miles are classified as Recreational and 26.6 miles are classified as Wild. Wild and Scenic Rivers are designated by the U.S. Congress or Secretary of the Interior and provide certain protection from development in order to protect the environmental and socio-economic importance of the rivers. The Wild and Scenic Rivers Act declares a national policy to preserve certain rivers and their immediate environments, maintain free-flowing conditions, protect water quality, and fulfill other vital national conservation purposes. This protection ensures that the river will be protected for the benefit and enjoyment of present and future generations. The Wild and Scenic Rivers Act defines Wild and Recreational rivers as follows:

> *Wild river areas—Those rivers or sections of rivers that are free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and waters unpolluted. These represent vestiges of primitive America.*
>
> *Recreational river areas—Those rivers or sections of rivers that are readily accessible by road or railroad, that may have some development along their shorelines, and that may have undergone some impoundment or diversion in the past.* (Wild and Scenic Rivers Act § 1273)

Regardless of the classification, each designated river is administered with the goal of non-degradation and enhancement of the values warranting designation (Haubert 1998). The Wild and Scenic portion of the St. Joe River is currently managed by the USFS. The USFS is directed by the Wild and Scenic Rivers Act to manage the river in such a way as to protect and enhance the values that made the St. Joe River eligible for the designation but not to limit other uses that do not substantially interfere with public use and enjoyment of these values.

Water Quality Listing History

Idaho's 1998 §303(d) list included all streams identified by DEQ and the U.S. Environmental Protection Agency (EPA) as exceeding water quality standards. The 1998 §303(d) list identified 23 streams within the St. Joe River subbasin as exceeding Idaho water quality temperature standards (Table 1).

Table 1. Streams of the St. Joe River subbasin included on the 1998 §303(d) list due to excess stream temperature

Stream Name	Applicable Stream Boundaries
St. Joe River Watershed	
Beaver Creek[a]	Headwaters to mouth
Bluff Creek[a]	Headwaters to mouth
Fishhook Creek[a]	Headwaters to mouth
Fly Creek[a]	Headwaters to mouth
Heller Creek[a]	Headwaters to mouth
Loop Creek[a]	Headwaters to mouth
Mosquito Creek[a]	Headwaters to mouth
Simmons Creek[a]	Headwaters to mouth
Gold Creek	East Fork Gold Creek to St. Joe River
Tank Creek	Headwaters to St. Joe River
Harvey Creek	Headwaters to St. Joe River
Blackjack Creek	Headwaters to St. Joe River
Bear Creek	Headwaters to Marble Creek
Little Bear Creek	Headwaters to Big Bear Creek
St. Maries River Watershed	
West Fork St. Maries River	Headwaters to St. Maries River
Emerald Creek	Confluence of East and West Forks to St. Maries River
East Fork Emerald Creek[a]	Headwaters to mouth
St. Maries River[a]	Headwaters to mouth
Middle Fork St. Maries River[a]	Headwaters to St. Maries River
Santa Creek	Headwaters to St. Maries River
Gold Center Creek	Windy Creek to Middle Fork St. Maries River
Flewsie Creek	Headwaters to Middle Fork St. Maries River
Gramp Creek	Headwaters to Gold Center Creek

[a] Added to the 1998 §303(d) list by the U.S. Environmental Protection Agency

DEQ and other agencies within the St. Joe River subbasin have continued to collect water temperature data since 1998. Since the completion of the 1998 §303(d) list, water temperature data collected within the subbasin have shown additional exceedances of Idaho water quality standards, and the associated assessment units (AUs) have been added to subsequent §303(d) lists of impaired waters (Table 2). AUs included in category 5 on the 2002 Integrated Report were addressed in previous TMDLs and have been moved to category 4a of the 2008 Integrated Report.

Table 2. Streams included in the 2002 and 2008 Integrated Report due to excess stream temperature

Stream Name	Assessment Unit
St. Joe River Watershed	
2002 Integrated Report Category 5 Waters Exceeding Temperature Criteria	
Beaver Creek	ID17010304PN048_02
Big Creek	ID17010304PN063_02
	ID17010304PN063_03
Bluff Creek	ID17010304PN045_03
Bussel Creek	ID17010304PN033_02
Fishhook Creek	ID17010304PN039_02
	ID17010304PN039_03
	ID17010304PN039_04
Fly Creek	ID17010304PN047_02

Stream Name	Assessment Unit
Gold Creek	ID17010304PN053_02
Loop Creek	ID17010304PN060_02
	ID17010304PN060_03
Marble Creek	ID17010304PN031_04
Mosquito Creek	ID17010304PN046_02
North Fork St. Joe River	ID17010304PN061_03
Simmons Creek	ID17010304PN052_02
	ID17010304PN052_03
Slate Creek	ID17010304PN062_03
St. Joe River – North Fork St. Joe River to St. Maries River	ID17010304PN027_05
Tank, Harvey and Blackjack Creek	ID17010304PN027_02
St. Joe River – Yankee Bar to Heller Creek	ID17010304PN041_03
Tributaries to St. Joe River above North Fork St. Joe River	ID17010304PN041_02
2008 Integrated Report Category 5 Waters Exceeding Temperature Criteria	
St. Joe River – North Fork St. Joe River to St. Maries River	ID17010304PN027_05
Marble Creek – Hoodo Creek to mouth	ID17010304PN031_04
St. Joe River watershed above Yankee Bar Creek including Neversweat, Yankee Bar, California and Medicine Creeks	ID17010304PN041_02
St. Joe River – Yankee Bar to Heller Creek	ID17010304PN041_03[a]
Slate Creek	ID17010304PN062_03
Big Creek	ID17010304PN063_02
	ID17010304PN063_03
St. Maries River Watershed	
2002 Integrated Report Category 5 Waters Exceeding Temperature Criteria	
Beaver Creek	ID17010304PN025_02
Carpenter Creek	ID17010304PN014_02
	ID17010304PN014_03
Charlie Creek	ID17010304PN011_03
Emerald Creek	ID17010304PN016_02
	ID17010304PN016_03
Gold Center Creek	ID17010304PN019_02
	ID17010304PN019_03
Merry Creek	ID17010304PN020_03
Middle Fork St. Maries River	ID17010304PN018_02
	ID17010304PN018_03
	ID17010304PN018_04
	ID17010304PN018_05
Olson Creek	ID17010304PN022_02
Renfro Creek	ID17010304PN024_02
	ID17010304PN024_03
Santa Creek	ID17010304PN010_02
	ID17010304PN010_03
	ID17010304PN010_04
St. Maries River—Carpenter Creek to Santa Creek	ID17010304PN012_05
St. Maries River—confluence of West Fork and Middle Fork St. Maries River to Carpenter Creek	ID17010304PN015_05
Thorn Creek	ID17010304PN026_02
	ID17010304PN026_03
Tyson Creek	ID17010304PN013_03
West Fork St. Maries River	ID17010304PN017_03

Stream Name	Assessment Unit
	ID17010304PN017_04
2008 Integrated Report Category 5 Waters Exceeding Temperature Criteria	
John Creek	ID17010304PN009_02
Tyson Creek	ID17010304PN013_03
Carpenter Creek	ID17010304PN014_02
	ID17010304PN014_03[a]
Merry Creek	ID17010304PN020_03
Olson Creek	ID17010304PN022_02[a]
Thorn Creek	ID17010304PN026_02
	ID17010304PN026_03

[a] Assessment units are lacking temperature data to determine an exceedance of Idaho water quality criteria and thus temperature should be removed as a pollutant.

AUs define all the waters of the state of Idaho. These units and the methodology used to develop them can be found in the *Water Body Assessment Guidance, Second Edition* (WBAG II) (Grafe et al. 2002). AUs are groups of similar streams that have similar land-use practices, ownership, or land management. Stream order, however, is the main basis for determining AUs—even if ownership and land use change significantly, an AU remains the same for a stream of the same order.

Using AUs to describe water bodies offers many benefits, primarily that all the waters of the state are defined consistently. In addition, using AUs fulfills the fundamental requirement of the EPA-required §305(b) report, a component of the Clean Water Act (CWA) wherein states report on the condition of all the waters of the state.

Current Assessment and Data Sources

The current analysis addresses water bodies in the St. Joe River subbasin that were addressed in the 2003 TMDLs (DEQ 2003a,b) and streams that were identified as exceeding Idaho water quality temperature standards following the completion of TMDLs in 2003 (Tables 3 and 4). For more information about St. Joe River subbasin characteristics, see the *St. Joe River Subbasin Assessment and Total Maximum Daily Loads* and *St. Maries River Subbasin Assessment and Total Maximum Daily Loads* (DEQ 2003a,b).

AUs addressed by an EPA-approved TMDL are reevaluated in this document because of new techniques in temperature TMDL development. TMDLs developed in 2003 relied on a mathematical equation to prescribe shade based on elevation to achieve a desired stream temperature. Due to the elevation of the watersheds analyzed, the shade requirements in most locations exceeded 100%. Complete stream shade is not achievable in a natural setting, so those streams addressed by the 2003 TMDLs were reevaluated in this document using potential natural vegetation (PNV) methods (Shumar and de Varona 2009).

Table 3. Streams evaluated for temperature in the St. Joe River subbasin following completion of the 2003 TMDLs and assessed in this TMDL analysis. (All streams are included in category 5 of the 2008 Integrated Report.)

Stream Name	Assessment Unit
St. Joe River Watershed	
St. Joe River	ID17010304PN027_05
Marble Creek	ID17010304PN031_04
California Creek	ID17010304PN041_02
Medicine Creek	
St. Joe River	
Yankee Bar Creek	
Slate Creek	ID17010304PN062_03
Big Creek	ID17010304PN063_03
East Fork Big Creek	ID17010304PN063_02
St. Maries River Watershed	
Merry Creek	ID17010304PN020_03
Ohlson Creek	ID17010304PN022_02
Gold Center Creek	ID17010304PN019_03
Tyson Creek	ID17010304PN013_03
Carpenter Creek	ID17010304PN014_02
	ID17010304PN014_03
Thorn Creek	ID17010304PN026_03
	ID17010304PN026_02
John Creek	ID17010304PN009_02

Table 4. Streams addressed in the 2003 TMDLs and reassessed in this TMDL analysis. (All streams are included in category 4a of the 2008 Integrated Report.)

Stream Name	Assessment Unit
St. Joe River Watershed	
Tank, Harvey and Blackjack Creek	17010304PN027_02
Bear and Little Bear Creek	17010304PN033_02
Fishhook Creek	17010304PN039_03
	17010304PN039_04
Heller Creek	17010304PN041_02
Sherlock Creek	17010304PN041_02a
East Fork and West Fork Bluff Creek	17010304PN045_02
Bluff Creek	17010304PN045_03
Mosquito Creek	17010304PN046_02
Fly Creek	17010304PN047_02
	17010304PN041_02
Beaver Creek	17010304PN048_02
Simmons Creek	17010304PN052_02
	17010304PN052_03
Gold Creek	17010304PN053_02
Loop Creek	17010304PN060_02
	17010304PN060_03
St. Maries River Watershed	
St. Maries River—Santa Creek to mouth	17010304PN007_05
St. Maries River—Carpenter to Santa Creek	17010304PN012_05
St. Maries River—confluence of West Fork and Middle Fork	17010304PN015_05
Santa Creek	17010304PN010_02
	17010304PN010_03
	17010304PN010_04
Charlie Creek	17010304PN011_03
Emerald Creek	17010304PN016_02
	17010304PN016_03
West Fork St. Maries River	17010304PN017_02
	17010304PN017_03
	17010304PN017_04
Middle Fork St. Maries River	17010304PN018_02
	17010304PN018_03
	17010304PN018_04
	17010304PN018_05
Gold Center Creek	17010304PN019_02
	17010304PN019_03

For a full list of data sources used to complete this TMDL analysis, please see Appendix C. Appendix D will contain the public comments received on the draft TMDL document following the 30-day comment period. The distribution list for the final document can be found in Appendix E.

Water Temperature and Aquatic Life

Elevated steam temperatures can be harmful to fish at all life stages, especially if those temperatures occur in combination with other habitat limitations such as low dissolved oxygen or poor food supply. Acceptable temperature ranges vary for different species of

fish, with coldwater species being the least tolerant of high water temperatures. For adult fish, long-term elevated temperature can result in reduced body weight, reduced oxygen exchange, increased susceptibility to disease, and reduced reproductive capacity. Acutely high temperatures can result in death if they persist for an extended length of time. Juvenile fish are even more sensitive than adult fish to temperature variations and can experience negative impacts at a lower threshold value, manifesting in altered growth rates. High temperatures also affect embryonic development of fish before they emerge from the substrate. Similar kinds of affects may occur with aquatic invertebrates, amphibians, and mollusks, although less is known about these species.

Temperature standards were developed to protect coldwater fisheries and other coldwater organisms (Appendix F). Native coldwater fishes in the St. Joe subbasin include westslope cutthroat trout, bull trout, and mountain whitefish.

For these TMDLs, temperature criteria for protection of cold water aquatic life and salmonid spawning beneficial uses have been applied throughout the subbasin. Criteria for the protection of bull trout beneficial use have been applied in applicable watersheds as defined by state and federal criteria. Assessments found widespread exceedances of Idaho numeric water temperature criteria, particularly for salmonid spawning.

Stream temperature data collected and/or assessed on the 12 additional AUs following the completion of TMDLs in 2003 were evaluated against the cold water aquatic life, spring and fall salmonid spawning, and bull trout beneficial uses. Stream temperature data loggers were deployed following the methodologies outlined by DEQ to ensure the data collected is representative of the location and to help eliminate sampling error (DEQ 2000c) (Figure 2). The elevation at which the data logger was deployed was taken into consideration when evaluating the salmonid spawning windows. Future efforts to monitor stream water temperature should follow the same protocols.

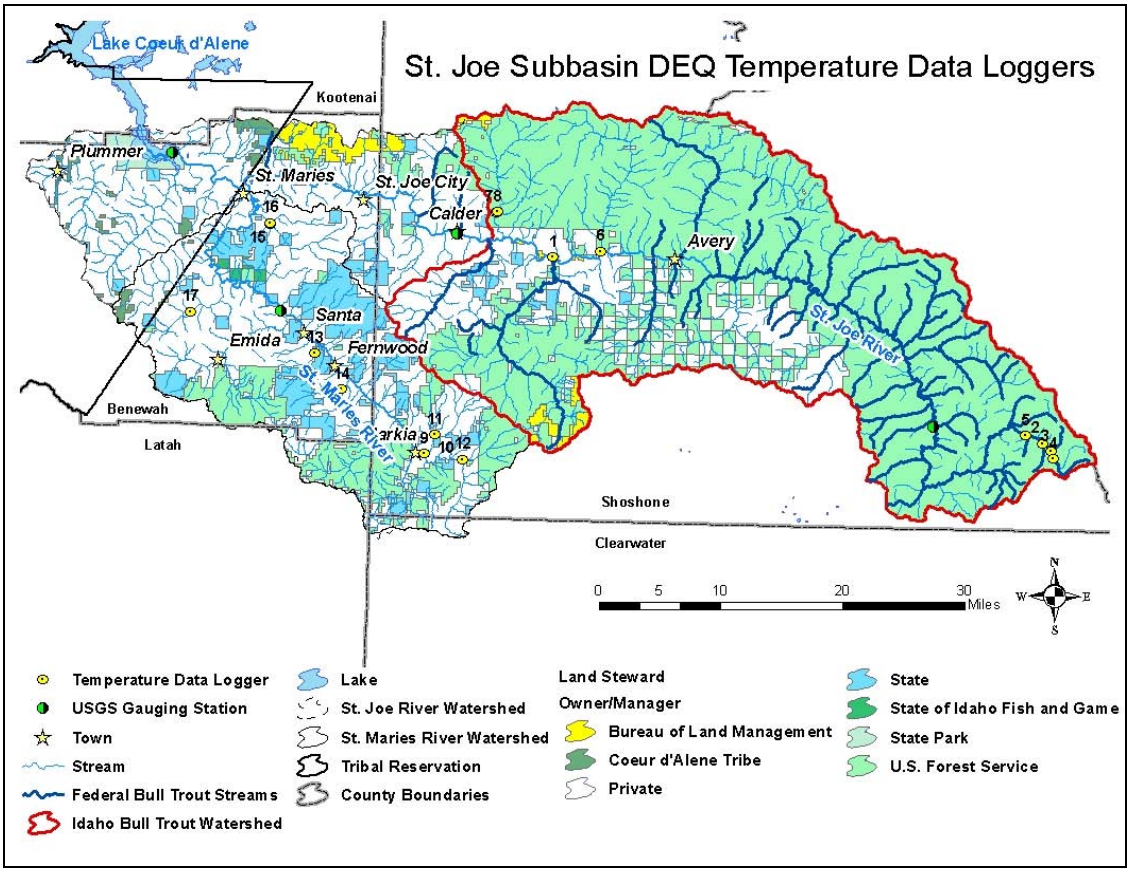


Figure 2. St. Joe River subbasin temperature data logger locations

All of the evaluated streams exceeded one or more temperature criteria (Tables 5 and 6). Salmonid spawning water temperature criteria were developed to protect native salmonid species during spawning and incubation periods. The DEQ Coeur d'Alene Regional Office set the general spawning and incubation windows with assistance from the Idaho Department of Fish and Game to better reflect and protect salmonid spawning and incubation in north Idaho. The adjusted spawning and incubation windows account for differences in elevation. The elevation-based spawning windows for north Idaho are as follows:

- Greater than 4,000 feet (1,220 meters)—July 1 through July 31
- 3,000–4,000 feet (914–1,220 meters)—May 15 through July 15
- Less than 3,000 feet (914 meters)—May 1 through July 1

Native salmonid species of the St. Joe River subbasin include westslope cutthroat trout, mountain whitefish, and bull trout. Westslope cutthroat trout are spring spawning salmonids; mountain whitefish and bull trout are both fall spawning salmonids.

Bull trout criteria were evaluated to assess Idaho and federal water quality temperature compliance in designated watersheds (Table 6). Data within the identified bull trout watersheds also showed violations of the temperature criteria. The applicable Idaho criteria to protect bull trout spawning and rearing is 13 °C (55 °F) maximum weekly

maximum temperature (MWMT) and 9 °C (48 °F) maximum daily average temperature (MDAT). Rearing criteria is applied June 1–August 31, and spawning criteria are applied September 1–October 31. The federal standard is a 7-day average temperature (MWMT) not to exceed a daily maximum of 10 °C (50 °F) and is applied June 1–September 30.

All temperature data collected and evaluated in this report exceeded the Idaho and federal bull trout criteria with the exception of the Medicine Creek temperature logger (ID #1998SCDATL0026) and the California Creek temperature logger (ID #1998SCDATL0024) (Table 6). Medicine Creek passed both the Idaho and federal standards, while California Creek failed the Idaho standard but passed the federal standard. Medicine and California Creeks are both located near the headwaters of the watershed and have a high mean elevation. Both watersheds also have little to no riparian vegetation disturbance.

It is currently DEQ's policy to allow for minor exceedances of water quality temperature criteria when the exceedance occurs less than 10% of the critical time period and there is no other evidence of thermal inputs (Grafe et al. 2002). Exceptions are also made for water temperature exceedances that occur during periods when air temperatures exceed the 90th percentile of air temperatures recorded in the area (Grafe et al. 2002). The data evaluated in Tables 5 and 6, with the exception of Medicine Creek, exceed the salmonid spawning criteria by more than 10%.

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

DEQ is currently seeking to change the water quality criteria by removal of the salmonid spawning 9°C maximum daily average temperature. If this change were to occur, all AUs assessed in this document exceed the 13°C maximum weekly maximum temperature and still require TMDL development (Table 5).

Table 5. Temperature data evaluated in the St. Joe River subbasin following completion of the St. Joe and St. Maries Rivers total maximum daily loads in 2003. (All assessment units are in category 5 of the 2008 Integrated Report.)

Stream Name	Assessment Unit	Map ID[a]	Temperature Logger ID	Number of Spring Spawning Dates Evaluated	Percent Exceedance of Spring Spawning Dates (%)		Number of Fall Spawning Dates Evaluated	Percent Exceedance of Fall Spawning Dates (%)	
					13 °C MWMT[b]	9 °C MDAT[c]		13 °C MWMT[b]	9 °C MDAT[c]
Marble Creek	ID17010304PN031_04[d]	1	1998SCDATL0021	0	0	0	76	64	83
California Creek	ID17010304PN041_02[d]	2	1998SCDATL0024	36	0	47	76	8	38
Medicine Creek	ID17010304PN041_02[d]	3	1998SCDATL0026	36	0	0	76	0	0
Upper St. Joe River	ID17010304PN041_02[e]	4	1998SCDATL0028	36	44	72	76	39	63
Yankee Bar Creek	ID17010304PN041_02[d]	5	1998SCDATL0029	3	31	50	66	41	52
Slate Creek	ID17010304PN062_03[e]	6	1998SCDATL0031	0	0	0	76	64	83
Big Creek	ID17010304PN063_03[e]	7	1998SCDATL0032	0	0	0	76	66	84
East Fork Big Creek	ID17010304PN063_02[e]	8	1998SCDATL0033	0	0	0	76	64	83
Merry Creek	ID17010304PN020_03	9	2002SCDATL0008	19	37	84	61	72	84
West Fork Merry Creek	ID17010304PN020_03	10	2002SCDATL0011	19	11	68	61	7	79
Corbett Creek (Merry Creek 1)	ID17010304PN020_03	11	2002SCDATL0007	19	32	84	61	44	80
Gold Center Creek	ID17010304PN019_03	12	2002SCDATL0001	19	0	5	61	82	84
Tyson Creek	ID17010304PN013_03	13	2002SCDATL0002	18	100	100	61	75	85
Carpenter Creek	ID17010304PN014_02	14	2002SCDATL0004	18	94	100	61	82	98
Thorn Creek	ID17010304PN026_03[f]	15	2002SCDATL0010	16	94	100	61	56	84
Canyon Creek	ID17010304PN026_02	16	2002SCDATL0003	16	94	100	61	59	84
John Creek	ID17010304PN009_02	17	2002SCDATL0000	16	88	100	61	72	84

[a] See Figure 2 for map location
[b] MWMT = maximum weekly maximum temperature
[c] MDAT = maximum daily average temperature
[d] Assessment unit within state and federal bull trout watershed
[e] Assessment unit within state bull trout watershed
[f] Assessment unit within federal bull trout watershed

Table 6. Bull trout temperature criteria evaluation for temperature loggers in bull trout watersheds

Stream Name	Assessment Unit	Map ID[a]	Temp Logger ID	Idaho Criteria				Federal Criteria	
				Number of Rearing Days Evaluated	Percent Exceedance Rearing Days (%) 13 °C MWMT[b]	Number of Spawning Days Evaluated	Percent Exceedance of Fall Spawning Days (%) 9 °C MDAT[c]	Number of Days Evaluated	Percent Days Exceeding 10 °C MWMT[a] (%)
Marble Creek	ID17010304PN031_04	1	1998SCDATL0021	31	100	32	64	76	100
California Creek	ID17010304PN041_02	2	1998SCDATL0024	31	13	50	22	91	9
Medicine Creek	ID17010304PN041_02	3	1998SCDATL0026	21	0	50	0	91	0
Saint Joe River	ID17010304PN041_02	4	1998SCDATL0028	31	71	50	34	n.a.	n.a.
Yankee Bar Creek	ID17010304PN041_02	5	1998SCDATL0029	31	48	35	34	91	32
Slate Creek	ID17010304PN062_03	6	1998SCDATL0031	31	100	50	64	n.a.	n.a.
Big Creek	ID17010304PN063_03	7	1998SCDATL0032	46	100	50	66	n.a.	n.a.
East Fork Big Creek	ID17010304PN063_02	8	1998SCDATL0033	31	100	50	64	n.a.	n.a.
Thorn Creek	ID17010304PN026_03	15	2002SCDATL0010	n.a.	n.a.	n.a.	n.a.	101	91

[a] See Figure 2 for map location
[b] MWMT = maximum weekly maximum temperature
[c] MDAT = maximum daily average temperature

During this TMDL effort, we also evaluated 20 AUs (15 in the St. Joe River watershed and 5 in the St. Maries River watershed) that are tributaries to stream segments identified as exceeding Idaho water quality temperature standards. The goal of this TMDL and the resulting implementation plan is to achieve natural stream temperatures by restoring or protecting natural stream shading. To achieve natural stream temperatures in the lower stream reaches, tributaries need to have natural stream shade. These 20 AUs lacked stream temperature data to evaluate Idaho water quality standards and are currently not identified as temperature limited. Modeling of these 20 AUs was done in this TMDL to help evaluate the watershed as a whole and to help direct implementation actions most likely to reduce stream temperatures (Table 7).

Table 7. Streams assessed lacking stream temperature data to evaluate Idaho water quality standards

Stream Name	Assessment Unit
St. Joe River Watershed	
Slate Creek—Tributaries to Slate including Dam, Flume, Red Top, Corvus, Fisher, Caim, Binney, Cedar, Fume, Marion, Lumberjack, Fritz, and West Fork Slate Creeks and other 1st- and 2nd–order tributaries	ID17010304PN062_02
Fishhook Creek—Tributaries to Fishhook including Middle, Outlaw, Lick, Wawa, and Horsecamp Creeks and other 1st- and 2nd-order tributaries	ID17010304PN039_02
Tributaries to Marble Creek above Hobo Creek	ID17010304PN035_02
Marble Creek—Delany Creek to Hobo Creek	ID17010304PN035_03
Homestead Creek watershed	ID17010304PN036_02
Hobo Creek—West Fork Hobo and Hobo Creek	ID17010304PN034_02
Marble Creek—Hobo Creek to Bussel Creek	ID17010304PN031_03
Bussel, Toles, Norton, and Lines Creeks	ID17010304PN033_02a
Bussel Creek—Norton Creek to St. Joe River	ID17010304PN033_03
Eagle Creek—North Fork Eagle and Grouse Creek	ID17010304PN032_02
Marble Creek tributaries from Hobo Creek to St. Joe River including Davies, Cranberry, Donkey, and Canyon Creeks	ID17010304PN031_02
Daveggio Creek watershed	ID17010304PN037_02
	ID17010304PN037_03
Boulder Creek watershed	ID17010304PN038_02
	ID17010304PN038_03
St. Maries River Watershed	
Charlie Creek—tributaries including Lemoosh, Lacy, Fagun, Preston, Hume, Ellis, Short, Pumas, Brown, Moolock, Elip, Katsuck, Kimta, and Eena Creeks	ID17010304PN011_02
Carpenter Creek	ID17010304PN014_03[a]
Olson Creek	ID17010304PN022_02[a]
Tyson Creek—North Fork Tyson Creek including other 1st- and 2nd-order tributaries	ID17010304PN013_02
Merry Creek—Mann, Corbett, and Ashenfelter Creeks including other 1st- and 2nd-order tributaries	ID17010304PN020_02

[a] Assessment unit is included in category 5 of the 2008 Integrated Report but is lacking temperature data to determine an exceedance of Idaho water quality criteria; thus, temperature should be removed as a pollutant.

St. Joe River Mainstem

The St. Joe River from the North Fork St. Joe River to the St. Maries River is discussed in detail because of its size and hydraulic differences from the other water bodies discussed in this document. The lower St. Joe River (ID17010304PN027_05) from the North Fork St. Joe River to the confluence with the St. Maries River has been identified as exceeding Idaho water quality temperature criteria and has been included in category 5 of Idaho's Integrated Report since 2002. Beneficial uses for this section of the river are designated as cold water aquatic life, salmonid spawning, primary contact recreation, domestic water supply, and as a special resource water. Water quality temperature criteria are applied to protect cold water aquatic life and salmonid spawning.

Water temperature data collected in 1998, 1999, 2000, and 2001 at the U.S. Geological Survey (USGS) gaging station (12414500) near Calder, Idaho, indicate exceedances of both cold water aquatic life and salmonid spawning water quality criteria (Tables 8, 9, and 10). Temperature data was collected during the summer months but not all data sets spanned the critical time period. The number of days within the critical time period that were used to evaluated water quality criteria varied each year. The data partial data sets contained enough information to assess and evaluate compliance with Idaho water quality standards (Grafe et al. 2002).

Table 8. Cold water aquatic life water temperature criteria evaluation for the St. Joe River at Calder, Idaho

Dates of Available Temperature Data	Days Evaluated in Critical Time Period	22 °C MDMT[a]		19 °C MDAT[b]	
		Days Exceeding	Percent Exceeding 31-day Critical Time Period (%)	Days Exceeding	Percent Exceeding 31-day Critical Time Period (%)
7/29–10/5, 1998	18	12	39	17	55
5/11–9/30, 1999	31	0	0	2	6
5/04–10/16, 2000	31	14	45	17	55
7/26–9/30, 2001	21	13	42	14	45

a MDMT = maximum daily maximum temperature
b MDAT = maximum daily average temperature

Table 9. Spring salmonid spawning water temperature criteria evaluation for the St. Joe River at Calder, Idaho

Dates of Available Temperature Data	Days Evaluated in Critical Time Period	13 °C MDMT[a]		9 °C MDAT[b]	
		Days Exceeding	Percent Exceeding 31-day Critical Time Period (%)	Days Exceeding	Percent Exceeding 31-day Critical Time Period (%)
7/29–10/5, 1998	No data within critical time period	-	-	-	-
5/11–9/30, 1999	51	0	0	2	6
5/04–10/16, 2000	28	9	29	23	74
7/26–9/30, 2001	No data within critical time period	-	-	-	-

a MDMT = maximum daily maximum temperature
b MDAT = maximum daily average temperature

Table 10. Fall salmonid spawning water temperature criteria evaluation for the St. Joe River at Calder, Idaho

Dates of Available Temperature Data	Days Evaluated in Critical Time Period	13 °C MDMT[a]		9 °C MDAT[b]	
		Days Exceeding	Percent Exceeding 31-day Critical Time Period (%)	Days Exceeding	Percent Exceeding 31-day Critical Time Period (%)
7/29–10/5, 1998	51	47	51	51	55
5/11–9/30, 1999	46	40	43	42	46
5/04–10/16, 2000	62	28	30	44	48
7/26–9/30, 2001	46	46	50	46	50

a MDMT = maximum daily maximum temperature
b MDAT = maximum daily average temperature

The St. Joe River upstream of the confluence with Mica Creek is designated as a bull trout water body in the Idaho bull trout conservation plan and included in the larger AU identified as temperature limited. Water temperature data collected at the USGS gauging station is outside of the designated Idaho bull trout watershed but the AU identified as temperature limited extends into an identified bull trout water (Batt 1996). Temperature data collected at the gauging station exceeds all applicable bull trout water temperature criteria (Table 11).

Table 11. Idaho bull trout water temperature criteria evaluation for the St. Joe River at Calder, Idaho

Dates of Available Temperature Data	Days Evaluated in Critical Time Period	13 °C MDMT[a] Rearing		Days Evaluated in Critical Time Period	9 °C MDAT[b] Spawning	
		Days Exceeding	Percent Exceeding 92-day Critical Time Period (%)		Days Exceeding	Percent Exceeding 61-day Critical Time Period (%)
7/29–10/5, 1998	34	34	37	35	35	57
5/11–9/30, 1999	92	37	40	30	26	43
5/04–10/16, 2000	92	25	27	45	28	46
7/26–9/30, 2001	37	37	40	30	31	51

a MDMT = maximum daily maximum temperature
b MDAT = maximum daily average temperature

Water temperature data were collected at this location only during summer months (Figure 3). The horizontal lines in Figure 3 represent the water temperature water quality criteria and the date range in which they are applied (for cold water aquatic life, salmonid spawning, and bull trout spawning and rearing). Water temperatures outside of the summer months are not within the critical time period for aquatic life impacts (Grafe et al. 2002). The critical time periods applied to the data collected are as follows:

- Cold water aquatic life—July 15 through August 15
- Spring salmonid spawning below 3,000 feet—May 1 through July 1
- Fall salmonid spawning—August 15 through November 15
- Idaho bull trout rearing—June 1 through August 31
- Idaho bull trout spawning—September 1 through October 31

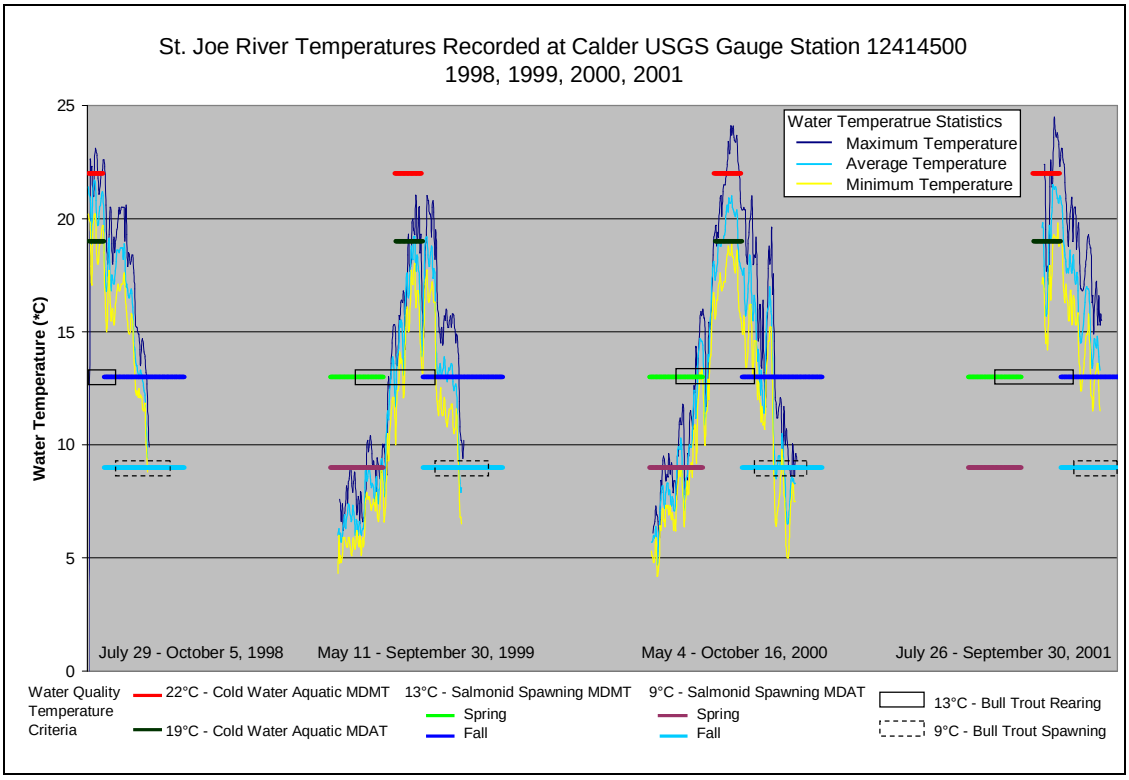


Figure 3. St. Joe River temperatures recorded at Calder, Idaho, USGS gaging station 12414500

The St. Joe River is different from the other water bodies discussed in this document because of its size and differing flow regimes—swift water above St. Joe City, Idaho, and slack water impounded by the Post Falls hydroelectric dam on the Spokane River below St. Joe City. The PNV methodology is generally applied to streams with a width of 50 meters (164 feet) or less. The St. Joe River below St. Joe City ranges in width from approximately 80 to 95 meters (270 to 300 feet), while the river above St. Joe City ranges in width from approximately 45 to 75 meters (145 to 250 feet). Applying PNV methodology to the river above St. Joe City is the upper limit to which riparian vegetation can impact stream temperature.

The height of riparian vegetation adjacent to larger rivers is only able to shade the near-bank areas, a relatively small area when compared to shade provided to narrower streams. However, this shading and cover should not be overlooked; it cools near-bank water, provides for fish cover and habitat, and sustains a vital ground water / surface water connection.

The St. Joe River below St. Joe City, Idaho, to the confluence with the St. Maries River is included as part of the AU (ID17010304PN027_05) that is identified as exceeding water quality criteria. This portion of the river is impacted by the hydroelectric dam operated in Post Falls, Idaho, along the Spokane River by Avista Utilities. The St. Joe River is elevated 8 feet above its normal (pre–dam construction) summer elevation. The artificial elevation of water has caused the river to become wider than natural and lose near-stream vegetation due to river bank erosion. These modifications have caused an increase in river surface area, allowing for more solar loading.

Idaho water quality standards recognize the impacts dams have on water bodies and allow for variances from water quality standards in these situations (IDAPA 58.01.02.260). Because the dam is altering the natural width of the river and the naturally occurring near-steam vegetation, the dam operation is precluding the attainment of the applicable water quality standards and targets set in this TMDL (IDAPA 58.01.02.206.01.6.iv).

This section of the river, although designated for salmonid spawning, is not consistent with salmonid spawning habitat. However, this section of river is used by native cutthroat and bull trout as a migratory route to tributaries streams that are used for spawning. For these reasons, local land managers and owners should take care to protect the riparian communities in an effort to reduce stream temperatures as much as possible.

Due to this distinct change in river process caused by the Post Falls dam, AU ID17010304PN027_05 should be split at St. Joe City during Idaho's next Integrated Report cycle. This split would create two AUs and be more representative of beneficial uses. The new AUs would include the mid St. Joe River reach from the confluence with the North Fork St. Joe River to St. Joe City, and the lower reach from St. Joe City to the confluence with the St. Maries River. PNV TMDL methodology is applied to the mid reach in this temperature TMDL, and the lower reach is recommended to be moved to category 3 (unassessed waters) during Idaho's next Integrated Report cycle.

5. Total Maximum Daily Loads

A TMDL prescribes an upper limit on discharge of a pollutant from all sources so as to ensure water quality standards are met. It further allocates this load capacity among the various sources of the pollutant. Pollutant sources fall into two broad classes: point sources, each of which receives a wasteload allocation, and nonpoint sources, each of which receives a load allocation. Natural background, when present, is considered part of the load allocation 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 be a part of the TMDL. In practical terms, 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. Calculation of the load capacity can be summarized by the following equation:

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

where:

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

The equation is written in this order because it represents the logical order in which a load analysis is conducted. First the load capacity is determined. Then the load capacity is broken down into its components. To calculate the allocation to pollutant sources, the necessary margin of safety and natural background, if relevant, are determined and subtracted from the load capacity; the remainder is allocated among pollutant sources (LC – MOS – NB = LA + WLA). When the breakdown and allocation are completed, the result is a TMDL, which must equal the load capacity.

The load capacity must be based on critical conditions—the conditions under which water quality standards are most likely to be violated. If protective under critical conditions, a TMDL will be more than protective under other conditions. The warm summer months of April through September are considered the key period in this TMDL when critical conditions (i.e., elevated stream temperatures) may occur. These months coincide with salmonid spawning and rearing and represent the time when stream temperatures are most likely to be elevated and impair this beneficial use.

Another step in a load analysis is the quantification of current pollutant loads by source. This quantification allows necessary load reductions to be specified as percentages of current conditions, considers equities in load reduction responsibility, and is necessary for pollutant trading to occur. A load is fundamentally a quantity of a pollutant discharged over some period of time and is the product of concentration and flow. Due to the diverse nature of various pollutants, and the difficulty of strictly dealing with loads, the federal rules allow for "other appropriate measures" to be used when necessary. These "other measures" must still

be quantifiable and relate to water quality standards, but they allow flexibility to deal with pollutant loads in more practical and tangible ways. The rules also recognize the particular difficulty of quantifying nonpoint loads and allow "gross allotment" as a load allocation where available data or appropriate predictive techniques limit more accurate estimates. For certain pollutants whose effects are long term, such as sediment and nutrients, EPA allows for seasonal or annual loads (Water Quality Planning and Management, 40 CFR Part 130).

5.1 In-stream Water Quality Targets

The PNV approach was used in the development of the temperature TMDLs discussed in this document. The Idaho water quality standards include a provision (IDAPA 58.01.02.200.09) specifying 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 for temperature, the natural level of shade and channel width become the target of the TMDL. The in-stream temperature that results from attaining these conditions is consistent with the water quality standards, even if it exceeds numeric temperature criteria. See Appendix F for further discussion of water quality standards and background provisions.

The PNV approach is described below. Additionally, the procedures and methodologies to develop PNV target shade levels and to estimate existing shade levels are described in Shumar and de Varona (2009). For a more complete discussion of shade and its effects on stream water temperature, see the *South Fork Clearwater Subbasin Assessment and Total Maximum Daily Load* (DEQ and EPA 2003) and *The Potential Natural Vegetation (PNV) Temperature Total Maximum Daily Load (TMDL) Procedures Manual* (Shumar and de Varona 2009).

Potential Natural Vegetation for Temperature TMDLs

There are several important contributors of heat to a stream, including ground water temperature, air temperature, and direct solar radiation (Poole and Berman 2001). Of these, direct solar radiation is the source of heat that is most likely to be controlled or manipulated. The parameters that affect the amount of solar radiation hitting a stream throughout its length are shade and stream morphology. Shade is provided by the surrounding vegetation and other physical features such as hillsides, canyon walls, terraces, and high banks. Stream morphology affects how closely riparian vegetation grows together and water storage in the alluvial aquifer. Streamside vegetation and channel morphology influence shade and are most likely to have been influenced by anthropogenic activities that can be most readily corrected and addressed by a TMDL.

Depending on how much vertical elevation surrounds the stream, vegetation further away from the riparian corridor can 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 provided to a stream in a number of ways. One way to is measure effective shade (i.e., that shade provided by all objects that intercept the sun as it makes its way across the sky), which can be measured in a given spot with a Solar Pathfinder (or other optical equipment), a device 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 or estimated using aerial photographs. In addition to shade, canopy

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

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

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

Existing shade levels were estimated from visual interpretation of aerial photographs. 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 shade curves, which were selected by analyzing probable vegetation at the streams and comparing that to shade curves developed for similar vegetation communities. A shade curve shows the relationship between effective shade and stream width. As a stream gets wider, stream shade decreases as the adjacent vegetation has less ability to shade the center of wide streams. As the vegetation gets taller, the plant community is able to provide more shade at any given channel width.

Existing and PNV shade levels were converted to solar loads from data collected on flat-plate collectors at the nearest National Renewable Energy Laboratory (NREL) weather stations collecting these data. In this analysis, data from the Spokane, Washington, and Kalispell, Montana, stations were 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 F). PNV shade and the associated target solar loads are assumed to be the natural condition; thus, stream temperatures under PNV conditions are assumed to be natural (so long as there are no point sources or any other anthropogenic sources of heat in the watershed) and are thereby considered to be consistent with the Idaho water quality standards.

Aerial Photograph Interpretation

Existing stream shade levels were estimated using aerial photographs and geographic information system (GIS) software. The software allowed the user to view high-resolution aerial photography on a computer screen along with other information such as streams, topography, monitoring locations, road networks, and other useful mapping information.

Stream shade levels were estimated by zooming the aerial photo to its highest resolution, other viewing photographs taken in the area, and relying on best professional judgment developed while working in the field.

Estimates of shade based on plant type and natural breaks in vegetation density were marked out on a 1:100,000 or 1:250,000 national hydrography dataset. Each interval was assigned a single value representing the bottom of a 10% shade class (adapted from the cumulative watershed effects [CWE] process [IDL 2000]). For example, if the estimated shade for a particular stream interval was between 50 and 59%, a shade class of 50% would be assigned to that stream interval. The estimate is based on a general observation of the aerial photos and best professional judgment about the kind of vegetation present, its density, and the width of the stream. Streams where the banks and water are clearly visible are usually in low shade classes (10%, 20%, or 30%). Streams with dense forest or heavy brush where no portion of the stream is visible are usually in high shade classes (70%, 80%, or 90%). More open canopies where portions of the stream may be visible usually fall into moderate class intervals (40%, 50%, or 60%).

It is important to note that visual shade estimates made from aerial photographs are strongly influenced by canopy cover. It is not always possible when using this method to visualize or anticipate shade characteristics resulting from topography and landform. However, research as shown that canopy cover and shade are similar based on research conducted by the Oregon Department of Environmental Quality (OWEB 2001), reinforcing the idea that riparian vegetation and objects proximal to the stream provide the most shade.

The visual estimates of shade in this TMDL were field verified with a Solar Pathfinder at 20 sites in the St. Joe River watershed and 26 sites in the St. Maries River watershed. The pathfinder measures the current effective shade and takes into consideration other physical features that block the sun from hitting the stream surface (e.g., hillsides, canyon walls, terraces, and man-made structures).

Pathfinder Methodology

The Solar Pathfinder is a device that allows one to trace the outline of shade-producing objects on monthly solar path charts. The percentage of the sun's path covered by these objects is the effective shade on the stream at the spot where the trace is made. In order to adequately characterize the effective shade on a stream segment, ten traces were taken at systematic intervals along the length of the stream in question.

At each sampling (i.e., trace-making) location, the Solar Pathfinder was placed in the middle of the stream at about the bankfull water level following the manufacturer's instructions. Systematic sampling was used because it is easiest to accomplish and does not bias the location of sampling. For each sampled reach, the sampler started at a unique location (such as 50 to 100 meters from a bridge or fence line) and then proceeded upstream or downstream stopping to take additional traces at fixed intervals (e.g., every 50 meters, every 50 paces, etc.).

When possible, the sampler also measured bankfull widths, photographed the landscape, and took notes while taking Solar Pathfinder traces. This documentation helps show changes in riparian plant communities and what kinds of plant species (the large, dominant, shade-producing ones) are present.

Stream Morphology

Measures of current bankfull width or near stream disturbance zone (NSDZ) width (the human-caused disturbance area between riparian vegetation) may not reflect widths that were present under natural conditions. As impacts to streams and riparian areas occur, width-to-depth ratios tend to increase such that streams become wider and shallower. Shade produced by vegetation covers a smaller percentage of the water surface in wider streams, and widened streams can also have less vegetative cover if shoreline vegetation has been eroded away.

Stream width alteration (i.e., NSDZ or bankfull width) may not be discernable from the aerial photograph work described previously. Accordingly, stream width must be estimated from available information. DEQ uses regional curves for the major basins in Idaho, developed with data compiled by the Idaho Department of Lands (Figure 4), to estimate natural bankfull width.

For each stream evaluated in the load analysis, natural bankfull width was estimated based on the drainage area of the Clearwater River curve (Figure 4). Although estimates from other curves were examined (i.e., Spokane, Kootenai, Pend Oreille), the Clearwater River curve was ultimately chosen because of the river's proximity to the St. Joe River watershed and the similarity of its geomorphic and weather characteristics to those of the St. Joe River watershed. Additionally, existing width data were evaluated and compared to these curve-based estimates when such data were available. However, bankfull width data from Beneficial Use Reconnaissance Program (BURP) survey locations represent only spot data (i.e., three measured widths in a reach several hundred meters long) that are not always representative of the stream as a whole.

In general, we found DEQ existing bankfull width data agreed with bankfull width estimates based on the Clearwater River basin curve and chose not to use natural width values any smaller than these estimates. Tables containing natural bankfull width estimates for each stream in each subwatershed are presented in Appendix G and H. The load analysis tables (Appendices I and J) contain a natural stream width and an existing stream width for every stream segment in the analysis based on the bankfull width results presented in Appendix G and H.

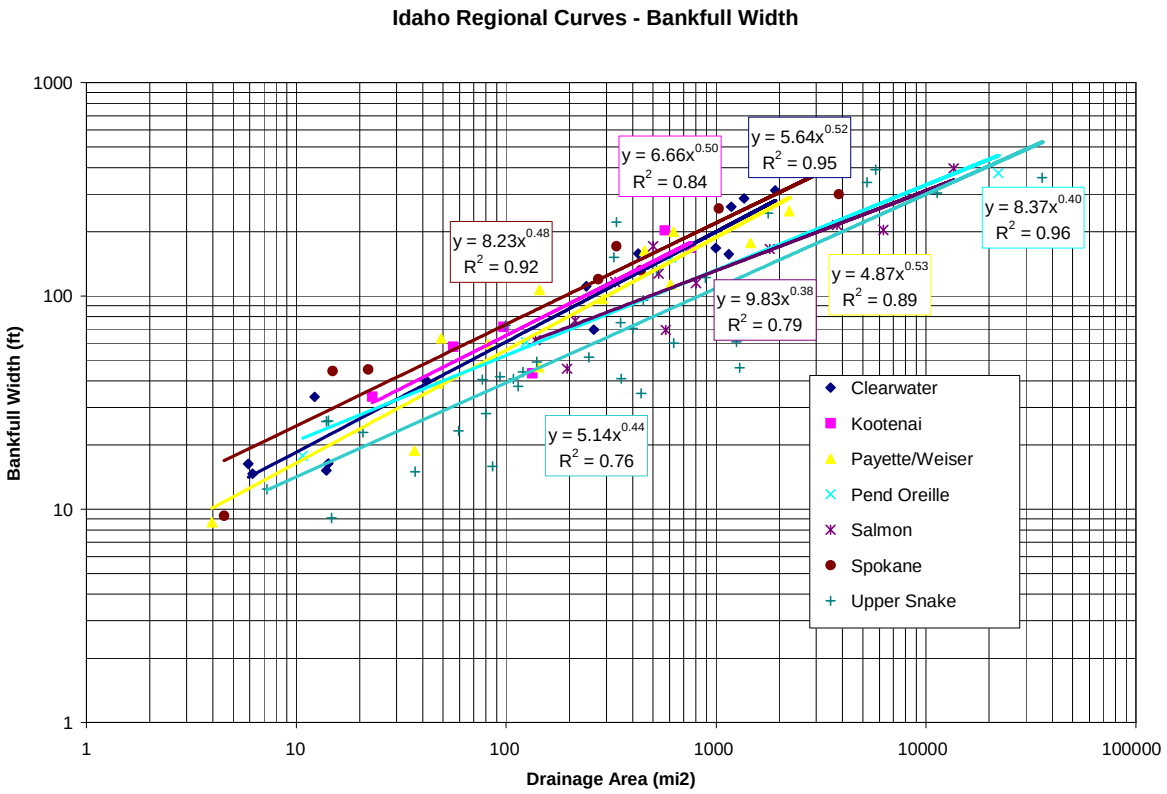


Figure 4. Bankfull width as a function of drainage area

Pollutant Load Development

The St. Joe River subbasin is located in the Northern Rockies Level III Ecoregion (McGrath et al. 2001). The Northern Rockies Ecoregion is known for extensive forests of Douglas-fir, subalpine fir, Engelmann spruce, western larch, lodgepole pine, and ponderosa pine, as well as Pacific indicator trees such as western redcedar, western hemlock, mountain hemlock, and grand fir. Pacific indicator trees are more numerous here than in the Idaho Batholith to the south (i.e., Lochsa River and south). Western white pine was once common in this ecoregion but is now all but gone due to blister rust, historic logging, and ecological changes caused by fire suppression (McGrath et al. 2001). Whitebark pine is also undergoing major declines in the region due to blister rust, pine bark beetles, and fire.

Shade Target Selection

For the Idaho Panhandle National Forests (IPNF), which include the St. Joe National Forest in the St. Joe River subbasin, the USFS has assembled natural vegetation groups into 11 vegetation response units (VRUs) that can be grouped into four basic forest types (A–D) based on temperature and moisture (Table 11). Group A is characterized by warm, dry forests (VRUs 1, 2, and 3). Group B is warm, moist forests (VRUs 4, 5, and 6). Group C is cool, moist forests (VRUs 7 and 8), while Group D is cold, dry forests (VRUs 9, 10, and 11). VRUs are ecological units of land having similar capabilities and potential for management and sharing similarities regarding soils, hydrologic function, landform and topology, lithology, climate, air quality, and natural processes (e.g., nutrient and biomass cycling,

succession, productivity, and fire regimes) (Shumar and de Varona 2009). These groupings have become the basis for the development of shade curves used in this document (Shumar and de Varona 2009). Detailed maps of the vegetation response units and the areas to which they were applied in the TMDL can be found in Appendix G for the St. Joe River watershed and Appendix H for the St. Maries River watershed.

Table 11. Potential natural vegetation basic forest types

Forest Type	Vegetation Response Units	Forest description
Group A	1, 2, and 3	This group contains the warmer and drier habitat types. These areas include warm, dry grasslands to moderately cool and dry upland sites. The dry, lower elevation open ridges are composed of Douglas-fir and ponderosa pine in well-stocked and fairly open-growing conditions. Moderately moist upland areas and dense draws also include larch and lodgepole pine, with lesser amounts of ponderosa pine. While the growing season is fairly long, high solar inputs and moderately shallow soils often result in soils that dry out early in the growing season, which results in low to moderate site productivity.
Group B	4, 5, and 6	This group occupies most of the moist sites along benches and stream bottoms. The moderating effects of the inland maritime climate ecologically influence this group. This group is widespread throughout the forest and has the most biological productivity. Douglas and grand fir, lodgepole and ponderosa pine, western larch, western red cedar, and quaking aspen commonly occur within the vegetation group.
Group C	7 and 8	This group contains the moist, lower subalpine forest setting and is common on the northwest- to east-facing slopes, riparian and poorly drained subalpine sites, and moist forest pockets. Vegetation productivity is moderate to high as a result of the high moisture-holding capacity and nutrient productivity of loess deposits, adequate precipitation, and a good growing season.
Group D	9, 10, and 11	This group is typified by cool and moderately dry conditions with moderate solar input. The local climate is characterized by a short growing season with early summer frosts. Due to generally shallow soils, slope position, and aspect, soil moisture is often limited during late summer months. This group is generally found on rolling ridges and upper reaches of convex mountain slopes. Subalpine fir, lodgepole pine, and Engelmann spruce are dominant tree species within this vegetation group.

Each forest group is composed of differing proportions of tree species (Table 12). The composition is important to the potential for providing shade and is unique to specific areas of the watershed based on the descriptions above.

Table 12. Coniferous vegetation composition for forest groups A through D

Tree species	Composition (%)			
	Group A	Group B	Group C	Group D
Ponderosa pine	22	2	—	—
Western white pine	—	40	11	—
Western larch	10	20	12	—
Douglas-fir	67	11	5	—
Grand fir/Western hemlock	—	10	—	—
Western redceder	—	8	—	—
Lodgepole pine	1	9	20	25
Subalpine fir	—	—	52	60
White bark pine	—	—	—	15

Forest groups A–D are used to describe coniferous forests. Two additional groups—called non-forest group 1 and 2—are used to describe areas with a mix of coniferous and hardwood trees species (described in more detail below). Although these groups are identified as "non-forest," they actually have a substantial tree component.

Shade Curves

To determine PNV shade targets, effective shade curves from the St. Joe National Forest groups were examined (see Figures G-86 through G-91 in Appendix G and Figures H-43 through H-48 in Appendix H). These curves were produced using vegetation community modeling of Idaho plant communities. Effective shade curves include percent shade on the vertical axis and stream width on the horizontal axis and reflect the fact that as a stream becomes wider, a given vegetation type loses its ability to shade wider and wider streams (Figure 5). Target shade values are assigned as a unique integer and not rounded down to a 10% shade class as the existing shade estimates are.

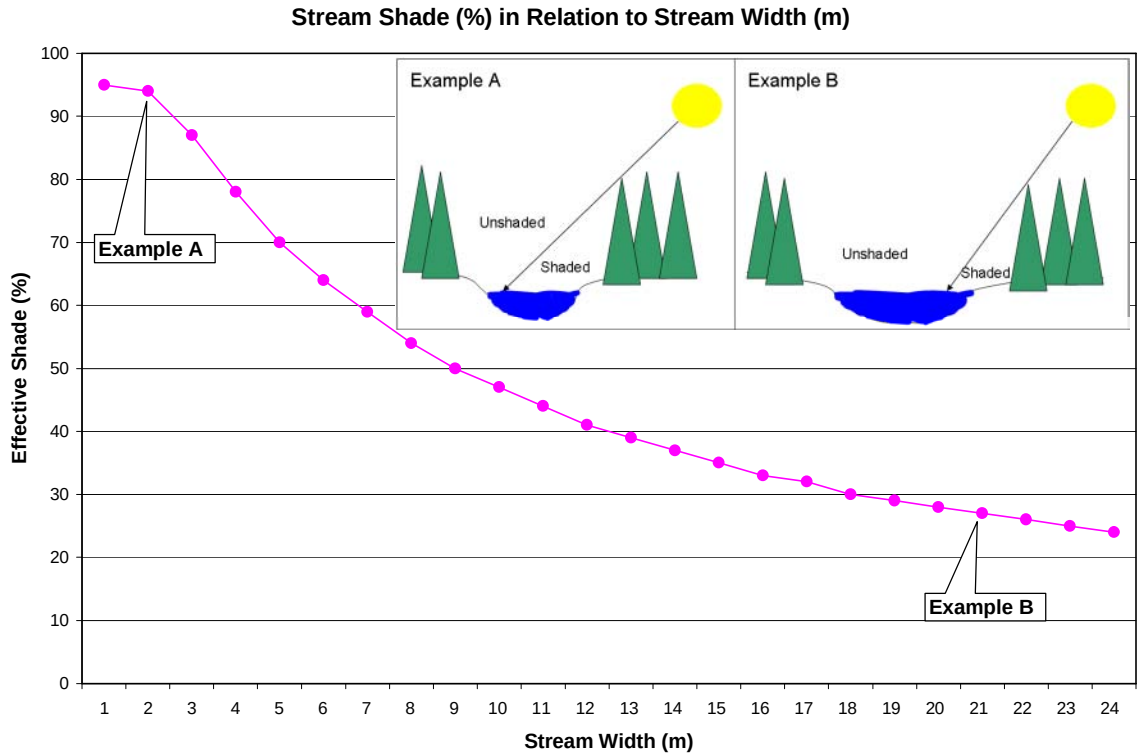


Figure 5. Example relationship between stream width and shade

Shade curves are used to assign target shade values for streams based on stream order and gradient. Stream order and gradient values for each subwatershed in the analysis are available in Appendices G and H.

Forest shade curves represent coniferous tree species and were used for stream reaches in both watersheds with a stream gradient of 3% or greater unless field documentation or aerial photograph interpretation suggested differently. Table 13 presents shade values for various stream widths for all four forest groups (A–D).

For streams with low gradients (<3%), a shade curve for non-forest group 1 was used rather than forest shade curves. It is expected that as streams transition from higher-elevation forests to lowlands that stream valleys will widen and stream gradients will decrease, resulting in meanders. Coniferous forest vegetation often gives way to deciduous hardwood species (e.g., alder, birch, and cottonwood) under such conditions due to flooding, deposition, and perennially wet soils. These hardwood shade curves were developed for northern Idaho forests based on hardwood species found in the region (see Shumar and de Varona 2009).

Lower-order streams (1st through 4th) with gradients of 3% or less received target shade values based on the non-forest group 1 (Figure G-90 in Appendix G and Figure H-47 in Appendix H), a curve based on a riparian community of Sitka alder (70% canopy cover) with some larch and Douglas-fir (5% canopy cover each). Higher order rivers (5th), received shade targets based on the non-forest group 2 curve (Figure H-48 in Appendix H), a curve based on black cottonwood, alder, and a variety of coniferous species. The non-forest

group 2 curve was only applied in the St. Maries River watershed. Table 13 includes shade values for various stream widths in the non-forest group 2 found in the St. Maries River watershed and shade values for the non-forest group 1 curve.

In some areas of the upper St. Joe River watershed burned during the 1910 fire, willows have become the dominant riparian species. These willow communities were noted by DEQ during field work in summer 2010. Application of the willow shade curve was limited to only those areas known to harbor a willow community (Figure G-91 in Appendix G). Table 13 includes target shade values for various stream widths in the willow vegetation type.

Table 13. Shade targets for the all vegetation types at various stream widths

Stream width (meters)	Average shade (%)						
	Non-forest Group 1	Willow	Forest				Non-forest Group 2
			Group A	Group B	Group C	Group D	
1	94	78	95	98	98	96	94
2	93	71	94	98	97	96	88
3	85	57	87	97	96	94	79
4	74	46	78	96	94	91	70
5	65	39	70	94	92	85	64
6	58	34	64	92	89	79	58
7	52	30	59	91	85	73	54
8	47	27	54	88	79	67	50
9	43	24	50	83	74	63	47
10	40	22	47	79	69	59	43
11	37	20	44	74	65	55	41
12	34	19	41	70	61	51	38
13	32	17	39	67	58	49	36
14	30	16	37	63	55	46	34
15	28	15	35	60	53	44	32
16	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	30
17	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	29
18	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	28
19	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	27
20	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	25

Assignment of each vegetation type (i.e., forest, hardwood [non-forest group 1 or 2], or willow) to stream reaches was determined by using GIS software. The base map used was compiled by the USFS and delineated the extent of each vegetation group. The vegetation types were then overlaid on the stream network to determine the appropriate shade target for the desired stream reach.

With natural variability in vegetation and ultimately the amount of shade provided to the stream, the shade target will be considered met when the estimated and potential shade are within 10%. This allows for the natural breaks in riparian vegetation and uncertainties in the development of shade curves. Shade curves are developed with the best available data and may not depict all the natural variations in riparian vegetation.

A digital elevation model was used to determine stream gradients. Error associated with the model has been minimized with interpretation of the aerial photography and field verification of existing riparian vegetation. Areas estimated to have a stream gradient of 3% or greater (using a digital elevation model) are normally assigned a forest group shade curve, but some areas were determined to harbor deciduous vegetation during aerial photograph interpretation

and field validation. For these areas, we used the non-forest group 1. Inversely, some stream reaches with slopes less than 3% were assigned coniferous forest types where warranted. The areas where field data or aerial photographs suggested a different shade curve than the typical modeling scenario are noted in the solar load analysis tables (Appendices I and J).

Monitoring Points

The aerial photograph interpretations were field verified with a Solar Pathfinder at 20 sites in the St. Joe River watershed (Table 14). Solar Pathfinder data collected within the St. Joe River watershed were collected at 10 transects per sampling reach and averaged to best determine the shade value representing stream shade for each reach. The averaged shade value was then translated to a 10% shade class for comparison with the estimated shade class to determine the accuracy of the aerial photograph interpretations made in the office. Depending on the magnitude of error between measured shade and estimated shade, the estimated shade value was adjusted to reflect the measured shade value or remained unchanged. In all but two locations, Upper and Lower Simmons Creek, the measured shade and estimated shade values were within acceptable limits (less than 20% difference) and the estimated shade values remained unchanged. The Simmons Creek shade estimates were adjusted to represent the field-verified shade value. Overall, aerial photograph interpretation overestimated the 20 sites in the St. Joe River watershed by an average of 4% (± 7.24% standard deviation).

Table 14. Comparison of estimated shade class and field-verified measurements within the St. Joe River watershed

Stream Name	Estimated Shade Class (%)	Measured Shade (%)	Shade Class (%)	Difference (%)
Heller Creek	80	85	80	0
Upper Loop Creek	60	42	40	20
Cliff Creek	70	63	60	10
East Fork Bluff Creek	80	81	80	0
Bluff Creek	70	72	70	0
Lower Simmons Creek	80	43	40	40
Upper Simmons Creek	60	30	30	30
Beaver Creek	50	46	40	10
Gold Creek	90	90	90	0
Marble Creek above Boulder Creek	20	40	40	-20
Marble Creek above Donkey Creek	30	58	50	-20
Marble Creek below Davaggio Creek	10	17	10	0
Fly Creek—lower	90	82	80	10
Fly Creek—mid	60	62	60	0
Fly Creek—upper	90	90	90	0
Mosquito Creek—lower	80	91	90	-10
Mosquito Creek—lower reach 2	70	74	70	0
Mosquito Creek—mid	60	69	60	0
Mosquito Creek—mid 2	30	39	30	0
Mosquito Creek—mid 3	30	27	20	10
			Average	4
			Standard Deviation	14.3
			95% Confidence Interval	7.24

The accuracy of the aerial photograph interpretations was field verified with a Solar Pathfinder at 26 sites in the St. Maries River watershed (Table 15). Overall, the original aerial photograph interpretation over-estimated shade by an average of 7% ± 5.99% (average ± 95% confidence interval). Small streams with high shade values (Highline, Post, Hidden, and Hume Creeks) tended to have existing shade accurately described in the photograph interpretation. Larger streams (e.g., East Fork Emerald and West Fork St. Maries) with lower shade levels tended to be overestimated an average of 24%. These data were used to correct the original aerial photograph interpretation. Existing shade data presented in this TMDL document represent those corrected values.

Table 15. Comparison of estimated shade class and field-verified measurements within the St. Maries River watershed

Stream Name	Estimated Shade Class (%)	Measured Shade (%)	Shade Class (%)	Difference (%)
East Fork Emerald Creek 1	70	47	40	30
East Fork Emerald Creek 2	50	34	30	20
East Fork Emerald Creek 3	60	56	50	10
East Fork Emerald Creek 4	70	36	30	40
East Fork Emerald Creek 5	90	80	80	10
East Fork Emerald Creek 6	50	38	30	20
Highline Creek	80	81	80	0
Post Creek	80	87	80	0
Tributary to East Fork Emerald Creek	90	87	80	10
West Fork St. Maries River 1	60	30	30	30
West Fork St. Maries River 2	50	21	20	30
Hidden Creek 1	80	75	70	10
Hidden Creek 2	70	77	70	0
Hidden Creek 3	70	76	70	0
Hume Creek	80	87	80	0
St. Maries River	10	14	10	0
Canyon Creek	60	77	70	-10
Santa Creek	10	<1	0	10
Thorn Creek 1	20	28	20	0
Thorn Creek 2	60	52	50	10
Middle Fork St. Maries River	20	16	10	10
St. Maries River 1	0	12	10	-10
St. Maries River 2	10	14	10	0
St. Maries River 3	0	13	10	-10
St. Maries River 4	10	27	20	-10
St. Maries River 5	0	12	10	-10
			Average	7
			Standard Deviation	14.02
			95% Confidence Interval	5.99

Follow-up monitoring of effective shade could take place on any reach throughout the study streams and be compared to estimates of existing shade seen in Appendices G and H and described in terms of solar loads in Appendices I and J. Appendices I and J also include solar load estimates for tributaries to streams addressed in this TMDL analysis. Those areas with the largest disparity between existing shade estimates and shade targets should be monitored with a Solar Pathfinder 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. For each estimate of existing shade, the length of the stream segment varies depending on land use or landscape that has affected that shade level. It is appropriate to monitor within a given existing shade segment to see if that segment has increased its existing shade towards target levels. Ten equally spaced Solar Pathfinder measurements within one segment and averaged together should suffice to determine new shade levels in the future.

5.2 Load Capacity

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

Solar load data were obtained from flat-plate collectors at NREL weather stations located within the region. For streams in the St. Joe River watershed, data from the Spokane, Washington, and Kalispell, Montana, stations were averaged. For streams in the St. Maries River watershed, only data from Spokane were used.

The solar loads used in this TMDL are spring/summer averages; thus, we used an average load for the 6-month period from April through September. These months coincide with the time of year when stream temperatures are increasing, deciduous vegetation is in leaf, and spring and fall salmonid spawning occur. These months are when cold water aquatic life criteria are more likely to be exceeded. Late July and early August typically represent the 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 also solar loads that affect salmonid spawning temperatures in spring and fall.

Tables in Appendices I and J show the PNV shade targets (identified as Potential Shade) and the corresponding potential spring/summer solar loads (in kilowatt-hours per square meter per day [kWh/m^2/day] and kilowatt-hours per day [kWh/day]) that serve as the load capacities for the streams.

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 photograph 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 Appendices G and H. Like load capacities (potential loads), existing loads in Appendices I and J 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 load analysis 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. If existing load exceeds potential load, this difference becomes the excess load to be discussed next in the load allocation section.

A summary of the existing spring/summer load (kWh/day), potential spring/summer load (kWh/day), load allocation (difference between existing and potential spring/summer load), and the average lack of shade are presented in tables found in Appendices I and J.

Any increase in the existing solar load in the St. Joe River subbasin is from nonpoint sources. No point sources that would increase stream temperature are permitted or known to exist. The biggest nonpoint source contributors are those activities adjacent to streams that impinge on the riparian vegetation. Road building immediately adjacent to the stream is the most extensive land use altering riparian vegetation and resulting in increased solar loads. Other land-use activities reducing riparian vegetation include but are not limited to grazing, mining, timber harvest, and dispersed recreation.

5.4 Load Allocation

This TMDL is based on PNV, which is equivalent to solar loads at background conditions. As such, the load allocation is essentially the desire to achieve natural background conditions. However, to reach that objective, load allocations are assigned to nonpoint source activities that have affected or may affect riparian vegetation and shade as a whole. Load allocations are stream reach specific and are dependent upon the target load for a given reach. Tables in Appendices I and J show the potential shade, which is converted to a potential spring/summer load by multiplying the inverse fraction (1 minus shade fraction) by the average loading to a flat-plate collector for the months of April through September (see full description in section 5.2). This calculation provides the load capacity of the stream and the solar load necessary to achieve background conditions. At this level of solar loading, there is no opportunity to further remove shade from the stream by any activity without exceeding its load capacity. Because this TMDL is dependent upon background conditions for achieving water quality standards, all tributaries to the waters examined also need to be in natural conditions in order to prevent excess heat loads to the system.

Marble Creek, a 4th-order tributary to the St. Joe River, is exceeding Idaho water quality temperature criteria. The lowest reach of Marble Creek (ID17010304PN031_04) from Bussel Creek to the St. Joe River has been included in category 5 of the Integrated Report since 2002. During this assessment, the entire Marble Creek watershed was evaluated to determine sources of excess solar load (Table 16). Not all AUs evaluated in the Marble Creek watershed have water temperature data to evaluate Idaho water quality standards, but all were included in this assessment to help direct potential implementation actions to help reduce water temperatures in the lower reaches.

Tables 16 and 17 show the total existing, total target, and total excess solar load (kWh/day) as well as average lack of shade 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.

Although this TMDL analysis focuses on total solar loads for streams, it is important to note that differences between existing shade and target shade, as depicted in the shade deficit (delta shade) figures in Appendices G and H, are the key to successfully restoring these waters to achieve water quality standards. Target shade levels for individual reaches should

be the goal land managers strive for with future implementation plans. Managers should focus on the largest differences between existing and target shade as priority locations for implementation efforts. Each load analysis table (Appendices I and J) contains a column that lists the lack of shade on the stream. This figure is derived from subtracting the target shade from the existing shade for each segment. Thus, stream segments with the largest shade deficit are anticipated to be locations where solar loading is greatest. The average lack of shade in each load analysis table is also listed in Tables 16 and 17, which present a general level of comparison among streams.

Table 16. Total solar loads and average lack of shade for streams assessed in the St. Joe River watershed

Water Body	Assessment Unit	Total Target Load (kWh/day)	Total Existing Load (kWh/day)	Excess Load (kWh/day)	Average Shade Difference (%)	Percent Above Background (%)
Tank, Harvey and Blackjack Creek	ID17010304PN027_02[a]	952	4,317	-3,365	12	353
		2,266	7,460	-5,194	7	229
		1,065	4,702	-3,637	15	342
Sherlock Creek—mining zone	ID17010304PN041_02a[a]	22,365	47,036	-24,671	27	110
Simmons Creek	ID17010304PN052_02[a]	23,231	68,591	-45,360	9	195
	ID17010304PN052_03[a]	373,969	417,434	-43,465	5	12
Gold Creek	ID17010304PN053_02[a]	178,423	280,440	-102,017	10	57
Loop Creek	ID17010304PN060_02[a]	64,156	128,277	-64,121	9	100
	ID17010304PN060_03[a]	359,257	379,207	-19,950	3	6
Bear and Little Bear Creeks	ID17010304PN033_02[a]	2,289	11,897	-9,608	15	420
Slate Creek	ID17010304PN062_02[c]	102,897	204,611	-101,714	9	99
	ID17010304PN062_03[b]	991,157	1,295,960	-304,803	14	31
Big Creek	ID17010304PN063_02[b]	207,742	266,497	-58,755	7	28
	ID17010304PN063_03[b]	624,847	769,786	-144,939	11	23
Bluff Creek, including East and West Forks	ID17010304PN045_02[a]	139,382	225,572	-86,190	10	62
	ID17010304PN045_03[a]	32,172	49,236	-17,064	12	53
Fishhook Creek	ID17010304PN039_02[c]	35,903	128,395	-92,492	14	258
	ID17010304PN039_03[a]	41,313	80,196	-38,883	14	94
	ID17010304PN039_04[a]	140,356	257,455	-117,099	20	83
Marble Creek Watershed						
Marble Creek—Bussel to St. Joe	ID17010304PN031_04[b]	1,706,961	1,780,047	-73,086	3	4
Tributaries to Marble Creek above Hobo Creek	ID17010304PN035_02[c]	15,159	59,934	-44,775	11	295
Marble Creek	ID17010304PN035_03[c]	268,584	351,346	-82,762	12	31
Homestead Creek	ID17010304PN036_02[c]	16,546	60,995	-44,449	15	269
Hobo Creek	ID17010304PN034_02[c]	21,776	54,896	-33,120	12	152
Marble Creek	ID17010304PN031_03[c]	239,659	259,793	-20,134	5	8
Bussel, Toles, Norton, and Lines Creeks	ID17010304PN033_02a[c]	27,057	87,357	-60,300	17	223
Bussel Creek	ID17010304PN033_03[c]	141,060	170,819	-29,759	9	21
Eagle Creek	ID17010304PN032_02[c]	10,489	55,575	-45,086	18	430
Tributaries to Marble Creek below Hobo Creek	ID17010304PN031_02[c]	9,856	42,317	-32,461	13	329
Daveggio Creek	ID17010304PN037_02[c]	8,705	31,862	-23,157	11	266
	ID17010304PN037_03[c]	6,250	23,232	-16,982	21	272
Boulder Creek	ID17010304PN038_02[c]	12,478	55,066	-42,588	13	341
	ID17010304PN038_03[c]	14,650	37,879	-23,229	14	159

Note: kWh/day = kilowatt hours per day

[a] Assessment unit in category 4a of Integrated Report: reviewed approved TMDL

[b] Assessment unit in category 5 of Integrated Report: new TMDL.

[c] Assessment unit not in category 4a or category 5 of 2010 Integrated Report: Source allocation developed to help reduce stream temperatures for downstream temperature-impaired stream segment that is failing Idaho water quality standards.

Table 17. Total solar loads and average lack of shade for streams assessed in the St. Maries River watershed

Water Body	Assessment Unit	Total Target Load (kWh/day)	Total Existing Load (kWh/day)	Excess Load (kWh/day)	Average Shade Difference (%)	Percent Above Background (%)
John Creek	ID17010304PN009_02[b]	198,942	249,392	-50,450	12	25
Santa Creek	ID17010304PN010_02[a]	43,724	185,501	-141,777	30	324
	ID17010304PN010_03[a]	158,306	229,151	-70,845	25	45
	ID17010304PN010_04[a]	866,094	935,894	-69,800	10	8
Charlie Creek	ID17010304PN011_02[c]	26,834	90,795	-63,961	18	238
	ID17010304PN011_03[a]	210,794	271,793	-60,999	14	29
Tyson Creek	ID17010304PN013_02[c]	25,338	65,225	-39,887	17	157
	ID17010304PN013_03[b]	48,350	72,173	-23,823	19	49
Carpenter Creek	ID17010304PN014_02[b]	109,004	266,298	-157,294	30	144
	ID17010304PN014_03[b]	35,874	34,987	887	12	-2
Emerald Creek	ID17010304PN016_02[a]	137,210	289,150	-151,940	18	111
	ID17010304PN016_03[a]	333,380	455,647	-122,267	17	37
West Fork St. Maries River	ID17010304PN017_02[a]	42,000	179,459	-137,459	21	327
	ID17010304PN017_03[a]	131,510	200,714	-69,204	23	53
	ID17010304PN017_04[a]	197,849	257,560	-59,711	21	30
Middle Fork St. Maries River	ID17010304PN018_02[a]	59,855	156,266	-96,411	19	161
	ID17010304PN018_03[a]	47,114	63,481	-16,367	12	35
	ID17010304PN018_04[a]	326,617	425,083	-98,466	19	30
	ID17010304PN018_05[a]	138,008	190,437	-52,429	27	38
Merry Creek	ID17010304PN020_02[c]	15,062	115,830	-100,768	21	669
	ID17010304PN020_03[b]	177,483	242,250	-64,767	8	36
Gold Center Creek	ID17010304PN019_02[a]	47,496	127,703	-80,207	15	169
	ID17010304PN019_03[a]	64,889	104,088	-39,199	21	60
Olson Creek	ID17010304PN022_02[b]	28,951	54,652	-25,701	12	89
Thorn Creek	ID17010304PN026_02[b]	170,837	189,554	-18,717	19	11
	ID17010304PN026_03[b]	98,231	98,986	-755	9	1
Upper St. Maries River	ID17010304PN015_05[a]	899,557	1,090,518	-190,961	13	21
Middle St. Maries River	ID17010304PN012_05[a]	2,051,100	2,352,966	-301,866	12	15
Lower St. Maries River	ID17010304PN007_05[a]	4,056,082	4,589,583	-533,501	11	13

Note: kWh/day = kilowatt hours per day
[a] Assessment unit in Section 4a of Integrated Report: reviewed TMDL
[b] Assessment unit in Section 5 of Integrated Report: new TMDL.
[c] Assessment unit not in Section 4a or Section 5 of 2010 Integrated Report. Source allocation developed to help reduce stream temperatures for downstream temperature-impaired stream segment that is failing Idaho water quality standards.

A certain amount of excess load is potentially created by the methodologies for determining existing shade and target shade levels for the load analysis. Because existing shade is reported as a 10% class level and target shade is a unique integer, there is usually 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 the target level, it would be recorded as 80% existing shade in the load analysis because it falls into the 80% shade class (i.e., shade of 80–90%). There is an automatic difference of 6% which could be attributed to the margin of safety.

The "percent above background" column in Tables 16 and 17 represents the amount of solar load calculated to be in excess of the target load. This percentage includes the uncertainty

inherent in applying the shade curve value and the estimated 10% shade classes. In watersheds where shade levels are at or near potential shade levels, this difference has been calculated to be up to 20%. Identifying the watersheds with the largest percentage of solar load above background can also help focus implementation efforts.

The St. Joe River above Neversweat Creek (ID17010304PN041_02), Beaver (ID17010304PN048_02), Mosquito (ID17010304PN046_02), Fly (ID17010304PN047_02 and ID17010304PN041_02), and Heller and Sherlock (ID17010304PN041_02) Creeks are all watersheds in which the estimated and target shade classes are within the same shade class, but because of the model difference (difference in the way existing and potential are calculated) there appears to be an excess solar load (Appendix A). The riparian vegetation along these streams receives little disturbance and the land use practices (e.g., lack of roads, timber harvest, or other anthropogenic removal of riparian vegetation) are consistent with the development and maintenance of full PNV.

All water bodies within the St. Maries River watershed were modeled to have diminished existing shade and need shade increases. Portions of all water bodies did have some stream reaches meeting target shade, mostly in the headwaters, but lacked enough shade throughout the watershed to be considered meeting TMDL targets.

Overall, stream shading conditions in the water bodies assessed in the St. Joe River watershed more closely resemble potential shade conditions than those assessed in the St. Maries River watershed. This difference exists because of the land use and land managers of the two watersheds. The upper St. Joe River watershed is mostly (95%) managed by the USFS, while the St. Maries River watershed has a mix of ownerships. The mixed ownership is more heavily harvested, grazed, and used for other agricultural and mining land uses, all of which impact riparian vegetation.

St. Joe River Solar Loading Analysis

The St. Joe River (ID17010304PN027_05) from the confluences of the North Fork St. Joe River to the St. Maries River is discussed in detail because of its size and hydraulic differences from the other water bodies discussed in this document. For the purposes of this TMDL and future water quality assessment efforts AU ID17010304PN027_05 was split into two sections. The upper section extends from the North Fork St. Joe River to St. Joe City, and the lower section includes the river from St. Joe City to the confluence with the St. Maries River. This break represents a distinct change in river flow patterns caused by the back water of Lake Coeur d'Alene and the Post Falls hydroelectric dam on the Spokane River. The upper section is a free-flowing river and the lower section is uniformly deep slack water.

Bankfull widths were measured at random locations to determine if the St. Joe River from the North Fork St. Joe River to St. Joe City to determine if river widths are near or larger than natural bankfull widths generated from the Clearwater regional curve. Knowing the bankfull width of the river is an important factor when applying shade targets. As water bodies become larger the riparian vegetation loses its ability to provide shade.

Measuring bankfull widths is best done in the field where the distance between bankfull indicators such as at the base of perennial vegetation, change in river bank slope, and/or the tops of depositional features can be measured. For this analysis only the approximate

bankfull width was measured from aerial photography to gain a general understanding of bankfull width. Vegetation and the water surface was used to help approximate bankfull width during this analysis.

To generate random sampling location for the measurement of bankfull widths the public land survey grid was overlaid on the aerial photograph. At each location a line from the township, range, section crossed the river bankfull width was measured. The existing measured widths were then compared the natural bankfull width calculated from the Clearwater regional cure at that location (Figure 6). Because of the resolution of the aerial photograph, the natural variability in the river system, and by not measuring bankfull widths in the field, there was variability in the existing width measurements even when measurements were taken within close proximity.

Comparing the calculated natural bankfull width to the measured bankfull widths shows that the St. Joe River from the North Fork St. Joe River to St. Joe City is wider than the calculated natural bankfull width. The calculated natural bankfull widths were used in the application of shade targets and load analysis because existing bankfull widths are significantly larger than calculated bankfull widths. Sixty percent (60%) of the sampled bankfull width measurements were above the calculated bankfull width, 33% of the samples were less than the calculated natural bankfull width, and 7% of the samples were the same as the calculated width (Figure 6).

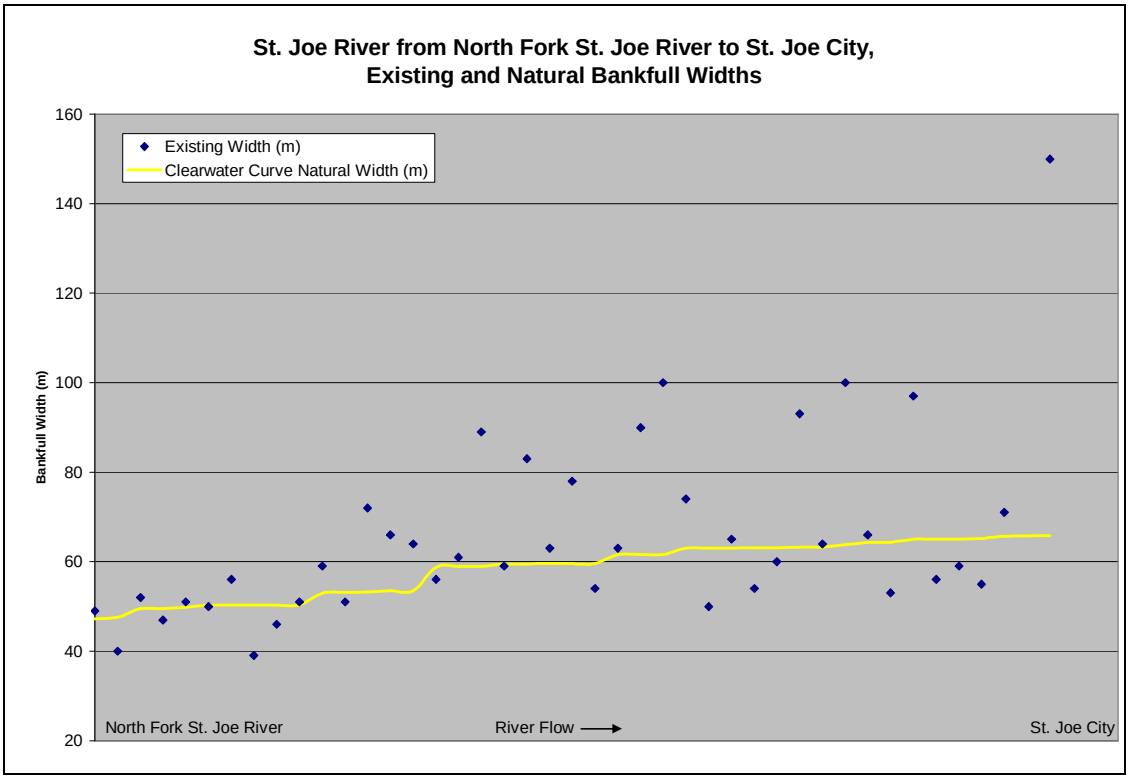


Figure 6. St. Joe River from North Fork St. Joe River to St. Joe City, existing and natural bankfull widths

Excess deposition leading to channel enlargement or aggradation is often associated with multiple depositional patterns (Rosgen 2006). Ninety (90) depositional features including point, mid-channel, delta, and side depositional bars were counted within the St. Joe River from the North Fork St. Joe River to St. Joe City aerial photograph (2009 aerial photograph). The presence of multiple split channels, mid-channel sediment bars, and the abundance of existing widths measured greater than the calculated natural bankfull widths suggests that this section of the river is currently wider than natural.

Two shade class estimates for this reach of river were used to characterize the current condition. Existing shade was classified as 0-9% (0% shade class) or 10-19% (10% shade class). Calculated natural bankfull widths generated from the Clearwater regional curve were used to apply target shade values (Table 18).

Table 18. Shade targets applied to the St. Joe River from North Fork St. Joe River to St. Joe City

River estimated natural bankfull width (m)	45	50	55	60	65	70
Percent Shade (%)	12	11	10	10	8	6

The St. Joe River from the North Fork to St. Joe City is lacking shade due to the proximity of an old rail road grade (now used as an access road), a highway, agricultural practices (cattle grazing or hay crop), and recreational lots (Figure 7, 8). Some reaches of the river are meeting TMDL shade targets (Figure 9, 10). Areas meeting shade targets are in a steep canyon and/or have an intact riparian communities. River reaches lacking the most shade should be field validated and prioritized for TMDL implementation (Figure 11, 12). As a result of the large bankfull widths the average lack of shade is relatively small when compared to other water bodies assessed in this TMDL (Table 19).

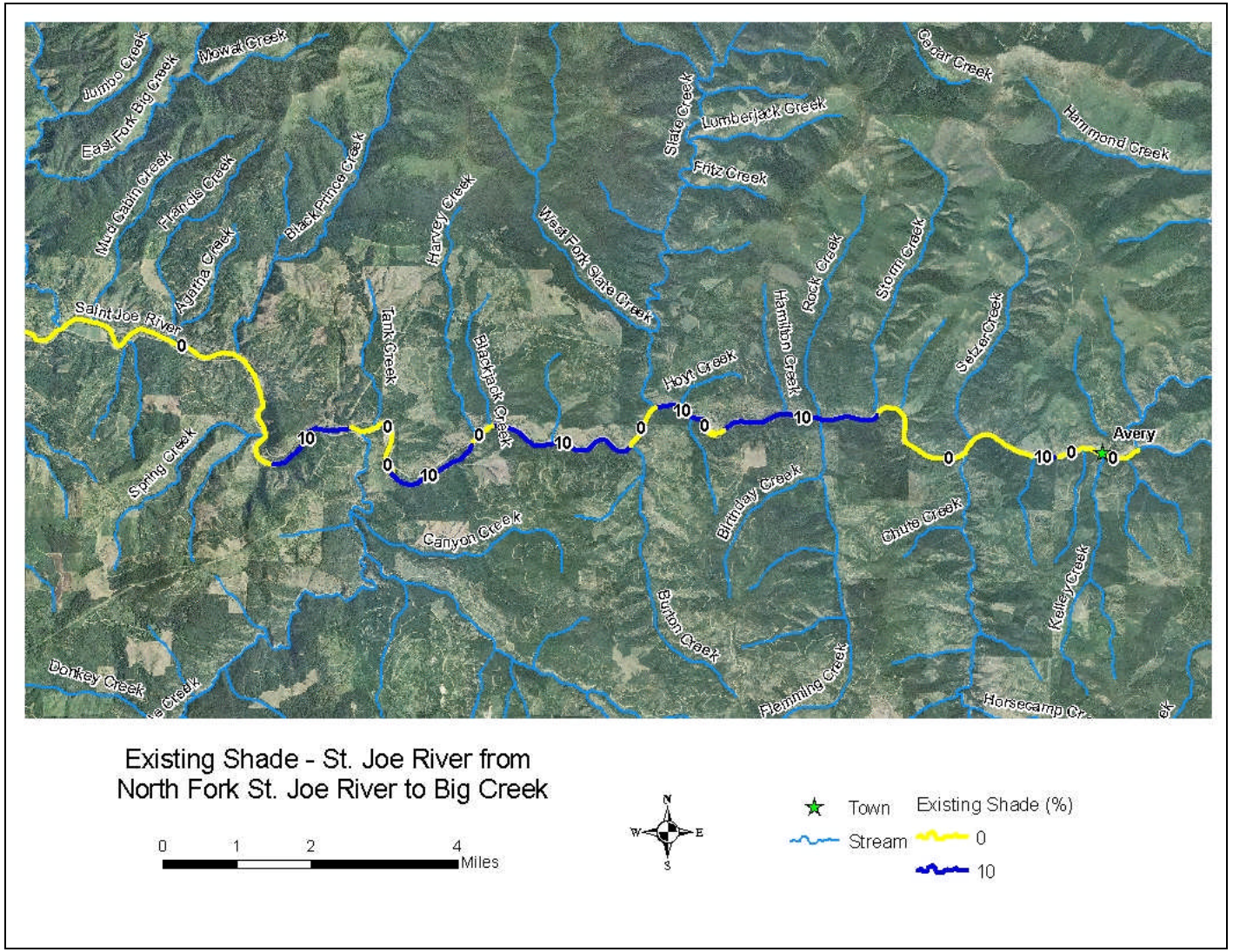


Figure 7. Existing shade-St. Joe River from North Fork St. Joe River to Big Creek

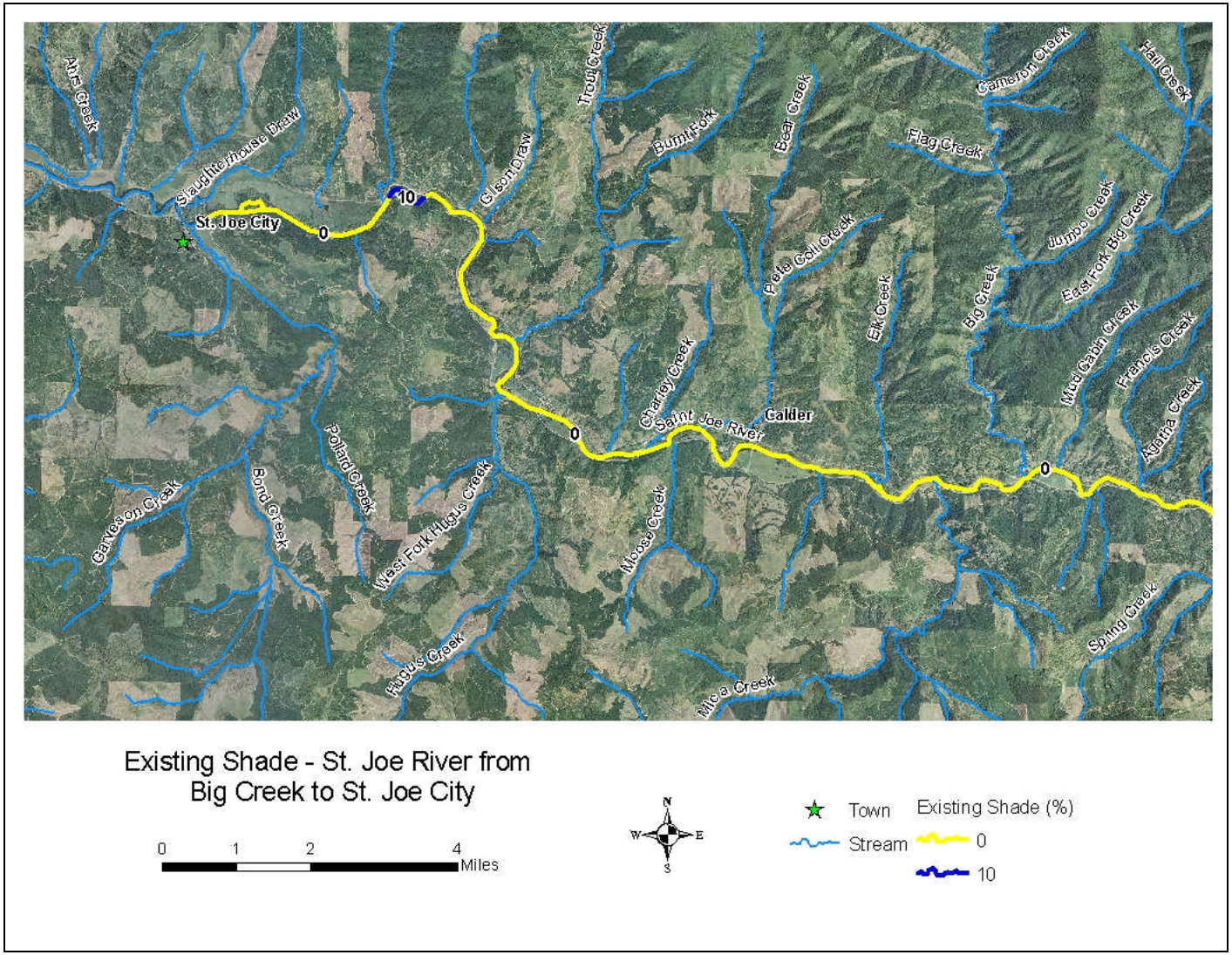


Figure 8. Existing shade-St. Joe River from Big Creek to St. Joe City

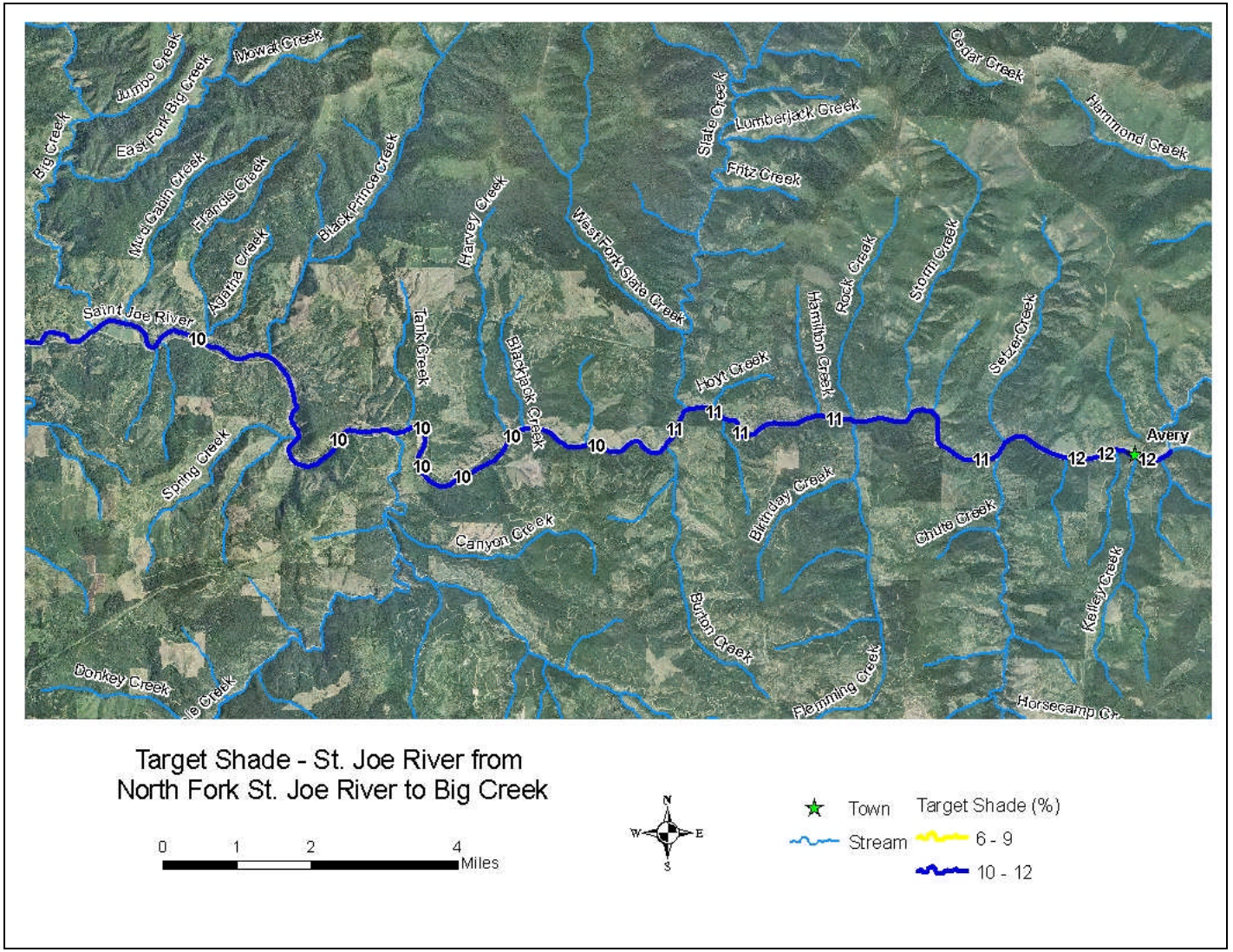


Figure 9. Target Shade-St. Joe River from North Fork St. Joe River to Big Creek

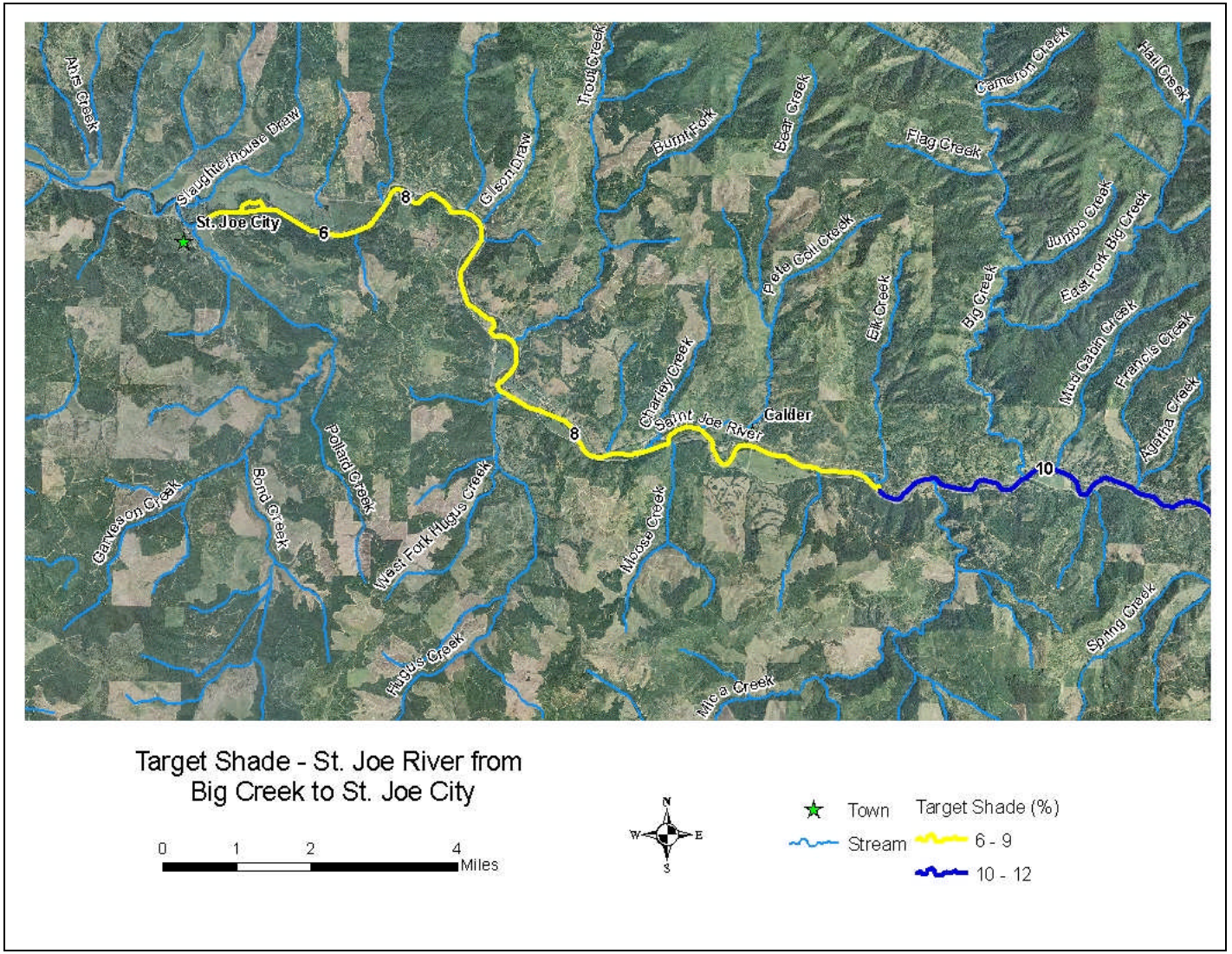


Figure 10. Target Shade-St. Joe River from Big Creek to St. Joe City

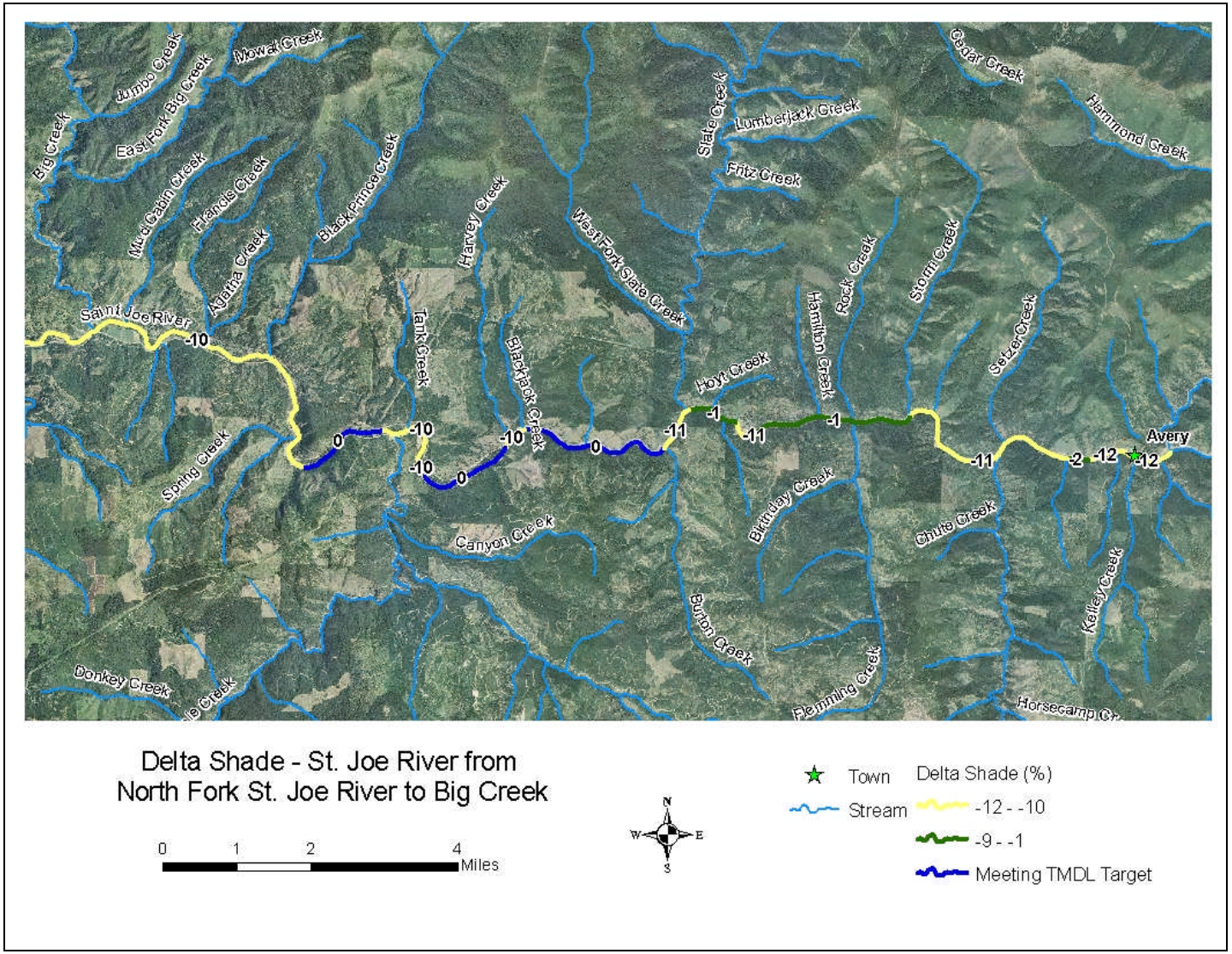


Figure 11. Delta Shade-St. Joe River from North Fork St. Joe River to Big Creek

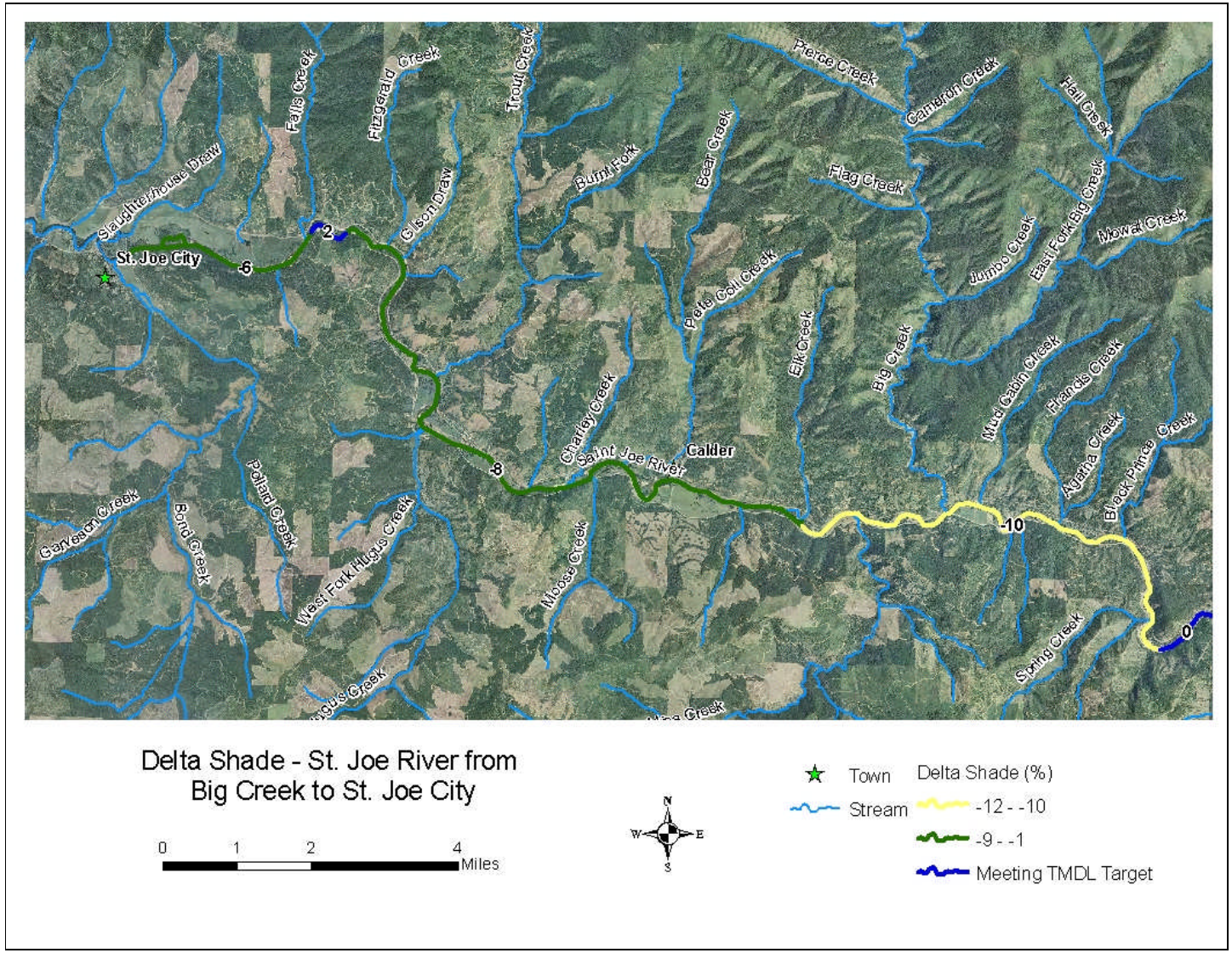


Figure 12. Delta Shade- St. Joe River from Big Creek to St. Joe City

Table 19. St. Joe River from North Fork River to St. Joe City solar loading table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)
AU# ID17010304PN027_05 - Mid St. Joe River reach - North Fork St. Joe River to St. Joe City													
1130	0	5.5	0.12	4.84	-0.66	45	45	50850	279675	50850	246114	-33561	-12
840	0	5.5	0.12	4.84	-0.66	45	45	37800	207900	37800	182952	-24948	-12
460	0.1	4.95	0.12	4.84	-0.11	45	45	20700	102465	20700	100188	-2277	-2
4540	0	5.5	0.11	4.895	-0.605	50	50	227000	1248500	227000	1111165	-137335	-11
3520	0.1	4.95	0.11	4.895	-0.055	50	50	176000	871200	176000	861520	-9680	-1
210	0	5.5	0.11	4.895	-0.605	50	50	10500	57750	10500	51397.5	-6352.5	-11
420	0	5.5	0.11	4.895	-0.605	50	50	21000	115500	21000	102795	-12705	-11
280	0	5.5	0.11	4.895	-0.605	50	50	14000	77000	14000	68530	-8470	-11
1130	0.1	4.95	0.11	4.895	-0.055	50	50	56500	279675	56500	276567.5	-3107.5	-1
1050	0	5.5	0.11	4.895	-0.605	50	50	52500	288750	52500	256987.5	-31762.5	-11
3420	0.1	4.95	0.1	4.95	0	60	55	205200	1015740	188100	931095	-84645	0
610	0	5.5	0.1	4.95	-0.55	65	55	39650	218075	33550	166072.5	-52002.5	-10
2180	0.1	4.95	0.1	4.95	0	60	55	130800	647460	119900	593505	-53955	0
460	0	5.5	0.1	4.95	-0.55	60	55	27600	151800	25300	125235	-26565	-10
1800	0	5.5	0.1	4.95	-0.55	60	55	108000	594000	99000	490050	-103950	-10
2080	0.1	4.95	0.1	4.95	0	60	60	124800	617760	124800	617760	0	0
11300	0	5.5	0.1	4.95	-0.55	70	60	791000	4350500	678000	3356100	-994400	-10
16350	0	5.5	0.08	5.06	-0.44	70	65	1144500	6294750	1062750	5377515	-917235	-8
1020	0.1	4.95	0.08	5.06	0.11	70	65	71400	353430	66300	335478	-17952	2
3240	0	5.5	0.08	5.06	-0.44	70	65	226800	1247400	210600	1065636	-181764	-8
2150	0	5.5	0.08	5.06	-0.44	70	65	150500	827750	139750	707135	-120615	-8
							Total	**3687100**	**19847080**	**3414900**	**17023798**	**-2823282**	**-6.90476**

Negative numbers in Table 19 represent excess solar load and river reaches lacking shade.

Wasteload Allocation

There are no known National Pollutant Discharge Elimination System (NPDES) permitted point sources in the affected subwatersheds of the St. Joe River watershed. Thus, there are no wasteload allocations either. Should a point source be proposed that would have thermal consequence on these waters, background provisions addressing such discharges in Idaho water quality standards (IDAPA 58.01.02.200.09 and IDAPA 58.01.02.401.03) should be invoked (see Appendix F).

There are two NPDES-permitted wastewater treatment plants (WWTP) in the St. Maries River watershed. The Santa-Fernwood WWTP (NPDES permit #ID-002284-5) and Clarkia (NPDES permit #ID-002507-1) WWTP.

There are no permitted industrial stormwater dischargers in the St. Joe or St. Maries River watersheds. Should an industrial stormwater discharger become established in either watershed that would have thermal consequence on these waters, background provisions addressing such discharges in Idaho water quality standards (IDAPA 58.01.02.200.09 and IDAPA 58.01.02.401.03) should be invoked (see Appendix F).

Effluent Temperature

Santa-Fernwood WWTP discharges to the St. Maries River near Fernwood, Idaho. St. Maries River designated uses include cold water aquatic life and primary contact recreation. The applicable numeric water temperature criteria to protect cold water aquatic life are 22 ºC (71.6 ºF) maximum daily maximum temperature (MDMT) and 19 ºC (66.2 ºF) maximum daily average temperature (MDAT) and are applicable the entire year. Monitoring conducted in 2006 as part of the NPDES permit requirements showed that the effluent temperatures exceeded the MDAT criterion, but because effluent temperatures were only monitored once per month, there is insufficient data to accurately evaluate the criteria. Effluent temperatures did not exceed the more applicable instantaneous criteria of 22 ºC (71.6 ºF) (Figure 13).

The Clarkia WWTP discharges to the St. Maries River throughout the year, and the most recently reported effluent temperatures are below Idaho water quality criteria (Figure 13). Effluent temperatures were monitored once per week and the maximum record temperature was reported to DEQ. Beneficial uses of the receiving water are classified as existing and include cold water aquatic life and secondary contact recreation. The applicable numeric water temperature criteria for cold water aquatic life are 22 ºC (71.6 ºF) MDMT and 19 ºC (66.2 ºF) MDAT and are applicable the entire year.

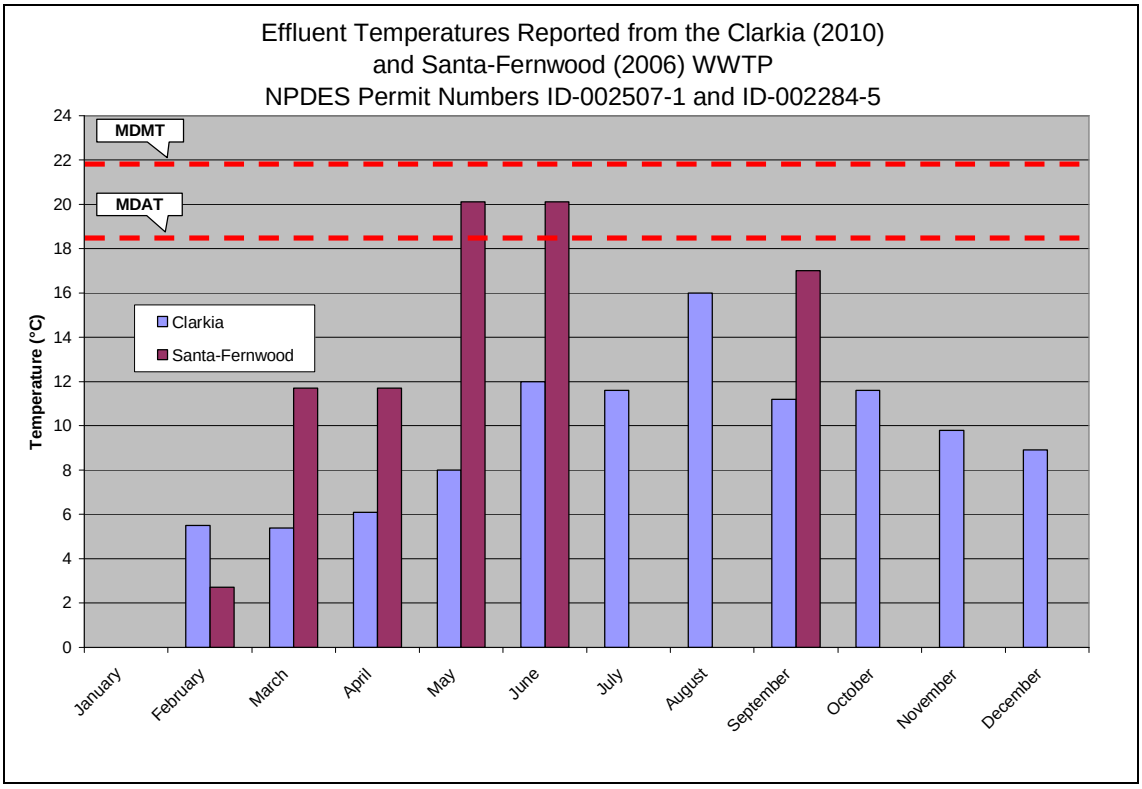


Figure 13. Effluent temperatures reported from the Clarkia (2010) and Santa-Fernwood (2006) Wastewater Treatment Plants (WWTPs)

Idaho water quality standards provide that in waters where stream temperatures exceed criteria due to background conditions, point sources must not increase stream temperatures greater than 0.3°C (IDAPA 58.01.02.401.01.e.). During the 2003 TMDL effort and it was determined that an effluent temperature of 95°C from the Santa-Fernwood and 188ºC from the Clarkia WWTP are needed to increase the receiving water more than 0.3°C (DEQ 2003b). This evaluation was conducting using a monthly average discharge recorded at the USGS gauging station for the months of May through September. The same river discharge value was applied to both WWTPs and a 9°C temperature criterion was used during the evaluation.

The potential of each WWTP to increase the temperature of the St. Maries River by more than 0.3°C was reevaluated using more appropriated river flows and water quality temperature criteria. The following temperature limit equation was used to determine the likelihood of the Santa-Fernwood and Clarkia WWTPs to raise the river temperature by more than 0.3°C:

$$Te = \frac{[Qe + (M * Qs)] * [Tc + 0.3°] - [(M * Qs) * Tc]}{Qe}$$

where: *Te* = effluent temperature required to increase receiving water by more than 0.3°C
Qe = effluent flow (cfs)

Qs = stream flow (cfs)
Tc = applicable temperature criteria (°C)
M = volume of mixing zone (%)

To best represent the West Fork of the St. Maries River flows near the Clarkia WWTP the river discharge data collected at the USGS gauge station was adjusted using the drainage area ratio method described below. The actual river discharge data collected at the gauge was used in calculating the Santa-Fernwood WWTP because of its close proximity to the gauging station. The average monthly flow from June through September was averaged to better understand the potential impacts during the critical time periods. The results of this analysis show that effluent temperatures would need to reach 97°C (207°F) and 60°C (140°F) at the Clarkia and Santa-Fernwood WWTP respectively to increase the river water by more than 0.3°C (Table 20).

Table 20. Temperature limit equation variables and results

Equation variable	Clarkia WWTP	Santa-Fernwood WWTP
Effluent flow (design flow)(cfs)	0.02	0.31
Stream flow	20	154
Applicable temperature criteria (°C)	22	22
Volume of mixing zone (%)	25	25
Effluent temperature required to increase receiving water by more than 0.3°C(°C)	**97**	**60**

Effluent temperatures recorded at the WWTPs and reported monthly to DEQ in the discharge monitoring reports (DMR) show that currently both facilities are able to maintain effluent temperatures below those calculated to increases the receiving water by more than 0.3°C. (Table 21). The Santa-Fernwood WWTP minimizes discharging to the St. Maries River during the summer months to help protect contact recreation and aquatic life beneficial uses.

Table 21. Effluent daily maximum temperatures reported from the Clarkia and Santa-Fernwood WWTPs

Year	Clarkia WWTP Daily Maximum Temp. (°C)				Santa-Fernwood WWTP Daily Maximum Temp. (°C)			
	June	July	August	September	June	July	August	September
2005	9.6	11.5	13.3	11.9	No discharge	No discharge	No discharge	No discharge
2006	10.2	12.3	13.2	11.6	20.1	No discharge	No discharge	17
2007	Not reported	11	12	11.9	No discharge	No discharge	No discharge	No discharge
2008	9	11.5	11.7	11.1	No discharge	No discharge	No discharge	No discharge
2009	11	10.5	12.1	12.7	No discharge	No discharge	No discharge	No discharge
2010	12	11.6	16	11.2	Not reported	Not reported	No discharge	No discharge

Effluent temperatures should continue to be monitored under the NPDES permit. The data presented above lack the temporal resolution to make a clear determination if effluent is impacting aquatic life in the vicinity of the discharge. Future temperature monitoring should be conducted more frequently. The critical period to evaluate cold water aquatic life is from July 15 through August 15, the time period when most surface waters reach their highest temperatures of the year (Grafe et al. 2002). A complete data record would include effluent temperature recorded every hour to evaluate both the MDMT and MDAT (DEQ 2000). Once the facilities have conducted continuous temperature monitoring, DEQ will make a determination if there is a temperature impairment caused by the discharge. If temperature is found to exceed criteria for cold water aquatic life, temperature wasteload allocations will be adjusted in a subsequent TMDL for the point sources. Additional mixing zone analysis may also be warranted during permit reissuing to help determine impacts to the beneficial uses of the receiving water.

Effluent Volume

Effluent discharge volume limits are not set in the current NPDES permits for either Santa-Fernwood or Clarkia Wastewater Treatment Plant (WWTP). The mass loading limits set in the permits were back calculated to determine the permit design flows to help evaluate the potential impacts of the WWTPs to the St. Maries River (Figure 14). St. Maries River flow at the Mashburn U.S. Geological Survey gauging station 12414900 has been recorded since 1965. The gauging station location is near the outfall of the Santa-Fernwood WWTP but is approximately 18 river miles downstream of Clarkia's outfall. To account for the lack of stream flow data near the Clarkia outfall, St. Maries River discharge data collected at the USGS gauging station near Mashburn was applied to the West Fork St. Maries River watershed using the following drainage area ratio calculation:

$$Y = (A1/A2)X,$$

where

Y = estimated median stream flow (cubic feet per second) from ungaged stream;
A1 = drainage area (square miles) from site of interest;
A2 = drainage area (square miles) from gauged stream; and
X = recorded stream flow (cubic feet per second) recorded at gaging station.

Effluent design flows are significantly less than river flows. The minimum stream flows recorded and estimated (drainage area ratio for the West Fork St. Maries River) between the years 2000 through 2011 were 28 cfs near Mashburn and 3.7 for the West Fork St. Maries River. Effluent design flows are approximately 1% and 0.5% of the river minimum flows (2000-2011) for the Santa-Fernwood and Clarkia WWTP (Figure 14).

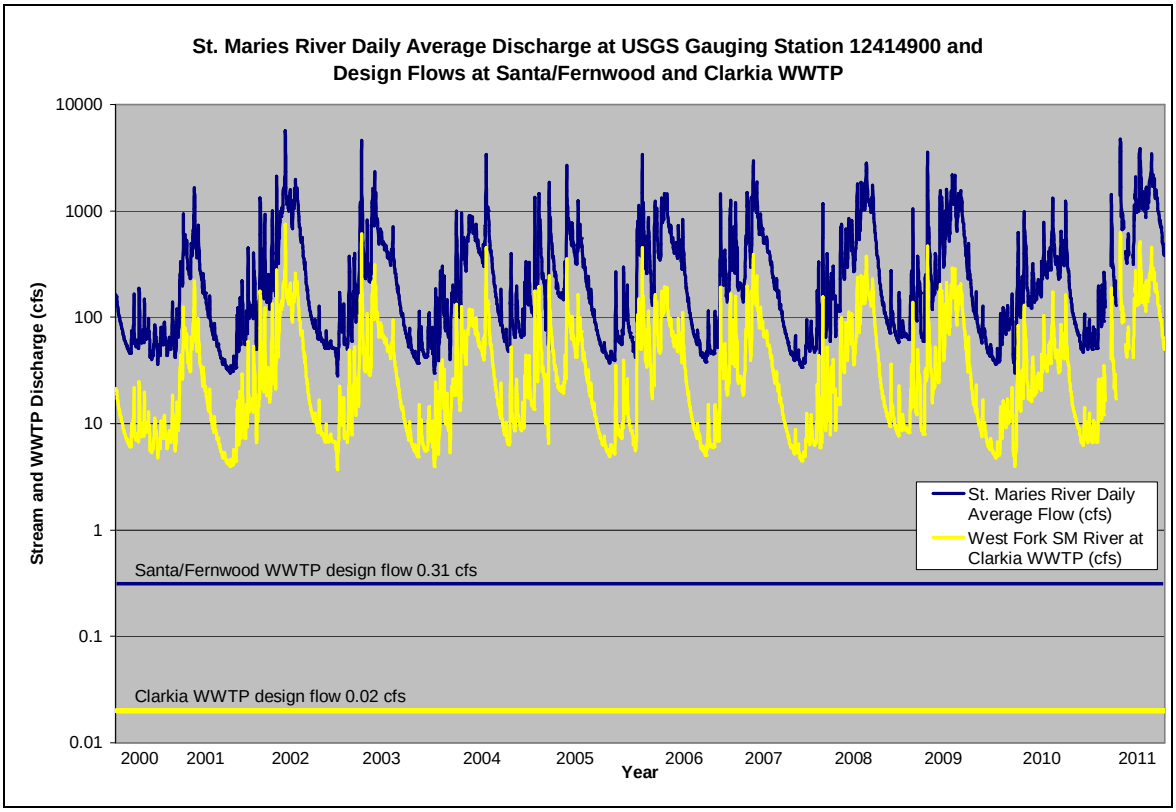


Figure 14. St. Maires River daily average discharge and design flows at Santa/Fernwood and Clarkia WWTP

Conclusion

A WLA was set in the *St. Maries River Subbasin Assessment and TMDL* in 2003 (DEQ 2003b) to help reduce St. Maries River in-stream temperatures. The allocation was set at 35°C (95°F) daily maximum effluent temperature. Following the re-evaluation this allocation is appropriate and will remain (Table 22). It is reasonable to assume that the facilities can meet this allocation after reviewing the data provided in the DMRs (Table 21 above).

To be consistent with recent guidance from EPA and to keep the load allocations consistent with both point and nonpoint sources of thermal loading the WLA was converted to a daily load (Table 22). The WLA was converted to a daily load by using the following equation:

$$\text{Heat Load}\left(\frac{\text{kcal}}{\text{day}}\right) = \text{Flow}\left(\frac{\text{meters}^3}{\text{second}}\right) \times \text{WLA} \times \left(\frac{1{,}000\ \text{liters}}{\text{meter}^3}\right) \times \left(\frac{1\text{kcal}}{\text{liter}}\right) \times \left(\frac{86{,}400\text{second}}{\text{day}}\right)$$

kcal is equal to a kilocalorie. A calorie is a unit of heat and is the energy needed to increase the temperature of 1 gram of water by 1°C. The WWTP design flow was used in the equation.

Table 22. Temperature wasteload allocations for WWTP in the St. Maries River watershed

Facility	Wasteload Allocation	Daily Wasteload Allocation (10^6 kcal/day)	Critical Time Period
Clarkia WWTP	35°C daily maximum	1.8	July 15 through August 15
Santa-Fernwood WWTP	35°C daily maximum	26.6	July 15 through August 15

Thermal discharge from these facilities is set to be protective of the cold water aquatic life designated beneficial use. Potential impacts from each facility were evaluated individually because of the distance separating the discharge points (approximately 18 miles). Should a point source be proposed that would have additional thermal consequence on these waters the cumulative impacts will be re-evaluated. Although the analysis conducted above showed that the two WWTP will have little impact to in-stream river temperature, the river to which the facilities discharge is temperature limited and as such each facility is given a WLA. Restricting the effluent temperature to 35°C will provide an additional margin of safety as it is conservative when compared to the temperature described above as necessary to increase stream temperatures by 0.3°C. Maintaining effluent limits below 35°C and achieving the desired stream shade targets will ensure that the designated beneficial uses are protected.

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 assigned to the next lower 10% class interval, which likely underestimates actual shade in the loading analysis. Although the load analysis used in this TMDL involves gross estimations that are likely to have large variances, load allocations are applied to the stream and its riparian vegetation rather than specific nonpoint source activities and can be adjusted as more information is gathered from the stream environment.

Seasonal Variation

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

Construction Stormwater and TMDL Wasteload Allocations

Construction Stormwater

In the previous St. Joe and St. Maries subbasin assessments and TMDLs there was no mention of construction stormwater requirement in the watersheds. We have included this section because of the potential for stormwater to contribute to existing pollutant loads. Increases of sediment, nutrients, *E. coli*, as well as temperature can be associated with stormwater runoff.

The Clean Water Act requires operators of construction sites to obtain permits to discharge stormwater to a water body or municipal storm sewer. In Idaho, EPA has issued a general permit for stormwater discharges from construction sites. In the past, stormwater was treated as a nonpoint source of pollutants. However, because stormwater can be managed on site through management practices or when discharged through a discrete conveyance such as a storm sewer, it now requires a Construction General Permit, a permitting program under the NPDES permitting system.

The Construction General Permit

If a construction project disturbs more than 1 acre of land (or is part of larger common development that will disturb more than 1 acre), the operator is required to apply for a Construction General Permit (CGP) from EPA after developing a site-specific Stormwater Pollution Prevention Plan (SWPPP).

Stormwater Pollution Prevention Plan

In order to obtain the CGP, operators must develop a site-specific SWPPP. The operator must document the erosion, sediment, and pollution controls he intends to use, inspect the controls periodically, and maintain the best management practices (BMPs) through the life of the project.

Construction Stormwater Requirements

When a stream is on Idaho's §303(d) list and has a TMDL developed, DEQ now incorporates a gross wasteload allocation (WLA) for anticipated construction stormwater activities. TMDLs developed in the past that did not have a WLA for construction stormwater activities will also be considered in compliance with provisions of the TMDL if the operator obtains a CGP under the NPDES program and implements the appropriate BMPs.

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

5.5 Implementation Strategies

Implementation strategies for TMDLs produced using PNV-based shade and solar load estimates should use the load analysis tables and shade estimates 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 second 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. Further field verification will likely find discrepancies with reported existing shade levels in the load analysis tables. Due to the inexact nature of the aerial photograph interpretation technique, these tables should not be viewed as complete until field verified. Implementation strategies should include Solar Pathfinder monitoring to simultaneously field verify the TMDL and mark progress towards achieving desired reductions in solar loads.

DEQ recognizes that implementation strategies for TMDLs may need to be modified if monitoring shows that TMDL goals are not being met or significant progress is not being made toward achieving the goals.

Time Frame

Increases in shade provided to the stream from riparian vegetation may only take a few years to establish, but many years will be required for vegetation to achieve its full potential to reduce solar inputs. Once implementation actions and strategies have been established, at least 20 years (depending on vegetation type) will be required for a diverse and mature vegetation community to become well established and provide maximum shade. Achievement of shade targets will not occur at once. Shade targets for smaller streams may be reached sooner than those established for larger streams given their smaller bankfull widths.

DEQ and the designated watershed advisory group (WAG) will continue to re-evaluate TMDLs on a 5-year cycle. During the 5-year review, implementation actions taken, in-progress, and planned will be reviewed, and pollutant load allocations will be reassessed accordingly.

Approach

TMDLs will be implemented through the continuation of ongoing pollution control activities in the watershed. The designated WAG, designated management agencies (DMAs), local organizations, and other appropriate public process participants are expected to do the following:

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

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

Responsible Parties

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

- Idaho Department of Lands for timber harvest activities, oil and gas exploration and development, and mining activities
- Idaho Soil and Water Conservation Commission for grazing and agricultural activities
- Idaho Transportation Department for public road construction
- Idaho State Department of Agriculture for aquaculture
- DEQ for all other activities

Although not an Idaho DMA, the USFS is responsible for implementing TMDL activities on land which it manages.

Reasonable Assurance

All load allocations within this document are directed at nonpoint source activities. The completion of on-the-ground actions designed to reduce pollutant loads will be completed through DMA and citizen participation. DEQ's continued interaction with these groups will help ensure progress is made towards pollutant reductions. DEQ will inform these groups on current water quality data, updated BMPs, and potential funding sources.

Monitoring Strategy

Monitoring conducted within the St. Joe River subbasin to evaluate the effectiveness of BMPs and ambient water quality will be done using DEQ-approved monitoring procedures at the time of sampling. These procedures will help to ensure the data collected is compatible and useable during the DEQ assessment process.

Monitoring progress towards achieving shade targets will follow the guidelines established in *The Potential Natural Vegetation (PNV) Temperature Total Maximum Daily Load (TMDL) Procedures Manual* (Shumar and de Varona 2009).

Pollutant Trading

Pollutant trading (i.e., water quality trading) is a contractual agreement to exchange pollution reductions between two parties. Pollutant trading is a business-like way of helping to solve water quality problems by focusing on cost-effective, local solutions to problems caused by pollutant discharges to surface waters. Pollutant trading is voluntary. Parties trade only if both are better off as a result of the trade. Trading allows parties to decide how to best reduce pollutant loads within the limits of certain requirements. The appeal of trading emerges when pollutant sources face substantially different pollutant reduction costs. Typically, a party facing relatively high pollutant reduction costs compensates another party to achieve an equivalent, though less costly, pollutant reduction.

Pollutant trading is recognized in Idaho's water quality standards in IDAPA 58.01.02.054.06. Currently, DEQ's policy is to allow for pollutant trading as a means to meet TMDLs and restore water quality limited water bodies to compliance with water quality standards. The

Water Quality Pollutant Trading Guidance (DEQ 2010) document sets forth the procedures for pollutant trading. No pollutant trading is currently planned for the watersheds in the St. Joe River subbasin.

5.6 Conclusions

Effective shade targets were established for streams exceeding water quality temperature standards in the St. Joe River subbasin (St. Joe and St. Maries River watersheds) based on the concept that maximum shading under PNV results in natural background temperature levels. Shade targets were derived from effective shade curves developed for similar vegetation types from within the subbasin. Existing shade was determined from aerial photograph interpretation and field verified using data collected with a Solar Pathfinder.

St. Joe River Watershed

Roads within the riparian corridor, road crossings, timber harvest, dispersed recreational activities, and/or historic mining activities are impacting target (potential) shade in the St. Joe River watershed. The St. Joe River above Neversweat Creek (ID17010304PN041_02), Beaver (ID17010304PN048_02), Mosquito (ID17010304PN046_02), Fly (ID17010304PN047_02 and ID17010304PN041_02), and Heller and Sherlock (ID17010304PN041_02) Creeks were modeled to be at or near natural background conditions (Appendix A). Portions of all other streams assessed had some stream reaches at or near background conditions, but the previously mentioned watersheds were the closest to natural background throughout the entire watershed.

St. Maries River Watershed

All streams in the analysis for this watershed lack shade to some degree. Of the specific mainstem portions examined in this analysis, Thorn Creek, John Creek, and lower Santa Creek were in the best condition with little or no excess solar load, although some segments on these streams did lack shade compared to their potential (targets). Many other streams had considerably higher excess loads and shade deficits.

Implementation and Monitoring

Potential (target) shade levels for individual reaches should be the goal land managers strive for with future implementation plans. Managers should focus on the largest differences between existing and target shade as priority locations for implementation efforts. Additional field verification with the Solar Pathfinder will help to narrow down the focus of implementation activities by better defining existing shade levels.

Portions of some watersheds have natural conditions that limit the growth of riparian vegetation. Steep topography, rocky slopes, or rock cliffs limit vegetative growth in these areas, and achieving potential natural shade as depicted by the modeled shade curve is not practical in these areas. These natural occurrences may result in lack of shade as identified in the model, but these areas will not be expected to reach full potential shading from riparian vegetation.

Stream segments with existing bankfull widths significantly wider (over 3 meters) than the estimated natural bankfull widths should also be a focus of future monitoring efforts. In these areas, existing and potential shade is limited due to the over-widened stream channel. The cause for the over widening is most likely due to excess bed load sediment. The excess bed

load alters the bankfull width-to-depth ratio, making the stream wider than it would be naturally. The greater width-to-depth ratio results in a wide, shallow stream oftentimes with mid-channel bars or extensive point bars. The excess near-bank stress applied to the stream banks in these situations also exacerbates the problem by causing bank instability and bank erosion. The eroded material is transported downstream resulting in more stream widening. In these locations, measures should be taken to mitigate bank erosion before the full potential riparian vegetation can be established.

Beaver damming is also a naturally occurring phenomenon within the St. Joe River subbasin. If not recognized during the aerial photographic interpretation, the beaver dam and resulting pond could result in a misinterpretation of the existing shade, potential shade, and stream width. When noted, beaver dams were incorporated into the PNV model as natural. If during implementation of this TMDL beaver dams are found to be causing erroneous PNV analysis, the area should be noted and incorporated into the TMDL 5-year review. Efforts to reach full potential shade in these areas may not be practical.

A summary of assessment outcomes for streams addressed in the St. Joe subbasin (St. Joe and St. Maries River watersheds) is presented in Table 23. As a result of this TMDL analysis four AUs are recommended to be moved from category 4a or 5 of the Integrated Report to category 2 or 3.

Table 23. Summary of assessment outcomes

Water Body Segment	Assessment Unit	Recommended Changes to Integrated Report	Justification
St. Joe River Watershed			
Bear/Little Bear Creek	17010304PN033_02	No change	Not meeting TMDL target
Beaver Creek	17010304PN048_02	Move to category 3	Riparian vegetation is at target
Big Creek and East Fork Big Creek	17010304PN063_02	Move to category 4a	TMDL completed
	17010304PN063_03		
Bluff Creek	17010304PN045_02	No change	Not meeting TMDL target
	17010304PN045_03	No change	Not meeting TMDL target
Fishhook Creek	17010304PN039_03	No change	Not meeting TMDL target
	17010304PN039_04	No change	Not meeting TMDL target
Fly Creek	17010304PN047_02	Move to category 2	Riparian vegetation is at potential
	17010304PN041_02[a]		
Gold Creek	17010304PN053_02	No change	Not meeting TMDL target
St. Joe River watershed above Yankee Bar Creek including Neversweat, Yankee Bar, California and Medicine Creeks	17010304PN041_02[a]	Move to category 2	Riparian vegetation is at target
Heller and Sherlock Creek	17010304PN041_02[a]	Move to category 2	Riparian vegetation is at target
	17010304PN041_02a	Move to category 4a	TMDL completed
Loop Creek	17010304PN060_02	No change	Not meeting TMDL target
	17010304PN060_03		
Marble Creek	17010304PN031_04	Move to category 4a	Not meeting TMDL target
Mosquito Creek	17010304PN046_02	Move to category 2	Riparian vegetation is at target
Simmons Creek	17010304PN052_02	No change	Not meeting TMDL target
	17010304PN052_03		
Slate Creek	17010304PN062_03	Move to category 4a	Not meeting TMDL target
Tank, Harvey and Blackjack Creek	17010304PN027_02	No change	Not meeting TMDL target

Water Body Segment	Assessment Unit	Recommended Changes to Integrated Report	Justification
St. Joe River—North Fork St. Joe River to St. Joe City	17010304PN027_05	Move to category 4a	Not meeting TMDL target
St. Maries River Watershed			
John Creek	17010304PN009_02	Move to category 4a	TMDL completed
Santa Creek	17010304PN010_02	No change	Not meeting TMDL target
	17010304PN010_03		
	17010304PN010_04		
Charlie Creek	17010304PN011_03	No change	Not meeting TMDL target
Tyson Creek	17010304PN013_03	Move to category 4a	TMDL completed
Carpenter Creek	17010304PN014_02	Move to category 4a	TMDL completed
Emerald Creek	17010304PN016_02	No change	Not meeting TMDL target
	17010304PN016_03		
West Fork St. Maries River	17010304PN017_02	No change	Not meeting TMDL target
	17010304PN017_03		
	17010304PN017_04		
Middle Fork St. Maries River	17010304PN018_02	No change	Not meeting TMDL target
	17010304PN018_03		
	17010304PN018_04		
	17010304PN018_05		
Gold Center Creek	17010304PN019_02	No change	Not meeting TMDL target
	17010304PN019_03		
Merry Creek	17010304PN020_03	Move to category 4a	TMDL completed
Thorn Creek	17010304PN026_02	Move to category 4a	TMDL completed
	17010304PN026_03		
St. Maries River—Santa Creek to mouth	17010304PN007_05	No change	Not meeting TMDL target
St. Maries River—Carpenter Creek to Santa Creek	17010304PN012_05		
St. Maries River—confluence of West and Middle Fork St. Maries River to Carpenter Creek	17010304PN015_05		

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Restriction of liability: Neither the state of Idaho nor the Department of Environmental Quality, nor any of their employees make any warranty, express or implied, or assume any legal liability or responsibility for the accuracy, completeness or usefulness of any information or data provided. Metadata is provided for all data sets, and no data should be used without first reading and understanding its limitations. The data could include technical inaccuracies or typographical errors. The Department of Environmental Quality may update, modify, or revise the data used at any time, without notice.

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.
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).
Assessment Unit (AU)	A segment of a water body that is treated as a homogenous unit, meaning that any designated uses, the rating of these uses, and any associated causes and sources must be applied to the entirety of the unit.
Beneficial Use	Any of the various uses of water, including, but not limited to, aquatic life, recreation, water supply, wildlife habitat, and aesthetics, 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

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.

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.

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.

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).

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

Geographic Information Systems (GIS)
A georeferenced database.

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

Headwater	The origin or beginning of a stream.
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.
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.
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.

Monitoring	A periodic or continuous measurement of the properties or conditions of some medium of interest, such as monitoring a water body.
National Pollutant Discharge Elimination System (NPDES)	A national program established by the Clean Water Act for permitting point sources of pollution. Discharge of pollution from point sources is not allowed without a permit.
Natural Condition	The condition that exists with little or no anthropogenic influence.
Nonpoint Source	A dispersed source of pollutants, generated from a geographical area when pollutants are dissolved or suspended in runoff and then delivered into waters of the state. Nonpoint sources are without a discernable point or origin. They include, but are not limited to, irrigated and non-irrigated lands used for grazing, crop production, and silviculture; rural roads; construction and mining sites; log storage or rafting; and recreation sites.
Not Fully Supporting	Not in compliance with water quality standards or not within the range of biological reference conditions for any beneficial use as determined through the *Water Body Assessment Guidance* (Grafe et al. 2002).
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.
Reference	A physical or chemical quantity whose value is known and thus is used to calibrate or standardize instruments.
Reference Site	A specific locality on a water body that is minimally impaired and is representative of reference conditions for similar water bodies.

Riparian	Associated with aquatic (stream, river, lake) habitats. Living or located on the bank of a water body.
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.
Total Maximum Daily Load (TMDL)	A TMDL is a water body's load capacity after it has been allocated among pollutant sources. It can be expressed on a time basis other than daily if appropriate. Sediment loads, for example, are often calculated on an annual basis. A TMDL is equal to the load capacity, such that load capacity = margin of safety + natural background + load allocation + wasteload allocation = TMDL. In common usage, a TMDL also refers to the written document that contains the statement of loads and supporting analyses, often incorporating TMDLs for several water bodies and/or pollutants within a given watershed.
Tributary	A stream feeding into a larger stream or lake.
Wasteload Allocation (WLA)	The portion of receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution. Wasteload allocations specify how much pollutant each point source may release to a water body.
Water Body	A stream, river, lake, estuary, coastline, or other water feature, or portion thereof.
Water Quality	A term used to describe the biological, chemical, and physical characteristics of water with respect to its suitability for a beneficial use.
Water Quality Criteria	Levels of water quality expected to render a body of water suitable for Its designated uses. Criteria are based on specific levels of pollutants that would make the water harmful if used for drinking, swimming, farming, or industrial processes.

Water Quality Limited	A label that describes water bodies for which one or more water quality criterion is not met or beneficial uses are not fully supported. Water quality limited segments may or may not be on a §303(d) list.
Water Quality Limited Segment (WQLS)	Any segment placed on a state's §303(d) list for failure to meet applicable water quality standards, and/or is not expected to meet applicable water quality standards in the period prior to the next list. These segments are also referred to as "§303(d) listed."
Water Quality Standards	State-adopted and U.S. Environmental Protection Agency-approved ambient standards for water bodies. The standards prescribe the use of the water body and establish the water quality criteria that must be met to protect designated uses.
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.

Appendix A. Watersheds Meeting Total Maximum Daily Load Targets

Five sub-watersheds within the upper St. Joe River watershed were found to be meeting TMDL shade targets (potential). St. Joe River watershed above Yankee Bar Creek (ID17010304PN041_02), Beaver (ID17010304PN048_02), Fly (ID17010304PN041_02/ ID17010304PN047_02), Mosquito (ID17010304PN046_02) and Heller/upper Sherlock Creeks (ID17010304PN041_02) exhibit riparian vegetation communities at or near potential natural vegetation (PNV). These watersheds are relatively unentered and have land-use practices (e.g., lack of roads, timber harvest, or other anthropogenic removal of riparian vegetation) consistent with the development and maintenance of full PNV.

Data collected by DEQ following the Beneficial Use Reconnaissance Program (BURP) protocols and assessed using the *Water Body Assessment Guidance, Second Edition* (Grafe et al. 2002) show support of beneficial uses in the St. Joe River watershed above Yankee Bar Creek, Mosquito, Fly, and Heller/Upper Sherlock Creeks (Table A-1). DEQ relies on data collected during BURP surveys to determine if beneficial uses are supported. During BURP surveys, data are collected and assessed to evaluate the macroinvertebrate and fish communities and stream and near-stream habitat. Data are then compressed into a condition score. Scores range from 0 to 3, with 0 being the poorest condition and 3 being the best. Sites with two or more condition ratings are then averaged to determine if the site supports beneficial uses. An average of 2 or more is considered supporting beneficial uses (Grafe et al. 2002).

Table A-1. Beneficial Use Reconnaissance Program (BURP) data collected within Beaver, Mosquito, Fly, and Heller/Upper Sherlock Creeks

Stream	Assessment Unit	BURP Site ID	Sample Year	SMI Score/ Condition Rating[a]	SHI Score/ Condition Rating[b]	SFI Score/ Condition Rating[c]	Average Score
St. Joe River watershed above Yankee Bar Creek including Neversweat, Yankee Bar, California and Medicine Creeks	17010304PN041_02	2002SCDAA062	2002	59.23 / 3	77 / 3	Not collected	3
		2004SDEQA021	2004	67.45 / 3	62 / 2	64.14 / 1	2
Beaver Creek	17010304PN048_02	-	-	-	-	-	-
Mosquito Creek	17010304PN046_02	1999SCDAA019	1999	60.59 / 2	72 / 3	98.26 / 3	2.67
		2001SCDAA030	2001	64.98 / 3	77 / 3	98.66 / 3	3
		2001SCDAE020	2001	66.03 / 3	79 / 3	98.33 / 3	3
		2001SCDAV003	2001	69.30 / 3	76 / 3	Not collected	3
		2002SCDAA038	2002	76.55 / 3	75 / 3	98.33 / 3	3
		2002SCDAV003	2002	71.48 / 3	75 / 3	Not collected	3
		2003SCDAA037	2003	66.55 / 3	79 / 3	Not collected	3
		2004SCDAA029	2004	73.47 / 3	81 / 3	92.59 / 3	3
		2005SCDAA007	2005	59.03 / 2	74 / 3	Not collected	2.5
		2006SCDAA020	2006	72.41 / 3	77 / 3	Not collected	3
Fly Creek	17010304PN041_02	2005SCDAA008	2005	69.25 / 3	83 / 3	84.35 / 3	3
		2006SCDAA022	2006	78.15 / 3	71 / 3	Not collected	3
	17010304PN047_02	2007SCDAA039	2007	80.00 / 3	73 / 3	98.74 / 3	3
		2008SCDAA031	2008	66.33 / 3	76 / 3	Not collected	3
Heller/upper Sherlock Creek	17010304PN041_02[d]	2006SCDAA021	2006	70.81 / 3	78 / 3	Not collected	3
		2006SCDAA022	2006	78.14 / 3	71 / 3	Not collected	3
		2007SCDAA037	2007	62.79 / 2	72 / 3	97.75 / 3	2.67
		2007SCDAA039	2007	80.00 / 3	73 / 3	98.73 / 3	3
		2008SCDAA030	2008	62.85 / 2	77 / 3	Not collected	2.5
		2008SCDAA031	2008	66.33 / 3	76 / 3	Not collected	3

[a] Stream macroinvertebrate index—used to evaluate support of cold water aquatic life. For an explanation of scoring methods and determining supporting status, see the *Water Body Assessment Guidance, Second Edition* (Grafe et al. 2002).
[b] Stream habitat index—used to evaluate support of cold water aquatic life. For an explanation of scoring methods and determining supporting status, see the *Water Body Assessment Guidance, Second Edition* (Grafe et al. 2002).
[c] Stream fish index—used to evaluate support of cold water aquatic life. For an explanation of scoring methods and determining supporting status, see the *Water Body Assessment Guidance, Second Edition* (Grafe et al. 2002).
[d] Beneficial Use Reconnaissance Program data was collected within the same assessment unit but not within the Heller/Upper Sherlock Creek watershed.

When assessing new data that indicate full support, only the AU that the monitoring data represents will be removed (de-listed) from the §303(d) list (i.e., removed from category 5 of the Integrated Report).

The last BURP survey completed within the Beaver Creek watershed was in 1994. These data are too old to properly assess beneficial uses. Data collected within similar and neighboring watersheds (Mosquito, Fly, and Copper Creeks) would suggest that Beaver Creek is also supporting beneficial uses. However, until a BURP survey can be completed within the Beaver Creek watershed, the AU should remain unassessed and in category 3 of the Integrated Report.

Heller/Upper Sherlock Creek (AU 17010304PN041_02) is located in the headwaters of the upper St. Joe River and is not accessible by road. Due to the difficulty accessing the watershed, BURP data have not been collected within the Heller/Upper Sherlock Creek watershed, only within similar watersheds within the same AU. BURP data collected in AU 17010304PN041_02 show attainment of beneficial uses. The upper section of Sherlock Creek is not impacted by historic mining practices, however, the lower section of Sherlock Creek is and is not recommended to be de-listed for temperature.

Data shown in Table A-1 demonstrate attainment of beneficial uses for the AUs for which data were collected. Upper St. Joe River watershed, Fly, Mosquito, and Heller/Upper Sherlock Creeks were also modeled using the PNV methodology and found to be within their respective shade targets (Figures A-1 through A-15).

All subwatersheds, including these five at background conditions, show a lack of stream shading in the figures due to the methods used to develop the TMDL. When this discrepancy occurs, the estimated and target shade classes are within the same shade class but there appears to be a lack of shade (less than 10%) because of the methods used to assign existing and target shade. Existing shade classification is grouped into shade classes based on the lowest 10% of the shade potential. The estimation method underestimates shade and the modeled potential shade overestimates shade to varying levels. This discrepancy occurs to some degree in every reach. TMDL shade targets will be considered met when the existing shade is within 10% of modeled shade at PNV.

One section of Heller Creek and upper St. Joe River are lacking shade greater than what would be generated from the model difference (Figure A-12 and A-15). These sections are located in Township 43 north range 10 east, and township 42 north range 10 east respectively, and are meadow complexes in which it was difficult to determine the appropriate shade target to apply. These areas are un-entered (no roads or timber harvest) and are exhibiting dense vegetation. The areas may have been impacted by fire altering the target shade vegetation curve that is applied following the PNV methodology.

The large section of Sherlock Creek not meeting TMDL targets is not include in the recommended de-list of temperature for this AU. The lower reach of Sherlock Creek was split from the original AU during the development of the 2008 Integrated Report. A temperature TMDL has been developed for this section of stream.

Existing, Potential, and Delta (Difference between Existing and Potential) Shade Estimates for Steams Meeting TMDL Targets

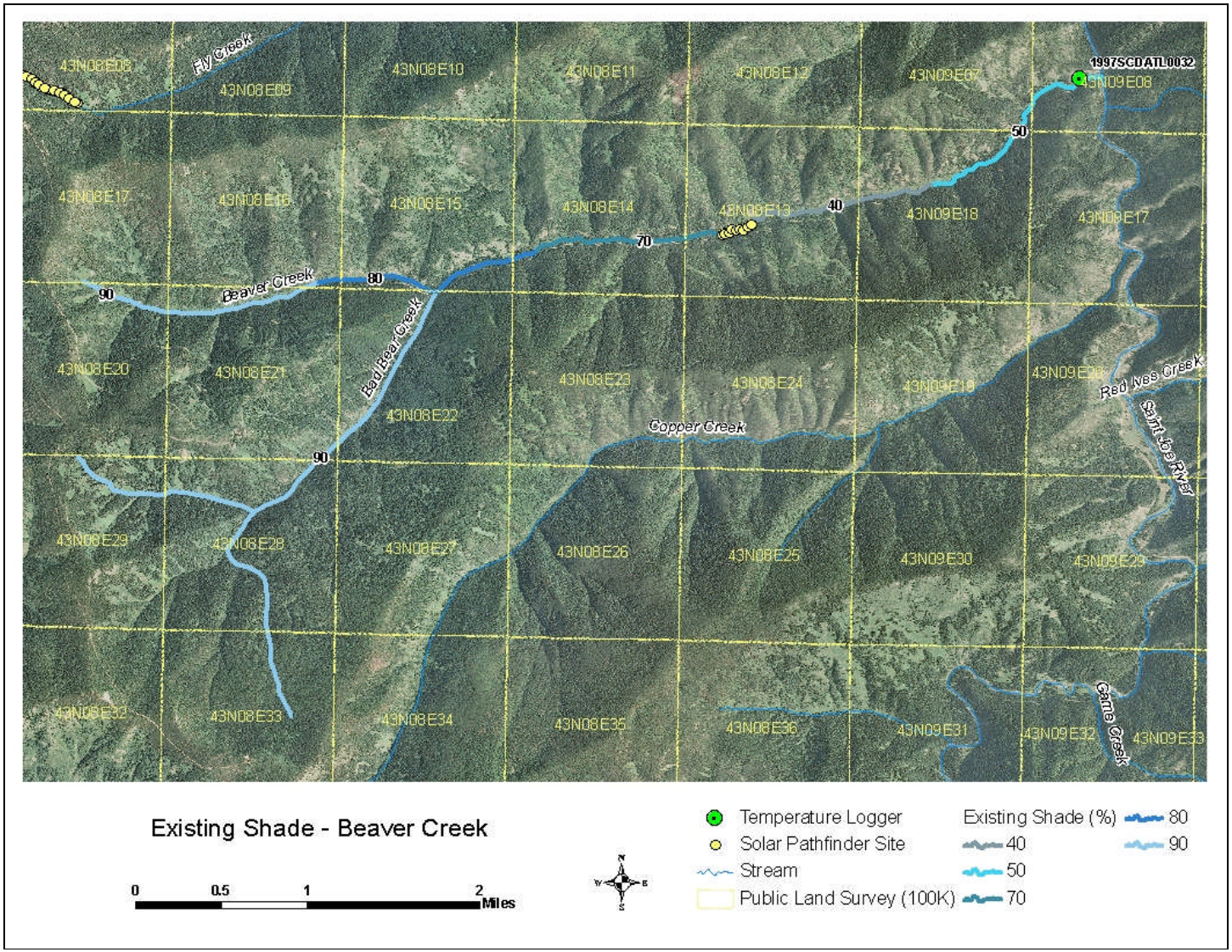


Figure A-1. Beaver Creek (AU ID17010304PN048_02) existing shade estimates

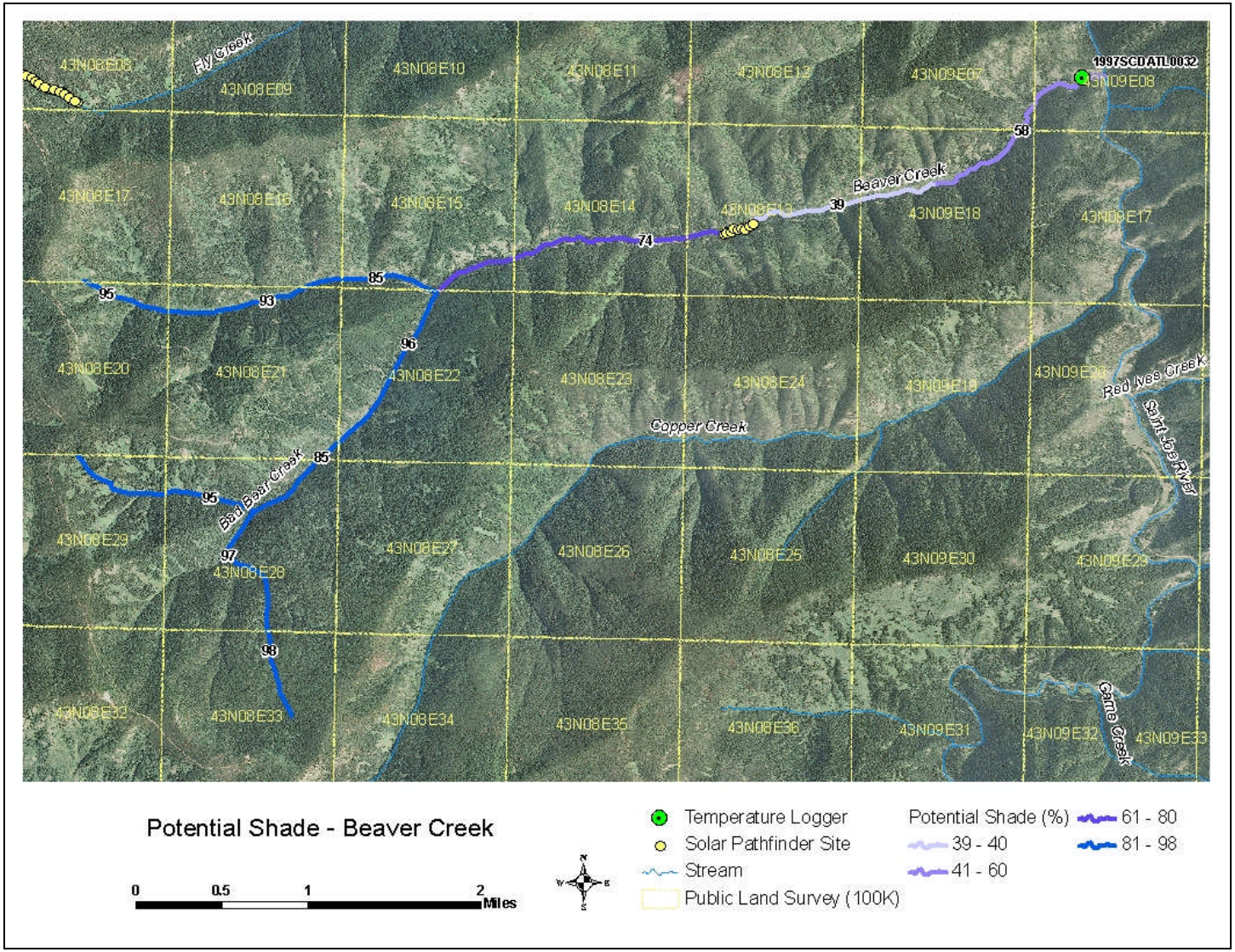


Figure A-2. Beaver Creek (AU ID17010304PN048_02) potential shade estimates

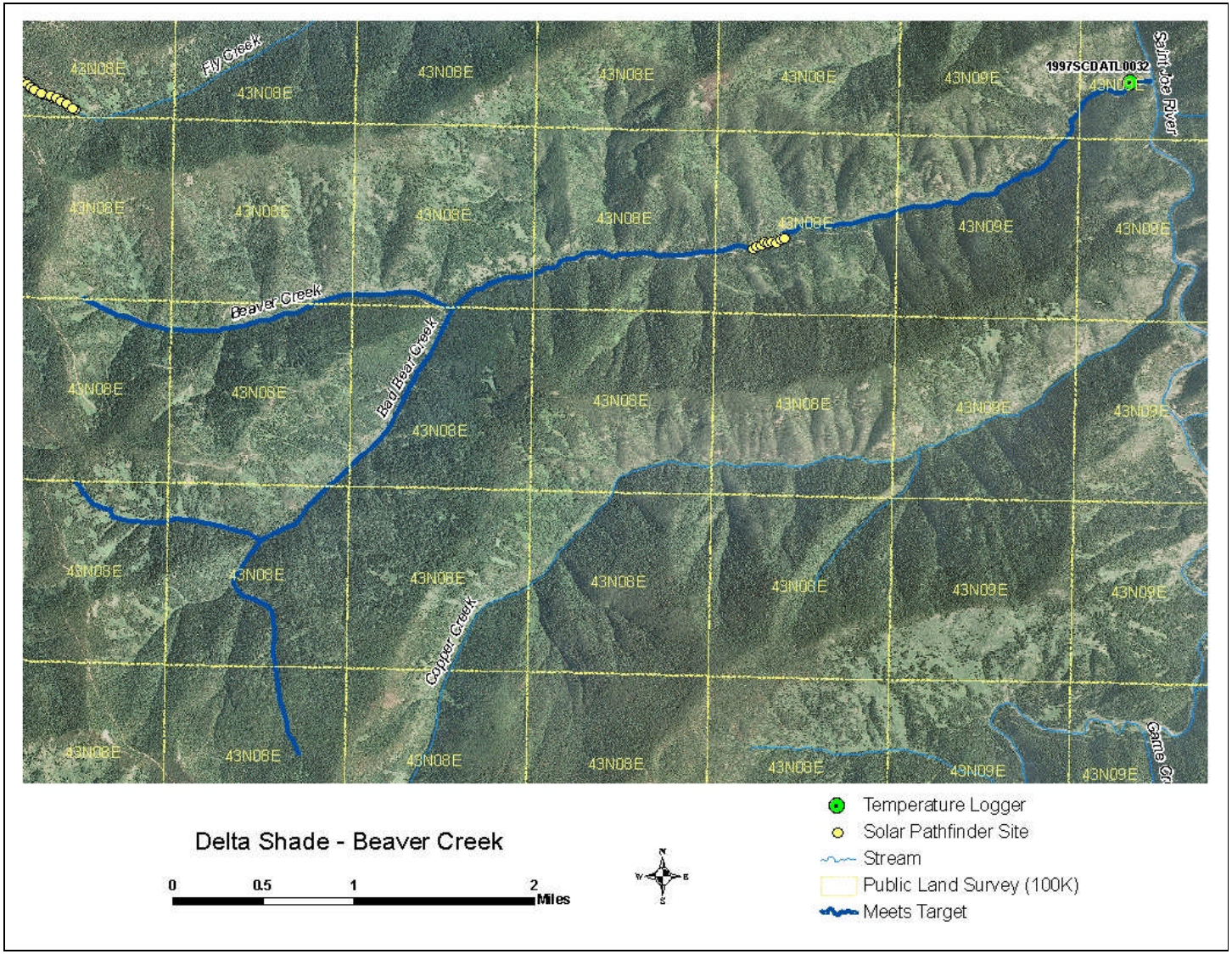


Figure A-3. Beaver Creek (AU ID17010304PN048_02) delta shade estimates

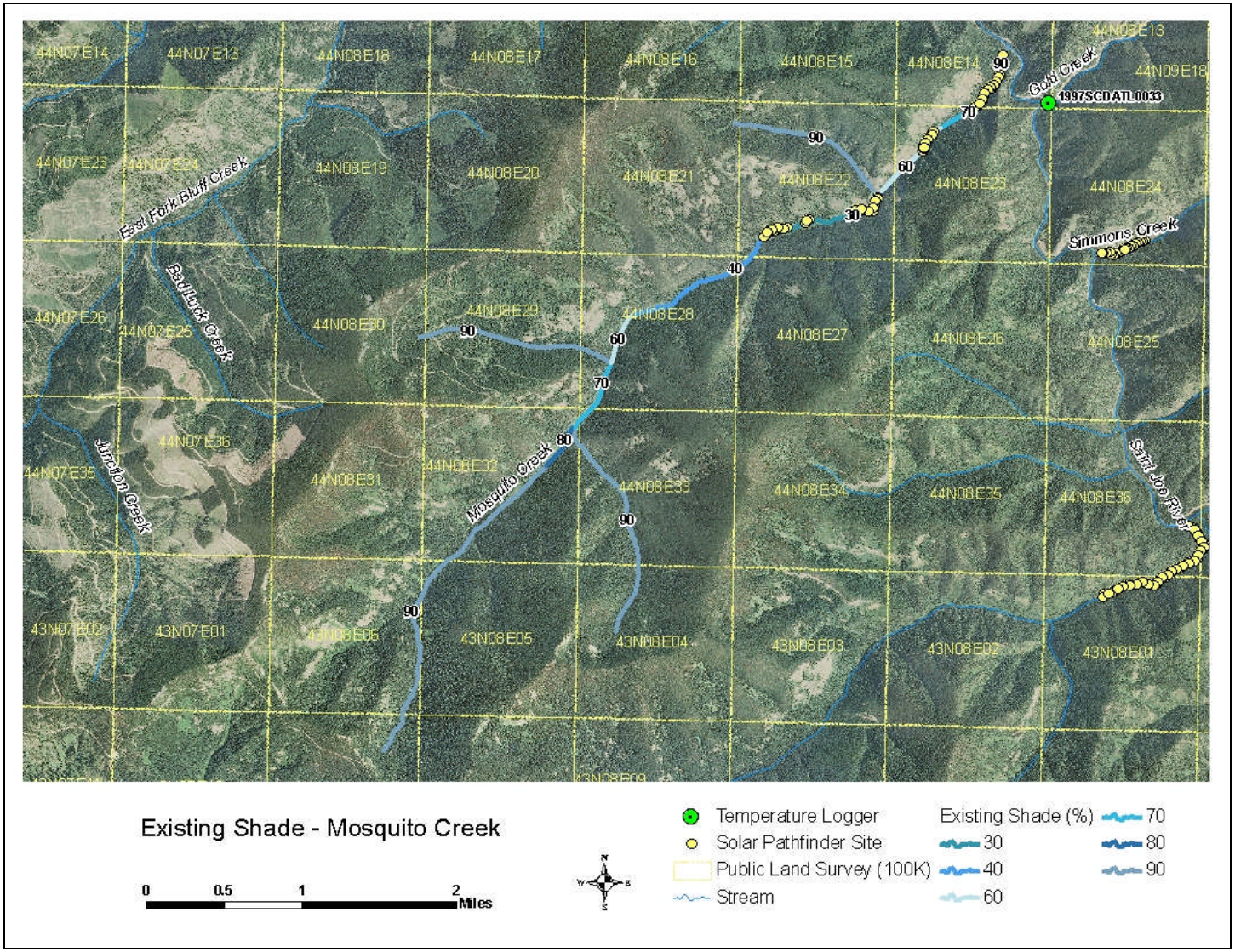


Figure A-4. Mosquito Creek (AU ID17010304PN046_02) existing shade estimates

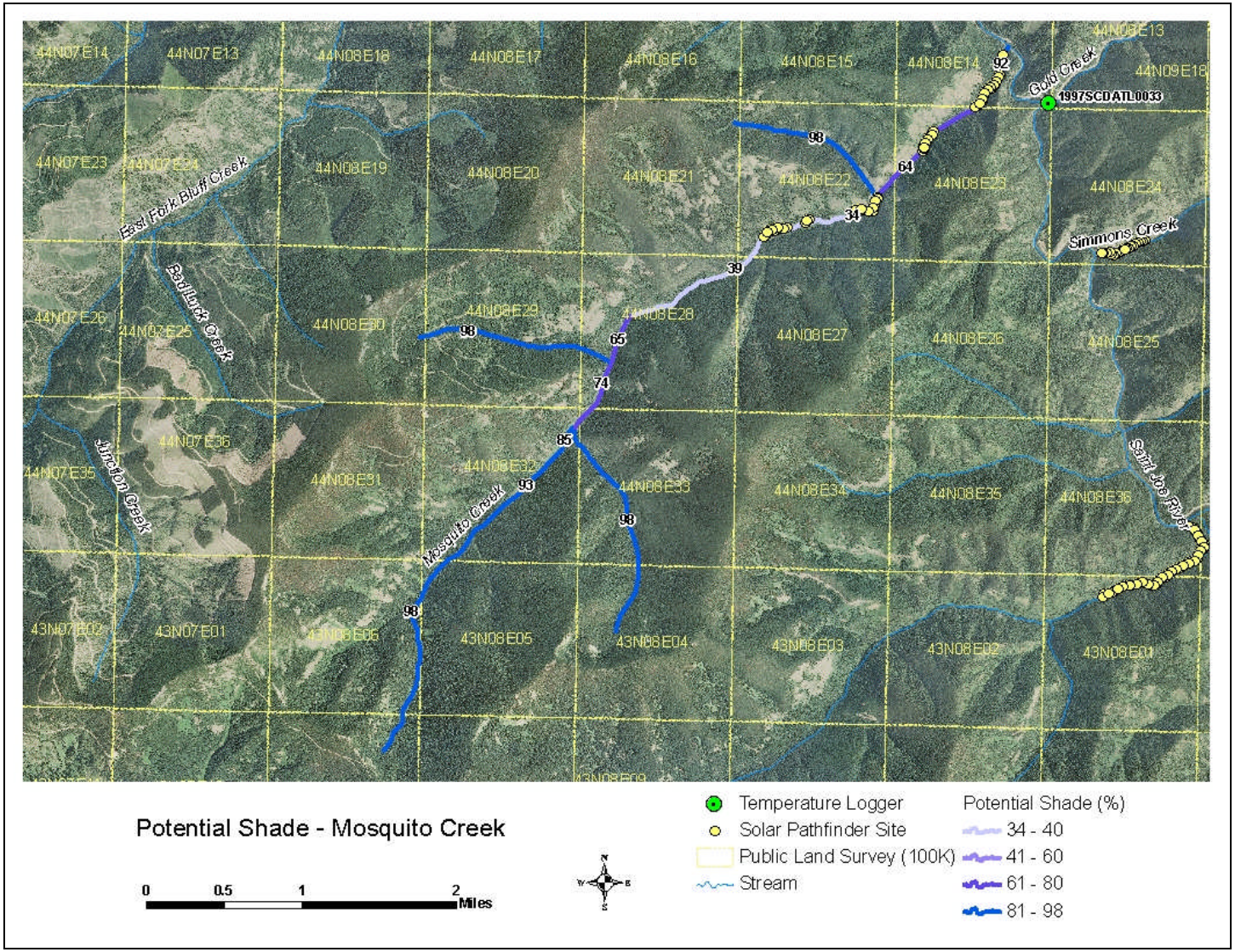


Figure A-5. Mosquito Creek (AU ID17010304PN046_02) potential shade estimates

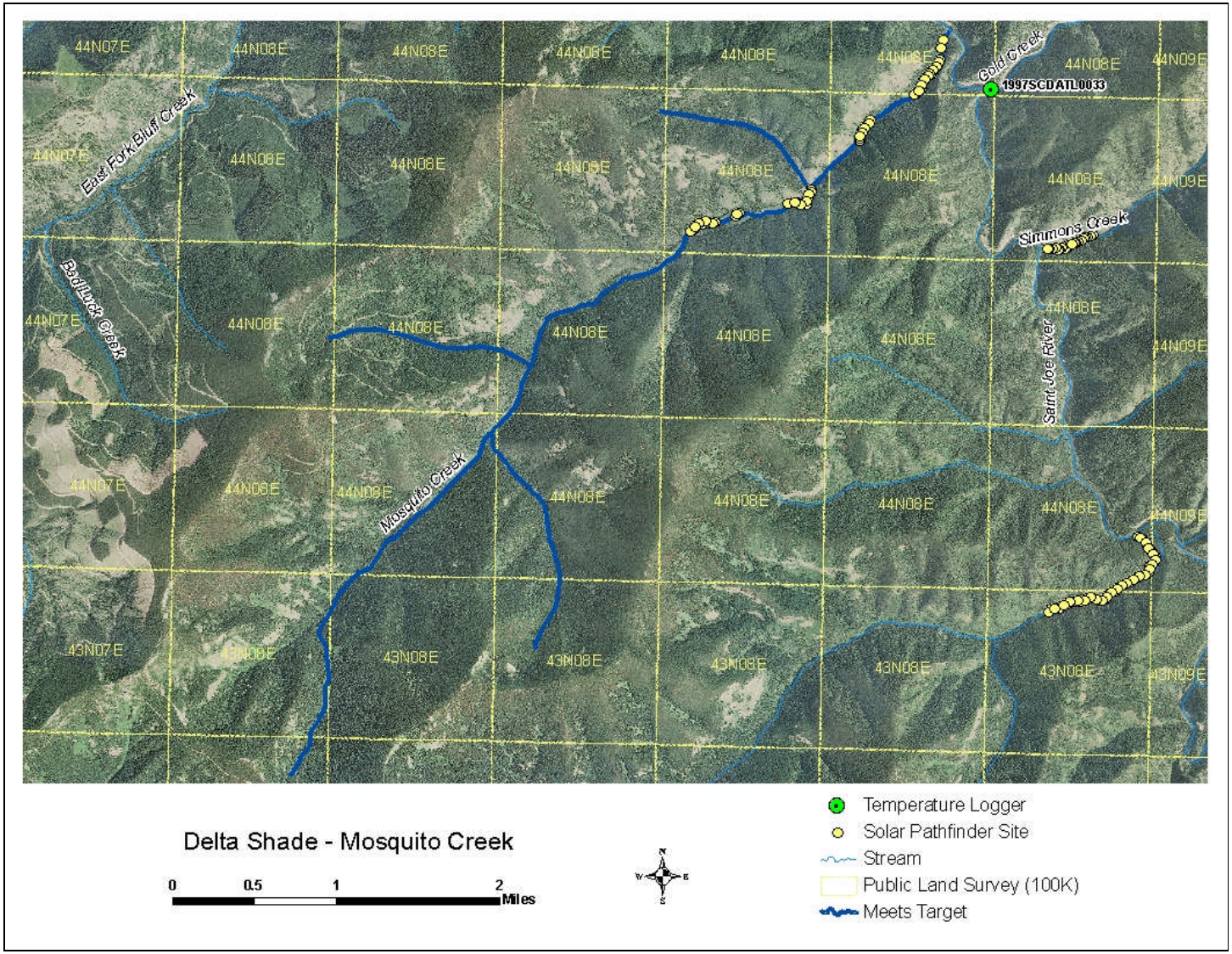


Figure A-6. Mosquito Creek (AU ID17010304PN046_02) delta shade estimates

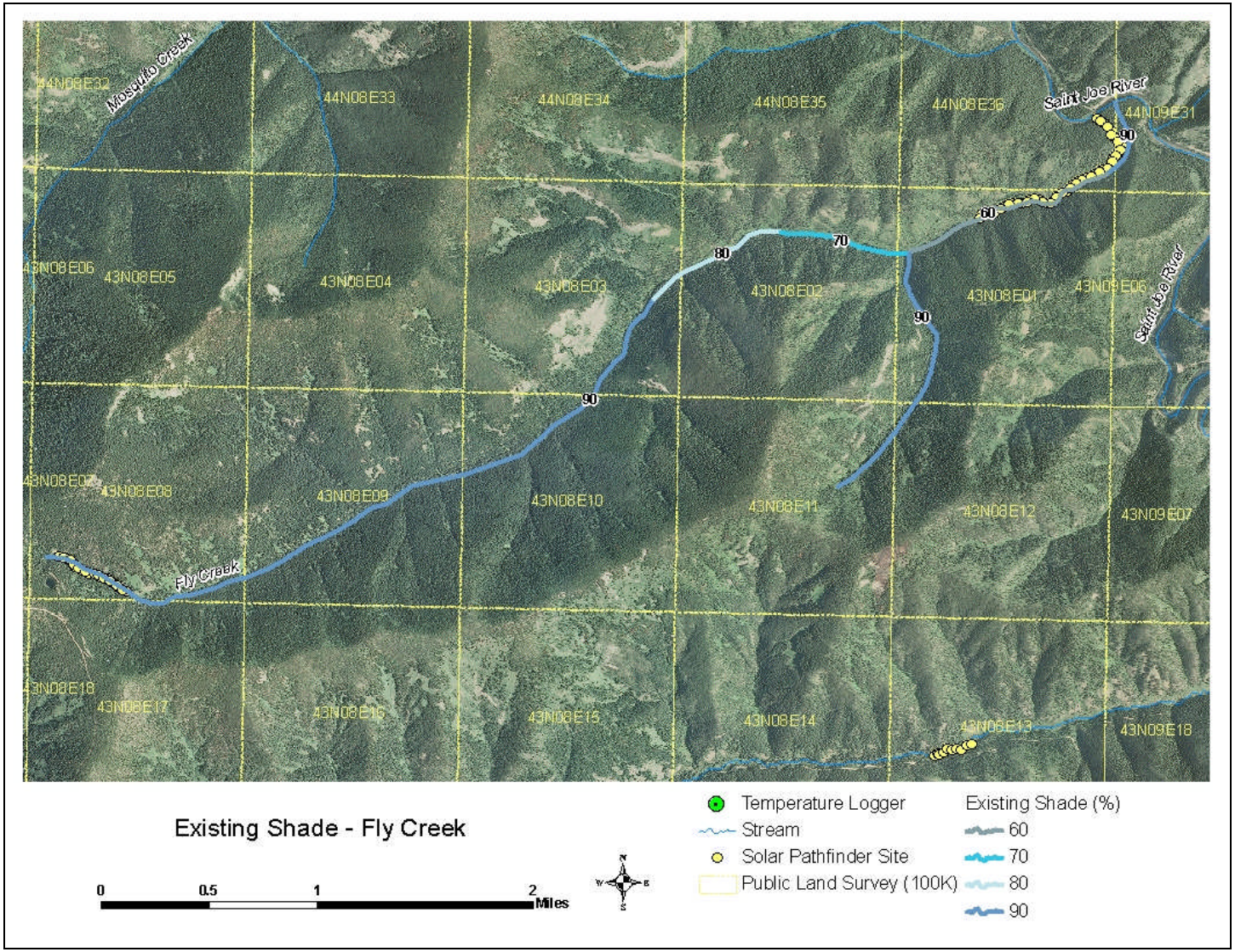


Figure A-7. Fly Creek (AU ID17010304PN047_02) existing shade estimates

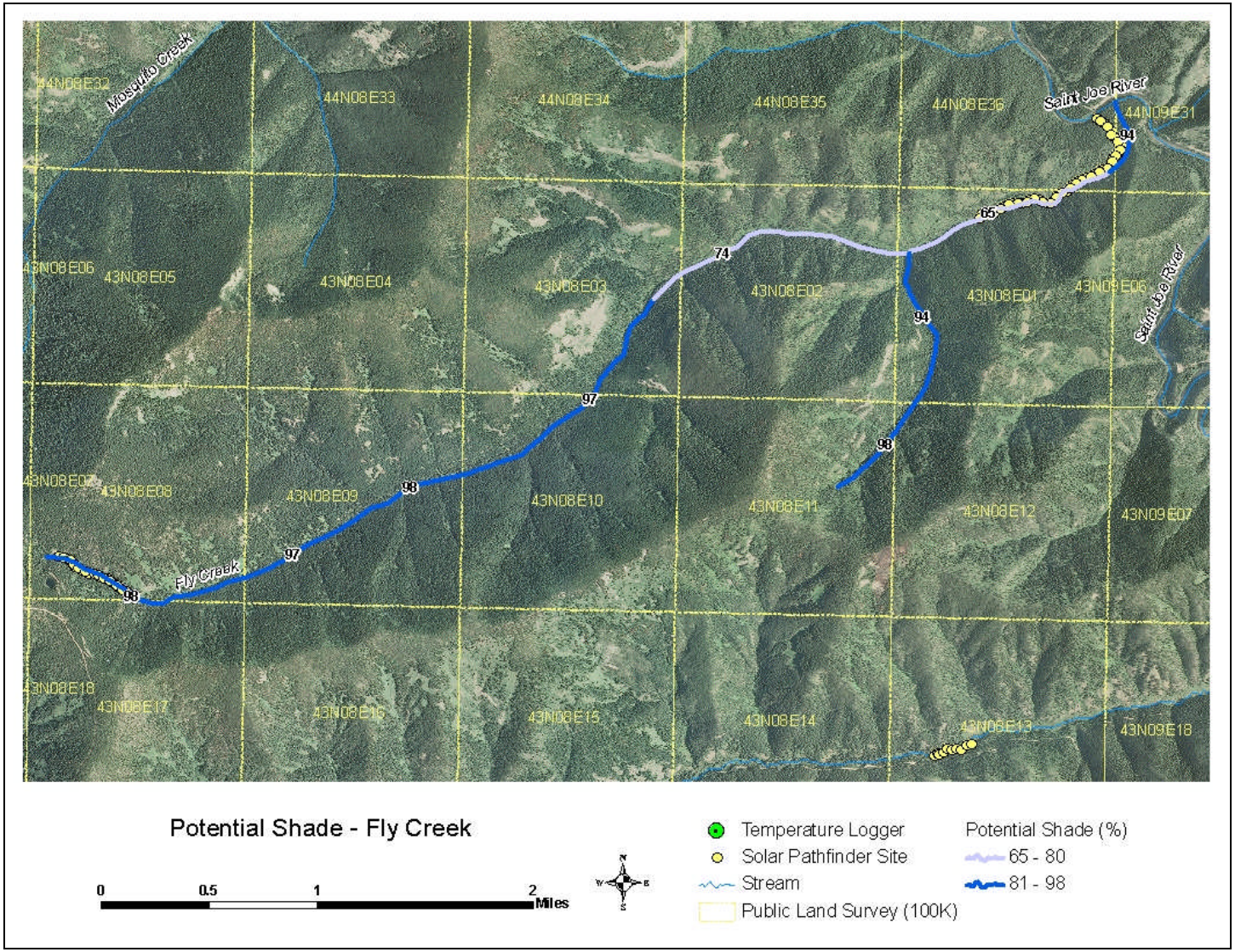


Figure A-8. Fly Creek (AU ID17010304PN047_02) potential shade estimates

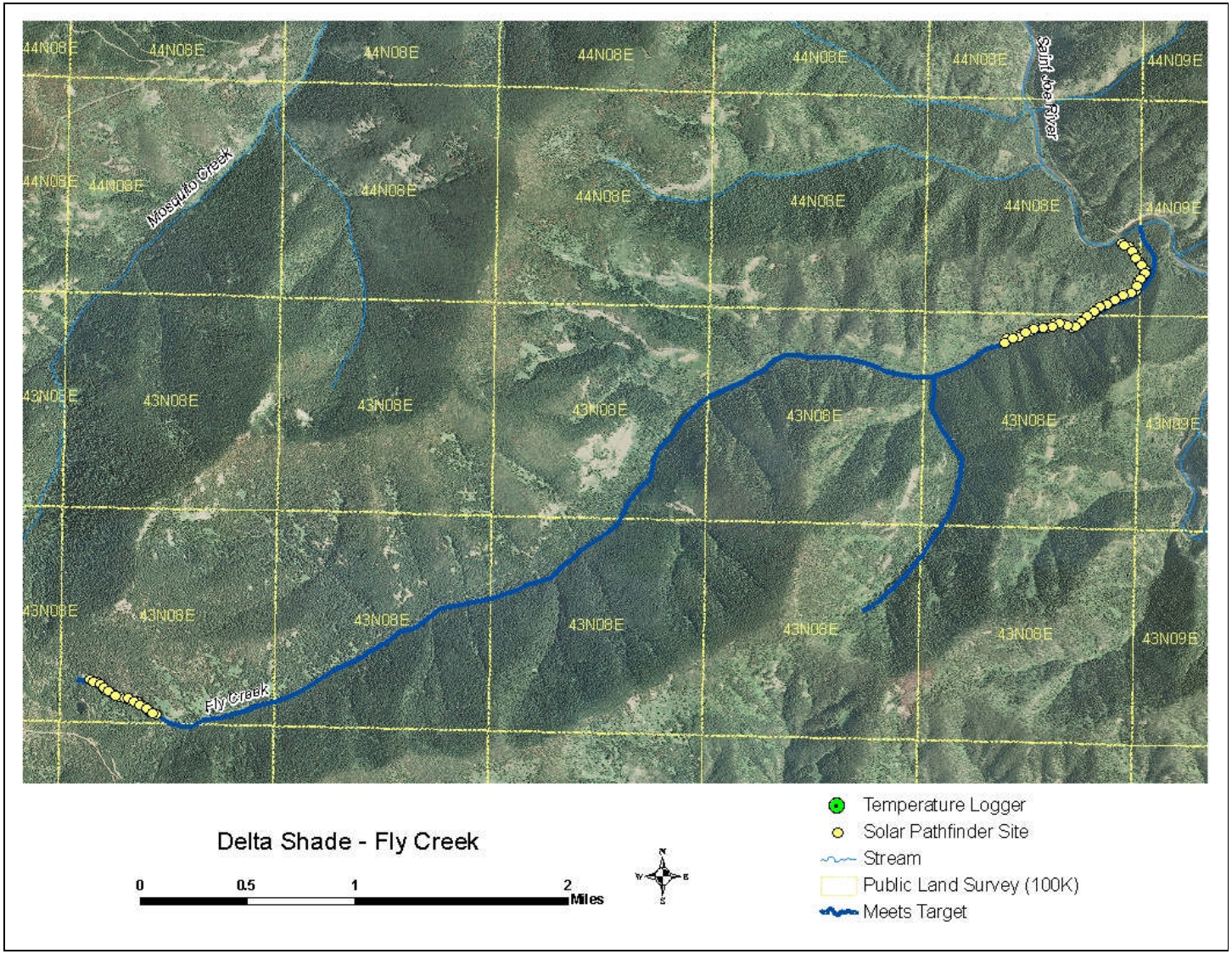


Figure A-9. Fly Creek (AU ID17010304PN047_02) delta shade estimates

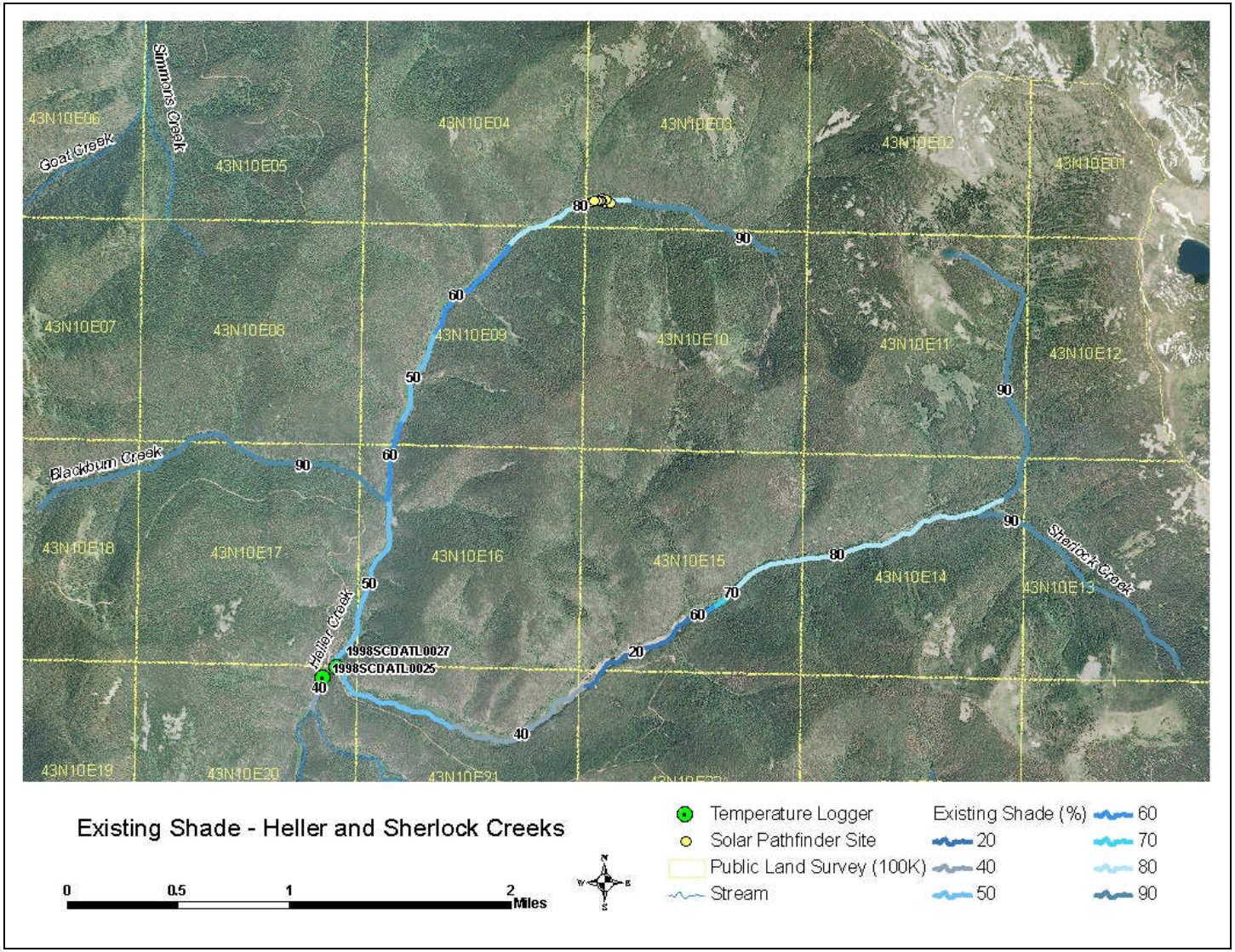


Figure A-10. Heller and Sherlock Creeks (AU ID17010304PN041_02/02a) existing shade estimates

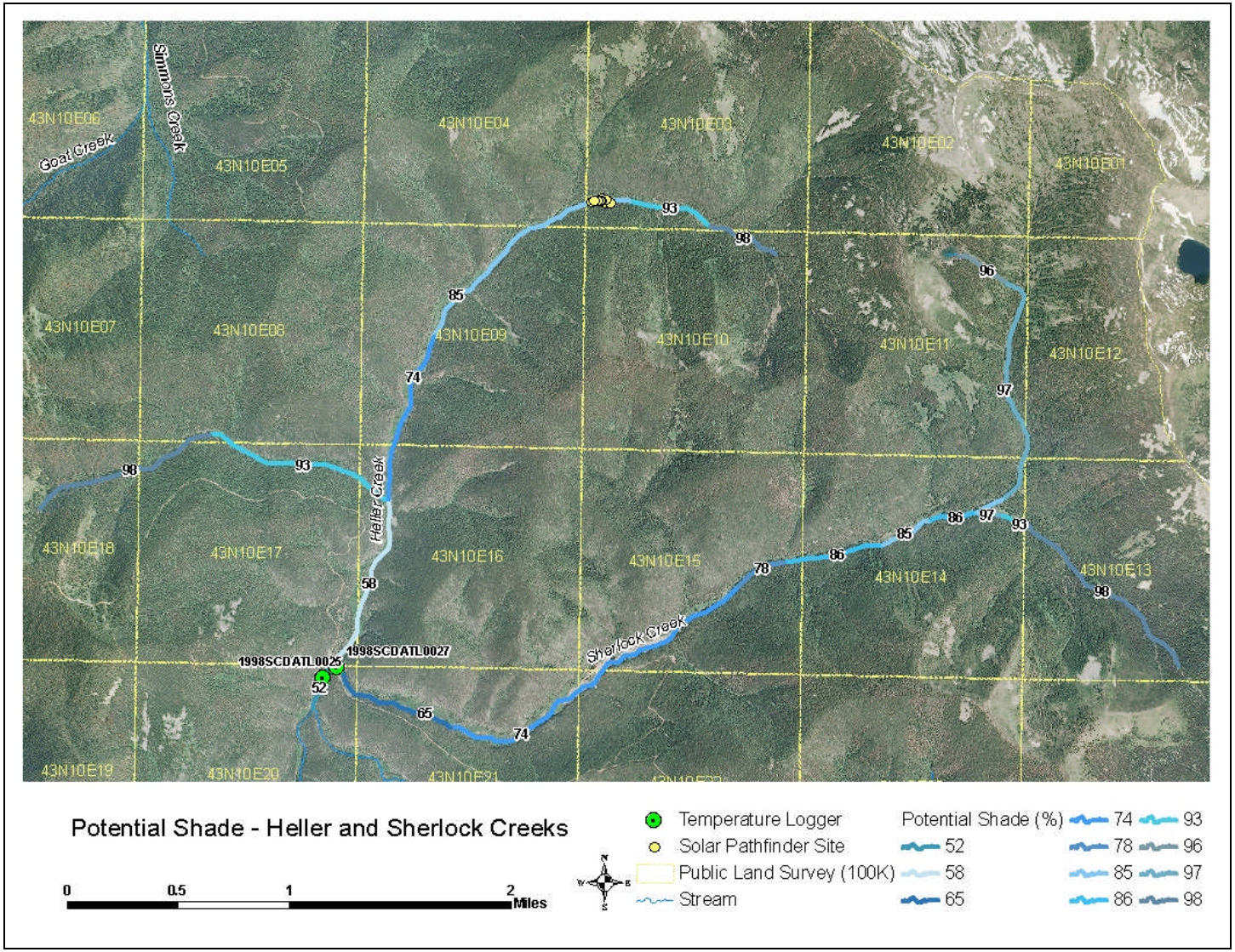


Figure A-11. Heller and Sherlock Creeks (AU ID17010304PN041_02/02a) potential shade estimates

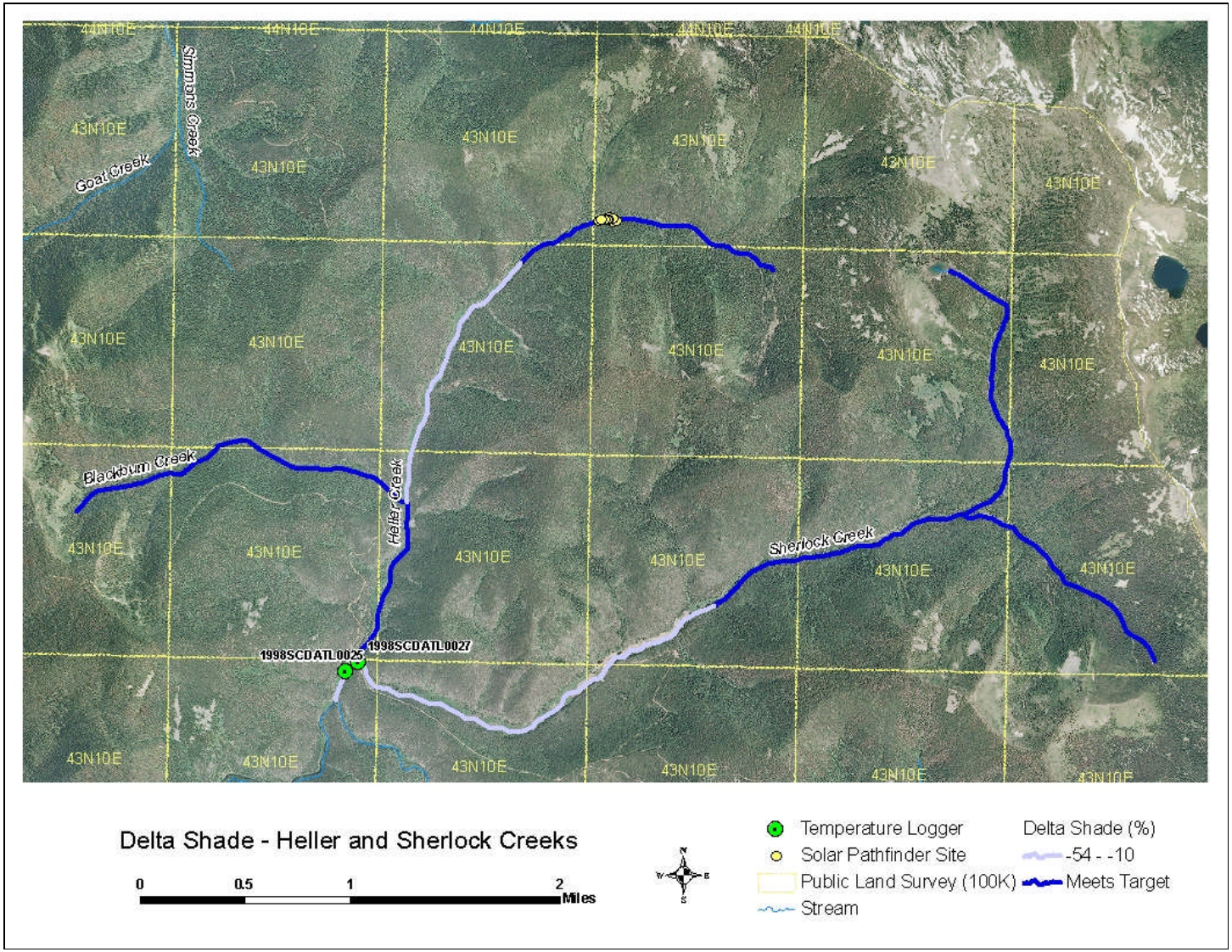


Figure A-12. Heller and Sherlock Creeks (AU ID17010304PN041_02/02a) delta shade estimates

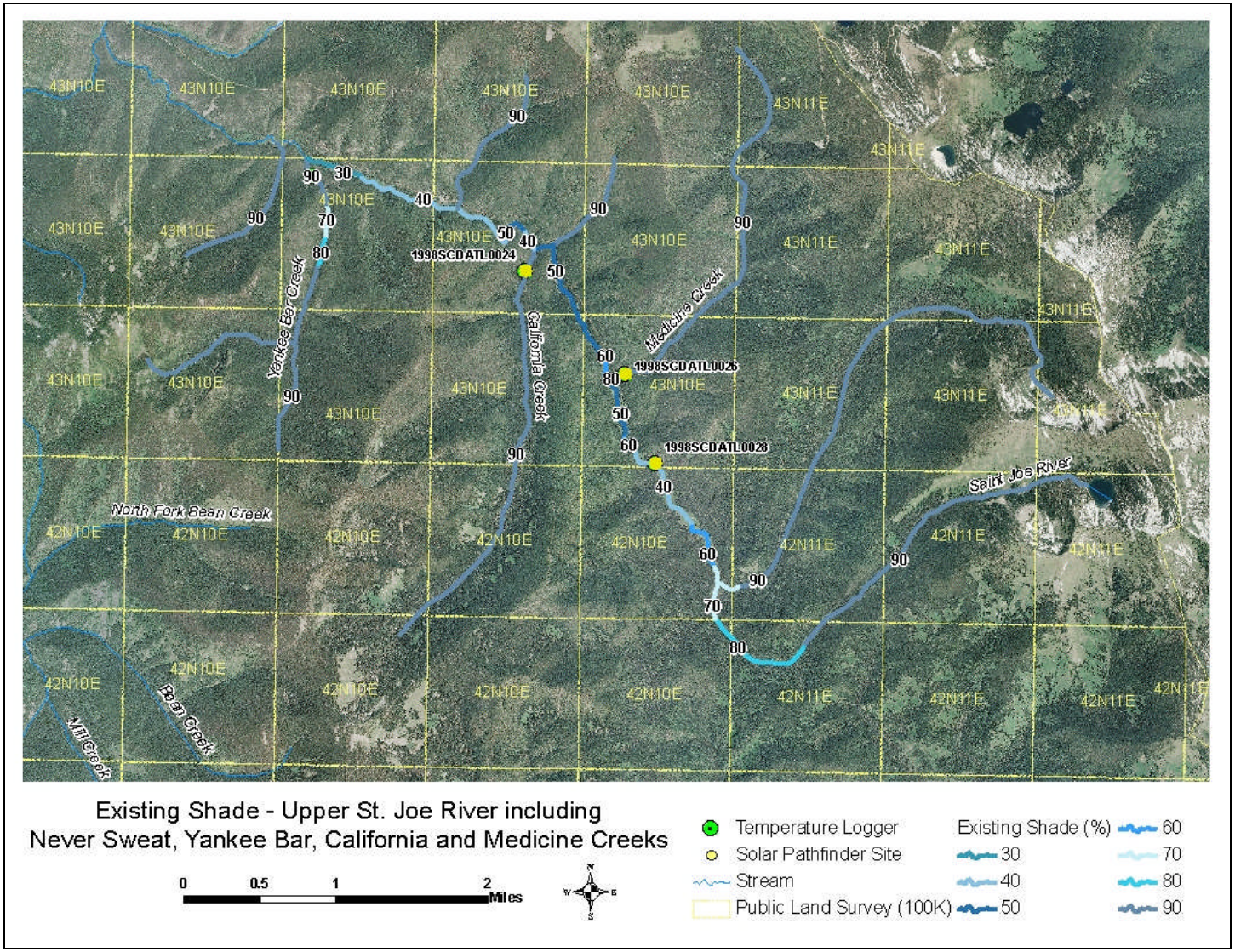


Figure A-13. Upper St. Joe River and tributaries (AU ID17010304PN041_02) existing shade estimates

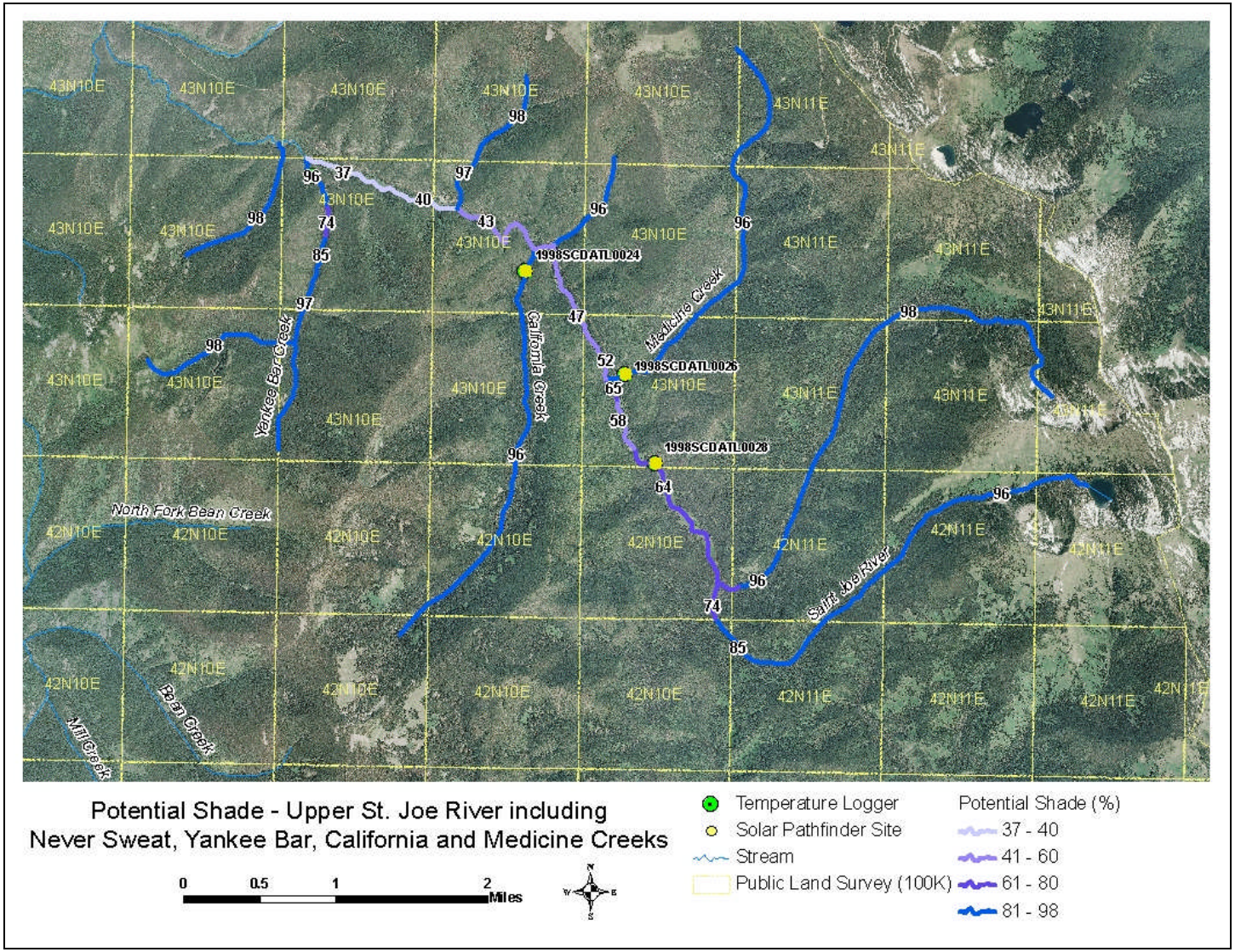


Figure A-14. Upper St. Joe River and tributaries (AU ID17010304PN041_02) potential shade estimates

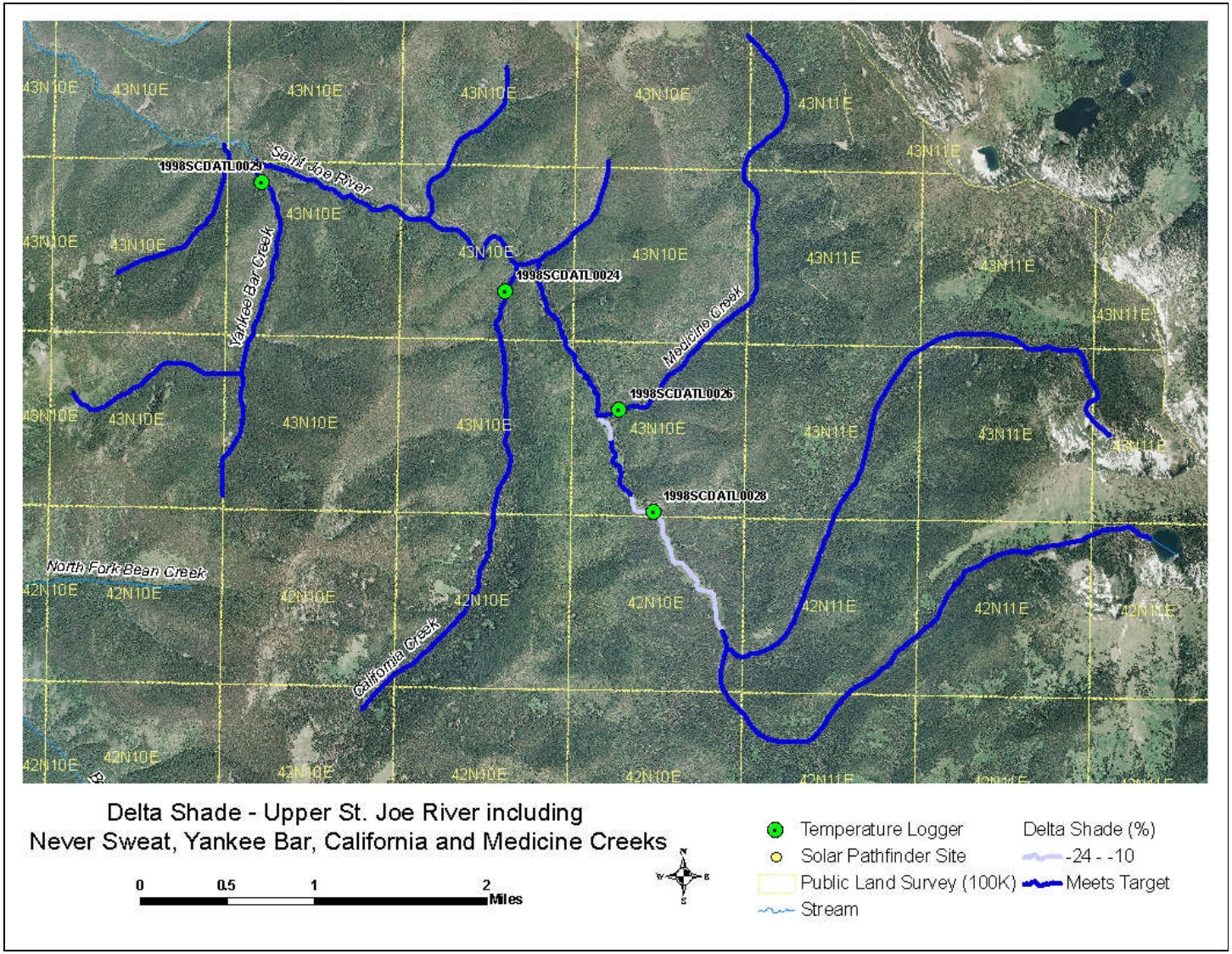


Figure A-15. Upper St. Joe River and tributaries (AU ID17010304PN041_02) delta shade estimates

Appendix B. Unit Conversion Chart

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

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

Appendix C. Data Sources and Other Data

This appendix includes sources of data used in the St. Joe River subbasin temperature total maximum daily load analysis.

Table C-1. Data sources for the St. Maries River watershed total maximum daily loads

Water Body	Data Source	Type of Data	Date Collected
5 monitoring sites within the St. Maries River watershed	DEQ Regional Office	Solar Pathfinder effective shade	Summer 2010
21 monitoring sites within the St. Maries River watershed	DEQ Regional Office and State Technical Services Office	Solar Pathfinder effective shade and stream width	Summer/Fall 2009
St. Maries River and 9 sub-watersheds	DEQ State Technical Services Office	Aerial photograph interpretation of existing shade and stream width estimation	Spring 2009
St. Joe River subbasin	U.S. Forest Service, DEQ, U.S. Environmental Protection Agency	Shade modeling	
St. Joe River subbasin	DEQ	Beneficial Use Reconnaissance Program photographs	1996–2008
St. Joe River subbasin	DEQ Idaho Assessment Data Base Supplementary Application (IDASA)	Temperature	

Table C-2. Data sources for the St. Joe River watershed total maximum daily loads

Water Body	Data Source	Type of Data	Date Collected
7 monitoring sites within the St. Joe River watershed	DEQ Regional Office	Solar Pathfinder effective shade	Summer 2010
11 monitoring sites within the St. Joe River watershed	DEQ Regional Office	Solar Pathfinder effective shade and stream width	Summer 2009
1 monitoring site within the Heller Creek watershed	U.S. Forest Service St. Joe River Ranger District	Solar Pathfinder effective shade and stream width	Summer 2009
St. Joe River watershed	DEQ State Technical Services Office	Aerial photograph interpretation of existing shade and stream width estimation	Spring 2009
St. Joe River subbasin	U.S. Forest Service, DEQ, U.S. Environmental Protection Agency	Shade modeling	
St. Joe River subbasin	DEQ	Beneficial Use Reconnaissance Program photographs	1996–2008

St. Joe River subbasin	DEQ Idaho Assessment Data Base Supplementary Application (IDASA)	Temperature	
St. Joe River at Calder, Idaho gaging station 12414500	U.S. Geological Survey	Temperature	1998-2001

Appendix D. Public Comments

A 30-day public comment period was open from July 13 through August 12, 2011. The draft document was posted to the DEQ webpage and was available for viewing at the DEQ Coeur d'Alene Regional Office. News articles were run in the Coeur d'Alene Press and St. Maries Gazette Record notifying the public of the comment period. DEQ received two set of comments during the public comment period. The commenter, comments, and DEQ response or action taken are discussed in the table below.

Commenter	Comment	DEQ Response or action
Jenny Wu Environmental Engineer U.S. Environmental Protection Agency 1200 Sixth Avenue, Suite 900 Seattle, Washington 98101-3140 Region 10 Watershed Unit	Page 13, 20 Additional AUs monitored. The section describes 20 AUs where inadequate information on temperature exists to determine impairments, but they are tributaries to temperature-impaired waters. The TMDL develops shade targets for these AUs to assist implementation. EPA appreciates the work done by IDEQ to provide information on shade targets to guide implementation.	No comment
	Page 17, Lower St. Joe River to Category 3. The section describes dividing the AU for the mainstem St. Joe River into two sections, above and below St. Joe City, because of the marked difference in systems where the lower St. Joe is slack water caused by Post Falls Dam in the Spokane River. EPA agrees that the AU should be divided into two areas to allow for the distinct characteristics. However, the Lower St. Joe River should remain on Category 5, because temperature exceedances still occur whether caused solely by Post Falls Dam or by other anthropogenic effects.	Data representing the lower section of the St. Joe River (St. Joe City to the St. Maries River) was not available during the development of the TMDL document. Water temperature data used to compare the mainstem St. Joe River to Idaho water quality standards was collected at the USGS gauging station near Calder, Idaho. Data collected at this location is not representative of the slack-water portion of the river. The lower portion of the river is significantly impacted by Coeur d'Alene Lake flow elevation management and the Post Falls HED. The impact has caused the river to become over-widened and loss of

		riparian vegetation. The impact of the Post Falls HED precludes the attainment of Idaho water quality standards. DEQ does not have assessment data at this time to justify keeping the lower section of the river in Category 5, therefore we consider it unassessed and will move it to Category 3. DEQ will make efforts to assess the lower reach of the river in the future.
	Page 30, Table 15. Simmons and East Fork Emerald Creek show large discrepancies between estimates from aerial photographs and Solar Pathfinder results. Please describe reasons for these differences.	Differences between estimates from aerial photographs and Solar Pathfinder results may have occurred for different reasons including; vegetative growth from the time the aerial photograph was taken and the shade estimates were made, topography is influencing the site and not taken into consideration when the estimate was made, or a different riparian community is present than what was anticipated. These are just a few possibilities. When a difference was noted between Solar Pathfinder results and shade estimates the shade class that was being evaluated was reviewed and changed if needed. Existing shade classifications where only changed when the difference between Solar Pathfinder results and shade estimates were greater than 20%.
	Page 52, Table 22. Temperature WLAs. The explanation and calculations for the temperature WLAs, as well as information on the facilities' discharges are well-	The temperature waste load allocation will be updated to include a conversion to energy units per day.

	explained. Please add another column in the Table converting 35^{o}C to energy units/day. This expression of daily load is required by the Anacostia decision, which was ruled on after 2003 when the original TMDL was written.	
	Page 54, Section 5.5, Implementation of Shade Targets. If any agreements or timelines are available for anticipated riparian plantings by DMAs, please include these in the Reasonable Assurances or Implementation sections.	Will include timelines if possible.
	Page 72, Table A-1. Delistings. Please include information on the number and dates of BURP samples collected.	BURP data collected within the watersheds that are meeting TMDL targets and attaining beneficial use support are include in Appendix A. A column was added to Table A-1 identifying the year the BURP survey was completed.
	Page 72, Heller-Sherlock stream. The text describes mining areas in the Heller-Sherlock area and specifies that the AU proposed for delisting is in the upper Heller. Additional language appears to confirm that the upper Heller-Sherlock Creek is largely untouched and currently meets the shade targets and biological indicators. Please clarify that the upper Heller-Sherlock Creek does not have mining or other anthropogenic impacts.	The mining impacted zone of Sherlock Creek is limited to the lower reaches of the stream. The mining impacted section of stream is not recommended to be de-listed. The upper reach of the stream is not impacted and is largely untouched and does have a riparian community meeting TMDL targets. This section of the document will be reviewed and updated to make the discussion more clear.
	Appendices G and H, Shade curves for St. Joe Watershed. Appendices G and H provide useful information on the shade targets and additional riparian vegetation in the St.	A watershed map of the St. Joe will be added.

	Joe and St. Maries watershed. The geographic scope on the tributary level is helpful for implementation, and the larger scale is useful to see system-wide trends. Appendix H has a map for the entire St. Maries watershed, but Appendix G does not for the St. Joe watershed. It would be helpful to include an overall map for the St. Joe watershed.	
	Estimate of temperature improvements. Are there any estimates on the improvements to temperatures if potential natural vegetation shade targets were achieved?	Table 6, page 12 summarizes the water temperature data collected within bull trout watersheds. During the assessment both the Federal and State water quality criteria were evaluated. The bull trout criterion is the most conservative (lowest) water temperature criteria applied in the watershed. The watersheds with the lowest percent exceedance of the criteria are also the watersheds that are meeting TMDL targets, and the watersheds exceeding the criteria with more frequency are watersheds needing reduction in solar loading.
	Industrial Stormwater Dischargers. Are there are any industrial stormwater discharge permittees in the basin? Please include language on whether or not they are in the basin and have dischargers that impact temperature. If they do, they should have a wasteload allocation.	There are no Industrial Stormwater Dischargers within the subbasin. Language will be added to the document.
Benewah County Commissioners 701 West College Avenue	We are skeptical about the standards that are being used in the evaluation of the rivers and tributaries. We are led to this	Idaho water quality standards will not be adjusted to conform to natural conditions rather the assessment methods DEQ uses

St. Maries, ID 83861	conclusion by the fact that some tributaries that have had no or very little activity by man in their watersheds are nonetheless found to be out of compliance with the standards. In our view, watersheds that are undisturbed by man must be within the natural range of variability and the standards should reflect that condition. The standards should be adjusted to conform to natural conditions, rather than to have unreal standards and expect natural conditions to somehow conform to the standards.	in these areas will be adjusted to account for the natural condition. If beneficial uses are not met in these types of areas then the situation causing the impairment is natural and would not warrant TMDL development. During future assessments if beneficial uses are found to not be supported in these areas the assessment unit will be moved to an appropriate section of the Integrated Report.
	The forest types in the St. Joe/St. Maries watersheds have a wide range of natural variability. Stand replacement wildfires are spaced at hundreds of years and drastically alter the vegetation for decades or even centuries. It appears the evaluation standards do not recognize this reality, as evidenced by watersheds that are still recovering from the 1910 Burn, but with no disturbance by man, being found to be out of compliance with the standards.	Water temperature criteria may be met in watersheds with minimal anthropogenic disturbance, but this co-occurrence was not documented during this analysis. Stream temperatures may naturally be increased due to solar loading associated with a natural reduction of stream shading as a result of fire, disease, wind damage, or other natural event. In this type of situation reductions in shade is natural and will not be considered a water quality criteria violation.

Appendix E. Distribution List

Copies of the final document will be provided to the St. Joe/St. Maries Watershed Advisory Group participants. Copies of the final document will also be posted the DEQ TMDL webpage and copies will be mailed to the St. Maries and Tri-County public libraries. The DEQ Coeur d'Alene Regional Office will be able to provide copies of the document by request.

DEQ Coeur d'Alene Regional Office
2110 Ironwood Parkway
Coeur d'Alene, ID 83814
(208) 769-1422

St. Maries Public Library
822 West College Avenue
St. Maries, ID 83861

Tri-County Public Library
46 Isaacson Street
Fernwood, ID 83830
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Appendix F. State and Site-Specific Water Quality Standards and Criteria

Water Quality Standards Applicable to Salmonid Spawning Temperature

Water quality standards for temperature are specific numeric values not to be exceeded during the salmonid spawning and egg incubation period, which varies by species. For spring-spawning salmonids (westslope cutthroat trout), the default spawning and incubation period recognized by DEQ is generally from March 15 to July 1 each year (Grafe et al. 2002). The Coeur d'Alene Regional Office set the general spawning and incubation windows with assistance from the Idaho Department of Fish and Game to better reflect and protect salmonid spawning and incubation in north Idaho. The adjusted spawning and incubation windows account for differences in elevation, a watershed characteristic not accounted for originally. Fall spawning can occur as early as August 15 and continue with incubation on into the following spring up to June 1. As per IDAPA 58.01.02.250.02.e.ii., the following water quality criteria need to be met during the specified time period:

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

The cold water aquatic life beneficial use, of which salmonid spawning is a subset, identifies water temperatures intended to protect and maintain a viable life community for coldwater fish species and for other coldwater species (IDAPA 58.01.02.250.01.02.b). As per IDAPA 58.01.02.250.02.b., the following water quality criteria need to be met for cold water aquatic life:

- 22 °C maximum instantaneous
- 19 °C maximum daily average

Bull trout (*Salvelinus confluentus*) is listed as a threatened species by the U.S. Fish and Wildlife Service. To protect the species in Idaho, a recovery plan was developed by the State in which water temperature criteria were set to protect the threatened species (IDAPA 58.01.02.250.02.g). The U.S. Environmental Protection Agency (EPA) also promulgated bull trout water quality temperature criteria (Title 40, Part 131, Subpart D, Section 131.33). State and federal temperature criteria are summarized below (Table B-1).

Table F-1. State and federal water temperature standards applicable in the St. Joe River subbasin

Type	Location	Criteria	Dates	
Cold Water Aquatic Life	Applies to entire subbasin	22 ºC (71.6 ºF) Maximum Daily Maximum Temperature (MDMT)	Applies entire year	
		19 ºC (66.2 ºF) Maximum Daily Average Temperature (MDAT)		
Salmonid Spawning	Applies to entire subbasin where beneficial use is designated or existing	13 ºC (55.4 ºF) Maximum Daily Maximum Temperature (MDMT)	Spring Spawning	Fall Spawning
		9 ºC (48.2 ºF) Maximum Daily Average Temperature (MDAT)	>4,000 ft Jun 1–July 31 3,000–4,000 ft May 15–July 15 <3,000 ft May 1–July 1	Aug 15–Nov 15
Idaho Bull Trout Criteria	St. Joe River watershed above and including Mica Creek	13 ºC (55.4 ºF) Maximum Weekly Maximum Temperature (MWMT)	Rearing Jun 1–Aug 31	n.a.
		9 ºC (48.2 ºF) Maximum Daily Average Temperature (MDAT)	n.a.	Spawning Sep 1–Oct 31
U.S. Environmental Protection Agency Bull Trout Criteria	Bad Bear, Bean, Bear, Beaver, Bedrock, Berge, Bird, Blue Grouse, Boulder, Broadaxe, Bruin, California, Cherry, Clear, Color, Copper, Dolly, Dump, Eagle, East Fork Bluff, East Fork Gold, Emerald, Fishhook, Float, Fly, Fuzzy, Gold, Heller, Indian, Kelley, Malin, Marble, Medicine, Mica, Mill, Mosquito, North Fork Bean, North Fork St. Joe River, North Fork Simmons, Nugget, Packsaddle, Periwinkle, Prospector, Quartz, Red Cross, Red Ives, Ruby, St. Joe River (above Siwash Creek), Setzer, Sherlock, Simmons, Siwash, Skookum, Thomas, Thorn, Three Lakes, Timber, Tinear, Trout, Tumbledown, Wahoo, Washout, Wilson and Yankee Bar Creek	10 ºC (50 ºF) Maximum Weekly Maximum (MWMT)	Jun 1–Sep 30	

Natural Background Provisions

For potential natural vegetation temperature TMDLs, it is assumed that natural temperatures may exceed these numeric criteria during the designated time periods. If potential natural vegetation targets are achieved, yet stream temperatures are warmer than these criteria, it is assumed that the stream's temperature is natural (provided there are no point sources or human-induced ground water sources of heat) and natural background provisions of Idaho's water quality standards apply (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 are exceeded due to natural conditions, then a point source discharge cannot raise the water temperature by more than 0.3 °C (IDAPA 58.01.02.401.03.a.v.).

Appendix G. St. Joe River Watershed Potential Natural Vegetation Figures: Existing, Potential, and Delta Shade; Vegetation Response Unit Groups and Stream Gradient; Bankfull Width Estimates; and Shade Curves

The underlying aerial photograph used to estimate existing shade and shown in the figures included in this appendix was taken during the summer of 2009.

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LIST OF FIGURES

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Existing, Potential, and Delta Shade Estimates

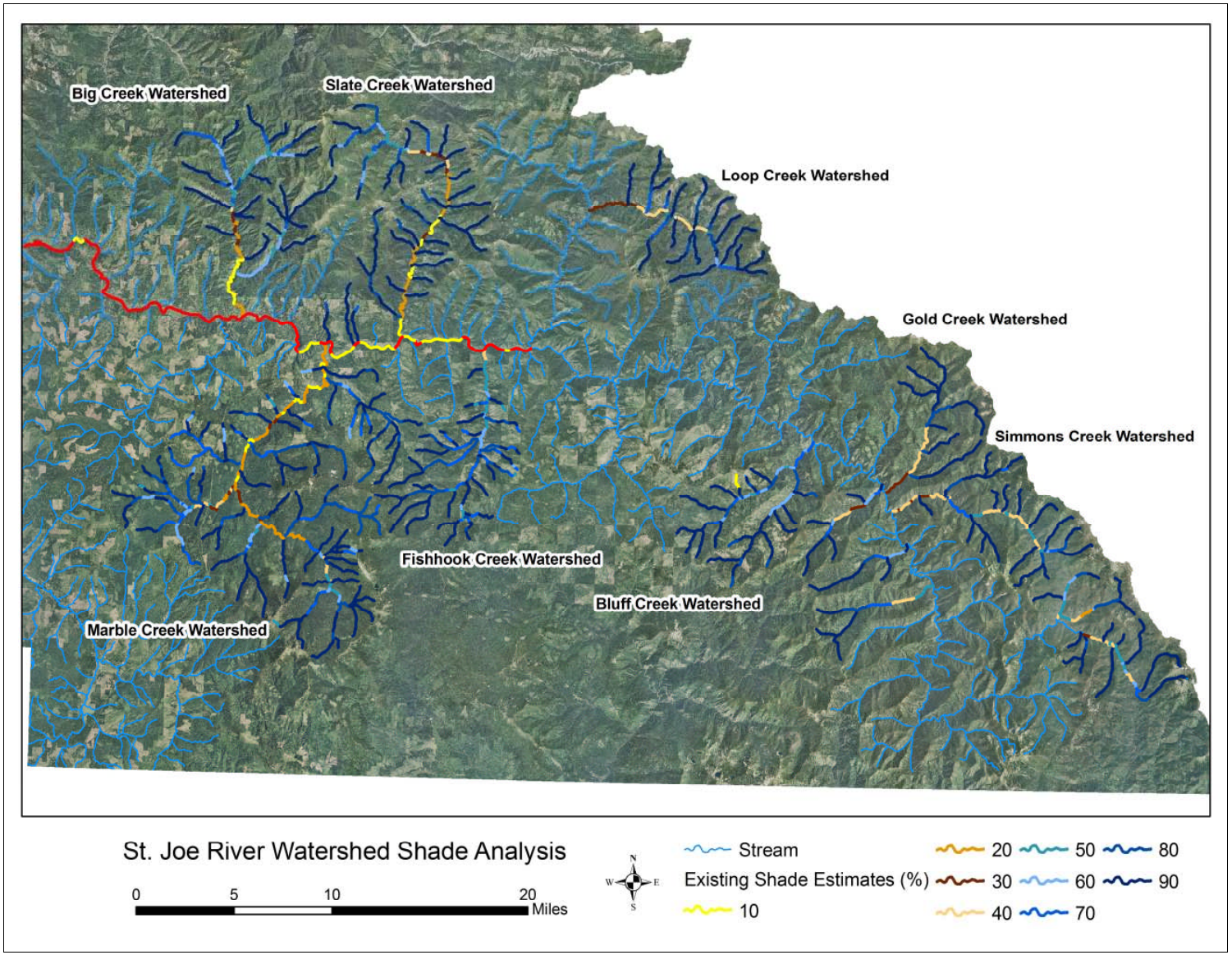


Figure G-1a. St. Joe River watershed shade analysis – existing shade estimates.

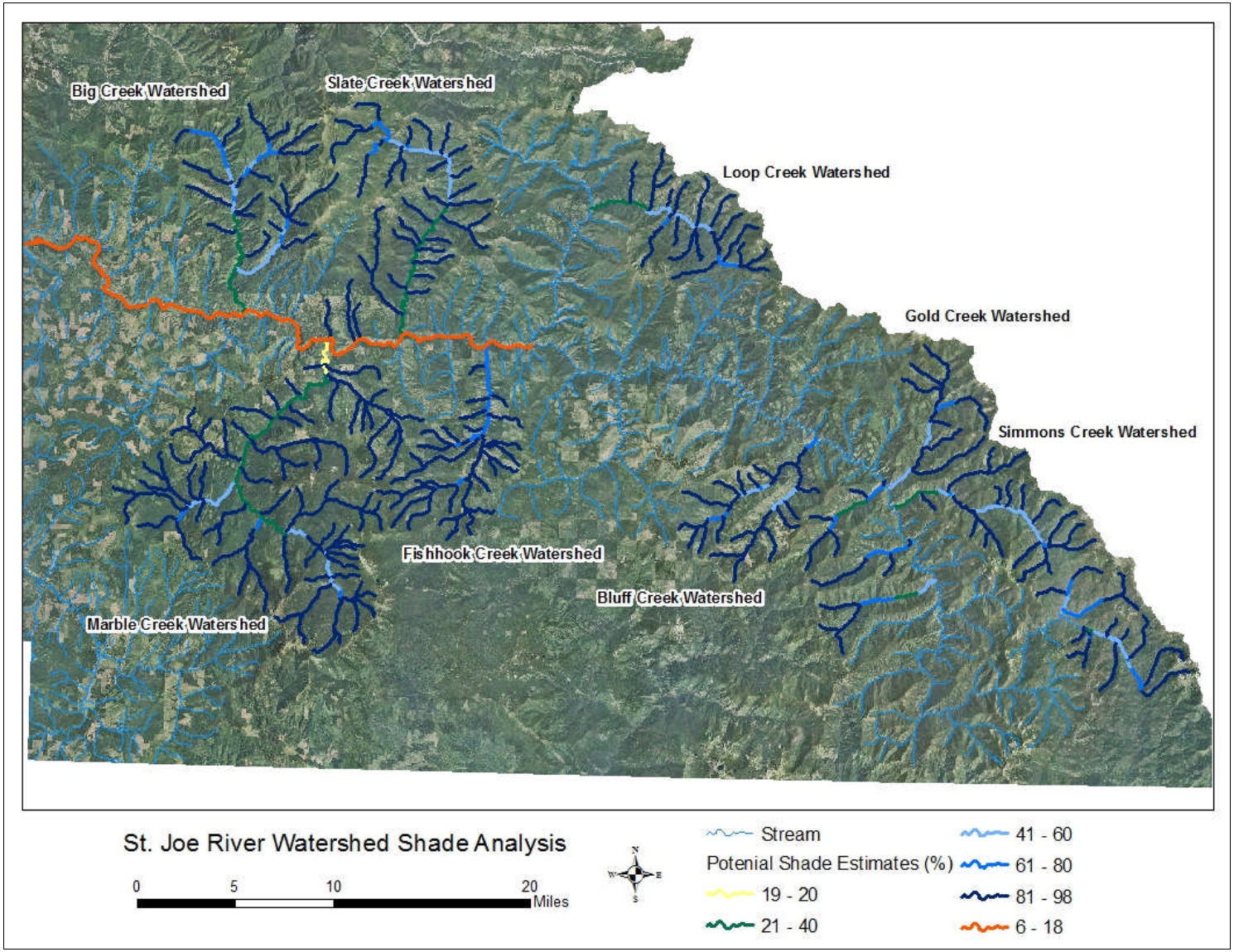


Figure G-1b. St. Joe River watershed shade analysis – potential shade estimates.

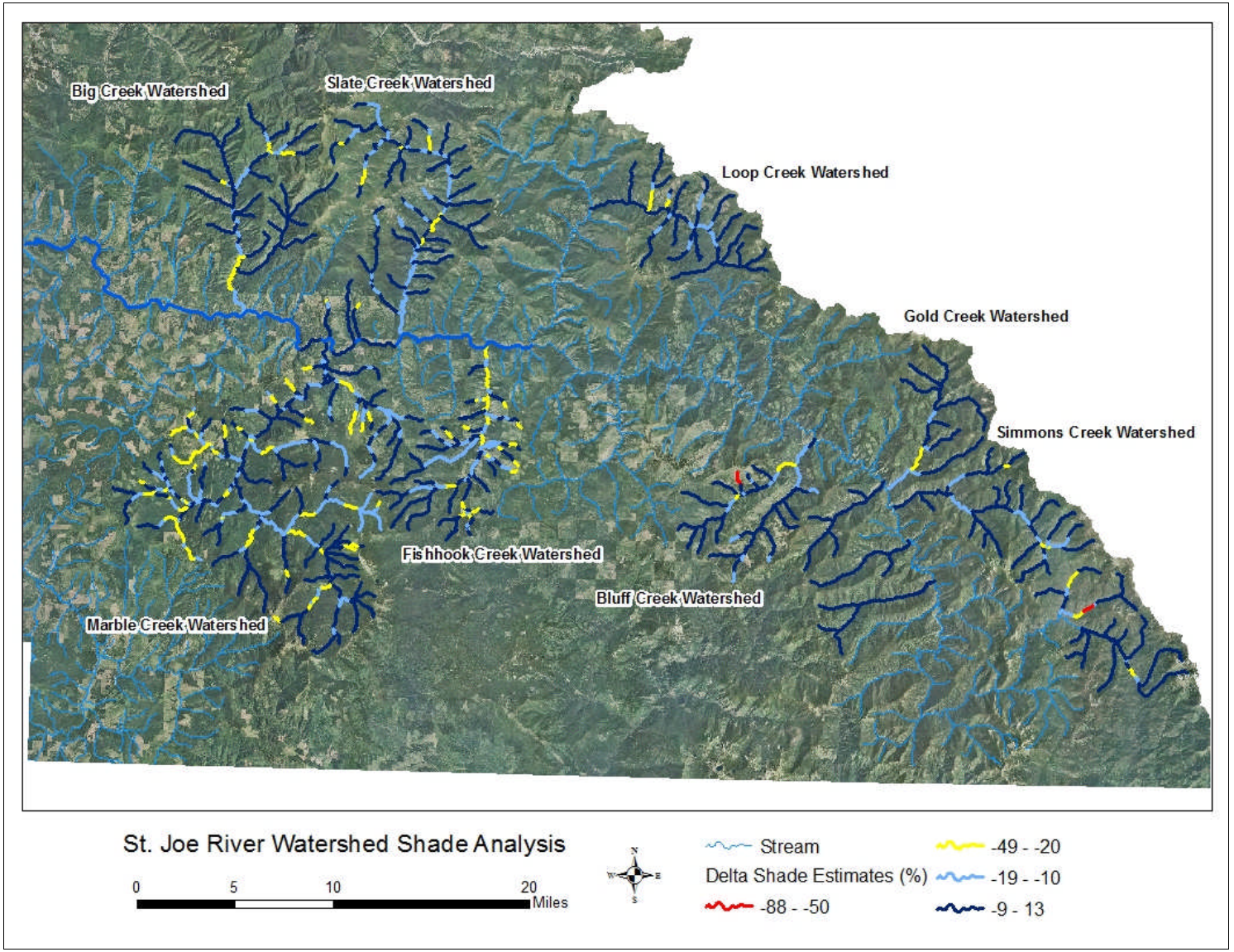


Figure G-1c. St. Joe River watershed shade analysis – delta shade estimates.

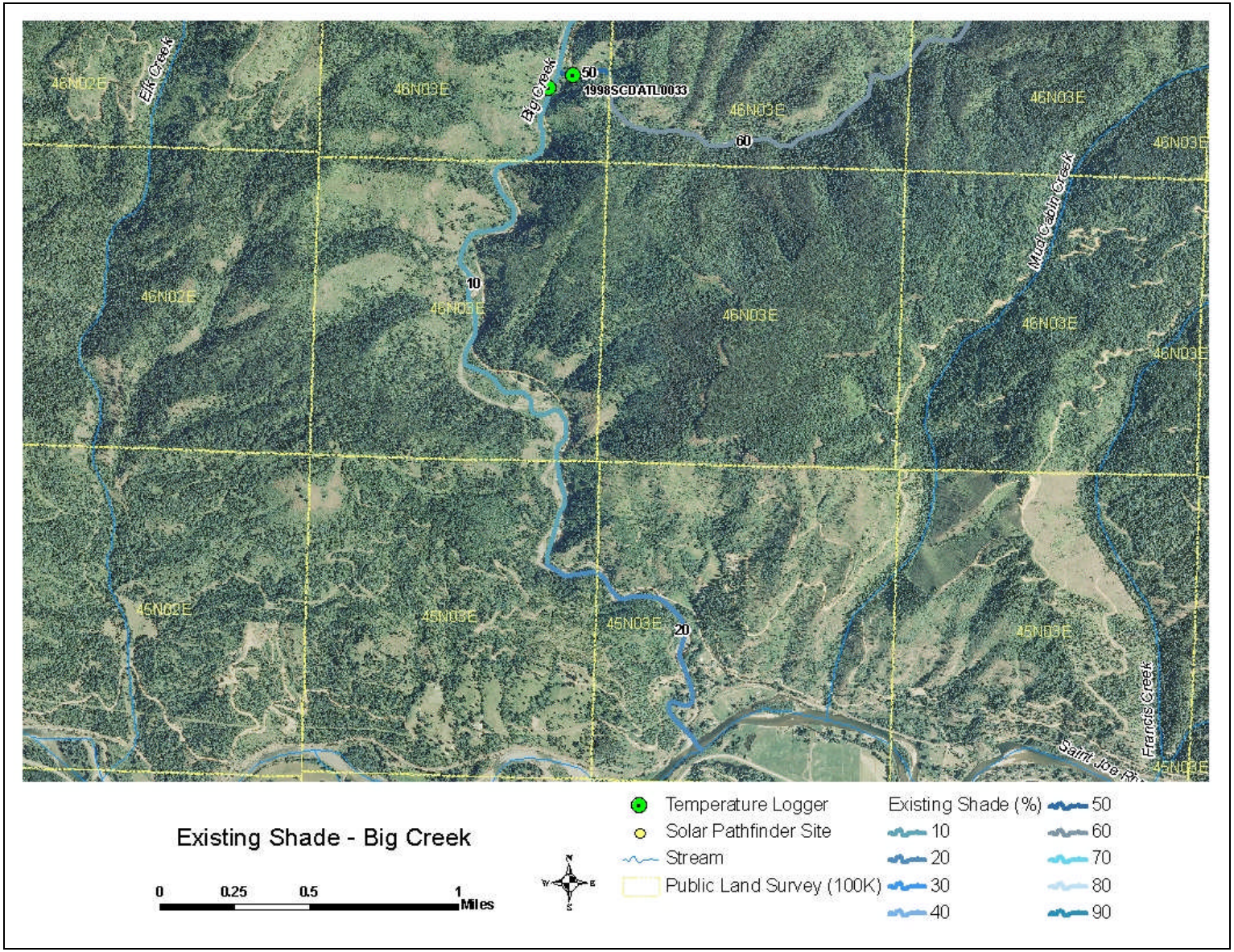


Figure G-1. Big Creek (AU ID17010304PN063_02/03) existing shade estimates

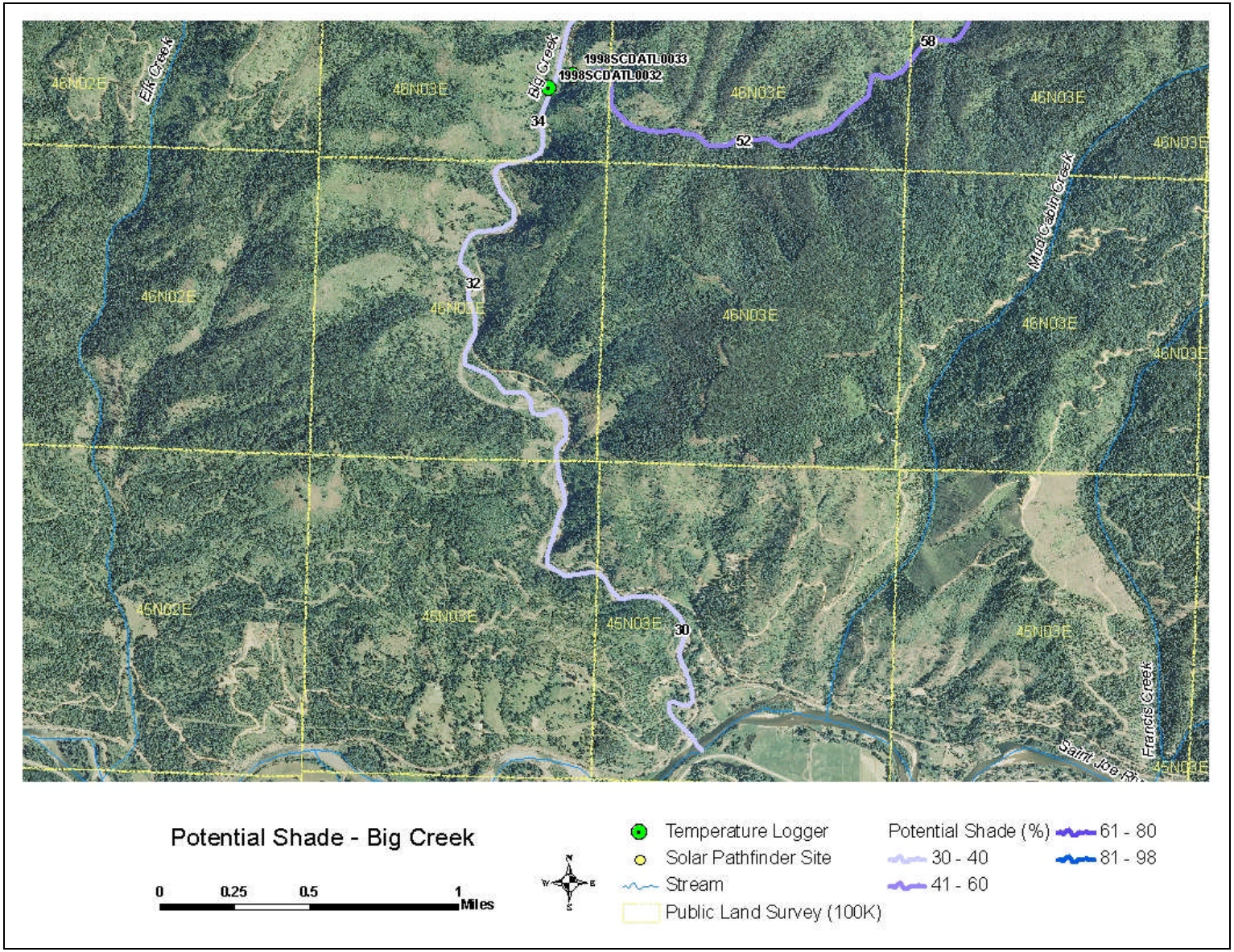


Figure G-2. Big Creek (AU ID17010304PN063_02/03) potential shade estimates

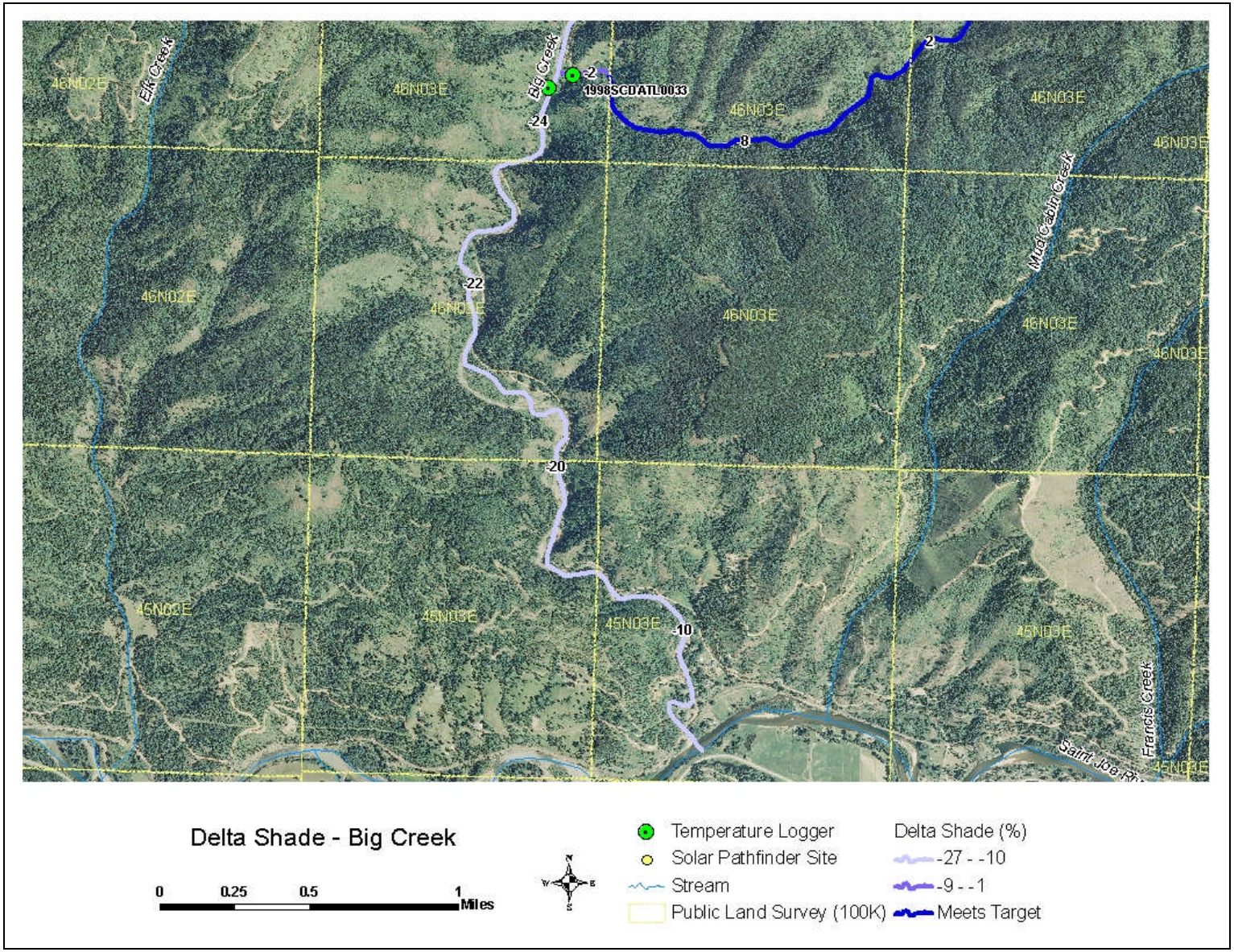


Figure G-3. Big Creek (AU ID17010304PN063_02/03) delta shade estimates

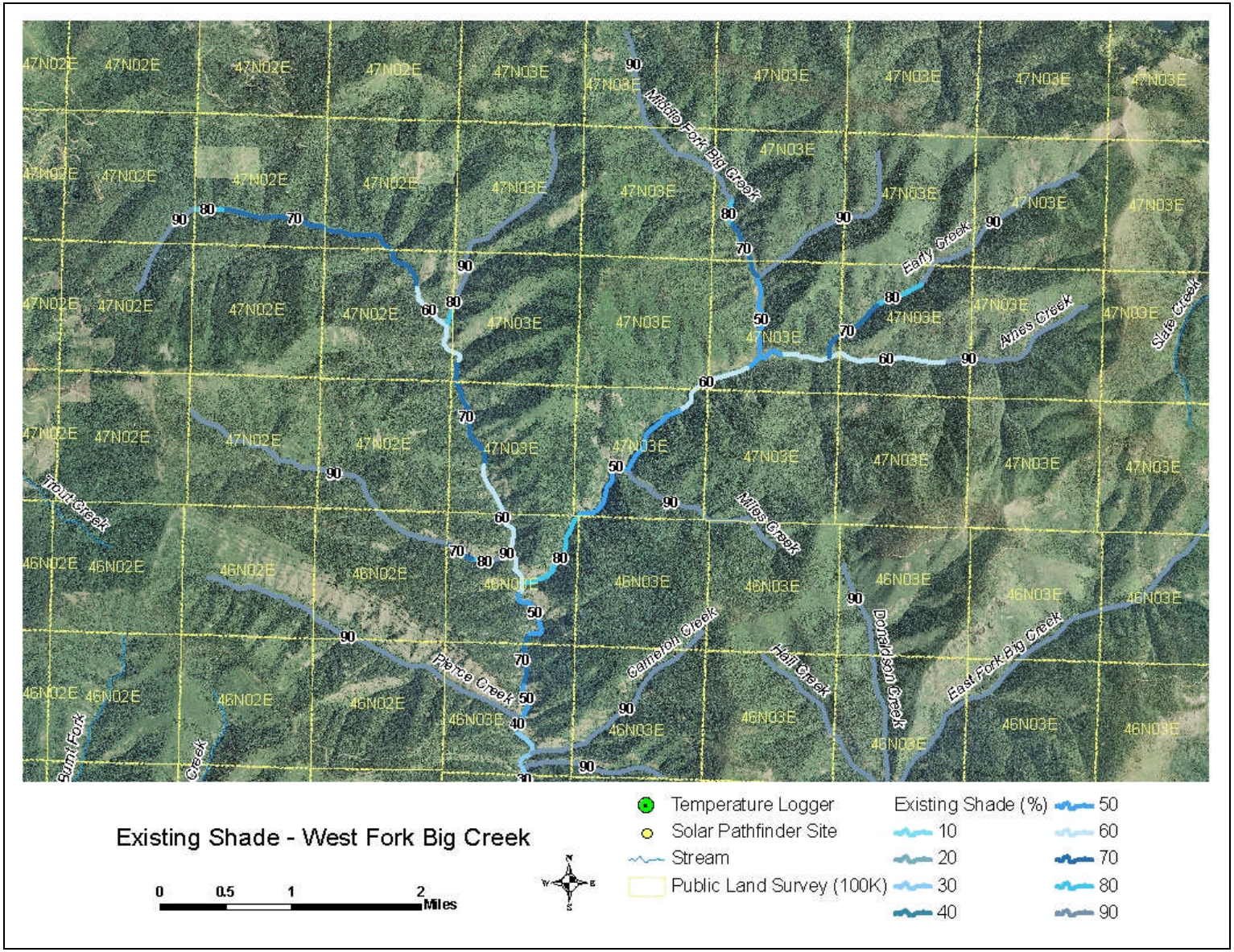


Figure G-4. West Fork Big Creek (AU ID17010304PN063_02/03) existing shade estimates

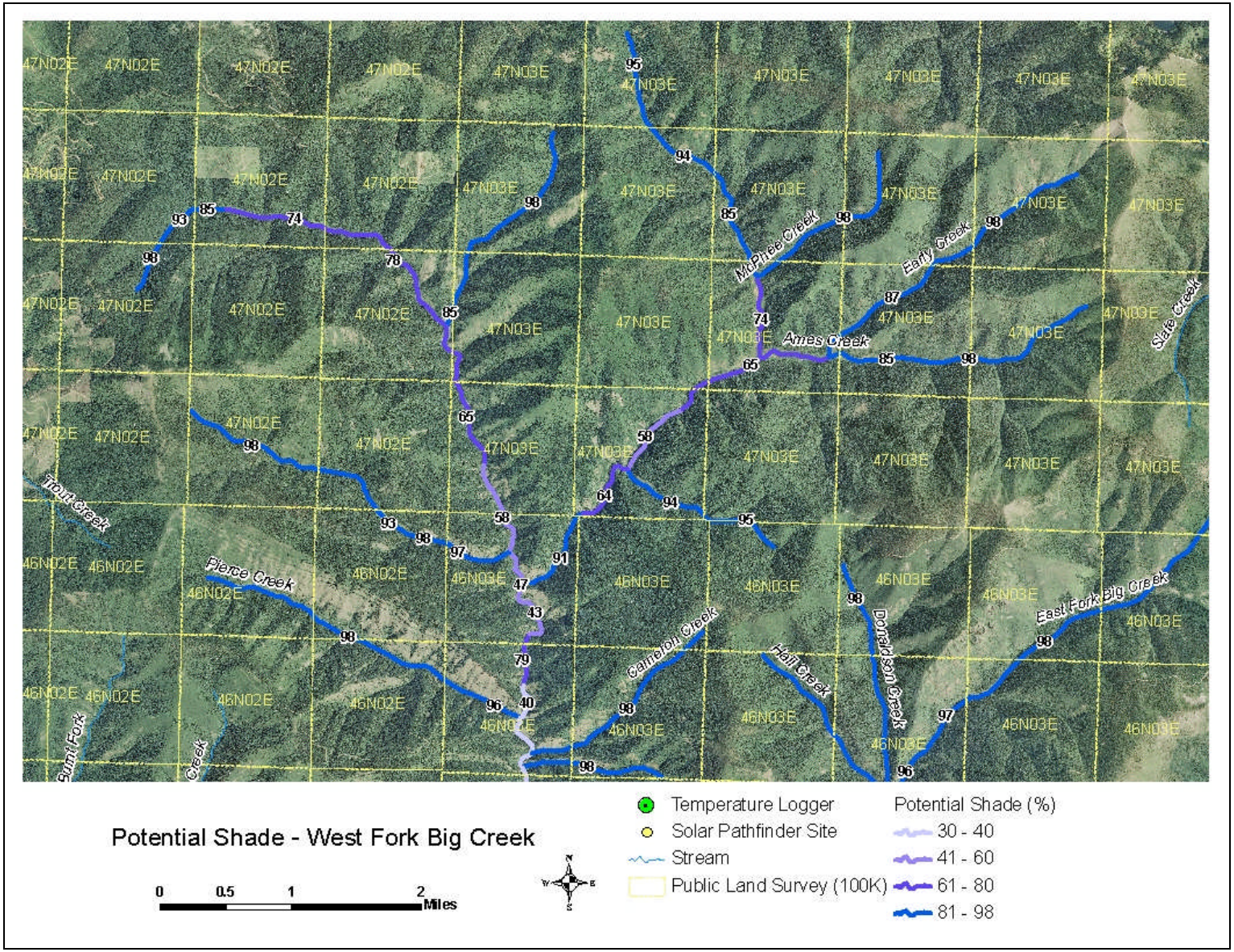


Figure G-5. West Fork Big Creek (AU ID17010304PN063_02/03) potential shade estimates

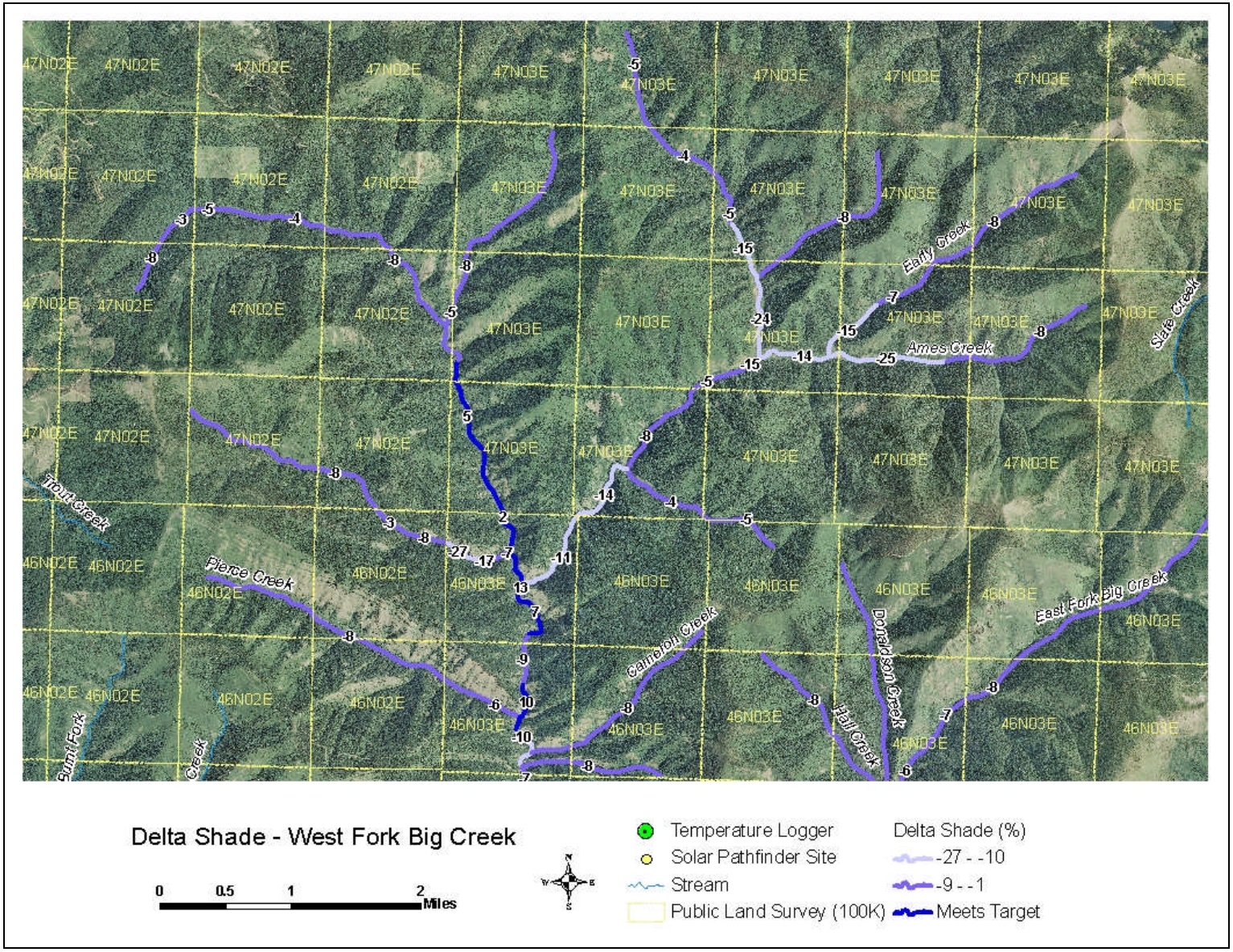


Figure G-6. West Fork Big Creek (AU ID17010304PN063_02/03) delta shade estimates

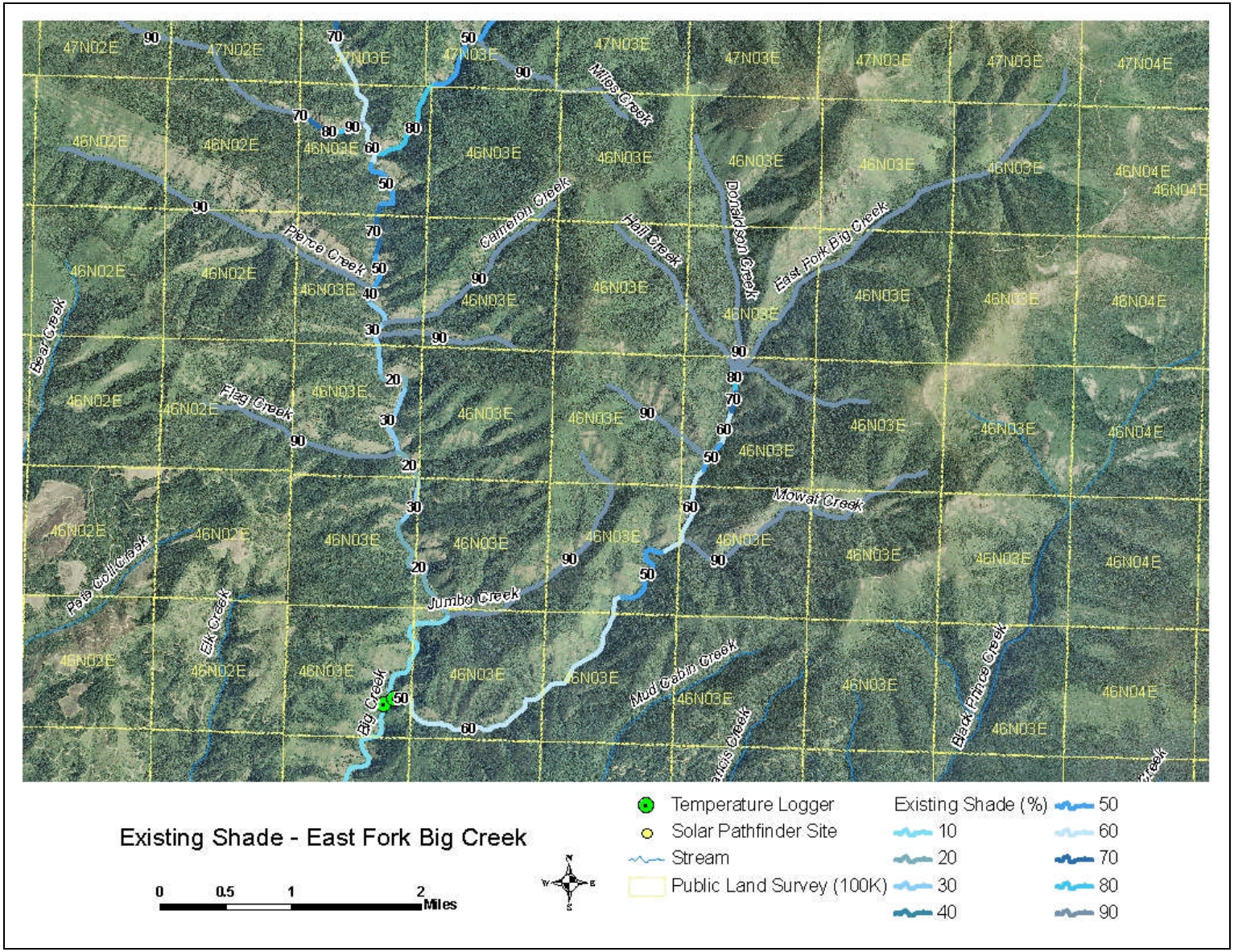


Figure G-7. East Fork Big Creek (AU ID17010304PN063_02/03) existing shade estimates

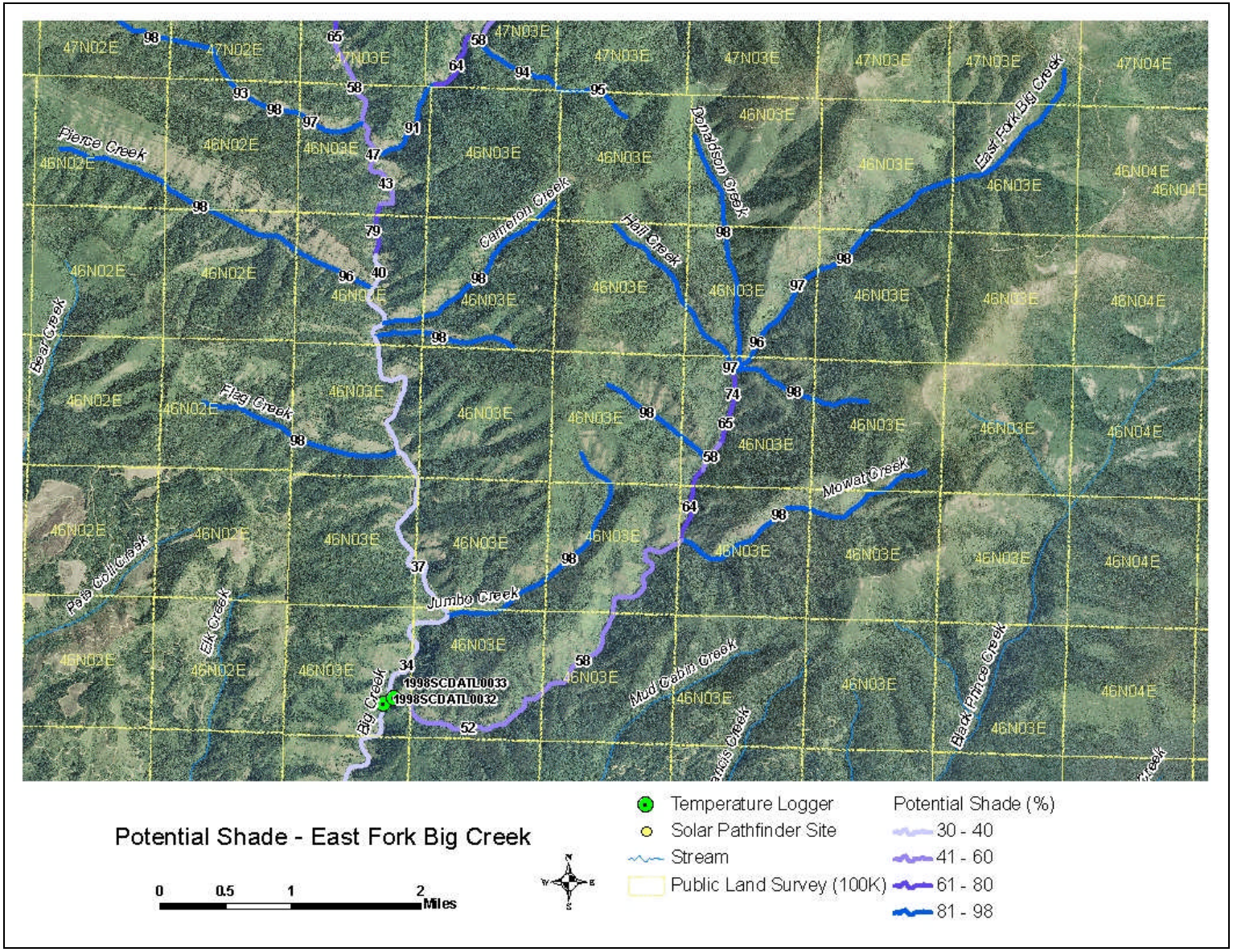


Figure G-8. East Fork Big Creek (AU ID17010304PN063_02/03) potential shade estimates

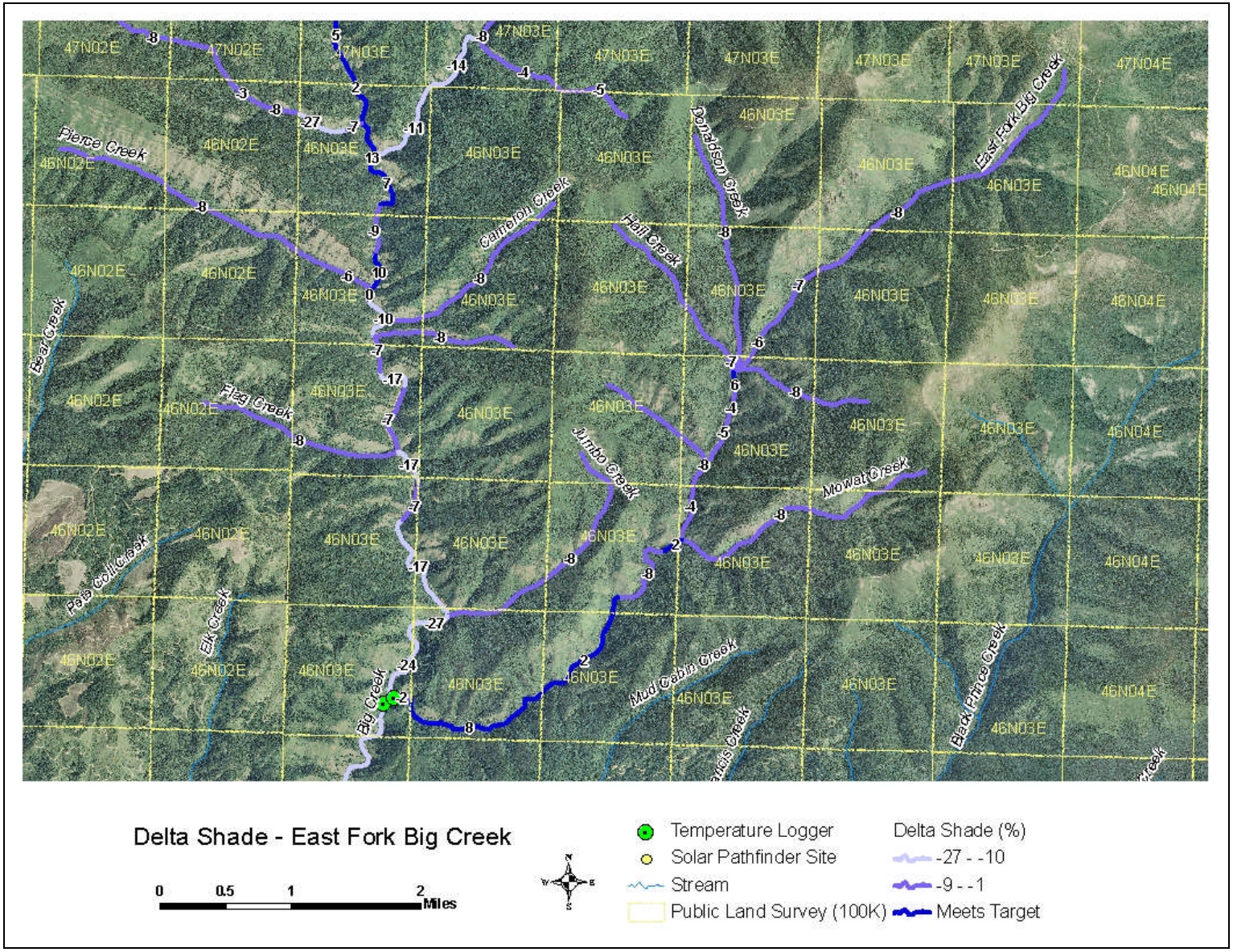


Figure G-9. East Fork Big Creek (AU ID17010304PN063_02/03) delta shade estimates

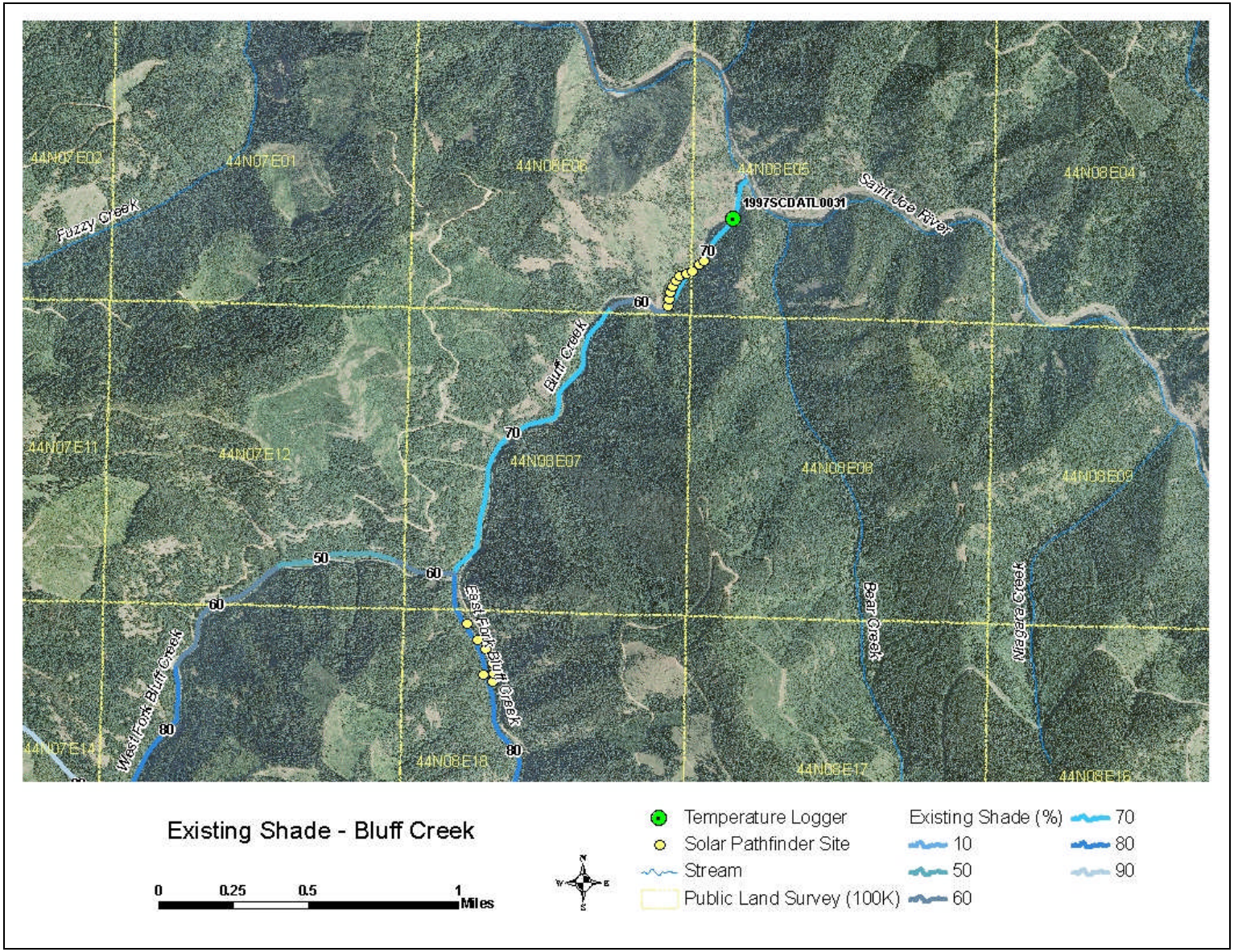


Figure G-10. Bluff Creek (AU ID17010304PN045_03) existing shade estimates

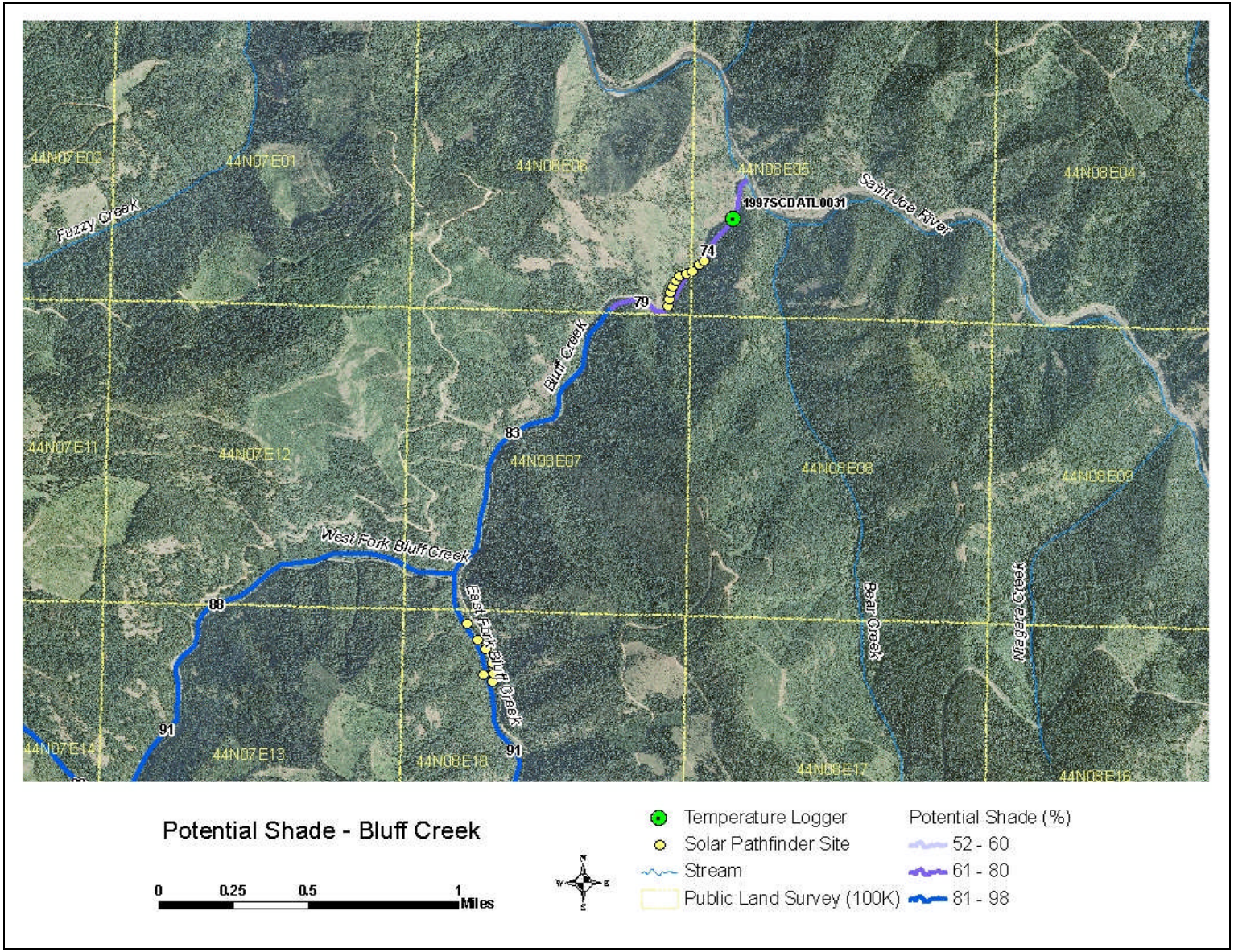


Figure G-11. Bluff Creek (AU ID17010304PN045_03) potential shade estimates

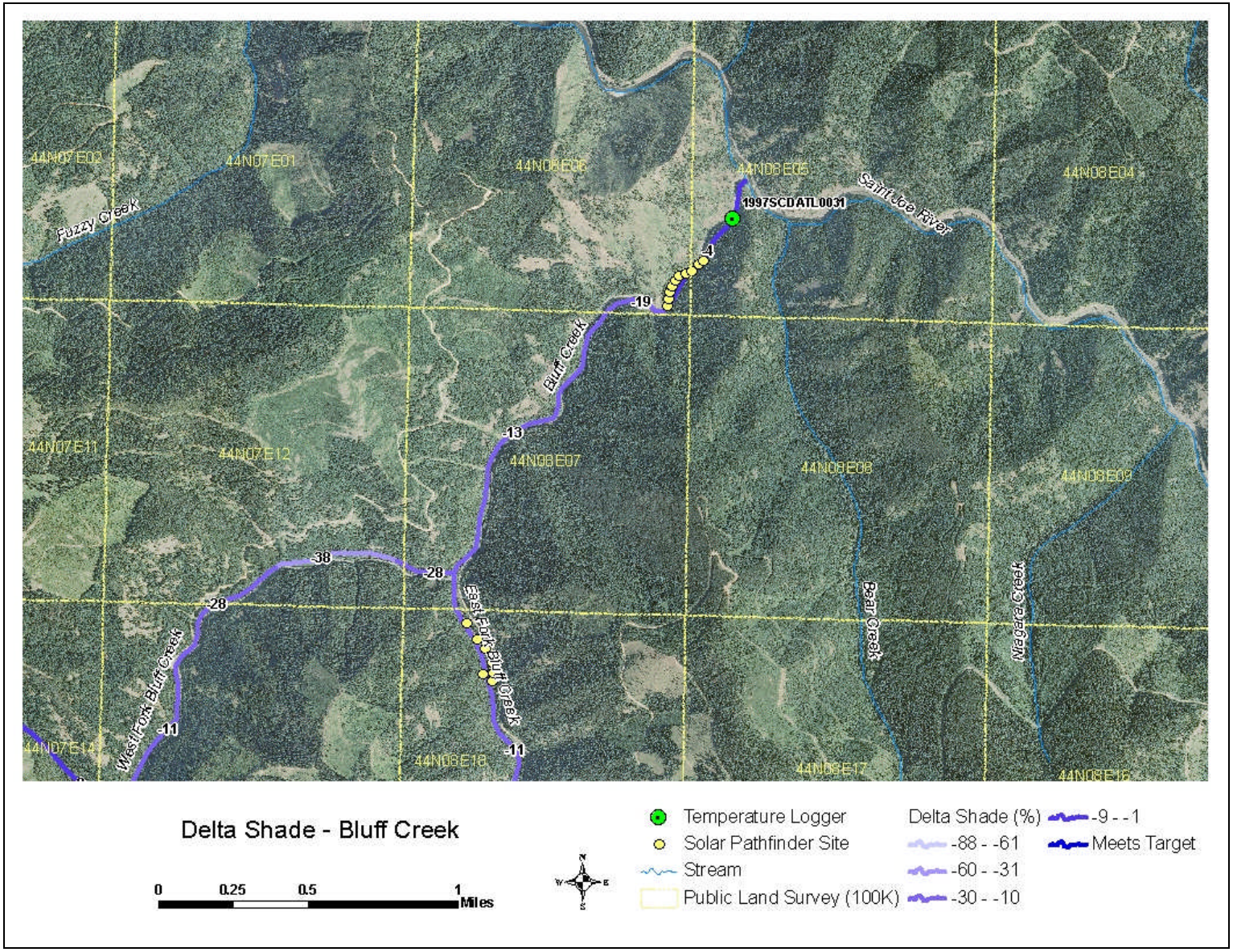


Figure G-12. Bluff Creek (AU ID17010304PN045_03) delta shade estimates

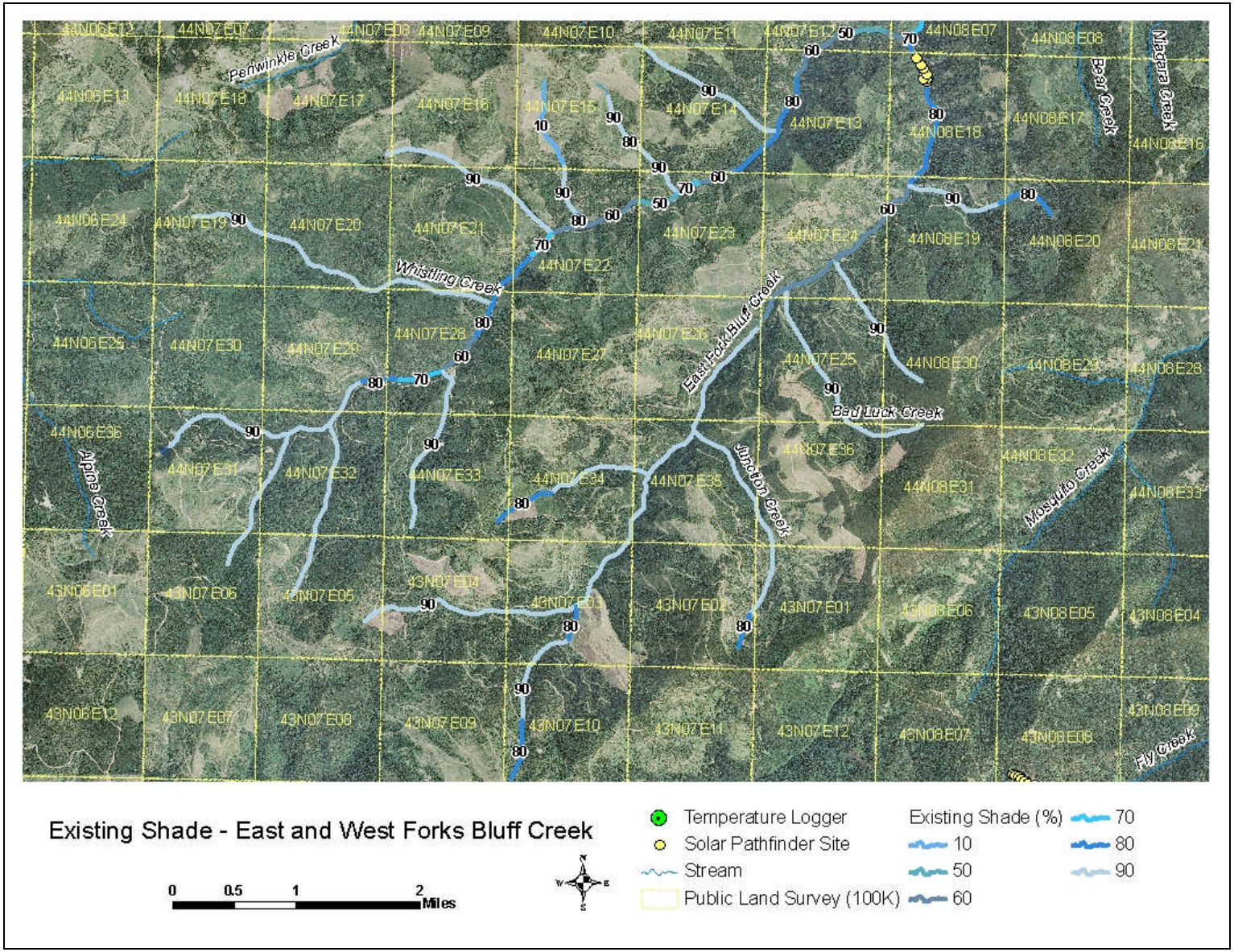


Figure G-13. East and West Forks Bluff Creek (AU ID17010304PN045_02) existing shade estimates

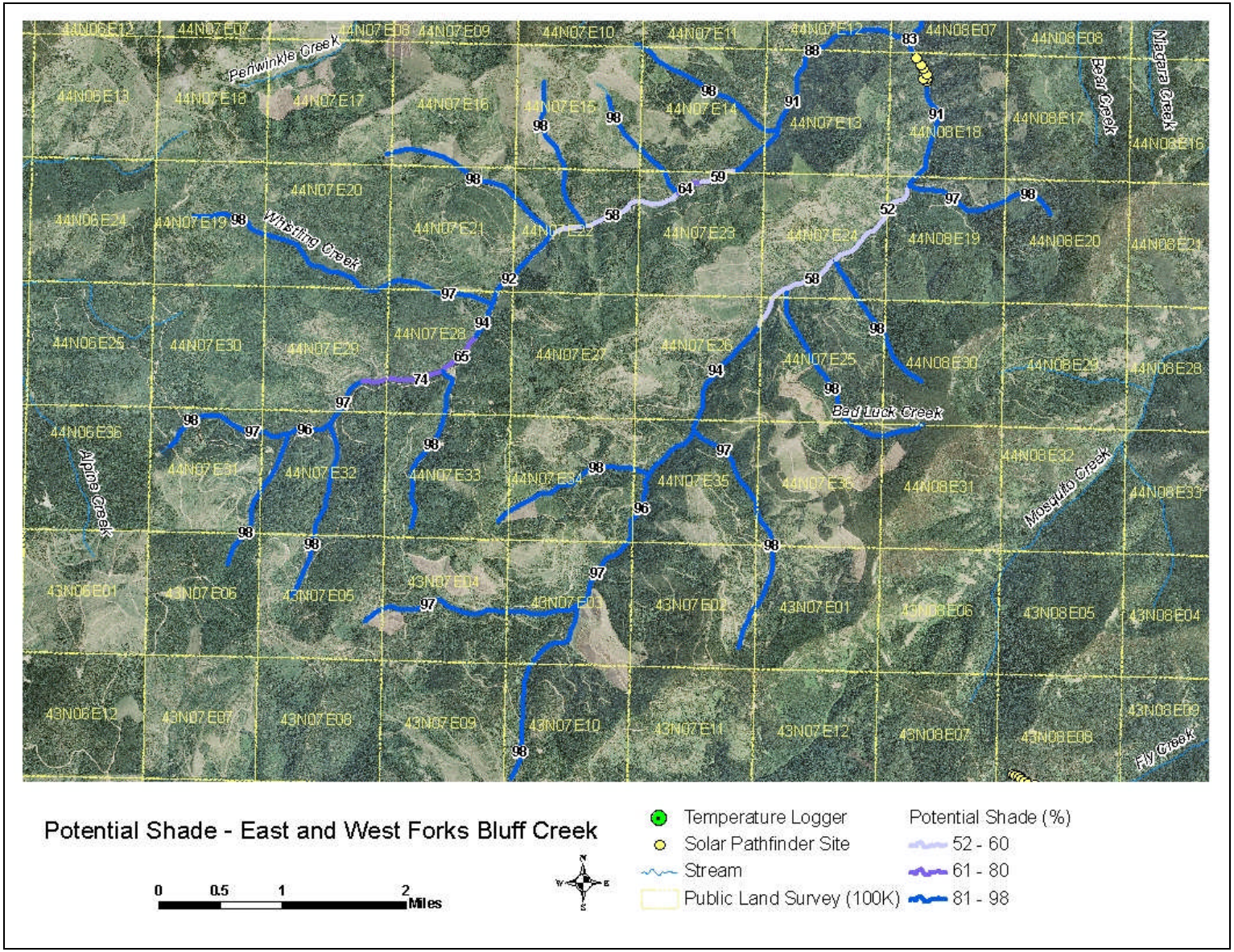


Figure G-14. East and West Forks Bluff Creek (AU ID17010304PN045_02) potential shade estimates

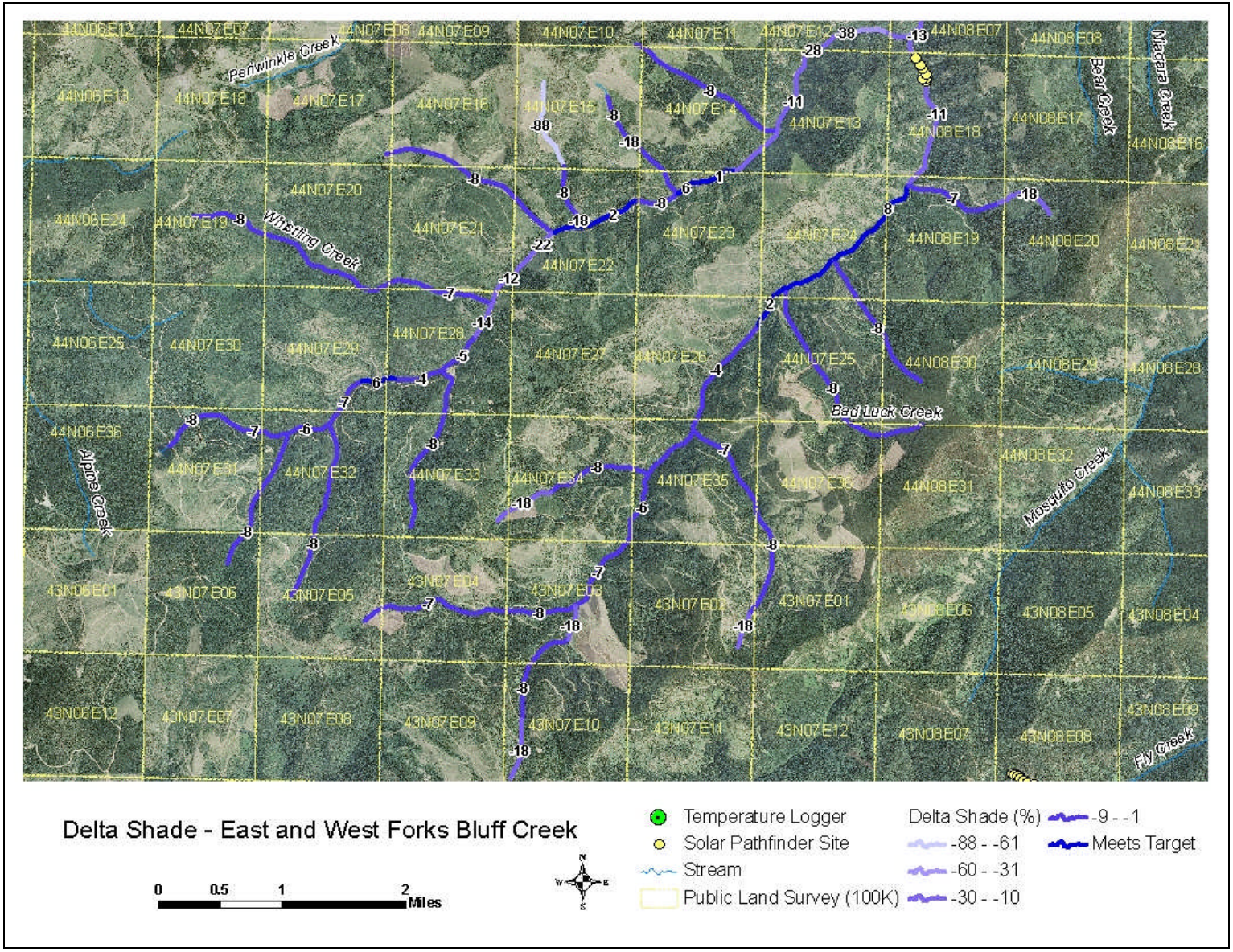


Figure G-15. East and West Forks Bluff Creek (AU ID17010304PN045_02) delta shade estimates

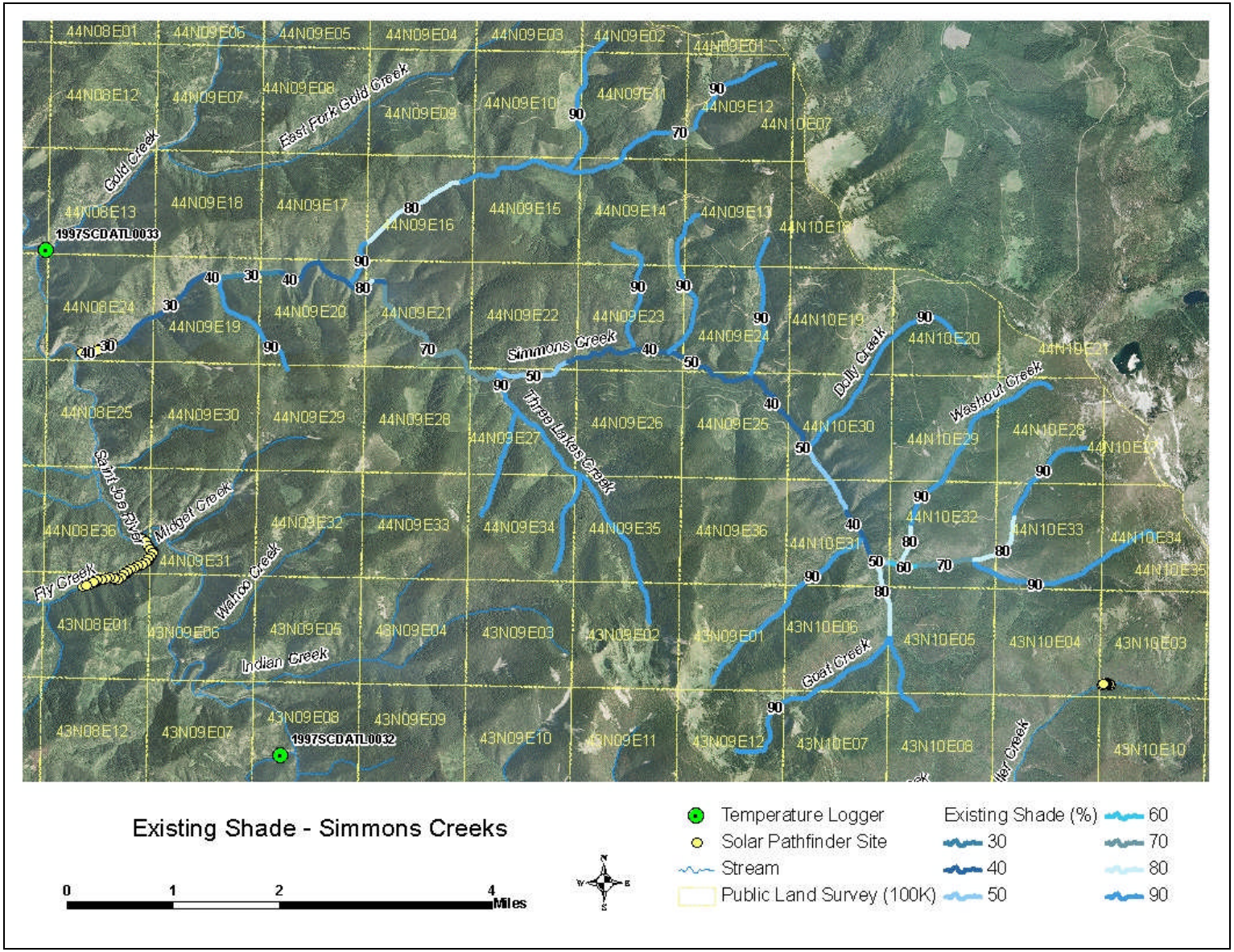


Figure G-16. Simmons Creek (AU ID17010304PN052_02/03) existing shade estimates

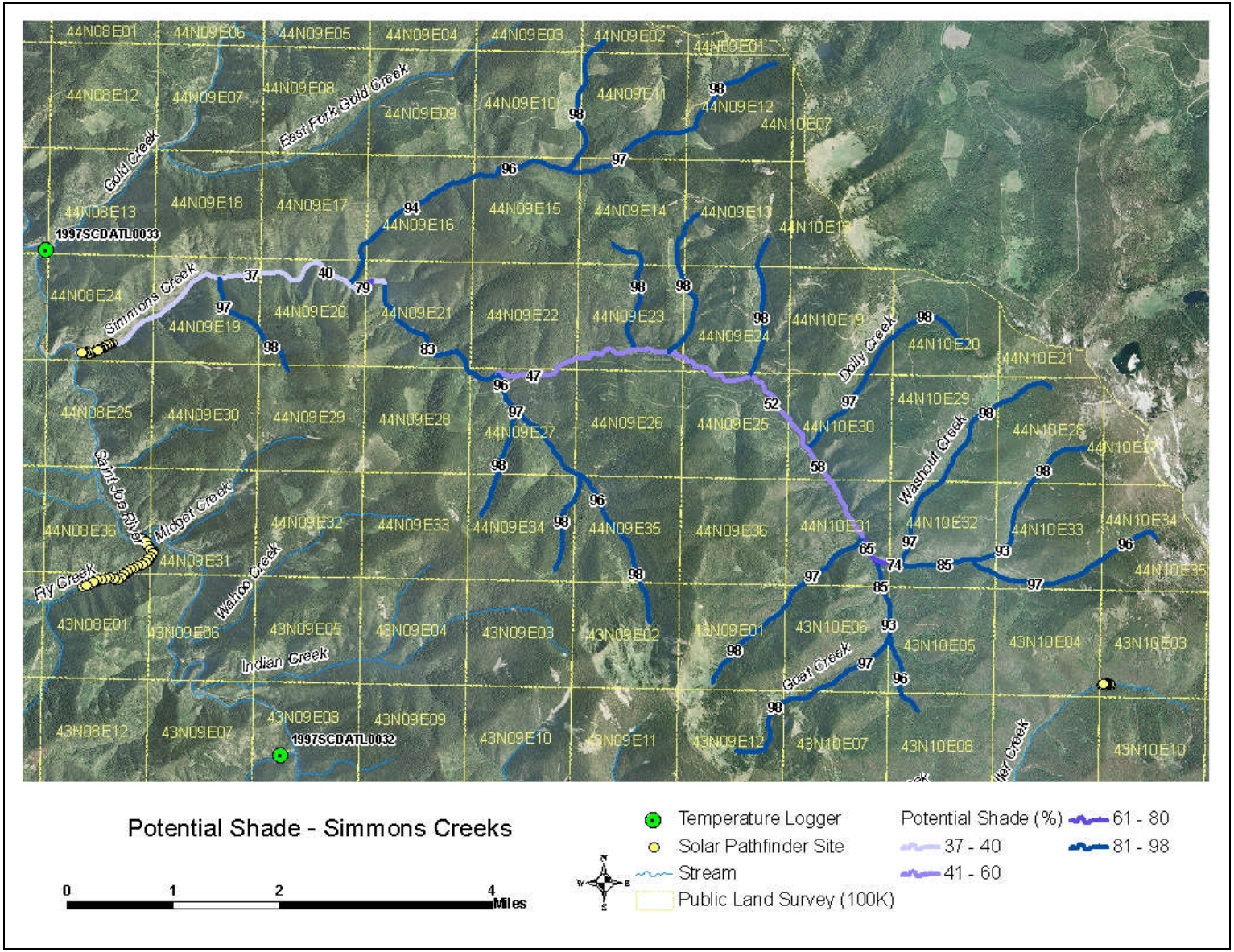


Figure G-17. Simmons Creek (AU ID17010304PN052_02/03) potential shade estimates

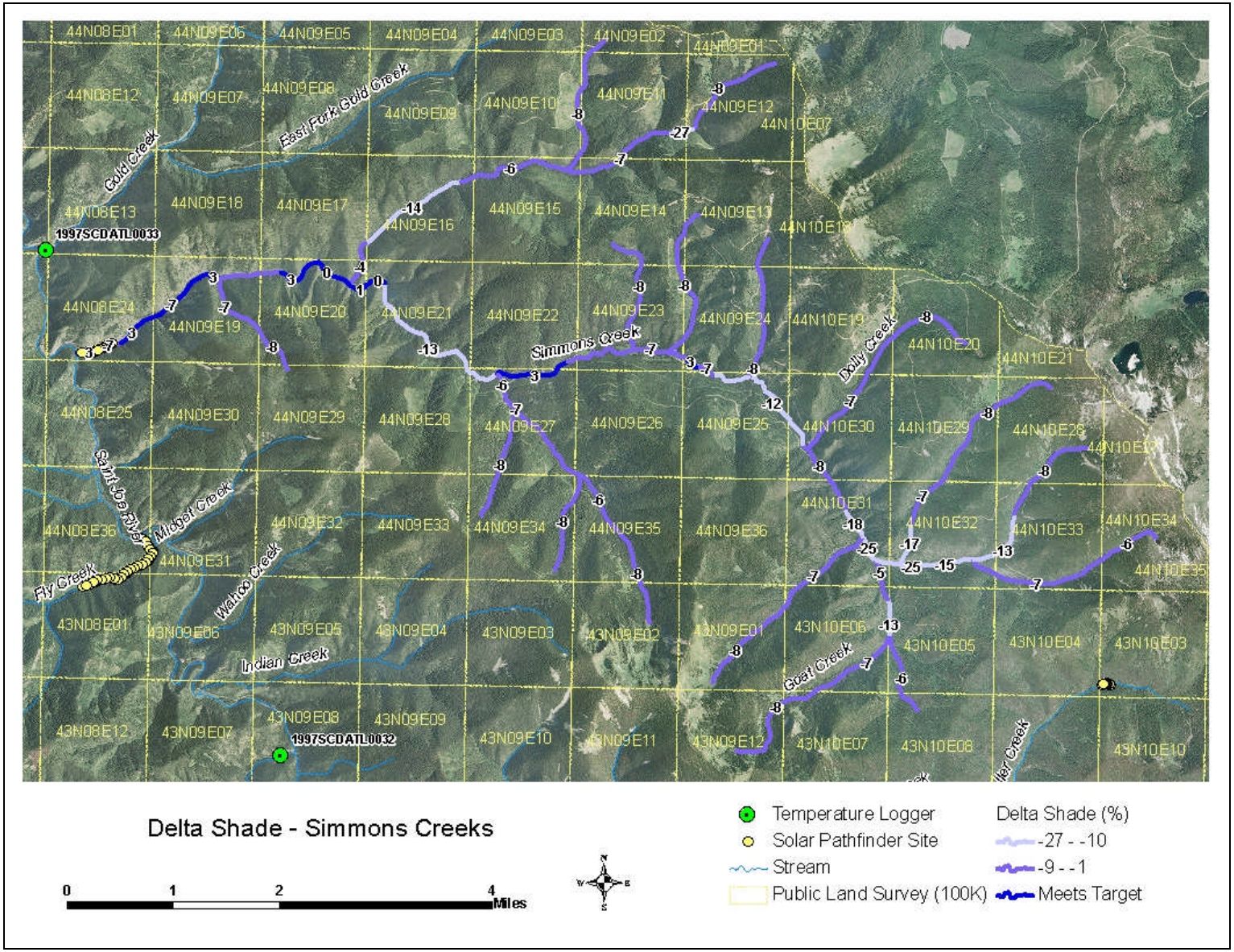


Figure G-18. Simmons Creek (AU ID17010304PN052_02/03) delta shade estimates

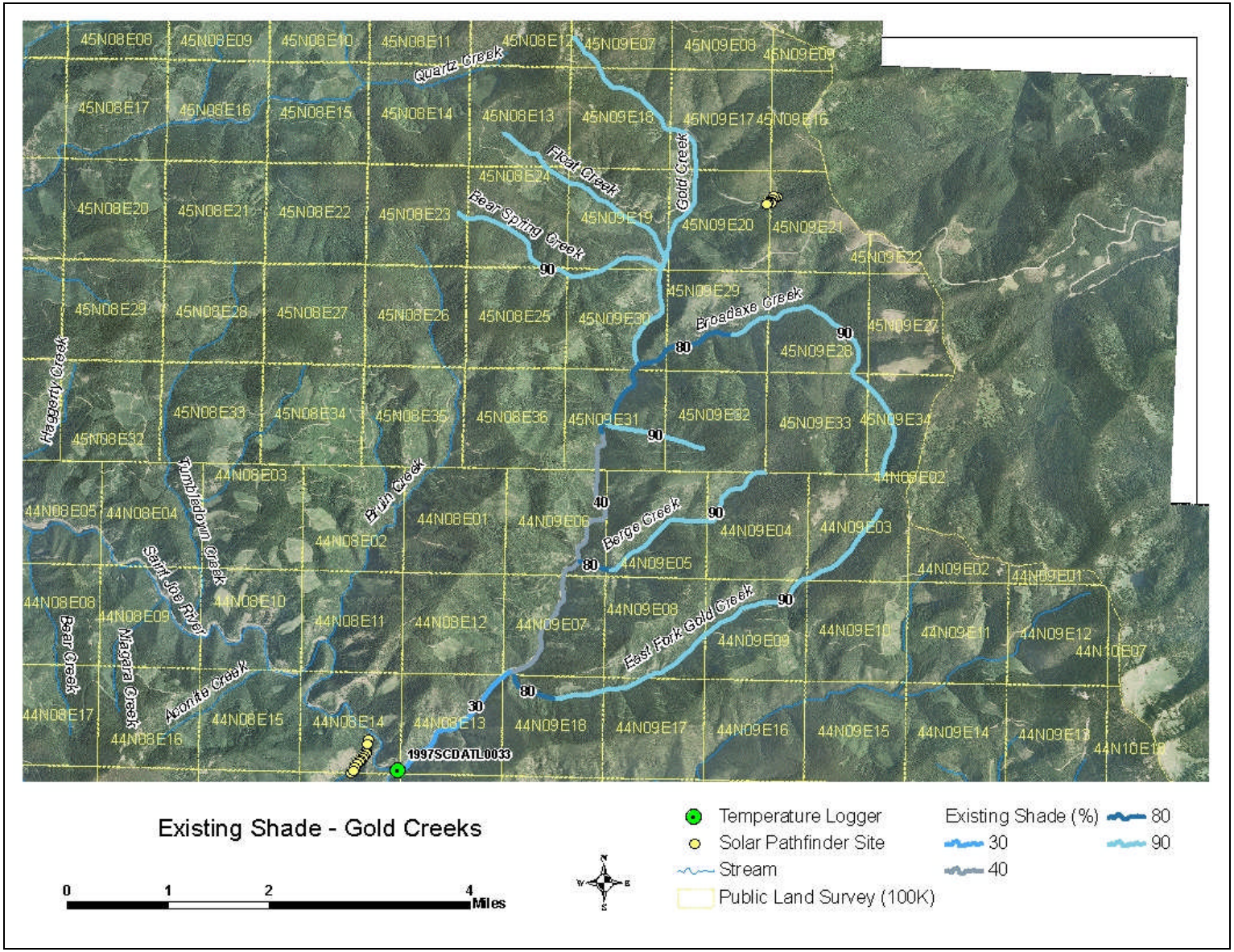


Figure G-19. Gold Creek (AU ID17010304PN053_02) existing shade estimates

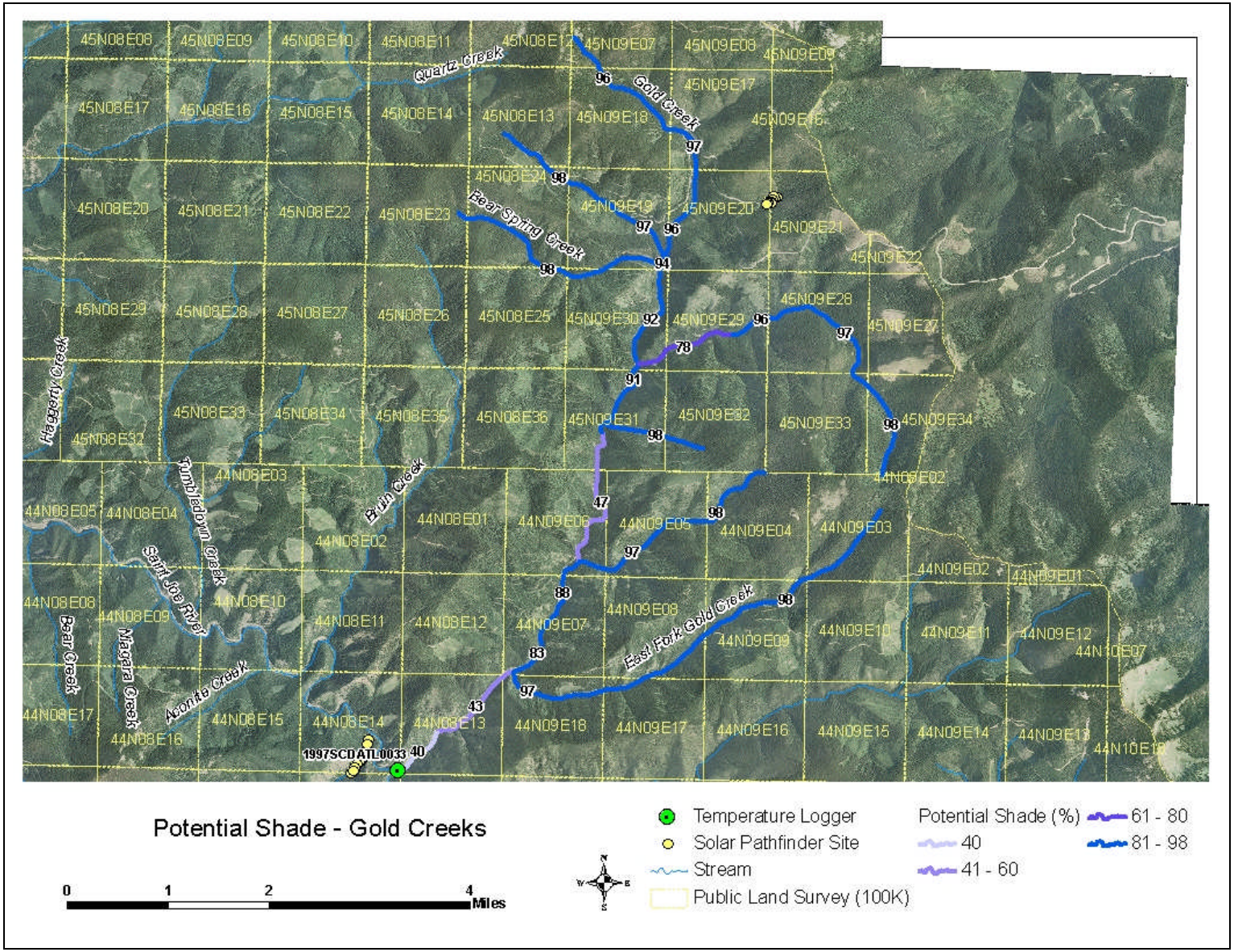


Figure G-20. Gold Creek (AU ID17010304PN053_02) potential shade estimates

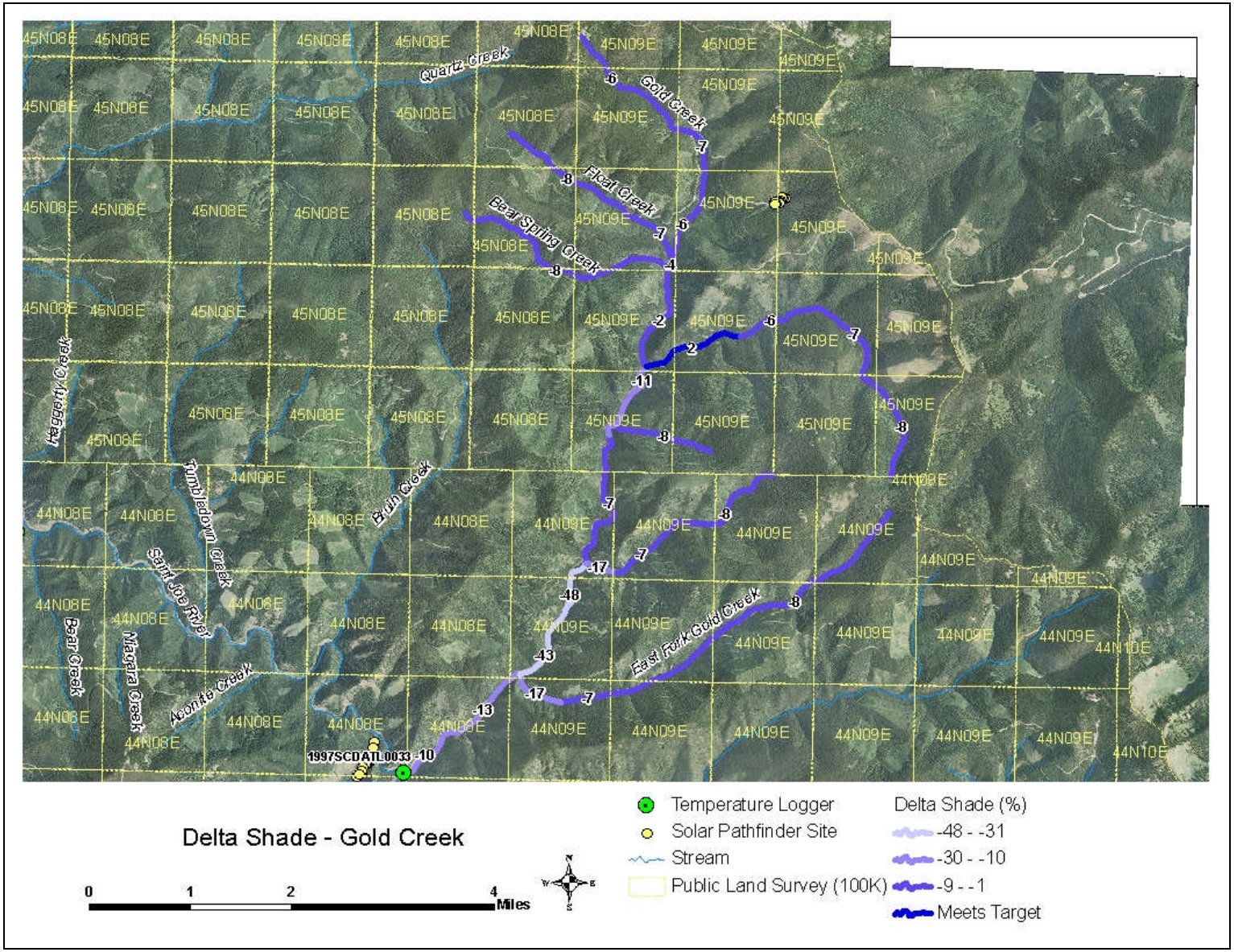


Figure G-21. Gold Creek (AU ID17010304PN053_02) delta shade estimates

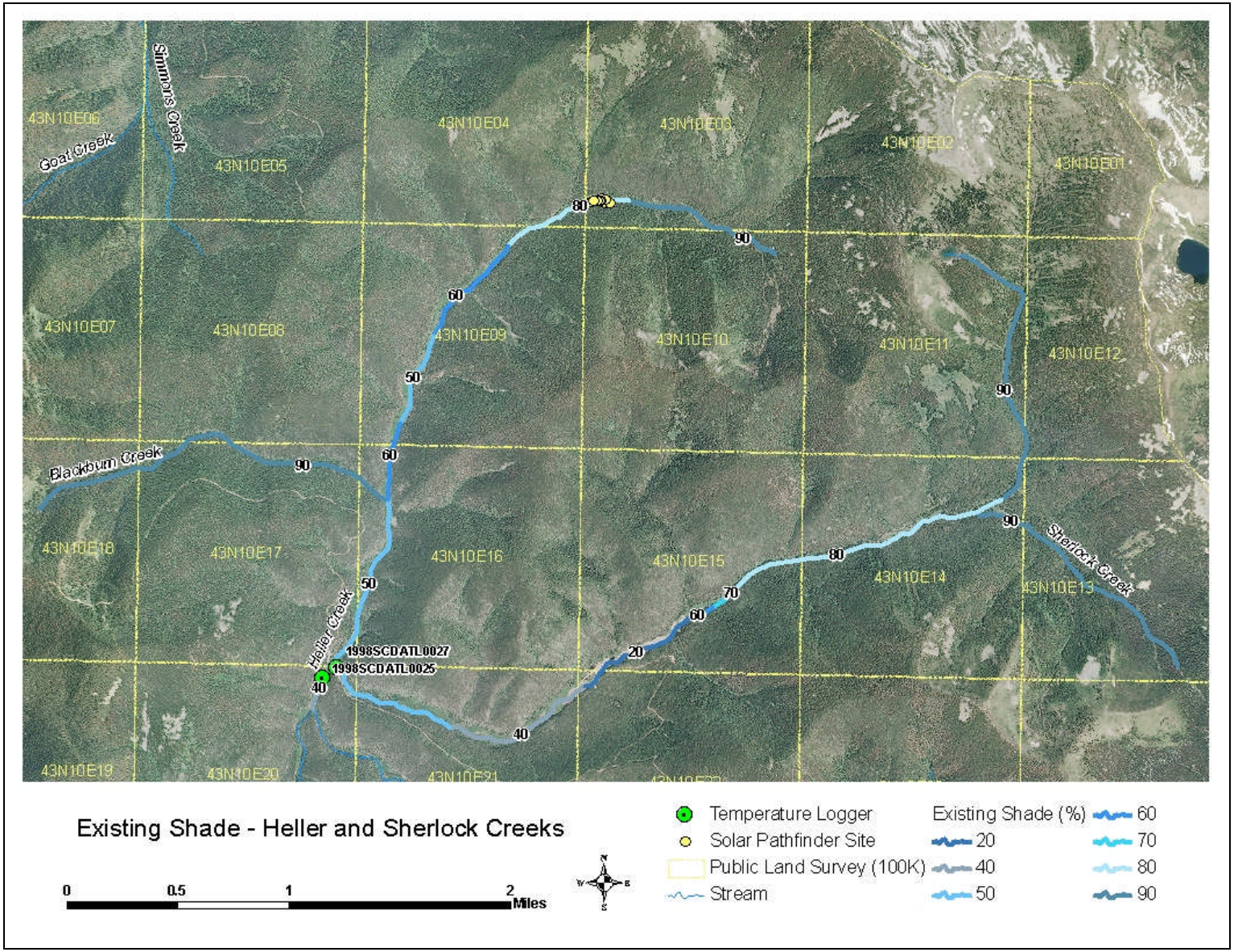


Figure G-22. Heller and Sherlock Creeks (AU ID17010304PN041_02/02a) existing shade estimates

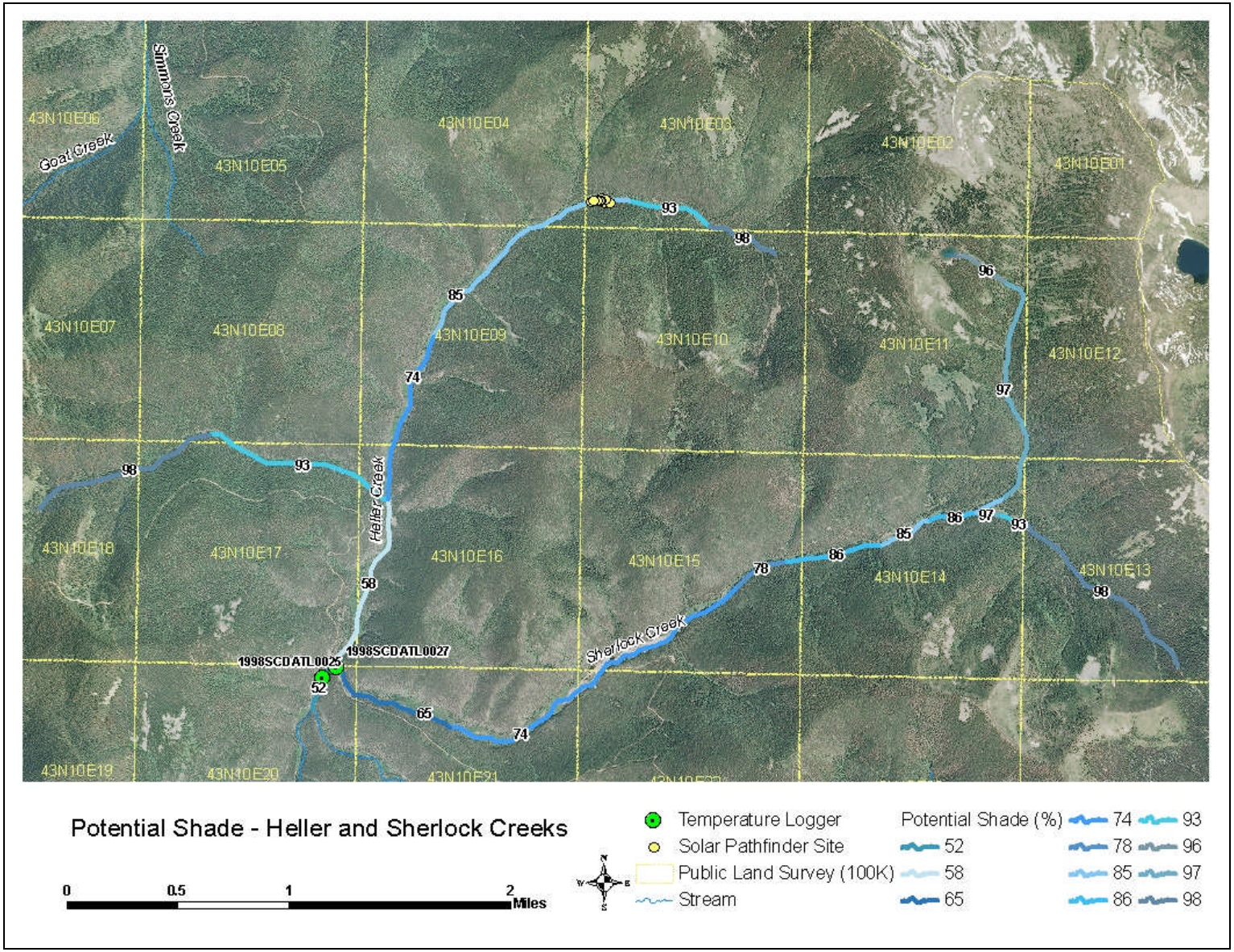


Figure G-23. Heller and Sherlock Creeks (AU ID17010304PN041_02/02a) potential shade estimates

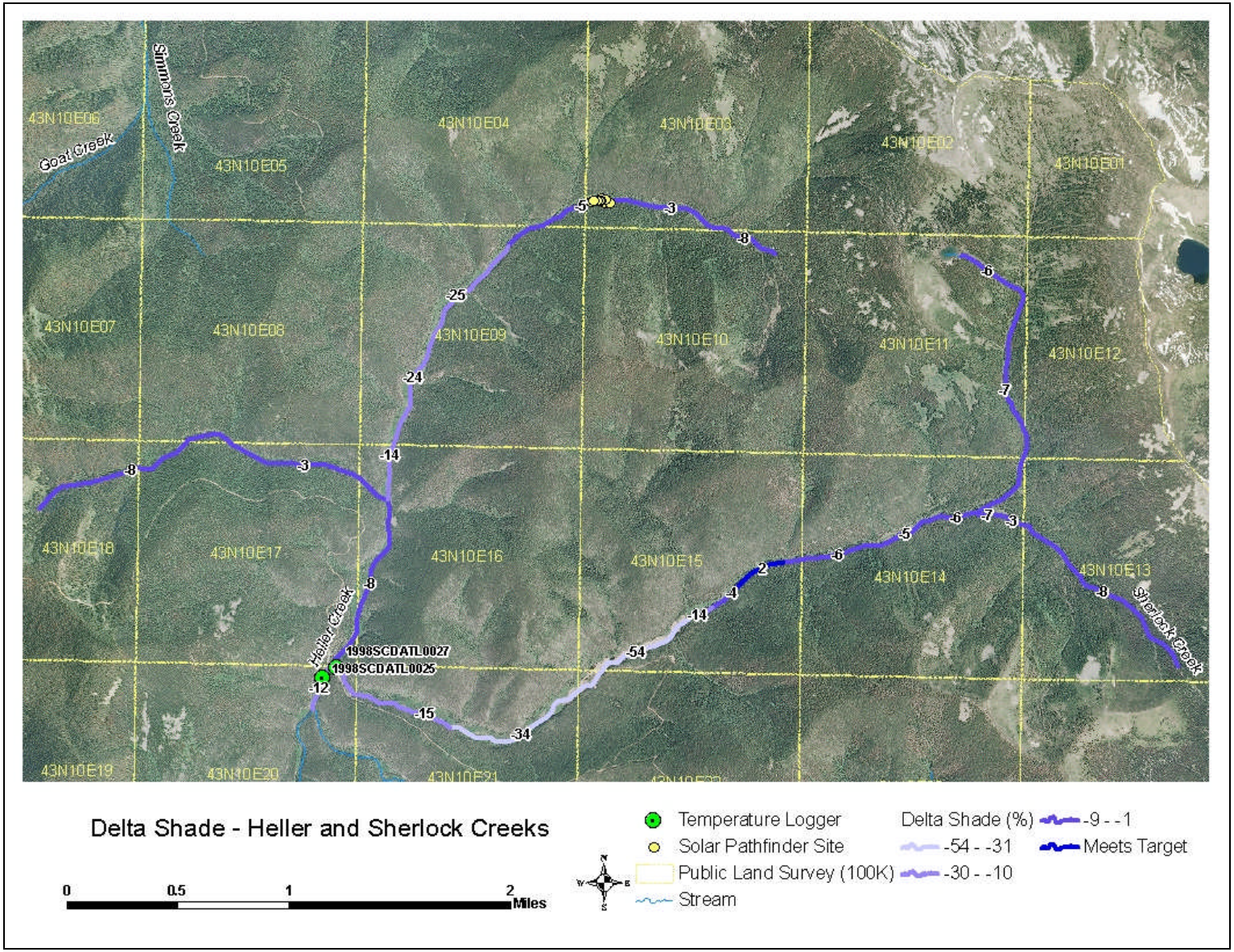


Figure G-24. Heller and Sherlock Creeks (AU ID17010304PN041_02/02a) delta shade estimates

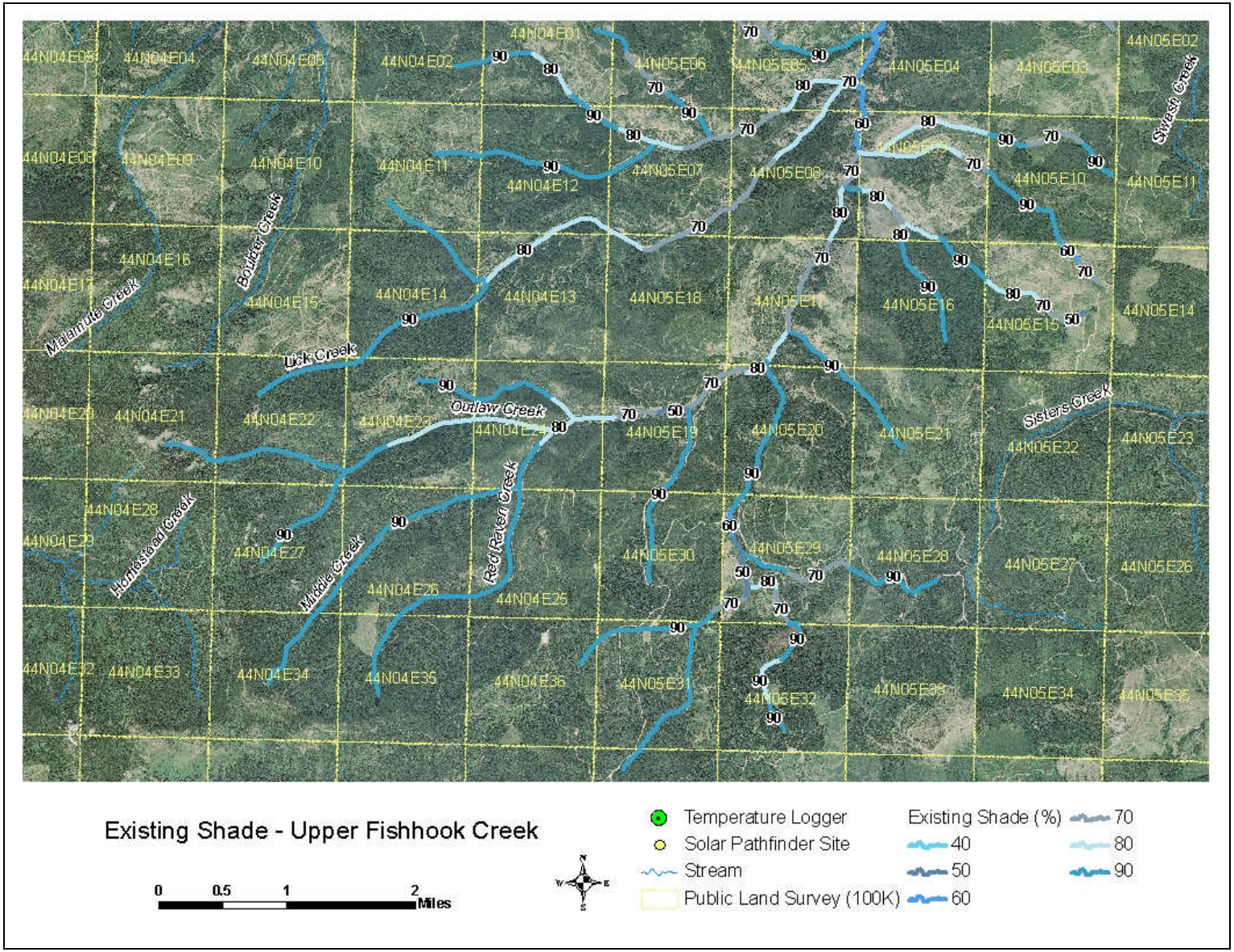


Figure G-25. Upper Fishhook Creek (AU ID17010304PN039_02/03) existing shade estimates

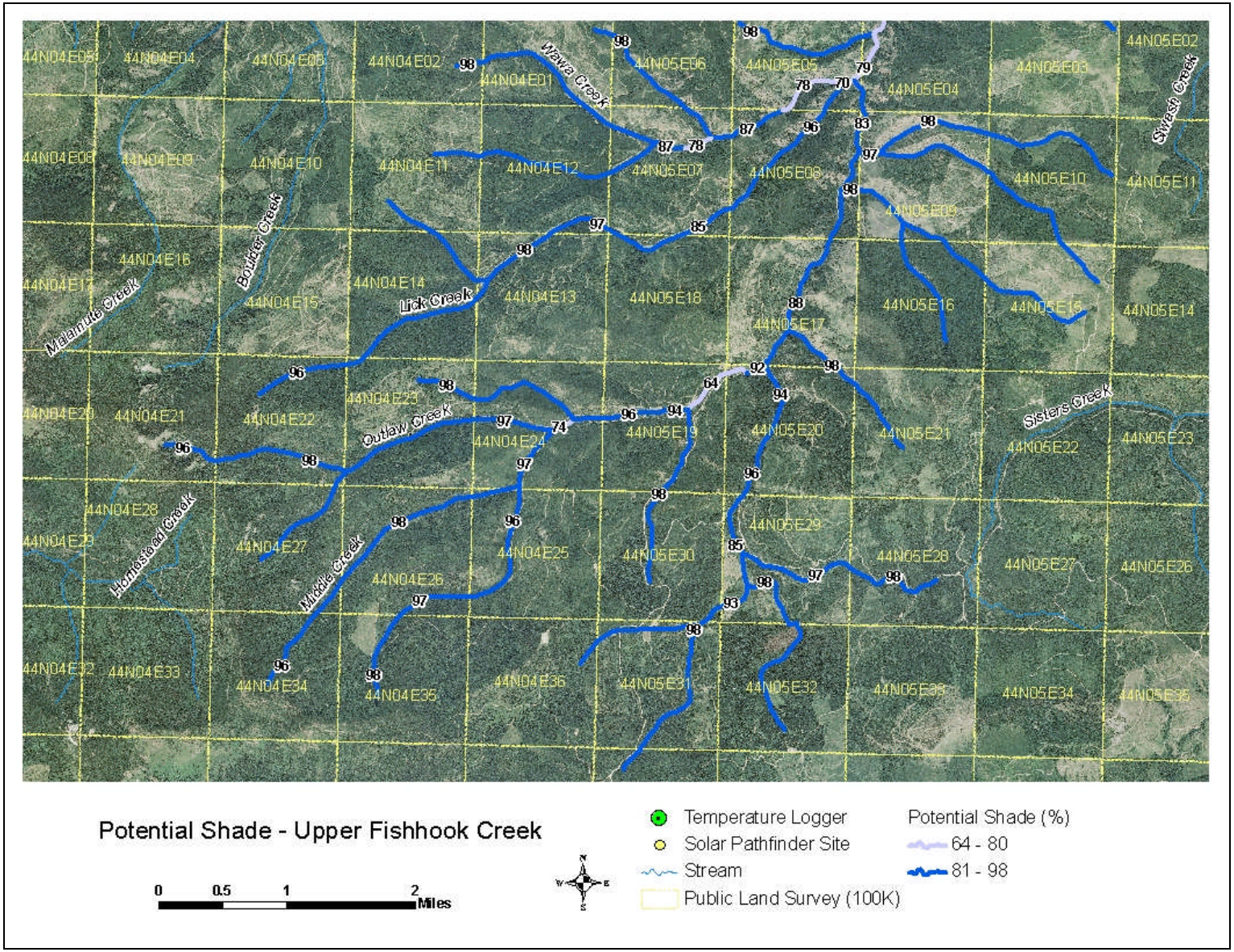


Figure G-26. Upper Fishhook Creek (AU ID17010304PN039_02/03) potential shade estimates

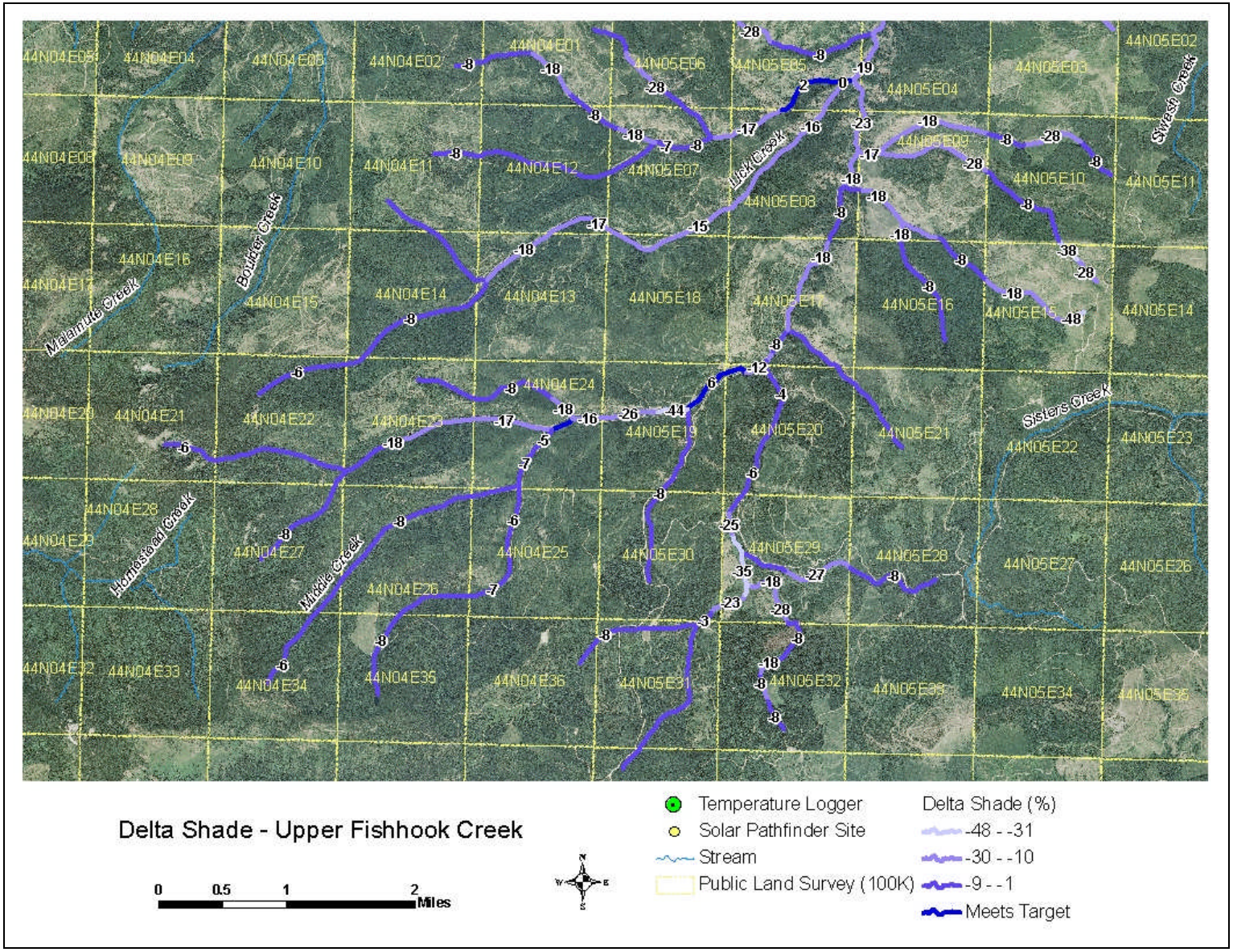


Figure G-27. Upper Fishhook Creek (AU ID17010304PN039_02/03) delta shade estimates

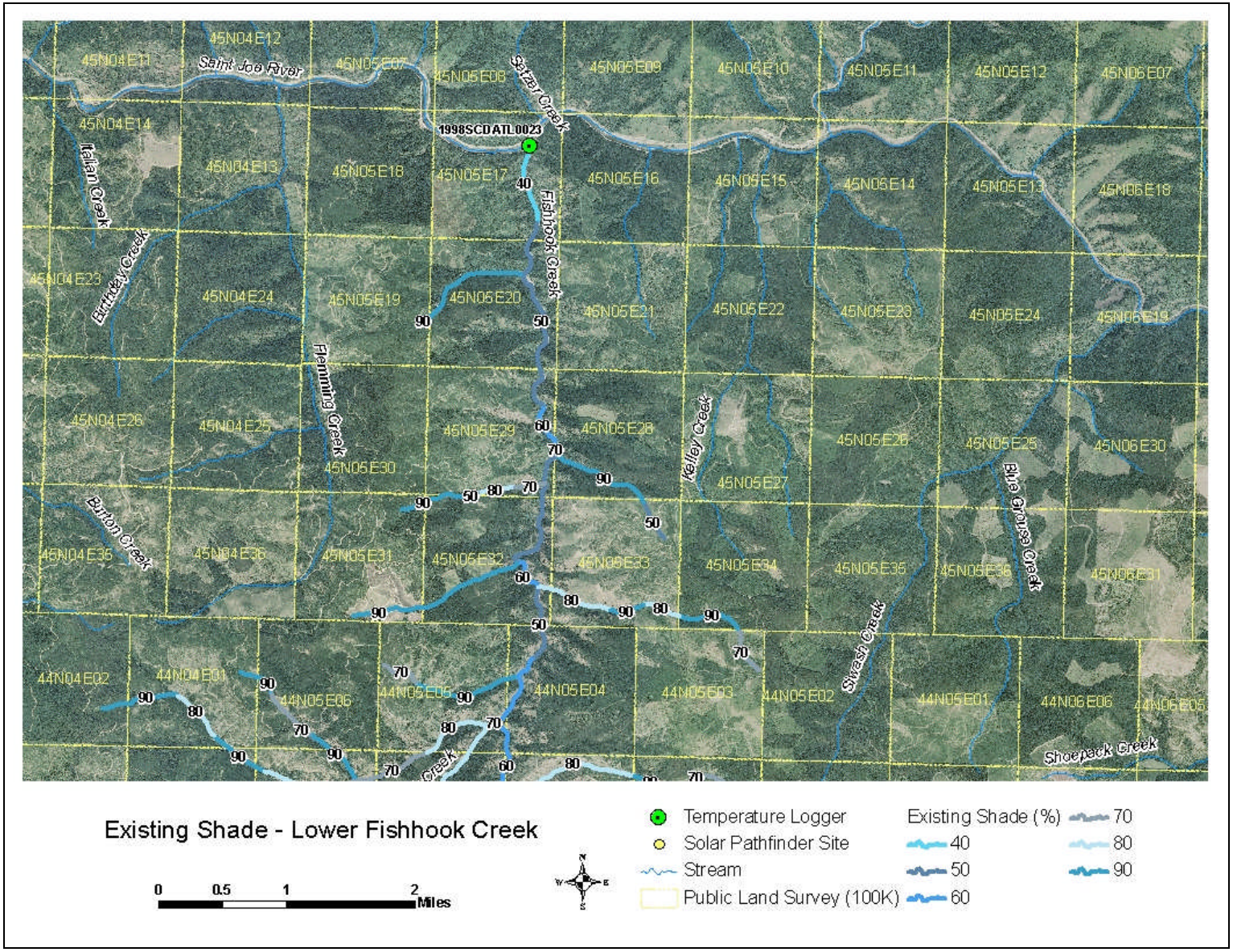


Figure G-28. Lower Fishhook Creek (AU ID17010304PN039_02/03/04) existing shade estimates

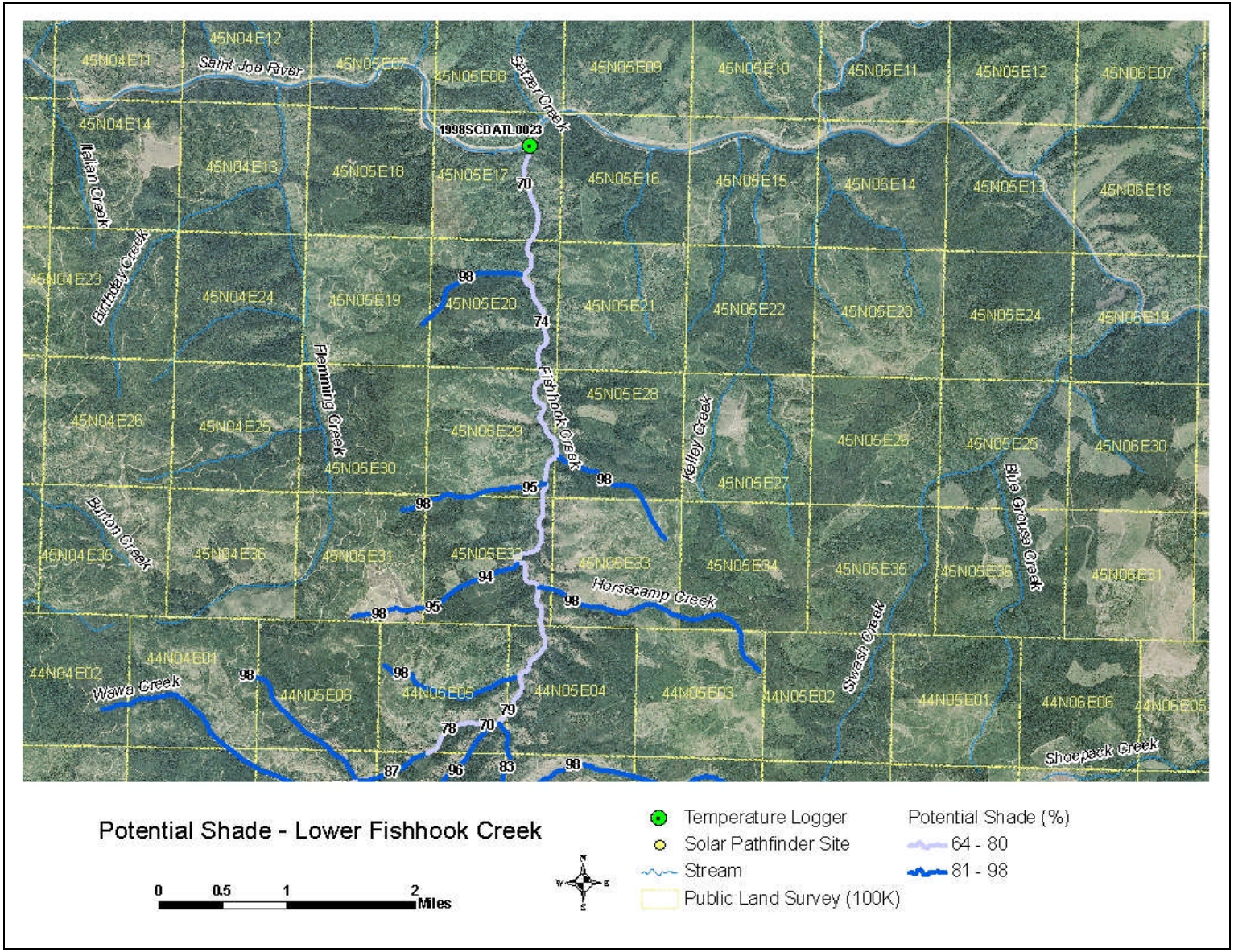


Figure G-29. Lower Fishhook Creek (AU ID17010304PN039_02/03/04) potential shade estimates

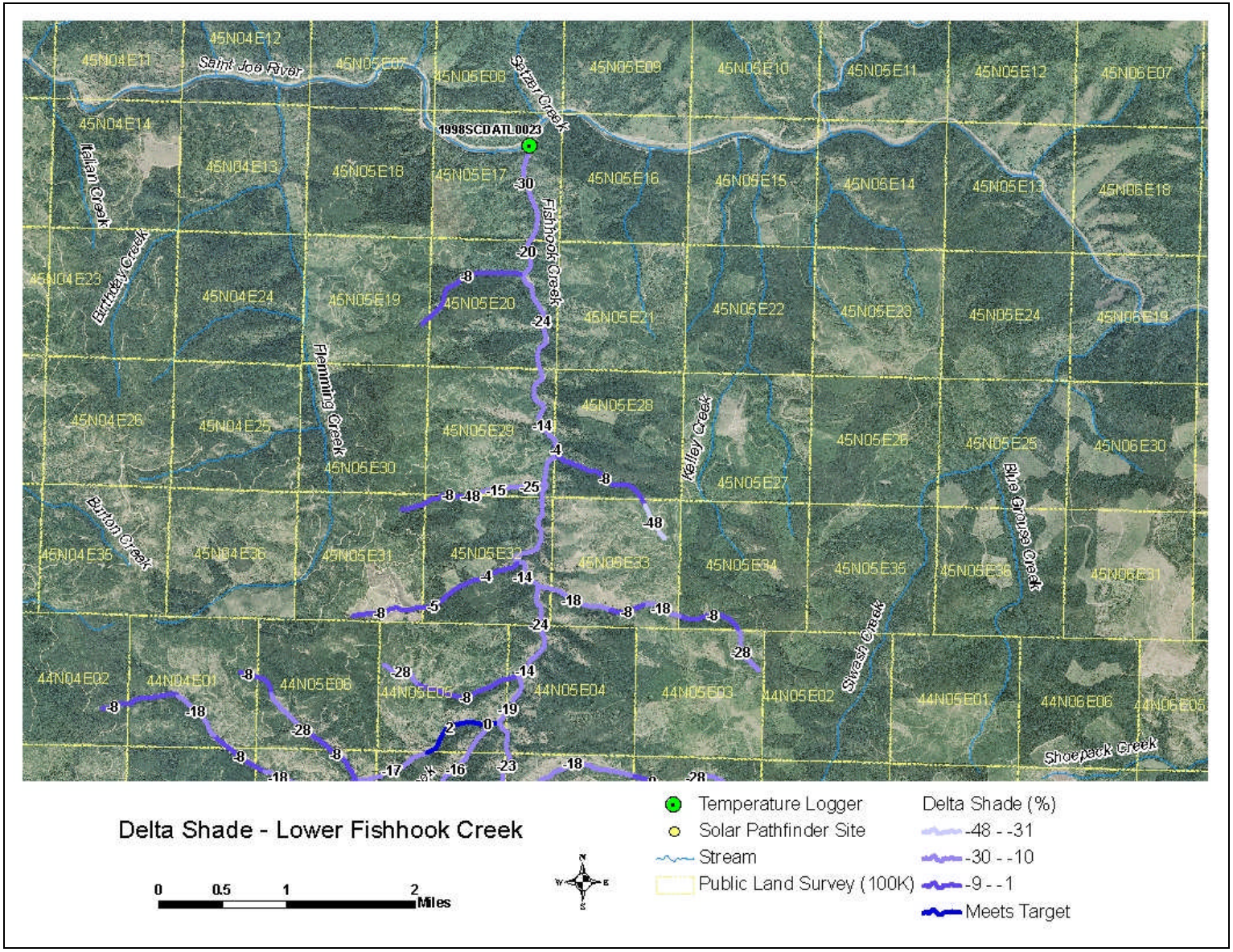


Figure G-30. Lower Fishhook Creek (AU ID17010304PN039_02/03/04) delta shade estimates

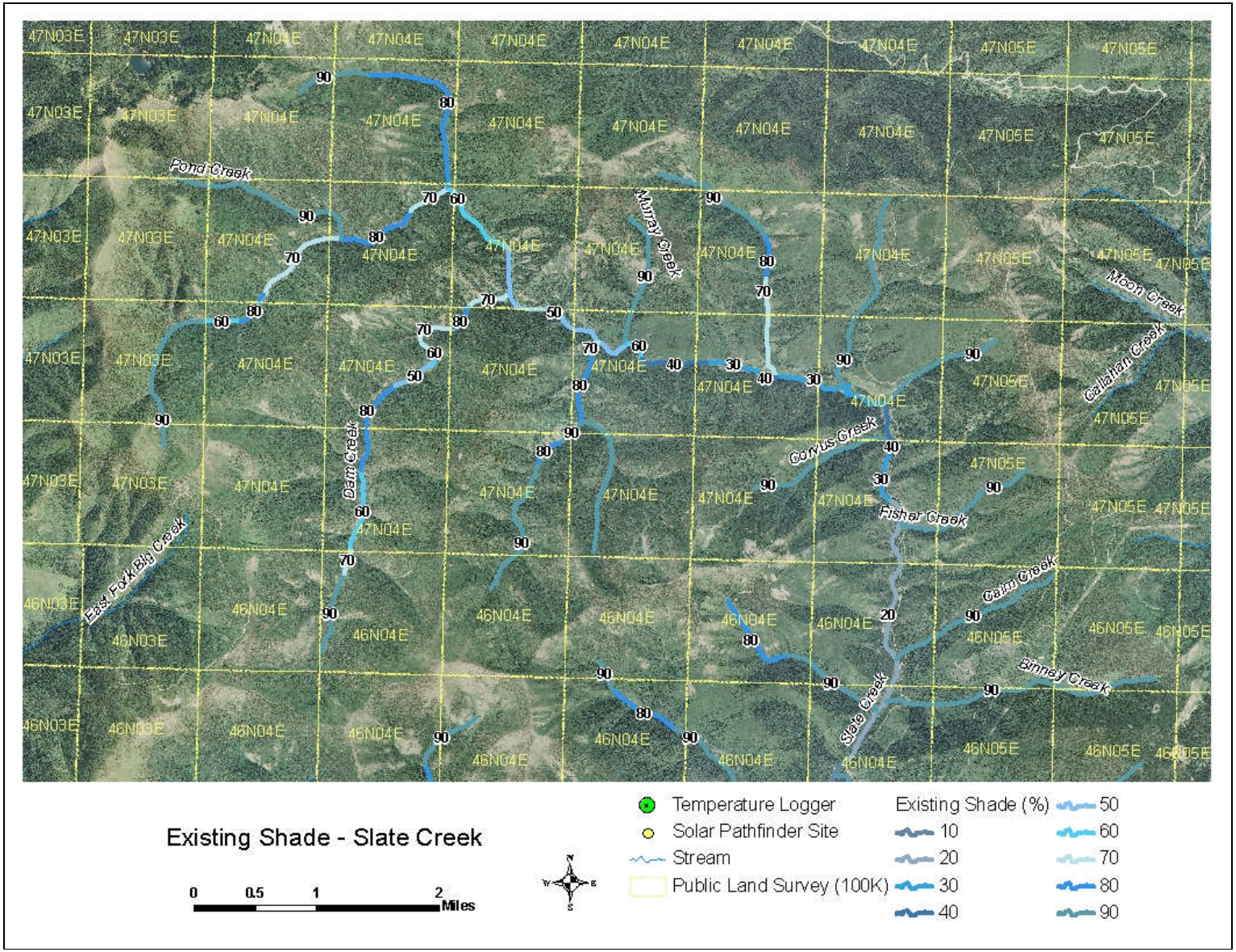


Figure G-31. Slate Creek (AU ID17010304PN062_02/03) existing shade estimates

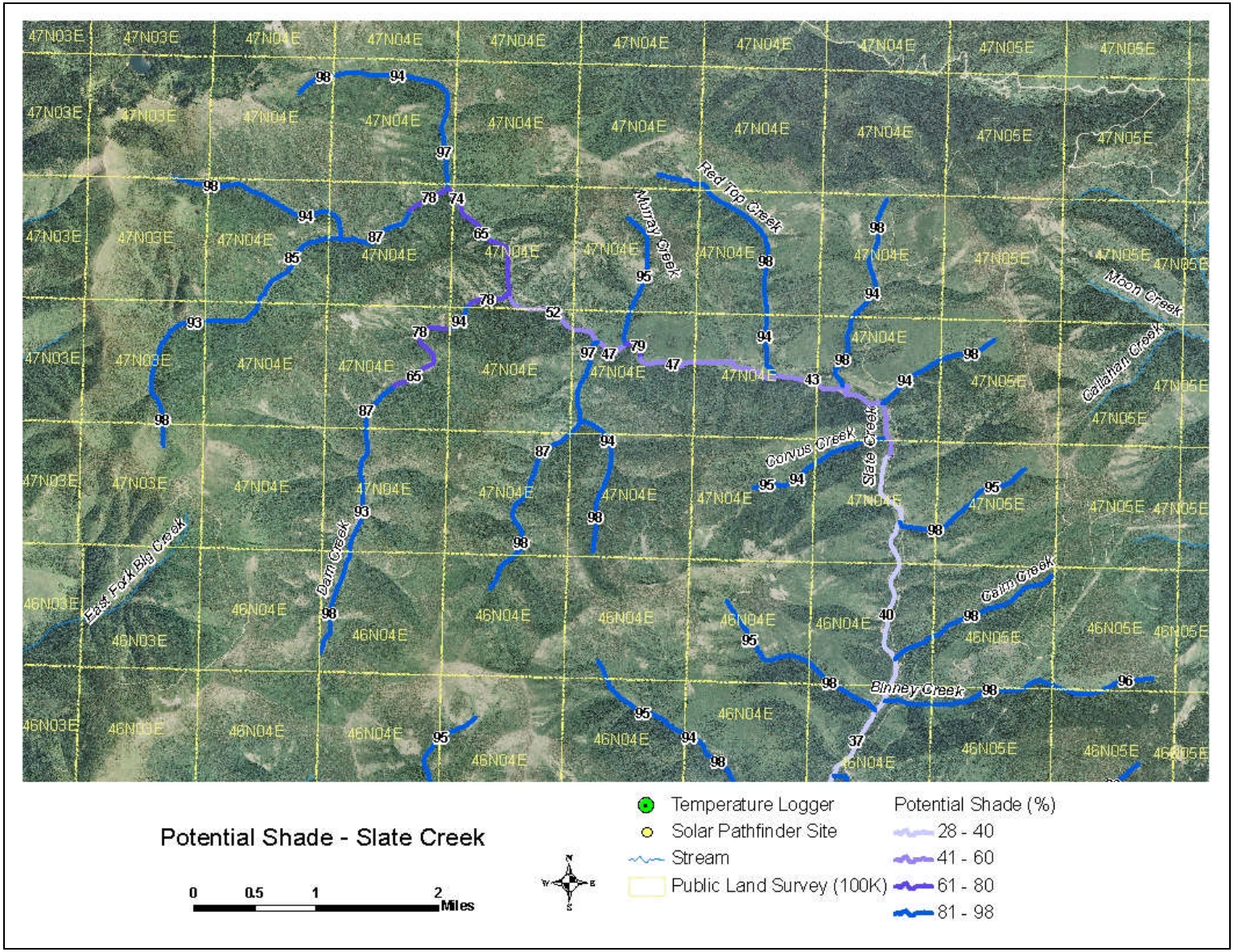


Figure G-32. Slate Creek (AU ID17010304PN062_02/03) potential shade estimates

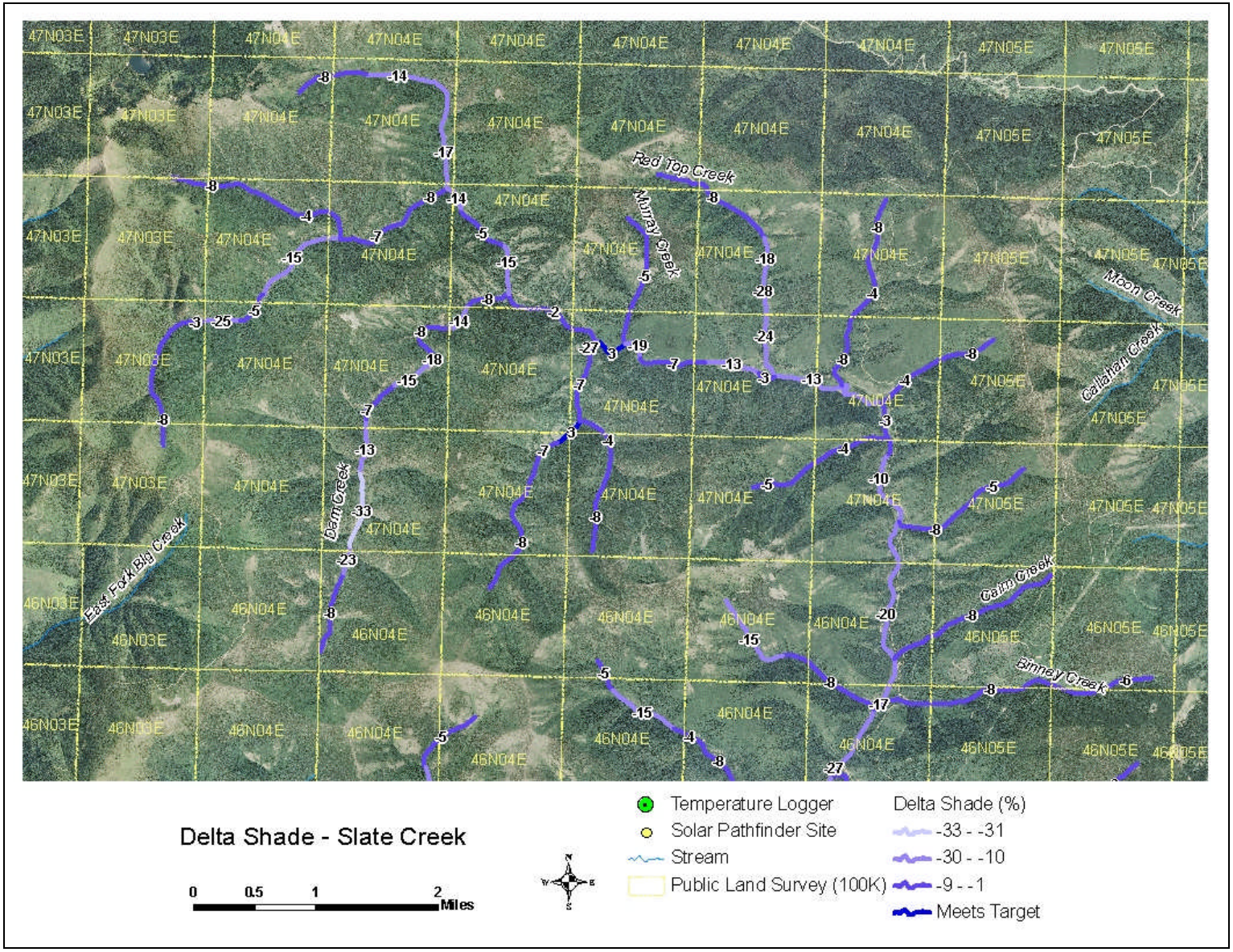


Figure G-33. Slate Creek (AU ID17010304PN062_02/03) delta shade estimates

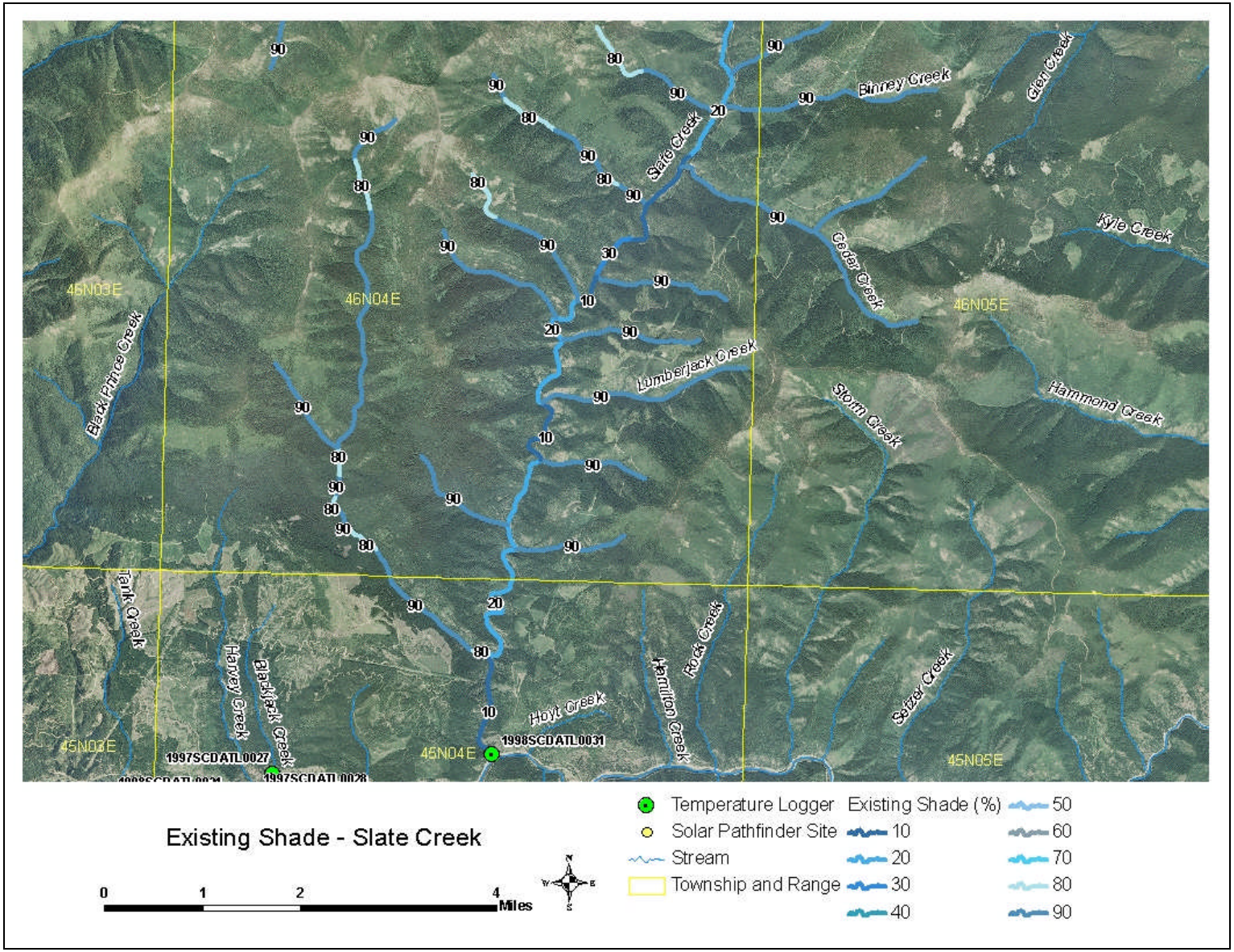


Figure G-34. Slate Creek (AU ID17010304PN062_02/03) existing shade estimates

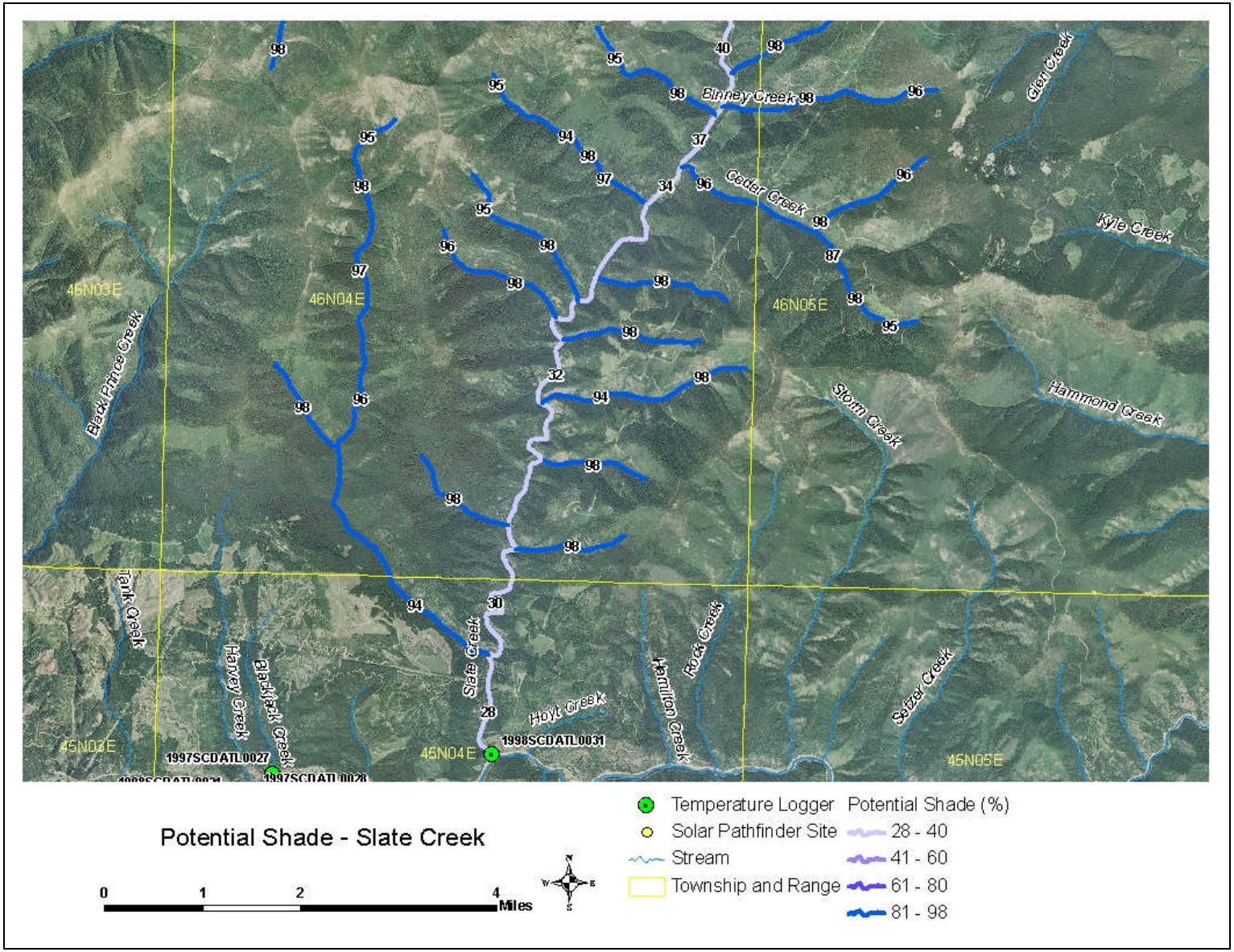


Figure G-35. Slate Creek (AU ID17010304PN062_02/03) potential shade estimates

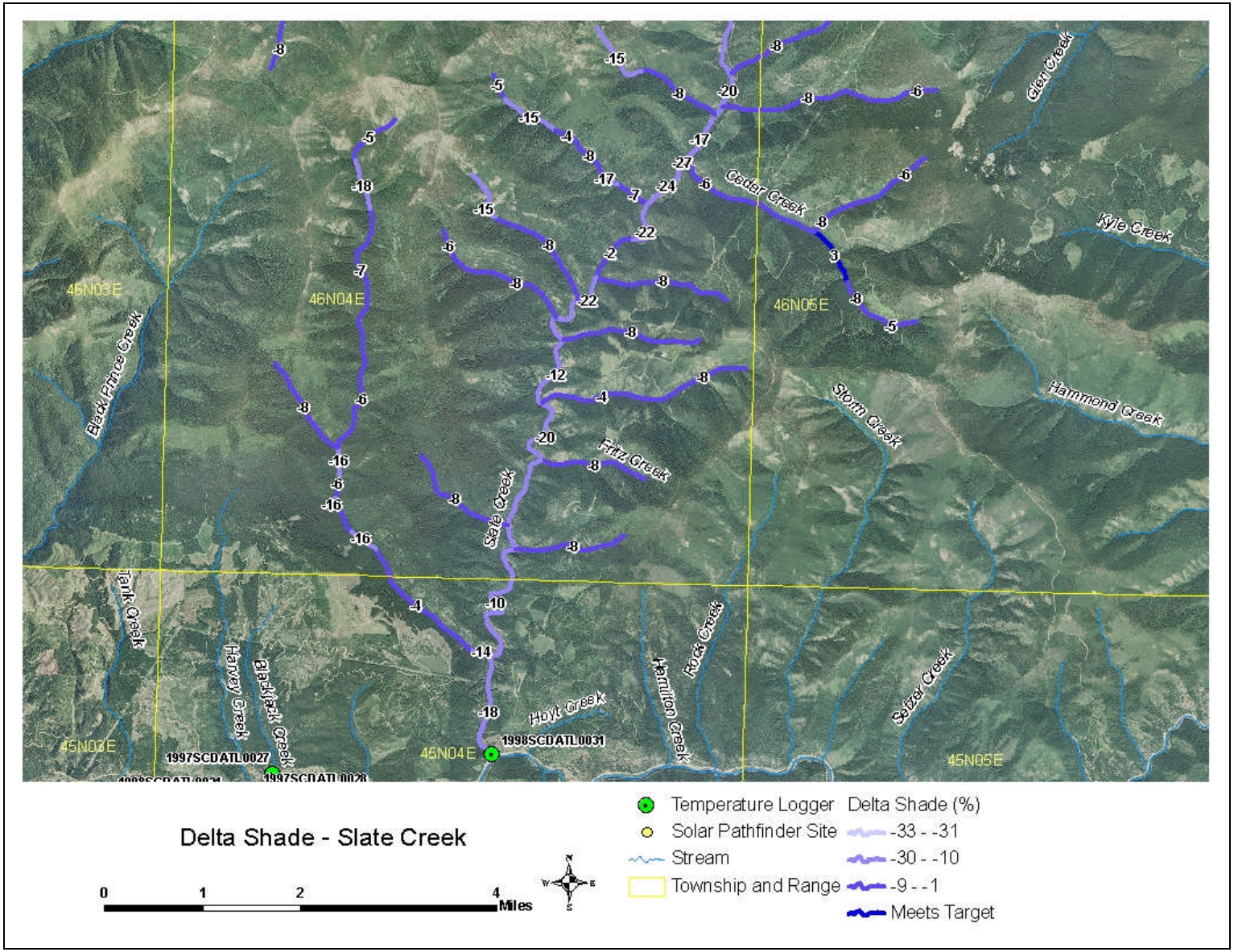


Figure G-36. Slate Creek (AU ID17010304PN062_02/03) delta shade estimates

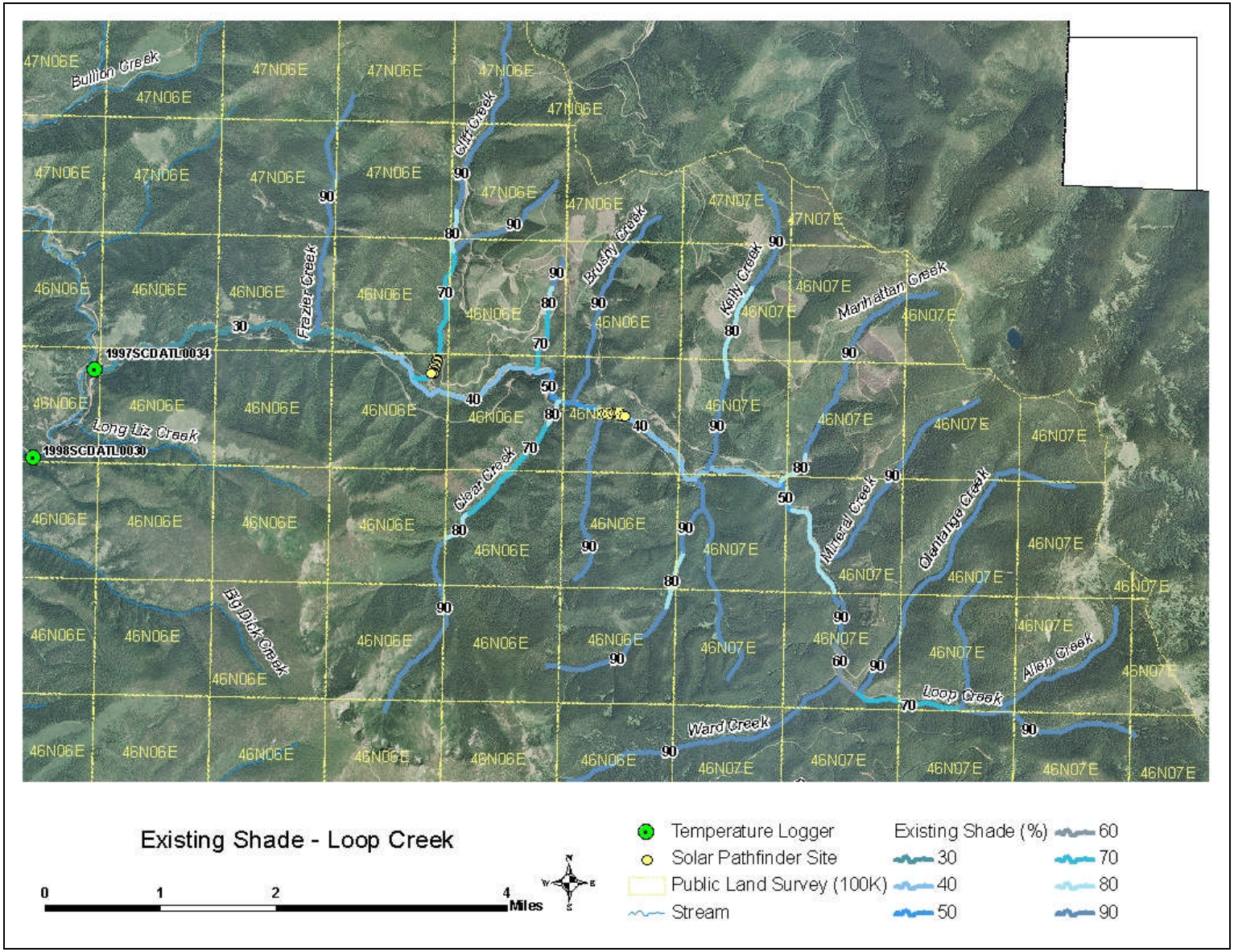


Figure G-37. Loop Creek (AU ID17010304PN060_02) existing shade estimates

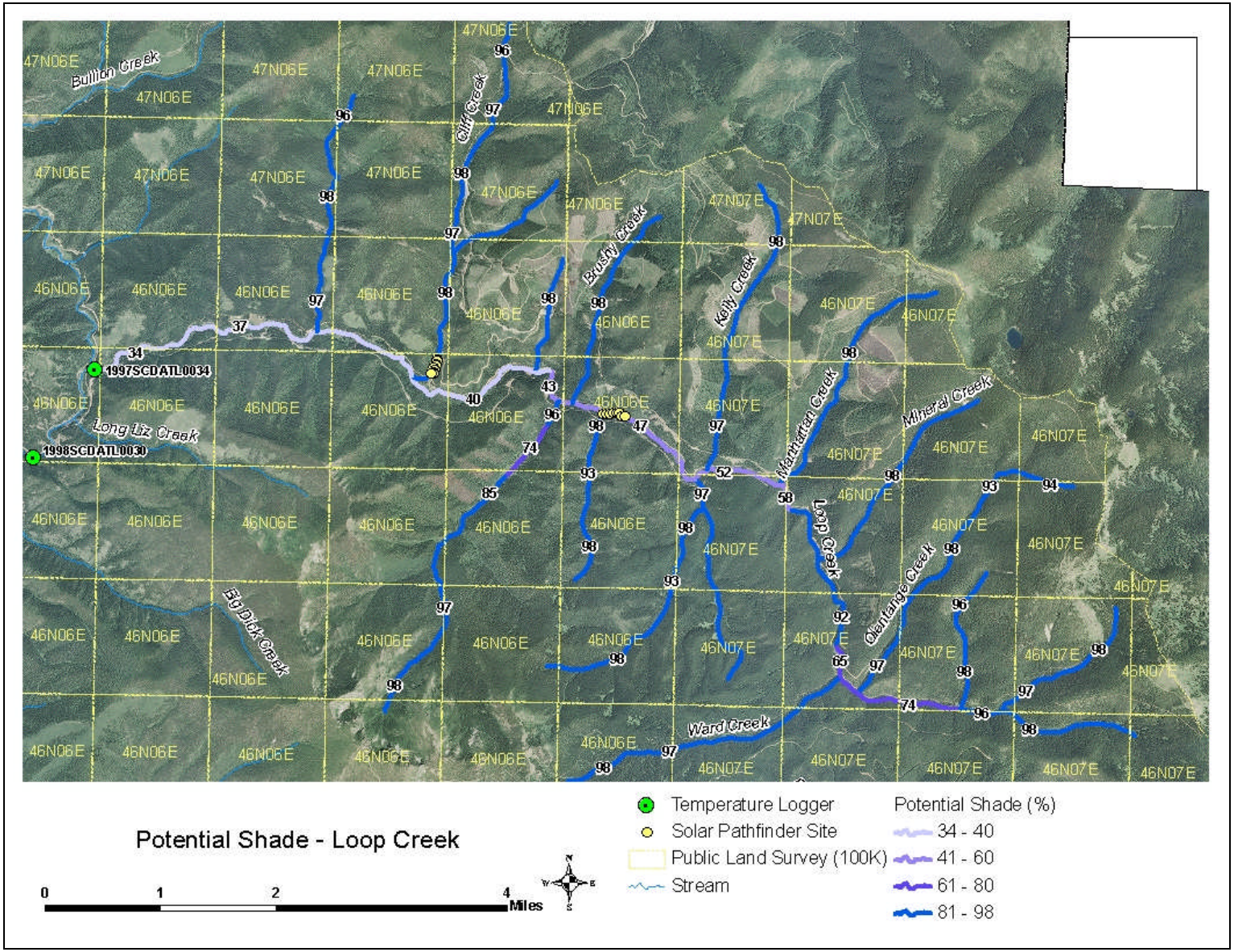


Figure G-38. Loop Creek (AU ID17010304PN060_02) potential shade estimates

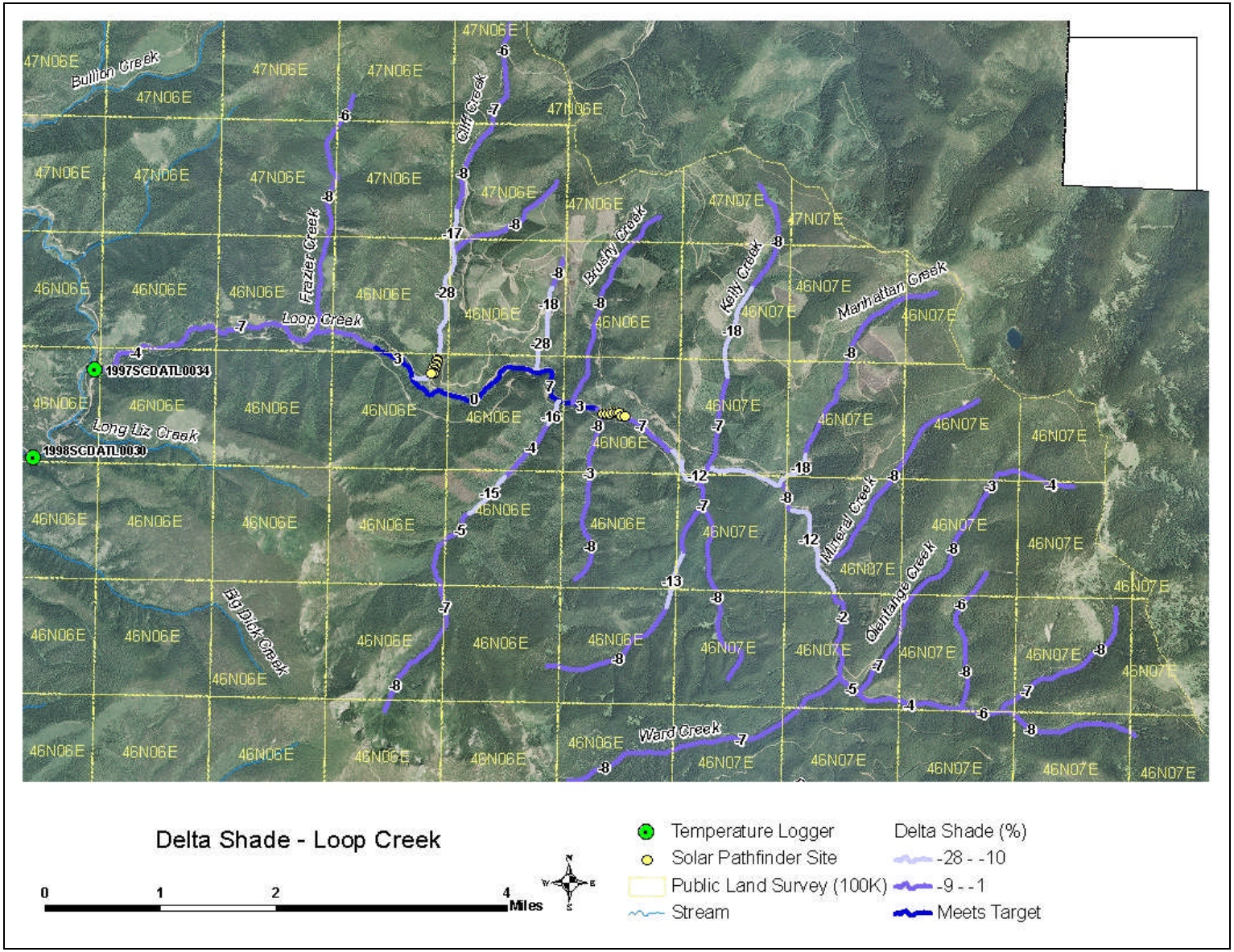


Figure G-39. Loop Creek (AU ID17010304PN060_02) delta shade estimates

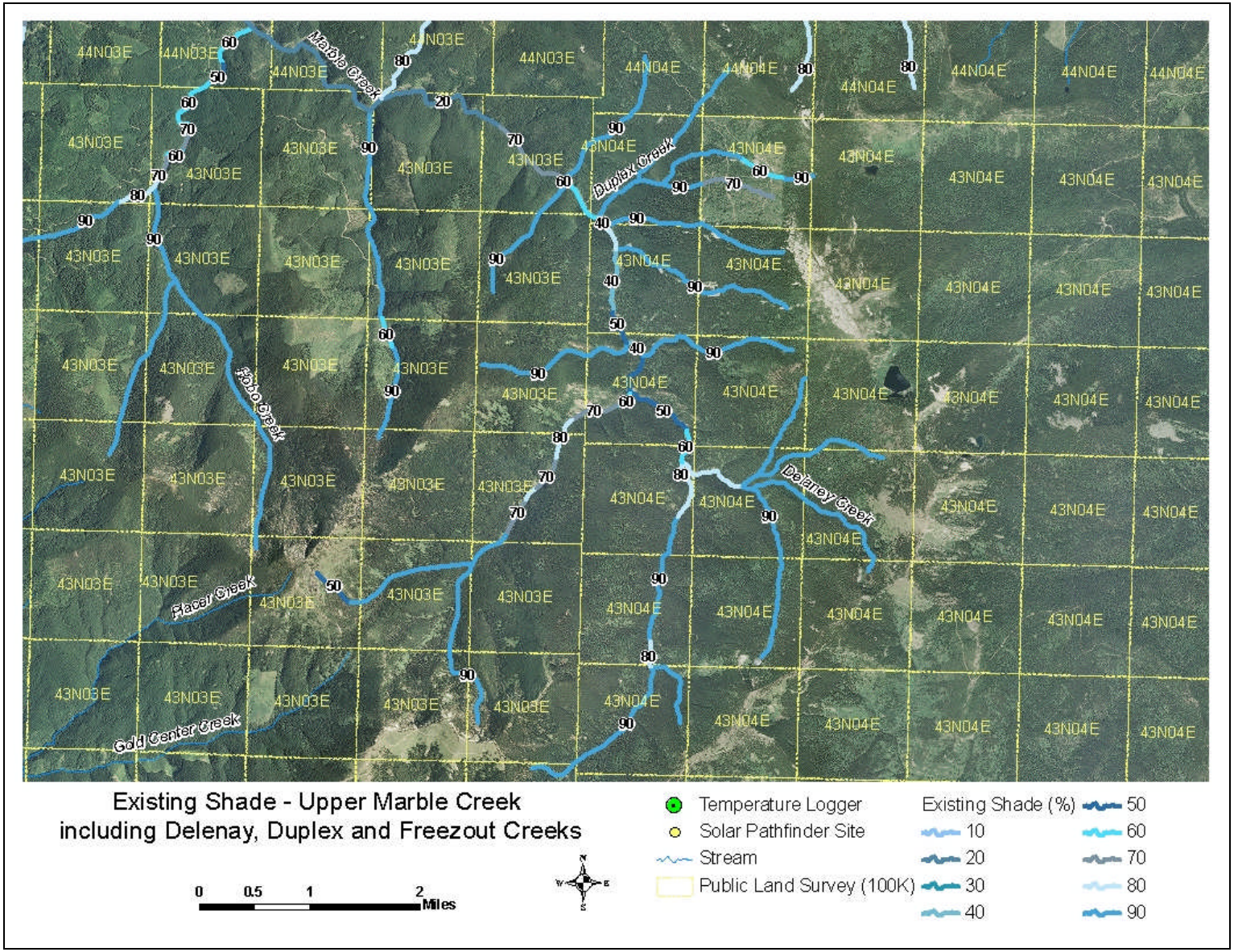


Figure G-40. Upper Marble Creek (AU ID17010304PN035_02/03) existing shade estimates

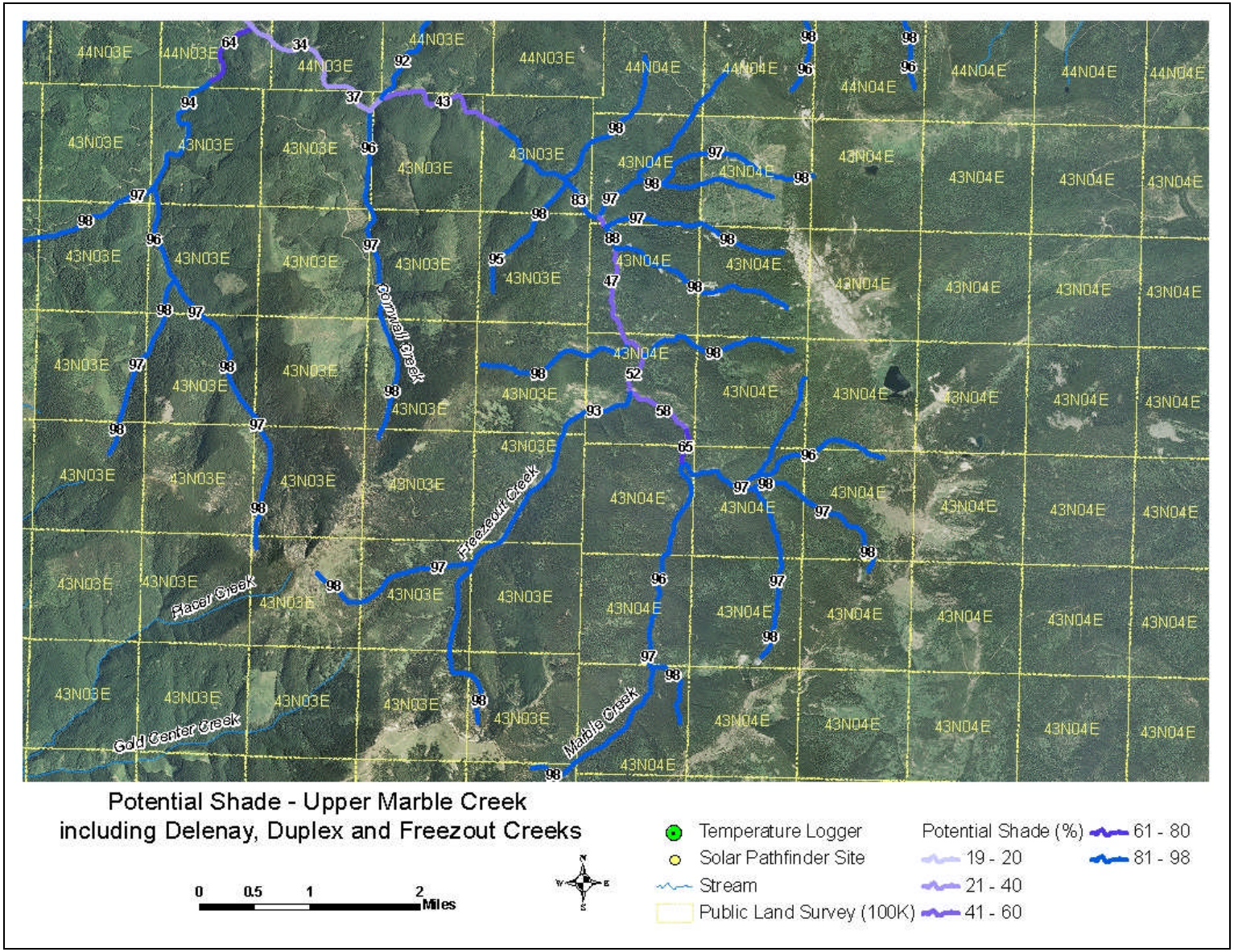


Figure G-41. Upper Marble Creek (AU ID17010304PN035_02/03) potential shade estimates

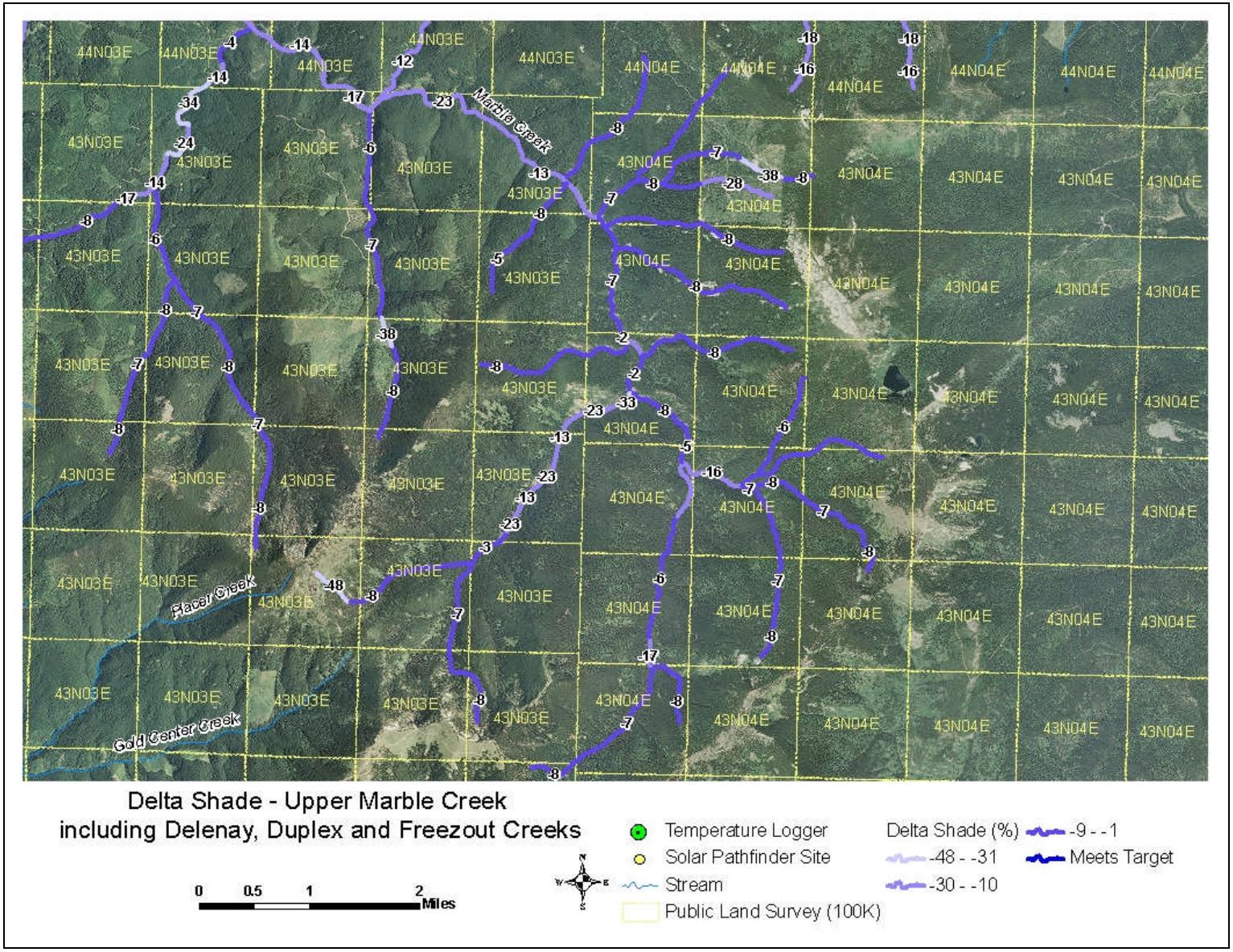


Figure G-42. Upper Marble Creek (AU ID17010304PN035_02/03) delta shade estimates

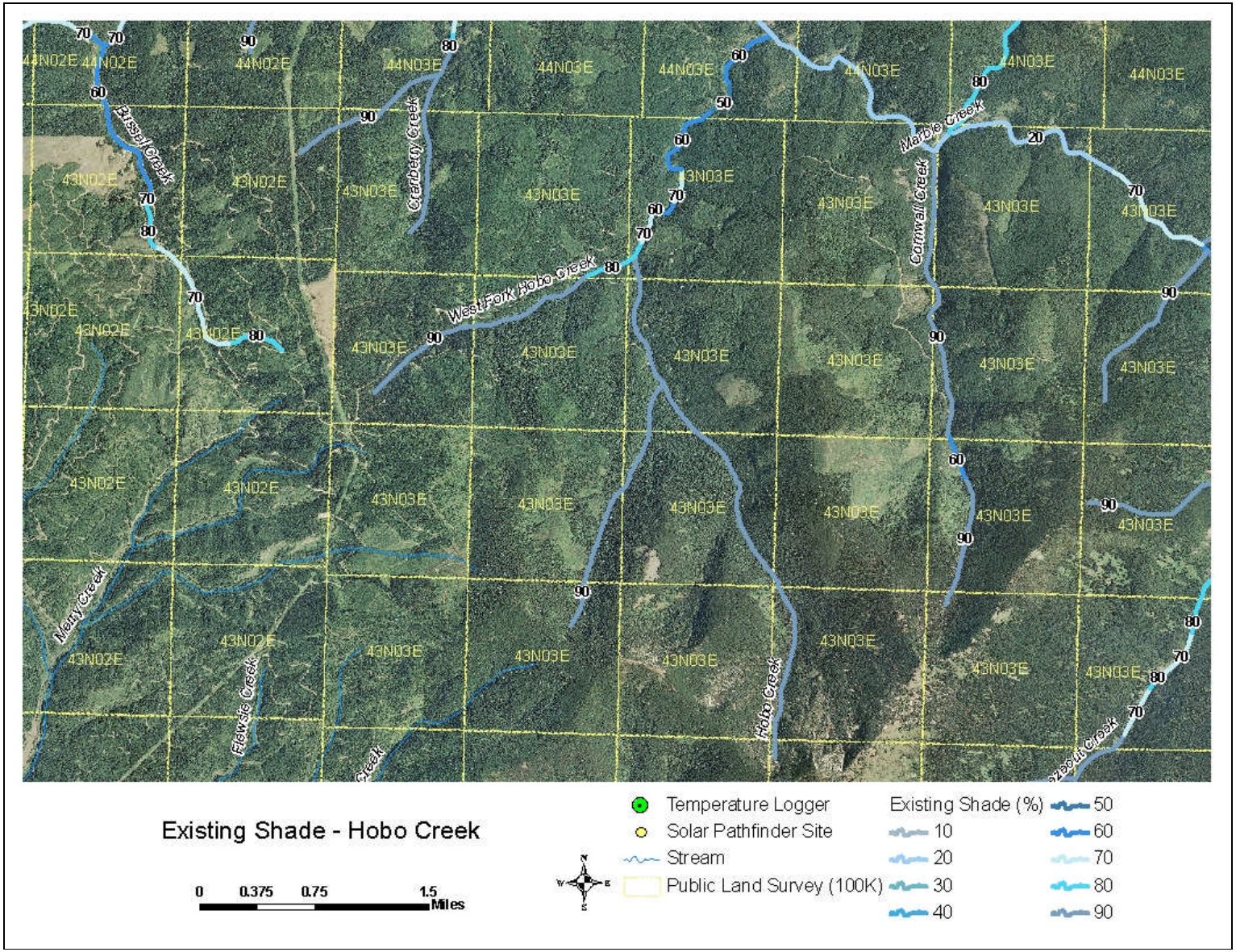


Figure G-43. Hobo Creek (AU ID17010304PN034_02) existing shade estimates

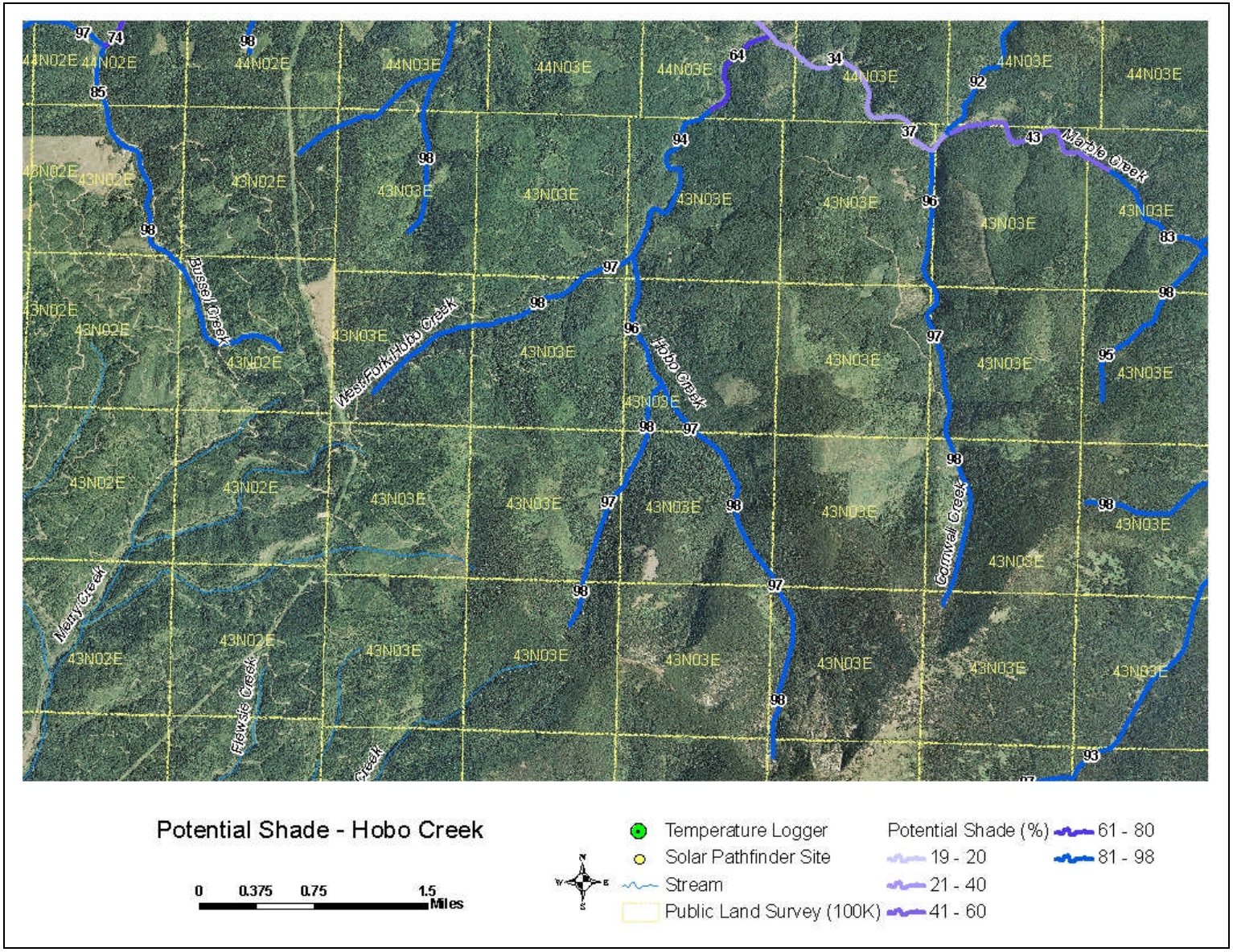


Figure G-44. Hobo Creek (AU ID17010304PN034_02) potential shade estimates

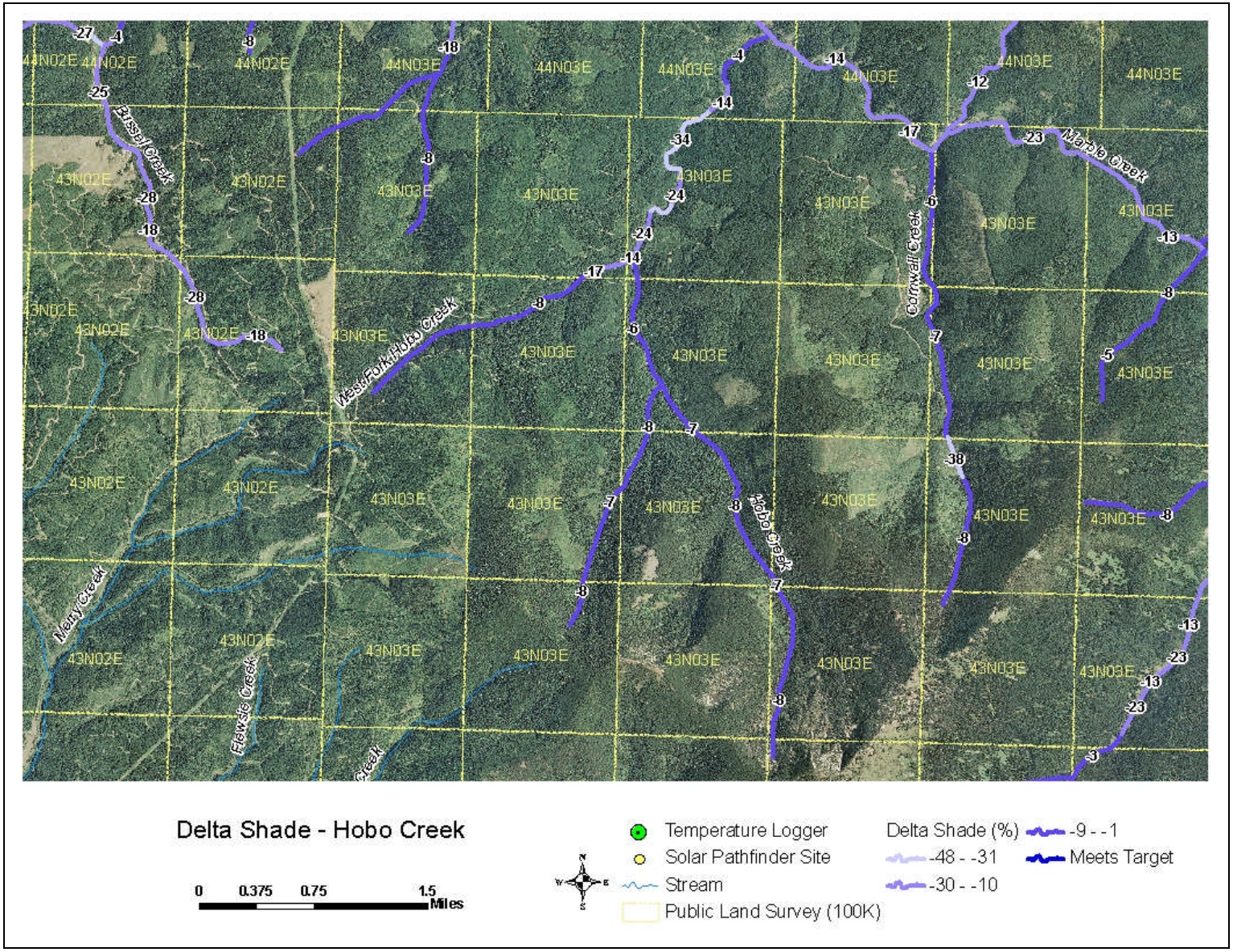


Figure G-45. Hobo Creek (AU ID17010304PN034_02) delta shade estimates

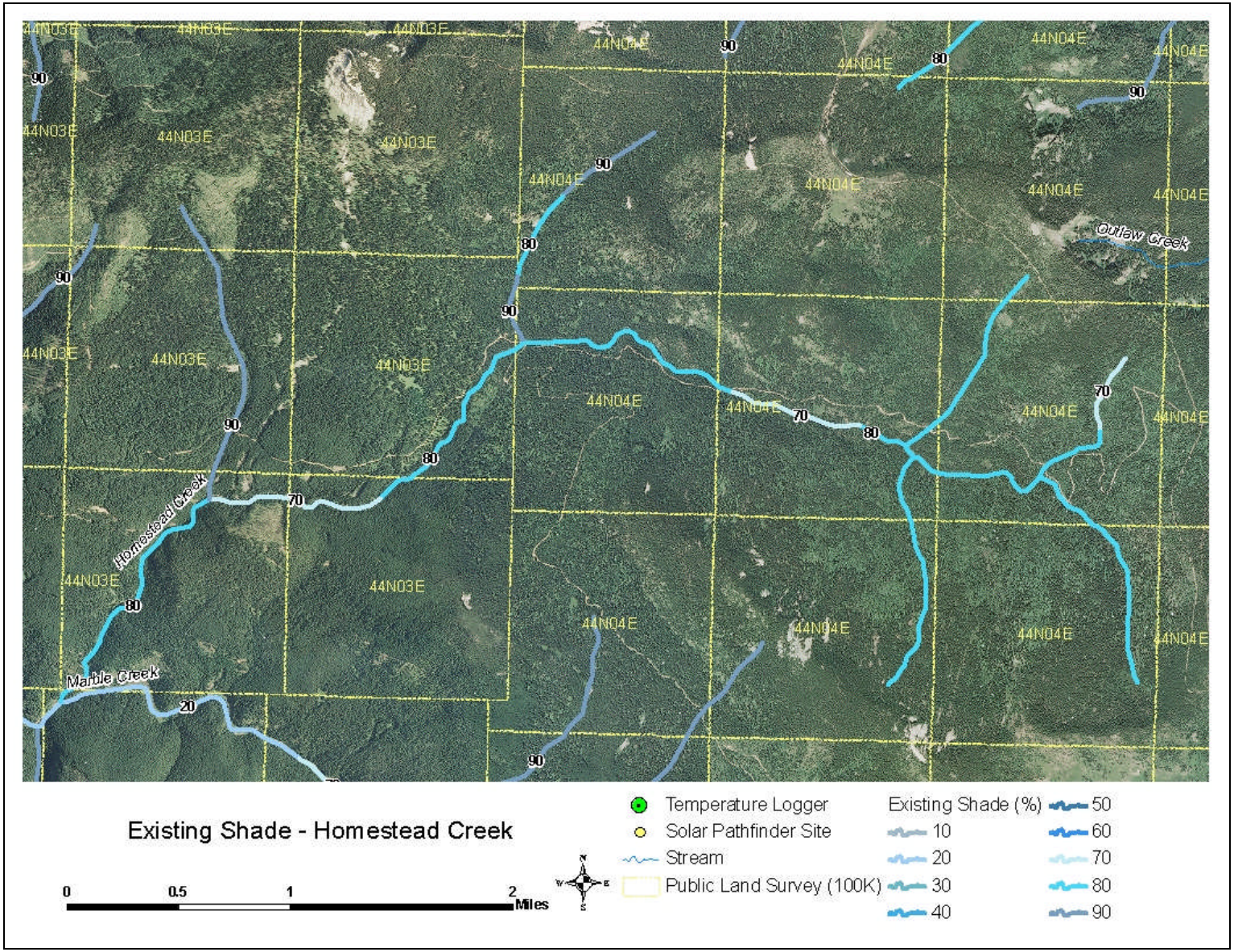


Figure G-46. Homestead Creek (AU ID17010304PN036_02) existing shade estimates

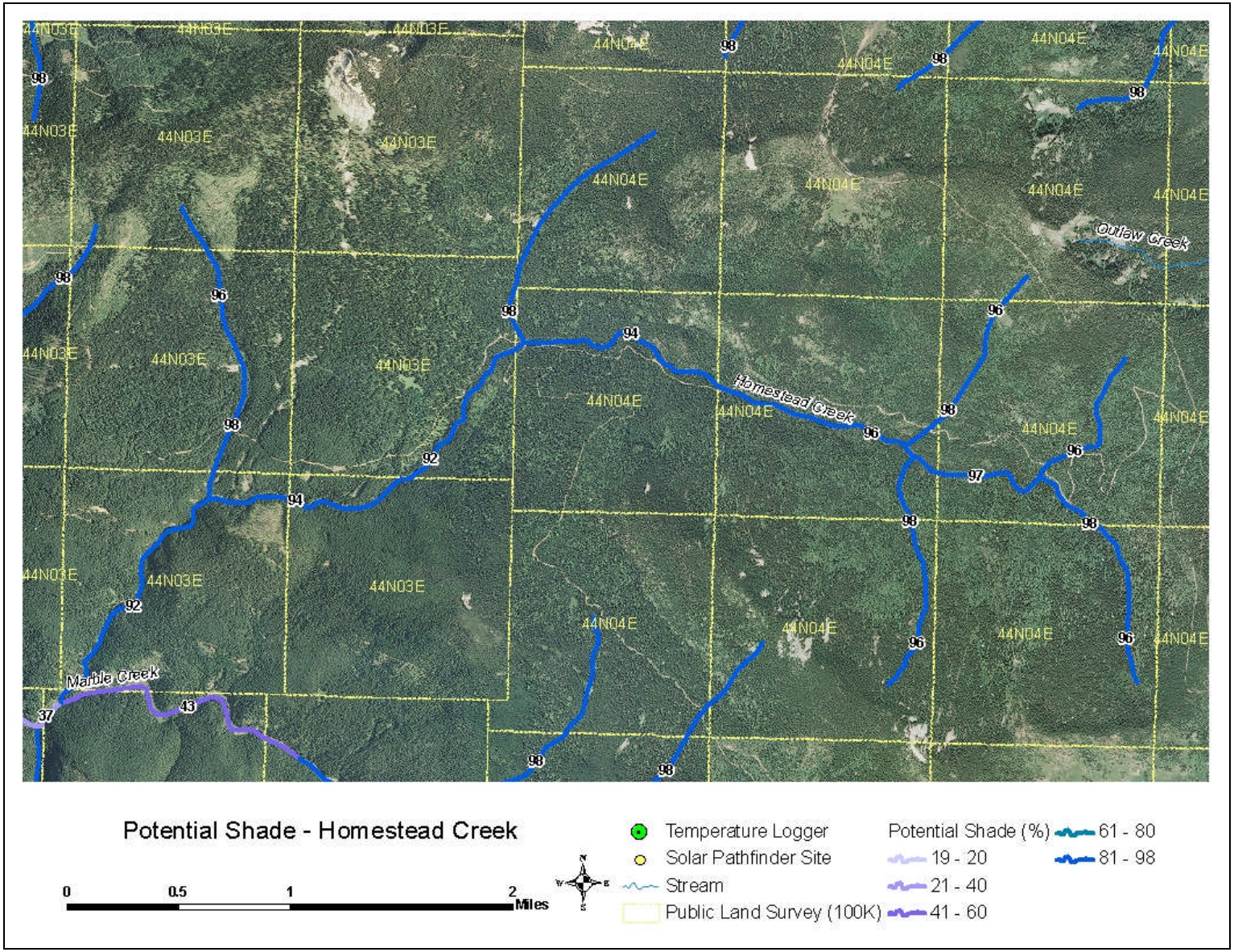


Figure G-47. Homestead Creek (AU ID17010304PN036_02) potential shade estimates

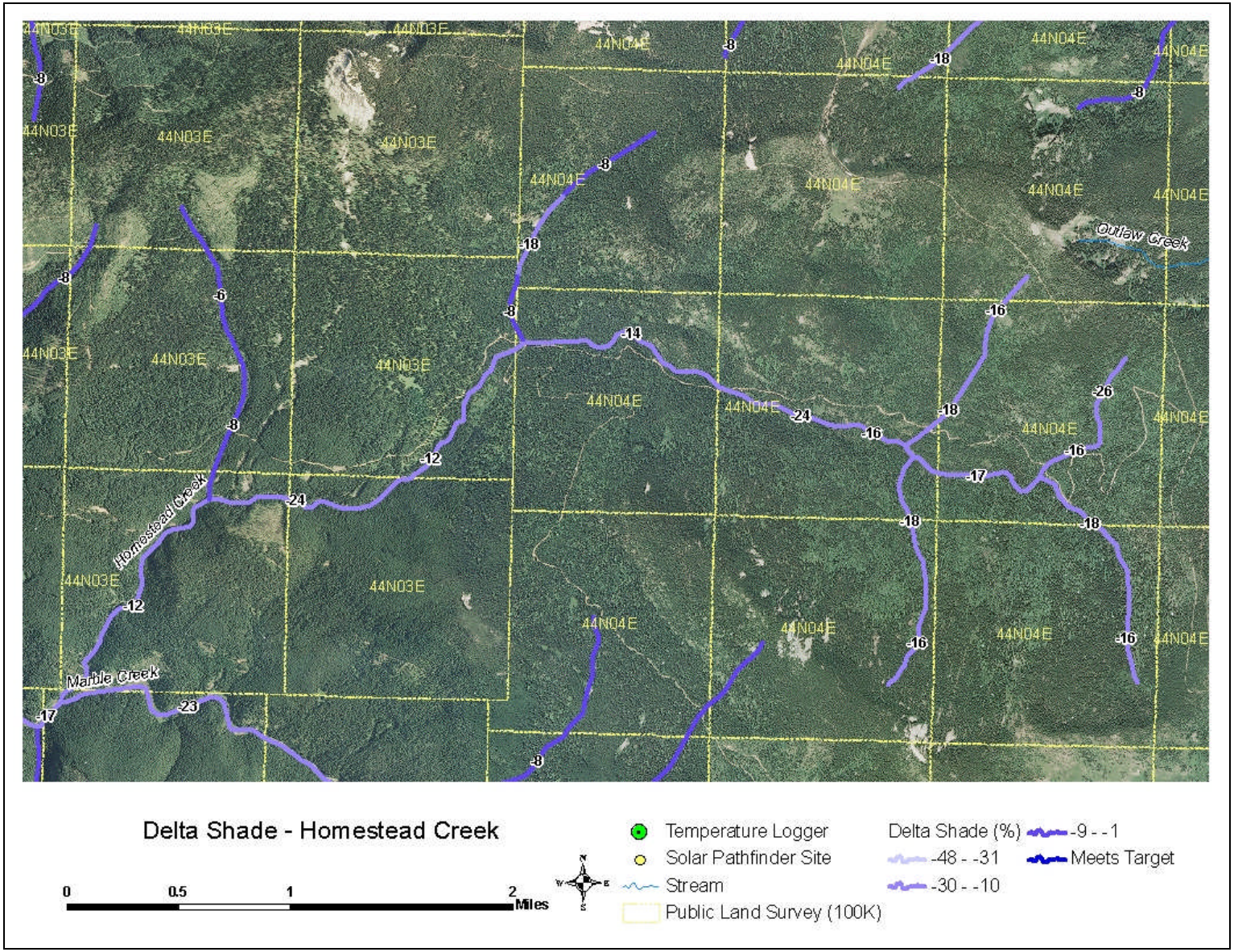


Figure G-48. Homestead Creek (AU ID17010304PN036_02) delta shade estimates

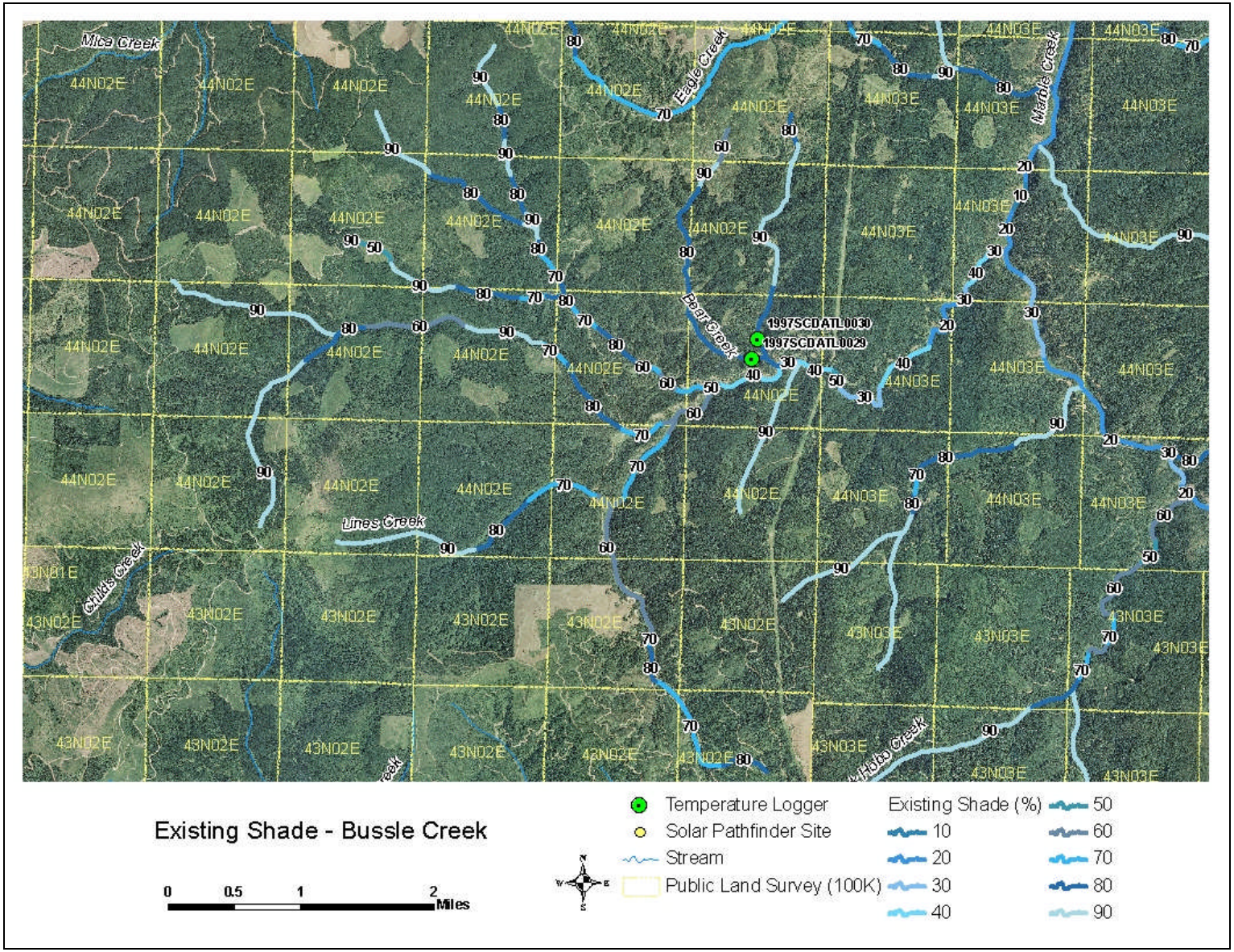


Figure G-49. Bussel Creek (AU ID17010304PN033_02a/02/03) existing shade estimates

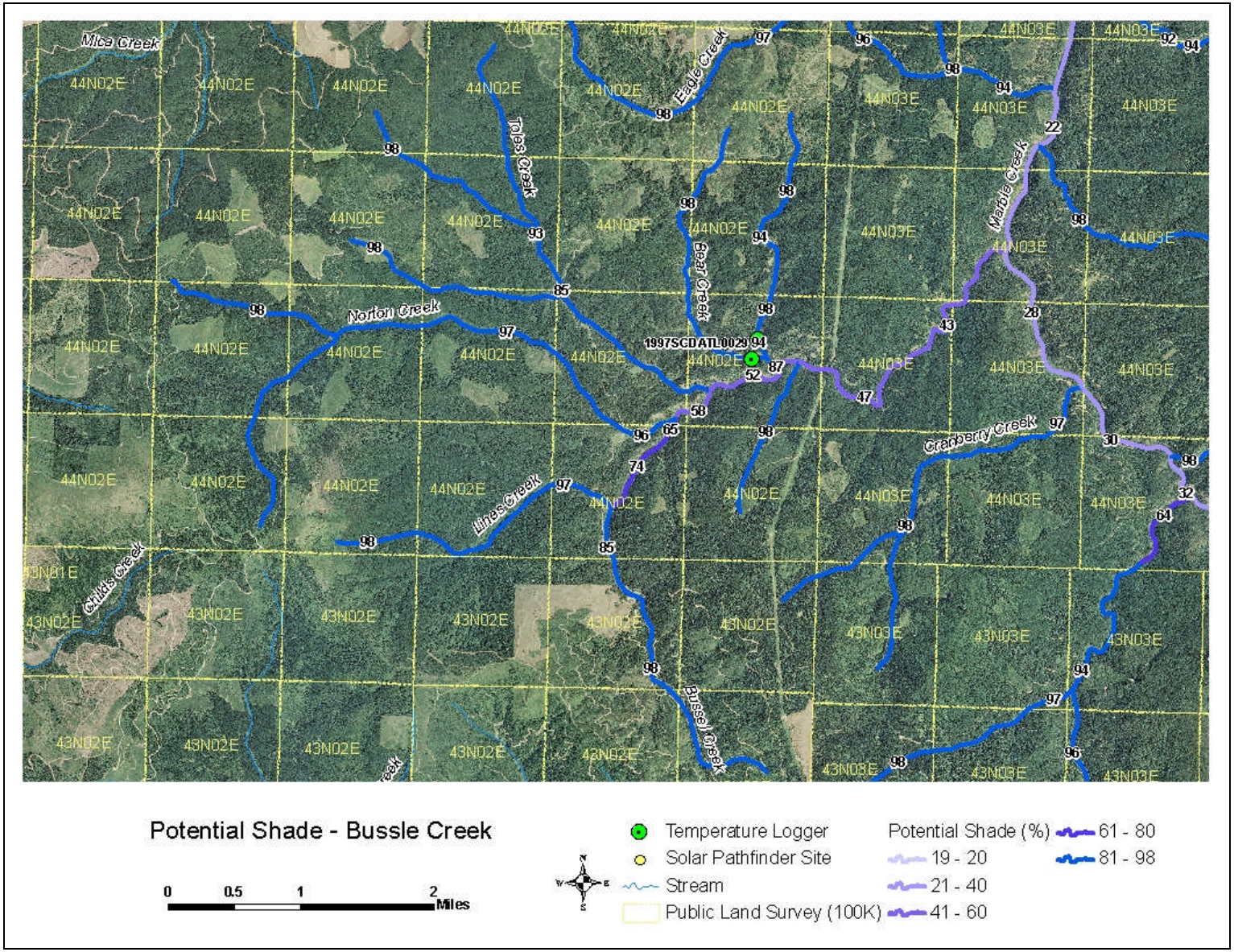


Figure G-50. Bussel Creek (AU ID17010304PN033_02a/02/03) potential shade estimates

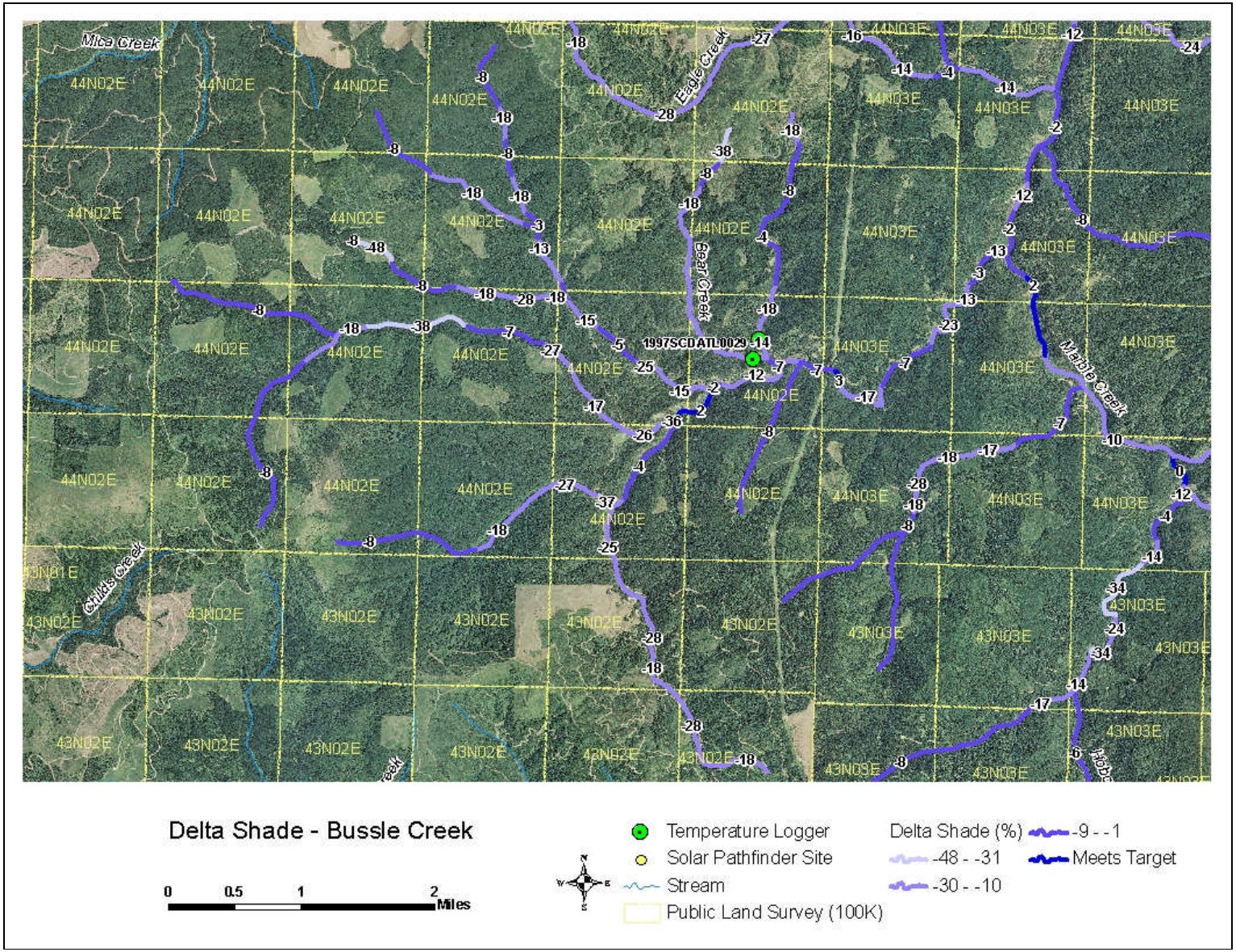


Figure G-51. Bussel Creek (AU ID17010304PN033_02a/02/03) delta shade estimates

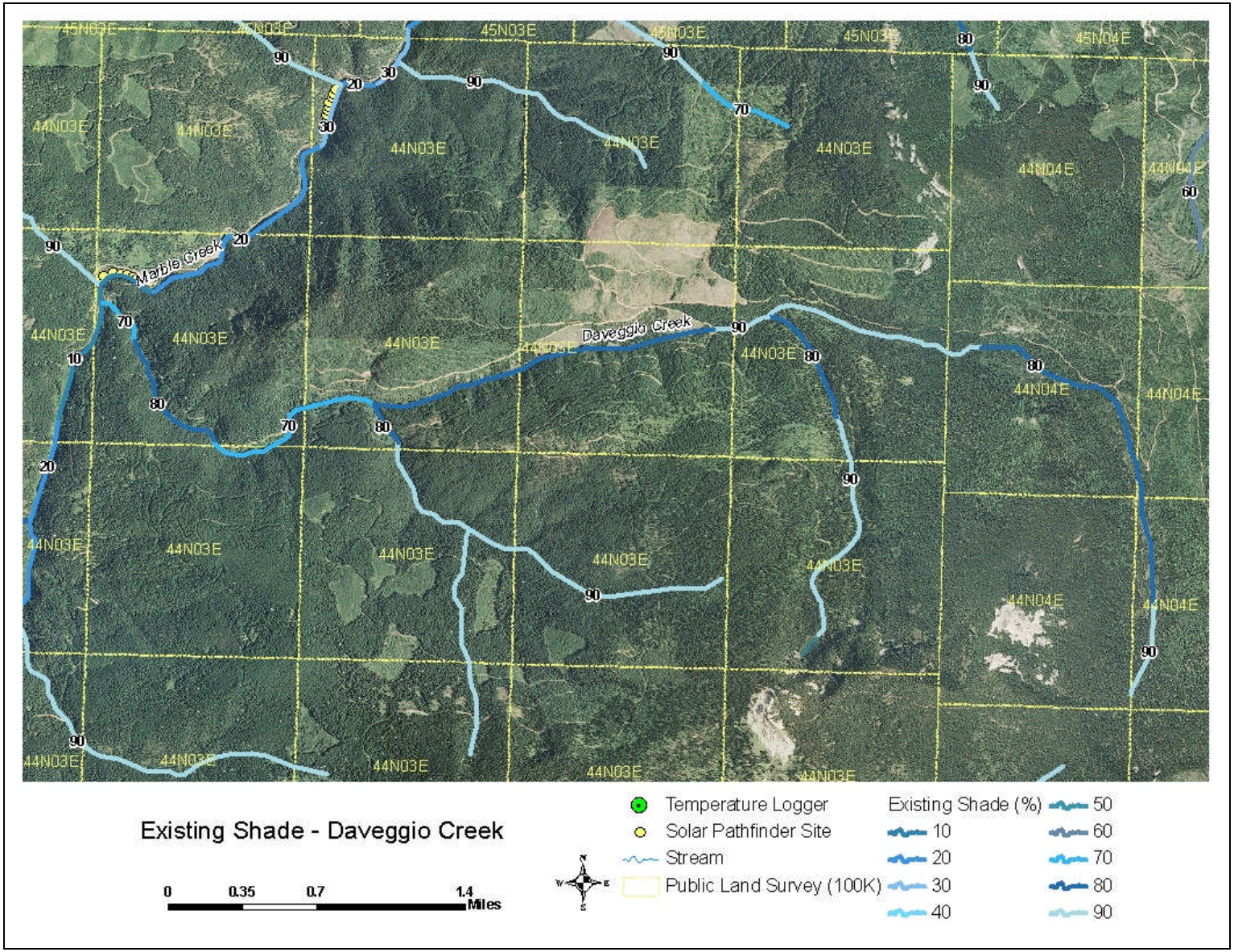


Figure G-52. Daveggio Creek (AU ID17010304PN037_02/03) existing shade estimates

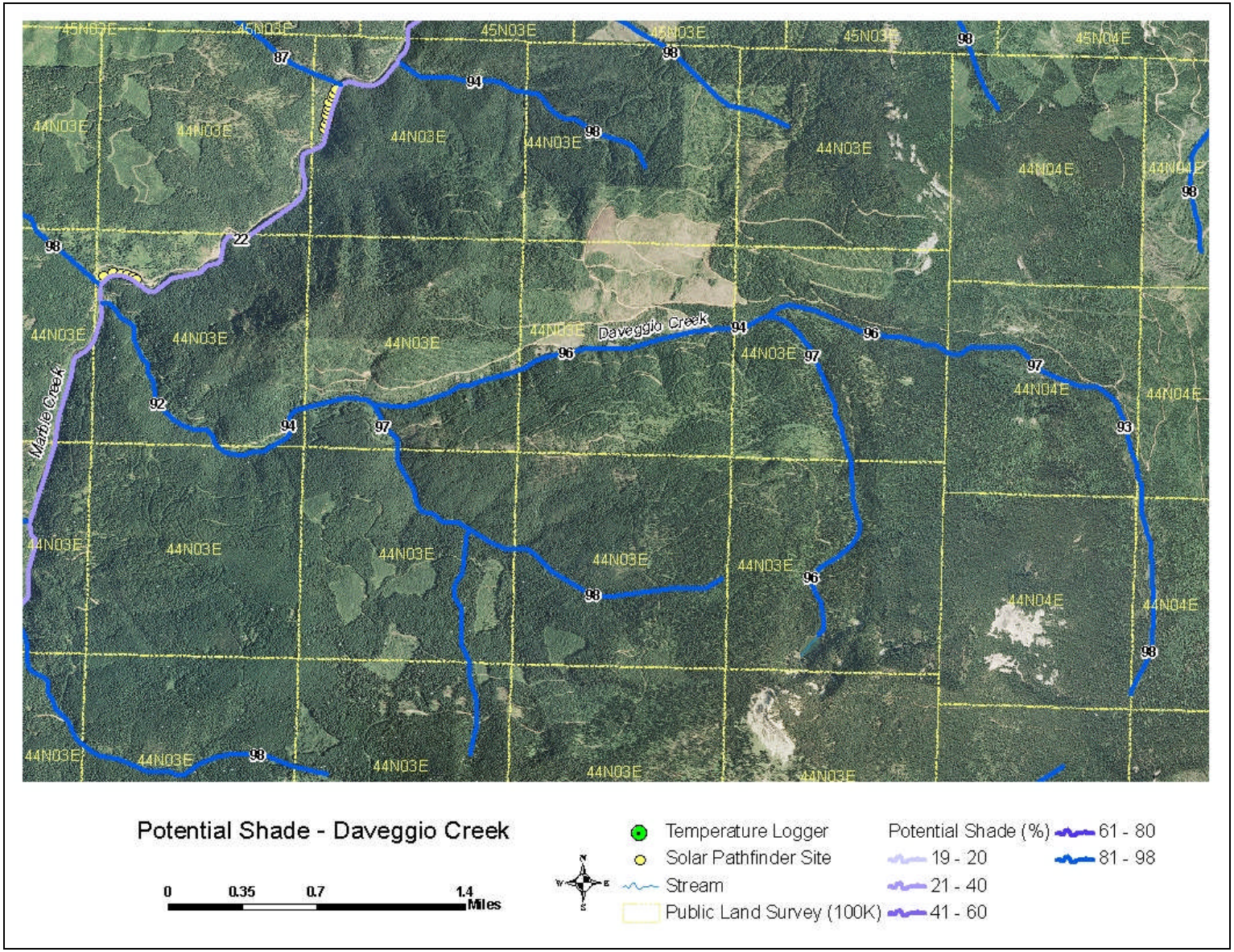


Figure G-53. Daveggio Creek (AU ID17010304PN037_02/03) potential shade estimates

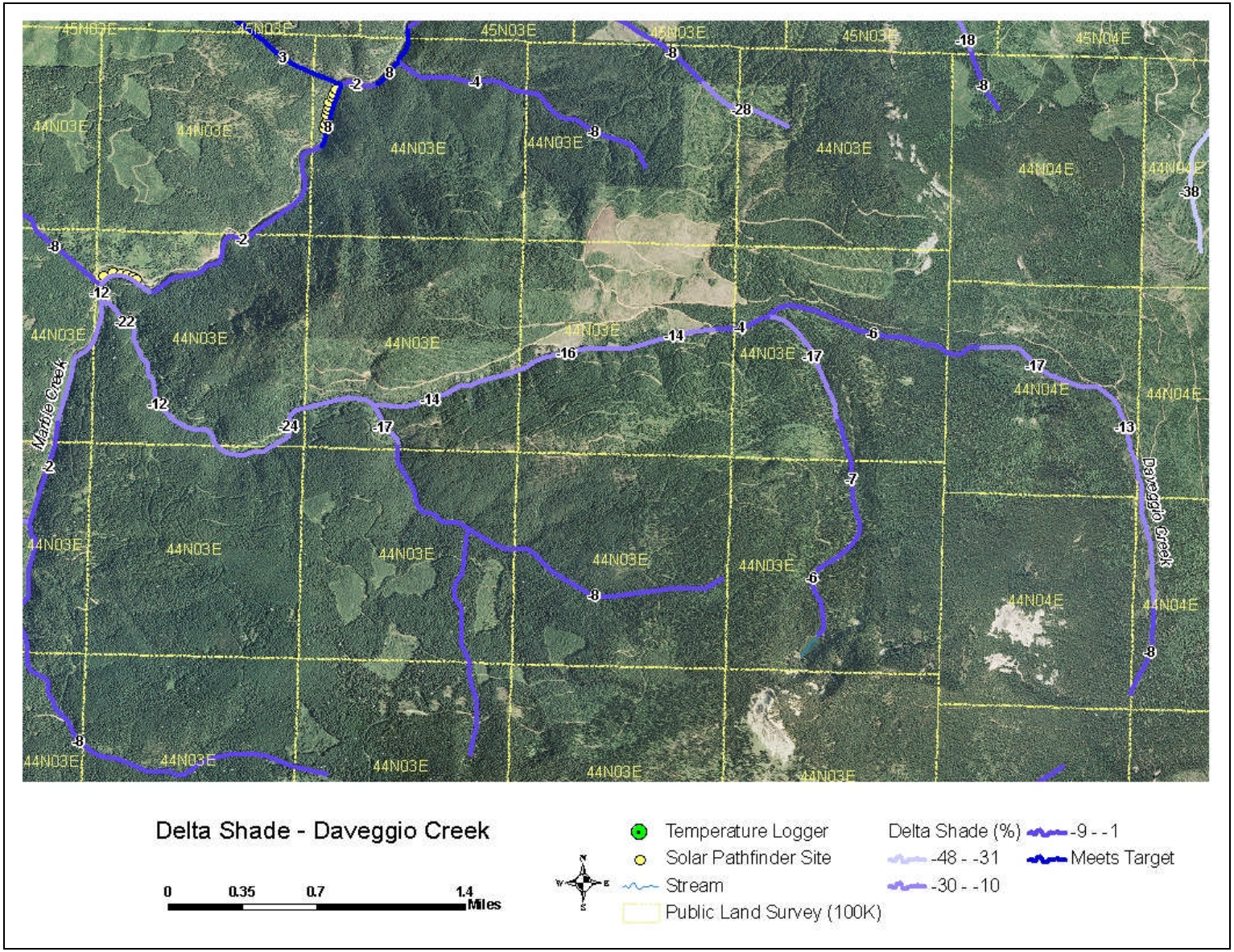


Figure G-54. Daveggio Creek (AU ID17010304PN037_02/03) delta shade estimates

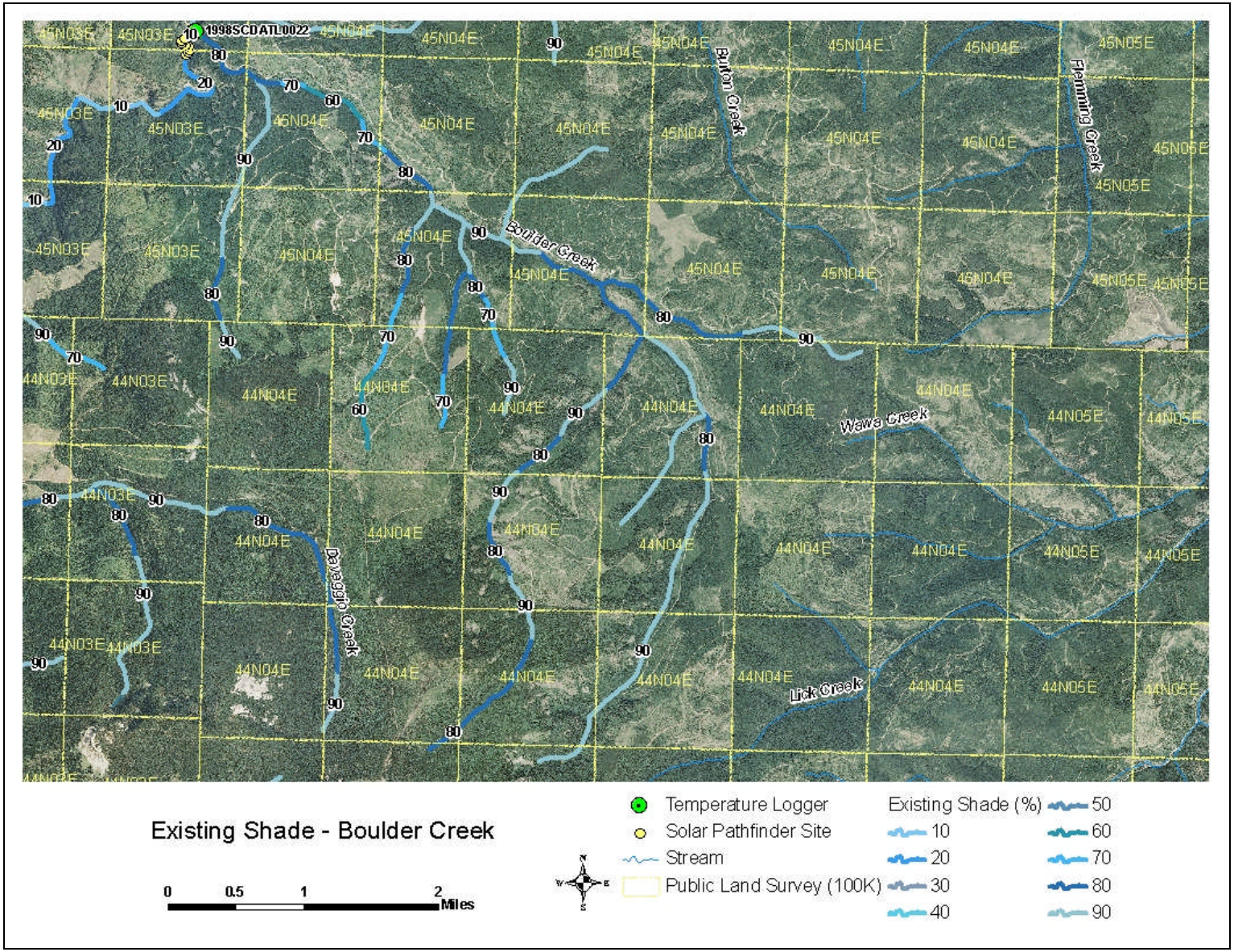


Figure G-55. Boulder Creek (AU ID17010304PN038_02/03) existing shade estimates

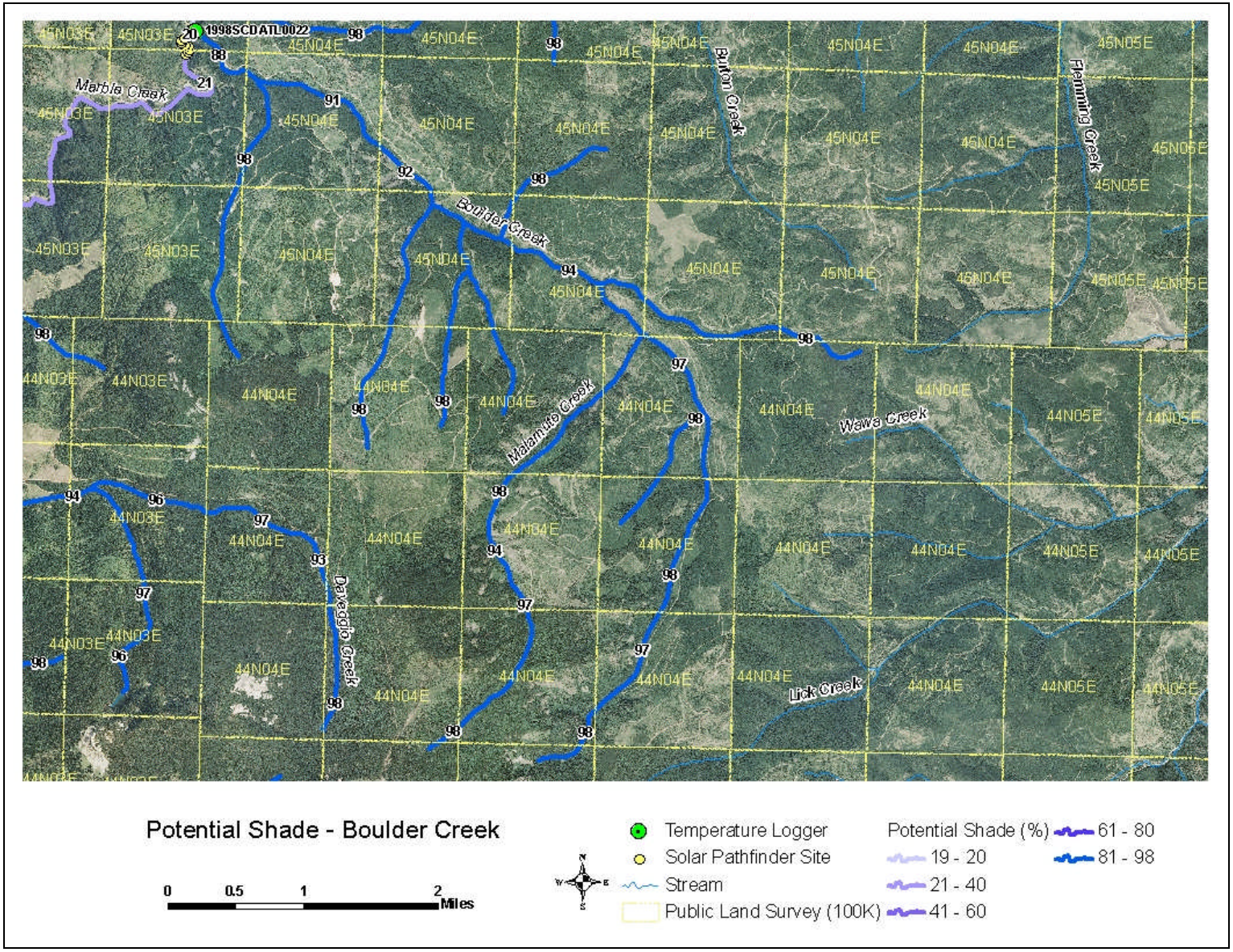


Figure G-56. Boulder Creek (AU ID17010304PN038_02/03) potential shade estimates

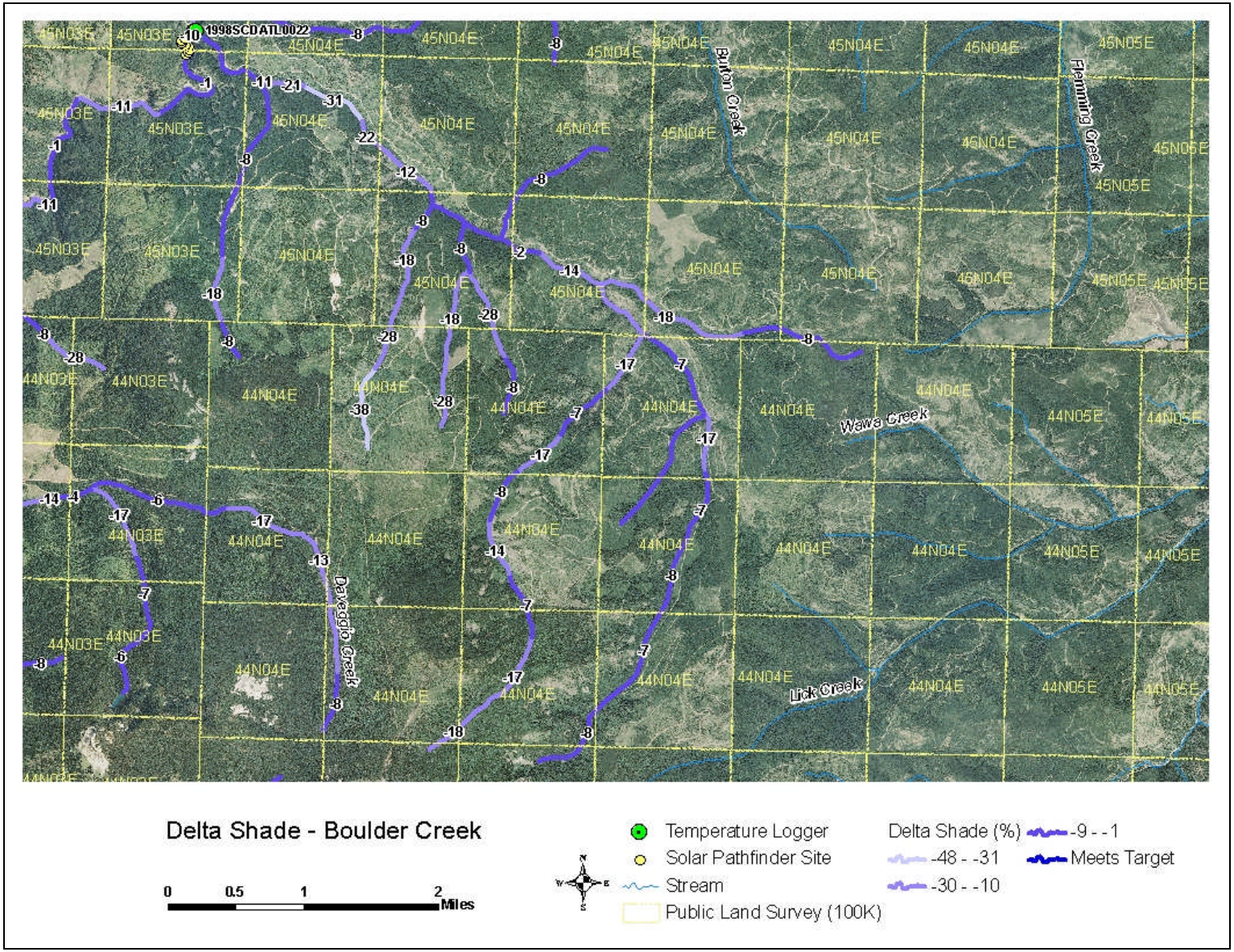


Figure G-57. Boulder Creek (AU ID17010304PN038_02/03) delta shade estimates

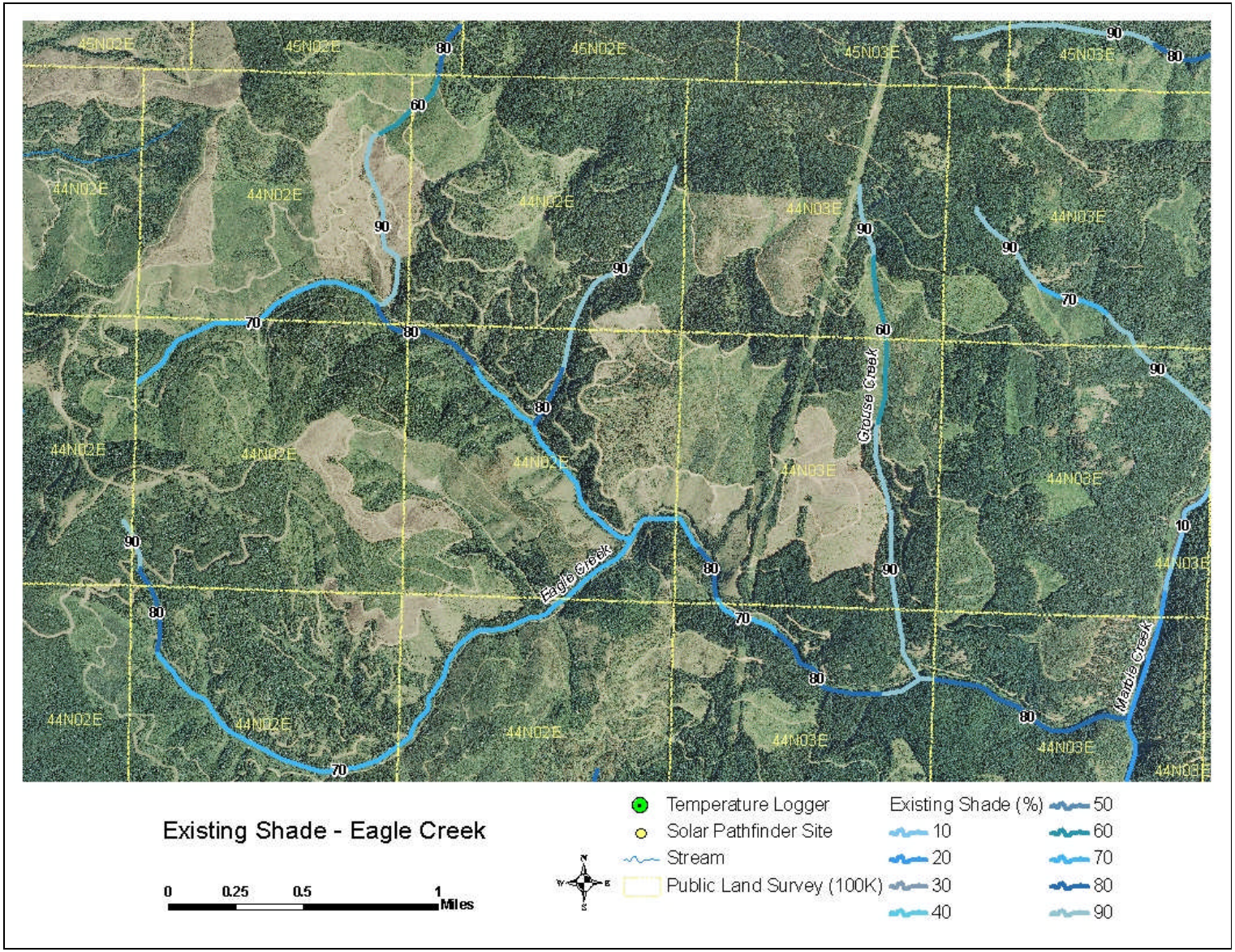


Figure G-58. Eagle Creek (AU ID17010304PN032_02) existing shade estimates

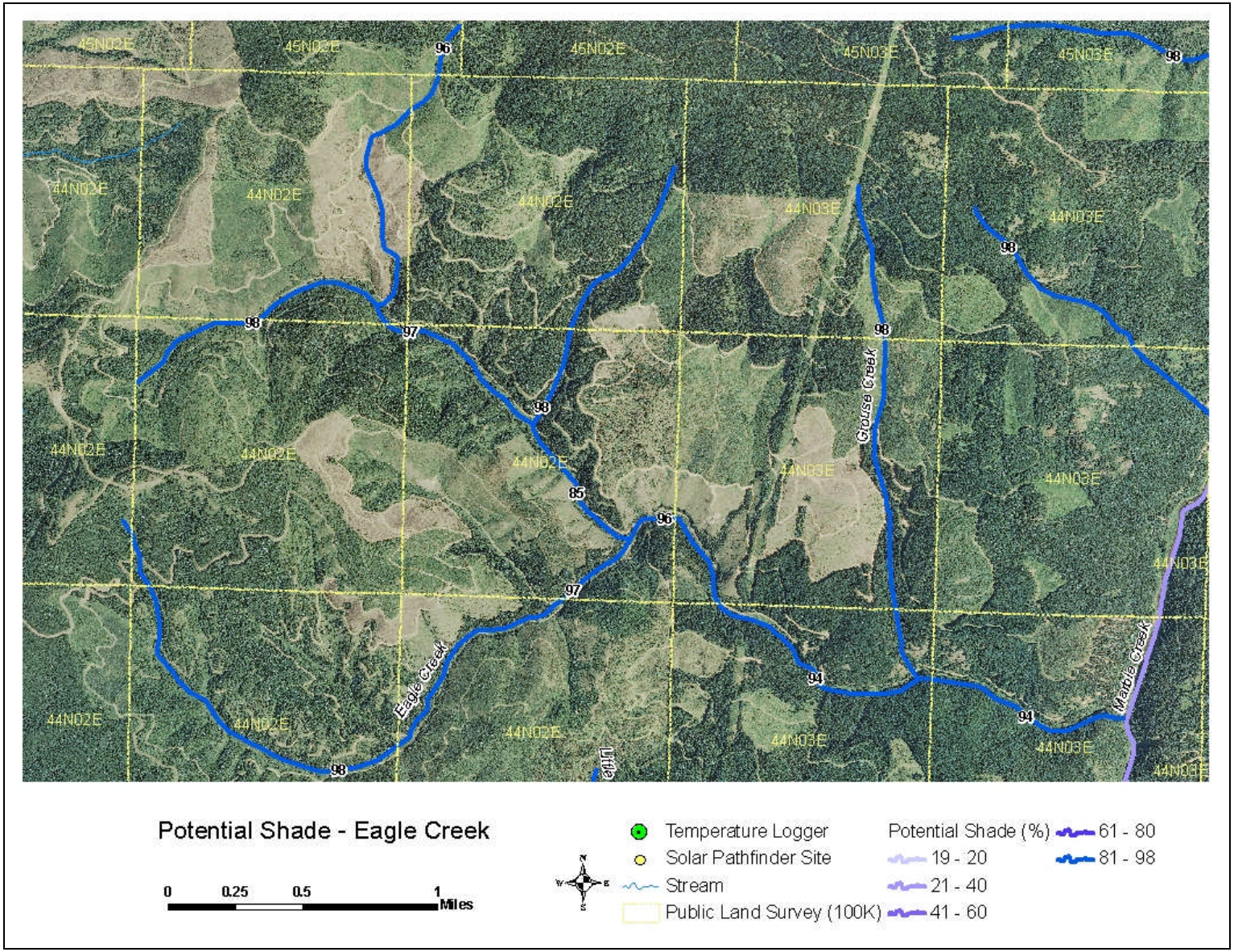


Figure G-59. Eagle Creek (AU ID17010304PN032_02) potential shade estimates

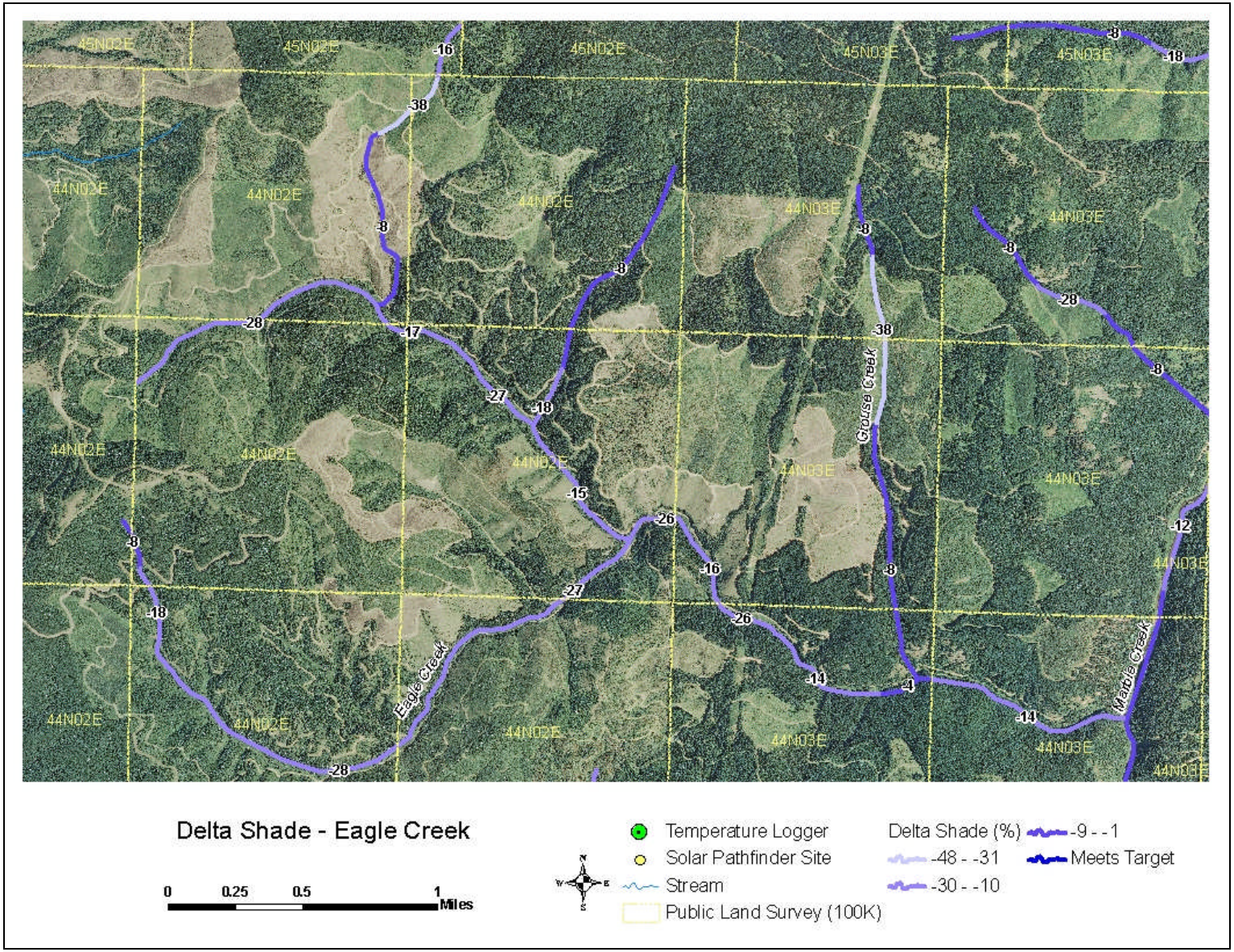


Figure G-60. Eagle Creek (AU ID17010304PN032_02) delta shade estimates

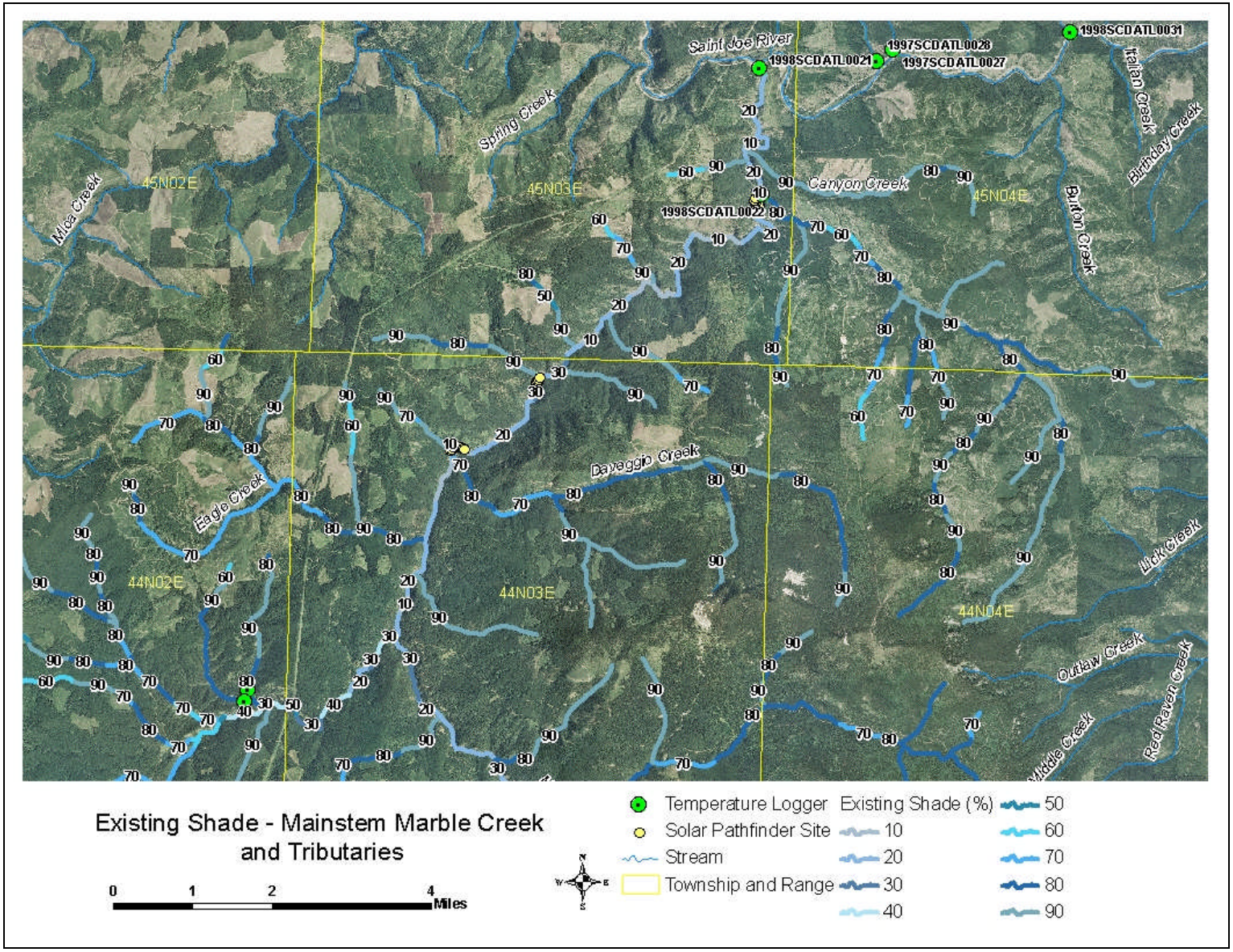


Figure G-61. Marble Creek (AU ID17010304PN031_02/03/04) existing shade estimates

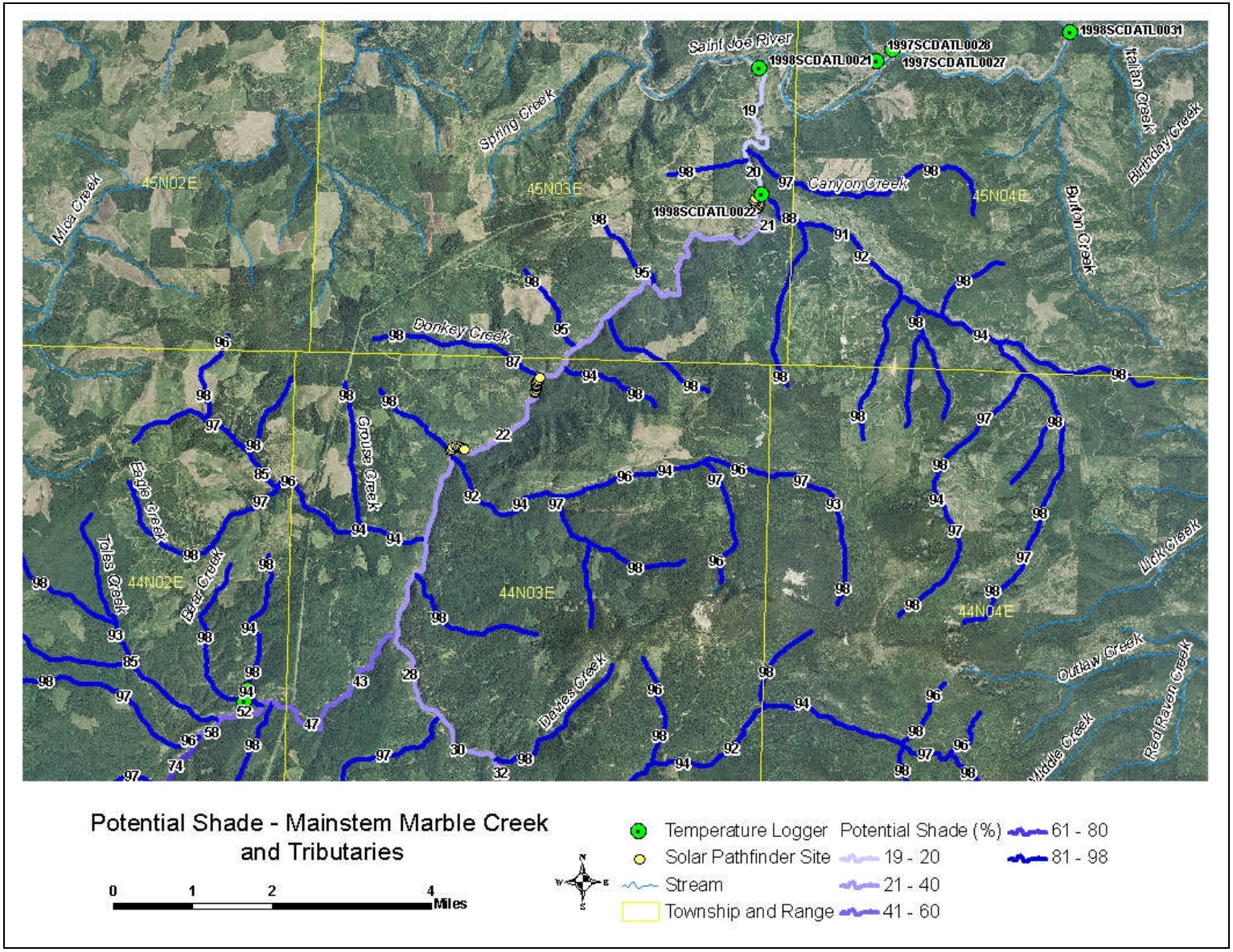


Figure G-62. Marble Creek (AU ID17010304PN031_02/03/04) potential shade estimates

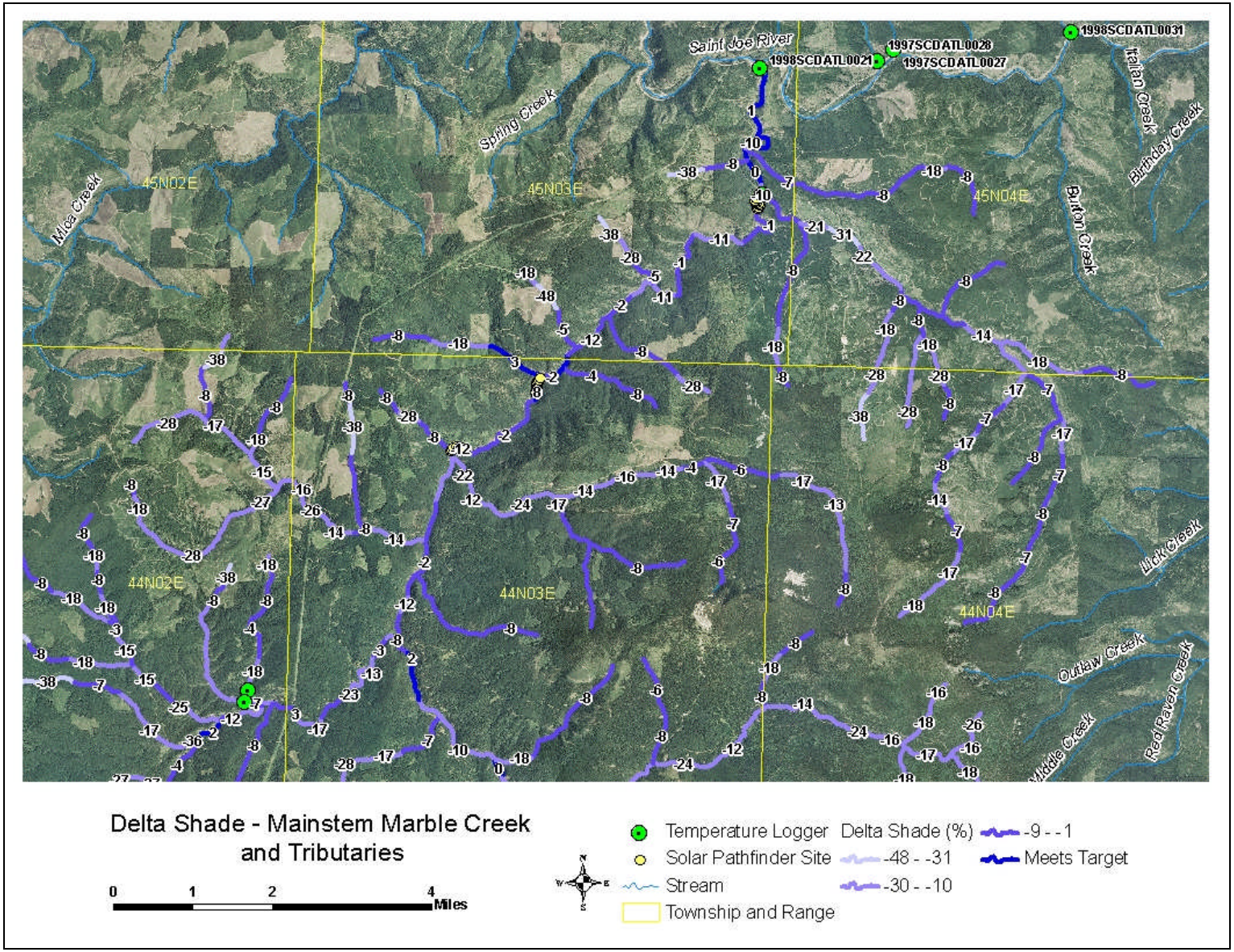


Figure G-63. Marble Creek (AU ID17010304PN031_02/03/04) delta shade estimates

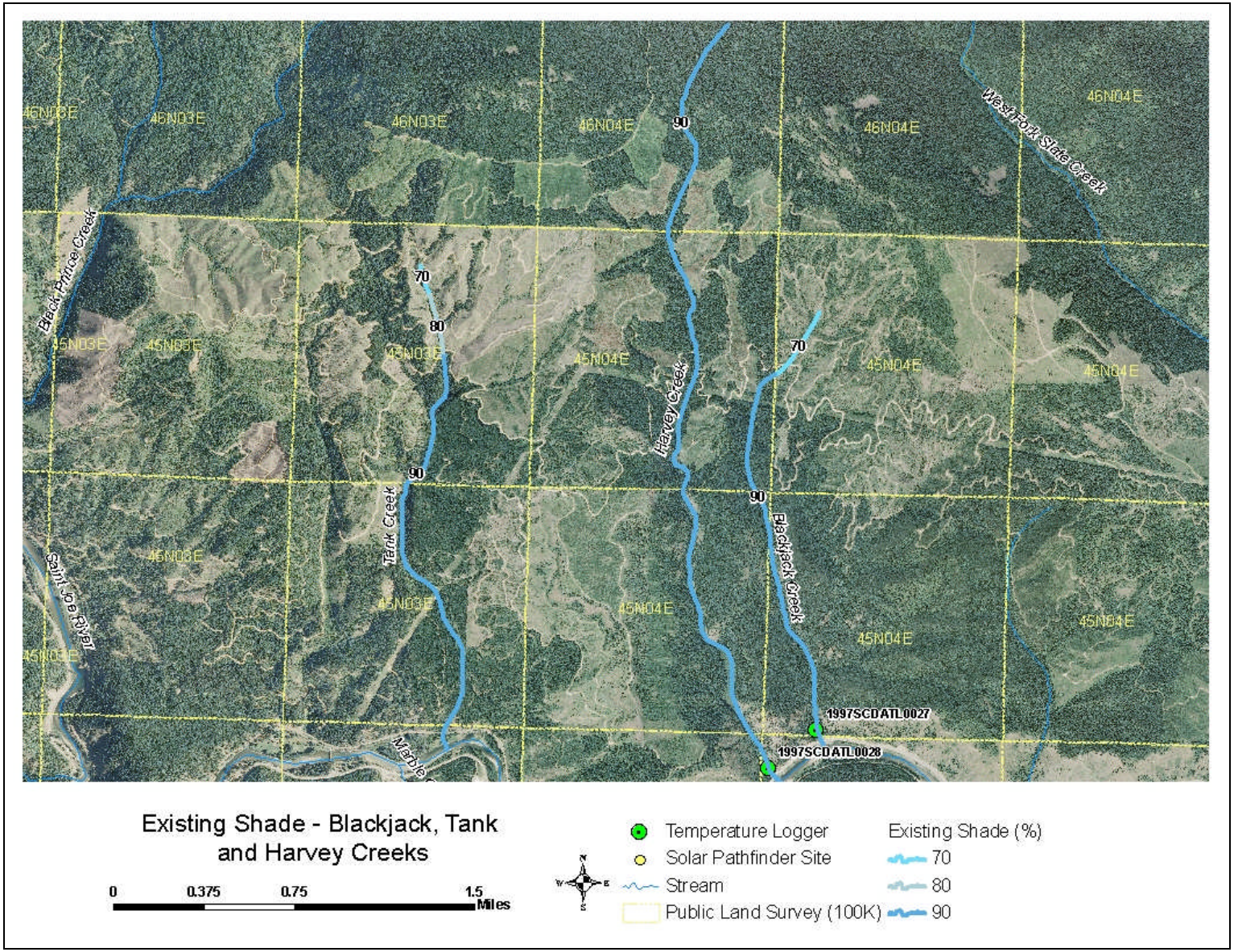


Figure G-64. Blackjack, Harvey, and Tank Creeks (AU ID17010304PN027_02) existing shade estimates

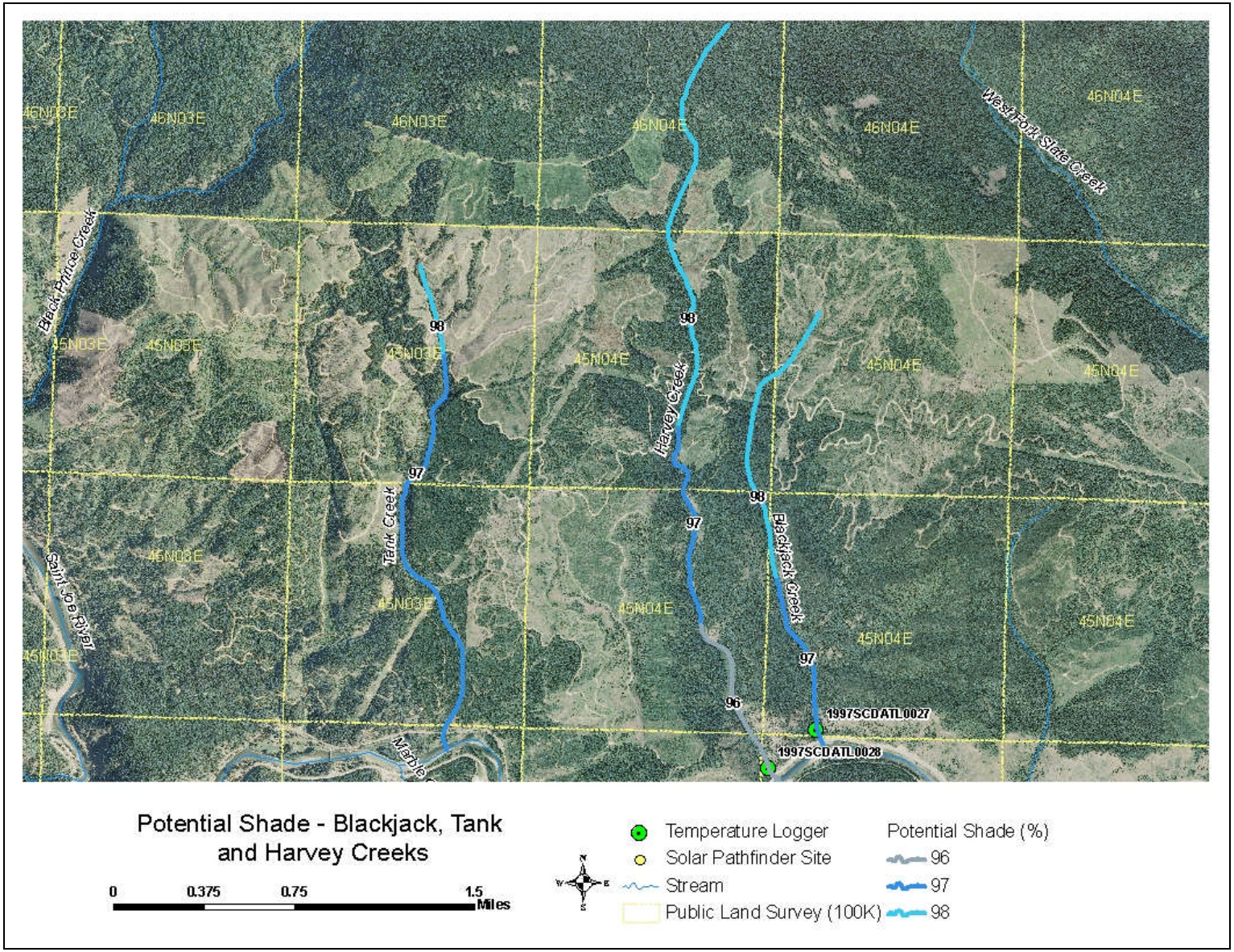


Figure G-65. Blackjack, Harvey, and Tank Creeks (AU ID17010304PN027_02) potential shade estimates

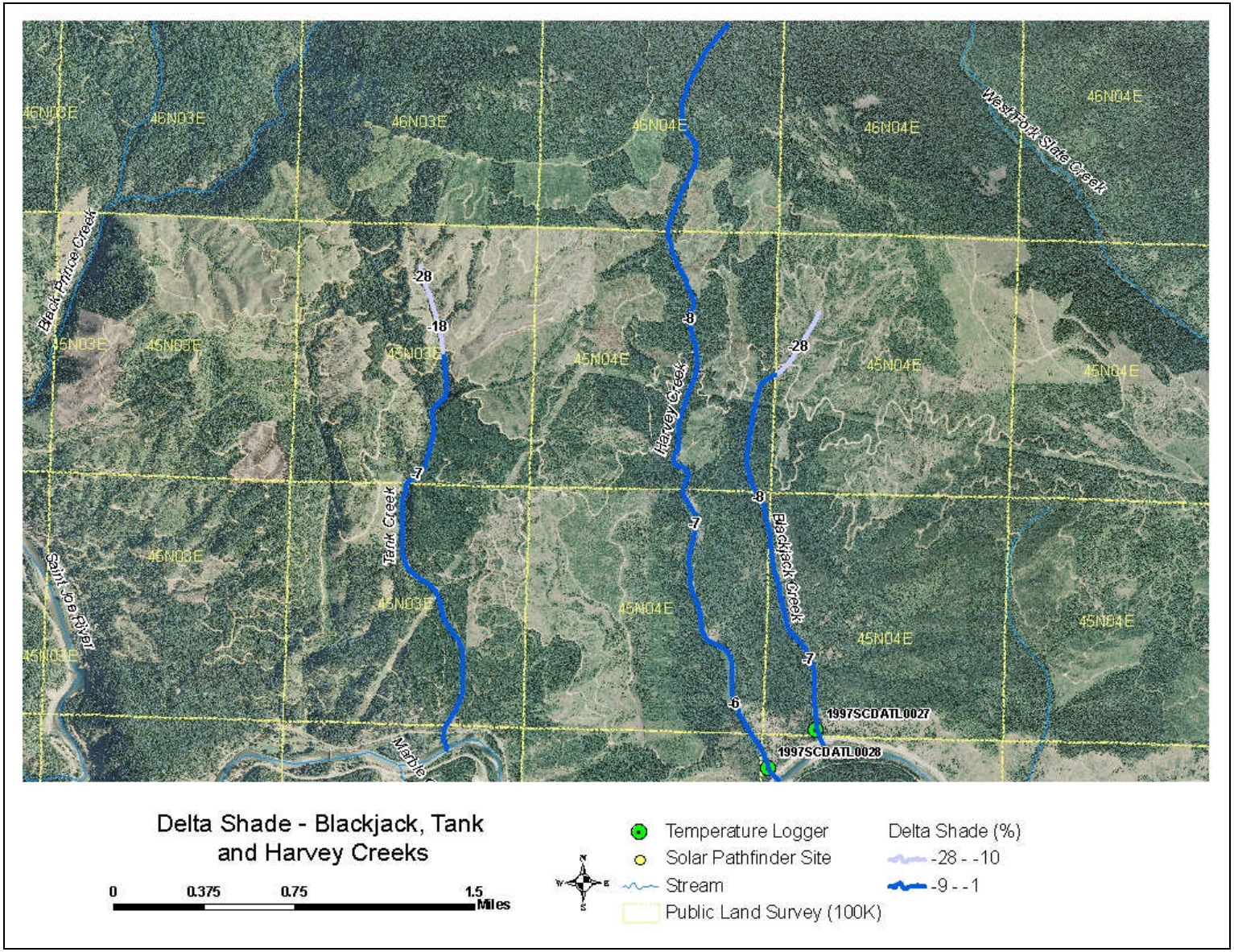


Figure G-66. Blackjack, Harvey, and Tank Creeks (AU ID17010304PN027_02) delta shade estimates

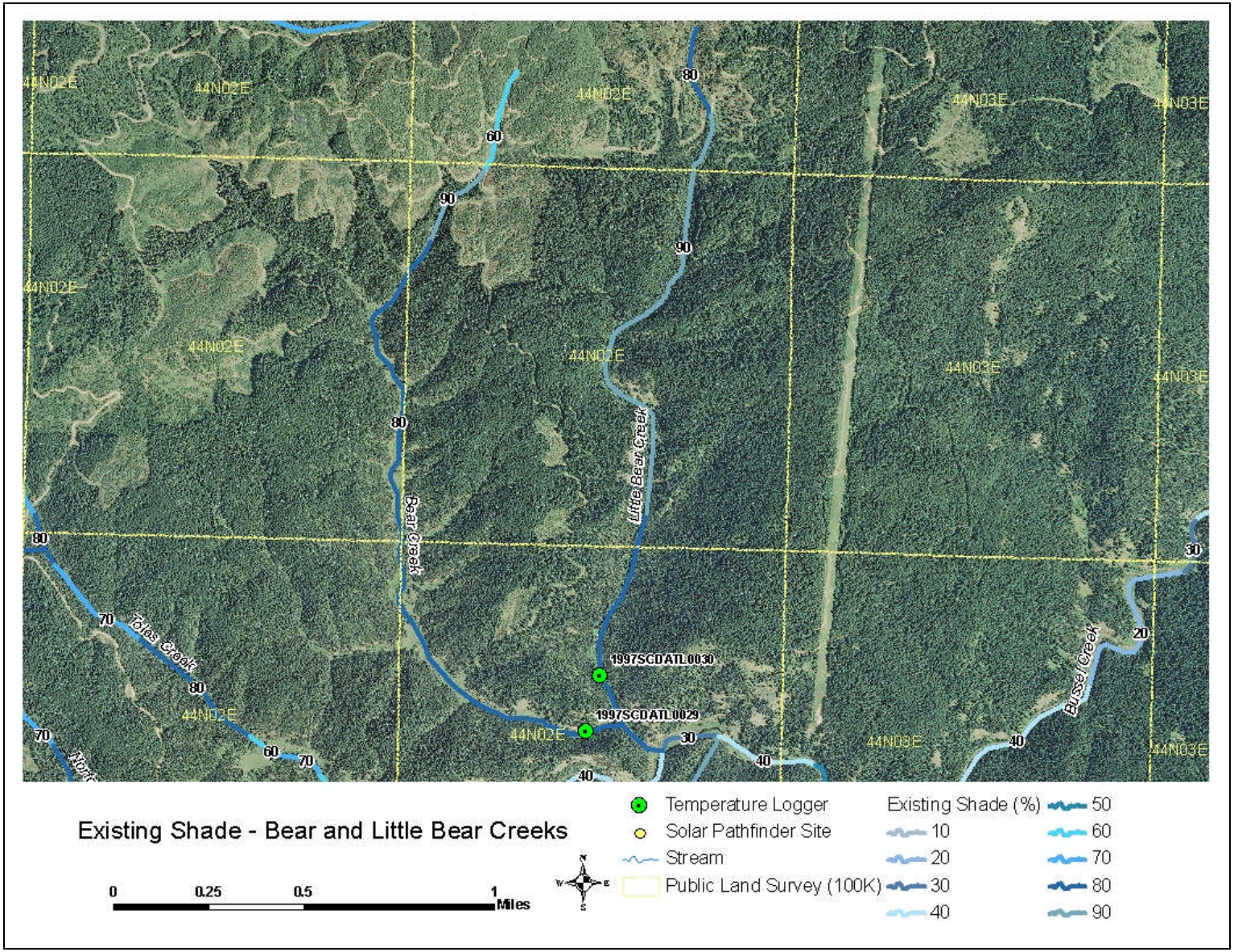


Figure G-67. Bear and Little Bear Creeks (AU ID17010304PN033_02) existing shade estimates

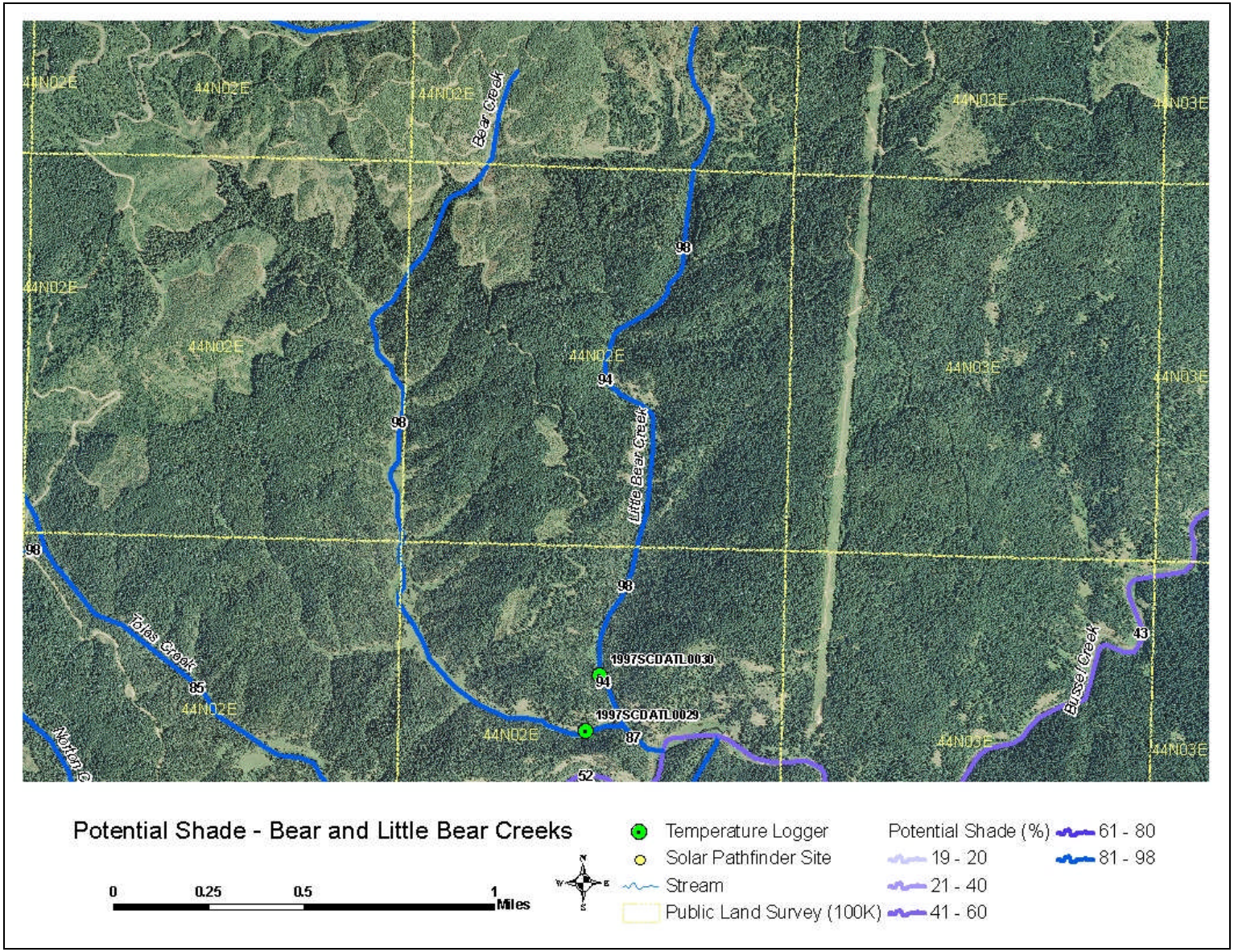


Figure G-68. Bear and Little Bear Creeks (AU ID17010304PN033_02) potential shade estimates

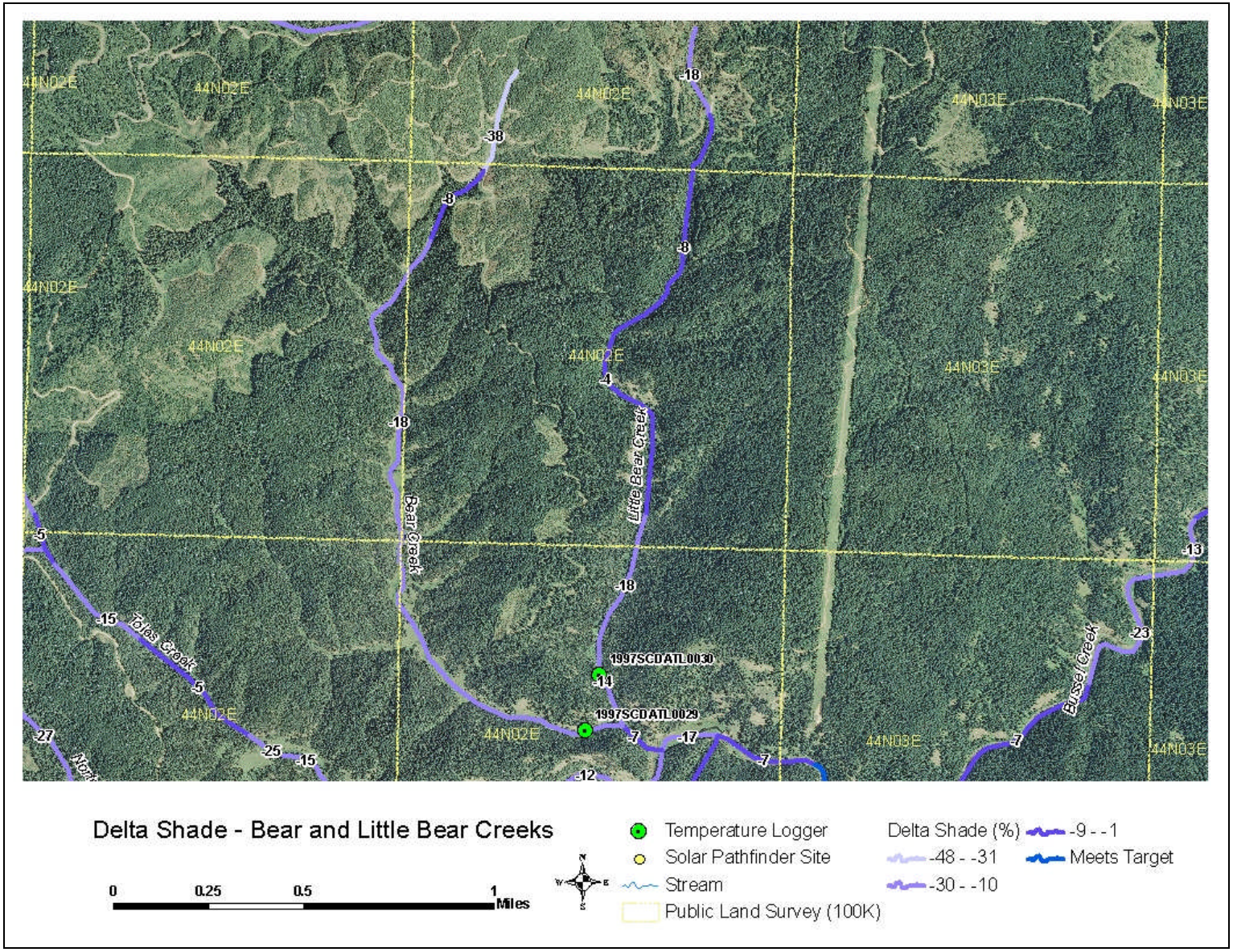


Figure G-69. Bear and Little Bear Creeks (AU ID17010304PN033_02) delta shade estimates

Vegetation Response Units (VRUs) and Stream Gradient (%) in the St. Joe River Watershed

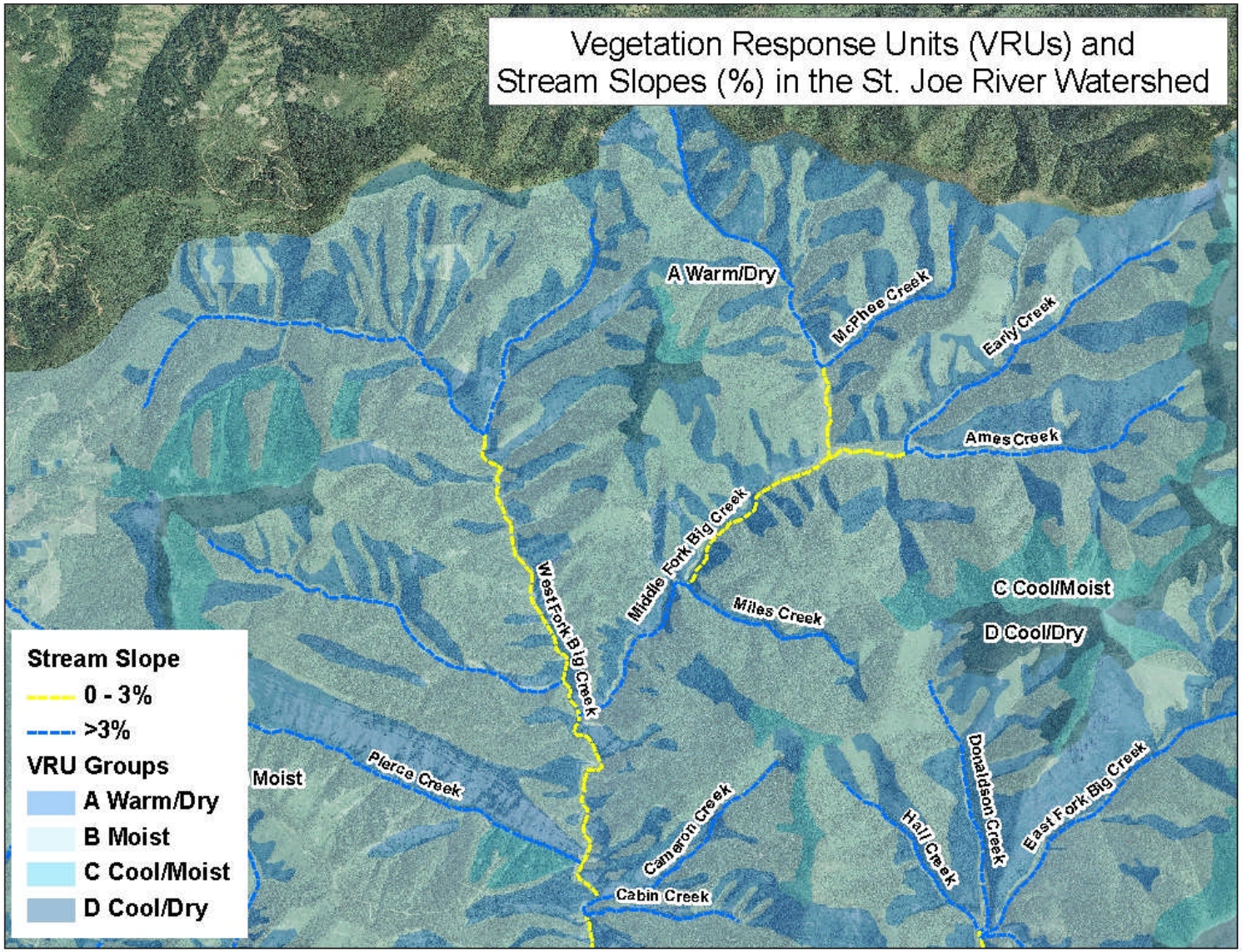


Figure G-70. Vegetation response units (VRUs) and stream gradient (%) in the St. Joe River watershed (Upper Big Creek)

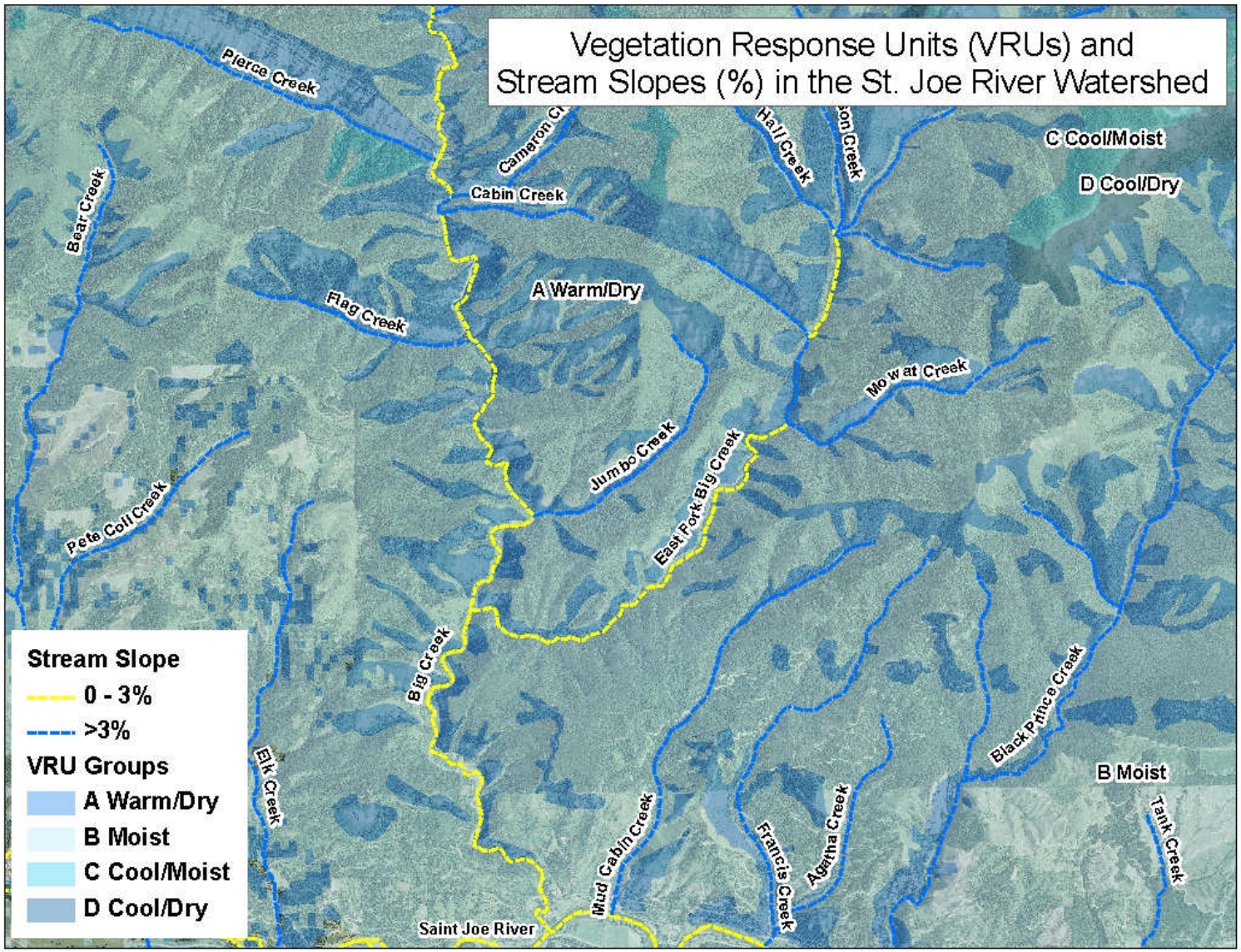


Figure G-71. Vegetation response units (VRUs) and stream gradient (%) in the St. Joe River watershed (Lower Big Creek)

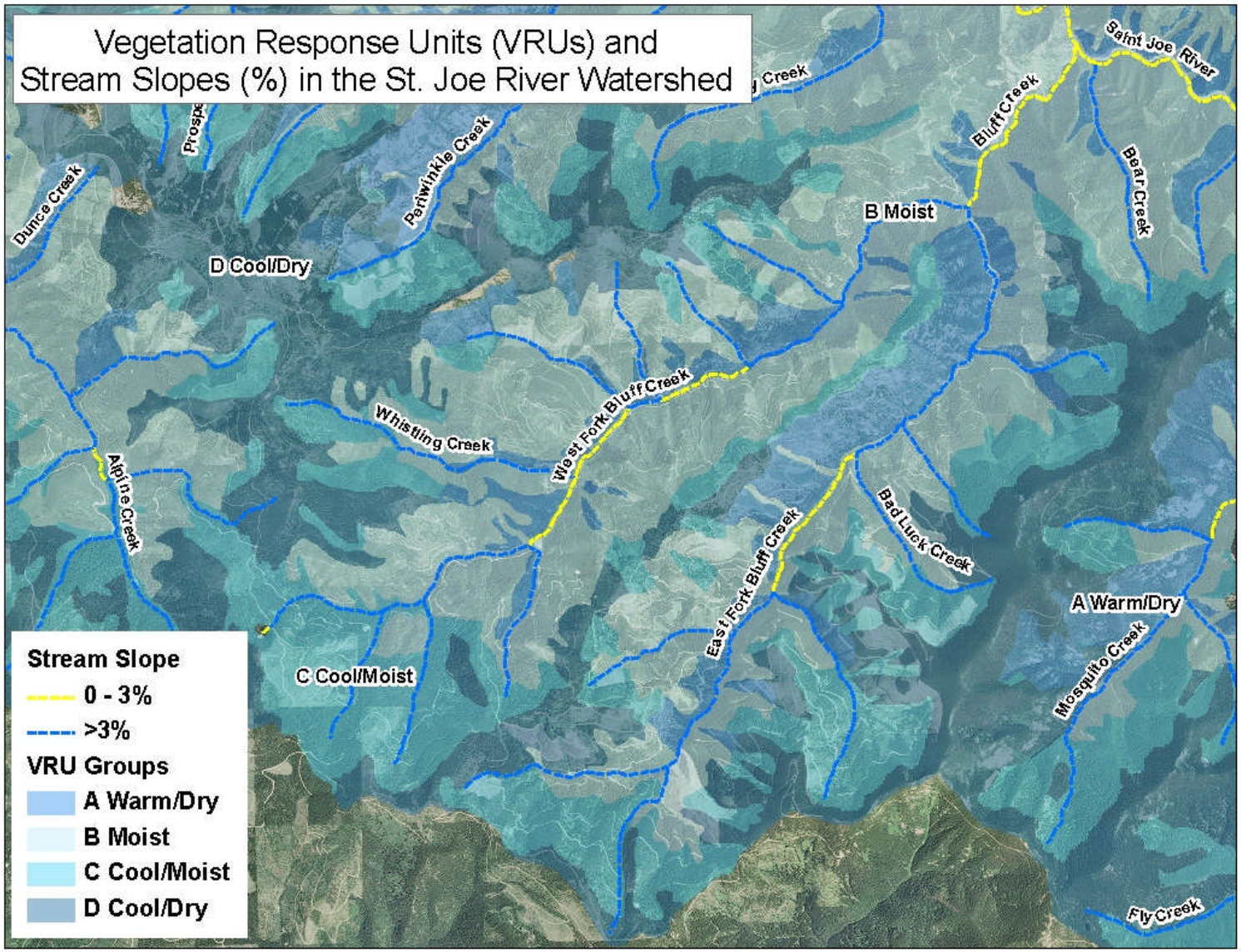


Figure G-72. Vegetation response units (VRUs) and stream gradient (%) in the St. Joe River watershed (Bluff Creek)

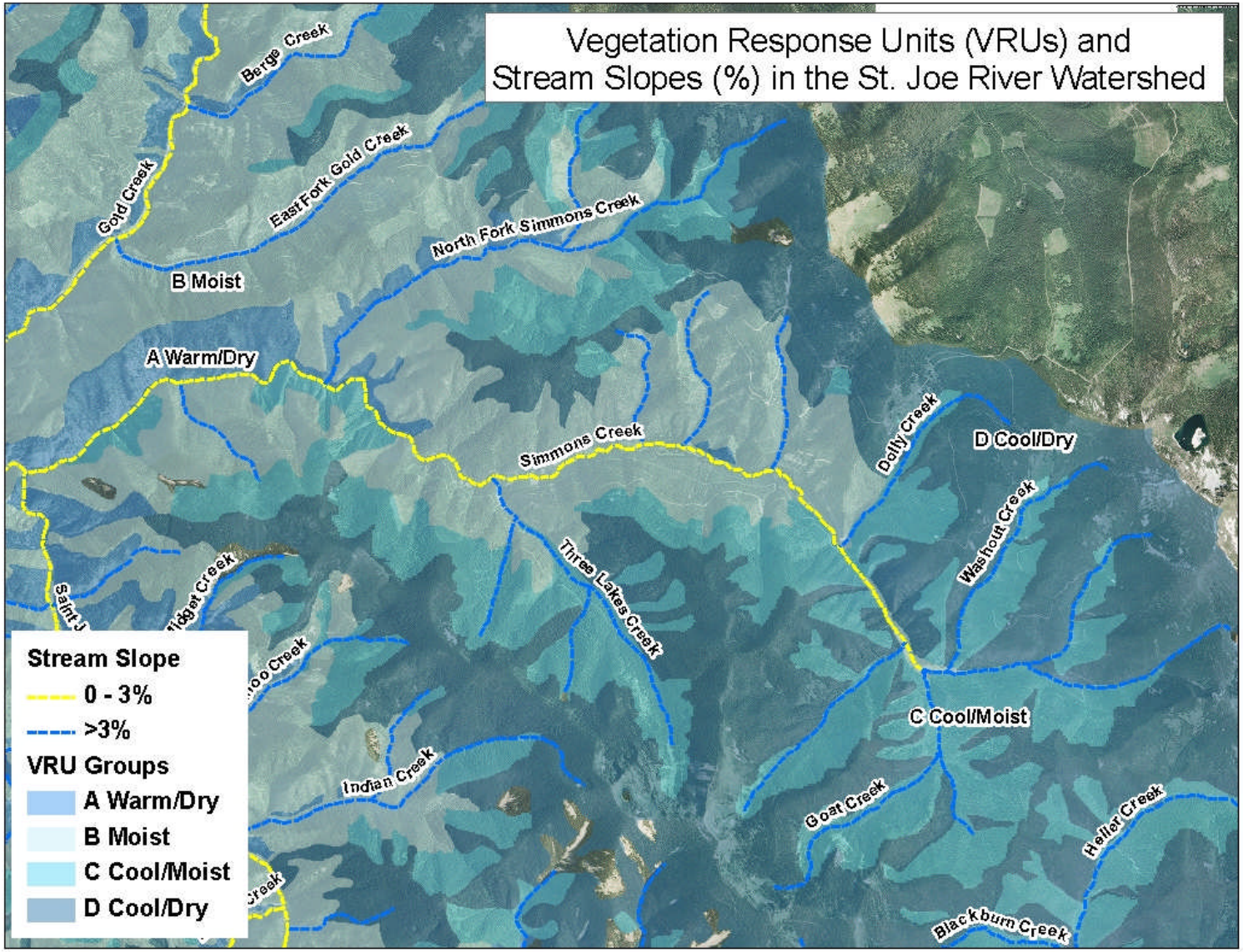


Figure G-73. Vegetation response units (VRUs) and stream gradient (%) in the St. Joe River watershed (Simmons Creek)

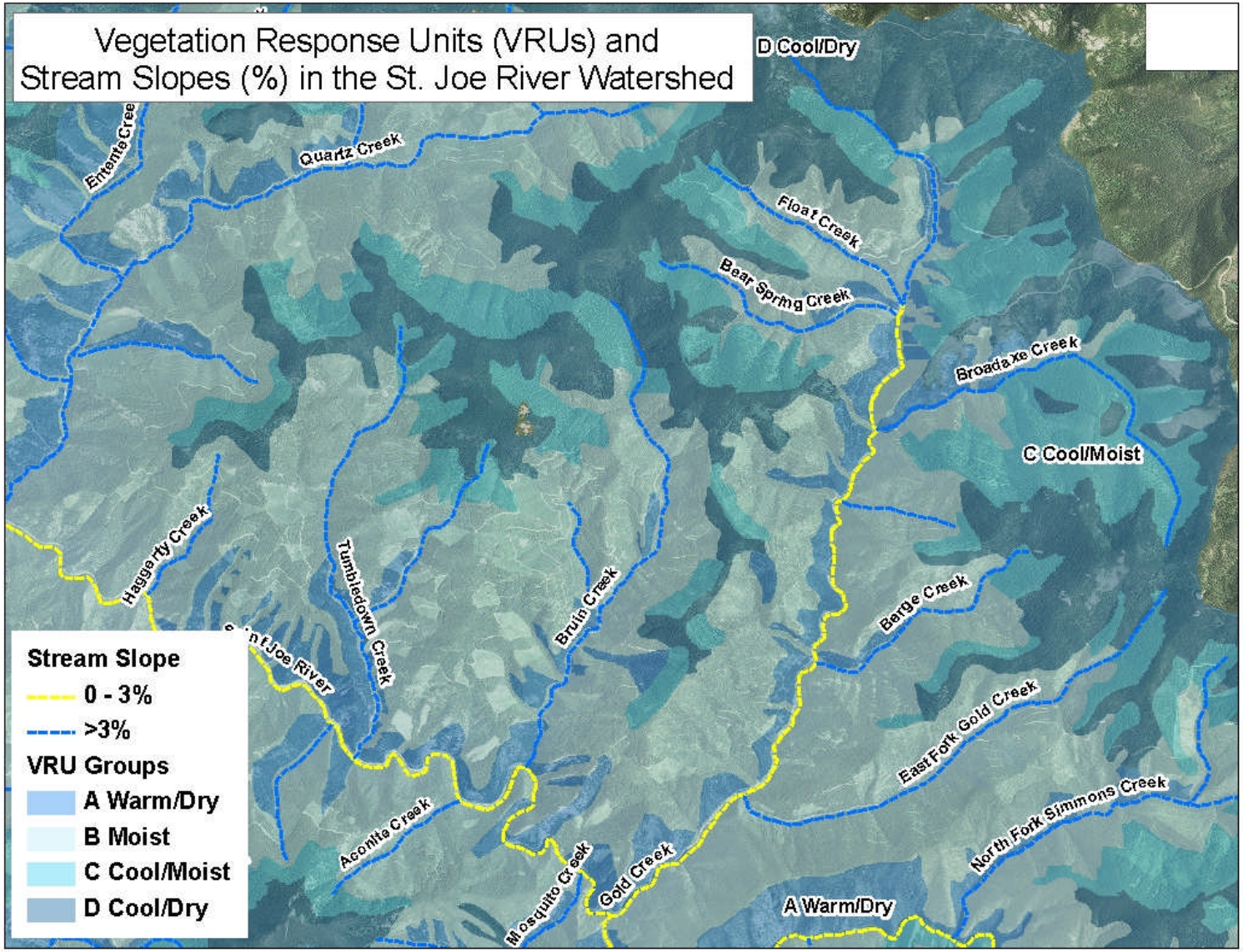


Figure G-74. Vegetation response units (VRUs) and stream gradient (%) in the St. Joe River watershed (Gold Creek)

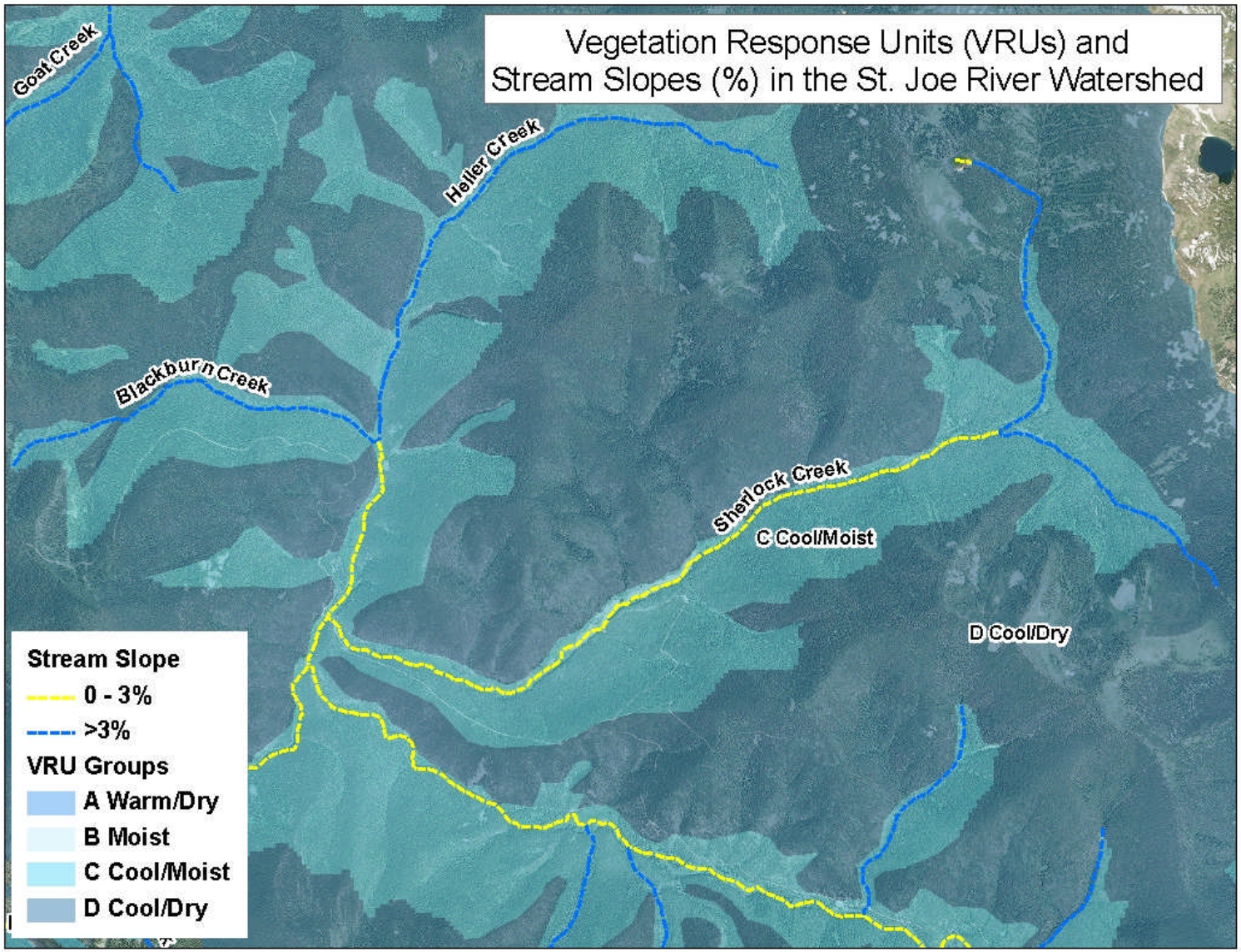


Figure G-75. Vegetation response units (VRUs) and stream gradient (%) in the St. Joe River watershed (Heller/Sherlock Creek)

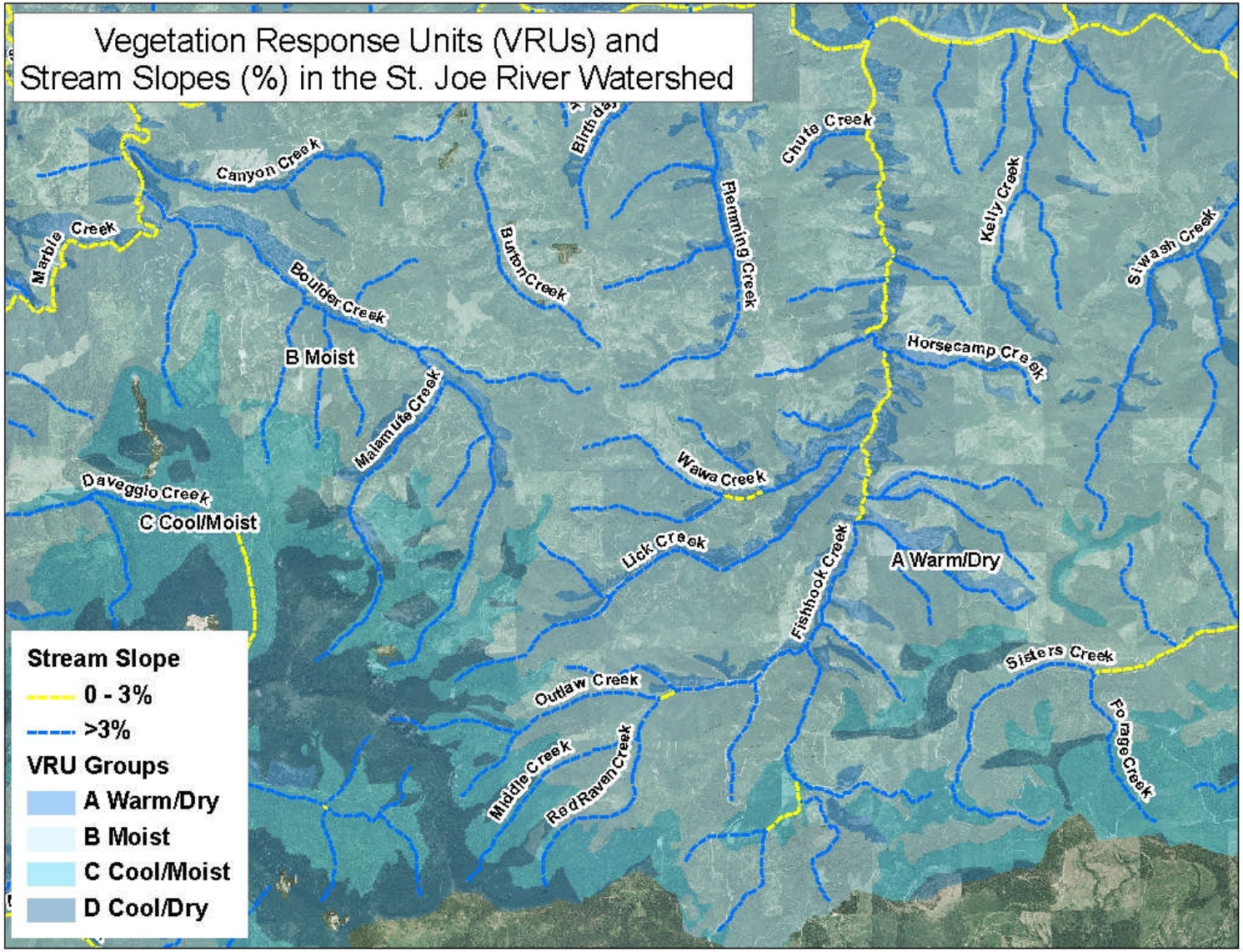


Figure G-76. Vegetation response units (VRUs) and stream gradient (%) in the St. Joe River watershed (Fishhook Creek)

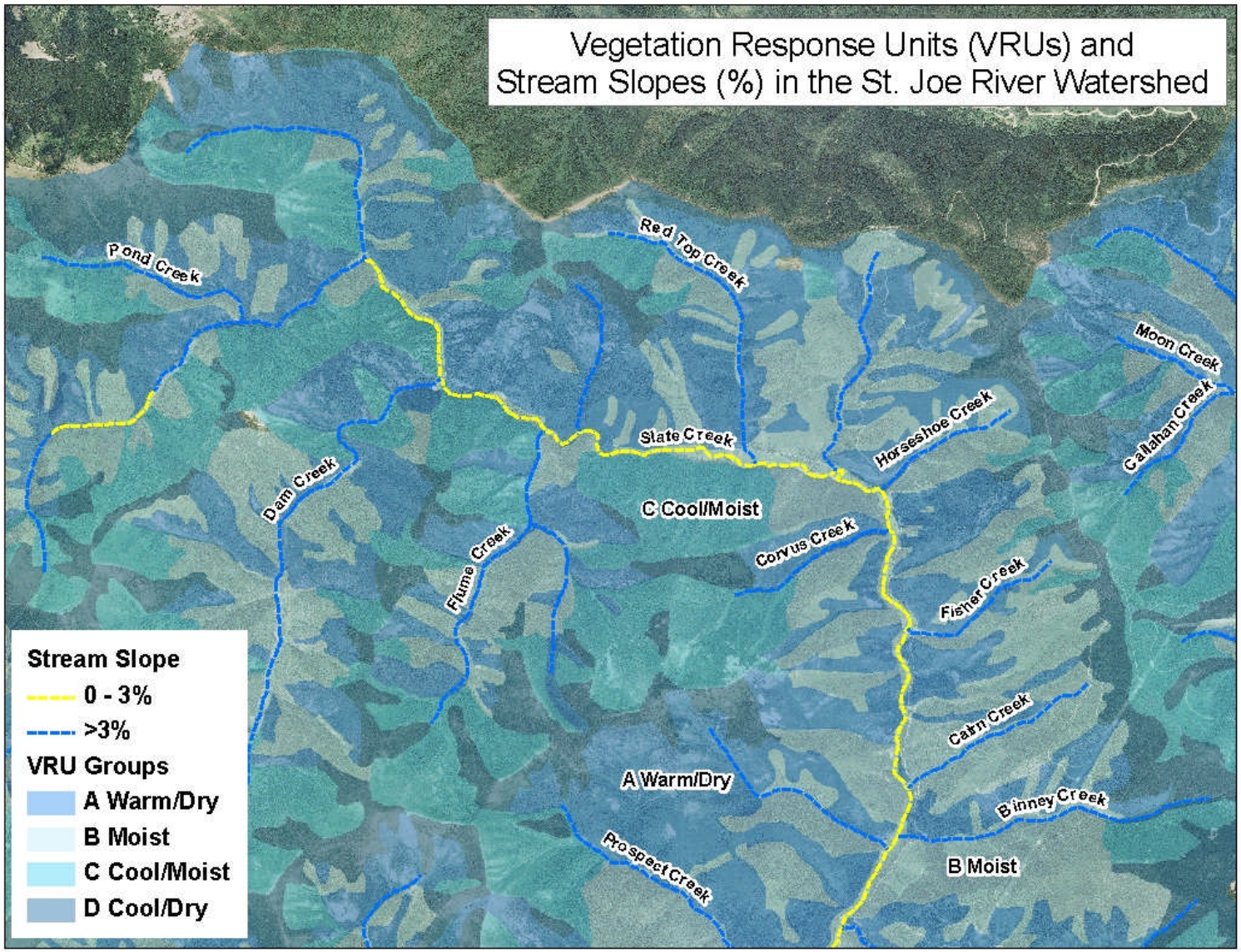


Figure G-77. Vegetation response units (VRUs) and stream gradient (%) in the St. Joe River watershed (Upper Slate Creek)

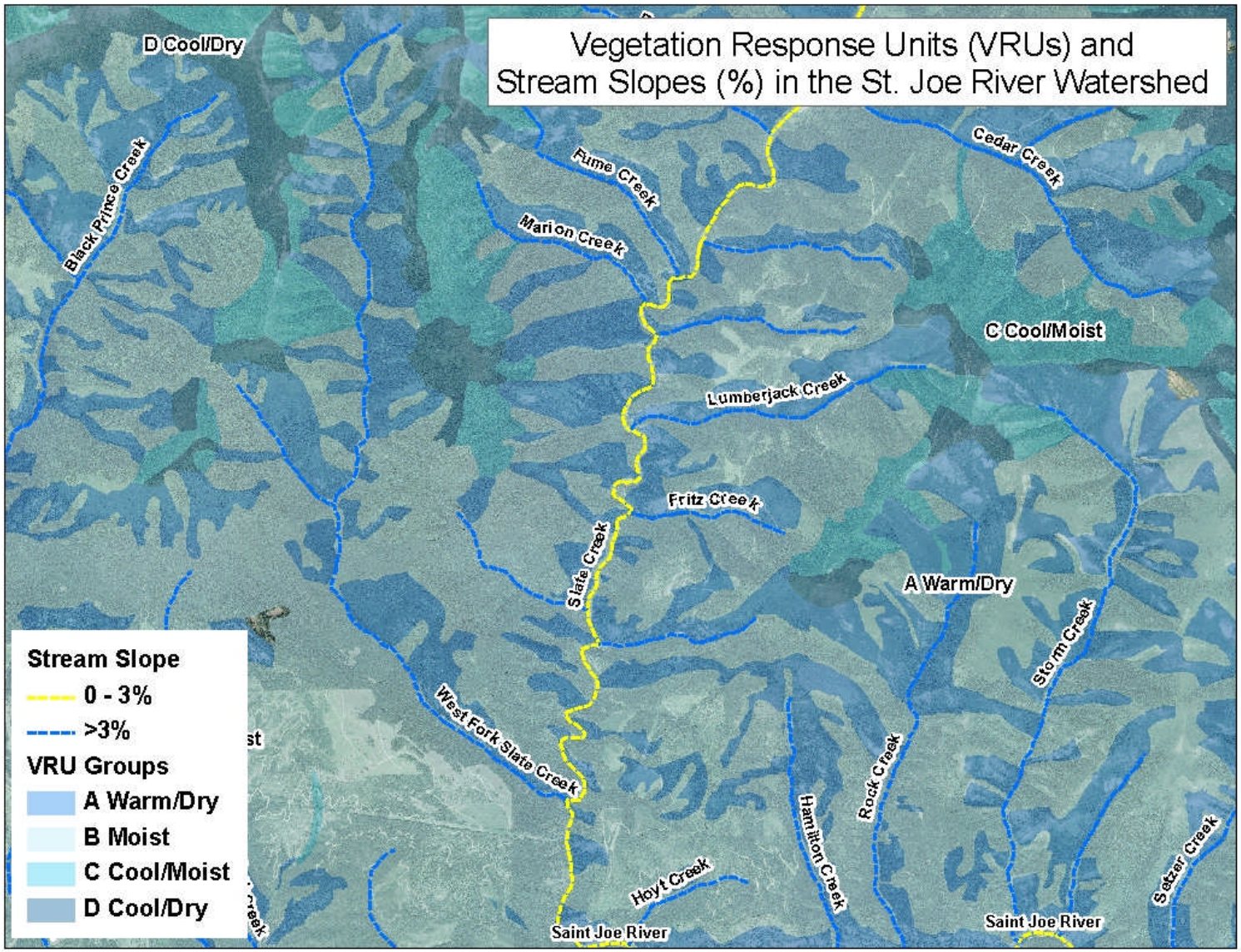


Figure G-78. Vegetation response units (VRUs) and stream gradient (%) in the St. Joe River watershed (Lower Slate Creek)

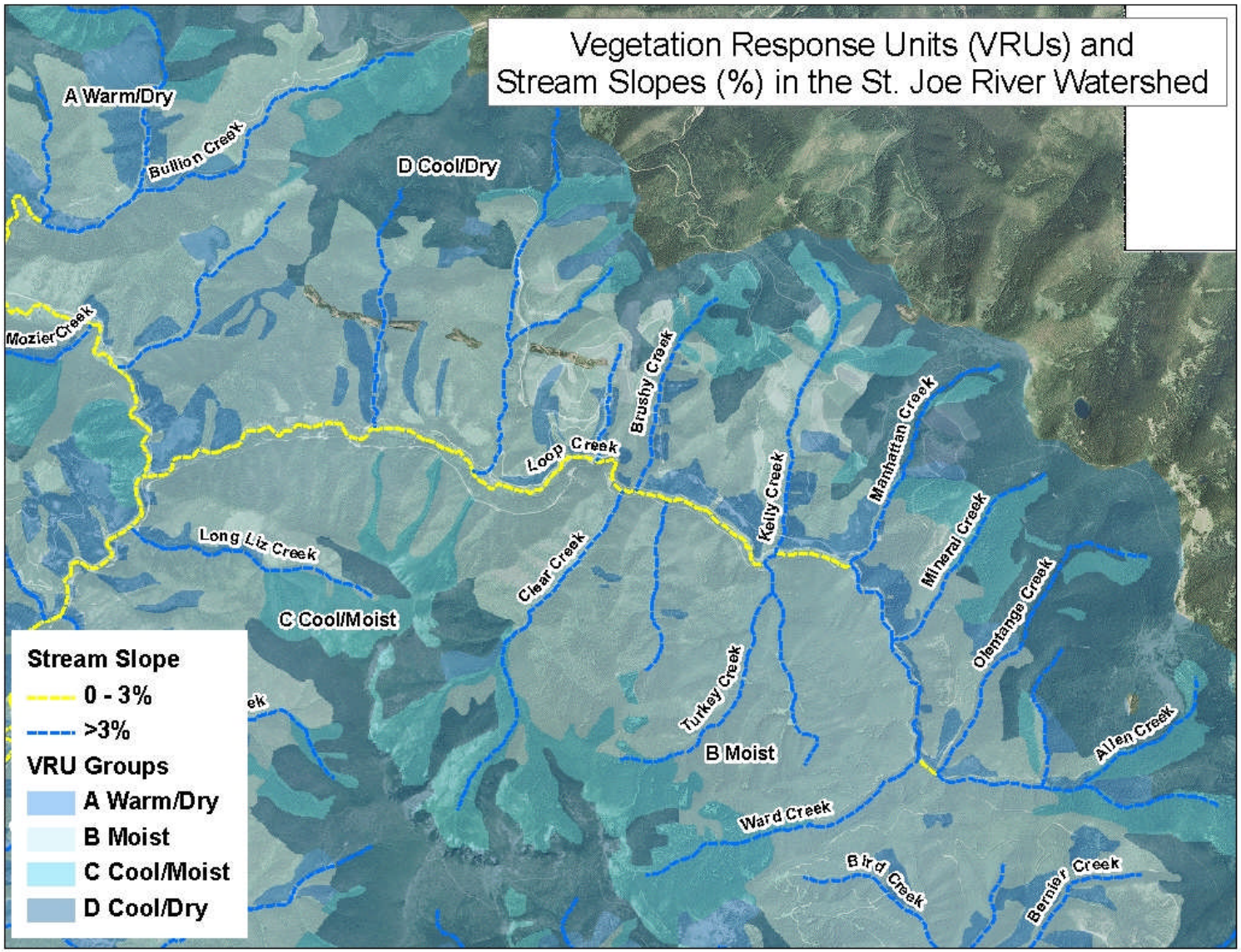


Figure G-79. Vegetation response units (VRUs) and stream gradient (%) in the St. Joe River watershed (Loop Creek)

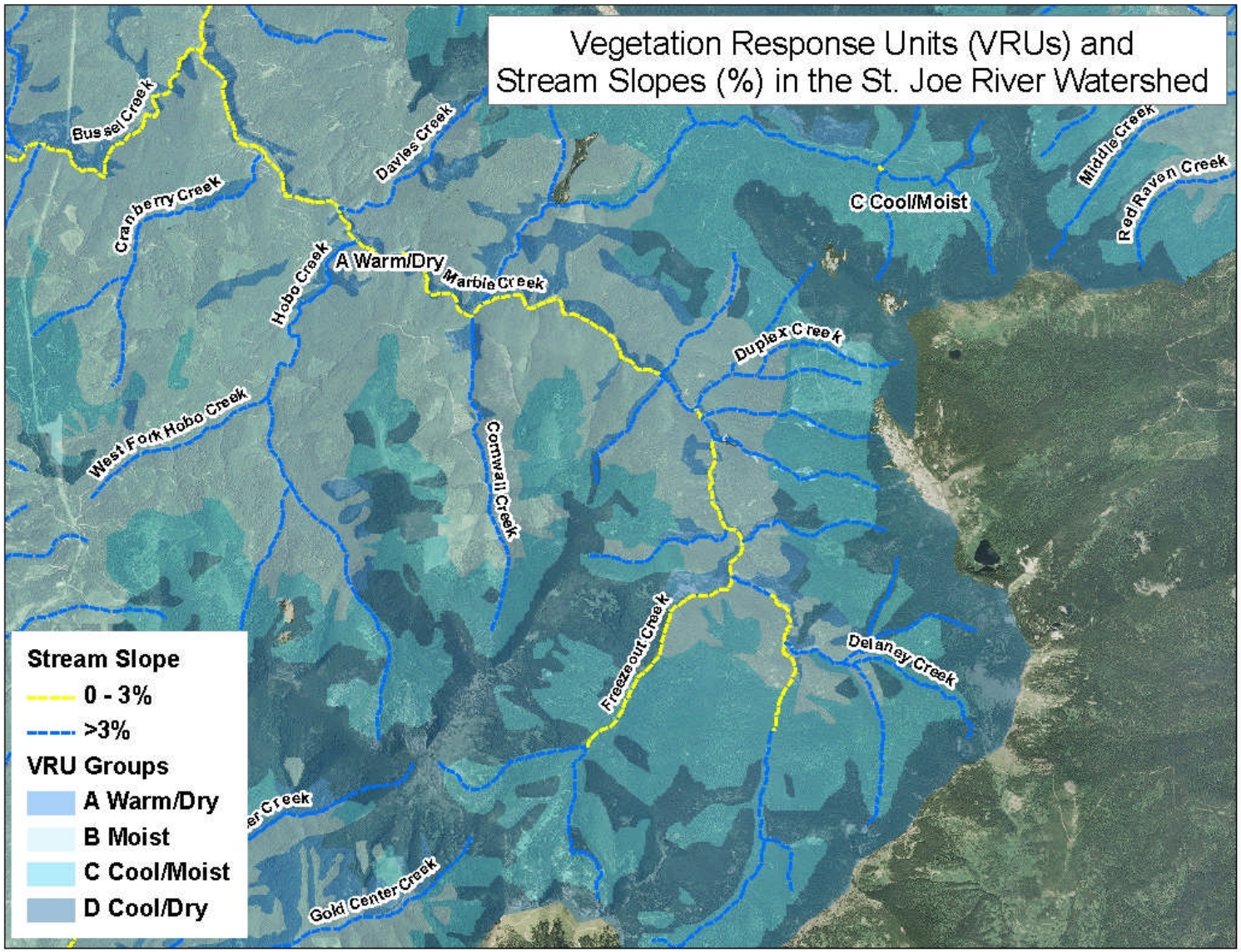


Figure G-80. Vegetation response units (VRUs) and stream gradient (%) in the St. Joe River watershed (Upper Marble Creek)

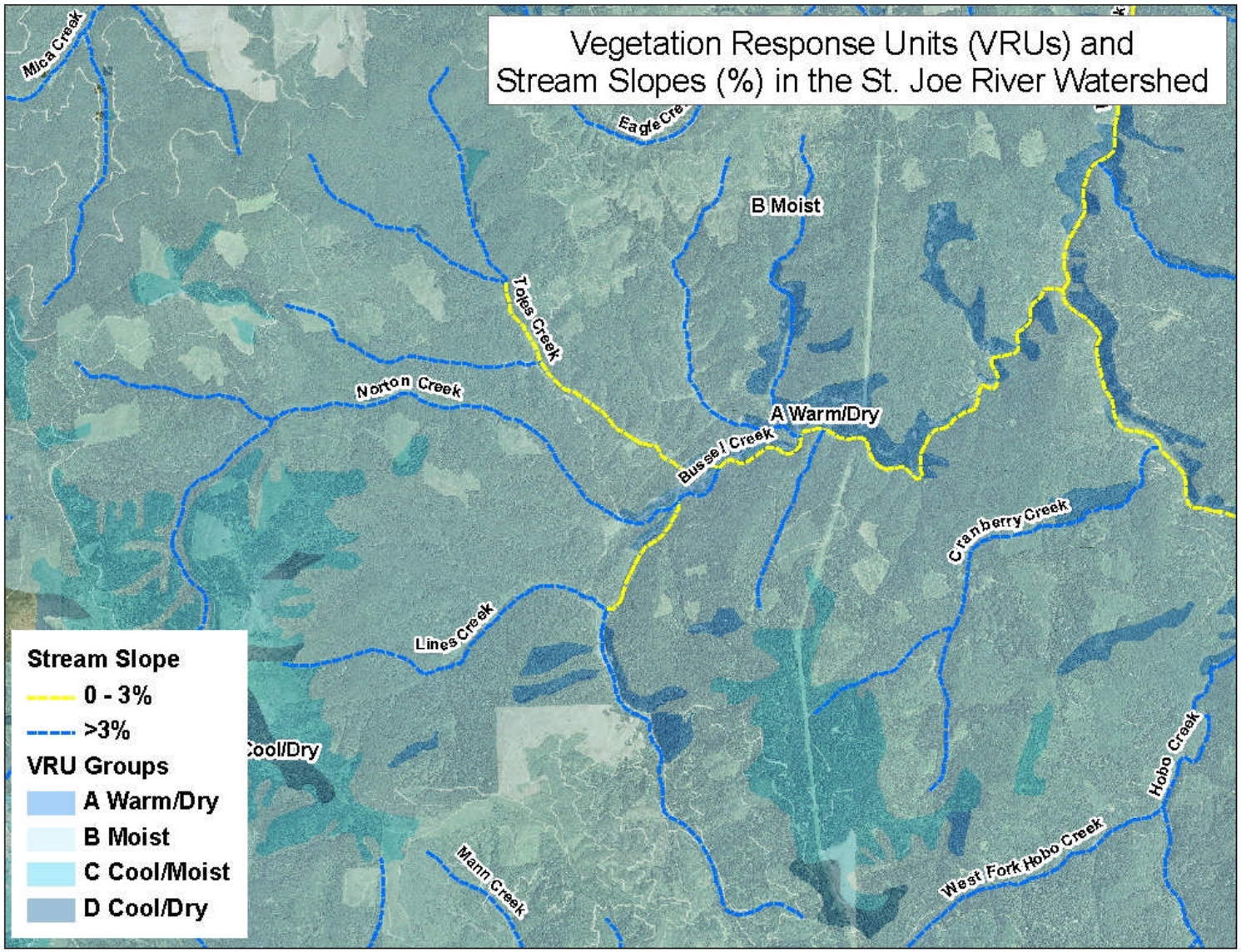


Figure G-81. Vegetation response units (VRUs) and stream gradient (%) in the St. Joe River watershed (Bussel Creek)

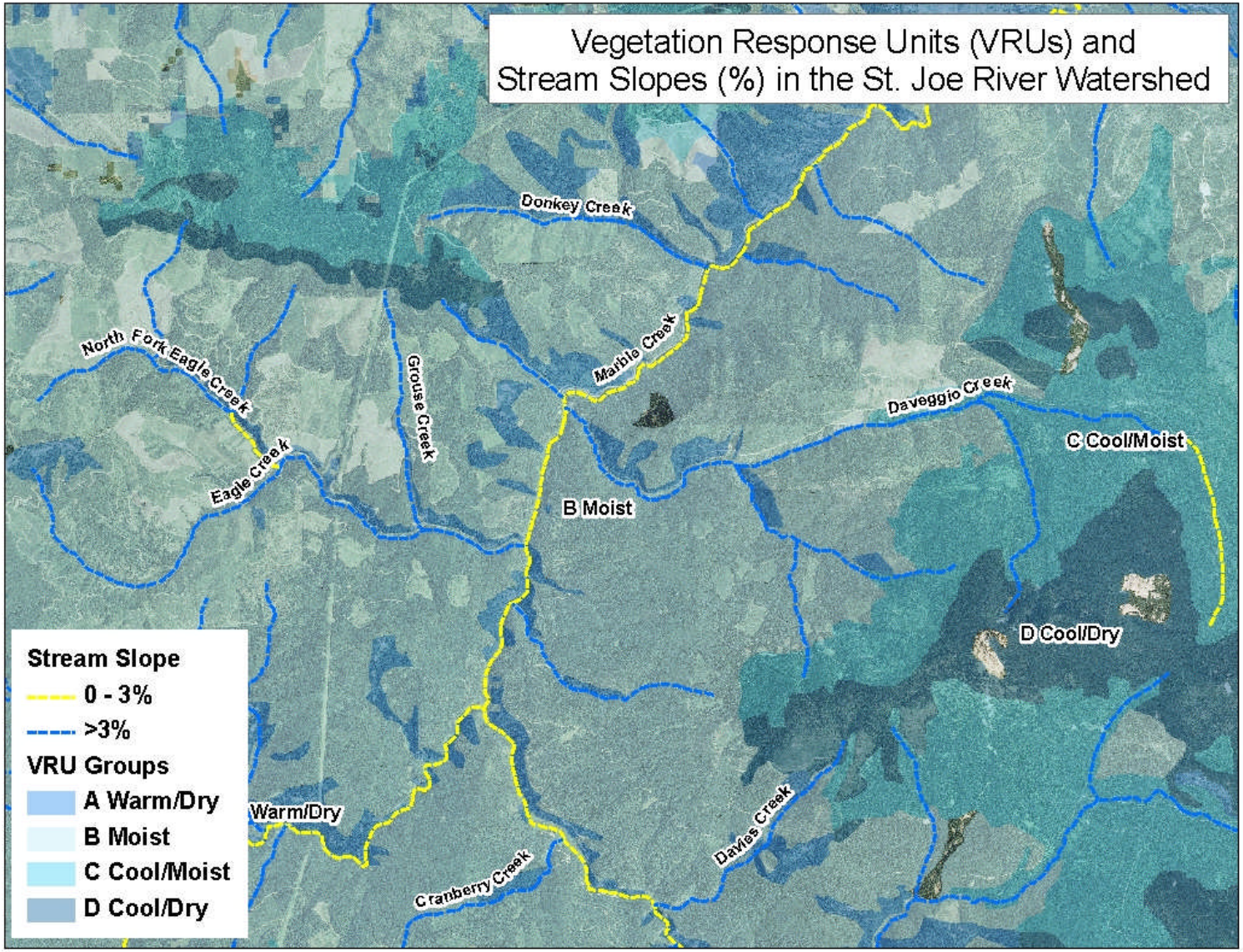


Figure G-82. Vegetation response units (VRUs) and stream gradient (%) in the St. Joe River watershed (Eagle/Daveggio Creek)

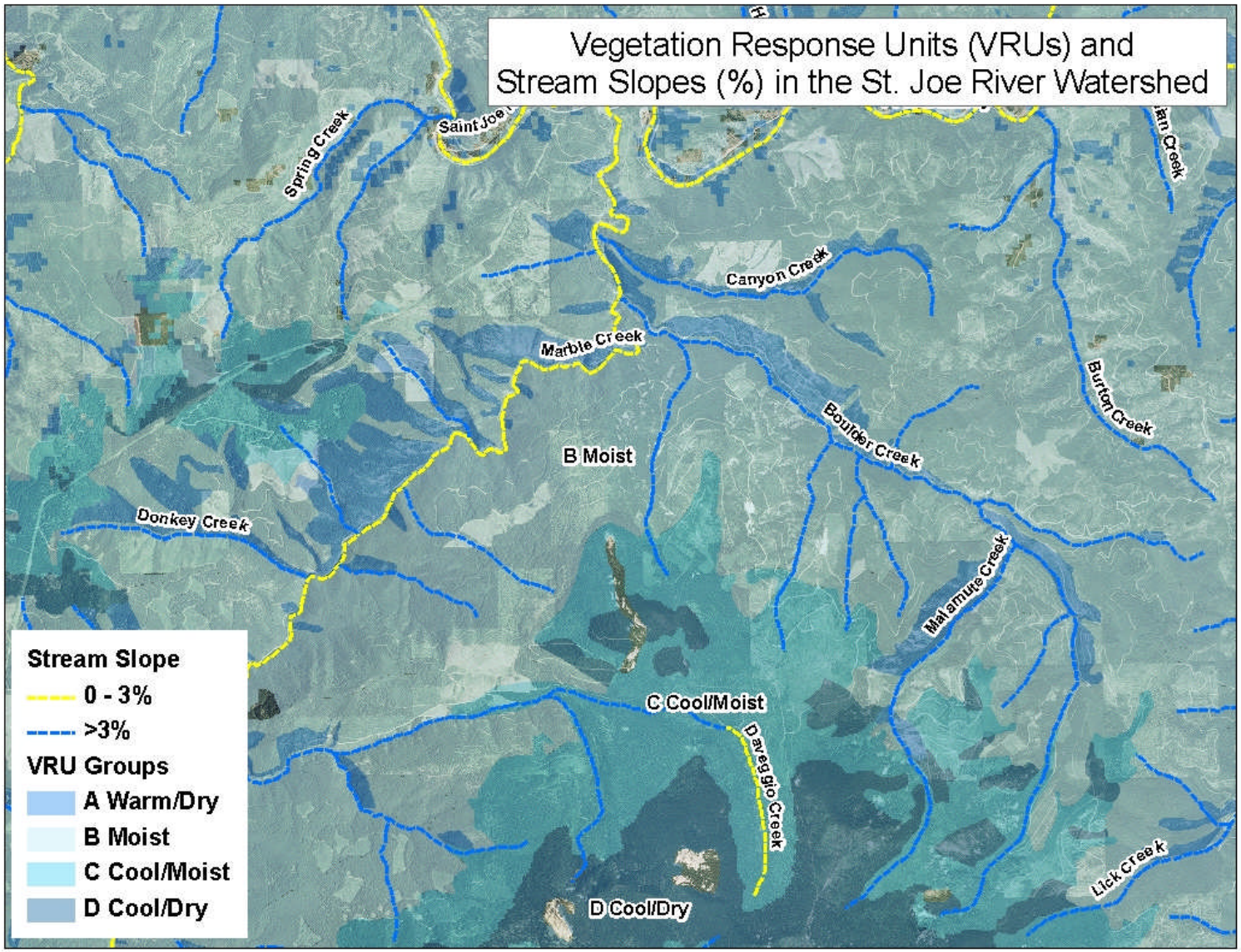


Figure G-83. Vegetation response units (VRUs) and stream gradient (%) in the St. Joe River Watershed (Mable/Boulder Creek)

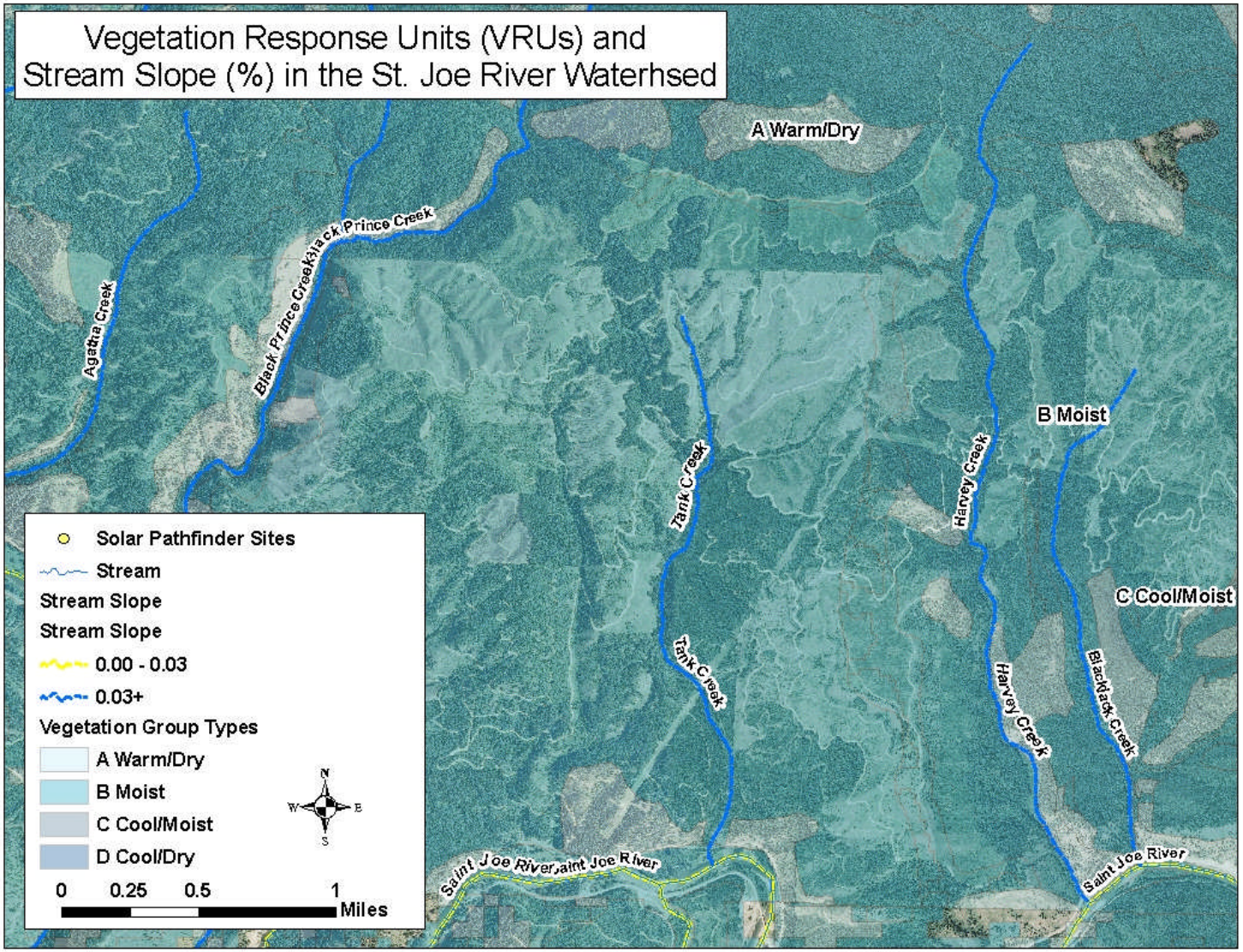


Figure G-84. Vegetation response units (VRUs) and stream gradient (%) in the St. Joe River watershed (Blackjack, Harvey, and Tank Creeks)

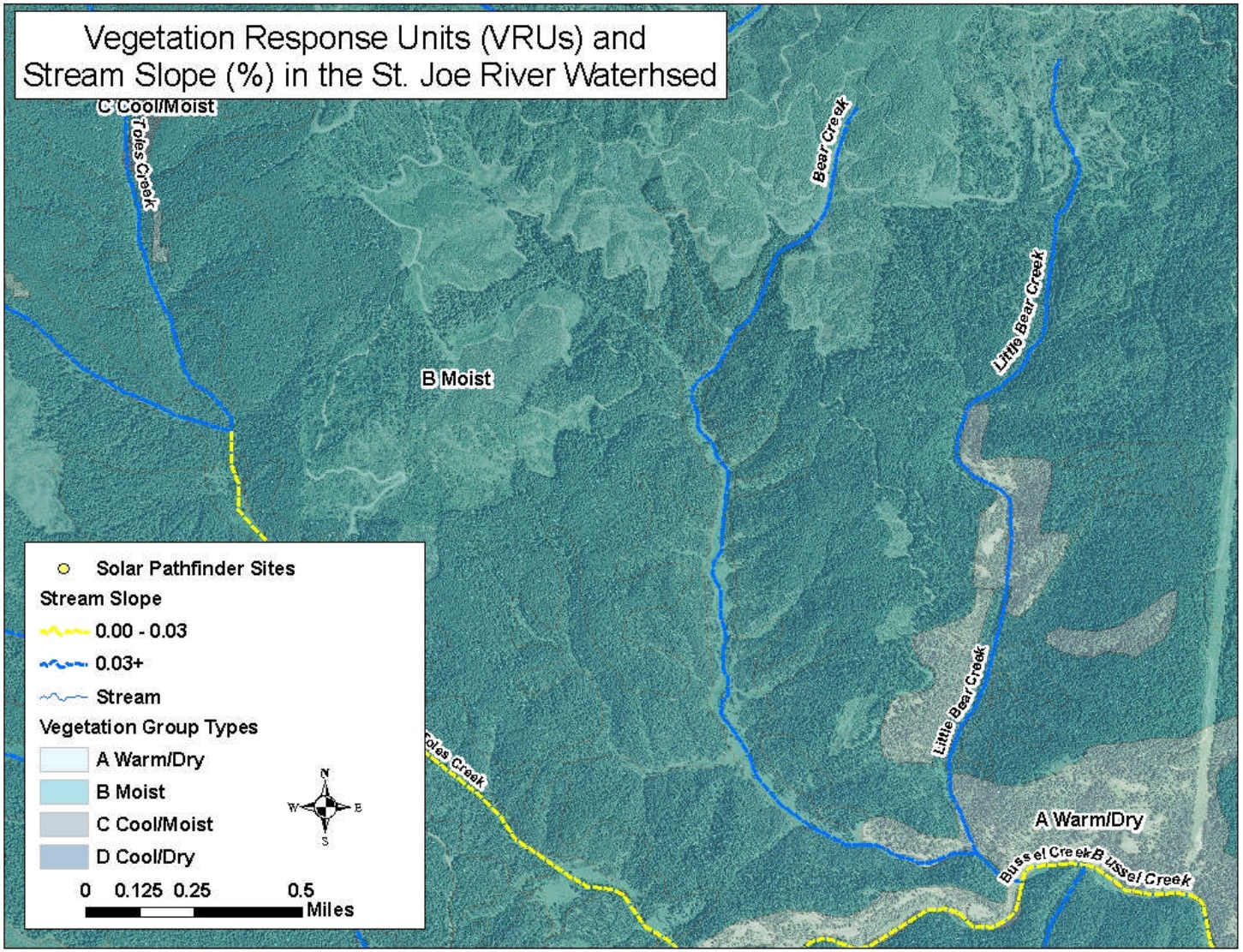


Figure G-85. Vegetation response units (VRUs) and stream gradient (%) in the St. Joe River watershed (Bear and Little Bear Creeks)

Natural Stream Bankfull Width Estimates

Table G-1. Natural bankfull width estimates for subwatersheds of the St. Joe River watershed

Watershed description	Watershed area (sq mi)	Clearwater Curve (m)	Average existing from BURP (m)	BURP ID
Upper St. Joe above Wisdom Creek	2.2	3		
Wisdom Creek (1st north trib)	4.0	4		
Upper St. Joe above Medicine Creek (2nd north trib)	8.0	5	9	2004SDEQA021
Medicine Creek (2nd north trib)	3.3	3	3	2002SCDAA062
Upper St. Joe above Bluebells Creek (3rd north trib)	11.9	6	9	1994SCDAA051
Bluebells Creek (3rd north trib)	0.6	1		
Upper St. Joe above California Creek (1st south trib)	12.5	6		
California Creek	3.3	3		
Upper St. Joe River above 4th north side trib	16.3	7		
Cascade Creek (4th north side trib)	0.9	2		
St. Joe River above Yankee Bar Creek	18.1	8		
Trib to Yankee Bar Creek	0.6	1		
Yankee Bar Creek	2.4	3		
St. Joe River above Neversweat Creek (third south side trib)	20.7	8		
Neversweat Creek (third south side trib)	0.6	1		
St. Joe River above Heller Creek	22.3	9		
Sherlock and Heller Creeks				
Sherlock Creek above first south trib	1.5	2		
South trib to Sherlock Creek	1.4	2		
Sherlock Creek near Gold Nugget Mine	5.3	4		
Sherlock Creek at mouth	6.9	5	6	2002SCDAA006
Heller Creek above Blackburn Creek	4.5	4		
Blackburn Creek (trib to Heller Creek)	1.5	2		
Heller Creek below Blackburn Creek	6.3	4		
Heller Creek above Sherlock Creek	7.1	5	5	2002SCDAA065
Heller Creek above St. Joe River	14.1	7		
St. Joe River - Bean Creek to Heller Creek				
St. Joe River below Heller Creek confluence	36.5	11	16	1994SCDAA050
St. Joe River below Aqua Creek (1st order north trib in seg)	41.8	12		
St. Joe River above Bean Creek	44.2	12		
Bean Creek				
Tinear Creek mouth	2.8	3		
Mill Creek mouth	1.7	2		
Tinear Creek below Mill Creek confluence	4.5	4		
Tinear Creek above Bean Creek	4.6	4		
Bean Creek above Tinear Creek	2.2	3		

Watershed description	Watershed area (sq mi)	Clearwater Curve (m)	Average existing from BURP (m)	BURP ID
Bean Creek above NF Bean Creek	6.9	5		
Trib to NF Bean Creek	1.1	2		
North Fork Bean Creek mouth	2.9	3		
Bean Creek below NF Bean Creek	9.9	6		
Bean Creek below Dump Creek	11.8	6		
Bean Creek at mouth	12.6	6		
Fly Creek				
Fly Creek above south trib	6.5	5		
South trib to Fly Creek	1.1	2		
Fly Creek mouth	8.3	5	6	
Mosquito Creek				
Mosquito Creek above 1st south trib	3.9	3		
1st south trib	1.4	2		
Mosquito Creek above 1st north trib	5.8	4		
1st north trib	1.1	2		
Mosquito Creek below 1st north trib	7.0	5		
Mosquito Creek above 2nd north trib	10.4	6		
2nd north trib	0.6	1		
Mosquito Creek at mouth	11.9	6		
Simmons Creek				
Simmons Creek above Goat Creek	1.2	2		
Goat Creek	1.5	2		
Simmons Creek below Goat Creek	3.2	3		
Middle Fork of Washout Creek	1.7	2		
South Fork Washout Creek	1.8	2		
Stream below MF and SF Washout	3.9	3		
Washout Creek	1.9	2		
Washout Creek above Simmons Creek	5.8	4		
Simmons Creek - Wampus to Washout	9.0	5		
Wampus Creek	2.0	2		
Simmons Creek - Dolly to Wampus Creek	12.0	6		
Dolly Creek	2.0	2		
Simmons Creek - Spruce to Dolly Creek	15.3	7		
Spruce Creek	1.6	2		
Simmons Creek - 1st trib downstream of Spruce to Spruce	17.7	8		
1st trib downstream of Spruce Creek	1.1	2		
North trib between NF Simmons and Spruce	0.6	1		
Simmons Creek above 3 Lakes Creek	20.9	8		

Watershed description	Watershed area (sq mi)	Clearwater Curve (m)	Average existing from BURP (m)	BURP ID
3 Lakes Creek	2.5	3		
1st south trib to 3 Lakes	0.4	1		
3 Lakes between tribs	3.7	3		
2nd south trib to 3 Lakes	0.7	1		
3 Lakes below 2nd trib	4.5	4		
Simmons Creek - NF Simmons to 3 Lakes	28.3	10		
NF Simmons above trib	2.7	3		
Trib to Simmons	1.2	2		
NF Simmons - trib to mouth	6.7	5		
Simmons Creek - south trib to NF Simmons	36.3	11		
1st south trib up from mouth	0.6	1		
Simmons - mouth to 1st south trib	38.6	11	11	2002SCDAA063
Gold Creek				
Gold Creek headwaters	4.9	4		
Float Creek	2.1	3		
Bear Spring Creek	2.0	2		
Gold Creek - below Bear Spring Creek	9.1	5		
Gold Creek - above Broadaxe Creek	9.6	6		
Broadaxe Creek	5.3	4		
Gold Creek - below Petty Creek	17.1	8		
Pretty Creek	0.7	1		
Gold Creek - below Berge Creek	21.0	8		
Berge Creek	2.2	3		
Gold Creek - above EF Creek	22.7	9	11	1996SCDAA015, 1994SCDAA049
EF Gold	3.6	3		
Gold Creek - EF to St. Joe	27.7	10	9	2002SCDAA047, 1996SCDAA014, 1994SCDAA048
Bluff Creek				
South trib to EF Bluff	1.2	2		
EF Bluff	1.8	2		
EF Bluff - South trib to 1st west trib (above west trib)	4.6	4		
1st west trib	1.1	2		
EF Bluff - 1st west to Junction Creek	5.9	4		
Junction Creek	2.2	3		
EF Bluff - Bad Luck to Junction	9.8	6		
Bad Luck Creek	1.4	2		
EF Bluff - below Bad Luck and unnamed trib	11.5	6		

Watershed description	Watershed area (sq mi)	Clearwater Curve (m)	Average existing from BURP (m)	BURP ID
Unnamed trib	0.5	1		
EF Bluff - Siamese to unnamed trib	13.1	7		
Siamese Creek	1.4	2		
EF Bluff - Siamese to confluence	15.8	7		
WF Bluff - org from Dismal Lake	1.0	2		
South trib to EF below Dismal Lake	1.1	2		
WF Bluff above named WF Bluff	2.3	3		
WF Bluff	1.2	2		
WF Bluff above 1st south trib	4.7	4		
1st south trib	1.1	2		
WF Bluff above Whistling Creek	6.2	4		
Whistling Creek	2.5	3		
WF Bluff below Whistling Creek	9.9	6		
1st north trib below Whistling Creek	1.5	2		
WF Bluff between 1st and 2nd north tribs	11.4	6		
2nd north trib below Whistling	0.6	1		
EF Bluff between 2nd and 3rd north tribs below Whistling	12.9	6		
3rd north trib below Whistling	0.6	1		
WF Bluff between 3rd and 4th north tribs	14.3	7		
4th north trib below Whistling	0.7	1		
WF Bluff above WF confluence	17.1	8		
Bluff Creek - EF WF confluence to St. Joe	34.4	11	7	2002SCDAA060
Bear Creek				
SF Bad Bear Creek	1.6	2		
NF Bad Bear Creek	0.7	1		
Bad Bear Creek	4.3	4		
Beaver Creek above Bad Bear	2.9	3		
Beaver Creek mainstem	12.8	6	9, 6	1994SCDAA052, 1994SCDAA053
Loop Creek				
Loop Creek	1.4	2		
Allen Creek	1.2	2		
Loop Creek - Wendle to Allen	2.9	3		
Wendle Creek	0.8	2		
Loop Creek - Olentange to Wendle	4.2	4		
Olentange Creek	2.4	3		
Loop Creek - Ward to Olentange	6.6	5		
Ward Creek	2.1	3		

Watershed description	Watershed area (sq mi)	Clearwater Curve (m)	Average existing from BURP (m)	BURP ID
Loop Creek - Mineral to Ward	9.4	6		
Mineral Creek	1.2	2		
Loop Creek - Manhattan to Mineral	11.1	6	11	1997SCDAA029
Manhattan Creek	2.0	2		
Loop Creek - Kelly to Manhattan	13.4	7		
Kelly Creek	2.6	3		
Loop Creek - Turkey to Kelly	16.1	7		
EF Turkey Creek	1.2	2		
WF Turkey Creek	1.9	2		
Turkey Creek	3.2	3		
Loop Creek - Bear to Turkey	20.2	8		
Bear Creek	0.9	2		
Loop Creek - Brushy to Bear	21.2	8		
Brushy Creek	1.7	2		
Loop Creek - Clear to Brushy	22.9	9		
Clear Creek	4.9	4		
Loop Creek - Moss to Clear	27.9	10		
Moss Creek	0.4	1		
Loop Creek - Cliff to Moss	29.8	10	15	1997SCDAA028
Cliff Creek	2.6	3		
trib to Cliff Creek	0.6	1		
Cliff Creek at confluence	3.8	3		
Loop Creek - Frazier to Cliff	34.8	11		
Frazier Creek	2.2	3		
Loop Creek - Frazier to NF St. Joe	39.8	12		
Slate Creek				
Slate Creek above Pond Creek	3.0	3		
Pond Creek	2.0	2		
Slate Creek - Pond to Elbow	5.7	4		
Elbow Creek	2.4	3		
Slate Creek - Elbow to Dam	9.2	5		
Dam Creek	6.1	4		
Slate Creek - Dam to Flume	16.0	7		
Flume Creek	2.2	3		
Foolhen Creek	1.3	2		
Flume Creek - Foolhen to mouth	3.9	3		
Slate Creek - Flume to Murray	20.0	8		
Murray Creek	0.6	1		
Slate Creek - Murray to Red Top	21.8	9		

Watershed description	Watershed area (sq mi)	Clearwater Curve (m)	Average existing from BURP (m)	BURP ID
Red Top Creek	1.8	2		
Slate Creek- Red Top to Summit	24.0	9	11	2003SCDAA044
Summit Creek	1.7	2		
Slate Creek - Summit to Horseshoe	25.8	9		
Horseshoe Creek	0.8	2		
Slate Creek - Horseshoe to Corvus	26.7	9		
Corvus Creek	1.0	2		
Slate Creek - Corvus to Fisher	29.0	10		
Fisher Creek	0.6	1		
Slate Creek - Fisher to Carlin	31.5	10		
Carlin Creek	0.6	1		
Slate Creek - Carlin to Binney	32.2	10		
Binney Creek	1.9	2		
Slate Creek - Binney to Rover	34.2	11		
Rover Creek	0.9	2		
Slate Creek - Rover to Cedar	35.7	11		
Cedar Creek	3.0	3		
Trib to Cedar	1.1	2		
Cedar Creek	5.8	4		
Slate Creek - Cedar to Prospect	41.8	12		
Prospect Creek	2.8	3		
Slate Creek - Prospect to Horn Gulch	45.4	13		
Horn Gulch	0.8	2		
Slate Creek - Horn Gulch to Fume Creek	46.4	13		
Fume Creek	1.1	2		
Slate Creek - Fume to Marion	47.6	13		
Marion Creek	1.4	2		
Slate Creek - Marion to Mack Gulch	49.1	13		
Mack Gulch	0.5	1		
Slate Creek - Mack Gulch to Lumberjack	50.7	13		
Lumberjack Creek	2.0	2		
Slate Creek - Lumberjack to Fritz	53.1	14		
Fritz Creek	0.8	1		
Slate Creek - Fritz to Daisy	54.6	14		
Daisy Creek	0.9	2		
Slate Creek - Daisy to Uhinian	55.5	14		
Uhinian Creek	0.7	1		
Slate Creek - Uhinian to West Fork	58.0	14		
West Fork	4.3	4		

Watershed description	Watershed area (sq mi)	Clearwater Curve (m)	Average existing from BURP (m)	BURP ID
Trib to West Fork	0.9	2		
West Fork	7.7	5		
Slate Creek - West Fork to mouth	66.3	15		
Big Creek				
West Fork Big Creek	5.5	4		
Trib to WF Big	1.5	2		
WF Big	9.5	6		
Deadman Gulch	2.6	3		
WF Big	12.2	6		
Middle Fork Big Creek	2.7	3		
McPhee Creek	1.0	2		
MF Big McPhee to Ames	4.2	4		
Ames Creek	2.6	3		
Early Creek	2.6	3		
Ames Creek	6.4	4		
MF Big - Ames to Miles	12.0	6		
Miles Creek	1.3	2		
MF Big - Miles to Big	14.5	7		
Big Creek - MF to Pieree	28.0	10		
Pieree Creek	3.0	3		
Big Creek - Pieree to Cameron	31.2	10		
Cameron Creek	1.0	2		
Big - Cameron to Cabin	32.2	10		
Cabin Creek	0.6	1		
Big - Cabin to Flag	33.7	11		
Flag Creek	1.4	2		
Big - Flag to Jumbo	37.3	11		
Jumbo Creek	1.4	2		
Big - Jumbo to EF Big	39.4	12		
EF Big	5.9	4		
Donaldson Creek	2.0	2		
Hall Creek	1.0	2		
Donaldson below Hall to EF Big		0		
EF Big above Rogers		0		
EF Big - below Rogers including Donaldson and Hall	9.0	5		
West side trib below Rogers Creek	0.7	1		
EF Big Creek - unnamed trib to Mowat Creek	10.8	6		
Mowat Creek	2.0	2		
EF Big - Mowat to Big Creek	15.0	7		

Watershed description	Watershed area (sq mi)	Clearwater Curve (m)	Average existing from BURP (m)	BURP ID
Big Creek	57.0	14		
Fishhook Creek				
EF Fishhook	0.7	1		
West unnamed trib to EF Fishhook	0.4	1		
EF Fishhook below unnamed trib	2.6	3		
South trib	0.8	1		
EF Fishhook	3.4	3		
East trib	2.8	3		
EF Fishhook	7.6	5	6	2003SCDAA047
WF Fishhook	1.3	2		
Red Raven	2.1	3		
Red Raven at mouth	3.9	3		
Middle	1.6	2		
Outlaw	0.5	1		
Trib to Outlaw	0.7	1		
Outlaw	2.2	3		
Middle below Outlaw	6.1	4		
Trib to Middle below Outlaw	0.5	1		
Middle above WF Fishhook	8.8	5		
WF above EF	9.4	6		
Fishhook	17.1	8		
Unnamed east trib below EF	0.6	1		
Fishhook	20.8	8		
NF unnamed trib above Cougar	1.2	2		
SF unnamed trib above Cougar	0.6	1		
Unnamed trib above Cougar	2.0	2		
Fishhook unnamed trib above Cougar	20.9	8		
SF Cougar	1.1	2		
NF Cougar	1.2	2		
Cougar	2.4	3		
Fishhook - Cougar to Lick	23.7	9		
Lick	1.6	2		
Unnamed trib to Lick	0.6	1		
Lick	5.0	4		
Wawa	1.5	2		
South unnamed trib to Wawa	0.9	2		
Wawa	2.6	3		
North unnamed trib to Wawa	0.8	2		
Wawa	4.1	4		

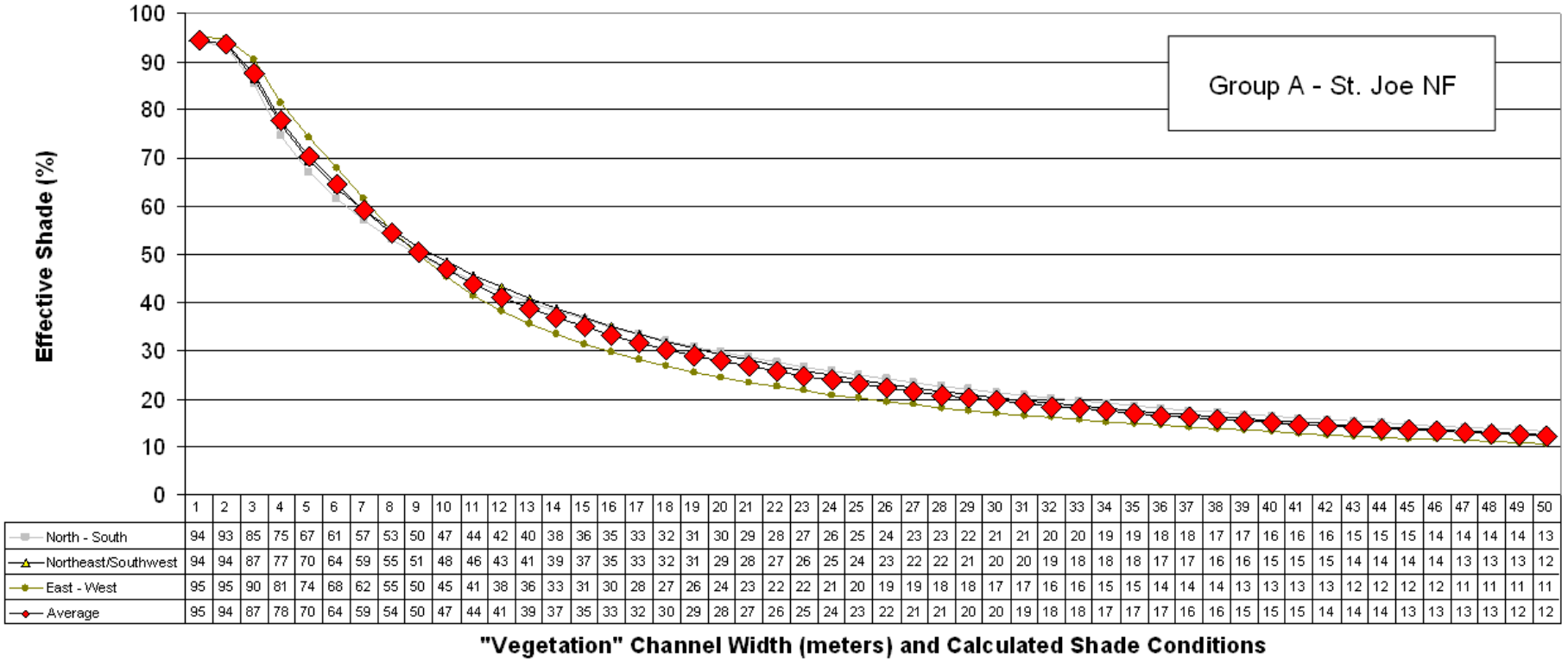
Watershed description	Watershed area (sq mi)	Clearwater Curve (m)	Average existing from BURP (m)	BURP ID
Lick	9.1	5		
Fishhook - Lick to unnamed trib	33.0	11		
Unnamed trib above Horsecamp	0.4	1		
Fishhook - unnamed to Horsecamp	34.3	11		
Horsecamp	1.1	2		
Fishhook - Horsecamp to west unnamed trib	35.5	11		
East unnamed trib	0.8	2		
Fishhook - 1st and 2nd unnamed trib below Horsecamp	37.8	11		
2nd unnamed trib below Horsecamp	0.6	1		
Fishhook - 2nd and 3rd unnamed trib below Horsecamp	37.9	11		
Chute	0.6	1		
Fishhook - Chute to St. Joe	41.8	12		
Marble Creek above Bussel Creek				
Marble	1.6	2		
East trib to Marble	0.5	1		
Marble	4.7	4		
Delaney	1.1	2		
South trib to Delaney	1.2	2		
Delaney	2.4	3		
SF of north trib to Delaney	0.7	1		
NF of north trib to Delaney	0.4	1		
North trib to Delaney	1.2	2		
Delaney	3.9	4		
Marble - Delany to Freezeout	9.3	5		
Freezeout	1.8	2		
West trib to Freezeout	1.2	2		
Freezeout	6.2	4		
Marble - Freezeout to Swing	15.7	7		
Swing	0.9	2		
Marble - Swing to unnamed trib	16.7	7		
Unnamed trib	0.8	1		
Marble - 1st unnamed trib to 2nd unnamed trib below Swing	18.1	8		
2nd unnamed trib below Swing	0.7	1		
Marble - 2nd and 3rd unnamed trib below Swing	19.0	8		
3rd unnamed trib below Swing	0.8	1		
Marble - 3rd unnamed trib and Duplex	19.8	8		

Watershed description	Watershed area (sq mi)	Clearwater Curve (m)	Average existing from BURP (m)	BURP ID
Duplex	1.3	2		
South trib to Duplex	0.2	1		
Duplex	1.6	2		
North trib to Duplex	0.4	1		
Duplex	2.2	3		
Marble - Duplex to 1st unnamed trib	22.5	9		
1st unnamed trib below Duplex	0.4	1		
Marble - 1st unnamed trib to 2nd unnamed trib	22.9	9		
2nd unnamed trib below Duplex	0.7	1		
Marble - 2nd unnamed trib to Homestead	26.5	9		
Homestead	0.6	1		
1st unnamed trib to Homestead	0.5	1		
Homestead	2.2	3		
2nd unnamed trib to Homestead	0.4	1		
Homestead	2.6	3		
3rd unnamed trib to Homestead	0.4	1		
Homestead	5.8	4		
4th unnamed trib to Homestead	0.7	1		
Homestead	9.3	5	10	2004SCDAA026
5th unnamed trib to Homestead	0.9	2		
Homestead	11.0	6		
Marble - Homestead to Cornwall	37.5	11		
Cornwall	4.1	4		
Marble - Cornwall to Hobo	43.0	12		
Hobo	3.4	3		
Trib to Hobo	1.2	2		
Hobo	5.6	4	10	1999SCDAA018
WF Hobo	2.4	3		
Hobo	10.3	6		
Marble - Hobo to Davis	53.4	14		
Davis	1.4	2		
Marble - Davis to Cranberry	56.0	14		
Cranberry	0.8	2		
Trib to Cranberry	0.7	1		
Cranberry	2.9	3		
Marble - Cranberry to Bussel	60.4	15		
Bussel Creek				
Bussel Creek above Lines	3.3	3		
Lines Creek	3.2	3		

Watershed description	Watershed area (sq mi)	Clearwater Curve (m)	Average existing from BURP (m)	BURP ID
Bussel - Lines to Norton	7.2	5		
Norton to unnamed trib	1.9	2		
Unnamed trib to Norton	1.1	2		
Norton unnamed trib to Bussel	5.0	4	5	2001SCDAE032
Bussel - Norton to Toles	12.4	6		
Toles	1.0	2		
Unnamed trib to Toles	1.0	2		
Toles	2.4	3	4, 2	1997SCDAA039, 2001SCDAE033
2nd unnamed trib to Toles	0.8	2		
Toles - 2nd unnamed trib to Bussel	3.8	3		
Bussel - Toles to Bear	16.4	7		
Bear	1.9	2		
Little Bear	1.4	2		
Bear - Little Bear to Bussel	3.3	3		
Bussel - Bear to unnamed trib	19.7	8		
Bussel - unnamed trib to Marble	23.0	9		
Unnamed trib to Marble below Bear	0.5	1		
Eagle Creek				
Eagle - above NF Eagle	2.3	3		
NF Eagle	1.0	2		
Trib to NF Eagle	0.9	2		
NF Eagle	2.7	3		
2nd north trib to NF Eagle	0.6	1		
NF Eagle at confluence with Eagle	3.5	3		
Eagle - NF Eagle to Grouse	8.0	5	5	2004SCDAA027
Grouse	0.8	2		
Eagle - Grouse to Marble	9.2	5		
Daveggio Creek				
Daveggio	3.8	3		
1st south trib to Daveggio	1.2	2		
Daveggio	6.9	5	7	2001SCDAE026
Little Daveggio	1.8	2		
South trib to Little Daveggio	0.2	1		
Little Daveggio	3.0	3		
Daveggio	11.0	6	10	2001SCDAE027
Marble Bussel to Daveggio				
Marble at Shearer Creek	84.0	17		
Marble at Daveggio	97.0	19		

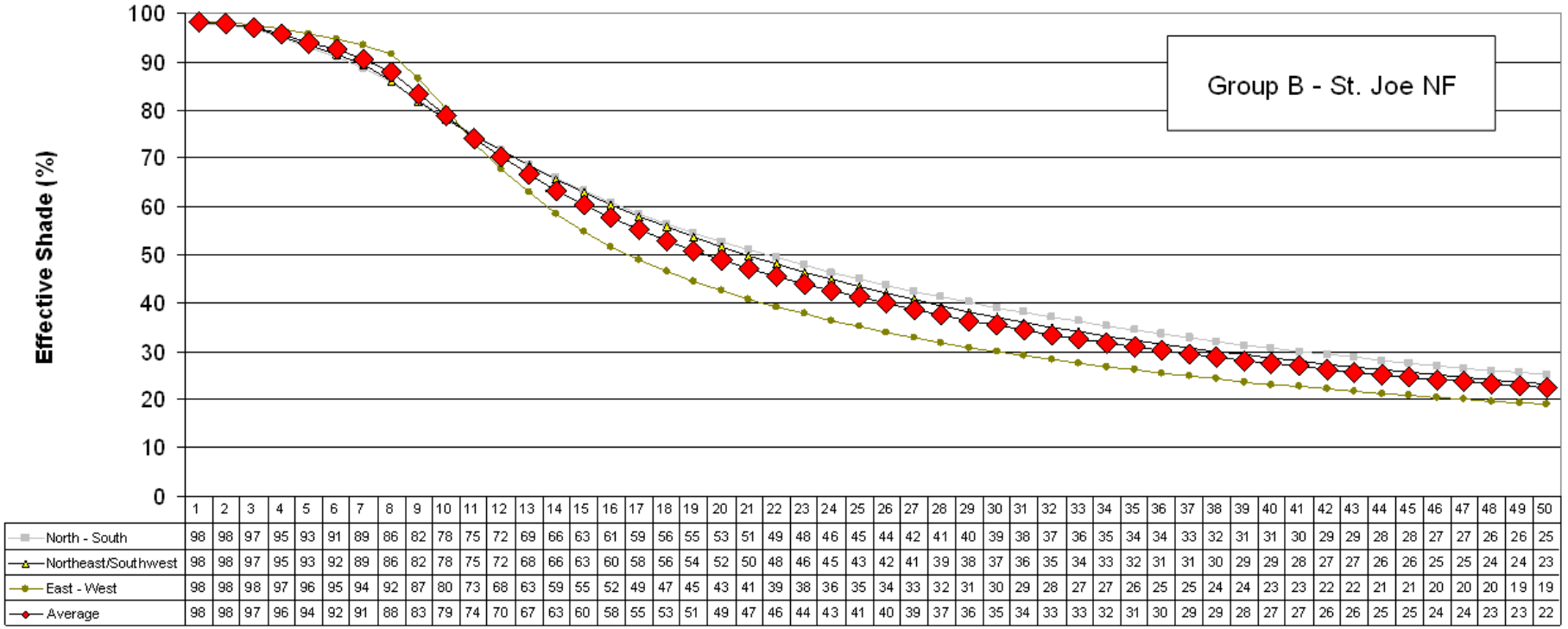
Watershed description	Watershed area (sq mi)	Clearwater Curve (m)	Average existing from BURP (m)	BURP ID
Marble and tribs from Daveggio to Joe				
Marble	107.5	20		
1st west Trib	0.6	1		
Marble	110.0	20		
Donkey	2.4	3		
Marble - Donkey to 1st east trib	113.0	20		
1st east trib	1.4	2		
Marble - 1st east to 1st west below Donkey	115.0	20		
1st west below Donkey	0.3	1		
Marble - 1st west to 2nd east	116.0	20		
2nd east	0.4	1		
Marble - 2nd east to 2nd west	116.8	20		
2nd west	0.4	1		
Marble - 2nd west to Boulder	121.0	21		
Marble - Boulder to west trib	138.0	22		
Unnamed west trib between Boulder and Canyon	0.6	1		
Marble - unnamed to Canyon	139.0	22		
Canyon	2.6	3		
Marble - Canyon to Joe	142.0	23		
Shearer Creek	1.1	2		
Boulder Creek				
Boulder	3.1	3		
Unnamed trib	0.5	1		
Boulder	3.9	3		
Walamute	3.8	3		
Boulder	7.8	5		
Unnamed below Walamute	1.8	2		
Boulder	10.4	6		
2nd unnamed below Walamute	0.7	1		
Boulder	11.2	6		
EF of unnamed below Walamute	0.4	1		
WF of unnamed below Walamute	0.4	1		
Unnamed below Walamute	0.9	2		
Boulder	12.3	6		
2nd unnamed below Walamute	2.0	2		
Boulder	15.5	7		
3rd south trib below Walamute	1.4	2		
Boulder	17.2	8	10	2004SCDAA025

St. Joe River Watershed Shade Curves



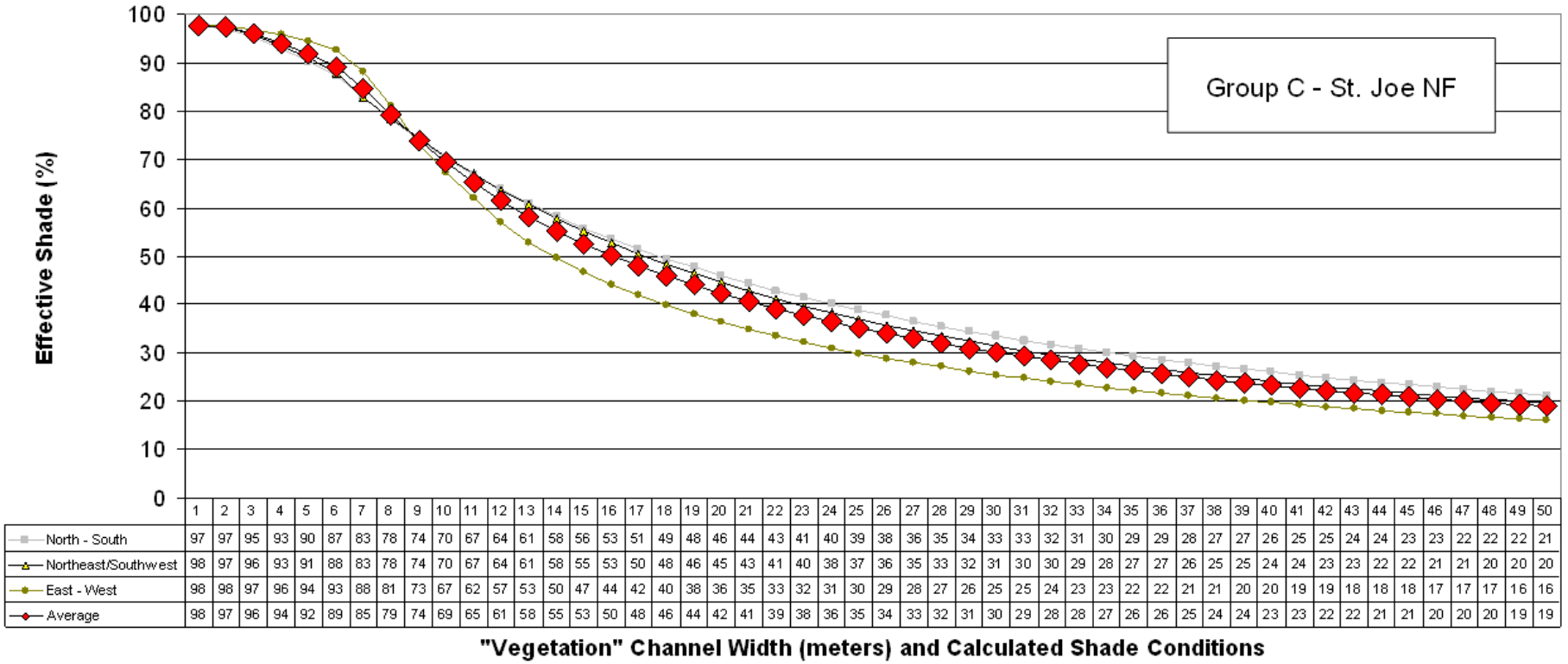
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North - South	94	93	85	75	67	61	57	53	50	47	44	42	40	38	36	35	33	32	31	30	29	28	27	26	25	24	23	23	22	21	21	20	20	19	19	18	18	17	17	16	16	16	15	15	15	14	14	14	14	13
Northeast/Southwest	94	94	87	77	70	64	59	55	51	48	46	43	41	39	37	35	33	32	31	29	28	27	26	25	24	23	22	22	21	20	20	19	18	18	18	17	17	16	16	15	15	15	14	14	14	14	13	13	13	12
East - West	95	95	90	81	74	68	62	55	50	45	41	38	36	33	31	30	28	27	26	24	23	22	22	21	20	19	19	18	18	17	17	16	16	15	15	14	14	14	13	13	13	13	12	12	12	12	11	11	11	11
Average	95	94	87	78	70	64	59	54	50	47	44	41	39	37	35	33	32	30	29	28	27	26	25	24	23	22	21	21	20	20	19	18	18	17	17	17	16	16	15	15	15	14	14	14	13	13	13	13	12	12

Figure G-86. System potential effective shade at various stream aspects and stream width conditions: Warm/Dry (Group A)—St. Joe National Forest



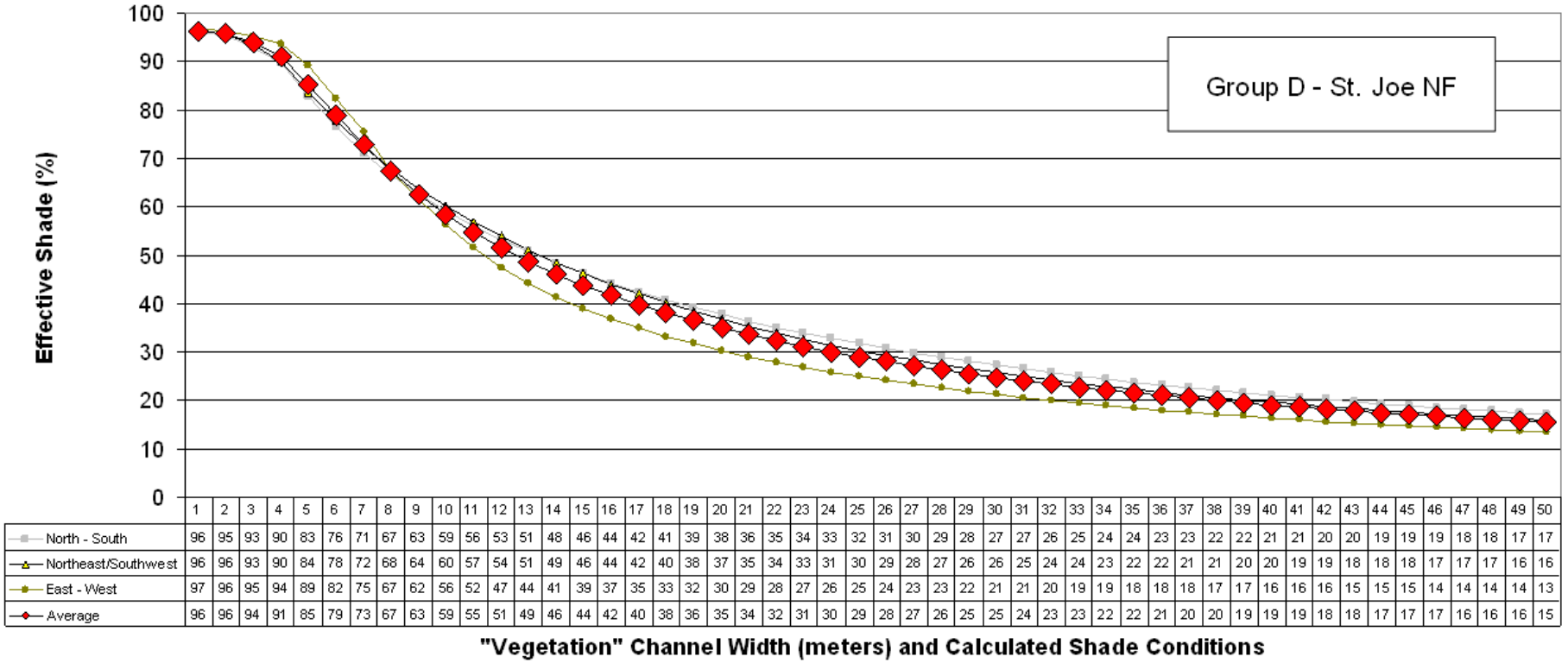
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North - South	98	98	97	95	93	91	89	86	82	78	75	72	69	66	63	61	59	56	55	53	51	49	48	46	45	44	42	41	40	39	38	37	36	35	34	34	33	32	31	31	30	29	29	28	28	27	27	26	26	25
Northeast/Southwest	98	98	97	95	93	92	89	86	82	78	75	72	68	66	63	60	58	56	54	52	50	48	46	45	43	42	41	39	38	37	36	35	34	33	32	31	31	30	29	29	28	27	27	26	26	25	25	24	24	23
East - West	98	98	98	97	96	95	94	92	87	80	73	68	63	59	55	52	49	47	45	43	41	39	38	36	35	34	33	32	31	30	29	28	27	27	26	25	25	24	24	23	23	22	22	21	21	20	20	20	19	19
Average	98	98	97	96	94	92	91	88	83	79	74	70	67	63	60	58	55	53	51	49	47	46	44	43	41	40	39	37	36	35	34	33	33	32	31	30	29	29	28	27	27	26	26	25	25	24	24	23	23	22

Figure G-87. System potential effective shade at various stream aspects and stream width conditions: Moist (Group B)—St. Joe National Forest



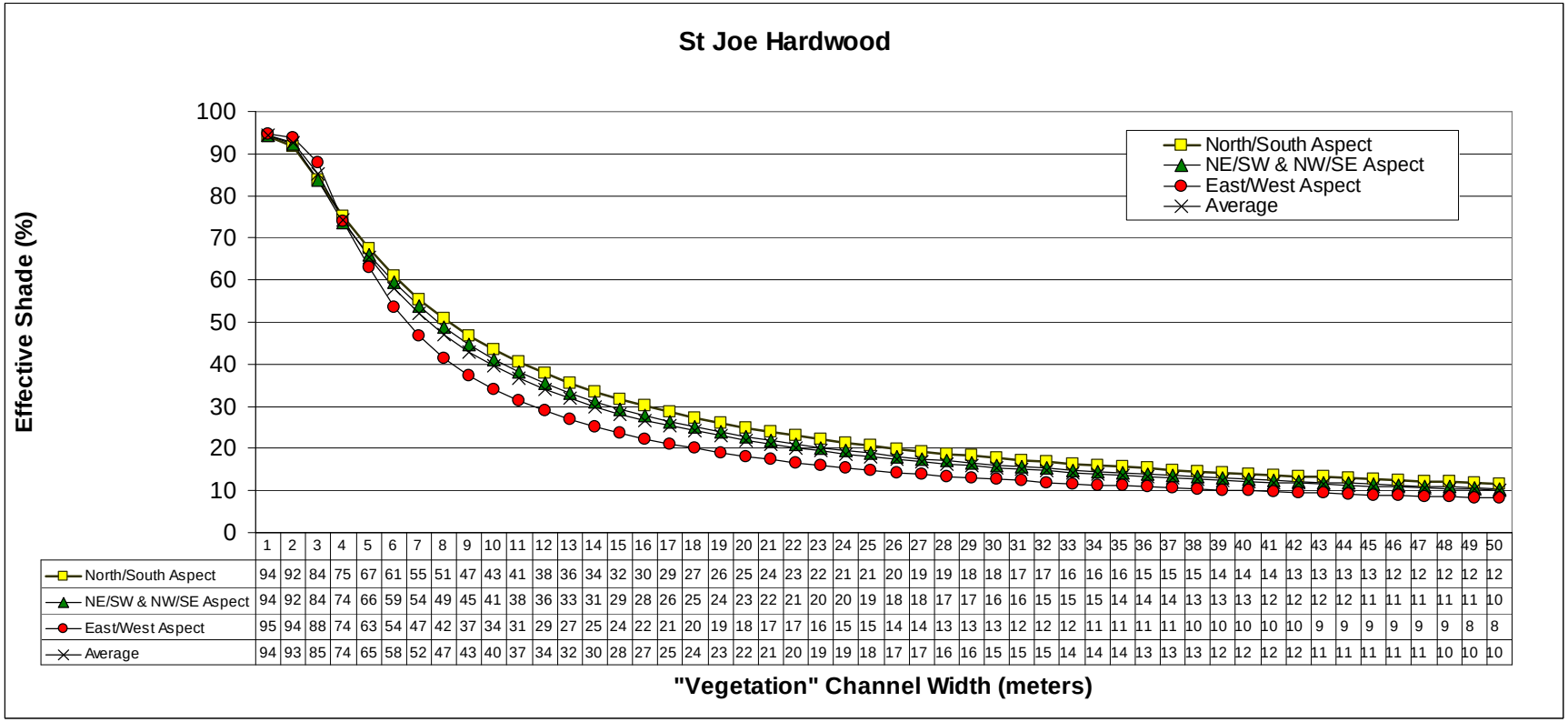
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North - South	97	97	95	93	90	87	83	78	74	70	67	64	61	58	56	53	51	49	48	46	44	43	41	40	39	38	36	35	34	33	33	32	31	30	29	29	28	27	27	26	25	25	24	24	23	23	22	22	22	21
Northeast/Southwest	98	97	96	93	91	88	83	78	74	70	67	64	61	58	55	53	50	48	46	45	43	41	40	38	37	36	35	33	32	31	30	30	29	28	27	27	26	25	25	24	24	23	23	22	22	21	21	20	20	20
East - West	98	98	97	96	94	93	88	81	73	67	62	57	53	50	47	44	42	40	38	36	35	33	32	31	30	29	28	27	26	25	25	24	23	23	22	22	21	21	20	20	19	19	18	18	18	17	17	17	16	16
Average	98	97	96	94	92	89	85	79	74	69	65	61	58	55	53	50	48	46	44	42	41	39	38	36	35	34	33	32	31	30	29	28	28	27	26	26	25	24	24	23	23	22	22	21	21	20	20	20	19	19

Figure G-88. System potential effective shade at various stream aspects and stream width conditions: Cool/Moist (Group C)—St. Joe National Forest



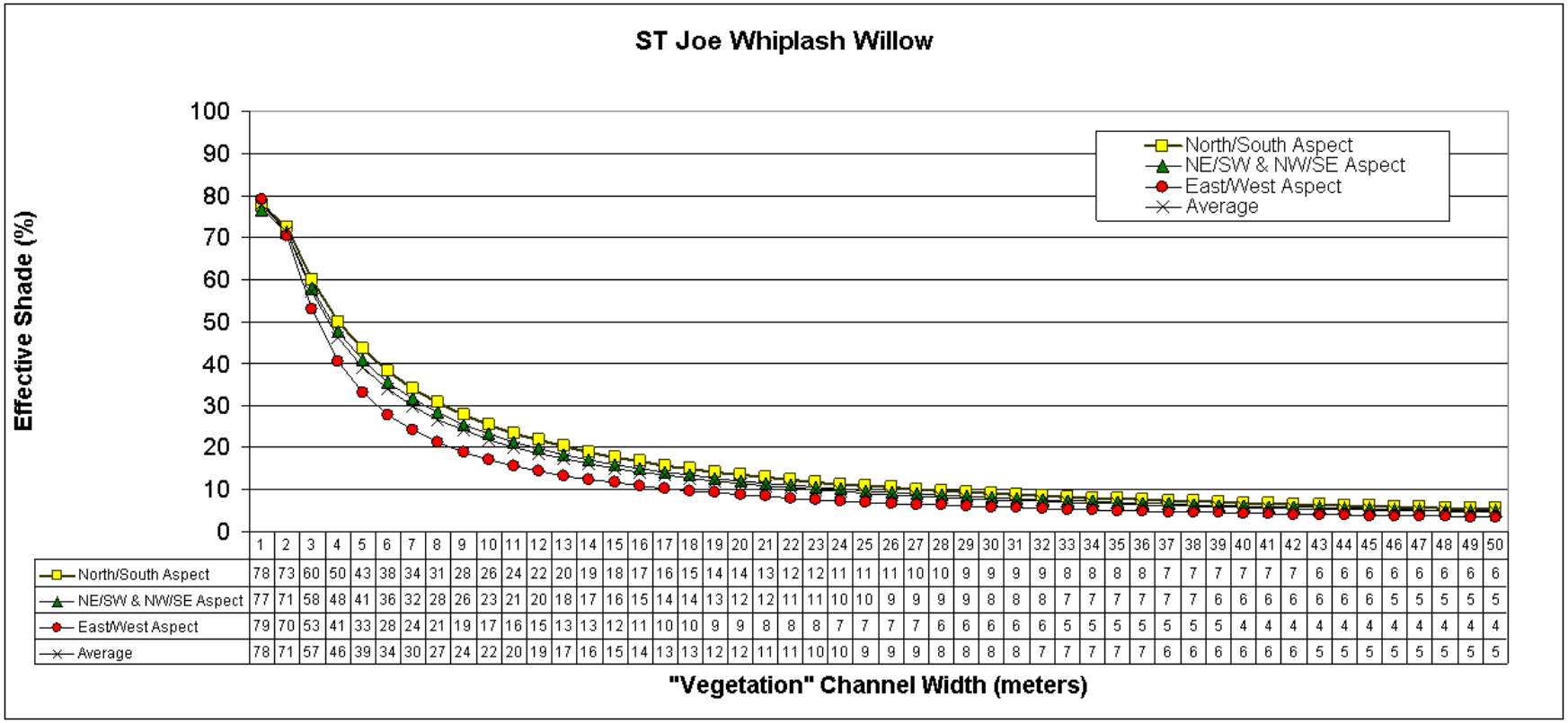
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
North - South	96	95	93	90	83	76	71	67	63	59	56	53	51	48	46	44	42	41	39	38	36	35	34	33	32	31	30	29	28	27	27	26	25	24	24	23	23	22	22	21	21	20	20	19	19	19	18	18	17	17
Northeast/Southwest	96	96	93	90	84	78	72	68	64	60	57	54	51	49	46	44	42	40	38	37	35	34	33	31	30	29	28	27	26	26	25	24	24	23	22	22	21	21	20	20	19	19	18	18	18	17	17	17	16	16
East - West	97	96	95	94	89	82	75	67	62	56	52	47	44	41	39	37	35	33	32	30	29	28	27	26	25	24	23	23	22	21	21	20	19	19	18	18	18	17	17	16	16	16	15	15	15	14	14	14	14	13
Average	96	96	94	91	85	79	73	67	63	59	55	51	49	46	44	42	40	38	36	35	34	32	31	30	29	28	27	26	25	25	24	23	23	22	22	21	20	20	19	19	19	18	18	17	17	17	16	16	16	15

Figure G-89. System potential effective shade at various stream aspects and stream width conditions: Cool/Dry (Group D)—St. Joe National Forest



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
North/South Aspect	94	92	84	75	67	61	55	51	47	43	41	38	36	34	32	30	29	27	26	25	24	23	22	21	21	20	19	19	18	18	17	17	16	16	16	15	15	15	14	14	14	13	13	13	13	12	12	12	12	12
NE/SW & NW/SE Aspect	94	92	84	74	66	59	54	49	45	41	38	36	33	31	29	28	26	25	24	23	22	21	20	20	19	18	18	17	17	16	16	15	15	15	14	14	14	13	13	13	12	12	12	12	11	11	11	11	11	10
East/West Aspect	95	94	88	74	63	54	47	42	37	34	31	29	27	25	24	22	21	20	19	18	17	17	16	15	15	14	14	13	13	13	12	12	12	11	11	11	11	10	10	10	10	10	9	9	9	9	9	9	8	8
Average	94	93	85	74	65	58	52	47	43	40	37	34	32	30	28	27	25	24	23	22	21	20	19	19	18	17	17	16	16	15	15	15	14	14	14	13	13	13	12	12	12	12	11	11	11	11	11	10	10	10

Figure G-90. System potential effective shade at various stream aspects and stream width conditions: St. Joe hardwood riparian community (non-forest group 1)



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
North/South Aspect	78	73	60	50	43	38	34	31	28	26	24	22	20	19	18	17	16	15	14	14	13	12	12	11	11	11	10	10	9	9	9	9	8	8	8	8	7	7	7	7	7	7	6	6	6	6	6	6	6	6
NE/SW & NW/SE Aspect	77	71	58	48	41	36	32	28	26	23	21	20	18	17	16	15	14	14	13	12	12	11	11	10	10	9	9	9	9	8	8	8	7	7	7	7	7	6	6	6	6	6	6	6	5	5	5	5	5	5
East/West Aspect	79	70	53	41	33	28	24	21	19	17	16	15	13	13	12	11	10	10	9	9	8	8	8	7	7	7	7	6	6	6	6	6	5	5	5	5	5	5	5	4	4	4	4	4	4	4	4	4	4	4
Average	78	71	57	46	39	34	30	27	24	22	20	19	17	16	15	14	13	13	12	12	11	11	10	10	9	9	9	8	8	8	8	7	7	7	7	7	6	6	6	6	6	6	5	5	5	5	5	5	5	5

Figure G-91. System potential effective shade at various stream aspects and stream width conditions: St. Joe willow riparian community

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Appendix H. St. Maries River Watershed Potential Natural Vegetation Figures: Existing, Potential, and Delta Shade; Vegetation Response Unit Groups and Stream Gradient; Bankfull Width Estimates; and Shade Curves

The underlying aerial photograph used to estimate existing shade and shown in the figures included in this appendix was taken during the summer of 2009.

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LIST OF FIGURES

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LIST OF TABLES

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Existing, Potential, and Delta Shade Estimates

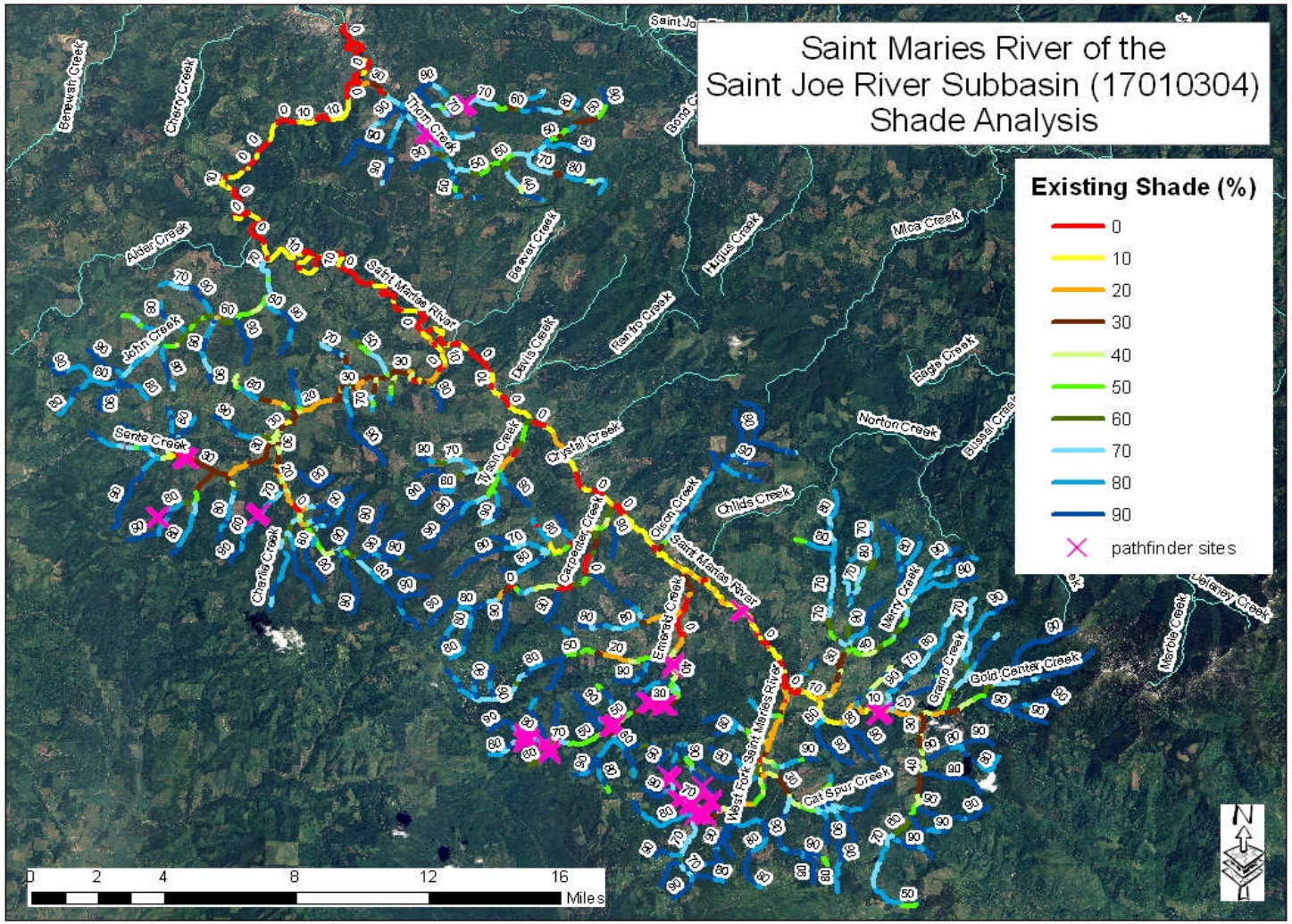


Figure H-1. Existing shade (%) for the St. Maries River watershed

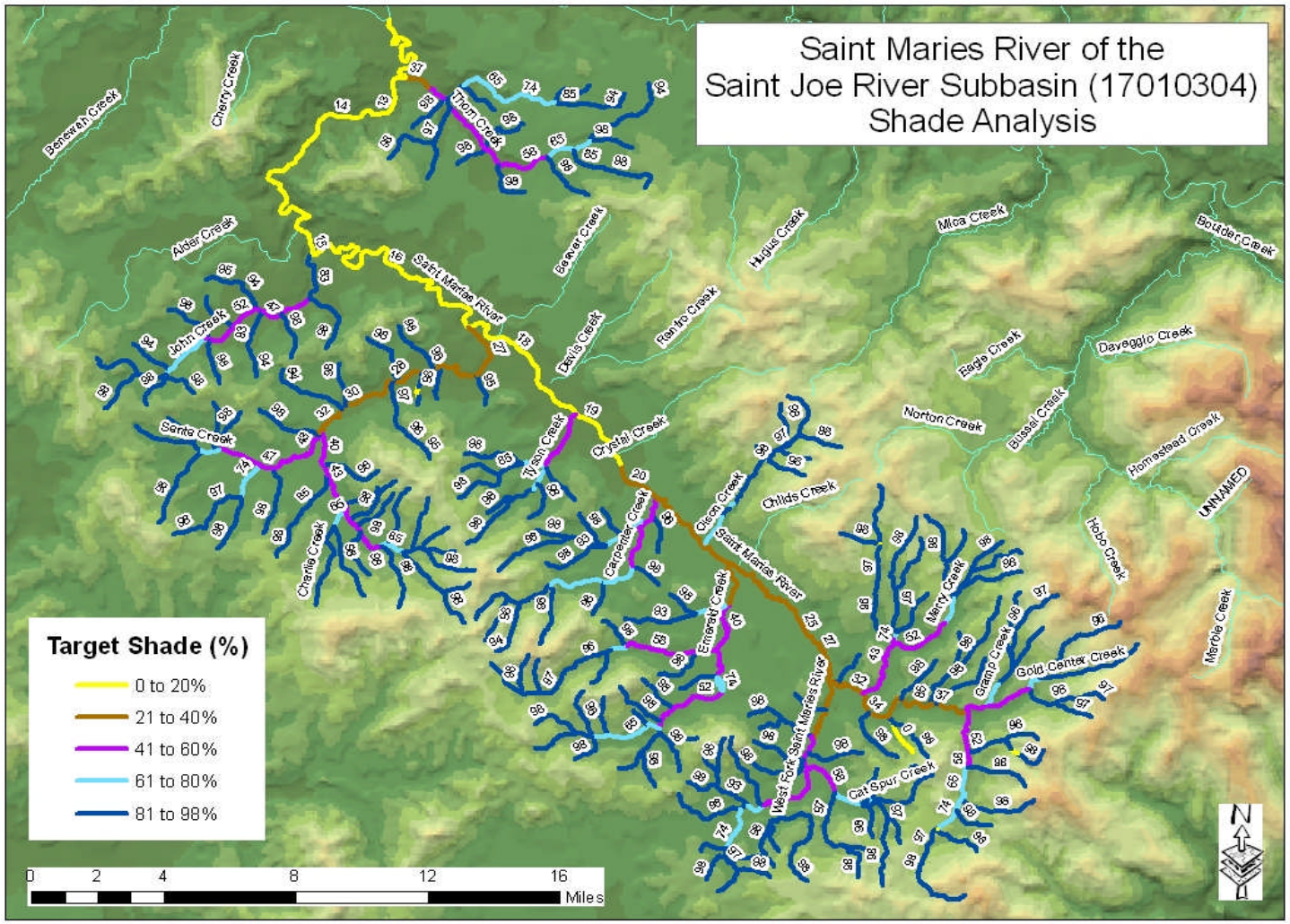


Figure H-2. Target shade (%) for the St. Maries River watershed

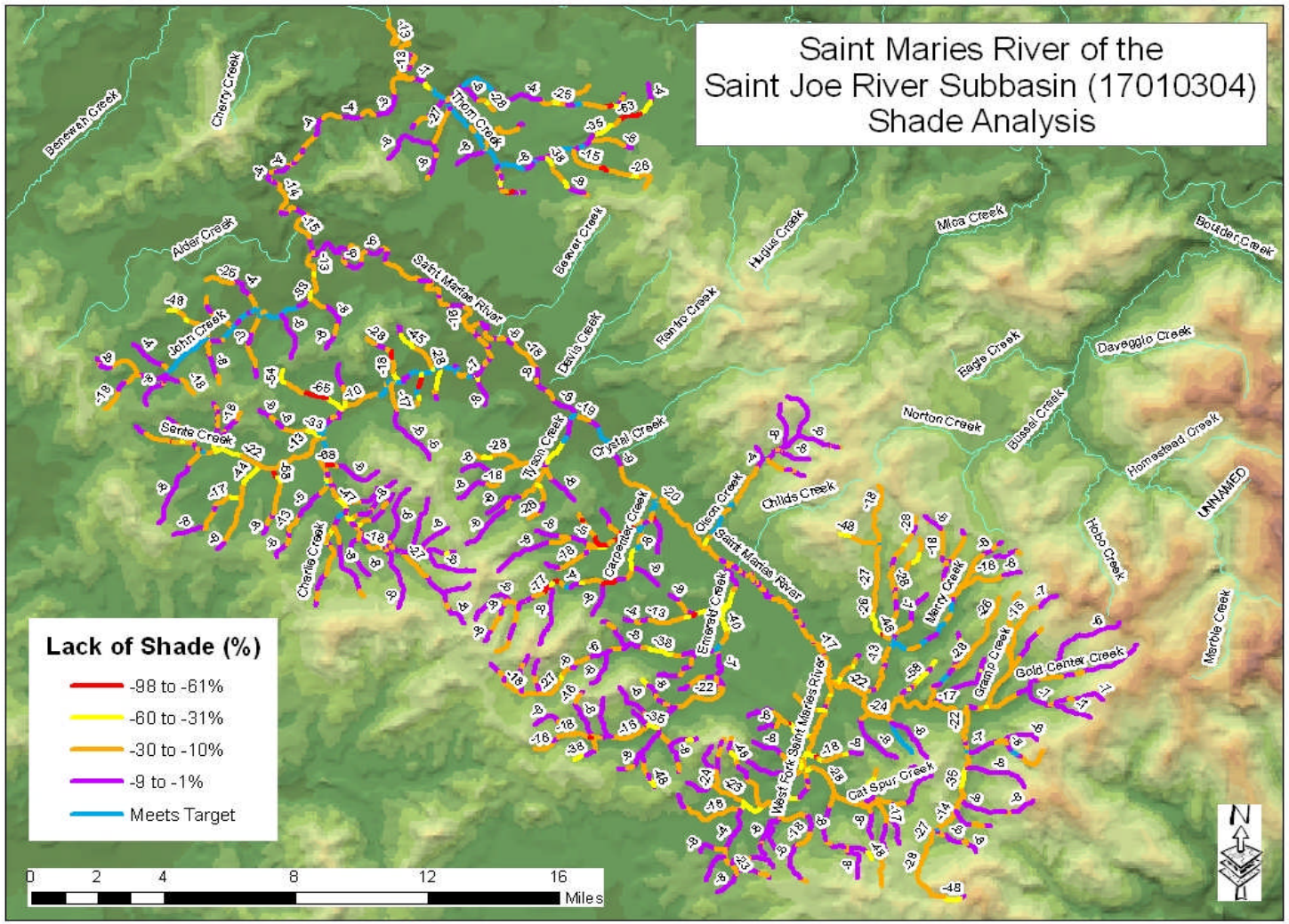


Figure H-3. Delta shade (%) for the St. Maries River watershed

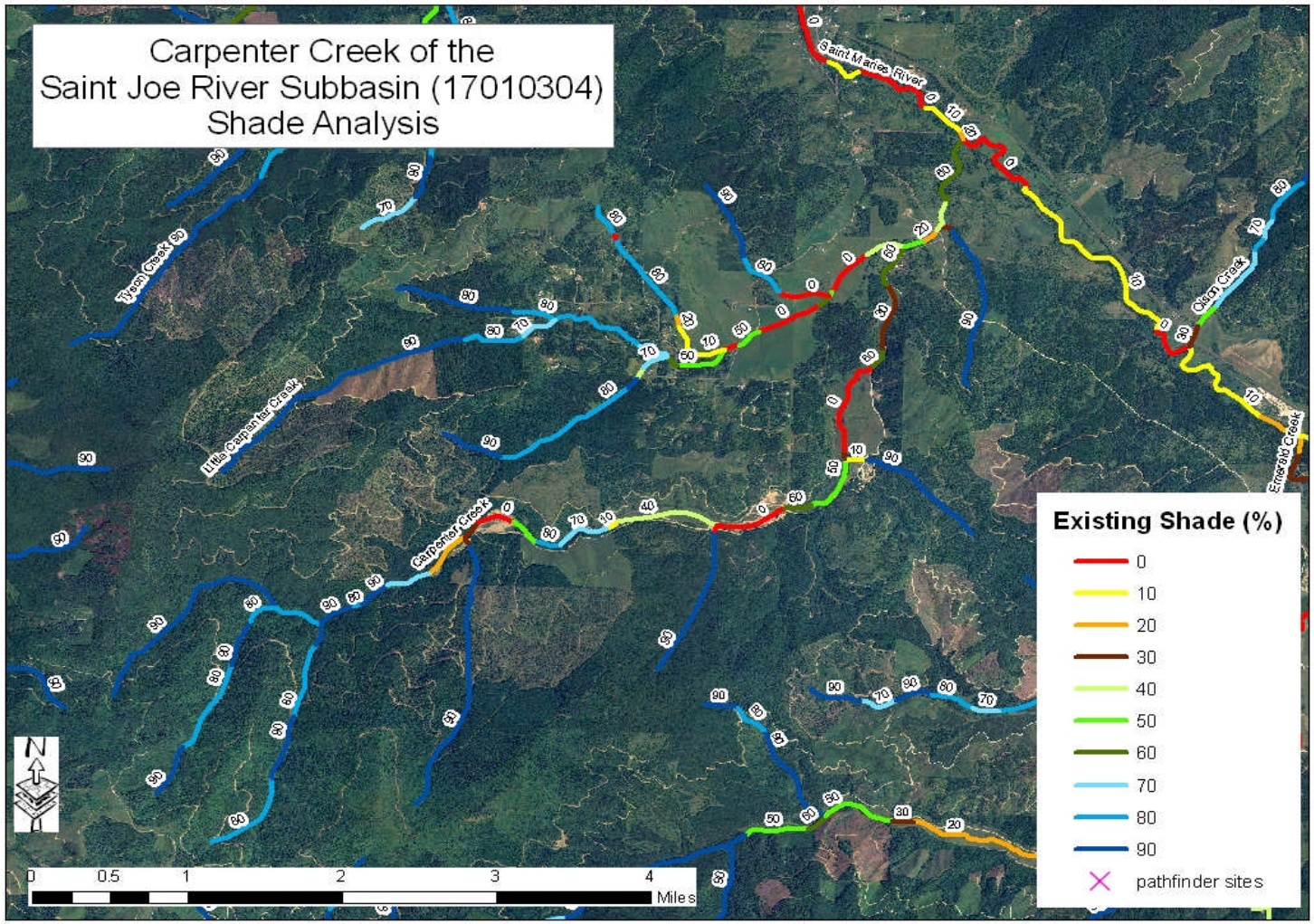


Figure H-4. Existing shade (%) for the Carpenter Creek watershed

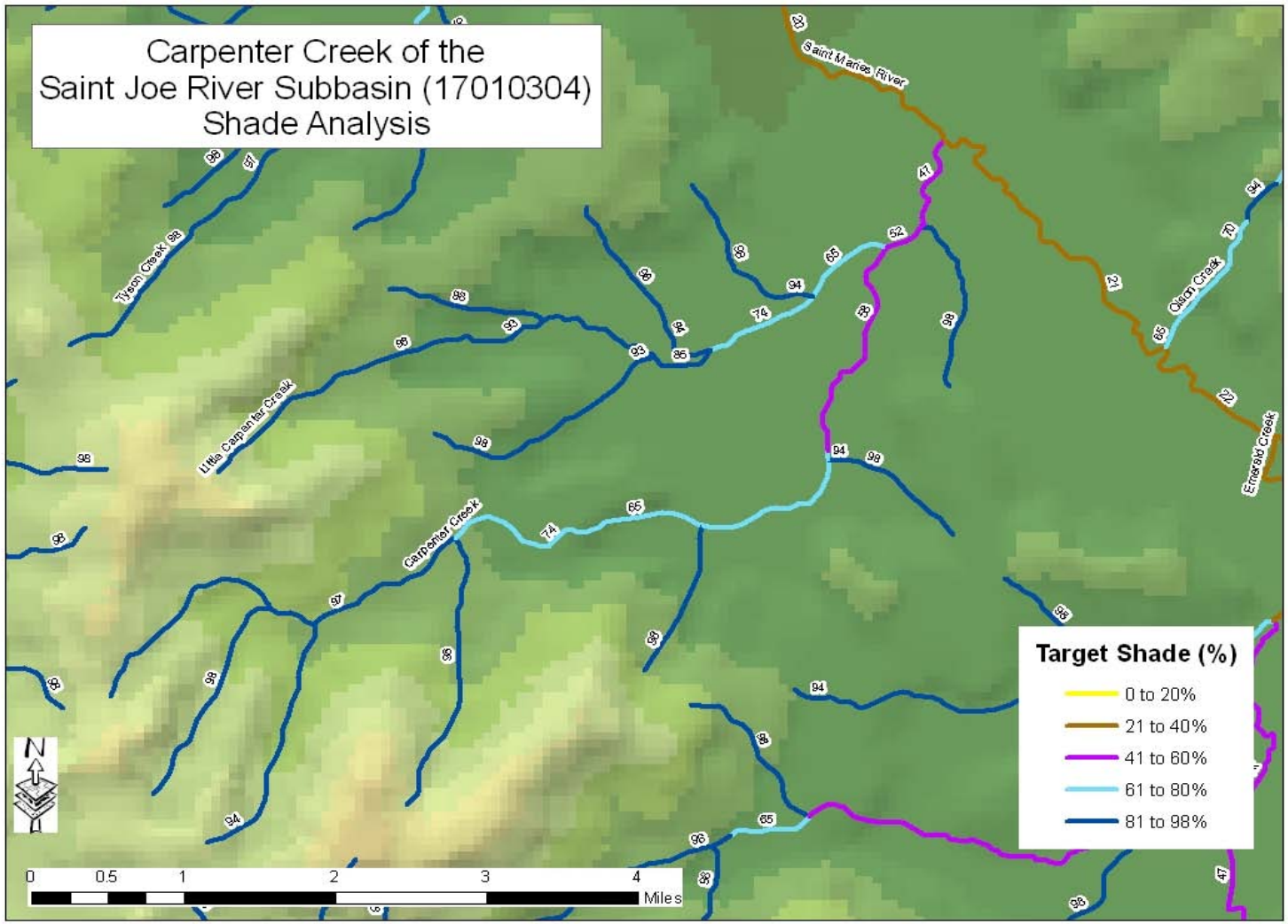


Figure H-5. Target shade (%) for the Carpenter Creek watershed

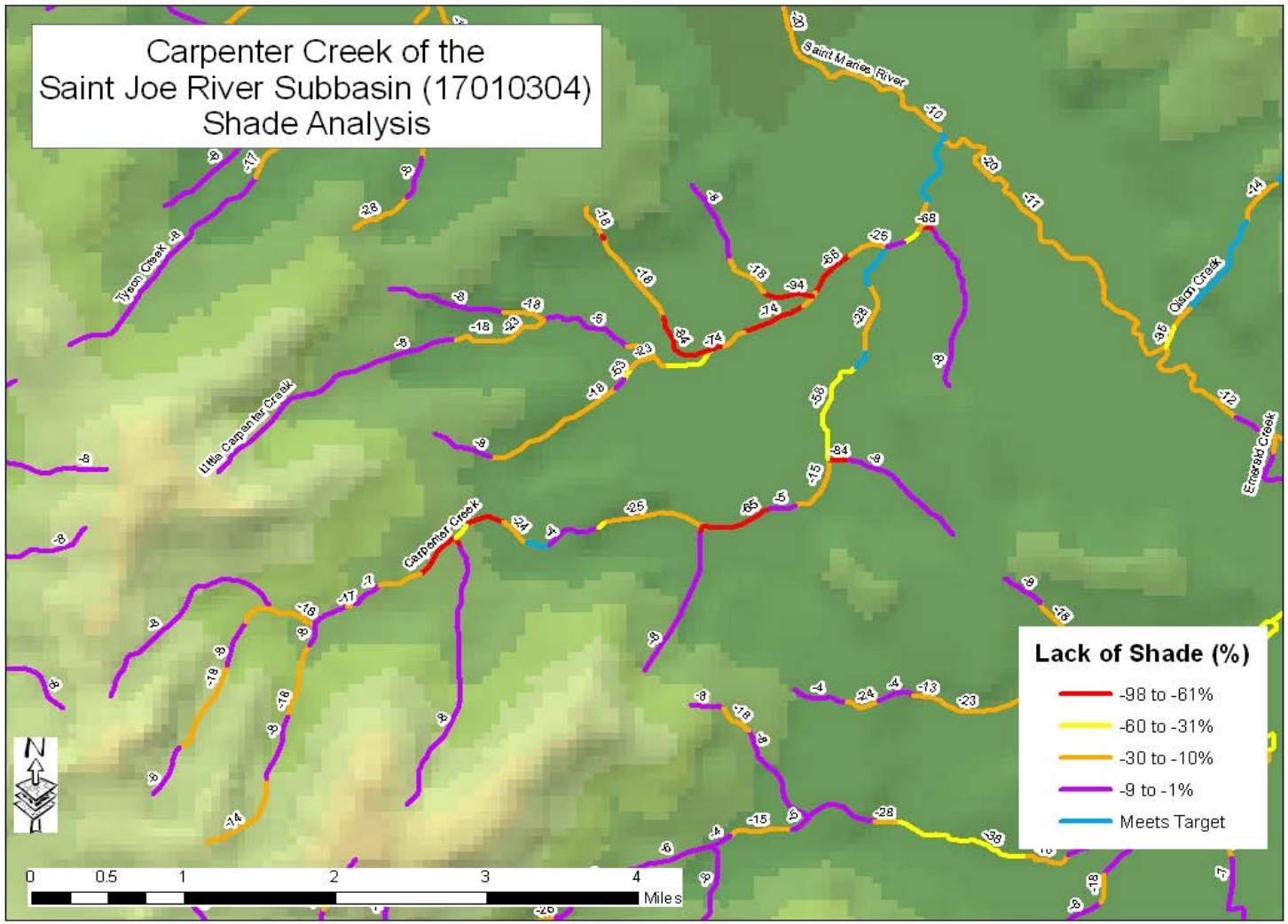


Figure H-6. Delta shade (%) for the Carpenter Creek watershed

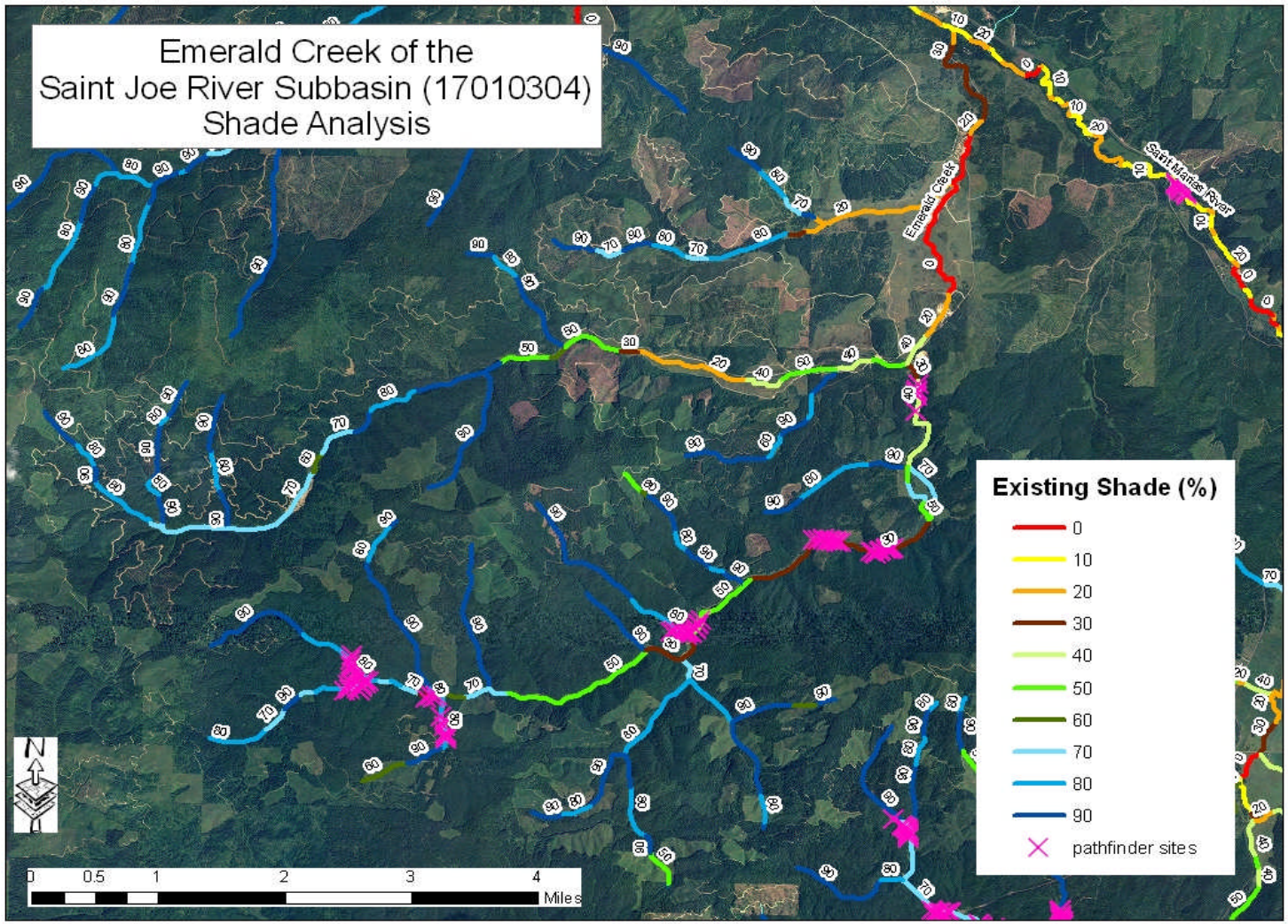


Figure H-7. Existing shade (%) for the Emerald Creek watershed

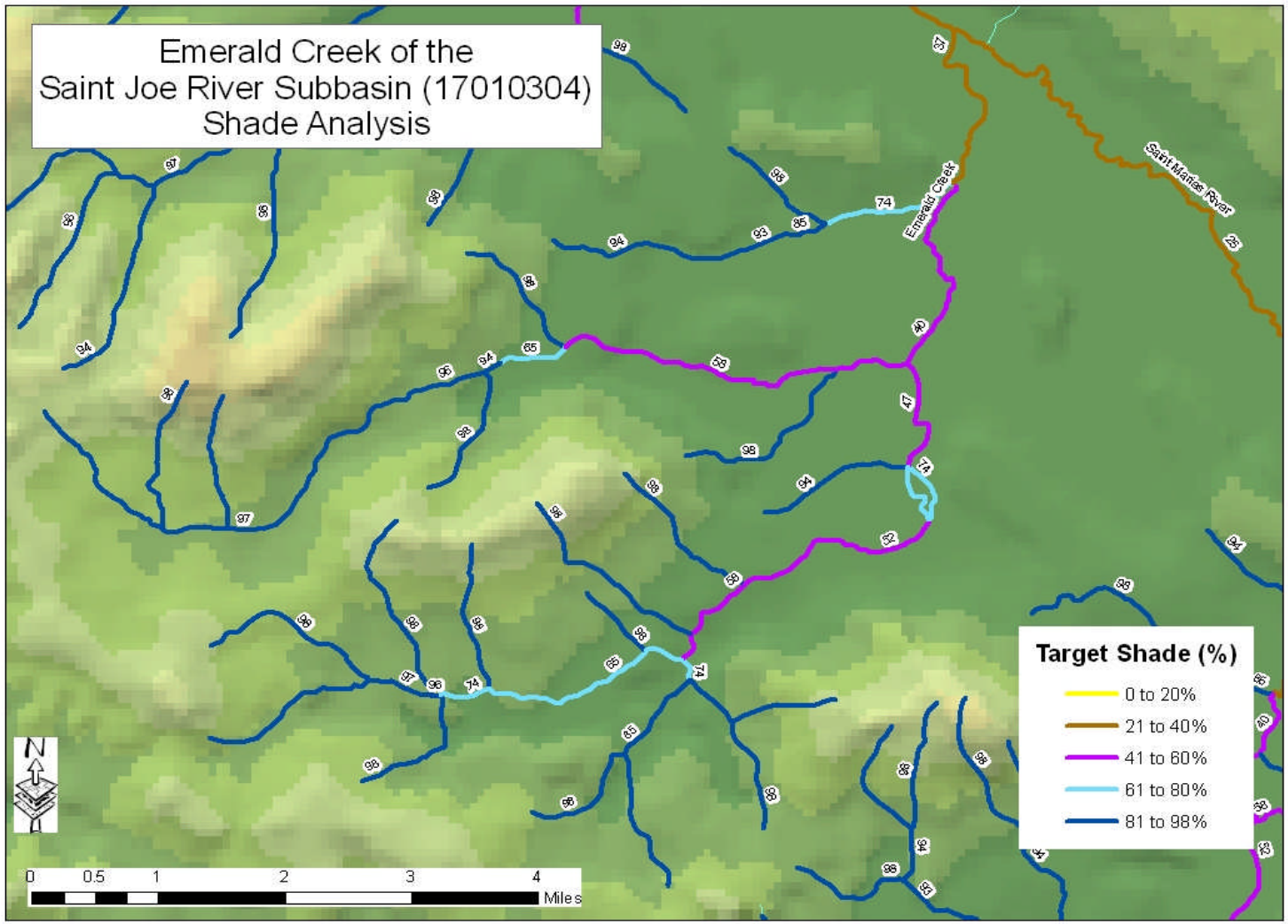


Figure H-8. Target shade (%) for the Emerald Creek watershed

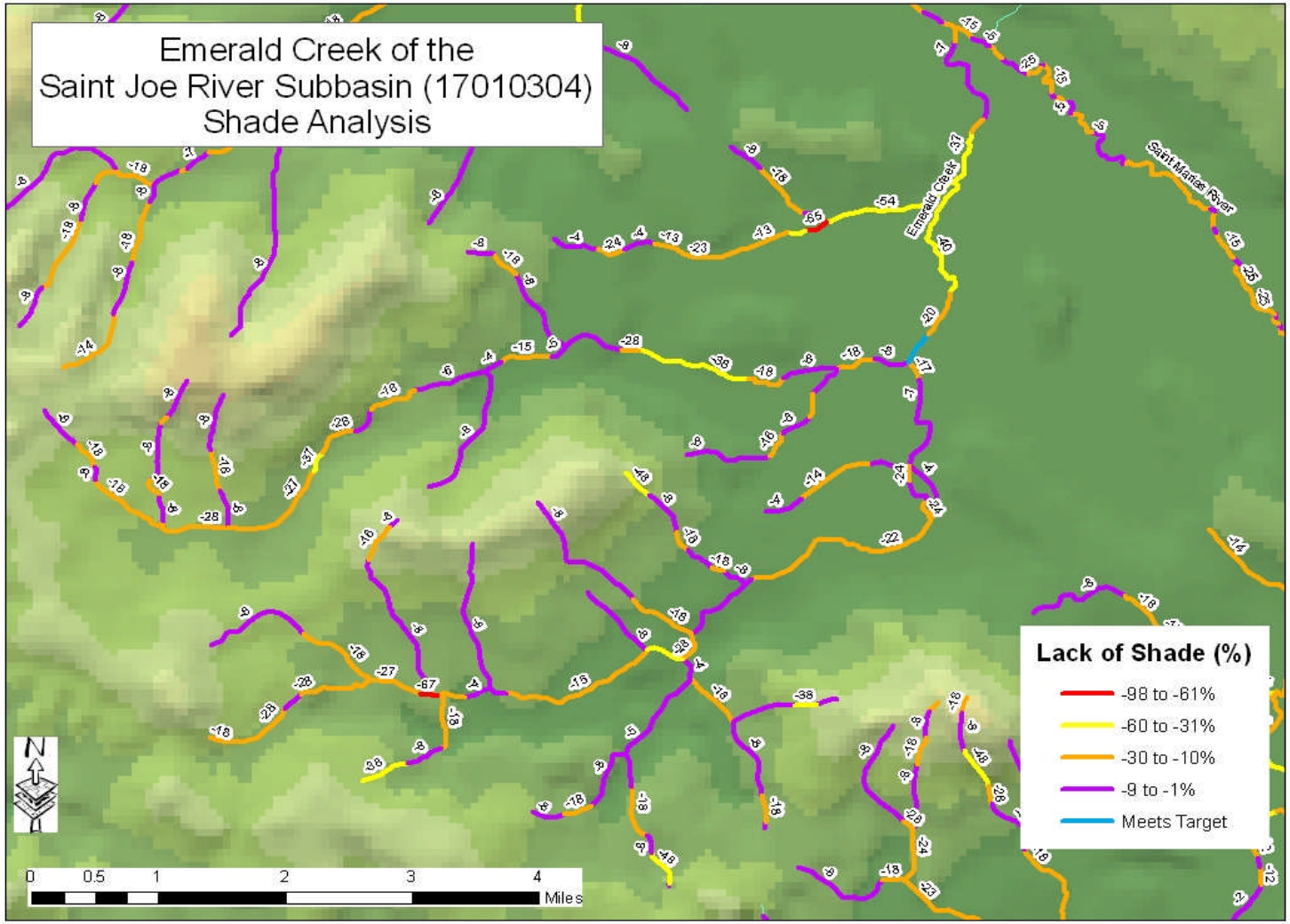


Figure H-9. Delta shade (%) for the Emerald Creek watershed

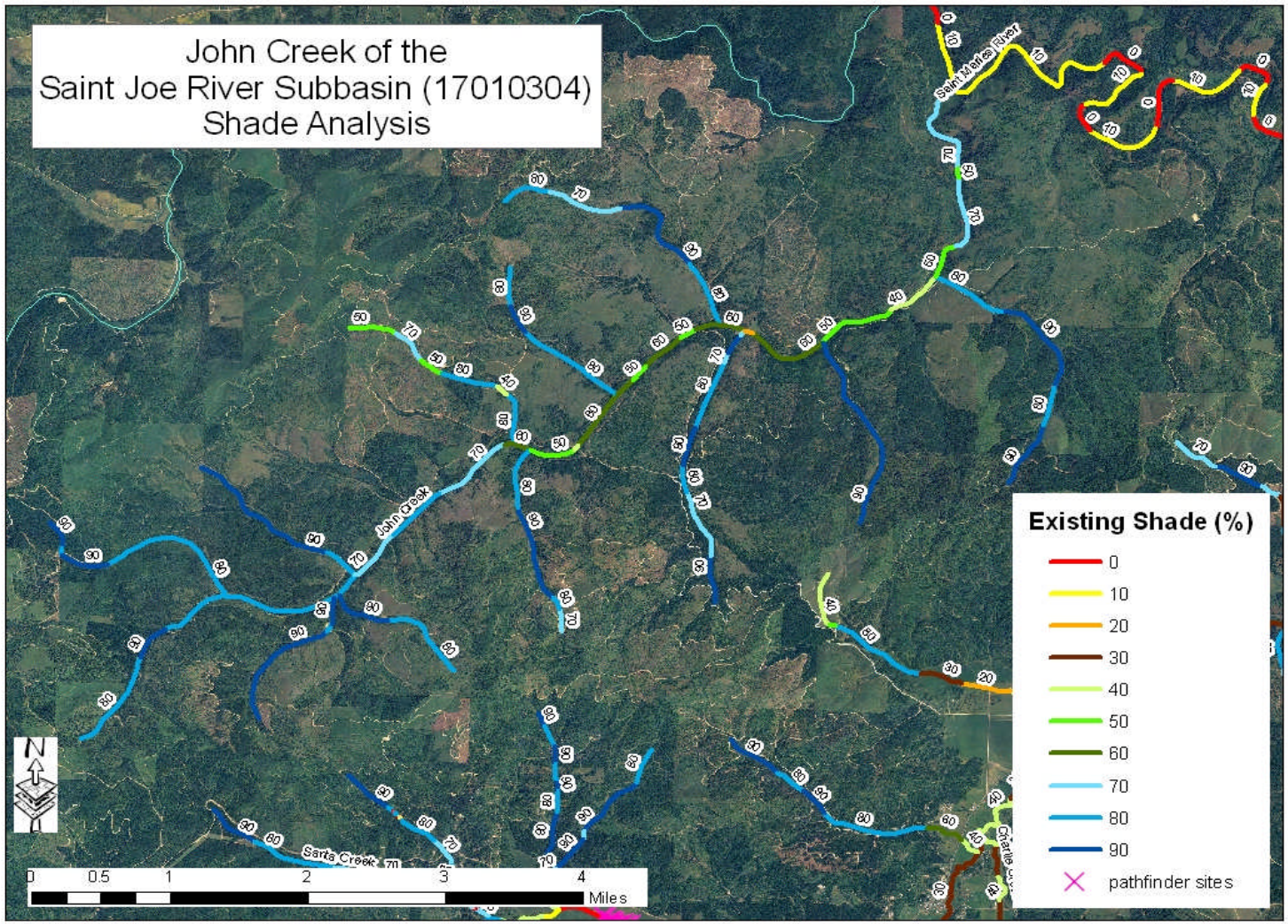


Figure H-10. Existing shade (%) for the John Creek watershed

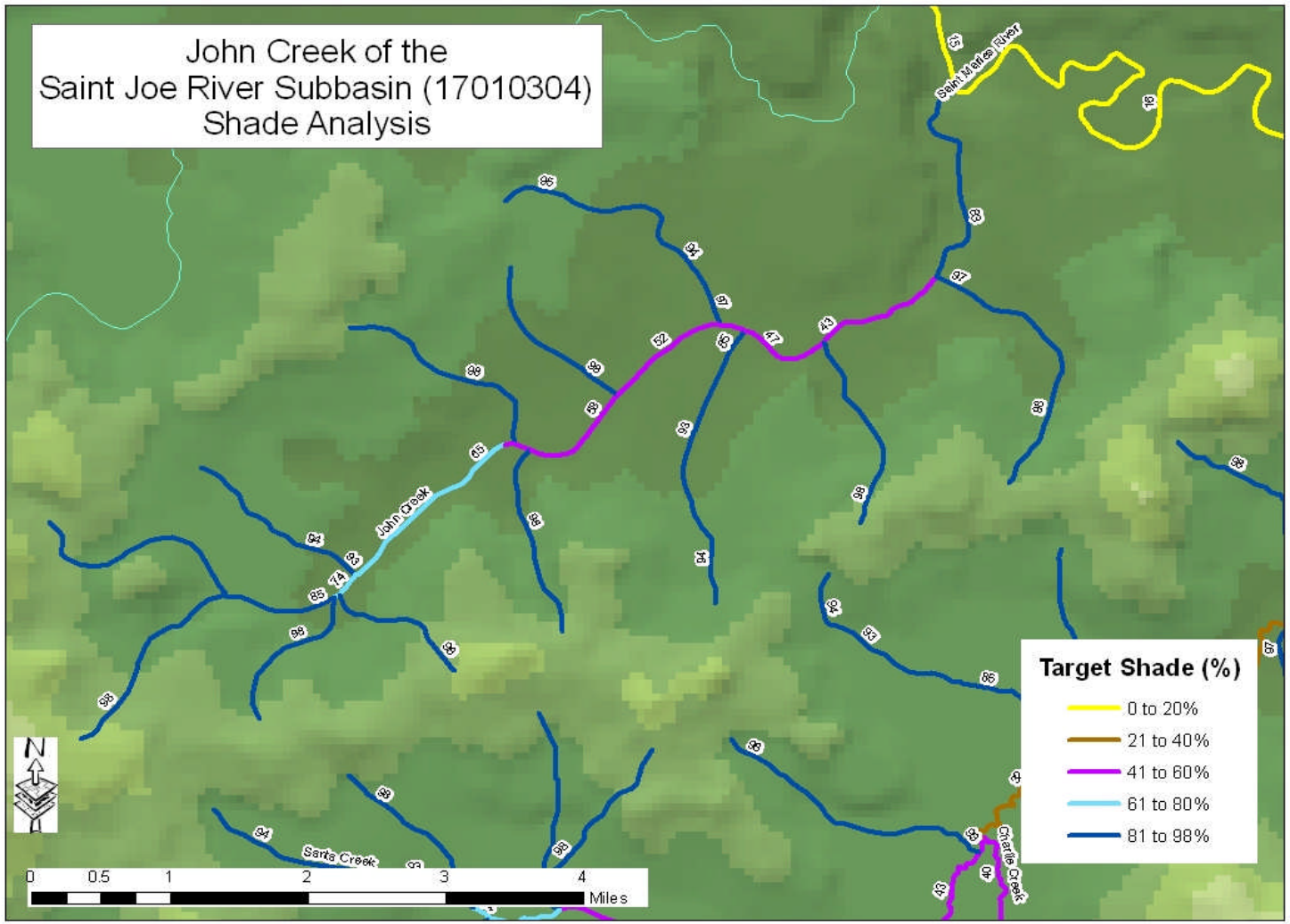


Figure H-11. Target shade (%) for the John Creek watershed



Figure H-12. Delta shade (%) for the John Creek watershed

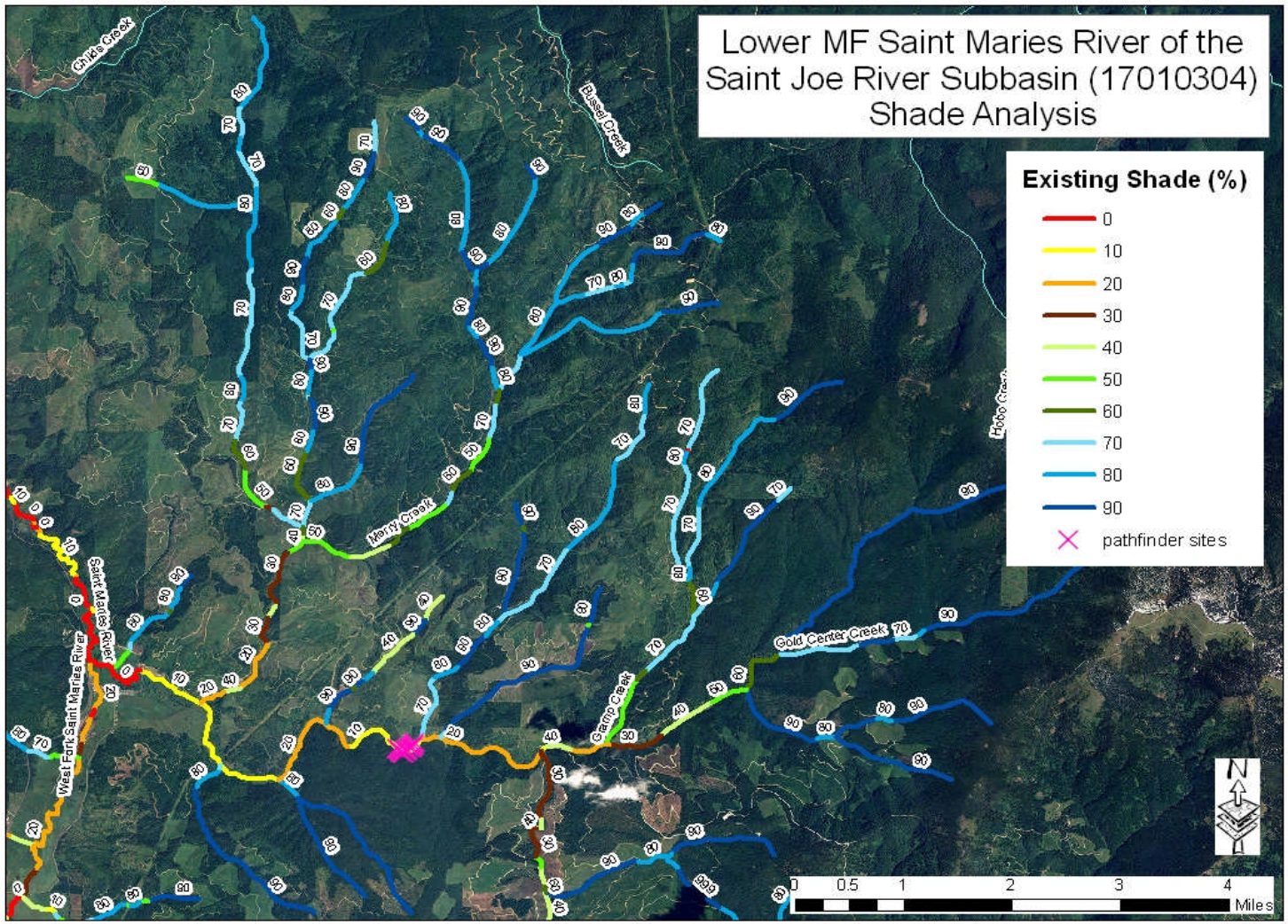


Figure H-13. Existing shade (%) for the lower Middle Fork St. Maries River watershed

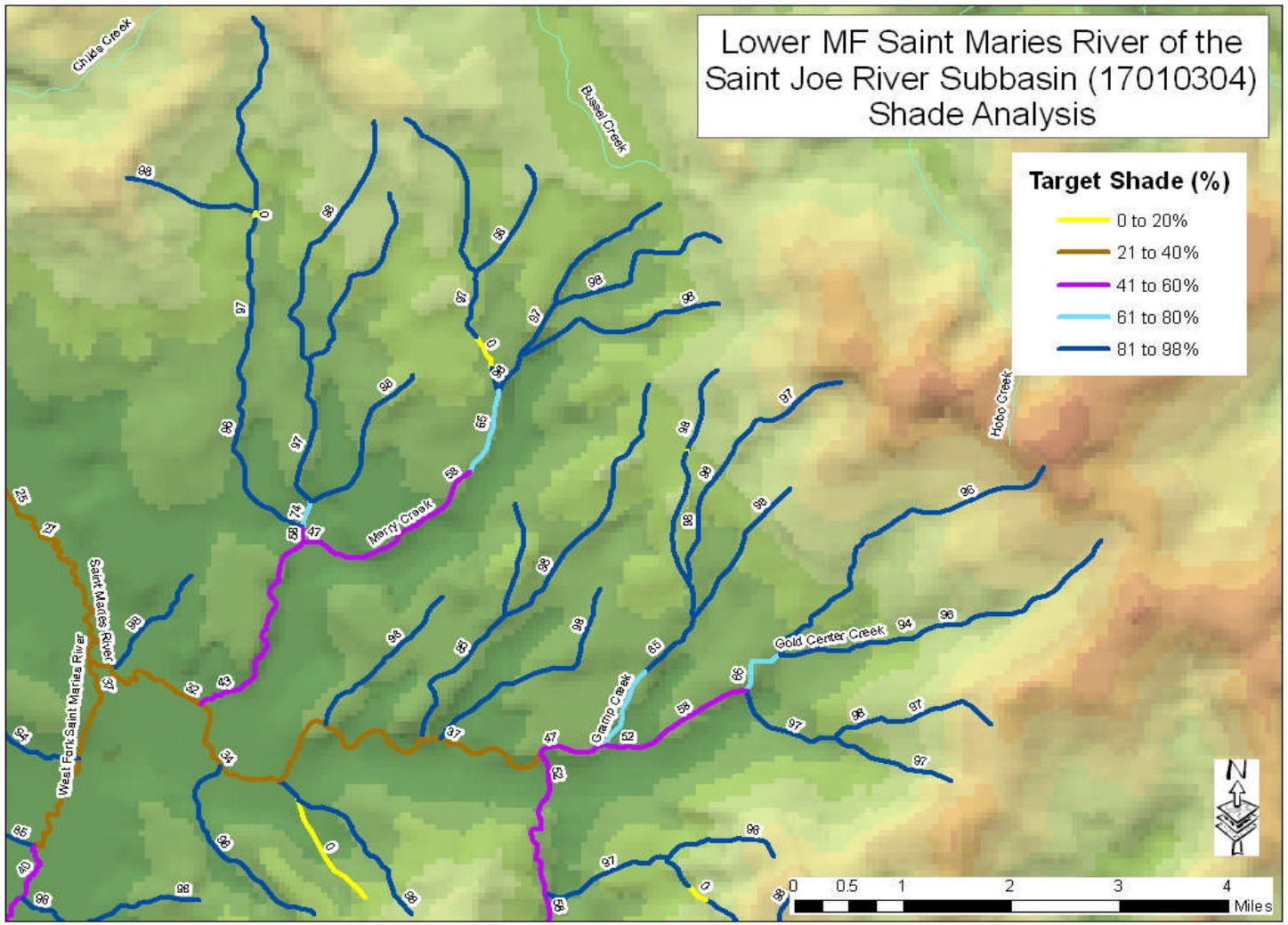


Figure H-14. Target shade (%) for the lower Middle Fork St. Maries River watershed

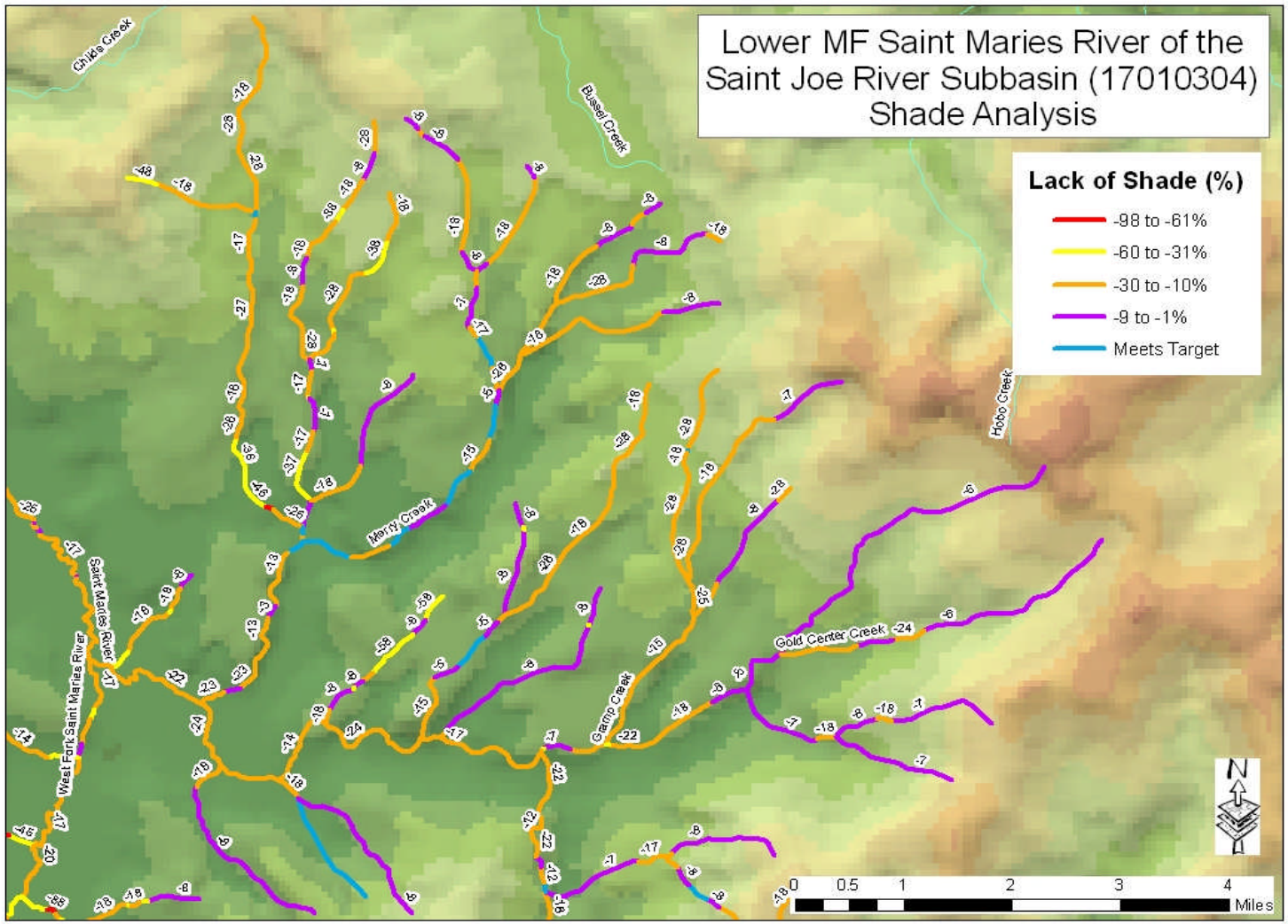


Figure H-15. Delta shade (%) for the lower Middle Fork St. Maries River watershed

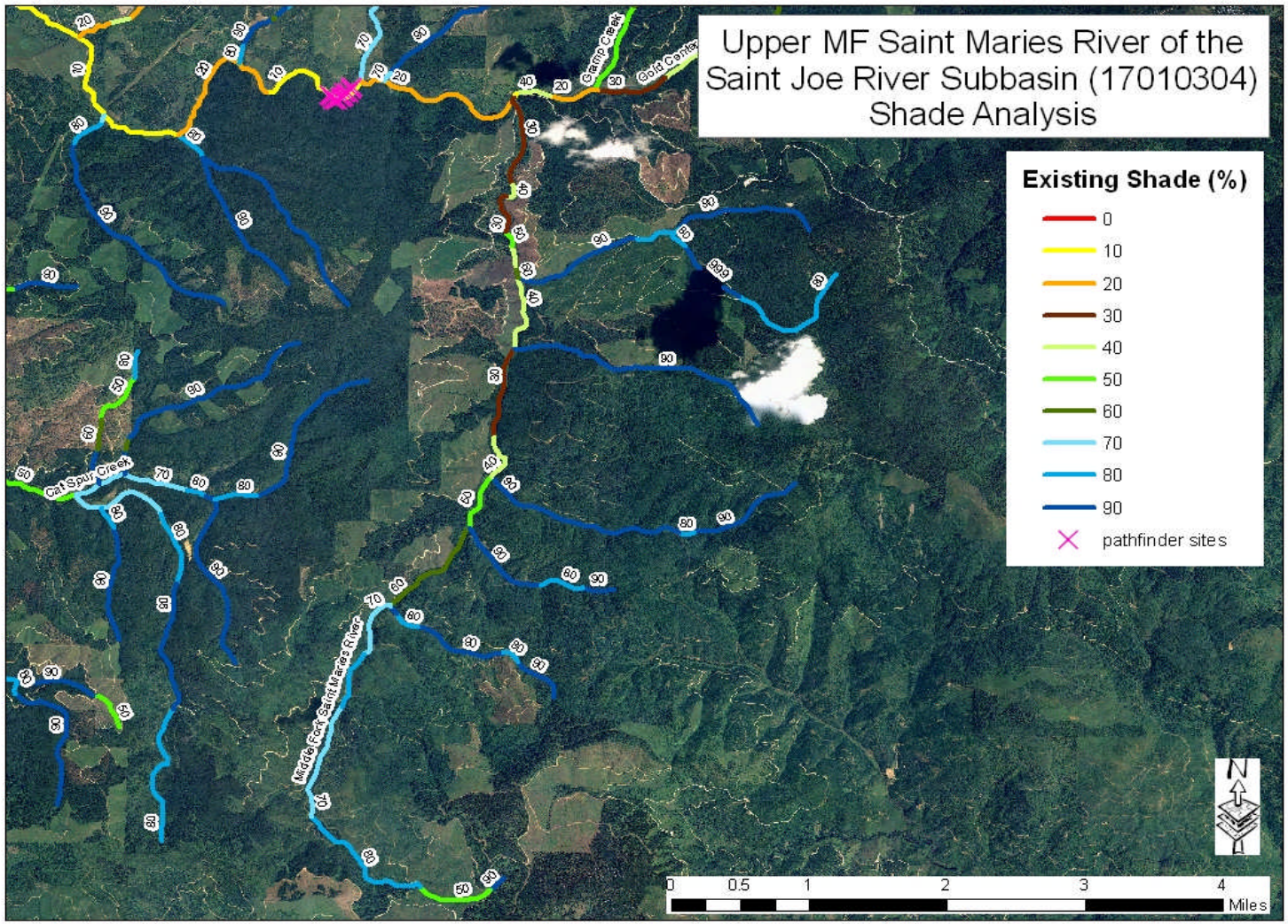


Figure H-16. Existing shade (%) for the upper Middle Fork St. Maries River watershed

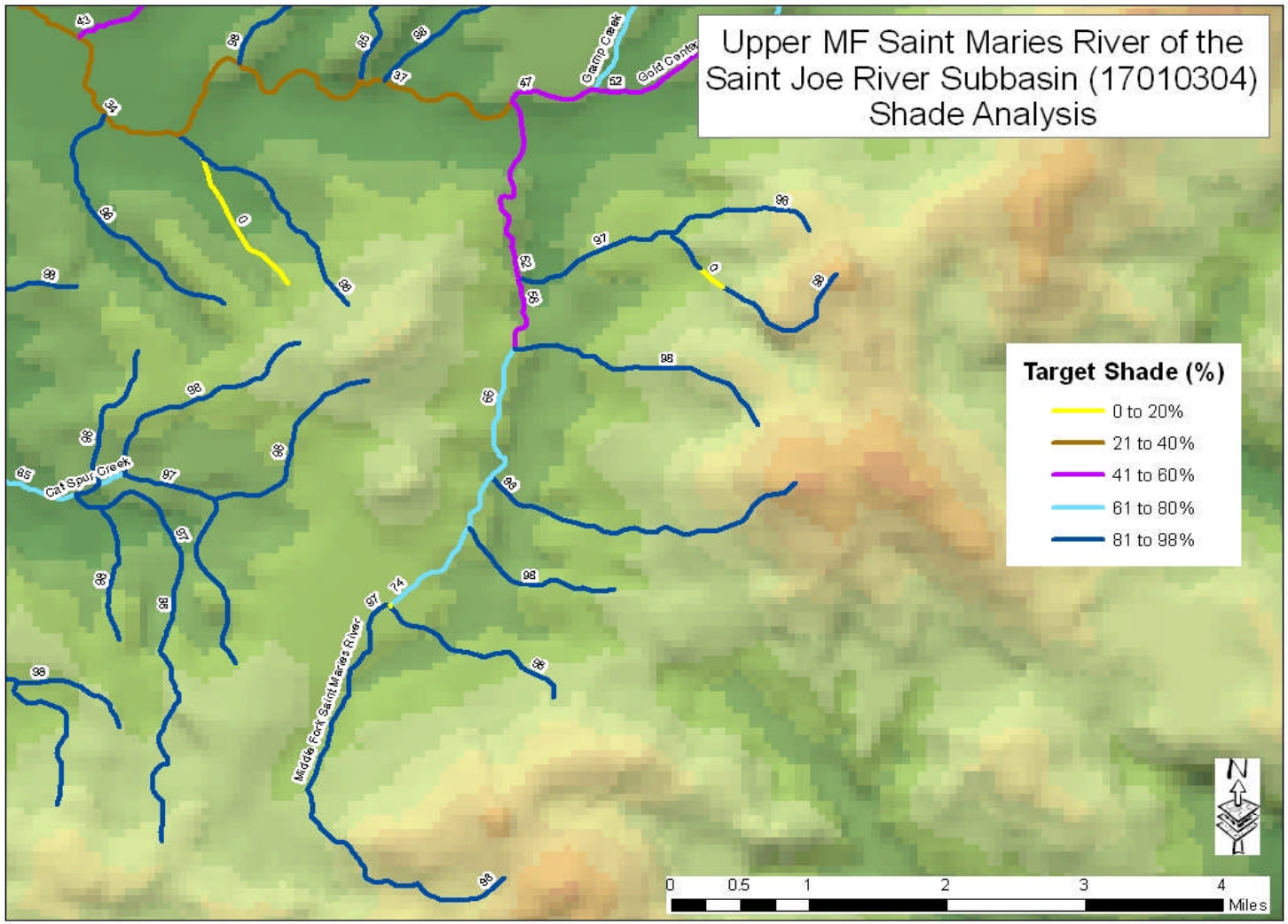


Figure H-17. Target shade (%) for the upper Middle Fork St. Maries River watershed

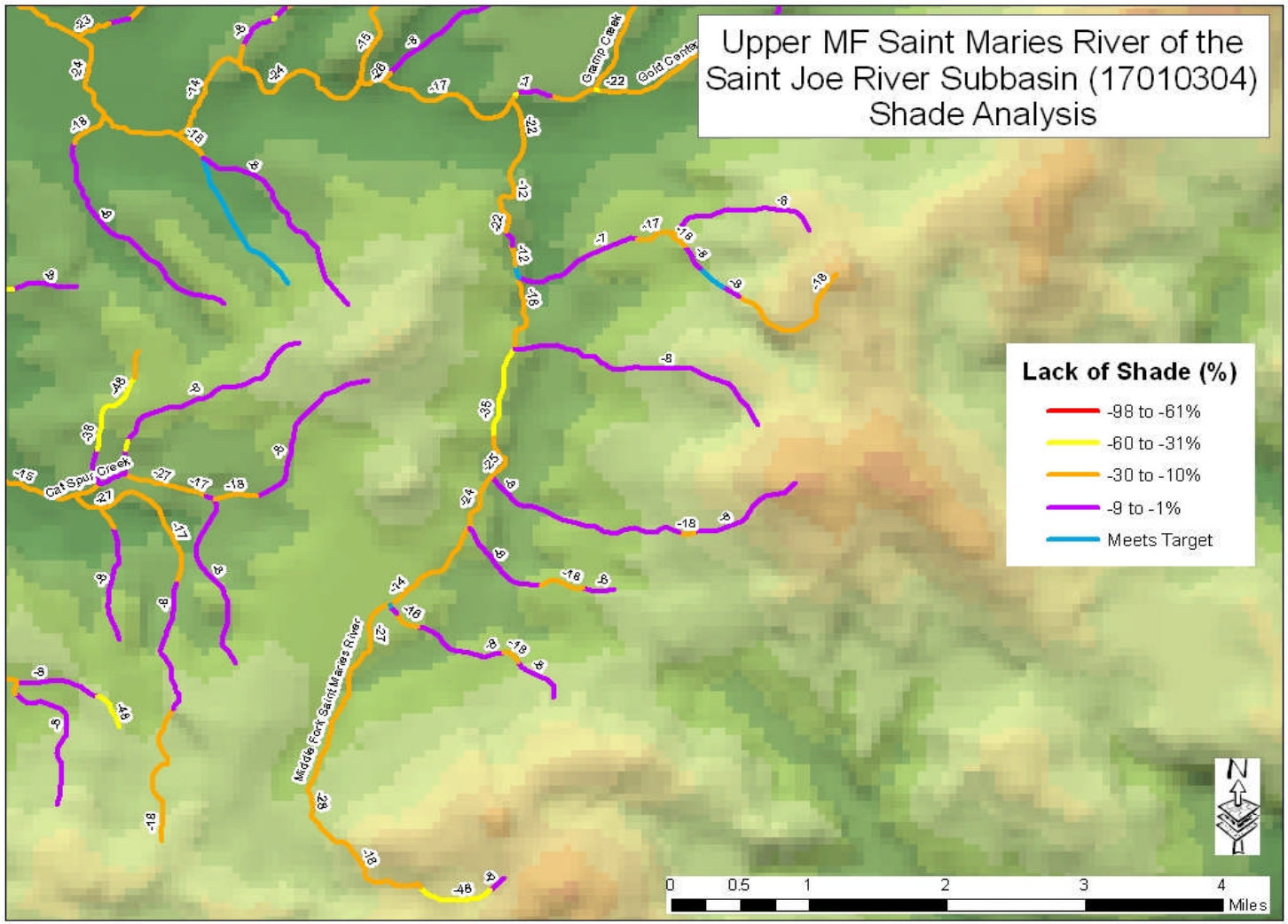


Figure H-18. Delta shade (%) for the upper Middle Fork St. Maries River watershed

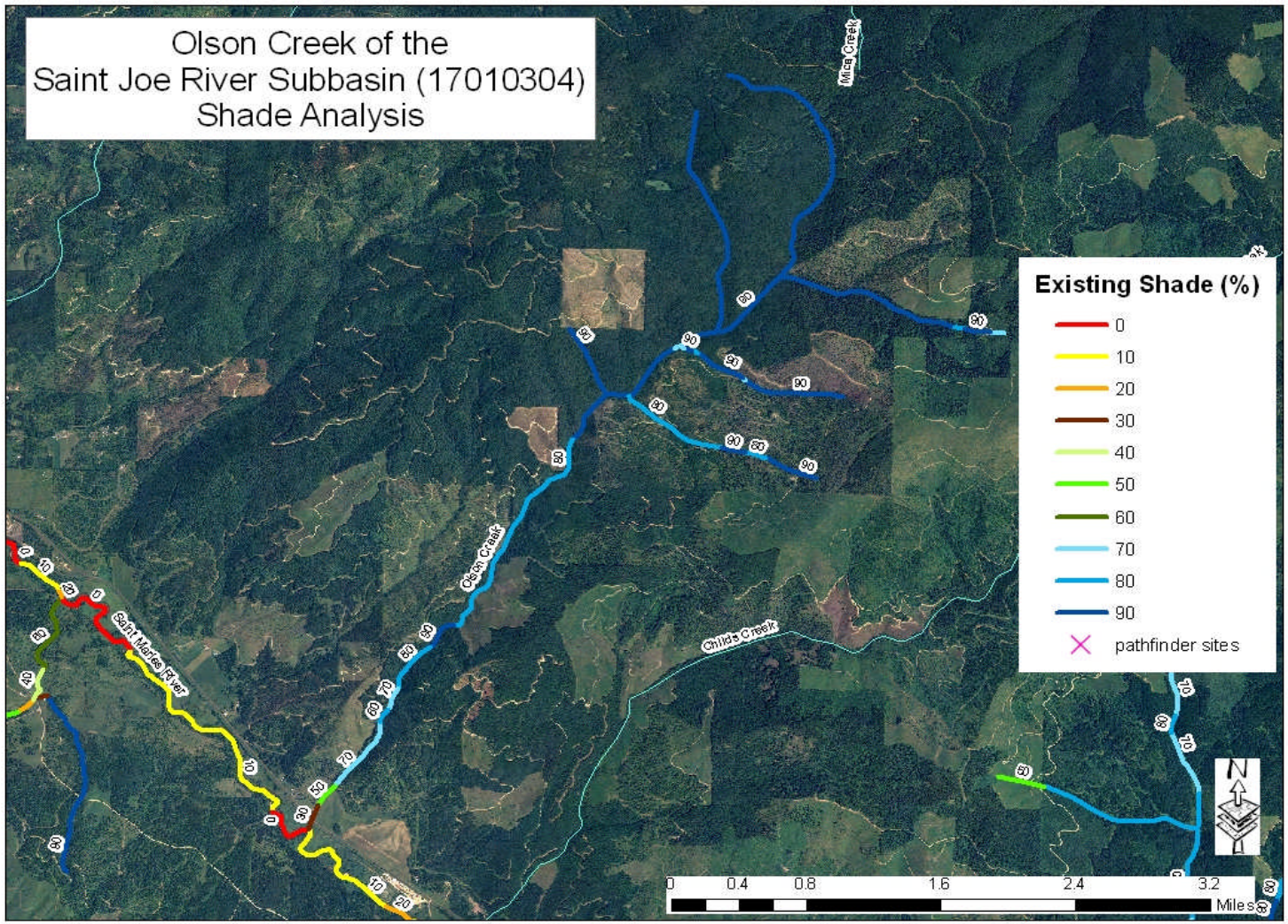


Figure H-19. Existing shade (%) for the Olsen Creek watershed

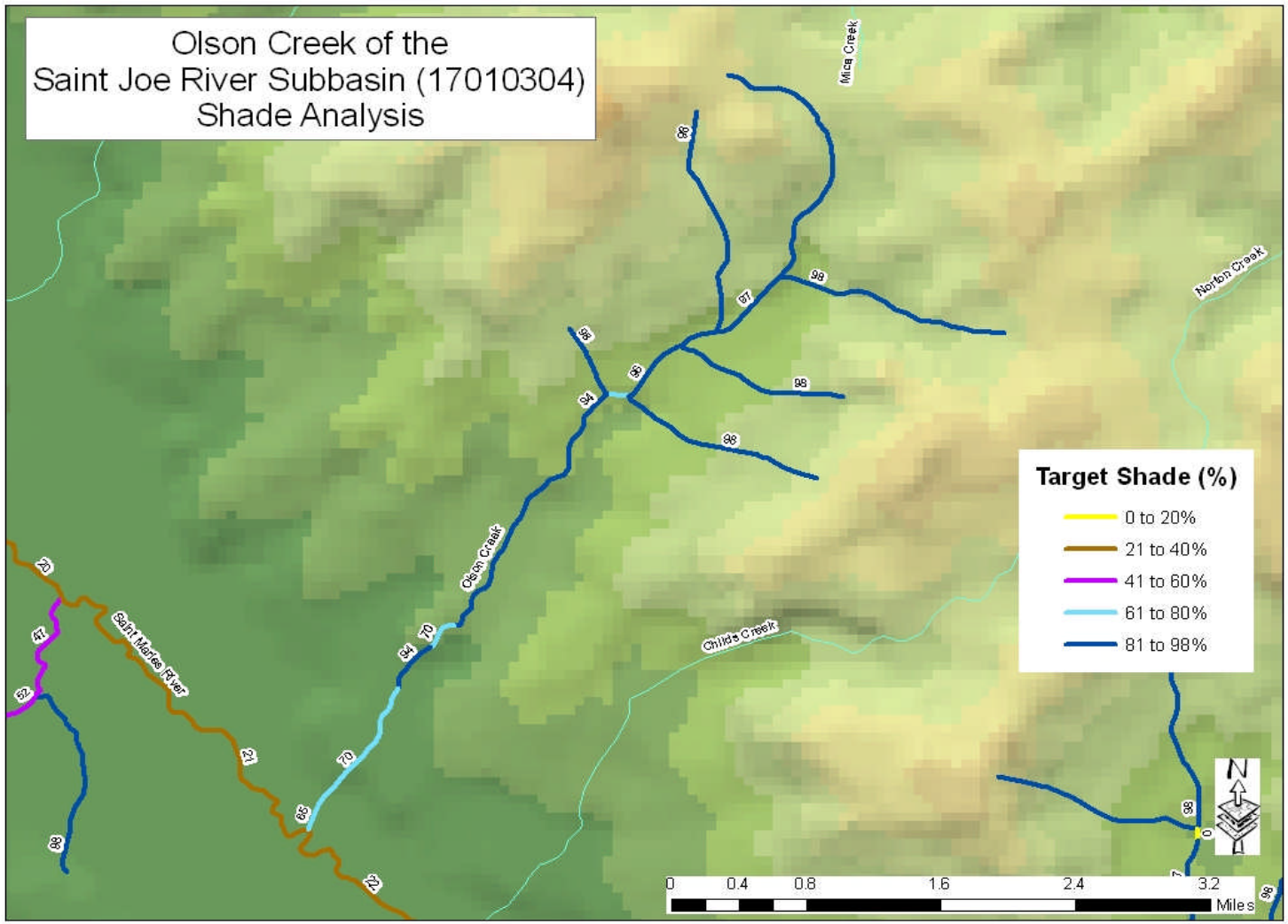


Figure H-20. Target shade (%) for the Olson Creek watershed

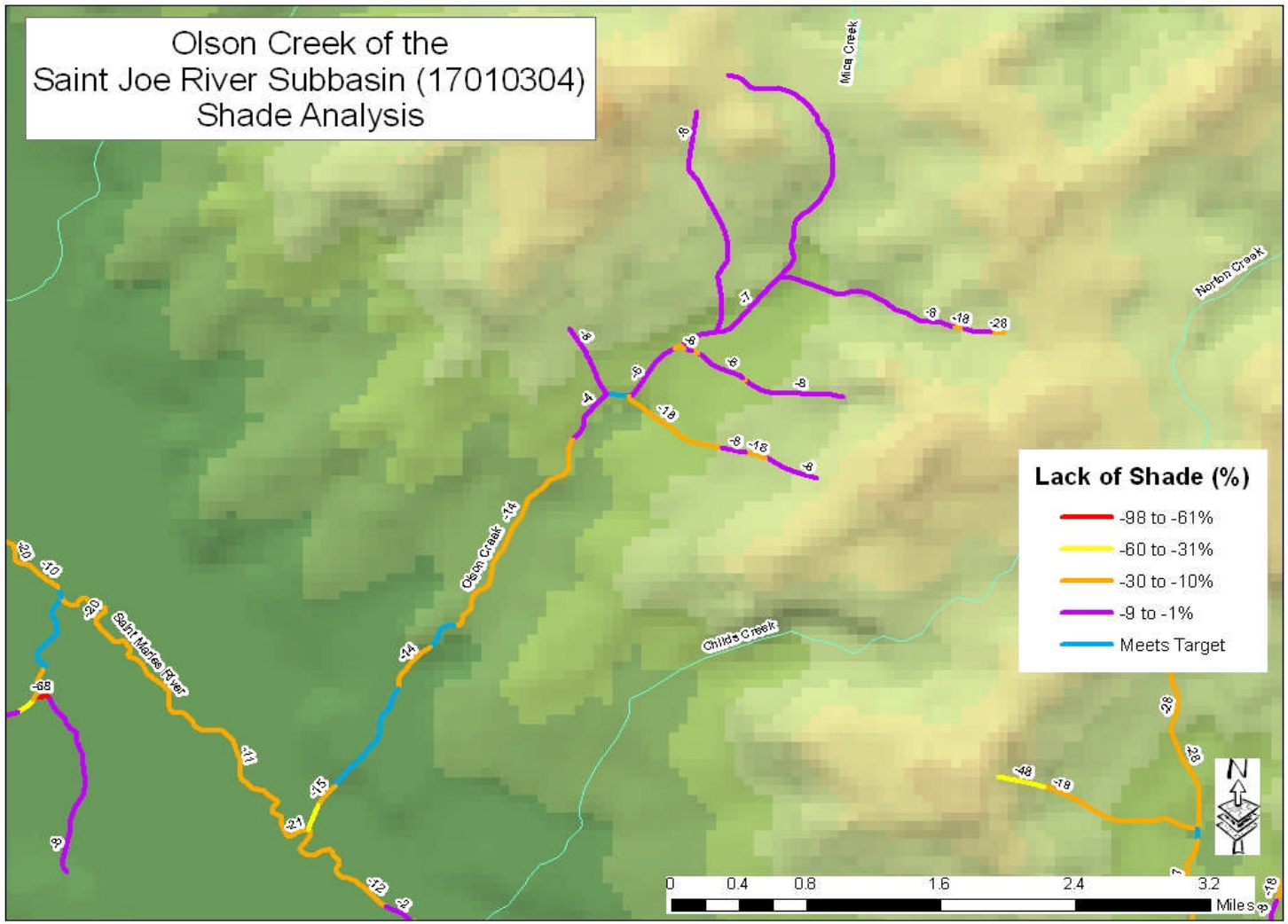


Figure H-21. Delta shade (%) for the Olson Creek watershed

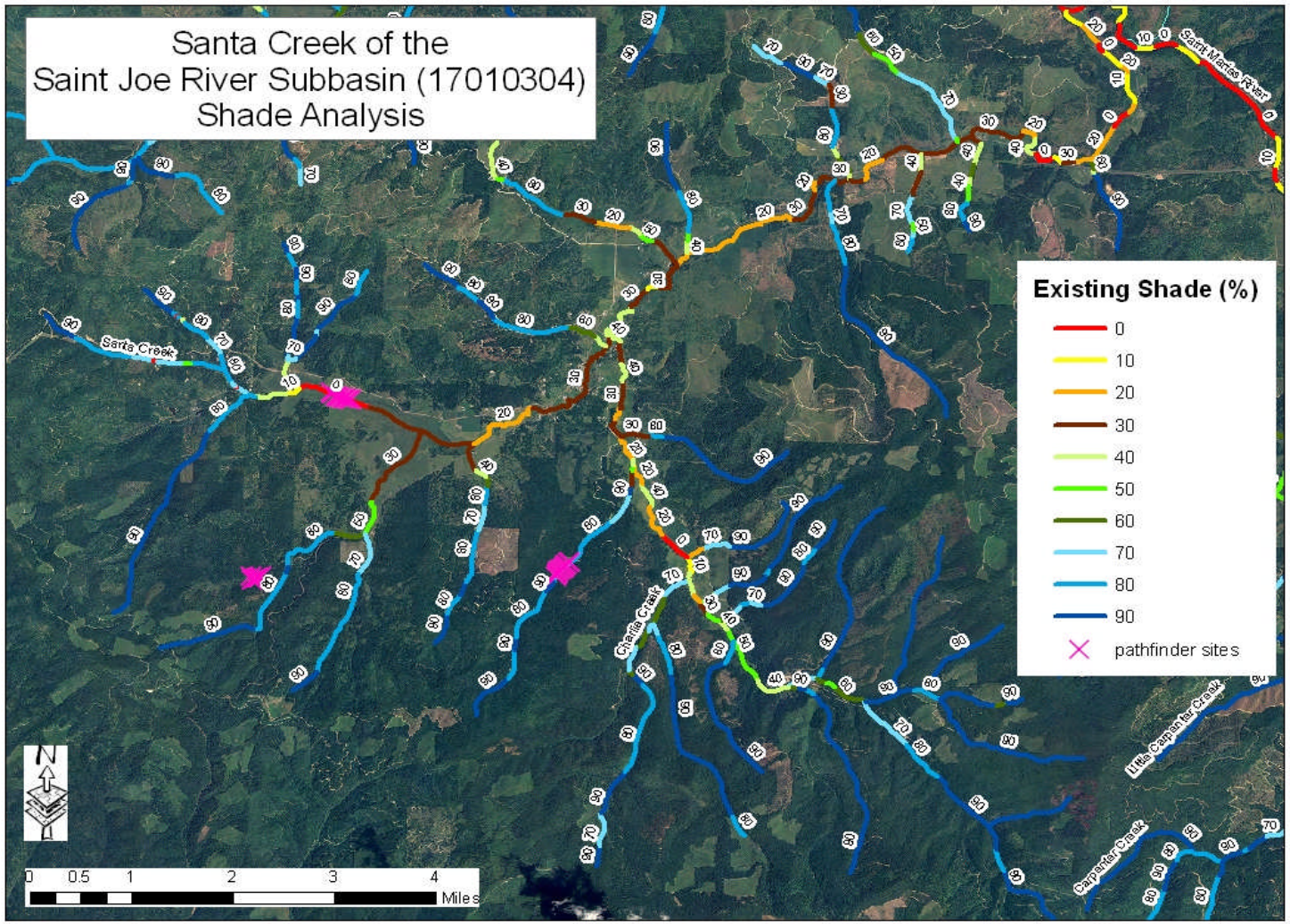


Figure H-22. Existing shade (%) for the Santa Creek watershed

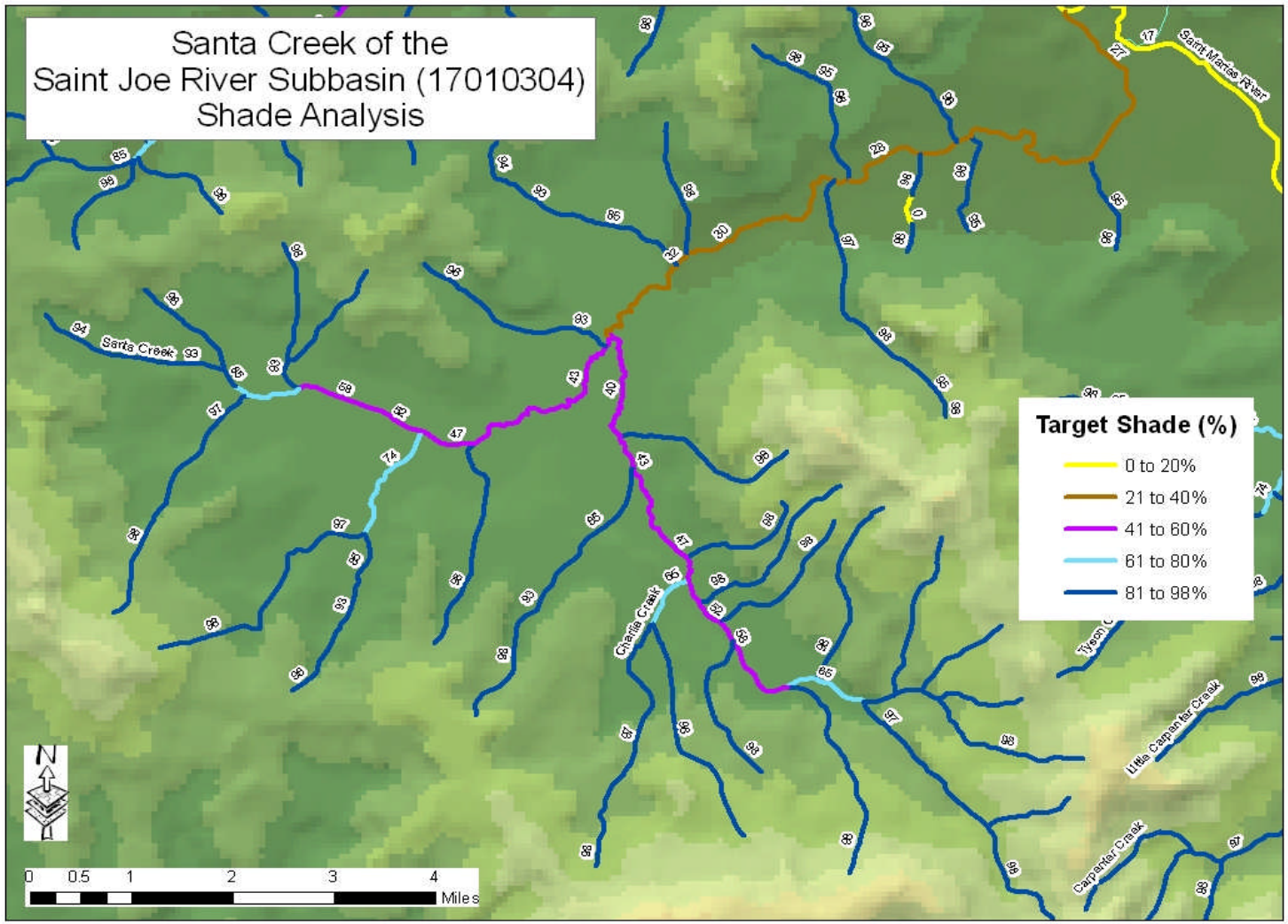


Figure H-23. Target shade (%) for the Santa Creek watershed

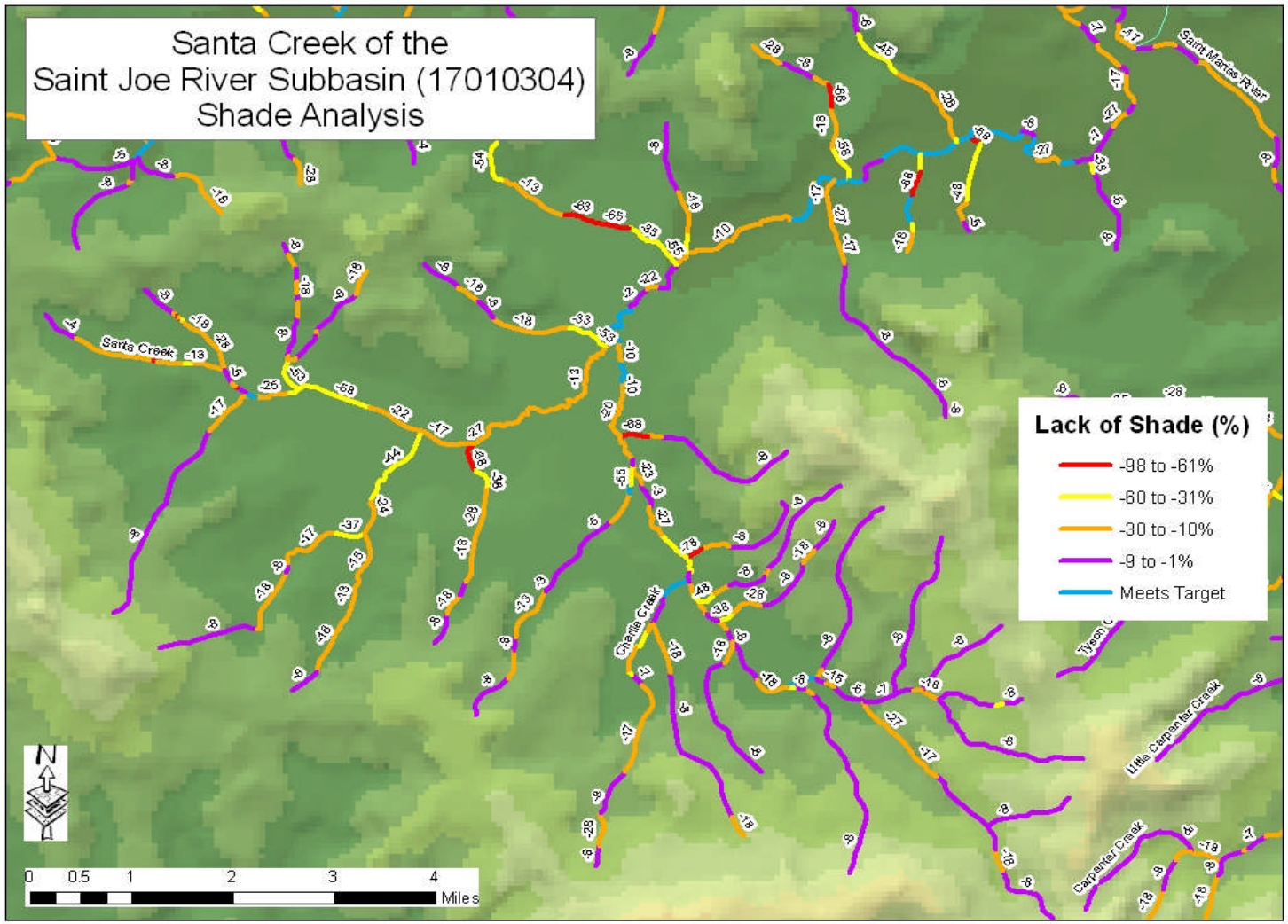


Figure H-24. Delta shade (%) for the Santa Creek watershed

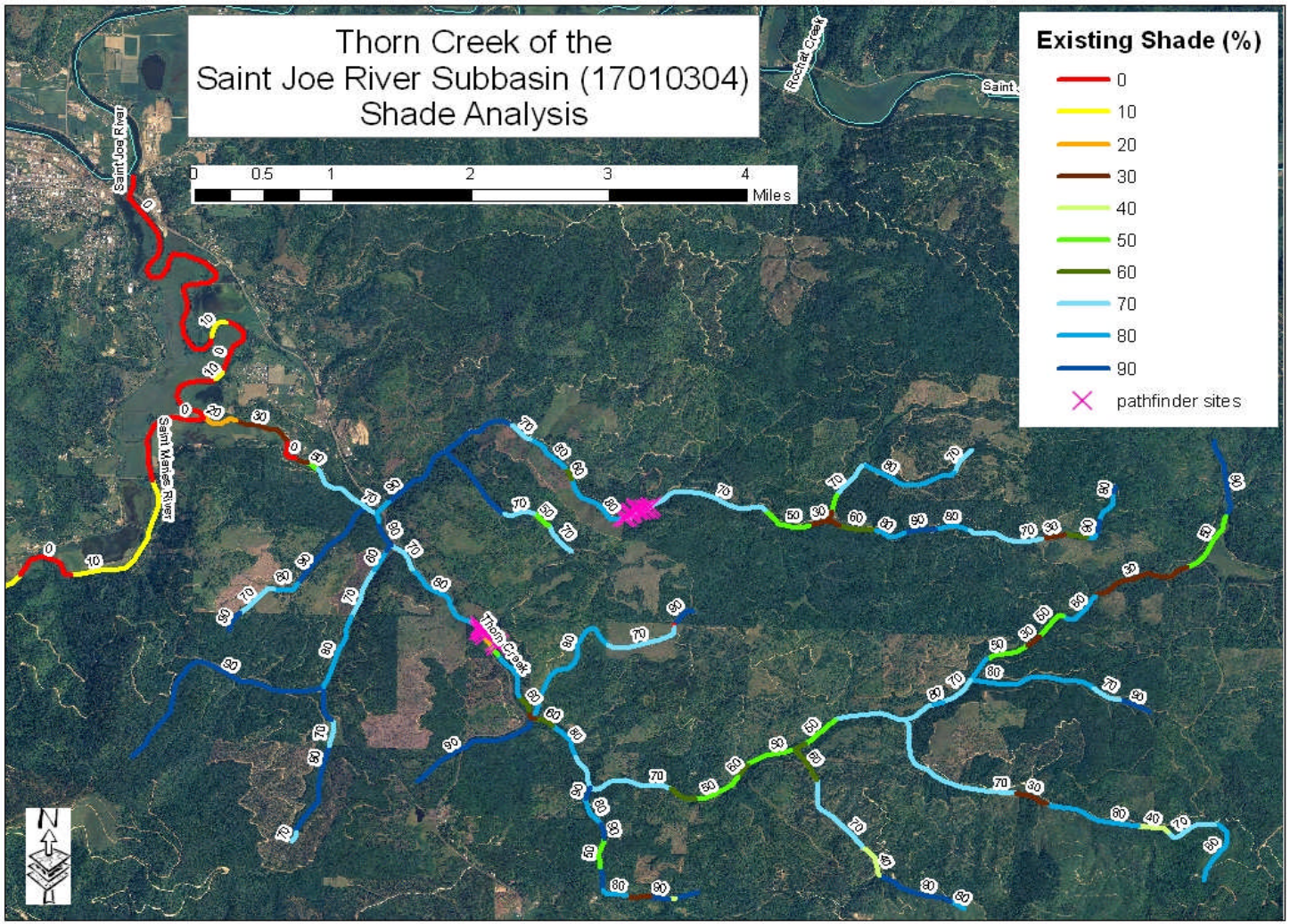


Figure H-25. Existing shade (%) for the Thorn Creek watershed

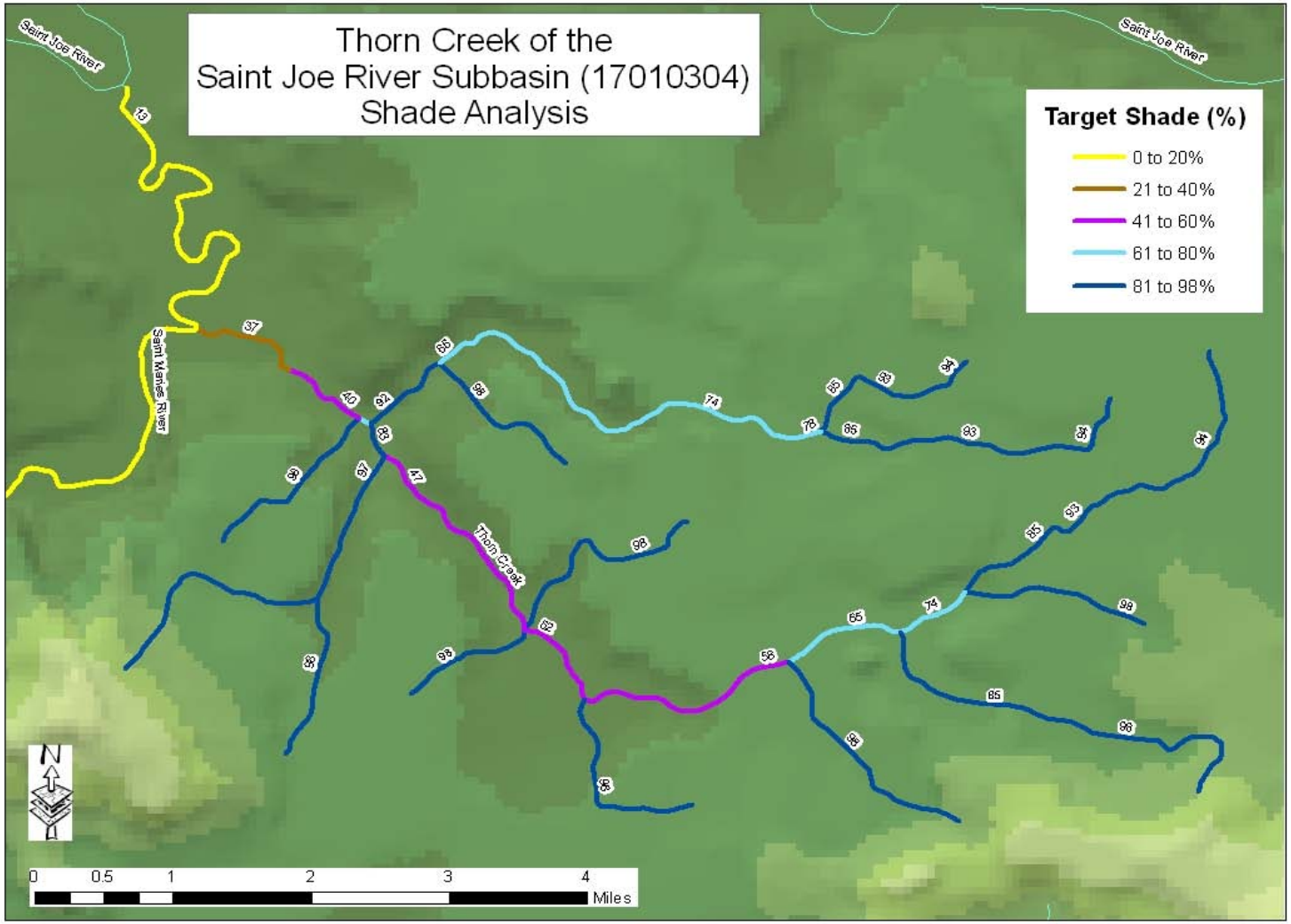


Figure H-26. Target shade (%) for the Thorn Creek watershed

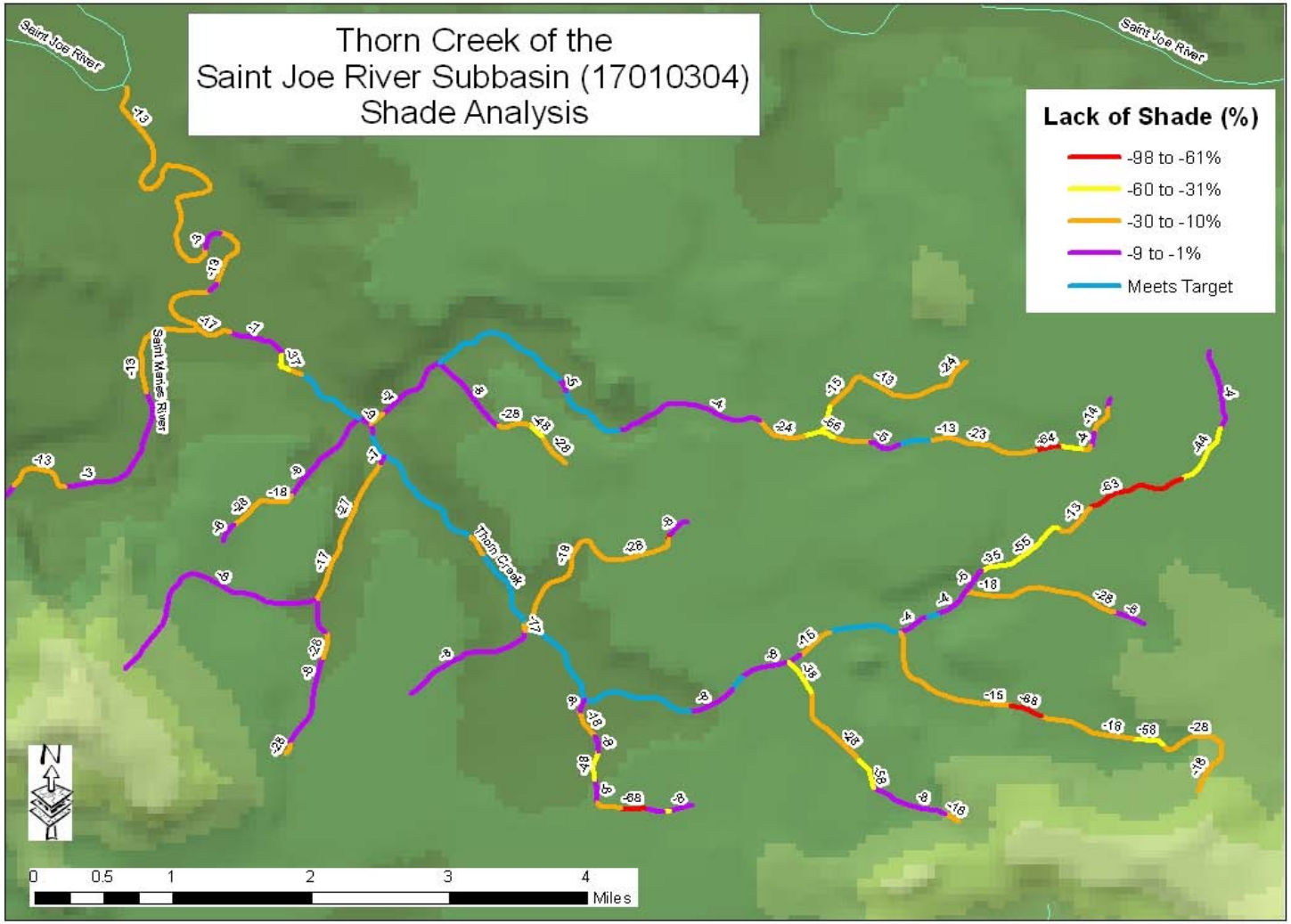


Figure H-27. Delta shade (%) for the Thorn Creek watershed

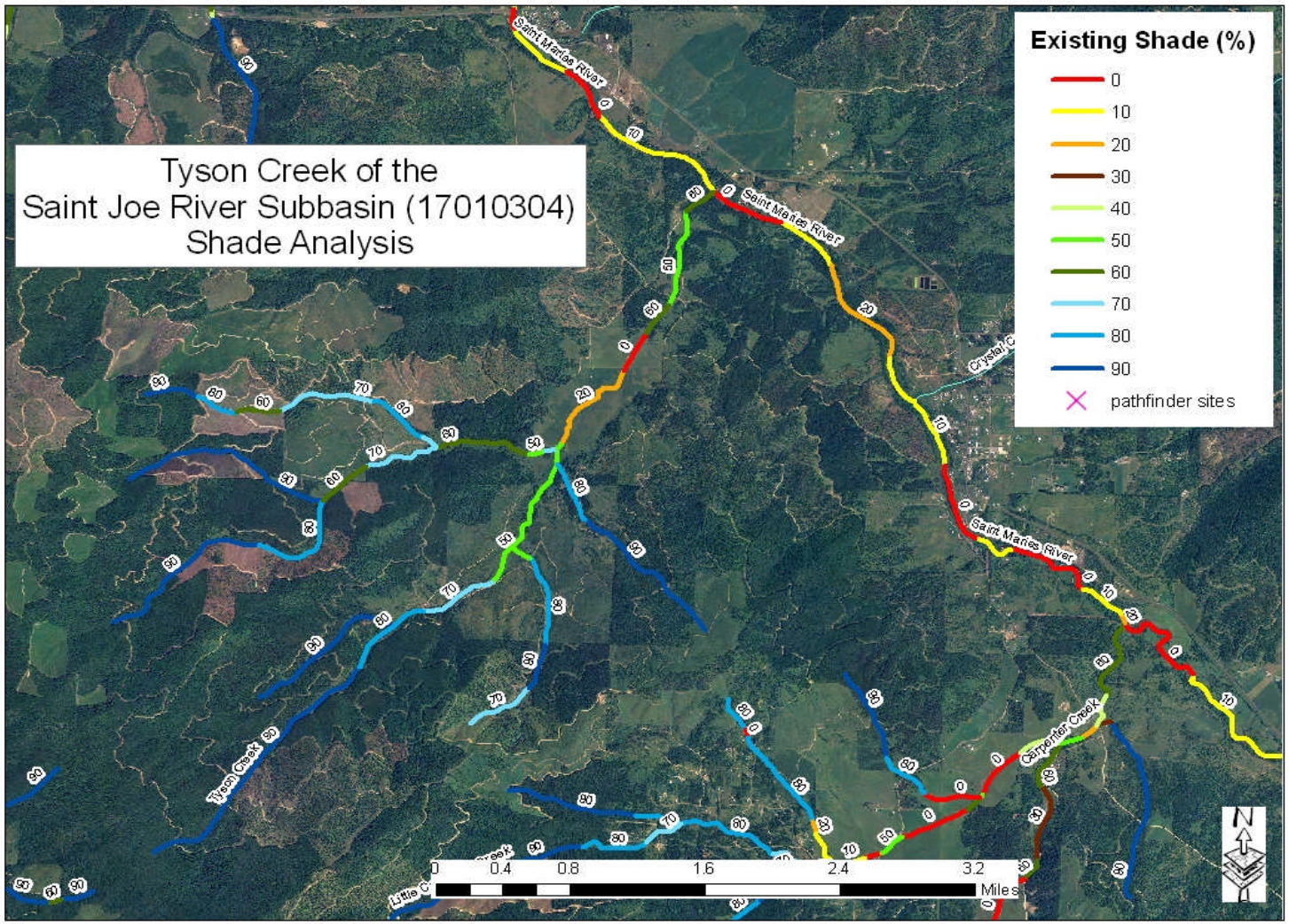


Figure H-28. Existing shade (%) for the Tyson Creek watershed

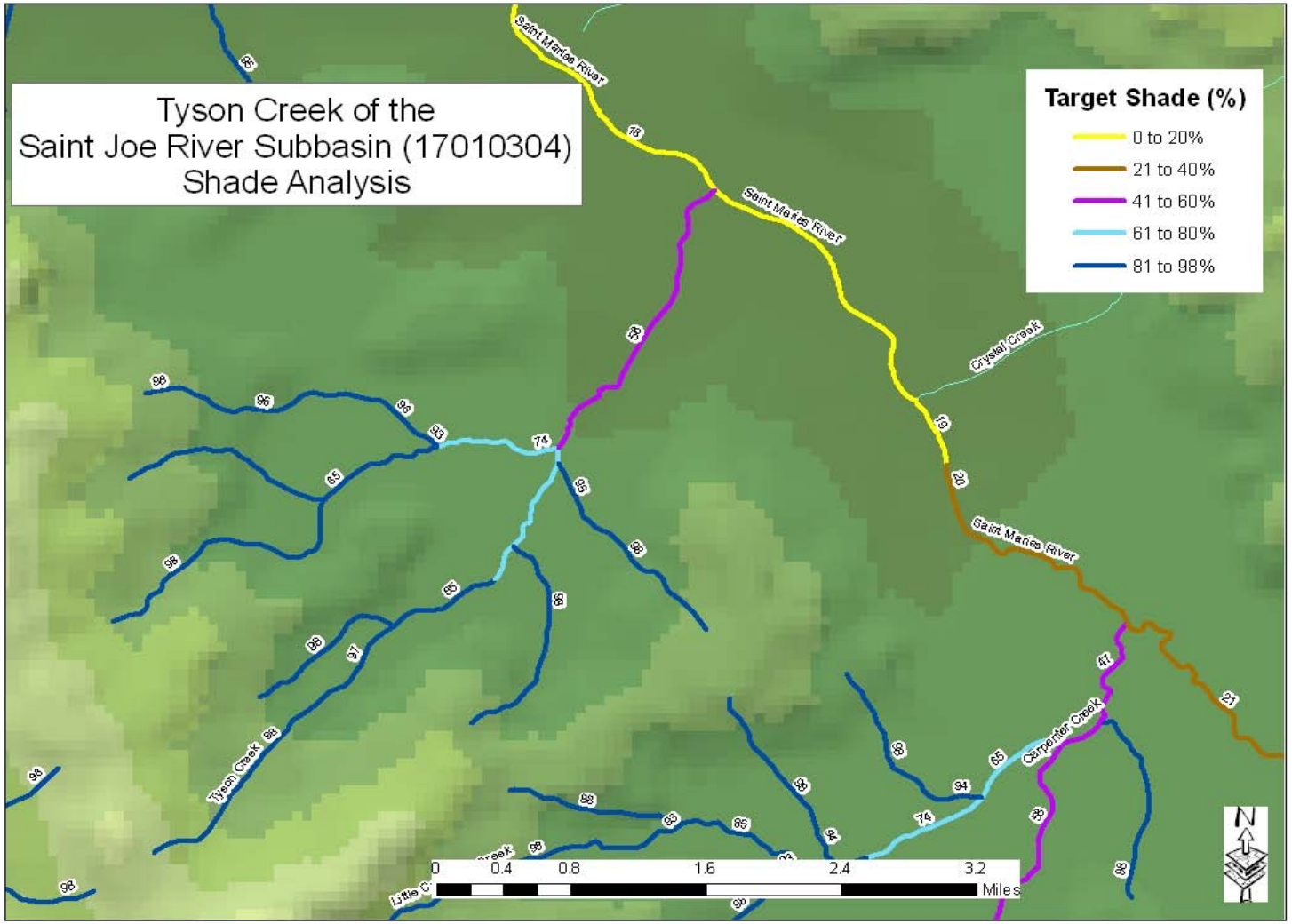


Figure H-29. Target shade (%) for the Tyson Creek watershed

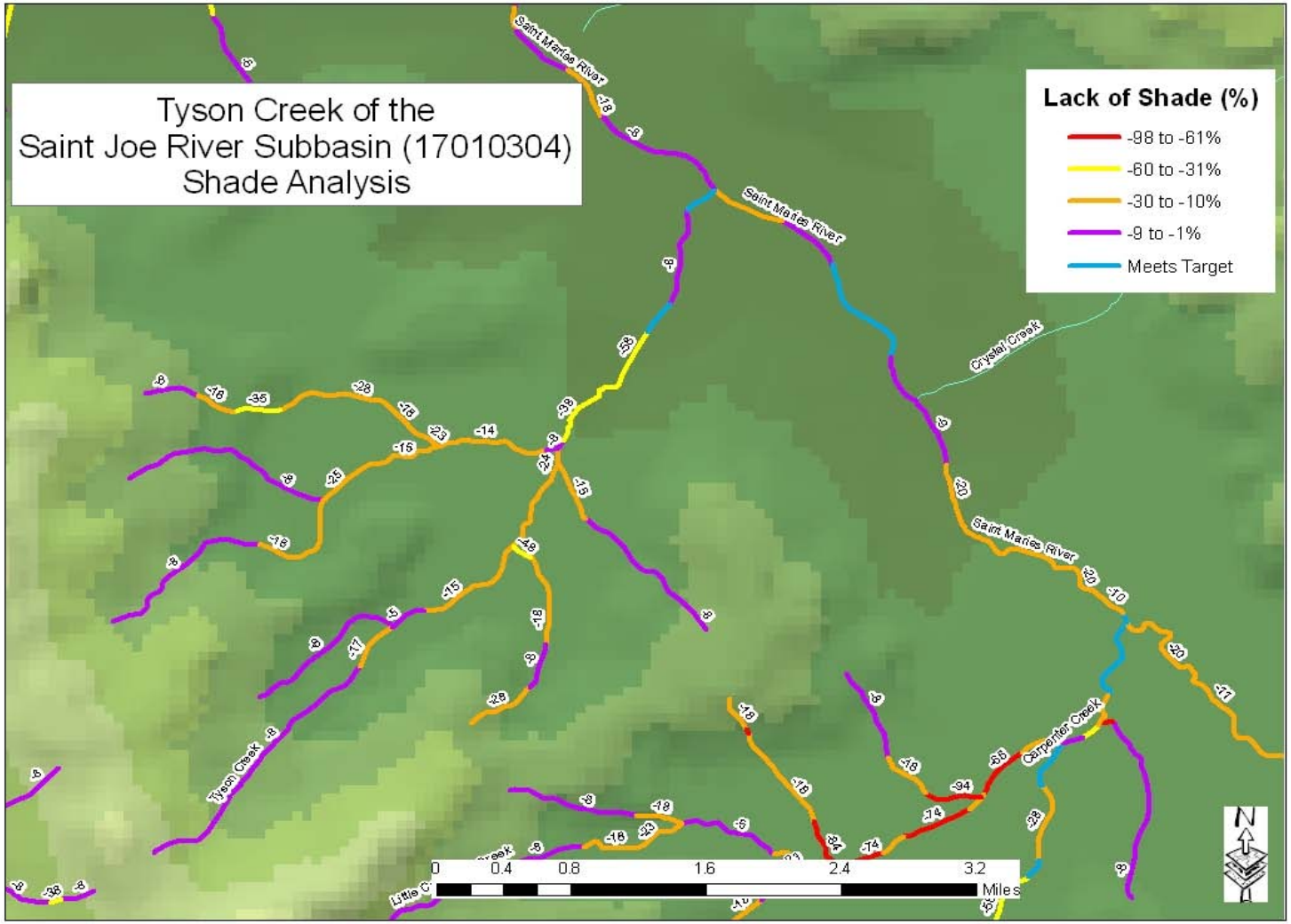


Figure H-30. Delta shade (%) for the Tyson Creek watershed

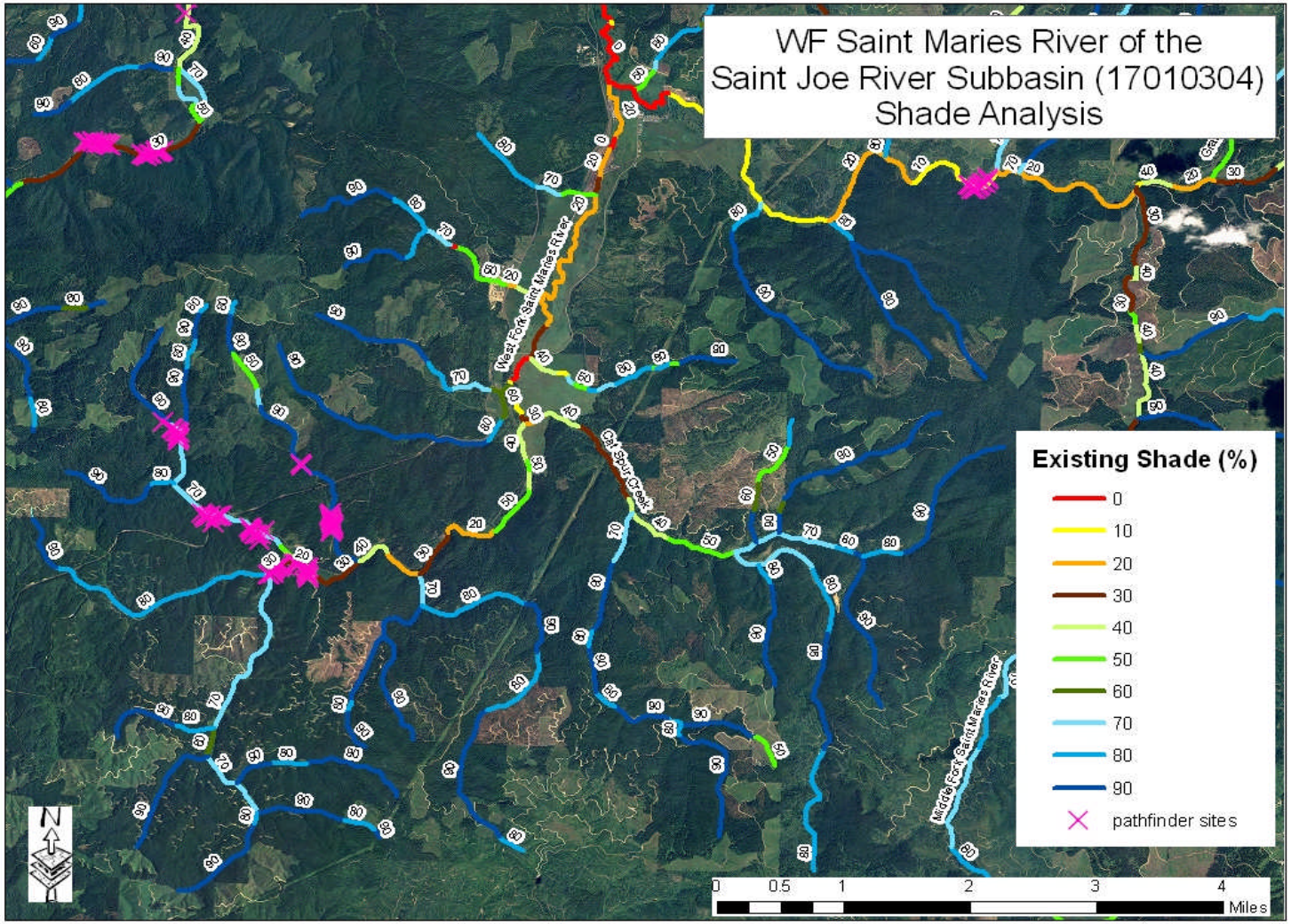


Figure H-31. Existing shade (%) for the West Fork St. Maries River watershed

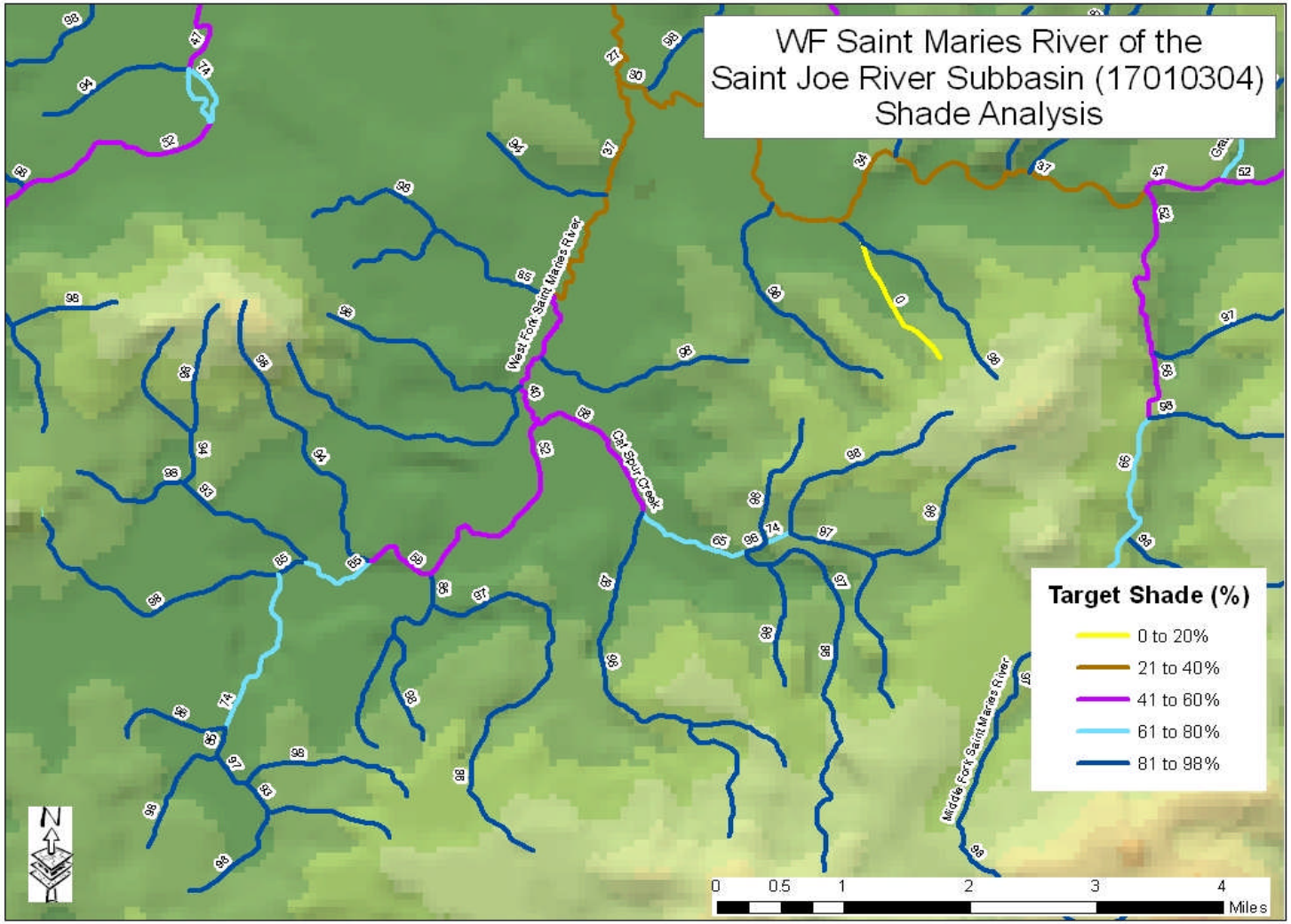


Figure H-32. Target shade (%) for the West Fork St. Maries River watershed

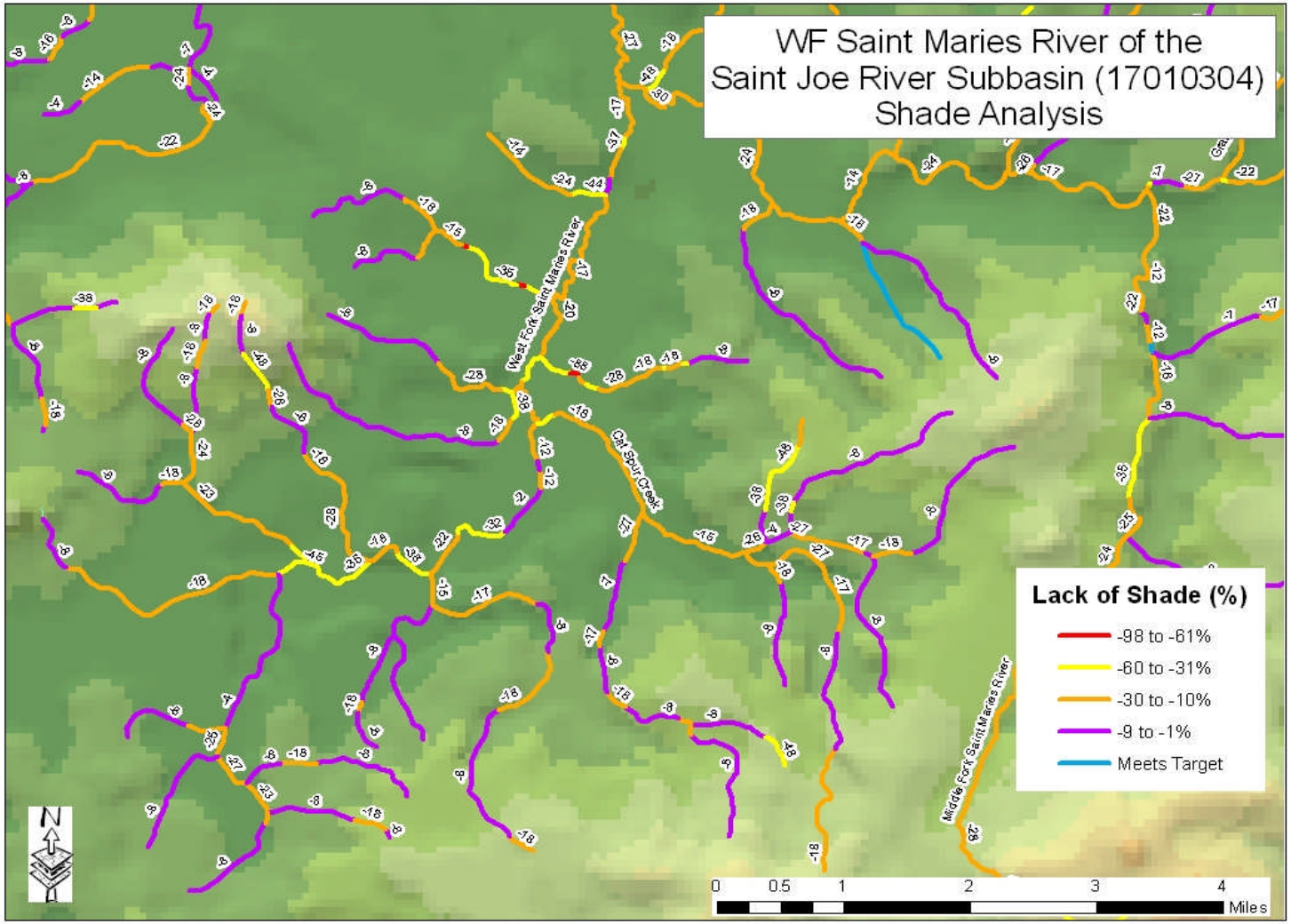


Figure H-33. Delta shade (%) for the West Fork St. Maries River watershed

Stream Gradient

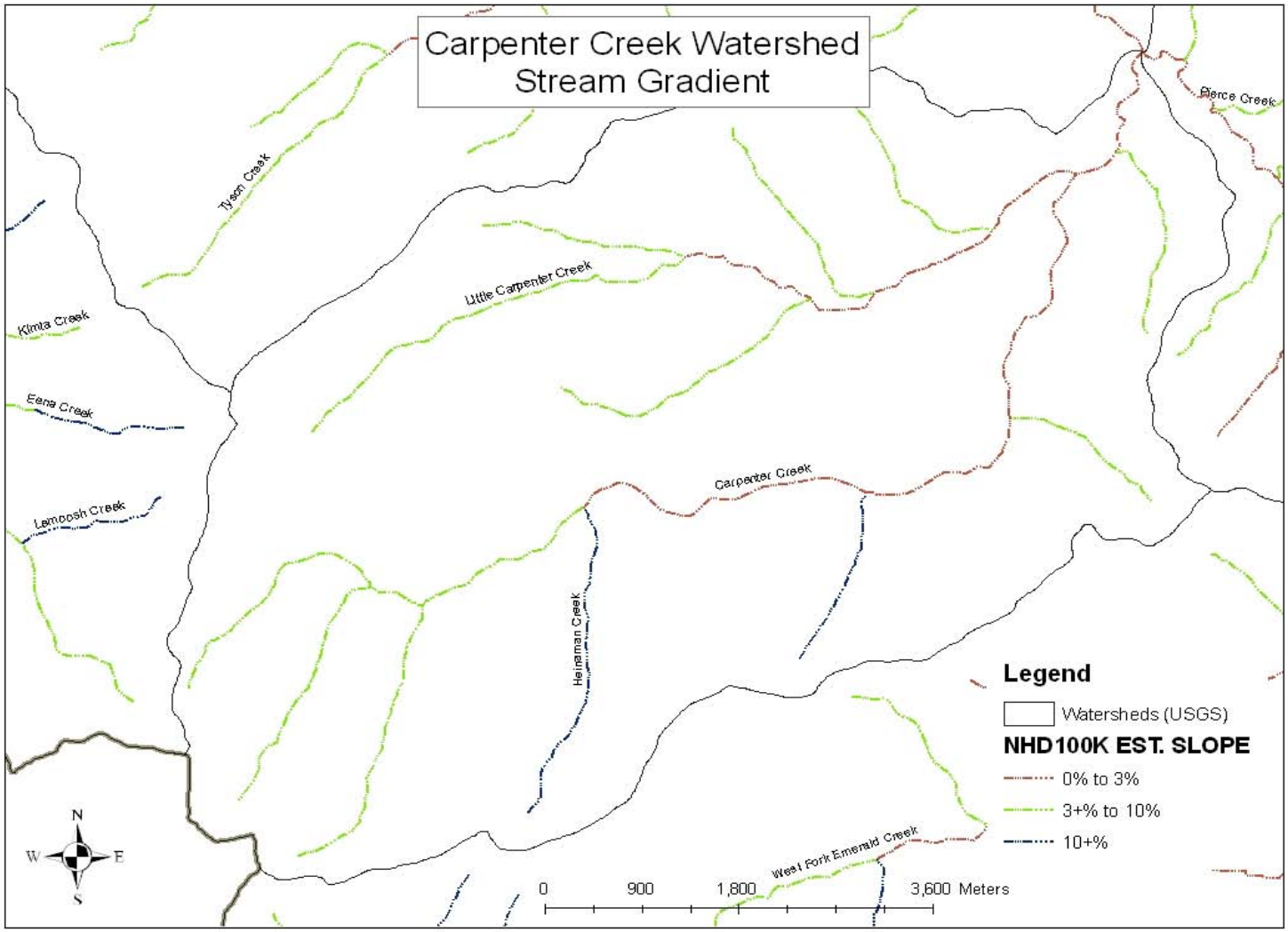


Figure H-34. Carpenter Creek watershed stream gradient

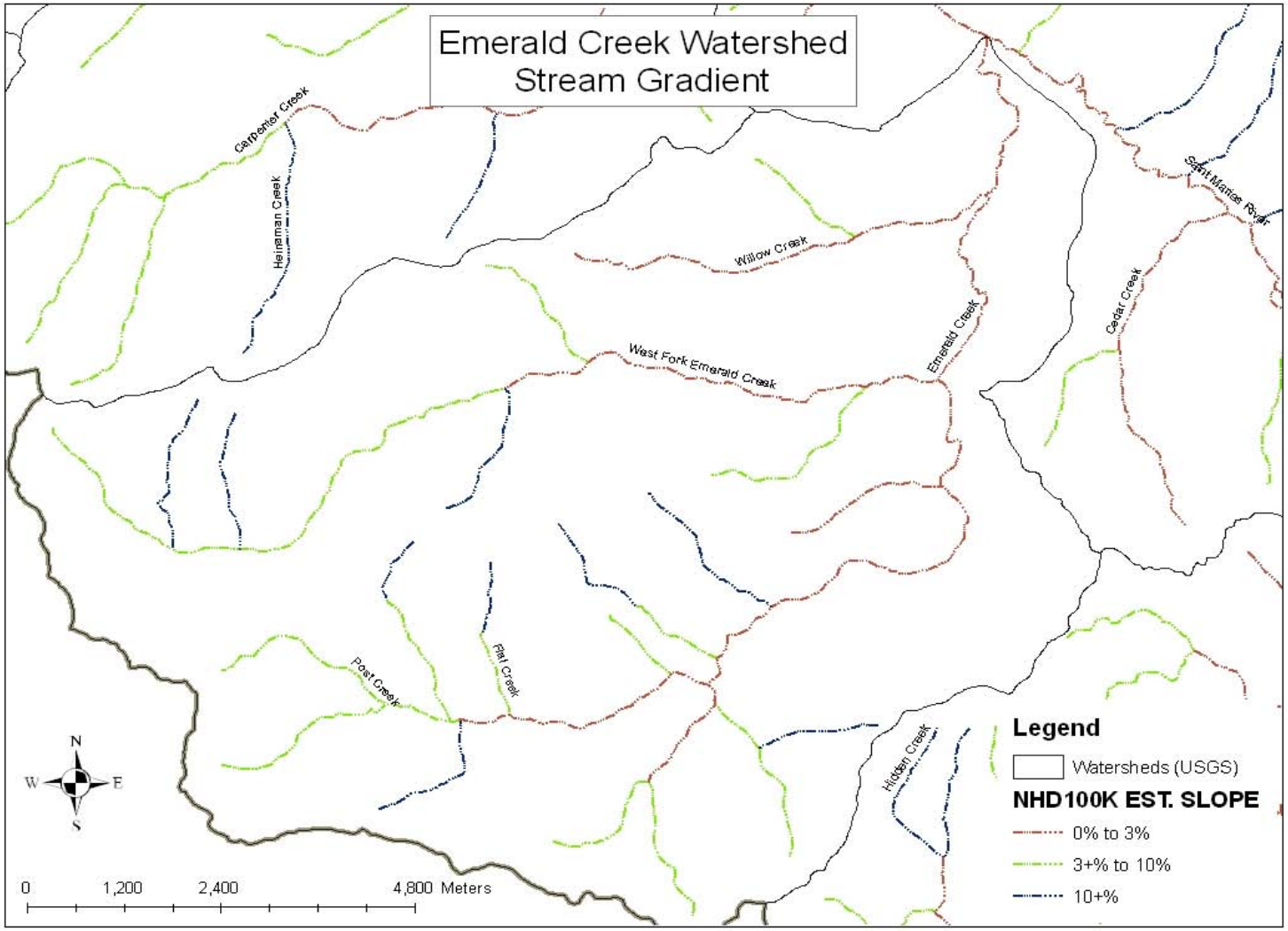


Figure H-35. Emerald Creek watershed stream gradient

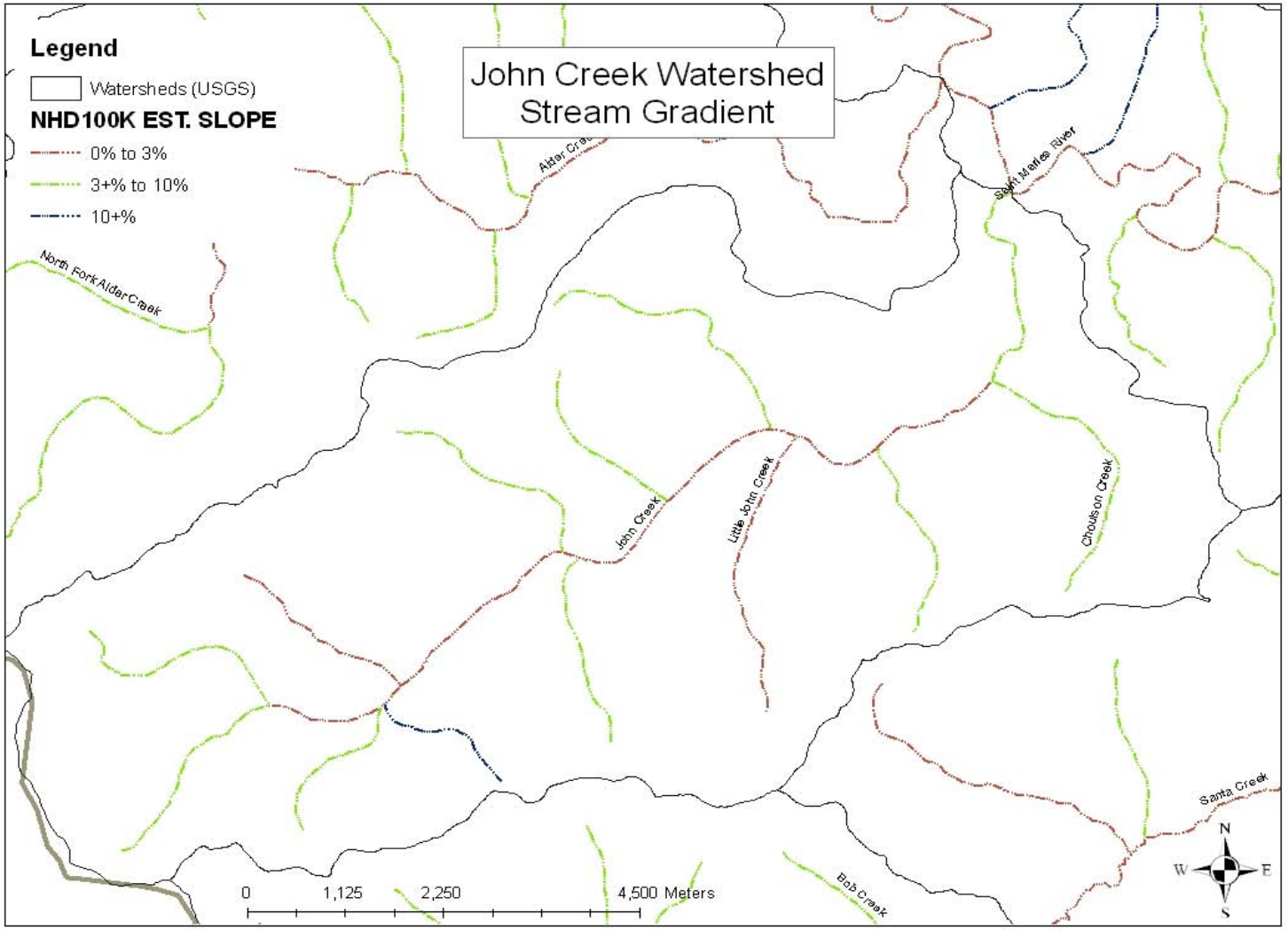


Figure H-36. John Creek watershed stream gradient

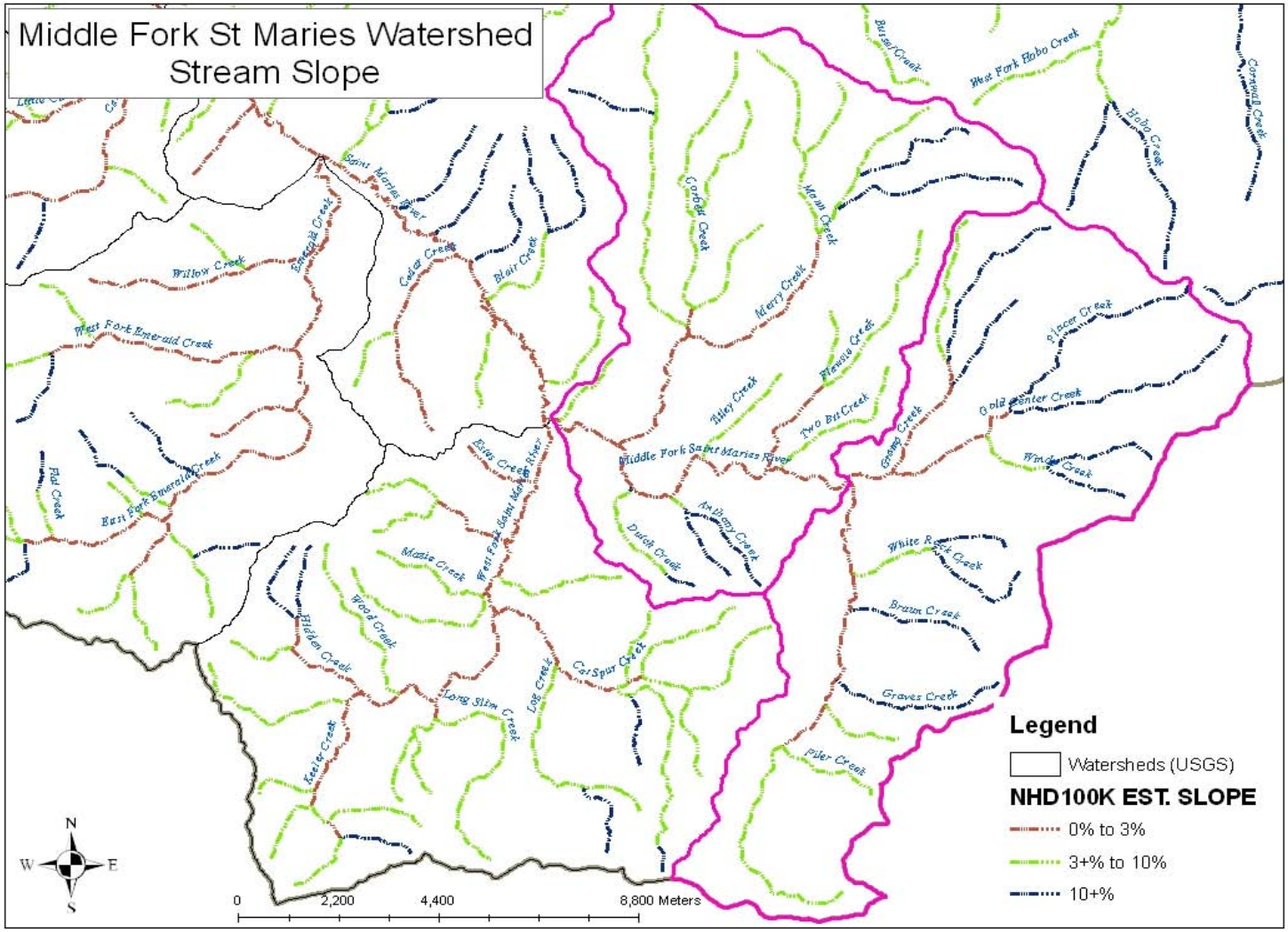


Figure H-37. Middle Fork St. Maries River watershed stream gradient

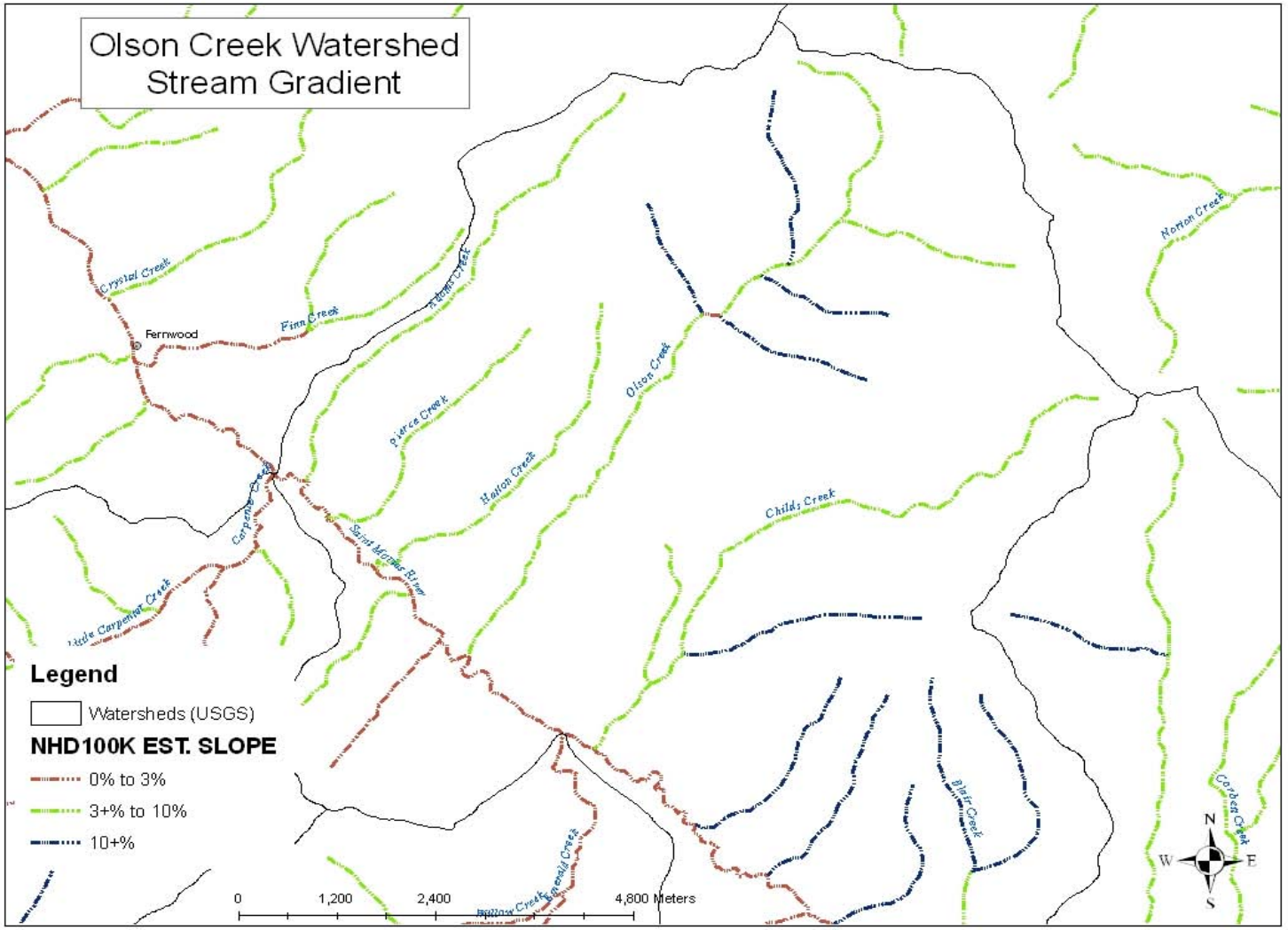


Figure H-38. Olson Creek watershed stream gradient

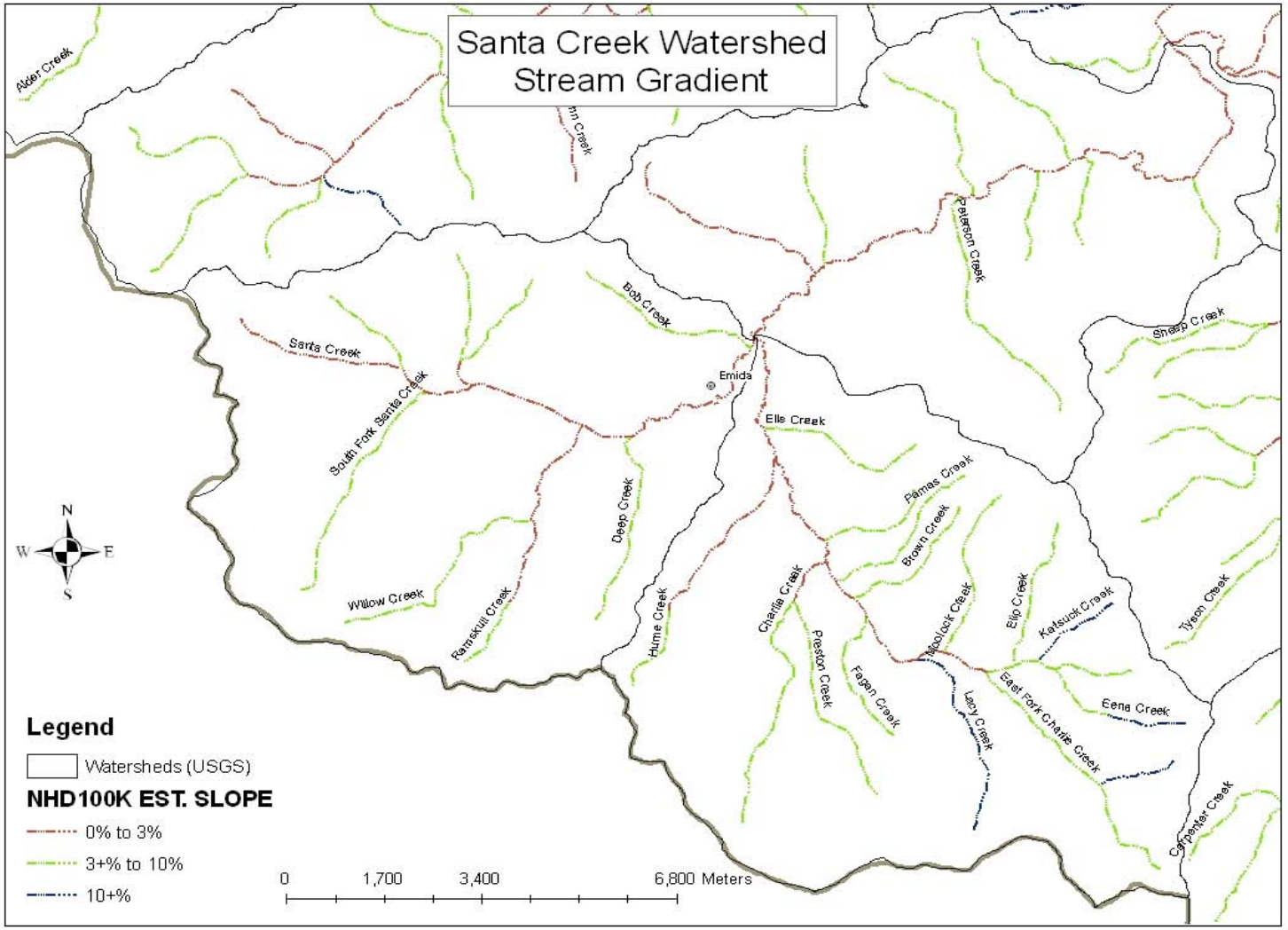


Figure H-39. Santa Creek watershed stream gradient

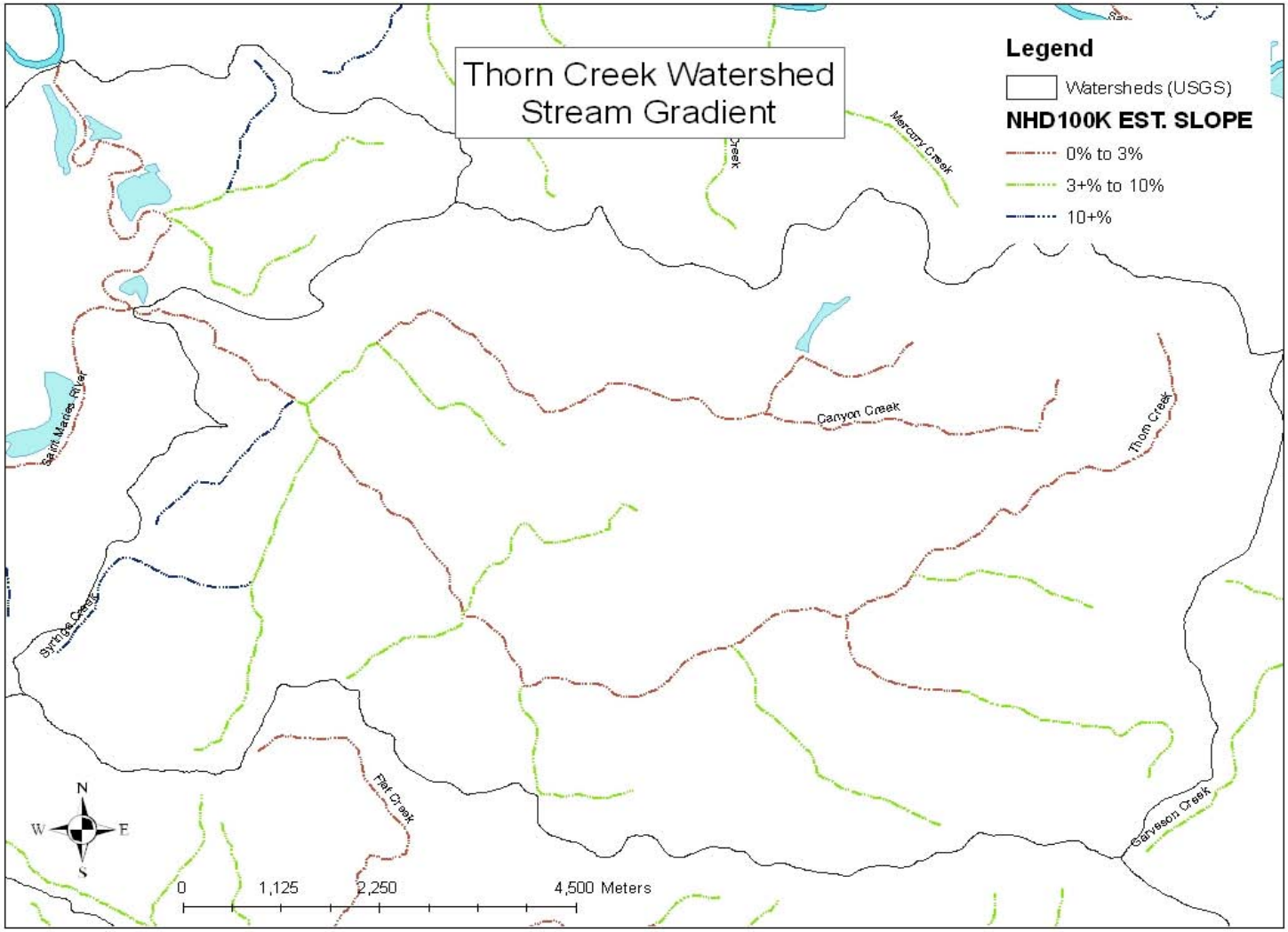


Figure H-40. Thorn Creek watershed stream gradient

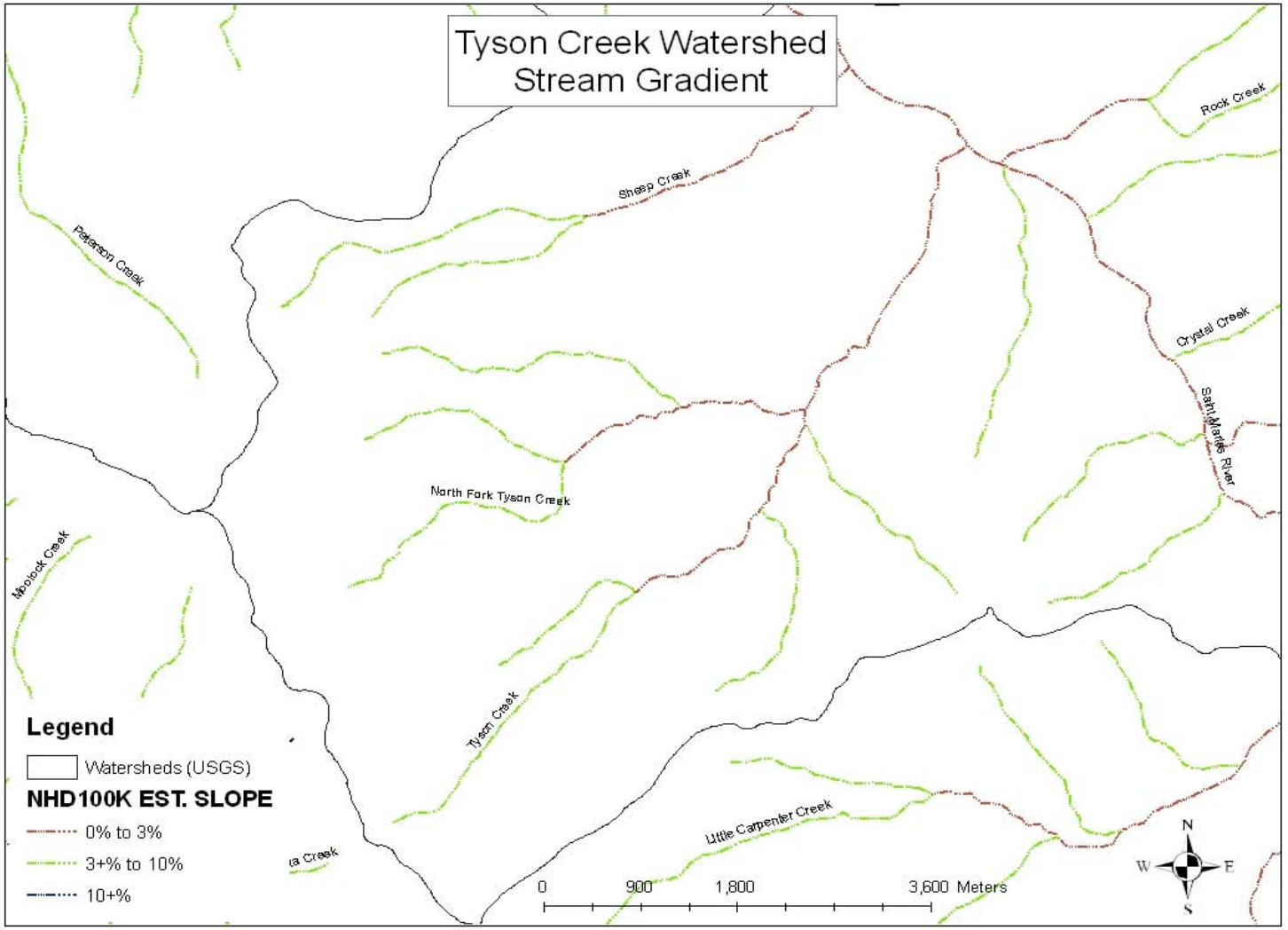


Figure H-41. Tyson Creek watershed stream gradient

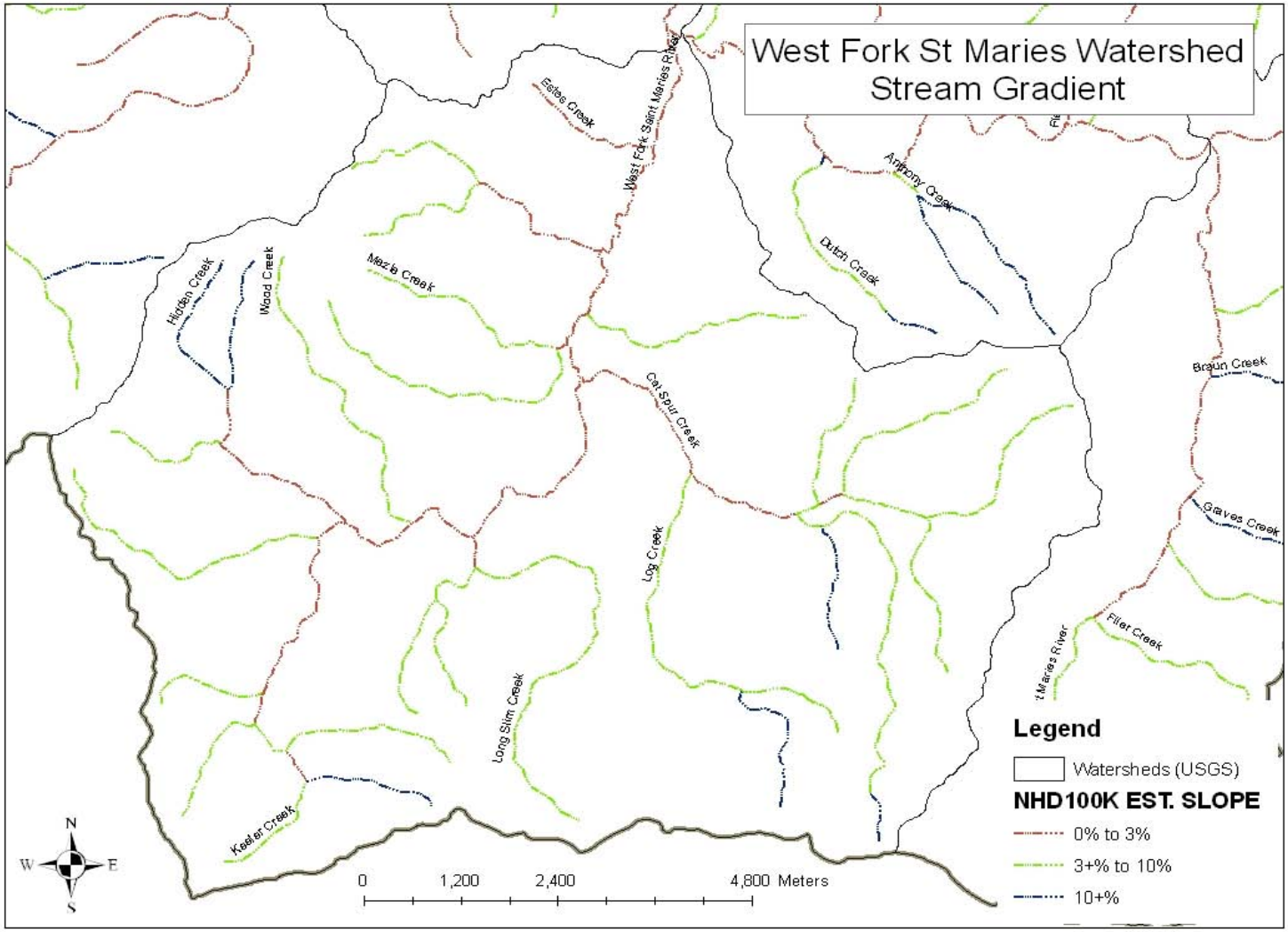


Figure H-42. West Fork St. Maries River watershed stream gradient

Natural Stream Bankfull Width Estimates

Table H-1. Natural bankfull width estimates for the Carpenter Creek subwatershed

Location	area (sq mi)	Spokane (m)	Kootenai (m)	PendOreille (m)	Clearwater (m)	BURP BFW Data (m)
Carpenter Creek @ mouth	19.8	11	9	8	8	
Carpenter Cr ab Little Carpenter Cr	11.5	8	7	7	6	5.1
Carpenter Cr bl Heinaman Cr	6.3	6	5	5	4	4.9
Carpenter Cr bl 2nd tributary	3.9	5	4	4	3	3.6
Carpenter Cr ab 1st tributary	1.34	3	2	3	2	
1st tributary to Carpenter Cr	0.93	2	2	2	2	
2nd tributary to Carpenter Cr	1.46	3	2	3	2	
Heineman Cr @ mouth	1.24	3	2	3	2	2.2
3rd tributary to Carpenter Cr	0.62	2	2	2	1	
4th tributary to Carpenter Cr	0.5	2	1	2	1	
5th tributary to Carpenter Cr	0.62	2	2	2	1	
Little Carpenter Cr @ mouth	7.2	6	5	6	5	
Little Carpenter Cr bl 3rd tributary	5.3	6	5	5	4	
Little Carpenter Cr ab 1st tributary	1.92	3	3	3	2	
1st tributary to Little Carpenter Cr	0.5	2	1	2	1	
2nd tributary to Little Carpenter Cr	1.2	3	2	3	2	
3rd tributary to Little Carpenter Cr	0.39	2	1	2	1	dry channel
4th tributary to Little Carpenter Cr	0.6	2	2	2	1	

Table H-2. Natural bankfull width estimates for the Emerald Creek subwatershed

Location	area (sq mi)	Spokane (m)	Kootenai (m)	PendOreille (m)	Clearwater (m)	BURP BFW Data (m)
Emerald Cr @ mouth	37.2	14	12	11	11	10.1
Emerald Cr ab Willow Cr	31.3	13	11	10	10	
Emerald Cr @ EF/WF confluence	30.1	13	11	10	10	
WF Emerald Cr @ mouth	12.4	8	7	7	6	
WF Emerald Cr bl 4th tributary	9.1	7	6	6	5	3.5
WF Emerald Cr bl 2nd tributary	3.3	4	4	4	3	
WF Emerald Cr ab 1st tributary	1.3	3	2	3	2	
Willow Cr @ mouth	4	5	4	4	4	
Willow Cr ab tributary	2.7	4	3	4	3	
tributary to Willow Cr	0.81	2	2	2	2	
1st tributary to WF Emerald Cr	0.73	2	2	2	1	
2nd tributary to WF Emerald Cr	0.41	2	1	2	1	
3rd tributary to WF Emerald Cr	0.89	2	2	2	2	
4th tributary to WF Emerald Cr	0.47	2	1	2	1	
5th tributary to WF Emerald Cr	0.76	2	2	2	1	
EF Emerald Cr @ mouth	17.7	10	9	8	8	
EF Emerald Cr bl Little EF Emerald	11.3	8	7	7	6	4.8
EF Emerald Cr ab Little EF Emerald	7.2	6	5	6	5	
EF Emerald Cr bl Flat Cr	5.6	6	5	5	4	
EF Emerald Cr ab Swamp Cr	2.8	4	3	4	3	
EF Emerald Cr ab Post Cr	1.5	3	2	3	2	
Post Cr @ mouth	0.9	2	2	2	2	
Swamp Cr @ mouth	0.83	2	2	2	2	
Highline Cr @ mouth	0.96	2	2	3	2	
Flat Cr @ mouth	0.75	2	2	2	1	
No Name Gulch @ mouth	0.46	2	1	2	1	
Garnet Gulch @ mouth	0.61	2	2	2	1	
1st Un-named tributary bl Garnet G.	0.66	2	2	2	1	
2nd Un-named tributary bl Garnet G.	0.52	2	1	2	1	
Little EF Emerald Cr @ mouth	4	5	4	4	4	
Little EF Emerald Cr ab 2nd trib	2.2	4	3	3	3	
Little EF Emerald Cr ab 1st trib	1.23	3	2	3	2	
1st tributary to Little EF Emerald	0.56	2	2	2	1	
2nd tributary to Little EF Emerald	1.7	3	3	3	2	
tributary to 2nd trib to Little EF	0.39	2	1	2	1	

Table H-3. Natural bankfull width estimates for the John Creek subwatershed

Location	area (sq mi)	Spokane (m)	Kootenai (m)	PendOreille (m)	Clearwater (m)	BURP BFW Data (m)
Johns Cr @ mouth	26.29	12	10	9	9	
Johns Cr ab Choulson Cr	22.42	11	10	9	9	
Johns Cr ab 9th tributary	19.95	11	9	8	8	7.3
Johns Cr ab Little Johns Cr	16.64	10	8	8	7	
Johns Cr ab 8th tributary	14.14	9	8	7	7	
Johns Cr ab 7th tributary	12.14	8	7	7	6	7.6
Johns Cr ab 6th tributary	10.24	8	6	6	6	
Johns Cr ab 5th tributary	9.4	7	6	6	6	3.9
Johns Cr ab 4th tributary	5.18	6	5	5	4	
Johns Cr ab 2nd tributary	3.33	4	4	4	3	
Johns Cr ab 1st tributary	1.94	3	3	3	2	
Choulson Cr @ mouth	2.48	4	3	4	3	
9th tributary @ mouth	1.05	3	2	3	2	
Little Johns Cr @ mouth	2.92	4	3	4	3	
8th tributary @ mouth	2.29	4	3	4	3	
7th tributary @ mouth	1.07	3	2	3	2	
6th tributary @ mouth	1.11	3	2	3	2	
5th tributary @ mouth	0.81	2	2	2	2	
4th tributary @ mouth	1.38	3	2	3	2	
3rd tributary @ mouth	0.62	2	2	2	1	
2nd tributary @ mouth	1.11	3	2	3	2	
1st tributary @ mouth	1.09	3	2	3	2	

Table H-4. Natural bankfull width estimates for the Middle Fork St. Maries River subwatershed

Location	area (sq mi)	Spokane (m)	Kootenai (m)	PendOreille (m)	Clearwater (m)	BURP BFW Data (m)
MF St Maries River @ mouth	69.3	19	17	14	16	
MF St Maries River bl Merry Cr	68	19	17	14	15	13.5
MF St Maries River ab Merry Cr	45	16	14	12	12	
MF St Maries River bl Flewsie Cr	39.3	15	13	11	12	
MF St Maries River bl Gold Center Cr	33.7	14	12	10	11	13.4
MF St Maries River ab Gold Center Cr	16.2	10	8	8	7	
MF St Marie River bl White Rock Cr	14.8	9	8	7	7	
MF St Maries River bl Graves Cr	8.5	7	6	6	5	6.6
MF St Maries River ab Filer Cr	3.9	5	4	4	3	5.3
Filer Cr @ mouth	1.07	3	2	3	2	
Scaler Cr @ mouth	0.97	2	2	3	2	
Graves Cr @ mouth	1.27	3	2	3	2	
Braun Cr @ mouth	1.37	3	2	3	2	
White Rock Cr @ mouth	2.6	4	3	4	3	
White Rock Cr ab tributary	1.43	3	2	3	2	
tributary to White Rock Cr	0.59	2	2	2	1	
Two Bit Cr @ mouth	1.16	3	2	3	2	
Flewsie Cr @ mouth	3.4	5	4	4	3	3.5
Flewsie Cr ab tributary	1.99	3	3	3	2	
tributary to Flewsie Cr	0.48	2	1	2	1	
Titley Cr @ mouth	0.86	2	2	2	2	
Anthony Cr @ mouth	1.6	3	3	3	2	
Anthony Cr ab tributary	0.87	2	2	2	2	
tributary to Anthony Cr	0.61	2	2	2	1	
Dutch Cr @ mouth	1.24	3	2	3	2	
Un-named trib to MF bl Merry Cr	0.3	1	1	2	1	

Table H-5. Natural bankfull width estimates for the Middle Fork St. Maries River subwatershed

Location	area (sq mi)	Spokane (m)	Kootenai (m)	PendOreille (m)	Clearwater (m)	BURP BFW Data (m)
Gold Center Cr @ mouth	17.5	10	8	8	8	10.1
Gold Center Cr bl Windy Cr	10.8	8	7	7	6	8.1
Gold Center Cr ab Windy Cr	7.9	7	6	6	5	11.6
Gold Center Cr ab Placer Cr	4.1	5	4	4	4	
Placer Cr @ mouth	2.9	4	3	4	3	
Windy Cr @ mouth	2.9	4	3	4	3	
Windy Cr ab tributary	0.88	2	2	2	2	
tributary to Windy Cr	0.56	2	2	2	1	
Gramp Cr @ mouth	4.4	5	4	5	4	4.6
Gramp Cr ab 1st tributary	1.66	3	3	3	2	dry channel
1st tributary to Gramp Cr	0.88	2	2	2	2	
2nd tributary to Gramp Cr	0.65	2	2	2	1	
Merry Cr @ mouth	22.7	11	10	9	9	
Merry Cr bl WF Merry Cr	21.1	11	9	9	8	11.9
Merry Cr bl Mann Cr	7.1	6	5	6	5	5.3
Merry Cr ab 1st tributary	1.11	3	2	3	2	2.5
1st tributary to Merry Cr	0.89	2	2	2	2	
2nd tributary to Merry Cr	1.79	3	3	3	2	
Mann Cr @ mouth	2.9	4	3	4	3	
Mann Cr ab tributary	1.45	3	2	3	2	
tributary to Mann Cr	0.6	2	2	2	1	
WF Merry Cr @ mouth	10.6	8	7	7	6	
WF Merry Cr ab Corbett Cr	6.1	6	5	5	4	
WF Merry Cr ab 1st tributary	2.2	4	3	3	3	
1st tributary to WF Merry Cr	0.96	2	2	3	2	
Corbett Cr @ mouth	4.5	5	4	5	4	
Corbett Cr ab Ashenfelter Cr	3.5	5	4	4	3	
Corbett Cr ab 1st tributary	1.27	3	2	3	2	
1st tributary to Corbett Cr	1.41	3	2	3	2	
Ashenfelter Cr @ mouth	0.93	2	2	2	2	

Table H-6. Natural bankfull width estimates for the Olson Creek subwatershed

Location	area (sq mi)	Spokane (m)	Kootenai (m)	PendOreille (m)	Clearwater (m)	BURP BFW Data (m)
Olson Creek @ mouth	9.2	7	6	6	5	
Olson Creek bl 5th tributary	7.2	6	5	6	5	
Olson Creek bl 3rd tributary	5.6	6	5	5	4	5.5
Olson Creek ab 1st tributary	1.47	3	2	3	2	
1st tributary to Olson Creek	1.77	3	3	3	2	
2nd tributary to Olson Creek	1.13	3	2	3	2	
3rd tributary to Olson Creek	0.71	2	2	2	1	
4th tributary to Olson Creek	0.69	2	2	2	1	
5th tributary to Olson Creek	0.39	2	1	2	1	

Table H-7. Natural bankfull width estimates for the Santa Creek subwatershed

Location	area (sq mi)	Spokane (m)	Kootenai (m)	PendOreille (m)	Clearwater (m)	BURP BFW Data (m)
Santa Creek @ mouth	73.8	20	17	14	16	15.7
Santa Cr bl Peterson Cr	63.1	18	16	13	15	10.9
Santa Cr bl Charlie Cr	51.6	17	15	12	13	
Santa Cr ab Charlie Cr	24.3	12	10	9	9	
Santa Cr bl Ramskull Cr	19	10	9	8	8	
Santa Cr bl SF Santa Cr	7.4	7	6	6	5	
Santa Cr ab 1st tributary	2.02	4	3	3	2	
1st tributary to Santa Cr	1.26	3	2	3	2	
SF Santa Cr @ mouth	2.76	4	3	4	3	
2nd tributary to Santa Cr @ mouth	1.91	3	3	3	2	
Tributary to 2nd tributary	0.46	2	1	2	1	
Ramskull Cr @ mouth	6.31	6	5	5	4	
Willow Cr @ mouth	3.3	4	4	4	3	
Deep Cr @ mouth	2.03	4	3	3	2	
Bob Creek @ mouth	1.83	3	3	3	2	
3rd tributary to Santa Cr @ mouth	3.43	5	4	4	3	
4th tributary to Santa Cr @ mouth	1.09	3	2	3	2	
Peterson Cr @ mouth	2.64	4	3	4	3	
5th tributary to Santa Cr @ mouth	1.61	3	3	3	2	
6th tributary to Santa Cr @ mouth	1.07	3	2	3	2	
7th tributary to Santa Cr @ mouth	1.31	3	2	3	2	
8th tributary to Santa Cr @ mouth	0.37	2	1	2	1	
9th tributary to Santa Cr @ mouth	0.51	2	1	2	1	
Charlie Cr @ mouth	27.1	12	11	10	10	
Charlie Cr bl EF Charlie Cr	21.1	11	9	9	8	
Charlie Cr ab EF Charlie Cr	6.5	6	5	5	5	5.1
Charlie Cr ab Preston Cr	4.4	5	4	5	4	
Preston Cr @ mouth	1.97	3	3	3	2	
Short Cr @ mouth	0.43	2	1	2	1	
Hume Cr @ mouth	2.09	4	3	3	3	
Ells Cr @ mouth	0.95	2	2	2	2	
EF Charlie Cr @ mouth	14.6	9	8	7	7	
EF Charlie Cr bl Lacy Cr	11	8	7	7	6	6.3
EF Charlie Cr bl Eena Cr	7.2	6	5	6	5	
EF Charlie Cr ab Eena Cr	3.6	5	4	4	3	
Lemoosh Cr @ mouth	0.44	2	1	2	1	
Eena Cr @ mouth	3.6	5	4	4	3	
Moolock Cr @ mouth	1.49	3	2	3	2	
Lacy Cr @ mouth	1.85	3	3	3	2	
Fagan Cr @ mouth	0.89	2	2	2	2	
Brown Cr @ mouth	0.66	2	2	2	1	
Pamas Cr @ mouth	0.76	2	2	2	1	
Eena Cr ab Kimta Cr	1.15	3	2	3	2	
Kimta Cr @ mouth	0.51	2	1	2	1	
Katsuck Cr @ mouth	0.4	2	1	2	1	
Elip Cr @ mouth	1.28	3	2	3	2	

Table H-8. Natural bankfull width estimates for the St. Maries River subwatershed

Location	area (sq mi)	Spokane (m)	Kootenai (m)	PendOreille (m)	Clearwater (m)	BURP BFW Data (m)
St Maries River @ mouth	488	49	45	30	43	
St Maries River bl John Cr	400	45	41	28	39	
St Maries River ab John Cr	374	43	39	27	37	
St Maries River bl Santa Cr	347	42	38	26	36	
St Maries River ab Santa Cr	273	37	34	24	32	
St Maries River bl Carpenter Cr	205	32	29	21	27	
St Maries River ab Carpenter Cr	185	31	28	21	26	
St Maries River bl Emerald Cr	165	29	26	20	24	
St Maries River ab Emerald Cr	128	26	23	18	21	
St Maries River @ MF/WF confluence	106	24	21	16	19	15.4

Table H-9. Natural bankfull width estimates for the Thorn Creek subwatershed

Location	area (sq mi)	Spokane (m)	Kootenai (m)	PendOreille (m)	Clearwater (m)	BURP BFW Data (m)
Thorn Cr @ mouth	34	14	12	10	11	
Thorn Cr ab Canyon Cr	22.4	11	10	9	9	
Thorn Cr ab Syringa Cr	19.1	10	9	8	8	
Thorn Cr ab 5th tributary	15.4	9	8	8	7	6
Thorn Cr ab 4th tributary	13.1	9	7	7	7	4.3
Thorn Cr ab 3rd tributary	9.1	7	6	6	5	
Thorn Cr ab 2nd tributary	5.4	6	5	5	4	
Thorn Cr ab 1st tributary	3.7	5	4	4	3	
1st tributary to Thorn Cr	1.3	3	2	3	2	
2nd tributary to Thorn Cr	3.1	4	4	4	3	
3rd tributary to Thorn Cr	1.8	3	3	3	2	
4th tributary to Thorn Cr	1.5	3	2	3	2	
5th tributary to Thorn Cr	0.9	2	2	2	2	
6th tributary to Thorn Cr	1.3	3	2	3	2	
Syringa Cr @ mouth	3.3	4	4	4	3	
Syringa Cr ab tributary	1.2	3	2	3	2	
tributary to Syringa Cr	1.3	3	2	3	2	
Canyon Cr @ mouth	9.7	7	6	6	6	
Canyon Cr ab 2nd tributary	8.6	7	6	6	5	
Canyon Cr ab 1st tributary	2.1	4	3	3	3	
1st tributary to Canyon Cr	2.3	4	3	4	3	
2nd tributary to Canyon Cr	0.5	2	1	2	1	

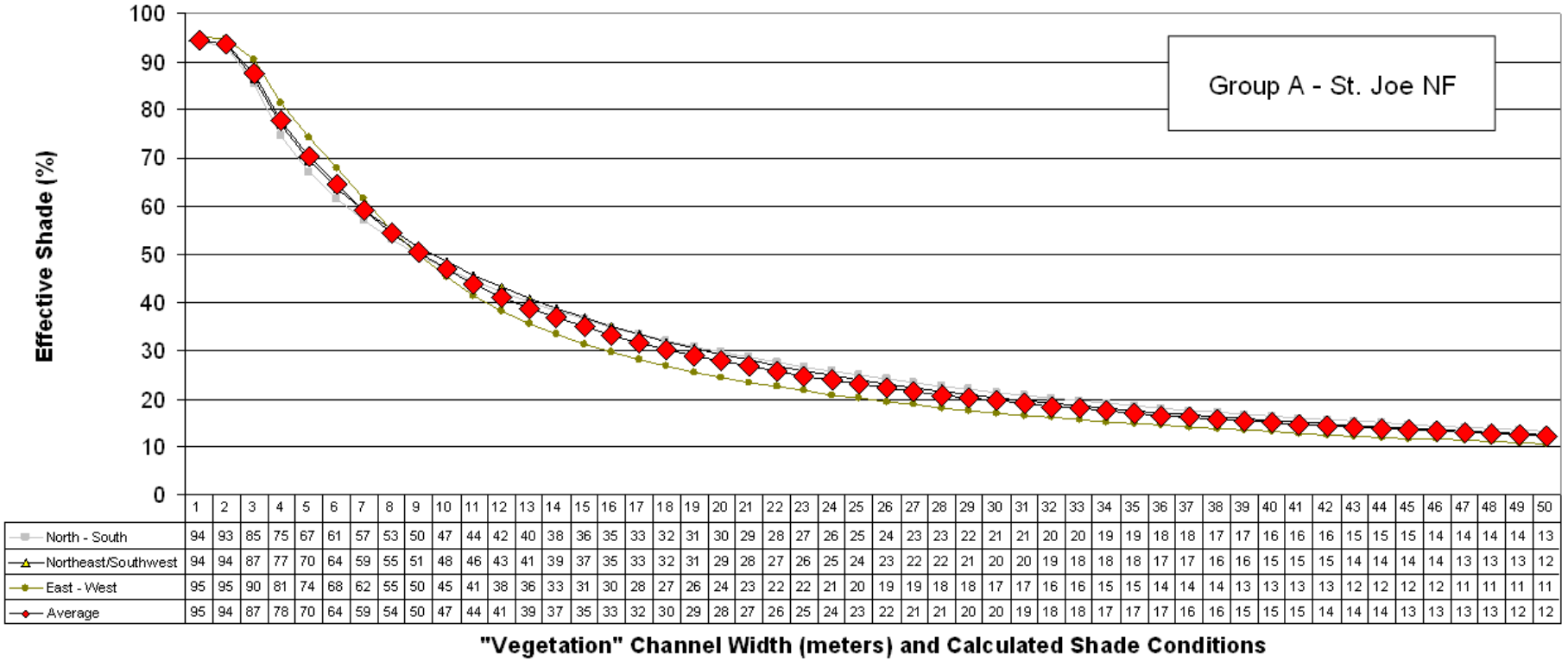
Table H-10. Natural bankfull width estimates for the Tyson Creek subwatershed

Location	area (sq mi)	Spokane (m)	Kootenai (m)	PendOreille (m)	Clearwater (m)	BURP BFW Data (m)
Tyson Creek @ mouth	12.6	8	7	7	6	5.2
Tyson Creek bl NF Tyson Cr	10.7	8	7	7	6	7.3
Tyson Creek ab NF Tyson Cr	6	6	5	5	4	6.9
Tyson Creek bl 2nd tributary	5	5	5	5	4	4.6
Tyson Creek ab 1st tributary	2.45	4	3	4	3	3.3
1st tributary to Tyson Cr	0.67	2	2	2	1	
2nd tributary to Tyson Cr	1.12	3	2	3	2	
3rd tributary to Tyson Cr	0.64	2	2	2	1	
NF Tyson Cr @ mouth	4.6	5	4	5	4	
1st tributary to NF Tyson Cr	0.97	2	2	3	2	
2nd tributary to NF Tyson Cr	0.84	2	2	2	2	

Table H-11. Natural bankfull width estimates for the West Fork St. Maries River subwatershed

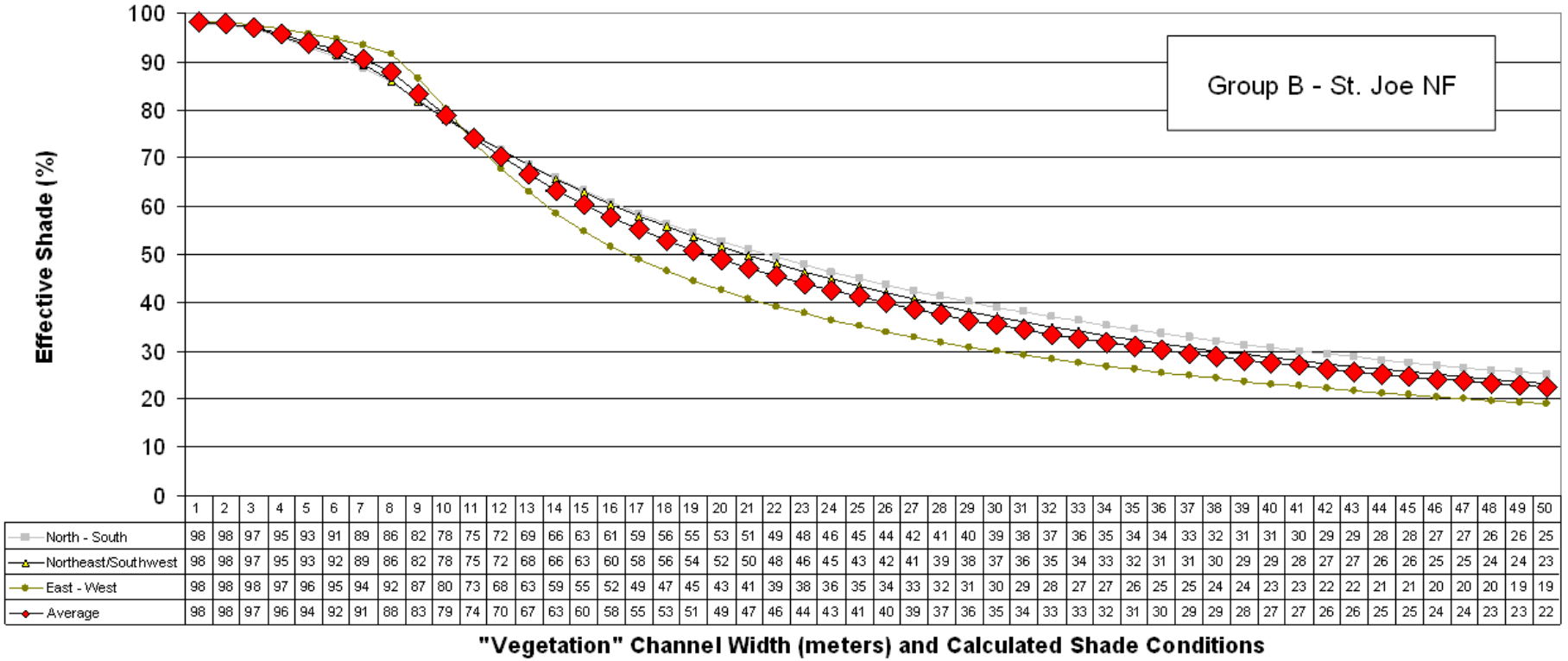
Location	area (sq mi)	Spokane (m)	Kootenai (m)	PendOreille (m)	Clearwater (m)	BURP BFW Data (m)
WF St Maries River @ mouth	36.6	14	12	11	11	
WF St Maries River bl Mazie Cr	31.1	13	11	10	10	
WF St Maries River bl Cat Spur Cr	28.8	13	11	10	10	
WF St Maries River ab Cat Spur Cr	16	9	8	8	7	
WF St Maries River bl Long Slim Cr	14.6	9	8	7	7	
WF St Maries River bl Hidden Cr	8.9	7	6	6	5	
WF St Maries River ab Keeler Cr	1.94	3	3	3	2	2.2
Keeler Cr @ mouth	4.2	5	4	5	4	
Keeler Cr bl 4th tributary	3.3	4	4	4	3	
Keeler Cr bl 2nd tributary	1.99	3	3	3	2	
Keeler Cr ab 1st tributary	0.9	2	2	2	2	
1st tributary to Keeler Cr	0.42	2	1	2	1	
2nd tributary to Keeler Cr	0.56	2	2	2	1	
3rd tributary to Keeler Cr	0.63	2	2	2	1	
4th tributary to Keeler Cr	0.46	2	1	2	1	
Hidden Cr @ mouth	2.7	4	3	4	3	
Hidden Cr bl 2nd tributary	1.87	3	3	3	2	
Hidden Cr ab 1st tributary	0.63	2	2	2	1	
1st tributary to Hidden Cr	0.54	2	1	2	1	
2nd tributary to Hidden Cr	0.29	1	1	2	1	
Wood Cr @ mouth	1.14	3	2	3	2	
Long Slim Cr @ mouth	3.9	5	4	4	3	
Long Slim Cr ab 1st tributary	2.5	4	3	4	3	
1st tributary to Long Slim Cr	1.34	3	2	3	2	
tributary to 1st Long Slim tributary	0.36	2	1	2	1	
Cat Spur Cr @ mouth	12.8	9	7	7	6	
Cat Spur Cr bl Kitten Cr	6.4	6	5	5	5	2.1
Cat Spur Cr ab 2nd tributary	2.8	4	3	4	3	
Cat Spur Cr ab 1st tributary	1.21	3	2	3	2	
1st tributary to Cat Spur Cr	0.99	2	2	3	2	
2nd tributary to Cat Spur Cr	1.02	3	2	3	2	
3rd tributary to Cat Spur Cr	0.15	1	1	1	1	
Kitten Cr @ mouth	2.4	4	3	4	3	
tributary to Kitten Cr	0.53	2	1	2	1	
Log Cr @ mouth	3.4	5	4	4	3	
tributary to Log Cr	0.82	2	2	2	2	
Mazie Cr @ mouth	2.24	4	3	4	3	
Mazie Cr ab Swede John Cr	1.09	3	2	3	2	
Swede John Cr @ mouth	1.13	3	2	3	2	
Unnamed trib to WF St Maries	0.7	2	2	2	1	
Bechtel Cr @ mouth	2.23	4	3	4	3	
Bechtel Cr ab tributary	0.78	2	2	2	2	
tributary to Bechtel Cr	0.54	2	1	2	1	
Estes Cr @ mouth	0.59	2	2	2	1	

St. Maries River Watershed Shade Curves



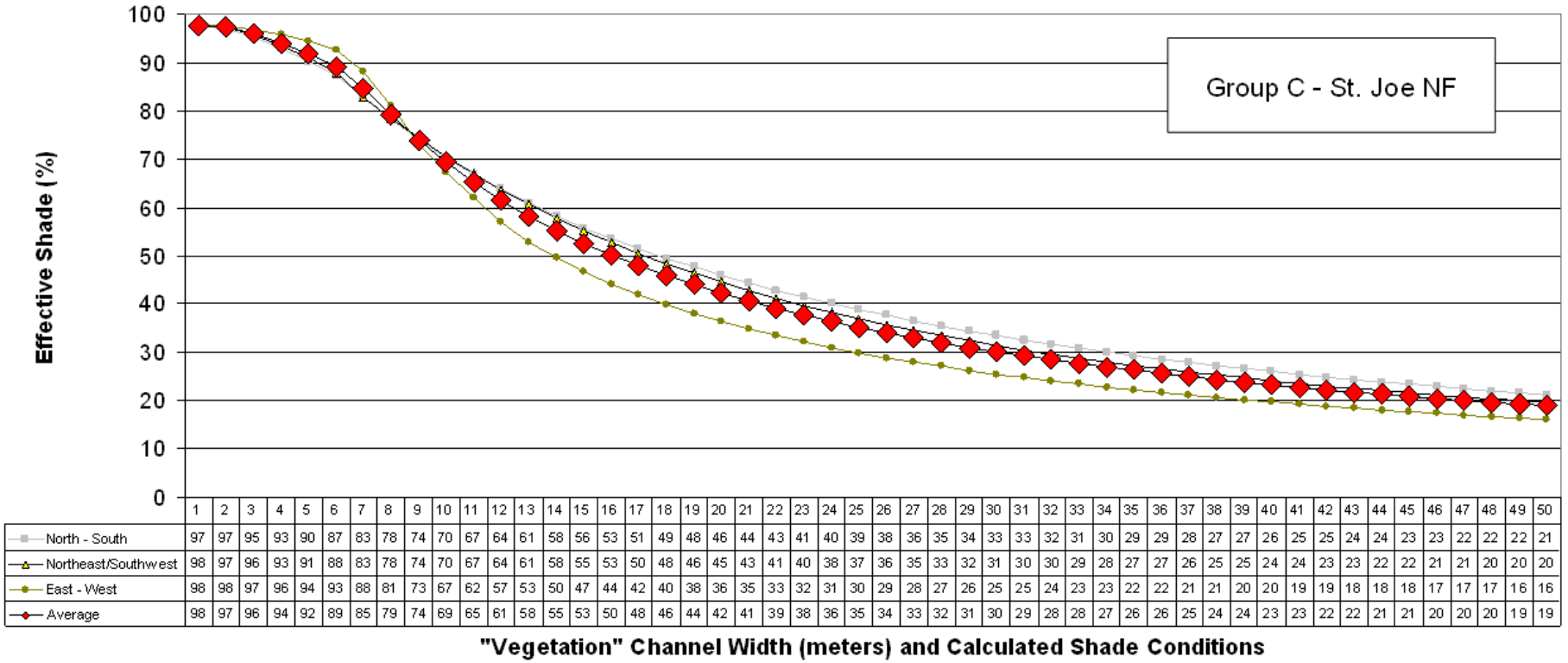
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North - South	94	93	85	75	67	61	57	53	50	47	44	42	40	38	36	35	33	32	31	30	29	28	27	26	25	24	23	23	22	21	21	20	20	19	19	18	18	17	17	16	16	16	15	15	15	14	14	14	14	13
Northeast/Southwest	94	94	87	77	70	64	59	55	51	48	46	43	41	39	37	35	33	32	31	29	28	27	26	25	24	23	22	22	21	20	20	19	18	18	18	17	17	16	16	15	15	15	14	14	14	14	13	13	13	12
East - West	95	95	90	81	74	68	62	55	50	45	41	38	36	33	31	30	28	27	26	24	23	22	22	21	20	19	19	18	18	17	17	16	16	15	15	14	14	14	13	13	13	13	12	12	12	12	11	11	11	11
Average	95	94	87	78	70	64	59	54	50	47	44	41	39	37	35	33	32	30	29	28	27	26	25	24	23	22	21	21	20	20	19	18	18	17	17	17	16	16	15	15	15	14	14	14	13	13	13	13	12	12

Figure H-43. System potential effective shade at various stream aspects and stream width conditions: Warm/Dry (Group A)—St. Joe National Forest



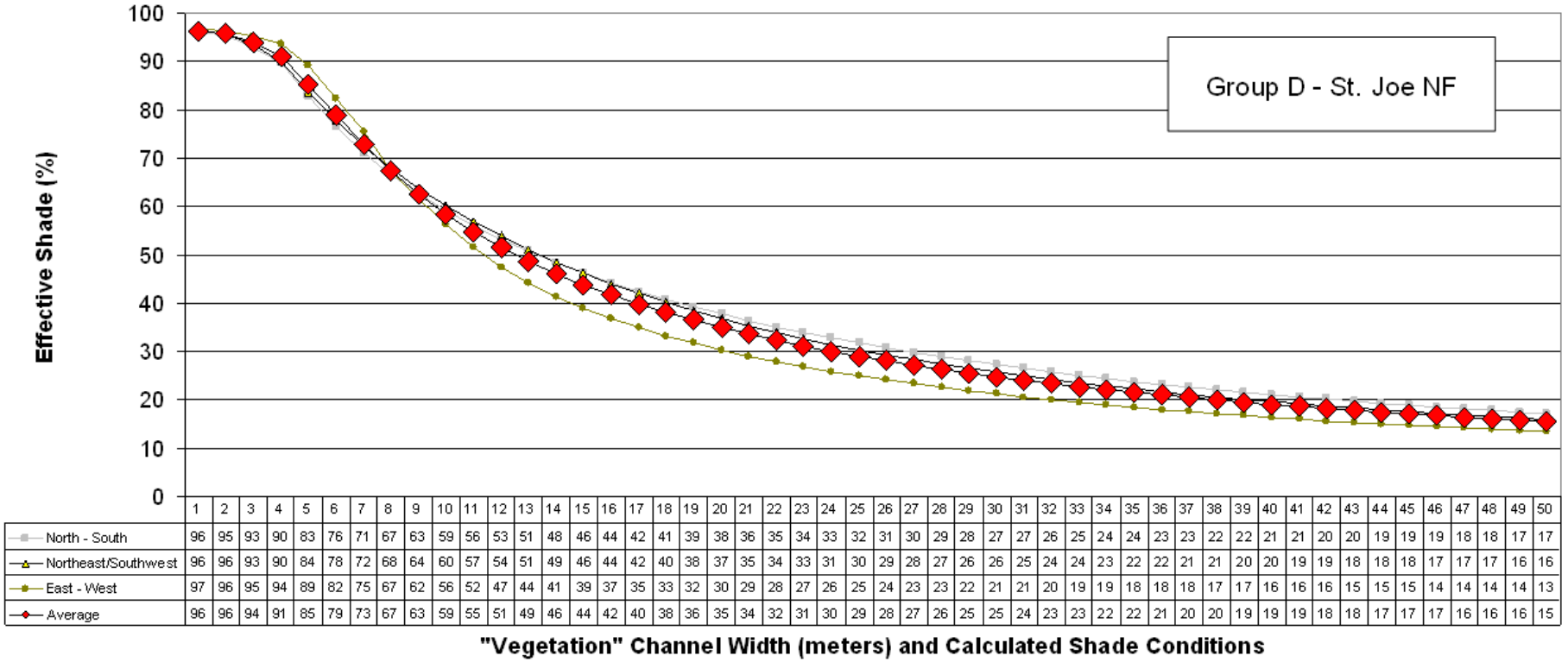
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
North - South	98	98	97	95	93	91	89	86	82	78	75	72	69	66	63	61	59	56	55	53	51	49	48	46	45	44	42	41	40	39	38	37	36	35	34	34	33	32	31	31	30	29	29	28	28	27	27	26	26	25
Northeast/Southwest	98	98	97	95	93	92	89	86	82	78	75	72	68	66	63	60	58	56	54	52	50	48	46	45	43	42	41	39	38	37	36	35	34	33	32	31	31	30	29	29	28	27	27	26	26	25	25	24	24	23
East - West	98	98	98	97	96	95	94	92	87	80	73	68	63	59	55	52	49	47	45	43	41	39	38	36	35	34	33	32	31	30	29	28	27	27	26	25	25	24	24	23	23	22	22	21	21	20	20	20	19	19
Average	98	98	97	96	94	92	91	88	83	79	74	70	67	63	60	58	55	53	51	49	47	46	44	43	41	40	39	37	36	35	34	33	33	32	31	30	29	29	28	27	27	26	26	25	25	24	24	23	23	22

Figure H-44. System potential effective shade at various stream aspects and stream width conditions: Moist (Group B)—St. Joe National Forest



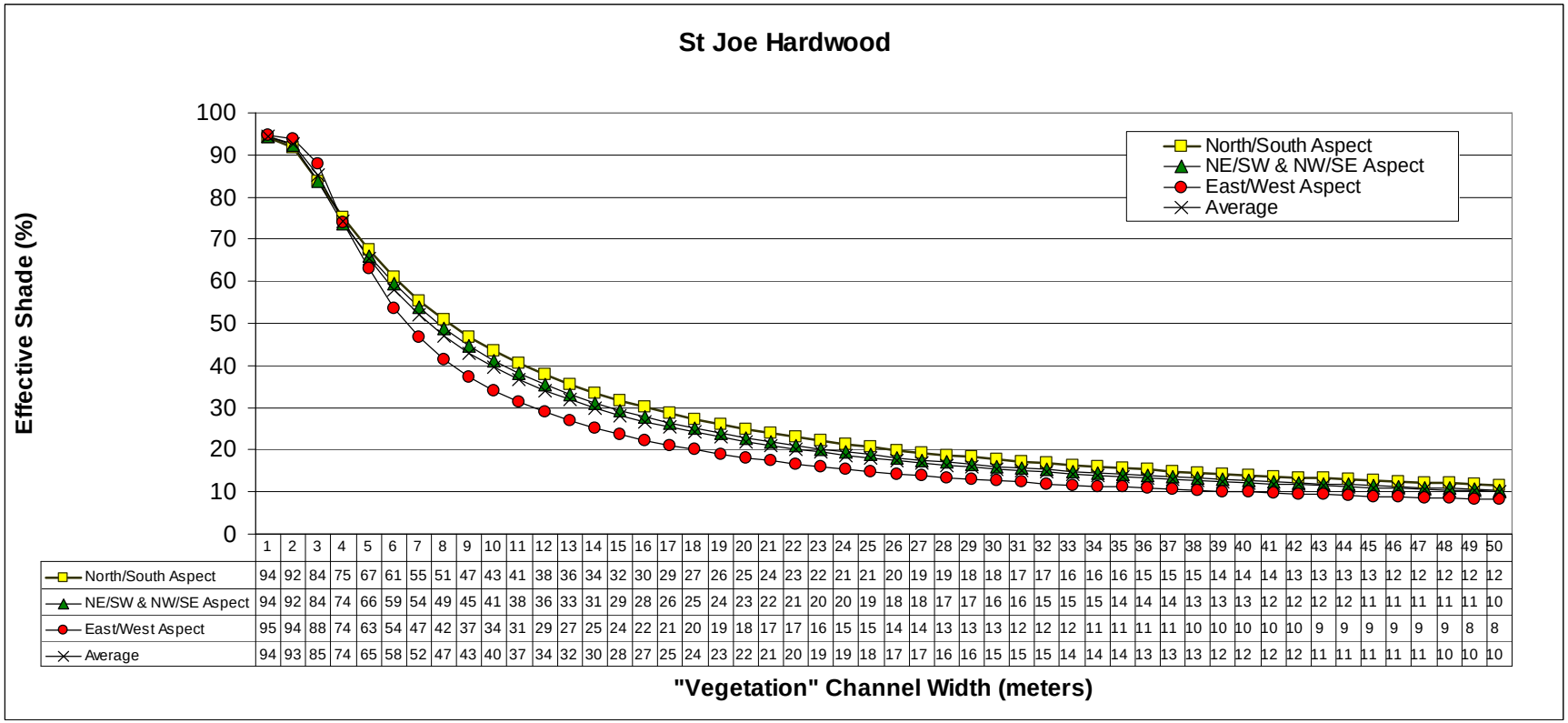
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
North - South	97	97	95	93	90	87	83	78	74	70	67	64	61	58	56	53	51	49	48	46	44	43	41	40	39	38	36	35	34	33	33	32	31	30	29	29	28	27	27	26	25	25	24	24	23	23	22	22	22	21
Northeast/Southwest	98	97	96	93	91	88	83	78	74	70	67	64	61	58	55	53	50	48	46	45	43	41	40	38	37	36	35	33	32	31	30	30	29	28	27	27	26	25	25	24	24	23	23	22	22	21	21	20	20	20
East - West	98	98	97	96	94	93	88	81	73	67	62	57	53	50	47	44	42	40	38	36	35	33	32	31	30	29	28	27	26	25	25	24	23	23	22	22	21	21	20	20	19	19	18	18	18	17	17	17	16	16
Average	98	97	96	94	92	89	85	79	74	69	65	61	58	55	53	50	48	46	44	42	41	39	38	36	35	34	33	32	31	30	29	28	28	27	26	26	25	24	24	23	23	22	22	21	21	20	20	20	19	19

Figure H-45. System potential effective shade at various stream aspects and stream width conditions: Cool/Moist (Group C)—St. Joe National Forest



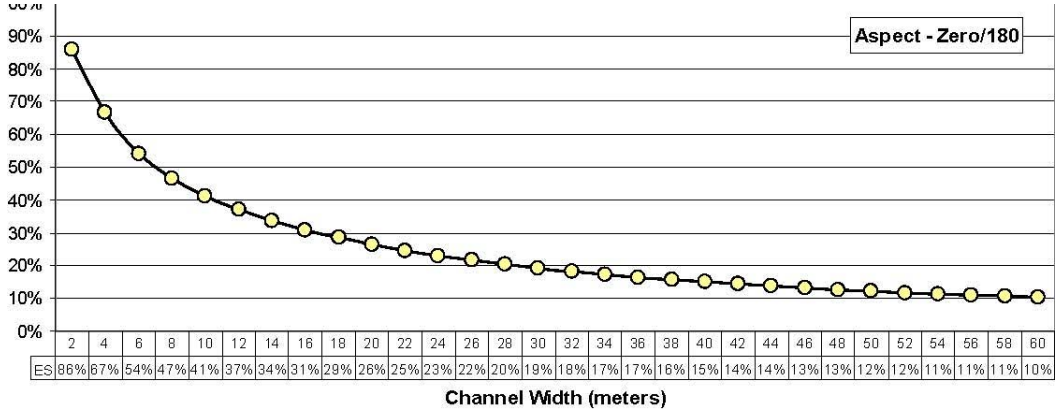
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
North - South	96	95	93	90	83	76	71	67	63	59	56	53	51	48	46	44	42	41	39	38	36	35	34	33	32	31	30	29	28	27	27	26	25	24	24	23	23	22	22	21	21	20	20	19	19	19	18	18	17	17
Northeast/Southwest	96	96	93	90	84	78	72	68	64	60	57	54	51	49	46	44	42	40	38	37	35	34	33	31	30	29	28	27	26	26	25	24	24	23	22	22	21	21	20	20	19	19	18	18	18	17	17	17	16	16
East - West	97	96	95	94	89	82	75	67	62	56	52	47	44	41	39	37	35	33	32	30	29	28	27	26	25	24	23	23	22	21	21	20	19	19	18	18	18	17	17	16	16	16	15	15	15	14	14	14	14	13
Average	96	96	94	91	85	79	73	67	63	59	55	51	49	46	44	42	40	38	36	35	34	32	31	30	29	28	27	26	25	25	24	23	23	22	22	21	20	20	19	19	19	18	18	17	17	17	16	16	16	15

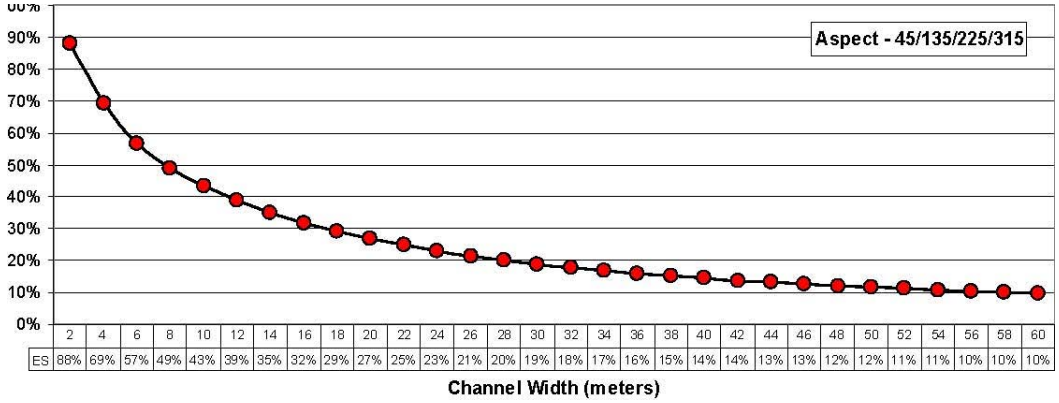
Figure H-46. System potential effective shade at various stream aspects and stream width conditions: Cool/Dry (Group D)—St. Joe National Forest



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
North/South Aspect	94	92	84	75	67	61	55	51	47	43	41	38	36	34	32	30	29	27	26	25	24	23	22	21	21	20	19	19	18	18	17	17	16	16	16	15	15	15	14	14	14	13	13	13	13	12	12	12	12	12
NE/SW & NW/SE Aspect	94	92	84	74	66	59	54	49	45	41	38	36	33	31	29	28	26	25	24	23	22	21	20	20	19	18	18	17	17	16	16	15	15	15	14	14	14	13	13	13	12	12	12	12	11	11	11	11	11	10
East/West Aspect	95	94	88	74	63	54	47	42	37	34	31	29	27	25	24	22	21	20	19	18	17	17	16	15	15	14	14	13	13	13	12	12	12	11	11	11	11	10	10	10	10	10	9	9	9	9	9	9	8	8
Average	94	93	85	74	65	58	52	47	43	40	37	34	32	30	28	27	25	24	23	22	21	20	19	19	18	17	17	16	16	15	15	15	14	14	14	13	13	13	12	12	12	12	11	11	11	11	11	10	10	10

Figure H-47. System potential effective shade at various stream aspects and stream width conditions: St. Joe hardwood riparian community (non-forest group 1)





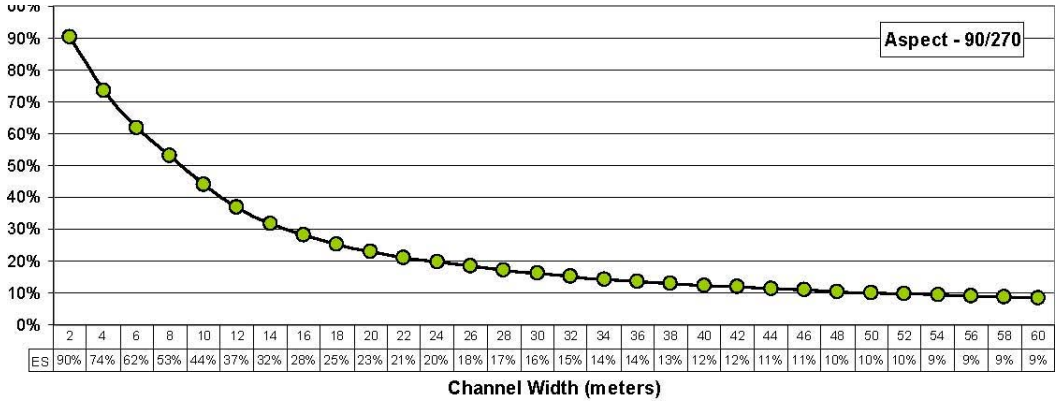


Figure H-48. System potential effective shade at various stream aspects and stream width conditions: "non-forest" assessment group 2

Appendix I. St. Joe River Watershed Potential Natural Vegetation Solar Load Analysis Tables

The load analysis tables in this appendix were developed using existing shade estimates generated from an aerial photograph taken during the summer of 2009. Solar radiation values from Natural Renewable Energy Laboratories in Spokane, Washington, and Kalispell, Montana, were averaged and used to complete the load calculations.

LIST OF TABLES

See List of Tables on page v.

Table I-1. Big Creek (AU ID17010304PN063_02) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	VRU	Comment
Big Creek Watershed - AU# ID17010304PN063_02															
900	0.9	0.55	0.98	0.11	-0.44	1	1	900	495	900	99	-396	-8	Group B	West Fork Big Creek
365	0.9	0.55	0.93	0.385	-0.165	2	2	730	401.5	730	281.05	-120.45	-3	St. Joe HW	West Fork Big Creek[1]
340	0.8	1.1	0.85	0.825	-0.275	3	3	1020	1122	1020	841.5	-280.5	-5	St. Joe HW	West Fork Big Creek[1]
1900	0.7	1.65	0.74	1.43	-0.22	4	4	7600	12540	7600	10868	-1672	-4	St. Joe HW	West Fork Big Creek[1]
980	0.7	1.65	0.78	1.21	-0.44	4	4	3920	6468	3920	4743.2	-1724.8	-8	Group A	West Fork Big Creek
630	0.6	2.2	0.65	1.925	-0.275	5	5	3150	6930	3150	6063.75	-866.25	-5	St. Joe HW	West Fork Big Creek[1]
1700	0.9	0.55	0.98	0.11	-0.44	1	1	1700	935	1700	187	-748	-8	Group B	Trib to WF Big
950	0.9	0.55	0.98	0.11	-0.44	2	2	1900	1045	1900	209	-836	-8	Group B	Trib to WF Big
330	0.8	1.1	0.85	0.825	-0.275	2	2	660	726	660	544.5	-181.5	-5	St. Joe HW	Trib to WF Big[1]
550	0.6	2.2	0.65	1.925	-0.275	5	5	2750	6050	2750	5293.75	-756.25	-5	St. Joe HW	WF Big
1400	0.7	1.65	0.65	1.925	0.275	5	5	7000	11550	7000	13475	1925	5	St. Joe HW	WF Big
1200	0.6	2.2	0.58	2.31	0.11	6	6	7200	15840	7200	16632	792	2	St. Joe HW	WF Big
1800	0.9	0.55	0.98	0.11	-0.44	1	1	1800	990	1800	198	-792	-8	Group B	Deadman Gulch
790	0.9	0.55	0.98	0.11	-0.44	1	1	790	434.5	790	86.9	-347.6	-8	Group B	Deadman Gulch
240	0.9	0.55	0.98	0.11	-0.44	2	2	480	264	480	52.8	-211.2	-8	Group B	Deadman Gulch
530	0.9	0.55	0.93	0.385	-0.165	2	2	1060	583	1060	408.1	-174.9	-3	St. Joe HW	Deadman Gulch[1]
450	0.9	0.55	0.98	0.11	-0.44	2	2	900	495	900	99	-396	-8	Group B	Deadman Gulch
370	0.7	1.65	0.97	0.165	-1.485	3	3	1110	1831.5	1110	183.15	-1648.35	-27	Group B	Deadman Gulch
270	0.8	1.1	0.97	0.165	-0.935	3	3	810	891	810	133.65	-757.35	-17	Group B	Deadman Gulch
210	0.9	0.55	0.97	0.165	-0.385	3	3	630	346.5	630	103.95	-242.55	-7	Group B	Deadman Gulch
450	0.6	2.2	0.58	2.31	0.11	6	6	2700	5940	2700	6237	297	2	St. Joe HW	WF Big
860	0.9	0.55	0.95	0.275	-0.275	1	1	860	473	860	236.5	-236.5	-5	Group A	Middle Fork Big Creek
1800	0.9	0.55	0.94	0.33	-0.22	2	2	3600	1980	3600	1188	-792	-4	Group A	Middle Fork Big Creek
300	0.8	1.1	0.85	0.825	-0.275	3	3	900	990	900	742.5	-247.5	-5	St. Joe HW	Middle Fork Big Creek[1]
730	0.7	1.65	0.85	0.825	-0.825	3	3	2190	3613.5	2190	1806.75	-1806.75	-15	St. Joe HW	Middle Fork Big Creek[1]
1400	0.9	0.55	0.98	0.11	-0.44	1	1	1400	770	1400	154	-616	-8	Group B	McPhee Creek
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	McPhee Creek
1100	0.5	2.75	0.74	1.43	-1.32	4	4	4400	12100	4400	6292	-5808	-24	St. Joe HW	MF Big McPhee to Ames
1300	0.9	0.55	0.98	0.11	-0.44	1	1	1300	715	1300	143	-572	-8	Group B	Ames Creek
650	0.9	0.55	0.98	0.11	-0.44	2	2	1300	715	1300	143	-572	-8	Group B	Ames Creek
1500	0.6	2.2	0.85	0.825	-1.375	3	3	4500	9900	4500	3712.5	-6187.5	-25	St. Joe HW	Ames Creek[1]
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group B	Early Creek
1400	0.9	0.55	0.98	0.11	-0.44	2	2	2800	1540	2800	308	-1232	-8	Group B	Early Creek
620	0.8	1.1	0.87	0.715	-0.385	3	3	1860	2046	1860	1329.9	-716.1	-7	Group B	Early Creek
910	0.7	1.65	0.85	0.825	-0.825	3	3	2730	4504.5	2730	2252.25	-2252.25	-15	St. Joe HW	Early Creek[1]

[1]Applied St. Joe hardwood shade curve although stream slope was greater than 3%. Vegetation resembled hardwood community not forest type.

Table I-1. Big Creek (AU ID17010304PN063_02) solar load analysis table (continued)

620	0.6	2.2	0.74	1.43	-0.77	4	4	2480	5456	2480	3546.4	-1909.6	-14	St. Joe HW	Ames Creek
320	0.5	2.75	0.74	1.43	-1.32	4	4	1280	3520	1280	1830.4	-1689.6	-24	St. Joe HW	Ames Creek
1000	0.9	0.55	0.95	0.275	-0.275	1	1	1000	550	1000	275	-275	-5	Group A	Miles Creek
1200	0.9	0.55	0.94	0.33	-0.22	2	2	2400	1320	2400	792	-528	-4	Group A	Miles Creek
700	0.9	0.55	0.98	0.11	-0.44	1	1	700	385	700	77	-308	-8	Group B	Pieree Creek
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group B	Pieree Creek
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Pieree Creek
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Pieree Creek
440	0.9	0.55	0.96	0.22	-0.33	3	3	1320	726	1320	290.4	-435.6	-6	Group C	Pieree Creek
140	0.9	0.55	0.96	0.22	-0.33	3	3	420	231	420	92.4	-138.6	-6	Group C	Pieree Creek
700	0.9	0.55	0.98	0.11	-0.44	1	1	700	385	700	77	-308	-8	Group B	Cameron Creek
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group B	Cameron Creek
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Cameron Creek
800	0.9	0.55	0.98	0.11	-0.44	1	1	800	440	800	88	-352	-8	Group B	Cabin Creek
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group B	Cabin Creek
600	0.9	0.55	0.98	0.11	-0.44	1	1	600	330	600	66	-264	-8	Group B	Flag Creek
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group B	Flag Creek
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Flag Creek
400	0.9	0.55	0.98	0.11	-0.44	1	1	400	220	400	44	-176	-8	Group B	Jumboo Creek
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group B	Jumboo Creek
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Jumboo Creek
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Jumboo Creek
600	0.9	0.55	0.98	0.11	-0.44	1	1	600	330	600	66	-264	-8	Group B	EF Big
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group B	EF Big
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	EF Big
780	0.9	0.55	0.98	0.11	-0.44	2	2	1560	858	1560	171.6	-686.4	-8	Group B	EF Big
680	0.9	0.55	0.98	0.11	-0.44	2	2	1360	748	1360	149.6	-598.4	-8	Group B	EF Big
700	0.9	0.55	0.97	0.165	-0.385	3	3	2100	1155	2100	346.5	-808.5	-7	Group B	EF Big
1000	0.9	0.55	0.96	0.22	-0.33	4	4	4000	2200	4000	880	-1320	-6	Group B	EF Big
910	0.9	0.55	0.98	0.11	-0.44	1	1	910	500.5	910	100.1	-400.4	-8	Group B	Donaldson Creek
800	0.9	0.55	0.98	0.11	-0.44	1	1	800	440	800	88	-352	-8	Group B	Donaldson Creek
730	0.9	0.55	0.98	0.11	-0.44	2	2	1460	803	1460	160.6	-642.4	-8	Group B	Donaldson Creek
550	0.9	0.55	0.98	0.11	-0.44	2	2	1100	605	1100	121	-484	-8	Group B	Donaldson Creek
800	0.9	0.55	0.98	0.11	-0.44	1	1	800	440	800	88	-352	-8	Group B	Hall Creek
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Hall Creek
490	0.9	0.55	0.98	0.11	-0.44	2	2	980	539	980	107.8	-431.2	-8	Group B	Hall Creek
53	0.9	0.55	0.97	0.165	-0.385	3	3	159	87.45	159	26.235	-61.215	-7	Group B	Donaldson below Hall to EF Big
37	0.9	0.55	0.97	0.165	-0.385	3	3	111	61.05	111	18.315	-42.735	-7	Group B	EF Big above Rogers
1800	0.9	0.55	0.98	0.11	-0.44	4	4	7200	3960	7200	792	-3168	-8	Group B	Rogers
250	0.8	1.1	0.74	1.43	0.33	4	4	1000	1100	1000	1430	330	6	St. Joe HW	EF Big
250	0.7	1.65	0.74	1.43	-0.22	4	4	1000	1650	1000	1430	-220	-4	St. Joe HW	EF Big
420	0.6	2.2	0.65	1.925	-0.275	5	5	2100	4620	2100	4042.5	-577.5	-5	St. Joe HW	EF Big
320	0.5	2.75	0.58	2.31	-0.44	6	6	1920	5280	1920	4435.2	-844.8	-8	St. Joe HW	EF Big
600	0.9	0.55	0.98	0.11	-0.44	1	1	600	330	600	66	-264	-8	Group B	West side trib below Roders Creek
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group B	West side trib below Roders Creek
110	0.5	2.75	0.58	2.31	-0.44	6	6	660	1815	660	1524.6	-290.4	-8	St. Joe HW	EF Big Crk-unnamed trib to Mowat Crk[1]
930	0.6	2.2	0.64	1.98	-0.22	6	6	5580	12276	5580	11048.4	-1227.6	-4	Group A	EF Big Crk-unnamed trib to Mowat Crk

[1]Applied St. Joe hardwood shade curve although stream slope was greater than 3%. Vegetation resembled hardwood community not forest type.

Table I-1. Big Creek (AU ID17010304PN063_02/03) solar load analysis table (continued)

800	0.9	0.55	0.98	0.11	-0.44	1	1	800	440	800	88	-352	-8	Group B	Mowat Creek
740	0.9	0.55	0.98	0.11	-0.44	1	1	740	407	740	81.4	-325.6	-8	Group B	Mowat Creek
960	0.9	0.55	0.98	0.11	-0.44	2	2	1920	1056	1920	211.2	-844.8	-8	Group B	Mowat Creek
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Mowat Creek
290	0.6	2.2	0.58	2.31	0.11	6	6	1740	3828	1740	4019.4	191.4	2	St. Joe HW	EF Big - Mowat to Big Creek
1100	0.5	2.75	0.58	2.31	-0.44	6	6	6600	18150	6600	15246	-2904	-8	St. Joe HW	EF Big - Mowat to Big Creek
700	0.6	2.2	0.58	2.31	0.11	6	6	4200	9240	4200	9702	462	2	St. Joe HW	EF Big - Mowat to Big Creek
1000	0.6	2.2	0.58	2.31	0.11	6	6	6000	13200	6000	13860	660	2	St. Joe HW	EF Big - Mowat to Big Creek
1000	0.6	2.2	0.52	2.64	0.44	7	7	7000	15400	7000	18480	3080	8	St. Joe HW	EF Big - Mowat to Big Creek
1000	0.6	2.2	0.52	2.64	0.44	7	7	7000	15400	7000	18480	3080	8	St. Joe HW	EF Big - Mowat to Big Creek
280	0.5	2.75	0.52	2.64	-0.11	7	7	1960	5390	1960	5174.4	-215.6	-2	St. Joe HW	EF Big - Mowat to Big Creek
Big Creek Watershed - AU# ID17010304PN063_03															
190	0.5	2.75	0.65	1.925	-0.825	5	5	950	2612.5	950	1828.75	-783.75	-15	St. Joe HW	MF Big - Ames to Miles
1000	0.6	2.2	0.65	1.925	-0.275	5	5	5000	11000	5000	9625	-1375	-5	St. Joe HW	MF Big - Ames to Miles
1100	0.5	2.75	0.58	2.31	-0.44	6	6	6600	18150	6600	15246	-2904	-8	St. Joe HW	MF Big - Ames to Miles
230	0.5	2.75	0.64	1.98	-0.77	6	6	1380	3795	1380	2732.4	-1062.6	-14	Group A	MF Big - Miles to Big
720	0.5	2.75	0.64	1.98	-0.77	6	6	4320	11880	4320	8553.6	-3326.4	-14	Group A	MF Big - Miles to Big
1300	0.8	1.1	0.91	0.495	-0.605	7	7	9100	10010	9100	4504.5	-5505.5	-11	Group B	MF Big - Miles to Big
130	0.6	2.2	0.47	2.915	0.715	8	8	1040	2288	1040	3031.6	743.6	13	St. Joe HW	Big Creek - MF to Pieree
780	0.5	2.75	0.43	3.135	0.385	9	9	7020	19305	7020	22007.7	2702.7	7	St. Joe HW	Big Creek - MF to Pieree
680	0.7	1.65	0.79	1.155	-0.495	10	10	6800	11220	6800	7854	-3366	-9	St. Joe HW	Big Creek - MF to Pieree
460	0.5	2.75	0.4	3.3	0.55	10	10	4600	12650	4600	15180	2530	10	St. Joe HW	Big Creek - MF to Pieree
160	0.4	3.3	0.4	3.3	0	10	10	1600	5280	1600	5280	0	0	St. Joe HW	Big Creek - Pieree to Cameron
370	0.3	3.85	0.4	3.3	-0.55	10	10	3700	14245	3700	12210	-2035	-10	St. Joe HW	Big Creek - Pieree to Cameron
260	0.3	3.85	0.4	3.3	-0.55	10	10	2600	10010	2600	8580	-1430	-10	St. Joe HW	Big - Cameron to Cabin
430	0.3	3.85	0.37	3.465	-0.385	11	11	4730	18210.5	4730	16389.45	-1821.05	-7	St. Joe HW	Big - Cabin to Flag
480	0.2	4.4	0.37	3.465	-0.935	11	11	5280	23232	5280	18295.2	-4936.8	-17	St. Joe HW	Big - Cabin to Flag
920	0.3	3.85	0.37	3.465	-0.385	11	11	10120	38962	10120	35065.8	-3896.2	-7	St. Joe HW	Big - Cabin to Flag
440	0.2	4.4	0.37	3.465	-0.935	11	11	4840	21296	4840	16770.6	-4525.4	-17	St. Joe HW	Big - Flag to Jumbo
550	0.3	3.85	0.37	3.465	-0.385	11	11	6050	23292.5	6050	20963.25	-2329.25	-7	St. Joe HW	Big - Flag to Jumbo
800	0.2	4.4	0.37	3.465	-0.935	11	11	8800	38720	8800	30492	-8228	-17	St. Joe HW	Big - Flag to Jumbo
800	0.2	4.4	0.37	3.465	-0.935	11	11	8800	38720	8800	30492	-8228	-17	St. Joe HW	Big - Flag to Jumbo
460	0.1	4.95	0.37	3.465	-1.485	11	11	5060	25047	5060	17532.9	-7514.1	-27	St. Joe HW	Big - Jumbo to EF Big
1100	0.1	4.95	0.34	3.63	-1.32	12	12	13200	65340	13200	47916	-17424	-24	St. Joe HW	Big - Jumbo to EF Big
600	0.1	4.95	0.34	3.63	-1.32	12	12	7200	35640	7200	26136	-9504	-24	St. Joe HW	Big Creek
1000	0.1	4.95	0.32	3.74	-1.21	13	13	13000	64350	13000	48620	-15730	-22	St. Joe HW	Big Creek
1000	0.1	4.95	0.32	3.74	-1.21	13	13	13000	64350	13000	48620	-15730	-22	St. Joe HW	Big Creek
1000	0.1	4.95	0.3	3.85	-1.1	14	14	14000	69300	14000	53900	-15400	-20	St. Joe HW	Big Creek
800	0.2	4.4	0.3	3.85	-0.55	14	14	11200	49280	11200	43120	-6160	-10	St. Joe HW	Big Creek
1000	0.2	4.4	0.3	3.85	-0.55	14	14	14000	61600	14000	53900	-7700	-10	St. Joe HW	Big Creek

AU ID17010304PN063_02	**Subtotals**	**190710**	**266497**	**190710**	**207742**	**-58755**	**-7**
AU ID17010304PN063_03	**Subtotals**	**193990**	**769786**	**193990**	**624847**	**-144939**	**-11**
	Total	**384700**	**1036283**	**384700**	**832589**	**-203694**	**-8**

Table I-2. Bluff Creek (AU ID17010304PN045_02) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	VRU	Stream Segment Description
Bluff Creek Watershed - AU# ID17010304PN045_02															
790	0.8	1.1	0.98	0.11	-0.99	1	1	790	869	790	86.9	-782.1	-18	Group C	South trib to EF Bluff
800	0.9	0.55	0.98	0.11	-0.44	1	1	800	440	800	88	-352	-8	Group C	South trib to EF Bluff
570	0.9	0.55	0.98	0.11	-0.44	2	2	1140	627	1140	125.4	-501.6	-8	Group B	South trib to EF Bluff
450	0.8	1.1	0.98	0.11	-0.99	2	2	900	990	900	99	-891	-18	Group B	South trib to EF Bluff
1900	0.9	0.55	0.97	0.165	-0.385	2	2	3800	2090	3800	627	-1463	-7	Group C	EF Bluff
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	EF Bluff
1100	0.9	0.55	0.97	0.165	-0.385	3	3	3300	1815	3300	544.5	-1270.5	-7	Group B	EF - South trib to 1st west trib
1000	0.9	0.55	0.96	0.22	-0.33	4	4	4000	2200	4000	880	-1320	-6	Group B	EF - South trib to 1st west trib
810	0.8	1.1	0.98	0.11	-0.99	1	1	810	891	810	89.1	-801.9	-18	Group C	1st west trib
1400	0.9	0.55	0.98	0.11	-0.44	2	2	2800	1540	2800	308	-1232	-8	Group B	1st west trib
850	0.9	0.55	0.96	0.22	-0.33	4	4	3400	1870	3400	748	-1122	-6	Group B	EF Bluff - 1st west to Junction
470	0.8	1.1	0.98	0.11	-0.99	1	1	470	517	470	51.7	-465.3	-18	Group C	Junction Creek
950	0.9	0.55	0.98	0.11	-0.44	1	1	950	522.5	950	104.5	-418	-8	Group C	Junction Creek
950	0.9	0.55	0.98	0.11	-0.44	2	2	1900	1045	1900	209	-836	-8	Group B	Junction Creek
1000	0.9	0.55	0.97	0.165	-0.385	3	3	3000	1650	3000	495	-1155	-7	Group B	Junction Creek
1700	0.9	0.55	0.94	0.33	-0.22	5	5	8500	4675	8500	2805	-1870	-4	Group B	EF Bluff - Bad Luck to Junction
630	0.6	2.2	0.58	2.31	0.11	6	6	3780	8316	3780	8731.8	415.8	2	St. Joe HW	EF Bluff - Bad Luck to Junction
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group C	Bad Luck Creek
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group B	Bad Luck Creek
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Bad Luck Creek
770	0.6	2.2	0.58	2.31	0.11	6	6	4620	10164	4620	10672.2	508.2	2	St. Joe HW	EF-below Bad Luck & unnamed trib[1]
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group C	Unnamed trib
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group B	Unnamed trib
590	0.6	2.2	0.52	2.64	0.44	7	7	4130	9086	4130	10903.2	1817.2	8	St. Joe HW	EF - Siamese to unnamed trib
860	0.6	2.2	0.52	2.64	0.44	7	7	6020	13244	6020	15892.8	2648.8	8	St. Joe HW	EF - Siamese to unnamed trib
810	0.8	1.1	0.98	0.11	-0.99	1	1	810	891	810	89.1	-801.9	-18	Group C	Siamese Creek
1300	0.9	0.55	0.97	0.165	-0.385	2	2	2600	1430	2600	429	-1001	-7	Group C	Siamese Creek
1100	0.8	1.1	0.91	0.495	-0.605	7	7	7700	8470	7700	3811.5	-4658.5	-11	Group B	EF Bluff - Siamese to confluence
1000	0.8	1.1	0.91	0.495	-0.605	7	7	7000	7700	7000	3465	-4235	-11	Group B	EF Bluff - Siamese to confluence
900	0.9	0.55	0.98	0.11	-0.44	1	1	900	495	900	99	-396	-8	Group C	WF Bluff - org from Dismal Lake
900	0.9	0.55	0.97	0.165	-0.385	2	2	1800	990	1800	297	-693	-7	Group C	WF Bluff - org from Dismal Lake
950	0.9	0.55	0.98	0.11	-0.44	1	1	950	522.5	950	104.5	-418	-8	Group C	South trib to EF below Dismal
950	0.9	0.55	0.97	0.165	-0.385	2	2	1900	1045	1900	313.5	-731.5	-7	Group C	South trib to EF below Dismal
600	0.9	0.55	0.96	0.22	-0.33	3	3	1800	990	1800	396	-594	-6	Group C	WF Bluff above named WF Bluff
1400	0.9	0.55	0.98	0.11	-0.44	1	1	1400	770	1400	154	-616	-8	Group C	WF Bluff
1000	0.9	0.55	0.97	0.165	-0.385	2	2	2000	1100	2000	330	-770	-7	Group C	WF Bluff

[1]Applied St. Joe hardwood shade curve although stream slope was greater than 3%. Vegetation resembled hardwood community not forest type.

Table I-2. Bluff Creek (AU ID17010304PN045_02/03) solar load analysis table (continued)

720	0.9	0.55	0.97	0.165	-0.385	3	3	2160	1188	2160	356.4	-831.6	-7	Group B	WF Bluff above 1st south trib
440	0.8	1.1	0.74	1.43	0.33	4	4	1760	1936	1760	2516.8	580.8	6	St. Joe HW	WF Bluff above 1st south trib[1]
640	0.7	1.65	0.74	1.43	-0.22	4	4	2560	4224	2560	3660.8	-563.2	-4	St. Joe HW	WF Bluff above 1st south trib[1]
1300	0.9	0.55	0.98	0.11	-0.44	1	1	1300	715	1300	143	-572	-8	Group B	1st south trib
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	1st south trib
1100	0.6	2.2	0.64	1.98	-0.22	5	5	5500	12100	5500	10890	-1210	-4	St. Joe HW	WF Bluff above Whistling Creek
1100	0.8	1.1	0.94	0.33	-0.77	5	5	5500	6050	5500	1815	-4235	-14	Group B	WF Bluff above Whistling Creek
1300	0.9	0.55	0.98	0.11	-0.44	1	1	1300	715	1300	143	-572	-8	Group C	Whistling Creek
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Whistling Creek
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Whistling Creek
1000	0.9	0.55	0.97	0.165	-0.385	3	3	3000	1650	3000	495	-1155	-7	Group B	Whistling Creek
840	0.8	1.1	0.92	0.44	-0.66	6	6	5040	5544	5040	2217.6	-3326.4	-12	Group B	WF Bluff below Whistling Creek
390	0.6	2.2	0.58	2.31	0.11	6	6	2340	5148	2340	5405.4	257.4	2	St. Joe HW	WF Bluff below Whistling Creek
1500	0.9	0.55	0.98	0.11	-0.44	1	1	1500	825	1500	165	-660	-8	Group B	1st north trib below Whistling
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	1st north trib below Whistling
440	0.7	1.65	0.92	0.44	-1.21	6	6	2640	4356	2640	1161.6	-3194.4	-22	Group B	WF between 1st and 2nd north tribs[1]
1200	0.1	4.95	0.98	0.11	-4.84	1	1	1200	5940	1200	132	-5808	-88	Group B	2nd north trib below Whistling
690	0.9	0.55	0.98	0.11	-0.44	1	1	690	379.5	690	75.9	-303.6	-8	Group B	2nd north trib below Whistling
170	0.8	1.1	0.98	0.11	-0.99	1	1	170	187	170	18.7	-168.3	-18	Group B	2nd north trib below Whistling
790	0.6	2.2	0.58	2.31	0.11	6	6	4740	10428	4740	10949.4	521.4	2	St. Joe HW	WF btwn 2nd&3rd north trib blw Whistling
550	0.5	2.75	0.58	2.31	-0.44	6	6	3300	9075	3300	7623	-1452	-8	St. Joe HW	WF btwn 2nd&3rd north trib blw Whistling
610	0.9	0.55	0.98	0.11	-0.44	1	1	610	335.5	610	67.1	-268.4	-8	Group B	3rd north trib below Whistling
150	0.8	1.1	0.98	0.11	-0.99	1	1	150	165	150	16.5	-148.5	-18	Group B	3rd north trib below Whistling
850	0.9	0.55	0.98	0.11	-0.44	1	1	850	467.5	850	93.5	-374	-8	Group B	3rd north trib below Whistling
350	0.7	1.65	0.64	1.98	0.33	6	6	2100	3465	2100	4158	693	6	Group A	WF between 3rd and 4th north tribs
470	0.6	2.2	0.59	2.255	0.055	7	7	3290	7238	3290	7418.95	180.95	1	Group A	WF between 3rd and 4th north tribs
780	0.8	1.1	0.91	0.495	-0.605	7	7	5460	6006	5460	2702.7	-3303.3	-11	Group B	WF between 3rd and 4th north tribs
1200	0.9	0.55	0.98	0.11	-0.44	1	1	1200	660	1200	132	-528	-8	Group B	4th north trib below Whistling
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group B	4th north trib below Whistling
810	0.8	1.1	0.91	0.495	-0.605	7	7	5670	6237	5670	2806.65	-3430.35	-11	Group B	WF Bluff above WF confluence
800	0.6	2.2	0.88	0.66	-1.54	8	8	6400	14080	6400	4224	-9856	-28	Group B	WF Bluff above WF confluence
660	0.5	2.75	0.88	0.66	-2.09	8	8	5280	14520	5280	3484.8	-11035.2	-38	Group B	WF Bluff above WF confluence
320	0.6	2.2	0.88	0.66	-1.54	8	8	2560	5632	2560	1689.6	-3942.4	-28	Group B	WF Bluff above WF confluence
Bluff Creek Watershed - AU# ID17010304PN045_03															
1800	0.7	1.65	0.83	0.935	-0.715	9	9	16200	26730	16200	15147	-11583	-13	Group B	Bluff - EF WF to St. Joe
330	0.6	2.2	0.79	1.155	-1.045	10	10	3300	7260	3300	3811.5	-3448.5	-19	Group B	Bluff - EF WF to St. Joe
840	0.7	1.65	0.74	1.43	-0.22	11	11	9240	15246	9240	13213.2	-2032.8	-4	Group B	Bluff - EF WF to St. Joe
					AU ID17010304PN045_02		**Subtotals**	**179240**	**225572**	**179240**	**139382**	**-86189**	**-10**		
					AU ID17010304PN045_03		**Subtotals**	**28740**	**49236**	**28740**	**32172**	**-17064**	**-12**		
							Total	**207980**	**274808**	**207980**	**171554**	**-103254**	**-10**		

[1]Applied St. Joe hardwood shade curve although stream slope was greater than 3%. Vegetation resembled hardwood community not forest type.

Table I-3. Fishhook Creek (AU ID17010304PN039_02) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	VRU	Stream Segment Description
Fishhook Creek Watershed AU# 17010304PN039_02															
1100	0.9	0.55	0.98	0.11	-0.44	1	1	1100	605	1100	121	-484	-8	Group B	EF Fishhook
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group B	EF Fishhook
120	0.9	0.55	0.98	0.11	-0.44	1	1	120	66	120	13.2	-52.8	-8	Group C	EF Fishhook
1100	0.9	0.55	0.98	0.11	-0.44	1	1	1100	605	1100	121	-484	-8	Group B	West unnamed trib to EF Fishhook
570	0.9	0.55	0.98	0.11	-0.44	1	1	570	313.5	570	62.7	-250.8	-8	Group C	West unnamed trib to EF Fishhook
240	0.9	0.55	0.93	0.385	-0.165	2	2	480	264	480	184.8	-79.2	-3	St. Joe HW	EF Fishook below unnamed trib
500	0.7	1.65	0.93	0.385	-1.265	2	2	1000	1650	1000	385	-1265	-23	St. Joe HW	EF Fishook below unnamed trib
130	0.5	2.75	0.85	0.825	-1.925	3	3	390	1072.5	390	321.75	-750.75	-35	St. Joe HW	EF Fishook below unnamed trib
430	0.9	0.55	0.98	0.11	-0.44	1	1	430	236.5	430	47.3	-189.2	-8	Group B	South trib
220	0.8	1.1	0.98	0.11	-0.99	1	1	220	242	220	24.2	-217.8	-18	Group B	South trib
150	0.9	0.55	0.98	0.11	-0.44	1	1	150	82.5	150	16.5	-66	-8	Group B	South trib
310	0.8	1.1	0.98	0.11	-0.99	1	1	310	341	310	34.1	-306.9	-18	Group B	South trib
720	0.9	0.55	0.98	0.11	-0.44	1	1	720	396	720	79.2	-316.8	-8	Group B	South trib
480	0.7	1.65	0.98	0.11	-1.54	1	1	480	792	480	52.8	-739.2	-28	Group B	South trib
390	0.8	1.1	0.98	0.11	-0.99	1	1	390	429	390	42.9	-386.1	-18	Group B	South trib
55	0.5	2.75	0.94	0.33	-2.42	1	1	55	151.25	55	18.15	-133.1	-44	St. Joe HW	South trib[1]
400	0.5	2.75	0.85	0.825	-1.925	3	3	1200	3300	1200	990	-2310	-35	St. Joe HW	EF Fishhook
700	0.9	0.55	0.98	0.11	-0.44	1	1	700	385	700	77	-308	-8	Group C	East trib
600	0.9	0.55	0.98	0.11	-0.44	1	1	600	330	600	66	-264	-8	Group B	East trib
940	0.7	1.65	0.97	0.165	-1.485	2	2	1880	3102	1880	310.2	-2791.8	-27	Group B	East trib
590	0.9	0.55	0.96	0.22	-0.33	3	3	1770	973.5	1770	389.4	-584.1	-6	Group C	East trib
320	0.5	2.75	0.85	0.825	-1.925	3	3	960	2640	960	792	-1848	-35	St. Joe HW	EF Fishhook[1]
260	0.6	2.2	0.85	0.825	-1.375	4	4	1040	2288	1040	858	-1430	-25	St. Joe HW	EF Fishhook[1]
1200	0.9	0.55	0.96	0.22	-0.33	4	4	4800	2640	4800	1056	-1584	-6	Group B	EF Fishhook
1000	0.9	0.55	0.94	0.33	-0.22	5	5	5000	2750	5000	1650	-1100	-4	Group B	EF Fishhook
1400	0.9	0.55	0.98	0.11	-0.44	1	1	1400	770	1400	154	-616	-8	Group B	WF Fishhook
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	WF Fishhook
510	0.9	0.55	0.98	0.11	-0.44	1	1	510	280.5	510	56.1	-224.4	-8	Group C	Red Raven
460	0.9	0.55	0.98	0.11	-0.44	1	1	460	253	460	50.6	-202.4	-8	Group C	Red Raven
880	0.9	0.55	0.97	0.165	-0.385	2	2	1760	968	1760	290.4	-677.6	-7	Group C	Red Raven
1000	0.9	0.55	0.97	0.165	-0.385	2	2	2000	1100	2000	330	-770	-7	Group C	Red Raven
1000	0.9	0.55	0.96	0.22	-0.33	3	3	3000	1650	3000	660	-990	-6	Group C	Red Raven
650	0.9	0.55	0.96	0.22	-0.33	1	1	650	357.5	650	143	-214.5	-6	Group D	Middle
680	0.9	0.55	0.98	0.11	-0.44	1	1	680	374	680	74.8	-299.2	-8	Group C	Middle
900	0.9	0.55	0.98	0.11	-0.44	1	1	900	495	900	99	-396	-8	Group C	Middle
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Middle
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Middle
610	0.9	0.55	0.97	0.165	-0.385	3	3	1830	1006.5	1830	301.95	-704.55	-7	Group B	Red Raven
240	0.8	1.1	0.85	0.825	-0.275	3	3	720	792	720	594	-198	-5	St. Joe HW	Red Raven[1]

[1]Applied St. Joe hardwood shade curve although stream slope was greater than 3%. Vegetation resembled hardwood community not forest type.

Table I-3. Fishhook Creek (AU ID17010304PN039_02) solar load analysis table (continued)

350	0.9	0.55	0.96	0.22	-0.33	1	1	350	192.5	350	77	-115.5	-6	Group D	Outlaw
600	0.9	0.55	0.98	0.11	-0.44	1	1	600	330	600	66	-264	-8	Group C	Outlaw
600	0.9	0.55	0.98	0.11	-0.44	1	1	600	330	600	66	-264	-8	Group C	Outlaw
800	0.9	0.55	0.98	0.11	-0.44	1	1	800	440	800	88	-352	-8	Group C	Outlaw
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group C	Trib to Outlaw
590	0.9	0.55	0.98	0.11	-0.44	1	1	590	324.5	590	64.9	-259.6	-8	Group C	Trib to Outlaw
640	0.9	0.55	0.98	0.11	-0.44	2	2	1280	704	1280	140.8	-563.2	-8	Group B	Outlaw
300	0.8	1.1	0.98	0.11	-0.99	2	2	600	660	600	66	-594	-18	Group B	Outlaw
800	0.8	1.1	0.98	0.11	-0.99	2	2	1600	1760	1600	176	-1584	-18	Group B	Outlaw
1000	0.8	1.1	0.97	0.165	-0.935	3	3	3000	3300	3000	495	-2805	-17	Group B	Outlaw
770	0.9	0.55	0.98	0.11	-0.44	1	1	770	423.5	770	84.7	-338.8	-8	Group B	Trib to Middle below Outlaw
1100	0.9	0.55	0.98	0.11	-0.44	1	1	1100	605	1100	121	-484	-8	Group B	Trib to Middle below Outlaw
380	0.8	1.1	0.98	0.11	-0.99	1	1	380	418	380	41.8	-376.2	-18	Group B	Trib to Middle below Outlaw
330	0.9	0.55	0.98	0.11	-0.44	1	1	330	181.5	330	36.3	-145.2	-8	Group B	Unnamed east trib below EF
400	0.9	0.55	0.98	0.11	-0.44	1	1	400	220	400	44	-176	-8	Group B	Unnamed east trib below EF
700	0.9	0.55	0.98	0.11	-0.44	1	1	700	385	700	77	-308	-8	Group B	Unnamed east trib below EF
700	0.9	0.55	0.98	0.11	-0.44	1	1	700	385	700	77	-308	-8	Group B	Unnamed east trib below EF
290	0.5	2.75	0.98	0.11	-2.64	1	1	290	797.5	290	31.9	-765.6	-48	Group B	NF unnamed trib above Cougar
390	0.7	1.65	0.98	0.11	-1.54	1	1	390	643.5	390	42.9	-600.6	-28	Group B	NF unnamed trib above Cougar
760	0.8	1.1	0.98	0.11	-0.99	1	1	760	836	760	83.6	-752.4	-18	Group B	NF unnamed trib above Cougar
860	0.9	0.55	0.98	0.11	-0.44	2	2	1720	946	1720	189.2	-756.8	-8	Group B	NF unnamed trib above Cougar
470	0.8	1.1	0.98	0.11	-0.99	2	2	940	1034	940	103.4	-930.6	-18	Group B	NF unnamed trib above Cougar
800	0.9	0.55	0.98	0.11	-0.44	1	1	800	440	800	88	-352	-8	Group B	SF unnamed trib above Cougar
700	0.9	0.55	0.98	0.11	-0.44	1	1	700	385	700	77	-308	-8	Group B	SF unnamed trib above Cougar
210	0.8	1.1	0.98	0.11	-0.99	1	1	210	231	210	23.1	-207.9	-18	Group B	SF unnamed trib above Cougar
220	0.7	1.65	0.98	0.11	-1.54	2	2	440	726	440	48.4	-677.6	-28	Group B	Unnamed trib above Cougar
490	0.8	1.1	0.98	0.11	-0.99	2	2	980	1078	980	107.8	-970.2	-18	Group B	Unnamed trib above Cougar
190	0.9	0.55	0.98	0.11	-0.44	2	2	380	209	380	41.8	-167.2	-8	Group B	Unnamed trib above Cougar
380	0.7	1.65	0.98	0.11	-1.54	1	1	380	627	380	41.8	-585.2	-28	Group B	SF Cougar
340	0.6	2.2	0.98	0.11	-2.09	1	1	340	748	340	37.4	-710.6	-38	Group B	SF Cougar
700	0.9	0.55	0.98	0.11	-0.44	1	1	700	385	700	77	-308	-8	Group B	SF Cougar
700	0.9	0.55	0.98	0.11	-0.44	1	1	700	385	700	77	-308	-8	Group B	SF Cougar
350	0.7	1.65	0.98	0.11	-1.54	2	2	700	1155	700	77	-1078	-28	Group B	SF Cougar
600	0.8	1.1	0.98	0.11	-0.99	2	2	1200	1320	1200	132	-1188	-18	Group B	SF Cougar
500	0.8	1.1	0.98	0.11	-0.99	2	2	1000	1100	1000	110	-990	-18	Group B	SF Cougar
580	0.9	0.55	0.98	0.11	-0.44	1	1	580	319	580	63.8	-255.2	-8	Group B	NF Cougar
770	0.7	1.65	0.98	0.11	-1.54	1	1	770	1270.5	770	84.7	-1185.8	-28	Group B	NF Cougar
470	0.9	0.55	0.98	0.11	-0.44	1	1	470	258.5	470	51.7	-206.8	-8	Group B	NF Cougar
700	0.8	1.1	0.98	0.11	-0.99	2	2	1400	1540	1400	154	-1386	-18	Group B	NF Cougar
800	0.8	1.1	0.98	0.11	-0.99	2	2	1600	1760	1600	176	-1584	-18	Group B	NF Cougar
290	0.8	1.1	0.97	0.165	-0.935	3	3	870	957	870	143.55	-813.45	-17	Group B	Cougar

[1]Applied St. Joe hardwood shade curve although stream slope was greater than 3%. Vegetation resembled hardwood community not forest type.

Table I-3. Fishhook Creek (AU ID17010304PN039_02) solar load analysis table (continued)

1100	0.9	0.55	0.96	0.22	-0.33	1	1	1100	605	1100	242	-363	-6	Group D	Lick
1100	0.9	0.55	0.98	0.11	-0.44	2	2	2200	1210	2200	242	-968	-8	Group B	Lick
1200	0.9	0.55	0.98	0.11	-0.44	2	2	2400	1320	2400	264	-1056	-8	Group B	Lick
700	0.9	0.55	0.98	0.11	-0.44	1	1	700	385	700	77	-308	-8	Group B	Unnamed trib to Lick
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group B	Unnamed trib to Lick
1000	0.8	1.1	0.98	0.11	-0.99	2	2	2000	2200	2000	220	-1980	-18	Group B	Lick
1300	0.8	1.1	0.97	0.165	-0.935	3	3	3900	4290	3900	643.5	-3646.5	-17	Group B	Lick
1500	0.7	1.65	0.85	0.825	-0.825	3	3	4500	7425	4500	3712.5	-3712.5	-15	St. Joe HW	Lick[1]
600	0.7	1.65	0.85	0.825	-0.825	3	3	1800	2970	1800	1485	-1485	-15	St. Joe HW	Lick[1]
1300	0.8	1.1	0.96	0.22	-0.88	4	4	5200	5720	5200	1144	-4576	-16	Group B	Lick
350	0.9	0.55	0.98	0.11	-0.44	1	1	350	192.5	350	38.5	-154	-8	Group B	Wawa
640	0.9	0.55	0.98	0.11	-0.44	1	1	640	352	640	70.4	-281.6	-8	Group B	Wawa
690	0.8	1.1	0.98	0.11	-0.99	1	1	690	759	690	75.9	-683.1	-18	Group B	Wawa
770	0.9	0.55	0.98	0.11	-0.44	2	2	1540	847	1540	169.4	-677.6	-8	Group B	Wawa
490	0.8	1.1	0.98	0.11	-0.99	2	2	980	1078	980	107.8	-970.2	-18	Group B	Wawa
430	0.9	0.55	0.98	0.11	-0.44	1	1	430	236.5	430	47.3	-189.2	-8	Group B	South unnamed trib to Wawa
1100	0.9	0.55	0.98	0.11	-0.44	1	1	1100	605	1100	121	-484	-8	Group B	South unnamed trib to Wawa
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	South unnamed trib to Wawa
410	0.9	0.55	0.98	0.11	-0.44	2	2	820	451	820	90.2	-360.8	-8	Group B	South unnamed trib to Wawa
370	0.8	1.1	0.87	0.715	-0.385	3	3	1110	1221	1110	793.65	-427.35	-7	Group A	Wawa
360	0.7	1.65	0.78	1.21	-0.44	4	4	1440	2376	1440	1742.4	-633.6	-8	Group A	Wawa
250	0.9	0.55	0.98	0.11	-0.44	1	1	250	137.5	250	27.5	-110	-8	Group B	North unnamed trib to Wawa
300	0.9	0.55	0.98	0.11	-0.44	1	1	300	165	300	33	-132	-8	Group B	North unnamed trib to Wawa
480	0.7	1.65	0.98	0.11	-1.54	1	1	480	792	480	52.8	-739.2	-28	Group B	North unnamed trib to Wawa
230	0.7	1.65	0.98	0.11	-1.54	2	2	460	759	460	50.6	-708.4	-28	Group B	North unnamed trib to Wawa
840	0.9	0.55	0.98	0.11	-0.44	2	2	1680	924	1680	184.8	-739.2	-8	Group B	North unnamed trib to Wawa
970	0.7	1.65	0.87	0.715	-0.935	3	3	2910	4801.5	2910	2080.65	-2720.85	-17	Group A	Wawa
920	0.8	1.1	0.78	1.21	0.11	4	4	3680	4048	3680	4452.8	404.8	2	Group A	Wawa
520	0.7	1.65	0.98	0.11	-1.54	1	1	520	858	520	57.2	-800.8	-28	Group B	Unnamed trib above Horescamp
700	0.9	0.55	0.98	0.11	-0.44	1	1	700	385	700	77	-308	-8	Group B	Unnamed trib above Horescamp
700	0.9	0.55	0.98	0.11	-0.44	1	1	700	385	700	77	-308	-8	Group B	Unnamed trib above Horescamp
620	0.7	1.65	0.98	0.11	-1.54	1	1	620	1023	620	68.2	-954.8	-28	Group B	Horsecamp
820	0.9	0.55	0.98	0.11	-0.44	1	1	820	451	820	90.2	-360.8	-8	Group B	Horsecamp
480	0.8	1.1	0.98	0.11	-0.99	1	1	480	528	480	52.8	-475.2	-18	Group B	Horsecamp
450	0.9	0.55	0.98	0.11	-0.44	2	2	900	495	900	99	-396	-8	Group B	Horsecamp
960	0.8	1.1	0.98	0.11	-0.99	2	2	1920	2112	1920	211.2	-1900.8	-18	Group B	Horsecamp
700	0.9	0.55	0.98	0.11	-0.44	1	1	700	385	700	77	-308	-8	Group B	East unnamed trib
700	0.9	0.55	0.95	0.275	-0.275	1	1	700	385	700	192.5	-192.5	-5	Group A	East unnamed trib
830	0.9	0.55	0.94	0.33	-0.22	2	2	1660	913	1660	547.8	-365.2	-4	Group A	East unnamed trib
600	0.9	0.55	0.98	0.11	-0.44	1	1	600	330	600	66	-264	-8	Group B	2nd unnamed trib below Horsecamp
250	0.9	0.55	0.98	0.11	-0.44	1	1	250	137.5	250	27.5	-110	-8	Group B	2nd unnamed trib below Horsecamp
160	0.5	2.75	0.98	0.11	-2.64	1	1	160	440	160	17.6	-422.4	-48	Group B	2nd unnamed trib below Horsecamp
470	0.8	1.1	0.95	0.275	-0.825	1	1	470	517	470	129.25	-387.75	-15	Group A	2nd unnamed trib below Horsecamp
380	0.7	1.65	0.95	0.275	-1.375	1	1	380	627	380	104.5	-522.5	-25	Group A	2nd unnamed trib below Horsecamp
500	0.5	2.75	0.98	0.11	-2.64	1	1	500	1375	500	55	-1320	-48	Group B	3rd unnamed trib below Horsecamp
1300	0.9	0.55	0.98	0.11	-0.44	1	1	1300	715	1300	143	-572	-8	Group B	3rd unnamed trib below Horsecamp
140	0.9	0.55	0.98	0.11	-0.44	1	1	140	77	140	15.4	-61.6	-8	Group B	Chute
1500	0.9	0.55	0.98	0.11	-0.44	1	1	1500	825	1500	165	-660	-8	Group B	Chute

[1]Applied St. Joe hardwood shade curve although stream slope was greater than 3%. Vegetation resembled hardwood community not forest type.

Table I-3. Fishhook Creek (AU ID17010304PN039_03/04) solar load analysis table (continued)

Fishhook Creek Watershed AU# 17010304PN039_03															
290	0.8	1.1	0.74	1.43	0.33	4	4	1160	1276	1160	1658.8	382.8	6	St. Joe HW	Middle below Outlaw[1]
520	0.8	1.1	0.96	0.22	-0.88	4	4	2080	2288	2080	457.6	-1830.4	-16	Group B	Middle above WF Fishhook
550	0.7	1.65	0.96	0.22	-1.43	4	4	2200	3630	2200	484	-3146	-26	Group B	Middle above WF Fishhook
380	0.5	2.75	0.94	0.33	-2.42	5	5	1900	5225	1900	627	-4598	-44	Group B	Middle above WF Fishhook
960	0.7	1.65	0.64	1.98	0.33	6	6	5760	9504	5760	11404.8	1900.8	6	Group A	WF above EF
350	0.8	1.1	0.92	0.44	-0.66	6	6	2100	2310	2100	924	-1386	-12	Group B	WF above EF
120	0.8	1.1	0.91	0.495	-0.605	7	7	840	924	840	415.8	-508.2	-11	Group B	Fishhook
370	0.8	1.1	0.88	0.66	-0.44	8	8	2960	3256	2960	1953.6	-1302.4	-8	Group B	Fishhook
870	0.7	1.65	0.88	0.66	-0.99	8	8	6960	11484	6960	4593.6	-6890.4	-18	Group B	Fishhook
440	0.7	1.65	0.88	0.66	-0.99	8	8	3520	5808	3520	2323.2	-3484.8	-18	Group B	Fishhook
760	0.8	1.1	0.88	0.66	-0.44	8	8	6080	6688	6080	4012.8	-2675.2	-8	Group B	Fishhook
500	0.7	1.65	0.88	0.66	-0.99	8	8	4000	6600	4000	2640	-3960	-18	St. Joe HW	Fishhook - un trib above Cougar
770	0.6	2.2	0.83	0.935	-1.265	9	9	6930	15246	6930	6479.55	-8766.45	-23	Group B	Fishook - Cougar to Lick
230	0.6	2.2	0.83	0.935	-1.265	9	9	2070	4554	2070	1935.45	-2618.55	-23	Group B	Fishook - Cougar to Lick
170	0.7	1.65	0.7	1.65	0	5	5	850	1402.5	850	1402.5	0	0	Group A	Lick
Fishhook Creek Watershed AU# 17010304PN039_04															
450	0.6	2.2	0.79	1.155	-1.045	10	10	4500	9900	4500	5197.5	-4702.5	-19	Group B	Fishhook - Lick to unnamed trib
230	0.6	2.2	0.79	1.155	-1.045	10	10	2300	5060	2300	2656.5	-2403.5	-19	Group B	Fishhook - Lick to unnamed trib
300	0.6	2.2	0.74	1.43	-0.77	11	11	3300	7260	3300	4719	-2541	-14	Group B	Fishhook - unnamed to Horsecamp
1000	0.5	2.75	0.74	1.43	-1.32	11	11	11000	30250	11000	15730	-14520	-24	Group B	Fishhook - unnamed to Horsecamp
520	0.6	2.2	0.74	1.43	-0.77	11	11	5720	12584	5720	8179.6	-4404.4	-14	Group B	Fishhook - Horsecamp to west un trib
1300	0.5	2.75	0.74	1.43	-1.32	11	11	14300	39325	14300	20449	-18876	-24	Group B	Fishhk-1st&2nd un trib below Horsecamp
410	0.5	2.75	0.74	1.43	-1.32	11	11	4510	12402.5	4510	6449.3	-5953.2	-24	Group B	FishHk-2nd&3rd un trib below Horsecamp
140	0.7	1.65	0.74	1.43	-0.22	11	11	1540	2541	1540	2202.2	-338.8	-4	Group B	Fishhhook - 3rd unnamed to Chute
600	0.6	2.2	0.74	1.43	-0.77	11	11	6600	14520	6600	9438	-5082	-14	Group B	Fishhhook - 3rd unnamed to Chute
550	0.5	2.75	0.74	1.43	-1.32	11	11	6050	16637.5	6050	8651.5	-7986	-24	Group B	Fishhhook - 3rd unnamed to Chute
1300	0.5	2.75	0.74	1.43	-1.32	11	11	14300	39325	14300	20449	-18876	-24	Group B	Fishhhook - 3rd unnamed to Chute
730	0.5	2.75	0.7	1.65	-1.1	12	12	8760	24090	8760	14454	-9636	-20	Group B	Fishhook - Chute to St. Joe
1100	0.4	3.3	0.7	1.65	-1.65	12	12	13200	43560	13200	21780	-21780	-30	Group B	Fishhook - Chute to St. Joe
					AU ID17010304PN039_02		**Subtotals**	**133765**	**128395**	**140175**	**35903**	**-92491**	**-14**		
					AU ID17010304PN039_03		**Subtotals**	**49410**	**80196**	**49410**	**41313**	**-38883**	**-14**		
					AU ID17010304PN039_04		**Subtotals**	**96080**	**257455**	**96080**	**140356**	**-117099**	**-20**		
							Total	**285665**	**466045**	**285665**	**217572**	**-248474**	**-14**		

[1]Applied St. Joe hardwood shade curve although stream slope was greater than 3%. Vegetation resembled hardwood community not forest type.

Table I-4. Gold Creek (AU ID17010304PN053_02) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	VRU	Stream Segment Description
AU# Gold Creek - ID17010304PN053_02															
1700	0.9	0.55	0.96	0.22	-0.33	1	1	1700	935	1700	374	-561	-6	Group D	Gold headwaters
1000	0.9	0.55	0.97	0.165	-0.385	2	2	2000	1100	2000	330	-770	-7	Group C	Gold headwaters
1000	0.9	0.55	0.97	0.165	-0.385	3	3	3000	1650	3000	495	-1155	-7	Group B	Gold headwaters
1000	0.9	0.55	0.96	0.22	-0.33	4	4	4000	2200	4000	880	-1320	-6	Group B	Gold headwaters
1400	0.9	0.55	0.98	0.11	-0.44	1	1	1400	770	1400	154	-616	-8	Group B	Float Creek
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Float Creek
1000	0.9	0.55	0.97	0.165	-0.385	3	3	3000	1650	3000	495	-1155	-7	Group B	Float Creek
1800	0.9	0.55	0.98	0.11	-0.44	1	1	1800	990	1800	198	-792	-8	Group B	Bear Spring Creek
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Bear Spring Creek
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Bear Spring Creek
190	0.9	0.55	0.94	0.33	-0.22	5	5	950	522.5	950	313.5	-209	-4	Group B	Gold Creek - Bear and Float
1800	0.9	0.55	0.92	0.44	-0.11	6	6	10800	5940	10800	4752	-1188	-2	Group B	Gold - Broadaxe to Bear Spring
1700	0.9	0.55	0.98	0.11	-0.44	1	1	1700	935	1700	187	-748	-8	Group C	Broadaxe Creek
1000	0.9	0.55	0.97	0.165	-0.385	2	2	2000	1100	2000	330	-770	-7	Group C	Broadaxe Creek
1000	0.9	0.55	0.97	0.165	-0.385	2	2	2000	1100	2000	330	-770	-7	Group C	Broadaxe Creek
1000	0.9	0.55	0.96	0.22	-0.33	3	3	3000	1650	3000	660	-990	-6	Group C	Broadaxe Creek
1700	0.8	1.1	0.78	1.21	0.11	4	4	6800	7480	6800	8228	748	2	Group A	Broadaxe Creek
590	0.8	1.1	0.92	0.44	-0.66	6	6	3540	3894	3540	1557.6	-2336.4	-12	Group B	Gold - Pretty to Broadaxe
580	0.8	1.1	0.91	0.495	-0.605	7	7	4060	4466	4060	2009.7	-2456.3	-11	Group B	Gold - Pretty to Broadaxe
1600	0.9	0.55	0.98	0.11	-0.44	1	1	1600	880	1600	176	-704	-8	Group B	Pretty Creek
220	0.8	1.1	0.91	0.495	-0.605	7	7	1540	1694	1540	762.3	-931.7	-11	Group B	Gold - Berge to Pretty Creek
1500	0.4	3.3	0.47	2.915	-0.385	8	8	12000	39600	12000	34980	-4620	-7	St. Joe HW	Gold - Berge to Pretty Creek
1000	0.4	3.3	0.47	2.915	-0.385	8	8	8000	26400	8000	23320	-3080	-7	St. Joe HW	Gold - Berge to Pretty Creek
1200	0.9	0.55	0.98	0.11	-0.44	1	1	1200	660	1200	132	-528	-8	Group B	Berge Creek
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Berge Creek
1000	0.9	0.55	0.97	0.165	-0.385	3	3	3000	1650	3000	495	-1155	-7	Group B	Berge Creek
520	0.8	1.1	0.87	0.715	-0.385	3	3	1560	1716	1560	1115.4	-600.6	-7	Group A	Berge Creek
1300	0.4	3.3	0.88	0.66	-2.64	8	8	10400	34320	10400	6864	-27456	-48	Group B	Gold Creek - EF to Berge
1000	0.4	3.3	0.83	0.935	-2.365	9	9	9000	29700	9000	8415	-21285	-43	Group B	Gold Creek - EF to Berge
1300	0.9	0.55	0.98	0.11	-0.44	1	1	1300	715	1300	143	-572	-8	Group B	EF Gold
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group B	EF Gold
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	EF Gold
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	EF Gold
1100	0.9	0.55	0.98	0.11	-0.44	2	2	2200	1210	2200	242	-968	-8	Group B	EF Gold
1000	0.9	0.55	0.97	0.165	-0.385	3	3	3000	1650	3000	495	-1155	-7	Group B	EF Gold
840	0.8	1.1	0.97	0.165	-0.935	3	3	2520	2772	2520	415.8	-2356.2	-17	Group B	EF Gold
1600	0.3	3.85	0.43	3.135	-0.715	9	9	14400	55440	14400	45144	-10296	-13	St. Joe HW	Gold Creek - EF to St. Joe
1000	0.3	3.85	0.4	3.3	-0.55	10	10	10000	38500	10000	33000	-5500	-10	St. Joe HW	Gold Creek - EF to St. Joe
							Total	**146470**	**280440**	**146470**	**178423**	**-102016**	**-10**		

Table I-5. Heller and Sherlock Creeks (AU ID17010304PN041_02/02a) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	VRU	Stream Segment Description
AU# ID17010304PN041_02 - Headwaters Sherlock and Heller Creeks															
370	0.9	0.55	0.96	0.22	-0.33	1	1	370	203.5	370	81.4	-122.1	-6	Group D	Sherlock Crk - frm Frog Lake
1800	0.9	0.55	0.97	0.165	-0.385	2	2	3600	1980	3600	594	-1386	-7	Group C	Sherlock Crk - frm Frog Lake
210	0.8	1.1	0.85	0.825	-0.275	3	3	630	693	630	519.75	-173.25	-5	St. Joe HW	Sherlock Crk - frm Frog Lake
1600	0.9	0.55	0.98	0.11	-0.44	1	1	1600	880	1600	176	-704	-8	Group C	First south trib to Sherlock Crk
180	0.9	0.55	0.93	0.385	-0.165	2	2	360	198	360	138.6	-59.4	-3	St. Joe HW	First south trib to Sherlock Crk
200	0.9	0.55	0.97	0.165	-0.385	2	2	400	220	400	66	-154	-7	Group C	First south trib to Sherlock Crk
350	0.8	1.1	0.86	0.77	-0.33	3	3	1050	1155	1050	808.5	-346.5	-6	Group C	Sherlock Creek
400	0.8	1.1	0.85	0.825	-0.275	3	3	1200	1320	1200	990	-330	-5	St. Joe HW	Sherlock Creek
730	0.8	1.1	0.85	0.825	-0.275	3	3	2190	2409	2190	1806.75	-602.25	-5	St. Joe HW	Sherlock Creek
380	0.8	1.1	0.74	1.43	0.33	4	4	1520	1672	1520	2173.6	501.6	6	St. Joe HW	Sherlock Creek
250	0.7	1.65	0.74	1.43	-0.22	4	4	1000	1650	1000	1430	-220	-4	St. Joe HW	Sherlock Creek
180	0.6	2.2	0.74	1.43	-0.77	4	4	720	1584	720	1029.6	-554.4	-14	St. Joe HW	Sherlock Creek
AU# ID17010304PN041_02a - Lower reaches of Sherlock Creek in mining impacted zone															
960	0.2	4.4	0.74	1.43	-2.97	4	4	3840	16896	3840	5491.2	-11404.8	-54	St. Joe HW	Sherlock Creek mining zone
1200	0.4	3.3	0.74	1.43	-1.87	4	4	4800	15840	4800	6864	-8976	-34	St. Joe HW	Sherlock Creek mining zone
490	0.5	2.75	0.65	1.925	-0.825	5	5	2450	6737.5	2450	4716.25	-2021.25	-15	St. Joe HW	Sherlock Creek mining zone
280	0.5	2.75	0.65	1.925	-0.825	5	5	1400	3850	1400	2695	-1155	-15	St. Joe HW	Sherlock Creek mining zone
270	0.5	2.75	0.65	1.925	-0.825	5	5	1350	3712.5	1350	2598.75	-1113.75	-15	St. Joe HW	Sherlock Creek mining zone
AU# ID17010304PN041_02 - Headwaters Sherlock and Heller Creeks															
540	0.9	0.55	0.98	0.11	-0.44	1	1	540	297	540	59.4	-237.6	-8	Group C	Heller Creek
630	0.9	0.55	0.93	0.385	-0.165	2	2	1260	693	1260	485.1	-207.9	-3	St. Joe HW	Heller Creek
650	0.8	1.1	0.85	0.825	-0.275	3	3	1950	2145	1950	1608.75	-536.25	-5	St. Joe HW	Heller Creek
320	0.8	1.1	0.85	0.825	-0.275	3	3	960	1056	960	792	-264	-5	St. Joe HW	Heller Creek
200	0.6	2.2	0.85	0.825	-1.375	3	3	600	1320	600	495	-825	-25	St. Joe HW	Heller Creek
680	0.6	2.2	0.85	0.825	-1.375	3	3	2040	4488	2040	1683	-2805	-25	St. Joe HW	Heller Creek
700	0.5	2.75	0.74	1.43	-1.32	4	4	2800	7700	2800	4004	-3696	-24	St. Joe HW	Heller Creek
570	0.6	2.2	0.74	1.43	-0.77	4	4	2280	5016	2280	3260.4	-1755.6	-14	St. Joe HW	Heller Creek
1400	0.9	0.55	0.98	0.11	-0.44	1	1	1400	770	1400	154	-616	-8	Group C	Blackburn Creek
1400	0.9	0.55	0.93	0.385	-0.165	2	2	2800	1540	2800	1078	-462	-3	St. Joe HW	Blackburn Creek
1300	0.5	2.75	0.58	2.31	-0.44	6	6	7800	21450	7800	18018	-3432	-8	St. Joe HW	Heller Creek above Sherlock
360	0.4	3.3	0.52	2.64	-0.66	7	7	2520	8316	2520	6652.8	-1663.2	-12	St. Joe HW	Heller Crk above St. Joe River
							Total	**55430**	**115792**	**55430**	**70470**	**-45322**	**-12**		
					Heller and Sherlock HW		**Subtotals**	**41590**	**68756**	**41590**	**48105**	**-20651**	**-9**		
					Sherlock mining zone		**Subtotals**	**13840**	**47036**	**13840**	**22365**	**-24671**	**-27**		

Note: Natural stream widths were used in the mining-impacted reach of Sherlock Creek. This reach of Sherlock Creek has undergone extensive restoration (stream channel reconstruction) to repair the reach to a more natural condition. Stream widths used in the restoration effort mimic those measured within the watershed.

Table I-6. Loop Creek (AU ID17010304PN060_02) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	VRU	Stream Segment Description
Loop Creek Assessment Unit ID # 17010304PN060_02															
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group C	Loop Creek
1000	0.9	0.55	0.97	0.165	-0.385	2	2	2000	1100	2000	330	-770	-7	Group C	Loop Creek
1300	0.9	0.55	0.98	0.11	-0.44	1	1	1300	715	1300	143	-572	-8	Group C	Allen Creek
1000	0.9	0.55	0.97	0.165	-0.385	2	2	2000	1100	2000	330	-770	-7	Group C	Allen Creek
600	0.9	0.55	0.96	0.22	-0.33	3	3	1800	990	1800	396	-594	-6	Group C	Loop Creek - Wendle to Allen
1100	0.9	0.55	0.96	0.22	-0.33	1	1	1100	605	1100	242	-363	-6	Group D	Wendle Creek
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Wendle Creek
1500	0.7	1.65	0.74	1.43	-0.22	4	4	6000	9900	6000	8580	-1320	-4	St. Joe HW	Loop - Olentange to Wendle
800	0.9	0.55	0.94	0.33	-0.22	1	1	800	440	800	264	-176	-4	Group D	Olentange Creek
1000	0.9	0.55	0.93	0.385	-0.165	2	2	2000	1100	2000	770	-330	-3	Group D	Olentange Creek
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Olentange Creek
1000	0.9	0.55	0.98	0.11	-0.44	3	3	3000	1650	3000	330	-1320	-8	Group B	Olentange Creek
1000	0.9	0.55	0.97	0.165	-0.385	3	3	3000	1650	3000	495	-1155	-7	Group B	Olentange Creek
330	0.6	2.2	0.65	1.925	-0.275	5	5	1650	3630	1650	3176.25	-453.75	-5	St. Joe HW	Loop - Ward to Olentange
1100	0.9	0.55	0.98	0.11	-0.44	1	1	1100	605	1100	121	-484	-8	Group C	Ward Creek
1000	0.9	0.55	0.97	0.165	-0.385	2	2	2000	1100	2000	330	-770	-7	Group C	Ward Creek
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Ward Creek
1100	0.9	0.55	0.97	0.165	-0.385	3	3	3300	1815	3300	544.5	-1270.5	-7	Group B	Ward Creek
450	0.6	2.2	0.65	1.925	-0.275	5	5	2250	4950	2250	4331.25	-618.75	-5	Group B	Loop Creek - Mineral to Ward
890	0.9	0.55	0.92	0.44	-0.11	6	6	5340	2937	5340	2349.6	-587.4	-2	Group B	Loop Creek - Mineral to Ward
520	0.8	1.1	0.92	0.44	-0.66	6	6	3120	3432	3120	1372.8	-2059.2	-12	Group B	Loop Creek - Mineral to Ward
1300	0.9	0.55	0.98	0.11	-0.44	1	1	1300	715	1300	143	-572	-8	Group C	Mineral Creek
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Mineral Creek
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Mineral Creek
700	0.8	1.1	0.92	0.44	-0.66	6	6	4200	4620	4200	1848	-2772	-12	Group B	Loop - Manhattan to Mineral
210	0.8	1.1	0.92	0.44	-0.66	6	6	1260	1386	1260	554.4	-831.6	-12	Group B	Loop - Manhattan to Mineral
360	0.6	2.2	0.58	2.31	0.11	6	6	2160	4752	2160	4989.6	237.6	2	Group B	Loop - Manhattan to Mineral
74	0.5	2.75	0.58	2.31	-0.44	6	6	444	1221	444	1025.64	-195.36	-8	Group B	Loop - Manhattan to Mineral
1200	0.9	0.55	0.98	0.11	-0.44	1	1	1200	660	1200	132	-528	-8	Group C	Manhattan Creek
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group C	Manhattan Creek
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Manhattan Creek
590	0.8	1.1	0.98	0.11	-0.99	2	2	1180	1298	1180	129.8	-1168.2	-18	Group B	Manhattan Creek
450	0.4	3.3	0.52	2.64	-0.66	7	7	3150	10395	3150	8316	-2079	-12	St. Joe HW	Loop - Kelly to Manhattan
1600	0.9	0.55	0.98	0.11	-0.44	1	1	1600	880	1600	176	-704	-8	Group C	Kelly Creek
1300	0.8	1.1	0.98	0.11	-0.99	2	2	2600	2860	2600	286	-2574	-18	Group B	Kelly Creek
1300	0.9	0.55	0.97	0.165	-0.385	3	3	3900	2145	3900	643.5	-1501.5	-7	Group B	Kelly Creek
230	0.4	3.3	0.52	2.64	-0.66	7	7	1610	5313	1610	4250.4	-1062.6	-12	St. Joe HW	Loop Creek - Turkey to Kelly
700	0.9	0.55	0.98	0.11	-0.44	1	1	700	385	700	77	-308	-8	Group B	EF Turkey Creek
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	EF Turkey Creek
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	EF Turkey Creek
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group C	WF Turkey Creek
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group B	WF Turkey Creek
820	0.8	1.1	0.93	0.385	-0.715	2	2	1640	1804	1640	631.4	-1172.6	-13	St. Joe HW	WF Turkey Creek
720	0.9	0.55	0.98	0.11	-0.44	2	2	1440	792	1440	158.4	-633.6	-8	Group B	WF Turkey Creek

Table I-6. Loop Creek (AU ID17010304PN060_02/03) solar load analysis table (continued)

450	0.9	0.55	0.97	0.165	-0.385	3	3	1350	742.5	1350	222.75	-519.75	-7	Group B	Turkey Creek
1100	0.9	0.55	0.98	0.11	-0.44	1	1	1100	605	1100	121	-484	-8	Group B	Bear Creek
970	0.9	0.55	0.93	0.385	-0.165	2	2	1940	1067	1940	746.9	-320.1	-3	St. Joe HW	Bear Creek
390	0.9	0.55	0.98	0.11	-0.44	2	2	780	429	780	85.8	-343.2	-8	Group B	Bear Creek
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group C	Brushy Creek
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Brushy Creek
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Brushy Creek
800	0.9	0.55	0.98	0.11	-0.44	1	1	800	440	800	88	-352	-8	Group C	Clear Creek
1000	0.9	0.55	0.97	0.165	-0.385	2	2	2000	1100	2000	330	-770	-7	Group C	Clear Creek
1000	0.9	0.55	0.97	0.165	-0.385	2	2	2000	1100	2000	330	-770	-7	Group C	Clear Creek
530	0.8	1.1	0.85	0.825	-0.275	3	3	1590	1749	1590	1311.75	-437.25	-5	St. Joe HW	Clear Creek
700	0.7	1.65	0.85	0.825	-0.825	3	3	2100	3465	2100	1732.5	-1732.5	-15	St. Joe HW	Clear Creek
1000	0.7	1.65	0.74	1.43	-0.22	4	4	4000	6600	4000	5720	-880	-4	St. Joe HW	Clear Creek
360	0.8	1.1	0.96	0.22	-0.88	4	4	1440	1584	1440	316.8	-1267.2	-16	Group B	Clear Creek
450	0.9	0.55	0.98	0.11	-0.44	1	1	450	247.5	450	49.5	-198	-8	Group B	Moss Creek
300	0.8	1.1	0.98	0.11	-0.99	1	1	300	330	300	33	-297	-18	Group B	Moss Creek
950	0.7	1.65	0.98	0.11	-1.54	1	1	950	1567.5	950	104.5	-1463	-28	Group B	Moss Creek
800	0.9	0.55	0.96	0.22	-0.33	1	1	800	440	800	176	-264	-6	Group D	Cliff Creek
1000	0.9	0.55	0.97	0.165	-0.385	2	2	2000	1100	2000	330	-770	-7	Group C	Cliff Creek
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Cliff Creek
630	0.8	1.1	0.97	0.165	-0.935	3	3	1890	2079	1890	311.85	-1767.15	-17	Group B	Cliff Creek
800	0.9	0.55	0.98	0.11	-0.44	1	1	800	440	800	88	-352	-8	Group C	trib to Cliff Creek
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group C	trib to Cliff Creek
1100	0.7	1.65	0.98	0.11	-1.54	1	1	1100	1815	1100	121	-1694	-28	Group B	Cliff Creek
980	0.7	1.65	0.98	0.11	-1.54	3	3	2940	4851	2940	323.4	-4527.6	-28	Group B	Cliff Creek at mouth
600	0.9	0.55	0.96	0.22	-0.33	1	1	600	330	600	132	-198	-6	Group D	Frazier Creek
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Frazier Creek
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Frazier Creek
1000	0.9	0.55	0.97	0.165	-0.385	3	3	3000	1650	3000	495	-1155	-7	Group B	Frazier Creek
Loop Creek Assessment Unit ID # 17010304PN060_03															
610	0.4	3.3	0.52	2.64	-0.66	7	7	4270	14091	4270	11272.8	-2818.2	-12	St. Joe HW	Loop Creek - Bear to Turkey
1200	0.4	3.3	0.47	2.915	-0.385	8	8	9600	31680	9600	27984	-3696	-7	St. Joe HW	Loop Creek - Bear to Turkey
66	0.4	3.3	0.47	2.915	-0.385	8	8	528	1742.4	528	1539.12	-203.28	-7	St. Joe HW	Loop Crk - Brushy to Bear
350	0.5	2.75	0.47	2.915	0.165	8	8	2800	7700	2800	8162	462	3	St. Joe HW	Loop Crk - Brushy to Bear
190	0.5	2.75	0.43	3.135	0.385	9	9	1710	4702.5	1710	5360.85	658.35	7	St. Joe HW	Loop Crk - Clear to Brushy
510	0.5	2.75	0.43	3.135	0.385	9	9	4590	12622.5	4590	14389.65	1767.15	7	St. Joe HW	Loop Crk - Moss to Clear
220	0.4	3.3	0.4	3.3	0	10	10	2200	7260	2200	7260	0	0	St. Joe HW	Loop Crk - Moss to Clear
1100	0.4	3.3	0.4	3.3	0	10	10	11000	36300	11000	36300	0	0	Group B	Loop Crk - Cliff to Moss
1000	0.4	3.3	0.4	3.3	0	10	10	10000	33000	10000	33000	0	0	Group B	Loop Crk - Cliff to Moss
720	0.4	3.3	0.37	3.465	0.165	11	11	7920	26136	7920	27442.8	1306.8	3	St. Joe HW	Loop Crk - Frazier to Cliff
860	0.3	3.85	0.37	3.465	-0.385	11	11	9460	36421	9460	32778.9	-3642.1	-7	St. Joe HW	Loop Crk - Frazier to Cliff
220	0.3	3.85	0.37	3.465	-0.385	11	11	2420	9317	2420	8385.3	-931.7	-7	St. Joe HW	Loop - Frazier to NF St. Joe
1000	0.3	3.85	0.37	3.465	-0.385	11	11	11000	42350	11000	38115	-4235	-7	St. Joe HW	Loop - Frazier to NF St. Joe
1100	0.3	3.85	0.37	3.465	-0.385	11	11	12100	46585	12100	41926.5	-4658.5	-7	St. Joe HW	Loop - Frazier to NF St. Joe
700	0.3	3.85	0.34	3.63	-0.22	12	12	8400	32340	8400	30492	-1848	-4	St. Joe HW	Loop - Frazier to NF St. Joe
800	0.3	3.85	0.34	3.63	-0.22	12	12	9600	36960	9600	34848	-2112	-4	St. Joe HW	Loop - Frazier to NF St. Joe
					AU ID17010304PN060_02		**Subtotals**	**136074**	**128277**	**136074**	**64156**	**-64120**	**-9**		
					AU ID17010304PN060_03		**Subtotals**	**107598**	**379207**	**107598**	**359257**	**-19950**	**-3**		
							Total	**243672**	**507484**	**243672**	**423413**	**-84071**	**-8**		

Table I-7. Simmons Creek (AU ID17010304PN052_02) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	VRU	Stream Segment Description
Simmons Creek - AU# ID17010304PN052_02															
650	0.9	0.55	0.96	0.22	-0.33	1	1	650	357.5	650	143	-214.5	-6	Group D	Simmons Crk above Goat Crk
650	0.9	0.55	0.96	0.22	-0.33	2	2	1300	715	1300	286	-429	-6	Group D	Simmons Crk above Goat Crk
1300	0.9	0.55	0.98	0.11	-0.44	1	1	1300	715	1300	143	-572	-8	Group C	Goat Creek
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group C	Goat Creek
1000	0.9	0.55	0.97	0.165	-0.385	2	2	2000	1100	2000	330	-770	-7	Group C	Goat Creek
580	0.8	1.1	0.93	0.385	-0.715	2	2	1160	1276	1160	446.6	-829.4	-13	St. Joe HW	Simmons Crk below Goat Crk[1]
280	0.8	1.1	0.85	0.825	-0.275	3	3	840	924	840	693	-231	-5	St. Joe HW	Simmons Crk below Goat Crk[1]
340	0.8	1.1	0.85	0.825	-0.275	3	3	1020	1122	1020	841.5	-280.5	-5	St. Joe HW	Simmons Crk below Goat Crk[1]
1700	0.9	0.55	0.98	0.11	-0.44	1	1	1700	935	1700	187	-748	-8	Group C	Middle Fork of Washout Creek
1000	0.8	1.1	0.93	0.385	-0.715	2	2	2000	2200	2000	770	-1430	-13	Group C	Middle Fork of Washout Creek[1]
1100	0.9	0.55	0.96	0.22	-0.33	1	1	1100	605	1100	242	-363	-6	Group D	South Fork Washout Creek
1000	0.9	0.55	0.97	0.165	-0.385	2	2	2000	1100	2000	330	-770	-7	Group C	South Fork Washout Creek
1000	0.9	0.55	0.97	0.165	-0.385	2	2	2000	1100	2000	330	-770	-7	Group C	South Fork Washout Creek
890	0.7	1.65	0.85	0.825	-0.825	3	3	2670	4405.5	2670	2202.75	-2202.75	-15	Group C	Stream below MF and SF Washout[1]
260	0.6	2.2	0.85	0.825	-1.375	3	3	780	1716	780	643.5	-1072.5	-25	Group B	Stream below MF and SF Washout[1]
1300	0.9	0.55	0.98	0.11	-0.44	1	1	1300	715	1300	143	-572	-8	Group C	Washout Creek
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group C	Washout Creek
1000	0.9	0.55	0.97	0.165	-0.385	2	2	2000	1100	2000	330	-770	-7	Group C	Washout Creek
650	0.8	1.1	0.97	0.165	-0.935	2	2	1300	1430	1300	214.5	-1215.5	-17	Group C	Washout Creek
180	0.6	2.2	0.74	1.43	-0.77	4	4	720	1584	720	1029.6	-554.4	-14	Group B	Washout above Simmons Creek[1]
180	0.5	2.75	0.74	1.43	-1.32	4	4	720	1980	720	1029.6	-950.4	-24	Group B	Washout above Simmons Creek[1]
1300	0.9	0.55	0.98	0.11	-0.44	1	1	1300	715	1300	143	-572	-8	St. Joe HW	Wampus Creek
1000	0.9	0.55	0.97	0.165	-0.385	2	2	2000	1100	2000	330	-770	-7	St. Joe HW	Wampus Creek
1000	0.9	0.55	0.97	0.165	-0.385	2	2	2000	1100	2000	330	-770	-7	St. Joe HW	Wampus Creek
1500	0.9	0.55	0.98	0.11	-0.44	1	1	1500	825	1500	165	-660	-8	Group C	Dolly Creek
1000	0.9	0.55	0.97	0.165	-0.385	2	2	2000	1100	2000	330	-770	-7	Group C	Dolly Creek
1000	0.9	0.55	0.97	0.165	-0.385	2	2	2000	1100	2000	330	-770	-7	Group C	Dolly Creek
610	0.9	0.55	0.98	0.11	-0.44	1	1	610	335.5	610	67.1	-268.4	-8	Group B	Spruce Creek
1300	0.9	0.55	0.98	0.11	-0.44	2	2	2600	1430	2600	286	-1144	-8	Group B	Spruce Creek
270	0.9	0.55	0.98	0.11	-0.44	2	2	540	297	540	59.4	-237.6	-8	Group B	Spruce Creek
1400	0.9	0.55	0.98	0.11	-0.44	1	1	1400	770	1400	154	-616	-8	Group B	1st trib downstream of Spruce
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	2nd trib downstream of Spruce
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group B	N. trib btwn NF Simmons & Spruce
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group B	N. trib btwn NF Simmons & Spruce
1500	0.9	0.55	0.98	0.11	-0.44	1	1	1500	825	1500	165	-660	-8	Group C	3 Lakes Creek
1000	0.9	0.55	0.96	0.22	-0.33	3	3	3000	1650	3000	660	-990	-6	Group C	4 Lakes Creek
1500	0.9	0.55	0.98	0.11	-0.44	1	1	1500	825	1500	165	-660	-8	Group C	1st south trib to 3 Lakes
470	0.9	0.55	0.96	0.22	-0.33	3	3	1410	775.5	1410	310.2	-465.3	-6	Group C	3 Lakes between tribs
470	0.9	0.55	0.96	0.22	-0.33	3	3	1410	775.5	1410	310.2	-465.3	-6	Group C	4 Lakes between tribs
470	0.9	0.55	0.96	0.22	-0.33	3	3	1410	775.5	1410	310.2	-465.3	-6	Group C	5 Lakes between tribs
1700	0.9	0.55	0.98	0.11	-0.44	1	1	1700	935	1700	187	-748	-8	Group C	2nd south trib to 3 Lakes
340	0.9	0.55	0.97	0.165	-0.385	3	3	1020	561	1020	168.3	-392.7	-7	Group B	3 Lakes below 2nd trib
340	0.9	0.55	0.96	0.22	-0.33	4	4	1360	748	1360	299.2	-448.8	-6	Group B	4 Lakes below 2nd trib

[1]Applied St. Joe hardwood shade curve although stream slope was greater than 3%. Vegetation resembled hardwood community not forest type.

Table I-7. Simmons Creek (AU ID17010304PN052_02/03) solar load analysis table (continued)

1700	0.9	0.55	0.98	0.11	-0.44	1	1	1700	935	1700	187	-748	-8	Group C	NF Simmons above trib
350	0.7	1.65	0.97	0.165	-1.485	2	2	700	1155	700	115.5	-1039.5	-27	Group C	NF Simmons above trib
1800	0.9	0.55	0.97	0.165	-0.385	3	3	5400	2970	5400	891	-2079	-7	Group B	NF Simmons above trib
1400	0.9	0.55	0.98	0.11	-0.44	1	1	1400	770	1400	154	-616	-8	Group B	Trib to Simmons
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Trib to Simmons
1700	0.9	0.55	0.96	0.22	-0.33	4	4	6800	3740	6800	1496	-2244	-6	Group B	NF Simmons - trib to mouth
1800	0.8	1.1	0.94	0.33	-0.77	5	5	9000	9900	9000	2970	-6930	-14	Group B	NF Simmons - trib to mouth
710	0.9	0.55	0.94	0.33	-0.22	5	5	3550	1952.5	3550	1171.5	-781	-4	Group B	NF Simmons - trib to mouth
950	0.9	0.55	0.98	0.11	-0.44	1	1	950	522.5	950	104.5	-418	-8	Group B	1st south trib up from mouth
950	0.9	0.55	0.97	0.165	-0.385	1	1	950	522.5	950	156.75	-365.75	-7	Group B	2nd south trib up from mouth
Simmons Creek - AU# ID17010304PN052_03															
440	0.4	3.3	0.65	1.925	-1.375	5	5	2200	7260	2200	4235	-3025	-25	St. Joe HW	Simmons - Wampus to Washout
470	0.4	3.3	0.58	2.31	-0.99	6	6	2820	9306	2820	6514.2	-2791.8	-18	St. Joe HW	Simmons - Dolly to Wampus Creek
540	0.5	2.75	0.58	2.31	-0.44	6	6	3240	8910	3240	7484.4	-1425.6	-8	St. Joe HW	Simmons - Dolly to Wampus Creek
590	0.5	2.75	0.58	2.31	-0.44	6	6	3540	9735	3540	8177.4	-1557.6	-8	St. Joe HW	Simmons - Dolly to Wampus Creek
110	0.5	2.75	0.58	2.31	-0.44	6	6	660	1815	660	1524.6	-290.4	-8	St. Joe HW	Simmons - Spruce to Dolly Creek
150	0.4	3.3	0.52	2.64	-0.66	7	7	1050	3465	1050	2772	-693	-12	St. Joe HW	Simmons - Spruce to Dolly Creek
1400	0.4	3.3	0.52	2.64	-0.66	7	7	9800	32340	9800	25872	-6468	-12	St. Joe HW	Simmons - Spruce to Dolly Creek
610	0.4	3.3	0.52	2.64	-0.66	7	7	4270	14091	4270	11272.8	-2818.2	-12	St. Joe HW	1st trib dwn Spruce to Spruce
290	0.4	3.3	0.47	2.915	-0.385	8	8	2320	7656	2320	6762.8	-893.2	-7	St. Joe HW	2nd trib dwn Spruce to Spruce
210	0.5	2.75	0.47	2.915	0.165	8	8	1680	4620	1680	4897.2	277.2	3	St. Joe HW	3rd trib dwn Spruce to Spruce
330	0.4	3.3	0.47	2.915	-0.385	8	8	2640	8712	2640	7695.6	-1016.4	-7	St. Joe HW	4th trib dwn Spruce to Spruce
560	0.4	3.3	0.47	2.915	-0.385	8	8	4480	14784	4480	13059.2	-1724.8	-7	Group B	Simmons
1100	0.4	3.3	0.47	2.915	-0.385	8	8	8800	29040	8800	25652	-3388	-7	St. Joe HW	Simmons above 3 Lakes Creek
1200	0.5	2.75	0.47	2.915	0.165	8	8	9600	26400	9600	27984	1584	3	St. Joe HW	Simmons above 3 Lakes Creek
1700	0.7	1.65	0.83	0.935	-0.715	9	9	15300	25245	15300	14305.5	-10939.5	-13	Group B	Simmon - NF Simmons to 3 Lakes
1000	0.7	1.65	0.83	0.935	-0.715	9	9	9000	14850	9000	8415	-6435	-13	Group B	Simmon - NF Simmons to 3 Lakes
210	0.4	3.3	0.4	3.3	0	10	10	2100	6930	2100	6930	0	0	Group B	Simmon - NF Simmons to 3 Lakes
260	0.8	1.1	0.79	1.155	0.055	10	10	2600	2860	2600	3003	143	1	Group B	Simmon - NF Simmons to 3 Lakes
180	0.4	3.3	0.4	3.3	0	10	10	1800	5940	1800	5940	0	0	Group B	Simmon - NF Simmons to 3 Lakes
700	0.4	3.3	0.4	3.3	0	10	10	7000	23100	7000	23100	0	0	St. Joe HW	Simmons - S. trib to NF Simmons
260	0.4	3.3	0.4	3.3	0	10	10	2600	8580	2600	8580	0	0	St. Joe HW	Simmons - S. trib to NF Simmons
380	0.4	3.3	0.37	3.465	0.165	11	11	4180	13794	4180	14483.7	689.7	3	St. Joe HW	Simmons - S. trib to NF Simmons
940	0.3	3.85	0.37	3.465	-0.385	11	11	10340	39809	10340	35828.1	-3980.9	-7	St. Joe HW	Simmons - S. trib to NF Simmons
220	0.4	3.3	0.37	3.465	0.165	11	11	2420	7986	2420	8385.3	399.3	3	St. Joe HW	Simmons - mouth to 1st south trib[1]
630	0.4	3.3	0.37	3.465	0.165	11	11	6930	22869	6930	24012.45	1143.45	3	St. Joe HW	Simmons - mouth to 1st south trib[1]
180	0.3	3.85	0.37	3.465	-0.385	11	11	1980	7623	1980	6860.7	-762.3	-7	St. Joe HW	Simmons - mouth to 1st south trib[1]
370	0.4	3.3	0.37	3.465	0.165	11	11	4070	13431	4070	14102.55	671.55	3	St. Joe HW	Simmons - mouth to 1st south trib[1]
250	0.4	3.3	0.37	3.465	0.165	11	11	2750	9075	2750	9528.75	453.75	3	St. Joe HW	Simmons - mouth to 1st south trib[1]
270	0.4	3.3	0.37	3.465	0.165	11	11	2970	9801	2970	10291.05	490.05	3	St. Joe HW	Simmons - mouth to 1st south trib[1]
390	0.3	3.85	0.37	3.465	-0.385	11	11	4290	16516.5	4290	14864.85	-1651.65	-7	St. Joe HW	Simmons - mouth to 1st south trib[1]
300	0.4	3.3	0.37	3.465	0.165	11	11	3300	10890	3300	11434.5	544.5	3	St. Joe HW	Simmons - mouth to 1st south trib[1]
					AU ID17010304PN052_02		**Subtotal**	**95270**	**68591**	**95270**	**23231**	**-45360**	**-9**		
					AU ID17010304PN052_03		**Subtotal**	**140730**	**417434**	**140730**	**373969**	**-43465**	**-5**		
							Total	**236000**	**486024**	**236000**	**397200**	**-88824**	**-7**		

[1]Applied St. Joe hardwood shade curve although stream slope was greater than 3%. Vegetation resembled hardwood community not forest type.

Table I-8. Slate Creek (AU ID17010304PN062_02/03) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	VRU	Comment
Slate Creek Watershed - AU# ID17010304PN062_02															
750	0.9	0.55	0.98	0.11	-0.44	1	1	750	412.5	750	82.5	-330	-8	Group C	Slate Crk above Pond Crk
990	0.9	0.55	0.98	0.11	-0.44	2	2	1980	1089	1980	217.8	-871.2	-8	Group B	Slate Crk above Pond Crk
370	0.9	0.55	0.93	0.385	-0.165	2	2	740	407	740	284.9	-122.1	-3	St. Joe HW	Slate Crk above Pond Crk
460	0.6	2.2	0.85	0.825	-1.375	3	3	1380	3036	1380	1138.5	-1897.5	-25	St. Joe HW	Slate Crk above Pond Crk
500	0.8	1.1	0.85	0.825	-0.275	3	3	1500	1650	1500	1237.5	-412.5	-5	St. Joe HW	Slate Crk above Pond Crk
1300	0.7	1.65	0.85	0.825	-0.825	3	3	3900	6435	3900	3217.5	-3217.5	-15	St. Joe HW	Slate Crk above Pond Crk
1200	0.9	0.55	0.98	0.11	-0.44	1	1	1200	660	1200	132	-528	-8	Group C	Pond Creek
400	0.9	0.55	0.94	0.33	-0.22	2	2	800	440	800	264	-176	-4	Group C	Pond Creek
1000	0.9	0.55	0.94	0.33	-0.22	2	2	2000	1100	2000	660	-440	-4	Group C	Pond Creek
1100	0.8	1.1	0.87	0.715	-0.385	3	3	3300	3630	3300	2359.5	-1270.5	-7	Group A	Slate Creek - Pond to Elbow
580	0.7	1.65	0.78	1.21	-0.44	4	4	2320	3828	2320	2807.2	-1020.8	-8	Group A	Slate Creek - Pond to Elbow
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group C	Elbow Creek
1000	0.8	1.1	0.94	0.33	-0.77	2	2	2000	2200	2000	660	-1540	-14	Group A	Elbow Creek
450	0.8	1.1	0.97	0.165	-0.935	3	3	1350	1485	1350	222.75	-1262.25	-17	Group B	Elbow Creek
950	0.8	1.1	0.97	0.165	-0.935	3	3	2850	3135	2850	470.25	-2664.75	-17	Group B	Elbow Creek
340	0.6	2.2	0.74	1.43	-0.77	5	4	1700	3740	1360	1944.8	-1795.2	-14	St. Joe HW	Slate Creek - Elbow to Dam
790	0.6	2.2	0.65	1.925	-0.275	6	5	4740	10428	3950	7603.75	-2824.25	-5	St. Joe HW	Slate Creek - Elbow to Dam
650	0.5	2.75	0.65	1.925	-0.825	7	5	4550	12512.5	3250	6256.25	-6256.25	-15	St. Joe HW	Slate Creek - Elbow to Dam
1100	0.9	0.55	0.98	0.11	-0.44	1	1	1100	605	1100	121	-484	-8	Group C	Dam Creek
370	0.7	1.65	0.93	0.385	-1.265	2	2	740	1221	740	284.9	-936.1	-23	St. Joe HW	Dam Creek[1]
1000	0.6	2.2	0.93	0.385	-1.815	3	2	3000	6600	2000	770	-5830	-33	St. Joe HW	Dam Creek[1]
690	0.8	1.1	0.93	0.385	-0.715	2	2	1380	1518	1380	531.3	-986.7	-13	St. Joe HW	Dam Creek[1]
310	0.8	1.1	0.87	0.715	-0.385	3	3	930	1023	930	664.95	-358.05	-7	Group A	Dam Creek
300	0.8	1.1	0.87	0.715	-0.385	3	3	900	990	900	643.5	-346.5	-7	Group A	Dam Creek
580	0.5	2.75	0.65	1.925	-0.825	5	4	2900	7975	2320	4466	-3509	-15	Group B	Dam Creek
150	0.6	2.2	0.78	1.21	-0.99	4	4	600	1320	600	726	-594	-18	Group A	Dam Creek
800	0.7	1.65	0.78	1.21	-0.44	4	4	3200	5280	3200	3872	-1408	-8	Group A	Dam Creek
350	0.8	1.1	0.94	0.33	-0.77	4	4	1400	1540	1400	462	-1078	-14	Group C	Dam Creek
650	0.7	1.65	0.78	1.21	-0.44	4	4	2600	4290	2600	3146	-1144	-8	Group A	Dam Creek
1400	0.5	2.75	0.52	2.64	-0.11	7	7	9800	26950	9800	25872	-1078	-2	St. Joe HW	Slate Creek - Dam to Flume
400	0.9	0.55	0.98	0.11	-0.44	1	1	400	220	400	44	-176	-8	Group C	Flume Creek
770	0.9	0.55	0.98	0.11	-0.44	2	2	1540	847	1540	169.4	-677.6	-8	Group B	Flume Creek
780	0.9	0.55	0.98	0.11	-0.44	2	2	1560	858	1560	171.6	-686.4	-8	Group B	Flume Creek
400	0.8	1.1	0.87	0.715	-0.385	3	3	1200	1320	1200	858	-462	-7	Group A	Flume Creek
410	0.9	0.55	0.87	0.715	0.165	3	3	1230	676.5	1230	879.45	202.95	3	Group A	Flume Creek
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group B	Foolhen Creek
1000	0.9	0.55	0.94	0.33	-0.22	2	2	2000	1100	2000	660	-440	-4	Group B	Foolhen Creek
930	0.8	1.1	0.87	0.715	-0.385	3	3	2790	3069	2790	1994.85	-1074.15	-7	Group A	Flume Creek - Foolhen to mouth
200	0.7	1.65	0.97	0.165	-1.485	3	3	600	990	600	99	-891	-27	Group B	Flume Creek - Foolhen to mouth
800	0.9	0.55	0.95	0.275	-0.275	1	1	800	440	800	220	-220	-5	Group A	Murray Creek
1000	0.9	0.55	0.95	0.275	-0.275	1	1	1000	550	1000	275	-275	-5	Group A	Murray Creek

[1]Applied St. Joe hardwood shade curve although stream slope was greater than 3%. Vegetation resembled hardwood community not forest type.

Table I-8. Slate Creek (AU ID17010304PN062_02/03) solar load analysis table (continued)

700	0.9	0.55	0.98	0.11	-0.44	1	1	700	385	700	77	-308	-8	Group B	Red Top Creek
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group B	Red Top Creek
540	0.8	1.1	0.98	0.11	-0.99	2	2	1080	1188	1080	118.8	-1069.2	-18	Group B	Red Top Creek
300	0.7	1.65	0.98	0.11	-1.54	2	2	600	990	600	66	-924	-28	Group B	Red Top Creek
1000	0.7	1.65	0.94	0.33	-1.32	2	2	2000	3300	2000	660	-2640	-24	Group A	Red Top Creek
800	0.9	0.55	0.98	0.11	-0.44	1	1	800	440	800	88	-352	-8	Group B	Summit Creek
1000	0.9	0.55	0.94	0.33	-0.22	2	2	2000	1100	2000	660	-440	-4	Group A	Summit Creek
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Summit Creek
700	0.9	0.55	0.98	0.11	-0.44	1	1	700	385	700	77	-308	-8	Group B	Horseshoe Creek
1000	0.9	0.55	0.94	0.33	-0.22	2	2	2000	1100	2000	660	-440	-4	Group A	Horseshoe Creek
360	0.9	0.55	0.95	0.275	-0.275	1	1	360	198	360	99	-99	-5	Group A	Corvus Creek
460	0.9	0.55	0.94	0.33	-0.22	2	2	920	506	920	303.6	-202.4	-4	Group A	Corvus Creek
1100	0.9	0.55	0.94	0.33	-0.22	2	2	2200	1210	2200	726	-484	-4	Group A	Corvus Creek
1000	0.9	0.55	0.95	0.275	-0.275	1	1	1000	550	1000	275	-275	-5	Group A	Fisher Creek
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group B	Fisher Creek
400	0.9	0.55	0.98	0.11	-0.44	1	1	400	220	400	44	-176	-8	Group B	Carlin Creek
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group B	Carlin Creek
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group B	Carlin Creek
700	0.9	0.55	0.96	0.22	-0.33	1	1	700	385	700	154	-231	-6	Group D	Binney Creek
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Binney Creek
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Binney Creek
1200	0.8	1.1	0.95	0.275	-0.825	1	1	1200	1320	1200	330	-990	-15	Group A	Rover Creek
700	0.9	0.55	0.98	0.11	-0.44	2	2	1400	770	1400	154	-616	-8	Group B	Rover Creek
700	0.9	0.55	0.98	0.11	-0.44	2	2	1400	770	1400	154	-616	-8	Group B	Rover Creek
830	0.9	0.55	0.95	0.275	-0.275	1	1	830	456.5	830	228.25	-228.25	-5	Group A	Cedar Creek
700	0.9	0.55	0.98	0.11	-0.44	2	2	1400	770	1400	154	-616	-8	Group B	Cedar Creek
1000	0.9	0.55	0.87	0.715	0.165	3	3	3000	1650	3000	2145	495	3	Group B	Cedar Creek
800	0.9	0.55	0.96	0.22	-0.33	1	1	800	440	800	176	-264	-6	Group D	Trib to Cedar
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Trib to Cedar
410	0.9	0.55	0.98	0.11	-0.44	2	2	820	451	820	90.2	-360.8	-8	Group B	Trib to Cedar
1400	0.9	0.55	0.96	0.22	-0.33	4	4	5600	3080	5600	1232	-1848	-6	Group B	Cedar Creek
1200	0.9	0.55	0.96	0.22	-0.33	4	4	4800	2640	4800	1056	-1584	-6	Group B	Cedar Creek
440	0.9	0.55	0.95	0.275	-0.275	1	1	440	242	440	121	-121	-5	Group A	Prospect Creek
980	0.8	1.1	0.95	0.275	-0.825	1	1	980	1078	980	269.5	-808.5	-15	Group A	Prospect Creek
370	0.9	0.55	0.94	0.33	-0.22	2	2	740	407	740	244.2	-162.8	-4	Group A	Prospect Creek
740	0.9	0.55	0.98	0.11	-0.44	2	2	1480	814	1480	162.8	-651.2	-8	Group B	Prospect Creek
320	0.8	1.1	0.97	0.165	-0.935	3	3	960	1056	960	158.4	-897.6	-17	Group B	Prospect Creek
580	0.9	0.55	0.97	0.165	-0.385	3	3	1740	957	1740	287.1	-669.9	-7	Group B	Prospect Creek
1300	0.9	0.55	0.98	0.11	-0.44	1	1	1300	715	1300	143	-572	-8	Group B	Horn Gulch
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Horn Gulch
460	0.8	1.1	0.95	0.275	-0.825	1	1	460	506	460	126.5	-379.5	-15	Group A	Fume Creek
470	0.8	1.1	0.95	0.275	-0.825	1	1	470	517	470	129.25	-387.75	-15	Group A	Fume Creek
1100	0.9	0.55	0.98	0.11	-0.44	1	1	1100	605	1100	121	-484	-8	Group B	Fume Creek
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Fume Creek

Table I-8. Slate Creek (AU ID17010304PN062_02/03) solar load analysis table (continued)

600	0.9	0.55	0.96	0.22	-0.33	1	1	600	330	600	132	-198	-6	Group C	Marion Creek
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Marion Creek
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Marion Creek
1300	0.9	0.55	0.98	0.11	-0.44	1	1	1300	715	1300	143	-572	-8	Group B	Mack Gulch
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group B	Mack Gulch
600	0.9	0.55	0.98	0.11	-0.44	1	1	600	330	600	66	-264	-8	Group B	Lumberjack Creek
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group B	Lumberjack Creek
1000	0.9	0.55	0.94	0.33	-0.22	2	2	2000	1100	2000	660	-440	-4	Group B	Lumberjack Creek
1000	0.9	0.55	0.94	0.33	-0.22	2	2	2000	1100	2000	660	-440	-4	Group B	Lumberjack Creek
900	0.9	0.55	0.98	0.11	-0.44	1	1	900	495	900	99	-396	-8	Group B	Fritz Creek
900	0.9	0.55	0.98	0.11	-0.44	1	1	900	495	900	99	-396	-8	Group B	Fritz Creek
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group B	Daisy Creek
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Daisy Creek
900	0.9	0.55	0.98	0.11	-0.44	1	1	900	495	900	99	-396	-8	Group B	Uhinian Creek
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group B	Uhinian Creek
1000	0.9	0.55	0.95	0.275	-0.275	1	1	1000	550	1000	275	-275	-5	Group A	West Fork
830	0.8	1.1	0.98	0.11	-0.99	2	2	1660	1826	1660	182.6	-1643.4	-18	Group B	West Fork
1300	0.9	0.55	0.97	0.165	-0.385	3	3	3900	2145	3900	643.5	-1501.5	-7	Group B	West Fork
1000	0.9	0.55	0.97	0.165	-0.385	3	3	3000	1650	3000	495	-1155	-7	Group B	West Fork
1000	0.9	0.55	0.96	0.22	-0.33	4	4	4000	2200	4000	880	-1320	-6	Group B	West Fork
1000	0.9	0.55	0.96	0.22	-0.33	4	4	4000	2200	4000	880	-1320	-6	Group B	West Fork
900	0.9	0.55	0.98	0.11	-0.44	1	1	900	495	900	99	-396	-8	Group B	Trib to West Fork
900	0.9	0.55	0.98	0.11	-0.44	2	2	1800	990	1800	198	-792	-8	Group B	Trib to West Fork
470	0.8	1.1	0.96	0.22	-0.88	4	4	1880	2068	1880	413.6	-1654.4	-16	Group B	West Fork
380	0.9	0.55	0.96	0.22	-0.33	4	4	1520	836	1520	334.4	-501.6	-6	Group B	West Fork
230	0.8	1.1	0.96	0.22	-0.88	4	4	920	1012	920	202.4	-809.6	-16	Group B	West Fork
440	0.9	0.55	0.96	0.22	-0.33	4	4	1760	968	1760	387.2	-580.8	-6	Group B	West Fork
510	0.8	1.1	0.96	0.22	-0.88	4	4	2040	2244	2040	448.8	-1795.2	-16	Group B	West Fork
1400	0.9	0.55	0.94	0.33	-0.22	5	5	7000	3850	7000	2310	-1540	-4	Group B	West Fork
1000	0.9	0.55	0.94	0.33	-0.22	5	5	5000	2750	5000	1650	-1100	-4	Group B	West Fork
290	0.8	1.1	0.94	0.33	-0.77	5	5	1450	1595	1450	478.5	-1116.5	-14	Group B	West Fork

Table I-8. Slate Creek (AU ID17010304PN062_02/03) solar load analysis table (continued)

Slate Creek Watershed - AU# ID17010304PN062_03															
490	0.5	2.75	0.47	2.915	0.165	8	8	3920	10780	3920	11426.8	646.8	3	St. Joe HW	Slate Creek - Flume to Murray
370	0.6	2.2	0.79	1.155	-1.045	8	8	2960	6512	2960	3418.8	-3093.2	-19	Group C	Slate Crk - Murray to Red Top
910	0.4	3.3	0.47	2.915	-0.385	8	8	7280	24024	7280	21221.2	-2802.8	-7	St. Joe HW	Slate Crk - Murray to Red Top[1]
770	0.3	3.85	0.43	3.135	-0.715	10	9	7700	29645	6930	21725.55	-7919.45	-13	St. Joe HW	Slate Crk - Murray to Red Top
250	0.4	3.3	0.43	3.135	-0.165	10	9	2500	8250	2250	7053.75	-1196.25	-3	St. Joe HW	Slate Crk - Murray to Red Top
960	0.3	3.85	0.43	3.135	-0.715	11	9	10560	40656	8640	27086.4	-13569.6	-13	St. Joe HW	Slate Creek- Red Top to Summit
750	0.3	3.85	0.43	3.135	-0.715	11	9	8250	31762.5	6750	21161.25	-10601.25	-13	St. Joe HW	Slate Crk - Summit to Horseshoe
480	0.4	3.3	0.43	3.135	-0.165	11	9	5280	17424	4320	13543.2	-3880.8	-3	St. Joe HW	Slate Creek - Hoseshoe to Corvus
240	0.4	3.3	0.43	3.135	-0.165	11	9	2640	8712	2160	6771.6	-1940.4	-3	St. Joe HW	Slate Creek - Corvus to Fisher
680	0.3	3.85	0.4	3.3	-0.55	12	10	8160	31416	6800	22440	-8976	-10	St. Joe HW	Slate Creek - Corvus to Fisher
360	0.2	4.4	0.4	3.3	-1.1	12	10	4320	19008	3600	11880	-7128	-20	St. Joe HW	Slate Creek - Corvus to Fisher
600	0.2	4.4	0.4	3.3	-1.1	10	10	6000	26400	6000	19800	-6600	-20	St. Joe HW	Slate Creek - Fisher to Carlin
1400	0.2	4.4	0.4	3.3	-1.1	10	10	14000	61600	14000	46200	-15400	-20	St. Joe HW	Slate Creek - Fisher to Carlin
590	0.2	4.4	0.4	3.3	-1.1	10	10	5900	25960	5900	19470	-6490	-20	Group B	Slate Creek - Carlin to Binney
170	0.2	4.4	0.37	3.465	-0.935	11	11	1870	8228	1870	6479.55	-1748.45	-17	St. Joe HW	Slate Creek - Binney to Rover
820	0.2	4.4	0.37	3.465	-0.935	11	11	9020	39688	9020	31254.3	-8433.7	-17	St. Joe HW	Slate Creek - Rover to Cedar
230	0.1	4.95	0.37	3.465	-1.485	13	11	2990	14800.5	2530	8766.45	-6034.05	-27	St. Joe HW	Slate Creek - Rover to Cedar
870	0.1	4.95	0.34	3.63	-1.32	20	12	17400	86130	10440	37897.2	-48232.8	-24	St. Joe HW	Slate Creek - Cedar to Prospect
130	0.1	4.95	0.32	3.74	-1.21	17	13	2210	10939.5	1690	6320.6	-4618.9	-22	St. Joe HW	Slate Crk - Prospect to Horn Gulch
670	0.1	4.95	0.32	3.74	-1.21	17	13	11390	56380.5	8710	32575.4	-23805.1	-22	St. Joe HW	Slate Crk - Prospect to Horn Gulch
920	0.3	3.85	0.32	3.74	-0.11	13	13	11960	46046	11960	44730.4	-1315.6	-2	St. Joe HW	Slate Crk - Prospect to Horn Gulch
240	0.1	4.95	0.32	3.74	-1.21	20	13	4800	23760	3120	11668.8	-12091.2	-22	St. Joe HW	Slate Crk - Horn Gulch to Fume Crk
350	0.1	4.95	0.32	3.74	-1.21	13	13	4550	22522.5	4550	17017	-5505.5	-22	St. Joe HW	Slate Crk - Horn Gulch to Fume Crk
620	0.2	4.4	0.32	3.74	-0.66	13	13	8060	35464	8060	30144.4	-5319.6	-12	St. Joe HW	Slate Creek - Fume to Marion
450	0.2	4.4	0.32	3.74	-0.66	13	13	5850	25740	5850	21879	-3861	-12	St. Joe HW	Slate Creek - Marion to Mack Gulch
1300	0.2	4.4	0.32	3.74	-0.66	13	13	16900	74360	16900	63206	-11154	-12	St. Joe HW	Slate Crk - Mack Gulch to Lumberjack
1400	0.1	4.95	0.3	3.85	-1.1	14	14	19600	97020	19600	75460	-21560	-20	St. Joe HW	Slate Creek - Lumberjack to Fritz
1300	0.2	4.4	0.3	3.85	-0.55	14	14	18200	80080	18200	70070	-10010	-10	St. Joe HW	Slate Creek - Fritz to Daisy
410	0.2	4.4	0.3	3.85	-0.55	14	14	5740	25256	5740	22099	-3157	-10	St. Joe HW	Slate Creek - Daisy to Uhinian
1700	0.2	4.4	0.3	3.85	-0.55	14	14	23800	104720	23800	91630	-13090	-10	St. Joe HW	Slate Creek - Uhinian to West Fork
1000	0.2	4.4	0.3	3.85	-0.55	14	14	14000	61600	14000	53900	-7700	-10	St. Joe HW	Slate Creek - Uhinian to West Fork
1900	0.1	4.95	0.28	3.96	-0.99	15	15	28500	141075	28500	112860	-28215	-18	St. Joe HW	Slate Creek - West Fork to mouth
					AU ID17010304PN062_02		**Subtotals**	**204140**	**204611**	**200130**	**102897**	**-101714**	**-9**		
					AU ID17010304PN062_03		**Subtotals**	**296310**	**1295960**	**276050**	**991157**	**-304803**	**-14**		
							Total	**500450**	**1500571**	**476180**	**1094053**	**-406517**	**-10**		

[1]Applied St. Joe hardwood shade curve although stream slope was greater than 3%. Vegetation resembled hardwood community not forest type.

Table I-9. Blackjack, Harvey, and Tank Creeks (AU ID17010304PN027_02) solar load analysis tables

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	VRU	Stream Segment Description
Blackjack Creek - AU# ID17010304PN027_02															
520	0.7	1.65	0.98	0.11	-1.54	1	1	520	858	520	57.2	-800.8	-28	Group B	Blackjack Creek
280	0.9	0.55	0.98	0.11	-0.44	1	1	280	154	280	30.8	-123.2	-8	Group B	Blackjack Creek
1160	0.9	0.55	0.98	0.11	-0.44	2	2	2320	1276	2320	255.2	-1020.8	-8	Group B	Blackjack Creek
1230	0.9	0.55	0.97	0.165	-0.385	3	3	3690	2029.5	3690	608.85	-1420.65	-7	Group B	Blackjack Creek
							Total	**6810**	**4317.5**	**6810**	**952.05**	**-3365.45**	**-12.75**		
Harvey Creek - AU# ID17010304PN027_02															
1425	0.9	0.55	0.98	0.11	-0.44	1	1	1425	783.75	1425	156.75	-627	-8	Group B	Harvey Creek
1470	0.9	0.55	0.98	0.11	-0.44	2	2	2940	1617	2940	323.4	-1293.6	-8	Group B	Harvey Creek
1440	0.9	0.55	0.97	0.165	-0.385	3	3	4320	2376	4320	712.8	-1663.2	-7	Group B	Harvey Creek
1220	0.9	0.55	0.96	0.22	-0.33	4	4	4880	2684	4880	1073.6	-1610.4	-6	Group B	Harvey Creek
							Total	**13565**	**7460.75**	**13565**	**2266.55**	**-5194.2**	**-7.25**		
Tank Creek - AU# ID17010304PN027_02															
200	0.7	1.65	0.98	0.11	-1.54	1	1	200	330	200	22	-308	-28	Group B	Tank Creek
400	0.8	1.1	0.98	0.11	-0.99	1	1	400	440	400	44	-396	-18	Group B	Tank Creek
1640	0.9	0.55	0.98	0.11	-0.44	2	2	3280	1804	3280	360.8	-1443.2	-8	Group B	Tank Creek
1290	0.9	0.55	0.97	0.165	-0.385	3	3	3870	2128.5	3870	638.55	-1489.95	-7	Group B	Tank Creek
							Total	**7750**	**4702.5**	**7750**	**1065.35**	**-3637.15**	**-15.25**		

Table I-10. Bear and Little Bear Creeks (AU ID17010304PN033_02) solar load analysis tables

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	VRU Group	Comment
Bear and Little Bear Creeks - AU# ID17010304PN033_02															
450	0.6	2.2	0.98	0.11	-2.09	1	1	450	990	450	49.5	-940.5	-38	B	Bear
390	0.9	0.55	0.98	0.11	-0.44	1	1	390	214.5	390	42.9	-171.6	-8	B	Bear
360	0.8	1.1	0.98	0.11	-0.99	1	1	360	396	360	39.6	-356.4	-18	B	Bear
1100	0.8	1.1	0.98	0.11	-0.99	2	2	2200	2420	2200	242	-2178	-18	St. Joe HW	Bear[1]
980	0.8	1.1	0.98	0.11	-0.99	2	2	1960	2156	1960	215.6	-1940.4	-18	St. Joe HW	Bear[1]
420	0.8	1.1	0.98	0.11	-0.99	2	2	840	924	840	92.4	-831.6	-18	B	Bear
390	0.8	1.1	0.98	0.11	-0.99	1	1	390	429	390	42.9	-386.1	-18	B	Little Bear
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	B	Little Bear
490	0.9	0.55	0.94	0.33	-0.22	2	2	980	539	980	323.4	-215.6	-4	A	Little Bear
430	0.9	0.55	0.94	0.33	-0.22	2	2	860	473	860	283.8	-189.2	-4	A	Little Bear
540	0.8	1.1	0.98	0.11	-0.99	2	2	1080	1188	1080	118.8	-1069.2	-18	B	Little Bear
420	0.8	1.1	0.94	0.33	-0.77	2	2	840	924	840	277.2	-646.8	-14	A	Little Bear
210	0.8	1.1	0.87	0.715	-0.385	3	3	630	693	630	450.45	-242.55	-7	A	Bear/Little Bear to Bussel
							Total	**11980**	**11897**	**11980**	**2289**	**-9608**	**-15**		

Table I-11. Marble Creek (AU ID17010304PN031_04) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	VRU	Stream Segment Description
Mainsteam Marble Creek - Bussel to St. Joe River - AU# ID17010304PN031_04															
550	0.2	4.4	0.22	4.29	-0.11	20	20	11000	48400	11000	47190	-1210	-2	St. Joe HW	Marble - Bussel to Shearer
360	0.1	4.95	0.22	4.29	-0.66	20	20	7200	35640	7200	30888	-4752	-12	St. Joe HW	Marble - Bussel to Shearer
510	0.2	4.4	0.22	4.29	-0.11	20	20	10200	44880	10200	43758	-1122	-2	St. Joe HW	Marble - Bussel to Shearer
800	0.2	4.4	0.22	4.29	-0.11	20	20	16000	70400	16000	68640	-1760	-2	St. Joe HW	Marble - Shearer to Eagle
790	0.2	4.4	0.22	4.29	-0.11	20	20	15800	69520	15800	67782	-1738	-2	St. Joe HW	Marble - Eagle to Daveggio
1000	0.1	4.95	0.22	4.29	-0.66	20	20	20000	99000	20000	85800	-13200	-12	St. Joe HW	Marble - Eagle to Daveggio
140	0.1	4.95	0.22	4.29	-0.66	20	20	2800	13860	2800	12012	-1848	-12	St. Joe HW	Marble
430	0.1	4.95	0.22	4.29	-0.66	20	20	8600	42570	8600	36894	-5676	-12	St. Joe HW	Marble
900	0.2	4.4	0.22	4.29	-0.11	20	20	18000	79200	18000	77220	-1980	-2	St. Joe HW	Marble
1000	0.2	4.4	0.22	4.29	-0.11	20	20	20000	88000	20000	85800	-2200	-2	St. Joe HW	Marble
490	0.3	3.85	0.22	4.29	0.44	20	20	9800	37730	9800	42042	4312	8	St. Joe HW	Marble
280	0.2	4.4	0.22	4.29	-0.11	20	20	5600	24640	5600	24024	-616	-2	St. Joe HW	Marble - Donkey to 1st east trib
240	0.3	3.85	0.22	4.29	0.44	20	20	4800	18480	4800	20592	2112	8	St. Joe HW	Marble - Donkey to 1st east trib
290	0.3	3.85	0.22	4.29	0.44	20	20	5800	22330	5800	24882	2552	8	St. Joe HW	Marble - 1st E to 1st W below Donkey
230	0.2	4.4	0.22	4.29	-0.11	20	20	4600	20240	4600	19734	-506	-2	St. Joe HW	Marble - 1st E to 1st W below Donkey
110	0.2	4.4	0.22	4.29	-0.11	20	20	2200	9680	2200	9438	-242	-2	St. Joe HW	Marble - 1st west to 2nd east
480	0.1	4.95	0.22	4.29	-0.66	20	20	9600	47520	9600	41184	-6336	-12	St. Joe HW	Marble - 1st west to 2nd east
380	0.2	4.4	0.22	4.29	-0.11	20	20	7600	33440	7600	32604	-836	-2	St. Joe HW	Marble - 1st west to 2nd east
590	0.2	4.4	0.22	4.29	-0.11	20	20	11800	51920	11800	50622	-1298	-2	St. Joe HW	Marble - 2nd east to 2nd west
670	0.1	4.95	0.22	4.29	-0.66	20	20	13400	66330	13400	57486	-8844	-12	St. Joe HW	Marble - 2nd east to 2nd west
630	0.1	4.95	0.21	4.345	-0.605	21	21	13230	65488.5	13230	57484.35	-8004.15	-11	St. Joe HW	Marble - 2nd west to Boulder
700	0.2	4.4	0.21	4.345	-0.055	21	21	14700	64680	14700	63871.5	-808.5	-1	St. Joe HW	Marble - 2nd west to Boulder
800	0.2	4.4	0.21	4.345	-0.055	21	21	16800	73920	16800	72996	-924	-1	St. Joe HW	Marble - 2nd west to Boulder
1000	0.1	4.95	0.21	4.345	-0.605	21	21	21000	103950	21000	91245	-12705	-11	St. Joe HW	Marble - 2nd west to Boulder
800	0.2	4.4	0.21	4.345	-0.055	21	21	16800	73920	16800	72996	-924	-1	St. Joe HW	Marble - 2nd west to Boulder
1000	0.2	4.4	0.21	4.345	-0.055	21	21	21000	92400	21000	91245	-1155	-1	St. Joe HW	Marble - 2nd west to Boulder
180	0.1	4.95	0.2	4.4	-0.55	22	22	3960	19602	3960	17424	-2178	-10	St. Joe HW	Marble - Boulder to west trib
580	0.2	4.4	0.2	4.4	0	22	22	12760	56144	12760	56144	0	0	St. Joe HW	Marble - Boulder to west trib
260	0.2	4.4	0.2	4.4	0	22	22	5720	25168	5720	25168	0	0	St. Joe HW	Marble - unnamed to Canyon
350	0.1	4.95	0.2	4.4	-0.55	22	22	7700	38115	7700	33880	-4235	-10	St. Joe HW	Marble - Canyon to Joe
700	0.2	4.4	0.19	4.455	0.055	23	23	16100	70840	16100	71725.5	885.5	1	St. Joe HW	Marble - Canyon to Joe
700	0.2	4.4	0.19	4.455	0.055	23	23	16100	70840	16100	71725.5	885.5	1	St. Joe HW	Marble - Canyon to Joe
1000	0.2	4.4	0.19	4.455	0.055	23	23	23000	101200	23000	102465	1265	1	St. Joe HW	Marble - Canyon to Joe
							Total	**393670**	**1780047.5**	**393670**	**1706961.85**	**-73085.65**	**-3.42424**		

Table I-12. Tributaries to Marble Creek above Hobo Creek (AU ID17010304PN035_02) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	VRU	Comment
Tributaries to Marble Creek above Hobo Creek - AU# ID17010304PN035_02															
700	0.9	0.55	0.98	0.11	-0.44	1	1	700	385	700	77	-308	-8	Group C	Marble
1000	0.9	0.55	0.97	0.165	-0.385	2	2	2000	1100	2000	330	-770	-7	Group C	Marble
1000	0.9	0.55	0.97	0.165	-0.385	2	2	2000	1100	2000	330	-770	-7	Group C	Marble
650	0.9	0.55	0.98	0.11	-0.44	1	1	650	357.5	650	71.5	-286	-8	Group C	East trib to Marble
500	0.9	0.55	0.98	0.11	-0.44	1	1	500	275	500	55	-220	-8	Group C	East trib to Marble
390	0.8	1.1	0.97	0.165	-0.935	2	2	780	858	780	128.7	-729.3	-17	Group C	Marble
900	0.9	0.55	0.96	0.22	-0.33	3	3	2700	1485	2700	594	-891	-6	Group C	Marble
1000	0.9	0.55	0.96	0.22	-0.33	3	3	3000	1650	3000	660	-990	-6	Group C	Marble
600	0.8	1.1	0.96	0.22	-0.88	4	4	2400	2640	2400	528	-2112	-16	Group B	Marble
320	0.8	1.1	0.96	0.22	-0.88	4	4	1280	1408	1280	281.6	-1126.4	-16	Group B	Marble
700	0.9	0.55	0.98	0.11	-0.44	1	1	700	385	700	77	-308	-8	Group C	Delaney
800	0.9	0.55	0.97	0.165	-0.385	2	2	1600	880	1600	264	-616	-7	Group C	Delaney
500	0.9	0.55	0.97	0.165	-0.385	2	2	1000	550	1000	165	-385	-7	Group C	Delaney
500	0.9	0.55	0.98	0.11	-0.44	2	2	1000	550	1000	110	-440	-8	Group B	Delaney
700	0.9	0.55	0.98	0.11	-0.44	1	1	700	385	700	77	-308	-8	Group C	South trib to Delaney
1000	0.9	0.55	0.97	0.165	-0.385	2	2	2000	1100	2000	330	-770	-7	Group C	South trib to Delaney
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	South trib to Delaney
160	0.9	0.55	0.97	0.165	-0.385	3	3	480	264	480	79.2	-184.8	-7	Group B	Delaney
310	0.9	0.55	0.96	0.22	-0.33	1	1	310	170.5	310	68.2	-102.3	-6	Group D	SF of north trib to Delaney
800	0.9	0.55	0.96	0.22	-0.33	1	1	800	440	800	176	-264	-6	Group D	SF of north trib to Delaney
1000	0.9	0.55	0.96	0.22	-0.33	1	1	1000	550	1000	220	-330	-6	Group D	SF of north trib to Delaney
600	0.9	0.55	0.96	0.22	-0.33	1	1	600	330	600	132	-198	-6	Group D	NF of north trib to Delaney
1000	0.9	0.55	0.96	0.22	-0.33	1	1	1000	550	1000	220	-330	-6	Group D	NF of north trib to Delaney
290	0.9	0.55	0.98	0.11	-0.44	2	2	580	319	580	63.8	-255.2	-8	Group B	North trib to Delaney
640	0.9	0.55	0.98	0.11	-0.44	1	1	640	352	640	70.4	-281.6	-8	Group C	Freezeout
390	0.9	0.55	0.98	0.11	-0.44	1	1	390	214.5	390	42.9	-171.6	-8	Group C	Freezeout
700	0.9	0.55	0.97	0.165	-0.385	2	2	1400	770	1400	231	-539	-7	Group C	Freezeout
1000	0.9	0.55	0.97	0.165	-0.385	2	2	2000	1100	2000	330	-770	-7	Group C	Freezeout
690	0.5	2.75	0.98	0.11	-2.64	1	1	690	1897.5	690	75.9	-1821.6	-48	Group C	West trib to Freezeout
680	0.9	0.55	0.98	0.11	-0.44	1	1	680	374	680	74.8	-299.2	-8	Group C	West trib to Freezeout
1300	0.9	0.55	0.97	0.165	-0.385	2	2	2600	1430	2600	429	-1001	-7	Group C	West trib to Freezeout

Table I-12. Tributaries to Marble Creek above Hobo Creek (AU ID17010304PN035_02) solar load analysis table (continued)

720	0.9	0.55	0.93	0.385	-0.165	1	2	720	396	1440	554.4	158.4	-3	St. Joe HW	Freezeout
550	0.7	1.65	0.93	0.385	-1.265	1	2	550	907.5	1100	423.5	-484	-23	St. Joe HW	Freezeout
230	0.8	1.1	0.93	0.385	-0.715	1	2	230	253	460	177.1	-75.9	-13	St. Joe HW	Freezeout
530	0.7	1.65	0.93	0.385	-1.265	2	2	1060	1749	1060	408.1	-1340.9	-23	St. Joe HW	Freezeout
630	0.8	1.1	0.93	0.385	-0.715	2	2	1260	1386	1260	485.1	-900.9	-13	St. Joe HW	Freezeout
740	0.7	1.65	0.93	0.385	-1.265	2	2	1480	2442	1480	569.8	-1872.2	-23	St. Joe HW	Freezeout
300	0.6	2.2	0.93	0.385	-1.815	2	2	600	1320	600	231	-1089	-33	St. Joe HW	Freezeout
700	0.9	0.55	0.98	0.11	-0.44	1	1	700	385	700	77	-308	-8	Group C	Swing
800	0.9	0.55	0.98	0.11	-0.44	2	2	1600	880	1600	176	-704	-8	Group B	Swing
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Swing
370	0.9	0.55	0.98	0.11	-0.44	1	1	370	203.5	370	40.7	-162.8	-8	Group C	Unnamed trib
960	0.9	0.55	0.98	0.11	-0.44	1	1	960	528	960	105.6	-422.4	-8	Group C	Unnamed trib
1100	0.9	0.55	0.98	0.11	-0.44	1	1	1100	605	1100	121	-484	-8	Group B	Unnamed trib
900	0.9	0.55	0.98	0.11	-0.44	1	1	900	495	900	99	-396	-8	Group C	2nd unnamed trib below Swing
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group C	3rd unnamed trib below Swing
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group B	4th unnamed trib below Swing
700	0.9	0.55	0.98	0.11	-0.44	1	1	700	385	700	77	-308	-8	Group C	3rd unnamed trib below Swing
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group C	4th unnamed trib below Swing
1000	0.9	0.55	0.96	0.22	-0.33	1	1	1000	550	1000	220	-330	-6	Group D	5th unnamed trib below Swing
460	0.9	0.55	0.98	0.11	-0.44	1	1	460	253	460	50.6	-202.4	-8	Group C	Duplex
700	0.6	2.2	0.98	0.11	-2.09	1	1	700	1540	700	77	-1463	-38	Group C	Duplex
700	0.9	0.55	0.97	0.165	-0.385	2	2	1400	770	1400	231	-539	-7	Group C	Duplex
700	0.9	0.55	0.98	0.11	-0.44	2	2	1400	770	1400	154	-616	-8	Group B	Duplex
1100	0.7	1.65	0.98	0.11	-1.54	1	1	1100	1815	1100	121	-1694	-28	Group C	South trib to Duplex
560	0.9	0.55	0.98	0.11	-0.44	1	1	560	308	560	61.6	-246.4	-8	Group B	South trib to Duplex
370	0.9	0.55	0.98	0.11	-0.44	2	2	740	407	740	81.4	-325.6	-8	Group B	Duplex
1100	0.9	0.55	0.98	0.11	-0.44	1	1	1100	605	1100	121	-484	-8	Group B	North trib to Duplex
1100	0.9	0.55	0.98	0.11	-0.44	1	1	1100	605	1100	121	-484	-8	Group C	North trib to Duplex
810	0.9	0.55	0.97	0.165	-0.385	3	3	2430	1336.5	2430	400.95	-935.55	-7	Group B	Duplex
1000	0.9	0.55	0.95	0.275	-0.275	1	1	1000	550	1000	275	-275	-5	Group A	1st unnamed trib below Duplex
1100	0.9	0.55	0.98	0.11	-0.44	1	1	1100	605	1100	121	-484	-8	Group B	2nd unnamed trib below Duplex
700	0.9	0.55	0.98	0.11	-0.44	1	1	700	385	700	77	-308	-8	Group B	2nd unnmed trib below Duplex
700	0.9	0.55	0.98	0.11	-0.44	1	1	700	385	700	77	-308	-8	Group B	3rd unnmed trib below Duplex
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group B	4th unnmed trib below Duplex
700	0.9	0.55	0.98	0.11	-0.44	1	1	700	385	700	77	-308	-8	Group C	Cornwall
700	0.9	0.55	0.98	0.11	-0.44	2	2	1400	770	1400	154	-616	-8	Group B	Cornwall
460	0.6	2.2	0.98	0.11	-2.09	2	2	920	2024	920	101.2	-1922.8	-38	Group B	Cornwall
1100	0.9	0.55	0.97	0.165	-0.385	3	3	3300	1815	3300	544.5	-1270.5	-7	Group B	Cornwall
1000	0.9	0.55	0.97	0.165	-0.385	3	3	3000	1650	3000	495	-1155	-7	Group B	Cornwall
1000	0.9	0.55	0.96	0.22	-0.33	4	4	4000	2200	4000	880	-1320	-6	Group B	Cornwall
							Total	**85220**	**59934**	**86720**	**15159**	**-44775**	**-11**		

Table I-13. Mainstem Marble Creek from Delaney Creek to Hobo Creek (AU ID17010304PN035_03) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	VRU	Stream Segment Description
Mainsteam Marble Creek Delany to Hobo Creek - AU# ID17010304PN035_03															
1100	0.8	1.1	0.96	0.22	-0.88	4	4	4400	4840	4400	968	-3872	-16	Group C	Delaney
520	0.6	2.2	0.65	1.925	-0.275	5	5	2600	5720	2600	5005	-715	-5	St. Joe HW	Marble - Delaney to Freezeout
1100	0.5	2.75	0.58	2.31	-0.44	6	6	6600	18150	6600	15246	-2904	-8	St. Joe HW	Marble - Delaney to Freezeout
610	0.5	2.75	0.52	2.64	-0.11	7	7	4270	11742.5	4270	11272.8	-469.7	-2	St. Joe HW	Marble - Freezeout to Swing
330	0.4	3.3	0.52	2.64	-0.66	7	7	2310	7623	2310	6098.4	-1524.6	-12	St. Joe HW	Marble - Swing to unnamed trib
120	0.5	2.75	0.52	2.64	-0.11	7	7	840	2310	840	2217.6	-92.4	-2	St. Joe HW	Mrable - 1st - 2nd unnamed trib below Swing
390	0.5	2.75	0.52	2.64	-0.11	7	7	2730	7507.5	2730	7207.2	-300.3	-2	St. Joe HW	Mrable - 1st - 2nd unnamed trib below Swing
970	0.4	3.3	0.47	2.915	-0.385	8	8	7760	25608	7760	22620.4	-2987.6	-7	St. Joe HW	Mrable - 1st - 2nd unnamed trib below Swing
130	0.8	1.1	0.88	0.66	-0.44	8	8	1040	1144	1040	686.4	-457.6	-8	Group B	Marble - 2nd - 3rd unnamed trib below Swing
160	0.8	1.1	0.88	0.66	-0.44	8	8	1280	1408	1280	844.8	-563.2	-8	Group B	Marble - 2nd - 3rd unnamed trib below Swing
92	0.8	1.1	0.88	0.66	-0.44	8	8	736	809.6	736	485.76	-323.84	-8	Group B	Marble - 2nd - 3rd unnamed trib below Swing
180	0.4	3.3	0.47	2.915	-0.385	8	8	1440	4752	1440	4197.6	-554.4	-7	HW	Marble - 3rd unnamed trib and Duplex
730	0.6	2.2	0.83	0.935	-1.265	9	9	6570	14454	6570	6142.95	-8311.05	-23	Group B	Marble - Duplex to 1st unnamed trib
83	0.6	2.2	0.83	0.935	-1.265	9	9	747	1643.4	747	698.445	-944.955	-23	Group B	Marble - 1st - 2nd unnamed trib
660	0.7	1.65	0.83	0.935	-0.715	9	9	5940	9801	5940	5553.9	-4247.1	-13	Group B	Marble - 2nd unnamed trib to Homestead
650	0.7	1.65	0.83	0.935	-0.715	9	9	5850	9652.5	5850	5469.75	-4182.75	-13	Group B	Marble - 2nd unnamed trib to Homestead
1100	0.2	4.4	0.43	3.135	-1.265	9	9	9900	43560	9900	31036.5	-12523.5	-23	St. Joe HW	Marble - 2nd unnamed trib to Homestead
1000	0.2	4.4	0.43	3.135	-1.265	9	9	9000	39600	9000	28215	-11385	-23	St. Joe HW	Marble - 2nd unnamed trib to Homestead
250	0.2	4.4	0.37	3.465	-0.935	11	11	2750	12100	2750	9528.75	-2571.25	-17	St. Joe HW	Marble - Homestead to Cornwall
700	0.2	4.4	0.37	3.465	-0.935	11	11	7700	33880	7700	26680.5	-7199.5	-17	St. Joe HW	Marble - Cornwall to Hobo
800	0.2	4.4	0.34	3.63	-0.77	12	12	9600	42240	9600	34848	-7392	-14	St. Joe HW	Marble - Cornwall to Hobo
1000	0.2	4.4	0.34	3.63	-0.77	12	12	12000	52800	12000	43560	-9240	-14	St. Joe HW	Marble - Cornwall to Hobo
							Total	**106063**	**351346**	**106063**	**268584**	**-82762**	**-12**		

Table I-14. Homestead Creek (AU ID17010304PN036_02) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	VRU	Steam Segement Description
Homestead Creek - AU# ID17010304PN036_02															
800	0.8	1.1	0.96	0.22	-0.88	1	1	800	880	800	176	-704	-16	Group D	Homestead
1000	0.8	1.1	0.98	0.11	-0.99	1	1	1000	1100	1000	110	-990	-18	Group C	Homestead
600	0.7	1.65	0.96	0.22	-1.43	1	1	600	990	600	132	-858	-26	Group D	1st unnamed trib to Homestead
590	0.8	1.1	0.96	0.22	-0.88	1	1	590	649	590	129.8	-519.2	-16	Group D	2nd unnamed trib to Homestead
1100	0.8	1.1	0.97	0.165	-0.935	2	2	2200	2420	2200	363	-2057	-17	Group C	Homestead
800	0.8	1.1	0.96	0.22	-0.88	1	1	800	880	800	176	-704	-16	Group D	2nd unnamed trib to Homestead
1000	0.8	1.1	0.98	0.11	-0.99	1	1	1000	1100	1000	110	-990	-18	Group C	2nd unnamed trib to Homestead
95	0.8	1.1	0.96	0.22	-0.88	3	3	285	313.5	285	62.7	-250.8	-16	Group C	Homestead
600	0.8	1.1	0.96	0.22	-0.88	1	1	600	660	600	132	-528	-16	Group D	3rd unnamed trib to Homestead
1000	0.8	1.1	0.98	0.11	-0.99	1	1	1000	1100	1000	110	-990	-18	Group C	3rd unnamed trib to Homestead
370	0.8	1.1	0.96	0.22	-0.88	3	3	1110	1221	1110	244.2	-976.8	-16	Group C	Homestead
970	0.7	1.65	0.94	0.33	-1.32	4	4	3880	6402	3880	1280.4	-5121.6	-24	Group C	Homestead
800	0.8	1.1	0.94	0.33	-0.77	4	4	3200	3520	3200	1056	-2464	-14	Group C	Homestead
1000	0.8	1.1	0.94	0.33	-0.77	4	4	4000	4400	4000	1320	-3080	-14	Group C	Homestead
810	0.9	0.55	0.98	0.11	-0.44	1	1	810	445.5	810	89.1	-356.4	-8	Group C	4th unnamed trib to Homestead
680	0.8	1.1	0.98	0.11	-0.99	1	1	680	748	680	74.8	-673.2	-18	Group C	4th unnamed trib to Homestead
520	0.9	0.55	0.98	0.11	-0.44	1	1	520	286	520	57.2	-228.8	-8	Group C	4th unnamed trib to Homestead
600	0.8	1.1	0.94	0.33	-0.77	4	4	2400	2640	2400	792	-1848	-14	Group C	Homestead
1000	0.8	1.1	0.92	0.44	-0.66	5	5	5000	5500	5000	2200	-3300	-12	Group C	Homestead
600	0.7	1.65	0.94	0.33	-1.32	5	5	3000	4950	3000	990	-3960	-24	Group B	Homestead
700	0.7	1.65	0.94	0.33	-1.32	5	5	3500	5775	3500	1155	-4620	-24	Group B	Homestead
600	0.9	0.55	0.96	0.22	-0.33	1	1	600	330	600	132	-198	-6	Group C	5th unnamed trib to Homestead
700	0.9	0.55	0.96	0.22	-0.33	1	1	700	385	700	154	-231	-6	Group C	5th unnamed trib to Homestead
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	5th unnamed trib to Homestead
1000	0.8	1.1	0.92	0.44	-0.66	6	6	6000	6600	6000	2640	-3960	-12	Group B	Homestead
1000	0.8	1.1	0.92	0.44	-0.66	6	6	6000	6600	6000	2640	-3960	-12	Group B	Homestead
							Total	**52275**	**60995**	**52275**	**16546**	**-44449**	**-15**		

Table I-15. Hobo Creek (AU ID17010304PN034_02) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	VRU	Stream Segment Description
Hobo Creek - AU# ID17010304PN034_02															
1400	0.9	0.55	0.98	0.11	-0.44	1	1	1400	770	1400	154	-616	-8	Group C	Hobo
1000	0.9	0.55	0.97	0.165	-0.385	2	2	2000	1100	2000	330	-770	-7	Group C	Hobo
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Hobo
1000	0.9	0.55	0.97	0.165	-0.385	3	3	3000	1650	3000	495	-1155	-7	Group B	Hobo
800	0.9	0.55	0.98	0.11	-0.44	1	1	800	440	800	88	-352	-8	Group C	Trib to Hobo
1000	0.9	0.55	0.97	0.165	-0.385	2	2	2000	1100	2000	330	-770	-7	Group C	Trib to Hobo
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Trib to Hobo
700	0.9	0.55	0.96	0.22	-0.33	4	4	2800	1540	2800	616	-924	-6	Group B	Hobo
800	0.9	0.55	0.96	0.22	-0.33	4	4	3200	1760	3200	704	-1056	-6	Group B	Hobo
700	0.9	0.55	0.98	0.11	-0.44	1	1	700	385	700	77	-308	-8	Group B	WF Hobo
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	WF Hobo
690	0.9	0.55	0.98	0.11	-0.44	2	2	1380	759	1380	151.8	-607.2	-8	Group B	WF Hobo
250	0.9	0.55	0.98	0.11	-0.44	2	2	500	275	500	55	-220	-8	Group B	WF Hobo
550	0.8	1.1	0.97	0.165	-0.935	3	3	1650	1815	1650	272.25	-1542.75	-17	Group B	WF Hobo
170	0.8	1.1	0.94	0.33	-0.77	5	5	850	935	850	280.5	-654.5	-14	Group B	Hobo
350	0.7	1.65	0.94	0.33	-1.32	5	5	1750	2887.5	1750	577.5	-2310	-24	Group B	Hobo
310	0.6	2.2	0.94	0.33	-1.87	5	5	1550	3410	1550	511.5	-2898.5	-34	Group B	Hobo
360	0.7	1.65	0.94	0.33	-1.32	5	5	1800	2970	1800	594	-2376	-24	Group B	Hobo
1000	0.6	2.2	0.94	0.33	-1.87	6	6	6000	13200	6000	1980	-11220	-34	Group B	Hobo
350	0.5	2.75	0.64	1.98	-0.77	6	6	2100	5775	2100	4158	-1617	-14	Group A	Hobo
820	0.6	2.2	0.64	1.98	-0.22	6	6	4920	10824	4920	9741.6	-1082.4	-4	Group A	Hobo
							Total	**44400**	**54896**	**44400**	**21776**	**-33119**	**-12**		

Table I-16. Tributaries to Marble Creek from Hobo Creek to St. Joe River (AU ID17010304PN031_02) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	VRU	Steam Segment Description
1st and 2nd order tributaries to Marble Creek from Hobo Creek to St. Joe River - AU# ID17010304PN031_02															
800	0.9	0.55	0.98	0.11	-0.44	1	1	800	440	800	88	-352	-8	Group B	Daivs
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Daivs
790	0.9	0.55	0.98	0.11	-0.44	2	2	1580	869	1580	173.8	-695.2	-8	Group B	Daivs
800	0.8	1.1	0.98	0.11	-0.99	2	2	1600	1760	1600	176	-1584	-18	Group B	Daivs
700	0.9	0.55	0.98	0.11	-0.44	1	1	700	385	700	77	-308	-8	Group B	Cranberry
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Cranberry
700	0.9	0.55	0.98	0.11	-0.44	1	1	700	385	700	77	-308	-8	Group C	Trib to Cranberry
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group B	Trib to Cranberry
290	0.9	0.55	0.98	0.11	-0.44	2	2	580	319	580	63.8	-255.2	-8	Group B	Cranberry
220	0.8	1.1	0.98	0.11	-0.99	2	2	440	484	440	48.4	-435.6	-18	Group B	Cranberry
280	0.7	1.65	0.98	0.11	-1.54	2	2	560	924	560	61.6	-862.4	-28	Group B	Cranberry
600	0.8	1.1	0.98	0.11	-0.99	2	2	1200	1320	1200	132	-1188	-18	Group B	Cranberry
700	0.8	1.1	0.97	0.165	-0.935	3	3	2100	2310	2100	346.5	-1963.5	-17	Group B	Cranberry
600	0.9	0.55	0.97	0.165	-0.385	3	3	1800	990	1800	297	-693	-7	Group B	Cranberry
600	0.9	0.55	0.97	0.165	-0.385	3	3	1800	990	1800	297	-693	-7	Group B	Cranberry
800	0.9	0.55	0.98	0.11	-0.44	1	1	800	440	800	88	-352	-8	Group B	Shearer
800	0.9	0.55	0.98	0.11	-0.44	1	1	800	440	800	88	-352	-8	Group B	Shearer
800	0.9	0.55	0.98	0.11	-0.44	2	2	1600	880	1600	176	-704	-8	Group B	Shearer
800	0.9	0.55	0.98	0.11	-0.44	2	2	1600	880	1600	176	-704	-8	Group B	Shearer
600	0.9	0.55	0.98	0.11	-0.44	1	1	600	330	600	66	-264	-8	Group B	1st west Trib
440	0.7	1.65	0.98	0.11	-1.54	1	1	440	726	440	48.4	-677.6	-28	Group B	2nd west Trib
930	0.9	0.55	0.98	0.11	-0.44	1	1	930	511.5	930	102.3	-409.2	-8	Group B	3rd west Trib
600	0.9	0.55	0.98	0.11	-0.44	1	1	600	330	600	66	-264	-8	Group B	Donkey
600	0.9	0.55	0.98	0.11	-0.44	1	1	600	330	600	66	-264	-8	Group B	Donkey
600	0.8	1.1	0.98	0.11	-0.99	2	2	1200	1320	1200	132	-1188	-18	Group B	Donkey
600	0.8	1.1	0.98	0.11	-0.99	2	2	1200	1320	1200	132	-1188	-18	Group B	Donkey
600	0.9	0.55	0.87	0.715	0.165	3	3	1800	990	1800	1287	297	3	Group A	Donkey
600	0.9	0.55	0.87	0.715	0.165	3	3	1800	990	1800	1287	297	3	Group A	Donkey
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group B	1st east trib
1100	0.9	0.55	0.94	0.33	-0.22	2	2	2200	1210	2200	726	-484	-4	Group A	1st east trib
390	0.8	1.1	0.98	0.11	-0.99	1	1	390	429	390	42.9	-386.1	-18	Group C	1st west below Donkey
600	0.5	2.75	0.98	0.11	-2.64	1	1	600	1650	600	66	-1584	-48	Group B	1st west below Donkey
1000	0.9	0.55	0.95	0.275	-0.275	1	1	1000	550	1000	275	-275	-5	Group A	1st west below Donkey
740	0.7	1.65	0.98	0.11	-1.54	1	1	740	1221	740	81.4	-1139.6	-28	Group B	2nd east
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group B	2nd east
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group B	2nd east
250	0.6	2.2	0.98	0.11	-2.09	1	1	250	550	250	27.5	-522.5	-38	Group B	2nd west
320	0.6	2.2	0.98	0.11	-2.09	1	1	320	704	320	35.2	-668.8	-38	Group B	2nd west
600	0.7	1.65	0.98	0.11	-1.54	1	1	600	990	600	66	-924	-28	Group B	2nd west
700	0.9	0.55	0.95	0.275	-0.275	1	1	700	385	700	192.5	-192.5	-5	Group A	2nd west
730	0.6	2.2	0.98	0.11	-2.09	1	1	730	1606	730	80.3	-1525.7	-38	Group B	West trib btn Boulder and Canyon
910	0.9	0.55	0.98	0.11	-0.44	1	1	910	500.5	910	100.1	-400.4	-8	Group B	West trib btn Boulder and Canyon
600	0.9	0.55	0.98	0.11	-0.44	1	1	600	330	600	66	-264	-8	Group B	Canyon
700	0.9	0.55	0.98	0.11	-0.44	1	1	700	385	700	77	-308	-8	Group B	Canyon
490	0.8	1.1	0.98	0.11	-0.99	2	2	980	1078	980	107.8	-970.2	-18	Group B	Canyon
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Canyon
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Canyon
1000	0.9	0.55	0.97	0.165	-0.385	3	3	3000	1650	3000	495	-1155	-7	Group B	Canyon
1100	0.9	0.55	0.97	0.165	-0.385	3	3	3300	1815	3300	544.5	-1270.5	-7	Group B	Canyon
							Total	**56850**	**42317**	**56850**	**9856**	**-32461**	**-13**		

Table I-17. Bussel Creek headwaters and tributaries (AU ID17010304PN033_02a) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	VRU	Stream Segment Description
Bussel Creek headwaters and tributaries - AU# ID17010304PN033_02a															
630	0.8	1.1	0.98	0.11	-0.99	1	1	630	693	630	69.3	-623.7	-18	Group B	Bussel
700	0.7	1.65	0.98	0.11	-1.54	1	1	700	1155	700	77	-1078	-28	Group B	Bussel
700	0.7	1.65	0.98	0.11	-1.54	2	2	1400	2310	1400	154	-2156	-28	Group B	Bussel
480	0.8	1.1	0.98	0.11	-0.99	2	2	960	1056	960	105.6	-950.4	-18	Group B	Bussel
99	0.7	1.65	0.98	0.11	-1.54	2	2	198	326.7	198	21.78	-304.92	-28	Group B	Bussel
710	0.6	2.2	0.85	0.825	-1.375	3	3	2130	4686	2130	1757.25	-2928.75	-25	St. Joe HW	Bussel[1]
1100	0.6	2.2	0.85	0.825	-1.375	3	3	3300	7260	3300	2722.5	-4537.5	-25	St. Joe HW	Bussel[1]
990	0.9	0.55	0.98	0.11	-0.44	1	1	990	544.5	990	108.9	-435.6	-8	Group B	Lines
770	0.9	0.55	0.98	0.11	-0.44	2	2	1540	847	1540	169.4	-677.6	-8	Group B	Lines
900	0.8	1.1	0.98	0.11	-0.99	2	2	1800	1980	1800	198	-1782	-18	Group B	Lines
900	0.7	1.65	0.97	0.165	-1.485	3	3	2700	4455	2700	445.5	-4009.5	-27	Group B	Lines
240	0.6	2.2	0.97	0.165	-2.035	3	3	720	1584	720	118.8	-1465.2	-37	Group B	Lines
140	0.6	2.2	0.74	1.43	-0.77	4	4	560	1232	560	800.8	-431.2	-14	St. Joe HW	Bussel - Lines to Norton
1000	0.7	1.65	0.74	1.43	-0.22	4	4	4000	6600	4000	5720	-880	-4	St. Joe HW	Bussel - Lines to Norton
210	0.6	2.2	0.65	1.925	-0.275	5	5	1050	2310	1050	2021.25	-288.75	-5	St. Joe HW	Bussel - Lines to Norton
700	0.9	0.55	0.98	0.11	-0.44	1	1	700	385	700	77	-308	-8	Group B	Norton
800	0.9	0.55	0.98	0.11	-0.44	1	1	800	440	800	88	-352	-8	Group B	Norton
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Norton
510	0.8	1.1	0.98	0.11	-0.99	2	2	1020	1122	1020	112.2	-1009.8	-18	Group B	Norton
600	0.9	0.55	0.98	0.11	-0.44	1	1	600	330	600	66	-264	-8	Group B	Unnamed trib to Norton
600	0.9	0.55	0.98	0.11	-0.44	1	1	600	330	600	66	-264	-8	Group B	Unnamed trib to Norton
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Unnamed trib to Norton
360	0.8	1.1	0.98	0.11	-0.99	2	2	720	792	720	79.2	-712.8	-18	Group B	Norton
600	0.6	2.2	0.93	0.385	-1.815	2	2	1200	2640	1200	462	-2178	-33	St. Joe HW	Norton [1]
700	0.6	2.2	0.93	0.385	-1.815	2	2	1400	3080	1400	539	-2541	-33	St. Joe HW	Norton [1]
1000	0.9	0.55	0.97	0.165	-0.385	3	3	3000	1650	3000	495	-1155	-7	St. Joe HW	Norton [1]
400	0.7	1.65	0.97	0.165	-1.485	3	3	1200	1980	1200	198	-1782	-27	Group B	Norton
1000	0.8	1.1	0.97	0.165	-0.935	3	3	3000	3300	3000	495	-2805	-17	Group B	Norton
580	0.7	1.65	0.96	0.22	-1.43	4	4	2320	3828	2320	510.4	-3317.6	-26	Group B	Norton
150	0.6	2.2	0.96	0.22	-1.98	4	4	600	1320	600	132	-1188	-36	Group B	Norton
890	0.9	0.55	0.98	0.11	-0.44	1	1	890	489.5	890	97.9	-391.6	-8	Group B	Toles
390	0.8	1.1	0.98	0.11	-0.99	2	2	780	858	780	85.8	-772.2	-18	Group B	Toles
440	0.9	0.55	0.98	0.11	-0.44	2	2	880	484	880	96.8	-387.2	-8	Group B	Toles
500	0.8	1.1	0.98	0.11	-0.99	2	2	1000	1100	1000	110	-990	-18	Group B	Toles
240	0.9	0.55	0.98	0.11	-0.44	2	2	480	264	480	52.8	-211.2	-8	Group B	Toles
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group B	Unnamed trib to Toles
600	0.8	1.1	0.98	0.11	-0.99	2	2	1200	1320	1200	132	-1188	-18	Group B	Unnamed trib to Toles
700	0.8	1.1	0.98	0.11	-0.99	2	2	1400	1540	1400	154	-1386	-18	Group B	Unnamed trib to Toles

[1]Applied St. Joe hardwood shade curve although stream slope was greater than 3%. Vegetation resembled hardwood community not forest type.

Table I-17. Bussel Creek headwaters and tributaries (AU ID17010304PN033_02a) solar load analysis table (continued)

160	0.9	0.55	0.93	0.385	-0.165	2	2	320	176	320	123.2	-52.8	-3	St. Joe HW	Toles
120	0.8	1.1	0.93	0.385	-0.715	2	2	240	264	240	92.4	-171.6	-13	St. Joe HW	Toles
470	0.7	1.65	0.85	0.825	-0.825	3	3	1410	2326.5	1410	1163.25	-1163.25	-15	St. Joe HW	Toles
150	0.8	1.1	0.85	0.825	-0.275	3	3	450	495	450	371.25	-123.75	-5	St. Joe HW	Toles
61	0.9	0.55	0.98	0.11	-0.44	1	1	61	33.55	61	6.71	-26.84	-8	Group B	2nd unnamed trib to Toles
550	0.5	2.75	0.98	0.11	-2.64	1	1	550	1512.5	550	60.5	-1452	-48	Group B	2nd unnamed trib to Toles
880	0.9	0.55	0.98	0.11	-0.44	1	1	880	484	880	96.8	-387.2	-8	Group B	2nd unnamed trib to Toles
820	0.8	1.1	0.98	0.11	-0.99	2	2	1640	1804	1640	180.4	-1623.6	-18	Group B	2nd unnamed trib to Toles
320	0.7	1.65	0.98	0.11	-1.54	2	2	640	1056	640	70.4	-985.6	-28	Group B	2nd unnamed trib to Toles
220	0.8	1.1	0.98	0.11	-0.99	2	2	440	484	440	48.4	-435.6	-18	Group B	2nd unnamed trib to Toles
76	0.8	1.1	0.85	0.825	-0.275	3	3	228	250.8	228	188.1	-62.7	-5	St. Joe HW	Toles - 2nd unnamed trib to Bussel
490	0.7	1.65	0.85	0.825	-0.825	3	3	1470	2425.5	1470	1212.75	-1212.75	-15	St. Joe HW	Toles - 2nd unnamed trib to Bussel
620	0.8	1.1	0.85	0.825	-0.275	3	3	1860	2046	1860	1534.5	-511.5	-5	St. Joe HW	Toles - 2nd unnamed trib to Bussel
160	0.6	2.2	0.85	0.825	-1.375	3	3	480	1056	480	396	-660	-25	St. Joe HW	Toles - 2nd unnamed trib to Bussel
190	0.7	1.65	0.85	0.825	-0.825	3	3	570	940.5	570	470.25	-470.25	-15	St. Joe HW	Toles - 2nd unnamed trib to Bussel
240	0.6	2.2	0.85	0.825	-1.375	3	3	720	1584	720	594	-990	-25	St. Joe HW	Toles - 2nd unnamed trib to Bussel
460	0.7	1.65	0.85	0.825	-0.825	3	3	1380	2277	1380	1138.5	-1138.5	-15	St. Joe HW	Toles - 2nd unnamed trib to Bussel
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group B	Unnamed trib
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group B	Unnamed trib
							Total	**66807**	**87357**	**66807**	**27057**	**-60300**	**-17**		

Table I-18. Bussel Creek mainstem below Norton Creek to Marble Creek (AU ID17010304PN033_03) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	VRU	Stream Segment Description
Bussel Creek mainstem below Norton Creek - AU# ID17010304PN033_03															
620	0.6	2.2	0.58	2.31	0.11	6	6	3720	8184	3720	8593.2	409.2	2	St. Joe HW	Bussel - Norton to Toles
130	0.5	2.75	0.52	2.64	-0.11	7	7	910	2502.5	910	2402.4	-100.1	-2	St. Joe HW	Bussel - Toles to Bear
920	0.4	3.3	0.52	2.64	-0.66	7	7	6440	21252	6440	17001.6	-4250.4	-12	St. Joe HW	Bussel - Toles to Bear
270	0.3	3.85	0.47	2.915	-0.935	8	8	2160	8316	2160	6296.4	-2019.6	-17	St. Joe HW	Bussel - Bear to unnamed trib
440	0.4	3.3	0.47	2.915	-0.385	8	8	3520	11616	3520	10260.8	-1355.2	-7	St. Joe HW	Bussel - unnamed trib to Marble
200	0.5	2.75	0.47	2.915	0.165	8	8	1600	4400	1600	4664	264	3	St. Joe HW	Bussel - unnamed trib to Marble
860	0.3	3.85	0.47	2.915	-0.935	8	8	6880	26488	6880	20055.2	-6432.8	-17	St. Joe HW	Bussel - unnamed trib to Marble
840	0.4	3.3	0.47	2.915	-0.385	8	8	6720	22176	6720	19588.8	-2587.2	-7	St. Joe HW	Bussel - unnamed trib to Marble
870	0.2	4.4	0.43	3.135	-1.265	9	9	7830	34452	7830	24547.05	-9904.95	-23	St. Joe HW	Bussel - unnamed trib to Marble
240	0.3	3.85	0.43	3.135	-0.715	9	9	2160	8316	2160	6771.6	-1544.4	-13	St. Joe HW	Bussel - unnamed trib to Marble
510	0.4	3.3	0.43	3.135	-0.165	9	9	4590	15147	4590	14389.65	-757.35	-3	St. Joe HW	Bussel - unnamed trib to Marble
230	0.3	3.85	0.43	3.135	-0.715	9	9	2070	7969.5	2070	6489.45	-1480.05	-13	St. Joe HW	Bussel - unnamed trib to Marble
							Total	**48600**	**170819**	**48600**	**141060**	**-29759**	**-9**		

Table I-19. Mainstem Marble Creek from Hobo Creek to Bussel Creek (AU ID17010304PN031_03) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	VRU	Stream Segment Description
Marble Creek mainstem Hobo to Bussel Creek AU# ID17010304PN031_03															
210	0.2	4.4	0.32	3.74	-0.66	13	13	2730	12012	2730	10210.2	-1801.8	-12	St. Joe HW	Marble - Hobo to Davis
420	0.3	3.85	0.3	3.85	0	14	14	5880	22638	5880	22638	0	0	St. Joe HW	Marble - Hobo to Davis
800	0.2	4.4	0.3	3.85	-0.55	14	14	11200	49280	11200	43120	-6160	-10	St. Joe HW	Marble - Davis to Cranberry
800	0.2	4.4	0.3	3.85	-0.55	14	14	11200	49280	11200	43120	-6160	-10	St. Joe HW	Marble - Davis to Cranberry
650	0.2	4.4	0.3	3.85	-0.55	14	14	9100	40040	9100	35035	-5005	-10	St. Joe HW	Marble - Cranberry to Bussel
270	0.3	3.85	0.28	3.96	0.11	15	15	4050	15592.5	4050	16038	445.5	2	St. Joe HW	Marble - Cranberry to Bussel
520	0.3	3.85	0.28	3.96	0.11	15	15	7800	30030	7800	30888	858	2	St. Joe HW	Marble - Cranberry to Bussel
240	0.3	3.85	0.28	3.96	0.11	15	15	3600	13860	3600	14256	396	2	St. Joe HW	Marble - Cranberry to Bussel
410	0.2	4.4	0.28	3.96	-0.44	15	15	6150	27060	6150	24354	-2706	-8	St. Joe HW	Marble - Cranberry to Bussel
							Total	**61710**	**259793**	**61710**	**239659**	**-20133**	**-5**		

Table I-20. Daveggio Creek (AU ID17010304PN037_02/03) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	VRU	Stream Segment Description
Tributaries to Daveggio Creek - AU# ID17010304PN037_02															
730	0.9	0.55	0.98	0.11	-0.44	1	1	730	401.5	730	80.3	-321.2	-8	Group C	Daveggio
900	0.8	1.1	0.93	0.385	-0.715	2	2	1800	1980	1800	693	-1287	-13	St. Joe HW	Daveggio
930	0.8	1.1	0.93	0.385	-0.715	2	2	1860	2046	1860	716.1	-1329.9	-13	St. Joe HW	Daveggio
910	0.8	1.1	0.97	0.165	-0.935	2	2	1820	2002	1820	300.3	-1701.7	-17	Group C	Daveggio
1700	0.9	0.55	0.96	0.22	-0.33	3	3	5100	2805	5100	1122	-1683	-6	Group C	Daveggio
900	0.9	0.55	0.96	0.22	-0.33	1	1	900	495	900	198	-297	-6	Group D	1st south trib to Daveggio
1000	0.9	0.55	0.97	0.165	-0.385	2	2	2000	1100	2000	330	-770	-7	Group C	1st south trib to Daveggio
990	0.8	1.1	0.97	0.165	-0.935	2	2	1980	2178	1980	326.7	-1851.3	-17	Group C	1st south trib to Daveggio
420	0.9	0.55	0.94	0.33	-0.22	4	4	1680	924	1680	554.4	-369.6	-4	Group C	Daveggio
700	0.8	1.1	0.94	0.33	-0.77	4	4	2800	3080	2800	924	-2156	-14	Group C	Daveggio
1000	0.8	1.1	0.96	0.22	-0.88	4	4	4000	4400	4000	880	-3520	-16	Group B	Daveggio
1000	0.8	1.1	0.94	0.33	-0.77	5	5	5000	5500	5000	1650	-3850	-14	Group B	Daveggio
1100	0.9	0.55	0.98	0.11	-0.44	1	1	1100	605	1100	121	-484	-8	Group C	Little Daveggio
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	Little Daveggio
800	0.9	0.55	0.98	0.11	-0.44	1	1	800	440	800	88	-352	-8	Group B	South trib to Little Daveggio
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group B	South trib to Little Daveggio
970	0.9	0.55	0.98	0.11	-0.44	2	2	1940	1067	1940	213.4	-853.6	-8	Group B	Little Daveggio
360	0.8	1.1	0.97	0.165	-0.935	3	3	1080	1188	1080	178.2	-1009.8	-17	Group B	Little Daveggio
							Total	**37590**	**31862**	**37590**	**8705**	**-23156**	**-11**		
Daveggio Creek Mainstem - AU# ID17010304PN037_03															
700	0.7	1.65	0.94	0.33	-1.32	5	5	3500	5775	3500	1155	-4620	-24	Group B	Daveggio
800	0.7	1.65	0.94	0.33	-1.32	5	5	4000	6600	4000	1320	-5280	-24	Group B	Daveggio
1000	0.8	1.1	0.92	0.44	-0.66	6	6	6000	6600	6000	2640	-3960	-12	Group B	Daveggio
430	0.7	1.65	0.92	0.44	-1.21	6	6	2580	4257	2580	1135.2	-3121.8	-22	Group B	Daveggio
							Total	**16080**	**23232**	**16080**	**6250**	**-16982**	**-21**		

Table I-21. Eagle Creek (AU ID17010304PN032_02) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	VRU	Stream Segment Description
Eagle Creek - AU# ID17010304PN032_02															
310	0.9	0.55	0.98	0.11	-0.44	1	1	310	170.5	310	34.1	-136.4	-8	Group B	Eagle - above NF Eagle
520	0.8	1.1	0.98	0.11	-0.99	1	1	520	572	520	57.2	-514.8	-18	Group B	Eagle - above NF Eagle
700	0.7	1.65	0.98	0.11	-1.54	2	2	1400	2310	1400	154	-2156	-28	Group B	Eagle - above NF Eagle
1000	0.7	1.65	0.98	0.11	-1.54	2	2	2000	3300	2000	220	-3080	-28	Group B	Eagle - above NF Eagle
1000	0.7	1.65	0.98	0.11	-1.54	2	2	2000	3300	2000	220	-3080	-28	Group B	Eagle - above NF Eagle
1000	0.7	1.65	0.97	0.165	-1.485	3	3	3000	4950	3000	495	-4455	-27	Group B	Eagle - above NF Eagle
700	0.7	1.65	0.98	0.11	-1.54	1	1	700	1155	700	77	-1078	-28	Group B	NF Eagle
1000	0.7	1.65	0.98	0.11	-1.54	1	1	1000	1650	1000	110	-1540	-28	Group B	NF Eagle
360	0.8	1.1	0.96	0.22	-0.88	1	1	360	396	360	79.2	-316.8	-16	GroupD	Trib to NF Eagle
490	0.6	2.2	0.98	0.11	-2.09	1	1	490	1078	490	53.9	-1024.1	-38	Group B	Trib to NF Eagle
600	0.9	0.55	0.98	0.11	-0.44	2	2	1200	660	1200	132	-528	-8	Group B	Trib to NF Eagle
600	0.9	0.55	0.98	0.11	-0.44	2	2	1200	660	1200	132	-528	-8	Group B	Trib to NF Eagle
740	0.8	1.1	0.97	0.165	-0.935	3	3	2220	2442	2220	366.3	-2075.7	-17	Group B	NF Eagle
500	0.7	1.65	0.97	0.165	-1.485	3	3	1500	2475	1500	247.5	-2227.5	-27	Group B	NF Eagle
700	0.9	0.55	0.98	0.11	-0.44	1	1	700	385	700	77	-308	-8	Group B	2nd north trib to NF Eagle
700	0.9	0.55	0.98	0.11	-0.44	1	1	700	385	700	77	-308	-8	Group B	3rd north trib to NF Eagle
370	0.8	1.1	0.98	0.11	-0.99	1	1	370	407	370	40.7	-366.3	-18	Group B	4th north trib to NF Eagle
940	0.7	1.65	0.85	0.825	-0.825	3	3	2820	4653	2820	2326.5	-2326.5	-15	St. Joe HW	NF Eagle - unnamed to Eagle
570	0.7	1.65	0.96	0.22	-1.43	4	4	2280	3762	2280	501.6	-3260.4	-26	Group B	Eagle - NF Eagle to Grouse
340	0.8	1.1	0.96	0.22	-0.88	4	4	1360	1496	1360	299.2	-1196.8	-16	Group B	Eagle - NF Eagle to Grouse
420	0.7	1.65	0.96	0.22	-1.43	4	4	1680	2772	1680	369.6	-2402.4	-26	Group B	Eagle - NF Eagle to Grouse
820	0.8	1.1	0.94	0.33	-0.77	5	5	4100	4510	4100	1353	-3157	-14	Group B	Eagle - NF Eagle to Grouse
240	0.9	0.55	0.94	0.33	-0.22	5	5	1200	660	1200	396	-264	-4	Group B	Eagle - NF Eagle to Grouse
440	0.9	0.55	0.98	0.11	-0.44	1	1	440	242	440	48.4	-193.6	-8	Group B	Grouse
1000	0.6	2.2	0.98	0.11	-2.09	1	1	1000	2200	1000	110	-2090	-38	Group B	Grouse
800	0.9	0.55	0.98	0.11	-0.44	2	2	1600	880	1600	176	-704	-8	Group B	Grouse
800	0.9	0.55	0.98	0.11	-0.44	2	2	1600	880	1600	176	-704	-8	Group B	Grouse
68	0.9	0.55	0.98	0.11	-0.44	2	2	136	74.8	136	14.96	-59.84	-8	Group B	Eagle - Grouse to Marble
700	0.8	1.1	0.94	0.33	-0.77	5	5	3500	3850	3500	1155	-2695	-14	Group B	Eagle - Grouse to Marble
600	0.8	1.1	0.94	0.33	-0.77	5	5	3000	3300	3000	990	-2310	-14	Group B	Eagle - Grouse to Marble
							Total	**44386**	**55575.3**	**44386**	**10489.16**	**-45086.14**	**-18**		

Table I-22. Boulder Creek (AU ID17010304PN038_02/03) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	VRU	Comment
Boulder Creek headwaters and tributaries - AU# ID17010304PN038_02															
700	0.9	0.55	0.98	0.11	-0.44	1	1	700	385	700	77	-308	-8	Group C	Boulder
800	0.9	0.55	0.98	0.11	-0.44	1	1	800	440	800	88	-352	-8	Group C	Boulder
1000	0.9	0.55	0.97	0.165	-0.385	2	2	2000	1100	2000	330	-770	-7	Group C	Boulder
800	0.9	0.55	0.98	0.11	-0.44	2	2	1600	880	1600	176	-704	-8	Group B	Boulder
1000	0.9	0.55	0.97	0.165	-0.385	3	3	3000	1650	3000	495	-1155	-7	Group B	Boulder
680	0.8	1.1	0.97	0.165	-0.935	3	3	2040	2244	2040	336.6	-1907.4	-17	Group B	Boulder
700	0.9	0.55	0.98	0.11	-0.44	1	1	700	385	700	77	-308	-8	Group B	Unnamed trib
700	0.9	0.55	0.98	0.11	-0.44	1	1	700	385	700	77	-308	-8	Group B	Unnamed trib
290	0.9	0.55	0.98	0.11	-0.44	1	1	290	159.5	290	31.9	-127.6	-8	Group B	Unnamed trib
600	0.9	0.55	0.97	0.165	-0.385	3	3	1800	990	1800	297	-693	-7	Group B	Boulder
700	0.9	0.55	0.97	0.165	-0.385	3	3	2100	1155	2100	346.5	-808.5	-7	Group B	Boulder
900	0.8	1.1	0.98	0.11	-0.99	1	1	900	990	900	99	-891	-18	Group C	Walamute
1000	0.8	1.1	0.97	0.165	-0.935	2	2	2000	2200	2000	330	-1870	-17	Group C	Walamute
840	0.9	0.55	0.97	0.165	-0.385	2	2	1680	924	1680	277.2	-646.8	-7	Group C	Walamute
700	0.8	1.1	0.94	0.33	-0.77	2	2	1400	1540	1400	462	-1078	-14	Group A	Walamute
700	0.9	0.55	0.98	0.11	-0.44	2	2	1400	770	1400	154	-616	-8	Group B	Walamute
680	0.8	1.1	0.97	0.165	-0.935	3	3	2040	2244	2040	336.6	-1907.4	-17	Group B	Walamute
770	0.9	0.55	0.97	0.165	-0.385	3	3	2310	1270.5	2310	381.15	-889.35	-7	Group B	Walamute
790	0.8	1.1	0.97	0.165	-0.935	3	3	2370	2607	2370	391.05	-2215.95	-17	Group B	Walamute
810	0.8	1.1	0.94	0.33	-0.77	5	5	4050	4455	4050	1336.5	-3118.5	-14	Group B	Boulder
700	0.9	0.55	0.98	0.11	-0.44	1	1	700	385	700	77	-308	-8	Group B	Unnamed below Walamute
800	0.9	0.55	0.98	0.11	-0.44	1	1	800	440	800	88	-352	-8	Group B	Unnamed below Walamute
900	0.8	1.1	0.98	0.11	-0.99	2	2	1800	1980	1800	198	-1782	-18	Group B	Unnamed below Walamute
1000	0.8	1.1	0.98	0.11	-0.99	2	2	2000	2200	2000	220	-1980	-18	Group B	Unnamed below Walamute
840	0.8	1.1	0.94	0.33	-0.77	5	5	4200	4620	4200	1386	-3234	-14	Group B	Boulder
500	0.9	0.55	0.92	0.44	-0.11	6	6	3000	1650	3000	1320	-330	-2	Group B	Boulder
800	0.9	0.55	0.98	0.11	-0.44	1	1	800	440	800	88	-352	-8	Group B	2nd unnamed below Walamute
1000	0.9	0.55	0.98	0.11	-0.44	1	1	1000	550	1000	110	-440	-8	Group B	3rd unnamed below Walamute
490	0.9	0.55	0.92	0.44	-0.11	6	6	2940	1617	2940	1293.6	-323.4	-2	Group B	Boulder
730	0.9	0.55	0.98	0.11	-0.44	1	1	730	401.5	730	80.3	-321.2	-8	Group B	EF of unnamed below Walamute
360	0.7	1.65	0.98	0.11	-1.54	1	1	360	594	360	39.6	-554.4	-28	Group B	EF of unnamed below Walamute
360	0.7	1.65	0.98	0.11	-1.54	1	1	360	594	360	39.6	-554.4	-28	Group B	EF of unnamed below Walamute
380	0.8	1.1	0.98	0.11	-0.99	1	1	380	418	380	41.8	-376.2	-18	Group B	EF of unnamed below Walamute
610	0.7	1.65	0.98	0.11	-1.54	1	1	610	1006.5	610	67.1	-939.4	-28	Group B	WF of unnamed below Walamute
600	0.8	1.1	0.98	0.11	-0.99	1	1	600	660	600	66	-594	-18	Group B	WF of unnamed below Walamute
700	0.8	1.1	0.98	0.11	-0.99	1	1	700	770	700	77	-693	-18	Group B	WF of unnamed below Walamute

Table I-22. Boulder Creek (AU ID17010304PN038_02/03) solar load analysis table (continued)

610	0.9	0.55	0.98	0.11	-0.44	2	2	1220	671	1220	134.2	-536.8	-8	Group B	Unnamed below Walamute
1000	0.6	2.2	0.98	0.11	-2.09	1	1	1000	2200	1000	110	-2090	-38	Group C	2nd unnamed below Walamute
940	0.7	1.65	0.98	0.11	-1.54	1	1	940	1551	940	103.4	-1447.6	-28	Group B	3rd unnamed below Walamute
850	0.8	1.1	0.98	0.11	-0.99	2	2	1700	1870	1700	187	-1683	-18	Group B	4th unnamed below Walamute
340	0.9	0.55	0.98	0.11	-0.44	2	2	680	374	680	74.8	-299.2	-8	Group B	5th unnamed below Walamute
500	0.9	0.55	0.98	0.11	-0.44	1	1	500	275	500	55	-220	-8	Group C	3rd south trib below Walamute
750	0.8	1.1	0.98	0.11	-0.99	1	1	750	825	750	82.5	-742.5	-18	Group B	4th south trib below Walamute
600	0.9	0.55	0.98	0.11	-0.44	1	1	600	330	600	66	-264	-8	Group B	5th south trib below Walamute
700	0.9	0.55	0.98	0.11	-0.44	2	2	1400	770	1400	154	-616	-8	Group B	6th south trib below Walamute
1000	0.9	0.55	0.98	0.11	-0.44	2	2	2000	1100	2000	220	-880	-8	Group B	7th south trib below Walamute
							Total	**65650**	**55066**	**65650**	**12478**	**-42588**	**-13**		

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	VRU	Stream Segment Description
Boulder Creek mainstem - AU# ID17010304PN038_03															
450	0.9	0.55	0.92	0.44	-0.11	6	6	2700	1485	2700	1188	-297	-2	Group B	Boulder
170	0.9	0.55	0.92	0.44	-0.11	6	6	1020	561	1020	448.8	-112.2	-2	Group B	Boulder
740	0.8	1.1	0.92	0.44	-0.66	6	6	4440	4884	4440	1953.6	-2930.4	-12	Group B	Boulder
480	0.7	1.65	0.92	0.44	-1.21	6	6	2880	4752	2880	1267.2	-3484.8	-22	Group B	Boulder
840	0.6	2.2	0.91	0.495	-1.705	7	7	5880	12936	5880	2910.6	-10025.4	-31	Group B	Boulder
310	0.7	1.65	0.91	0.495	-1.155	7	7	2170	3580.5	2170	1074.15	-2506.35	-21	Group B	Boulder
1100	0.8	1.1	0.88	0.66	-0.44	8	8	8800	9680	8800	5808	-3872	-8	Group B	Boulder
							Total	**27890**	**37879**	**27890**	**14650**	**-23228**	**-14**		

Appendix J. St. Maries River Watershed Potential Natural Vegetation Solar Load Analysis Tables

The load analysis tables in this appendix were developed using existing shade estimates generated from an aerial photograph taken during the summer of 2009. Solar radiation values from Natural Renewable Energy Laboratories in Spokane, Washington, and Kalispell, Montana, were averaged and used to complete the load calculations.

LIST OF TABLES

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Table J-1. John Creek (AU ID17010304PN009_02) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**John Creek**	
AU# ID17010304PN009_02															
1300	0.8	1.14	0.98	0.114	-1.026	1	1	1300	1482	1300	148.2	-1333.8	-18	Group B	
470	0.9	0.57	0.98	0.114	-0.456	2	2	940	535.8	940	107.16	-428.64	-8	Forest	
840	0.8	1.14	0.98	0.114	-1.026	2	2	1680	1915.2	1680	191.52	-1723.68	-18		
1400	0.8	1.14	0.85	0.855	-0.285	3	3	4200	4788	4200	3591	-1197	-5	St Joe	after 1st
70	0.8	1.14	0.74	1.482	0.342	4	4	280	319.2	280	414.96	95.76	0	Hardwood	after 2nd
300	0.8	1.14	0.74	1.482	0.342	4	4	1200	1368	1200	1778.4	410.4	0		after 3rd
690	0.7	1.71	0.65	1.995	0.285	5	5	3450	5899.5	3450	6882.75	983.25	0		after 4th
740	0.8	1.14	0.65	1.995	0.855	5	5	3700	4218	3700	7381.5	3163.5	0		
1000	0.7	1.71	0.65	1.995	0.285	5	5	5000	8550	5000	9975	1425	0		
120	0.6	2.28	0.58	2.394	0.114	6	6	720	1641.6	720	1723.68	82.08	0		
200	0.6	2.28	0.58	2.394	0.114	6	6	1200	2736	1200	2872.8	136.8	0		after 5th
540	0.5	2.85	0.58	2.394	-0.456	6	6	3240	9234	3240	7756.56	-1477.44	-8		after 6th
70	0.4	3.42	0.58	2.394	-1.026	6	6	420	1436.4	420	1005.48	-430.92	-18		
780	0.6	2.28	0.58	2.394	0.114	6	6	4680	10670.4	4680	11203.92	533.52	0		
250	0.6	2.28	0.52	2.736	0.456	7	7	1750	3990	1750	4788	798	0		after 7th
230	0.5	2.85	0.52	2.736	-0.114	7	7	1610	4588.5	1610	4404.96	-183.54	-2		
530	0.6	2.28	0.52	2.736	0.456	7	7	3710	8458.8	3710	10150.56	1691.76	0		
200	0.5	2.85	0.52	2.736	-0.114	7	7	1400	3990	1400	3830.4	-159.6	-2		
250	0.6	2.28	0.52	2.736	0.456	7	7	1750	3990	1750	4788	798	0		
40	0.6	2.28	0.52	2.736	0.456	7	7	280	638.4	280	766.08	127.68	0		
310	0.6	2.28	0.52	2.736	0.456	7	7	2170	4947.6	2170	5937.12	989.52	0		after 8th
100	0.2	4.56	0.47	3.021	-1.539	8	8	800	3648	800	2416.8	-1231.2	-27		after LJ
1000	0.6	2.28	0.47	3.021	0.741	8	8	8000	18240	8000	24168	5928	0		
950	0.5	2.85	0.43	3.249	0.399	9	9	8550	24367.5	8550	27778.95	3411.45	0		after 9th
700	0.4	3.42	0.43	3.249	-0.171	9	9	6300	21546	6300	20468.7	-1077.3	-3		
470	0.5	2.85	0.83	0.969	-1.881	9	9	4230	12055.5	4230	4098.87	-7956.63	-33	Group B	after Choulson
950	0.7	1.71	0.83	0.969	-0.741	9	9	8550	14620.5	8550	8284.95	-6335.55	-13	Forest	
120	0.5	2.85	0.83	0.969	-1.881	9	9	1080	3078	1080	1046.52	-2031.48	-33		
1300	0.7	1.71	0.83	0.969	-0.741	9	9	11700	20007	11700	11337.3	-8669.7	-13		
							Total	**93,890**	**202,960**	**93,890**	**189,298**	**-13,662**	**-7**		

Table J-2. John Creek tributaries (AU ID17010304PN009_02) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**John Creek Tributaries**	
AU# ID17010304PN009_02															
390	0.9	0.57	0.98	0.114	-0.456	1	1	390	222.3	390	44.46	-177.84	-8	Group B	1st
80	0.8	1.14	0.98	0.114	-1.026	1	1	80	91.2	80	9.12	-82.08	-18	Forest	tributary
580	0.9	0.57	0.98	0.114	-0.456	1	1	580	330.6	580	66.12	-264.48	-8		
1800	0.8	1.14	0.98	0.114	-1.026	2	2	3600	4104	3600	410.4	-3693.6	-18		
1600	0.9	0.57	0.98	0.114	-0.456	1	1	1600	912	1600	182.4	-729.6	-8		2nd
100	0.8	1.14	0.98	0.114	-1.026	2	2	200	228	200	22.8	-205.2	-18		tributary
330	0.9	0.57	0.98	0.114	-0.456	2	2	660	376.2	660	75.24	-300.96	-8		
1100	0.8	1.14	0.98	0.114	-1.026	1	1	1100	1254	1100	125.4	-1128.6	-18		3rd
720	0.9	0.57	0.98	0.114	-0.456	1	1	720	410.4	720	82.08	-328.32	-8		tributary
1900	0.9	0.57	0.94	0.342	-0.228	1	1	1900	1083	1900	649.8	-433.2	-4	St Joe	4th
430	0.8	1.14	0.93	0.399	-0.741	2	2	860	980.4	860	343.14	-637.26	-13	Hardwood	tributary
570	0.5	2.85	0.98	0.114	-2.736	1	1	570	1624.5	570	64.98	-1559.52	-48	Group B	5th
460	0.7	1.71	0.98	0.114	-1.596	1	1	460	786.6	460	52.44	-734.16	-28	Forest	tributary
300	0.5	2.85	0.98	0.114	-2.736	1	1	300	855	300	34.2	-820.8	-48		
660	0.8	1.14	0.98	0.114	-1.026	2	2	1320	1504.8	1320	150.48	-1354.32	-18		
160	0.4	3.42	0.98	0.114	-3.306	2	2	320	1094.4	320	36.48	-1057.92	-58		
670	0.8	1.14	0.98	0.114	-1.026	2	2	1340	1527.6	1340	152.76	-1374.84	-18		
290	0.7	1.71	0.98	0.114	-1.596	1	1	290	495.9	290	33.06	-462.84	-28		6th
160	0.8	1.14	0.98	0.114	-1.026	1	1	160	182.4	160	18.24	-164.16	-18		tributary
1200	0.9	0.57	0.98	0.114	-0.456	2	2	2400	1368	2400	273.6	-1094.4	-8		
770	0.8	1.14	0.98	0.114	-1.026	2	2	1540	1755.6	1540	175.56	-1580.04	-18		
490	0.8	1.14	0.98	0.114	-1.026	1	1	490	558.6	490	55.86	-502.74	-18		7th
360	0.9	0.57	0.98	0.114	-0.456	1	1	360	205.2	360	41.04	-164.16	-8		tributary
1300	0.8	1.14	0.98	0.114	-1.026	2	2	2600	2964	2600	296.4	-2667.6	-18		
590	0.8	1.14	0.95	0.285	-0.855	1	1	590	672.6	590	168.15	-504.45	-15	Group A	8th
890	0.7	1.71	0.95	0.285	-1.425	1	1	890	1521.9	890	253.65	-1268.25	-25	Forest	tributary
1300	0.9	0.57	0.94	0.342	-0.228	2	2	2600	1482	2600	889.2	-592.8	-4		
840	0.8	1.14	0.97	0.171	-0.969	3	3	2520	2872.8	2520	430.92	-2441.88	-17		
600	0.9	0.57	0.94	0.342	-0.228	1	1	600	342	600	205.2	-136.8	-4	St Joe	LittleJohn
870	0.7	1.71	0.94	0.342	-1.368	1	1	870	1487.7	870	297.54	-1190.16	-24	Hardwood	Creek
330	0.8	1.14	0.93	0.399	-0.741	2	2	660	752.4	660	263.34	-489.06	-13		
490	0.9	0.57	0.93	0.399	-0.171	2	2	980	558.6	980	391.02	-167.58	-3		
870	0.8	1.14	0.93	0.399	-0.741	2	2	1740	1983.6	1740	694.26	-1289.34	-13		
130	0.7	1.71	0.85	0.855	-0.855	3	3	390	666.9	390	333.45	-333.45	-15		
270	0.9	0.57	0.85	0.855	0.285	3	3	810	461.7	810	692.55	230.85	0		
60	0.7	1.71	0.85	0.855	-0.855	3	3	180	307.8	180	153.9	-153.9	-15		
2500	0.9	0.57	0.98	0.114	-0.456	2	2	5000	2850	5000	570	-2280	-8		9th tributary
850	0.9	0.57	0.98	0.114	-0.456	1	1	850	484.5	850	96.9	-387.6	-8		Choulson
480	0.8	1.14	0.98	0.114	-1.026	1	1	480	547.2	480	54.72	-492.48	-18		Creek
1300	0.9	0.57	0.98	0.114	-0.456	2	2	2600	1482	2600	296.4	-1185.6	-8		
890	0.8	1.14	0.97	0.171	-0.969	3	3	2670	3043.8	2670	456.57	-2587.23	-17		
							Total	**48,270**	**46,432**	**48,270**	**9,644**	**-36,788**	**-16**		

Table J-3. Upper Santa Creek (AU ID17010304PN010_02/03) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**Santa Creek, headwaters to Charlie Cr**
AU# ID17010304PN010_02														
640	0.9	0.57	0.94	0.342	-0.228	1	1	640	364.8	640	218.88	-145.92	-4	St Joe
1000	0.8	1.14	0.94	0.342	-0.798	1	1	1000	1140	1000	342	-798	-14	Hardwood
320	0.7	1.71	0.93	0.399	-1.311	2	2	640	1094.4	640	255.36	-839.04	-23	
60	0	5.7	0.93	0.399	-5.301	2	2	120	684	120	47.88	-636.12	-93	
430	0.7	1.71	0.93	0.399	-1.311	2	2	860	1470.6	860	343.14	-1127.46	-23	
110	0.5	2.85	0.93	0.399	-2.451	2	2	220	627	220	87.78	-539.22	-43	
540	0.8	1.14	0.93	0.399	-0.741	2	2	1080	1231.2	1080	430.92	-800.28	-13	
250	0.8	1.14	0.85	0.855	-0.285	3	3	750	855	750	641.25	-213.75	-5	after 1st
100	0.7	1.71	0.85	0.855	-0.855	3	3	300	513	300	256.5	-256.5	-15	
30	0	5.7	0.74	1.482	-4.218	4	4	120	684	120	177.84	-506.16	-74	
220	0.7	1.71	0.74	1.482	-0.228	4	4	880	1504.8	880	1304.16	-200.64	-4	
130	0.8	1.14	0.65	1.995	0.855	5	5	650	741	650	1296.75	555.75	0	after SF
570	0.4	3.42	0.65	1.995	-1.425	5	5	2850	9747	2850	5685.75	-4061.25	-25	
190	0.1	5.13	0.65	1.995	-3.135	5	5	950	4873.5	950	1895.25	-2978.25	-55	
							Subtotal	**11,060**	**25,530**	**11,060**	**12,983**	**-12,547**	**-28**	
AU# ID17010304PN010_03														
1200	0	5.7	0.58	2.394	-3.306	6	6	7200	41040	7200	17236.8	-23803.2	-58	after 2nd
910	0.3	3.99	0.52	2.736	-1.254	7	7	6370	25416.3	6370	17428.32	-7987.98	-22	
900	0.3	3.99	0.47	3.021	-0.969	8	8	7200	28728	7200	21751.2	-6976.8	-17	after ramskull
1300	0.2	4.56	0.47	3.021	-1.539	8	8	10400	47424	10400	31418.4	-16005.6	-27	after deep
2200	0.3	3.99	0.43	3.249	-0.741	9	9	19800	79002	19800	64330.2	-14671.8	-13	
210	0.3	3.99	0.43	3.249	-0.741	9	9	1890	7541.1	1890	6140.61	-1400.49	-13	
							Subtotal	**52,860**	**229,151**	**52,860**	**158,306**	**-70,846**	**-25**	
							Total	**63,920**	**254,682**	**63,920**	**171,289**	**-83,393**	**-27**	

Table J-4. Upper Santa Creek tributaries (AU ID17010304PN010_02) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**Upper Santa Creek Tributaries**	
AU# ID17010304PN010_02															
610	0.9	0.57	0.98	0.114	-0.456	1	1	610	347.7	610	69.54	-278.16	-8	Group B	1st
80	0.8	1.14	0.98	0.114	-1.026	1	1	80	91.2	80	9.12	-82.08	-18	Forest	tributary
20	0	5.7	0.98	0.114	-5.586	1	1	20	114	20	2.28	-111.72	-98		
40	0.8	1.14	0.98	0.114	-1.026	1	1	40	45.6	40	4.56	-41.04	-18		
30	0	5.7	0.98	0.114	-5.586	1	1	30	171	30	3.42	-167.58	-98		
30	0.4	3.42	0.98	0.114	-3.306	1	1	30	102.6	30	3.42	-99.18	-58		
30	0	5.7	0.98	0.114	-5.586	1	1	30	171	30	3.42	-167.58	-98		
460	0.8	1.14	0.98	0.114	-1.026	2	2	920	1048.8	920	104.88	-943.92	-18		
380	0.7	1.71	0.98	0.114	-1.596	2	2	760	1299.6	760	86.64	-1212.96	-28		
230	0.8	1.14	0.98	0.114	-1.026	2	2	460	524.4	460	52.44	-471.96	-18		
3600	0.9	0.57	0.98	0.114	-0.456	2	2	7200	4104	7200	820.8	-3283.2	-8		SF Santa
890	0.8	1.14	0.97	0.171	-0.969	3	3	2670	3043.8	2670	456.57	-2587.23	-17		Creek
180	0.9	0.57	0.98	0.114	-0.456	1	1	180	102.6	180	20.52	-82.08	-8		2nd
270	0.8	1.14	0.98	0.114	-1.026	1	1	270	307.8	270	30.78	-277.02	-18		tributary
220	0.9	0.57	0.98	0.114	-0.456	1	1	220	125.4	220	25.08	-100.32	-8		
190	0.8	1.14	0.98	0.114	-1.026	1	1	190	216.6	190	21.66	-194.94	-18		
140	0.9	0.57	0.98	0.114	-0.456	1	1	140	79.8	140	15.96	-63.84	-8		
270	0.8	1.14	0.98	0.114	-1.026	1	1	270	307.8	270	30.78	-277.02	-18		
690	0.9	0.57	0.98	0.114	-0.456	2	2	1380	786.6	1380	157.32	-629.28	-8		
80	0.7	1.71	0.98	0.114	-1.596	2	2	160	273.6	160	18.24	-255.36	-28		
600	0.4	3.42	0.93	0.399	-3.021	2	2	1200	4104	1200	478.8	-3625.2	-53	Hardwood	
450	0.8	1.14	0.98	0.114	-1.026	1	1	450	513	450	51.3	-461.7	-18	Group B	trib to 2nd
880	0.9	0.57	0.98	0.114	-0.456	1	1	880	501.6	880	100.32	-401.28	-8	Forest	tributary
100	0.7	1.71	0.98	0.114	-1.596	1	1	100	171	100	11.4	-159.6	-28		
490	0.9	0.57	0.98	0.114	-0.456	1	1	490	279.3	490	55.86	-223.44	-8		
140	0.7	1.71	0.98	0.114	-1.596	1	1	140	239.4	140	15.96	-223.44	-28		
500	0.9	0.57	0.98	0.114	-0.456	1	1	500	285	500	57	-228	-8		Ramskull
1100	0.8	1.14	0.98	0.114	-1.026	1	1	1100	1254	1100	125.4	-1128.6	-18		Creek
790	0.8	1.14	0.93	0.399	-0.741	2	2	1580	1801.2	1580	630.42	-1170.78	-13	St Joe	
750	0.7	1.71	0.85	0.855	-0.855	3	3	2250	3847.5	2250	1923.75	-1923.75	-15	Hardwood	
620	0.5	2.85	0.74	1.482	-1.368	4	4	2480	7068	2480	3675.36	-3392.64	-24		
1500	0.3	3.99	0.74	1.482	-2.508	4	4	6000	23940	6000	8892	-15048	-44		
1600	0.9	0.57	0.98	0.114	-0.456	1	1	1600	912	1600	182.4	-729.6	-8	Group B	Willow
1100	0.8	1.14	0.98	0.114	-1.026	2	2	2200	2508	2200	250.8	-2257.2	-18	Forest	Creek
110	0.9	0.57	0.98	0.114	-0.456	2	2	220	125.4	220	25.08	-100.32	-8		
1100	0.8	1.14	0.97	0.171	-0.969	3	3	3300	3762	3300	564.3	-3197.7	-17		
470	0.6	2.28	0.97	0.171	-2.109	3	3	1410	3214.8	1410	241.11	-2973.69	-37		
550	0.9	0.57	0.98	0.114	-0.456	1	1	550	313.5	550	62.7	-250.8	-8		Deep
390	0.8	1.14	0.98	0.114	-1.026	1	1	390	444.6	390	44.46	-400.14	-18		Creek
240	0.9	0.57	0.98	0.114	-0.456	1	1	240	136.8	240	27.36	-109.44	-8		
910	0.8	1.14	0.98	0.114	-1.026	1	1	910	1037.4	910	103.74	-933.66	-18		
460	0.7	1.71	0.98	0.114	-1.596	2	2	920	1573.2	920	104.88	-1468.32	-28		
290	0.8	1.14	0.98	0.114	-1.026	2	2	580	661.2	580	66.12	-595.08	-18		
170	0.6	2.28	0.98	0.114	-2.166	2	2	340	775.2	340	38.76	-736.44	-38		
210	0.4	3.42	0.98	0.114	-3.306	2	2	420	1436.4	420	47.88	-1388.52	-58		
500	0.3	3.99	0.98	0.114	-3.876	2	2	1000	3990	1000	114	-3876	-68		
700	0.9	0.57	0.98	0.114	-0.456	1	1	700	399	700	79.8	-319.2	-8		Bob
380	0.8	1.14	0.98	0.114	-1.026	1	1	380	433.2	380	43.32	-389.88	-18		Creek
380	0.9	0.57	0.98	0.114	-0.456	1	1	380	216.6	380	43.32	-173.28	-8		
1300	0.8	1.14	0.98	0.114	-1.026	2	2	2600	2964	2600	296.4	-2667.6	-18		
470	0.6	2.28	0.93	0.399	-1.881	2	2	940	2143.2	940	375.06	-1768.14	-33	St Joe	
250	0.4	3.42	0.93	0.399	-3.021	2	2	500	1710	500	199.5	-1510.5	-53	Hardwood	
							Total	**52,410**	**86,024**	**52,410**	**20,866**	**-65,158**	**-26**		

Table J-5. Lower Santa Creek (AU ID17010304PN010_04) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**Santa Creek, Charlie Cr to mouth**
AU# ID17010304PN010_04														
940	0.4	3.42	0.32	3.876	0.456	13	13	12220	41792.4	12220	47364.72	5572.32	0	St Joe
430	0.3	3.99	0.32	3.876	-0.114	13	13	5590	22304.1	5590	21666.84	-637.26	-2	Hardwood
180	0.1	5.13	0.32	3.876	-1.254	13	13	2340	12004.2	2340	9069.84	-2934.36	-22	
690	0.3	3.99	0.32	3.876	-0.114	13	13	8970	35790.3	8970	34767.72	-1022.58	-2	
260	0.2	4.56	0.32	3.876	-0.684	13	13	3380	15412.8	3380	13100.88	-2311.92	-12	
2000	0.2	4.56	0.3	3.99	-0.57	14	14	28000	127680	28000	111720	-15960	-10	
690	0.3	3.99	0.3	3.99	0	14	14	9660	38543.4	9660	38543.4	0	0	
220	0.2	4.56	0.3	3.99	-0.57	14	14	3080	14044.8	3080	12289.2	-1755.6	-10	
330	0.3	3.99	0.3	3.99	0	14	14	4620	18433.8	4620	18433.8	0	0	
550	0.3	3.99	0.28	4.104	0.114	15	15	8250	32917.5	8250	33858	940.5	0	
530	0.2	4.56	0.28	4.104	-0.456	15	15	7950	36252	7950	32626.8	-3625.2	-8	
2610	0.3	3.99	0.28	4.104	0.114	15	15	39150	156208.5	39150	160671.6	4463.1	0	
260	0.2	4.56	0.28	4.104	-0.456	15	15	3900	17784	3900	16005.6	-1778.4	-8	
450	0.4	3.42	0.28	4.104	0.684	15	15	6750	23085	6750	27702	4617	0	
390	0	5.7	0.27	4.161	-1.539	16	16	6240	35568	6240	25964.64	-9603.36	-27	
190	0.1	5.13	0.27	4.161	-0.969	16	16	3040	15595.2	3040	12649.44	-2945.76	-17	
170	0.3	3.99	0.27	4.161	0.171	16	16	2720	10852.8	2720	11317.92	465.12	0	
950	0.2	4.56	0.27	4.161	-0.399	16	16	15200	69312	15200	63247.2	-6064.8	-7	
340	0	5.7	0.27	4.161	-1.539	16	16	5440	31008	5440	22635.84	-8372.16	-27	
230	0.2	4.56	0.27	4.161	-0.399	16	16	3680	16780.8	3680	15312.48	-1468.32	-7	
530	0.1	5.13	0.27	4.161	-0.969	16	16	8480	43502.4	8480	35285.28	-8217.12	-17	
190	0.2	4.56	0.27	4.161	-0.399	16	16	3040	13862.4	3040	12649.44	-1212.96	-7	
390	0.1	5.13	0.27	4.161	-0.969	16	16	6240	32011.2	6240	25964.64	-6046.56	-17	
150	0	5.7	0.27	4.161	-1.539	16	16	2400	13680	2400	9986.4	-3693.6	-27	
460	0.2	4.56	0.27	4.161	-0.399	16	16	7360	33561.6	7360	30624.96	-2936.64	-7	
340	0.1	5.13	0.27	4.161	-0.969	16	16	5440	27907.2	5440	22635.84	-5271.36	-17	
							Total	**213,140**	**935,894**	**213,140**	**866,094**	**-69,800**	**-10**	

Table J-6. Lower Santa Creek tributaries (AU ID17010304PN010_02) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**Lower Santa Creek Tributaries**	
AU# ID17010304PN010_02															
680	0.4	3.42	0.94	0.342	-3.078	1	1	680	2325.6	680	232.56	-2093.04	-54	St Joe Hardwood	3rd tributary
80	0.5	2.85	0.94	0.342	-2.508	1	1	80	228	80	27.36	-200.64	-44		
1200	0.8	1.14	0.93	0.399	-0.741	2	2	2400	2736	2400	957.6	-1778.4	-13		
520	0.3	3.99	0.93	0.399	-3.591	2	2	1040	4149.6	1040	414.96	-3734.64	-63		
570	0.2	4.56	0.85	0.855	-3.705	3	3	1710	7797.6	1710	1462.05	-6335.55	-65		
190	0.4	3.42	0.85	0.855	-2.565	3	3	570	1949.4	570	487.35	-1462.05	-45		
250	0.5	2.85	0.85	0.855	-1.995	3	3	750	2137.5	750	641.25	-1496.25	-35		
580	0.3	3.99	0.85	0.855	-3.135	3	3	1740	6942.6	1740	1487.7	-5454.9	-55		
1200	0.9	0.57	0.98	0.114	-0.456	1	1	1200	684	1200	136.8	-547.2	-8	Group B Forest	4th tributary
710	0.8	1.14	0.98	0.114	-1.026	2	2	1420	1618.8	1420	161.88	-1456.92	-18		
170	0.5	2.85	0.98	0.114	-2.736	2	2	340	969	340	38.76	-930.24	-48		
210	0.4	3.42	0.98	0.114	-3.306	2	2	420	1436.4	420	47.88	-1388.52	-58		
230	0.9	0.57	0.98	0.114	-0.456	1	1	230	131.1	230	26.22	-104.88	-8		Peterson Creek
560	0.9	0.57	0.95	0.285	-0.285	1	1	560	319.2	560	159.6	-159.6	-5	Group A Forest	
2500	0.9	0.57	0.98	0.114	-0.456	2	2	5000	2850	5000	570	-2280	-8	Group B Forest	
730	0.8	1.14	0.97	0.171	-0.969	3	3	2190	2496.6	2190	374.49	-2122.11	-17		
210	0.7	1.71	0.97	0.171	-1.539	3	3	630	1077.3	630	107.73	-969.57	-27		
550	0.8	1.14	0.97	0.171	-0.969	3	3	1650	1881	1650	282.15	-1598.85	-17		
560	0.7	1.71	0.98	0.114	-1.596	1	1	560	957.6	560	63.84	-893.76	-28		5th tributary
590	0.9	0.57	0.98	0.114	-0.456	1	1	590	336.3	590	67.26	-269.04	-8		
260	0.7	1.71	0.95	0.285	-1.425	1	1	260	444.6	260	74.1	-370.5	-25	Group A Forest	
390	0.3	3.99	0.98	0.114	-3.876	2	2	780	3112.2	780	88.92	-3023.28	-68	Group B Forest	
710	0.8	1.14	0.98	0.114	-1.026	2	2	1420	1618.8	1420	161.88	-1456.92	-18		
170	0.4	3.42	0.98	0.114	-3.306	2	2	340	1162.8	340	38.76	-1124.04	-58		
330	0.6	2.28	0.98	0.114	-2.166	2	2	660	1504.8	660	75.24	-1429.56	-38		
140	0.4	3.42	0.98	0.114	-3.306	2	2	280	957.6	280	31.92	-925.68	-58		
260	0.8	1.14	0.98	0.114	-1.026	1	1	260	296.4	260	29.64	-266.76	-18		6th tributary
100	0.7	1.71	0.98	0.114	-1.596	1	1	100	171	100	11.4	-159.6	-28		
130	0.5	2.85	0.98	0.114	-2.736	1	1	130	370.5	130	14.82	-355.68	-48		
510	0.7	1.71	0.98	0.114	-1.596	2	2	1020	1744.2	1020	116.28	-1627.92	-28		
410	0.3	3.99	0.98	0.114	-3.876	2	2	820	3271.8	820	93.48	-3178.32	-68		
310	0.4	3.42	0.98	0.114	-3.306	2	2	620	2120.4	620	70.68	-2049.72	-58		
500	0.9	0.57	0.98	0.114	-0.456	1	1	500	285	500	57	-228	-8		7th tributary
410	0.6	2.28	0.95	0.285	-1.995	1	1	410	934.8	410	116.85	-817.95	-35	Group A Forest	
500	0.5	2.85	0.95	0.285	-2.565	1	1	500	1425	500	142.5	-1282.5	-45		
1600	0.7	1.71	0.98	0.114	-1.596	2	2	3200	5472	3200	364.8	-5107.2	-28	Group B Forest	
60	0.5	2.85	0.98	0.114	-2.736	2	2	120	342	120	13.68	-328.32	-48		
150	0.9	0.57	0.95	0.285	-0.285	1	1	150	85.5	150	42.75	-42.75	-5	Group A Forest	8th tributary
450	0.8	1.14	0.98	0.114	-1.026	1	1	450	513	450	51.3	-461.7	-18	Group B Forest	
240	0.5	2.85	0.98	0.114	-2.736	1	1	240	684	240	27.36	-656.64	-48		
120	0.4	3.42	0.98	0.114	-3.306	1	1	120	410.4	120	13.68	-396.72	-58		
250	0.6	2.28	0.98	0.114	-2.166	1	1	250	570	250	28.5	-541.5	-38		
380	0.4	3.42	0.98	0.114	-3.306	1	1	380	1299.6	380	43.32	-1256.28	-58		
180	0.3	3.99	0.98	0.114	-3.876	1	1	180	718.2	180	20.52	-697.68	-68		
390	0.9	0.57	0.98	0.114	-0.456	1	1	390	222.3	390	44.46	-177.84	-8		9th tributary
1000	0.9	0.57	0.95	0.285	-0.285	1	1	1000	570	1000	285	-285	-5	Group A Forest	
60	0.4	3.42	0.95	0.285	-3.135	1	1	60	205.2	60	17.1	-188.1	-55		
180	0.6	2.28	0.95	0.285	-1.995	1	1	180	410.4	180	51.3	-359.1	-35		
							Total	**38,580**	**73,946**	**38,580**	**9,875**	**-64,071**	**-35**		

Table J-7. Charlie Creek (AU ID17010304PN011_02/03) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**Charlie Creek**	
AU# ID17010304PN011_02															
340	0.9	0.57	0.98	0.114	-0.456	1	1	340	193.8	340	38.76	-155.04	-8	Group B	
590	0.7	1.71	0.98	0.114	-1.596	1	1	590	1008.9	590	67.26	-941.64	-28	Forest	
820	0.9	0.57	0.98	0.114	-0.456	2	2	1640	934.8	1640	186.96	-747.84	-8		
1610	0.8	1.14	0.97	0.171	-0.969	3	3	4830	5506.2	4830	825.93	-4680.27	-17		
230	0.9	0.57	0.97	0.171	-0.399	3	3	690	393.3	690	117.99	-275.31	-7		
90	0.6	2.28	0.96	0.228	-2.052	4	4	360	820.8	360	82.08	-738.72	-36		
420	0.7	1.71	0.96	0.228	-1.482	4	4	1680	2872.8	1680	383.04	-2489.76	-26		
360	0.6	2.28	0.96	0.228	-2.052	4	4	1440	3283.2	1440	328.32	-2954.88	-36		
140	0.7	1.71	0.96	0.228	-1.482	4	4	560	957.6	560	127.68	-829.92	-26		
540	0.6	2.28	0.65	1.995	-0.285	5	5	2700	6156	2700	5386.5	-769.5	-5	St Joe	after Preston
470	0.7	1.71	0.65	1.995	0.285	5	5	2350	4018.5	2350	4688.25	669.75	0	Hardwood	
							Subtotal	**17,180**	**26,146**	**17,180**	**12,233**	**-13,913**	**-18**		
AU# ID17010304PN011_03															
170	0.4	3.42	0.47	3.021	-0.399	8	8	1360	4651.2	1360	4108.56	-542.64	-7		after EF
300	0.1	5.13	0.47	3.021	-2.109	8	8	2400	12312	2400	7250.4	-5061.6	-37		
560	0	5.7	0.47	3.021	-2.679	8	8	4480	25536	4480	13534.08	-12001.92	-47		after Short
620	0.2	4.56	0.47	3.021	-1.539	8	8	4960	22617.6	4960	14984.16	-7633.44	-27		
490	0.4	3.42	0.43	3.249	-0.171	9	9	4410	15082.2	4410	14328.09	-754.11	-3		
380	0.2	4.56	0.43	3.249	-1.311	9	9	3420	15595.2	3420	11111.58	-4483.62	-23		
110	0.4	3.42	0.43	3.249	-0.171	9	9	990	3385.8	990	3216.51	-169.29	-3		after Hume
470	0.2	4.56	0.43	3.249	-1.311	9	9	4230	19288.8	4230	13743.27	-5545.53	-23		
400	0.3	3.99	0.43	3.249	-0.741	9	9	3600	14364	3600	11696.4	-2667.6	-13		after Ells
230	0.2	4.56	0.4	3.42	-1.14	10	10	2300	10488	2300	7866	-2622	-20		
500	0.3	3.99	0.4	3.42	-0.57	10	10	5000	19950	5000	17100	-2850	-10		
360	0.4	3.42	0.4	3.42	0	10	10	3600	12312	3600	12312	0	0		
440	0.3	3.99	0.4	3.42	-0.57	10	10	4400	17556	4400	15048	-2508	-10		
240	0.4	3.42	0.4	3.42	0	10	10	2400	8208	2400	8208	0	0		
							Subtotal	**47,550**	**201,347**	**47,550**	**154,507**	**-46,840**	**-16**		
							Total	**64,730**	**227,493**	**64,730**	**166,740**	**-60,753**	**-17**		

Table J-8. Charlie Creek tributaries (AU ID17010304PN011_02) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**Charlie Creek Tributaries**	
AU# ID17010304PN011_02															
380	0.8	1.14	0.98	0.114	-1.026	1	1	380	433.2	380	43.32	-389.88	-18	Group B	Preston
2800	0.9	0.57	0.98	0.114	-0.456	2	2	5600	3192	5600	638.4	-2553.6	-8	Forest	Creek
700	0.8	1.14	0.98	0.114	-1.026	2	2	1400	1596	1400	159.6	-1436.4	-18		
190	0.7	1.71	0.98	0.114	-1.596	2	2	380	649.8	380	43.32	-606.48	-28		
1400	0.9	0.57	0.98	0.114	-0.456	1	1	1400	798	1400	159.6	-638.4	-8		Short
470	0.7	1.71	0.98	0.114	-1.596	1	1	470	803.7	470	53.58	-750.12	-28		Creek
280	0.2	4.56	0.98	0.114	-4.446	1	1	280	1276.8	280	31.92	-1244.88	-78		
890	0.9	0.57	0.98	0.114	-0.456	1	1	890	507.3	890	101.46	-405.84	-8		Hume
500	0.8	1.14	0.98	0.114	-1.026	1	1	500	570	500	57	-513	-18		Creek
220	0.9	0.57	0.98	0.114	-0.456	1	1	220	125.4	220	25.08	-100.32	-8		
950	0.8	1.14	0.93	0.399	-0.741	2	2	1900	2166	1900	758.1	-1407.9	-13	St Joe	
220	0.9	0.57	0.93	0.399	-0.171	2	2	440	250.8	440	175.56	-75.24	-3	Hardwood	
1400	0.8	1.14	0.85	0.855	-0.285	3	3	4200	4788	4200	3591	-1197	-5		
590	0.7	1.71	0.85	0.855	-0.855	3	3	1770	3026.7	1770	1513.35	-1513.35	-15		
130	0.9	0.57	0.85	0.855	0.285	3	3	390	222.3	390	333.45	111.15	0		
250	0.3	3.99	0.85	0.855	-3.135	3	3	750	2992.5	750	641.25	-2351.25	-55		
90	0.5	2.85	0.85	0.855	-1.995	3	3	270	769.5	270	230.85	-538.65	-35		
2500	0.9	0.57	0.98	0.114	-0.456	1	1	2500	1425	2500	285	-1140	-8	Group B	Ells
230	0.8	1.14	0.98	0.114	-1.026	2	2	460	524.4	460	52.44	-471.96	-18	Forest	Creek
460	0.3	3.99	0.98	0.114	-3.876	2	2	920	3670.8	920	104.88	-3565.92	-68		
							Total	**25,120**	**29,788**	**25,120**	**8,999**	**-20,789**	**-22**		

Table J-9. East Fork Charlie Creek (AU ID17010304PN011_02/03) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**EF Charlie Creek**	
AU# ID17010304PN011_02															
1300	0.9	0.57	0.98	0.114	-0.456	1	1	1300	741	1300	148.2	-592.8	-8	Group B	
380	0.8	1.14	0.98	0.114	-1.026	1	1	380	433.2	380	43.32	-389.88	-18	Forest	
440	0.9	0.57	0.98	0.114	-0.456	2	2	880	501.6	880	100.32	-401.28	-8		
1200	0.9	0.57	0.98	0.114	-0.456	2	2	2400	1368	2400	273.6	-1094.4	-8		after Lemoosh
740	0.8	1.14	0.97	0.171	-0.969	3	3	2220	2530.8	2220	379.62	-2151.18	-17		
1000	0.7	1.71	0.97	0.171	-1.539	3	3	3000	5130	3000	513	-4617	-27		
							Subtotal	**10,180**	**10,705**	**10,180**	**1,458**	**-9,247**	**-14**		
AU# ID17010304PN011_03															
580	0.6	2.28	0.65	1.995	-0.285	5	5	2900	6612	2900	5785.5	-826.5	-5	St Joe	after Eena
140	0.5	2.85	0.65	1.995	-0.855	5	5	700	1995	700	1396.5	-598.5	-15	Hardwood	
170	0.6	2.28	0.65	1.995	-0.285	5	5	850	1938	850	1695.75	-242.25	-5		
500	0.7	1.71	0.65	1.995	0.285	5	5	2500	4275	2500	4987.5	712.5	0		after Moolock
620	0.4	3.42	0.58	2.394	-1.026	6	6	3720	12722.4	3720	8905.68	-3816.72	-18		after Lacy
990	0.5	2.85	0.58	2.394	-0.456	6	6	5940	16929	5940	14220.36	-2708.64	-8		
210	0.4	3.42	0.58	2.394	-1.026	6	6	1260	4309.2	1260	3016.44	-1292.76	-18		
220	0.5	2.85	0.52	2.736	-0.114	7	7	1540	4389	1540	4213.44	-175.56	-2		after Brown
230	0.3	3.99	0.52	2.736	-1.254	7	7	1610	6423.9	1610	4404.96	-2018.94	-22		
160	0.2	4.56	0.52	2.736	-1.824	7	7	1120	5107.2	1120	3064.32	-2042.88	-32		after Pamas
240	0.4	3.42	0.52	2.736	-0.684	7	7	1680	5745.6	1680	4596.48	-1149.12	-12		
							Subtotal	**23,820**	**70,446**	**23,820**	**56,287**	**-14,159**	**-12**		
							Total	**34,000**	**81,151**	**34,000**	**57,745**	**-23,406**	**-13**		

Table J-10. East Fork Charlie Creek tributaries (AU ID17010304PN011_02) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**EF Charlie Creek Tributaries**	
AU# ID17010304PN011_02															
1500	0.9	0.57	0.98	0.114	-0.456	1	1	1500	855	1500	171	-684	-8	Group B	Lemoosh Cr
2800	0.9	0.57	0.98	0.114	-0.456	2	2	5600	3192	5600	638.4	-2553.6	-8	Forest	Eena Cr
330	0.8	1.14	0.98	0.114	-1.026	1	1	330	376.2	330	37.62	-338.58	-18		after Kimta
120	0.8	1.14	0.98	0.114	-1.026	2	2	240	273.6	240	27.36	-246.24	-18		after Katsuck
290	0.9	0.57	0.98	0.114	-0.456	2	2	580	330.6	580	66.12	-264.48	-8		
530	0.9	0.57	0.97	0.171	-0.399	3	3	1590	906.3	1590	271.89	-634.41	-7		after Elip
320	0.9	0.57	0.98	0.114	-0.456	1	1	320	182.4	320	36.48	-145.92	-8		Kimta Cr
110	0.6	2.28	0.98	0.114	-2.166	1	1	110	250.8	110	12.54	-238.26	-38		
970	0.9	0.57	0.98	0.114	-0.456	1	1	970	552.9	970	110.58	-442.32	-8		
1700	0.9	0.57	0.98	0.114	-0.456	1	1	1700	969	1700	193.8	-775.2	-8		Katsuck Cr
2900	0.9	0.57	0.98	0.114	-0.456	2	2	5800	3306	5800	661.2	-2644.8	-8		Elip Cr
3200	0.9	0.57	0.98	0.114	-0.456	1	1	3200	1824	3200	364.8	-1459.2	-8		Moolock Cr
180	0.8	1.14	0.98	0.114	-1.026	2	2	360	410.4	360	41.04	-369.36	-18		
3300	0.9	0.57	0.98	0.114	-0.456	1	1	3300	1881	3300	376.2	-1504.8	-8		Lacy Cr
170	0.8	1.14	0.98	0.114	-1.026	2	2	340	387.6	340	38.76	-348.84	-18		
170	0.9	0.57	0.98	0.114	-0.456	2	2	340	193.8	340	38.76	-155.04	-8		
90	0.6	2.28	0.98	0.114	-2.166	2	2	180	410.4	180	20.52	-389.88	-38		
2300	0.9	0.57	0.98	0.114	-0.456	1	1	2300	1311	2300	262.2	-1048.8	-8		Fagan Cr
400	0.8	1.14	0.98	0.114	-1.026	2	2	800	912	800	91.2	-820.8	-18		
590	0.9	0.57	0.98	0.114	-0.456	1	1	590	336.3	590	67.26	-269.04	-8		Brown Cr
300	0.8	1.14	0.98	0.114	-1.026	1	1	300	342	300	34.2	-307.8	-18		
1100	0.9	0.57	0.98	0.114	-0.456	1	1	1100	627	1100	125.4	-501.6	-8		
240	0.7	1.71	0.98	0.114	-1.596	1	1	240	410.4	240	27.36	-383.04	-28		
120	0.8	1.14	0.98	0.114	-1.026	1	1	120	136.8	120	13.68	-123.12	-18		
170	0.7	1.71	0.98	0.114	-1.596	1	1	170	290.7	170	19.38	-271.32	-28		
260	0.6	2.28	0.98	0.114	-2.166	1	1	260	592.8	260	29.64	-563.16	-38		
1900	0.9	0.57	0.98	0.114	-0.456	1	1	1900	1083	1900	216.6	-866.4	-8		Pamas Cr
120	0.8	1.14	0.98	0.114	-1.026	1	1	120	136.8	120	13.68	-123.12	-18		
630	0.9	0.57	0.98	0.114	-0.456	1	1	630	359.1	630	71.82	-287.28	-8		
270	0.7	1.71	0.98	0.114	-1.596	1	1	270	461.7	270	30.78	-430.92	-28		
300	0.5	2.85	0.98	0.114	-2.736	1	1	300	855	300	34.2	-820.8	-48		
							Total	**35,560**	**24,157**	**35,560**	**4,144**	**-20,012**	**-17**		

Table J-11. Tyson Creek (AU ID17010304PN013_02/03) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**Tyson Creek**	
AU# ID17010304PN013_02															
2800	0.9	0.57	0.98	0.114	-0.456	2	2	5600	3192	5600	638.4	-2553.6	-8	Group B	
520	0.8	1.14	0.97	0.171	-0.969	3	3	1560	1778.4	1560	266.76	-1511.64	-17	Forest	
370	0.8	1.14	0.85	0.855	-0.285	3	3	1110	1265.4	1110	949.05	-316.35	-5	St Joe	after 1st
770	0.7	1.71	0.85	0.855	-0.855	3	3	2310	3950.1	2310	1975.05	-1975.05	-15	Hardwood	
400	0.5	2.85	0.74	1.482	-1.368	4	4	1600	4560	1600	2371.2	-2188.8	-24		
990	0.5	2.85	0.74	1.482	-1.368	4	4	3960	11286	3960	5868.72	-5417.28	-24		after 2nd
							Subtotal	**16,140**	**26,032**	**16,140**	**12,069**	**-13,963**	**-16**		
AU# ID17010304PN013_03															
160	0.5	2.85	0.74	1.482	-1.368	4	4	640	1824	640	948.48	-875.52	-24		after 3rd
90	0.5	2.85	0.58	2.394	-0.456	6	6	540	1539	540	1292.76	-246.24	-8		after NF
1100	0.2	4.56	0.58	2.394	-2.166	6	6	6600	30096	6600	15800.4	-14295.6	-38		
430	0	5.7	0.58	2.394	-3.306	6	6	2580	14706	2580	6176.52	-8529.48	-58		
360	0.6	2.28	0.58	2.394	0.114	6	6	2160	4924.8	2160	5171.04	246.24	0		
980	0.5	2.85	0.58	2.394	-0.456	6	6	5880	16758	5880	14076.72	-2681.28	-8		
340	0.8	1.14	0.58	2.394	1.254	6	6	2040	2325.6	2040	4883.76	2558.16	0		
							Subtotal	**20,440**	**72,173**	**20,440**	**48,350**	**-23,824**	**-19**		
							Total	**36,580**	**98,205**	**36,580**	**60,419**	**-37,786**	**-18**		

Table J-12. Tyson Creek tributaries (AU ID17010304PN013_02) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**Tyson Creek Tributaries**	
AU# ID17010304PN013_02															
1600	0.9	0.57	0.98	0.114	-0.456	1	1	1600	912	1600	182.4	-729.6	-8	Group B	1st tributary
680	0.7	1.71	0.98	0.114	-1.596	1	1	680	1162.8	680	77.52	-1085.28	-28	Forest	2nd tributary
490	0.9	0.57	0.98	0.114	-0.456	1	1	490	279.3	490	55.86	-223.44	-8		
930	0.8	1.14	0.98	0.114	-1.026	2	2	1860	2120.4	1860	212.04	-1908.36	-18		
200	0.5	2.85	0.98	0.114	-2.736	2	2	400	1140	400	45.6	-1094.4	-48		
1700	0.9	0.57	0.98	0.114	-0.456	1	1	1700	969	1700	193.8	-775.2	-8		3rd tributary
620	0.8	1.14	0.95	0.285	-0.855	1	1	620	706.8	620	176.7	-530.1	-15	Group A	
1800	0.9	0.57	0.98	0.114	-0.456	1	1	1800	1026	1800	205.2	-820.8	-8	Group B	NF Tyson
1100	0.8	1.14	0.98	0.114	-1.026	2	2	2200	2508	2200	250.8	-2257.2	-18	Forest	
550	0.6	2.28	0.85	0.855	-1.425	3	3	1650	3762	1650	1410.75	-2351.25	-25	St Joe	
740	0.7	1.71	0.85	0.855	-0.855	3	3	2220	3796.2	2220	1898.1	-1898.1	-15	Hardwood	
960	0.6	2.28	0.74	1.482	-0.798	4	4	3840	8755.2	3840	5690.88	-3064.32	-14		
160	0.5	2.85	0.74	1.482	-1.368	4	4	640	1824	640	948.48	-875.52	-24		
120	0.7	1.71	0.74	1.482	-0.228	4	4	480	820.8	480	711.36	-109.44	-4		
2100	0.9	0.57	0.98	0.114	-0.456	2	2	4200	2394	4200	478.8	-1915.2	-8	Group B	1st to NF
530	0.9	0.57	0.98	0.114	-0.456	1	1	530	302.1	530	60.42	-241.68	-8	Forest	2nd to NF
420	0.8	1.14	0.98	0.114	-1.026	1	1	420	478.8	420	47.88	-430.92	-18		
430	0.6	2.28	0.95	0.285	-1.995	1	1	430	980.4	430	122.55	-857.85	-35	Group A	
950	0.7	1.71	0.98	0.114	-1.596	2	2	1900	3249	1900	216.6	-3032.4	-28	Group B	
610	0.8	1.14	0.98	0.114	-1.026	2	2	1220	1390.8	1220	139.08	-1251.72	-18	Forest	
180	0.7	1.71	0.93	0.399	-1.311	2	2	360	615.6	360	143.64	-471.96	-23	Hardwood	
							Total	**29,240**	**39,193**	**29,240**	**13,268**	**-25,925**	**-18**		

Table J-13. Carpenter Creek (AU ID17010304PN014_02/03) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**Carpenter Creek**	
AU# ID17010304PN014_02															
2500	0.9	0.57	0.98	0.114	-0.456	2	2	5000	2850	5000	570	-2280	-8	Forest	
550	0.8	1.14	0.98	0.114	-1.026	2	2	1100	1254	1100	125.4	-1128.6	-18	Group B	after 1st
390	0.9	0.57	0.97	0.171	-0.399	3	3	1170	666.9	1170	200.07	-466.83	-7		after 2nd
90	0.8	1.14	0.97	0.171	-0.969	3	3	270	307.8	270	46.17	-261.63	-17		
350	0.9	0.57	0.97	0.171	-0.399	3	3	1050	598.5	1050	179.55	-418.95	-7		
470	0.7	1.71	0.97	0.171	-1.539	3	3	1410	2411.1	1410	241.11	-2169.99	-27		
570	0.2	4.56	0.97	0.171	-4.389	3	3	1710	7797.6	1710	292.41	-7505.19	-77		
190	0.3	3.99	0.74	1.482	-2.508	4	4	760	3032.4	760	1126.32	-1906.08	-44	St Joe	after Heineman
420	0	5.7	0.74	1.482	-4.218	4	4	1680	9576	1680	2489.76	-7086.24	-74	Hardwood	
340	0.5	2.85	0.74	1.482	-1.368	4	4	1360	3876	1360	2015.52	-1860.48	-24		
260	0.8	1.14	0.74	1.482	0.342	4	4	1040	1185.6	1040	1541.28	355.68	0		
590	0.7	1.71	0.74	1.482	-0.228	4	4	2360	4035.6	2360	3497.52	-538.08	-4		
80	0.1	5.13	0.65	1.995	-3.135	5	5	400	2052	400	798	-1254	-55		
1100	0.4	3.42	0.65	1.995	-1.425	5	5	5500	18810	5500	10972.5	-7837.5	-25		
760	0	5.7	0.65	1.995	-3.705	5	5	3800	21660	3800	7581	-14079	-65		after 3rd
280	0.6	2.28	0.65	1.995	-0.285	5	5	1400	3192	1400	2793	-399	-5		
710	0.5	2.85	0.65	1.995	-0.855	5	5	3550	10117.5	3550	7082.25	-3035.25	-15		
100	0.3	3.99	0.65	1.995	-1.995	5	5	500	1995	500	997.5	-997.5	-35		after 4th
1100	0	5.7	0.58	2.394	-3.306	6	6	6600	37620	6600	15800.4	-21819.6	-58		
220	0.6	2.28	0.58	2.394	0.114	6	6	1320	3009.6	1320	3160.08	150.48	0		
810	0.3	3.99	0.58	2.394	-1.596	6	6	4860	19391.4	4860	11634.84	-7756.56	-28		
520	0.6	2.28	0.58	2.394	0.114	6	6	3120	7113.6	3120	7469.28	355.68	0		
							Subtotal	**49,960**	**162,553**	**49,960**	**80,614**	**-81,939**	**-27**		
AU# ID17010304PN014_03															
200	0.5	2.85	0.52	2.736	-0.114	7	7	1400	3990	1400	3830.4	-159.6	-2		after Little
200	0.2	4.56	0.52	2.736	-1.824	7	7	1400	6384	1400	3830.4	-2553.6	-32		
350	0.4	3.42	0.52	2.736	-0.684	7	7	2450	8379	2450	6703.2	-1675.8	-12		
890	0.6	2.28	0.47	3.021	0.741	8	8	7120	16233.6	7120	21509.52	5275.92	0		
							Subtotal	**12,370**	**34,987**	**12,370**	**35,874**	**887**	**-12**		
							Total	**62,330**	**197,539**	**62,330**	**116,487**	**-81,052**	**-25**		

Table J-14. Carpenter Creek tributaries (ID AU17010304PN014_02) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**Carpenter Creek Tributaries**	
AU# ID17010304PN014_02															
610	0.9	0.57	0.98	0.114	-0.456	1	1	610	347.7	610	69.54	-278.16	-8	Forest Group B	1st tributary
1100	0.8	1.14	0.98	0.114	-1.026	1	1	1100	1254	1100	125.4	-1128.6	-18		
530	0.9	0.57	0.98	0.114	-0.456	2	2	1060	604.2	1060	120.84	-483.36	-8		
330	0.8	1.14	0.98	0.114	-1.026	2	2	660	752.4	660	75.24	-677.16	-18		
1100	0.8	1.14	0.94	0.342	-0.798	1	1	1100	1254	1100	376.2	-877.8	-14	St Joe Hardwood	2nd tributary
740	0.9	0.57	0.98	0.114	-0.456	1	1	740	421.8	740	84.36	-337.44	-8	Forest Group B	
850	0.8	1.14	0.98	0.114	-1.026	2	2	1700	1938	1700	193.8	-1744.2	-18		
250	0.9	0.57	0.98	0.114	-0.456	2	2	500	285	500	57	-228	-8		
3200	0.9	0.57	0.98	0.114	-0.456	2	2	6400	3648	6400	729.6	-2918.4	-8		Heineman Cr
70	0.3	3.99	0.98	0.114	-3.876	2	2	140	558.6	140	15.96	-542.64	-68		
1700	0.9	0.57	0.98	0.114	-0.456	1	1	1700	969	1700	193.8	-775.2	-8		3rd tributary
70	0	5.7	0.98	0.114	-5.586	1	1	70	399	70	7.98	-391.02	-98		
1470	0.9	0.57	0.98	0.114	-0.456	1	1	1470	837.9	1470	167.58	-670.32	-8		4th tributary
220	0.1	5.13	0.94	0.342	-4.788	1	1	220	1128.6	220	75.24	-1053.36	-84	St Joe Hardwood	
2000	0.9	0.57	0.98	0.114	-0.456	1	1	2000	1140	2000	228	-912	-8	Forest Group B	5th tributary
120	0.3	3.99	0.98	0.114	-3.876	1	1	120	478.8	120	13.68	-465.12	-68		
							Total	**19,590**	**16,017**	**19,590**	**2,534**	**-13,483**	**-28**		

Table J-15. Little Carpenter Creek and tributaries (ID AU17010304PN014_02) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**Little Carpenter Creek & Tributaries**	
AU# ID17010304PN014_02															
1300	0.9	0.57	0.98	0.114	-0.456	1	1	1300	741	1300	148.2	-592.8	-8	Forest Group B	1st tributary
450	0.8	1.14	0.98	0.114	-1.026	1	1	450	513	450	51.3	-461.7	-18		
680	0.9	0.57	0.98	0.114	-0.456	1	1	680	387.6	680	77.52	-310.08	-8		2nd tributary
1600	0.8	1.14	0.98	0.114	-1.026	1	1	1600	1824	1600	182.4	-1641.6	-18		
140	0.9	0.57	0.98	0.114	-0.456	2	2	280	159.6	280	31.92	-127.68	-8		
130	0.4	3.42	0.93	0.399	-3.021	2	2	260	889.2	260	103.74	-785.46	-53	St Joe Hardwood	
290	0.7	1.71	0.93	0.399	-1.311	2	2	580	991.8	580	231.42	-760.38	-23		
370	0.8	1.14	0.98	0.114	-1.026	1	1	370	421.8	370	42.18	-379.62	-18	Forest Group B	3rd tributary
50	0	5.7	0.98	0.114	-5.586	30	1	1500	8550	50	5.7	-8544.3	-98	water	
1100	0.8	1.14	0.98	0.114	-1.026	1	1	1100	1254	1100	125.4	-1128.6	-18	Forest Group B	
120	0.2	4.56	0.94	0.342	-4.218	1	1	120	547.2	120	41.04	-506.16	-74	Hardwood	
670	0.1	5.13	0.94	0.342	-4.788	1	1	670	3437.1	670	229.14	-3207.96	-84		
950	0.9	0.57	0.98	0.114	-0.456	1	1	950	541.5	950	108.3	-433.2	-8	Forest Group B	4th tributary
540	0.8	1.14	0.98	0.114	-1.026	1	1	540	615.6	540	61.56	-554.04	-18		
550	0	5.7	0.94	0.342	-5.358	1	1	550	3135	550	188.1	-2946.9	-94	Hardwood	
3100	0.9	0.57	0.98	0.114	-0.456	1	1	3100	1767	3100	353.4	-1413.6	-8	Forest Group B	Little Carpenter
660	0.8	1.14	0.98	0.114	-1.026	2	2	1320	1504.8	1320	150.48	-1354.32	-18		
410	0.7	1.71	0.93	0.399	-1.311	2	2	820	1402.2	820	327.18	-1075.02	-23	Hardwood	
1000	0.8	1.14	0.85	0.855	-0.285	3	3	3000	3420	3000	2565	-855	-5		after 1st
350	0.7	1.71	0.85	0.855	-0.855	3	3	1050	1795.5	1050	897.75	-897.75	-15		
160	0.6	2.28	0.85	0.855	-1.425	3	3	480	1094.4	480	410.4	-684	-25		after 2nd
570	0.5	2.85	0.85	0.855	-1.995	3	3	1710	4873.5	1710	1462.05	-3411.45	-35		
150	0	5.7	0.74	1.482	-4.218	4	4	600	3420	600	889.2	-2530.8	-74		after 3rd
280	0.5	2.85	0.74	1.482	-1.368	4	4	1120	3192	1120	1659.84	-1532.16	-24		
680	0	5.7	0.74	1.482	-4.218	4	4	2720	15504	2720	4031.04	-11472.96	-74		
170	0.6	2.28	0.74	1.482	-0.798	4	4	680	1550.4	680	1007.76	-542.64	-14		
50	0.5	2.85	0.65	1.995	-0.855	5	5	250	712.5	250	498.75	-213.75	-15		after 4th
560	0	5.7	0.65	1.995	-3.705	5	5	2800	15960	2800	5586	-10374	-65		
440	0.4	3.42	0.65	1.995	-1.425	5	5	2200	7524	2200	4389	-3135	-25		
							Total	**32,800**	**87,729**	**31,350**	**25,856**	**-61,873**	**-33**		

Table J-16. West Fork Emerald Creek and tributaries (AU ID17010304PN016_02) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**WF Emerald Creek & Tributaries**	
AU# ID17010304PN016_02															
570	0.9	0.57	0.98	0.114	-0.456	1	1	570	324.9	570	64.98	-259.92	-8	Forest	1st tributary
110	0.8	1.14	0.98	0.114	-1.026	1	1	110	125.4	110	12.54	-112.86	-18	Group B	
800	0.9	0.57	0.98	0.114	-0.456	1	1	800	456	800	91.2	-364.8	-8		
290	0.8	1.14	0.98	0.114	-1.026	1	1	290	330.6	290	33.06	-297.54	-18		
370	0.9	0.57	0.98	0.114	-0.456	1	1	370	210.9	370	42.18	-168.72	-8		
90	0.7	1.71	0.98	0.114	-1.596	1	1	90	153.9	90	10.26	-143.64	-28		
780	0.9	0.57	0.98	0.114	-0.456	1	1	780	444.6	780	88.92	-355.68	-8		2nd tributary
560	0.8	1.14	0.98	0.114	-1.026	1	1	560	638.4	560	63.84	-574.56	-18		
520	0.9	0.57	0.98	0.114	-0.456	1	1	520	296.4	520	59.28	-237.12	-8		
1900	0.9	0.57	0.98	0.114	-0.456	2	2	3800	2166	3800	433.2	-1732.8	-8		3rd tributary
350	0.9	0.57	0.98	0.114	-0.456	1	1	350	199.5	350	39.9	-159.6	-8		4th tributary
390	0.8	1.14	0.98	0.114	-1.026	1	1	390	444.6	390	44.46	-400.14	-18		
1200	0.9	0.57	0.98	0.114	-0.456	1	1	1200	684	1200	136.8	-547.2	-8		
1100	0.9	0.57	0.98	0.114	-0.456	1	1	1100	627	1100	125.4	-501.6	-8		5th tributary
360	0.8	1.14	0.98	0.114	-1.026	1	1	360	410.4	360	41.04	-369.36	-18		
410	0.9	0.57	0.98	0.114	-0.456	1	1	410	233.7	410	46.74	-186.96	-8		
320	0.8	1.14	0.98	0.114	-1.026	1	1	320	364.8	320	36.48	-328.32	-18		
460	0.9	0.57	0.98	0.114	-0.456	1	1	460	262.2	460	52.44	-209.76	-8		
630	0.9	0.57	0.98	0.114	-0.456	1	1	630	359.1	630	71.82	-287.28	-8		WF Emerald
380	0.8	1.14	0.98	0.114	-1.026	1	1	380	433.2	380	43.32	-389.88	-18		
180	0.9	0.57	0.98	0.114	-0.456	1	1	180	102.6	180	20.52	-82.08	-8		
940	0.8	1.14	0.98	0.114	-1.026	2	2	1880	2143.2	1880	214.32	-1928.88	-18		
1010	0.7	1.71	0.98	0.114	-1.596	2	2	2020	3454.2	2020	230.28	-3223.92	-28		after 1st
1500	0.7	1.71	0.97	0.171	-1.539	3	3	4500	7695	4500	769.5	-6925.5	-27		after 2nd
290	0.6	2.28	0.97	0.171	-2.109	3	3	870	1983.6	870	148.77	-1834.83	-37		
570	0.7	1.71	0.96	0.228	-1.482	4	4	2280	3898.8	2280	519.84	-3378.96	-26		
390	0.9	0.57	0.96	0.228	-0.342	4	4	1560	889.2	1560	355.68	-533.52	-6		
660	0.8	1.14	0.96	0.228	-0.912	4	4	2640	3009.6	2640	601.92	-2407.68	-16		
940	0.9	0.57	0.96	0.228	-0.342	4	4	3760	2143.2	3760	857.28	-1285.92	-6		
230	0.9	0.57	0.94	0.342	-0.228	5	5	1150	655.5	1150	393.3	-262.2	-4		after 3rd
660	0.5	2.85	0.65	1.995	-0.855	5	5	3300	9405	3300	6583.5	-2821.5	-15	St Joe	
250	0.6	2.28	0.65	1.995	-0.285	5	5	1250	2850	1250	2493.75	-356.25	-5	Hardwood	
800	0.5	2.85	0.58	2.394	-0.456	6	6	4800	13680	4800	11491.2	-2188.8	-8		after 4th
230	0.3	3.99	0.58	2.394	-1.596	6	6	1380	5506.2	1380	3303.72	-2202.48	-28		
1500	0.2	4.56	0.58	2.394	-2.166	6	6	9000	41040	9000	21546	-19494	-38		
530	0.4	3.42	0.58	2.394	-1.026	6	6	3180	10875.6	3180	7612.92	-3262.68	-18		
720	0.5	2.85	0.58	2.394	-0.456	6	6	4320	12312	4320	10342.08	-1969.92	-8		
510	0.4	3.42	0.58	2.394	-1.026	6	6	3060	10465.2	3060	7325.64	-3139.56	-18		after 5th
460	0.5	2.85	0.58	2.394	-0.456	6	6	2760	7866	2760	6607.44	-1258.56	-8		
							Total	**67,380**	**149,141**	**67,380**	**82,956**	**-66,185**	**-15**		

Table J-17. East Fork Emerald Creek (ID AU17010304PN016_02/03) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**EF Emerald Creek**	
AU# ID17010304PN016_02															
780	0.8	1.14	0.98	0.114	-1.026	1	1	780	889.2	780	88.92	-800.28	-18	Forest	
380	0.7	1.71	0.98	0.114	-1.596	1	1	380	649.8	380	43.32	-606.48	-28	Group B	
280	0.9	0.57	0.98	0.114	-0.456	2	2	560	319.2	560	63.84	-255.36	-8		
160	0.7	1.71	0.98	0.114	-1.596	2	2	320	547.2	320	36.48	-510.72	-28		
810	0.8	1.14	0.98	0.114	-1.026	2	2	1620	1846.8	1620	184.68	-1662.12	-18		
150	0.8	1.14	0.97	0.171	-0.969	3	3	450	513	450	76.95	-436.05	-17		after post
140	0.7	1.71	0.97	0.171	-1.539	3	3	420	718.2	420	71.82	-646.38	-27		
140	0.8	1.14	0.97	0.171	-0.969	3	3	420	478.8	420	71.82	-406.98	-17		
280	0.7	1.71	0.97	0.171	-1.539	3	3	840	1436.4	840	143.64	-1292.76	-27		
160	0.3	3.99	0.97	0.171	-3.819	3	3	480	1915.2	480	82.08	-1833.12	-67	beaver	
120	0.3	3.99	0.96	0.228	-3.762	4	4	480	1915.2	480	109.44	-1805.76	-66	ponds	after swamp
310	0.6	2.28	0.74	1.482	-0.798	4	4	1240	2827.2	1240	1837.68	-989.52	-14	St Joe	after highline
590	0.7	1.71	0.74	1.482	-0.228	4	4	2360	4035.6	2360	3497.52	-538.08	-4	Hardwood	
2100	0.5	2.85	0.65	1.995	-0.855	5	5	10500	29925	10500	20947.5	-8977.5	-15		
510	0.3	3.99	0.65	1.995	-1.995	5	5	2550	10174.5	2550	5087.25	-5087.25	-35		after no name
							Subtotal	**23,400**	**58,191**	**23,400**	**32,343**	**-25,848**	**-26**		
AU# ID17010304PN016_03															
430	0.3	3.99	0.58	2.394	-1.596	6	6	2580	10294.2	2580	6176.52	-4117.68	-28		after little EF
1100	0.5	2.85	0.58	2.394	-0.456	6	6	6600	18810	6600	15800.4	-3009.6	-8		after garnet
2700	0.3	3.99	0.52	2.736	-1.254	7	7	18900	75411	18900	51710.4	-23700.6	-22		
270	0.5	2.85	0.74	1.482	-1.368	4	4	1080	3078	1080	1600.56	-1477.44	-24		west split
460	0.7	1.71	0.74	1.482	-0.228	4	4	1840	3146.4	1840	2726.88	-419.52	-4		
210	0.5	2.85	0.74	1.482	-1.368	4	4	840	2394	840	1244.88	-1149.12	-24		
150	0.5	2.85	0.74	1.482	-1.368	4	4	600	1710	600	889.2	-820.8	-24		east split
720	0.7	1.71	0.74	1.482	-0.228	4	4	2880	4924.8	2880	4268.16	-656.64	-4		
1420	0.4	3.42	0.47	3.021	-0.399	8	8	11360	38851.2	11360	34318.56	-4532.64	-7		after 2nd
280	0.3	3.99	0.47	3.021	-0.969	8	8	2240	8937.6	2240	6767.04	-2170.56	-17		
							Subtotal	**48,920**	**167,557**	**48,920**	**125,503**	**-42,055**	**-16**		
							Total	**72,320**	**225,749**	**72,320**	**157,846**	**-67,903**	**-22**		

Table J-18. East Fork Emerald Creek tributaries (AU ID17010304PN016_02) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**EF Emerald Creek Tributaries**	
AU# ID17010304PN016_02															
1500	0.9	0.57	0.98	0.114	-0.456	1	1	1500	855	1500	171	-684	-8	Forest	Post Creek
1100	0.8	1.14	0.98	0.114	-1.026	2	2	2200	2508	2200	250.8	-2257.2	-18	Group B	
140	0.9	0.57	0.98	0.114	-0.456	1	1	140	79.8	140	15.96	-63.84	-8		Swamp Creek
540	0.8	1.14	0.98	0.114	-1.026	1	1	540	615.6	540	61.56	-554.04	-18		
2000	0.9	0.57	0.98	0.114	-0.456	2	2	4000	2280	4000	456	-1824	-8		
100	0.8	1.14	0.98	0.114	-1.026	2	2	200	228	200	22.8	-205.2	-18		
620	0.6	2.28	0.98	0.114	-2.166	1	1	620	1413.6	620	70.68	-1342.92	-38		Highline Creek
480	0.9	0.57	0.98	0.114	-0.456	1	1	480	273.6	480	54.72	-218.88	-8		
780	0.8	1.14	0.98	0.114	-1.026	2	2	1560	1778.4	1560	177.84	-1600.56	-18		
2100	0.9	0.57	0.98	0.114	-0.456	1	1	2100	1197	2100	239.4	-957.6	-8		Flat Creek
1100	0.9	0.57	0.98	0.114	-0.456	1	1	1100	627	1100	125.4	-501.6	-8		No Name Gulch
1900	0.9	0.57	0.98	0.114	-0.456	1	1	1900	1083	1900	216.6	-866.4	-8		Garnet Gulch
900	0.8	1.14	0.98	0.114	-1.026	1	1	900	1026	900	102.6	-923.4	-18		
330	0.5	2.85	0.98	0.114	-2.736	1	1	330	940.5	330	37.62	-902.88	-48		1st tributary
100	0.6	2.28	0.98	0.114	-2.166	1	1	100	228	100	11.4	-216.6	-38		
630	0.9	0.57	0.98	0.114	-0.456	1	1	630	359.1	630	71.82	-287.28	-8		
300	0.8	1.14	0.98	0.114	-1.026	1	1	300	342	300	34.2	-307.8	-18		
390	0.9	0.57	0.98	0.114	-0.456	1	1	390	222.3	390	44.46	-177.84	-8		
170	0.8	1.14	0.98	0.114	-1.026	1	1	170	193.8	170	19.38	-174.42	-18		
330	0.9	0.57	0.98	0.114	-0.456	1	1	330	188.1	330	37.62	-150.48	-8		
520	0.9	0.57	0.94	0.342	-0.228	1	1	520	296.4	520	177.84	-118.56	-4	St Joe	2nd tributary
1100	0.8	1.14	0.94	0.342	-0.798	1	1	1100	1254	1100	376.2	-877.8	-14	Hardwood	
460	0.9	0.57	0.94	0.342	-0.228	1	1	460	262.2	460	157.32	-104.88	-4		
40	0.6	2.28	0.94	0.342	-1.938	1	1	40	91.2	40	13.68	-77.52	-34		
							Total	**21,610**	**18,343**	**21,610**	**2,947**	**-15,396**	**-16**		

Table J-19. East Fork Emerald Creek and tributaries (AU ID17010304PN016_02/03) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**Little EF Emerald Creek**	
AU# ID17010304PN016_02															
410	0.9	0.57	0.98	0.114	-0.456	1	1	410	233.7	410	46.74	-186.96	-8	Forest	1st tributary
380	0.8	1.14	0.98	0.114	-1.026	1	1	380	433.2	380	43.32	-389.88	-18	Group B	
920	0.9	0.57	0.98	0.114	-0.456	1	1	920	524.4	920	104.88	-419.52	-8		
80	0.9	0.57	0.98	0.114	-0.456	1	1	80	45.6	80	9.12	-36.48	-8		2nd tributary
380	0.8	1.14	0.98	0.114	-1.026	1	1	380	433.2	380	43.32	-389.88	-18		
1100	0.9	0.57	0.98	0.114	-0.456	2	2	2200	1254	2200	250.8	-1003.2	-8		
790	0.8	1.14	0.98	0.114	-1.026	2	2	1580	1801.2	1580	180.12	-1621.08	-18		
260	0.9	0.57	0.98	0.114	-0.456	1	1	260	148.2	260	29.64	-118.56	-8		trib to 2nd
300	0.6	2.28	0.98	0.114	-2.166	1	1	300	684	300	34.2	-649.8	-38		
830	0.9	0.57	0.98	0.114	-0.456	1	1	830	473.1	830	94.62	-378.48	-8		
40	0.9	0.57	0.98	0.114	-0.456	1	1	40	22.8	40	4.56	-18.24	-8		Little EF
500	0.5	2.85	0.98	0.114	-2.736	1	1	500	1425	500	57	-1368	-48		
260	0.9	0.57	0.98	0.114	-0.456	1	1	260	148.2	260	29.64	-118.56	-8		
750	0.8	1.14	0.98	0.114	-1.026	2	2	1500	1710	1500	171	-1539	-18		
430	0.9	0.57	0.98	0.114	-0.456	2	2	860	490.2	860	98.04	-392.16	-8		
1400	0.8	1.14	0.85	0.855	-0.285	3	3	4200	4788	4200	3591	-1197	-5	St Joe	
							Subtotal	**14,700**	**14,615**	**14,700**	**4,788**	**-9,827**	**-15**	Hardwood	
AU# ID17010304PN016_03															
310	0.7	1.71	0.74	1.482	-0.228	4	4	1240	2120.4	1240	1837.68	-282.72	-4		
							Subtotal	**1,240**	**2,120**	**1,240**	**1,838**	**-283**	**-4**		
							Total	**15,940**	**16,735**	**15,940**	**6,626**	**-10,110**	**-14**		

Table J-20. Emerald Creek and tributaries (AU ID17010304PN016_02/03) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**Lower Emerald Creek**	
AU# ID17010304PN016_02															
590	0.9	0.57	0.94	0.342	-0.228	1	1	590	336.3	590	201.78	-134.52	-4	St Joe	Willow Creek
380	0.7	1.71	0.94	0.342	-1.368	1	1	380	649.8	380	129.96	-519.84	-24	Hardwood	
400	0.9	0.57	0.94	0.342	-0.228	1	1	400	228	400	136.8	-91.2	-4		
470	0.8	1.14	0.93	0.399	-0.741	2	2	940	1071.6	940	375.06	-696.54	-13		
270	0.7	1.71	0.93	0.399	-1.311	2	2	540	923.4	540	215.46	-707.94	-23		
1100	0.8	1.14	0.93	0.399	-0.741	2	2	2200	2508	2200	877.8	-1630.2	-13		
210	0.3	3.99	0.85	0.855	-3.135	3	3	630	2513.7	630	538.65	-1975.05	-55		
300	0.2	4.56	0.85	0.855	-3.705	3	3	900	4104	900	769.5	-3334.5	-65		
1800	0.2	4.56	0.74	1.482	-3.078	4	4	7200	32832	7200	10670.4	-22161.6	-54		
480	0.9	0.57	0.98	0.114	-0.456	1	1	480	273.6	480	54.72	-218.88	-8	Forest	trib to Willow
530	0.8	1.14	0.98	0.114	-1.026	1	1	530	604.2	530	60.42	-543.78	-18	Group B	
320	0.7	1.71	0.98	0.114	-1.596	2	2	640	1094.4	640	72.96	-1021.44	-28		
150	0.9	0.57	0.98	0.114	-0.456	2	2	300	171	300	34.2	-136.8	-8		
170	0.2	4.56	0.98	0.114	-4.446	2	2	340	1550.4	340	38.76	-1511.64	-78		
							Subtotal	**16,070**	**48,860**	**16,070**	**14,176**	**-34,684**	**-28**		
AU# ID17010304PN016_03															
460	0.4	3.42	0.4	3.42	0	10	10	4600	15732	4600	15732	0	0	St Joe	Emerald Cr
650	0.2	4.56	0.4	3.42	-1.14	10	10	6500	29640	6500	22230	-7410	-20	Hardwood	
1900	0	5.7	0.4	3.42	-2.28	10	10	19000	108300	19000	64980	-43320	-40		
810	0	5.7	0.37	3.591	-2.109	11	11	8910	50787	8910	31995.81	-18791.19	-37		after willow
230	0.2	4.56	0.37	3.591	-0.969	11	11	2530	11536.8	2530	9085.23	-2451.57	-17		
1400	0.3	3.99	0.37	3.591	-0.399	11	11	15400	61446	15400	55301.4	-6144.6	-7		
170	0.2	4.56	0.37	3.591	-0.969	11	11	1870	8527.2	1870	6715.17	-1812.03	-17		
							Subtotal	**58,810**	**285,969**	**58,810**	**206,040**	**-79,929**	**-20**		
							Total	**74,880**	**334,829**	**74,880**	**220,216**	**-114,613**	**-25**		

Table J-21. Upper West Fork St. Maries River (AU ID17010304PN017_02/03) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**Upper WF St Maries River**	
AU# ID17010304PN017_02															
800	0.9	0.57	0.98	0.114	-0.456	1	1	800	456	800	91.2	-364.8	-8	Forest	
3100	0.8	1.14	0.98	0.114	-1.026	2	2	6200	7068	6200	706.8	-6361.2	-18	Group B	
400	0.3	3.99	0.85	0.855	-3.135	3	3	1200	4788	1200	1026	-3762	-55	St Joe	after keeler
							Subtotal	**8,200**	**12,312**	**8,200**	**1,824**	**-10,488**	**-27**	Hardwood	
AU# ID17010304PN017_03															
330	0.2	4.56	0.65	1.995	-2.565	5	5	1650	7524	1650	3291.75	-4232.25	-45		after hidden
740	0.3	3.99	0.65	1.995	-1.995	5	5	3700	14763	3700	7381.5	-7381.5	-35		
470	0.4	3.42	0.58	2.394	-1.026	6	6	2820	9644.4	2820	6751.08	-2893.32	-18		after wood
550	0.2	4.56	0.58	2.394	-2.166	6	6	3300	15048	3300	7900.2	-7147.8	-38		
690	0.3	3.99	0.52	2.736	-1.254	7	7	4830	19271.7	4830	13214.88	-6056.82	-22		after long slim
730	0.2	4.56	0.52	2.736	-1.824	7	7	5110	23301.6	5110	13980.96	-9320.64	-32		
750	0.5	2.85	0.52	2.736	-0.114	7	7	5250	14962.5	5250	14364	-598.5	-2		
250	0.4	3.42	0.52	2.736	-0.684	7	7	1750	5985	1750	4788	-1197	-12		
130	0.5	2.85	0.52	2.736	-0.114	7	7	910	2593.5	910	2489.76	-103.74	-2		
570	0.4	3.42	0.52	2.736	-0.684	7	7	3990	13645.8	3990	10916.64	-2729.16	-12		
							Subtotal	**33,310**	**126,740**	**33,310**	**85,079**	**-41,661**	**-22**		
							Total	**41,510**	**139,052**	**41,510**	**86,903**	**-52,149**	**-23**		

Table J-22. Keeler Creek and tributaries (AU ID17010304PN017_02) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**Keeler Creek**	
AU# ID17010304PN017_02															
140	0.9	0.57	0.98	0.114	-0.456	1	1	140	79.8	140	15.96	-63.84	-8	Forest	1st tributary
420	0.8	1.14	0.98	0.114	-1.026	1	1	420	478.8	420	47.88	-430.92	-18	Group B	
1100	0.9	0.57	0.98	0.114	-0.456	1	1	1100	627	1100	125.4	-501.6	-8		
1400	0.9	0.57	0.98	0.114	-0.456	1	1	1400	798	1400	159.6	-638.4	-8		2nd tributary
470	0.8	1.14	0.98	0.114	-1.026	1	1	470	535.8	470	53.58	-482.22	-18		
540	0.9	0.57	0.98	0.114	-0.456	1	1	540	307.8	540	61.56	-246.24	-8		
1700	0.9	0.57	0.98	0.114	-0.456	1	1	1700	969	1700	193.8	-775.2	-8		3rd tributary
1100	0.9	0.57	0.98	0.114	-0.456	1	1	1100	627	1100	125.4	-501.6	-8		4th tributary
500	0.8	1.14	0.98	0.114	-1.026	1	1	500	570	500	57	-513	-18		
1400	0.9	0.57	0.98	0.114	-0.456	1	1	1400	798	1400	159.6	-638.4	-8		Keeler Cr
140	0.8	1.14	0.98	0.114	-1.026	2	2	280	319.2	280	31.92	-287.28	-18		
490	0.7	1.71	0.93	0.399	-1.311	2	2	980	1675.8	980	391.02	-1284.78	-23	Hardwood	after 1st
570	0.7	1.71	0.97	0.171	-1.539	2	2	1140	1949.4	1140	194.94	-1754.46	-27	Forest G-C	after 2nd
400	0.6	2.28	0.85	0.855	-1.425	3	3	1200	2736	1200	1026	-1710	-25	St Joe	after 3rd
2370	0.7	1.71	0.74	1.482	-0.228	4	4	9480	16210.8	9480	14049.36	-2161.44	-4	Hardwood	after 4th
							Total	**21,850**	**28,682**	**21,850**	**16,693**	**-11,989**	**-14**		

Table J-23. Hidden Creek and tributaries (AU ID17010304PN017_02) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**Hidden Creek**	
AU# ID17010304PN017_02															
170	0.8	1.14	0.98	0.114	-1.026	1	1	170	193.8	170	19.38	-174.42	-18	Forest	1st tributary
360	0.9	0.57	0.98	0.114	-0.456	1	1	360	205.2	360	41.04	-164.16	-8	Group B	
390	0.8	1.14	0.98	0.114	-1.026	1	1	390	444.6	390	44.46	-400.14	-18		
880	0.9	0.57	0.98	0.114	-0.456	1	1	880	501.6	880	100.32	-401.28	-8		
1300	0.9	0.57	0.98	0.114	-0.456	1	1	1300	741	1300	148.2	-592.8	-8		2nd tributary
300	0.8	1.14	0.98	0.114	-1.026	1	1	300	342	300	34.2	-307.8	-18		
1600	0.9	0.57	0.98	0.114	-0.456	1	1	1600	912	1600	182.4	-729.6	-8		Hidden Cr
150	0.7	1.71	0.98	0.114	-1.596	1	1	150	256.5	150	17.1	-239.4	-28		
170	0.7	1.71	0.94	0.342	-1.368	1	1	170	290.7	170	58.14	-232.56	-24	St Joe	after 1st
580	0.7	1.71	0.94	0.342	-1.368	1	1	580	991.8	580	198.36	-793.44	-24	Hardwood	
1700	0.7	1.71	0.93	0.399	-1.311	2	2	3400	5814	3400	1356.6	-4457.4	-23		after 2nd
310	0.5	2.85	0.85	0.855	-1.995	3	3	930	2650.5	930	795.15	-1855.35	-35		
							Total	**10,230**	**13,344**	**10,230**	**2,995**	**-10,348**	**-18**		

Table J-24. Wood Creek (AU ID17010304PN017_02) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**Wood Creek**
AU# ID17010304PN017_02														
210	0.8	1.14	0.98	0.114	-1.026	1	1	210	239.4	210	23.94	-215.46	-18	Forest
520	0.9	0.57	0.98	0.114	-0.456	1	1	520	296.4	520	59.28	-237.12	-8	Group B
590	0.5	2.85	0.98	0.114	-2.736	1	1	590	1681.5	590	67.26	-1614.24	-48	
240	0.7	1.71	0.98	0.114	-1.596	1	1	240	410.4	240	27.36	-383.04	-28	
860	0.9	0.57	0.98	0.114	-0.456	1	1	860	490.2	860	98.04	-392.16	-8	
1000	0.9	0.57	0.94	0.342	-0.228	2	2	2000	1140	2000	684	-456	-4	St Joe
370	0.9	0.57	0.94	0.342	-0.228	2	2	740	421.8	740	253.08	-168.72	-4	Hardwood
560	0.9	0.57	0.94	0.342	-0.228	2	2	1120	638.4	1120	383.04	-255.36	-4	
							Total	**6,280**	**5,318**	**6,280**	**1,596**	**-3,722**	**-15**	

Table J-25. Long Slim Creek and tributaries (AU ID17010304PN017_02) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**Long Slim Creek**	
AU# ID17010304PN017_02															
570	0.9	0.57	0.98	0.114	-0.456	1	1	570	324.9	570	64.98	-259.92	-8	Forest	1st tributary
150	0.8	1.14	0.98	0.114	-1.026	1	1	150	171	150	17.1	-153.9	-18	Group B	
1000	0.9	0.57	0.98	0.114	-0.456	2	2	2000	1140	2000	228	-912	-8		
850	0.9	0.57	0.98	0.114	-0.456	2	2	1700	969	1700	193.8	-775.2	-8		
1600	0.9	0.57	0.98	0.114	-0.456	1	1	1600	912	1600	182.4	-729.6	-8		trib to 1st
360	0.8	1.14	0.98	0.114	-1.026	1	1	360	410.4	360	41.04	-369.36	-18		Long Slim
2000	0.9	0.57	0.98	0.114	-0.456	1	1	2000	1140	2000	228	-912	-8		
1200	0.8	1.14	0.98	0.114	-1.026	2	2	2400	2736	2400	273.6	-2462.4	-18		
800	0.9	0.57	0.98	0.114	-0.456	2	2	1600	912	1600	182.4	-729.6	-8		
1500	0.8	1.14	0.97	0.171	-0.969	3	3	4500	5130	4500	769.5	-4360.5	-17		
420	0.7	1.71	0.85	0.855	-0.855	3	3	1260	2154.6	1260	1077.3	-1077.3	-15	Hardwood	
							Total	**18,140**	**16,000**	**18,140**	**3,258**	**-12,742**	**-12**		

Table J-26. Cat Spur Creek and tributaries (AU ID17010304PN017_02/03) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**Cat Spur Creek & Tributaries**	
AU# ID17010304PN017_02															
2300	0.9	0.57	0.98	0.114	-0.456	2	2	4600	2622	4600	524.4	-2097.6	-8	Forest	1st tributary
2500	0.9	0.57	0.98	0.114	-0.456	1	1	2500	1425	2500	285	-1140	-8	Group B	2nd tributary
130	0.6	2.28	0.98	0.114	-2.166	2	2	260	592.8	260	29.64	-563.16	-38		
300	0.9	0.57	0.98	0.114	-0.456	2	2	600	342	600	68.4	-273.6	-8		
350	0.8	1.14	0.98	0.114	-1.026	1	1	350	399	350	39.9	-359.1	-18		3rd tributary
690	0.5	2.85	0.98	0.114	-2.736	1	1	690	1966.5	690	78.66	-1887.84	-48		
380	0.6	2.28	0.98	0.114	-2.166	1	1	380	866.4	380	43.32	-823.08	-38		
440	0.9	0.57	0.98	0.114	-0.456	1	1	440	250.8	440	50.16	-200.64	-8		
1800	0.8	1.14	0.98	0.114	-1.026	1	1	1800	2052	1800	205.2	-1846.8	-18		Kitten Cr
1700	0.9	0.57	0.98	0.114	-0.456	2	2	3400	1938	3400	387.6	-1550.4	-8		
920	0.8	1.14	0.97	0.171	-0.969	3	3	2760	3146.4	2760	471.96	-2674.44	-17		
870	0.7	1.71	0.97	0.171	-1.539	3	3	2610	4463.1	2610	446.31	-4016.79	-27		
370	0.7	1.71	0.97	0.171	-1.539	3	3	1110	1898.1	1110	189.81	-1708.29	-27		after trib
1400	0.9	0.57	0.98	0.114	-0.456	1	1	1400	798	1400	159.6	-638.4	-8		trib to Kitten
290	0.8	1.14	0.98	0.114	-1.026	1	1	290	330.6	290	33.06	-297.54	-18		
490	0.5	2.85	0.98	0.114	-2.736	1	1	490	1396.5	490	55.86	-1340.64	-48		Log Cr
990	0.9	0.57	0.98	0.114	-0.456	1	1	990	564.3	990	112.86	-451.44	-8		
210	0.8	1.14	0.98	0.114	-1.026	1	1	210	239.4	210	23.94	-215.46	-18		after trib
770	0.9	0.57	0.98	0.114	-0.456	2	2	1540	877.8	1540	175.56	-702.24	-8		
320	0.8	1.14	0.98	0.114	-1.026	2	2	640	729.6	640	72.96	-656.64	-18		
640	0.9	0.57	0.98	0.114	-0.456	2	2	1280	729.6	1280	145.92	-583.68	-8		
200	0.8	1.14	0.97	0.171	-0.969	3	3	600	684	600	102.6	-581.4	-17		
1000	0.9	0.57	0.97	0.171	-0.399	3	3	3000	1710	3000	513	-1197	-7		
700	0.7	1.71	0.97	0.171	-1.539	3	3	2100	3591	2100	359.1	-3231.9	-27		
1900	0.9	0.57	0.98	0.114	-0.456	1	1	1900	1083	1900	216.6	-866.4	-8		trib to Log
140	0.8	1.14	0.98	0.114	-1.026	2	2	280	319.2	280	31.92	-287.28	-18		
2200	0.9	0.57	0.98	0.114	-0.456	1	1	2200	1254	2200	250.8	-1003.2	-8		Cat Spur Cr
500	0.8	1.14	0.98	0.114	-1.026	2	2	1000	1140	1000	114	-1026	-18		
110	0.9	0.57	0.97	0.171	-0.399	3	3	330	188.1	330	56.43	-131.67	-7		after 1st
240	0.8	1.14	0.97	0.171	-0.969	3	3	720	820.8	720	123.12	-697.68	-17		
770	0.7	1.71	0.97	0.171	-1.539	3	3	2310	3950.1	2310	395.01	-3555.09	-27		
320	0.7	1.71	0.74	1.482	-0.228	4	4	1280	2188.8	1280	1896.96	-291.84	-4	Hardwood	after 2nd
310	0.7	1.71	0.96	0.228	-1.482	4	4	1240	2120.4	1240	282.72	-1837.68	-26	Forest Group B	after 3rd
							Subtotal	**45,300**	**46,677**	**45,300**	**7,942**	**-38,735**	**-18**		
AU# ID17010304PN017_03															
960	0.5	2.85	0.65	1.995	-0.855	5	5	4800	13680	4800	9576	-4104	-15	St Joe	after Kitten
570	0.4	3.42	0.65	1.995	-1.425	5	5	2850	9747	2850	5685.75	-4061.25	-25	Hardwood	
210	0.4	3.42	0.58	2.394	-1.026	6	6	1260	4309.2	1260	3016.44	-1292.76	-18		after Log
1200	0.3	3.99	0.58	2.394	-1.596	6	6	7200	28728	7200	17236.8	-11491.2	-28		
480	0.4	3.42	0.58	2.394	-1.026	6	6	2880	9849.6	2880	6894.72	-2954.88	-18		
280	0.2	4.56	0.58	2.394	-2.166	6	6	1680	7660.8	1680	4021.92	-3638.88	-38		
							Subtotal	**20,670**	**73,975**	**20,670**	**46,432**	**-27,543**	**-24**		
							Total	**65,970**	**120,652**	**65,970**	**54,374**	**-66,278**	**-19**		

Table J-27. West Fork St. Maries River (AU ID17010304PN017_04) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**Lower WF St Maries River**	
AU# ID17010304PN017_04															
150	0.3	3.99	0.4	3.42	-0.57	10	10	1500	5985	1500	5130	-855	-10	St Joe	
480	0.1	5.13	0.4	3.42	-1.71	10	10	4800	24624	4800	16416	-8208	-30	Hardwood	
80	0.1	5.13	0.4	3.42	-1.71	10	10	800	4104	800	2736	-1368	-30		after Mazie
490	0	5.7	0.4	3.42	-2.28	10	10	4900	27930	4900	16758	-11172	-40		
530	0.3	3.99	0.4	3.42	-0.57	10	10	5300	21147	5300	18126	-3021	-10		after unnamed
480	0.2	4.56	0.4	3.42	-1.14	10	10	4800	21888	4800	16416	-5472	-20		
2030	0.2	4.56	0.37	3.591	-0.969	11	11	22330	101824.8	22330	80187.03	-21637.77	-17		after Bechtel
240	0.3	3.99	0.37	3.591	-0.399	11	11	2640	10533.6	2640	9480.24	-1053.36	-7		after Estes
420	0.2	4.56	0.37	3.591	-0.969	11	11	4620	21067.2	4620	16590.42	-4476.78	-17		
160	0	5.7	0.37	3.591	-2.109	11	11	1760	10032	1760	6320.16	-3711.84	-37		
860	0.2	4.56	0.37	3.591	-0.969	11	11	9460	43137.6	9460	33970.86	-9166.74	-17		
							Total	**55,810**	**257,560**	**55,810**	**197,849**	**-59,711**	**-21**		

Table J-28. West Fork St. Maries River tributaries (AU ID17010304PN017_02) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**Lower WF St Maries Tributaries**	
AU# ID17010304PN017_02															
3300	0.9	0.57	0.98	0.114	-0.456	1	1	3300	1881	3300	376.2	-1504.8	-8	Forest	Swede John
350	0.8	1.14	0.98	0.114	-1.026	2	2	700	798	700	79.8	-718.2	-18	Group B	
380	0.6	2.28	0.98	0.114	-2.166	2	2	760	1732.8	760	86.64	-1646.16	-38		
1600	0.9	0.57	0.98	0.114	-0.456	1	1	1600	912	1600	182.4	-729.6	-8		Mazie Cr
490	0.8	1.14	0.98	0.114	-1.026	2	2	980	1117.2	980	111.72	-1005.48	-18		
540	0.7	1.71	0.98	0.114	-1.596	2	2	1080	1846.8	1080	123.12	-1723.68	-28		
140	0.6	2.28	0.98	0.114	-2.166	2	2	280	638.4	280	31.92	-606.48	-38		
140	0.6	2.28	0.85	0.855	-1.425	3	3	420	957.6	420	359.1	-598.5	-25	Hardwood	after SJ
780	0.9	0.57	0.98	0.114	-0.456	1	1	780	444.6	780	88.92	-355.68	-8	Forest	Un-named
70	0.5	2.85	0.98	0.114	-2.736	1	1	70	199.5	70	7.98	-191.52	-48	Group B	
210	0.8	1.14	0.98	0.114	-1.026	1	1	210	239.4	210	23.94	-215.46	-18		
40	0.5	2.85	0.98	0.114	-2.736	1	1	40	114	40	4.56	-109.44	-48		
540	0.8	1.14	0.98	0.114	-1.026	1	1	540	615.6	540	61.56	-554.04	-18		
230	0.7	1.71	0.98	0.114	-1.596	1	1	230	393.3	230	26.22	-367.08	-28		
150	0.8	1.14	0.98	0.114	-1.026	1	1	150	171	150	17.1	-153.9	-18		
180	0.5	2.85	0.98	0.114	-2.736	1	1	180	513	180	20.52	-492.48	-48		
130	0.7	1.71	0.98	0.114	-1.596	1	1	130	222.3	130	14.82	-207.48	-28		
160	0.1	5.13	0.98	0.114	-5.016	1	1	160	820.8	160	18.24	-802.56	-88		
440	0.4	3.42	0.98	0.114	-3.306	1	1	440	1504.8	440	50.16	-1454.64	-58		
1100	0.8	1.14	0.94	0.342	-0.798	1	1	1100	1254	1100	376.2	-877.8	-14	St Joe	Estes
330	0.7	1.71	0.94	0.342	-1.368	1	1	330	564.3	330	112.86	-451.44	-24	Hardwood	
470	0.5	2.85	0.94	0.342	-2.508	1	1	470	1339.5	470	160.74	-1178.76	-44		
920	0.9	0.57	0.98	0.114	-0.456	1	1	920	524.4	920	104.88	-419.52	-8	Forest	trib to bechtel
470	0.8	1.14	0.98	0.114	-1.026	1	1	470	535.8	470	53.58	-482.22	-18	Group B	
1400	0.9	0.57	0.98	0.114	-0.456	1	1	1400	798	1400	159.6	-638.4	-8		Bechtel Cr
610	0.8	1.14	0.98	0.114	-1.026	2	2	1220	1390.8	1220	139.08	-1251.72	-18		
390	0.7	1.71	0.85	0.855	-0.855	3	3	1170	2000.7	1170	1000.35	-1000.35	-15	Hardwood	after trib
70	0	5.7	0.85	0.855	-4.845	50	3	3500	19950	210	179.55	-19770.45	-85	pond	
940	0.5	2.85	0.85	0.855	-1.995	3	3	2820	8037	2820	2411.1	-5625.9	-35	St Joe	
110	0.2	4.56	0.85	0.855	-3.705	3	3	330	1504.8	330	282.15	-1222.65	-65	Hardwood	
400	0.4	3.42	0.85	0.855	-2.565	3	3	1200	4104	1200	1026	-3078	-45		
							Total	**26,980**	**57,125**	**23,690**	**7,691**	**-49,434**	**-31**		

Table J-29. Middle Fork St. Maries River and tributaries (AU ID17010304PN018_02/03) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**Upper MF St Maries & Tributaries**	
AU# ID17010304PN018_02															
680	0.9	0.57	0.98	0.114	-0.456	1	1	680	387.6	680	77.52	-310.08	-8	Forest	Filer Cr
240	0.8	1.14	0.98	0.114	-1.026	1	1	240	273.6	240	27.36	-246.24	-18	Group B	
1100	0.9	0.57	0.98	0.114	-0.456	2	2	2200	1254	2200	250.8	-1003.2	-8		
320	0.8	1.14	0.98	0.114	-1.026	2	2	640	729.6	640	72.96	-656.64	-18		
120	0.9	0.57	0.98	0.114	-0.456	2	2	240	136.8	240	27.36	-109.44	-8		
30	0.7	1.71	0.98	0.114	-1.596	2	2	60	102.6	60	6.84	-95.76	-28		
370	0.9	0.57	0.98	0.114	-0.456	1	1	370	210.9	370	42.18	-168.72	-8		Scaler Cr
540	0.8	1.14	0.98	0.114	-1.026	1	1	540	615.6	540	61.56	-554.04	-18		
1200	0.9	0.57	0.98	0.114	-0.456	2	2	2400	1368	2400	273.6	-1094.4	-8		
1400	0.9	0.57	0.98	0.114	-0.456	1	1	1400	798	1400	159.6	-638.4	-8		Graves Cr
190	0.8	1.14	0.98	0.114	-1.026	1	1	190	216.6	190	21.66	-194.94	-18		
2400	0.9	0.57	0.98	0.114	-0.456	2	2	4800	2736	4800	547.2	-2188.8	-8		
3300	0.9	0.57	0.98	0.114	-0.456	2	2	6600	3762	6600	752.4	-3009.6	-8		Braun Cr
1700	0.8	1.14	0.98	0.114	-1.026	1	1	1700	1938	1700	193.8	-1744.2	-18	Forest G-C	White Rock Cr
220	0.9	0.57	0.98	0.114	-0.456	2	2	440	250.8	440	50.16	-200.64	-8	Forest	
330	0.9	0.57	0.98	0.114	-0.456	2	2	660	376.2	660	75.24	-300.96	-8	Group B	
250	0.8	1.14	0.98	0.114	-1.026	2	2	500	570	500	57	-513	-18		
450	0.8	1.14	0.97	0.171	-0.969	3	3	1350	1539	1350	230.85	-1308.15	-17		
1500	0.9	0.57	0.97	0.171	-0.399	3	3	4500	2565	4500	769.5	-1795.5	-7		
1700	0.9	0.57	0.98	0.114	-0.456	1	1	1700	969	1700	193.8	-775.2	-8		trib to White
110	0.8	1.14	0.98	0.114	-1.026	1	1	110	125.4	110	12.54	-112.86	-18		Rock
210	0.9	0.57	0.98	0.114	-0.456	1	1	210	119.7	210	23.94	-95.76	-8	Forest	MF St Maries
910	0.5	2.85	0.98	0.114	-2.736	1	1	910	2593.5	910	103.74	-2489.76	-48	Group C	
1700	0.8	1.14	0.98	0.114	-1.026	2	2	3400	3876	3400	387.6	-3488.4	-18	Forest	
1500	0.7	1.71	0.98	0.114	-1.596	2	2	3000	5130	3000	342	-4788	-28	Group B	
740	0.8	1.14	0.97	0.171	-0.969	3	3	2220	2530.8	2220	379.62	-2151.18	-17		
780	0.7	1.71	0.97	0.171	-1.539	3	3	2340	4001.4	2340	400.14	-3601.26	-27		
1400	0.6	2.28	0.74	1.482	-0.798	4	4	5600	12768	5600	8299.2	-4468.8	-14	St Joe	after Filer
710	0.5	2.85	0.74	1.482	-1.368	4	4	2840	8094	2840	4208.88	-3885.12	-24	Hardwood	after Scaler
630	0.4	3.42	0.65	1.995	-1.425	5	5	3150	10773	3150	6284.25	-4488.75	-25		after Graves
1100	0.3	3.99	0.65	1.995	-1.995	5	5	5500	21945	5500	10972.5	-10972.5	-35		
980	0.4	3.42	0.58	2.394	-1.026	6	6	5880	20109.6	5880	14076.72	-6032.88	-18		after Braun
							Subtotal	**66,370**	**112,866**	**66,370**	**49,383**	**-63,483**	**-17**		
AU# ID17010304PN018_03															
140	0.6	2.28	0.52	2.736	0.456	7	7	980	2234.4	980	2681.28	446.88	0		after White
260	0.4	3.42	0.52	2.736	-0.684	7	7	1820	6224.4	1820	4979.52	-1244.88	-12		Rock
200	0.5	2.85	0.52	2.736	-0.114	7	7	1400	3990	1400	3830.4	-159.6	-2		
530	0.3	3.99	0.52	2.736	-1.254	7	7	3710	14802.9	3710	10150.56	-4652.34	-22		
230	0.4	3.42	0.52	2.736	-0.684	7	7	1610	5506.2	1610	4404.96	-1101.24	-12		
1100	0.3	3.99	0.52	2.736	-1.254	7	7	7700	30723	7700	21067.2	-9655.8	-22		
							Subtotal	**17,220**	**63,481**	**17,220**	**47,114**	**-16,367**	**-12**		
							Total	**83,590**	**176,347**	**83,590**	**96,496**	**-79,850**	**-16**		

Table J-30. Middle Fork St. Maries River and tributaries (AU ID17010304PN018_02/04/05) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**Lower MF St Maries & Tributaries**	
AU# ID17010304PN018_02															
620	0.9	0.57	0.98	0.114	-0.456	1	1	620	353.4	620	70.68	-282.72	-8	Forest	Two Bit Cr
20	0.5	2.85	0.98	0.114	-2.736	1	1	20	57	20	2.28	-54.72	-48	Group B	
3000	0.9	0.57	0.98	0.114	-0.456	2	2	6000	3420	6000	684	-2736	-8		
120	0.7	1.71	0.98	0.114	-1.596	2	2	240	410.4	240	27.36	-383.04	-28		
510	0.8	1.14	0.98	0.114	-1.026	1	1	510	581.4	510	58.14	-523.26	-18		Flewsie Cr
850	0.7	1.71	0.98	0.114	-1.596	1	1	850	1453.5	850	96.9	-1356.6	-28		
1700	0.8	1.14	0.98	0.114	-1.026	2	2	3400	3876	3400	387.6	-3488.4	-18		
1400	0.7	1.71	0.98	0.114	-1.596	2	2	2800	4788	2800	319.2	-4468.8	-28		
140	0.7	1.71	0.85	0.855	-0.855	3	3	420	718.2	420	359.1	-359.1	-15	St Joe	after tributary
290	0.8	1.14	0.85	0.855	-0.285	3	3	870	991.8	870	743.85	-247.95	-5	Hardwood	
650	0.9	0.57	0.85	0.855	0.285	3	3	1950	1111.5	1950	1667.25	555.75	0		
380	0.8	1.14	0.85	0.855	-0.285	3	3	1140	1299.6	1140	974.7	-324.9	-5		
1100	0.7	1.71	0.85	0.855	-0.855	3	3	3300	5643	3300	2821.5	-2821.5	-15		
390	0.9	0.57	0.98	0.114	-0.456	1	1	390	222.3	390	44.46	-177.84	-8		trib to Flewsie
60	0.6	2.28	0.98	0.114	-2.166	1	1	60	136.8	60	6.84	-129.96	-38		
1400	0.9	0.57	0.98	0.114	-0.456	1	1	1400	798	1400	159.6	-638.4	-8		
450	0.4	3.42	0.98	0.114	-3.306	1	1	450	1539	450	51.3	-1487.7	-58		Titley Cr
290	0.9	0.57	0.98	0.114	-0.456	1	1	290	165.3	290	33.06	-132.24	-8		
870	0.4	3.42	0.98	0.114	-3.306	1	1	870	2975.4	870	99.18	-2876.22	-58		
200	0.8	1.14	0.98	0.114	-1.026	2	2	400	456	400	45.6	-410.4	-18		
160	0.9	0.57	0.98	0.114	-0.456	2	2	320	182.4	320	36.48	-145.92	-8		
50	0.6	2.28	0.98	0.114	-2.166	2	2	100	228	100	11.4	-216.6	-38		
500	0.9	0.57	0.98	0.114	-0.456	2	2	1000	570	1000	114	-456	-8		
230	0.8	1.14	0.98	0.114	-1.026	2	2	460	524.4	460	52.44	-471.96	-18		
2700	0.9	0.57	0.98	0.114	-0.456	2	2	5400	3078	5400	615.6	-2462.4	-8		Anthony Cr
420	0.8	1.14	0.98	0.114	-1.026	2	2	840	957.6	840	95.76	-861.84	-18		after tributary
1900	0.9	0.57	0.98	0.114	-0.456	1	1	1900	1083	1900	216.6	-866.4	-8		trib to Anthony
2900	0.9	0.57	0.98	0.114	-0.456	1	1	2900	1653	2900	330.6	-1322.4	-8		Dutch Cr
450	0.8	1.14	0.98	0.114	-1.026	2	2	900	1026	900	102.6	-923.4	-18		
70	0.7	1.71	0.98	0.114	-1.596	2	2	140	239.4	140	15.96	-223.44	-28		
280	0.9	0.57	0.98	0.114	-0.456	1	1	280	159.6	280	31.92	-127.68	-8		un-named
380	0.8	1.14	0.98	0.114	-1.026	1	1	380	433.2	380	43.32	-389.88	-18		
60	0.6	2.28	0.98	0.114	-2.166	1	1	60	136.8	60	6.84	-129.96	-38		
800	0.8	1.14	0.98	0.114	-1.026	1	1	800	912	800	91.2	-820.8	-18		
130	0.7	1.71	0.98	0.114	-1.596	1	1	130	222.3	130	14.82	-207.48	-28		
350	0.5	2.85	0.98	0.114	-2.736	1	1	350	997.5	350	39.9	-957.6	-48		
							Subtotal	**41,940**	**43,400**	**41,940**	**10,472**	**-32,928**	**-21**		
AU# ID17010304PN018_04															
1800	0.2	4.56	0.37	3.591	-0.969	11	11	19800	90288	19800	71101.8	-19186.2	-17	St Joe	MF St Maries
270	0.2	4.56	0.37	3.591	-0.969	11	11	2970	13543.2	2970	10665.27	-2877.93	-17	Hardwood	after Two Bit
50	0.2	4.56	0.37	3.591	-0.969	11	11	550	2508	550	1975.05	-532.95	-17		
1500	0.1	5.13	0.34	3.762	-1.368	12	12	18000	92340	18000	67716	-24624	-24		after Flewsie
520	0.2	4.56	0.34	3.762	-0.798	12	12	6240	28454.4	6240	23474.88	-4979.52	-14		
1300	0.2	4.56	0.34	3.762	-0.798	12	12	15600	71136	15600	58687.2	-12448.8	-14		after Titley
960	0.1	5.13	0.34	3.762	-1.368	12	12	11520	59097.6	11520	43338.24	-15759.36	-24		after Anthony
1100	0.1	5.13	0.34	3.762	-1.368	12	12	13200	67716	13200	49658.4	-18057.6	-24		after Dutch
							Subtotal	**87,880**	**425,083**	**87,880**	**326,617**	**-98,466**	**-19**		
AU# ID17010304PN018_05															
1100	0.1	5.13	0.32	3.876	-1.254	15	15	16500	84645	16500	63954	-20691	-22	Non-forest	after Merry
790	0	5.7	0.3	3.99	-1.71	16	16	12640	72048	12640	50433.6	-21614.4	-30	Group 2	
370	0	5.7	0.3	3.99	-1.71	16	16	5920	33744	5920	23620.8	-10123.2	-30		after un-named
							Subtotal	**35,060**	**190,437**	**35,060**	**138,008**	**-52,429**	**-27**		
							Total	**164,880**	**658,920**	**164,880**	**475,097**	**-183,823**	**-21**		

Table J-31. Gold Creek and tributaries (AU ID17010304PN019_02/03) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**Gold Center Creek & Tributaries**	
AU# ID17010304PN019_02															
5500	0.9	0.57	0.96	0.228	-0.342	2	2	11000	6270	11000	2508	-3762	-6	Mixed Forest	Placer Cr
1900	0.9	0.57	0.97	0.171	-0.399	1	1	1900	1083	1900	324.9	-758.1	-7	A/B/C/D	Windy Cr
290	0.8	1.14	0.98	0.114	-1.026	2	2	580	661.2	580	66.12	-595.08	-18	Forest	
1500	0.9	0.57	0.97	0.171	-0.399	3	3	4500	2565	4500	769.5	-1795.5	-7	Group B	
1700	0.9	0.57	0.97	0.171	-0.399	1	1	1700	969	1700	290.7	-678.3	-7	Mixed Forest	trib to windy
230	0.8	1.14	0.98	0.114	-1.026	1	1	230	262.2	230	26.22	-235.98	-18	Forest	
710	0.9	0.57	0.98	0.114	-0.456	1	1	710	404.7	710	80.94	-323.76	-8	Group B	
1200	0.9	0.57	0.97	0.171	-0.399	1	1	1200	684	1200	205.2	-478.8	-7	Mixed Forest	Gramp Cr
1860	0.8	1.14	0.96	0.228	-0.912	2	2	3720	4240.8	3720	848.16	-3392.64	-16	A/B/C/D	
1600	0.7	1.71	0.98	0.114	-1.596	2	2	3200	5472	3200	364.8	-5107.2	-28	Forest	
200	0.8	1.14	0.98	0.114	-1.026	2	2	400	456	400	45.6	-410.4	-18	Group B	
590	0.6	2.28	0.85	0.855	-1.425	3	3	1770	4035.6	1770	1513.35	-2522.25	-25	St Joe	after 1st
1200	0.7	1.71	0.85	0.855	-0.855	3	3	3600	6156	3600	3078	-3078	-15	Hardwood	after 2nd
190	0.6	2.28	0.74	1.482	-0.798	4	4	760	1732.8	760	1126.32	-606.48	-14		
1100	0.5	2.85	0.74	1.482	-1.368	4	4	4400	12540	4400	6520.8	-6019.2	-24		
1400	0.7	1.71	0.98	0.114	-1.596	1	1	1400	2394	1400	159.6	-2234.4	-28	Forest G-B	1st to Gramp
50	0	5.7	0	5.7	0	50	50	2500	14250	2500	14250	0	0	water	
160	0.8	1.14	0.98	0.114	-1.026	1	1	160	182.4	160	18.24	-164.16	-18	Forest	
2000	0.7	1.71	0.98	0.114	-1.596	2	2	4000	6840	4000	456	-6384	-28	Group B	
280	0.7	1.71	0.98	0.114	-1.596	1	1	280	478.8	280	31.92	-446.88	-28		2nd to Gramp
1600	0.9	0.57	0.98	0.114	-0.456	1	1	1600	912	1600	182.4	-729.6	-8		
340	0.8	1.14	0.98	0.114	-1.026	1	1	340	387.6	340	38.76	-348.84	-18		
270	0.7	1.71	0.98	0.114	-1.596	1	1	270	461.7	270	30.78	-430.92	-28		
3200	0.9	0.57	0.96	0.228	-0.342	2	2	6400	3648	6400	1459.2	-2188.8	-6	Mixed Forest	Gold Center
170	0.8	1.14	0.94	0.342	-0.798	4	3	680	775.2	510	174.42	-600.78	-14	A/B/C/D	Creek
340	0.7	1.71	0.94	0.342	-1.368	6	3	2040	3488.4	1020	348.84	-3139.56	-24		
550	0.9	0.57	0.94	0.342	-0.228	8	3	4400	2508	1650	564.3	-1943.7	-4		
1200	0.7	1.71	0.9	0.57	-1.14	10	4	12000	20520	4800	2736	-17784	-20		
930	0.6	2.28	0.65	1.995	-0.285	11	5	10230	23324.4	4650	9276.75	-14047.65	-5	St Joe	after Placer
							Subtotal	**85,970**	**127,703**	**69,250**	**47,496**	**-80,207**	**-15**	Hardwood	
AU# ID17010304PN019_03															
560	0.5	2.85	0.58	2.394	-0.456	8	6	4480	12768	3360	8043.84	-4724.16	-8		after Windy
920	0.4	3.42	0.58	2.394	-1.026	8	6	7360	25171.2	5520	13214.88	-11956.32	-18		
850	0.3	3.99	0.52	2.736	-1.254	8	7	6800	27132	5950	16279.2	-10852.8	-22		
40	0.2	4.56	0.52	2.736	-1.824	8	7	320	1459.2	280	766.08	-693.12	-32		
560	0.2	4.56	0.47	3.021	-1.539	8	8	4480	20428.8	4480	13534.08	-6894.72	-27		after Gramp
420	0.4	3.42	0.47	3.021	-0.399	8	8	3360	11491.2	3360	10150.56	-1340.64	-7		
50	0.1	5.13	0.47	3.021	-2.109	10	8	500	2565	400	1208.4	-1356.6	-37		
70	0.3	3.99	0.47	3.021	-0.969	11	8	770	3072.3	560	1691.76	-1380.54	-17		
							Subtotal	**28,070**	**104,088**	**23,910**	**64,889**	**-39,199**	**-21**		
							Total	**114,040**	**231,791**	**93,160**	**112,385**	**-119,406**	**-17**		

Table J-32. Merry Creek and tributaries (AU ID17010304PN020_02/03) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**Merry Creek & Tributaries**	
AU# ID17010304PN020_02															
230	0.8	1.14	0.98	0.114	-1.026	1	1	230	262.2	230	26.22	-235.98	-18	Forest	1st tributary
1400	0.9	0.57	0.98	0.114	-0.456	1	1	1400	798	1400	159.6	-638.4	-8	Group B	
230	0.8	1.14	0.98	0.114	-1.026	2	2	460	524.4	460	52.44	-471.96	-18		
100	0.7	1.71	0.98	0.114	-1.596	2	2	200	342	200	22.8	-319.2	-28		
160	0.8	1.14	0.98	0.114	-1.026	2	2	320	364.8	320	36.48	-328.32	-18		
440	0.7	1.71	0.98	0.114	-1.596	2	2	880	1504.8	880	100.32	-1404.48	-28		
480	0.8	1.14	0.98	0.114	-1.026	2	2	960	1094.4	960	109.44	-984.96	-18		
870	0.9	0.57	0.98	0.114	-0.456	1	1	870	495.9	870	99.18	-396.72	-8		2nd tributary
2400	0.8	1.14	0.98	0.114	-1.026	2	2	4800	5472	4800	547.2	-4924.8	-18		
270	0.9	0.57	0.98	0.114	-0.456	1	1	270	153.9	270	30.78	-123.12	-8		Mann Cr
130	0.8	1.14	0.98	0.114	-1.026	1	1	130	148.2	130	14.82	-133.38	-18		
640	0.9	0.57	0.98	0.114	-0.456	1	1	640	364.8	640	72.96	-291.84	-8		
1500	0.8	1.14	0.98	0.114	-1.026	2	2	3000	3420	3000	342	-3078	-18		
380	0.9	0.57	0.98	0.114	-0.456	2	2	760	433.2	760	86.64	-346.56	-8		
260	0.8	1.14	0.97	0.171	-0.969	3	3	780	889.2	780	133.38	-755.82	-17		after tributary
680	0.9	0.57	0.97	0.171	-0.399	3	3	2040	1162.8	2040	348.84	-813.96	-7		
180	0.8	1.14	0.97	0.171	-0.969	3	3	540	615.6	540	92.34	-523.26	-17		
540	0.9	0.57	0.97	0.171	-0.399	3	3	1620	923.4	1620	277.02	-646.38	-7		
380	0.8	1.14	0.97	0.171	-0.969	3	3	1140	1299.6	1140	194.94	-1104.66	-17		
220	0.9	0.57	0.98	0.114	-0.456	1	1	220	125.4	220	25.08	-100.32	-8		trib to Mann
1600	0.8	1.14	0.98	0.114	-1.026	1	1	1600	1824	1600	182.4	-1641.6	-18		
180	0.9	0.57	0.98	0.114	-0.456	1	1	180	102.6	180	20.52	-82.08	-8		
270	0.9	0.57	0.98	0.114	-0.456	1	1	270	153.9	270	30.78	-123.12	-8		Merry Cr
290	0.8	1.14	0.98	0.114	-1.026	1	1	290	330.6	290	33.06	-297.54	-18		
620	0.9	0.57	0.98	0.114	-0.456	1	1	620	353.4	620	70.68	-282.72	-8		
1100	0.8	1.14	0.98	0.114	-1.026	2	2	2200	2508	2200	250.8	-2257.2	-18		
970	0.8	1.14	0.97	0.171	-0.969	3	3	2910	3317.4	2910	497.61	-2819.79	-17		after 1st
660	0.7	1.71	0.96	0.228	-1.482	4	4	2640	4514.4	2640	601.92	-3912.48	-26		after 2nd
							Subtotal	**31,970**	**33,499**	**31,970**	**4,460**	**-29,039**	**-15**		
AU# ID17010304PN020_03															
250	0.6	2.28	0.65	1.995	-0.285	5	5	1250	2850	1250	2493.75	-356.25	-5	St Joe	after Mann
540	0.7	1.71	0.65	1.995	0.285	5	5	2700	4617	2700	5386.5	769.5	0	Hardwood	
590	0.5	2.85	0.65	1.995	-0.855	5	5	2950	8407.5	2950	5885.25	-2522.25	-15		
460	0.6	2.28	0.58	2.394	0.114	6	6	2760	6292.8	2760	6607.44	314.64	0		
220	0.7	1.71	0.58	2.394	0.684	6	6	1320	2257.2	1320	3160.08	902.88	0		
690	0.5	2.85	0.58	2.394	-0.456	6	6	4140	11799	4140	9911.16	-1887.84	-8		
400	0.6	2.28	0.52	2.736	0.456	7	7	2800	6384	2800	7660.8	1276.8	0		
620	0.4	3.42	0.52	2.736	-0.684	7	7	4340	14842.8	4340	11874.24	-2968.56	-12		
780	0.5	2.85	0.47	3.021	0.171	8	8	6240	17784	6240	18851.04	1067.04	0		
290	0.5	2.85	0.43	3.249	0.399	9	9	2610	7438.5	2610	8479.89	1041.39	0		after WF Merry
980	0.3	3.99	0.43	3.249	-0.741	10	9	9800	39102	8820	28656.18	-10445.82	-13		
220	0.4	3.42	0.43	3.249	-0.171	9	9	1980	6771.6	1980	6433.02	-338.58	-3		
440	0.3	3.99	0.43	3.249	-0.741	12	9	5280	21067.2	3960	12866.04	-8201.16	-13		
910	0.2	4.56	0.43	3.249	-1.311	14	9	12740	58094.4	8190	26609.31	-31485.09	-23		
240	0.4	3.42	0.43	3.249	-0.171	9	9	2160	7387.2	2160	7017.84	-369.36	-3		
430	0.2	4.56	0.43	3.249	-1.311	12	9	5160	23529.6	3870	12573.63	-10955.97	-23		
							Subtotal	**68,230**	**238,625**	**60,090**	**174,466**	**-64,159**	**-7**		
							Total	**100,200**	**272,124**	**92,060**	**178,926**	**-93,197**	**-12**		

Table J-33. West Fork Merry Creek and tributaries (AU ID17010304PN020_02/03) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**WF Merry Creek & Tributaries**	
AU# ID17010304PN020_02															
450	0.5	2.85	0.98	0.114	-2.736	1	1	450	1282.5	450	51.3	-1231.2	-48	Forest	1st tributary
1600	0.8	1.14	0.98	0.114	-1.026	2	2	3200	3648	3200	364.8	-3283.2	-18	Group B	
510	0.7	1.71	0.98	0.114	-1.596	1	1	510	872.1	510	58.14	-813.96	-28		Corbett Cr
450	0.9	0.57	0.98	0.114	-0.456	1	1	450	256.5	450	51.3	-205.2	-8		
560	0.8	1.14	0.98	0.114	-1.026	1	1	560	638.4	560	63.84	-574.56	-18		
220	0.6	2.28	0.98	0.114	-2.166	1	1	220	501.6	220	25.08	-476.52	-38		
740	0.8	1.14	0.98	0.114	-1.026	2	2	1480	1687.2	1480	168.72	-1518.48	-18		
460	0.9	0.57	0.98	0.114	-0.456	2	2	920	524.4	920	104.88	-419.52	-8		
420	0.8	1.14	0.98	0.114	-1.026	2	2	840	957.6	840	95.76	-861.84	-18		
910	0.7	1.71	0.98	0.114	-1.596	2	2	1820	3112.2	1820	207.48	-2904.72	-28		
190	0.9	0.57	0.97	0.171	-0.399	3	3	570	324.9	570	97.47	-227.43	-7		after 1st
410	0.8	1.14	0.97	0.171	-0.969	3	3	1230	1402.2	1230	210.33	-1191.87	-17		
30	0.4	3.42	0.97	0.171	-3.249	3	3	90	307.8	90	15.39	-292.41	-57		
540	0.9	0.57	0.97	0.171	-0.399	3	3	1620	923.4	1620	277.02	-646.38	-7		
330	0.8	1.14	0.97	0.171	-0.969	3	3	990	1128.6	990	169.29	-959.31	-17		
890	0.6	2.28	0.97	0.171	-2.109	3	3	2670	6087.6	2670	456.57	-5631.03	-37		
430	0.7	1.71	0.74	1.482	-0.228	4	4	1720	2941.2	1720	2549.04	-392.16	-4	Hardwood	after Ashenfelter
830	0.8	1.14	0.98	0.114	-1.026	1	1	830	946.2	830	94.62	-851.58	-18	Forest	1st to Corbett
610	0.6	2.28	0.98	0.114	-2.166	1	1	610	1390.8	610	69.54	-1321.26	-38	Group B	
1100	0.7	1.71	0.98	0.114	-1.596	2	2	2200	3762	2200	250.8	-3511.2	-28		
70	0.5	2.85	0.98	0.114	-2.736	2	2	140	399	140	15.96	-383.04	-48		
600	0.7	1.71	0.98	0.114	-1.596	2	2	1200	2052	1200	136.8	-1915.2	-28		
1700	0.9	0.57	0.98	0.114	-0.456	1	1	1700	969	1700	193.8	-775.2	-8		Ashenfelter Cr
990	0.8	1.14	0.98	0.114	-1.026	2	2	1980	2257.2	1980	225.72	-2031.48	-18		
1600	0.8	1.14	0.98	0.114	-1.026	1	1	1600	1824	1600	182.4	-1641.6	-18		WF Merry Cr
500	0.7	1.71	0.98	0.114	-1.596	2	2	1000	1710	1000	114	-1596	-28		
190	0.8	1.14	0.98	0.114	-1.026	2	2	380	433.2	380	43.32	-389.88	-18		
670	0.7	1.71	0.98	0.114	-1.596	2	2	1340	2291.4	1340	152.76	-2138.64	-28		
360	0.8	1.14	0.98	0.114	-1.026	2	2	720	820.8	720	82.08	-738.72	-18		
960	0.8	1.14	0.97	0.171	-0.969	3	3	2880	3283.2	2880	492.48	-2790.72	-17		after 1st
1700	0.7	1.71	0.97	0.171	-1.539	3	3	5100	8721	5100	872.1	-7848.9	-27		
440	0.8	1.14	0.96	0.228	-0.912	4	4	1760	2006.4	1760	401.28	-1605.12	-16		
640	0.7	1.71	0.96	0.228	-1.482	4	4	2560	4377.6	2560	583.68	-3793.92	-26		
500	0.6	2.28	0.96	0.228	-2.052	4	4	2000	4560	2000	456	-4104	-36		
730	0.5	2.85	0.96	0.228	-2.622	4	4	2920	8322	2920	665.76	-7656.24	-46		
120	0.3	3.99	0.96	0.228	-3.762	4	4	480	1915.2	480	109.44	-1805.76	-66		
540	0.7	1.71	0.96	0.228	-1.482	4	4	2160	3693.6	2160	492.48	-3201.12	-26		
							Subtotal	**52,900**	**82,331**	**52,900**	**10,601**	**-71,729**	**-25**		
AU# ID17010304PN020_03															
100	0.6	2.28	0.58	2.394	0.114	6	6	600	1368	600	1436.4	68.4	0	St Joe	after Corbett
110	0.4	3.42	0.58	2.394	-1.026	6	6	660	2257.2	660	1580.04	-677.16	-18	Hardwood	
							Subtotal	**1,260**	**3,625**	**1,260**	**3,016**	**-609**	**-9**		
							Total	**54,160**	**85,956**	**54,160**	**13,618**	**-72,338**	**-24**		

Table J-34. Olson Creek and tributaries (AU ID17010304PN022_02) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**Olson Creek & Tributaries**	
AU# ID17010304PN022_02															
130	0.7	1.71	0.98	0.114	-1.596	1	1	130	222.3	130	14.82	-207.48	-28	Forest	1st tributary
260	0.9	0.57	0.98	0.114	-0.456	1	1	260	148.2	260	29.64	-118.56	-8	Group B	
90	0.8	1.14	0.98	0.114	-1.026	1	1	90	102.6	90	10.26	-92.34	-18		
1800	0.9	0.57	0.98	0.114	-0.456	2	2	3600	2052	3600	410.4	-1641.6	-8		
2400	0.9	0.57	0.98	0.114	-0.456	2	2	4800	2736	4800	547.2	-2188.8	-8		2nd tributary
970	0.9	0.57	0.98	0.114	-0.456	1	1	970	552.9	970	110.58	-442.32	-8		3rd tributary
30	0.7	1.71	0.98	0.114	-1.596	1	1	30	51.3	30	3.42	-47.88	-28		
510	0.9	0.57	0.98	0.114	-0.456	1	1	510	290.7	510	58.14	-232.56	-8		
70	0.8	1.14	0.98	0.114	-1.026	1	1	70	79.8	70	7.98	-71.82	-18		
80	0.9	0.57	0.98	0.114	-0.456	1	1	80	45.6	80	9.12	-36.48	-8		
30	0.7	1.71	0.98	0.114	-1.596	1	1	30	51.3	30	3.42	-47.88	-28		
530	0.9	0.57	0.98	0.114	-0.456	1	1	530	302.1	530	60.42	-241.68	-8		4th tributary
190	0.8	1.14	0.98	0.114	-1.026	1	1	190	216.6	190	21.66	-194.94	-18		
240	0.9	0.57	0.98	0.114	-0.456	1	1	240	136.8	240	27.36	-109.44	-8		
1100	0.8	1.14	0.98	0.114	-1.026	1	1	1100	1254	1100	125.4	-1128.6	-18		
780	0.9	0.57	0.98	0.114	-0.456	1	1	780	444.6	780	88.92	-355.68	-8		5th tributary
2900	0.9	0.57	0.98	0.114	-0.456	2	2	5800	3306	5800	661.2	-2644.8	-8		Olson Cr
860	0.9	0.57	0.97	0.171	-0.399	3	3	2580	1470.6	2580	441.18	-1029.42	-7		after 1st
370	0.9	0.57	0.97	0.171	-0.399	3	3	1110	632.7	1110	189.81	-442.89	-7		after 2nd
80	0.7	1.71	0.96	0.228	-1.482	4	4	320	547.2	320	72.96	-474.24	-26		after 3rd
650	0.9	0.57	0.96	0.228	-0.342	4	4	2600	1482	2600	592.8	-889.2	-6		
210	0.9	0.57	0.74	1.482	0.912	4	4	840	478.8	840	1244.88	766.08	0	Hardwood	after 4th
570	0.9	0.57	0.94	0.342	-0.228	5	5	2850	1624.5	2850	974.7	-649.8	-4	Forest	after 5th
2400	0.8	1.14	0.94	0.342	-0.798	5	5	12000	13680	12000	4104	-9576	-14	Group B	
330	0.9	0.57	0.7	1.71	1.14	5	5	1650	940.5	1650	2821.5	1881	0	Forest G-A	
560	0.8	1.14	0.94	0.342	-0.798	5	5	2800	3192	2800	957.6	-2234.4	-14	Forest G-B	
230	0.7	1.71	0.7	1.71	0	5	5	1150	1966.5	1150	1966.5	0	0	Forest	
160	0.8	1.14	0.7	1.71	0.57	5	5	800	912	800	1368	456	0	Group A	
800	0.7	1.71	0.7	1.71	0	5	5	4000	6840	4000	6840	0	0		
260	0.5	2.85	0.65	1.995	-0.855	5	5	1300	3705	1300	2593.5	-1111.5	-15	St Joe	
260	0.3	3.99	0.65	1.995	-1.995	5	5	1300	5187	1300	2593.5	-2593.5	-35	Hardwood	
							Total	**54,510**	**54,652**	**54,510**	**28,951**	**-25,701**	**-12**		

Table J-35. Thorn Creek (AU ID17010304PN026_02/03) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	Thorn Creek	
AU# ID17010304PN026_02															
180	0.9	0.57	0.94	0.342	-0.228	1	1	180	102.6	180	61.56	-41.04	-4	St Joe	
810	0.5	2.85	0.94	0.342	-2.508	1	1	810	2308.5	810	277.02	-2031.48	-44	Hardwood	
1200	0.3	3.99	0.93	0.399	-3.591	2	2	2400	9576	2400	957.6	-8618.4	-63	beaver ponds	
530	0.8	1.14	0.93	0.399	-0.741	2	2	1060	1208.4	1060	422.94	-785.46	-13		
400	0.5	2.85	0.85	0.855	-1.995	3	3	1200	3420	1200	1026	-2394	-35		
180	0.3	3.99	0.85	0.855	-3.135	3	3	540	2154.6	540	461.7	-1692.9	-55	beaver ponds	
510	0.5	2.85	0.85	0.855	-1.995	3	3	1530	4360.5	1530	1308.15	-3052.35	-35		
330	0.8	1.14	0.85	0.855	-0.285	3	3	990	1128.6	990	846.45	-282.15	-5		
440	0.7	1.71	0.74	1.482	-0.228	4	4	1760	3009.6	1760	2608.32	-401.28	-4		after 1st
120	0.8	1.14	0.74	1.482	0.342	4	4	480	547.2	480	711.36	164.16	0		
380	0.7	1.71	0.74	1.482	-0.228	4	4	1520	2599.2	1520	2252.64	-346.56	-4		
850	0.7	1.71	0.65	1.995	0.285	5	5	4250	7267.5	4250	8478.75	1211.25	0		after 2nd
450	0.5	2.85	0.65	1.995	-0.855	5	5	2250	6412.5	2250	4488.75	-1923.75	-15		
160	0.6	2.28	0.65	1.995	-0.285	5	5	800	1824	800	1596	-228	-5		
590	0.5	2.85	0.58	2.394	-0.456	6	6	3540	10089	3540	8474.76	-1614.24	-8		after 3rd
180	0.6	2.28	0.58	2.394	0.114	6	6	1080	2462.4	1080	2585.52	123.12	0		
590	0.5	2.85	0.58	2.394	-0.456	6	6	3540	10089	3540	8474.76	-1614.24	-8		
330	0.6	2.28	0.52	2.736	0.456	7	7	2310	5266.8	2310	6320.16	1053.36	0		
990	0.7	1.71	0.52	2.736	1.026	7	7	6930	11850.3	6930	18960.48	7110.18	0		
430	0.7	1.71	0.52	2.736	1.026	7	7	3010	5147.1	3010	8235.36	3088.26	0		after 4th
480	0.8	1.14	0.52	2.736	1.596	7	7	3360	3830.4	3360	9192.96	5362.56	0		
220	0.6	2.28	0.52	2.736	0.456	7	7	1540	3511.2	1540	4213.44	702.24	0		
60	0.3	3.99	0.52	2.736	-1.254	7	7	420	1675.8	420	1149.12	-526.68	-22		
50	0.3	3.99	0.47	3.021	-0.969	8	8	400	1596	400	1208.4	-387.6	-17		after 5th
60	0.3	3.99	0.47	3.021	-0.969	8	8	480	1915.2	480	1450.08	-465.12	-17		after 6th
200	0.6	2.28	0.47	3.021	0.741	8	8	1600	3648	1600	4833.6	1185.6	0		
600	0.8	1.14	0.47	3.021	1.881	8	8	4800	5472	4800	14500.8	9028.8	0		
180	0.5	2.85	0.47	3.021	0.171	8	8	1440	4104	1440	4350.24	246.24	0		
270	0.2	4.56	0.47	3.021	-1.539	8	8	2160	9849.6	2160	6525.36	-3324.24	-27		
1100	0.8	1.14	0.47	3.021	1.881	8	8	8800	10032	8800	26584.8	16552.8	0		
400	0.7	1.71	0.47	3.021	1.311	8	8	3200	5472	3200	9667.2	4195.2	0		
30	0.9	0.57	0.47	3.021	2.451	8	8	240	136.8	240	725.04	588.24	0		
							Subtotal	**68,620**	**142,067**	**68,620**	**162,949**	**20,883**	**-12**		
AU# ID17010304PN026_03															
320	0.9	0.57	0.83	0.969	0.399	9	9	2880	1641.6	2880	2790.72	1149.12	0	Group B forest	after syringa
110	0.8	1.14	0.83	0.969	-0.171	9	9	990	1128.6	990	959.31	-169.29	-3		
150	0.7	1.71	0.79	1.197	-0.513	10	10	1500	2565	1500	1795.5	-769.5	-9		after canyon
780	0.7	1.71	0.4	3.42	1.71	10	10	7800	13338	7800	26676	13338	0	St Joe	after last
130	0.5	2.85	0.4	3.42	0.57	10	10	1300	3705	1300	4446	741	0	Hardwood	
160	0.3	3.99	0.4	3.42	-0.57	10	10	1600	6384	1600	5472	-912	-10		
270	0	5.7	0.37	3.591	-2.109	11	11	2970	16929	2970	10665.27	-6263.73	-37		
700	0.3	3.99	0.37	3.591	-0.399	11	11	7700	30723	7700	27650.7	-3072.3	-7		
450	0.2	4.56	0.37	3.591	-0.969	11	11	4950	22572	4950	17775.45	-4796.55	-17		
							Subtotal	**31,690**	**98,986**	**31,690**	**98,231**	**-755**	**-9**		
							Total	**100,310**	**241,053**	**100,310**	**261,180**	**20,127**	**-11**		

Table J-36. Thorn Creek tributaries (AU ID17010304PN026_02) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**Thorn Creek Tributaries**	
AU# ID17010304PN026_02															
380	0.9	0.57	0.98	0.114	-0.456	1	1	380	216.6	380	43.32	-173.28	-8	Group B forest	1st tributary
350	0.7	1.71	0.98	0.114	-1.596	1	1	350	598.5	350	39.9	-558.6	-28		
1500	0.8	1.14	0.98	0.114	-1.026	2	2	3000	3420	3000	342	-3078	-18		
860	0.8	1.14	0.98	0.114	-1.026	1	1	860	980.4	860	98.04	-882.36	-18		2nd tributary
620	0.7	1.71	0.98	0.114	-1.596	1	1	620	1060.2	620	70.68	-989.52	-28		
360	0.4	3.42	0.98	0.114	-3.306	2	2	720	2462.4	720	82.08	-2380.32	-58	beaver ponds	
1100	0.8	1.14	0.98	0.114	-1.026	2	2	2200	2508	2200	250.8	-2257.2	-18		
390	0.3	3.99	0.98	0.114	-3.876	2	2	780	3112.2	780	88.92	-3023.28	-68	beaver ponds	
1800	0.7	1.71	0.85	0.855	-0.855	3	3	5400	9234	5400	4617	-4617	-15	Hardwood	
180	0.8	1.14	0.98	0.114	-1.026	1	1	180	205.2	180	20.52	-184.68	-18	Group B forest	3rd tributary
900	0.9	0.57	0.98	0.114	-0.456	1	1	900	513	900	102.6	-410.4	-8		
400	0.4	3.42	0.98	0.114	-3.306	1	1	400	1368	400	45.6	-1322.4	-58	beaver ponds	
1100	0.7	1.71	0.98	0.114	-1.596	2	2	2200	3762	2200	250.8	-3511.2	-28		
460	0.6	2.28	0.98	0.114	-2.166	2	2	920	2097.6	920	104.88	-1992.72	-38		
280	0.9	0.57	0.98	0.114	-0.456	1	1	280	159.6	280	31.92	-127.68	-8		4th tributary
70	0.4	3.42	0.98	0.114	-3.306	1	1	70	239.4	70	7.98	-231.42	-58		
230	0.9	0.57	0.98	0.114	-0.456	1	1	230	131.1	230	26.22	-104.88	-8		
270	0.3	3.99	0.98	0.114	-3.876	1	1	270	1077.3	270	30.78	-1046.52	-68	beaver ponds	
300	0.8	1.14	0.98	0.114	-1.026	1	1	300	342	300	34.2	-307.8	-18		
270	0.9	0.57	0.98	0.114	-0.456	2	2	540	307.8	540	61.56	-246.24	-8		
370	0.5	2.85	0.98	0.114	-2.736	2	2	740	2109	740	84.36	-2024.64	-48		
200	0.9	0.57	0.98	0.114	-0.456	2	2	400	228	400	45.6	-182.4	-8		
360	0.8	1.14	0.98	0.114	-1.026	2	2	720	820.8	720	82.08	-738.72	-18		
150	0.9	0.57	0.98	0.114	-0.456	2	2	300	171	300	34.2	-136.8	-8		
1600	0.9	0.57	0.98	0.114	-0.456	2	2	3200	1824	3200	364.8	-1459.2	-8		5th tributary
300	0.9	0.57	0.98	0.114	-0.456	1	1	300	171	300	34.2	-136.8	-8		6th tributary
30	0	5.7	0.98	0.114	-5.586	1	1	30	171	30	3.42	-167.58	-98		
900	0.7	1.71	0.98	0.114	-1.596	1	1	900	1539	900	102.6	-1436.4	-28		
1700	0.8	1.14	0.98	0.114	-1.026	2	2	3400	3876	3400	387.6	-3488.4	-18		
250	0.9	0.57	0.98	0.114	-0.456	1	1	250	142.5	250	28.5	-114	-8		last tributary
530	0.7	1.71	0.98	0.114	-1.596	1	1	530	906.3	530	60.42	-845.88	-28		
320	0.8	1.14	0.98	0.114	-1.026	1	1	320	364.8	320	36.48	-328.32	-18		
1200	0.9	0.57	0.98	0.114	-0.456	2	2	2400	1368	2400	273.6	-1094.4	-8		
							Total	**34,090**	**47,487**	**34,090**	**7,888**	**-39,599**	**-27**		

Table J-37. Canyon Creek and tributaries (AU ID17010304PN026_02) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**Canyon Creek**	
AU# ID17010304PN026_02															
350	0.7	1.71	0.94	0.342	-1.368	1	1	350	598.5	350	119.7	-478.8	-24	St Joe	1st tributary
1120	0.8	1.14	0.93	0.399	-0.741	2	2	2240	2553.6	2240	893.76	-1659.84	-13	Hardwood	
530	0.7	1.71	0.85	0.855	-0.855	3	3	1590	2718.9	1590	1359.45	-1359.45	-15		
200	0.5	2.85	0.85	0.855	-1.995	3	3	600	1710	600	513	-1197	-35		
130	0.3	3.99	0.85	0.855	-3.135	3	3	390	1556.1	390	333.45	-1222.65	-55	beaver ponds	
430	0.7	1.71	0.98	0.114	-1.596	1	1	430	735.3	430	49.02	-686.28	-28	Group B forest	2nd tributary
220	0.5	2.85	0.98	0.114	-2.736	1	1	220	627	220	25.08	-601.92	-48		
360	0.7	1.71	0.98	0.114	-1.596	1	1	360	615.6	360	41.04	-574.56	-28		
1000	0.9	0.57	0.98	0.114	-0.456	1	1	1000	570	1000	114	-456	-8		
130	0.9	0.57	0.94	0.342	-0.228	1	1	130	74.1	130	44.46	-29.64	-4	Hardwood	Canyon Creek
370	0.8	1.14	0.94	0.342	-0.798	1	1	370	421.8	370	126.54	-295.26	-14		
170	0.9	0.57	0.94	0.342	-0.228	1	1	170	96.9	170	58.14	-38.76	-4		
140	0.8	1.14	0.94	0.342	-0.798	1	1	140	159.6	140	47.88	-111.72	-14		
270	0.6	2.28	0.94	0.342	-1.938	1	1	270	615.6	270	92.34	-523.26	-34		
280	0.3	3.99	0.94	0.342	-3.648	2	2	560	2234.4	560	191.52	-2042.88	-64	beaver ponds	
880	0.7	1.71	0.93	0.399	-1.311	2	2	1760	3009.6	1760	702.24	-2307.36	-23	Hardwood	
410	0.8	1.14	0.93	0.399	-0.741	2	2	820	934.8	820	327.18	-607.62	-13		
360	0.9	0.57	0.85	0.855	0.285	3	3	1080	615.6	1080	923.4	307.8	0		
370	0.8	1.14	0.85	0.855	-0.285	3	3	1110	1265.4	1110	949.05	-316.35	-5		
440	0.6	2.28	0.85	0.855	-1.425	3	3	1320	3009.6	1320	1128.6	-1881	-25		
150	0.3	3.99	0.86	0.798	-3.192	3	3	450	1795.5	450	359.1	-1436.4	-56	beaver ponds	
220	0.3	3.99	0.78	1.254	-2.736	4	4	880	3511.2	880	1103.52	-2407.68	-48		
600	0.5	2.85	0.74	1.482	-1.368	4	4	2400	6840	2400	3556.8	-3283.2	-24	Hardwood	
1000	0.7	1.71	0.74	1.482	-0.228	4	4	4000	6840	4000	5928	-912	-4		
770	0.7	1.71	0.74	1.482	-0.228	4	4	3080	5266.8	3080	4564.56	-702.24	-4		
850	0.8	1.14	0.65	1.995	0.855	5	5	4250	4845	4250	8478.75	3633.75	0		
160	0.6	2.28	0.65	1.995	-0.285	5	5	800	1824	800	1596	-228	-5		
550	0.8	1.14	0.65	1.995	0.855	5	5	2750	3135	2750	5486.25	2351.25	0		
270	0.7	1.71	0.65	1.995	0.285	5	5	1350	2308.5	1350	2693.25	384.75	0		
940	0.9	0.57	0.65	1.995	1.425	5	5	4700	2679	4700	9376.5	6697.5	0		
950	0.9	0.57	0.92	0.456	-0.114	6	6	5700	3249	5700	2599.2	-649.8	-2	Group B forest	
200	0.8	1.14	0.92	0.456	-0.684	6	6	1200	1368	1200	547.2	-820.8	-12		
							Total	**46,470**	**67,784**	**46,470**	**54,329**	**-13,455**	**-19**		

Table J-38. Syringa Creek and tributaries (AU ID17010304PN026_02) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**Syringa Creek**
AU#ID17010304PN026_02														
140	0.7	1.71	0.98	0.114	-1.596	1	1	140	239.4	140	15.96	-223.44	-28	Group B forest
1200	0.9	0.57	0.98	0.114	-0.456	1	1	1200	684	1200	136.8	-547.2	-8	1st tributary
330	0.7	1.71	0.98	0.114	-1.596	2	2	660	1128.6	660	75.24	-1053.36	-28	
440	0.9	0.57	0.98	0.114	-0.456	2	2	880	501.6	880	100.32	-401.28	-8	
3000	0.9	0.57	0.98	0.114	-0.456	2	2	6000	3420	6000	684	-2736	-8	Syringa Creek
940	0.8	1.14	0.97	0.171	-0.969	3	3	2820	3214.8	2820	482.22	-2732.58	-17	
640	0.7	1.71	0.97	0.171	-1.539	3	3	1920	3283.2	1920	328.32	-2954.88	-27	
260	0.8	1.14	0.97	0.171	-0.969	3	3	780	889.2	780	133.38	-755.82	-17	
90	0.9	0.57	0.97	0.171	-0.399	3	3	270	153.9	270	46.17	-107.73	-7	
							Total	**14,670**	**13,515**	**14,670**	**2,002**	**-11,512**	**-16**	

Table J-39. Upper St. Maries River (AU ID17010304PN015_05) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**St Maries River, MF/WF to Carpenter Cr**
AU# ID17010304PN015_05														
1100	0	5.7	0.27	4.161	-1.539	19	19	20900	119130	20900	86964.9	-32165.1	-27	Non-forest
50	0.1	5.13	0.27	4.161	-0.969	19	19	950	4873.5	950	3952.95	-920.55	-17	Group 2
610	0	5.7	0.27	4.161	-1.539	19	19	11590	66063	11590	48225.99	-17837.01	-27	
40	0.2	4.56	0.27	4.161	-0.399	19	19	760	3465.6	760	3162.36	-303.24	-7	
1300	0.1	5.13	0.27	4.161	-0.969	19	19	24700	126711	24700	102776.7	-23934.3	-17	
70	0.2	4.56	0.27	4.161	-0.399	19	19	1330	6064.8	1330	5534.13	-530.67	-7	
120	0	5.7	0.27	4.161	-1.539	19	19	2280	12996	2280	9487.08	-3508.92	-27	
60	0.2	4.56	0.27	4.161	-0.399	19	19	1140	5198.4	1140	4743.54	-454.86	-7	
440	0	5.7	0.25	4.275	-1.425	20	20	8800	50160	8800	37620	-12540	-25	
120	0.1	5.13	0.25	4.275	-0.855	20	20	2400	12312	2400	10260	-2052	-15	
390	0	5.7	0.25	4.275	-1.425	20	20	7800	44460	7800	33345	-11115	-25	
130	0.2	4.56	0.25	4.275	-0.285	20	20	2600	11856	2600	11115	-741	-5	
400	0.1	5.13	0.25	4.275	-0.855	20	20	8000	41040	8000	34200	-6840	-15	
70	0.2	4.56	0.25	4.275	-0.285	20	20	1400	6384	1400	5985	-399	-5	
230	0.1	5.13	0.25	4.275	-0.855	20	20	4600	23598	4600	19665	-3933	-15	
80	0.2	4.56	0.25	4.275	-0.285	20	20	1600	7296	1600	6840	-456	-5	
1500	0.1	5.13	0.25	4.275	-0.855	20	20	30000	153900	30000	128250	-25650	-15	
900	0.2	4.56	0.25	4.275	-0.285	21	21	18900	86184	18900	80797.5	-5386.5	-5	
450	0.1	5.13	0.25	4.275	-0.855	21	21	9450	48478.5	9450	40398.75	-8079.75	-15	
320	0.2	4.56	0.25	4.275	-0.285	21	21	6720	30643.2	6720	28728	-1915.2	-5	
130	0.1	5.13	0.25	4.275	-0.855	21	21	2730	14004.9	2730	11670.75	-2334.15	-15	
90	0.2	4.56	0.25	4.275	-0.285	21	21	1890	8618.4	1890	8079.75	-538.65	-5	
550	0.1	5.13	0.25	4.275	-0.855	21	21	11550	59251.5	11550	49376.25	-9875.25	-15	
50	0.2	4.56	0.25	4.275	-0.285	21	21	1050	4788	1050	4488.75	-299.25	-5	
210	0	5.7	0.25	4.275	-1.425	21	21	4410	25137	4410	18852.75	-6284.25	-25	
420	0.2	4.56	0.25	4.275	-0.285	21	21	8820	40219.2	8820	37705.5	-2513.7	-5	
230	0.1	5.13	0.25	4.275	-0.855	21	21	4830	24777.9	4830	20648.25	-4129.65	-15	
260	0.2	4.56	0.25	4.275	-0.285	21	21	5460	24897.6	5460	23341.5	-1556.1	-5	
260	0.1	5.13	0.25	4.275	-0.855	21	21	5460	28009.8	5460	23341.5	-4668.3	-15	
200	0.1	5.13	0.22	4.446	-0.684	24	24	4800	24624	4800	21340.8	-3283.2	-12	
280	0.2	4.56	0.22	4.446	-0.114	24	24	6720	30643.2	6720	29877.12	-766.08	-2	
1400	0.1	5.13	0.22	4.446	-0.684	24	24	33600	172368	33600	149385.6	-22982.4	-12	
530	0	5.7	0.21	4.503	-1.197	25	25	13250	75525	13250	59664.75	-15860.25	-21	
2500	0.1	5.13	0.21	4.503	-0.627	25	25	62500	320625	62500	281437.5	-39187.5	-11	
1200	0	5.7	0.2	4.56	-1.14	26	26	31200	177840	31200	142272	-35568	-20	
							Total	**212,120**	**1,090,518**	**212,120**	**899,557**	**-190,961**	**-13**	

Table J-40. Middle Fork St. Maries River (AU ID17010304PN012_05) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**St Maries River, Carpenter Cr to Santa Cr**
AU# ID17010304PN012_05														
100	0.2	4.56	0.2	4.56	0	27	27	2700	12312	2700	12312	0	0	
460	0.1	5.13	0.2	4.56	-0.57	27	27	12420	63714.6	12420	56635.2	-7079.4	-10	
900	0	5.7	0.2	4.56	-1.14	27	27	24300	138510	24300	110808	-27702	-20	
400	0.1	5.13	0.2	4.56	-0.57	27	27	10800	55404	10800	49248	-6156	-10	
850	0	5.7	0.2	4.56	-1.14	27	27	22950	130815	22950	104652	-26163	-20	
1300	0.1	5.13	0.19	4.617	-0.513	28	28	36400	186732	36400	168058.8	-18673.2	-9	
1200	0.2	4.56	0.19	4.617	0.057	28	28	33600	153216	33600	155131.2	1915.2	0	
650	0.1	5.13	0.19	4.617	-0.513	29	29	18850	96700.5	18850	87030.45	-9670.05	-9	
720	0	5.7	0.19	4.617	-1.083	29	29	20880	119016	20880	96402.96	-22613.04	-19	
1400	0.1	5.13	0.18	4.674	-0.456	30	30	42000	215460	42000	196308	-19152	-8	
580	0	5.7	0.18	4.674	-1.026	30	30	17400	99180	17400	81327.6	-17852.4	-18	
670	0.1	5.13	0.18	4.674	-0.456	30	30	20100	103113	20100	93947.4	-9165.6	-8	
210	0	5.7	0.18	4.674	-1.026	30	30	6300	35910	6300	29446.2	-6463.8	-18	
550	0.1	5.13	0.18	4.674	-0.456	30	30	16500	84645	16500	77121	-7524	-8	
1900	0	5.7	0.18	4.674	-1.026	31	31	58900	335730	58900	275298.6	-60431.4	-18	
440	0.1	5.13	0.18	4.674	-0.456	31	31	13640	69973.2	13640	63753.36	-6219.84	-8	
360	0	5.7	0.17	4.731	-0.969	32	32	11520	65664	11520	54501.12	-11162.88	-17	
320	0.1	5.13	0.17	4.731	-0.399	32	32	10240	52531.2	10240	48445.44	-4085.76	-7	
560	0	5.7	0.17	4.731	-0.969	32	32	17920	102144	17920	84779.52	-17364.48	-17	
870	0.1	5.13	0.17	4.731	-0.399	32	32	27840	142819.2	27840	131711.04	-11108.16	-7	
490	0	5.7	0.17	4.731	-0.969	32	32	15680	89376	15680	74182.08	-15193.92	-17	
							Total	**440,940**	**2,352,966**	**440,940**	**2,051,100**	**-301,866**	**-12**	

Table J-41. Lower St. Maries River (AU ID17010304PN007_05) solar load analysis table

Segment Length (meters)	Existing Shade (fraction)	Existing Summer Load (kWh/m^2/day)	Potential Shade (fraction)	Potential Summer Load (kWh/m^2/day)	Potential Load minus Existing load (kWh/m^2/day)	Existing Stream Width (m)	Natural Stream Width (m)	Existing Segment Area (m^2)	Existing Summer Load (kWh/day)	Natural Segment Area (m^2)	Potential Summer Load (kWh/day)	Potential Load minus Existing Load (kWh/day)	Lack of Shade (%)	**St Maries River, Santa Cr to mouth**
AU# ID17010304PN007_05														
1400	0	5.7	0.16	4.788	-0.912	36	36	50400	287280	50400	241315.2	-45964.8	-16	Non-forest
880	0.1	5.13	0.16	4.788	-0.342	36	36	31680	162518.4	31680	151683.84	-10834.56	-6	Group 2
720	0	5.7	0.16	4.788	-0.912	36	36	25920	147744	25920	124104.96	-23639.04	-16	
180	0.1	5.13	0.16	4.788	-0.342	36	36	6480	33242.4	6480	31026.24	-2216.16	-6	
1400	0	5.7	0.16	4.788	-0.912	36	36	50400	287280	50400	241315.2	-45964.8	-16	
560	0.1	5.13	0.16	4.788	-0.342	36	36	20160	103420.8	20160	96526.08	-6894.72	-6	
2200	0	5.7	0.16	4.788	-0.912	36	36	79200	451440	79200	379209.6	-72230.4	-16	
420	0.1	5.13	0.16	4.788	-0.342	37	37	15540	79720.2	15540	74405.52	-5314.68	-6	
500	0	5.7	0.16	4.788	-0.912	37	37	18500	105450	18500	88578	-16872	-16	
920	0.1	5.13	0.16	4.788	-0.342	37	37	34040	174625.2	34040	162983.52	-11641.68	-6	
630	0	5.7	0.16	4.788	-0.912	37	37	23310	132867	23310	111608.28	-21258.72	-16	
930	0.1	5.13	0.16	4.788	-0.342	37	37	34410	176523.3	34410	164755.08	-11768.22	-6	
410	0	5.7	0.16	4.788	-0.912	37	37	15170	86469	15170	72633.96	-13835.04	-16	
860	0.1	5.13	0.16	4.788	-0.342	37	37	31820	163236.6	31820	152354.16	-10882.44	-6	
570	0	5.7	0.16	4.788	-0.912	37	37	21090	120213	21090	100978.92	-19234.08	-16	
2500	0.1	5.13	0.16	4.788	-0.342	37	37	92500	474525	92500	442890	-31635	-6	
120	0	5.7	0.15	4.845	-0.855	39	39	4680	26676	4680	22674.6	-4001.4	-15	
730	0.1	5.13	0.15	4.845	-0.285	39	39	28470	146051.1	28470	137937.15	-8113.95	-5	
1700	0	5.7	0.15	4.845	-0.855	39	39	66300	377910	66300	321223.5	-56686.5	-15	
150	0.1	5.13	0.15	4.845	-0.285	39	39	5850	30010.5	5850	28343.25	-1667.25	-5	
220	0	5.7	0.15	4.845	-0.855	39	39	8580	48906	8580	41570.1	-7335.9	-15	
600	0.1	5.13	0.15	4.845	-0.285	39	39	23400	120042	23400	113373	-6669	-5	
520	0	5.7	0.15	4.845	-0.855	39	39	20280	115596	20280	98256.6	-17339.4	-15	
350	0.1	5.13	0.15	4.845	-0.285	39	39	13650	70024.5	13650	66134.25	-3890.25	-5	
1900	0	5.7	0.14	4.902	-0.798	40	40	76000	433200	76000	372552	-60648	-14	
340	0.1	5.13	0.14	4.902	-0.228	40	40	13600	69768	13600	66667.2	-3100.8	-4	
70	0	5.7	0.14	4.902	-0.798	40	40	2800	15960	2800	13725.6	-2234.4	-14	
470	0.1	5.13	0.14	4.902	-0.228	40	40	18800	96444	18800	92157.6	-4286.4	-4	
230	0	5.7	0.14	4.902	-0.798	40	40	9200	52440	9200	45098.4	-7341.6	-14	
710	0.1	5.13	0.14	4.902	-0.228	40	40	28400	145692	28400	139216.8	-6475.2	-4	
330	0	5.7	0.14	4.902	-0.798	40	40	13200	75240	13200	64706.4	-10533.6	-14	
150	0.1	5.13	0.14	4.902	-0.228	40	40	6000	30780	6000	29412	-1368	-4	
590	0	5.7	0.14	4.902	-0.798	40	40	23600	134520	23600	115687.2	-18832.8	-14	
150	0.1	5.13	0.14	4.902	-0.228	41	41	6150	31549.5	6150	30147.3	-1402.2	-4	
1100	0	5.7	0.14	4.902	-0.798	41	41	45100	257070	45100	221080.2	-35989.8	-14	
980	0.1	5.13	0.14	4.902	-0.228	41	41	40180	206123.4	40180	196962.36	-9161.04	-4	
970	0	5.7	0.14	4.902	-0.798	41	41	39770	226689	39770	194952.54	-31736.46	-14	
1100	0.1	5.13	0.14	4.902	-0.228	41	41	45100	231363	45100	221080.2	-10282.8	-4	
820	0	5.7	0.13	4.959	-0.741	42	42	34440	196308	34440	170787.96	-25520.04	-13	
1800	0.1	5.13	0.13	4.959	-0.171	42	42	75600	387828	75600	374900.4	-12927.6	-3	
1300	0	5.7	0.13	4.959	-0.741	42	42	54600	311220	54600	270761.4	-40458.6	-13	
990	0	5.7	0.13	4.959	-0.741	42	42	41580	237006	41580	206195.22	-30810.78	-13	
120	0.1	5.13	0.13	4.959	-0.171	42	42	5040	25855.2	5040	24993.36	-861.84	-3	
830	0	5.7	0.13	4.959	-0.741	43	43	35690	203433	35690	176986.71	-26446.29	-13	
290	0.1	5.13	0.13	4.959	-0.171	43	43	12470	63971.1	12470	61838.73	-2132.37	-3	
4000	0	5.7	0.13	4.959	-0.741	43	43	172000	980400	172000	852948	-127452	-13	
							Total	**842,230**	**4,589,583**	**842,230**	**4,056,082**	**-533,501**	**-11**	