South Fork Clearwater River Subbasin Assessment and Total Maximum Daily Loads

Idaho Department of Environmental Quality
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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
µ	micro, one-one thousandth
§	Section (usually a section of federal or state rules or statutes)
ACOE	Army Corps of Engineers
ALTA	aquatic landtype association
ave.	average
BA	biological assessment
BAG	Basin Advisory Group
BLM	United States Bureau of Land Management
BMP	best management practice
BOD	biological oxygen demand
BPA	Bonneville Power Administration
Btu	British thermal unit
BURP	Beneficial Use Reconnaissance Program
C	Celsius
CAFO	confined animal feeding operation
CFI	Clearwater Forest Industries
CFR	Code of Federal Regulations (refers to citations in the federal administrative rules)
cfs	cubic feet per second
cfu	colony forming units
cm	centimeters
CRP	Cropping Reserve Program
CWA	Clean Water Act
CWAL	cold water aquatic life
CWE	cumulative watershed effects
DEQ	Idaho Department of Environmental Quality
DO	dissolved oxygen
DRG	digital Raster graphic
ECA	equivalent clearcut acres
EMAP	Environmental Monitoring and Assessment Program
EQIP	Environmental Quality Incentive Program
ESA	Endangered Species Act
ESU	ecologically significant unit
F	Fahrenheit
Fish TAG	Fisheries Technical Advisory Group
FLIR	forward-looking infra-red
FPA	Idaho Forest Practices Act

FSA Farm Services Administration

FWS U.S. Fish and Wildlife Service

GIS Geographical Information Systems

HALT habitat alteration

HI DEQ's Habitat Index

HTG habitat type groups

HUC Hydrologic Unit Code

ICBEMP Interior Columbia Basin Environmental Management Program

IDA Idaho Department of Agruculture

IDAPA Refers to citations of Idaho administrative rules

IDC Idaho Department of Commerce

IDHW Idaho Department of Health and Welfare

ITD Idaho Transportation Dept.

IDFG Idaho Department of Fish and Game

IDL Idaho Department of Lands

IDWR Idaho Department of Water Resources

INFISH Federal Inland Native Fish Strategy

km kilometer

km^2 square kilometer

LA load allocation

LFG landform group

LC load capacity

m meter

m^3 cubic meter

M&E monitoring and evaluation

mi mile

mi^2 square miles

MBI macroinvertebrate biotic index

MGD million gallons per day

mg/L milligrams per liter

mm millimeter

MMBF million board feet

MOS margin of safety

MOU Memorandum of Understanding

MWMT maximum weekly maximum temperature

N nitrogen

n.a. not applicable

NA not assessed

NB natural background

nd no data (data not available)

NEPA National Environmental Policy Act

NEZSED Nez Perce National Forest sediment model

NFS not fully supporting

NMFS National Marine Fisheries Service

NO2 nitric oxide

NO3 nitrous oxide

NPDES National Pollutant Discharge Elimination System

NPNF Nez Perce National Forest

NPT Nez Perce Tribe

NRCS Natural Resources Conservation Service

NTU nephlometric turbidity unit

NWI National Wetlands Inventory

ORW Outstanding Resource Water

P phosphorus

PACFISH The federal Pacific Anadromous Fish Strategy

PCB polychloro bi-phenols

PCR primary contact recreation

PFC proper functioning condition

ppm part(s) per million

QA quality assurance

QALT flow alteration

QC quality control

RFI DEQ's river fish index

RHCA riparian habitat conservation area

RM river mile

RMI DEQ's river macroinvertebrate index

RUSLE revised universal soil loss equation

SBA subbasin assessment

SCR secondary contact recreation

SF CWR South Fork Clearwater River

SFI DEQ's stream fish index

SHI DEQ's stream habitat index

SMI DEQ's stream macroinvertebrate index

SS salmonid spawning

SSOC stream segment of concern

SSURGO Soil Survey Geographic Database

STATSGO State Soil Geographic Database

STP sewage treatment plant

TAG technical advisory group

TIN total inorganic nitrogen

TIR thermal infra-red

TKN total Kjeldahl nitrogen

TMDL total maximum daily load

TN total nitrogen

TP total phosphorus

TSS total suspended solids

t/y tons per year

U.S. United States

U.S.C. United States Code

USDA United States Department of Agriculture

USDI United States Department of the Interior

USEPA United States Environmental Protection Agency

USFS United States Forest Service

USGS United States Geological Survey

VRU vegetative response units

WAG Watershed Advisory Group

WBAG *Water Body Assessment Guidance*

WB water body

WBID water body identification number

WEPP Watershed Erosion Prediction Project sediment model

WLA wasteload allocation

WQS water quality standard(s)

WWTP waste water treatment plant

Executive Summary

The federal Clean Water Act (CWA) requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters. States and tribes, pursuant to Section 303 of the CWA, are to adopt water quality standards (WQS) necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the waters whenever possible. Section 303(d) of the CWA establishes requirements for states and eligible 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 of impaired waters, currently every two years. For waters identified on this list, states and tribes must develop a total maximum daily load (TMDL) for the pollutants, set at a level to achieve WQS. This document addresses the water bodies in the South Fork Clearwater River (SF CWR) Subbasin that have been placed on what has come to be known as the "303(d) list." This document was prepared collaboratively under a Memorandum of Agreement by the Idaho Department of Environmental Quality (DEQ), the Nez Perce Tribe (NPT), and the U.S. Environmental Protection Agency (USEPA).

This subbasin assessment and TMDLs have been developed to comply with Idaho's WQS and TMDL schedule. The first part of this document, the subbasin assessment, is an important first step in leading to the TMDL. This assessment describes the physical, biological, and cultural setting; water quality status; pollutant sources; and recent pollution control actions in the SF CWR Subbasin located in north-central Idaho. The starting point for the assessment was Idaho's 1998 303(d) list of water quality limited water bodies. Eighteen stream segments and one lake in the SF CWR Subbasin were included on this list. The subbasin assessment portion of this document examines the current status of 303(d) listed waters. It defines the extent of impairment and causes of water quality limitation throughout the subbasin. The loading analysis, or TMDL, portion of the document quantifies pollutant sources and allocates responsibility for load reductions needed to return listed waters to a condition of meeting WQS.

Subbasin Assessment at a Glance

The SF CWR Subbasin is entirely within Idaho County, with the county seat at Grangeville, Idaho, and partially on the Nez Perce Reservation (Figure A). Total maximum daily loads were completed in 2000 for the six stream segments in the Cottonwood Creek watershed within the SF CWR Subbasin. This document addresses the remaining 12 listed stream segments and Lucas Lake. Their extent, beneficial uses, and suspected pollutants are shown in Table A. However, at the completion of the assessment of temperature impairment to water quality, it was concluded that many unlisted stream segments throughout the subbasin need heat load reductions to meet WQS. Heat load reductions in terms of stream shading increases were established for stream segments throughout the subbasin.

A new, comprehensive system of water quality accounting is being established by DEQ and USEPA which uses water quality "assessment units" (AUs). The correlation between AUs and the water bodies assessed in this report is presented in Appendix C.

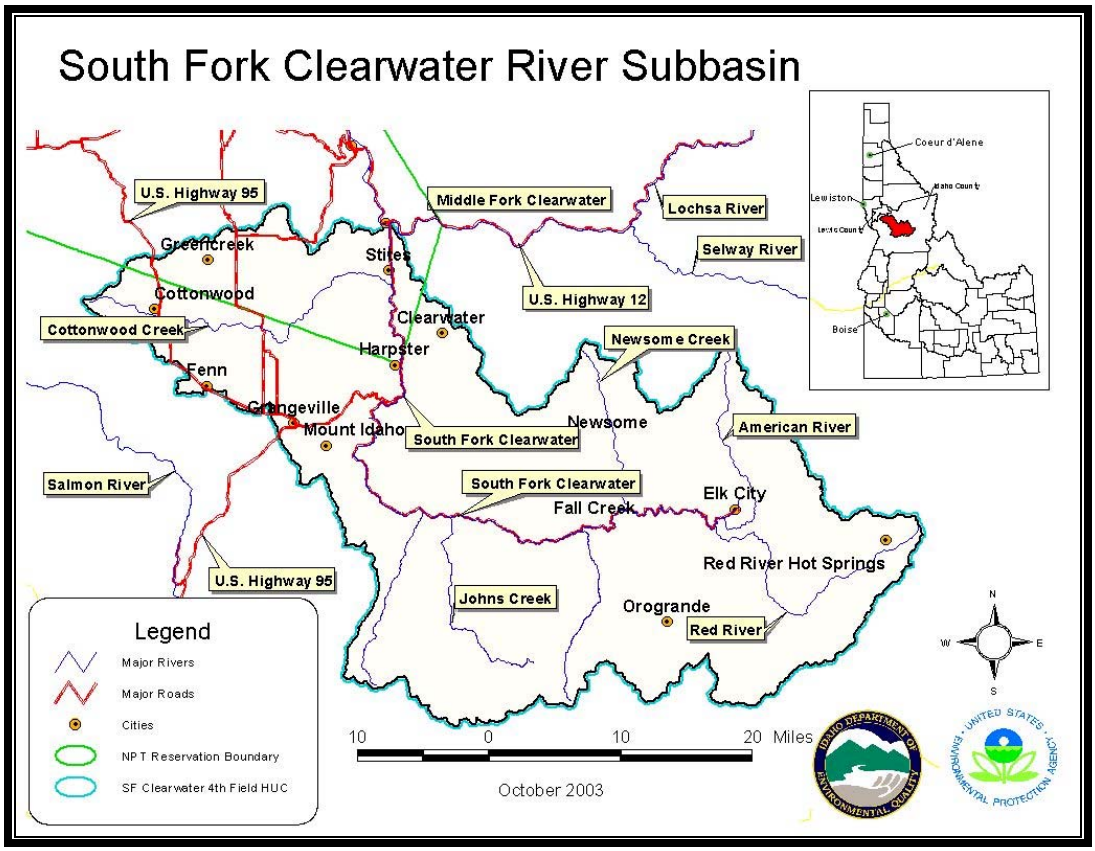

Figure A. The South Fork Clearwater River Subbasin in North-Central Idaho

Table A. Water quality limited water bodies in the SF CWR Subbasin.

Stream Name	Water Body Identification Numbers[a]	Boundaries (1998 303(d) list)[b]	Beneficial Uses[c]	303(d) Listed Pollutant[d]	TMDLs Completed
South Fork Clearwater River	1, 12, 22, 30, 36	Red River to Clearwater River	CW/SS(d) PCR(d) SRW (d)	Halt, Sed, Temp	Sed, Temp
Three mile Creek	10	Headwaters to SF CWR	CW/SS(d) SCR(d)	Bac, DO, Qalt, Halt, NH_3, Nut, Sed, Temp	Bac, DO, Nut, Sed, Temp
Butcher Creek	11	Headwaters to SF CWR	CW/SS(d) SCR(d)	Bac, DO, Qalt, Halt, Sed, Temp	Sed, Temp
Dawson Creek	38	Headwaters to Red River	CW/SS(e) PCR/SCR(e)	Sed	Temp
Little Elk Creek	57	Headwaters to Elk Creek	CW/SS(e) PCR/SCR(e)	Temp	Temp
Big Elk	58	Headwaters	CW/SS(e)	Temp	Temp

Stream Name	Water Body Identification Numbers[a]	Boundaries (1998 303(d) list)[b]	Beneficial Uses[c]	303(d) Listed Pollutant[d]	TMDLs Completed
Creek		to Elk Creek	PCR/SCR(e)		
Buffalo Gulch	59	Headwaters to American River	CW/SS(e) PCR/SCR(e)	Sed	Temp
New-some Creek	62	Beaver Creek to SF CWR	CW/SS(e) PCR/SCR(e)	Sed	Temp
Nugget Creek	64	Headwaters to Newsome Creek	CW/SS(e) PCR/SCR(e)	Sed	Temp
Beaver Creek	65	Headwaters to Newsome Creek	CW/SS(e) PCR/SCR(e)	Sed	Temp
Sing Lee Creek	73	Headwaters to Newsome Creek	CW/SS(e) PCR/SCR(e)	Sed	Temp
Cougar Creek	79	Headwaters to SF CWR	CW/SS(e) PCR/SCR(e)	Sed	Temp
Lucas Lake			CW/SS(e) PCR/SCR(e)	Sed	
58 Other Water Bodies[e]					Temp

[a] A new accounting system for water quality tracking is being setup using water quality "assessment units" (AUs). A given water body may contain one or more AUs. The correlation between water bodies assessed in this document and AUs may be found in Appendix C.

[b] Refers to a list created in 1998 of water bodies in Idaho that did not fully support at least one beneficial use. This list is required under section 303 subsection "d" of the Clean Water Act. This list may change in the future.

[c] CW = Cold Water, SS = Salmonid Spawning, PCR = Primary Contact Recreation, SCR = Secondary Contact Recreation, SWR= Special Resource Water, (d) = designated beneficial use, (e) = existing beneficial use

[d] Bac = bacteria, DO = dissolved oxygen, Qalt = flow alteration, Halt = habitat alteration, NH_3 = ammonia, Nut = nutrients, Sed = sediment, Temp = temperature

[e] Temperature TMDLs were written for the 58 other water bodies in the SF CWR Subbasin, excepting those water bodies covered by the Cottonwood Creek TMDL.

Pollutant analyses were conducted in four distinct groupings: subbasin-wide analyses for temperature (heat loading); subbasin-wide analyses for sediment; Threemile and Butcher Creeks for bacteria, nutrients, dissolved oxygen, and ammonia; and Lucas Lake for sediment.

Subbasin-wide temperature analyses were conducted in light of an extensive database indicating that no stream in the SF CWR Subbasin, not even ones in relatively pristine condition, meets the Idaho numeric temperature criteria for salmonid spawning. However, the Idaho WQS recognize that stream temperatures may naturally exceed numeric criteria and that pollution control measures should only address the human-caused increases in

temperature. The non-point temperature assessments assumed that the human-caused effects were increased solar insolation, primarily a result of reduced streamside vegetation and, secondarily a result of increased stream width. Shading and stream width analyses were conducted on all perennial streams in the subbasin. The human-caused stream temperature increase was quantified in terms of the percent decrease in stream shade and increase in stream width. Targets were set based on best estimates of natural conditions for stream shade and stream width. It was recognized that minor amounts of human-caused heat loading occur, such as from hatchery facilities or old mining sites, but allocations were limited to the major source of increased heat loading, reduced stream shading and increased stream width. Point source temperature loadings were calculated based on temperatures and flows, and were generally very low except at the Grangeville wastewater treatment plant (WWTP). Targets for all WWTPs were set to limit temperature increases in receiving waters to less than 0.3^{o}C (0.5^{o}F) above the temperature criteria, as per the WQS and USEPA temperature guidance (USEPA 2003).

Subbasin-wide sediment analyses were based on a limited stream turbidity and total suspended solids (TSS) data set from four locations in the lower subbasin and a sediment delivery budget to streams from various sources. The sediment budget was developed using estimates from different models and data sets from the various sediment sources throughout the subbasin, as follows: NEZSED erosion model estimates of sediment from federally-managed timber land; RUSLE erosion model estimates of sediment from agricultural and range land; a stream bank erosion model estimate of in-stream erosion; WEPP erosion model estimates of sediment from county roads; a Nez Perce National Forest inventory of mass failures extrapolated to include the complete subbasin; and an estimate based on average annual rock crush of gravel from State Highway 14 reaching the river. Point sources of sediment in the subbasin (municipal WWTPs, suction dredges, construction and industrial stormwater runoff) were found to be insignificant in relation to the nonpoint sources.

Turbidity data were compared directly to the state WQS with loadings calculated using turbidity to TSS relationships. Sediment targets and allocations in the lower basin were set to meet the state turbidity criteria. Sediment targets for the upper basin, where no turbidity data were available, were set based on the percent load reduction needed at the mouth of the SF CWR, the Stites bridge control location. It was recognized that minor amounts of human-caused sediment loading occurs, such as from hatchery facilities or old mining sites, but allocations were limited to the major sources identified in the sediment budget. Point source allocations were established at required technology based levels, or at levels in existing National Pollutant Discharge Elimination System (NPDES) permits.

Threemile and Butcher Creeks are 303(d) listed for several other pollutants in addition to sediment and temperature. They were both also evaluated for nutrients, dissolved oxygen, bacteria, and ammonia. Threemile Creek is particularly impacted because it receives effluent from the Grangeville WWTP, which at times makes up more than 50% of the stream flow. Data for pollutants were collected near the mouth of Butcher Creek and at four locations on Threemile Creek. Bacteria, dissolved oxygen, and ammonia data were compared to the state WQS. Nutrient levels were compared to both USEPA guidelines and the state's narrative WQS to determine impairment. In the case of Threemile Creek, where water quality

impairment was identified, the target was set for phosphorus based on the USEPA guidelines and local monitoring results. These targets, and the seasonality of their application, may require adjustments in the future as additional data and information are collected. The phosphorus TMDL is expected to result in compliance with the numeric dissolved oxygen standard as well as the narrative nutrient criteria. A bacteria TMDL was also established for Threemile Creek to address the seasonally high levels of *E. coli*.

Lucas Lake, near Elk City, is an old "glory hole" about 2 acres in size from the mining days. It was 303(d) listed because it was identified in the Idaho 1988 *Water Quality Status Report and Nonpoint Source Assessment* (DEQ 1989) as not supporting one or more beneficial uses due to sediment siltation. Turbidity and metals samples were collected for the lake and compared against the state WQS. No impairment was identified.

Key Findings

The SF CWR subbasin assessment and TMDLs have been written with input from a local Watershed Advisory Group consisting of 16 members representing a wide range of interests and land managers. This group met monthly over the course of the project to review progress and provide input. A Fisheries Technical Advisory Group of professionals knowledgeable of the fisheries resources in the subbasin met several times and provided detailed information about the presence and condition of salmonid species in the subbasin.

As a result of the subbasin assessment, temperature TMDLs were written for all 74 water bodies in the part of the subbasin covered by this document; sediment TMDLs were written for the main stem SF CWR, Butcher Creek, and Threemile Creek; and nutrient and bacteria TMDLs were written for Threemile Creek. It is expected that these TMDLs will improve conditions throughout the subbasin for all aquatic species, including threatened and endangered fish species such as bull trout, spring chinook salmon, and steelhead.

Water temperatures are elevated above WQS at all monitoring locations throughout the subbasin. Shading of the water surface has been reduced by logging, roading, mining, grazing, and agricultural activities near the streams and rivers. To a lesser degree, stream channel configurations have been altered by the same human activities. Water channels that have been made wider and shallower, with less vegetative shading, are being heated by solar insolation. The degree to which shade has been reduced and channels altered was assessed on a stream reach by stream reach basis. Current stream shading was assessed using aerial photograph interpretation and other analytical techniques. Potential shade in forested areas was assumed to be 90%. Channel widths in forested areas were assumed to have been little altered in relation to the size of coniferous trees and their ability to provide shade. Potential shade in non-forested areas was calculated from the size and density of an expected natural vegetation and an expected natural channel width. Targets were set to restore stream shading and stream channel morphology to conditions representing minimal human impact.

Whereas stream heat load capacity can be described in terms of joules per day, and some discussion of heat loading in relation to stream shade and channel width is included in this document, loading for temperature is presented in terms of stream shade and stream width.

The load capacity of a given stream reach is set at the heat loading that would occur if the reach were in a relatively undisturbed condition in terms of the channel morphology and streamside vegetation. In the forested part of the subbasin, 3,640 stream reaches were evaluated, of which 54% need various percentage increases of stream canopy closure. An ArcView shapefile is included with the TMDL so users can locate stream reaches and identify whether or not a shade increase is needed, and how much. For the non-forested streams and rivers, more variable current conditions led to the need to have shade and stream width targets defined on a more site-specific basis. Any need for increased shade and/or stream width reduction must be calculated on the ground using a set of graphs which require input of wetted stream width, aspect of the stream, and one of twelve expected natural vegetation categories.

Point source contributions to water temperature increases are minor throughout the subbasin except for the effects of the effluent from the Grangeville WWTP on Threemile Creek. Allocations are established for all WWTPs such that they will not increase stream temperature more than 0.3^{o}C (0.5^{o}F) above established temperature criteria per IDAPA 58.01.02.401.03.a.v, and USEPA regional temperature guidance (USEPA 2003).

Sediment loadings to waters of the SF CWR Subbasin fall into two relatively distinct categories: sediment loadings from agricultural and grazing areas on the order of 10-30 times natural background (per water body) compared to sediment loadings from forested areas no greater than twice natural background. For Threemile and Butcher Creeks which are the primary agricultural areas in the subbasin, TSS based on the turbidity WQS need to be reduced 71% and 46%, respectively, to meet the state WQS. At Stites on the main stem SF CWR, with dilution from the forested part of the watershed, TSS loading needs to be reduced by 25%. At the Harpster control location, which is above the majority of agricultural and grazing areas, turbidity meets the WQS.

Water quality in the upper basin was determined to be degraded by coarse sediment, primarily sand-sized material, as it affects salmonid spawning. The problem is more-or-less basin-wide wherever human activities have occurred. In order to meet water quality objectives, sediment load reduction allocations of 25% were set for the Harpster control location as well as three other upstream control locations (above Johns Creek, above Tenmile Creek, and above Crooked River) on the main stem SF CWR. Control locations were set on the main stem with the goal of directing land managers to reduce sediment from appropriate locations throughout the upper basin. For example, to meet the load allocated to the main South Fork Clearwater River at Harpster reductions may occur anywhere in the watershed above Harpster. The 25% load reduction target was selected as consistent with the load reduction required at the Stites location at the mouth of the main stem.

Point sources of sediment loading include five municipal WWTPs, suction dredge mining operations, and construction and industrial stormwater runoff. All of these sources are very minor in comparison to loading from human-caused nonpoint source runoff. Allocations for these facilities are based on meeting turbidity and treatment requirements in Idaho WQS, and technology based limits for WWTPs.

Bacteria levels in Threemile Creek substantially exceed the *E. coli* criteria in Idaho WQS. Limited data are available to assess the source of bacteria loading, but it is believed that livestock grazing in and around the creek is the most significant source. Other potential sources include stormwater runoff and leaking sewer lines in Grangeville, failed septic systems, and waterfowl and other wildlife. A general load reduction of 82% - 93% has been set for all nonpoint sources. The Grangeville WWTP is a known point source, but due to its disinfection facilities, it contributes less than allowed by the WQS and its NPDES permit. It received an allocation equal to the WQS, with no required load reduction.

Nutrient levels in Threemile Creek substantially exceed USEPA's regional guidance for both nitrogen and phosphorus. The majority of the nutrients are contained in the effluent from the WWTP; however, a considerable portion is also from nonpoint sources. Required load reductions are developed for phosphorus as the limiting nutrient for both the WWTP and non-point sources. Since dissolved oxygen (DO) and nutrient levels are linked, the state WQS of 6 mg/L of DO is set as a target for DO. In order to attain the targets, phosphorus load reductions were set at 32% from the headwaters to the WWTP, 32% from the WWTP outfall to the Nez Perce Reservation boundary, and 0% from the reservation boundary to the mouth. The WWTP received a 97% phosphorus load reduction.

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

Stream	Pollutant(s)
South Fork Clearwater River	Sediment, Temperature
Threemile Creek	Bacteria, Nutrients, DO, Sediment, Temperature
Butcher Creek	Sediment, Temperature
Dawson Creek	Temperature
Little Elk Creek	Temperature
Big Elk Creek	Temperature
Buffalo Gulch	Temperature
Newsome Creek	Temperature
Beaver Creek	Temperature
Nugget Creek	Temperature
Sing Lee Creek	Temperature
Cougar Creek	Temperature
58 Other Water Bodies	Temperature

Timeframe.

Development of the implementation plan has already begun. The plan is expected to be completed in time to submit for 319 funding in 2004/2005. Wasteload allocations will be incorporated into NPDES permits when they are reissued or reopened. The Grangeville permit is expected to be reissued within the next 1-2 years, and the recently reissued permits

for Kooskia, Stites, Elk City and Red River Ranger Station will need to be re-opened to incorporate revised limits.

Implementation of nonpoint source controls has already begun, but is expected to proceed in earnest once the implementation plan is complete and funds are available. A majority of the sources of temperature and sediment loading are nonpoint in origin, and realistically it may take many years if not decades to fully achieve the goals of the TMDL. Certain improvements such as controlling temperature and nutrients from the Grangeville treatment facility or controlling nonpoint bacteria sources are likely to occur within a few years. In order to improve stream temperature, restored riparian communities and stream channels are needed. In smaller streams and watersheds, for example, the exclosure on Big Elk Creek, significant improvement may be seen in several years. It is likely to take decades to see such improvement throughout the watershed given the large scale of needed improvements and the time needed for riparian vegetation to grow to maturity.

1. Subbasin Assessment – Watershed Characterization

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 (33 U.S.C. 1251). States and tribes, pursuant to section 303 of the CWA are to adopt water quality standards (WQS) wherever attainable necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the waters. Section 303(d) of the CWA establishes requirements for states and tribes to identify and prioritize water bodies that are water quality limited (i.e., water bodies that do not meet WQS. States and tribes must periodically publish a priority list of impaired waters, currently every two years. For waters identified on this list, states and tribes must develop a total maximum daily load (TMDL) for the pollutants, set at a level to achieve WQS. This document addresses the water bodies in the South Fork Clearwater River (SF CWR) Subbasin that have been placed on what is known as the "303(d) list."

The overall purpose of this subbasin assessment (SBA) and TMDL is to characterize and document pollutant loads and set load allocations to meet existing WQS within the SF CWR Subbasin. The first portion of this document, the SBA, is partitioned into four major sections: watershed characterization, water quality concerns and status, pollutant source inventory, and a summary of past and present pollution control efforts (Chapters 1 – 4). This information is used to develop a TMDL for each pollutant of concern for the SF CWR Subbasin (Chapter 5).

1.1 Introduction

In 1972, Congress passed public law 92-500, the Federal Water Pollution Control Act, more commonly called the Clean Water Act. The goal of this act is to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (Water Pollution Control Federation 1987). 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 is protecting and managing waters to insure "swimmable and fishable" conditions. This goal, along with a 1972 goal to restore and maintain chemical, physical, and biological integrity, relates water quality with more than just chemistry.

Background

The federal government, through the U.S. Environmental Protection Agency (USEPA), assumed the dominant role in defining and directing water pollution control programs across the country. The Idaho Department of Environmental Quality (DEQ) implements the CWA in Idaho, while the USEPA oversees Idaho and certifies the fulfillment of CWA requirements and responsibilities. The USEPA implements the CWA on the Nez Perce Reservation. Because this document addresses water quality issues pertaining to the authorities of DEQ, USEPA and the Nez Perce Tribe (NPT), it has been prepared under the auspices of a Memorandum of Agreement (Appendix A).

Section 303 of the CWA requires DEQ and tribes to adopt, with USEPA approval, WQS and to review those standards every three years. Additionally, DEQ and tribes must monitor waters to identify those not meeting WQS. For those waters not meeting standards, DEQ and tribes must establish TMDLs for each pollutant impairing the waters. Further, states and tribes must set appropriate controls to restore water quality and allow the water bodies to meet their designated uses. These requirements result in a list of impaired waters, called the "303(d) list." This list describes water bodies not meeting WQS. Waters identified on this list require further analysis. A SBA and TMDL provide a summary of the water quality status and allowable TMDL for water bodies on the 303(d) list. This document, the *South Fork Clearwater River Subbasin Assessment and Total Maximum Daily Loads,* provides this summary for the currently listed waters in the SF CWR Subbasin.

The SBA sections of this report (Chapters 1 – 4) include an evaluation and summary of the current water quality status, pollutant sources, and control actions in the SF CWR Subbasin to date. While the SBA is not a requirement of the TMDL, USEPA, DEQ, and the NPT completed this assessment to ensure impairment listings are up to date and accurate.

The TMDL 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 WQS (40 CFR §130). Consequently, a TMDL is specific to a water body and each of its pollutants. The TMDL also includes pollutant allocations among various sources of the pollutant. The USEPA considers certain unnatural conditions, such as flow alteration, a lack of flow, or habitat alteration, that are not the result of the discharge of a specific pollutant as "pollution." TMDLs are not required for water bodies impaired by pollution, but not by specific pollutants. 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.

Idaho and Tribal Roles

Idaho and tribes adopt WQS to protect public health and welfare, enhance the quality of water, and protect biological integrity. A WQS 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.

The state and/or tribe may assign or designate beneficial uses for particular Idaho water bodies to support. State of Idaho beneficial uses are identified in the Idaho WQS and include:

- Aquatic life support – cold water, seasonal cold water, warm water, salmonid spawning, modified
- Contact recreation – primary (swimming), secondary (boating)
- Water supply – domestic, agricultural, industrial

- Wildlife habitats, aesthetics, special resource water, and outstanding resource water

The Idaho legislature designates uses for water bodies on state lands. Industrial water supply, wildlife habitat, and aesthetics are designated beneficial uses for all water bodies in the state. If a water body is unclassified, then cold water aquatic life and primary or secondary contact recreation are used as additional default designated uses when water bodies are assessed (IDAPA 58.01.02.101.01.a).

An SBA entails analyzing and integrating multiple types of water body data, such as biological, physical/chemical, and landscape data to address several objectives:

- Determine the degree of designated beneficial use support of the water body (i.e., attaining or not attaining WQS).
- Determine the degree of achievement of biological integrity.
- Compile descriptive information about the water body, particularly the identity and location of pollutant sources.
- Determine the causes and extent of the impairment when water bodies are not attaining WQS.

1.2 Physical and Biological Characteristics

The majority of text and statistics in this section are taken directly from the *South Fork Clearwater River Biological Assessment* (USFS 1999), and the *South Fork Clearwater River Landscape Assessment* (USFS 1998).

The SF CWR Subbasin is located in north-central Idaho and encompasses an area of approximately 1,175 square miles (752,000 acres) with a 207 mile perimeter (Figure 1). The subbasin extends from the headwaters above Elk City (elevation 6,382 feet) to the confluence with the Middle Fork of the Clearwater River at Kooskia, Idaho (elevation 1,280 feet). The lower 12.8 miles of the SF CWR main stem flow through the NPT Reservation. The NPT Reservation encompasses 84,035 acres of the subbasin.

Idaho State Code divides the SF CWR Subbasin into 82 numbered water bodies (IDAPA 58.01.02.120.07). These are the water body units to which the 303(d) list applies and which this document refers to by name and number. Table 1 lists the major watersheds, their associated water bodies, water body numbers, and their number of acres. Figure 2 shows the distribution of the water bodies throughout the SF CWR Subbasin.

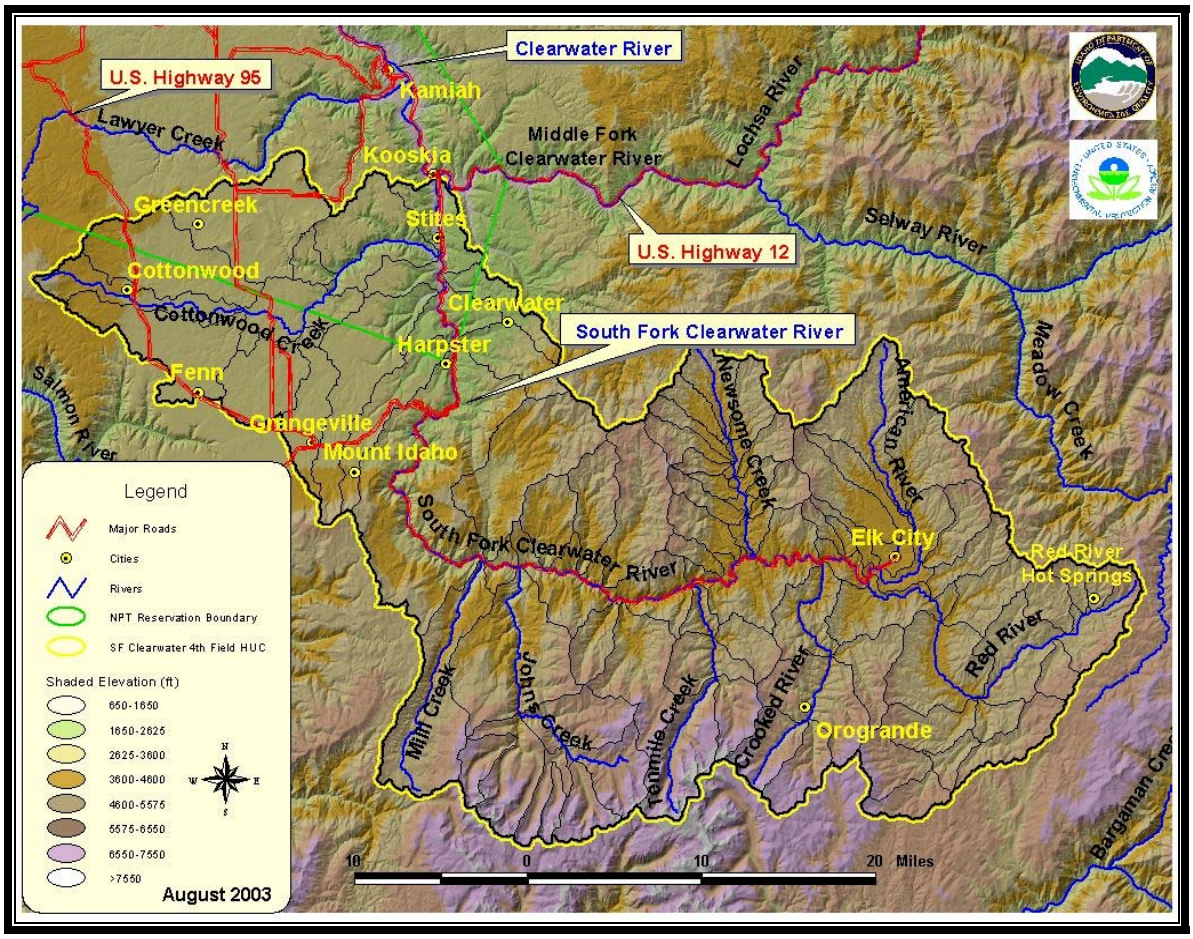

Figure 1. The South Fork Clearwater River Subbasin in North-Central Idaho

Table 1. SF CWR Subbasin watersheds, water bodies, and acreages.

Watershed/Water Body	Acreage
South Fork Clearwater River	115,223
WB 1 – Lower South Fork Clearwater River	19,723
WB 12 – Mid-Lower South Fork Clearwater River	56,690
WB 22 – Middle South Fork Clearwater River	18,950
WB 30 – Mid-Upper South Fork Clearwater River	17,165
WB 36 – Upper South Fork Clearwater River	2,695
Threemile Creek	21,440
WB 10 – Threemile Creek	
Butcher Creek	10,000
WB 11 – Butcher Creek	
Mill Creek	23,249
WB 13 – Mill Creek	

Watershed/Water Body	Acreage
Johns Creek	72,150
WB 14 – Lower Johns Creek	26,300
WB 15 – Gospel Creek	10,830
WB 16 – West Fork Gospel Creek	4,465
WB 17 – Middle Johns Creek	10,180
WB 18 – Upper Johns Creek	8,660
WB 19 – Moores Creek	3,960
WB 20 – Square Mountain Creek	2,270
WB 21 – Hagen Creek	5,520
Wing Creek	5,329
WB 23 – Wing Creek	
Twentymile Creek	14,545
WB 24 –Twentymile Creek	
Tenmile Creek	34,410
WB 25 – Lower Tenmile Creek	2,500
WB 26 – Middle Tenmile Creek	7,230
WB 27 – Upper Tenmile Creek	13,630
WB 28 – Williams Creek	5,900
WB 29 – Sixmile Creek	5,150
Crooked River	45,659
WB 31 – Lower Crooked River	9,470
WB 32 – Upper Crooked River	14,470
WB 33 – West Fork Crooked River	7,580
WB 34 – East Fork Crooked River	6,670
WB 35 – Relief Creek	7,470
Red River	103,348
WB 37 – Lower Red River	10,200
WB 38 – Middle Red River	16,000
WB 39 – Moose Butte Creek	7,050
WB 40 – Lower South Fork Red River	3,100
WB 41 – Middle South Fork Red River	2,700
WB 42 – West Fork Red River	6,370
WB 43 – Upper South Fork Red River	4,730
WB 44 – Trapper Creek	7,060

Watershed/Water Body	Acreage
WB 45 – Upper Red River	19,000
WB 46 – Soda Creek	3,340
WB 47 – Bridge Creek	3,260
WB 48 – Otterson Creek	2,460
WB 49 – Trail Creek	4,540
WB 50 – Siegel Creek	7,760
WB 51 – Red Horse Creek	5,800
American River	58,612
WB 52 – Lower American River	7,216
WB 53 – Kirks Fork American River	6,258
WB 54 – East Fork American River	11,500
WB 55 – Upper American River	15,275
WB 56 – Elk Creek	2,324
WB 57 – Little Elk Creek	5,081
WB 58 – Big Elk Creek	8,821
WB 59 – Buffalo Gulch	2,139
Whiskey Creek	1,660
WB 60 – Whiskey Creek	
Maurice Creek	1,094
WB 61 Maurice Creek	
Newsome Creek	42,576
WB 62 – Lower Newsome Creek	4,144
WB 63 – Bear Creek	3,831
WB 64 – Nugget Creek	1,450
WB 65 – Beaver Creek	3,732
WB 66 – Middle Newsome Creek	1,134
WB 67 – Mule Creek	5,498
WB 68 – Upper Newsome Creek	6,354
WB 69 – Haysfork Creek	3,170
WB 70 – Baldy Creek	2,723
WB 71 – Pilot Creek	3,916
WB 72 – Sawmill Creek	1,768
WB 73 – Sing Lee Creek	1,554
WB 74 – West Fork Newsome Creek	3,303

Watershed/Water Body	Acreage
Leggett Creek	4,918
WB 75 – Leggett Creek	
Fall Creek	2,334
WB 76 – Fall Creek	
Silver Creek	16,509
WB 77 – Silver Creek	
Peasley Creek	9,112
WB 78 – Peasley Creek	
Cougar Creek	7,731
WB 79 – Cougar Creek	
Meadow Creek	24,115
WB 80 – Meadow Creek	
Sally Ann Creek	8,890
WB 81 – Sally Ann Creek	
Rabbit Creek	6,190
WB 82 – Rabbit Creek	

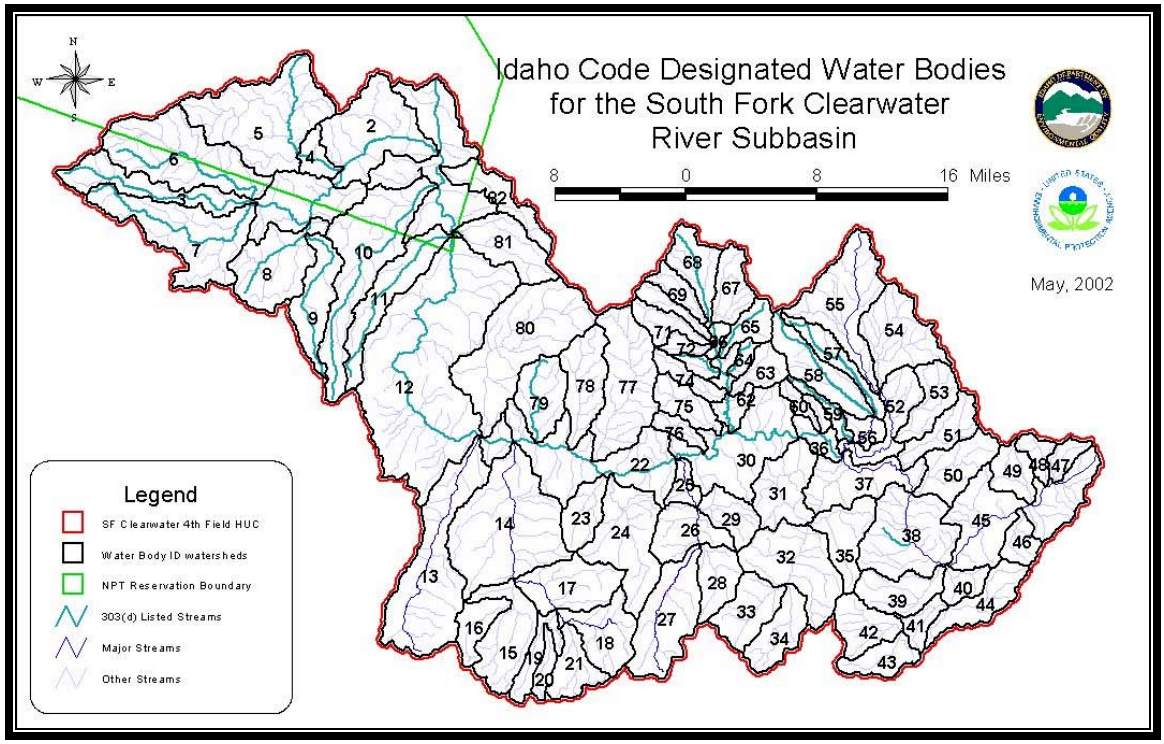

Figure 2. Water Bodies and Water Body Numbers in the SF CWR Subbasin

Climate

Northern Idaho is dominated by Pacific maritime air masses and prevailing westerly winds. Over 85% of the annual precipitation occurs during the fall, winter, and spring months. Cyclonic storms consisting of a series of frontal systems moving east produce long duration, low-intensity precipitation during this period of the year. In winter and spring, this inland maritime regime is characterized by prolonged gentle rains, fog, cloudiness, and high humidity; with deep snow accumulations at higher elevations. Winter temperatures are often 15 to 25 ^{o}F warmer than the continental locations of the same latitude. The climate during the summer months is influenced by stationary high-pressure systems over the northwest coast. These warm dry systems result in only 10-15% of the annual precipitation falling during the summer. Figure 3 shows precipitation distribution and climatic stations. Table 2 summarizes climatic information from several stations in the area of the SF CWR Subbasin.

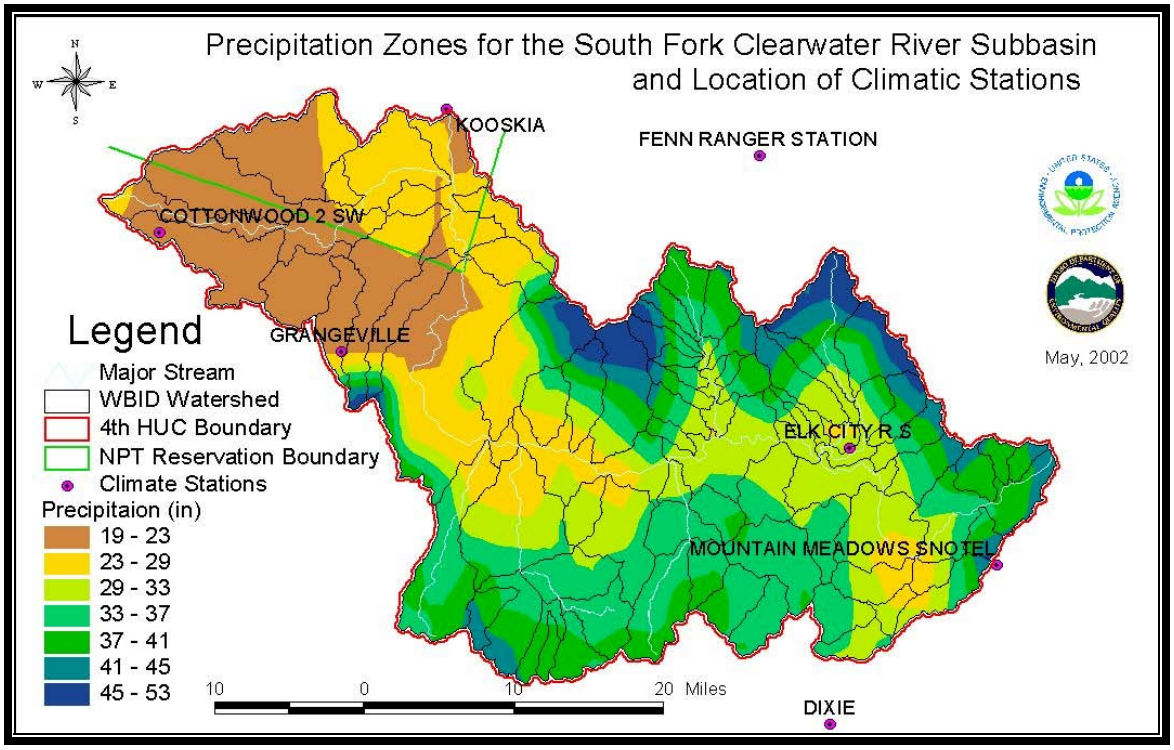

Figure 3. Climatic Stations and Precipitation Zones in the SF CWR Subbasin

Table 2. Summary of climatic data for various stations in and around the SF CWR Subbasin.

Station Name	Elevation (feet)	Period of Record	Mean Annual Temperature (ºF)	Mean Annual Precipitation (inches)	Avg. Number of Days Above 90ºF Per Year
Cottonwood	3,950	1950-2000	46.5	22.5	5.5
Dixie	5,620	1952-2000	36.2	28.5	1.2
Elk City	4,060	1950-2000	41.3	30.2	12.2
Fenn	1,590	1948-2000	49.1	38.1	40.5
Grangeville	3,360	1948-2000	46.3	23.8	14.0
Kooskia	1,280	1908-2000	50.4	24.2	53.2
Mountain Meadows	6,360	1989-2000	34.5	45.8	0.1

Subbasin Characteristics

The subbasin hydrography, hydrology, geology, landforms, and soils are described below.

Hydrography

The SF CWR flow regime reflects the annual precipitation and temperature patterns. Precipitation in the subbasin ranges from 25 inches at the lower elevations to over 50 inches at the higher elevations. Ten percent of the annual precipitation in Kooskia falls as snow, whereas 40% of the precipitation in Elk City is snow. Annual runoff from the SF CWR Subbasin averages about 12 inches, as measured by the U.S. Geological Survey (USGS) stream gage at Stites. Mean annual streamflow at Stites, the lower end of the subbasin, is 1,060 cubic feet per second (cfs). Streamflows are highest in May with an average of 3,370 cfs. Flows are lowest in September with an average of 258 cfs.

The SF CWR typically experiences annual flood peaks during late April, early May, or early June. An average spring runoff peak at Stites is about 5,000 to 7,000 cfs. The largest flood of record was on June 8, 1964, with an estimated peak of 17,500 cfs. Floods occasionally result from snowmelt or rain-on-snow between November and March. An analysis of peak flow records at Stites shows that 15% of flood peaks occurred during this period. Only 5% of flood peaks occurred during these months upstream near the forest boundary as shown by historic gaging station records. Further upstream, near Elk City, only 3% of flood peaks occurred during these months. These differences show the transition of climatic conditions from the lower to upper parts of the subbasin, as well as the relative dominance of peak flows during spring runoff.

The major tributaries in the upper reaches of the SF CWR watershed (i.e., American River, Red River, Crooked River, and Newsome Creek) have a runoff regime very similar to the main stem. They drain large areas of rolling upland terrain and typically do not have a flashy

response to floods due to elevation, climate, relatively deep soils, forest vegetation, and moderate topography.

The runoff regimes of tributaries between Newsome Creek and the Nez Perce National Forest (NPNF) boundary in the lower part of the subbasin are relatively complex, and depend on size, elevation, and landform. For example, Johns Creek and Tenmile Creek drain high elevation terrain in their headwaters and mid- to low-elevation breaklands in their lower reaches. Due to the high elevation headwaters, peak flows often occur several weeks later in the spring than the upper subbasin streams. Medium size, mid-elevation tributaries, including Silver Creek, Mill Creek, Twentymile Creek, and Meadow Creek have a similar runoff regime to the major upper basin streams described above. The smaller tributaries in this reach of the South Fork Canyon often originate on low elevation breaklands that are subject to winter rain-on-snow events or spring and summer thunderstorms. These events can produce localized floods and debris torrents.

Butcher Creek, Threemile Creek, and Cottonwood Creek drain the Camas Prairie and have a significantly different runoff regime. They often have their annual peak flows in the midwinter, associated with rain-on-snow or rapid snowmelt events. Spring rains can also produce peak flows in these streams. These streams experience low flows earlier in the season than upstream tributaries.

Hydrology

Four basic hydrologic zones have been described in the SF CWR Subbasin by the NPNF (USFS 1999).

Zone 1- High Elevation Mountains. This includes those areas above 6,000 feet, often on glaciated landforms. Annual precipitation is typically 40-60 inches. High snow accumulations and relatively late, prolonged snowmelt are common. Stream channels are highly variable within this zone ranging from very steep, confined headwater streams to relatively flat channels located in glaciated valleys. Examples in this zone include upper Johns Creek and Tenmile Creek.

Zone 2- Mid Elevation Rolling Uplands. This zone is typically between 4,000 and 6,000 feet elevation with relatively low relief rolling hills. Annual precipitation is 30 to 40 inches. These areas have a moderate annual snow pack and snowmelt in May. Stream channels range in size and flow through relatively steep confined headwaters to low gradient, unconfined alluvial valley bottoms. This zone covers the largest portion of the SF CWR Subbasin and is best exemplified by the tributaries of Red River, American River, Newsome Creek, and Crooked River.

Zone 3- Low Elevation Breaklands. This zone is less than 4,000 feet in elevation and is comprised of steep sideslopes in the major stream and river canyons. Precipitation is typically 20 to 30 inches per year, with a low to moderate snow pack. The runoff regime is complex with a mix of snowmelt, rain-on-snow, and heavy rain resulting in peak runoff events. These occur typically in early spring. Streams are generally confined to steep valley

walls with gradients that vary. Debris torrents are relatively common in smaller drainages. This zone is found all along the South Fork Canyon and up the major drainages.

Zone 4- Low Elevation Plateaus. This zone is less than 4,000 feet in elevation and has a rolling topography. Annual precipitation is 20 to 30 inches. The snow pack is low to moderate. The runoff regime is mixed with snowmelt, rain-on-snow, and heavy rain resulting in peak flows at varying times from midwinter to early spring. This zone is best exemplified by the Camas Prairie tributaries: Butcher Creek, Threemile Creek, and Cottonwood Creek.

Figure 4 shows the mean monthly hydrographs as expressed as percent of annual flow from stream gages representative of the hydrologic zones within the SF CWR Subbasin. The Zone 1 plot is from Johns Creek, Zone 2 is from the SF CWR near Elk City, and Zones 3 and 4 are from Lapwai Creek. Although it is not in the SF CWR Subbasin, Lapwai Creek was used as the example for Zones 3 and 4, because it is the only stream draining the Camas Prairie with a long term gaging record.

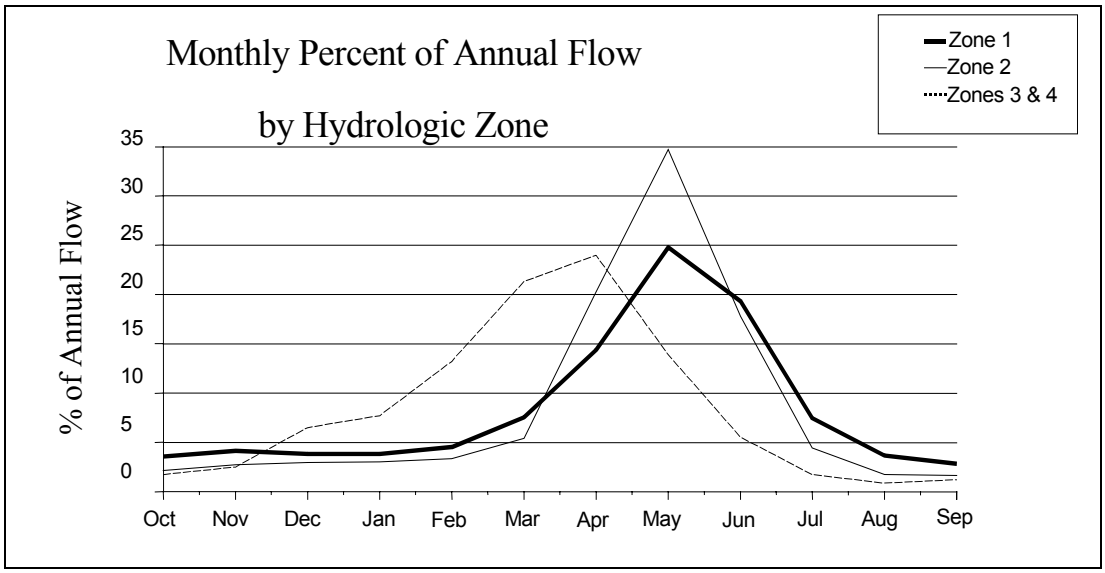

Figure 4. Monthly Percent of Annual Flow

Since the figures are expressed as percentages, the plots do not represent the relative magnitude of flow, but rather the distribution of flow over the water year (October 1-September 30). For example, the relatively large percentage of flow in the month of May in Zone 2 does not necessarily represent a higher peak flow from this zone, but rather that the peak flow consistently occurs in the month of May. This is in contrast to Zones 3 and 4, where peak flows commonly occur during any of several months, depending on annual weather conditions.

Geology, Landforms, and Soils

Landform groups are broad ecological land units that possess unique patterns of landform, geology (Figure 5), vegetation (Figure 6), climate, soils, and disturbance regimes. The SF CWR Subbasin is comprised of seven landform groups (LFGs). A summary description of each of these landforms, soils, erosional hazards, and vegetation follows. Aquatic landtype associations (ALTAs) have also been used to characterize the SF CWR Subbasin (Figure 7). The ALTAs emphasize patterns of stream networks and terrestrial-aquatic interactions that consider landform, geology, elevation, ground water temperatures, and hydrologic disturbance regimes. The LFG descriptions that follow include the corresponding ALTAs for reference.

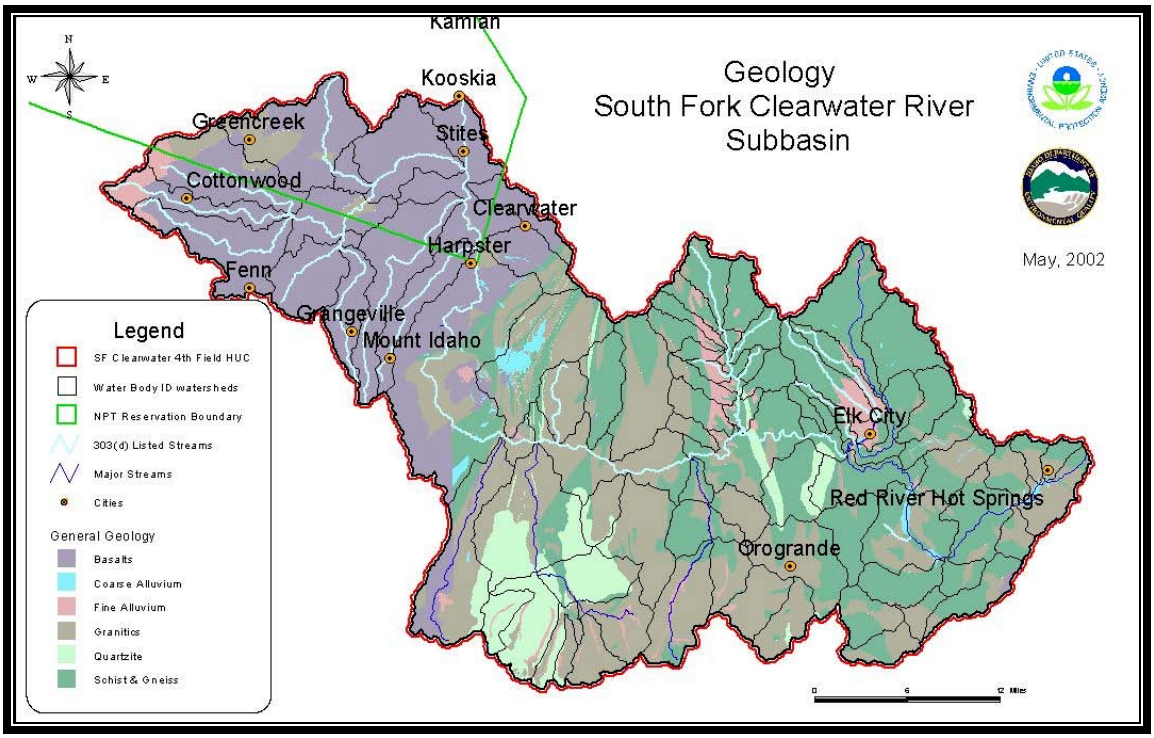

Figure 5. Geology of the SF CWR Subbasin

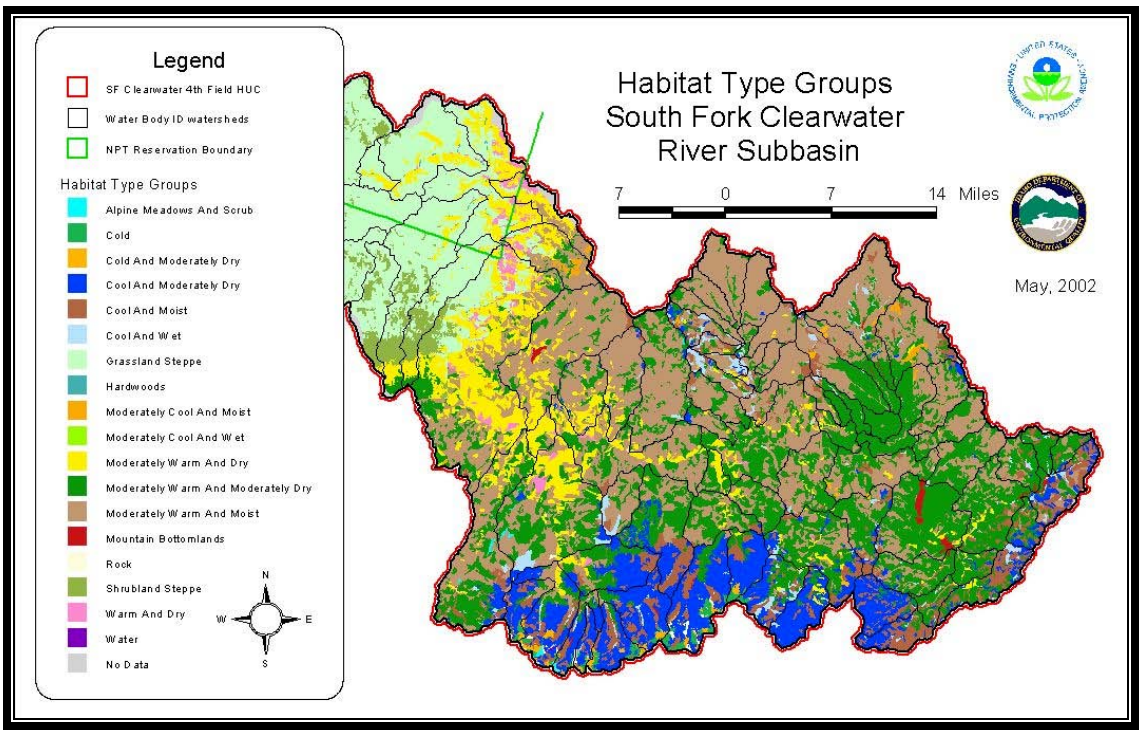

Figure 6. Habitat Type Groups of the SF CWR Subbasin

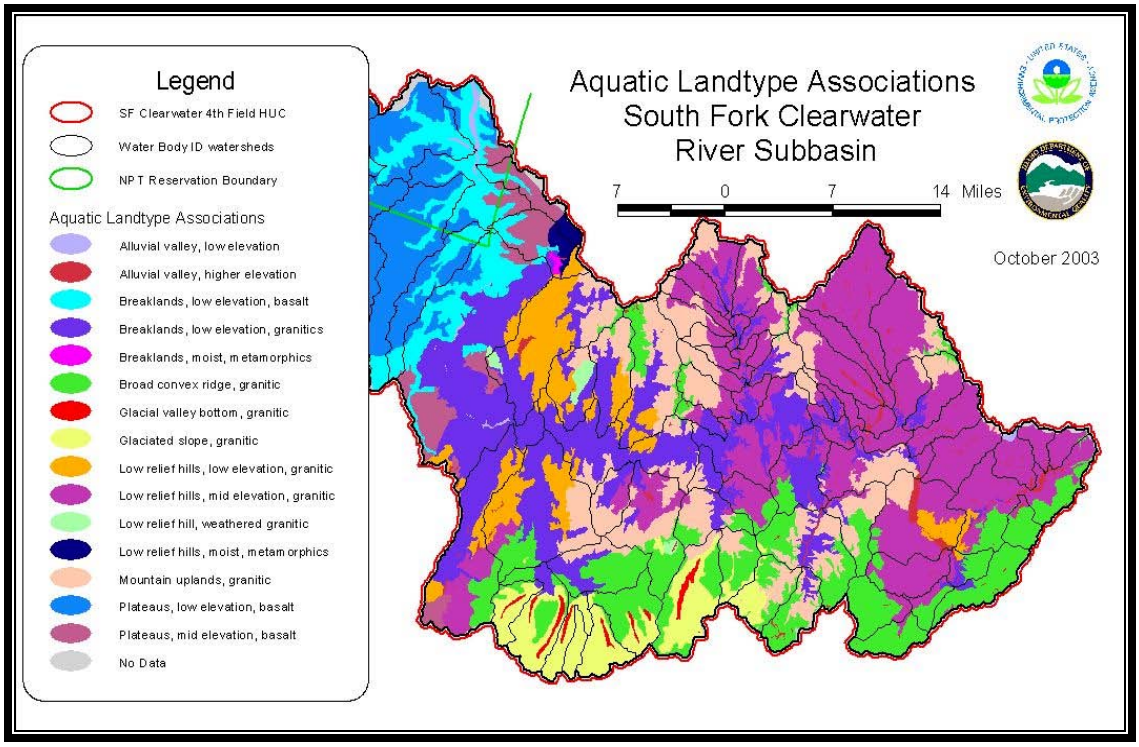

Figure 7. Aquatic Landtype Associations of the SF CWR Subbasin

Landform Group 1: Rolling Uplands-Granodiorite (ALTA 9)
This group comprises approximately 0.5% of the total analysis area, with elevations ranging from 3,800 to 5,000 feet. This LFG occurs on the upper reaches of East Fork Cougar Creek and Covert Creek and is characterized by rolling uplands derived from moderately well weathered granodiorite. The erosion hazard is very high for this material, and when it erodes, it generates mostly sand and small gravel. Sediment delivery efficiency is moderate. Surface erosional processes dominate in this LFG, but erosion is buffered by a volcanic ash-influenced soil surface layer. The slopes are moderate at 20-50%.

Cool, moderately moist habitat types are dominant. Aspect and elevation, coupled with ecological events and processes like fire, competition, herbivory, and pathogen activity are the primary influences on vegetation composition. Upland habitat types include grand fir series. Dominant overstory tree species are lodgepole pine, Douglas fir, western larch, Ponderosa pine, and grand fir. Mid and low shrubs, forbs, and grasses can dominate the understory. High water tables in sediment-filled valley bottoms favor development of meadow and meadow/shrub complexes interspersed with forest.

Landform Group 2: Rolling Uplands-Gneiss, Granite, Quartizite, and Schist (ALTAs 1,4,6, 21)
This group comprises approximately 56% of the SF CWR Subbasin, (area east of Grangeville, except along the main stem and tributary canyons and glaciated headwaters), with elevations ranging from 2,800 to 8,000 feet. It is characterized by rolling hills and convex slopes derived from moderately- to well-weathered gneiss, granite, quartzite and schist. The erosion hazard is moderate to high for these materials, which generate mostly sands and gravels. The sediment delivery efficiency is moderate. Surface erosional processes dominate in this LFG, but surface soil erosion is buffered by a volcanic ash influenced soil surface layer. The slopes are moderate at 20-50%.

Cool and cold, moderately moist habitat types are dominant. Aspect and elevation coupled with the ecological events and processes like fire, competition, herbivory, and pathogen activity are the primary influences on vegetation composition. Upland habitat types include grand fir and subalpine fir series. Dominant overstory tree species are lodgepole pine, Douglas fir, Engelmann spruce, western larch, grand fir, Ponderosa pine, and subalpine fir. Shrubs, forbs, and grasses can dominate the understory. Forest habitat types dominate streamside zones. Upland tree species often grow next to streams on well-drained adjacent hillslopes. Meadow/shrub complexes occur most extensively along Red River, American River, Elk Creek, and Meadow Creek.

Landform Group 3: Breaklands-Gneiss, Quartzite, Schist, and Granite (ALTA 3)
This LFG comprises approximately 12% of the SF CWR Subbasin (middle reaches of the SF CWR and lower reaches of Mill Creek, Johns Creek, Tenmile Creek, Crooked River, and Peasley Creek), at elevations ranging from 1,600 to 7,000 feet. This LFG is characterized by stream breaklands, mass wasted slopes, and colluvial slopes derived from moderately well-weathered granite, quartzite, gneiss, and schist. The erosion hazard is high, with these materials generating mostly sand to cobble materials. The sediment delivery efficiency is high. Surface erosion occurs on the steepest south aspects and little volcanic ash remains to

buffer against erosion. Channel scour, colluviation, and mass wasting are important landforming processes. The slopes range from 40-80%.

Habitat types vary from warm and dry to cold and moist depending on aspect and elevation. Ponderosa pine and Douglas fir series dominate lower elevations; grand fir series dominate north aspects and higher elevations. Subalpine fir is found at highest elevations. Dominant species are Ponderosa pine, Douglas fir, grand fir, western larch, lodgepole pine, subalpine fir, and Engelmann spruce. Streamside vegetation includes shrub complexes along lower elevation stream bottoms and conifer dominated communities on north aspects or higher elevations.

Landform Group 4: Glaciated Lands-Quartzite and Diorite (ALTA 2, 5)
This group comprises approximately 5% of the subbasin (upper reaches of Tenmile Creek and Johns Creek in the Gospel Hump Wilderness) with elevations ranging from 5,200 to 8,000 feet. It is characterized by steep, ice-scoured cirques and glacial troughs with inclusions of gently sloping ice scoured ridges, glacial valley bottom, and moraine deposits derived from poorly weathered Precambrian quartzite and Cretaceous quartz diorite. The erosion hazard is high, with the quartzite and quartz diorite generating sand to cobble size material. The sediment delivery efficiency is moderate to high. Sediment movement is buffered by abundant rock and locally abundant volcanic ash surface soil. Surface erosion occurs on steep slopes with shallow soils. Debris torrents, colluviation, and mass wasting are also important landforming processes. The slopes vary from 10-100%.

The vegetation is composed of cold and dry to wet grand fir and subalpine fir habitat types depending on elevation, soil depth, and aspect. Dominant species are lodgepole pine, Engelmann spruce, subalpine fir, Douglas fir, grand fir, and whitebark pine. Shrub and herbaceous communities are intermingled with forest communities in valley bottoms. Herbaceous communities are found on dry ridges.

Landform Group 5: Rolling Hills and Plateaus-Basalt (ALTA 15)
This LFG comprises approximately 1% of the SF CWR Subbasin with elevations ranging from 3,600 to 5,400 feet. It occurs primarily along headwater streams south and east of Grangeville, and is characterized by low rolling hills and plateaus of low to moderate relief, derived from moderately weathered Columbia River basalt. The erosion hazard from these materials is only slight in comparison to other geologic materials in the subbasin, generating clay to cobble size materials. The sediment delivery efficiency is low. The soils have volcanic ash surface layers, and highly aggregated subsoils with a high rock content that buffers effectively against erosion. Surface erosional processes dominate in this landform but are slight in comparison to other LFGs. The slopes are moderate, varying from 10-40%.

Warm to cool and dry to moderately moist habitat types are dominant depending on aspect, elevation, and ecological processes. Upland habitat types include Douglas fir, grand fir, and subalpine fir series. Dominant tree species are grand fir, Engelmann spruce, Douglas fir, lodgepole pine, Ponderosa pine, western larch, and subalpine fir. Mid and low shrubs, forbs, and grasses dominate the understory. Meadow/shrub complexes occur occasionally.

Landform Group 6: Steep Mountain Slopes and Stream Breaklands-Basalt and Andesite (ALTA 7)

This group comprises approximately 6% of the SF CWR Subbasin (along the SF CWR from Kooskia for 18 miles upstream and along the main canyons of Threemile Creek, Butcher Creek, and Cottonwood Creek), with elevations ranging from 1,300 to 5,200 feet. Steep mountain slopes, stream breaklands, and mass wasted slopes derived from poorly to moderately weathered Columbia River basalt ad Seven Devil volcanics characterize this LFG. The erosion hazard is slight compared to other geologic materials in the subbasin, generating mostly silts, clays, gravels, and cobbles. Sediment delivery efficiency is high. Surface erosion, colluviation, and mass wasting are important landforming processes. Little volcanic ash is present to buffer surface soils against erosion. Slopes are steep, varying from 40-80%.

Plant community composition is highly dependent on aspect and varies from very dry to moderately moist. Bunchgrass, ponderosa pine, and Douglas fir series dominate lower elevations and grand fir series dominate north aspects and higher elevations. Dominant species are Ponderosa pine, Douglas fir, grand fir, western larch, lodgepole pine, and Engelmann spruce. Streamside vegetation includes shrub and deciduous tree complexes along lower elevation stream bottoms and conifer dominated communities on north aspects or higher elevations. Extensive grazing and development have altered riparian vegetation along lower gradient reaches. Fish cover and bank stability have been reduced.

Landform Group 7: Plateaus- Basalt, Prairie (ALTA 16)
This LFG comprises approximately 20% of the SF CWR Subbasin (Camas Prairie and area south of Battle Ridge) with elevations ranging from 1,800 to 4,200 feet. This group is characterized by plateaus of low relief, derived from Columbia River basalt. The erosion hazard is only slight compared to other subbasin geology, generating mostly silt, gravel, and cobble. The sediment delivery hazard is low. Soils have mixed volcanic ash surface layers, and highly aggregated subsoils that help buffer against erosion. Slopes are gentle, varying from 5-40%.

Vegetation patterns are influenced by thin soils, low elevations, and warm dry habitat. Grasslands and open park-like stands of Ponderosa pine and Douglas fir once dominated this LFG. Upland shrub species occur with scattered trees in stream bottoms. Bunchgrass habitat types are on uplands. Existing vegetation is now primarily cropland, hay, and pasture with some remaining forestland that has been heavily impacted by grazing and timber harvest. Riparian areas were generally shrub-dominated prior to grazing and tillage impacts.

Table 3 shows the characteristics of each of the seven landform groups in the SF CWR Subbasin as related to potential sediment effects to the SF CWR and downstream areas. "Sediment Hazard from Substratum Erosion" describes the likelihood that geologic erosion would occur and that resulting sediment would be transported to a stream channel. "Mass Erosion Hazard" describes the likelihood that mass sediment delivery from lower slopes directly into a channel would occur.

Table 3. SF CWR Subbasin landform group characteristics.

Landform Group	Description	Parent Material	Sediment Hazard from Substratum Erosion	Mass Wasting Hazard
1	Rolling Uplands	Granodiorite	Very High	Low to Moderate
2	Rolling Uplands	Granite, Gneiss, Schist, Quartzite	Moderate to High	Low to Moderate
3	Breaklands	Granite, Gneiss, Schist, Quartzite	Moderate	Moderate to High
4	Glaciated Lands	Quartzite, Diorite	Low to High	Low to Moderate
5	Forested Rolling Hills and Plateaus	Basalt	Low	Low to Moderate
6	Steep Mountain Slopes and Stream Breaklands	Basalt, Andesite	Low	Moderate
7	Rolling Plateaus-Prairie	Basalt	Low	Low

Fisheries and Aquatic Fauna

The fisheries resources in the SF CWR Subbasin are thoroughly described in Appendix D. A fisheries technical advisory group (Fish TAG) was convened to develop a complete description of the fisheries resources in the SF CWR system.

Subwatershed Characteristics

The SF CWR Subbasin 303(d) listed segments are described below in the context of the subwatershed in which they are located. These were compiled from the NPNF *South Fork Clearwater River Landscape Assessment* (USFS 1998), Ecological Reporting Units. Although this discussion is limited to those subwatersheds containing 303(d) listed segments, Table 4 is included to allow comparison of the watershed condition within the SF CWR Subbasin as a whole. Channel types are described using the Rosgen (1994) classification system based on channel thread, channel entrenchment, sinuosity, bankfull width-to-depth ratio, stream gradient, and stream substrate. The primary A, B, and C channel types are broadly characterized by decreasing stream gradient and increasing sinuosity, with A channel types being characteristic of steep mountain streams, and C channel types being characteristic of meandering streams flowing across plains.

Table 4. Watershed condition indicators.

Watershed	Area (acres)	Roads (miles)	Road Density (mi/mi^2)	Timber Harvest (acres)	Timber Harvest (%)	ECA[1] (%)	Sed. Yield (%)[2]
Mill Creek	23,249	94	2.6	4,586	20	8	8
Johns Creek	72,150	60	0.5	1,198	3	<1	1
Twentymile Creek	14,545	17	0.7	153	1	1	4
Tenmile Creek	34,410	24	0.4	336	1	1	1
Crooked River	45,659	137	2.0	4,616	10	6	8
Red River	103,348	588	3.6	22,939	22	12	24
American River	58,612	213	2.3	8,129	14	10	14
Newsome Creek	42,576	220	3.3	8,010	19	7	13
Silver Creek	16,509	27	1.1	1,097	7	5	3
Peasley Creek	9,112	55	3.8	2,016	22	13	20
Cougar Creek	7,731	48	4.0	1,750	23	12	15
Meadow Creek	24,115	164	4.4	7,684	32	11	16

[1] Equivalent Clearcut Acres
[2] Sediment Yield percent over background
Source: USFS 1998

American River Watershed

The 303(d) listed water bodies in this watershed are Big Elk Creek, Little Elk Creek, Buffalo Gulch, and Lucas Lake. This watershed (58,612 acres) is almost entirely composed of mid- to upper-elevation low relief hills and alluvial valleys (ALTAs 6, 18) with some mountain uplands (ALTA 21) on the western and eastern edges. The watershed is located in Hydrologic Zone 2, characterized by mid-period snowmelt and moderate to low gradient channels.

Stream channels are predominantly low to moderate gradient B and C channel types (Rosgen 1994) with higher gradient channels in the mountain uplands. Along with the Red River, this watershed has a large amount of mid- to upper-elevation alluvial valleys (ALTA 18), and these features are spread more evenly throughout the watershed than is typical of the subbasin, where this ALTA is a linear feature along the tributary main stem. ALTA 18 is composed predominantly of C channel typess (Rosgen 1994).

The American River has been significantly affected by human activity. Historic mining occurred along significant portions of the higher order streams in the lower basin. Grazing has affected stream/riparian processes. There have been about 8,000 acres of timber harvest in the watershed (14% of the area); about 925 acres of this has been in a Riparian Habitat Conservation Area (RHCA). The RHCA's are portions of watersheds in national forests where riparian dependent resources receive primary emphasis, and federal management

activities are subject to specific standards and guidelines. They include riparian corridors, wetlands, intermittent streams, and other areas that help maintain the integrity of aquatic ecosystems by: 1) influencing the delivery of coarse sediment, organic matter, and woody debris to streams, 2) providing root strength for channel stability, 3) shading the stream, and 4) protecting water quality (USFS and BLM 1995). There are about 200 miles of existing roads in the watershed (2.3 mi/mi^2), and about 60 miles in the RHCA. Some sections of road encroach on stream/riparian processes. The NPNF considers about half this watershed to have a low level of human development. The current equivalent clearcut area (ECA) is 10%, and the current sediment yield is 14% over natural base. Big and Little Elk Creeks are part of the Elk City municipal watershed.

The overall condition for this watershed is considered low, with some subwatersheds within it in moderate condition. Stream and riparian processes have been altered principally by historic dredge mining, as well as by road encroachment and grazing. These activities have affected channel patterns, floodplain connectivity, and habitat conditions. The alteration in sediment regimes is a result of change from infrequent, large-scale disturbance events to frequent disturbances. These changes are significant in terms of aquatic processes and aquatic species, and the viability of fish populations in this watershed, including resilience to natural disturbance events, has been reduced as a consequence.

Red River Watershed

The 303(d) listed stream in this watershed is Dawson Creek. Red River is a large (103,348 acres) watershed with the largest alteration of historic sediment regimes in the SF CWR Subbasin. The lower area of the watershed is comprised of ALTA 6, mid- to upper-elevation low relief hills, with areas of ALTA 18, mid- to upper-elevation alluvial valleys. The mid-elevation subwatershed is mostly ALTA 4, low relief hills generally associated with lower elevations, along with some ALTA 18. The upper watershed is composed of ALTA 1, high elevation broad ridges. Red River is predominantly in Hydrologic Zone 2, mid-elevation rolling uplands, with the upper subdivision in Hydrologic Zone 1, high elevation mountains.

Streams in this watershed have a high frequency of B and C channel types (Rosgen 1994), and have a branched channel pattern.

Management activity in this watershed has included historic mining, roads encroaching on the stream corridors, and grazing on the main stem. About 23,000 acres of timber have been harvested (22% of the subwatershed). Approximately 5,000 acres of this harvest occurred in the RHCA. There are approximately 588 miles of existing road (3.6 mi/mi^2) in the watershed, and about 175 miles in the RHCA. There are few large areas with low levels of human development, although those areas that do exist are found in the upper basin. The current ECA for the watershed is 12% and the current sediment yield is estimated at 24% over natural base.

The overall condition for this watershed is considered low, with a portion of the upper watershed considered moderate condition. The current sediment yield is the highest percent over base for the SF CWR Subbasin, with the stream channels sensitive to these effects. As a

result of management over several decades, this watershed has been subjected to one of the highest frequencies of disturbance and a reduction in habitat condition. The watershed condition has changed from patches of active disturbance and recovery, surrounded by areas of stable, high quality habitat, to homogeneously degraded habitat. The ability of aquatic species to persist as well as rebuild or repopulate areas from local stronger populations has been reduced.

Newsome Creek Watershed

The 303(d) listed water bodies in this watershed are lower Newsome Creek (Beaver Creek to SF CWR), Beaver Creek, Nugget Creek, and Sing Lee Creek. The Newsome/Leggett Creek watersheds (47,809 acres) are comprised primarily of mid- to upper-elevation low relief hills (ALTA 6), with a ring of mountain uplands (ALTA 21) on three sides. There are small patches of steep breaklands (ALTA 3) along the main stem channel. Narrow alluvial valleys (ALTA 18) are found along portions of the main stem and major tributary streams. The watersheds lie primarily in Hydrologic Zone 2.

The Newsome Creek main stem is predominantly a B3/B4 channel type (Rosgen 1994). The tributary streams have a wide range of conditions, ranging from A through E channel types with most of the lower gradient, higher quality fish habitat (B and C channel types) occurring in conjunction with ALTAs 18 and 6.

The Newsome Creek area has had a considerable amount of management activity. Most of the main stem channels and some tributaries had historic mining that affected stream and riparian processes. Additionally, a road parallels the main stem, encroaching on the riparian area and stream floodplain. Approximately 8,000 acres have been harvested for timber (19% of the area) with about 1,300 of these acres in the RHCA. The current ECA for Newsome Creek is 7%. There are approximately 220 miles of existing road in the Newsome Creek watershed (3.3 mi/mi^2); 55 miles in the RHCA. About one third of the watershed is considered to have a low level of human development by the NPNF. Current sediment yield is estimated at13% over natural base.

The Newsome Creek watershed condition is considered to be low quality by the NPNF. Stream/riparian processes have been altered by historic mining and road impacts. Sediment yields have been influenced from an infrequent disturbance regime changing to a frequent disturbance regime. Connectivity with the SF CWR main stem (the movement of aquatic species up or downstream) has also been reduced by unsuitable habitat conditions.

Cougar Creek Watershed

Cougar Creek is considered water quality limited (303(d) listed) from its headwaters to the confluence with the SF CWR. The watershed (7,731 acres) is composed predominantly of ALTAs 3 and 4, with some ALTA 21 in the upper end. It is located primarily in Hydrologic Zone 3. The main stem is predominantly B channel, with higher gradient A channels in tributaries.

Approximately 2,309 acres of timber have been harvested (29% of the watershed). There are 48 miles of existing roads, with a watershed road density of 5.1 mi/mi^2. The current ECA is 12%, and sediment yields are estimated at 15% over natural base levels.

The Cougar Creek watershed is considered to be low quality by the NPNF. Accelerated sediment yields have led to a reduction in aquatic habitat diversity and a deteriorated condition.

South Fork Clearwater River Canyon

The SF CWR is considered water quality limited (303(d) listed) from its headwaters at the confluence of Red River and American River to the mouth at Kooskia. The South Fork Canyon watershed (90,058 acres) includes the main stem South Fork River and the face drainage tributaries. This area is primarily ALTA 3, low elevation breaklands, with upper portions of the canyon considered ALTA 6. The canyon is in Hydrologic Zone 3. Most of the land area below the NPNF boundary is assigned to the Camas Prairie Watershed for descriptive purposes.

Historic mining has affected portions of the main stem and some tributaries, primarily in upper river areas. Timber harvest has occurred on 19,545 acres (22% of the area) with about 3,300 acres in the RHCA. The majority of timber harvests occurred between 1960 and 1990, mainly as clearcuts. There are approximately 487 miles of existing roads, with about 160 miles located in the RHCA. Many roads, including the highway along the river, encroach on stream/riparian processes. About one third of the area is considered to have a low level of human development. Management activity has also affected the sediment regime, although the precise effects on the main stem are unknown.

The lower reaches of the SF CWR have been affected to various degrees by aggradation, channelization, diking, riparian vegetation removal, and encroachment by roads and buildings. Aggradation of the river is associated with bedload from upstream sources, most noticeably from the major Camas Prairie tributaries (Butcher Creek, Threemile Creek, and Cottonwood Creek), and localized bank erosion. In the unconfined reaches of the South Fork, this has resulted in a wider, shallower channel with fewer large pools. Fish habitat has been affected by less cover, fewer deep holding areas, elevated sediment yields, and warmer summer water temperatures. These conditions have resulted in reduced connectivity and rearing capability.

Camas Prairie Watersheds

The 303(d) listed water bodies on the Camas Prairie are Cottonwood Creek, Threemile Creek, and Butcher Creek. This area of the SF CWR Subbasin (199,000 acres) includes the basalt plateau and the steep canyons at lower elevations along the large streams and SF CWR. Most of the area to the west of the NPNF boundary was assigned to these watersheds. Cottonwood, Grangeville, Harpster, Kooskia, Stites, and Clearwater are centers of residential development. This SBA will focus on Threemile Creek and Butcher Creek subwatersheds. The Cottonwood Creek TMDL was completed in 2000 by DEQ, USEPA, and the NPT.

The Camas Prairie watersheds are comprised of silt-loam soils overlying the Mafic (99%) and Calc-Alkaline (1%) volcanic flows. The Brody-Wapshilla association and the Telcher-Suloaf silt loams dominate the mountain soils. The Nez Perce, Ferdinand, and Shebang silt loams are the dominant soil series on the plateau. The Klickson-Suloaf complex is the dominant soil series on the canyon side slopes, and the Typic Xerofluvents comprise the flood plains and stream channels (Barker 1982).

The Camas prairie streams are among the most heavily impacted in the subbasin. Most streams on agricultural land have been modified by riparian tree and shrub removal, field plowing, and channelization. This has resulted in channel erosion, channel destabilization, and sediment deposition. Livestock feedlots and season-long grazing have impacted certain reaches. As the streams flow from the prairie via breaklands to the main stem SF CWR, erosion of channels is common due to steeper gradients and altered upstream conditions. As these streams reach the SF CWR valley floor, their gradients drop considerably, causing deposition of bedload sediment. This has resulted in aggraded channels. Impacts of the increased sediment yields to tributary channels include wider, shallower channels, loss of pools, loss of riparian shading, and warmer summer water temperatures.

Threemile Creek originates in forested headwaters (5,000 feet elevation), four miles south of Grangeville and flows approximately 16 miles to its confluence with the SF CWR at river mile 7.6. The watershed is approximately 24,966 acres in size and 99% privately owned (less than 0.5% owned by the Bureau of Land Management (BLM 1999). The lower 5 miles flow through the NPT Reservation.

The upper reaches of Threemile Creek flow through dryland farming and livestock grazing areas. As the stream passes through the city of Grangeville it is impacted by storm water runoff, domestic livestock grazing, and the Grangeville waste water treatment plant (WWTP). Additional dryland farms are situated along the stream for approximately 4 miles north of Grangeville before it flows through a steep canyon for approximately 8 miles and into the SF CWR. The Threemile Creek drainage is in poor condition due to agricultural activities, riparian degradation from grazing, and sewage effluent. Logging and roads in the canyon reaches have also resulted in localized adverse effects to the stream (BLM 1999).

Butcher Creek originates 1 mile south of Mt. Idaho in forested headwaters (5,000 feet elevation) and flows 11.9 miles to its confluence with the SF CWR at river mile 11.7. The watershed is approximately 11,203 acres, and is 98% privately owned, 2% state-owned, and less than 0.001% BLM-owned (BLM 1999). The lower 1.8 miles of Butcher Creek flow within the NPT Reservation boundary.

The headwater area consists of moderately sloped rolling hills with agriculture and wood lot areas. During the past years the number of residences and ranchettes has increased in the headwater areas. The stream flows through a moderately steep canyon from the town of Mt. Idaho to the mouth. Cattle grazing occurs over the entire length of the creek, but predominantly in the extreme upper and lower reaches (Fuller et al. 1985). Fuller et al. (1985) found sparse riparian vegetation at the two extremes but dense vegetation in the

canyon proper. High annual runoff was evident and indications of past flooding were identified in the lower reaches. Logging has occurred in the past throughout the drainage.

Stream Characteristics

Stream characteristics for the 303(d) listed segments discussed below are compiled from the *South Fork Clearwater River Biological Assessment* (USFS 1999). Ratings for habitat parameters refer to *the Matrix of Pathways and Indictors of Watershed Condition for Chinook, Steelhead, and Bull Trout- Local adaptation for the Clearwater Basin and Lower Salmon* (NMFS et al. 1998). This matrix is used by federal land management agencies to describe watershed conditions as high, moderate, or low condition for endangered species consultation. Stream and watershed parameters (temperature, cobble embeddedness, road density, etc.) are evaluated using quantitative and qualitative indicators.

American River Watershed

The 303(d) listed segments/water bodies occurring within American River watershed include: Buffalo Gulch, Big Elk Creek, Little Elk Creek, and Lucas Lake.

Buffalo Gulch
Buffalo Gulch flows into the American River at river mile 0.7, and provides habitat for steelhead, westslope cutthroat trout, brook trout, and sculpin. Spring chinook salmon may use the stream for rearing; however, such use has not been documented. The lower reaches of the creek have been dredge mined; and roads, logging, and grazing have impacted the stream. Monitoring by the BLM measured 65% cobble embeddedness and spawning gravels had 48% fine sediment less than 6.3 mm (BLM 1995a). Rosgen (1994) B type channels dominate in the lower reaches, while A channel types (Rosgen 1994) dominate the upper reaches (BLM 1995a). The average gradients ranged from 2-9%, and unstable stream banks ranged from 2-30%. Limiting habitat factors include high levels of deposited sediment, high summer water temperatures, and a lack of good quality pools (USFS 1999).

Big Elk Creek
Big Elk Creek provides habitat for steelhead, spring chinook, salmon, westslope cutthroat trout, brook trout, mountain whitefish, sculpin, and dace. Bull trout may use Big Elk Creek for adult and subadult rearing; however, an Idaho Department of Fish and Game (IDFG) survey in 1998 did not document the presence of bull trout. The lower reaches meander through a broad meadow, while the middle reaches flow through stringer meadows and forested stream bottoms. Grazing is light in the stream bottoms and moderate in the meadow areas. Land use impacts include grazing, roads, and logging. Cobble embeddedness was 52%, and spawning gravels had 40% fines less than 6.3 mm (USFS 1999). A 1991 BLM survey identified C channels as dominant in the lower reaches, and B channel types (Rosgen 1994) in the upper reaches. Average gradient ranged from 1-3 %, and unstable stream banks varied from 2-10%. The seven-day running average maximum temperature during steelhead and cutthroat trout spawning periods was 11.5 ^{o}C (52.7 ^{o}F) (rated high quality). The seven-day running average maximum temperature for the bull trout spawning interval was 13.4 ^{o}C (56.1 ^{o}F) (rated low quality). Primary limiting habitat factors include high levels of

deposited sediment, high summer water temperatures, and lack of good quality pools. Water temperatures are cooler in upstream reaches (USFS 1999).

Little Elk Creek

Little Elk Creek provides habitat for steelhead, spring chinook salmon, westslope cutthroat trout, brook trout, mountain whitefish, sculpin, and dace. Bull trout may use Little Elk Creek for adult and subadult rearing; however, an IDFG survey in 1998 did not document the presence of bull trout (USFS 1999). The upper reaches flow through stringer meadows and forested stream bottoms, while the lower reaches meander through a broad meadow. Grazing is light in the stream bottoms and moderate in the meadow areas. Land use impacts include grazing, mining, roads, and logging. BLM monitoring in 1986 showed cobble embeddedness to be 56% (rated low condition), while spawning gravels had 37% fines less than 6.3 mm surveyed (rated low condition) (USFS 1999). A BLM survey conducted in 1992 (USFS 1999) identified C channel types as dominant in the lower reaches, and B channel types (Rosgen 1994) in the upper reaches. The average gradient ranged from 1-2 %, and unstable stream banks varied from 10-25% in the lower reaches downstream from the NPNF boundary. The seven-day running average maximum temperature during steelhead and cutthroat trout spawning periods was 14.1 ^{o}C (57.4 ^{o}F) at stream mile 0.01 and 10.6 ^{o}C (51.1 ^{o}F) at stream mile 4.2. The seven-day running average maximum temperature for the bull trout spawning interval was 19.6 ^{o}C (67.3 ^{o}F) at stream mile 0.01 (rated low condition) and 15.2 ^{o}C (59.4 ^{o}F) at stream mile 4.2 (rated low condition). Primary limiting habitat factors include high levels of deposited sediment, high summer water temperatures, and lack of good quality pools. Water temperatures are cooler in upstream reaches.

Lucas Lake

Lucas Lake is currently listed on Idaho's 303(d) list for sediment pollution. It is a sink or depression that may be an old "glory hole," (pit left by hydraulic mining) or it may be a natural feature. Lucas Lake has steep underwater banks, and appears to maintain full pool conditions throughout the year. The lake is surrounded by a very small, steep, contributing watershed composed of small-grained sedimentary deposits. Many raw outcroppings of this erosive sedimentary rock are visible. The riparian area appears healthy. There is a distinct blue-green color to the water, probably colloidal in nature, which may have been mistaken for toxic substances in past assessments. Abundant water boatman (*Hemiptera corixidae*) and backswimmer (*Hemiptera notonectidae*) aquatic insects were observed, and there have been reports of fish (Appendix N).

Riparian Characteristics of the American River Watershed

The riparian vegetation includes grand fir/arrowleaf groundsel, subalpine fir/twisted stalk, subalpine fir/bluejoint, sedge meadows, shrub/sedge complexes, and riparian shrubs (e.g. willow, alders etc.). Many of the low gradient reaches in the Elk City township have been dredge mined and lack grass/sedge meadow vegetation. The shrub component is lacking or reduced due to browsing by domestic animals and wildlife and the mining impacts.

Red River Watershed

Dawson Creek discussed below is the only 303 (d) listed water body in the Red River Watershed.

Dawson Creek
Dawson Creek provides habitat for steelhead, spring chinook salmon, and westslope cutthroat trout. Bull trout presence is not documented (DEQ 1998). The NPNF classifies the Red River watershed as a stronghold for these four fish species. Reconnaissance-level surveys conducted of the lower reach (DEQ 1995, BLM 2001) identified a B type channel with a gradient of 1-2 %. The dominant substrate particle size was small gravel while the subdominant substrate was sand/silt size. The average width was 2-4 feet and the average depth 0.3 feet. Stream bank stability was rated 95-100% for the reaches surveyed. Percent surface fines ranged 15-25% (BLM 2001) to 49% (DEQ 1995). Cobble embeddedness was rated 40-50% (BLM 2001). The instantaneous temperature was 13ºC, and discharge ranged from 0.3 cfs (BLM 2001) to 0.6 cfs (DEQ 1995). The BLM survey noted the presence of 6-inch trout and spotted frogs. Land use observed at the time included livestock grazing (horses), timber harvest, roads, and a private residence. Localized logging was noted along the stream/riparian area on private lands.

Common Riparian Vegetation of the Dawson Creek Watershed
Common riparian vegetation includes alder, Carex sp., western yarrow, grand fir, menziesia (fool's huckleberry), and arrowleaf groundsel (BLM 2001).

Newsome Creek Watershed

The Newsome Creek watershed provides habitat for steelhead, spring chinook salmon, westslope cutthroat trout, bull trout, and several other species including long nose dace, suckers, sculpin, and whitefish. The four 303(d) listed water bodies include: Newsome Creek (Beaver Creek to SF CWR), Beaver Creek, Nugget Creek, and Sing Lee Creek.

Newsome Creek
Newsome Creek width-to-depth ratios rate high condition for B and C channel types (Rosgen 1994) and low condition for A channels. The first mile upstream from the mouth (B channel) rates as low condition due to a very high width-to-depth ratio. Some channel reaches have been altered by dredge mining. Stream bank stability is rated low condition for main stem Newsome Creek. Floodplain connectivity is rated low condition due to extensive dredging and road encroachment.

Cobble embeddedness exceeded 30% (low condition) throughout all measured reaches in the watershed, and ranged from 34-94% (USFS 1999). Percent surface fines rated low condition, with 18% fines for riffles and 31% for pools (USFS 1999). Fines by depth rated low condition (36%) as measured by McNeil core sampling in 1984. The acting woody debris is rated low condition, ranging from 0-5 pieces per 100 meters. The pool frequency is rated low condition with no reaches meeting pool frequency standards, but the pool quality is rated high in the main stem from habitat improvement structures (USFS 1999).

Temperatures rated low condition for steelhead and bull trout, exceeding 18ºC in surveys conducted in 1995 and 1996 (USFS 1999).

Beaver Creek
Surveys conducted of Beaver Creek, one reach BURP (DEQ 1995), and two reaches NPNF (USFS 1996b) identified predominantly B channel type (Rosgen 1994) with a gradient ranging from 3-7 %. The average wetted width was 2.7 meters and the average wetted depth was 0.2 meters. Stream bank stability was rated 70-100% for the reaches surveyed. Percent surface fines were 46% (DEQ 1995). Cobble embeddedness was rated at 50-75% (DEQ 1995). Instantaneous temperatures were 10ºC and 12ºC, and discharge was 6.7 cfs (DEQ 1995).

Nugget Creek
Two surveys conducted of Nugget Creek (DEQ 1995, USFS 1996b) identified predominantly B channel type (Rosgen 1994) with a gradient of 3.3-3.5%. The average wetted width was 2.13 meters and the average wetted depth was 0.05 meters. Stream bank stability was rated 99-100% for the reaches surveyed. Percent surface fines were 35% (DEQ 1995). Cobble embeddedness was rated 48% (USFS 1996b). The instantaneous temperature was 11ºC (USFS 1996b) and discharge was 1.0 cfs (DEQ 1995).

Sing Lee Creek
The survey conducted of lower Sing Lee Creek (DEQ 1995) identified predominantly B channel types (Rosgen 1994) with a gradient of 3.5%. The average wetted width was 1.6 meters and the average wetted depth was 0.04 meters. Stream bank stability was rated 90% for the reach surveyed. Percent surface fines were 50%. Discharge was 1.8 cfs.

Riparian Characteristics of the Newsome Creek Watershed
Streamside vegetation includes grand fir/arrow leaf groundsel, subalpine fir/twisted stalk, subalpine fir/bluejoint, sedge meadows, and shrub/sedge complexes.

Cougar Creek Watershed

Cougar Creek is 303(d) listed as impaired by sediment. Its stream characteristics are discussed below.

Cougar Creek
The bottom substrate of Cougar Creek consists mainly of boulders and bedrock. The main stem is predominantly a B-1 channel, with short sections of B-2 and C-2 channel types (Rosgen 1994). Stream gradients average 4-5% although a few reaches vary between 7-8%. Cobble embeddedness estimates are high and are thought to be limiting fish production. Cobble embeddedness averaged 65% in 1989 surveys (USFS 1999) and 58% and 64% at two locations in 1996 surveys (USFS 1999). There are very low levels of acting and potential large woody debris. Pool frequency is rated low. Pools per mile ranged from 46.7 to 91.9 in 1989 surveys. Flood plain connectivity is considered low due to roads paralleling the stream. Stream bank stability is moderate, with B channel types rated 94-95% stable. The stream bankfull width-to-depth ratio is considered low condition. Thermographs in the summer of

1996 recorded a high of 19.8 ^{o}C (67.6 ^{o}F) and a daily average of 17.6 ^{o}C (63.7 ^{o}F) (USFS 1999).

Riparian Vegetation Characteristics of the Cougar Creek Watershed
The riparian condition is rated as moderate due to poor bank cover in lower reaches. Upper reaches have relatively good bank cover. Livestock grazing has also degraded riparian and stream bank conditions.

South Fork Clearwater River Canyon

Chinook salmon, steelhead, westslope cutthroat trout, and bull trout are present in the main stem of the SF CWR. The face drainages currently are rated low condition for road density and streamside road density. There are an average of 3.51 miles of roads per square mile of watershed, and an average streamside road density of 4.36 miles per square mile. Landslide prone road density is considered moderate at 1.1 miles per square mile throughout the face drainages. Potential changes in peak/base flow and water yield rate as low condition. The average ECA for the face drainages (9.6%) suggests that there should not be significant effects on peak/base flow related to fires or logging. However the moderately high ECA values in some watersheds (15-30%) and extremely high ECA values in Nelson Creek (48.2%) and Earthquake Creek (36.1%) may be causing localized impacts in individual watersheds and on the main stem SF CWR (USFS 1999).

Sediment yield from the face drainages and SF CWR main stem is currently 9% over base, rating as moderate condition. Stream bank stability of the main stem is rated high condition due to armoring along Highway 14. The opposite bank is primarily composed of bedrock and large boulders. Suspended sediment levels are fairly low, rating high condition for habitat. Main stem suspended sediment averages exceeded 25 milligrams per liter (mg/L) for 8 days and 80 mg/L for one day during years 1988-1992 (USFS 1999).

The main stem SF CWR begins at the confluence of the American River and the Red River. From this point to about Tenmile Creek, the river is relatively low-gradient (C channel) riffle/pool habitat dominated by gravel and cobble substrate. The channel has been altered by dredge mining and the placement of State Highway 14. From Tenmile Creek to Mill Creek, the river becomes steeper and more confined with the substrate dominated by boulders and cobbles. The channel type is typically A, B, or G (Rosgen 1994). This is a high-energy reach through which the sediment is readily transported. From Mill Creek to just above Threemile Creek, the river alternates between relatively flat, unconfined reaches and steep, narrow, confined reaches. The Rosgen (1994) channel type varies widely (A, B, C, or G). The river also changes direction near the forest boundary and begins to flow nearly due north. From Butcher Creek to its confluence with the Clearwater River at Kooskia, the SF CWR is a relatively flat, unconfined, C channel, dominated by riffle/pool habitat with gravel and cobble substrate. This lowest reach of the river has been partially confined by dikes in the vicinity of Stites and Kooskia.

Cobble embeddedness (40%) is rated low condition for the upper SF CWR. Percent surface fines were 12% in the upper SF CWR and were rated moderate condition. Percent fines by

depth for spawning gravels are rated poor condition for the upper SF CWR and 40% were less than 6.3 mm (USFS 1999).

Temperature is rated low condition for bull trout and steelhead spawning, rearing, and migration. The highest mean weekly temperature was 26.6 ^{o}C (80.0 ^{o}F) at Mount Idaho, and temperatures exceeded 15.5 ^{o}C (59.9 ^{o}F) during the steelhead spawning interval (USFS 1999).

Generally temperatures in the SF CWR main stem are too warm for native fish and temperatures increase after the river leaves the NPNF. Several factors contribute to this temperature increase including stream aspect (north-south), elevation, warmer ambient air temperature, and a high width-to-depth ratio. Data collected in the SF CWR between 1991 and 1993 by the NPNF, BLM, and USGS (USFS 1999) show temperatures exceeding levels conducive to chinook, steelhead/rainbow, cutthroat, and bull trout optimal growth, migration, and survival (Table 5).

Table 5. SF CWR temperatures, 1991-1993 (USFS 1999).

Site	Year	Days >20 ^{o}C (68 ^{o}F)	Maximum Temperature
Mt. Idaho	1991	44 (24 consecutive days)	24.1 ^{o}C (75.4 ^{o}F)
Mt. Idaho	1992	14 (9 consecutive days)	22.3 ^{o}C (72.1 ^{o}F)
Stites	1992	34	27.1 ^{o}C (80.8 ^{o}F)
Mt. Idaho	1993	0	19.0 ^{o}C (66.2 ^{o}F)
Stites	1993	32	22.6 ^{o}C (72.7 ^{o}F)

Data collected by the BLM just upstream of the Crooked River Bridge (approximately 27 miles upstream from the Mt. Idaho Bridge) suggest that the temperatures recorded at the Mt. Idaho site are indicative of those found throughout the upper SF CWR basin (USFS 1999).

Water Temperature Conditions Summarized in 1999 NPNF Biological Assessment (USFS 1999):

1. Summer maximum water temperatures in the upper reaches of the main stem are probably significantly elevated above natural, since the river there is primarily composed of inflows from impacted tributaries such as the American River, Red River, Newsome Creek, and Crooked River.

2. The main stem may become relatively cooler as it flows through the steep narrow reaches from Golden Canyon to the Mt. Idaho Bridge as a result of topographic shading and inflow from large cool tributaries such as Tenmile Creek and Johns Creek.

3. Below the NPNF boundary, the main stem warms considerably for the reasons discussed above.

Riparian Characteristics of SF CWR Main Stem
Riparian vegetation has been severely reduced for the entire length of the main stem by State Highway 14. Invasions of knapweed have occurred along both banks. Herbicides are routinely applied by the Idaho Transportation Department (ITD). A number of different compounds have been approved for use in the SF CWR watershed including Amine 4, Garlon 3A, Karmex DF, Oust XP, Transline, and Krovar I (Funkenhouser 2002). These products are applied according to the manufacturer's recommendations, and if applied correctly are acceptable for use near water bodies.

Floodplain connectivity is rated low condition. The location of the highway has led to a reduction in riparian and wetland areas and a significant change in riparian vegetation/succession.

Camas Prairie

Threemile Creek and Butcher Creek headwater areas have gravel and cobble substrate. As the streams flow through upper prairie areas, the channel types (Rosgen 1994) are typically B and the dominant substrate changes to silt and sand. These streams become steeper and their valleys more confined as they cut into low elevation breaklands, with the substrate changing to predominantly gravel and cobble. Significant amounts of bedload from these streams are delivered to the lower main stem SF CWR, as evidenced by the accumulation of alluvial fans at their mouths. These systems respond quickly to midwinter snowmelt and rain-on-snow events, frequently resulting in localized flooding.

Threemile Creek
Threemile Creek provides spawning and juvenile rearing habitat for steelhead trout, and historically chinook salmon. Surveys conducted in 1982 collected 6 young of the year (YOY) rainbow/steelhead and one YOY chinook salmon at stream mile 0.8. (Kucera et al. 1983). Adult steelhead have been observed during the past in the segment of the creek flowing through Grangeville (BLM 1999). Bull trout use of this creek has not been documented. Spring/summer chinook salmon use the creek for rearing (Kucera et al. 1983); however, spring chinook salmon use of the creek is at very low levels. A 1996 flood event resulted in severe channel and stream bank scouring. Previous flood events have also resulted in severe channel scouring. Large woody debris is lacking in-stream. The primary limiting factors for fish production include low flows, high summer water temperatures, poor riffle/ pool ratios, lack of good quality pools, and lack of in-stream cover (BLM 1999). Kucera et al.'s (1983) survey found cobble embeddedness ranged from 40-60%, with substrates ranging from small rubble and loose gravels to small boulder at the three stations.

Butcher Creek
Butcher Creek provides spawning and juvenile rearing habitat for steelhead. Spring/summer chinook salmon use Butcher Creek for rearing; however, such use is at very low levels. Bull trout use of this creek has not been documented. In 1982 rainbow/steelhead trout and young of the year spring/summer chinook salmon were sampled in Butcher Creek (Kucera et al. 1983). Recent electrofishing conducted by the NPT, June 27, 2002, documented 7 age one rainbow/steelhead and 3 juveniles (NPT 2002b). The primary limiting factors for fish

production include low summer stream flow, high summer water temperatures, extreme variations in stream flow, and lack of in-stream cover (BLM 1999). Kucera et al.'s (1983) survey found cobble embeddedness ranged from 25-60%, with substrates varying from small to large rubble at the three stations.

Vegetation Characteristics of Lower SF CWR Tributaries
Plant community composition is dependent of aspect, elevation, and soils. Habitat types vary from warm and dry (15 inches precipitation) to cool and moist (30 inches of precipitation). Common vegetation types include conifer, Palouse/canyon grasslands, and agriculture (dry farming–wheat, barley). The Palouse/canyon grasslands vegetation includes bluebunch wheatgrass, Idaho fescue, arrowleaf balsamroot, cheat grass, and shrubs/trees associated with some aspects. Good examples of relic Palouse grasslands are very rare, as agricultural activity and livestock grazing have altered these habitats significantly. Canyon grasslands in poor ecological condition generally are heavily infested with noxious weeds; yellow star thistle is the most common weed infesting range lands in the area. Common timber types include Douglas fir and ponderosa pine; grand fir occurs at higher elevations and areas with higher moisture regimes (BLM 1999)

1.3 Cultural Characteristics

Land ownership, land use, and cultural aspects of the SF CWR Watershed are discussed below.

Land Ownership

The SF CWR Subbasin includes a mixture of private and public lands covering approximately 752,000 acres (Figure 8). Table 6 lists the acreage of the major management groups. The Camas Prairie portion of the watershed contains approximately 199,000 acres and is comprised of private, BLM, state of Idaho, and NPT ownership.

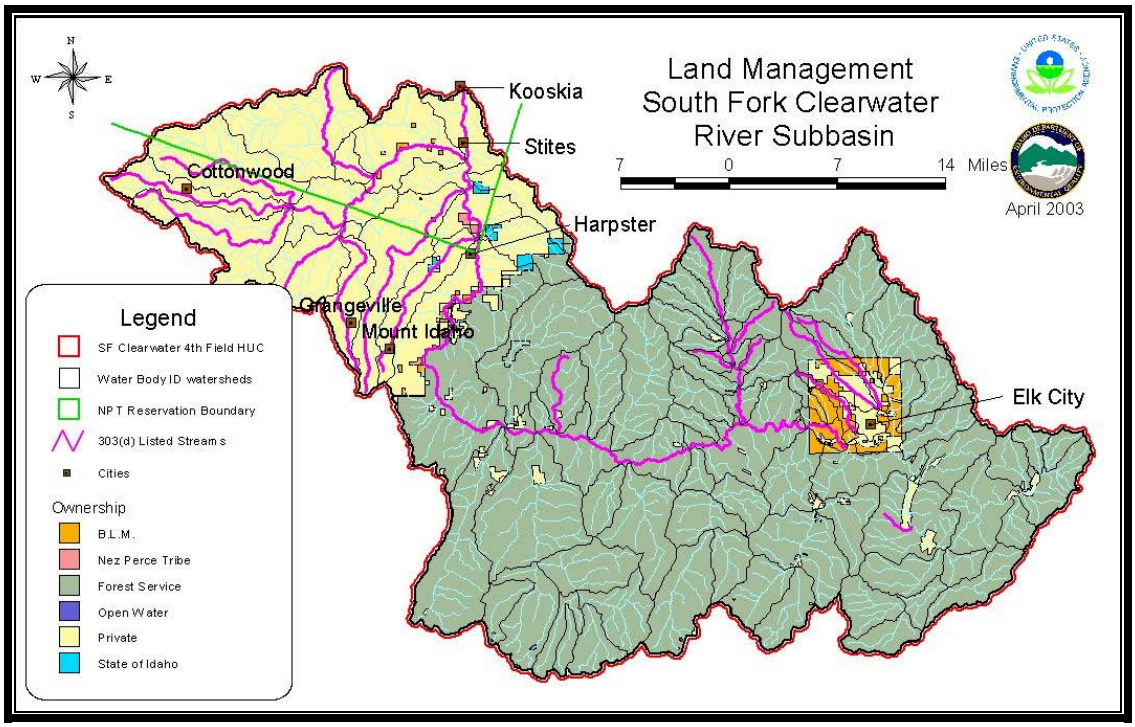

Figure 8. Major Land Managers of the SF CWR Subbasin

Table 6. Acreages of the SF CWR Subbasin land management groups.

Land Ownership/Management Agency	Acres	Percent
Nez Perce National Forest	516,262	68
Bureau of Land Management	14,906	2
Private	218,316	29
Nez Perce Tribe	564	<1
Idaho State Department of Lands	3,330	<1

Nez Perce Tribe Treaty Rights

Members of the Nez Perce Tribe have used and occupied the SF CWR Subbasin and surrounding area since time immemorial. Prior to the Treaty of 1855, the Nez Perce had exclusive use and occupancy over an area of approximately 13 million acres in central Idaho, northeastern Oregon, and southeastern Washington. Nez Perce members have and continue to use much of this territory, including the SF CWR Subbasin for hunting, fishing, gathering, and pasturing.

By virtue of the Treaties of 1855 and 1863, the Nez Perce Tribe reserved to itself certain rights, which are described in the treaties referenced below.

Treaty with the Nez Perce of 1855, Article 3: "The exclusive right of taking fish in all streams where running through or bordering said Reservation is further secured to said

Indians; as also the right of taking fish in all usual and accustomed places in common with citizens of the Territory; and of erecting temporary buildings for curing, together with the privilege of hunting, gathering roots and berries, and pasturing their horses and cattle upon open and unclaimed land."

Treaty with the Nez Perce of 1863, Article 8: "The United States also agrees to reserve all springs or fountains not adjacent to, or directly connected with, the streams or rivers within the lands hereby relinquished, and to keep back from settlement or entry so much of the surrounding land as may be necessary to prevent the said springs or fountains being enclosed; and, further, to preserve a perpetual right of way to and from the same, as watering places, for the use in common of both whites and Indians."

Communities

The largest town in the SF CWR Subbasin and the Idaho County seat is Grangeville (population 3,208). Other towns in the watershed include Kooskia (population 708), Cottonwood (population 852), Stites (population 215), Elk City (population 670), Mt. Idaho (population 75), Greencreek (population 50), Clearwater (population 35), Orogrande (population 10), Harpster, Big Butte, and Golden.

The current population estimate for Idaho County is 15,311. As the population of the Idaho County towns (Table 7) is only 5,693, approximately 10,000 residents live in rural areas. Growth trends in north-central Idaho show rural areas experiencing an influx of new residents. An analysis for Clearwater Economic Development Association (USFS 1998) showed nine communities with populations less than 1,000 growing in excess of 4% per year since 1991. In addition, unincorporated areas in Idaho County are attracting a greater share of new residents and exceeding city population growth. Many of the people locating in the rural areas are self-employed or retirees. Retirees tend to spend more of their income locally than other groups, and individuals who are self employed are not competing for jobs that others can fill. Table 7 shows population trends in Idaho County.

Table 7. Population trends in Idaho County.

Location	1970	1980	1990	1992
Cottonwood	867	941	822	852
Ferdinand	157	144	135	141
Grangeville	3636	3666	3226	3208
Kooskia	809	784	692	708
Riggins	533	527	443	460
Stites	263	253	220	215
White Bird	185	154	108	109

History and Economics

The SF CWR was once a major producer of steelhead and spring chinook salmon. The main stem and almost all tributaries with adequate access and discharge supported spawning and rearing for steelhead. Cutthroat and bull trout populations are also believed to have thrived throughout the subbasin. The lower SF CWR may have supported runs of coho and fall chinook salmon. The productivity of the subbasin is believed to have been historically higher as a function of nutrient supplementation from the Pacific Ocean when large numbers of anadromous salmonids provided nutrients both in the form of thousands of decaying carcasses from returning adults and the millions of eggs laid annually. In addition, the rearing juveniles provided a large prey base for resident salmonids.

The decline of the fishery and habitat in the SF CWR Subbasin probably began in 1861 when gold was discovered in the basin. Early mining, along with the associated grazing and timber harvest, is likely to have created only localized degradation. The decline accelerated in 1900 when large-scale hydraulic and dredge mining began. Road construction, primarily to access mining claims, also increased. A lull in large-scale mining occurred between about 1910 and 1930. In 1930, large-scale mining projects resumed and continued through the late 1950s. Newsome Creek, American River, Red River, and Crooked River were among the most heavily impacted. Between 40 and 50 miles of prime spawning and rearing habitat were drastically altered and heavily degraded by dredge mining, and large amounts of sediment were released into the tributaries and the SF CWR main stem.

As hydraulic and dredge mining activity declined, commercial timber harvest and road construction activity increased, most dramatically during the 1960s. This increase created another large, sustained peak in sediment levels. Harvest units typically did not have riparian buffers, and roads were poorly constructed. Streams were frequently straightened to accommodate roads, and the reconstruction of the South Fork Highway (Highway 14) resulted in constriction, steepening of the channel, and direct sediment delivery.

Grazing probably peaked in the 1920s and currently occurs at a lower level. Grazing impacts have been most severe in some of the important anadromous spawning and rearing areas in the Red River, American River, and Meadow Creek. Grazing has also impacted a number of smaller tributaries and has had severe impacts in many of the lower mainstem tributaries as well.

In 1911, a dam was constructed on the lower SF CWR main stem below the NPNF boundary near Harpster, near river mile 22 (upstream from the mouth), to provide power to the city of Grangeville. A fish ladder was installed in 1935 and remained until 1949, when it was destroyed by high water. Thus, the dam was a complete barrier to fish migration, and anadromous salmonids (chinook, coho, steelhead) and Pacific lamprey were excluded from the upper watershed from 1911 to 1935, and from 1949 until 1963, when the dam was removed. A second dam was constructed on the Clearwater River main stem near Lewiston in 1927 and was removed in 1974. This dam's fish ladder was remodeled around 1939 because the original ladder functioned poorly. Even though run sizes were sharply reduced, some passage of anadromous fish is believed to have occurred during 1927-1939. Two

potential fish barriers on the SF CWR include the Kooskia Flower Mill Dam and the Dewey Mine Dam. Fish passage conditions from these dams are not fully known, but they don't appear to have been complete migration barriers (N. Gerhardt 2002d). These two dams no longer exist. Construction of downstream dams on the main stem of the Snake and Columbia Rivers has also contributed to the decline of anadromous fisheries in the SF CWR Subbasin.

The exclusion of anadromous salmonids from the upper watershed caused a major decrease in the availability of forage fish for cutthroat and bull trout. This decrease coupled with habitat degradation is believed to have caused sharp reductions in cutthroat and bull trout populations beginning in the 1930s. Increased fishing pressure following completion of a road adjacent to the SF CWR in 1932 may have also contributed to the decline (Appendix D).

Anadromous salmonids returned to the upper SF CWR watershed through a combination of natural straying and reintroduction efforts after the Harpster dam was removed. However, by this time, prime spawning and rearing areas were heavily degraded. Populations of anadromous and resident fish have never recovered, and current population levels represent only a small percentage of their original levels. Even in the current degraded condition, under-utilized spawning and rearing habitat is available in the watershed. Thus the potential remains for the SF CWR to play a significant role in the recovery of anadromous salmonids if escapement at downstream dams can be improved.

Land Use

Primary land uses and economic interests within the subbasin include timber harvesting, mining, grazing, outfitting and guiding, recreation, and agriculture.

Timber Harvest

Timber harvest was associated with early mining activity between 1860 and 1910, and with homesteading from 1910-1920. In 1863, a sawmill was built in the vicinity of Elk City. By the turn of the century, as many as seven sawmills were producing lumber in the Elk City mining district. Commercial timber harvest began in the 1940s. During the 1940s and the 1950s, the rate of timber harvest was relatively low. The sawlog timber volumes sold in the subbasin since 1971 are shown in Table 8. The volume peaked in 1972 at 83.4 million board feet (MMBF). The lowest level was in 1992 with a figure of 0.3 MMBF.

In 1958, the Shearer Lumber Products sawmill near Elk City opened. This mill, as well as other mills which opened about the same time, created a large demand for timber. As a result the rate of harvest increased during the 1960s and 1970s. Clearcutting was the dominant silvicultural system used. Since the 1980s, the rate of timber harvest has been decreasing, as well as the amount of clearcutting.

In 1974, the state of Idaho adopted the Forest Practices Act (FPA), which oversees forest practices. Inspections are made by the state to ensure compliance with these rules and

regulations. From 1991 to 1993, the number of harvest activities on private land increased from 107 to 234. The size of individual harvests is also increasing.

Table 8. Sawlog volume sold from SF CWR Subbasin.

5 Year Intervals	Total MMBF[a]	Average MMBF/Year
1971-75	289.3	57.9
1976-80	284.3	56.9
1981-85	224.4	44.9
1986-90	221.0	44.2
1991-95	91.8	18.4
1996-2000	72.4	14.5

[a]Million board feet

Mining

The first major gold discovery in the subbasin was in June 1861, near Elk City. A placer mining boom followed, concentrated in the upper part of the basin. Hydraulic mining began in the mid-1860s resulting in thousands of cubic yards of sediment being washed into stream channels and rivers. The first dredge operated in the Elk City area in 1891. In 1902, the first ore processing mill, the "American Eagle," was built and full scale lode mining began. In upland areas, lode mines averaged a few acres in size and most work was completed with hand tools, which limited watershed impacts. However, the mills were located near streams for water and power supply, and it is likely that cyanide and mercury contaminated tailings were discharged into them.

The 1930s depression era brought a revival of placer mining and some lode mining. Most of the heavy dredging occurred in the tributaries (Newsome Creek, American River, Red River, and Crooked River), and in the upper section of the SF CWR main stem extending from the mouth of Newsome Creek to the upper reaches. Most of these impacts occurred in the lower gradient sections, which provide the richest spawning and rearing habitat.

Hydraulic mining of hillsides also revived in the 1930s. Large amounts of sediment caused changes in stream morphology as the volume was too great to be washed downstream. The pits left by hydraulic mining, called "glory holes" continue to be a focus of current restoration efforts. Their large, unvegetated, unstable banks are constantly eroding and contributing sediment to the system.

By 1960, more than 24 million cubic yards of material had been dredged in the subbasin, affecting approximately 30 miles of stream. Recent mining activity consists mostly of small scale suction dredging, placer and lode operations, and aggregate sources (rock pits). Approximately 70 aggregate sources have been developed in the subbasin over the years. Most are bank excavations above an entry road, and others utilize existing dredge tailings.

The USFS mining regulations have led to a reduction in mining impacts since 1974. One provision in these regulations requires that the operator furnish a bond to ensure that reclamation occurs. Environmental laws passed in the 1970s and 1980s have also reduced mining impacts.

Grazing

Domestic sheep and cattle arrived in the mid-1860s, with the gold rush and the movement of people to the area. It is estimated that more grazing by domestic livestock occurred at the turn of the century than occurs now. The NPT pastured large bands of horses throughout the area. It is also known that the NPT practiced prescribed fire management.

Livestock management increased with the number of settlers, and operations were concentrated in suitable areas around major trailheads leading to the large mining camps. Grazing laws were enacted in 1908 with the establishment of the NPNF. The livestock industry thrived on the range land of the area. Stites was the major livestock shipping location for the county.

Currently there are twelve active NPNF cattle allotments in the subbasin. The allotments are designated areas of land upon which a specified number of livestock may be grazed under a range allotment management plan. Grazing allotments total approximately 222,100 acres of the 515,000 acres within the NPNF portion of the subbasin. Approximately 105,450 of the allotment acreage have forage and are suitable for grazing. The rest is forested.

The degree of impact from grazing has fluctuated over the years. Recent monitoring indicates that the NPNF allotments are not major contributors to degraded fish habitat or water quality. However, about one third of the allotments have localized areas of overuse, which cause damage to stream banks and reduce riparian vegetation (USFS 1998).

Private, BLM, state, and tribal lands have been grazed by domestic livestock since the mid-1800s. The extent, location, and effects of the early grazing are not known. The earliest surveys done in Cottonwood Creek in 1962 documented riparian zones in poor condition and high water temperatures. Subsequent studies (1974, 1980, 1982, 1987, and 1992) all indicate a lack of riparian vegetation, lack of vegetative diversity, and severe channelization of the stream (USFS 1999). It is not known to what extent these impacts are attributable to grazing.

Outfitting/Guiding

There are currently seven different outfitters who utilize portions of the watershed for big game hunting (elk, deer, black bear, and cougar), fishing, and pack trips. There are currently no outfitter-guide permits for water related activities, such as rafting or kayaking.

Recreation

Recreation use includes big game hunting, fishing, horseback riding, hiking, cross-country skiing, swimming, whitewater kayaking, snorkeling and scuba diving, camping,

photography, wildlife viewing, picnicking, arts and craft activities, outdoor learning, berry picking, wood cutting, off-road vehicle use, sight seeing, and recreational dredge-mining. The early trails and wagon roads provided access for the nearby prairie and river communities to hunt, fish, and camp in the NPNF. The main stem of the SF CWR and the Red River have most of the developed campgrounds on the forest. In 2001, the north-central Idaho chinook fishing season brought $46 million dollars to the region (IDC 2002).

Recreation/tourism has been a traditional and historic use of the SF CWR area for as long as 110 years. The gravesite of G. Colgate lies alongside Highway 12 in the nearby Lochsa River subbasin. In 1893, Colgate was cook for a group of easterners engaged in a guided hunt along the Lochsa River (Hendrickson 2002). According to 1999-2000 Idaho Department of Commerce (IDC) figures, tourism is second only to lumber in north-central Idaho in revenue generated. Agriculture is third. In Idaho County, the gap between lumber and tourism is smaller than in north-central Idaho as a whole (Laughy 2002). In 1997, travel and tourism expenditures were 47.4 million dollars and agricultural sales were 32.6 million dollars. The lumber industry (all sales of manufactured lumber products, including logging, trucking, milling, etc.) was estimated to have generated 50.5 million dollars in 2000. According to IDC, travel and tourism figures do not reflect the income of proprietors and thus is underestimated. In summary, the three major industries in Idaho County are agriculture, lumber/milling, and tourism. They are all of similar size, with agriculture being the smallest. Travel and tourism is the most rapidly growing industry, while the others are declining.

Agriculture

In the mid-1800s settlers began moving into the area and established homesteads and ranches. Larger tracts were put into crop production with the development of mechanized equipment, resulting in the loss of riparian areas and wetlands. Predominantly agricultural land use occurs in the Threemile Creek and Butcher Creek watersheds (Table 9).

Table 9. Percent land use in Threemile and Butcher Creeks.

Water body Segment	Cropland	Pasture and Range	Forest	Steep Canyons	Urban
Threemile Creek	63.5	12.3	4.7	14.6	0.3
Butcher Creek	53.9	35.2	2.0	8.7	0.2

The majority of cropland is devoted to dryland agriculture. About 10% of area farmers are now using direct seed and no-tilling practices, with the trend on the increase (Rowan, September 23, 2002). The major crops are winter wheat, spring wheat, barley, peas, lentils, and canola. Most of the cropland is on gently sloping, well-drained soils. Farming practices include conventional tillage for seedbed preparation, plow, disc, harrow, fertilization of inorganic nitrogen (on average 100 pounds per acre for winter wheat) and phosphorus, and pesticide application for control of weeds and insects. Crops are generally grown in rotation with winter wheat following a legume or canola.

Range and grazing lands tend to be on the steeper slopes or areas with soils unsuitable for crop production. Some areas have large numbers of animals confined to relatively small areas with direct access to the creek. Currently none of these areas are officially designated as "confined animal feeding operations" (CAFOs) (Rowan, September 23, 2002).

Approximately 60% of all private agricultural land has had riparian vegetation removed according to Idaho Soil and Water Conservation District representatives (USFS 1999). During spring runoff, flooding of cropland, pasture, and hay land adjacent to streams occurs. Little vegetation is left to trap sediments during these periods of runoff. Severe stream bank erosion has also occurred in some areas resulting from the high velocity flows associated with seasonal flooding.

The majority of cropland is left in a tilled condition going into winter. Soil erosion occurs following winter rains (November to March) on snow and frozen soil resulting in rapid runoff. When the soil is partially frozen, the surface water infiltration is greatly reduced and runoff erodes topsoil down to the frozen layer, carrying sediment onto lower lands and into stream systems. Localized high intensity rainstorms, which may occur at any time during the year, also contribute to soil erosion.

Agricultural chemical use on private land is widespread, and approximately two thirds of the cropland area receives at least one chemical application per year. Appendix E lists chemicals identified as being used in support of agriculture and grazing on the Camas Prairie. Approximately 46 different herbicides and pesticides are used on the Camas Prairie for weed and insect control (Sandlund 2002).

2. Subbasin Assessment-Water Quality Concerns and Water Quality Status

This section identifies the 13 water quality limited segments in the SF CWR Subbasin, the applicable WQS for these water bodies, existing water quality data, and data gaps. The SF CWR Subbasin, HUC 17060305, is comprised of the 82 water body units defined by Idaho Code (IDAPA 58.01.02.120.07) (see Table 1).

2.1 Water Quality Limited Segments Occurring in the SF CWR Subbasin

The water quality limited water bodies (DEQ 1999), beneficial uses, and pollutants are shown in Table 10. Figure 9 shows the water quality limited stream and river segments and their associated watersheds.

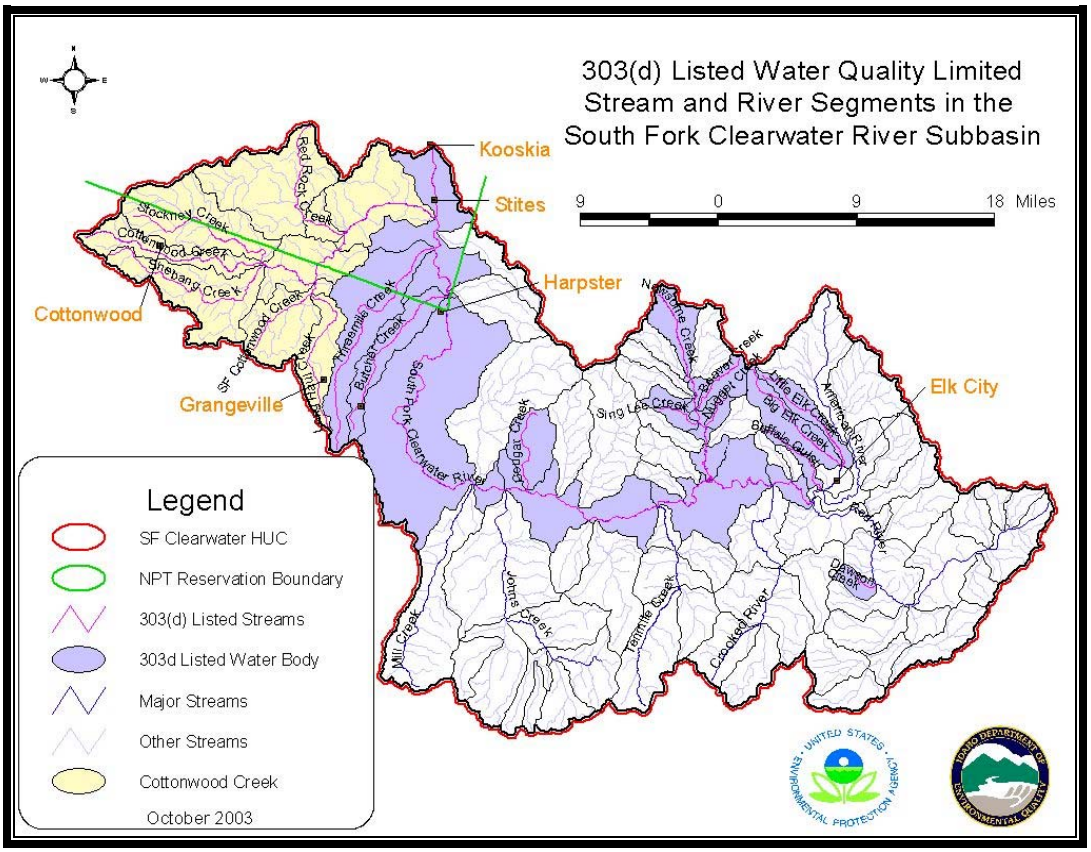

Figure 9. Water Quality Limited Water Bodies in the SF CWR Subbasin

The CWA requires the restoration and maintenance of the chemical, physical, and biological integrity of the nation's waters (33 USC §§ 1251 – 1387). States and qualified Tribes, pursuant to Section 318 of the CWA, are to adopt WQS necessary to protect fish, shellfish, and wildlife while providing recreation in and on water whenever attainable. Section 303(d) of the CWA establishes requirements for states and qualified Tribes to identify and prioritize water bodies that are water quality limited. States and qualified Tribes must publish a

priority list of impaired waters every two years. For waters identified on this list, states and qualified Tribes must develop a TMDL set at a level to achieve WQS.

Table 10. Water quality limited water bodies in the SF CWR Subbasin.

Stream Name	Water Body ID(s)	Boundaries (1998 303(d) list)[a]	Beneficial Uses[b]	Stream Miles	Pollutant[c]
Threemile Creek	10	Headwaters to SF CWR	CW/SS(d) SCR(d)	49.8	Bac, DO, Qalt, Halt, NH_3, Nut, Sed, Temp
Butcher Creek	11	Headwaters to SF CWR	CW/SS(d) SCR(d)	18.9	Bac, DO, Qalt, Halt, Sed, Temp
Newsome Creek	62	Beaver Creek to SF CWR	CW/SS(e) PCR/SCR(e)	12.4	Sed
Lucas Lake	52		CW/SS(e) PCR/SCR(e)	.00	Sed
Beaver Creek	65	Headwaters to Newsome Creek	CW/SS(e) PCR/SCR(e)	6.7	Sed
Buffalo Gulch	59	Headwaters to American River	CW/SS(e) PCR/SCR(e)	6.5	Sed
Dawson Creek	38	Headwaters to Red River	CW/SS(e) PCR/SCR(e)	2.3	Sed
Nugget Creek	64	Headwaters to Newsome Creek	CW/SS(e) PCR/SCR(e)	4.6	Sed
Sing Lee Creek	73	Headwaters to Newsome Creek	CW/SS(e) PCR/SCR(e)	4.5	Sed
South Fork Clearwater River	1, 12, 22, 30, 36	Red River to Clearwater River	CW/SS(d) PCR(d) SRW (d)	248.8	Halt, Sed, Temp
Cougar Creek	79	Headwaters to SF CWR	CW/SS(e) PCR/SCR(e)	17.1	Sed
Little Elk Creek	57	Headwaters to Elk Creek	CW/SS(e) PCR/SCR(e)	12.7	Temp
Big Elk Creek	58	Headwaters to Elk Creek	CW/SS(e) PCR/SCR(e)	19.7	Temp

[a]Refers to a list created in 1998 of water bodies in Idaho that did not fully support at least one beneficial use. This list is required under section 303 subsection "d" of the Clean Water Act.
[b]CW = Cold Water, SS = Salmonid Spawning, PCR = Primary Contact Recreation, SCR = Secondary Contact Recreation, SWR= Special Resource Water
(d) = designated beneficial use, (e) = existing beneficial use
[c]Bac = bacteria, DO = dissolved oxygen, Qalt = flow alteration, Halt = habitat alteration, NH_3 = ammonia, Nut = nutrients, Sed = sediment, Temp = temperature

As a result of the court-ordered 303(d) listing by USEPA in 1994 (DEQ 1999), the entire main stem SF CWR and 49 tributaries were listed as water quality–limited, not including the

Cottonwood Creek drainage, which was addressed by a separate TMDL effort (DEQ, NPT, USEPA 2000). Streams were listed for numerous reasons, not only WQS violations. Nine streams came to the 303(d) list as a result of being identified in Appendix D of DEQ's 1992 305(b) report (DEQ 1992). The remaining 40 tributaries and the main stem SF CWR itself were listed because of information accumulated from the NPNF plan (USFS 1987), other NPNF studies, and Idaho's water quality status report (DEQ 1989).

Waters identified in Appendix D of the 1992 305(b) report were listed as potentially impaired sites needing further assessment to verify any actual WQS violations (including impaired beneficial uses) (DEQ 1989). Waters identified in USFS plan and other studies as not meeting forest plan objectives are not necessarily violating state WQS, as forest plan objectives may be quite different from state WQS. Idaho's Stream Segment of Concern (SSOC) listing process was a mechanism for the public to voice concerns about particular water bodies. Unfortunately, these lists likewise had little evidence of actual water quality problems or impaired uses. The SSOC waters were often identified as impaired simply because they were favored by the interested public. In all these cases, little actual data were available to assess whether or not these waters were violating WQS or impairing beneficial uses.

In 1998, DEQ attempted to rectify that situation by processing several years worth of Beneficial Use Reconnaissance Program (BURP) data in order to assess the status of beneficial uses and record WQS violations for these 303(d) listed streams. The 1998 DEQ 303(d) list (DEQ 1999) removed 39 of the original 49 tributaries listed under the court order. Section 3.2 discusses the analyses of the BURP data. The tributaries remaining on the 303(d) list are shown in Table 10. For waters within the Nez Perce Reservations, the 1994 303(d) list remains in effect.

2.2 Applicable Water Quality Standards

The water quality criteria (narrative and numeric) that are relevant for the designated and existing beneficial uses for the SF CWR Subbasin are discussed below. Designated beneficial uses listed for the main stem SF CWR include salmonid spawning, primary contact recreation, and special resource water (IDAPA 58.01.02). The beneficial uses of the 303(d) tributaries are listed above in Table 10. For undesignated 303(d) listed tributaries, the existing beneficial use for aquatic life in the SF CWR Subbasin is salmonid spawning and the existing beneficial use for recreation is primary or secondary contact recreation (IDAPA 58.01.02.101.01).

Beneficial Uses

Idaho WQS require that surface waters of the state be protected for beneficial uses, wherever attainable (IDAPA 58.01.02.050.02). These beneficial uses are interpreted as existing uses, designated uses, and "default" uses as briefly described in the following paragraphs. The *Water Body Assessment Guidance*, second edition (Grafe et al. 2002) gives a more detailed description of beneficial use identification for use assessment purposes.

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." The existing beneficial uses and the level of water quality necessary to protect the uses shall be maintained and protected (IDAPA 58.01.02.003.35, .050.02, and 051.01 and .053). Existing uses include uses which have occurred since 1975, whether or not the level of water quality to fully support the uses exists.

Designated Uses

Designated uses under the CWA are "those uses specified in WQS for each water body or segment, whether or not they are being attained." Designated uses are simply uses officially recognized by the state. In Idaho these include things like aquatic life support, recreation in and on the water, domestic water supply, and agricultural use. Water quality must be sufficiently maintained to meet the most sensitive use. 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 specifically listed for water bodies in Idaho in tables in the Idaho WQS (see IDAPA 58.01.02.003.22 and .100, and IDAPA 58.01.02.109-160).

Presumed Uses

In Idaho, most water bodies listed in the tables of designated uses in the WQS do not yet have specific use designations. Until such time as specific uses are designated, 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," Idaho WQS indicate that the numeric criteria for cold water aquatic life and primary or secondary contact recreation criteria will be applied to undesignated waters. If other more restrictive existing use occur in the water body (e.g., salmonid spawning), then the criteria for those uses would apply as well (e.g., intergravel dissolved oxygen, temperature). However, if for example, cold water aquatic life is not found to be an existing use, a use designation 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).

Water Quality Criteria

Details of Idaho WQS may be seen in the state of Idaho Web site (www2.state.id.us/adm/adminrules/rules/IDAPD581/0102.pdf) or obtained from DEQ's Lewiston Regional Office. Idaho WQS include criteria necessary to protect designated beneficial uses. The standards are divided into three sections: General Surface Water Criteria, Surface Water Quality Criteria for Use Designations, and Site-Specific Surface Water Quality Criteria (IDAPA 58.01.02). The numeric standards that exist in these rules for *Escherichia coli* (*E. coli)* bacteria, temperature, turbidity, ammonia, and dissolved oxygen

will be used in the TMDL. The standards for nutrients and sediment are narrative standards. A narrative standard states that the level of a pollutant cannot exceed quantities above natural background that impair beneficial uses. Because these pollutants do not have numeric standards, surrogate numeric targets are proposed in the TMDL (Sections 5.2 and 5.3). According to IDAPA 58.01.02.070.07, numeric WQS are to apply to intermittent waters during optimum flow periods sufficient to support the uses for which the water body is designated. Optimum flows are defined as 5.0 cfs for recreation and water supply uses and 1.0 cfs for aquatic life uses.

These WQS pertain to those times and locations where stream flow is non-intermittent. Idaho rule (IDAPA 58.01.02.003.50) defines an intermittent stream as "A stream which has a period of zero flow for at least one week during most years. Where flow records are available, a stream with a 7Q2 (seven day, 2 year low flow) hydrologic-based design flow of less than one-tenth (0.1) cfs is considered intermittent. Streams with perennial pools which create significant aquatic life uses are not intermittent." Stream segments of zero flow occur between perennial pools within portions of the Threemile Creek and Butcher Creek watersheds.

Idaho WQS pertaining to point source discharges stipulate "the width of the mixing zone is not to exceed more than twenty five percent (25%) of the stream width, and more than twenty five percent (25%) of the volume of the stream flow" (IDAPA 58.01.02.060.01).

Also, in the case of permitted point source discharges, additional stipulations for the mixing of wastewater discharge may be applied. For example, unless specific exemptions are made, "the temperature of the wastewater must not affect the receiving water outside the mixing zone so that: (i) the temperature of the receiving water or of downstream waters will interfere with designated beneficial uses, (ii) daily and seasonal temperature cycle characteristics of the water body are not maintained, … (iv) if the water is designated for cold water aquatic life or salmonid spawning, the induced variation is more than plus one (+1) degrees C" (IDAPA 58.01.02.401.03.a). The wastewater may not increase turbidity of receiving water outside the mixing zone by more than 5 nephlometric turbidity units (NTU) over background, when background turbidity is 50 NTU or less, or by more than 10% when background is more than 50 NTU, not to exceed a maximum increase of 25 NTU (IDAPA 58.01.02.401.03.b). These and other considerations specific to the WWTP point source discharge will be determined by the local DEQ permitting engineer during 401 permit certification.

A subset of the Idaho WQS as defined in Idaho Code 58.01.02 that pertains to the SF CWR Subbasin follows below. All surface water quality criteria are subject to the clause, "Surface waters are not to vary from the following characteristics due to human activities.".

Temperature Idaho State Standard for Cold Water Aquatic Life: Water temperatures of twenty-two(22) degrees C (71.6 ^{o}F)or less with a maximum daily average of no greater than nineteen (19) degrees C (66.2 ^{o}F) (IDAPA 58.01.02.250.02b).

Idaho State Standard for Salmonid Spawning: Water temperatures of thirteen (13) degrees C (55.4 ^{o}F)or less with a maximum daily average no greater than nine (9) degrees C (48.2 ^{o}F) (IDAPA 58.01.02.250.02e). (See Appendix D for SF CWR fish varieties spawning intervals.)

Federal Bull Trout Standard: 10°C (50 ^{o}F)expressed as an average of daily maximum temperatures over a seven-day period, referred to as the "mean weekly maximum temperature (MWMT). Applies during months of June, July, August, and September to water bodies identified in Appendix B of the July 1997 Federal Register.

Sediment

Idaho State Standard for Sediment: Sediment shall not exceed quantities specified in Sections 250 and 252, or in the absence of specific sediment criteria, quantities which impair designated beneficial uses. Determinations of impairment shall be based on water quality monitoring and surveillance and the information utilized as described in Section 350 (IDAPA 58.01.02.200.08).

Turbidity standard for Cold Water Aquatic Life: Turbidity below any applicable mixing zone set by the Department, shall not exceed background turbidity by more than fifty (50) NTU instantaneously or more than twenty-five (25) NTU for more than ten (10) consecutive days (IDAPA 58.01.02.250.02d).

Nutrients

Idaho State Standard for Excess Nutrients: Surface waters shall be free from excess nutrients that can cause visible slime growth or other nuisance aquatic growths impairing designated beneficial uses (IDAPA 58.01.02.200.06).

Pathogens

Idaho State Standard for Primary and Secondary Contact Recreation. Primary Contact Recreation: Waters designated for primary contact recreation are not to contain *E. coli* bacteria significant to public health in concentrations exceeding:

a. A single sample of four hundred six (406) *E. coli* organisms per one hundred (100) ml; or

b. A geometric mean of one hundred twenty-six (126) *E. coli* organisms per one hundred (100) ml based on a minimum of five (5) samples taken every three (3) to five (5) days over a thirty (30) day period (IDAPA 58.01.02.251.01).

Secondary Contact Recreation: Waters designated for secondary contact recreation are not to contain *E. coli* bacteria significant to public health in concentrations exceeding:

a. A single sample of five hundred seventy-six (576) *E. coli* organisms per one hundred (100) ml; or

b. A geometric mean of one hundred twenty-six (126) *E. coli* organisms per one hundred (100) based on a minimum of five (5) samples taken every three (3) to five (5) days over a thirty (30) day period (IDAPA 58.01.02.251.02).

Ammonia — Idaho State Standard for Cold Water Aquatic Life and Salmonid Spawning As defined in tables in 58,01.02.250.02.c.i. and ii.; pH dependent.

Dissolved Oxygen — Idaho State Standard for Cold Water Aquatic Life:

Waters designated for cold water aquatic life are not to vary from the following characteristics due to human activities:
a. Dissolved oxygen concentrations exceeding 6 mg/L at all times.

Idaho State Standard for Salmonid Spawning:
(1) Intergravel dissolved oxygen
(a) One (1) day minimum of not less than five point zero (5.0) mg/L.
(b) Seven day average mean of not less than six point zero (6.0) mg/L.

(2) Water Column dissolved oxygen
(a) One (1) day minimum of not less than six point zero (6.0) mg/L or ninety percent (90%) of saturation, whichever is greater (IDAPA 58.01.02.250.02).

2.3 Summary and Analysis of Existing Water Quality Data

Table 12 displays sources of existing water quality and stream habitat data obtained from local agencies used in the development of the temperature and sediment TMDLs.

Subbasin-wide Biological and Other Data

The stream habitat data, reference stream data, and fish data assembled for this analysis is discussed below. Sources for the data are shown in Table 11.

Stream Habitat Data

The BLM (Johnson 1999) completed the *Biological Assessment of the Lower South Fork Clearwater River and Tributaries* as part of its biological assessment of ongoing and proposed BLM activities on Endangered Species Act (ESA) listed salmonids. The main stem SF CWR below the NPNF, and tributaries including Threemile Creek, Butcher Creek, Mill Creek, and Sally Ann Creek, were assessed using the *Matrix of Pathways and Indicators of Watershed Condition - Local Adaptation for the Clearwater Basin* (NMFS et al. 1998). For most of the criteria evaluated, conditions in the lower SF CWR and tributaries were suboptimal, rating "low" for habitat condition.

Table 11. Sources of water quality data.

Data Type[a]	Source[b]	Location
Stream Habitat Data	Lower SF CWR and tributaries Biological Assessment SF CWR Biological Assessment	BLM NPNF
Reference Stream Data	NPNF Wallowa-Whitman National Forest	Appendix N Appendix N
Fisheries Resources Report	Fish TAG Report	Appendix D
Fish TAG Report	SF CWR Fish TAG	Appendix D
BURP Data	DEQ	Appendix K
Flow Data	1995 Earthinfo compact disc USGS (Boise office) USEPA Storet database Clearwater Subbasin summary, NWPP Council (2001)	Section 2.3.2
Temperature Data	NPNF, NPT, BLM, IDFG, and DEQ thermographs Thermal Infrared Imaging	Appendix J DEQ Report (2001)
Sediment Data: TSS and Bedload Sediment Loading Calculations Stream Erosion Inventory Sediment Budget	 NPNF, NPT and DEQ TMDL DEQ, NPT, USEPA (TMDL) TMDL	 Appendix M Chapter 5 Appendix L Appendix L

[a]Fish TAG = fisheries technical advisory group, BURP = Beneficial Use Reconnaissance Program, TSS = total suspended solids
[b]NPNF – Nez Perce National Forest, DEQ = Department of Environmental Quality, USGS = U.S. Geological Survey, USEPA = U.S. Environmental Protection Agency, NWPP = Northwest Power Planning Council , NPT = Nez Perce Tribe, BLM = Bureau of Land Management, IDFG = Idaho Department of Fish and Game

The *South Fork Clearwater River Biological Assessment* (USFS 1999) rates the biological condition of 15 major watersheds in the SF CWR Subbasin for ESA listed species using the *Matrix of Pathways and Indicators of Watershed Condition - Local Adaptation for the Clearwater Basin* (NMFS et al. 1998). The watersheds assessed include the Red River, American River, Crooked River, Newsome Creek, Leggett Creek, Tenmile Creek, Twentymile Creek, Wing Creek, Silver Creek, Peasley Creek, Cougar Creek, Johns Creek, Meadow Creek, Mill Creek, and the SF CWR main stem and face drainages. Summarized at a watershed scale, the majority of water quality and habitat elements rate as "low" condition, while watershed condition (road parameters), channel conditions, and species take (harassment, redd disturbance, juvenile harvest) rate as "moderate" condition. Appendix K contains the Environmental Baseline/Habitat Condition rating. Water quality and stream

habitat results for the 303(d) listed segments are discussed in Chapter 1, Stream Characteristics.

Reference Stream Habitat Data

To better assess the condition of streams and rivers of the SF CWR Subbasin as they are affected by sediment, we acquired two data sets for hydrologic systems considered to be in good to near pristine condition. We acquired data sets that consisted of measures of cobble embeddedness, percent pools, residual pool volumes, pool filling, bank full width, and Rosgen channel type. Stream habitat data were acquired from the NPNF for Meadow Creek in the Selway basin and Bargamin Creek that drains into the Salmon River. These two systems lie immediately to the east of the SF CWR Subbasin, are largely unroaded or otherwise disturbed, have similar geology and geomorphology to the forested streams of the upper SF CWR, and have reasonable data sets because they are recognized by the NPNF as being systems in good condition that can be used as reference. As a reference for the lower SF CWR main stem, particularly within the basalts, we acquired data from the Wallowa-Whitman National Forest for the Imnaha River above the Forest Service boundary. The Imnaha River lies about 50 miles to the west of the SF CWR Subbasin in Oregon. It flows down out of the Eagle Cap Wilderness through some relatively undisturbed basalt forest lands into the Snake River.

To compare these reference data to streams and rivers in the SF CWR Subbasin, we acquired two different data sets for the subbasin. We acquired the set of stream habitat data from the NPNF, which covered portions of the upper basin streams. We also contracted with a private company to collect these same data for the main stem SF CWR. The reference data are presented in Appendix N.

Fish Data

Pertinent fish data including IDFG snorkeling surveys conducted for the SF CWR main stem in 2000, historic influences on fisheries resources, and current status of salmonid populations in the subbasin are discussed in Appendix D, Fisheries Resources. Tables 12 and 13 list species known to be present in the SF CWR Subbasin.

A Fish TAG was convened to provide professional judgement regarding the status of local fish populations, the habitat quality in the subbasin, and the effects of nonpoint source pollutants. The group was comprised of fish biologists and hydrologists from the National Marine Fisheries Service (NMFS), NPT, NPNF, IDFG, USEPA, and BLM. In order to prioritize restoration needs for fisheries in the subbasin, the group ranked the quality of the 82 water bodies for each species.

Water bodies were ranked for current fish population presence, current condition of habitat, natural inherent water body potential, pollutant severity, and conservation/preservation priority. Areas ranked "conserve" are areas currently considered to be of high habitat quality. Appendix D shows the Fish TAG water body ranking chart and maps illustrating current habitat condition by species, water body potential by species, and restoration potential.

Table 12. Salmon, trout, and char species present in the SF CWR Subbasin.

Common Name	Scientific Name
Bull trout	*Salvelinus confluentus*
Spring chinook salmon	*Oncorhynchus tschawytscha*
Snake River fall chinook	*Oncorhynchus tschawytscha*
Steelhead rainbow /redband trout	*Oncorhynchus mykiss*
Westslope cutthroat trout	*Oncorhynchus clarki lewisi*
Brook trout (introduced species)	*Salvelinus fontinalis*

Table 13. Other fish species known to occur in the SF CWR Subbasin.

Common Name	Scientific Name	Origin
Pacific lamprey	*Lampetra tridentatus*	Native
Mountain whitefish	*Prosopium williamsoni*	Native
Northern pikeminnow	*Ptychocheilus oregonensis*	Native
Chiselmouth	*Acrocheilus alutaceus*	Native
Bridgelip sucker	*Catostomus columbianus*	Native
Sculpin	*Cottus sp.*	Native
Black bullhead	*Ictalurus melas*	Introduced
Redside shiner	*Richardsonius balteatus*	Native
Speckled dace	*Rhinichthys osculus*	Native
Longnose dace	*Rhinichthys cataractae*	Native
Smallmouth bass	*Micropterus dolomieui*	Introduced

BURP Data and WBAG Assessment

IDAPA 58.01.02.053 establishes a procedure to determine whether a water body fully supports designated and existing beneficial uses. The procedure detailed in the *1996 Water Body Assessment Guidance* (WBAG) (DEQ 1996a) and revised in 2002 (Grafe et al. 2002) relies on physical, chemical, and biological parameters to identify water quality limited segments that require TMDL development.

The General Surface Water Quality Criteria (IDAPA 58.01.02.200) for Idaho set forth general guidance for surface water quality. The Surface Water Quality Criteria for Aquatic Life Use Designations (IDAPA 58.01.02.250) set forth specific numeric criteria to be met for particular beneficial uses. It also sets forth “narrative” standards that require a logical accumulation of

evidence to determine whether a water body is supporting its beneficial uses. The WBAG sets forth a methodology whereby a water body is first assessed using the numeric criteria for a particular beneficial use, then identifies indices and methods for "narrative" assessment of pollutants for which numeric criteria do not apply or are not available (DEQ 1996a; Grafe et al. 2002). Sediment is the primary pollutant addressed by narrative means in the WBAG.

Idaho determines if its narrative sediment criteria are being met by collecting BURP data to verify if viable communities of aquatic organisms are present and if evidence of beneficial use exists in the stream. The BURP is a consistent scientific process used statewide for collecting this data. The evaluatation of the BURP data using WBAG results in indices used to compare water quality with the standards to determine beneficial use support status. Figure 10 shows all of the BURP locations in the SF CWR Subbasin.

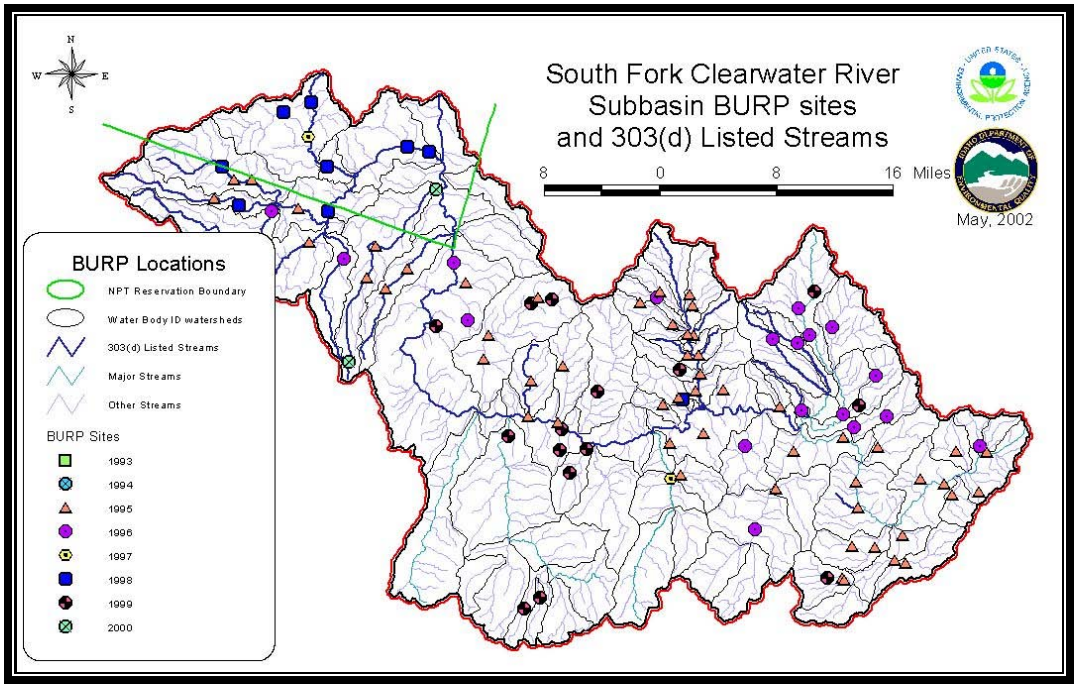

Figure 10. Locations of BURP Sites Throughout the SF CWR Subbasin

BURP surveys were completed on the 303(d) streams in the SF CWR Subbasin during the summer monitoring seasons of 1995, 1996, and 2000. The BURP surveys collected data on fish, macroinvertebrates, and stream habitat. The data were analyzed through a systematized and statistical process to determine whether a particular water body supports its beneficial uses as described in the WBAG. The WBAG results using the 1996 version for the 303(d) listed water bodies are presented in Table 14. Several streams have two BURP sites; and therefore, two sets of results. These are the WBAG results that were used in the development of the 1998 303(d) list (DEQ 1999). Table 15 presents the results of analyzing the same data for the 303(d) listed water bodies using the 2002 version of WBAG.

Table 14. WBAG version 1996 results for 303(d) listed water bodies in the SF CWR Subbasin.

Water Body	Macro-invertebrate Biotic Index (MBI)	Salmonid Age Classes[a]	Temper-ature (^{0}C)	Habitat Index (HI)	Support Status[b]
Threemile Creek (L)[c]	3.30	1	16	104	NFS
Threemile Creek (U)[d]	2.61	0	15	75	NFS
Butcher Creek (L)	3.04	1	23	85	NFS
Butcher Creek (U)	3.42	0	18	85	NV
Newsome Creek (L)	3.79	5+j	19	104	NFS
Newsome Creek (U)	3.71	5?	16	89	NV
Beaver Creek	2.18	3+j	13	104	NFS
Buffalo Gulch	2.93	1+j	9	98	NFS
Dawson Creek	4.13	1	9	99	NFS
Nugget Creek	4.23	1	11	106	NFS
Sing Lee Creek	3.22	2	15	141	NFS
SF Clearwater	*e	*	*	*	*
Cougar Creek (L)	4.12	0	13	101	NFS
Cougar Creek (U)	3.61	Fish barrier ½ mi below BURP[f] reach	12	99	FS

[a]+j = including juveniles
[b]FS = Full support, NFS = Not full support, NV = Needs verification, from 1998 303(d) list (DEQ 1999)
[c]L = Lower
[d]U = Upper
[e]To be assessed using the Large River Protocol, which is not yet available
[f]Beneficial Use Reconnaissance Program

Within the 1996 WBAG protocol, the macroinvertebrate biotic index (MBI) is the primary indices used to confirm beneficial uses support status. The MBI score is generated from seven different qualities about macroinvertebrates (aquatic insects). Examples of the qualities include diversity of species, richness of species diversity, species guilds, and pollutant tolerance of insects present. An MBI score of 3.5 or more indicates that the macroinvertebrate community is not impaired, a score between 2.5 and 3.5 indicates that more information is needed, and a score of 2.5 or less indicates that the macroinvertebrate community is impaired. Newsome Creek, Dawson Creek, Nugget Creek, and Cougar Creek MBI scores indicate that these water bodies are supporting their beneficial uses.

The second indicator of full supprt of beneficial uses is the presence of salmonid species and their young of the year in a stream. If three age classes of fish, including juveniles (fish <100 mm in length) are present, then a water body is considered to be fully supporting salmonid

spawning. If only two age classes including juveniles are present, then the habitat index (HI) is considered. The HI utilizes both quantitative and qualitative stream data to determine the level of habitat impairment within three ranges as compared to the ecoregion reference condition. If the HI is 73 or greater, the water body is considered to be fully supporting its beneficial uses. Less than two age classes of salmonids, including juveniles, indicates that the water body is not fully supporting its beneficial uses. If no fish length data or no fish data exist at all, then salmonid spawning beneficial use is not assessed (DEQ 1996a). The HI scores and presence of salmonids in Beaver Creek and Sing Lee indicate that these water bodies are supporting their beneficial uses.

Following a literal interpretation of the WBAG 1996 version, only Threemile Creek and Butcher Creek data are not fully supporting their beneficial uses, with Buffalo Gulch needing verification. The reasoning for maintaining the other water bodies on the 1998 303(d) list is unknown at this time.

Table 15. WBAG version 2002 assessment of the 303(d) listed wadeable streams in the SF CWR Subbasin.

Water Body	SMI	SHI	SFI	WB Score
Threemile	MS	MS	MS	1.6
Butcher	1.0	1.0	MS	1.0
Dawson	2.0	2.0	2.0	2.0
Buffalo Gulch	2.0	3.0	3.0	2.7
Newsome	3.0	3.0	ND	3.0
Nuggett	3.0	3.0	3.0	3.0
Beaver	1.0	3.0	3.0	2.3
Sing Lee	1.0	3.0	ND	2.0
Cougar	2.0	3.0	ND	2.5

SMI = Stream Macrobiotic Index; SHI = Stream Habitat Index; SFI = Stream Fish Index; MS = Multiple Sites; ND = No Data.

In the WBAG version 2002, a Water Body Score of 2 or greater is passing. All of the water bodies except Threemile Creek and Butcher Creek in the SF CWR have scores of 2 or greater. Note that Sing Lee Creek, Cougar Creek, Beaver Creek, Dawson Creek, and Buffalo Gulch, though passing, have the lowest scores.

These WBAG assessment results of the 303(d) listed water bodies above Harpster indicate that sediment may not be significantly impairing water quality in the upper basin water bodies. However, in the context of the narrative sediment WQS, we need to look at other data types and reach a conclusion based on all of them. Using WBAG version 2002, these BURP data by themselves cannot be used to make the status call because they are more than 5 years old and were collected using somewhat different methods. Also, WBAG version 2002 requires consideration of qualified non-BURP data, which is not shown in Table 15.

For all the other BURP sites in the SF CWR Subbasin shown in Figure 10, assessments using either the WBAG version 1996 or version 2002 indicate full support of beneficial uses.

Subbasin Flow Characteristics

The following gauging station data were obtained from a variety of sources including a 1995 Earthinfo® compact disc, the USGS, and a 1998 USEPA Storet compact disc (Table 16). There are a number of active gauging stations in the subbasin, perhaps more than the typical subbasin (Table 16). The USGS maintains an active gage on the SF CWR at Stites (#13338500). Flow data have been collected here since 1964. The USGS also collects water quality trend monitoring data at this site. The USGS has had two other gages on the SF CWR in the past, one near Elk City (#13337500) at the confluence of the American and Red Rivers (1944 to 1974), and one near Grangeville (#13338000, 1910 to 1963). The Grangeville station was moved to Stites just prior to the removal of a dam that existed on the SF CWR near the NPNF boundary. The NPNF has four active gauging stations in the subbasin that have operated since 1986; on Red River, South Fork Red River, Trapper Creek, and Johns Creek. Summary statistics are provided for the SF CWR stations in Tables 17-19.

Additionally, there were several stations across the basin that operated for very short periods of time. Two stations established and operated in the late 1980s on Crooked River, one near Orogrande (#13337510) and the other near the river mouth near Elk City (#13337520). Station #13337200, at Red Horse Creek near Elk City, collected a few discharge measurements in the late 1970s, as did stations on Leggett Creek near Golden (#13337540), Peasley Creek near Golden (#13337700), and Sally Ann Creek near Stites (#13338200). These data are of limited value due to their small amount.

USGS Station Information

Station #13338500 SF CWR at Stites
Drainage area = 1,150 square miles

- Elevation = 1,311 feet
- Latitude and Longitude = 46°05'12" 115°58'32"
- Location = NE1/4 SE1/4 NE1/4 sec.29 T32N R4E, Idaho County, on left bank 0.4 mile upstream from county road bridge, 0.4 mile downstream from Cottonwood Creek, at river mile 4.0.
- Extremes of Record = Maximum discharge 12,100 cfs, gage height 8.82 feet, on February 7, 1996; minimum discharge 48 cfs, gage height 2.39 feet, on November 30, 1987.
- Period of Record = October 1910 – April 1912, October 1964 - present.
- Extremes Outside of Record = 17,500 cfs, gage height 10.3 feet, on June 8, 1964.

Station #13337500 SF CWR near Elk City

- Drainage area = 261 square miles
- Elevation = 3,816 feet
- Latitude and Longitude = 45°49'29" 115°31'36"
- Period of Record = 1945 - 1974

Station #13338000 SF CWR near Grangeville

- Drainage area = 865 square miles
- Elevation (Datum) = 1,830 feet
- Latitude and Longitude = 45°54'49" 116°00'17"
- Period of Record = 1911 – 1963, 2000 -- present

Station #13342450 Lapwai Creek near Lapwai

- Drainage Area = 235 square miles
- Elevation = 865 feet
- Latitude and Longitude = 46°25’36”’116 °48’15”
- Period of Record = 1974 – present

The SF CWR has a snowmelt runoff dominated flow pattern. Highest mean monthly flows occur in spring (April-June) and lowest flows occur in the fall and winter. It is likely that April high flows are predominantly prairie and other lower elevation snowmelt runoff events, whereas June high flows are predominantly high country snowmelt runoff. An average spring runoff peak at Stites is about 5,000 to 7,000 cfs. The annual runoff from the subbasin as measured at Stites averages about 12 inches. The largest flood had an estimated peak of 17,500 cfs. Floods occasionally result from snowmelt or rain-on-snow events between November and March.

The major tributary streams in the upper forested region (American, Red, and Crooked Rivers, and Newsome Creek) have runoff regimes very similar to the SF CWR (USFS 1999). These streams typically do not have a flashy response to storms. Their moderately rolling topography, relatively deep soils, forest vegetation, and cooler climate ameliorate rapid runoff. Further down the drainage below Newsome Creek to the NPNF boundary the tributary runoff regimes become more complex. High elevations in Johns and Tenmile Creeks create later runoff peaks and cooler water inputs into the SF CWR later in the summer (USFS 1999). Smaller tributaries in the canyon breaklands can be more flashy in response to rain-on-snow events and thunderstorms that create localized flooding and debris torrents. Tributaries on the prairie have very different runoff patterns than those in the forested region. Peak flows can occur in mid-winter in addition to spring peaks due to rain-on-snow and/or rapid snowmelt (USFS 1999). Low flows are reached earlier in the season and last longer through the year than up-river tributaries.

Because the TMDLs developed in this document are heavily dependent on understanding the flows in Threemile and Butcher Creeks, as well as Cottonwood Creek, we have estimated flow patterns in these drainages based on flow data from Lapwai Creek. Lapwai Creek drains the Camas prairie, at the same elevations as Threemile and Butcher Creeks, and has many of the same vegetative, geologic, landform, and land use characteristics. We constructed stochastic flow regimes for Threemile and Butcher Creeks based on the flow patterns from Lapwai Creek following roughly the same procedure used in the Cottonwood Creek TMDL (DEQ, NPT, USEPA 2000).

Table 16. USGS and Storet Stations in the SF CWR Subbasin.

Station #	Location	Parameters	Source[a]	Time Period
13337500	SF CWR near Elk City	Discharge, monthly and annual means	Earthinfo	1911-1963 2000-present
13337510	Crooked River near Orogrande	Discharge, water temperature	USGS, Boise	1986-1989
13337520	Crooked River near mouth	Discharge, water temperature	USGS, Boise	1984-1988
13338000	SF CWR near Grangeville	Discharge, monthly and annual means	Earthinfo	1914-1963
13338500	SF CWR at Stites	Discharge, monthly and annual means, peaks	USGS, Web site	1965-present
13338500	SF CWR at Stites	WQ parameters, summary statistics	Storet CD	1972-1992
13337200	Red Horse Creek near Elk City	Instant discharge, temperature, specific conditions	Earthinfo	5 days in 1970s
13337540	Leggett Creek near Golden	Instant discharge, temperature, specific conditions	Earthinfo	11 days in 1973-1981
13337700	Peasley Creek near Golden	Instant discharge, temperature, specific conditions	Earthinfo	11 days in 1973-1981
13338200	Sally Ann Creek near Stites	Instant discharge, temperature, specific conditions	Earthinfo	5 days in 1970s
209 Storet Stations	Throughout the subbasin	WQ parameters, summary statistics, most very limited	Storet CD	Limited, ending in 1998

[a]These sources are where data were found. They are not necessarily the only location or the most complete set of data for these stations. Earthinfo = http://www.earthinfo.com/ , USGS = U.S. Geological Survey, USGS Web site = http://waterdata.usgs.gov/nwis/sw/ , Storet = USEPA computerized data base (USEPA undated).

Table 20 shows that maximum flows in Lapwai Creek generally occur in April, while in the SF CWR Subbasin in general the maximum flows occur in May. The flows and sediment delivery calculations from Cottonwood Creek figure prominently in understanding flows and sediment in the SF CWR Subbasin. The mean daily flows for the 10 years (1992 through 2001) for Stites and Lapwai Creek (USGS data) and Threemile, Butcher, and Harpster Creeks (derived data) were used for the sediment TMDL calculations. The plots of those flows are presented in Chapter 5 as part of the sediment loading calculations.

Table 17. Flow data (cubic feet per second) for the SF CWR near Grangeville (#13338000), 1910-1963.

Month	Ave. Mean Monthly (cfs)	Max. Mean Monthly (cfs) (year)	Min. Mean Monthly (cfs) (year)
October	263	1,032 (1960)	104 (1937)
November	320	1,319 (1928)	101 (1937)
December	322	1,161 (1928)	117 (1936)
January	283	1,260 (1928)	94 (1937)
February	312	661 (1928)	119 (1937)
March	566	1,443 (1934)	197 (1955)
April	1945	3,390 (1943)	714 (1955)
May	3225	6,489 (1948)	932 (1934)
June	2197	4,821 (1948)	510 (1934)
July	654	1,716 (1955)	175 (1934)
August	218	413 (1948)	88 (1931)
September	191	386 (1959)	93 (1935)
Annual Mean	875	1,474 (1948)	494 (1937)

From a sediment loading and sediment loading exceedance point of view, the mean monthly flow rates are not the correct indicators of the major periods of sediment movement. As discussed in detail in Chapter 5, it is the few days of extreme high flows that occur at a five-year interval or less when the majority of sediment is moved in the SF CWR Subbasin. Table 21 shows the statistical frequency of these extreme high flows based on the complete records and USGS calculations (NWPP Council 2001), while Table 22 shows the dates and magnitudes of extreme events at the Stites and Harpster USGS stations.

Table 18. Flow data (cubic feet per second) for the SF CWR near Elk City (#13337500), 1944-1974.

Month	Ave. Mean Monthly (cfs)	Max. Mean Monthly (cfs) (year)	Min. Mean Monthly (cfs) (year)
October	70	263 (1960)	25 (1953)
November	90	247 (1969)	29 (1953)
December	97	285 (1959)	31 (1953)
January	99	428 (1969)	37 (1955)
February	109	373 (1968)	31 (1966)
March	176	479 (1972)	49 (1955)
April	662	1,216 (1969)	226 (1955)
May	1137	2,001 (1948)	413 (1973)
June	585	1,622 (1964)	207 (1973)
July	146	364 (1955)	74 (1966)
August	57	106 (1964)	27 (1961)
September	53	117 (1968)	25 (1953)
Annual Mean	274	401 (1965)	133 (1973)

The only high flow event at Lapwai that corresponds directly with the record at Stites is 1996, when the high flow at Lapwai was 5,010, the highest flow on record for the site. Other high flows at Lapwai were 2,200 cfs in December 1976; 2,050 cfs in February 1982; 3,380 cfs in February 1986; and 3,190 cfs in January 1997.

Not evident in the flow data presented above, but discussed in Chapter 5, is the timing and magnitude of extreme flows from Cottonwood, Butcher, and Threemile Creeks on sediment loading to the lower main stem of the SF CWR. The discordance between the flow regimes of Cottonwood, Butcher, and Threemile Creeks in relation to the rest of the subbasin leads to a special set of problems for sediment delivered into the main stem from these three tributaries.

Other flow data used in the TMDL calculations are those flow data collected at the time and location of the total suspended solids (TSS), bedload, biological, and chemical sampling. Those instantaneous flow data are presented in Appendix M with their associated water quality monitoring data.

Table 19. Flow data (cubic feet per second) for the SF CWR at Stites (#13338500), 1910-1912, 1964-1998.

Month	Ave. Mean Monthly (cfs)	Max. Mean Monthly (cfs) (year)	Min. Mean Monthly (cfs) (year)
October	282	677 (1976)	108 (1988)
November	358	893 (1969)	139 (1988)
December	460	2,365 (1976)	167 (1988)
January	540	1,665 (1969)	144 (1988)
February	655	2,211 (1996)	227 (1994)
March	996	2,387 (1978)	312 (1977)
April	2089	3,549 (1978)	807 (1973)
May	3312	5,528 (1976)	947 (1992)
June	2507	5,706 (1975)	463 (1992)
July	831	2,063 (1975)	314 (1973)
August	292	528 (1975)	137 (1973)
September	247	473 (1968)	115 (1987)
Annual Mean	1046	1,711 (1976)	451 (1992)

Table 20. Mean monthly flows (cubic feet per second) for the SF CWR at Elk City and Stites, and for Lapwai Creek at Lapwai.

Month	Elk City (cfs)	Stites (cfs)	Lapwai (cfs)
January	99	556	72
February	109	663	124
March	176	994	208
April	662	2070	223
May	1,140	3,420	136
June	585	2,660	54
July	146	821	17
August	57	289	8.2
September	53	262	12
October	70	292	17
November	90	354	24
December	97	463	61

Table 21. Magnitude and frequency of instantaneous peak flow at gaging stations in SF CWR Subbasin.

Station	Period of Record	Daily discharge (cubic feet per second) recurrence interval (years) and exceedance probability (%) based on indicated period of record							
		2 yr 50%	5 yr 20%	10 yr 10%	25 yr 4%	50 yr 2%	100 yr 1%	200 yr 0.5%	500 yr 0.2%
SF CWR Near Elk City	1945-74	1,940	2,610	3,050	3,610	4,030	4,440	4,870	5,430
SF CWR Near Grange-ville	1911-20 1923-63	5,040	6,800	7,990	9,540	10,700	11,900	13,200	14,900
SF CWR Near Stites	1964-99	6,470	9,480	11,600	14,400	16,500	18,800	21,100	24,300
Lapwai Cr. at Spalding	1975-97	798	1,880	2,960	4,800	6,590	8,770	11,400	15,700

Table 22. SF CWR instantaneous peak discharges (cubic feet per second) during major flood events.

Location	1933	1934	1938	1948	1957	1964	1974	1996
SF CWR near Grangeville	6,090	2,380	6,740	12,600	8,910	NA	NA	NA
SF CWR near Stites	NA	NA	NA	NA	NA	17,500	6.750	8,010

Subbasin-wide Water Column Data

Subbasin-wide water quality data is presented and discussed below.

Temperature

The temperature of stream water usually varies on seasonal and daily time scales, and differs by location according to climate, elevation, extent of streamside vegetation, and the relative importance of ground water inputs. Other factors affecting stream temperatures include solar radiation, cloud cover, evaporation, humidity, air temperature, wind, inflow of tributaries, and width to depth ratio. Diurnal temperature fluctuations are common in small streams, especially if unshaded, due to day versus night changes in air temperature and absorption of solar radiation during the day.

Aquatic species are restricted in distribution to a certain temperature range, and many respond more to the magnitude of temperature variation and amount of time spent at a particular temperature rather than an average value (MacDonald et al. 1991). Although species have adapted to cooler and warmer extremes of most natural waters, few taxa are able to tolerate very high temperatures. Reduced oxygen solubility at high water temperatures can compound the stress on fish caused by marginal dissolved oxygen concentrations.
Hourly stream temperatures were measured at various locations throughout the watershed during the summers of 1999 through 2001. Summary statistics for these data are presented in Appendix J. Water temperature criteria were exceeded in all streams monitored in at least one of the three years when monitoring was conducted. Figure 11 illustrates the most recent maximum weekly maximum temperature (MWMT) statistics for each site. Since the year that these data were collected may vary from site to site, this information should not be used to draw reach-by-reach comparisons; however, it is useful to illustrate the general pattern of stream temperature across the subbasin.

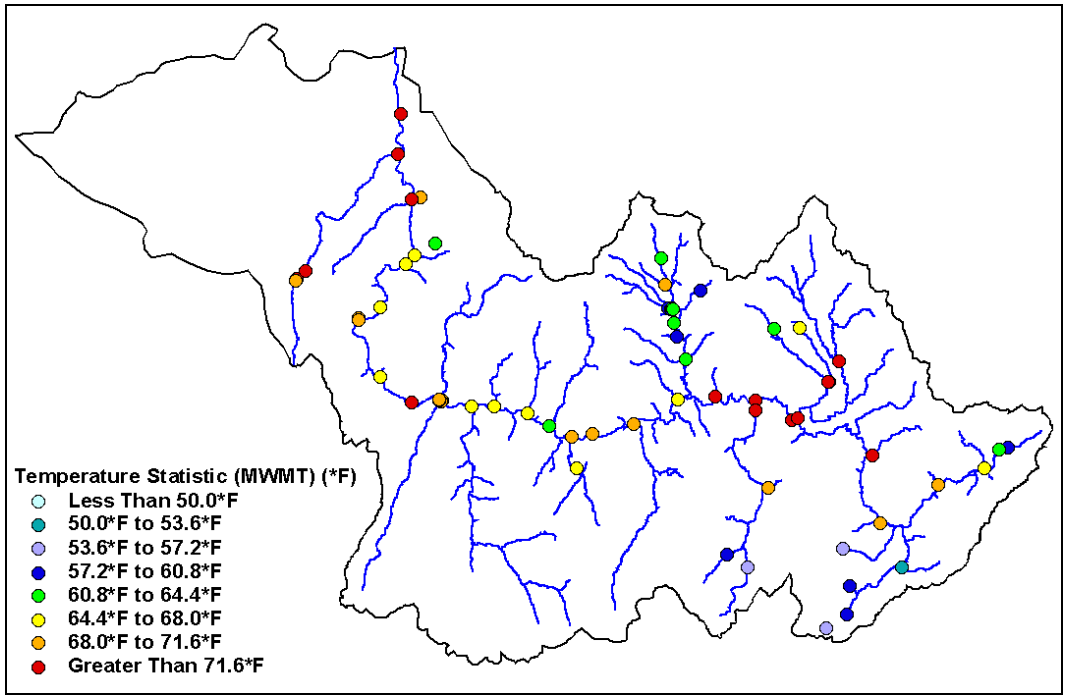

Figure 11. Recent Annual Maximum Weekly Maximum Temperature (MWMT) (^{o}F) Temperature Statistic Values Observed in the SF CWR Subbasin

Main Stem Temperature Condition

Stream temperatures within the main stem SF CWR generally follow two distinct longitudinal (downstream) heating patterns: 1) water temperatures remain relatively stable in the upper reaches (river mile [RM] 65 through 23.1); and 2) water temperatures increase dramatically in bottom reaches (Figure 12). Tributary temperatures presented on this figure are generally less than main stem temperatures. Tributary temperatures presented in this figure are values observed at the mouth.

It is important to point out that water temperatures are already elevated at the headwaters (beginning) of the SF CWR, which originates from the combined flows of the American River and the Red River. Stream temperatures appear to decrease slightly as the river travels immediately downstream from the confluence. This indicates that factors influencing stream temperature conditions are dramatically different between the headwater reach of the Clearwater River (RM 65 through 23.1), and the American River and Red River systems.

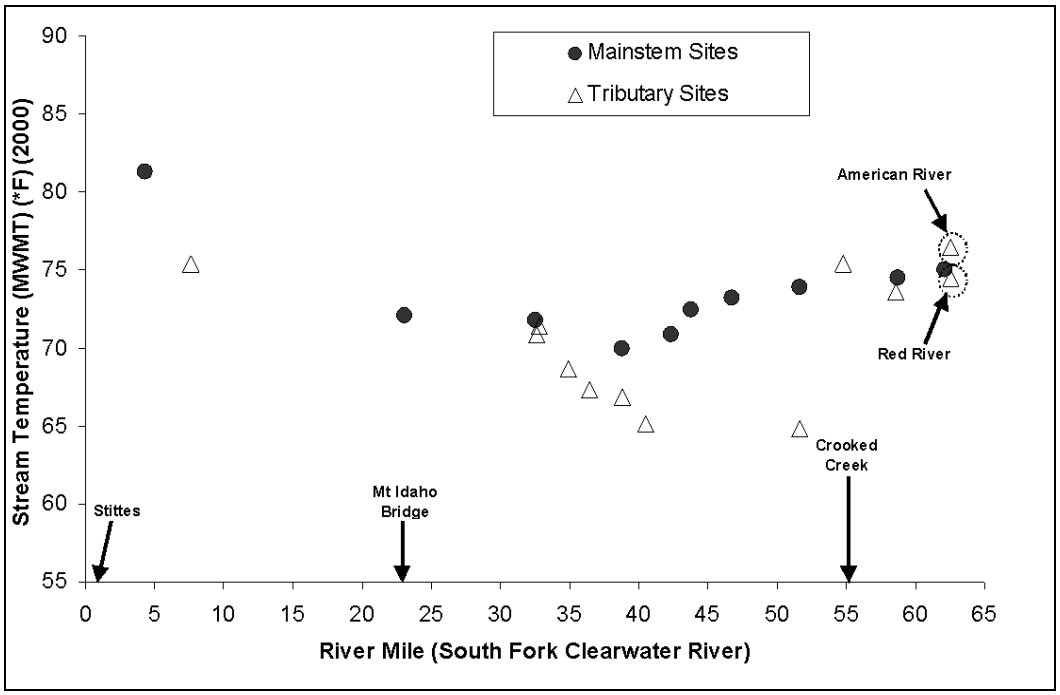

Figure 12. Maximum Weekly Maximum Temperatures Measured along the SF CWR Main Stem in 2000

Thermal Infrared Imaging

Thermal infrared imaging (TIR) was conducted on the SF CWR in order to measure river temperatures at a high spatial resolution. The TIR data were collected by specialized detectors attached to a helicopter during two flights on August 3, 2000. A detailed description of the methods used to collect and process this data is presented in the report, *Final Report - Paired Color Infrared and Thermal Infrared Imaging and Analysis for Selected Idaho Streams, Prepared for Idaho Department of Environmental Quality* (IRZ Consulting 2001).

Processed river temperature data for both the morning (approximately 8 a.m.) and the afternoon (approximately 6 p.m.) flights are presented in Figure 13. In addition, temperature data collected during the TIR flight period from ground-based monitoring are also presented in this image. As can be seen, TIR data collected during the morning corresponds closely with measured ground level data. However, afternoon TIR data appear to be elevated above measured values. It was reported in the TIR final report (IRZ Consulting 2001) that there

was a discrepancy between instream calibration temperature data and stream temperatures calculated from the TIR data. Regardless, afternoon TIR data presented in Figure 13 can still be used to illustrate relative temperature trends along the main stem of the SF CWR. These trends correspond closely with heating trends observed in ground level data (Figure 12).

As can be seen in this image, stream temperatures increase dramatically downstream of the Mt. Idaho Bridge. In addition, the diurnal variability (i.e., the difference between morning and afternoon temperature) increased dramatically in these downstream areas. These results indicate that factors that influence stream temperature conditions, such as vegetative and topographic shade, width-to-depth ratio, and aspect, are dramatically different between these two sections of the SF CWR.

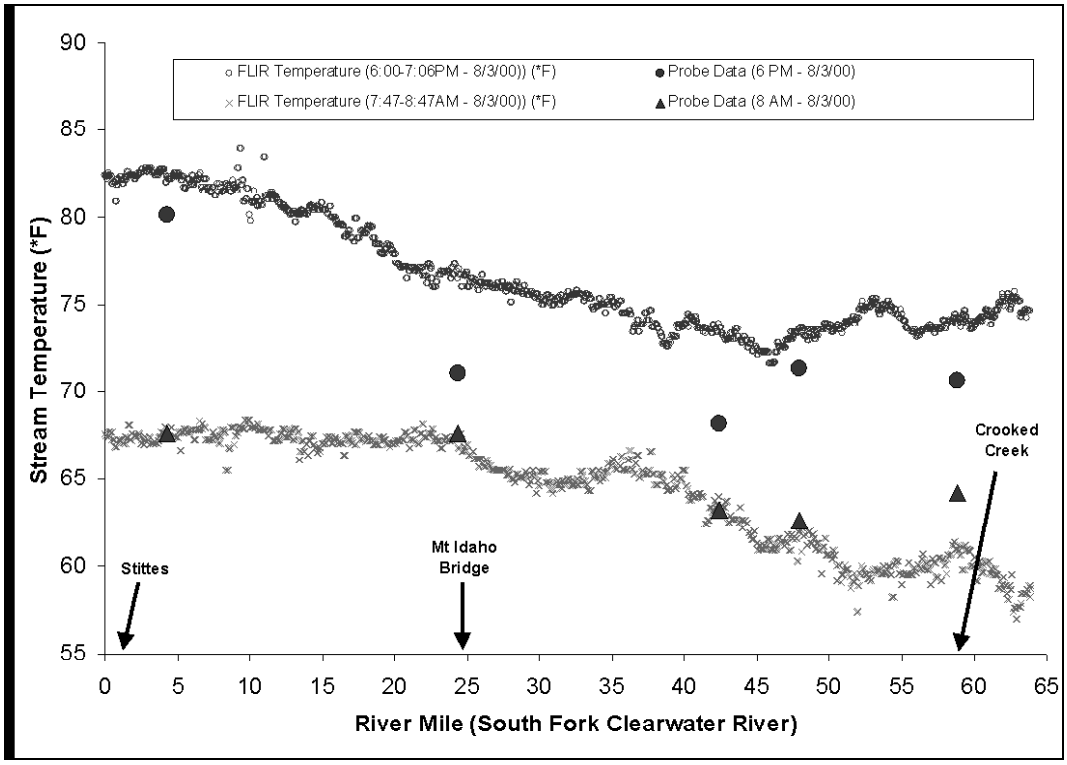

Figure 13. SF CWR Temperatures Derived from Instream Monitors and Remote Sensed Thermal Infrared Imaging (TIR a.k.a. FLIR) for August 3, 2000

Main Stem Diurnal Temperature Pattern

Measured stream temperatures within the main stem SF CWR on August 3, 2000, are presented in Figure 14. This is the same period of forward-looking infrared (FLIR)/TIR data collection (Figure 13). The diurnal profile presented in Figure 13 shows that temperatures remain relatively constant throughout the course of the entire day in the upper portions of the river. This indicates that very little stream heating (i.e., net energy input) is occurring within this section of the river. Water temperatures measured at the Mt. Idaho Bridge (RM 24.4) indicate that daily minimum water temperatures are elevated from values measured in

upstream sites. This can indicate a gradient change between this site and upper sites, which would affect the amount of heat energy dissipation from the river into the surrounding environment during the non-daylight periods. It is important to point out that daily maximum temperatures are similar to upstream locations, indicating that stream heating processes between these locations are similar.

Daily maximum water temperatures increase dramatically on the SF CWR at the Stites monitoring location (RM 4.3). However, it is important to note that nighttime temperatures are identical to the upstream location at the Mt. Idaho Bridge (RM 24.4), indicating that these two sites are exposed to similar stream heating conditions during non-daylight periods. Daytime temperatures measured at the Stites location illustrate a dramatic heating profile, indicating large energy loads.

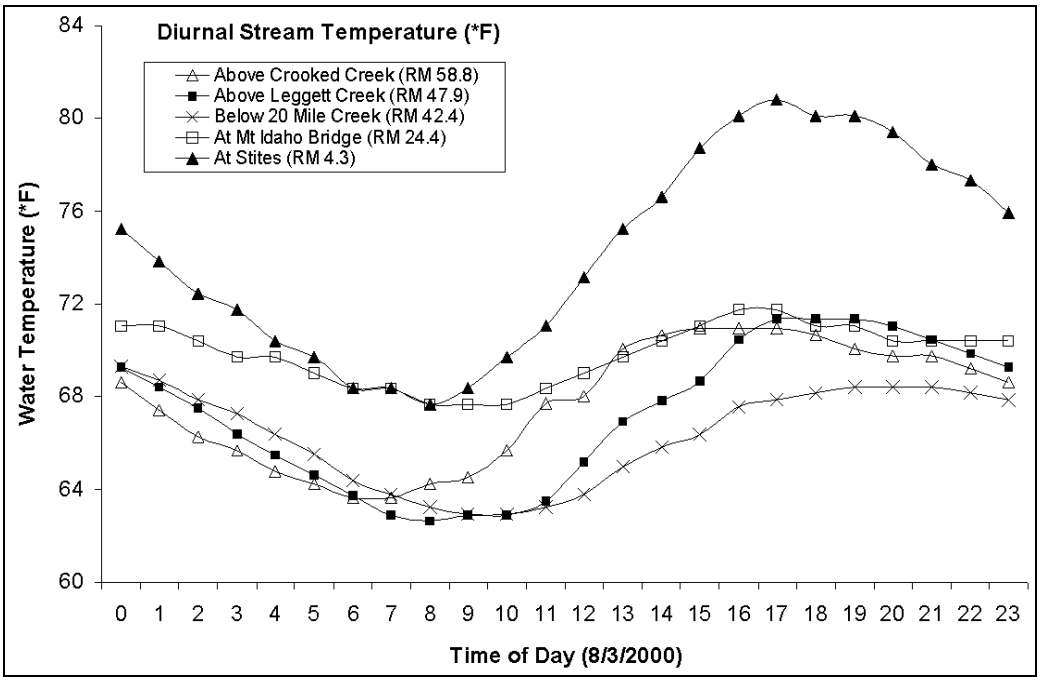

Figure 14. Observed Diurnal Temperatures in the Main Stem SF CWR on August 3, 2000

Red River Temperature Condition

As mentioned above, the SF CWR originates from the confluence of the American and Red River systems. Accordingly, upstream temperatures of the SF CWR are directly dependent on the temperature conditions within these two rivers. Measured stream temperatures observed within Red River are illustrated in Figure 15. This profile indicates a large increase in stream temperature within the upper reaches of this system (approximately RM 18 – 26), which are maintained until the mouth (i.e., confluence with the American River) and ultimately many miles downstream in the SF CWR (Figure 12). Figure 16 presents diurnal temperatures measured within Red River on August 3, 2000. The shape of the diurnal temperature profile remains relatively constant at all locations. However the diurnal range

(i.e., minimum and maximum temperatures) increases as the river travels downstream, indicating greater heating conditions within these downstream reaches. Once again, elevated stream temperatures within this tributary are maintained throughout the entire length of the SF CWR.

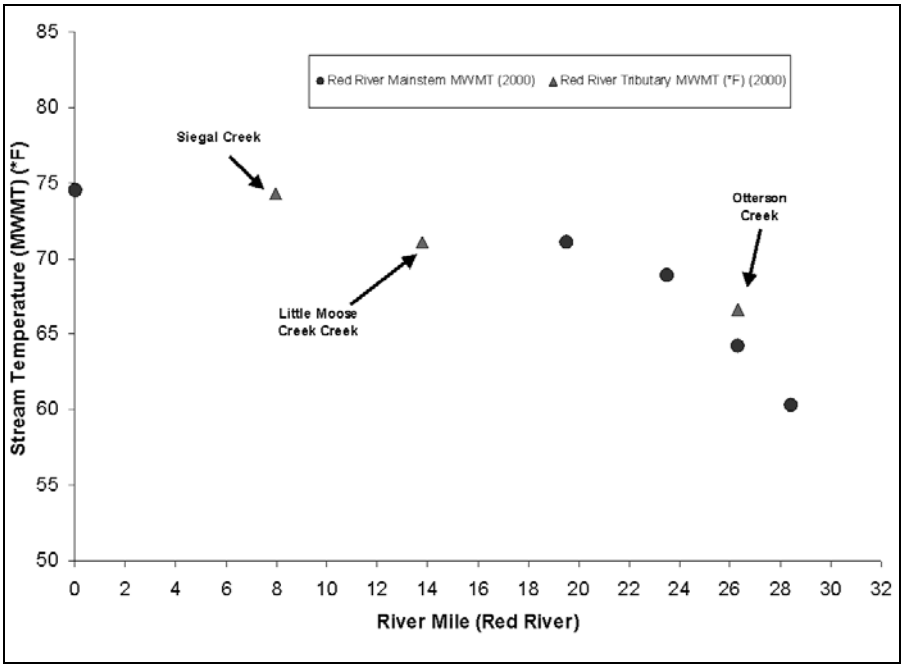

Figure 15. Maximum Weekly Mean Temperatures Measured along Red River in 2000

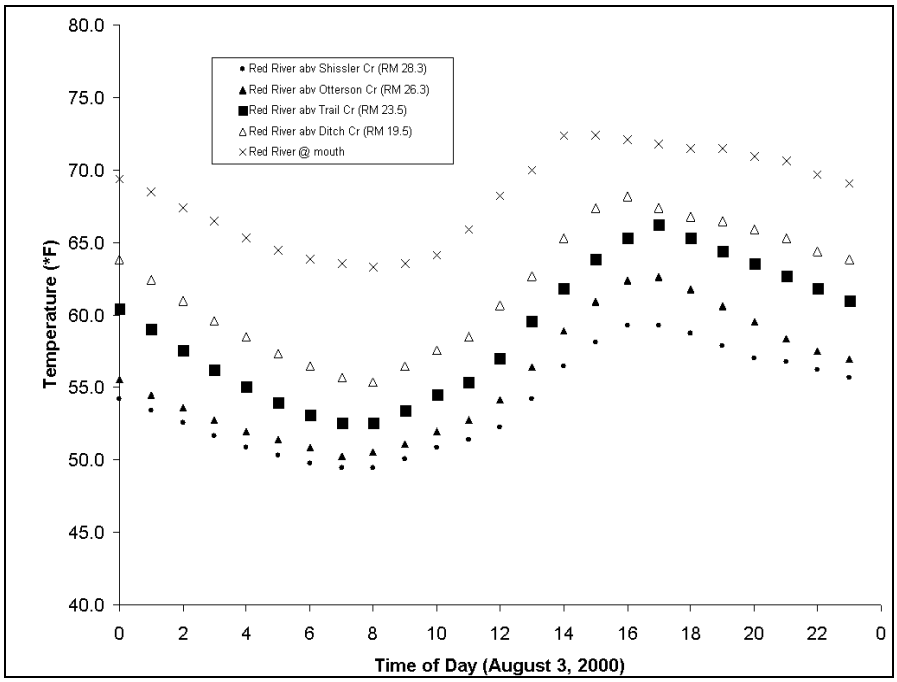

Figure 16. Observed Diurnal Temperatures in Red River on August 3, 2000

American River Temperature Condition

The American River is one of the two river systems that combine to form the main stem SF CWR. Accordingly, upstream temperatures of the SF CWR are directly dependent on the temperature conditions within the American River. Ultimately, American River water that enters the SF CWR is comprised of several tributary streams within the American River system (Figure 17). Temperatures illustrated on this figure show that water temperatures increase dramatically within lower meadow reaches of the river system. These elevated temperatures are maintained throughout the entire length of the SF CWR. Figures 18 and 19 illustrate that the diurnal temperature range increases dramatically within these lower reaches of this river system.

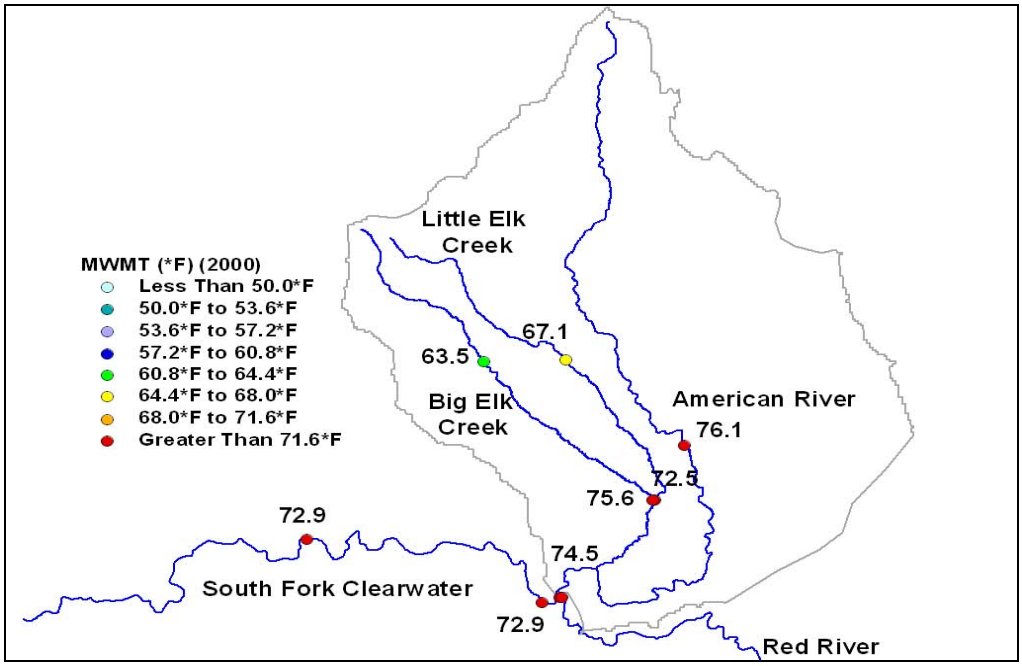

Figure 17. Measured Maximum Weekly Mean Temperature (°F) in the American River System in 2000

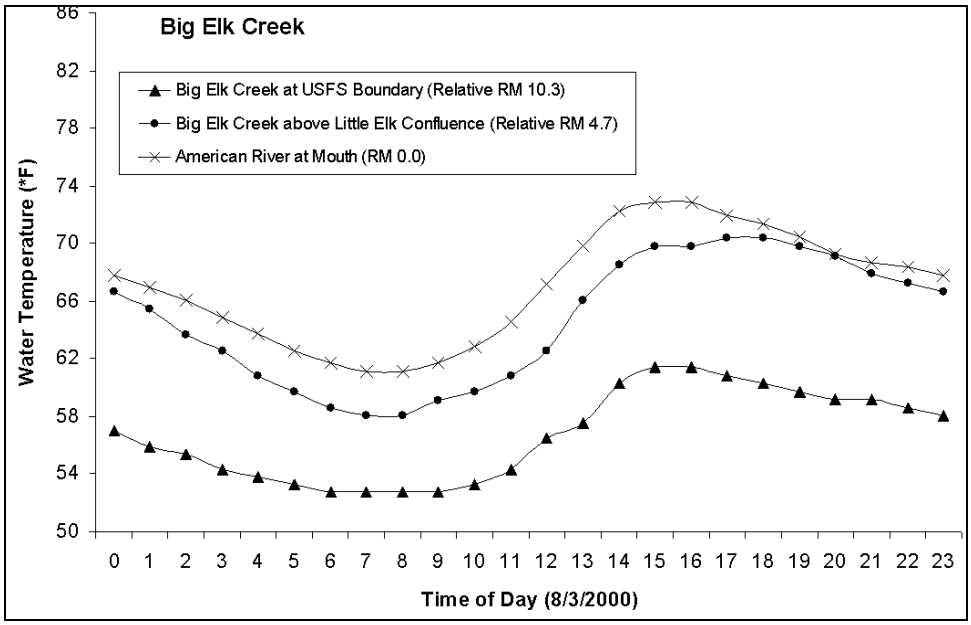

Figure 18. Diurnal Temperatures Measured in Big Elk Creek and the American River (mouth) on August 3, 2000

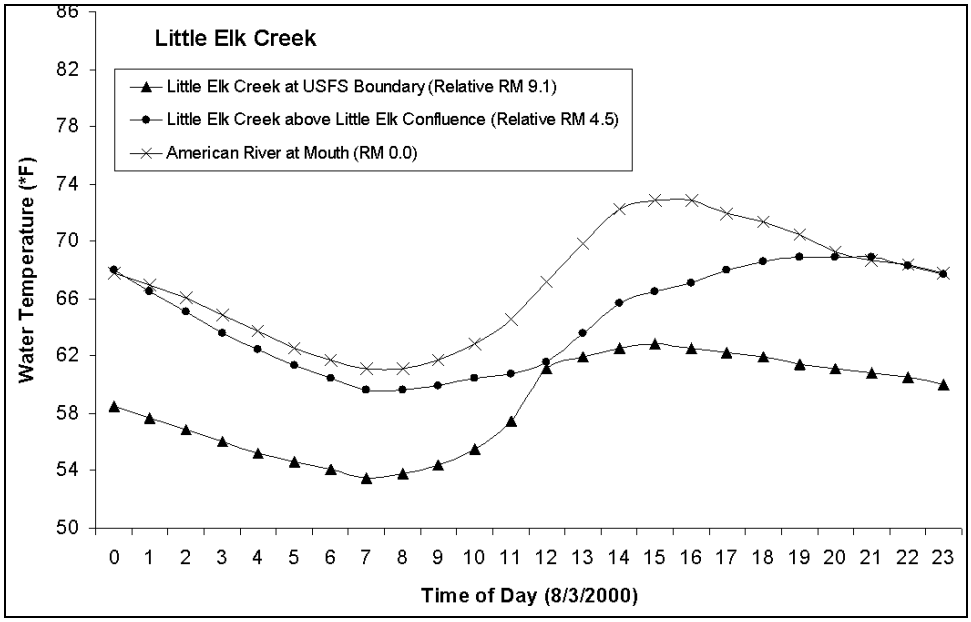

Figure 19. Diurnal Temperatures Measured in Little Elk Creek and the American River (mouth) on August 3, 2000

Threemile Creek Temperature Condition

Threemile Creek is an important tributary in the lower reaches of the SF CWR Subbasin. Figure 20 illustrates calculated MWMT temperature statistics for three sites on this stream system in 2000. As can be seen in this image, water temperatures are elevated throughout the system. It is impossible to determine water temperature conditions within headwater reaches of this creek because no data are available for this section of the stream. It could be assumed that stream temperatures in the forested headwater reach are lower than values measured near the city of Grangeville. This relationship was observed in other parts of the subbasin with "headwaters" data (Figure 11).

The diurnal temperature pattern within this stream shows that the Grangeville WWTP effluent discharging to the stream increased daily maximum temperatures on August 3, 2000, but more significantly, daily minimum temperatures were dramatically elevated at this downstream location on this date (Figure 21). The only conclusion that can be made from these three data sets is that river temperature was already elevated upstream from the WWTP effluent site (RM 12.9).

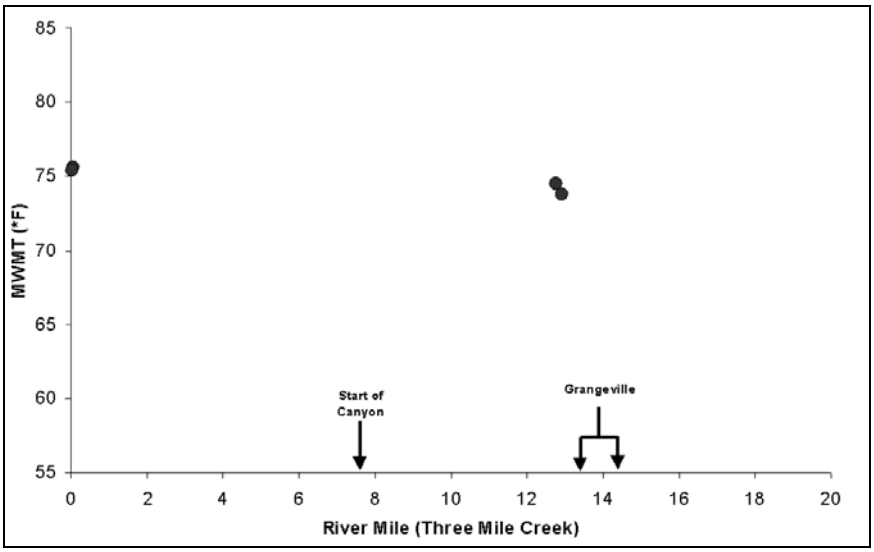

Figure 20. Maximum Weekly Mean Temperatures Measured in Threemile Creek in 2000

Seasonal Variation

Stream reaches within the SF CWR Subbasin experience prolonged warming starting in late spring and extending into the fall. Maximum temperatures typically occur in July and August (Figures 22, 23, and 24). The longitudinal downstream heating pattern described above is maintained throughout the summer period, as can be seen in these figures.

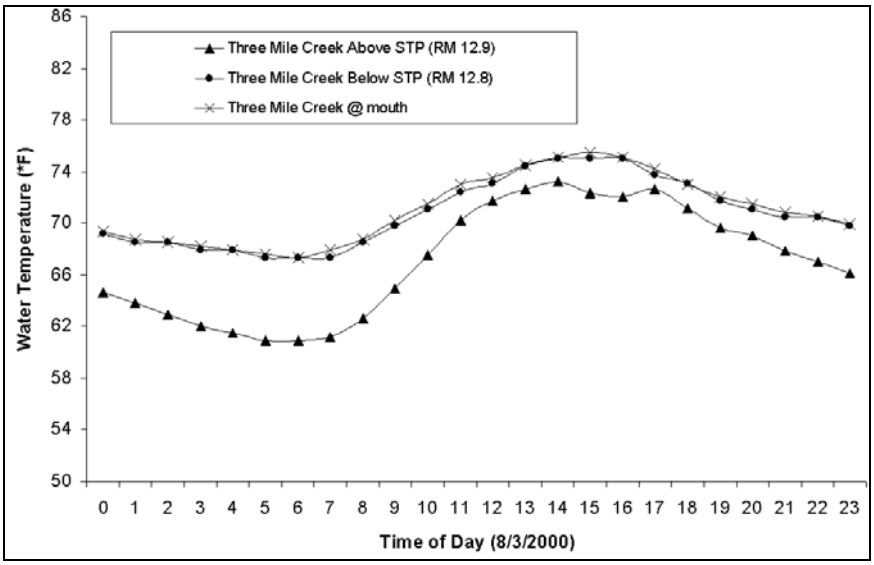

Figure 21. Diurnal Temperature Measured in Threemile Creek on August 3, 2000

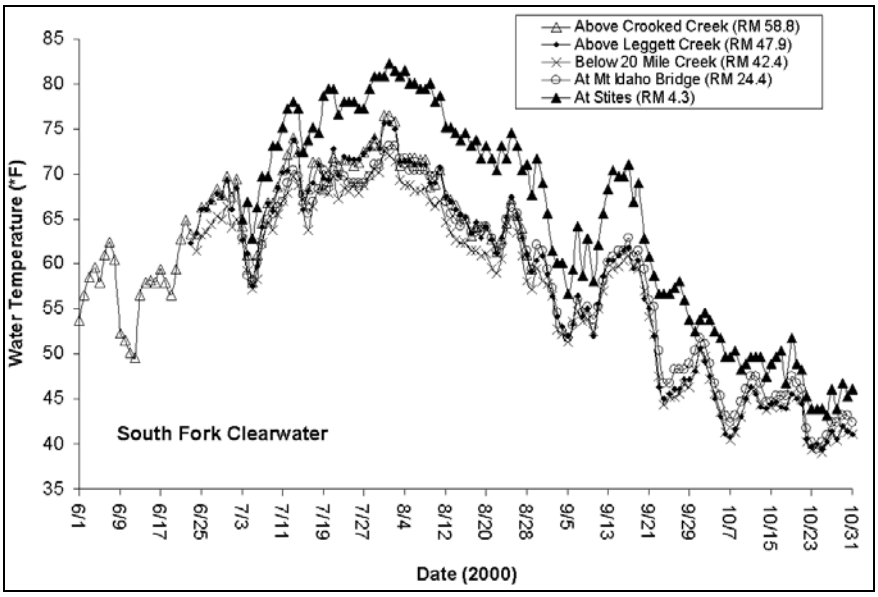

Figure 22. Seasonal Variations in Daily Maximum Temperatures in the SF CWR (Summer 2000)

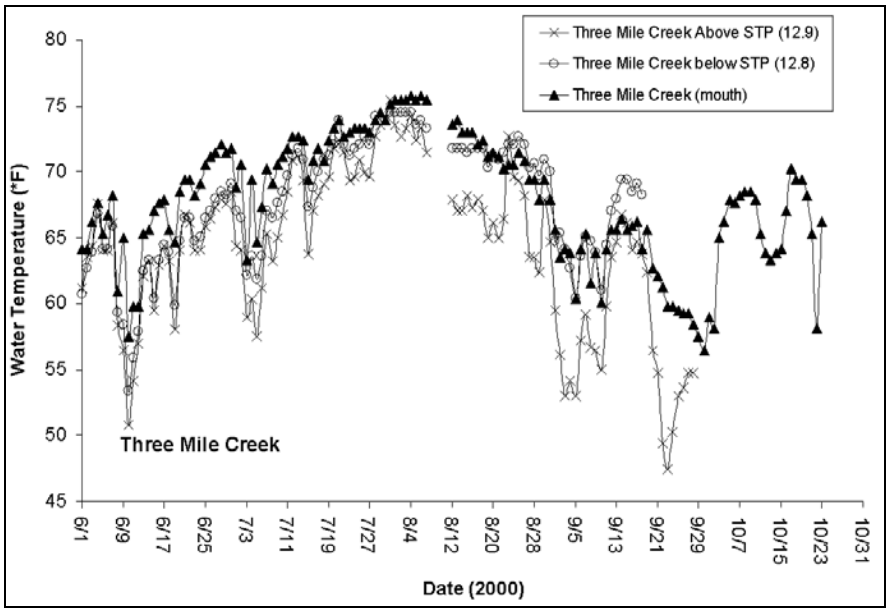

Figure 23. Seasonal Variations in Daily Maximum Temperatures in Threemile Creek (Summer 2000)

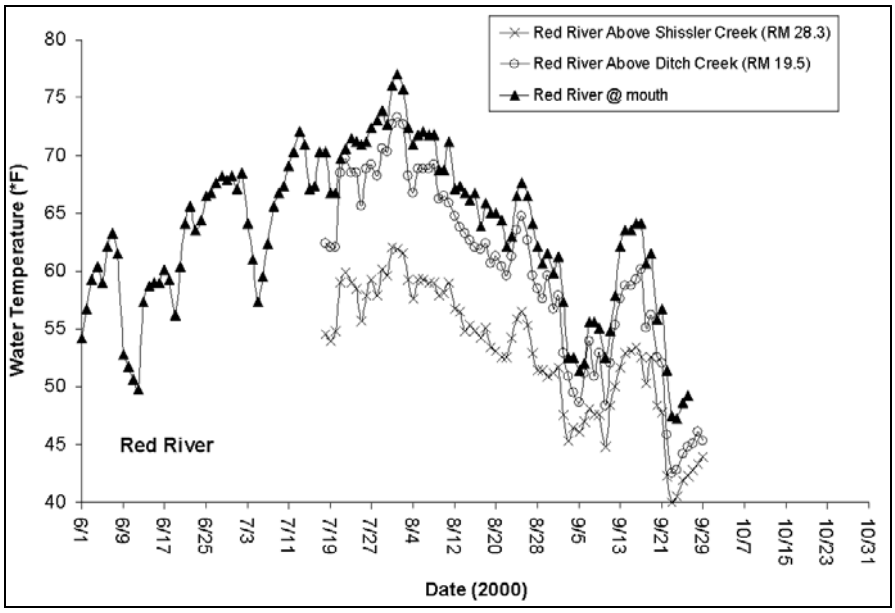

Figure 24. Seasonal Variations in Daily Maximum Temperatures in the Red River (Summer 2000)

Sediment

Sediment suspended in the water column can adversely affect aquatic life. Many fish species are adapted to the high suspended sediment levels of short duration that commonly occur during natural spring runoff events. However, longer durations of exposure can interfere with feeding behavior, damage gills, reduce available food, reduce growth rates, smother eggs and fry in the substrate, damage habitat, and induce mortality. Eggs, fry, and juveniles

are particularly sensitive to suspended sediment, although at high enough concentrations adult fish are affected as well.

Turbidity is a measure of the extent to which light passing through water is scattered due to suspended material. The Idaho turbidity standard states that turbidity shall not exceed background by more than 50 NTU instantaneously or 25 NTU for more than 10 consecutive days.

Total suspended solids concentrations include the amount of solids suspended in the water, whether mineral (such as soil particles) or organic (such as algae). The TSS test measures the actual weight of material per volume of water. A comprehensive review of TSS criteria conducted by DEQ and USEPA (Rowe et al. 1998) suggests that 25 mg/L is a highly protective threshold for salmonids. This threshold can be variable but likely ranges from about 25 mg/L to 80 mg/L, depending on duration.

Bedload is material generally of sand size or larger that is carried by the stream on or immediately above its bed. Excessive bedload causes the loss of spawning and rearing habitat (i.e., cobble embeddedness, filling of pools, bed aggradation) and can lead to changes in channel width that then lead to increased temperature and reduction in aquatic habitat. The percentage of small gravel and finer particles less than 6.35 mm is often used as an indicator of habitat quality for salmonid fishes. Deposition of fine sediments in spawning substrate has been shown to be a major cause of embryo and larval mortality. Survival is high only if the eggs receive an adequate supply of DO, an adequate flow of water through the gravel to supply this oxygen, and necessary flows to remove metabolic wastes (Beschta and Platts 1986). Percent emergence of swim-up fry has also been shown to be reduced by fine sediment by a number of researchers. When particle sizes less than 6.35 mm reach 20-25% of the total substrate, embryo survival and emergence of swim-up fry is reduced by 50% (Bjornn and Reiser 1991).

When the fine textured bedload sediment is in excess of transport capacity, coarser particles on the stream substrate tend to become surrounded or partially buried (embedded) by sand and silt. Embeddedness quantitatively measures the extent to which the larger particles are embedded or buried by fine sediment. Areas with high embeddedness have very little space for invertebrates or juvenile fish to hide or seek protection from the current. Research has noted lower aquatic insect and salmonid fish densities in areas with high levels of cobble embeddedness. Levels above 30% are considered to indicate poor habitat conditions in the Clearwater River Basin (NMFS et al. 1998).

It is generally believed that many of the streams 303(d) listed as impaired by sediment may be impaired by both suspended sediment and bedload sediment, as they both affect salmonid spawning. However, at the beginning of our analyses, we found that water column data related to the hypothesized sediment pollution were few and disparate, and would have been very difficult to use for a systematic analysis. Therefore, the NPT, DEQ, and USEPA launched a monitoring effort to collect data on both TSS and bedload for the main stem of the SF CWR, Threemile Creek, and Butcher Creek. A reasonable data set had been collected and was available for Cottonwood Creek as a result of the TMDL there (DEQ, NPT, USEPA

2000). The additional monitoring effort for this TMDL resulted in bedload and TSS data for the SF CWR main stem at Stites and at a private bridge above Harpster, and TSS data for Butcher and Threemile Creeks. These data, along with the derived rating curves, are presented in Appendix M. Reasonable sediment rating curves were developed for both bedload and TSS for the Harpster and Stites locations, and for TSS at the Butcher and Threemile locations. The total bedload for Threemile and Butcher Creeks was derived from instream erosion data and is discussed in Chapter 3 as a pollution source.

Chapter 5 presents the sediment loading calculations, wherein the sediment rating curves are coupled with the daily flow records to identify whether turbidity exceeds the state WQS. Appendix M shows the development of the relationship at each site between turbidity and TSS. This sets the stage for relating the WQS of 25 NTU above background over 10 days to loading calculations of TSS. The excess TSS loads plotted in Figure 25 are the sediment loads above the load capacities based on the 25 NTU standard. Generally, the exceedances occur in the January through May time period during the times when extreme high flows occur. Figure 25 also includes blow-ups of two years' data to show that the exceedances do occur in relatively narrow time frames in the January through May critical time period. These are episodic events so they cannot be predicted any more closely.

The data indicate that TSS exceedances do not occur at Harpster. Based on these limited data, it appears that TSS is not a pollutant of concern above Harpster. The TSS-based loading allocations are indicated for Threemile and Butcher Creeks, and the lower main stem water body of the SF CWR

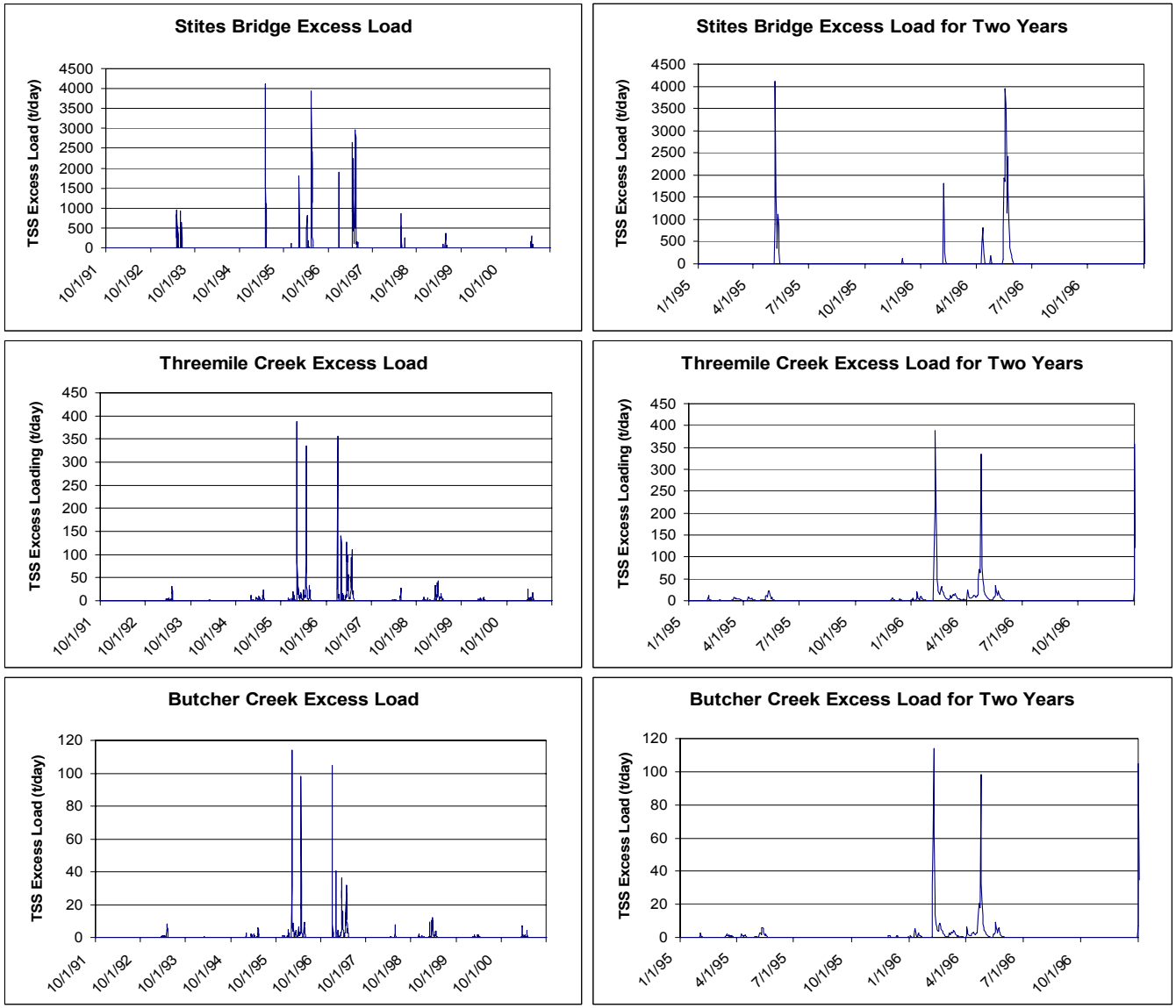

Figure 25. Total Suspended Solids Excess Loads for Stites, Threemile Creek, and Butcher Creek

Conclusions from the Water Column Data for the SF CWR Subbasin

The temperature data presented in Appendix J clearly show that all of the water bodies in the SF CWR Subbasin monitored for temperature exceed the state WQS. It is likely that most if not all, of the water bodies in the subbasin exceed the temperature standards. A temperature loading analysis is warranted for the whole subbasin. The loading analysis will include point sources for temperature problems. It will also include consideration that some level of temperature standards exceedance is probably a natural condition in the SF CWR Subbasin. The critical time period for the water temperature analysis is during the months of July and August when air temperatures and water temperatures are highest, and when water flows are lowest. Although stream temperature problems occur throughout the subbasin, the Fish TAG identified those water bodies with the most critical temperature problems (Appendix D).

Turbidity, TSS, and flow data for Threemile Creek, Butcher Creek, and the lower main stem SF CWR show exceedances of the WQS during periods of high flows throughout the three water bodies. The periods of high flows occur episodically during January through May. The exceedances occur with both fine and coarse sediment. Indicators of use impairment are cobble embeddedness, bank instability, and a lack of pools in Threemile and Butcher Creeks, and a lack of pools and cobble embeddedness in the main stem SF CWR. Sediment TMDLs need to be developed for Threemile Creek, Butcher Creek, and the lower main stem SF CWR.

For the 303(d) listed water bodies upstream from the mouth of Butcher Creek, water quality limitations in relation to the WQS are much less clearly indicated by the data. Existing TSS data coupled with flow data, presented in Chapter 5, indicate that the main stem and streams upstream from Harpster are meeting the turbidity water quality standards. The general consensus is that any water quality impairment upstream from Harpster is the result primarily of sand-sized material.

Overall, the evidence is mixed whether a sediment loading analysis and TMDL is warranted for the water bodies upstream from Harpster. WBAG assessments of BURP data from the 303(d) listed as well as all other water bodies above Harpster indicate that beneficial uses are being supported. WBAG assessments are not available for the main stem water bodies for lack of an appropriate data set and/or approved assessment tools. The sediment budget developed in Appendix L identifies some of the 303(d) listed tributaries as having above average sediment loading rates for the subbasin. However, the highest sediment loading rates are for the main stem water bodies, and some non-303(d) listed tributaries. Except for the main stem and middle Red River water bodies, all others in the upper basin have sediment loadings less than 50% over natural background. Average cobble embeddedness rates throughout the upper basin and main stem are elevated both in relation to reference watersheds and generally accepted levels of cobble embeddedness for good salmonid spawning. The Fish TAG identified self-supporting populations of salmonids throughout the upper basin, but also identified about half the water bodies in the upper basin as being limited by sediment.

In the final analysis, the three parties considered all lines of evidence, including information and input from the WAG and resource professionals, in relation to the state WQS. The three parties could not agree on the need to write sediment TMDLs for the upper tributaries. The parties did agree, however, that a sediment TMDL is warranted for the upper SF CWR main stem and that land managers should be encouraged to reduce sediment loading throughout most of the managed portions of the subbasin, including tributaries, to improve salmonid habitat in the upper basin and contribute to the load reductions needed for the upper and lower reaches of the main stem. To accomplish these goals, loading analyses should be completed for control locations at the pour points for each of the four main stem water bodies upstream from Butcher Creek. Load reductions of human-caused sediment for each of these control locations should be proportionate to the load reduction calculated for the Stites control location. Sediment load reduction allocations for each of the four locations will be gross load reduction allocations, leaving the where and how of the load reductions to the discretion of the WAG and local land managers.

For the sediment analysis of the upper main stem water bodies, the critical flow period is the same as downstream water bodies: those episodic times of very high flow conditions that occur from January through May. While it is generally believed that the primary impairment to salmonid spawning is sand-sized bedload sediment, loading analyses will be for the whole sediment load with the assumption that reducing the whole sediment load will result in the necessary reduction of bedload.

Summary and Analysis of Existing Water Quality Data for Threemile Creek and Butcher Creek

Threemile Creek and Butcher Creek are 303 (d) listed for a number of pollutants in addition to sediment and temperature, including bacteria, dissolved oxygen, nutrients, and ammonia (Threemile Creek only). These additional pollutants are discussed below for each of these two water bodies.

Threemile Creek

Threemile Creek has been designated by the state of Idaho for salmonid spawning and secondary recreation beneficial uses. The salmonid spawning WQS apply over the entire reach of the creek. There are portions of the creek not far from the mouth blocked by landslides, where the creek travels subsurface, which restricts fish migration during low flows. In addition, a series of 2-meter falls occurs approximately 9.5 kilometers upstream from the mouth, which may limit fish passage on a seasonal basis. Fuller et al. (1984) documented rainbow/steelhead above this potential barrier at stream kilometer 10.3.

Threemile Creek data were collected biweekly (February 2, 2000, through January 22, 2001) by DEQ at the six monitoring sites shown in Figure 26. Parameters sampled included continuous temperature at the mouth, flow, pH, DO, turbidity, TSS, total and ortho-phosphorous, nitrates and ammonia, and *E. coli* and coliform bacteria. Sporadic measurements were taken at sites called “Big Barn” and “Headwaters.”

Butcher Creek

Butcher Creek beneficial uses are currently undesignated by the state of Idaho. Prior to designation, according to Idaho Code, "undesignated waters shall be protected for beneficial uses, which includes all recreational use in and on the water and the protection and propagation of fish, shellfish, and wildlife, wherever attainable" (IDAPA 58.01.02.101). Studies by the NPT and DEQ (Fuller et al. 1984, DEQ 1995, NPT 2002) have established salmonid spawning as an existing beneficial use. Butcher Creek also has the beneficial uses of primary and/or secondary contact recreation.

The salmonid spawning water quality criteria apply over the entire length of the Butcher Creek, although there is a series of falls approximately 6 miles upstream from the mouth that may limit fish movement upstream. This TMDL will use the mouth of the creek as the point of compliance for meeting salmonid spawning water quality criteria.

Butcher Creek data were collected by the NPT monthly (February 27, 2001, through February 26, 2002) approximately 1 mile upstream from its confluence with the SF CWR. Parameters sampled included continuous temperature at the mouth, flow, pH, DO, turbidity, TSS, total and ortho-phosphorous, nitrates and ammonia, and *E. coli* and coliform bacteria.

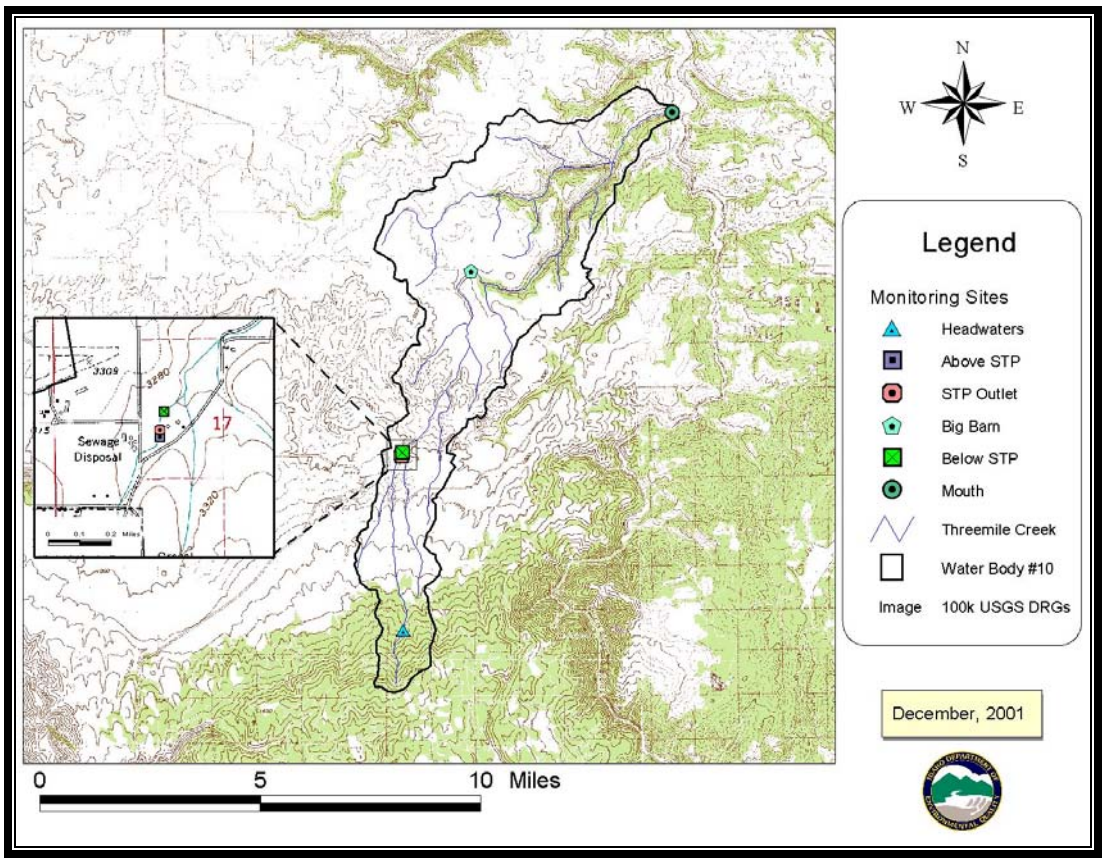

Figure 26. Monitoring Sites on Threemile Creek

Flow Characteristics

Instantaneous flows collected while monitoring Threemile Creek and Butcher Creek are shown in Figures 27 and 28. Appendix M shows flow curves for the two creeks based on extrapolation of these data and flow data from Lapwai Creek.

The minimum flow for all sites on Threemile Creek was measured on August 8, 2000, and the maximum flow was measured on May 16, 2000 (Table 23). Although there was consistent flow above the WWTP outfall, on two occasions the flow at the WWTP outfall was greater than or equal to the flow below the outfall. On the average, the outfall contributed 43% of the flow below the outfall. It contributed 30% of the flow, 50% of the time.

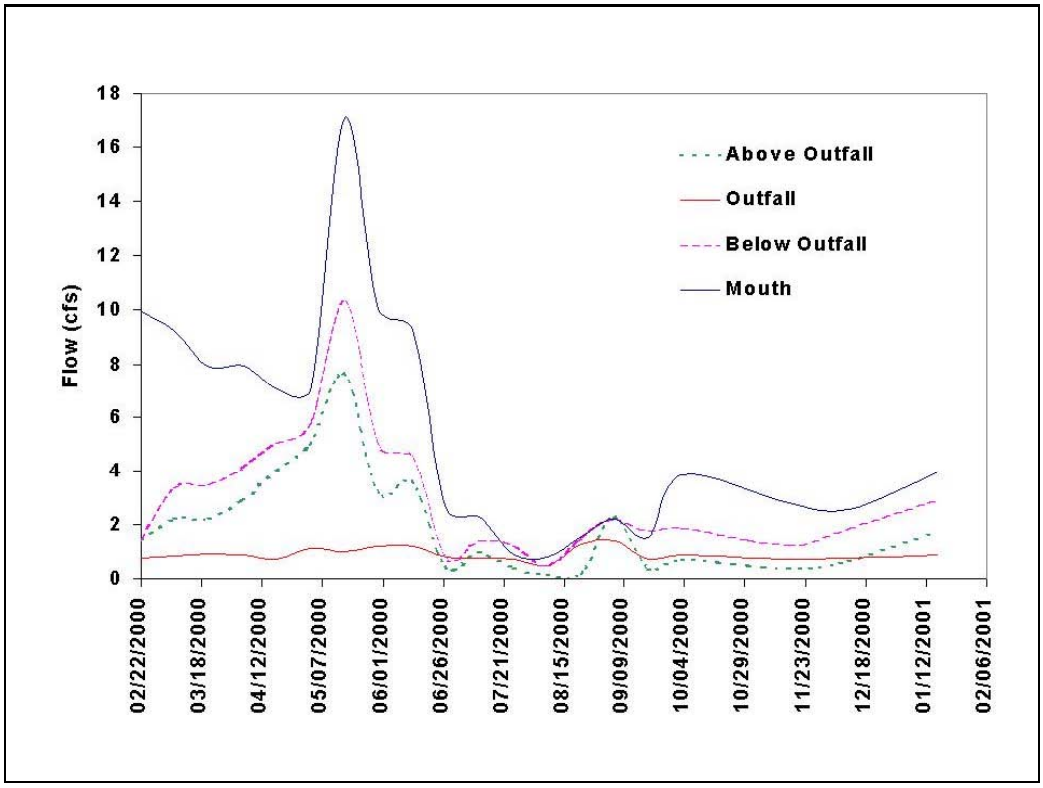

Figure 27. Stream Flow at Four Monitoring Points on Threemile Creek

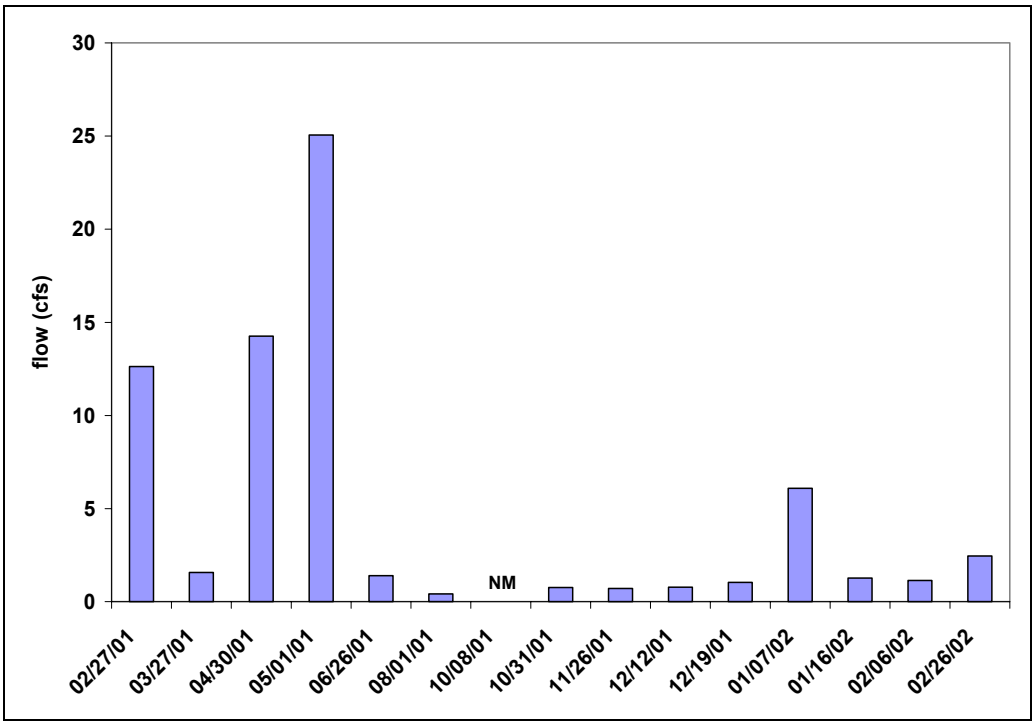

Figure 28. Flows Monitored in Butcher Creek

Table 23. Monitored flows in Threemile Creek from February 22, 2000, to February 6, 2001.

	Above Outfall	Outfall	Below Outfall	Mouth
Mean (cfs)[a]	2.01	0.90	3.32	5.51
Maximum (cfs)	7.60	1.38	10.35	17.09
Minimum (cfs)	0.14	0.49	0.49	0.81

[a] cubic feet per second

During the entire monitoring period (February 2000 through February 2001) the area received near average precipitation, and temperatures were slightly higher than normal (Figure 29). However, during the summer, the region experienced lower than normal precipitation and higher temperatures.

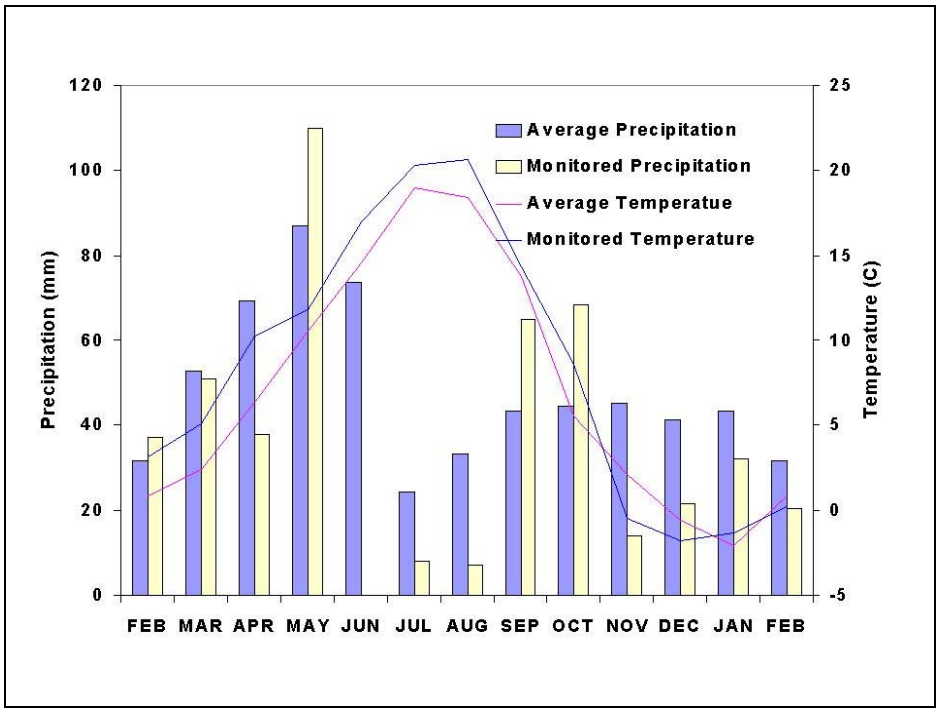

Figure 29. Measured Monthly Temperature and Precipitation vs. 40 Year Monthly Averages for Temperature and Precipitation

Peak flows occurred during the spring due to snowmelt. The WWTP outfall volume is nearly constant year round, with an average of 0.90 cfs. The flow at the mouth was greater than 1.0 cfs during most of the year, except during late July and early August when the discharge measured only 0.81 cfs. Immediately below the WWTP outfall, stream flows were above 1.0 cfs except for one June day when the discharge measured 0.76 cfs. However, the monitoring point below the outfall may not be representative of upper Threemile Creek. The WWTP is a constant source of water and adds a significant portion of the flow during the summer and fall months.

Pathogens

Pathogens are a small subset of microorganisms (e.g., certain bacteria, viruses, and protozoa), which if taken into the body through contaminated water or food, can cause sickness or even death. Some pathogens are also able to cause illness by entering the body through the skin or mucous membranes.

Direct measurement of pathogen levels in surface water is difficult because pathogens usually occur in very low numbers and analysis methods are unreliable and expensive. Consequently, indicator bacteria which are often associated with pathogens, but which generally occur in higher concentrations and are thus more easily measured, are assessed. *E. coli*, a type of fecal coliform bacteria, are used by the state of Idaho as the indicator for the presence of pathogenic microorganisms.

The major sources of pathogens in the watershed include livestock grazing, confined livestock management, wild game and waterfowl, and failing septic systems. Animals dependent on the stream as a water source contribute bacteria directly to the stream in addition to breaking down stream banks and grazing on streamside vegetation. This results in reduced stream buffering and a increased likelihood of wastes entering the stream. Because fecal coliform can survive for long periods of time in the stream substrate, bacterial numbers may be influenced by past activities and can be resuspended by stream flow or animal disturbance. *E. coli* counts may also increase with storm and runoff events, as pathogens are washed into the stream. Figure 30 shows the measured *E. coli* bacteria collected from Threemile Creek during the 2000-2001 monitoring period.

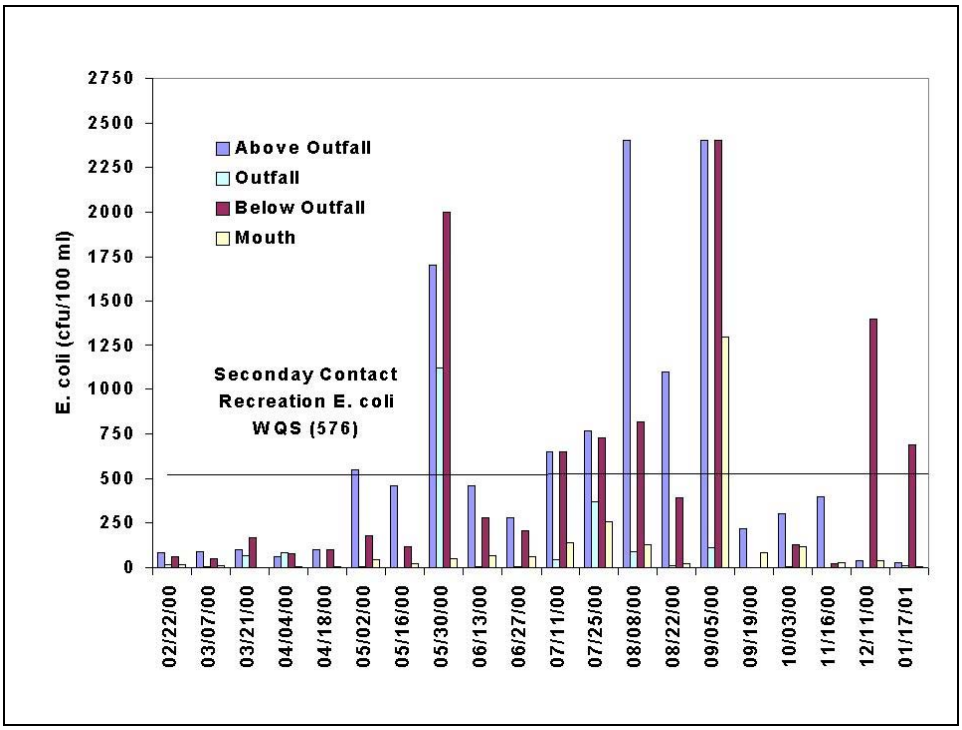

Figure 30. *E. coli* Bacteria Monitoring Results for Threemile Creek

The state of Idaho criteria for *E. coli* are not to exceed 126 colony forming units (cfu) per 100 ml as a monthly mean or 406 cfu per 100 ml as an instantaneous sample for primary contact recreation. The secondary contact recreation criteria are the same as primary contact recreation for the monthly mean, and not to exceed 576 cfu per 100 ml for an instantaneous sample.

Threemile Creek is designated for secondary contact recreational use by the state of Idaho. The instantaneous criterion for *E. coli* concentrations is not to exceed 576 organisms per 100 ml at any time. Eighteen exceedances of secondary contact criteria were documented at the Threemile Creek monitoring sites: eight located at the site above the WWTP outfall, one at the WWTP outfall, seven below the WWTP outfall, one at the Big Barn, and one at the mouth. Generally high bacterial counts occurred during high stream flow (storm events). Potential bacteria sources include storm water runoff from the city of Grangeville, livestock

grazing and/ or confinement adjacent to the creek, waterfowl and wild game, and failing septic systems.

The WWTP is also a source of bacteria, but the concentrations are generally low. Historically, a few exceedances of the fecal coliform permit limits occurred, but in recent years fecal coliform concentrations have been well within the permit compliance limits of 100 cfu/100ml. Low levels of fecal coliform are routinely detected in the WWTP effluent although it is chlorinated.

Butcher Creek had no instantaneous exceedances of either primary or secondary contact recreation during the 15-month sampling period (Figure 31). The highest *E. coli* levels (instantaneous counts of 250 and 160) were associated with high flows and exceeded the monthly average target of 126 cfu per100 ml. This may indicate bacteria entering the stream as a result of overland flow from rain events. Best management practices (BMPs) that reduce sediment and heat loading in Butcher Creek may also reduce levels of bacteria. These activities may include the removing cattle from areas of the creek, fencing, and re-establishing riparian buffer zones. Although a TMDL is not warranted at this time for pathogens, monitoring should continue to observe for potential exceedances.

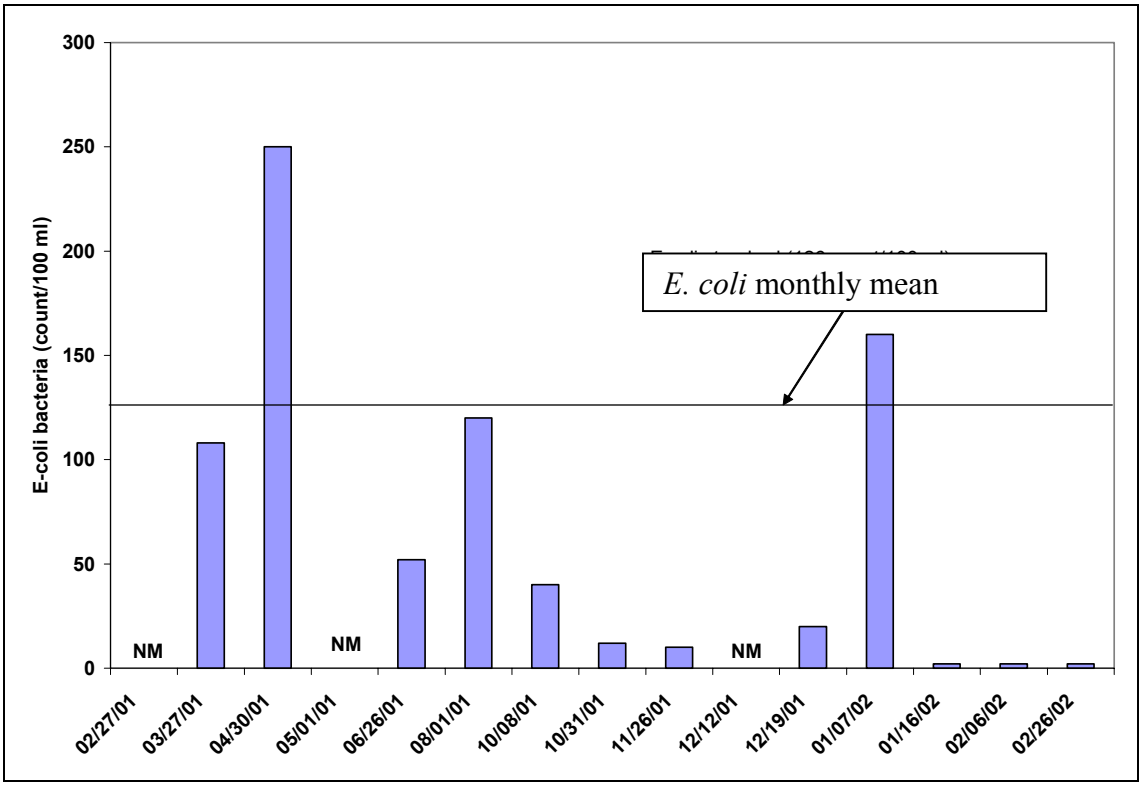

Figure 31. *E. coli* Monitoring Results for Butcher Creek

Dissolved Oxygen

The Idaho criteria for DO in the water column for cold water aquatic life and salmonid spawning is a one-day minimum of not less than 6.0 mg/L or 90% saturation, whichever is greater. The criteria for intergravel DO for salmonid spawning is 6.0 mg/L or greater for a weekly mean and 5.0 mg/L or greater for a daily minimum. The DO levels in a stream may be reduced by excessive nutrient loading and consequent algae growth. The biological decomposition of algae utilizes oxygen and may deplete it under low flow conditions.

Instantaneous DO levels in Threemile Creek were very close to a criteria deficiency during three sampling events at the mouth (July 25, 2000 – 6.07 mg/L; August 8, 2000 – 6.03 mg/L; and August 22, 2000 – 6.40 mg/L) (Figure 32). The results from this study are inconclusive and follow-up studies will be undertaken in the future.

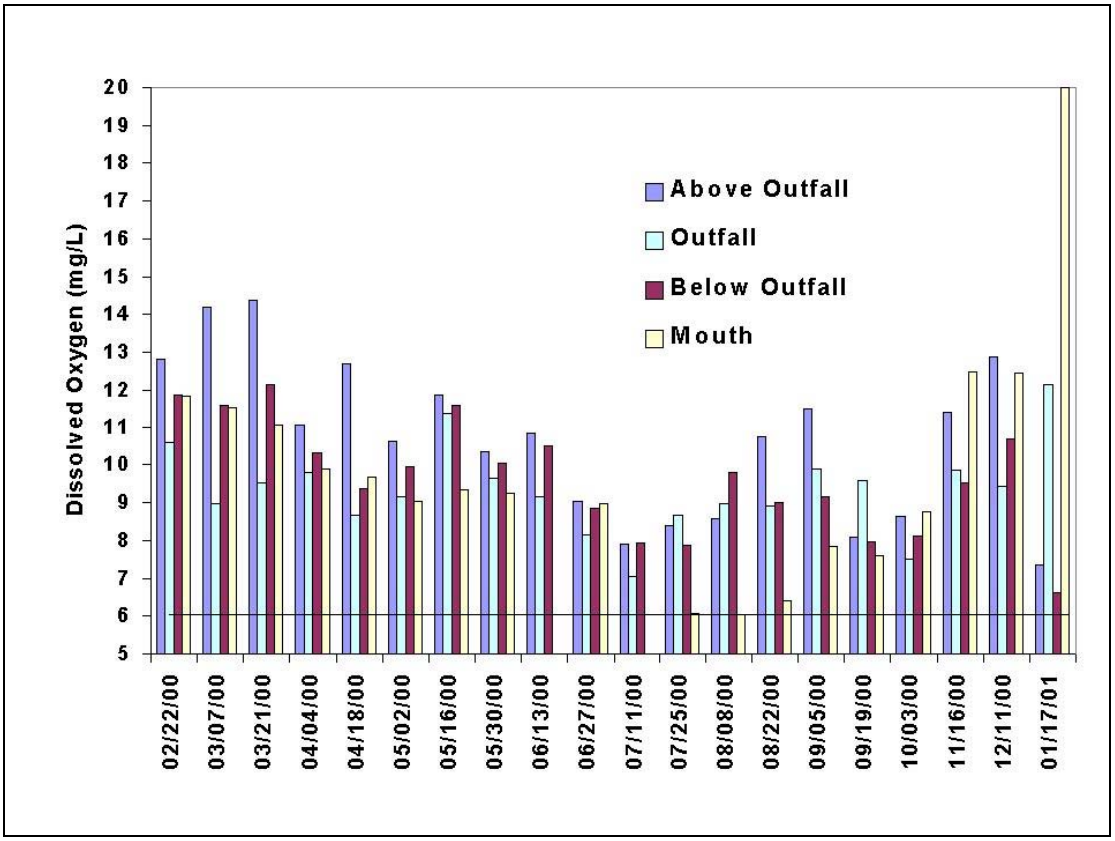

Figure 32. Dissolved Oxygen Monitoring Results for Threemile Creek

Butcher Creek instantaneous DO levels ranged from 10.1 to 19.9 mg/L during the 15-month monitoring period (Figure 33). While these data show an adequate amount of DO in the water column, no diurnal measurements were taken to determine the range of DO throughout the day. However, as the levels of phosphorous and nitrogen in Butcher Creek are not likely to stimulate nuisance algae growth during the critical time period (summer growing season), and DO levels were well above the 6.0 mg/L criteria for all sampling dates, a DO TMDL is not warranted at this time.

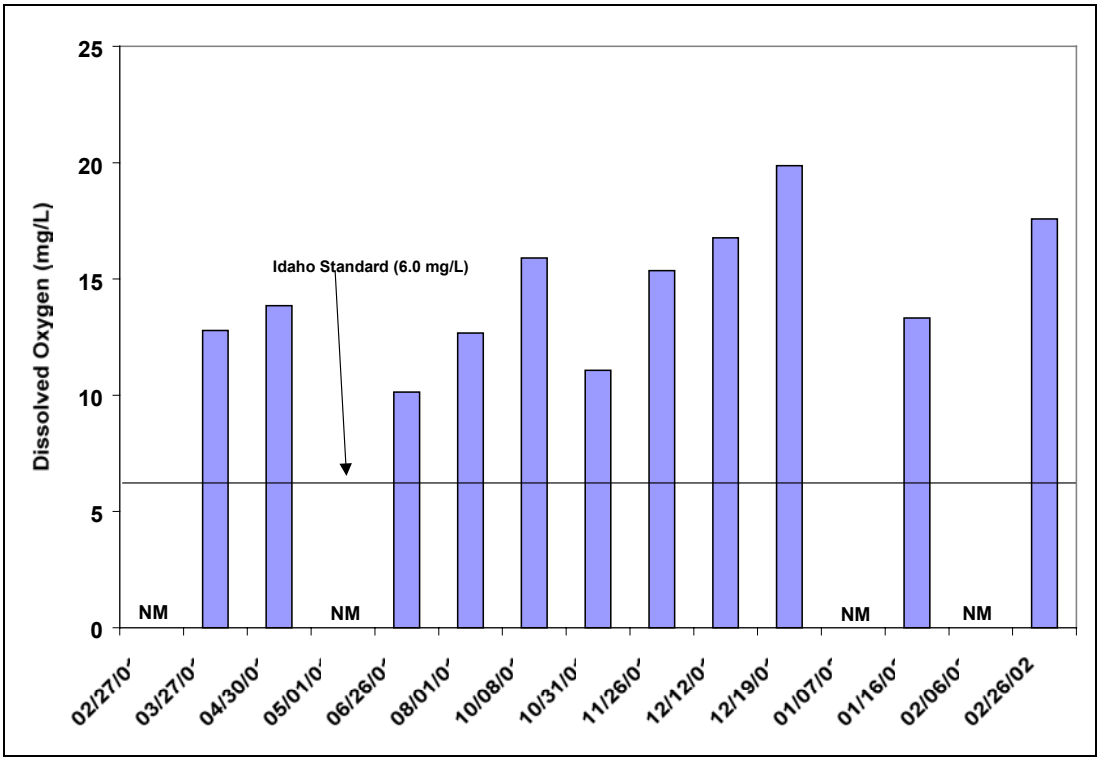

Figure 33. Dissolved Oxygen Monitoring Results for Butcher Creek

Ammonia

Ammonia was measured in Threemile Creek and Butcher Creek as total ammonia, which combines the forms of dissolved gas, ammonium hydroxide, and the ammonium ion. Ammonia can be both toxic to aquatic animal life and provide a source of nitrogen to plants. As temperature and pH increase in the stream so will the total ammonia level. The critical period for salmonid spawning is April through October. The Idaho criteria establishes ammonia limits depending on pH and water temperature. None of the ammonia concentrations shown in Figure 34 exceed the WQS.

The Grangeville WWTP National Pollution Discharge Elimination System (NPDES) permit allows releases up to 5.0 mg/L total ammonia as N into Threemile Creek. The WWTP exceeded its limit once during the monitoring period.

The ammonia criteria were never exceeded in Butcher Creek (Figure 35), although during August the temperature, pH, and ammonia levels were high (See Figures 35 and 37).

Both Threemile and Butcher Creeks, therefore, appear to be in compliance with the WQS for ammonia and no TMDLs for ammonia will be developed. It is recommended that Threemile Creek be removed from the 303(d) list for ammonia.

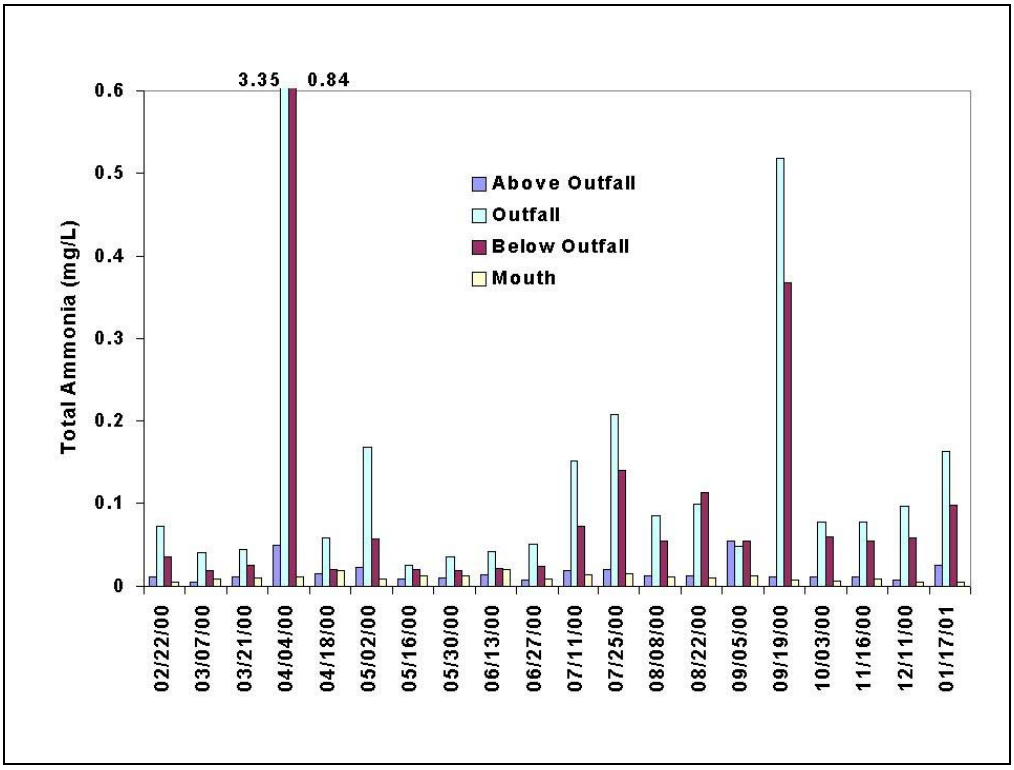

Figure 34. Total Ammonia Monitoring Results for Threemile Creek

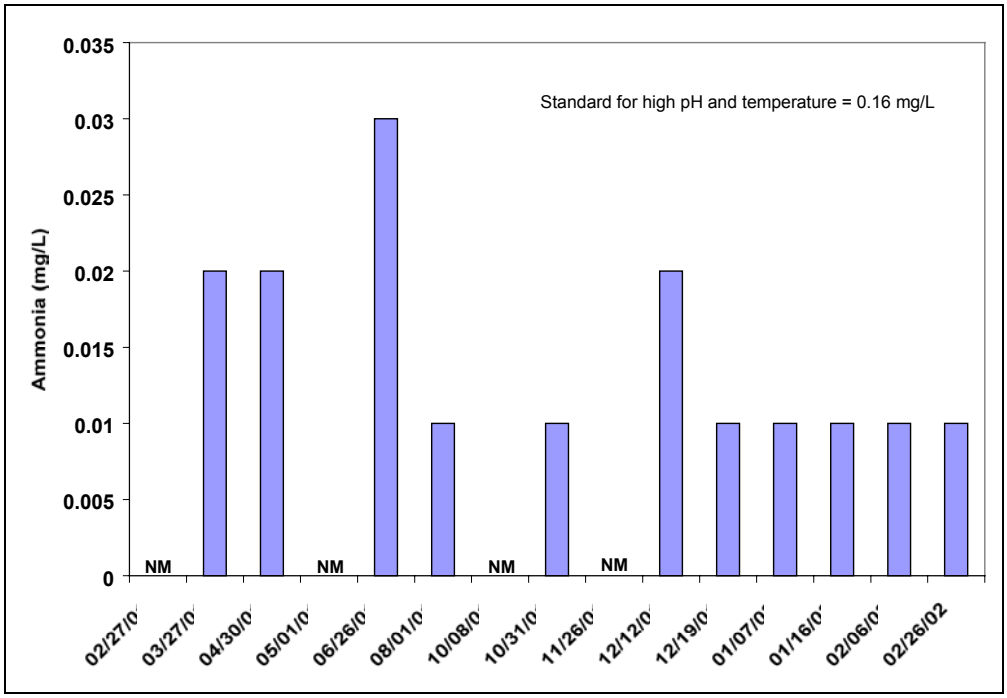

Figure 35. Total Ammonia Monitoring Results for Butcher Creek

pH

Threemile Creek pH levels ranged from 6.21 to 8.88 at the mouth. Generally, pH averaged 7.6 for all the Threemile Creek sites at all times of the year with little seasonal fluctuation (Figure 36). Butcher Creek's pH ranged from 7.5 to 8.64 for the sampling period (Figure 37). Generally the pH averaged 8.1 at all times of the year with little seasonal fluctuation.

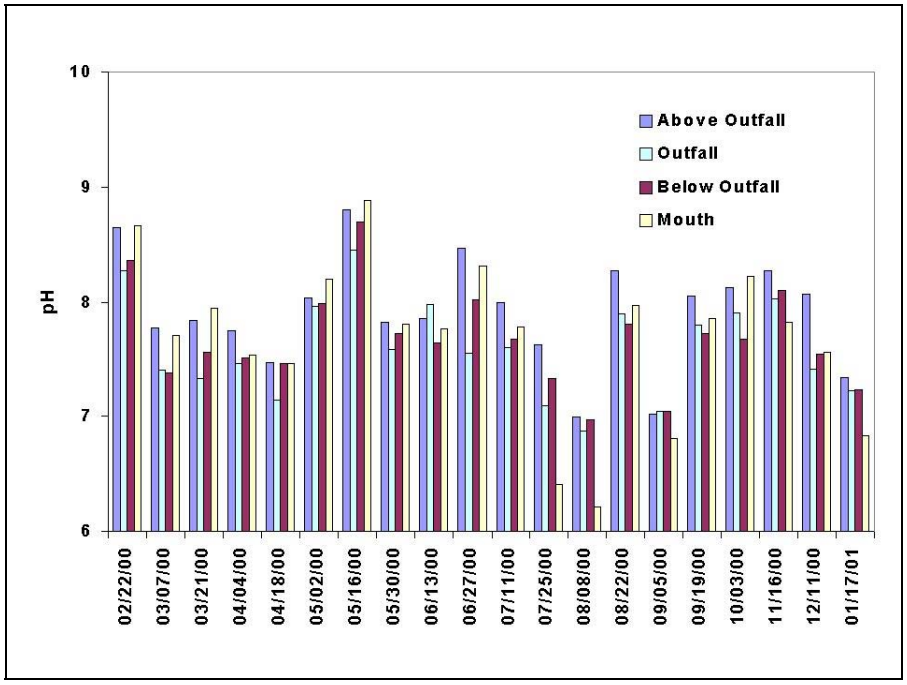

Figure 36. pH Monitoring Results for Threemile Creek

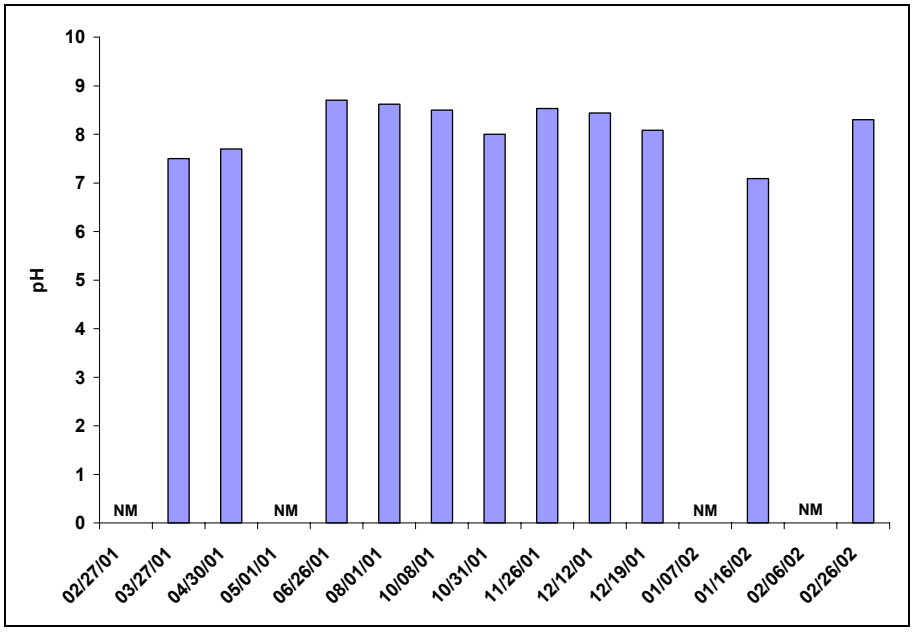

Figure 37. pH Monitoring Results for Butcher Creek

Nutrients

Nuisance aquatic growth can adversely impact aquatic life and recreation. Algae of various types grow in the water and on the beds of streams. Algae provide a food source for many aquatic insects, which in turn serve as food for fish. Algae grow where the substrate is suitable and sufficient nutrients (nitrogen and phosphorus) are available to support growth. Flow, temperature, and sunlight penetration into the water all must combine with nutrient availability to produce conditions suitable for photosynthetic growth. When nutrients exceed the quantities needed to support primary productivity, algae blooms may develop. Subsequent death and decay of algae creates an oxygen demand. If the demand is high enough due to large algae blooms, DO concentrations in the water body may decline to low levels that harm fish. Algae blooms and excessive rooted macrophytes can also physically interfere with recreational activities such as swimming and wading and directly alter fish habitat. In addition, decomposing algae can create objectionable odors, and some species produce toxins that impair the agricultural water supply.

Nutrient limitations occur when a nutrient, usually phosphorus or nitrogen, is below the level needed for algal growth in the water column. Influxes of these nutrients will stimulate algal growth if other factors, such as light, temperature, and flow, are conducive to growth. Alternatively, a system can have high enough levels of nutrients that growth is limited by other factors besides nutrients, and nutrient levels must be decreased to limiting levels to have an effect on algal biomass.

Idaho's narrative standard for nutrients states: "surface waters shall be free from excess nutrients that can cause visible slime growth or other aquatic growths impairing beneficial uses" (IDAPA 58.01.02.200.06). Salmonid spawning beneficial uses can be impaired when excess algae decompose, resulting in depleted dissolved oxygen levels. Primary/secondary contact recreation can be also impacted by visible slime and algae growth caused by excessive nutrients when temperature and sunlight are not limiting. Salmonid spawning can be impaired when excess algae decompose, resulting in depleted DO levels.

Phosphorus Compounds

Total phosphorus (TP) consists of both particulate and dissolved fractions of both organic and inorganic phosphorus compounds. Dissolved phosphorus consists of all forms of phosphorus in solution, whether organic or inorganic. Phosphorus in solution in surface waters occurs almost solely as phosphates. Orthophosphate ($PO4^{-3}$) is the form that plants can use, and thus best correlates to short-term stimulation of growth.

In order to prevent nuisance algae growth and dissolved oxygen problems, USEPA (1986) developed a national guideline for streams of 0.1 mg/L TP. More recently USEPA (2000) developed a nutrient criteria for total phosphorus of 0.030 mg/L TP specific to Columbia Plateau subecoregion streams. These criteria provide USEPA's most recent recommendations to states and authorized tribes for use in establishing their water quality standards. USEPA further recommends that, wherever possible, states develop nutrient criteria that fully reflect localized conditions and protect specific designated uses.

Total phosphorus in Threemile Creek ranged from 0.06 mg/L (headwaters) to 4.55 (WWTP outfall). Ortho-phosphorus concentrations ranged from 0.04 mg/L above the WWTP outfall to 3.72 mg/L at the outfall, with an overall average of 0.93 mg/L (Table 24). The WWTP outfall had the largest range in values, while the mouth had the lowest range. The ratio of ortho-phosphorus to total P ranged from 0 to 1 and averaged 0.47 (above outfall), 0.82 (outfall), 0.85 (below outfall), and 0.72 (mouth).

Table 24. Ortho-phosphorus concentrations on Threemile Creek (February 22, 2000, to February 6, 2001).

	Above Outfall	Outfall	Below Outfall	Mouth
Mean (mg/L)	0.05	1.79	1.03	0.22
Maximum (mg/L)	0.09	3.72	2.87	0.31
Minimum (mg/L)	0.02	0.15	0.30	0

Concentrations of P in ground water ranged from 0.01 to 0.28mg/L on the Camas Prairie with a median of 0.05 mg/L (Crockett 1995). A well sampled in the Threemile Creek watershed had average P levels of 0.03 mg/L (Hagen 2002).

Grangeville's WWTP contributes 43% of the flow to the creek and a concentration of 1.79 mg/L P on an annual average with peak concentrations in the spring and summer. At the WWTP outfall monitoring point, the concentration of ortho-phosphorus is high in the late winter and summer and low in spring and late fall/early winter (Figure 37). The facility controls concentrations of P entering the creek using holding tanks, which settle out solids containing P. High P levels from the WWTP in the late winter and early spring may be a result of sediment entering the city's sewage system through leaks in pipes during times of high precipitation. The city of Grangeville has recently begun a program of maintaining the sewer pipes to reduce inflow.

There is no seasonal change in ortho-phosphorus above the outfall or at the mouth of Threemile Creek (Figure 38). Above the outfall, P concentrations in the creek may be influenced by storm water runoff from Grangeville, the natural background levels in soils, geological sources, and land management activities such as livestock grazing. The mouth of Threemile Creek has a fairly constant concentration of P.

Total phosphorus in Butcher Creek ranged from 0.1 to 0.49 mg/L, and averaged 0.16 mg/L. There were three exceedances of USEPA recommended levels for TP during the 15 months monitored (0.49 mg/L, 0.23 mg/L, and 0.24 mg/L). Ortho-phosphorus, the form of P most readily available for plant uptake, ranged from 0.054 mg/L to 0.109 mg/L, and averaged 0.094 mg/L (Figure 39). Five samples exceeded 0.1 mg/L ortho-phosphorus at the mouth of Butcher Creek.

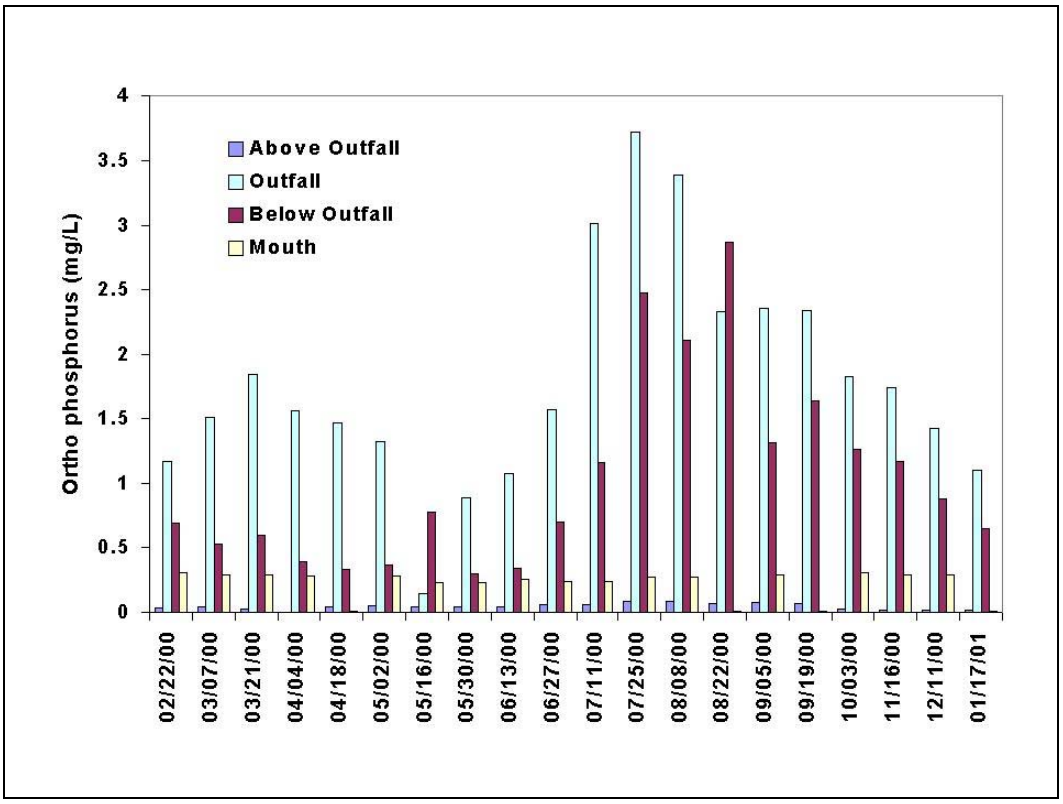

Figure 38. Ortho-phosphorus Monitoring Results for Threemile Creek

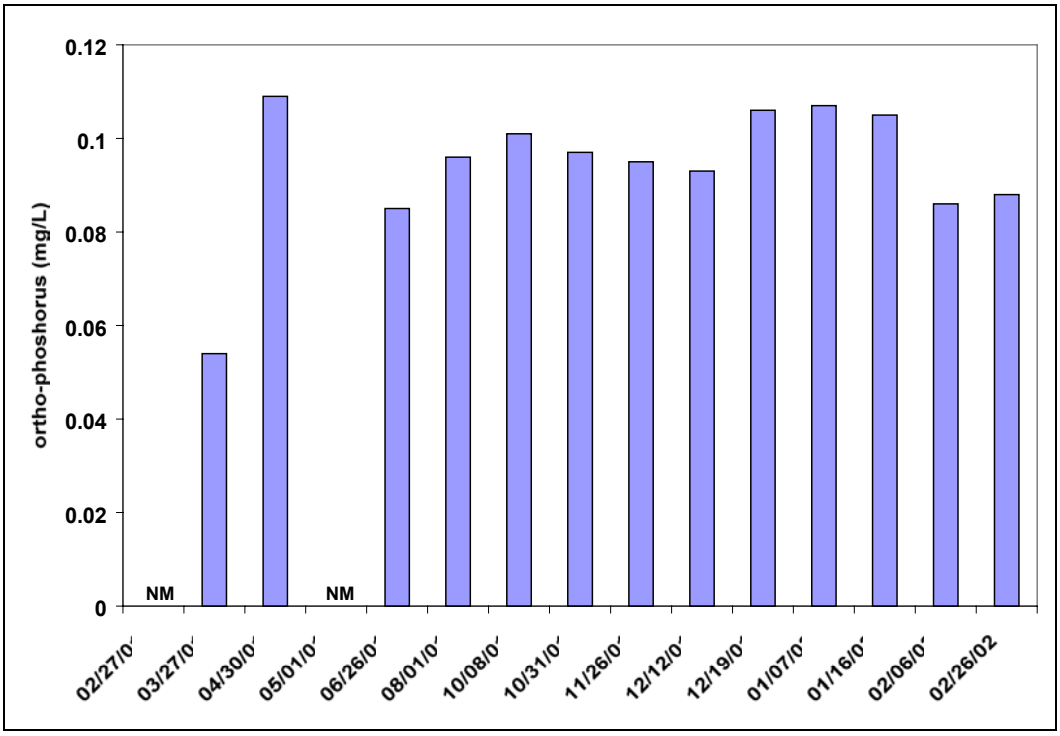

Figure 39. Ortho-Phosphorus Monitoring Results for Butcher Creek

Nitrogen Compounds

In surface waters, nitrogen (N) occurs as nitrate (NO_3), nitrite (NO_2), ammonia, and organic N. Nitrate-nitrite covers most of the nitrogen available in surface waters. Ammonia is also available for plant uptake. Total Kjeldahl nitrogen (TKN) is the fraction of organic N bound in the aquatic organisms and unavailable for plant growth. Upon decomposition, organic N can be converted to inorganic N and become available for plant uptake. Total nitrogen (TN) is composed of inorganic and organic nitrogen.

In order to prevent nuisance algae growth, USEPA (1993) developed a national guideline for streams of 0.3 mg/L TN. More recently, USEPA (2000) developed a recommended nutrient criterion of 0.22 – 0.36 mg/L TN specific to the Columbia Plateau subecoregion streams.

A ground water well monitored by the Idaho Department of Water Resources (IDWR) within the Threemile Creek watershed contained very low levels of NO_3. Nitrate concentrations were less than 0.05 mg/L in seven out of eight years, with a maximum concentration of 0.074 in 1996 (Hagen 2002).

Threemile Creek average annual TN levels exceeded 0.30 mg/L at each monitoring point along Threemile Creek, except at the headwaters. The TN concentrations ranged from 0.16 mg/L above the outfall to 24.95 mg/L at the outfall, with an overall average of 7.14 mg/L (Table 25). The largest range in values was seen below the outfall and the lowest range was above the outfall. The ratio of inorganic N to TN ranged from 0-1 and averaged 0.25 (above outfall), 0.91 (at outfall), 0.88 (below outfall), and 0.86 (mouth).

Table 25. Total nitrogen data summaries for Threemile Creek (February 22, 2000 to February 6, 2001).

	Above Outfall	Outfall	Below Outfall	Mouth
Mean (mg/L)	0.35	17.4	8.72	2.31
Maximum (mg/L)	1.16	24.95	22.22	8.33
Minimum (mg/L)	0.16	12.37	2.47	0.23

Concentrations of TN above the WWTP outfall after the creek has passed through some grazing land, farmland, and the city of Grangeville averaged 0.35 mg/L and had a maximum of 1.16 mg/L. However, the summer month values were lower than 0.30 mg/L.

At the outfall monitoring point, the concentration of TN is highest in the late winter and summer and lowest in the spring and late fall/early winter (Figure 40). The WWTP outfall appears to influence levels downstream. Although there is no seasonal change in TN above the outfall, at the mouth TN concentrations are greater in the winter and spring than in the summer and early fall.

Sources of N in the watershed include the WWTP, livestock management, and agricultural practices, including fertilizer application.

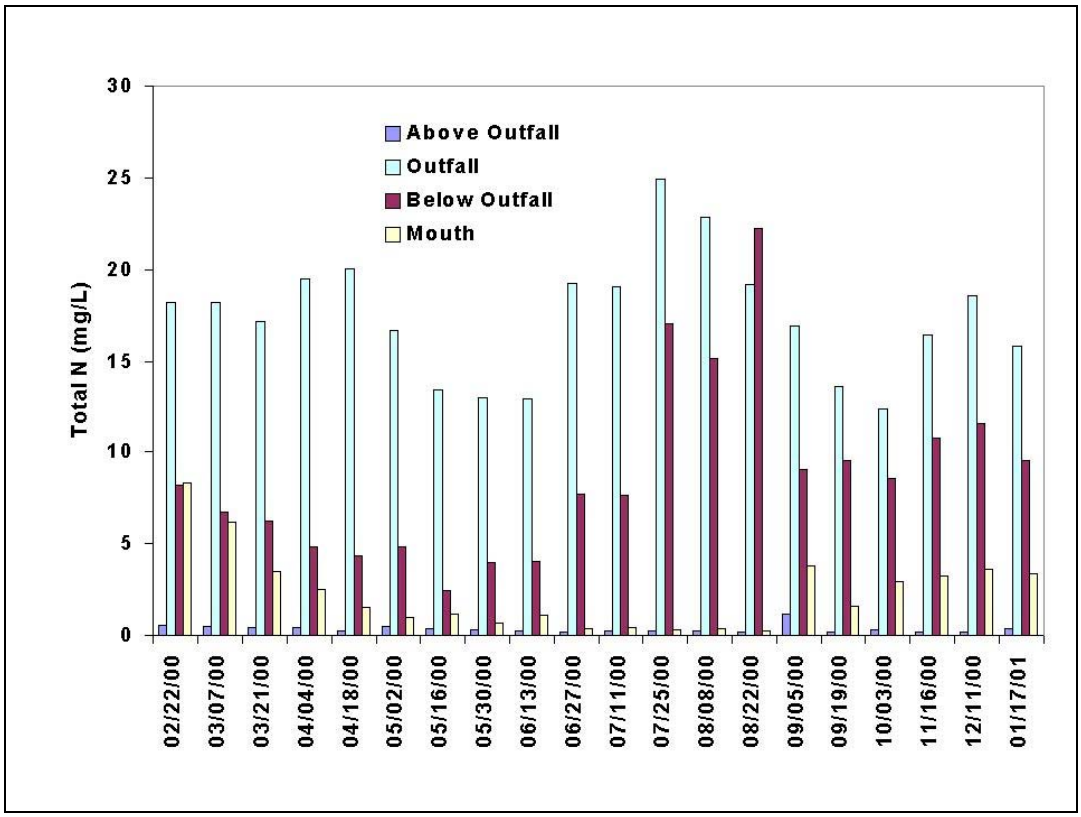

Figure 40. Total Nitrogen Monitoring Results for Threemile Creek

The TN concentrations in Butcher Creek averaged 1.24 mg/L (Figure 41). The highest levels occurred in January, February, and March and correlated with high stream flows. The TN levels exceeded 0.30 mg/L for 11 out of 14 samples. However, during the summer growing season, values were near or just above this target (0.33 mg/L on June 26 and August 1, 2001).

The concentrations of TN at the mouth of Butcher Creek show a high degree of seasonality and relationship with flow: highest levels in the spring, then decreasing in the summer. Due to the N levels approaching 0.3 mg/L during the summer growing season/critical time period, and no violations of the DO criteria, it is concluded that beneficial uses are currently being met. Although no TMDL is established for N at this time, consistently high fall and winter values (ranging from 0.5 to 5.01 mg/L) warrant further observation. Best management practices that reduce temperature and sediment pollution in the watershed (i.e., vegetative buffers, fences, livestock exclosures, and grazing management) should also effectively reduce levels of N. Follow-up implementation effectiveness monitoring is recommended to ensure an overall reduction in N loading.

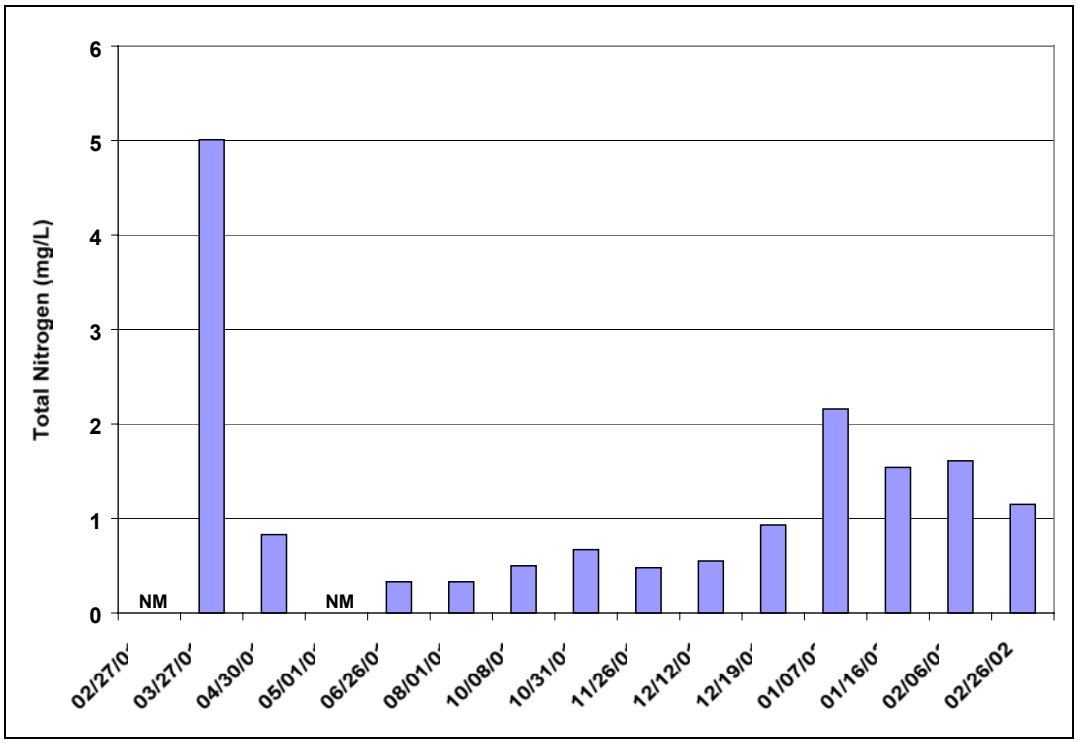

Figure 41. Total Nitrogen Monitoring Results for Butcher Creek

Other Water Quality Studies

An Idaho Division of Environmental Quality report (DEQ 1979) summarized a study conducted on Threemile Creek in 1976 and 1977. The purpose was to assess the effect of Grangeville's WWTP on the stream and develop effluent limitations for the discharge as required for an NPDES permit. A secondary purpose was to determine if Threemile Creek met requirements for Class A waters. Five sampling stations were selected and monitored during high and low flow periods. Field and laboratory analyses were carried out for each site and date. Bacteria levels were well above the standard and both P and N levels were found in high concentrations (Table 26).

Table 26. Total phosphorus, nitrate-nitrogen, and bacteria for all stations and dates along Threemile Creek.

	Total P (mg/L)[a]	NO_3-N (mg/L)[b]	*E. coli* (cfu/100 mL)[c]
Above Grangeville			
November 17, 1976	0.18	0.01	200
November 18, 1976	0.15	0.02	200
June 7, 1977	0.14	0.03	900
June 8, 1977	0.17	0.01	740
Above Outfall			
November 17, 1976	0.13	0.10	200
November 18, 1976	0.20	0.01	400
June 7, 1977	0.19	0.02	680
June 8, 1977	0.25	0.11	4500
100 feet Below Outfall			
November 17, 1976	6.55	11.41	200
November 18, 1976	5.44	10.20	200
June 7, 1977	3.55	4.33	855
June 8, 1977	2.44	4.52	5400
1.25 miles Below Outfall			
November 17, 1976	5.75	12.60	200
November 18, 1976	6.55	9.56	200
June 7, 1977	2.24	4.55	3100
June 8, 1977	2.98	4.64	780
3 miles Below Outfall			
November 17, 1976	3.54	8.85	200
November 18, 1976	5.51	10.25	200
June 7, 1977	1.84	1.62	380
June 8, 1977	2.55	4.52	520

[a] Total phosphorus in milligrams per liter
[b] Nitrate-nitrogen in milligrams per liter
[c] Colony forming units per 100 milliliters

The study concluded that the WWTP contributed to the pollution of the creek through additions of nutrients, and that the bacterial problem was caused by nonpoint source pollution from livestock and poor private septic facilities upstream of the WWTP. The recommendations at the time were to upgrade the WWTP to reduce nutrients and revise the chlorinating procedure to maintain acceptable bacteria levels. Best management practices for

the nonpoint sources were identified for agricultural runoff, summer livestock grazing, and winter livestock holding areas.

On the Clearwater Plateau continued sampling for nutrients and pesticides by IDWR and the Idaho Department of Agriculture (IDA) have documented significant zones of ground water contamination exceeding the 10 mg/L drinking water standard for NO_3-N, with a maximum 80 mg/L NO_3-N measured in the sampling. This contamination appears to be located in geologic environments where granitic outcrops exist as islands surrounded by basalt.

In April 1995, IDWR produced a Water Information Bulletin (Crockett 1995) that summarized the results of a ground water monitoring program carried out from 1991 through 1993. One of the objectives of the study was to determine the background levels in ground water in the aquifers of Idaho. The results indicate that the Clearwater aquifer contains elevated background levels of TP and NO_3 (Table 27).

Table 27. Range and median of nutrients in the Clearwater aquifer measured from 1991 through 1993 (Crockett 1995).

	Nitrate (mg/L)[a]	Ammonia (mg/L)	Phosphorus (mg/L)
Range	0.05 – 19.00	0.01 – 0.29	0.01 – 0.28
Median	0.38	0.01	0.05

[a] milligrams per liter

In 1998 DEQ produced a report on the reconnaissance of NO_2 and NO_3 in the Camas Prairie ground water. Although the report indicates elevated levels of NO_3 on the prairie, the single well within the Threemile Creek watershed contained very low levels of NO_3. Nitrate concentrations were less than 0.05 mg/L in seven of eight years (maximum was 0.074 mg/L in 1996), while concentrations of P averaged 0.03 mg/L (Hagen 2002).

Threemile Creek Conclusions

Flow was below normal and air temperatures were higher than normal during the summer months that Threemile Creek was monitored. The low flow and high temperatures could indicate a year where there may have been less recreational use and higher than normal concentrations of pollutants in the creek.

Pathogen levels in the creek are above the secondary contact criteria set by the state. Potential sources include grazing/livestock operations, septic systems, and waterfowl and animals.

Dissolved oxygen levels were borderline at the mouth on two occasions and no data were available to evaluate diurnal DO sags. Further monitoring to verify DO levels at critical times is warranted

In-stream ammonia concentrations were below the criteria set by the state of Idaho. The Grangeville WWTP discharges ammonia and is well within its permit limit. Since ammonia levels are below criteria, a TMDL will not be written. It is recommended that Threemile Creek be delisted for ammonia.

The nutrient levels in Threemile Creek are generally an order of magnitude or more higher than the USEPA "Goldbook" guidelines (USEPA 1986). Nitrogen levels above the WWTP outfall are lower than the 0.3 mg/L guideline. At the WWTP outfall and below it, the TN concentrations are much higher and are a cause for concern. At the mouth of the creek the level of TN tends to be seasonal, decreasing in the summer when the concentration at the outfall reaches its maximum. This may indicate that plants are taking up the TN. Phosphorus concentrations are at or below the USEPA guidelines above the WWTP outfall, but are higher than the guidelines at and below the outfall. The TP concentrations at and below the outfall also increase in the spring and summer. The WWTP outfall directly influences the site below it. There are no indications that the concentration of TP has any seasonality at the mouth; the concentration of TP remains at a steady 0.30 mg/L regardless of flow, temperature, or any other parameter measured during this monitoring period.

Due to the significantly elevated levels of TN and TP, these nutrients were considered for the development of TMDLs. The deleterious effects of high and/or unbalanced nutrient levels, i.e., nuisance algal growth and/or low DO, can be controlled if nutrient levels are returned to levels that limit algal growth.

Butcher Creek Conclusions

There were no instantaneous exceedances of either primary or secondary contact recreation *E. coli* criteria during the 15-month sampling period, although on two occasions levels exceeded 126 cfu. Since *E. coli* concentrations were below criteria on all sampling dates, a TMDL will not be written. It is recommended that Butcher Creek be delisted for bacteria.

Dissolved oxygen levels were never low enough to cause a concern and may indicate the lack of excessive algae growth in the creek at the monitoring site. Since the DO concentrations were above the criteria on all the sampling dates, a TMDL will not be written. It is recommended that Butcher Creek be delisted for DO.

The nitrogen levels in Butcher Creek are generally higher than the USEPA guidelines, and generally occur in winter during periods of high flow. Phosphorus levels were generally within the guidelines set by USEPA. Nitrogen levels are elevated, but there is no indication that there is a DO or nuisance algae problem. A TMDL for nutrients will not be written; however, the implementation of the TMDLs being written for temperature and sediment is expected to lower the N levels.

Summary and Analysis of Existing Water Quality Data for Lucas Lake

Lucas Lake is a small, locally named water body that is 303(d) listed for sediment. Based on a DEQ report by Steed (2002), Appendix P, Lucas Lake supports beneficial uses of primary contact recreation and cold water aquatic life.

Lucas Lake was originally listed in 1994, based on earlier BLM reports that indicated possible problems with sediment. Since the lake lies in a placer mining zone, DEQ monitoring included a screening for toxic substances (metals). DEQ sampled the lake in December 2001 and again in June 2002. The results from the sampling are shown in Appendix N.

The TSS concentrations from both sampling periods are below the 4 mg/L detection limit. Although turbidity is not reported, it is unlikely that 4 mg/L could correlate to anything close to the WQS of 50 NTU above background. (A handwritten note of the lab sheet indicates an NTU reading of 0.80 NTU.)

The metal screening did not indicate any problems with toxic metals.

It is recommended that Lucas Lake be removed from the 303(d) list for sediment.

2.4 Data Gaps

Data gaps identified in this section provide readers with an idea of the amount of error involved in the analyses, and set the stage for research and data development necessary to improve the quality of these analyses.

Flow

In order to do flow-based analyses for sediment TMDLs, it would be helpful to have actual flow measurements, rather than extrapolating from existing data sets. While the level of error introduced by extrapolated flow is probably less that the error in the sediment yield curves, better flow data is important to understanding water quality.

We did not have continuous flow data for the points above and below the WWTP at Grangeville, and virtually no flow data for any of the other point sources. The effects of point sources for nutrients, temperature, and sediment are all dependent on some kind of flow estimation that corresponds to water quality data of the effluent.

Water Column Data

Diurnal DO monitoring is needed to determine the effects of the Grangeville WWTP on DO levels in Threemile Creek.

Intergravel DO data would be helpful in determining if the criteria are being met for salmonid spawning in Threemile Creek and Butcher Creek.

Increased frequency of sampling for *E. coli* to more accurately determine criteria exceedances and genetic fingerprinting to determine the source of pathogens would be helpful in Threemile Creek and Butcher Creek.

An analysis of streambed and bank sediments is recommended to determine exchange coefficients for phosphorus in order to evaluate effects of phosphorus in the system.

There are no good data sets for background turbidity and TSS to relate to the state WQS. Our estimates of background are based on the sediment budget and; therefore, incorporate the huge errors involved in translating sediment source data to in-stream sediment results.

Similarly, more extensive turbidity and TSS data throughout at least the lower part of the basin, over several years, would improve the reliability of our sediment loading analyses. For the most part, the data set we have applied to the loading analysis would be considered below the minimum necessary by most professionals.

We attempted to collect and model bedload data, realizing that some sort of quantification would be necessary to write the TMDLs. We were only able to collect a minimal amount of bedload data for the Stites and Harpster sites, yet the impairment we are trying to address throughout the subbasin above Harpster is bedload. Bedload data for all of the 303(d) listed water bodies would have been helpful. We failed in our modeling effort because we were unable to collect enough data to get the model to work reliably.

More systematic monitoring on an annual basis of the effects of suction dredging on water column and substrate sediment levels would allow better quantification of sediment loading impacts from this industry.

Temperature

Continuously recorded stream temperature data exist for a large number of sites in the SF CWR Subbasin. Many of these sites are at the mouths of streams—the warmest locations. A few streams have several temperature recording sites such that the beginning of a linear temperature profile can be developed. However, for the most part, we lack information about stream temperatures along the full lengths of any stream. We have neither recorded data for temperature profiles, nor stream parameter and heat loading data to be able to model the profiles. We assume that the stream temperature data from one or a few sites within a given water body represent the temperature profile for the whole water body.

The narrative part of the Idaho WQS identifies temperature (heat) pollution to be controlled and regulated as that part of heat loading which has resulted from human activity, as opposed to the level of heat loading or stream temperature that existed prior to human intervention. We do not have data or models that quantify the level of heat loading or stream temperatures prior to human intervention.

Biological and Other

We have no baseline data for the condition of fish populations and their spawning habitat, or other physical/hydrologic data prior to human intervention in the subbasin. We attempt to overcome this deficiency with data from reference sites, modeling, and professional judgement.

We acquired stream habitat data sets from reference watersheds and compared them to streams in the SF CWR Subbasin. Cobble embeddedness is the primary parameter for which we could quantify the differences, but we were unable to determine the relationship between percent cobble embeddedness and sediment loading. Much better reference data would be useful to be able to fully assess the impact of human activity in any particular water body.

Currently data is lacking in order to quantify the effects of agricultural chemicals on stream biota and their accumulation in fish tissue. A study conducted by USEPA and the Columbia River Inter-tribal Fish Commission in 1996-97 detected 92 chemicals in fish tissues collected in the Columbia Basin, including the Clearwater River (USEPA 2002). The concentrations of pesticides were higher in the resident species, especially mountain whitefish, white sturgeon, largescale sucker, and whole body walleye than in anadromous species. Of the anadromous fish species, Pacific lamprey had higher levels of polychlorinated biphenyls (PCBs). This appears to be associated with the high amount of fat in these fish types since PCBs and pesticides are readily absorbed by fats. The NPT will begin assessing fish tissue for heavy metals and volatile organic compounds (including pesticides) as part of their Environmental Monitoring Assessment Program (EMAP) in 2003. Studies of the effects of agricultural chemicals on stream macroinvertebrates (insects) have not been done.

Beneficial Uses

Beneficial use support status assessment for the main stem SF CWR is not available at this time. The assumption was made that the main stem is not fully supporting its beneficial uses, but data are largely nonexistent to support this assumption.

While there is ample information in the literature relating sediment and/or temperature to fish spawning and reproductive health, there is little site-specific data linking sediment and/or temperature in the SF CWR Subbasin to its beneficial uses.

3. Subbasin Assessment – Pollutant Source Inventory

This section summarizes point and nonpoint sources of pollutants in the SF CWR Subbasin.

3.1 Sources of Pollutants of Concern

The primary nonpoint pollution sources in the SF CWR Subbasin are forestry, grazing, agriculture, mining, roads, and storm water runoff. Additional sources include natural and road-related mass failures. Agricultural related nonpoint source pollution is caused by tillage practices and livestock management. Potential impacts to water quality also stem from livestock grazing. Forestry related nonpoint pollution sources include forest roads, skid trails, stream crossings, and loss of stream shade within riparian areas.

Storm water related pollution is caused by construction activities, residential and business activities, roadways, and parking lots. Discrete facilities within the watershed such as mills and gravel pits also contribute storm water runoff. For the sites not currently managed under the USEPA NPDES Storm Water Program, the TMDL pollutant loads and allocations have been grouped with nonpoint storm water discharge activities. Activities that are covered by the storm water program are addressed under point source discussions.

Point Sources

Several types of point sources exist within the SF CWR Subbasin, including municipal WWTPs, suction dredge mining operations, and storm water runoff. Point sources are generally minor contributors to the loading of the most significant pollutants in the SF CWR Subbasin (temperature, sediment, nutrients and bacteria), when compared to nonpoint source loading. However, the Grangeville wastewater treatment plant (WWTP) is a significant contributor to nutrient and heat loading in Threemile Creek.

Municipal Wastewater Treatment Plants

Five municipal WWTPs exist within the SF CWR Subbasin: Kooskia, Stites, Grangeville, Elk City, and Red River Ranger Station. Each of these facilities has been issued an NPDES permit by USEPA to discharge wastewater to waters of the United States. These permits contain conditions and limits for certain pollutants based on the design flow for each facility and have a five-year life. The USEPA reissued NPDES permits for Kooskia, Stites, Elk City and Red River Ranger Station in October 2002. Typically, reissuance of NPDES permits should occur immediately following completion of a TMDL, so that wasteload allocations for point sources in the TMDL can be incorporated into the permit. However, due to delays in initiating work on the SF CWR TMDL, the NPDES permits for all facilities except Grangeville have already been reissued. Table 28 lists the five municipal WWTPs, and identifies existing permit limits and the design flows. Figure 42 shows their locations in the SF CWR Subbasin

Table 28. NPDES permitted point sources in the SF CWR Subbasin.

Source	Permit #	Expiration Date	Location	Receiving Water	Permit Limits	Discharge Volume (MGD[a])
City of Kooskia	ID-002181-4	9/30/07	Kooskia	SF CWR	BOD[b] TSS[c] TRC[d] Fecal[e]	0.20
City of Stites	ID-002034-6	9/30/07	Stites	SF CWR	BOD TSS TRC, Fecal	0.070
Elk City	ID-002201-2	9/30/07	Elk City	Elk Creek	BOD TSS TRC Fecal	0.12
Red River Ranger Station	ID-002069-9	9/30/07	S.F. Red River	South Fork Red River	BOD TSS	0.0063
City of Grange-ville	ID-002003-6	12/29/92	Grangeville	Threemile Creek	BOD TSS TRC Fecal TA[f], pH	0.88

[a]Million gallons per day
[b]Biological oxygen demand
[c]Total suspended solids
[d]Total residual chlorine
[e]Fecal coliform bacteria
[f]Total ammonia

The most significant pollutants discharged from WWTPs include nutrients (N and P), bacteria (*E. coli*, fecal coliform, etc.), sediment (TSS), oxygen demanding materials (biological oxygen demand [BOD]), and heat. Depending on the concentrations of these pollutants in the effluent, and the magnitude of the discharge compared to the stream flow, WWTP discharge can be an exceedingly minor contributor or a major contributor. Kooskia, Stites, Elk City, and the Red River Ranger Station discharges are relatively small in comparison to stream flow. However, the discharge from the Grangeville WWTP can be quite significant in comparison to the flow in Threemile Creek, particularly during the summer and fall. More specific discussions of pollutant loading from these facilities are included in later sections.

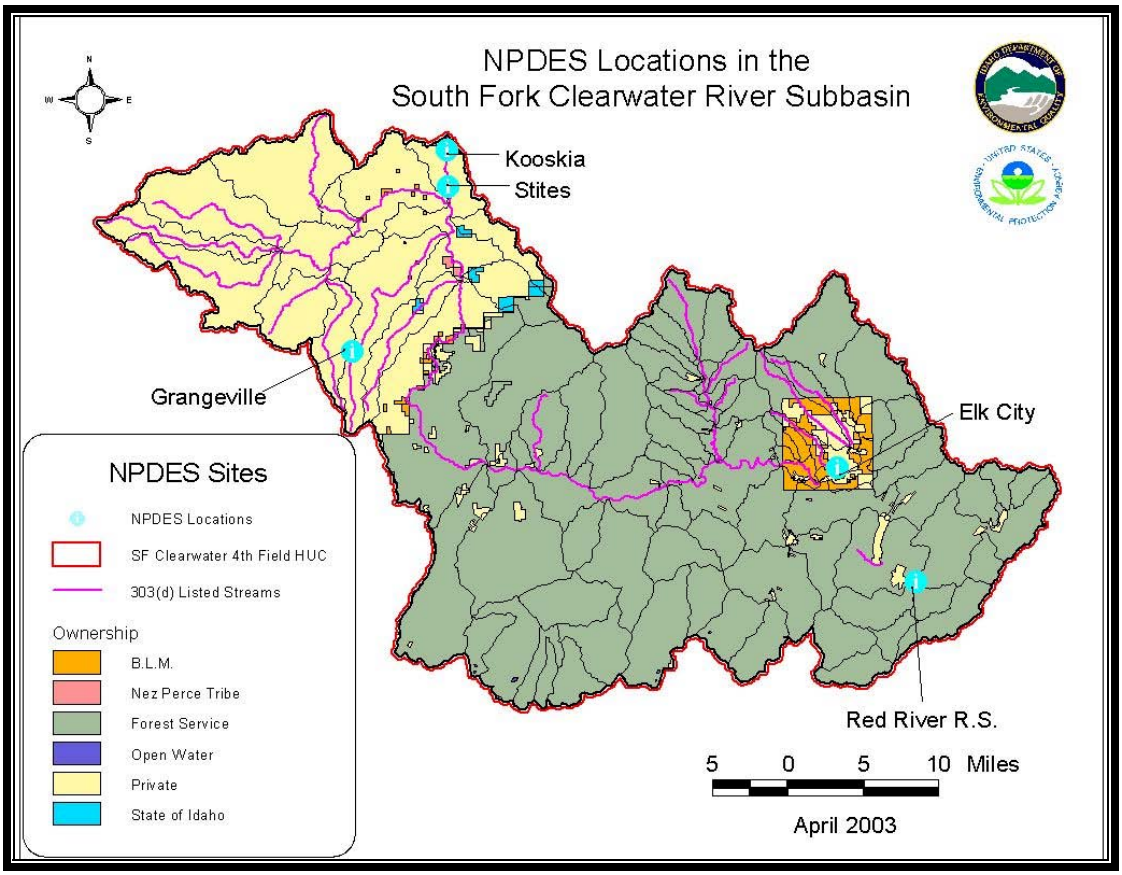

Figure 42. Locations of NPDES Permitted Sites in the SF CWR Subbasin

Suction Dredge Mining

Gold was discovered in the SF CWR Subbasin in 1861, with relatively active and intense hydraulic and dredge mining occurred off and on until World War II. Since that time, there has been far less mining activity, although there was a surge in suction dredge mining in the 1970s as a result of increasing gold prices.

A suction dredge typically consists of a floating platform on which a pump and sluice box are mounted, with a 2” to 12” flexible suction hose that reaches the bottom of the stream. The gasoline-powered pump is used to lift gravel from the stream bottom through the hose onto the sluice box mounted on a floating platform for gold recovery. The objective is to get to bedrock where it is most common to find the largest deposits of gold. The intake size of the hose and the horsepower of the engine driving the pump determine the volume of gravel that a dredge can potentially move. The amount of material actually moved depends on the skill of the operator and the conditions in which the operator is working (USEPA 1993).

Large gravel and cobble discharged to the stream is typically deposited immediately behind the sluice box. Finer material such as fine gravel and sand may move some distance downstream as bedload, and silt and finer materials are carried further downstream in the

water column. Large rock and boulder piles can form where dredges have remained in one place for a long time. Large pools may also be formed by this process.

The IDWR regulates suction dredging through the Idaho Stream Channel Protection Act (IDAPA 37.03.07.064). Under this statute, dredge miners are required to obtain a permit from IDWR (IDWR 2003). Small-scale operations (≤5" nozzle; ≤ 15 horsepower) are covered under the Individual Recreational Dredging Application permit process (a.k.a. General Permit). In the SF CWR Subbasin, dredging is only allowed from July 15 through August 15 each year, in order to avoid periods when chinook, cutthroat, and steelhead are spawning and eggs are incubating. The USEPA reviewed the IDWR General Permit for suction dredge mines in 1998, and found that it adequately addressed environmental concerns from these operations (USEPA 1998). Although there is currently no limit on the number of facilities which can operate in the SF CWR Subbasin under the General Permit, the actual number of permits issued in recent years has been limited to 15 in 2000, seven in 2001, and eight in 2002 (IDWR 2002).

Larger scale operations, or facilities that operate in waters not listed under the IDWR General Permit, must obtain permits from IDWR and the Army Corps of Engineers (ACOE) under the Joint Application Permit process. In 2000, the USFS received three applications to operate suction dredges within the NPNF which did not fall within the General Permit. The Genesis Placer proposal is to operate two dredges (5 and 8 inch diameter nozzles) year around in the Red River. A draft environmental impact statement was issued for this proposal in July 2000. The El Luky Duk proposal is to operate four different dredges of 3, 5, 6 and 8 inch diameter nozzles from July to October on the SF CWR. The Booger Placer proposal is to operate an 8 inch dredge on Little Elk Creek. Within the past five years, the only known operation of dredges >5 inch was a test run of the 8 inch Booger Placer dredge on July 6-7, 2000.

When compared to other sediment sources in the subbasin including roads and natural erosion processes, sediment loading from current recreational suction dredge operations appears to be minimal given their limited number, size, and 30 day annual operating window allowed under the current IDWR general permit. This is consistent with Harvey and Lisle (1998) who indicate that single dredging operations cannot mobilize significant volumes of fine sediment compared with the volume mobilized during high seasonal flows from throughout a watershed, when large portions of the streambed are entrained.

Suction dredges are considered to be point sources, and therefore are required to obtain an NPDES permit to discharge (USEPA 1998). Currently no NPDES permits have been issued for suction dredges within the SF CWR Subbasin, and an application for permit coverage has only been received for the Genesis dredge on Red River.

A great deal of literature exists on the effects of suction dredge mining on water quality and stream habitat. While the literature is mixed in terms of the nature and severity of effects from dredge mining operations, serious impacts to water quality and habitat have been documented, depending on the size, location and manner in which dredges are operated. For a recent summary of suction dredge impacts, see Harvey and Lisle (1998).

The NPNF began tracking, inspecting, and monitoring suction dredges in the SF CWR in 1980, with a more concentrated effort since 1995. The focus has been primarily on recreational dredging (5" or less diameter nozzle), but also to some extent on commercial dredging (greater than 5" diameter nozzle). The NPNF requires a Notice of Intent (NOI) from recreational suction dredgers which indicates the dates and locations of proposed mining. Inspections of these operations and instream monitoring are performed seasonally (DeRito 2000). The monitoring system is still being refined.

While turbidity and streambed composition data have been collected from some of these facilities off and on since 1980, there is little information available from which to estimate loading from an individual operation, or the industry as a whole. Monitoring results overall are mixed. Turbidity data that have been processed to date generally show turbidity levels below the mixing zone of small facilities (≤5 inch nozzle) to be less than 50 NTU above upstream measurements. The most recent published monitoring in the SF CWR (DEQ 2003) indicates that such facilities operating properly under IDWR permits meet the ambient turbidity criteria, but it is not clear if they would meet the turbidity treatment requirements for point sources of 5 NTU above background outside any applicable mixing zone (IDAPA 58.01.02.401.03.b.i.). Surface fines data have been difficult to interpret due to a lack of pre-dredge data, limited sample numbers, and relatively little information (DeRito 2000).

Although data from larger facilities is sparse and largely unpublished in draft reports, it suggests that these facilities have a greater impact on water column and substrate sediment levels than recreational dredges. Table 29 summarizes all available results of bedload, surface sediment and suspended sediment from dredges greater than 5 inches in the SFCWR. Surface fine sediment data from the Mendenhall and McCroskey facility suggest that surface fine sediment increases significantly in tailings below each facility (statistically significant at a 95% confidence level), but appear to return to pre-dredge levels by the following year. Bedload movement below Richardson's facility increases several-fold while the dredge is operating. Although the bedload rates are not as high as would be expected naturally at other times of year, they are cause for concern since the primary form of sediment causing impairment in the upper SF CWR is elevated substrate sediment levels thought to be due to bedload movement. Further increasing bedload sediment transport may cause additional impacts to cutthroat, chinook and bull trout spawning and incubation which occur prior to increased substrate fines levels being flushed out by high spring flows. Table 29 also clearly indicates that suspended sediment levels increase significantly below these operations, in some cases by an order of magnitude or more.

Available turbidity data is summarized in Table 30. Turbidity data for the Richardson facility on Newsome Creek are estimated based on TSS levels reported in a USFS (1980b) report, and the TSS to turbidity relationship for the Harpster location from Appendix M, page M-15. While none of the data indicates levels exceeding the 25 or 50 NTU ambient criteria, turbidity remains more than 5 NTU above background from 400 to greater than 600 feet below the dredge. This is consistent with statements in the report that turbidity plumes remain noticeable for the entire length of Newsome Creek below the dredge. Downstream mixing zone boundaries below smaller dredges in DEQ 2000 ranged from 130 – 360 feet

below the dredge. While mixing zones are quite site specific, and may be smaller in Newsome Creek due to its smaller flow, it appears likely that the Richardson facility would have exceeded 5 NTU above background outside the mixing zone.

Turbidity was only measured at one other large facility, a test of the Booger Placer dredge on Little Elk Creek in July 2000. As indicated in Table 30, turbidities significantly exceeded the 50 NTU instantaneous ambient turbidity criteria. It is also highly likely that the 5 NTU treatment technique requirement was exceeded, although the boundaries of a mixing zone were not established. The magnitude of these results is most likely due to the relatively large size of the dredge, and small size of the water body.

Table 29. Summary of sample results for suction dredges larger than 5 inches (USFS 1980a; USFS 2000).

Dredge	Location	Dredge Size	Date	Flow	Percent Surface Fine Sediment		Bedload Movement Below Dredge		Suspended Sediment and Turbidity	
		(inches)		(cfs)	Control	Dredge tailings	Control (lb/hr)	Below (lb/hr)	Control (lb/hr)	Below (lb/hr)
Mendenhall	Newsome Creek	8	Aug. 17-18, 1980		14%	34%				
		8	Aug. 4-5, 1980 (prior to dredge operating)		20%	14%				
McCroskey	Newsome Creek	5 and 6	Aug. 15-16, 1979		14%	26%			49	140 -340
Richardson	Newsome Creek	8	July 24-27, 1980				0.13	0.31 - 2.39	23	93 - 385
Richardson	Newsome Creek	8	Aug. 7, 1980				0.11	0.12 - 0.74	17	26 - 142

Table 30. Turbidity and TSS data for 8 inch section dredges (USFS 1980a; DEQ 2000).

Facility	Date	Stream		Above	Below							
					25 feet	50 feet	100 feet	200 feet	400 feet	600 feet	0.6 miles	2.0 miles
Richard-son	7/24/80	Newsome Creek	TSS (mg/L)	1.87	30	26	16	15.30	14.20	7.40		
			Estimated Turbidity (NTU)	0.91	12.49	10.85	6.73	6.44	5.99	3.19		
			Turbidity Increase above Background (NTU)	--	11.59	9.94	5.82	5.53	5.08	2.28		
Richard-son	8/7/80	Newsome Creek	TSS (mg/L)	1.98					16.54	16.54	5.05	1.90
			Estimated Turbidity (NTU)	0.95					6.95	6.95	2.22	0.92
			Turbidity Increase above Background (NTU)						5.99	5.99	1.26	-0.03
Booger Placer	7/6/00	Little Elk Creek	Turbidity (NTU)	1.9		20.8 - 230						
	7/7/00	Little Elk Creek	Turbidity (NTU)	2.0		135 - >1,000						

Confined Animal Feeding Operations

Confined animal feeding operations are facilities which confine, maintain, or feed animals for at least 45 days per year, and which harbor a minimum number of animals as defined in federal regulations (40 CFR §122.23). Smaller operations can also be classified as CAFOs if they are determined by USEPA or IDA to be significant contributors of pollution. A CAFO is considered to be a point source and therefore is subject to NPDES permits. While quite a number of animal feeding operations exist in the subbasin, particularly in the Threemile and Butcher Creek watersheds, there is no record that any of these operations are large enough outright to be considered a CAFO, nor have any animal feeding operations yet been determined to be significant contributors of pollution. Pollutant loading and allocations for existing animal feeding operations will therefore be addressed through the nonpoint source loading and allocation.

Storm Water

Storm water discharges from certain municipalities, construction activities, and industrial operations are considered to be a point sources of pollution under federal regulations (40 CFR 122.26).

There are currently no municipal separate storm sewer systems within the SF CWR Subbasin meeting the definitions of 40 CFR 122.26 and which are required to obtain an NPDES storm water discharge permit. As a result, storm water discharges from these are addressed as a component of the nonpoint source loading and allocation.

Construction activities disturbing one or more acres must obtain NPDES storm water permit coverage from USEPA for discharges occurring during the active construction phase; however, within the SF CWR, there is no information available to determine current sediment contribution from construction-related storm water runoff to the SF CWR drainage. However, construction sites and activities are generally not extensive and are widely dispersed throughout the watershed, therefore, construction activity is not considered to be a significant anthropogenic sediment contribution at this time.

Twenty-nine categories of industrial operations (determined by Standard Industrial Classification code) are required to obtain coverage under USEPA's general storm water NPDES permit for any storm water discharges associated with industrial activities. Within the SW CWR, no industrial facilities are currently authorized to discharge under USEPA's *Multi Sector General Permit for Storm Water Associated with Industrial Activity*, according to USEPA's list of permitted storm water facilities in February 2003. Such facilities may exist in the SF CWR, and yet be unaware of their obligation to apply for NPDES permit coverage.

Two facilities that have greater potential for impact due to their size and proximity to surface water are the Clearwater Forest Industries (CFI) timber processing facility in Kooskia and the Shearer Lumber Mill near Elk City. Historically Clearwater Forest Industries discharged

storm water, log deck sprinkling water, and process water through a series of seven outfalls. Process water (e.g., boiler blowdown) may be a source of excess heat loading, and storm water and log deck runoff could be sources of sediment loading.

An application for an NPDES permit was received by USEPA on March 29, 1996. The facility was contacted in August 2001 to determine if there were any updates in the application. At that time the facility indicated that they were attempting to contain all process (non-stormwater) wastewater on-site, in order to avoid the need for NPDES permit coverage, and instead apply for coverage under USEPA's Multi-Sector General Permit for industrial stormwater. Since that time, CFI has determined that there are times when they cannot contain process wastewater on-site and must discharge to the SF CWR, primarily during the spring when the source of their raw water (SF CWR) is of low quality (CFI 2003). As a result, it appears that renewal of their NPDES wastewater permit is required. More information can be obtained by visiting the Region 10 USEPA Web site at www.epa.gov/r10earth.

Shearer Lumber Mill is located on the SF CWR just below the confluence of Red River and American River. Runoff from the mill is collected through surface and underground collection systems and disposed in an underground infiltration gallery (Wilhite 2002). Shearer Lumber was covered by the NPDES General Storm Water Permit from May 1997 through September 2000, but is not currently included in the permit.

There is no information available to determine current sediment contribution from municipal, industrial or construction related storm water to the SF CWR drainage, although it is generally believed to be quite low compared to other anthropogenic sources, and the overall nonpoint source sediment load.

Nonpoint Sources

Land use practices (mining, timber harvesting, agricultural practices, and grazing) contributing nonpoint pollutants to the SF CWR Subbasin were discussed in Section 1.3. Table 31 identifies acres of land use within each water body in the subbasin. Figure 43 shows the distribution of land use throughout the SF CWR Subbasin.

Table 31. Land use in each SF CWR Subbasin WBID units.

Water Body ID	Water Body Name	Agriculture (acres)	Grazing (acres)	Forestry (acres)	Urban (acres)	Water (acres)
1	Lower SF CWR	6,758	8,513	4,129	0	0
2	Lower Cottonwood Creek	6,195	8,088	2,017	0	0
3	Upper Cottonwood Creek	16,303	3,100	1,494	248	2
4	Lower Red Rock Creek	1,499	1,279	200	0	0
5	Upper Red Rock Creek	21,080	1,821	75	0	0
6	Stockney Creek	18,793	589	190	0	0
7	Shebang Creek	16,713	684	175	0	0

Water Body ID	Water Body Name	Agriculture (acres)	Grazing (acres)	Forestry (acres)	Urban (acres)	Water (acres)
8	S.F. Cottonwood Creek	12,218	192	10	0	0
9	Long Haul Creek	7,356	519	137	255	0
10	Threemile Creek	14,235	4,146	2,671	391	0
11	Butcher Creek	6,432	2,393	1,921	0	0
12	Mid-Lower SF CWR	3,025	12,551	40,063	0	44
13	Mill Creek	0	1,127	21,977	0	0
14	Lower Johns Creek	0	1,145	25,225	0	10
15	Gospel Creek	0	1,462	9,291	0	32
16	West Fork Gospel Creek	0	377	4,023	0	16
17	Middle Johns Creek	0	316	9,879	0	5
18	Upper Johns Creek	0	232	8,442	0	0
19	Moores Creek	0	315	3,546	0	0
20	Square Mountain Creek	0	216	2,051	0	0
21	Hagen Creek	0	215	5,225	0	22
22	Middle SF CWR	0	1,335	17,591	0	28
23	Wing Creek	0	31	5,298	0	0
24	Twentymile Creek	0	198	14,422	1	13
25	Lower Tenmile Creek	0	69	2,377	0	0
26	Middle Tenmile Creek	0	25	7,200	0	4
27	Upper Tenmile Creek	0	810	12,626	0	18
28	Williams Creek	0	71	5,810	0	4
29	Sixmile Creek	0	72	5,054	0	0
30	Mid-Upper SF CWR	0	486	16,655	0	28
31	Lower Crooked River	0	421	9,060	0	1
32	Upper Crooked River	0	434	14,050	0	0
33	West Fork Crooked River	0	533	7,044	0	13
34	East Fork Crooked River	0	18	6,429	0	0
35	Relief Creek	0	355	7,129	0	0
36	Upper SF CWR	0	105	2,586	0	5
37	Lower Red River	0	720	9,610	0	3
38	Middle Red River	0	1,682	14,362	0	0
39	Moose Butte Creek	0	339	6,748	0	0
40	Lower S.F. Red River	0	260	2,892	0	0

Water Body ID	Water Body Name	Agriculture (acres)	Grazing (acres)	Forestry (acres)	Urban (acres)	Water (acres)
41	Middle S.F. Red River	0	149	2,640	0	0
42	West Fork Red River	0	147	6,258	2	0
43	Upper S.F. Red River	0	342	3,912	2	0
44	Trapper Creek	0	495	6,501	0	0
45	Upper Red River	0	940	18,216	0	0
46	Soda Creek	0	263	3,071	1	0
47	Bridge Creek	0	10	2,150	0	0
48	Otterson Creek	0	6	2,380	0	0
49	Trail Creek	0	65	4,472	0	0
50	Siegel Creek	0	164	7,579	0	0
51	Red Horse Creek	0	144	5,540	0	0
52	Lower American River	0	284	6,928	0	2
53	Kirks Fork	0	137	6,067	1	0
54	East Fork American River	0	178	11,059	0	0
55	Upper American River	0	290	14,628	0	0
56	Elk Creek	0	662	1,639	24	0
57	Little Elk Creek	0	475	4,605	0	2
58	Big Elk Creek	0	910	7,901	3	0
59	Buffalo Gulch	0	105	2,034	0	0
60	Whiskey Creek	0	15	1,645	0	0
61	Maurice Creek	0	18	1,074	0	0
62	Lower Newsome Creek	0	119	4,024	0	3
63	Bear Creek	0	101	3,730	0	0
64	Nugget Creek	0	78	1,372	0	0
65	Beaver Creek	0	76	3,567	0	0
66	Middle Newsome Creek	0	38	1,096	0	0
67	Mule Creek	0	143	5,217	0	0
68	Upper Newsome Creek	0	74	5,818	0	0
69	Haysfork Creek	0	92	3,012	0	0
70	Baldy Creek	0	113	2,534	1	0
71	Pilot Creek	0	76	3,816	1	0
72	Sawmill Creek	0	14	1,757	0	0
73	Sing Lee Creek	0	36	1,516	0	0

Water Body ID	Water Body Name	Agriculture (acres)	Grazing (acres)	Forestry (acres)	Urban (acres)	Water (acres)
74	West Fork Newsome Creek	0	139	3,167	1	0
75	Leggett Creek	0	203	4,789	0	1
76	Fall Creek	0	111	2,223	0	1
77	Silver Creek	0	222	16,172	2	0
78	Peasley Creek	0	301	8,793	1	0
79	Cougar Creek	0	379	7,353	0	0
80	Meadow Creek	0	844	23,002	0	0
81	Sally Ann Creek	2,370	1,365	5,148	0	0
82	Rabbit Creek	2,464	828	1,945	0	0

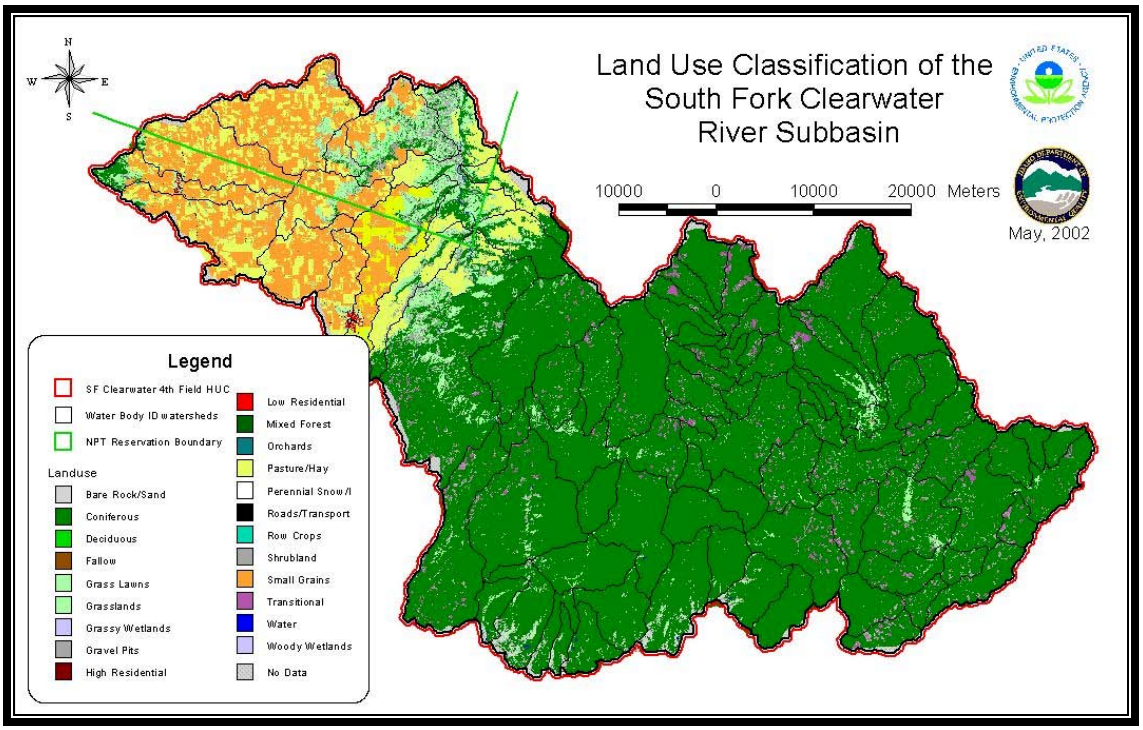

Figure 43. Land Use Distribution in the SF CWR Subbasin

Sediment

As early settlers began moving into the SF CWR Subbasin, surface erosion rates increased due to road construction, mining, timber harvest, building construction, agriculture, and grazing. This SBA identifies the major sources of sediment as road erosion, stream bank erosion, mass failures, agricultural field erosion, and grazed land erosion. Using various methods in a Geographical Information Systems (GIS) environment, we calculated estimates

of the magnitude of the erosion from each source and created a sediment budget from the results. Summary results from the sediment budget on a water body by water body basis are presented in Table 32.

The largest nonpoint sources of sediment in the subbasin are the agricultural lands in the Threemile, Butcher, Sally Ann, and Rabbit Creek drainages and the lower main stem sidewalls (Table 32). Another large source is erosion caused by livestock grazing, from grazed lands and from increased in-stream erosion as the result of reduced vegetative cover.

Surface erosion from agricultural, grazing, and forestlands outside the federal ownership perimeter was modeled using the RUSLE model (Renard et al. 1997) in a GIS environment (Engel 1999). The modeling was done by staff from the University of Idaho Biological and Engineering Department following methods reported in Boll et al. (2001), with an updated land use map for the SF CWR area.

Lands within the outside perimeter of the NPNF, including BLM and private inclusions, were evaluated for sediment production using the NEZSED sediment model (USFS 1981). This model estimates sediment produced by forest practices and then routes it through the hydrologic system. The most important source of estimated sediment in this model is from forest roads. Less important sources are logging areas, burned areas, logging decks, and other forest practice impacted areas. The NEZSED model does not estimate sediment from grazing or mining practices that occur within the federal perimeter, nor does it include estimates of human activity-related mass failures.

Mass failures within the federal perimeter were accounted for by an inventory conducted by the NPNF and the BLM. We extrapolated those results to estimate sediment from mass failures throughout the SF CWR Subbasin.

The primary effect of grazing on sediment is increased stream bank erosion as the cattle access the stream. We conducted an inventory of stream bank erosion to quantify sediment from this source. We inventoried all of the known eroding streams in the subbasin. The inventory method is presented in Appendix L.

Using the WEPP road model, the University of Idaho developed a database to model sediment from county roads outside the federal perimeter (Flanagan and Livingston 1995). For gravel and other sediment coming from State Highway 14 that follows the main stem from Kooskia to Elk City, we estimated the amount of sediment being delivered to the river based on the amount of rock ITD crushes on a yearly basis. The estimate was adjusted for delivery, as were other sediment sources (Appendix L).

All of these sources of sediment and our calculations are presented in Appendix L, Sediment Budget. Summary sediment delivery results for all subbasin water bodies are shown in Table 32.

Table 32. Sediment loads from nonpoint sources for each of the water bodies in the SF CWR Subbasin.

Water Body No.	Area	WEPP & Highway 14	NEZSED	RUSLE	Mass Failures	Instream Erosion	Total Sediment	Background Sediment Rate	Total Background Sediment	Routing Coeffic-ient	Routed Activity Sediment
	(mi^2)	(t/WB/yr)	(t/yr/WB)	(t/WB/yr)	(t/WB/yr)	(t/WB/yr)	(t/WB/yr)	(t/mi^2)	(t/WB/yr)		(t/WB/yr)
1	30.8	72		2638	21		2,732	30E	925	0.54	975
2	26.5	MD		12572	MD	MD	12,572	30E	794	0.55	6,532
3	33.2	MD		19807	MD	MD	19,807	30E	995	0.53	10,017
4	4.6	MD		2633	MD	MD	2,633	30E	139	0.76	1,892
5	36.7	MD		25261	MD	MD	25,261	30E	1,101	0.52	12,632
6	31.2	MD		19898	MD	MD	19,898	30E	937	0.54	10,207
7	28.7	MD		11691	MD	MD	11,691	30E	862	0.55	5,918
8	19.8	MD		10108	MD	MD	10,108	30E	594	0.58	5,558
9	13.8	MD		6194	MD	MD	6,194	30E	413	0.62	3,606
10	33.6	205		11632	43	616	12,496	30E	1,007	0.53	6,105
11	16.8	137		1708	21	211	2,078	30E	503	0.60	948
12 NFM	27.6	177		4817	21		5,015	30E	694	0.55	2,379
12 FM	61.0	948	2,651		381		3,980	38	2,503	0.55	813
13	36.6		1,050		180		1,230	27	971	0.52	136
14	41.2		1,248		8		1,256	29	1,212	0.51	23
15	16.9		1,207				1,207	72	1,207	0.60	0
16	7.0		346				346	50	346	0.70	0
17	15.9		510				510	32	509	0.61	1
18	13.6		544				544	40	544	0.63	0

Water Body No.	Area	WEPP & Highway 14	NEZSED	RUSLE	Mass Failures	Instream Erosion	Total Sediment	Background Sediment Rate	Total Background Sediment	Routing Coeffic-ient	Routed Activity Sediment
	(mi^2)	(t/WB/yr)	(t/yr/WB)	(t/WB/yr)	(t/WB/yr)	(t/WB/yr)	(t/WB/yr)	(t/mi^2)	(t/WB/yr)		(t/WB/yr)
19	6.2		551				551	89	551	0.72	0
20	3.6		316				316	89	316	0.80	0
21	8.7		417				417	48	417	0.68	0
22	29.6	468	1,167		23		1,658	36	1,073	0.54	318
23	8.3		256				256	30	251	0.68	3
24	22.9		476				476	20	458	0.57	10
25	3.8		120				120	30	115	0.79	4
26	11.3		313				313	27	303	0.65	7
27	21.3		998				998	47	998	0.58	0
28	9.2		262				262	29	262	0.67	0
29	8.0		152				152	17	135	0.69	11
30	26.8	472	848				1,320	28	752	0.55	314
31	14.8		418				418	25	371	0.62	29
32	22.6		460				460	19	425	0.57	20
33	11.9		270				270	23	267	0.64	2
34	10.5		287				287	27	280	0.66	4
35	11.7		226				226	17	196	0.64	19
36	4.2	148	147				295	26	109	0.77	144
37	16.1		376		49		425	17	281	0.61	87
38	25.1		680			210	891	20	503	0.56	217

Water Body No.	Area	WEPP & Highway 14	NEZSED	RUSLE	Mass Failures	Instream Erosion	Total Sediment	Background Sediment Rate	Total Background Sediment	Routing Coeffic-ient	Routed Activity Sediment
	(mi^2)	(t/WB/yr)	(t/yr/WB)	(t/WB/yr)	(t/WB/yr)	(t/WB/yr)	(t/WB/yr)	(t/mi^2)	(t/WB/yr)		(t/WB/yr)
39	11.1		261			12	273	17	192	0.65	53
40	4.9		112				112	18	88	0.75	18
41	4.4		108				108	19	82	0.77	20
42	10.0		186				186	17	170	0.66	10
43	7.4		136				136	17	124	0.70	8
44	11.1		215				215	18	193	0.65	14
45	30.1		745			62	807	20	593	0.54	116
46	5.2		115				115	18	95	0.74	15
47	3.7		90				90	21	80	0.79	8
48	3.9		81				81	21	81	0.78	0
49	7.1		160			3	163	20	142	0.70	15
50	12.2		266			15	282	18	216	0.64	42
51	9.1		217				217	21	192	0.67	17
52	11.3		281				281	17	196	0.65	55
53	9.8		235				235	23	225	0.66	7
54	17.9		413				413	18	329	0.60	50
55	23.9		622		28	39	689	24	560	0.56	73
56	3.6		128			124	252	29	105	0.79	116
57	7.9		190			25	215	18	144	0.69	49
58	13.8		416			63	479	24	337	0.62	88

Water Body No.	Area	WEPP & Highway 14	NEZSED	RUSLE	Mass Failures	Instream Erosion	Total Sediment	Background Sediment Rate	Total Background Sediment	Routing Coeffic-ient	Routed Activity Sediment
	(mi^2)	(t/WB/yr)	(t/yr/WB)	(t/WB/yr)	(t/WB/yr)	(t/WB/yr)	(t/WB/yr)	(t/mi^2)	(t/WB/yr)		(t/WB/yr)
59	3.3		86			4	90	21	69	0.80	17
60	2.6		62				62	21	53	0.84	8
61	1.7		39				39	20	33	0.91	5
62	6.5		189			36	225	24	157	0.71	49
63	6.0		143				143	20	117	0.72	19
64	2.3		44				44	16	37	0.86	6
65	5.8		122				122	19	112	0.73	7
66	1.8		52				52	24	43	0.90	8
67	8.6		190				190	18	152	0.68	26
68	9.9		224				224	21	209	0.66	10
69	5.0		135				135	23	114	0.75	15
70	4.3		119				119	25	107	0.77	9
71	6.1		163				163	26	158	0.72	4
72	2.8		77				77	28	77	0.83	0
73	2.4		73				73	27	66	0.85	6
74	5.2		151				151	28	143	0.74	6
75	7.8		231			0	231	26	205	0.69	18
76	3.6		108				108	26	95	0.79	10
77	25.8		639		11		650	24	623	0.56	15
78	14.2		440		8		448	27	378	0.62	44

Water Body No.	Area	WEPP & Highway 14	NEZSED	RUSLE	Mass Failures	Instream Erosion	Total Sediment	Background Sediment Rate	Total Background Sediment	Routing Coeffic-ient	Routed Activity Sediment
	(mi^2)	(t/WB/yr)	(t/yr/WB)	(t/WB/yr)	(t/WB/yr)	(t/WB/yr)	(t/WB/yr)	(t/mi^2)	(t/WB/yr)		(t/WB/yr)
79	12.1		343		15		357	23	279	0.64	50
80	37.5		1,164		12	53	1,229	27	1,003	0.52	118
81-NFM	9.8	53		1205		1	1,258	30E	294	0.66	639
81-FM	4.1		129				129	28	114	0.66	10
82-NFM	9.0	28	0	784		0	812	30E	270	0.67	365
82-FM	0.7		13				13	18	12	0.66	1
Totals		2,708	26,210	130947	822	1,473	162,160		33,378		71,169

Explanation of Table 32 (A complete discussion is presented in Appendix L, Sediment Budget.)

"t/WB/yr" means tons per water body per year.
"E" is the estimated background erosion rate.
"MD" is missing data from the water bodies covered in the Cottonwood Creek TMDL for which we did not allocate resources to complete.
"FM" means federally managed lands
"NFM" means not federally managed lands
"Area" is the area of each water body in square miles.
"WEPP & Highway 14" is a combination of sediment production from roads outside the federally managed area estimated using the WEPP model and estimates of sediment from Highway 14.
"NEZSED" is sediment production from lands within the overall boundary of federal ownership estimated using the NEZSED model.
"RUSLE" is sediment production from agriculture and grazing lands predicted by the RUSLE model.
"Mass Failures" are estimates of sediment from road related mass failures delivered to streams based on data from the NPNF.
"Instream Erosion" is sediment estimated using the Natural Resources Conservation Service (NRCS) field methods described in the Sediment Budget (Appendix L).

(Continued on next page)

Explanation of Table 32 (continued)

"Total Sediment" is the total estimated sediment produced from the landscape in a water body, on an annual basis. These numbers are for the water body *per se*, and, in this table, are not cumulative from all water bodies upstream.

"Background Sediment Rate" is the rate derived by the NPNF for NEZSED, or our estimated rate based on the literature.

"Total Background Sediment" is the total amount of sediment from the water body landscape that is estimated to be background.

"Routing Coefficient" is that of Roehl (1962) and is an estimate of what proportion of sediment produced on the landscape is routed through the streams.

"Routed Activity Sediment" is the Total Sediment minus the Background Sediment multiplied by the Routing Coefficient, resulting an estimate of human-caused sediment being delivered by the stream at the mouth of each water body.

Water bodies 1, 10, 11, 12, 22, 30, 36, 59, 62, 64, 65, 73, and 79 are the 303(d) listed water bodies.

Water bodies 12, 81, and 82 are reported in two parts, that part managed by federal agencies, and that part in private ownership.

Water bodies 2 through 9 are those that were covered in the Cottonwood Creek TMDL.

Sediment Transport

One of the major issues with the sediment budget approach to sediment loading analysis is the question of sediment yield, or sediment routing, as we have chosen to term it in this document. There are methods for validating estimates of sediment production from the landscape and we have looked at various sources of information to be relatively sure that our estimates of sediment production make sense. However, what happens to sediment once it enters a stream network is highly uncertain in terms of being able to predict and quantify. At a conceptual level, we know that some portion of sediment delivered to a stream is actually stored within a watershed in such places as bars, floodplains, outwash fans, etc. The steeper and more energetic a stream, the higher the likelihood that sediment will be flushed through rather than stored. And, in general, the larger the water body being analyzed, the greater the amount of sediment that will be stored.

In consultation with several hydrologists in the region, we concluded that it would be nearly impossible to predict sediment routing in any sort of a reliable way. We decided, therefore, to use the routing coefficient developed by Roehl (1962), which simply relates the amount of sediment routed through a watershed to the size of the watershed. The R1/R4 suite of models (USFS 1981) for sediment estimation from forestlands uses this equation. We decided to apply it to all of our sediment sources on a uniform, water body basis, i.e., it was applied to each water body independently based on the area of that water body. However, consistent with USFS use, it was not applied at a cumulative water body level, or at the level of the total SF CWR subbasin. The sediment budget summary in Table 32, above, shows the use of the routing coefficient. Appendix L, Sediment Budget, explains its use further.

While we have very poor bedload data to use to draw any reliable conclusions about our use of the routing coefficient, the data we do have indicate that somewhat more sediment is being produced in the landscape than we have been able to account for in our TSS and bedload data. In other words, it appears that there is more storage in the watersheds than the Roehl equation predicts, especially for Threemile and Butcher Creeks. Since we switch from

instream-based, TSS sediment estimation to sediment-budget-based, total sediment estimation from the non-federal to the federal part of the subbasin, we have had to make adjustments in our calculations to account for problems in our routing estimates. These are explained more fully in Appendix L.

Human Caused Sediment

For the water bodies above Harpster, the total amount of human-caused (activity) sediment being routed through the water bodies ranges from zero for those water bodies in the wilderness to a high of 3,191 t/year for the water body around Harpster (WB 12). The next two highest sediment producing water bodies are the next two water bodies upstream from Harpster on the main stem (WB 22 and WB 30). Aside from these main stem water bodies, the following water bodies upstream from Harpster are producing greater than 100 tons of sediment per year: Mill Creek, Middle Red River (which includes Dawson Creek), Upper Red River, Lower Elk Creek, and Meadow Creek. Water bodies producing between 50 and 100 tons of sediment per year include: Lower Red River, Moose Butte Creek, Lower American River, East Fork American River, Upper American River, Big Elk Creek, and Cougar Creek. Figure 44 shows the distribution of human-caused sediment by water body.

To account for the varying sizes of the water bodies, another way of looking at sediment production is on a per unit area basis. Apart from the main stem water bodies which produce the most sediment on a per unit area basis, the following water bodies are producing the most sediment: Lower Elk Creek at 32 t/mi^2/yr, Middle Red River at 9 t/mi^2/yr (which includes Dawson Creek), Lower Newsome Creek at 8 t/mi^2/yr, Big Elk Creek at 6 t/mi^2/yr, Little Elk Creek at 6 t/mi^2/yr, Lower Red River at 5 t/mi^2/yr, and Buffalo Gulch at 5 t/mi^2/yr. Water bodies in the 3-5 t/mi^2/yr range include Mill Creek, Meadow Creek, Cougar Creek, Peasley Creek, Haysfork Creek, Mule Creek, Bear Creek, Middle Newsome Creek, Maurice Creek, Lower and Upper American River, Siegel Creek, Moose Butte Creek, Lower and Middle South Fork Red River, and Upper Red River. The other 303(d) listed water bodies, Sing Lee Creek, Nugget Creek, and Beaver Creek, are producing in the range of 1 to 3 t/mi^2/yr of human caused sediment. Figure 45 shows the distribution of human-caused sediment per unit area.

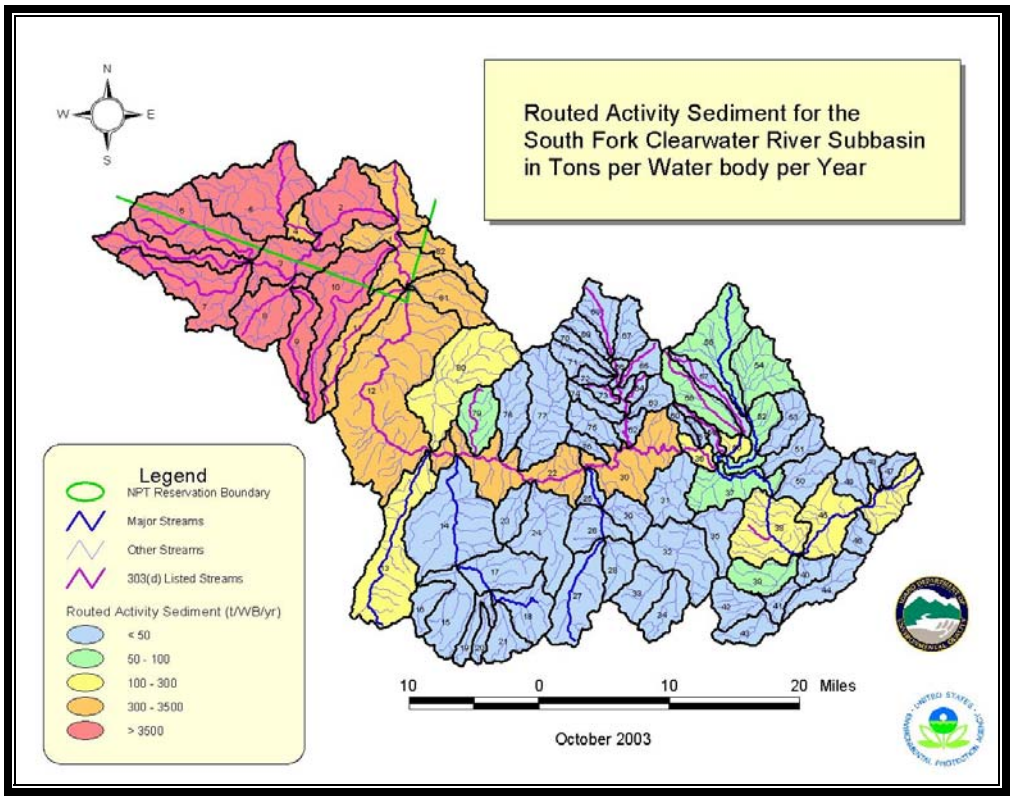

Figure 44. Sediment Production by Water Body in the SF CWR Subbasin

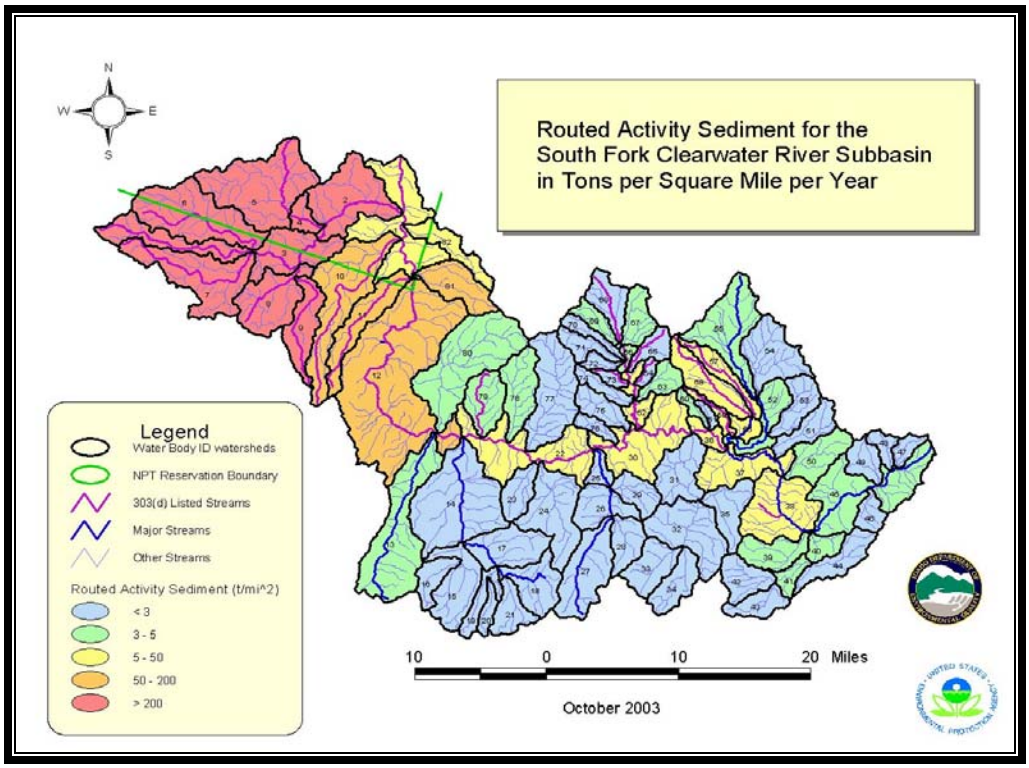

Figure 45. Annual Sediment Production per Square Mile in the SF CWR Subbasin

Sediment from Roads

The sediment budget is based on a number of data sources as presented in Appendix L and summarized in Table 32. The NEZSED model predicts sediment delivery from all forest practices, but beyond the first few years after a fire or harvest activity, the largest amount of sediment comes from roads. Table 33 shows the distribution of roads in the subbasin in relation to streams. Shaded cells show water bodies that have the highest road densities, road stream crossings, or miles of roads close to streams. Most of the 303(d) listed water bodies have high road densities and/or a large number of stream crossings.

Table 33. Road data for the SF CWR Subbasin.

WB ID	Water Body Name	Area (mi^2)	Miles of Stream	Road Miles per Water Body (mi/WB)	Road Density (mi/mi^2)	Road Crossings	Miles of Road Within 100 Feet of Stream
1	Lower SF CWR	30.8	38.3	62.3	2.0	24	4.1
10	Threemile Cr.	33.6	49.8	70.7	2.1	62	3.9
11	Butcher Cr.	16.8	18.9	32.2	1.9	13	0.7
12	Mid-Lower SF CWR	89.0	114.2	344	3.9	132	12.4
13	Mill Cr.	36.6	44.7	108.0	3.0	40	5.0
14	Lower Johns Cr.	41.2	52.1	77.3	1.9	24	3.1
15	Gospel Cr.	16.9	21.3	6.2	0.4	4	0.2
16	WF Gospel Cr.	7.0	5.9	3.0	0.4	1	0.1
17	Middle Johns Cr.	15.9	18.9	9.8	0.6	3	0.3
18	Upper Johns Cr.	13.6	21.3	9.4	0.7	5	0.4
19	Moores Cr.	6.2	8.8	9.1	1.5	6	1.5
20	Square Mntn. Cr.	3.6	5.0	1.4	0.4	0	0.0
21	Hagen Cr.	8.7	11.3	3.5	0.4	0	0.0
22	Middle SF CWR	29.6	49.8	79.2	2.7	45	8.4
23	Wing Cr.	8.3	11.0	13.9	1.7	2	0.2
24	Twentymile Cr.	22.9	27.9	35.7	1.6	12	1.1
25	Lower Tenmile Cr.	3.8	6.4	2.4	0.6	0	0.0
26	Middle Tenmile Cr.	11.3	15.0	17.6	1.6	5	0.4
27	Upper Tenmile Cr.	21.3	21.7	21.3	1.0	6	0.4
28	Williams Cr.	9.2	11.7	2.2	0.2	1	0.1
29	Sixmile Cr.	8.0	13.8	15.5	1.9	6	0.6
30	Mid-Upper SF CWR	26.8	40.2	93.4	3.5	36	7.9
31	Lower Crooked R.	14.8	19.9	46.8	3.2	11	1.4

WB ID	Water Body Name	Area (mi^2)	Miles of Stream	Road Miles per Water Body (mi/WB)	Road Density (mi/mi^2)	Road Crossings	Miles of Road Within 100 Feet of Stream
32	Upper Crooked R.	22.6	33.7	46.2	2.0	23	2.3
33	WF Crooked R.	11.9	13.5	11.4	1.0	1	0.1
34	EF Crooked R.	10.5	12.0	6.9	0.7	1	0.0
35	Relief Cr.	11.7	13.5	43.2	3.7	5	0.6
36	Upper SF CWR	4.2	6.5	12.2	2.9	4	0.3
37	Lower Red R.	16.1	24.9	93.4	5.8	31	4.0
38	Middle Red R.	25.1	43.6	129.6	5.2	58	6.0
39	Moose Butte Cr.	11.1	15.2	57.0	5.1	19	4.5
40	Lower SF Red R.	4.9	6.4	20.5	4.2	4	0.9
41	Middle SF Red R.	4.4	7.8	18.8	4.3	9	0.8
42	WF Red R.	10.0	14.9	23.7	2.4	7	0.5
43	Upper SF Red R.	7.4	7.9	27.1	3.7	4	0.5
44	Trapper Cr.	11.1	13.8	34.1	3.1	7	0.5
45	Upper Red R.	30.1	43.4	113.9	3.8	42	6.3
46	Soda Cr.	5.2	8.0	19.2	3.7	10	0.5
47	Bridge Cr.	3.7	7.2	7.3	1.9	3	0.6
48	Otterson Cr.	3.9	6.2	3.0	0.8	0	0.0
49	Trail Cr.	7.1	9.4	16.7	2.3	6	0.5
50	Siegel Cr.	12.2	13.6	43.9	3.6	16	3.0
51	Red Horse Cr.	9.1	14.0	21.9	2.4	12	1.8
52	Lower American R.	11.3	20.1	38.0	3.4	18	3.7
53	Kirks Fork	9.8	17.1	16.7	1.7	4	1.3
54	East Fork American R.	17.9	33.1	53.0	3.0	27	6.5
55	Upper American R.	23.9	39.3	61.4	2.6	29	4.6
56	Elk Cr.	3.6	4.4	10.0	2.8	6	0.3
57	Little Elk Cr.	7.9	12.7	26.8	3.4	12	1.3
58	Big Elk Cr.	13.8	19.7	40.5	2.9	19	1.3
59	Buffalo Gulch	3.3	6.5	14.5	4.3	9	0.8
60	Whiskey Cr.	2.6	4.2	9.0	3.5	3	0.2
61	Maurice Cr.	1.7	2.6	5.1	3.0	0	0.0
62	Lower Newsome Cr.	6.5	12.4	31.0	4.8	12	1.1

WB ID	Water Body Name	Area (mi^2)	Miles of Stream	Road Miles per Water Body (mi/WB)	Road Density (mi/mi^2)	Road Crossings	Miles of Road Within 100 Feet of Stream
63	Bear Cr.	6.0	8.0	32.7	5.5	4	0.2
64	Nugget Cr.	2.3	4.6	10.4	4.6	4	0.2
65	Beaver Cr.	5.8	6.7	14.9	2.6	1	0.0
66	Middle Newsome Cr.	1.8	2.3	7.8	4.4	6	0.6
67	Mule Cr.	8.6	13.8	44.4	5.2	8	0.8
68	Upper Newsome Cr.	9.9	15.7	22.9	2.3	16	2.6
69	Haysfork Cr.	5.0	9.5	24.7	5.0	7	0.4
70	Baldy Cr.	4.3	8.0	19.9	4.7	3	0.3
71	Pilot Cr.	6.1	10.4	6.9	1.1	2	0.2
72	Sawmill Cr.	2.8	6.0	0.3	0.1	0	0.0
73	Sing Lee Cr.	2.4	4.5	10.3	4.2	3	0.2
74	WF Newsome Cr.	5.2	7.2	14.5	2.8	6	1.0
75	Leggett Cr.	7.8	11.9	34.7	4.4	12	1.6
76	Fall Cr.	3.6	7.8	12.2	3.3	7	0.4
77	Silver Cr.	25.8	41.0	38.6	1.5	12	0.7
78	Peasley Cr.	14.2	22.3	66.1	4.7	24	1.9
79	Cougar Cr.	12.1	17.1	51.4	4.3	26	5.1
80	Meadow Cr.	37.5	47.8	168.1	4.5	47	6.2
81	Sally Ann Cr.	18.0	18.3	71.0	4.0	19	2.4
82	Rabbit Cr.	10.0	11.2	19.0	2.0	10	0.9

*Road Density Greater than 4.2
**Road Crossings Greater than 20 per water body
***Stream Miles Within 100 feet of Stream Greater than 2

Fisheries Technical Advisory Group Assessment of Sediment

Sediment production and delivery to a stream network, or even documented sediment in a stream channel, does not lead directly to the conclusion that the Idaho sediment WQS are being exceeded, or that beneficial uses are being impaired beyond a level acceptable under the narrative conditions of the WQS. The Fish TAG of fisheries professionals knowledgeable of fish conditions in the SF CWR Subbasin was created and asked for its best professional judgement.

The results of Fish TAG deliberations are presented in Appendix D. Whereas the Fish TAG had access to the results presented above, as well as numerous other sources of information,

its deliberations included the whole SF CWR Subbasin and did not focus to any degree on the 303(d) listed water bodies. The conclusions about sediment problems (Figure 46) are relevant to the question of importance of sediment to salmonid spawning. Generally, the fisheries biologists think there are sediment problems in all the water bodies where any significant human activity has taken place. However, among those with sediment problems above Harpster, the biologists think that fish habitat conditions are poor in Cougar Creek, Lower and Middle Newsome Creek, Buffalo Gulch, Maurice Creek, Lower Crooked River, Lower and Middle Red River (which includes Dawson Creek), Lower Elk Creek, and Lower American River.

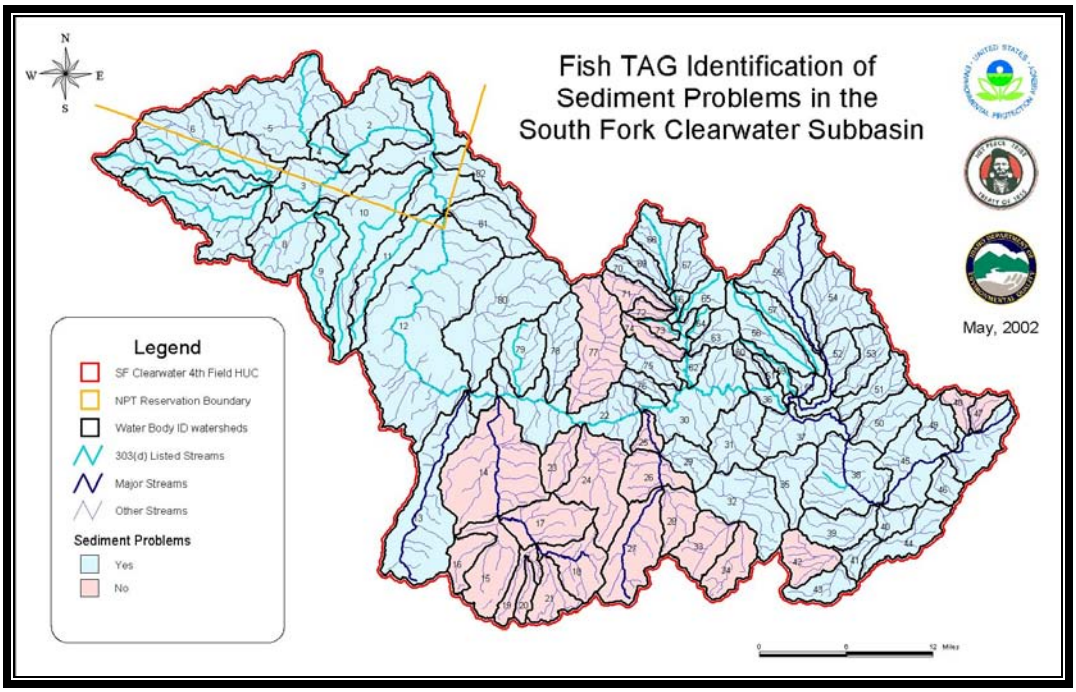

Figure 46. Fish TAG Assessment of Water Bodies in the SF CWR Subbasin with Significant Sediment Problems

The significant point of the Fish TAG identification of water bodies impacted by sediment is that they correspond relatively well with those identified by the sediment budget as having the highest sediment load (see Figure 46).

Temperature

Stream temperatures are primarily controlled by channel morphology, stream flow, shading, and air temperature. Wide, shallow streams with little shade will heat most quickly. In tributaries, forestry, mining, grazing, and other activities that cause widening of the channel, reduced depth, or reduced shade can increase stream temperatures and adversely affect salmonids. The introduction of bedload sediment resulting in increased surface area of streams may occur through overland flow from sources such as roads, agricultural practices, bank slumping, and erosion.

The lower SF CWR is naturally warm during the summer due to high air temperatures and local reach characteristics. Thermal refugia, or cold spots, in the main stem represent important areas for the survival and growth of salmonids, especially for adult fluvial bull trout. The cool water plumes at the mouths of tributaries represent another type of thermal refuge, so any activity that affects the associated tributary's temperature has the potential to degrade the quality of these areas (USFS 1999). Appendices G, H, and I present more details of water heating processes in the subbasin and our approaches to analyzing the situation.

Aquaculture Facilities

Two aquaculture facilities (hatcheries) exist in the SF CWR Subbasin, the Lukes Gulch hatchery discharging up to 1.8 cfs to the SF CWR approximately 5 miles south of Stites, and the Newsome Creek hatchery discharging up to 1 cfs to Newsome Creek approximately 3 miles upstream from the mouth. The Lukes Gulch hatchery operates from March until June 15 and rears fall chinook fingerlings (NPT 2003b). Maximum annual production is estimated to be 4,167 pounds. The Newsome Creek hatchery raises spring chinook fingerlings, and operates from May until October (NPT 2003a). Maximum annual production is estimated to be 2,601 pounds. Because the annual production from both of these facilities is less than 20,000 pounds per year, they are considered to be nonpoint sources (40 CFR §122.24 Appendix C).

These facilities are potential contributors of sediment and heat loading to their receiving waters. TSS levels in the Newsome Creek facility effluent are expected to range from 0.44 – 1.97 mg/L (NPT 2003a), and from 1.1 – 1.54 mg/L in effluent from the Lukes Gulch facility (NPT 2003b). These levels are generally well below ambient levels in the receiving water for each facility, and well below any TSS levels that would correspond to the state's turbidity WQS, i.e., TSS levels would have to be >20 mg/L before one would start to be concerned that the turbidity criteria would be exceeded.

The Newsome Creek facility uses Newsome Creek as its sole source of water, and since temperature does not increase as it passes through the facility (NPT 2003a), it is not considered to be a source of heat loading to Newsome Creek.

The Lukes Gulch facility uses a mix of SF CWR water and well water, the proportions varying between March and June. The well water is warmer than river water during this time, so effluent from the facility exceeds the temperature of SF CWR by up to 8.9 ^{o}F. SF CWR flows during this time period are approximately 1,000 – 2,500 cfs, so the 1.8 cfs discharge from the hatchery is expected to increase SF CWR temperature by no more than 0.07 ^{o}F. The SF CWR currently meets applicable temperature criteria between March and June, and this very minor increase in temperature is not expected to cause any exceedances of temperature criteria in the SF CWR.

3.2 Data Gaps

This assessment has identified several data gaps that limit full assessment of the effects of 303(d) listed pollutants on beneficial uses. Some of the data gaps will be filled with additional sampling efforts. As part of the TMDL implementation phase, a long-term monitoring plan will be developed that will address data gaps. Data limitations are also indicated in the TMDL loading analysis (Sections 5.1 through 5.3).

Point Sources

Additional nutrient monitoring and diurnal DO monitoring is needed to determine the effects of the Grangeville WWTP on Threemile Creek, particularly during the April – June time frame.

Nutrient monitoring is also recommended for Elk Creek. Observations indicate there are areas with potential excess algae growth which could result in low DO. Diurnal DO monitoring is recommended to evaluate effects of the Elk City WWTP.

Given the lack of consistent monitoring of the effects of suction dredging, a monitoring plan should be established to further characterize and assess the sediment and habitat impacts of this industry on an ongoing basis.

There is a need to collect temperature data from the outflow of each of the WWTPs. Similarly, there is a need to collect flow data in the recipient streams at the point of discharge for each of the WWTPs.

Nonpoint Sources

The nature of the problem of nonpoint source pollution is that there are always significant data gaps resulting from extrapolation of data points across a landscape. Nonpoint source pollutant analysis can always benefit from a greater density of sampling, such sampling being limited by time and money.

Bacteria

Data are generally lacking altogether for bacteria in the upper part of the basin upstream from Harpster. Monitoring in other areas of north Idaho of grazed forest and meadow systems has shown elevated levels of bacteria. For the SF CWR SBA, this type of data was not available.

Temperature

For the purposes of this TMDL, we assume that the majority of human caused nonpoint source heat loading over background is the result of streamside vegetative alteration causing reduced shading of the streams and increased stream widths. We set our heat loading reduction targets based on this assumption. However, we lack data or models that describe pre-human vegetative condition/shading or stream channel morphology. We have used the

results of various studies and models to arrive at a best approximation of desired streamside vegetative conditions and assume that these conditions will mitigate the effects of human activity with regard to stream temperature.

Sediment

Nonpoint source sediment is identified as bedload and TSS coming from a number of sources. Various models and direct monitoring techniques have been used to quantify the amounts of sediment from different sources and the fate of the sediment as it is transported through the system. Clearly, a high level of uncertainty exists when mixing and matching so many different technical approaches and models. A more unified and quality controlled system of measuring or modeling sediment production, routing, fate, and transport throughout the subbasin could add substantially to the reliability of the results of this analysis.

Probably the largest source of uncertainty in the overall sediment budget analysis is the routing of the bedload. It is recognized that sediment produced by various sources on the landscape is not all routed directly through the hydrologic system. Differing percentages of sediment are stored at various locations in the system (depositional areas, alluvial fans, floodplains, etc.), depending on the nature of the watershed and the events producing the sediment. As a generality, the larger the watershed under consideration, the higher percentage of the sediment that is stored, rather than transported through the system. With our various models and measurements, we are getting better at calculating sediment production on the landscape. However, we have relatively little ability to quantify the routing of such sediment. For the purposes of this TMDL, we used the Roehl (1962) routing equation for all particle sizes except the coarse bedload. For coarse bedload, we applied the results of a study by Beechie (2001). Both of these methods provide coarse generalities, and a method for quantifying sediment routing through any particular hydrologic system would add greatly to the sediment budget analysis.

The single largest source of sediment in the subbasin appears to be surface erosion from agricultural and grazing lands. Numbers for this source were generated using the RUSLE (Renard, et al. 1997) model in a GIS environment (Engle 1999). The largest source of error, as this model was applied to the private lands of the subbasin, was the land use map. An up-to-date land use map could change the results from this model. Similarly, the C-factor for erosion from the different land uses needs to be validated for the different land uses of the subbasin.

The largest portion of sediment in the SF CWR Subbasin is shown in this TMDL to move in pulses associated with high rainfall, rapid snowmelt, or large rain-on-snow events. In the largest of these, rain-on-snow events such as occurred in 1996, a significant portion of the sediment is generated by mass failures. The NPNF inventoried mass failures from the 1996 events; however, no similar inventory exists for the private lands. We extrapolated the results from the federally managed lands to the private lands, coupled with an aerial photo investigation. Several assumptions had to be made about percent delivery and whether the mass failure was natural or road related. A complete inventory of mass failures over the

whole subbasin describing date of occurrence, size, percent delivery, particle size distribution, and cause would significantly improve the reliability of information about this sediment source. Alternatively, a model could be developed to predict sediment delivery from mass failures over time, but these events are so episodic as to be hard to predict except over a very long time frame.

To develop this TMDL, we collected data on in-stream erosion rates using a methodology developed by the NRCS (Appendix L). The field measurements for the methodology are fairly well set out, but the final calculation requires an estimation of bank recession rate, based largely on best professional judgement. While we conducted considerable field correlation and quality control of these estimates in the field, a better method for developing these estimates would increase the reliability of this method and confidence in its results.

We were able to better quantify sediment from roads. We developed estimates of sediment from the State Highway 14 that runs from Kooskia to Elk City based on the amount of gravel that is crushed each year and distributed on the road. We reduced the sediment load through estimates of percent roads delivering and the routing coefficient. Above the NPNF boundary, NEZSED was applied to Highway 14. Better collaboration with ITD could result in a much better understanding and quantification of this sediment load.

For the roads outside the federal boundary, we estimated sediment from the county roads using the WEPP model. However, we have no data for sediment coming from private forest practice or agricultural roads. The *Forest Practices Cumulative Watershed Effects Process for Idaho* (IDL 2000) identifies roads as the major source of sediment from forest practices. Similarly, NEZSED shows that sediment from roads is usually the major component. An equivalent rate of sediment production could be assumed for private agriculture and grazing use roads. However, we do not have an inventory of these roads, or any reasonable way to estimate their contribution to the sediment budget. It is unlikely that privately owned roads produce a greater magnitude of sediment than the WEPP modeled roads, so would be fairly insignificant in the larger picture of sediment production from this landscape. We assume that the nonpoint source sediment load reductions allocated to these water bodies will result in any needed sediment reductions from private roads as well.

The NEZSED model does not estimate surface erosion coming from cattle grazing. We estimated the effects of livestock as they affect stream bank stability, but we have no data to estimate the amount of sediment that is being delivered from cattle trails and from other effects of livestock grazing. This is a data gap for the federally managed lands only. For the private lands, the RUSLE model estimates sediment coming from grazing in the land use and land cover parameters.

We lack data on the legacy effects of sediment left in place from the dredge and placer mining that took place in this subbasin 50 to 100 years ago. Relatively large portions of the stream channels were altered significantly by these operations. Today they appear relatively stable, with the dredge mining spoils appearing much the same as they have historically. While these dredge-mined areas are considered to be poor salmonid habitat, we have not

been able to differentiate between historic and more recent sediment effects. Studies and data are limited on the effects of suction dredging taking place in the SF CWR Subbasin.

While the NEZSED model as part of the R1/R4 suite of models has estimated the background sedimentation rate for forested landscapes, a similar estimation of background erosion rates for agricultural and grazing lands is largely nonexistent. While it would take a significant change in the estimate of background erosion rates for private lands to change their load reduction allocations very much, the fact remains that this parameter is estimated with limited information.

4. Subbasin Assessment – Summary of Past and Present Pollution Control Efforts

4.1 Point Source Control Efforts

Of the point sources of pollution in the SF CWR Subbasin, the community WWTPs are among the largest in the subbasin, however they have a relatively strong record for treatment before discharging to waters of the subbasin. Other point sources of interest are wood products industrial plants and recreational suction dredge mining operations.

Wastewater Treatment Facilities

Red River

The Red River Ranger Station is located near the confluence of the South Fork Red River and the main stem of Red River. The WWTP, operated by the NPNF, consists of secondary treatment and chlorine disinfection. Sewage flows to a waste stabilization pond followed by passage through a sand filter for treatment. This is followed by chlorine disinfection prior to release into the South Fork Red River at the confluence with Red River proper (USEPA 2002e). Exceedances listed in discharge monitoring reports between 1995 and 2000, according to the USEPA fact sheet for plans to reissue the NPDES permit to the Red River Ranger Station (USEPA 2002e), included exceedances of the following parameters:

- BOD (1995-2000)
- TSS (1995-1997, 1999)
- Fecal coliform (1995)
- pH (1995)

The NPDES permit for the Red River Ranger Station WWTP expired on December 31, 1978, and was administratively extended on October 29, 1979. A renewal application was received by USEPA on June 25, 2001, and USEPA reissued the permit on October 1, 2002. The new permit includes the stipulation that the permittee develop a facility plan and schedule in the event that average annual input exceeds capacity for three consecutive months. More information is available on the Region 10 USEPA Web site at www.epa.gov/r10earth (USEPA 2002e).

Elk City

Elk City is located in the American River watershed. The Elk City Water and Sewer Association municipal WWTP uses treatment equivalent to secondary treatment and chlorine disinfection. The facility collects wastewater through a gravity sewer collection system and treats it in an aerated waste stabilization pond. It is then disinfected using chlorine prior to release into Elk Creek, a tributary of the American River (USEPA 2002d). Exceedances listed in discharge monitoring reports between 1995 and 2000, according to the USEPA fact

sheet for plans to reissue the NPDES permit to the Elk City Water and Sewer Association (USEPA 2002d), included exceedances of the following parameters:

- BOD (1995, 1998)
- Total residual chlorine (1995-1998)
- BOD percent removal (1995-2000)
- pH (1996-1998)

The NPDES permit for the Elk City Water and Sewer Association expired on May 31, 1993. The initial renewal application was received by USEPA in December 1992. An updated renewal application was filed on July 9, 2001. The USEPA reissued the permit on October 1, 2002. The new permit includes the stipulation that the permittee develop a facility plan and schedule in the event that average annual values exceed capacity for three consecutive months. More information can be obtained by visiting the Region 10 USEPA Web site at www.epa.gov/r10earth (USEPA 2002d).

Grangeville

The city of Grangeville operates a municipal WWTP that discharges into Threemile Creek. Originally the system consisted of a trickling filter and primary clarifier with anaerobic digestion, followed by drying beds and treatment in a single chlorine tank before discharge. This system was ineffective, as high flows in the spring often overloaded the system.

In 1989, the City of Grangeville upgraded with a new $3 million system designed to handle 0.88 million gallons per day (MGD). The new system consists of activated sludge and a boat clarifier inside oxidation ditches, followed by a clear water weir and three chlorine contact tanks. The treated effluent is discharged into Threemile Creek via an underground pipe (Klecha 2002). Inspections in 1996 (USEPA 1997) and 2002 (DEQ 2003) found the facility to be generally in compliance. An NPDES permit was issued to Grangeville on December 30, 1987, and expired on December 29, 1992. The USEPA will initiate reissuance of the permit once the SF CWR TMDL is complete.

Stites

The City of Stites is located on the main stem SF CWR. The municipal WWTP for the City of Stites uses treatment equivalent to secondary treatment and chlorine disinfection. Sewage is moved through a pump station to a lagoon cell where it is treated. It then undergoes chlorine disinfection before release into the SF CWR (USEPA 2002b). Exceedances listed in discharge monitoring reports between 1995 and 2000, according to the USEPA fact sheet for plans to reissue an NPDES permit to the City of Stites (USEPA 2002b), included exceedances of the following parameters:

- BOD (1995)
- TSS (1995-2000)
- Fecal coliform (1995-1999)
- BOD percent removal (1995-1999)

The NPDES permit for the City of Stites municipal WWTP expired on January 9, 1991. The renewal application was received by USEPA on July 31, 2001. Upon completing an anti-degradation analysis, USEPA concluded that continued discharge will not reduce water quality beyond the mixing zone. The USEPA reissued the permit on October 1, 2002. The new permit includes the stipulation that the permittee develop a facility plan and schedule in the event that average annual values exceed the capacity for three consecutive months. More information can be obtained by visiting the Region 10 USEPA Web site at www.epa.gov/r10earth (USEPA 2002b).

Terry Nab, the engineer developing the facility plan for the City of Stites, is recommending as part of this plan that the City of Stites connect with the City of Kooskia's WWTP. The City of Stites recently applied for financial assistance with the U.S. Department of Agriculture's Rural Utilities Service, which has prepared an Environmental Assessment evaluating the effects of connecting the City of Stites to the City of Kooskia's sewage system. The proposed project would additionally make improvements to the City of Stites' sewage collection system. The comment period required under the National Environmental Policy Act (NEPA) process ended July 19, 2002. As of this time, the cities have decided to move forward with project, but have not yet begun construction.

Clearwater Forest Industries

Clearwater Forest Industries (CFI) is located off State Highway 12 between Stites and Kooskia. The timber processing operation has a total of seven outfalls discharging to the main stem SF CWR. Outfalls 1, 3, and 7 combine wastewater from log deck sprinkling during April through October, and storm water. Outfalls 2, 5, and 6 are for storm water only. Outfall 4 is for a combination of storm water and boiler blowdown with recycled kiln condensate. Treatment of outfalls 3, 4, and 7 is provided through the use of settling ponds, while outfalls 1, 2, 5, and 6 receive no treatment prior to release to the SF CWR (USEPA 2002c).

An application for an NPDES permit was received by USEPA on March 29, 1996. The facility was contacted in August 2001 to determine if there were any updates in the application. At that time the facility indicated that they were attempting to contain all process (non-stormwater) wastewater on-site, in order to avoid the need for NPDES permit coverage, and instead apply for coverage under USEPA's Multi-Sector General Permit for industrial stormwater. Since that time, CFI has determined that there are times when they cannot contain process wastewater on-site and must discharge to the SF CWR, primarily during the spring when the source of their raw water (SF CWR) is of low quality (CFI 2003). As a result, it appears that renewal of their NPDES wastewater permit is required. More information can be obtained by visiting the Region 10 USEPA Web site at www.epa.gov/r10earth.

Kooskia

The City of Kooskia is located on the main stem SF CWR near the confluence with the Middle Fork Clearwater River. The City of Kooskia operates a municipal WWTP that uses

treatment equivalent to secondary treatment and disinfection. Sewage is treated in a two-cell aerated lagoon, followed by a settling contact chamber. Wastewater is then disinfected by chlorination prior to discharge to a polishing ditch prior to release into the SF CWR at river mile 0.5 (USEPA 2002a). Exceedances listed in discharge monitoring reports between 1995 and 2000, according to the USEPA fact sheet for plans to reissue an NPDES permit to the City of Kooskia (USEPA 2002a), included exceedances of the following parameters:

- TSS (1995-1999)
- Fecal coliform (1995-2000)
- BOD percent removal (1995-1999)
- pH (1996)

The NPDES permit for the City of Kooskia expired on March 20, 1991. A renewal application was received by USEPA on May 24, 2001. Upon completing an anti-degradation analysis, USEPA concluded that continued discharge will not reduce water quality beyond the mixing zone in the SF CWR and reissued the permit on June 26, 2002. The new permit includes the stipulation that the permittee develop a facility plan and schedule in the event that average annual values exceed capacity for three consecutive months. More information is available on the Region 10 USEPA Web site at www.epa.gov/r10earth (USEPA 2002a).

Suction Dredge Mining

The IDWR regulates suction dredging through the Idaho Stream Channel Protection Act (IDAPA 37.03.07.064). Under this statute, dredge miners are required to obtain a permit from IDWR (IDWR 2003). Small-scale operations (less than or equal to 5 inch nozzle; less than or equal to 15 horsepower) are covered under the One Stop Recreational Dredging Application permit process (a.k.a. General Permit). The U.S. Army Corps of Engineers (ACOE) has determined that recreational suction dredge mining activities that meet the criteria established by IDWR for their One-Stop Recreational Dredging Permit do not require a CWA Section 404 permit (ACOE 2003).

In the SF CWR Subbasin, dredging is only allowed in the SF CWR mainstem, and only from July 15 through August 15 each year, in order to avoid periods when chinook, cutthroat, and steelhead are spawning and eggs are incubating. The USEPA reviewed the IDWR General Permit for suction dredge mines in 1998, and found that it adequately addresses environmental concerns from these operations (USEPA 1998). Although there is currently no limit on the number of facilities which can operate in the SF CWR Subbasin under the General Permit, the actual number of permits issued in recent years was15 in 2000, seven in 2001, and eight in 2002 (IDWR 2002).

Larger scale operations, or facilities that operate in waters or time frames not listed under the IDWR General Permit, must obtain permits from IDWR and the ACOE under the Joint Application Permit process. In 2000, the USFS received applications to operate suction dredges within the NPNF which did not fall within the General Permit. The Genesis Placer proposal is to operate two dredges (5 and 8 inch diameter nozzles) year around in the Red River. A draft environmental impact statement was issued for this proposal in July 2000.

The El Luky Duk proposal is to operate four different dredges of 3, 5, 6 and 8 inch diameter nozzles from July to October on the SF CWR. The Booger Placer proposal is to operate an 8 inch dredge on Little Elk Creek. The Clearwater #1 proposal by Daniel Templeton plans to operate an 8 inch dredge powered by three 8 horsepower engines in the SF CWR just upstream of the confluence with Johns Creek. Within the past five years, the only known operation of dredges greater than 5 inch was a test run of the 8 inch Booger Placer dredge on July 6-7, 2000.

When compared to other sediment sources in the subbasin including roads and natural erosion processes, sediment loading from current recreational suction dredge operations appears to be minimal given their limited number, size, and 30 day annual operating window allowed under the current IDWR general permit. This is consistent with Harvey and Lisle (1998) who indicate that single dredging operations cannot mobilize significant volumes of fine sediment compared with the volume mobilized during high seasonal flows from throughout a watershed, when large portions of the streambed are entrained.

Suction dredges are considered to be point sources, and therefore are required to obtain an NPDES permit to discharge (USEPA 1998). Currently no NPDES permits have been issued for suction dredges within the SF CWR, but an application for permit coverage has been received for the Genesis dredge on Red River.

A great deal of literature exists on the effects of suction dredge mining on water quality and stream habitat. While the literature is mixed in terms of the nature and severity of effects from dredge mining operations, serious impacts to water quality and habitat have been documented, depending on the size, location and manner in which dredges are operated. For a recent summary of suction dredge impacts, see Harvey and Lisle (1998).

The NPNF began tracking, inspecting, and monitoring suction dredges in the SF CWR in 1980, with a more concentrated effort since 1995. The focus has been primarily on recreational dredging (5 inch or less diameter nozzle), but also to some extent on commercial dredging (greater than 5 inch diameter nozzle). The NPNF requires a Notice of Intent (NOI) from recreational suction dredgers which indicates the dates and locations of proposed mining. Between 1995 and 2000 inspections of these operations and instream monitoring were performed seasonally (DeRito 2000). The NPNF and DEQ have discussed additional monitoring of these operations, but there are no firm plans at this time.

4.2 Nonpoint Source Control Efforts

Nonpoint source pollution control efforts in the SF CWR Subbasin are numerous and widespread. For the most part, they come from the implementation of standardized BMPs for forestry and agriculture. Several specially funded projects have been implemented in the subbasin since passage of the CWA.

Agriculture

State, tribal, federal, and private lands in the subbasin have been cultivated and grazed since the mid-1800s (USFS 1998). Records are kept only on current contracts with private landowners for land enrolled in the Conservation Reserve Program through the Farm Services Agency. Currently, the records show contracts as early as 1992 and extending through 2011. Land enrolled in the program in the SF CWR drainage as a whole totals 1,743.7 acres, which includes the Cottonwood Creek watershed. Most of the land is enrolled as permanent wildlife habitat. There are some lands under contract to maintain existing vegetative cover, others to maintain permanent grasses and lagoons, some to provide wildlife food plots, two to maintain shallow water areas, one to establish a shelter belt (windbreak adjacent to a stream), and one to establish a tree planting plot (Sickels 2002).

The NRCS in Grangeville has treated, or is currently treating, approximately 320 acres of cropland, pasture, and hay land under the NRCS Environmental Quality Incentives Program in the SF CWR Subbasin. The program encourages using no-till agriculture, planting grass waterways, and seeding pastures and hay lands (Spencer 2002). Cottonwood Creek has had a significant amount of land treated through Cottonwood Creek TMDL implementation efforts, including a large number of acres seeded using no-till/direct-seed methods and several acres managed under nutrient management plans. An off-site water facility and some filter strips have also been installed. Additionally, more areas are expected to receive treatment in the near future. For more information, refer to the *Cottonwood Creek TMDL Implementation Plan* available at the NRCS office in Grangeville.

The NPT Land Services Division is responsible for writing conservation plans of operations for agriculture leases on Indian-owned land, based on wise land use practices and owner input. The conservation plans of operations requirements include residue management and specific tilling requirements. Residue is not to be burned and, except for harvested grass seed, must be returned to the soil. Residue cannot be grazed or baled without authorization. Residue requirements are additionally in place specifying percent coverage for various low and high-residue crops. Tilling and seeding operations are to be performed across slope or as close as possible to contour. These operations must be performed parallel to diversions or terraces, where present (NPT 2002a).

Grazing regulations in the NPNF were enacted when the forest was established in 1908. Currently, there are 12 grazing allotments active in the subbasin (USFS 1998).

Forestry

Timber harvest in the SF CWR Subbasin began in the mid- to late-1800s in association with mining activities. Commercial harvest began in the 1940s. From this time until the 1960s, harvest was largely selective, removing only high-value species. At this time ground skidding, even on steep slopes, was not considered problematic. As a result, skid trail density was higher than that of the present (USFS 1998). Since 1970, cable yarding has been required on steep slopes, reducing the amount of skid trails necessary. In addition, it has become common practice to obliterate these trails when they are no longer necessary. Fuels

abatement practices and site preparation activities have also been changed to reduce the amount of soil disturbances on harvested areas. In the 1960s and 1970s, clearcutting became the dominant harvest method, but decreased in the mid-1980s (USFS 1998).

In 1974, rules and regulations were adopted under the FPA, giving oversight of all forest practices on forest land to the state of Idaho. Inspections are made by the IDL and the federal land management agencies to ensure compliance (USFS 1998). The NPNF, through the federal Pacific Anadromous Fish Strategy (PACFISH), generally does not permit timber harvest in riparian habitat conservation areas and other areas where the activity would pose an unacceptable risk to aquatic or riparian habitat (USFS and BLM 1995).

The NPT's Forest Management Plan (1999) outlines BMPs that are to be implemented on tribal-owned lands during harvest activities. These include planting riparian buffer strips, following yarding practice requirements, following road design stipulations, and allowing revegetation time prior to beginning grazing activities (NPT 1999).

4.3 Watershed Improvement Projects

The USFS administers approximately two-thirds of the land in the SF CWR Subbasin as the NPNF. The NPNF, in conjunction with the BLM and the NPT, has been involved in numerous watershed improvement activities in the SF CWR Subbasin. Pollution control efforts have been a regular part of forestry operations. In the 1980s the Bonneville Power Administration (BPA) funded a habitat improvement project. The BPA and the NPNF entered into an agreement in 1984 (Project 84-5) to improve fish habitat in accordance with the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (Siddall 1992). The act stipulated mitigation and enhancement of fish populations affected by hydroelectric power development in the Pacific Northwest. The original agreement included plans to improve the Crooked and Red Rivers. A series of amendments subsequently resulted in the plan including improvements in four glory holes. These massive holes left in hillsides from hydraulic mining from 1852 through the 1950s exposed large areas of bare soil on extremely steep slopes. Some efforts were executed in an attempt to reduce erosion prior to Project 84-5 at some of these glory holes, but they were largely ineffective.

The USFS and BLM produced a land management plan, PACFISH (USFS and BLM 1995), in response to the declining salmon populations in the subbasin and the listing of Snake River fall chinook (*Oncorhynchus tshawhytscha*) as threatened in the Clearwater Basin under the ESA of 1973 (Federal Register 1992). The plan's strategies and goals aim to slow degradation and begin the restoration of habitat for anadromous fish. The plan sets forth management measures for proposed and new activities involving resource management and land use decisions that pose an unacceptable risk to anadromous fish. The strategy is applied to all proposed projects (including recreation, mining, timber, roads, and grazing management projects) required to comply with the ESA, NEPA, the National Forest Management Act, the Federal Land Policy and Management Act, and any other applicable environmental law. It additionally outlined measures for restoration of watersheds and fish and wildlife habitat within anadromous fish habitat. This was adopted as an interim plan

prior to the decisions resulting from the Interior Columbia Basin Ecosystem Management Project (ICBEMP) (USFS and BLM 2000). The PACFISH policy is still in place.

In 1994, BLM and USFS, in order to determine the status of the whole Columbia Basin ecosystem upstream from The Dalles, OR, commenced the ICBEMP (USFS and BLM 2000). Findings from this project were considered for the *South Fork Clearwater River Landscape Assessment* completed by the NPNF in 1998 (USFS 1998). This document characterized both social and ecological conditions within the subbasin on which to base forest management decisions. It identified water quality as one of the key issues to be addressed. Resulting recommendations from this document included road maintenance and fish habitat conservation. Road decommissioning activities in the NPNF increased after 1995, and currently forest improvements focus on road decommissioning and instream improvements (Gerhardt 2002b).

The NPNF released the *South Fork Clearwater River Biological Assessment* (BA) in April 1999 (USFS 1999). In accordance with the ESA, this assessment presents the existing conditions in the subbasin using the best available data. Screening of ongoing and proposed activities was presented on a watershed basis. The BA is used to assess all ongoing and proposed activities that affect listed species, including Snake River steelhead (*Oncorhynchus mykiss*), bull trout (*Salvelinus confluentus*), and fall chinook salmon (*O. tshawhytscha*) (USFS 1999). The NPNF conducts regular monitoring of forest practices. The results are reported annually in forest plan monitoring and evaluation reports.

The Clinton administration's Roadless Area Conservation Rule (USFS 2002b), issued on January 12, 2001, established prohibitions on road construction and reconstruction and timber harvest in inventoried roadless areas on National Forest System lands. In the NPNF, 127,000 acres of current inventoried roadless areas (6% of the NPNF) are potentially affected by this rule (USFS 2002b).

The NPT Fisheries Watershed Division has constructed exclosures in meadows and riparian areas, implemented channel alignment improvements, and performed plantings on stream banks and meadows throughout the watershed. Monitoring of these projects has been on-going to assess effectiveness. Project areas have included Red River, Newsome Creek, Johns Creek, McComas Meadows (Meadow Creek), and Mill Creek (McRoberts 2002). The NPT is currently planning road decommissioning in several watersheds in the subbasin.

Specific pollution control activities are presented in the following text by watershed. In addition to these specific projects, the BA presents road and trail maintenance and stabilization activities as well as outfitter, timber sale, and grazing allotment controls as they contribute to the mitigation efforts throughout the SF CWR Subbasin (USFS 1999).

Red River

Road building, logging, grazing, and dredge mining have heavily impacted the Red River drainage. Much of the riparian vegetation has been eliminated and the river channel has been straightened as a result of these activities. Project 84-5, a product of the agreement between

BPA and the NPNF in 1984, involved the installation of instream structures, re-establishment of vegetation, installation of streamside fencing to alleviate grazing impacts, and stabilization of areas previously disturbed by dredging activities. From 1985 to 1989, six sediment traps were constructed in the Red River drainage to reduce sediment reaching fish rearing and spawning areas (Siddall 1992).

The Cal-Idaho glory hole, the largest in the SF CWR Subbasin, is located on private land (Stewart 2002). Runoff from this pit transports sediment to the Red River. In 1990, as part of Project 84-5, a rock crib check dam to trap sediment was installed in a small canyon that drains the majority of the glory hole (Siddall 1992). The dam was effective; however its storage capacity proved to be too small and it was soon filled with sediment (Gerhardt 2002c). Further projects focusing on the Cal-Idaho glory hole were discussed in the mid-1990s, but actions were not initiated. The NPNF had a completed design for a more elaborate trap at the outlet to Red River. The trap was to be constructed busing BPA funds, but the landowner did not grant permission (Gerhardt 2002c). Shearer Lumber started using the Cal-Idaho glory hole as a wood waste disposal site, covering the eroding banks with wood waste. This, in fact, has been successful in halting the erosion. Unfortunately, the owner of the site could not be convinced to continue with this operation (Wilhite 2002).

Many improvement activities had been complicated due to the large amount of degraded land being privately owned. There were difficulties in acquiring riparian easements and providing long-term maintenance of fence and instream structures throughout the execution of Project 84-5. Permission to perform work on private land was often delayed or not granted (Siddall 1992).

Activities in 1990 and 1991, however, focused on private land just below the confluence of the South Fork Red River and the Red River proper. These activities were collectively known as the "Mullins Project," named after the private landowner, E. Mullins. The BPA-funded project was largely the result of cooperation from the Idaho National Guard, the Red River Ranger District, Shearer Lumber Company, Kelly Creek Flycasters, Potlatch Corporation, IDFG, and the U.S. Fish and Wildlife Service. Within this meadow area of approximately 0.75 mile in stream length, the channel was realigned, banks stabilized, and width to depth ratio decreased. Instream structures were also installed, and riparian vegetation was planted. As of April 1992, the project was considered successful (Siddall 1992).

In 1993, the BPA, the National Fish and Wildlife Foundation, IDFG, Rocky Mountain Elk Foundation, and Trout Unlimited purchased a 314-acre parcel in the lower Red River drainage. This parcel became the Red River Wildlife Management Area and was deeded to IDFG to manage with the goal of restoring the lower Red River Meadow ecosystem to high quality habitat for bull trout (*Salvelinus confluentus*), steelhead trout (*Oncorhynchus mykiss*), chinook salmon (*Oncorhynchus tshawytscha*), and other fish species (LRK Communications 2001). Project planning began in 1994 and implementation began in 1996. Monitoring was initiated in 1997 to assess the effectiveness of the project. As of 2001, channel length in the project area had been increased by 5,045 feet compared to pre-restoration conditions. Slope had been decreased by 40 percent, and sinuosity had been increased by 60 percent. These

efforts have resulted in a decreased water velocity at bankfull, alleviating areas of bank erosion. Channel width and depth characteristics have additionally been improved in the project area (LRK Communications 2001). More information on the project can be accessed at http://boise.uidaho.edu/hosted/redriver (LRK Communications 2001).

The 1999 NPNF BA summarized proposed activities that may have affects on the Red River drainage (USFS 1999). Included in the summary was a discussion of the proposed Hercules Mine reclamation and Soda Creek 1 and 2 Rock Pit restorations. The Hercules Mine, a lode gold mine, is located in the Ditch Creek drainage. Reclamation would involve removing trash and mining structures, breaking-up the road surface over roughly 20 acres, and seeding trees. Reclamation of Soda Creek 1 and 2 Rock Pits would include reshaping pits, replacing topsoil, creating water bars, and planting vegetation to reduce erosion (USFS 1999). Neither of these projects started prior to the drafting of this document (USFS 2002a). Improvements were made in the Bridge Creek Campground near Red River Hot Springs to alleviate sediment input and fish harassment as recommended by the 1999 BA (USFS 1999). Campsites adjacent to a tributary of Bridge Creek were blocked and tables removed to decrease traffic in the area (Sherwood 2002).

In 2001, the NPT, in cooperation with the NPNF, initiated a road and culvert inventory, which will be used to develop a transportation plan and prioritize upgrades in the watershed (McRoberts 2002). Currently, several vegetation treatment projects with associated aquatic improvement are being analyzed for the Red River basin, including the Red River Salvage and Red Pines projects.

Crooked River

The agreement between BPA and the NPNF (Project 84-5) for the Crooked River included, among others, goals of improving fish and riparian habitat. The project area extended from the confluence with the SF CWR to Fivemile Creek. Primary focus was placed on riparian revegetation, creation of floodplains where tailings piles had confined flow, and cover installation in the existing channel. Bank stabilization also occurred in areas where sharp bends in the channel had caused unstable and eroding banks (Siddall 1992).

The NPNF's 1999 BA summarized projects with potential watershed affects in the Crooked River drainage (USFS 1999). According to the BA, drilling exploration (Petsite III mine exploration) and resulting road construction (approximately 2.5 miles of road) occurred southeast of the Old Orogrande town site in 1996 and 1997. Some restoration occurred following these activities (USFS 1999). Three additional planned restoration projects (two road obliterations, one road closure, and some fish habitat structures in Crooked River) were not completed.

The NPNF and DEQ are working with the proponent of the Golden Eagle Mine, which was established in 1974, to minimize potential watershed affects. The only impact from this mine at the time of the BA was a road that was to be repaired by the end of the 2000 field season by the NPNF (USFS 1999).

American River

Elk City is located in the American River watershed. The BLM administers approximately 14,000 acres of land in the SF CWR Subbasin, primarily in the Elk City township. In the mid-1990s, the BLM prepared an aquatic habitat management plan for fish-bearing streams in the Elk City township. Activities outlined in the plan include riparian and wetland restoration, installation of instream fish habitat structures, relocation of stream channels, and construction of rearing ponds and channels (USFS 1999). Activities have been focused primarily on the dredged areas of American River. Implementation has been slowed by issues arising with mining claims. To date, the plan is roughly 30 percent implemented (Johnson 2002b). The BLM has recently closed problem roads under its jurisdiction to motorized vehicles in an effort to reduce erosion. The BLM has made road improvements, such as culvert removal and replacement, and is currently in the process of finalizing plans to further survey and improve existing roads (Johnson 2002b).

In addition to road closures and improvements, BLM has been involved with riparian exclosures and stream channel restoration efforts throughout the watershed. Instream structures and some riparian plantings have been the primary focus of restoration efforts. A total of 5 miles of instream structures/improvements have been completed on the American River by BLM. Approximately 0.3 miles of the East Fork American River have received improvements (Johnson 2002b). Grazing plans have been developed to reduce grazing impacts along stream banks and include restrictions on seasonal use, standards for utilization, and riparian grazing restrictions. Streams with overgrazing problems, including Elk Creek and Big Elk Creek, have had riparian exclosures constructed. The BLM Elk Creek and Big Elk Creek riparian pasture exclosures have been put in place for a total of 1 mile in stream length (Johnson 2002b). Section 7 ESA consultations with NMFS have been completed for all BLM grazing allotments (Johnson 2002b).

Newsome Creek

The Haysfork glory hole is a result of hydraulic mining activities in the early 1900s. This glory hole has contributed high levels of sediment into the Newsome Creek system. Efforts to rehabilitate the area began in the mid-1980s and continue today. Efforts in the mid-1980s proved ineffective, as slope failure returned the pit to the steep-sloped condition that had existed prior to rehabilitation. The glory hole was scheduled for work under the Project 84-5, but following concerns from contractors, engineers, and hydrologists, activities did not commence until 1991. At this time, the top of the glory hole was seeded with grass and fertilized. The drainage system in the hole was improved and the area was lined with erosion control material. Existing sediment traps were emptied on the stream side of the hole, and a third trap was installed above the two existing traps (Siddall 1992). In 1997, a large settling pond with a 40-year storage capacity was created at the mouth of the draw which drains the glory hole in an effort to reduce sediment input to Newsome Creek from the glory hole (USFS 1999). Efforts to date have been partially effective. The upper slopes and portions of the lower slopes have been stabilized. However, oversteepened and unstable slopes still exist on the site.

In addition to these efforts, the NPT, in collaboration with the NPNF, has set the goal of decommissioning approximately 7 miles of roads in the Newsome Creek drainage and is initiating a feasibility study to determine the destiny of the dredge mine tailings and their effect on the stream channel (McRoberts 2002). Also, an EAWS for Newsome Creek is in the final stages of completion, which makes recommendations for instream, riparian, and upland improvements.

Leggett Creek

Two projects were initiated in the Leggett Placer glory hole by the NPNF as part of Project 84-5. Trees and shrubs were planted in the glory hole in 1987, and a sediment trap was constructed adjacent to the road below Leggett Placer. Runoff was also diverted from Leggett Placer through the pond (Siddall 1992).

There were no records of glory hole planting success as of 1991, and in his Project 84-5 report, Siddall stated that further planting would be ineffective (Siddall 1992). The sediment trap was reported to be 50 percent effective at best early on, delivering sediment to Leggett Creek in major storm events (Siddall 1992). Sediment is currently removed from the trap every year and relocated to a flat area near the mouth of Leggett Creek, where it is contoured and seeded. This has reportedly worked well (USFS 1999).

Johns Creek

The NPNF has rehabilitated several roads and trails and obliterated various roads in the Johns Creek watershed (USFS 1999). In addition, the 1999 BA outlined plans to stabilize a slide on Road 9429, although work had not begun as of 2002 (USFS 2002a).

The NPT Fisheries Watershed Division installed approximately 2.5 miles of fence in the Johns Creek watershed. The resulting exclosure protects approximately 1 mile of stream length along Johns Creek from the effects of grazing. This work was accomplished with funds from the National Atmospheric and Oceanic Administration's Pacific Coastal Salmon Recovery Fund (McRoberts 2002).

Meadow Creek

Fisher Placer activities utilized water from Meadow Creek for mining operations using a 4-mile flume. Since mining ended in 1918, some revegetation has occurred naturally in the Fisher Placer. Heavy erosion has prevented vegetative growth on the steep west and north sides of the glory hole, and erosion still occurs throughout the placer. From 1982 to 1987, seeding with grasses and clover took place along the slopes. This was successful in some areas, but did not take hold in more heavily eroding areas. In 1988, BPA funds were used to plant trees on the slopes of the main glory hole as well as on two test plots to determine success. At 3.5 months, erosion was determined to be quite significant at both plots (Siddall 1992). Erosion of the slopes has continued, with significant movement in 2000. The glory hole is currently located on private land (Paradis 2002) in the Meadow Creek watershed on a hillside. It is not immediately adjacent to Meadow Creek or a tributary (Lewis 2002).

As a part of Project 84-5, a partial fish barrier was removed from Meadow Creek in 1986. Prior attempts had been made to modify barriers–once in the late 1970s using explosives and again in 1984 with further blasting. Both attempts were ineffective at improving passage. With annual maintenance efforts, though, the 1986 effort has proved successful (Siddall 1992).

The Meadow Face EIS and Record of Decision have been completed. This project contains a large component of watershed improvement work, including soils restoration, road decommissioning, road improvements, landslide stabilization and instream improvements. The NPT Fisheries Watershed Division has been involved in fence installation, riparian and stream channel improvements, and road decommissioning activities in the Meadow Creek drainage since 1997 with funding from BPA and in conjunction with the NPNF. Fencing activities began in 1997 in McComas Meadows, protecting the area from the impacts of grazing. A total of approximately 600 acres is currently protected in this area. In addition, riparian plantings, channel redirection, and removal of a constructed ditch have further improved the habitat of Meadow Creek. Culvert replacements are planned for the watershed as is decommissioning of approximately 20 miles of roads (McRoberts 2002). The NPNF performed channel restoration activities on Swede Creek, a tributary of Meadow Creek, in 2001 (USFS 2002a).

A stabilization plan was developed for a large slide area near the mouth of Meadow Creek. The slide contributes large quantities of sediment to Meadow Creek and the SF CWR. The plan involves a relief ditch to partially drain ponds at the head of the slide, but has not yet been implemented (USFS 1999).

South Fork Main Stem

Watershed improvement recommendations for the SF CWR main stem are summarized in the 1999 NPNF BA (USFS 1999). These improvements include the obliteration and rehabilitation of roads and the removal of sediment from the Leggett Placer (mentioned previously). Additionally, the document recommended reclamation activities on a small portion of the Prospector Bunny Mine. Seeding and mulching activities were suggested to rehabilitate deep gullies and unstable slopes at this site (USFS 1999).

Road rehabilitation activities on the Fisher Placer Road and Road 279L were completed by the NPNF by 2001. These resulted in improved drainage and stabilized road surfaces, which will reduce erosion. In addition, Bully Creek Road rehabilitation activities were completed in 2001, resulting in road stabilization in an area that had experienced past failures and had the potential for a number of future ones. These failures had restricted access for maintenance and resulted in a number of plugged culverts. Areas disturbed during rehabilitation activities were reseeded and mulched (USFS 2002a).

The Starbucky EIS in the Santiam, Buckhorn and several smaller face watersheds is currently being implemented. In includes road improvements, road decommissioning, and mine stabilization.

5. Total Maximum Daily Loads

A load is fundamentally a quantity of a pollutant discharged over some period of time and is the product of concentration and flow. A TMDL prescribes an upper limit, called the load or load capacity (LC), on the pollutant load discharged from all sources so as to assure water quality standards are met. The load capacity is allocated among the various sources of the pollutant. Pollutant sources fall into two broad classes: point sources, each of which receives a wasteload allocation (WLA); and nonpoint sources, which receive a load allocation (LA). Natural background (NB), when present, is considered part of the LA, but is often broken out on its own because it represents a part of the load not subject to control. The magnitude of the natural background load determines the amount of the LC that is available for allocation to human-made pollutant sources.

Because of uncertainties regarding quantification of loads and the relation of specific loads to attainment of water quality standards, the rules regarding TMDLs (40 CFR § 130) require that a margin of safety (MOS) be a part of the TMDL. The MOS may be implicit, as in conservative assumptions used in calculating the LC, WLA, and LAs. The MOS may also be explicitly stated as an added, separate, quantity in the TMDL calculation

The TMDL components presented above can be summarized symbolically as:

$$\mathbf{LC = MOS + NB + LA + WLA = TMDL}$$

The equation is written in this order because it represents the logical order in which a loading analysis is conducted. First the LC is determined. Then the LC is broken down into its components: taking into consideration the MOS and NB, the remaining portion of the LC is then allocated among point and nonpoint pollution sources.

Another step in a loading analysis is the quantification of current pollutant loads by source. This allows the specification of load reductions as percentages from current conditions, considers equities in load reduction responsibility, and is necessary in order for pollutant trading to occur. Also a required part of the loading analysis is that the LC 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 LC and pollutant source loads vary, and not necessarily in concert, determination of critical conditions can be more complicated than it may appear.

Due to the diverse nature of various pollutants, and the difficulty of strictly dealing with loads, the federal rules allow for “other appropriate measures” to be used when necessary. These “other measures” must still be quantifiable, and relate to water quality standards, but they allow flexibility to deal with pollutant loading in more practical and tangible ways. The rules also recognize the particular difficulty of quantifying nonpoint loads and allow “gross allotment” as a LA where available data or appropriate predictive techniques limit more accurate estimates. For certain pollutants whose effects are long term, such as sediment and nutrients, seasonal or annual loads are allowed.

This document has four types of TMDLs: a bacteria TMDL for Threemile Creek, nutrient and associated dissolved oxygen TMDLs for Threemile Creek, a set of temperature TMDLs that cover all of the water bodies in the subbasin, and a set of sediment TMDLs for Threemile Creek, Butcher Creek and the main stem SF CWR. The Threemile Creek bacteria TMDL is presented in Section 5.1, the nutrient TMDLs for Threemile Creek in Section 5.2, the temperature TMDLs in Section 5.3, and the sediment TMDLs in Section 5.4.

5.1 Bacteria TMDL – Threemile Creek

Threemile Creek is listed for bacteria, and data discussed in Chapter 2 indicate that development of a bacteria TMDL is warranted. Threemile Creek has been designated by the state of Idaho for secondary contact recreation. A secondary contact recreation designation is for waters in which only incidental human contact with the water is expected. It is not likely that such water bodies would be used for swimming, but some water contact, such as from fishing or other activities may occur. Idaho WQS include criteria for *E. coli* that is intended to provide protection from microbiological illnesses that may be caused by incidental water contact. The purpose of this TMDL is to reduce bacteria levels in order to meet these criteria and fully support the secondary contact recreation beneficial use.

Design Conditions

Numeric criteria to protect recreational beneficial uses apply to all perennial reaches of Threemile Creek and to intermittent reaches of Threemile Creek during periods of optimum flow (defined as 5 cfs or greater in Idaho WQS). Four sampling points in Threemile Creek were monitored twice per month for one year to estimate bacteria concentrations. At all four of these locations (above the Grangeville WWTP outfall, at the outfall, below the outfall, and at the mouth), flow was measured throughout the year. While there may be locations in the headwaters and in the canyon reach of the Threemile Creek that are intermittent in nature, the locations sampled were all perennial. As a result, the numeric bacteria criteria are applicable at these locations, and the TMDL was developed based on flow and concentration data collected from these sites.

Data shown in Table 34 indicate that bacteria WQS are exceeded consistently from May through September, with fewer violations from October through January. Peak concentrations appear to occur in August and September, which is also the period of lowest flow. In order to address critical conditions, the LC and allocations were developed based on the flows and concentrations that occur during this time. It is expected that reductions driven by these allocations will be protective other times of the year when *E. coli* concentrations are lower.

Target Selection

The criteria for *E. coli* concentrations in Idaho WQS intended to protect the secondary contact recreation beneficial use are:

- not to exceed 576 cfu per 100 ml at any time, and
- not to exceed a geometric mean of 126 cfu per 100 ml based on a minimum of 5 samples taken every 3 to 5 days over a 30-day period.

These criteria are the targets of the TMDL and have been used to establish the LC and allocations.

Monitoring Points

A comprehensive monitoring plan for bacteria should be implemented to assure planners that mitigation practices are sufficiently addressing the pollution problems. It is recommended that additional sites be monitored and that more frequent monitoring occur during times when elevated concentrations are expected in order to evaluate compliance with the 126 cfu/100 ml monthly *E. coli* criteria. In addition to existing sites, a site near the headwaters would enable planners to determine the NB concentration of bacteria. Continued monitoring above the WWTP outfall, at the outfall, and below the outfall would enable planners to monitor the city improvements to the sewer lines and WWTP modifications. A site at the head of the canyon would identify contributions from farmland below the WWTP.

Load Capacity

The LC is the greatest amount of pollutant loading a water body can receive and still meet WQS. The LC will vary with flow, that is, at higher flows a water body can accept greater loading and still comply with criteria. The LCs were estimated for the four sampling locations using the average flow recorded during August and September multiplied by the monthly mean *E. coli* criteria of 126 cfu/100 ml. While elevated concentrations of *E. coli* occur during periods of high runoff (e.g., in May), the LC was established utilizing the low flow period because a much lower bacteria loading is necessary in order to remain in compliance with established criteria.

Table 34 lists LCs at the three sampling locations used to establish the monthly criteria. The loading is presented in terms of colony forming units per day. This is not a very practical measure as there is seldom information from which to estimate such daily loads. As a result, the allocations include the percent reduction in bacteria loading needed to achieve the LC in addition to the numeric criteria.

Table 34. *E. coli* load capacities for Threemile Creek.

Location	Target (cfu/100 ml)	Critical Flow (cfs)	Load Capacity (cfu/day)
Above Outfall	126	0.7	2.1E+12
Below Outfall	126	1.5	4.7E+12
Mouth	126	2.6	7.9E+12

Estimates of Existing *E. coli* Loads

Estimates of the current concentrations and loading are presented in Table 35. Concentration data were collected during the February 2000 through February 2001 time period, with two samples collected during most months. Flow, concentration, and loading are presented by month, and are averages of the two monthly measurements. As discussed in Chapter 2, flows during this time period were somewhat below average for the time period.

Table 35. Average monthly flow, *E. coli* concentration, and loading in Threemile Creek.

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Above Outfall	Flow (cfs)[a]	1.8	1.4	2.2	3.4	5.3	2.0	0.7	0.2	1.3	0.7	0.3	0.7
	Measured *E. coli* (cfu/100 ml)[b]	28	86	95	82	903	370	710	1750	1350	300	400	41
	Measured load (cfu/day)[c]	1.13 E+12	5.07 E+12	7.52 E+12	7.18 E+12	5.44 E+13	1.13 E+13	1.33 E+13	2.84 E+13	2.30 E+13	5.65 E+12	9.03 E+12	1.35 E+12
Grange-ville WWTP (at outfall)	Flow (cfs)	1.4	1.9	2.5	1.8	1.2	1.5	3.8	3.3	2.7	2.0	1.9	1.7
	Measured *E. coli* (cfu/100 ml)	9	17	38	43	375	4	208	51	56	4	0	1
	Measured load (cfu/day)	1.97 E+11	3.73 E+11	8.34 E+11	9.44 E+11	8.23 E+12	8.78 E+10	4.56 E+12	1.12 E+12	1.23 E+12	8.78 E+10	0.00 E+00	2.19 E+10
Below Outfall	Flow (cfs)	2.9	1.5	3.4	4.6	7.0	2.6	1.3	1.0	1.7	1.4	1.3	1.1
	Measured *E. coli* (cfu/100 ml)	690	62	110	89	767	245	690	605	1201	130	20	1400
	Measured load (cfu/day)	4.39 E+13	5.24 E+12	1.18 E+13	1.03 E+13	6.59 E+13	1.29 E+13	2.74 E+13	2.23 E+13	4.54 E+13	5.17 E+12	8.80 E+11	7.78 E+13
At Mouth	Flow (cfs)	4.0	9.9	8.5	7.5	11.4	5.9	1.6	1.2	1.9	3.8	2.8	2.6
	Measured *E. coli* (cfu/100 ml)	5	17	6	6	38	67	200	77	691	120	26	38
	Measured load (cfu/day)	7.63 E+11	3.81 E+12	1.81 E+12	2.00 E+12	8.71 E+12	7.75 E+12	1.42 E+13	4.72 E+12	4.45 E+13	8.54 E+12	2.22 E+12	4.76 E+12

[a] cubic feet per second
[b] colony forming units per one-hundred milliliters
[c] colony forming units per day

Load and Wasteload Allocations

Nonpoint source allocations and WLAs are presented in Table 36, and include a WLA for the Grangeville WWTP and allocations for the other three monitoring stations. Because source-specific loading information was not available, the nonpoint allocations are gross allotments to all nonpoint sources within the reach upstream of each point, and include all sources, such as storm water runoff, animal feeding operations, septic systems, etc.

Allocations were established at the same loading and concentration as the LC in Table 34, without an explicit margin of safety. Due to the lack of sufficient information, it was not possible to differentiate background loading from anthropogenic loading, so background loading is included within the gross allocation to nonpoint sources. The percent reduction needed to achieve nonpoint source LAs is also shown, in order to provide some perspective on the magnitude of source control needed during the critical period.

The WLA for the Grangeville WWTP is established at the level of the applicable water quality criteria for *E. coli*. The monthly geometric mean limit of 126 cfu/100 ml is the same as in NPDES permits for other wastewater facilities in the SF CWR Subbasin (USEPA 2002a-d). The maximum daily limit of 576 cfu/100 ml is somewhat higher than for other regional WWTPs because Threemile Creek is designated for secondary contact recreation rather than primary contact recreation. These limits are expected to be incorporated into Grangeville's permit when it is reissued.

Margin of Safety

An implicit MOS has been incorporated into the TMDL by utilizing conservative assumptions. The period of lowest flows was used to estimate the LC. This results in a LC far below that needed to achieve criteria during 10 months of the year. The LC is also somewhat conservative during the critical August and September period, since the flows measured during the year used to derive the allocations were somewhat below normal (Chapter 2). The resulting allocations range from 36% to 92% reductions for nonpoint sources and send a clear message that major reductions are needed in order to meet criteria.

Seasonal Variation/Critical Conditions

Although the TMDL does not include seasonal allocations, it does consider seasonal variations in loading. Table 35 lists concentrations and loading by month, and the annual variation and peak in concentration in August and September is apparent. The TMDL addresses critical conditions by deriving allocations from the period of highest concentration and lowest flow, which both occur in August and September.

Background

As discussed previously, it was not possible to differentiate background from anthropogenic loading, so background has been included with other sources in the gross nonpoint source allocation. This has been identified as a data gap, and in the future it may be possible to

refine relative source contributions and refine allocations if more definitive monitoring is conducted.

Table 36. *E. coli* nonpoint source allocations and wasteload allocations for Threemile Creek.

Location	Target (cfu/100 ml)[a]	Allocation Type	Critical Flow (cfs)[b]	*E. coli* conc. (cfu/100 ml)	*E. coli* Current Load (cfu/day)[c]	*E. coli* Load Capacity (cfu/day)	*E. coli* Allocation (cfu/day)	*E. coli* Allocation (cfu/100 ml)	*E. coli* Load Reduction
Headwaters to Grangeville WWTP Outfall[d]	126	NPS - LA[e]	0.71	1530	2.7E+10	2.2E+09	2.2E+09	126 - monthly geo. Mean 576 - daily max.	92%
Grangeville WWTP Outfall to Nez Perce Reservation	126	NPS - LA	0.71	903	1.6E+10	2.2E+09	2.2E+09	126 - monthly geo. Mean 576 - daily max.	86%
	126	PS - WLA[f] Grangeville WWTP	0.89	53	1.2E+09	2.7E+09	2.7E+09	126 - monthly geo. Mean 576 - daily max.	0.0%
Nez Perce Reservation Boundary to mouth	126	NPS - LA	1.54	196	7.4E+09	4.7E+09	4.7E+09	126 - monthly geo. Mean 576 - daily max.	36%

[a] cfu/100 ml = colony forming units per 100 milliliters
[b] cfs = cubic feet per second
[c] cfu/day = colony forming units per day
[d] WWTP = wastewater treatment plant
[e] NPS-LA = nonpoint source load allocation
[f] PS-LA = point source waste load allocation

Reserve

An explicit reserve for future growth has not been set aside within the TMDL. Any increased discharge from future growth or development within the Threemile Creek watershed would need to be consistent with these allocations. In other words, it could not increase *E. coli* concentrations above target criteria identified above.

5.2 Nutrient TMDL – Threemile Creek

Threemile Creek has been designated by the state of Idaho for salmonid spawning and secondary contact recreation. Idaho's narrative standard states: "surface waters shall be free from excess nutrients that can cause visible slime growth or other aquatic growths impairing beneficial uses" (IDAPA 58.01.02.200.06). Salmonid spawning aquatic life beneficial uses can be impaired when excess algae decompose, depleting DO in the water column. Primary and secondary contact recreation can be also impacted by visible slime and algae growth resulting from excess nutrients when temperature and sunlight are not limiting.

Threemile Creek is listed for nutrients and data discussed in Chapter 2 indicate that development of a nutrient TMDL is warranted. Nitrogen and phosphorus are nutrients that are essential to the growth of algae in streams. By examining the concentrations and ratios of these nutrients, it can be determined whether one or both of these nutrients must be controlled in order to prevent excess algae growth, and low dissolved oxygen levels which may result from excess algae growth and decomposition.

Nitrogen to phosphorus ratios (mole to mole) of less than 7 generally indicate systems in which nitrogen is the limiting nutrient (Reynolds 1984). Ratios of greater than 7 generally indicate systems which are limited by phosphorus. Data collected above the Grangeville WWTP indicate the system is usually nitrogen limited during the summer months. Total nitrogen levels during the summer average 0.39 mg/L, just slightly above the USEPA Ecoregional nutrient target range of 0.22 - 0.36 mg/L (USEPA 2000), and are more than an order of magnitude below nitrogen levels below the WWTP. Although the reach above the WWTP is theoretically nitrogen limited, since nitrogen levels are so close to ecoregional nutrient target levels, further controlling nitrogen appears to be of minimal benefit.

The reach below the WWTP is phosphorus limited at all times of the year, and is the area of greatest concern due to the relatively low gradient, high nutrient concentrations, and low shade, conditions which tend to promote algae growth.

Results at the mouth are mixed, with both nitrogen and phosphorus limiting conditions occurring. These results are difficult to interpret, since the subsurface flow at the mass failure above this sampling location appears to be controlling phosphorus levels.

Controlling nitrogen appears to be of limited value above the WWTP, and in the canyon reach above the mouth. Since phosphorus is the limiting nutrient in the reach of greatest concern immediately below the WWTP, and since the costs of controlling nitrogen in

wastewater treatment plant effluent are quite high, the TMDL will only focus on controlling phosphorus.

Reducing levels of phosphorus is expected to result in decreased algae growth, thus meeting the narrative nutrient standard. Due to the very low flows in Threemile Creek during the summer, it was infeasible to model the relationship between phosphorus and DO. However, it is expected that achieving the phosphorus reductions identified in the TMDL will result in compliance with the DO standard, and phosphorus is considered to be a surrogate measure for the DO TMDL.

Design Conditions

Numeric criteria and narrative standards to protect salmonid spawning and recreational beneficial uses apply to all perennial reaches of Threemile Creek and to intermittent reaches of Threemile Creek during periods of optimum flow (defined as 5 cfs or greater in Idaho WQS). Four sampling points in Threemile Creek were monitored twice per month for one year to estimate phosphorus and nitrogen concentrations. At all four of these locations (above the Grangeville WWTP outfall, at the outfall, below the outfall, and at the mouth), flow was measured throughout the year. While there may be locations in the headwaters and in the canyon reach of the Threemile Creek that are intermittent in nature, the locations sampled were all perennial. As a result, the numeric salmonid spawning criteria and narrative nutrient standards are applicable at these locations, and the TMDL was developed based on flow and concentration data collected from these sites.

Data shown in Table 37 indicate that levels of TP consistently exceeded USEPA (2000) regional guidance of 0.030 mg/L TP for the Columbia Plateau streams and frequently exceeded USEPA guidance commonly known as the "Goldbook" (USEPA 1986) recommendations (0.1 mg/L). The headwaters had a consistent TP level of 0.056 mg/L. Above the WWTP outfall, TP ranged from 0.038 to 0.166 mg/L. Below the WWTP, TP ranged from 0.24 to 3.14 mg/L. The mouth had a fairly constant level of TP, ranging from 0.272 to 0.336 mg/L.

The critical time period for algae growth, and the time frame in which TMDL allocations have been typically applied in the Clearwater River basin, is April through September. However, within this window, it is expected that most growth occurs during the warmest months, July through mid-September, which is also the period of lowest flow with increased risk of low DO levels. In order to address the critical time period for algae growth, the LC and allocations were developed based on the flows and concentrations which occur during this time. It is expected that reductions driven by these allocations will be protective of beneficial uses during other times of the year.

Target Selection

Targets were selected for TP based on site specific characteristics of the Threemile Creek watershed and regional guidance levels discussed above. The targets are set to avoid promoting nuisance algae growth. Grangeville is still considering options for the WWTP,

including land application of its wastewater during the critical time period for excessive algae growth (July through mid-September). A waste load allocation has been established for the WWTP which will ensure compliance with the TP target set for the segment immediately downstream from the outlet. The three TP targets described below have been used to establish the LC and allocations of the TMDL.

A TP target of 0.08 mg/L was set for the segment of Threemile Creek beginning at the headwaters and ending upstream of the WWTP outfall. This target was selected based on averaging the level of TP (0.056 mg/L) in the forested headwaters with the USEPA "Goldbook" (USEPA 1986) value of 0.1 mg/L, recommended to prevent nuisance algae growth in streams. The TP background value was averaged with the USEPA (1986) value to derive a target for this portion, due to this segment's location. The segment begins in the relatively nutrient-poor forested headwater soils and progresses downstream to more nutrient rich prairie soils. The USEPA (1986) guidance was utilized because the local reference values for background TP exceeded the USEPA (2000) eco-regional guidance value of 0.030 mg/L, and the nutrient rich soils in agricultural lands are expected to further increase nutrient levels in Threemile Creek naturally. In addition, the "Goldbook" (USEPA 1986) value has been used in previously developed regional TMDLs, including the adjacent Cottonwood Creek TMDL.

A TP target of 0.1 mg/L was selected for the segment beginning at the WWTP outfall and ending at the Nez Perce Reservation boundary in the canyon. This target is based on the USEPA "Goldbook" (USEPA 1986) and reflects a slight increase from the upstream target due to natural enrichment anticipated with the change in soil type and the distance downstream from headwater areas.

A TP target of 0.3 mg/L was selected for the segment beginning at the Nez Perce Reservation boundary and ending at the mouth. Monitoring has demonstrated that the TP concentration at the mouth does not vary substantially with flow, season, or short duration changes in WWTP discharge. It is consistently near 0.3 mg/L. The exact mechanism causing these stable concentrations regardless of flow, loading and season is unknown, but it is suspected that phosphorous is taken up and released in an equilibrium reaction with soil particles as the stream flows subsurface through a large landslide for a distance of approximately 0.75 mile, 1 mile upstream from the mouth. Approximately 2 cfs continually flow subsurface at all flow rates. During the critical time period for which targets are designated, flows ranged from 1.2 cfs to 1.9 cfs at the mouth. Thus, during this interval, all flow was subsurface through the landslide. Although a detailed research study of the effects of the mass failure on TP concentrations is recommended, it is beyond the scope of this analysis. Without such information, at this time it is not reasonable to establish a TP target that would drive further phosphorus reductions upstream because it appears that it would have no benefit below the landslide. However, as nonpoint and point source treatments are implemented, targets may be re-evaluated.

A DO target based on the Idaho WQS of 6.0 mg/L was established.

Monitoring Points

A comprehensive monitoring plan for nutrients should be implemented to assure planners that mitigation practices are sufficiently addressing the pollution problems. It is recommended that three sites be monitored: one above the WWTP outfall; a second at the county road (known as Butcher Creek Road) crossing on the canyon rim (a.k.a. "Big Barn" site): and the third at the mouth. Monitoring will continue at the WWTP outfall as required by the NPDES permit.

Load Capacity

The LC is the greatest amount of pollutant loading a water body can receive and still meet WQS. The LC will vary with flow, i.e., at higher flows a water body can accept greater loading and still comply with standards. The LCs were estimated for the three segments (above the WWTP, from the WWTP to the Nez Perce Reservation boundary, from the Nez Perce Reservation boundary to the mouth) using the average flows recorded during July, August, and September, multiplied by the TP target for that site. Average flows during this time were determined to be adequately protective, because the TMDL focuses only on the critical portion of the year, which coincides with the annual period of low flow, and because flows in the subbasin in 2000 were well below average flows based on historical records in the SF CWR. While elevated concentrations of TP occur during periods of high runoff (e.g., in May), the LC was established utilizing the critical growing season for aquatic vegetation. Nutrient levels greater than the LC at this time may result in excess algae growth and depleted oxygen in the water column, thus impairing beneficial uses. Table 37 lists the LC for the critical time period at three sampling locations presented in kilograms per day. The LC for the “below outfall” site does not include WWTP loading.

Table 37. Total phosphorus (TP) load capacities for Threemile Creek.

Location	TP Target (mg/L)	Critical Flow (cfs)[a]	TP Load Capacity (kg/day)[b]
Headwater to Grangeville WWTP Outfall	0.08	0.7	0.14
Grangeville WWTP Outfall to Nez Perce Reservation Boundary	0.10	1.6	0.39
Nez Perce Reservation Boundary to Mouth	0.30	1.5	1.13

[a] cubic feet per second
[b] kilograms per day

Estimates of Existing Total Phosphorus Loads

Estimates of the current concentrations and loading are presented in Table 38. Flow, concentration, and loading are presented by month, and are averages of the two monthly measurements. As discussed in Chapter 2, flows were somewhat below average for the time period.

Monthly variations in TP concentrations and loading are shown in Table 38. Below the WWTP outfall, TP concentrations vary considerably throughout the year, with the highest concentrations and lowest in-stream flows occurring in July and August.

Above the outfall, concentrations and flows are highest in the spring (March, April, and May). Flows from the Grangeville WWTP are relatively stable year around. While total loading increases for TP at the mouth during the spring, concentrations remains fairly constant at 0.3 mg/L. This may be due to an interaction of P with soils in the landslide area as described above.

Load and Wasteload Allocations

Nonpoint source allocations for TP and a WLA for the Grangeville WWTP are presented in Table 39. Because source-specific loading information was not available, the nonpoint allocations are gross allocations to all nonpoint sources within each reach, and include all sources, such as unregulated storm water runoff, farming practices, animal feeding operations, septic systems, etc.

Allocations were established at the same loading and concentration as the LC in Table 37, without an explicit margin of safety. Due to the lack of sufficient information, it was not possible to differentiate background loading from anthropogenic loading, so background loading is included within the gross allocation to nonpoint sources. The percent reduction needed to achieve nonpoint source load allocations is also shown, in order to provide some perspective on the magnitude of source control needed during the critical period.

Table 38. Average monthly flow, total phosphorus (TP) concentration, and loading in Threemile Creek.

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Above Outfall	Flow (cfs)[a]	1.8	1.4	2.2	3.4	5.3	2.0	0.7	0.2	1.3	0.7	0.3	0.7
	Measured TP (mg/L)[b]	0.058	0.142	0.108	0.094	0.112	0.091	0.112	0.115	0.137	0.078	0.038	0.064
	Measured Load (kg/day)[c]	0.255	0.486	0.581	0.782	1.452	0.445	0.186	0.048	0.436	0.128	0.032	0.102
Grange-ville WWTP (at outfall)	Flow (cfs)	1.4	1.9	2.5	1.8	1.2	1.5	3.8	3.3	2.7	2.0	1.9	1.7
	Measured TP (mg/L)	0.896	0.741	0.876	0.799	1.100	0.99	0.737	0.876	1.056	0.869	0.735	0.740
	Measured Load (kg/day)	3.095	4.170	5.399	3.973	2.656	3.226	8.384	7.210	6.014	4.324	4.258	3.775
Below Outfall	Flow (cfs)	2.9	1.5	3.4	4.6	7.0	2.6	1.3	1.0	1.7	1.4	1.3	1.1
	Measured TP (mg/L)	0.922	0.909	0.985	0.482	0.369	0.591	2.130	2.820	16.69	12.84	7.01	1.82
	Measured Load (kg/day)	6.564	3.225	8.218	5.377	6.329	3.803	6.879	6.830	70.233	44.922	21.781	4.809
At Mouth	Flow (cfs)	4.0	9.9	8.5	7.5	11.4	5.9	1.6	1.2	1.9	3.8	2.8	2.6
	Measured TP (mg/L)	0.306	0.330	0.321	0.326	0.283	0.282	0.277	0.298	0.305	0.336	0.316	0.311
	Measured Load (kg/day)	2.957	8.017	6.699	5.974	7.879	4.078	1.071	0.860	1.388	3.148	2.165	1.955

[a] cubic feet per second
[b] milligrams per liter
[c] kilograms per day

Table 39. Total phosphorus (TP) load allocations and wasteload allocations for Threemile Creek.

Location	TP Target (mg/L)[a]	Allocation Type	Critical Flow (cfs)[b]	Peak Concen-tration (mg/L)	Average Current Load (kg/day)[c]	TP Load Capacity (kg/day)	TP Load Allocation (kg/day)	TP Load Reduction (%)
Headwaters to Grangeville WWTP Outfall[d]	0.08	NPS-LA[e]	0.71	0.13	0.24	0.14	0.14	32
Grangeville WWTP Outfall to Nez Perce Reservation Boundary	0.10	NPS-LA	0.71	0.13	0.12	0.17	0.17	32
		PS-WLA[f] Grangeville WWTP	0.89	4.6	7.3	0.22	0.22	97
Nez Perce Reservation Boundary to Mouth	0.30	NPS-LA	1.54	0.31	1.10	1.13	1.13	0
Applicable Period	July1-Sept 15							

[a] milligrams per liter
[b] cubic feet per second
[c] kilograms per day
[d] WWTP = wastewater treatment plant,
[e] NPS-LA = nonpoint source load allocation
[f] PS-WLA = point source waste load allocation

The WLA for the Grangeville WWTP was established based on the 0.1 mg/L TP target during the critical time period (July through mid- September), and average WWTP flows measured by DEQ during July-September 2000. The WLA does not apply during the remainder of the year. These limits are expected to be incorporated into Grangeville's NPDES permit when it is reissued, as monthly average limits. If further studies being conducted by DEQ and Grangeville indicate that DO or other nutrient impairments occur earlier in the summer (e.g., June), then the Grangeville WWTP and nonpoint source allocations will be revised to include this new time period.

Margin of Safety

An implicit margin of safety has been incorporated into the TMDL by utilizing conservative assumptions. The period of greatest aquatic plant growth and lowest flows was used to estimate the LC. The LC is also conservative during the critical time of July through mid-September, since the flows measured during the year used to derive the allocations were somewhat below normal (Chapter 2). The resulting TP allocations range from 32% to 90% reductions for nonpoint sources. These percentages indicate that major reductions are needed in order to meet targets set for standards attainment.

Seasonal Variation/Critical Conditions

The TP TMDL includes seasonal allocations in order to address the growing season when nutrient enrichment may result in nuisance algae growth and lower DO levels. The period in which allocations apply is also believed to encompass critical conditions for nutrient impairments, because it includes the periods of lowest flows and highest stream temperatures, which are the most conducive to rapid algae growth and depressed DO levels.

Background

As discussed previously, it was not possible to differentiate background from anthropogenic loading, so background has been included with other sources in the gross nonpoint source allocation. This has been identified as a data gap, and in the future it may be possible to refine relative source contributions and refine allocations if more definitive monitoring is conducted.

Reserve

An explicit reserve for future growth has not been set aside within the TMDL. Discharge from future growth or development within the Threemile Creek watershed would need to be consistent with the allocations, and could not increase TP concentrations above the target criteria identified.

5.3 Temperature TMDLs

In-Stream Water Quality Targets

Nine water bodies were identified in Chapter 2 (Table 10) as water quality limited due to temperature. In addition, all other streams in the subbasin that have been monitored have been found to exceed temperature criteria (Appendix J), even though they are not currently 303(d) listed for temperature. The goal of the temperature TMDLs is to achieve applicable temperature criteria and restore all of the temperature-impaired water bodies (listed or not) to "full support of designated beneficial uses" (Idaho Code 39.3611, 3615).

The five water bodies that make up the SF CWR main stem and Three Mile Creek have designated beneficial uses of cold water aquatic life and salmonid spawning. Little Elk Creek, Big Elk Creek and Butcher Creek have existing beneficial uses of cold water aquatic life and salmonid spawning. All these streams must meet the cold water aquatic life temperature criteria, and the salmonid spawning temperature criteria when spawning occurs (Table 40). In addition, USEPA has established temperature criteria for bull trout for a number of water bodies in the subbasin, including two that are 303(d) listed: Big Elk and Little Elk Creeks. Appendix B shows the complete list of streams in the SF CWR Subbasin for which USEPA has established bull trout temperature criteria. These streams must meet the federally-promulgated bull trout temperature standard of 10 ^{o}C (50 ^{o}F) as an average of daily maximum temperatures over a seven-day period (MWMT) for the months of June through September.

Table 40. Applicable water temperature criteria.

Beneficial use	Criteria		Reference
Cold Water Aquatic Life	19 ^{o}C (66.2 ^{o}F) daily average	22 ^{o}C(71.6 ^{o}F) daily maximum	IDAPA 58.01.02.250.02.b
Salmonid Spawning	9 ^{o}C (48.2 ^{o}F) daily average	13 ^{o}C (55.4 ^{o}F) daily maximum	IDAPA58.01.02.250.02.e.ii
Bull Trout	10 ^{o}C (50 ^{o}F) MWMT[a]		40 CFR Part 131.33(a)

[a] maximum weekly maximum temperature

Idaho water quality standards include a provision (IDAPA 58.01.02.401.03.a.v) that addresses point source discharges in circumstances where natural temperature conditions exceed existing criteria, as follows:

> "If temperature criteria for the designated aquatic life use are exceeded in the receiving waters upstream of the discharge due to natural background conditions, then Subsections 401.03.a.iii. and 401.03.a.iv. do not apply and instead wastewater must not raise the receiving water temperatures by more than three tenths (0.3) degrees C."

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Design Conditions

Heat loading sources on the main stem SF CWR were evaluated through an assessment of measured temperature data with support from model analysis (Appendix I and J). Temperature data indicate that much of the excess heat loading in the upper main stem is the result of loading from the headwater tributaries, from both natural and human caused processes. Human caused heat loading measured in the tributaries is largely a result of the loss of shade from riparian vegetation from such activities as grazing, road construction, dredge mining, and timber harvest. The influence of shade on stream temperature is much more significant on smaller streams with smaller water volumes than larger streams. In addition, tributaries are often locations of lower observed stream temperatures within the SF CWR Subbasin; therefore, protecting these tributary source areas, even if they are currently below the criteria, will reduce the cumulative temperature effects on the main stem. The management of tributary conditions is the most effective method to reduce stream temperature in the main stem.

Analysis also showed that main stem heat loading conditions increased dramatically in lower reaches of the SF CWR main stem, which resulted in a large rise in stream temperatures. Once again, landuse activities occurring within this portion of the basin have resulted in very low shade conditions. Reach scale dynamics (aspect, width/depth ratio, flow, etc.) become more dominant components of the heat loading process in this section of the river, and when coupled with the low shade conditions, have resulted in very high water temperatures.

Heat loading and final nonpoint source heat load allocations, i.e., stream shade and stream channel configuration, focus on the predominant sources of human-caused heat loading in the subbasin. Many minor sources of human-caused heat loading exist throughout the subbasin. Some like old mines, developments, and the like are discussed in chapter 3, while others are largely unidentifiable or unquantifiable. Load allocations are designed and set for the major human-caused addition of heat, with the assumption that the minor and unmeasureable sources are included within these allocations, and reductions from these minor sources will not be necessary in order to meet the goals of the TMDLs and Idaho WQS.

Although criteria are also exceeded at other times of the year, the critical time period for water temperature has been determined to be the months of July and August when air and water temperatures are at their peak and the most dramatic exceedances of criteria occur. As a result, the TMDLs focus on achieving temperature targets for these months. If the temperature standards are attained during July and August, when water flows are low and air temperatures are high, it is expected that temperature criteria will be met throughout the rest of the year.

The SF CWR Subbasin is predominantly forested and managed for various forest practices (Figure 8). Under the auspices of the Idaho FPA (IDAPA 20.02.01), the Forest Practices Act Advisory Committee developed a Cumulative Watershed Effects (CWE) methodology for assessing stream temperature problems on lands covered under the FPA (IDL 2000, Appendix G). A modified version of this methodology is applied to the streams in the

subbasin that are primarily influenced by forest practices. All other streams and rivers in the SF CWR Subbasin are assessed using a methodology developed by the USEPA (Appendix F). While the two methods have the same goals, the actual results in terms of TMDL development are somewhat different for the two parts of the SF CWR Subbasin.

Target Selection

The cold water aquatic life criteria of 19 ^{o}C (66.2 ^{o}F) daily average and 22 ^{o}C (71.6 ^{o}F) as a daily maximum apply to all waters year around. In addition, more restrictive salmonid spawning criteria of 9 ^{o}C (48.2 ^{o}F) daily average and 13 ^{o}C (55.4 ^{o}F) daily maximum apply to most streams in the subbasin on a seasonal basis depending on which salmonid species are present (Table 41). The criterion for bull trout waters identified in federal regulations is 10 ^{o}C (50 ^{o}F) MWMT or less during the months of June through September (Appendix B includes a list of streams in the SF CWR Subbasin covered by the federal bull trout criteria). Using a conversion factor developed by Sugden et al. (1998) for northern Idaho and western Montana, 9 ^{o}C (48.2 ^{o}F) daily average temperature is equivalent to 9.7 ^{o}C (49.5 ^{o}F) MWMT, such that the federal bull trout temperature standard and Idaho's salmonid standrad are roughly equivalent in terms of MWMT. Therefore, we assume they are equivalent and use 10°C (50°F) MWMT for both standards in the FPA CWE analysis discussed in Appendix G. The cold water biota aquatic life standard of 19 ^{o}C (66.2^{o}F) can be converted to 21 ^{o}C (69.8 ^{o}F) MWMT.

The time periods when salmonid spawning numeric criteria are applicable for different salmonid species found in the SF CWR are listed in Table 41, and are based on the findings of the Fish TAG (Appendix D) and federal regulations for bull trout. The distribution of salmonid species within the SF CWR Subbasin is listed in Table 42 (and shown in a series of maps at the end of Appendix D), which indicates that salmonids are present in all water bodies covered by the SF CWR TMDLs; hence, the salmonid spawning criteria are applicable in all these waterbodies. Reviewing the spawning and incubation windows in Table 41, if bull trout, cutthroat trout, spring/summer chinook salmon, brook trout or steelhead, (mid-upper reaches and tributaries) are present, the salmonid spawning window includes the critical July-August time period, and hence the salmonid spawning criteria are applicable for all the temperature TMDLs. Reviewing the species distribution information in Table 42, all streams included in the SF CWR Subbasin TMDL have one or more of these species present; therefore, the salmonid spawning criteria are applicable.

Application of the Idaho WQS for the development of TMDL targets, however, requires consideration of human causation. Many streams in the SF CWR Subbasin that exceed the numeric temperature criteria are relatively undisturbed by human intervention and, therefore, meet the WQS for temperature. It can be assumed then that many, if not most, other streams in the SF CWR Subbasin probably exceed the numeric temperature criteria naturally. Targets for TMDLs need to be designed to address heat loading that is human caused. The most important human-caused effects on increased stream heat loading are increased direct insolation and streamside heating as a result of the removal or diminishment of streamside vegetation and the widening of stream channels. The temperature TMDLs herein, therefore,

set shading targets and stream channel width targets as those parameters needed to be modified or managed to meet the Idaho WQS.

Table 41. Time periods of salmonid spawning and incubation in the SF CWR Subbasin.

Salmonid Species	Dates Criteria Are Applicable
Bull Trout	June 1 – September 30
Cutthroat Trout	March 15 – August 15
Spring/Summer Chinook Salmon	August 15 – April 30
Steelhead/Rainbow Trout (lower SF CWR and tributaries)	February 1 – June 1
Steelhead/Rainbow Trout (middle and upper SF CWR and tributaries)	February 1 – July 15
Whitefish	October 1 – February 28
Brook Trout	August 15 – February 28

Table 42. Salmonid species distribution in the SF CWR Subbasin.

South Fork Clearwater River Subbasin																
WB ID[a]	Water Body Name	Acres	Current Fish Population Presence[b]					Current Habitat Condition[c]	Natural Inherent Conditions				Pollutant Problems[d]			Conservation Preservation Priority[e]
			BUT	CUT	SCH	ST RBT	BRT	Salmonids	BUT	CUT	SCH	ST RBT	SED	TEMP	NUTR	
1	Lower SF CWR	19,723	Y	Y	Y	Y	Y	P	F	F	F	F	Y	Y	Y?	M (main stem)
2	Lower Cottonwood Cr.	16,929	N	N	N	Y	N	P	P	P	P	G	Y	Y	N	L
3	Upper Cottonwood Cr.	21,223	N	N	N	Y	N	P	P	P	P	F	Y	N	N	L
4	Lower Red Rock Cr.	2,969	N	N	N	N	N	P	P	P	P	G	Y	N	N	L
5	Upper Red Rock Cr.	23,481	N	N	N	N	N	P	P	P	P	F	Y	N	N	L
6	Stockney Cr.	19,978	N	N	N	N	N	P	P	P	P	F	Y	N	N	L
7	Shebang Cr.	18,380	N	N	N	N	N	P	P	P	P	F	Y	N	N	L
8	S.F. Cottonwood Cr.	12,676	N	N	N	N	N	P	P	P	P	F	Y	N	N	L
9	Long Haul Cr.	8,812	N	N	N	N	N	P	P	P	P	F	Y	N	N	L
10	Threemile Cr.	21,475	N	N	Y	Y	N	P	P	P	P	F	Y	Y	Y	L
11	Butcher Cr.	10,723	N	N	Y	Y	N	P	P	P	P	F	Y	Y	Y	M
12	Mid-Lower SF CWR	56,691	Y	Y	Y+	Y	Y	P	F	F	F	F	Y	Y	N	M (main stem)
13	Mill Cr.	23,410	Y	Y	Y+	Y	N	F	F	G	F	G	Y	Y	N	M
14	Lower Johns Cr.	26,378	Y+	Y	Y	Y	N	G	G	G	F	G	N	N	N	C/H
15	Gospel Cr.	10,832	Y	Y	N	Y	N	G	G	G	P	G	N	N	N	C/H
16	W. F. Gospel Cr.	4,467	Y	Y	N	N	N	G	G	G	P	F	N	N	N	C/H
17	Middle Johns Cr.	10,200	Y+	Y	Y	Y	N	G	G	G	F	G	N	N	N	C/H

South Fork Clearwater River Subbasin																
WB ID[a]	Water Body Name	Acres	Current Fish Population Presence[b]					Current Habitat Condition[c]	Natural Inherent Conditions				Pollutant Problems[d]			Conservation Preservation Priority[e]
			BUT	CUT	SCH	ST RBT	BRT	Salmonids	BUT	CUT	SCH	ST RBT	SED	TEMP	NUTR	
18	Upper Johns Cr.	8,674	Y+	Y	N	Y	N	G	G	G	P	G	N	N	N	C/H
19	Moores Cr.	3,987	Y+	Y	N	Y	N	G	G	G	P	G	N	N	N	C/H
20	Square Mountain Cr.	2,289	Y	Y	N	Y	N	G	G	G	P	F	N	N	N	C/H
21	Hagen Cr.	5,537	Y	Y	N	Y	N	G	G	G	P	F	N	N	N	C/H
22	Middle SF CWR	18,952	Y	Y	Y+	Y	Y	F	F	F	F	G	Y	Y	N	M (main stem)
23	Wing Cr.	5,329	N	Y	N	N	N	F	P	F	P	F	N	N	N	L
24	Twentymile Cr.	14,641	Y	Y	N	Y	N	G	F	G	P	F	N	N	N	C/M
25	Lower Tenmile Cr.	2,447	Y+	Y	Y	Y	N	G	F	F	F	G	N	N	N	C/H
26	Middle Tenmile Cr.	7,227	Y+	Y	Y+	Y	N	G	G	G	F	G	N	N	N	C/H
27	Upper Tenmile Cr.	13,617	Y+	Y	Y	Y	N	G	G	G	F	G	N	N	N	C/H
28	Williams Cr.	5,891	Y	Y	N	Y	N	G	F	G	F	G	N	N	N	C/H
29	Sixmile Cr.	5,130	Y	Y	Y	Y	N	F	F	G	F	G	Y	N	N	M
30	Mid-Upper SF CWR	17,165	Y	Y	Y+	Y	Y	F	F	F	G	G	Y	Y	N	M
31	Lower Crooked R.	9,481	Y	Y	Y+	Y	Y	P	F	G	G	G	Y	Y	N	H
32	Upper Crooked R.	14,488	Y+	Y	Y+	Y	Y	F	G	G	G	G	Y	Y	N	H
33	W. F. Crooked R.	7,594	Y+	Y	Y	Y	Y+	G	G	G	G	G	N	N	N	C/H
34	E. F. Crooked R.	6,689	Y+	Y	Y	Y	N	G	G	G	G	G	N	N	N	C/H
35	Relief Cr.	7,484	Y	Y	Y+	Y	N	F	F	G	G	G	Y	Y	N	M

South Fork Clearwater River Subbasin																
WB ID[a]	Water Body Name	Acres	Current Fish Population Presence[b]					Current Habitat Condition[c]	Natural Inherent Conditions				Pollutant Problems[d]			Conservation Preservation Priority[e]
			BUT	CUT	SCH	ST RBT	BRT	Salmonids	BUT	CUT	SCH	ST RBT	SED	TEMP	NUTR	
36	Upper SF CWR	2,695	Y	Y	Y+	Y	Y	P	F	F	G	G	Y	Y	N	H
37	Lower Red R.	10,333	Y	Y	Y+	Y	Y	P	F	G	G	G	Y	Y	N	M
38	Middle Red R.	16,042	Y	Y	Y+	Y	Y	P	F	G	G	G	Y	Y	Y?	H
39	Moose Butte Cr.	7,087.55	Y	Y	Y+	Y	Y	F	F	G	G	G	Y	Y	N	H
40	Lower S.F. Red R.	3,154	Y+	Y	Y+	Y	Y	F	G	G	G	G	Y	Y	N	H
41	Middle S.F. Red R.	2,791	Y+	Y	Y+	Y	Y	F	G	G	G	G	Y	N	N	H
42	W. F. Red R.	6,406	Y+	Y	Y	Y	Y	G	G	G	G	G	N	N	N	C/H
43	Upper S.F. Red R.	4,744	Y+	Y	Y	Y	Y	F	G	G	G	G	Y	N	N	H
44	Trapper Cr.	7,077	Y	Y	N	Y	Y+	F	G	G	F	G	Y	N	N	H
45	Upper Red R.	19,250	Y	Y	Y+	Y	Y+	F	G	G	G	G	Y	Y	N	H
46	Soda Cr.	3,353	N	Y	N	N	Y+	F	F	G	F	G	Y	N	N	H
47	Bridge Cr.	2,380	N	Y	N	N	Y+	G	F	G	F	G	N	N	N	C/M
48	Otterson Cr.	2,488	Y	Y	Y	N	Y+	G	F	G	F	G	N	N	N	C/M
49	Trail Cr.	4,560	Y	Y	Y	N	Y+	F	F	G	F	G	Y	N	N	H
50	Siegel Cr.	7,784	Y	Y	Y	Y	Y+	F	F	G	G	G	Y	Y	N	H
51	Red Horse Cr.	5,806	Y	Y	Y	Y	Y+	F	F	G	G	G	Y	Y	N	H
52	Lower American R.	7,215	Y	Y	Y+	Y	Y	P	F	G	G	G	Y	Y	Y?	H
53	Kirks Fork	6,257	Y	Y	Y	Y	Y	F	F	G	G	G	Y	Y	N	H

South Fork Clearwater River Subbasin																
WB ID[a]	Water Body Name	Acres	Current Fish Population Presence[b]					Current Habitat Condition[c]	Natural Inherent Conditions				Pollutant Problems[d]			Conservation Preservation Priority[e]
			BUT	CUT	SCH	ST RBT	BRT	Salmonids	BUT	CUT	SCH	ST RBT	SED	TEMP	NUTR	
54	E.F. American R.	11,445	Y	Y	Y+	Y	Y+	F	G	G	G	G	Y	N	N	H
55	Upper American R.	15,275	Y	Y	Y+	Y	Y+	F	F	G	G	G	Y	Y	N	H
56	Elk Cr.	2,324	Y	Y	Y+	Y	Y+	P	F	G	G	G	Y	Y	Y	H
57	Little Elk Cr.	5,081	Y	Y	Y	Y	Y+	F	F	G	G	G	Y	Y	V	H
58	Big Elk Cr.	8,821	Y	Y	Y+	Y	Y+	F	F	G	G	G	Y	Y	V	H
59	Buffalo Gulch	2,139	N	Y	N	Y	N	P	P	G	F	G	Y	Y	N	M
60	Whiskey Cr.	1,659	Y	Y	Y	Y	Y	F	F	G	F	G	Y	Y	N	M
61	Maurice Cr.	1,094	N	Y	N	Y	N	P	P	G	F	G	Y	Y	N	M
62	Lower Newsome Cr.	4,145	Y	Y	Y+	Y	Y	P	F	G	G	G	Y	Y	N	H
63	Bear Cr.	3,832	Y	Y	Y	Y	N	F	F	G	G	G	Y	Y?	N	H
64	Nugget Cr.	1,451	Y	Y	N	N	N	F	F	G	F	G	Y	Y?	v	M
65	Beaver Cr.	3,733	Y	Y	N	Y	N	F	F	G	F	G	Y	Y?	v	H
66	Middle Newsome Cr.	1,135	Y	Y	Y+	Y	N	F	F	G	G	G	Y	Y	N	H
67	Mule Cr.	5,497	Y	Y	Y	Y	N	F	F	G	G	G	Y	Y?	N	H
68	Upper Newsome Cr.	6,356	Y	Y	Y+	Y	N	F	F	G	G	G	Y	Y	N	H
69	Haysfork Cr.	3,172	N	Y	Y	Y	N	F	F	G	G	G	Y	Y?	N	H
70	Baldy Cr.	2,724	Y+	Y	Y	Y	N	F	G	G	G	G	Y	Y?	N	H
71	Pilot Cr.	3,918	Y+	Y	Y	Y	N	G	G	G	G	G	N	Y?	N	C/H

South Fork Clearwater River Subbasin																
WB ID[a]	Water Body Name	Acres	Current Fish Population Presence[b]					Current Habitat Condition[c]	Natural Inherent Conditions				Pollutant Problems[d]			Conservation Preservation Priority[e]
			BUT	CUT	SCH	ST RBT	BRT	Salmonids	BUT	CUT	SCH	ST RBT	SED	TEMP	NUTR	
72	Sawmill Cr.	1,769	Y	Y	Y	Y	N	G	F	G	G	G	N	Y?	N	C/M
73	Sing Lee Cr.	1,556	N	Y	Y	Y	N	F	F	G	G	G	N	Y?	N	M
74	W.F. Newsome Cr.	3,305	Y	Y	Y	Y	N	F	F	G	G	G	N	Y	N	H
75	Leggett Cr.	4,992	N	Y	Y	Y	N	F	F	G	F	G	Y	Y	N	M
76	Fall Cr.	2,334	N	Y	N	N	N	F	P	F	P	G	Y	N	N	L
77	Silver Cr.	16,517	Y	N	N	Y	Y+	G	F	G	P	F	N	N	N	C/L
78	Peasley Cr.	9,093	N	Y	N	Y	N	F	F	G	F	G	Y	Y?	N	M
79	Cougar Cr.	7,737	N	Y	N	N	N	P	P	F	P	F	Y	Y?	N	L
80	Meadow Cr.	24,010	Y	Y	Y+	Y	Y+	P	F	G	F	G	Y	Y	N	M
81	Sally Ann Cr.	8,891	Y	Y	N	Y	N	P	F	F	P	F	Y	Y	N	M
82	Rabbit Cr.	6,191	Y	Y	N	Y	Y	P	F	F	P	F	Y	Y	N	L

[a] water body identification number
[b] Y+ = known spawning and rearing population
BUT = bull trout, CUT = cutthroat trout, SCH = spring chinook salmon, ST RBT = steelhead/rainbow trout, BRT = brook trout
[c] G = good, F = fair, P = poor
[d] SED = sediment, TEMP = temperature, NUTR = nutrients
[e] C/G or C/F or C/P = ratings for conservation rather than restoration. All other ratings in this column are priorities for restoration

Surrogate Water Temperature Targets

Shade is one of the most important factors affecting stream temperature. As mentioned previously, two approaches for evaluating shade were used to develop surrogate targets for the TMDL: CWE and System Potential Vegetation (SPV). Percent effective shade and percent canopy closure have been identified as surrogate targets for achieving the temperature standards. Percent effective shade over a stream, or percent canopy closure, depending on the approach, are practical targets because they are the primary factors that can be managed to alter heat loading and stream temperature. Such targets also allow detailed monitoring of streamside conditions affected by management and progress towards target attainment.

While it is recognized that there are some technical differences between "percent effective shade" of the SPV method and "percent canopy closure" of the CWE method, both approaches address near-stream vegetation conditions, and the two terms are used interchangeably in the discussions to follow. The technical differences between the two do not translate into significant differences in the amount or location of vegetation needed to protect stream temperatures.

For the portions of the SF CWR Subbasin with the potential for a largely complete conifer canopy cover over the stream, the CWE temperature model developed for north Idaho under the auspices of the FPA (IDL 2000) is used. The CWE model is an empirical, reach-based model that predicts the amount of stream canopy closure required in a given 200-foot elevation range empirically predicted to maintain a given stream temperature. Each elevation reach has a predicted percent canopy closure target. Canopy closure requirements increase with decreasing elevation (as would be expected to account for cumulative effects) increased exposure times to energy inputs, and increased air temperatures at lower elevations. The CWE model and its results are discussed in more detail in Appendix G.

The CWE temperature model relationship was developed from data collected in north Idaho, where the MWMT is predicted by elevation and percent canopy closure. The model assumes that water temperature has been protected upstream. It accounts for three of the primary environmental factors affecting stream temperature: local air temperature as it varies by elevation, micro-environmental modification by the vegetation and its canopy, and shade of the stream surface by the riparian canopy. Thus, the CWE model predicts the amount of canopy closure required at a given elevation to maintain stream temperatures within the water quality standards. In applying the model, the amount of required shade has been limited to that determined to be the maximum possible for coniferous sites in the SF CWR Subbasin, or approximately 90% canopy closure.

In non-forested areas in the subbasin, and for large streams where the CWE approach is not applicable (e.g., SF CWR main stem), an approach that estimates the effective shade produced by a mature native vegetation community (SPV) has been utilized.

"System potential land cover" is necessary to achieve "system potential effective shade," and is defined for purpose of the TMDL as "the potential near-stream vegetation that can grow and reproduce on a site, given the climate, elevation, soil properties, plant biology, and hydrologic processes." System potential does not consider management or land use as limiting factors. In essence, system potential is the design condition used for TMDL analysis that meets the temperature standard by minimizing human-related warming.

System potential is an estimate of the condition where anthropogenic activities that cause stream warming are minimized. System potential is not an estimate of pre-settlement conditions. Although it is helpful to consider historic land cover patterns, channel conditions, and hydrology, many areas have been altered to the point that the historic condition is no longer attainable given drastic changes in stream location and hydrology (channel armoring, wetland draining, urbanization, etc.).

Loading capacity in the SF CWR Subbasin is largely controlled by nonpoint source influences of heat to the system. Heat accumulates through much of the watershed by direct solar radiation loading. System potential was estimated as August solar radiation levels that would reach the stream surface under conditions where anthropogenic activities would not measurably increase temperature. Similarly, the CWE model estimates percent canopy closure conditions required during the hottest time of the year, late July and early August, to protect stream temperatures.

Current effective shade conditions were modeled using Heat Source 6.5 (Boyd 1996; ODEQ 2002) using recently collected field data and other spatial data (i.e., bank full width, digital elevation models, digital orthophoto quads, and streamside vegetation). These features were measured on a fine scale using existing GIS databases and digital orthophoto quads (Chapter 3). Simulations were performed for all currently 303(d) listed streams including the SF CWR main stem, Big Elk Creek, Little Elk Creek, Butcher Creek, and Threemile Creek. The Red River was also analyzed because it is a meadow-dominated system that dramatically influences the temperature profile translated downstream.

"System potential effective shade" was simulated by increasing tree heights and densities to those expected at "system potential land cover." System potential land cover was calculated for various forested, non-forested, and wetland plant communities. The output of this effort is a series of curves and graphs that identify effective shade targets given different vegetation types, channel widths, and aspect (north, south, east, and west). The details of this approach may be found in Appendix F.

Using the CWE and the SPV methods, surrogate measures of percent stream shading have been developed. The target percent stream shading is the necessary percent stream shading needed to achieve temperature standards during the period of the year with highest ambient air temperatures (late July and early August), which is the critical time period for stream temperatures.

Using the approach of percent shade targets distributed throughout the SF CWR Subbasin, shading conditions were established under which stream temperature criteria have the highest

probability of being achieved throughout the subbasin. While it is recommended that progress towards attainment of stream temperature targets be monitored using continuous in-stream temperature monitoring devices, evaluation by land managers of progress towards the reach-by-reach shade targets should help guide decisions regarding methods to increase stream shade.

Heat Loading Capacity

The heat load needed to achieve state and federal temperature criteria during the critical time of the year is used as the loading capacity for all water bodies. The actual heat loading, in Langleys per day or British thermal units (Btu) per day, needed to achieve temperature criteria in each waterbody can be derived. Examples of this are shown in graphs of shade levels and corresponding Langley loadings in Appendix F. Wastewater treatment plant heat loading in Btus per day which would achieve applicable temperature criteria are listed in a series of tables in Appendix O. Given that the heat energy (Langley or Btu) loading is not very useful in guiding nonpoint or point source management practices, we have instead focused on the temperature criteria and the surrogate target of percent shade in addressing point and nonpoint sources respectively.

Estimates of Existing Heat Loading

Increased stream temperatures in the SF CWR Subbasin are primarily the result of increased heat loading from increased solar radiation reaching the water surface and increased local environmental temperatures as a result of the removal of riparian shading. Logging, road building, mining, agriculture, livestock grazing, fire, and residential construction are the primary anthropogenic causes of riparian shade reduction over the last century. In some cases, lack of shade beyond that which will maintain stream temperatures within the applicable standard is natural and/or may be the result of forest fires and other natural disturbance processes. Solar radiation and resultant heat loading have also been increased in numerous locations around the SF CWR Subbasin through widening of the stream channel (an increase in the width-to-depth ratio). This is the result of dredge mining, deterioration and/or removal of the streamside vegetation, channelization, and sediment accumulation resulting in stream aggradation.

Increasing net heat loading to the surface of a stream segment will result in higher stream temperatures. Heat loading to a stream surface, however, has both temporal and spatial variability within the water bodies for which TMDLs are being developed. Predicting the stream temperature at any location and time in a water body requires an understanding of how heat is distributed through space and time. In reality, it is most useful to describe heat loading throughout a water body in a way that provides information about maintaining water temperatures that supports the water body's beneficial uses.

In terms of timing, heat loading in the SF CWR Subbasin is at its greatest during late July and early August and is reflected in the high stream temperatures at this time (see Figure 13 and Appendix J stream temperature plots). July and August are the critical months for temperature exceedances, though exceedances can occur from April through October,

depending on the water body. Water temperatures increase in April through June, but are consistently at their peaks during late July and early August. Water temperatures decrease rapidly after the first wet cold fronts of late August or early September. Heat loading and stream temperature are analyzed for the critical period of July through August, and it is assumed that if stream temperatures are in compliance with the temperature WQS during this period, they will be in compliance throughout the rest of the year.

The effects of heat loading on stream temperature were evaluated using measured in-stream and remotely sensed water temperature data, calculated percent shade (the most significant factor influencing heat loading), and stream temperature. The in-stream temperature data in Section 2.3 and Appendix J show the stream temperatures for specific locations in each water body. These data are often collected near the mouth where temperatures are likely to be the highest and can be assumed to integrate all the heat loading and unloading occurring upstream from the monitoring site. These data indicate that all streams monitored exceeded applicable temperature criteria between 1999 through 2001. Exceedances of the criteria occurred as early as April in water bodies at lower elevations in the watershed (e.g., Threemile Creek) and continue into early October in some other water bodies (e.g., lower SF CWR). Standards are usually exceeded by the greatest amount in late July and early August, which corresponds with the highest air temperatures. An example of water temperature data, showing peaks in July and August, can be seen in Figure 47.

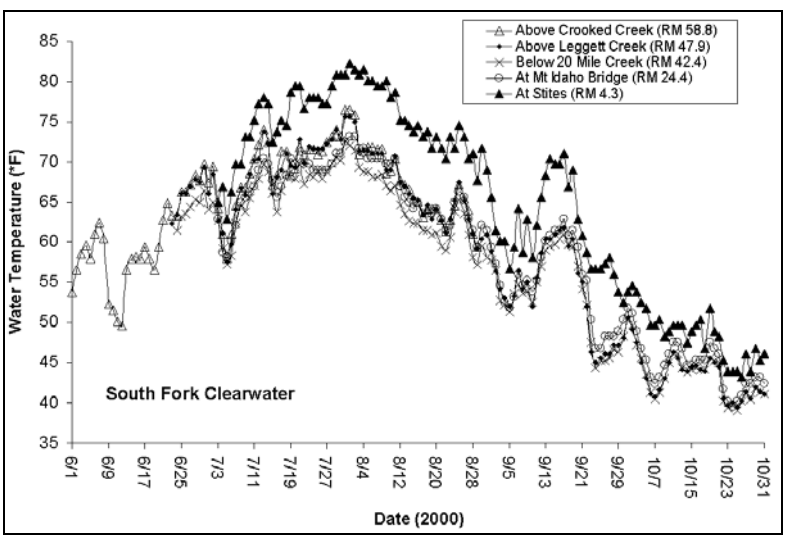


Figure 47. Seasonal Variation in Maximum Water Temperature at Various Locations along the SF CWR in 2000

Water temperature criteria apply throughout all water bodies and at all times. Spatial and temporal variations in heat loading can be evaluated using remotely sensed surface water temperatures or a series of in-stream temperature monitors. A number of factors influence these patterns (Appendix I), but in general, the common pattern is that stream temperatures increase in a downstream direction and significant diurnal fluctuations can occur. Section 2.3 discusses patterns of heat loading in the SF CWR and several tributaries in more detail. The main stem SF CWR temperatures are already significantly elevated at the confluence of

the American and Red Rivers, but remain relatively stable until the Mt. Idaho bridge, where temperatures begin to increase dramatically. Similarly, an evaluation of data from Red River, Big and Little Elk Creeks, and Threemile Creek indicate that temperatures increase dramatically in the lower reaches of these tributaries as well.

Figure 48 illustrates the diurnal temperature pattern in Big Elk Creek. The temperatures at the NPNF boundary, reflecting largely forested conditions, are much lower than temperatures at a point 5 miles downstream (RM 4.7). The primary difference between these two monitoring stations is that a series of meadows occur between the two, in which much of the riparian vegetation (shading) has been removed as a result of long-term grazing. Measured data for Big Elk Creek clearly show the effect of shade on heat loading and stream temperature that occurs in the SF CWR Subbasin.

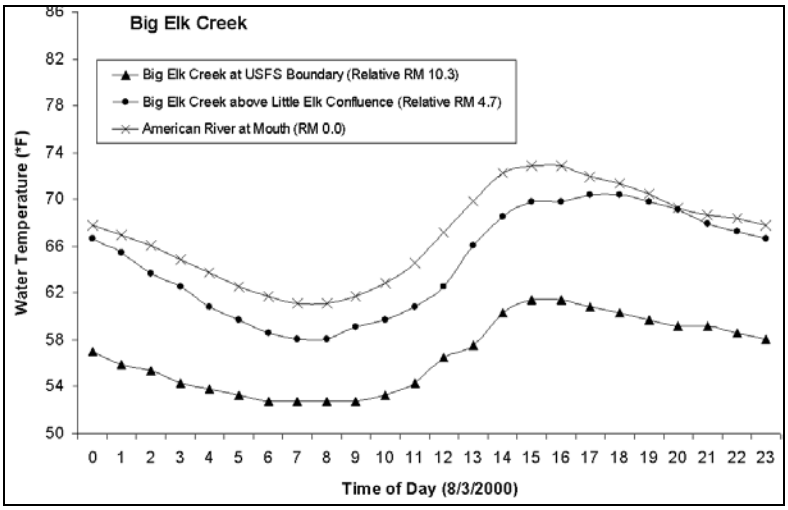


Figure 48. Diurnal Temperatures Measured Big Elk Creek and the American River (mouth) on August 3, 2000

Current shade conditions were estimated using CWE (percent canopy closure) and SPV (percent effective shade) methods for forested and non-forested areas, respectively (Appendices F and G). The CWE determination of current percent canopy closure for the SF CWR Subbasin is presented in Figure 49. Focusing on water bodies currently 303(d) listed for temperature, Figures 50 and 51 show current CWE percent canopy closure data for the Threemile Creek/Butcher Creek area and the Big Elk Creek/Little Elk Creek area. Figures 52 - 56 list current effective shade for Threemile Creek, Big and Little Elk Creeks (meadow areas), the main stem SF CWR, and Butcher Creek. The line presented on these figures represents the 0.25-mile moving average condition, which was calculated at 100-foot intervals along the stream segments.

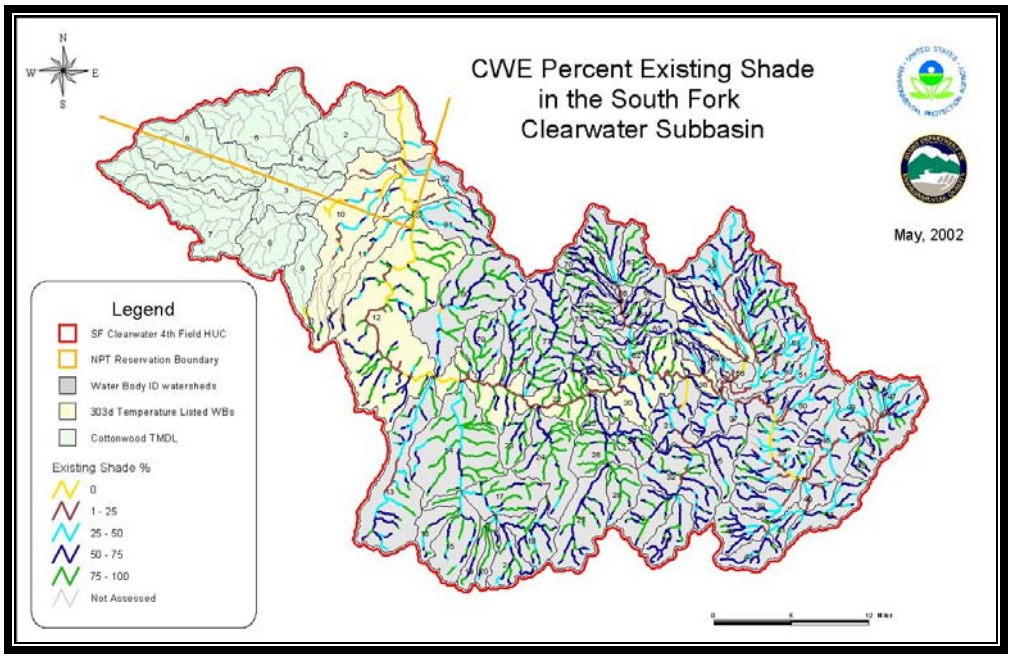


Figure 49. Current Percent Canopy Closure Determined by Aerial Photographic Interpretation of the SF CWR Subbasin

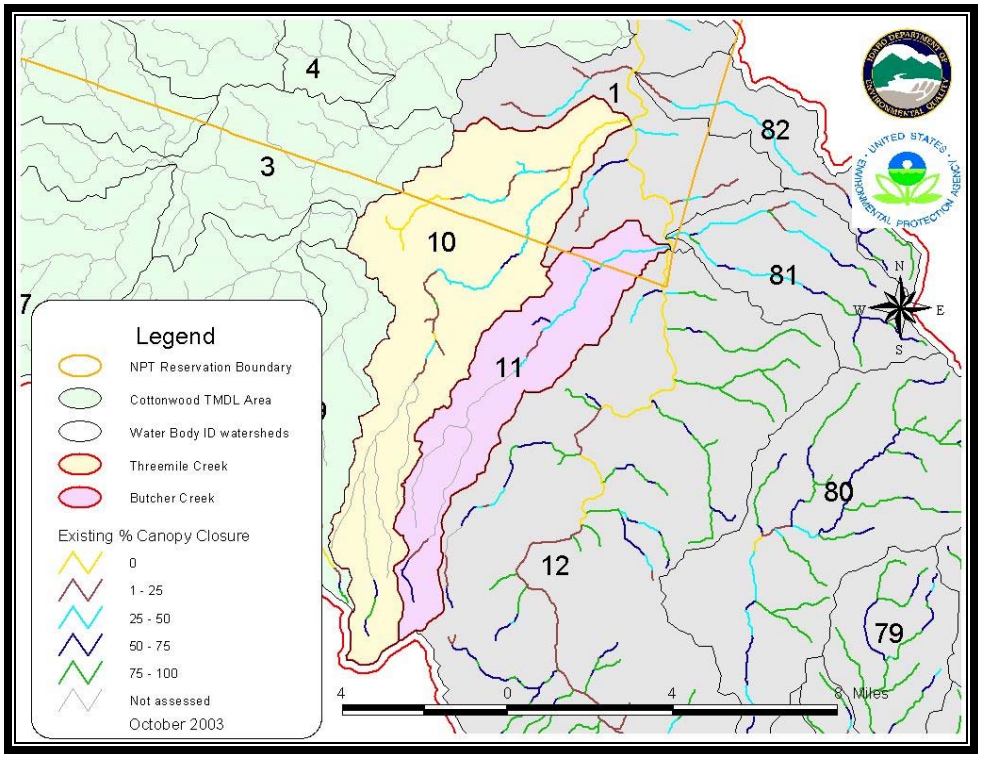


Figure 50. Current Percent Canopy Closure of Threemile and Butcher Creeks

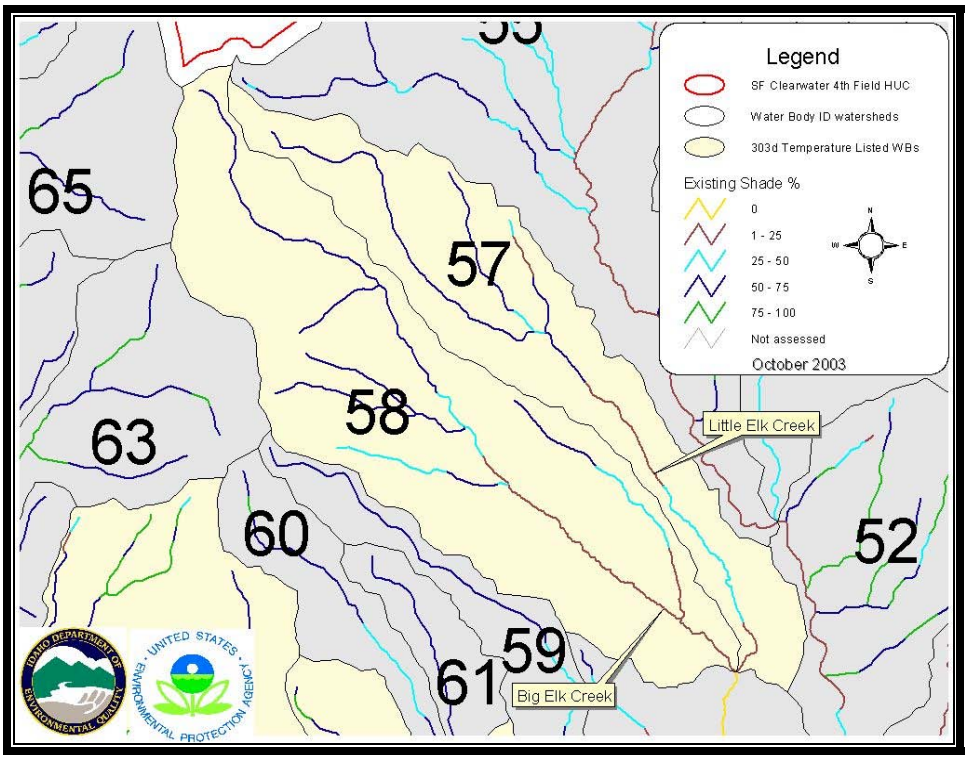


Figure 51. Current Percent Canopy Closure of Big Elk and Little Elk Creeks

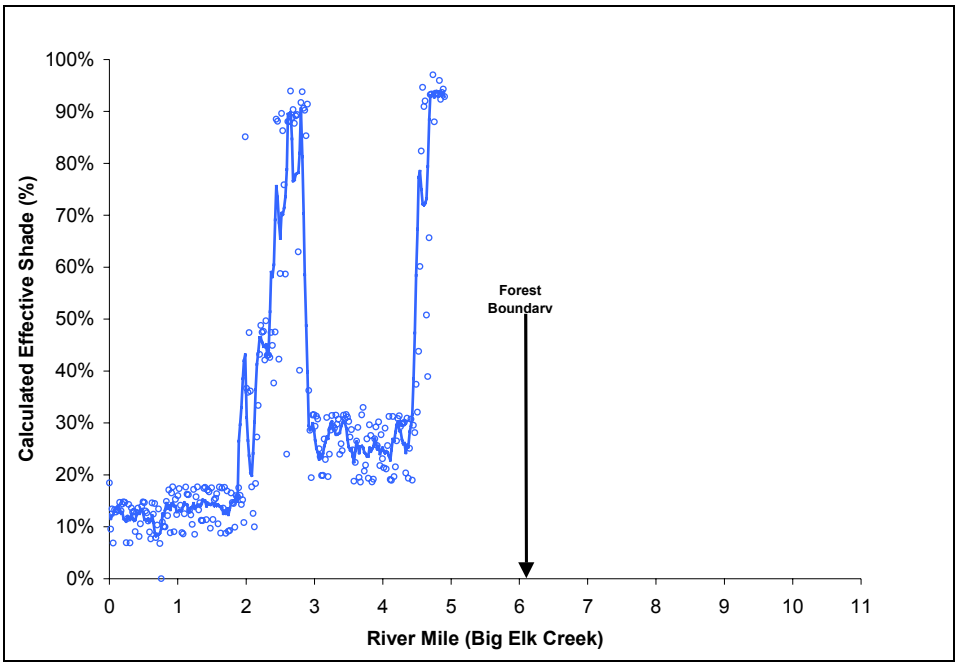


Figure 52. Big Elk Creek Current Effective Shade, Lower Reaches

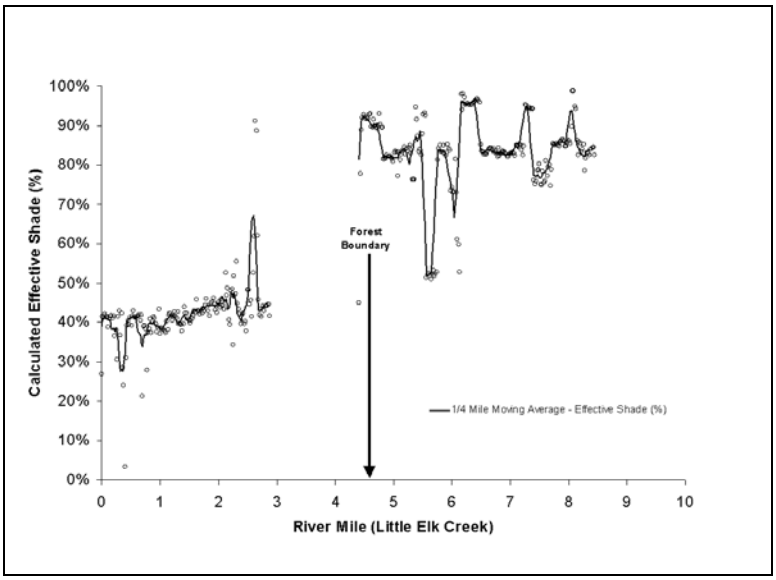


Figure 53. Little Elk Creek Current Effective Shade, Lower Reaches

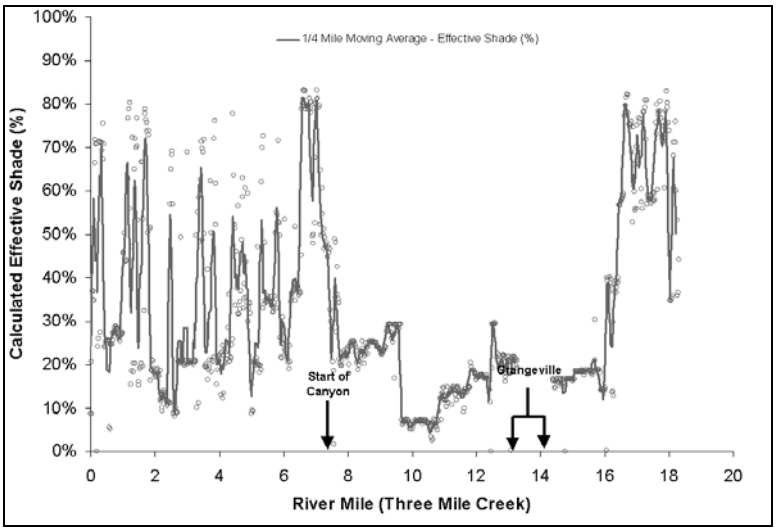


Figure 54. Threemile Creek Current Effective Shade

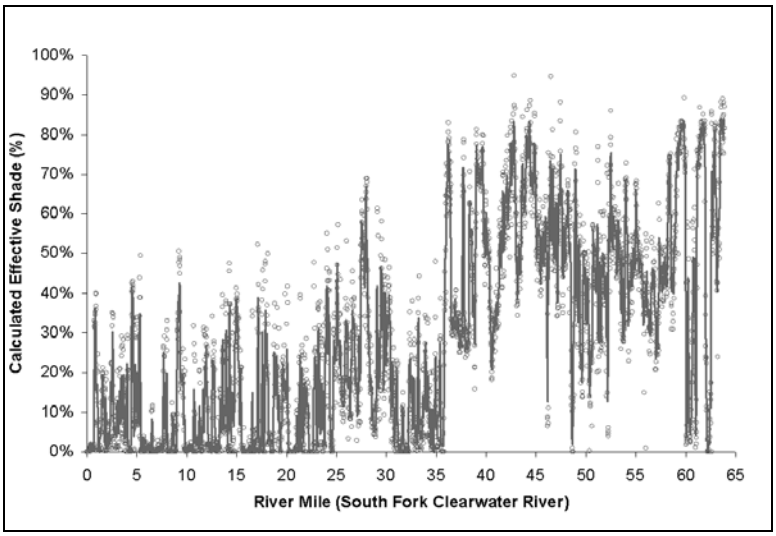


Figure 55. South Fork Clearwater River Current Effective Shade

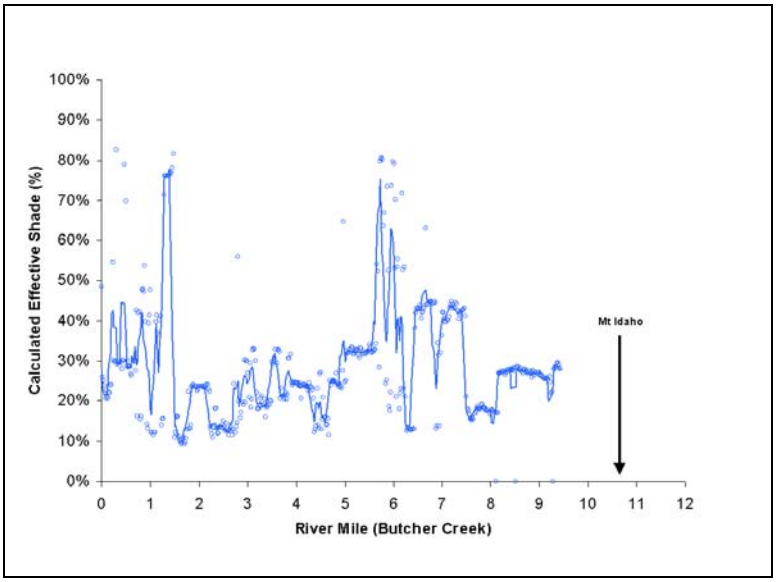


Figure 56. Butcher Creek Current Effective Shade

Point sources are another source of heat loading in the subbasin. While Section 3.1 identifies a number of point sources known to exist in the SF CWR Subbasin, only the five municipal WWTPs listed in Table 43 are expected to have a significant effect on stream temperature. Other point sources in the subbasin include suction dredge operations and industrial and construction related stormwater. The heat of water and sediment is not believed to increase significantly as it passes through the pumps and piping of suction dredge operations, and stormwater runoff during the critical time period for temperature (July-August) is minimal or nonexistent since precipitation during these months is the lowest for the year (WRCC 2003).

Table 43. Point sources that may affect stream temperature.

Facility Location	NPDES Permit Number[a]	Type of Facility	Receiving Water	Design Flow (MGD)[b]
Grangeville	ID-002003-6	Wastewater Treatment Plant	Threemile Creek	0.88
Kooskia	ID-002181-4	Wastewater Treatment Plant	South Fork Clearwater River	0.2
Stites	ID-002034-6	Wastewater Treatment Plant	South Fork Clearwater River	0.07
Elk City	ID-002201-2	Wastewater Treatment Plant	Elk Creek	0.12
Red River Ranger Station	ID-002069-9	Wastewater Treatment Plant	South Fork Red River	0.0063

[a] National Pollution Discharge Elimination system
[b] million gallons per day

Heat Load Allocation

Allocation of heat load is the process in which the heat loads necessary to achieve the load capacity (i.e., water temperature criteria) are assigned to the various nonpoint and point sources and background. Shade conditions for nonpoint sources are used as a surrogate to achieve in-stream temperature criteria in the SF CWR Subbasin. The allocation process for point sources must explicitly identify a heat load (i.e., a temperature or range of temperatures), also known as a WLA, which will be subsequently incorporated into NPDES permits.

Shade targets were established for the SF CWR and all tributaries, whether or not they are included on the current 303(d) list, for two reasons. First, the entire SF CWR main stem is 303(d) listed for temperature. As discussed in Section 2.3, a significant portion of heat loading to the SF CWR is from tributaries, and it is necessary to address elevated temperatures in the tributaries in order to reduce main stem SF CWR temperatures. Second, as also pointed out in Section 2.3, the applicable temperature criteria are exceeded at some time in all streams monitored within the SF CWR Subbasin. While most of these streams are not currently on the 303(d) list, including shade targets for them in the TMDL will address human-caused temperature problems measured in the main stem, as well as in these streams, and preclude the need to include them in future 303(d) lists and TMDLs.

To the extent possible, the allocation process should also identify what portion of the total load allocation is natural background. Clearly there is significant natural solar radiation loading to all SF CWR Subbasin streams. Some streams have significant human influences that have elevated stream temperature (e.g., Red River, Big Elk Creek). Also, as mentioned previously, some streams that have very little human influence, such as Johns and Silver Creeks, also exceed applicable temperature criteria. In all cases it is difficult to quantify what portion of the loading is from background and what portion is human caused. Rather

than attempting to identify the specific natural background heat load, it is assumed that by establishing and achieving shade targets, and correcting channel problems in some locations, the majority of human caused heat loading will be addressed. What remains will largely be natural heat loading (background). Temperature in some streams may still exceed numeric criteria, but if human-caused sources of heat loading have been addressed, these streams will be in compliance with Idaho WQS (IDAPA 58.01.02.250.02).

Nonpoint source allocations (shade targets) have been assigned independent of land use or land ownership. Reductions in stream shade have occurred as a result of a variety of land use activities, and on private, state, and federal lands. In order to resolve temperature problems, improvements will need to be made across all land use and ownership categories. The location and degree of shade loss and channel alteration are the major factors that must be considered in restoration. As a result, allocations were established based on conditions at a given location, regardless of land use or land ownership.

Non-point source load allocation

Nonpoint source load allocations consist of a series of shade targets established for each stream in the SF CWR Subbasin. As discussed in Section 3.1 and Appendix G, shade targets for forested areas have been developed utilizing the CWE process. Specific percent canopy closure targets for each 200-foot elevation reach have been developed. Due to the sheer number of stream segments evaluated, these are included as a map in Appendix G accompanied by an ArcView shapefile on CD or diskette. For illustration, targets for forested areas in currently 303(d) listed streams are shown Figures 57, 58, and 59.

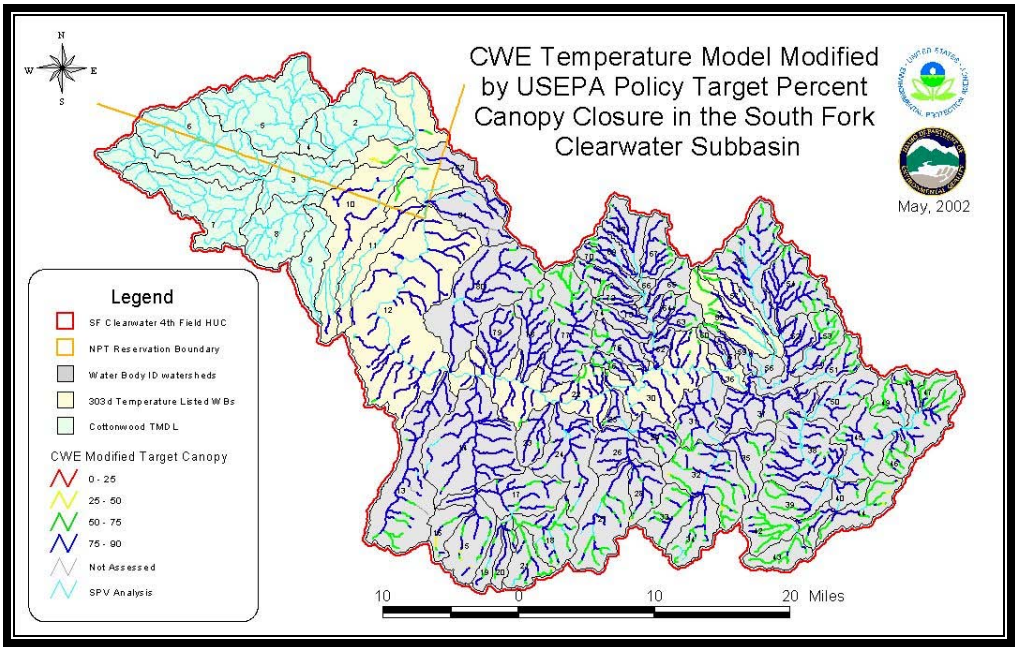


Figure 57. Cumulative Watershed Effects (CWE)-Based Target Percent Canopy Closure for the SF CWR Subbasin

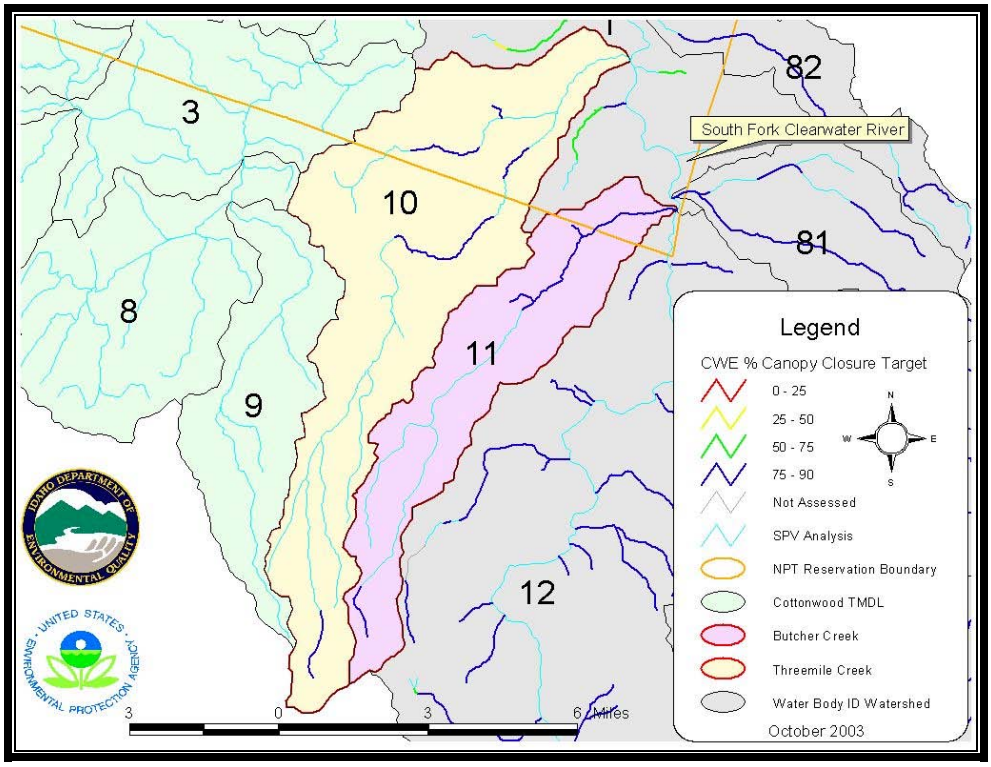


Figure 58. Cumulative Watershed Effects (CWE)-Based Target Percent Canopy Closure for the Threemile/Butcher Creeks Area

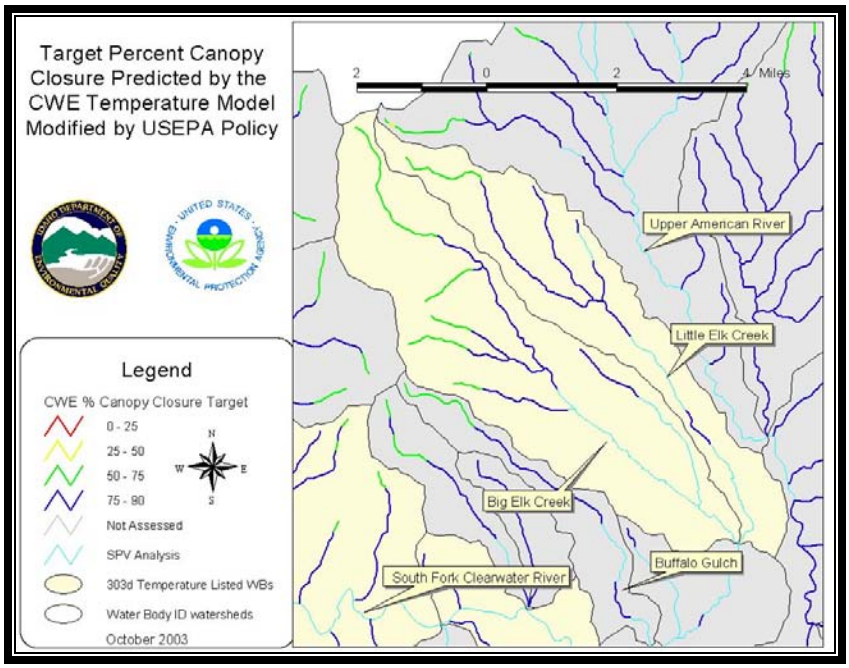


Figure 59. Cumulative Watershed Effects (CWE)-Based Target Percent Canopy Closure for the Big and Little Elk Creeks Area

In non-forested areas the allocation consists of effective shade targets established through the SPV process outlined in Appendix F. A series of curves has been developed for 12 different vegetative response units (VRUs) and three wetland types (Appendix F). Reach-specific targets may be derived from these curves using site-specific information on channel width and aspect. Effective shade targets for currently listed 303(d) streams based on existing vegetation and channel width information were estimated and are shown in Figures 60-64. Target conditions (gray lines) are plotted against the current shade conditions (dark lines).

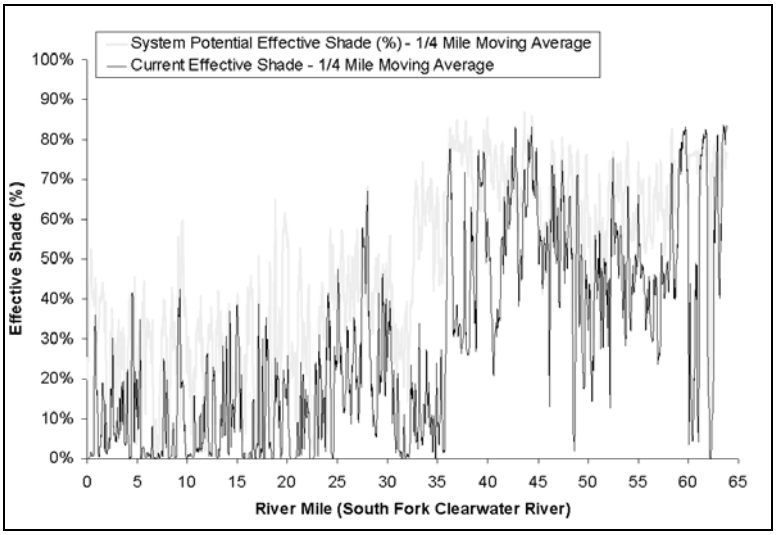


Figure 60. Current and System Potential Effective Shade Conditions for the SF CWR

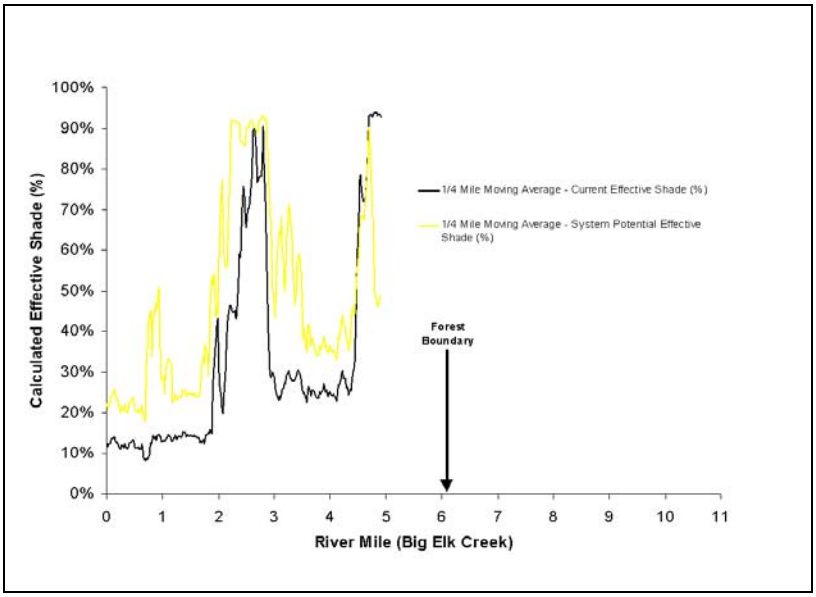


Figure 61. Current and System Potential Effective Shade Conditions for Big Elk Creek

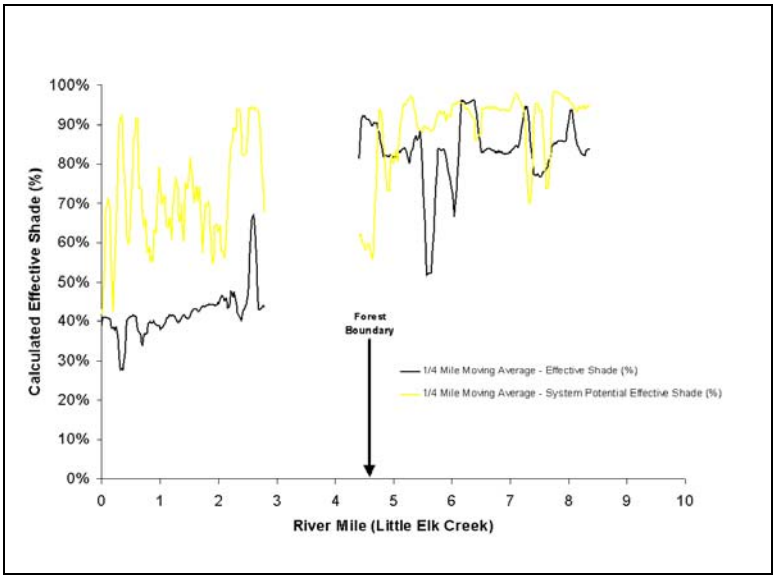


Figure 62. Current and System Potential Effective Shade Conditions for Little Elk Creek

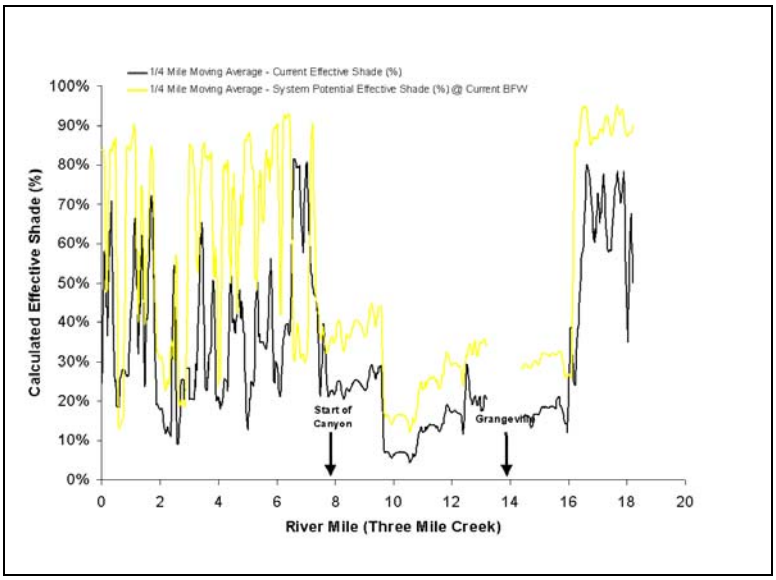


Figure 63. Current and System Potential Effective Shade Conditions for Threemile Creek

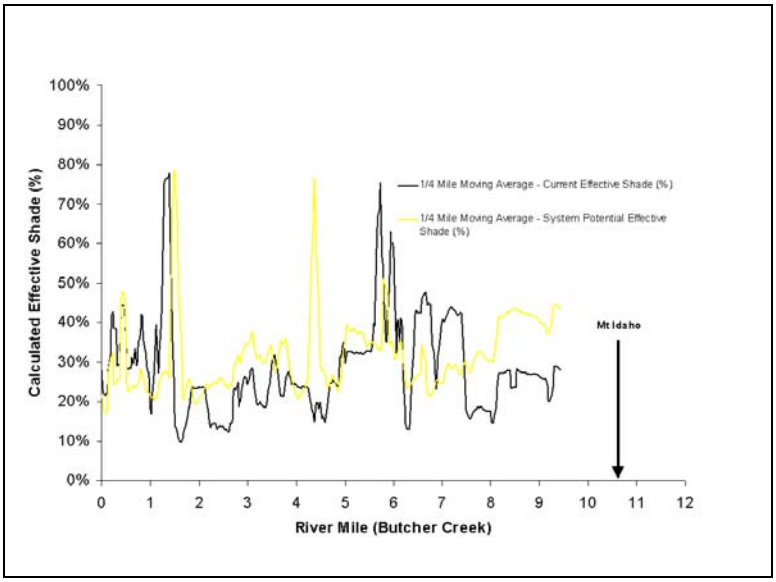


Figure 64. Current and System Potential Effective Shade Conditions for Butcher Creek

The nonpoint source shade allocations result in the need to increase shade in most of the watershed historically managed by man. Increases in shade are not needed in areas that have natural vegetation and channel conditions. These areas primarily occur in high elevation forests, and portions of lightly managed watersheds, such as Johns and Silver Creeks. A summary of the general increases in shaded needed throughout the SF CWR subbasin is listed in Table 44.

Current shade levels are highly variable in all land use types, and reflect a wide range of natural and man-induced disturbance conditions, and variability in vegetation types. For example, mapped meadow areas often contain small patches of coniferous trees, resulting in a naturally wide range of shade. The summary of needed shade increases shown in the last column of Table 44 provides a general impression of the average difference between currnt and target shade levels needed. However, landowners and land managers must consult detailed allocations within the TMDL, coupled with on-site field verification, in order to establish site specific targets.

Table 44. Nonpoint source shade increase summary.

Land Use Type	Current shade	Average Percent Shade Increase Needed
SF CWR Mainstem	0 – 95%	19%
Forested areas	0 – 90%	21%
Upper Meadow areas	0 – 97%	24%
Agricultural areas	0 - 83%	19%

Point Source Wasteload Allocations

As indicated in Chapter 3, point sources in the SF CWR include WWTPs, storm water runoff, and suction dredging. Of these, only WWTPs are known to be contributors of heat to the SF CWR and are the focus of WLAs in this TMDL.

It has been established that temperatures in all SF CWR streams monitored in recent years exceed established water quality criteria, primarily during the summer months. Since even streams at high elevations with little or no human impact exceed temperature criteria, it has been concluded that streams temperatures naturally exceed criteria throughout the subbasin, primarily during the warmest months of the year. The temperature exception for natural conditions in the Idaho WQS (IDAPA 58.01.02.401.03.a.v) provides that:

"If temperature criteria for the designated aquatic life use are exceeded in the receiving waters upstream of the discharge due to natural background conditions, then Subsections 401.03.a.iii. and 401.03.a.iv. do not apply and instead wastewater must not raise the receiving water temperatures by more than three tenths (0.3) degrees C."

This standard is consistent with recently issued temperature guidance (USEPA 2003), which supports allowance of "de-minimis" increases.

The natural stream temperature at each of the treatment facilities will vary daily, seasonally, and from year to year, and is clearly the most difficult of these variables to establish. Further, at each of the facilities, upstream human activities likely have increased stream temperature above background levels, so stream temperatures upstream of each outfall are not considered to be natural. Natural stream temperatures may be modeled, but such

modeling is beyond the scope of this TMDL, and likely is not feasible for very small streams such as Elk Creek, Threemile Creek, and the South Fork Red River.

It is not necessary to know natural background temperatures in order to establish effluent limits that will not increase temperature by more than 0.3°C (0.5 °F). If the calculation is made at criteria temperatures, the resulting heat load will also meet the limit at higher receiving water temperatures. If natural temperatures are actually lower than the criteria, the effluent limit so calculated will still more than meet standards, as a greater increase would be allowed (1.0 °C = 1.8 °F) in such circumstances. So the conservative approach taken here is to calculate the allowable heat load as if the natural background temperature was equal to the applicable numeric criterion.

Given the lack of natural stream temperature data, for the purposes of calculating effluent limits, it has been conservatively assumed that the in-stream temperature upstream of a treatment facility does not exceed the applicable temperature criteria. Effluent temperatures that would increase the stream temperature by 0.3°C are then calculated using a mass balance equation and provisions in Idaho WQS which allow mixing zones of up to 25% by volume of the stream flow (IDAPA 58.01.02.060). This approach is consistent with recommendations in the USEPA temperature guidance (USEPA 2003). The mass balance equation is as follows:

$$T_E = \frac{[Q_E + (0.25 * Q_S)] * [T_C + 0.3C] - [(0.25 * Q_S) * T_C]}{Q_E}$$

Where:

T_E = effluent temperature (°C)
Q_E = effluent flow (cfs)
Q_S = stream flow (cfs)
T_C = applicable temperature criteria (cfs)
0.25 = 25% by volume mixing zone allowance (unitless)

Based on these calculations, very high effluent temperatures at Kooskia, Stites, Red River Ranger Station, and, to some degree, Elk City would not significantly increase in-stream temperatures below the mixing zone (See Appendix O). However, since all of the receiving waters for these facilities naturally exceed temperature criteria, and since other anthropogenic sources in these watersheds are also increasing stream temperatures, it is not reasonable to allow treatment facilities to further increase their effluent temperatures. USEPA enforces this concept with their anti-backsliding provisions of the NPDES permitting process. Consequently, allocations for these facilities will be based on current maximum temperatures, as recommended in the temperature guidance (USEPA 2003).

Local data to estimate maximum effluent temperatures are sparse; only Grangeville, and more recently, Kooskia, have monitored and reported effluent temperatures historically. Effluent data collected by Grangeville between 1989 and 2001 and included in USEPA's Permit Compliance System database (USEPA 2003b) were reviewed, and a maximum temperature of 23 °C (73.4 °F)was reached during six different months (typically August) over the 12-year period. This is consistent with data reported in TMDLs in eastern Oregon

for other small community WWTPs: Pendleton, OR – 22 °C; Hermiston, OR – 23°C; La Grande, OR – 23°C (ODEQ 2000, ODEQ 2001). Therefore, establishing a maximum daily limit of 23°C, which would apply at times when temperature criteria are expected to be exceeded, appears to be reasonable for Kooskia, Stites, Red River Ranger Station, and portions of the year for Elk City.

Kooskia began monitoring effluent temperature in May of 2003. Peak temperatures were reached during July 2003, with a maximum daily temperature of 26 ^{o}C (78.8 ^{o}F) recorded on July 31 (Kooskia 2003). Based on these data, a maximum daily limit of 26 °C (78.8 ^{o}F) will be established as the wasteload allocation for Kooskia and Stites, which is in close proximity. This allocation will apply from July 15 – August 31, and from October 1 – 15, when temperature criteria in the SF CWR are expected to be exceeded.

The wasteload allocation for the Red River Ranger Station and Elk City will include a maximum daily limit of 23 ^{o}C (73.4 ^{o}F), based on data from Grangeville and eastern Oregon communities. While Elk City and the Red River Ranger Station have thus far not reported the temperature of their effluent, these facilities are located at 4,060 and 4,330 feet elevation respectively, whereas Kooskia and Grangeville lie at 1,280 and 3,360 feet elevation respectively. While the surface area and shape of the waste treatment ponds at these facilities will likely affect effluent temperature, for purposes of this allocation it is expected that temperatures of the Grangeville effluent are more comparable to that of Elk City and the Red River Ranger Station due to the relatively low elevation of Kooskia. This allocation may be adjusted in the future if effluent monitoring at Elk City and the Red River Ranger Station indicates that effluent temperature from these facilities exceeds 23 ^{o}C (73.4 ^{o}F).

Effluent temperatures for Grangeville, and Elk City under low stream flow conditions, may have a significant impact on stream temperature. Wasteload allocations for these facilities will be based on mass balance calculations in Tables 45 - 47 to ensure that permit limits do not result in greater than a 0.3°C increase in stream temperature.

Table 45. Elk City wastewater treatment plant (WWTP) maximum daily effluent temperatures (°C)[a] that would not increase temperatures in Elk Creek by more than 0.3 °C between June 1 and September 30 when federal bull trout criteria apply.

Elk Creek Flow Above WWTP (cfs)[b]	WWTP Effluent Discharge (cfs)							
	0.01	0.02	0.03	0.04	0.05	0.10	0.15	0.20
3	23.0	20.6	16.8	14.9	13.8	11.6	10.8	10.4
5	23.0	23.0	21.8	18.7	16.8	13.1	11.8	11.2
10	23.0	23.0	23.0	23.0	23.0	16.8	14.3	13.1
15	23.0	23.0	23.0	23.0	23.0	20.6	16.8	14.9
20	23.0	23.0	23.0	23.0	23.0	23.0	19.3	16.8
25	23.0	23.0	23.0	23.0	23.0	23.0	23.0	18.7
30	23.0	23.0	23.0	23.0	23.0	23.0	23.0	20.6
35	23.0	23.0	23.0	23.0	23.0	23.0	23.0	22.4
>35	23.0	23.0	23.0	23.0	23.0	23.0	23.0	23.0

[a] Applicable between June 1 and September 30 when federal bull trout temperature criteria apply
[b] cubic feet per second

Table 46. Grangeville wastewater treatment plant (WWTP) maximum daily effluent temperatures (°C) [a] which would not increase temperatures in Threemile Creek by more than 0.3 °C between April 1 and May 31 when the salmonid spawning criteria is applicable.

Threemile Creek Flow Above WWTP Outfall (cfs) [b]	WWTP Effluent Discharge (cfs)				
	0.4	1.0	1.5	2.0	2.5
0.1	9.3	9.3	9.3	9.3	9.3
1	9.5	9.4	9.4	9.3	9.3
3	9.9	9.5	9.5	9.4	9.4
5	10.2	9.7	9.6	9.5	9.5
7	10.6	9.8	9.7	9.6	9.5
9	11.0	10.0	9.8	9.6	9.6
10	11.2	10.1	9.8	9.7	9.6

[a] Applicable between April 1 and May 31 when salmonid spawning temperature criteria apply
[b] cubic feet per second

Table 47. Grangeville wastewater treatment plant (WWTP) maximum daily effluent temperature (°C) that would not increase Threemile Creek temperature more than 0.3 °C between July 15 and September 15 when coldwater aquatic life temperature criteria apply.

Threemile Creek Flow Above WWTP Outfall (cfs)	WWTP Effluent Discharge (cfs)				
	0.3	0.5	1.0	1.5	2.0
0.1	19.3	19.3	19.3	19.3	19.3
1.0	19.6	19.5	19.4	19.4	19.3
2.0	19.8	19.6	19.5	19.4	19.4
3.0	20.1	19.8	19.5	19.5	19.4

Specific WLAs for all WWTPs are listed in Table 48. Heat loads (Btu/day) that correspond to these allocations are listed in tables in Appendix O. These allocations are intended to apply only during times when it is expected that the receiving waters will exceed numeric temperature criteria, based on historic data in Appendix J. It is expected that these limits will be incorporated directly into NPDES permits, since a 25% mixing zone provision has already been included in WLAs for Grangeville and Elk City. For Kooskia, Stites, and Red River Ranger Station, the WLAs should be interpreted as an end-of-pipe limit (i.e., no mixing zone), since it represents the reasonable maximum end-of-pipe temperature.

Table 48. Temperature wasteload allocations for wastewater treatment plants.

Facility	Wasteload Allocation	Applicable Period
Kooskia Wastewater Treatment Plant	26 °C (78.8 °F), daily maximum	July 15 – August 31 October 1 – 15
Stites Wastewater Treatment Plant	26 °C (78.8 °F), daily maximum	July 15 – August 31 October 1 – 15
Red River Ranger Station Wastewater Treatment Plant	23 °C (73.4 °F), daily maximum	July 15 – August 31
Elk City Wastewater Treatment Plant	23 °C (73.4 °F), daily maximum	May 15 – 31
	See 45	June 1 – September 30
Grangeville	See Table 46	April 1 – May 31
	See Table 47	July 15 – September 15

An evaluation of localized impacts of thermal plumes on salmonids, as recommended in the temperature guidance, was not conducted as part of this TMDL. The guidance describes potential adverse impacts from thermal plumes, which may occur at different temperatures ranging from 13 °C to 32 °C (55.4 °F to 89.6 °F), for different exposure periods. The

evaluation in the TMDL supporting allocations for all facilities focused on achieving salmonid spawning (9 ^{o}C (48.2 ^{o}F) daily average), bull trout (10 ^{o}C (50 ^{o}F) MWMT), or the cold water aquatic life criteria (19 ^{o}C (66.2 ^{o}F) daily average) at the edge of a 25% by volume mixing zone. Given the nature of this evaluation, and the size and location of the WWTPs, the only scenario in the temperature guidance which would appear to warrant further impacts analysis is whether the WWTP effluent causes stream temperature to exceed 13°C, or cause increases in stream temperature of more than 0.25 °C (0.45 ^{o}F), in the vicinity of active salmonid spawning and egg incubation areas. Prior to issuing NPDES permits based on these WLAs, it is recommended that stream channels in the vicinity and downstream of these outfalls be surveyed by fisheries biologists to establish the nearest downstream spawning areas. Mixing zone calculations should then be conducted to determine if the wasteload allocations would cause stream temperature to exceed 13°C, or cause stream temperature to increase more than 0.25°C in these spawning areas. If so, wasteload allocations and NPDES permit limits should be adjusted to avoid these conditions.

Margin of Safety

The CWA requires that each TMDL be established with an MOS. The statutory requirement that TMDLs incorporate an MOS is intended to account for uncertainty in available data or in the actual effect controls will have on loading reductions and receiving water quality. An MOS is expressed as unallocated assimilative capacity or conservative analytical assumptions used in establishing the TMDL (e.g., derivation of numeric targets, modeling assumptions, or effectiveness of proposed management actions).

The MOS may be implicit, as in conservative assumptions used in calculating the LC, WLA, and LA. The MOS may also be explicitly stated as an added, separate quantity in the TMDL calculation. In any case, assumptions should be stated and the basis behind the MOS documented. The MOS is not meant to compensate for a failure to consider factors that affect water quality.

A TMDL and associated MOS, which result in an overall allocation, represent the best estimate of how standards can be achieved. The TMDL process accommodates the ability to track and ultimately refine assumptions within the TMDL implementation-planning component.

The following factors may be considered in evaluating and deriving an appropriate MOS:

- The analysis and techniques used in evaluating the components of the TMDL process and deriving an allocation scheme.
- The characterization and estimates of source loading (e.g., confidence regarding data limitation, analysis limitation, or assumptions).
- An analysis of relationships between the source loading and in-stream impact.
- The prediction of the response of receiving waters under various allocation scenarios (e.g., the predictive capability of the analysis and simplifications in the selected techniques).

- The implications of the MOS on the overall load reductions identified in terms of reduction feasibility and implementation time frames.

A number of areas of uncertainty exist in the SF CWR Subbasin temperature TMDL. Among the more significant are:

- The relationship between stream temperature and shade levels.
- Estimating CWE and system potential shade levels.
- Estimating point source effluent temperatures.

The TMDL accounts for these uncertainties by incorporating implicit MOS. The procedure to develop shade targets utilizing the CWE methodology is based on achieving existing temperature criteria. Analysis above indicates that temperatures naturally exceed criteria throughout the subbasin; therefore, shade targets and WLAs that are developed to meet the criteria are inherently conservative. In addition, by definition SPV targets represent riparian vegetation conditions absent human disturbance, and are therefore the best achievable.

Seasonal Variation/Critical Conditions

Temperature varies seasonally due to changes in solar radiation loading, air temperature, and other factors, as illustrated in Section 2.3. Water temperatures peak in the July – August time period, which coincides with spawning and incubation periods for key sensitive aquatic species including spring/summer chinook salmon, cutthroat trout, bull trout, and steelhead. Egg and larval stages of salmonids are the most sensitive to elevated temperatures, so the July – August time period, when the magnitude of temperature exceedances is the greatest and flows are the lowest, is the most critical period for temperature.

The TMDLs have addressed the seasonal nature and this critical time period by developing shade targets (CWE and SPV) and WLAs specifically for this period. The CWE analysis targets early August in deriving canopy closure targets that have been associated with water temperature compliance, and the heat loading resulting from system potential vegetation targets is estimated for the August time frame. Seasonal WLAs apply only during the time period when violations are expected to occur, and have been established to meet Idaho temperature criteria, including natural condition provisions, during the critical low flow summer months. By developing targets for the most critical time period, it is expected that shade targets will be protective at other times of the year as well.

Background

The natural background heat loading is an important component of the TMDL, because temperatures throughout the subbasin appear to naturally exceed existing water quality criteria at certain times. The TMDL does not attempt to quantify the natural background heat loading or establish the natural thermal regime of individual water bodies. Rather, the TMDL allocations incorporate natural background by setting shade targets that are expected to achieve natural background temperatures. This is consistent with direction provided in Idaho WQS (IDAPA 58.01.02.200.09), which say that when natural background conditions

exceed any applicable water quality criteria, the water quality criteria shall not apply; instead, pollutant levels shall not exceed natural background conditions.

Reserve

A reserve capacity for future growth has not been specifically identified or incorporated within these temperature TMDLs. Future management activities and growth of municipalities is expected to be possible within the allocations and WLAs established.

5.4 Sediment TMDLs

Sediment TMDLs are developed below for seven water bodies in the SF CWR Subbasin: Threemile Creek, Butcher Creek, and the five water bodies of the main stem SF CWR. Point sources of sediment within the subbasin are relatively minor in relation to the nonpoint sources. However, all known point sources are evaluated and WLAs set.

The details of the data sets and some of the calculations for the nonpoint source of sediment are presented in Appendix M. A sediment budget (Appendix L) was developed for all the major nonpoint sediment sources in the SF CWR Subbasin; the results of which are used to calibrate and validate the sediment loadings calculations.

In-Stream Water Quality Targets for Sediment

The goal of a sediment TMDL is to restore "full support of designated beneficial uses" (Idaho Code 39.3611). A part of the analysis discussed herein uses a TSS target derived from the turbidity WQS based on equations found in Appendix M. Other parts of the analysis use the narrative sediment standard and are driven by reasoning processes rather than hard numbers. Setting the targets for the narrative-derived TMDLs involved the WAG and other interest groups to arrive at a method that would address the sediment impairment in the subbasin and not adversely affect one economic interest over another.

In general, in-stream TSS targets are set for Threemile Creek, Butcher Creek, and the lower main stem SF CWR at Stites. The sediment targets for the main stem SF CWR above Butcher Creek are set at the targeted percent sediment load reduction from the Stites location, (i.e., 25% of the total human-caused sediment load). The human-caused loads and targets for the locations upstream from Butcher Creek are based on the sediment budget presented in Appendix L.

Design Conditions

The 303(d) listed streams in the SF CWR Subbasin for which sediment TMDLs were developed are Threemile Creek and Butcher Creek in the lower end of the subbasin and the whole of the main stem SF CWR from Kooskia up to the confluence of the Red and American Rivers. The main stem SF CWR is divided into five water bodies in state code (IDAPA 58.01.02.120.07) and sediment TMDLs are developed for each one of them.

Salmonid spawning aquatic life use is the most limiting designated or existing beneficial use for all of these water bodies.

Sediment loading to streams and rivers in the SF CWR Subbasin is dominated by spring runoff events, particularly those extreme events that have a recurrence of once every five years or longer. Sediment loadings for the SF CWR TMDLs are calculated on an annual basis. However, it is clear that only significant load reductions during the extreme events will result in attainment of the water quality targets. The majority of sediment load reductions for the SF CWR Subbasin must come from Cottonwood Creek if the subbasin is to meet WQS. The sediment TMDL for Cottonwood Creek has been written (DEQ, NPT, USEPA 2000) and the SF CWR Subbasin TMDLs rely on some of its calculated loadings to balance the sediment budget.

Sediment loading calculations focus on the large and predominant sources of sediment in the subbasin. Many other minor sources of sediment exist throughout the subbasin, such as the fish hatchery facilities, old mines, and other largely unidentifiable and unquantifiable sources (see Chapter 3). Gross sediment load allocations are established at key control locations within the watershed, and include all nonpoint sources of sediment. It is expected that a majority of the sediment reductions needed to achieve the allocations will come from the major anthropogenic sources, principally agriculture, roads, and stream bank erosion control.

The sediment loading analyses and target development are driven by the turbidity standard which states that waters shall not exceed 25 NTU over background for greater than 10 days and shall not exceed 50 NTU over background at any time. The turbidity measurements used in the calculations are instantaneous samples. Similarly, the extreme flows which generate the greatest amount of sediment are in effect instantaneous, or at least do not last for 10 days. To transform the instantaneous turbidity data to produce continuous sediment loading numbers, a stochastic flow model of daily average flow for 10 years is developed. The resulting continuous flow/turbidity/TSS model results are then compared to the 25 NTU over background criterion to develop daily loading, daily load capacity, daily natural background loading, and daily excess sediment loading. These results are then annualized to produce the loading figures presented in this report. Doing all the calculations on a daily, essentially continuous basis, using the 25 NTU criterion automatically includes all times when the 50 NTU criterion is exceeded. Subsequent discussions of the loading calculations for these TMDLs refer to achieving the 25 NTU criterion. It is to be understood that the methods used for the calculations automatically include the times when the 50 NTU criterion applies, and will also ensure this portion of the turbidity standard is met.

The narrative sediment WQS states that sediment "shall not exceed quantities … which impair designated beneficial uses" (IDAPA 58.01.02.200.08). Sediment load reduction calculations for the main stem SF CWR above Butcher Creek are based on restoring beneficial uses that are impaired in this part of the river. DEQ's protocol for assessing beneficial use support status for large rivers has not been applied to the main stem SF CWR for lack of adequate data. However, sediment loading, coupled with the Fish TAG conclusions (Appendix D), cobble embeddedness data, and other reference watershed data

(Appendix N) have led to the conclusion that beneficial uses are impaired in the main stem and that TMDLs are required. The requirement for load reductions in the main stem will likely result in load reductions from water bodies flowing into the main stem. Targets are set at four main stem SF CWR control points upstream from the mouth of Butcher Creek.

Bedload in the form of sand-sized particles is considered to be the primary pollutant of interest in the main stem SF CWR water bodies above Butcher Creek. Bedload is also considered to be a problem in Butcher Creek, Threemile Creek, and the lower reach of the main stem. While we do have some bedload data, there are insufficient data to calculate loads and set targets for bedload. Therefore, it is assumed that sediment load reductions to meet TSS-based targets will result in adequate bedload reductions as well. The basis for this assumption is discussed in the sections to follow.

Sediment loading calculations for these SF CWR TMDLs are based on daily average flows and monitoring results of associated in-stream TSS. The calculated results are then annualized so sediment LAs can be made. The following sections of this report present the calculations in the order they come into play: development of the stochastic flow models; development of the flow to TSS and bedload relationships; estimations of current sediment loading; estimations of the proportions of current sediment loading that are natural background; estimations of loading capacities based on the WQS, flow, and background; calculations of excess sediment loading from the current loading and loading capacities; determination of a MOS; and estimation of a required sediment load reduction to meet WQS. The summary results of all the calculations and estimations are presented for control locations for Butcher and Threemile Creeks and the main stem SF CWR at Stites and Harpster in Tables 49 through 52.

Table 49. Threemile Creek loading calculations.

Parameter[a]	Equation[b]	Minimum	Maximum	Average
Daily Flow for Last 10 Years (cfs)	Derived from Lapwai Creek and Lipscomb (1998) correction	0.19	411	16
Existing TSS, Daily Average (mg/L) [c]	(flow) * (0.9779)	0.19	402	16
Existing TSS (t/day)	(TSS) * (flow) * (0.0027)	0.0001	446	3.0
Existing TSS, Yearly Average (t/y)		18	3,992	1,112
Existing Turbidity (NTU)	(flow) * (1.8182)	0.25	542	21
Background Ratio	(535 t/y/WB) / (6640 t/y/WB)			0.08 (8%)
Background TSS (mg/L)	(TSS daily average) * (background ratio)	0.02	35	1.3
Background TSS (t/day)	TSS (t/day) * background ratio	0	38	0.27
Load Capacity (t/day)	((17 mg/L) * daily flow * 0.0027) + background TSS (t/day)	0.008	57.8	1.0
Excess Load (t/day)	If load capacity > TSS (t/day) Else, TSS (t/day) – load capacity	0 0	0 388	0 2.1
Excess Load (t/y)				775
Load Reduction (%)	Excess load / (TSS – background TSS) yearly average			0.77 (77%)

[a] cfs = cubic feet per second, TSS = total suspended solids, mg/L – milligrams per liter, t/day = tons per day, t/y = tons per year, NTU = nephlometric turbidity units
[b] t/y/WB = tons per year per water body
[c] From sediment yield curves in Appendix M
Threemile Creek watershed area = 21, 478 acres or 33.5 square miles
Threemile Creek sediment yield equation: 25 NTU Idaho WQS criterion = 17 mg/L = (25 NTU * 0.674)

Table 50. Butcher Creek loading calculations.

Parameter[a]	Equation[b]	Minimum	Maximum	Average
Daily Flow for Last 10 Years (cfs)	Derived from Lapwai Creek and Lipscomb (1998) correction	0.07	159	6.2
Existing TSS, Daily Average (mg/L)	(flow) * (2.381) + 5.89 [c]	6.1	384	20.6
Existing TSS (t/day)	(TSS) * (flow) * (0.0027)	0.001	165	1.2
Existing TSS, Yearly Average (t/y)		13.8	1,537	435.6
Existing Turbidity (NTU)	((flow) * (2.6118)) + 3.7317	3.9	418	19.9
Background Ratio	(303 t/y/WB) / (1,251 t/y/WB)			0.24 (24%)
Background TSS (mg/L)	(TSS daily average) * (background ratio)	1.5	92.7	5.0
Load Capacity (mg/L)	Background + 25.25 mg/L	26.7	117.98	30.2
Background TSS (t/day)	TSS (t/day) * background ratio	0.0003	39.8	0.29
Load Capacity (t/day)	((25.25 mg/L) * daily flow * (0.0027)) + background TSS (t/day)	0.005	50.6	0.71
Excess Load (t/day)	If load capacity > TSS (t/day) Else, TSS (t/day) – load capacity	0 0	0 114	0 0.55
Excess Load (t/y)				199.4
Load Reduction (%)	Excess load / (TSS – background TSS) yearly average			0.61 (61%)

[a] cfs = cubic feet per second, TSS = total suspended solids, mg/L – milligrams per liter, t/day = tons per day, t/y = tons per year, NTU = nephlometric turbidity units
[b] t/y/WB = tons per year per water body
[c] From sediment yield curves in Appendix M
Butcher Creek watershed area = 10,723 acres or 16.8 square miles
Butcher Creek sediment yield equation: 25 NTU Idaho WQS standards = 25.25 mg/L = ((25 NTU) * 0.9056) + 2.6113

Table 51. Stites USGS station loading calculations.

Parameter[a]	Equation[b]	Minimum	Maximum	Average
Daily Flow for Last 10 Years (cfs)	Stites USGS station and Lipscomb (1998) correction	90	9,140	1,099
Existing TSS, Daily Average (mg/L)	(flow^1.953) * (0.00005) [c]	0.03	272	9.7
Existing TSS (t/day)	TSS (mg/L) * flow * (0.0027)	.008	6,715	104
Existing TSS, Yearly Average (t/y)		NA	NA	38,157
Existing Bedload, (t/y)	3 * (10^(-12)) * (flow^3.6237)	NA	NA	2,542
Existing Turbidity (NTU)	(flow) * (0.0058)	0.5	53	6.4
Background Ratio	(19,884 t/y/WB) / (91,052 t/y/WB)			0.22 (22%)
Background TSS (mg/L)	(TSS daily average) * (background ratio)	0.007	60.2	2
Load Capacity (mg/L)	Background TSS (mg/L) + 45 mg/L	45	1,05.2	47
Background TSS (t/day)	TSS (t/day) * background ratio	0.002	1,485	23
Load Capacity (t/day)	((46.9 mg/L) * daily flow * (0.0027) + (background TSS (t/day))	11.4	2,842	186
Excess Load (t/day)	If load capacity > TSS (t/day) Else, TSS (t/day) – load capacity	0 0	0 3,873	0 21
Excess Load (t/y)				7,574
Load Reduction (%)	Excess load / (TSS – background TSS) yearly average			0.25 (25%)

[a] cfs = cubic feet per second, TSS = total suspended solids, mg/L – milligrams per liter, t/day = tons per day, t/y = tons per year, NTU = nephlometric turbidity units
[b] t/y/WB = tons per year per water body
[c] From sediment yield curves in Appendix M
Watershed area = 1,150 square miles
Stites sediment yield equation: 25 NTU Idaho WQS standards = 45 mg/L = (25 NTU) * 1.8074

Table 52. Harpster site loading calculations.

Parameter[a]	Equation[b]	Minimum	Maximum	Average
Daily Flow for Last 10 Years (cfs)	(Stites USGS station) – (Prairie flow) and Lipscomb (1998) correction	42	7,479	860
Existing TSS, Daily average (mg/L)	(Flow) * (0.0066) + 6.7219 [c]	4.5	52.8	9.8
Existing TSS (t/day)	(TSS) * (flow) * (0.0027)	0.5	1,067	45.3
Existing TSS, Yearly Average (t/y)		NA	NA	15,053
Existing Bedload, (t/y)	6 * (10^(-9)) * (flow^2.713)	NA	NA	1,212
Existing Turbidity (NTU)	(TSS-3.8524) / 2.0474	0.3	23.9	2.9
Background Ratio	(14,856 t/y/WB) / (20,621 t/y/WB)			0.72 (72%)
Background TSS (mg/L)	(TSS daily average) * (background ratio)	3.1	36.6	6.8
Load Capacity (mg/L)	(Background TSS) + (60 mg/L)	63.1	96.6	66.8
Background TSS (t/day)	TSS (t/day) * (background ratio)	0.4	739	31.4
Load Capacity (t/day)	(60 mg/L) * daily flow * (0.0027) + (background TSS (t/day))	7.2	1,958	186
Excess Load (t/day)	If load capacity > TSS (t/day) Else, TSS (t/day) – load capacity	0 0	0 0	0 0
Excess Load (t/y)				0
Load Reduction (%)	Excess load / TSS, yearly average			0

[a] cfs = cubic feet per second, TSS = total suspended solids, mg/L – milligrams per liter, t/day = tons per day, t/y = tons per year, NTU = nephlometric turbidity units

[b] t/y/WB = tons per year per water body

[c]From sediment yield curves in Appendix M

Watershed area = 880 square miles

Harpster sediment yield equation: 25 NTU Idaho WQS standards = 60 mg/L = ((25 NTU) * (2.4281)) - 0.3334

Discussion of Tables 49 through 52

For Threemile Creek, the sediment budget calculations (Appendix L) indicate that 6,640 t/y of sediment are produced, whereas these TSS data (Table 49) indicate that only about 1,112 t/y of TSS are being output at the mouth. If one adds in the estimate of bedload for Threemile Creek, 615 t/y, this results in an estimate of 1,727 t/y of sediment discharged from the mouth, or only about 26% of the total from the sediment budget calculations. This 74% discrepancy may be the result of much more storage in this watershed than we have accounted for in the routing coefficient. There is an old mass failure about 1 mile above the mouth, above which sediment is accumulating. At the lower flows over most of the year, the stream goes subsurface above the mass failure, which probably accounts for the consistently low TSS and turbidity at low flows. The effect of the mass failure on sediment throughput, however, is not well understood. Another real possibility for the discrepancy would be that bedload is poorly estimated.

The sediment budget calculations (Appendix L) for Butcher Creek indicate that 1,251 t/y of sediment are produced, whereas these TSS data (Table 50) indicate that only about 435 t/y of TSS are being output at the mouth. If one adds in the estimate of bedload for Butcher Creek, 211 t/y, this results in an estimate of 646 t/y of sediment discharged from the mouth, which is only 52% of the sediment predicted by the sediment budget. This 48% discrepancy is consistent with the data from Stites and may be the result of more storage in the watershed than accounted for in the routing coefficient. Also, the estimate for has a large level of uncertainty.

The sediment budget calculations (Appendix L) for the mouth of the SF CWR at Stites indicate that 91,052 t/y of sediment are produced in the SF CWR watershed, whereas the TSS data indicate that only about 38,157 t/y of TSS (Table 51) are being output at the mouth. If one adds in the estimate of bedload for the South Fork, 2,541 t/y, this results in an estimate of 40,698 t/y of sediment discharged from the mouth, which is only 45% of the calculated sediment budget. This 55% discrepancy may be the result of more storage in the watersheds than accounted for in the routing coefficient, or could as well be the result of poor estimation of bedload, given the few data available.

For the Harpster site, the sediment budget calculations (Appendix L) indicate that 19,624 t/y of sediment are produced in the SF CWR watershed above Harpster, whereas these TSS data (Table 52) indicate that about 15,053 t/y of TSS are being output. If one adds in the estimate of bedload at Harpster, 1,212 t/y, this results in an estimate of 16,265 t/year of sediment discharged from the mouth. This <10 percent discrepancy is somewhat surprising giving the level of reliability of the data and the relationships being used. However, it is noted that these numbers are very close to numbers generated in the past by the NPNF for sediment loading at the Mt. Idaho bridge (Kenny 1995).

Target Selection

The targets for Threemile Creek, Butcher Creek and lowest reach of the main stem SF CWR (water body #1) are derived using TSS data collected at bridges near the mouths of Threemile and Butcher Creeks and at the bridge at Stites over the SF CWR (near the USGS

gaging station at Stites). Loading calculations and targets are set using the state WQS of 25 NTU over background with the assumption that the duration of excursions greater than 25 NTU is greater than 10 days.

The sediment targets for the four main stem water bodies upstream from the mouth of Butcher Creek (i.e., water bodies #12, #22, #30, and #36) are set based on the percent load reduction required at Stites, the pour point for the basin. The data suggest that bedload sediment in the SF CWR Subbasin above Butcher Creek is impacting the beneficial uses of the waters above this point. However, bedload data at hand are insufficient to set bedload targets. It is assumed that targets based on total sediment loads will address the bedload issue. Targets for the main stem above Butcher Creek are set as a percentage of the total human-caused sediment load. The percentage is the same as that calculated for the Stites location. The human-caused sediment load is that calculated in the sediment budget in Appendix L.

Flow Data and Flow Estimation

Mean daily flow data recorded by the USGS are available for the lower main stem SF CWR ranging back to 1911. For the period of 1923-1963, the recording station was relocated at a site above the dam at Harpster. Since 1965, the recording station has been at Stites. Daily flow data from the USGS site at Stites are shown in Figure 65. The flow data for 10 years, from 1991 through 2001, were selected for the calculations. Examination of the flow chart shows that this is a reasonably representative time period. It includes the 1995 and 1996 high flow events, but as can be seen, these were not unusually high flow years. The USGS predicts that the 8,000 cfs flows of 1995 and 1996 have a return period of five years (see Table 21). The other major feature to note about the USGS plot is the variation in flow on an annual basis, almost two orders of magnitude.

Flow and loading calculations for each watershed were accomplished in a spreadsheet format with 3,658 daily mean flow records, one for each day of the 10 years of record used.

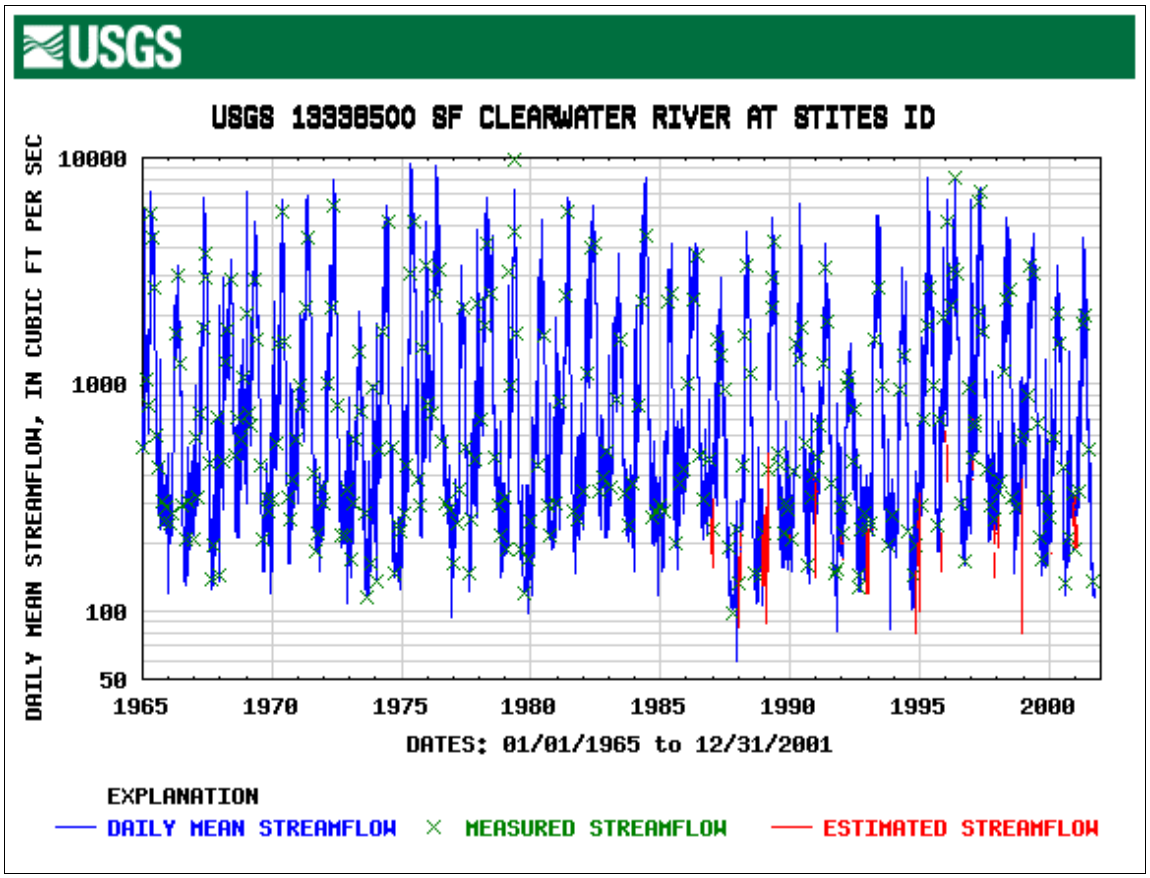


Figure 65. U.S. Geological Survey (USGS) Flow Record from Stites

It is generally recognized by local residents and hydrologists working in the area that the flow patterns from the watersheds in the lower subbasin, those watersheds to the west of the federal lands, are significantly different from those in the upper basin both in terms of the timing and duration of peak flows and the duration of minimum flows. The nearest USGS gaging station with similar flow patterns to the lower elevation streams flowing off the Camas Prairie is on Lapwai Creek. Of particular interest for the analyses are the flows of Cottonwood Creek, Threemile Creek, and Butcher Creek. Flows for Cottonwood Creek were calculated for the Cottonwood Creek TMDL based on flows from Lapwai Creek (DEQ, NPT, USEPA 2000). A similar procedure as used in the Cottonwood Creek TMDL using USGS measured flow from Lapwai Creek over the same 10-year time period from 1991 through 2001 was followed to calculate flows for Threemile Creek and Butcher Creek. The USGS chart of flows for Lapwai Creek is presented in Figure 66.

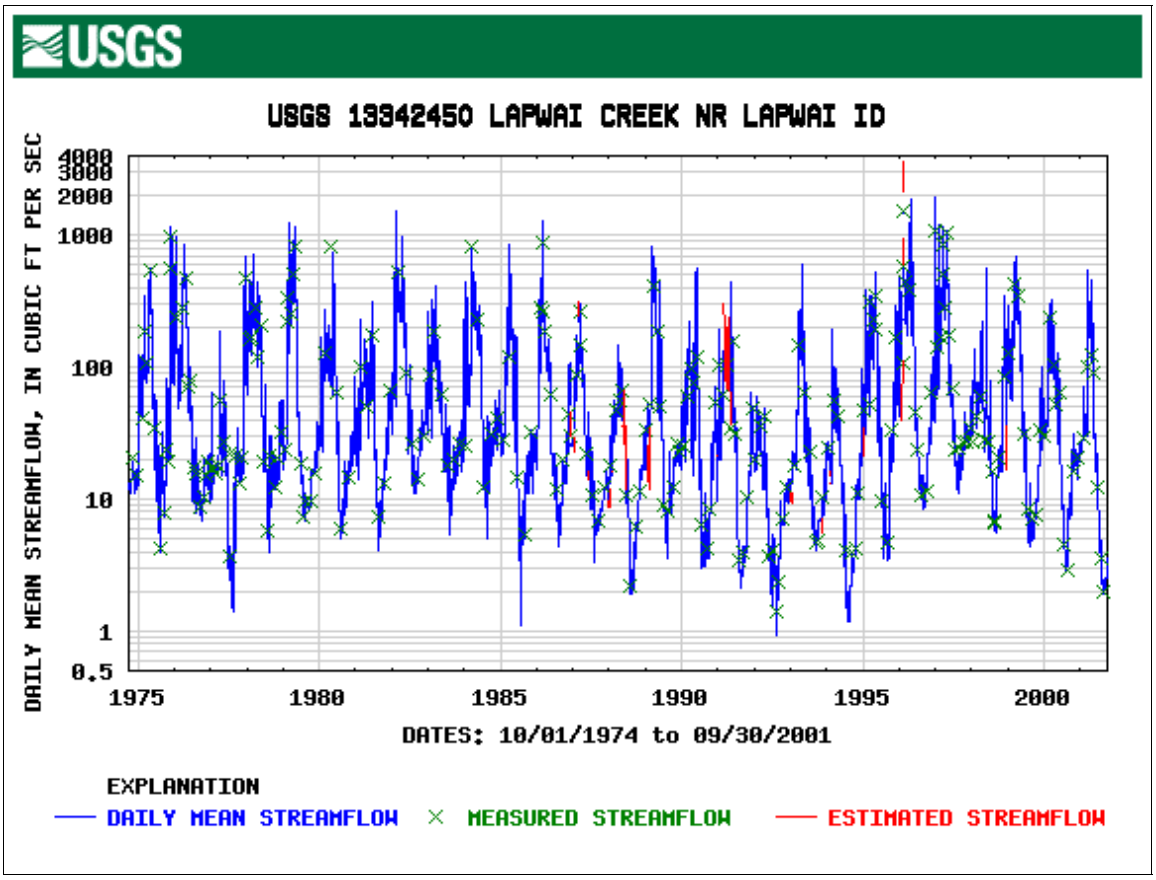


Figure 66. U.S. Geological Survey (USGS) Flow Data for Lapwai Creek

The flow at Lapwai Creek is much more variable from year to year compared to the flow at Stites, and the annual range of flow rates approaches three orders of magnitude.

Of particular concern about transposing the Lapwai Creek flow data to other watersheds is the single extreme flow event of February 1996. The flow rates for the three days when this flow occurred were reduced before using these flow data to calculate the stochastic flow models for Threemile, Cottonwood, and Butcher Creeks. It did not seem reasonable to extrapolate such an extreme event from Lapwai Creek to other watersheds where anecdotal evidence suggests that while the event was very large, it was not of the extreme nature as occurred in Lapwai Creek. In Figures 67 and 68 showing the graphs of the calculated flows for Threemile and Butcher Creeks, the February 1996 flows have been reduced to only slightly greater than other high flows that occurred in 1996 and 1997.

Daily flows for Threemile and Butcher Creeks were calculated in a two-step process. Since the volume of runoff from a watershed is proportional to the size of the watershed, everything else being equal, daily flow from Lapwai Creek was multiplied the values 33.5/235 for Threemile Creek and 16.8/235 for Butcher Creek (33.5, 16.8, and 235 are areas in square miles of Threemile, Butcher and Lapwai Creeks, respectively).

However, everything else is not equal between Threemile, and Butcher, and Lapwai Creeks, especially the precipitation. They all also have somewhat different geology, soils, physiography, land cover, and other features. Most notably, Threemile Creek and Butcher Creek receive more precipitation than Lapwai Creek. The USGS (Lipscomb 1998) provides statistically derived estimates of mean annual and mean monthly discharge for water bodies in central Idaho. The proportion of the mean annual flow from the USGS estimates were compared against the area adjusted mean annual flows to calculate daily flows over the 10 years, such that the mean annual flow over the 10 years equaled the USGS developed discharge rate for the two watersheds. This then is assumed to be a daily flow pattern representative of each watershed over the long term. The derived 10-year flow patterns for Threemile and Butcher Creeks are shown in Figures 67 and 68. The same calculations for were performed for Cottonwood Creek so the data would be available to calculate the flow pattern at Harpster, based on removal of high flows from these prairie streams.

For daily flow at Stites, the flow record from the USGS station was used and adjusted upwards to meet the long term annual discharge calculated by the USGS (Lipscomb 1998), resulting in a flow curve representative of the long term flow at the site. For daily flow at Harpster, the daily flows for Cottonwood, Threemile, and Butcher Creeks were subtracted from the Stites daily flow to account for the change in flow pattern as result of the different timing of peak flows from these three major tributaries. The flow was then adjusted to match the USGS estimate (Lipscomb 1998).

These calculations result in an estimate mean daily discharge based on the flow pattern over the last 10 years for Threemile Creek, Butcher Creek, and the Harpster site on the SF CWR (Figures 67, 68, and 69) and are assumed to be representative of long term flows in the respective watersheds. These flow estimates form the basis from which sediment movement in the basin can be calculated.

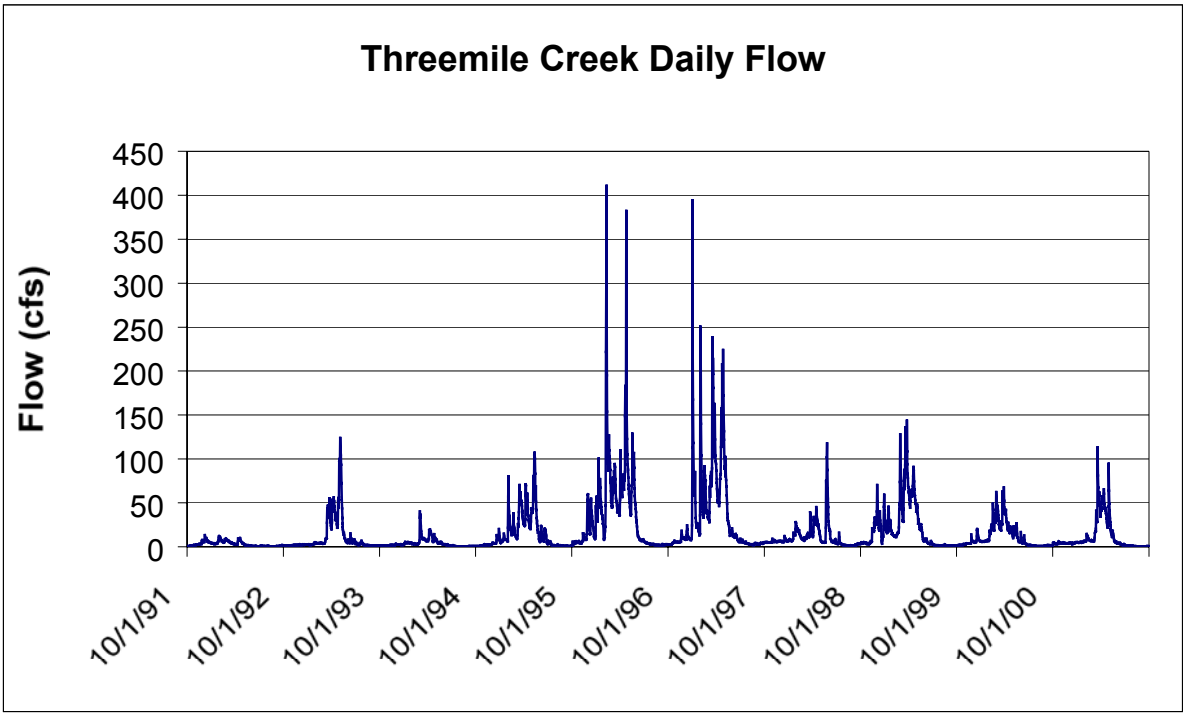


Figure 67. Derived 10-Year Flow for Threemile Creek

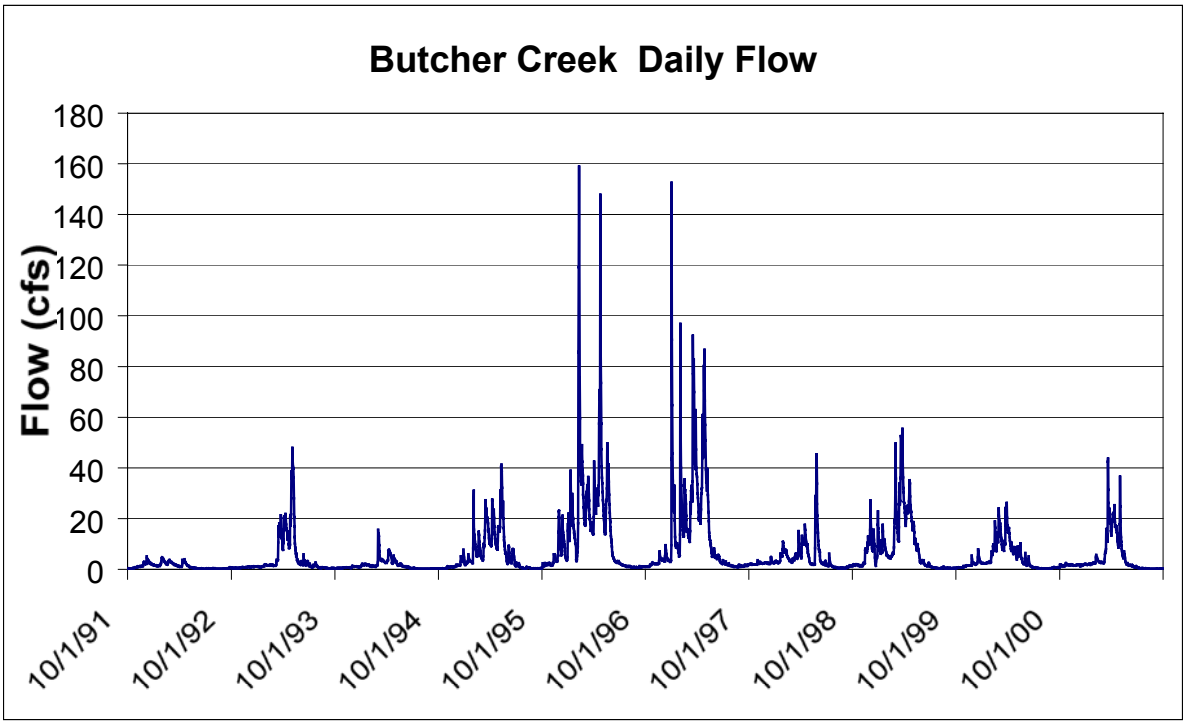


Figure 68. Derived 10-Year Flow for Butcher Creek

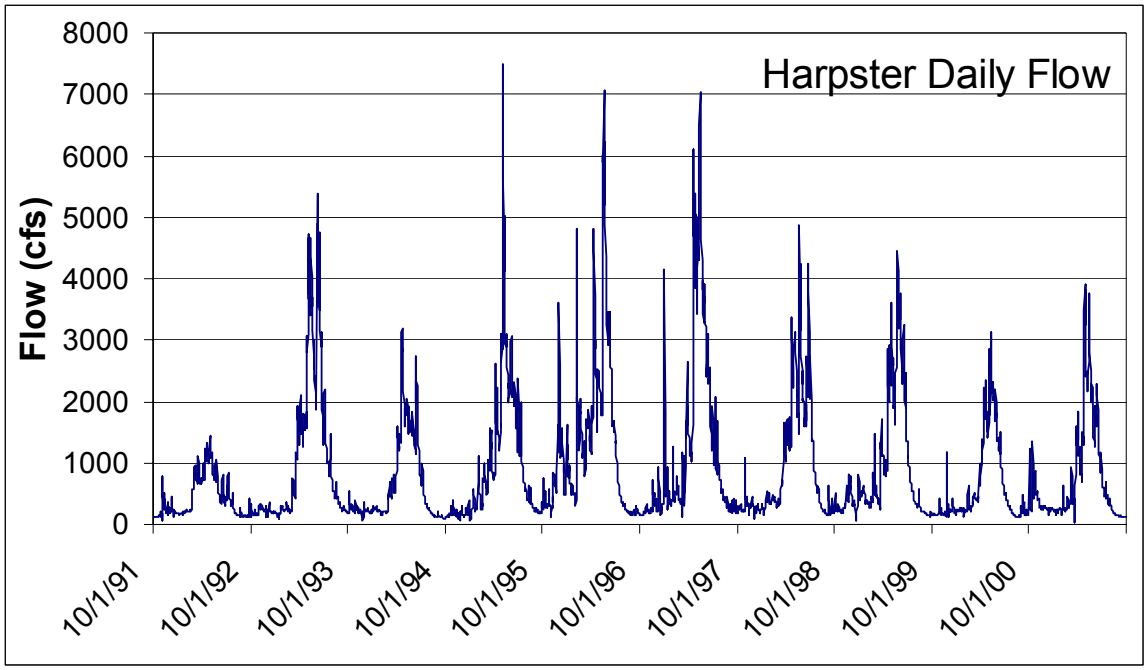


Figure 69. Derived 10-Year Flow for the Harpster Site on the SF CWR

TSS and Bedload Data

TSS and bedload data reported herein are the results of several different efforts on the part of DEQ, NPT, and USEPA. The USEPA provided funding for some of these efforts. DEQ collected instantaneous flow, TSS, and turbidity data for Threemile Creek as part of its detailed monitoring of that water body. The NPT collected instantaneous flow, TSS, turbidity, and bedload data for Butcher Creek as part of its monitoring of that water body. DEQ contracted with Western Watershed Analysts of Lewiston, Idaho, to provide flow and bedload data for the main stem SF CWR and Threemile Creek.

Unfortunately, flows in Threemile Creek and Butcher Creek over the sample period were below the level where significant bedload moved or could be sampled. Therefore, bedload for these streams is estimated from the sediment budget. Similarly, for the year when the contractor was to sample bedload in the upper main stem SF CWR, flows did not allow the bedload to be sampled. The result is that sampled bedload data exist only for the Stites and Harpster sites.

Other TSS and turbidity data exist for the SF CWR Subbasin, but come from such diverse locations and time periods as to make them difficult to use for a subbasin-wide analysis. DEQ collected turbidity and flow data for a number of streams in the SF CWR Subbasin (Thomas 1991) and these data provide a comparison for the results of the calculations. The NPNF collected TSS, turbidity, and flow data at the Mt. Idaho bridge from 1988-1992, analyzed these data, and extrapolated them using the data from Thomas (1991). These results were used to help validate the results from the 1991-2001 time frame of the analyses. Sediment yield curves are developed from the TSS and bedload data. The data and sediment yield curves for the Threemile, Butcher, Stites, and Harpster sites are presented in Appendix

M. The sediment yield curves for each site are presented in the summary sediment loading calculations Tables 49 through 52.

Estimates of Existing Sediment Loads

Regulations allow that loadings "…may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading," (Water quality planning and management, 40 CFR 130.2(I)). An estimate must be made for each point source. Nonpoint sources are typically estimated based on the type of sources (land use) and area (such as a subwatershed), but may be aggregated by type of source or land area. To the extent possible, background loads should be distinguished from human-caused increase in nonpoint loads.

Point Sources

Existing sediment loads from the point sources in the SF CWR Subbasin are presented in Table 53

Table 53. Sediment loads from point sources in the SF CWR Subbasin.

Facility	NPDES Permit[a]	Design Flow (MGD)[b]	Current Monthly TSS Permit Limit (mg/L)[c]	Current TSS Concentra-tion (mg/L)[d]	Current TSS Load (t/y)[d]
Kooskia Wastewater Treatment Plant	ID-002181-4	0.20	70	34	4.3
Grangeville Wastewater Treatment Plant	ID-002003-6	0.88	30	11	12.3
Elk City Wastewater Treatment Plant	ID-002201-2	0.12	70	21.6	1.5
Stites Wastewater Treatment Plant	ID-002034-6	0.07	70	45.6	3.0
Red River Ranger Station Wastewater Treatment Plant	ID-002069-9	0.0063	30	5.0	0.08
Clearwater Forest Industries	ID-002770-7	0.0019	None currently	Data not available	Data not available
Storm Water Sources	None currently	NA	None currently	Data not available	Data not available
Suction Dredge Industry	None currently	NA	None currently	Data not available	Unknown (see discussion)

[a] National Pollution Discharge Elimination Permit number
[b] million gallons per day
[c] TSS = total suspended solids, mg/L – milligrams per liter

[d] Based on data from March 1999 through February 2002, t/y = tons per year

Estimates of loading from WWTPs are averages based on flow and TSS monitoring data collected by each facility and reported to USEPA in monthly discharge monitoring reports for the period from March 1999 through February 2002.

Estimates for Clearwater Forest Industries, storm water sources and suction dredging are not available due to the lack of monitoring data from which to quantify annual loads. As explained in Section 3.1, sediment loading from these sources is expected to be minor when compared to nonpoint sources of sediment.

Nonpoint Sources

For Threemile Creek, Butcher Creek, and the Stites location on the lower main stem SF CWR, sediment loads are calculated from in-stream TSS and bedload data. The TSS and bedload yield curves (Appendix M) were coupled with daily flow data in a spreadsheet to predict TSS loads and bedloads on a daily basis. The average daily TSS sediment loads in mg/L were then converted to tons of sediment per day and tons of sediment per year. Average daily NTUs were calculated from a similarly developed relationship. The summaries of these results for the Threemile, Butcher, Stites, and Harpster locations are presented in Tables 49 through 52.

For the water bodies above Harpster, estimates of existing nonpoint source sediment loads are from the sediment budget presented in Appendix L. Table 30 in Section 3.1 summarizes the results from Appendix L. The TSS-based method for the downstream water bodies and the sediment budget-based method for the upstream water bodies are quite different and produce results that should only be compared in light of the different methods. When compared, the results of the two methods compare reasonably well, lending confidence to both methods.

Table 54 shows the total nonpoint source sediment load, the background sediment load, and the human-caused sediment load for each control location. Both methods include assessments of which parts of the loads are human-caused and which parts are estimated background loads. Each number is the sum of all the sediment yields upstream from that control location. Human-caused sediment is the total sediment load minus the background sediment load.

Table 54. Estimated cumulative sediment loads from nonpoint sources in the SF CWR Subbasin.[a]

Water Body Name	Water Body ID	Control Location	Total Load (ton/year)	Background Load (ton/year)	Human-Caused Load (ton/year)
Lower SF CWR	1	Stites Bridge	38,157	8,439	29,718
Threemile Creek	10	Mouth	1,112	97	1,015
Butcher Creek	11	Mouth	441	106	335
Mid-Lower SF CWR	12	Harpster Bridge	20,622	14,856	5,736
Middle SF CWR	22	Above Johns Creek	11,185	8,898	2,297
Mid-Upper SF CWR	30	Above Tenmile Creek	7,827	5,993	1,835
Upper SF CWR	36	Above Crooked River	4,527	3,279	1,248

[a] Loads presented for these sites are cumulative of all areas upstream of the control location. Loads for water bodies 1, 10, and 11 are total suspended solids loads, while loads for water bodies 12, 22, 30, and 36 are total sediment loads, calculated using different methods.

Estimates of Background Sediment Loading

The background sediment loading for each of the control locations in the subbasin (Table 54) is calculated from background loading rates for each of the water bodies or rates for groupings of water bodies. Background sediment loading was developed from the sediment budget (Appendix L). The background ratio for each control location was calculated using the routed background erosion for all areas upstream of the control location divided by the total tons of sediment routed from a watershed. The background loads in Table 54 are cumulative for all the water bodies upstream from the control locations.

Background erosion rates have been developed for all federally managed watersheds and range from 16 to 90 tons per square mile per year. After reviewing the range of background figures from the federally-managed lands, background figures used in other TMDLs, erosion studies at Washington State University, predictions by the RUSLE model, and best professional judgement, a background erosion rate of 30 tons per square mile per year was assigned for the non-federal lands. The routing coefficient was that used by the NPNF to route sediment using the NEZSED model (Roehl 1962) and that used throughout the sediment budget calculations in this TMDL. The background ratios developed from the sediment budget for the Threemile, Butcher, Stites, and Harpster sites are presented Tables 49 through 52.

For the Threemile, Butcher, and Stites locations, the amount of daily load that is attributed to background was calculated by multiplying the daily load by the background ratio. This results in different background loads depending on flow, as would be expected naturally, as higher flows naturally would have resulted in greater movement of sediment. For the control

locations upstream from Butcher Creek, including the Harpster site, the background loading rate is simply the yearly rate based on the sums from the sediment budget.

Results for the Stites, Threemile, and Butcher locations are not directly comparable to those of the other four water bodies because of different methods used for the calculations. This is especially noticeable in the background loads shown in Table 54. The background load for Stites would be approximately 20,000 t/y if calculated from the sediment budget, and the total sediment load would be in the range of 90,000 t/y if calculated from the sediment budget (the TSS-based estimates for Stites are 8,439 t/y background load and 38,157 t/y total load [Table 54]). This magnitude of difference between the TSS-based calculations and the sediment budget-based calculations is noticeable throughout these sediment loading calculations. Part of the difference is that TSS-based estimates do not include bedload, whereas the sediment budget does. More importantly, however, current sediment routing models do not adequately account for sediment storage in a watershed. The sediment budget adds up eroded sediment from numerous sources, but does not adequately account for where that sediment goes once detached from its location. It is likely that much more of it is being stored in floodplains, low slope areas, and other locations than is being moved through the active waterways.

Sediment Load Capacity

The goal of the sediment TMDLs is to achieve both the numeric turbidity standard and the narrative sediment standard. Calculations of the fine sediment load capacities needed to achieve the numeric turbidity WQS relate the turbidity to TSS levels at the Threemile, Butcher, Stites, Harpster, and Mt. Idaho monitoring locations. The fine sediment load capacity calculations are based on daily flow records coupled with sediment yield curves developed from TSS and bedload monitoring data collected at these sites. The load capacity for Cottonwood Creek as it empties into the SF CWR is quoted from the Cottonwood Creek TMDL (DEQ, NPT, USEPA 2000).

Total suspended solids sediment load capacity and excess load capacity were calculated based on the Idaho WQS of "turbidity … shall not exceed background turbidity by more than fifty NTU instantaneously or more than twenty-five NTU for more than ten consecutive days" (IDAPA 58.01.02.250.02.d). Using the daily flow method for the loading calculations, all exceedances over 25 NTU are included in the calculations, including exceedances over the 50 NTU criterion. Plots of the sediment loadings at Threemile Creek and Butcher Creek showed that turbidity is elevated for periods of considerably greater than 10 days. Loading calculations are based, therefore, on the 25 NTU above background WQS. As sediment loading reductions are accomplished, using this standard to make the loading calculations will result in a large MOS for loading reductions as turbidity begins to be reduced to less than 10 consecutive days of exceedances.

The load capacity was calculated based on the relationship between turbidity in NTUs and the TSS in milligrams per liter (mg/L), resulting in a calculation of the amount of TSS in milligrams per liter that 25 NTUs from the state WQS represents. For example, in Threemile Creek, 25 NTUs is equivalent to 17 mg/L TSS. For each day then, the load capacity is the 17

mg/L plus the percentage of the load that is background. Since the background load varies with flow, the load capacity varies with flow as well.

The annualized TSS load capacities for five locations are presented in Table 55. However, these numbers are relatively meaningless for loading calculations based on daily flows. They are shown here because they are expected as part of a TMDL. The useful numbers for calculations using the daily flow method are those for excess loading shown in the next section.

Table 55. Total suspended solids (TSS)-based load capacities for water bodies in the lower SF CWR Subbasin.

Water Body Name	Water Body ID	Sampling Location	TSS[a] (t/y)
Lower SF CWR	1	Stites Bridge	68,095
Cottonwood Creek	2	At the mouth	5,110
Threemile Creek	10	At the mouth	366
Butcher Creek	11	At the mouth	261
Mid-lower SF CWR	12	Harpster Bridge	61,631

[a]Based on daily flow calculations summed and averaged for 10 years.

In the absence of a numeric standard for coarse sediment, or any particular knowledge about the level of loading that might impair beneficial uses, the coarse sediment load capacities for these same sites are assumed to be proportional to the total coarse sediment loading for the lower main stem, or about 7%. This is consistent with USGS data for the Clearwater River indicating that bedload is in the range of 5-10% of total sediment load (Jones and Seitz 1980).

The load capacity for the five lower water bodies is dependant on flow on a day-to-day basis, or even hour-to-hour basis for extremely flashy streams like Threemile and Butcher Creeks. In general, the highest load capacities occur during the highest flows, which occur episodically January through May. The load capacities in Table 55 are based on load capacities calculated on a daily basis and averaged over 10 years to arrive at a yearly rate. Since on most days the existing load is less than the load capacity, the average load capacity may be far greater than the existing load over a year. However, load capacity exceedances also occur on a daily basis and when these are summed and averaged, load exceedances summed over a year occur even when yearly average load capacity is greater than yearly average existing load.

A good example of this can be found in the data set for Stites. The average annual load at Stites is about 38,000 t/y (Table 54). The average annual load capacity at Stites is 69,000 t/y (Table 55). However, the average annual load exceedance at Stites is about 7,500 t/y because there are days of high flow and heavy erosion every year when the actual loading on a daily basis exceeds the load capacity. It is during these few days of extreme high flows, such as the 1996 events, when excess loading adds up significantly. These are the sediment loading

events that really exceed the capacity of the system to handle sediment, and these are the events that need to be managed if sediment in the SF CWR system is to be reduced to meet WQS.

Figure 70 shows the variability of load capacity over the 10-year period that these calculations were based on. Also in Figure 70 is an associated graph for each one of the three sites showing the load capacity in more detail, for two years.

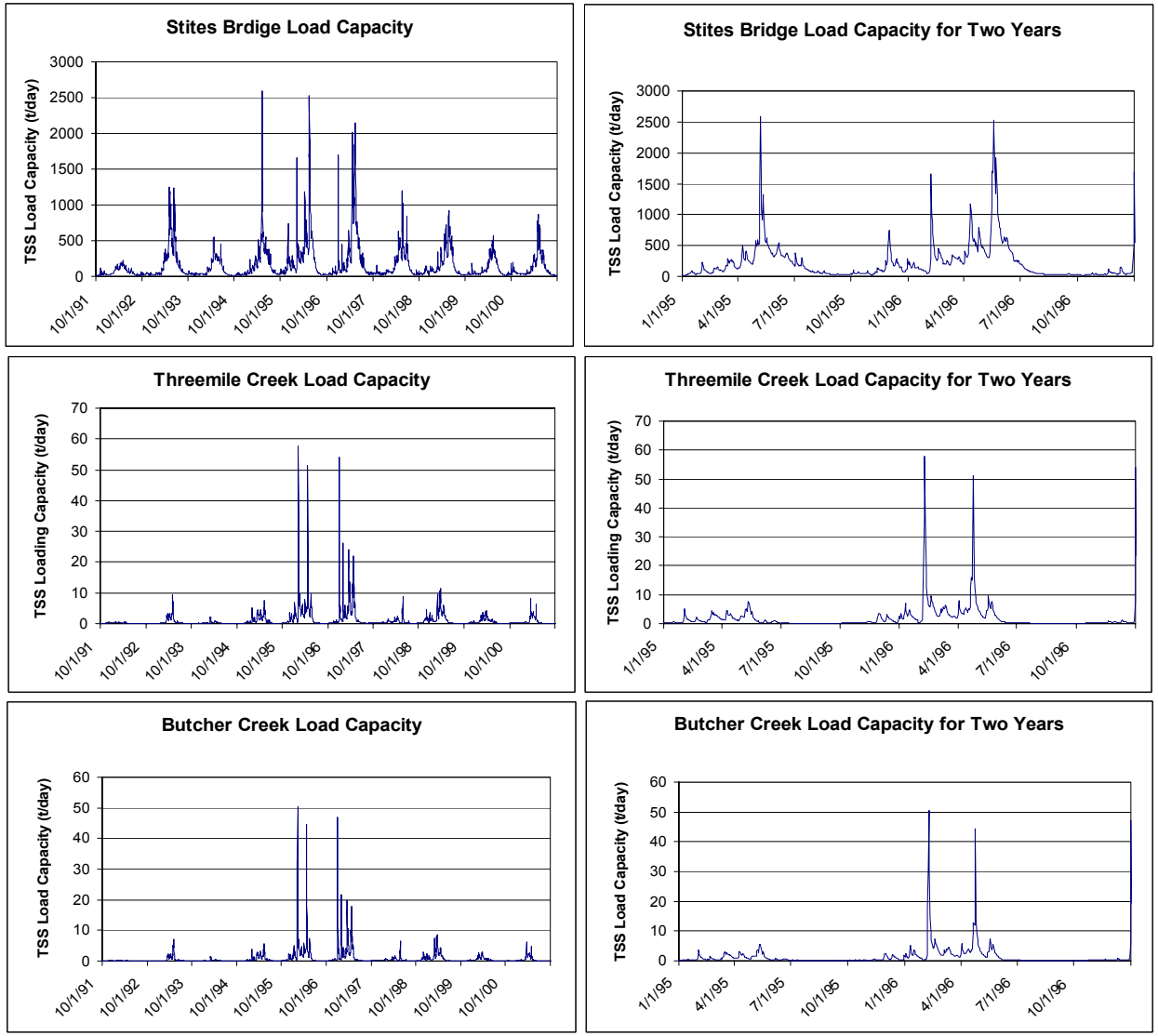


Figure 70. Average Daily Total Suspended Solids (TSS) Load Capacities for the Stites Site on the SF CWR, Threemile Creek, and Butcher Creek for the 10-Year Analysis Period and Enlarged Showing Details for 1995 and 1996

Upstream from the mouth of Butcher Creek (water body #12 and upstream), from the control location called the Harpster site, load capacities are calculated in a different manner based on the available data. Below Harpster, load capacities were calculated on a daily basis, but above Harpster, they were calculated on an annual basis. The daily and annual load capacities are not very comparable. Above the Mt. Idaho bridge, TSS and flow coupled data for the rest the subbasin are not adequate to support making estimates of daily loading and daily loading exceedances. The private bridge above Harpster was set as the control location for the entire subbasin above the confluence of Butcher Creek with the main stem because it is a good sampling site.

Upstream from Harpster we do not differentiate between fine and coarse sediment. Nez Perce National Forest data show that bedload may represent anywhere from 2% to 60% of the total loading from any particular stream, depending on watershed area, geology, and stream type (Gloss 1995). Therefore, load capacity is based on total sediment load, with the assumption that load reductions will result in both fine and coarse sediment loading reductions proportional to the total load.

Lacking specific in-stream data to calculate load capacities for the 303(d) listed water bodies, load capacities are calculated based on the sediment budget and the target load reduction. For example, the load capacity for the control location on the main stem SF CWR above the mouth of Johns Creek is calculated from sum of total sediment for all the water bodies above Johns Creek (water bodies #22-79) minus 25% of the sum of the human-caused sediment for the same set of water bodies. This change from in-stream sediment estimates to sediment source estimates is partially justified by the fact that estimates of human caused in-stream and sediment sources at the Harpster control location are essentially equal, in the 19,000-20,000 t/y range. The NPNF came up with similar figures (16,100 t/y) with their analyses of NEZSED data (Kenny 1995) for the area above the Mt. Idaho bridge. The NPNF calculations did not include estimates for in-stream erosion, sand and gravel applied to the highway, mining, or mass failures greater then 10 yd^3.

The loading capacities for the 303(d) listed water bodies above Harpster/Butcher Creek are presented in 56. Again, these numbers are not directly comparable to the numbers in Table 54 above because different calculation methods were used. The numbers in Table 56 are truly annually based, rather than daily data averaged over a year (Table 55). The load capacity at Harpster calculated using the sediment budget method is 19,180 t/day, vs. the 62,000 t/day shown in Table 55. The difference is as discussed above for the example at Stites. Numbers calculated for the table below (Table 56) correspond better to the conceptual framework for TMDL loading calculations presented earlier.

Excess Loading

Excess loading occurs when the current loading is greater than the load capacity. Excess loading on a daily basis is the current load minus the load capacity. The excess loads addressed by the TMDLs for Threemile Creek, Butcher Creek, and the Stites site are shown

Table 56. Total sediment loading capacity of water bodies in the upper SF CWR Subbasin.

Water Body Name	Water Body ID	Control Location	Load Capacity (t/y)
Mid-lower SF CWR (Johns Cr. to Butcher Cr.)	12	Harpster Bridge	19,180
Middle SF CWR (Tenmile Cr. to Johns Cr.)	22	Above mouth of Johns Cr.	10,621
Mid-upper SF CWR (Crooked R. to Tenmile Cr.)	30	Above mouth of Tenmile Cr.	7,369
Upper SF CWR (Confluence to Crooked R.)	36	Above mouth of Crooked R.	4,215

in Figures 71, 72, and 73. The first figure in each of these sets of figures shows the distribution and magnitude of excess loads over the10 years used in the calculations, and the subsequent figure shows more detail of only two years of those same data. The figures show that excess loading only occurs over short time frames, the same time frames as high flows, and that the episodes of excess loading are limited to January through May each year.

The excess load is summed over the 10 years of data and divided by 10 to calculate an average amount of excess loading on a yearly basis. When this figure is divided by the average annual human-caused TSS yield, the result is the percent reduction of human-caused TSS needed for a given water body. The summaries of these calculations are presented in Tables 49 through 52 and Table 57. These calculations indicate that significant load reductions in TSS are needed for Threemile Creek, Butcher Creek, and for the main stem SF CWR at Stites.

Table 57. Total suspended solids (TSS) excess loading for water bodies in the lower SF CWR Subbasin.

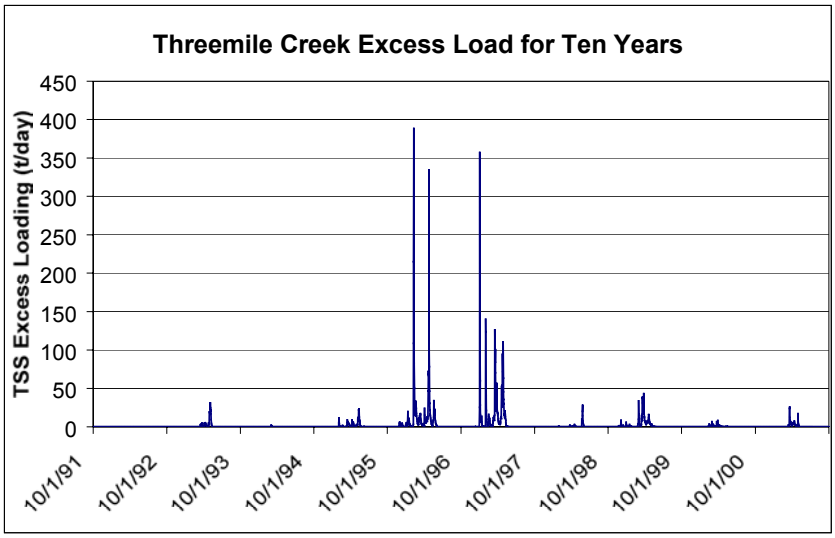
Water Body Name	Water Body ID	Control Location	Human Caused Loading (t/y)	Excess TSS Loading [a] (t/y)	Excess TSS Loading (%)
Lower SF CWR	1	Stites Bridge	29,718	7,574	25
Threemile Creek	10	At the mouth	1,015	780	77
Butcher Creek	11	At the mouth	335	203	61
Mid-lower SF CWR	12	Harpster Bridge	4,632	0	0

[a] Based on daily flow calculations summed and averaged for 10 years.

One could subtract the excess TSS loading from the human caused loading to arrive at another sort of estimate of load capacity on an annual basis. However, based on the daily

flow and loading approach used in these calculations, that figure does not have much meaning.

These data indicate that TSS does not exceed that state WQS at Harpster. However, application of the narrative standard, as discussed in Chapter 2, results in a conclusion that the four main stem water bodies above Butcher Creek are impaired by coarse sediment. For lack of any other data, the excess load for these water bodies is set at the 25% excess load calculated for the Stites location.



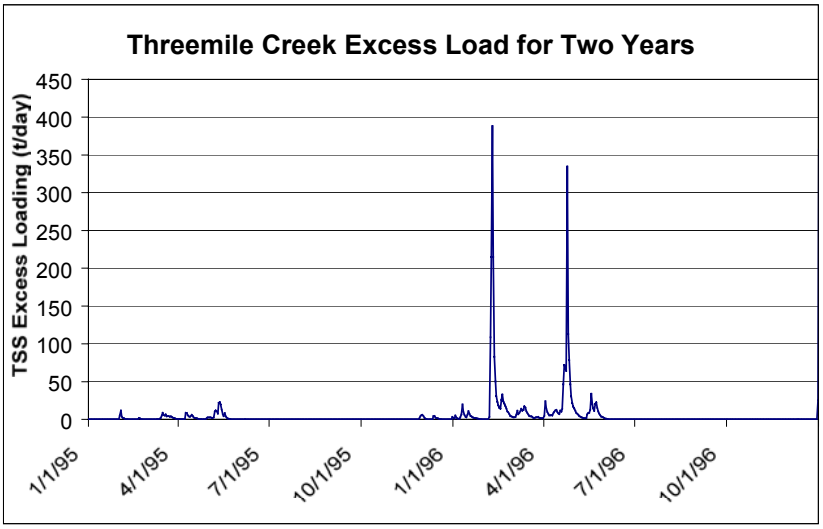
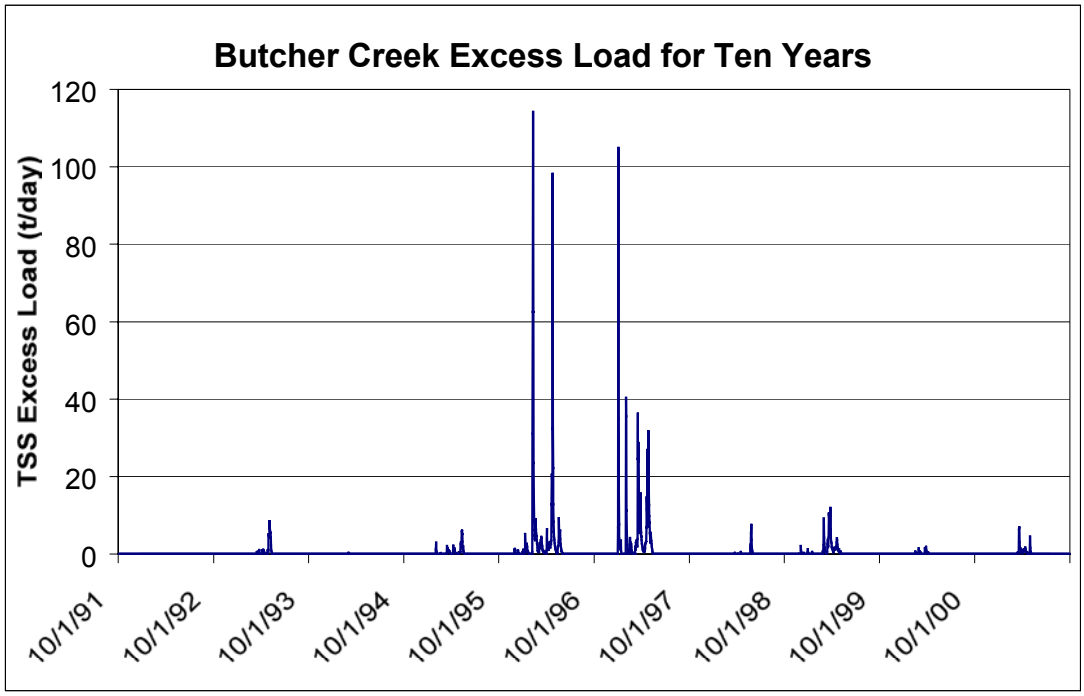


Figure 71. Excess Sediment Loading for Threemile Creek for the 10-Year Analysis Period and Enlarged Showing Detail for 1995 and 1996



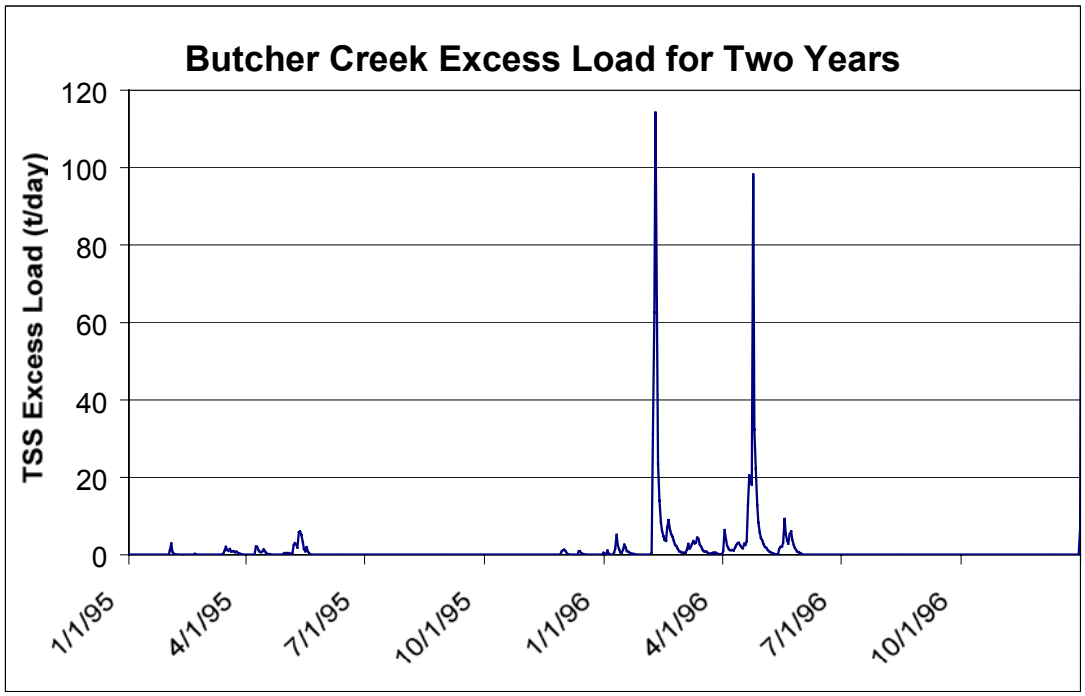
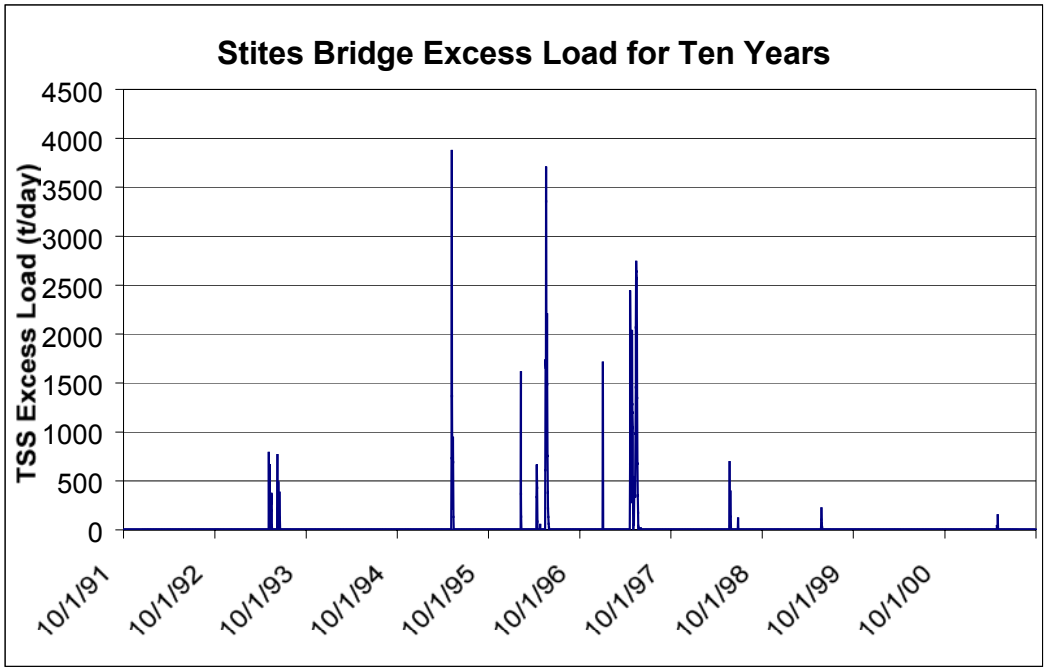


Figure 72. Excess Sediment Loading for Butcher Creek for the 10-Year Analysis Period and Enlarged Showing Detail for 1995 and 1996



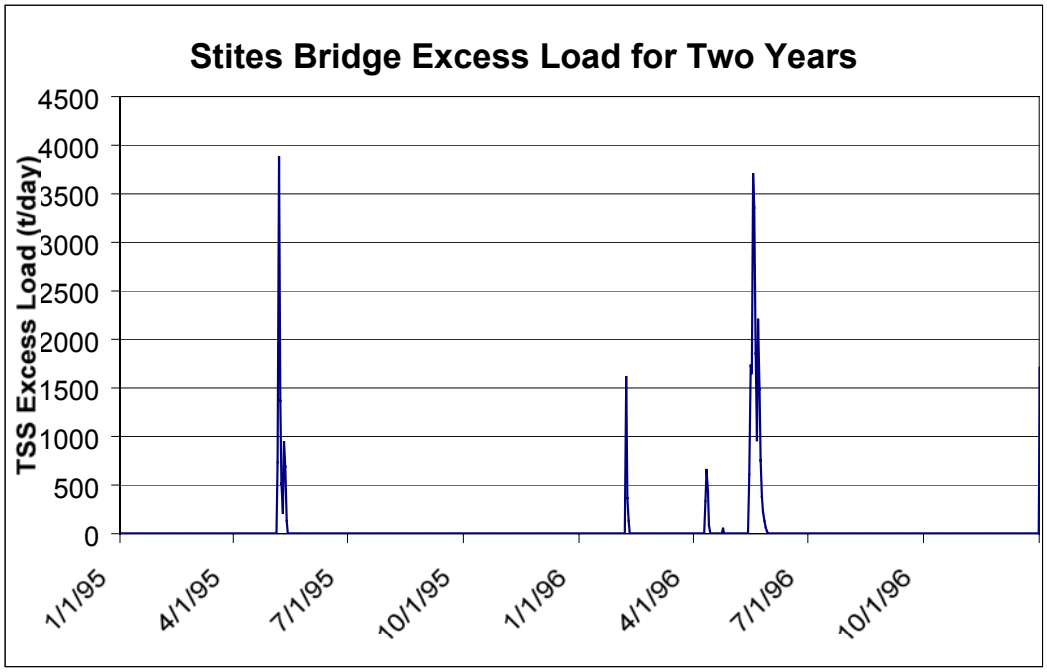


Figure 73. Excess Sediment Loading at Stites for the 10-Year Analysis Period and Enlarged Showing Detail for 1995 and 1996

Margin of Safety

Loading calculations using 25 NTU over background as the WQS above which loading is treated as an exceedance results in a significant MOS. As sediment reduction activities proceed to the point where the 25 NTU over background loadings no longer exceed 10 days, the standard becomes 50 NTU over background. All exceedance loading calculations for nonpoint source sediment in these TMDLs have this MOS built into them. Therefore, no further load allocation to MOS has been built into the TMDLs.

For example, at Stites, the 25 NTU over background for more than 10 days standard has only been exceeded during one event during the last 10 years. So, one can conclude that the Stites location is close to the threshold where the 50 NTU over background standard should be in effect. Using the 50 NTU over background standard in the same calculations as above, the excess load at Stites is only 3,578 t/y, compared to 7,754 t/y at 25 NTU, and the percent load reduction required would be 9% compared to 25%. Similar calculations could be done for Threemile Creek and Butcher Creek. However, the point is that use of the 25 NTU over background as the basis for the loading calculations provides a very large MOS in the loading calculations. The use of the 25 NTU standard in the loading calculations is justified because that is the standard that should be applied for the current situation, but as compliance with the TMDL is accomplished, the 50 NTU over background instantaneous criterion is the only one that can be applied if there are no exceedances greater than 10 days duration.

Seasonal Variation

Calculations for sediment TMDLs of the SF CWR Subbasin have focused on the seasonality and episodic nature of sediment loading to the 303(d) water bodies. Clearly, almost all of the loading occurs between January and May (Figures 71, 72 and 73), but more importantly, the problem loadings occur during extreme, five-year (or longer) recurring episodic events. These episodic events are not predictable by nature, they have been accounted for by running the calculations over a 10-year period. An examination of the flow regime data indicated that a 10-year time frame for the calculations was adequate to capture the effects of these major sediment-producing episodes.

Sediment Load Allocations

Sediment loading in the SF CWR Subbasin is dominated by nonpoint sources. A number of nonpoint sources have been identified, coming from lands with a number of different owners and management agencies. While sediment from point sources is relatively insignificant in the overall picture of the subbasin, WLAs are set for the purposes of NPDES permitting, and will be incorporated into these permits by the USEPA.

Wasteload Allocations for Wastewater Treatment Plants and Clearwater Forest Industries

As can be seen by comparing sediment loading in Table 58 with total sediment loading in the various watersheds in Table 59, WWTPs and CFI contribute only a very minor amount to the

overall sediment loading, so it is not necessary to require load reductions from these facilities. Currently permitted facilities include the Kooskia, Stites, Grangeville, Elk City, and Red River Ranger Station WWTPs. Federal technology standards outlined in 40 CFR 133.105 (Treatment Equivalent to Secondary Treatment) apply to facilities treating domestic sewage, and vary based on the type of treatment process used by that facility. For those facilities using stabilization ponds/lagoons (i.e., Kooskia, Stites, Elk City, and Red River Ranger Station), federal regulations specify monthly and weekly average TSS limits of 45 and 65 mg/L respectively. For other treatment types (i.e., Grangeville), the monthly and weekly average TSS limits are 30 and 45 mg/L respectively.

The state of Idaho also has technology standards for facilities that treat domestic sewage using stabilization ponds/lagoons of 70 and 105 mg/L as monthly and weekly averages, respectively. These limits have not been approved by USEPA, and therefore the federal requirements specified above apply.

In the case of Red River Ranger Station, federal regulations that address anti-backsliding prohibit new effluent limits from being less stringent than previous limits in an NPDES permit. The previous and current limits in the NPDES permit are 30 and 45 mg/L TSS as monthly and weekly averages. Therefore, the Red River Ranger Station limits must remain at 30 and 45 mg/L. After reviewing effluent data from Red River Ranger Station, the facility appears to be meeting the current limits.

Clearwater Forest Industries is in the process of obtaining an NPDES discharge permit for stormwater and approximately 1,900 gallons per day of boiler blowdown and kiln condensate. The stormwater component of their wasteload allocation is discussed further in the section below. No monitoring of the non-contact cooling water has been conducted, but review of monitoring of other industrial facility non-contact cooling water suggests that TSS levels are likely to be less than 10 mg/L. Given the exceedingly small flow in comparison to the SF CWR and expected low TSS and turbidity levels, no reduction in this loading is needed in order to achieve the turbidity targets in the SF CWR. The ambient turbidity criteria, which is the overall goal of the sediment TMDL in this reach, will be established as the wasteload allocation for the boiler blowdown and kiln condensate portion of CFI's discharge.

Wasteload allocations for the Kooskia, Stites, Elk City, and Grangeville WWTPs will be the technology based TSS limits described above. The Red River Ranger Station WWTP's WLA will be based on the current NPDES limits and anti-backsliding provision (Table 58).

Wasteload Allocations for Storm Water Discharge.

A comprehensive inventory of storm water sources subject to NPDES permit requirements[1] has not been established, but these sources are not considered to be significant components of

[1] NPDES permits are required for storm water discharges from a) construction activities disturbing one or more acres, b) certain categories of industrial activities, and c) municipal storm drainage systems located in Census Bureau – defined "urbanized areas". For further information regarding stormwater permit requirements, see the Region 10 USEPA web site at www.epa.gov/r10earth.

the anthropogenic sediment load either individually or cumulatively (Section 3.1). Due to the lack of facility specific information, a single generalized WLA covering both the industrial and construction stormwater categories has been established. Currently there are no municipal storm water sources in the SF CWR subject to NPDES permit requirements, so these sources are included in the nonpoint source allocations.

The overall goal of the sediment TMDL in the mid-lower watershed, where most industrial and/or construction storm water discharges are likely to exist, is to achieve Idaho's 25 NTU above background turbidity criteria (50 NTU above background instantaneous)(IDAPA 58.01.02.250.02.d.). Therefore, the allocation for regulated industrial/construction storm water discharges is compliance with this turbidity criteria, or compliance with appropriate BMPs to control sediment as required by the applicable NPDES storm water permit. It is recognized that monitoring compliance with a turbidity allocation may be difficult or impossible. As a result, if during the course of applying for NPDES permit coverage, it is determined to be infeasible to conduct compliance monitoring for any facility, the allocation is interpreted to be the installation of appropriate storm water BMPs as described in local ordinances or the *Idaho Catalogue of Storm Water Best Management Practices* (DEQ 2003c), whichever is more stringent, in lieu of the turbidity allocation.

Storm water sources that are not subject to NPDES permit requirements, including all municipal sources of storm water, are included within the general load allocation for nonpoint sources.

Wasteload Allocations for Suction Dredge Mining.

As indicated in Chapter 3, suction dredging may have adverse effects on both water column and substrate sediment levels. A two-part allocation will be established to address these impacts.

Turbidity, as a surrogate for sediment, is a parameter which can be measured easily and reliably in the field, directly relates to the water column impacts of suction dredges, and for which specific ambient and treatment criteria are included in Idaho WQS. The water column portion of the interpretation of the narrative sediment standard is based upon treatment requirements for point sources in the Idaho WQS (IDAPA 58.01.02.401.03.b). In essence, the standard requires that turbidity below any applicable mixing zone must not exceed background turbidity by more than 5 NTU, or by more than 10% if background turbidity is 50 NTU or higher.

Substrate sediment problems caused by increased bedload movement are more difficult to measure and quantify in the field, and incorporate in a WLA or NPDES permit. As indicated in Chapter 3, increased bedload or surface fine sediment has been observed hundreds of feet below 5 and 8 inch dredges (USFS 1980b). However, the current operation of a limited number of recreational dredges appears to result in minimal downstream increases in bedload or surface fine sediment levels below the area of active mining. The daily volume of sediment processed by these existing operations therefore appears to be a

reasonable surrogate measure to prevent increased bedload movement and surface fine sediment downstream of suction dredges.

Since 2000, up to 15 recreational suction dredges/year have applied for coverage under the IDWR General Permit (IDWR 2002). The General Permit allows these dredges to operate only in the main stem SF CWR, between July 15 – August 15, and to process no more than 2 cubic yards of material per hour as averaged over the period of operation for the entire day. Based on available data, for the purpose of this allocation it is assumed that 15 such operations could operate each year during the July 15 – August 15 window without resulting in increased bedload movement or surface fine sediment levels downstream of active mining. Assuming these dredges move no more than 2 cubic yards of material per hour, and further assuming a normal 8 hour work day, an allowable daily mass sediment loading from dredgers is:

15 dredges x 2 yd^3/hour x 8 hr/day = 240 yd^3/day

1 yd^3 = 27 ft^3

Sediment density = 96.8 lbs/ft^3 x 27 ft^3= 2614 lbs/yd^3 (Hausenbuiller 1985)

240 yd^3 x 2614 lbs/yd^3 = 627,360 lbs = 314 tons/day

This is an industry wide WLA which applies to dredges of all sizes. Furthermore, suction dredge mining has historically occurred in the upper SF CWR and tributaries. Accordingly, the WLA will be established for the entire SF CWR watershed above the Harpster Bridge, including tributaries.

The effectiveness of this allocation in controlling bedload related problems is also contingent upon the following two key assumptions:

- Each facility complies with all applicable permitting processes, including those of USEPA (NPDES permit), IDWR (Stream Channel Alteration Permit), USFS (Plan of Operations approval; Decision Notice and Finding of No Significant Impact), BLM (Decision Notice and Finding of No Significant Impact), and ACOE (Clean Water Act Section 404 permit), which include important operational considerations to minimize substrate problems.

- The location of permitted facilities is such that mixing zones do not overlap, in order to avoid localized excessive impacts from suspended and bedload sediment mobilized by these operations, and in no case are individual dredges separated by less than 100 feet, consistent with IDAPA 37.03.07.064.

Recommended implementation procedures

As indicated in Chapter 3, suction dredges are considered to be point sources and are therefore required to obtain NPDES permits from the USEPA. In order to most easily mesh with current IDWR permitting processes, in implementing this WLA it is recommended that USEPA adopt a similarly tiered NPDES permit process. Specifically, it is recommended that a general permit process be established for dredges of less than or equal to 5 inch nozzle size and less than or equal to 15 hp, and that each dredge be limited to discharge no more than 2 yd^3 /hour, as averaged over the period of operation for the entire day. Should the IDWR permitting process be terminated, it is recommended that the general permit conditions of, and attachments to, the IDWR permit be incorporated into the USEPA general NPDES permit.

Given the greater volume of material discharged, and greater chance of causing sediment related problems, it is recommended that larger dredges be required to apply for an individual NPDES permit. Finally, since the WLA applies to the entire industry, it should be available for allocation on a first come-first served basis, with first opportunity given to facilities currently permitted by IDWR.

It is expected that achieving the wasteload allocation will ensure compliance with the numeric turbidity criteria and the narrative sediment standard. Given the lack of consistent monitoring of the effects of this industry in the SF CWR watershed, it is recommended that the USFS, IDEQ and USEPA establish a monitoring plan to further characterize and assess these impacts on an ongoing basis.

Table 58. Sediment wasteload allocations for the SF CWR Subbasin.

Facility[a]	NPDES Permit Number	Design Flow (MGD)[b]	Wasteload Allocation[c]		
			Monthly Average TSS Concentration (mg/L)	Weekly Average TSS Concentration (mg/L)	Annual TSS Load (t/y)
Kooskia WWTP	ID-002181-4	0.20	45	60	13.7
Grangeville WWTP	ID-002003-6	0.88	30	45	40.3
Elk City WWTP	ID-002201-2	0.12	45	60	8.2
Stites WWTP	ID-002034-6	0.07	45	60	4.8
Red River Ranger Station WWTP	ID-002069-9	0.0063	30	45	0.29

Facility[a]	NPDES Permit Number	Design Flow (MGD)[b]	Wasteload Allocation[c]		
			Monthly Average TSS Concentration (mg/L)	Weekly Average TSS Concentration (mg/L)	Annual TSS Load (t/y)
Clearwater Forest Industries	ID-002770-7	0.0019	Turbidity shall not exceed background turbidity by more than 50 NTU instantaneously, or by more than 25 NTU for more than 10 consecutive days.		
Storm Water Industrial and Construction Activities	ID-R050000 ID-R100000	NA	Turbidity shall not exceed background turbidity by more than 50 NTU instantaneously, or by more than 25 NTU for more than 10 consecutive days. [f]		
Suction Dredge Industry	None currently	SF Clearwater River above Harpster Bridge, including tributaries[d] July 15 – August 15: • Turbidity below any applicable mixing zone shall not exceed background turbidity by more than 5 NTU when background turbidity is 50 NTU or less, and • Turbidity below any applicable mixing zone shall not exceed background turbidity by more than 10% when background turbidity is more than 50 NTU, and shall not exceed a maximum increase of 25 NTU, and • 314 tons/day total sediment discharge. [e] August 16 – July 14: • Zero wasteload allocation. SF Clearwater River below Harpster Bridge: • Zero wasteload allocation.			

[a] WWTP = wastewater treatment plant, CAFO = confined animal feeding operation
[b] MGD = million gallons per day
[c] TSS = total suspended solids, mg/L = milligrams per liter, t/y = tons per year, NTU = nephelometric turbidity unit, BMP = best management practice
[d] Each facility must comply with all other applicable permitting processes, including those of the Idaho Department of Water Resources, U.S. Forest Service, Bureau of Land Management, Army Corps of Engineers, and U.S. Environmental Protection Agency, which include important operational considerations to minimize substrate problems.
[e] This WLA only allows discharge of sediment which occurs on the bed of the stream, and does not allow the discharge of sediment which occurs above the high water mark either directly or through undercutting of stream banks.
[f] If it is determined as part of the NPDES permitting process that monitoring compliance with this wasteload allocation is infeasible, the allocation is interpreted to be the installation of appropriate storm water BMPs as described in local ordinances or the Idaho Catalogue of Storm Water Best Management Practices (DEQ 2003c), whichever is more stringent, in lieu of the turbidity allocation.

Nonpoint Source Sediment Load Allocations

The excess load of nonpoint source sediment in Table 59 is calculated using the two methods discussed above. The excess loads for the Stites, Threemile Creek, and Butcher Creek control locations are based on TSS daily loading calculations, while the excess loads for Harpster and upstream are based on yearly loading calculations from the sediment budget. In the case of the daily calculations, those days when the existing load exceeds the daily load capacity are summed and averaged over the 10 years. For Harpster and above, the excess load is calculated by subtracting the yearly background load from the load capacity and comparing the result to the activity load. For Harpster and above the load capacity was fixed based on the current activity load and the percent load reduction needed at Stites (the pour point for the basin). The discussion used to justify the 25% load reduction for all water bodies above Stites is presented in Appendix M, Loading Calculations.

Surrogate Sediment Target

A number of instream measures exist which characterize substrate fine sediment including: cobble embeddedness, percent depth fines, percent surface fines, residual pool volume, width-to-depth ratios, etc. Target or threshold values have been set for a number of these by various entities to evaluate habitat quality. The NPNF has established Desired Future Conditions for different fish species as part of their integrated Forest Planning Process (USFS 1992). The Desired Future Conditions for steelhead and chinook rearing habitat in B and C channel types, for 3rd to 5th order streams, includes cobble embeddedness <25 % and fines by depth <19% to attain 100% habitat capability. NMFS uses similar values to evaluate habitat quality in ESA biological assessments (NMFS 1998). Habitat quality is rated as "high" condition with cobble embeddedness levels <20%; percent surface fines <=20 (C channels); and percent fines by depth <20. The Columbia River Inter-Tribal Fish Commission (CRITFC 1995) sets the following goals for salmonid rearing habitat: <=30 percent cobble embeddedness, and <=20 percent surface fines, in order to meet desired fishery production levels.

Reference watershed data may also be used to evaluate decreasing trends in sedimentation (see Appendix N). Meadow Creek and Bargamin Creek are recognized as being relatively undisturbed and have similar geology, rainfall, and topography as the upper basin of the SF CWR. Lower Meadow Creek cobble embeddedness of 32% may be used as a reference value to compare to the main stem SF CWR (48% cobble embeddedness), although the data exhibits variability and lower Meadow Creek is somewhat steeper and more confined. Data for similarly sized streams for upper Meadow Creek and Bargamin Creek was also compared with the data set from the SF CWR. In almost all cases, cobble embeddedness in the SF CWR is significantly higher than in upper Meadow Creek and Bargamin Creek (refer to graphs and/or values), and these comparisons may be used to establish decreasing trends in cobble embeddedness.

In light of the reference watershed data showing that cobble embeddedness in the SF CWR is higher than that of lower Meadow Creek, a surrogate target of a decreasing trend in substrate fine sediment levels (cobble embeddedness, depth fines, surface fines) is being set for the

main stem SF CWR above Harpster. This surrogate target is set as a monitoring tool to verify that sediment reduction activities in the main stem face drainages and in other contributing watersheds are reducing substrate sediment in the river. The NPNF and the BLM may choose to continue monitoring at established river monitoring sites, or they may choose to continue monitoring the sites established at the control locations for this TMDL. In either case, the intent of the decreasing trend target is to provide an indicator of the effectiveness of the BMPs or other sediment reduction activities of implementation.

It is recognized that uncertainty exists in establishing the most appropriate substrate sediment level for comparison; therefore, the goal of TMDL is a statistically significant decreasing trend in substrate fine sediment levels (cobble embeddedness, depth fines, surface fines). A detailed monitoring plan will be developed as part of the implementation plan in order to evaluate effectiveness of BMPs in reducing instream sediment levels. This plan will identify the specific entities responsible for collecting the data, which parameters will be sampled, and the locations and frequencies of sampling.

Table 59. Sediment load allocations for nonpoint sources in the SF CWR Subbasin. [a]

Water Body Name	Water Body ID	Control Location	Total Load (t/y)[b]	Background Load (t/y)[b]	Human Caused Load (t/y)[b]	Excess Load (t/y)[b]	Target Load (t/y)[b]	Load Reduction (%)
Lower SF CWR	1	Stites Bridge	38,157	8,439	29,718	7,754	21,964	25
Threemile Creek	10	Mouth	1,112	97	1,015	780	235	77
Butcher Creek	11	Mouth	441	106	335	203	132	61
Mid-Lower SF CWR	12	Harpster Bridge	20,622	14,856	5,736	1,434	4,302	25
Middle SF CWR	22	Above Johns Creek	11,185	8,898	2,297	574	1,723	25
Mid-Upper SF CWR	30	Above Tenmile Creek	7,827	5,993	1,835	456	1,379	25
Upper SF CWR	36	Above Crooked River	4,527	3,279	1,248	312	936	25

[a] Loads presented for these sites are cumulative of all areas upstream of the control location. Loads for water bodies 1, 10, and 11 are total suspended solids loads, while loads for water bodies 12, 22, 30, and 36 are total sediment loads.

[b] t/y = tons per year

5.5 Implementation Strategy

"An implementation plan identifies and describes the specific pollution controls or management measures to be undertaken, the mechanisms by which the selected pollution control and management measures will be put into action, and describes the authorities, regulations, permits, contracts, commitments, or other evidence sufficient to ensure that implementation will take place. The plan also describes when implementation will take place, identifies when various tasks or action items will begin and end, when mid-term and final objectives will be met, and establishes dates for meeting water quality targets." (Dailey et al. 1999, p 67)

Development of the SF CWR Subbasin implementation plan will occur through a collaborative process involving a number of entities and interest parties, including the SF CWR WAG, landowners, land managers (private, state, federal and tribal), and resource agencies. Further details on the parties involved, contents, and the timeframe for development of the plan are included in later sections of this strategy.

Implementation of the TMDLs presented in this document should occur in an integrated fashion to address the pollutants in a cost effective manner. The major human-caused pollutant sources that have been identified in the SF CWR Subbasin include roads, forestry, livestock grazing, agriculture, mining, eroding streambanks, mass failures, and highway gravel. In the upper basin above Harpster, sediment and temperature problems are widespread and occur in many of the same areas with many of the same causes. Similarly, in the lower basin, especially Threemile Creek, the sediment, temperature, bacteria and nutrient problems are all closely related and should be addressed with a comprehensive implementation strategy. It is recommended that the implementation strategy be broadly based to address as many of the pollutants as possible with any particular project or BMP. This will likely be the most cost effective way to address the problems.

> "Application of effective BMPs is crucial to achieving the pollutant load reductions and targets of the TMDLs. Consequently, the implementation plan, to the extent practicable, must be explicit about which BMPs or systems of BMPs will be employed to achieve the targets, where and when the BMPs will be employed, and how application of the BMPs will achieve the stated targets. USEPA guidance specifically identifies several criteria by which BMPs will be judged:
>
> - A data-based analysis showing that the selected BMPs have been demonstrated to be effective in addressing the issue or pollutant in question (i.e., a history of successful application in similar situations);
> - An explanation of the mechanisms by which application of the BMPs will be assured; and
> - A plan for tracking the implementation and effectiveness of the BMPs." (Dailey et al. 1999, p 67)

As implementation progresses, pollutant reductions may be accomplished in a variety of ways at the discretion of the implementing landowners, managers, and agencies. Over time, implementation strategies for the TMDLs may need to be modified if monitoring shows that the TMDL goals are not being met, or that significant progress is not being made toward achieving the goals.

The following are issues with each one of the TMDL pollutants that should be kept in mind while developing an implementation plan:

Temperature

Shade targets are established in the TMDL (CWE percent canopy closure and SPV percent effective shade) as surrogate measures necessary to achieve temperature criteria. While specific information and direction regarding how these targets are to be implemented will be established in the implementation plan, certain general considerations accompany these targets.

The overall intent is to meet temperature criteria by increasing shade, or in areas where shade targets are already met, to maintain natural shade levels, which incorporate natural disturbance regimes (e.g., fire, mass wasting, insects, disease, etc). While these shade targets do not preclude management of the riparian zone, only activities that will result in negligible shade reduction, or through careful evaluation, will result in long term benefits in terms of stream temperature, are consistent with the targets.

Application of these targets is expected to be carried out at a stream reach scale, as defined in the NPNF *Basinwide Survey Methodology* (USFS 1996) or similar guidance. Typically the stream reaches are 0.5 mile in length, but this may vary considerably given the nature and size of the stream. In all cases (both SPV and CWE), a site evaluation will be essential in order to 1) confirm current shade conditions, 2) confirm channel conditions, 3) determine why shade is above or below target values, and 4) establish appropriate BMPs. While the shade targets provide a useful goal for restoration, the key to implementation is to tailor management to the problems unique to each stream reach.

In much of the watershed it is expected that shade targets will be achieved through passive restoration, that is, allowing vegetation to grow to a mature state. In some locations (e.g., dredge mined areas, grazed areas), active restoration through plantings and channel modification will likely be warranted.

There may be circumstances in which it is necessary to temporarily reduce shade in order to achieve increased shade and ecological health in the long term. For example, active channel restoration or prescribed fire may temporarily reduce existing shade, but lead to long-term temperature benefits. These activities would be consistent with TMDL targets, provided they are carefully evaluated to establish whether or not the long-term temperature benefits outweigh the short-term loss of shade.

In still other areas, it is recognized that it may not be possible to achieve the desired shade due to essentially irreversible human caused changes, such as major roads or railroads adjacent to the stream. In these areas, it is expected that the implementation plan will identify local or other offsetting measures (e.g., plantings along the stream) that would minimize the effects of permanent human-caused shade loss.

Sediment

Sediment targets (Table 59) are set based on loading from various sources on the landscape shown in Table 30. Implementation of the sediment TMDLs should be based on the various data types and assumptions that went into developing the targets as described in Appendix L.

Nonpoint source sediment load reductions are divided for each control location by management responsibility in Table 60. This is provided as guidance for locations of implementation efforts. Management responsibilities were divided as follows: NPNF, BLM, the state (state highway), Idaho County (county roads), and private individuals. Small amounts of land managed by the NPT and IDL are too small to be broken out. Generally, the loading division by management responsibility used the following scheme: all RUSLE results were identified as private; all WEPP results were identified as county roads; mass failures were divided between the NPNF and private based on locations in the GIS, since we had no data that any occurred on BLM land; in-stream erosion results were divided between the NPNF, BLM, and private based on locations; and NEZSED results were divided between NPNF, BLM, and private based on percentage of ownership.

Table 60. Sediment excess loads by management responsibility in the SF CWR Subbasin.

Control Location	Management Responsibility[a]	Human-Caused Load (tons/year) [b]	Target Sediment Load (tons/year) [b]	Excess Sediment Load (tons/year) [b]
Stites[c]	All	29,718	21,964	7,754
	NPNF	2,009	1,391	618
	State Highway	1,151	863	288
	County Roads	516	387	129
	BLM	250	187	63
	Private	11,006	8,254	2,752
	Cottonwood TMDL[d]	22,300	6,640	15,660
Threemile Creek[c]	All	1,015	235	780
	County Roads	134	39	95
	Private	881	196	685
Butcher Creek[c]	All	335	132	203
	Private	325	128	197
	County Roads	111	60	51

Control Location	Management Responsibility[a]	Human-Caused Load (tons/year) [b]	Target Sediment Load (tons/year) [b]	Excess Sediment Load (tons/year) [b]
	BLM	6	3	3
Harpster (Johns Creek to Threemile Creek) [e]	All	5,736	4,302	1,434
	NPNF	1,658	1,243	415
	State Highway	1,151	863	288
	County Roads	98	74	25
	BLM	135	101	34
	Private	2,792	2,094	698
Tenmile Creek to Johns Creek[e]	All	2,297	1,723	574
	NPNF	1,168	876	292
	State Highway	630	473	156
	BLM	135	101	34
	Private	306	230	77
Crooked River to Tenmile Creek[e]	All	1,835	1,376	459
	NPNF	1,003	752	251
	State Highway	375	281101	94
	BLM	135	101	34
	Private	301	226	75
American and Red Rivers Confluence to Crooked River [e]	All	1,248	936	312
	NPNF	708	531	177
	State Highway	114	86	29
	BLM	135	101	34
	Private	284	213	71

[a] NPNF = Nez Perce National Forest, BLM = Bureau of Land Management

[b] Totals for Stites do not equal the sum of the parts because of different estimation methods used in the Cottonwood Creek TMDL; other totals do not all add up due to rounding

[c] Total suspended solids (TSS)-based loading calculations

[d] Derived from the Cottonwood Creek TMDL

[e] Sediment budget-based calculations

Site specific treatments and BMPs for sediment reductions will be identified in the implementation plan. The following are a few examples of the many forest and agricultural practices which could be implemented to reduce sediment.

- Road improvements including: culvert and stream crossing upgrades, sidecast removal or reduction, road removal or closure, stabilizing cut and fill banks, hardening surfaces, and improving maintenance.

- Stabilizing mass failures.

- Grazing management including: reducing concentration of animals, fencing and off-site water installation, and rotational grazing systems.

- Agricultural BMPs including: nutrient management, grassed waterways, Conservation Reserve Program (CRP) vegetative plantings, filter and riparian buffer strips, reduced channel straightening, road buffers, and direct seeding.

- Land management activities which attenuate water yield are also recommended and may include: wetland and riparian buffer enhancement/development, and no-till agriculture.

- Instream habitat restoration in intensively mined areas including: re-establishing historic fluvial processes, pool frequency, pool depth etc. through channel reconstruction (ie. Red River project).

The following data sets may be monitored as implementation proceeds:

Threemile and Butcher Creeks
- Percent Eroding Banks
  - SCC, Soil and Water Conservation District (SWCD), NRCS, NPT
- RUSLE model for changed farming practices
  - SCC, SWCD, NRCS
- Road Erosion Buffering
  - ITD, Road District

Main Stem SF CWR
- In-channel habitat and substrate conditions
  - NPT, NPNF, BLM
- Highway Gravel
  - ITD
- Percent Eroding Stream Banks
  - NPNF, BLM, SWCD, SCC, NRCS
- NEZSED model results to track forest activity sediment reductions
  - NPNF, BLM
- Cobble embeddedness, percent surface fines, percent fines by depth, residual pool volume, width to depth ratios
  - NPNF, BLM

As BMPs and other management practices are designed to reduce sediment, modeled or expected results need to include the routing coefficient used in the sediment budget. Generally, sediment sources on the land need to be reduced by about twice the amount specified in the targets in order to account for routing. In other words, the sediment targets

are instream targets set for the instream control locations. Sediment reduction activities on the land must reduce sediment by both the amount lost during routing and the amount required by the target. For example, the 29 t/y sediment reduction target for gravel from Highway 14 between the confluence and Crooked River is a target reduction for gravel in the river channel. Actual reduction of gravel applied to the road surface should be back calculated using the routing coefficient shown in Table 32, e.g., (29 t/y)/(0.77)=38 t/y.

In addition, estimations of potential sediment reduction need to consider any assumptions built into the sediment budget (Appendix L). To continue the example of gravel applied to Highway 14 between the confluence and Crooked River, loading calculations were based on an assumption that only 80% of the highway delivers to the river. Further back calculations to account for this assumption results in a needed reduction of gravel delivery from the road surface to the stream channel on the order of 47 t/y [(38 t/y)/(0.8) = 47 t/y].

Another way that any particular management group might look at the needed sediment reduction from their operations is simply to reduce their sediment contribution by 25%. In the case of operations in Butcher Creek, the sediment reduction is 61%, and in Threemile Creek, it is 77%. However, if a method of estimation different from that used in the TMDL is used, it should be clearly shown in the implementation plan how the target will be attained.

Since the sediment budget for the upper basin indicates that sediment is coming from dispersed sources, it is expected that sediment reductions will come from throughout the upper basin as well. Table 31 provides a guide to the sediment sources throughout the subbasin and can be used to help prioritize where action needs to take place. Activities designed to restore streamside vegetation will work toward achieving both sediment and temperature targets. For example, the most cost-effective way to address the temperature TMDL is reestablishment of streamside vegetation, which at the same time will reduce in-stream erosion. In some areas, in-stream erosion would be reduced to virtually zero by the reestablishment of streamside vegetation. For the control location above Crooked River, in-stream erosion reduced to zero would result in almost two-thirds of the total sediment load reduction needed. Those areas with in-stream erosion problems are also those contributing most to the heat loading problem.

Bacteria

Levels of bacteria that exceed the state WQS were identified at several times throughout the year and at several locations in Threemile Creek. The target is set at the state WQS of a geometric mean of 126 cfu/100 ml. Available data indicate that effluent from the Grangeville WWTP is not contributing to the problem beyond its permitted level of 100 cfu/100 ml. Probable causes are livestock defecation near and in the creek, stormwater runoff from the city of Grangeville, wildlife defecation near and in the creek, and possibly failing sewage disposal systems.

While the precise sources of bacteria in Threemile Creek have not been identified, sources that are the result of human activity are known to exist and should be addressed in the implementation plan. BMPs that reduce sediment and heat loading may also reduce levels of

bacteria. These activities may include the removal of cattle from areas of the creek, fencing, re-establishing riparian buffer zones, and improving stormwater management. Continued monitoring of bacteria as described below will better isolate the sources of bacteria.

Nutrients/DO

Monitored levels of nitrogen and phosphorus in Threemile Creek exceed USEPA recommended levels by as much as 2 orders of magnitude. A TMDL was developed for phosphorus with the assumption that limiting P will result in decreased nuisance algal growth and/or DO deficiencies. Targets are set at 0.08 mg/L TP above the WWTP outfall, 0.10 mg/L TP from the WWTP outfall to the Big Barn site at the head of the canyon, and 0.30 mg/L TP at the mouth.

Sources of P in the watershed include: urban runoff, agriculture and grazing practices, stream bank instability, sediment from roads, and the WWTP. The City of Grangeville is working to reduce P from the WWTP and the wasteload allocation for the WWTP will be incorporated into Grangeville's NPDES permit by the USEPA. It can be expected that BMPs effective in dealing with bacteria, temperature and sediment issues in Threemile Creek will also be effective in reducing nonpoint nutrient loading to the creek. Examples include: stormwater management, minimum till farming, riparian buffer planting and enhancement, stream bank stabilization, fencing with off-site watering for livestock, and road/culvert maintenance.

Approach

The implementation plan will be developed jointly through a collaborative process involving the WAG, landowners, land managers, and responsible resource agencies. Contents of the implementation plan are expected to include:

A description of how targets are to be attained (e.g., explains details of how to implement SPV and CWE targets).
An identification of BMPs and BMP locations.
An identification of existing efforts that will help achieve TMDL goals.
An implementation schedule with milestones based on restoration priorities.
Provisions to seek funding sources and sponsoring agencies.

Reasonable Assurance

Reasonable assurance of the implementation of nonpoint source control actions is required in a TMDL when point source WLAs are made less restrictive as a result of expected reductions from nonpoint source allocations. Where there are not reasonable assurances, the entire load reduction must be assigned to point sources (USEPA 1991). Wasteload allocations in these TMDLs are not less restrictive than current NPDES limits. In addition, except for the case of nutrients in Threemile Creek, point source loading compared to the overall load capacity is very minor. As a result, assigning the entire load reduction to point sources would result in essentially no improvement in conditions in the SF CWR. The implementation plan will

address many aspects of reasonable assurance for nonpoint sources as summarized above under the section titled "Approach."

Nonetheless, for forested areas in the SF CWR Subbasin, water quality problems caused by nonpoint sources of sediment and heat are improving as a result of work by land managers, federal policies, and the Idaho's FPA. There is no reason to expect that the trend will not continue. The TMDLs identify areas of highest pollutant input and should allow for prioritization of areas for additional work.

In the agricultural and grazing areas of the subbasin, no-till and minimum-till farming have been making an impact in the Cottonwood drainage, and there is reason to expect that farmers in the Threemile and Butcher Creek watersheds will adopt these practices as well. Similarly, there are programs being put in place by the SCC to limit livestock access to stream banks, which would allow vegetation to regrow along the streams. The Idaho Department of Agriculture has an active program working with AFOs to eliminate water pollution from these operations.

Time Frame

Implementation plans are to be developed within 18 months of USEPA approval of the TMDL, and are intended to achieve the water quality goals provided in a TMDL package. Development of the implementation plan has already begun and is expected to be completed in time for submittal of nonpoint source projects for CWA Section 319 funding in 2004/2005. Wasteload allocations will be incorporated into NPDES permits when they are reissued or reopened. The Grangeville NPDES permit is expected to be reissued within the next 1-2 years, and the recently reissued permits for Kooskia, Stites, Elk City, and Red River Ranger Station will need to be reopened to incorporate revised limits.

Implementation of nonpoint source controls has already begun, but is expected to proceed more rapidly once the implementation plan is complete and funds are available. A majority of the sources of pollutant loading are nonpoint in origin, and realistically it may take many years if not decades to fully achieve the goals of the TMDL. Certain improvements, such as controlling temperature and nutrients from the Grangeville WWTP or controlling nonpoint bacteria sources, are likely to occur fairly rapidly, within a few years. In order to substantially improve stream temperatures, mature riparian communities and a stable hydrologic regime and stream channel are needed. In smaller streams and watersheds, for example at an exclosure on Big Elk Creek, significant improvement may be seen in a few years. Realistically though, it is likely to take decades to see such improvement throughout the watershed given the large scale of needed improvements and the time frame needed to for riparian vegetation to grow to maturity.

Participating Parties

Responsible agencies and interest groups expected to play an important role in developing and implementing restoration measures include: the SF CWR WAG, NPNF, NPT, IDL, ISWCD, SCC, BLM, ITD, IDWR, BIA, Idaho Department of Agriculture, NRCS, DEQ,

NMFS, USEPA, IDFG, U.S. Fish and Wildlife Service, Idaho County, local highway districts, municipalities, industries, and local landowners.

Monitoring Strategy

Monitoring needs include continued monitoring of in-stream temperatures, determining point source discharge temperatures, and monitoring to establish reach-specific shade targets. Monitoring for stream temperature trends and standards attainment should occur near the mouths of each of the water bodies 303(d) listed for temperature, as well as those other 303(d) listed streams that are protected for bull trout. A total of 13 monitoring points should be established in the SF CWR Subbasin: five on the main stem near the lower ends of the water bodies, and one each near the mouths of Threemile Creek, Butcher Creek, Newsome Creek, American River, Big Elk Creek, Little Elk Creek, Red River and Crooked River. Stream temperature should be monitored using a device that at a minimum can make hourly recordings over the course of six months, encompassing the critical months of July and August. Monitoring should occur every summer until such time as the WQS are attained, or until this TMDL is revised and another plan established.

Monitoring of point source temperatures is needed so that the facilities can verify compliance with WLAs using current operations or determine if treatment revisions will be necessary. Monitoring requirements will be included in revised NPDES permits, but point sources are encouraged to begin collecting data immediately.

Determining reach-specific channel width, aspect, and current effective shade is needed in order to verify SPV shade targets and determine whether increases in shade are needed. A systematic procedure and time frame for collecting these data across federal, state, and private land is needed.

As with temperature, improvements in sediment condition throughout the basin should be monitored. For each of the control locations, one to several types of data are identified to monitor whether control measures are being put in place. Table 61 presents the targets for the different data types for the areas upstream from each of the control locations. The targets are the cumulative sediment from all portions of the subbasin upstream from the control locations. The current condition and targets are set based on the data type. As noted above, where both TSS and sediment budget methods of calculating the sediment loading are used, the sum of the different targets do not add to the total sediment load target at any particular control location.

In Table 61, methods are described by which sediment implementation results could be monitored. Monitoring of sediment reduction should be designed to measure against the TSS-based targets or the sediment load-based targets. Implementing agencies should collect data to track progress. The implementation plan will identify how monitoring data will be acquired, organized and maintained for each of the control locations.

Table 61. Sediment load targets by data type in the SF CWR Subbasin.

Control Location	Data Type	Target Type[a]	Current Condition[b]	Target[b]
Stites[c]	Sediment Load	TSS tons/year	29,718	22,144
	Cottonwood TMDL[d]	TSS tons/year	22,300	6,640
Threemile Creek[c] (mouth)	Sediment Load	TSS tons/year	1,015	235
	In-stream Erosion Model	Tons/year	357	103
	RUSLE Model (ag and grazing)	Tons/year	5,632	1,633
	WEPP Model (roads)	Tons/year	134	39
Butcher Creek[c] (mouth)	Sediment Load	TSS tons/year	335	132
	RUSLE Model (ag and grazing)	Tons/year	723	390
	WEPP Model (roads)	Tons/year	111	60
	In-stream Erosion Model	Tons/year	131	71
Johns Creek to Threemile Creek[e] (Harpster Bridge)	Sediment Load	Tons/year	5,736	4,302
	RUSLE Model (ag and grazing)	Tons/year	2,268	1,701
	NEZSED (forestry and grazing)	Tons/year	1,439	1,079
	Highway Gravel	Tons/year	1,151	863
	In-stream Erosion Model	Tons/year	405	304
Tenmile Creek to Johns Creek[e]	Sediment Load	Tons/year	2,297	1,723
	NEZSED (forestry and grazing)	Tons/year	1,292	969
	Highway Gravel	Tons/year	630	474
Crooked River to Tenmile Creek[e]	Sediment Load	Tons/year	1,835	1,376
	NEZSED (forestry and grazing)	Tons/year	1,083	812
	Highway Gravel	Tons/year	375	281
	In-stream Erosion Model	Tons/year	376	282
Confluence to Crooked River[e]	Sediment Load	Tons/year	1,248	936
	NEZSED (forestry and grazing)	Tons/year	903	677
	Highway Gravel	Tons/year	114	85
	In-stream Erosion Model	Tons/year	231	173

[a] TSS = total suspended solids

[b] All numbers for the control locations on the main stem are cumulative for all areas upstream

[c] Total suspended sediment (TSS)-based loading calculations

[d] Derived from the Cottonwood Creek TMDL

[e] Sediment budget-based calculations

A surrogate target for sediment has been set as an improving trend for in-stream habitat. It is expected that the management agencies will establish long term monitoring sites for cobble embeddedness and/or several habitat parameters at no less than one for each of the control locations. In addition to reduced loading as calculated against the above targets, the TMDL will be successful only if a statistically significant improving trend of river habitat is demonstrated. This trend monitoring is a measure of BMP effectiveness and would need to be carefully designed if there is any intent to measure the effectiveness of one suite of BMPs vs. another.

For suction dredging, it is expected that achieving the wasteload allocation will ensure compliance with the numeric turbidity criteria and the narrative sediment standard. Monitoring required as part of the NPDES permitting process, will be an important tool to evaluate ongoing compliance with this allocation. Given the lack of consistent monitoring of the effects of this industry in the SF CWR watershed, it is also recommended that the NPNF, DEQ and USEPA establish a monitoring plan to further characterize and assess these impacts on an ongoing basis.

For the bacteria and nutrient/DO TMDLs in Threemile Creek, it is recommended that a monitoring network be established to determine background loading and the distribution of nonpoint source loading of these pollutants. Specifically, it is recommended that monitoring locations be established in the forested headwaters for background, a location above the city and one below the city but above the WWTP to identify problems with runoff from the city, below the WWTP to capture effects of the WWTP, at the top of the canyon above the falls to capture the effects from the agricultural lands, above the mass failure in the lower end of the canyon, and one and the mouth of the creek. The critical time periods when these sites should be sampled are July, August and September on a bi-weekly basis. If these sites were monitored each year during implementation, trend analysis could lead to conclusions about BMP effectiveness. A more detailed research study of the effects of the mass failure on phosphorus concentrations is also recommended, but is likely beyond the scope of routine follow up monitoring during implementation.

5.6 Summary and Conclusions

This subbasin assessment and TMDLs have been developed to comply with Idaho's WQS and TMDL schedule. The first part of this document, the subbasin assessment describes the physical, biological, and cultural setting; water quality status; pollutant sources; and recent pollution control actions in the SF CWR Subbasin located in north-central Idaho. The starting point for the assessment was Idaho's 1998 303(d) list of water quality limited water bodies. Eighteen stream segments and one lake in the SF CWR Subbasin were included on this list. The subbasin assessment portion of this document examines the current status of 303(d) listed waters. It defines the extent of impairment and causes of water quality limitation throughout the subbasin.

Subbasin-wide temperature analyses were conducted in light of an extensive database indicating that no stream in the SF CWR Subbasin, not even those in relatively pristine condition, meets the Idaho numeric temperature criteria for salmonid spawning. However,

the Idaho WQS recognize that stream temperatures may naturally exceed numeric criteria and that pollution control measures should only address the human-caused increases in temperature. The non-point temperature assessments assumed that the human-caused effects were increased solar insolation, primarily a result of reduced streamside vegetation and, secondarily a result of increased stream width. Shading and stream width analyses were conducted on all perennial streams in the subbasin. The human-caused stream temperature increase was quantified in terms of the percent decrease in stream shade and increase in stream width. Targets were set based on best estimates of natural conditions for stream shade and stream width. Heat loadings were calculated based on current temperatures and flows, and were generally very low except at the Grangeville WWTP. Targets for all WWTPs were set to limit temperature increases in receiving waters to less than 0.3 ^{o}C (0.5 ^{o}F) above the temperature criteria, as per the WQS.

Subbasin-wide sediment analyses were based on a limited stream turbidity data set from four locations in the lower subbasin and a sediment delivery budget to streams from various sources. The sediment budget was developed using estimates from different models and data sets from the various sediment sources throughout the subbasin, as follows: NEZSED erosion model estimates of sediment from federally-managed timber land; RUSLE erosion model estimates of sediment from agricultural and range land; a stream bank erosion model estimate of in-stream erosion; WEPP erosion model estimates of sediment from county roads; a NPNF inventory of mass failures extrapolated to include the complete subbasin; and an estimate based on average annual rock crush of gravel from State Highway 14 reaching the river. Current discharge of sediment from point sources in the subbasin (municipal WWTPs, suction dredges, construction and industrial stormwater runoff) were found to be very minor in relation to the nonpoint sources.

Turbidity data were compared directly to the state WQS with loadings calculated using turbidity to total suspended solids (TSS) relationships. Sediment targets and allocations in the lower basin were set to meet the state turbidity criteria. Sediment targets for the upper basin, where no turbidity data were available, were set based on the percent load reduction needed at the mouth of the SF CWR, the Stites bridge control location. Point source allocations were established at required technology based levels in State or federal regulations, or at levels in existing NPDES permits.

Threemile and Butcher Creeks are 303(d) listed for several other pollutants in addition to sediment and temperature. They were both also evaluated for nutrients, dissolved oxygen, bacteria, and ammonia. Threemile Creek is particularly impacted because it receives effluent from the Grangeville WWTP, which at times makes up more than 50% of the stream flow. Data for pollutants were collected near the mouth of Butcher Creek and at four locations on Threemile Creek. Bacteria, dissolved oxygen, and ammonia data were compared to the state WQS. Nutrient levels were compared to both USEPA guidelines and the state's narrative WQS to determine impairment. In the case of Threemile Creek, where a water quality impairment was identified, the target was set for phosphorus based on the USEPA guidelines, and data collected in the watershed. These targets, and the seasonality of their application, may require adjustments in the future as additional data and information are collected.

Lucas Lake, near Elk City, is an old "glory hole" from the mining days of about 2 acres in size. It was originally 303(d) listed in 1994 based on data from the Idaho 1988 Water Quality Status Report and Nonpoint Source Assessment which indicated that it did not support one or more beneficial uses due to sediment/siltation. Turbidity and metals samples were collected for the lake and compared against the state WQS. No impairment was identified.

As a result of the subbasin assessment, temperature TMDLs were written for all 74 water bodies in the subbasin; sediment TMDLs were written for the SF CWR watershed, Butcher Creek, and Threemile Creek; and nutrient and bacteria TMDLs were written for Threemile Creek (Table 62). It is expected that these TMDLs will improve conditions throughout the subbasin for all aquatic species, including threatened and endangered fish species such as bull trout, fall chinook salmon, and steelhead.

Table 62. Streams and pollutants for which TMDLs were developed.

Stream	Pollutant(s)
South Fork Clearwater River	Sediment, Temperature
Threemile Creek	Bacteria, Nutrients, DO, Sediment, Temperature
Butcher Creek	Sediment, Temperature
Dawson Creek	Temperature
Little Elk Creek	Temperature
Big Elk Creek	Temperature
Buffalo Gulch	Temperature
Newsome Creek	Temperature
Beaver Creek	Temperature
Nugget Creek	Temperature
Sing Lee Creek	Temperature
Cougar Creek	Temperature
58 remaining water bodies	Temperature

Development of the implementation plan has already begun. The plan is expected to be completed in time to submit for 319 funding in 2004/2005. Wasteload allocations will be incorporated into NPDES permits when they are reissued or reopened. The Grangeville permit is expected to be reissued within the next 1-2 years, and the recently reissued permits for Kooskia, Stites, Elk City and Red River Ranger Station will need to be re-opened to incorporate revised limits.

Implementation of nonpoint source controls has already begun, but is expected to proceed in earnest once the implementation plan is complete and funds are available. A majority of the sources of temperature and sediment loading are nonpoint in origin, and realistically it may take many years if not decades to fully achieve the goals of the TMDL. Certain

improvements such as controlling temperature and nutrients from the Grangeville treatment facility or controlling nonpoint bacteria sources are likely to occur within a few years. In order to improve stream temperature, restored riparian communities and stream channels are needed. In smaller streams and watersheds, for example, the exclosure on Big Elk Creek, significant improvement may be seen in several years. It is likely to take decades to see such improvement throughout the watershed given the large scale of needed improvements and the time needed for riparian vegetation to grow to maturity.

It is expected that implementation of the TMDLs as presented in this document will result in full restoration of the waters of the SF CWR Subbasin to meet the Idaho WQS. Further, this restoration will contribute substantially to improved habitat for threatened and endangered aquatic species in the subbasin.

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GIS Coverages:

Restriction of liability: Neither the state of Idaho nor the Department of Environmental Quality, nor any of their employees make any warranty, express or implied, or assume any legal liability or responsibility for the accuracy, completeness or usefulness of any information or data provided. The data could include technical inaccuracies or typographical errors. The Department of Environmental Quality may update, modify, or revise the data used at any time, without notice.

Glossary

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

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

Acre-Foot A volume of water that would cover an acre to a depth of one foot. Often used to quantify reservoir storage and the annual discharge of large rivers.

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

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

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

Assessment Database (ADB) The ADB is a relational database application designed for the U.S. Environmental Protection Agency for tracking water quality assessment data, such as use attainment and causes and sources of impairment. States need to track this information and many other types of assessment data for thousands of water bodies, and integrate it into meaningful reports. The ADB is designed to make this process accurate, straightforward, and user-friendly for participating states, territories, tribes, and basin commissions.

Adfluvial	Describes fish whose life history involves seasonal migration from lakes to streams for spawning.
Adjunct	In the context of water quality, adjunct refers to areas directly adjacent to focal or refuge habitats that have been degraded by human or natural disturbances and do not presently support high diversity or abundance of native species.
Alevin	A newly hatched, incompletely developed fish (usually a salmonid) still in nest or inactive on the bottom of a water body, living off stored yolk.
Algae	Non-vascular (without water-conducting tissue) aquatic plants that occur as single cells, colonies, or filaments.
Alluvium	Unconsolidated recent stream deposition.
Ambient	General conditions in the environment. 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 (Armantrout 1998, EPA 1996).
Anadromous	Fish, such as salmon and sea-run trout, that live part or the majority of their lives in the salt water but return to fresh water to spawn.
Anaerobic	Describes the processes that occur in the absence of molecular oxygen and describes the condition of water that is devoid of molecular oxygen.
Anoxia	The condition of oxygen absence or deficiency.
Anthropogenic	Relating to, or resulting from, the influence of human beings on nature.

Anti-Degradation Refers to the U.S. Environmental Protection Agency's interpretation of the Clean Water Act goal that states and tribes maintain, as well as restore, water quality. This applies to waters that meet or are of higher water quality than required by state standards. State rules provide that the quality of those high quality waters may be lowered only to allow important social or economic development and only after adequate public participation (IDAPA 58.01.02.051). In all cases, the existing beneficial uses must be maintained. State rules further define lowered water quality to be 1) a measurable change, 2) a change adverse to a use, and 3) a change in a pollutant relevant to the water's uses (IDAPA 58.01.02.003.56).

Aquatic Occurring, growing, or living in water.

Aquifer An underground, water-bearing layer or stratum of permeable rock, sand, or gravel capable of yielding of water to wells or springs.

Assemblage (aquatic) An association of interacting populations of organisms in a given water body; for example, a fish assemblage, or a benthic macroinvertebrate assemblage (also see Community) (EPA 1996).

Assimilative Capacity The ability to process or dissipate pollutants without ill effect to beneficial uses.

Autotrophic An organism is considered autotrophic if it uses carbon dioxide as its main source of carbon. This most commonly happens through photosynthesis.

Batholith A large body of intrusive igneous rock that has more than 40 square miles of surface exposure and no known floor. A batholith usually consists of coarse-grained rocks such as granite.

Bedload Material (generally sand-sized or larger sediment) that is carried along the streambed by rolling or bouncing.

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

Beneficial Use Reconnaissance Program (BURP)	A program for conducting systematic biological and physical habitat surveys of water bodies in Idaho. BURP protocols address lakes, reservoirs, and wadeable streams and rivers.
Benthic	Pertaining to or living on or in the bottom sediments of a water body.
Benthic Organic Matter.	The organic matter on the bottom of a water body.
Benthos	Organisms living in and on the bottom sediments of lakes and streams. Originally, the term meant the lake bottom, but it is now applied almost uniformly to the animals associated with the lake and stream bottoms.
Best Management Practices (BMPs)	Structural, nonstructural, and managerial techniques that are effective and practical means to control nonpoint source pollutants.
Best Professional Judgment	A conclusion and/or interpretation derived by a trained and/or technically competent individual by applying interpretation and synthesizing information.
Biological Oxygen Demand (BOD)	The amount of dissolved oxygen used by organisms during the decomposition (respiration) of organic matter, expressed as mass of oxygen per volume of water, over some specified period of time.
Biological Integrity	1) The condition of an aquatic community inhabiting unimpaired water bodies of a specified habitat as measured by an evaluation of multiple attributes of the aquatic biota (EPA 1996). 2) The ability of an aquatic ecosystem to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to the natural habitats of a region (Karr 1991).
Biomass	The weight of biological matter. Standing crop is the amount of biomass (e.g., fish or algae) in a body of water at a given time. Often expressed as grams per square meter.
Biota	The animal and plant life of a given region.

Biotic A term applied to the living components of an area.

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

Coliform Bacteria A group of bacteria predominantly inhabiting the intestines of humans and animals but also found in soil. Coliform bacteria are commonly used as indicators of the possible presence of pathogenic organisms (also see Fecal Coliform Bacteria).

Colluvium Material transported to a site by gravity.

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

Conductivity The ability of an aqueous solution to carry electric current, expressed in micro (μ) mhos/cm at 25 °C. Conductivity is affected by dissolved solids and is used as an indirect measure of total dissolved solids in a water sample.

Cretaceous The final period of the Mesozoic era (after the Jurassic and before the Tertiary period of the Cenozoic era), thought to have covered the span of time between 135 and 65 million years ago.

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

Cubic Feet per Second A unit of measure for the rate of flow or discharge of water. One cubic foot per second is the rate of flow of a stream with a cross-section of one square foot flowing at a mean velocity of one foot per second. At a steady rate, once cubic foot per second is equal to 448.8 gallons per minute and 10,984 acre-feet per day.

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

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

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

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

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

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

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

Dissolved Oxygen (DO) — The oxygen dissolved in water. Adequate DO is vital to fish and other aquatic life.

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

E. coli — Short for *Escherichia Coli*, *E. coli* are a group of bacteria that are a subspecies of coliform bacteria. Most *E. coli* are essential to the healthy life of all warm-blooded animals, including humans. Their presence is often indicative of fecal contamination.

Ecology	The scientific study of relationships between organisms and their environment; also defined as the study of the structure and function of nature.
Ecological Indicator	A characteristic of an ecosystem that is related to, or derived from, a measure of a biotic or abiotic variable that can provide quantitative information on ecological structure and function. An indicator can contribute to a measure of integrity and sustainability. Ecological indicators are often used within the multimetric index framework.
Ecological Integrity	The condition of an unimpaired ecosystem as measured by combined chemical, physical (including habitat), and biological attributes (EPA 1996).
Ecosystem	The interacting system of a biological community and its non-living (abiotic) environmental surroundings.
Effluent	A discharge of untreated, partially treated, or treated wastewater into a receiving water body.
Endangered Species	Animals, birds, fish, plants, or other living organisms threatened with imminent extinction. Requirements for declaring a species as endangered are contained in the Endangered Species Act.
Environment	The complete range of external conditions, physical and biological, that affect a particular organism or community.
Eocene	An epoch of the early Tertiary period, after the Paleocene and before the Oligocene.
Eolian	Windblown, referring to the process of erosion, transport, and deposition of material by the wind.
Ephemeral Stream	A stream or portion of a stream that flows only in direct response to precipitation. It receives little or no water from springs and no long continued supply from melting snow or other sources. Its channel is at all times above the water table. (American Geologic Institute 1962).
Erosion	The wearing away of areas of the earth's surface by water, wind, ice, and other forces.

Eutrophic	From Greek for "well nourished," this describes a highly productive body of water in which nutrients do not limit algal growth. It is typified by high algal densities and low clarity.
Eutrophication	1) Natural process of maturing (aging) in a body of water. 2) The natural and human-influenced process of enrichment with nutrients, especially nitrogen and phosphorus, leading to an increased production of organic matter. 2)
Exceedance	A violation (according to DEQ policy) of the pollutant levels permitted by water quality criteria.
Existing Beneficial Use or Existing Use	A beneficial use actually attained in waters on or after November 28, 1975, whether or not the use is designated for the waters in Idaho's *Water Quality Standards and Wastewater Treatment Requirements* (IDAPA 58.01.02).
Exotic Species	A species that is not native (indigenous) to a region.
Extrapolation	Estimation of unknown values by extending or projecting from known values.
Fauna	Animal life, especially the animals characteristic of a region, period, or special environment.
Fecal Coliform Bacteria	Bacteria found in the intestinal tracts of all warm-blooded animals or mammals. Their presence in water is an indicator of pollution and possible contamination by pathogens (also see Coliform Bacteria).
Fecal Streptococci	A species of spherical bacteria including pathogenic strains found in the intestines of warm-blooded animals.
Feedback Loop	In the context of watershed management planning, a feedback loop is a process that provides for tracking progress toward goals and revising actions according to that progress.
Fixed-Location Monitoring	Sampling or measuring environmental conditions continuously or repeatedly at the same location.
Flow	See Discharge.

Fluvial	In fisheries, this describes fish whose life history takes place entirely in streams but migrate to smaller streams for spawning.
Focal	Critical areas supporting a mosaic of high quality habitats that sustain a diverse or unusually productive complement of native species.
Fully Supporting	In compliance with water quality standards and within the range of biological reference conditions for all designated and exiting beneficial uses as determined through the *Water Body Assessment Guidance* (Grafe et al. 2002).
Fully Supporting Cold Water	Reliable data indicate functioning, sustainable cold water biological assemblages (e.g., fish, macroinvertebrates, or algae), none of which have been modified significantly beyond the natural range of reference conditions (EPA 1997).
Fully Supporting but Threatened	An intermediate assessment category describing water bodies that fully support beneficial uses, but have a declining trend in water quality conditions, which if not addressed, will lead to a "not fully supporting" status.
Geographical Information Systems (GIS)	A georeferenced database.
Geometric Mean	A back-transformed mean of the logarithmically transformed numbers often used to describe highly variable, right-skewed data (a few large values), such as bacterial data.
Grab Sample	A single sample collected at a particular time and place. It may represent the composition of the water in that water column.
Gradient	The slope of the land, water, or streambed surface.
Ground Water	Water found beneath the soil surface saturating the layer in which it is located. Most ground water originates as rainfall, is free to move under the influence of gravity, and usually emerges again as stream flow.

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

Habitat The living place of an organism or community.

Headwater The origin or beginning of a stream.

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

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

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

Hydrologic Unit Code (HUC) The number assigned to a hydrologic unit. Often used to refer to fourth field hydrologic units.

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

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

Influent A tributary stream.

Inorganic Materials not derived from biological sources.

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

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

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

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

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

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

Knickpoint Any interruption or break of slope.

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

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

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

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

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

Loading Capacity (LC) A determination of how much pollutant a water body can receive over a given period without causing violations of state water quality standards. Upon allocation to various sources, and a margin of safety, it becomes a total maximum daily load.

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

Loess A uniform wind-blown deposit of silty material. Silty soils are among the most highly erodible.

Lotic An aquatic system with flowing water such as a brook, stream, or river where the net flow of water is from the headwaters to the mouth.

Luxury Consumption A phenomenon in which sufficient nutrients are available in either the sediments or the water column of a water body, such that aquatic plants take up and store an abundance in excess of the plants' current needs.

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

Macrophytes Rooted and floating vascular aquatic plants, commonly referred to as water weeds. These plants usually flower and bear seeds. Some forms, such as duckweed and coontail (*Ceratophyllum sp.*), are free-floating forms not rooted in sediment.

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

Mass Wasting A general term for the down slope movement of soil and rock material under the direct influence of gravity.

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

Median The middle number in a sequence of numbers. If there are an even number of numbers, the median is the average of the two middle numbers. For example, 4 is the median of 1, 2, 4, 14, 16; and 6 is the median of 1, 2, 5, 7, 9, 11.

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

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

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

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

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

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

National Pollution Discharge Elimination System (NPDES)	A national program established by the Clean Water Act for permitting point sources of pollution. Discharge of pollution from point sources is not allowed without a permit.
Natural Condition	A condition indistinguishable from that without human-caused disruptions.
Nitrogen	An element essential to plant growth, and thus is considered a nutrient.
Nodal	Areas that are separated from focal and adjunct habitats, but serve critical life history functions for individual native fish.
Nonpoint Source	A dispersed source of pollutants, generated from a geographical area when pollutants are dissolved or suspended in runoff and then delivered into waters of the state. Nonpoint sources are without a discernable point or origin. They include, but are not limited to, irrigated and non-irrigated lands used for grazing, crop production, and silviculture; rural roads; construction and mining sites; log storage or rafting; and recreation sites.
Not Assessed (NA)	A concept and an assessment category describing water bodies that have been studied, but are missing critical information needed to complete an assessment.
Not Attainable	A concept and an assessment category describing water bodies that demonstrate characteristics that make it unlikely that a beneficial use can be attained (e.g., a stream that is dry but designated for salmonid spawning).
Not Fully Supporting	Not in compliance with water quality standards or not within the range of biological reference conditions for any beneficial use as determined through the *Water Body Assessment Guidance* (Grafe et al. 2002).
Not Fully Supporting Cold Water	At least one biological assemblage has been significantly modified beyond the natural range of its reference condition (EPA 1997).
Nuisance	Anything which is injurious to the public health or an obstruction to the free use, in the customary manner, of any waters of the state.

Nutrient Any substance required by living things to grow. An element or its chemical forms essential to life, such as carbon, oxygen, nitrogen, and phosphorus. Commonly refers to those elements in short supply, such as nitrogen and phosphorus, which usually limit growth.

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

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

Organic Matter Compounds manufactured by plants and animals that contain principally carbon.

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

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

Parameter A variable, measurable property whose value is a determinant of the characteristics of a system, such as temperature, dissolved oxygen, and fish populations are parameters of a stream or lake.

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

Pathogens Disease-producing organisms (e.g., bacteria, viruses, parasites).

Perennial Stream A stream that flows year-around in most years.

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

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

PH The negative $\log_{10}$ of the concentration of hydrogen ions, a measure which in water ranges from very acid (pH=1) to very alkaline (pH=14). A pH of 7 is neutral. Surface waters usually measure between pH 6 and 9.

Phased TMDL A total maximum daily load (TMDL) that identifies interim load allocations and details further monitoring to gauge the success of management actions in achieving load reduction goals and the effect of actual load reductions on the water quality of a water body. Under a phased TMDL, a refinement of load allocations, wasteload allocations, and the margin of safety is planned at the outset.

Phosphorus An element essential to plant growth, often in limited supply, and thus considered a nutrient.

Physiochemical In the context of bioassessment, the term is commonly used to mean the physical and chemical factors of the water column that relate to aquatic biota. Examples in bioassessment usage include saturation of dissolved gases, temperature, pH, conductivity, dissolved or suspended solids, forms of nitrogen, and phosphorus. This term is used interchangeable with the terms "physical/chemical" and "physicochemical."

Plankton Microscopic algae (phytoplankton) and animals (zooplankton) that float freely in open water of lakes and oceans.

Point Source A source of pollutants characterized by having a discrete conveyance, such as a pipe, ditch, or other identifiable "point" of discharge into a receiving water. Common point sources of pollution are industrial and municipal wastewater.

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

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

Population A group of interbreeding organisms occupying a particular space; the number of humans or other living creatures in a designated area.

Pretreatment The reduction in the amount of pollutants, elimination of certain pollutants, or alteration of the nature of pollutant properties in wastewater prior to, or in lieu of, discharging or otherwise introducing such wastewater into a publicly owned wastewater treatment plant.

Primary Productivity The rate at which algae and macrophytes fix carbon dioxide using light energy. Commonly measured as milligrams of carbon per square meter per hour.

Protocol A series of formal steps for conducting a test or survey.

Qualitative Descriptive of kind, type, or direction.

Quality Assurance (QA) A program organized and designed to provide accurate and precise results. Included are the selection of proper technical methods, tests, or laboratory procedures; sample collection and preservation; the selection of limits; data evaluation; quality control; and personnel qualifications and training. The goal of QA is to assure the data provided are of the quality needed and claimed (Rand 1995, EPA 1996).

Quality Control (QC) Routine application of specific actions required to provide information for the quality assurance program. Included are standardization, calibration, and replicate samples. QC is implemented at the field or bench level (Rand 1995, EPA 1996).

Quantitative Descriptive of size, magnitude, or degree.

Reach A stream section with fairly homogenous physical characteristics.

Reconnaissance	An exploratory or preliminary survey of an area.
Reference	A physical or chemical quantity whose value is known, and thus is used to calibrate or standardize instruments.
Reference Condition	1) A condition that fully supports applicable beneficial uses with little affect from human activity and represents the highest level of support attainable. 2) A benchmark for populations of aquatic ecosystems used to describe desired conditions in a biological assessment and acceptable or unacceptable departures from them. The reference condition can be determined through examining regional reference sites, historical conditions, quantitative models, and expert judgment (Hughes 1995).
Reference Site	A specific locality on a water body that is minimally impaired and is representative of reference conditions for similar water bodies.
Representative Sample	A portion of material or water that is as similar in content and consistency as possible to that in the larger body of material or water being sampled.
Resident	A term that describes fish that do not migrate.
Respiration	A process by which organic matter is oxidized by organisms, including plants, animals, and bacteria. The process converts organic matter to energy, carbon dioxide, water, and lesser constituents.
Riffle	A relatively shallow, gravelly area of a streambed with a locally fast current, recognized by surface choppiness. Also an area of higher streambed gradient and roughness.
Riparian	Associated with aquatic (stream, river, lake) habitats. Living or located on the bank of a water body.
Riparian Habitat Conservation Area (RHCA)	A U.S. Forest Service description of land within the following number of feet up-slope of each of the banks of streams: - 300 feet from perennial fish-bearing streams - 150 feet from perennial non-fish-bearing streams - 100 feet from intermittent streams, wetlands, and ponds in priority watersheds.

River	A large, natural, or human-modified stream that flows in a defined course or channel, or a series of diverging and converging channels.
Runoff	The portion of rainfall, melted snow, or irrigation water that flows across the surface, through shallow underground zones (interflow), and through ground water to creates streams.
Sediments	Deposits of fragmented materials from weathered rocks and organic material that were suspended in, transported by, and eventually deposited by water or air.
Settleable Solids	The volume of material that settles out of one liter of water in one hour.
Species	1) A reproductively isolated aggregate of interbreeding organisms having common attributes and usually designated by a common name. 2) An organism belonging to such a category.
Spring	Ground water seeping out of the earth where the water table intersects the ground surface.
Stagnation	The absence of mixing in a water body.
Stenothermal	Unable to tolerate a wide temperature range.
Stratification	A Department of Environmental Quality classification method used to characterize comparable units (also called classes or strata).
Stream	A natural water course containing flowing water, at least part of the year. Together with dissolved and suspended materials, a stream normally supports communities of plants and animals within the channel and the riparian vegetation zone.
Stream Order	Hierarchical ordering of streams based on the degree of branching. A first-order stream is an unforked or unbranched stream. Under Strahler's (1957) system, higher order streams result from the joining of two streams of the same order.

Storm Water Runoff Rainfall that quickly runs off the land after a storm. In developed watersheds the water flows off roofs and pavement into storm drains that may feed quickly and directly into the stream. The water often carries pollutants picked up from these surfaces.

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

Subbasin A large watershed of several hundred thousand acres. This is the name commonly given to 4th field hydrologic units (also see Hydrologic Unit).

Subbasin Assessment (SBA) A watershed-based problem assessment that is the first step in developing a total maximum daily load in Idaho.

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

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

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

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

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

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

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

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

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

Total Maximum Daily Load (TMDL) A TMDL is a water body's loading capacity after it has been allocated among pollutant sources. It can be expressed on a time basis other than daily if appropriate. Sediment loads, for example, are often calculated on an annual bases. TMDL = Loading Capacity = Load Allocation + Wasteload Allocation + Margin of Safety. In common usage, a TMDL also refers to the written document that contains the statement of loads and supporting analyses, often incorporating TMDLs for several water bodies and/or pollutants within a given watershed.

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

Total Suspended Solids (TSS) The dry weight of material retained on a filter after filtration. Filter pore size and drying temperature can vary. American Public Health Association Standard Methods (Greenborg, Clescevi, and Eaton 1992) call for using a filter of 2.0 micron or smaller; a 0.45 micron filter is also often used. This method calls for drying at a temperature of 103-105 °C.

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

Tributary A stream feeding into a larger stream or lake.

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

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

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

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

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

Water Body Identification Number (WBID) A number that uniquely identifies a water body in Idaho and ties in to the Idaho Water Quality Standards and GIS information.

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

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

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

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

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

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

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

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

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

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

Watershed

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

2)

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

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

Appendix A. Memorandum of Agreement

MEMORANDUM OF AGREEMENT AMONG
THE U.S. ENVIRONMENTAL PROTECTION AGENCY
THE IDAHO DEPARTMENT OF ENVIRONMENTAL QUALITY AND
THE NEZ PERCE TRIBE RELATING TO THE
DEVELOPMENT OF A TMDL FOR THE SOUTH FORK OF THE CLEARWATER RIVER
HYDROLOGIC UNIT

WHEREAS, the U.S. Environmental Protection Agency (EPA), the State of Idaho Department of Environmental Quality (DEQ), and the Nez Perce Tribe (collectively "the Parties") each desire to develop a government to government agreement for the development of a total maximum daily load (TMDL) for the South Fork of the Clearwater River hydrologic unit code (HUC # 17060305).

WHEREAS, the Parties wish to work together to restore water quality, build, support, and promote cooperation among citizens, business, and governments at the community level for purposes of formulating effective community support and a South Fork of the Clearwater River HUC TMDL (hereinafter "the TMDL").

THEREFORE, the parties enter into this Memorandum of Agreement (the Agreement), and agree as follows:

1. The Parties will each provide staff to coordinate and to provide technical advice to draft the TMDL, in addition to any other assistance each respective agency desires to provide.

2. The TMDL produced by the technical staff will be jointly presented to the Parties on or before December 31, 2001, or other deadline consistent with the court approved schedule, for approval under their respective authorities. This agreement does not constitute approval by any Party of any TMDL.

3. For purposes of developing this TMDL, the Parties agree that the water quality standards as determined by 40 C.F.R. § 131.21, including those which EPA has approved or promulgated for the State of Idaho, are an appropriate measure for calculating the TMDL.

4. Communications between the Parties while implementing this Agreement generally will be at the staff level. If a dispute arises the issue will be presented to immediate supervisors and the staffs will present the matter to progressively higher levels of management until consensus is reached. Alternative methods of dispute resolution may be utilized, if consented to by all Parties.

5. The Parties recognize that each Party reserves all rights, powers, and remedies now or hereafter existing in law or in equity, by statute, treaty, or otherwise. Nothing in this Agreement is or shall be construed to be a waiver of the sovereignty of the Nez Perce Tribe, the State of Idaho, or the United States. By entering into this Agreement, the Parties reserve, and do not waive, their claims to jurisdiction over all or parts of the South Fork of the Clearwater River and sources of pollution affecting the South Fork of the Clearwater River. This Agreement is intended solely for the purposes of facilitating inter-governmental cooperation between the Parties, and creates no rights in third parties or the right to judicial review.

2

6. This Agreement shall be effective upon the date of signature by all of the Parties. Any Party may voluntarily withdraw from this Agreement by providing thirty (30) days written notice to the other Parties

NEZ PERCE TRIBE

BY: Samuel N. Penney — 10-25-2000
Samuel N. Penney, Chairman — Date

BY: Arthur M. Taylor — 10/25/00
Arthur M. Taylor, Secretary — Date

IDAHO DEPARTMENT OF ENVIRONMENTAL QUALITY

BY: C. Stephen Allred — 10/31/2000
C. Stephen Allred, Director — Date

U.S. ENVIRONMENTAL PROTECTION AGENCY

BY: Chuck Findley — 11-08-00
Chuck Findley, Acting Regional Administrator — Date

Appendix B. Federal Bull Trout Criteria

Federal Bull Trout Criteria

Federal Register

§ 131.33 Idaho.

(a) Temperature criteria for bull trout.

(1) Except for those streams or portions of streams located in Indian country, or as may be modified by the Regional Administrator, EPA Region X, pursuant to paragraph (a) (3) of this section, a temperature criterion of 10 ^{0}C, expressed as an average of daily maximum temperatures over a seven-day period, applies to the waterbodies identified in paragraph (a) (2) of this section during the months of June, July, August, and September.

(2) The following waters are protected for bull trout spawning and rearing:

(xviii) SOUTH FORK CLEARWATER BASIN: American River, Baker Gulch, Baldy Creek, Bear Creek, Beaver Creek, Big Canyon Creek, Big Elk Creek, Blanco Creek, Boundary Creek, Box Sing Creek, Boyer Creek, Cartwright Creek, Cole Creek, Crooked River, Dawson Creek, Deer Creek, Ditch Creek, East Fork American River, East Fork Crooked River, Elk Creek, Fivemile Creek, Flint Creek, Fourmile Creek, Fox Creek, French Gulch, Galena Creek, Gospel Creek, Hagen Creek, Haysfork Creek, Johns Creek, Jungle Creek, Kirks Fork American River, Little Elk Creek, Little Moose Creek, Little Siegel Creek, Look Creek, Mackey Creek, Meadow Creek, Melton Creek, Middle Fork Red River, Mill Creek, Monroe Creek, Moores Creek, Moores Lake Creek, Moose Butte Creek, Morgan Creek, Mule Creek, Newsome Creek, Nuggett Creek, Otterson Creek, Pat Brennan Creek, Pilot Creek, Quartz Creek, Queen Creek, Rabbit Creek, Rainbow Gulch, Red River, Relief Creek, Ryan Creek, Sally Ann Creek, Sawmill Creek, Schooner Creek, Schwartz Creek, Sharmon Creek, Siegel Creek, Silver Creek, Sixmile Creek, Sixtysix Creek, Snoose Creek, Sourdough Creek, South Fork Red River, Square Mountain Creek, Swale Creek, Swift Creek, Taylor Creek, Tenmile Creek, Trail Creek, Trapper Creek, Trout Creek, Twentymile Creek, Twin Lakes Creek, Umatilla Creek, West Fork Big Elk Creek, West Fork Crooked River, West Fork Gospel Creek, West Fork Newsome Creek, West Fork Red River, West Fork Twentymile Creek, Whiskey Creek, Whitaker Creek, Williams Creek.

Appendix C. Assessment Units for the South Fork Clearwater River Subbasin TMDLs

Appendix C. Assessment Units for the South Fork Clearwater River Subbasin TMDLs

The South Fork Clearwater River Subbasin TMDLs are written for water bodies as defined in the Idaho code (IDAPA 58.01.02.120.07). However, the state of Idaho and USEPA are moving towards a water quality accounting system based on assessment units. One water body may contain one or more assessment units. Table C-1 shows the assessment units accounted for by the TMDLs in this document and their relation to the 303(d) list.

The Assessment Unit code contains information that can be used to relate the assessment units to water bodies, hydrologic units, and the state as follows: The ID prefix indicates the state of Idaho; the numbers 17060305 is the hydrologic unit code for the South Fork Clearwater River Subbasin; CL001 through CL082 are the water bodies in the South Fork Clearwater River Subbasin (the numbers here are the water body numbers used in tables throughout this document); and the last numbers identify the assessment unit within the water body.

For the individual assessment unit identifiers, the rationale for the particular numbers and letters are as follows: 02 indicates first and second order streams; 03 indicates third order streams, 04 indicates fourth order streams, 05 indicates fifth order streams; "T" indicates a tribal water within the boundaries of the NPT reservation; and "a" indicates a subdivision of the water body for any characteristic thought to be important to water quality assessment.

The Lucas Lake assessment unit appears at the end of the table, with its unique code showing that it is a lake in water body 52 (CL052L_00), the lower American River water body.

Table C-1. Assessment units correlated to the 1998 303(d) list and water bodies with completed TMDLs in the SF CWR Subbasin.

Assess-ment Unit	Water Body Description	303(d) Listed Pollutants[a,b]	TMDLs Completed[b]
ID17060305 CL001_02	South Fork Clearwater R. - Butcher Cr. to mouth	Halt, Sed, Temp	Sed, Temp
ID17060305 CL001_02T	South Fork Clearwater R. - Butcher Cr. to mouth	Halt, Sed, Temp	Sed, Temp
ID17060305 CL001_05T	South Fork Clearwater R. - Butcher Cr. to mouth	Halt, Sed, Temp	Sed, Temp
ID17060305 CL010_02	Threemile Cr. - source to mouth	Bac, DO, Nut, NH3, Qalt, Halt, Sed, Temp	Sed, Temp, Bac, DO, Nut
ID17060305 CL010_02T	Threemile Cr. - source to mouth	Bac, DO, Nut, NH3, Qalt, Halt, Sed, Temp	Sed, Temp, Bac, DO, Nut
ID17060305 CL010_03T	Threemile Cr. - source to mouth	Bac, DO, Nut, NH3, Qalt, Halt, Sed, Temp	Sed, Temp, Bac, DO, Nut
ID17060305 CL011_02	Butcher Cr. - source to mouth	Bac, DO, Qalt, Halt, Sed, Temp	Sed, Temp

Assess-ment Unit	Water Body Description	303(d) Listed Pollutants[a,b]	TMDLs Completed[b]
ID17060305 CL011_02T	Butcher Cr. - source to mouth	Bac, DO, Qalt, Halt, Sed, Temp	Sed, Temp
ID17060305 CL012_02	South Fork Clearwater R. - Johns Cr. to Butcher Cr.	Halt, Sed, Temp	Sed, Temp
ID17060305 CL012_02a	South Fork Clearwater R. - Johns Cr. to Butcher Cr.	Halt, Sed, Temp	Sed, Temp
ID17060305 CL012_05	South Fork Clearwater R. - Johns Cr. to Butcher Cr.	Halt, Sed, Temp	Sed, Temp
ID17060305 CL012_05T	South Fork Clearwater R. - Johns Cr. to Butcher Cr.	Halt, Sed, Temp	Sed, Temp
ID17060305 CL013_02	Mill Cr. - source to mouth	None	Temp
ID17060305 CL013_03	Mill Cr. - source to mouth	None	Temp
ID17060305 CL014_02	Johns Cr. - Gospel Cr. to mouth	None	Temp
ID17060305 CL014_04	Johns Cr. - Gospel Cr. to mouth	None	Temp
ID17060305 CL015_02	Gospel Cr. - source to mouth	None	Temp
ID17060305 CL015_03	Gospel Cr. - source to mouth	None	Temp
ID17060305 CL016_02	West Fork Gospel Cr. - source to mouth	None	Temp
ID17060305 CL017_02	Johns Cr. - Moores Cr. to Gospel Cr.	None	Temp
ID17060305 CL017_03	Johns Cr. - Moores Cr. to Gospel Cr.	None	Temp
ID17060305 CL018_02	Johns Cr. - source to Moores Cr.	None	Temp
ID17060305 CL018_03	Johns Cr. - source to Moores Cr.	None	Temp
ID17060305 CL019_02	Moores Cr. - source to mouth	None	Temp
ID17060305 CL020_02	Square Mountain Cr. - source to mouth	None	Temp
ID17060305 CL021_02	Hagen Cr. - source to mouth	None	Temp
ID17060305 CL022_02	South Fork Clearwater R. - Tenmile Cr. to Johns Cr.	Halt, Sed, Temp	Sed, Temp
ID17060305	South Fork Clearwater R. - Tenmile Cr.	Halt, Sed, Temp	Sed, Temp

Assess-ment Unit	Water Body Description	303(d) Listed Pollutants[a,b]	TMDLs Completed[b]
CL022_02a	to Johns Cr.		
ID17060305 CL022_05	South Fork Clearwater R. - Tenmile Cr. to Johns Cr.	Halt, Sed, Temp	Sed, Temp
ID17060305 CL023_02	Wing Cr. - source to mouth	None	Temp
ID17060305 CL023_03	Wing Cr. - source to mouth	None	Temp
ID17060305 CL024_02	Twentymile Cr. - source to mouth	None	Temp
ID17060305 CL024_03	Twentymile Cr. - source to mouth	None	Temp
ID17060305 CL025_02	Tenmile Cr. - Sixmile Cr. to mouth	None	Temp
ID17060305 CL025_04	Tenmile Cr. - Sixmile Cr. to mouth	None	Temp
ID17060305 CL026_02	Tenmile Cr. - Williams Cr. to Sixmile Cr.	None	Temp
ID17060305 CL026_03	Tenmile Cr. - Williams Cr. to Sixmile Cr.	None	Temp
ID17060305 CL027_02	Tenmile Cr. - source to Williams Cr.	None	Temp
ID17060305 CL028_02	Williams Cr. - source to mouth	None	Temp
ID17060305 CL029_02	Sixmile Cr. - source to mouth	None	Temp
ID17060305 CL029_03	Sixmile Cr. - source to mouth	None	Temp
ID17060305 CL030_02	South Fork Clearwater R. - Crooked R. to Tenmile Cr.	Halt, Sed, Temp	Sed, Temp
ID17060305 CL030_05	South Fork Clearwater R. - Crooked R. to Tenmile Cr.	Halt, Sed, Temp	Sed, Temp
ID17060305 CL031_02	Crooked R. - Relief Cr. to mouth	None	Temp
ID17060305 CL031_03	Crooked R. - Relief Cr. to mouth	None	Temp
ID17060305 CL032_02	Crooked R. - confluence of West and East Fork Crooked R.s to Relief Cr.	None	Temp
ID17060305 CL032_03	Crooked R. - confluence of West and East Fork Crooked R.s to Relief Cr.	None	Temp
ID17060305 CL033_02	West Fork Crooked R. - source to mouth	None	Temp

Assess-ment Unit	Water Body Description	303(d) Listed Pollutants[a,b]	TMDLs Completed[b]
ID17060305 CL034_02	East Fork Crooked R. - source to mouth	None	Temp
ID17060305 CL035_02	Relief Cr. - source to mouth	None	Temp
ID17060305 CL036_02	South Fork Clearwater R. - confluence of American R. and Red R. to Crooked R.	Halt, Sed, Temp	Sed, Temp
ID17060305 CL036_05	South Fork Clearwater R. - confluence of American R. and Red R. to Crooked R.	Halt, Sed, Temp	Sed, Temp
ID17060305 CL037_02	Red R.- Siegel Cr. to mouth	None	Temp
ID17060305 CL037_04	Red R.- Siegel Cr. to mouth	None	Temp
ID17060305 CL038_02	Red R. - South Fork Red R. to Siegel Cr.	Sed	Temp
ID17060305 CL038_02a	Red R. - South Fork Red R. to Siegel Cr.	None	Temp
ID17060305 CL038_04	Red R. - South Fork Red R. to Siegel Cr.	None	Temp
ID17060305 CL039_02	Moose Butte Cr. - source to mouth	None	Temp
ID17060305 CL039_03	Moose Butte Cr. - source to mouth	None	Temp
ID17060305 CL040_02	South Fork Red R. - Trapper Cr. to mouth	None	Temp
ID17060305 CL040_03	South Fork Red R. - Trapper Cr. to mouth	None	Temp
ID17060305 CL041_02	South Fork Red R. - West Fork Red R. to Trapper Cr.	None	Temp
ID17060305 CL041_03	South Fork Red R. - West Fork Red R. to Trapper Cr.	None	Temp
ID17060305 CL042_02	West Fork Red R. - source to mouth	None	Temp
ID17060305 CL042_03	West Fork Red R. - source to mouth	None	Temp
ID17060305 CL043_02	South Fork Red R. - source to West Fork Red R.	None	Temp
ID17060305 CL044_02	Trapper Cr. - source to mouth	None	Temp
ID17060305 CL045_02	Red R. - source to South Fork Red R.	None	Temp
ID17060305	Red R. - source to South Fork Red R.	None	Temp

Assess-ment Unit	Water Body Description	303(d) Listed Pollutants[a,b]	TMDLs Completed[b]
CL045_03			
ID17060305 CL046_02	Soda Cr. - source to mouth	None	Temp
ID17060305 CL047_02	Bridge Cr. - source to mouth	None	Temp
ID17060305 CL048_02	Otterson Cr. - source to mouth	None	Temp
ID17060305 CL049_02	Trail Cr. - source to mouth	None	Temp
ID17060305 CL050_02	Siegel Cr. - source to mouth	None	Temp
ID17060305 CL051_02	Red Horse Cr. - source to mouth	None	Temp
ID17060305 CL052_02	American R. - East Fork American R. to mouth	None	Temp
ID17060305 CL052_04	American R. - East Fork American R. to mouth	None	Temp
ID17060305 CL053_02	Kirks Fork - source to mouth	None	Temp
ID17060305 CL053_03	Kirks Fork - source to mouth	None	Temp
ID17060305 CL054_02	East Fork American R. - source to mouth	None	Temp
ID17060305 CL054_03	East Fork American R. - source to mouth	None	Temp
ID17060305 CL055_02	American R. - source to East Fork American R.	None	Temp
ID17060305 CL055_03	American R. - source to East Fork American R.	None	Temp
ID17060305 CL056_02	Elk Cr. - confluence of Big Elk and Little Elk Cr.s to mouth	None	Temp
ID17060305 CL056_03	Elk Cr. - confluence of Big Elk and Little Elk Cr.s to mouth	None	Temp
ID17060305 CL057_02	Little Elk Cr. - source to mouth	Temp	Temp
ID17060305 CL058_02	Big Elk Cr. - source to mouth	Temp	Temp
ID17060305 CL058_03	Big Elk Cr. - source to mouth	Temp	Temp
ID17060305 CL059_02	Buffalo Gulch - source to mouth	Sed	Temp

Assess-ment Unit	Water Body Description	303(d) Listed Pollutants[a,b]	TMDLs Completed[b]
ID17060305 CL060_02	Whiskey Cr. - source to mouth	None	Temp
ID17060305 CL061_02	Maurice Cr. - source to mouth	None	Temp
ID17060305 CL062_02	Newsome Cr. - Beaver Cr. to mouth	Sed	Temp
ID17060305 CL062_04	Newsome Cr. - Beaver Cr. to mouth	Sed	Temp
ID17060305 CL063_02	Bear Cr. - source to mouth	None	Temp
ID17060305 CL064_02	Nugget Cr. - source to mouth	Sed	Temp
ID17060305 CL065_02	Beaver Cr. - source to mouth	Sed	Temp
ID17060305 CL066_04	Newsome Cr. - Mule Cr. to Beaver Cr.	None	Temp
ID17060305 CL067_02	Mule Cr. - source to mouth	None	Temp
ID17060305 CL067_03	Mule Cr. - source to mouth	None	Temp
ID17060305 CL068_02	Newsome Cr. - source to Mule Cr.	None	Temp
ID17060305 CL068_03	Newsome Cr. - source to Mule Cr.	None	Temp
ID17060305 CL069_02	Haysfork Cr. - source to mouth	None	Temp
ID17060305 CL070_02	Baldy Cr. - source to mouth	None	Temp
ID17060305 CL071_02	Pilot Cr. - source to mouth	None	Temp
ID17060305 CL071_03	Pilot Cr. - source to mouth	None	Temp
ID17060305 CL072_02	Sawmill Cr. - source to mouth	None	Temp
ID17060305 CL073_02	Sing Lee Cr. - source to mouth	Sed	Temp
ID17060305 CL074_02	West Fork Newsome Cr. - source to mouth	None	Temp
ID17060305 CL074_02a	West Fork Newsome Cr. - source to mouth	None	Temp
ID17060305	Leggett Cr. - source to mouth	None	Temp

Assess-ment Unit	Water Body Description	303(d) Listed Pollutants[a,b]	TMDLs Completed[b]
CL075_02			
ID17060305 CL076_02	Fall Cr. - source to mouth	None	Temp
ID17060305 CL077_02	Silver Cr. - source to mouth	None	Temp
ID17060305 CL077_02a	Silver Cr. - source to mouth	None	Temp
ID17060305 CL077_03	Silver Cr. - source to mouth	None	Temp
ID17060305 CL078_02	Peasley Cr. - source to mouth	None	Temp
ID17060305 CL079_02	Cougar Cr. - source to mouth	Sed	Temp
ID17060305 CL080_02	Meadow Cr. - source to mouth	None	Temp
ID17060305 CL080_03	Meadow Cr. - source to mouth	None	Temp
ID17060305 CL081_02	Sally Ann Cr. - source to mouth	None	Temp
ID17060305 CL081_03	Sally Ann Cr. - source to mouth	None	Temp
ID17060305 CL081_03T	Sally Ann Cr. - source to mouth	None	Temp
ID17060305 CL082_02	Rabbit Cr. - source to mouth	None	Temp
ID17060305 CL052L_00	Lucas Lake	Sed	None

[a]Refers to a list created in 1998 of water bodies in Idaho that did not fully support at least one beneficial use. This list is required under section 303 subsection "d" of the Clean Water Act.
[b]Bac = bacteria, DO = dissolved oxygen, Qalt = flow alteration, Halt = habitat alteration, NH_3 = ammonia, Nut = nutrients, Sed = sediment, Temp = temperature

Appendix D. Fisheries Resources

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South Fork Clearwater River Subbasin Assessment and TMDLs

Fisheries Resources

October 2002

Fisheries Technical Advisory Group

Report prepared by:
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Fisheries Resources

Introduction

In order to acquire the most up-to-date and professional information about the fisheries resources in the South Fork Clearwater River (SF CWR) Subbasin, a Fisheries Technical Advisory Group (Fish TAG) was assembled to provide input to the subbasin assessment (SBA) and Total Maximum Daily Load (TMDL) process. The following individuals made up the SF CWR Fish TAG:

Lillian Herger	U.S. Environmental Protection Agency	Seattle
Bob Ries/Gary Kedish	National Marine Fisheries Service	Moscow
Daniel Stewart	Idaho Department of Environmental Quality	Grangeville
Ann Storrar	Nez Perce Tribe	Lapwai
Heidi McRoberts	Nez Perce Tribe	Lapwai
Joe DuPont	Idaho Department of Lands	Coeur d'Alene
Jody Brostrom	Idaho Department of Fish and Game	Lewiston
Craig Johnson	U.S. Bureau of Land Management	Cottonwood
Scott Russell	U.S. Forest Service	Grangeville
Nick Gerhardt	U.S. Forest Service	Grangeville

Fish TAG meetings were held on March 1 and March 29, 2001, where general information about the fisheries resources in the subbasin was discussed. In addition, a report was prepared by Lillian Herger and Ann Storrar documenting the known information regarding aquatic species in the SF CWR Subbasin. That report forms the majority of this appendix.

A third meeting of the Fish TAG was held as a field trip through the SF CWR Subbasin on July 9, 2001, where factors impacting fishery resources were discussed.

On June 14, 2002, the Fish TAG met one final time to draw conclusions about the conditions of the salmonid populations and their aquatic habitat in the SF CWR Subbasin. At that meeting, Gary Kedish replaced Bob Ries from National Marine Fisheries Service. For that meeting, the Fish TAG members were provided with summaries of most of the data that had been collected for the SBA to that date. The conclusions from that final meeting have been inserted in this document as "Conclusions" sections for each of the salmonid species discussed, and as Table D-11 and Figures D-9 through D-21 at the end of this document.

Data and information regarding the aquatic species in the SF CWR Subbasin have been thoroughly reviewed and reported in the following documents. Much of the information in these reports is from Quigley and Arbelbide (1997).

- *Biological Assessment of South Fork Clearwater River* (chinook), (USFS 1995)
- *South Fork Clearwater River Subbasin Landscape Assessment* (USFS 1998)
- *South Fork Clearwater River Subbasin Bull Trout Problem Assessment* (DEQ 1998)
- *Biological Assessment of the South Fork Clearwater River Subbasin* (steelhead/bull trout) (USFS 1999)

- *Lower South Fork Clearwater River and Tributaries Biological Assessment* (BLM 1999)
- *Cottonwood Creek Total Maximum Daily Load* (DEQ, NPT, and USEPA 2000)
- *Clearwater River Subbasin Salmon and Steelhead Production Plan* (NPT and IDFG 1990)

Based on the information in these documents the following sections provide a brief overview description of most aquatic species within the SF CWR Subbasin, including their distribution, life history, status, and reasons for decline. Also, newly available data on species abundance in the watershed are presented. Communications with local biologists were used to generate life history phase timelines for each salmonid species (Attachment D-1). Although the presence and distribution of most fish species in the subbasin are commonly known, consistent long-term fisheries abundance data are not available.

Historic Influences on Fisheries Resources

Historically, land management in the subbasin has altered fish habitat. The most far-reaching activities have been in-channel placer mining and hydraulic mining on the hill slopes. These practices, which were common and widespread during the early 1900s, contributed to extreme alterations in channel morphology, particularly with respect to altered sediment loads. The signature of these practices is still evident today. Other land management practices that have influenced aquatic habitat quality include timber harvest, road system development, and agriculture. Direct human influence on habitat will be the main issue addressed in the TMDL, yet, in discussing salmonid status, it is important to recognize other human related practices that broadly influence the fish populations in the SF CWR Subbasin. These include construction/operation of dams and hatchery facilities, introduction of non-native species, and hatchery stocking.

Dams

Construction and operation of mainstem dams on the Columbia and Snake Rivers are considered the major cause of the decline of anadromous fish (USFS 1998). Upstream migrations of fish are delayed and smolts may be killed by turbines or become injured and disoriented, making them more susceptible to predation. Migration also may be delayed in the impoundments behind dams.

Other dams, built in the early 1900s, are believed to have had a major effect on anadromous species in the subbasin. On the main stem SF CWR, the earliest known dam was the Dewey Dam, built in about 1895 approximately 0.1 miles above the mouth of Mill Creek (Gerhardt 1999). It was approximately 6-8 feet high. There is no known documentation of fish passage conditions at this dam and it washed out after only a few years. The Harpster Dam, built on the SF CWR in 1911 (at river mile 22), completely excluded anadromous salmonids from the upper watershed until 1935, when a fish ladder was installed. The ladder was destroyed in 1949, once more eliminating anadromous fish passage until the dam was removed in 1963 (USFS 1995).

Dams were also located on the Clearwater River main stem. The Kooskia Flour Mill Dam, located on the Clearwater River about 1 mile above the mouth of the SF CWR, was built prior to 1910 and was in place until sometime in the 1930s (Gerhardt 1999). The dam is estimated to have been about 6 feet high. Although fish passage is not documented, it has been suggested that upstream migration of anadromous salmonids was probably not impaired by this structure (Gerhardt 1999). A second dam was constructed on the main stem Clearwater River near Lewiston in 1927 and was removed in 1974. A fish ladder was installed on this dam in 1939, but the dam completely blocked adult chinook salmon passage (NPT and IDFG 1990).

Following dam construction, numbers of anadromous fish were typically drastically reduced. Hatchery stocking was used to supplement the fish stocks to help with their recovery following the removal of these dams. Naturally spawning stocks did eventually return to the system. The dams are believed to have contributed to a sharp decline of cutthroat and bull trout populations from the 1930s through the 1960s by eliminating their prey base and reducing connectivity of resident fish populations (USFS 1995).

Mitigation Efforts Using Hatcheries

To mitigate the effects of dam construction/operation on migration and the subsequent decline of anadromous fish stocks, hatchery produced fish were planted in the subbasin. Chinook brood stock come from the Rapid River Hatchery and the Dworshak National Fish Hatchery, and steelhead come from the Dworshak National Fish Hatchery (North Fork B-run stock). Parr and smolts are produced to mitigate fish harvest and to supplement natural production. While supplementation is a viable method to insure the continuance of a stock, hatchery production can cause problems that can further the decline of a stock in the long term. These problems include: 1) genetic introgression and associated loss of fitness and loss of local adaptations of the native stock, 2) reduced wild spawning escapement for collection of brood stock, 3) ecological interactions between hatchery and wild fish, and 4) transmission of disease. Since endemic chinook stocks were eliminated in the SF CWR Subbasin, genetic risk to the local stock was not considered an issue. Currently, stocking of chinook and steelhead occurs in areas with past out planting activity to minimize risk to locally adapted and naturally reproducing populations. Hatchery supplementation has clouded the lines of genetic distinction between stocks throughout the subbasin (USFS 1998).

Introduced Non-Native Species (Brook Trout)

Introduction of non-native eastern brook trout can present a significant negative influence on native trout species. In the SF CWR Subbasin, the primary species of concern for brook trout interaction are cutthroat and bull trout. Brook trout introduction often results in encroachment/competition with native westslope cutthroat trout that is detrimental to the native species. Introduced brook trout are a known risk to the persistence of cutthroat trout, particularly where populations are isolated (Griffith 1988, Behnke 1992). Brook trout can replace bull trout populations by hybridizing with bull trout, leading to a net reduction in bull trout numbers via reduced breeding success. Also, brook trout have demonstrated a competitive advantage over bull trout resulting in bull trout displacement. Brook trout have

been recognized as a significant threat to the persistence of bull trout populations (Reiman and McIntyre 1993).

In the SF CWR Subbasin, brook trout were stocked in the American River, Red River, and Crooked River, and Meadow, Mill, Johns, Cottonwood, Cougar, Peasley, Rabbit, Silver, Threemile, Sixmile, and Twentymile Creeks. Brook trout are present in the main stems of Crooked River, American River, and Newsome Creek, and in smaller tributaries to the Red, American, and Crooked Rivers. Brook trout are also strongly established in Silver Creek, both upstream and downstream of a natural barrier 0.25 miles above the mouth. Figure D-17 shows the current distribution of brook trout in the SF CWR Subbasin.

Other Trout Introductions

Yellowstone cutthroat trout have been stocked in some high lakes and tributaries in the subbasin in the past, and some loss of genetic integrity of native westslope cutthroat trout may have resulted. Since the late 1970s, only westslope cutthroat have been stocked in mountain lakes, and tributary stocking is no longer practiced. The extent of the loss of genetic integrity, if any, is unknown. Hatchery rainbow trout have also been planted in the subbasin and, likewise, the effects are unknown. Steelhead fry were planted in Silver Creek in 1996 and 1999 by U.S. Geological Service (Rubin 2001).

Salmon, Trout, and Char Species of the SF CWR

Salmon, trout, and char species that inhabit the main stem of the SF CWR are listed in Table D-1 and their known presence in selected tributary streams of the subbasin are listed in Table D-2. All are native to the subbasin except for brook trout.

Table D-1. Salmon, trout, and char species known to be present in the SF CWR main stem.

Common Name	Scientific Name
Bull trout	*Salvelinus confluentus*
Spring chinook salmon/Snake River fall chinook salmon	*Oncorhynchus tschawytscha*
Steelhead/rainbow/redband trout*	*Oncorhynchus mykiss*
Redband trout	*Oncorhynchus mykiss gibbsi*
Westslope cutthroat trout	*Oncorhynchus clarki lewisi*
Yellowstone cutthroat trout	*Oncorhynchus clarki bouveri*
Brook trout	*Salvelinus fontinalis*

*Redband trout or rainbow are the non-anadromous form of this species.

Table D-2. Salmon, trout, and char species known to be present in the SF CWR tributaries.

Subwatershed	Bull Trout	Spring Chinook Salmon*	Steelhead/ Rainbow/ Redband Trout	Westslope Cutthroat Trout	Snake River Fall Chinook Salmon**	Brook Trout
SF CWR main stem	X	X	X	X	X	X
Cottonwood Creek			X			
Threemile Creek		X	X			
Sally Ann Creek			X	X		
Butcher Creek		X	X			
Sears Creek			X			
Green Creek			X			
Lightening Creek						X
Mill Creek (off forest)		X	X	X		
Schwartz Creek			X			
Meadow Creek	--	X	X	X		X
Mill Creek	X	X	X	X		X
Johns Creek	X	X	X	X		
Cougar Creek	--	--	Lower	Lower		
Peasley Creek	--	--	--	--		
Silver Creek	Lower	--	Lower	--		X
Twenty Creek/ Wing Creek	Lower	--	--	X		
Tenmile Creek	X	X	X	X		X
Newsome Creek/ Leggett Creek	X	X	X	X		X
Crooked River	X	X	X	X		X
American River	X	X	X	X		X
Red River	X	X	X	X		X

* Spring Chinook salmon are considered a "stream" species type.
** Fall Chinook Salmon are considered "ocean type" and are found in a more restricted range tied principally to mainstem rivers and larger tributary systems.

Extirpated Species

Coho salmon historically used the Clearwater River basin for spawning and rearing. However, coho became extirpated from Idaho in the mid-1980s, with adult fish no longer returning to Idaho waters. Reports verify that historic runs of coho utilized the Clearwater

River and Lochsa River and there are anecdotal accounts of coho use of the SF CWR (Johnson 2001). In recent years the Nez Perce Tribe has been involved in supplementation releases of coho salmon. Returning adults were documented in the lower Clearwater River basin (Potlatch River and Lapwai Creek) in 1999 and 2000. Coho have not been observed or documented in the SF CWR Subbasin in recent times.

Non-Game Species Presence

The presence of many non-game fish species in the subbasin has been determined (Table D-3), but the distribution of these species has not been summarized or is not well known. Below are brief descriptions of each species that has been observed in the subbasin from Simpson and Wallace (1978). The remainder of this document will focus on the salmon, trout, and char species.

Table D-3. Non-game fish species known to occur in the SF CWR subbasin.

Common Name	Scientific Name	Origin
Pacific lamprey	*Lampetra tridentatus*	Native
Mountain whitefish	*Prosopium williamsoni*	Native
Northern pikeminnow	*Ptychocheilus oregonensis*	Native
Chiselmouth	*Acrocheilus alutaceus*	Native
Bridgelip sucker	*Catostomus columbianus*	Native
Sculpin	*Cottus sp.*	Native
Black bullhead	*Ictalurus melas*	Introduced
Redside shiner	*Richardsonius balteatus*	Native
Speckled dace	*Rhinichthys osculus*	Native
Longnose dace	*Rhinichthys cataractae*	Native
Smallmouth bass	*Micropterus dolomieui*	Introduced

The Pacific lamprey is an anadromous and parasitic lamprey widely distributed along the Pacific coast. It is found in all areas accessible to salmon and steelhead (Simpson and Wallace 1978). Waters used by Pacific lamprey in the SF CWR Subbasin include the main stem SF CWR, Red River, American River, Crooked River, Mill Creek, Meadow Creek, Johns Creek, and Tenmile Creek. The Pacific lamprey is listed as a state of Idaho endangered species and was traditionally an important ceremonial and subsistence species for native peoples. Recently, eleven conservation organizations in Oregon, California, and Washington have petitioned the U.S. Fish and Wildlife Service, under the federal Endangered Species Act, to list four species of lamprey as threatened or endangered (www.onrc.org/info/lamprey/petition.pdf). Pacific lamprey adults enter freshwater between July and September and migrate inland. They spawn in sandy gravel immediately upstream from riffles in the spring of the following year and die soon after. The juvenile lampreys (ammocoetes) remain in freshwater for up to the next six years in soft substrate as filter-

feeders before emigrating to the ocean. The timing of life history stages of the Pacific lamprey in the SF CWR is outlined in Table D-4 (Brostrom 2001).

Table D-4. Pacific lamprey life history timing in the SF CWR subbasin.

Life History Stage	SF CWR Main Stem	Major Creeks and Rivers	Other Perennial Streams
Residence	All Year	All Year	All Year
Adult Migration	May 1-Sept 30	May 1-Sept 30	May 1-Sept 30
Spawning	Feb 1-May 31	Feb 1-May 31	Feb 1-May 31
Incubation and Emergence	Feb 1-June 30	Feb 1-June 30	Feb 1-June 30
Rearing	All Year	All Year	All Year

Mountain whitefish prefer cold mountain streams with deep pools. They are well distributed in most of the larger tributaries and in the main stem SF CWR. These fish mature in three years and spawn in the fall when temperatures approach 6 °C (October through November). Extensive downstream movement by pre- and post-spawning whitefish has been documented in the Clearwater River basin (Pettit and Wallace 1975, Rockhold and Berg 1995). Eggs are laid in riffles and hatch in March. The desired spawning substrate is gravel and small cobble with an adequate current to keep silt removed from the eggs. Mountain whitefish eat primarily aquatic and terrestrial insects. Waters inhabited by whitefish in the SF CWR Subbasin include Red River, American River, Crooked River, Mill Creek, Meadow Creek, Johns Creek, and Tenmile Creek. The timing of life history stages for mountain whitefish in the SF CWR is outlined in Table D- 5 (Brostrom 2001).

Table D-5. Mountain whitefish life history timing in the SF CWR subbasin.

Life History Stage	SF CWR Main Stem	Major Creeks and Rivers	Other Perennial Streams
Residence	All Year	All Year	All Year
Adult Migration	May 1-Nov 30	May 1-Nov 30	May 1-Nov 30
Spawning	Oct 1-Dec 15	Oct 1-Dec 15	Oct 1-Dec 15
Incubation and Emergence	Oct 1-Feb 28	Oct 1-Feb 28	Oct 1-Feb 28
Rearing	All Year	All Year	All Year

Northern pikeminnows spawn in shallow water on gravel substrate in late May to early June. They feed on aquatic invertebrates and fish.

Chiselmouths spawn in spring and early summer when water temperatures reach 60 °F. Spawning occurs in streams over gravel or small rubble. Adults feed exclusively on algae although the young will feed on the surface and consume insects.

Bridgelip suckers prefer the colder water of small, fast flowing rivers with gravel to rocky substrates. Spawning occurs in late May to Jane.

Sculpin species are thought to be indicators of high water quality (high dissolved oxygen, cold temperatures, and low pollution levels). Generally sculpin spawn in May and early June with adhesive eggs deposited in rock crevices and under rocks. A single male usually protects the nest until the eggs hatch after 30 days at 50 °F. Sculpin eat insects and small fish and are an important food source for trout.

Speckled dace live in a variety of habitats, but normally prefer shallow, cool, and quiet waters. They spawn in spring and are omnivorous feeders.

Longnose dace primarily live in stream riffle areas and spawn over gravel in the spring when water temperatures reach 53 °F. Their diet consists of immature aquatic insects. They are an important forage fish for trout.

Redside shiners prefer lakes, ponds, or rivers with slow-moving currents. Spawning occurs in June or July with adults moving into spawning areas when the water temperature reaches at least 50 °F. The eggs are adhesive and attach to the substrate or submerged vegetation. The fry feed on small planktonic organisms, but by the second year of life the young fish switch to a diet of insects (mostly terrestrial).

Black bullheads (found in upper Cottonwood Creek) have a high tolerance for turbid water with low oxygen and warm temperatures as high as 85 °F. Spring spawning occurs when water temperatures reach 65 °F. They eat primarily snails, aquatic insects, crustaceans, and plant material.

Other Aquatic Species of Concern

Amphibians, crayfish, and bivalves are additional aquatic species found in the SF CWR.

Amphibians

The following amphibians have been observed during surveys of tributaries throughout the SF CWR Subbasin: spotted frogs (*Rana pretiosa)*, tailed frogs (*Ascaphus truei*), Pacific giant salamanders *(Dicamptodon tenabrosus),* long-toed salamanders (*Ambystoma macrodactylum)*, and western toads (*Bufo boreas*). Spotted frogs are fairly common throughout the subbasin, but evidence of other frog species is limited. The current amphibian distribution has probably been altered from the historical distribution due to land management effects on aquatic habitat in the (Blair 2001). Long-toed salamanders are relatively common in many areas including timber harvest sites, but trend information is not available.

Spotted frogs are found in mountainous areas near cold streams and lakes. They breed from March to June and release free egg clusters. Tailed frogs breed from May to September with eggs attached to the downstream side of rocks in cold, swift-flowing mountain streams. Tailed frog tadpoles have sucking mouth parts used to cling to rocks. They feed on algae and invertebrates and transform in 1-3 years. Pacific giant salamanders breed in the spring in

river headwaters and lay eggs on submerged timber. Larvae transform during their second or third year.

Crayfish

Freshwater crayfish are present in the SF CWR watershed and have been documented by surveys in the American River (IDFG 2000) and Butcher Creek (DEQ 1995).

Bivalves

Freshwater mussels are have been found in the main stem SF CWR as well as the American River, Crooked River, and Red River by IDFG (IDFG 2000).

Salmonid Resources

Salmonid distribution, life history, stock description, population status, and factors influencing current status are discussed below.

Spring Chinook Salmon

Spring chinook salmon distribution, life history, stock description, population status, and factors influencing current status are discussed below.

Distribution

The current distribution of spring chinook salmon is probably similar to the historic distribution in the subbasin. Areas with very high habitat potential are Red River, Crooked River, American River, and the lower reaches of Newsome Creek. Areas with high habitat potential are lower Johns Creek and Tenmile Creek. Spring chinook have been documented in all of these drainages as well as Meadow Creek, Mill Creek, and Johns Creek (USFS 1998). Spring chinook use the main stem SF CWR for juvenile and adult migration and, to a limited extent, for spawning and juvenile rearing (Figure D-1). The larger tributaries are used for spawning and juvenile rearing.

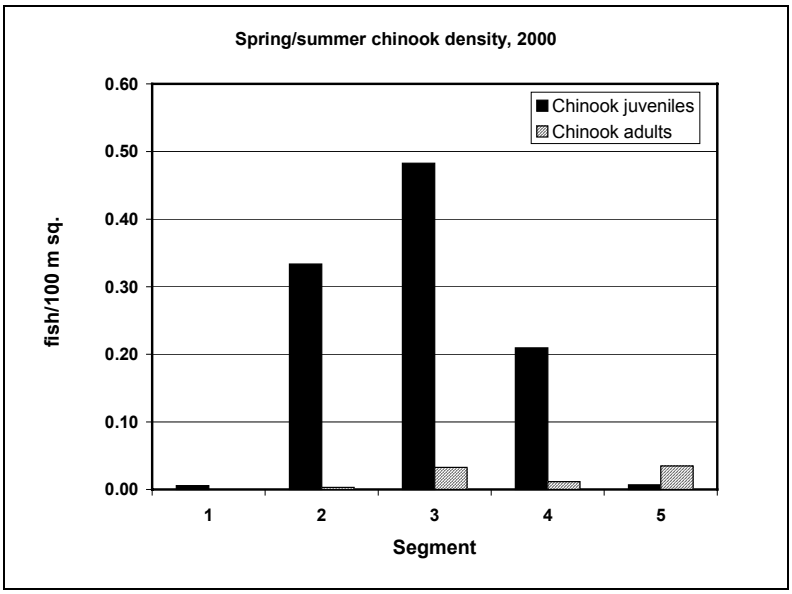

Figure D-1. Spring Chinook Salmon Density in the Main Stem SF CWR Based on 2000 Snorkel Surveys

Life History

The timing of life history stages of spring chinook within the SF CWR Subbasin are shown in Table D-6 (Brostrom 2001).

Table D-6. Spring chinook salmon life history timing in the SF CWR subbasin.

Life History Stage	SF CWR Main Stem	Major Creeks and Rivers	Other Perennial Streams
Adult Migration	April 15-Sept 15	April 15-Sept 15	
Spawning	Aug 15-Sept 30	Aug 15-Sept 30	Aug 15-Sept 30
Incubation and Emergence	Aug 15-April 30	Aug 15-April 30	Aug 15-April 30
Rearing	All Year	All Year	All Year
Juvenile Out Migration	Sept 1-June 30	Sept 1-June 30	Sept 1-June 30

Stock Description

--Stock origin and hatchery supplementation

Historically, it is likely that spring chinook of the SF CWR were a separate stock from others occurring in the Clearwater Subbasin. Currently, spring chinook have mixed hatchery and natural origin. Hatchery plants (mostly Rapid River hatchery stock) were used to mitigate the loss of spring chinook caused by dam construction/operation. Stocking for harvest mitigation and supplementation for natural production is ongoing, with satellite hatcheries with weirs and acclimation ponds at Red River and Crooked River (operated by the Idaho

Department of Fish and Game), and direct releases into Newsome Creek, Mill Creek and Meadow Creek. In most years hundreds of thousands of sub-yearlings are released in the subbasin (Stream Net 2000). Another satellite facility is being built on Newsome Creek as part of the Nez Perce Tribal Hatchery. This facility will be online in 2002. All facilities have monitoring and evaluation programs in place. Naturally produced chinook salmon return to spawn, and it is likely they have developed local adaptations.

--Population status

The spring chinook population is maintained tenuously through the use of hatchery supplementation. Although Snake River chinook salmon have been listed under the Endangered Species Act, spring chinook of the Clearwater Basin are not included in the listing. This portion of the population is exempt because the Lewiston Dam blocked all indigenous chinook from the Clearwater Basin, and mixed broodstock were used for reintroduction, thus, the genetic origin of the Clearwater stocks is questionable (see above) and probably exclusively of hatchery origin. Nevertheless, SF CWR spring chinook are considered an important meta-population within the Clearwater basin, and are listed as a species of special concern by the state of Idaho and a sensitive species by the U.S. Forest Service and Bureau of Land Management.

--Current abundance

Spring chinook numbers are severely reduced from their historic pre-dam abundance. There is a decreasing trend in the abundance of SF CWR spring chinook and the population has a high risk of extirpation. Data from trend redd surveys in Red River, American River, Crooked River, and Newsome Creek indicate low spawning activity in the SF CWR with fewer than 150 total redds in most years (Figure D-2, Attachment D-2). Hatchery return counts are also low, with less than 400 adults in most years (Figure D-3, Attachment D-3). Despite large numbers in 1997, the overall trend has declined (Stream Net 2000, Elms-Cockrum In Press).

Factors Influencing Current Status

The following factors have been identified as effecting current status of spring chinook salmon.

--Subbasin factors

- Fine sediment and channel alteration from in-channel placer mining in the areas of high habitat potential including Crooked River, American River, and Newsome Creek, and to a lesser degree Red River and the main stem SF CWR.
- High water temperatures.
- Lack of instream cover.
- Issues associated with hatchery supplementation.

--Downstream factors

- Construction and operation of the main stem dams on the Columbia and Snake River system which result in: 1) delays in both upstream and downstream migration; 2) death, injury, or disorientation of smolts passing through turbines; and 3) large-scale

riverine habitat alteration (conversion of flowing system to series of lacustrine habitats).

- Harvest of adults in Columbia River system and the ocean (coded wire tag data show less than 1% of Idaho chinook are harvested in the ocean) (IDFG 2001).
- Predation by introduced species.
- Downstream habitat degradation.

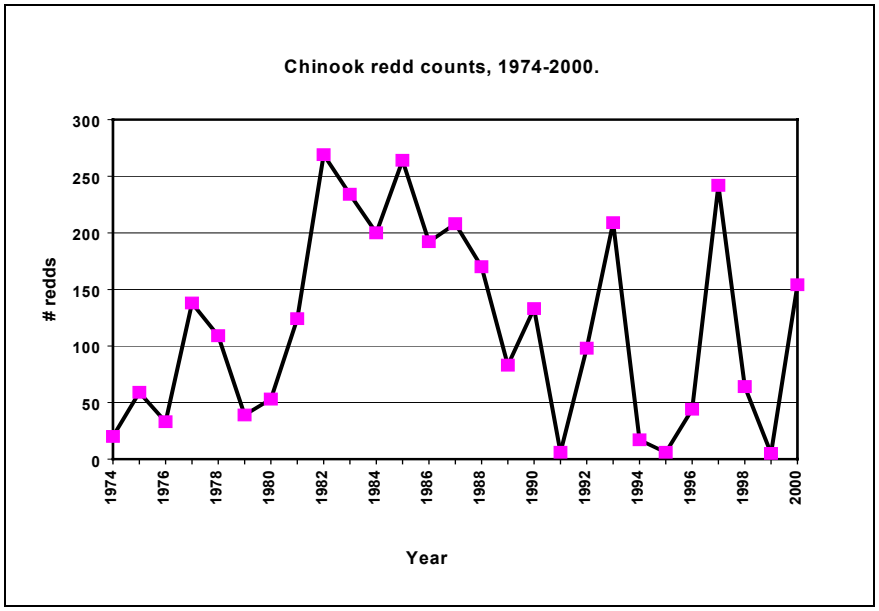

Figure D-2. Spring Chinook Redd Counts from the SF CWR Subbasin Based on Observations at Several Locations, 1974-2000

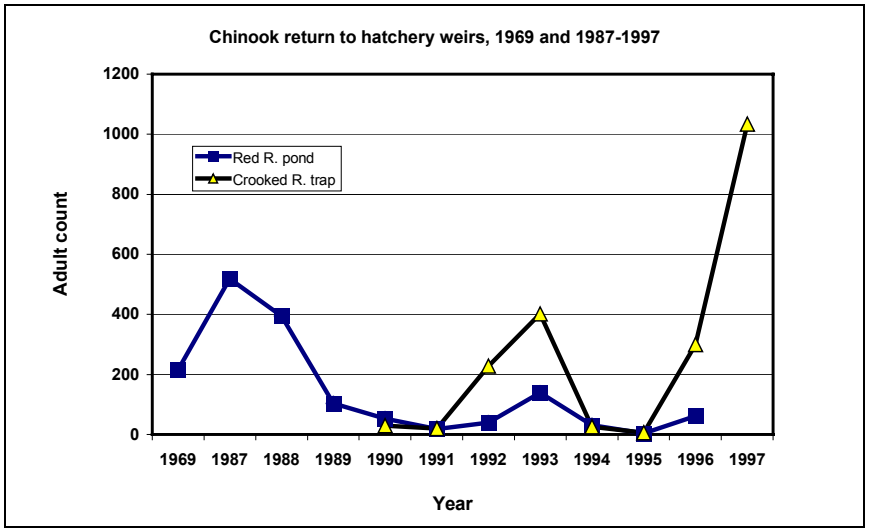

Figure D-3. Spring Chinook Adult Returns to Red River Pond and Crooked River Hatcheries of the SF CWR, 1969 and 1987-1997

Conclusions

Conclusions of the Fish TAG with respect to spring chinook salmon current distribution and potential distribution in the SF CWR Subbasin are shown in Figures D-9 and D-10, respectively. Table D-11 summarizes the conclusions for all salmonids of concern. Figure D-18 shows the general conclusions about current fish habitat conditions throughout the subbasin, while Figures D-19 and D-20 identify watersheds exhibiting sediment and temperature problems, respectively. Figure D-21 identifies areas recommended for conservation and others prioritized for restoration of salmonid habitat in the SF CWR Subbasin.

Fall Chinook Salmon

Snake River fall chinook salmon are listed as ”threatened” under the Endangered Species Act. The listed population includes all natural populations of fall-run chinook salmon in the main stem Snake River and several tributaries, including the Clearwater basin. Critical habitat for the listed environmentally significant unit (ESU) is designated to include river reaches presently or historically accessible to Snake River fall chinook. In the Clearwater system, this encompasses the main stem Clearwater River from its confluence with the Snake River upstream to its confluence with Lolo Creek and the North Fork Clearwater River from its confluence with the Clearwater River upstream to Dworshak Dam.

Anecdotal evidence suggests that fall chinook salmon were historically present in the lower portion of the SF CWR (up to Harpster). Nez Perce tribal elders reported seeing adult fall chinook in the lower section of the SF CWR. These observations suggest that many fish were seen prior to the Lewiston Dam construction and few fish were seen in the years immediately following. Currently, observations of fall chinook in the SF CWR have been very rare.

Distribution

The majority of fall chinook redds have been down river from the North Fork Clearwater River. Limited spawning occurs in the North Fork Clearwater River and SF CWR. Aerial surveys have not found any redds in the Middle Fork Clearwater River; however, historical reports have documented the occurrences of fall chinook salmon in the Middle Fork Clearwater River and Selway River. During 1999 and 2000, fall chinook salmon were documented in the Potlatch River, a tributary to Clearwater River tributary at river mile 15.1. Nez Perce tribal elders reported seeing adult fall chinook in the lower section of the SF CWR in the past.

Life History

The timing of life history stages of fall chinook within the SF CWR Subbasin are outlined in Table D-7 (Brostrom 2001).

Table D-7. Fall chinook life history timing in the SF CWR subbasin.

Life History Stage	SF CWR Main Stem
Adult Migration	Sept 15-Nov 30
Spawning	Oct 1-Dec 15
Incubation and Emergence	Oct 1-May 15
Juvenile Out Migration	May 1-Aug 31

Fall chinook salmon begin entering the Columbia River in August and continue through October, with the peak occurring in early September. Returning adults generally have spent three to four years in the ocean. Adults generally arrive in the Lower Clearwater River in October and are present through mid-December; peak spawning activity occurs during November. Spawning fall chinook salmon use shallow (e.g., 0.2 meter) to deep (e.g., 6.5 meters) waters with velocities ranging from 0.4 to 2.1 meters per second and relatively homogenous substrate, ranging in size from 2.5 to 15.0 cm (Groves and Chandler 1999). Fry emerge in April and May. After emergence, fry concentrate in shallow, slow water near the riverbanks, which provide cover. These areas are often associated with narrow bands of riparian vegetation along the margins of the rivers during high flow periods. The salmon rear in the main stem rivers before emigrating to the ocean from June through August the following year as sub-yearlings.

Abundance

Current fall chinook use of the SF CWR is very low. A total of nine redds have been observed during annual aerial surveys of the lower SF CW, which began in 1992 (mouth to Harpster). One carcass has also been found. Survey data for various portions of the Clearwater basin are in Attachment D-4.

Hatchery Supplementation

In 1997, the Nez Perce Tribe started the operation of a fall chinook satellite facility along the Clearwater River immediately down river from the mouth of Big Canyon Creek. The facility operation includes the acclimation and release of yearling smolts (from Lyons Ferry Hatchery, Washington). During 1997 and 1998, approximately 150,000 smolts were released each year, and during 1999 approximately 300,000 smolts were released. Aerial surveys conducted during 1999 and 2000 have documented high redd counts in the lower Clearwater River, which can partially be attributed to operation of this satellite facility.

Factors Influencing Current Status in the Clearwater Basin

- Construction and operation of the main stem dams on the Columbia and Snake River system which result in: 1) delays in both upstream and downstream migration; 2) death injury, or disorientation of smolts passing through turbines; and 3) large-scale riverine habitat alteration (conversion of flowing system to series of lacustrine habitats).

- Fine sediment deposition in the substrate adversely impacts spawning and rearing habitats, while land uses that encroach on floodplains, riparian areas, and channels impacts rearing and spawning habitats.
- River-based recreation (e.g., power and float boating and steelhead fishing), a major activity occurring in the Clearwater River during the fall chinook spawning period (down river from the North Fork Clearwater River), can disturb spawning fish and redds.
- The lower Clearwater River altered flow regimes as a result of the operation of Dworshak Dam. These altered flow regimes can result in elevated water temperatures in the main stem rivers, particularly the SF CWR during the summer, which adversely impacts sub-yearling rearing habitat.

Steelhead Trout

Distribution

Steelhead use the lower main stem and its tributaries as spawning, early rearing, and overwintering habitat. The canyon reaches of tributaries such as Johns Creek, Newsome Creek, Tenmile Creek, and Crooked River are considered the best spawning and rearing habitat. Habitat quality varies in American River, Red River, Newsome Creek, Mill Creek, and Meadow Creek due to human activities that have degraded sections of each stream. Currently, Johns Creek and Tenmile Creeks are considered areas with strong steelhead populations.

Life History

There are two runs (A-run and B-run) of steelhead that occur in the SF CWR Subbasin. The following description of these runs is from the *Clearwater Subbasin Summary* (NW Power Planning Council 2001). A-run steelhead occupy the lower Clearwater River, including the Middle Fork Clearwater River, Lower SF CWR, and tributaries (Kiefer et al. 1992). B-run steelhead occupy the Lochsa, Selway, upper SF CWRs, and were extirpated by Dworshak Dam on the North Fork Clearwater (Kiefer et al. 1992). B-run steelhead have been documented in only two subbasins in the Columbia River system, the Clearwater and Salmon (NPT and IDFG 1990). A-run steelhead trout from the Clearwater basin have typically spent one year in saltwater environments; B-run steelhead trout will have spent 1-3 years in saltwater environments before returning to spawn, with over 90% having spent two years there (Miller 2001). Due to differing lengths of ocean residence, differentiation of the two forms of Clearwater steelhead trout can be based on size; B-run fish average 75-100 mm larger than A-run fish (Columbia Basin Fish and Wildlife Authority 1991). B-run steelhead enter the Columbia River later in the year than A-run and benefit from the extra ocean time to rear, resulting in a two ocean (two years in the ocean prior to returning to spawn) A-run fish being smaller than a two ocean B-run fish (Miller 2001). The timing of life history stages of steelhead runs within the SF CWR are outlined in Table D-8 (Brostrom 2001).

Table D-8. Steelhead life history timing in the SF CWR subbasin.

Life History Stage	SF CWR Main Stem	Major Creeks and Rivers	Other Perennial Streams
A-Run (Lower SF Main Stem and its Tributaries)			
Residence	Sept 1-Feb 1		
Migration to Tributaries	Feb 1-May 15	Feb 1-May 15	
Spawning		Feb 1-May 15	Feb 1-May 15
Incubation and Emergence		Feb 1-June 1	Feb 1-June 1
Rearing	All Year	All Year	All Year
Juvenile Out Migration	Feb 1-June 1	Feb 1-June 1	Feb 1-June 1
B-Run (Middle and Upper SF Main Stem and its Tributaries)			
Residence	Dec 1-July 15		
Migration to Tributaries	Feb 1-May 15	Jan 1-May 31	
Spawning	Feb 1-May 31	Feb 1-May 31	Feb 1-May 31
Incubation and Emergence	Feb 1-July 15	Feb 1-July 15	Feb 1-July 15
Rearing	All Year	All Year	All Year
Juvenile Out Migration	Feb 1-June 30	Feb 1-June 30	Feb 1-June 30

Stock Description

--Stock origin and hatchery supplementation

Historically, it is likely that the SF CWR steelhead were a separate stock (adapted to local conditions) from others in the Clearwater system. The present population is of mixed hatchery, natural, and wild origin.

As with chinook salmon, hatchery supplementation has been used in the subbasin to mitigate the decline of steelhead populations caused by dam construction and operation. Following the removal of the Harpster dam, steelhead broodstock from the Lewiston dam and the North Fork Clearwater River were planted in the upper main stem SF CWR and tributaries of Red River, American River, Crooked River, and Newsome Creek. Smolt stocking was discontinued in the late 1980s in the upper river and tributaries with the exception of research releases. Beginning again in 2000, unmarked smolts of Dworshak (North Fork) B-run steelhead have been released in Red River, Crooked River, American River, Newsome Creek, Meadow Creek, and Mill Creek. Returning hatchery origin adults in excess of hatchery needs have also been planted in Newsome Creek, Mill Creek, Meadow Creek and American River. Genetic sampling of steelhead from Johns Creek and Tenmile Creek indicate that a portion of what might have been the endemic population remains; those creeks will be managed without hatchery supplementation (J. Brostrom 2001).

--Population status

Both A-run and B-run steelhead of the Clearwater Basin are included in the Snake River ESU of west coast steelhead (Busby et al. 1996). Declines of wild/natural adult steelhead in the ESU (including the SF CWR) are well documented and have resulted in their listing as "threatened" under the Endangered Species Act. They are considered a species of special concern by the state of Idaho and considered a sensitive species by the U.S. Forest Service. The SF CWR steelhead are an important metapopulation of the Clearwater basin.

--Current abundance

Steelhead populations in the SF CWR are considered depressed (Quigley and Arbelbide 1997). Their abundance has declined over the past seven decades through a combination of downstream and local activities. Generally, abundance of steelhead correlates with numbers of returning adults and numbers of hatchery steelhead planted in the SF CWR. Wild steelhead populations have declined in the subbasin even though hatchery supplementation has increased. Redd counts conducted in Crooked River and Red River have been relatively stable, yet low (Figure D-4, Attachment D-5) (Stream Net 2000). Data from recent years indicate a decline in returns to the Crooked River fish trap (Figure D-5, Attachment D-6) (Stream Net 2000, IDFG 2001). Steelhead were relatively numerous in the SF CWR main stem compared to other species observed during 2000 snorkel surveys (Attachment D-7), but most of the steelhead observed were likely residual unmarked hatchery steelhead (Figure D-6, Attachment D-7) (IDGF 2001).

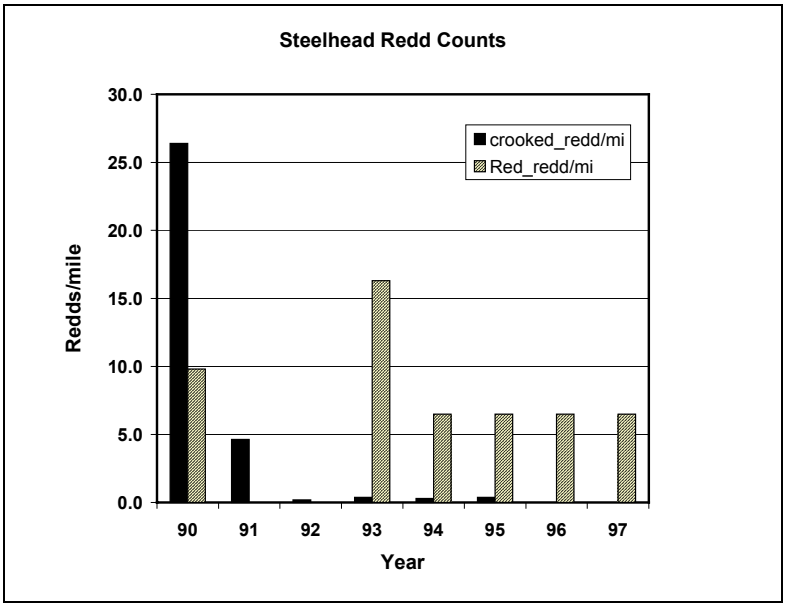

Figure D-4. Steelhead Redds per Mile from Surveys in the Crooked (1990-1997) and Red Rivers (1990, 1993-1997)

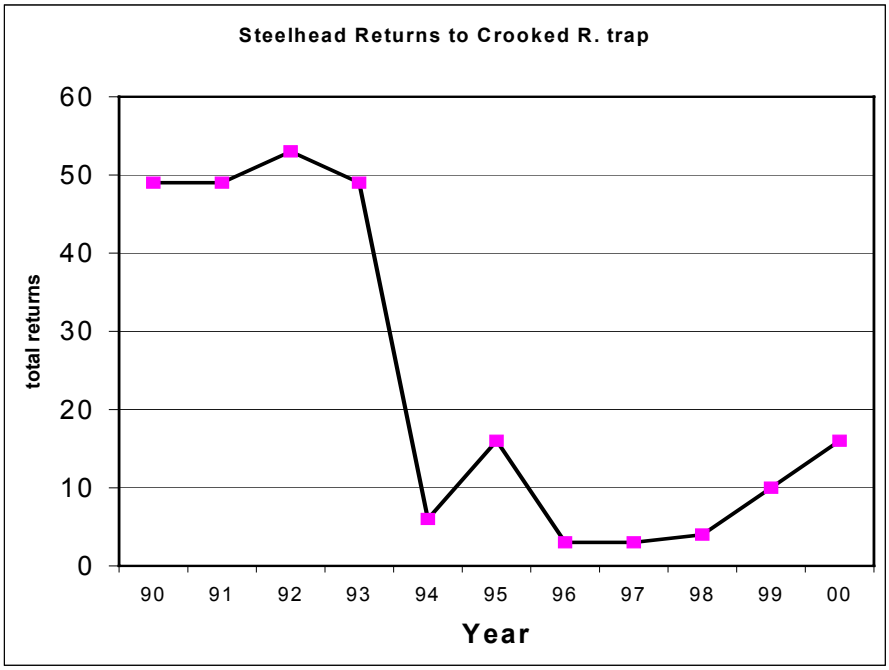

Figure D-5. Total Number of Steelhead Adults Returning to the Crooked River Fish Trap, 1990-2000

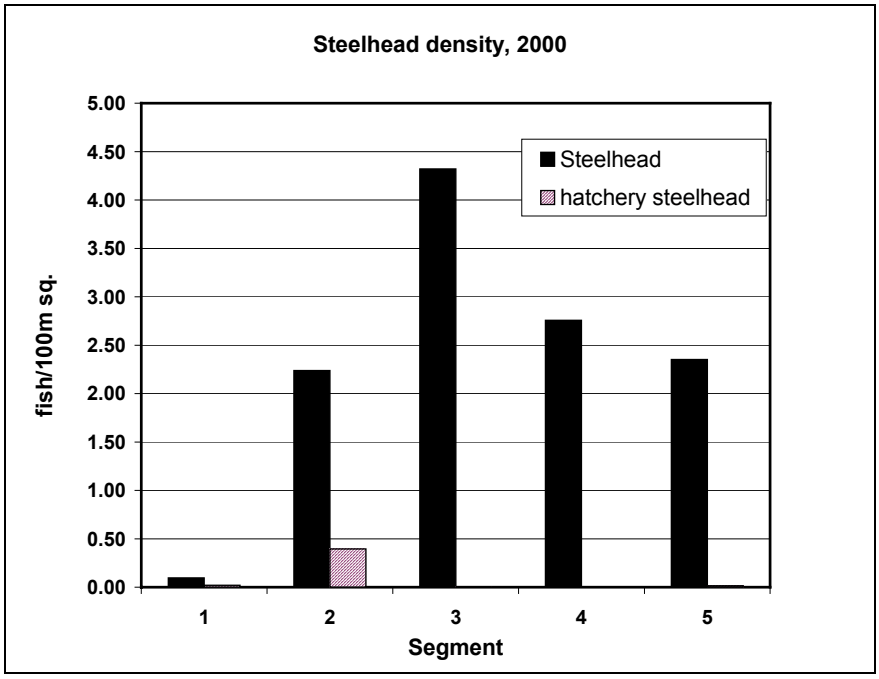

Figure D-6. Steelhead Density in the Main Stem SF CWR Based on 2000 Snorkel Surveys

Factors Influencing Current Status

--Subbasin factors

- Fine sediment and channel alteration in the main stem SF CWR, Crooked River, American River, Red River, and Newsome Creek. Exceptions are Johns Creek and Tenmile Creek, which have not had significant mining. The extensive road network also contributes to the increased sediment yield. An altered sediment regime has been noted in American River, Miller Creek, Newsome Creek, and Meadow Creek.
- High water temperature.

--Downstream factors

- Construction and operation of the main stem dams on the Columbia and Snake River system which result in: 1) delays in both upstream and downstream migration; 2) death, injury, or disorientation of smolts passing through turbines; and 3) large-scale riverine habitat alteration (conversion of flowing system to series of lacustrine habitats).
- Barriers to migration.
- Predation.
- Hatchery supplementation issues.
- Commercial fishing in the Columbia River, along the coast, and in the ocean.

Conclusions

Conclusions of the Fish TAG with respect to the current distribution and potential distribution of steelhead/rainbow trout in the SF CWR Subbasin are shown in Figures D-15 and D-16, respectively. Table D-11 summarizes the conclusions for all salmonids of concern. Figure D-18 shows the general conclusions about the current fish habitat condition throughout the subbasin, while Figures D-19 and D-20 identify watersheds exhibiting sediment and temperature problems, respectively. Figure D-21 identifies areas recommended for conservation and others prioritized for restoration of salmonid habitat in the SF CWR Subbasin.

Rainbow/Redband Trout

Rainbow or redband trout are the non-anadromous form of steelhead. Non-anadromous rainbow trout in the Upper Columbia River basin have been further divided into two groups. One group evolved in sympatry with steelhead and the other group is allopatric with steelhead, or evolved outside the historical range of steelhead. Sympatric rainbow/redband trout (termed "residuals") are considered the non-anadromous form that is historically derived or associated with steelhead. Both anadromous and non-anadromous forms exist in sympatry in most populations. Morphologically, juveniles of both forms are indistinguishable and cannot be differentiated, especially while snorkeling. Rainbow/redband trout use the main stem SF CWR for migration and rearing (both juveniles and adults). Spawning and rearing generally occur in the tributary streams. In the main stem, rainbow/redband density ranged from 0 to 0.03 fish per $100m^2$ based on snorkel studies conducted in summer 2000 (Attachment D-7). Rainbow/edband and steelhead juveniles

cannot be differentiated while snorkeling. The distribution and status of rainbow/redband populations in the SF CWR drainage is not known.

Bull Trout

Distribution

Historically, migratory bull trout are believed to have been distributed throughout the subbasin, particularly in tributary main stems. Currently, bull trout are still broadly distributed in the SF CWR. Most of the migratory fish are found in the lower portion of the subbasin, and resident fish are mostly at higher elevations. Although the residents are broadly distributed, their numbers are low.

Current important bull trout areas include Tenmile Creek and upper Johns Creek, which hold the highest populations and are considered population strongholds. Crooked River also has high habitat condition. Newsome Creek and Red River were historic strongholds that currently have good bull trout density in a few of their tributaries. The American River was also a historic stronghold but current bull trout density is low. There is abundant good habitat available at high elevations, but habitat quality is greatly reduced in the middle and low elevation areas, particularly due to increased water temperature. These are the areas that are most important to the larger migratory portion of the population.

Life History

The SF CWR Subbasin has historically supported two types of bull trout life history strategies. The large migratory component of the population uses the main stem and the larger tributaries for subadult/adult rearing. These fish migrate to smaller tributaries to spawn. Bull trout with a resident life history strategy are found in the upper reaches of the subbasin. The timing of the life history stages of bull trout within the SF CWR Subbasin are outlined in Table D-9 (Brostrom 2001).

Table D-9. Bull trout life history timing in the SF CWR subbasin.

Life History Stage	SF CWR Main Stem	Major Creeks and Rivers	Other Perennial Streams
Residence	All Year	All Year	All Year
Adult Migration (pre spawn)	April 1-July 15	April 1-July 15	April 1-July 15
Adult Migration (post spawn)	Sept 1-Oct 31	Sept 1-Oct 31	Sept 1-Oct 31
Spawning		Aug 15-Nov 30	Aug 15-Nov 30
Incubation and Emergence		Aug 15-Mar 31	Aug 15-Mar 31
Rearing	All Year	All Year	All Year

Stock Description

--Stock origin

The bull trout population is native and wild. There is no hatchery supplementation that would affect the bull trout stock. The extent of hybridization with introduced brook trout has not been documented (see below).

--Population status

Bull trout in the SF CWR Subbasin are listed as "threatened" under the Endangered Species Act and the SF CWR is identified as a key watershed for the *Idaho Bull Trout Conservation Plan* (Batt 1996). Overall, the bull trout population in the SF CWR is considered weak and depressed.

--Historic/current abundance

There is no historic data on bull trout densities, but anecdotal accounts support that large numbers of migratory bull trout used the upper subbasin. Compared to these historic accounts the current abundance is dramatically reduced and very low. While bull trout abundance in the main stem SF CWR is generally low, there is greater abundance in the upper reaches (Figure D-7, Attachment D-7) (IDGF 2001).

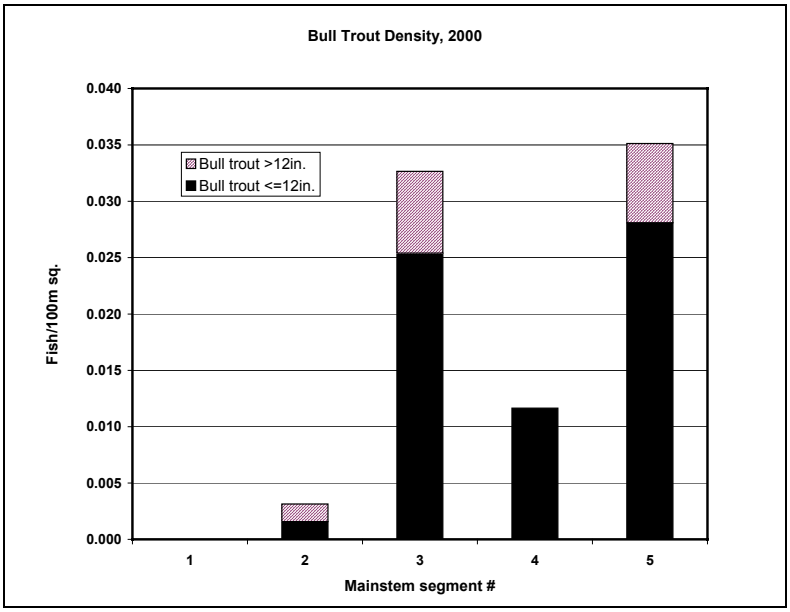

Figure D-7. Bull Trout Density in the Main Stem SF CWR Based on 2000 Snorkel Surveys

Factors Influencing Current Status

Effects to the bull trout population of the watershed from downstream activities are minor compared to effects from activities within the subbasin because bull trout do not range far

downstream from the SF CWR. Subbasin factors that have contributed to the decline of bull trout in the SF CWR Subbasin include the following:

- Habitat degradation. Although the subbasin has an inherently high capacity to support migratory bull trout, human uses (mining, roads, grazing, and timber harvest) have reduced habitat quality in the lower and middle reaches, which are most important to the migratory portion of the population. Major habitat concerns are high summer water temperatures and fine sediment intrusion that result in loss of rearing space and loss of pool habitat. Channel simplification results in low habitat complexity and reduced woody debris retention. Currently, Johns Creek and Tenmile Creek are exceptions within the watershed and have relatively high habitat quality.

- Angling. Roads adjacent to the river make the main stem accessible to anglers and poachers. Bull trout have been closed to sport harvest since 1994, but are still caught incidentally during seasons open for other species.

- Interactions with introduced brook trout. Brook trout have been recognized as a significant threat to the persistence of bull trout populations (Reiman and McIntyre 1993). In the SF CWR Subbasin, brook trout are present in almost every subwatershed except Johns Creek and Twentymile Creek. Brook trout have the ability to hybridize with bull trout, and hybridization leads to net reductions in bull trout numbers via reduced breeding success. In addition, brook trout have a competitive advantage over bull trout, which results in bull trout displacement.

- Population isolation. The loss of the migratory component of the population due to harvest (angling/poaching) and habitat degradation in the middle and low elevation reaches of the river results in long distances between resident population strongholds. This loss of connection by the migratory component results in isolation of resident populations, which increases the extinction risk to the overall population.

Conclusions

Conclusions of the Fish TAG with respect to bull trout current distribution and potential distribution in the SF CWR Subbasin are shown in Figures D-13 and D-14, respectively. Table D-11 summarizes the conclusions for all salmonids of concern. Figure D-18 shows the general conclusions about current fish habitat conditions throughout the subbasin, while Figures D-19 and D-20 identify watersheds exhibiting sediment and temperature problems, respectively. Figure D-21 identifies areas recommended for conservation and others prioritized for restoration of salmonid habitat in the SF CWR Subbasin.

Westslope Cutthroat Trout

Distribution

Westslope cutthroat trout historically ranged throughout western Montana, central and northern Idaho, the southern Canadian provinces, and a small portion of Wyoming. They were also found in isolated populations in Washington (Lake Chelan) and Oregon (John Day basin) (Behnke 1992). The current range and abundance of this interior cutthroat stock have been drastically reduced over the past 100 years, and it is estimated that only 2.5% of the historic range is still occupied by genetically pure westslope cutthroat trout (Liknes and Graham 1988).

Historically, westslope cutthroat were the dominant salmonid in streams of central Idaho (Likens and Graham 1988). In the SF CWR they are the most widely distributed salmonid species, using a range of habitats including both main stem and smaller high gradient reaches. The current distribution in the subbasin is thought to be similar to the historic distribution, but current abundance is reduced from historic levels. Although there are numerous sub-populations, the migratory portion of the population that used to inhabit the main stem and larger tributaries (Newsome Creek and Crooked River) has probably been extirpated. Resident populations in many of the upper reaches persist with varying population strengths. Currently, the upper portions of Johns Creek, Tenmile Creek, Crooked River, Meadow Creek and Mill Creek are considered population strongholds.

Life History

The westslope cutthroat trout in the SF CWR Subbasin exhibit two general life history patterns. The migratory component of the population uses the main stem as adults year-round, and only moves to smaller tributaries for spawning (Behnke 1992). Conversely, the resident component spends its entire life in tributaries. Use of different areas of the watershed by life history phase is not distinct for westslope cutthroat trout as the majority of these fish are residents and use the drainages where they occur for all life history phases. In contrast, the migratory component of the population use the main stem of the SF CWR and larger tributaries to rear and grow, and then migrates to smaller tributaries for spawning. The timing of the life history stages of westslope cutthroat trout within the SF CWR Subbasin are outlined in Table D-10 (Brostrom 2001).

Stock Description

--Stock origin

Westslope cutthroat trout of the SF CWR are considered to be mostly a native (nonintroduced) and wild population. Some hybridization has occurred due to the planting of hatchery Yellowstone cutthroat trout in Johns Creek, Tenmile Creek, Mill Creek, Meadow Creek, and Crooked River. This hatchery stocking may have resulted in some genetic introgression (repeated back-crossing of hybrid descendants with a parental species), which can lead to decreased population of native cutthroat trout populations in these drainages.

Table D-10. Westslope cutthroat trout life history timing in the SF CWR subbasin.

Life History Stage	SF CWR Main Stem	Major Creeks and Rivers	Other Perennial Streams
Residence	All Year	All Year	All Year
Adult Migration	March 1-June 30	Mar 1-July 15	Mar 1-July 15
Spawning		Mar 15-June 30	Mar 15-June 30
Incubation and Emergence		Mar 15-Aug 15	Mar 15-Aug 15
Rearing	All Year	All Year	All Year

--Population status

Currently, westslope cutthroat trout are not listed under the federal Endangered Species Act. This species is considered a sensitive species by the U.S. Forest Service (Region 1) and is a species of special concern in the state of Idaho.

--Current abundance

Year 2000 sampling verified that westslope cutthroat trout are distributed throughout the main stem CWR. Larger, migratory fish appear to be rare based on these data (Figure D-8, Attachment D-7) (IDGF 2000).

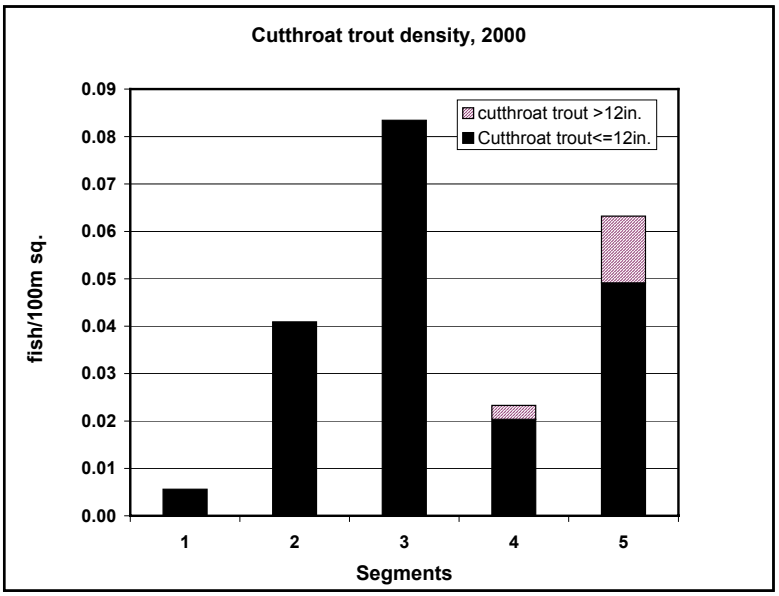

Figure D-8. Cutthroat Trout Density in the Main Stem SF CWR Based on 22 June through 8 August 2000 Snorkel Surveys

Factors Influencing Current Status

Because westslope cutthroat trout are not anadromous, downstream activities only indirectly influence their population (e.g., reduced forage source and reduced nutrients to stream due to a reduced number of migration to the subbasin). Subbasin factors that have contributed to the decline of westslope cutthroat trout include the following:

- Habitat degradation. Loss of stream riparian area integrity results in high summer water temperatures. Fine sediment intrusion results in loss of rearing space and loss of pool habitat. Channel simplification results in low habitat complexity and reduced woody debris retention. Habitat degradation is most profound in Red River, American River, Newsome Creek, and Crooked Creek.

- Angling. Angling has reduced the large migratory component of the population due to easy access to the middle and lower portions of the watershed (river adjacent road) and the vulnerability of these fish to angling efforts.

- Competition with introduced species. Introduction of non-native brook trout has led to the displacement of westslope cutthroat trout. Brook trout strongholds in the watershed are the Red River and Silver Creek drainages. They are also present in Crooked River, Newsome Creek, and American River.

- Hybridization. This is a risk where Yellowstone cutthroat trout have been stocked (Johns Creek, Tenmile Creek, and Crooked River).

- Population isolation. Loss of the migratory component of the population due to harvest (angling/poaching) and habitat degradation in the middle and low elevation reaches results in long distances between resident population strongholds. This loss of connection by the migratory component results in isolation of resident populations, which increases the risk to the overall population.

Conclusions

Conclusions of the Fish TAG with respect to westslope cutthroat trout current distribution and potential distribution in the SF CWR Subbasin are shown in Figures D-11 and D-12, respectively. Table D-11 summarizes the conclusions for all salmonids of concern. Figure D-18 shows the general conclusions about the current fish habitat condition throughout the subbasin, while Figures D-19 and D-20 identify watersheds exhibiting sediment and temperature problems, respectively. Figure D-21 identifies areas recommended for conservation and others prioritized for restoration of salmonid habitat in the SF CWR Subbasin.

Fisheries Management

The SF CWR main stem and most tributaries are currently managed under a six-trout catch limit throughout the Memorial Day to November 30 general fishing season. Streams known

to have wild steelhead populations (Crooked River, Johns Creek, and Tenmile Creek) have a two-trout limit. In addition, the SF CWR main stem is managed for exploitation of hatchery steelhead and surplus hatchery chinook when the numbers of returning adults are high enough to allow a season.

The Idaho Department of Fish and Game has established programs and management objectives that pertain to the SF CWR (IDFG 2001). Program directions include increasing emphasis on habitat protection, continuing emphasis on protection and enhancement of wild trout, and continuing emphasis on protection and enhancement of salmon and steelhead. Objectives that pertain to the SF CWR Clearwater include:

- Maintain and improve fish habitat and water quality.
- Maintain a diversity of fishing opportunity to meet angler demand.
- Increase fishing access.
- Maintain existing populations of chinook salmon and steelhead trout.
- Maintain or restore wild native populations of fish in suitable waters.
- Fully utilize fish habitat capabilities by increasing populations of suitable fish species to carrying capacity of the habitat.

Hatchery Facilities in the SF CWR Subbasin

Nez Perce Tribe Fish Facilities

The following facilities are managed by the Nez Perce Tribe in the SF CWR subbasin with the goal of increasing production of spring and fall chinook.

Newsome Creek

A smolt trap at the mouth of Newsome Creek is operated by the Nez Perce Tribal Hatchery Monitoring and Evaluation (NPTH M&E) Project. The trap is a rotary screw trap and its function is to monitor the out migration of juvenile spring chinook. The trap is operated from late spring to early fall, dependent on stream flows and fish movements. Upstream approximately 300 yards, NPTH M&E also operate a temporary fish weir and trap. It is a picket style weir and its function is to monitor adult spring chinook upstream passage. Beginning in 2002, this trap will also collect spring chinook broodstock to be held and spawned at the NPTH Newsome Creek Acclimation Facility. Information collected from the smolt trap and weir will be used to improve the management and operation of the acclimation facility now under construction near the Newsome town site. This facility will be operational May through mid-October and will contain two flow- through ponds: an adult holding raceway and a juvenile acclimation pond with a total water requirement of 1.24 cubic feet per second (cfs). The acclimation pond will rear 75,000 parr and the adult holding pond will contain up to 84 fish. The overall goal of these projects is to establish a self-perpetuating population of spring chinook in Newsome Creek.

Lukes Gulch

The Lukes Gulch facility will be operational in early 2002. Portable, circular tanks will be installed for acclimation of 200,000 sub-yearling fall chinook smolts, February through mid-June, with a total surface water requirement of 2.5 cfs. Up to 1.0 cfs of ground water will be pumped from one well to raise the water temperature to 54 °F in the rearing pond. Pumping will cease once the river water temperature reaches 54 °F.

The number of fish held at these satellite facilities is below the threshold limit for state and federal regulations that require water quality monitoring. However, the tribe will monitor influent and effluent bimonthly during the operating period for total suspended solids, settled solids, and dissolved oxygen. Additional sampling for nutrients may be implemented based on water quality concerns.

Idaho Department of Fish and Game/Lower Snake River Compensation Program Facilities in the Subbasin

Extensive descriptions of hatchery facilities in the Clearwater Basin are given in the *Clearwater Subbasin Summary* (NW Power Planning Council 2001). This information can be reviewed at the following Web site: http://www.cbfwf.org.

Conclusions

Conclusions by the Fish TAG are displayed in Table D-11 and a series of maps (Figures D-9 through D-21) showing the distribution of salmonid species throughout the SF CWR Subbasin.

Table D-11. Results of fish tag assessments of salmonid and habitat conditions in the SF CWR subbasin.

WB ID	WATER BODY NAME	ACRES	Current Fish Population Presence*					Current Habitat Condition**	Natural Inherent Conditions**				Pollutant Problems			Conservation Preservation
			BUT	CUT	SCH	ST RBT	BRT	Salmonids	BUT	CUT	SCH	ST RBT	SED	TEMP	NUTR	Priority***
1	Lower SF CWR	19,722.51	Y	Y	Y	Y	Y	P	F	F	F	F	Y	Y	Y?	M (main stem)
2	L. Cottonwood Creek	16,928.92	N	N	N	Y	N	P	P	P	P	G	Y	Y		L
3	U. Cottonwood Creek	21,222.86	N	N	N	Y	N	P	P	P	P	F	Y	N		L
4	L. Red Rock Creek	2,968.83	N	N	N	N	N	P	P	P	P	G	Y	N		L
5	U. Red Rock Creek	23,480.76	N	N	N	N	N	P	P	P	P	F	Y	N		L
6	Stockney Creek	19,977.77	N	N	N	N	N	P	P	P	P	F	Y	N		L
7	Shebang Creek	18,380.20	N	N	N	N	N	P	P	P	P	F	Y	N		L
8	SF Cottonwood Cr.	12,676.30	N	N	N	N	N	P	P	P	P	F	Y	N		L
9	Long Haul Creek	8,811.76	N	N	N	N	N	P	P	P	P	F	Y	N		L
10	Threemile Creek	21,474.81	N	N	Y	Y	N	P	P	P	P	F	Y	Y	Y	L
11	Butcher Creek	10,723.48	N	N	Y	Y	N	P	P	P	P	F	Y	Y	Y	M
12	Mid-Lower SF CWR	56,691.11	Y	Y	Y+	Y	Y	P	F	F	F	F	Y	Y		M (main stem)
13	Mill Creek	23,410.24	Y	Y	Y+	Y	N	F	F	G	F	G	Y	Y		M
14	Lower Johns Creek	26,377.99	Y+	Y	Y	Y	N	G	G	G	F	G	N	N		C/H
15	Gospel Creek	10,831.77	Y	Y	N	Y	N	G	G	G	P	G	N	N		C/H
16	West Fork Gospel Cr.	4,467.34	Y	Y	N	N	N	G	G	G	P	F	N	N		C/H
17	Middle Johns Creek	10,199.89	Y+	Y	Y	Y	N	G	G	G	F	G	N	N		C/H
18	Upper Johns Creek	8,673.57	Y+	Y	N	Y	N	G	G	G	P	G	N	N		C/H
19	Moores Creek	3,987.19	Y+	Y	N	Y	N	G	G	G	P	G	N	N		C/H
20	Square Mountain Cr.	2,289.02	Y	Y	N	Y	N	G	G	G	P	F	N	N		C/H
21	Hagen Creek	5,537.44	Y	Y	N	Y	N	G	G	G	P	F	N	N		C/H
22	Middle SF CWR	18,952.46	Y	Y	Y+	Y	Y	F	F	F	F	G	Y	Y		M (main stem)
23	Wing Creek	5,329.18	N	Y	N	N	N	F	P	F	P	F	N	N		L
24	Twentymile Creek	14,640.67	Y	Y	N	Y	N	G	F	G	P	F	N	N		C/M
25	Lower Tenmile Creek	2,447.18	Y+	Y	Y	Y	N	G	F	F	F	G	N	N		C/H
26	Middle Tenmile Creek	7,227.17	Y+	Y	Y+	Y	N	G	G	G	F	G	N	N		C/H
27	Upper Tenmile Creek	13,617.29	Y+	Y	Y	Y	N	G	G	G	F	G	N	N		C/H
28	Williams Creek	5,890.59	Y	Y	N	Y	N	G	F	G	F	G	N	N		C/H
29	Sixmile Creek	5,129.97	Y	Y	Y	Y	N	F	F	G	F	G	Y	N		M
30	Mid-Upper SF CWR	17,165.37	Y	Y	Y+	Y	Y	F	F	F	G	G	Y	Y		M

Table D-11. Results of fish tag assessments of salmonid and habitat conditions in the SF CWR subbasin.

WB ID	WATER BODY NAME	ACRES	Current Fish Population Presence*					Current Habitat Condition**	Natural Inherent Conditions**				Pollutant Problems			Conservation Preservation
			BUT	CUT	SCH	ST RBT	BRT	Salmonids	BUT	CUT	SCH	ST RBT	SED	TEMP	NUTR	Priority***
31	Lower Crooked River	9,480.90	Y	Y	Y+	Y	Y	P	F	G	G	G	Y	Y		H
32	Upper Crooked River	14,487.38	Y+	Y	Y+	Y	Y	F	G	G	G	G	Y	Y		H
33	West Fork Crooked R.	7,594.45	Y+	Y	Y	Y	Y+	G	G	G	G	G	N	N		C/H
34	East Fork Crooked R.	6,688.73	Y+	Y	Y	Y	N	G	G	G	G	G	N	N		C/H
35	Relief Creek	7,484.49	Y	Y	Y+	Y	N	F	F	G	G	G	Y	Y		M
36	Upper SF CWR	2,695.17	Y	Y	Y+	Y	Y	P	F	F	G	G	Y	Y		H
37	Lower Red River	10,333.34	Y	Y	Y+	Y	Y	P	F	G	G	G	Y	Y		M
38	Middle Red River	16,041.61	Y	Y	Y+	Y	Y	P	F	G	G	G	Y	Y	Y?	H
39	Moose Butte Creek	7,087.55	Y	Y	Y+	Y	Y	F	F	G	G	G	Y	Y		H
40	Lower Red River	3,153.83	Y+	Y	Y+	Y	Y	F	G	G	G	G	Y	Y		H
41	Middle Red River	2,791.15	Y+	Y	Y+	Y	Y	F	G	G	G	G	Y	N		H
42	West Fork Red River	6,405.94	Y+	Y	Y	Y	Y	G	G	G	G	G	N	N		C/H
43	Upper Red River	4,744.28	Y+	Y	Y	Y	Y	F	G	G	G	G	Y	N		H
44	Trapper Creek	7,076.77	Y	Y	N	Y	Y+	F	G	G	F	G	Y	N		H
45	Upper Red River	19,249.68	Y	Y	Y+	Y	Y+	F	G	G	G	G	Y	Y		H
46	Soda Creek	3,353.28	N	Y	N	N	Y+	F	F	G	F	G	Y	N		H
47	Bridge Creek	2,380.29	N	Y	N	N	Y+	G	F	G	F	G	N	N		C/M
48	Otterson Creek	2,488.27	Y	Y	Y	N	Y+	G	F	G	F	G	N	N		C/M
49	Trail Creek	4,560.11	Y	Y	Y	N	Y+	F	F	G	F	G	Y	N		H
50	Siegel Creek	7,783.69	Y	Y	Y	Y	Y+	F	F	G	G	G	Y	Y		H
51	Red Horse Creek	5,806.21	Y	Y	Y	Y	Y+	F	F	G	G	G	Y	Y		H
52	Lower American R.	7,215.12	Y	Y	Y+	Y	Y	P	F	G	G	G	Y	Y	Y?	H
53	Kirks Fork	6,257.49	Y	Y	Y	Y	Y	F	F	G	G	G	Y	Y		H
54	EF American River	11,444.75	Y	Y	Y+	Y	Y+	F	G	G	G	G	Y	N		H
55	Upper American R.	15,275.05	Y	Y	Y+	Y	Y+	F	F	G	G	G	Y	Y		H
56	Elk Creek	2,323.89	Y	Y	Y+	Y	Y+	P	F	G	G	G	Y	Y	Y	H
57	Little Elk Creek	5,081.05	Y	Y	Y	Y	Y+	F	F	G	G	G	Y	Y		H
58	Big Elk Creek	8,820.95	Y	Y	Y+	Y	Y+	F	F	G	G	G	Y	Y		H
59	Buffalo Gulch	2,138.81	N	Y	N	Y	N	P	P	G	F	G	Y	Y		M
60	Whiskey Creek	1,659.19	Y	Y	Y	Y	Y	F	F	G	F	G	Y	Y		M

Table D-11. Results of fish tag assessments of salmonid and habitat conditions in the SF CWR subbasin.

WB ID	WATER BODY NAME	ACRES	Current Fish Population Presence*					Current Habitat Condition**	Natural Inherent Conditions**				Pollutant Problems			Conservation Preservation
			BUT	CUT	SCH	ST RBT	BRT	Salmonids	BUT	CUT	SCH	ST RBT	SED	TEMP	NUTR	Priority***
61	Maurice Creek	1,093.79	N	Y	N	Y	N	P	P	G	F	G	Y	Y		M
62	Lower Newsome Cr.	4,145.33	Y	Y	Y+	Y	Y	P	F	G	G	G	Y	Y		H
63	Bear Creek	3,832.48	Y	Y	Y	Y	N	F	F	G	G	G	Y	Y?		H
64	Nugget Creek	1,451.46	Y	Y	N	N	N	F	F	G	F	G	Y	Y?		M
65	Beaver Creek	3,733.24	Y	Y	N	Y	N	F	F	G	F	G	Y	Y?		H
66	Middle Newsome Cr.	1,135.41	Y	Y	Y+	Y	N	F	F	G	G	G	Y	Y		H
67	Mule Creek	5,497.49	Y	Y	Y	Y	N	F	F	G	G	G	Y	Y?		H
68	Upper Newsome Cr.	6,355.59	Y	Y	Y+	Y	N	F	F	G	G	G	Y	Y		H
69	Haysfork Creek	3,171.89	N	Y	Y	Y	N	F	F	G	G	G	Y	Y?		H
70	Baldy Creek	2,724.18	Y+	Y	Y	Y	N	F	G	G	G	G	Y	Y?		H
71	Pilot Creek	3,917.87	Y+	Y	Y	Y	N	G	G	G	G	G	N	Y?		C/H
72	Sawmill Creek	1,769.33	Y	Y	Y	Y	N	G	F	G	G	G	N	Y?		C/M
73	Sing Lee Creek	1,555.92	N	Y	Y	Y	N	F	F	G	G	G	N	Y?		M
74	WF Newsome Creek	3,304.66	Y	Y	Y	Y	N	F	F	G	G	G	N	Y		H
75	Leggett Creek	4,992.17	N	Y	Y	Y	N	F	F	G	F	G	Y	Y		M
76	Fall Creek	2,333.69	N	Y	N	N	N	F	P	F	P	G	Y	N		L
77	Silver Creek	16,516.61	Y	N	N	Y	Y+	G	F	G	P	F	N	N		C/L
78	Peasley Creek	9,092.74	N	Y	N	Y	N	F	F	G	F	G	Y	Y?		M
79	Cougar Creek	7,737.01	N	Y	N	N	N	P	P	F	P	F	Y	Y?		L
80	Meadow Creek	24,009.74	Y	Y	Y+	Y	Y+	P	F	G	F	G	Y	Y		M
81	Sally Ann Creek	8,891.48	Y	Y	N	Y	N	P	F	F	P	F	Y	Y		M
82	Rabbit Creek	6,190.89	Y	Y	N	Y	Y	P	F	F	P	F	Y	Y		L

* Y+ = known spawning and rearing population

BUT = Bull Trout CUT = Cutthroat Trout SCH = Spring Chinook

ST RBT = Steelhead/Rainbow Trout BRT = Brook Trout

** G = Good, F = Fair, P = Poor

*** L = Low, M = Medium, H = High; C/L, C/M, and C/H = ratings for conservation rather than restoration. All other ratings in this column are priorities for restoration

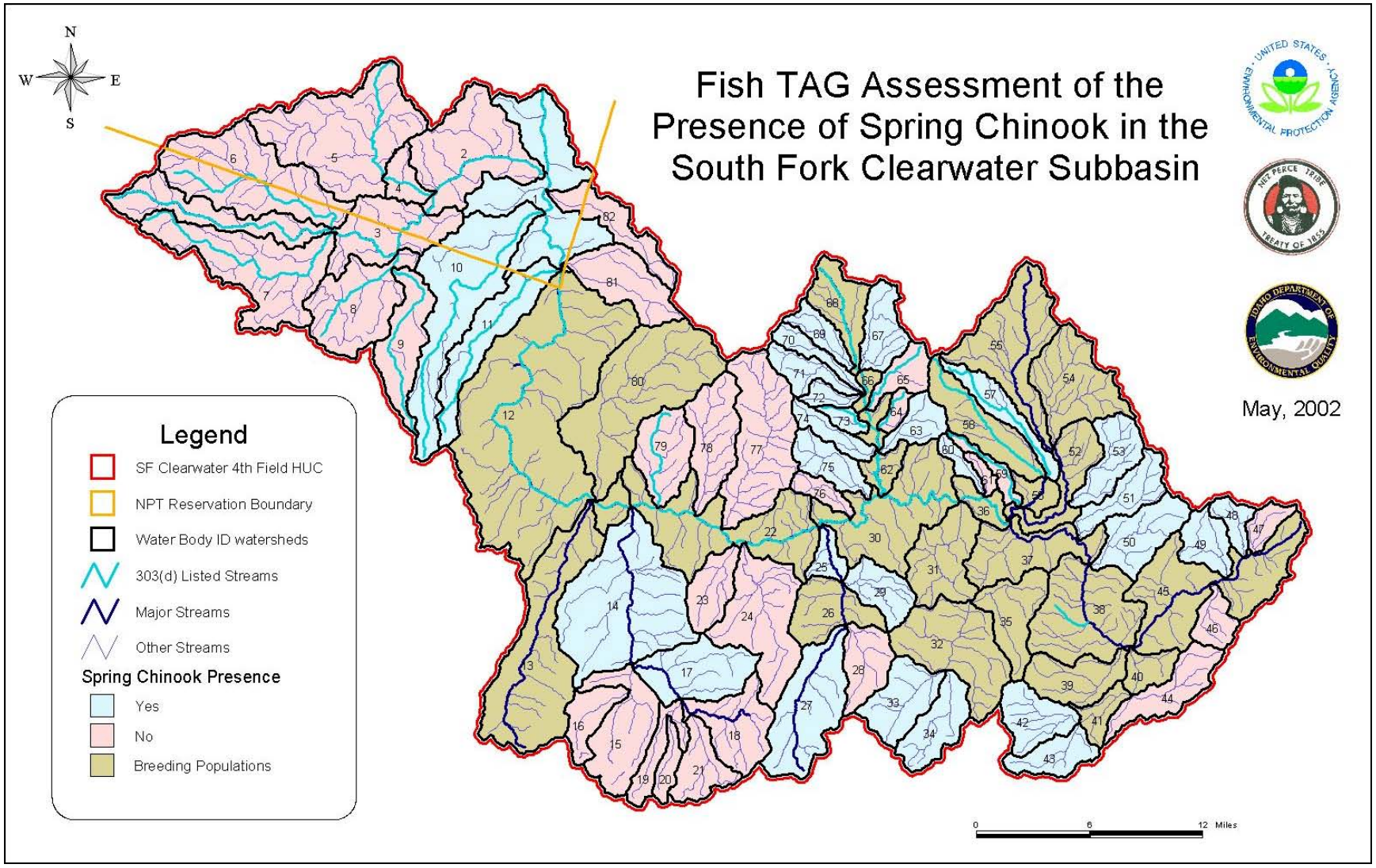

Figure D-9. Fish TAG Assessment of the Presence of Spring Chinook in the SF CWR Subbasin

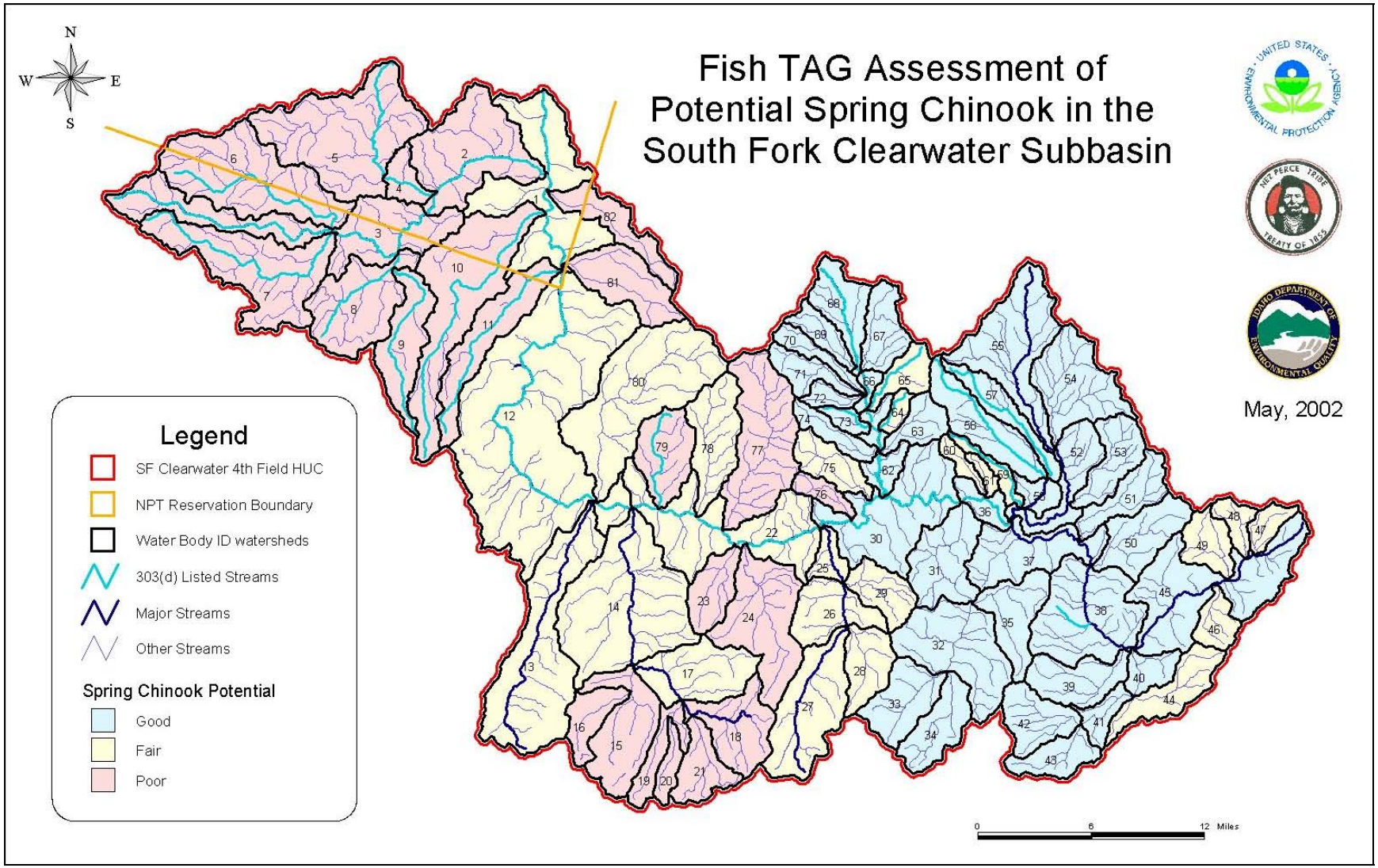

Figure D-10. Fish TAG Assessment of Potential Spring Chinook in the SF CW Subbasin

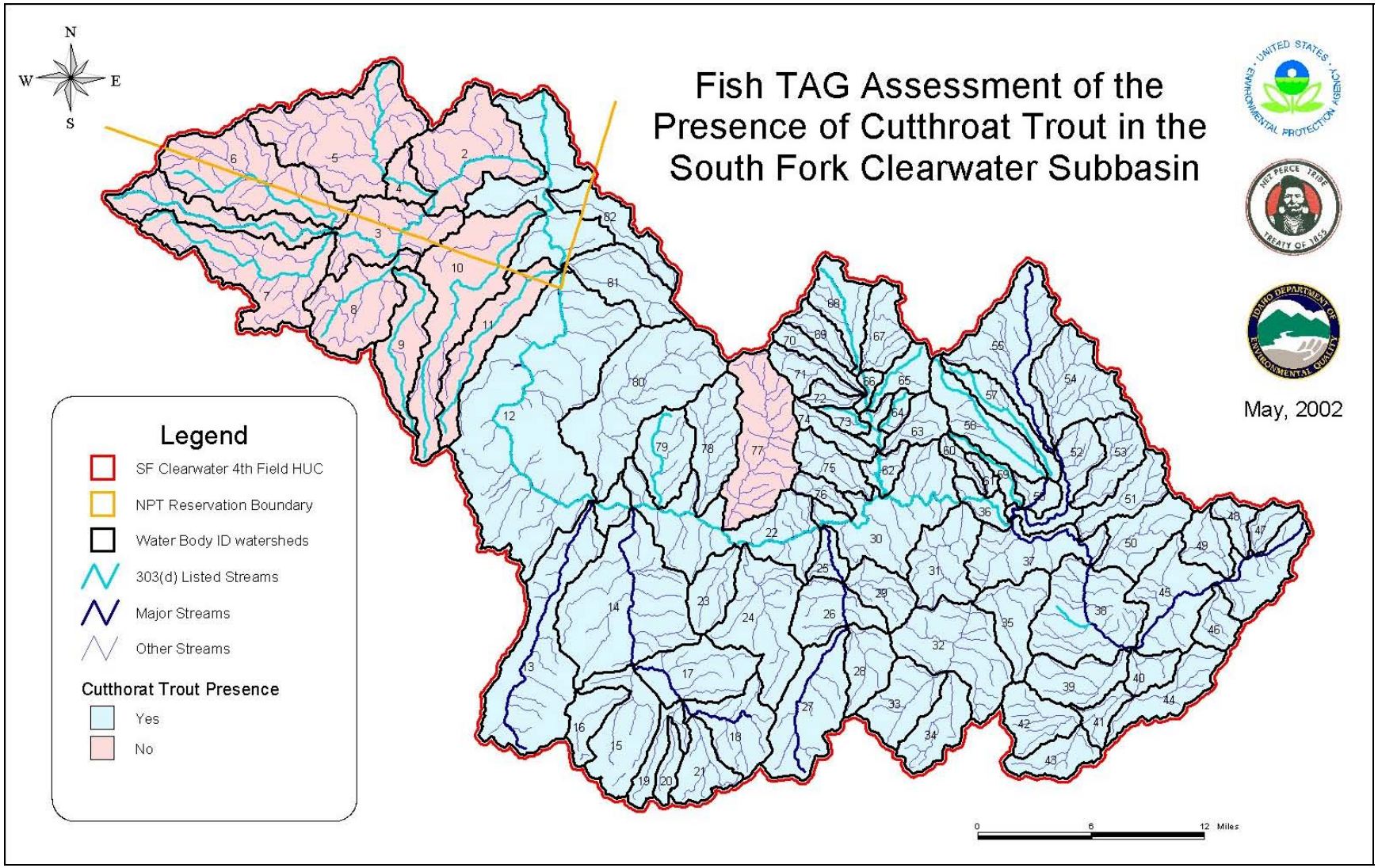

Figure D-11. Fish TAG Assessment of the Presence of Cutthroat Trout in the SF CWR Subbasin

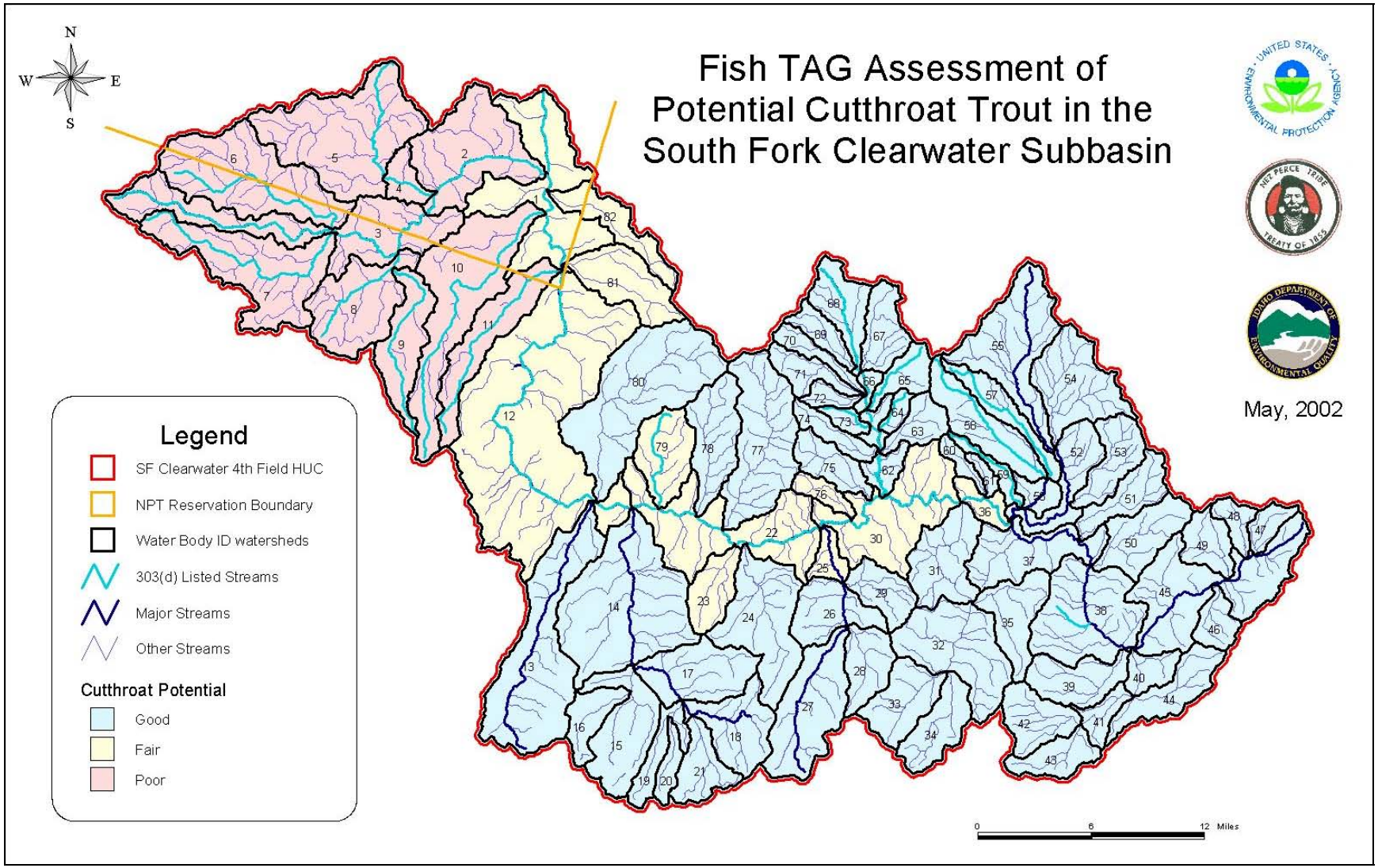

Figure D-12. Fish TAG Assessment of Potential Cutthroat Trout in the SF CWR Subbasin

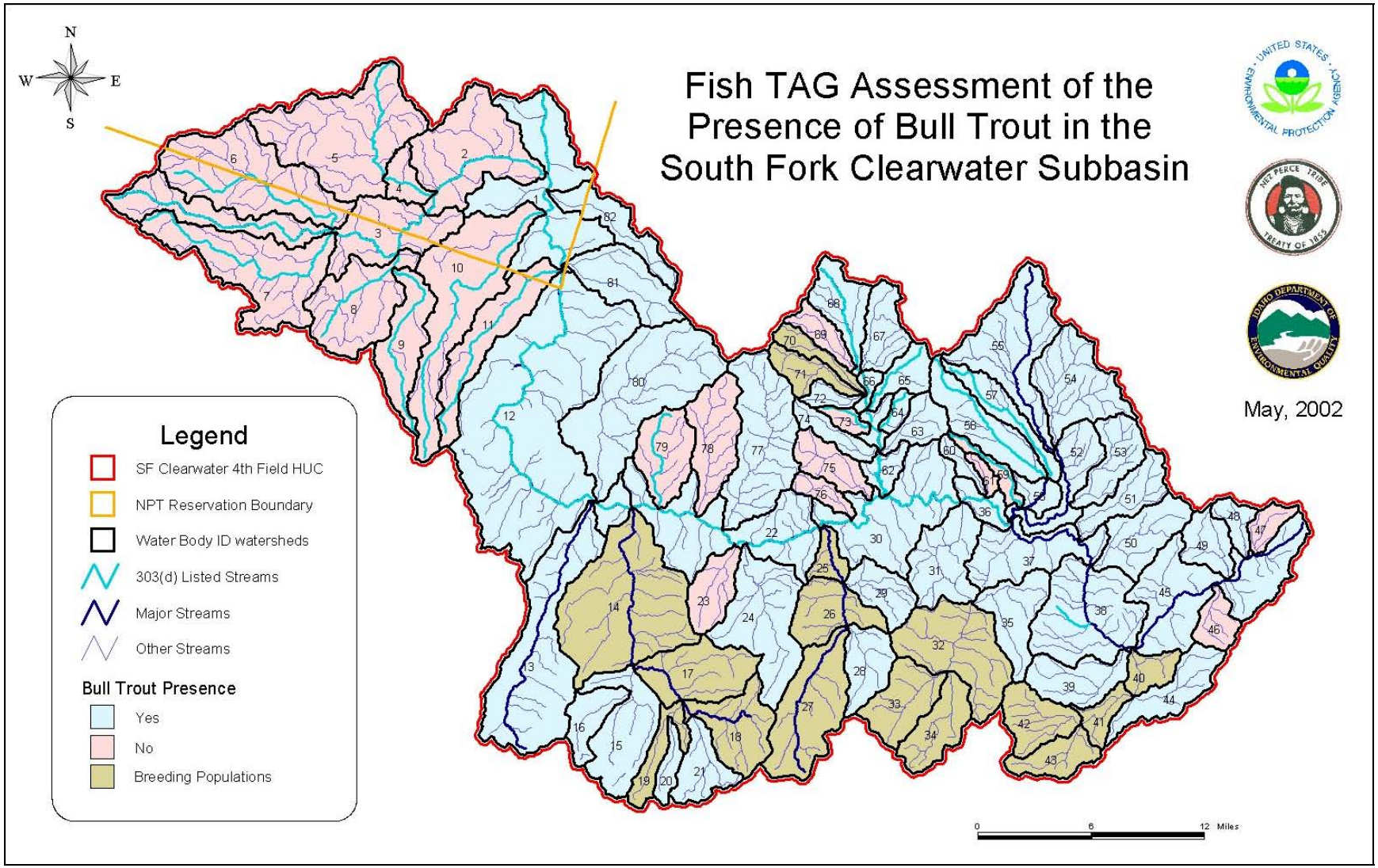

Figure D-13. Fish TAG Assessment of the Presence of Bull Trout in the SF CWR Subbasin

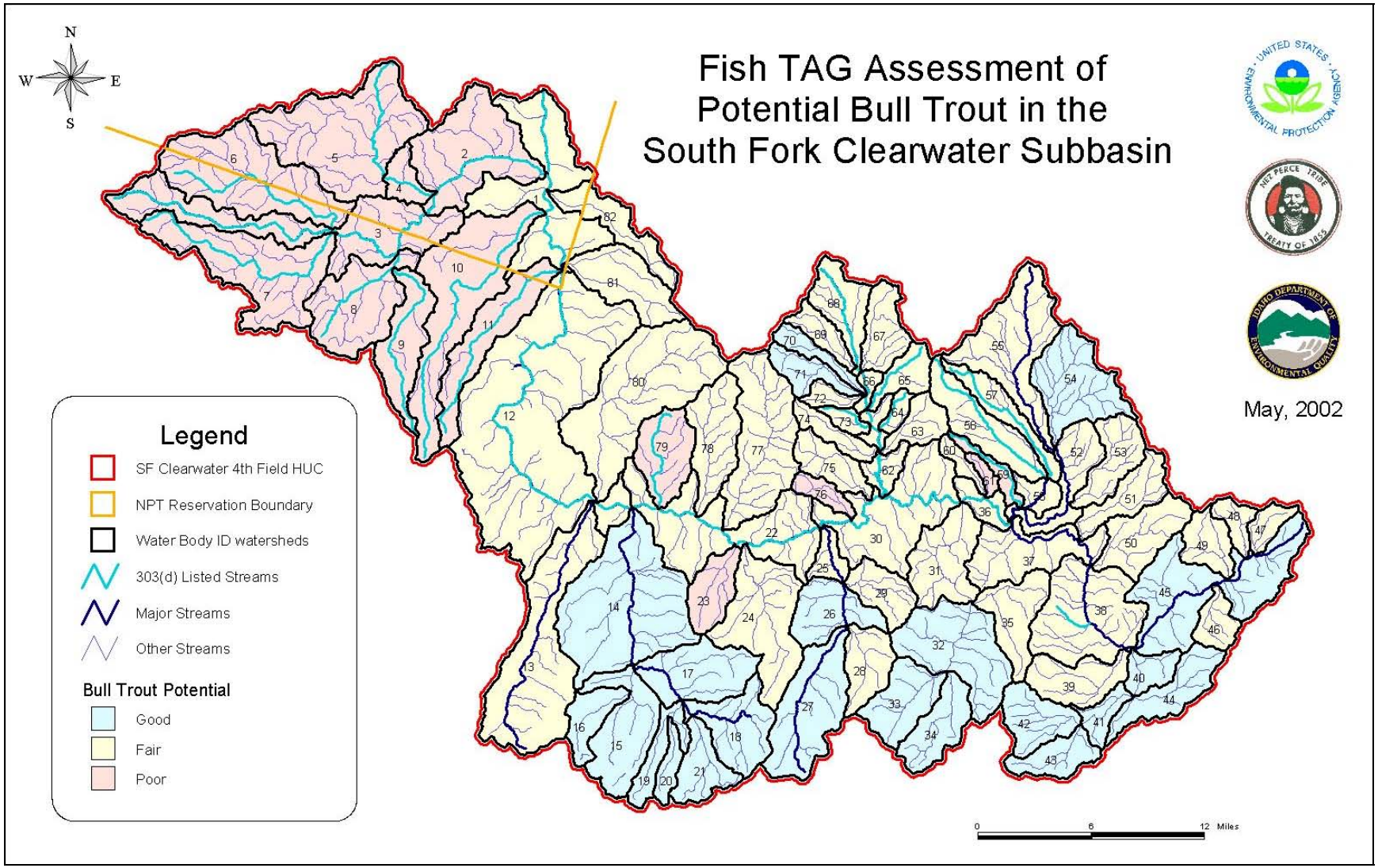

Figure D-14. Fish TAG Assessment of Potential Bull Trout in the SF CWR Subbasin

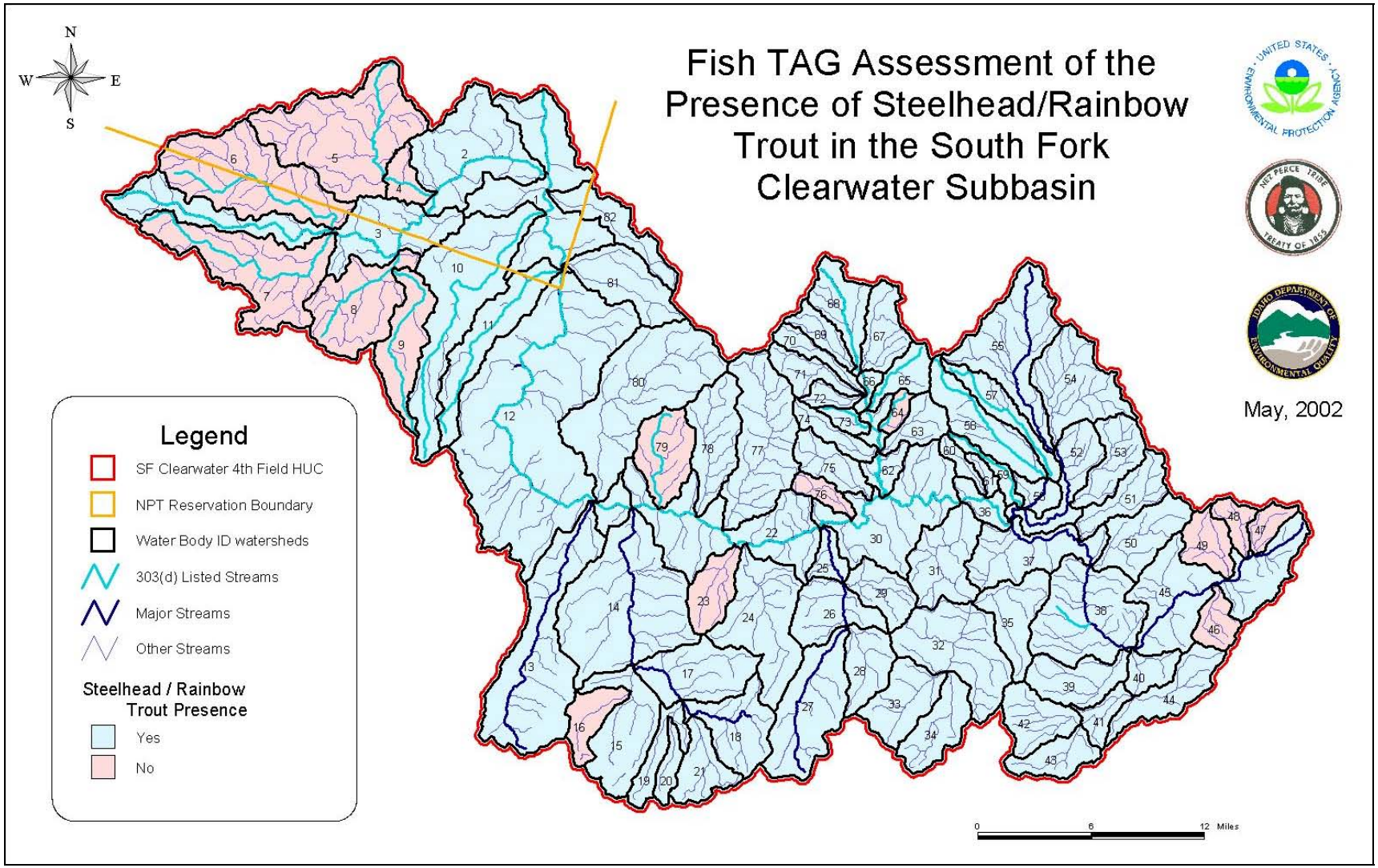

Figure D-15. Fish TAG Assessment of the Presence of Steelhead/Rainbow Trout in the SF CWR Subbasin

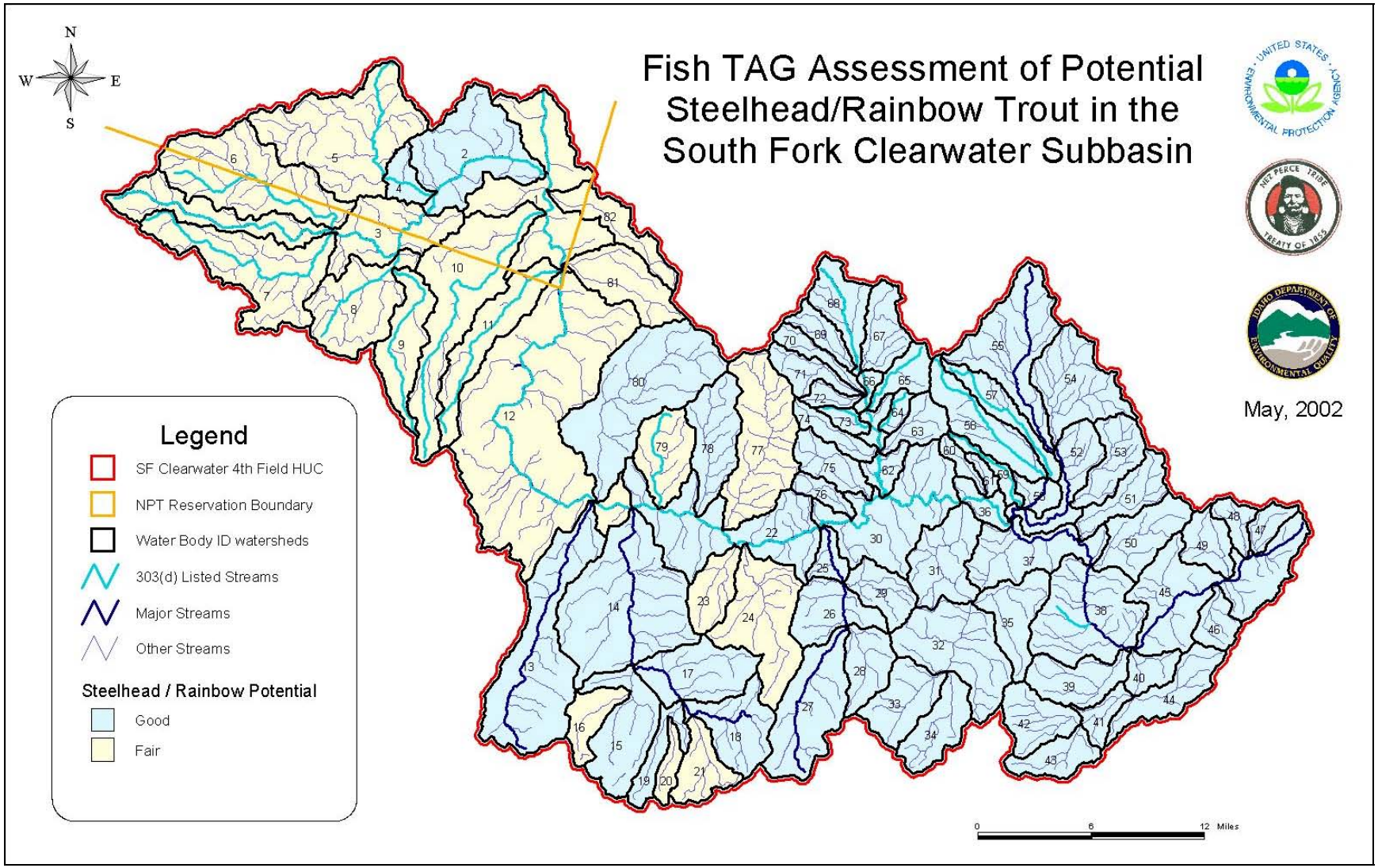

Figure D-16. Fish TAG Assessment of Potential Steelhead/Rainbow Trout in the SF CWR Subbasin

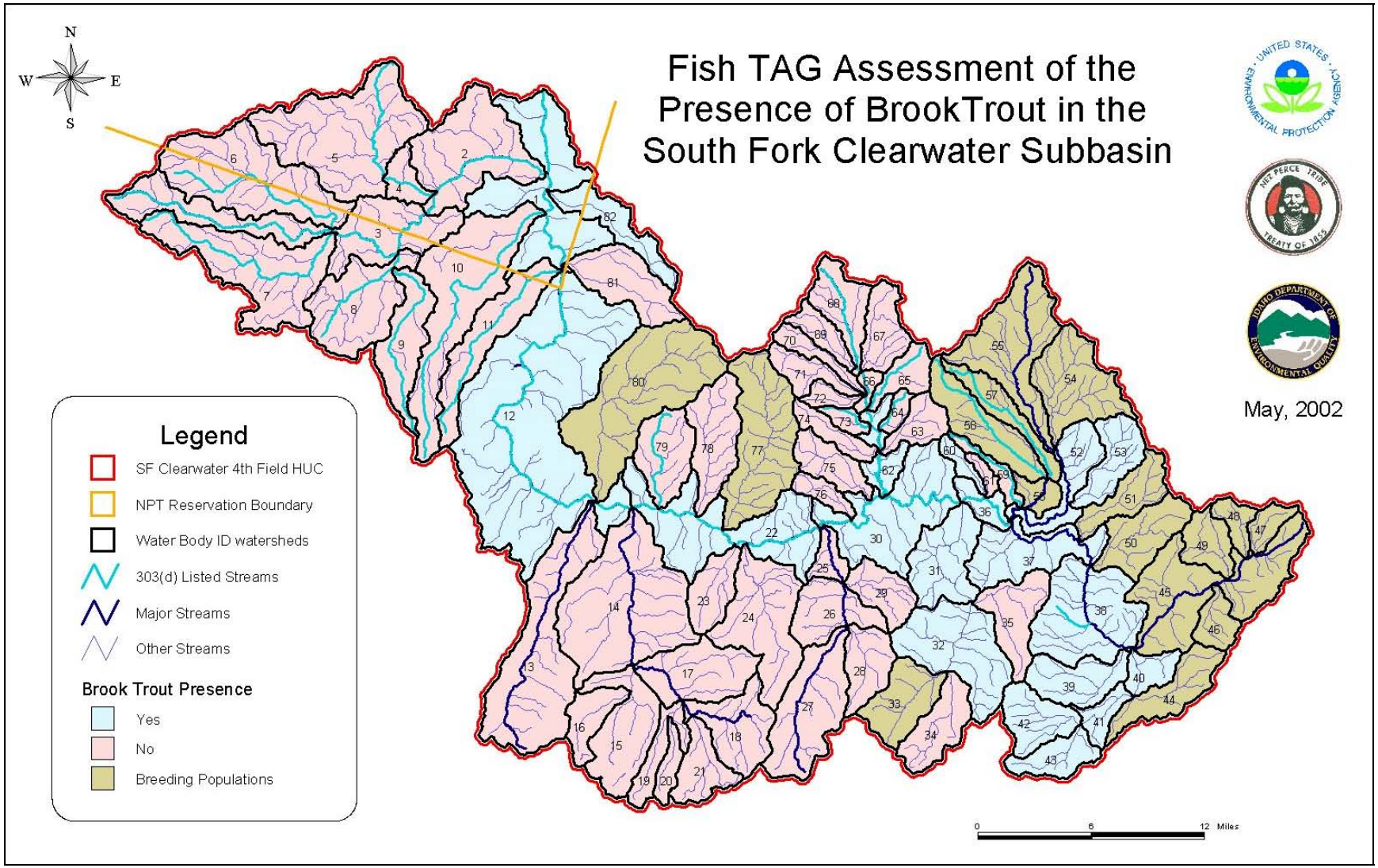

Figure D-17. Fish TAG Assessment of the Presence of Brook Trout in the SF CWR Subbasin

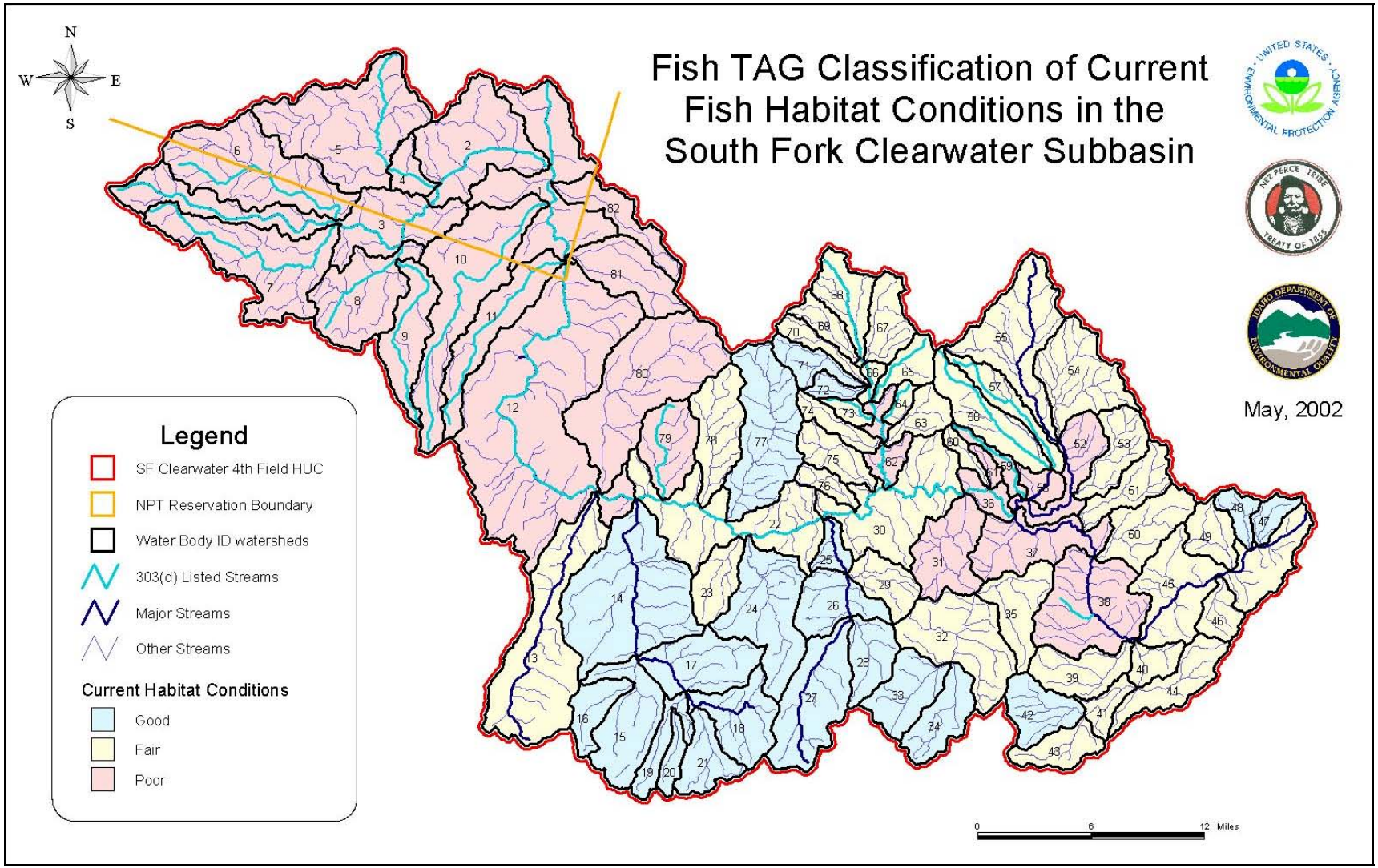

Figure D-18. Fish TAG Classification of Current Fish Habitat Conditions in the SF CWR Subbasin

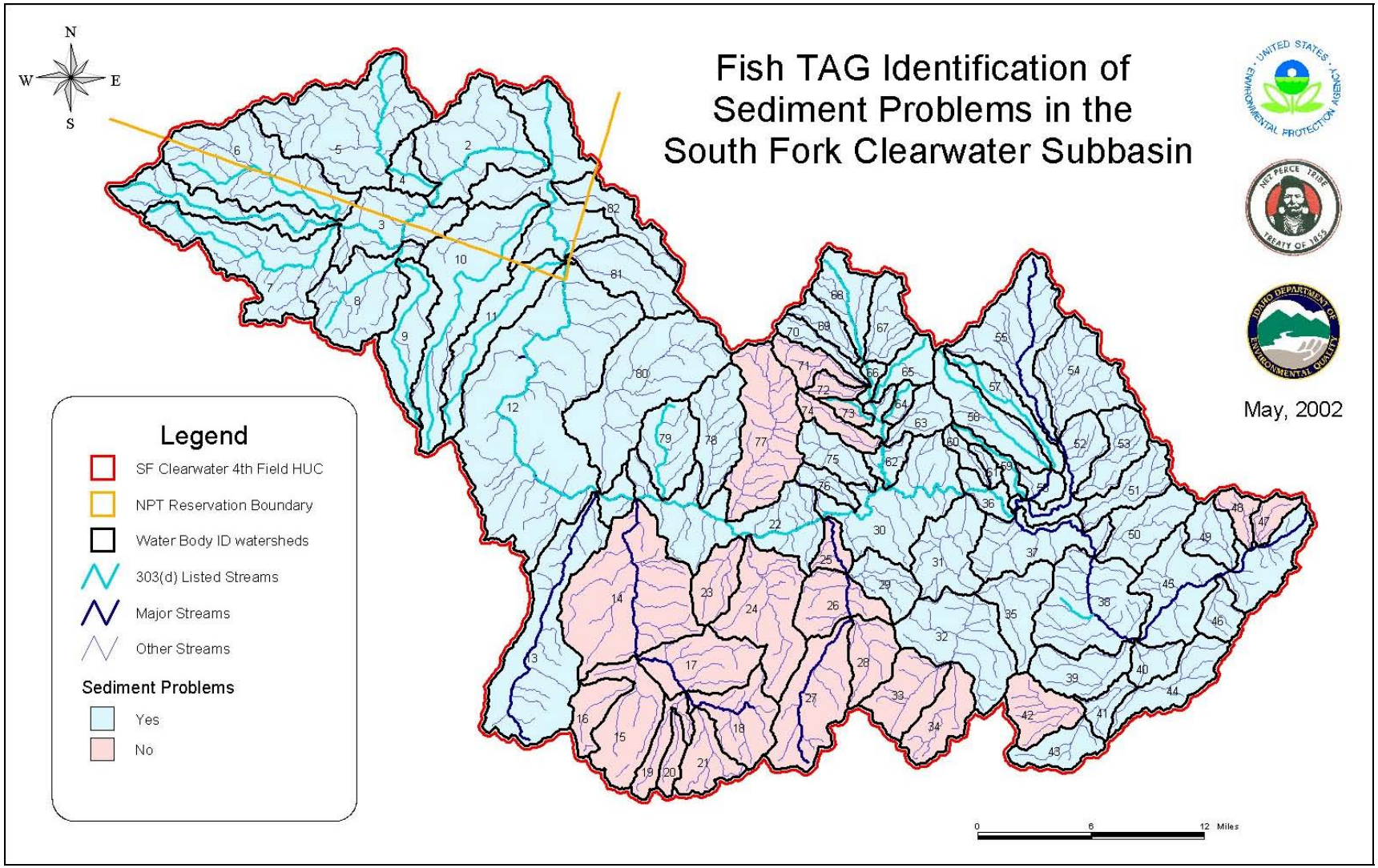

Figure D-19. Fish TAG Identification of Sediment Problems in the SF CWR Subbasin

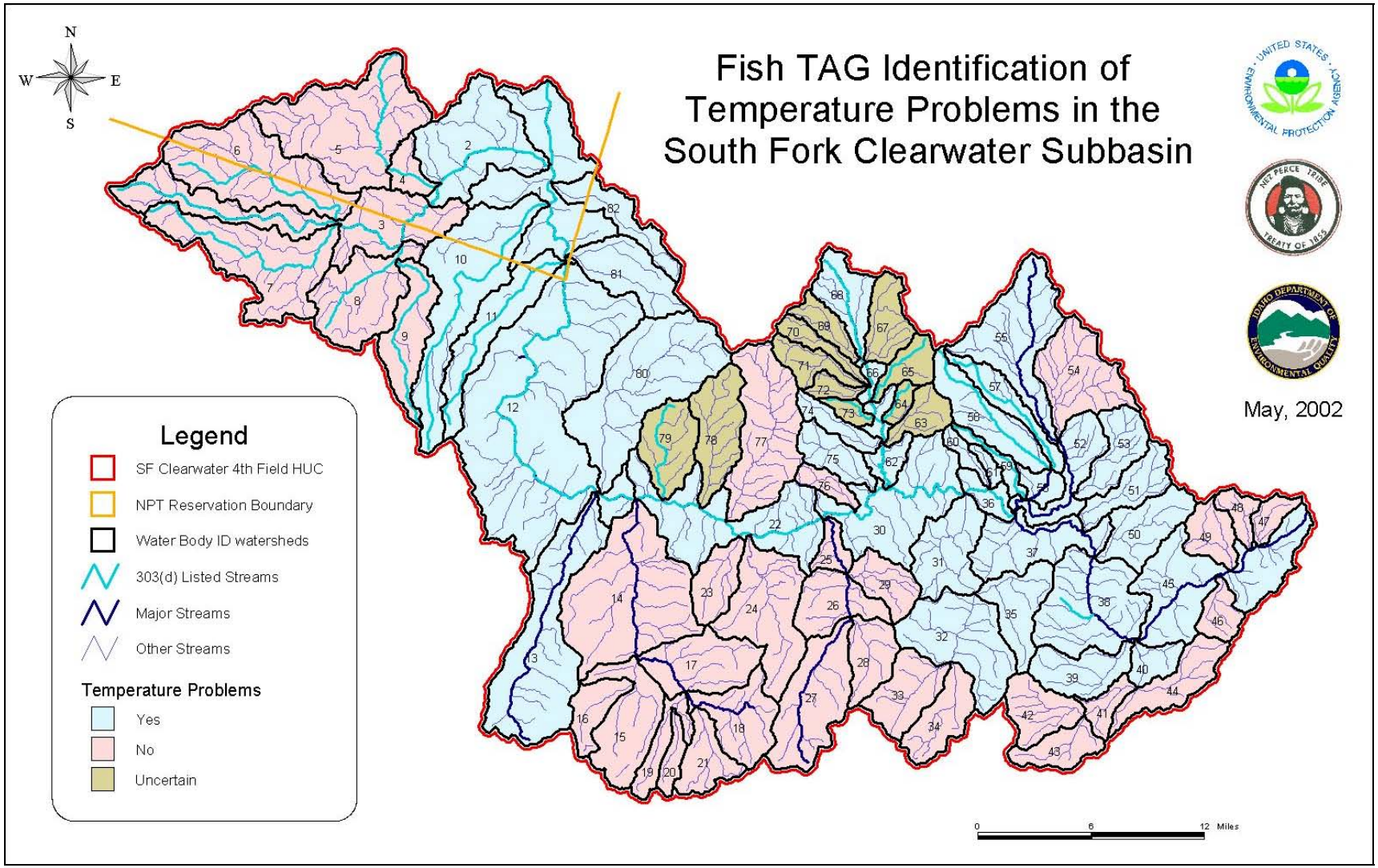

Figure D-20. Fish TAG Identification of Temperature Problems in the SF CWR Subbasin

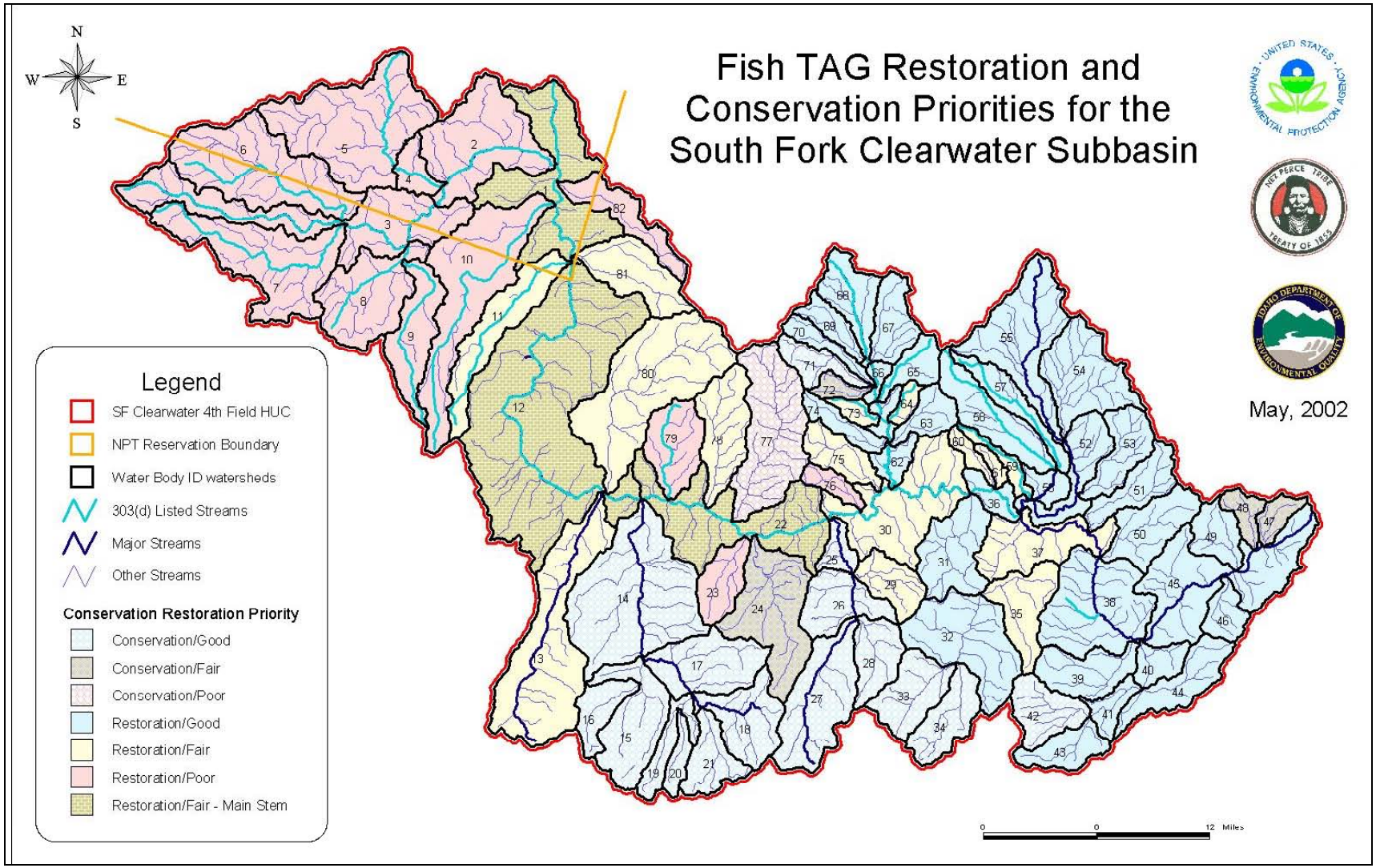

Figure D-21. Fish TAG Restoration and Conservation Recommendations for the SF CWR Subbasin

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Attachments

Attachment D-1. Timing of life history stages of salmonids within the SF CWR Subbasin.

Life History Stage	SF CWR Main Stem	Major Creeks and Rivers	Other Perennial Streams
A-Run Steelhead (Lower SF Main Stem and its Tributaries)			
Residence	Sept 1-Feb 1		
Migration to Tributaries	Feb 1-May 15	Feb 1-May 15	
Spawning		Feb 1-May 15	Feb 1-May 15
Incubation and Emergence		Feb 1-June 1	Feb 1-June 1
Rearing	All Year	All Year	All Year
Juvenile Out Migration	Feb 1-June 1	Feb 1-June 1	Feb 1-June 1
B-Run Steelhead (Middle and Upper SF Main Stem and its Tributaries)			
Residence	Dec 1-July 15		
Migration to Tributaries	Feb 1-May 15	Jan 1-May 31	
Spawning	Feb 1-May 31	Feb 1-May 31	Feb 1-May 31
Incubation and Emergence	Feb 1-July 15	Feb 1-July 15	Feb 1-July 15
Rearing	All Year	All Year	All Year
Juvenile Out Migration	Feb 1-June 30	Feb 1-June 30	Feb 1-June 30
Fall Chinook			
Adult Migration	Sept 15-Nov 30		
Spawning	Oct 1-Dec 15		
Incubation and Emergence	Oct 1-May 15		
Juvenile Out Migration	May 1-Aug 31		
Spring Chinook			
Adult Migration	April 15-Sept 15	April 15-Sept 15	
Spawning	Aug 15-Sept 30	Aug 15-Sept 30	Aug 15-Sept 30
Incubation and Emergence	Aug 15-April 30	Aug 15-April 30	Aug 15-April 30
Rearing	All Year	All Year	All Year
Juvenile Out Migration	Sept 1-June 30	Sept 1-June 30	Sept 1-June 30
Bull Trout			
Residence	All Year	All Year	All Year

Life History Stage	SF CWR Main Stem	Major Creeks and Rivers	Other Perennial Streams
Adult Migration (pre spawn)	April 1-July 15	April 1-July 15	April 1-July 15
Adult Migration (post spawn)	Sept 1-Oct 31	Sept 1-Oct 31	Sept 1-Oct 31
Spawning		Aug 15-Nov 30	Aug 15-Nov 30
Incubation and Emergence		Aug 15-Mar 31	Aug 15-Mar 31
Rearing	All Year	All Year	All Year
Westslope Cutthroat Trout			
Residence	All Year	All Year	All Year
Adult Migration	March 1-June 30	Mar 1-July 15	Mar 1-July 15
Spawning		Mar 15-June 30	Mar 15-June 30
Incubation and Emergence		Mar 15-Aug 15	Mar 15-Aug 15
Rearing	All Year	All Year	All Year
Mountain Whitefish			
Residence	All Year	All Year	All Year
Adult Migration	May 1-Nov 30	May 1-Nov 30	May 1-Nov 30
Spawning	Oct 1-Dec 15	Oct 1-Dec 15	Oct 1-Dec 15
Incubation and Emergence	Oct 1-Feb 28	Oct 1-Feb 28	Oct 1-Feb 28
Rearing	All Year	All Year	All Year
Pacific Lamprey			
Residence	All Year	All Year	All Year
Adult Migration	May 1-Sept 30	May 1-Sept 30	May 1-Sept 30
Spawning	Feb 1-May 31	Feb 1-May 31	Feb 1-May 31
Incubation and Emergence	Feb 1-June 30	Feb 1-June 30	Feb 1-June 30
Rearing	All Year	All Year	All Year
Brook Trout			
Residence	All Year	All Year	All Year
Spawning		Aug 15-Oct 31	Aug 15-Oct 31
Incubation and Emergence		Aug 15-Feb 28	Aug 15-Feb 28

(Source: Brostrom 2001).
Note: Major creeks and rivers include the Red, American, and Crooked Rivers, and Mill, Meadow, Johns, and Tenmile Creeks.

Attachment D-2. Spring chinook redd counts from the SF CWR subbasin based on observations in several locations, 1974-1997.

Year	# of Observation Locations	Total	Mean
1974	3	20	6
1975	3	59	19
1976	3	33	11
1977	4	138	34
1978	4	109	27
1979	4	39	9
1980	4	53	13
1981	5	124	24
1982	5	269	53
1983	5	234	46
1984	5	200	40
1985	5	264	52
1986	5	192	38
1987	5	208	41
1988	5	170	34
1989	5	83	16
1990	5	133	26
1991	5	6	1
1992	5	98	19
1993	5	209	41
1994	5	17	3
1995	5	6	1
1996	5	44	8
1997	5	187	37

(Source: Stream Net 2000)

Attachment D-2. Cont. Observation locations for spring chinook redd surveys.

Years	Location	River Mile
1974-1997	Crooked River	0-11.7
1974-1997	Red River	0-28.5
1977-1997	SF of Red River	0-11.7
1981-1997	American River	0-21.6
1974-1997	Newsome Creek	0-15.7

(Source: Stream Net 2000)

Attachment D-3. Adult spring chinook returns to the Red River pond hatchery, 1969-1996.

Red River Pond Hatchery Trap				
Year	**Unknown**	**Females**	**Males**	**Total Returns**
1969	215	--	--	215
1987		220	299	519
1988		209	185	394
1989		49	55	104
1990		16	37	53
1991		7	11	18
1992		16	23	39
1993		65	74	139
1994		13	18	31
1995		2	2	4
1996		14	48	62
Crooked River Hatchery Trap				
Year	**Unknown**	**Females**	**Males**	**Total Returns**
1990		10	19	29
1991		5	15	20
1992		94	134	228
1993		211	191	402
1994		18	8	26
1995		0	6	6
1996		94	205	299
1997	1034			1034

(Source: Stream Net 2000)

Attachment D-4. Number of fall chinook salmon redds counted in the Clearwater River subbasin, 1988-2000.

River	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Clearwater (RM 0-41)	21	10	4	4	25	36	30	20	66	58	78	179	163	285
Clearwater (RM 41-74)					1	0	0	0	0	0	0	2	8	16
M.F. Clearwater (RM 74-98)							0	0	0	0	0	0	0	0
N.F. Clearwater					0	0	7	0	2	14	0	1	0	1
S.F. Clearwater					0	0	0	0	1	0	0	2	1*	5
Totals	21	10	4	4	26	36	37	20	69	72	78	184	172	307

* A fall chinook salmon carcass was found in the SF CWR

An empty cell indicates no searches were conducted in the corresponding river segments during a specific year.

Attachment D-5. Steelhead redd count data from the Crooked and Red Rivers.

Year	Stream	Count	Survey River Mile	Redd/mile
90	Crooked	219	8.3	26.4
91	Crooked	50	10.8	4.6
92	Crooked	2	10.8	0.2
93	Crooked	4	10.4	0.4
94	Crooked	3	10.4	0.3
95	Crooked	4	10.4	0.4
96	Crooked	0	10.4	0.0
97	Crooked	0	12.8	0.0
90	Red	2	9.8	0.2
93	Red	5	16.3	0.3
94	Red	6	6.5	0.9
95	Red	6	6.5	0.9
96	Red	2	6.5	0.3
97	Red	0	6.5	0.0

(Source: Stream Net 2000)

Attachment D-6. Number of steelhead adults returning to the Crooked River fish trap, 1991-1996.

Year	Weir Catch	Wild	Hatchery
90	49	17	32
91	49	5	44
92	53	19	34
93	49	17	22
94	6	5	1
95	16	15	2
96	3	2	1
97	3	3	0
98	4	2	2
99	10	3	7
00	16	6	10

(Source: Stream Net 2000)

Attachment D-7. Summary of SF CWR main stem snorkel data collected summer 2000.

Segment	SECTION (KM)*	TYPE	AREA_m^2	sum_sthd	sum_stac	sum_RBT	sum_ct<=12	sum_ct>12	sum_ct_all	sum_bkt
1	end 18.2	mix b-c	35,622.626	0.10	0.02	0.00	0.01	0.00	0.01	0.00
2	end 56.4	C-Meadow	63,570.987	2.24	0.39	0.03	0.04	0.00	0.04	0.00
3	end 75.7	B-Canyon	27,558.280	4.32	0.00	0.02	0.08	0.00	0.08	0.01
4	end 95.3	B-Canyon	34,355.668	2.76	0.00	0.01	0.02	0.00	0.02	0.00
5	end 103.2	B-Canyon	14,237.941	2.35	0.01	0.02	0.05	0.01	0.06	0.01

Segment	SECTION*	TYPE	AREA_m^2	bull_sum<=12	bull_sum>12	sum_bull_all	sum_wht	sum_ch_juv	sum_ch_adult	sum_coho
1	end 18.2	mix b-c	35,622.626	0.00	0.00	0.00	0.19	0.01	0.00	0.00
2	end 56.4	C-Meadow	63,570.987	0.00	0.00	0.00	0.98	0.33	0.00	0.00
3	end 75.7	B-Canyon	27,558.280	0.03	0.01	0.03	0.76	0.48	0.03	0.00
4	end 95.3	B-Canyon	34,355.668	0.01	0.00	0.01	0.59	0.21	0.01	0.00
5	end 103.2	B-Canyon	14,237.941	0.03	0.01	0.04	0.67	0.01	0.04	0.00

(Source: IDFG 2000)
RBT= hatchery origin rainbow trout (as determined by fin erosion)
Sthd= wild/natural steelhead/rainbow trout
Stac=adipose fin-clipped steelhead
Ct= cutthroat trout
Bkt= brook trout
Bull= bull trout
Wht= whitefish
Ch= chinook

SF CWR Main Stem Segment Designations

Segment #	Start Landmark	End Landmark	Start River km	End River km
1	SF CWR Mouth	Butcher Creek Confluence	0	18.2
2	Butcher Creek Confluence	Johns Creek Confluence	18.2	56.4
3	Johns Creek Confluence	Ten Mile Creek Confluence	56.4	75.7
4	Ten Mile Creek Confluence	Crooked River Confluence	75.7	95.3
5	Crooked River Confluence	Beginning of SF CWR	95.3	103.2

Appendix E. Agricultural Chemicals

Agricultural Chemicals

Chemicals used in agriculture on the Camas Prairie
Source: B. Sandlund, NRCS, Grangeville, 2002

The Web site: <www.cdms.net> contains information on these chemicals

2-4, D ester and amine
Acclaim
Achieve
Aim
Ally
Amber
Arsenal
Assert
Assure
Avenge
Banvel
Basagram
Beacon
Bromate
Buctril
Capture
Cassaron
Crossbow
Curtail
Diuron
Farge
Finesswe
Glean
Gramoxone
Harmony Extra and GT
Hoelon
Karmex
Kerb
Landmaster
Malathion
Maverick
MCPA
Oast
Poast
Puma
Pursuit
Roundup
Sencor
Singer
Starne
Tordon 22K
Transline
Treflan
Velpar
Weedmaster

Appendix F. System Potential Vegetation Methods and Results

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Appendix F. System Potential Vegetation Methods and Results

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Overview

Appendix F is divided into two sections. The first section provides information and analysis about factors associated with the current stream temperature conditions in the South Fork Clearwater River Subbasin. The second section presents potential land cover condition information and data previously developed for this subbasin. This section also presents the methods utilized in this total maximum daily load (TMDL) to develop an understanding of expected (or potential) vegetation land cover conditions, which included an accounting of natural disturbance processes. The final section of this appendix illustrates the methods used to develop "system potential effective shade" estimates, which are applied in this TMDL as "surrogate measures."

Current Condition Assessment

Summary - Stream Parameters that Control Temperature Change

Riparian vegetation, stream morphology, hydrology, point source discharge, climate, and geographic location influence stream temperature. While climate and geographic location are outside of human control, riparian condition, channel morphology, hydrology, and point source discharges are affected by human activities. Specifically, the elevated summertime stream temperatures attributed to anthropogenic sources within the South Fork Clearwater River Subbasin result from the following:

- Riparian vegetation disturbance reduces stream surface shading via decreased riparian vegetation height, width, and/or density, thus increasing the amount of solar radiation reaching the stream surface.
- Riparian vegetation disturbance results in increased temperatures in the microclimate around the stream resulting in increased heating of the water.
- Localized channel widening (increased wetted width to depth ratios) increases the stream surface area exposed to energy processes, namely solar radiation and long-wave radiation.
- Point source discharges directly increase instream temperatures via mass transfer.

Ultimately, these factors affect the energy (thermodynamic) processes within the river. A brief description of stream thermodynamic processes that control temperature change is presented in Appendix I.

Riparian Vegetation – Current Condition

A summary of current vegetation conditions for the South Fork Clearwater River Subbasin is discussed in the *South Fork Clearwater River Landscape Assessment, Volume I – Narrative* (USDA 1998) and is presented below. These conclusions were developed from the review of historical and existing data and were intended to provide a brief summary of landscape conditions and associated trends.

> "The summary of vegetation conditions can best be addressed by identifying the ecological processes that have most changed: alteration of terrestrial disturbance regimes and introduction of nonnative species.
>
> Fire suppression has resulted in more advanced successional states in the subbasin. This is shown by increases in medium and large tree classes in most settings, and reductions in young tree classes and shrublands or montane parkland. Shade tolerant species like grand fir and subalpine fir have increased, while early seral species like lodgepole pine, ponderosa pine, and whitebark pine have decreased. Stand densities have probably increased over historic in some settings (VRU 3 and 4) with consequent increased risk of insect and disease activity and more severe fire. Old growth is probably more abundant than historically, basin-wide, but has declined in ponderosa pine types and increased in mixed conifer and spruce-fir types. In moist grand fir settings (VRU 7 and 10), some fragmentation and isolation of old growth has occurred.
>
> Timber harvest has not replicated the frequency, scale, or kind of historic disturbance. Across watersheds, vegetation conditions are more uniform. Within stands, vegetation structure has been simplified through clearcutting and removal of fire tolerant ponderosa pine and larch. Heterogeneity of disturbance size and stand structure have been lost in many harvested areas. Harvest and fire suppression have resulted in loss of large patches of fire-killed trees, and large snags of long lasting species like larch.
>
> The introduction of nonnative species has highly altered grassland steppe communities. Annual grasses and noxious weeds are well established at low elevations. Fire behavior and soil productivity may change in response to these altered plant communities."

The follow points describing current vegetation conditions were included in the *South Fork Clearwater River Landscape Assessment* (USDA 1998):

- Conversion of foothills grassland on prairie and hill slopes to cropland, hay land, and pasture has been extensive on private lands.

- Annual grasses and noxious weeds have become established on grassland habitat types on low elevation steep south facing slopes.
- Forest succession, fire suppression, and timber harvest have resulted in declines in large open-growth ponderosa pine. Early seral, intolerant species like lodgepole pine and western larch have also declined with fire suppression.
- Patch sizes are smaller on lodgepole sites and larger on moist grand fir sites, when compared to historic conditions.
- Whitebark pine is in serious decline from blister rust, fire exclusion, and mountain pine beetle. Western white pine, never abundant in the subbasin, has also declined from blister rust.
- Grand fir, Douglas fir, and subalpine fir have increased.
- Early seral structural stages, including forest openings, seedling and sapling, and pole stands with snags and down wood, have decreased because of fire suppression. Medium and large tree classes have increased in most areas, except for larch and ponderosa pine forests.
- Large patches of fire-killed snags have declined with fire suppression. Numbers of large diameter snags have declined where timber harvest has occurred.

Current Vegetation Land Cover Condition Data

A geographical information systems (GIS) coverage of the current vegetation land cover condition, called Pi_stratum, was obtained from the Nez Perce National Forest (NPNF). Specifically, the Pi_stratum is a six-digit code designed to stratify timber stands based on aerial photo interpreted properties for timber stand sampling and extrapolation. Figure F-1 illustrates an example area along the South Fork Clearwater River main stem, where the Pi_stratum coverage was overlaid onto a digital ortho quad photograph. The specific codes associated with the Pi_stratum are presented in Table F-1 and the six-digit code is illustrated in Figure F-1. This coverage is available for the entire subbasin. Figure F-2 illustrates assigned species composition within the Pi_stratum data set.

Figure F-1. Example of Pi_stratum Vegetation Land Cover Classification

Pi_stratum current land cover data are coded for species type, canopy density, and size/structure. Species type is coded according to the dominant existing over-story species. Canopy density is presented as the percentage of ground that is covered by over-story vegetation when viewed from directly above or measured by a densiometer at ground level. Size/structure classes are divided by diameter at breast height (dbh) for woody vegetation.

Vegetation Size Class Distribution Summary from the Pi_stratum Data Set

Figure F-3 illustrates the land cover distribution by vegetation size class for a 300-meter buffer surrounding the South Fork Clearwater River within the NPNF (approximately river miles 63.9 through 24.4) and areas below the NPNF boundary. These areas roughly correspond with the two different temperature regimes observed in this river (see Chapter 2). A much higher proportion of larger trees (expressed as dbh) are present within the NPNF reach. This area of the river does not exhibit a large temperature increase. The greater percentage of smaller trees within the non-NPNF areas results in lower shade potential (i.e., a shorter object will tend to produce a lower shade horizon.) Similarly, a higher proportion of the "non-stocked with trees" category is present within the lower reach. The percentage of roads within the 300-meter buffer is approximately similar between the two reaches. A very large percentage (>50%) of near-stream areas in the lower reach are covered with "tree" vegetation.

Table F-1. Nez Perce Pi_stratum codes legend (NPNF 2001).

Digit 1 – Status	Digit 2 - Condition
1 - non-forest (potential)	0 – water
2 – forest	1 - land (unproductive)
	2 - incapable (forest but can't produce marketable products)
	3 - Capable (forest and can produce marketable products)
Digit 3 - Species Composition	**Digit 4 - Size Class**
0 – not stocked with trees	0 – not stocked or not applicable
1 – ponderosa pine/Douglas fir	1 - seedling/sapling (to 4.9 inch dbh)*
2 – lodgepole pine	2 - poles (5.0 - 8.9 inch dbh)
3 – subalpine fir	3 - small saw (9 - 13.9 inch dbh)
4 - mixed conifer	4 - large saw (14.0 – 20.9 dbh)
5 - white bark pine	5 – big tree (21 inch or greater dbh)
6 - bracken/coneflower	
Digit 5 – Vertical Structure	**Digit 6 - Crown Closure**
0 - single storied stand	0 - 0-10%
1 - two storied stand	1 - 10-40%
	2 - 40-70%
	3 - >70%

*diameter at breast height

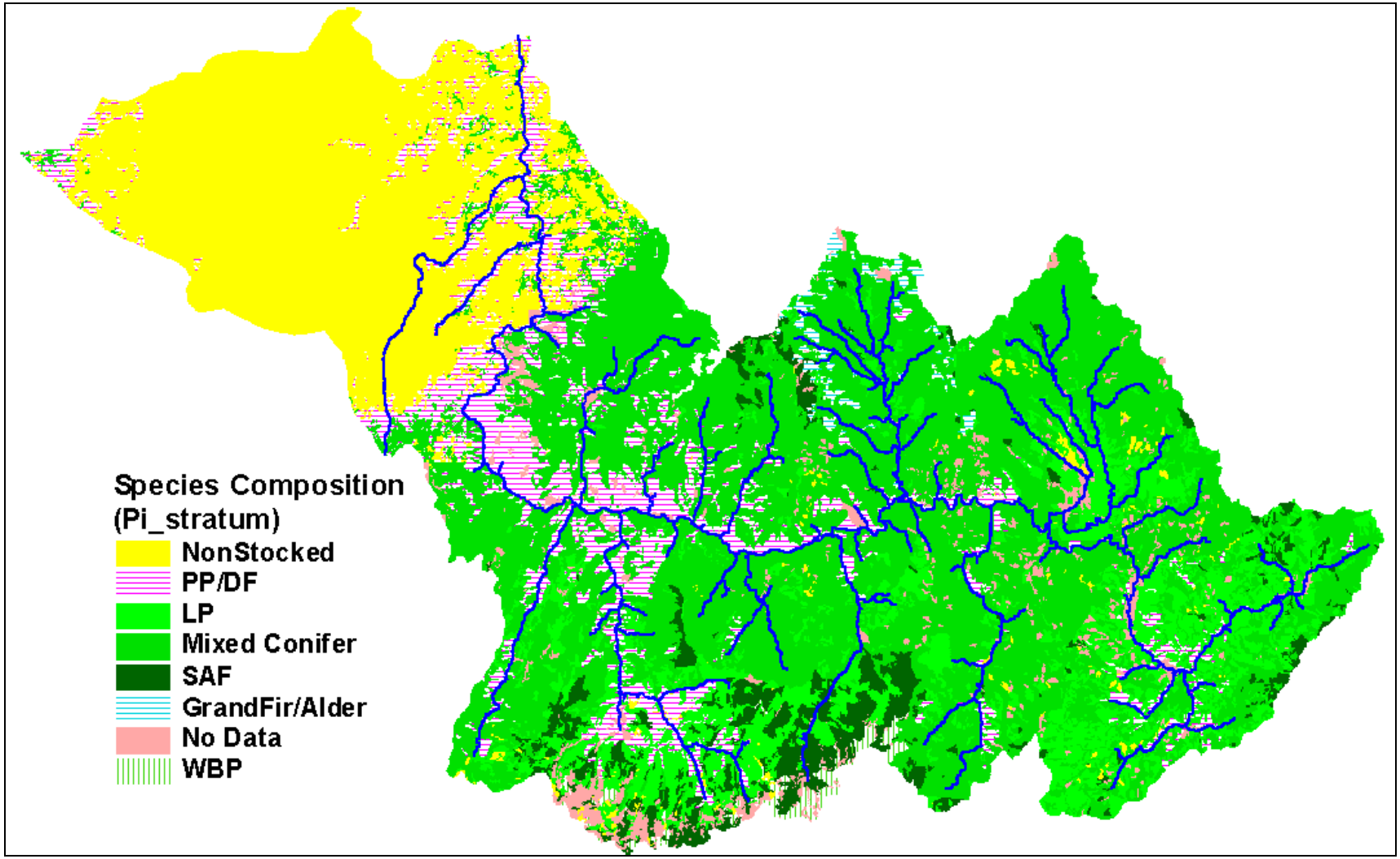
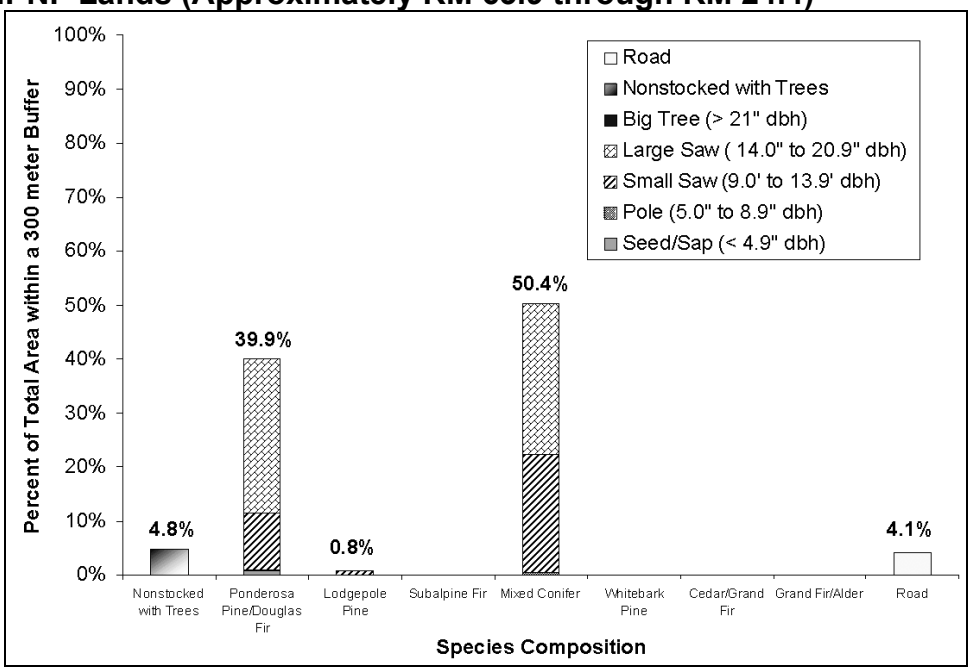


Figure F-2. Current Vegetation Species Composition within the South Fork Clearwater River Subbasin

NPNF Lands (Approximately RM 63.9 through RM 24.4)



Non-NPNF Lands (Approximately RM 24.4 through mouth)

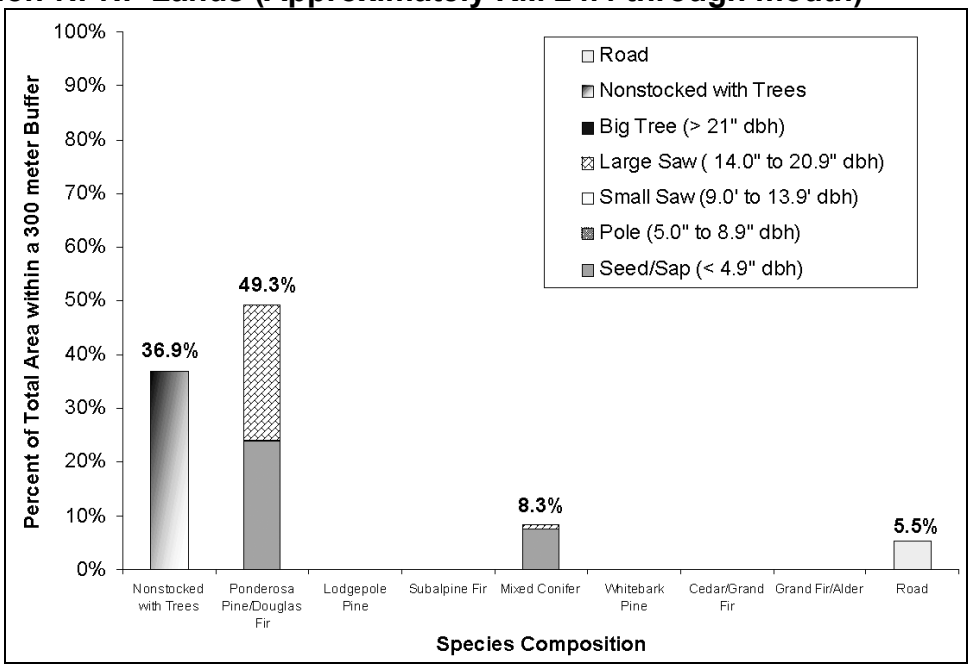


Figure F-3. Near-Stream Vegetation Size Classes within a 300-Meter Buffer of the South Fork Clearwater River within Nez Perce National Forest Lands (upper) and Below Nez Perce National Forest Lands (lower)

Field Measured Vegetation Condition

Near-stream vegetation conditions were measured by the NPNF during the past decade. Diameter at breast height, vegetation height, and condition were measured for 1,870 trees. Figure F-4 illustrates the distribution of observed tree height and dbh, separated by species, for all observed (non-snag) trees included in this study. Table F-2 presents calculated percentile information for this data.

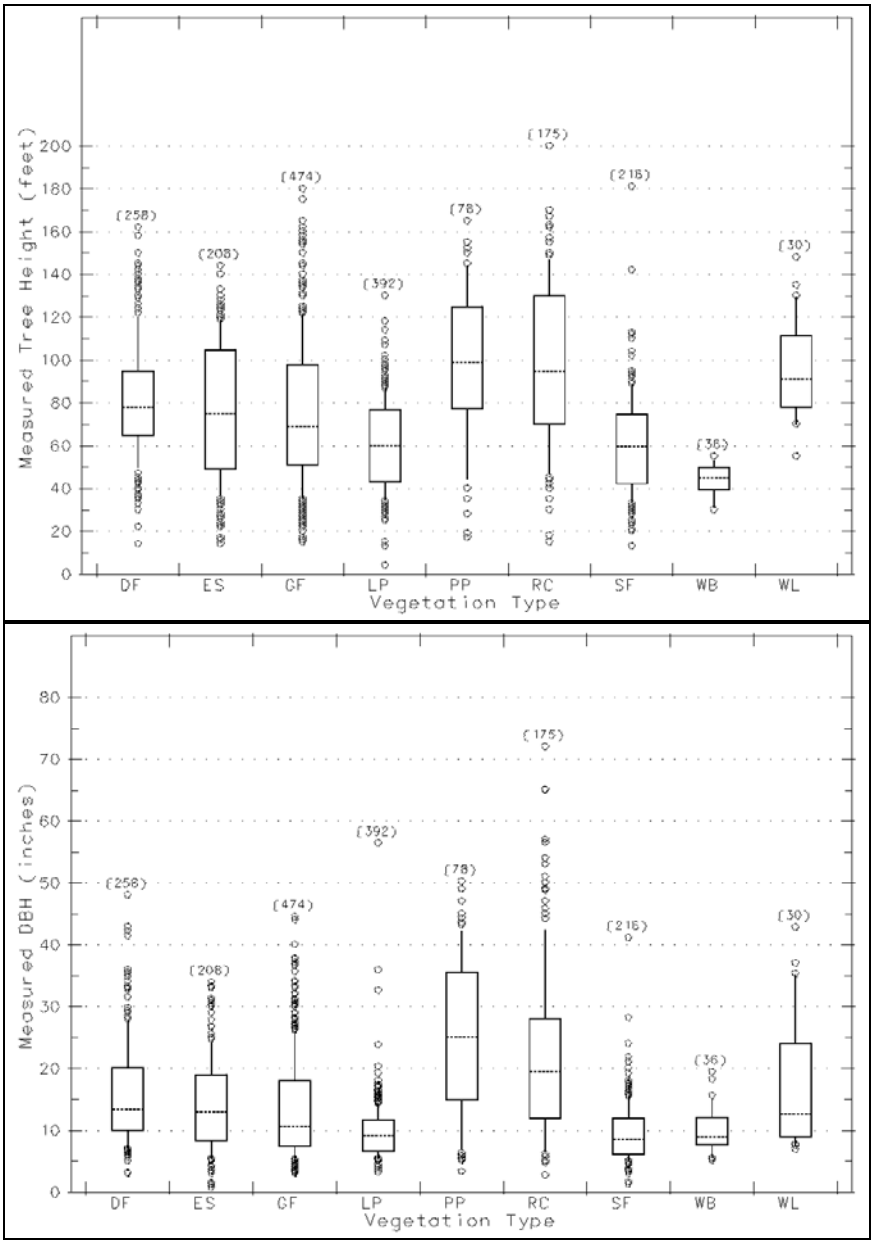


Figure F-4. Measured Tree Heights and Diameter at Breast Height Conditions within the Nez Perce National Forest (NPNF 2002)

Table F-2. Current condition percentile summary for the Nez Perce National Forest.

Tree Height Percentile Summary										
Vegetation Type	**N**	**1%**	**5%**	**10%**	**20%**	**50%**	**80%**	**90%**	**95%**	**99%**
Douglas Fir	258	27	40	50	60	78	100	120	138	153
Engelmann Spruce	208	16	30	37	45	75	108	118	124	139
Grand Fir	474	17	27	36	48	69	104	121	140	161
Lodgepole Pine	392	24	30	35	40	60	80	87	92	109
Ponderosa Pine	78	17	28	45	74	99	131	144	150	165
Western Red Cedar	175	17	39	47	60	95	133	147	151	177
Subalpine Fir	216	20	29	34	40	60	81	88	95	142
Whitebark Pine	36	30	30	31	38	45	50	53	55	55
Western Larch	30	55	63	70	76	91	117	130	141	148
–Diameter at Breast Height Percentile Summary (inches)										
Vegetation Type	**N**	**1%**	**5%**	**10%**	**20%**	**50%**	**80%**	**90%**	**95%**	**99%**
Douglas Fir	258	4.2	5.6	7.1	9	13.4	22.3	27.7	33	42.5
Engelmann Spruce	208	1.1	4.1	5.5	7.2	13	20.4	24.2	30	33.3
Grand Fir	474	3.3	5	5.4	6.8	10.7	20.5	26	30.1	37.7
Lodgepole Pine	392	4.4	5.1	5.5	6.2	9.1	12.3	14.3	16	24.4
Ponderosa Pine	78	3.3	5.4	6.9	12.5	25	39	42.2	45.1	50.2
Western Red Cedar	175	4.2	5	6.6	9	19.5	30	42.3	51.4	66.8
Subalpine Fir	216	1.8	4.8	5.2	5.9	8.6	13	15.4	17.7	27.5
Whitebark Pine	36	5.1	5.3	5.7	7.4	8.9	13	15.1	18.4	19.4
Western Larch	30	6.9	7.2	7.7	8.4	12.6	26.1	35	39.6	42.8

*N = number of trees sampled

Species Specific Growth Curves

The ground level data were used to develop species-specific growth curves. Specifically, the data were used to develop second-order polynomial equations for each tree species sampled during these monitoring activities. Calculated second-order polynomial equations provide a reasonable prediction during tree height modeling where tree size (i.e., dbh) falls within the diameter range of the data used to generate equation coefficients (Garman et al. 1995). Table F-3 presents a summary of calculated regression coefficients. It is important to note that snag trees were not included in model development.

$$\text{Vegetation Height} = (a*dbh^2)+(b*dbh)+(c)$$

Table F-3. Calculated regression coefficients and model information.

	a	b	c	R^2	N
Engelmann Spruce	15.097	5.4849	-0.0658	0.68	208
Douglas Fir	10.765	6.4305	-0.0991	0.65	258
Grand Fir	7.326	6.6186	-0.0857	0.77	474
Ponderosa Pine	26.414	3.8410	-0.0327	0.65	78
Subalpine Fir	9.955	6.3610	-0.0872	0.64	218
Lodgepole Pine	10.728	6.5604	-0.1190	0.49	393
Western Red Cedar	18.63	5.0542	-0.0497	0.70	175
Western Larch	56.778	2.9801	-0.0276	0.66	30
Whitebark Pine	20.955	3.2703	-0.0888	0.37	36

Sampling/Measuring Current Riparian Land Cover

Streams were obtained from GIS coverages at a 1:24K scale. These stream layers were then segmented into data sampling locations (points) at 100-foot intervals. These point data layers form the basis for automated sampling performed using the GIS tool "Ttools[1]". At every distance node (i.e., every 100 feet) along the stream longitudinally, land cover was sampled at 15-foot intervals out to 120 feet from the channel edge on both stream banks. Sampling was conducted at a perpendicular angle from the calculated stream aspect. A total of 18 vegetation samples were taken at each stream distance node (Figure F-5).

The species-specific growth curves presented in Table F-3 were used to assign tree heights based upon the dbh value reported within the P-stratum data set. roads were included in the analysis and locations were obtained from a GIS data layer.

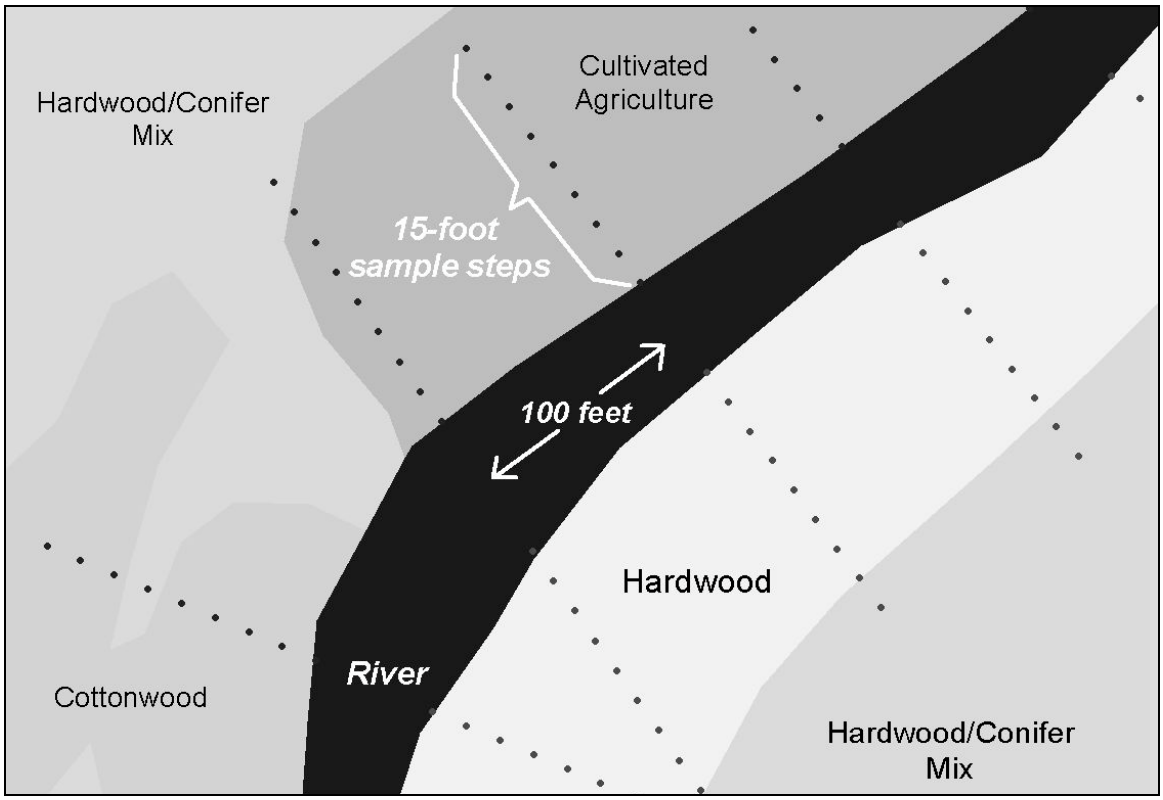
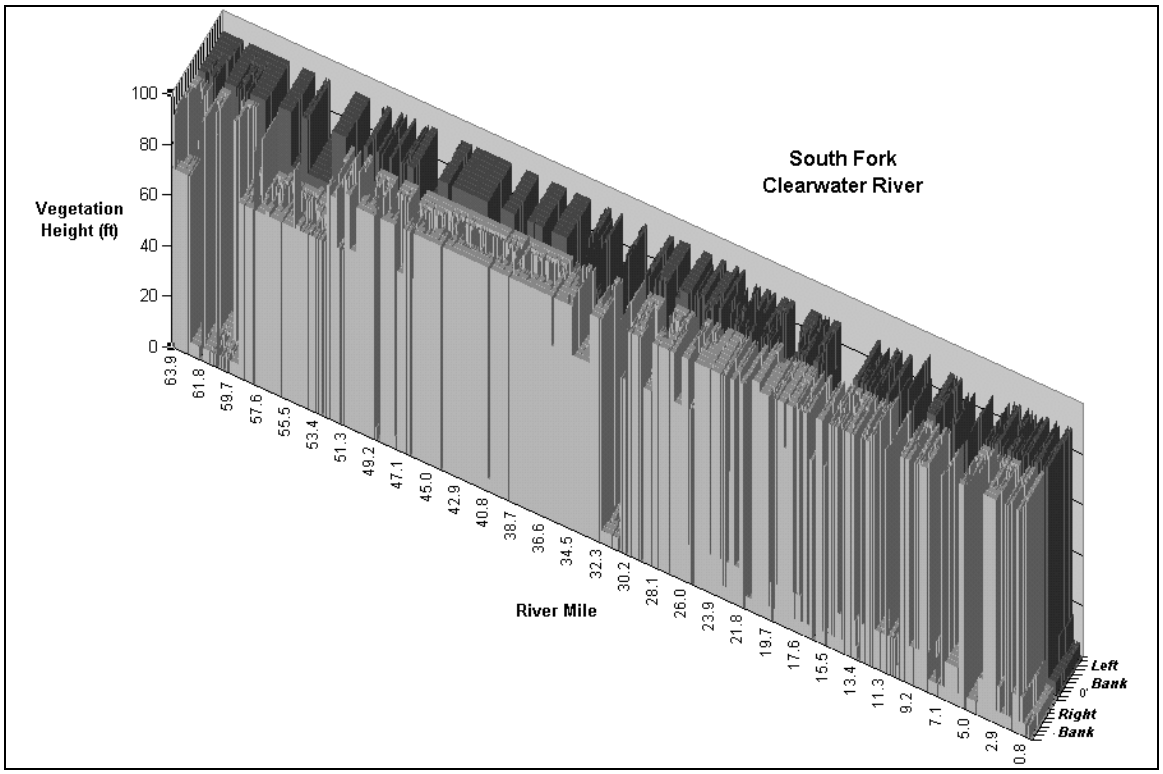


Figure F-5. Example of TTools Automated Vegetation Sampling Methodology

Using the methodology discussed above, current near-stream land cover conditions, as established from the Pi_stratum data set, were sampled for the South Fork Clearwater River, Threemile Creek, Butcher Creek, Little Elk Creek, Big Elk Creek, Elk Creek, Newsome Creek, and Red River. These river systems were chosen for analysis because they are on the 303(d) list and represent examples of a large main stem river system, upper meadow dominated systems, and lower subbasin tributary systems. Current riparian conditions measured within 240 feet of near-stream area (120 feet of each side of the stream) are presented in Figure F-6. Although not included in these images, canopy density of the vegetation cover was included in the Pi-stratum data set and was sampled during this analysis.



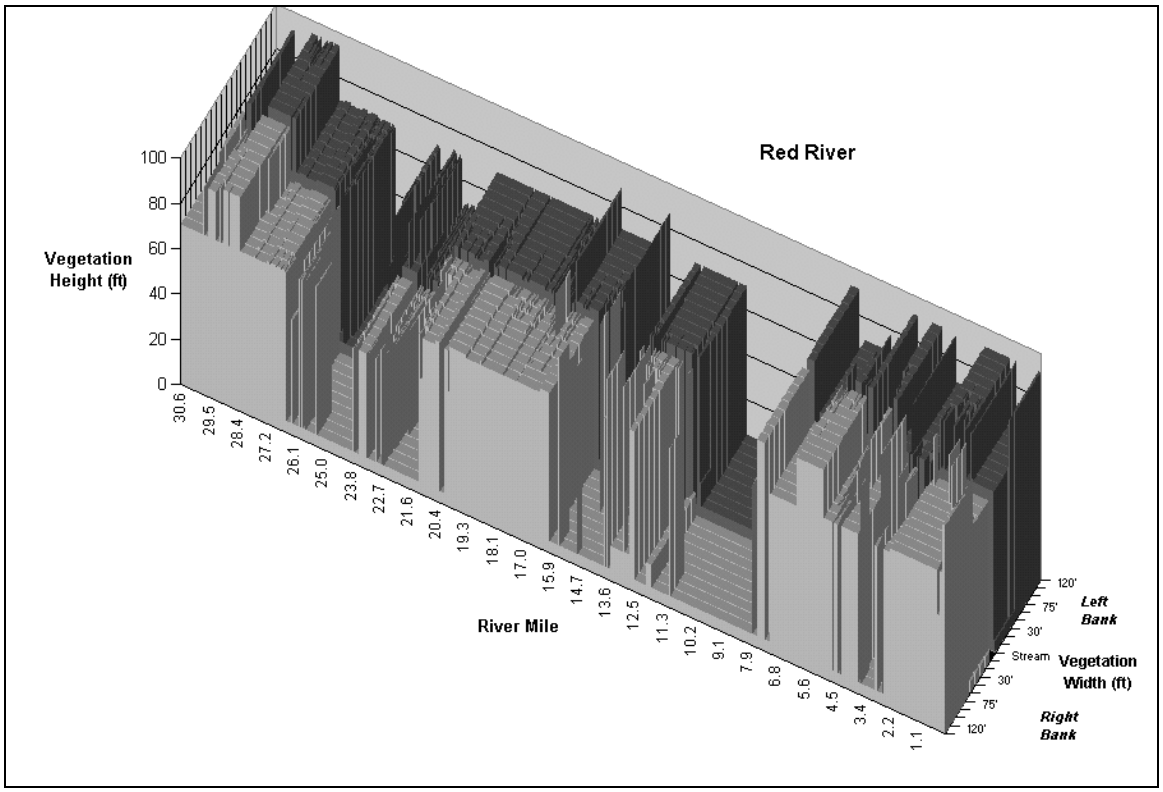


Figure F-6. South Fork Clearwater River and Red River Current Near-Stream Vegetation Condition

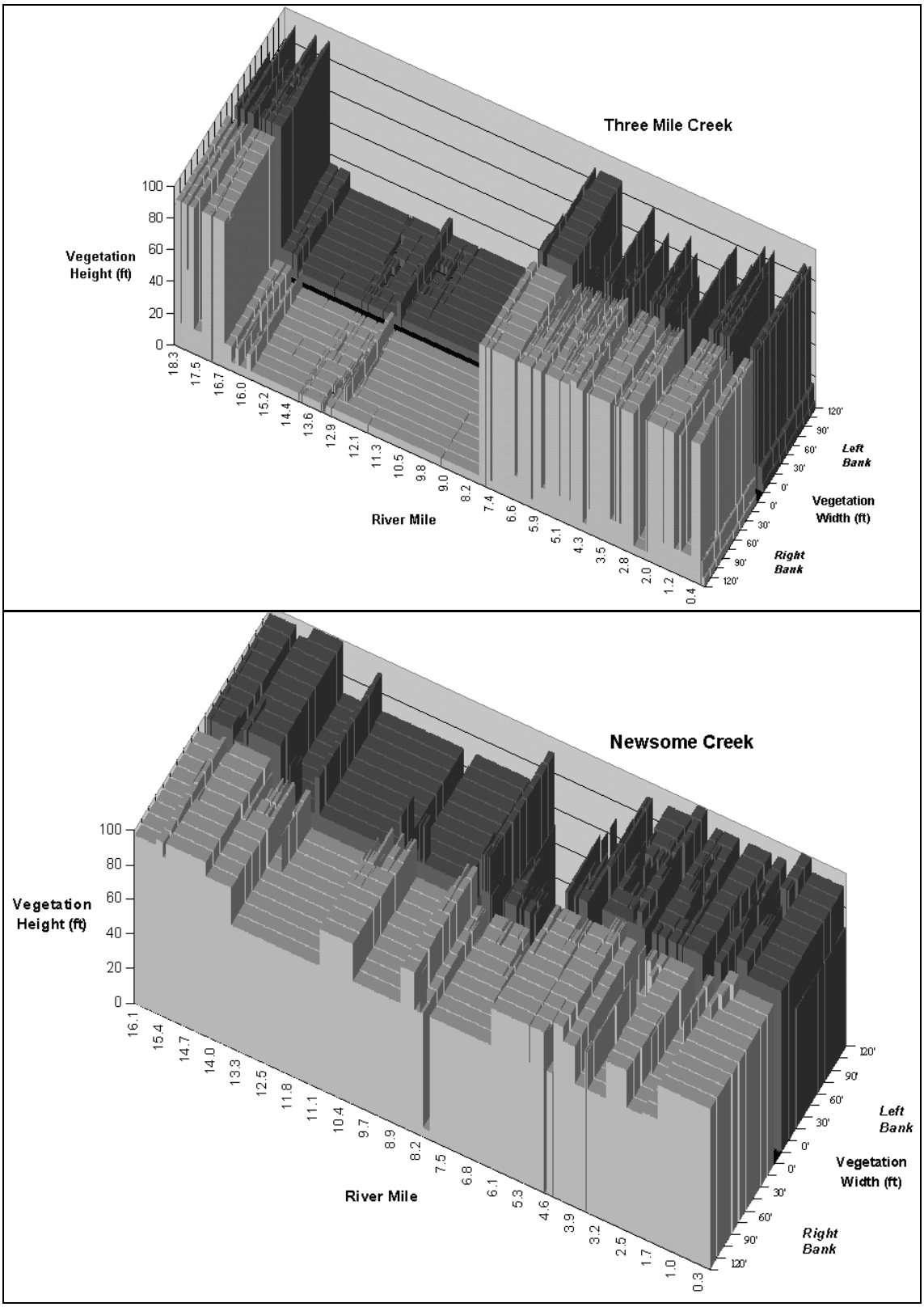


Figure F-6 (continued). Threemile Creek and Newsome Creek Current Near-Stream Vegetation Condition

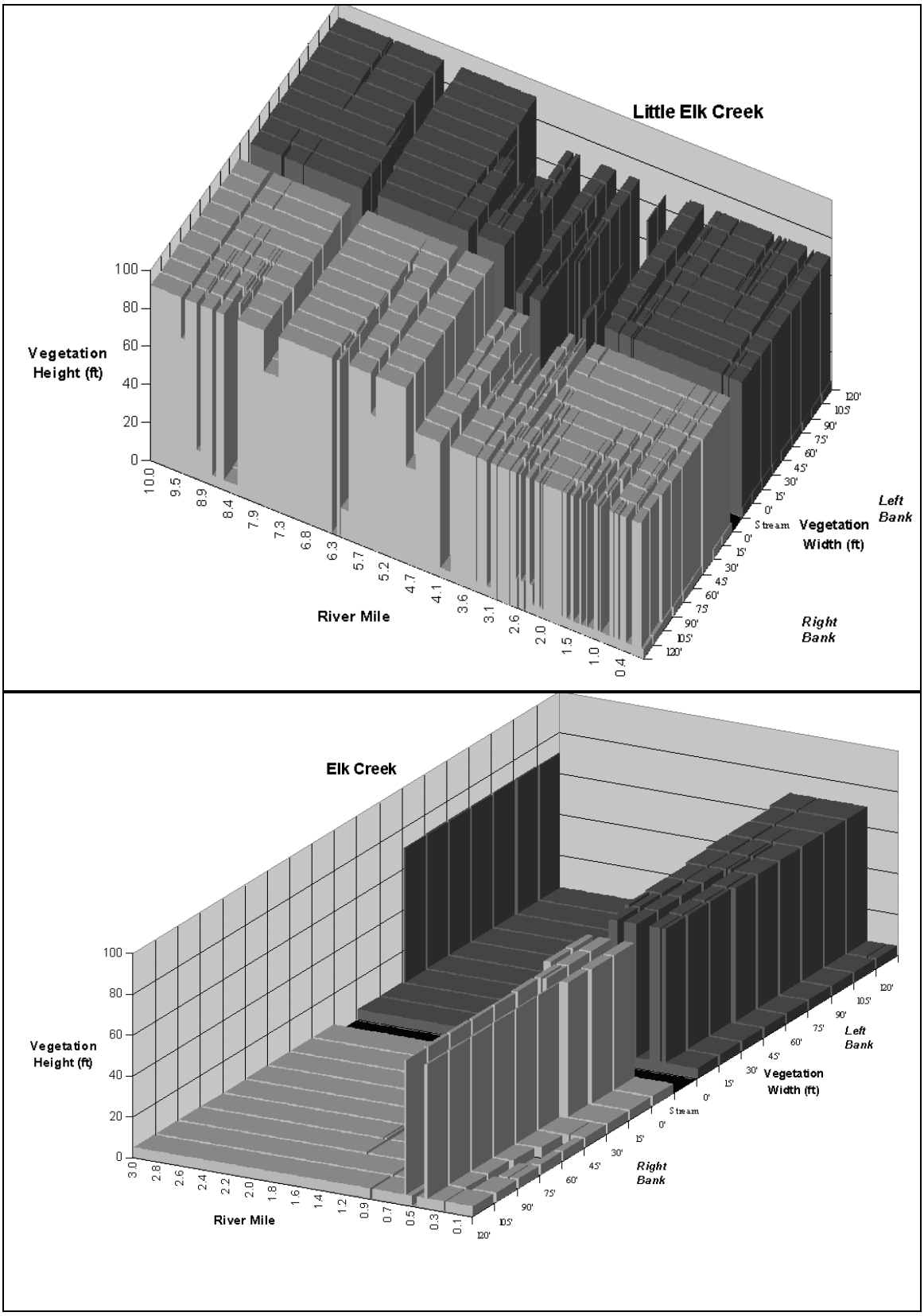
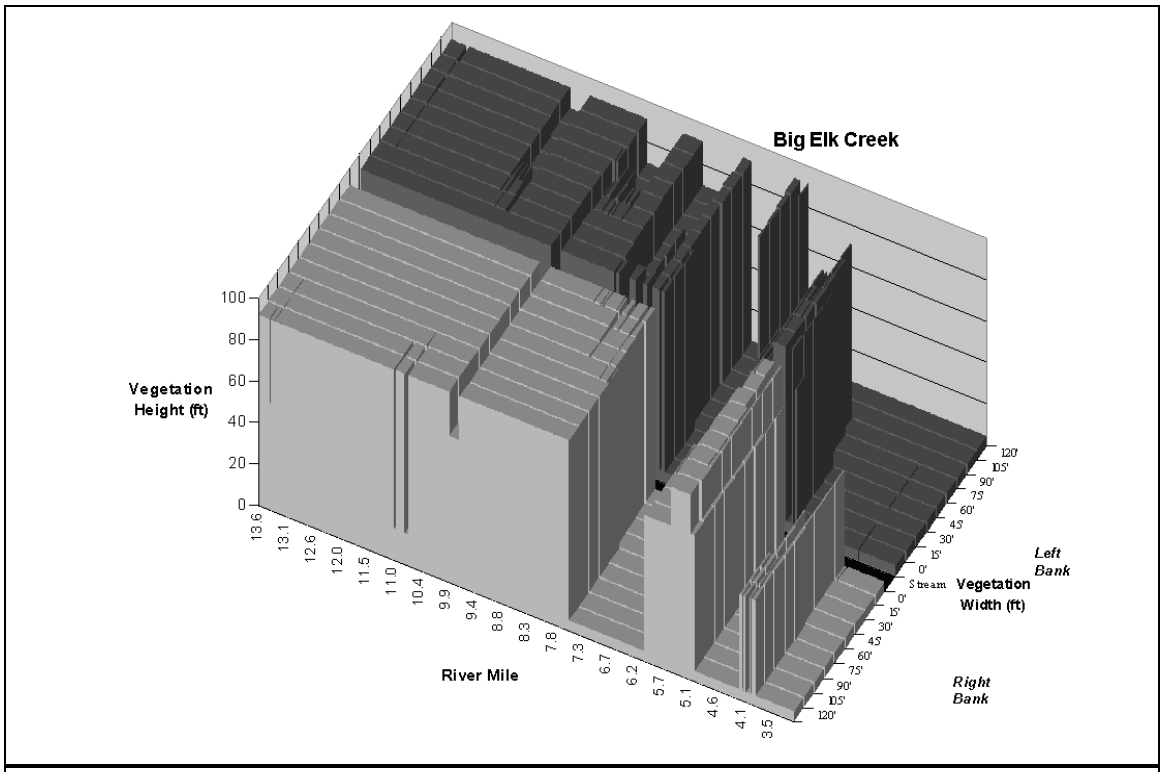


Figure F-6 (continued). Little Elk Creek and Elk Creek Current Near-Stream Vegetation Condition



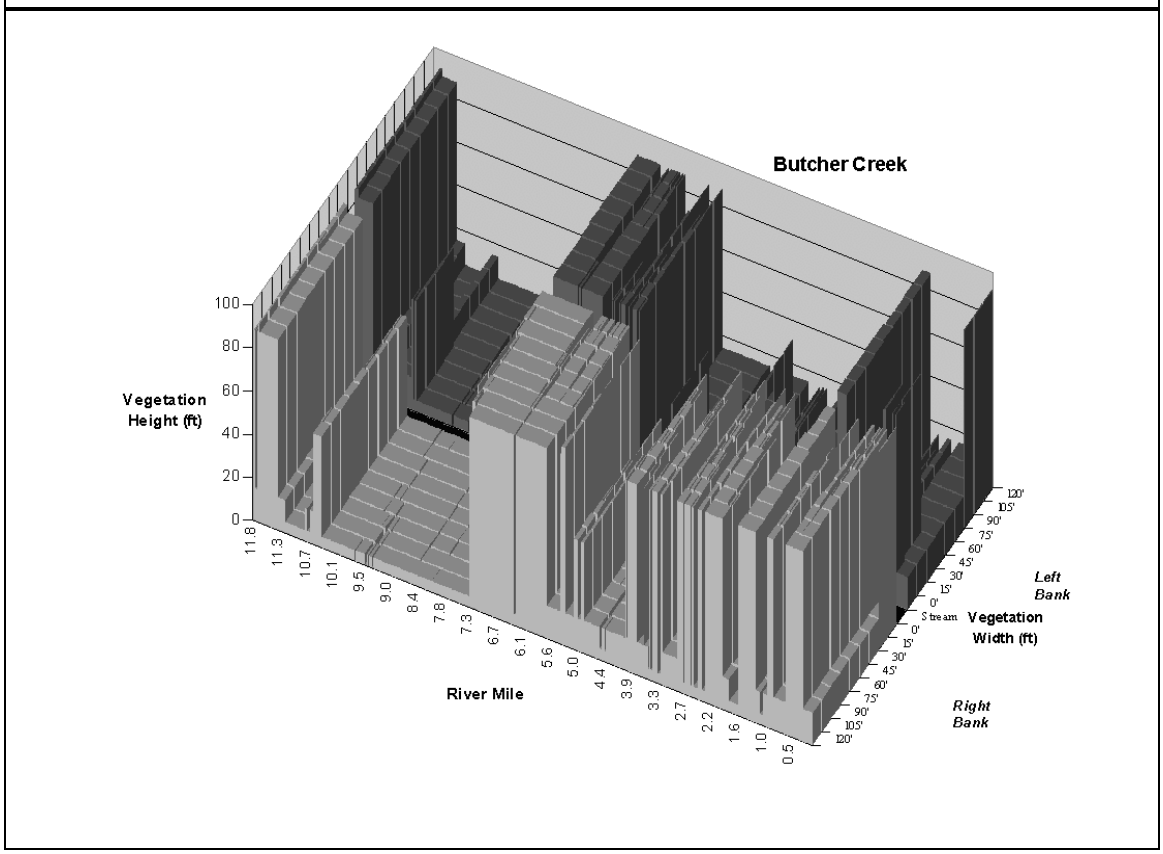


Figure F-6 (continued). Big Elk Creek and Butcher Creek Current Near-Stream Vegetation Condition

Effective Shade – Current Condition

As described in Appendix I, stream shade is defined as the amount of solar energy that is obscured or reflected by vegetation or topography above a stream. Effective shade is defined as the amount of potential solar radiation not reaching the stream surface. Spatial GIS data and point measurements of current vegetation conditions (presented above) were used to calculate current effective shade conditions along streams within the South Fork Clearwater River Subbasin. Current effective shade conditions were calculated using the "Heat Source" shade calculator[2]. This method allows for the incorporation of GIS-derived information to increase the spatial resolution of calculated values.

GIS-Derived Information Used for Effective Shade Calculation

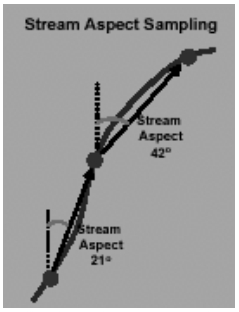
Factors that influence stream shade production along a river are presented in Table F-4. Many of these are directly influenced by human activities, while others are not. Along with topographic shade angle, the parameters listed in this table were used to estimate current effective shade conditions along the South Fork Clearwater River and several tributaries. Using information present within the spatially-explicit GIS data sets dramatically increased the spatial resolution of estimated current effective shade conditions over levels developed from just using point measurements alone.

Table F-4. Factors that influence stream shade.

Description	Parameter
Season/Time	Date/Time
Stream Characteristics	Aspect, **Channel Width**
Geographic Position	Latitude, Longitude
Vegetative Characteristics	**Near Stream Land Cover Height, Width, and Density**
Solar Position	Solar Altitude, Solar Azimuth

Bold type - influenced by human activities

Stream Aspect – Stream aspect was sampled at every stream data node (every 100 feet) using the T-tools (Figure F-7). The stream aspect was calculated as the downstream angle between two stream nodes and north. The units are recorded as degrees from north in the downstream direction. Stream aspect data are used to:
Reference the longitudinal direction and allow the calculation of the transverse direction at each stream data node.
Position the stream relative to simulated surrounding features such as the sun, surrounding near stream land cover, and shade-producing topographic features.



[2] This shade calculator has been used by Oregon Department of Environmental Quality and Washington Department of Ecology during the development of temperature TMDLs during the past several years.

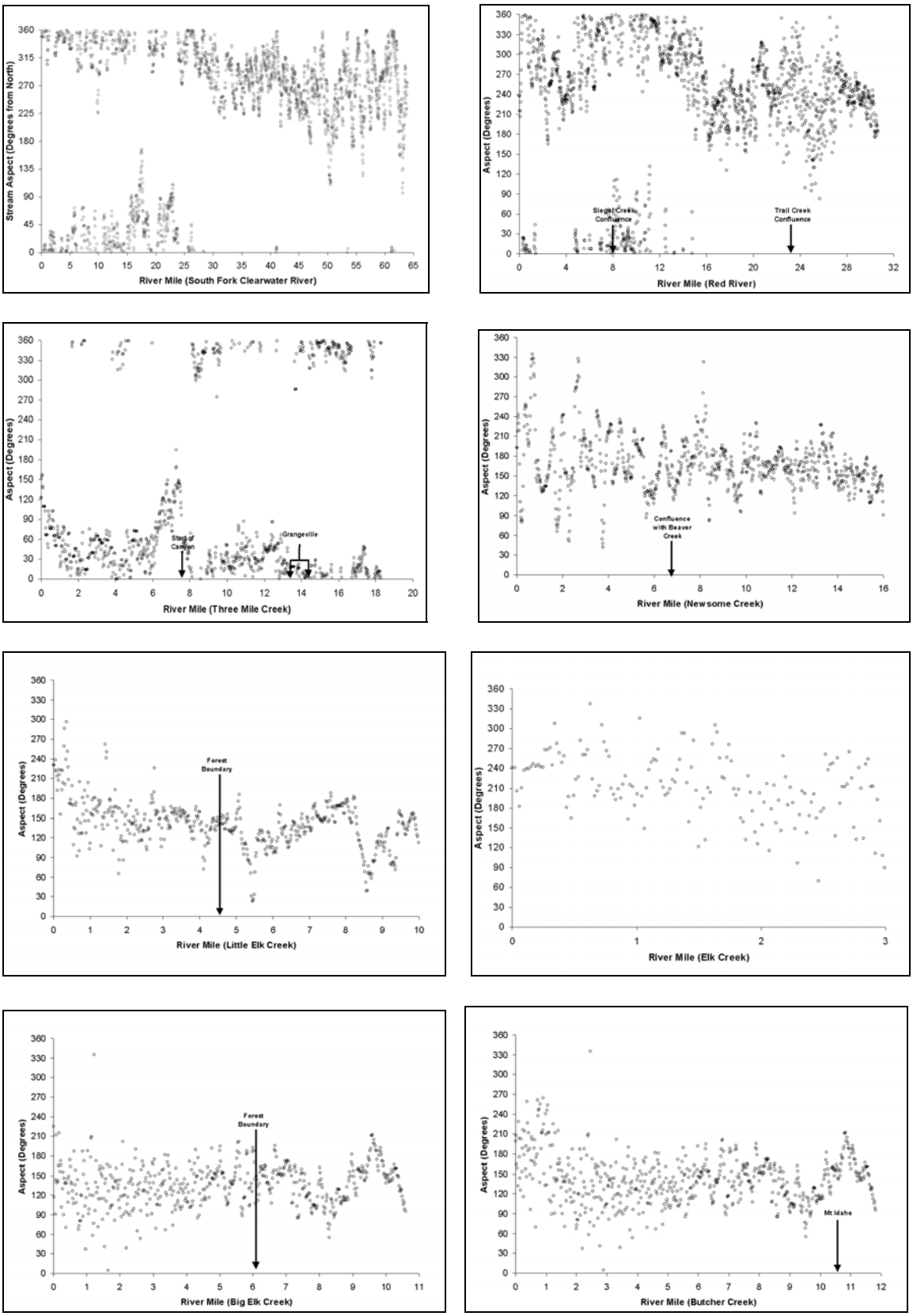
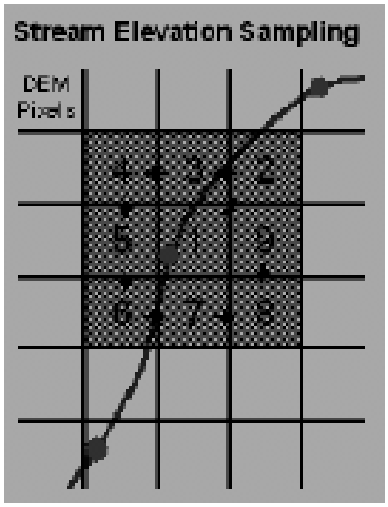


Figure F-7. Stream Aspect

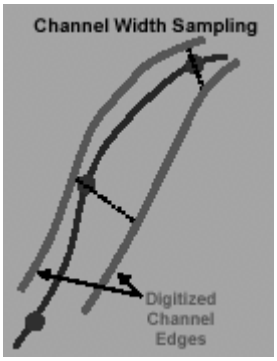
Stream Elevation and Gradient – Stream elevation and gradient were sampled from digital elevation models (DEMs) at each 100-foot model data node using the Ttools. In order to find the lowest pixel nearest to the stream segment node, T-tools samples nine pixels: the pixel that falls directly on the stream segment node and the eight surrounding pixels. The lowest elevation sampled is assigned to the stream segment node. Stream elevation data are used to calculate stream gradients. Both sampled elevation and gradient data are plotted for the aerial extent displayed (Figure F-8). In this fashion, stream elevation and gradient were derived for all stream reaches analyzed. Stream elevation data were used for calculating solar radiation loading and solar position.



$$\text{Stream Gradient} = \frac{\text{Change in Stream Elevation}}{\text{Stream Segment Length}} = \frac{\text{Change in Stream Elevation}}{(\text{\# of Stream Nodes})(\text{Segment Interval})}$$

Topography and Topographic Shade –Topographic features produce shade to the stream system that controls the time of the local sunrise and sunset. Such features include distant mountain ranges, canyons, or other near-stream relief. At each stream data node (every 100 feet), the topographic shade angle was sampled from DEMs to the west, south, and east using TTools. Calculated values are presented in Figure F-9.

Channel Near-Stream Disturbance Zone and Bankfull Width – Near-stream disturbance zone width (NSDZ) is defined for purpose of the TMDL as the width, from left bank to right bank, between shade-producing near-stream vegetation. This distance is often similar to bankfull width. The NSDZ can be measured from digitized channel edge polylines developed from DOQ photographs. At each stream segment node, Ttools measured the distance between the left and right channel edge polylines in the transverse direction (i.e., perpendicular to the aspect). The NSDZ sampling was used for the South Fork Clearwater River (Figure F-10). The bankfull width data were obtained from Department of Environmental Quality sampling of other rivers within the South Fork Clearwater River Subbasin in the summer of 2000 (Figure F-10), where available.



The NSDZ data were used to approximate bankfull width and serve as inner boundaries where transverse near-stream land cover sampling started within Ttools.

The bankfull width and NSDZ width data were used to establish distance between shade-producing features during effective shade calculations.

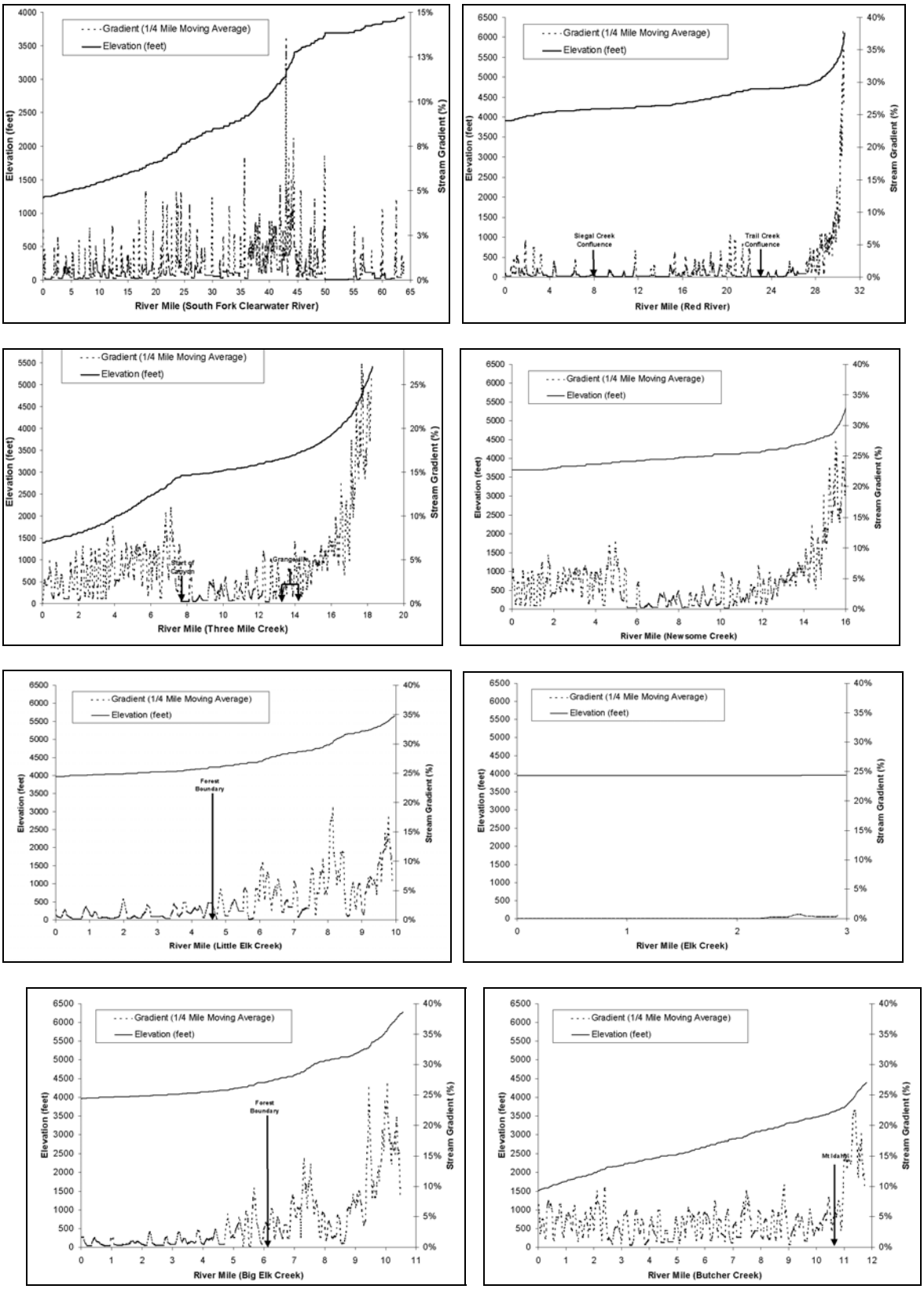


Figure F-8. Stream Elevation and Gradient

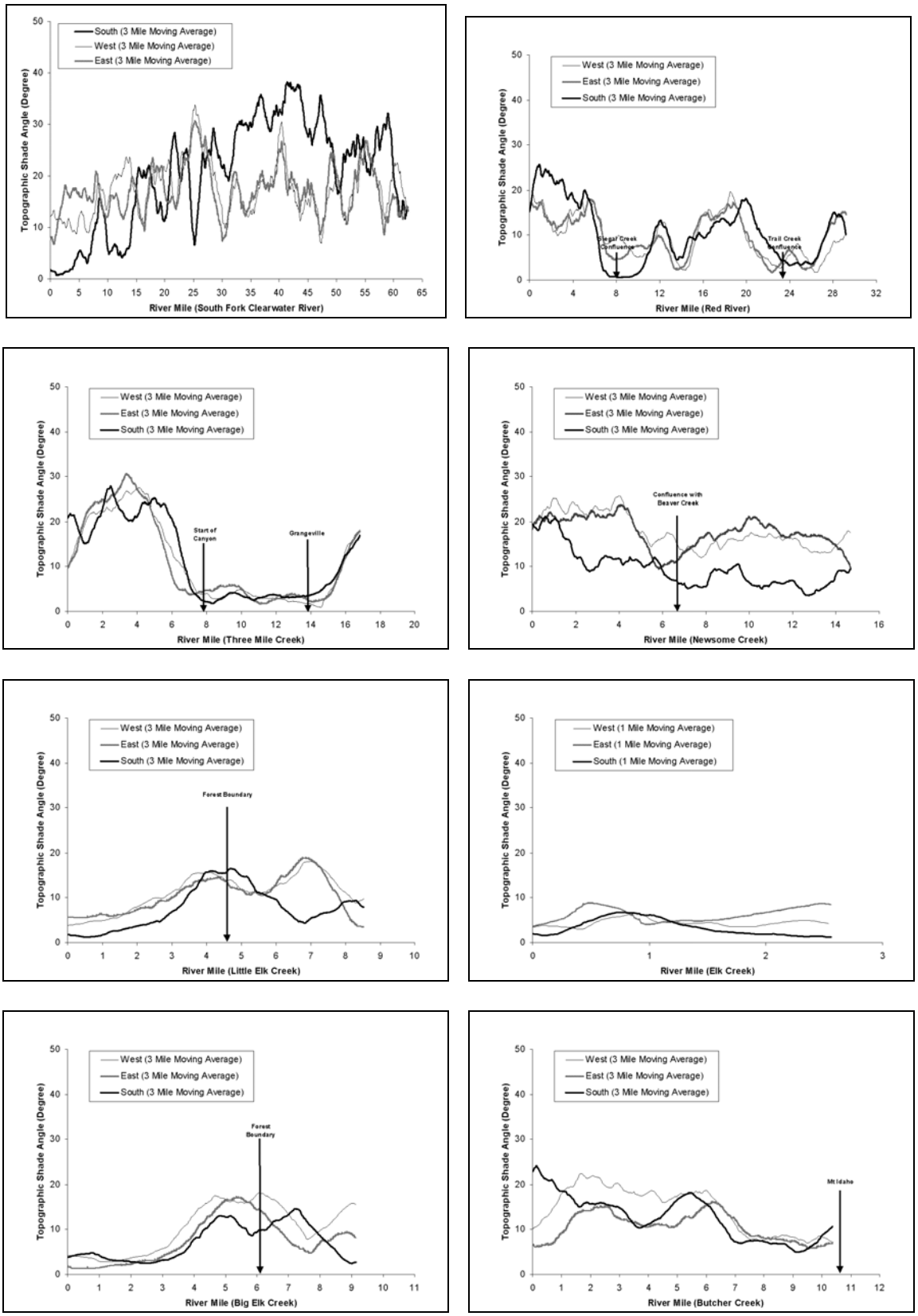


Figure F-9. Topographic Shade Angle

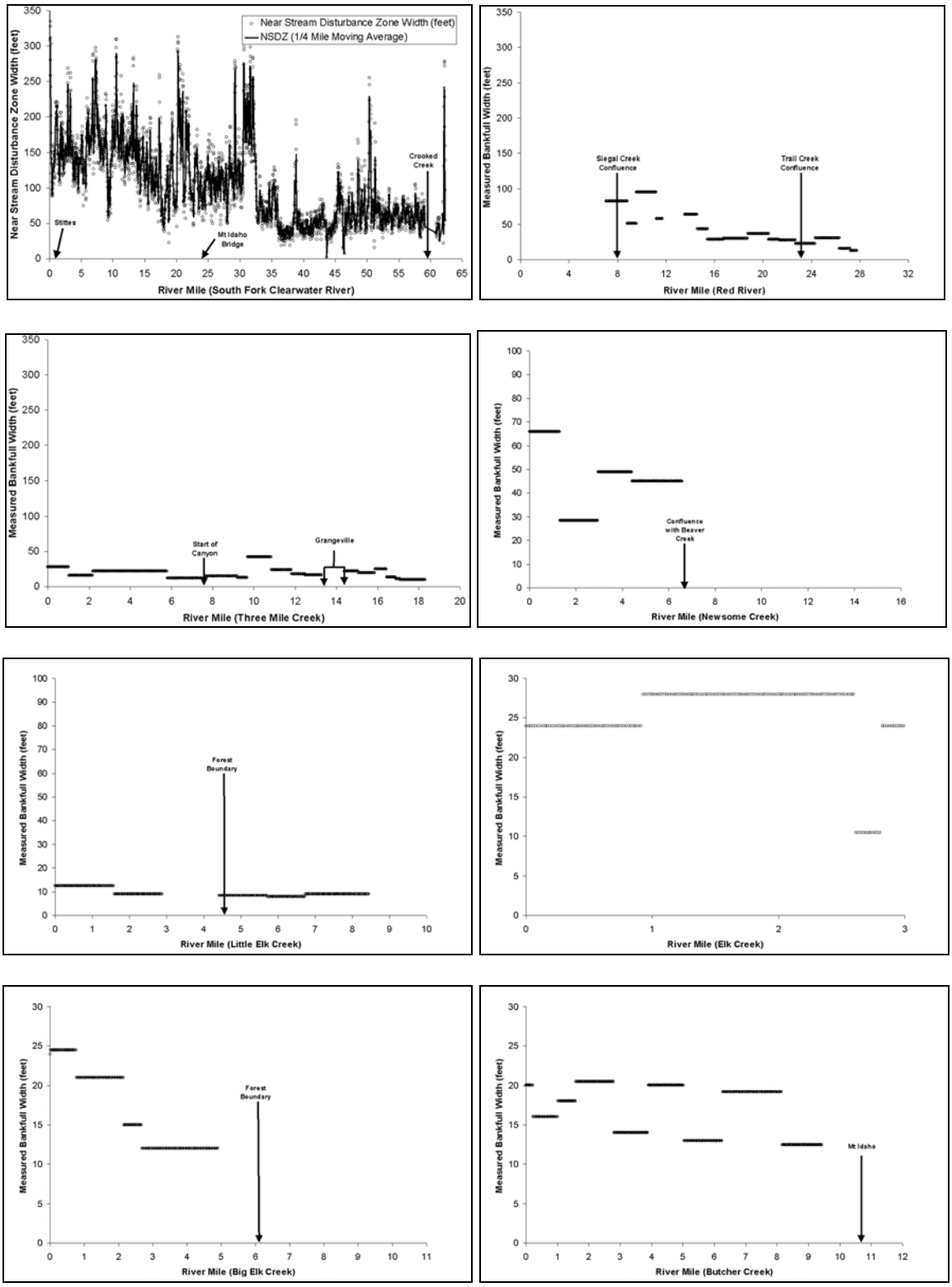


Figure F-10. Calculated Near-Stream Disturbance Zone (NSDZ) Width and Measured Bankfull Width Data

Calculated Current Effective Shade Levels

Near-stream land cover information sampled from the Pi_stratum data set (see Figure F-6) was used to calculate current effective shade levels in 303(d) listed streams in the South Fork Clearwater River subbasin, and Red River. Specifically, effective shade was calculated for each 100-foot model node, taking into account: 1) stream elevation (see Figure F-8), 2) stream aspect (see Figure F-7), 3) topographic shade angle (see Figure F-9), and 4) NSDZ or bankfull width (see Figure F-10).

In addition, the stream location on the earth's surface was calculated in GIS, and the sun's position (i.e., solar altitude and solar azimuth) and movement through the sky were calculated for August 3, 2000. This day corresponds with the FLIR data collection and with the period of the year with maximum river temperatures (Figure F-11).

Calculated current effective shade levels for 303(d) listed streams and Red River are presented in Figure F-12. Current effective shade conditions could only be calculated for areas with an assigned bankfull width or NSDZ (see Figure F-10).

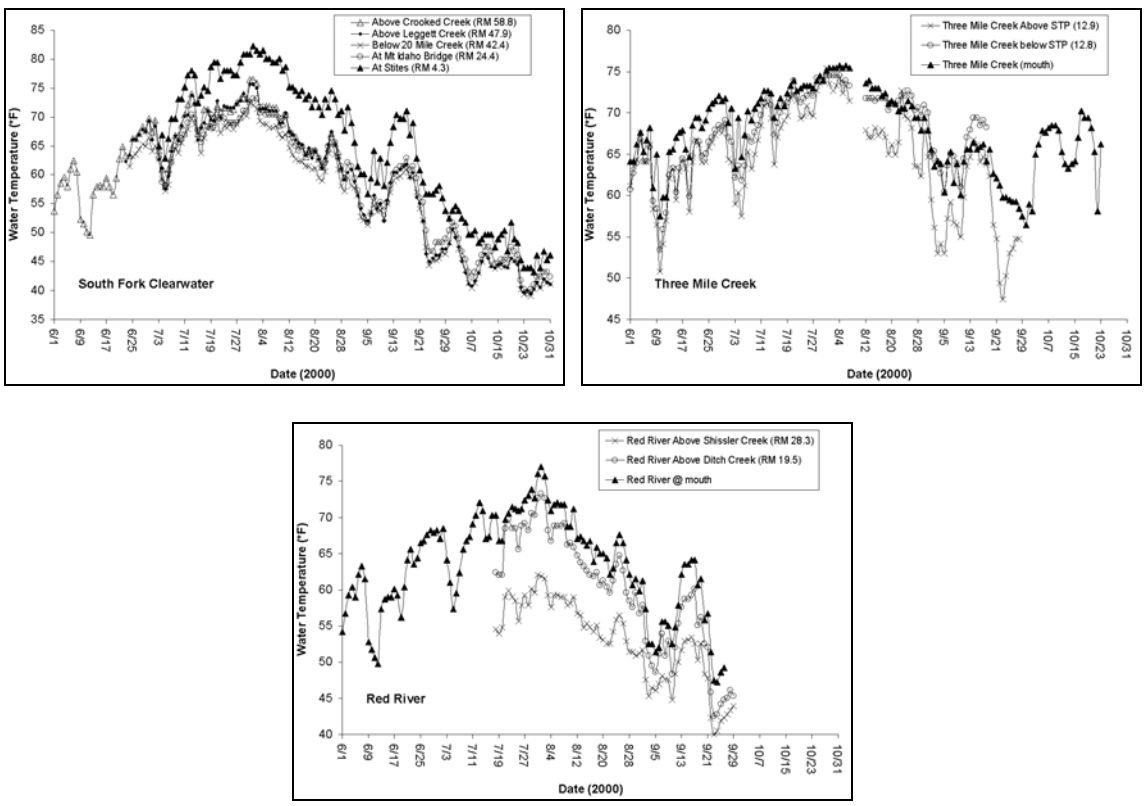


Figure F-11. Seasonal Variations in Temperature (Daily Maximum) in the South Fork Clearwater River, Threemile Creek, and Red River in the Summer of 2000

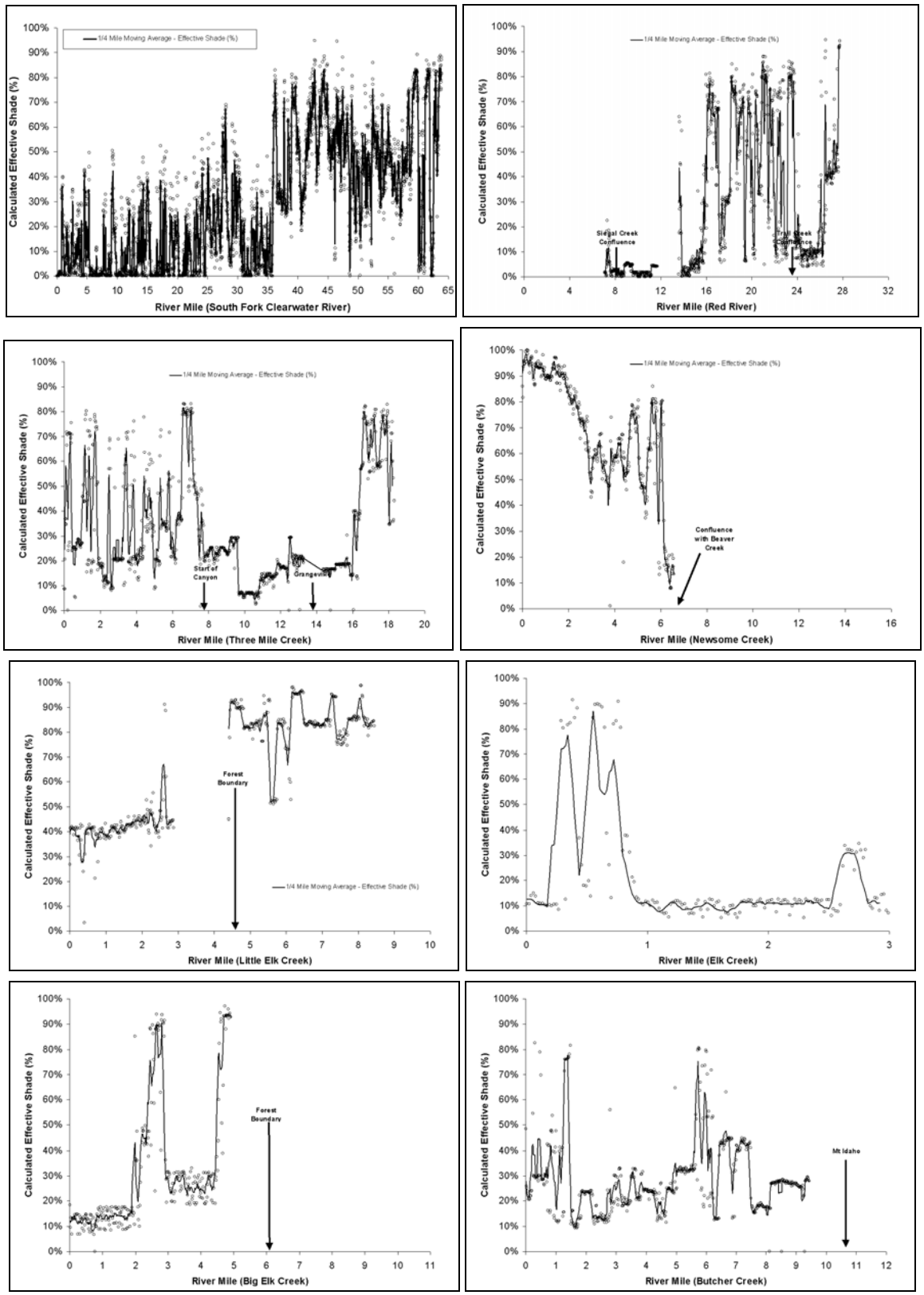


Figure F-12. Calculated Current Effective Shade for 303(d) listed streams and Red River

Current Effective Shade and Stream Temperature

When compared with effective shade levels, measured temperatures within the South Fork Clearwater River Subbasin (Figure F-13), illustrate that energy loading from solar radiation is a dominant factor causing elevated stream temperature in the lower reaches of this river system. In addition, the consequences of cumulative effects of frequent, but spatially minor, low shade areas are clearly presented within the lower Clearwater River (downstream of approximately river mile 24.4), resulting in great temperature increases (the cumulative effects principle is described in Appendix I). Temperatures are already relatively elevated at the beginning of the main stem South Fork Clearwater River, which is the confluence of Red and American River systems. These elevated temperatures reduce slightly as the river travels through the forested areas of the NPNF. The diurnal temperature pattern within this upper reach is maintained throughout the reach, but the diurnal variation increases dramatically in the lower sections of the river (Figure F-13). This downstream area corresponds with periodically low effective shade conditions.

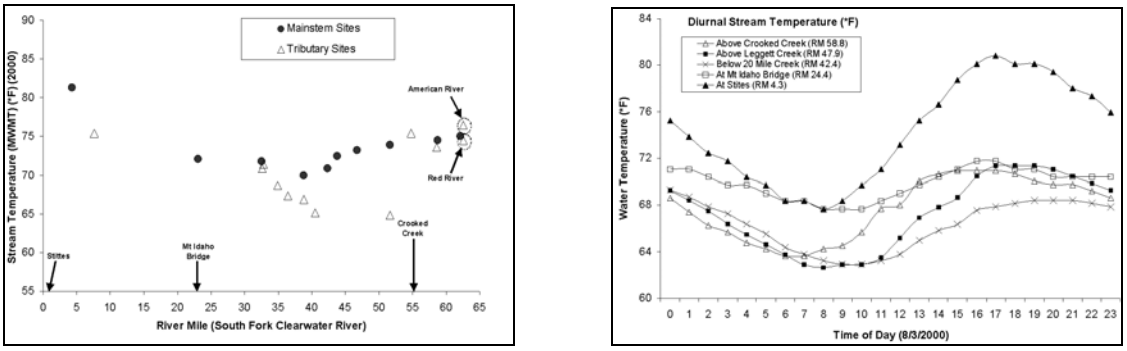


Figure F-13. SF Clearwater River Main Stem – Calculated Maximum Weekly Maximum Temperatures in 2000 and Observed Diurnal Temperatures on August 3, 2000

As mentioned above, stream temperatures are elevated in the South Fork Clearwater River at the confluence of the Red and American Rivers. Elevated stream temperatures in the Red River illustrate a similar pattern of stream temperature increase within areas of infrequent, low effective shade conditions (Figure F-14). These elevated temperatures developed in the Red River (along with the other headwater streams) affect temperature conditions for many miles downstream in the South Fork Clearwater (Figure F-13).

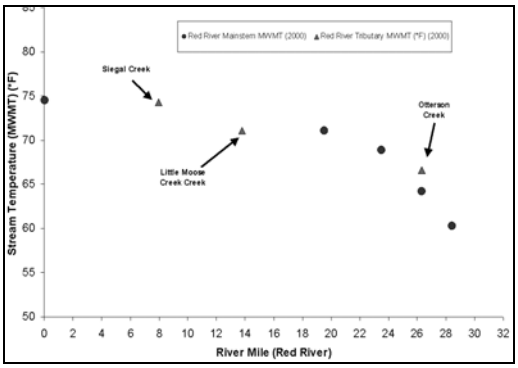


Figure F-14. Maximum Weekly Maximum Temperatures Measured along the Red River in 2000

Stream Side Activities Influencing Riparian and Stream Side Processes

Areas where current and/or historic stream side activities influence riparian and stream side processes are presented within the NPNF *South Fork Clearwater River Landscape Assessment* (USDA 1998). Stream side activities were separated into three categories within this analysis: 1) historic mining activities near the stream, 2) road encroachment on stream channels, and 3) current or historic grazing effects on stream or riparian processes (Figure F-15). These disturbance processes can have a tremendous effect on the parameters that influence temperature conditions within these rivers. For example, Figure F-16 illustrates that road encroachment along the South Fork Clearwater River Subbasin can result in great reduction of localized stream surface shade conditions in the river.

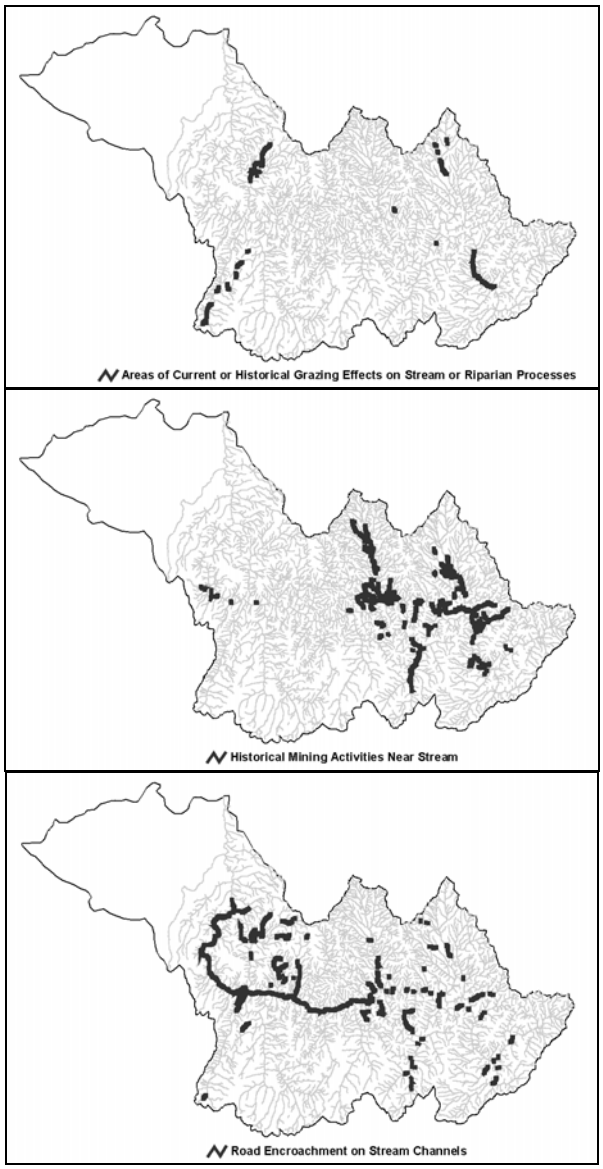


Figure F-15. Stream Side Activities Influencing Riparian and Stream Side Processes in the South Fork Clearwater River Subbasin

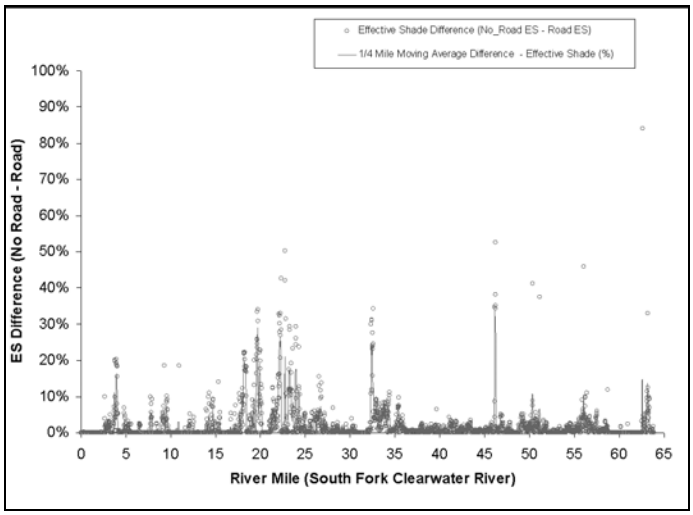


Figure F-16. Calculated Effective Shade (ES) Reduction Resulting from Road Encroachment (Measured as Percent Shade)

System Potential Vegetation TMDL Components

Temperature Nonpoint Sources – Clean Water Act §303(d)(1)

Riparian vegetation, stream morphology, hydrology, climate, and geographic location all influence stream temperature. While climate and geographic location are outside of human control, riparian condition, channel morphology, and hydrology are affected by land use activities. Human activities that can degrade thermal water quality conditions in the South Fork Clearwater River Subbasin watersheds are associated with agriculture, forestry, roads, urban development, and rural residential related riparian disturbance. Specifically, the elevated summertime stream temperatures attributed to anthropogenic nonpoint sources result from the first two items discussed below. Non-anthropogenic sources are also discussed.

Near-Stream Vegetation Disturbance and Removal

This reduces stream surface shading via decreased riparian vegetation height, width, and/or density, thus increasing the amount of solar radiation reaching the stream surface (shade is commonly measured as percent effective shade or percent open sky). Riparian vegetation also plays an important role in shaping the channel morphology, resisting erosive high flows, and maintaining floodplain roughness.

Channel Modifications and Widening (Increased Width to Depth Ratios)

Channel modifications and widening increase the stream surface area exposed to energy processes, namely solar radiation. Bankfull width or NSDZ widening decreases the potential shading effectiveness of shade-producing near-stream vegetation.

Natural Sources and Stream Temperature Natural Conditions

Natural conditions that may impact riparian vegetation and result in elevated stream temperatures include drought, fires, insect damage to riparian vegetation, diseased riparian vegetation, and wind throw and blow down in riparian areas. The processes through which natural conditions affect stream temperatures include increased stream surface exposure to solar radiation and decreased summertime flows.

It was reported within the *South Fork Clearwater River Landscape Assessment* (USDA 1998) that:

> "Pre-settlement disturbances like fire affected the pattern of vegetation because fires tended to vary in size, frequency, severity, and distribution; both randomly and in response to terrain and conditions before the fire. This pervasive disturbance produced both some predictable patterns and great heterogeneity. Fire suppression has reduced this heterogeneity. Timber harvest has created some age class diversity, but not to the degree that fire did. Further, the uniformity of harvest treatments and harvest unit size has resulted in less diversity at the landscape and stand level."

This document goes on to make the following conclusions:

> "Historical sediment delivery and water yield were highly dependent on natural fire regimes. Current sediment delivery and water yield are more closely aligned with disturbances associated with road construction, timber harvest, mining, and grazing." (USDA 1998, p.)
>
> "Timber harvest has replaced fire as the dominant vegetation disturbance process, but this harvest has not sustained landscape pattern; specifically for elements like large pine, larch, and snags. Susceptibility to certain pathogens (root rots and spruce budworm) has increased with increases in grand fir and subalpine fir." (USDA 1998, p.)
>
> "Predominantly pulse disturbances of fire and flood have been supplanted by wide scale press disturbances of harvest and road-related sediment regimes that have impacted aquatic integrity." (USDA 1998, p.)

Loading Capacity – 40 CFR 130.2(f)

The loading capacity provides a reference for calculating the amount of pollutant reduction needed to bring water into compliance with standards. The U.S. Environmental Protection Agency's (USEPA)'s current regulation defines loading capacity as "the greatest amount of loading that a water can receive without violating water quality standards." (40 CFR § 130.2(f)).

The approach used to calculate the temperature loading capacity for this portion of the South Fork Clearwater River Subbasin TMDL is "system potential." System potential is achieved

when nonpoint source solar radiation loading is representative of near stream vegetation and channel morphology conditions without human disturbance and point source discharges cause no measurable temperature increases in surface waters.

System Potential Effective Shade - Defined

The primary factors that affect shade are near-stream vegetation height and channel width (i.e., bankfull width). The maximum level of shade practical at a particular site is termed the "system potential" effective shade level. System potential effective shade occurs when:

1. Near-stream vegetation is at a mature life stage
   - Vegetation community is mature and undisturbed from anthropogenic sources
   - Vegetation height and density are at or near the potential expected for the given plant community
   - Vegetation is sufficiently wide to maximize solar attenuation
   - Vegetation width accommodates channel migrations

2. Channel width reflects a suitable range for hydrologic process given that near-stream vegetation is at a mature life stage
   - Stream banks reflect appropriate ranges of stability via vegetation rooting strength and floodplain roughness
   - Sedimentation reflects appropriate levels of sediment input and transport
   - Substrate is appropriate to channel type
   - Local high flow shear velocities are within appropriate ranges based on watershed hydrology and climate

System Potential Land Cover

As listed above, "system potential land cover" is necessary to achieve "system potential effective shade" and is defined for purposes of the TMDL as "the potential near-stream land cover condition which can grow and reproduce on a site, given climate, elevation, soil properties, plant biology, and hydrologic processes." System potential does not consider management or land use as limiting factors. In essence, system potential is the design condition used for TMDL analysis that meets the temperature standard by minimizing human related warming.

System potential is an estimate of the condition where anthropogenic activities that cause stream warming are minimized. System potential is not an estimate of pre-settlement conditions. Although it is helpful to consider historic land cover patterns, channel conditions, and hydrology, many areas have been altered to the point that the historic condition is no longer attainable given drastic changes in stream location and hydrology (channel armoring, wetland draining, urbanization, etc.).

System Potential Simulation

Loading capacity in the South Fork Clearwater River Subbasin is largely controlled by nonpoint source influences of heat to the system. Temperatures rise throughout much of the watershed due to accumulated heat energy. The greatest change in the heat budget has been an increase in direct solar radiation loading due to human-caused reductions in shade.

System potential was estimated as the August solar radiation levels that would reach the stream surface under conditions where anthropogenic activities would not measurably increase temperature. The system potential radiation load is the loading capacity.

Current conditions were modeled using an effective shade calculator (Heat Source 6.5 [Boyd 1996]), using recently collected field data and other spatial data sources (i.e., bankfull width data, DEM, DOQ, and Pi_stratum). These features were measured on a very fine scale using existing GIS databases and by digitizing with digital orthophoto quadrats. Specifically, "system potential effective shade" was simulated by incorporating expected vegetation stand height and density conditions at "system potential land cover."

It is important to distinguish between site potential shade and system potential shade, the latter being a broad scale view. For a given location, it is expected that site potential shade could be greater than system potential shade. Over a large area (e.g., a river reach), it is unlikely that all sites will be at their site potential due to localized natural disturbances (e.g., fire, flood, landslide, disease, etc.) causing some fraction of the area to be in a less than "mature" state. Accordingly, "system potential land cover" used to calculate "system potential effective shade" incorporates a disturbance component that was developed from available land cover data sets.

Land Cover Classification

Vegetation Response Units (VRUs), Habitat Type Groups (HTGs), and the National Wetland Inventory (NWI) are three land cover classifications available for the South Fork Clearwater River Subbasin. Land cover classifications from these sources are spatially explicit and are mapped out for the basin.

The VRUs and HTGs emphasize the vegetation component of land cover and differentiate between forest and non-forest land cover types. These were used, along with NWI data, to establish the vegetative community descriptions used in to develop appropriate shade targets for the South Fork Clearwater River Subbasin. Brief descriptions of VRUs, HTGs, and the NWI are presented below, and detailed information about VRU and HTG is presented in Appendix H**.**

Vegetation Response Units

The VRUs are broad ecological land units that display unique patterns of habitat type groups (potential vegetation) and terrain. The VRU classification and delineation was developed for the South Fork Clearwater River Subbasin and was reported within the *South Fork Clearwater River Landscape Assessment* (USDA 1998) (Figure F-17). The components used

to build the VRU classification system are habitat type groups (potential vegetation), landform, and pre-settlement disturbance processes (like fire regimes). The VRUs are basically a product of geology, landform, climate, and soil. Individual VRUs have similar patterns of disturbance and successional processes. Patterns of plant community composition, age class structure, and patch size will tend to fall within certain ranges for each VRU. The VRUs are intended to provide a means to estimate resource capabilities, ecological integrity, and responses to natural and human-caused disturbances. Ultimately, VRUs are intended to be templates for assessing historic and current condition and developing target or desired landscapes.

Table F-5 illustrates the percent distribution of VRU classes within a 300-meter buffer surrounding the South Fork Clearwater River and several major tributaries. As can be seen in this table, riparian areas are often dominated by a few VRU classes, and the total number of VRU classes for each river system is limited. A detailed description of the 13 individual VRU habitat types within the South Fork Clearwater River Subbasin are provided in Appendix H.

Table F-5. Percent distribution of Vegetation Response Units (VRUs) within a 300-meter buffer surround the South Fork Clearwater River and several major tributaries.

VRU #	SF CWR	Three-mile Creek	Crooked Creek	Red River	American River	Little Elk Creek	Big Elk/Elk Creek	Newsome Creek
1	- -	- -	20.4	1.5	- -	- -	3.0	0.3
2	- -	- -	5.4	- -	- -	- -	- -	- -
3	88.0	39.0	50.9	2.1	- -	- -	1.4	21.8
4	- -	- -	- -	12.7	- -	- -	- -	- -
5	- -	- -	- -	- -	- -	- -	- -	- -
6	6.8	- -	13.2	83.7	79.7	54.7	69.8	29.8
7	0.4	- -	10.1	- -	6.0	37.8	14.0	41.1
8	- -	- -	- -	- -	- -	- -	- -	- -
9	- -	- -	- -	- -	- -	0.2	0.3	- -
10	- -	- -	- -	- -	14.3	7.2	11.5	7.1
12	4.4	8.7	- -	- -	- -	- -	- -	- -
16	- -	52.3	- -	- -	- -	- -	- -	- -
17								
98	0.4	- -	- -	0.0	0.1	- -	0.0	- -

(VRU #98 signifies “no code”)

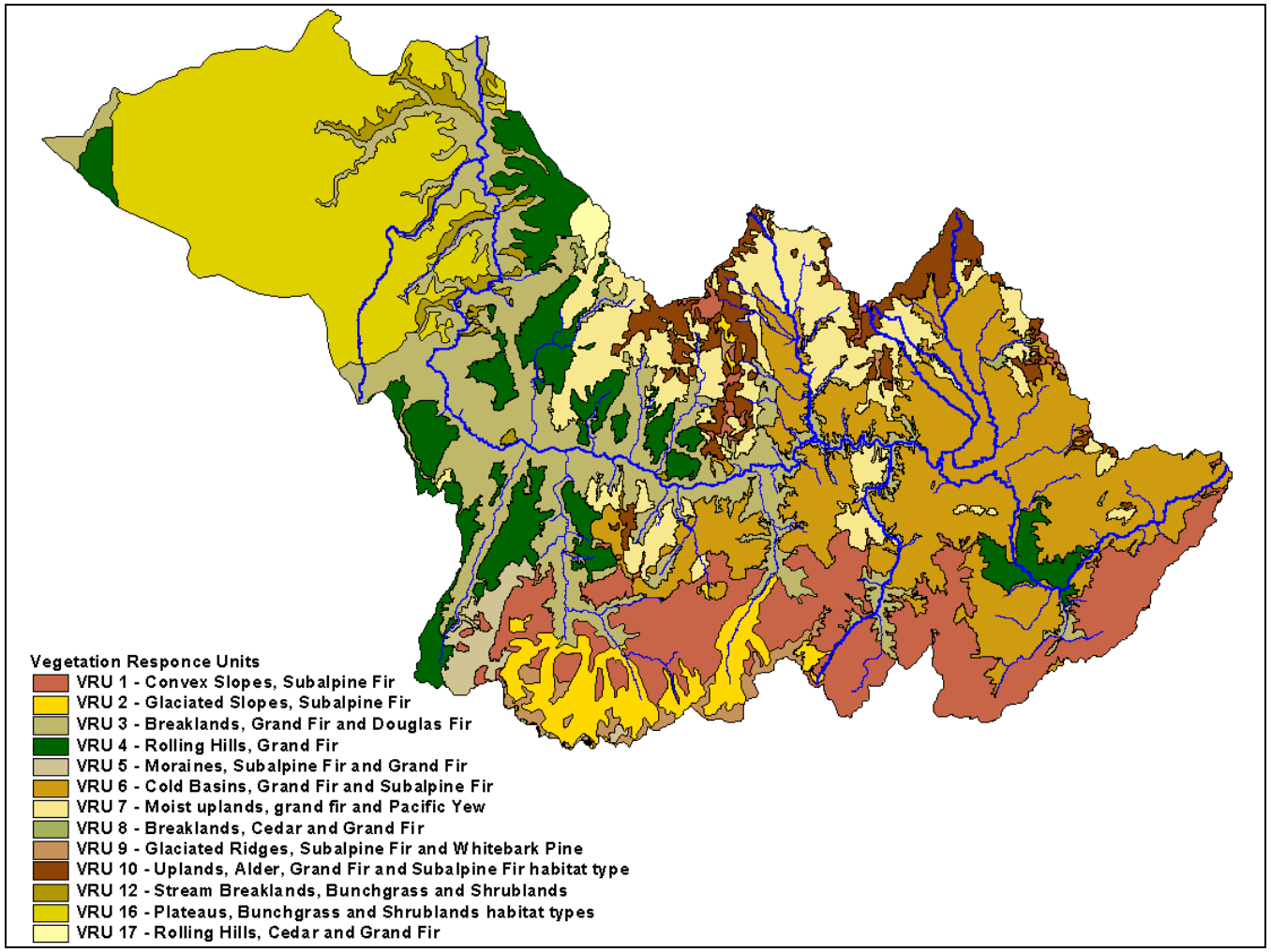


Figure F-17. Vegetation Response Units (VRUs) for the South Fork Clearwater River Subbasin

Forested Vegetation Response Units – Vegetation communities listed for each "forested" VRU are presented in Table F-6. Vegetation is separated into dominant vegetation and "other overstory" vegetation. The relative proportion of vegetation size class composition for each "forested" VRU is summarized in Table F-7.

Table F-6. Vegetation composition within "forested" Vegetation Response Units (VRUs).

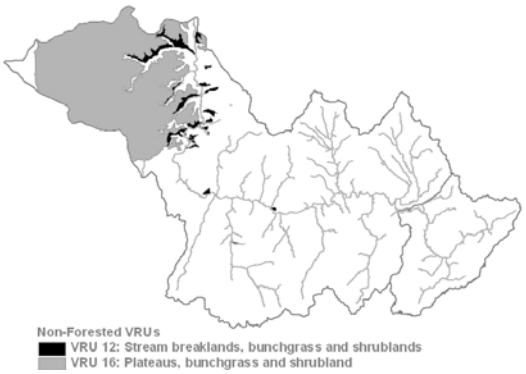
VRU #		Dominant Vegetation*	Other Overstory*
1	Convex slopes, subalpine fir	GF, SAF, LP	ES, WL, DF, WBP
2	Glaciated slopes, subalpine fir	SAF, LP, ES	
3 - South	Breaklands, grand fir and Douglas fir	DF, PP	
3 - North	Breaklands, grand fir and Douglas fir	GF, DF	PP, WL, ES, LP
4	Rolling hills, grand fir	GF, DF, PP, WL	LP, ES
5	Moraines, subalpine fir and grand fir	LP, ES	GF, DF, SAF, WL
6	Cold basins, grand fir and subalpine fir	LP, WL, DF, ES, GF	WBP
7	Moist uplands, grand fir and Pacific yew	GF, DF, PY	WL, ES, LP
8	Breaklands, cedar and grand fir	GF, DF	WL, WRC, WWP, ES, PY, PP, LP
9	Glaciated ridges, subalpine fir and whitebark pine	WBP, SAF, ES, LP	
10	Uplands, alder, grand fir and subalpine fir	GF, SAF, ES, Sitka, Alder	
17	Rolling hills, cedar and grand fir	GF, DF	WRC, WWP, WL, ES, PP

*GF, Grand Fir; SAF, Subalpine Fir; LP, Lodgepole Pine; ES, Engelmann Spruce; WL, Western Larch; DF, Douglas Fir; WBP, Whitebark Pine; PP, Ponderosa Pine; PY, Pacific Yew; WRC, Western Red Cedar; WWP, Western White Pine

Table F-7. Relative proportion (percentage) of vegetation size classes for Vegetation Response Units (VRUs).

VRU #	Non-Forest (non-stock)	Seedling/ Sapling	Pole	Medium Tree	Large Tree
1	5-10	20-30	20-30	20-30	5-15
2	10-25	10-30	30-65	5-15	10-10
3-South	5-20	5-30	10-20	20-40	20-40
3-North	5-20	5-30	10-20	20-40	20-40
4	5-10	5-50	10-30	20-30	10-50
5	5	10-40	20-60	5-30	3-10
6	5-10	10-30	30-45	20-40	5-20
7	1-10	5-20	10-25	25-35	35-45
8	5-20	5-30	10-20	30-50	20-30
9	30-40	10-30	15-60	1-10	1
10	10-25	15-25	20-30	25-40	15-25
17	10-25	15-25	20-30	20-35	15-40

Non–Forested Vegetation Response Units –Two VRUs within the South Fork Clearwater River Subbasin are dominated by non-forest vegetation. Vegetation Response Units 12 and 16 are located primarily within the low elevation areas of the subbasin (see image to right). Detailed descriptions about these VRUs are presented below (USDA 1998).



VRU 12: Stream breaklands, bunchgrass, and shrublands – This VRU is rare on NPNF lands in the subbasin, but is common in the lower canyon on private lands. Bluebunch wheatgrass and Idaho fescue habitat types are dominant. Shrubland habitat types are common. Bluebunch wheatgrass and Idaho fescue were historically important. Shrublands occupied draws or lower slopes. Very frequent (5-25 years), low severity fires maintained open grasslands and rejuvenated shrublands.

***VRU 12: Changes from historic conditions* -** On all lands, only general trends have been noted. Disturbed grasslands (annuals and weeds) and pasture have replaced native perennials over more than 50% of their prior extent. Upland shrublands have increased as much as 100% due to fire suppression and brush invasions of former grasslands. About 2 acres have burned annually on NPNF lands in the subbasin since fire suppression became effective, a decline of about 82%.

VRU 16: Plateaus, bunchgrass, and shrubland – This VRU occurs only on non-NPNF lands. Bluebunch wheatgrass, Idaho fescue, and shrubland habitat types are common. Bluebunch wheatgrass and Idaho fescue were historically important. Shrublands occupied draws, lower slopes, and north aspects. Very frequent (5-25 years), low severity fires maintained open grasslands and rejuvenated shrublands.

VRU 16: Changes from historic conditions – On all lands, only general trends have been noted. Annual cropland has replaced native perennials on more than 80% of their prior extent. Hayland and pasture have largely replaced the remaining native prairie. Upland shrublands have probably also decreased. Fire incidence has certainly declined, but to what extent is unknown.

Habitat Type Groups

Habitat type grouping is based on similarities in natural disturbance regimes, successional patterns, and structural characteristics of mature stands. The HTGs are intended to assist with sub-regional and landscape assessments. Habitat Type Groups were developed for northern Idaho and western Montana. Classified HTGs within the South Fork Clearwater River Subbasin were subsequently adapted from the original HTG coverage (Figure F-18). The HTGs are separated into forest and non-Forest categories. A detailed description for each category is presented in Appendix H. The HTG information was obtained from the document, *Biophysical Classification – Habitat Groups and Descriptions*.

Vegetation Response Units and Habitat Type Groups

Extensive GIS sampling was conducted on both the VRU and HTG coverages in order to determine the distribution of HTGs for each VRU within a 300-meter buffer surrounding the South Fork Clearwater River and several major tributaries. Table F-8 presents the measured distribution for these parameters.

The HTG coverage is at a higher spatial resolution of vegetation land conditions than the VRU. Accordingly, several HTGs are often observed for each VRU. However, there is a very close relationship between land cover conditions described within these two data sets.

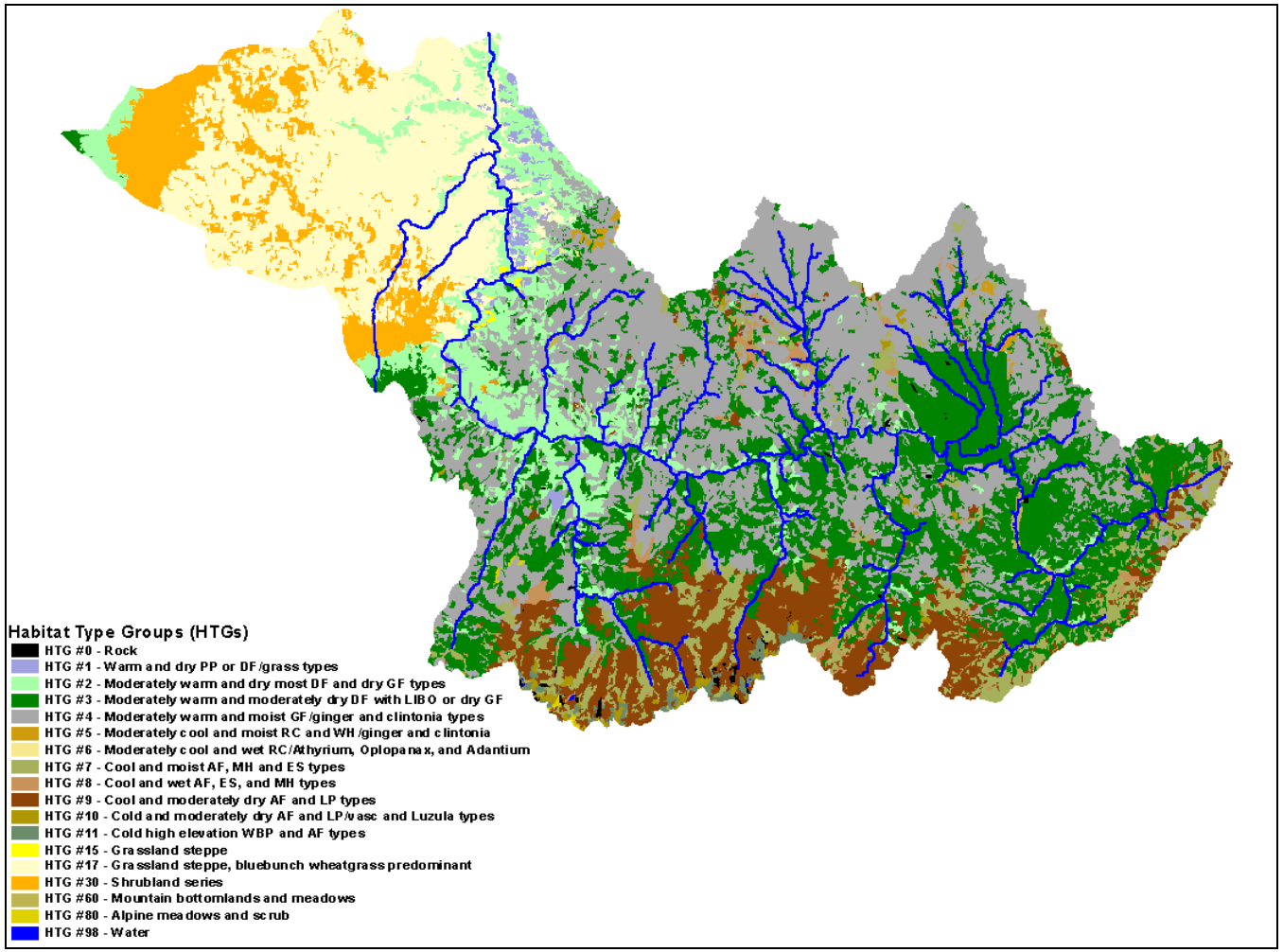


Figure F-18. Habitat Type Groups Within the South Fork Clearwater River Subbasin

Table F-8. Percent distribution of Habitat Type Groups (HTGs) for each classified Vegetation Response Units (VRUs) zone within a 300-meter buffer surrounding the South Fork Clearwater River and several major tributaries.

Main Stem South Fork Clearwater River

HTG (VRU 3)	% of Total	HTG (VRU 6)	% of Total	HTG (VRU 7)	% of Total	HTG (VRU 12)	% of Total	HTG (VRU 99)	% of Total
0	1.0%	0	0.0%			0	0.0%	0	0.2%
1	5.4%					1	0.6%	1	0.0%
2	35.6%	2	0.2%	2	0.0%	2	1.2%	2	0.1%
3	14.5%	3	4.6%	3	0.2%				
4	18.0%	4	2.0%	4	0.3%	4	0.0%	4	0.0%
7	0.2%								
15	0.1%					15	0.4%	15	0.0%
17	12.1%					17	2.2%	17	0.0%
30	0.0%								
50	1.2%					50	0.0%	50	0.0%
98	0.0%							98	0.0%
Total	**88.0%**	**Total**	**6.8%**	**Total**	**0.4%**	**Total**	**4.4%**	**Total**	**0.4%**

Threemile Creek

HTG (VRU 3)	% of Total	HTG (VRU 12)	% of Total	HTG (VRU 16)	% of Total
1	0.2%			1	0.2%
2	15.1%	2	4.1%	2	0.7%
3	3.6%				
17	17.4%	17	4.5%	17	30.3%
30	1.2%	30	0.1%	30	21.1%
50	1.4%			50	0.0%
Total	**39.0%**	**Total**	**8.7%**	**Total**	**52.3%**

Red River

HTG (VRU 1)	% of Total	HTG (VRU 3)	% of Total	HTG (VRU 4)	% of Total	HTG (VRU 6)	% of Total	HTG (VRU 99)	% of Total
				0	0.1%	0	0.5%		
						1	0.0%		
2	0.0%	2	1.1%	2	2.7%	2	2.4%		
3	0.1%	3	0.7%	3	8.7%	3	39.0%		
		4	0.3%	4	0.7%	4	9.9%		
7	1.2%			7	0.3%	7	6.7%		
8	0.1%					8	3.8%		
9	0.1%					9	4.3%		
				60	0.2%	60	17.1%	60	0.0%
Total	**1.5%**	**Total**	**2.1%**	**Total**	**12.7%**	**Total**	**83.7%**	**Total**	**0.0%**

Big Elk Creek

HTG (VRU 1)	% of Total	HTG (VRU 3)	% of Total	HTG (VRU 6)	% of Total	HTG (VRU 7)	% of Total	HTG (VRU 9)	% of Total	HTG (VRU 10)	% of Total	HTG (VRU 99)	% of Total
3	0.0%			3	53.2%	3	1.1%	3	0.3%	3	0.2%	3	0.0%
		4	1.2%	4	16.5%	4	7.7%	4	0.0%	4	6.5%		
7	1.3%	7	0.1%	7	0.1%	7	2.1%			7	2.5%		
8	0.8%					8	3.2%	8	0.0%	8	2.4%		
9	0.9%							9	0.0%	9	0.0%		
Total	3.0%	Total	1.4%	Total	69.8%	Total	14.0%	Total	0.3%	Total	11.5%	Total	0.0%

Table F-8 (continued). Percent distribution of Habitat Type Groups (HTGs) for each classified Vegetation Response Units (VRUs) zone within a 300-meter buffer surrounding the South Fork Clearwater River and several major tributaries.

American River

HTG (VRU 6)	% of Total	HTG (VRU 7)	% of Total	HTG (VRU 10)	% of Total	HTG (VRU 99)	% of Total
0	0.4%						
2	0.1%						
3	59.9%	3	1.5%	3	1.8%	3	0.1%
4	14.3%	4	4.1%	4	10.0%		
7	0.3%			7	2.4%		
8	1.1%	8	0.4%	8	0.1%		
9	1.2%						
60	2.3%						
Total	**79.7%**	**Total**	**6.0%**	**Total**	**14.3%**	**Total**	**0.1%**

Little Elk Creek

HTG (VRU 6)	% of Total	HTG (VRU 7)	% of Total	HTG (VRU 10)	% of Total	HTG (VRU 99)	% of Total
0	0.4%						
2	0.1%						
3	59.9%	3	1.5%	3	1.8%	3	0.1%
4	14.3%	4	4.1%	4	10.0%		
7	0.3%			7	2.4%		
8	1.1%	8	0.4%	8	0.1%		
9	1.2%						
60	2.3%						
Total	**79.7%**	**Total**	**6.0%**	**Total**	**14.3%**	**Total**	**0.1%**

Crooked Creek

HTG (VRU 1)	% of Total	HTG (VRU 2)	% of Total	HTG (VRU 3)	% of Total	HTG (VRU 6)	% of Total	HTG (VRU 7)	% of Total
0	0.0%			0	0.4%				
				1	0.2%				
2	1.2%	2	0.2%	2	7.5%	2	0.2%	2	0.1%
3	9.3%	3	0.6%	3	26.7%	3	8.1%	3	3.8%
4	0.9%	4	0.2%	4	12.5%	4	3.6%	4	5.2%
7	1.8%	7	0.9%	7	1.3%	7	0.3%	7	0.7%
8	4.1%	8	2.4%						
9	3.0%	9	1.1%	9	2.2%	9	1.0%	9	0.3%
Total	**20.4%**	**Total**	**5.4%**	**Total**	**50.9%**	**Total**	**13.2%**	**Total**	**10.1%**

Newsome Creek

HTG (VRU 1)	% of Total	HTG (VRU 3)	% of Total	HTG (VRU 6)	% of Total	HTG (VRU 7)	% of Total	HTG (VRU 10)	% of Total
		0	0.0%						
		2	3.2%						
		3	2.1%	3	8.0%	3	11.2%		
4	0.3%	4	10.3%	4	13.2%	4	29.8%	4	7.1%
		7	4.0%	7	2.7%	7	0.0%		
		8	1.9%	8	4.4%	8	0.0%		
		9	0.3%	9	0.2%				
				60	1.4%	60	0.0%		
Total	**0.3%**	**Total**	**21.8%**	**Total**	**29.8%**	**Total**	**41.1%**	**Total**	**7.1%**

National Wetlands Inventory

A wetland database has been developed for the South Fork Clearwater River Subbasin (Harrison and Kellogg 1987). The database, part of the National Wetlands Inventory (NWI), contains a description of riparian wetland locations throughout the subbasin. Wetlands are broken into three main categories: 1) herbaceous, 2) forested, and 3) shrub. These are subdivided into numerous other units based on site-specific information. Classifications were developed through an analysis of aerial photographs, examining visible vegetation, hydrology, and geography. Figure F-19 illustrates the spatial distribution of wetland areas within the South Fork Clearwater River Subbasin.

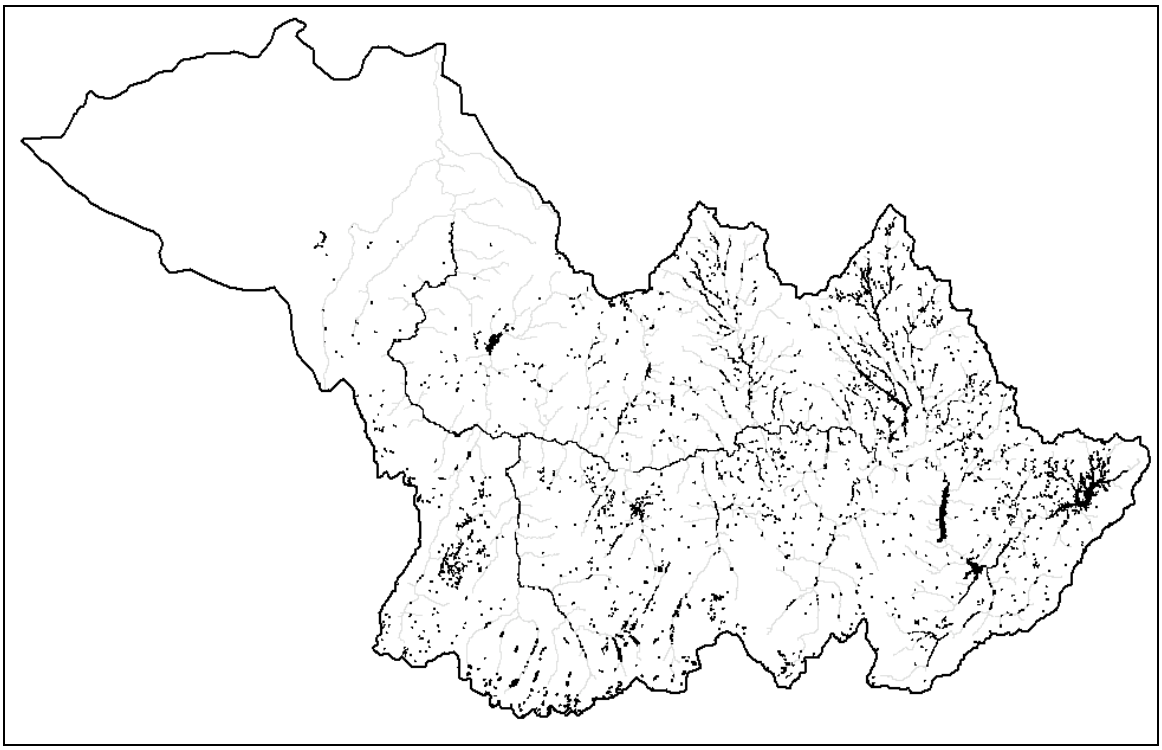


Figure F-19. National Wetlands Inventory for the South Fork Clearwater River Subbasin

It was estimated from this work that only 4-6% of the land area within NPNF meets the Forest Service riparian area definition for a riparian wetland. The purpose of this inventory was to map out riparian wetland areas so that those areas could be protected, and thus provide benefits to the public through flood and storm damage control, erosion control, water quality improvement, and fish and wildlife resource protection.

System Potential Land Cover Condition - "Forest" Vegetation

Mature vegetation height information for species present within the South Fork Clearwater River Subbasin is listed in Table F-9. Note that the upper end of measured tree heights within the South Fork Clearwater River Subbasin (illustrated in Figure F-4 and presented in Table F-2) correspond closely with the values reported below.

Table F-9. Mature vegetation height condition (U.S. Department of Agriculture Fire Effects Information System [fs.fed.us/database/feis])

Vegetation Type	Height (ft)	Average Value (ft)	High Elev (ft)	Mid - Low Elev (ft)
Grand fir	131 - 164	148	140	152
Engelmann spruce	45 - 130	88	65	110
Douglas fir	100 - 130	115		
Subalpine fir	60 - 100	80		
Ponderosa pine	90 - 130	110		
Lodgepole pine	60 - 80	70		
Western red cedar	70 - 100	85		
Western larch		164	130 (upper SW facing)	170 (lower NE facing)
Rocky mountain maple	20 - 30	25		
Western white pine		200		
Whitebark pine	50 - 70	60		
Sitka alder	10 - 15	12		
Pacific yew	20 - 40	30		
Black cottonwood		100		
Western hemlock	100 - 150	125	110	140
Red osier dogwood	3 - 19	11		
Thimbleberry	6.6 - 8.2	7.4		
Western snowberry	2 - 4	3		
Western serviceberry	3 - 26	15		
Booth willow	9 - 18	14		
Geyer willow	up to 20	15		
Drummond willow	6.5 - 13	10		
Carex rostrata	1 - 4	2.5		
Carex lenticularis	0.1 - 1	0.5		

As mentioned previously, it is unlikely that all sites throughout a watershed will be at a mature condition due to localize natural disturbances (e.g., fire, flood, landslide, disease, etc.). causing some fraction of the area to be in a less than "mature" state. Accordingly, the relative proportion of size classes established for each VRU was used to incorporate age structure for the estimate of height conditions, which was used to establish system potential effective shade conditions. That is, the riparian community is represented by various age classes. Those age classes will be used to calculate respective height conditions for these age classes. Size class information for each VRU is presented in Table F-7.

The following steps were used to estimate size class distribution for each VRU based on the reported ranges in Table F-7:

- Step 1 - Allocate maximum value for percent "large tree" class
- Step 2 - Allocate maximum value for percent "non-stock" class
- Step 3 - Allocate maximum, or remaining, value for percent "medium tree" class
- Step 4 - Allocate maximum, or remaining, value for percent "pole" class
- Step 5 - Allocate remaining value for percent "seedling/sapling" class

For example, VRU 4 would be allocated 50% for "large tree" (i.e., maximum value), 10% for "non-stocked" (i.e., maximum value), 30% for "medium tree" (i.e., maximum or remaining value), 10% for "pole" (i.e., maximum or remaining value), and 0% for "seedling/sapling" (i.e., remaining value). As can be seen, this method incorporates an estimate of expected open areas ("non-stock"), as well as incorporates disturbance through using the expected size classes.

The following rules were used to estimate height conditions for each of the size classes.

- "Large tree" was assigned the average of mature vegetation height (see Table F-9)
- "Medium tree" and "pole" were assigned a height calculated from species-specific growth curves developed from data collected within the NPNF (see Table F-3). The dbh values used in this calculation were assigned the maximum of the range listed for the size class (see Table F-1)
- "Seedling/sapling" was assigned a value of 20 feet
- "Non-stock" was assigned a height of zero

As noted in Table F-6, numerous vegetation species (categorized into "dominant" and "other overstory" groups)are shown to be present within each VRU category. Vegetation height conditions were developed for each species present within the respective VRU, which were summarized into a weighted average condition using values calculated using the size class distribution rule set presented above. These values for each species were average within "dominant," and "other overstory" groups (see Table F-6). A weighting factor of 80% for dominant and 20% for "other overstory" was used (i.e., (75' * 80% = 60' (dominant)) plus (90 * 20% = 18 (other overstory)) = 78').

Overhang was assigned a value of 10% of the final vegetation height (i.e., 78 feet * 10% = 7.8 feet). Overhang is the tree branch length from the trunk of the tree.

System Potential Land Cover Condition - "Non-Forest" Vegetation

Vegetation height, used to develop system potential effective shade, for "non-forest" areas, was calculated as the average of mature vegetation height. The percent of the stream bank not covered by any vegetation for "non-forest" areas is 10% for both shrub and wetland areas. This is analogous to the "non-stock" category in forested areas.

Shrub vegetation used to calculate vegetation height was obtained from HTG 30 (shrub steppe) (Appendix H). Based on shrub species in HTG 30, the average mature height was 8.4 feet. Grass was assigned a height of 1 foot. The distributions of shrub and grass were assigned 80% and 20%, respectively. Overhang was assigned 50% of height.

Riparian Wetlands

Approximately 4-6% of the land area within the NPNF is comprised of riparian wetlands (Figure F-20). Specifically, the NWI categorized wetland communities into scrub, herbaceous, and forest.

Herbaceous Meadow Wetland

A discussion of the best example of potential mature vegetation for a herbaceous meadow system in the South Fork Clearwater River Subbasin is included in the document, *Analysis of the Riparian Vegetation of Red River Meadows* (Brunsfeld 1994). The average of mature average vegetation heights of listed potential vegetation was 13.75 feet, and the average sedge height was 1.5 feet. The average of mature average vegetation heights of listed potential vegetation was used in calculating system potential conditions.

Forest Meadow Wetland

Bureau of Land Management staff provided site data from the East Fork of American River, (East Fork American River - Site # 3) which is a good example of a mature forest meadow wetland vegetation community within the South Fork Clearwater River Subbasin (Craig Johnson, BLM, personal communication). The distribution of vegetation measured at this site was 18% tree, 22% shrub, and 60% sedge. Tree vegetation at this site was 50% grand fir, 33% Engelmann spruce, and 17% lodgepole pine. Similar to "herbaceous meadow wetlands," the average of mature average vegetation heights of listed potential vegetation was used in calculating system potential conditions.

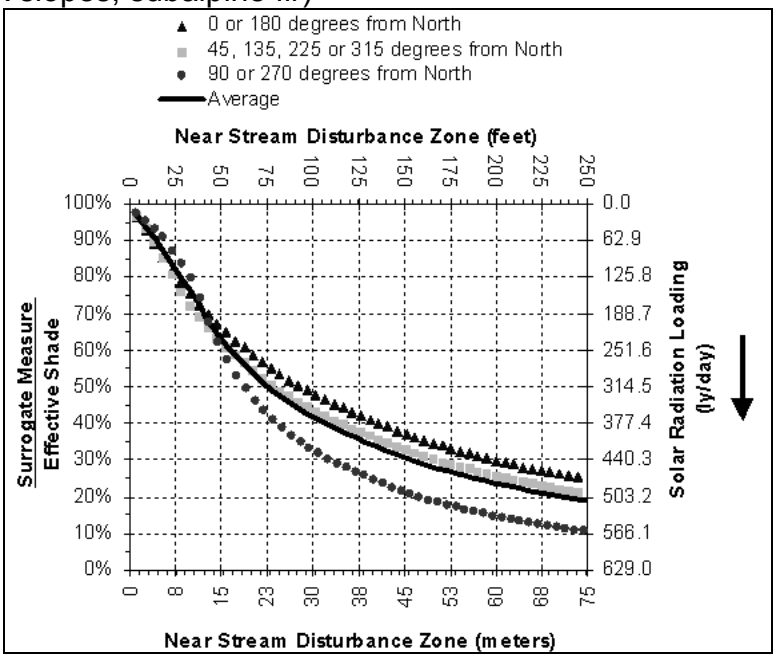
Scrub Meadow Wetland

Because of a lack of information, system potential land cover conditions used to develop system potential shade conditions for scrub meadow wetland systems were assigned values obtained from herbaceous meadow wetlands.

System Potential Effective Shade Calculation

System potential effective shade conditions were calculated using the estimated vegetation stand information presented above (Figure F-20). The Heat Source 6.5 shade calculator was used for this analysis (Boyd 1996).

VRU 1 (Convex slopes, subalpine fir)



VRU 2 (Glaciated slopes, subalpine fir)

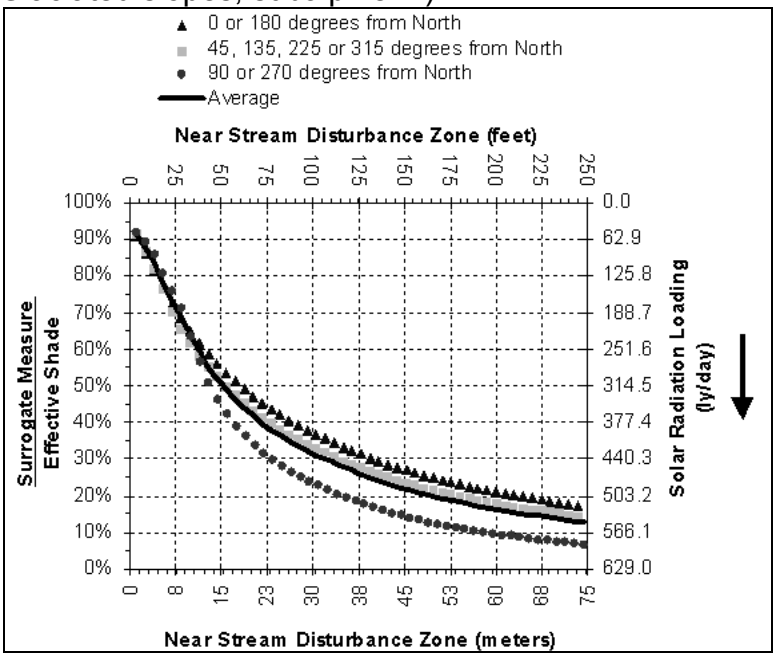
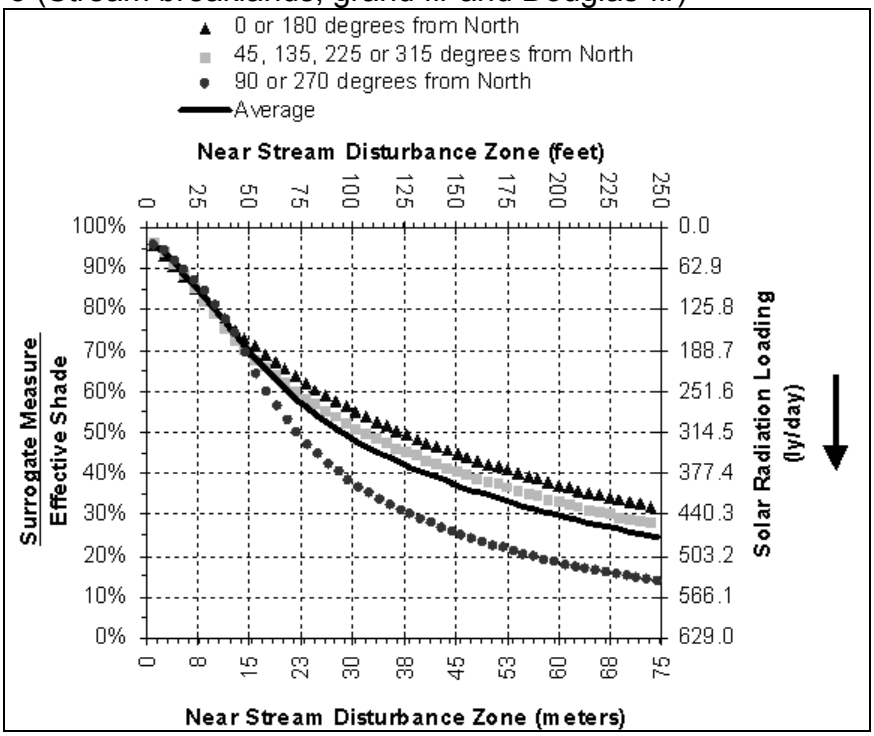


Figure F-20. Shade Curves Developed for Vegetation Response Units (VRUs)

VRU 3 (Stream breaklands, grand fir and Douglas-fir)



VRU 4 (Rolling hills, grand fir)

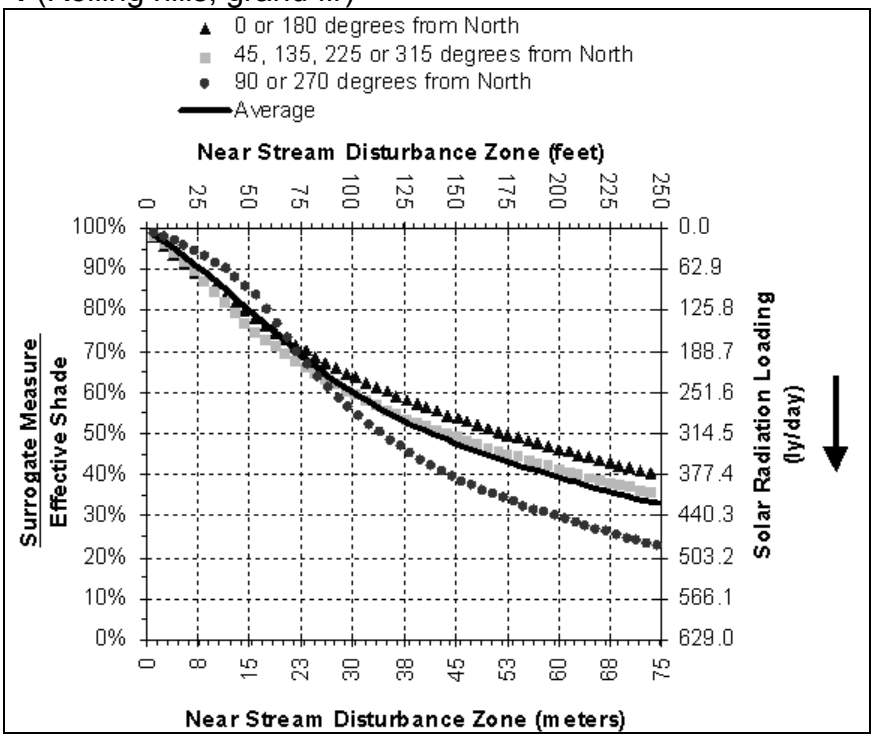
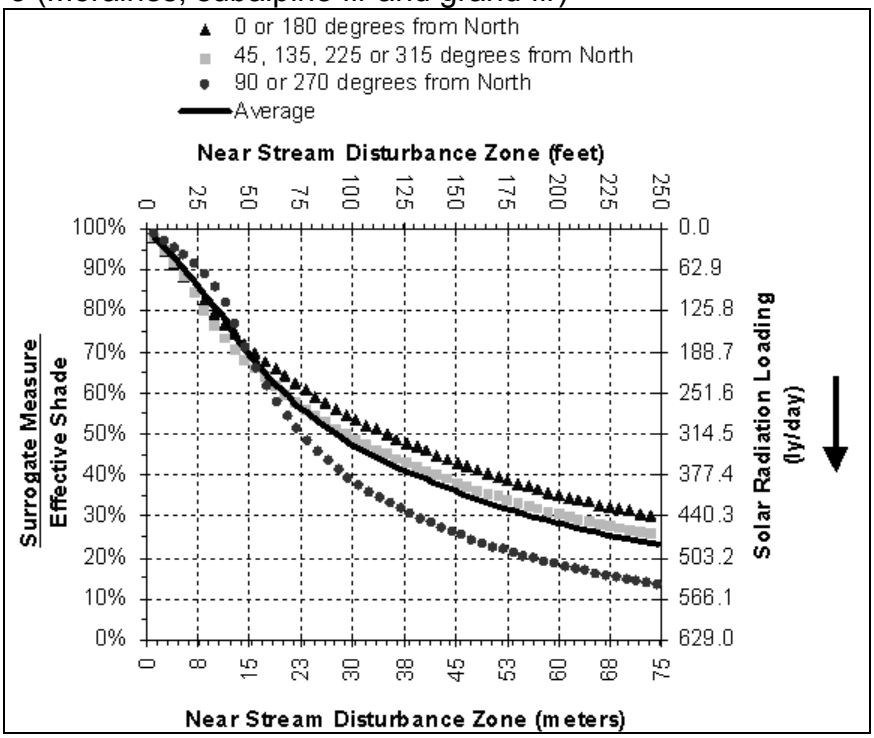


Figure F-20 (continued). Shade Curves Developed for Vegetation Response Units (VRUs)

VRU 5 (Moraines, subalpine fir and grand fir)



VRU 6 (Cold basins, grand fir and subalpine fir)

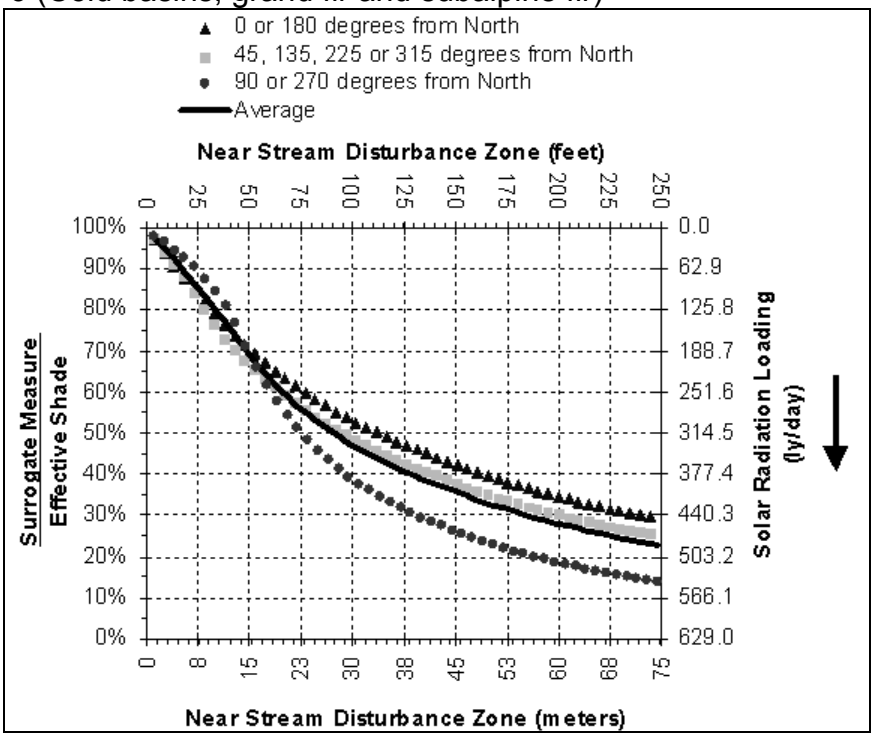
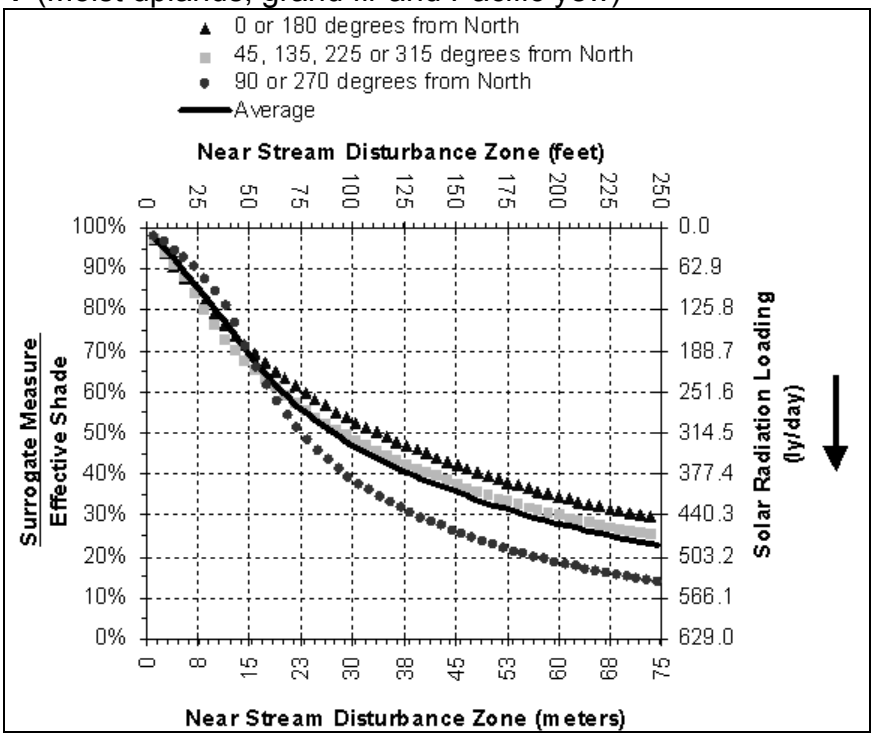


Figure F-20 (continued). Shade Curves Developed for Vegetation Response Units (VRUs)

VRU 7 (Moist uplands, grand fir and Pacific yew)



VRU 8 (Stream breaklands, cedar and grand fir)

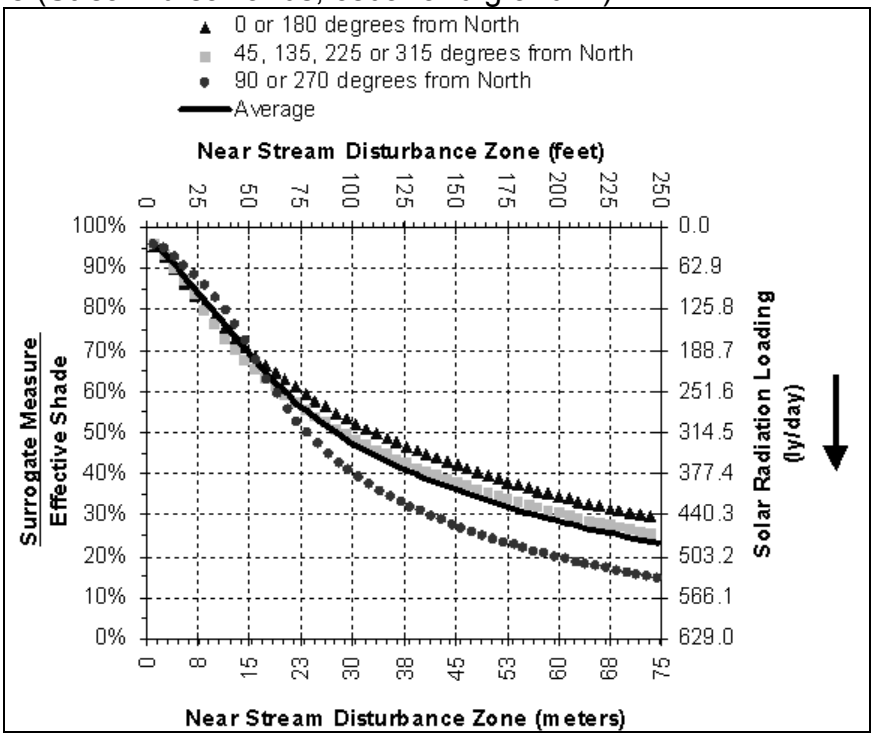
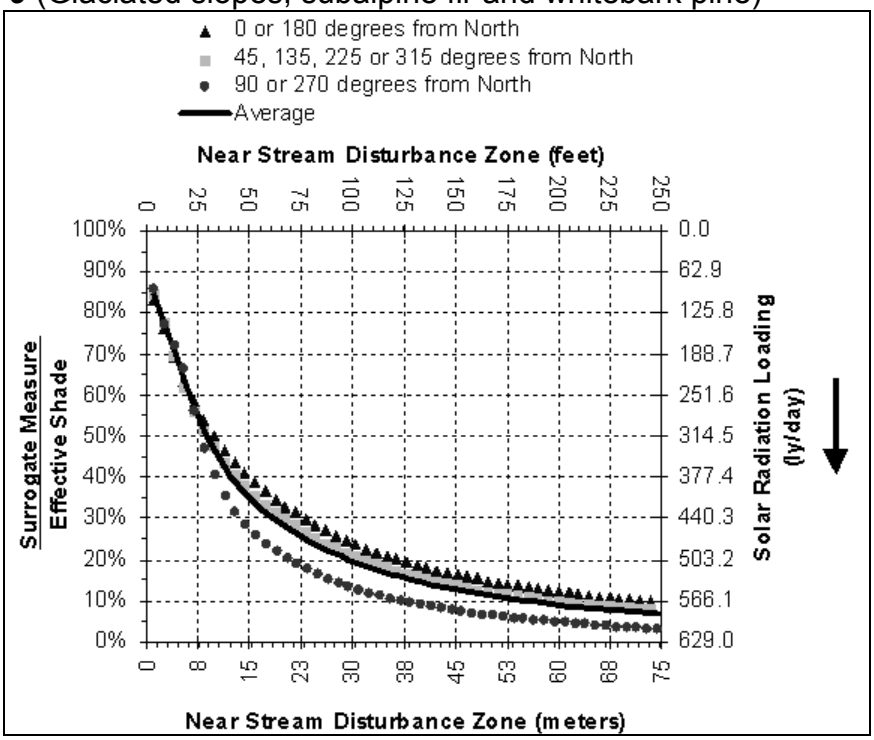


Figure F-20 (continued). Shade Curves Developed for Vegetation Response Units (VRUs)

VRU 9 (Glaciated slopes, subalpine fir and whitebark pine)



VRU 10 (Uplands, alder, grand fir and subalpine fir habitat types)

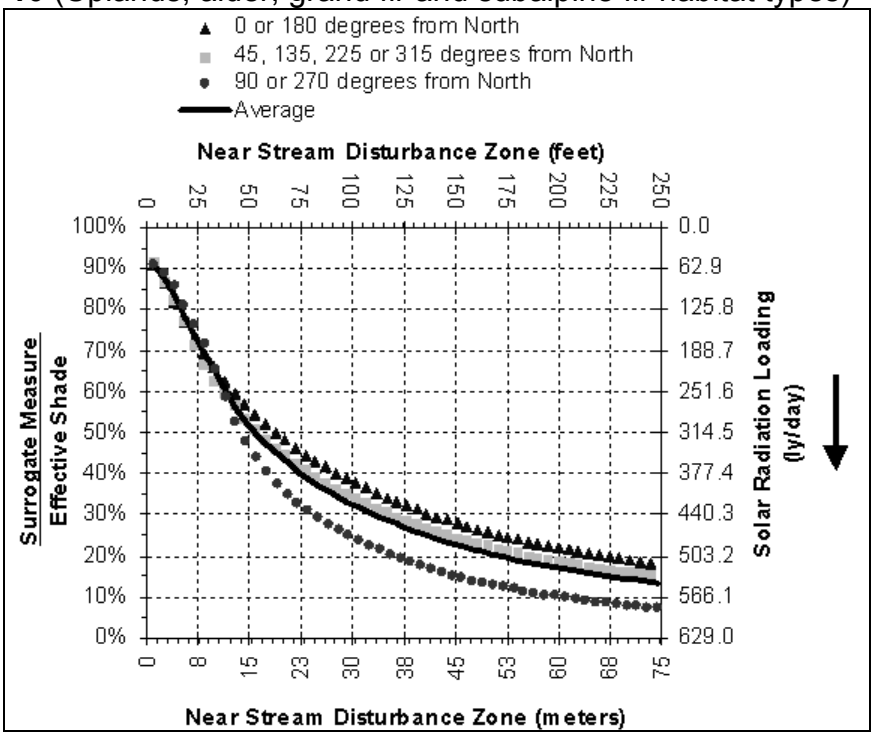
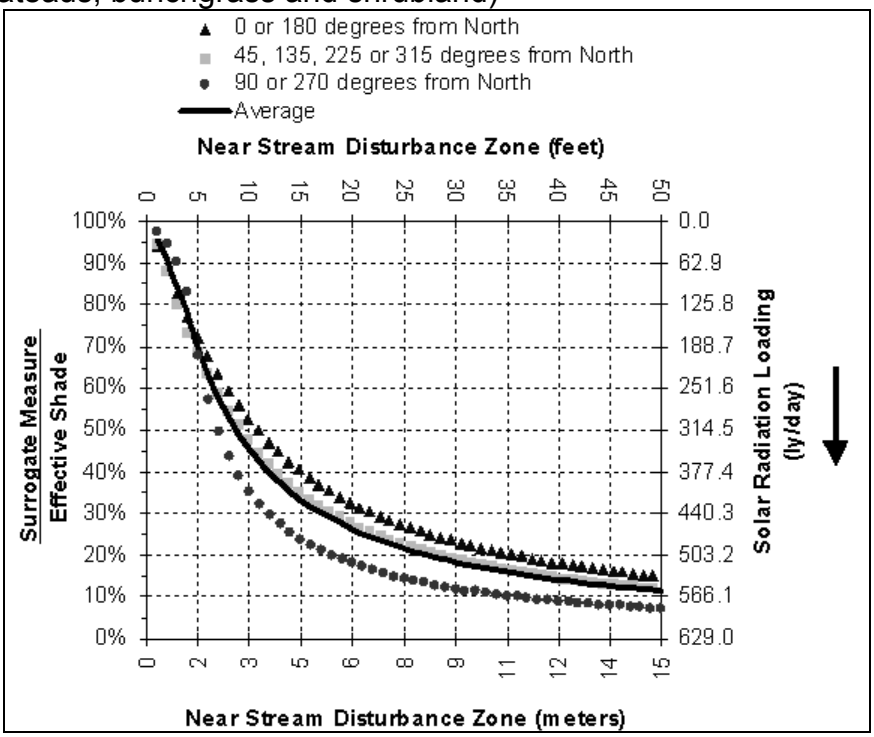


Figure F-20 (continued). Shade Curves Developed for Vegetation Response Units (VRUs)

VRU 12 (Stream breaklands, bunchgrass and shrubland) and
VRU 16 (Plateaus, bunchgrass and shrubland)



VRU 17 (Rolling hills, cedar and grand fir)

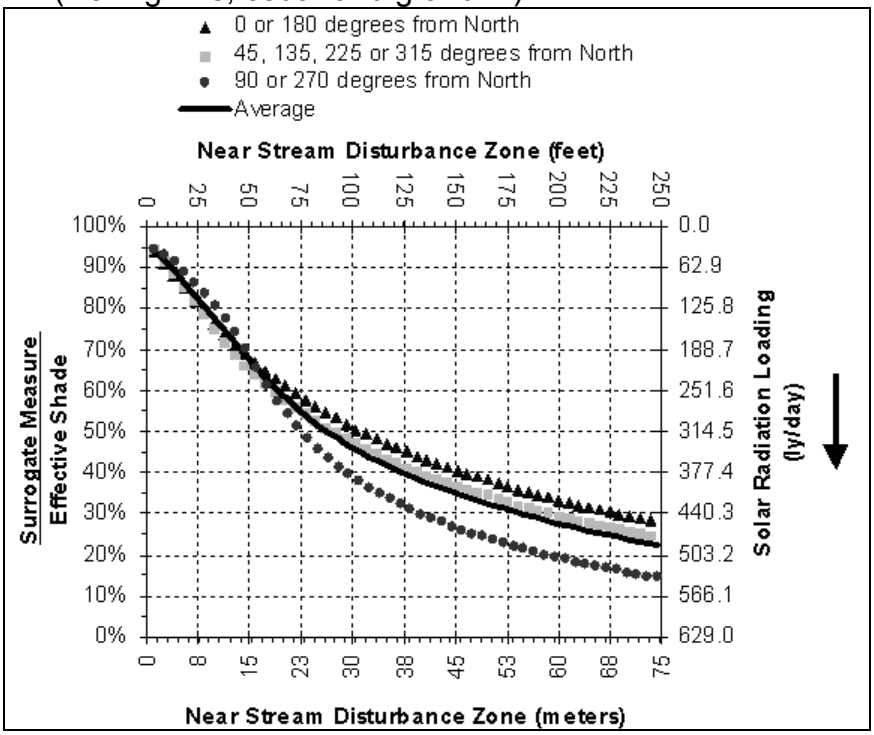
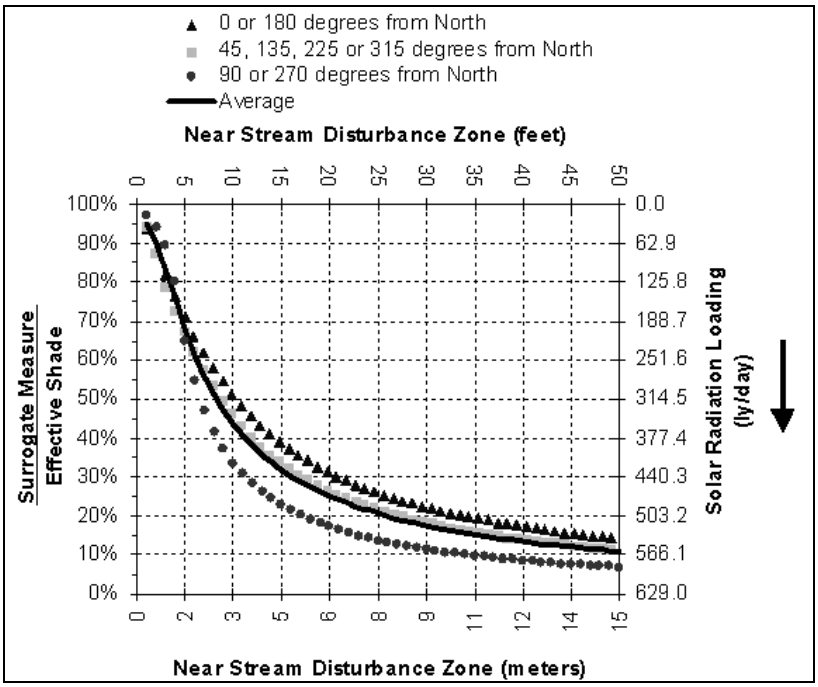


Figure F-20 (continued). Shade Curves Developed for Vegetation Response Units (VRUs)

Herbaceous/Scrub Wetland



Forest Wetland

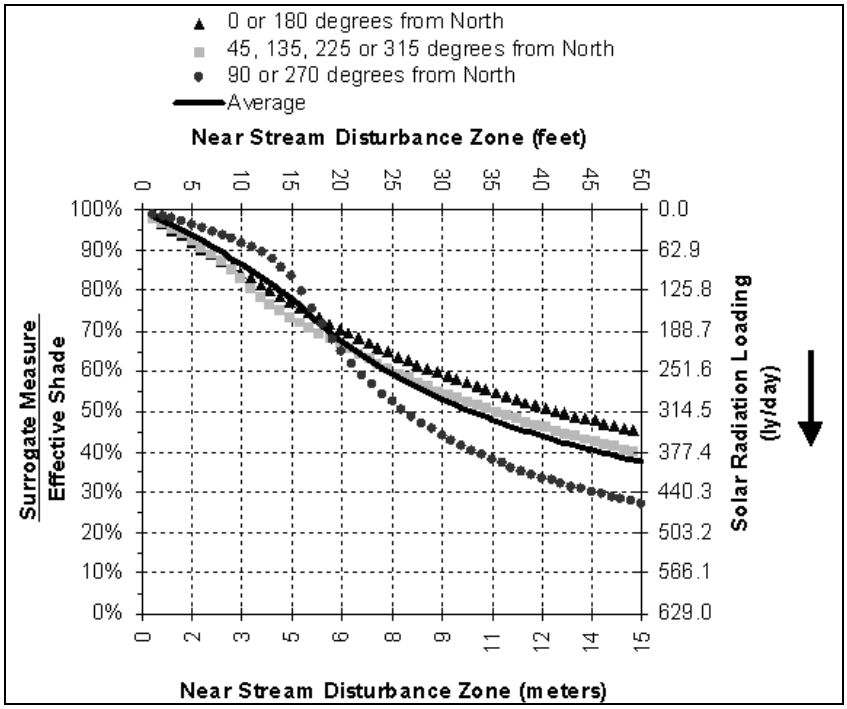


Figure F-20 (continued). Shade Curves Developed for Derived Wetland Areas

Spatial Allocation of Vegetation Land Cover

A determination of the spatial location of vegetation communities throughout the watershed is necessary to apply system potential effective shade in the South Fork Clearwater River Subbasin. Accordingly, the following rule set was used to determine this information.

The method utilized three main sources of information: 1) the HTG land cover data set, 2) the VRU land cover data set, and 3) the NWI land cover data set. The HTGs and VRUs are available for the entire subbasin and the NWI land cover data set is available for almost the entire watershed. Figures F-21 and F-22 illustrate the rule set described below.

"Forested" Communities–

Riparian community composition was developed from information provided within the VRU and HTG land cover data sets, while incorporating site-specific field data. The HTG land cover data set is at a higher spatial resolution than the VRU. However, the VRUs was developed specifically for the South Fork Clearwater River Subbasin to describe and develop an understanding of historic and current conditions and the development of target or desired landscapes.

Accordingly, vegetation composition used to develop system potential vegetation composition for "forested" areas was obtained from VRUs. However, the HTG land cover classification was used to spatially allocate "forested" and "non-forested" locations throughout the watershed. In addition, the NWI land cover classification was used to delineate wetlands areas.

"Non-Forested" Communities

Two VRUs are described as "non-forest" conditions (i.e., VRU 12 [Stream breaklands, bunchgrass and shrublands] and VRU 16 [Plateaus, bunchgrass and shrubland]). These two VRUs are primarily located within low elevation areas outside of NPNF boundary. Shrublands are the dominant vegetation within draws and lower slopes in these two VRUs. Once again, the HTG land cover classification was used to spatially allocate these "non-forest" locations throughout the watershed. In addition, the NWI was used to delineate wetlands areas within these coded "non-forested" areas.

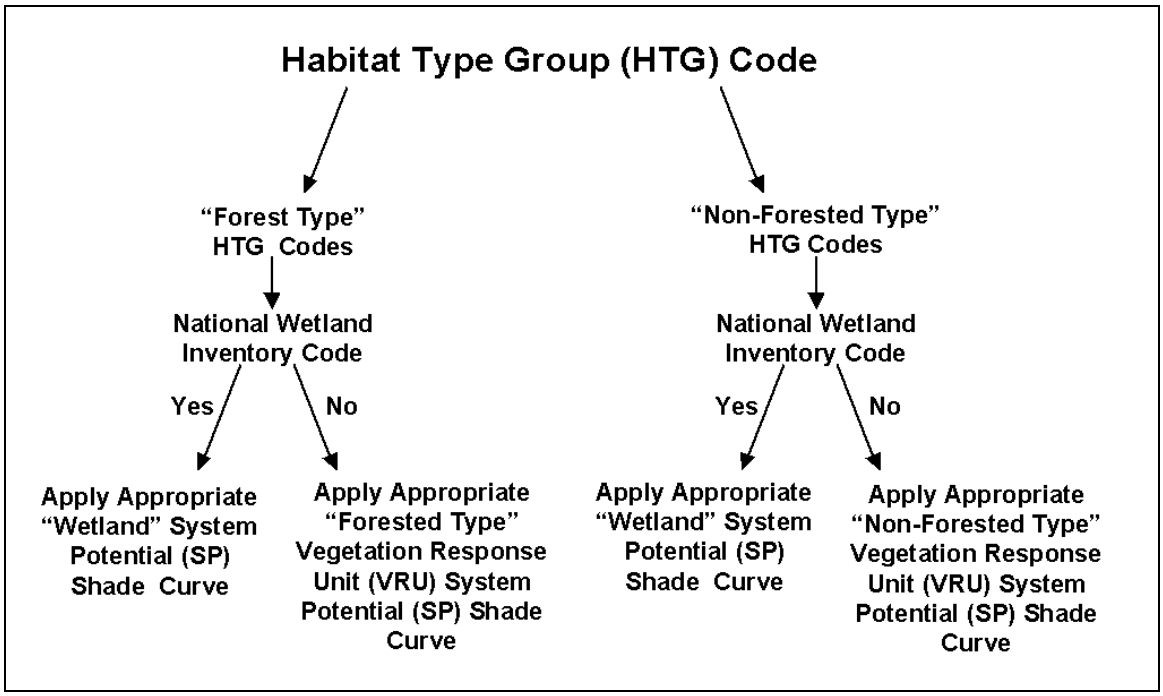


Figure F-21. Vegetation Composition Application Rule Set – South Fork Clearwater River Main Stem

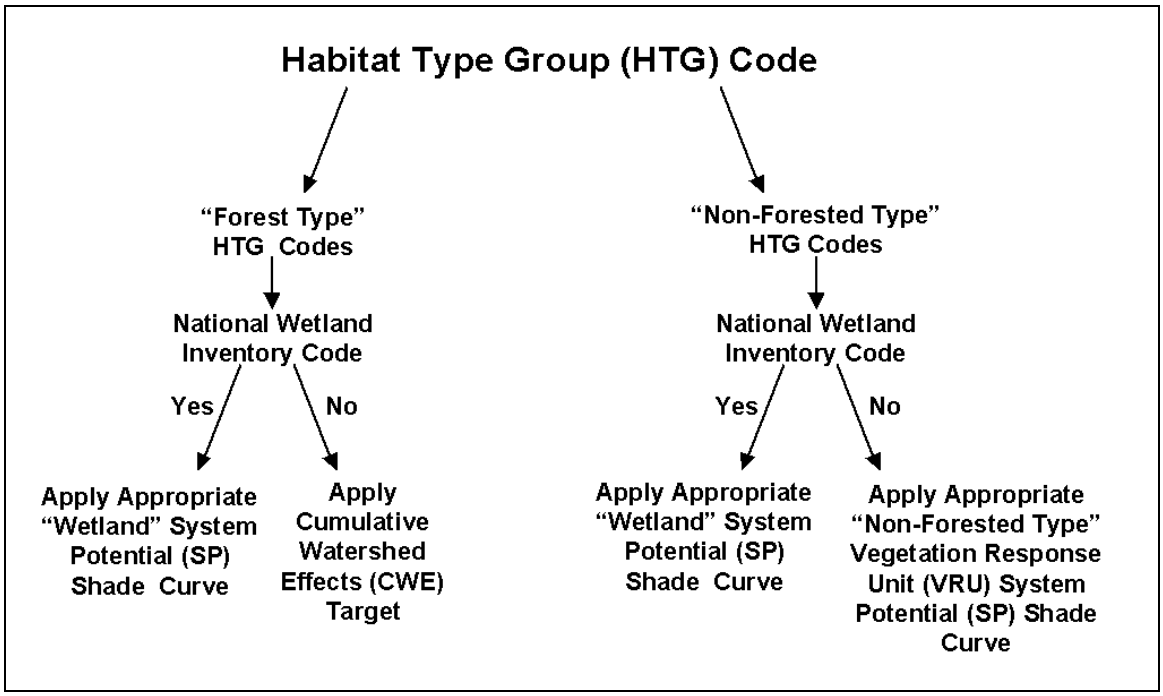


Figure F-22. Vegetation Composition Application Rule Set – Areas Other than the South Fork Clearwater River Main Stem

Site Specific Calculation of "System Potential Effective Shade"

The rule set illustrated above was applied to the South Fork Clearwater River and other tributaries throughout the subbasin. Specifically, system potential effective shade conditions for each 100-foot modeling reach was calculated using the system potential land cover condition derived using the VRU, HTG, and NWI data sets. In addition, all relevant landscape features impacting effective shade production were included in model development for each 100-foot segment (i.e., bankfull width [e.g., NSDZ], aspect, elevation, topographic shade angle, latitude, and longitude [see Figures F-6 through F-10]).

Using the rule set presented above, system potential effective shade conditions were calculated and are presented in Figure F-23. Current effective shade conditions, which were initially presented in Figure F-12, are also plotted on this figure.. System potential effective shade conditions presented in Figure F-23 utilize the same algorithms and vegetation community conditions used to develop the shade curves (see Figure F-21).

As can be seen in Figure F-23, observed current effective conditions are often similar to calculated system potential effective shade conditions; however, there are many areas where current levels are much below potential conditions. It is important to note that this line represents a 0.25-mile moving average condition from the 100-foot measurements. This was done so that general patterns in current and potential shade conditions could become more apparent in Figure F-23.

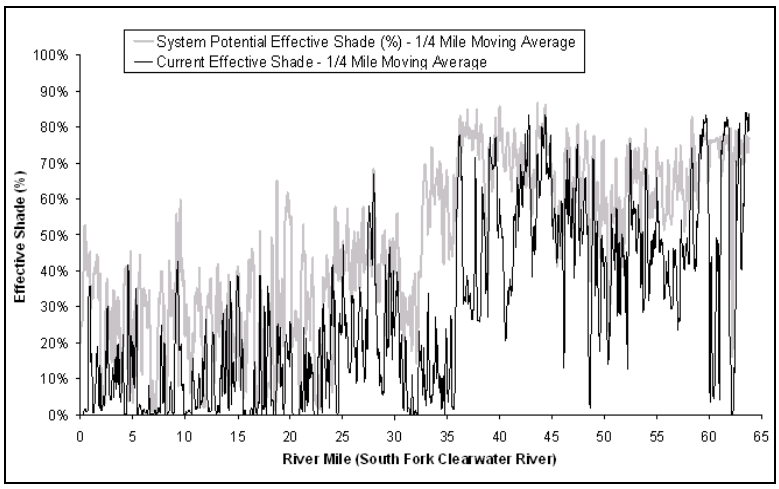
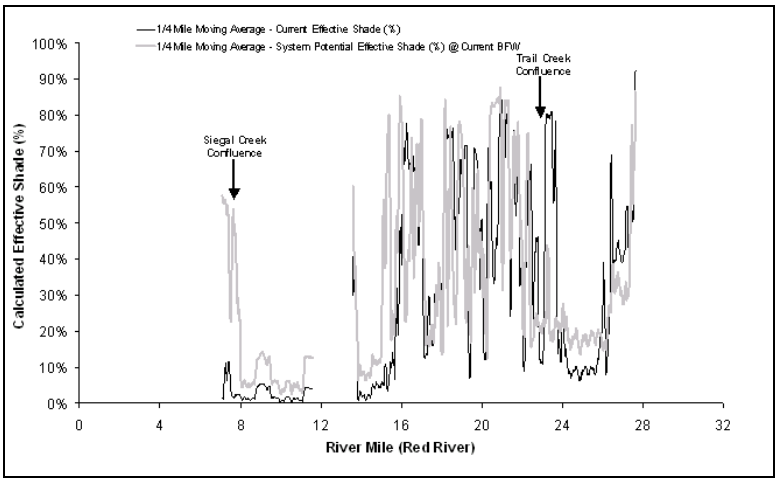
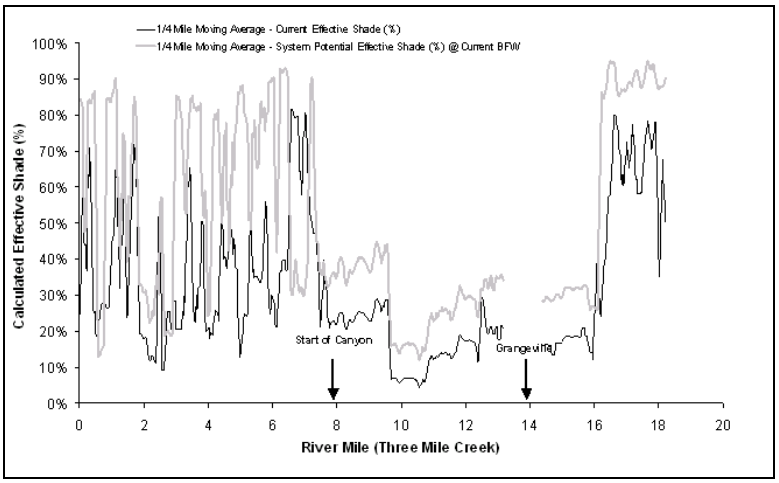


Figure F-23. Current and System Potential Effective Shade Conditions - South Fork Clearwater River and Major Tributaries





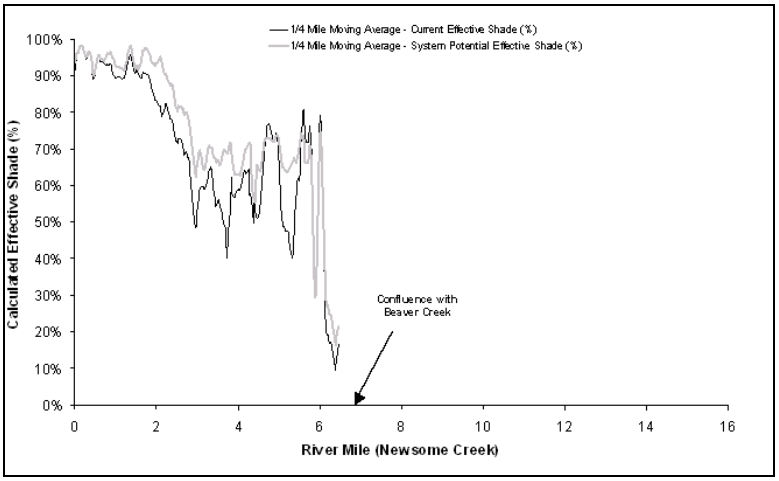
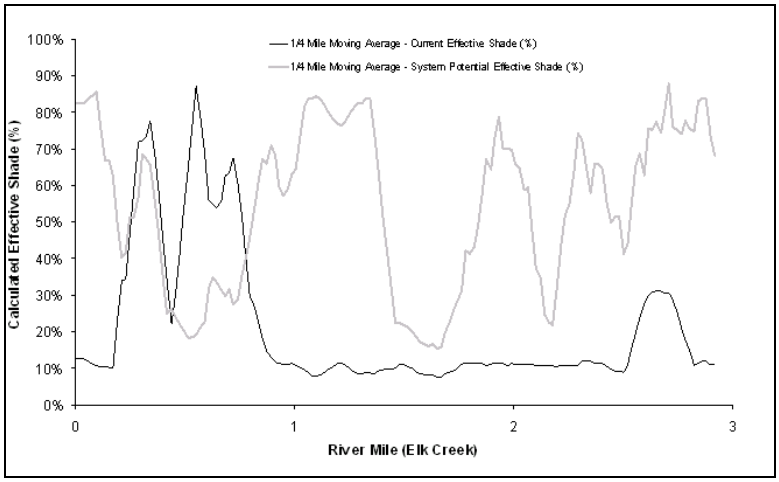


Figure F-23 (continued). Current and System Potential Effective Shade Conditions – Red River, Three Mile Creek, and Newsome Creek



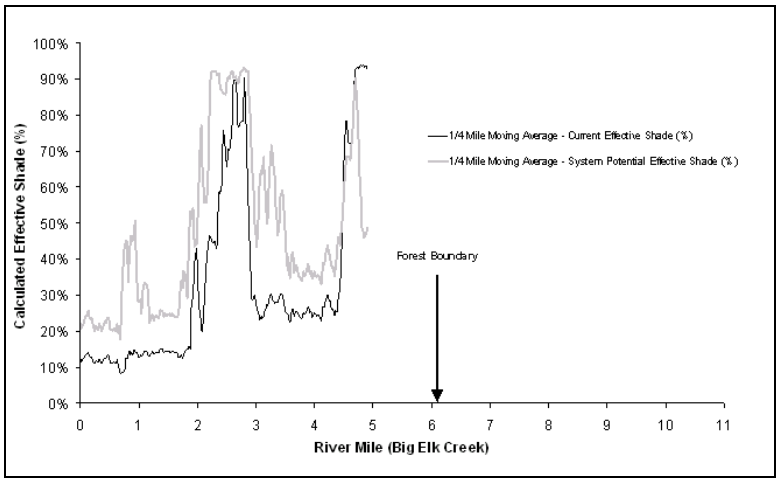


Figure F-23 (continued). Current and System Potential Effective Shade Conditions – Little Elk, Elk, and Big Elk Creeks

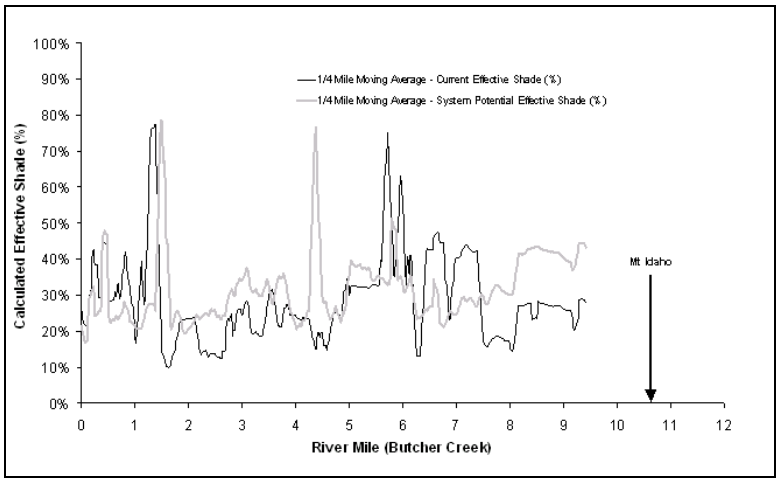


Figure F-23 (continued). Current and System Potential Effective Shade Conditions – Butcher Creek.

Temperature Impairments

Nine water bodies were identified in Chapter 3 as water quality limited due to temperature and are included in the Idaho 1998 303(d) List (Table F-10). As part of the TMDL effort for the South Fork Clearwater River Subbasin, hourly stream temperatures were measured at various locations throughout the watershed during the past several summers. Stream temperatures follow a longitudinal (downstream) heating pattern. All streams in the subbasin that have been monitored have been found to exceed temperature criteria, even though they are not all currently 303(d) listed. The goal of this effort is to achieve applicable temperature criteria and restore all of these to "full support of designated beneficial uses" (Idaho Code § 39.3611, 3615).

Table F-10. Water bodies included in Idaho 1998 303(d) list for temperature.

Water Body	Boundary
SF Clearwater River	Butcher Creek to mouth
SF Clearwater River	Johns Creek to Butcher Creek
SF Clearwater River	Johns Creek to Butcher Creek
SF Clearwater River	Tenmile Creek to Johns Creek
SF Clearwater River	Crooked River to Johns Creek
Threemile Creek	Confluence of Red River and American River to Crooked Creek
Butcher Creek	Source to mouth
Big Elk Creek	Source to mouth
Little Elk Creek	Source to mouth

Water Quality Standard Identification

The five water bodies of the South Fork Clearwater River main stem and Threemile Creek have designated beneficial uses of cold water aquatic life and salmonid spawning. Little Elk Creek, Big Elk Creek, and Butcher Creek have existing beneficial uses of cold water aquatic life and salmonid spawning. All these streams must therefore meet the cold water temperature criteria and meet the salmonid spawning temperature criteria when spawning occurs (Table F-11).

Table F-11. Applicable temperature criteria.

Beneficial Use	Criteria		Reference
Cold Water Aquatic Life	19°C (66.2°F) daily average	22°C (71.6°F) daily max.	IDAPA 58.01.02.250.02.b
Salmonid Spawning	9°C (48.2°F) daily average	13°C (55.4°F) daily max.	IDAPA 58.01.02.250.02.e.ii
Bull Trout	10°C (50°F) MWMT*		40 CFR Part 131.33(a)

*maximum weekly maximum temperature

In addition, USEPA has established temperature criteria for bull trout (Figure F-11) for a number of water bodies in the subbasin, including two which are 303(d) listed: Big Elk and Little Elk Creeks (See Appendix B for a full listing). These creeks must meet the federally-promulgated bull trout temperature criteria of 10 ^{o}C (50 ^{o}F) as an average of daily maximum temperatures over a seven day period (MWMT).

Seasonal Variation – Clean Water Act §303(d)(1)

Stream reaches within the South Fork Clearwater River Subbasin experience prolonged warming starting in late spring and extending into the fall. Maximum temperatures typically occur in July and August (see Figure F-11). The TMDL focuses the analysis during this critical period.

Nonpoint Source Component of Loading Capacity

Solar radiation load at system potential vegetation conditions is the loading capacity. Portions of the loading capacity are typically divided among natural, human, and future nonpoint pollutant sources. Table F-12 lists load allocations (i.e., distributions of the loading capacity) according to land use. In the South Fork Clearwater River Subbasin, the loading capacity of the system is all allocated to natural sources. No assimilative capacity exists for the other sources. This requires that nonpoint sources reduce temperature inputs to reach system potential conditions. The means of achieving these conditions is through restoring and protecting riparian vegetation and narrowing stream channel widths. The remainder of this section describes how those conditions are assessed.

Table F-12. Temperature allocation summary.

Nonpoint Sources	
Source	Loading Allocation Distribution of Solar Radiation Loading Capacity
Natural	100%
Agriculture	0%
Forestry	0%
Urban	0%
Future Sources	0%

Surrogate Measures and Nonpoint Source Load Allocations – 40 CFR § 130.2(i)

The South Fork Clearwater River Subbasin temperature TMDL incorporates measures other than "daily loads" to fulfill 303(d) requirements. Although a loading capacity for heat energy can be derived (e.g., Langleys per day), it is of limited value in guiding management activities needed to solve identified water quality problems. In addition to heat energy loads,

this TMDL allocates "other appropriate measures" (or surrogates measures) as provided under USEPA regulations (40 CFR
130.2(i)).

The *Report of the Federal Advisory Committee on the Total Maximum Daily Load (TMDL) Program* (FACA 1998) offers a discussion on the use of surrogate measures for TMDL development. The report says:

> *"*When the impairment is tied to a pollutant for which a numeric criterion is not possible, or where the impairment is identified but cannot be attributed to a single traditional "pollutant," the state should try to identify another (surrogate) environmental indicator that can be used to develop a quantified TMDL, using numeric analytical techniques where they are available, and best professional judgment (BPJ) where they are not. The criterion must be designed to meet water quality standards, including the waterbody's designated uses. The use of BPJ does not imply lack of rigor; it should make use of the "best" scientific information available, and should be conducted by "professionals." When BPJ is used, care should be taken to document all assumptions, and BPJ-based decisions should be clearly explained to the public at the earliest possible stage.
>
> If they are used, surrogate environmental indicators should be clearly related to the water quality standard that the TMDL is designed to achieve. Use of a surrogate environmental parameter should require additional post-implementation verification that attainment of the surrogate parameter results in elimination of the impairment. If not, a procedure should be in place to modify the surrogate parameter or to select a different or additional surrogate parameter and to impose additional remedial measures to eliminate the impairment."

The nonpoint source assessment presented above demonstrated that stream temperatures warm as a result of increased solar radiation loads, due to anthropogenic disturbances to near-stream vegetation and channel morphology. A loading capacity for radiant heat energy (i.e., incoming solar radiation) can be used to define a reduction target that forms the basis for identifying a surrogate. The specific surrogate used is percent effective shade (expressed as the percent reduction in potential solar radiation load delivered to the water surface).

Factors that affect water temperature are interrelated. The surrogate measures (percent effective shade and channel width) rely on restoring and protecting riparian vegetation to increase stream surface shade levels and reducing the NSDZ width by reducing stream bank erosion and stabilizing channels.This will reduce the surface area of the stream exposed to radiant energy. Shade is more effective on narrow streams than on wider streams given the same flow of water at a given point because shadows cast by trees cover a greater percentage of the stream surface in narrow streams. Effective shade screens the water's surface from direct rays of the sun. Highly shaded streams often experience cooler stream temperatures than similar, but less shaded streams, due to reduced solar radiation input (Brown 1969,

Beschta et al. 1987, Holaday 1992, Li et al. 1994). Accordingly, the surrogate measure used in this portion of the temperature TMDL is "system potential effective shade."

Over the years, the term, "shade," has been used in several contexts, including its components such as shade angle or shade density. For purposes of this TMDL, shade is defined as the percent reduction of potential direct beam solar radiation load delivered to the water surface. Thus, the role of effective shade in this TMDL is to prevent or reduce heating by solar radiation and serve as a linear translator to the solar loading capacities. Effective shade is presented in greater detail in Appendix I.

Channel width is only evaluated within this TMDL as a function of stream effective shade production. It is expected that factors and efforts associated with achieving effective shade targets will promote channel recovery and improvement. That is, effective shade allocations associated with this TMDL will achieve, through passive restoration, system potential channel width conditions. One exception is that areas with serious channel alteration due to past mining may require active reconfiguration to achieve desired channel conditions. A specific target is not set for this parameter, but it is expected that these areas will be identified in the TMDL implementation plan along with appropriate restoration strategies.

Effective Shade Surrogate Measures

The loading allocation is defined in Langleys per day, which is a unit of energy calculated by the shade calculator (i.e., Heat Source 6.5 [Boyd 1996]). However, a load allocation in terms of Langleys per day is not very useful in guiding nonpoint source management practices. Fortunately, percent effective shade is a surrogate measure that can be calculated directly from the loading capacity (i.e., Langleys per day). Percent effective shade is simple to quantify in the field or through mathematical calculations. Figure F-20 displayed derived effective shade curves for the South Fork Clearwater River Subbasin. Specifically, given a measured or estimated channel width (or NSDZ) and the directional aspect of a stream, the percent effective shade or the solar radiation loading can be estimated from the data in Figure F-24. (Effective shade is plotted on the left y-axis, and the associated heat load in Langleys per day is plotted on the right y-axis on this figure.) Langleys per day presented in this figure is the load capacity.

Shade curves were applied to site-specific areas using the rule sets illustrated in Figures F-21 and F-22. Figure F-24 illustrates the calculated system potential effective shade presented in Figure F-23 and the corresponding energy in Langleys per day.

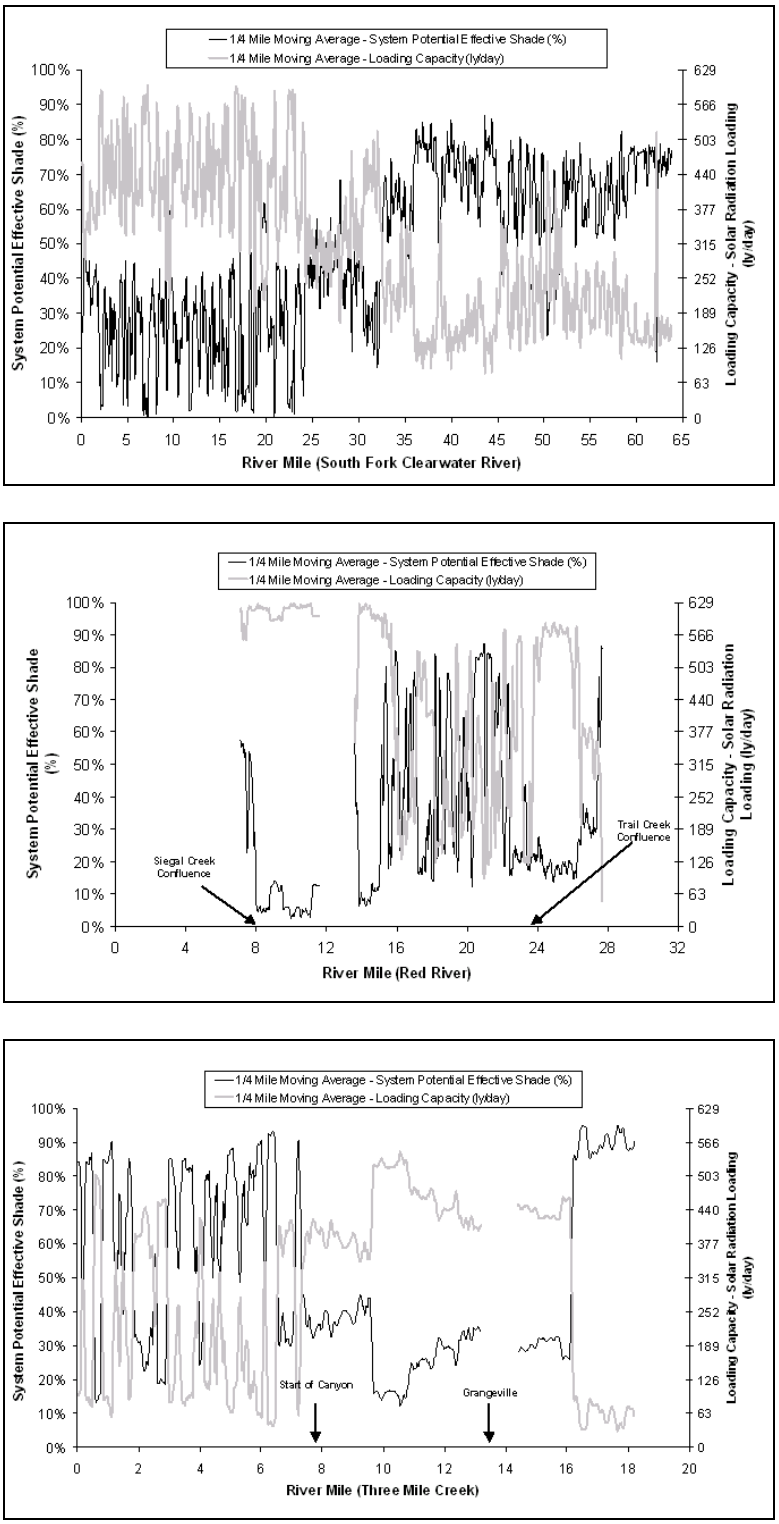
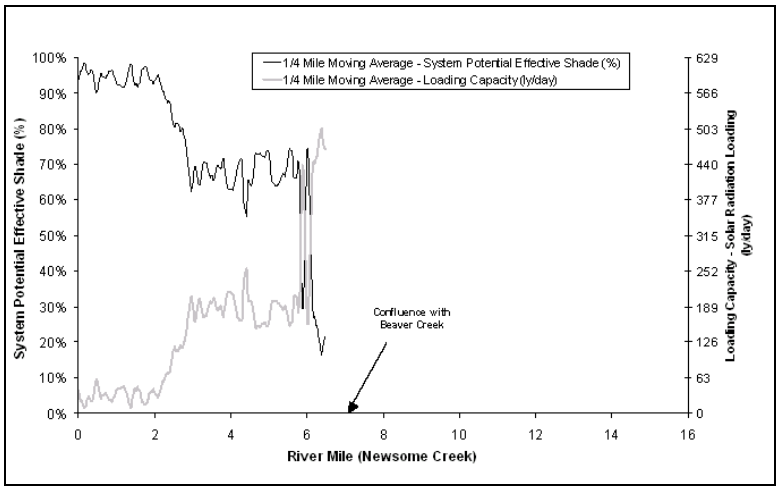
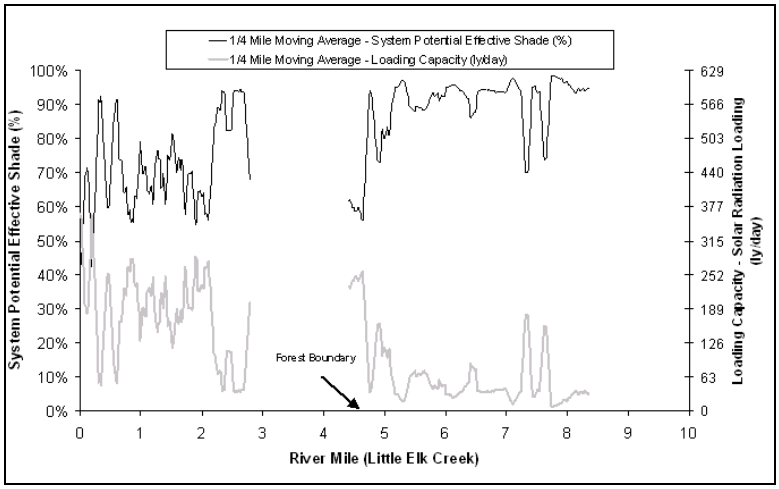


Figure F-24. System Potential Effective Shade and Loading Capacity – South Fork Clearwater River, Red River and Three Mile Creek





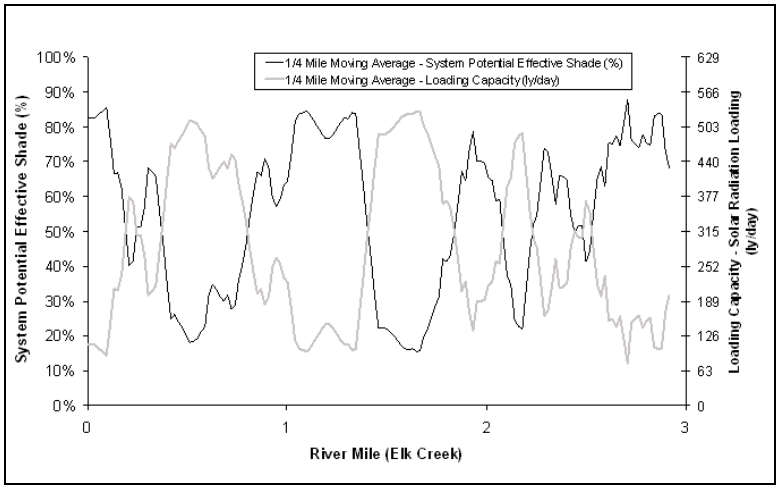
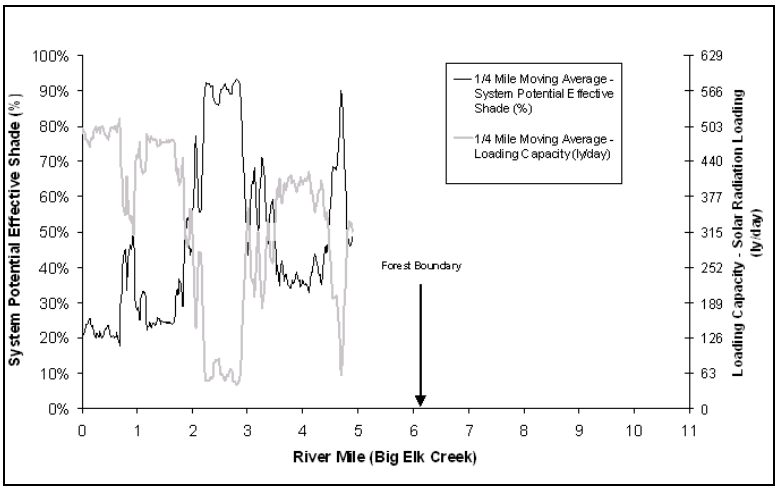


Figure F-24 (continued). System Potential Effective Shade and Loading Capacity –Newsome Creek, Little Elk Creek, and Elk Creek



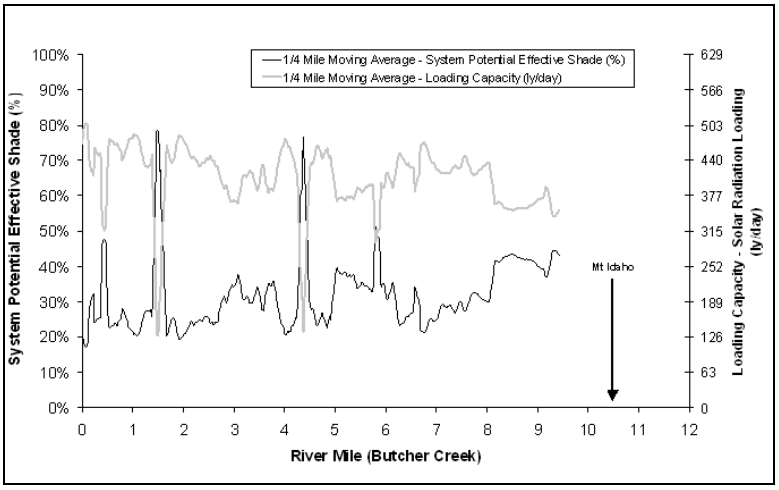


Figure F-24 (continued). System Potential Effective Shade and Loading Capacity –Big Elk Creek and Butcher Creek

Margins of Safety – Clean Water Act §303(d)(1)

The Clean Water Act requires that each TMDL be established with a margin of safety (MOS). The statutory requirement that TMDLs incorporate an MOS is intended to account for uncertainty in available data or in the actual effect controls will have on loading reductions and receiving water quality. An MOS is expressed as unallocated assimilative capacity or conservative analytical assumptions used in establishing the TMDL (e.g., derivation of numeric targets, modeling assumptions, or effectiveness of proposed management actions).

The MOS may be implicit, as in conservative assumptions used in calculating the loading capacity, wasteload allocation, and load allocations. The MOS may also be explicitly stated as an added, separate quantity in the TMDL calculation. In any case, assumptions should be stated and the basis behind the MOS documented. The MOS is not meant to compensate for a failure to consider factors that effect water quality.

A TMDL and associated MOS, which result in an overall allocation, represents the best estimate of how standards can be achieved. The selection of the MOS should clarify the implications for monitoring and implementation planning in refining the estimate if necessary (adaptive management). The TMDL process accommodates the ability to track and ultimately refine assumptions within the TMDL implementation/planning component (Table F-13).

Table F-13. Approaches for incorporating a margin of safety into a TMDL.

Type of Margin of Safety	Available Approaches
Explicit	Set numeric targets at more conservative levels than analytical results indicate. Add a safety factor to pollutant loading estimates. Do not allocate a portion of available loading capacity; reserve for margin of safety.
Implicit	Make conservative assumptions in derivation of numeric targets. Make conservative assumptions when developing numeric model applications. Make conservative assumptions when analyzing prospective feasibility of practices and restoration activities.

The following factors may be considered in evaluating and deriving an appropriate MOS:

- The analysis and techniques used in evaluating the components of the TMDL process and deriving an allocation scheme.
- Characterization and estimates of source loading (e.g., confidence regarding data limitations, analysis limitations, or assumptions).
- Analysis of relationships between the source loading and instream impact.
- Prediction of response of receiving waters under various allocation scenarios (e.g., the predictive capability of the analysis, simplifications in the selected techniques).
- The implications of the MOS on the overall load reductions identified in terms of reduction feasibility and implementation time frames.

Calculating a numeric MOS is not easily performed with the methodology presented in this document. However, the TMDL accounts for uncertainties in the analysis by incorporating an implicit margin of safety.

By definition, system potential effective shade, developed from system potential vegetation conditions, is the highest level of shade achievable; and therefore, represents an implicit MOS.

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Appendix G. The Cumulative Watershed Effects Temperature Model Applied to the South Fork Clearwater River Subbasin

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The Cumulative Watershed Effects Temperature Model Applied to the South Fork Clearwater River Subbasin

Report prepared by:
Tom Dechert, TMDL Project Manager, DEQ

For the South Fork Clearwater River (SF CWR) Subbasin assessment and total maximum daily load (TMDL), streams were divided into two categories for temperature analysis: 1) those that still retain a reasonable semblage of the natural forest canopy and are primarily managed for forestry and/or natural vegetative conditions, and 2) those where the natural vegetation has been greatly altered by grazing, agriculture, mining, and road building. This later category includes all of the main stem SF CWR. Those lands primarily managed for forestry are being analyzed using a method developed under Idaho's Forest Practices Act (FPA) (IDL 2000), and all the others are being analyzed using a method developed by the U.S. Environmental Protection Agency (USEPA) based on the system's potential vegetation (Appendix F). In both cases, vegetative shading is the primary factor being analyzed as the parameter affecting stream temperature. This appendix describes the FPA Cumulative Watershed Effects (CWE) temperature model as it was applied for the forested portions of the SF CWR Subbasin.

Background

The six modes of heat transfer important in stream temperature analyses are (Adams and Sullivan 1990):

- Solar radiation (short wave)
- Radiation between the stream and the adjacent vegetation and sky (long wave)
- Evaporation from the stream
- Convection between the stream and the air
- Conduction between the stream and the streambed
- Ground water and tributary mass inflow/outflow

There are process-based stream temperature models such as Heat Source (Boyd 1996) or SSTEMP (Theurer et al. 1984, Bartholow 1997) for analyzing stream temperatures by quantifying the heat transfer processes. However, these models tend to require extensive inputs, many of which are not easily available or reliable for remote, mountain streams. The relative importance of each mode of heat transfer varies according to the specific environmental conditions present from reach to reach.

Analyses have established that the primary environmental factors affecting stream temperature are local air temperature, stream depth, ground water inflow, and the extent to which riparian canopy and topography shade the stream (Sullivan and Adams 1990, Theurer et al. 1984, Beschta and Weatherred 1984). In forested environments with small first and second order streams, stream shading and local air temperature are widely recognized as the major environmental determinants of stream temperature, accounting for up to 90% of stream

temperature variability (Brown 1971, IDL 2000). Stream shading is also the primary factor that has been modified by human activities. The Idaho water quality standards for temperature apply only to characteristics that may vary due to human activities.
The Idaho Forest Practices Act Coordinating Committee (IDL 2000) developed an empirical model of stream temperatures in forested environments in Idaho north of the Salmon River based on continuous water temperature measurements, elevation, and percent canopy cover data. The model is identified as the Cumulative Watershed Effects (CWE) temperature model and is represented by the following equation:

$$MWMT = 29.1 - 0.00262\ E - 0.0849\ C$$

where MWMT = maximum weekly maximum temperature (^{o}C)
E = stream reach elevation (feet)
C = riparian canopy closure (%)

Data for this model were collected throughout north Idaho. The model utilizes percent stream canopy closure and elevation to predict the maximum weekly mean maximum stream temperature (the MWMT of the hottest week of the year). Elevation and percent canopy closure are easy to acquire: elevation from topographic maps and percent canopy closure from aerial photography correlated to percent canopy closure collected using a densiometer. In mountainous terrain such as the SF CWR Subbasin, increases in elevation result in reductions in ambient air temperature, thus reducing heat loading in a predictable manner. In addition, increases in shading decrease heat loading by reducing solar insolation impinging on the water surface and by lowering the local air temperature under the canopy. The utility of the CWE temperature model is that it can be solved for percent canopy closure, the major environmental factor that changes as a result of human activity.

The following is quoted from the *Forest Practices Cumulative Watershed Effects Process for Idaho* (IDL 2000) pp C-3 and C-4:

> The shade-elevation/temperature relationships used in this section were developed from data collected throughout Idaho between 1991 and 1998. Two hundred and forty-six data sets have been analyzed to develop shade-elevation/temperature relationships for both northern and southern Idaho with R-square values of 0.58 and 0.71, respectively.
>
> The shade-elevation/temperature relationship has been validated in Washington State (Sullivan and Adams 1990). In that study, a simple temperature screen based on elevation and canopy closure over the stream correctly identified the temperature category according to Washington water quality criteria 89% of the time. A temperature screen specific to eastern Washington (CMER, 1993) accurately predicted the necessary level of canopy cover at 69% of locations, with most errors leading to conservative predictions.

Idaho has the following water temperature standards, reflecting the needs of different beneficial uses in streams:

1) Cold Water Biota (22°C instantaneous maximum and 19°C maximum daily average) - Applies to all streams in the state throughout the year.
2) Salmonid Spawning (13°C instantaneous maximum and 9°C maximum daily average) - Applies to streams with salmonids (trout, salmon, char and whitefish) present during the spawning and incubation period.
3) Bull Trout (12°C daily average during June, July and August and 9°C daily average during September and October) - Applies to streams where spawning or rearing bull trout occur.

Using different methodologies (instantaneous maximums and maximum daily averages) to evaluate Idaho stream temperature standards makes this process confusing and difficult. To simplify this approach, the CWE process evaluates all temperature standards using one methodology--a rolling 7-day average of daily maximum temperatures, otherwise known as the maximum weekly maximum temperature (MWMT). The MWMT is chosen for several reasons. First, instantaneous maximums can be short in duration and may not represent the impact stream temperature will have on fish, especially if significant cooling occurs soon after the peak temperature. Second, the daily average does not allow evaluation of peak temperatures and can mask large fluctuations around the mean. Greater fluctuation around the mean can be one effect of intensive forest canopy management, and can negatively influence fish. Finally, MWMT is consistent with other temperature criteria that have been established or recommended to protect bull trout and other fish species (ODEQ 1995; USDA Forest Service 1995; USEPA 1997; Sugden et. al., 1998).

The conversion of Idaho's stream temperature standards to MWMT is show below. These conversions were accomplished using formulas developed by Sugden et al. (1998) in their analysis of 220 different stream temperature data sets collected in Northern Idaho and Western Montana between 1991 and 1997.

Cold Water Biota
22°C instantaneous max = 21.01°C MWMT
19°C daily average = 21.75°C MWMT

Salmonid Spawning
13°C instantaneous maximum = 12.36°C MWMT
9°C daily average = 9.70°C MWMT

Bull Trout
12°C daily average (June, July and August) = 13.31°C MWMT
9°C daily average (September and October) = 9.7°C MWMT

Methods

Using the conversion factor developed by Sugden et al. (1998) for northern Idaho and western Montana, a 9°C (48.2°F) daily average temperature is equivalent to a 9.7°C (49.5°F) MWMT. This means that the federal bull trout temperature standard and Idaho's salmonid spawning standard are roughly equivalent in terms of MWMT. We assume they are equivalent and use a 10°C (50°F) MWMT for both standards in our calculations below.

In terms of timing, heat loading in the SF CWR Subbasin is at its greatest during late July and early August and is reflected in the higher stream temperatures at this time (see temperature discussion in Chapter 2 and temperature plots in Appendix J). July and August are the critical months for temperature exceedances. Water temperatures begin to increase through May and June, but are consistently at their peaks during late July and early August. Water temperatures decrease rapidly after the first wet cold fronts of late August or early September. The time periods for which the standards apply are dependent on the salmonid species spawning and incubation times in the particular water body. The spawning time periods for the different salmonid species in the SF CWR Subbasin are presented Appendix D, Attachment D-1. The salmonid species known to be present in the different water bodies of the SF CWR Subbasin are presented in Appendix D, Tables D-1, D-2 and D-11, and Figures D-9 through D-17.

The CWE process analyzes heat loading and stream temperature for the critical period of late July through early August since the data used to develop the model were collected in this time period. Application of the process assumes that if stream temperatures are in compliance with the water quality standards during this period, they will be in compliance throughout the rest of the year.

The stream temperature data in Table J-1 (Appendix J) show the stream temperatures for one location in the water body. These data were usually collected near the mouth of the stream where temperatures are likely to be the highest. They give some idea of the overall magnitude of heat loading to the water body, but provide little information about where in the water body heat is gained. Since water quality standards apply throughout a water body, it is necessary to understand heat loading throughout a water body.

Solar insolation at some reference elevation over the whole of a water body can be assumed to be constant at any given moment (i.e., there is no spatial variation in solar insolation at the scale of a water body). Spatial variation of heat loading to a stream is largely a function of how solar insolation interacts with a stream and its immediate surroundings. In forested environments, the major component of this interaction is the amount of shade reducing direct solar insolation on the water surface and/or other surfaces in the immediate environment of the stream. The CWE temperature model predicts the spatial distribution of heat loading throughout a water body based on elevation and the percent canopy closure over the stream.

The CWE temperature analysis method throughout a water body is straightforward. The majority of the data are gathered using aerial photographs and topographic maps and/or a

geographical information system (GIS). All the perennial streams are divided into 200-foot elevational reaches (i.e., any given analysis reach can have a maximum of 200 feet difference in elevation between its lower end and upper end). Reaches are also broken at perennial stream intersections and at points where there is a major change in canopy closure along the reach. This process resulted in over 3,500 reaches identified for the SF CWR Subbasin.

The stream segments are identified in the GIS such that each stream segment can be located on a map. For each stream segment, several data types are established: the elevation at the lower end of the reach, the current percent canopy closure from aerial photo interpretation, and general orientation of the stream reach. Using maps and information about salmonid distribution such as those presented in Appendix D and Appendix J, each reach is classified according to the level of beneficial uses it should support. From these data, the CWE model is run to predict the percent canopy closure needed to protect stream temperatures for the desired beneficial use.

Under the FPA-developed CWE process, the target percent canopy closure to protect beneficial uses is that calculated by the model. Any required percent canopy closure increase is determined by subtracting the existing percent canopy closure from the CWE model targeted percent canopy closure, resulting in a CWE target percent canopy closure increase. If the current canopy is greater than the target canopy, then no canopy closure increase is required.

However, in the interest of building further stream temperature protection into the TMDL process, USEPA Region 10 has determined that no percent canopy closure target should be set at less than the current percent canopy closure (Psyk 2001). In other words, when the CWE temperature model is used to set targets for a TMDL, the target canopy is to be either the CWE-modeled percent canopy closure, or the current percent canopy closure, whichever is greater.

CWE Temperature Model Results for SF CWR Subbasin

The targets by stream segment are presented in graphic form on a map and in an associated table. The ArcView shapefiles containing the graphics and target allocation data are on the diskette included with this document.

Using the CWE process, we analyzed the current shade condition of 3,500+ stream reaches in the 82 watersheds for which TMDLs are being developed. Existing percent canopy closures as determined by the CWE methods are presented in Figures G-1 through G-3. Figure G-1 shows the existing shade for the whole subbasin, except the Cottonwood Creek watershed. Figures G-2 and G-3 show the existing shade for the Threemile and Butcher Creek areas, and the area around Little and Big Elk Creeks. We selected these two areas to show at a larger scale because they are the 303(d) listed areas of interest. Parts of the middle reaches of Threemile Creek and Butcher Creek were not assessed for lack of aerial photos. The TMDL for these areas uses the System Potential Vegetation (SPV) methods.

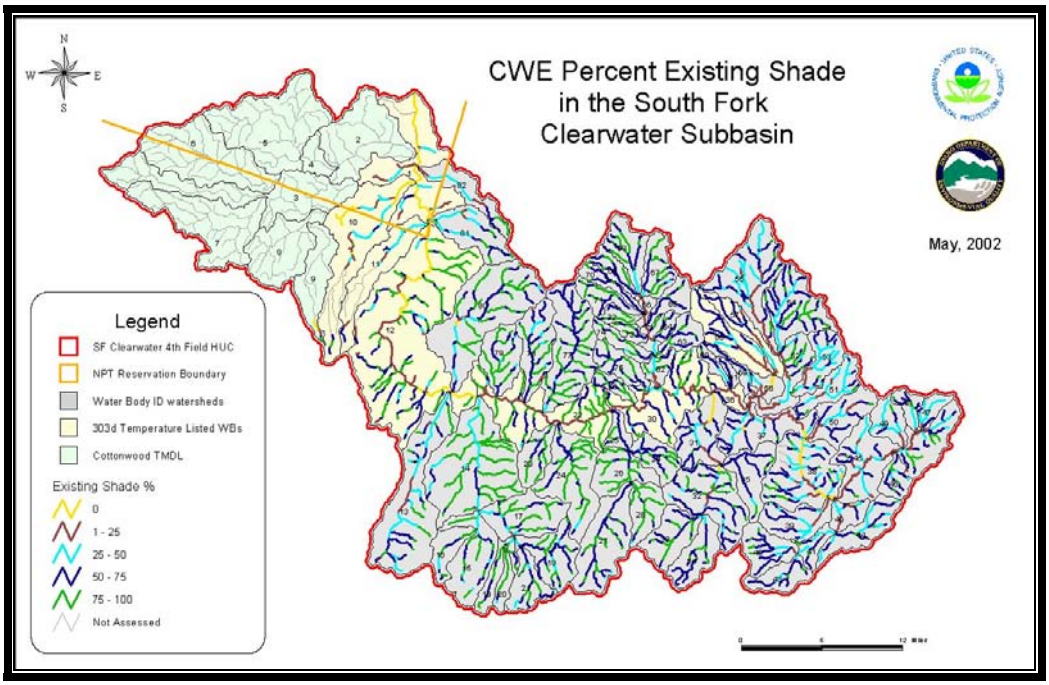

Figure G-1. Current Percent Canopy Closure Over Streams in the SF CWR Subbasin

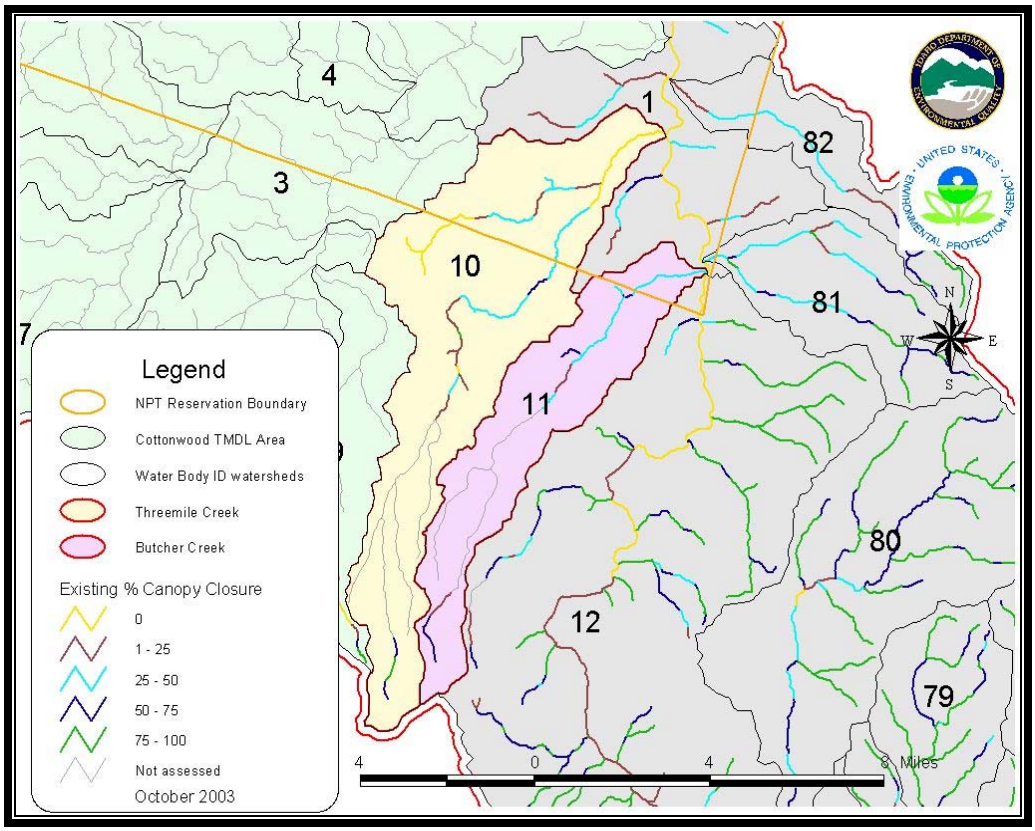

Figure G-2. Existing Percent Canopy Closure of Threemile Creek, Butcher Creek and Surrounding Streams

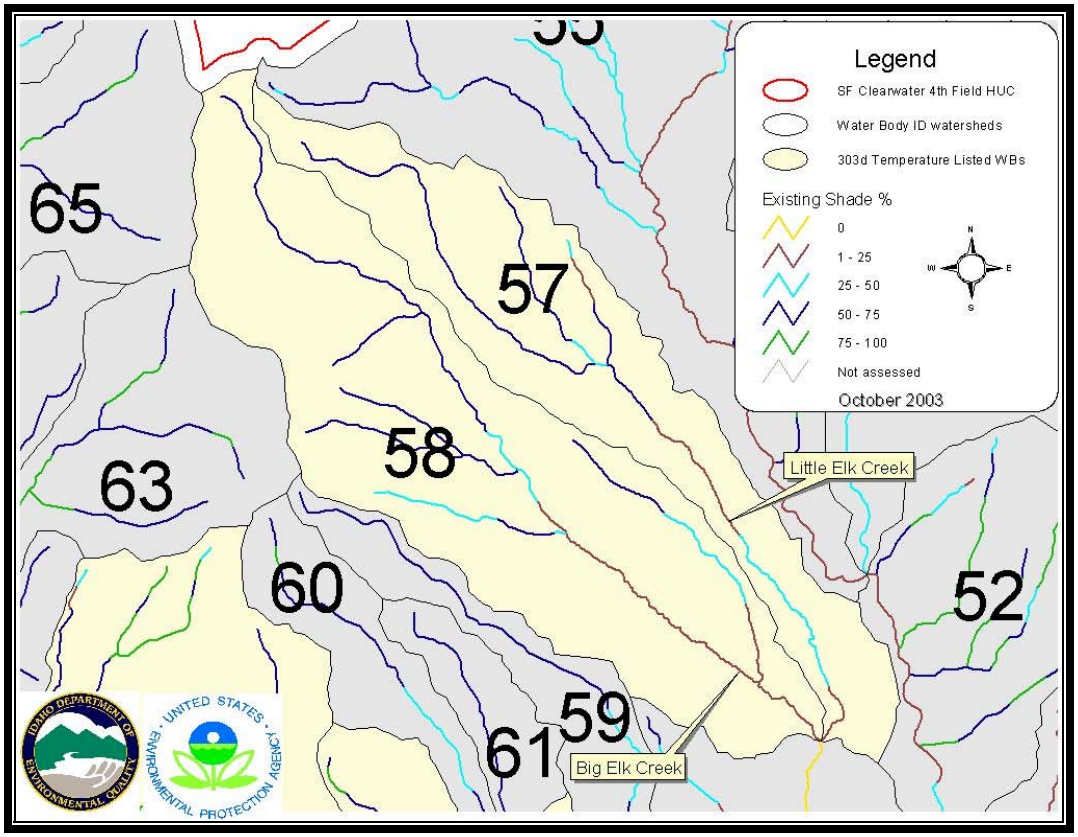

Figure G-3. Existing Percent Canopy Closure of Little Elk Creek, Big Elk Creek and Surrounding Streams

At the time of interpreting the aerial photos to determine existing percent canopy closure, we also identified areas that are meadows, hay lands, agricultural lands, or that had been dredge mined or for some other reason could not be considered related to forest practices. These areas are being analyzed using the SPV methods and are identified in the subsequent maps as such.

Figures G-4 through G-6 show the percent canopy closure that the CWE temperature model predicts is needed to protect stream temperatures. Given that the whole subbasin is being analyzed for salmonid spawning, the primary variable controlling the predicted percent canopy closure needed is elevation. The predicted needed percent canopy closure decreases regularly with elevation. Once again, we show the subbasin as a whole (Figure G-4), then the two selected areas in more detail (Figures G-5 and G-6). Any area of interest can be printed in more detail using ArcView and the enclosed ArcView shapefile.

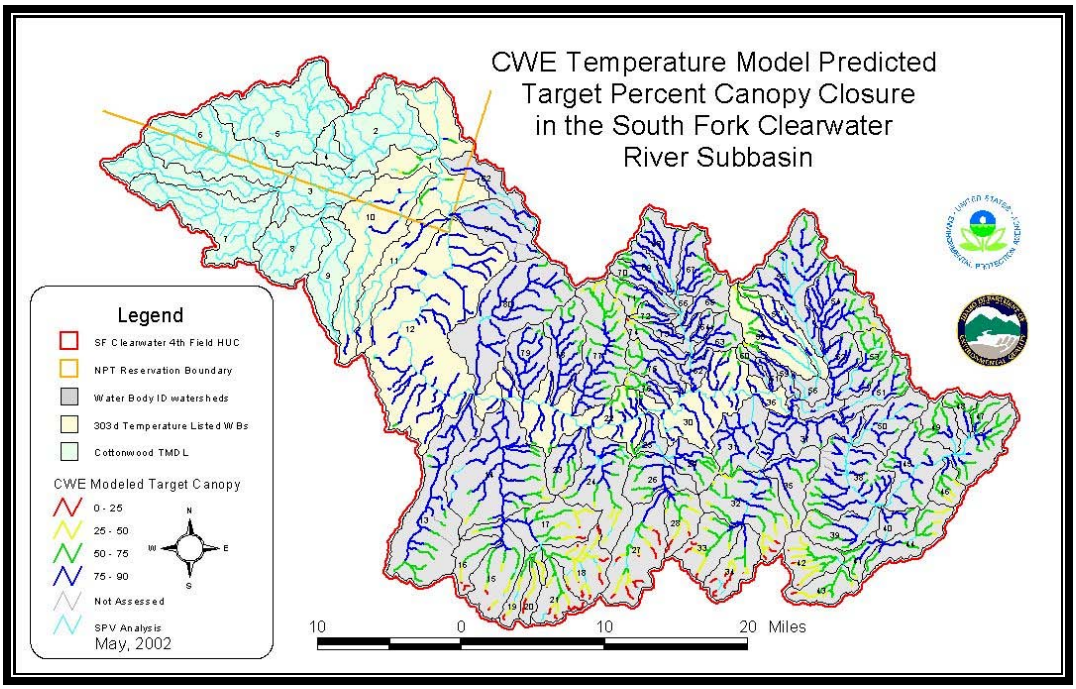

Figure G-4. Percent Canopy Closure Predicted by the CWE Temperature Model as Needed to Protect Stream Temperatures for Salmonid Spawning in the SF CWR Subbasin

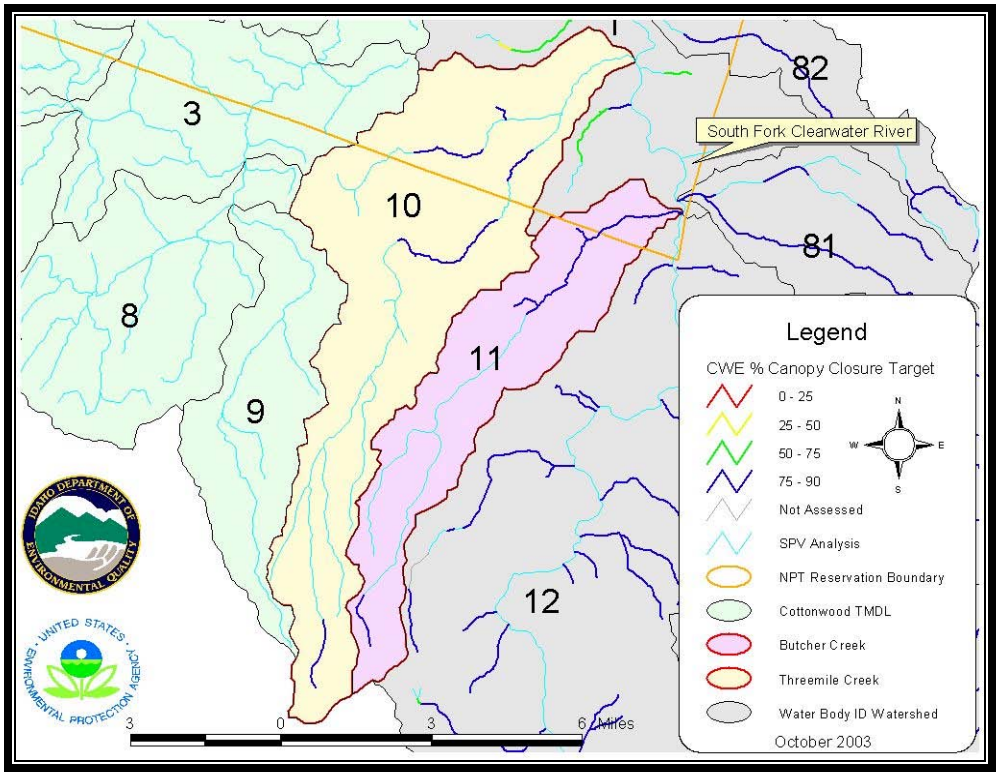

Figure G-5. Percent Canopy Closure Predicted by the CWE Temperature Model as Needed to Protect Stream Temperatures for Salmonid Spawning in the Threemile and Butcher Creeks Area

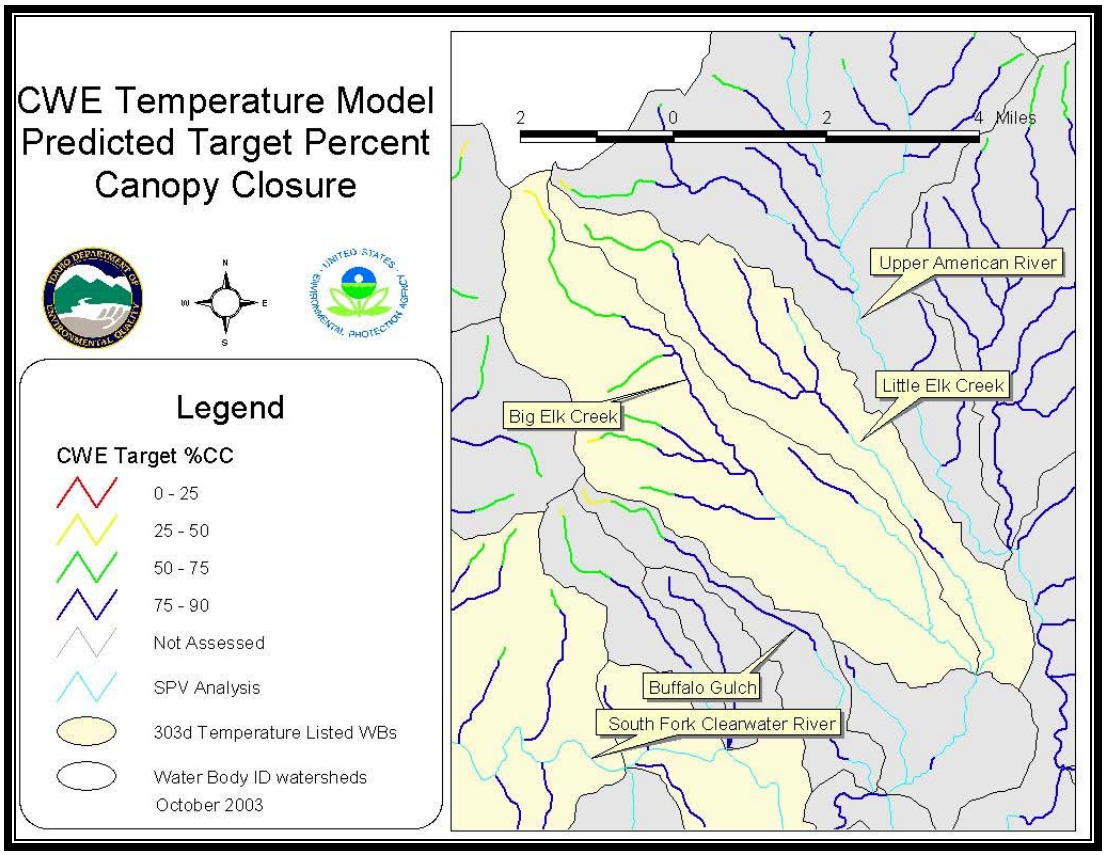

Figure G-6. Percent Canopy Closure Predicted by the CWE Temperature Model as Needed to Protect Stream Temperatures for Salmonid Spawning in the Little Elk and Big Elk Creeks Area

As noted above, USEPA determined that, as an added measure of protection of stream temperatures, TMDLs developed using the CWE temperature model should not set stream shade targets at less than existing percent canopy closure. Thus, in order to set the percent canopy closure targets for each of the stream segments, the existing percent canopy closure was compared to the CWE-predicted percent canopy closure, and the greater of the two was chosen. Figures G-7 through G-9 show the percent canopy closure targets set using the CWE model modified by the USEPA condition. The regular progression of needed percent canopy closure is broken in places where existing percent canopy is greater than that predicted as needed by the CWE temperature model.

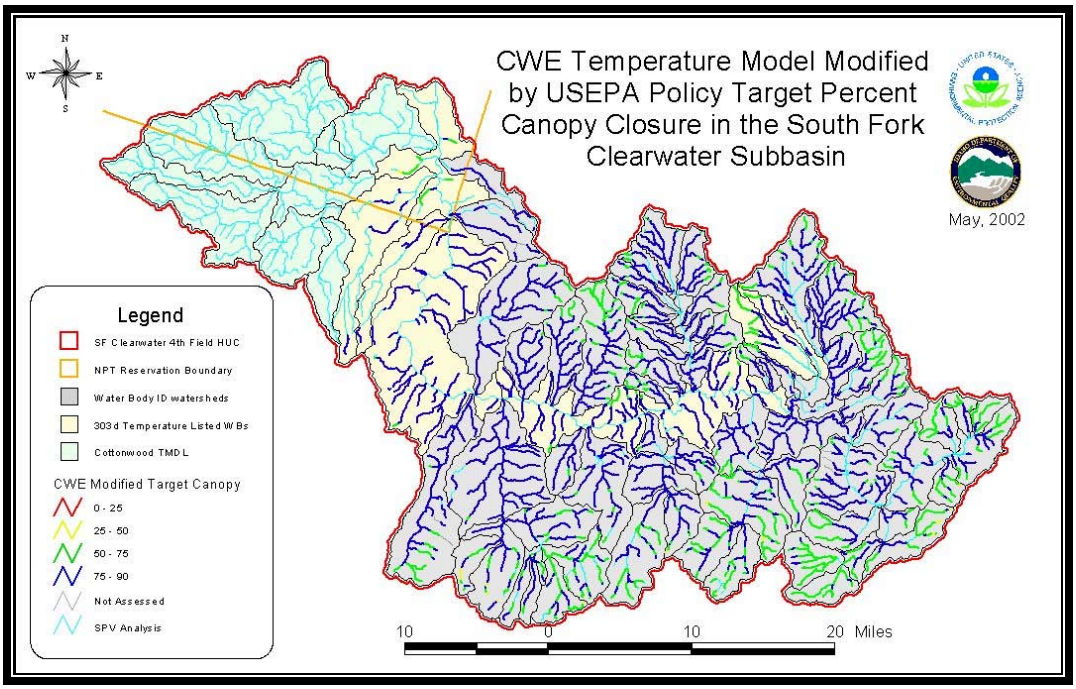

Figure G-7. Percent Canopy Closure Targets for the Forested Portions of the SF CWR Subbasin

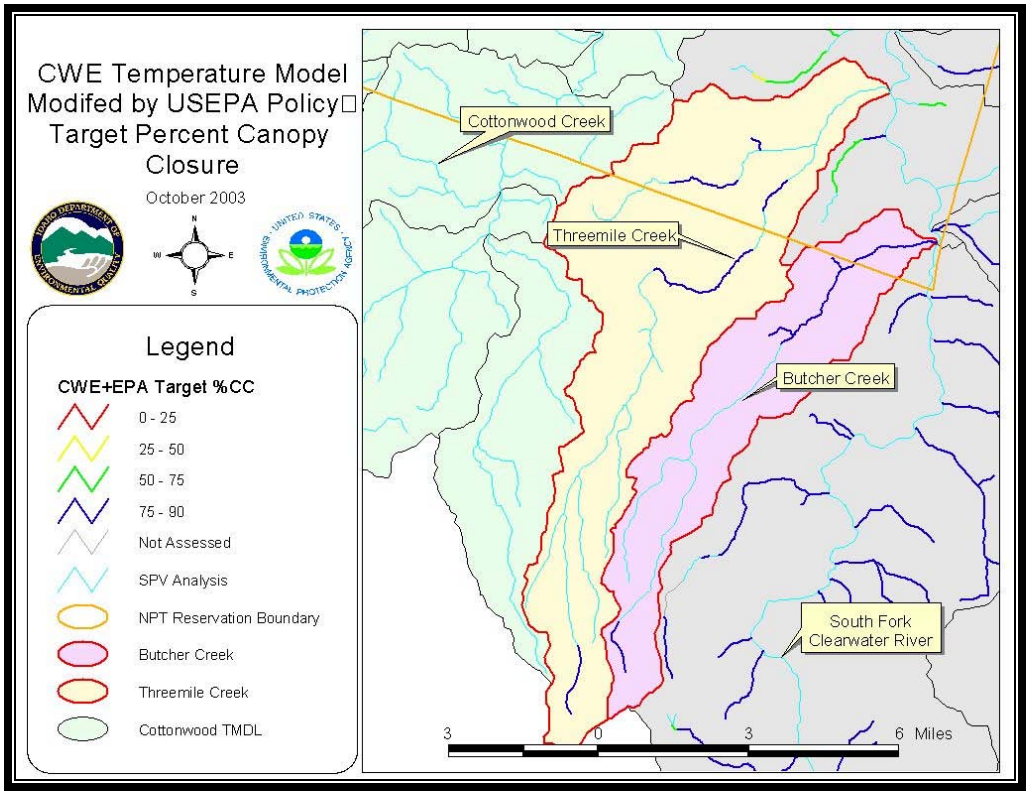

Figure G-8. Percent Canopy Closure Targets for the Forested Portions of the Threemile Creek, Butcher Creek and Adjacent Streams

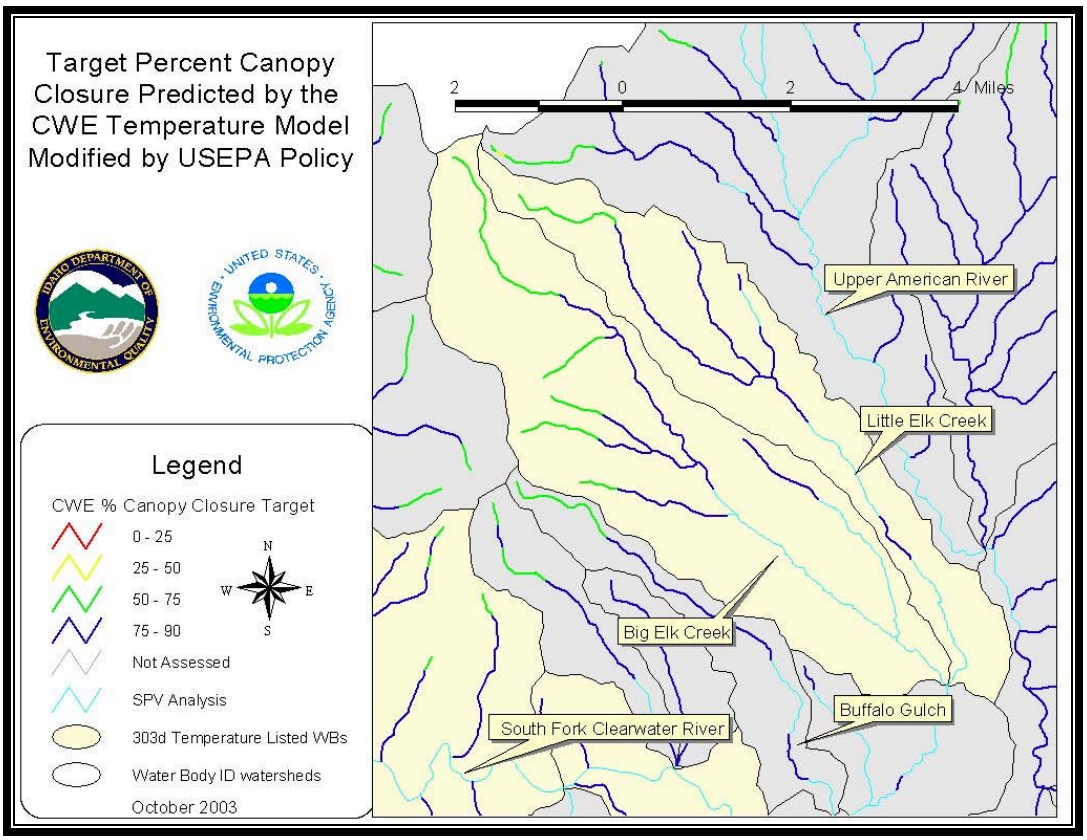

Figure G-9. Percent Canopy Closure Targets for the Forested Portions of the Little Elk and Big Elk Creeks and Adjacent Streams

Finally, in order to show the increase in percent canopy closure needed in the forested areas to be able to attain the TMDL targets, the existing percent canopy closure is subtracted from the target percent canopy closure on a stream segment by stream segment basis. The percent canopy closure increase needed is shown in Figures G-10 through G-12. These data are included in an ArcView shapefile included on diskette with this document.

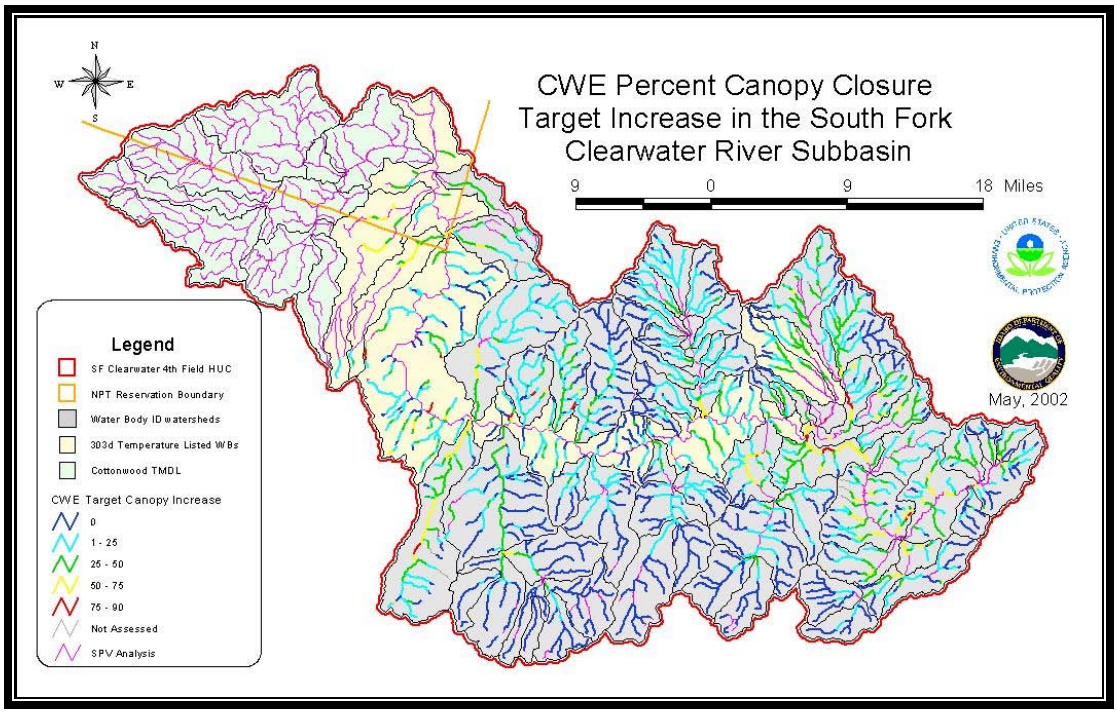

Figure G-10. Percent Canopy Closure Increase Needed in the Forested Areas of the SF CWR Subbasin

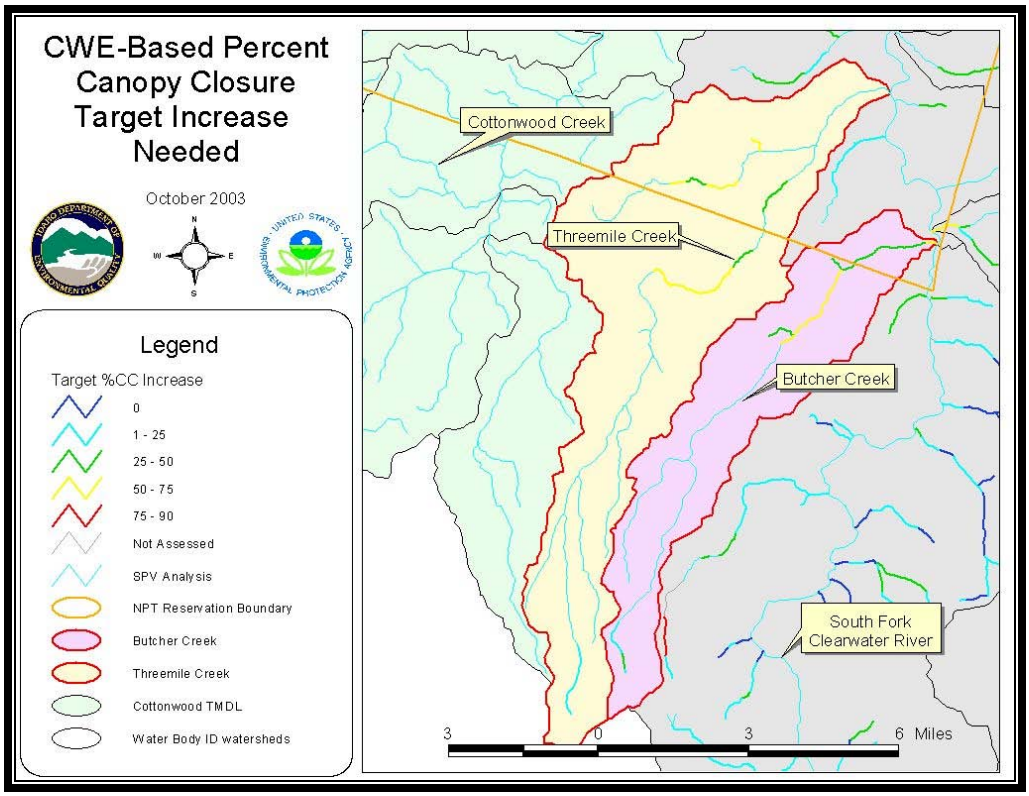

Figure G-11. Percent Canopy Closure Increase Needed in the Forested Areas of Threemile Creek, Butcher Creek and Adjacent Streams

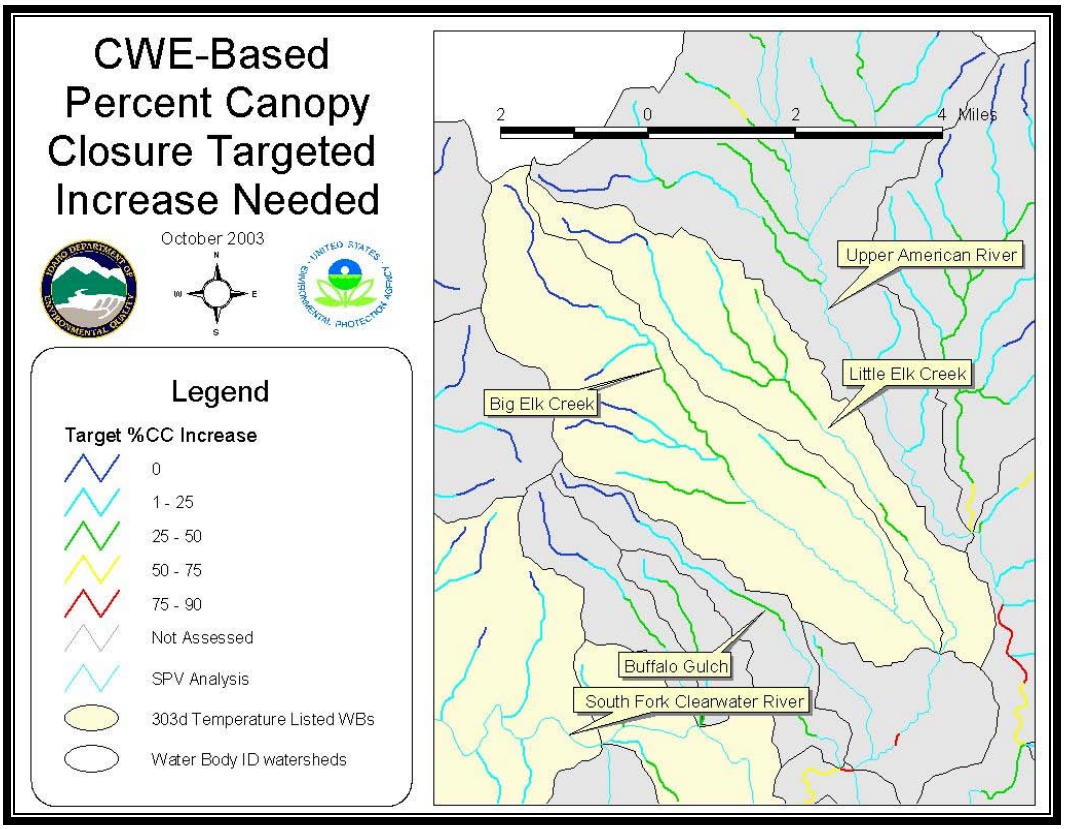

Figure G-12. Percent Canopy Closure Increase Needed in the Forested Areas of Little Elk and Big Elk Creeks and Adjacent Streams

The heat load reduction allocations presented in terms of the surrogate target, percent canopy closure, are specific to the 303(d) listed water quality limited streams. In those situations where the effects of heat loading from non-303(d) listed streams are contributing to water standard exceedances in a 303(d) listed water body, the assigned load reduction allocation, defined in terms of the surrogate target, percent canopy closure increase, has been distributed appropriately throughout the water bodies wherever percent stream canopy closure is inadequate according to the CWE analytical methods and model, modified by the USEPA conditions. This resulted in TMDLs being developed for all 82 water bodies in the SF CWR Subbasin.

Riparian areas along streams do not naturally exhibit 100% or even 90% canopy cover for the entire length of the streams. Natural events (fires, landslides, wind events) may affect riparian vegetation along small stream segments or entire streams. In addition, larger streams (Crooked River, American River, Red River, lower Johns Creek) have larger stream widths that do not allow for a high canopy closure. Also, colder habitat types typically found at high elevations or in cold air drainages often do not support 90% canopy cover. An evaluation of the densiometer field data in conjunction with the aerial photo interpretation results indicates that 90% canopy closure is approximately the greatest percent canopy closure one should expect. The surrogate targets have been set, therefore, with 90% canopy closure as the maximum possible. We have not attempted to sort out the site-specific conditions in relation

to the CWE predictions where even 90% canopy closure is not possible, but leave that question for the land managers as they develop their implementation plans.

The heat load targets are the state's water quality temperature standards for salmonid spawning for the most limiting salmonid species or the federally promulgated temperature standards for bull trout. The critical time period has been determined to be the months of July and August; therefore, the targets are set for those months. If the targets are attained during July and August, when water flows are low and air temperatures are high, it is relatively certain that water quality temperature standards will be met throughout the rest of the year.

For federally protected bull trout watersheds, the target shall be 10°C (50°F) MWMT during the months of July and August. The list of federally protected water bodies (Appendix B) includes all the water bodies of the SF CWR Subbasin except for the main stem SF CWR, Threemile Creek, Butcher Creek, Wing Creek, Red Horse Creek, Buffalo Gulch, Maurice Creek, Sing Lee Creek, Leggett Creek, Fall Creek, Peasley Creek, and Cougar Creek. For other streams that support cutthroat trout, the target shall be 9°C (48.2^{o}F) mean daily temperature for the month of July. For water bodies that support only rainbow trout, the target shall be 9°C (48.2^{o}F) mean daily temperature from July 1 through July 15.

To address the concern regarding conversion of CWE results to heat loading per unit time, we take an approach of separating the effects of insolation from the other heat flux processes. The two primary environmental variables that determine stream temperature are air temperature and stream shading. Air temperature enters into the heat transfer relationships for many of the heat transfer processes associated with streams (e.g., convection, evaporation, long wave radiation), and is the primary driver of average water temperature. The CWE accounts for the variation in air temperature based on elevation. Stream shading affects the amount of solar radiation impinging on the water surface, and is the primary driver of the diurnal fluctuations in water temperature. The CWE results are in effect the change in heat loading associated with changes in stream shading.

In order to quantify heat loading to a stream surface due to insolation, we used SSTEMP (Bartholow 1997) derived data for August 1 (median hottest day) for insolation rates and calculated the heat loading for different levels of percent shade. The amounts of solar radiation incident on the stream and its immediate surroundings at different shadings for two stream orientations are presented in Table G-1. Fixed conditions used in SSTEMP to develop the solar radiation numbers are 47 degrees latitude; 5,000 feet elevation; a stream width of 10 feet; a buffer height of 60 feet; a buffer width of 30 feet; and topographic shade of 30 degrees. These are generalized standard conditions for streams of the SF CWR Subbasin. Under these conditions, incident solar radiation decreases regularly by 21 watts per square meter for every 10% increase in canopy density for north-south oriented streams and 26 watts per square meter for east-west oriented streams.

Table G-1. Average daily solar radiation incident on a stream related to canopy closure.

	Stream Orientation	
Canopy Closure (percent)	North-South (watts per square meter)	East-West (watts per square meter)
0	226	274
10	205	248
20	185	223
30	164	197
40	143	172
50	122	146
60	101	120
70	80	95
80	59	69
90	38	43
100	17	18

These heat flux amounts do not represent the total heat flux, but just the heat flux directly from the sun (insolation). This is the portion of heat flux this TMDL addresses because it is readily increased by human activities that reduce stream shading and can be managed to decrease stream temperatures. Insolation flux rates decrease linearly with increases in shading (Table G-2). Considering the CWE model above, the decrease in stream temperature due to increased percent canopy closure at a given elevation is also linear. Assuming the CWE model is correct, the linear decrease in temperature implies that the change in heat flux is constant and directly related to shading. These results indicate that the total heat flux is linearly related to the insolation rates, such that the percentage heat reduction required by the TMDL will be the same whether it is calculated from total heat flux or from insolation rates. In this TMDL, we use the CWE model with percent shade as the dependent variable directly related to insolation rates.

Table G-2. The heat loading capacities for the SF CWR in terms of CWE-derived percent stream canopy closure by elevation and associated insolation rates for the 10°C MWMT regulation-defined heat loading capacity.

Elevation Zones (feet)	Percent Stream Canopy Closure (percent)	Insolation Rate North-South Oriented Stream (watts/meter^2)	Insolation Rate East-West Oriented Stream (watts/meter^2)
5,400-5,599	58	105	125
5,200-5,399	64	93	110
5,000-5,199	71	78	92
4,800-4,999	77	65	77
4,600-4,799	83	53	61
4,400-4,599	89	40	46
4,200-4,399	95	28	31
4,000-4,199	100	17	18
3,800-3,999	100 *	**	**
3,600-3,799	100 *	**	**
3,400-3,599	100 *	**	**
3,200-3,399	100 *	**	**
3,000-3,199	100 *	**	**
2,800-2,999	100 *	**	**
2,600-2,799	100 *	**	**
2,400-2,599	100 *	**	**
2,200-2,399	100 *	**	**
2,000-2,199	100 *	**	**
1,800-1,999	100 *	**	**
1,600-1,799	100 *	**	**
1,400-1,599	100 *	**	**
1,200-1,399	100 *	**	**
1,000-1,199	100 *	**	**
800-999	100 *	**	**

* Below about 4,000 feet elevation, the CWE model predicts a need for greater than 100% canopy closure to protect a maximum stream temperature of 10°C MWMT. Since this is not possible, 90% canopy closure is set as the surrogate heat loading capacity. In some cases, 90% canopy closure may not be achievable because of the canopy type, in which case it should be noted in the implementation plan.

** SSTEMP predicts insolation rates of 17 or 18 watts per square meter for 100% canopy closure

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USEPA (40 CFR 131.E.1.i.d (1997))

Appendix H. U.S. Forest Service Vegetation Response Unit and Habitat Type Group Descriptions

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U.S. Forest Service Vegetation Response Unit and Habitat Type Group Descriptions

This appendix presents detailed information for Vegetation Response Units (VRUs) and Habitat Type Groups (HTGs) for the South Fork Clearwater River Subbasin. The VRU information was obtained from the *South Fork Clearwater River Landscape Assessment* (USFS 1998). The HTG information was obtained from the document *Biophysical Classification – Habitat Groups and Descriptions* 5/96.

Vegetation Response Units

The VRUs are broad ecological land units that display unique patterns of habitat type groups (potential vegetation) and terrain. A VRU classification and delineation was developed for the South Fork Clearwater River Subbasin. Detailed information for each VRU within the subbasin is provided below.

VRU 1: Convex Slopes, Subalpine Fir

This VRU is common in the South Fork Clearwater River Subbasin at mid and upper elevations. Grand fir and subalpine fir habitat types are dominant.

Historic Conditions

Lodgepole pine was historically dominant in many settings in this VRU. Engelmann spruce, western larch, Douglas fir, and whitebark pine were less common. Wet meadows are important elements of this landscape. The relative proportion of trees by size class was about 5-10% non-forest (non-stocked), 20-30% seedling/sapling, 20-30% pole, 20-30% medium tree, and 5-15% large tree at any given time over this VRU in the subbasin. Old growth was typically limited to moist draw bottoms and north slopes and usually comprised from 10 to 15% of the area.

Large, infrequent (75 to 150 years) severe fires were typical of most settings. Historically, about 700 acres burned per year in the subbasin. About 60-80% of stands originated from stand-replacing fires, and 20-40% from mixed severity fires. Moist lower slopes were most prone to mixed fire. Lodgepole pine, western larch, and Douglas fir sometimes survived one or more fires to form a scattered overstory. Large blocks (500 to 2,000 acres) of pole and medium-size fire-killed trees were typically present at any time within any 10,000 acres of this VRU. Mountain pine beetle activity cycled with fire in lodgepole pine and may have been important in developing fuel conditions that favored stand-replacing fires.

Changes from Historic Conditions –

With advancing forest succession and fire suppression, seral lodgepole pine, western larch, and whitebark pine have declined, and more shade tolerant grand fir and subalpine fir have increased. Lodgepole pine forests have decreased by 12% and Engelmann spruce-subalpine fir forests have increased by 9%. Blister rust has further reduced whitebark pine populations.

Today, only about 70 acres of this VRU burn per year in the subbasin; a 90% decrease. Advancing forest succession has resulted in an 88% reduction in trees in the seedling/sapling structural stage and a 37% increase in trees in the medium and large tree stages. Fire suppression has also resulted in increased stand densities, as shade tolerant understories develop. Harvest has affected about 10% of the area. Recent harvest patterns have replaced large-scale, infrequent burned areas with frequent, small harvested areas more uniformly distributed across watersheds than the historical burned areas. The average harvest unit size is smaller than historic burn patch and there is not as much diversity in frequency of structural stages within subwatersheds. Each watershed is more like other watersheds in terms of the representation of structural stages. Due to fire suppression, extensive snag patches that result from large fires are no longer created.

VRU 2: Glaciated Slopes, Subalpine Fir

This VRU is common in the South Fork Clearwater River Subbasin at upper elevations. Subalpine fir and whitebark pine habitat types are dominant.

Historic Conditions

Lodgepole pine, Engelmann spruce, and subalpine fir were historically dominant on side slopes in this VRU. Whitebark pine was important on ridges. Rock outcrops, lakes and wetlands, and montane parklands were important elements of this landscape. The relative proportion of trees by size class was about 10-25% non-forest, 10-30% seedling/sapling, 30-65% pole, and 5-15% medium tree. Old growth was typically limited to moist trough bottoms and open ridges and usually comprised less than 10% of the area.

Historically about 400 acres burned per year in the subbasin. Midslopes tended to experience stand-replacing fires at infrequent intervals (75 to 150 years). Open ridges or moist valley bottoms were more prone to mixed severity fires. Medium blocks (100 to 1,000 acres) of pole-size fires killed trees were often present at any time within 20,000 acres of this VRU.

Changes from Historic Conditions–

With advancing forest succession and fire suppression, seral whitebark pine has declined. Blister rust has further reduced whitebark pine by a total of more than 75%. More shade tolerant Engelmann spruce-subalpine fir forests have increased more than 70%. Today, only about 18 acres burn each year in the subbasin, a 96% decrease. Advancing forest succession has resulted in an 84% decline in non-forest openings, a 71% decline in trees in the seedling/sapling structural stage, a 74% decline in trees in the pole stage, and a 746% increase in trees in the medium and large tree stages. Fire suppression has also resulted in increased stand densities in Engelmann spruce-subalpine fir forests, as shade tolerant understories develop. No recorded harvest has occurred. Due to fire suppression, extensive snag patches that result from large fires are no longer created.

VRU 3: Stream Breaklands, Grand Fir and Douglas Fir

This VRU is common at lower to mid elevations in canyons in the South Fork Clearwater River Subbasin.

Historic Conditions

Small to medium blocks (10 to 200 acres) of pole and medium-size fire-killed trees were abundant at any time within any 10,000 acres of this VRU. Old growth pine and western larch, bunchgrass, understories, and rock outcrops are important elements of this landscape. On the VRU as a whole, the relative proportion of trees by size class was about 5-20% non-forest or non-stocked, 5-30% seedling/sapling, 10-20% pole, 20-40% medium tree, and 20-40% large tree.

On south aspects, dry Douglas fir habitat types were dominant. Open stands of large Douglas fir and ponderosa pine were historically common. Low and mixed severity fires occurred at very frequent intervals (5 to 25 years) on south aspects. Here, 60-90% of the stands survived through one or more fires. Ponderosa pine old growth occupied about 40 to 60% of these warm dry sites.

On north aspects, grand fir habitat types were dominant. Grand fir and Douglas fir were common cover types, with ponderosa pine and western larch and sometimes Engelmann spruce or lodgepole pine mixed in. Pacific yew grew on lower slopes. Mixed severity fires were common at frequent intervals (25 to 75 years) on north aspects. About 30-60% of the stands retained 10 or more trees per acre through at least one fire. Twenty to 30% of the stands included at least 10 trees per acre older than 150 years. Ponderosa pine, western larch, Douglas fir, and grand fir formed the old overstory.

Changes from Historic Conditions

With advancing forest succession and fire suppression, ponderosa pine/Douglas fir forests have declined by 13%. Annual grasslands and weedlands have increased. Timber harvest has resulted in a 128% increase in non-forest (non-stocked) openings. Forest succession and fire suppression have resulted in a 33% decline in trees in the seedling/sapling structural stage, an 83% decline in trees in the pole stage, a 36% decrease in trees in the medium tree stage, and a 6% increase in trees in the large tree stage. However, more of the large trees are in mixed conifer and less in open pine stands than before. Timber harvest has affected about 11% of the Forest lands in the subbasin over 50 years. Today, about 255 acres burn annually in the subbasin, a decline of 70%. Prescribed fire on dry south aspects burns an additional 500 to 1,000 acres annually. The ratio of stand replacement harvest to mixed or low severity treatments has been about 60% replacement to 34% less severe treatments. This is probably within the range of natural variability, but harvest has, until recently, favored removal of the fire tolerant overstory pine and retention of understory Douglas fir and grand fir, the reverse of fire disturbance effects. This is a higher ratio of stand replacement than would have occurred under natural disturbance regimes. Total canopy cover appears to have declined. Whether this is due to increased mortality from insects and disease or harvest is uncertain.

Due to fire suppression, extensive snag patches that result from large fires are no longer created.

VRU 4: Rolling Hills, Grand Fir

This VRU is common in the South Fork Clearwater River Subbasin at low and mid elevations. Grand fir habitat types are dominant.

Historic Conditions

Grand fir, Douglas fir, ponderosa pine, and western larch were historically dominant in this VRU. Lodgepole pine and Engelmann spruce were less common. Old growth pine and western larch and meadow complexes were important elements of this landscape. The relative proportion of trees by size class was about 5-10% non-forest, 5-50% seedling/sapling, 10-30% pole, 20-30% medium tree, and 10-50% large tree.

Mixed and stand-replacing fires occurred at moderate intervals. About 50-60% of stands originated from stand-replacing fires and 40-50% experienced mixed and low severity fires. Ponderosa pine, western larch, Douglas fir, and grand fir often survived mixed severity fires to form a scattered overstory of old large trees. Ten to 25% of the stands included at least 10 trees per acre older than 150 years. Small to large blocks (1,100 to 2,000 acres) of pole-size trees to large fire-killed trees were common at any time within any 10,000 acres of this VRU.

Changes from Historic Conditions –

With advancing forest succession and fire suppression, ponderosa pine/Douglas fir forests have declined by 32%. Lodgepole pine forests have decreased by 31%. Grand fir/Douglas fir forests have increased by 43%. Forest succession and fire suppression have resulted in a 33% decline in trees in the seedling/sapling structural stage and a 12% decrease in trees in the large tree stage. The harvest of overstory pines has been most concentrated in this VRU, affecting about 29% of the Forest acres within the last 50 years. Today, about 5 acres burn annually in the subbasin, a decline of 99%. The ratio of stand replacement harvest to mixed or low severity treatments has been about 60% replacement to 40% less severe treatments. This is slightly more replacement than would have occurred under natural disturbance regimes. This is probably within the range of natural variability, but harvest has, until recently, favored removal of the fire tolerant overstory pine and retention of understory Douglas fir and grand fir, the reverse of fire disturbance effects. Total canopy cover appears to be about the same. Due to fire suppression, extensive snag patches that result from large fires are no longer created.

VRU 5: Moraines, Subalpine Fir and Grand Fir

This VRU is rare in the South Fork Clearwater River Subbasin at mid to upper elevations. Grand fir and subalpine fir habitat types are dominant. Lodgepole pine and Engelmann spruce are common seral species. Grand fir, Douglas fir, subalpine fir, and western larch are minor components.

Historic Conditions

In swales, Engelmann spruce-subalpine fir old growth was usually extensive between areas where rare, large, stand-replacing fires occurred in this VRU. About 10-20% of stands included at least 10 trees per acre older than 150 years. Wetlands and old growth Engelmann spruce-subalpine fir forests were important elements of this landscape. The relative proportion of trees by size class was about 5% non-forest (non-stocked), 10-40% seedling/sapling, 20-60% pole, 5-30% medium tree, and 3-10% large tree.

Mixed and stand-replacing fires occurred at infrequent intervals. About 35% of the stands originated from stand-replacing fires and 65% experienced mixed or low severity fires. Small to large blocks (100 to 2,000 acres) of pole-size to medium-size fire killed trees occurred occasionally within any 10,000 acres of this VRU.

Changes from Historic Conditions

With advancing forest succession and fire suppression, mixed conifer and Engelmann spruce-subalpine fir forests have increased. It is uncertain if whitebark pine was ever an important component in this area, but it is present now in only very small amounts. Forest succession and fire suppression have resulted in declines in trees in the seedling/sapling and pole structural stages and increases in trees in the medium and large trees stages. Harvest has affected about 19% of the Forest acres within the last 50 years. No acres have burned in the subbasin since fire suppression became effective. The ratio of stand replacement harvest to mixed or low severity treatments has been about 70% replacement to 30% less severe treatments. This is probably more replacement than would have occurred under natural disturbance regimes. Due to fire suppression, extensive snag patches that result from large fires are no longer created.

VRU 6: Cold Basins, Grand Fir and Subalpine Fir

This VRU is very common in the subbasin at mid elevations. Grand fir and subalpine fir habitat types are dominant.

Historic Conditions

Lodgepole pine was the dominant seral species in this VRU. Western larch, Douglas fir, and Engelmann spruce were important. Grand fir was important on mesic sites. Whitebark pine was found occasionally. Five to 15% of stands included at least 10 trees per acre older than 150 years. Large disturbances and meadow complexes were important elements of this landscape. The relative proportion of trees by size class was 5-10% non-forest (non-stocked), 10-30% seedling/sapling, 30-45%pole, 20-40% medium tree, and 5-20% large tree.

Medium to large stand-replacing fires occurred at infrequent interval (75 to 150 years). About 60-90% of the stands originated from stand-replacing fires and 10-40% experienced mixed severity fires. Moderate to large blocks (500 to 1,000 acres) of pole-size to medium-size fire-killed trees were common at any time within any 10,000 acres of this VRU.

Changes from Historic Conditions

With advancing forest succession and fire suppression, lodgepole pine has decreased by 23% and more shade tolerant mixed conifer and Engelmann spruce-subalpine fir forests have increased by 30%. Whitebark pine has essentially disappeared as even a minor component. Forest succession and fire suppression have resulted in a 53% decline in trees in the seedling/sapling stage, a 46% decline in trees in the pole structural stage, a 32% increase in trees in the medium tree stage, and a 20% increase in trees in the large tree stage. Riparian meadows appear to have declined either due to forest encroachment or agricultural conversion. Harvest has affected about 18% of the Forest acres within the last 50 years. About 13 acres have burned annually in the subbasin since fire suppression became effective, a decline of about 99%. The ratio of stand replacement harvest to mixed or low severity treatments has been about 70% replacement to 30% less severe treatments. This is probably within the range of what would have occurred under natural disturbance regimes. Due to fire suppression, extensive snag patches that result from large fires are no longer created.

VRU 7: Moist Uplands, Grand Fir and Pacific Yew

This VRU is common in the subbasin at mid elevations, but quite rare elsewhere in northern Idaho. Mesic grand fir habitat types are dominant and Pacific yew phases are common.

Historic Conditions

Grand fir, Douglas fir, and Pacific yew were the dominant species in this VRU. Western larch, Engelmann spruce, and lodgepole pine were less common. Old overstory trees (grand fir, western larch, Douglas fir, Engelmann spruce, and lodgepole pine) were common. About 30-40% of stands had 10 or more trees per acre older than 150 years. Two or more age classes were common. Pacific yew and mesic old growth were important elements of this landscape. The relative proportion of trees by size class was about 1 – 10% non-forest (non-stocked), 5-20% seedling/sapling, 10-25% pole, 25-35% medium tree, and 35-45% large tree.

Small to medium fires of mixed severity occurred at infrequent intervals (75 to 150 years). Large stand-replacing fires occurred more infrequently. About 60% of the stands experienced mixed severity fires and about 40% originated from stand-replacing fires. Small and scattered blocks (5-100 acres) and infrequent large blocks of fire-killed medium and large trees occurred occasionally within any 10,000 acres of this VRU.

Changes from Historic Conditions

With harvest and planting, Douglas fir/ponderosa pine forests have increased 107%. Upland and riparian shrublands have declined. Forest succession and fire suppression have resulted in a 57% decline in trees in the seedling/sapling stage, a 45% decline in trees in the pole structural stage, and a 22% increase in trees in the large tree stage. Harvest has affected about 28% of the Forest acres within the last 50 years. About 5 acres have burned annually in the subbasin since fire suppression became effective, a decline of about 99%. The ratio of stand replacement harvest to mixed or low severity treatments has been about 70% replacement to

30% less severe treatments. This relative proportion of stand replacement is higher than would have occurred under natural disturbance regimes. Due to fire suppression, snag patches that result from large fires are no longer created.

VRU 8: Stream Breaklands, Cedar and Grand Fir

This VRU is rare in the subbasin, but is common north of the subbasin at low and mid elevations. Moist grand fir and cedar habitat types are dominant.

Historic Conditions

Grand fir and Douglas fir were the dominant species in this VRU. Western larch, western redcedar, western white pine, Engelmann spruce, and Pacific yew were less common. Ponderosa pine and lodgepole pine were minor species. Old overstory trees (Douglas fir, western larch, grand fir, and occasionally ponderosa pine) were common on ridges and lower slopes. About 10-15% of stands had 10 or more trees per acre older than 150 years. Coastal disjunct plant species, early seral tall shrub and hardwood communities, and cedar old growth along major streams were important elements of this landscape. The relative proportion of trees by size class was about 5-20% non-forest (non-stocked), 5-30% seedling/sapling, 10-20% pole, 30-50% medium tree, and 20-30% large tree.

Small to medium fires occurred at moderate intervals (25-75 years) and large stand-replacing fires occurred at infrequent intervals (75 to 150 years). About 40-50% of stands experienced mixed severity fires, and 50-60% of stands originated from stand-replacing fires. Small and scattered blocks (5-100 acres) of fire-killed medium-size and large trees were common at any time within any 10,000 acres of this VRU, and large blocks (500 to 1,000 acres) occurred from time to time.

Changes from Historic Conditions

This VRU is poorly represented in the subbasin and only a few trends can be seen. Western white pine has almost disappeared because of blister rust and forest succession. Shrubs, hardwoods, trees in the seedling/sapling stage, and trees in the pole structural stage have probably declined. Trees in the medium and large tree stages have increased. Harvest has affected 2% of the acres. No acres have burned in the subbasin since fire suppression has become effective, a decline of 100%. Due to fire suppression, extensive snag patches that result from large fires are no longer created.

VRU 9: Glaciated Slopes, Subalpine Fir and Whitebark Pine

This VRU is rare in the subbasin, at highest elevations, but is more common to the south and east of the subbasin. Cold subalpine fir and whitebark pine habitat types are dominant.

Historic Conditions

This VRU was the major stronghold of whitebark pine. Subalpine fir, Engelmann spruce, and lodgepole pine were also common. Old whitebark pine or lodgepole pine were common on rock outcrops and open ridges. About 5-15% of the stands had 10 or more trees per acre older than 150 years. Whitebark pine and open alpine communities were important elements of this landscape. The relative proportion of trees by size class was 30-40% non-forest (non-stocked), 10-30% seedling/sapling, 15-60% pole, 1-10% medium tree, and 1% or less large tree.

Mixed severity fires occurred at moderate and infrequent intervals (25 to 10 years). About 40-60% of the stands experienced mixed severity fires and 40-60% of the stands originated from stand-replacing fires. Small to moderate blocks (50-200 acres) of fire-killed trees were common at any one time in any 10,000 acres of this VRU.

Changes from Historic Conditions

Some conclusions are based on limited data from neighboring watersheds. Anecdotal information suggests that similar changes have occurred in the subbasin. With advancing forest succession, fire suppression, and blister rust, whitebark pine has declined by 69%, and more shade tolerant Engelmann spruce-subalpine fir forests have increased by 190%. Today, only about 12 acres burn per year in the subbasin, a 90% decrease. Advancing forest succession has resulted in a 62% reduction in trees in the seedling/sapling structural stage, a 72% decline in trees in the pole stage, and a 4200% increase in trees in the medium tree stage. No recorded harvest has occurred. Due to fire suppression, snag patches that result from large fires are no longer created.

VRU 10: Uplands, Alder, Grand Fir and Subalpine Fir Habitat Types

This VRU is common in the South Fork Clearwater River Subbasin, but rare to the south. It is also called the grand fir mosaic. Mesic grand fir, subalpine fir, and alder habitat types are dominant.

Historic Conditions

Grand fir, Engelmann spruce, subalpine fir, and Sitka alder were historically important cover types in this VRU. Douglas fir, western larch, lodgepole pine, and Pacific yew were common on ridges. About 15-30% of the stands had 10 or more trees per acre older than 150 years. Open canopied and multi-aged old growth and tall shrub communities were important elements of this landscape. The relative proportion of trees by size class was 10-25% non-forest, 15-25% seedling/sapling, 20-30% pole, 25-40% medium tree, and 15-25% large tree.

Small fires occurred frequently, but mixed severity infrequent fires were typical. Stand-replacing fires were usually confined to ridges. About 40-60% of the stands experienced mixed severity fires and 40-60% of stands originated from stand-replacing fires. Small

blocks (5-50 acres) of fire-killed medium-size and large trees were common at any one time in any 10,000 acres of this VRU.

Changes from Historic Conditions

With forest succession and fire suppression, shrublands have declined 77%. Other changes in cover type have been minor. Forest succession and fire suppression have resulted in a 91% decline in trees in the seedling/sapling stage, a 63% decline in trees in the pole structural stage, a 25% increase in trees in the medium tree stage, and a 147% increase in trees in the large tree stage. Harvest has affected about 4% of the Forest acres within the last 50 years. About 2 acres have burned annually since fire suppression became effective, a decline of about 99%. The ratio of stand replacement harvest to mixed or low severity treatments has been about 80% replacement to 20% less severe treatments. This relative proportion of stand replacement is higher than what would have occurred under natural disturbance regimes. Due to fire suppression, snag patches that result from large fires are no longer created.

VRU 12: Stream Breaklands, Bunchgrass and Shrubland

This VRU is rare on National Forest lands in the subbasin, but is common in the lower canyon on private lands. Bluebunch wheatgrass and Idaho fescue habitat types are dominant, and shrubland habitat types are common.

Historic Conditions

Bluebunch wheatgrass and Idaho fescue were historically important. Shrublands occupied draws or lower slopes. Very frequent (5-25 years) low severity fires maintained open grasslands and rejuvenated shrublands.

Changes from Historic Conditions

This VRU is poorly represented on Forest lands. On all lands, only general trends are indicated. Disturbed grasslands (annuals and weeds) and pasture have replaced native perennials over more than 50% of their prior extent. Upland shrublands have increased as much as 100% due to fire suppression and brush invasions of former grasslands. About 2 acres have burned annually on National Forest lands in the subbasin since fire suppression became effective, a decline of about 82%.

VRU 16: Plateaus, Bunchgrass and Shrubland

This VRU occurs only on non-National Forest lands. Bluebunch wheatgrass, Idaho fescue, and shrubland habitat types are common.

Historic Conditions

Bluebunch wheatgrass and Idaho fescue were historically important on this VRU. Shrublands occupied draws, lower slopes, and north aspects. Very frequent (5-25 years) low severity fires maintained open grasslands and rejuvenated shrublands.

Changes from Historic Conditions

On all lands, only general trends can been seen. Annual cropland has replaced native perennials over more than 80% of their prior extent. Hayland and pasture have largely replaced the remaining native prairie. Upland shrublands have probably also decreased. Fire incidence has certainly declined, but to what extent is unknown.

VRU 17: Rolling Hills, Cedar and Grand Fir

This VRU is rare in the South Fork Clearwater River Subbasin. Mesic grand fir and western redcedar habitat types are dominant.

Historic Conditions

Grand fir and Douglas fir were historically important cover types on this VRU. Western redcedar, western white pine, western larch, Engelmann spruce, and ponderosa pine were less common. About 20-35% of the stands had 10 or more trees per acre older than 150 years. Ridge top groves of large old cedar and grand fir old growth and early seral tall shrub communities were important elements of this landscape. The relative proportion of trees by size class was 10-25% non-forest, 15-25% seedling/sapling, 20-30% pole, 20-35% medium tree, and 15-40% large tree.

Small fires occurred frequently, but mixed severity infrequent (75 to 150 years) fires were typical. About 40-60% of the stands originated from mixed severity fires and 40-60% of the stands originated from stand-replacing fires. Moderate sized blocks (50-500 acres) of fire-killed medium-size and large trees were common at any one time in any 10,000 acres of this VRU.

Changes from Historic Conditions

This VRU is poorly represented in the subbasin and only a few trends can be seen. Western white pine has virtually disappeared due to blister rust and forest succession. Shrubs, hardwoods, trees in the seedling/sapling structural stage, and trees in the pole structural stage have probably declined. Trees in the medium and large tree stages have increased, but numbers of the largest old trees may have been reduced by harvest. Harvest has affected 11% of the acres. The ratio of replacement treatment to less severe treatments has been about 100% replacement. This is well above the historic ratio. No acres have burned in the subbasin since fire suppression has become effective, a decline of 100%. Due to fire suppression, extensive snag patches that result from large fires are no longer created.

Habitat Type Groups

Habitat type grouping is based on similarities in natural disturbance regimes, successional patterns, and structural characteristics of mature stands. The HTGs are intended to assist with subregional and landscape assessments. The HTGs are separated into forest and non-forest categories. Table H-1 presents vegetation conditions expected for non-forest HTGs and Table H-2 presents vegetation conditions expected for forest HTGs. A detailed description of HTGs is presented below.

Forested Habitat Type Groups and Descriptions

HTG #1 - Warm and Dry - *Pinus ponderosa Types or Pseudotsuga menziesii/Grass Types*

This HTG is characterized in naturally functioning ecosystems by dry and open-grown park-like stands of *Pinus ponderosa* or *Pseudotsuga menziesii* with bunch grass understories. Most of the sites occur on hot and dry landscapes at low elevations and on west and south aspects. A natural fire-free interval of 5 to 25 years on these sites maintained these open-grown park-like stands (Fischer 1987). These fires were low severity, under-burning fires. Stand replacement fires were probably rare.

HTG # 2 - Moderately Warm and Dry - Most *Pseudotsuga menziesii* Types and Dry *Abies grandis* Types

These habitat types are characterized in naturally functioning ecosystems by open-grown stands of *Pinus ponderosa* or *Pseudotsuga menziesii* with grass and brush understories. Most of the sites normally occur at lower elevations on many aspects, but are also found at higher elevation on more southerly and westerly aspects. The natural fire-free interval for under-burning was historically 5 to 50 years (Fischer 1987). The mostly low- and moderate-severity fires maintained open, park-like stands dominated by *Pinus ponderosa*. In some cases, stand composition was also high in *Pseudotsuga menziesii* and *Larix occidentalis*. Little information is available on stand-replacing fires, but these severe intensity fires occurred only after a fire-free interval probably exceeding 500 years on dry land types and 50-200 years on moist land types (Smith 1995).

HTG #3 - Moderately Warm and Moderately Dry - *Pseudotsuga menziesii* with *Linnaea borealis* Understory and Most *Abies grandis* Types

This HTG contains a highly variable group of habitat types. The group is a transition type between the dry and moist habitat types. It includes types characteristic of each. These habitat types were characterized in naturally functioning ecosystems by mixed species stands of *Pinus ponderosa*, *Pseudotsuga menziesii*, *Larix occidentalis*, *Pinus contorta,* and *Abies grandix*. Understories in absence of fire or other disturbance are composed primarily of dense *Pseudotsuga menziesii* or *Abies grandix* thickets, though other tree species may be present. The natural fire-free interval for under-burning was 15 to 50 years. Mixed intensities of moderate and severe fires commonly created mosaics of even-aged stands with

survivor individuals and groups of trees (Smith 1995). Also common in this HTG are open, park-like stands dominated by *Pinus ponderosa*, *Larix occidentalis,* and *Pseudotsuga menziesii*.

HTG #4 - Moderately Warm and Moist - *Abies grandis Asarum* and *Clintonia* Types

These are warm and moist habitats that occur along the lower slopes and valley bottoms. The group is highly diverse and nearly all the conifer species in the area can occur in this HTG. Understory vegetation may be dominated by a wide variety of species. The fire-free interval is wide, from 50 years for the drier types to over 200 years for the more moist types. Typical fires are minor ground fires that create a mosaic within the stand. On the other extreme, with drying, a complete stand replacement fire can occur. Many times this is the result of a fire burning from an adjacent and drier type. Fire exclusion on these sites has changed them very little except to reduce the number of acres in early succession types.

HTG #5 - Moderately Cool and Moist - *Thuja plicata* and *Tsuga heterophylla Asarum* and *Clintonia* Types

These are moderately cool and moist sites. They contain many species, including *Thuja plicata*, western *Tsuga heterophylla*, *Pseudotsuga menziesii*, *Picea engelmannii*, *Abies grandix*, *Pinus contorta*, *Tsuga mertensiana*, *Larix occidentalis,* and *Pinus monticola*. Very high basal areas can be achieved on these types. Fire frequency is low due to the maritime influence on these sites. Fire severity can be highly variable due the common moist conditions, but can be severe during periods of drought. Fire-free intervals range from 50 to greater than 200 years (Fischer 1987). Many species do well on these sites and may thrive for centuries without disturbance. *Thuja plicata* is the most notable example.

HTG #6 - Moderately Cool and Wet - *Thuja plicata Athyrium*, *Oplopanax,* and *Adiantum* Types

These are very wet sites. They are forested riparian areas along streams and are associated with wetlands. Due to these very wet conditions, the fire-free interval can be very long. Intervals are probably much longer than the majority of fire group eleven, 50 to greater than 200 years. Centuries may pass without severe, stand-replacing fires (Smith 1995).

HTG #7 - Cool and Moist - *Clintonia* and *Menziesia* Types

These types are characterized by cool and moist site conditions. Species diversity can be high with *Larix occidentalis*, *Pseudotsuga menziesii*, *Pinus monticola, Picea Engelmannii*, *Pinus contorta*, *Abies lasiocarpa,* and *Abies grandix*. Other sites are dominated by *Pinus contorta* after stand-replacing burns. These sites are probably too cool for *Tsuga heterophylla* and *Thuja plicata*. Fire history information is scarce. Fire intervals are estimated at greater than 120 years for most sites (Fischer 1987).

HTG #8 - Cool and Wet - Calamagrostis canadensis, Equisetum, Galium, and Streptopus

These are very wet sites. They are forested riparian areas along streams and associated with wetlands. Due to these very wet conditions, the fire-free interval can be very long. Intervals between severe, stand-replacing fires are probably much longer than the majority of fire group nine (90 to 130 years) and are probably in excess of 150 years.

HTG #9 - Cool and Moderately Dry - Cooler *Abies lasiocarpa* and *Pinus contorta* Types

These are the cooler *Abies lasiocarpa* habitat types within the area. The fire-free interval of these types is 50-130 years (Fischer 1987). These periodic fire disturbances and the high number of moderate- to high-intensity fires favor species such as *Pinus contorta*, *Pseudotsuga menziesii,* and *Larix occidentalis*. Other species on these sites are commonly *Abies lasiocarpa, Picea*, and *Pinus albicaulis*. Stands dominated by *Pinus contorta* and over 80 years of age tend to build fuels to become a part of large stand-replacing fire events encompassing thousands of acres (Fischer 1987). These sites, especially in the *Vaccinium caespitosum* and *scoparium* types, are quite frosty.

HTG #10 - Cold and Moderately Dry - *Vaccinium scoparium* and *Luzula* Types

These types are upper elevation, cold, dry sites. Many of these sites are above the cold limits of conifers such as *Pseudotsuga menziesii*, *Larix occidentalis,* and *Pinus monticola*. Common species are *Pinus albicaulis*, *Pinus contorta*, *Tsuga mertensiana, Abies lasiocarpa,* and *Larix lyallii*. The fire-free interval varies considerably from 35 to over 300 years. Stand-replacing fires occur after intervals of more than 200 years (Fischer et al. 1987). Most fires are of low severity because of discontinuous fuels (Arno 1989).

HTG #11 - Cold - High elevation *Pinus albicaulis* and *Abies lasiocarpa* Types

These types are cold, high elevation sites. They are near timberline and above the cold limits of species such as *Pseudotsuga menziesii* and *Larix occidentalis*. Common species are *Pinus albicaulis, Tsuga mertensiana, Abies lasiocarpa,* and *Larix lyallii*. The fire-free interval varies considerably from 35 to over 300 years. Stand replacement fires occur after intervals of more than 200 years (Fischer et al. 1987).

Table H-1. Non-forested Habitat Type Groups (HTGs) (USDA FS 1992).

Habitat Type	Phase	Code	Fire Group Code	
Grassland Steppe (**HTG 15**)		015		
Poasec-Danuni *Agropyron spicatum* Agrspi (lithic) *Festuca idahoensis* *Festuca scabrella* *Andropogon* spp.		 017 018 019 020		
Shrubland Steppe (**HTG 30**)		030		
Artemisia rigida-Poa secunda *Artemesia tridentata* *Purshia tridentata* *Celtis reticulata* *Cercocarpus ledifolius* Cerled-agrspi *Rhus glabra-agropyron spicatum* *Symphoricarpos albus*		040 032 035 041 036 044 042 043		
Hardwoods (**HTG 50**)		050		
Mountain Bottomlands (**HTG 60**)		060		0
Carex spp. (wet complex) *Carex*/grass (moist complex) *Deschampsia caespitosa* Tall forb types *Crataegus douglasii* *Alnus* spp. *Salix* spp *Populus tremuloides* *Populus trichocarpa*		061 065 062 070 071 073 074 078 079		
Alpine Meadows and Scrub (**HTG 80**)		080		0
Sedge/grass types (Includes *Carhoo-Fesida, Cargey-Fesida, Fesvir-Carex*) Forb types Shrub types		081 084 087		
Rock (**HTG 0**)		0		0
Water (**HTG 98**)		98		0

Table H-2. Summary information for forested Habitat Type Groups within the South Fork Clearwater River Subbasin.

Habitat Types Comprising Habitat Group 1				
Habitat Type	**Phase**	**Code**	**Fire Group Code**	
			MT	**ID**
Pinus ponderosa/Agropyron spicatum		130	2	1
Pinus ponderosa/Festuca idahoensis	*Festuca idahoensis* *Festuca scabrella*	140 141 142	2 2 2	1
Pinus ponderosa/Purshia tridentata	*Agropyron spicatum* *Festuca idahoensis*	160 161 162	2 2 2	
Pseudotsuga menziesii/ Agropyron spicatum		210	4	1
Pseudotsuga menziesii/Festuca Idahoensis		220	5	1
Pseudotsuga menziesii/Festuca scabrella		230	4	
Pseudotsuga menziesii/ Symphoricarpos albus	*Agropyron spicatum*	311	4	1
Pseudotsuga menziesii/ Calamagrostis rubescens	*Agropyron spicatum*	321	4	

Habitat Types Comprising Habitat Group 3				
Habitat Type	**Phase**	**Code**	**Fire Group Code**	
			MT	**ID**
Pseudotsuga menziesii/Linnaea borealis	*Symphoricarpos albus* *Vaccinium globulare*	290 291 293	6 6 6	
Abies grandix/Xerophyllum tenax	*Coptis occidentalis* *Vaccinium globulare*	510 511 512	6 11 6	7 7 7
Abies grandix/Vaccinium globulare		515	6	7
Abies grandix/Linnaea borealis	*Linnaea borealis* *Xerophyllum tenax*	590 591 592	11 11 6	 7 7
Abies grandix/Clintonia uniflora	*Xerophyllum tenax*	523	11	7

Table H-2 (continued). Summary information for forested Habitat Type Groups within the South Fork Clearwater River Subbasin.

Habitat Types Comprising Habitat Group 2				
Habitat Type	**Phase**	**Code**	**Fire Group Code**	
			MT	**ID**
Pinus ponderosa/ Symphoricarpos albus	*Symphoricarpos albus*	170 171	2 2	1
Pinus ponderosa/Physocarpus malvaceus		190		2
Pseudotsuga menziesii/ Vaccinium caespitosum		250	6/7	2
Pseudotsuga menziesii/ Physocarpus malvaceus	*Physocarpus malvaceus* *Calamagrostis rubescens* *Smilacina stellata*	260 261 262 263	6 6 4	2 2
Pseudotsuga menziesii/ Vaccinium globulare	*Vaccinium globulare* *Arctostaphylos uva-ursi* *Xerophyllum tenax*	280 281 282 283	6 6 6	2
Pseudotsuga menziesii/Linnaea borealis	*Calamagrostis rubescens*	292	6	
Pseudotsuga menziesii/ Symphoricarpos albus	*Calamagrostic rubescens* *Symphoricarpos albus*	310 312 313	6 6 6	2
Pseudotsuga menziesii/ Calamagrostis rubescens	*Arctostaphylos uva-ursi* *Calamagrostis rubescens* *Pinus ponderosa*	320 322 323 324	6 4	 2 2
Pseudotsuga menziesii/Carex geyeri		330		2
Pseudotsuga menziesii/Spiraea betulifolia		340	4	1
Pseudotsuga menziesii/ Arctostaphylos uva-ursi		350	6	
Pseudotsuga menziesii/ Juniperus communis		360		
Pseudotsuga menziesii/Arnica cordifolia		370		
Abies grandis/Spiraea betulifolia		505	4	2
Abies grandis/Physocarpus malvaceus	*Coptis occidentalis* *Physocarpus malvaceus*	506 507 508	4 4 4	 2 2

Table H-2 (continued). Summary information for forested Habitat Type Groups within the South Fork Clearwater River Subbasin.

Habitat Types Comprising Habitat Group 4				
Habitat Type	**Phase**	**Code**	**Fire Group Code**	
			MT	**ID**
Abies grandis/Asarum caudatum	*Asarum caudatum*	516		
	Menziesia ferruginea	517		7
	Taxus brevifolia	518		7
		519		7
Abies grandis/Clintonia uniflora	*Clintonia uniflora*	520	11	7
	Aralia nudicaulis	521	11	7
	Physocarpus malvaceus	522	11	
		524	11	7
	Menziesia ferruginea	525	11	7
	Taxus brevifolia	526	11	7
Abies grandis/Senecio triangularis		529	7	

Table H-2 (continued). Summary information for forested Habitat Type Groups within the South Fork Clearwater River Subbasin.

Habitat Types Comprising Habitat Group 5				
Habitat Type	**Phase**	**Code**	**Fire Group Code**	
			MT	**ID**
Thuja plicata/Clintonia uniflora	*Clintonia uniflora* *Aralia nudicaulis* *Menziesia ferruginea* *Xerophyllum tenax* *Taxus brevifolia*	530	11	
		531	11	8
		532	11	
		533	11	8
		534	11	8
		535	11	8
Thuja plicata/Asarum caudatum	*Asarum caudatum* *Menziesia ferruginea* *Taxus brevifolia*	545	11	
		546	11	8
		547	11	8
		548	11	8
Thuja plicata/Gymnocarpium dryopteris		555	11	8
Tsuga heterophylla/ Gymnocarpium dryopteris		565	11	8
Tsuga heterophylla/Clintonia uniflora	*Clintonia uniflora* *Aralia nudicaulis* *Xerophyllum tenax* *Menziesia ferruginea*	570	11	
		571	11	8
		572	11	8
		573	11	8
		574	11	8
Tsuga heterophylla/Asarum caudatum	*Aralia nudicaulis* *Menziesia ferruginea* *Asarum caudatum*	575	11	
		576	11	8
		577	11	8
		578	11	8

Table H-2 (continued). Summary information for forested Habitat Type Groups within the South Fork Clearwater River Subbasin.

Habitat Types Comprising Habitat Group 6				
Habitat Type	Phase	Code	Fire Group Code	
			MT	ID
Thuja plicata/Athyrium filix-femina	*Adiantum pedatum*	540		
	Athyrium filix-femina	541		9
		542		9
Thuja plicata/Oplopanax horridum		550	11	9
Thuja plicata/Adiantum pedatum		560		9

Habitat Type Groups Comprising Habitat Group 7				
Habitat Type	Phase	Code	Fire Group Code	
			MT	ID
Picea/Clintonia uniflora	*Vaccinium caespitosum*	420	9	
	Clintonia uniflora	421	9	
		422	9	
Picea/Linnaea borealis		470	7	
Tsuga heterophylla/Menziesia ferruginea		579		
Abies lasiocarpa/Clintonia uniflora	*Clintonia uniflora*	620	9	
	Aralia nudicaulis	621	9	5
	Vaccinium caespitosum	622	9	
	Xerophyllum tenax	623	9	
	Menziesia ferruginea	624	9	5
		625	9	5
Abies lasiocarpa/Linnaea borealis	*Linnaea borealis*	660	9	
	Xerophyllum tenax	661	9	
		662	9	
Abies lasiocarpa/Menziesia ferruginea	*Coptis occidentalis*	670	9	
	Luzula hitchcockii	671		5
	Xerophyllum tenax	672		5
	Vaccinium scoparium	673		5
		674		5
Tsuga mertensiana/Menziesia ferruginea	*Luzula hitchcockii*	680	9	
	Xerophyllum tenax	681		5
		682		5

Habitat Type Groups Comprising Habitat Group 7				
Habitat Type	Phase	Code	Fire Group Code	
			MT	ID
Tsuga mertensiana/Clintonia uniflora	*Menziesia ferruginea*	685		
	Xerophyllum tenax	686		5
		687		5
Abies lasiocarpa/Vaccinium scoparium	*Thalictrum occidentale*	733		
Abies lasiocarpa/Alnus sinuata		740		
Abies lasiocarpa/Luzula hitchcockii	*Menziesia ferruginea*	832	10	

Habitat Types Comprising Habitat Group 8				
Habitat Type	Phase	Code	Fire Group Code	
			MT	ID
Picea/Equisetum arvense		410	9	
Picea/Galium triflorum		440	9	
Picea/Smilacina stellata		480	8	
Abies lasiocarpa/Oplopanax horridum		610	9	
Abies lasiocarpa/Galium triflorum	*Galium triflorum*	630		
	Calamagrostis canadensis	631	9	
		632		
Abies lasiocarpa/Streptopus amplexifolius	*Menziesia ferruginea*	635		
	Ligusticum canbyi	636		5
		637		5
Abies lasiocarpa/Calamagrostis canadensis	*Calamagrostis canadensis*	650	9	
		651	9	5
	Ligusticum canbyi	652		5
	Galium triflorum	653	9	
	Vaccinium caespitosum	654	7	5
	Ledum glandulosum	653		5
Tsuga mertensiana/Streptopus amplexifolius	*Luzula hitchockii*	675		
	Menziesia ferruginea	676		5
		677		5

Table H-2 (continued). Summary information for forested Habitat Type Groups within the South Fork Clearwater River Subbasin.

Habitat Types Comprising Habitat Group 9				
Habitat Type	Phase	Code	Fire Group Code	
			MT	ID
Picea/Vaccinium caespitosum		450	7	
Abies lasiocarpa/Vaccinium caespitosum		640	7	3
Abies lasiocarpa/Linnaea borealis	*Vaccinium scoparium*	663	7	
Abies lasiocarpa/Xerophyllum tenax	*Vaccinium globulare* *Vaccinium scoparium* *Coptis occidentalis* *Luzula hitchcockii*	690 691 692 693 694	 8 8 7 	 4 4 4 4
Tsuga mertensiana/ Xerophyllum tenax	*Luzula hitchcockii* *Xerophyllum tenax* *Vaccinium scoparium*	710 711 712 713	8 7	 4 4 4
Abies lasiocarpa/Vaccinium globulare		720	7	4
Abies lasiocarpa/Vaccinium scoparium	*Calamagrostis rubescens*	731		
Abies lasiocarpa/ Calamagrostis rubescens		750		4
Abies lasiocarpa/Arnica cordifolia		780		
Pinus contorta/Purshia tridentate		910		3
Pinus contorta/Vaccinium caespitosum c.t.		920	7	3
Pinus contorta/Linnaea borealis c.t.		930	7	
Pinus contorta/Calamagrostis rubescens c.t.		950	7	3

Table H-2 (continued). Summary information for forested Habitat Type Groups within the South Fork Clearwater River Subbasin.

Habitat Types Comprising Habitat Group 10				
Habitat Type	**Phase**	**Code**	**Fire Group Code**	
			MT	**ID**
Abies lasiocarpa/Vaccinium scoparium	*Vaccinium scoparium*	730 732	7	3
Abies lasiocarpa-Pinus albicaulis/ Vaccinium scoparium		820	10	6
Abies lasiocarpa/Luzula hitchcockii	*Vaccinium scoparium*	830 831	10	6
Tsuga mertensiana/Luzula hitchcockii	*Vaccinium scoparium* *Menziesia ferruginea*	840 841 842	10 10 10	6
Pinus contorta/Xerophyllum tenax c.t.		9225		3
Pinus contorta/Vaccinium scoparium		940	7	3

Habitat Types Comprising Habitat Group 11				
Habitat Type	**Phase**	**Code**	**Fire Group Code**	
			MT	**ID**
Pinus albicaulis-Abies lasiocarpa h.t.s.		850	10	6
Alpine larch-Abies lasiocarpa h.t.s.		860	10	6
Pinus albicaulis h.t.s.		870	10	6

c.t. =
h.t.s. = habitat type series

Appendix I. Overview of Stream Heating Processes

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Appendix I. Overview of Stream Heating Processes

Report prepared by:
Peter Leinenbach, Landscape Ecologist, Region 10, USEPA

At any particular time, a defined stream reach is capable of sustaining a particular water column temperature. Stream temperature changes that result within a defined reach are explained rather simply. The temperature of a parcel of water traversing a stream/river reach enters the reach at a given temperature. If that temperature is greater than the energy balance of the stream reach is capable of supporting, the temperature will decrease. If that temperature is less than energy balance is capable of supporting, the temperature will increase. Stream temperature changes within a defined reach are induced by the difference in energy balance between the parcel of water and the surrounding environment and transport of the parcel through the reach. The general relationships between stream parameters, thermodynamic processes (heat and mass transfer), and stream temperature changes are outlined in the flow chart below (Figure I-1.).

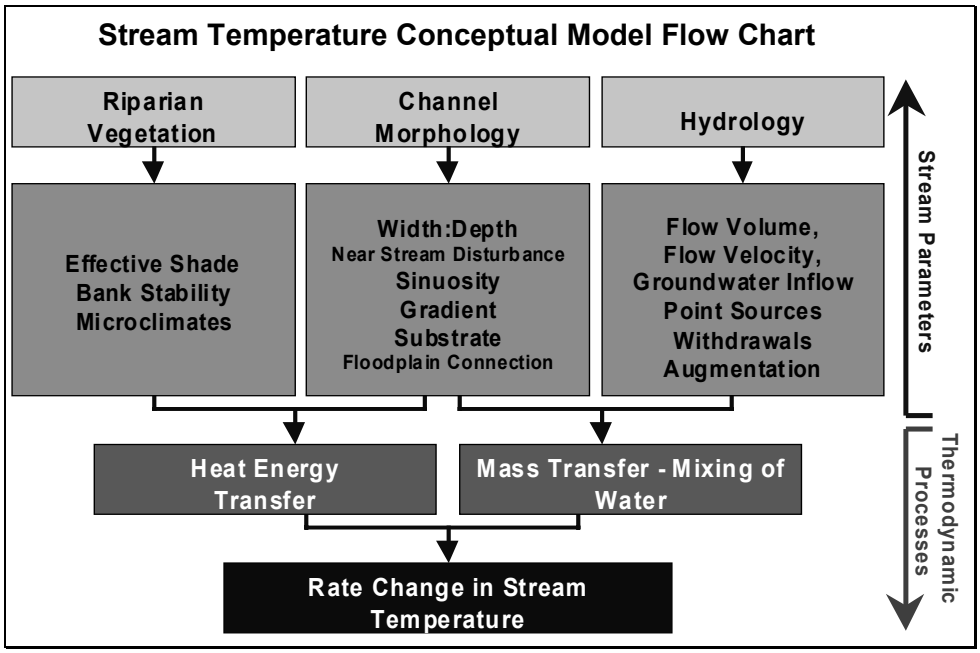

Figure I-1. Stream Temperature Conceptual Model Flow Chart

Cumulative Effects

It takes time for a water parcel to traverse the longitudinal distance of the defined reach, during which the energy processes drive stream temperature change. At any particular instant, water that enters the upstream portion of the reach is never exactly the temperature that is supported by the defined reach. As the water is transferred downstream, heat energy and hydraulic processes that are variable with time and space interact with the water parcel and induce water temperature changes. Further, heat energy is stored within this parcel of water and its temperature is the result of the heat energy processes upstream. This is

commonly referred to as a cumulative temperature effect, where conditions at a site contribute to heating of an already heated parcel of stream water. The described scenario is a simplification; however, understanding the basic processes in which stream temperature changes occur over the course of a defined reach and period of time is essential.

Thermal Role of Riparian Vegetation

The role of near-stream land cover in maintaining a healthy stream condition and water quality is well documented and accepted in scientific literature (Beschta et al. 1987). Riparian vegetation plays an important role in controlling stream temperature changes. The list of significant impacts that near-stream land cover has upon the stream and the surrounding environment is long, but warrants listing.

- Near-stream vegetation produces shadows, that when cast across a stream reduce solar radiant loading. The height, width, and density of the vegetation determine the extent of this effect..
- Near-stream land cover creates a thermal microclimate that generally maintains cooler air temperatures, higher relative humidity, and lower wind speeds along stream corridors.
- Near-stream vegetation affects bank stability. Specifically, channel morphology is often highly influenced by land cover type and condition, as they affect floodplain and instream roughness by contributing coarse woody debris and influencing sedimentation, stream substrate composition, and stream bank stability.

The warming of water temperature as a stream travels and drops in elevation (longitudinal heating) is a natural process. However, rates of heating can be dramatically reduced when high levels of shade exist and solar radiation loading is minimized. The overriding justification for attempting to reduce solar radiation loading is to minimize longitudinal heating. A limiting factor in reducing longitudinal stream heating is that there is a natural maximum level of shade that a given stream is capable of attaining.

Stream Surface Shade - Defined

Stream surface shade is an important parameter that controls the stream heating derived from solar radiation. Solar radiation has the potential to be the largest heat transfer mechanism in a stream system. Human activities can degrade near-stream land cover and/or channel morphology, and in turn, decrease shade. It follows that human-caused reductions in stream surface shade have the potential to cause significant increases in heat delivery to a stream system. Stream shade levels can also serve as indicators of near-stream land cover and channel morphology condition. For these reasons, stream shade is a focus of this analytical effort.

Shade is the amount of solar energy that is obscured or reflected by vegetation or topography above a stream. Shade is expressed in units of energy per unit area per unit time or as a percent of total possible energy. Canopy cover is the percent of the sky covered by vegetation or topography. Shade producing features will cast shadows on the water, while canopy cover may not. In order to assess the ability of riparian land cover to shield a stream

from solar radiation, two basic characteristics of shade must be addressed: *shade duration* and *shade quality*. The length of time that a stream receives shade is referred to as *shade duration*. The density of shade that affects the amount of radiation blocked by the shade-producing features is referred to as *shade quality*. Effective shade (Figure I-2) is amount of potential solar radiation not reaching the stream surface and is a function of *shade duration* and *shade quality*.

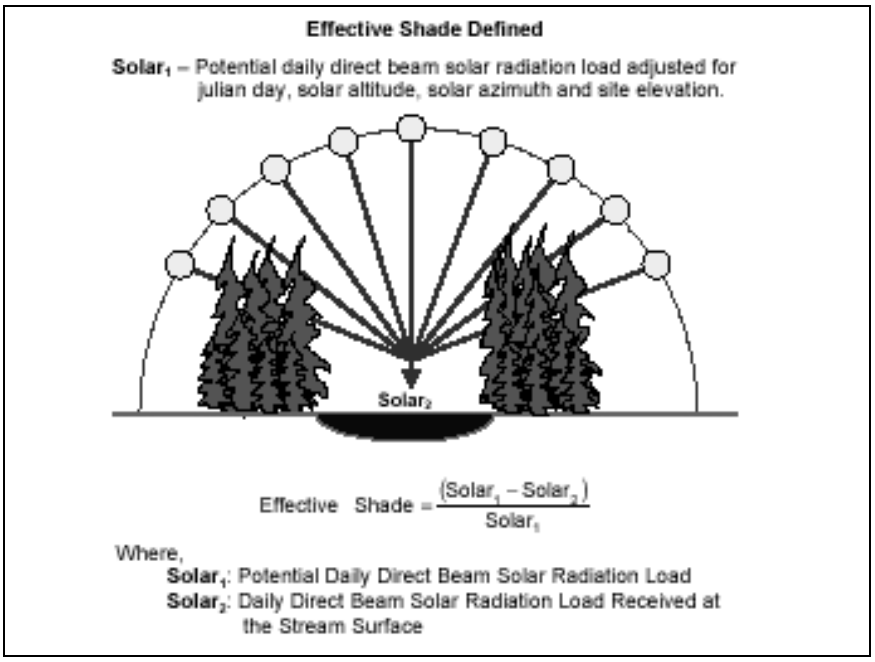

Figure I-2. Definition of Effective Shade

In the northern hemisphere, the earth tilts on its axis toward the sun during summertime months, allowing longer day length and higher solar altitude, both of which are functions of solar declination (a measure of the earth's tilt toward the sun) (Figure I-3). Geographic position (latitude and longitude) fixes the stream to a position on the globe, while aspect provides the stream/riparian orientation. Near-stream land cover height, width, and density describe the physical barriers between the stream and sun that can attenuate and scatter incoming solar radiation (i.e., produce shade) (Table I-1). The solar position has a vertical component (solar altitude) and a horizontal component (solar azimuth) that are both functions of time/date (solar declination) and the earth's rotation (hour angle measured as 15° per hour). While the interaction of these shade variables may seem complex, the mathematics that describes them is relatively straightforward geometry. Using solar tables or mathematical simulations, the potential daily solar load can be quantified. The measured solar load at the stream surface can easily be measured with a Solar Pathfinder© or estimated using mathematical shade simulation computer programs (Boyd 1996, Park 1993).

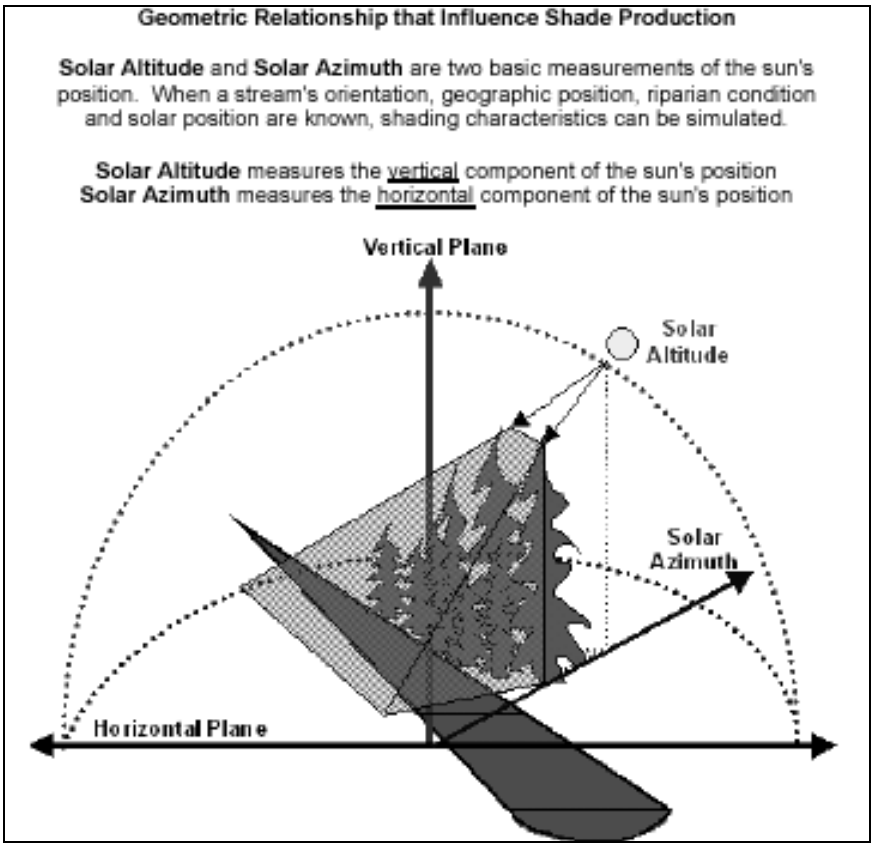

Figure I-3. Parameters that Affect Shade and Geometric Relationships

Table I-1. Factors that influence stream shade.

Description	Parameter
Season/Time	Date/Time
Stream Characteristics	Aspect, **Channel Width**
Geographic Position	Latitude, Longitude
Vegetative Characteristics	**Near-Stream Land Cover Height, Width, and Density**
Solar Position	Solar Altitude, Solar Azimuth

Bold type - influenced by human activities

Microclimate - Surrounding Thermal Environment

A secondary consequence of near-stream vegetation is its affect on the riparian microclimate. Riparian corridors often produce microclimates that surround the stream where cooler air temperatures, higher relative humidity, and lower wind speeds are characteristic. Riparian microclimates tend to moderate daily air temperatures. Relative humidity increases result from the evapotranspiration that is occurring by riparian plant communities. Wind speed is reduced simply by the physical blockage produced by riparian vegetation. Dong et al. (1998) analyzed microclimate data along 20 small streams in western Washington and found that riparian vegetation removal via timber harvests increased near stream air temperatures by up to 8 °F. Chen et al. (1995) detected that edge effects (i.e., atmospheric conditions outside of the near-stream buffer) penetrated to distances greater than 600 feet into a well-vegetated area. Riparian buffers commonly occur on both side of the stream, compounding the edge influence of the microclimate.

Brosofske et al. (1997) reported that a minimum stream buffer width of 150 feet was required to maintain soil temperatures that reflect those of a normal microclimate. Ground temperatures can be a source of heat energy to the stream. When the ground is warmer than the stream, heat will transfer from the stream bank to the water column. In fact, ground surfaces can conduct heat to a stream hundreds of times faster than an air column surrounding the stream. Solids (ground surfaces) have conductivities on the order of 500 to 3,500 times greater than gases (air) (Halliday and Resnick 1988). Impoverished riparian areas that allow excessive stream bank warming will introduce heat into the stream faster than cooler, highly vegetated stream banks. Riparian condition is again implicated as a controlling factor in stream temperature dynamics, in part because ground/soil temperatures are a function of shading.

Air affects stream temperatures at a slower *rate* than the ground. Nevertheless, this should not be interpreted to mean that air temperatures do not affect stream temperature. Air can deliver heat to a stream via the convection/conduction pathway, which is the slowest of the water energy transfer processes (Bowen 1926, Beschta and Weatherred 1984, Boyd 1996, Chen 1996). However, prolonged exposure to air temperatures warmer than the stream can induce gradual stream heating. Thus, a cooler microclimate will induce less stream warming.

Thermal Role of Channel Morphology

Changes in channel morphology, mainly channel widening, impact stream temperatures. As a stream widens, the surface area exposed to radiant sources and the ambient air temperature increases, resulting in increased energy exchange between the stream and its environment (Boyd 1996). Further, wide channels are likely to have relatively little shade due to the distance between the banks and the increased surface area to shade ratio. Conversely, narrow channels are more likely to receive a lot of shade. An additional benefit inherent of narrow/deep channels is the higher frequency of pools that contribute to aquatic habitat.

Channel widening is often related to degraded riparian conditions that allow increased stream bank erosion and sedimentation of the streambed, both of which correlate strongly with

riparian vegetation type and condition (Rosgen 1994). Riparian vegetation strengthens the stream bank with its roots (rooting strength) and contributes to floodplain and stream bank roughness that dissipates erosive energies associated with flowing water. Established or mature woody riparian vegetation provide the highest level of rooting strength and floodplain and stream bank roughness. Annual (grassy) riparian vegetation communities offer less rooting strength and floodplain and stream bank roughness.

Channel morphology is not solely dependent on riparian conditions. Sedimentation can deposit material in the channel, fill pools, and agrade the streambed, reducing channel depth and increasing channel width. High flow events play a major role in shaping the stream channel. Channel modification usually occurs during high flow events. Naturally, land uses that affect the magnitude and timing of high flow events may negatively impact channel width and depth. Riparian vegetation conditions will affect the resilience of the stream banks and floodplain during periods of sediment introduction and high flow. Disturbance processes may have drastically differing results depending on the ability of riparian vegetation to shape and protect channels. Riparian vegetation composition and condition affect channel morphology by:

- **Building stream banks:** Vegetation traps suspended sediments, encourages deposition of sediment in the floodplain, and reduces incoming sources of sediment.
- **Maintaining stable stream banks:** High rooting strength and high stream bank and floodplain roughness prevent stream bank erosion.
- **Reducing flow velocity (erosive kinetic energy):** Vegetation supplies large woody debris to the active channel, creates high pool:riffle ratios, and adds channel complexity that reduces shear stress exposure to stream bank soil particles.

Thermal Role of Hydrology

Brown (1969) proposed that water temperature change is a proportional function of heat exchange per unit volume:

$$\Delta T_w \propto \frac{\Delta Heat \quad Energy}{Volume}$$

Therefore, large volume streams are less responsive to temperature change than are low flow streams. Specifically, stream flow volume will affect the wetted channel dimensions (width and depth), flow velocity, travel time, and the stream assimilative capacity. Human-related reductions in flow volume can have a significant influence on stream temperature dynamics, most likely increasing diurnal variability in stream temperature. Figure I-4 illustrates the estimated mean August flow conditions for hydrological subunits within the South Fork Clearwater River subbasin (Lipscomb 1998). As can be seen in this image, stream flow conditions are very low throughout the subbasin during the summer, especially within the subbasin tributaries.

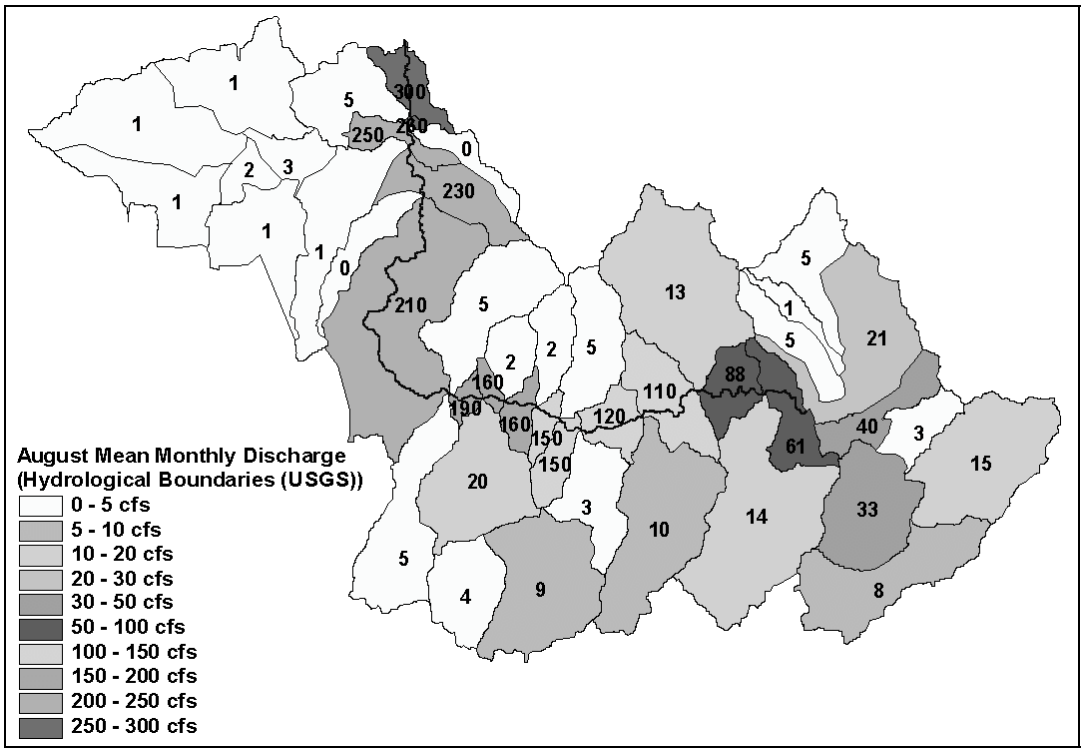

Figure I-4. Estimated August Mean Monthly Flow Conditions for the South Fork Clearwater River Subbasin (Lipscomb 1998)

Thermal Role of Ground Water

Ground water inflow has a cooling effect on summertime stream temperatures. Subsurface water is insulated from surface heating processes. Ground water temperatures fluctuate little and are cool (45 ^{o}F to 55 ^{o}F). Many land use activities that disturb riparian vegetation and associated floodplain areas may affect the surface water connectivity to ground water sources. Ground water inflow not only cools summertime stream temperatures, but also augments summertime flows. Reductions in or elimination of ground water inflow will have a compounding warming effect. The ability of riparian soils to capture, store and slowly release ground water is largely a function of floodplain/riparian area health.

The effects of ground water hydrology were not analyzed in this total maximum daily load (TMDL) effort. However, targets developed as part of this TMDL should passively promote the protection and creation of ground water areas and the connectivity of these areas with the stream.

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Appendix J. Stream and River Temperature Data

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Stream and River Temperature Data

This appendix contains a summary of the stream and river temperature data of the South Fork Clearwater River (SF CWR) Subbasin. The data summaries are shown in table and graphical formats below.

Summary data for 142 temperature loggers are shown in Table J-1. These are data collected by various agencies and are from several years. Some water bodies have several monitoring stations, others have only one, and many have none.

Each of the temperature logger data sets is evaluated in a computer program developed by the Idaho Department of Environmental Quality (DEQ) to compare the data to the state water quality standards (WQS) and the federal bull trout standard. Input to the program requires the temperature data organized by date and time, elevation, and location of the temperature logger location. The program also requires the dates of the spawning periods for the various salmonids using a particular water body. Table J-1 shows the salmonids determined to be present in each of the water bodies. The spawning period for each of the species was determined by the Fisheries Technical Advisory Group (Fish TAG) and is shown in Appendix D, Attachment D-1. Results of the stream temperature evaluation program for selected sites on the 303(d) listed water bodies Little Elk Creek, Big Elk Creek, Threemile Creek, Butcher Creek, and the main stem SF CWR at Stites are shown in Figures J-1 through J-6, and are discussed below.

For each of the temperature recording locations and for each year of data, a plot is made of the temperature data, as can be seen below for the selected streams. Different statistics can be shown on the plot. For example, Little Elk Creek at the mouth shows the daily maximums, daily averages, and the daily diurnal difference, along with lines showing the salmonid spawning daily average WQS and the cold water biota daily average WQS; Little Elk Creek at the Nez Perce National Forest boundary and Big Elk Creek show the same data except the diurnal differences are not shown; and the other three figures show the daily maximums, averages, and minimums for their water bodies, along with the WQS lines.

(In this appendix, we continue to use the antiquated terminology “Cold Water Biota” as well as the currently approved terminology “Cold Water Aquatic Life” primarily because the computerized model print out still produces that results as “Cold Water Biota”. The two sets of terms are equivalent.)

In addition to the plots, different data sets are produced summarizing the data in relation to the different WQS. For bull trout, for example, the data set shows the WQS criteria, the number of days of exceedance, and the percentage exceedance. These results must be evaluated in relation to both the dates when the data were collected and the specified spawning periods. Also, in the case of Idaho salmonid spawning standards evaluation, the program evaluates separately for spring and fall spawners since different species

spawn at different times. Representative data sets from the 303(d) listed water bodies are shown on the following pages.

For all of the temperature logger sites and dates, the most important data for exceedance analyses are presented in Table J-1.

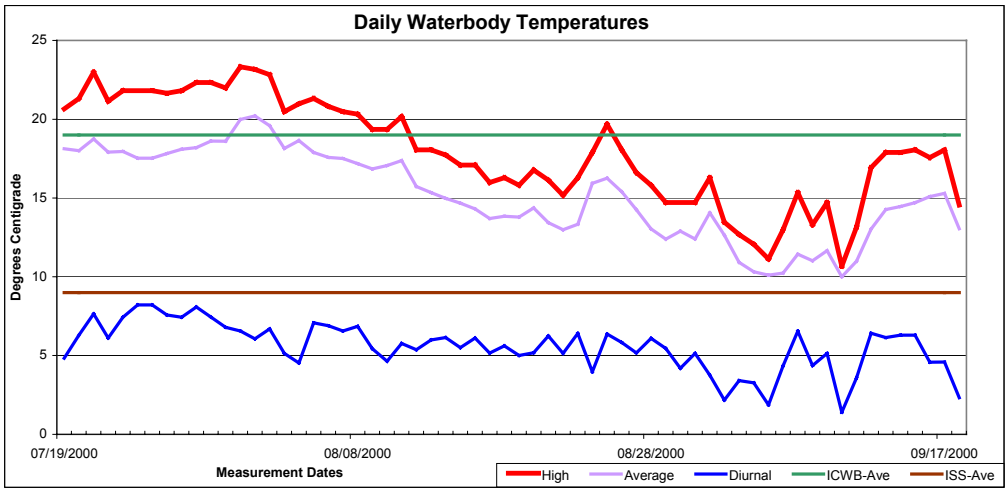
The tables below are auto-generated by the DEQ temperature assessment program and offer little opportunity for manipulation. For example, they all show assessments for bull trout water quality standards, even though some water bodies do not support bull trout and are not federally protected for bull trout. For that reason, a short discussion of the salient points is presented after each set of tables and figures. The purpose of presenting all the somewhat confusing data is to show the reader examples of typical temperature profiles in the SF CWR Subbasin.

DEQ Summary of Temperature Data

Data Source Name: DEQ-LRO
Water Body Name: Little Elk Creek
Data Collection Site: LittleElk-02, 50 m abv mouth
Data Period: 07/19/2000 - 09/18/2000

MDMT = 23.3, 31 Jul
MWMT = 22.5, 02 Aug
MDAT = 20.2, 01 Aug
MWAT = 19.1, 03 Aug

HUC4 Number: 17060305
HUC4 Name: South Fork Clearwater
North of the Salmon Clearwater Divide
Idaho Bull Trout Elevation: 1160 M
Waterbody ID Number: 57



STATISTICS	
Instantaneous Maximum	23.3 °C
Instantaneous Minimum	8.6 °C
Overall Mean	0.0 °C
Mean Daily Maximum	18.0 °C
Mean Daily Average	15.2 °C
Mean Daily Minimum	12.4 °C
Maximum Daily Average	20.2 °C
Maximum 7-Day Maximum	22.5 °C
Maximum 7-Day Average	19.1 °C
Minimum 7-Day Minimum	9.0 °C

EPA Bull Trout
Criteria Exceedance Summary

Criteria	Exceedance Counts Nmbr	Prcnt	
10 °C 7-Day Avg of Daily Max	56	100%	
Nmbr of 7-Day Avg's w/in Dates	56	01-Jun	30-Sep

Idaho Cold Water Biota
Criteria Exceedance Summary

Criteria	Exceedance Counts Nmbr	Prcnt	
22 °C Instantaneous	6	10%	
19 °C Average	3	5%	
Days Evaluated & Date Range	62	06/22/2000	09/21/2000

Idaho Salmonid Spawning
Criteria Exceedance Summary

Criteria	Exceedance Counts Nmbr	Prcnt	
13 °C Instantaneous Spring	28	100%	
9 °C Average Spring	28	100%	
Spring Days Eval'd w/in Dates	28	01-Jun	15-Aug
13 °C Instantaneous Fall	29	85%	
9 °C Average Fall	34	100%	
Fall Days Eval'd w/in Dates	34	16-Aug	30-Sep
13 °C Instantaneous Total *	57	92%	
9 °C Average Total *	62	100%	
Tot Days Eval'd w/in Both Dates *	62		

* If spring & fall dates overlap double counting may occur.

Figure J-1. Temperature Data for Little Elk Creek, 50 meters above the Mouth

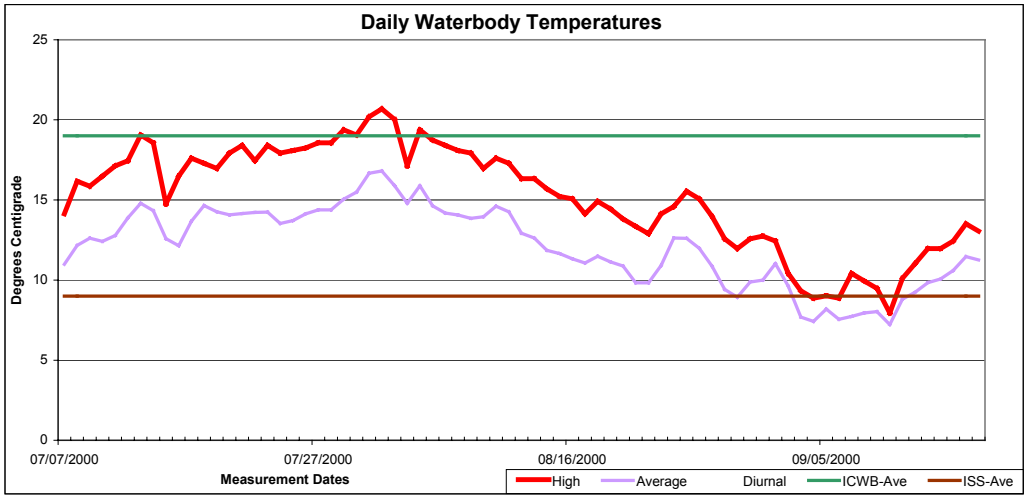
Comparing the data from Little Elk Creek at the mouth to those for Little Elk Creek at the USFS boundary (next page) shows the magnitude of the temperature increase across the unshaded meadows that the creek travels through between these two points. Otherwise the patterns are relatively the same. This stream is evaluated for salmonid spawning throughout the summer because of the presence of cutthroat trout and spring chinook salmon and because of required protection for bull trout.

DEQ Summary of Temperature Data

Data Source Name: DEQ-LRO
Water Body Name: Little Elk Creek
Data Collection Site: LittleElk-01 at USFS Boundary
Data Period: 07/07/2000 - 09/17/2000

MDMT = 20.7, 01 Aug
MWMT = 19.5, 02 Aug
MDAT = 16.8, 01 Aug
MWAT = 15.8, 04 Aug

HUC4 Number: 17060305
HUC4 Name: South Fork Clearwater North of the Salmon Clearwater Divide
Idaho Bull Trout Elevation: 1280 M
Waterbody ID Number: 57



STATISTICS	
Instantaneous Maximum	20.7 °C
Instantaneous Minimum	5.5 °C
Overall Mean	0.0 °C
Mean Daily Maximum	15.2 °C
Mean Daily Average	12.1 °C
Mean Daily Minimum	9.3 °C
Maximum Daily Average	16.8 °C
Maximum 7-Day Maximum	19.5 °C
Maximum 7-Day Average	15.8 °C
Minimum 7-Day Minimum	6.2 °C

EPA Bull Trout
Criteria Exceedance Summary

Criteria	Exceedance Counts Nmbr	Prcnt	
10 °C 7-Day Avg of Daily Max	61	91%	
Nmbr of 7-Day Avg's w/in Dates	67	01-Jun	30-Sep

Criteria Exceedance Summary

Criteria	Exceedance Counts Nmbr	Prcnt	
22 °C Instantaneous	0	0%	
19 °C Average	0	0%	
Days Evaluated & Date Range	73	06/22/2000	09/21/2000

Idaho Salmonid Spawning
Criteria Exceedance Summary

Criteria	Exceedance Counts Nmbr	Prcnt	
13 °C Instantaneous Spring	40	100%	
9 °C Average Spring	40	100%	
Spring Days Eval'd w/in Dates	40	01-Jun	15-Aug
13 °C Instantaneous Fall	13	39%	
9 °C Average Fall	23	70%	
Fall Days Eval'd w/in Dates	33	16-Aug	30-Sep
13 °C Instantaneous Total *	53	73%	
9 °C Average Total *	63	86%	
Tot Days Eval'd w/in Both Dates *	73		

* If spring & fall dates overlap double counting may occur.

Figure J-2. Temperature Data for Little Elk Creek at the USFS Boundary

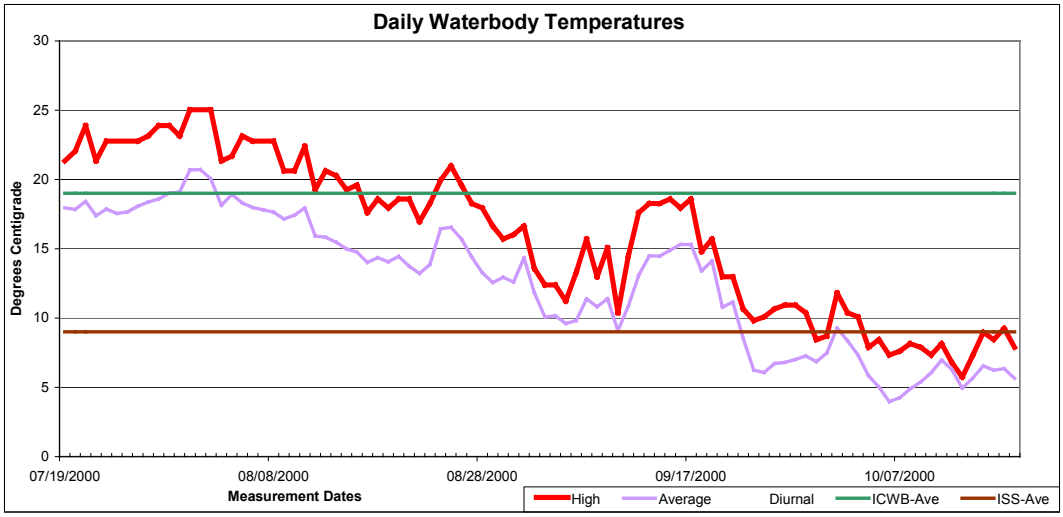
Even though the water temperature at the USFS boundary was significantly cooler than at the mouth, water temperatures still exceeded the salmonid spawning WQS during most of the monitoring period.

DEQ Summary of Temperature Data

Data Source Name: DEQ-LRO
Water Body Name: Big Elk Creek
Data Collection Site: BigElk-01 at mouth
Data Period: 07/19/2000 - 10/18/2000

MDMT = 25.0, 02 Aug
MWMT = 24.2, 02 Aug
MDAT = 20.7, 01 Aug
MWAT = 19.5, 30 Jul

HUC4 Number: 17060305
HUC4 Name: South Fork Clearwater
North of the Salmon Clearwater Divide
Idaho Bull Trout Elevation: 1160 M
Waterbody ID Number: 58



STATISTICS	
Instantaneous Maximum	25.0 °C
Instantaneous Minimum	0.3 °C
Overall Mean	0.0 °C
Mean Daily Maximum	16.0 °C
Mean Daily Average	12.6 °C
Mean Daily Minimum	9.3 °C
Maximum Daily Average	20.7 °C
Maximum 7-Day Maximum	24.2 °C
Maximum 7-Day Average	19.5 °C
Minimum 7-Day Minimum	2.2 °C

EPA Bull Trout
Criteria Exceedance Summary

Criteria	Exceedance Counts Nmbr	Prcnt	
10 °C 7-Day Avg of Daily Max	68	100%	
Nmbr of 7-Day Avg's w/in Dates	68	01-Jun	30-Sep

Idaho Cold Water Biota
Criteria Exceedance Summary

Criteria	Exceedance Counts Nmbr	Prcnt	
22 °C Instantaneous	18	20%	
19 °C Average	5	5%	
Days Evaluated & Date Range	65	06/22/2000	09/21/2000

Idaho Salmonid Spawning
Criteria Exceedance Summary

Criteria	Exceedance Counts Nmbr	Prcnt	
13 °C Instantaneous Spring	28	100%	
9 °C Average Spring	28	100%	
Spring Days Eval'd w/in Dates	28	01-Jun	15-Aug
13 °C Instantaneous Fall	30	65%	
9 °C Average Fall	37	80%	
Fall Days Eval'd w/in Dates	46	16-Aug	30-Sep
13 °C Instantaneous Total *	58	78%	
9 °C Average Total *	65	88%	
Tot Days Eval'd w/in Both Dates *	74		

* If spring & fall dates overlap double counting may occur.

Figure J-3. Temperature Data for Big Elk Creek at the Mouth

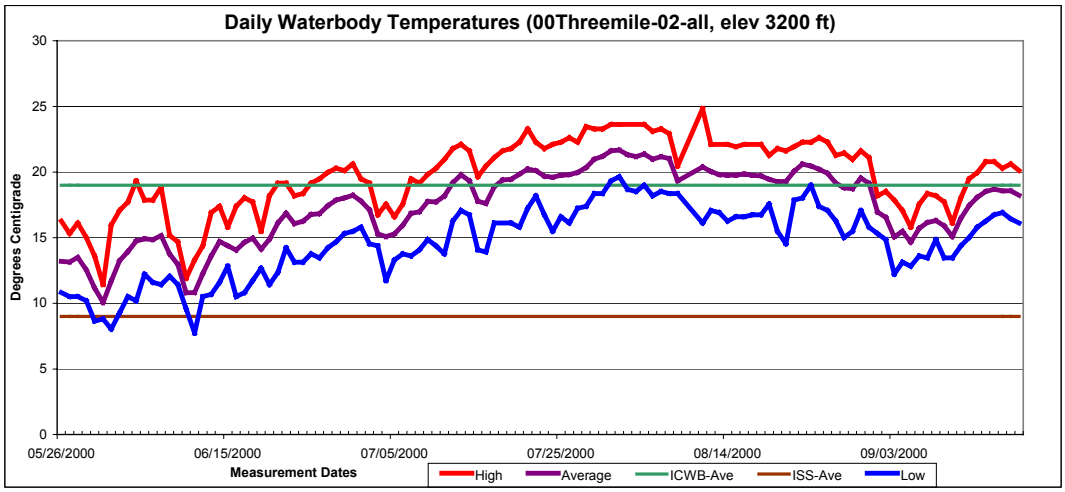
The pattern of temperatures of Big Elk Creek at the mouth looks fairly similar to Little Elk Creek at the mouth, except that Big Elk Creek is even warmer. Salmonid spawning criteria are exceeded well into September for a high percentage of the days of this record.

DEQ Summary of Temperature Data

Data Source Name: DEQ-LRO
Water Body Name: Threemile Creek
Data Collection Site: Threemile-02, blw Grangeville STP
Data Period: 5/26/00 - 9/18/00

MDMT = 24.8, 11 Aug
MWMT = 23.5, 04 Aug
MDAT = 21.7, 01 Aug
MWAT = 21.3, 04 Aug

HUC4 Number: 17060305
HUC4 Name: South Fork Clearwater
North of the Salmon Clearwater Divide
Idaho Bull Trout Elevation: 975 M
Waterbody ID Number: 10



STATISTICS	
Instantaneous Maximum	31.4 °C
Instantaneous Minimum	7.7 °C
Overall Mean	0.0 °C
Mean Daily Maximum	19.8 °C
Mean Daily Average	17.5 °C
Mean Daily Minimum	14.7 °C
Maximum Daily Average	28.8 °C
Maximum 7-Day Maximum	24.2 °C
Maximum 7-Day Average	22.0 °C
Minimum 7-Day Minimum	9.4 °C

EPA Bull Trout
Criteria Exceedance Summary

Criteria	Exceedance Counts Nmbr	Prcnt	
50 °C 7-Day Avg of Daily Max	0	0%	
Nmbr of 7-Day Avg's w/in Dates	109	01-Jun	30-Sep

Idaho Cold Water Biota
Criteria Exceedance Summary

Criteria	Exceedance Counts Nmbr	Prcnt	
22 °C Instantaneous	31	27%	
19 °C Average	45	39%	
Days Evaluated & Date Range	88	06/22/2000	09/21/2000

Idaho Salmonid Spawning
Criteria Exceedance Summary

Criteria	Exceedance Counts Nmbr	Prcnt	
13 °C Instantaneous Spring	6	86%	
9 °C Average Spring	7	100%	
Spring Days Eval'd w/in Dates	7	01-Mar	01-Jun
13 °C Instantaneous Fall	0	0%	
9 °C Average Fall	0	0%	
Fall Days Eval'd w/in Dates	0	16-Dec	30-Dec
13 °C Instantaneous Total *	6	86%	
9 °C Average Total *	7	100%	
Tot Days Eval'd w/in Both Dates *	7		

* If spring & fall dates overlap double counting may occur.

Figure J-4. Temperature Data for Threemile Creek Below the Wastewater Treatment Plant

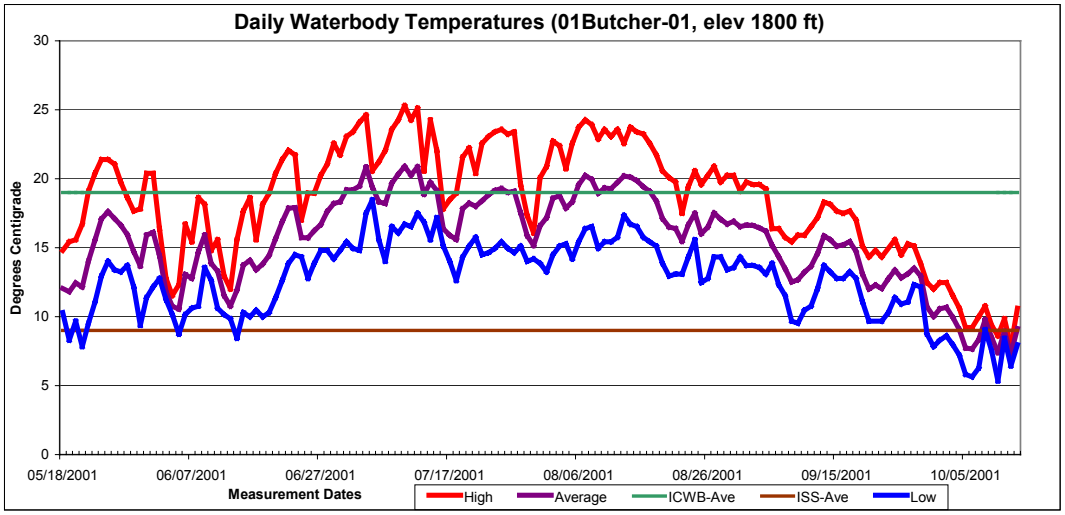
Threemile Creek has not been designated for bull trout so is not compared to this standard. The number of exceedances of the salmonid spawning criteria are small, but they cover 100% of the record (May 26 through June 1), because the spawning and incubation period for A-run steelhead ends on June 1. The graph indicates that stream temperatures are well elevated by the beginning of this record. Cold water biota standards exceedance numbers are probably the best indicators of the true level of exceedance at this site, although it should be kept in mind that this site is designated for salmonid spawning.

DEQ Summary of Temperature Data

Data Source Name: Nez Perce Tribe
Water Body Name: Butcher Creek
Data Collection Site: Butcher-01, 1 mile abv mouth
Data Period: 5/18/01 - 10/13/01

MDMT = 25.3, 10 Jul
MWMT = 23.9, 14 Jul
MDAT = 20.9, 10 Jul
MWAT = 20.1, 14 Jul

HUC4 Number: 17060305
HUC4 Name: South Fork Clearwater
North of the Salmon Clearwater Divide
Idaho Bull Trout Elevation: 550 M
Waterbody ID Number: 10



STATISTICS	
Instantaneous Maximum	25.3 °C
Instantaneous Minimum	5.3 °C
Overall Mean	0.0 °C
Mean Daily Maximum	18.5 °C
Mean Daily Average	15.5 °C
Mean Daily Minimum	12.7 °C
Maximum Daily Average	20.9 °C
Maximum 7-Day Maximum	23.9 °C
Maximum 7-Day Average	20.1 °C
Minimum 7-Day Minimum	6.7 °C

EPA Bull Trout
Criteria Exceedance Summary

Criteria	Exceedance Counts Nmbr	Prcnt	
50 °C 7-Day Avg of Daily Max	0	0%	
Nmbr of 7-Day Avg's w/in Dates	122	01-Jun	30-Sep

Idaho Cold Water Biota
Criteria Exceedance Summary

Criteria	Exceedance Counts Nmbr	Prcnt	
22 °C Instantaneous	36	24%	
19 °C Average	27	18%	
Days Evaluated & Date Range	92	06/22/2001	09/21/2001

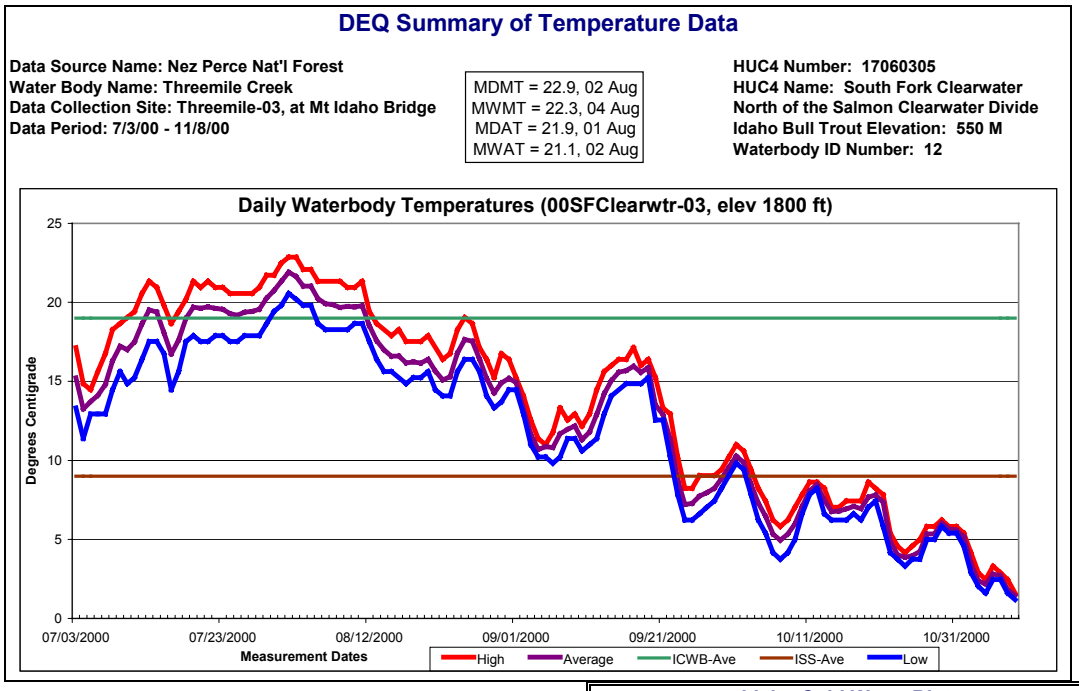
Idaho Salmonid Spawning
Criteria Exceedance Summary

Criteria	Exceedance Counts Nmbr	Prcnt	
13 °C Instantaneous Spring	15	100%	
9 °C Average Spring	15	100%	
Spring Days Eval'd w/in Dates	15	01-Mar	01-Jun
13 °C Instantaneous Fall	0	0%	
9 °C Average Fall	0	0%	
Fall Days Eval'd w/in Dates	0	16-Dec	30-Dec
13 °C Instantaneous Total *	15	100%	
9 °C Average Total *	15	100%	
Tot Days Eval'd w/in Both Dates *	15		

* If spring & fall dates overlap double counting may occur.

Figure J-5. Temperature Data for Butcher Creek, 1 Mile Above the Mouth

Butcher Creek has not been designated as protected for bull trout so is not compared to this standard. The number of days of salmonid spawning criteria exceedances is small, but represents 100% of the record (May 18 through June 1), because the spawning and incubation period for A-run steelhead ends on June 1. Cold water biota standards exceedance numbers are probably better indicators of the true level of exceedance at this site, although it should be kept in mind that this site is to support salmonid spawning.



STATISTICS	
Instantaneous Maximum	22.9 ºC
Instantaneous Minimum	1.2 ºC
Overall Mean	0.0 ºC
Mean Daily Maximum	13.9 ºC
Mean Daily Average	12.8 ºC
Mean Daily Minimum	11.8 ºC
Maximum Daily Average	21.9 ºC
Maximum 7-Day Maximum	22.3 ºC
Maximum 7-Day Average	21.1 ºC
Minimum 7-Day Minimum	2.0 ºC

Idaho Cold Water Biota
Criteria Exceedance Summary

Criteria	Exceedance Counts Nmbr	Prcnt	
22 °C Instantaneous	5	4%	
19 °C Average	26	20%	
Days Evaluated & Date Range	81	06/22/2000	09/21/2000

Idaho Salmonid Spawning
Criteria Exceedance Summary

Criteria	Exceedance Counts Nmbr	Prcnt	
13 °C Instantaneous Spring	0	0%	
9 °C Average Spring	0	0%	
Spring Days Eval'd w/in Dates	0	01-Jan	15-Apr
13 °C Instantaneous Fall	29	38%	
9 °C Average Fall	41	54%	
Fall Days Eval'd w/in Dates	76	16-Aug	30-Oct
13 °C Instantaneous Total *	29	38%	
9 °C Average Total *	41	54%	
Tot Days Eval'd w/in Both Dates *	76		

* If spring & fall dates overlap double counting may occur.

Figure J-6. Temperature Data for the Main Stem South Fork Clearwater River at the Mt. Idaho Bridge

The main stem SF CWR is not federally protected for bull trout spawning and rearing so the federal bull trout criteria do not apply. The Fish TAG identified spring chinook as the only salmonid possibly spawning in the lower main stem SF CWR during the temperature critical times of year (Appendix D). The main stem exceeds the cold water biota criteria for a significant period.

Table J-1. Summary water temperature data for stream and river monitoring locations in the SF CWR subbasin.

						No. of Days Exceeding***:				
WB	**Water Body Name**	**Location***	**Dates Monitored**	**Salmonids Present****	**Elev. (ft)**	**Fed. Bull Trout**	**Spring SS**	**Fall SS**	**CWAL daily max.**	**CWAL daily ave.**
1	South Fork Clearwater R.	SF Clearwater at Stites (USGS Gage)	7/9/99-10/30/99	Rain/Stl	1,200	NA	7	0	34	35
1	South Fork Clearwater R.	SF Clearwater at Stites (USGS Gage)	7/4/00-11/8/00	Rain/Stl	1,200	NA	12	0	49	45
1	South Fork Clearwater R.	SF Clearwater at Stites (USGS Gage)	7/11/01-10/2701	Rain/Stl	1,200	NA	5	0	46	46
1	South Fork Clearwater R.	SF Clearwater at Lukes Gulch	6/15/00 - 10/22/00	Rain/Stl	1,400	NA	31	0	35	40
2	Cottonwood Cr.	Cottonwood Cr. Above Mouth	6/2/00-10/15/00	Rain/Stl	1,200	NA	44	0	91	83
10	Threemile Cr.	Threemile Cr. at Mouth	4/7/00-8/9/00	Rain/Stl	1,200	NA	97	0	25	27
10	Threemile Cr.	Threemile Cr. at Mouth	5/26/00-10/23/00	Rain/Stl	1,200	NA	51	0	35	47
10	Threemile Cr.	Threemile Cr. at Mouth	4/7/00-5/24/00	Rain/Stl	1,200	NA	44	0	1	1
10	Threemile Cr.	Threemile Cr. Below Grangeville WWTP	5/26/00-9/18/00	Rain/Stl	3,200	NA	7	0	31	45
10	Threemile Cr.	Threemile Cr. Below Grangeville WWTP	5/26/00-10/23/00	Rain/Stl	3,200	NA	7	0	29	43
10	Threemile Cr.	Threemile Cr. Below Grangeville WWTP	4/7/00-5/24/00	Rain/Stl	3,200	NA	32	0	1	1
10	Threemile Cr.	Threemile Cr. Below Grangeville WWTP	4/7/00-5/24/00	Rain/Stl	3,200	NA	31	0	1	1

						No. of Days Exceeding***:				
WB	Water Body Name	Location*	Dates Monitored	Salmonids Present**	Elev. (ft)	Fed. Bull Trout	Spring SS	Fall SS	CWAL daily max.	CWAL daily ave.
10	Threemile Cr.	Threemile Cr. Above Grangeville WWTP	5/26/00-8/7/00	Rain/Stl	3,200	NA	50	0	12	9
10	Threemile Cr.	Threemile Cr. Above Grangeville WWTP	8/12/00-9/28/00	Rain/Stl	3,200	NA	0	0	2	1
10	Threemile Cr.	Threemile Cr. Above Grangeville WWTP	4/7/00-5/24/00	Rain/Stl	3,200	NA	24	0	1	1
10	Threemile Cr.	Threemile Cr. at Spencer Ranch	5/26/00-10/6/00	Rain/Stl	3,000	NA	47	0	60	28
10	Threemile Cr.	Threemile Cr. at Spencer Ranch	4/7/00-5/24/00	Rain/Stl	3,000	NA	14	0	1	1
11	Butcher Cr.	Butcher Cr. 1 mi Above Mouth	5/18/01-10/13/01	Rain/Stl	1,800	NA	15	0	36	27
12	South Fork Clearwater R.	SF Clearwater at Mt. Idaho Bridge	7/7/98-9/14/98	Chinook, Rain/Stl	1,800	NA	9	0	0	10
12	South Fork Clearwater R.	SF Clearwater at Mt. Idaho Bridge	7/16/99-10/8/99	Chinook, Rain/Stl	1,800	NA	0	0	0	7
12	South Fork Clearwater R.	SF Clearwater at Mt. Idaho Bridge	7/3/00-11/8/00	Chinook, Rain/Stl	1,800	NA	0	41	5	26
12	South Fork Clearwater R.	SF Clearwater at Mt. Idaho Bridge	7/11/01-11/27/01	Chinook, Rain/Stl	1,800	NA	5	0	0	13
12	South Fork Clearwater R.	SF Clearwater Below Mill Cr.	7/16/99-10/7/99	Chinook, Rain/Stl	2,200	NA	0	0	0	0
12	South Fork Clearwater R.	SF Clearwater Below Mill Cr.	6/20/00-9/01/00	Chinook, Rain/Stl	2,200	NA	26	0	3	8

						No. of Days Exceeding***:				
WB	Water Body Name	Location*	Dates Monitored	Salmonids Present**	Elev. (ft)	Fed. Bull Trout	Spring SS	Fall SS	CWAL daily max.	CWAL daily ave.
12	South Fork Clearwater R.	SF Clearwater Below Mill Cr.	5/25/01-10/27/01	Chinook, Rain/Stl	2,200	NA	43	0	0	4
12	South Fork Clearwater R.	SF Clearwater at USFS Boundary	5/25/01-10/27/01	Chinook, Rain/Stl	1,800	NA	44	0	0	16
12	South Fork Clearwater R.	Castle Cr. at Mouth	7/4/01-10/27/01	Rain/Stl	2,200	NA	12	1	37	18
12	South Fork Clearwater R.	Earthquake Cr. at Mouth	7/6/01-10/27/01	Rain/Stl	2,200	NA	10	0	0	0
12	South Fork Clearwater R.	Green Cr. at Mouth	7/4/01-10/22/01	Rain/Stl	1,600	NA	43	0	0	0
12	South Fork Clearwater R.	Lightning Cr. at Mouth	7/4/01-10/8/01	Rain/Stl	1,600	NA	43	0	0	0
12	South Fork Clearwater R.	Schwartz Cr. at Mouth	7/11/01-10/27/01	Rain/Stl	1,800	76	5	0	0	0
12	South Fork Clearwater R.	Sears Cr. at Mouth	7/11/01 - 10/22/01	Rain/Stl	2,200	NA	5	0	0	0
13	Mill Cr.	Mill Cr. at Mouth	7/14/99 - 10/7/99	Bull, Chinook, Rain/Stl, Cut, Brook	2,200	71	33	40	0	0
13	Mill Cr.	Mill Cr. at Mouth	6/17/00 - 10/4/00	Bull, Chinook, Rain/Stl, Cut, Brook	2,200	95	60	36	3	1
13	Mill Cr.	Mill Cr. at Mouth	5/25/01 - 10/27/01	Bull, Chinook, Rain/Stl, Cut, Brook	2,200	122	68	45	0	0
14	Johns Cr.	Johns Cr. at Gage	8/8/99 - 10/20/99	Bull, Chinook. Rain/Stl, Cut	2,400	46	8	41	0	0

						No. of Days Exceeding***:				
WB	Water Body Name	Location*	Dates Monitored	Salmonids Present**	Elev. (ft)	Fed. Bull Trout	Spring SS	Fall SS	CWAL daily max.	CWAL daily ave.
14	Johns Cr.	Johns Cr. at Gage	7/12/00 - 10/31/00	Bull, Chinook, Rain/Stl, Cut	2,400	70	35	35	0	0
14	Johns Cr.	Johns Cr. at Gage	7/11/01 - 10/30/01	Bull, Chinook, Rain/Stl, Cut	2,400	76	36	45	0	0
22	South Fork Clearwater R.	SF Clearwater Below Twentymile Cr.	6/24/00 - 11/7/00	Chinook, Rain/Stl	3,000	NA	22	38	2	7
22	South Fork Clearwater R.	SF Clearwater Below Twentymile Cr.	7/12/01 - 10/9/01	Chinook, Rain/Stl	3,000	NA	4	46	1	3
22	South Fork Clearwater R.	SF Clearwater Below Peasley Cr.	7/16/99 - 10/6/99	Chinook, Rain/Stl	2,600	NA	0	41	0	0
22	South Fork Clearwater R.	SF Clearwater Below Peasley Cr.	6/20/00 - 9/1/00	Chinook, Rain/Stl	2,600	NA	26	17	1	7
22	South Fork Clearwater R.	SF Clearwater Below Peasley Cr.	6/19/01 - 10/27/01	Chinook, Rain/Stl	2,600	NA	27	46	0	0
22	South Fork Clearwater R.	SF Clearwater Above Droogs Cr.	6/24/00 - 11/7/00	Chinook, Rain/Stl	3,000	NA	22	38	5	7
22	South Fork Clearwater R.	SF Clearwater Above Droogs Cr.	7/12/01 - 10/9/01	Chinook, Rain/Stl	3,000	NA	4	46	0	2
24	Twentymile Cr.	Twentymile Cr. at Mouth	8/7/98 - 10/31/98	Bull, Rain/Stl, Cut	3,000	43	9	0	0	0
24	Twentymile Cr.	Twentymile Cr. 1 km Above Road 1875 Crossing	4/4/00 - 9/8/00	Bull, Rain/Stl, Cut	4,200	82	58	0	0	0
25	Tenmile Cr.	Tenmile Cr. at Mouth	7/25/00 - 9/29/00	Bull, Cut, Chinook, Rain/Stl	3,400	47	22	25	0	0

						No. of Days Exceeding***:				
WB	Water Body Name	Location*	Dates Monitored	Salmonids Present**	Elev. (ft)	Fed. Bull Trout	Spring SS	Fall SS	CWAL daily max.	CWAL daily ave.
30	South Fork Clearwater R.	SF Clearwater Above Moose Cr.	6/23/00 - 10/18/00	Chinook, Rain/Stl, Cut	3,600	NA	54	38	21	16
30	South Fork Clearwater R.	SF Clearwater Above Moose Cr.	7/12/01 - 10/9/01	Chinook, Rain/Stl, Cut	3,600	NA	35	46	11	8
30	South Fork Clearwater R.	SF Clearwater Above Leggett Cr.	6/23/00 - 11/2/00	Chinook, Rain/Stl, Cut	3,600	NA	54	38	14	12
30	South Fork Clearwater R.	SF Clearwater Above Leggett Cr.	7/12/01 - 10/9/01	Chinook, Rain/Stl, Cut	3,600	NA	35	46	5	6
30	South Fork Clearwater R.	SF Clearwater Above Tenmile Cr.	6/23/00 - 11/7/00	Chinook, Rain/Stl, Cut	3,400	NA	54	38	7	16
30	South Fork Clearwater R.	SF Clearwater Above Tenmile Cr.	7/12/01 - 10/9/01	Chinook, Rain/Stl, Cut	3,400	NA	35	46	2	6
31	Crooked R.	Crooked R. at Lower Satellite Intake	5/16/98 - 9/08/98	Bull, Chinook, Rain/Stl, Brook, Cut	3,800	93	61	24	3	0
31	Crooked R.	Crooked R. at Lower Satellite Intake	7/11/00 - 9/30/00	Bull, Chinook, Rain/Stl, Brook, Cut	3,800	55	5	20	0	0
31	Crooked R.	Crooked R. 5 km Above Mouth	6/01/00 - 8/22/00	Bull, Chinook, Rain/Stl, Brook, Cut	4,000	73	66	7	8	0
31	Crooked R.	Crooked R. 1 km Above Mouth	5/31/00 - 9/7/00	Bull, Chinook, Rain/Stl, Brook, Cut	3,800	94	71	23	13	6
31	Crooked R.	Crooked R. 1 km Above Mouth	4/2/00 - 5/30/00	Bull, Chinook, Rain/Stl, Brook, Cut	3,800	0	0	0	0	0
32	Crooked R.	Just Below EF and WF Confluence	7/29/99 - 10/15/99	Bull, Chinook, Rain/Stl, Cut	4,600	32	16	15	0	0

						No. of Days Exceeding***:				
WB	Water Body Name	Location*	Dates Monitored	Salmonids Present**	Elev. (ft)	Fed. Bull Trout	Spring SS	Fall SS	CWAL daily max.	CWAL daily ave.
33	West Fork Crooked R.	WF Crooked R. 1.6 km Above Fork	6/1/99 - 11/1/99	Bull, Chinook, Rain/Stl, Cut	4,800	54	25	14	0	0
33	West Fork Crooked R.	WF Crooked R. 1.6 km Above Fork	7/11/00 - 9/29/00	Bull, Chinook, Rain/Stl, Cut	4,800	53	36	19	0	0
34	East Fork Crooked R.	EF Crooked R.-2.3 km Above Fork	6/1/99 - 11/3/99	Bull, Chinook, Cut	4,800	29	18	13	0	0
34	East Fork Crooked R.	EF Crooked R. 2.3 km Above Fork	7/11/00 - 9/29/00	Bull, Chinook, Cut	4,800	45	36	6	0	0
35	Relief Cr.	Relief Cr. 0.6 km Above Mouth	5/27/99 - 10/14/99	Bull, Chinook, Rain/Stl, Cut	4,200	92	46	18	0	0
35	Relief Cr.	Relief Cr. 0.6 km Above Mouth	7/11/00 - 9/30/00	Bull, Chinook, Rain/Stl, Cut	4,200	63	36	23	0	0
36	South Fork Clearwater R.	SF Clearwater Above Elk City Mill	6/23/00 - 11/7/00	Rain/Stl	3,800	NA	23	0	18	14
36	South Fork Clearwater R.	SF Clearwater Above Elk City Mill	7/12/01 - 10/9/01	Rain/Stl	1,800	NA	4	0	10	5
36	South Fork Clearwater R.	SF Clearwater Above Crooked R. Bridge	5/15/00 - 8/29/00	Rain/Stl	3,800	NA	44	0	13	18
37	Red R.	Red R. at Mouth Below Bridge	5/5/00 - 9/26/00	Bull, Chinook, Rain/Stl, Cut, Brook	3,800	118	75	38	13	16
38	Little Moose Cr.	10 m Upstream of USFS Stream Gage	5/25/00 - 9/12/00	Bull, Chinook, Rain/Stl, Cut, Brook	4,200	103	70	19	3	0
39	Moose Butte Cr.	Upper Moose Butte Cr.	8/2/01 - 10/31/01	Bull, Chinook, Cut, Brook	5,000	34	14	26	0	0

						No. of Days Exceeding***:				
WB	Water Body Name	Location*	Dates Monitored	Salmonids Present**	Elev. (ft)	Fed. Bull Trout	Spring SS	Fall SS	CWAL daily max.	CWAL daily ave.
41	South Fork Red R.	SF Red R. Below Road 222 Crossing	7/26/01 - 10/14/01	Bull, Cut, Rain/Stl, Brook	4,600	29	12	5	0	0
42	West Fork Red R.	WF Red R. 75m Above Mouth	5/25/00 - 9/12/00	Bull, Rain/Stl, Cut, Brook	5,200	55	29	14	0	0
42	West Fork Red R.	WF Red R. 75 m Above Mouth	5/25/00 - 9/12/00	Bull, Rain/Stl, Cut, Brook	5,200	69	46	8	0	0
42	West Fork Red R.	WF Red R. 20 m Above Mouth	5/27/99 - 10/31/99	Bull, Rain/Stl, Cut, Brook	5,200	55	32	15	0	0
42	West Fork Red R.	WF Red R. 20 m Above Mouth	5/25/00 - 9/12/00	Bull, Rain/Stl, Cut, Brook	5,200	70	47	9	0	0
43	WF of SF Red R.	WF of SF Red R. at Mouth	7/26/01 - 10/23/01	Bull, Rain/Stl, Cut	5,400	48	19	0	0	0
43	WF of SF Red R.	Upper WF of SF Red R.	7/17/01 - 10/15/01	Bull, Rain/Stl, Cut	5,800	55	18	0	0	0
45	Red R.	Red R. Above Shissler Cr.	7/18/00 - 9/29/00	Bull, Chinook, Rain/Stl, Cut, Brook	4,800	47	29	16	0	0
45	Red R.	Red R. Above Shissler Cr.	6/27/01 - 10/23/01	Bull, Chinook, Rain/Stl, Cut, Brook	4,800	76	45	24	0	0
45	Red R.	Red R. Above Trail Cr.	7/18/00 - 9/29/00	Bull, Chinook, Rain/Stl, Cut, Brook	4,600	65	29	30	0	0
45	Red R.	Red R. Above Trail Cr.	6/27/01 - 10/23/01	Bull, Chinook, Rain/Stl, Cut, Brook	4,600	90	50	41	0	0
45	Red R.	Red R. Above Ditch Cr.	7/18/00 - 9/29/00	Bull, Chinook, Rain/Stl, Cut, Brook	4,400	62	29	30	3	0

						No. of Days Exceeding***:				
WB	Water Body Name	Location*	Dates Monitored	Salmonids Present**	Elev. (ft)	Fed. Bull Trout	Spring SS	Fall SS	CWAL daily max.	CWAL daily ave.
45	Red R.	Red R. Above Ditch Cr.	6/27/01 - 10/23/01	Bull, Chinook, Rain/Stl, Cut, Brook	4,400	90	50	39	0	0
45	Red R.	Red R. Above Otterson Cr.	7/18/00 - 10/16/00	Bull, Chinook, Rain/Stl, Cut, Brook	4,800	56	29	23	0	0
45	Red R.	Red R. Above Otterson Cr.	6/27/01 - 10/31/01	Bull, Chinook, Rain/Stl, Cut, Brook	4,800	90	49	29	0	0
48	Otterson Cr.	Otterson Cr. at Mouth	7/18/00 - 10/16/00	Bull, Chinook, Cut, Brook	4,600	58	29	28	0	0
48	Otterson Cr.	Otterson Cr. at Mouth	6/28/01 - 10/31/01	Bull, Chinook, Cut, Brook	4,600	89	49	37	0	0
50	Siegel Cr.	Siegel Cr. at USFS Boundary	7/18/00 - 9/29/00	Bull, Chinook, Rain/Stl, Cut, Brook	4,200	65	29	32	18	0
52	American R.	American R. 30 ft Upstream of Mouth	5/15/00 - 09/26/00	Bull, Chinook, Rain/Stl, Cut, Brook	3,800	118	74	38	23	12
52	American R.	American R. at River Mile 9.1	5/15/00 - 09/26/00	Bull, Chinook, Rain/Stl, Cut, Brook	4,000	118	76	37	26	13
57	Little Elk Cr.	Little Elk Cr. at USFS Boundary	7/7/00-9/17/00	Bull, Chinook, Cut, Rain/Stl, Brook	4,200	61	40	23	0	0
57	Little Elk Cr.	Little Elk Cr. 50 m Above Mouth	7/19/00-9/17/00	Bull, Chinook, Cut, Brook, Rain/Stl	3,800	56	28	34	6	3
58	Big Elk Cr.	Big Elk Cr. At Mouth	7/19/00-10/18/00	Bull, Chinook, Rain/Stl, Cut, Brook	3,800	68	28	37	18	5
58	Big Elk Cr.	Big Elk Cr. at USFS Boundary	7/15/00-10/17/00	Bull, Chinook, Rain/Stl, Cut, Brook	4,400	54	32	22	0	0

						No. of Days Exceeding***:				
WB	Water Body Name	Location*	Dates Monitored	Salmonids Present**	Elev. (ft)	Fed. Bull Trout	Spring SS	Fall SS	CWAL daily max.	CWAL daily ave.
62	Newsome Cr.	Newsome Cr. at Mouth	6/25/99-10/16/99	Bull, Chinook, Rain/Stl, Cut	3,600	90	51	41	0	0
63	Bear Cr.	Bear Cr. at Mouth	6/24/00-10/18/00	Bull Chinook, Rain/Stl, Cut	3,800	78	53	26	0	0
63	Bear Cr.	Bear Cr. at Mouth	6/28/01-10/8/01	Bull Chinook, Rain/Stl, Cut	3,800	77	49	29	0	0
65	NF Beaver Cr.	NF Beaver Cr. at Mouth	7/8/00-10/22/00	Bull, Rain/Stl, Cut	4,400	62	39	0	0	0
65	NF Beaver Cr.	NF Beaver Cr. at Mouth	6/30/01-10/8/01	Bull, Rain/Stl, Cut	4,400	87	45	0	0	0
65	SF Beaver Cr.	SF Beaver Cr. At Mouth	6/29/00-10/18/00	Rain/Stl, Cut	4,400	58	39	0	0	0
65	SF Beaver Cr.	SF Beaver Cr. at Mouth	6/30/01-10/8/01	Rain/Stl, Cut	4,400	73	43	0	0	0
65	Beaver Cr.	Beaver Cr. at Mouth	6/29/00 - 10/18/00	Bull, Rain/Stl, Cut	4,400	79	48	0	0	0
65	Beaver Cr.	Beaver Cr. at Mouth	6/28/01-10/8/01	Bull, Rain/Stl, Cut	3,800	89	49	0	0	0
68	Newsome Cr.	Newsome Cr. Below Radcliff	7/9/00-10/16/00	Bull, Rain/Stl, Cut, Chinook	4,000	69	38	27	0	0
68	Newsome Cr.	Newsome Cr. Below Radcliff	7/25/01-10/17/01	Bull, Rain/Stl, Cut, Chinook	4,000	62	22	33	0	0
68	Newsome Cr.	Newsome Cr. Above Haysfork	7/9/00-10/24/00	Bull, Rain/Stl, Cut, Chinook	4,000	73	38	31	6	0
68	Newsome Cr.	Newsome Cr. Above Haysfork	7/27/01-11/6/01	Bull, Rain/Stl, Cut, Chinook	4,000	60	20	39	0	0
70	Baldy Cr.	Baldy Cr. 0.3 km Above Mouth	6/1/99-10/30/99	Bull, Chinook, Rain/Stl, Cut	4,000	84	47	18	0	0

						No. of Days Exceeding***:				
WB	Water Body Name	Location*	Dates Monitored	Salmonids Present**	Elev. (ft)	Fed. Bull Trout	Spring SS	Fall SS	CWAL daily max.	CWAL daily ave.
71	Pilot Cr.	Pilot Cr. 50 m Below Bridge By Mouth	6/25/99-10/10/99	Bull, Chinook, Rain/Stl, Cut	4,000	67	38	17	0	0
71	Pilot Cr.	Pilot Cr. 50 m Below Bridge By Mouth	7/9/00-9/29/00	Bull, Chinook, Rain/Stl, Cut	4,000	62	38	24	0	0
71	Pilot Cr.	Pilot Cr. Above Dredging	7/12/00-8/23/00	Bull, Chinook, Rain/Stl, Cut	4,000	37	35	8	0	0
71	Pilot Cr.	Pilot Cr. Above Dredging	6/29/01-10/2/01	Bull, Chinook, Rain/Stl, Cut	4,000	84	48	31	0	0
72	Sawmill Cr.	Sawmill Cr. at Mouth	6/29/00-10/18/00	Bull, Chinook, Cut, Rain/Stl	4,000	72	46	25	0	0
72	Sawmill Cr.	Sawmill Cr. at Mouth	6/29/01-10/02/01	Bull, Rain/Stl, Chinook, Cut	4,000	78	48	28	0	0
73	Sing Lee Cr.	Sing Lee Cr. at Mouth	7/8/00-10/18/00	Chinook, Cut, Rain/Stl	3,800	NA	39	25	0	0
73	Sing Lee Cr.	Sing Lee Cr. at Mouth	6/28/01-10/8/01	Chinook, Cut, Rain/Stl	3,800	NA	49	28	0	0
75	Leggett Cr.	Leggett Cr. at Mouth	8/2/99-10/10/99	Chinook, Rain/Stl, Cut	3,600	NA	14	19	0	0
75	Leggett Cr.	Leggett Cr. at Mouth	6/24/00-10/24/00	Chinook, Rain/Stl, Cut	3,600	NA	53	29	0	0
77	Silver Cr.	Silver Cr. at Mouth	7/14/99-10/7/99	Bull, Rain/Stl, Brook	2,800	69	2	35	0	0
77	Silver Cr.	Silver Cr. at Mouth	6/17/00-10/12/00	Bull, Rain/Stl, Brook	2,800	89	29	29	0	0
77	Silver Cr.	Silver Cr. at Mouth	6/20/01-10/27/01	Bull, Rain/Stl, Brook	2,800	97	26	41	0	0

						No. of Days Exceeding***:				
WB	Water Body Name	Location*	Dates Monitored	Salmonids Present**	Elev. (ft)	Fed. Bull Trout	Spring SS	Fall SS	CWAL daily max.	CWAL daily ave.
78	Peasley Cr.	Peasley Cr. at Mouth	7/17/99-10/7/99	Rain/Stl	2,600	NA	0	0	0	0
78	Peasley Cr.	Peasley Cr. at Mouth	6/30/00-10/19/00	Rain/Stl	2,600	NA	16	0	0	0
78	Peasley Cr.	Peasley Cr. at Mouth	6/17/00-10/12/00	Rain/Stl	2,600	NA	29	0	0	0
78	Peasley Cr.	Peasley Cr. at Mouth	6/19/01-10/27/01	Rain/Stl	2,600	NA	57	0	0	0
79	Cougar Cr.	Cougar Cr. at Mouth	7/14/99-10/7/99	Cut, Rain/Stl	2,400	NA	33	0	0	0
79	Cougar Cr.	Cougar Cr. at Mouth	6/17/00-10/12/00	Cut, Rain/Stl	2,400	NA	60	0	0	0
79	Cougar Cr.	Cougar Cr. at Mouth	6/19/01-10/27/01	Cut, Rain/Stl	2,400	NA	58	0	0	0
80	Meadow Cr.	Meadow Cr. at Mouth	6/15/00-10/12/00	Bull, Chinook, Rain/Stl, Cut, Brook	2,200	99	62	40	4	4
80	Meadow Cr.	Meadow Cr. at Mouth	6/19/01-10/27/01	Bull, Chinook, Rain/Stl, Cut, Brook	2,200	98	58	46	1	3
80	Meadow Cr.	Meadow Cr. at Campground	7/14/99-10/6/99	Bull, Chinook, Rain/Stl, Cut, Brook	2,200	72	33	42	1	2
80	Meadow Cr.	Lower Meadow Cr.	5/15/99-10/15/99	Bull, Chinook, Rain/Stl, Cut, Brook	3,000	112	66	41	46	8
80	Meadow Cr.	Lower Meadow Cr.	5/15/00-9/26/00	Bull, Chinook, Rain/Stl, Cut, Brook	3,200	118	72	38	44	20
80	Meadow Cr.	Middle Meadow Cr.	5/15/99-10/14/99	Bull, Chinook, Rain/Stl, Cut, Brook	3,200	110	65	41	19	0
80	Meadow Cr.	Middle Meadow Cr.	5/15/00-9/26/00	Bull, Chinook, Rain/Stl, Cut, Brook	3,200	118	72	35	28	3
80	Meadow Cr.	Upper Meadow Cr.	5/15/99-10/20/99	Bull, Chinook,	3,600	104	57	29	0	0

						No. of Days Exceeding***:				
WB	**Water Body Name**	**Location***	**Dates Monitored**	**Salmonids Present****	**Elev. (ft)**	**Fed. Bull Trout**	**Spring SS**	**Fall SS**	**CWAL daily max.**	**CWAL daily ave.**
				Rain/Stl, Cut, Brook						
80	NF Meadow Cr.	NF Meadow Cr.	5/15/99-10/21/99	Bull, Chinook, Rain/Stl, Cut, Brook	3,200	109	66	36	0	0
80	NF Meadow Cr.	NF Meadow Cr.	5/15/00-9/26/00	Bull, Chinook, Rain/Stl, Cut, Brook	3,200	116	72	31	0	0
80	Meadow Cr.	Meadow Cr. at McComas Meadows	5/15/00-9/26/00	Bull, Chinook, Rain/Stl, Cut, Brook	3,200	116	72	34	0	0
81	Sally Ann Cr.	Sally Ann Cr. at Mouth	5/5/01-7/17/01	Bull, Cut	1,400	47	45	0	8	5
81	Sally Ann Cr.	Wall Cr. at Mouth	7/3/01-10/22/01	Cut	1,600	NA	44	0	0	0

* USGS = U.S. Geological Survey, WWTP = wastewater treatment plant, USFS = U.S. Forest Service

** Bull = bull trout, Chinook = chinook salmon, Rain/Stl = rainbow/steelhead trout, Cut = cutthroat trout, Brook = brook trout

*** NA = The bull trout standard is not applicable. Water body has not been designated as protected (Appendix B). SS = salmonid spawning, CWAL = cold water aquatic life

Appendix K. Summary of Stream Habitat Data

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Appendix K. Summary of Stream Habitat Data

Prepared by Ann Storrar, Nez Perce Tribe
and
Karla Baker, DEQ

Summary of DEQ BURP Stream Habitat Data

The graphs following this text summarize in a visual form the Beneficial Use Reconnaissance Program (BURP) stream habitat data collected by the Department of Environmental Quality (DEQ) in the South Fork Clearwater River (SF CWR) Subbasin for the years 1995-2000. The significance of each of the parameters is explained below and a comparison to regional references is provided. These data refer to one location in a stream, the BURP site, which is usually near the mouth, and may not necessarily be representative of the whole stream. The greater value of these data is the overall view one can get of stream habitat conditions in the SF CWR Subbasin.

Width-to-Depth Ratio

A change in the width-to-depth ratio can be used as an indicator of change in the relative balance between sediment load and sediment transport capacity. Sediment accumulation in stream channels reduces stream depth. Large width-to-depth ratios are often a result of lateral bank erosion due to increased peak flow, increased sediment availability, and eroding banks due to loss of streamside vegetation (Overton 1995 et al., Beschta and Platts 1986). The biological community suffers adverse effects from a decrease in channel depth and an increase in channel width. A decrease in depth may reduce the quantity and quality of pools, reducing available habitat for fish. The increase in width will lead to increased incidence of solar radiation and higher water temperatures. The combination of shallower pools and increased insolation can decrease the suitability of the stream for cold water fish. Width-to-depth ratios generally vary with channel type.

The SF CWR BURP width-to-depth ratios are suboptimal according to the federal Pacific Anadromous Fish Strategy (PACFISH) (USFS and BLM 1995) and state of Idaho guidance (DEQ 1996). The PACFISH objectives specify an optimal ratio of less than 10 for mean wetted width to mean depth. The DEQ (1996) *Waterbody Assessment Guidance* specifies an optimal wetted width-to-depth ratio as less than 7. Only 5 of the 103 sites surveyed had width-to-depth ratios below 10, indicating most streams are wider and shallower than they should be according to these references.

Pool Frequency and Quality

Salmonids often require backwater or dammed pools with water moving at a slow velocity to permit survival of harsh winter conditions. In addition, pools of all shapes, sizes, and quality are needed to support different age classes (Beschta and Platts 1986). Juvenile fish need shallow, low quality pools that other fish will not use, until increased growth allows them to

eventually compete without predation stress in the higher quality pools that have better food supplies and winter rearing habitat.

The frequency and size of pools is dependent on stream size, gradient, confinement, flow, sediment load, and amount of large woody debris (Overton et al. 1995). Pools characterized by low flow velocities (backwater or dammed pools) are particularly susceptible to infilling with sediment, thus the depth, area, or volume of these pools can serve as indicators of coarse sediment loading due to land management practices. Overton et al. (1995) found fewer deep pools in an intensely timber-managed watershed than in a non-timber-managed watershed. A decrease in the amount of large woody debris may lead to a reduction in the number and size of pools, and a change in peak flows will alter the ability of a stream to transport sediment, altering pool measurements (MacDonald et al. 1991). Landslides, debris flows, and other mass movements typically result in loss of pool area and volume.

Pool-to-Run Ratios

The SF CWR BURP pool-to-run ratios are optimal according to two references. A ratio of 1 to 3 is considered optimal by the *Waterbody Assessment Guidance* (DEQ 1996). A ratio of 1 to 1 is considered optimal by other experts (Platts et al. 1983). The majority of BURP sites had ratios below 1 to 1, and only 8 of the 103 sites exceeded a ratio of 1 to 3.

Pools per Mile

The SF CWR BURP number of pools per mile is well below the optimal level as rated by the *Matrix of Pathways and Indicators for Watershed Condition for Chinook, Steelhead and Bull Trout* (NMFS et al. 1998). This reference is applied locally for biological assessments required for activities on federal lands.

Substrate Composition and Percent Fines

The particle size of the bed material directly affects the flow resistance in the channel, the stability of the bed, and the amount of aquatic habitat (Beschta and Platts 1986). In addition, the size of the bed material controls the amount and type of habitat for small fish and invertebrates. If the bed is composed only of fine materials, the spaces between particles are too small for many organisms. The greatest number of species is usually associated with complex substrates of stone, gravels, and sand. Coarse materials provide a variety of small niches important for juvenile fish and benthic invertebrates. The mix of coarse particle in riffles has been shown to provide the richest aquatic insect habitat (Gordon 1992). Numerous studies have demonstrated reduced invertebrate abundance with fully embedded streambed particles (Meehan and Murphy 1991). Salmon and trout have evolved and adapted to the natural size distributions of channel sediments. It is believed that no single particle-size group will create the ideal environment for all phases of salmonid growth and survival (Beschta and Platts 1986).

The optimum spawning substrate mix appears to be gravel containing small amounts of fine sediment and some small rubble to support egg pockets and guard against bed erosion from floods (Beschta and Platts 1986). High amounts of fine sediments in spawning substrate

have been shown to be a major cause of embryo and larval mortality. Survival is high only if the eggs receive an adequate supply of oxygen, an adequate flow of water through the gravel to supply this oxygen, and necessary flows to remove metabolic wastes (Beschta and Platts 1986). Percent emergence of swim-up fry has also been shown to be reduced by too much fine sediment (<6.35 millimeters [mm]) by a number of researchers (Bjornn and Reiser 1991). When particle sizes less than 6.35 mm exceed 20-25% of the total substrate, embryo survival and emergence of swim-up fry is reduced by 50% (Bjornn and Reiser 1991).

The percent fine sediment at BURP sites is well above optimal levels as rated by DEQ (1996), fisheries researchers, and the *Matrix of Pathways and Indicators for Watershed Condition for Chinook, Steelhead and Bull Trout* (NMFS et al. 1998). Less than 10% fines is considered optimal by the DEQ *Waterbody Assessment Guidance* (DEQ 1996). The matrix of pathways guidance (NMFS et al. 1998) rates high condition habitat as that containing less than or equal to 10% fines in A and B channel types and less than or equal to 20% for C and E channel types. Ninety-eight of the 103 BURP sites evaluated exceed 20% fine sediment and 86 sites exceed 30% fines.

Bank Stability

Eroding stream banks deliver sediment directly to the channel. Steeper banks are subject to more erosion and failure, and streams with poor banks will often have poor in-stream habitat. Protection from erosion is provided by plant root systems as well as by boulder, cobble, or gravel material. Channels with banks and riparian vegetation in good condition handle flooding with less habitat damage. Channel bank conditions are closely linked to the quality of fish habitat.

Platts et al. (1983) and PACFISH (USFS and BLM 1995) rate values greater than 80% stability as excellent and as meeting interim objectives for restoring anadromous fisheries. Comparing to these standards, the bank stability for the SF CWR subbasin is generally optimal with only 23 out of the 103 sites evaluated rating less than 80% stability. The *Matrix of Pathways and Indicators for Watershed Condition for Chinook, Steelhead and Bull Trout* criteria for bank stability differs by channel type, with C channel types less than 80%, A and B channel types less than 90%, and E channel types less than 95% rated as poor condition (NMFS et al. 1988). The BURP bank stability data generally rate moderate to good condition as compared to this reference.

Large Woody Debris

Woody debris and root wads create habitat diversity by forming pools and waterfalls, trapping sediment, and enhancing channel and bank stability. Research has shown a direct relationship between the amount of woody debris and salmonid production, and woody debris removal has been shown to reduce fish populations.

The BURP data represent the number of pieces of large woody debris greater than 1 meter in length and 10 centimeters in diameter within the reach. The PACFISH (USFS and BLM 1995) objectives require more than 20 pieces per mile (1.25 pieces per 100 meters), greater than 12 inches (30.5 cm) wide and 35 feet long (10.67 meters). This reference is not directly

comparable to BURP data because the lengths and widths of pieces are not recorded. Large woody debris at most sites in the BURP data set exceeded 1.25 pieces per 100 meters with the exception of the Cottonwood watershed.

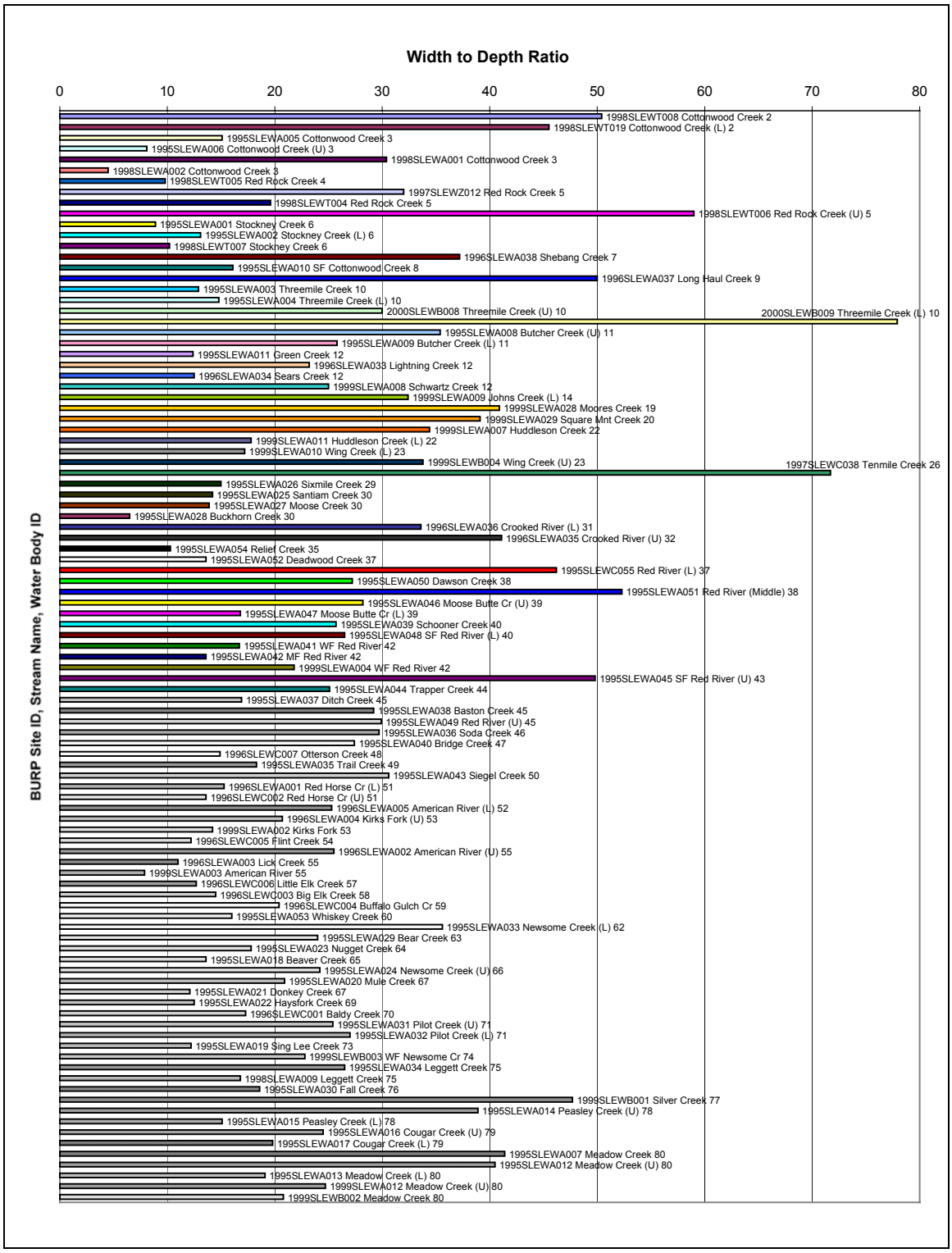

Figure K-1. Width-to-Depth Ratios of the SF CWR Subbasin from the BURP Data Set

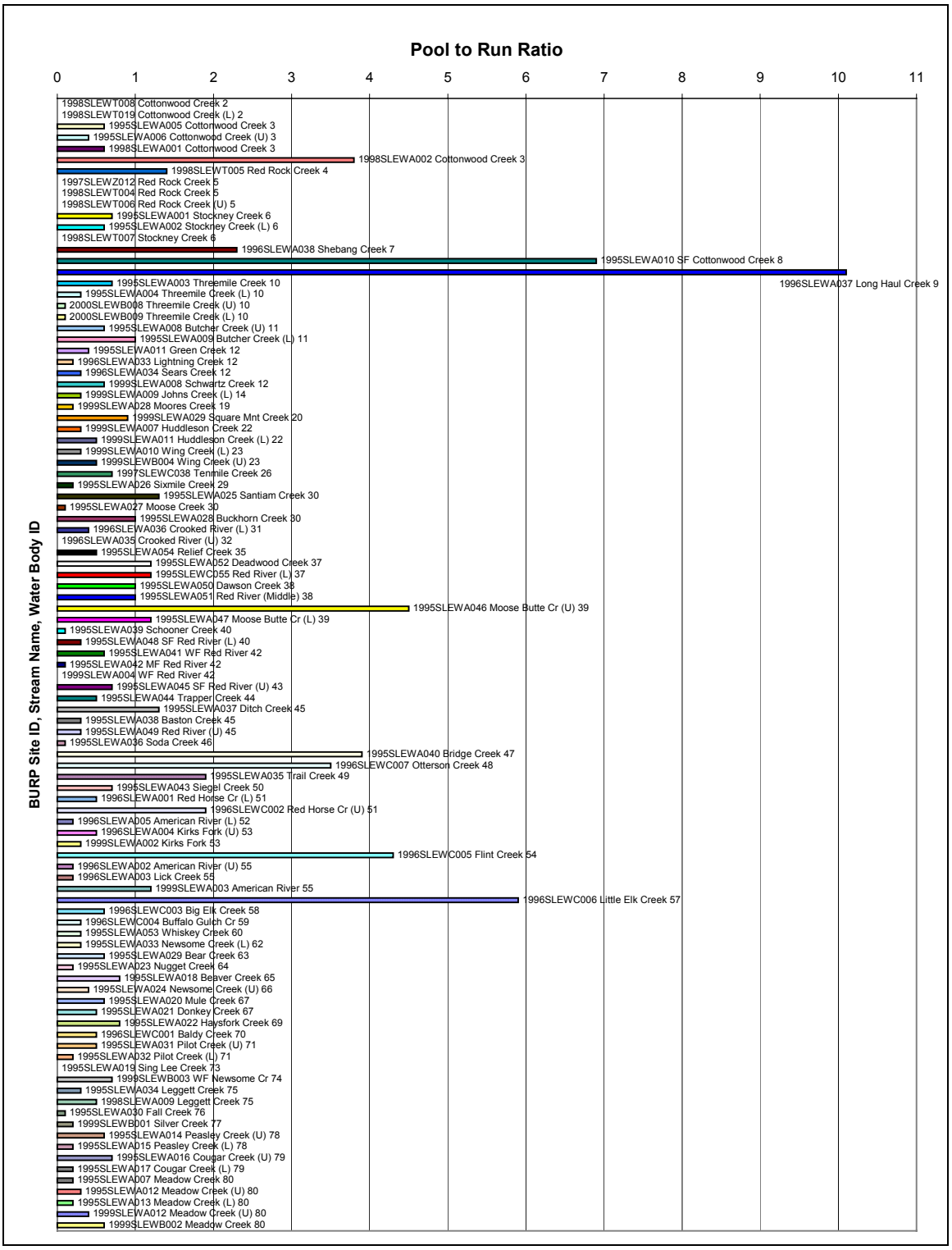

Figure K-2. Pool-to-Run Ratios of the SF CWR Subbasin from the BURP Data Set

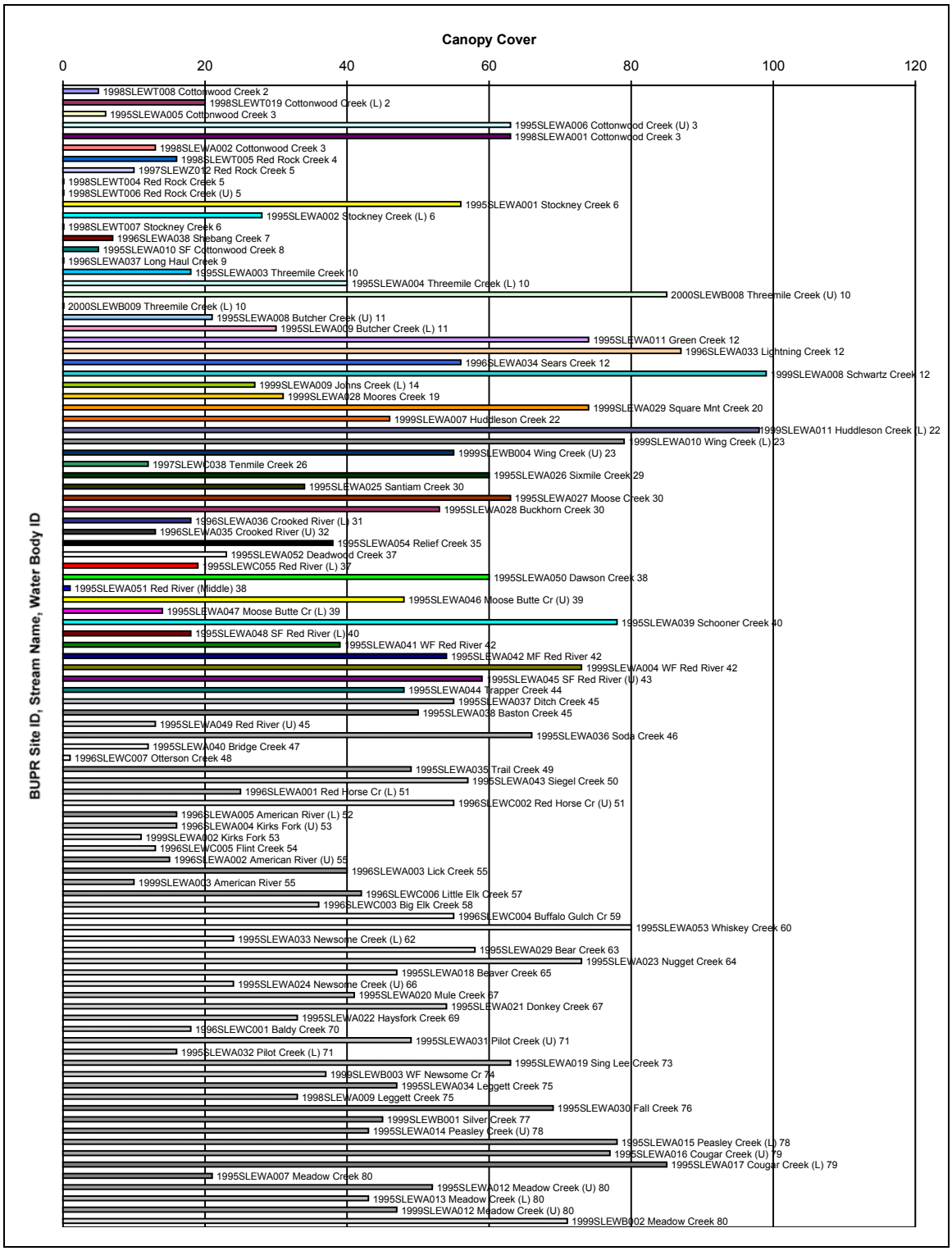

Figure K-3. Canopy Cover of the SF CWR Subbasin from the BURP Data Set

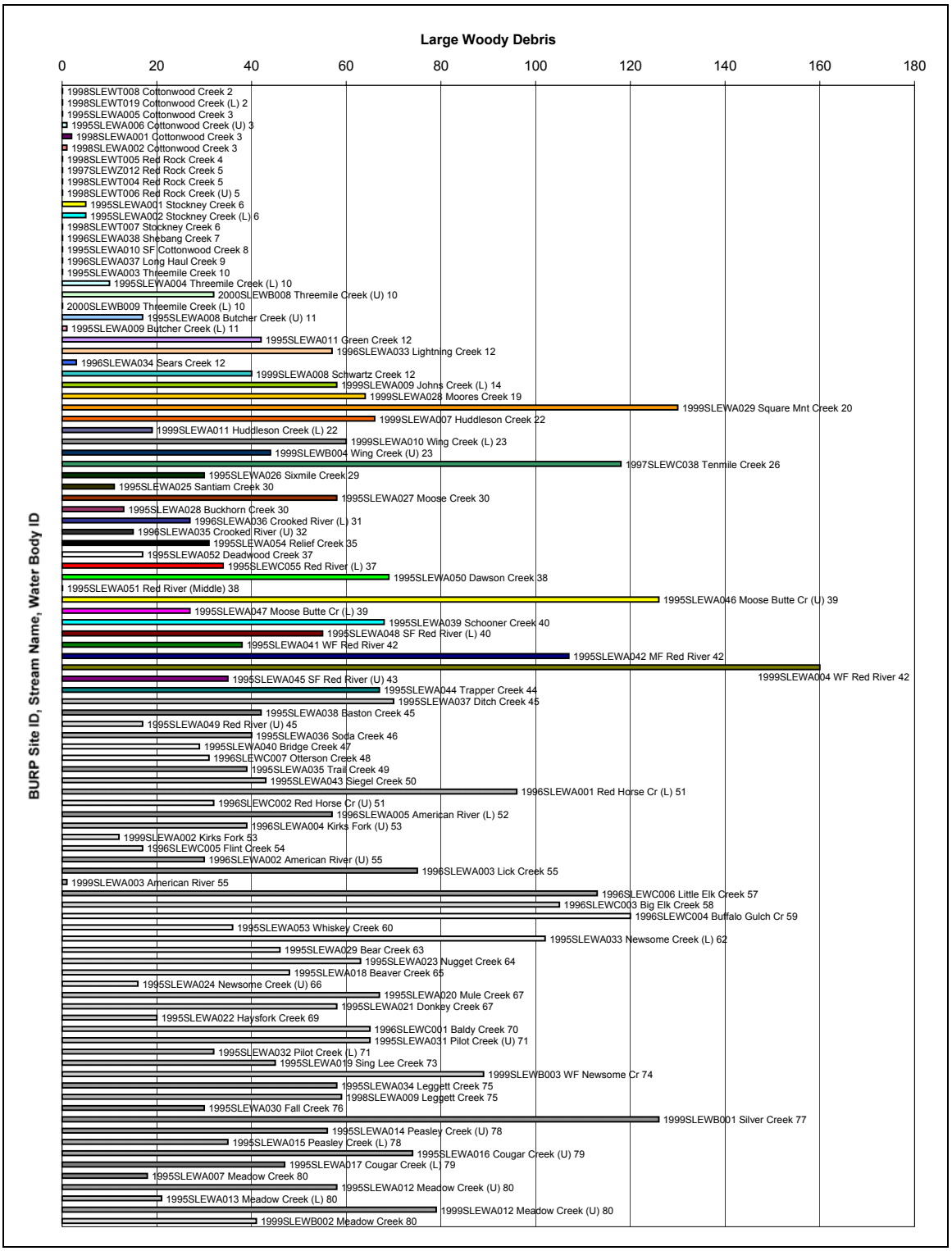

Figure K-4. Large Woody Debris of the SF CWR Subbasin from the BURP Data Set

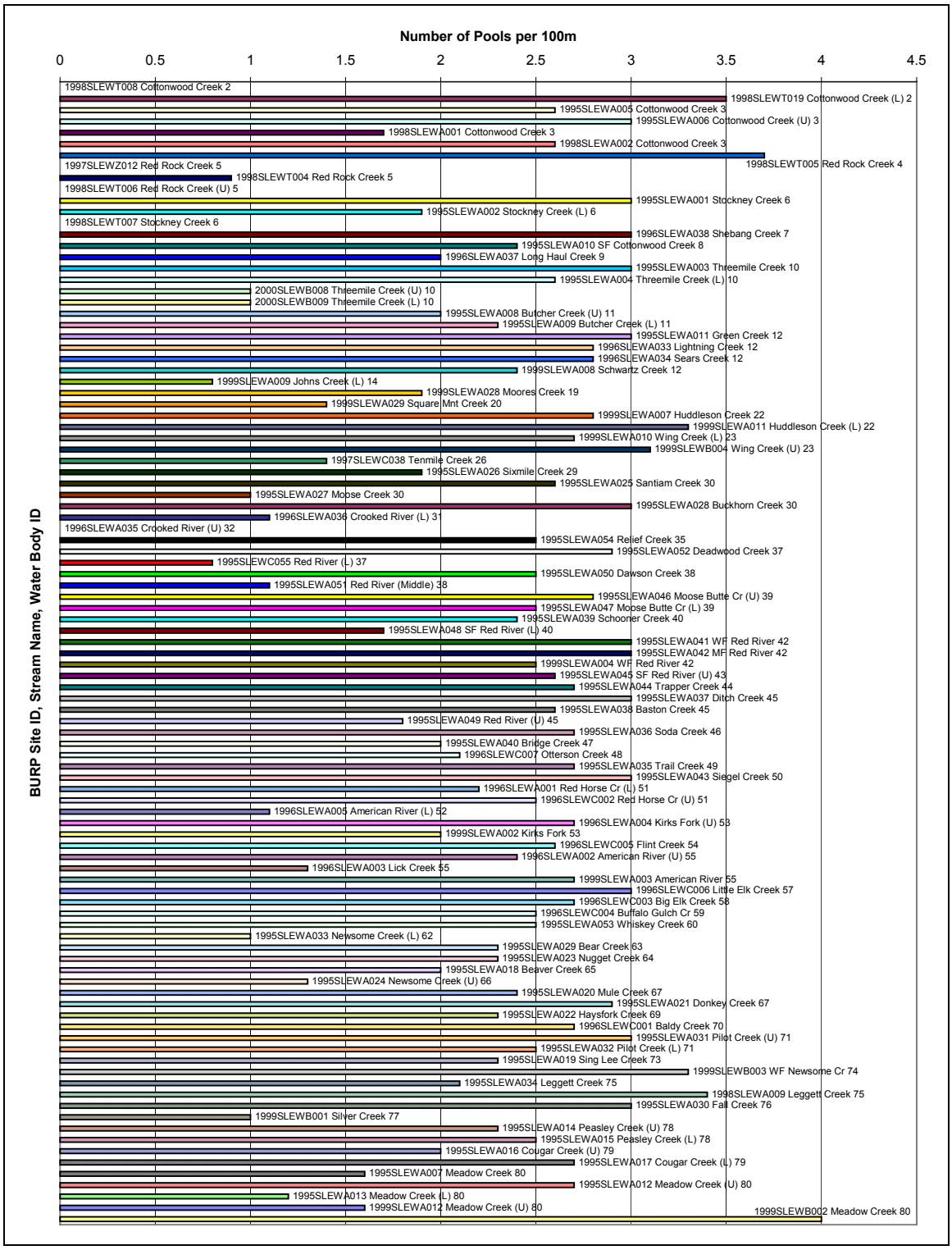

Figure K-5. Number of Pools per Meter of the SF CWR Subbasin from the BURP Data Set

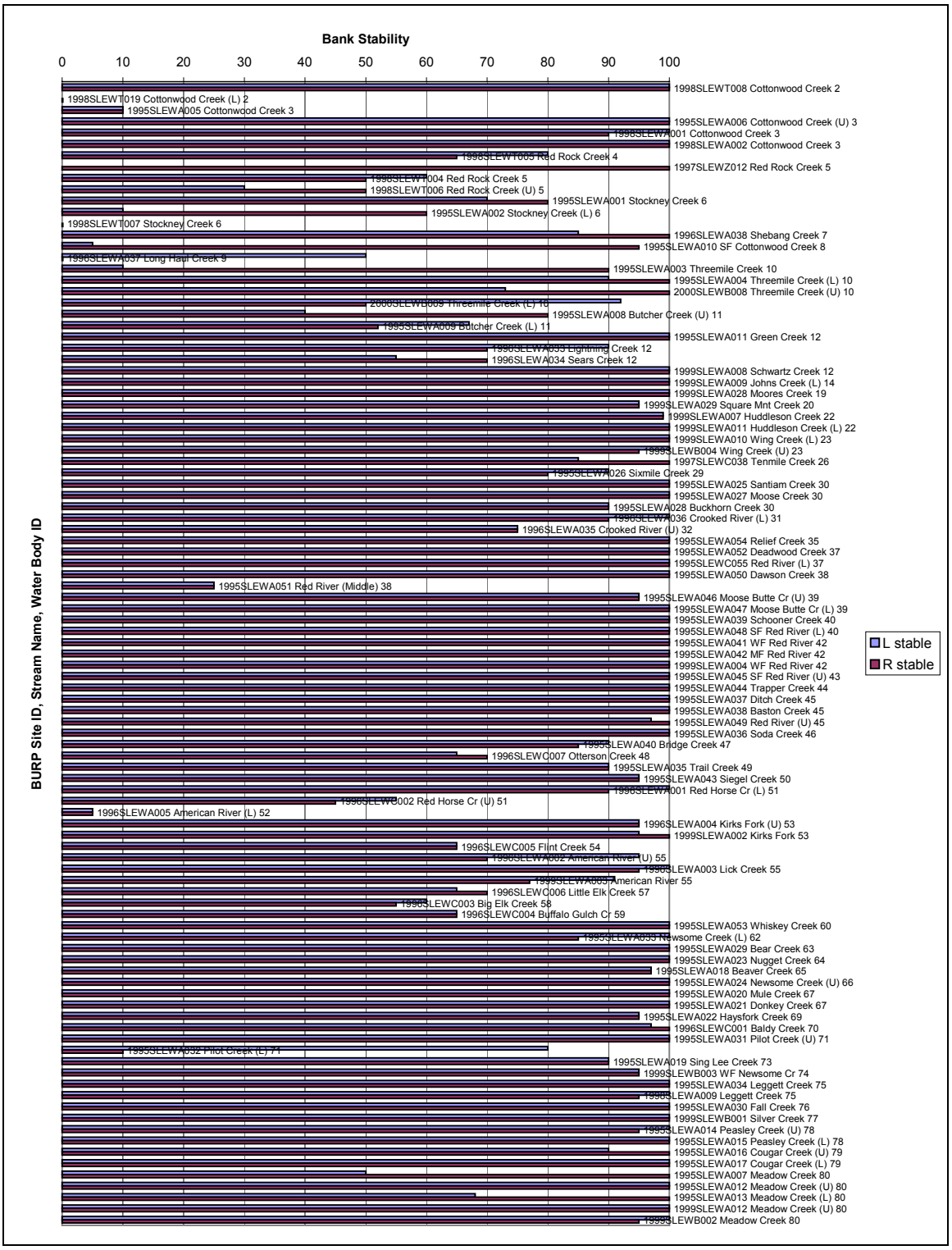

Figure K-6. Bank Stability of the SF CWR Subbasin from the BURP Data Set

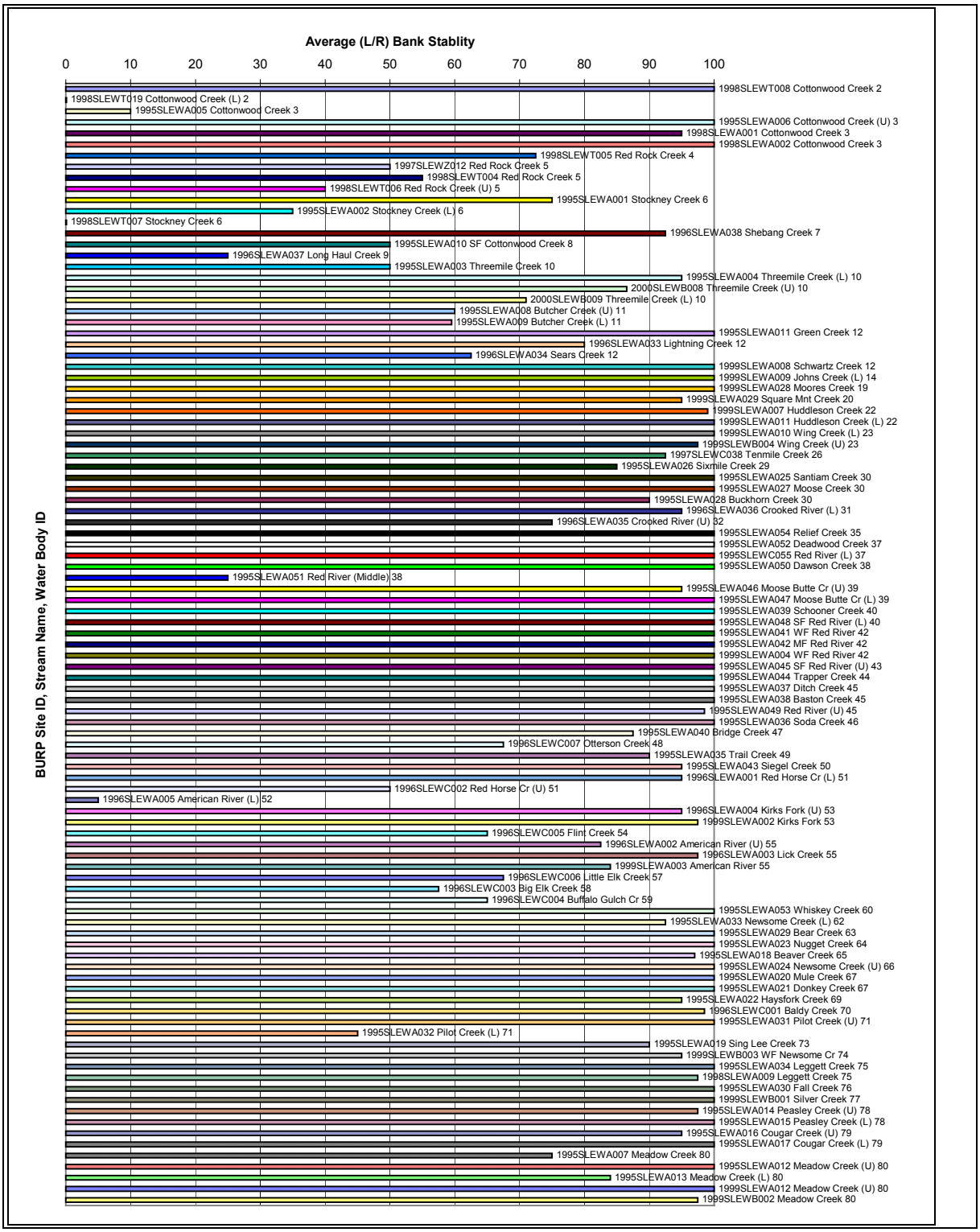

Figure K-7. Average Left/Right Bank Stability of the SF CWR Subbasin from the BURP Data Set

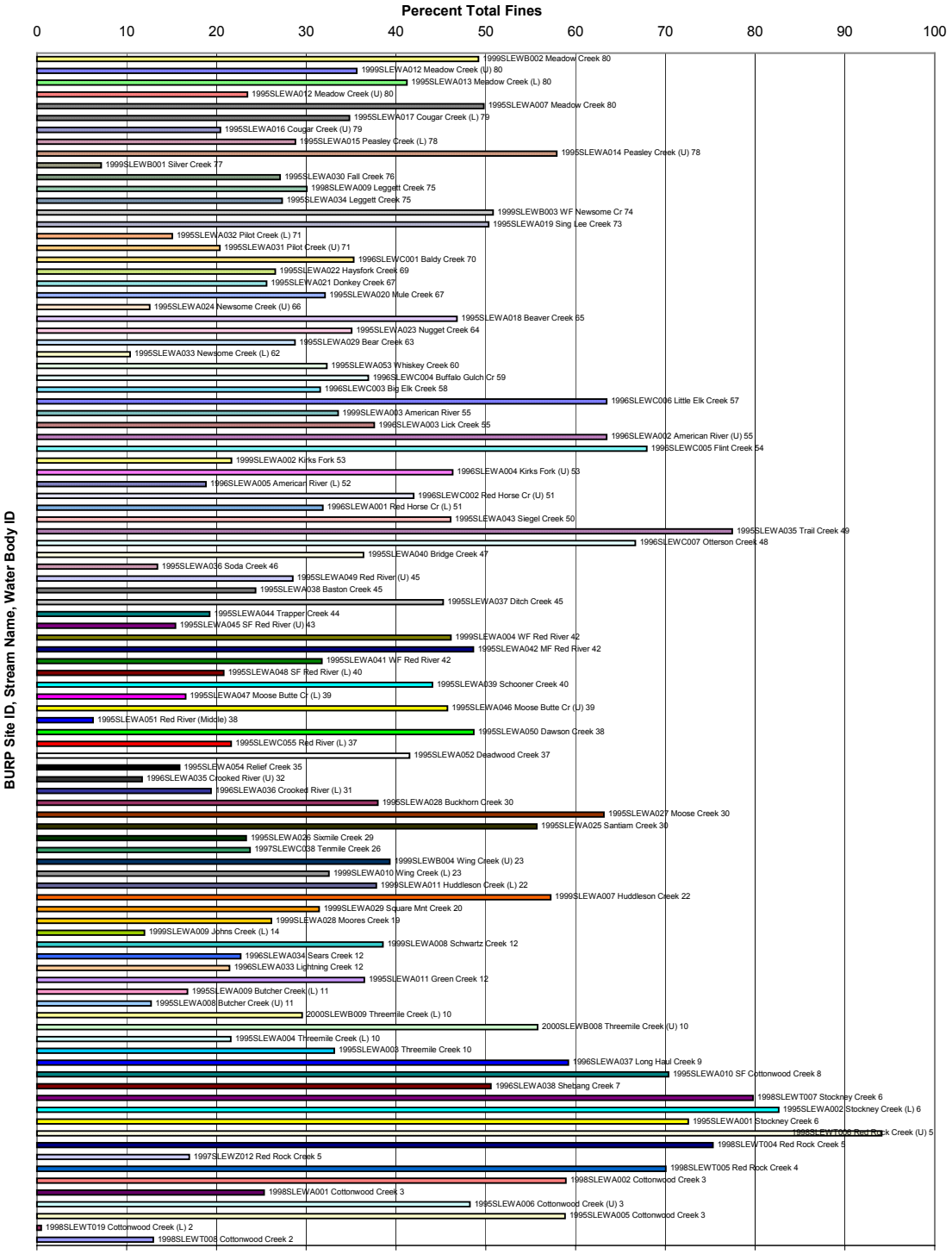

Figure K-8. Percent Total Fines of the SF CWR Subbasin from the BURP Data Set

Summary of NPNF Stream Habitat Conditions for the SF CWR Subbasin

Table K-1 below illustrates the USFS (1999) rating of the biological condition of 15 major watersheds in the SF CWR Subbasin for ESA listed species using the *Matrix of Pathways and Indicators of Watershed Condition-Local Adaptation for the Clearwater Basin* (NMFS et al. 1998). The watersheds assessed include Red River, American River, Crooked River, Newsome Creek, Leggett Creek, Tenmile Creek, Twentymile Creek, Wing Creek, Silver Creek, Peasley Creek, Cougar Creek, Johns Creek, Meadow Creek, Mill Creek, and the SF CWR main stem and face drainages. Summarized at a watershed scale, the majority of water quality and habitat elements rate as "low" condition, while watershed condition (road parameters), channel conditions, and species take (harassment, redd disturbance, juvenile harvest) rate as "moderate" condition.

Table K-1. Environmental Baseline Habitat Condition (USFS 1999).

Indicator	High	Moderate	Low
Watershed Condition			
Watershed Road Density		X	
Streamside Road Density			X
Landslide Prone Road Density		X	
Riparian Vegetation Condition		X	
Change in Peak/Base Flow		X	
Water Yield (ECA)		X	
Sediment Yield		X	
Channel Conditions and Dynamics			
Width/Depth Ratio		X	
Streambank Stability		X	
Floodplain Connectivity			X
Water Quality			
Temperature (Steelhead) Spawning			X
Temperature (Steelhead) Rearing and Migration			X
Temperature (Bull Trout)			X
Turbidity or Suspended Sediment		X	
Chemical Contaminants – Nutrients		X	
Habitat Access			
Physical Barriers – Adults	X		
Physical Barriers – Juvenile	X		
Habitat Elements			

Indicator	High	Moderate	Low
Cobble Embeddedness			X
Percent Fines (Surface or by Depth)			X
Large Woody Debris			X
Pool Frequency			X
Pool Quality			X
Off-Channel Habitat			X
Habitat Refugia		X	
Take			
Harassment		X	
Redd Disturbance		X	
Juvenile Harvest		X	
Bull Trout Sub-Population Characteristics			
Sub-Population Size		X	
Growth and Survival			X
Life History Diversity and Isolation		X	
Persistence and Genetic Integrity		X	
Bull Trout Integration of Species and Habitat			X

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Appendix L. South Fork Clearwater River Subbasin Sediment Budget

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Appendix L. South Fork Clearwater River Subbasin Sediment Budget

This document establishes the record of the sediment budget developed for sources of sediment in the South Fork Clearwater River (SF CWR) Subbasin Assessment and Total Maximum Daily Loads (TMDL). The methods used to establish the sediment budget consisted of identifying the major sources of sediment in the subbasin, identifying methods of quantifying that sediment on a yearly basis, planning and implementing projects to collect missing data, organizing all of the data in a geographical information systems (GIS) format so they could be compared and analyzed, and using the results as the basis for the sediment loading calculations presented in Chapter 5.

The major sources of sediment identified in the subbasin are forestry, agriculture, grazing, mining, roads, mass failures, and in-stream erosion.

The SF CWR Subbasin has two distinct areas of management; and therefore, different types of sets of data about human caused sediment. The eastern two-thirds of the subbasin is dominantly managed by the Nez Perce National Forest (NPNF) and the Bureau of Land Management (BLM) and has data sets consistent with federally managed lands. The lower one-third of the subbasin is largely private land dominated by agriculture and grazing, with different types of sediment data available. The task was to consider the types of data, figure out how to fill in the gaps, and make it all fit together in a reasonable manner consistent with the narrative water quality sediment standard.

In the final analysis, we put together the patchwork of data shown in Table L-1, which quantifies all the major sources of sediment in the SF CWR Subbasin.

The results of the NPNF Sediment Model (NEZSED) and the Revised Universal Soil Loss Equation (RUSLE) models were already available at the outset of the project. Significant to our analysis of the area of federally-managed lands; however, NEZSED does not include estimates of human activity-induced mass failures, estimates of in-stream erosion, estimates of road gravel loading from the highway, nor the general effects of mining or grazing.

The NPNF also already had an inventory of mass failures for the upper two-thirds of the subbasin. We extrapolated those results, along with data from the Cottonwood Creek TMDL (DEQ, NPT, USEPA 2000) and an aerial photo interpretation, to arrive at an estimate of mass failures in the non-inventoried part of the basin

We concluded that the sediment producing effects of grazing and mining could largely be quantified if we inventoried stream bank erosion. With funds made available by U.S. Environmental Protection Agency (USEPA), we hired an inventory crew that inventoried all of the significantly eroding stream banks in the subbasin, except for the Cottonwood Creek watershed. This resulted in a uniform data set across all the lands with respect to in-stream erosion.

Table L-1. Data sources for the SF CWR subbasin sediment budget.

Data Type*	Sediment Source
NEZSED Model	Fire Erosion
NEZSED Model	Road Erosion
NEZSED Model	Logging Erosion
NEZSED Model	Natural Erosion
NRCS Stream Erosion Inventory	Forest and Mining In-Stream Erosion
NRCS Stream Erosion Inventory	Agriculture and Grazing In-Stream Erosion
NPNF/BLM Mass Failure Inventory	Mass Failures
Mass Failure Extrapolation	Agriculture and Grazing Mass Failures
WEPP Roads Model	Non-Federal Roads
RUSLE Model	Agriculture and Grazing Land Erosion
ITD Gravel Estimate	Highway Gravel Use
Mining Glory Hole Sediment Estimate	Eroding Walls

*NEZSED = Nez Perce National Forest Sediment Model, NRCS = Natural Resources Conservation Service, NPNF = Nez Perce National Forest, BLM = Bureau of Land Management, WEPP = Watershed Erosion Prediction Project, RUSLE = Revised Universal Soil Loss Equation, ITD = Idaho Transportation Department

Also with funds made available by USEPA, we funded a project through the University of Idaho to develop a geographic position system (GPS)/GIS interface for the Watershed Erosion Prediction Project (WEPP) road model. This allowed us to rapidly collect the data to run the model using GPS, transfer it to the GIS, and load it into the model. This provided the data set for the non-federal roads, except for the main highway along the river from Kooskia to Elk City. It had been observed that large portions of the gravel used to maintain safe driving conditions in the winter were ending up in the river. We got an estimate from the Idaho Transportation Department (ITD) of the amount of gravel being applied to the road each year.

Each sediment source, its appropriate data set or model, the calculation results, and the implications to the sediment loading calculations are discussed below.

Forest Practices (NEZSED Model)

Most of the federally managed land is forested. The main data set from the federally managed lands was derived from the NEZSED model. The NEZSED model is a computerized sediment delivery prediction model developed by the NPNF based on guidelines developed by hydrologists and soil scientists from the U.S. Forest Service (USFS) Northern and Intermountain Regions (USFS 1981). We used portions of the data set developed for the South Fork Clearwater Landscape Assessment (USFS 1998). The sediment yield was modeled for the period 1870 through 2000 and includes the effects of fire, timber harvest, and roads. It includes natural baseline data and results in a reasonable estimate of background loads. The model predicts sediment yield recovery to background

rates within five and seven years for burned areas and logged areas, respectively. The model predicts continuing sediment production from roads so long as they remain on the landscape.

The NEZSED sediment delivery model, along with the whole family of models using the R1/R4 (USFS 1981) methods, has been subject to considerable scrutiny and has been found to underpredict more often than it overpredicts. In a fairly intensive research project on the NPNF, Gloss (1994) found that the model underpredicted actual sediment yield on the order of 50%. We do not attempt to correct any of the predictions in our use of the NEZSED data; however, the idea that sediment yield from the upper part of the basin may be greater than predicted lends weight to our final recommendations that sediment loads from the federally-managed parts of the subbasin need to be reduced to fully restore the beneficial uses. Further, since sediment-loading reductions are presented as percentages measured by NEZSED, any under prediction would be compensated for.

On the other hand, considering the NEZSED model results in relation to the subbasin as a whole, the magnitude of human activity-caused sediment from agricultural and grazing practices in the subbasin far outweighs the amount of sediment coming from forestry. If one is going to be concerned about error levels of the estimates, total human-caused sediment from forestry is probably less than the error in estimates of eroded sediment from agricultural and grazing lands in the subbasin.

The NEZSED data were received from the NPNF by sixth order HUC as defined by the forest. We reallocated those results to the water bodies defined in IDAPA 58.01.02.120.07, based primarily on the number of miles of roads by area, since the majority of NEZSED sediment is produced from roads. Table L-2 shows the breakdown of sediment yield for each of the water bodies in the federally managed portion of the subbasin. Generally, Table L-2 shows total sediment yield, then subtracts out the background sediment, resulting in an estimate of human-caused sediment.

This human-caused sediment is then routed through the hydrologic network based on the Roehl (1962) equation, resulting in the final estimate of human-caused sediment in the water that must be addressed in this TMDL. The Roehl (1962) equation produces a routing coefficient that is applied to all of the sediment sources identified in the SF CWR Subbasin. The routing equation simply identifies a relationship between size of the drainage and the percent of eroded material that moves out of the drainage (Routing Coefficient = drainage area in square miles raised to the negative 0.18 power [$RC = A^{(-0.18)}$]. The larger the drainage, the smaller the routing coefficient, indicating that more of the material is being stored inside the watershed. Figure L-1 displays the magnitude of forest practice-caused sediment from the various water bodies in the subbasin.

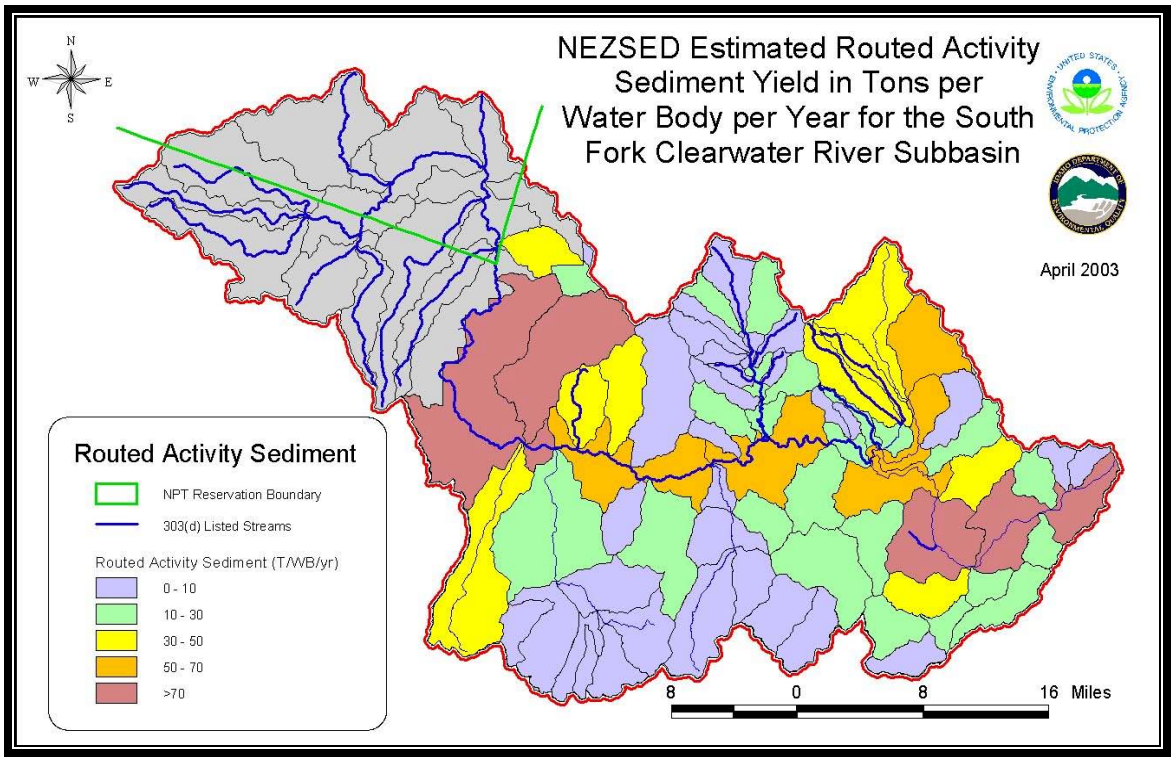

Figure L-1. NEZSED Estimated Human-Caused Sediment Yield per Year

The interesting results from these data are the totals and the few water bodies that are delivering 50 tons/year or greater to the system. The major contributors of human-caused sediment are the main stem water bodies; lower, middle, and upper Red River; lower American River; East Fork American River; and Meadow Creek. Cougar Creek and Buffalo Gulch produce slightly less sediment than these other water bodies. Total modeled human-caused sediment is only about 10% of background.

Table L-2. NEZSED model sediment estimates for the SF CWR Subbasin.

Water Body Name	Water Body No.	Area	Total	Back-ground Rate	Total Back-ground	Human Caused Rate	Rate From Roads	Total Human Caused	Routing Coeffic-ient	Total Routed	Total Human Caused Routed
		(mi^2)	(t/WB/yr)	($t/mi^2/yr$)	(t/WB/yr)	($t/mi^2/yr$)	(t/mi/yr)	(t/WB/yr)		(t/WB/yr)	(t/WB/yr)
Mid-L. SF CWR	12	60.98	2,650.54	38.22	2,502.85	2.26	0.50	147.69	0.55	1,457.80	81.23
Mill	13	36.58	1,050.29	26.77	971.08	2.18	0.74	79.21	0.52	549.45	41.44
L. Johns	14	41.22	1,247.94	29.40	1,211.61	0.88	0.47	36.34	0.51	638.97	18.60
Gospel	15	16.92	1,207.07	71.68	1,207.05	0.00	0.00	0.03	0.60	725.44	0.02
WF Gospel	16	6.98	345.93	49.80	345.59	0.05	0.11	0.34	0.70	243.83	0.24
Mid Johns	17	15.94	510.02	31.95	508.97	0.07	0.11	1.06	0.61	309.85	0.64
U. Johns	18	13.55	543.73	40.16	543.73	0.00	0.00	0.00	0.63	340.11	0.00
Moores	19	6.23	550.76	88.81	550.64	0.02	0.01	0.12	0.72	396.24	0.09
Sq. Mountain	20	3.58	316.43	88.86	316.36	0.02	0.05	0.07	0.80	251.57	0.06
Hagen	21	8.65	416.83	48.47	416.83	0.00	0.00	0.00	0.68	282.67	0.00
M. SF CWR	22	29.61	1,167.08	36.24	1,072.65	3.19	1.19	94.43	0.54	634.21	51.31
Wing	23	8.33	256.28	30.16	251.20	0.61	0.36	5.08	0.68	175.00	3.47
Twentymile	24	22.88	476.47	20.04	458.20	0.80	0.51	18.27	0.57	271.24	10.40
L. Tenmile	25	3.82	119.74	30.06	114.81	1.29	2.09	4.93	0.79	94.06	3.87
M. Tenmile	26	11.29	313.35	26.85	303.10	0.91	0.58	10.25	0.65	202.55	6.63
U. Tenmile	27	21.28	998.22	47.09	998.21	0.00	0.00	0.01	0.58	575.71	0.01
Williams	28	9.20	262.21	28.53	262.19	0.00	0.01	0.02	0.67	175.84	0.01
Sixmile	29	8.02	151.53	16.84	135.04	2.06	1.06	16.49	0.69	104.18	11.34

Water Body Name	Water Body No.	Area	Total	Back-ground Rate	Total Back-ground	Human Caused Rate	Rate From Roads	Total Human Caused	Routing Coeffic-ient	Total Routed	Total Human Caused Routed
		(mi^2)	(t/WB/yr)	($t/mi^2/yr$)	(t/WB/yr)	($t/mi^2/yr$)	(t/mi/yr)	(t/WB/yr)		(t/WB/yr)	(t/WB/yr)
Mid-U. SF CWR	30	26.82	847.55	28.03	751.79	3.57	1.03	95.77	0.55	468.86	52.98
L. Crooked	31	14.81	417.69	25.07	370.98	3.16	1.00	46.72	0.62	257.12	28.76
U. Crooked	32	22.64	460.01	18.82	425.24	1.54	0.75	34.77	0.57	262.36	19.83
WF Crooked	33	11.87	269.93	22.62	266.51	0.29	0.30	3.42	0.64	172.93	2.19
EF Crooked	34	10.45	286.97	27.08	280.26	0.65	0.98	6.71	0.66	188.10	4.40
Relief	35	11.69	226.15	16.73	195.80	2.59	0.70	30.36	0.64	145.27	19.50
U. SF CWR	36	4.21	147.47	25.90	109.31	9.04	3.12	38.15	0.77	113.84	29.45
L. Red	37	16.15	375.79	17.41	281.17	5.86	1.01	94.62	0.61	227.77	57.35
M. Red	38	25.07	680.29	20.06	502.62	7.09	1.37	177.67	0.56	380.95	99.49
Moose Butte	39	11.07	261.49	17.24	191.91	6.29	1.22	69.58	0.65	169.62	45.14
L. SF Red	40	4.93	111.80	17.93	88.23	4.79	1.15	23.57	0.75	83.90	17.69
M. SF Red	41	4.36	107.84	18.88	82.13	5.91	1.37	25.72	0.77	82.73	19.73
WF Red	42	10.01	185.86	17.06	170.06	1.58	0.67	15.79	0.66	122.77	10.43
U. SF Red	43	7.41	135.89	17.10	124.16	1.62	0.44	11.73	0.70	94.75	8.18
Trapper	44	11.06	215.15	17.56	193.15	2.00	0.65	21.99	0.65	139.60	14.27
U. Red	45	30.08	744.99	19.74	592.77	5.07	1.34	152.23	0.54	403.71	82.49
Soda	46	5.24	115.14	18.11	94.53	3.95	1.08	20.62	0.74	85.46	15.30
Bridge	47	3.72	89.97	21.49	79.93	2.70	1.38	10.04	0.79	71.03	7.93

Water Body Name	Water Body No.	Area	Total	Back-ground Rate	Total Back-ground	Human Caused Rate	Rate From Roads	Total Human Caused	Routing Coeffic-ient	Total Routed	Total Human Caused Routed
		(mi^2)	(t/WB/yr)	($t/mi^2/yr$)	(t/WB/yr)	($t/mi^2/yr$)	(t/mi/yr)	(t/WB/yr)		(t/WB/yr)	(t/WB/yr)
Otterson	48	3.89	81.15	20.78	80.85	0.08	0.10	0.30	0.78	63.55	0.23
Trail	49	7.13	160.17	19.89	141.60	2.61	1.11	18.57	0.70	112.48	13.04
Siegel	50	12.16	266.48	17.74	215.88	4.16	1.15	50.60	0.64	169.96	32.27
Red Horse	51	9.07	216.56	21.19	191.96	2.72	1.13	24.61	0.67	145.61	16.54
L. American	52	11.27	281.16	17.38	195.69	7.59	2.25	85.47	0.65	181.80	55.27
Kirks Fork	53	9.78	235.13	22.95	224.70	1.06	0.62	10.43	0.66	155.98	6.92
EF American	54	17.88	413.33	18.44	328.64	4.75	1.60	84.68	0.60	245.96	50.39
U. American	55	23.87	621.65	23.54	559.81	2.60	1.01	61.85	0.56	351.19	34.94
Elk	56	3.63	128.09	28.96	105.13	6.33	2.29	22.96	0.79	101.56	18.20
Little Elk	57	7.94	190.05	18.15	143.91	5.82	1.72	46.14	0.69	130.89	31.77
Big Elk	58	13.78	416.10	24.45	337.22	5.72	1.95	78.87	0.62	259.49	49.19
Buffalo	59	3.34	86.48	20.70	69.15	5.19	1.19	17.32	0.80	69.59	13.94
Whiskey	60	2.59	62.36	20.54	52.98	3.63	1.05	9.38	0.84	52.53	7.90
Maurice	61	1.71	38.92	19.56	33.46	3.20	1.08	5.47	0.91	35.34	4.96
L. Newsome	62	6.48	188.94	24.24	156.82	4.96	1.04	32.12	0.71	134.98	22.95
Bear	63	5.99	143.43	19.57	117.05	4.41	0.81	26.38	0.72	103.93	19.11
Nugget	64	2.27	44.24	16.47	37.39	3.01	0.66	6.84	0.86	38.17	5.90
Beaver	65	5.83	122.06	19.18	112.01	1.72	0.67	10.05	0.73	88.86	7.32
M. Newsome	66	1.77	51.81	24.15	42.99	4.95	1.12	8.82	0.90	46.73	7.95

Water Body Name	Water Body No.	Area	Total	Back-ground Rate	Total Back-ground	Human Caused Rate	Rate From Roads	Total Human Caused	Routing Coeffic-ient	Total Routed	Total Human Caused Routed
		(mi^2)	(t/WB/yr)	($t/mi^2/yr$)	(t/WB/yr)	($t/mi^2/yr$)	(t/mi/yr)	(t/WB/yr)		(t/WB/yr)	(t/WB/yr)
Mule	67	8.59	190.11	17.69	151.61	4.49	0.87	38.50	0.68	129.09	26.14
U. Newsome	68	9.93	223.54	21.13	208.98	1.47	0.64	14.56	0.66	147.88	9.63
Haysfork	69	4.96	134.79	23.20	114.38	4.14	0.83	20.41	0.75	101.05	15.30
Baldy	70	4.26	118.57	25.21	106.88	2.76	0.59	11.69	0.77	91.36	9.01
Pilot	71	6.12	163.02	25.87	158.09	0.81	0.71	4.94	0.72	117.66	3.56
Sawmill	72	2.76	76.91	27.70	76.72	0.07	0.55	0.19	0.83	64.04	0.15
Sing Lee	73	2.43	73.04	27.12	65.90	2.94	0.69	7.14	0.85	62.25	6.08
WF Newsome	74	5.16	151.06	27.77	143.29	1.51	0.54	7.78	0.74	112.42	5.79
Leggett	75	7.80	231.19	26.29	205.04	3.35	0.75	26.15	0.69	159.73	18.07
Fall	76	3.65	107.71	26.18	95.30	3.41	1.02	12.41	0.79	85.33	9.83
Silver	77	25.81	638.58	24.18	623.03	0.60	0.40	15.55	0.56	355.71	8.66
Peasley	78	14.21	440.00	26.61	377.84	4.38	0.94	62.17	0.62	272.90	38.56
Cougar	79	12.09	342.80	23.07	278.69	5.31	1.25	64.12	0.64	218.88	40.94
Meadow	80	37.52	1,164.39	26.75	1,003.16	4.30	0.96	161.23	0.52	606.37	83.96
Sally Ann	81	4.09	128.74	27.63	113.56	3.70	0.62	15.19	0.66	85.37	10.07
Rabbit	82	0.68	12.90	17.69	12.03	1.28	0.21	0.87	0.67	8.64	0.58
	Totals	857.09	26,209.85		23,852.35			2,357.51		16,006.74	1,449.60

In-Stream Erosion

As noted above, the NEZSED model does not account for sediment coming from human-caused mass failures, impacts from grazing, or impacts from mining. (The background sedimentation rate in NEZSED does include naturally occurring mass failures.) In order to account for the impacts of grazing and mining as they affect stream stability, we collected data on in-stream erosion throughout the whole subbasin, except Cottonwood Creek. The methods followed in this data collection exercise appear as an attachment at the end of this appendix (Attachment L-1). Streams sampled and the results are shown in Table L-3.

Table L-3. In-stream sediment produced in the SF CWR Subbasin.

In-Stream Erosion Data					
Water Body No.	**Water Body Name**	**Sediment in Tons per Stream Mile**	**Sediment in Tons per Water Body**	**Routing Coeffic-ient**	**Routed Sediment**
		(t/mi/yr)	**(t/WB/yr)**		**(t/WB/yr)**
10	Threemile Creek	39	616	0.58	357
11	Butcher Creek	23	211	0.62	131
38	Middle Red River	14	210	0.56	118
39	Moose Butte Creek	17	12	0.65	8
45	Upper Red River	5	62	0.54	34
49	Trail Creek	3	3	0.70	2
50	Siegel Creek	22	15	0.64	10
55	Upper American River	3	39	0.56	22
56	Elk Creek	53	124	0.79	98
57	Little Elk Creek	2	25	0.69	17
58	Big Elk Creek	11	63	0.62	39
59	Buffalo Gulch	1	4	0.80	3
62	Lower Newsome Creek	4	36	0.71	26
75	Leggett Creek	1	1	0.69	1
80	Meadow Creek	15	53	0.52	27
81-Non FS* Land	Sally Ann Creek	1	1	0.66	1
82-Non FS Land	Rabbit Creek	1	1	0.67	1
	Total	213	1,473		891

*Non FS = not federally managed

The largest producers of in-stream sediment are Threemile Creek, Butcher Creek, Middle Red River, and Elk Creek. We note in the methods that we only sampled streams known to be actively eroding. These data show that the grand majority of sediment from in-stream erosion is coming from a few locations. The total routed in-stream erosion sediment being produced is about 60% of the total routed human-caused sediment being produced from forest activities on the federal lands. About half of that, however, is coming from Threemile and Butcher Creeks.

State Highway (Highway 14) from Kooskia to Elk City

Another major source of sediment is the state highway from Kooskia to Elk City. It is regularly graveled during the winter to improve driving conditions and much of the gravel ends up in the river.

We estimated the amount of sediment coming from the state highway based on the gravel crushed by ITD for the Reed's Bar shed. The ITD crushes approximately 10,000 tons of gravel every four years or so that is used for the portion of the road from the Mt. Idaho bridge to Elk City, a distance of 50 miles. This results in about 200 tons of gravel per mile , which over 4 years equals about 50 tons/mile/year. Of course, not all of this reaches the river, but a significant portion does. Some portion is applied to parts of the road that have some sort of a buffer to the river. We estimated that about 80% of the highway is directly adjacent to the river. Given these conditions, we used a 40 tons/mile rate for the state highway from Harpster to Elk City. We placed these estimates in the sediment budget before the routing equation was applied, so the estimates are reduced by the Roehl (1962) routing coefficient. Table L-4 shows the estimates of sediment from State Highway 14. These estimates of total sediment delivery are the same order of magnitude as those from NEZSED and the in-stream erosion survey.

Table L-4. Sediment delivered from State Highway 14 along the SF CWR.

Water Body No.	Water Body Name	Miles of Road	Tons of Sediment	Routing Coefficient	Routed Sediment
		(miles)	(t/WB/yr)		(t/WB/yr)
12	Mid-Lower SF CWR	23.7	948	0.55	521
22	Middle SF CWR	11.7	468	0.54	253
30	Mid-Upper SF CWR	11.8	472	0.55	260
36	Upper SF CWR	3.7	148	0.77	114
	Total	50.9	2,036		1,148

Mass Failures

Another major source of sediment identified from both privately and publicly managed lands is mass failures that are related to human activities. For the most part, these are mass failures associated with roads. In general, a few mass failures occur every year, but the major contributors of sediment are the major episodes of mass failure that occur during large rain-on-snow events or during other high precipitation events when the soil mantle becomes supersaturated. The last major mass failure event in the region occurred during the storms of 1996. The NPNF and BLM conducted an inventory of the mass failures that occurred during that event.

We acquired the NPNF mass failure database and identified those mass failures associated with roads. An estimate of percent delivery of sediment to the stream was not consistently included in the database. As an alternative, we applied the Roehl (1962) routing coefficient to the total sediment production to arrive at an estimate of percent delivery. This is consistent with our and NEZSED's application of the routing coefficient to all the sediment sources in the subbasin, in the absence of a better way to approach the routing question in a more site-specific or source-specific manner.

The NPNF data set documents mass failures that occurred primarily during the 1996 storms. This sediment production rate cannot be assumed to occur annually. Based on data from the last century, McClelland et al. (1997) conclude that major rain-on-snow events of the sort that cause major mass failure episodes occur on a 15 to 20 year interval. We, therefore, assumed a 15-year interval and divided the total sediment produced by the mass failures by 15 to arrive at a yearly rate. Table L-5 shows these results.

The NPNF data set only covers lands east of the main federal ownership boundary. We used three approaches to arrive at an estimate of mass failures that occurred on the non-federal lands (water bodies 1, 10,11, and 12, those areas downstream from the Mt. Idaho bridge). We looked at the mass failure rate from the NPNF data set for basalt geologic and basaltic aquatic landtypes that the NPNF has mapped over the prairie lands. This resulted in estimates of three to seven mass failures for the non-federal area. In addition, as we examined aerial photos of the area for evidence of recent mass failures. Three mass failures were identified that appeared to be about 200 cubic yards in size each. On-the-ground surveys of Cottonwood Creek (DEQ, NPT, USEPA 2000) identified several large debris torrents that had occurred in similar terrain. Based on this combination of information, we chose to ascribe four mass failures in the 200-500 cubic yard size class to water bodies 1, 10, 11, and 12 as shown in Table L-5. Anecdotal evidence and other observations confirm that it is likely that at least this much material moved massively during the 1996 event.

Table L-5. Sediment from road-related mass failures.

Mass Failure Data						
Water Body No.	Water Body Name	Number of Mass Failures (15 yr)	Total Mass Failure Sediment per Water Body	Mass Failure Sediment per Year per Water Body	Routing Coefficient	Routed Mass Failure Sediment
			(t/WB)	(t/WB/yr)		(t/WB/yr)
1 (Est)	Lower SF CWR	1	320	21	0.54	12
10 (Est)	Threemile Creek	2	640	43	0.53	23
11 (Est)	Butcher Creek	1	320	21	0.60	13
12-Non FS* Land (E)	Mid-Lower SF CWR	1	320	21	0.55	12
12-FS** Land	Mid-Lower SF CWR	28	5,715	381	0.55	210
13	Mill Creek	4	2,697	180	0.52	94
14	Lower Johns Creek	1	122	8	0.51	4
22	Middle SF CWR	4	340	23	0.54	12
37	Lower Red River	2	737	49	0.61	30
55	Upper American R.	3	423	28	0.56	16
77	Silver Creek	2	170	11	0.56	6
78	Peasley Creek	1	122	8	0.62	5
79	Cougar Creek	3	219	15	0.64	9
80	Meadow Creek	2	180	12	0.52	6
	Total					451

*Non FS = not federally managed
**FS = federally managed

The data show that the largest sediment rate from mass failures is in the mid-lower SF CWR, which is also the largest water body in the subbasin. This is consistent with other data about the location of rain-on-snow induced mass failures occurring at lower elevations (McClelland et al. 1997), such as the location of the mid-lower SF CWR. At higher elevations, the precipitation occurs as snow and thus does not result in over saturated soil mantle conditions. While the estimated total sediment delivery from mass failures is less than that for NEZSED/forestry, state and county roads, and in-stream erosion, it is significant in relation to them and constitutes a major portion of the total sediment budget for the land above Harpster.

County Roads Outside the Federal Boundary (WEPP Roads Model)

The major sources of sediment from private lands are agriculture, grazing, and roads. The two other sources of sediment from non-federal lands, gravel from State Highway 14 and mass failures, have been accounted for above. To be able to quantify the sediment coming from the graveled county roads, we initiated a project, with funding from USEPA, with the Agricultural and Biological Engineering Department at the University of Idaho to develop methods to apply the WEPP roads model (Elliot et al. 1995, Flanagan and Livingston 1995) to unpaved public roads on the non-federal lands. Details of the results of the project are available at the DEQ Lewiston Regional Office in the final project report (Boll et al. 2002). A summary of the results is in Table L-6.

The WEPP road model is a process-based model of surface erosion originally developed for agriculture. A roads module was later added and is being developed by the USFS as a method of more detailed analysis beyond the NEZSED approach (Elliot et al. 1995). The model requires detailed input of climate, soils, road surface, local topography, road drain spacing, road design, road surface condition, and relationship of the road to surface drainage systems. The amount of detail required is often difficult to attain at the large scale needed for a subbasin assessment.

We contracted with the University of Idaho to develop a GPS capability to record needed model inputs and a GIS interface to manipulate the GPS data to provide the inputs for the WEPP road model. Essentially, the system was set up to run over and over again for every road segment defined by every high point in a road and every low point and/or cross drain. The data in Table L-6 show numbers for sediment detachment and sediment delivery. The model calculates sediment produced (detachment) from the road prism by precipitation events (a 30-year climate generator was used), then routes the sediment across the landscape to the surface water system (delivery). If a cross drain or road ditch empties directly into a surface water system channel, then delivery is 100%. Otherwise, the sediment carrying water is “buffered” such that percent sediment delivery is reduced by the landscape conditions before the water reaches a stream channel.

Table L-6. Sediment predicted by the WEPP road model for county roads in the SF CWR Subbasin.

WEPP Data									
Water Body No.	Water Body Name	Total Detached Sediment	Total Delivered Sediment	Weighted Detached Sediment	Weighted Delivered Sediment	Est. Total Detached Sediment	Est. Total Delivered Sediment	Routing Coefficient	Est. Total Routed Sediment
		Sampled	Sampled	Sampled	Sampled	Calculated	Calculated	Calculated	Calculated
		(t/WB/yr)	(t/WB/yr)	(t/mi/yr)	(t/mi/yr)	(t/WB/yr)	(t/WB/yr)		(t/WB/yr)
1	Lower SF CWR	36	16	4	2	253	110	0.54	60
10	Threemile Creek	79	51	6	4	393	253	0.53	134
11	Butcher Creek	124	59	12	6	390	185	0.60	111
12	Mid-Lower SF CWR	103	40	10	4	701	271	0.55	149
81	Sally Ann Creek	57	21	8	3	177	64	0.66	42
82	Rabbit Creek	23	12	4	2	56	29	0.67	20
	Total								516

We collected data of a sample of the roads in each of the water bodies to the west of the federal lands. We calculated a weighted average of sediment per mile of road sampled in a water body and extrapolated that sediment erosion rate to all the unpaved county roads in our GIS coverage of the water body. Since WEPP predicts sediment delivery to a stream channel, once again there is need to route the sediment through the hydrologic system of the water body. As with all the other sediment data for this sediment budget, we routed the sediment using the Roehl (1962) routing coefficient.

The estimated sediment produced by county roads is of the same magnitude as estimated sediment from NEZSED, in-stream erosion, the state highway, and mass failures. Given the error of the estimates, it would be difficult to argue that any one of these is more or less important than the other in the overall sediment budget, or that any one of them is not important to reducing the sediment load in the SF CWR Subbasin

Agriculture and Grazing Land Surface Erosion (RUSLE)

The sediment production situation for the agricultural and grazing lands on the lands to the west of the NPNF boundary within the SF CWR Subbasin is quite different from the sources discussed above. The Cottonwood Creek TMDL (DEQ, NPT, USEPA 2000) identifies a sediment load from Cottonwood Creek alone approximately five times greater than all the sediment discussed above from the rest of the subbasin. The Threemile Creek watershed encompasses many of the same land use practices and produces a proportionate amount of sediment. Since we have to account for all the sediment as it leaves the subbasin at Kooskia, we have included sediment data from the Cottonwood Creek TMDL, as well as developed some of our own for comparison purposes.

We were fortunate that at the time when we were starting work on this TMDL, the same group at the University of Idaho who did the WEPP work for us was completing a RUSLE model (Renard et al. 1997) of the Clearwater Basin (Boll and Brooks 2002). They are currently running the model in a GIS mode (Engel 1999), which requires inputs of digital coverages of the various parameters.

They reran the model in a more detailed manner for our areas of interest, specifically updating the land use map of Cottonwood Creek, Threemile Creek, Butcher Creek, Sally Ann Creek, and Rabbit Creek, as well as using the SSURGO soils data set instead of the STATSGO soils data set. The original land use map had been developed from satellite imagery and ground-truthed in the Lawyers Creek watershed. We found that in the SF CWR Subbasin, it showed far too much cropland and too little hay and grassland. We adjusted these data such that only the Threemile Creek and Cottonwood Creek watershed show any significant annual cropland, which is consistent with the cropping pattern in the region.

Table L-7 shows the results of the RUSLE model of sediment production in all the water bodies to the west of the federal boundary, including the Cottonwood Creek water bodies (upper and lower Cottonwood Creek, upper and lower Red Rock Creek, Stockney Creek, Shebang Creek, South Fork Cottonwood Creek, and Long Haul Creek). As with the

NEZSED data, we subtracted out an estimate of background sediment to produce an estimate of human-caused sediment, then routed it using the routing coefficient. We used a value of 30 tons/square mile as the estimate of the background sedimentation rate. This number was derived in part from the range of background sedimentation rates used in NEZSED for dry forest types on the same landtypes that occur to the west of the NPNF. We also examined RUSLE results from Washington State University where efforts were made to determine a minimal erosion rate under grassland conditions (McCool et al. 2000).

In comparison to the estimated sediment production from other sources in the subbasin, these numbers are an order of magnitude greater. For the croplands, we compared the estimated sediment numbers to those from Washington State University (McCool et al. 2000) and they are what would be expected for croplands in this region. From the total routed human-caused sediment, 10,473 tons/year are from the water bodies being addressed in this TMDL, of which 9,547 tons/year are from the 303(d) listed water bodies. The differences between the estimates of sediment production for Cottonwood Creek using the RUSLE model and the sediment loading estimates in the Cottonwood Creek TMDL are discussed in Appendix M, Sediment Loading Calculations.

Table L-7. RUSLE model sediment predictions from agriculture, grazing and forestry outside the federal ownership boundary in the SF CWR Subbasin.

RUSLE Data							
Water Body No.	Water Body Name	Sediment in Tons per Square Mile	Sediment in Tons per Water Body	Estimated Background	Human-Caused Sediment	Routing Coefficient	Routed Human-Caused Sediment
		(t/mi^2/yr)	(t/WB/yr)	(t/WB/yr)	(t/WB/yr)		(t/WB/yr)
1	Lower SF CWR	86	2,638	925	1,713	0.54	925
2	Lower Cottonwood Cr.	494	12,572	794	11,778	0.55	6,478
3	Upper Cottonwood Cr.	599	19,807	995	18,812	0.53	9,970
4	Lower Red Rock Cr.	567	2,633	139	2,493	0.76	1,895
5	Upper Red Rock Cr.	704	25,261	1,101	24,160	0.52	12,563
6	Stockney Cr.	650	19,898	937	18,962	0.54	10,239
7	Shebang Cr.	423	11,691	862	10,830	0.55	5,956
8	SF Cottonwood Cr.	520	10,108	594	9,513	0.58	5,518
9	Long Haul Cr.	479	6,194	413	5,781	0.62	3,584
10	Threemile Cr.	347	11,632	1,007	10,626	0.53	5,632
11	Butcher Cr.	102	1,708	503	1,205	0.60	723
12-Non FS* Land	Mid-Lower SF CWR	55	4,817	694	4,123	0.55	2,268
81-Non FS Land	Sally Ann Cr.	87	1,205	294	911	0.66	601
82-Non FS Land	Rabbit Cr.	96	784	270	514	0.67	344
	Total	5,209	130,947	9,525	121,422		66,698

*Non FS = not federally managed

Sediment Budget

All of the data discussed above are summarized in Table L-8. These summary data are used in the sediment loading calculations discussed in the sediment TMDLs in Chapter 5 of this document. Of interest for the purposes of a TMDL and loading reductions is the difference of nearly two magnitudes between sediment loading from forested water bodies compared to water bodies used primarily for agriculture and grazing. The same data are presented graphically in Figures L-2 and L-3.

Table L-8 and Figures L-2 and L-3 identify those water bodies that appear to be contributing significant amounts of sediment to the main stem SF CWR. For the water bodies above Harpster, the total amount of human-caused sediment being routed through the water bodies ranges from zero for those water bodies in the wilderness to a high of 3,191 tons/year for the lower-mid SF CWR around Harpster (water body no. 12). The next two highest sediment producing water bodies are the next two water bodies upstream from Harpster on the main stem (middle SF CWR (water body no. 22) and the upper-mid SF CWR (water body no. 30)). Aside from these main stem water bodies, the following water bodies upstream from Harpster are producing greater than 100 tons of sediment per year: Mill Creek, middle Red River (which includes Dawson Creek), upper Red River, lower Elk Creek, and Meadow Creek. Water bodies producing between 50 and 100 tons of sediment per year include: lower Red River, Moose Butte Creek, lower American River, East Fork American River, upper American River, Big Elk Creek, and Cougar Creek. Figure L-2 shows the distribution of human-caused sediment by water body.

To account for the varying sizes of the water bodies, another way of looking at sediment production is on a per unit area basis. Apart from the main stem water bodies which produce the most sediment on a per unit area basis, the following water bodies are producing the most sediment: lower Elk Creek, 32 tons per square mile per year ($t/mi^2/yr$); middle Red River (which includes Dawson Creek), 98.6 $t/mi^2/yr$; lower Newsome Creek, 87.5 $t/mi^2/yr$; Big Elk Creek, 6.4 $t/mi^2/yr$; Little Elk Creek, 6.1 $t/mi^2/yr$; lower Red River, 5.4 $t/mi^2/yr$; and Buffalo Gulch, 5.1 $t/mi^2/yr$. Water bodies in the 3-5 $t/mi^2/yr$ range include Mill Creek, Meadow Creek, Cougar Creek, Peasley Creek, Haysfork Creek, Mule Creek, Bear Creek, middle Newsome Creek, Maurice Creek, lower and upper American River, Siegel Creek, Moose Butte Creek, lower and middle South Fork Red River, and upper Red River. The other 303(d) listed water bodies, Sing Lee Creek, Nugget Creek, and Beaver Creek, are producing in the range of 1 to 3 $t/mi^2/yr$ of human-caused sediment. Figure L-3 shows the distribution of human-caused sediment per unit area.

Table L-8. Summary sediment budget for all assessed nonpoint sources in the SF CWR Subbasin.

Water Body No.*	Area	WEPP and State Highway	NEZSED	RUSLE	Mass Failures	In-stream Erosion	Total Sediment	Background Sediment Rate	Total Background Sediment	Routing Coefficient	Routed Human-Caused Sediment
	(mi^2)	(t/yr/WB)	(t/yr/WB)	(t/WB/yr)	(t/WB/yr)	(t/WB/yr)	(t/WB/yr)	(t/mi^2)	(t/WB/yr)		(t/WB/yr)
1	30.8	72.44		2,637.89	21.33		2,731.67	30.00	924.60	0.54	974.97
2	26.5			12,571.52			12,571.52	30.00	793.50	0.55	6,531.78
3	33.2			19,806.96			19,806.96	30.00	994.80	0.53	10,016.73
4	4.6			2,632.50			2,632.50	30.00	139.20	0.76	1,891.57
5	36.7			25,261.17			25,261.17	30.00	1,100.70	0.52	12,632.50
6	31.2			19,898.12			19,898.12	30.00	936.60	0.54	10,206.73
7	28.7			11,691.41			11,691.41	30.00	861.60	0.55	5,917.66
8	19.8			10,107.69			10,107.69	30.00	594.30	0.58	5,557.88
9	13.8			6,193.82			6,193.82	30.00	413.10	0.62	3,605.64
10	33.6	205.14		11,632.46	42.67	615.75	12,496.02	30.00	1,006.50	0.53	6,104.73
11	16.8	137.24		1,708.16	21.33	211.20	2,077.93	30.00	502.80	0.60	948.35
12 NFS	27.6	177.16		4,816.93	21.33		5,015.42	30.00	693.60	0.55	2,378.55
12 FS	61.0	948.00	2,650.54		381.02		3,979.56	38.22	2,502.85	0.55	812.72
13	36.6		1,050.29		179.82		1,230.11	26.77	971.08	0.52	135.51
14	41.2		1,247.94		8.10		1,256.04	29.40	1,211.61	0.51	22.75
15	16.9		1,207.07				1,207.07	71.68	1,207.05	0.60	0.02
16	7.0		345.93				345.93	49.80	345.59	0.70	0.24
17	15.9		510.02				510.02	31.95	508.97	0.61	0.64

Water Body No.*	Area	WEPP and State Highway	NEZSED	RUSLE	Mass Failures	In-stream Erosion	Total Sediment	Background Sediment Rate	Total Background Sediment	Routing Coefficient	Routed Human-Caused Sediment
	(mi^2)	(t/yr/WB)	(t/yr/WB)	(t/WB/yr)	(t/WB/yr)	(t/WB/yr)	(t/WB/yr)	(t/mi^2)	(t/WB/yr)		(t/WB/yr)
18	13.6		543.73				543.73	40.16	543.73	0.63	0.00
19	6.2		550.76				550.76	88.81	550.64	0.72	0.09
20	3.6		316.43				316.43	88.86	316.36	0.80	0.06
21	8.7		416.83				416.83	48.47	416.83	0.68	0.00
22	29.6	468.00	1,167.08		22.68		1,657.75	36.24	1,072.65	0.54	317.96
23	8.3		256.28				256.28	30.16	251.20	0.68	3.47
24	22.9		476.47				476.47	20.04	458.20	0.57	10.40
25	3.8		119.74				119.74	30.06	114.81	0.79	3.87
26	11.3		313.35				313.35	26.85	303.10	0.65	6.63
27	21.3		998.22				998.22	47.09	998.21	0.58	0.01
28	9.2		262.21				262.21	28.53	262.19	0.67	0.01
29	8.0		151.53				151.53	16.84	135.04	0.69	11.34
30	26.8	472.00	847.55				1,319.55	28.03	751.79	0.55	314.08
31	14.8		417.69				417.69	25.07	370.98	0.62	28.76
32	22.6		460.01				460.01	18.82	425.24	0.57	19.83
33	11.9		269.93				269.93	22.62	266.51	0.64	2.19
34	10.5		286.97				286.97	27.08	280.26	0.66	4.40
35	11.7		226.15				226.15	16.73	195.80	0.64	19.50

Water Body No.*	Area	WEPP and State Highway	NEZSED	RUSLE	Mass Failures	In-stream Erosion	Total Sediment	Background Sediment Rate	Total Background Sediment	Routing Coefficient	Routed Human-Caused Sediment
	(mi^2)	(t/yr/WB)	(t/yr/WB)	(t/WB/yr)	(t/WB/yr)	(t/WB/yr)	(t/WB/yr)	(t/mi^2)	(t/WB/yr)		(t/WB/yr)
36	4.2	148.00	147.47				295.47	25.90	109.31	0.77	143.71
37	16.1		375.79		49.14		424.93	17.41	281.17	0.61	87.13
38	25.1		680.29			210.34	890.63	20.06	502.62	0.56	217.28
39	11.1		261.49			12.00	273.49	17.34	191.91	0.65	52.92
40	4.9		111.80				111.80	17.93	88.23	0.75	17.69
41	4.4		107.84				107.84	18.88	82.13	0.77	19.73
42	10.0		185.86				185.86	17.06	170.06	0.66	10.43
43	7.4		135.89				135.89	17.10	124.16	0.70	8.18
44	11.1		215.15				215.15	17.56	193.15	0.65	14.27
45	30.1		744.99			62.26	807.25	19.74	592.77	0.54	116.23
46	5.2		115.14				115.14	18.11	94.53	0.74	15.30
47	3.7		89.97				89.97	21.49	79.93	0.79	7.93
48	3.9		81.15				81.15	20.78	80.85	0.78	0.23
49	7.1		160.17			2.93	163.10	19.89	141.60	0.70	15.10
50	12.2		266.48			15.49	281.96	17.74	215.88	0.64	42.15
51	9.1		216.56				216.56	21.19	191.96	0.67	16.54
52	11.3		281.16				281.16	17.38	195.69	0.65	55.27
53	9.8		235.13				235.13	22.95	224.70	0.66	6.92

Water Body No.*	Area	WEPP and State Highway	NEZSED	RUSLE	Mass Failures	In-stream Erosion	Total Sediment	Background Sediment Rate	Total Background Sediment	Routing Coefficient	Routed Human-Caused Sediment
	(mi^2)	(t/yr/WB)	(t/yr/WB)	(t/WB/yr)	(t/WB/yr)	(t/WB/yr)	(t/WB/yr)	(t/mi^2)	(t/WB/yr)		(t/WB/yr)
54	17.9		413.33				413.33	18.44	328.64	0.60	50.39
55	23.9		621.65		28.19	38.86	688.70	23.54	559.81	0.56	72.81
56	3.6		128.09			123.59	251.68	28.96	105.13	0.79	116.20
57	7.9		190.05			24.53	214.58	18.15	143.91	0.69	48.67
58	13.8		416.10			62.61	478.70	24.45	337.22	0.62	88.23
59	3.3		86.48			3.94	90.41	20.70	69.15	0.80	17.11
60	2.6		62.36				62.36	20.54	52.98	0.84	7.90
61	1.7		38.92				38.92	19.56	33.46	0.91	4.96
62	6.5		188.94			36.04	224.97	24.24	156.82	0.71	48.69
63	6.0		143.43				143.43	19.57	117.05	0.72	19.11
64	2.3		44.24				44.24	16.47	37.39	0.86	5.90
65	5.8		122.06				122.06	19.18	112.01	0.73	7.32
66	1.8		51.81				51.81	24.15	42.99	0.90	7.95
67	8.6		190.11				190.11	17.69	151.61	0.68	26.14
68	9.9		223.54				223.54	21.13	208.98	0.66	9.63
69	5.0		134.79				134.79	23.20	114.38	0.75	15.30
70	4.3		118.57				118.57	25.21	106.88	0.77	9.01
71	6.1		163.02				163.02	25.87	158.09	0.72	3.56

Water Body No.*	Area	WEPP and State Highway	NEZSED	RUSLE	Mass Failures	In-stream Erosion	Total Sediment	Background Sediment Rate	Total Background Sediment	Routing Coefficient	Routed Human-Caused Sediment
	(mi^2)	(t/yr/WB)	(t/yr/WB)	(t/WB/yr)	(t/WB/yr)	(t/WB/yr)	(t/WB/yr)	(t/mi^2)	(t/WB/yr)		(t/WB/yr)
72	2.8		76.91				76.91	27.70	76.72	0.83	0.15
73	2.4		73.04				73.04	27.12	65.90	0.85	6.08
74	5.2		151.06				151.06	27.77	143.29	0.74	5.79
75	7.8		231.19			0.20	231.39	26.29	205.04	0.69	18.21
76	3.6		107.71				107.71	26.18	95.30	0.79	9.83
77	25.8		638.58		11.34		649.92	24.18	623.03	0.56	14.98
78	14.2		440.00		8.10		448.10	26.61	377.84	0.62	43.58
79	12.1		342.80		14.58		357.38	23.07	278.69	0.64	50.25
80	37.5		1,164.39		11.99	52.58	1,228.95	26.75	1,003.16	0.52	117.59
81-NFS	9.8	52.62		1,205.09		0.60	1,258.31	30.00	294.30	0.66	639.25
81-FS	4.1		128.74				128.74	27.63	113.56	0.66	10.07
82-NFS	9.0	27.76	0.00	783.68		0.30	811.73	30.00	269.70	0.67	365.04
82-FS	0.7		12.90				12.90	17.69	12.03	0.66	0.58
Totals		2,708.36	26,209.85	130,947.41	821.63	1,473.20	162,160.45		33,377.65		71,168.85

*FS = federally managed lands, NFS = not federally managed lands

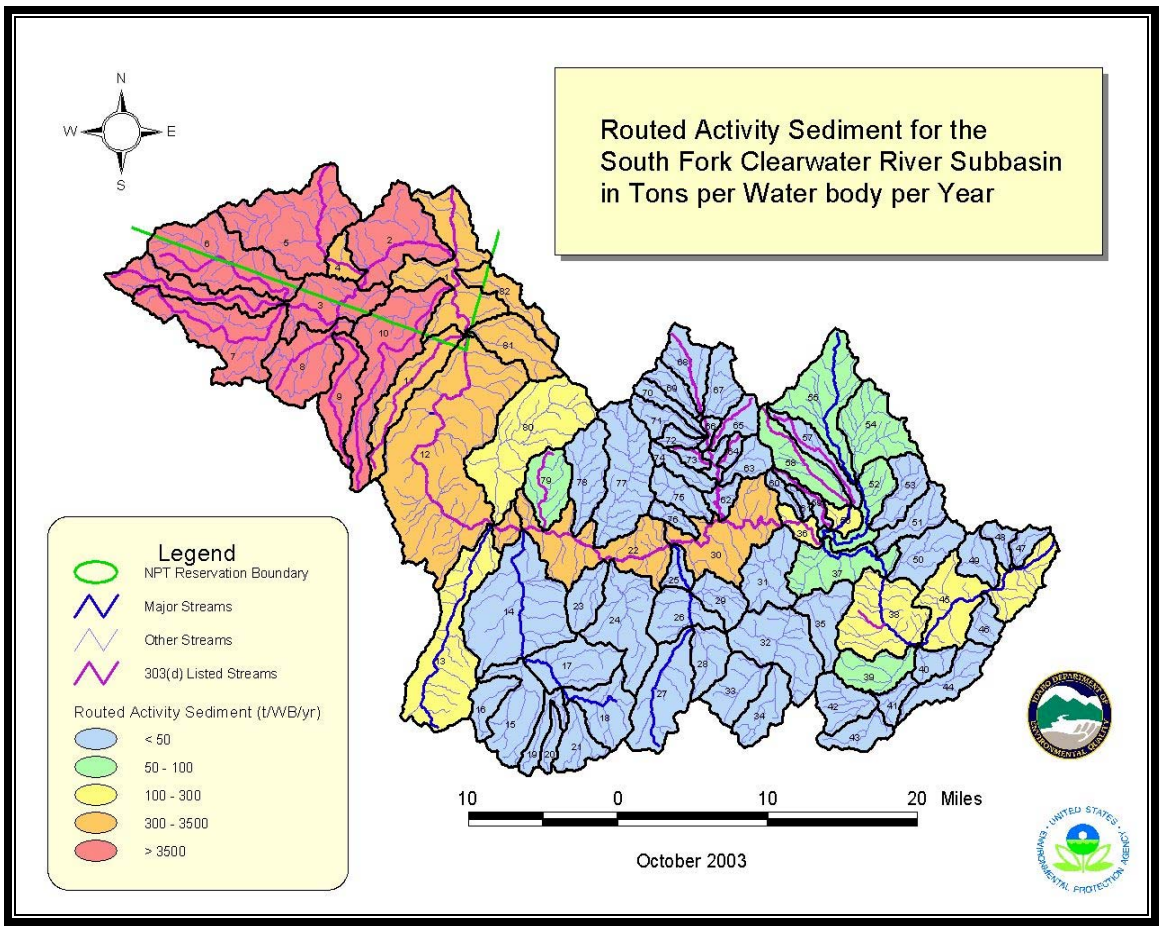

Figure L-2. Annual Sediment Production by Water Body in the SF CWR Subbasin

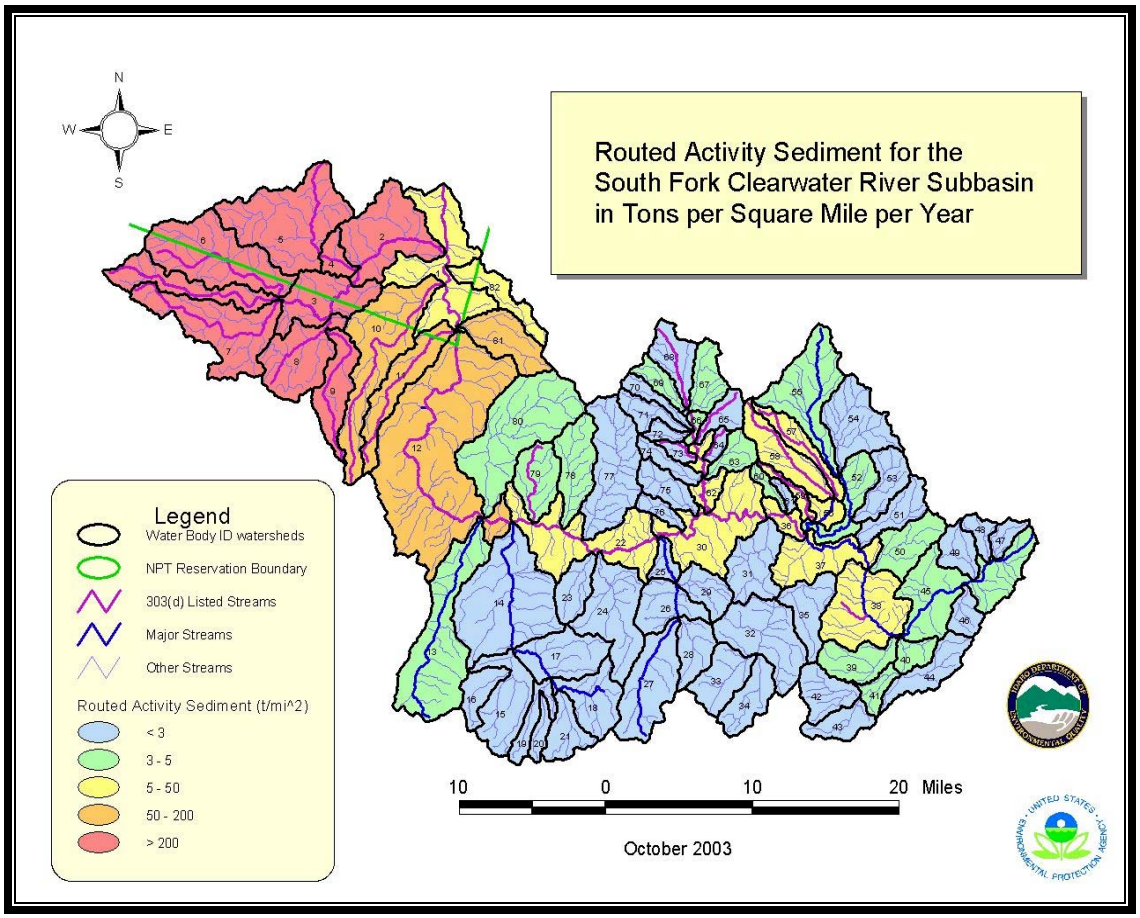

Figure L-3. Annual Sediment Production per Square Mile in the SF CWR Subbasin

Generally, one can conclude from these data that human-caused sediment production is highest in the part of the subbasin where agriculture and grazing dominate (i.e., in the water bodies below Mill Creek. In the water bodies upstream from Mill Creek, the lands along the main stem SF CWR are producing the highest levels of human-caused sediment. Above that, the next level of sediment production comes from the Newsome Creek, American River, and Red River drainages, and Mill, Cougar, Meadow, and Peasley Creeks. These areas include all of the 303(d) listed water bodies, even though the 303(d) listed water bodies themselves are not those producing the highest levels of sediment.

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Attachment L-1: South Fork Clearwater River Subbasin TMDL Stream Bank Erosion Inventory Method

This narrative is intended to document the methodology used to quantify bank erosion in the South Fork Clearwater River (SF CWR) Subbasin. Stream banks were inventoried to quantify bank erosion rates and average annual erosion rates per unit length of stream. These data were used to develop a quantitative sediment budget for the sediment total maximum daily loads.

This inventory followed methods outlined in proceedings from a Natural Resource Conservation Service (NRCS) Channel Evaluation Workshop (1983). Using the direct volume method, sample reaches of selected watersheds within the SF CWR Subbasin were surveyed to determine the magnitude of chronic bank erosion.

Site Selection

Stream reaches with significant eroding bank problems were identified through information from the Nez Perce National Forest (NPNF), U.S. Bureau of Land Management, Idaho County Soil and Water Conservation District, Department of Environmental Quality, Nez Perce Tribe, and other sources. In general, stream reaches identified as having problems tended to be response reaches, Rosgen B and C channel types, with unconsolidated stream bank material. We concluded that, given limited resources and the fact that we were only interested in stream reaches contributing significant amounts of sediment in relation to the whole subbasin, there would be very little value in measuring bank erosion in A type channels. Therefore, we limited our survey to low gradient reaches with known or expected significant bank erosion problems.

Low gradient streams with known bank erosion problems or having characteristics indicating problems were identified using topographic maps, geology maps, NPNF aquatic landtype maps, and aerial photos. The identified reaches were divided into "uniform reaches" for sampling based on available data. Normally a uniform reach was less than 2 miles long. Within each uniform reach, a sample reach of at least 10-20% of the total length of the uniform reach was selected by the field crew. Exact sample reaches were often selected based on access and permission by land owners, although the field crew made every effort to ensure that the sample reach would be representative of the overall uniform reach. Data collected for the sample reach were assumed to be representative of the total uniform reach. In some cases, fieldwork revealed that the uniform reaches were not in fact uniform, and subdivisions were made during the sampling process. Lumping of uniform reaches after initial layout was not allowed.

Field Methods

The NRCS (1983) document outlines field methods used in this inventory. However, some modifications to the field methods were made and are documented here. In

addition, we added data types to be collected that could be used to model flow and stream temperature characteristics, as seen on the field forms attached below.

For each sample reach, two levels of data were collected. A set of data was collected for the sample reach in general (see the Sample Reach Summary Form at the end of this document). The whole sample reach, and therefore, the whole uniform reach it represented, is considered to have the characteristics recorded on the Sample Reach Summary Form. Most of the data on this form were collected for other characterization and modeling purposes. The critical measure, recession rate, was determined for the whole sample reach, rather than at each eroding bank.

The field crew was trained by the NRCS in the use of the methodology. Within the sample reach, the field crews surveyed both right and left banks for eroding length and non-eroding length. Within a given sample reach, 100% of both banks were surveyed and documented on the field forms. One crew member walked along each bank, measuring the parameters identified on the Stream Erosion Inventory Worksheet. A new worksheet was started for every new eroding bank encountered. A particular worksheet shows the intervening length between the previous eroding bank and the length of the current eroding bank where measurements were taken. One worksheet was completed for every length of eroding bank, such that for a given sample reach, several (sometimes numerous) worksheets were completed. As noted above, the length of each sample reach was 10-20% of length of the uniform reach identified in the office. The worksheet asks for "Bank Material Classes," so that eroding banks with significantly different particle size classes over the height of the eroding bank would be recorded separately.

The average annual lateral recession rate is the thickness of soil eroded from a bank surface (perpendicular to the face) in an average year. Recession rates are measured in feet per year. Channel erosion often occurs as "chunk" or "blowout" type erosion. A channel bank may not erode for a period of years when no major runoff events occur. When a major storm does occur, the bank may be cut back tens of feet for short distances. It is necessary to assign recession rates to banks with such processes in mind. When a bank is observed after a flood and ten feet of bank have been eroded, that ten feet must be averaged with the years when no erosion occurred. This will result in a much lower average annual lateral recession rate than a recession rate for one storm. We had the good fortune of surveying the Red River Watershed Management Area where recession rates have been recorded for years so the field crew was able to calibrate its estimates of recession rates against real data. The field crew estimated average annual recession rates by considering evidence of what had happened in the stream over the last 10 years and projecting what might happen in the stream over the next 10 years based on data and statistics of long term flows and extreme events.

The recession rate is critical to completing the calculations, but in some cases it is simply impossible to assess in the field. The indicators used to determine recession rate simply are not present in some cases. The field crew made the determination whether a reasonable estimate of the recession rate could be made in the field. Otherwise, the

recession rate was calculated in the office using the correlation methods developed by NRCS and discussed below.

Bank Erosion Calculations

The direct volume method is a procedure which uses on-the-ground measurement of eroding bank surface area, coupled with estimates of recession rate and eroding bank particle size to calculate the total tons of eroding material over a given length of stream. The direct volume method is summarized in the following equation:

$$\frac{(eroding\ area)(lateral\ recession\ rate)(density)}{2000 lbs / ton} = E$$

E = erosion rate in tons/year

The eroding area is in square feet, the lateral recession rate is in feet per year, and density is in pounds per cubic foot of the identified particle size distribution. The total erosion rate for the sample reach is extrapolated to the uniform reach it represents, and erosion rates for all the uniform reaches are summed to develop a total erosion rate for the water body or watershed of interest. Because we selected all the reaches in the subbasin that we had reason to believe were contributing significant sediment through stream bank erosion, we did not attempt to extrapolate our results to the complete stream network in a water body or watershed. We assume that our set of "uniform reaches" is the complete set of reaches that are contributing significant sediment to the sediment budget of the subbasin.

The eroding area is the product of the length of the eroding bank and the eroding bank height. Eroding bank length and bank height were measured while walking along the stream channel. The eroding areas for all the eroding banks within a sample reach were summed and multiplied by the lateral recession rate for the sample reach to get the total volume of eroding bank material.

As noted above in the field procedures, it is not always possible to determine the lateral recession rate in the field. The NRCS method uses the correlation between the "total" of "Rated Factors" one through five (see field sheet below) and lateral recession rates from field assessments to develop a relationship for predicting the recession rate when it cannot be determined in the field. We followed this procedure to estimate lateral recession rates for the approximately 10% of sample reaches where recession rates could not be estimated in the field.

Total bank erosion is expressed as an annual average. However, the frequency and magnitude of bank erosion events are a function of stream discharge. Because channel erosion events typically result from above average flow event, the annual average bank erosion value should be considered a long term average.

The following conversion rates were used to convert eroded bank material volume to eroded bank material weight in pounds. When eroding banks had significant differences in texture from top to bottom and the field crew recorded such, the texture volume-weights were calculated separately and summed.

Soil Texture	Volume-Weight (pounds/cubic foot)
Clay	60-70
Silt	75-90
Sand	90-110
Gravel	110-120
Loam	80-100
Sandy loam	90-110
Gravelly loam	110-120
Very gravelly sands/loams	120-130
Cobbles, boulders, etc.	120-130

The question arises in using these data for construction of a sediment budget as to how much of the eroded bank sediment is actually transported through the system and how much is simply re-deposited in bars and flood plains further down the channel but still within the same water body. The degree to which eroded sediment is flushed through a system is dependent on the flow event causing the erosion, as well as channel characteristics. For the purposes of calculating the sediment budget, we used the same routing coefficient (Roehl 1962) for the in-stream erosion data as we used for all the other sediment source data.

Even then, we realized that the methods being applied resulted in huge estimates of sediment production from stream banks dominated by cobbles, such as those in Threemile, Butcher, and lower Newsome Creeks. While it is clear that the recession rates for these low gradient, cobble-dominated streams is high, as these streams meander around under high flow events, it is also clear that our estimates of sediment delivery from one water body to the next using the Roehl (1962) equation was far too high for cobble-dominated bank systems. Only some small proportion of cobble-sized material eroded from banks of meandering streams is actually delivered to the adjacent water body over the 10 to 20 year time frame of this analysis.

For cobble-dominated streams, we applied the concepts discussed in Beechie (2001) and recognized that only eroded material from reaches near the mouth of a given water body would likely be delivered to the adjacent downstream water body. Beechie (2001) shows

that annual travel distance for coarse in-stream material is on the order of twenty times the bankfull width of a stream. Since we had collected bankfull width for each uniform reach as part of the data set, we calculated an annual travel distance for each uniform reach having a significant cobble component, and only delivered cobble from those uniform reaches that were within the travel distance from the mouth. Finer in-stream erosion materials were delivered using the Roehl (1962) equation.

STREAM EROSION CONDITION INVENTORY WORKSHEET

Stream Name_____Reach Number_____
Left or Right Bank (circle)
Average Bank Height_____Sample Length_____
Non-Eroding Length_____Bank Material Classes (see reverse side)_____

RATED FACTORS	RATING
1. BANK EROSION EVIDENCE	
Does not appear to be eroding	0
Erosion evident	1
Surface of bank eroding and top of bank has cracking present	2
Slumps and clumps sloughing off into stream (SIZE)	3
2. BANK STABILITY CONDITION (Ability to withstand erosion from streamflows)	
Very little unprotected bank, no undercut vegetation, **AND/OR** bank materials non-erosive	0
Predominantly bare and unprotected, some rills, moderate undercut vegetation	1
Almost completely bare, unprotected bank, rills, severely undercut vegetation, exposed roots	2
Bare, numerous rills/gullies, very severely undercut vegetation, falling trees and/or fences	3
3. BANK COVER/VEGETATION	
Predominantly covered with perennials **AND/OR** stable rock/bedrock	0
40% or less bare/erodible, **AND/OR** cover is annual and perennials mixed	1
40% to 70% bare/erodible, **AND/OR** cover is mostly annual vegetation	2
Predominantly bare and erodible/no cover	3
4. LATERAL CHANNEL STABILITY	
No evidence of significant lateral movement of channel	0
Active lateral movement of channel	1
5. CHANNEL BOTTOM STABILITY	
Channel in bedrock **OR** not eroding (Stable)	0
Minor channel bed degradation/downcutting	1
Significant evidence of downcutting, active headcuts	2
6. IN-CHANNEL DEPOSITION	
No evidence of recent deposition (includes all sizes of bedload type materials)	0
Mobile material in recent deposition, deposits will probably move down channel in next high flow	1
Deposition is stable **AND/OR** vegetated (more than this growing season) channel is aggrading	-1

TOTAL_____

Factors contributing to erosion (concentrated flows, animal access-trampling, grazing impacts to vegetation, fire return flows, roads, bridges, culverts)_____

Other notes_____

(Over)

Bank Material Classes

(Circle best Choice/s)

Soil Classes

<15% coarse fragments, just use the fine soil class
(15-35%) Gravelly (gr), Cobbley (co), Bouldery (b)
(35-60%) Very gravelly (vgr), very cobbley (vco), very bouldery (vb)
(>60%) Extremely gravelly (exgr) extremely cobbley (exco), extremely bouldery (exbo)

sand – sa
sandy loam – sal
loamy sand – lsa
clayey sand – csa
silt – si
loamy silt – lsi
silt loam – sil
clayey silt – csi
loam – l
clay – c
loamy clay – lc
sandy clay – sac
silty clay – sic

Notes_____

SAMPLE REACH SUMMARY FORM

Stream Name _____
Reach Number_____
Hydrological Unit_____
GPS Coordinate: Start_____
End_____
WBID_____
Rosgen Channel Type _____
Slope/Gradient_____
Bank Full Width_____
Bank Full Depth_____
Floodplain Width_____
Average Wetted Width (ft.)_____
Average Wetted Depth (ft.) _____
Average Surface Velocity (ft/sec)_____
Sinuosity_____
Dominant Particle Size_____
Adjacent Land Use_____
Canopy Shade Height (ft.)_____
Canopy Shade Crown Width (ft.)_____
Canopy Offset (from waters edge) (ft.)_____
Canopy Density
Topographic Altitude: Rt._____ & Lft._____
Mannings "n"_____
Recession Rate (Field Estimate)_____

Field Crew_____

Canopy Density Examples

Open Pine	65%	
Closed Pine	75%	X % Covered
Tight Spruce/Fir	85%	
Dense Emergent Vegetation	90%	

Bed Particle Size

Clay	.001
Silt	.004 to .06 .03 median
Sand	.06 (Fine) to 2mm
Gravel	4mm (Pea Size) to 64mm (tennis Ball size)
Cobble	> 64mm to 250mm (Volleyball size)
Boulder	> 250mm
Bedrock	

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Appendix M. Total Suspended Solids and Bedload Data

The sediment loading analyses and target development are driven by the turbidity standard which says that waters shall not exceed 25 NTU over background for greater than 10 days and shall not exceed 50 NTU over background at any time. The turbidity measurements used in the calculations are instantaneous samples. Similarly, the extreme flows which generate the greatest amount of sediment are in effect instantaneous, or at least do not last for 10 days. To transform the instantaneous turbidity data to produce continuous sediment loading numbers, a stochastic flow model of daily average flow for 10 years is developed. The resulting continuous flow/turbidity/TSS model results are then compared to the 25 NTU over background criterion to develop daily loading, daily load capacity, daily natural background loading, and daily excess sediment loading. These results are then annualized to produce the loading figures presented in this report. Doing all the calculations on a daily, essentially continuous basis, using the 25 NTU criterion automatically includes all times when the 50 NTU criterion is exceeded. Subsequent discussions of the loading calculations refer to the 25 NTU criterion. It is to be understood that the methods used for the calculations automatically include the times when the 50 NTU criterion applies.

The total suspended solids (TSS) and bedload data reported herein are the results of several different efforts on the part of the Department of Environmental Quality (DEQ), the Nez Perce Tribe (NPT), and the U.S. Environmental Protection Agency (USEPA). The USEPA provided funding for some of these efforts. DEQ collected instantaneous flow, TSS, and turbidity data for Threemile Creek as part of its detailed monitoring of that water body. The NPT collected instantaneous flow, TSS, turbidity, and bedload data for Butcher Creek as part of its monitoring of that water body. DEQ contracted with Western Watershed Analysts of Lewiston, Idaho, to provide flow and bedload data for the main stem South Fork Clearwater River (SF CWR) and Threemile Creek.

Unfortunately, flows in Threemile Creek and Butcher Creek over the sample period were below the level where significant bedload moved or could be sampled. Therefore, bedload for these streams was estimated from the sediment budget. Similarly, for the year when the contractor was to sample bedload in the upper main stem SF CWR, flows did not allow the bedload to be sampled. The result is that sampled bedload data exist only for the Stites and Harpster sites.

Other TSS and turbidity data exist for the SF CWR subbasin, but come from such diverse locations and time periods as to make them difficult to use for a subbasin wide analysis. DEQ collected turbidity and flow for a number of streams in the SF CWR subbasin (Thomas 1991) and these data provide a comparison for the results of our calculations. The Nez Perce National Forest (NPNF) collected TSS, turbidity and flow data at the Mt. Idaho bridge from 1988-1992, analyzed these data, and extrapolated them using the data from Thomas (1991). These results were also used to help validate the results from the 1991-2001 stochastic flow data used in the sediment loading calculations in Chapter 5.

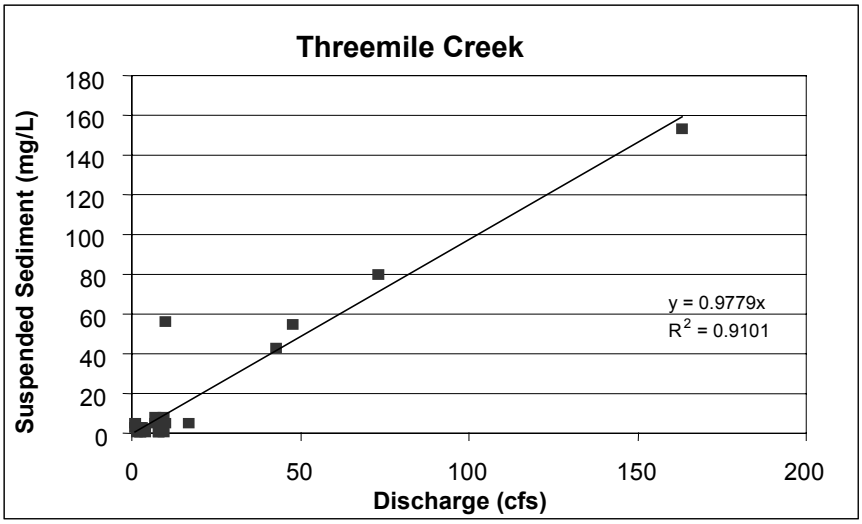
Sediment yield curves were developed from the TSS and bedload data. The data and sediment yield curves for the Threemile, Butcher, Stites, and Harpster sites are presented in

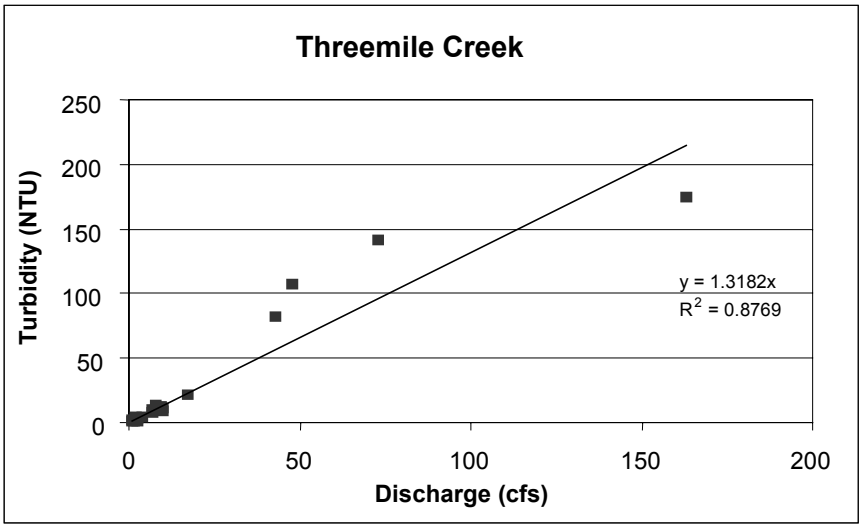
the tables and figures on the following pages (Tables M-1 through M-6 and Figures M-1 through M-4).

Table M-1. Threemile Creek turbidity and total suspended solids (TSS) data.

Date	Discharge (cfs)*	TSS (mg/L)**	TSS (tons/day)	Turbidity (NTU)***
03/08/2001	48	55	7.089	107
03/09/2001	163	153	67.335	175
03/10/2001	73	80	15.727	142
03/13/2001	43	43	5.004	82
02/22/2000	10	56	1.501	9
03/07/2000	9	1	0.025	12
03/21/2000	8	1	0.021	10
04/04/2000	8	1	0.021	14
04/18/2000	7	8	0.152	10
05/02/2000	7	5	0.094	8
05/16/2000	17	5	0.231	22
05/30/2000	10	5	0.136	11
06/13/2000	9	8	0.200	13
06/27/2000	3	1	0.007	4
07/11/2000	2	3	0.018	1
07/25/2000	1	3	0.007	3
08/08/2000	1	5	0.011	2
08/22/2000	2	2	0.008	2
09/05/2000	2	2	0.012	4
09/19/2000	2	1	0.004	2
10/03/2000	4	2	0.021	5
11/16/2000	3	3	0.023	nd
12/11/2000	3	1	0.007	nd
01/17/2001	4	1	0.011	nd

* cubic feet per second
** milligrams per liter
*** nephlometric turbidity units





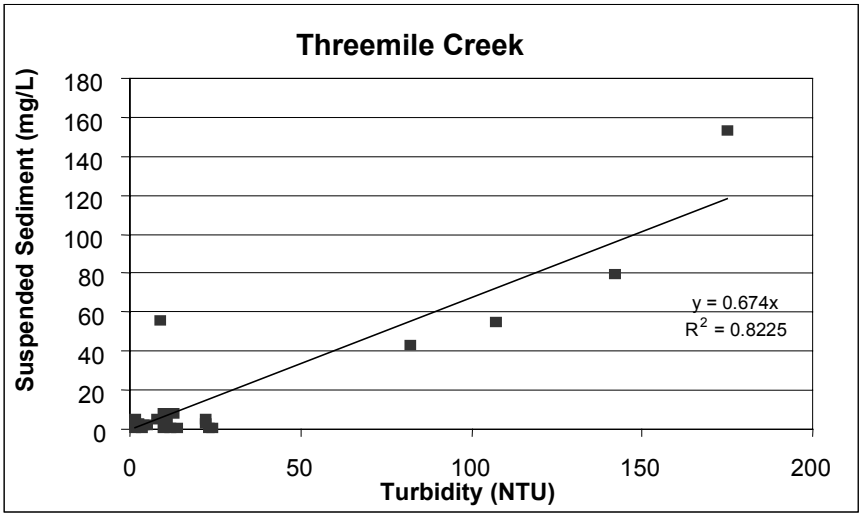


Figure M-1. Threemile Creek Sediment Yield Curves

Table M-2. Butcher Creek turbidity and total suspended solids (TSS) data.

Date	Discharge (cfs)*	TSS (mg/L)**	TSS (tons/day)	Turbidity (NTU)***
01/07/02	6.1	45.3	0.745	31.0
01/16/02	1.3	0.6	0.002	4.1
02/27/02	12.6	16.7	0.568	39.0
03/27/02	1.6	11.5	0.049	12.8
04/30/02	14.3	29.0	1.120	43.2
05/01/02	25.1	75.8	5.137	64.4
10/31/02	0.8	8.1	0.017	2.9
11/26/02	0.7	12.7	0.024	1.5
12/12/02	0.8	8.8	0.018	3.2
12/19/02	1.0	3.3	0.009	3.00

* cubic feet per second
** milligrams per liter
*** nephlometric turbidity units

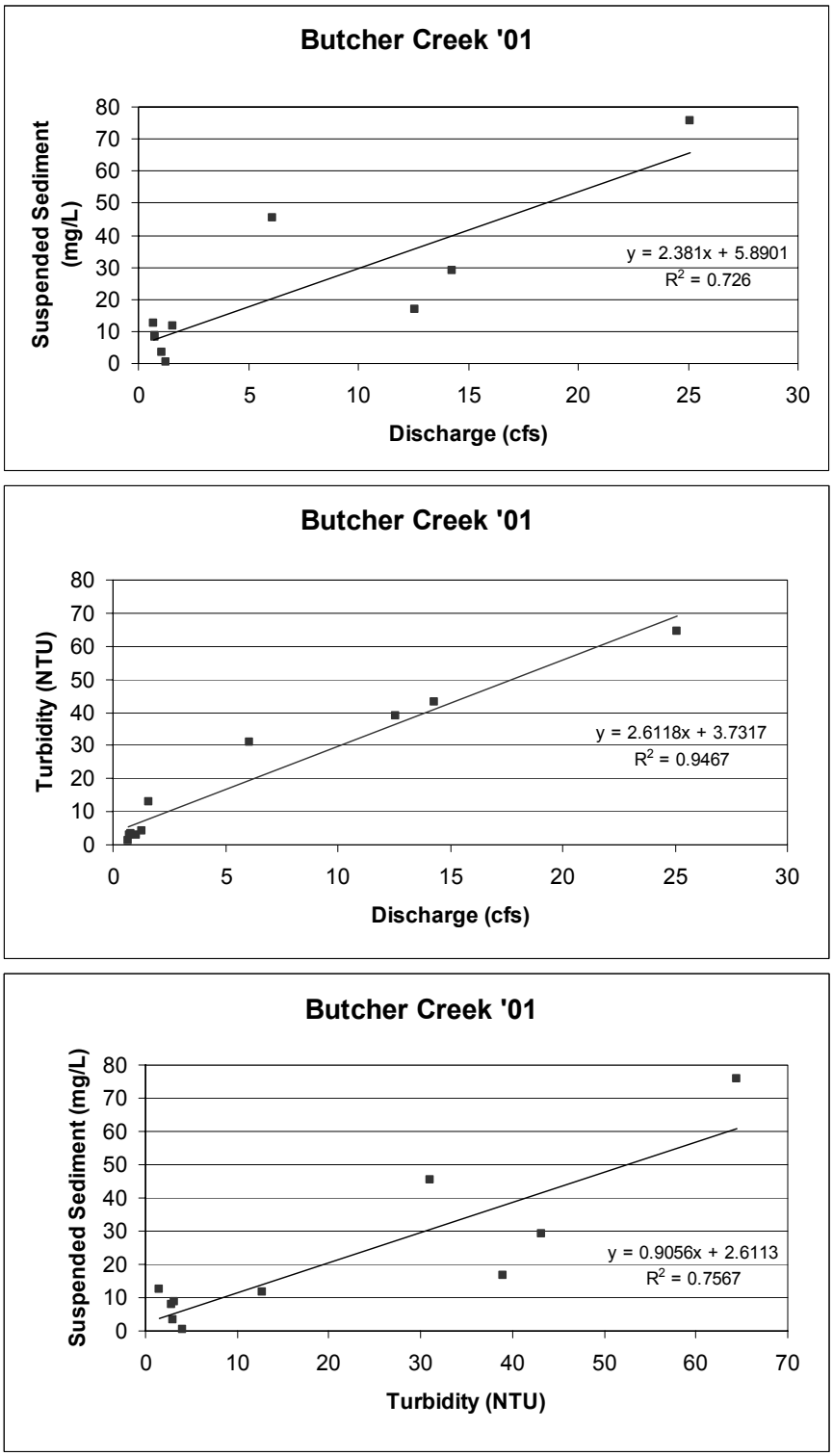


Figure M-2. Butcher Creek Sediment Yield Curves

Table M-3. Stites bridge turbidity and total suspended solids (TSS) data.

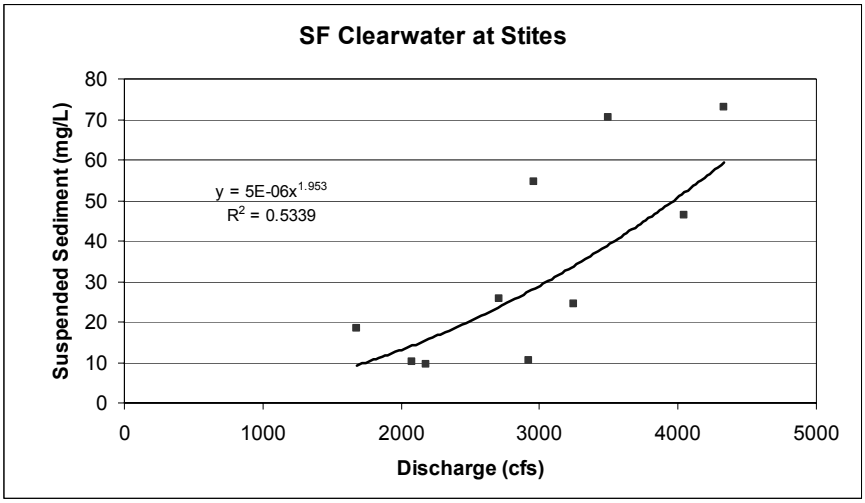
Date	Discharge (cfs)*	TSS (mg/L)**	TSS (tons/day)	Turbidity (NTU)***
03/27/2001	1,680	18.4	83	17.1
04/26/2001	2,960	54.7	437	19.4
05/01/2001	4,330	73.1	855	53.4
05/02/2001	3,500	70.6	667	22.9
05/05/2001	2,710	25.6	187	6.9
05/14/2001	3,250	24.6	216	5.5
05/15/2001	4,040	46.2	504	19.3
05/18/2001	2,920	10.4	82	5.7
05/21/2001	2,080	10.2	57	3.9
05/24/2001	2,180	9.5	56	3.3

* cubic feet per second
** milligrams per liter
*** nephlometric turbidity units

Table M-4. Stites bridge bedload data.

Date*	Discharge (cfs)**	Bedload (grams)	Bedload (tons/day)	TSS*** (tons/day)	Total Sediment (tons/day)
03/27/2001	1,570	24.79	1.4	83	84
03/27/2001	1,550	53.66	2.9	83	86
04/26/2001	2,970	132.22	14.0	437	451
04/26/2001	2,950	146.23	15.5	437	452
05/14/2001	3,330	253.85	25.0	216	241
05/14/2001	3,300	237.67	23.4	216	239
05/15/2001	4,020	261.29	27.2	504	531
05/15/2001	3,980	740.51	77.0	504	581
05/18/2001	2,950	206.07	10.1	82	92
05/18/2001	2,950	157.74	7.7	82	90
05/21/2001	2,060	24.91	1.2	57	58
05/24/2001	2,140	62.48	3.1	56	59
05/24/2001	2,140	89.20	4.4	56	60

* duplicate dates indicate two samples from same site on the same day
** cubic feet per second
*** total suspended solids


SF Clearwater at Stites
Suspended Sediment (mg/L)
Discharge (cfs)
y = 5E-06x^1.953
R^2 = 0.5339
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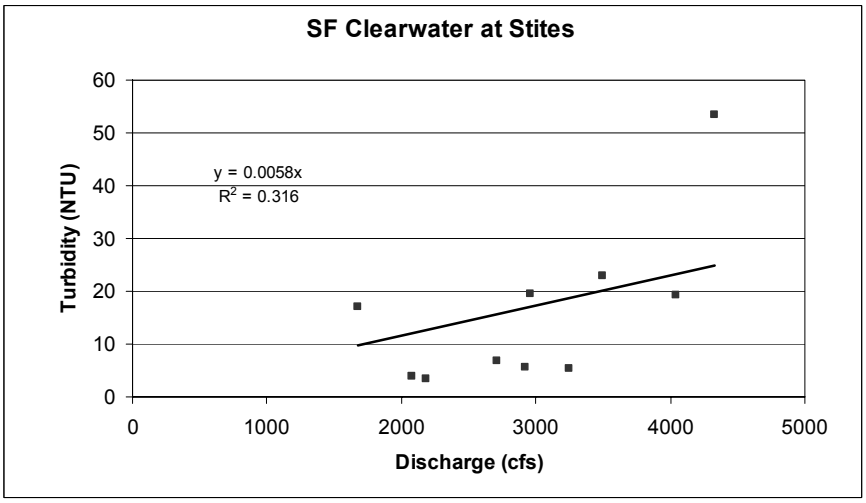
30
40
50
60
70
80
0
1000
2000
3000
4000
5000


SF Clearwater at Stites
Turbidity (NTU)
Discharge (cfs)
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R^2 = 0.316
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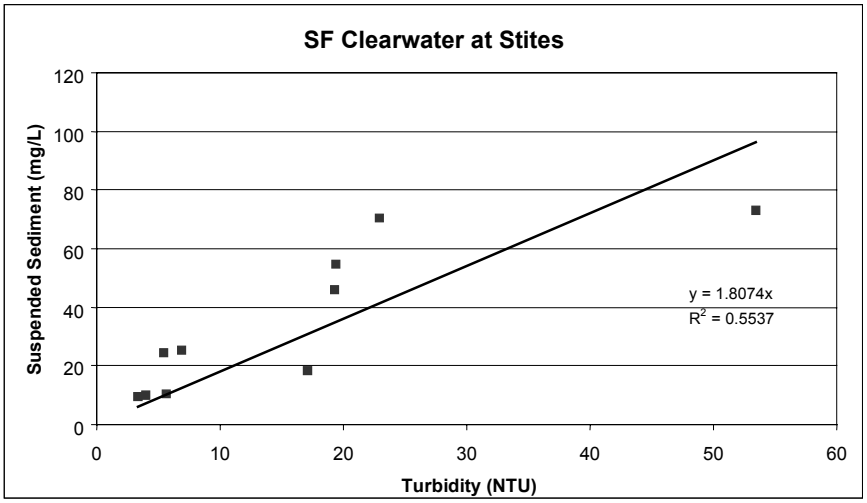
50
60
0
1000
2000
3000
4000
5000


SF Clearwater at Stites
Suspended Sediment (mg/L)
Turbidity (NTU)
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R^2 = 0.5537
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120
0
10
20
30
40
50
60

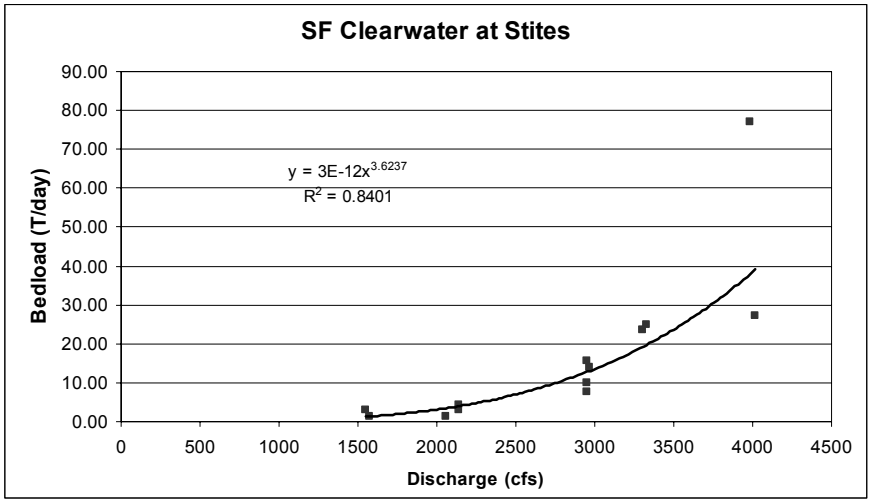


Figure M-3. Stites Bridge Sediment Yield Curves

Table M-5. Harpster total suspended solids (TSS) data.

Date	Discharge (cfs)*	TSS (mg/L)**	TSS (tons/day)	Turbidity (NTU)***
03/26/01	1,450	43.6	171	22
04/27/01	2,710	51.8	379	22
05/01/01	3,250	27.8	244	11
05/02/01	2,560	16.9	117	8
05/05/01	2,010	11.0	60	5
05/13/01	2,350	14.2	90	5
05/15/01	2,890	23.4	183	7
05/18/01	2,150	10.9	63	3
05/21/01	1,580	6.8	29	2
05/24/01	1,650	10.7	48	3
03/21/88	498	9.1	12	7
03/31/88	615	10.7	18	8
04/05/88	1,010	13.5	37	12
04/11/88	1,190	24.0	77	11
04/19/88	4,030	84.0	914	13
04/25/88	2,740	15.0	111	8
05/03/88	2,030	6.7	37	6
05/09/88	2,750	10.8	80	10
05/16/88	3,140	11.5	97	5

Date	Discharge (cfs)*	TSS (mg/L)**	TSS (tons/day)	Turbidity (NTU)***
05/31/88	2,430	13.0	85	10
06/06/88	2,456	3.4	23	4
06/27/88	1,300	3.6	13	5
03/15/89	1,057	8.5	24	8
03/28/89	1,610	12.1	53	10
04/11/89	1,830	10.6	52	9
04/25/89	3,410	19.3	178	6
05/08/89	4,810	31.0	403	9
05/16/89	2,410	15.7	102	2
05/22/89	2,090	12.6	71	8
06/07/89	2,410	14.5	94	3
06/16/89	3,120	39.3	331	8
07/05/89	722	2.6	5	2
04/11/90	1,420	2.8	11	3.6
04/18/90	1,990	15.3	82	4
04/25/90	1,830	7.9	39	3
05/10/90	4,410	2.9	35	4
05/16/90	2,410	9.3	61	5
05/24/90	2,190	39.0	231	nd
06/01/90	4,000	12.0	130	nd
06/06/90	2,510	24.0	163	nd
06/13/90	2,160	7.0	41	nd
07/01/90	779	2.7	6	nd
07/26/90	583	13.0	20	nd
04/05/91	1,470	27.0	107	10
04/12/91	1,240	4.9	16	8
04/19/91	1,090	6.5	19	6
05/03/91	1,230	4.1	14	5
05/09/91	3,620	88.0	860	20
05/17/91	2,740	13.0	96	6
05/23/91	3,230	14.0	122	7
05/31/91	2,850	12.0	92	7
06/10/91	2,220	7.3	44	4
06/14/91	1,990	8.3	45	2

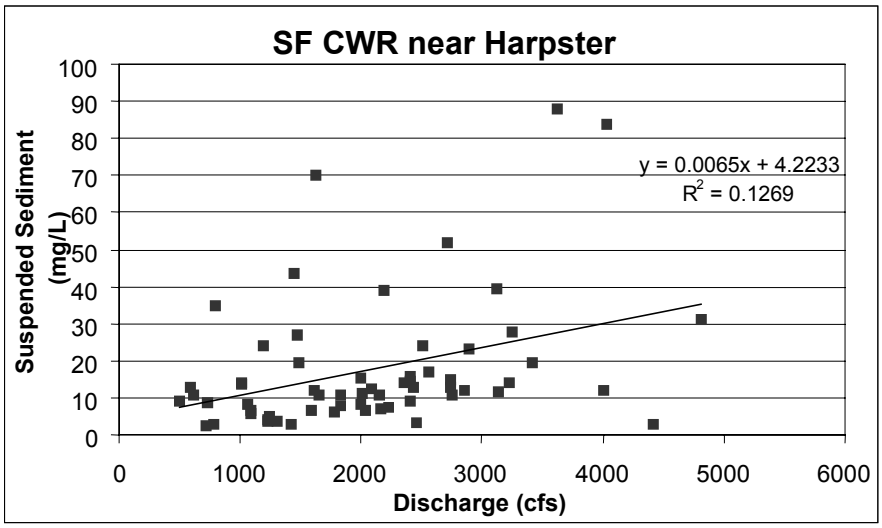
Date	Discharge (cfs)*	TSS (mg/L)**	TSS (tons/day)	Turbidity (NTU)***
06/19/91	1,630	70.0	308	6
07/02/91	1,780	6.1	29	4
03/17/92	1,010	14.2	39	10
04/10/92	1,230	3.7	12	16
04/24/92	1,090	5.7	17	4
04/30/92	1,490	19.6	79	7
05/29/92	729	8.7	17	3
07/09/92	799	34.9	75	18

* cubic feet per second
** milligrams per liter
*** nephlometric turbidity units

Table M-6. Harpster bedload data.

Date	Discharge (cfs)*	Bedload (grams)	Bedload (tons/day)	TSS (tons/day)	Total Sediment (tons/day)
03/26/01	1,450	60	2.8	171	174
03/26/01	1,450	73	3.4	171	174
05/05/01	2,010	185	4.3	60	64
05/05/01	2,010	211	5.0	60	65
05/13/01	2,350	339	15.9	90	106
05/13/01	2,350	207	9.7	90	100
05/15/01	2,890	347	16.3	183	199
05/15/01	2,890	356	16.8	183	200
05/18/01	2,150	118	5.5	63	69
05/18/01	2,150	119	5.6	63	69
05/21/01	1,580	59	2.8	29	32
05/21/01	1,580	71	3.4	29	32
05/24/01	1,650	67	3.2	48	51
05/24/01	1,650	60	2.9	48	51

* cubic feet per second
** total suspended solids


SF CWR near Harpster
Suspended Sediment (mg/L)
Discharge (cfs)
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R2 = 0.1269
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50
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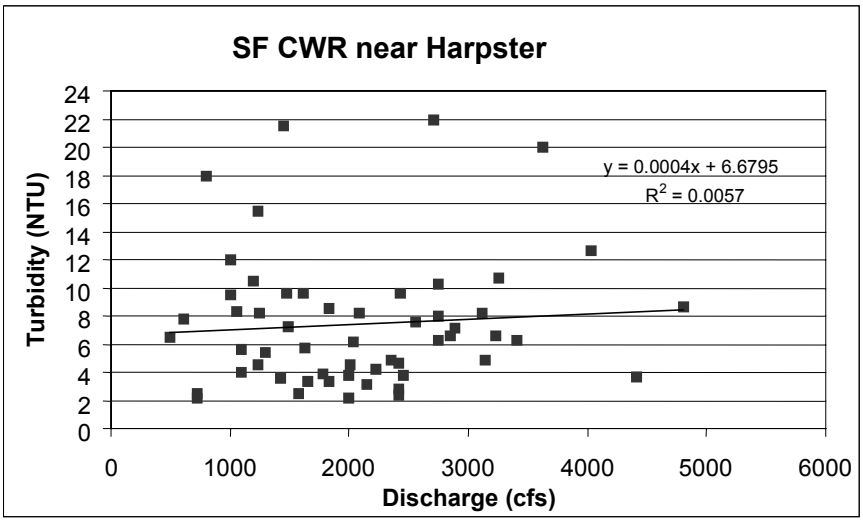
80
90
100
0
1000
2000
3000
4000
5000
6000


SF CWR near Harpster
Turbidity (NTU)
Discharge (cfs)
y = 0.0004x + 6.6795
R2 = 0.0057
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6
8
10
12
14
16
18
20
22
24
0
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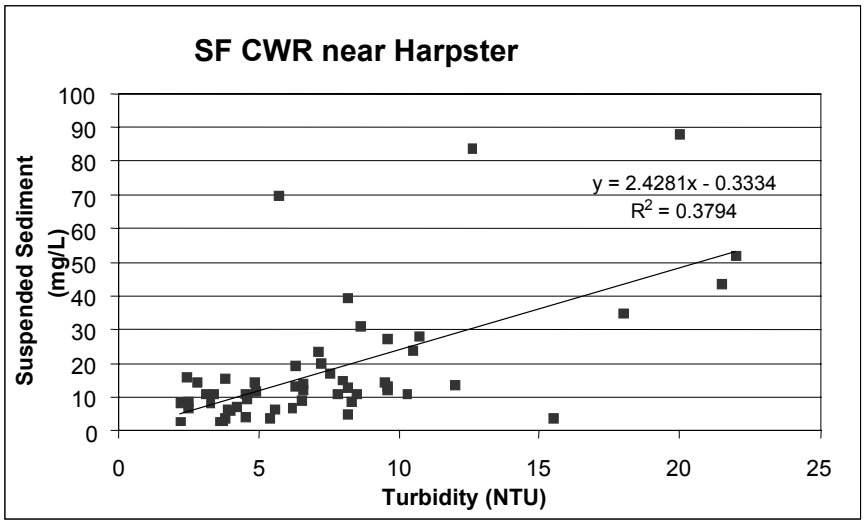
2000
3000
4000
5000
6000


SF CWR near Harpster
Suspended Sediment (mg/L)
Turbidity (NTU)
y = 2.4281x - 0.3334
R2 = 0.3794
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50
60
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80
90
100
0
5
10
15
20
25

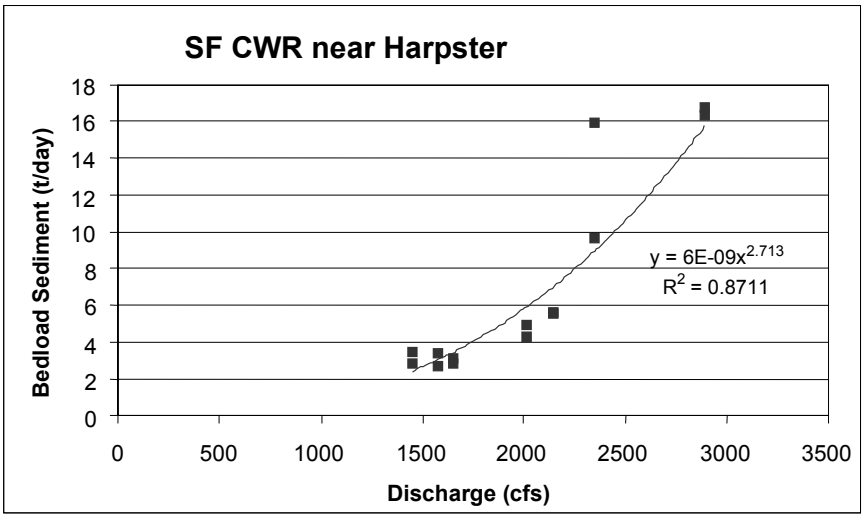


Figure M-4. Harpster Sediment Yield Curves

The TSS and bedload yield curves were coupled with daily flow data in the spreadsheet to predict TSS loads and bedloads on a daily basis. At this point, the estimates of daily flow were coupled with the sediment yield curves to produce estimates of average daily TSS sediment load in milligrams per liter (mg/L), which were then converted to tons of sediment per day and tons of sediment per year. Average daily nephlometric turbidity unit (NTU) values were calculated from a similarly developed relationship. The NTU to TSS relationships for the four locations are presented in Figures M-1 through M-4 as well.

The TSS sediment load capacity and excess load capacity were then calculated based on the Idaho water quality standard (WQS) of "turbidity … shall not exceed background turbidity by more than fifty NTU instantaneously or more than twenty-five NTU for more than ten consecutive days" (IDAPA 58.01.02.250.02.d). Plots of the sediment loadings at the Threemile, Butcher, and Stites sites show that turbidity is elevated for periods considerably greater than 10 days. Loading calculations are based, therefore, on the 25 NTU above background WQS. Assuming that as sediment loading reductions are accomplished, selection of this standard with which to make the calculations results in a large margin of safety for loading reductions as turbidity begins to be reduced to less than 10 consecutive days of exceedances.

Background sediment loading was developed from the sediment budget (Appendix L). The background ratio for each watershed was calculated using an assumed background erosion rate, multiplied by the routing coefficient, and divided by the total tons of sediment routed from a watershed. Background erosion rates have been developed for all federally managed watersheds and range from 16 to 90 tons per square mile per year. After reviewing the range of background figures from the federally-managed lands, background figures used in other total maximum daily load reports (TMDLs), erosion studies at Washington State University, predictions by the RUSLE model, and best professional judgement, a background erosion rate of 30 tons per square mile per year was assigned for the non-federal lands. The routing coefficient was that used by the NPNF to route sediment using the NEZSED model (Roehl

1962), and which has been used throughout the sediment budget calculations. The background ratio developed from the sediment budget for each of the four sites is presented in the loading calculations in Chapter 5.

Using the background ratio, the amount of daily load that is attributed to background was calculated by multiplying the daily load by the background ratio. Note that this results in different background loads depending on flow, as would be expected naturally, as higher flows naturally result in greater movement of sediment.

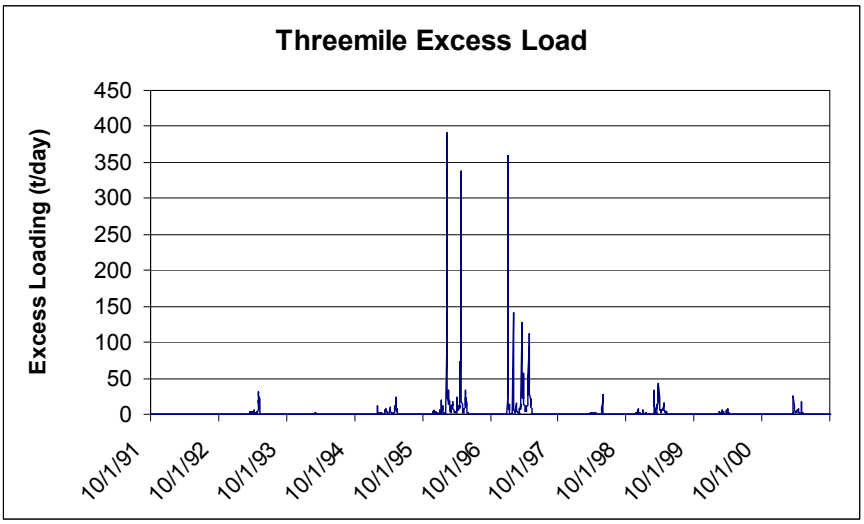
The load capacity was calculated by the relationship between turbidity in NTU to the TSS in milligrams per liter, resulting in a relationship then used to calculate the amount of TSS in milligrams per liter that the 25 NTU from the state WQS represent. For example, in Threemile Creek, 25 NTU are equivalent to 17 mg/L TSS. For each day then, the load capacity is the 17 mg/L plus the percentage of the load that is background. Since the background load varies with flow, the load capacity varies with flow as well.

Excess loading occurs when current loading is greater than the load capacity. Excess loading on a daily basis is the current load minus the load capacity. The excess load addressed by the TMDL for Threemile and Butcher Creeks and the Stites site on the SF CWR is shown in the following set of paired figures (Figures M-5 through M-7). The first figure for Threemile Creek shows the distribution and magnitude of excess loads over the 10 years of calculations, and the subsequent figure for Threemile Creek shows more detail of only two years of those same data. The point of the figures is to show that excess loading only occurs over short time frames, the same time frames as high flows, and that the episodes of excess loading are limited to January through May each year.

The excess load is summed over the 10 years of data, then divided by 10. The result is the amount of excess loading on a yearly basis. When divided by the average annual TSS yield per year, this results in the percent reduction needed in TSS sediment for a given water body. The summaries of these calculations are presented in Tables M-8 through M-11. These calculations indicate that significant load reductions in TSS are needed for Threemile Creek, Butcher Creek, and for the main stem SF CWR at Stites. The TSS-based sediment TMDLs for these water bodies are presented in Chapter 5.

The excess load calculations and resulting sediment reduction targets have a large margin of safety built in them based on the use of the 25 NTU over background over 10 days WQS vs. the 50 NTU over background instantaneous standard. As water bodies come closer into being in compliance with the turbidity standards, the periods of exceedance will become less than 10 days, and the 50 NTU over background standard will be in effect. For example, in only one event in the last 10 years has the Stites location exceeded the 25 NTU over background for greater than 10 days. So, one can conclude that the Stites location is close to the threshold where the 50 NTU over background standard should be in effect. Using the 50 NTU over background standard in the same calculations as above, excess load at Stites is only 3,578 tons per year, compared to 9,356 tons per year using the 25 NTU standard, and the percent load reduction required would be 9% compared to 25%. Similar calculations could be done for Threemile Creek and Butcher Creek. However, the point is that use of the

25 NTU over background as the basis for the loading calculations provides a very large margin of safety in the loading calculations. The use of the 25 NTU in the loading calculations is justified because that is the standard that should be applied for the current situation, but as compliance with the TMDL is accomplished, the 50 NTU over background standard likely will be the appropriate standard at that point.



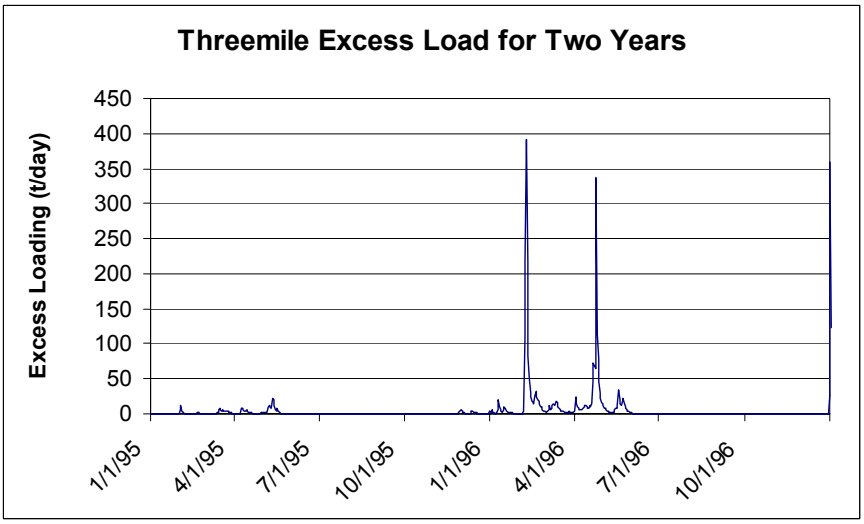
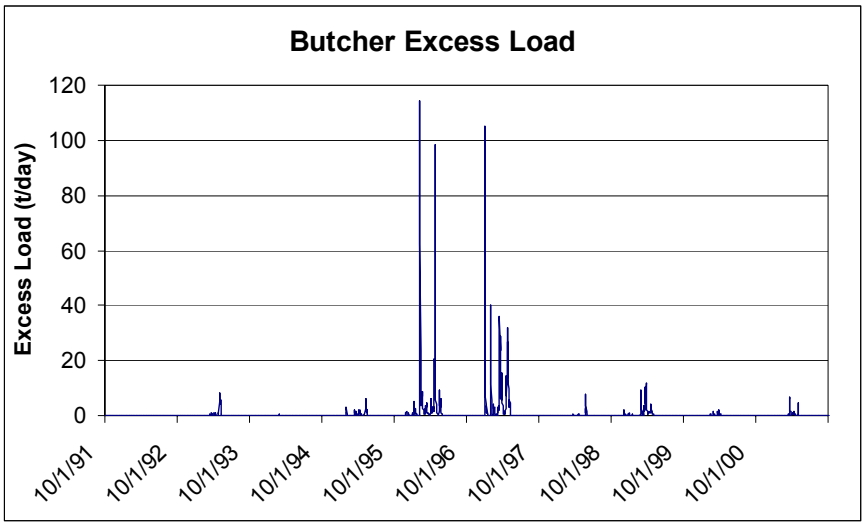


Figure M-5. Excess Sediment Loading for Threemile Creek for the Ten-Year Analysis Period and Two Critical Years in More Detail



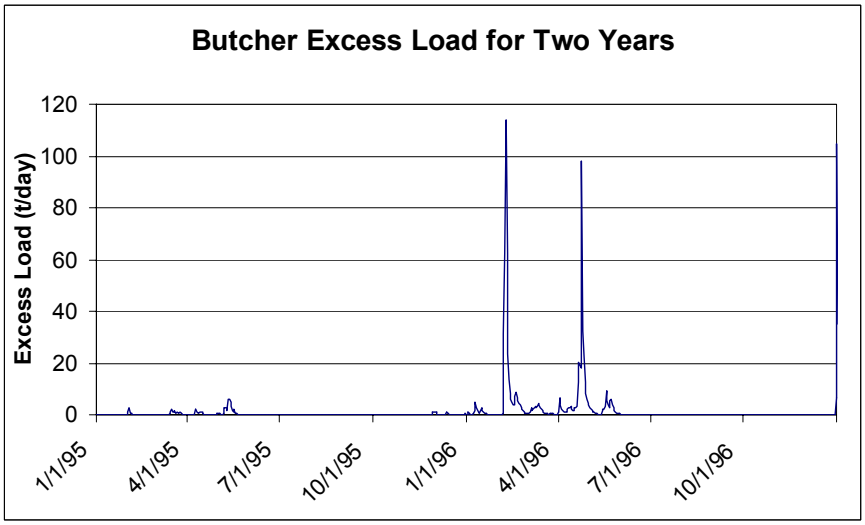
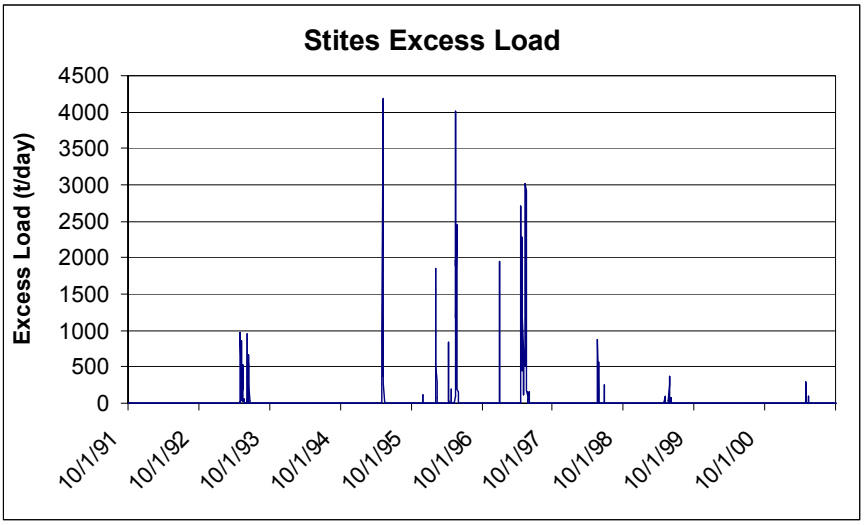


Figure M-6. Excess Sediment Loading for Butcher Creek for the Ten-Year Analysis Period and Two Critical Years in More Detail



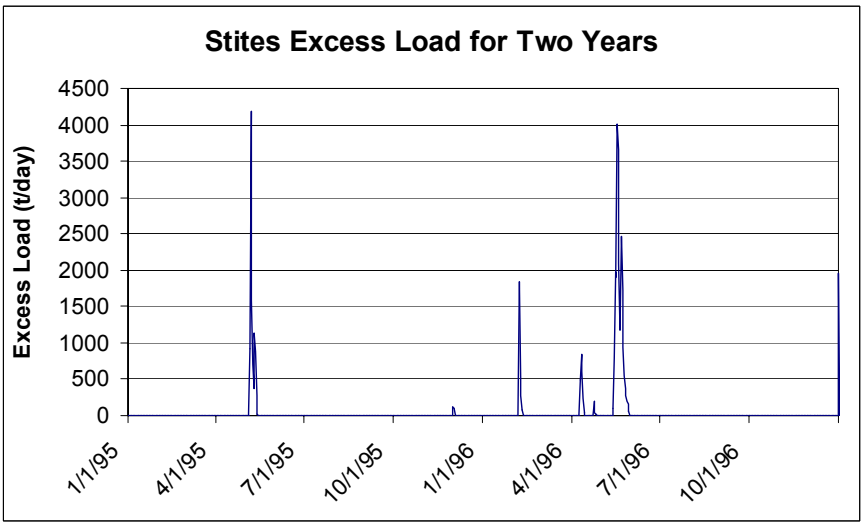


Figure M-7. Excess Sediment Loading at Stites for the Ten-Year Analysis Period and Two Critical Years in More Detail

References

IDAPA 58.01.02. Idaho water quality standards and wastewater treatment requirements.

Roehl, J.W. 1962. Sediment source areas, delivery ratios, and influencing morphological factors. Int'l. Assoc. Scientific Hydrology, Commission of Land Erosion, Publ. 59, pp 202-213.

Thomas, D.B. 1991. South Fork Clearwater River turbidity, Idaho County, Idaho, 1988. Water Quality Status Report no. 96. Idaho Dept. of Health and Welfare, Division of Environment, Boise, ID. 14 pp + app.

Appendix N. Reference Watersheds

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Appendix N. Reference Watersheds

One method chosen to assess the seriousness of sedimentation in the upper South Fork Clearwater River (SF CWR) Subbasin was to compare stream habitat data to that from watersheds that are generally recognized to be in good condition. With input from the Watershed Advisory Group, hydrologists, biologists, and other specialists, we selected Upper Meadow Creek and Bargamin Creeks as reference streams for the tributaries of the SF CWR. The Imnaha River from across the Snake River in Oregon and the lower, main stem reach of Meadow Creek were selected as a reference rivers to compare to the main stem SF CWR.

Reference Comparisons for the SF CWR Tributaries

The Nez Perce National Forest monitors conditions in the Meadow Creek and Bargamin Creek watersheds because they are relatively undisturbed. Reference and comparison locations are shown in Figure N-1. Figure N-1 also shows that Meadow and Bargamin Creeks have similar geology to the SF CWR Subbasin. Likewise, Meadow and Bargamin Creeks have similar rainfall and topography to the upper basin of the SF CWR Subbasin.

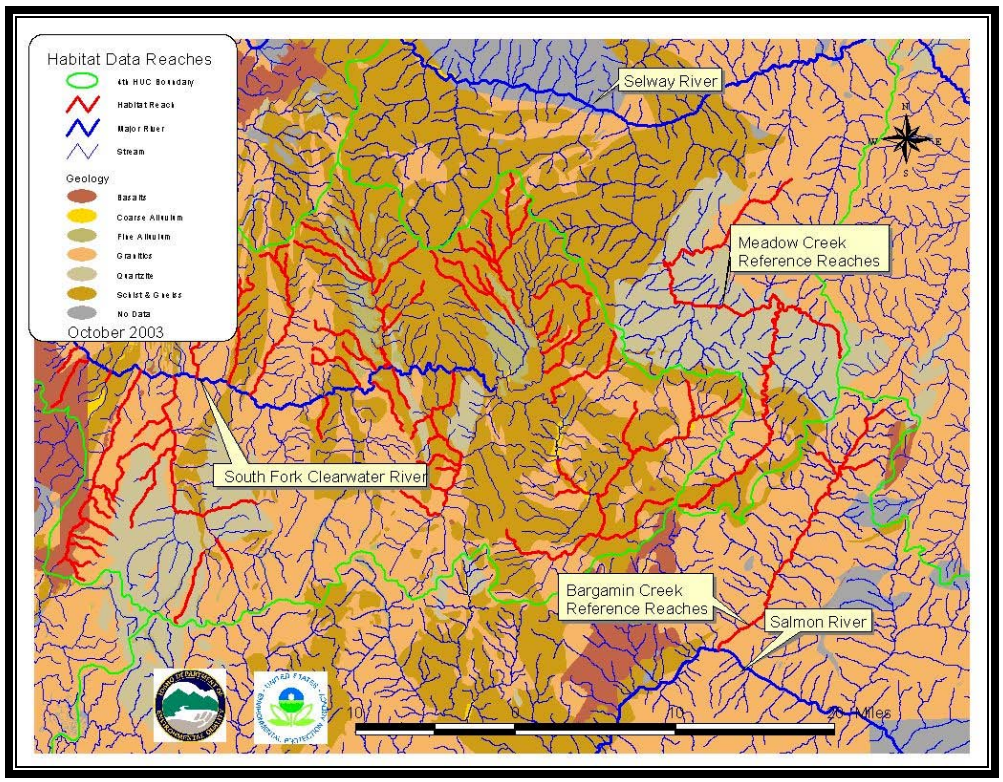

Figure N-1. Locations of Stream Habitat Reference Data for Upper Meadow Creek, Bargamin Creek, and Various Stream Reaches in the SF CWR Subbasin

We sorted the data by stream order into two categories, first and second order vs. third and fourth, so that we would be comparing data from similarly sized streams. We compared the stratified data from the Upper Meadow and Bargamin Creek watersheds against stratified stream data from the entire SF CWR Subbasin and against stratified data from the Newsome Creek watershed only. We selected the Newsome Creek watershed because it has several 303(d) listed segments and is relatively well sampled. The comparisons are shown in the following series of figures (Figures N-2 through N-6).

Plots of the data show good trends, but the variability of the data is such that statistical significance at one standard deviation cannot be shown. In almost all cases, cobble embeddedness (CE) in the SF CWR Subbasin is significantly higher than in Upper Meadow and Bargamin Creeks. Similarly, for the pool parameters measured, pool qualities in Meadow and Bargamin Creeks were better than in the SF CWR Subbasin. Only a few of the comparisons (average pool tailout depth for small streams from both Newsome Creek and the whole SF CWR against the reference streams and pool average maximum depth for large streams between Newsome Creek and the reference streams) showed statistical significance.

We conclude from these data that sedimentation in the SF CWR Subbasin is increased over the level in Upper Meadow and Bargamin Creeks watersheds. Cobble embeddedness is the one parameter where the differences approach statistical significance in every comparison.

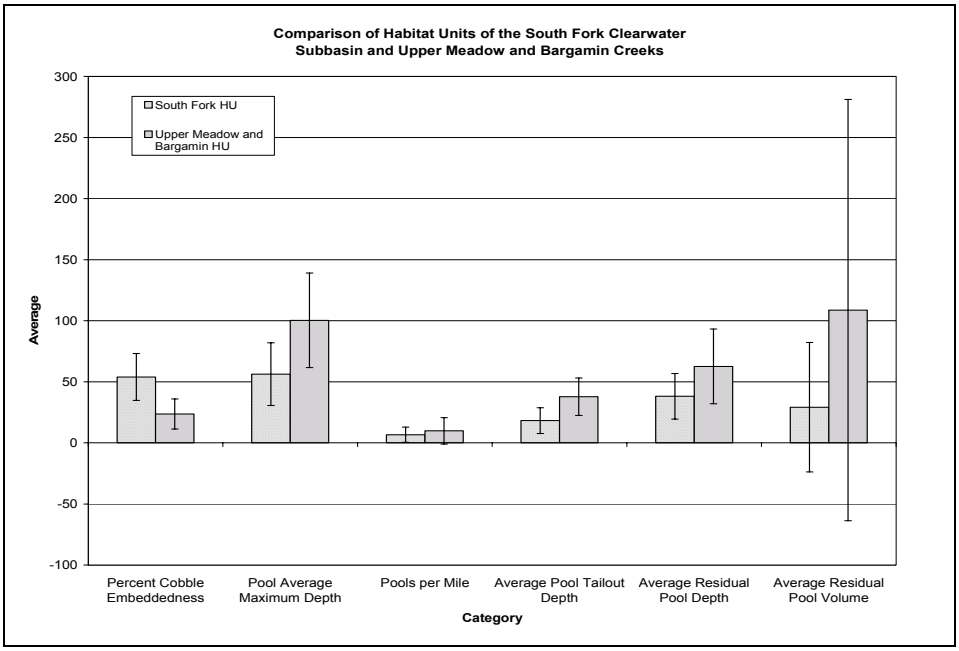

Figure N-2. Comparison of Stream Habitat Data from the SF CWR Subbasin to Similar Data from Upper Meadow and Bargamin Creeks

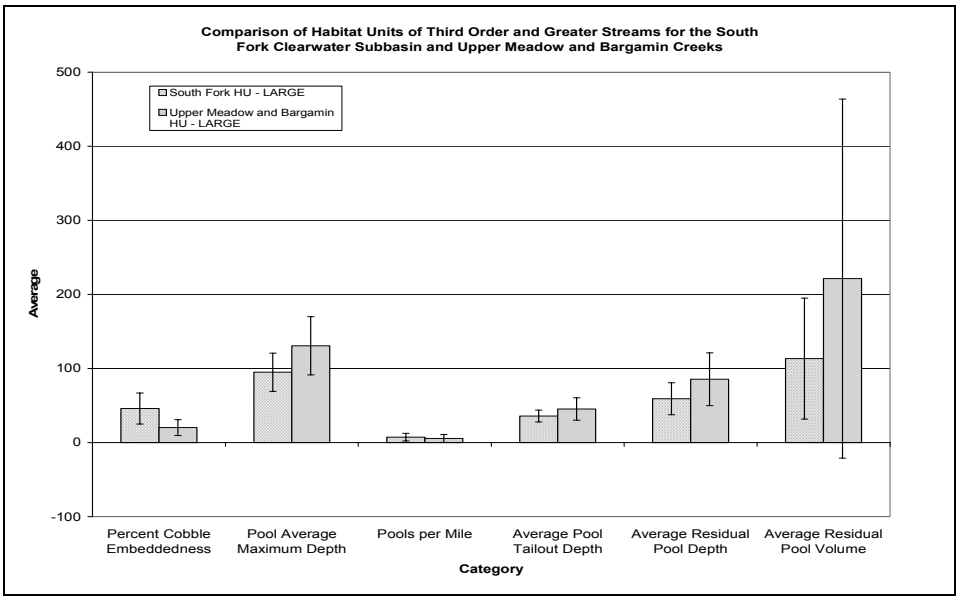

Figure N-3. Comparison of Third and Fourth Order Stream Habitat Data from the SF CWR Subbasin to Similar Data from Upper Meadow and Bargamin Creeks

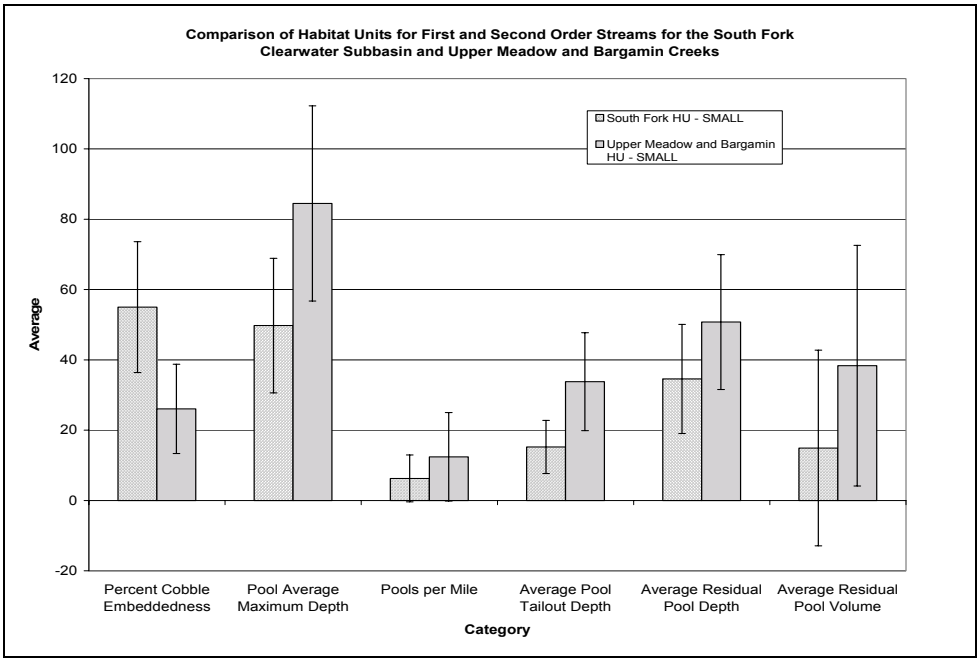

Figure N-4. Comparison of First and Second Order Stream Habitat Data from the SF CWR Subbasin to Similar Data from Upper Meadow and Bargamin Creeks

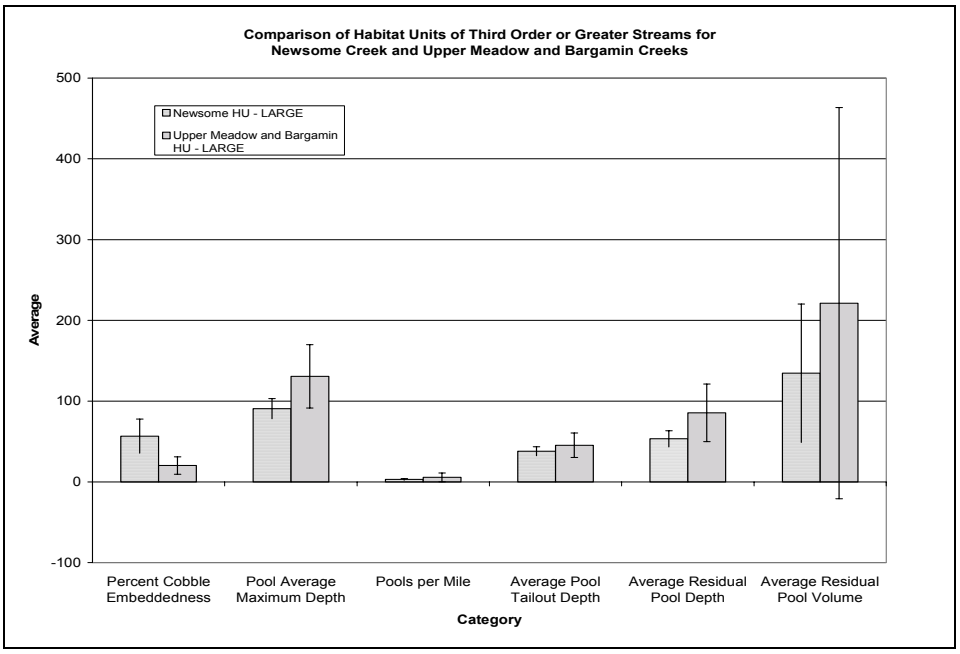

Figure N-5. Comparison of Third and Fourth Order Stream Habitat Data from Newsome Creek to Similar Data from Upper Meadow and Bargamin Creeks

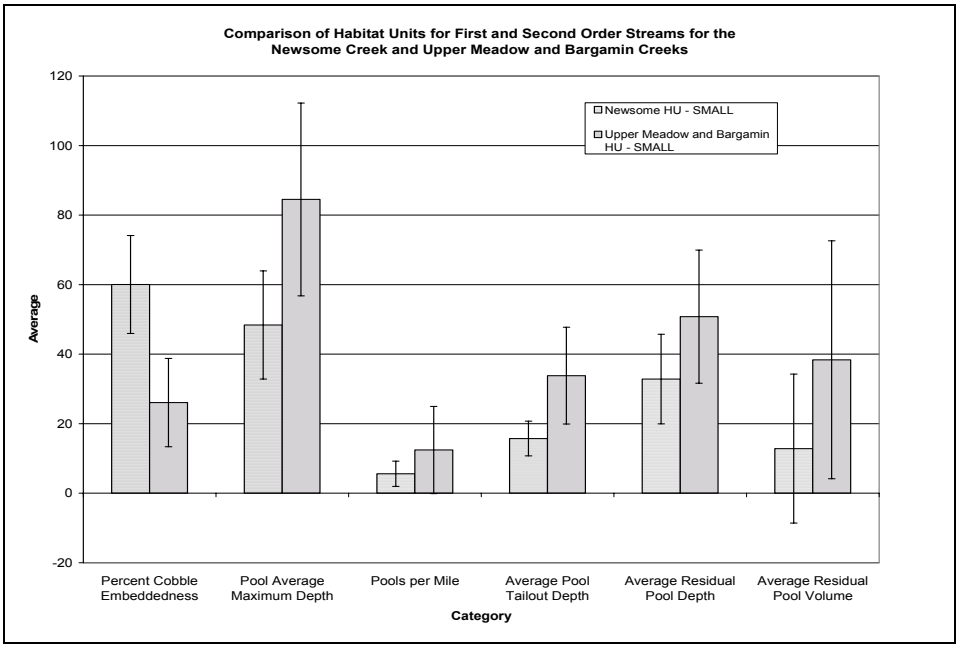

Figure N-6. Comparison of First and Second Order Stream Habitat Data from Newsome Creek to Similar Data from Upper Meadow and Bargamin Creeks

Table N-1 presents the data from which the above graphs were developed and includes the number of data points and the calculations of standard deviations.

Generally, our conclusions from these data are that bedload in the SF CWR upper basin is resulting in significant increases in CE throughout the area in addition to some reduction of pool volume and size.

Analysis of the data, however, shows that while CE is elevated in the SF CWR Subbasin in comparison to the reference watersheds, the condition is fairly widespread throughout the basin and not specific to the 303(d) listed water bodies, or even to water bodies that exhibit high levels of human impact. Table N-2 shows the data set distributed among water bodies, along with some other conditions of each water body. Shaded water bodies are those with low road densities; and therefore, little impact from human activities. Average CE in those water bodies ranges from 12% in the Gospel-Hump Wilderness up to 72% Silver Creek. Many of the water bodies exhibiting greater than 30% CE have been assessed using Beneficial Use Reconnaissance Program techniques and evaluated according to the Department of Environmental Quality's *Water Body Assessment Guidance* (Grafe et al. 2002), and show full support of their beneficial uses. The only 303(d) listed streams with CE data are Cougar Creek and Lower Newsome Creek. Lower Newsome Creek exhibits very good macroinvertebrate index scores (Chapter 2). Cougar Creek drains a highly weathered granitic watershed, which may account for high CE here.

From these data, therefore, we cannot conclude that the reference stream data indicate impairment of beneficial uses of the 303(d) listed streams. Rather, the reference stream data seem to indicate more of an upper basin-wide issue of elevated sediment levels. This is consistent with the conclusions of the Fisheries Technical Advisory Group (Appendix D).

Table N-1. Stream habitat data for Upper Meadow and Bargamin Creek watersheds and various streams in the SF CWR subbasin.

Habitat Units	Statistic	Count	Percent Cobble Embedded-ness	Pool Average Maximum Depth	Pools per Mile	Average Pool Tailout Depth	Average Residual Pool Depth	Average Residual Pool Volume
Upper Meadow and Bargamin - LARGE	Average	65	20.25	130.69	5.57	45.36	85.45	221.34
Upper Meadow and Bargamin - LARGE	Standard Deviation	65	10.74	39.20	5.45	15.23	35.67	242.18
Upper Meadow and Bargamin - SMALL	Average	85	26.06	84.51	12.43	33.81	50.76	38.36
Upper Meadow and Bargamin - SMALL	Standard Deviation	85	12.70	27.75	12.57	13.92	19.16	34.23
South Fork Clearwater - LARGE	Average	69	46.06	94.95	7.29	35.88	59.24	113.45
South Fork Clearwater - LARGE	Standard Deviation	69	20.90	25.75	5.11	7.92	21.51	81.64
South Fork Clearwater - SMALL	Average	661	55.01	49.77	6.29	15.25	34.56	14.94
South Fork Clearwater - SMALL	Standard Deviation	661	18.62	19.15	6.67	7.57	15.52	27.83
Newsome - LARGE	Average	3	56.67	90.67	3.00	38.00	53.33	134.59
Newsome - LARGE	Standard Deviation	3	21.13	12.50	1.00	5.57	10.02	85.80
Newsome - SMALL	Average	45	60.04	48.38	5.60	15.72	32.85	12.82
Newsome - SMALL	Standard Deviation	45	14.07	15.56	3.65	4.97	12.87	21.41

Table N-2. Cobble embeddedness data for the SF CWR.

Water Body Name	WBID*	CE** Count	CE Mean	CE Max	CE Min	CE*** STD	BURP****	Road Density	Sediment	Dredge Mined	303(d) Listed	
			%	%	%		(?)	(mi/mi^2)	(t/WB/yr)	(?)	(?)	Comments
Mill	13	82	45	95	10	20	No	3.0	145	No	No	
Lower Johns	14	45	48	84	13	20	Yes	1.9	23	No	No	Bull Trout Spawning
Middle Johns	17	8	38	62	14	19	No	0.6	0.64	No	No	Wilderness & Bull Trout Spawning
Upper Johns	18	3	29	29	29	0	No	0.7	0	No	No	Wilderness & Bull Trout Spawning
Moores	19	2	12	12	12	0	Yes	1.5	0.09	No	No	Wilderness & Bull Trout Spawning
Hagen	21	2	12	12	12	0	No	0.4	0	No	No	Wilderness
Lower Crooked	31	34	52	100	23	17	Yes	3.2	29	Yes	No	
Upper Crooked	32	50	58	95	0	22	Yes	2.0	20	Yes	No	Bull Trout Spawning
Middle Red	38	6	64	76	45	10	Yes	5.2	217	Yes	No	Includes Dawson Creek
Lower SF Red	40	5	43	48	29	8	Yes	4.2	18	No	No	Bull Trout Spawning
Middle SF Red	41	5	44	58	34	10	No	4.3	20	No	No	Bull Trout Spawning
Upper Red	45	51	54	94	29	16	Yes	3.8	116	No	No	
Otterson	48	14	40	61	14	13	Yes	0.8	0.23	No	No	BURP Reference
Red Horse	51	25	50	60	36	7	Yes	2.4	17	Yes	No	
Lower American	52	19	72	84	64	8	No	3.4	55	No	No	Side Channels Only
Kirks Fork	53	24	54	19	35	11	Yes	1.7	7	No	No	

Water Body Name	WBID*	CE** Count	CE Mean	CE Max	CE Min	CE*** STD	BURP****	Road Density	Sediment	Dredge Mined	303(d) Listed	
			%	%	%		(?)	(mi/mi^2)	(t/WB/yr)	(?)	(?)	Comments
Upper American	55	31	55	63	42	5	Yes	2.6	7.3	Yes	No	
Little Elk	57	2	86	86	86	0	Yes	3.4	49	Yes	No	Listed for Temperature
Big Elk	58	14	62	79	37	14	Yes	2.9	88	Yes (lower)	No	Listed for Temperature
Lower Newsome	62	3	57	81	43	21	Yes	4.8	49	Yes	Yes	
Nugget	64	1	48	48	48	0	Yes	4.6	6	Yes	No	
Baldy	70	11	56	94	34	16	Yes	4.7	9	Yes (lower)	No	Bull Trout Spawning
Pilot	71	15	64	82	45	13	Yes	1.1	4	Yes (lower)	No	Bull Trout Spawning
Leggett	75	25	59	86	39	13	Yes	4.4	18	Y	No	
Silver	77	11	72	91	44	16	Yes	1.5	15	No	No	Mostly Roadless
Peasley	78	21	77	91	63	9	Yes	4.7	44	No	No	
Cougar	79	9	94	97	92	4	Yes	4.3	50	No	Yes	Granitics
SF sidewall streams		19	42	85	22	15	No	NA	NA	Yes	Yes	
SF Totals		545	54	100	0	19						
Upper Meadow Reference		10	49	68	39	8						

Water Body Name	WBID*	CE** Count	CE Mean	CE Max	CE Min	CE*** STD	BURP****	Road Density	Sediment	Dredge Mined	303(d) Listed	
			%	%	%		(?)	(mi/mi^2)	(t/WB/yr)	(?)	(?)	Comments
Bargamin		18	43	73	19	14						

* Water body identification number
** cobble embeddedness
*** cobble embeddedness standard deviation
**** Beneficial Use Reconnaissance Program (has stream been surveyed by?)

Reference Comparisons of the Main Stem SF CWR

For the main stem SF CWR, we compared data from the Imnaha River across the border in Oregon and from lower Meadow Creek. It was assumed that the Imnaha River and lower Meadow Creek have similar flow volumes to the SF CWR, although Figure N-7 in conjunction with the pool volume data to follow indicate that the SF CWR probably is a somewhat larger river. Lower Meadow Creek is a steeper, more confined system (Figure N-8). The Imnaha River was chosen particularly as representative of a river system in the Columbia River basalt plateau. The following sets of figures (Figures N-7 through N-9) show the comparisons for different river habitat parameters.

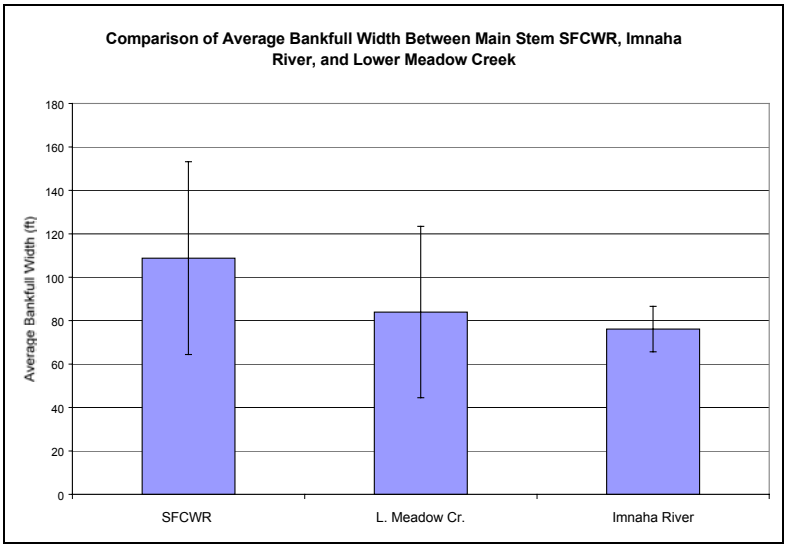

Figure N-7. Comparison of Average Bankfull Width of the SF CWR, Lower Meadow Creek, and the Imnaha River

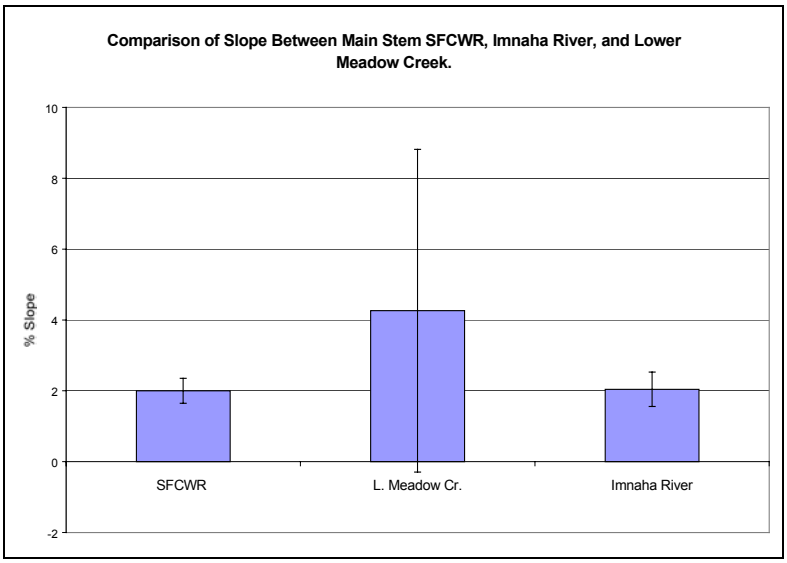

Figure N-8. Comparison of Average Slopes of the SF CWR, Lower Meadow Creek, and the Imnaha River

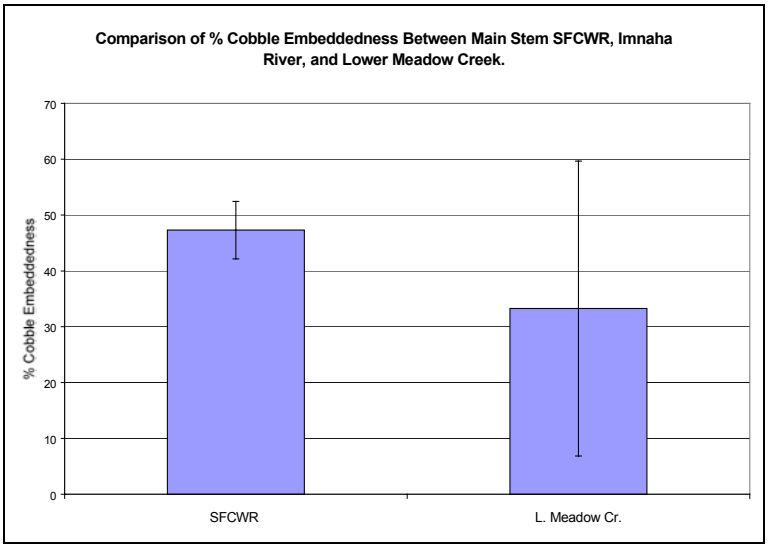

Figure N-9. Comparison of Cobble Embeddedness of the SF CWR and Lower Meadow Creek

Cobble embeddedness data were not available for the Imnaha River. The level of CE in the main stem SF CWR is elevated by comparison to lower Meadow Creek, but not by as much as for the smaller streams. There is also some question as to the validity of CE measurements in larger rivers.

The SF CWR has larger residual pool volume than either lower Meadow Creek or the Imnaha River (Figure N-10). Figures N-11 through N-15 show that the SF CWR also has

larger pool width, pool length, bank full depth, bank full width, and width-to-depth ratio than either the Imnaha River or lower Meadow Creek.

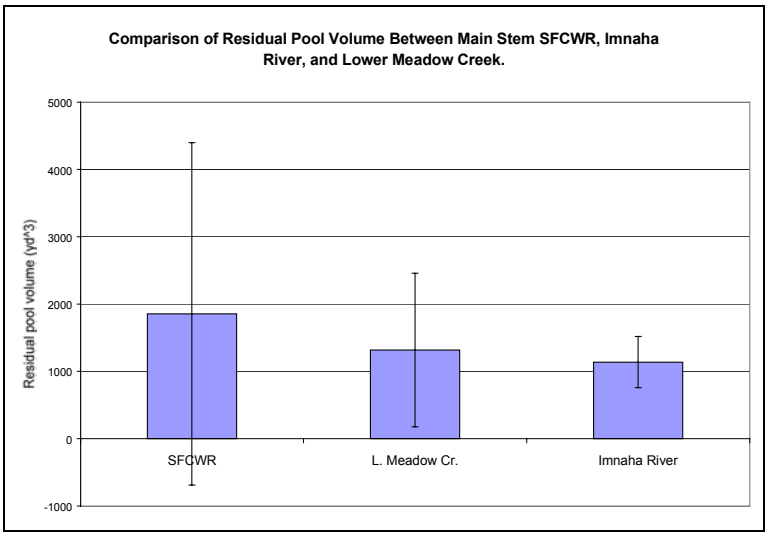

Figure N-10. Residual Pool Volume Comparisons of the SF CWR, Lower Meadow Creek, and the Imnaha River

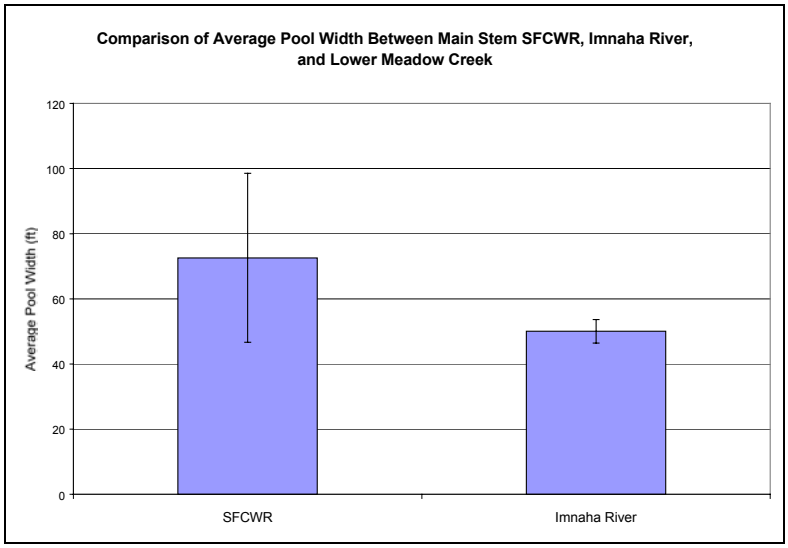

Figure N-11. Comparison of Pool Widths of the SF CWR and the Imnaha River

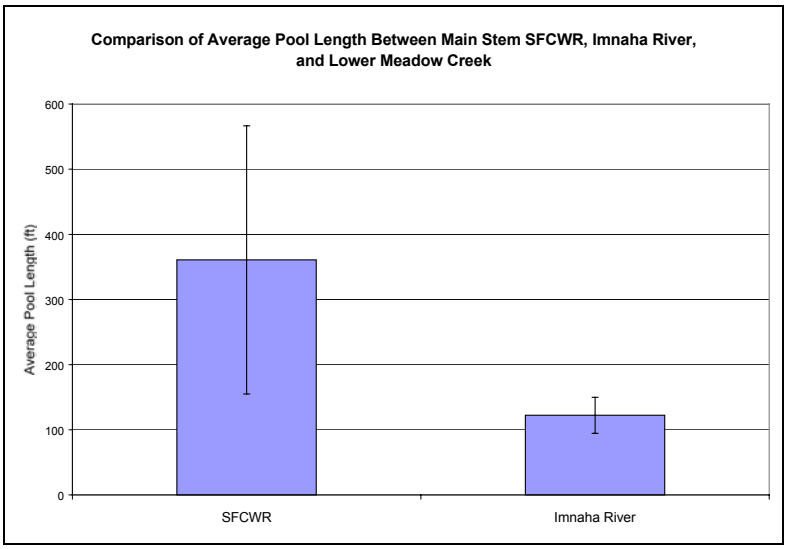

Figure N-12. Comparison of Pool Lengths of the SF CWR and the Imnaha River

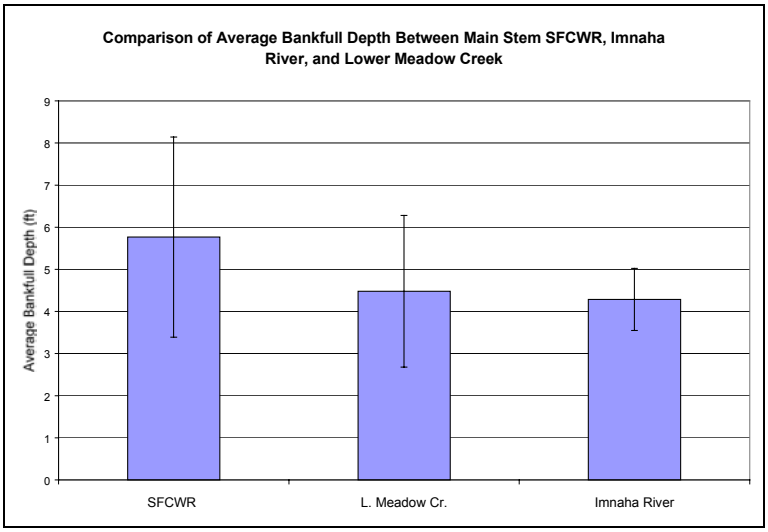

Figure N-13. Comparison of Bankfull Depths of the SF CWR, Lower Meadow Creek, and the Imnaha River

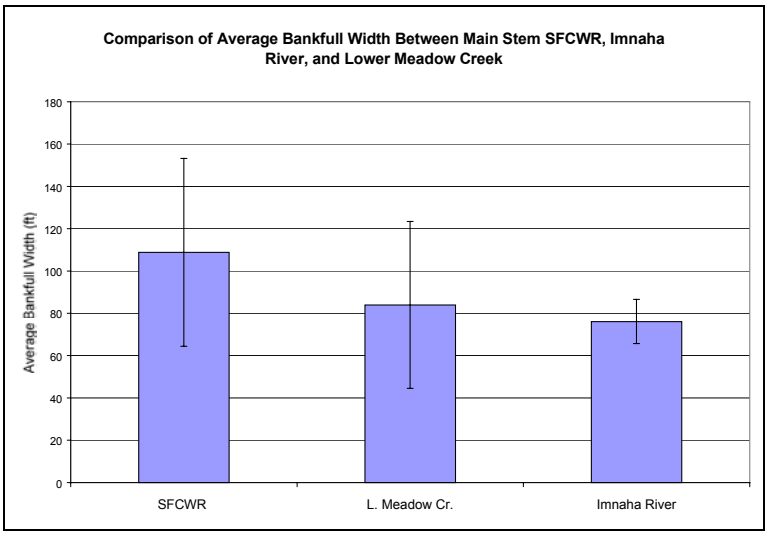

Figure N-14. Comparison of Bankfull Widths of the SF CWR, Lower Meadow Creek, and the Imnaha River

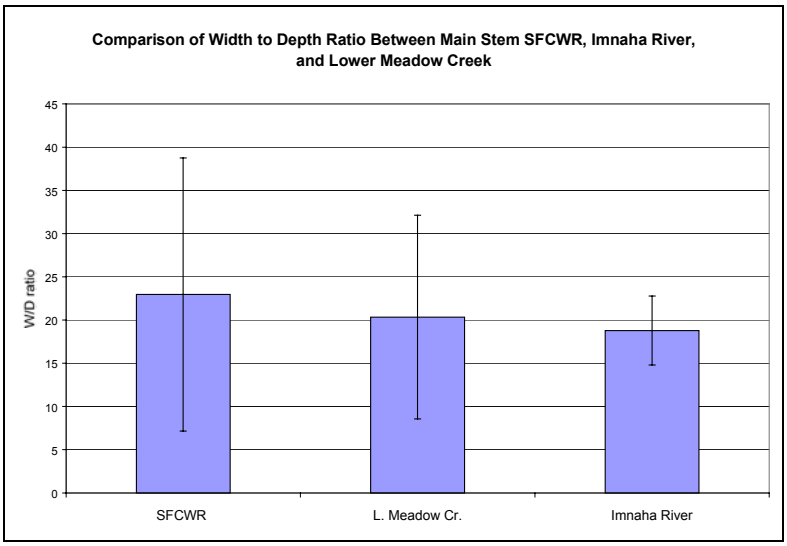

Figure N-15. Comparison of Width-to-Depth Ratios of the SF CWR, Lower Meadow Creek, and the Imnaha River

The SF CWR has the lowest number of pools per mile of any of the three systems (Figure N-16). Lower Meadow Creek, with a steeper, more confined channel, may not be a good comparison for pools per mile. The Imnaha River is more comparable in consideration of slope, and does have more pools per mile than the SF CWR, but the pools are smaller.

In general, given the variability of these data and the differences between the river systems, we cannot conclude that habitat in the main stem SF CWR is impaired in comparison to these other systems. It does appear that CE in the SF CWR is elevated in comparison to these reference river systems.

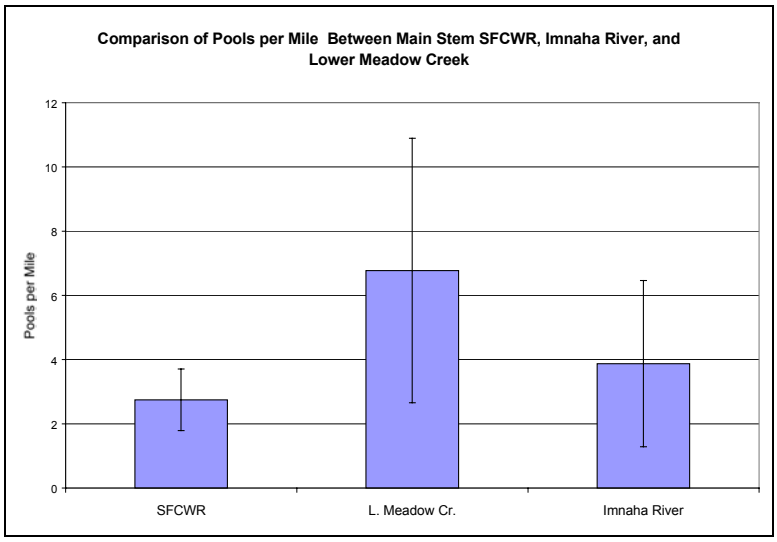

Figure N-16. Comparison of Number of Pools per Mile of the SF CWR, Lower Meadow Creek, and the Imnaha River

The above data indicate that the sizes of the rivers may be significantly different and this may be affecting the comparisons. We stratified the reaches by pool size and ran the comparisons again (Figure N-17). Some small part of the differences among the systems could be accounted for with this stratification, but the patterns remain the same.

In the end, however, we cannot conclude that the reference rivers indicate any significant impairment of habitat conditions in the main stem SF CWR.

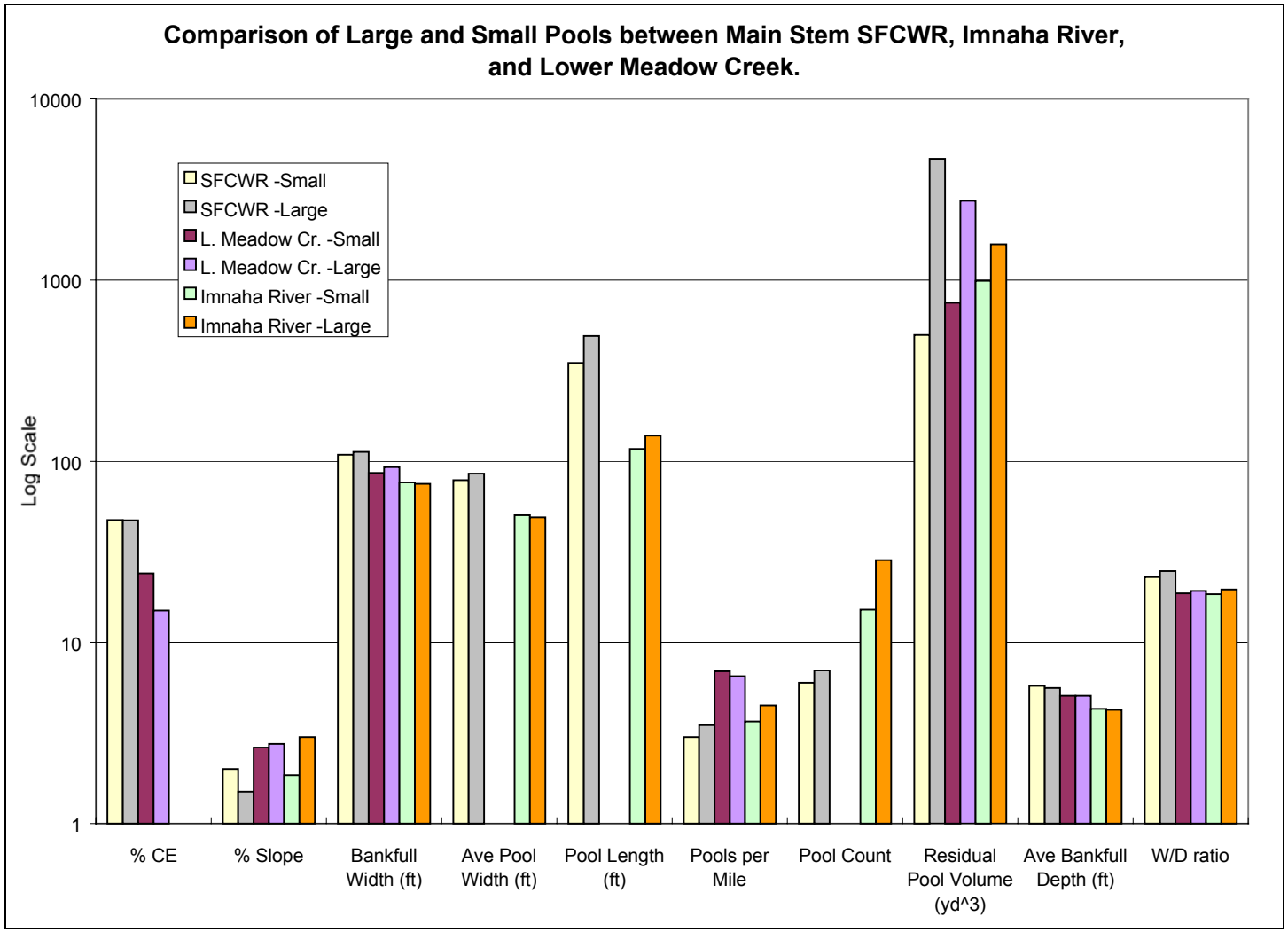

Figure N-17. Comparisons of the Main Stem SF CWR with the Imnaha River and Lower Meadow Creek

Appendix O. Wastewater Treatment Plant (WWTP) Effluent Temperature and Heat Loading Analysis

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Appendix O. Wastewater Treatment Plant (WWTP) Effluent Temperature and Heat Loading Analysis

Table O-1. Kooskia WWTP effluent temperature (^{o}C) which would increase receiving water temperatue by 0.3^{o}C when the receiving water meets the salmonid spawning temperature criteria.

SF CWR flow above WWTP outfall (cfs)	WWTP Effluent Discharge (cfs)				
	0.015	0.02	0.03	0.04	0.05
100	509.3	384.3	259.3	196.8	159.3
200	1009.3	759.3	509.3	384.3	309.3
300	1509.3	1134.3	759.3	571.8	459.3
400	2009.3	1509.3	1009.3	759.3	609.3
500	2509.3	1884.3	1259.3	946.8	759.3
600	3009.3	2259.3	1509.3	1134.3	909.3
700	3509.3	2634.3	1759.3	1321.8	1059.3

Incremental heat load (million BTU/day) added by effluent, based on effluent and receiving water temperature in table above.

SFCWR flow above WWTP outfall (cfs)	WWTP Effluent Discharge (cfs)				
	0.015	0.02	0.03	0.04	0.05
100	72.83	72.84	72.87	72.90	72.93
200	145.61	145.62	145.65	145.68	145.71
300	218.39	218.41	218.44	218.47	218.50
400	291.18	291.19	291.22	291.25	291.28
500	363.96	363.98	364.00	364.03	364.06
600	436.74	436.76	436.79	436.82	436.85
700	509.53	509.54	509.57	509.60	509.63

Table O-2. Kooskia WWTP heat loading if effluent temperature is capped at 26°C when the receiving water meets the salmonid spawning temperature criteria.

SF CWR flow above WWTP outfall (cfs)	WWTP Effluent Discharge (cfs)				
	0.015	0.02	0.03	0.04	0.05
100	26.0	26.0	26.0	26.0	26.0
200	26.0	26.0	26.0	26.0	26.0
300	26.0	26.0	26.0	26.0	26.0
400	26.0	26.0	26.0	26.0	26.0
500	26.0	26.0	26.0	26.0	26.0
600	26.0	26.0	26.0	26.0	26.0
700	26.0	26.0	26.0	26.0	26.0

Incremental heat load (million BTU/day) added by effluent, based on capping effluent temperature at 26 C, and receiving water temperature in table above.

SFCWR flow above WWTP outfall (cfs)	WWTP Effluent Discharge (cfs)				
	0.015	0.02	0.03	0.04	0.05
100	2.47	3.30	4.95	6.60	8.25
200	2.47	3.30	4.95	6.60	8.25
300	2.47	3.30	4.95	6.60	8.25
400	2.47	3.30	4.95	6.60	8.25
500	2.47	3.30	4.95	6.60	8.25
600	2.47	3.30	4.95	6.60	8.25
700	2.47	3.30	4.95	6.60	8.25

Table O-3. Stites WWTP effluent temperature (°C) which would increase receiving water temperature by 0.3°C when the receiving water meets the salmonid spawning temperature criteria.

SF CWR flow above WWTP outfall (cfs)	WWTP Effluent Discharge (cfs)							
	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08
100	759.3	384.3	259.3	196.8	159.3	134.3	116.4	103.1
200	1509.3	759.3	509.3	384.3	309.3	259.3	223.6	196.8
300	2259.3	1134.3	759.3	571.8	459.3	384.3	330.7	290.6
400	3009.3	1509.3	1009.3	759.3	609.3	509.3	437.9	384.3
500	3759.3	1884.3	1259.3	946.8	759.3	634.3	545.0	478.1
600	4509.3	2259.3	1509.3	1134.3	909.3	759.3	652.2	571.8
700	5259.3	2634.3	1759.3	1321.8	1059.3	884.3	759.3	665.6

Incremental heat load (million BTU/day) added by effluent, based on effluent and receiving water temperatue in table above.

SF CWR flow above WWTP outfall (cfs)	WWTP Effluent Discharge (cfs)							
	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08
100	72.81	72.84	72.87	72.90	72.93	72.96	72.99	73.02
200	145.60	145.62	145.65	145.68	145.71	145.74	145.77	145.80
300	218.38	218.41	218.44	218.47	218.50	218.52	218.55	218.58
400	291.16	291.19	291.22	291.25	291.28	291.31	291.34	291.37
500	363.95	363.98	364.00	364.03	364.06	364.09	364.12	364.15
600	436.73	436.76	436.79	436.82	436.85	436.87	436.90	436.93
700	509.51	509.54	509.57	509.60	509.63	509.66	509.69	509.72

Table O-4. Stites WWTP heat loading if effluent temperature is capped at 26°C when the receiving water meets the salmonid spawning temperature criteria.

SF CWR flow above WWTP outfall (cfs)	WWTP Effluent Discharge (cfs)							
	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08
100	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0
200	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0
300	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0
400	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0
500	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0
600	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0
700	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0

Incremental heat load (million BTU/day) added by effluent, based on capping effluent temperature at 26 C, and receiving water temperature in table above.

SF CWR flow above WWTP outfall (cfs)	WWTP Effluent Discharge (cfs)							
	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08
100	1.65	3.30	4.95	6.60	8.25	9.90	11.55	13.20
200	1.65	3.30	4.95	6.60	8.25	9.90	11.55	13.20
300	1.65	3.30	4.95	6.60	8.25	9.90	11.55	13.20
400	1.65	3.30	4.95	6.60	8.25	9.90	11.55	13.20
500	1.65	3.30	4.95	6.60	8.25	9.90	11.55	13.20
600	1.65	3.30	4.95	6.60	8.25	9.90	11.55	13.20
700	1.65	3.30	4.95	6.60	8.25	9.90	11.55	13.20

Table O-5. Grangeville WWTP effluent temperature (°C) which would increase receiving water temperature by 0.3°C when the receiving water meets the salmonid spawning temperature criteria.

Threemile Creek flow above WWTP outfall (cfs)	WWTP Effluent Discharge (cfs)				
	0.4	1	1.5	2	2.5
0.1	9.3	9.3	9.3	9.3	9.3
1	9.5	9.4	9.4	9.3	9.3
3	9.9	9.5	9.5	9.4	9.4
5	10.2	9.7	9.6	9.5	9.5
7	10.6	9.8	9.7	9.6	9.5
9	11.0	10.0	9.8	9.6	9.6
10	11.2	10.1	9.8	9.7	9.6

Incremental heat load (million BTU/day) added by effluent, based on effluent and receiving water temperature in table above.

Threemile Creek flow above WWTP outfall (cfs)	WWTP Effluent Discharge (cfs)				
	0.4	1	1.5	2	2.5
0.1	1.24	2.98	4.44	5.90	7.35
1	1.89	3.64	5.09	6.55	8.01
3	3.35	5.09	6.55	8.01	9.46
5	4.80	6.55	8.01	9.46	10.92
7	6.26	8.01	9.46	10.92	12.37
9	7.72	9.46	10.92	12.37	13.83
10	8.44	10.19	11.65	13.10	14.56

Table O-6. Elk City WWTP effluent temperature (°C) which would increase receiving water temperature by 0.3°C when the receiving water meets the federal bull trout temperature criteria.

Elk Creek flow above WWTP outfall (cfs)	WWTP Effluent Discharge (cfs)							
	0.01	0.02	0.03	0.04	0.05	0.1	0.15	0.2
3	31.8	20.6	16.8	14.9	13.8	11.6	10.8	10.4
5	46.8	28.1	21.8	18.7	16.8	13.1	11.8	11.2
10	84.3	46.8	34.3	28.1	24.3	16.8	14.3	13.1
15	121.8	65.6	46.8	37.4	31.8	20.6	16.8	14.9
20	159.3	84.3	59.3	46.8	39.3	24.3	19.3	16.8
25	196.8	103.1	71.8	56.2	46.8	28.1	21.8	18.7
30	234.3	121.8	84.3	65.6	54.3	31.8	24.3	20.6
35	271.8	140.6	96.8	74.9	61.8	35.6	26.8	22.4

Incremental heat load (million BTU/day) added by effluent, based on effluent and receiving water temperature in table above.

Elk Creek flow above WWTP outfall (cfs)	WWTP Effluent Discharge (cfs)							
	0.01	0.02	0.03	0.04	0.05	0.1	0.15	0.2
3	2.21	2.24	2.27	2.30	2.33	2.47	2.62	2.77
5	3.67	3.70	3.73	3.76	3.78	3.93	4.08	4.22
10	7.31	7.34	7.37	7.39	7.42	7.57	7.72	7.86
15	10.95	10.98	11.00	11.03	11.06	11.21	11.35	11.50
20	14.59	14.61	14.64	14.67	14.70	14.85	14.99	15.14
25	18.22	18.25	18.28	18.31	18.34	18.49	18.63	18.78
30	21.86	21.89	21.92	21.95	21.98	22.13	22.27	22.42
35	25.50	25.53	25.56	25.59	25.62	25.77	25.91	26.06

Table O-7. Elk City WWTP heat loading if effluent temperature is capped at 23°C when the receiving water meets the federal bull trout temperature criteria.

Elk Creek flow above WWTP outfall (cfs)	WWTP Effluent Discharge (cfs)							
	0.01	0.02	0.03	0.04	0.05	0.1	0.15	0.2
3	23.0	20.6	16.8	14.9	13.8	11.6	10.8	10.4
5	23.0	23.0	21.8	18.7	16.8	13.1	11.8	11.2
10	23.0	23.0	23.0	23.0	23.0	16.8	14.3	13.1
15	23.0	23.0	23.0	23.0	23.0	20.6	16.8	14.9
20	23.0	23.0	23.0	23.0	23.0	23.0	19.3	16.8
25	23.0	23.0	23.0	23.0	23.0	23.0	21.8	18.7
30	23.0	23.0	23.0	23.0	23.0	23.0	23.0	20.6
35	23.0	23.0	23.0	23.0	23.0	23.0	23.0	22.4

Incremental heat load (million BTU/day) added by effluent, based on capping effluent temperature at 23 C, and receiving water temperature in table above.

Elk Creek flow above WWTP outfall (cfs)	WWTP Effluent Discharge (cfs)							
	0.01	0.02	0.03	0.04	0.05	0.1	0.15	0.2
3	1.36	2.24	2.27	2.30	2.33	2.47	2.62	2.77
5	1.36	2.72	3.73	3.76	3.78	3.93	4.08	4.22
10	1.36	2.72	4.08	5.43	6.79	7.57	7.72	7.86
15	1.36	2.72	4.08	5.43	6.79	11.21	11.35	11.50
20	1.36	2.72	4.08	5.43	6.79	13.59	14.99	15.14
25	1.36	2.72	4.08	5.43	6.79	13.59	18.63	18.78
30	1.36	2.72	4.08	5.43	6.79	13.59	20.38	22.42
35	1.36	2.72	4.08	5.43	6.79	13.59	20.38	26.06

Table O-8. Red River Ranger Station effluent temperature (°C) which would increase receiving water temperature by 0.3°C when the receiving water meets the federal bull trout temperature criteria.

SF Red River flow above WWTP outfall (cfs)	WWTP Effluent Discharge (cfs)					
	0.002	0.004	0.006	0.008	0.01	0.02
5	196.8	103.1	71.8	56.2	46.8	28.1
10	384.3	196.8	134.3	103.1	84.3	46.8
20	759.3	384.3	259.3	196.8	159.3	84.3
30	1134.3	571.8	384.3	290.6	234.3	121.8
40	1509.3	759.3	509.3	384.3	309.3	159.3
50	1884.3	946.8	634.3	478.1	384.3	196.8
60	2259.3	1134.3	759.3	571.8	459.3	234.3

Incremental heat load (million BTU/day) added by effluent, based on effluent and receiving water temperature in table above.

SF Red River flow above WWTP outfall (cfs)	WWTP Effluent Discharge (cfs)					
	0.002	0.004	0.006	0.008	0.01	0.02
5	3.64	3.65	3.66	3.66	3.67	3.70
10	7.28	7.29	7.30	7.30	7.31	7.34
20	14.56	14.57	14.57	14.58	14.59	14.61
30	21.84	21.85	21.85	21.86	21.86	21.89
40	29.12	29.12	29.13	29.14	29.14	29.17
50	36.40	36.40	36.41	36.41	36.42	36.45
60	43.68	43.68	43.69	43.69	43.70	43.73

Table O-9. Red River Ranger Station WWTP heat loading if effluent temperature is capped at 23°C when the receiving water meets the federal bull trout temperature criteria.

SF Red River flow above WWTP outfall (cfs)	WWTP Effluent Discharge (cfs)					
	0.002	0.004	0.006	0.008	0.01	0.02
5	23.0	23.0	23.0	23.0	23.0	23.0
10	23.0	23.0	23.0	23.0	23.0	23.0
20	23.0	23.0	23.0	23.0	23.0	23.0
30	23.0	23.0	23.0	23.0	23.0	23.0
40	23.0	23.0	23.0	23.0	23.0	23.0
50	23.0	23.0	23.0	23.0	23.0	23.0
60	23.0	23.0	23.0	23.0	23.0	23.0

Incremental heat load (million BTU/day) added by effluent, based on effluent and receiving water temperature in table above.

SF Red River flow above WWTP outfall (cfs)	WWTP Effluent Discharge (cfs)					
	0.002	0.004	0.006	0.008	0.01	0.02
5	0.27	0.54	0.82	1.09	1.36	2.72
10	0.27	0.54	0.82	1.09	1.36	2.72
20	0.27	0.54	0.82	1.09	1.36	2.72
30	0.27	0.54	0.82	1.09	1.36	2.72
40	0.27	0.54	0.82	1.09	1.36	2.72
50	0.27	0.54	0.82	1.09	1.36	2.72
60	0.27	0.54	0.82	1.09	1.36	2.72

Appendix P. Lucas Lake, Beneficial Use Assessment and Reconnaissance Metals Monitoring

Water Quality Summary Report 33

Lucas Lake, Beneficial Use Assessment and Reconnaissance Metals Monitoring

August 2, 2002

Water Quality Summary Report 33

Lucas Lake, Beneficial Use Assessment and Reconnaissance Metals Monitoring Idaho County, Idaho

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August 2, 2002

Prepared by:
Robert Steed
Office of Technical Services
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Introduction

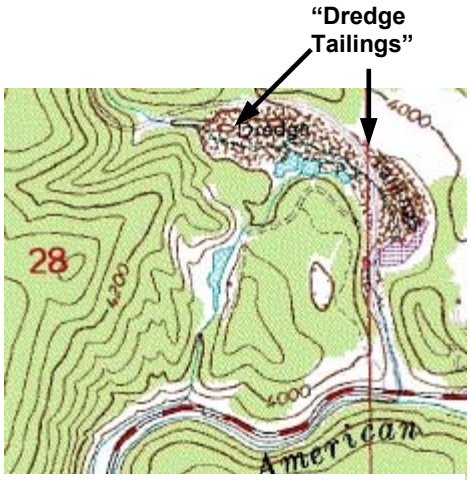

Figure 1. Lucas Lake and surrounding area

Lucas Lake, which is a small (less than one acre) locally-named waterbody, is in Idaho county, Idaho (45º 49' 17"N and 115º 28' 04" W). Lucas Lake outflow discharges into the American River between the town of Elk City and the South Fork Clearwater River. Lucas Lake's location is indicated on Figures 1 and 2.

Although it is not classified in Idaho's Water Quality Standards, Lucas Lake is currently listed on Idaho's 1998 §303(d) list[1] with sediment as its pollutant. Lucas Lake was originally put in Idaho's §303(d) program because of its 1988 305(b)[2] status, which was suggested by the Bureau of Land Management (BLM). The pollutants on the 1988 §305(b) report were identified only as "sediment and toxic substances." These §305(b) listings were the basis for listing Lucas Lake on Idaho's 1994 §303(d) list. Based on recent observations and anecdotal information, Lucas Lake's existing beneficial uses include Cold Water Aquatic Life and Primary Contact Recreation.

Figure 2. Location of Lucas Lake in Idaho

The only available previous assessment of Lucas Lake was performed by the BLM in 1981. This assessment, by Craig Johnson on August 21, 1981, is comprised of half a page of field notes and five captioned photographs. Craig states that the "Lake has suspended/sediment (colloidal?)."

Objectives

The Objectives of this study are to:

- Analyze appropriate metals and sediment samples, and collect water quality information to determine Lucas Lake's support status, and
- Determine if Lucas Lake should remain on Idaho's §303(d) list and have a TMDL developed.

[1] The 303(d) list is a federally required, public reviewed, list of waterbodies whose status is "not fully supporting" one or more beneficial uses.
[2] The 305(b) report is a report to congress listing waterbody beneficial use status and/or monitoring status, and may include causes and sources of pollution for impaired waterbodies.

Methods

Preliminary Site Visit

Daniel Stewart and Robert Steed visited Lucas Lake on November 13, 2001. Lucas Lake is a short walk south from neighboring dredge tailings. There is no surface water connection with these dredge tailings contrary to what is shown on the United States Geological Service (USGS) 1:24K map (see Figure 1). The outlet does function and discharges to the American River.

Lucas Lake is a sink or depression, whose genesis is unknown to the author. Daniel Stewart has hypothesized that it may be an old "glory hole" (a large open pit ore is extracted from). It is also possible that it is a natural erosional feature. Lucas Lake has steep underwater banks (steeper than 45º), and appears to maintain full pool conditions throughout the year. Lucas Lake is surrounded by a very small, steep, contributing watershed, which is conifer covered and made up of small grained (1-10mm) sedimentary outcrops and clay. (In Figure 3, the outcrops are light, almost-white areas, not quite as light and white as the lake surface.) Many raw outcroppings of this erosive sedimentary parent material are visible. Lucas Lake has healthy riparian vegetation that filters sediment around approximately 95% of its perimeter. With no non-natural sediment sources identified, it is anticipated that Lucas Lake sedimentation rates reflect natural conditions. There is a distinct blue-green color to the water, probably colloidal in nature, which may have been mistaken for toxic substances in past assessments. Abundant waterboatman (*Hemiptera Corixidae*) or backswimmer (*Hemiptera Notonectidae*) insects were observed, but past observations of fish were not verified. Lucas Lake has characteristics of both a lake and a wetland.

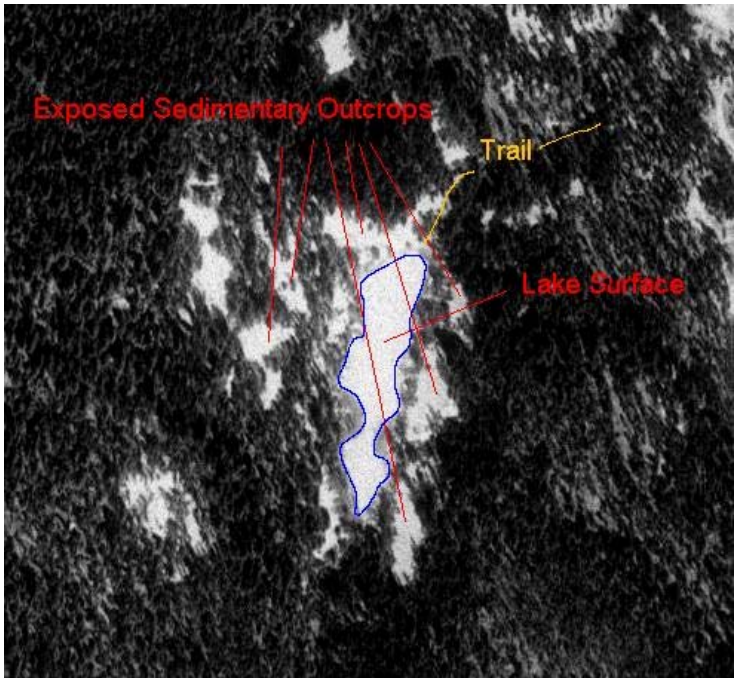

Figure 3. Aerial photo of Lucas Lake and watershed

Metals Monitoring Objectives

This investigation is to evaluate Lucas Lake for two existing uses: Cold Water Aquatic Life and Primary Contact Recreation. The bases for declaring these existing beneficial uses are direct observation (Cold Water Aquatic Life) and Anecdotal reference (Primary Contact Recreation).

To assess Cold Water Aquatic Life as an existing beneficial use, Lucas lake was monitored for toxic substances (metals), and compared to Aquatic Life Criteria for Toxic Substances

(Equivalent to 40 CFR 131.36(b)(1), Columns B1, B2 and D2[3]). Based on the neighboring lode and typical mining practices in the area, the following list of potential toxics was developed: cadmium, zinc, arsenic, mercury, copper, and iron. Iron is not identified in Aquatic Life Criteria for Toxic Substances and should be compared to a value of 5000µg/l as an asphyxiate (Bruce Schuld, personal communication).

For the other beneficial use, Primary Contact Recreation, Lucas Lake is to be monitored for pathogens, and compared to Idaho Water Quality Standards, *E. coli* Criteria.

Figure 4. Using auger to drill through ice

Monitoring

On December 18, 2001, at 11:48 am, Robert Steed and Daniel Stewart collected water quality samples from Lucas Lake. The lake was frozen over with a slight snow cover. A hole was drilled through approximately 6 inches of ice and snow, with a steel auger (see Figure 4.). Three 500-ml samples of Lucas Lake water were taken, using new, 3-foot long disposable bailers, at a depth of 0 to 2.5 feet below lake surface. Samples were collected and transported in decontaminated or new sterilized equipment. Samples were then chilled and transported to State of Idaho Bureau of Laboratories. These samples were submitted at 8:43 am the following day (December 19, 2001) for immediate analysis.

Description of Samples Collected During Initial Visit

Samples were taken and labeled as follows:

Sample container 1 was

- not filtered
- analyzed for hardness
- not preserved.

Sample container 2 was

- not filtered
- analyzed for total iron
- preserved with 3 ml nitric acid.

Sample container 3 was

- filtered with a 0.45 µm filter using syringes and disposable filter cartridges
- analyzed for dissolved: cadmium, zinc, arsenic, mercury, and copper; these analyses supplied at least 50 – 60 ml/analyte
- preserved with 3 ml nitric acid.

[3] Code of Federal Regulations, Title 40, Part 131, Section 6.

Field Parameters

The following field parameters were measured immediately after samples were taken (see Figure 5):

- Water Temperature – 3.6ºC
- pH – 7.46
- Dissolved Oxygen – 8.98 mg/l
- Conductivity – 31.6 µS/cm.

Figure 5. Measuring field parameters with a multi-meter

Sediment Monitoring During Follow-Up Visit

One June 12, 2002, Daniel Stewart performed a follow-up monitoring visit to Lucas Lake. During this visit he measured turbidity at 0.80 NTU,[4] and also collected a sample to be analyzed for Total Suspended Sediment (TSS). This sample was transported to University of Idaho's Analytical Sciences Laboratory (lab) for analysis. Both 0.80 NTU and 1 mg/l TSS (see lab results in Table 1) indicate low sediment.

Analysis Results

Analysis results from the initial visit were received from the lab on January 18, 2002, and are presented in Table 1. A copy of the lab bench sheet is included as Appendix A.

Table 1. Metals Water Quality Report Data

STORET[a]	Test Performed	Results	Completed
01000	Arsenic, Dissolved	6 (µg/l)	01/14/02
01025	Cadmium, Dissolved	< 1 (µg/l)	01/04/02
01040	Copper, Dissolved	< 10 (µg/l)	12/20/01
00900	Hardness (as $CaCO_3$)	6 (mg/l)	01/08/02
01046	Iron, Dissolved	90 (µg/l)	12/20/01
01045	Iron, Total	150 (µg/l)	12/21/01
71890	Mercury, Dissolved	< 0.5 (µg/l)	12/27/01
00530	Total Suspended Solids (TSS) (105 C)	1 (mg/l)	12/20/01
01090	Zinc, Dissolved	20 (µg/l)	12/20/01

a. Reference identification for test performed, from EPA Water Quality database

Analysis results from the follow-up visit were received from the lab on June 28, 2002, and are presented in Table 2. A copy of the Certificate of Analysis is included as Appendix B.

Table 2. Sediment Water Quality Report Data

Test No.	Test Performed	Results	MDL [a]
EPA 160.2	Non-Filterable Residue/TSS [b]	BDL [c]	4 mg/l

a. method detection limit
b. total suspended solids
c. below detection limit

[4] Nephelometric Turbidity Units

Discussion

Metals

Hardness-dependent metals criteria are calculated by formula. Originally, formulas were based on total recoverable metals values, but the Environmental Protection Agency later recommended metals criteria be based on the more bioavailable dissolved form, and developed conversion factors to estimate the dissolved fraction of the metals values. Idaho has subsequently adopted either the conversion factors values or the Code of Federal Regulations (CFR) formula values as acceptable criteria. The criteria in Table 3 were developed using an inhouse metals calculator spreadsheet. This spreadsheet calculates both the conversion factors and resulting criteria values for a given hardness value. The lowest hardness that is to be used in calculating metals criteria, according to CFR, is 25 mg/l. Lucas Lake's hardness was much lower, at 6 mg/l.

Table 3. Metals Calculator Input and Outputs.

Metal	Hardness	CMC[a] (µg/l)	CCC[b] (µg/l)
Arsenic (III)	25	360	190
Cadmium	25	0.8227	0.3369
Copper	25	4.6090	3.4719
Mercury	25	2.0400	0.0120
Zinc	25	35.3574	32.1519

a. Criterion Maximum Concentration, from 40 CFR 131.36(b)(1), Column B1
b. Criterion Continuous Concentration, from 40 CFR 131.36(b)(1), Column B2

Table 4. Lucas Lake Results Compared to Criteria.

Status	Test Performed	Results	CMC[a] (µg/l)	CCC[b] (µg/l)	HH[c](µg/l)
Pass	Arsenic, Dissolved	6 (µg/l)	360	190	50
BDL	Cadmium, Dissolved	<1 (µg/l)	0.82	0.34	-
Pass	Copper, Dissolved	<10 (µg/l)	4.61	3.47	-
Pass	Iron, Total	150 (µg/l)	5000 as asphyxiate		
BDL	Mercury, Dissolved	<0.5 (µg/l)	2.04	0.01	0.15
Pass	Zinc, Dissolved	20 (µg/l)	35.4	32.2	-

a. Criterion Maximum Concentration, from 40 CFR 131.36(b)(1), Column B1
b. Criterion Continuous Concentration, from 40 CFR 131.36(b)(1), Column B2
c. Human Health, from 40 CFR 131.36(b)(1), Column D2

The results indicate good water quality, with all but two of the analytes (cadmium and mercury) at concentrations less than calculated criteria. Concentrations of cadmium and mercury were below detection limits (BDL), which means the concentration is some value less than the detection limit of 1µg/l and 0.5 µg/l, respectively. In order to make more exact determinations of cadmium and mercury concentrations, further investigation (ultra-clean monitoring methods) and additional laboratory analysis (at significant cost) would be needed, which would be beyond the scope of this metals reconnaissance effort.

Sediment

Based on observation of the site, it appears that there are minimal anthropogenic sources of sediment, limited to recreation on the North shore near the trail. The underwater banks of Lucas Lake are steep, nearly matching above water banks, which demonstrates minimal sediment deposition, or recent genesis. Most banks are well vegetated with sedges and bushes, which also demonstrates bank stability and indicates that over-surface flow-filtering mechanisms are functional.

Field and laboratory results show minimal water column sediment. Idaho Water Standards criteria for turbidity for Cold Water Aquatic Life (IDAPA 58.01.02.250.02.d) states: "Turbidity, below any applicable mixing zone set by the Department, shall not exceed background turbidity by more than fifty (50) NTU instantaneously or more than twenty-five (25) NTU for more than ten (10) consecutive days." Turbidity measured on June 12, 2002 was 60 times less than the instantaneous criteria.

Total Suspended Solids (TSS) concentrations are below the 4 mg/l detection limit. It is unlikely that sediment is impairing beneficial uses.

Conclusions

- Water quality metals criteria have been not been exceeded as far as we know.
- From visual observation, sediment does not appear to be impairing existing beneficial uses.
- Lucas Lake should be removed from the §303(d) list, and should not be a candidate for TMDL development.
- The potential exists for cadmium and mercury concentrations in Lucas Lake to be above Water Quality criteria. However, given the low metals values (some BDL), and the morphology of the lake, and the BDL results, DEQ concludes that Lucas Lake does not have problems with toxic substances.

Appendix A. State Of Idaho Laboratory Water Quality Report

State of Idaho, Department of Health and Welfare
Bureau of Laboratories - Boise Laboratory
2220 Old Penitentiary Road, Boise, Idaho 83712
WATER QUALITY REPORT - CHEMICAL REPORT

LAB: BOISE, Phone: (208) 334-2235
Section Manager, Inorganic Chemistry: Barry Pharaoh

RECEIVED
JAN 18 2002
DEPT. OF ENVIRONMENTAL QUALITY
TECHNICAL SERVICES OFFICE

IDEQ-BSO
ROBERT STEED
1410 N. HILTON
BOISE, ID 83706

Tracking Number: 41201-0281/
(Please Refer to this Tracking Number on any communications)

Grant/Project: 8206
Watersheds
Survey Name:
Storet:
NPDES No.:
Sample Location: DEEP PART OF LAKE
Submitted by: ROBERT STEED
Purpose: Other
Taken From: Lake - L
Type of Sample: Grab
Composite: No
Preservation: HNO3, Cooled 4° C

Date Collected: 12/18/01 Date Received in Lab: 12/19/01
Time Collected: 11:00

STORET	TEST PERFORMED	RESULTS	COMPLETED	ANST
01000	Arsenic, Dissolved	6 (ug/l)	01/14/02	JS
01025	Cadmium, Dissolved	<1 (ug/l)	01/04/02	JS
01040	Copper, Dissolved	<10 (ug/l)	12/20/01	HH
00900	Hardness (as CaCO3)	6 (mg/l)	01/08/02	BO
01046	Iron, Dissolved	90 (ug/l)	12/20/01	HH
01045	Iron, Total	150 (ug/l)	12/21/01	HH
71890	Mercury, Dissolved	<0.5 (ug/l)	12/27/01	JS
00530	Total Suspended Solids (105 C)	1 (mg/l)	12/20/01	LB
01090	Zinc, Dissolved	20 (ug/l)	12/20/01	HH

Steve Rodebaugh
LAB # 1-17-02
ID00018

Page 1

Appendix B. University of Idaho Analytical Sciences Laboratory Certificate of Analysis.

University of Idaho
Holm Research Center
Moscow, Idaho 83844-2203
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CERTIFICATE OF ANALYSIS

Submitted by:
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UIASL Case #: WJUN02-14
Submitter Case #: Grangeville
Group: WATER
Date Received: 06/12/2002
Report Status: Final

Laboratory Comments:

1st Level QC: jp Date: 6-18-02

2nd Level QC: [signature] Date: 6-18-02

ANALYTICAL SCIENCES LABORATORY

WJUN02-14
Grangeville

CERTIFICATE OF ANALYSIS

RECEIVED
JUN 28 2002
DEPT. OF ENVIRONMENTAL QUALITY
TECHNICAL SERVICES OFFICE

Owner:

Project Name:

Submitter ID: Lucas Lake
UIASL #: W0201459
Samp. Type: Water - Surface

Test: EPA 160.2-Non-Filterable Residue/T.S.S.
Ref: 06/13/2002 03:33:49 PM

EPA 160.2	Results	MDL	Units
Non-Filterable Res.	BDL	4	mg/L

Samples will be discarded one month after date of final report, unless otherwise requested.
All samples classified as hazardous waste will be returned to the submitter after analysis.

Turbidity Ø.8Ø NTU'S

ND - None Detected QNS - Quantity Not Sufficient for Analysis NA - Not Applicable NQA - Non-quantifiable Area
EDL - Estimated Detection Limit MDL - Method Detection Limit BDL - Below Detection Limit

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Appendix Q. Unit Conversion Chart

Table Q-1. Metric – English unit conversions.

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

[1] 1 ft^3/sec = 0.65 million gallons per day; 1 million gallons per day is equal to 1.55 ft^3/sec.
[2] The ratio of 1 ppm = 1 mg/L is approximate and is only accurate for water

Appendix R. Public Comment Distribution List

South Fork Clearwater River Subbasin Assessment and TMDLs
Public Comment Version
Distribution List

Department of Environmental Quality, State Office
1410 N. Hilton, Boise, ID 83706

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

Department of Environmental Quality, Grangeville Office
300 W. Main Street, Grangeville, ID 93530

US Environmental Protection Agency, Region 10
1435 N. Orchard, Boise, ID 83706

Nez Perce Tribe
120 Bever Grade, Lapwai, ID 83540

Ken Gortsema, City of Grangeville
225 W. North Street, Grangeville, ID 83530

Grangeville Public Library
225 West North Street, Grangeville, ID 83530

Kooskia Public Library
P.O. Box 447, Kooskia, ID 83539

Idaho County Library
P.O. Box 419, Elk City, Idaho 83525

Kamiah Community Library
P.O. Box 846, Kamiah, ID 83536

Nick Gerhardt, Nez Perce National Forest
Rt. 2, Box 475, Grangeville, ID 83530

Craig Johnson, Bureau of Land Management
Rt. 3, Box 181, Cottonwood, ID 83522

Palouse Clearwater Environmental Institute
P.O. Box 8596, Moscow, ID 83843

University of Idaho Library, Government Documents
University of Idaho, Moscow, ID 83843

Lewis & Clark State College Library
500 8th Ave., Lewiston, ID 83501

Eileen Rowan, Soil Conservation Commission
2200 Michigan Avenue, Orofino, ID 83544

Todd Bates, Idaho Department of Lands
P.O. Box 190, Kamiah, ID 83536

Susan Burch, U.S. Fish & Wildlife Service
1387 S. Vinnell Way, Room 368, Boise, ID 83709

Dale Brege, NOAA Fisheries
102 North College, Grangeville, ID 83530

Clearwater Basin Advisory Group Members

South Fork Clearwater River Watershed Advisory Group Members

Appendix S. Responses to Public Comments

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Appendix S. Responses to Public Comments

A draft of the *South Fork Clearwater River Subbasin Assessment and TMDLs* was available for public comment from June 1, 2003 through July 15, 2003. The draft was distributed for comment to those individuals and entities listed in Appendix R. In addition, the draft was available for review and comment on the DEQ, USEPA and NPT web sites.

Comments received are identified by number of the comment letter as assigned below:

No. 1 – Letter from Dick Wilhite, chair of the SF Clearwater WAG:
"The South Fork Clearwater WAG submits the following public comments on the South Fork Clearwater Sub-basin Assessment and the draft TMDL. These comments were either expressed at the July 1, 2003 WAG meeting or have been submitted by WAG representatives. A list of those in attendance is attached at the end of this letter."

No. 2 – Letter from Phil Jahn, WAG member representing federal land managers:
"This is my response to the South Fork Clearwater River Watershed Advisory Group letter to the Clearwater Basin Advisory Group. The version of the letter we had for review was current as of July 8, 2003. The letter seems to include the individual views of several WAG members and I was unable to provide my comments in time for the July 10 BAG meeting. This represents my input as the WAG representative for the federal land management agencies."

No. 3 – Letter from Kevin Gardes on behalf of the City of Grangeville:
"I am writing to comment on the Draft SF Clearwater River Subbasin Assessment and TMDLs. My comments are on behalf of the City of Grangeville."

No. 4 – Letter from Jane Kissinger, Grangeville City Councilwoman:
"I write this letter to you from the perspective of a citizen in a small community and as a member of the Grangeville City Council. I have served on the Council for 14 years. In that period of time, I have witnessed the closure of the last of our five sawmills, the closure of the Camas Prairie Railroad and the severe deterioration of our economy."

No. 5 – Letter from Jonathan Oppenheimer on behalf of Idaho Conservation League:
"Thank you for allowing us to comment on the water quality assessment and Total Maximum Daily Loads standards (TMDLs) in the South Fork Clearwater River (SF CWR) Subbasin Assessment and TMDLs. The Idaho Conservation League has a long history of involvement with resource management issues. As Idaho's largest state-based conservation organization we represent over 3,000 members, many of whom have a deep personal interest in protecting our water, wildlands, and wildlife from the harmful effects of pollution and watershed degradation."

No. 6 – Email from Bonnie Schonefeld, WAG member representing environmentalists:
"I would like to respond to the public comment draft of the TMDL, and to the letter written to the Clearwater Basin Advisory Group (BAG) by the South Fork Clearwater Watershed Advisory Group (WAG). I was unable to attend the meeting at which that letter was drafted, but would like to add my comments as the environmental representative of the WAG."

No. 7 – Email from Borg Hendrickson, WAG member representing recreation:
"The SF Clearwater WAG's July of '03 letter to the BAG was written without my input, as I was unable to attend the meeting at which it was composed. I would not have concurred and do not concur with some of its contents."

No. 8 – Email from Linwood Laughy, WAG member representing outfitters/guides:
"As a member of the South Fork Clearwater Watershed Advisory Group, I wish to make some remarks regarding the SF TMDL Public Draft."

Comments have been grouped by topic. Comments were copied into the topical area from the letters received. They were copied for the most part on a whole paragraph by whole paragraph basis. Where a part of a paragraph has been extracted to a separate topical area, it is set off by (…) notation.

Process -- General

No. 1
What is the advantage of doing the TMDLs under the MOU? The state should be capable of doing the TMDLs themselves. The state is better able to dialog with the local residents. Local residents would prefer to work with DEQ. The NPT only has jurisdiction within the reservation boundary over a very few miles at the lower end of the SF Clearwater watershed, yet has exerted an inordinate influence over this TMDL. The TMDL itself is probably far more complicated and less likely to be implemented than if DEQ had done it alone.

(***Response:*** This TMDL is written under an MOA with the NPT, USEPA and DEQ because portions of the SF CWR Subbasin are contained within the Nez Perce Tribe Reservation boundary, and the Tribe has ceded territory treaty rights in other areas of the watershed. An agreement was reached whereby the TMDLs would be written cooperatively by the three agencies using the state's processes and water quality standards in order to set aside jurisdictional differences, focus on restoring water quality, and promote support and cooperation among citizens, businesses, and governments.)

One of my main concerns is that if any question of detriment water quality exists, even if it is totally off the wall, the EPA and NPT say it *must* be fixed. There is data within the tables of this draft that is inaccurate. How much data that we are not familiar with is incorrect? We need more than one or two years of data to help set the TMDLs.

Two sets of the TMDLs in this document are being written without clear evidence of impairment to beneficial uses. This reflects the tribal and federal mind set that if any question exists about water quality, then the TMDL must be written, as opposed to a local perspective that TMDLs should not be written unless there is clear evidence of impairment. No matter what people say, TMDLs will result in some level of restriction to private and industrial use of the land, which is not warranted without clear evidence. Especially in an economically depressed area like Idaho County, governmental restrictions simply so bureaucrats can justify their jobs is out of order.

TMDLs need to be set at realistic and attainable levels, so that they can be met without harming the local economy but also help with the water quality. They need to be set so they are easily attainable and then after they have been met and water quality still needs improvement, then reset and try to attain them again, with the least amount of impact to all.

Response: *The three parties preparing this subbasin assessment and TMDLs are well aware of the general process issues raised above. We are legally obligated to write the documents in a particular time frame. In the case of the South Fork Clearwater River Subbasin Assessment and TMDLs, we asked for and received a rare extension of time to complete the process. We have collected far more data, and completed far more analyses than time or resources allow for most TMDLs in the state of Idaho. The courts have made it clear that lack of data is not an excuse for not completing TMDLs. TMDLS must be written with the available data, under the assumption that if and when more data become available, they can be modified. Existing data are used to determine whether impairments exist, using the state water quality standards as the measure.*

Some interpretation of narrative water quality standards is necessary, and it is clear from the comments that some of the TMDLs are not supported by all the WAG members. However, the TMDLs were based on the best available data and followed the state of Idaho's process for meeting CWA requirements. We are aware of the specifics of the concerns expressed above, have examined them carefully, and conclude that the decisions to write the TMDLs in question are reasonable and justified.

Process -- Public Participation

No. 1
Generally speaking, the South Fork Clearwater WAG does not support this TMDL. Generally speaking, this is a dismal failure in the bureaucratic process of using local input on a mandated project to address the water quality of Idaho. As a group, we want to have quality and quantity water. We do not want to see water quality and quantity come before the livelihood of our county.

I have been a member of the South Fork Water Advisory Group (WAG) for nearly two years, attending one meeting each month. I have listened to agency people informing us on temperature, sediment, nutrients, etc. I understood that the group was to make recommendations and have a say in the final decision. Although we as a group have made decisions on several important issues, the agency people have not acted upon those proposals. In fact, when the temperature was found unreasonable to attain, it was lowered another 5 degrees instead of being raised. Even though we have been told that this will be changed when the final document is written, it still appears in the draft. I, again, state that these temperatures are unreasonable and can never be reached.

The WAG has largely bought off, or been worn down, on the need for temperature TMDLs basin-wide even though the Draft TMDL data, both WBAG 1996 and WBAG 2000, show

that all listed water bodies except Three Mile and Butcher Ck. are fully supporting their beneficial uses. The WAG agrees with the need for sediment TMDLs for the lower part of the basin. It is the opinion of the WAG that addressing these areas will likely return all streams in the basin to the full beneficial use support status. Let's deal with the major problems first, the ones people can agree on, and see where we are after that. For plans that are supposedly going to be voluntary in their implementation, it does no good to include issues that are not agreed upon by those who will have to do the implementation.

No. 5
A key element to the success of this proposal is public cooperation and participation. We feel that the success of this TMDL assessment and subsequent implementation would be improved by increased public participation. This concept was given little priority in the draft assessment. The role of the Watershed Advisory Group (WAG) was not clearly defined in the assessment or TMDL. Aside from the WAG, formulating a strategy that involves the greater public would improve the efficacy of the TMDLs through establishing a basis of education, trust, and collaboration.

No. 7
I would have welcomed more active participation by Nez Perce Tribe representatives. According to the Nez Perces' 1855 treaty with the United States, all of the SF Clearwater watershed falls within reservation boundaries. This fact, combined with the fact of the Nez Perces' cultural longevity in the area and the development of their fisheries program in recent years, make Nez Perce involvement in the WAG process pertinent and valuable.

I would like here to add some general comments regarding the WAG process. I think almost everyone WAG members and agency personnel would agree that in some ways, the SF Clearwater WAG process has been, as the WAG letter states, a "dismal failure" in that it became a painful saga of tremendous contention and, at times, even of chaos. I'd like to suggest what I feel would be a better process for future WAGs: I suggest that initial WAG formation and ongoing WAG meetings be conducted by a neutral facilitator who has a strong character and training in group dynamics and methods of mediation. No meetings conducted primarily by agency folks; no WAG member chair; no dominating tactics by vocal WAG members; no side-winding surprises by agency representatives vying for supremacy. But a skilled neutral facilitator. Please.

No. 8
First, I unfortunately find myself in agreement with that portion of the letter from the SF WAG of July 7, and probably only that portion, that referred to the process as a "dismal failure." However, my reasoning is much different than expressed in that letter. I had assumed that the WAG process would present community members with the opportunity for meaningful dialogue regarding the future of the SFCR and with the opportunity to search for creative solutions to problems facing the river, always with the possibility of reaching some consensus in this regard. In these respects, the WAG was indeed a dismal failure.

The draft I have seen of the letter apparently crafted at the July 1, 2003 WAG meeting, which I was unable to attend, does not represent my perspective at all. As stated in that letter, the unchanging position of several WAG members can be summarized as follows:

1. Water quality and quantity are of secondary concern after the economic well-being of the region.
2. The WAG does not want to see any added restrictions on the free use of any part of the entire SF drainage, particularly if such restrictions might cause problems with position #1 above.
3. State and federal water quality standards are too high, can't be met, and therefore are not worthy of pursuit, particularly of course if such pursuit would bump up against position #1 above.

In other words, the basic position of the WAG as stated in the July 7 letter addressing the SF TMDL was not much different than that of the miners who dredged the drainage in the early 1900s.

These three general beliefs were blended with frequently confusing models, sometimes limited data sets, interagency disagreements, masses of confusing information, and behind-the-scenes maneuvering. The failure in the process was not only dismal, it was depressing. And just in case you missed this point: I do not agree with positions 1, 2 and 3 above!

I would finally like to express my appreciation to the many agency folks who tried to accomplish their task of meeting the requirements of state and federal law under what was clearly a difficult situation. While the process was flawed and they didn't always do a commendable job, the challenge was immense and I found them to be sincere in their efforts.

Response: *The watershed advisory group (WAG) was established to solicit input from the wide range of local interests in the South Fork Clearwater River Subbasin. It is unfortunate, but not surprising given the wide range of views represented, that many of those interests are not fully satisfied with the results of the subbasin assessment and TMDLs. We have taken the global mandates of the federal Clean Water Act, coupled them with sometimes ambiguous state water quality standards, considered the WAG's input, and have crafted a plan to restore water quality in South Fork Clearwater River Subbasin. The plan may be imperfect, but we do think it is a reasonable synthesis of all available data and opinions, and a good compromise among the federal, state, local and tribal viewpoints that will meet state WQS. We will recommend to management that a neutral facilitator be considered for future WAGs involving the 3 parties and diverse local interests.*

Process – Economic Analysis

No. 1
Several members of the WAG have asked for economic analyses of the impacts that the TMDLs will have, especially for the changes that will be required of the WWTP. There is a real issue here that should be addressed. Regulations such as those being emplaced by this

TMDL are an economic cost to our community. There is a real fear that our communities are dying economically. Especially if Endangered Species considerations are going to drive decisions within the TMDL, then economic analyses should be required. But even within the CWA process itself, much more attention needs to be given to the economic impacts.

Economic impacts on the public, business and industry should be considered in writing the TMDLs. Without an economy water quality doesn't matter.

No. 4
Grangeville has always been a progressive city and the Council wants to see our city do its part in preserving our environment and protecting our streams. However, it is unfortunate that many of the government environmental regulations placed upon small communities carry a huge price tag and thus place a great financial strain on tight budgets.

No. 7
While the WAG letter states that "As a group, we do not want to see water quality and quantity come before the livelihood of our county," the letter is expressing the opinion only of a majority of our 16-person group. I do not accept "poor economic conditions" as an excuse for pollution. Indeed, I feel that economic "poorness" may be ameliorated by the "richness" of one's environmental surroundings. In other words, I do not agree that Idaho County residents have, under any economic circumstances, the right to pollute, or damage in any other way, the SF Clearwater watershed. Nor do I believe they have the right to ignore needed improvements.

However, if we wish to talk of economics, I'd like to remind the reader that according to an economic survey done in 2000 for the Kooskia Chamber of Commerce, the Idaho Department of Commerce economic figures for recent years show that, second only to timber, tourism is a powerful engine in central Idaho's economy. Removing federal dollars from the picture, agriculture sits third in the list of mainstays in the area's economy. Tourism flourishes here primarily because of the quality and beauty of our natural environment. In light of the already existing lucrativeness of tourism in our area, the exceptional potential for growth in tourism, and the already heavy use of the South Fork by local recreationists, I find it extremely narrow-sighted for some WAG members to have stated at meetings that asking even one cattleman to go to the expense of putting up a fence to limit his cows' access to the stream is asking too much. The spirit of this statement apparent in the WAG letter is inappropriate.

According to recently published figures, Kooskia alone reaped $3 million in economic benefit from one (2001) salmon-steelhead fishing season. If we wish to put economics first, these figures point directly to the importance of maintaining high water quality in order to support fish survival. We have, according to a fisheries study presented to the WAG, seven sensitive, threatened and endangered fish living part of their life cycles in the SF Clearwater watershed, the one watershed in Idaho pointed to as the habitat with the greatest potential for supporting species recoveries. I favor any restrictions on any sector of the SF Clearwater drainage that does support that survival and any TMDL targets that do support that survival.

I find no standards or targets in the TMDL, excepting where they may be more stringent, that will negatively and/or drastically impact the socio-economic situation in Idaho County. Nor do I feel that we need to conduct an economic impact study. We know what we need to know: streams in the watershed are impaired and it's up to us to improve them. An economic impact study would be irrelevant to the focal issues: impairment/improvement.

No. 8
I would be remiss if I did not challenge the frequently expressed belief at WAG meetings that Idaho County's economic lifeblood is logging and agriculture, since this position appears to underlie a significant part of the objections to the TMDL. Contrary to the statement expressed by the WAG's tourism representative that "you can't make any money cleaning toilets," travel and tourism play a significant and growing role in the economy of the state, of north central Idaho, and of Idaho County. For example, in some recent years total sales in the travel and tourism sector have exceeded the sales of all agricultural products on both a county and regional basis. To ignore the economic advantages to the county and region of clean and plentiful water in our rivers and streams is a grave mistake. Even beyond the major economic impact of travel and tourism, many people in today's world of telecommunications select the area in which they choose to live and work based upon the quality of the nearby environment, with particular emphasis on clean air and water. Many of these potential newcomers can bring with them small businesses, retirement income, and the strong probability of an expanded tax base.

On a related note, I recall in the early 1970s during the implementation of the Wild and Scenic Rivers Act in Idaho County that a common local opinion was that the land along the Middle Fork of the Clearwater River would become worthless because of government regulations on land use. Today the highest priced land in the county is that within the scenic easement boundaries.

Response: *We agree with the general concept that economic impacts should be factored into decisions on how to address environmental problems. In theory, the subbasin assessment and TMDL development should concern itself primarily with the technical question of whether waters are polluted and how much the pollutants need to be reduced for the waters to meet water quality standards. The economic questions should come during implementation when decisions are made of how to reduce the pollutant loading. In reality, however, the development of the subbasin assessment and TMDLs is not a purely technical problem and requires numerous decisions that take into consideration political, social and economic interests. We think we have been sensitive to these interests, through interactions with the WAG and others, and have attempted to structure the TMDLs so they do not limit options available for reducing the pollutants.*

We are obligated to write subbasin assessments and TMDLs within the framework of state and federal regulations. None of the rules or regulations under which these TMDLs were developed includes any consideration of economic factors or analyses as a component of the TMDL process. In the current climate of limited government finances and a court-ordered time frame for completing the TMDLs, the option of

economic analysis was not available, nor is it clear that the results could influence TMDL targets.

Process – Effects on Grangeville

No. 4
I would like to see some tolerance extended to small communities. It stands to reason that costly solutions to environmental problems require an increase in taxes and water and sewer rates. Our citizens must bear the brunt of these expenses at a time when Grangeville and all of Idaho County are experiencing economic depression and high unemployment.

I feel some slack should be give to small towns in meeting environmental quality standards. If not, we may end up protecting water quality and fish habitat while destroying the quality of life for human beings.

The Grangeville city Council has been forced to authorize the expenditure of thousands of dollars for water and fish studies on Three-Mile Creek to try to protect our rights – thousands of dollars our city budget can ill afford. Therefore, I hope you will:

1. Carefully consider the points made by Kevin Gardes, P.E., of Kimball Engineering – the engineer conducting our water study.
2. Grant consideration to Grangeville and other small communities who are facing additional financial stress from government imposed environmental regulations.

Response: *This subbasin assessment and TMDLs have identified temperature and nutrient problems with the city of Grangeville WWTP, and as a permitted point source, the city is under pressure to deal with the problems. The possible solutions to the problems and the time frames for implementing those solutions do appear limiting in light of the technical complexity and economics of the situation. USEPA, DEQ, and the NPT have let it be known that they understand the need for time to develop and implement possible solutions. We are committed to working with the city and their engineers to craft a viable strategy for addressing the problems, and have adjusted wasteload allocations for nutrients based on comments from Kevin Gardes, Kimball Engineering. We commend the city in their efforts to work with us in the development of the TMDLs and look forward to continued constructive engagement between the city and agencies as we look for viable means to bring Threemile Creek up to state standards.*

Process – Combining TMDL and IDWR WAGs

No. 1
It has not been easy to keep the IDWR water planning process separate from the TMDL water quality process with respect to the understanding of the WAG members. While it may seem like an efficiency of effort to have the same WAG for both processes, many of the WAG members see them as the same water planning process, implying that they probably should be combined in some way.

Response: *The TMDL process took longer than expected, thus overlapping the timeframe set up for the WAG to work with the IDWR water planning process. The resultant effort to work on both processes at the same time was confusing because they do raise many of the same issues. The WAG's recommendation of combining the two processes will be forwarded to program staff of DEQ and IDWR for consideration.*

Process – Address Aesthetics

No. 7
… Also, I recommend that a means be found to address watershed "aesthetics" in the TMDL process.

Response: *We appreciate the concern about watershed aesthetics, but the TMDL process by law can only address loading of pollutants to surface water. It is our expectation that when streamside vegetation is reestablished to a state somewhat resembling its natural condition as a result of implementing the sediment and temperature TMDLs, aesthetics will be improved.*

Water Quality Standards -- Temperature

No. 1
Since November 2001, the WAG has heard presentations by the agencies, and the WAG has repeatedly informed the agencies of unrealistic water quality standards. The natural water temperature exceeds the WQS. Streamside shade restoration will not make the impact necessary to lower the temperature. We have heard of fish populations, in streams like Three Mile Creek, where there was never factual data to support such classifications. The list of unattainable water quality standards does not end here. The agencies need to work more with the community to reach attainable standards, those that will not be negatively and drastically impacting the socio-economic impacts of Idaho County.

The Water quality standards are unrealistic for the South Fork Clearwater drainage. The 'natural' temperature presently exceeds the WQS. The agencies have acknowledged that fact, and have commented the human cause components will be the targets.

… In fact, when the temperature was found unreasonable to attain, it was lowered another 5 degrees instead of being raised. Even though we have been told that this will be changed when the final document is written, it still appears in the draft. I, again, state that these temperatures are unreasonable and can never be reached.

The state's water temperature standards are almost too bizarre for words. We have numeric temperature standards which everyone agrees are unrealistic and largely unattainable. So, in order to address this problem, the state inserts language in the code that we only have to deal with the human caused part of heat loading in the TMDL. But the point sources such as the WWTPs still have to deal with the unrealistic numeric standards. We clearly need some

temperature standards that relate directly to natural conditions and the needs of the fish in the waters being considered.

No. 7
First, I have throughout the WAG process understood that implementation of proposed improvements involves "moving towards" targets, making genuine attempts towards improving water quality. Therefore, I have no objection to temperature targets that some people consider unachievable.

Response: *The agencies recognize that there are in fact problems with existing temperature criteria. Much time and effort has been spent over the last few years trying to develop temperature criteria that work better. USEPA has issued new guidance for temperature standards for Washington, Oregon, and Idaho. The temperature standards issues have been a major stumbling block in the development of these TMDLs, partly because they changed in the middle of the process, but also partly because the numeric criteria are probably cooler than stream temperatures would be naturally in lower elevation streams in the absence of man's influence.*

In the end, however, the nonpoint source temperature TMDLs are written based on the simple premise of returning stream and river shading to its natural level. It is assumed that human disturbance of natural stream shading is a major source of increased heat loading that is human caused and is the most easily remedied. Stream widening also increases heat loading and may be due to human activities, but making channel modifications is typically more difficult and expensive. The targets of all of the nonpoint temperature TMDLs are set in an attempt to return stream shading to its natural level. These targets are reasonable and attainable. They are expected to restore full beneficial use conditions of the streams, even though the stream temperature under those more natural conditions is not currently known.

The discrepancy between the target base for nonpoint vs. point sources in this TMDL is real, as noted by the commentor. The Grangeville WWTP is the only point source with a significant heat load problem. We were unable to develop an acceptable estimate of natural stream temperatures for Threemile Creek. In the absence of reliable site-specific temperature data, the wasteload allocation is based on the numeric temperature criteria, with the provision that Grangeville can increase stream temperature by 0.3^{o}C above these criteria. This approach is consistent with the most recent guidance for establishing point source allocations, but we realize that if natural background temperatures are somewhat higher than the current criteria, this results in a very conservative estimate of the needed heat load reductions by the Grangeville WWTP.

Beneficial Uses – General

No. 1
The WAG has largely bought off, or been worn down, on the need for temperature TMDLs basin-wide even though the Draft TMDL data, both WBAG 1996 and WBAG 2000, show that all listed water bodies except Three Mile and Butcher Ck. are fully supporting their beneficial uses.

Response: *An issue throughout the assessment of sediment and nutrients in this document has been the question of what constitutes impairment of beneficial uses, particularly impairment of the salmonid spawning beneficial use. The Idaho water quality standards leave considerable room for interpretation. DEQ utilizes the WBAG methodology to provide such interpretations. However, the three parties were not able to reach agreement in all cases on the interpretation of WBAG results. TMDLs were only written for waterbodies for which all three parties could agree.*

Beneficial Uses – Endangered Species

No. 1
Endangered species considerations have greatly influenced the actions of the government agencies involved with this TMDL, yet there evidently is no authority for them to be doing so under the Clean Water Act. Salmonid spawning is occurring throughout the upper basin above Harpster, by general consensus of the Fisheries Technical Advisory Group and reported in this TMDL. There should be no question of full-support status for all streams above Harpster given the fish populations that exist up there. The fact that they are not adequate for some tribal needs, or some vague plan by NMFS, should not be construed as evidence that water quality, as envisioned under the Clean Water Act, is not being attained.

No. 2
The fish species currently listed under the Endangered Species Act were discussed during the TMDL process. They must be considered in the context of the South Fork Clearwater River subbasin. However, there is no evidence to suggest that ESA-listed species greatly affected the draft TMDL, as indicated in the WAG letter.

No. 6
The WAG letter draft that I saw indicated that ESA listed species greatly affected the draft TMDL. The WAG and agencies did discuss species listed under the ESA. The ESA is the law and must be considered in this basin. However, at no time did I feel that the species listed under the ESA was the driving force behind the draft TMDL, nor do I feel it had any great impact on the draft. In fact, my concern is that not enough significance was given to listed species nor to the fact the SF CWR has the greatest habitat potential in the state for species recovery. The DEQ should be striving to attain the highest possible water quality and habitat in this basin, not the lowest quality capable of sustaining minimum numbers of the species.

Response: *The issue of habitat for endangered species, especially spring chinook and steelhead, has been a major consideration throughout the deliberations for this*

document. The targets of the most relevant TMDLs, sediment and temperature, were derived from existing Idaho water quality standards. These standards are established to fully support cold water aquatic life and salmonid spawning. Some of the salmonid species intended to be protected by these standards are threatened or endangered species under the ESA. While it is expected that these TMDLs will be an important step in improving water quality conditions for these species, the targets and goals within the TMDLs reflect what is needed to achieve Idaho's WQS, and have not been further modified simply because some of the salmonid species in the subbasin are listed under the ESA.

We have reached compromise agreements among the agencies for this subbasin assessment process to move forward. As with any compromise, there are parties on both sides of the issue, as shown in the comments. We have given full and fair consideration to endangered species within the requirements of the CWA and Idaho's water quality standards.

Beneficial Uses -- Threemile Creek

No. 1
…We have heard of fish populations, in streams like Three Mile Creek, where there was never factual data to support such classifications…

Three Mile Creek (Grangeville Wastewater Treatment Plant) is a terribly big issue. We loudly disagree with the draft on this issue. We as a group voted to take the salmonid spawning issue off the creek above the falls. An ironic situation is involved with this creek. If the WWTP puts their water on the land in the summer, the creek will be dry below the plant and there will be no water to test! Where is the thinking here? Do you want water or do you want NO water?

Motion on November 20, 2002: That we change the beneficial use status of Three Mile Creek, above the falls at sk 9.5, from salmonid spawning to cold water biota. Vote: In favor (14) Opposed (0)

No. 3
Page 29, subsection entitled *Threemile Creek*: The third sentence states "Adult steelhead have been observed during the past in the segment of the creek flowing through Grangeville (BLM 1999)."

It is our understanding that this sentence comes from Craig Johnson (BLM) and is based on anecdotal evidence. The statement about steelhead evidently comes from a conversation that Daniel Stewart (IDEQ) had with a former USFS-Moose Cr. ranger district fire type, Mark Woods (currently Fire Warden, Southern Idaho Timber Protective Association, McCall, ID, 208-634-2268), that was cited by Mr. Johnson. Mr. Stewart recently tracked down Mr. Woods to verify the account. The person who caught the fish was Bruce Fulton and it was in the early 60's. The fish was purported to be 18" in length. The fish was found in the Creek after high water went down. This fish likely was washed out of someone's pond along the

creek. The fish was not identified as a steelhead. In previous studies on the Creek, other rainbow trout in this size range (this size being the upper end) have been found in Threemile Creek. It is our understanding that there is no way that a fish in the 18" size range could be conclusively called a steelhead without further evidence, which to our knowledge does not exist. We request that any reference to finding steelhead in the upper portion of Threemile Creek (above the migration barrier – chute/falls) be removed from the TMDL.

The City of Grangeville is actively pursuing reclassification of the upper portion of Threemile Creek from salmonid spawning to year-round cold water biota. The City hired EcoAnalysts of Moscow to perform fish survey work, including characterization of a potential migration barrier on Threemile Creek. This work is being done in consultation with IDEQ-Lewiston. A full migration barrier has been identified. Previously, portions of the fish survey and barrier characterization report have been sent to Tom Dechert in draft form. A full report will be submitted in the near future to IDEQ. Recent electrofishing activities on Threemile Creek revealed some adult rainbow trout, but no young of year trout (none were found that would have shown spawning activity in the last 2 years). In other words a viable (reproducing) population is not present in the upper portion of Threemile Creek. This ongoing work should be identified in the TMDL, to give a link back to the TMDL in the future when reclassification is completed.

The City of Grangeville recently completed a survey of local landowners in the Grangeville area (upstream of the WWTP) that have ponds in the near vicinity to Threemile Creek, and that have been stocked with fish in the past. I am attaching an e-mail from Ken Gortsema, Public Works Director in Grangeville that indicates the results of the City's survey. (*The email is not copied into this TMDL document because it contains personal information of landowners. It is available for review at the DEQ office in Lewiston.)* As you can see, there are a number of ponds that have been stocked with rainbow trout that overflow into Threemile Creek. The occasional rainbow trout that turns up in previous electrofishing activities is almost certainly a result of escapees from one of the ponds identified.

Response: *Salmonid spawning is one of the designated beneficial uses in the Idaho administrative rules for Threemile Creek (IDAPA 58.01.02.120.07). The point of these comments is that salmonid spawning in not a beneficial use of Threemile Creek; that in fact its highest beneficial use is cold water aquatic life. The conclusion is that the salmonid spawning designation in the administrative rules is incorrect and needs to be changed.*

It is beyond the scope of the subbasin assessment to change a designated beneficial use, especially if that change is to downgrade the use designation, as changing the beneficial use from salmonid spawning to cold water aquatic life would be. The only tool available for downgrading a beneficial use designation is the Use Attainability Analysis (UAA). A UAA pulls together all the information to justify the use change, which will then be moved forward through the administrative rule making process, approval by the state legislature, and final approval by USEPA. Some of the comment provided comes from the UAA process that has been set in motion to try to change the beneficial use designation for Threemile Creek.

It is unknown at this time whether the UAA and subsequent steps will result in an eventual USEPA approved change to the Idaho administrative rule designation for Threemile Creek. In the meantime, the subbasin assessment and TMDL loading analyses have been developed based on the current designation. We have no authority to do otherwise, except to defer the development of the TMDL altogether, which is strongly discouraged under current guidance for TMDL development in Idaho. At whatever time it is known that the UAA/rule change has been successful, the waste load allocation for the WWTP will be adjusted accordingly. In the meantime, the City of Grangeville is encouraged to begin considering options to reduce heat loading to Threemile Creek. This TMDL does not stipulate or advocate any particular solution for the WWTP, including land application; only that the City of Grangeville begin looking for ways to deal with the problems their WWTP effluent is causing in Threemile Creek.

It seems prudent to develop the temperature TMDLs based on the salmonid spawning beneficial use as an indicator to the city of Grangeville and landowners along Threemile Creek of the magnitude of water quality degradation from both nutrients and temperature. Planning needs to take place to come up with measures to correct the problems. There are both point source and non-point source contributions to the problems, and the solutions may be complex and a long time in coming. From the water quality point of view, there is no reason to delay identifying the problem in general terms, and encouraging the development of solutions.

Pollutant Sources – CAFOs

No. 1
This document states that Confined Animal Feeding Operations (CAFOs) are a point source and also a non-point source. There are no outright CAFOs (as per CAFO definition) in this sub-basin, but there are small animal feeding operations.

On page 212 the TMDL states that CAFOs are common in neighboring areas. This is untrue!! Most of the last paragraph should be taken out!!

Response: *We appreciate these inconsistencies being brought to our attention and have made the corrections.*

Nonpoint Sediment Sources – Roads

No. 1
The major contribution of sediment in the drainage is from the roads. At this time, the road district will have to explore options on how to make a reduction in the impact. At this time, there are limited alternatives.

If there is a reduction in sediment loading from the roads, ultimately the temperature will also decrease. At this time, the road district will have to explore options on how to make a reduction in the impact. Again, there are limited alternatives.

No. 7
The major contributor to sediment in the watershed is not roads, as the WAG letter states, but, as I understand the information presented to us, agricultural run-off. Further, to address the sediment issue, as the letter does, by complaining "there are limited alternatives," reflects an attitude that can only negatively impact the watershed. I am glad that the TMDL has been written, that it has, in effect, pushed through at least some of the wall that such an attitude erects.

Response: *Roads probably are the major source of sediment in the forested part of the subbasin, while agriculture is the major source in the non-forested part. For roads that fall under the jurisdiction of the Forest Practices Act, a large number of BMPs have been developed to address sediment. The federal management agencies have developed additional BMPs for roads on their land. For county roads, especially those running through agricultural lands, economically viable sediment reduction BMPs are much harder to come by. We look forward to working with the road districts as they begin examining their alternatives.*

Nonpoint Sediment Sources – Suction Dredge Mining

No. 1
Suction dredge mining: Current federal regulations from the Idaho Water Rights Board address suction dredge (recreational) mining. There is not a significant impact on sediment with current operations, as being federally regulated. Therefore, the South Fork Clearwater WAG is in agreement with the comments on pages 99 and 100 (3.1- Sources of Pollutants of Concern/Suction Dredge Mining).

No. 2
The Idaho Water Resources Board does not set federal regulations for suction dredge mining, as stated in the WAG letter (no. 1). They have oversight responsibility for the Idaho Stream Alteration Act that does affect suction dredge mining. There are separate federal mining regulations that apply to suction dredging on federal lands.

No. 6
On Page 100 of the draft TMDL state that "...dredging is only allowed from July 15 through August 15 each year, in order to avoid periods when chinook, cutthroat, and steelhead are spawning and eggs are incubating." It also mentions that the USFS has received three applications to operate suction dredges for larger scale operations who propose to operate dredges larger than 5 inches. One application is for year round dredging in Red River, another is for operation July-October on the SF CWR. Issuing permits for these time frames would be inconsistent with the need to avoid spawning and incubating time periods.

Response: *We understand and appreciate that these comments are supportive of the TMDL as it addresses suction dredging. The comments identify regulatory agencies that need to be aware of controls established by Idaho's water quality standards.*

Nonpoint Temperature Sources -- Roads

No. 1
If there is a reduction in sediment loading from the roads, ultimately the temperature will also decrease. At this time, the road district will have to explore options on how to make a reduction in the impact. Again, there are limited alternatives.

Response: *We certainly agree most of the BMPs as we know them that would reduce sediment from roads will also result in reducing temperatures.*

Missing Data

No. 8
A second concern relates to the need for additional data in several areas with which to make wise, scientifically-based decisions. The lack of adequate data was a problem throughout the WAG process. The TMDL mentions the need for additional data, but treats this topic very lightly.

Response: *We agree that filling data gaps is an important consideration. Additional discussion of data gaps and the need to fill them has been included in Section 5.5 Implementation Strategies. It is expected that more detailed plans and commitments to collect this data will be included in the Implementation Plan, and we encourage stakeholder participation in its development.*

Delisting Proposal – Sediment

No. 1
As a group, we voted to take sediment off the list of problems above the Mt. Idaho Bridge. The agencies came back and told us that that was done. ONLY now sediment is listed for all the tributaries into the main South Fork, so what did we actually accomplish? The SFC WAG voted no on sediment TMDL above the Mt. Idaho Bridge.

Motion on November 20, 2002: That with the additional data received today that the WAG move to remove all streams (from the 303-d list) above Harpster Bridge, with the exception of Beaver Creek in the upper reaches, that would have been listed for sediment on the 1998 WBAG.
Vote: In favor (11) Opposed (3)

Motion on May 21, 2003, to clarify the November 20 motion:
That the tributaries as well as the main stem of the South Fork of the Clearwater be removed from the sediment TMDL, above Harpster Bridge, with the exception of Beaver Creek.
Vote: In favor (8) Opposed (2) Abstain from the vote (2)

No. 5
We understand the need to assess this watershed and set TMDLs based on state regulations and the best available data. We feel, though, that insufficient discussion and evidence was given to support the decision to delist the eight streams for sediment. Habitat for fish and macroinvetebrates have been degraded for decades by human activities and should not be further compromised through more lenient restrictions on development.

There was insufficient discussion in the SBA concerning the delisting of the many tributaries in the upper main stem of the SF CWR. The statements and comments that were in the report regarding the delisted streams were not clear and were not well organized and documented. A more complete and succinct summary of the rationale for delisting the tributaries of the upper SF CWR should be provided to the public and also be made available for comment in a supplementary document.

Response: *This TMDL is not the official proposal to delist these tributaries, which will occur during the 2004 Integrated Report process, in which the 303(d) list is established. We appreciate the comments we received on this issue, but encourage you to submit your comments on these issues during the 2004 listing process.*

Sediment as represented by total suspended solids, cobble embeddedness, pool frequency, pool volume, and turbidity all have an effect on the ability of fish and macroinvertebrate species to survive, spawn, migrate, and seek habitat. A high amount of fine sediment decreases interstitial space on the stream bed and thereby decreases the dissolved oxygen concentrations along and in the stream bed. Habitat for smaller fish and other species becomes filled with fine sediment, thus decreasing species diversity and abundance.

Of the streams on the 303(d) list for sediment, only three are proposed for TMDLs for sediment. All of the streams that are being delisted for sediment pollution are also classified for salmonid spawning and secondary contact recreation, both of which depend largely on the levels of sediment in the water and along the beds of these streams. Sediment loads should not be defined based solely on turbidity, but as a combination of turbidity and cobble embeddedness, especially in the portion of the SF CWR subbasin above Harpster. The Water Body Assessment Guidance does not restrict the assessment of impairment for sediment to a limited amount or type of data. Inclusion of additional data in assessing the streams proposed for sediment delisting may convey that they are impaired, do not meet beneficial use of salmonid spawning, and should be provided for public comment.

Discussion concerning the degree of cobble embeddedness needs to be included in the SBA and deserves to be included among the criteria for sediment TMDL development. Cobble embeddedness is used throughout much of the Pacific NW as an indicator of management-related sediment impacts in streams, with high cobble embeddedness levels associated with declines in salmonid spawning activity. There needs to be a discussion of the importance of the cobble embeddedness and percent fine sediment data and how it can affect the vitality of fish and macroinvertebrate species. The assessment and TMDL gives poor indication that the tributaries to be delisted are not free from impairments and pollution from sediment. Rather, in the assessment the main rationale seems to be based on assumptions that all of the

SF CWR sediment problems would be resolved by reductions in lower parts of the subbasin. Also, the assessment and TMDL do not indicate that the beneficial uses are being entirely met. Salmon once flourished in the SF CWR and tributaries. Due to habitat degradation and the effect of dams and pollution, and other developments their populations have decreased drastically. Now they exist in these streams in smaller populations and with less vigor because the habitat is not optimal for their existence. A basic first step to improving salmon habitat would be to set stricter TMDLs for sediment in order that pool frequencies increase and cobble embeddedness decrease.

In the TMDL section for Total Suspended Solids and Bedload Data, it was indicated that some of the data, due to spatial and temporal diversity, were difficult to use for subbasin analysis. More data needs to be collected while other parameters and indicators (percent fine sediment, pool frequency, pool volume, and cobble embeddedness, total dissolved solids, Wolman pebble count) need to be given a more complete analysis, especially in streams above Harpster. In order that a more thorough description of the subbasin be developed, we recommend that assessments be based on data sets that were developed over multiple sessions of sampling throughout various times of the year at a diversity of sites. In addition, consultations with the US Fish and Wildlife Service and the Idaho Department of Fish and Game would increase the value and usefulness of your assessment and inventory of fish species and habitats.

We suggest that TMDLs for sediment be set for the streams and main stem of the SF CWR and subbasin above Harpster. Cobble embeddedness surrogate targets below 20-30% should be set in salmon rearing habitat depending on channel type. Targets should be set on reference conditions for cobble embeddedness, percent fines by depth, and pool volume. Surface fine sediment should be less than or equal to 20% in spawning areas. There should also be an objective set for an increasing trend in residual pool volume. The current proposal is not only ignoring the full scope of sediment problems in the subbasin, it is also inconsistent with the management objectives of the Nez Perce National Forest, the National Oceanic and Atmospheric Administration – Fisheries consultation for the Endangered Species Act, and designation by the state as a Special Resource Water.

No. 6
I strongly object to delisting any of the tributaries or upper main stem of the SF CWR for sediment. While the lower SF CWR has greater sediment from ag lands, the upper SF CWR does have significant sources of sediment that could be addressed in the implementation plan. Also, the upper SF CWR has the highest percentage of critical habitat for spawning spring/summer chinook and steelhead which should carry greater weight in the equation. All of the listed streams had high cobble embeddedness numbers that support listing.

Much discussion was given to various testing numbers and the validity of one scientific method of measuring or another. I have been kayaking the SF CWR, all of it above Harpster, for over 20 years and I don't need a test to tell me that there is a problem with sediment. I can see it with my own eyes every time I boat this river.

No. 7
I do not concur with some WAG members' contention that we ought to have delisted any 303d listed streams in the watershed. Indeed, I feel we ought to have added some.

I would like to have seen greater, consistent attention given to studying cobble embeddedness and stream flow and recommend that thorough, consistent data be built in these two areas for future use. Also, I recommend that a means be found to address watershed "aesthetics" in the TMDL process.

No. 8
In terms of the TMDL itself, I have concerns about the proposed delisting for sediment of 7 SF tributaries. If the SF mainstem has sediment problems throughout much of its length, at least some of this sediment must be coming from its tributaries. Further, all of these same streams exceed water quality standards for temperature, and temperature is negatively impacted by sediment. It thus seems unwise to leave unaddressed the issue of sediment in these 7 streams. Cobble embeddedness as it relates to salmonid spawning adds to my concerns in this area.

Response: *The final document has been changed such that delisting of tributary streams above Harpster is not being recommended as a conclusion. It has been concluded that the delisting recommendations are properly a function of the integrated listing process within which the 303(d) list is created, the next cycle for revision occurring in 2004.*

Consistent with the state of Idaho guidance for pollutant assessment related to the development of TMDLs, we have collected and analyzed all of the available and pertinent data. We solicited a wide range of professional opinion. We drew our conclusions based on the totality of the data and professional opinion. The volume of available information is huge, much of which is presented in the subbasin assessment. Idaho's narrative standard for sediment requires the use of best professional judgement, based on all the information.

As the public comments reflect, there is not any broad agreement on 1) the definition of beneficial use impairment, 2) how to measure whether sediment is impairing beneficial uses, and 3) how to weigh different measures against each other within the state water quality guidance. In the South Fork Clearwater River Subbasin, these questions are confounded by impacts on beneficial uses of elevated stream temperatures. The BURP/WBAG information, the Fish TAG information, the sediment budget information, the reference watershed information, local users information, and technical literature information all address these issues in different ways. In the final analysis, the three parties weighed all of the available data, information and input from the WAG and resource professionals in relation to the state water quality standards. The parties could not agree on the need to write sediment TMDLs in the upper tributaries, but did agree to write sediment TMDLs for the mainstem South Fork Clearwater River, as presented in the final TMDL.

TMDLs – Grangeville WWTP

No. 1
The Grangeville wastewater treatment plant's requirements to land apply their waster water will greatly reduce and sometimes totally eliminate the flow of Three Mile Creek. What sort of impact on water quality is that? That is not considered. Also, what economic impact is it on the City of Grangeville?

Response: *There is no requirement in the TMDL for the Grangeville WWTP to land apply their waste water. That possibility has been under discussion, was overstated in the public comment draft of the TMDL, and has been corrected in the final version.*

…An ironic situation is involved with this creek. If the WWTP puts their water on the land in the summer, the creek will be dry below the plant and there will be no water to test! Where is the thinking here? Do you want water or do you want NO water?

No. 3
Page 145, subsection entitled *Target Selection*: The second sentence states " Grangeville is considering land application of its wastewater during the critical time period for excessive growth (July thru mid-September)."

Page 147, subsection entitled *Load and Wasteload Allocations*: Third paragraph, first sentence, states "The WLA for the Grangeville WWTP was established as 0 for both TP and TN, as the city has agreed to land apply effluent during the critical time period (July through mid-September)."

The sentence on Page 145 is correct, the one on Page 147 is not. (***Response:*** *Page 147 has been corrected.)* After the TMDL is finalized the City of Grangeville will complete a wastewater facility plan to determine their options and select a preferred alternative to meet the requirements outlined in their next NPDES permit and the requirements of the TMDL as incorporated into the permit. While land application is certainly an alternative that will be considered, it has not been selected as the preferred alternative. Options (e.g. treatment) that continue the wastewater treatment plant's year-round discharge to Threemile Creek will also be evaluated.

Response: *There is no intent in the TMDLs to limit the city of Grangeville's options for meeting the state water quality standards. The water quantity issue is one the city and community will have to grapple with as they evaluate options to improve water quality.*

TMDLs – Grangeville WWTP and Temperature

No. 3
Page xiii, states "Sub-basin-wide temperature analyses were conducted in light of an extensive database indicating that no stream in the SF CWR Subbasin, not even ones in

relatively pristine condition, meets the Idaho numeric temperature criteria for salmonid spawning."

and

Section 5.3 Temperature TMDLs

On pages 178 and 179, Tables 45 and 46 list the daily maximum effluent temperatures for the Grangeville wastewater treatment plant. They appear to be based on 9°C (Table 45) and 19°C (Table 46). These values are the daily average criteria for Salmonid Spawning and Cold Water Biota, respectively. It would seem more appropriate to either change the Table from "Maximum" to "Average", or recalculate the Table utilizing the daily maximum criteria from the WQ standards.

Response: *Tables 45 and 46 are intended to insure compliance with the daily average criteria for salmonid spawning. While the wasteload allocation is expressed as a "maximum daily" value, "daily discharge" is defined in 40 CFR 122.2 as "… the average measurement of the pollutant over the day…". Consequently, daily average effluent values may be used for compliance determinations, which is consistent with the use of a daily average temperature criteria.*

Per IDAPA 58.01.02.401.03.a.v, "If temperature criteria for the designated aquatic life use exceeded in the receiving waters upstream of the discharge due to natural background conditions, then Sub sections 401.03.a.iii. and 401.03.a.iv. do not apply and instead wastewater must not raise the receiving water temperatures by more than three tenths (0.3) degrees C."

However, it appears that for Tables 45 and 46 the WQ standard criteria is utilized as the stating point and no consideration is given if the stream naturally exceeds the WQ criteria. For instance, if the water temperature above the WWTP outfall is naturally 10°C (daily average) for a given day in May, and the effluent discharge is 1.0 cfs, and the Creek flow is 7 cfs, the Table lists 9.8°C as the daily maximum. In this example, it does not seem that the intent of the natural conditions provision is incorporated into the Tables. It would be more appropriate to utilize a target temperature that is 0.3°C higher than the upstream (of discharge) water temperature, measured on a daily basis, except for periods when the Creek is meeting WQ standards.

When the draft SF Clearwater TMDL was presented to the Clearwater BAG in Clarkston on July 10, 2003, the impression left from the DEQ presentation was that the State is moving away from a numeric target with respect to temperature to a narrative target (percent canopy or shading) due to the recognized problem of streams naturally exceeding the temperature standard. However, this same line of reasoning is not applied to point sources, such as wastewater treatment plant discharges. There is a good deal of cover over Threemile Creek as it moves from the base of the forested mountain area through the City to the wastewater treatment plant outfall. It therefore, seems reasonable to assume that the temperature in Threemile Creek just above the outfall pipe represents the natural temperature condition, and the wastewater treatment plant discharge target should be 0.3°C above this reading, measured on a daily basis.

Response: *Several options for determining the natural temperature of Threemile Creek were considered in drafting the TMDL, including using temperatures measured immediately upstream of the outfall, as suggested by the commentor. In reviewing land use information for the watershed upstream of the outfall, it was determined that road construction and timber harvest had occurred in the uppermost watershed, including encroachment within the riparian zone. Between the forested upper watershed and Grangeville, land use changes to a mix of residential and pasture (grazing) with at least two road crossings. While riparian vegetation (primarily hawthorne and low grass) occurs in the pasture area, grazing appears to have impacted vegetation and streambanks in this reach, which would affect stream shading and stream temperature. Threemile Creek flows through the city of Grangeville below this point, where there are numerous stream crossings and a severely altered stream channel. Given the extent of human activities within the watershed upstream of the WWTP, particularly factors within the riparian area which would affect stream temperature, the watershed and hence temperature conditions could not be considered to represent "natural conditions" for purposes of establishing a wasteload allocation for temperature for the Grangeville WWTP.*

TMDLs – Kooskia WWTP and Temperature

No. 1
The City of Kooskia will be asking for a motion by the SFC WAG to support the City of Kooskia, as to have the Regulatory Agencies to use waste load allocations for effluent temperature, based on mass balance calculations and provisions as set in Idaho Water Quality Standards and not using their best guess scenario to establish a daily maximum temperature. Where as Stites has received funding to transport their wastewater to Kooskia beginning this winter, and where as Elk City has the capacity to store their wastewater in the summer, those two communities will not be included in this motion.

Response: *The wasteload temperature allocations for Kooskia have been revised in the final TMDL to reflect recent temperature data provided by the city, which indicates that effluent temperatures reach a maximum of 26°C.*

TMDLs – Grangeville WWTP and Nutrients

No. 3
…We request that a TP target of 0.1 mg/l, converted to mass loading (lb/day), as identified in the TMDL be used to calculate a wasteload allocation for the wastewater treatment plant, not 0 mg/l as identified in the draft TMDL.

(Response: *Thank you. We have corrected this in the final document.)*

Page 145, subsection entitled *Target Selection*: The fifth paragraph addresses a TN target of 0.3 mg/l.

With a TP target of 0.1 mg/l, phosphorus would become the limiting nutrient, and there would not be a need for a nitrogen limit. Use of a limiting nutrient has been standard practice on other TMDLs (e.g. Paradise Creek). EPA has previously accepted that phosphorus is normally limiting in freshwater systems. At this point in time, there are treatment technologies that may reduce TP to levels in the 0.1 mg/l range, however we do not know of any to treat TN to 0.3 mg/l levels. We request that all mention of a TN target be removed from the TMDL.

Response: *Thank you for the comment. We have revised the nutrient TMDLs to eliminate the TMDL for nitrogen, and focused the TMDL on phosphorus as the limiting nutrient. The expectation is that phorphorus will be reduced to a level that will limit nuisance algal growth.*

TMDLs – Nutrients/DO

No. 1
…And nutrient/DO TMDLs are written for Three Mile Creek, where no impairment is shown. In addition, in the case of Three Mile Creek, there is no evidence that the nutrient load reductions being required of the WWTP will result in improved water quality. In fact if the city decided to land apply, water quanity during the summer will be reduced and water quality during that time period may decline.

Response: *Both phosphorus and nitrogen concentrations in the creek below the WWTP are more than 100 times the USEPA guidance concentrations. While no direct link could be shown to the beneficial uses, such high levels are a very strong indication that beneficial uses are being impaired, and in and of themselves warrant development of the nutrient TMDL. In addition, IDEQ is currently collecting 24-hour DO data to document the relation of nutrients to numeric DO concentrations in Threemile Creek. Phosphorus targets and the seasonality of their application may require adjustments in the future as additional data is collected.*

TMDLs – Bacteria

No. 1
The document also states that animal feeding operations can be significant contributions to water quality detriment. However the Lower Boise River coliform bacteria DNA testing showed that through the lower reaches of the Boise River, which flows through a predominantly agricultural area, agriculture only had 9-14% of the sources of coliform bacteria. And that wildlife, especially water fowl and avian (34.9%), and deer and elk (15.4%) were the significant contributors. Why isn't some of this type of data used to help write TMDLs?

Response: *We appreciate this comment about the possible sources of bacteria in Threemile Creek. We do not truly know the source of the bacteria, and do not have the resources to conduct the sort of research as was conducted in the Lower Boise River. The bottom line for the TMDL, however, is that bacteria levels in Threemile*

need to be reduced in order to meet water quality standards. The effects of livestock on the water quality of Threemile Creek need to be addressed for the sediment and temperature TMDLs as well as the bacteria TMDL.

TMDLs – Sediment

No. 1
As a group, we voted to take sediment off the list of problems above the Mt. Idaho Bridge. The agencies came back and told us that that was done. ONLY now sediment is listed for all the tributaries into the main South Fork, so what did we actually accomplish? The SFC WAG voted no on sediment TMDL above the Mt. Idaho Bridge.

Motion on November 20, 2002: That with the additional data received today that the WAG move to remove all streams (from the 303-d list) above Harpster Bridge, with the exception of Beaver Creek in the upper reaches, that would have been listed for sediment on the 1998 WBAG. Vote: In favor (11) Opposed (3)

Motion on May 21, 2003, to clarify the November 20 motion: That the tributaries as well as the main stem of the South Fork of the Clearwater be removed from the sediment TMDL, above Harpster Bridge, with the exception of Beaver Creek. Vote: In favor (8) Opposed (2) Abstain from the vote (2)

Specifically, TMDLs are written for sediment in the main stem above Harpster where no impairment of beneficial uses is shown….

No. 5
We suggest that TMDLs for sediment be set for the streams and main stem of the SF CWR and subbasin above Harpster. Cobble embeddedness surrogate targets below 20-30% should be set in salmon rearing habitat depending on channel type. Targets should be set on reference conditions for cobble embeddedness, percent fines by depth, and pool volume. Surface fine sediment should be less than or equal to 20% in spawning areas. There should also be an objective set for an increasing trend in residual pool volume. The current proposal is not only ignoring the full scope of sediment problems in the subbasin, it is also inconsistent with the management objectives of the Nez Perce National Forest, the National Oceanic and Atmospheric Administration – Fisheries consultation for the Endangered Species Act, and designation by the state as a Special Resource Water.

Response: *These two comments bracket opinions that range from believing that no sediment TMDLs are warranted above Harpster to believing that all streams above Harpster not in pristine condition deserve sediment TMDLs (also see comments on the proposed sediment delistings above). To the best of the three agencies's (DEQ, NPT, USEPA) abilities to interpret the intent of the Clean Water Act and Idaho's water quality standards, there is agreement that that sediment from many tributaries above Harpster is accumulating in the main stem and impairing beneficial uses in*

the main stem. One must keep in mind that "impairment" is a legally defined condition and does not equal degradation or other general terms for the effects of sediment. Likewise, the opinions of the WAG are advisory; it is the legal responsibility of the agencies to identify when and where impairment occurs. Similarly, management objectives of other agencies, while perhaps providing some level of understanding of impairment, do not constitute legal definitions of impairment.

Sediment impairment in the state narrative water quality standard is defined in terms of beneficial uses. In the case of the streams above Harpster, the beneficial use in question is salmonid spawning. The sediment TMDLs for the main stem above Harpster extend the numeric 25% sediment reduction target for Stites throughout the system. Reference watershed and research data in the subbasin assessment indicate that one of the effects of sediment being added to the main stem is degraded in-stream habitat. The effects of the targeted reduction in sediment on in-stream habitat are not quantifiable, yet we agree with commentors that stream habitat needs to be improved. In the final draft of this document, we have set a surrogate target of an improving trend in river habitat. The improving trend surrogate target is set to insure that BMPs applied to the landscape actually result in improved stream habitat.

We think that the 25% sediment reduction target is conservative, and when coupled with the improving river habitat trend, will insure that the river will be returned to full support of its beneficial uses, as relates to sediment. One must remember as well that temperature TMDLs have been written for the basin as a whole, the implementation of which should result in streamside vegetative restoration throughout the basin. Such vegetative restoration will almost automatically result in a significant reduction of sediment loading to streams.

<u>TMDLs – Temperature</u>

No. 1
With respect to the temperature TMDLs, from the forest industry perspective, we see no need for the caveat added by EPA to the CWE temperature model. The shade targets in this TMDL pretty clearly indicate that the CWE temperature model targets by themselves are more protective than the EPA-promulgated System Potential Vegetation (SPV) targets. The forest industry developed the CWE model based on local data, which EPA apparently turned down without much data at all. The SPV data used in this TMDL is much less specific than the CWE data, and results in lower, much less well-defined targets. It's simply another case of the feds riding rough-shod over locally developed and accepted methods.

No. 5
We appreciate efforts to assess our streams and rivers, assuring citizens that our water and wildlife are not being neglected. We also appreciate efforts to restore our streams and supporting tributaries. This has impacts not only on the quality of human use and recreation,

but also on wildlife habitat. It has not gone unnoticed that temperature TMDLs were developed for all 74 water bodies in the subbasin. We commend you for that effort.

No. 7
First, I have throughout the WAG process understood that implementation of proposed improvements involves "moving towards" targets, making genuine attempts towards improving water quality. Therefore, I have no objection to temperature targets that some people consider unachievable.

Response: *Generally, the targets for the temperature TMDLs throughout this document have been set for the level of shade attainable under natural conditions, which incorporates impacts from natural disturbance processes such as fire and mass wasting. These shade targets do not represent maximum tree heights or maximum riparian vegetation density, but are intended to represent shade levels which could realistically be expected to occur given a natural disturbance process and minimal human disturbance. The modification to the CWE methodology helps insure that this level of shade will be maintained in forested zones, even though the CWE model may not indicate it. This is consistent with our goal of restoring streamside vegetation and shade throughout the subbasin to enhance both the temperature and sediment effects on water quality. The complete streamside shade restoration goal is justified by identifying shade as the most important component of stream heating that is human caused and can be managed. By focusing on the human-caused and manageable component of stream heating, and setting targets to largely eliminate those effects, this TMDL has side-stepped many of the controversial issues associated with interpreting the numeric water temperature criteria. We think this is justified given the recent change in the Idaho water quality standards allowing such an approach, and will result in significant improvements to stream temperatures throughout the subbasin.*

Implementation -- General

No. 2
The federal land management agencies have reviewed the draft South Fork Clearwater River Subbasin Assessment and TMDL and we feel that the provisions are generally implementable, with specific measures to be worked out within the implementation plan. We look forward to working with the IDEQ, EPA, NPT and WAG on development of the implementation plan.

No. 5
For some of the TMDLs, adequate plans and strategies for implementing and monitoring the TMDLs were developed. Plans to implement and monitor the TMDLs for sediment and temperature were developed. The strategy for temperature is deserving of merit. However, the sediment TMDL lacks a timeframe and provides few actual basic steps required for the implementation and monitoring of the TMDLs and reductions. Additionally, there were no indicators of progress or interim measures of success established in the assessment. These

are important in determining if implementation is effective and if reductions are being fulfilled. The TMDLs for *E. Coli* and Nutrients for Threemile Creek did not include monitoring or implementation plans. If strategies for the sediment and temperature TMDLs were developed, the same should be completed for the bacteria and nutrient TMDLs.

No. 7
I feel that perhaps the weakest aspect of upcoming TMDL implementation is provision for monitoring of progress and of support for such monitoring. Monitoring should be vigorously, consistently conducted for years to come.

No. 8
Finally, the TMDL could be improved with greater attention paid to a plan for future monitoring of stream and river conditions.

Response: *Thank you for these comments. For the final document, we have completely revised the discussion of implementation planning into one section that addresses all the TMDLs in a more-or-less integrated fashion. Considerable monitoring has been identified as a needed component of implementation.*

Implementation – Negative Effects

No. 1
The South Fork Clearwater WAG does not want to see the TMDL be utilized to apply added restrictions on any sector of the drainage.

Economic consideration: LOGGING and AGRICULTURE are the lifeblood of this county. In any decision made, these must be considered. In the South Fork drainage, these occupations must be recovered and preserved for our county to survive. It's WAY past time for the NezPerce Forest to manage this drainage and clear the dead and dying trees. The whole area at the head of this drainage will burn one of these summers and the sediment will flow thick from the blackened forest. The water temperature will soar then. We should address this issue. It must be cleaned up now but I fear it's too late.

Recreation is important to tourists as well as to those of us who live and play here. Many roads and trails are used by recreation. Road obliteration in most cases is not necessary. Each time a road is gated and a road is obliterated, recreationists are closer to being locked out of the area. Hunting, swimming, tubing, fishing, etc. are all important to our economics.

As for the roads on federal lands, one option is to decommission the roads. Many on the SF WAG do not view this alternative as favorable. Many of the listed roads to be de-commissioned are used for recreation by many Idaho County residents and visitors to the county. Also, some of the roads are completely overgrown, and are not contributing sediment to the drainage. Therefore, why disturb what has naturally grown back?

…No matter what people say, TMDLs will result in some level of restriction to private and industrial use of the land, which is not warranted without clear evidence. Especially in an

economically depressed area like Idaho County, governmental restrictions simply so bureaucrats can justify their jobs is out of order.

No. 2
The WAG letter (no. 1) refers to a list of roads to be decommissioned. There is not such a list for federal lands in the South Fork Clearwater subbasin. The South Fork Clearwater Landscape Assessment, completed by the Nez Perce National Forest in 1998, included maps showing the results of a preliminary assessment of roads that may not be needed for long term access. Before any of these roads could decommissioned, they would go through an appropriate level of NEPA analysis, including public involvement.

No. 6
At no time was a list of roads for decommissioning discussed with or given to the WAG. Road decommissioning was discussed as one of many possibilities of measures that could be taken under the implementation plan. Closing roads to motorized use either permenently or seasonally is a management tool that has and should be used when necessary for wildlife, water quality, sediment, and road bed issues. I would like to point out that NONE of these closures or decommissions lock anyone out of the forest. These areas are open 24/7 to all other uses except motorized. I frequently use, and have never had a problem using, areas behind closed roads.

No. 7
I would like to note that no list of roads for decommissioning was ever presented at a WAG meeting that I attended, and no focus whatever was given during the WAG process to the notion of decommissioning roads.

Response: *Generally, the TMDLs for nonpoint sources of pollutants will result in an implementation plan that identifies possible BMPs to address the loading targets. For nonpoint sources of pollutants, actual implementation of those BMPs is voluntary on the part of the land owner/manager. Certainly, the system provides some incentives of various kinds to ecourage implementation of the BMPs. Any possible negative effects of implementing the BMPs, however, should be weighed during the period of decision to implement. All the situations brought up in the comments above should be addressed during the implementation planning and decision to implement phases. The TMDLs themselves in this document do not prescribe any specific action.*

Implementation – Grangeville WWTP

No. 3
One potential solution for the City of Grangeville will be land application of it's WWTP effluent during part of the summer period. This will mean removal of the flow from Threemile Creek during the period of time the Creek normally has it's lowest flow levels. There is a good chance sections of the Creek will go dry depending on the time of year and/or whether the yearly precipitation levels are above or below normal. Since Grangeville gets its municipal water from groundwater wells, the flow it provides to Threemile Creek,

through the WWTP outfall, is fairly recent from a historical perspective. Obviously, in a situation like this, there is a benefit to leaving the flow in the stream, however from an economic stand point, land application may be less expensive in the long run than treatment of temperature, phosphorus and nitrogen (if left in the TMDL). Therefore, the TMDL was remiss in not considering these impacts and investigating what incremental or phased improvements the treatment plant could make that would not be as much of an economic burden to the City and would provide the benefit of flow year-round in the stream. In other words, flexibility was not built into the draft TMDL that would enable a more holistic solution to be explored.

Response: *Similar to the response above for nonpoint source pollutants, the TMDL itself does not prescribe any particular action, only the level of load reductions that are needed. However, we are also aware that in the case of point source pollutants, the TMDL leads directly to action within the NPDES permitting system. And we are aware that the NPDES permitting system has some time frames associated with it. Having said that, we think that the NPDES permitting system, including input from DEQ, has the capability to allow for incremental and/or phased improvements to the treatment plant, for example through the establishment of a compliance schedule. We encourage you to discuss this with permitting officials from USEPA and staff engineers from DEQ.*

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