Jim Ford Creek Watershed

2016 Temperature TMDL

Hydrologic Unit Code 17060306

Draft

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Acknowledgments

Cover photo of lower Jim Ford Creek taken by Mark Shumar (DEQ) on September 23, 2015.

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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

AFO animal feed operation

AU assessment unit

BMP best management practice

BURP Beneficial Use Reconnaissance Program

C Celsius

CFR Code of Federal Regulations

CHD Clearwater Highway District

CGP Construction General Permit

Clearwater SWCD Clearwater Soil and WaterConservation District

CWA Clean Water Act

DEQ Department of Environmental Quality

EPA United States Environmental Protection Agency

EQUIP Environmental Quality Incentive Program

ft feet

GIS geographic information systems

IASCD Idaho Association of Soil Conservation Districts

IDAPA Refers to citations of Idaho administrative rules

IDFG Idaho Department of Fish and Game

IDL Idaho Department of Lands

ISWCC Idaho Soil and Water Conservation Commission

kWh kilowatt-hour

LA load allocation

LC load capacity

m meter

MOS margin of safety

MS4 municipal separate storm sewer system

MSGP multi-sector general permit

NB natural background

NPDES National Pollutant Discharge Elimination System

NRCS Natural Resources Conservation Service

NREL National Renewable Energy Laboratory

NTU nephelometric turbidity unit

PNV potential natural vegetation

SWPPP Stormwater Pollution Prevention Plan

TMDL total maximum daily load

US United States

U.S.C. United States Code

WAG watershed advisory group

WLA	wasteload allocation
WQPA	Water Quality Program for Agriculture
WRS	watershed restoration strategy
WWTP	wastewater treatment plant
yd	yard

Executive Summary

The federal Clean Water Act (CWA) requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters. States and tribes, pursuant to CWA §303, are to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the nation's waters whenever possible. CWA §303(d) establishes requirements for states and tribes to identify and prioritize water bodies that are water quality limited (i.e., water bodies that do not meet water quality standards).

States and tribes must periodically publish a priority list (a "§303(d) list") of impaired waters. Currently, this list is published every 2 years as the list of Category 5 water bodies in Idaho's Integrated Report (DEQ 2014). 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 addresses the nine assessment units (AUs) in the Jim Ford Creek watershed that are in Category 4(a) of Idaho's most recent Integrated Report for temperature impairment. All temperature TMDLs are being revised to the potential natural vegetation (PNV) style where riparian shade is the dominant influence on heat load to the stream. The TMDL analysis establishes water quality targets and load capacities, estimates existing pollutant loads, and allocates load reductions needed to return listed waters to a condition meeting water quality standards. In compliance with Idaho Code §39-3611(7), this TMDL describes current water quality status, pollutant sources addressed by the TMDL, and recent pollution control efforts in the Jim Ford Creek watershed to address the TMDL. Temperature is the only pollutant addressed.

This TMDL describes the key physical and biological characteristics of the subbasin; water quality concerns and status; pollutant sources; and recent pollution control actions in the Jim Ford Creek watershed, located in northern Idaho. For more detailed information about the subbasin and previous TMDLs, see the *Jim Ford Creek Total Maximum Daily Load* (DEQ et al. 2000).

Watershed at a Glance

Jim Ford Creek is a tributary of the Clearwater River in the southern part of Clearwater County, Idaho (Figure A). The creek drains a 65,838-acre watershed that has two distinct portions. In the upper portion, Jim Ford Creek flows through rolling forested uplands and the Weippe Prairie until it reaches the city of Weippe. Below Weippe, the creek enters a narrow, steep basalt canyon nearly 14 miles long. A 65-foot waterfall at the top of the canyon restricts fish passage upstream.

Currently, two point sources are identified in the Jim Ford Creek watershed. The Weippe wastewater treatment plant (ID0020354) is located along Jim Ford Creek at the confluence with Grasshopper Creek. Another point source within the Jim Ford Creek watershed is the stormwater runoff from Empire Lumber Company (formerly Hutchins Lumber). To determine loads and allocations, runoff from this facility was grouped with nonpoint source stormwater discharge activities in the TMDL. Timberline High School discharged as a point source to Grasshopper Creek when the TMDL was written but has replaced the system with a drainfield and no longer discharges to Grasshopper Creek. The primary nonpoint sources of pollutants in the Jim Ford

Creek watershed are grazing, timber harvest activities, nonirrigated croplands, urban runoff, land development activities, and hydropower.

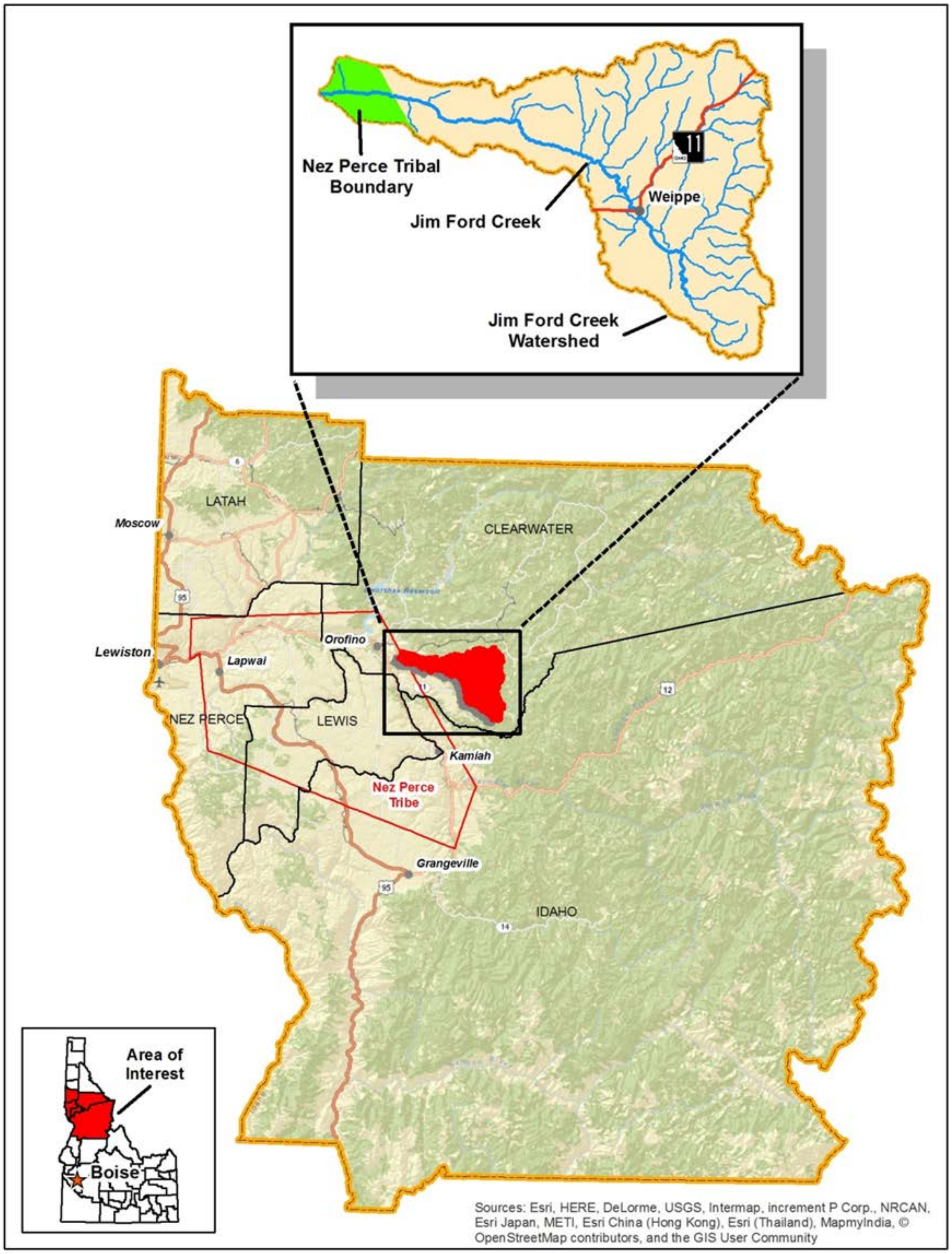

Figure A. Jim Ford Creek watershed location.

Key Findings

The AUs in the Jim Ford Creek watershed were placed on the 1998 §303(d) list of impaired waters, or subsequent lists, for reasons associated with temperature criteria violations, and the Idaho Department of Environmental Quality has developed temperature TMDLs for these waters (Table A).

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

The 2nd-order AUs where the bulk of the small tributaries are located had the largest excess loads. The Jim Ford Creek tributaries AU (ID17060306CL035_02) includes 23 different tributary bodies, and the Grasshopper Creek AU (ID17060306CL036_02) includes 8 water bodies, most of which are on the Weippe Prairie. The relatively low-gradient portions of the prairie are subject to the most agricultural conversion where the historic hawthorn shrub vegetation has been replaced by reed canary grass and other pasture grasses. These areas lack the most shade as a result. The larger order streams are primarily in the forested canyon portion of the watershed where the stream enjoys shade from topography and a forest canopy that is largely undisturbed. The 4th-order AUs of Jim Ford Creek (ID17060306CL034_04 and ID17060306CL035_04) and the 3rd-order portion of Winter Creek (ID17060306CL037_03) all had no excess loads due to abundant shade.

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

Assessment Unit Name	Assessment Unit Number	Pollutant	TMDL Completed	Recommended Changes to Next Integrated Report	Justification
Jim Ford Creek	ID17060306CL034_04	Temperature	Yes	Remain in Category 4a	Excess solar load from a lack of existing shade
Jim Ford Creek tributaries	ID17060306CL035_02	Temperature	Yes	Remain in Category 4a	Excess solar load from a lack of existing shade
Jim Ford Creek	ID17060306CL035_03	Temperature	Yes	Remain in Category 4a	Excess solar load from a lack of existing shade
Jim Ford Creek	ID17060306CL035_04	Temperature	Yes	Remain in Category 4a	Excess solar load from a lack of existing shade
Grasshopper Creek	ID17060306CL036_02	Temperature	Yes	Remain in Category 4a	Excess solar load from a lack of existing shade
Grasshopper Creek	ID17060306CL036_03	Temperature	Yes	Remain in Category 4a	Excess solar load from a lack of existing shade
Winter Creek tributaries	ID17060306CL037_02	Temperature	Yes	Move from Category 3 to Category 4a	Excess solar load from a lack of existing shade
Winter Creek	ID17060306CL037_03	Temperature	Yes	Move to Category 2	No excess solar load or existing shade deficit
Winter Creek	ID17060306CL038_02	Temperature	Yes	Remain in Category 4a	Excess solar load from a lack of existing shade

Public Participation

The Jim Ford Creek Watershed Advisory Group (WAG), Clearwater Basin Advisory Group, other agencies, nongovernment organizations, and the public played a role in the current and previous TMDL development processes, and their continued participation will be critical after the public comment period and in implementing the TMDL.

This review was developed with participation from the Jim Ford Creek WAG. Meeting dates were as follows:

- May 11, 2016—Jim Ford Creek TMDL review status and structuring of the WAG
- June 16, 2016—Review of Jim Ford Creek TMDL review nutrient and bacteria criteria and data

The general public will have the opportunity to comment on this draft document during the public comment period.

Introduction

This document addresses water bodies in the Jim Ford Creek watershed that have been placed in Category 5 of Idaho's most recent federally approved Integrated Report (DEQ 2014). This total maximum daily load (TMDL) characterizes and documents pollutant loads within the Jim Ford Creek watershed. The first portion of this document presents key characteristics or updated information for the subbasin assessment, which is divided into four major sections: subbasin characterization (section 1), water quality concerns and status (section 2), pollutant source inventory (section 3), and a summary of past and present pollution control efforts (section 4). While the subbasin assessment is not a requirement of the TMDL, the Idaho Department of Environmental Quality (DEQ) performs the assessment to ensure impairment listings are up-to-date and accurate.

The subbasin assessment is used to develop a TMDL for each pollutant of concern for the Jim Ford Creek watershed. The TMDL (section 5) is a plan to improve water quality by limiting pollutant loads. Specifically, a TMDL is an estimation of the maximum pollutant amount that can be present in a water body and still allow that water body to meet water quality standards (40 CFR 130). Consequently, a TMDL is water body- and pollutant-specific. The TMDL also allocates allowable discharges of individual pollutants among the various sources discharging the pollutant. Effective shade targets were established for nine AUs based on the concept of maximum shading under potential natural vegetation (PNV) resulting in natural background temperatures.

Regulatory Requirements

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

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

The CWA requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters. States and tribes, pursuant to CWA §303, are to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the nation's waters whenever possible. DEQ must review those standards every 3 years, and EPA must approve Idaho's water quality standards. Idaho adopts water quality standards to protect public health and welfare, enhance water quality, and protect biological integrity. A water quality standard defines the goals of a water body by designating the use or uses for the water, setting criteria necessary to protect those uses, and preventing degradation of water quality through antidegradation provisions.

CWA §303(d) establishes requirements for states and tribes to identify and prioritize water bodies that are water quality limited (i.e., water bodies that do not meet water quality standards). States and tribes must periodically publish a priority list (a "§303(d) list") of impaired waters. Currently, this list is published every 2 years as the list of Category 5 waters in Idaho's Integrated Report. For waters identified on this list, states and tribes must develop a TMDL for the pollutants, set at a level to achieve water quality standards.

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

1 Watershed Assessment—Watershed Characterization

Jim Ford Creek is a tributary of the Clearwater River in the southern part of Clearwater County, Idaho (Figure 1). It drains a 65,838-acre watershed that has two distinct portions. In the upper portion, Jim Ford Creek flows through rolling forested uplands and the Weippe Prairie until it reaches the city of Weippe. Below Weippe, the creek enters a narrow, steep basalt canyon nearly 14 miles long. A 65-foot waterfall at the top of the canyon restricts fish passage upstream.

Currently, two point sources are identified in the Jim Ford Creek watershed. The Weippe wastewater treatment plant (WWTP) (ID0020354) is located along Jim Ford Creek at the confluence with Grasshopper Creek. Another point source within the Jim Ford Creek watershed is the stormwater runoff from Empire Lumber Company (formerly Hutchins Lumber). To determine loads and allocations, runoff from this facility was grouped with nonpoint source stormwater discharge activities in the TMDL. Timberline High School discharged as a point source to Grasshopper Creek when the TMDL was written but has replaced the system with a drainfield and no longer discharges to Grasshopper Creek. The primary nonpoint sources of pollutants in the Jim Ford Creek watershed are grazing, timber harvest activities, nonirrigated croplands, urban runoff, land development activities, and hydropower.

The *Jim Ford Creek Total Maximum Daily Load* (DEQ et al. 2000) is found at *www.deq.idaho.gov/media/454495-_water_data_reports_surface_water_tmdls_jim_ford_creek_jim_ford_entire.pdf*.

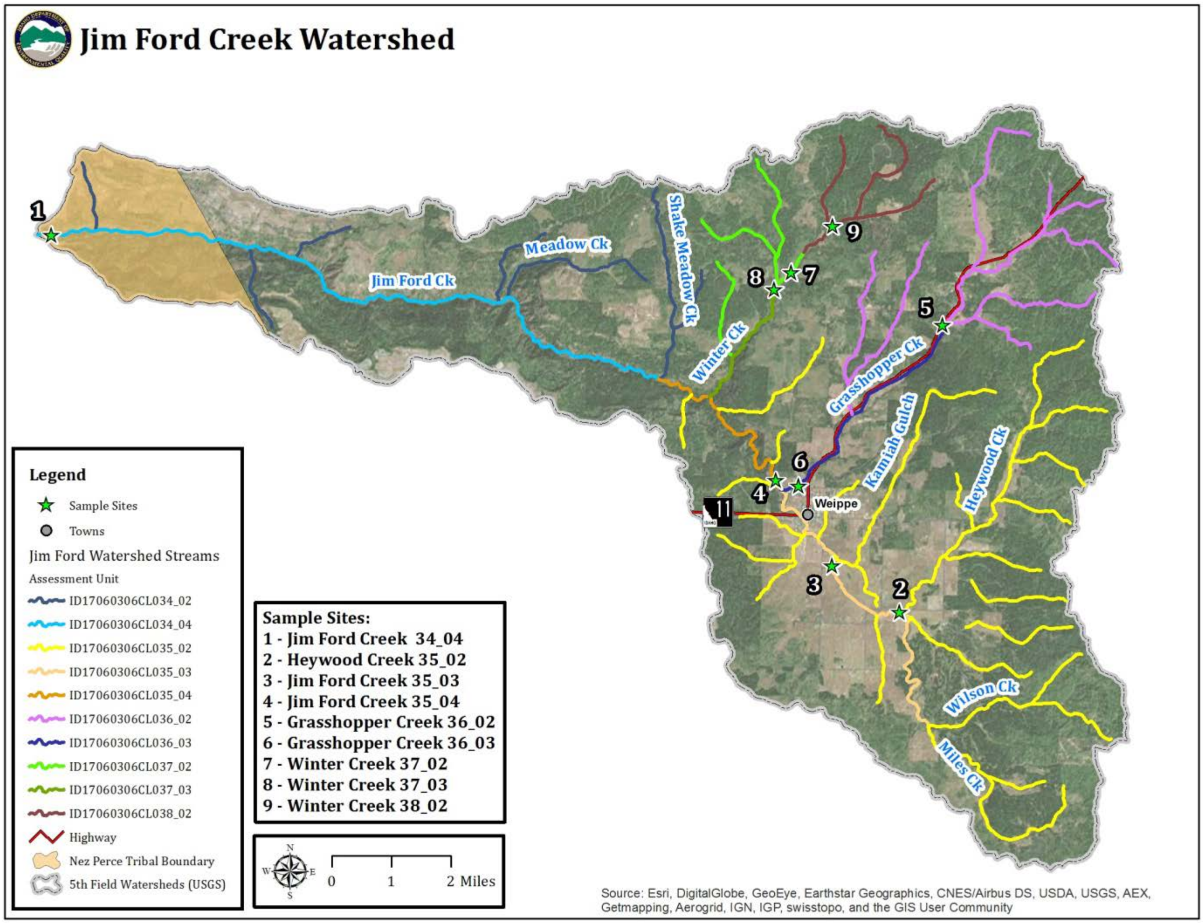

Figure 1. Jim Ford Creek watershed.

2 Subbasin Assessment—Water Quality Concerns and Status

2.1 Water Quality Limited Assessment Units Occurring in the Subbasin

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

2.1.1 Assessment Units

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

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

2.1.2 Listed Waters

Table 1 shows the pollutants listed and the basis for listing for each §303(d)-listed AU in the subbasin (i.e., AUs in Category 5 of the Integrated Report).

Table 1. Jim Ford Creek watershed §303(d)-listed assessment units in the watershed.

Assessment Unit Name	Assessment Unit Number	Listed Pollutants	Listing Basis
Jim Ford Creek	ID17060306CL034_04	Temperature	1998 §303(d) list
Jim Ford Creek tributaries	ID17060306CL035_02	Temperature	1998 §303(d) list
Jim Ford Creek	ID17060306CL035_03	Temperature	1998 §303(d) list
Jim Ford Creek	ID17060306CL035_04	Temperature	1998 §303(d) list
Grasshopper Creek	ID17060306CL036_02	Temperature	1998 §303(d) list
Grasshopper Creek	ID17060306CL036_03	Temperature	1998 §303(d) list
Winter Creek tributaries	ID17060306CL037_02	Temperature	1998 §303(d) list
Winter Creek	ID17060306CL037_03	Temperature	1998 §303(d) list
Winter Creek	ID17060306CL038_02	Temperature	1998 §303(d) list

2.2 Applicable Water Quality Standards and Beneficial Uses

Idaho water quality standards (IDAPA 58.01.02) list beneficial uses and set water quality goals for waters of the state. Idaho water quality standards require that surface waters of the state be protected for beneficial uses, wherever attainable (IDAPA 58.01.02.050.02). These beneficial uses are interpreted as existing, designated, and presumed uses as described briefly in the following paragraphs. The *Water Body Assessment Guidance* (Grafe et al. 2002) provides a more detailed description of beneficial use identification for use assessment purposes.

Beneficial uses include the following:

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

2.2.1 Existing Uses

Existing uses under the CWA are “those uses actually attained in the water body on or after November 28, 1975, whether or not they are included in the water quality standards” (40 CFR 131.3). The existing instream water uses and the level of water quality necessary to protect the uses shall be maintained and protected (IDAPA 58.01.02.051.01). Existing uses need to be protected, whether or not the level of water quality to fully support the uses currently exists. A practical application of this concept would be to apply the existing use of salmonid spawning to a water that supported salmonid spawning since November 28, 1975, but does not now due to other factors, such as blockage of migration, channelization, sedimentation, or excess heat.

2.2.2 Designated Uses

Designated uses under the CWA are "those uses specified in water quality standards for each water body or segment, whether or not they are being attained" (40 CFR 131.3). Designated uses are simply uses officially recognized by the state. In Idaho, these include uses such as aquatic life support, recreation in and on the water, domestic water supply, and agricultural uses. Multiple uses often apply to the same water; in this case, water quality must be sufficiently maintained to meet the most sensitive use (designated or existing). Designated uses may be added or removed using specific procedures provided for in state law, but the effect must not be to preclude protection of an existing higher quality use such as cold water aquatic life or salmonid spawning. Designated uses are described in the Idaho water quality standards (IDAPA 58.01.02.100) and specifically listed by water body in sections 110–160.

2.2.3 Presumed Uses

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

2.2.4 Beneficial Uses in the Subbasin

Six AUs in this addendum are designated for cold water aquatic life and primary contact recreation beneficial uses while three AUs have presumed cold water aquatic life and secondary contact recreation beneficial uses. One AU is designated for domestic water supply. One AU has an existing salmonid spawning beneficial use (Table 2).

Table 2. Jim Ford Creek watershed beneficial uses of §303(d)-listed streams.

Assessment Unit Name	Assessment Unit Number	Beneficial Uses	Type of Use	Use Support
Jim Ford Creek—waterfall (12.5 miles upstream) to mouth	ID17060306CL034_04	CW, PCR, SS	Designated, Existing	NFS (CW,SS) FS (PCR)
Heywood, Wilson Creeks and tributaries	ID17060306CL035_02	CW, PCR	Designated	NFS
Jim Ford Creek—source to Jim Ford Cr waterfall (12.5 miles)	ID17060306CL035_03	CW, PCR	Designated	NFS
Jim Ford Creek—source to Jim Ford Creek waterfall	ID17060306CL035_04	CW, PCR	Designated	NFS
Grasshopper Creek—source to mouth	ID17060306CL036_02	CW, PCR, DWS	Designated	NFS
Grasshopper Creek—source to mouth	ID17060306CL036_03	CW, PCR	Designated	NFS
Winter Creek	ID17060306CL037_02	CW, SCR	Presumed	NFS
Winter Creek—waterfall (3.4 miles upstream) to mouth	ID17060306CL037_03	CW, SCR	Presumed	NFS (CW) FS (SCR)
Winter Creek—source to Winter Creek waterfall	ID17060306CL038_02	CW, SCR	Presumed	NFS

Notes: Cold water (CW), salmonid spawning (SS), primary contact recreation (PCR), secondary contact recreation (SCR), domestic water supply (DWS), not fully supporting (NFS), fully supporting (FS)

2.2.5 Water Quality Criteria to Support Beneficial Uses

Beneficial uses are protected by a set of water quality criteria, which include *numeric* criteria for pollutants such as bacteria, dissolved oxygen, pH, ammonia, temperature, and turbidity, and *narrative* criteria for pollutants such as sediment and nutrients (IDAPA 58.01.02.250–251) (Table 3). For more about temperature criteria and natural background provisions relevant to the PNV approach, see Appendix A.

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

Parameter	Primary Contact Recreation	Secondary Contact Recreation	Cold Water Aquatic Life	Salmonid Spawning[a]
Water Quality Standards: IDAPA 58.01.02.250–251				
Temperature[b]	—	—	22 °C or less daily maximum; 19 °C or less daily average **Seasonal Cold Water**: Between summer solstice and autumn equinox: 26 °C or less daily maximum; 23 °C or less daily average	13 °C or less daily maximum; 9 °C or less daily average **Bull Trout**: Not to exceed 13 °C maximum weekly maximum temperature over warmest 7-day period, June–August; not to exceed 9 °C daily average in September and October
EPA Bull Trout Temperature Criteria: Water Quality Standards for Idaho, 40 CFR Part 131				
Temperature	—	—	—	7-day moving average of 10 °C or less maximum daily temperature for June–September

[a] During spawning and incubation periods for inhabiting species
[b] Temperature exemption: Exceeding the temperature criteria will not be considered a water quality standard violation when the air temperature exceeds the ninetieth percentile of the 7-day average daily maximum air temperature calculated in yearly series over the historic record measured at the nearest weather reporting station.

DEQ's procedure to determine whether a water body fully supports designated and existing beneficial uses is outlined in IDAPA 58.01.02.050.02. The procedure relies heavily upon biological parameters and is presented in detail in the *Water Body Assessment Guidance* (Grafe et al. 2002). This guidance requires DEQ to use the most complete data available to make beneficial use support status determinations (Figure 2).

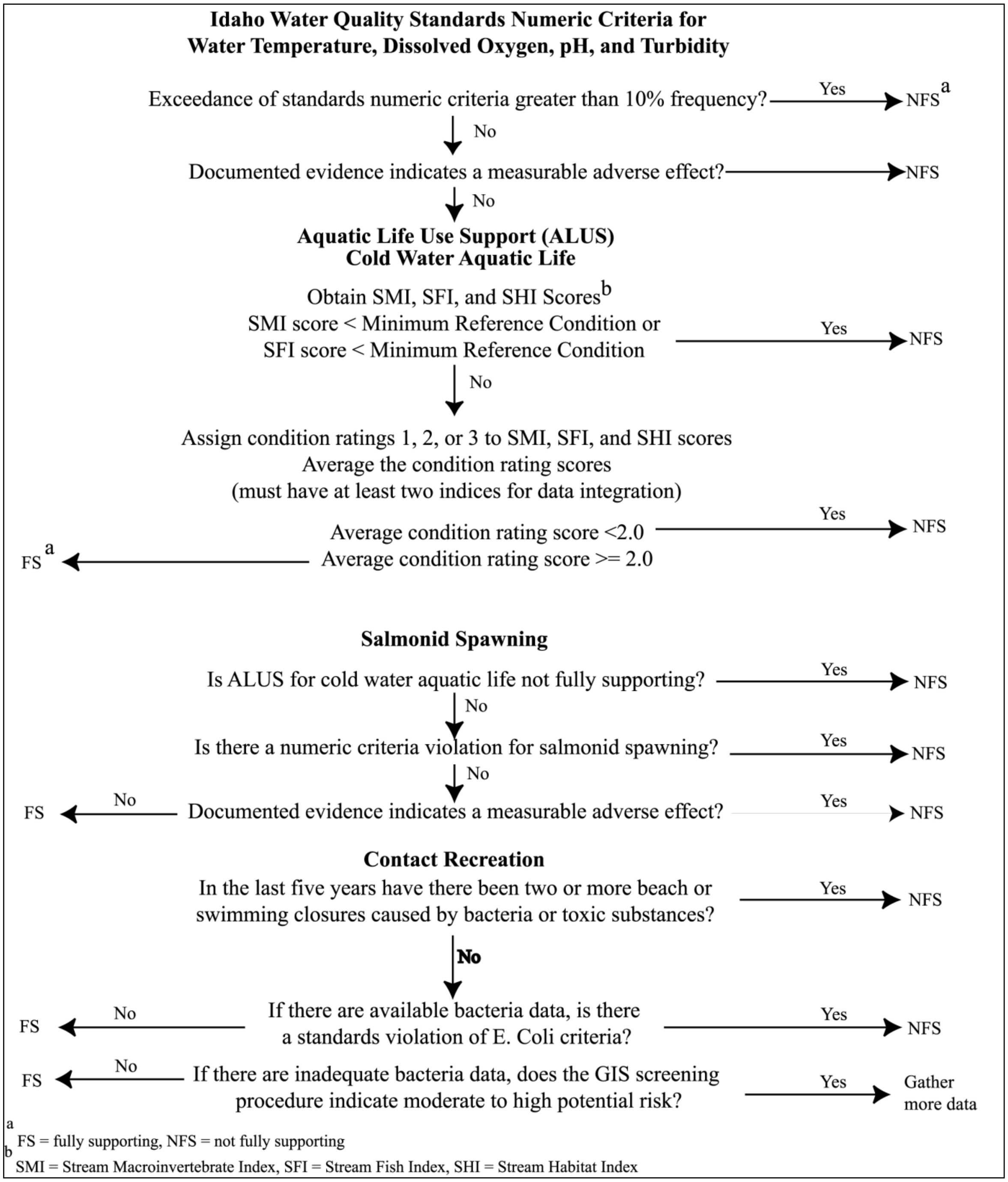

Figure 2. Determination steps and criteria for determining support status of beneficial uses in wadeable streams (Grafe et al. 2002).

2.3 Summary and Analysis of Existing Water Quality Data

For this Jim Ford Creek watershed temperature TMDL, a PNV approach was used (section 5). Temperature criteria for protecting cold water aquatic life beneficial uses were applied throughout the watershed, and temperature criteria for protecting salmonid spawning was applied in the lower AU where that is an existing use. Temperature data were collected in Jim Ford

Creek at two sites above and below the town of Weippe in 2015. These data are presented in Appendix E. Temperature criteria exceedances continue to be an issue in Jim Ford Creek.

In addition, Beneficial Use Reconnaissance Program (BURP) data, which relate to the cold water aquatic life and salmonid spawning beneficial use support, were collected and compiled into Table 4. Data sources for this section are provided in Appendix B.

2.3.1 Status of Beneficial Uses

Data were evaluated against cold water aquatic life and salmonid spawning criteria, where applicable. Assessments found that eight AUs listed for temperature were lacking shade, and DEQ recommends that those AUs remain in Category 4a. One AU (3rd order Winter Creek) was found to have no excess solar load from lack of existing shade, and DEQ recommends that this AU be moved to Category 2.

The BURP data, which relate to the cold water aquatic beneficial use support, were collected and compiled into Table 4.

Table 4. Beneficial Use Reconnaissance Program data for the Jim Ford Creek watershed.

Assessment Unit Name	Assessment Unit Number	SMI	SFI	SHI	Average	Current Integrated Report Category
Jim Ford Creek—waterfall (12.5 miles upstream) to mouth	ID17060306CL034_04	2	1	3	2	4a, 4c
Heywood, Wilson Creeks and tributaries	ID17060306CL035_02	1/0	NA/0	1/1	1/0	4a, 4c
Jim Ford Creek—source to Jim Ford Creek waterfall (12.5 miles)	ID17060306CL035_03	0	0	1	0	4a, 4c
Jim Ford Creek—source to Jim Ford Creek waterfall	ID17060306CL035_04	0	0	2	0	4a, 4c
Grasshopper Creek—source to mouth	ID17060306CL036_02	NA	NA	NA	NA	4a, 4c
Grasshopper Creek—source to mouth	ID17060306CL036_03	0	0	1	0	4a, 4c
Winter Creek—Winter Creek waterfall (3.4 miles upstream)	ID17060306CL037_02	1	NA	1	1	3[a]
Winter Creek—waterfall (3.4 miles upstream) to mouth	ID17060306CL037_03	1	0	3	0	4a, 4c
Winter Creek—source to Winter Creek waterfall	ID17060306CL038_02	NA	NA	NA	NA	4a, 4c

a. This assessment unit was listed as unassessed in error when assessment units were delineated. DEQ is recommending that this assessment unit to Category 4a.
*Note*s Stream macroinvertebrate index (SMI); stream fish index (SFI); stream habitat index (SHI); not assessed (NA)

3 Subbasin Assessment—Pollutant Source Inventory

Pollutants of concern for this TMDL are limited to temperature, for which the methodology and natural background provision established in Idaho water quality standards have changed. Most of the pollutants that impair beneficial uses in streams are naturally occurring stream characteristics that have been altered by humans and when these sources reach unnatural levels, they are considered *pollutants* and can impair the beneficial uses in the stream.

Load allocations were established in the *Jim Ford Creek Total Maximum Daily Load* approved by EPA in 2000 (DEQ et al. 2000). Wasteload allocations were also established for the two permitted point sources in the watershed. Timberline High School discharged as a point source to Grasshopper Creek when the TMDL was written but has replaced the system with a drainfield and no longer discharges to Grasshopper Creek; therefore, no wasteload allocation is assigned. The Weippe WWTP does not discharge to a stream during the critical time period and did not receive a wasteload allocation for temperature.

3.1 Point Sources

Two permitted point sources were identified in the watershed when the TMDL was written. Timberline High School discharged as a point source to Grasshopper Creek but has replaced the system with a drainfield and no longer discharges to Grasshopper Creek; therefore, no wasteload allocation is assigned. The Weippe WWTP (ID0020354) does not discharge to a stream during the critical time period and did not receive a wasteload allocation for temperature.

EPA published a new Multi-Sector General Permit (MSGP) on September 29, 2008, to replace the 2000 MSGP. This permit covers industrial facility stormwater management in areas where EPA has National Pollutant Discharge Elimination System (NPDES) authority. The 2008 MSGP applies to all new and existing facilities and requires that stormwater be controlled according to terms and conditions of the permit. A permit search can be performed and information about the MSGP entities under EPA's authority and can be accessed at *https://www.epa.gov/npdes*.

3.2 Nonpoint Sources

The primary nonpoint sources of pollutants in the Jim Ford Creek watershed are grazing, timber harvest activities, nonirrigated croplands, urban runoff, land development activities, and hydropower. A detailed discussion of nonpoint sources in the watershed are provided in the *Jim Ford Creek Total Maximum Daily Load* (DEQ et al. 2000).

4 Subbasin Assessment—Summary of Past and Present Pollution Control Efforts

The Jim Ford Creek TMDL was approved by EPA in May 2000. The *Jim Ford Creek TMDL Ag Implementation Plan* (Clearwater SWCD 2014) addresses load capacities for pollutants in Jim Ford Creek and the necessary best management practices (BMPs) needed to meet those load reductions. Targets, load analyses, and load allocations are discussed briefly in this section and presented in more detail in other sections of this document. This section summarizes the implementation efforts the Clearwater Soil and Water Conservation District (Clearwater SWCD), agency partners, and local landowners conducted since 2000 to meet the goals of the TMDL.

4.1 Background

Jim Ford Creek is a 3rd-order tributary of the Clearwater River in the southern part of Clearwater County, Idaho. The creek flows 20 miles northwest from an elevation of 4,068 feet to 1,050 feet at its confluence with the Clearwater River near Orofino, Idaho. It drains a 65,838-acre watershed that has two distinct land types. In the upper segment, Jim Ford Creek flows through rolling forested uplands and through the Weippe Prairie until it reaches Weippe. Below Weippe, the creek enters into a narrow steep basalt canyon nearly 14 miles long. A 65-foot waterfall at the top of the canyon restricts fish passage upstream. Primary land uses in the watershed consist of timber production, grazing, recreation, dryland agriculture, and a small urban area in Weippe. In the lower segment of the watershed, a small hydropower facility is located along the creek 2 miles downstream from Weippe. The majority of the watershed projects implemented since 2000 were focused on riparian areas in the forested uplands and Weippe Prairie.

4.2 Pollutants of Concern

The pollutants of concern identified in the Jim Ford Creek TMDL were pathogens (bacteria), excess nutrients, course sediment, and temperature. An in depth discussion about the limiting factors and the pollutants of concern is found in the Jim Ford Creek TMDL (DEQ et al. 2000).

4.3 Summary of Past and Present Pollution Control Efforts

Watershed projects implemented since 2000 included partnerships with the Idaho Department of Lands (IDL), Clearwater Highway District (CHD), Potlatch Corporation, Nez Perce Tribe, Idaho Department of Fish and Game (IDFG), and private landowners. The Clearwater SWCD has been the sponsor of the majority of funding through the EPA §319 Clean Water Grant, Idaho State Agriculture Water Quality Program, and Idaho Water Quality Program for Agriculture (WQPA).

Federal program funding was provided and administered by the Natural Resources Conservation Service (NRCS) and Farm Service Agency for programs consisting of the Environmental Quality Incentive Program (EQIP), Conservation Reserve Program, and Continuous Conservation Reserve Program.

In 2000, the Clearwater SWCD received $275,000 from the Idaho Soil and Water Conservation Commission (ISWCC) for the WQPA as part of the Jim Ford Creek Watershed Enhancement Project. In 2001, the Clearwater SWCD received $400,000 from the EPA §319 Clean Water Grant to supplement work that was accomplished through the Jim Ford Creek Watershed Enhancement Project. These funds were dispersed over a 5-year period from 2000 to 2005 between the two funding sources and assisted by the strong partnerships of the agencies listed in section 4.4, Table 5 (Clearwater SWCD 2000).

To aid in developing the Jim Ford Creek ag implementation plan, the Watershed Advisory Group (WAG) helped develop a Watershed Restoration Strategy (WRS) to ensure reasonable progress toward attaining water quality standards through watershed improvement projects, restoration activities, and management practices. The WRS provided the framework for the implementation plan and focused on riparian restoration.

Figure 3 illustrates an example of the WRS for riparian restoration and the feedback process.

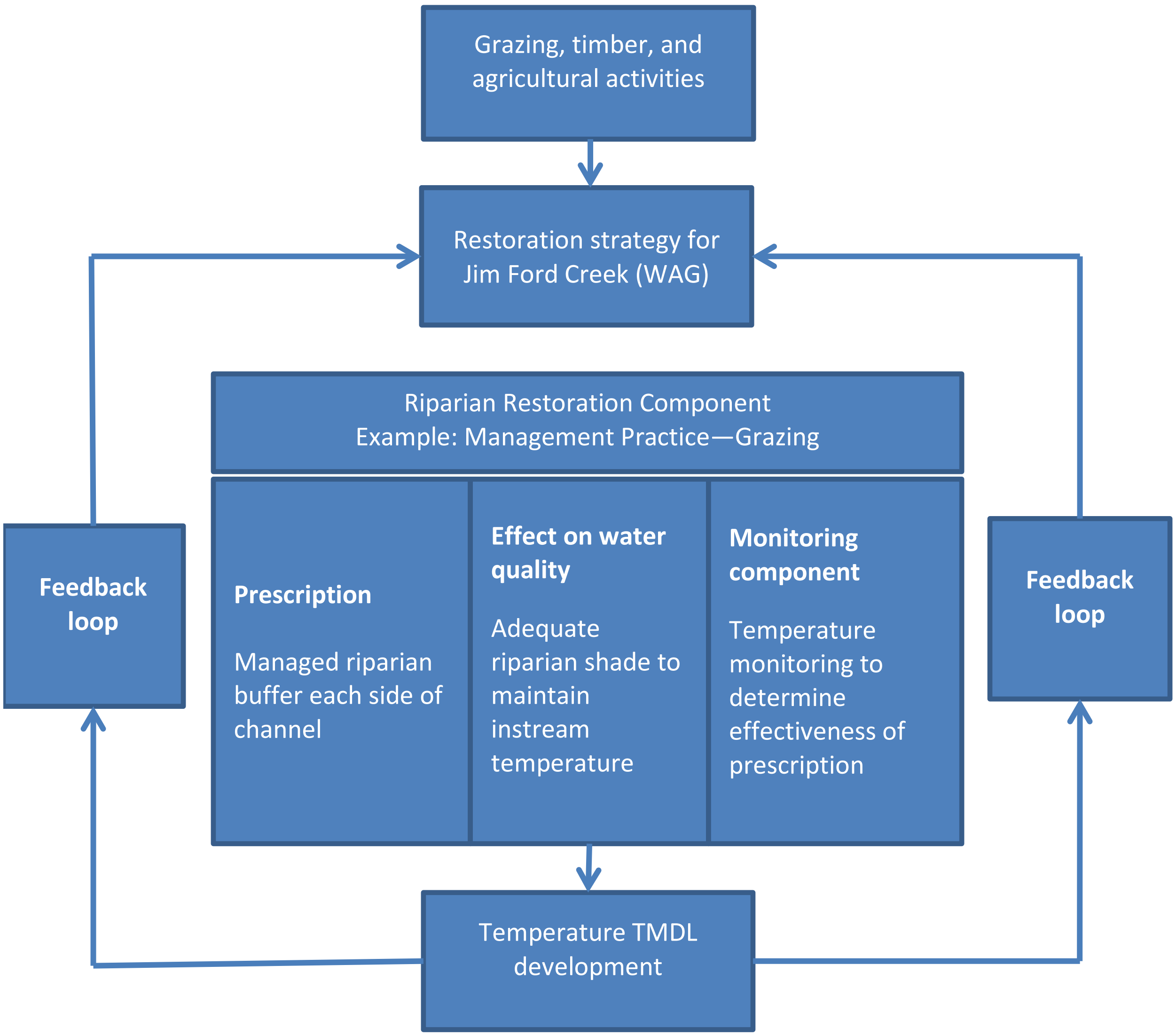

Figure 3. Riparian restoration strategy and feedback process.

The WRS focused on reducing sediment, temperature, nutrients, and bacteria. BMPs included in the WRS were prescribed grazing, nutrient management, alternate livestock water supplies, ponds, livestock exclusions, riparian buffers, tree and shrub planting, riparian fencing, streambank stabilization, conservation cropping, tillage practices and wetland enhancements.

The effects of some BMPs such as riparian plantings, bank stabilization, and thermal load reduction may take years to be fully realized. Although specific targets and allocations were identified in the TMDL, the ultimate success of the TMDL is not whether the specific targets and allocations were met, but whether beneficial uses and water quality standards were achieved.

4.4 Natural Resource Partnerships

Pollution control efforts since 2000 within the Jim Ford Creek watershed have been examined according to land use and activities. They are divided between point and nonpoint sources. Table 5 lists the designated management agencies, natural resource responsibility represented, and type of involvement.

Table 5. Natural resource partnerships.

Designated Management Agency	Resource Responsibility	Type of Involvement (regulatory, funding, and assistance)
Idaho Soil and Water Conservation Commission	Agriculture, grazing, forestry, roads, and wetlands	Funding and technical and administrative assistance
Clearwater Soil and Water Conservation District	Agriculture, grazing, forestry, roads, and wetlands	Funding and technical and administrative assistance
Idaho Department of Lands	Grazing, forestry, and roads	Regulatory, matching funds, and technical oversight
Potlatch Corporation	Grazing, forestry, and roads	Matching funds and technical oversight
Clearwater Highway District	Roads	Matching funds and technical oversight
Private Landowners	Agriculture, grazing, and forestry	Matching funds
Idaho Fish and Game	Wetlands	Matching funds and technical oversight
Natural Resource Conservation Service	Agriculture	Matching funds and technical oversight

4.5 Restoration Activities

Funding from the WQPA focused on agricultural practices within the Weippe Prairie and surrounding uplands. In many instances, NRCS used their EQIP program funding to compliment WQPA BMPs implemented among the private landowners in the watershed. Between 2000 and 2005, the Clearwater SWCD worked with landowners and installed BMPs to address nonpoint source pollution impacting water quality in Jim Ford Creek, primarily high instream temperatures and excessive nutrients and bacteria.

Dove-tailing into the WQPA and EQIP practices were projects funded by the EPA §319 Clean Water Grant. A compilation of program funding for BMPs installed and projects completed over 5 years is provided below.

Water Quality Program for Agriculture (2000–2005)

The Clearwater SWCD had a total of 15 contracts with private landowners that treated over 2,350 acres. Of the BMPs, 19 were management practices and 53 were structural practices. Most of the practices were installed through landowner contracts between the Clearwater SWCD and the landowner. In some instances, NRCS had supplemental contracts with the same landowner for other practices relating to agriculture, pasture and hayland, and forestry. All practices were installed in numerous tributaries to Jim Ford Creek including Grasshopper, Heywood, and Miles and Wilson Creeks.

The Clearwater SWCD and NRCS worked together to address the natural resource concerns of the watershed and toward the goals of improving the overall water quality and habitat of the tributaries to Jim Ford Creek and main stem Jim Ford Creek. (Clearwater SWCD 2014)

Natural Resource Concerns and Goals

Beneficial uses in Jim Ford Creek and its tributaries were impaired for cold water biota, salmonid spawning, and contact recreation.

Resource concerns focused in the watershed consisted of the following:

- Habitat quality—streambank erosion and degradation
- Surface water quality—nutrients (mainly phosphorous), bacteria (primarily fecal coliform and *Escherichia coli*), sedimentation (limiting the salmonid spawning), and water temperature extremes (limiting cold water biota and salmonid spawning)

Goals Associated with the Natural Resource Concerns

1. To control erosion and trap sediment with crop residue management, permanent vegetative plantings, and maintenance of the stream buffers and filter areas. Turbidity goals were not to exceed background by more than 50 nephelometric turbidity units (NTU) instantaneously or 25 NTU for more than 10 consecutive days.
2. Lower or modify water temperature and stream recharge by improving upland vegetative cover in the watershed, improving infiltration rates of soil water, providing multilayer shading along stream buffers, water spreading in meadows, constructing wetlands, and other ways to flatten the stream hydrograph. Cold water biota maximum daily temperatures should not exceed 22 °C (72°F) at any one time. For salmonid spawning, the daily average temperatures should not exceed 9 °C (48°F) as a daily average or 13 °C (55°F) as the daily maximum. These daily averages applied to steelhead from February 1 to July 15, spring Chinook Salmon from August 1 to April 1, and fall Chinook Salmon from August 15 to June 15.
3. Apply comprehensive nutrient management plans with landowners and remove nutrients through controlled harvesting or grazing. Surface waters were to be free from excess nutrients that could cause visible slime growth or other nuisance aquatic growths impairing designated beneficial uses.
4. Reduce bacteria in surface water by eliminating direct discharges from sources, constructing wetlands, improving filter areas and buffers, and better distribution of livestock.

The NRCS staff worked with the landowners in the Jim Ford Creek watershed to install the following BMPs:

- Stream buffers and filter strips—134 acres
- Prescribed grazing—8,172 acres

- Comprehensive nutrient management plans—10,910 acres
- Crop residue management—3,716 acres
- Fence—24,844 feet

These practices complimented the efforts the Clearwater SWCD implemented through the WQPA. The Clearwater SWCD, using state WQPA funds, worked with the landowners in the Jim Ford Creek watershed to install the following NRCS-approved agricultural practices from 2000 to 2005:

- Access roads—56 feet
- Fence—40,381 feet
- Grade stabilization structures—10 each
- Heavy use area protection—17 each
- Pasture and hayland planting—240.3 acres
- Pipeline—1,996 feet
- Pond—5 each
- Pumping plant for water control—2 each
- Riparian forest buffer (riparian plantings)—8,780 each
- Roof runoff structure—2 each
- Spring development—2 each
- Stream channel stabilization—62 feet
- Subsurface drain—4,700 feet
- Tree/shrub establishment—1,875 each
- Waste management system upgrades (animal feeding operation [AFO])—2 each
- Waste storage facility—3 each
- Watering facility—9 each
- Wetland restoration/enhancement—12 acres

Monitoring activities specifically related to the riparian restoration tasks targeted in the implementation plan were conducted through joint efforts between the Clearwater SWCD, ISWCC, Nez Perce Tribe, Idaho Association of Soil Conservation Districts (IASCD), and DEQ (Appendix C).

The NRCS field staff has protocols for follow-up field evaluations on their installation of management and structural practices (Clearwater SWCD 2000).

Jim Ford Creek Watershed Enhancement Project (2001–2002)

The Clearwater SWCD received funding through the EPA §319 Clean Water Grant to implement the WQPA on Jim Ford Creek. The §319 grant funds furthered the work in the Jim Ford Creek watershed to address nonpoint source pollution and improve water quality. The Jim Ford Creek Watershed Enhancement Project consisted of four major subprojects partnering with IDL, CHD, IDFG, Potlatch Corporation, and private landowners.

Subproject 1 (Idaho Department of Lands)

IDL implemented three projects on state endowment land in the Jim Ford Creek watershed that was consistent with those BMPs identified in the WRS developed for Jim Ford Creek as part of the TMDL implementation plan. These practices focused primarily on riparian areas in the upper portion of the watershed and targeted nonpoint source pollution conditions detrimental to water quality identified in the Jim Ford Creek TMDL. Those conditions included high instream temperatures, and excessive nutrients and bacteria.

The three projects were located on Miles Creek (tributary to Jim Ford Creek), Wilson Creek (tributary to Miles Creek), and Space Creek (tributary to Grasshopper Creek). All three of these projects were completed between 2000 and 2002.

Miles Creek Project—The project area contained natural meadows along Miles Creek that have historically been grazed by livestock. IDL leases grazing rights to a local cattlemen's association that was responsible for livestock management and control, and fence maintenance. The association had been active in helping IDL develop a pasture system of fences to protect water quality and tree plantings in the area. However, it is difficult to keep livestock out of the meadows and streams, which are primary sources of both forage and water.

This project rehabilitated 3.64 miles of stream reach by constructing livestock exclusion fences, planting a riparian zone with woody plants and trees, reestablishing nonfunctional portions of the stream, replacing outdated and undersized culverts to meet 50-year flood events, and raising and rocking a section of road where it is close to and crosses Miles Creek. Two cattle guards were also installed on the main Winter Creek Road.

In places, the existing state gravel road has been impeding stream flow due to improperly sized culverts, as well as a source of sediment when the creek exceeded its banks at high flow. Water backed up behind a portion of the road during snowmelt in the spring, inundating the meadow and becoming a source of nutrients and bacteria into Miles Creek. Multiple culverts were installed at each of five locations to allow a natural drainage pattern. The road was raised in places to allow for larger culverts to fit properly in the road system.

The following is a composite of work completed:

- Installed road rocking and culvert
- Completed 3.64 miles of riparian fence construction
- Planted 9,200 willow cuttings
- Planted 3,300 lodgepole pine seedlings
- Planted 1,100 dogwood seedlings
- Planted 2,500 hawthorn seedlings
- Planted 100 alders, 100 cottonwoods, and 200 spireas
- Completed one-quarter mile of stream rehabilitation and realignment

Wilson Creek Project—This project rehabilitated 1.5 miles of stream reach by planting a riparian zone with woody plants, and the surrounding meadows with conifer trees. IDL leases grazing rights to the same cattlemen's association as in Miles Creek. The riparian plantings served as both a source of shade to cool the stream and a filtration zone for nutrients and bacteria. The willow and other brush plantings along with the conifers were planted within a 16-acre area of adjacent meadows along Wilson Creek. No livestock exclusion fences were necessary along Wilson Creek after the cattlemen's association constructed a pasture division fence that provided for total livestock exclusion since 2000.

Space Creek Project—The Space Creek project was similar to the Miles and Wilson Creeks projects in scope; 1.18 miles of riparian fence was built on a 25-foot setback on either side of Space Creek. The riparian zone was planted with woody plants and conifer trees and two rocked water gaps for livestock watering were installed.

The monitoring of all the component practices that were installed on all three projects was jointly accomplished by the IDL staff and the grazing allotment leaseholder. The leaseholder monitored and maintained the entire riparian fence that had been installed. The IDL field staff monitored all of the riparian plantings for survival and heartiness. Nutrients, pathogens, and temperature monitoring were completed by the IASCD monitoring staff during the 2003 and 2004 field seasons (IASCD 2005). These data are discussed in Appendix C.

Subproject 2 (Potlatch Corporation)

The Potlatch Corporation completed two projects on Potlatch-owned land in the Jim Ford Creek watershed in 2002. Like the projects implemented by IDL above, these projects addressed nonpoint source pollution associated with grazing issues and excessive nutrients, bacteria and temperature near Winter Creek and sediment transport issues and potential mass slope failure on a section of steep gradient on Green Road connecting to Jim Ford Creek.

Winter Creek Project—This project improved 6 miles of riparian zone adjacent to Winter Creek. All grazing was permanently eliminated in the Winter Creek watershed. The overall stream health and water quality has improved with natural vegetation regeneration, improved and stabilized stream banks, and the reduction in sediment and nutrients entering Winter and Jim Ford Creeks.

The following BMPs have been completed on this project:

- Built 6 miles of riparian fence (Figure 4).
- Relocated and built new livestock corrals (Figure 5).
- Installed 2 new cattle guards on Winter Creek Road.
- Built an off-site livestock watering pond.
- Planted 3,000 pine seedlings along Winter Creek.

Figure 4. Riparian fencing.

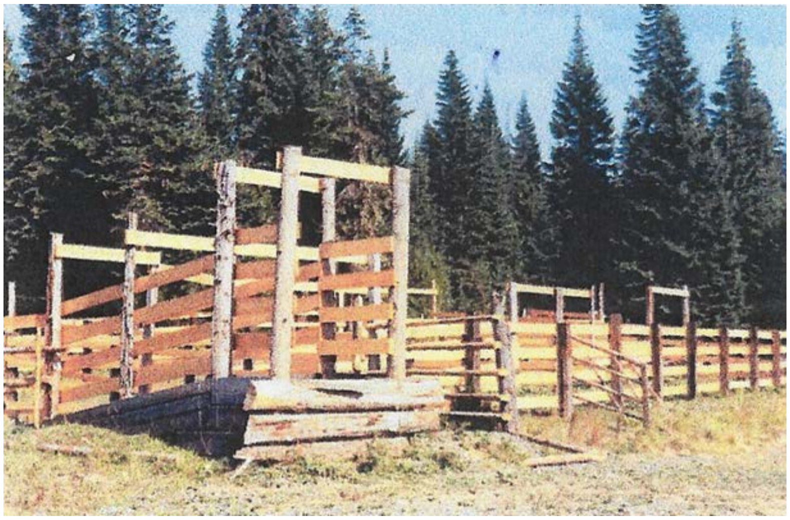

Figure 5. Bennett Creek Grazing Association—new corral and loading chute.

Green Road Project**—**An existing road (Green Road) on Potlatch Corporation property, purchased from the United States Forest Service in the mid-1990s had a mass failure on a steep section of road approximately 100 feet wide and 800 feet long reaching to Jim Ford Creek.

The Jim Ford Creek TMDL (DEQ et al. 2000) noted there were problems with sediment and large cobble filling pools and moving the channel in the lower reach of Jim Ford Creek.

The Green Road Project stabilized and repaired the slope failure using gabion baskets and rock, installed 240 feet of 18-inch steel culverts in key locations for proper drainage, and rocked one-half mile of road down to Jim Ford Creek to prevent further sediment delivery to the lower reach of Jim Ford Creek.

Work completed on that project consisted of the following:

- Installed 240 feet of 18-inch culvert.
- Applied 640 cubic yards (yd^3) of crushed aggregate to road surface.
- Reshaped portions of problem road area.

Monitoring of all the component practices that were installed on both projects was accomplished by Potlatch Corporation staff and the Bennett Creek grazing allotment leaseholder. The leaseholder monitored and maintained the entire riparian fence that had been installed. The riparian plantings were monitored for survival and heartiness by the Potlatch Corporation forestry staff. A private consultant provided photo point documentation. The Potlatch Corporation forestry staff monitored any changes in sediment transport off the Green Road due to adverse overland flow conditions.

Subproject 3 (Clearwater Highway District)

Each year precipitation from winter snowmelt, spring thaws, and localized thunderstorms cause serious runoff problems. The soil type resists water entry, resulting in a flashy, concentrated runoff that causes water over roadways, gully washing, bank erosion, and increased turbidity in the streams.

As a program for runoff control, the CHD has maintained an aggressive process of rock lining most of their drainage ditches (to slow the water down for better water infiltration), replacing outdated and undersized culverts, and seeding steep cut banks. Those BMPs have been very effective in targeting adverse road conditions and water conveyance by reducing flows and sediment transport detrimental to water quality as identified in the Jim Ford Creek TMDL. Most of the BMPs are associated with each of the previously mentioned road projects.

The following BMPs were installed in between 2000 and 2002 (Figure 6 and Figure 7):

Wilson Road

- 168 yd^3 of pit run rock (ditch armoring)
- 144 yd^3 of 5/8-inch gravel (road surfacing)
- 45 feet of 4 x 5-foot steel culvert
- 30 feet of 18-inch steel culvert

Chapman Road

- 36 yd^3 of 5/8-inch gravel (road surfacing)
- Two 15-inch x 32-foot culverts replaced
- 12 yd^3 rock riprap (culvert splash pad)

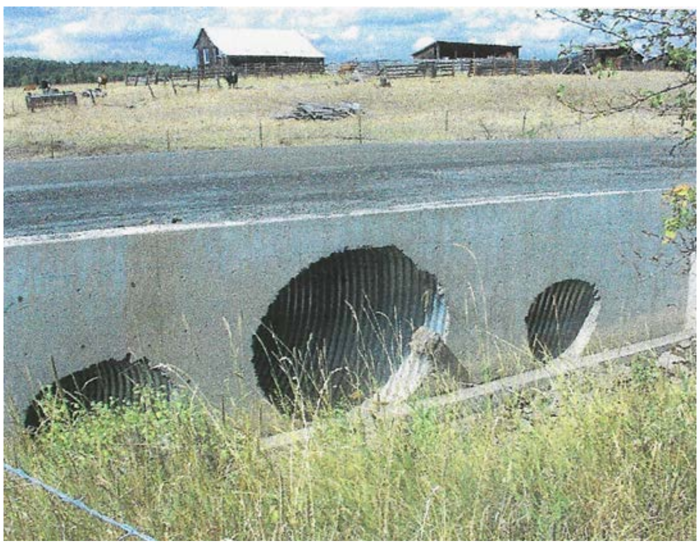

Figure 6. Newly installed culvert.

The CHD road crews performed regular visual monitoring of the culverts and road system for sustainability and effectiveness. All culverts, road ditches, and sediment traps were monitored for flow characteristics directly proportional to runoff events. Appropriate maintenance was carried out as necessary.

Figure 7. Streambank stabilization (rock riprap).

Subproject 4 (Private Landowners)

In keeping with the aggressive riparian restoration strategies laid out in the Jim Ford Creek TMDL implementation plan, the Clearwater SWCD realized the need to focus on other possible sources of nutrient and bacteria loads in the watershed. The AFO sites were negatively influencing the water quality of various tributaries to Jim Ford Creek. Two of the projects focused on feedlot restoration with the third project focusing on wetland restoration and enhancement.

Feedlot Restoration 1 (AFO)—The first feedlot restoration site was located in the Heywood Creek drainage and supported a 120 cow-calf livestock operation. This operation lacked the infrastructure to properly house and feed the number of animals on the site (Figure 8). The Clearwater SWCD worked with the landowner to design and construct a complete AFO facility that included the following:

- 6,000-square foot (ft^2) covered manure stacking pad and loafing area with a stanchion system for feeding
- 200 feet of pipeline
- 650 feet of corral fence
- 380 feet of gutter system
- 1 water trough system

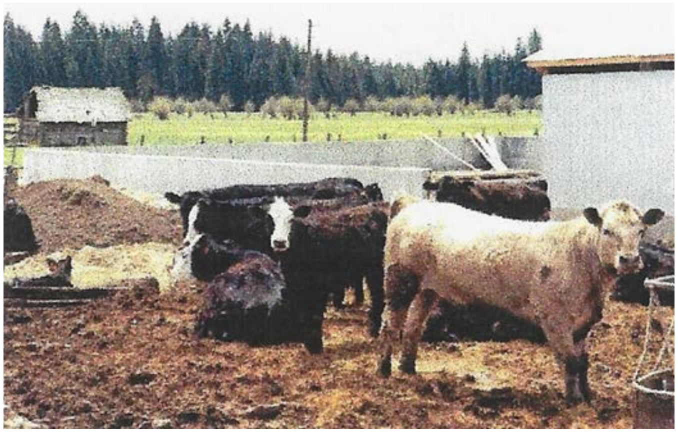

Figure 8. Feedlot condition before project.

For this AFO facility, two buildings were constructed with sidewalls to properly manage the feeding and manure storage for the 120 cow-calf livestock operation (Figure 9). A fence was constructed and a corral system within the feedlot complex was created to effectively manage the rotation and movement of the animals to reduce the impact of soil distribution and potential water quality problems. A pipeline was installed to convey water from the supply source. A roof runoff system was constructed by using a series of bermed and fenced ditches from the buildings to collect and transfer all clean, uncontaminated roof runoff at the feedlot site to a suitable outlet offsite. The ditches consisted of 6-inch perforated drain tile, covered with filter cloth and drain rock. The ditches were also fenced on both sides to exclude livestock access.

Figure 9. Feedlot project under construction.

Follow-up monitoring was performed at the mouth of Heywood Creek by IASCD and DEQ as part of an overall monitoring plan. This feedlot operation was maintained and managed for the life of the contract to effectively manage feeding and proper disposal of all solid waste. The operation was also managed to ensure that Heywood Creek's water quality will not be compromised from animal waste leaving the site.

Feedlot Restoration 2 (AFO)—The second feedlot restoration site was located in the Grasshopper Creek drainage and supported a 60 cow-calf livestock operation. This project, half the size of restoration 1, mirrored the BMPs that were implemented. The only added practice was two grade stabilization structures that were installed to capture and divert upland runoff from entering the corral complex.

BMPs installed on this livestock restoration site included: a 3,852 ft^2 covered manure stacking pad/loafing area, with a stanchion system for feeding, pipeline for watering livestock, gutter system and drain for roof runoff water conveyance, and two grade stabilization structures to capture upland runoff and divert it away from the corral system (Figure 10).

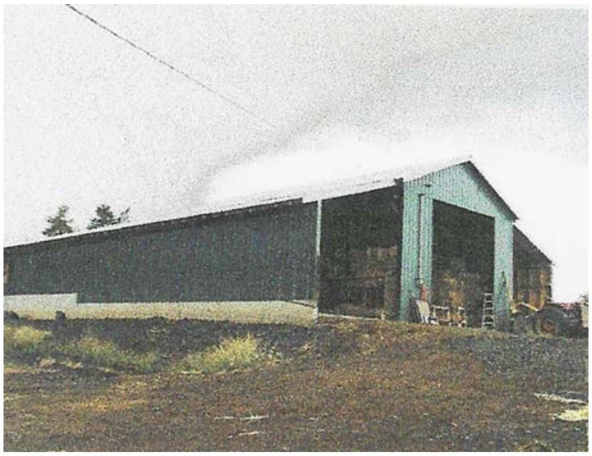

Figure 10. Barn complex after feedlot restoration project.

Chapman Road Wetland Restoration—The Weippe Prairie historically consisted of wetland complexes, serving an important stop for migratory waterfowl and home for numerous wetland associated wildlife species. Over time, agricultural development drained and diminished wetland acres. Due to the elevation and flatness of the prairie today, many areas remain inundated with water most of the spring, which makes it difficult to maintain agricultural practices (Figure 11).

The Chapman Road wetland restoration is the last of the private landowner projects in the Weippe Prairie installed between 2000 and 2002. The 25-acre Chapman Wetland was completed in fall 2002 with help from landowners, IDFG, ISWCC, Clearwater SWCD, and NRCS. A 30-year contract was signed by the landowners and associated agencies to enhance and manage this wetland for years to come.

Construction consisted of numerous deep and shallow water complexes ranging from marshy areas less than 1-foot deep to areas exceeding 8 feet. For the safety of adjacent landowner property and to control the volume of stored water in the complex, open-ended berms, culverts, and a water control structure were incorporated.

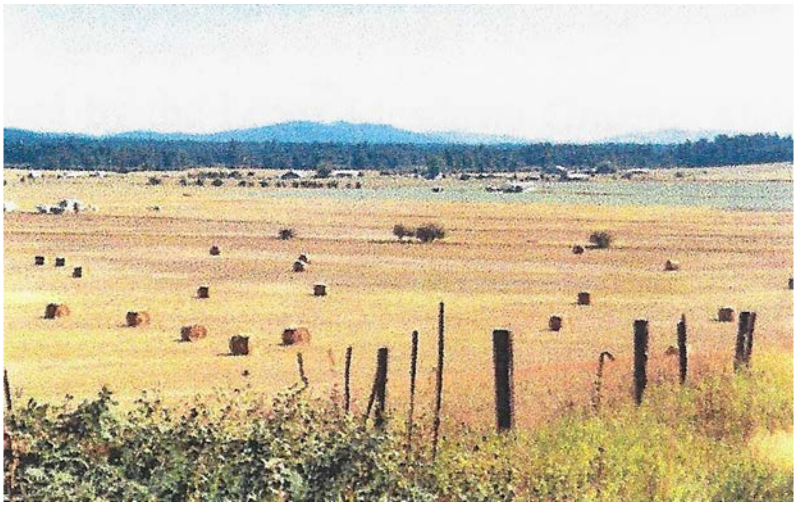

Figure 11. Beginning stage of wetland restoration.

The goal of the wetland project was to enhance, restore, protect, manage, and maintain the functional values of the wetland thereby conserving natural resource values including fish and wildlife habitat, water quality improvement, aesthetic values and environmental education (Figure 12). IDFG secured additional funding from the United States Fish and Wildlife Service to further develop the wetland. Funding included the procuring wetland vegetative plantings of trees, shrubs, sedges, and rushes. The additional funding package included dollars for an interpretive center/viewing station (built in 2003), and a maintenance budget. This 25-acre wetland has been the site for wetland training classes for high school students each year since it was built.

The major landowner, Mr. Chapman, purchased an additional 140-acre parcel of land across the road from this wetland and enrolled 100 acres into an NRCS-sponsored federal Wetland Reserve Program for the life of that property (Clearwater SWCD 2003).

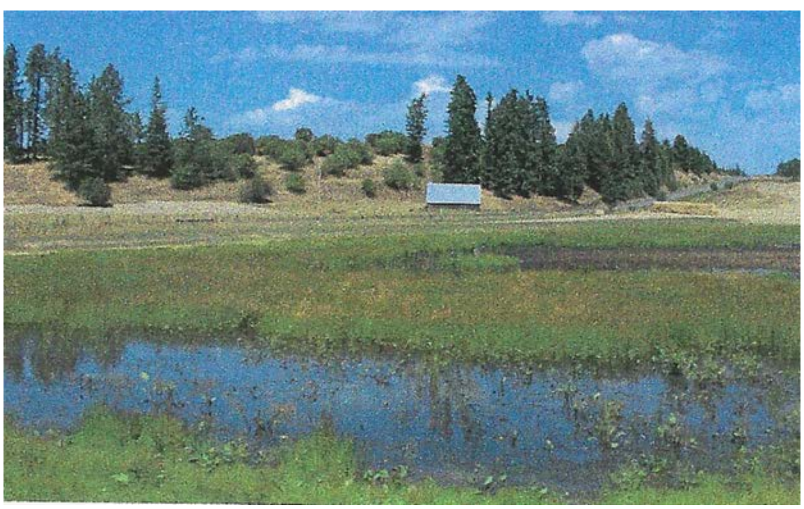

Figure 12. Completed Chapman Road wetland.

4.6 Empire Lumber Company—Enhancements in Stormwater Planning and Management

The Empire Lumber Weippe Operations mill has been covered by the EPA NPDES MSGP, including all inspection, monitoring, and reporting requirements. The operation verified coverage under the new MSGP 2015 permit, an updated Stormwater Pollution Prevention Plan (SWPPP), and are taking the four consecutive quarters of stormwater samples for the required lab analysis. No MSGP stormwater sample has exceeded the MSGP benchmark standards since Empire Lumber took over facility ownership. EPA inspectors have been onsite, and verified compliance with all applicable permit requirements. The following lists enhancements made since the Jim Ford Creek TMDL was written in 2000—most occurred after Empire Lumber purchased the facility in 2005.

Stormwater management improvement enhancements initiated by Empire Lumber include the following:

- Installed a drain and pipe system (designed by Reidesel Engineering) to drain all facility log yards and much of the rest of the facility. This effort minimized runoff from the disturbed surface areas on the facility, instead routing that potentially sediment-laden runoff, including log irrigation runoff, into a settling pond on the southwest end of the property.
- Extensive rocking and gravelling of the log yards and areas with disturbed surface. This effort made the log yards more accessible year round, minimized track out of sediment by mobile equipment, and cut down on erosion by significantly improving infiltration.
- Established a protocol in the facility SWPPP to monitor water levels in the southwest corner settling pond and use pumps to prevent overflow into the Weippe storm drain system, instead routing any excess water down a south-central draw through 200 yards of healthy vegetation including some riparian vegetation and a settling pond before reaching the lone facility outfall. This effort ensured that potentially sediment-laden water (which also includes contributions from offsite areas to the facility's north and east) outflows would be absorbed in that typically dry draw or filtered by vegetation before reaching the outfall.
- Reclaimed a large percentage of wood and yard debris previously piled on the south side of the property north of the facility outfall. This effort minimized a potential source of leachates above the facility outfall.
- Established a system of culverts, contouring, rock surfacing, and revegetation to minimize impacts of facility activities on waterways through the property to minimize impacts to surface water and outflows.
- Added a 27-acre parcel on the north side, across Pleasant Acres Road. This area drains mostly into itself or the historical mill property and is mostly grass surfaced with limited surface disturbances. It has provided more options for storage or future activities in areas where runoff can be practically managed.
- Rebuilt the large log mill in 2009 to be maximally efficient with near 100% containment of hazardous materials and potential storm water hazards. At the same time, containment at the historic log mill was significantly enhanced. These efforts minimized exposure of potential pollutants to stormwater, cut down on wood by-product volume, and enhanced handling of those by-products to minimize stormwater exposure.

- The facility is installed an impervious surface pad around the shop and equipment parking area in spring 2016 which drains into an oil/water separator, with the runoff then routed to the southwest side settling pond. This effort will capture most or all potential pollutants from the shop, equipment maintenance, and equipment storage area, keeping those potential pollutants from reaching storm or ground water.
- Generally, operational facility managers are fully aware of environmental regulations and considerations and have expert help onsite regularly and available for support as needed. This effort has resulted in establishing management and housekeeping policies that ensure compliance with applicable environmental regulations and being ecologically good neighbors.

4.7 Future Strategy

Continued monitoring will determine the effectiveness of current and future BMP implementation. Continuing to reduce nonpoint pollutant sources will be a priority in the Jim Ford Creek watershed with continued monitoring to assess beneficial use support in the subbasin. The implementation plan for the Jim Ford Creek watershed will be updated with input from the Jim Ford Creek WAG to prioritize restoration work that needs to be completed or augmented within the subbasin.

DEQ will assess water quality status while developing the biennial Integrated Report and 5-year TMDL review processes. DEQ will continue to collect water quality data to determine beneficial use support.

5 Total Maximum Daily Loads

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

Load capacity can be summarized by the following equation:

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

Where:

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

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

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

Another step in a load analysis is quantifying current pollutant loads by source. This step allows for the specification of load reductions as percentages from current conditions, considers equities in load reduction responsibility, and is necessary for pollutant trading to occur. A load is fundamentally a quantity of pollutant discharged over some period of time and is the product of concentration and flow. Due to the diverse nature of various pollutants, and the difficulty of strictly dealing with loads, the federal rules allow for "other appropriate measures" to be used when necessary (40 CFR 130.2). These other measures must still be quantifiable and relate to water quality standards, but they allow flexibility to deal with pollutant load 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 temperature, EPA allows for seasonal or annual loads.

5.1 Instream Water Quality Targets

For the Jim Ford Creek temperature TMDLs, we used a PNV approach. The Idaho water quality standards include a provision (IDAPA 58.01.02.200.09) that if natural conditions exceed numeric water quality criteria, exceedance of the criteria is not considered a violation of water quality standards. In these situations, natural conditions essentially become the water quality standard, and for temperature TMDLs, the natural level of shade and channel width become the TMDL target. The instream temperature that results from attaining these conditions is consistent with the water quality standards, even if it exceeds numeric temperature criteria. Appendix A provides further discussion of water quality standards and natural background provisions.

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

5.1.1 Factors Controlling Water Temperature in Streams

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

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

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

5.1.2 Potential Natural Vegetation for Temperature TMDLs

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

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

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

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

5.1.2.1 Existing Shade Estimates

Existing shade was estimated for eight AUs from visual interpretation of aerial photos. Estimates of existing shade based on plant type and density were marked out as stream segments on a 1:100,000 or 1:250,000 hydrography taking into account natural breaks in vegetation density. Stream segment length for each estimate of existing shade varies depending on the land use or landscape that has affected that shade level. Each segment was assigned a single value representing the bottom of a 10% shade class (adapted from the cumulative watershed effects process, IDL 2000). For example, if shade for a particular stream segment was estimated somewhere between 50% and 59%, we assigned a 50% shade class to that segment. The estimate is based on a general intuitive observation about the kind of vegetation present, its density, and stream width. Streams where the banks and water are clearly visible are usually in low shade classes (10%, 20%, or 30%). Streams with dense forest or heavy brush where no portion of the stream is visible are usually in high shade classes (70%, 80%, or 90%). More open canopies where portions of the stream may be visible usually fall into moderate shade classes (40%, 50%, or 60%).

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

Solar Pathfinder Field Verification

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

At each sampling location, the Solar Pathfinder was placed in the middle of the stream at about the bankfull water level. Ten traces were taken following the manufacturer's instructions (i.e., orient to south and level). Systematic sampling was used because it is easiest to accomplish without biasing the sampling location. For each sampled segment, the sampler started at a unique location, such as 50 to 100 meters (m) from a bridge or fence line, and proceeded upstream or downstream taking additional traces at fixed intervals (e.g., every 50 m, 50 paces, etc.).

Alternatively, one can randomly locate points of measurement by generating random numbers to be used as interval distances.

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

The results of the Solar Pathfinder field verification revealed that the original aerial interpretation largely overestimated existing shade by about one 10% shade class (Table 6). Of the 10 field sites, 4.5 showed overestimates of one shade class, 4 showed correct estimations, and 1.5 were overestimates by two or more shade classes. The overall average overestimate was 9% ± 5.58 (average ± 95% C.I.). These data were used to correct the existing shade estimations at the site locations and to "calibrate the eyes" for a second round of aerial interpretation.

Table 6. Solar Pathfinder field verification results for the Jim Ford Watershed.

aerial class	pathfinder actual	pathfinder class	delta		Site Name
60	49.98	50	10		Jim Ford 1
80	71.12	70	10		Jim Ford 2
30	25.96	20	10		Grasshopper
30	27.64	20	10		Heywood
90	92.25	90	0		Heywood trib 1
90	92.84	90	0		Heywood trib 2
40	46.65	40	0		Wilson
60	58.48	50	10		Winter 1a
80	58.48	50	30		Winter 1b
60	49.37	40	20		Winter 2
50	55.94	50	0		Winter 3
			9	average	
			9.44	std dev	
			5.58	95%CI	

5.1.2.2 Target Shade Determination

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

Natural Bankfull Widths

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

Since, natural bankfull width may not be known or interpreted from aerial photo interpretation and may not reflect existing bankfull widths, this parameter must be estimated from available information. We used regional curves for the major basins in Idaho—developed from data compiled by Diane Hopster of the Idaho Department of Lands—to estimate natural bankfull width (Figure 13).

For each stream evaluated in the load analysis, natural bankfull width was estimated based on the drainage area of the Clearwater curve from Figure 13. Although estimates from other curves were examined (i.e., Spokane, Kootenai, and Pend Oreille), the Clearwater curve was ultimately chosen because of its proximity to the Jim Ford Creek watershed and similarities in climate and geology. Existing width data should also be evaluated and compared to these curve estimates if such data are available. However, for the Jim Ford watershed, only a few BURP sites exist, and bankfull width data from those sites represent only spot data (e.g., only three measured widths in a reach just several hundred meters long) that are not always representative of the stream as a whole.

In general, we found BURP bankfull width data to generally agree with natural bankfull width estimates from the Clearwater basin curve and chose not to make natural widths any smaller than these Clearwater basin estimates for the tributary water bodies. Natural bankfull width estimates for each stream in this analysis are presented in Table 7. The load analysis tables (Appendix D) contain a natural bankfull width and an existing bankfull width for every stream segment in the analysis based on the bankfull width results presented in Table 7. Existing widths and natural widths are the same in the load tables when there are no data to support making them differ.

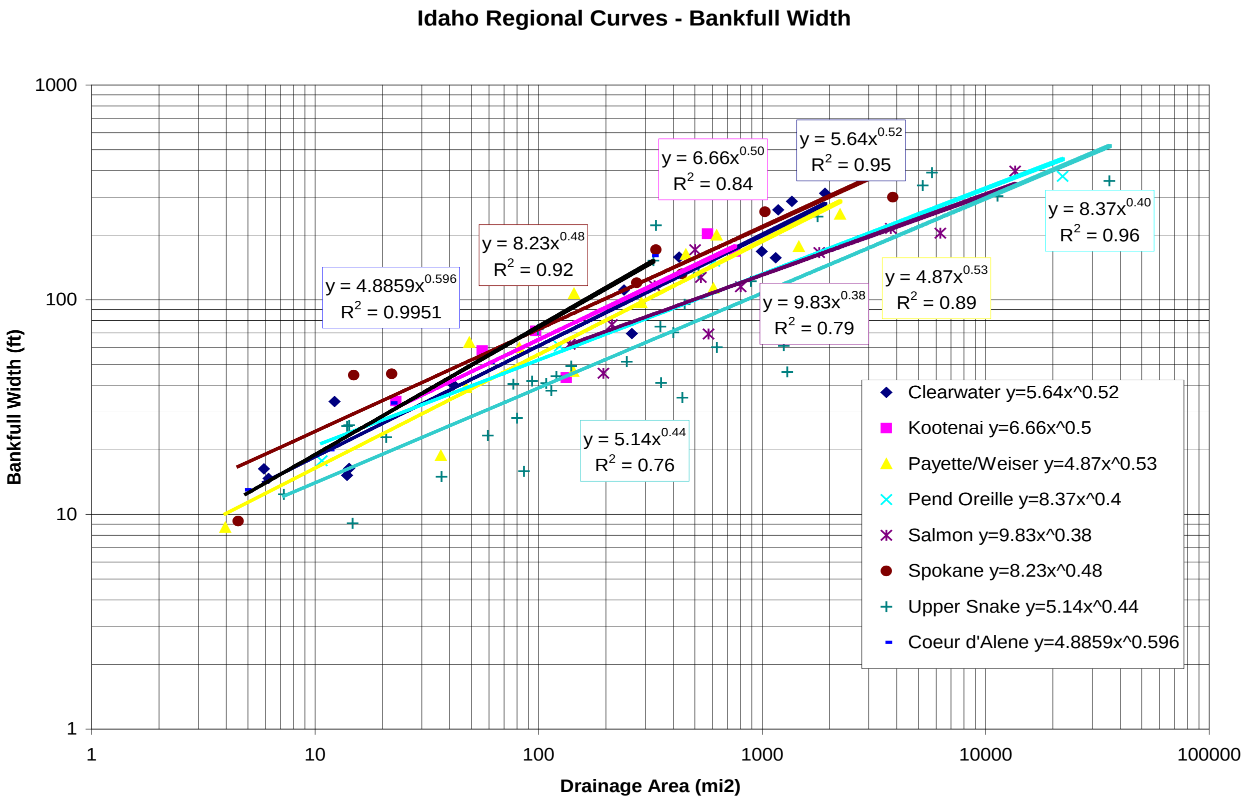

Figure 13. Bankfull width as a function of drainage area.

Table 7. Bankfull width estimates for various locations within the Jim Ford watershed.

Location	area (sq mi)	Spokane (m)	Kootenai (m)	PendOreille (m)	Clearwater (m)	Field Data (yr)
Jim Ford @ mouth	100.8	23	20	16	19	12.9(97), 16.8(04), 14.8(14)
Jim Ford bl Winter Creek	70.5	19	17	14	16	
Jim Ford bl Grasshopper Creek	54.9	17	15	13	14	6.7(14)
Jim Ford ab Grasshopper Creek	39.1	15	13	11	12	8.5(97), 10.8(14)
Jim Ford bl Heywood Creek	24.9	12	10	9	9	
Jim Ford ab Heywood Creek	13.2	9	7	7	7	
Grasshopper Cr bl Space Cr	9.5	7	6	6	6	
Grasshopper Creek @ mouth	15.8	9	8	8	7	
Miles Creek @ mouth	4.9	5	4	5	4	
Heywood Creek @ mouth	11.7	8	7	7	6	3.7(05), 2.6(14)
Wilson Creek @ mouth	3.5	5	4	4	3	
Wilson Cr bl tributary (midway)	1.5	3	2	3	2	4.4(98)
Winter Creek @ mouth	11.6	8	7	7	6	
Winter Creek @ road loop	5.8	6	5	5	4	6.9(98), 3.1(14), 4.7(14)
037_02 upper tributary	2.49	4	3	4	3	
037_02 right fork of upper tributary	1.14	3	2	3	2	
037_02 lower tributary	1.14	3	2	3	2	
Kamiah Gulch @ Jim Ford	4.2	5	4	5	4	
un-named trib south of Weippe	2.8	4	3	4	3	
un-named trib bl Heywood Cr	1.2	3	2	3	2	

Design Conditions

The Jim Ford Creek watershed is found within the Northern Rockies level 3 ecoregion of McGrath et al. (2001), an ecoregion known for the merging of drier batholith forests (Douglas fir, ponderosa pine) meets Pacific maritime influenced forests (western redcedar, western white pine). Upper Jim Ford Creek is found in the Weippe Prairie level 4 ecoregion (McGrath et al.

2001), an area of gently sloping basalt plateau of loess and volcanic ash dominated soils. Forests are of mixed conifers – ponderosa pine, Douglas fir, grand fir, western redcedar, and western larch. Hay farming, grazing and logging are dominant activities. Although further to the east, the Weippe Prairie shares some similarities in vegetation to the Camas and Palouse Prairie regions to the west. Especially when it comes to hawthorn shrub dominated riparian areas. Lower Jim Ford Creek is found within the Lower Clearwater Canyons level 4 ecoregion (McGrath et al. 2001). Warmer and drier than surrounding hills, this region is known for savanna, Douglas fir and pondersosa pine. Riparian trees include western redcedar, western white pine, grand fir, and cottonwoods in valley bottoms.

Shade Curve Selection

To determine PNV shade targets for the Jim Ford Creek watershed, effective shade curves from the Clearwater National Forest were examined (Table 8) (Shumar and de Varona 2009). Additionally, for nonforest areas the hawthorn shade curves were used. The hawthorn shade curve was developed post-2009 and was used by DEQ in a variety of Palouse area temperature TMDLs (Paradise Creek, South Fork Palouse River, and Palouse River tributaries). The hawthorn community type is based on a shrub-dominated community with a canopy density of 83.5%, an average height of 4 meters and an overhang of 1 meter. The Weippe Prairie is known to have shallow soils over clay pans that limit vegetation growth. For prairie reaches of Jim Ford Creek and associated tributaries, DEQ used a hawthorn/grass mix shade curve based on an open meadow/shrub community with a canopy density of 92%, an average height of 2.4 meters and an overhang of 0.6 meters. These curves were produced using vegetation community modeling of Idaho plant communities. Effective shade curves include percent shade on the vertical axis and stream width on the horizontal axis. For Jim Ford Creek watershed, curves for the most similar vegetation type were selected for shade target determinations. Forested lands in the headwaters of most tributary streams were placed in the Clearwater North Fork Uplands forest type, whereas the canyon portion of Jim Ford Creek was prescribed the Clearwater North Fork Breaklands forest type. Tributary streams and upper Jim Ford Creek in the non-forested Weippe Prairie lands were placed in the hawthorn nonforest vegetation type.

Table 8. Shade curves for target determination for the Jim Ford Creek watershed.

Forest Types	Nonforest Types
Clearwater North Fork Breaklands	Hawthorn
Clearwater North Fork Uplands	Hawthorn/grass

5.2 Load Capacity

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

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

The PNV shade targets are shown in Appendix D (Tables D-1–D-9 and Figure D-1). The tables also show corresponding target summer loads (in kilowatt-hours per square meter per day [kWh/m^2/day] and kWh/day) that serve as the load capacities for the streams. Existing and target loads in kWh/day can be summed for the entire stream or portion of stream examined in a single load analysis table. These total loads are shown at the bottom of their respective columns in each table. Because load calculations involve stream segment area calculations, the segments channel width that typically only has one or two significant figures dictates the level of significance of the corresponding loads. One significant figure in the resulting load can create rounding errors when existing and target loads are subtracted. The totals row of each load table represents total loads with two significant figures in an attempt to reduce apparent rounding errors.

The AU with the largest target load (i.e., load capacity) was Jim Ford Creek (AU ID 17060306CL034_04) with 830,000 kWh/day (Table D-1). The smallest target load was in the Winter Creek tributaries AU (AU ID 17060306CL037_02) with 7,300 kWh/day (Table D-7).

5.3 Estimates of Existing Pollutant Loads

Regulations allow that loads "...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 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 the field-verified aerial photo interpretations. There are currently two NPDES-permitted point sources in the affected AUs. Like target shade, existing shade was converted to a solar load by multiplying the fraction of open stream by the solar radiation measured on a flat-plate collector at the NREL weather station. Existing shade data are presented in Appendix D, Tables D-1 to D-9 and Figure D-2. Like load capacities (target loads), existing loads in Tables D-1 to D-9 are presented on an area basis (kWh/m^2/day) and as a total load (kWh/day). Existing loads in kWh/day are also summed for the entire stream or portion of stream examined in a single load analysis table. The difference between target and existing load is also summed for the entire table. If the existing load exceeds target load, this difference becomes the excess load (i.e., shade deficit depicted in the shade deficit figure in Appendix D, Table D-3.

The AU with the largest existing load was Jim Ford Creek (AU ID17060306CL034_04) with 670,000 kWh/day (Table D-1). The smallest existing load was in the Winter Creek AU (AU ID17060306CL037_03) with 28,000 kWh/day (Table D-8).

5.4 Load and Wasteload Allocation

Because this TMDL is based on PNV, which is equivalent to background load, the load allocation is essentially the desire to achieve background conditions. However, to reach that objective, load allocations are assigned to nonpoint source activities that have affected or may affect riparian vegetation and shade as a whole. Therefore, load allocations are stream-segment specific and dependent upon the target load for a given segment. Tables D-1 to D-9 in Appendix D show the target shade and corresponding target summer load. This target load (i.e., load capacity) is necessary to achieve background conditions. There is no opportunity to further remove shade from the stream by any activity without exceeding its load capacity. Additionally, because this TMDL is dependent upon background conditions for achieving water quality standards, all tributaries to the waters examined here need to be in natural conditions to prevent excess heat loads to the system.

Table 9 shows the total existing, target, and excess loads and the average lack of shade for each water body examined. The size of a stream influences the size of the excess load. Large streams have higher existing and target loads by virtue of their larger channel widths. Table 9 lists the AUs in order of their excess loads, from highest to lowest. Therefore, large AUs tend to be listed first and small AUs last.

Although this TMDL analysis focuses on total solar loads, it is important to note that differences between existing and target shade, as depicted in the shade deficit figure (Appendix D, Figure D-3), are the key to successfully restoring these waters to achieving water quality standards. Target shade levels for individual reaches should be the goal managers strive for with future implementation plans. Managers should focus on the largest differences between existing and target shade as locations to prioritize implementation efforts. Each load analysis table contains a column that lists the lack of shade on the stream segment. This value is derived from subtracting target shade from existing shade for each segment. Thus, stream segments with the largest lack of shade are in the worst shape. The average lack of shade derived from the last column in each load analysis table is listed in Table 9 and provides a general level of comparison among streams.

Table 9. Total solar loads and average lack of shade for all waters.

Water Body/ Assessment Unit	Total Existing Load	Total Target Load	Excess Load (%Reduction)	Average Lack of Shade (%)
		(kWh/day)		
Jim Ford Creek Tributaries ID17060306CL035_02	440,000	230,000	220,000 (50%)	-39
Grasshopper Creek ID17060306CL036_02	200,000	65,000	130,000 (65%)	-40
Jim Ford Creek ID17060306CL035_03	330,000	280,000	52,000 (16%)	-11
Winter Creek ID17060306CL038_02	65,000	17,000	48,000 (74%)	-31
Grasshopper Creek ID17060306CL036_03	170,000	140,000	26,000 (15%)	-15
Winter Creek tributaries ID17060306CL037_02	33,000	7,300	26,000 (79%)	-32
Jim Ford Creek ID17060306CL034_04	670,000	830,000	0 (0%)	-3
Jim Ford Creek ID17060306CL035_04	230,000	320,000	0 (0%)	-1
Winter Creek ID17060306CL037_03	28,000	38,000	0 (0%)	0

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

Second-order AUs where the bulk of the small tributaries are located had the largest excess loads. The Jim Ford Creek tributaries AU (ID17060306CL035_02) includes 23 different tributary bodies, Grasshopper Creek AU (ID17060306CL036_02) includes 8 water bodies, most of which are on the Weippe Prairie. The relatively low gradient portions of the prairie are subject to the most agricultural conversion where the historic hawthorn shrub vegetation has been replaced by reed canary grass and other pasture grasses. These areas lack the most shade as a result.

The larger order streams are primarily in the forested canyon portion of the watershed where the stream enjoys shade from topography and a forest canopy that is largely undisturbed. The 4th-order AUs of Jim Ford Creek (ID17060306CL034_04 and ID17060306CL035_04) and the 3rd-order portion of Winter Creek (ID17060306CL037_03) all had no excess loads due to abundant shade.

The 3rd-order portions of Jim Ford Creek (ID17060306CL035_03) and Grasshopper Creek (ID17060306CL036_03) were intermediate in shade loss between the two extremes. These AUs are within the prairie region, but because they are wider streams, they have lower shade targets that make them less vulnerable.

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

The above PNV-style TMDL is replacing existing approved temperature TMDLs for the Jim Ford Creek watershed described in *Jim Ford Creek Total Maximum Daily Load* (DEQ et al. 2000). The previous temperature TMDL used differences in temperature to create percent reductions to be used as load allocations. The PNV-style temperature TMDL converts shade values to actual daily solar loads in kWh/day. Thus, the two allocation methods are not directly comparable. However, we show the percent reductions for the various streams for the two TMDLs in Table 10 below for illustration.

Table 10. Comparison between 2000 and 2015 TMDL allocations for all waters.

Stream Name	Assessment Unit Number	2000 Average Load Allocation (%)	2015 Average Load Allocation (%)
Jim Ford Creek	ID17060306CL034_04	31	0
Miles and Wilson Creeks (portion of AU)	ID17060306CL035_02	0	37
Kamiah Gulch (portion of AU)	ID17060306CL035_02	0	54
Heywood Creek (portion of AU)	ID17060306CL035_02	5	37
Jim Ford Creek	ID17060306CL035_03	10	16
Jim Ford Creek	ID17060306CL035_04	14	0
Grasshopper Creek	ID17060306CL036_02 ID17060306CL036_03	17	15–65
Winter Creek	ID17060306CL037_02 ID17060306CL037_03 ID17060306CL038_02	40	0–79

There are two conundrums created by this kind of comparison. For example, Miles and Wilson Creeks and Kamiah Gulch did not show exceedances of temperature criteria in the 2000 TMDL analysis, yet in 2015, these watersheds clearly lack shade. Also, the 4th-order segments of Jim Ford Creek had temperature criteria exceedances in 2000 but showed no shade deficit in 2015. The latter example can be explained by an accumulation of heat from the 2nd- and 3rd-order AUs above that result in higher temperatures in Jim Ford Creek in the canyon. Fortunately, abundant shade in these 4th-order AUs likely prevent further heating.

There are possible reasons for the first conundrum that cannot be answered at this time without more investigation. It is possible that the 2nd-order AUs, including Miles and Wilson Creeks and Kamiah Gulch, were adequately shaded in 2000 but are no longer shaded in 2015. Or these streams could be exceptionally cool or buffered in some way that despite shade deficits, they do not exceed temperature criteria.

There are two existing point source discharges with NPDES permits in the affected watershed and their wasteload allocations are addressed in the previous TMDL (DEQ et al. 2000). The Weippe WWTP does not discharge to a stream during the critical time period and did not receive a wasteload allocation for temperature. Timberline High School discharged as a point source to

Grasshopper Creek when the TMDL was written but has replaced the system with a drainfield and no longer discharges to Grasshopper Creek.

5.4.1 Water Diversion

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

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

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

Additionally, Idaho water quality standards indicate the following:

> The adoption of water quality standards and the enforcement of such standards is not intended to…interfere with the rights of Idaho appropriators, either now or in the future, in the utilization of the water appropriations which have been granted to them under the statutory procedure… (IDAPA 58.01.02.050.01)

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

5.4.2 Margin of Safety

The margin of safety in this TMDL is considered implicit in the design. Because the target is essentially background conditions, loads (shade levels) are allocated to lands adjacent to these streams at natural background levels. Because shade levels are established at natural background or system potential levels, it is unrealistic to set shade targets at higher, or more conservative, levels. Additionally, existing shade levels are reduced to the next lower 10% shade class, which likely underestimates actual shade in the load 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.

5.4.3 Seasonal Variation

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

5.4.4 Reasonable Assurance

Under CWA §319, each state is required to develop and submit a nonpoint source management plan. Idaho's most recent *Nonpoint Source Management Plan* was approved in March 2015 (DEQ 2015). The plan was submitted to and approved by the EPA. The plan identifies programs to achieve implementation of nonpoint source BMPs, includes a schedule for program milestones, outlines key agencies and agency roles, is certified by the state attorney general to ensure that adequate authorities exist to implement the plan, and identifies available funding sources.

Idaho's nonpoint source management program describes many of the voluntary and regulatory approaches the state will take to abate nonpoint pollution sources. One of the prominent programs described in the plan is the provision for public involvement, such as the formation of basin advisory groups and WAGs.

Idaho water quality standards refer to existing authorities to control nonpoint pollution sources in Idaho. Some of these authorities and responsible agencies are listed in Table 11.

Table 11. State of Idaho's regulatory authority for nonpoint pollution sources.

Authority	Water Quality Standard Citation	Responsible Agency
Rules Pertaining to the Idaho Forest Practices Act (IDAPA 20.02.01)	58.01.02.350.03(a)	Idaho Department of Lands
Solid Waste Management Rules and Standards (IDAPA 58.01.06)	58.01.02.350.03(b)	Idaho Department of Environmental Quality
Individual/Subsurface Sewage Disposal Rules (IDAPA 58.01.03)	58.01.02.350.03(c)	Idaho Department of Environmental Quality
Stream channel Alteration Rules (IDAPA 37.03.07)	58.01.02.350.03(d)	Idaho Department of Water Resources
Rathdrum Prairie Sewage Disposal Regulations (Panhandle District Health Department)	58.01.02.350.03(e)	Idaho Department of Environmental Quality/ Panhandle District Health Department
Rules Governing Exploration, Surface Mining and Closure of Cyanidation Facilities (IDAPA 20.03.02)	58.01.02.350.03(f)	Idaho Department of Lands
Dredge and Placer Mining Operations in Idaho (IDAPA 20.03.01)	58.01.02.350.03(g)	Idaho Department of Lands
Rules Governing Dairy Waste (IDAPA 02.04.14)	58.01.02.350.03(h)	Idaho State Department of Agriculture

Idaho uses a voluntary approach to address agricultural nonpoint sources; however, regulatory authority is found in the water quality standards (IDAPA 58.01.02.350.01–03). IDAPA 58.01.02.055.07 refers to the *Idaho Agricultural Pollution Abatement Plan* (Ag Plan) (ISWCC and DEQ 2015), which provides direction to the agricultural community regarding approved BMPs. A portion of the Ag Plan outlines responsible agencies or elected groups (soil and water conservation districts) that will take the lead if nonpoint source pollution problems need to be addressed. For agricultural activity, the Ag Plan assigns the local soil and water conservation districts to assist the landowner/operator with developing and implementing BMPs to abate nonpoint source pollution associated with the land use. If a voluntary approach does not succeed in abating the pollutant problem, the state may seek injunctive relief for those situations determined to be an imminent and substantial danger to public health or the environment (IDAPA 58.01.02.350.02(a)).

The Idaho water quality standards and wastewater treatment requirements specify that if water quality monitoring indicates that water quality standards are not being met, even with the use of BMPs or knowledgeable and reasonable practices, the state may request that the designated agency evaluate and/or modify the BMPs to protect beneficial uses. If necessary, the state may seek injunctive or other judicial relief against the operator of a nonpoint source activity in accordance with the DEQ director's authority provided in Idaho Code §39-108 (IDAPA 58.01.02.350). The water quality standards list designated agencies responsible for reviewing and revising nonpoint source BMPs: IDL for timber harvest activities, oil and gas exploration and development, and mining activities; ISWCC for grazing and agricultural activities; Idaho Transportation Department for public road construction; Idaho State Department of Agriculture for aquaculture; and DEQ for all other activities (IDAPA 58.01.02.010.24).

5.4.5 Construction Stormwater and TMDL Wasteload Allocation

There are currently two NPDES-permitted point sources in the affected watersheds (Table 12). The city of Weippe WWTP wasteload allocation was addressed in the previous TMDL (DEQ et al. 2000). The facility does not discharge during the critical time period for cold water aquatic life (July 1 through August 15) and does not require a temperature wasteload allocation. Empire Lumber has an industrial stormwater general permit because of their proximity to Grasshopper Creek, however, they too do not discharge during the critical time period and did not receive a temperature WLA. If a point source is proposed that would have thermal consequences on these waters, background provisions in Idaho water quality standards addressing such discharges (IDAPA 58.01.02.200.09; IDAPA 58.01.02.401.01) should be involved (Appendix A).

Table 12. NPDES permits in the Jim Ford Creek watershed.

Facility	Permit #	Water body	Comment
City of Weippe WWTP	ID0020354	Jim Ford Creek	No discharge May through December
Empire Lumber	IDR053050 Industrial stormwater GP	Grasshopper Creek	No discharge during July through August

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

5.4.5.1 Municipal Separate Storm Sewer Systems

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

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

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

5.4.5.2 Industrial Stormwater Requirements

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

Multi-Sector General Permit and Stormwater Pollution Prevention Plans

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

Industrial Facilities Discharging to Impaired Water Bodies

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

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

TMDL Industrial Stormwater Requirements

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

5.4.5.3 Construction Stormwater

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

Construction General Permit and Stormwater Pollution Prevention Plans

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

TMDL Construction Stormwater Requirements

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

Postconstruction Stormwater Management

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

5.4.6 Reserve for Growth

A growth reserve has not been included in this TMDL. The load capacity has been allocated to the existing sources in the watershed. Any new sources must obtain an allocation from the existing load allocation.

5.5 Implementation Strategies

Implementation strategies for TMDLs produced using PNV-based shade and solar loads should incorporate the load analysis tables presented in this TMDL (Appendix D, Tables D-1–D-9). These tables need to be updated, first to field verify the remaining existing shade levels and second to monitor progress toward achieving reductions and TMDL goals. Using the Solar Pathfinder to measure existing shade levels in the field is important to achieving both objectives. It is likely that further field verification will find discrepancies with reported existing shade levels in the load analysis tables. Due to the inexact nature of the aerial photo interpretation technique, these tables should not be viewed as complete until verified. Implementation strategies should include Solar Pathfinder monitoring to simultaneously field verify the TMDL and mark progress toward achieving desired load reductions.

DEQ recognizes that implementation strategies for TMDLs may need to be modified if monitoring shows that TMDL goals are not being met or significant progress is not being made toward achieving the goals. Reasonable assurance (addressed in section 5.4.4) for the TMDL to meet water quality standards is based on the implementation strategy. There may be a variety of reasons that individual stream segments do not meet shade targets, including natural phenomena (e.g., beaver ponds, springs, wet meadows, and past natural disturbances) and/or historic land-use activities (e.g., logging, grazing, and mining). It is important that existing shade for each stream segment be field verified to determine if shade differences are real and result from activities that are controllable. Information within this TMDL (maps and load analysis tables) should be used to guide and prioritize implementation investigations. The information in this TMDL may need further adjustment to reflect new information and conditions in the future.

5.5.1 Time Frame

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

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

5.5.2 Implementation Monitoring Strategy

Effective shade monitoring can take place on any segment throughout the Jim Ford Creek watershed and be compared to existing shade estimates seen in Appendix D, Figure D-2 and described in Tables D-1 to D-9. Those areas with the largest disparity between existing and target shade should be monitored with Solar Pathfinders to verify existing shade levels and determine progress toward meeting shade targets. Since many existing shade estimates have not been field verified, they may require adjustment during the implementation process. Stream segment length for each estimate of existing shade varies depending on the land use or landscape that has affected that shade level. It is appropriate to monitor within a given existing shade segment to see if that segment has increased its existing shade toward target levels. Ten equally spaced Solar Pathfinder measurements averaged together within that segment should suffice to determine new shade levels in the future.

5.5.3 Pollutant Trading

Pollutant trading (also known as 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 one of the tools available to meet reductions called for in a TMDL where point and nonpoint sources both exist in a watershed.

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 voluntary. Parties trade only if both are better off because of the trade, and trading allows parties to decide how to best reduce pollutant loads within the limits of certain requirements.

Pollutant trading is recognized in Idaho’s water quality standards at IDAPA 58.01.02.055.06. DEQ allows for pollutant trading as a means to meet TMDLs, thus restoring water quality limited water bodies to compliance with water quality standards. DEQ’s *Water Quality Pollutant Trading Guidance* sets forth the procedures to be followed for pollutant trading (DEQ 2010).

5.5.3.1 Trading Components

The major components of pollutant trading are trading parties (buyers and sellers) and credits (the commodity being bought and sold). Ratios are used to ensure environmental equivalency of trades on water bodies covered by a TMDL. All trading activity must be recorded in the trading database by DEQ or its designated party.

Both point and nonpoint sources may create marketable credits, which are a reduction of a pollutant beyond a level set by a TMDL:

- Point sources create credits by reducing pollutant discharges below NPDES effluent limits set initially by the wasteload allocation.
- Nonpoint sources create credits by implementing approved BMPs that reduce the amount of pollutant runoff. Nonpoint sources must follow specific design, maintenance, and monitoring requirements for that BMP; apply discounts to credits generated, if required; and provide a water quality contribution to ensure a net environmental benefit. The water quality contribution also ensures the reduction (the marketable credit) is surplus to the reductions the TMDL assumes the nonpoint source is achieving to meet the water quality goals of the TMDL.

5.5.3.2 Watershed-Specific Environmental Protection

Trades must be implemented so that the overall water quality of the water bodies covered by the TMDL are protected. To do this, hydrologically based ratios are developed to ensure trades between sources distributed throughout TMDL water bodies result in environmentally equivalent or better outcomes at the point of environmental concern. Moreover, localized adverse impacts to water quality are not allowed.

5.5.3.3 Trading Framework

For pollutant trading to be authorized, it must be specifically mentioned within a TMDL document. After adoption of an EPA-approved TMDL, DEQ, in concert with the WAG, must develop a pollutant trading framework document. The framework would mesh with the implementation plan for the watershed that is the subject of the TMDL. The elements of a trading document are described in DEQ's pollutant trading guidance (DEQ 2010).

6 Conclusions

Effective shade targets were established for water bodies in eight AUs based on the concept of maximum shading under PNV resulting in natural background temperature levels. Shade targets were derived from effective shade curves developed for similar vegetation types in Idaho. Existing shade was determined from aerial photo interpretation and partially field verified with Solar Pathfinder data. Target and existing shade levels were compared to determine the amount of shade needed to bring water bodies into compliance with temperature criteria in Idaho's water quality standards (IDAPA 58.01.02). A summary of assessment outcomes, including recommended changes to listing status in the next Integrated Report, is presented in Table 12.

Second-order AUs where the bulk of the small tributaries are located had the largest excess loads. The Jim Ford Creek tributaries AU (ID17060306CL035_02) includes 23 different tributary bodies, Grasshopper Creek AU (ID17060306CL036_02) includes 8 water bodies, most of which are on the Weippe Prairie. The relatively low gradient portions of the prairie are subject to the most agricultural conversion where the historic hawthorn shrub vegetation has been replaced by reed canary grass and other pasture grasses. These areas lack the most shade as a result. The larger order streams are primarily in the forested canyon portion of the watershed where the stream enjoys shade from topography and a forest canopy that is largely undisturbed. The 4th-order AUs of Jim Ford Creek (ID17060306CL034_04 and ID17060306CL035_04) and the 3rd-order portion of Winter Creek (ID17060306CL037_03) all had no excess loads due to abundant shade.

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

Table 13. Summary of assessment outcomes for temperature impairment.

Assessment Unit Name	Assessment Unit Number	Pollutant	TMDL Completed	Recommended Changes to Next Integrated Report	Justification
Jim Ford Creek	ID17060306CL034_04	Temperature	Yes	Remain in Category 4a	Excess solar load from a lack of existing shade
Jim Ford Creek tributaries	ID17060306CL035_02	Temperature	Yes	Remain in Category 4a	Excess solar load from a lack of existing shade
Jim Ford Creek	ID17060306CL035_03	Temperature	Yes	Remain in Category 4a	Excess solar load from a lack of existing shade
Jim Ford Creek	ID17060306CL035_04	Temperature	Yes	Remain in Category 4a	Excess solar load from a lack of existing shade
Grasshopper Creek	ID17060306CL036_02	Temperature	Yes	Remain in Category 4a	Excess solar load from a lack of existing shade
Grasshopper Creek	ID17060306CL036_03	Temperature	Yes	Remain in Category 4a	Excess solar load from a lack of existing shade
Winter Creek tributaries	ID17060306CL037_02	Temperature	Yes	Move from Category 3 to Category 4a	Excess solar load from a lack of existing shade
Winter Creek	ID17060306CL037_03	Temperature	Yes	Move to Category 2	No excess solar load or existing shade deficit
Winter Creek	ID17060306CL038_02	Temperature	Yes	Remain in Category 4a	Excess solar load from a lack of existing shade

This document was prepared with input from the public, as described in Appendix E. Following the public comment period, comments and DEQ responses will also be included in this appendix, and a distribution list will be included in Appendix G.

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GIS Coverages

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USDA – FSA Aerial Photography Field Office - 2013 National Agricultural Imagery Program (NAIP) 0.5m imagery

USDA – FSA Aerial Photography Field Office - 2015 National Agricultural Imagery Program (NAIP) 1.0m imagery

Glossary

§303(d)

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

Ambient

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

Anthropogenic

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

Assessment Unit (AU)

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

Beneficial Use

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

Beneficial Use Reconnaissance Program (BURP)

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

Exceedance

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

Fully Supporting

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

Load Allocation (LA)

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

Load	The quantity of a substance entering a receiving stream, usually expressed in pounds or kilograms per day or tons per year. Load is the product of flow (discharge) and concentration.
Load Capacity (LC)	How much pollutant a water body can receive over a given period without causing violations of state water quality standards. Upon allocation to various sources, a margin of safety, and natural background contributions, it becomes a total maximum daily load.
Margin of Safety (MOS)	An implicit or explicit portion of a water body's loading capacity set aside to allow for uncertainty about the relationship between the pollutant loads and the quality of the receiving water body. This is a required component of a total maximum daily load (TMDL) and is often incorporated into conservative assumptions used to develop the TMDL (generally within the calculations and/or models). The MOS is not allocated to any sources of pollution.
Natural Condition	The condition that exists with little or no anthropogenic influence.
Nonpoint Source	A dispersed source of pollutants generated from a geographical area when pollutants are dissolved or suspended in runoff and then delivered into waters of the state. Nonpoint sources are without a discernable point of origin. They include, but are not limited to, irrigated and nonirrigated lands used for grazing, crop production, and silviculture; rural roads; construction and mining sites; log storage or rafting; and recreation sites.
Not Assessed (NA)	A concept and an assessment category describing water bodies that have been studied but are missing critical information needed to complete a use support assessment.
Not Fully Supporting	Not in compliance with water quality standards or not within the range of biological reference conditions for any beneficial use as determined through the *Water Body Assessment Guidance* (Grafe et al. 2002).
Point Source	A source of pollutants characterized by having a discrete conveyance, such as a pipe, ditch, or other identifiable "point" of discharge into a receiving water. Common point sources of pollution are industrial and municipal wastewater.

Pollutant

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

Pollution

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

Potential Natural Vegetation (PNV)

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

Riparian

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

Stream Order

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

Total Maximum Daily Load (TMDL)

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

Wasteload Allocation (WLA)

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

	Wasteload allocations specify how much pollutant each point source may release to a water body.
Water Body	A stream, river, lake, estuary, coastline, or other water feature, or portion thereof.
Water Quality Criteria	Levels of water quality expected to render a water body suitable for its designated uses. Criteria are based on specific levels of pollutants that would make the water harmful if used for drinking, swimming, farming, or industrial processes.
Water Quality Standards	State-adopted and US Environmental Protection Agency-approved ambient standards for water bodies. The standards prescribe the use of the water body and establish the water quality criteria that must be met to protect designated uses.

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

Water Quality Standards Applicable to Salmonid Spawning Temperature

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

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

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

Natural Background Provisions

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

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

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

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Appendix B. Data Sources

Table B-1. Data sources for the Jim Ford Creek watershed assessment.

Water Body	Data Source	Type of Data	Collection Date
Jim Ford Watershed	DEQ Lewiston Regional Office	Solar Pathfinder effective shade and stream width	Summer 2015
Jim Ford Watershed	DEQ State Technical Services Office	Aerial photo interpretation of existing shade and stream width estimation	Summer 2015
Jim Ford Creek	DEQ IDASA Database	Temperature	2015

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Appendix C. Implementation Monitoring in Jim Ford Creek (Idaho Association of Soil Conservation Districts)

The Idaho Association of Soil Conservation Districts (IASCD) collected water quality data from Jim Ford Creek and several of its tributaries from April 2003 through July 2004. The monitoring project was initiated to evaluate water quality in the Jim Ford Creek watershed as a follow-up to the TMDL.

The monitoring data from the 2003–2004 report reviews monitoring results utilizing the following parameters:

- Total phosphorus (TP)
- Orthophosphorus (OP)
- Bacteria (Escherichia coli)
- Nitrogen components—NO2, NO3, NH3
- Total suspended solids (TSS)
- Instantaneous water temperature
- Turbidity
- Dissolved oxygen (DO)
- Percent (%) Saturation
- Total dissolved solids (TDS)

The University of Idaho Analytical Science Laboratory (UIASL) conducted all inorganic parameter testing and Anatek Labs, Inc. performed bacteria analysis.

Some key assumptions of the TMDL were:

- Fine sediment is not degrading water quality in Jim Ford Creek.
- Coarse sediment is impairing salmonid spawning and rearing in lower Jim Ford Creek.
- Temperature exceedances are common throughout the watershed.
- Jim Ford Creek is impaired by excess nutrients, which negatively affect dissolved oxygen levels in the stream.
- E. coli bacteria levels exceed water quality standards during summer months.

The Jim Ford Creek Watershed Advisory Group and supporting agencies created a TMDL implementation plan consisting of a Watershed Restoration Strategy (WRS). The WRS provided the framework necessary to implement BMPs aimed at improving water quality through practices such as riparian restoration, bank stabilization, animal waste systems, conservation cropping and tillage practices, and livestock exclusion.

Monitoring Site Descriptions

The seven monitoring sites selected for the Jim Ford Creek Watershed Enhancement Project were sites where data was initially collected for TMDL development in 1998. Below is a general description of site locations; these sites are also illustrated graphically in Figure 1.

JF-1 Jim Ford Creek (mouth)

JF-2 Winter Creek (below agricultural influence)

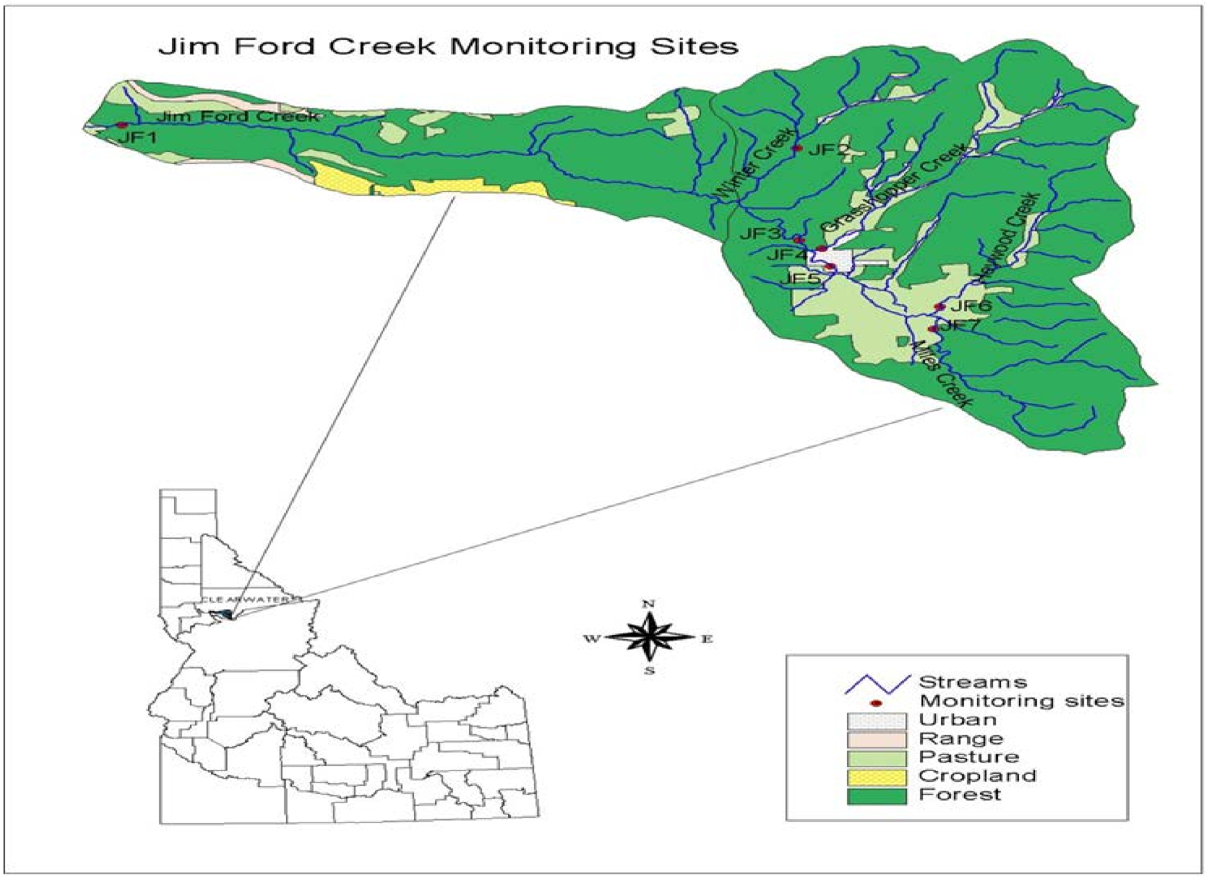
JF-3 Jim Ford Creek (downstream of City of Weippe WWTP)

JF-4 Grasshopper Creek (mouth)

JF-5 Jim Ford Creek (upstream of City of Weippe WWTP)

JF-6 Heywood Creek (mouth)

JF-7 Miles Creek (mouth)



Summary of Water Quality Monitoring (comparison between 1998 and 2003–2004)

Improvements in water quality were noticeable in a number of streams assessed during the monitoring study and water quality generally improved as one moved downstream from the headwaters to the mouth of Jim Ford Creek. It was likely that intensive land use on the Weippe Prairie accounted for the elevated numbers seen in the data set, while the relatively untouched, rugged canyon lands found in the middle section of Jim Ford Creek may allow pollutants to settle out, assimilate and/or be diluted, thereby accounting for the improved water quality observed at the mouth.

Contrary to the conclusions of the TMDL, fine sediment appeared to be an issue in the headwater tributaries as well as the upper section of Jim Ford Creek itself. While TSS levels never exceeded the instantaneous target of 80 mg/L, it appeared that sediment levels were high enough to partially account for the high levels of phosphorus observed in the upper watershed.

Excessive stream temperature was a major concern throughout the Jim Ford Creek watershed. Aquatic organisms from microbes to fish were dependent on certain temperature ranges for their optimal health. Aquatic insects were sensitive to temperature and would move in a stream to find their optimal temperature. Temperature was also critical for fish spawning and embryo development. If stream temperatures are outside of optimal levels for prolonged periods of time, organisms become stressed and may die or be unable to reproduce. Temperature typically had an inverse relationship with DO. DO levels throughout the system were low during the months when water temperatures were high and flows were minimal.

Total phosphorus loading was more of an issue in the upper watershed, but violations also occurred at the mouth albeit much less frequently.

Bacteria levels in 2004 were noticeably lower than in 1998 throughout the watershed, likely due to the implementation of livestock exclusions, and manure management practices.

An abbreviated summary for each site follows.

<u>Winter Creek</u>

- Several BMPs, aimed primarily at mitigating the impacts of livestock, were implemented in the watershed.
- The 13 °C instantaneous temperature standard was violated seven times (33.3%) during the 2003-2004 sampling period, although it did not cause DO levels to drop below the 6.0 mg/L water quality standard.
- TSS concentrations never exceeded the 80 mg/L target and the 2004 TSS median was 20 % lower than the 1998 median.
- OP and TP were in the expected range, with the only reading to exceed the 0.075 mg/L TMDL target occurring during the highest turbidity event on 12/2/03. Overall, there was a 76% reduction in median TP levels from 1998 to 2004.
- The median E. coli count was reduced by 80 % from 1998 to 2004.

<u>Grasshopper Creek</u>

A nominal number of BMPs were implemented in this watershed.

Elevated total dissolved solids and conductivity readings were evident at this site

TP was consistently below the EPA Gold Book criterion of 0.1mg/L, but exceeded the 0.075 mg/L TMDL target three times during the growing season of April through October.

<u>Miles Creek</u>

BMPs including fencing, revegetation, and livestock management structures were implemented within this watershed,.

DO levels fell below numeric water quality standard only when flows fell below one cfs.

Multiple exceedances of the 0.075 mg/L TP standard were observed. Median TP levels have increased by 38% since 1998

Median E. coli readings were 75% lower than those observed in 1998.

Temperatures were consistently elevated during the summer months and frequently exceeded the temperature standard.

Heywood Creek

BMPs have been implemented in the watershed, including fencing, forest buffer, revegetation and livestock management structures.

TP readings were consistently elevated at this site and exceeded the TMDL target 77% of the time.

E. coli levels were relatively low, although they exceeded the water quality standard twice during the study.

Temperatures were high during the summer months and exceeded the water quality standard a number of times.

JF-5 (main stem, above City of Weippe)

BMPs were implemented, including revegetation, grade stabilizations, wetland creation, and livestock management structures.

DO levels fell below numeric water quality standard only when flows fell below one cfs.

TP consistently exceeded the TMDL target at this site, although median levels were 9% lower in 2004 than in 1998.

Temperatures exceeded state criteria throughout the summer months.

Median E. coli level was 29% lower than observed in 1998.

JF-3 (main stem, below City of Weippe)

BMPs were implemented, including revegetation, fencing, and an off-site watering facility for livestock.

TP levels exceeded the TMDL target nearly 40% of the time, although median TP levels were 18% lower than in 1998.

Median E. coli level was 14% lower than in 1998.

JF-1 (main stem, mouth)

The median turbidity was 62% lower than in 1998.

Median TSS level dropped 50% from the 1998 level.

Water Temperatures exceeded the salmonid spawning instantaneous criteria during late April and May and exceeded the cold water aquatic life criteria in July.

Median TP level was 45% lower than in 1998 although levels still exceeded the TMDL target four times during the study.

Recommendations based on the 2003–2004 Monitoring Event

Significant erosion was evident along a number of streams, and treatment should be applied to streams that are already undergoing the most severe erosion. Based on visual assessments, TSS rates, and turbidity levels, the greatest erosion problems seem to be located on the main stem of Jim Ford Creek above Weippe and on Miles and Heywood Creeks. TP levels were also much higher in those streams but would likely be reduced as sediment levels were decreased. DO levels would likely increase as reductions of TP and TSS occurred. The revegetation of stream banks would help reduce sediment transport in problem areas, as healthy riparian vegetation was effective in reducing bank erosion. Riparian vegetation would also filter sediment transported in surface water runoff.

Excessive stream temperatures were a widespread problem within this watershed and would be a difficult problem to overcome. Perhaps the most effective strategy would be to work toward the establishment of natural full potential canopy shade. Reducing sediment loads within critical reaches would assist in reducing stream temperatures as well, since suspended particles tend to absorb more heat.

Significant reductions in bacteria levels have already been observed in watersheds where livestock exclusion via fencing has been used. Continuing to fence cattle away from creeks and developing off-stream watering facilities is apt to be the most cost-effective method to reduce bacteria levels and sediment levels in problem areas.

BMP placement in this watershed had improved overall water quality and continued implementation of targeted stream improvements to reduce sediment loads, lower temperatures, and lower nutrient levels would be important. (IASCD Monitoring Report December. 2005).

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Appendix D. Existing and Potential Solar Load Tables and Target Shade Curves

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Table D-1. Existing and target solar loads for Jim Ford Creek (AU ID17060306CL034_04).

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
034_04	Jim Ford Creek	1	980	CNF Breakland	34%	3.63	16	16,000	58,000	40%	3.30	16	16,000	53,000	(5,000)	0%
034_04	Jim Ford Creek	2	550	CNF Breakland	34%	3.63	16	8,800	32,000	30%	3.85	16	8,800	34,000	2,000	-4%
034_04	Jim Ford Creek	3	980	CNF Breakland	34%	3.63	16	16,000	58,000	50%	2.75	16	16,000	44,000	(14,000)	0%
034_04	Jim Ford Creek	4	920	CNF Breakland	34%	3.63	16	15,000	54,000	20%	4.40	16	15,000	66,000	12,000	-14%
034_04	Jim Ford Creek	5	690	CNF Breakland	34%	3.63	16	11,000	40,000	40%	3.30	16	11,000	36,000	(4,000)	0%
034_04	Jim Ford Creek	6	1300	CNF Breakland	32%	3.74	17	22,000	82,000	40%	3.30	17	22,000	73,000	(9,000)	0%
034_04	Jim Ford Creek	7	330	CNF Breakland	32%	3.74	17	5,600	21,000	50%	2.75	17	5,600	15,000	(6,000)	0%
034_04	Jim Ford Creek	8	280	CNF Breakland	32%	3.74	17	4,800	18,000	40%	3.30	17	4,800	16,000	(2,000)	0%
034_04	Jim Ford Creek	9	2700	CNF Breakland	32%	3.74	17	46,000	170,000	60%	2.20	17	46,000	100,000	(70,000)	0%
034_04	Jim Ford Creek	10	740	cottonwood	50%	2.75	17	13,000	36,000	50%	2.75	17	13,000	36,000	0	0%
034_04	Jim Ford Creek	11	180	cottonwood	48%	2.86	18	3,200	9,200	30%	3.85	18	3,200	12,000	2,800	-18%
034_04	Jim Ford Creek	12	590	cottonwood	48%	2.86	18	11,000	31,000	70%	1.65	18	11,000	18,000	(13,000)	0%
034_04	Jim Ford Creek	13	1300	cottonwood	48%	2.86	18	23,000	66,000	50%	2.75	18	23,000	63,000	(3,000)	0%
034_04	Jim Ford Creek	14	580	cottonwood	48%	2.86	18	10,000	29,000	80%	1.10	18	10,000	11,000	(18,000)	0%
034_04	Jim Ford Creek	15	1400	cottonwood	48%	2.86	18	25,000	72,000	60%	2.20	18	25,000	55,000	(17,000)	0%
034_04	Jim Ford Creek	16	270	cottonwood	48%	2.86	18	4,900	14,000	40%	3.30	18	4,900	16,000	2,000	-8%
034_04	Jim Ford Creek	17	420	cottonwood	48%	2.86	18	7,600	22,000	70%	1.65	18	7,600	13,000	(9,000)	0%
034_04	Jim Ford Creek	18	130	cottonwood	48%	2.86	18	2,300	6,600	30%	3.85	18	2,300	8,900	2,300	-18%
034_04	Jim Ford Creek	19	110	cottonwood	46%	2.97	19	2,100	6,200	70%	1.65	19	2,100	3,500	(2,700)	0%
							Totals		830,000					670,000	-150,000	

Note: All assessment unit (AU) numbers start with ID17060306CL in all load tables (Tables D-1–D-9). Significant figures are controlled by the lowest level in the calculation, typically that of the channel width. Some rounding errors may result.

Table D-2. Existing and target solar loads for Jim Ford Creek tributaries (AU ID17060306CL035_02).

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
035_02	Miles Creek	1	1200	CNF Upland	98%	0.11	1	1,000	100	60%	2.20	1	1,000	2,000	2,000	-38%
035_02	Miles Creek	2	870	CNF Upland	98%	0.11	2	2,000	200	40%	3.30	2	2,000	7,000	7,000	-58%
035_02	Miles Creek	3	1200	CNF Upland	98%	0.11	2	2,000	200	90%	0.55	2	2,000	1,000	800	-8%
035_02	Miles Creek	4	610	CNF Upland	96%	0.22	3	2,000	400	20%	4.40	3	2,000	9,000	9,000	-76%
035_02	Miles Creek	5	110	CNF Upland	96%	0.22	3	300	70	40%	3.30	3	300	1,000	900	-56%
035_02	Miles Creek	6	170	CNF Upland	96%	0.22	3	500	100	20%	4.40	3	500	2,000	2,000	-76%
035_02	Miles Creek	7	280	CNF Upland	96%	0.22	3	800	200	40%	3.30	3	800	3,000	3,000	-56%
035_02	Miles Creek	8	360	CNF Upland	96%	0.22	3	1,000	200	70%	1.65	3	1,000	2,000	2,000	-26%
035_02	Miles Creek	9	620	hawthorn	60%	2.20	4	2,000	4,000	70%	1.65	4	2,000	3,000	(1,000)	0%
035_02	Miles Creek	10	1100	hawthorn	60%	2.20	4	4,000	9,000	40%	3.30	4	4,000	10,000	1,000	-20%
035_02	Miles Creek	11	750	hawthorn	60%	2.20	4	3,000	7,000	0%	5.50	4	3,000	20,000	10,000	-60%
035_02	trib to Miles	1	460	CNF Upland	98%	0.11	1	500	60	90%	0.55	1	500	300	200	-8%
035_02	trib to Miles	2	210	CNF Upland	98%	0.11	1	200	20	50%	2.75	1	200	600	600	-48%
035_02	trib to Miles	3	460	CNF Upland	98%	0.11	1	500	60	90%	0.55	1	500	300	200	-8%
035_02	trib to Miles	4	300	CNF Upland	98%	0.11	1	300	30	60%	2.20	1	300	700	700	-38%
035_02	trib to Miles	5	220	CNF Upland	98%	0.11	1	200	20	90%	0.55	1	200	100	80	-8%
035_02	Wilson Creek	1	2300	CNF Upland	98%	0.11	1	2,000	200	90%	0.55	1	2,000	1,000	800	-8%
035_02	Wilson Creek	2	330	CNF Upland	98%	0.11	2	700	80	60%	2.20	2	700	2,000	2,000	-38%
035_02	Wilson Creek	3	230	hawthorn	88%	0.66	2	500	300	40%	3.30	2	500	2,000	2,000	-48%
035_02	Wilson Creek	4	250	hawthorn	88%	0.66	2	500	300	40%	3.30	2	500	2,000	2,000	-48%
035_02	Wilson Creek	5	140	CNF Upland	98%	0.11	2	300	30	70%	1.65	2	300	500	500	-28%
035_02	Wilson Creek	6	130	hawthorn	88%	0.66	2	300	200	40%	3.30	2	300	1,000	800	-48%
035_02	Wilson Creek	7	740	hawthorn	71%	1.60	3	2,000	3,000	60%	2.20	3	2,000	4,000	1,000	-11%
035_02	Wilson Creek	8	370	hawthorn	71%	1.60	3	1,000	2,000	70%	1.65	3	1,000	2,000	0	-1%
035_02	Wilson Creek	9	900	hawthorn	71%	1.60	3	3,000	5,000	60%	2.20	3	3,000	7,000	2,000	-11%
035_02	Wilson Creek	10	460	beaver ponds	0%	5.50	20	9,200	51,000	0%	5.50	20	9,200	51,000	0	0%
035_02	trib to Wilson	1	2000	CNF Upland	98%	0.11	1	2,000	200	90%	0.55	1	2,000	1,000	800	-8%
035_02	3rd trib to Jim Ford	1	990	CNF Upland	98%	0.11	1	1,000	100	90%	0.55	1	1,000	600	500	-8%
035_02	3rd trib to Jim Ford	2	390	hawthorn	97%	0.17	1	400	70	40%	3.30	1	400	1,000	900	-57%
035_02	3rd trib to Jim Ford	3	580	hawthorn	97%	0.17	1	600	100	20%	4.40	1	600	3,000	3,000	-77%
035_02	3rd trib to Jim Ford	4	1200	hawthorn	88%	0.66	2	2,000	1,000	40%	3.30	2	2,000	7,000	6,000	-48%
035_02	3rd trib to Jim Ford	5	970	hawthorn	88%	0.66	2	2,000	1,000	60%	2.20	2	2,000	4,000	3,000	-28%

Table D-2 (cont.). Existing and target solar loads for Jim Ford Creek tributaries (AU ID17060306CL035_02).

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
035_02	un-named #1	1	2300	CNF Upland	98%	0.11	1	2,000	200	90%	0.55	1	2,000	1,000	800	-8%
035_02	un-named #1	2	200	hawthorn	88%	0.66	2	400	300	40%	3.30	2	400	1,000	700	-48%
035_02	un-named #1	3	770	hawthorn	88%	0.66	2	2,000	1,000	20%	4.40	2	2,000	9,000	8,000	-68%
035_02	un-named #2	1	590	CNF Upland	98%	0.11	1	600	70	80%	1.10	1	600	700	600	-18%
035_02	un-named #2	2	1500	CNF Upland	98%	0.11	1	2,000	200	90%	0.55	1	2,000	1,000	800	-8%
035_02	un-named #2	3	830	hawthorn	88%	0.66	2	2,000	1,000	60%	2.20	2	2,000	4,000	3,000	-28%
035_02	Heywood Creek	1	2900	CNF Upland	98%	0.11	1	3,000	300	90%	0.55	1	3,000	2,000	2,000	-8%
035_02	Heywood Creek	2	150	CNF Upland	98%	0.11	2	300	30	70%	1.65	2	300	500	500	-28%
035_02	Heywood Creek	3	51	CNF Upland	98%	0.11	2	100	10	10%	4.95	2	100	500	500	-88%
035_02	Heywood Creek	4	230	CNF Upland	98%	0.11	2	500	60	80%	1.10	2	500	600	500	-18%
035_02	Heywood Creek	5	340	hawthorn	88%	0.66	2	700	500	70%	1.65	2	700	1,000	500	-18%
035_02	Heywood Creek	6	180	hawthorn	88%	0.66	2	400	300	50%	2.75	2	400	1,000	700	-38%
035_02	Heywood Creek	7	150	hawthorn	71%	1.60	3	500	800	30%	3.85	3	500	2,000	1,000	-41%
035_02	Heywood Creek	8	92	hawthorn	71%	1.60	3	300	500	20%	4.40	3	300	1,000	500	-51%
035_02	Heywood Creek	9	290	hawthorn	71%	1.60	3	900	1,000	30%	3.85	3	900	3,000	2,000	-41%
035_02	Heywood Creek	10	1200	hawthorn	71%	1.60	3	4,000	6,000	40%	3.30	3	4,000	10,000	4,000	-31%
035_02	Heywood Creek	11	710	hawthorn	60%	2.20	4	3,000	7,000	50%	2.75	4	3,000	8,000	1,000	-10%
035_02	Heywood Creek	12	99	hawthorn	60%	2.20	4	400	900	20%	4.40	4	400	2,000	1,000	-40%
035_02	Heywood Creek	13	440	hawthorn	60%	2.20	4	2,000	4,000	60%	2.20	4	2,000	4,000	0	0%
035_02	Heywood Creek	14	280	hawthorn	60%	2.20	4	1,000	2,000	40%	3.30	4	1,000	3,000	1,000	-20%
035_02	Heywood Creek	15	120	hawthorn	51%	2.70	5	600	2,000	10%	4.95	5	600	3,000	1,000	-41%
035_02	Heywood Creek	16	400	hawthorn	51%	2.70	5	2,000	5,000	40%	3.30	5	2,000	7,000	2,000	-11%
035_02	Heywood Creek	17	150	hawthorn	51%	2.70	5	800	2,000	10%	4.95	5	800	4,000	2,000	-41%
035_02	Heywood Creek	18	170	hawthorn	51%	2.70	5	900	2,000	40%	3.30	5	900	3,000	1,000	-11%
035_02	Heywood Creek	19	300	hawthorn/grass	37%	3.47	5	2,000	7,000	30%	3.85	5	2,000	8,000	1,000	-7%
035_02	Heywood Creek	20	390	hawthorn/grass	37%	3.47	5	2,000	7,000	20%	4.40	5	2,000	9,000	2,000	-17%
035_02	Heywood Creek	21	1400	hawthorn/grass	32%	3.74	6	8,000	30,000	0%	5.50	6	8,000	40,000	10,000	-32%
035_02	Heywood Creek	22	380	hawthorn/grass	32%	3.74	6	2,000	7,000	20%	4.40	6	2,000	9,000	2,000	-12%
035_02	1st to Heywood	1	1200	CNF Upland	98%	0.11	1	1,000	100	90%	0.55	1	1,000	600	500	-8%
035_02	1st to Heywood	2	550	CNF Upland	98%	0.11	1	600	70	70%	1.65	1	600	1,000	900	-28%
035_02	1st to Heywood	3	660	hawthorn	97%	0.17	1	700	100	60%	2.20	1	700	2,000	2,000	-37%
035_02	2nd to Heywood	1	2200	CNF Upland	98%	0.11	1	2,000	200	90%	0.55	1	2,000	1,000	800	-8%
035_02	2nd to Heywood	2	130	hawthorn	97%	0.17	1	100	20	10%	4.95	1	100	500	500	-87%
035_02	2nd to Heywood	3	91	hawthorn	97%	0.17	1	90	10	60%	2.20	1	90	200	200	-37%
035_02	3rd to Heywood	1	2000	CNF Upland	98%	0.11	1	2,000	200	90%	0.55	1	2,000	1,000	800	-8%
035_02	3rd to Heywood	2	250	hawthorn	97%	0.17	1	300	50	40%	3.30	1	300	1,000	1,000	-57%
035_02	4th to Heywood	1	450	CNF Upland	98%	0.11	1	500	60	90%	0.55	1	500	300	200	-8%
035_02	4th to Heywood	2	1000	CNF Upland	98%	0.11	1	1,000	100	80%	1.10	1	1,000	1,000	900	-18%
035_02	4th to Heywood	3	250	hawthorn	97%	0.17	1	300	50	40%	3.30	1	300	1,000	1,000	-57%

Table D-2 (cont.). Existing and target solar loads for Jim Ford Creek tributaries (AU ID17060306CL035_02).

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
035_02	5th to Heywood	1	990	CNF Upland	98%	0.11	1	1,000	100	90%	0.55	1	1,000	600	500	-8%
035_02	5th to Heywood	2	760	hawthorn	97%	0.17	1	800	100	60%	2.20	1	800	2,000	2,000	-37%
035_02	5th to Heywood	3	610	hawthorn	97%	0.17	1	600	100	80%	1.10	1	600	700	600	-17%
035_02	5th to Heywood	4	300	hawthorn	88%	0.66	2	600	400	40%	3.30	2	600	2,000	2,000	-48%
035_02	5th trib to Jim Ford	1	80	hawthorn	97%	0.17	1	80	10	40%	3.30	1	80	300	300	-57%
035_02	5th trib to Jim Ford	2	110	hawthorn	97%	0.17	1	100	20	30%	3.85	1	100	400	400	-67%
035_02	5th trib to Jim Ford	3	29	hawthorn	97%	0.17	1	30	5	0%	5.50	1	30	200	200	-97%
035_02	5th trib to Jim Ford	4	780	hawthorn	97%	0.17	1	800	100	40%	3.30	1	800	3,000	3,000	-57%
035_02	5th trib to Jim Ford	5	840	hawthorn/grass	72%	1.54	2	2,000	3,000	20%	4.40	2	2,000	9,000	6,000	-52%
035_02	5th trib to Jim Ford	6	620	hawthorn/grass	72%	1.54	2	1,000	2,000	40%	3.30	2	1,000	3,000	1,000	-32%
035_02	Kamiah Gulch	1	280	hawthorn	97%	0.17	1	300	50	60%	2.20	1	300	700	700	-37%
035_02	Kamiah Gulch	2	660	hawthorn	97%	0.17	1	700	100	70%	1.65	1	700	1,000	900	-27%
035_02	Kamiah Gulch	3	1000	CNF Upland	98%	0.11	1	1,000	100	80%	1.10	1	1,000	1,000	900	-18%
035_02	Kamiah Gulch	4	290	hawthorn	88%	0.66	2	600	400	50%	2.75	2	600	2,000	2,000	-38%
035_02	Kamiah Gulch	5	480	CNF Upland	98%	0.11	2	1,000	100	60%	2.20	2	1,000	2,000	2,000	-38%
035_02	Kamiah Gulch	6	110	hawthorn	88%	0.66	2	200	100	40%	3.30	2	200	700	600	-48%
035_02	Kamiah Gulch	7	180	hawthorn	88%	0.66	2	400	300	20%	4.40	2	400	2,000	2,000	-68%
035_02	Kamiah Gulch	8	140	hawthorn	88%	0.66	2	300	200	40%	3.30	2	300	1,000	800	-48%
035_02	Kamiah Gulch	9	330	hawthorn	88%	0.66	2	700	500	30%	3.85	2	700	3,000	3,000	-58%
035_02	Kamiah Gulch	10	160	hawthorn	88%	0.66	2	300	200	0%	5.50	2	300	2,000	2,000	-88%
035_02	Kamiah Gulch	11	130	hawthorn	88%	0.66	2	300	200	40%	3.30	2	300	1,000	800	-48%
035_02	Kamiah Gulch	12	96	hawthorn	71%	1.60	3	300	500	10%	4.95	3	300	1,000	500	-61%
035_02	Kamiah Gulch	13	380	hawthorn	71%	1.60	3	1,000	2,000	40%	3.30	3	1,000	3,000	1,000	-31%
035_02	Kamiah Gulch	14	61	hawthorn	71%	1.60	3	200	300	10%	4.95	3	200	1,000	700	-61%
035_02	Kamiah Gulch	15	170	hawthorn	71%	1.60	3	500	800	90%	0.55	3	500	300	(500)	0%
035_02	Kamiah Gulch	16	200	hawthorn	71%	1.60	3	600	1,000	40%	3.30	3	600	2,000	1,000	-31%
035_02	Kamiah Gulch	17	480	hawthorn	71%	1.60	3	1,000	2,000	10%	4.95	3	1,000	5,000	3,000	-61%
035_02	Kamiah Gulch	18	750	hawthorn	71%	1.60	3	2,000	3,000	40%	3.30	3	2,000	7,000	4,000	-31%
035_02	Kamiah Gulch	19	500	hawthorn/grass	44%	3.08	4	2,000	6,000	20%	4.40	4	2,000	9,000	3,000	-24%
035_02	Kamiah Gulch	20	840	hawthorn/grass	44%	3.08	4	3,000	9,000	40%	3.30	4	3,000	10,000	1,000	-4%
035_02	6th trib to Jim Ford	1	600	hawthorn/grass	93%	0.39	1	600	200	30%	3.85	1	600	2,000	2,000	-63%
035_02	6th trib to Jim Ford	2	360	hawthorn/grass	93%	0.39	1	400	200	50%	2.75	1	400	1,000	800	-43%
035_02	6th trib to Jim Ford	3	180	hawthorn/grass	93%	0.39	1	200	80	0%	5.50	1	200	1,000	900	-93%
035_02	6th trib to Jim Ford	4	310	hawthorn/grass	93%	0.39	1	300	100	40%	3.30	1	300	1,000	900	-53%
035_02	6th trib to Jim Ford	5	700	hawthorn/grass	44%	3.08	4	3,000	9,000	30%	3.85	4	3,000	10,000	1,000	-14%
035_02	7th trib to Jim Ford	1	170	CNF Upland	98%	0.11	1	200	20	90%	0.55	1	200	100	80	-8%
035_02	7th trib to Jim Ford	2	450	hawthorn	97%	0.17	1	500	80	10%	4.95	1	500	2,000	2,000	-87%
035_02	7th trib to Jim Ford	3	310	hawthorn	97%	0.17	1	300	50	30%	3.85	1	300	1,000	1,000	-67%
035_02	7th trib to Jim Ford	4	95	hawthorn	97%	0.17	1	100	20	80%	1.10	1	100	100	80	-17%
035_02	7th trib to Jim Ford	5	300	hawthorn/grass	93%	0.39	1	300	100	10%	4.95	1	300	1,000	900	-83%
035_02	7th trib to Jim Ford	6	110	hawthorn/grass	93%	0.39	1	100	40	40%	3.30	1	100	300	300	-53%
035_02	7th trib to Jim Ford	7	550	hawthorn/grass	72%	1.54	2	1,000	2,000	10%	4.95	2	1,000	5,000	3,000	-62%
035_02	7th trib to Jim Ford	8	110	hawthorn/grass	72%	1.54	2	200	300	30%	3.85	2	200	800	500	-42%

Table D-2 (cont.). Existing and target solar loads for Jim Ford Creek tributaries (AU ID17060306CL035_02).

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
035_02	8th trib to Jim Ford	1	230	CNF Upland	98%	0.11	1	200	20	90%	0.55	1	200	100	80	-8%
035_02	8th trib to Jim Ford	2	140	CNF Upland	98%	0.11	1	100	10	80%	1.10	1	100	100	90	-18%
035_02	8th trib to Jim Ford	3	110	CNF Upland	98%	0.11	1	100	10	40%	3.30	1	100	300	300	-58%
035_02	8th trib to Jim Ford	4	460	CNF Upland	98%	0.11	1	500	60	90%	0.55	1	500	300	200	-8%
035_02	8th trib to Jim Ford	5	250	hawthorn	97%	0.17	1	300	50	30%	3.85	1	300	1,000	1,000	-67%
035_02	8th trib to Jim Ford	6	1100	hawthorn/grass	72%	1.54	2	2,000	3,000	20%	4.40	2	2,000	9,000	6,000	-52%
035_02	8th trib to Jim Ford	7	270	hawthorn/grass	55%	2.48	3	800	2,000	40%	3.30	3	800	3,000	1,000	-15%
035_02	8th trib to Jim Ford	8	480	hawthorn/grass	55%	2.48	3	1,000	2,000	20%	4.40	3	1,000	4,000	2,000	-35%
035_02	8th trib to Jim Ford	9	110	hawthorn/grass	55%	2.48	3	300	700	20%	4.40	3	300	1,000	300	-35%
035_02	8th trib to Jim Ford	10	180	hawthorn	97%	0.17	1	200	30	40%	3.30	1	200	700	700	-57%
035_02	8th trib to Jim Ford	11	1000	hawthorn/grass	93%	0.39	1	1,000	400	10%	4.95	1	1,000	5,000	5,000	-83%
035_02	8th trib to Jim Ford	12	200	hawthorn/grass	93%	0.39	1	200	80	30%	3.85	1	200	800	700	-63%
035_02	8th trib to Jim Ford	13	41	hawthorn/grass	93%	0.39	1	40	20	0%	5.50	1	40	200	200	-93%
035_02	8th trib to Jim Ford	14	100	hawthorn/grass	93%	0.39	1	100	40	20%	4.40	1	100	400	400	-73%
035_02	8th trib to Jim Ford	15	53	hawthorn/grass	93%	0.39	1	50	20	0%	5.50	1	50	300	300	-93%
035_02	8th trib to Jim Ford	16	74	hawthorn/grass	93%	0.39	1	70	30	30%	3.85	1	70	300	300	-63%
035_02	9th trib to Jim Ford	1	590	hawthorn	97%	0.17	1	600	100	80%	1.10	1	600	700	600	-17%
035_02	9th trib to Jim Ford	2	210	hawthorn/grass	93%	0.39	1	200	80	10%	4.95	1	200	1,000	900	-83%
035_02	9th trib to Jim Ford	3	740	hawthorn/grass	93%	0.39	1	700	300	20%	4.40	1	700	3,000	3,000	-73%
035_02	9th trib to Jim Ford	4	51	hawthorn/grass	93%	0.39	1	50	20	40%	3.30	1	50	200	200	-53%
035_02	9th trib to Jim Ford	5	100	hawthorn/grass	93%	0.39	1	100	40	10%	4.95	1	100	500	500	-83%
035_02	9th trib to Jim Ford	6	140	hawthorn/grass	93%	0.39	1	100	40	20%	4.40	1	100	400	400	-73%
035_02	9th trib to Jim Ford	7	95	hawthorn/grass	93%	0.39	1	100	40	80%	1.10	1	100	100	60	-13%
035_02	11th trib to Jim Ford	1	1800	CNF Upland	98%	0.11	1	2,000	200	90%	0.55	1	2,000	1,000	800	-8%
035_02	12th trib to Jim Ford	1	510	CNF Upland	98%	0.11	1	500	60	60%	2.20	1	500	1,000	900	-38%
035_02	12th trib to Jim Ford	2	210	CNF Upland	98%	0.11	1	200	20	70%	1.65	1	200	300	300	-28%
035_02	12th trib to Jim Ford	3	350	CNF Breakland	95%	0.28	1	400	100	90%	0.55	1	400	200	100	-5%
035_02	13th trib to Jim Ford	1	1100	hawthorn	97%	0.17	1	1,000	200	50%	2.75	1	1,000	3,000	3,000	-47%
035_02	13th trib to Jim Ford	2	200	hawthorn	97%	0.17	1	200	30	60%	2.20	1	200	400	400	-37%
035_02	13th trib to Jim Ford	3	45	hawthorn	97%	0.17	1	50	8	0%	5.50	1	50	300	300	-97%
035_02	13th trib to Jim Ford	4	200	hawthorn	97%	0.17	1	200	30	70%	1.65	1	200	300	300	-27%
035_02	13th trib to Jim Ford	5	240	hawthorn	97%	0.17	1	200	30	60%	2.20	1	200	400	400	-37%
035_02	13th trib to Jim Ford	6	440	CNF Breakland	94%	0.33	2	900	300	90%	0.55	2	900	500	200	-4%
035_02	13th trib to Jim Ford	7	130	CNF Breakland	94%	0.33	2	300	100	70%	1.65	2	300	500	400	-24%
035_02	13th trib to Jim Ford	8	1600	CNF Breakland	94%	0.33	2	3,000	1,000	90%	0.55	2	3,000	2,000	1,000	-4%
035_02	14th trib to Jim Ford	1	120	CNF Breakland	95%	0.28	1	100	30	0%	5.50	1	100	600	600	-95%
035_02	14th trib to Jim Ford	2	96	CNF Breakland	95%	0.28	1	100	30	50%	2.75	1	100	300	300	-45%
035_02	14th trib to Jim Ford	3	1400	CNF Breakland	95%	0.28	1	1,000	300	90%	0.55	1	1,000	600	300	-5%
							Totals		230,000					440,000	220,000	

Table D-3. Existing and target solar loads for Jim Ford Creek (AU ID17060306CL035_03).

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
035_03	Jim Ford Creek	1	230	beaver ponds	0%	5.50	5	1,000	6,000	0%	5.50	5	1,000	6,000	0	0%
035_03	Jim Ford Creek	2	320	hawthorn/grass	37%	3.47	5	2,000	7,000	40%	3.30	5	2,000	7,000	0	0%
035_03	Jim Ford Creek	3	100	hawthorn/grass	37%	3.47	5	500	2,000	20%	4.40	5	500	2,000	0	-17%
035_03	Jim Ford Creek	4	150	hawthorn/grass	37%	3.47	5	800	3,000	40%	3.30	5	800	3,000	0	0%
035_03	Jim Ford Creek	5	2500	hawthorn/grass	37%	3.47	5	10,000	30,000	10%	4.95	5	10,000	50,000	20,000	-27%
035_03	Jim Ford Creek	6	660	hawthorn/grass	37%	3.47	5	3,000	10,000	30%	3.85	5	3,000	10,000	0	-7%
035_03	Jim Ford Creek	7	340	hawthorn/grass	32%	3.74	6	2,000	7,000	10%	4.95	6	2,000	10,000	3,000	-22%
035_03	Jim Ford Creek	8	1500	hawthorn/grass	28%	3.96	7	10,000	40,000	10%	4.95	7	10,000	50,000	10,000	-18%
035_03	Jim Ford Creek	9	170	hawthorn/grass	28%	3.96	7	1,000	4,000	20%	4.40	7	1,000	4,000	0	-8%
035_03	Jim Ford Creek	10	890	hawthorn/grass	28%	3.96	7	6,000	20,000	10%	4.95	7	6,000	30,000	10,000	-18%
035_03	Jim Ford Creek	11	160	hawthorn/grass	28%	3.96	7	1,000	4,000	0%	5.50	7	1,000	6,000	2,000	-28%
035_03	Jim Ford Creek	12	140	hawthorn/grass	28%	3.96	7	1,000	4,000	10%	4.95	7	1,000	5,000	1,000	-18%
035_03	Jim Ford Creek	13	79	hawthorn/grass	28%	3.96	7	600	2,000	0%	5.50	7	600	3,000	1,000	-28%
035_03	Jim Ford Creek	14	180	hawthorn/grass	22%	4.29	9	2,000	9,000	0%	5.50	9	2,000	10,000	1,000	-22%
035_03	Jim Ford Creek	15	370	hawthorn/grass	22%	4.29	9	3,000	10,000	10%	4.95	9	3,000	10,000	0	-12%
035_03	Jim Ford Creek	16	160	hawthorn/grass	22%	4.29	9	1,000	4,000	30%	3.85	9	1,000	4,000	0	0%
035_03	Jim Ford Creek	17	400	hawthorn/grass	20%	4.40	10	4,000	18,000	0%	5.50	10	4,000	22,000	4,000	-20%
035_03	Jim Ford Creek	18	250	hawthorn/grass	18%	4.51	11	2,800	13,000	10%	4.95	11	2,800	14,000	1,000	-8%
035_03	Jim Ford Creek	19	170	hawthorn/grass	18%	4.51	11	1,900	8,600	20%	4.40	11	1,900	8,400	(200)	0%
035_03	Jim Ford Creek	20	690	hawthorn/grass	17%	4.57	12	8,300	38,000	10%	4.95	12	8,300	41,000	3,000	-7%
035_03	Jim Ford Creek	21	110	hawthorn	25%	4.13	12	1,300	5,400	30%	3.85	12	1,300	5,000	(400)	0%
035_03	Jim Ford Creek	22	76	hawthorn	25%	4.13	12	910	3,800	10%	4.95	12	910	4,500	700	-15%
035_03	Jim Ford Creek	23	380	hawthorn	25%	4.13	12	4,600	19,000	30%	3.85	12	4,600	18,000	(1,000)	0%
035_03	Jim Ford Creek	24	200	hawthorn	25%	4.13	12	2,400	9,900	50%	2.75	12	2,400	6,600	(3,300)	0%
							Totals		280,000					330,000	52,000	

Table D-4. Existing and target solar loads for Jim Ford Creek (AU ID17060306CL035_04).

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
035_04	Jim Ford Creek	1	140	hawthorn	21%	4.35	14	2,000	8,700	50%	2.75	14	2,000	5,500	(3,200)	0%
035_04	Jim Ford Creek	2	730	CNF Breakland	38%	3.41	14	10,000	34,000	50%	2.75	14	10,000	28,000	(6,000)	0%
035_04	Jim Ford Creek	3	1700	CNF Breakland	38%	3.41	14	24,000	82,000	70%	1.65	14	24,000	40,000	(42,000)	0%
035_04	Jim Ford Creek	4	1300	CNF Breakland	38%	3.41	14	18,000	61,000	60%	2.20	14	18,000	40,000	(21,000)	0%
035_04	Jim Ford Creek	5	160	CNF Breakland	38%	3.41	14	2,200	7,500	70%	1.65	14	2,200	3,600	(3,900)	0%
035_04	Jim Ford Creek	6	460	CNF Breakland	36%	3.52	15	6,900	24,000	60%	2.20	15	6,900	15,000	(9,000)	0%
035_04	Jim Ford Creek	7	600	CNF Breakland	34%	3.63	16	9,600	35,000	40%	3.30	16	9,600	32,000	(3,000)	0%
035_04	Jim Ford Creek	8	1100	CNF Breakland	34%	3.63	16	18,000	65,000	30%	3.85	16	18,000	69,000	4,000	-4%
								Totals	320,000					230,000	-84,000	

Table D-5. Existing and target solar loads for Grasshopper Creek (AU ID17060306CL036_02).

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
036_02	Grasshopper Creek	1	1100	CNF Upland	98%	0.11	1	1,000	100	90%	0.55	1	1,000	600	500	-8%
036_02	Grasshopper Creek	2	440	CNF Upland	98%	0.11	1	400	40	80%	1.10	1	400	400	400	-18%
036_02	Grasshopper Creek	3	330	hawthorn	88%	0.66	2	700	500	50%	2.75	2	700	2,000	2,000	-38%
036_02	Grasshopper Creek	4	490	hawthorn	88%	0.66	2	1,000	700	30%	3.85	2	1,000	4,000	3,000	-58%
036_02	Grasshopper Creek	5	190	hawthorn	88%	0.66	2	400	300	50%	2.75	2	400	1,000	700	-38%
036_02	Grasshopper Creek	6	250	hawthorn	71%	1.60	3	800	1,000	40%	3.30	3	800	3,000	2,000	-31%
036_02	Grasshopper Creek	7	880	hawthorn	71%	1.60	3	3,000	5,000	50%	2.75	3	3,000	8,000	3,000	-21%
036_02	Grasshopper Creek	8	89	hawthorn	71%	1.60	3	300	500	0%	5.50	3	300	2,000	2,000	-71%
036_02	Grasshopper Creek	9	510	hawthorn	60%	2.20	4	2,000	4,000	40%	3.30	4	2,000	7,000	3,000	-20%
036_02	Grasshopper Creek	10	66	hawthorn	60%	2.20	4	300	700	0%	5.50	4	300	2,000	1,000	-60%
036_02	Grasshopper Creek	11	220	hawthorn	60%	2.20	4	900	2,000	20%	4.40	4	900	4,000	2,000	-40%
036_02	Grasshopper Creek	12	510	hawthorn	60%	2.20	4	2,000	4,000	30%	3.85	4	2,000	8,000	4,000	-30%
036_02	Grasshopper Creek	13	450	hawthorn	51%	2.70	5	2,000	5,000	50%	2.75	5	2,000	6,000	1,000	-1%
036_02	Grasshopper Creek	14	190	hawthorn	51%	2.70	5	1,000	3,000	30%	3.85	5	1,000	4,000	1,000	-21%
036_02	Grasshopper Creek	15	100	hawthorn	51%	2.70	5	500	1,000	40%	3.30	5	500	2,000	1,000	-11%
036_02	Grasshopper Creek	16	380	hawthorn	51%	2.70	5	2,000	5,000	30%	3.85	5	2,000	8,000	3,000	-21%
036_02	Grasshopper Creek	17	200	hawthorn	51%	2.70	5	1,000	3,000	50%	2.75	5	1,000	3,000	0	-1%
036_02	1st to Grasshopper	1	520	CNF Upland	98%	0.11	1	500	60	90%	0.55	1	500	300	200	-8%
036_02	1st to Grasshopper	2	320	CNF Upland	98%	0.11	1	300	30	80%	1.10	1	300	300	300	-18%
036_02	1st to Grasshopper	3	290	hawthorn	97%	0.17	1	300	50	40%	3.30	1	300	1,000	1,000	-57%
036_02	2nd to Grasshopper	1	1000	CNF Upland	98%	0.11	1	1,000	100	90%	0.55	1	1,000	600	500	-8%
036_02	2nd to Grasshopper	2	1100	CNF Upland	98%	0.11	1	1,000	100	80%	1.10	1	1,000	1,000	900	-18%
036_02	2nd to Grasshopper	3	470	hawthorn	97%	0.17	1	500	80	40%	3.30	1	500	2,000	2,000	-57%
036_02	3rd to Grasshopper	1	700	CNF Upland	98%	0.11	1	700	80	90%	0.55	1	700	400	300	-8%
036_02	3rd to Grasshopper	2	340	CNF Upland	98%	0.11	1	300	30	80%	1.10	1	300	300	300	-18%
036_02	3rd to Grasshopper	3	830	hawthorn	97%	0.17	1	800	100	60%	2.20	1	800	2,000	2,000	-37%
036_02	3rd to Grasshopper	4	240	hawthorn	88%	0.66	2	500	300	40%	3.30	2	500	2,000	2,000	-48%
036_02	3rd to Grasshopper	5	250	hawthorn	88%	0.66	2	500	300	20%	4.40	2	500	2,000	2,000	-68%
036_02	3rd to Grasshopper	6	360	hawthorn	88%	0.66	2	700	500	60%	2.20	2	700	2,000	2,000	-28%
036_02	3rd to Grasshopper	7	410	hawthorn	88%	0.66	2	800	500	10%	4.95	2	800	4,000	4,000	-78%
036_02	3rd to Grasshopper	8	87	hawthorn	88%	0.66	2	200	100	0%	5.50	2	200	1,000	900	-88%
036_02	3rd to Grasshopper	9	1400	hawthorn	71%	1.60	3	4,000	6,000	10%	4.95	3	4,000	20,000	10,000	-61%
036_02	3rd to Grasshopper	10	630	hawthorn	71%	1.60	3	2,000	3,000	20%	4.40	3	2,000	9,000	6,000	-51%
036_02	Space Creek	1	1800	CNF Upland	98%	0.11	1	2,000	200	90%	0.55	1	2,000	1,000	800	-8%
036_02	Space Creek	2	710	CNF Upland	98%	0.11	1	700	80	70%	1.65	1	700	1,000	900	-28%
036_02	Space Creek	3	380	hawthorn	88%	0.66	2	800	500	50%	2.75	2	800	2,000	2,000	-38%
036_02	Space Creek	4	460	hawthorn	88%	0.66	2	900	600	20%	4.40	2	900	4,000	3,000	-68%
036_02	Space Creek	5	470	hawthorn	88%	0.66	2	900	600	30%	3.85	2	900	3,000	2,000	-58%
036_02	Space Creek	6	260	hawthorn	88%	0.66	2	500	300	20%	4.40	2	500	2,000	2,000	-68%
036_02	Space Creek	7	180	hawthorn	71%	1.60	3	500	800	40%	3.30	3	500	2,000	1,000	-31%
036_02	Space Creek	8	580	hawthorn	71%	1.60	3	2,000	3,000	30%	3.85	3	2,000	8,000	5,000	-41%

Table D-5 (cont.). Existing and target solar loads for Grasshopper Creek (AU ID17060306CL036_02).

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
036_02	trib to Space	1	300	CNF Upland	98%	0.11	1	300	30	80%	1.10	1	300	300	300	-18%
036_02	trib to Space	2	870	hawthorn	97%	0.17	1	900	100	20%	4.40	1	900	4,000	4,000	-77%
036_02	trib to Space	3	770	hawthorn	88%	0.66	2	2,000	1,000	30%	3.85	2	2,000	8,000	7,000	-58%
036_02	5th trib to Grasshopper	1	310	CNF Upland	98%	0.11	1	300	30	90%	0.55	1	300	200	200	-8%
036_02	5th trib to Grasshopper	2	770	hawthorn	97%	0.17	1	800	100	30%	3.85	1	800	3,000	3,000	-67%
036_02	5th trib to Grasshopper	3	450	hawthorn	97%	0.17	1	500	80	80%	1.10	1	500	600	500	-17%
036_02	5th trib to Grasshopper	4	490	hawthorn	97%	0.17	1	500	80	20%	4.40	1	500	2,000	2,000	-77%
036_02	5th trib to Grasshopper	5	130	hawthorn	97%	0.17	1	100	20	50%	2.75	1	100	300	300	-47%
036_02	5th trib to Grasshopper	6	100	hawthorn	97%	0.17	1	100	20	80%	1.10	1	100	100	80	-17%
036_02	5th trib to Grasshopper	7	34	hawthorn	97%	0.17	1	30	5	0%	5.50	1	30	200	200	-97%
036_02	5th trib to Grasshopper	8	490	hawthorn	88%	0.66	2	1,000	700	70%	1.65	2	1,000	2,000	1,000	-18%
036_02	5th trib to Grasshopper	9	79	hawthorn	88%	0.66	2	200	100	40%	3.30	2	200	700	600	-48%
036_02	5th trib to Grasshopper	10	500	hawthorn	88%	0.66	2	1,000	700	70%	1.65	2	1,000	2,000	1,000	-18%
036_02	5th trib to Grasshopper	11	210	hawthorn	88%	0.66	2	400	300	40%	3.30	2	400	1,000	700	-48%
036_02	5th trib to Grasshopper	12	67	hawthorn	88%	0.66	2	100	70	70%	1.65	2	100	200	100	-18%
036_02	5th trib to Grasshopper	13	100	hawthorn	88%	0.66	2	200	100	20%	4.40	2	200	900	800	-68%
036_02	5th trib to Grasshopper	14	64	hawthorn	88%	0.66	2	100	70	50%	2.75	2	100	300	200	-38%
036_02	5th trib to Grasshopper	15	230	hawthorn	88%	0.66	2	500	300	40%	3.30	2	500	2,000	2,000	-48%
036_02	5th trib to Grasshopper	16	91	hawthorn	88%	0.66	2	200	100	80%	1.10	2	200	200	100	-8%
036_02	5th trib to Grasshopper	17	530	hawthorn	88%	0.66	2	1,000	700	30%	3.85	2	1,000	4,000	3,000	-58%
036_02	5th trib to Grasshopper	18	210	hawthorn	71%	1.60	3	600	1,000	30%	3.85	3	600	2,000	1,000	-41%
036_02	5th trib to Grasshopper	19	160	hawthorn	71%	1.60	3	500	800	70%	1.65	3	500	800	0	-1%
036_02	5th trib to Grasshopper	20	150	hawthorn	71%	1.60	3	500	800	30%	3.85	3	500	2,000	1,000	-41%
036_02	5th trib to Grasshopper	21	200	hawthorn	71%	1.60	3	600	1,000	80%	1.10	3	600	700	(300)	0%
036_02	5th trib to Grasshopper	22	130	hawthorn	71%	1.60	3	400	600	30%	3.85	3	400	2,000	1,000	-41%
036_02	trib to 5th	1	230	CNF Upland	98%	0.11	1	200	20	50%	2.75	1	200	600	600	-48%
036_02	trib to 5th	2	98	CNF Upland	98%	0.11	1	100	10	60%	2.20	1	100	200	200	-38%
036_02	trib to 5th	3	82	CNF Upland	98%	0.11	1	80	9	90%	0.55	1	80	40	30	-8%
036_02	trib to 5th	4	210	CNF Upland	98%	0.11	1	200	20	60%	2.20	1	200	400	400	-38%
036_02	trib to 5th	5	240	hawthorn	97%	0.17	1	200	30	90%	0.55	1	200	100	70	-7%
036_02	trib to 5th	6	430	hawthorn	97%	0.17	1	400	70	50%	2.75	1	400	1,000	900	-47%
036_02	trib to 5th	7	640	hawthorn	97%	0.17	1	600	100	30%	3.85	1	600	2,000	2,000	-67%
036_02	trib to 5th	8	140	hawthorn	88%	0.66	2	300	200	0%	5.50	2	300	2,000	2,000	-88%
036_02	trib to 5th	9	220	hawthorn	88%	0.66	2	400	300	30%	3.85	2	400	2,000	2,000	-58%
036_02	trib to 5th	10	74	hawthorn	88%	0.66	2	100	70	0%	5.50	2	100	600	500	-88%
036_02	trib to 5th	11	150	hawthorn	88%	0.66	2	300	200	20%	4.40	2	300	1,000	800	-68%
036_02	trib to 5th	12	220	hawthorn	88%	0.66	2	400	300	70%	1.65	2	400	700	400	-18%
036_02	trib to 5th	13	240	hawthorn	88%	0.66	2	500	300	40%	3.30	2	500	2,000	2,000	-48%
036_02	trib to 5th	14	380	hawthorn	88%	0.66	2	800	500	30%	3.85	2	800	3,000	3,000	-58%
036_02	trib to 5th	15	480	hawthorn	88%	0.66	2	1,000	700	10%	4.95	2	1,000	5,000	4,000	-78%
036_02	trib to 5th	16	120	hawthorn	88%	0.66	2	200	100	40%	3.30	2	200	700	600	-48%
							Totals		65,000					200,000	130,000	

Table D-6. Existing and target solar loads for Grasshopper Creek (AU ID17060306CL036_03).

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
036_03	Grasshopper Creek	1	160	hawthorn	45%	3.03	6	1,000	3,000	50%	2.75	6	1,000	3,000	0	0%
036_03	Grasshopper Creek	2	400	hawthorn	45%	3.03	6	2,000	6,000	20%	4.40	6	2,000	9,000	3,000	-25%
036_03	Grasshopper Creek	3	340	hawthorn	45%	3.03	6	2,000	6,000	40%	3.30	6	2,000	7,000	1,000	-5%
036_03	Grasshopper Creek	4	99	hawthorn	45%	3.03	6	600	2,000	60%	2.20	6	600	1,000	(1,000)	0%
036_03	Grasshopper Creek	5	190	hawthorn	45%	3.03	6	1,000	3,000	50%	2.75	6	1,000	3,000	0	0%
036_03	Grasshopper Creek	6	430	hawthorn	45%	3.03	6	3,000	9,000	60%	2.20	6	3,000	7,000	(2,000)	0%
036_03	Grasshopper Creek	7	170	hawthorn	45%	3.03	6	1,000	3,000	30%	3.85	6	1,000	4,000	1,000	-15%
036_03	Grasshopper Creek	8	120	hawthorn	45%	3.03	6	700	2,000	60%	2.20	6	700	2,000	0	0%
036_03	Grasshopper Creek	9	81	hawthorn	45%	3.03	6	500	2,000	20%	4.40	6	500	2,000	0	-25%
036_03	Grasshopper Creek	10	350	hawthorn	45%	3.03	6	2,000	6,000	0%	5.50	6	2,000	10,000	4,000	-45%
036_03	Grasshopper Creek	11	130	hawthorn	45%	3.03	6	800	2,000	20%	4.40	6	800	4,000	2,000	-25%
036_03	Grasshopper Creek	12	150	hawthorn	45%	3.03	6	900	3,000	30%	3.85	6	900	3,000	0	-15%
036_03	Grasshopper Creek	13	140	hawthorn	45%	3.03	6	800	2,000	20%	4.40	6	800	4,000	2,000	-25%
036_03	Grasshopper Creek	14	260	hawthorn	45%	3.03	6	2,000	6,000	10%	4.95	6	2,000	10,000	4,000	-35%
036_03	Grasshopper Creek	15	160	hawthorn	45%	3.03	6	1,000	3,000	20%	4.40	6	1,000	4,000	1,000	-25%
036_03	Grasshopper Creek	16	180	hawthorn	45%	3.03	6	1,000	3,000	30%	3.85	6	1,000	4,000	1,000	-15%
036_03	Grasshopper Creek	17	81	hawthorn	45%	3.03	6	500	2,000	10%	4.95	6	500	2,000	0	-35%
036_03	Grasshopper Creek	18	350	hawthorn	39%	3.36	7	2,000	7,000	30%	3.85	7	2,000	8,000	1,000	-9%
036_03	Grasshopper Creek	19	290	hawthorn	39%	3.36	7	2,000	7,000	40%	3.30	7	2,000	7,000	0	0%
036_03	Grasshopper Creek	20	130	hawthorn	39%	3.36	7	900	3,000	30%	3.85	7	900	3,000	0	-9%
036_03	Grasshopper Creek	21	190	hawthorn	39%	3.36	7	1,000	3,000	20%	4.40	7	1,000	4,000	1,000	-19%
036_03	Grasshopper Creek	22	120	hawthorn	39%	3.36	7	800	3,000	10%	4.95	7	800	4,000	1,000	-29%
036_03	Grasshopper Creek	23	310	hawthorn	39%	3.36	7	2,000	7,000	20%	4.40	7	2,000	9,000	2,000	-19%
036_03	Grasshopper Creek	24	150	hawthorn	39%	3.36	7	1,000	3,000	10%	4.95	7	1,000	5,000	2,000	-29%
036_03	Grasshopper Creek	25	200	hawthorn	39%	3.36	7	1,000	3,000	20%	4.40	7	1,000	4,000	1,000	-19%
036_03	Grasshopper Creek	26	200	hawthorn	39%	3.36	7	1,000	3,000	30%	3.85	7	1,000	4,000	1,000	-9%
036_03	Grasshopper Creek	27	350	hawthorn	39%	3.36	7	2,000	7,000	20%	4.40	7	2,000	9,000	2,000	-19%
036_03	Grasshopper Creek	28	450	hawthorn	39%	3.36	7	3,000	10,000	30%	3.85	7	3,000	10,000	0	-9%
036_03	Grasshopper Creek	29	250	hawthorn	39%	3.36	7	2,000	7,000	40%	3.30	7	2,000	7,000	0	0%
036_03	Grasshopper Creek	30	140	hawthorn	39%	3.36	7	1,000	3,000	30%	3.85	7	1,000	4,000	1,000	-9%
036_03	Grasshopper Creek	31	370	hawthorn	39%	3.36	7	3,000	10,000	50%	2.75	7	3,000	8,000	(2,000)	0%
							Totals		140,000					170,000	26,000	

Table D-7. Existing and target solar loads for Winter Creek tributaries (AU ID17060306CL037_02).

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
037_02	Upper tributary	1	580	hawthorn	97%	0.17	1	600	100	50%	2.75	1	600	2,000	2,000	-47%
037_02	Upper tributary	2	190	hawthorn	97%	0.17	1	200	30	80%	1.10	1	200	200	200	-17%
037_02	Upper tributary	3	310	CNF Upland	98%	0.11	1	300	30	90%	0.55	1	300	200	200	-8%
037_02	Upper tributary	4	560	hawthorn	97%	0.17	1	600	100	40%	3.30	1	600	2,000	2,000	-57%
037_02	Upper tributary	5	1000	hawthorn	88%	0.66	2	2,000	1,000	20%	4.40	2	2,000	9,000	8,000	-68%
037_02	Upper tributary	6	610	hawthorn	71%	1.60	3	2,000	3,000	40%	3.30	3	2,000	7,000	4,000	-31%
037_02	Upper tributary	7	130	CNF Upland	96%	0.22	3	400	90	80%	1.10	3	400	400	300	-16%
037_02	Rt Fk to Upper	1	99	hawthorn	97%	0.17	1	100	20	60%	2.20	1	100	200	200	-37%
037_02	Rt Fk to Upper	2	260	CNF Upland	98%	0.11	1	300	30	90%	0.55	1	300	200	200	-8%
037_02	Rt Fk to Upper	3	220	CNF Upland	98%	0.11	1	200	20	70%	1.65	1	200	300	300	-28%
037_02	Rt Fk to Upper	4	590	CNF Upland	98%	0.11	1	600	70	90%	0.55	1	600	300	200	-8%
037_02	Rt Fk to Upper	5	250	hawthorn	97%	0.17	1	300	50	50%	2.75	1	300	800	800	-47%
037_02	Rt Fk to Upper	6	160	hawthorn	97%	0.17	1	200	30	10%	4.95	1	200	1,000	1,000	-87%
037_02	Rt Fk to Upper	7	1100	CNF Upland	98%	0.11	2	2,000	200	80%	1.10	2	2,000	2,000	2,000	-18%
037_02	Rt Fk to Upper	8	250	hawthorn	88%	0.66	2	500	300	30%	3.85	2	500	2,000	2,000	-58%
037_02	Rt Fk to Upper	9	140	CNF Upland	98%	0.11	2	300	30	80%	1.10	2	300	300	300	-18%
037_02	Lower tributary	1	120	hawthorn	97%	0.17	1	100	20	60%	2.20	1	100	200	200	-37%
037_02	Lower tributary	2	490	CNF Upland	98%	0.11	1	500	60	90%	0.55	1	500	300	200	-8%
037_02	Lower tributary	3	520	CNF Upland	98%	0.11	1	500	60	80%	1.10	1	500	600	500	-18%
037_02	Lower tributary	4	67	hawthorn	97%	0.17	1	70	10	30%	3.85	1	70	300	300	-67%
037_02	Lower tributary	5	1400	hawthorn	88%	0.66	2	3,000	2,000	80%	1.10	2	3,000	3,000	1,000	-8%
037_02	Lower tributary	6	400	CNF Upland	98%	0.11	2	800	90	90%	0.55	2	800	400	300	-8%
							Totals		7,300					33,000	26,000	

Table D-8. Existing and target solar loads for Winter Creek (AU ID17060306CL037_03).

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
037_03	Winter Creek	1	580	hawthorn	51%	2.70	5	3,000	8,000	50%	2.75	5	3,000	8,000	0	-1%
037_03	Winter Creek	2	900	hawthorn	51%	2.70	5	5,000	10,000	60%	2.20	5	5,000	10,000	0	0%
037_03	Winter Creek	4	2400	CNF Breakland	65%	1.93	6	10,000	20,000	80%	1.10	6	10,000	10,000	(10,000)	0%
							Totals		38,000					28,000	-10,000	

Table D-9. Existing and target solar loads for Winter Creek (AU ID17060306CL038_02).

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Shade	Solar Radiation (kWh/m²/day)	Segment Width (m)	Segment Area (m²)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
038_02	Winter Creek	1	460	CNF Upland	98%	0.11	1	500	60	90%	0.55	1	500	300	200	-8%
038_02	Winter Creek	2	64	CNF Upland	98%	0.11	1	60	7	30%	3.85	1	60	200	200	-68%
038_02	Winter Creek	3	96	CNF Upland	98%	0.11	1	100	10	90%	0.55	1	100	60	50	-8%
038_02	Winter Creek	4	450	hawthorn	97%	0.17	1	500	80	60%	2.20	1	500	1,000	900	-37%
038_02	Winter Creek	5	330	CNF Upland	98%	0.11	1	300	30	70%	1.65	1	300	500	500	-28%
038_02	Winter Creek	6	320	CNF Upland	98%	0.11	2	600	70	80%	1.10	2	600	700	600	-18%
038_02	Winter Creek	7	770	hawthorn	88%	0.66	2	2,000	1,000	40%	3.30	2	2,000	7,000	6,000	-48%
038_02	Winter Creek	8	140	hawthorn	88%	0.66	2	300	200	20%	4.40	2	300	1,000	800	-68%
038_02	Winter Creek	9	78	hawthorn	88%	0.66	2	200	100	60%	2.20	2	200	400	300	-28%
038_02	Winter Creek	10	260	hawthorn	71%	1.60	3	800	1,000	40%	3.30	3	800	3,000	2,000	-31%
038_02	Winter Creek	11	360	hawthorn	71%	1.60	3	1,000	2,000	20%	4.40	3	1,000	4,000	2,000	-51%
038_02	Winter Creek	12	420	CNF Upland	96%	0.22	3	1,000	200	50%	2.75	3	1,000	3,000	3,000	-46%
038_02	Winter Creek	13	170	CNF Upland	94%	0.33	4	700	200	60%	2.20	4	700	2,000	2,000	-34%
038_02	Winter Creek	14	440	CNF Upland	94%	0.33	4	2,000	700	90%	0.55	4	2,000	1,000	300	-4%
038_02	Winter Creek	15	400	CNF Upland	94%	0.33	4	2,000	700	50%	2.75	4	2,000	6,000	5,000	-44%
038_02	Winter Creek	16	170	hawthorn	60%	2.20	4	700	2,000	30%	3.85	4	700	3,000	1,000	-30%
038_02	trib to Winter	1	710	CNF Upland	98%	0.11	1	700	80	60%	2.20	1	700	2,000	2,000	-38%
038_02	trib to Winter	2	1300	hawthorn	88%	0.66	2	3,000	2,000	40%	3.30	2	3,000	10,000	8,000	-48%
038_02	trib to Winter	3	470	hawthorn	88%	0.66	2	900	600	60%	2.20	2	900	2,000	1,000	-28%
038_02	trib to Winter	4	110	hawthorn	71%	1.60	3	300	500	80%	1.10	3	300	300	(200)	0%
038_02	trib to Winter	5	740	hawthorn	71%	1.60	3	2,000	3,000	50%	2.75	3	2,000	6,000	3,000	-21%
038_02	trib to Winter	6	660	CNF Upland	98%	0.11	1	700	80	90%	0.55	1	700	400	300	-8%
038_02	trib to Winter	7	480	hawthorn	97%	0.17	1	500	80	60%	2.20	1	500	1,000	900	-37%
038_02	trib to Winter	8	340	CNF Upland	98%	0.11	1	300	30	90%	0.55	1	300	200	200	-8%
038_02	trib to Winter	9	190	CNF Upland	98%	0.11	1	200	20	80%	1.10	1	200	200	200	-18%
038_02	trib to Winter	10	680	hawthorn	88%	0.66	2	1,000	700	40%	3.30	2	1,000	3,000	2,000	-48%
038_02	trib to Winter	11	270	CNF Upland	98%	0.11	2	500	60	80%	1.10	2	500	600	500	-18%
038_02	trib to Winter	12	380	hawthorn	88%	0.66	2	800	500	50%	2.75	2	800	2,000	2,000	-38%
038_02	trib to Winter	13	320	hawthorn	88%	0.66	2	600	400	80%	1.10	2	600	700	300	-8%
038_02	trib to Winter	14	120	hawthorn	88%	0.66	2	200	100	60%	2.20	2	200	400	300	-28%
038_02	trib to Winter	15	360	hawthorn	88%	0.66	2	700	500	30%	3.85	2	700	3,000	3,000	-58%
							Totals		17,000					65,000	48,000	

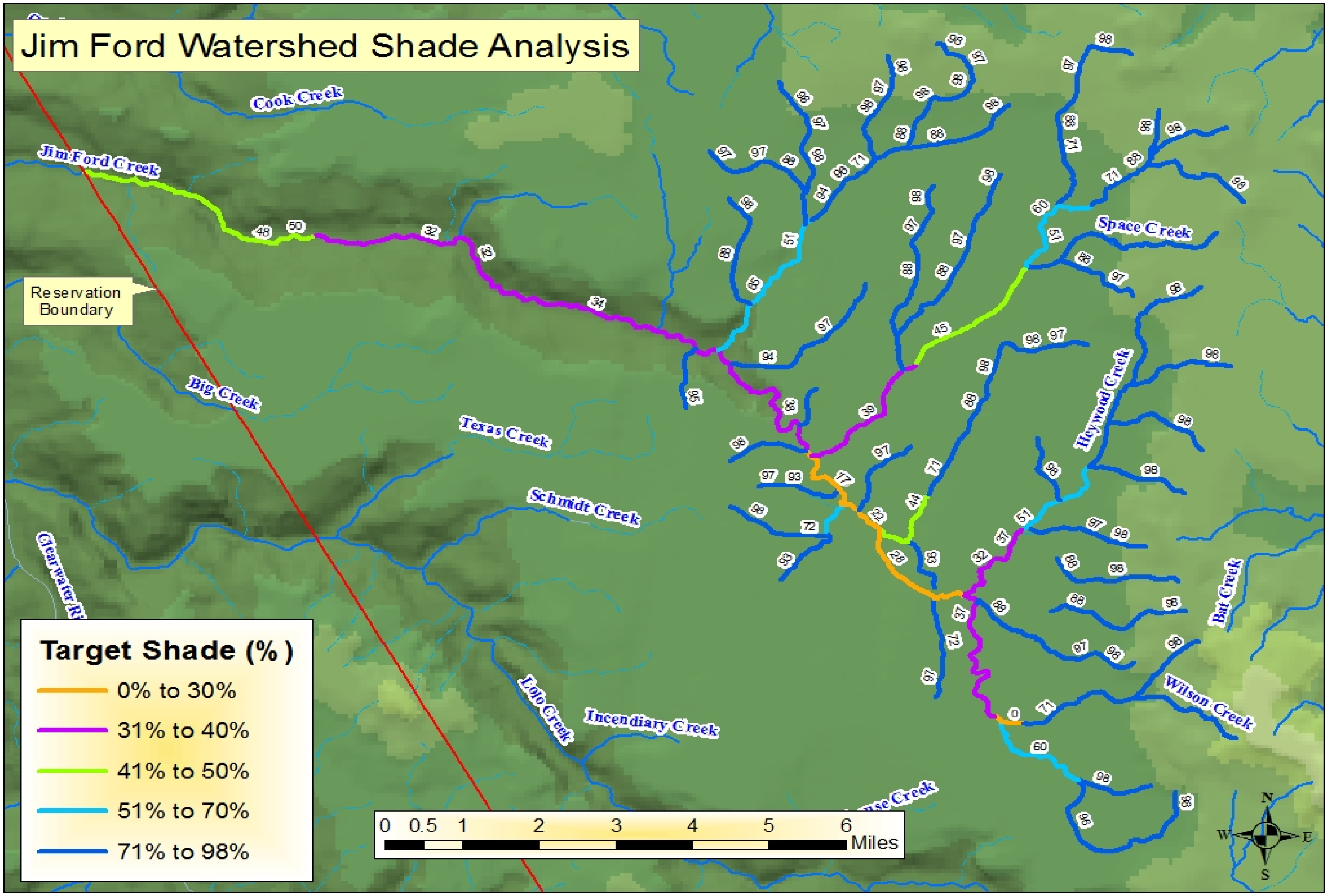

Figure D-1. Target shade for Jim Ford Creek watershed.

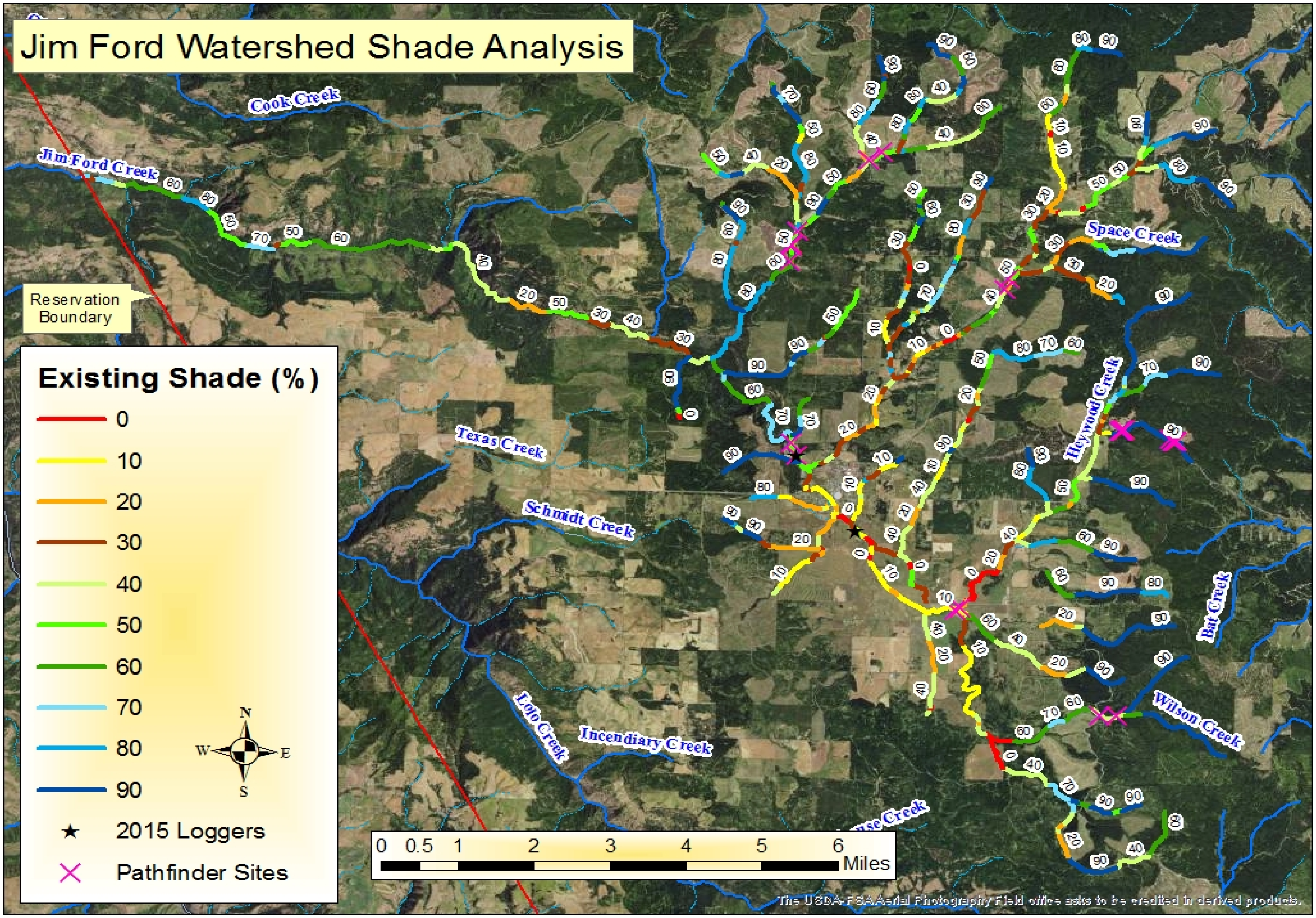

Figure D-2. Existing shade estimated for Jim Ford Creek watershed by aerial photo interpretation.

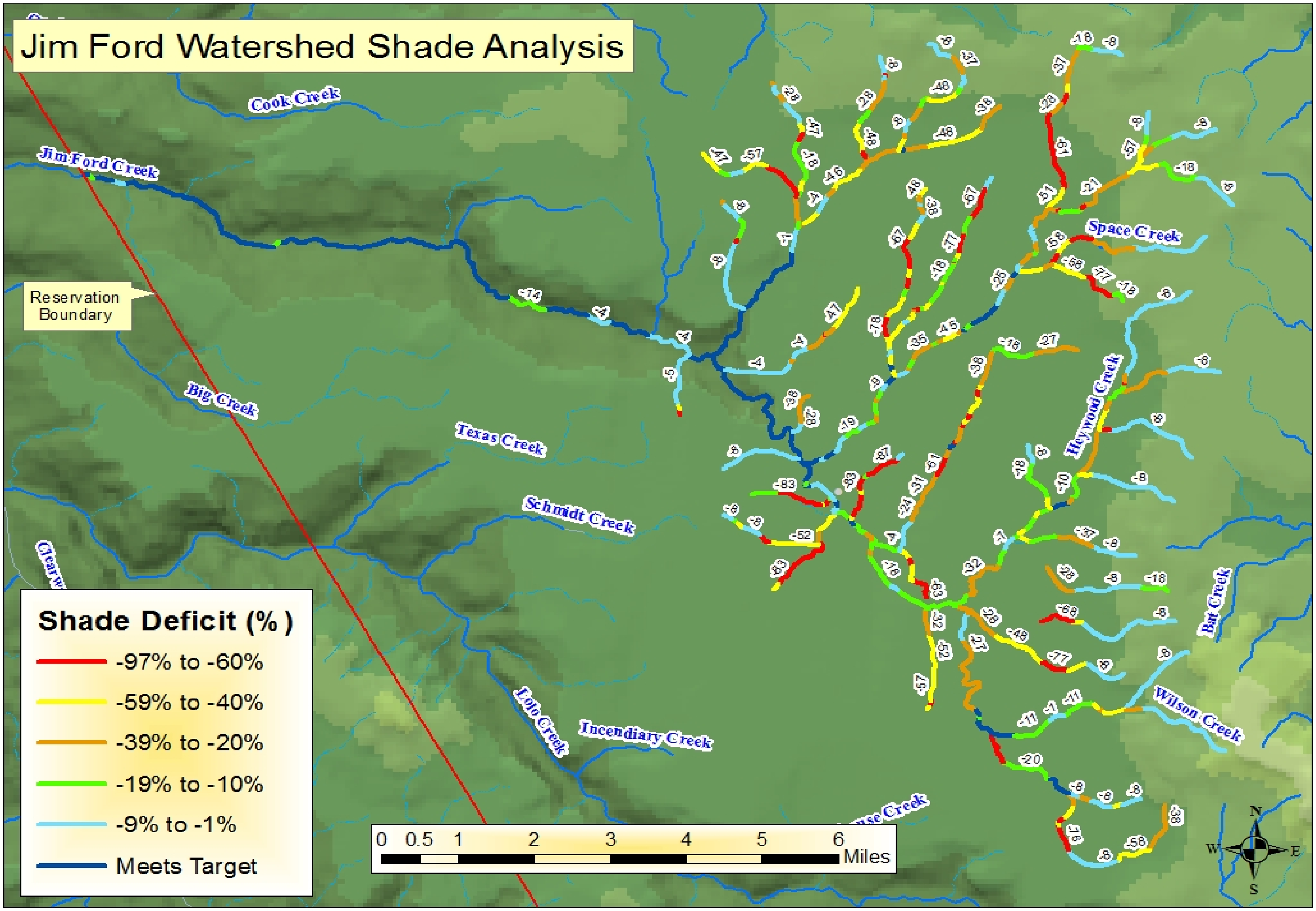

Figure D-3. Shade deficit (difference between existing and target) for Jim Ford Creek watershed.

Appendix E. Temperature Data

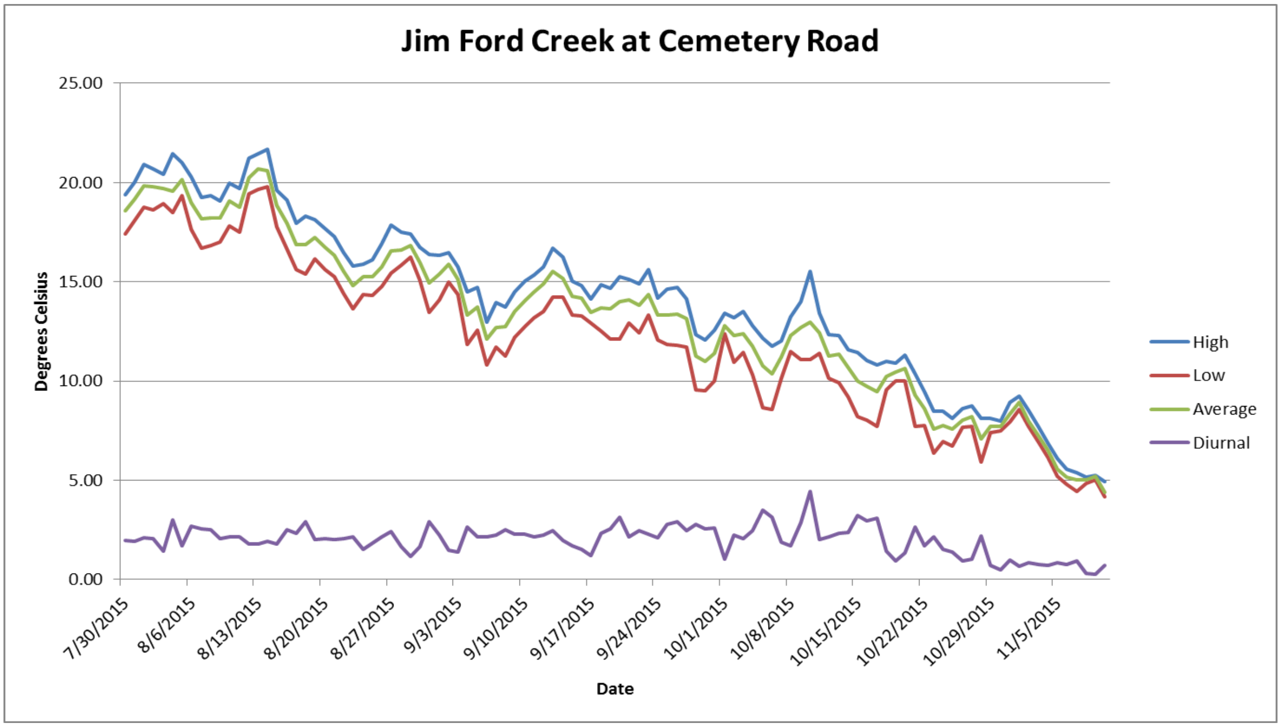

Figure E-1. 2015 temperature data for Jim Ford Creek at the Cemetery Road crossing above Weippe.

SITE INFORMATION	Serial Number			
	10281142			
Data Source Name:	DEQ-Lewiston			
Waterbody Name:	Jim Ford Creek			
Data Collection Site:	ID17060306CL035_03			
Date Period:	7/30/2015 to 11/10/2015			
HUC Number:	17060306			
HUC Name:	CLEARWATER			
Site Description:	Cemetery Rd xing above Weippe			
Elevation:	914			
Highest Daily Maximum	21.68	8/14/2015		
Maximum 7-Day Maximum	20.67	8/6/2015		
Mean Daily Maximum	14.13			
Highest Daily Average	20.67	8/13/2015		
Maximum 7-Day Average	19.60	8/6/2015		
Mean Daily Average	13.20			
Lowest Daily Minimum	4.19	11/10/2015		
Minimum 7-Day Minimum	4.94	11/10/2015		
Mean Daily Minimum	12.14			
Highest Daily Diurnal	4.43	10/10/2015		
Mean Daily Diurnal	1.99			
Monthly Means	Max	Min	Avg	Diurnal
Jan.	0.00	0.00	0.00	0.00
Feb.	0.00	0.00	0.00	0.00
Mar.	0.00	0.00	0.00	0.00
Apr.	0.00	0.00	0.00	0.00
May	0.00	0.00	0.00	0.00
Jun.	0.00	0.00	0.00	0.00
Jul.	0.00	0.00	0.00	0.00
Aug.	18.75	16.65	17.75	2.10
Sep.	14.69	12.44	13.70	2.26
Oct.	11.06	9.03	10.11	2.03
Nov.	0.00	0.00	0.00	0.00
Dec.	0.00	0.00	0.00	0.00

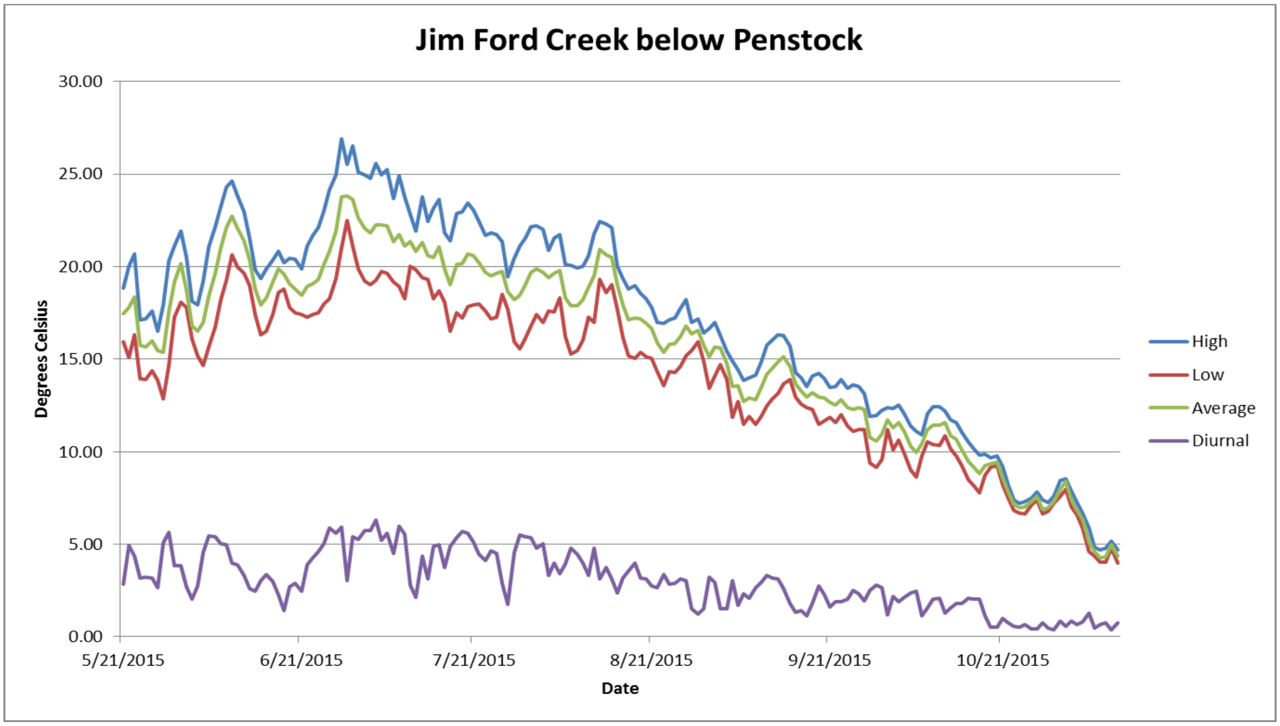

Figure E-2. 2015 temperature data for Jim Ford Creek below the hydro-plant penstock.

SITE INFORMATION	Serial Number			
	10281143			
Data Source Name:	DEQ-Lewiston			
Waterbody Name:	Jim Ford Creek			
Data Collection Site:	ID17060306CL035_04			
Date Period:	5/21/2015 to 11/10/2015			
HUC Number:	17060306			
HUC Name:	CLEARWATER			
Site Description:	bl penstock of hydropower plant			
Elevation:	902			
Highest Daily Maximum	26.92	6/28/2015		
Maximum 7-Day Maximum	25.62	7/4/2015		
Mean Daily Maximum	17.11			
Highest Daily Average	23.81	6/29/2015		
Maximum 7-Day Average	22.85	7/4/2015		
Mean Daily Average	15.63			
Lowest Daily Minimum	3.96	11/10/2015		
Minimum 7-Day Minimum	4.53	11/10/2015		
Mean Daily Minimum	14.12			
Highest Daily Diurnal	6.30	7/4/2015		
Mean Daily Diurnal	2.99			
Monthly Means	Max	Min	Avg	Diurnal
Jan.	0.00	0.00	0.00	0.00
Feb.	0.00	0.00	0.00	0.00
Mar.	0.00	0.00	0.00	0.00
Apr.	0.00	0.00	0.00	0.00
May	0.00	0.00	0.00	0.00
Jun.	21.89	18.09	19.93	3.80
Jul.	22.90	18.20	20.52	4.70
Aug.	19.39	16.05	17.83	3.33
Sep.	14.32	12.06	13.23	2.26
Oct.	10.04	8.73	9.38	1.31
Nov.	0.00	0.00	0.00	0.00
Dec.	0.00	0.00	0.00	0.00

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Appendix F. Public Participation and Public Comments

This TMDL was developed with participation from the Jim Ford Creek Watershed Advisory Group (WAG). meeting dates were as follows:

- May 11, 2016—Jim Ford Creek TMDL review status and structuring of the WAG
- June 16, 2016—Review of Jim Ford Creek TMDL review nutrient and bacteria criteria and data
- July 21, 2016—Jim Ford Creek TMDL review of sediment
- August 18, 2016—Jim Ford Creek TMDL Temperature Addendum PNV methodology review

[Public comments and DEQ responses to be inserted following public comment period.]

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Appendix G. Distribution List

[To be added following the public comment period.]

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