Blackfoot River Subbasin Assessment and Total Daily Maximum Loads

Addendum

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October 2012

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Cover photo provided by DEQ.

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Abbreviations, Acronyms, and Symbols

§303(d) Refers to section 303 subsection (d) of the Clean Water Act, or a list of impaired water bodies required by this section

AU assessment unit

AWS agricultural water supply

BLM United States Bureau of Land Management

BMP best management practice

BURP Beneficial Use Reconnaissance Program

C Celsius

CFR Code of Federal Regulations (refers to citations in the federal administrative rules)

cfs cubic feet per second

cfu colony forming units

CGP Construction General Permit

CWA Clean Water Act

CWAL cold water aquatic life

DEQ Idaho Department of Environmental Quality

DO dissolved oxygen

DWS domestic water supply

EPA United States Environmental Protection Agency

F Fahrenheit

FPA Idaho Forest Practices Act

GIS geographical information systems

HUC hydrologic unit code

ITD Idaho Transportation Department

IDAPA Refers to citations of Idaho administrative rules

IDL Idaho Department of Lands

ISCC Idaho Soil and Water Conservation Commission

kWh kilowatt-hour

LA load allocation

LC load capacity

m meter

m^2 square meter

mg milligram

MGD million gallons per day

mg/L milligram per liter

mL milliliter

MOS margin of safety

MPN most probable number

N nitrogen

NB natural background

NPDES National Pollutant Discharge Elimination System

NREL National Renewable Energy Laboratory

P phosphorus

PCR primary contact recreation

PFC proper functioning condition

PNV potential natural vegetation

SBA subbasin assessment

SCR secondary contact recreation

SEI streambank erosion inventory

SMA Surface Mining Act

TKN total Kjeldahl nitrogen

TMDL total maximum daily load

TN total nitrogen

TP total phosphorus

US United States

USC United States Code

USFS United States Forest Service

USGS United States Geological Survey

WAG watershed advisory group

WLA wasteload allocation

Executive Summary

This subbasin assessment (SBA) and total maximum daily load (TMDL) analysis has been developed to address the water bodies in the Blackfoot River subbasin (hydrologic unit code 17040207) that have been placed on Idaho's current Clean Water Act (CWA) Section 303(d) list for impaired waters. The SBA describes the physical, biological, and cultural setting; water quality status; pollutant sources; and recent pollution control actions in the Blackfoot River subbasin located in southeastern Idaho.

Regulatory Requirements

This document has been prepared in accordance with federal and state regulations, including the CWA, which requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters. States and tribes, pursuant to CWA §303, are to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the nation's waters whenever possible. CWA §303(d) establishes requirements for states and tribes to identify and prioritize water bodies that are water quality limited (i.e., water bodies that do not meet water quality standards). States and tribes must periodically publish a priority list (§303(d) list) of impaired waters. Currently, this list must be published every 2 years and is included as the list of Category 5 waters in *Idaho's 2010 Integrated Report* (DEQ 2011a). For waters identified on the §303(d) list, states and tribes must develop a TMDL for the pollutants, set at a level to achieve water quality standards.

The SBA is an important first step leading to the TMDL. Fifty-four segments of the Blackfoot River subbasin were identified on the §303(d) list of water quality limited water bodies. The SBA examines the status of §303(d)-listed waters and defines the extent of impairment and causes of water quality limitation throughout the subbasin. The TMDL analysis quantifies pollutant sources and allocates responsibility for load reductions needed to return listed waters to a condition meeting water quality standards.

Subbasin at a Glance

The Blackfoot River subbasin has an area of over 1,000 square miles in southeastern Idaho (Figure A). Chief activities within the subbasin are agriculture, both dryland and irrigated; livestock grazing; and phosphate mining. Major drainages include Wolverine, Brush, Corral, Meadow, Trail, Slug, Dry Valley, Angus, Diamond, and Lanes Creeks and Little Blackfoot River. Blackfoot Reservoir, though not listed for water quality concerns, splits the Blackfoot River subbasin roughly in half.

Historically, Blackfoot River water bodies sustained several beneficial uses. All streams supported cold water aquatic life and agriculture water supply as well as secondary contact recreation with the bigger streams also supporting primary contact recreation. Most streams also maintained spawning populations of salmonids. Domestic water supply has been officially declared a designated use in the Blackfoot River above the reservoir. Current information suggests that some beneficial uses, such as cold water aquatic life and salmonid spawning, are impaired and are not fully supported in several streams in the subbasin.

Subbasin:	Blackfoot River
HUC:	17040207
Beneficial Uses:	Cold water aquatic life, salmonid spawning, primary/secondary contact recreation, agricultural water supply, domestic water supply
Uses Affected:	Cold water aquatic life, salmonid spawning, secondary contact recreation
Pollutants:	Sediment, nutrients, bacteria, temperature, dissolved oxygen
Sources:	Point source: none Nonpoint source: agriculture, grazing, mining, recreation, roads

Figure A. Blackfoot River subbasin area.

Key Findings

In the Blackfoot River subbasin, 54 assessment units (AUs) are listed as impaired in Category 5 of the 2010 Integrated Report (DEQ 2011a). The causes include sediment (23 AUs), bacteria (22 AUs), selenium (17 AUs), dissolved oxygen (2 AUs), temperature (11 AUs), and combined biota/habitat bioassessments (4 AUs).

Sources of pollutant input above natural levels have been identified from various reports. Sediment input is the result of agricultural and livestock practices, changes in the natural hydrograph, roads, mining activities, and mass-wasting (e.g., landslides). The Idaho Department of Environmental Quality (DEQ) investigation showed that sediment was the main cause of impairment and that excess erosion in this subbasin is more significant from unstable, eroding streambanks than from upland erosion. Excess streambank erosion generally occurs during snowmelt and runoff in early spring, so the stability characteristics of streambanks were measured by DEQ at bank-full widths to determine rates of excess erosion above natural background levels. Sediment TMDLs were developed for those streams in which excess sediment was determined to be impairing water quality. Sources of bacteria to streams are varied and likely linked to human activity, grazing, agricultural practices, and wildlife. Bacteria TMDLs were developed for the AUs that exhibited bacteria levels in excess of water quality standards. Temperature and dissolved oxygen listings are interrelated and most likely due to the broad-scale removal of riparian habitat over time from grazing and agricultural practices. Potential natural vegetation TMDLs were developed to address temperature listings on the main stem Blackfoot River and will also serve as a surrogate for dissolved oxygen listings on the same AUs. Sources of selenium range from erosion of natural deposits and current and historic mining practices. Selenium TMDLs will not be developed in this document; rather they are being addressed under the Comprehensive Environmental Response, Compensation, and Liability Act, a mining reclamation program. Assessment outcomes for listed pollutants in the 2010 Integrated Report are given in Table A.

Table A. Summary of assessment outcomes.

Water Body/ Assessment Unit	Listed Pollutants	TMDLs Completed	Recommended Changes to Next Integrated Report	Justification
Deadman Creek ID17040207SK002_02b	Sediment	Yes	Move to Category 4a	TMDL completed
Grave Creek ID17040207SK005_02 ID17040207SK005_02a ID17040207SK005_03	Sediment	Yes	Move to Category 4a	TMDL completed
Warbonnet Creek ID17040207SK005_02b	*E. coli*, sediment	Yes	Move to Category 4a	TMDLs completed
Wood Creek ID17040207SK005_02c	Sediment	Yes	Move to Category 4a	TMDL completed
Coyote Creek ID17040207SK005_02d	Sediment	Yes	Move to Category 4a	TMDL completed
Sunday Creek ID17040207SK005_02e	Sediment	Yes	Move to Category 4a	TMDL completed
Corral Creek ID17040207SK006_02	*E. coli*	No	Unassessed for SCR; Move to Category 3	Not sampled
Corral Creek ID17040207SK006_03	*E. coli*	No	Move to Category 2	Meets water quality targets; listed in error
Corral Creek ID17040207SK006_04	*E. coli*	Yes	Move to Category 4a	TMDL completed
Chicken Creek ID17040207SK006_02a	Sediment	Yes	Move to Category 4a	TMDL completed
Bear Creek ID17040207SK006_02b	Sediment	Yes	Move to Category 4a	TMDL completed
Sawmill Creek ID17040207SK007_02a	*E. coli*	Yes	Move to Category 4a	TMDL completed
Thompson Creek ID17040207SK008_02	*E. coli*, sediment	Yes	Move to Category 4a	TMDLs completed
Thompson Creek ID17040207SK008_03	*E. coli*	No	Unassessed for SCR; Move to Category 3	Not sampled
Collett Creek ID17040207SK009_02a	*E. coli*, sediment	Yes	Move to Category 4a	TMDLs completed
Poison Creek ID17040207SK009_02b	*E. coli*, sediment	Yes	Move to Category 4a	TMDLs completed
Little Blackfoot River ID17040207SK009_03	Sediment	Yes	Move to Category 4a	TMDL completed

Water Body/ Assessment Unit	Listed Pollutants	TMDLs Completed	Recommended Changes to Next Integrated Report	Justification
State Land Creek ID17040207SK010_02a	Sediment	Yes	Move to Category 4a	TMDL completed
Blackfoot River ID17040207SK010_04 ID17040207SK010_05	Temperature, DO	Yes	Move temperature to Category 4a; delist DO and show as observed effect of temperature exceedance	Temperature TMDL completed and serves as surrogate for DO
Upper Johnson Creek ID17040207SK012_02a	Combined biota/ habitat bioassessments	No	Move to Category 2	Meets water quality targets; listed in error
Lower Johnson Creek ID17040207SK012_03a	Combined biota/ habitat bioassessments	Yes	List in Category 4a for sediment; delist for combined biota/habitat bioassessments; list in Category 4c for channelization	TMDL completed; sediment identified as pollutant; stream has been channelized and diverted
Goodheart Creek ID17040207SK012_02b	Sediment	Yes	Move to Category 4a	TMDL completed
Spring Creek ID17040207SK015_02	*E. coli*	No	Unassessed for SCR; Move to Category 3	Not sampled
Spring Creek ID17040207SK015_03	*E. coli*	No	Move to Category 2	Meets water quality targets; listed in error
Upper Mill Canyon ID17040207SK015_02a	Sediment	No	Delist for sediment	Meets water quality targets
Diamond Creek ID17040207SK016_02	*E. coli*	No	Unassessed for SCR; Move to Category 3	Not sampled
Diamond Creek ID17040207SK016_02a	*E. coli*	No	Move to Category 2	Meets water quality targets; Listed in error
Diamond Creek ID17040207SK016_03 ID17040207SK016_03a	*E. coli*	Yes	Move to Category 4a	TMDL completed

Water Body/ Assessment Unit	Listed Pollutants	TMDLs Completed	Recommended Changes to Next Integrated Report	Justification
Lower Chippy Creek ID17040207SK021_03	Sediment, combined biota/ habitat bioassessments, habitat assessments	Yes	Move to Category 4a; delist for combined biota/habitat bioassessments, habitat assessments	TMDL completed; sediment identified as pollutant
Angus Creek ID17040207SK023_02	*E. coli*	No	Unassessed for SCR; Move to Category 3	Not sampled
Angus Creek ID17040207SK023_02b	*E. coli*	Yes	Move to Category 4a	TMDL completed
Angus Creek ID17040207SK023_04	*E. coli*	No	Move to Category 2	Meets water quality targets; listed in error
Clarks Cut ID17040207SK025_02c	Sediment	Yes	Move to Category 4a and Category 2	TMDL completed and AWS use supported
Crooked Creek ID17040207SK025_03b	Sediment	Yes	Move to Category 4a	TMDL completed
Rawlins Creek ID17040207SK027_02	Sediment	Yes	Move to Category 4a	TMDL completed
Rawlins Creek ID17040207SK027_03	Fecal coliform	Yes	Move to Category 4a; change bacteria type from fecal coliform to *E. coli*	TMDL completed
Poison Creek ID17040207SK027_02b	*E. coli*	No	Move to Category 2	Meets water quality targets; listed in error
Cedar Creek ID17040207SK029_02	*E. coli*	Yes	Move to Category 4a	TMDL completed
Cedar Creek ID17040207SK029_03	*E. coli*	No	Move to Category 2	Meets water quality targets; listed in error
Cedar Creek ID17040207SK029_03	Sediment, benthic macroinvertebrate bioassessments, combined biota/habitat bioassessments, habitat assessment	Yes	Move to Category 4a; delist for benthic macroinvertebrate bioassessment, combined biota/habitat bioassessments, habitat assessments	Sediment TMDL completed; sediment identified as pollutant

Water Body/ Assessment Unit	Listed Pollutants	TMDLs Completed	Recommended Changes to Next Integrated Report	Justification
Jones Creek ID17040207SK031_02	Sediment	Yes	Move to Category 4a	TMDL completed

Notes: total maximum daily load (TMDL); *Escherichia coli* (*E. coli*); secondary contact recreation (SCR); dissolved oxygen (DO); agricultural water supply (AWS)

1. Subbasin Assessment—Watershed Characterization

This document presents an addendum to the Blackfoot River subbasin assessment (SBA) and total maximum daily load (TMDL) and addresses the water bodies in the Blackfoot River subbasin placed on the Clean Water Act (CWA) Section 303(d) list for impaired waters and included in Category 5 waters of *Idaho's 2010 Integrated Report* (DEQ 2011a).

1.1 Introduction—Regulatory Requirements

This document was prepared in compliance with both federal and state regulatory requirements including the CWA, which requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters. States and tribes, pursuant to CWA §303, are to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the nation's waters whenever possible.

CWA §303(d) establishes requirements for states and tribes to identify and prioritize water bodies that are water quality limited (i.e., water bodies that do not meet water quality standards). States and tribes must periodically publish a priority list (§303(d) list) of impaired waters. For waters identified on this list, states and tribes must develop a TMDL for the pollutants, set at a level to achieve water quality standards.

1.2 Public Participation and Comment Opportunities

Development of the Blackfoot River subbasin (hydrologic unit code [HUC] 17040207) assessment and addendum included public participation in the May 2012 watershed advisory group's (WAG's) review of the initial draft document.

1.3 Physical and Biological Characteristics

A detailed discussion of the physical and biological characteristics is provided in the *Blackfoot River TMDL Waterbody Assessment and Total Maximum Daily Load* including climate, subbasin and subwatershed characteristics, stream characteristics, and cultural characteristics approved by the US Environmental Protection Agency (EPA) in 2002 (DEQ 2001).

2. Subbasin Assessment—Water Quality Concerns and Status

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

2.1 Water Quality Limited Assessment Units Occurring in the Subbasin

In the Blackfoot River subbasin, there are 54 assessment units (AUs) listed as impaired in the 2010 Integrated Report (DEQ 2011a). The causes include sediment (23 AUs), bacteria (22 AUs), selenium (17 AUs), dissolved oxygen (2 AUs), temperature (11 AUs), and combined biota/habitat bioassessments (4 AUs). Selenium TMDLs will not be developed in this document; rather they are being addressed under the Comprehensive Environmental Response, Compensation, and Liability Act, a mining reclamation program.

2.1.1 Additional Waters Listed Since SBA/TMDL Approval

Table 1 shows the pollutants listed for each water body and AU in the Blackfoot River subbasin that has been added since publication of the *Blackfoot River TMDL Waterbody Assessment and Total Maximum Daily Load* approved by EPA in 2002 (DEQ 2001).

Table 1. Additional §303 (d)-listed water bodies and pollutants in the Blackfoot River subbasin.

Water Body	Assessment Unit	Pollutants
Angus Creek	ID17040207SK023_02	*E. coli*
Angus Creek	ID17040207SK023_02b	*E. coli*, selenium, temperature
Angus Creek	ID17040207SK023_04	*E. coli*, temperature
Bear Creek	ID17040207SK006_02b	Sediment
Blackfoot River	ID17040207SK010_04	DO, selenium, temperature
Blackfoot River	ID17040207SK010_05	DO, selenium, temperature
Cedar Creek	ID17040207SK029_02	*E. coli*
Cedar Creek	ID17040207SK029_03	Benthic macroinvertabrate bioassessment, combined biota/habitat bioassessments, *E coli*, habitat assessment, sediment
Chicken Creek	D17040207SK006_02a	Sediment
Chicken Creek	ID17040207SK013_02b	Selenium
Lower Chippy Creek	ID17040207SK021_03	Combined biota/habitat bioassessments, habitat assessments, sediment
Clarks Cut	ID17040207SK025_02c	Sediment
Collett Creek	ID17040207SK009_02a	*E. coli*, sediment
Corral Creek	ID17040207SK006_02	*E. coli*
Corral Creek	ID17040207SK006_03	*E. coli*
Corral Creek	ID17040207SK006_04	*E. coli*
Coyote Creek	ID17040207SK005_02d	Sediment
Crooked Creek	ID17040207SK025_03b	Sediment
Deadman Creek	ID17040207SK002_02b	Sediment
Diamond Creek	ID17040207SK016_02	*E. coli*,
Diamond Creek	ID17040207SK016_02a	*E. coli*, temperature
Diamond Creek	ID17040207SK016_03	*E. coli*, temperature

Water Body	Assessment Unit	Pollutants
Diamond Creek	ID17040207SK016_03a	*E. coli*, temperature
Dry Valley Creek	ID17040207SK013_02a	Selenium
Dry Valley Creek	ID17040207SK013_03	Selenium
Goodheart Creek	ID17040207SK012_02b	Sediment, selenium
Grave Creek	ID17040207SK005_02	Sediment
Grave Creek	ID17040207SK005_02a	Sediment
Grave Creek	ID17040207SK005_03	Sediment
Upper Johnson Creek	ID17040207SK012_02a	Combined biota/habitat bioassessments
Lower Johnson Creek	ID17040207SK012_03a	Combined biota/habitat bioassessments
Jones Creek	ID17040207SK031_02	Sediment
Little Blackfoot River	ID17040207SK009_03	Sediment
Maybe Creek	ID17040207SK014_02	Selenium
Mill Canyon	ID17040207SK015_02a	Sediment, selenium
Mill Canyon	ID17040207SK015_02b	Selenium
Olsen Creek	ID17040207SK021_02a	Temperature
Poison Creek	ID17040207SK009_02b	*E. coli*, sediment
Poison Creek	ID17040207SK027_02b	*E. coli*
Rasmussen Creek	ID17040207SK023_02a	Selenium
Rawlins Creek	ID17040207SK027_02	Sediment
Rawlins Creek	ID17040207SK027_03	Fecal coliform
Sawmill Creek	ID17040207SK007_02a	*E. coli*
Sheep Creek	ID17040207SK022_02	Selenium, temperature
Sheep Creek	ID17040207SK022_03	Selenium
Sheep Creek	ID17040207SK022_03a	Selenium
Spring Creek	ID17040207SK015_02	*E. coli*, selenium, temperature
Spring Creek	ID17040207SK015_03	*E. coli*, selenium, temperature
State Land Creek	ID17040207SK010_02a	Sediment, selenium
Sunday Creek	ID17040207SK005_02e	Sediment
Thompson Creek	ID17040207SK008_02	*E. coli*, sediment
Thompson Creek	ID17040207SK008_03	*E. coli*
Warbonnet Creek	ID17040207SK005_02b	*E. coli*, sediment
Wood Creek	ID17040207SK005_02c	Sediment

Not all of the water bodies will require a TMDL; however, a thorough investigation, using the available data, was performed before this conclusion was made.

2.2 Applicable Water Quality Standards and Beneficial Uses

Idaho "Water Quality Standards" (IDAPA 58.01.02) designate beneficial uses and set water quality goals for the waters of the state.

Idaho water quality standards require that surface waters of the state be protected for *beneficial uses*, wherever attainable (IDAPA 58.01.02.050.02). These beneficial uses are interpreted as existing uses, designated uses, and presumed uses as briefly described in the following sections and in Table 2. The *Water Body Assessment Guidance* (Grafe et al. 2002) gives a more detailed description of beneficial use identification for use assessment purposes.

2.2.1 Existing Uses

Existing uses under the CWA are "those uses actually attained in the water body on or after November 28, 1975, whether or not they are included in the water quality standards." The existing instream water uses and the level of water quality necessary to protect the uses shall be maintained and protected (IDAPA 58.01.02.050.02; and .02.054). Existing uses include uses actually occurring, whether or not the level of quality exists to fully support the uses. A practical application of this concept would be to apply the existing use of salmonid spawning to a water that could support salmonid spawning, but salmonid spawning is not occurring due to other factors, such as dams blocking migration.

2.2.2 Designated Uses

Designated uses under the CWA are "those uses specified in water quality standards for each water body or segment, whether or not they are being attained." Designated uses are uses officially recognized by the state. In Idaho, these designated uses include aquatic life support, recreation in and on the water, domestic water supply, and agricultural uses. 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 IDAPA 58.01.02.010.24 and .02.110–160, in addition to citations for existing uses.

2.2.3 Presumed Uses

In Idaho, most water bodies listed in the water quality standards do not yet have specific use designations. These undesignated uses will be designated. In the interim, and absent information on existing uses, DEQ presumes that most waters in the state will support cold water aquatic life and either primary contact recreation (PCR) or secondary contact recreation (SCR) (IDAPA 58.01.02.101.01). To protect these presumed uses, DEQ will apply the numeric cold water criteria and PCR or SCR criteria to undesignated waters.

If in addition to these presumed uses, an additional existing use (e.g., salmonid spawning) exists, because of the requirement to protect levels of water quality for existing uses, then the additional numeric criteria for salmonid spawning would apply (e.g., intergravel dissolved oxygen [DO] and temperature) (Appendix A). However, for example, if 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).

Table 2. Beneficial uses of §303(d)-listed streams.

Water Body/ Assessment Unit	Beneficial Uses	Type of Use (designated, existing, presumed)
Angus Creek ID17040207SK023_02 ID17040207SK023_02b ID17040207SK023_04	CWAL, SCR	Presumed
Bear Creek ID17040207SK006_02b	CWAL, SCR	Presumed
Blackfoot River ID17040207SK010_04 ID17040207SK010_05	CWAL, SS, PCR, DWS	Designated
Cedar Creek ID17040207SK029_02 ID17040207SK029_03	CWAL, SCR	Presumed
Chicken Creek ID17040207SK006_02a	CWAL, SCR	Presumed
Chicken Creek ID17040207SK013_02b	CWAL, SCR	Presumed
Lower Chippy Creek ID17040207SK021_03	CWAL, SCR	Presumed
Clarks Cut ID17040207SK025_02c	AWS[a]	Existing[a]
Collett Creek ID17040207SK009_02a	CWAL, SCR	Presumed
Corral Creek ID17040207SK006_02 ID17040207SK006_03 ID17040207SK006_04	CWAL, SCR	Presumed
Coyote Creek ID17040207SK005_02d	CWAL, SCR	Presumed
Crooked Creek ID17040207SK025_03b	CWAL, SCR	Presumed
Deadman Creek ID17040207SK002_02b	CWAL, SCR	Presumed
Diamond Creek ID17040207SK016_02 ID17040207SK016_02a ID17040207SK016_03 ID17040207SK016_03a	CWAL, SCR	Presumed
Dry Valley Creek ID17040207SK013_02a ID17040207SK013_03	CWAL, SCR	Presumed

Water Body/ Assessment Unit	Beneficial Uses	Type of Use (designated, existing, presumed)
Goodheart Creek ID17040207SK012_02b	CWAL, SCR	Presumed
Grave Creek ID17040207SK005_02 ID17040207SK005_02a ID17040207SK005_03	CWAL, SCR	Presumed
Johnson Creek ID17040207SK012_02a ID17040207SK012_03a	CWAL, SCR	Presumed
Jones Creek ID17040207SK031_02	CWAL, SCR	Presumed
Little Blackfoot River ID17040207SK009_03	CWAL, SCR	Presumed
Maybe Creek ID17040207SK014_02	CWAL, SCR	Presumed
Mill Canyon ID17040207SK015_02a ID17040207SK015_02b	CWAL, SCR	Presumed
Olsen Creek ID17040207SK021_02a	CWAL, SCR	Presumed
Poison Creek ID17040207SK009_02b	CWAL, SCR	Presumed
Poison Creek ID17040207SK027_02b	CWAL, SCR	Presumed
Rasmussen Creek ID17040207SK023_02a	CWAL, SCR	Presumed
Rawlins Creek ID17040207SK027_02 ID17040207SK027_03	CWAL, SCR	Presumed
Sawmill Creek ID17040207SK007_02a	CWAL, SCR	Presumed
Sheep Creek ID17040207SK022_02 ID17040207SK022_03 ID17040207SK022_03a	CWAL, SCR	Presumed
Spring Creek ID17040207SK015_02 ID17040207SK015_03	CWAL, SCR	Presumed
State Land Creek ID17040207SK010_02a	CWAL, SCR	Presumed
Sunday Creek ID17040207SK005_02e	CWAL, SCR	Presumed

Water Body/ Assessment Unit	Beneficial Uses	Type of Use (designated, existing, presumed)
Thompson Creek ID17040207SK008_02 ID17040207SK008_03	CWAL, SCR	Presumed
Warbonnet Creek ID17040207SK005_02b	CWAL, SCR	Presumed
Wood Creek ID17040207SK005_02c	CWAL, SCR	Presumed

Notes: cold water aquatic life (CWAL), salmonid spawning (SS), primary contact recreation (PCR), secondary contact recreation (SCR), agricultural water supply (AWS), domestic water supply (DWS)
a. See section 5.1

2.3 Criteria to Support Beneficial Uses

Beneficial uses are protected by a set of criteria, which include *narrative* criteria for pollutants such as sediment and nutrients and *numeric* criteria for pollutants such as bacteria, DO, pH, ammonia, temperature, and turbidity (IDAPA 58.01.02.250).

Table 3 includes the most common numeric criteria used in TMDLs.

Figure 1 provides an outline of the stream assessment process for determining support status of the beneficial uses of cold water aquatic life, salmonid spawning, and contact recreation.

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

Designated and Existing Beneficial Uses				
Water quality parameter	**Primary contact recreation**	**Secondary contact recreation**	**Cold water aquatic life**	**Salmonid spawning (during spawning and incubation periods for inhabiting species)**
Water Quality Standards: IDAPA 58.01.02.250				
Bacteria, pH, and DO	Less than 126 *E. coli*/100 mL[a] as a geometric mean of 5 samples over 30 days; no sample greater than 406 *E. coli* organisms/100 mL	Less than 126 *E. coli*/100 mL as a geometric mean of 5 samples over 30 days; no sample greater than 576 *E.coli*/100 mL	●pH between 6.5 and 9.0 ●DO exceeds 6.0 mg/L	●pH between 6.5 and 9.5 ●Water column DO: DO exceeds 6.0 mg/L in water column or 90% saturation, whichever is greater ●Intergravel DO: DO exceeds 5.0 mg/L for a 1-day minimum and exceeds 6.0 mg/L for a 7-day average
Temperature[b]	—	—	22 °C or less daily maximum; 19 °C or less daily average	●13 °C or less daily maximum; 9 °C or less daily average ●Bull trout: not to exceed 13 °C maximum weekly maximum temperature over warmest 7-day period, June–August; not to exceed 9 °C daily average in September and October
Turbidity	—	—	Turbidity shall not exceed background by more than 50 NTU instantaneously or more than 25 NTU for more than 10 consecutive days.	—
Ammonia	—	-—	Ammonia not to exceed calculated concentration based on pH and temperature.	—

Designated and Existing Beneficial Uses				
Water quality parameter	**Primary contact recreation**	**Secondary contact recreation**	**Cold water aquatic life**	**Salmonid spawning (during spawning and incubation periods for inhabiting species)**
EPA Bull Trout Temperature Criteria: Water Quality Standards for Idaho, 40 CFR Part 131				
Temperature	—	—	—	7-day moving average of 10 °C or less maximum daily temperature for June–September

Notes: dissolved oxygen (DO); milligram per liter (mg/L); nephelometric turbidity units (NTU); metric-English conversion chart provided in Appendix B.
a. *Escherichia coli* organisms per 100 milliliters (mL)
b. Temperature Exemption—Exceeding the temperature criteria will not be considered a water quality standard violation when the air temperature exceeds the 90th percentile of the 7-day average daily maximum air temperature calculated in yearly series over the historic record measured at the nearest weather reporting station.

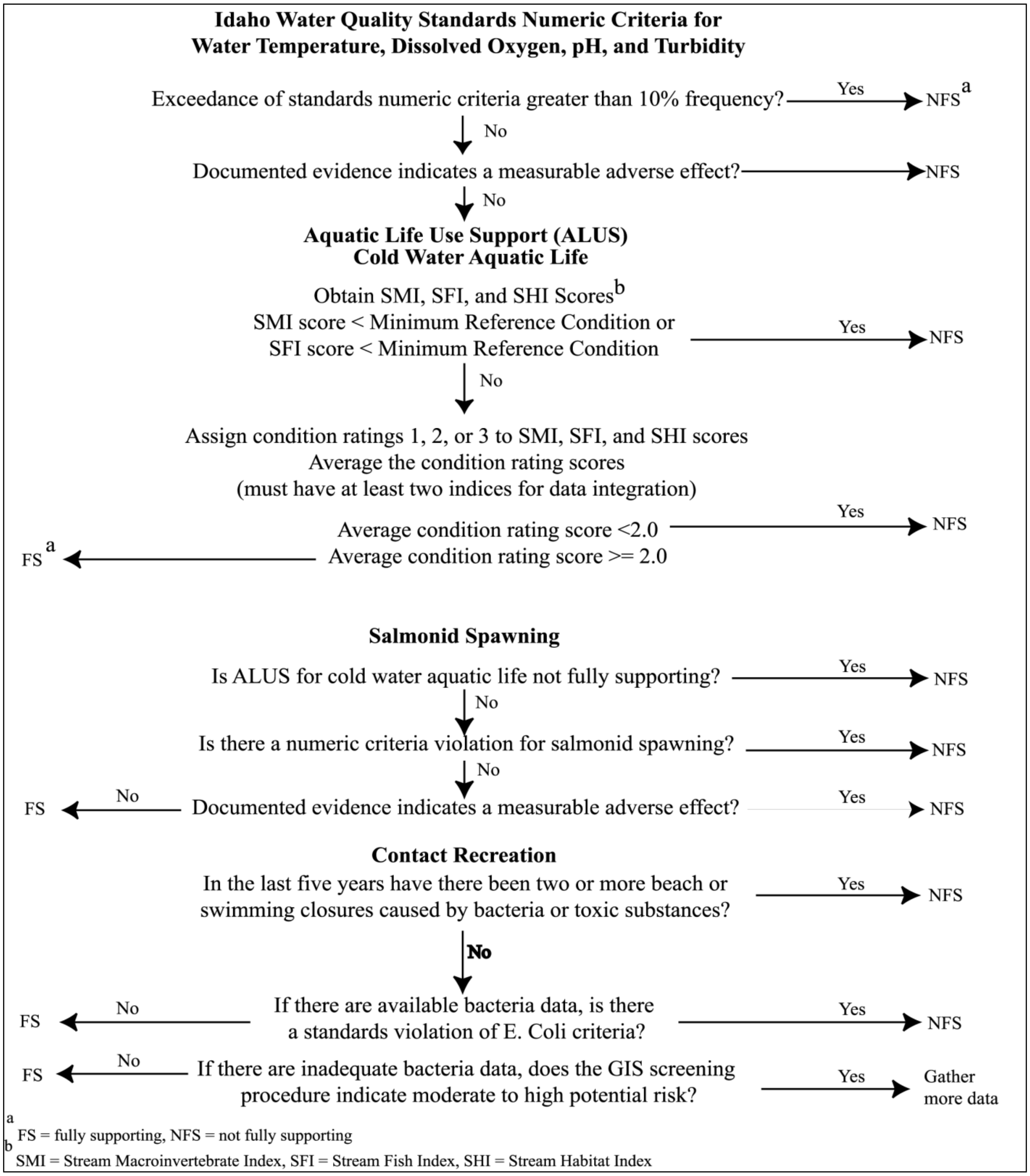

Figure 1. Steps and criteria for determining support status of beneficial uses in wadeable streams (Grafe et al. 2002).

2.4 Summary and Analysis of Existing Water Quality Data

A detailed summary and analysis of existing water quality data for the Blackfoot River subbasin is provided in the *Blackfoot River TMDL Waterbody Assessment and Total Maximum Daily Load* approved by EPA in 2002 (DEQ 2001). This TMDL deals specifically with sediment, *Escherichia coli* (*E. coli)*, DO, and temperature.

3. Subbasin Assessment—Pollutant Source Inventory

A detailed discussion of the pollutant sources in the Blackfoot River subbasin is provided in the *Blackfoot River TMDL Waterbody Assessment and Total Maximum Daily Load* approved by EPA in 2002 (DEQ 2001).

4. Monitoring and Status of Water Quality Improvements

In 2006, DEQ assembled the *Blackfoot River TMDL Implementation Plan* in association with the Idaho Soil and Water Conservation Commission (ISCC), Idaho Department of Lands (IDL), Bureau of Land Management (BLM), US Forest Service (USFS) Caribou-Targhee National Forest, and Idaho Transportation Department (ITD) (DEQ 2006).

4.1 Responsible Parties

Table 4 provides a summary of the federal, state, and local governments; individuals; or entities that are involved in or responsible for implementing the TMDL.

Table 4. Designated management agencies and responsibility in implementing the Blackfoot River total maximum daily load.

Designated Management Agency	Resource Responsibility
Idaho Soil and Water Conservation Commission	Agriculture
Bureau of Land Management (BLM)	BLM Land
US Forest Service (USFS) Caribou-Targhee National Forest	USFS Land
Idaho Department of Lands	State endowment lands, timber harvest, and mining
Idaho Department of Transportation	Roads

4.1.1 Idaho Soil and Water Conservation Commission and Idaho Department of Lands—Agriculture

The Idaho Soil and Water Conservation Commission (ISCC) completed an implementation plan for the agricultural component of TMDL implementation. ISCC used current loads, target exceedances, percent reductions, and bank stability analysis to rank stream segments for nutrient and sediment best management practice (BMP) implementation. ISCC further prioritized those waters by identifying critical areas that would have the most impact on the quality of the receiving waters (DEQ 2006). Table 5 provides a summary of critical areas defined in the agricultural implementation plan. A full description of the process for ranking water bodies and their specific stream segments is located in DEQ (2006) and at http://www.deq.idaho.gov/media/450462-water_data_reports_surface_water_tmdls_blackfoot_river_blackfoot_river_implementation_entire.pdf.

Table 5. Idaho Soil and Water Conservation Commission agriculture implementation summary.

Water Body	Pollutant	Activity or Strategy	Priority
Wolverine Creek	Sediment, nutrients	Riparian, range, animal facilities	High
Lower Blackfoot River	Sediment, nutrients	Riparian, crop and pasture, animal facilities	High
Brush Creek	Sediment, nutrients	Crop and pasture	High
Middle Blackfoot River	Sediment, nutrients	Riparian, crop and pasture, range acres	Medium
Meadow Creek	Sediment, nutrients	Crop and pasture	Medium
Lanes Creek	Sediment, nutrients	None[a]	Medium
Upper Blackfoot River	Sediment, nutrients	Riparian, crop and pasture	Medium
Slug Creek	Sediment, nutrients	None[a]	Low
Diamond Creek	Sediment, nutrients	None[a]	Low

Source: DEQ 2006
a. Implementation activities already completed.

A general schedule for all ISCC agricultural implementation activities is contained in DEQ (2006). Table 6 is a copy of the timeline. According to the timeline prescribed in the implementation plan, ISCC should have completed assessment reports and conservation plans on all of the project areas and should be finalizing BMP designs (DEQ 2006).

Table 6. Idaho Soil and Water Conservation Commission agricultural implementation plan timeline.

Task	Output	Milestone
Evaluate the project areas	Assessment reports	2008
Develop conservation plans and contracts	Completed plans and contracts	2010
Finalize best management practice (BMP) designs	Completed BMP plans and designs	2012
Design and install approved BMPs	Certify BMP installations	2015
Track BMP installations	Implementation progress reports	2017
Evaluate BMP and project effectiveness	Complete project effectiveness reports	2020

IDL submitted an implementation section for grazing on Idaho endowment lands. Table 7 summarizes the components of the grazing plan.

Table 7. Idaho Department of Lands grazing implementation plan.

Task	Milestone
Prepare grazing management plans for allotments to meet water quality standards	Rotating 10-year cycle based on lease renewal interval
Implement grazing management plans on allotments	One year following development of grazing plan
Perform best management practice grazing management review, and inspection on selected allotments	Annually at end of grazing season
Develop and implement site-specific monitoring of selected allotments	Annually

4.1.2 Bureau of Land Management—BLM Lands

BLM submitted an implementation plan for BLM lands in the Blackfoot River subbasin. Table 8 provides a summary of implementation activities outlined in DEQ (2006). In addition to the strategies outlined in Table 8, BLM indicated that they would monitor for stubble height annually and conduct proper functioning condition (PFC) analysis every 3–5 years along critical reaches on high-priority streams. In medium-priority streams, BLM stated they would monitor one-half of the stream segments for stubble height every 1–2 years and measure streambank stability and PFC every 3–5 years. Low-priority streams will be monitored for PFC during scheduled allotment assessments and stubble height for compliance as time permits. The time frames discussed for monitoring are the only time frames mentioned in the implementation plan. No specific time frames were established for specific implementation activities in the high- and medium-priority stream segments.

Table 8. Bureau of Land Management implementation summary.

Water Body	Pollutant	Activity or Strategy	Priority
Blackfoot River	Sediment, nutrients	Reinstate primary use of area as a stock driveway; restrict overnight use of riparian area by cattle; remove fences restricting cattle movement; develop water sources; limit use on key forage species on steep slopes to 50%; and reseed areas of agriculture trespass. If all else fails, fence riparian area and restrict use; install signs to indicate public lands.	High[a]
Wolverine Creek	Sediment, nutrients	Remove livestock from riparian habitat; exclude livestock for at least three seasons; install exclusion fencing; limit overuse on key forage species on steep slopes. If all else fails, adjust the stocking rate to >acres/AUM	High[a]
Jones Creek	Nutrients	Limit use on key forage species on steep slopes to 50%.	High[a]
Brush Creek	Sediment	Work towards 80% bank stability, riparian/wetland areas towards PFC, 4-inch stubble heights	Medium
Dry Valley Creek	Sediment	Work towards 80% bank stability, riparian/wetland areas towards PFC, 4-inch stubble heights	Medium
Lanes Creek	Sediment	Work towards 80% bank stability, riparian/wetland areas towards PFC, 4-inch stubble heights	Medium
Meadow Creek	Sediment	Work towards 80% bank stability, riparian/wetland areas towards PFC, 4-inch stubble heights	Medium
Trail Creek	Sediment	Work towards 80% bank stability, riparian/wetland areas towards PFC, 4-inch stubble heights	Medium
All remaining unlisted streams on BLM within the subbasin	None	Monitored for PFC	Low

Notes: proper functioning condition (PFC); animal unit month (AUM)
a. All high priority goals are working towards 80% bank stability, riparian/wetland areas towards PFC, 4-inch stubble heights as well as activities listed in table.

4.1.3 USFS Caribou-Targhee National Forest—Forest Lands

The USFS submitted an implementation plan for Caribou-Targhee National Forest lands in the Blackfoot River subbasin. Table 9 provides a summary of implementation activities outlined in DEQ (2006).

Table 9. USFS Caribou-Targhee National Forest implementation summary.

Water Body	Pollutant	Activity or Strategy	Monitoring	Timeline
Upper Blackfoot River	Sediment	Maintain the Blackfoot River road near the region called “The Narrows” by working with county to minimize dust; maintain a vegetative buffer; minimize side cast; and continue general road maintenance	Depth fines and streambank stability every 5 years	Ongoing
Trail Creek	Sediment	Maintain adjacent roads by working with county to minimize dust; maintain a vegetative buffer; minimize side cast; and continue general road maintenance	Depth fines every 5 years and streambank stability every 2 years	Ongoing
Slug Creek	Sediment	Revised grazing standards	Depth fines every 5 years and streambank stability every 2 years	2004
Dry Valley Creek	Sediment	Modified grazing practices	Depth fines every 5 years, streambank stability every 2 years, and turbidity monitoring during high and low flows annually	2004
Maybe Creek	Sediment	Remedial actions for mining	Remedial action monitoring for 10 years	2005
Angus Creek	Sediment	Modify grazing practices, conduct mining site investigations	Depth fines every 5 years and streambank stability every 2 years	2005[a]
Lanes Creek	Sediment	Revised grazing standards	Depth fines every 5 years and streambank stability every 2 years	2004
Bacon Creek	Sediment	Revised grazing standards	None[b]	2004
Sheep Creek	Sediment	Grazing modifications	Depth fines every 5 years and streambank stability every 2 years	2003
Diamond Creek	Sediment	Grazing modifications	Depth fines every 5 years and streambank stability every 2 years	2004

a. Time line is for mining site investigation.
b. No monitoring scheduled because overall stream condition is good.

4.1.4 Idaho Department of Lands—Timber Harvest

IDL, the designated state agency responsible for administering and enforcing the Forest Practices Act (FPA) on all forestland in the state, submitted an implementation plan for timber harvest in the Blackfoot River subbasin. The actual harvest and processing of trees into logs has relatively little impact on water quality. Rather, the main impact to water quality is from the construction and use of timber harvest roads. To address sediment delivery into streams from roads, the specific BMPs are identified in the FPA. As part of administering the FPA, IDL will monitor and inspect timber harvests for compliance with the FPA. If inadequate BMP implementation is identified, IDL will use standard FPA enforcement procedures to rectify the situation.

4.1.5 Idaho Department of Lands—Mining

IDL is designated the lead agency for surface mining practices on state land. IDL will continue to work collaboratively with all state and federal agencies in implementing the 1971 Surface Mining Act (SMA).

4.1.6 Idaho Transportation Department—Roads

An implementation plan for roads was submitted by ITD. In their continuing role as the designated agency with responsibility for roads, ITD will control erosion and manage sediment within construction limits based on existing policies, while acknowledging new and improved erosion and sediment control products and practices. They will also undertake a proactive effort to inventory and correct existing problem areas. ITD also provides support to local transportation agencies including those in Bingham, Bonneville, and Caribou Counties and Blackfoot, Idaho.

4.2 Accomplished Activities

Table 10 provides a summary of implementation activities accomplished by the designated land management agencies.

Table 10. Completed implementation activities by land management agencies.

Agency	Project
BLM	Cedar Ford—2.47 miles of fence installed, 476 acres excluded, and 2.5 miles of river protected.
BLM	Cutthroat Trout—1.46 mile of fence installed, 528 acres excluded, and 2.4 miles of river protected.
BLM	Deadman Creek—0.48 miles of fence installed, 19 acres excluded, and 0.26 miles of river protected.
BLM	Morgan Bridge—5.12 miles of fence installed, 449 acres excluded, and 3.1 miles of river protected.
BLM	Trail Creek—1.7 miles of fence installed, 100 acres excluded, and 3.5 miles of river protected.
BLM	Installed pump, pipeline, tank, and trough system for off-river watering.
BLM	Installed 3 trench and pond systems for off-river watering.
BLM	Installed 4 cattle guards.
IDL	Brush Creek—installed well-based off-site water system.
IDL	Rich Creek—Added two troughs and 1.5 miles of pipeline to existing well-based off-site water system.
IDL	Developed and troughed Horse Camp Spring.
IDL	Developed and troughed Sunday Creek Spring.
IDL	Corral Creek—installed 4 troughs for off-river watering.
IDL	Corral Creek—installed drift fence.
IDL	Sawmill Creek—installed trough for off-river watering.
ISCC	Blackfoot River—installed 14,742 linear feet of fence, excluding 502 acres.
ISCC	Blackfoot River—installed 3 float-through water crossings.
ISCC	Removed 3,912 linear feet of damaged or failing fencing.
ISCC	Installed one off-site watering system.
USFS	Diamond Creek grazing allotment—conducted a grazing BMP review.

Notes: Bureau of Land Management (BLM); Idaho Department of Lands (IDL); Idaho Soil and Water Conservation Commission (ISCC); US Forest Service (USFS); best management practice (BMP).

4.3 Future Strategy

Monitoring in the Blackfoot River watershed has varied in form and intensity. Many streams have had Beneficial Use Reconnaissance Program (BURP) assessments, streambank erosion inventories (SEI), and/or McNeil Core Sampler depth fines or traditional water-quality sampling. Continuous monitoring of temperature, pH, DO, specific conductance, and turbidity has been in effect on the Blackfoot River at China Hat Bridge since 2004. While monitoring has been successful in aiding determination of baseline conditions, attainment of TMDLs, and associated beneficial uses, locations will need to be reassessed to evaluate progress in conjunction with the proposed timelines presented in land management implementation plans.

The attainment of beneficial uses in tributaries of the Blackfoot River will be monitored on a limited basis under the BURP protocol. Continuous monitoring of the main stem Blackfoot River will continue. Streams will also be assessed to evaluate their progress toward beneficial use attainment status through SEIs and/or depth fine sampling. The combination of these approaches will aid in defining the current state of the watershed and help focus implementation. Coordinating and sharing this information with the lead management and implementation agencies, landowners, and interested parties will further aid in improving watershed health.

4.4 Planned Time Frame

Currently, two agencies have submitted a time frame for their implementation strategies. ISCC submitted their agriculture implementation strategy that outlines tasks and goals designed to improve water quality through BMPs. ISCC estimates that broad scale implementation of BMPs in the watershed will take 10 years. Meeting TMDL targets, including streambank stability targets, depth fine targets, and PFC should be met in conjunction with this timeline. IDL provided a timeline for implementation of grazing management plans on endowment lands. This timeline is based on the 10-year lease periods of the allotments. According to the schedule of allotment lease renewals provided in the implementation plan, full implementation of general grazing management plans should be accomplished by 2015 while site-specific planning and implementation will continue beyond that date.

DEQ requests that other agencies tasked with implementation strategies provide timelines for implementation. A reasonable expectation for water body improvements resulting from timely implementation of BMPs is 10–20 years. Continued monitoring, as previously described, will ascertain which water bodies are responding to implementation plans and where additional effort is needed.

5. Total Maximum Daily Loads

A TMDL prescribes an upper limit (or *load capacity*) on discharge of a pollutant from all sources to ensure water quality standards are met. This load capacity can be represented by Equation 1:

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

Equation 1. Load capacity.

where:

LC = load capacity.

MOS = margin of safety. Because of uncertainties about load quantification and the relationship between specific loads and attainment of water quality standards, 40 CFR 130 requires a MOS, which is effectively a reduction in the LC available for allocation to pollutant sources.

NB = natural background. When present, NB may be considered part of load allocation (LA), but it is often considered separately because it represents a part of the load not subject to control. NB is also a reduction in the LC available for allocation to human-made pollutant sources.

LA = load allocation for all nonpoint sources.

WLA = wasteload allocation for all point sources.

A load is a quantity of a pollutant discharged over some period; numerically, it is the product of concentration and flow. Due to the diverse nature of various pollutants, and the difficulty of strictly dealing with loads, 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 water quality standards also recognize the particular difficulty of quantifying nonpoint loads and allow “gross allotment” as a load allocation where available data or appropriate predictive techniques limit more accurate estimates. For certain pollutants with long-term effects, such as sediment and nutrients, EPA allows for seasonal or annual loads. However, recent court cases have required articulating these as daily loads also.

5.1 Sediment Total Maximum Daily Loads

Twenty-three AUs within the Blackfoot River subbasin are listed in Category 5 of the 2010 Integrated Report for sedimentation/siltation impairment. Two additional AUs, upper and lower Johnson Creek, are listed for combined biota/habitat bioassessments and were evaluated for potential sediment impairment. No sediment point sources are known to exist in any of the affected watersheds.

Two SEIs were conducted on upper Johnson Creek (ID17040207SK012_02a) in 2011 with resulting stability rates of 97% and 99%. These SEIs, along with a visual examination of the stream, strongly suggest that the stream is meeting sediment water quality targets. The 2004 BURP site, on which the listing of the stream is based, produced a failing score for stream habitat and showed an excessive level of fine sediment in the sampling location. However, the 2011 DEQ on-site examination of this BURP location found that it was inappropriately sited in a nonrepresentative section directly below a road crossing and along a portion of the stream impacted by camping. This section of the stream represents less than 3% of the 2.85 miles of upper Johnson Creek in this AU. With the exception of the area immediately below the road crossing, upper Johnson Creek is a well-functioning, high-quality stream. This is further confirmed by the passing score associated with the 1996 BURP sampling performed just upstream of the 2004 site. The original listing was based on faulty data, and the AU should be moved to Category 2 in the 2012 Integrated Report. Upper Johnson Creek will be reevaluated during the 2012 BURP season.

Through a 2011 SEI, lower Johnson Creek (ID17040207SK012_03a) was found to have a streambank stability of 22%, well below the target level. A 2004 BURP assessment cites the presence of excess fine sediment and slumping banks. Excess sediment is certainly a factor in the failure of this stream to achieve its beneficial uses. The pollutant for this AU should be changed to sediment and the listing should be moved to Category 4a in the 2012 Integrated Report. In addition, observation of the stream in the field during the 2011 SEI and examination of aerial photographs show that it has been diverted out of its natural channel via an 800-foot canal to an unnamed tributary to the northwest. Therefore, the AU should be listed under Category 4c for stream channelization.

In the summer of 1983, a severe thunderstorm caused a mine dump above upper Mill Canyon (ID17040207SK015_02a) to fail. Sediment from the dump was washed down the canyon and deposited in the stream. Following the event, the dump was repaired, and sediment control ponds were constructed (HWS Consulting Group Inc. 2008). The listing of this AU for sediment impairment was based on the dump failure event. A 1998 BURP assessment showed only slightly elevated fine sediment levels (29.87%) and passing scores. Another BURP assessment in 2003 showed higher fine sediment levels but may have been negatively affected because it was conducted within a breached beaver pond that was referenced in the field notes. An SEI performed in 2011 showed the streambank to be 99% stable and the streambed to be primarily composed of gravel with no excess sediment. The 2003 BURP site was mistakenly conducted within a beaver complex, against BURP protocol. Beaver complexes retain large amounts of sediment. Wolman pebble counts performed within a beaver complex inherently result in high sediment numbers that are not representative of the entire stream. Therefore, deference is given to the 1998 site in consideration of site selection, knowledge of the sediment source, and the recent SEI. The stream is meeting its target for sediment and that listing should be removed from the 2012 Integrated Report.

The Little Blackfoot River (ID10740207SK009_03) was originally placed into Category 5 based on a 1999 BURP assessment. At the time of that assessment, mining and grazing were actively impacting the stream. Access to the stream for additional assessments was denied in 2006, 2007, and 2008. In 2009, a bank stability rate of 98% was obtained from an SEI conducted on the state-owned portion of the AU. Aerial photographs show that the lower half of the AU is no longer impacted by grazing or mining, and the stream appears to functioning properly, while the upper half of the AU, above the state land, is intensively grazed and the stream is heavily impacted. A TMDL has been calculated for this stream based on the 2009 SEI. However, additional monitoring is required to determine the level to which beneficial uses have been attained over the entire length of this stream. Pending access approval, this stream will be reevaluated during the 2012 BURP season.

Two SEIs were conducted on Warbonnet Creek (ID10740207SK005_02b) with results that differed significantly from each other. The lower portion of the stream lies on private land and has very limited grazing. The streambank was 98% stable in this reach. Above this fenced private land lies state land that is heavily grazed. Warbonnet Creek through this reach is only 1% stable and is producing significant amounts of excess sediment. The sediment load calculated below is based on the upper reach of the creek.

In addition to being listed for sediment, lower Chippy Creek (ID10740207SK021_03) and Cedar Creek (ID10740207SK029_03) are listed for combined biota/habitat bioassessments, habitat assessment, and benthic macroinvertebrate bioassessments. The SEIs performed on these streams (49% and 52% stable, respectively) clearly show that these streams are not meeting their water quality target with respect to sediment input. This excess sediment is confirmed by earlier Wolman pebble counts during BURP evaluations of both streams. The reason these AUs fail to achieve their beneficial uses appears to be sediment impairment, and the additional listings for these AUs should be eliminated.

In 1906, Barzilla Clark constructed a channel at the south end of Grays Lake to divert water to Meadow Creek and the Blackfoot River (USFWS 1982). This water body, Clarks Cut (ID17040207SK025_02c), is a man-made transbasin diversion canal built for the sole purpose of delivering irrigation water for agriculture from the Willow Creek subbasin (HUC 7040205) to the Blackfoot River subbasin. Data for the years in which instantaneous readings are available

(US Geological Survey [USGS] gaging station 13057300; years 2000–2004) show that flow in Clarks Cut is intermittent and that almost all of the flow occurs during May and June.

In 1999, DEQ conducted a BURP assessment on Clarks Cut and has subsequently determined that the data are not valid for assessing beneficial uses in this AU. DEQ's BURP protocols are not intended to assess beneficial uses on intermittent streams or irrigation canals. Man-made waterways are to be protected for the use for which they were developed (IDAPA 58.01.02.101.02). Listing this man-made water body for other presumed uses was done in error and should be removed from the 2012 Integrated Report.

The 2002 Integrated Report assumed impairment of cold water aquatic life (based on the 1999 BURP information) and listed sediment as the pollutant of concern in Clarks Cut. DEQ reviewed the available information for Clarks Cut and recommends that this AU be removed from Category 5 and moved to Category 2 of the 2012 Integrated Report. DEQ acknowledges that the diverted water Clarks Cut carries flows into Sheep and Meadow Creeks and has the potential to impact those water bodies. Because Clarks Cut waterway is a constructed canal, streambank stability is not an appropriate surrogate measure of water quality. A site-specific water column sediment target in Clarks Cut was not attempted because of a lack of available turbidity or suspended sediment data. To comply with Idaho water quality standards and protect the receiving waters, the Idaho state standard (IDAPA 58.01.02.250.e) is set so that turbidity shall not exceed background turbidity by more than 50 nephelometric turbidity units (NTU) instantaneously or more than 25 NTU for more than 10 consecutive days. This target will be refined once additional water quality data are collected.

5.1.1 Instream Water Quality Targets

Natural condition streambank stability potential is generally 80% or greater for Rosgen (1996) A, B, and C channel types in plutonic, volcanic, metamorphic, and sedimentary geology types (Overton et al. 1995). Therefore, an 80% bank stability target based on SEIs has been selected as the target for sediment. This target is presumed to meet the TMDL goal to restore full support of designated beneficial uses on all Category 5-listed streams. Full support shall be established by demonstrating a declining trend in sediment in conjunction with stream inventory scores that indicate full support of beneficial uses.

5.1.2 Load Capacity

The load capacity for sediment from streambank erosion shall be based on assumed natural streambank stabilities of ≥80% (Overton et al. 1995). Because it is presumed that beneficial uses were or would be supported at natural background sediment loading rates, the load capacity lies somewhere between the current loading level and sediment loading from natural streambank erosion.

Natural background loading rates are not necessarily the load capacities. An adaptive management approach will be used to provide reductions in sediment loading based on BMP usage coupled with data collection and monitoring to determine the loading point at which beneficial uses are supported.

5.1.3 Estimates of Existing Pollutant Loads

DEQ monitors streambank stability by conducting SEIs. When bioassessments indicate impairment and sediment is suspected as a pollutant, DEQ staff identifies homogenous reaches of AUs to monitor for streambank stability by examining existing data and aerial photos. In the field, DEQ staff measures the length of the streambanks that are completely stable and the length, bank height, and condition of streambanks that are eroding. Recession rates (feet per year) of the eroding streambanks are determined in the field according to their condition. The percentage of stable or eroding streambanks is extrapolated to similar stream types in the AU. The bank erosion volume is then calculated using Equation 2:

$$E = [A_E \times R_{LR} \times \rho_B]/2{,}000$$

Equation 2. Bank erosion volume.

where:

E = bank erosion over sampled stream reach, tons per year per sample reach
A_E = area eroding , square feet (ft^2)
R_{LR} = lateral recession rate, feet per year
ρ_B = bulk density of bank material, pounds per cubic feet (lb/ft^3)

DEQ conducted SEIs at the locations indicated in Table 11 based on AUs that were listed in Category 5 of the 2010 Integrated Report for sediment. Table 11 also shows the current level of bank stability determined through those inventories. SEIs for those streams are included in Appendix C.

5.1.4 Load Allocations

Sediment load allocations are estimated targets designed to improve water quality and allow beneficial uses of the affected streams to be fully supported. These targets are based on the presumptive natural streambank stability of 80%, discussed previously in section 5.1.2. Table 11 shows the load capacity of each stream calculated at that natural, minimally erosive state, current load of the stream, and amount of load reduction needed to achieve the target load. Since no point sources for sediment exist in the affected watershed, the entire load is allocated to nonpoint sources.

Table 11. Sediment load allocation.

Water Body	Category 5 Listed Assessment Unit	Current Bank Stability (%)	Current Load (ton/year)	Target Load (ton/year)	Target Load (lb/day)	Load Reduction (%)
Bear Creek	ID17040207SK006_02b	11	938	211	1,155	78
Cedar Creek	ID17040207SK029_03	52	34.7	14.5	79	58
Chicken Creek	ID17040207SK006_02a	68	16.8	10.6	58	37
Collett Creek	ID17040207SK009_02a	23	112	28.9	158	74
Coyote Creek	ID17040207SK005_02d	61	21.3	11.0	60	48
Crooked Creek	ID17040207SK025_03b	15	59.2	14.0	77	76
Deadman Creek	ID17040207SK002_02b	62	5.67	2.96	16	48
Goodheart Creek	ID17040207SK012_02b	56	137	62.6	343	54
Grave Creek tributary— Bilious	ID17040207SK005_02	0	4.03	0.81	4	80
Grave Creek tributary—West	ID17040207SK005_02	22	66.2	17.1	94	74
Grave Creek	ID17040207SK005_02a	22	11.0	2.82	15	74
Grave Creek	ID17040207SK005_03	63	4.04	2.17	12	46
Jones Creek	ID17040207SK031_02	17	1,110	265	1,451	76
Little Blackfoot River	ID17040207SK009_03	98	9.02	9.02	49	0
Lower Chippy Creek	ID17040207SK021_03	49	459	178	975	61
Lower Johnson Creek	ID17040207SK012_03a	22	226	57.7	316	74
Poison Creek	ID17040207SK009_02b	0	123	24.6	135	80
Rawlins Creek	ID17040207SK027_02	19	256	63.0	345	75
State Land Creek	ID17040207SK010_02a	4	109	22.7	124	79
Sunday Creek	ID17040207SK005_02e	0	6.34	1.27	7	80
Thompson Creek	ID17040207SK008_02	14	2,150	501	2,743	77
Upper Mill Creek	ID17040207SK015_02a	99	0.00	0.00	0	0
Warbonnet Creek	ID17040207SK005_02b	1	514	104	569	80
Wood Creek	ID17040207SK005_02c	65	3.55	2.05	11	42

Note: pound per day (lb/day)

5.1.4.1 Margin of Safety

The margin of safety (MOS) factored into streambank sediment load allocations is implicit. The MOS includes the conservative assumptions used to develop existing sediment loads. Because it is presumed that beneficial uses were or would be supported at natural background sediment loading rates, the load capacity lies somewhere between the current loading level and sediment loading from natural streambank erosion. Establishing the target load at the more restrictive natural streambank erosion level is conservative and results in an implicit MOS.

5.1.4.2 Seasonal Variation

Annual erosion and sediment delivery are functions of climatic variability and the geomorphic state of the stream. Years with greater than average runoff typically produce higher erosion and subsequently higher sediment loads from unstable streambanks. Stable streambanks that allow peak flow access to the floodplain are able to withstand extreme hydrologic events without becoming unstable. The annual average sediment load is not distributed equally throughout the year. Erosion, in stable systems, typically occurs during a few critical months during spring runoff when bank-full (high) flow occurs.

While streambank erosion is predominantly a springtime process, the ability of a stream to support beneficial uses is a long-term issue with regard to sediment. The SEI method allows for estimating average annual erosion rates. This direct volume method allows for determining the extent of chronic bank erosion and estimates the needed reductions.

5.1.4.3 Wasteload Allocation

There are no known National Pollutant Discharge Elimination System (NPDES)-permitted point sources in the affected watersheds. Thus, there are no wasteload allocations (WLAs). If a point source is proposed that would have consequence on these waters, then background provisions addressing such discharges in IDAPA 58.01.02.401 should be involved. However, DEQ has provided for Construction General Permits (CGPs) issued by EPA under the stormwater permitting program to account for this type of point source that applies required BMPs.

5.1.4.4 Reasonable Assurance

After TMDL acceptance by DEQ, EPA, and stakeholders, the next step of the Idaho water body management process is implementation. Idaho’s water quality standards identify designated agencies that are responsible for evaluating and modifying BMPs to protect impaired water bodies. The implementation strategies should incorporate field verification of the load analyses included in this TMDL.

Ongoing assessment of the support status of the water bodies with TMDLs will be reported in a 5-year review of the TMDL. If full support status has not been obtained, further implementation will be needed and further reassessment performed until full support status is reached. If full support status is reached, the requirements of the TMDL will be considered complete.

5.2 Bacteria Total Maximum Daily Loads

Twelve streams (22 AUs) within the Blackfoot River subbasin are listed in Category 5 of the 2010 Integrated Report for bacterial impairment. Historically, Idaho monitored for fecal coliform, but the standard changed in 2006 to *E. coli*, a common intestinal bacteria found in warm-blooded animals and therefore considered more directly pathogenic to humans.

Idaho “Water Quality Standards” (IDAPA 58.01.02.251) specify that *E. coli* levels should not exceed a geometric mean of 126 colony forming units (cfu)/100 milliliters (mL) based on five samples taken over a 30-day period. A single measurement of 406 cfu/100 mL for PCR and 576 cfu/100 mL for SCR suggests a likely exceedance of the geometric mean criterion and requires additional sampling to permit the calculation of the geometric mean. However, a single water sample exceeding an *E. coli* standard does not in itself constitute a violation of water quality standards. An exceedance of the geometric mean criteria does constitute a water quality violation.

Table 12 reflects all bacteria sampling conducted on the subject streams since 1999. In cases where an exceedance of the SCR standard occurred, additional samples were collected to calculate a geometric mean for the five-sample set. Those geometric means, and the data sets from which they were calculated, are shown in the shaded blocks in Table 12.

Table 12. *E. coli* sampling data.

Water Body	Assessment Unit	*E. coli* Results (cfu/100 mL or MPN/100 mL)[a]	Date Sampled
Angus Creek	ID17040207SK023_02b	2,400	8/26/03
		12	8/28/03
		9 (duplicate)	8/28/03
		2,000	9/4/03
		580	9/8/03
		490	9/11/03
		Geometric mean: 428	
		44	8/17/05
Angus Creek	ID17040207SK023_04	70	9/7/99
		199	8/29/06
		29	8/6/08
Cedar Creek	ID17040207SK029_02	727	8/9/07
		1,986	8/14/07
		866	8/20/07
		816	8/23/07
		>2,419	8/27/07
		Geometric mean: 1,198	
Cedar Creek	ID17040207SK029_03	180	9/8/99
Collett Creek	ID17040207SK009_02a	687	8/14/07
		86	8/20/07
		219	8/23/07
		291	8/27/07
		24	8/31/07
		Geometric mean: 155	
Corral Creek	ID17040207SK006_03	77	8/26/03
		24	8/6/08
Corral Creek	ID17040207SK006_04	40	9/8/99
		4,400	8/26/03
		2,400	8/28/03

Water Body	Assessment Unit	*E. coli* Results (cfu/100 mL or MPN/100 mL)[a]	Date Sampled
		1,400	9/4/03
		1,400	9/8/03
		1,100	9/11/03
		Geometric mean: 1,868	
		31	8/6/08
Diamond Creek	ID17040207SK016_02a	7	8/16/07
Diamond Creek	ID17040207SK016_03	25	8/29/06
		816	9/5/06
		194	9/11/06
		276	9/14/06
		157	9/18/06
		133	9/21/06
		Geometric mean: 247	
Diamond Creek	ID17040207SK016_03a	1,100	8/21/01
		980	8/27/01
		>2,400	8/30/01
		1,700	9/4/01
		150	9/12/01
		Geometric mean: 920	
		47	8/29/06
Poison Creek	ID17040207SK009_02b	2,000	8/27/02
		130	9/3/02
		90	9/9/02
		63	9/16/02
		63	9/19/02
		Geometric mean: 156	
Poison Creek	ID17040207SK027_02b	461	8/9/07
Rawlins Creek	ID17040207SK027_03	750	9/8/99
		250	9/15/99
		86	9/21/99
		41	9/22/99
		130	9/27/99
		Geometric mean: 154	
Sawmill Creek	ID17040207SK007_02a	816	8/9/07
		980	8/14/07
		1,414	8/20/07
		550	8/23/07
		1,733	8/27/07

Water Body	Assessment Unit	*E. coli* Results (cfu/100 mL or MPN/100 mL)[a]	Date Sampled
		Geometric mean: 1,015	
Spring Creek	ID17040207SK015_03	435	8/29/06
		172	9/5/06
		53	9/11/06
		50	9/14/06
		46	9/18/06
		Geometric mean: 98	
Thompson Creek	ID17040207SK008_02	866	8/14/07
		980	8/20/07
		387	8/23/07
		1,733	8/27/07
		1,986	8/31/07
		Geometric mean: 1,025	
Warbonnet Creek	ID17040207SK005_02b	1,300	8/17/05
		1,300	8/22/05
		580	8/25/05
		1,700	8/29/05
		920	9/1/05
		Geometric mean: 1,089	

Notes: assessment unit (AU); colony forming unit (cfu); milliliter (mL); most probable number (MPN)
a. Where an exceedance of the secondary contact recreation standard occurred, additional samples were collected to calculate a geometric mean for the five-sample set. Those geometric means, and the data sets from which they were calculated, are shown in the shaded blocks in the table.

Portions of Angus Creek (ID17040207SK023_04), Cedar Creek (ID17040207SK029_03), Corral Creek (ID17040207SK006_03), Diamond Creek (ID17040207SK016_02a), Poison Creek (ID17040207SK027_02b), and Spring Creek (ID17040207SK015_03) were found to meet the standard for recreational contact and should be delisted for bacterial impairment.

Five AUs, Angus Creek (ID17040207SK023_02), Corral Creek (ID17040207SK006_02), Diamond Creek (ID17040207SK016_02), Spring Creek (ID17040207SK015_02), and Thompson Creek (ID17040207SK008_03), have not been monitored for *E. coli*. These AUs were erroneously listed in Category 5 and should instead reflect a status of unassessed with respect to recreational contact.

One stream, Rawlins Creek (ID17040207SK027_03), is still listed for fecal coliform impairment. However, this TMDL addresses the *E. coli* loads in that stream. The listing for this stream should be updated to match Idaho water quality standards in the 2012 Integrated Report.

For four of the AUs where an extended sample set was collected to calculate a geometric mean, one of the samples at each fell outside of the standard sampling protocol. On both Angus Creek (ID17040207SK023_02b) and Corral Creek (ID17040207SK006_04), one sample was taken after 2 days rather than the prescribed 3-day minimum. At Rawlins Creek (ID17040207SK027_03), one sample was collected after only 1 day, and at Diamond Creek (ID17040207SK016_03a), the final sample was taken on the eighth day instead of the 7-day maximum. In all of these cases, the data sets were examined to evaluate the potential impact of these variances on the outcome of the calculated geometric mean and found to have no effect in determining whether the AU was attaining its recreational contact beneficial use.

5.2.1 Instream Water Quality Targets

The Idaho water quality standard for *E. coli* bacteria, used as the target for developing the TMDL, is a geometric mean of 126 cfu/100 mL (IDAPA 58.01.02.251.01).

5.2.2 Load Capacity

The *E. coli* load capacity is expressed as the geometric mean of 126 cfu/100 mL. The load capacity is expressed as a concentration (cfu/100 mL) because it is difficult to calculate a mass load due to several variables (i.e., temperature, moisture conditions, and flow) that influence the die-off rate of *E. coli* bacteria in the environment.

5.2.3 Estimates of Existing Pollutant Loads

Livestock and wildlife are the most likely sources of *E. coli* bacteria found in the listed water bodies. No confined animal feeding operations or failing human septic systems are known in the affected watersheds. The percentage of the load contribution coming from each nonpoint source cannot be determined from the available data. Existing loads are based on the geometric mean of five samples collected over a 30-day period.

5.2.4 Load Allocations

Bacteria are living organisms that have an associated die-off rate. The die-off rate fluctuates with varying water quality and environmental conditions. Flow and temperature dictate the actual mass of bacteria in the water and complicate the load allocation process because of the continuous fluctuation of flow and temperature that occurs during any given time period. To simplify this process, the allocation is expressed in terms of 126 cfu/100 mL, the target geometric mean concentration currently required by Idaho water quality standards.

The instream load allocations listed in Table 13 have been assigned to each water body to ensure compliance with Idaho water quality standards throughout the watershed. Table 13 includes the load capacity based on the maximum geometric mean for five *E. coli* samples, existing load, and reduction in *E. coli* bacteria concentration that must occur to meet the load allocation assigned to each water body.

Table 13. *E. coli* bacteria load allocation.

Water Body	Category 5 Listed Assessment Unit	Existing Load (cfu/100 mL)	Load Capacity (cfu/100 mL)	Load Reduction (%)
Angus Creek	ID17040207SK023_02b	230	126	45
Cedar Creek	ID17040207SK029_02	1198	126	89
Collett Creek	ID17040207SK009_02a	155	126	19
Corral Creek	ID17040207SK006_04	1868	126	93
Diamond Creek	ID17040207SK016_03	247	126	49
Diamond Creek	ID17040207SK016_03a	920	126	86
Poison Creek	ID17040207SK009_02b	156	126	19
Rawlins Creek	ID17040207SK027_03	154	126	18
Sawmill Creek	ID17040207SK007_02a	1015	126	88
Thompson Creek	ID17040207SK008_02	1025	126	88
Warbonnet Creek	ID17040207SK005_02b	1089	126	88

Notes: colony forming unit (cfu); milliliter (mL)

5.2.4.1 Margin of Safety

In the case of *E. coli*, the pollutant load capacity has been calculated for the most critical time periods identified and is applied year-round. Existing loads are based on sampling done during periods when bacteria concentrations are likely to be higher (e.g., heavy grazing or warm temperatures). Application of these conservative methods is considered an implicit MOS.

5.2.4.2 Seasonal Variation

This TMDL is based on summer *E. coli* loads. In the affected watersheds, concentrations of bacteria are likely to be the highest during the summer growing season. Grazing activity increases the bacterial load, warm temperatures encourage bacterial growth, and diminished stream flows reduce the dilution capacity of streams. This season is also the time period when SCR is most likely to occur. While recreational water contact is less likely outside of the summer season, it may occur at any time during the year, and the water quality standards for *E. coli* remain in effect throughout the year.

5.2.4.3 Wasteload Allocation

There are no known NPDES-permitted point sources in the affected watersheds. Thus, there are no WLAs. If a point source is proposed that would have consequence on these waters, then background provisions addressing such discharges in the Idaho water quality standards should be involved.

5.2.4.4 Reasonable Assurance

After TMDL acceptance by DEQ, EPA, and stakeholders, the next step of the Idaho water body management process is implementation. Idaho water quality standards identify designated agencies that are responsible for evaluating and modifying BMPs to protect impaired water bodies. The implementation strategies should incorporate field verification of the load analysis tables included in this TMDL.

Ongoing assessment of the support status of the water bodies with TMDLs will be reported in a 5-year review of the TMDL. If full support status has not been obtained, further implementation will be needed and further reassessment performed until full support status is reached. If full support status is reached, the requirements of the TMDL will be considered complete.

5.3 Temperature and Dissolved Oxygen Total Maximum Daily Loads

This TMDL addresses two AUs on the main stem upper Blackfoot River (ID17040207SK010_04 and ID17040207SK010_05), which are listed in Category 5 of the 2010 Integrated Report for temperature impairment (i.e., exceeding the 22 °C maximum standard) (IDAPA 58.01.02.250.02.b). These AUs are also listed for exceedance of the minimum DO criterion (IDAPA 58.01.02.250.02), which mandates a minimum concentration of 6.0 mg/L in streams and rivers.

DEQ has collected nearly continuous water quality data at China Hat Bridge on the upper Blackfoot River since 2004. Table 14 shows the general relationship between discharge during the critical months of July and August (data from USGS gaging station 13063000 [USGS 2012]), temperature exceedances, and DO exceedances throughout the year at China Hat Bridge. The temperature and DO data used in Table 14 were collected and reviewed for quality assurance in accordance with USGS guidelines (Wagner et al. 2006) and data not meeting quality assurance standards were not included. Weather conditions, equipment failures, and other factors resulted in variances in the number of days that are represented in each of the years shown in Table 14.

Table 14. July and August discharge, temperature, and dissolved oxygen exceedances at China Hat Bridge.

Year	July Average Measured Discharge[a] (cfs)	% of July Mean	August Average Measured Discharge[a] (cfs)	% of August Mean	% of July+August Mean Combined	Number of Days Temperature Standard Exceeded	Highest Temperature (°C)	Number of Days DO Standard Exceeded	Lowest DO Concentration (mg/L)	Number of Days DO Data Available (June 21–September 21)
2004	62.6	52[b]	42.7	51[b]	52[b]	32	27.0	28	4.9	85
2005	117.1	97	78.8	95	96	34	25.4	21	4.5	83
2006	98.5	81[b]	61.6	74[b]	78[b]	26	27.2	30	4.8	85
2007	26.6	22[b]	14.7	18[b]	20[b]	36	27.6	32	4.3	67
2008	97.7	81[b]	56.3	68[b]	75[b]	36	24.5	9	5.1	91
2009	179.9	149[c]	109.6	132[c]	142[c]	5	22.7	0	6.1	85
2010	109.3	90	70.2	85	88	23	24.7	7	5.6	93
2011[d]	302.5	250[b]	165.8	200[c]	230[c]	0	20.5	0	6.1	79
Mean 1914–2010	121		83							

Notes: cubic feet per second (cfs); milligram per liter (mg/L); dissolved oxygen (DO); temperature and DO data from DEQ near-continuous sonde record.
a. Discharge data source: USGS 2012.
b. Greater than 15% below average discharge.
c. Above average discharge.
d. The 2011 discharge data are provisional.

Figure 2 shows the temperature and DO data collected during 2010, a year in which flows in July and August were 88% of normal. Temperature and DO vary daily and seasonally. The graph illustrates the inverse relationship of water temperature and DO concentration. Figure 2 shows in 2010, exceedance of the minimum DO standard occurred primarily during July and August, which is also the case for all years in which DO exceedances occurred.

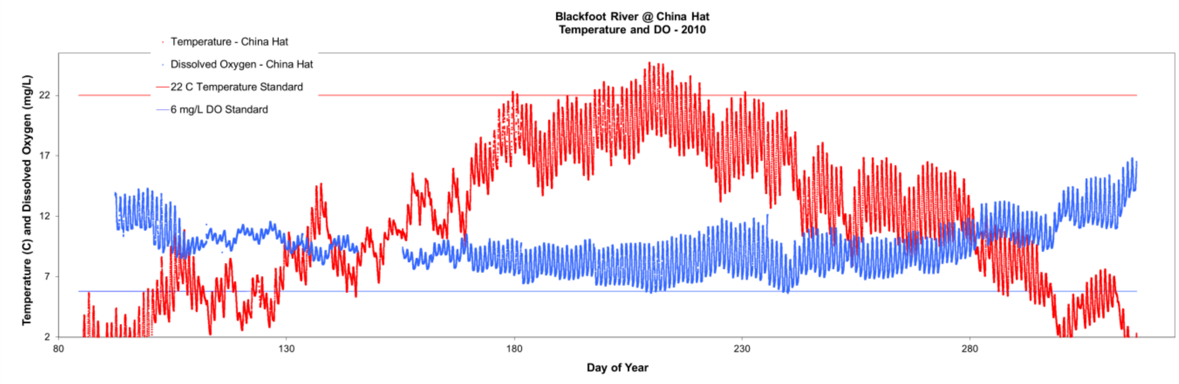

Figure 2. Blackfoot River temperature and dissolved oxygen levels in 2010.

Water samples were collected at the China Hat Bridge site from 2004 through 2007 and analyzed for various nutrients, including ammonia, nitrate+nitrite (NO_2+NO_3), total Kjeldahl nitrogen, total nitrogen (TN), orthophosphate, and total phosphorus (TP). Table 15 calculates the median values for those constituents over the 4 years of sampling.

Table 15. Nutrient concentrations on the upper Blackfoot River 2004–2007.

Location	Date	Ammonia (mg/L)	NO_2+NO_3 (mg/L)	TKN (mg/L)	TN (mg/L)	Ortho-P (mg/L)	TP (mg/L)
China Hat	7/21/04	0.0025[a]	0.005	0.359	0.364	0.011	0.045
China Hat	8/3/04	0.0025[a]	0.007	0.333	0.34	0.006	0.039
China Hat	8/12/04	0.0025[a]	0.0025[a]	0.324	0.3265	0.007	0.035
China Hat	8/24/04	0.0025[a]	0.0025[a]	0.249	0.2515	0.005	0.027
China Hat	9/2/04	0.0025[a]	0.0025[a]	0.27	0.2725	0.006	0.023
China Hat	9/13/04	0.0025[a]	0.0025[a]	0.258	0.2605	0.0025[a]	0.033
China Hat	9/22/04	0.0025[a]	0.0025[a]	0.145	0.1475	0.005	0.013
China Hat	9/29/04	0.0025[a]	0.0025[a]	0.216	0.2185	0.0025[a]	0.02
China Hat	10/7/04	0.0025[a]	0.0025[a]	0.154	0.1565	0.0025[a]	0.019
China Hat	10/14/04	0.0025[a]	0.0025[a]	0.064	0.0665	0.006	0.015
China Hat	10/21/04	0.0025[a]	0.005	0.273	0.278	0.015	0.059
China Hat	11/1/04	0.007	0.0025[a]	0.164	0.1665	0.005	0.02
China Hat	11/9/04	0.0025[a]	0.0025[a]	0.222	0.2245	0.009	0.019
China Hat	11/16/04	0.0025[a]	0.0025[a]	0.115	0.1175	0.007	0.017
China Hat	11/23/04	0.0025[a]	0.0025[a]	0.176	0.1785	0.009	0.025
China Hat	3/29/05	0.029	0.068	0.152	0.22	—	0.038
China Hat	4/26/05	0.053	0.088	0.747	0.835	0.074	0.251
China Hat	5/9/05	—	0.060	—	—	—	0.170
China Hat	5/11/05	—	0.090	—	—	—	0.110
China Hat	5/12/05	—	0.360	—	—	—	0.120
China Hat	6/2/05	0.006	0.012	0.492	0.504	—	0.098
China Hat	6/9/05	0.0025[a]	0.009	0.393	0.402	0.036	0.078
China Hat	6/20/05	0.018	0.0025[a]	0.297	0.2995	0.028	0.061
China Hat	7/19/05	0.0025[a]	0.0025[a]	0.137	0.1395	0.009	0.028
China Hat	8/11/05	0.017	0.0025[a]	0.177	0.1795	0.005	0.017
China Hat	9/8/05	0.0025[a]	0.0025[a]	0.163	0.1655	0.0025[a]	0.014
China Hat	9/26/05	0.0025[a]	0.0025[a]	0.108	0.1105	0.0025[a]	0.012
China Hat	10/25/05	0.0025[a]	0.0025[a]	0.080	0.0825	0.0025[a]	0.015
China Hat	11/17/05	0.0025[a]	0.012	0.15	0.162	0.0025[a]	0.015
China Hat	4/14/06	0.0025[a]	0.130	1.200	1.33	—	0.240
China Hat	4/26/06	0.024	0.050	0.420	0.47	0.082	0.130
China Hat	5/30/06	0.0025[a]	0.040	0.140	0.18	0.030	0.057
China Hat	6/29/06	0.0025[a]	0.010	0.210	0.22	0.017	0.040
China Hat	7/17/06	0.0025[a]	0.020	0.070	0.09	0.007	0.024
China Hat	11/16/06	0.0025[a]	0.080	0.280	0.36	0.005[a]	0.022
China Hat	4/13/07	0.005[a]	0.06	0.59	0.65	0.030	0.126
China Hat	5/1/07	0.005[a]	0.03	0.52	0.55	0.024	0.120

Location	Date	Ammonia (mg/L)	NO_2+NO_3 (mg/L)	TKN (mg/L)	TN (mg/L)	Ortho-P (mg/L)	TP (mg/L)
China Hat	5/31/07	0.005[a]	0.005[a]	0.27	0.275	0.016	0.047
China Hat	7/26/07	0.005[a]	0.03	0.33	0.36	0.005[a]	0.036
China Hat	9/20/07	0.005[a]	0.005[a]	0.05[a]	0.055	0.005[a]	0.016
Median		0.003	0.005	0.222	0.225	0.007	0.034

Notes: nitrate (NO_2); nitrite (NO_3); total Kjeldahl nitrogen (TKN); total nitrogen (TN); orthophosphate (ortho-P); total phosphorus (TP); milligram per liter (mg/L)
a. Results were below the minimum detection limit. Values recorded as one-half of the detection limit.

The median concentrations for TN and TP shown in Table 15 are relatively low compared to other southeast Idaho rivers, suggesting nutrients in the upper Blackfoot River are not excessive. The Bear River has a TP target of 0.075 mg/L (0.05 mg/L above lakes and at the Utah border) (DEQ 2011b). The TP target for the Portneuf River is 0.125 mg/L during high flows and 0.07 mg/L for low flows (DEQ 2010a). Targets on both the Bear and Portneuf Rivers are significantly higher than the median TP concentration (0.034 mg/L) in the upper Blackfoot River. The upper Snake River between Idaho Falls and American Falls Reservoir had a median TP concentration of 0.033 mg/L from 2004 through 2007, very similar to levels seen in the Blackfoot River. During the same period, TN in the Snake River was approximately 0.434 mg/L, nearly double the concentration observed in the Blackfoot River. In addition, during the critical months of July and August, median values of TN and TP in the upper Blackfoot River were reduced to 0.216 and 0.032 mg/L, respectively.

Higher concentrations of nutrients can cause excessive growth of aquatic vegetation. This overabundance of plants can deplete DO concentrations. A nutrient study (Marcarelli et al. 2006) was conducted in 2005 and 2006 on several water bodies in southeast Idaho, including the upper Blackfoot River. The study assessed chlorophyll *a* and ash-free dry mass responses to increased nitrogen (N) and phosphorus (P). At the Blackfoot River China Hat Bridge site, chlorophyll *a* and ash-free dry mass were most often colimited by nitrogen and phosphorus, indicating neither nutrient was in excess supply relative to the other. Dodds and Welch (2000) state that at levels exceeding 200 mg/square meter (m^2), benthic chlorophyll becomes aesthetically unpleasant and can interfere with recreational use. Chlorophyll *a* concentrations on nutrient study control diffuser disks ranged from approximately 25 to 150 mg/m^2 during the nutrient study at China Hat Bridge (Marcarelli et al. 2006), below the level cited by Dodds and Welch (2000). Additionally, excess algal growth has not been observed by DEQ staff during near-weekly visits to the China Hat Bridge site during the entire data collection period that began in 2004. Although some macrophyte beds are located in wide reaches of the river on the Blackfoot Wildlife Management Area, nuisance algal growth has not been noted at other Blackfoot River sites upstream of Blackfoot Reservoir.

In 2010, the water temperature standard was exceeded on 23 days, and there were exceedances of the DO standard on 7 days (Figure 2). On the upper Blackfoot River, the only anthropogenic cause that has been identified for reduced DO levels is elevated temperature due to shade reduction along the river. Neither excess nutrients nor surplus aquatic vegetation have been found in the main stem river. As shown in Table 14, reduced flow in dry years does result in increased temperatures and decreased DO because of diminished assimilative capacity. In 2007, when flows in July and August were only 20% of normal, water temperature reached a maximum of 27.6 °C and DO fell below 6 mg/L on 32 days to a minimum of 4.3 mg/L. However, at 88% of mean monthly flows, river conditions in 2010 represent a typical summer.

Figure 3 shows the projected effects of a 2 °C reduction in water temperature that might result from implementing the temperature TMDL. In this simulation, the temperature-oxygen solubility relationship is used to calculate new DO levels from the 2 °C reduction in water temperatures. These calculations suggest that the number of days the DO standard would be exceeded would drop from 7 to 1 and that the minimum DO values during those exceedances would go from 5.6 to 5.9 mg/L.

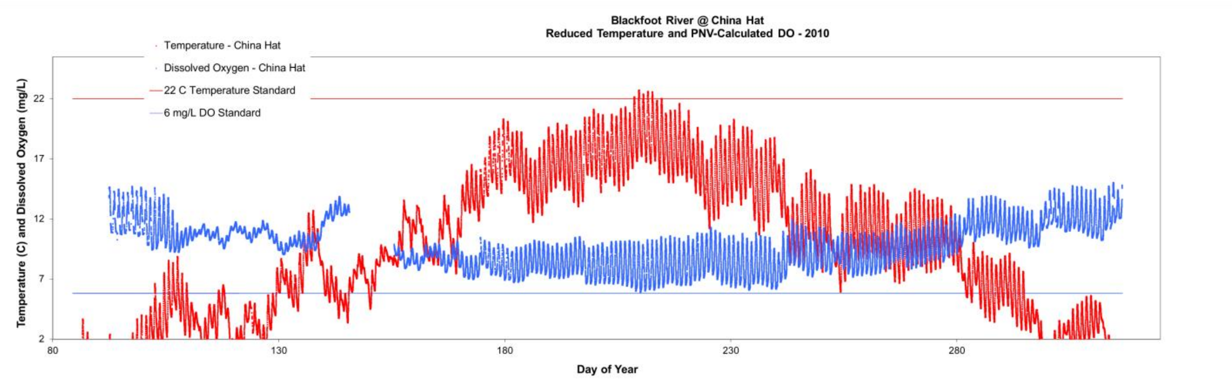

Figure 3. Recalculated dissolved oxygen levels based on 2 °C temperature reduction.

This simulation takes into account only the explicit relationship between temperature and oxygen saturation potential and thus, minimizes the corresponding positive change in DO levels. In the field, actual improvements in DO arising from a similar decrease in temperature are likely to be greater because of increased shading and corresponding changes that will likely decrease photosynthesis and respiration rates. In addition, bank stabilization associated with implementing temperature TMDL will improve riparian habitat and move the river toward more allochthonous inputs, thus improving metabolic dynamics.

Because of the inverse relationship of water temperature and DO concentration, any temperature reductions achieved through implementation of this temperature TMDL will naturally result in improved DO concentrations. Therefore, this temperature TMDL will serve as a surrogate to improve the existing DO impairment.

5.3.1 Instream Water Quality Targets

For the upper Blackfoot River temperature TMDL, DEQ used a potential natural vegetation (PNV) approach. Idaho “Water Quality Standards” (IDAPA 58.01.02.200.09) include a provision that establishes if natural conditions exceed numeric water quality criteria, exceedance of the criteria is not considered a violation of water quality standards. In these situations, natural conditions essentially become the water quality standard, and the natural shade level and channel width become the TMDL target. The instream temperature resulting from attainment of these conditions is consistent with the water quality standards, although it may exceed numeric temperature criteria. Appendix A provides further discussion of water quality standards and background provisions. The PNV approach is described below. Additionally, the procedures and methodologies to develop PNV target shade levels and to estimate existing shade levels are described in Shumar and De Varona (2009). For a more complete discussion of shade and its effects on stream water temperature, refer to *The Potential Natural Vegetation (PNV) Temperature Total Maximum Daily Load (TMDL) Procedures Manual* (Shumar and De Varona 2009).

5.3.1.1 Potential Natural Vegetation for Temperature Total Maximum Daily Loads

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

Depending on how much vertical elevation also surrounds the stream, vegetation further away from the riparian corridor can provide shade. However, riparian vegetation provides a substantial amount of shade on a stream by virtue of its proximity. DEQ measures the amount of shade that a stream enjoys in a number of ways. Effective shade, that shade provided by all objects that intercept the sun as it makes its way across the sky, can be measured in a given spot with a Solar Pathfinder or with other optical equipment similar to a fish-eye lens on a camera. Effective shade can also be modeled using detailed information about riparian plants and their communities, topography, and the stream’s aspect. In addition to shade, canopy cover is a similar parameter that affects solar radiation. Canopy cover is the vegetation that hangs directly over the stream and can be measured using a densiometer, or estimated visually either on site or using aerial photography. All of these methods provide information about how much the stream is covered and how much of it is exposed to direct solar radiation.

PNV along a stream is a riparian plant community that could grow to an overall mature state, although some level of natural disturbance is usually included in the development and use of shade targets. The PNV can be removed by disturbance either naturally (e.g., wildfire, disease or old age, wind damage, and wildlife grazing) or anthropogenically (e.g., domestic livestock grazing, vegetation removal, and erosion). The idea behind PNV as targets for temperature TMDLs is that PNV provides a natural level of solar loading to the stream without any anthropogenic removal of shade-producing vegetation. Anything less than PNV (with the exception of natural levels of disturbance and age distribution) results in the stream heating up from anthropogenically created additional solar inputs. PNV is estimated from models of plant community structure (shade curves for specific riparian plant communities), and existing vegetative cover or shade is measured. Comparing PNV and vegetative cover or shade indicates how much excess solar load the stream is receiving, and what potential there is to decrease solar gain. Streams disturbed by wildfire, flood, or some other natural disturbance will be at less than PNV and require time to recover. Streams disturbed by human activity may require additional restoration above and beyond natural recovery.

Existing shade was estimated for the upper Blackfoot River from field measurements and visual observations of aerial photos. These field measurements were taken by measuring shade with a Solar Pathfinder at consecutive points along the river from the bow of a canoe (section 5.3.1.2). PNV targets were determined by analyzing probable vegetation at the streams and comparing it to shade curves developed for similar vegetation communities in Idaho (see Shumar and De Varona 2009). A shade curve shows the relationship between effective shade and stream width. As a stream gets wider, the shade decreases as the vegetation has less ability to shade the center of wide streams. As the vegetation gets taller, the more shade the plant community is able to provide at any given channel width. Existing and PNV shade was converted to solar loads from data collected on flat-plate collectors at the nearest National Renewable Energy Laboratory (NREL) weather station collecting these data. In this case, the Pocatello, Idaho, station was used. The difference between existing and target solar load, assuming existing load is higher, is the load reduction needed to bring the stream back into compliance with water quality standards (Appendix A). PNV shade and loads are assumed to be the natural condition; thus stream temperatures under PNV conditions are assumed to be natural (as long as there are no point sources or any other anthropogenic sources of heat in the watershed) and are considered to be consistent with the Idaho water quality standards, although they may exceed numeric criteria.

5.3.1.2 Solar Pathfinder Methodology

The Solar Pathfinder is a device that allows one to trace the outline of shade-producing objects on monthly solar path charts. The percentage of the sun's path covered by these objects is the effective shade on the stream at the spot that the tracing is made. To adequately characterize the effective shade on a stream reach, 10 traces should be taken at systematic or random intervals along the length of the stream in question.

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

Measure bank-full widths and make notes while taking Solar Pathfinder traces, and photograph the landscape of the stream at several unique locations. Pay special attention to changes in riparian plant communities and what kinds of plant species (e.g., the large, dominant, shade-producing ones) are present. Additionally, take densiometer readings at the same location as Solar Pathfinder traces. The readings and traces provide the potential to develop relationships between canopy closure and effective shade for a given stream.

In the upper Blackfoot River TMDL, DEQ measured shade continuously from the Upper Valley confluence to the Caribou-Targhee National Forest boundary below a region called "The Narrows" and again from a road crossing below Trail Creek to the Blackfoot Reservoir with a boat-mounted Solar Pathfinder. Shade data from these Solar Pathfinder measurements were used in the TMDL for existing shade in place of aerial photo interpretation of existing shade for these regions. The Blackfoot River between these two Solar Pathfinder regions required aerial photo interpretation of existing shade.

5.3.1.3 Aerial Photo Interpretation

Expectations of shade based on plant type and density are provided for natural breaks in vegetation density, marked out on a 1:100,000 or 1:250,000 hydrography. Each interval is assigned a single value representing the bottom of a 10% shade class as described below (adapted from the cumulative watershed effects process [IDL 2000]). For example, if shade is estimated for a particular stretch of stream between 0% and 9.9%, the value of 0% is assigned to that stream section. The estimate is based on a general intuitive observation about the kind of vegetation present, its density, and the stream width. Streams where the banks and water are clearly visible usually are in low-shade classes (0% to 30%). Streams with dense forest or heavy brush where no portion of the stream is visible are usually in high shade classes (70%–90%). More open canopies where portions of the stream may be visible usually fall into moderate shade classes (40%–60%).

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

5.3.1.4 Stream Morphology

Measures of current bank-full width or near stream disturbance zone width may not reflect widths that were present under PNV. As impacts to streams and riparian areas occur, width-to-depth ratios tend to increase so that streams become wider and shallow. Shade produced by vegetation covers a lower percentage of the water surface in wider streams, and widened streams can also have less vegetative cover if shoreline vegetation has been eroded away.

This natural width factor (i.e., near stream disturbance zone or bank-full width) may not be known or discernible from the aerial photo work described previously. Accordingly, this parameter must be estimated from available information. DEQ uses regional curves for the major basins in Idaho and data compiled by Diane Hopster, Idaho Department of Lands, to estimate natural bank-full width (Figure 4).

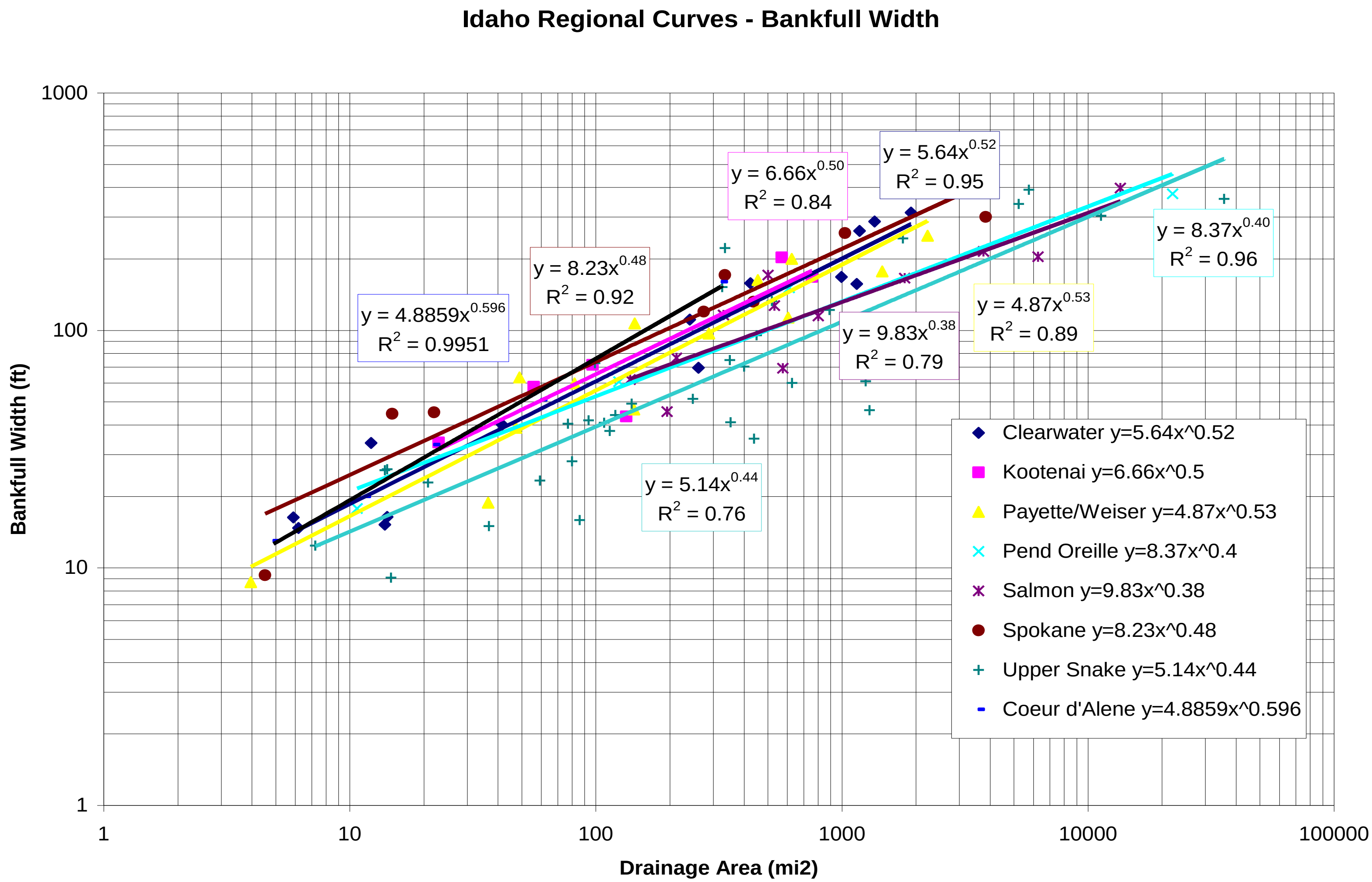

Figure 4. Bank-full width as a function of drainage area.

For each stream evaluated in the load analysis, natural bank-full width is estimated based on drainage area of the Upper Snake Basin regional curve from Figure 4 (Table 16). Although estimates from other curves could be examined, the Upper Snake Basin regional curve was ultimately chosen because of its proximity to and inclusion of the Blackfoot River subbasin. Additionally, existing width data should be evaluated and compared to these curve estimates if such data are available. However, for the upper Blackfoot River subbasin only a few BURP sites exist, and bank-full width data from those sites represent only spot data (three measured widths in a reach only several hundred meters long) that are not always representative of the stream as a whole. DEQ measured channel widths at various locations along the upper Blackfoot River using aerial photographs from the ArcGIS mapping system. In general, DEQ found aerial photo width measurements to be smaller than the bank-full width estimates from the Upper Snake Basin regional curve and chose not to make natural widths any larger than these aerial photo estimates. The load analysis tables contain a natural bank-full width and an existing bank-full width for every stream segment in the analysis based on the bank-full width results presented in Table 16.

Table 16. Channel width estimates for various locations on the upper Blackfoot River.

Location	Area (square miles)	Upper Snake Basin (meters)	Existing (meters)
Blackfoot River above reservoir	346	21	16
Blackfoot River at gaging station	333	20	16
Blackfoot River above Trail Creek	300	19	13
Blackfoot River below Dry Valley Creek	185	16	16
Blackfoot River below Upper Valley	136	14	14

5.3.1.5 Design Conditions

The majority of the upper Blackfoot River is found in the Cold Valleys level IV Ecoregion of the Middle Rockies level III Ecoregion of McGrath et al. (2001). Cold Valleys are bottomlands, terraces, marshlands, alluvial fans, and foothills where the PNV is mostly sagebrush steppe. Wet bottomlands support sedges, rushes, and willows. As the Blackfoot River enters Long Valley and the Blackfoot Lava Field above the reservoir, it crosses into the Sagebrush Steppe Valleys level IV Ecoregion of the Northern Basin and Range level III Ecoregion (McGrath et al. 2001). This level IV Ecoregion is also dominated by sagebrush grasslands that generally lack the woodlands or saltbush/greasewood communities of other parts of the Northern Basin and Range Ecoregion.

5.3.1.6 Target Selection

To determine PNV shade targets for the upper Blackfoot River, the effective shade curve for the Geyer willow/sedge community vegetation type of the southern Idaho nonforest curves in Shumar and De Varona (2009) was examined. These curves were produced using vegetation community modeling of Idaho plant communities. Effective shade curves include percent shade on the vertical axis and stream width on the horizontal axis. As a stream becomes wider, a given vegetation type loses its ability to shade wider and wider streams. The Geyer willow/sedge community shade curve is presented in Figure C-1, Appendix C.

The Geyer willow/sedge community shade curve is based on information provided by Hansen and Hall's (2002) *Classification and Management of BLM's Riparian and Wetland Sites in Eastern and Southern Idaho*. Hansen and Hall (2002) describe a Geyer willow (*Salix geyeriana*)/beaked sedge (*Carex rostrata*) habitat type, ranging in elevation from 5,200 to 7,200 feet and occupying broad, level floodplains of riverine systems, or it may be found in narrow bands along smaller streams in open, U-shaped canyons. Geyer willow habitat types occupy intermediate elevations between Drummond's willow (*Salix drummondiana*) types at higher elevations and lower elevation communities dominated by yellow willow (*Salix lutea*). Geyer willow and Booth's willow (*Salix boothii*) dominate the overstory shrub layer of the Geyer willow/beaked sedge habitat type, although both species may not be present on all sites. Other subordinate shrub species may include mountain alder (*Alnus incana*), sandbar willow (*Salix exigua*), and Drummond's willow. The understory is dominated by sedges (*Carex* sp.), and there may be a variety of forbs present. The shade curve (Figure C-1, Appendix C) is based on a community comprised mostly of Geyer willow (50%) and Booth's willow (39%) with smaller amounts of Drummond's willow (6%), planeleaf willow (*Salix planifolia*) (3%), sandbar willow (1%), bog birch (*Betulaglandulosa*) (1%), and quaking aspen (*Populus tremuloides*) (0.1%) (Shumar and De Varona 2009).

5.3.1.7 Monitoring Points

A large portion of the Blackfoot River under examination in this TMDL received shade measurements via a Solar Pathfinder mounted on the front of a canoe. Existing shade values used in the load analysis for this portion of the river are average shade values calculated from these Solar Pathfinder measurements. Figure 5 presents Solar Pathfinder results from the first 9 miles of the Blackfoot River. Shade levels stayed relatively constant for the first 7 miles with an average shade of 1.4%. As the river travels through a region known as "The Narrows," significant topographic shade helps to increase the average shade level to 8.9%.

The lower region receiving Solar Pathfinder measurements begins at about 37.4 miles from the headwaters (Figure 6). Here, shade levels averaged 3.6% until mile mark 41.7 where the shade levels were not recorded again until mile 43.3. Shade decreased slightly at this point to an average of 3.1%. After another small gap in data recording, shade was again measured at 3.5% from mile 46.5 to mile 48.9. At about 49 miles downstream, shade levels increased again to an average of 9.9%. In the load analysis, these existing shade levels are rounded to the nearest whole number.

The small gaps described above and the middle portion of the upper Blackfoot River under examination did not receive Solar Pathfinder measurements (Figure 7). Existing shade in these areas required aerial photo interpretation where shade levels are estimated to the 10% shade class. In this case, interpreted shade levels were assumed to be within the 0%–9.9% class interval. The accuracy of the aerial photo interpretations was field verified by comparing the Solar Pathfinder measurements made above and below this middle segment of the river.

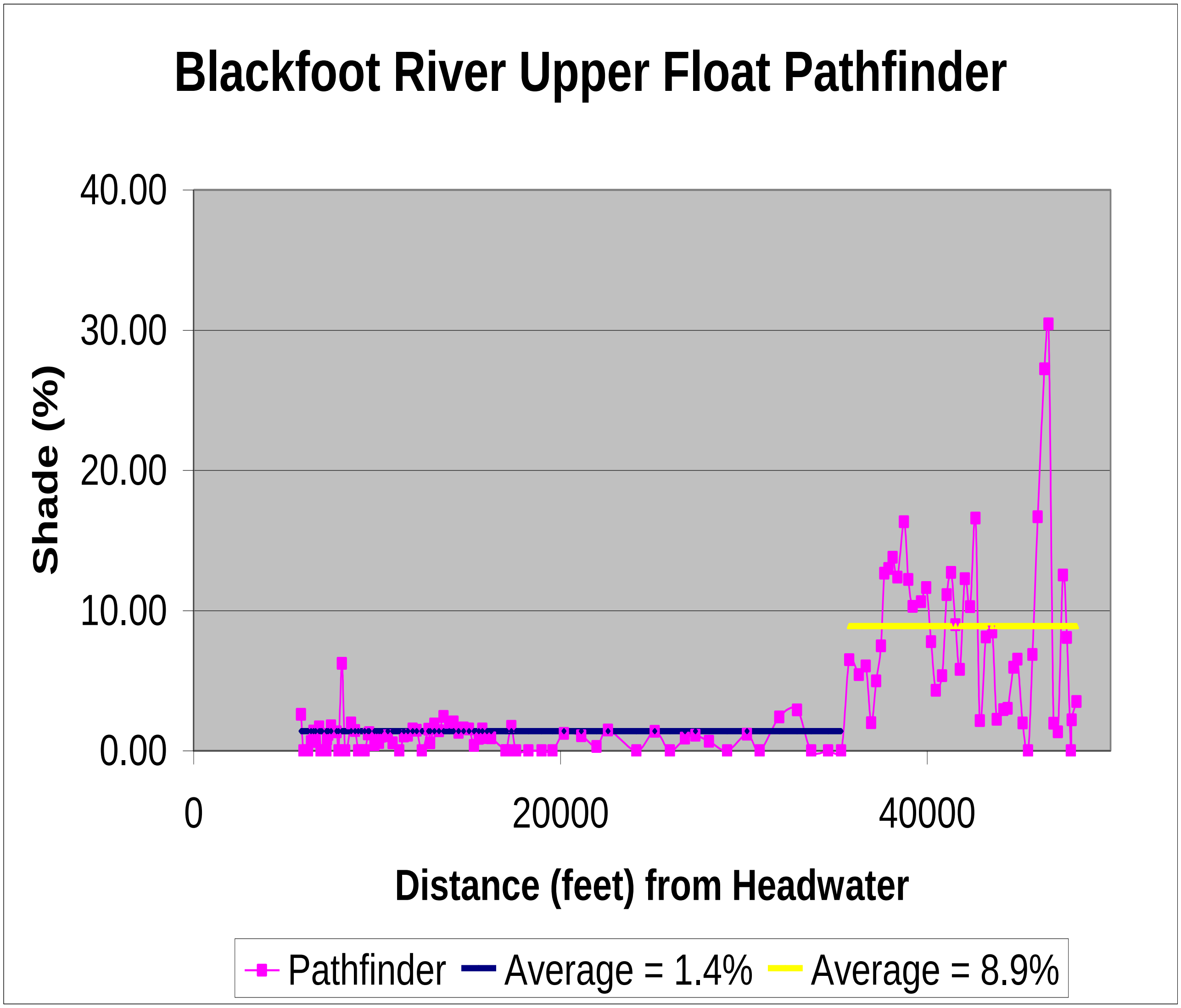

Figure 5. Solar Pathfinder shade measurements from Diamond /Lanes Creek confluence to Slug Creek bridge.

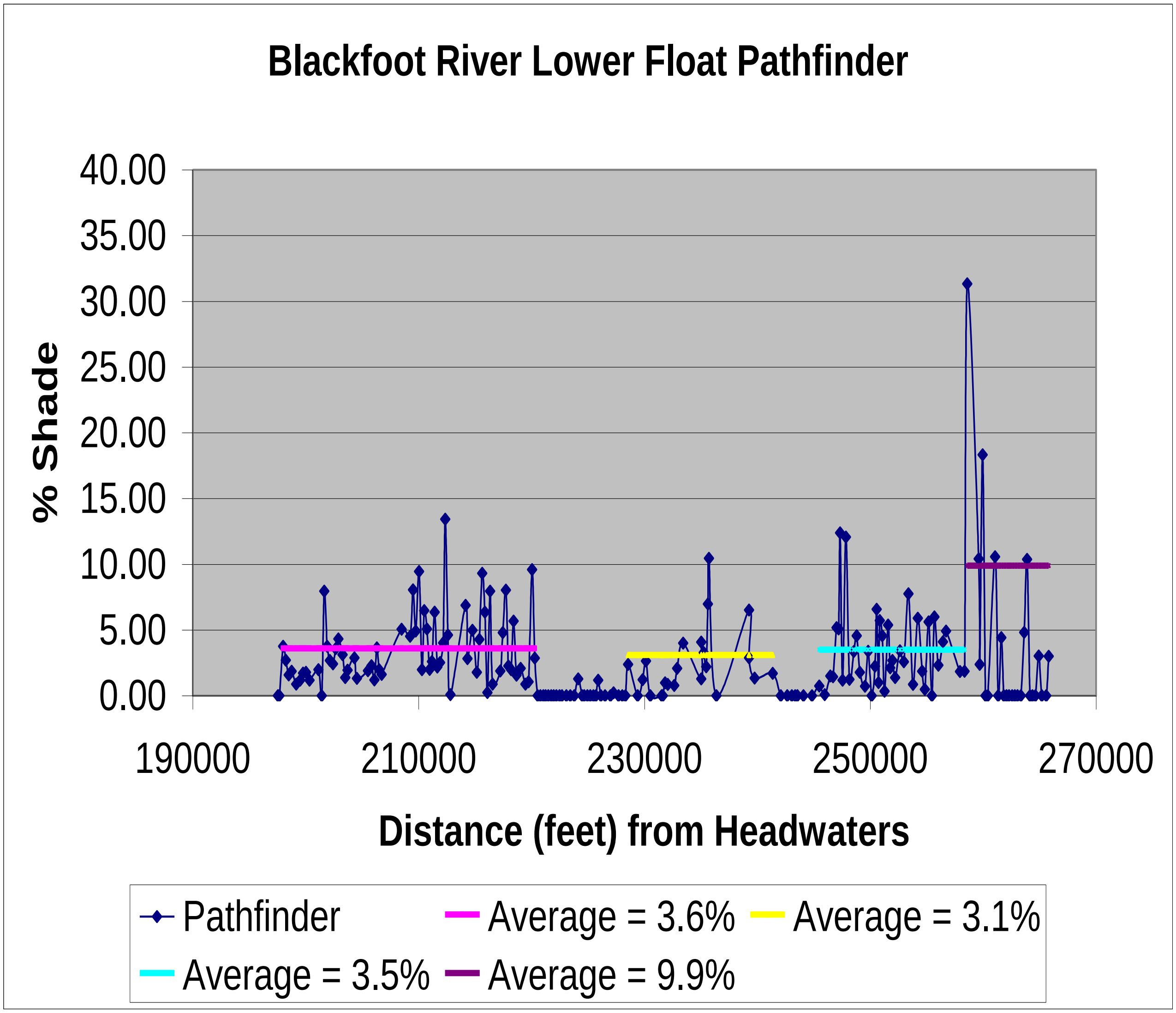

Figure 6. Solar Pathfinder shade measurements from Fox Hills Ranch to Blackfoot Reservoir.

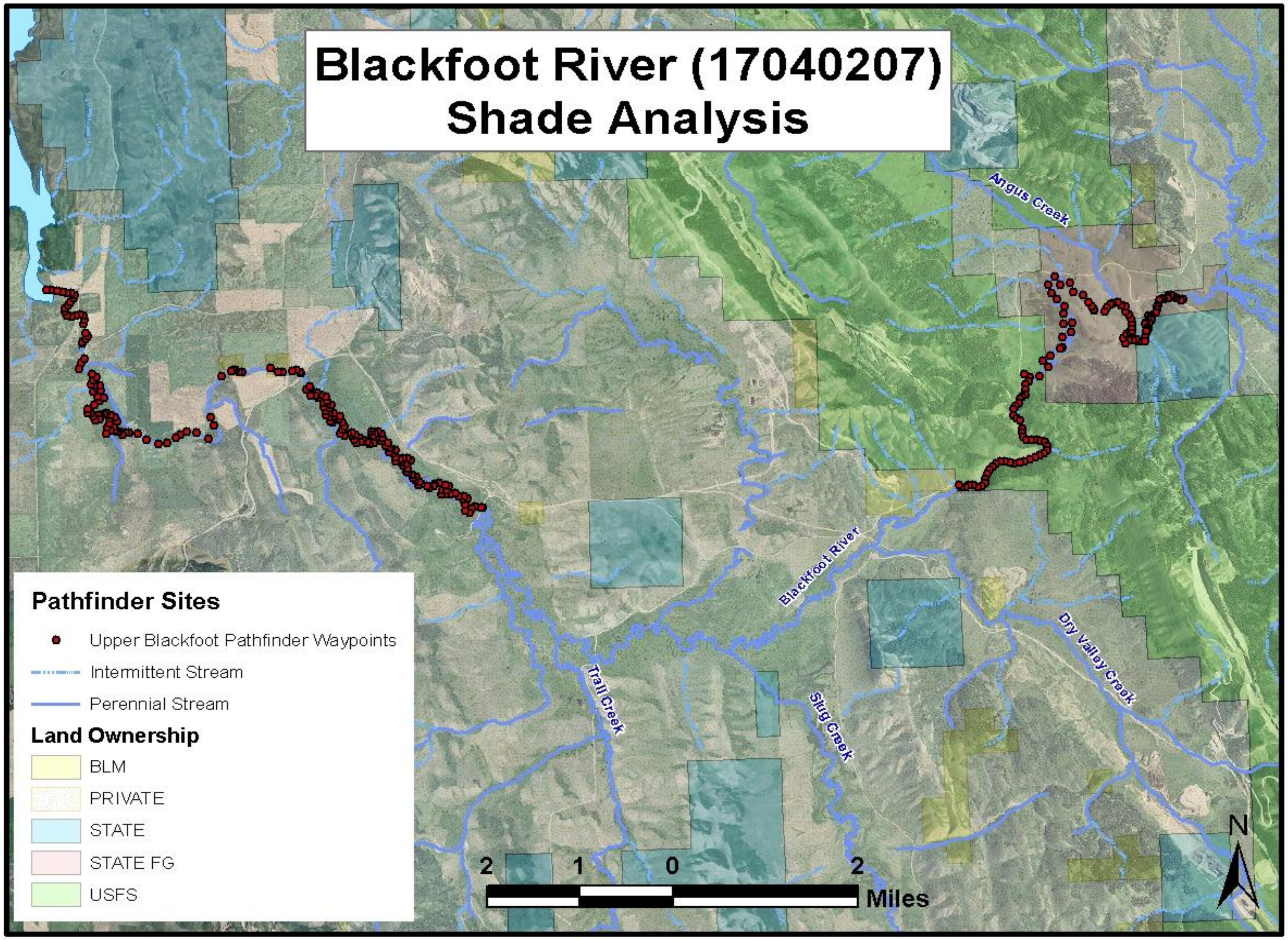

Figure 7. Location of Solar Pathfinder measurements for the upper Blackfoot River.

Effective shade monitoring can take place on any reach throughout the upper Blackfoot River and be compared to estimates of existing shade as seen on Figure 8 and described in Table 17. Those areas with the largest disparity between existing shade estimates and shade targets should be monitored with Solar Pathfinders to verify the existing shade levels and to determine progress towards meeting shade targets. Note that many existing shade estimates have not been field verified and may require adjustment during the implementation process. Stream segments for each change in existing shade vary in length depending on land use or landscape that has affected that shade level. It is appropriate to monitor within a given existing shade segment to see if that segment has increased its existing shade towards target levels. Ten equally spaced Solar Pathfinder measurements within that segment averaged together should suffice to determine new shade levels in the future.

5.3.2 Load Capacity

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

DEQ obtained solar load data for flat-plate collectors from the NREL weather station in Pocatello, Idaho. The solar loads used in this TMDL are spring and summer averages, thus, an average load was used for the 6-month period from April through September. These months coincide with the time of year when stream temperatures are increasing and deciduous vegetation is in leaf and extend into early fall spawning time. Table 17 and Figure 9 show the PNV shade targets (identified as target shade) and their corresponding target summer load (in kilowatt-hours per square meter per day [kWh/m^2/day] and kilowatt-hours per day [kWh/day]) that serve as the load capacities for the streams.

The effective shade calculations are based on a 6-month period from April through September. This time period coincides with the critical time period when temperatures affect beneficial uses, such as spring and fall salmonid spawning, and when cold water aquatic life criteria may be exceeded during summer months. Late July and early August typically represent the period of highest stream temperatures. Solar gains can begin early in the spring and affect not only the highest temperatures reached later in the summer, but also salmonid spawning temperatures in spring and fall. Thus, solar loading in these streams is evaluated from spring (April) to early fall (September). The target solar load for the upper Blackfoot River is a little less than 4.3 million kWh/day (Table 17).

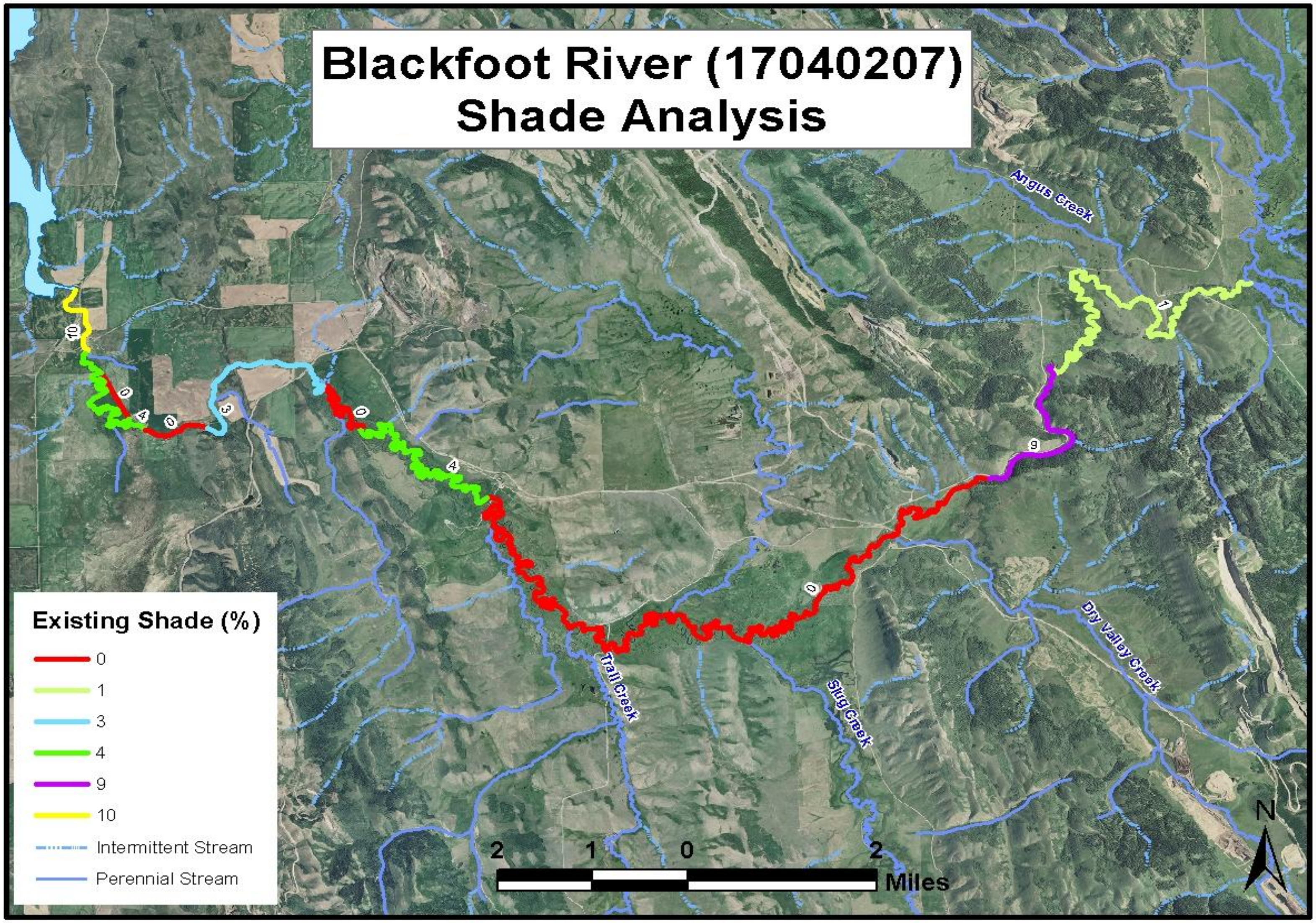

Figure 8. Existing shade estimated for the upper Blackfoot River by Solar Pathfinder measurements and aerial photo interpretation.

Table 17. Existing and target solar loads for upper Blackfoot River.

Segment Details					Target					Existing					Summary	
AU	Stream Name	Number (top to bottom)	Length (m)	Vegetation Type	Shade	Insolation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Shade	Insolation (kWh/m^2/day)	Segment Width (m)	Segment Area (m^2)	Solar Load (kWh/day)	Excess Load (kWh/day)	Lack of Shade
010_04	Blackfoot River	1	10,000	Geyers willow	19%	4.98	14	140,000	697,410	1%	6.09	14	140,000	852,390	154,980	-18%
010_04	Blackfoot River	2	420	Geyers willow	19%	4.98	14	5,880	29,291	9%	5.60	14	5,880	32,907	3,616	-10%
010_04	Blackfoot River	3	3,200	Geyers willow	18%	5.04	15	48,000	242,064	9%	5.60	15	48,000	268,632	26,568	-9%
010_04	Blackfoot River	4	8,600	Geyers willow	17%	5.10	16	137,600	702,379	0%	6.15	16	137,600	846,240	143,861	-17%
010_05	Blackfoot River	5	13,000	Geyers willow	17%	5.10	16	208,000	1,061,736	0%	6.15	16	208,000	1,279,200	217,464	-17%
010_05	Blackfoot River	6	6,300	Geyers willow	17%	5.10	16	100,800	514,534	4%	5.90	16	100,800	595,123	80,590	-13%
010_05	Blackfoot River	7	2,300	Geyers willow	17%	5.10	16	36,800	187,846	0%	6.15	16	36,800	226,320	38,474	-17%
010_05	Blackfoot River	8	3,900	Geyers willow	17%	5.10	16	62,400	318,521	3%	5.97	16	62,400	372,247	53,726	-14%
010_05	Blackfoot River	9	1,200	Geyers willow	17%	5.10	16	19,200	98,006	0%	6.15	16	19,200	118,080	20,074	-17%
010_05	Blackfoot River	10	410	Geyers willow	17%	5.10	16	6,560	33,486	4%	5.90	16	6,560	38,730	5,245	-13%
010_05	Blackfoot River	11	3,000	Geyers willow	24%	4.67	11	33,000	154,242	4%	5.90	11	33,000	194,832	40,590	-20%
010_05	Blackfoot River	11 side	990	Geyers willow	21%	4.86	13	12,870	62,529	0%	6.15	13	12,870	79,151	16,622	-21%
010_05	Blackfoot River	12	630	Geyers willow	17%	5.10	16	10,080	51,453	4%	5.90	16	10,080	59,512	8,059	-13%
010_05	Blackfoot River	13	1,600	Geyers willow	17%	5.10	16	25,600	130,675	10%	5.54	16	25,600	141,696	11,021	-7%
								Totals	4,284,172					5,105,061	820,889	

Note: Colored cells in the existing shade column are those segments where aerial photo interpretation to shade class level occurred; meter (m); kilowatt-hour per square meter per day (kWh/m^2/day); square meter (m^2).

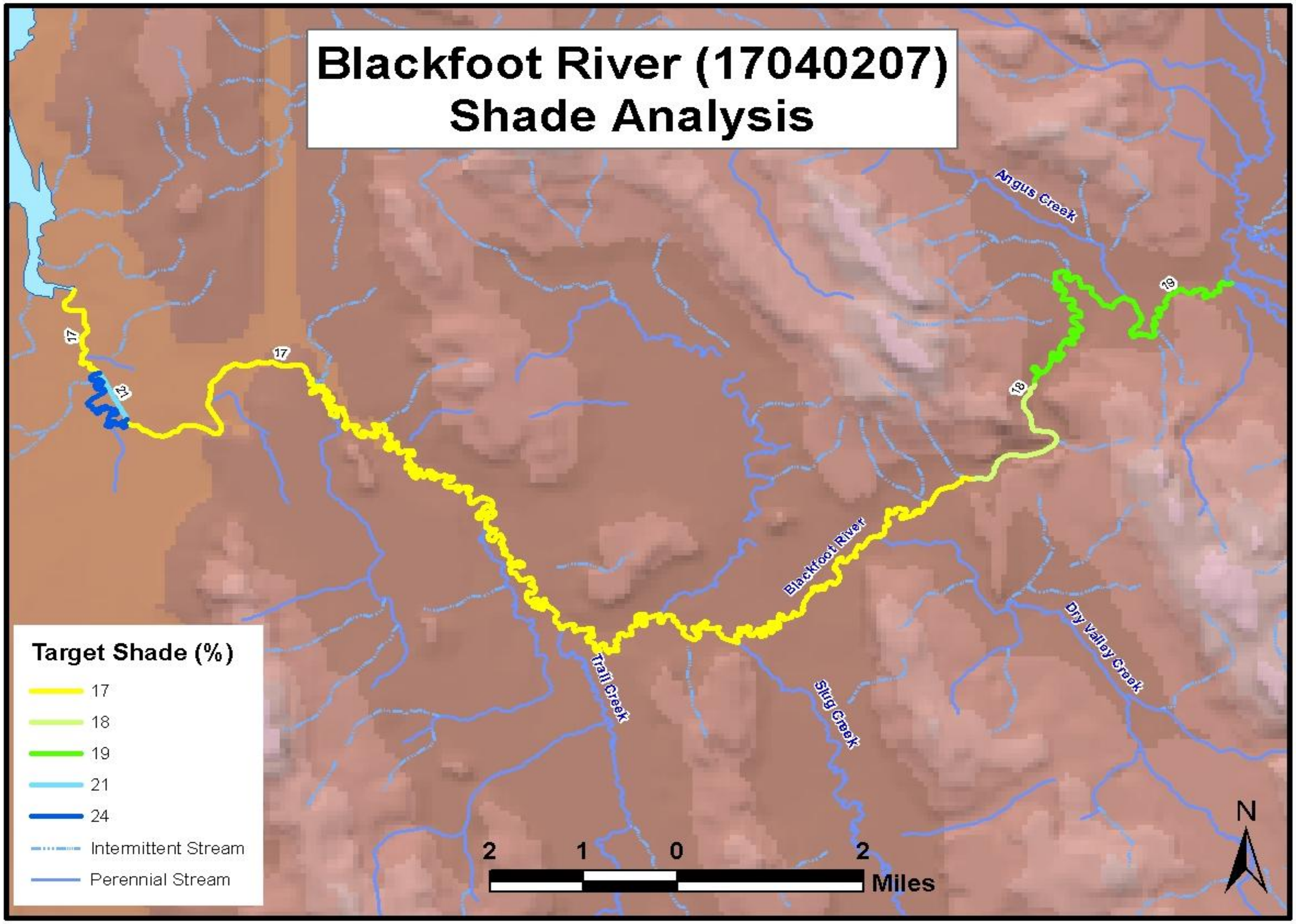

Figure 9. Target shade for the upper Blackfoot River.

5.3.3 Estimates of Existing Pollutant Loads

Regulations allow that loadings "...may range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading" ("Water Quality Planning and Management" [40 CFR 130.2(g)]). An estimate must be made for each point source. Nonpoint sources are typically estimated based on the type of sources (land use) and area (such as a subwatershed) but may be aggregated by type of source or land area. To the extent possible, background loads should be distinguished from human-caused increases in nonpoint loads.

Existing loads in this temperature TMDL come from estimates of existing shade as determined from aerial photo interpretations and Solar Pathfinder data. Like target shade, existing shade was converted to a solar load by multiplying the fraction of open stream by the solar radiation measured on a flat-plate collector at the NREL weather stations. Existing shade data are presented in Table 17 and Figure 8. Like load capacities (target loads), existing loads in Table 17 are presented on an area basis (kWh/m^2/day) and as a total load (kWh/day).

Existing and target loads in kWh/day can be summed for the entire stream, or a portion of the stream can be examined in a single load analysis table. These total loads are shown at the bottom of their respective columns in each table. The difference between target load and existing load is also summed for the entire table. If existing load exceeds target load, the difference becomes the excess load (section 5.3.4). The existing solar load for the upper Blackfoot River is a little more than 5.1 million kWh/day (Table 17).

5.3.4 Load Allocation

Because this TMDL is based on PNV, which is equivalent to background loading, the load allocation is essentially the desire to achieve background conditions. However, to reach that objective, load allocations are assigned to nonpoint source activities that have or may affect riparian vegetation and shade as a whole. Therefore, load allocations are stream reach-specific and depend on the target load for a given reach. Table 17 shows the target shade that is converted to a target summer load by multiplying the inverse fraction (1 minus shade fraction) by the average loading to a flat-plate collector for April–September. This target load capacity of the stream is needed to achieve background conditions. No opportunity is available to further remove shade from the stream by any activity without exceeding its load capacity. Additionally, because this TMDL depends on background conditions for achieving the water quality standards, all tributaries to the waters examined here need to be in natural conditions to prevent excess heat loads to the system.

Table 18 shows the total existing, total target, and total excess heat load (kWh/day) as well as the proportion of the existing load that is in excess. The stream size influences the excess load size. Large streams have higher existing and target loads by virtue of their larger channel widths as compared to smaller streams. What is important from a stream temperature standpoint is the size of the excess load relative to the size of the existing or target load.

Table 18. Total solar loads and average lack of shade for all waters.

Water Body/Assessment Unit	Total Existing Load (kWh/day)	Total Target Load (kWh/day)	Excess Load (kWh/day)	Proportion in Excess (%)
Blackfoot River ID17040207SK010_04	2,000,169	1,671,144	329,025	16
Blackfoot River ID17040207SK010_05	3,104,891	2,613,027	491,864	16
Blackfoot River (both AU) ID17040207SK010_04 ID17040207SK010_05	5,105,061	4,284,172	820,889	16

Note: kilowatt-hour per day (kWh/day)

Although the TMDL analysis dwells on total heat loads for these streams, differences between existing and target shade, as depicted in Figure 10, are the key to successfully restoring these waters to water quality standards. Target shade levels for individual reaches should be the goal managers strive for with future implementation plans. Managers should key in on the largest differences between existing and target shade as locations to prioritize implementation efforts. Each load analysis table contains a final column that lists the lack of shade on the stream. The data in the final column is derived from subtracting the target shade from the existing shade for each segment. Thus, stream segments with the largest lack of shade are in the worst shape.

Average existing shade on the upper Blackfoot River generally varies from 1% to 4% (Figure 8). In “The Narrows” region and again close to the reservoir, topography helps raise that existing shade to 9%–10%. The middle region and several smaller areas, where no Solar Pathfinder data were collected, were placed in the 0% shade class (0%–9.9%) consistent with Solar Pathfinder results from the rest of the river. Target shade for the river, based on the Geyer willow/sedge community type, varies from 17% to 24% depending on channel width (Figure 9). Thus, the river generally lacks most of the desired shade needed to maintain natural temperatures. However, due to the large channel widths, the lack of shade results in only a 16% increase in solar load.

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

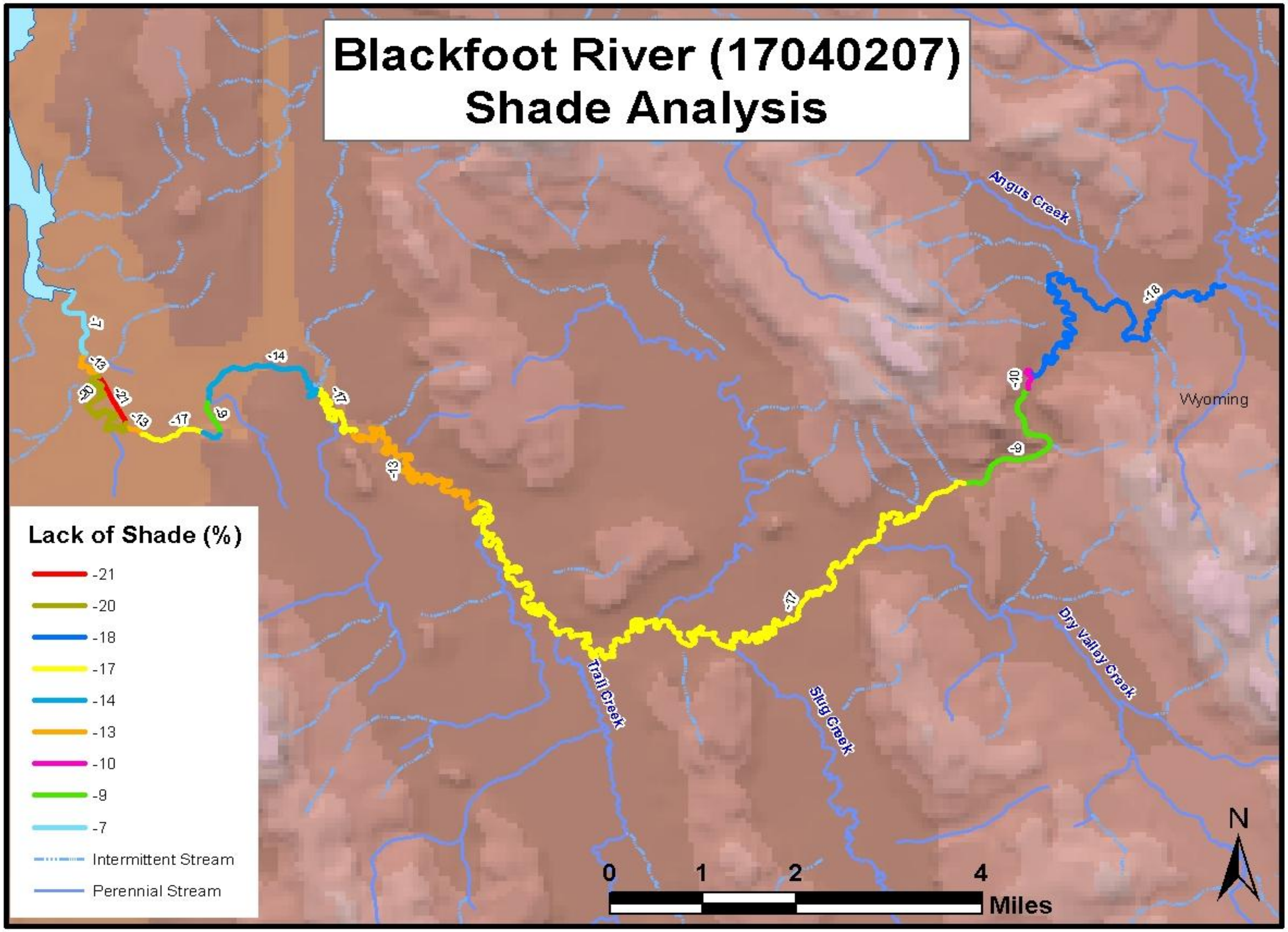

Figure 10. Lack of shade (difference between existing and target) for the upper Blackfoot River.

A certain amount of excess load is potentially created by the existing and target shade differences inherent in the load analysis. Because existing shade is reported as a 10% shade class and target shade is any integer from 0 through 100, there is usually a difference between them. For example, a particular stretch of stream has a target shade of 86% based on its vegetation type and natural bank-full width. If existing shade on that stretch of stream were at target level, it would be recorded as 80% existing shade in the load analysis because it falls into that existing shade class. There is an automatic difference of 6%, which could be attributed to the MOS.

5.3.4.1 Wasteload Allocation

There are no known NPDES-permitted point sources in the affected watersheds. Thus, there are no WLAs. If a point source is proposed that would have thermal consequence on these waters, then background provisions addressing such discharges in IDAPA 58.01.02.200.09 and IDAPA 58.01.02.401.01 should be involved (Appendix A).

5.3.4.2 Reasonable Assurance

After TMDL acceptance by DEQ, EPA, and stakeholders, the next step of the Idaho water body management process is implementation. Idaho water quality standards identify designated agencies that are responsible for evaluating and modifying BMPs to protect impaired water bodies. The implementation strategies should incorporate field verification of the load analysis tables included in this TMDL.

Ongoing assessment of the support status of the water bodies with TMDLs will be reported in a 5-year review of the TMDL. If full support status has not been obtained, further implementation will be needed and further reassessment performed until full support status is reached. If full support status is reached, the requirements of the TMDL will be considered complete.

5.3.4.3 Margin of Safety

The MOS in this TMDL is considered implicit in the design. Because the target is essentially background conditions, loads (shade levels) are allocated to lands adjacent to these streams at natural background levels. Because shade levels are established at natural background or system potential levels, it is unrealistic to set shade targets at higher, or more conservative, levels. Additionally, existing shade levels are reduced to a 10% shade class, which likely underestimates actual shade in the load analysis. Although the load analysis used in this TMDL involves gross estimations that are likely to have large variances, load allocations are applied to the stream and its riparian vegetation rather than specific nonpoint source activities and can be adjusted as more information is gathered from the stream environment.

5.3.4.4 Seasonal Variation

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

5.4 Construction Stormwater and Total Maximum Daily Load Wasteload Allocations

5.4.1 Construction Stormwater

The CWA requires construction site operators to obtain permit coverage to discharge stormwater to a water body or to a municipal storm sewer. In Idaho, EPA has issued a general permit for stormwater discharges from construction sites. In the past, stormwater was treated as a nonpoint source of pollutants. However, because stormwater can be managed on site through management practices or when discharged through a discrete conveyance such as a storm sewer, it now requires an NPDES permit.

5.4.2 Construction General Permit

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

5.4.3 Stormwater Pollution Prevention Plan

To obtain the CGP, operators must develop a site-specific SWPPP. The operator must document the erosion, sediment, and pollution controls to be used; inspect the controls periodically; and maintain BMPs through the life of the project.

5.4.4 Construction Stormwater Requirements

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

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

5.5 Pollutant Trading

Pollutant trading (also known as *water quality trading*) is a contractual agreement to exchange pollution reductions between two parties. Pollutant trading is a business-like way of helping to solve water quality problems by focusing on cost-effective local solutions to problems caused by pollutant discharges to surface waters.

The appeal of trading emerges when pollutant sources face substantially different pollutant reduction costs. Typically, a party facing relatively high pollutant reduction costs compensates another party to achieve an equivalent, though less costly, pollutant reduction.

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

Pollutant trading is recognized in IDAPA 58.01.02.055.06. Currently, DEQ's policy allows for pollutant trading as a means to meet TMDLs, thus restoring water quality limited water bodies to compliance with water quality standards. The *Water Quality Pollutant Trading Guidance* (DEQ 2010b) provides the procedures to be followed for pollutant trading: http://www.deq.idaho.gov/media/488798-water_quality_pollutant_trading_guidance_0710.pdf.

5.5.1 Trading Components

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

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

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

5.5.2 Watershed-Specific Environmental Protection

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

5.5.3 Trading Framework

For pollutant trading to be authorized, it must be specifically mentioned within a TMDL document. After adoption of an EPA-approved TMDL, DEQ, with the WAG, must develop a pollutant trading framework document as part of an implementation plan for the watershed that is the subject of the TMDL.

The elements of a trading document are described in DEQ (2010b), available at http://www.deq.idaho.gov/media/488798-water_quality_pollutant_trading_guidance_0710.pdf.

5.6 Public Participation

Idaho House Bill 145 changed how WAGs are involved in TMDL development and review. The basic process for developing TMDLs and implementation plans is described below.

DEQ works with the WAG and shares available information pertinent to the SBA/TMDL, such as monitoring data, water quality assessments, and relevant reports. The WAG has the opportunity to actively participate in DEQ's TMDL preparation.

Once a draft TMDL is complete, it is reviewed first by the WAG and EPA, then by the public. After WAG comments have been considered and incorporated, if the WAG does not agree with an SBA/ TMDL, the WAG's position and basis are documented in a public notice and the SBA/TMDL is available for review. If the WAG still disagrees with the SBA/TMDL after public comments have been considered and incorporated, DEQ must incorporate the WAG's dissenting opinion. 0 provides a distribution list, and in the final version of this addendum, public comments will be included in Appendix E.

5.7 Implementation Strategies

DEQ recognizes that implementation strategies for TMDLs may need to be modified if monitoring shows that TMDL goals of restoring beneficial uses or complying with water quality standards are not being met or significant progress is not being made toward achieving the goals. Conversely, goals may be met by improving riparian management techniques.

5.7.1 Time Frame

The expected time frame for attaining the water quality standards and restoring beneficial uses is a function of management intensity, climate, ecological potential, and natural variability of environmental conditions. If implementation of BMPs is embraced enthusiastically, some improvements may be seen in as little as several years. Even with aggressive implementation, however, some natural processes required to satisfy this TMDL's requirements may not be seen for many years. The deleterious effects of historic land management practices have accrued over many years, and recovery of natural systems may take longer than administrative needs allow.

Similarly, the expected time frame for restoring the Blackfoot River subbasin and its component streams to natural stream condition highly depends on several variables, principally the effort taken by those responsible for implementing such measures. In an ideal situation, where implementation occurs within 5 years of TMDL approval, vegetative recovery to natural conditions could occur within 20 years of planting and near exclusion of livestock.

5.7.2 Approach

It is anticipated that by improving riparian management practices, overall riparian zone recovery will precipitate streambank stabilization, reduce sedimentation, increase canopy cover, and lower stream temperatures, all of which will improve stream habitat. Implementing riparian zone recovery practices will contribute to overall improvement in stream morphology and habitat, shifting stream health towards beneficial use attainment.

The designated management agencies, WAG, and other appropriate public process participants are expected to implement the following:

- Develop BMPs to achieve load allocations.
- Give reasonable assurance that management measures will meet load allocations through both quantitative and qualitative analysis of management measures.
- Adhere to measurable milestones for progress.
- Develop a timeline for implementation, with reference to costs and funding.
- Develop a monitoring plan to determine if BMPs are being implemented, if individual BMPs are effective, if load allocations and wasteload allocations are being met, and whether or not water quality standards are being met.

5.7.3 Responsible Parties

Several designated land management agencies are involved where watershed implementation is concerned. The ISCC, IDL, ITD, BLM, and USFS are identified as the state and federal entities that will be involved in or responsible for implementing the TMDL. The designated management agencies will recommend specific control actions and will then submit the implementation plan to DEQ. DEQ will act as a repository for approved implementation plans and conduct 5-year reviews of progress toward TMDL goals.

In addition to the designated management agencies, the public, through the WAG, will be provided with opportunities to be involved in developing the implementation plan to the maximum extent practical.

5.7.4 Monitoring Strategy

The objectives of a monitoring effort are to demonstrate long-term recovery, better understand natural variability, track implementation of projects and BMPs, and track effectiveness of TMDL implementation. This monitoring and evaluation mechanism is a major component of the "reasonable assurance of implementation" for the TMDL implementation plan.

The implementation plan will be tracked by accounting for the numbers, types, and locations of watershed improvement projects; educational activities; or other actions taken to improve or protect water quality. Reports submitted to DEQ will be the mechanism for tracking specific implementation efforts.

The monitoring and evaluation component has two basic categories:

1. Track the implementation progress of specific watershed improvement plans.
2. Track the progress of improving water quality through monitoring physical, chemical, and biological parameters.

Monitoring plans will provide information on progress made toward achieving TMDL allocations and water quality standards and will provide interim progress evaluation, an important component of an adaptive management approach.

While DEQ has the primary responsibility for watershed monitoring, other agencies and entities have shown an interest in such monitoring. In these instances, data sharing is encouraged. The designated agencies have primary responsibility for BMP monitoring.

5.8 Conclusions

This TMDL is a starting point for restoring beneficial uses on many water bodies in the subbasin. Because many factors influence water quality, implementation should be organized within an adaptive management framework. Through the efforts of both private and public entities, water quality in impaired streams can be greatly improved. The determinations established in this TMDL regarding water quality in the Blackfoot River subbasin are summarized in Table 19.

Table 19. Summary of assessment outcomes.

Water Body/ Assessment Unit	Listed Pollutants	TMDLs Completed	Recommended Changes to Next Integrated Report	Justification
Deadman Creek ID17040207SK002_02b	Sediment	Yes	Move to Category 4a	TMDL completed
Grave Creek ID17040207SK005_02 ID17040207SK005_02a ID17040207SK005_03	Sediment	Yes	Move to Category 4a	TMDL completed
Warbonnet Creek ID17040207SK005_02b	*E. coli,* sediment	Yes	Move to Category 4a	TMDLs completed
Wood Creek ID17040207SK005_02c	Sediment	Yes	Move to Category 4a	TMDL completed
Coyote Creek ID17040207SK005_02d	Sediment	Yes	Move to Category 4a	TMDL completed
Sunday Creek ID17040207SK005_02e	Sediment	Yes	Move to Category 4a	TMDL completed
Corral Creek ID17040207SK006_02	*E. coli*	No	Unassessed for SCR; Move to Category 3	Not sampled
Corral Creek ID17040207SK006_03	*E. coli*	No	Move to Category 2	Meets water quality targets; listed in error
Corral Creek ID17040207SK006_04	*E. coli*	Yes	Move to Category 4a	TMDL completed
Chicken Creek ID17040207SK006_02a	Sediment	Yes	Move to Category 4a	TMDL completed
Bear Creek ID17040207SK006_02b	Sediment	Yes	Move to Category 4a	TMDL completed
Sawmill Creek ID17040207SK007_02a	*E. coli*	Yes	Move to Category 4a	TMDL completed
Thompson Creek ID17040207SK008_02	*E. coli,* sediment	Yes	Move to Category 4a	TMDLs completed
Thompson Creek ID17040207SK008_03	*E. coli*	No	Unassessed for SCR; Move to Category 3	Not sampled
Collett Creek ID17040207SK009_02a	*E. coli,* sediment	Yes	Move to Category 4a	TMDLs completed
Poison Creek ID17040207SK009_02b	*E. coli,* sediment	Yes	Move to Category 4a	TMDLs completed
Little Blackfoot River ID17040207SK009_03	Sediment	Yes	Move to Category 4a	TMDL completed

Water Body/ Assessment Unit	Listed Pollutants	TMDLs Completed	Recommended Changes to Next Integrated Report	Justification
State Land Creek ID17040207SK010_02a	Sediment	Yes	Move to Category 4a	TMDL completed
Blackfoot River ID17040207SK010_04 ID17040207SK010_05	Temperature, DO	Yes	Move temperature to Category 4a; delist DO and show as observed effect of temperature exceedance	Temperature TMDL completed and serves as surrogate for DO
Upper Johnson Creek ID17040207SK012_02a	Combined biota/ habitat bioassessments	No	Move to Category 2	Meets water quality targets; listed in error
Lower Johnson Creek ID17040207SK012_03a	Combined biota/ habitat bioassessments	Yes	List in Category 4a for sediment; delist for combined biota/habitat bioassessments; list in Category 4c for channelization	TMDL completed; sediment identified as pollutant; stream has been channelized and diverted
Goodheart Creek ID17040207SK012_02b	Sediment	Yes	Move to Category 4a	TMDL completed
Spring Creek ID17040207SK015_02	*E. coli*	No	Unassessed for SCR; Move to Category 3	Not sampled
Spring Creek ID17040207SK015_03	*E. coli*	No	Move to Category 2	Meets water quality targets; listed in error
Upper Mill Canyon ID17040207SK015_02a	Sediment	No	Delist for sediment	Meets water quality targets
Diamond Creek ID17040207SK016_02	*E. coli*	No	Unassessed for SCR; Move to Category 3	Not sampled
Diamond Creek ID17040207SK016_02a	*E. coli*	No	Move to Category 2	Meets water quality targets; Listed in error
Diamond Creek ID17040207SK016_03 ID17040207SK016_03a	*E. coli*	Yes	Move to Category 4a	TMDL completed

Water Body/ Assessment Unit	Listed Pollutants	TMDLs Completed	Recommended Changes to Next Integrated Report	Justification
Lower Chippy Creek ID17040207SK021_03	Sediment, combined biota/ habitat bioassessments, habitat assessments	Yes	Move to Category 4a; delist for combined biota/habitat bioassessments, habitat assessments	TMDL completed; sediment identified as pollutant
Angus Creek ID17040207SK023_02	*E. coli*	No	Unassessed for SCR; Move to Category 3	Not sampled
Angus Creek ID17040207SK023_02b	*E. coli*	Yes	Move to Category 4a	TMDL completed
Angus Creek ID17040207SK023_04	*E. coli*	No	Move to Category 2	Meets water quality targets; listed in error
Clarks Cut ID17040207SK025_02c	Sediment	Yes	Move to Category 4a and Category 2	TMDL completed and AWS use supported
Crooked Creek ID17040207SK025_03b	Sediment	Yes	Move to Category 4a	TMDL completed
Rawlins Creek ID17040207SK027_02	Sediment	Yes	Move to Category 4a	TMDL completed
Rawlins Creek ID17040207SK027_03	Fecal coliform	Yes	Move to Category 4a; change bacteria type from fecal coliform to *E. coli*	TMDL completed
Poison Creek ID17040207SK027_02b	*E. coli*	No	Move to Category 2	Meets water quality targets; listed in error
Cedar Creek ID17040207SK029_02	*E. coli*	Yes	Move to Category 4a	TMDL completed
Cedar Creek ID17040207SK029_03	*E. coli*	No	Move to Category 2	Meets water quality targets; listed in error
Cedar Creek ID17040207SK029_03	Sediment, benthic macroinvertebrate bioassessments, combined biota/habitat bioassessments, habitat assessment	Yes	Move to Category 4a; delist for benthic macroinvertebrate bioassessment, combined biota/habitat bioassessments, habitat assessments	Sediment TMDL completed; sediment identified as pollutant

Water Body/ Assessment Unit	Listed Pollutants	TMDLs Completed	Recommended Changes to Next Integrated Report	Justification
Jones Creek ID17040207SK031_02	Sediment	Yes	Move to Category 4a	TMDL completed

Notes: total maximum daily load (TMDL); *Escherichia coli* (*E. coli*); secondary contact recreation (SCR); dissolved oxygen (DO); agricultural water supply (AWS)

References

Armantrout, N.B., compiler. 1998. *Glossary of Aquatic Habitat Inventory Terminology*. Bethesda, MD: American Fisheries Society.

CFR (Code of Federal Regulations). 2012. “Water Quality Planning and Management.” 40 CFR 130.

CFR (Code of Federal Regulations). 2012. “Water Quality Standards.” 40 CFR 131.

DEQ (Idaho Department of Environmental Quality). 2001. *Blackfoot River TMDL Waterbody Assessment and Total Maximum Daily Load*. Pocatello, ID: DEQ.

DEQ (Idaho Department of Environmental Quality). 2005. *Catalog of Stormwater Best Management Practices for Idaho Cities and Counties*. Boise, ID: DEQ.

DEQ (Idaho Department of Environmental Quality). 2006. *Blackfoot River TMDL Implementation Plan*. Pocatello, ID: DEQ.

DEQ (Idaho Department of Environmental Quality). 2010a. *Portneuf River TMDL Revision and Addendum*. Pocatello, ID: DEQ.

DEQ (Idaho Department of Environmental Quality). 2010b. *Water Quality Pollutant Trading Guidance*. Boise, ID: DEQ.

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

DEQ (Idaho Department of Environmental Quality). 2011b. *Bear River Basin: Addendum to the Bear River/Malad Subbasin Assessment and Total Maximum Daily Load Plan for HUCs 16010102, 16010201, 1600202, 16010204*. Pocatello, ID: DEQ.

Dodds, W.K. and E.B. Welch. 2000. “Establishing Nutrient Criteria in Streams.” *Journal of North American Benthological Society* 19:186–196.

EPA (US Environmental Protection Agency). 1996. *Biological Criteria: Technical Guidance for Streams and Small Rivers*. Washington, DE: EPA, Office of Water. EPA 822-B-96-001.

Grafe, C.S., C.A. Mebane, M.J. McIntyre, D.A. Essig, D.H. Brandt, and D.T. Mosier. 2002. *Water Body Assessment Guidance.* 2nd ed.-final. Boise, ID: Department of Environmental Quality.

Hansen, P.L. and J.B. Hall. 2002. *Classification and Management of USDI Bureau of Land Management’s Riparian and Wetland Sites in Eastern and Southern Idaho*. Bitterroot Restoration, Inc. Corvallis, MT: Ecological Solutions Group LLC.

Hughes, R.M. 1995. “Defining Acceptable Biological Status by Comparing with Reference Condition.” W.S. Davis and T.P. Simon, eds. *Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making*. Boca Raton, FL: CRC Press.

HWS Consulting Group Inc. 2008. *Draft Final Engineering Evaluation/Cost Analysis For A Portion of the Mill Creek Drainage at North Maybe Mine Site*. Greenwood Village, CO.

IDAPA. 2012. "Idaho Water Quality Standards." Idaho Administrative Code. IDAPA 58.01.02

IDL (Idaho Department of Lands). 2000. *Forest Practices Cumulative Watershed Effects Process for Idaho*. Boise, ID: IDL.

Karr, J.R. 1991. "Biological Integrity: A Long-Neglected Aspect of Water Resource Management." *Ecological Applications* 1:66-84.

Marcarelli A.M., A.T. Rugenski, H. Bechtold and R.S. Inouye. 2006. *Nutrient Limitation of Biofilms in Southeast Idaho Rivers*. Pocatello, ID. Report to Idaho Department of Environmental Quality.

McGrath, C.L., A.J. Woods, J.M. Omernik, S.A. Bryce, M. Edmondson, J.A. Nesser, J. Shelden, R.C. Crawford, J.A. Comstock, and M.D. Plocher. 2001. *Ecoregions of Idaho*. Reston, VA: US Geological Survey.

Overton, C.K., J.D. McIntyre, R. Armstrong, S.L. Whitwell, and K.A. Duncan. 1995. *User's Guide to Fish Habitat: Descriptions that Represent Natural Conditions in the Salmon River Basin, Idaho*. Ogden, UT: US Forest Service, Intermountain Research Station. General Technical Report INT-GTR-322.

OWEB (Oregon Watershed Enhancement Board). 2001. "Stream Shade and Canopy Cover Monitoring Methods." In *Water Quality Monitoring Technical Guide Book,* chap. 14 addendum. Salem, OR: OWEB.

Poole, G.C., and C.H. Berman. 2001. "An Ecological Perspective on In-Stream Temperature: Natural Heat Dynamics and Mechanisms of Human-Caused Thermal Degradation." *Environmental Management* 27(6):787–802.

Rosgen, D. 1996. *Applied River Morphology*. Pagosa Springs, CO: Wildland Hydrology.

Shumar, M.L. and J. De Varona. 2009. *The Potential Natural Vegetation (PNV) Temperature Total Maximum Daily Load (TMDL) Procedures Manual*. Boise, ID: Idaho Department of Environmental Quality.

Strahler, A.N. 1957. "Quantitative Analysis of Watershed Geomorphology." *Transactions American Geophysical Union* 38:913–920.

US Congress. 1972. Clean Water Act (Federal water pollution control act). 33 USC §1251–1387.

US Congress. 1987. Water Quality Act of 1987. Public Law 100-4.

USFWS (US Fish and Wildlife Service). 1982. *Master Plan Report for Grays Lake National Wildlife Refuge Wayan, Idaho*. USFWS, Region One.

USGS (US Geological Survey). 1987. *Hydrologic Unit Maps*. Denver, CO: USGS. Water supply paper 2294.

USGS (US Geological Survey). 2012. "USGS Water Data for the Nation." National Water Information System: Web Interface. *http://waterdata.usgs.gov/nwis?*

Wagner, R.J., R.W. Boulger, Jr., C.J. Oblinger, and B.A. Smith. 2006. *Guidelines and Standard Procedures for Continuous Water-Quality Monitors - Station Operation, Record Computation, and Data Reporting*. US Geological Survey Techniques and Methods 1-D3.

Geographic Information System Coverages

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Glossary

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

Alluvium
Unconsolidated recent stream deposition.

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

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

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

Aquatic
Occurring, growing, or living in water.

Aquifer
An underground, water-bearing layer or stratum of permeable rock, sand, or gravel capable of yielding water to wells or springs.

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

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

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

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

Best Management Practices (BMPs)
Structural, nonstructural, and managerial techniques that are effective and practical means to control nonpoint source pollutants.

Biological Integrity	1) The condition of an aquatic community inhabiting unimpaired water bodies of a specified habitat as measured by an evaluation of multiple attributes of the aquatic biota (EPA 1996). 2) The ability of an aquatic ecosystem to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to the natural habitats of a region (Karr 1991).
Biota	The animal and plant life of a given region.
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 develop information on, and control the quality of, the nation's water resources.
Coliform Bacteria	A group of bacteria predominantly inhabiting the intestines of humans and animals but also found in soil. Coliform bacteria are commonly used as indicators of the possible presence of pathogenic organisms (also see Fecal Coliform Bacteria, *E. coli*, and Pathogens).
Community	A group of interacting organisms living together in a given place.
Criteria	In the context of water quality, numeric or descriptive factors taken into account in setting standards for various pollutants. These factors are used to determine limits on allowable concentration levels, and to limit the number of violations per year. The US Environmental Protection Agency develops criteria guidance; states establish criteria.
Cubic Feet per Second (cfs)	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, one cubic foot per second is equal to 448.8 gallons per minute and 10,984 acre-feet per day.
Depth Fines	Percent by weight of particles of small size within a vertical core of volume of a streambed or lake bottom sediment. The upper size threshold for fine sediment for fisheries purposes varies from 0.8 to 6.5 millimeters depending on the observer and methodology used. The depth sampled varies but is typically about one foot (30 centimeters).
Designated Uses	Those water uses identified in state water quality standards that must be achieved and maintained as required under the Clean Water Act.
Discharge	The amount of water flowing in the stream channel at the time of measurement. Usually expressed as cubic feet per second (cfs).

Dissolved Oxygen (DO)
The oxygen dissolved in water. Adequate DO is vital to fish and other aquatic life.

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

E. coli
Escherichia coli (E. coli) are a subspecies of coliform bacteria. Most *E. coli* are essential to the healthy life of all warm-blooded animals, including humans, but their presence in water is often indicative of fecal contamination. *E. coli* are used by Idaho as the indicator for the presence of pathogenic microorganisms.

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 nonliving (abiotic) environmental surroundings.

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

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

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

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

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

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

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

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

Flow
See Discharge.

Geographic 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.

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 emerges again as stream-flow.

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 (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, 4th-field hydrologic units have been more commonly called subbasins; 5th-and 6th-field hydrologic units have since been delineated for much of the country and are known as watersheds and subwatersheds, respectively.

Hydrologic Unit Code (HUC)
The number assigned to a hydrologic unit and often used to refer to the land are encompassed by the 4th-field hydrologic units.

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

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.

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. A load is the product of flow (discharge) and concentration.

Load Capacity (LC)
How much pollutant a water body can receive over a given period without causing violations of state water quality standards. Upon allocation to various sources, a margin of safety, and natural background contributions, it becomes a total maximum daily load.

Macroinvertebrate
An invertebrate animal (without a backbone) large enough to be seen without magnification and retained by a 500 micrometer mesh (US #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 load capacity set aside to allow for uncertainty about the relationship between the pollutant loads and the quality of the receiving water body. The margin of safety 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 margin of safety is not allocated to any sources of pollution.

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

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; 6 is the median of 1, 2, 5, 7, 9, 11.

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

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

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

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

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

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

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

Nitrogen
An element essential to plant growth and thus considered a nutrient.

Nonpoint Source
A dispersed source of pollutants, generated from a geographical area when pollutants are dissolved or suspended in runoff and then delivered into waters of the state. Nonpoint sources are without a discernible point or origin and include, but are not limited to, irrigated and nonirrigated lands used for grazing, crop production, and silviculture; rural roads; construction and mining sites; log storage or rafting; and recreation sites.

Not Attainable
A concept and an assessment category describing water bodies with characteristics that make it unlikely that a beneficial use can be attained (e.g., a stream that is dry but designated for salmonid spawning).

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

Nutrient
Any substance required by living things to grow. An element or its chemical forms essential to life, such as carbon, oxygen, nitrogen, and phosphorus. Commonly refers to those elements in short supply, such as nitrogen and phosphorus, which usually limit growth.

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

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.
Parameter	A variable, measurable property whose value is a determinant of the characteristics of a system (e.g., temperature, dissolved oxygen, and fish populations are parameters of a stream or lake).
Pathogens	A small subset of microorganisms (e.g., certain bacteria, viruses, and protozoa) that can cause sickness or death. Direct measurement of pathogen levels in surface water is difficult. Consequently, indicator bacteria that are often associated with pathogens are assessed. *E. coli*, a type of fecal coliform bacteria, are used by Idaho as the indicator for the presence of pathogenic microorganisms.
pH	The negative log10 of the concentration of hydrogen ions, a measure which in water ranges from very acidic (pH=1) to very alkaline (pH = 14). A pH of 7 is neutral. Surface waters usually measure between pH 6 and 9.
Phased TMDL	A total maximum daily load (TMDL) that identifies interim load allocations and details further monitoring to gauge the success of management actions in achieving load reduction goals and the effect of actual load reductions on the water quality of a water body. Under a phased TMDL, a refinement of load allocations, wasteload allocations, and the margin of safety is planned at the outset.
Phosphorus	An element essential to plant growth, often in limited supply, and thus considered a nutrient.
Physiochemical	In the context of bioassessment, the term is commonly used to mean the physical and chemical factors of the water column that relate to aquatic biota. Examples in bioassessment usage include saturation of dissolved gases, temperature, pH, conductivity, dissolved or suspended solids, forms of nitrogen, and phosphorus. This term is used interchangeable with the term "physical/chemical."
Point Source	A source of pollutants characterized by having a discrete conveyance, such as a pipe, ditch, or other identifiable "point" of discharge into a receiving water. Common point sources of pollution are industrial and municipal wastewater.
Pollutant	Generally, any substance introduced into the environment that adversely affects the usefulness of a resource or the health of humans, animals, or ecosystems.
Pollution	A very broad concept that encompasses human-caused changes in the environment that alter the functioning of natural processes and produce undesirable environmental and health effects. Pollution 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.

Protocol	A series of formal steps for conducting a test or survey.
Qualitative	Descriptive of kind, type, or direction.
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 is used to calibrate or standardize instruments.
Reference Condition	1) A condition that fully supports applicable beneficial uses with little effect 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.
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.
Riparian	Associated with aquatic (stream, river, lake) habitats. Living or located on the bank of a water body.
River	A large natural or human-modified stream that flows in a defined course or channel or in a series of diverging and converging channels.
Runoff	The portion of rainfall, melted snow, or irrigation water that flows across the land surface, through shallow underground zones (interflow), and through ground water to create 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.
Stream	A natural water course containing flowing water, at least part of the year. Together with dissolved and suspended materials, a stream normally supports communities of plants and animals within the channel and the riparian vegetation zone.
Stream Order	Hierarchical ordering of streams based on the degree of branching. A 1st-order stream is an unforked or unbranched stream. Under Strahler's (1957) system, higher-order streams result from two streams of the same order joining.
Stormwater Runoff	Rainfall that quickly runs off the land after a storm. In developed watersheds the water flows off roofs and pavement into storm drains that may feed quickly and directly into the stream. The water often carries pollutants picked up from these surfaces.
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 and name commonly given to 4^{th}-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 6.5 millimeters depending on the observer and methodology used. Results are typically expressed as a percentage of observation points with fine sediment.
Surface Runoff	Precipitation, snow melt, or irrigation water in excess of what can infiltrate the soil surface and be stored in small surface depressions; a major transporter of nonpoint source pollutants in rivers, streams, and lakes. Surface runoff is also called overland flow.

Surface Water

All water naturally open to the atmosphere (e.g., rivers, lakes, reservoirs, streams, impoundments, seas, estuaries) 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).

Total Maximum Daily Load (TMDL)

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

Tributary

A stream feeding into a larger stream or lake.

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.

Wasteload Allocation (WLA)

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

Water Body

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

Water Column

Water between the interface with the air at the surface and the 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 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 US Environmental Protection Agency-approved ambient standards for water bodies. The standards prescribe the use of the water body and establish the water quality criteria that must be met to protect designated uses.

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

Watershed
1) All the land that 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 that contributes water to a point of interest in a water body.

Water Body Identification Number (WBID)
A number that uniquely identifies a water body in Idaho and ties in to the Idaho water quality standards and GIS information.

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

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

Water Quality Standards Applicable to Salmonid Spawning Temperature

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

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

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

Natural Background Provisions

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

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

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

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Appendix B—Metric-English Unit Conversion Chart.

Table A-1. Metric–English unit conversions.

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

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

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Appendix C—Data Sources

Table C-1. Data sources for Blackfoot River total maximum daily loads.

Water Body	Data Source	Type of Data	When Collected
Blackfoot River tributaries	DEQ Pocatello Regional Office	Streambank erosion inventories	2008–2011
Blackfoot River	DEQ Pocatello Regional Office	Solar Pathfinder effective shade and stream width	2009
Blackfoot River	DEQ State Technical Services Office	Aerial photo Interpretation of existing shade and stream width estimation	2011
Blackfoot River	DEQ IDASA Database and DEQ Pocatello Regional Office	Temperature	2008–2010

Table C-2. Bear Creek (ID17040207SK006_02b) streambank erosion inventory worksheet.

STREAMBANK EROSION INVENTORY WORKSHEET

Stream:	Bear Creek SK006_02b	**Stream Segment Location (DD)**		**Elevation (ft)**
Section:	R-1	*Upstream:* 42.93353	111.70451	
Date Collected:	8/19/2008	*Downstream:* 42.93501	111.70798	
Field Crew:	MCT, DWZ	**Landuse and Notes:**		
Data Reduced By:	MCT			

Streambank Erosion Calculations

Average Erosive Bank Height	2.6875	ft
Total Inventoried Bank Length	1609	ft
Inventoried Bank to Bank Length	3218	ft
Erosive Bank Length	1431	ft
Bank to Bank Eroding Segment Length	2862	ft
Percent Eroding Bank	89%	%
Eroding Area	7691.625	ft^2
Recession Rate	0.215	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	74.4164719	tons/year/sample reach
Erosion Rate (Er)	244.200728	tons/mile/year
Feet of similar stream type	18666	ft
Eroding Bank Extrapolation	36064.046	ft
Total Streambank Erosion (existing load)	937.721546	tons/year

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	1729.675
Allowed Erosion over sampled reach (with load reduction (20%)	16.73461
Allowed Erosion Rate	54.9153
Eroding Bank Extrapolation (with reduction)	7212.809
Total Streambank Erosion	210.8727

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	3
Bank Stability Condition (0-3)	1
Bank Cover/Vegetation (0-3)	2
Lateral Channel Stablity (0-3)	0.5
Channel Bottom Stability (0-3)	2
In-Channel Deposition (0-1)	1
Total = Slight (0-4); Moderate (5-8); Severe (9+)	9.5
Recession Rate	**0.215**

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
244.2007281	937.72155	54.9153	210.872672	77.51222921

Bank #	Erosive Bank Ht	Bank Length (unstable)	Bank Length (stable)	Notes
1	3	357		
2			39	
3	2.5	57		
4			48	
5	3	75		
6			25	
7	3	105		
8			12	
9	2.5	303		
10			30	
11	2.5	123		
12			12	
13	2	84		
14			12	
15	3	327		
16				
17				
18				
19				
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36				
37				
38				
Total	**2.6875**	**1431**	**178**	**1609**

Table C-3. Cedar Creek (ID17040207SK029_03) streambank erosion inventory worksheet.

STREAMBANK EROSION INVENTORY WORKSHEET

		Stream Segment Location (DD)		**Elevation (ft)**
Stream:	Cedar Creek SK0029_03		Latitude	Longitude
Reach:	3	*Beginning:*	43.20888	111.99702
Date Collected:	10/28/2011	*Ending:*	43.20810	111.99419
Field Crew:	DG, JS	**Landuse and Notes:**	Grazing, farming	
Data Reduced By:	DG	**Soil Type:**	Silt	

Streambank Erosion Calculations

Average Erosive Bank Height	1.20734908	ft
Total Inventoried Bank Length	1115.48557	ft
Inventoried Bank to Bank Length	2230.97113	ft
Erosive Bank Length	534.776904	ft
Bank to Bank Eroding Segment Length	1069.55381	ft
Percent Eroding Bank	48%	%
Eroding Area	1291.32481	ft^2
Recession Rate	0.06	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	3.48657698	tons/year/sample reach
Erosion Rate (Er)	16.5032404	tons/mile/year
Feet of similar stream type	9973	ft
Eroding Bank Extrapolation	10631.9009	ft
Total Streambank Erosion (existing load)	34.6583226	tons/year

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	538.7122	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	1.454523	tons/yr/sample
Allowed Erosion Rate	6.884787	tons/mile/year
Eroding Bank Extrapolation (with reduction)	2126.38	ft
Total Streambank Erosion	14.45869	tons/year

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
16.50324041	34.6583226	6.884787412	14.4586867	58.28220859

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	1
Bank Stability Condition (0-3)	0.5
Bank Cover/Vegetation (0-3)	1
Lateral Channel Stablity (0-3)	0.5
Channel Bottom Stability (0-3)	1
In-Channel Deposition (0-1)	1
Total = Slight (0-4); Moderate (5-8); Severe (9+)	5
Recession Rate	**0.06**

Converted Data

Bank #	Erosive Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1	0.0	0.0	105.0	
2	2.6	6.6	0.0	
3	0.0	0.0	6.6	
4	1.6	6.6	0.0	
5	0.0	0.0	65.6	
6	1.3	32.8	0.0	
7	0.0	0.0	19.7	
8	1.3	6.6	0.0	
9	0.0	0.0	45.9	
10	2.3	3.3	0.0	
11	0.0	0.0	13.1	
12	3.3	32.8	0.0	
13	0.0	0.0	72.2	
14	19.7	39.4	0.0	
15	0.0	0.0	39.4	
16	2.0	19.7	0.0	
17	0.0	0.0	6.6	
18	3.3	52.5	0.0	
19	2.6	72.2	0.0	
20	16.4	32.8	0.0	
21	0.0	0.0	196.9	
22	1.3	65.6	0.0	
23	1.0	78.7	0.0	
24	1.6	85.3	0.0	
25	0.0	0.0	9.8	
26	0.0	0.0	0.0	
27	0.0	0.0	0.0	
28	0.0	0.0	0.0	
29	0.0	0.0	0.0	
30	0.0	0.0	0.0	
31	0.0	0.0	0.0	
32	0.0	0.0	0.0	
33	0.0	0.0	0.0	
34	0.0	0.0	0.0	
35	0.0	0.0	0.0	
36	0.0	0.0	0.0	
37	0.0	0.0	0.0	
38	0.0	0.0	0.0	
39	0.0	0.0	0.0	
40	0.0	0.0	0.0	
41	0.0	0.0	0.0	
42	0.0	0.0	0.0	
43	0.0	0.0	0.0	
44	0.0	0.0	0.0	
45	0.0	0.0	0.0	
46	0.0	0.0	0.0	
47	0.0	0.0	0.0	
48	0.0	0.0	0.0	
49	0.0	0.0	0.0	
50	0.0	0.0	0.0	
	1.2	**534.8**	**580.7**	**1115.5**
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Raw Data

Bank #	Erosive Bank Ht (m)	Erosive Bank Length (m)	Stable Bank Length (m)	
1			32	
2	0.8	2		
3			2	
4	0.5	2		
5			20	
6	0.4	10		
7			6	
8	0.4	2		
9			14	
10	0.7	1		
11			4	
12	1	10		
13			22	
14	6	12		
15			12	
16	0.6	6		
17			2	
18	1	16		
19	0.8	22		
20	5	10		
21			60	
22	0.4	20		
23	0.3	24		
24	0.5	26		
25			3	
26				
27				
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50				
	1.314285714	**163**	**177**	**340**
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Table C-4. Chicken Creek (ID17040207SK006_02a) streambank erosion inventory worksheet.

STREAMBANK EROSION INVENTORY WORKSHEET

Stream:	Chicken Creek SK006_02a		**Stream Segment Location (DD)**		**Elevation (ft)**
Section:	R-1 Govt Dam Rd		*Upstream:*	42.96129 111.71902	
Date Collected:		8/11/2008	*Downstream:*	42.96964 111.72104	
Field Crew:	M Thompson, F Raben		**Landuse and Notes:**		
Data Reduced By:	MCT		**Soil Type:**	Siltey Clay	

Streambank Erosion Calculations

Average Erosive Bank Height	2.17692308	ft
Total Inventoried Bank Length	1355	ft
Inventoried Bank to Bank Length	2710	ft
Erosive Bank Length	428	ft
Bank to Bank Eroding Segment Length	856	ft
Percent Eroding Bank	32%	%
Eroding Area	1863.44615	ft^2
Recession Rate	0.04	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	3.35420308	tons/year/sample reach
Erosion Rate (Er)	13.0702526	tons/mile/year
Feet of similar stream type	5428	ft
Eroding Bank Extrapolation	4285.05387	ft
Total Streambank Erosion (existing load)	16.7908188	tons/year

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	1179.892	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	2.123806	tons/yr/sample
Allowed Erosion Rate	8.275791	tons/mile/year
Eroding Bank Extrapolation (with reduction)	857.0108	ft
Total Streambank Erosion	10.63157	tons/year

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	1
Bank Stability Condition (0-3)	0.5
Bank Cover/Vegetation (0-3)	0
Lateral Channel Stablity (0-3)	0
Channel Bottom Stability (0-3)	0.5
In-Channel Deposition (0-1)	1
Total = Slight (0-4); Moderate (5-8); Severe (9+)	3
Recession Rate	**0.04**

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
13.07025258	16.7908188	8.275790769	10.6315698	36.68%

Raw Data

Bank #	Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1			39	
2	0.4	45		
3			6	
4	0.6	39		
5			3	
6	0.4	36		
7			120	
8			48	
9			75	
10			69	
11	0.4	42		
12			159	
13			51	
14	0.6	42		
15			18	
16			30	
17	0.3	36		
18	0.3	27		
19			60	
20	0.3	12		
21			75	
22			30	
23	0.5	14		
24	1.5	12		
25			36	
26			45	
27			6	
28	3	39		
29			9	
30	3	39		
31			9	
32	17	45		
33			39	
34				
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
	2.17692308	**428**	**927**	**1355**
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Table C-5. Collett Creek (ID17040207SK009_02a) streambank erosion inventory worksheet.

STREAMBANK EROSION INVENTORY WORKSHEET

			Stream Segment Location (DD)		Elevation (ft)
Stream:	Collett SK009_02a			Latitude	Longitude	
Reach:	1	*Beginning:*	42.94296	-111.56692	
Date Collected:	8/13/2009	*Ending:*	42.94116	-111.57072	
Field Crew:	JS,DZ	**Landuse and Notes:**		grazing	
Data Reduced By:	JS	**Soil Type:**	silt		

Streambank Erosion Calculations

Average Erosive Bank Height	1.50918635	ft
Total Inventoried Bank Length	1473.09712	ft
Inventoried Bank to Bank Length	2946.19423	ft
Erosive Bank Length	1138.45145	ft
Bank to Bank Eroding Segment Length	2276.90289	ft
Percent Eroding Bank	77%	%
Eroding Area	3436.27077	ft^2
Recession Rate	0.15	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	23.1948277	tons/year/sample reach
Erosion Rate (Er)	83.1368747	tons/mile/year
Feet of similar stream type	5627	ft
Eroding Bank Extrapolation	10974.3149	ft
Total Streambank Erosion (existing load)	111.795433	tons/year

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	889.2712	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	6.002581	tons/yr/sample
Allowed Erosion Rate	21.51496	tons/mile/year
Eroding Bank Extrapoltation (with reduction)	2194.863	ft
Total Streambank Erosion	28.9315	tons/year

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	3
Bank Stability Condition (0-3)	1
Bank Cover/Vegetation (0-3)	2
Lateral Channel Stablity (0-3)	0
Channel Bottom Stability (0-3)	1
In-Channel Deposition (0-1)	1
Total = Slight (0-4); Moderate (5-8); Severe (9+)	8
Recession Rate	**0.15**

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
83.13687472	111.795433	21.51496066	28.9314981	74.12103746

Converted Data

Bank #	Erosive Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1	1.6	246.1		
2			32.8	
3	1.3	180.4		
4			52.5	
5	0.7	278.9		
6	3.6	98.4		
7	0.7	55.8		
8	2.6	62.3		
9	2.0	101.7		
10	0.7	32.8		
11			134.5	
12	1.0	42.7		
13			114.8	
14	1.0	39.4		
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
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40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
	1.5	1138.5	334.6	1473.1
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Raw Data

Bank #	Erosive Bank Ht (m)	Erosive Bank Length (m)	Stable Bank Length (m)	
1	0.5	75		
2			10	
3	0.4	55		
4			16	
5	0.2	85		
6	1.1	30		
7	0.2	17		
8	0.8	19		
9	0.6	31		
10	0.2	10		
11			41	
12	0.3	13		
13			35	
14	0.3	12		
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
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47				
48				
49				
50				
	0.46	347	102	449
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Table C-6. Coyote Creek (ID17040207SK005_02d) streambank erosion inventory worksheet.

STREAMBANK EROSION INVENTORY WORKSHEET

		Stream Segment Location (DD)			**Elevation (ft)**
Stream:	Coyote SK005_02d		Latitude	Longitude	
Reach:	1	*Beginning:*	42.98522	111.88017	
Date Collected:	8/18/2009	*Ending:*	42.98457	111.88461	
Field Crew:	JS,DZ	**Landuse and Notes:**		grazing	
Data Reduced By:	JS	**Soil Type:**		silt	

Streambank Erosion Calculations

Average Erosive Bank Height	1.9	ft
Total Inventoried Bank Length	1443.6	ft
Inventoried Bank to Bank Length	2887.1	ft
Erosive Bank Length	561.0	ft
Bank to Bank Eroding Segment Length	1122.0	ft
Percent Eroding Bank	39%	%
Eroding Area	2108.3565	ft^2
Recession Rate	0.05	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	4.74380212	tons/year/sample reach
Erosion Rate (Er)	17.3509306	tons/mile/year
Feet of similar stream type	5050	ft
Eroding Bank Extrapolation	5047.27452	ft
Total Streambank Erosion (existing load)	21.3389157	tons/year

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	1085.002	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	2.441255	tons/yr/sample
Allowed Erosion Rate	8.929134	tons/mile/year
Eroding Bank Extrapolation (with reduction)	1009.455	ft
Total Streambank Erosion	10.98143	tons/year

Recession Rate Calculation Worksheet

Slope Factor	**Rating**
Bank Erosion Evidence (0-3)	2
Bank Stability Condition (0-3)	0
Bank Cover/Vegetation (0-3)	1
Lateral Channel Stablity (0-3)	0
Channel Bottom Stability (0-3)	0
In-Channel Deposition (0-1)	1
Total = Slight (0-4); Moderate (5-8); Severe (9+)	4
Recession Rate	**0.05**

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
17.35093059	21.3389157	8.929133872	10.9814303	48.5380117

Converted Data

Bank #	Erosive Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1			52.5	
2	2.3	32.8		
3			236.2	
4			78.7	
5	2.3	16.4		
6			78.7	
7	1.3	32.8		
8			59.1	
9	1.3	39.4		
10			19.7	
11	1.0	45.9		
12			39.4	
13	1.3	62.3		
14			29.5	
15	0.7	62.3		
16			68.9	
17	5.2	144.4		
18			114.8	
19	4.3	32.8		
20			19.7	
21	0.7	75.5		
22			52.5	
23	0.3	16.4		
24			32.8	
25				
26				
27				
28				
29				
30				
31				
32				
33				
34				
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36				
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45				
46				
47				
48				
49				
50				
	1.9	**561.0**	**882.5**	**1443.6**
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Raw Data

Bank #	Erosive Bank Ht (m)	Erosive Bank Length (m)	Stable Bank Length (m)	
1			16	
2	0.7	10		
3			72	
4			24	
5	0.7	5		
6			24	
7	0.4	10		
8			18	
9	0.4	12		
10			6	
11	0.3	14		
12			12	
13	0.4	19		
14			9	
15	0.2	19		
16			21	
17	1.6	44		
18			35	
19	1.3	10		
20			6	
21	0.2	23		
22			16	
23	0.1	5		
24			10	
25	1.6	2		
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				
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44				
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46				
47				
48				
49				
50				
	0.658333333	**173**	**269**	**442**
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Table C-7. Crooked Creek (ID17040207SK025_03b) streambank erosion inventory worksheet.

STREAMBANK EROSION INVENTORY WORKSHEET

		Stream Segment Location (DD)			**Elevation (ft)**
Stream:	Crooked Creek SK025_03b		Latitude	Longitude	
Reach:	1	*Beginning:*	43.03803	111.60439	
Date Collected:	10/20/2011	*Ending:*	43.03936	111.60506	
Field Crew:	DG, JS	**Landuse and Notes:**		Grazing	
Data Reduced By:	DG	**Soil Type:**		Silt	

Streambank Erosion Calculations

Average Erosive Bank Height	0.44619423	ft
Total Inventoried Bank Length	1194.22572	ft
Inventoried Bank to Bank Length	2388.45145	ft
Erosive Bank Length	1010.49869	ft
Bank to Bank Eroding Segment Length	2020.99738	ft
Percent Eroding Bank	85%	%
Eroding Area	901.757362	ft^2
Recession Rate	0.155	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	6.2897576	tons/year/sample reach
Erosion Rate (Er)	27.8087463	tons/mile/year
Feet of similar stream type	10052	ft
Eroding Bank Extrapolation	19032.0743	ft
Total Streambank Erosion (existing load)	59.2317116	tons/year

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	213.1426	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	1.48667	tons/yr/sample
Allowed Erosion Rate	6.572976	tons/mile/year
Eroding Bank Extrapolation (with reduction)	3806.415	ft
Total Streambank Erosion	14.00022	tons/year

Recession Rate Calculation Worksheet

Slope Factor	**Rating**
Bank Erosion Evidence (0-3)	3
Bank Stability Condition (0-3)	0.5
Bank Cover/Vegetation (0-3)	2
Lateral Channel Stablity (0-3)	0.5
Channel Bottom Stability (0-3)	1.5
In-Channel Deposition (0-1)	1
Total = Slight (0-4); Moderate (5-8); Severe (9+)	8.5
Recession Rate	**0.155**

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
27.80874626	59.2317116	6.572976388	14.0002228	76.36363636

Converted Data

Bank #	Erosive Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1	1.0	98.4	0.0	
2	0.0	0.0	6.6	
3	0.7	13.1	0.0	
4	0.0	0.0	52.5	
5	0.7	78.7	0.0	
6	0.0	0.0	19.7	
7	1.3	59.1	0.0	
8	3.0	32.8	0.0	
9	1.0	236.2	0.0	
10	0.0	0.0	9.8	
11	3.6	157.5	0.0	
12	1.0	131.2	0.0	
13	5.6	45.9	0.0	
14	1.6	39.4	0.0	
15	0.0	0.0	95.1	
16	3.0	118.1	0.0	
17	0.0	0.0	0.0	
18	0.0	0.0	0.0	
19	0.0	0.0	0.0	
20	0.0	0.0	0.0	
21	0.0	0.0	0.0	
22	0.0	0.0	0.0	
23	0.0	0.0	0.0	
24	0.0	0.0	0.0	
25	0.0	0.0	0.0	
26	0.0	0.0	0.0	
27	0.0	0.0	0.0	
28	0.0	0.0	0.0	
29	0.0	0.0	0.0	
30	0.0	0.0	0.0	
31	0.0	0.0	0.0	
32	0.0	0.0	0.0	
33	0.0	0.0	0.0	
34	0.0	0.0	0.0	
35	0.0	0.0	0.0	
36	0.0	0.0	0.0	
37	0.0	0.0	0.0	
38	0.0	0.0	0.0	
39	0.0	0.0	0.0	
40	0.0	0.0	0.0	
41	0.0	0.0	0.0	
42	0.0	0.0	0.0	
43	0.0	0.0	0.0	
44	0.0	0.0	0.0	
45	0.0	0.0	0.0	
46	0.0	0.0	0.0	
47	0.0	0.0	0.0	
48	0.0	0.0	0.0	
49	0.0	0.0	0.0	
50	0.0	0.0	0.0	
	0.4	**1010.5**	**183.7**	**1194.2**
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Raw Data

Bank #	Erosive Bank Ht (m)	Erosive Bank Length (m)	Stable Bank Length (m)	
1	0.3	30		
2			2	
3	0.2	4		
4			16	
5	0.2	24		
6			6	
7	0.4	18		
8	0.9	10		
9	0.3	72		
10			3	
11	1.1	48		
12	0.3	40		
13	1.7	14		
14	0.5	12		
15			29	
16	0.9	36		
17				
18				
19				
20				
21				
22				
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24				
25				
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27				
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29				
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44				
45				
46				
47				
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49				
50				
	0.618181818	**308**	**56**	**364**
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Table C-8. Deadman Creek (ID17040207SK002_02b) streambank erosion inventory worksheet.

STREAMBANK EROSION INVENTORY WORKSHEET

			Stream Segment Location (DD)			**Elevation (ft)**
Stream:	Deadman Creek SK002_02b			Latitude	Longitude	
Reach:		1	*Beginning:*	43.07913	111.93182	
Date Collected:		10/5/2011	*Ending:*	43.07728	111.93954	
Field Crew:	JS, GM		**Landuse and Notes:**		Grazing	
Data Reduced By:	DG		**Soil Type:**		Silt	

Streambank Erosion Calculations

Average Erosive Bank Height	0.10061242	ft
Total Inventoried Bank Length	2601.70604	ft
Inventoried Bank to Bank Length	5203.41208	ft
Erosive Bank Length	997.37533	ft
Bank to Bank Eroding Segment Length	1994.75066	ft
Percent Eroding Bank	38%	%
Eroding Area	200.696698	ft^2
Recession Rate	0.06	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	0.54188109	tons/year/sample reach
Erosion Rate (Er)	1.09971384	tons/mile/year
Feet of similar stream type	24643	ft
Eroding Bank Extrapolation	20888.7532	ft
Total Streambank Erosion (existing load)	5.67450383	tons/year

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	104.7056	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	0.282705	tons/yr/sample
Allowed Erosion Rate	0.573732	tons/mile/year
Eroding Bank Extrapolation (with reduction)	4177.751	ft
Total Streambank Erosion	2.960448	tons/year

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	2
Bank Stability Condition (0-3)	1
Bank Cover/Vegetation (0-3)	1
Lateral Channel Stablity (0-3)	0
Channel Bottom Stability (0-3)	1
In-Channel Deposition (0-1)	0
Total = Slight (0-4); Moderate (5-8); Severe (9+)	5
Recession Rate	**0.06**

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
1.099713836	5.67450383	0.573732284	2.96044838	47.82894737

Converted Data

Bank #	Erosive Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1	0.0	0.0	49.2	
2	1.0	29.5	0.0	
3	0.0	0.0	78.7	
4	1.3	16.4	0.0	
5	0.0	0.0	105.0	
6	0.7	3.3	0.0	
7	0.0	0.0	216.5	
8	0.3	3.3	0.0	
9	0.0	0.0	55.8	
10	0.7	3.3	0.0	
11	0.0	0.0	521.7	
12	0.3	3.3	0.0	
13	0.0	0.0	45.9	
14	1.0	6.6	0.0	
15	0.0	0.0	72.2	
16	0.0	0.0	26.2	
17	0.3	23.0	0.0	
18	0.0	0.0	13.1	
19	0.7	19.7	0.0	
20	0.0	0.0	55.8	
21	0.7	6.6	0.0	
22	0.0	0.0	6.6	
23	1.0	6.6	0.0	
24	0.0	0.0	98.4	
25	0.3	9.8	0.0	
26	0.0	0.0	49.2	
27	0.3	32.8	0.0	
28	0.3	6.6	0.0	
29	0.0	0.0	105.0	
30	0.3	255.9	0.0	
31	0.0	0.0	13.1	
32	0.3	29.5	0.0	
33	0.0	0.0	13.1	
34	0.3	39.4	0.0	
35	0.0	0.0	9.8	
36	0.3	45.9	0.0	
37	0.0	0.0	6.6	
38	0.3	3.3	0.0	
39	0.0	0.0	13.1	
40	0.7	19.7	0.0	
41	0.0	0.0	3.3	
42	1.0	19.7	0.0	
43	0.0	0.0	13.1	
44	1.0	6.6	0.0	
45	0.0	0.0	6.6	
46	1.0	39.4	0.0	
47	0.0	0.0	13.1	
48	0.3	85.3	0.0	
49	0.0	0.0	6.6	
50	0.3	26.2	0.0	
51	0.0	0.0	6.6	
52	0.3	255.9	0.0	
53	0.0	0.0	0.0	
54	0.0	0.0	0.0	
147	0.0	0.0	0.0	
148	0.0	0.0	0.0	
149	0.0	0.0	0.0	
150	0.0	0.0	0.0	
	0.1	**997.4**	**1604.3**	**2601.7**
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Raw Data

Bank #	Erosive Bank Ht (m)	Erosive Bank Length (m)	Stable Bank Length (m)	
1			15	
2	0.3	9		
3			24	
4	0.4	5		
5			32	
6	0.2	1		
7			66	
8	0.1	1		
9			17	
10	0.2	1		
11			159	
12	0.1	1		
13			14	
14	0.3	2		
15			22	
16			8	
17	0.1	7		
18			4	
19	0.2	6		
20			17	
21	0.2	2		
22			2	
23	0.3	2		
24			30	
25	0.1	3		
26			15	
27	0.1	10		
28	0.1	2		
29			32	
30	0.1	78		
31			4	
32	0.1	9		
33			4	
34	0.1	12		
35			3	
36	0.1	14		
37			2	
38	0.1	1		
39			4	
40	0.2	6		
41			1	
42	0.3	6		
43			4	
44	0.3	2		
45			2	
46	0.3	12		
47			4	
48	0.1	26		
49			2	
50	0.1	8		
51			2	
52	0.1	78		
53				
54				
147				
148				
149				
150				
	0.176923077	**304**	**489**	**793**
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Table C-9. Goodheart Creek (ID17040207SK012_02b) streambank erosion inventory worksheet.

STREAMBANK EROSION INVENTORY WORKSHEET

Stream:	Goodheart Creek SK012_02b	**Stream Segment Location (DD)**			**Elevation (ft)**
Section:	Reach-A, above water access point	*Upstream:*	42.67854	111.31493	
Date Collected:	8/26/2008	*Downstream:*	42.67727	111.31876	
Field Crew:	DWZ,	**Landuse and Notes:**			
Data Reduced By:	MCT	**Soil Type:**	Silt		

Streambank Erosion Calculations

Average Erosive Bank Height	4.20909091	ft
Total Inventoried Bank Length	1887	ft
Inventoried Bank to Bank Length	3774	ft
Erosive Bank Length	564	ft
Bank to Bank Eroding Segment Length	1128	ft
Percent Eroding Bank	30%	%
Eroding Area	4747.85455	ft^2
Recession Rate	0.075	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	16.0240091	tons/year/sample reach
Erosion Rate (Er)	44.836655	tons/mile/year
Feet of similar stream type	4042	ft
Eroding Bank Extrapolation	3544.2035	ft
Total Streambank Erosion (existing load)	50.3478272	tons/year

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	3177.022	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	10.72245	tons/yr/sample
Allowed Erosion Rate	30.0024	tons/mile/year
Eroding Bank Extrapolation (with reduction)	708.8407	ft
Total Streambank Erosion	33.6902	tons/year

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	1
Bank Stability Condition (0-3)	0.5
Bank Cover/Vegetation (0-3)	1
Lateral Channel Stablity (0-3)	0
Channel Bottom Stability (0-3)	2
In-Channel Deposition (0-1)	1
Total = Slight (0-4); Moderate (5-8); Severe (9+)	5.5
Recession Rate	**0.075**

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
44.83665501	50.3478272	30.0024	33.690195	33.08510638

Raw Data

Bank #	Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1	7	30		
2	6	51		
3	6	126		
4			99	
5	4	36		
6			393	
7	4	36		
8			114	
9	1	27		
10			30	
11	1.9	75		
12			120	
13	3.8	45		
14			60	
15	3	54		
16			237	
17			237	
18	4.1	51		
19			33	
20	5.5	33		
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
	4.20909091	**564**	**1323**	**1887**
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Table C-10. Grave Creek (ID17040207SK005_02a) streambank erosion inventory worksheet.

STREAMBANK EROSION INVENTORY WORKSHEET

		Stream Segment Location (DD)		**Elevation (ft)**
Stream:	Grave Creek SK005_02a (above Wood Cr		Lattitude	Longitude
Reach:		*Beginning:*	42.97716	111.88619
Date Collected:	10/14/2011	*Ending:*	42.97268	111.88567
Field Crew:	DG, GM	**Landuse and Notes:**	State land, Grazing	
Data Reduced By:	DG	**Soil Type:**	Silt	

Streambank Erosion Calculations

Average Erosive Bank Height	0.21872266	ft
Total Inventoried Bank Length	2158.79265	ft
Inventoried Bank to Bank Length	4317.58531	ft
Erosive Bank Length	1679.79003	ft
Bank to Bank Eroding Segment Length	3359.58006	ft
Percent Eroding Bank	78%	%
Eroding Area	734.816287	ft^2
Recession Rate	0.09	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	2.97600596	tons/year/sample reach
Erosion Rate (Er)	7.27874974	tons/mile/year
Feet of similar stream type	5811	ft
Eroding Bank Extrapolation	12402.8384	ft
Total Streambank Erosion (existing load)	10.9867663	tons/year

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	188.8707	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	0.764927	tons/yr/sample
Allowed Erosion Rate	1.870866	tons/mile/year
Eroding Bank Extrapolation (with reduction)	2480.568	ft
Total Streambank Erosion	2.823942	tons/year

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
7.278749742	10.9867663	1.870866145	2.82394228	74.296875

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	1.5
Bank Stability Condition (0-3)	1
Bank Cover/Vegetation (0-3)	1.5
Lateral Channel Stablity (0-3)	0
Channel Bottom Stability (0-3)	1
In-Channel Deposition (0-1)	1
Total = Slight (0-4); Moderate (5-8); Severe (9+)	6
Recession Rate	**0.09**

Converted Data

Bank #	Erosive Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1	0.7	249.3	0.0	
2	0.0	0.0	6.6	
3	0.7	16.4	0.0	
4	0.0	0.0	6.6	
5	0.7	55.8	0.0	
6	0.0	0.0	29.5	
7	0.7	39.4	0.0	
8	0.0	0.0	6.6	
9	1.0	59.1	0.0	
10	0.0	0.0	9.8	
11	1.0	13.1	0.0	
12	0.0	0.0	6.6	
13	1.0	13.1	0.0	
14	0.0	0.0	6.6	
15	1.0	91.9	0.0	
16	0.0	0.0	6.6	
17	0.7	108.3	0.0	
18	0.0	0.0	16.4	
19	1.3	167.3	0.0	
20	0.0	0.0	9.8	
21	0.7	52.5	0.0	
22	2.6	26.2	0.0	
23	0.0	0.0	3.3	
24	3.3	65.6	0.0	
25	0.0	0.0	13.1	
26	0.7	72.2	0.0	
27	0.0	0.0	23.0	
28	1.0	9.8	0.0	
29	0.0	0.0	42.7	
30	1.3	13.1	0.0	
31	0.3	19.7	0.0	
32	0.0	0.0	39.4	
33	0.7	98.4	0.0	
34	1.6	13.1	0.0	
35	0.3	45.9	0.0	
36	0.0	0.0	29.5	
37	0.3	3.3	0.0	
38	0.0	0.0	9.8	
39	0.7	9.8	0.0	
40	0.3	85.3	0.0	
41	0.0	0.0	26.2	
42	0.7	29.5	0.0	
43	0.0	0.0	3.3	
44	1.0	59.1	0.0	
45	0.0	0.0	42.7	
46	0.7	26.2	0.0	
47	0.0	0.0	29.5	
48	0.3	6.6	0.0	
49	0.0	0.0	9.8	
50	2.0	42.7	0.0	
51	0.7	55.8	0.0	
52	0.0	0.0	23.0	
53	1.6	19.7	0.0	
54	1.0	26.2	0.0	
55	0.0	0.0	19.7	
56	1.0	52.5	0.0	
57	0.0	0.0	13.1	
58	1.0	13.1	0.0	
59	0.0	0.0	19.7	
60	0.7	19.7	0.0	
61	0.0	0.0	26.2	
62	0.0	0.0	0.0	
148	0.0	0.0	0.0	
149	0.0	0.0	0.0	
150	0.0	0.0	0.0	
	0.2	1679.8	479.0	2158.8
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Raw Data

Bank #	Erosive Bank Ht (m)	Erosive Bank Length (m)	Stable Bank Length (m)	
1	0.2	76		
2			2	
3	0.2	5		
4			2	
5	0.2	17		
6			9	
7	0.2	12		
8			2	
9	0.3	18		
10			3	
11	0.3	4		
12			2	
13	0.3	4		
14			2	
15	0.3	28		
16			2	
17	0.2	33		
18			5	
19	0.4	51		
20			3	
21	0.2	16		
22	0.8	8		
23			1	
24	1	20		
25			4	
26	0.2	22		
27			7	
28	0.3	3		
29			13	
30	0.4	4		
31	0.1	6		
32			12	
33	0.2	30		
34	0.5	4		
35	0.1	14		
36			9	
37	0.1	1		
38			3	
39	0.2	3		
40	0.1	26		
41			8	
42	0.2	9		
43			1	
44	0.3	18		
45			13	
46	0.2	8		
47			9	
48	0.1	2		
49			3	
50	0.6	13		
51	0.2	17		
52			7	
53	0.5	6		
54	0.3	8		
55			6	
56	0.3	16		
57			4	
58	0.3	4		
59			6	
60	0.2	6		
61			8	
62				
148				
149				
150				
	0.294117647	512	146	658
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Table C-11. Grave Creek (ID17040207SK005_03) streambank erosion inventory worksheet.

STREAMBANK EROSION INVENTORY WORKSHEET

Stream:	Grave Creek SK005_03	**Stream Segment Location (DD)**		**Elevation (ft)**
Section:	R-1 Lower	*Upstream:*	43.03146 111.90835	
Date Collected:	8/14/2008	*Downstream:*	43.03461 111.90832	
Field Crew:	MCT, F Raben	**Landuse and Notes:**		
Data Reduced By:	MCT	**Soil Type:**	Silt	

Streambank Erosion Calculations

Average Erosive Bank Height	2.54166667	ft
Total Inventoried Bank Length	1584	ft
Inventoried Bank to Bank Length	3168	ft
Erosive Bank Length	588	ft
Bank to Bank Eroding Segment Length	1176	ft
Percent Eroding Bank	37%	%
Eroding Area	2989	ft^2
Recession Rate	0.03	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	4.03515	tons/year/sample reach
Erosion Rate (Er)	13.4505	tons/mile/year
Feet of similar stream type	0	ft
Eroding Bank Extrapolation	1176	ft
Total Streambank Erosion (existing load)	4.03515	tons/year

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	1610.4	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	2.17404	tons/yr/sample
Allowed Erosion Rate	7.2468	tons/mile/year
Eroding Bank Extrapolation (with reduction)	235.2	ft
Total Streambank Erosion	2.17404	tons/year

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	1
Bank Stability Condition (0-3)	0.5
Bank Cover/Vegetation (0-3)	0.5
Lateral Channel Stablity (0-3)	0
Channel Bottom Stability (0-3)	0
In-Channel Deposition (0-1)	0
Total = Slight (0-4); Moderate (5-8); Severe (9+)	2
Recession Rate	**0.03**

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
13.4505	4.03515	7.2468	2.17404	46.12244898

Raw Data

Bank #	Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1	1	39		
2			90	
3	1	48		
4			9	
5	2.5	87		
6			99	
7	2.5	99		
8			105	
9	3	30		
10			60	
11	3	24		
12			99	
13			39	
14	3	66		
15			78	
16	3	33		
17			81	
18	2.5	27		
19			36	
20	3	42		
21			42	
22	3	54		
23			120	
24	3	39		
25			138	
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
	2.54166667	**588**	**996**	**1584**
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Table C-12. Grave Creek Tributary—Bilious Creek (ID17040207SK005_02) streambank erosion inventory worksheet.

STREAMBANK EROSION INVENTORY WORKSHEET

		Stream Segment Location (DD)			Elevation (ft)
Stream:	Bilious Cr SK005_02 (Grave Tribs)		Latitude	Longitude	
Reach:	1	*Beginning:*	42.99236	111.90569	
Date Collected:	10/14/2011	*Ending:*	42.99100	111.90752	
Field Crew:	DG, GM	Landuse and Notes:		Grazing	
Data Reduced By:	DG	Soil Type:		Silt	

Streambank Erosion Calculations

Average Erosive Bank Height	0.0984252	ft
Total Inventoried Bank Length	715.223098	ft
Inventoried Bank to Bank Length	1430.4462	ft
Erosive Bank Length	715.223098	ft
Bank to Bank Eroding Segment Length	1430.4462	ft
Percent Eroding Bank	100%	%
Eroding Area	140.791949	ft^2
Recession Rate	0.075	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	0.47517283	tons/year/sample reach
Erosion Rate (Er)	3.50787402	tons/mile/year
Feet of similar stream type	5357	ft
Eroding Bank Extrapolation	12144.4462	ft
Total Streambank Erosion (existing load)	4.03420334	tons/year

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	28.15839	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	0.095035	tons/yr/sample
Allowed Erosion Rate	0.701575	tons/mile/year
Eroding Bank Extrapolation (with reduction)	2428.889	ft
Total Streambank Erosion	0.806841	tons/year

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	3
Bank Stability Condition (0-3)	0.5
Bank Cover/Vegetation (0-3)	1
Lateral Channel Stablity (0-3)	0
Channel Bottom Stability (0-3)	0
In-Channel Deposition (0-1)	1
Total = Slight (0-4); Moderate (5-8); Severe (9+)	5.5
Recession Rate	**0.075**

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
3.507874021	4.03420334	0.701574804	0.80684067	80

Converted Data

Bank #	Erosive Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1	0.3	98.4	0.0	
2	1.6	26.2	0.0	
3	1.0	183.7	0.0	
4	0.7	137.8	0.0	
5	0.7	236.2	0.0	
6	0.7	32.8	0.0	
7	0.0	0.0	0.0	
8	0.0	0.0	0.0	
9	0.0	0.0	0.0	
10	0.0	0.0	0.0	
11	0.0	0.0	0.0	
12	0.0	0.0	0.0	
13	0.0	0.0	0.0	
14	0.0	0.0	0.0	
15	0.0	0.0	0.0	
16	0.0	0.0	0.0	
17	0.0	0.0	0.0	
18	0.0	0.0	0.0	
19	0.0	0.0	0.0	
20	0.0	0.0	0.0	
21	0.0	0.0	0.0	
22	0.0	0.0	0.0	
23	0.0	0.0	0.0	
24	0.0	0.0	0.0	
25	0.0	0.0	0.0	
26	0.0	0.0	0.0	
27	0.0	0.0	0.0	
28	0.0	0.0	0.0	
29	0.0	0.0	0.0	
30	0.0	0.0	0.0	
31	0.0	0.0	0.0	
32	0.0	0.0	0.0	
33	0.0	0.0	0.0	
34	0.0	0.0	0.0	
35	0.0	0.0	0.0	
36	0.0	0.0	0.0	
37	0.0	0.0	0.0	
38	0.0	0.0	0.0	
39	0.0	0.0	0.0	
40	0.0	0.0	0.0	
41	0.0	0.0	0.0	
42	0.0	0.0	0.0	
43	0.0	0.0	0.0	
44	0.0	0.0	0.0	
45	0.0	0.0	0.0	
46	0.0	0.0	0.0	
47	0.0	0.0	0.0	
48	0.0	0.0	0.0	
49	0.0	0.0	0.0	
50	0.0	0.0	0.0	
	0.1	715.2	0.0	715.2
	Ave Bank Ht	Total Erosive	Total Stable	Total Bank Length

Raw Data

Bank #	Erosive Bank Ht (m)	Erosive Bank Length (m)	Stable Bank Length (m)	
1	0.1	30		
2	0.5	8		
3	0.3	56		
4	0.2	42		
5	0.2	72		
6	0.2	10		
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
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35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
	0.25	218	0	218
	Ave Bank Ht	Total Erosive	Total Stable	Total Bank Length

Table C-13. Grave Creek Tributary—West Creek (ID17040207SK005_02) streambank erosion inventory worksheet.

STREAMBANK EROSION INVENTORY WORKSHEET

		Stream Segment Location (DD)			**Elevation (ft)**
Stream:	West Creek SK005_02 (Grave tribs)		Latitude	Longitude	
Reach:	1	*Beginning:*	42.98727	111.89424	
Date Collected:	10/14/2011	*Ending:*	42.98600	111.89713	
Field Crew:	DG, GM	**Landuse and Notes:**		Grazing	
Data Reduced By:	DG	**Soil Type:**		Silt	

Streambank Erosion Calculations

Average Erosive Bank Height	0.84645669	ft
Total Inventoried Bank Length	1158.13648	ft
Inventoried Bank to Bank Length	2316.27297	ft
Erosive Bank Length	898.950133	ft
Bank to Bank Eroding Segment Length	1797.90027	ft
Percent Eroding Bank	78%	%
Eroding Area	1521.84471	ft^2
Recession Rate	0.105	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	7.19071628	tons/year/sample reach
Erosion Rate (Er)	32.7828218	tons/mile/year
Feet of similar stream type	9508	ft
Eroding Bank Extrapolation	16558.1949	ft
Total Streambank Erosion (existing load)	66.2246309	tons/year

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	392.125	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	1.85279	tons/yr/sample
Allowed Erosion Rate	8.446961	tons/mile/year
Eroding Bank Extrapolation (with reduction)	3311.639	ft
Total Streambank Erosion	17.06372	tons/year

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
32.78282176	66.2246309	8.446960643	17.0637188	74.23357664

Recession Rate Calculation Worksheet

Slope Factor	**Rating**
Bank Erosion Evidence (0-3)	3
Bank Stability Condition (0-3)	0.5
Bank Cover/Vegetation (0-3)	1
Lateral Channel Stablity (0-3)	0
Channel Bottom Stability (0-3)	2
In-Channel Deposition (0-1)	0
Total = Slight (0-4); Moderate (5-8); Severe (9+)	6.5
Recession Rate	**0.105**

Converted Data

Bank #	Erosive Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1	0.7	59.1	0.0	
2	0.0	0.0	23.0	
3	1.3	85.3	0.0	
4	0.0	0.0	6.6	
5	1.0	32.8	0.0	
6	6.6	210.0	0.0	
7	0.0	0.0	13.1	
8	6.6	39.4	0.0	
9	0.0	0.0	19.7	
10	2.6	26.2	0.0	
11	0.0	0.0	6.6	
12	3.0	23.0	0.0	
13	0.0	0.0	32.8	
14	2.3	52.5	0.0	
15	0.0	0.0	19.7	
16	0.3	39.4	0.0	
17	0.0	0.0	26.2	
18	1.0	19.7	0.0	
19	0.0	0.0	26.2	
20	3.9	19.7	0.0	
21	0.0	0.0	3.3	
22	4.9	3.3	0.0	
23	0.0	0.0	16.4	
24	1.6	19.7	0.0	
25	0.0	0.0	6.6	
26	2.6	26.2	0.0	
27	0.0	0.0	13.1	
28	1.0	65.6	0.0	
29	0.0	0.0	13.1	
30	1.6	124.7	0.0	
31	0.0	0.0	19.7	
32	0.7	13.1	0.0	
33	0.0	0.0	13.1	
34	0.7	39.4	0.0	
35	0.0	0.0	0.0	
36	0.0	0.0	0.0	
37	0.0	0.0	0.0	
38	0.0	0.0	0.0	
39	0.0	0.0	0.0	
40	0.0	0.0	0.0	
41	0.0	0.0	0.0	
42	0.0	0.0	0.0	
43	0.0	0.0	0.0	
44	0.0	0.0	0.0	
45	0.0	0.0	0.0	
46	0.0	0.0	0.0	
47	0.0	0.0	0.0	
48	0.0	0.0	0.0	
49	0.0	0.0	0.0	
50	0.0	0.0	0.0	
	0.8	**899.0**	**259.2**	**1158.1**
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Raw Data

Bank #	Erosive Bank Ht (m)	Erosive Bank Length (m)	Stable Bank Length (m)	
1	0.2	18		
2			7	
3	0.4	26		
4			2	
5	0.3	10		
6	2	64		
7			4	
8	2	12		
9			6	
10	0.8	8		
11			2	
12	0.9	7		
13			10	
14	0.7	16		
15			6	
16	0.1	12		
17			8	
18	0.3	6		
19			8	
20	1.2	6		
21			1	
22	1.5	1		
23			5	
24	0.5	6		
25			2	
26	0.8	8		
27			4	
28	0.3	20		
29			4	
30	0.5	38		
31			6	
32	0.2	4		
33			4	
34	0.2	12		
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
	0.716666667	**274**	**79**	**353**
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Table C-14. Jones Creek (ID17040207SK031_02) streambank erosion inventory worksheet.

STREAMBANK EROSION INVENTORY WORKSHEET

Stream:	Jones Creek SK031_02		**Stream Segment Location (DD)**		**Elevation (ft)**
Section:	R-1		*Upstream:*	43.24987 111.97269	
Date Collected:	7/31/2008		*Downstream:*	43.2512 111.97433	
Field Crew:	MCT, DWZ		**Landuse and Notes:**		
Data Reduced By:	MCT		**Soil Type:**	Silt	

Streambank Erosion Calculations

Average Erosive Bank Height	10.5625	ft
Total Inventoried Bank Length	629	ft
Inventoried Bank to Bank Length	1258	ft
Erosive Bank Length	525	ft
Bank to Bank Eroding Segment Length	1050	ft
Percent Eroding Bank	83%	%
Eroding Area	11090.625	ft^2
Recession Rate	0.27	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	134.751094	tons/year/sample reach
Erosion Rate (Er)	1131.13796	tons/mile/year
Feet of similar stream type	4534	ft
Eroding Bank Extrapolation	8618.68045	ft
Total Streambank Erosion (existing load)	1106.07297	tons/year

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	2657.525	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	32.28893	tons/yr/sample
Allowed Erosion Rate	271.0422	tons/mile/year
Eroding Bank Extrapolation (with reduction)	1723.736	ft
Total Streambank Erosion	265.0362	tons/year

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	3
Bank Stability Condition (0-3)	2
Bank Cover/Vegetation (0-3)	2
Lateral Channel Stablity (0-3)	0
Channel Bottom Stability (0-3)	3
In-Channel Deposition (0-1)	0
Total = Slight (0-4); Moderate (5-8); Severe (9+)	10
Recession Rate	**0.27**

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
1131.137957	1106.07297	271.0422	265.036151	76.03809524

Raw Data

Bank #	Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1	12	84		
2			18	
3	8.5	39		
4			21	
5	12.5	48		
6			18	
7	10.1	108		
8	12	54		
9	10.2	42		
10			27	
11	9.2	66		
12			20	
13	10	84		
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
	10.5625	**525**	**104**	**629**
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Table C-15. Little Blackfoot River (ID17040207SK009_03) streambank erosion inventory worksheet.

STREAMBANK EROSION INVENTORY WORKSHEET

			Stream Segment Location (DD)		Elevation (ft)
Stream:	Little Blackfoot SK009_03		Latitude	Longitude	
Reach:	1	*Beginning:*	42.89720	-111.49062	
Date Collected:	8/26/2009	*Ending:*	42.89680	-111.49660	
Field Crew:	js,dz	**Landuse and Notes:**			
Data Reduced By:	js	**Soil Type:**			

Streambank Erosion Calculations

Average Erosive Bank Height	5.6	ft
Total Inventoried Bank Length	1627.3	ft
Inventoried Bank to Bank Length	3254.6	ft
Erosive Bank Length	36.1	ft
Bank to Bank Eroding Segment Length	72.2	ft
Percent Eroding Bank	2%	%
Eroding Area	402.6	ft^2
Recession Rate	0.02	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	0.36231323	tons/year/sample reach
Erosion Rate (Er)	1.17557785	tons/mile/year
Feet of similar stream type	20665.0	ft
Eroding Bank Extrapolation	988.77122	ft
Total Streambank Erosion (existing load)	4.96332011	tons/year

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	3630.452	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	3.267407	tons/yr/sample
Allowed Erosion Rate	10.60157	tons/mile/year
Eroding Bank Extrapolation (with reduction)	197.7542	ft
Total Streambank Erosion	44.76012	tons/year

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	0
Bank Stability Condition (0-3)	0
Bank Cover/Vegetation (0-3)	1
Lateral Channel Stablity (0-3)	0
Channel Bottom Stability (0-3)	0
In-Channel Deposition (0-1)	0
Total = Slight (0-4); Moderate (5-8); Severe (9+)	1
Recession Rate	**0.02**

Summary for Load Reductions

Existing		Proposed			
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction	
1.175577853	4.96332011	1.175577853	4.96332011	0	No Reduction Required

Converted Data

Bank #	Erosive Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1			495.4	
2	5.6	36.1		
3			656.2	
4			439.6	
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
	5.6	**36.1**	**1591.2**	**1627.3**
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Raw Data

Bank #	Erosive Bank Ht (m)	Erosive Bank Length (m)	Stable Bank Length (m)	
1			151	
2	1.7	11		
3			200	
4			134	
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
	1.7	**11**	**485**	**496**
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Table C-16. Lower Chippy Creek (ID17040207SK021_03) streambank erosion inventory worksheet.

STREAMBANK EROSION INVENTORY WORKSHEET

Stream:	Lower Chippy Creek SK021_03	**Stream Segment Location (DD)**			**Elevation (ft)**
Section:	R-1	*Upstream:*	42.92408	111.31186	
Date Collected:	8/27/2008	*Downstream:*	42.92408	111.31186	
Field Crew:	MCT, DWZ	**Landuse and Notes:**			
Data Reduced By:	MCT	**Soil Type:**	Silt/clay		

Streambank Erosion Calculations

Average Erosive Bank Height	3.87741935	ft
Total Inventoried Bank Length	3297	ft
Inventoried Bank to Bank Length	6594	ft
Erosive Bank Length	1695	ft
Bank to Bank Eroding Segment Length	3390	ft
Percent Eroding Bank	51%	%
Eroding Area	13144.4516	ft^2
Recession Rate	0.105	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	62.1075339	tons/year/sample reach
Erosion Rate (Er)	99.4624746	tons/mile/year
Feet of similar stream type	21044	ft
Eroding Bank Extrapolation	25027.5978	ft
Total Streambank Erosion (existing load)	458.525776	tons/year

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	5113.541	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	24.16148	tons/yr/sample
Allowed Erosion Rate	38.69354	tons/mile/year
Eroding Bank Extrapolation (with reduction)	5005.52	ft
Total Streambank Erosion	178.3787	tons/year

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
99.46247463	458.525776	38.69354323	178.3787	61.09734513

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	3
Bank Stability Condition (0-3)	0.5
Bank Cover/Vegetation (0-3)	1
Lateral Channel Stablity (0-3)	0
Channel Bottom Stability (0-3)	1
In-Channel Deposition (0-1)	1
Total = Slight (0-4); Moderate (5-8); Severe (9+)	6.5
Recession Rate	**0.105**

Raw Data

Bank #	Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1			36	
2	4	135		
3			39	
4	4	18		
5			51	
6	3	21		
7			111	
8	5	75		
9			54	
10	2	27		
11	9.5	135		
12	4	57		
13	3	18		
14			45	
15	6	15		
16			93	
17	2	45		
18			102	
19	6	81		
20			102	
21	5	63		
22			54	
23	5	78		
24	3	51		
25			36	
26	3	171		
27	4	18		
28			27	
29	4	45		
30			18	
31	5.5	39		
32	4	24		
33			51	
34	5	126		
35	2	30		
36			102	
37			54	
38	2	60		
39			42	
40	2	33		
41	4	51		
42	4	30		
43			18	
44			33	
45	6	51		
46			45	
47	2	51		
48			195	
49	3	39		
50			57	
51	2	24		
52			90	
53	2	27		
54			147	
55	4.2	57		
	3.87741935	**1695**	**1602**	**3297**
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Table C-17. Lower Johnson Creek (ID17040207SK012_03a) streambank erosion inventory worksheet.

STREAMBANK EROSION INVENTORY WORKSHEET

		Stream Segment Location (DD)			**Elevation (ft)**
Stream:	Lower Johnson Creek SK012_03a		Latitude	Longitude	
Reach:	1	*Beginning:*	42.67737	111.40747	
Date Collected:	10/3/2011	*Ending:*	42.68061	111.40692	
Field Crew:	DG, GM	**Landuse and Notes:**		Grazing	
Data Reduced By:	DG	**Soil Type:**		Silt/gravel	

Streambank Erosion Calculations

Average Erosive Bank Height	1.73884515	ft
Total Inventoried Bank Length	1768.37271	ft
Inventoried Bank to Bank Length	3536.74541	ft
Erosive Bank Length	1384.51444	ft
Bank to Bank Eroding Segment Length	2769.02888	ft
Percent Eroding Bank	78%	%
Eroding Area	4814.91242	ft^2
Recession Rate	0.12	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	26.0005271	tons/year/sample reach
Erosion Rate (Er)	77.6322675	tons/mile/year
Feet of similar stream type	13597	ft
Eroding Bank Extrapolation	24060.0641	ft
Total Streambank Erosion (existing load)	225.918319	tons/year

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	1229.971	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	6.641841	tons/yr/sample
Allowed Erosion Rate	19.83118	tons/mile/year
Eroding Bank Extrapolation (with reduction)	4812.013	ft
Total Streambank Erosion	57.71089	tons/year

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	1.5
Bank Stability Condition (0-3)	1.5
Bank Cover/Vegetation (0-3)	1.5
Lateral Channel Stablity (0-3)	0
Channel Bottom Stability (0-3)	1.5
In-Channel Deposition (0-1)	1
Total = Slight (0-4); Moderate (5-8); Severe (9+)	7
Recession Rate	**0.12**

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
77.63226751	225.918319	19.83118113	57.7108881	74.4549763

Converted Data

Bank #	Erosive Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)
1	2.3	59.1	0.0
2	3.9	32.8	0.0
3	2.3	26.2	0.0
4	0.0	0.0	3.3
5	1.3	19.7	0.0
6	0.0	0.0	19.7
7	1.0	19.7	0.0
8	3.3	29.5	0.0
9	1.6	6.6	0.0
10	0.0	0.0	13.1
11	3.0	32.8	0.0
12	1.6	19.7	0.0
13	0.0	0.0	29.5
14	1.3	26.2	0.0
15	1.0	32.8	0.0
16	0.0	0.0	39.4
17	3.3	3.3	0.0
18	0.0	0.0	13.1
19	2.0	59.1	0.0
20	6.6	101.7	0.0
21	0.0	0.0	39.4
22	3.9	91.9	0.0
23	0.0	0.0	29.5
24	2.0	16.4	0.0
25	0.0	0.0	26.2
26	1.6	39.4	0.0
27	3.3	29.5	0.0
28	0.0	0.0	13.1
29	2.6	29.5	0.0
30	0.0	0.0	19.7
31	1.0	23.0	0.0
32	0.0	0.0	42.7
33	4.9	6.6	0.0
34	0.0	0.0	19.7
35	1.0	29.5	0.0
36	0.0	0.0	9.8
37	6.6	32.8	0.0
38	0.0	0.0	9.8
39	0.7	23.0	0.0
40	0.0	0.0	6.6
41	2.3	6.6	0.0
42	0.0	0.0	16.4
43	3.6	229.7	0.0
44	6.6	249.3	0.0
45	0.0	0.0	26.2
46	5.9	85.3	0.0
47	0.0	0.0	6.6
48	6.6	23.0	0.0
49	0.0	0.0	0.0
50	0.0	0.0	0.0
	1.7	**1384.5**	**383.9**	**1768.4**
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Raw Data

Bank #	Erosive Bank Ht (m)	Erosive Bank Length (m)	Stable Bank Length (m)	
1	0.7	18		
2	1.2	10		
3	0.7	8		
4			1	
5	0.4	6		
6			6	
7	0.3	6		
8	1	9		
9	0.5	2		
10			4	
11	0.9	10		
12	0.5	6		
13			9	
14	0.4	8		
15	0.3	10		
16			12	
17	1	1		
18			4	
19	0.6	18		
20	2	31		
21			12	
22	1.2	28		
23			9	
24	0.6	5		
25			8	
26	0.5	12		
27	1	9		
28			4	
29	0.8	9		
30			6	
31	0.3	7		
32			13	
33	1.5	2		
34			6	
35	0.3	9		
36			3	
37	2	10		
38			3	
39	0.2	7		
40			2	
41	0.7	2		
42			5	
43	1.1	70		
44	2	76		
45			8	
46	1.8	26		
47			2	
48	2	7		
49				
50				
	0.913793103	**422**	**117**	**539**
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Table C-18. Poison Creek (ID17040207SK009_02b) streambank erosion inventory worksheet.

STREAMBANK EROSION INVENTORY WORKSHEET

		Stream Segment Location (DD)			**Elevation (ft)**
Stream:	Poison Creek SK009_02b		Latitude	Longitude	
Reach:	1	*Beginning:*	43.03149	111.71758	
Date Collected:	10/13/2011	*Ending:*	43.03606	111.72293	
Field Crew:	DG, JS	**Landuse and Notes:**		Grazing	
Data Reduced By:	DG, JS	**Soil Type:**		Silt/gravel/cobble	

Streambank Erosion Calculations

Average Erosive Bank Height	0.48775153	ft
Total Inventoried Bank Length	3149.6063	ft
Inventoried Bank to Bank Length	6299.21261	ft
Erosive Bank Length	3150	ft
Bank to Bank Eroding Segment Length	6300	ft
Percent Eroding Bank	100%	%
Eroding Area	3072.83465	ft^2
Recession Rate	0.06	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	8.29665356	tons/year/sample reach
Erosion Rate (Er)	13.90851	tons/mile/year
Feet of similar stream type	43525	ft
Eroding Bank Extrapolation	93360.8811	ft
Total Streambank Erosion (existing load)	122.949664	tons/year

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	614.4901	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	1.659123	tons/yr/sample
Allowed Erosion Rate	2.781354	tons/mile/year
Eroding Bank Extrapolation (with reduction)	18672.18	ft
Total Streambank Erosion	24.58686	tons/year

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	1
Bank Stability Condition (0-3)	0.5
Bank Cover/Vegetation (0-3)	1
Lateral Channel Stablity (0-3)	0.5
Channel Bottom Stability (0-3)	1
In-Channel Deposition (0-1)	1
Total = Slight (0-4); Moderate (5-8); Severe (9+)	5
Recession Rate	**0.06**

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
13.90851	122.949664	2.781354335	24.5868596	80.00249966

Converted Data

Bank #	Erosive Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1	0.0	0.0	26.2	
2	1.3	23.0	0.0	
3	0.7	32.8	0.0	
4	0.0	0.0	216.5	
5	0.7	59.1	0.0	
6	0.0	0.0	65.6	
7	0.8	32.8	0.0	
8	0.0	0.0	72.2	
9	6.6	72.2	0.0	
10	0.0	0.0	65.6	
11	4.9	39.4	0.0	
12	1.6	65.6	0.0	
13	0.7	150.9	0.0	
14	0.3	68.9	0.0	
15	5.2	16.4	0.0	
16	0.3	65.6	0.0	
17	0.0	0.0	36.1	
18	9.8	65.6	0.0	
19	0.0	0.0	98.4	
20	1.3	65.6	0.0	
21	0.3	85.3	0.0	
22	0.0	0.0	52.5	
23	1.0	72.2	0.0	
24	0.3	65.6	0.0	
25	2.0	16.4	0.0	
26	0.3	59.1	0.0	
27	0.0	0.0	39.4	
28	2.0	91.9	0.0	
29	0.0	0.0	85.3	
30	1.6	39.4	0.0	
31	0.0	0.0	19.7	
32	0.3	52.5	0.0	
33	0.0	0.0	19.7	
34	1.3	59.1	0.0	
35	0.0	0.0	26.2	
36	1.6	32.8	0.0	
37	0.0	0.0	65.6	
38	0.7	32.8	0.0	
39	4.6	124.7	0.0	
40	0.0	0.0	13.1	
41	2.6	65.6	0.0	
42	5.9	118.1	0.0	
43	0.0	0.0	52.5	
44	4.9	85.3	0.0	
45	0.0	0.0	26.2	
46	2.6	183.7	0.0	
47	0.0	0.0	29.5	
48	0.8	72.2	0.0	
49	3.0	19.7	0.0	
50	0.7	65.6	0.0	
51	0.0	0.0	13.1	
52	2.3	26.2	0.0	
53	0.0	0.0	0.0	
149	0.0	0.0	0.0	
150	0.0	0.0	0.0	
	0.5	**2126.0**	**1023.6**	**3149.6**
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Raw Data

Bank #	Erosive Bank Ht (m)	Erosive Bank Length (m)	Stable Bank Length (m)	
1			8	
2	0.4	7		
3	0.2	10		
4			66	
5	0.2	18		
6			20	
7	0.25	10		
8			22	
9	2	22		
10			20	
11	1.5	12		
12	0.5	20		
13	0.2	46		
14	0.1	21		
15	1.6	5		
16	0.1	20		
17			11	
18	3	20		
19			30	
20	0.4	20		
21	0.1	26		
22			16	
23	0.3	22		
24	0.1	20		
25	0.6	5		
26	0.1	18		
27			12	
28	0.6	28		
29			26	
30	0.5	12		
31			6	
32	0.1	16		
33			6	
34	0.4	18		
35			8	
36	0.5	10		
37			20	
38	0.2	10		
39	1.4	38		
40			4	
41	0.8	20		
42	1.8	36		
43			16	
44	1.5	26		
45			8	
46	0.8	56		
47			9	
48	0.25	22		
49	0.9	6		
50	0.2	20		
51			4	
52	0.7	8		
53				
149				
150				
	0.675757576	**648**	**312**	**960**
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Table C-19. Rawlins Creek (ID17040207SK027_02) streambank erosion inventory worksheet.

STREAMBANK EROSION INVENTORY WORKSHEET

			Stream Segment Location (DD)			Elevation (ft)
Stream:	Rawlins Creek SK027_02			Latitude	Longitude	
Reach:		1	*Beginning:*	43.14361	111.86774	
Date Collected:		10/21/2011	*Ending:*	43.13831	111.86940	
Field Crew:	DG, GM		**Landuse and Notes:**		Grazing	
Data Reduced By:	DG		**Soil Type:**		Silt	

Streambank Erosion Calculations

Average Erosive Bank Height	0.68897638	ft
Total Inventoried Bank Length	3293.96326	ft
Inventoried Bank to Bank Length	6587.92652	ft
Erosive Bank Length	2677.16536	ft
Bank to Bank Eroding Segment Length	5354.33072	ft
Percent Eroding Bank	81%	%
Eroding Area	3689.00739	ft^2
Recession Rate	0.155	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	25.7308265	tons/year/sample reach
Erosion Rate (Er)	41.2447722	tons/mile/year
Feet of similar stream type	29495	ft
Eroding Bank Extrapolation	53298.3945	ft
Total Streambank Erosion (existing load)	256.13131	tons/year

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
41.24477216	256.13131	10.14944883	63.0283911	75.39215686

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	907.7852	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	6.331801	tons/yr/sample
Allowed Erosion Rate	10.14945	tons/mile/year
Eroding Bank Extrapolation (with reduction)	10659.68	ft
Total Streambank Erosion	63.02839	tons/year

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	3
Bank Stability Condition (0-3)	0.5
Bank Cover/Vegetation (0-3)	2
Lateral Channel Stablity (0-3)	1
Channel Bottom Stability (0-3)	1
In-Channel Deposition (0-1)	1
Total = Slight (0-4); Moderate (5-8); Severe (9+)	8.5
Recession Rate	**0.155**

Converted Data

Bank #	Erosive Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1	1.6	23.0	0.0	
2	0.0	0.0	3.3	
3	1.0	19.7	0.0	
4	0.0	0.0	6.6	
5	0.7	78.7	0.0	
6	0.0	0.0	6.6	
7	1.3	52.5	0.0	
8	0.0	0.0	6.6	
9	1.3	105.0	0.0	
10	0.0	0.0	6.6	
11	1.3	3.3	0.0	
12	0.0	0.0	23.0	
13	1.0	39.4	0.0	
14	0.0	0.0	6.6	
15	1.3	26.2	0.0	
16	0.0	0.0	6.6	
17	0.7	85.3	0.0	
18	0.0	0.0	6.6	
19	1.6	118.1	0.0	
20	1.0	45.9	0.0	
21	1.3	45.9	0.0	
22	0.0	0.0	19.7	
23	1.3	78.7	0.0	
24	0.7	59.1	0.0	
25	1.6	131.2	0.0	
26	0.7	39.4	0.0	
27	0.0	0.0	6.6	
28	2.3	82.0	0.0	
29	1.3	6.6	0.0	
30	0.7	26.2	0.0	
31	2.0	32.8	0.0	
32	0.0	0.0	9.8	
33	0.3	39.4	0.0	
34	0.0	0.0	16.4	
35	0.7	19.7	0.0	
36	2.6	78.7	0.0	
37	0.0	0.0	16.4	
38	0.7	6.6	0.0	
39	0.0	0.0	29.5	
40	2.3	52.5	0.0	
41	0.0	0.0	19.7	
42	1.0	52.5	0.0	
43	0.0	0.0	19.7	
44	1.3	6.6	0.0	
45	0.0	0.0	6.6	
46	1.6	65.6	0.0	
47	0.0	0.0	6.6	
48	1.0	13.1	0.0	
49	0.0	0.0	6.6	
50	0.7	19.7	0.0	
51	1.6	131.2	0.0	
52	2.3	19.7	0.0	
53	0.0	0.0	6.6	
54	1.6	13.1	0.0	
55	1.0	59.1	0.0	
56	1.6	45.9	0.0	
57	1.0	6.6	0.0	
58	0.0	0.0	13.1	
59	2.0	59.1	0.0	
60	0.0	0.0	6.6	
61	1.6	19.7	0.0	
62	0.0	0.0	32.8	
63	2.0	65.6	0.0	
64	0.0	0.0	13.1	
65	1.0	6.6	0.0	
66	0.0	0.0	26.2	
67	2.0	98.4	0.0	
68	0.0	0.0	9.8	
69	2.0	62.3	0.0	
70	0.0	0.0	6.6	
71	1.0	13.1	0.0	
72	0.0	0.0	29.5	
73	1.0	6.6	0.0	
74	0.0	0.0	19.7	
75	1.0	19.7	0.0	
76	0.0	0.0	19.7	
77	0.7	13.1	0.0	
78	0.0	0.0	3.3	
79	1.6	85.3	0.0	
80	0.0	0.0	19.7	
81	2.0	32.8	0.0	
82	0.0	0.0	16.4	
83	1.0	13.1	0.0	
84	5.9	19.7	0.0	
85	9.8	32.8	0.0	
86	3.3	19.7	0.0	
87	2.6	16.4	0.0	
88	0.0	0.0	13.1	
89	1.6	65.6	0.0	
90	0.0	0.0	9.8	
91	1.0	9.8	0.0	
92	0.0	0.0	6.6	
93	1.0	9.8	0.0	
94	1.3	32.8	0.0	
95	0.0	0.0	19.7	
96	1.0	19.7	0.0	
97	1.3	42.7	0.0	
98	0.0	0.0	19.7	
99	1.3	52.5	0.0	
100	1.0	19.7	0.0	
101	0.0	0.0	42.7	
102	1.6	39.4	0.0	
103	3.3	29.5	0.0	
104	0.0	0.0	36.1	
105	1.6	39.4	0.0	
106	0.0	0.0	9.8	
107	1.0	3.3	0.0	
108	0.0	0.0	6.6	
150	0.0	0.0	0.0	
	0.7	**2677.2**	**616.8**	**3294.0**
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Raw Data

Bank #	Erosive Bank Ht (m)	Erosive Bank Length (m)	Stable Bank Length (m)	
1	0.5	7		
2			1	
3	0.3	6		
4			2	
5	0.2	24		
6			2	
7	0.4	16		
8			2	
9	0.4	32		
10			2	
11	0.4	1		
12			7	
13	0.3	12		
14			2	
15	0.4	8		
16			2	
17	0.2	26		
18			2	
19	0.5	36		
20	0.3	14		
21	0.4	14		
22			6	
23	0.4	24		
24	0.2	18		
25	0.5	40		
26	0.2	12		
27			2	
28	0.7	25		
29	0.4	2		
30	0.2	8		
31	0.6	10		
32			3	
33	0.1	12		
34			5	
35	0.2	6		
36	0.8	24		
37			5	
38	0.2	2		
39			9	
40	0.7	16		
41			6	
42	0.3	16		
43			6	
44	0.4	2		
45			2	
46	0.5	20		
47			2	
48	0.3	4		
49			2	
50	0.2	6		
51	0.5	40		
52	0.7	6		
53			2	
54	0.5	4		
55	0.3	18		
56	0.5	14		
57	0.3	2		
58			4	
59	0.6	18		
60			2	
61	0.5	6		
62			10	
63	0.6	20		
64			4	
65	0.3	2		
66			8	
67	0.6	30		
68			3	
69	0.6	19		
70			2	
71	0.3	4		
72			9	
73	0.3	2		
74			6	
75	0.3	6		
76			6	
77	0.2	4		
78			1	
79	0.5	26		
80			6	
81	0.6	10		
82			5	
83	0.3	4		
84	1.8	6		
85	3	10		
86	1	6		
87	0.8	5		
88			4	
89	0.5	20		
90			3	
91	0.3	3		
92			2	
93	0.3	3		
94	0.4	10		
95			6	
96	0.3	6		
97	0.4	13		
98			6	
99	0.4	16		
100	0.3	6		
101			13	
102	0.5	12		
103	1	9		
104			11	
105	0.5	12		
106			3	
107	0.3	1		
108			2	
150				
	0.484615385	**816**	**188**	**1004**
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Table C-20. State Land Creek (ID17040207SK010_02a) streambank erosion inventory worksheet.

STREAMBANK EROSION INVENTORY WORKSHEET

Stream:	State Land Creek SK010_02a	**Stream Segment Location (DD)**			**Elevation (ft)**
Section:	R-1	*Upstream:*	42.78043	111.49423	
Date Collected:	7/29/2008	*Downstream:*	42.78344	111.49197	
Field Crew:	DWZ, GM	**Landuse and Notes:**			
Data Reduced By:	MCT	**Soil Type:**	Silt		

Streambank Erosion Calculations

Average Erosive Bank Height	0.61666667	ft
Total Inventoried Bank Length	1638	ft
Inventoried Bank to Bank Length	3276	ft
Erosive Bank Length	1566	ft
Bank to Bank Eroding Segment Length	3132	ft
Percent Eroding Bank	96%	%
Eroding Area	1931.4	ft^2
Recession Rate	0.09	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	7.82217	tons/year/sample reach
Erosion Rate (Er)	25.2143209	tons/mile/year
Feet of similar stream type	21083	ft
Eroding Bank Extrapolation	43444.5495	ft
Total Streambank Erosion (existing load)	108.502762	tons/year

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	404.04	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	1.636362	tons/yr/sample
Allowed Erosion Rate	5.27472	tons/mile/year
Eroding Bank Extrapolation (with reduction)	8688.91	ft
Total Streambank Erosion	22.69828	tons/year

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	2
Bank Stability Condition (0-3)	1.5
Bank Cover/Vegetation (0-3)	1.5
Lateral Channel Stablity (0-3)	0
Channel Bottom Stability (0-3)	0
In-Channel Deposition (0-1)	1
Total = Slight (0-4); Moderate (5-8); Severe (9+)	6
Recession Rate	**0.09**

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
25.21432088	108.502762	5.27472	22.698279	79.08045977

Raw Data

Bank #	Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1	1	156		
2			72	
3	0.6	240		
4	0.5	300		
5	0.8	270		
6	0.4	300		
7	0.4	300		
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
	0.61666667	**1566**	**72**	**1638**
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Table C-21. Sunday Creek (ID17040207SK005_02e) streambank erosion inventory worksheet.

STREAMBANK EROSION INVENTORY WORKSHEET

			Stream Segment Location (DD)		Elevation (ft)
Stream:	Sunday Creek SK005_02e			Latitude	Longitude	
Reach:		1	*Beginning:*	43.00134	111.86312
Date Collected:		9/30/2011	*Ending:*	43.00372	111.86076
Field Crew:	DG, JS, GM		**Landuse and Notes:**		Grazing
Data Reduced By:	DG		**Soil Type:**		Silt

Streambank Erosion Calculations

Average Erosive Bank Height	0.04593176	ft
Total Inventoried Bank Length	1240.15748	ft
Inventoried Bank to Bank Length	2480.31496	ft
Erosive Bank Length	1240.15748	ft
Bank to Bank Eroding Segment Length	2480.31496	ft
Percent Eroding Bank	100%	%
Eroding Area	113.925228	ft^2
Recession Rate	0.055	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	0.28196494	tons/year/sample reach
Erosion Rate (Er)	1.20047244	tons/mile/year
Feet of similar stream type	26638	ft
Eroding Bank Extrapolation	55756.315	ft
Total Streambank Erosion (existing load)	6.33843936	tons/year

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
1.200472443	6.33843936	0.240094489	1.26768787	80

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	22.78505	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	0.056393	tons/yr/sample
Allowed Erosion Rate	0.240094	tons/mile/year
Eroding Bank Extrapolation (with reduction)	11151.26	ft
Total Streambank Erosion	1.267688	tons/year

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	1
Bank Stability Condition (0-3)	0.5
Bank Cover/Vegetation (0-3)	1
Lateral Channel Stablity (0-3)	1
Channel Bottom Stability (0-3)	0
In-Channel Deposition (0-1)	1
Total = Slight (0-4); Moderate (5-8); Severe (9+)	4.5
Recession Rate	**0.055**

Converted Data					Raw Data				
Bank #	Erosive Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)		Bank #	Erosive Bank Ht (m)	Erosive Bank Length (m)	Stable Bank Length (m)	
1	0.3	262.5	0.0		1	0.1	80		
2	0.3	157.5	0.0		2	0.1	48		
3	0.3	177.2	0.0		3	0.1	54		
4	0.3	19.7	0.0		4	0.1	6		
5	0.3	328.1	0.0		5	0.1	100		
6	0.3	196.9	0.0		6	0.1	60		
7	0.3	98.4	0.0		7	0.1	30		
8	0.0	0.0	0.0		8				
9	0.0	0.0	0.0		9				
10	0.0	0.0	0.0		10				
11	0.0	0.0	0.0		11				
12	0.0	0.0	0.0		12				
13	0.0	0.0	0.0		13				
14	0.0	0.0	0.0		14				
15	0.0	0.0	0.0		15				
16	0.0	0.0	0.0		16				
17	0.0	0.0	0.0		17				
18	0.0	0.0	0.0		18				
19	0.0	0.0	0.0		19				
20	0.0	0.0	0.0		20				
21	0.0	0.0	0.0		21				
22	0.0	0.0	0.0		22				
23	0.0	0.0	0.0		23				
24	0.0	0.0	0.0		24				
25	0.0	0.0	0.0		25				
26	0.0	0.0	0.0		26				
27	0.0	0.0	0.0		27				
28	0.0	0.0	0.0		28				
29	0.0	0.0	0.0		29				
30	0.0	0.0	0.0		30				
31	0.0	0.0	0.0		31				
32	0.0	0.0	0.0		32				
33	0.0	0.0	0.0		33				
34	0.0	0.0	0.0		34				
35	0.0	0.0	0.0		35				
36	0.0	0.0	0.0		36				
37	0.0	0.0	0.0		37				
38	0.0	0.0	0.0		38				
39	0.0	0.0	0.0		39				
40	0.0	0.0	0.0		40				
41	0.0	0.0	0.0		41				
42	0.0	0.0	0.0		42				
43	0.0	0.0	0.0		43				
44	0.0	0.0	0.0		44				
45	0.0	0.0	0.0		45				
46	0.0	0.0	0.0		46				
47	0.0	0.0	0.0		47				
48	0.0	0.0	0.0		48				
49	0.0	0.0	0.0		49				
50	0.0	0.0	0.0		50				
	0.0	1240.2	0.0	1240.2		0.1	378	0	378
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**		**Ave Bank Ht**	**Total Erosive**	**Total Stable**	**Total Bank Length**

Table C-22. Thompson Creek (ID17040207SK008_02) streambank erosion inventory worksheet.

STREAMBANK EROSION INVENTORY WORKSHEET

Stream:	Thompson Creek SK008_02	**Stream Segment Location (DD)**		**Elevation (ft)**
Section:	R-1	*Upstream:*	42.91531 111.77239	
Date Collected:	8/21/2008	*Downstream:*	42.90806 111.77943	
Field Crew:	MCT, DWZ	**Landuse and Notes:**		
Data Reduced By:	MCT	**Soil Type:**	Silt	

Streambank Erosion Calculations

Average Erosive Bank Height	2.89285714	ft
Total Inventoried Bank Length	2694	ft
Inventoried Bank to Bank Length	5388	ft
Erosive Bank Length	2316	ft
Bank to Bank Eroding Segment Length	4632	ft
Percent Eroding Bank	86%	%
Eroding Area	13399.7143	ft^2
Recession Rate	0.61	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	367.822157	tons/year/sample reach
Erosion Rate (Er)	720.89866	tons/mile/year
Feet of similar stream type	13064	ft
Eroding Bank Extrapolation	27093.9332	ft
Total Streambank Erosion (existing load)	2151.5002	tons/year

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	3117.343	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	85.57106	tons/yr/sample
Allowed Erosion Rate	167.7117	tons/mile/year
Eroding Bank Extrapolation (with reduction)	5418.787	ft
Total Streambank Erosion	500.5304	tons/year

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	3
Bank Stability Condition (0-3)	2
Bank Cover/Vegetation (0-3)	3
Lateral Channel Stablity (0-3)	2
Channel Bottom Stability (0-3)	2
In-Channel Deposition (0-1)	1
Total = Slight (0-4); Moderate (5-8); Severe (9+)	13
Recession Rate	**0.61**

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
720.8986599	2151.5002	167.7116571	500.530359	76.7357513

Raw Data

Bank #	Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1	3.5	180		
2			48	
3	3	126		
4	2.5	180		
5	6	96		
6	5	51		
7	4	66		
8			87	
9	3	129		
10			39	
11	1.5	180		
12			30	
13	2.5	183		
14			18	
15	2.2	312		
16			27	
17	1.1	402		
18			51	
19	1.2	279		
20			18	
21	2.6	102		
22			60	
23	2.4	30		
24				
25				
26				
27				
28				
29				
30				
31				
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48				
49				
50				
	2.89285714	**2316**	**378**	**2694**
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Table C-23. Upper Johnson Reach 1 (ID17040207SK012_02a) streambank erosion inventory worksheet.

STREAMBANK EROSION INVENTORY WORKSHEET

		Stream Segment Location (DD)	Latitude	Longitude	Elevation (ft)
Stream:	Upper Johnson Creek SK012_02a		Latitude	Longitude	
Reach:	1	*Beginning:*	42.66669	111.42871	
Date Collected:	10/3/2011	*Ending:*	42.66943	111.42484	
Field Crew:	DG, GM	**Landuse and Notes:**		U.S. Forest land	
Data Reduced By:	DG	**Soil Type:**		**Silt**	

Streambank Erosion Calculations

Average Erosive Bank Height	0.09186352	ft
Total Inventoried Bank Length	1748.68767	ft
Inventoried Bank to Bank Length	3497.37533	ft
Erosive Bank Length	16.4041995	ft
Bank to Bank Eroding Segment Length	32.808399	ft
Percent Eroding Bank	1%	%
Eroding Area	3.01389493	ft^2
Recession Rate	0.02	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	0.00271251	tons/year/sample reach
Erosion Rate (Er)	0.00819016	tons/mile/year
Feet of similar stream type	5574	ft
Eroding Bank Extrapolation	137.38626	ft
Total Streambank Erosion (existing load)	0.01135871	tons/year

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	64.25624	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	0.057831	tons/yr/sample
Allowed Erosion Rate	0.174614	tons/mile/year
Eroding Bank Extrapolation (with reduction)	27.47725	ft
Total Streambank Erosion	0.242168	tons/year

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	0
Bank Stability Condition (0-3)	0
Bank Cover/Vegetation (0-3)	0
Lateral Channel Stablity (0-3)	0
Channel Bottom Stability (0-3)	0
In-Channel Deposition (0-1)	1
Total = Slight (0-4); Moderate (5-8); Severe (9+)	1
Recession Rate	**0.02**

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
0.008190158	0.01135871	0.008190158	0.01135871	0

Converted Data

Bank #	Erosive Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1	0.0	0.0	26.2	
2	0.3	3.3	0.0	
3	0.0	0.0	328.1	
4	0.0	0.0	183.7	
5	2.0	6.6	0.0	
6	0.0	0.0	393.7	
7	1.0	3.3	0.0	
8	0.0	0.0	190.3	
9	0.0	0.0	367.5	
10	1.3	3.3	0.0	
11	0.0	0.0	203.4	
12	0.0	0.0	39.4	
13	0.0	0.0	0.0	
14	0.0	0.0	0.0	
15	0.0	0.0	0.0	
16	0.0	0.0	0.0	
17	0.0	0.0	0.0	
18	0.0	0.0	0.0	
19	0.0	0.0	0.0	
20	0.0	0.0	0.0	
21	0.0	0.0	0.0	
22	0.0	0.0	0.0	
23	0.0	0.0	0.0	
24	0.0	0.0	0.0	
25	0.0	0.0	0.0	
26	0.0	0.0	0.0	
27	0.0	0.0	0.0	
28	0.0	0.0	0.0	
29	0.0	0.0	0.0	
30	0.0	0.0	0.0	
31	0.0	0.0	0.0	
32	0.0	0.0	0.0	
33	0.0	0.0	0.0	
34	0.0	0.0	0.0	
35	0.0	0.0	0.0	
36	0.0	0.0	0.0	
37	0.0	0.0	0.0	
38	0.0	0.0	0.0	
39	0.0	0.0	0.0	
40	0.0	0.0	0.0	
41	0.0	0.0	0.0	
42	0.0	0.0	0.0	
43	0.0	0.0	0.0	
44	0.0	0.0	0.0	
45	0.0	0.0	0.0	
46	0.0	0.0	0.0	
47	0.0	0.0	0.0	
48	0.0	0.0	0.0	
49	0.0	0.0	0.0	
50	0.0	0.0	0.0	
	0.1	16.4	1732.3	1748.7
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Raw Data

Bank #	Erosive Bank Ht (m)	Erosive Bank Length (m)	Stable Bank Length (m)	
1			8	
2	0.1	1		
3			100	
4			56	
5	0.6	2		
6			120	
7	0.3	1		
8			58	
9			112	
10	0.4	1		
11			62	
12			12	
13				
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49				
50				
	0.35	5	528	533
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Table C-24. Upper Johnson Reach 2 (ID17040207SK012_02a) streambank erosion inventory worksheet.

STREAMBANK EROSION INVENTORY WORKSHEET

			Stream Segment Location (DD)			Elevation (ft)
Stream:	Upper Johnson SK012_02a			Latitude	Longitude	
Reach:		2	*Beginning:*	42.65884	111.43233	
Date Collected:		3/10/2011	*Ending:*	42.65494	111.43235	
Field Crew:	DG, GM		**Landuse and Notes:**		Forest land	
Data Reduced By:	DG		**Soil Type:**		Gravel	

Streambank Erosion Calculations

Average Erosive Bank Height	0.05905512	ft
Total Inventoried Bank Length	1778.21523	ft
Inventoried Bank to Bank Length	3556.43045	ft
Erosive Bank Length	49.2125985	ft
Bank to Bank Eroding Segment Length	98.425197	ft
Percent Eroding Bank	3%	%
Eroding Area	5.81251164	ft^2
Recession Rate	0.02	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	0.00523126	tons/year/sample reach
Erosion Rate (Er)	0.01553302	tons/mile/year
Feet of similar stream type	5574	ft
Eroding Bank Extrapolation	406.949182	ft
Total Streambank Erosion (existing load)	0.02162919	tons/year

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	42.00508	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	0.037805	tons/yr/sample
Allowed Erosion Rate	0.112252	tons/mile/year
Eroding Bank Extrapolation (with reduction)	81.38984	ft
Total Streambank Erosion	0.156307	tons/year

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
0.015533021	0.02162919	0.015533021	0.02162919	0

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	0
Bank Stability Condition (0-3)	0
Bank Cover/Vegetation (0-3)	0
Lateral Channel Stablity (0-3)	0
Channel Bottom Stability (0-3)	0
In-Channel Deposition (0-1)	1
Total = Slight (0-4); Moderate (5-8); Severe (9+)	1
Recession Rate	**0.02**

Converted Data

Bank #	Erosive Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1	0.0	0.0	492.1	
2	0.0	0.0	111.5	
3	1.3	9.8	0.0	
4	0.0	0.0	141.1	
5	1.6	39.4	0.0	
6	0.0	0.0	984.3	
7	0.0	0.0	0.0	
8	0.0	0.0	0.0	
9	0.0	0.0	0.0	
10	0.0	0.0	0.0	
11	0.0	0.0	0.0	
12	0.0	0.0	0.0	
13	0.0	0.0	0.0	
14	0.0	0.0	0.0	
15	0.0	0.0	0.0	
16	0.0	0.0	0.0	
17	0.0	0.0	0.0	
18	0.0	0.0	0.0	
19	0.0	0.0	0.0	
20	0.0	0.0	0.0	
21	0.0	0.0	0.0	
22	0.0	0.0	0.0	
23	0.0	0.0	0.0	
24	0.0	0.0	0.0	
25	0.0	0.0	0.0	
26	0.0	0.0	0.0	
27	0.0	0.0	0.0	
28	0.0	0.0	0.0	
29	0.0	0.0	0.0	
30	0.0	0.0	0.0	
31	0.0	0.0	0.0	
32	0.0	0.0	0.0	
33	0.0	0.0	0.0	
34	0.0	0.0	0.0	
35	0.0	0.0	0.0	
36	0.0	0.0	0.0	
37	0.0	0.0	0.0	
38	0.0	0.0	0.0	
39	0.0	0.0	0.0	
40	0.0	0.0	0.0	
41	0.0	0.0	0.0	
42	0.0	0.0	0.0	
43	0.0	0.0	0.0	
44	0.0	0.0	0.0	
45	0.0	0.0	0.0	
46	0.0	0.0	0.0	
47	0.0	0.0	0.0	
48	0.0	0.0	0.0	
49	0.0	0.0	0.0	
50	0.0	0.0	0.0	
	0.1	**49.2**	**1729.0**	**1778.2**
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Raw Data

Bank #	Erosive Bank Ht (m)	Erosive Bank Length (m)	Stable Bank Length (m)	
1			150	
2			34	
3	0.4	3		
4			43	
5	0.5	12		
6			300	
7				
8				
9				
10				
11				
12				
13				
14				
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46				
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48				
49				
50				
	0.45	**15**	**527**	**542**
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Table C-25. Upper Mill Canyon (ID17040207SK015_02a) streambank erosion inventory worksheet.

STREAMBANK EROSION INVENTORY WORKSHEET

		Stream Segment Location (DD)			Elevation (ft)
Stream:	Upper Mill Canyon SK015_02a		Latitude	Longitude	
Reach:	1	*Beginning:*	42.80748	111.31139	
Date Collected:	10/19/2011	*Ending:*	42.80585	111.31395	
Field Crew:	DG, JS	**Landuse and Notes:**		U.S. Forest land	
Data Reduced By:	DG	**Soil Type:**		Silt	

Streambank Erosion Calculations

Average Erosive Bank Height	0.00656168	ft
Total Inventoried Bank Length	1295.93176	ft
Inventoried Bank to Bank Length	2591.86352	ft
Erosive Bank Length	13.1233596	ft
Bank to Bank Eroding Segment Length	26.2467192	ft
Percent Eroding Bank	1%	%
Eroding Area	0.17222257	ft^2
Recession Rate	0.02	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	0.000155	tons/year/sample reach
Erosion Rate (Er)	0.00063152	tons/mile/year
Feet of similar stream type	11587	ft
Eroding Bank Extrapolation	260.920137	ft
Total Streambank Erosion (existing load)	0.00154087	tons/year

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	3.401396	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	0.003061	tons/yr/sample
Allowed Erosion Rate	0.012472	tons/mile/year
Eroding Bank Extrapolation (with reduction)	52.18403	ft
Total Streambank Erosion	0.030432	tons/year

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	0
Bank Stability Condition (0-3)	0
Bank Cover/Vegetation (0-3)	0.5
Lateral Channel Stablity (0-3)	0
Channel Bottom Stability (0-3)	0.5
In-Channel Deposition (0-1)	0
Total = Slight (0-4); Moderate (5-8); Severe (9+)	1
Recession Rate	**0.02**

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
0.000631516	0.00154087	0.000631516	0.00154087	0

Converted Data

Bank #	Erosive Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1	0.0	0.0	59.1	
2	0.3	13.1	0.0	
3	0.0	0.0	26.2	
4	0.0	0.0	196.9	
5	0.0	0.0	32.8	
6	0.0	0.0	114.8	
7	0.0	0.0	597.1	
8	0.0	0.0	255.9	
9	0.0	0.0	0.0	
10	0.0	0.0	0.0	
11	0.0	0.0	0.0	
12	0.0	0.0	0.0	
13	0.0	0.0	0.0	
14	0.0	0.0	0.0	
15	0.0	0.0	0.0	
16	0.0	0.0	0.0	
17	0.0	0.0	0.0	
18	0.0	0.0	0.0	
19	0.0	0.0	0.0	
20	0.0	0.0	0.0	
21	0.0	0.0	0.0	
22	0.0	0.0	0.0	
23	0.0	0.0	0.0	
24	0.0	0.0	0.0	
25	0.0	0.0	0.0	
26	0.0	0.0	0.0	
27	0.0	0.0	0.0	
28	0.0	0.0	0.0	
29	0.0	0.0	0.0	
30	0.0	0.0	0.0	
31	0.0	0.0	0.0	
32	0.0	0.0	0.0	
33	0.0	0.0	0.0	
34	0.0	0.0	0.0	
35	0.0	0.0	0.0	
36	0.0	0.0	0.0	
37	0.0	0.0	0.0	
38	0.0	0.0	0.0	
39	0.0	0.0	0.0	
40	0.0	0.0	0.0	
41	0.0	0.0	0.0	
42	0.0	0.0	0.0	
43	0.0	0.0	0.0	
44	0.0	0.0	0.0	
45	0.0	0.0	0.0	
46	0.0	0.0	0.0	
47	0.0	0.0	0.0	
48	0.0	0.0	0.0	
49	0.0	0.0	0.0	
50	0.0	0.0	0.0	
	0.0	**13.1**	**1282.8**	**1295.9**
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Raw Data

Bank #	Erosive Bank Ht (m)	Erosive Bank Length (m)	Stable Bank Length (m)	
1			18	
2	0.1	4		
3			8	
4			60	
5			10	
6			35	
7			182	
8			78	
9				
10				
11				
12				
13				
14				
15				
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47				
48				
49				
50				
	0.1	**4**	**391**	**395**
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Table C-26. Warbonnet Creek Reach 1 (ID17040207SK005_02b) streambank erosion inventory worksheet.

STREAMBANK EROSION INVENTORY WORKSHEET

		Stream Segment Location (DD)			Elevation (ft)
Stream:	Warbonnet Creek SK005_02b		Latitude	Longitude	
Reach:	1	*Beginning:*	43.00363	111.90450	
Date Collected:	9/30/2011	*Ending:*	43.00146	111.90897	
Field Crew:	JS, DG, GM	**Landuse and Notes:**		Private, grazing	
Data Reduced By:	DG	**Soil Type:**		Silt	

Streambank Erosion Calculations

Average Erosive Bank Height	0.08530184	ft
Total Inventoried Bank Length	1902.88714	ft
Inventoried Bank to Bank Length	3805.77428	ft
Erosive Bank Length	32.808399	ft
Bank to Bank Eroding Segment Length	65.616798	ft
Percent Eroding Bank	2%	%
Eroding Area	5.59723343	ft^2
Recession Rate	0.02	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	0.00503751	tons/year/sample reach
Erosion Rate (Er)	0.01397774	tons/mile/year
Feet of similar stream type	600	ft
Eroding Bank Extrapolation	86.3064532	ft
Total Streambank Erosion (existing load)	0.00662589	tons/year

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	64.92791	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	0.058435	tons/yr/sample
Allowed Erosion Rate	0.162142	tons/mile/year
Eroding Bank Extrapolation (with reduction)	17.26129	ft
Total Streambank Erosion	0.07686	tons/year

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	0
Bank Stability Condition (0-3)	0
Bank Cover/Vegetation (0-3)	0
Lateral Channel Stablity (0-3)	0
Channel Bottom Stability (0-3)	0
In-Channel Deposition (0-1)	1
Total = Slight (0-4); Moderate (5-8); Severe (9+)	1
Recession Rate	**0.02**

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
0.013977736	0.00662589	0.013977736	0.00662589	0

Converted Data

Bank #	Erosive Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1	0.0	0.0	262.5	
2	0.0	0.0	72.2	
3	0.3	3.3	0.0	
4	0.0	0.0	105.0	
5	0.0	0.0	190.3	
6	0.0	0.0	164.0	
7	0.0	0.0	328.1	
8	0.0	0.0	229.7	
9	0.0	0.0	170.6	
10	0.0	0.0	65.6	
11	3.6	26.2	0.0	
12	0.0	0.0	32.8	
13	0.3	3.3	0.0	
14	0.0	0.0	150.9	
15	0.0	0.0	98.4	
16	0.0	0.0	0.0	
17	0.0	0.0	0.0	
18	0.0	0.0	0.0	
19	0.0	0.0	0.0	
20	0.0	0.0	0.0	
21	0.0	0.0	0.0	
22	0.0	0.0	0.0	
23	0.0	0.0	0.0	
24	0.0	0.0	0.0	
25	0.0	0.0	0.0	
26	0.0	0.0	0.0	
27	0.0	0.0	0.0	
28	0.0	0.0	0.0	
29	0.0	0.0	0.0	
30	0.0	0.0	0.0	
31	0.0	0.0	0.0	
32	0.0	0.0	0.0	
33	0.0	0.0	0.0	
34	0.0	0.0	0.0	
35	0.0	0.0	0.0	
36	0.0	0.0	0.0	
37	0.0	0.0	0.0	
38	0.0	0.0	0.0	
39	0.0	0.0	0.0	
40	0.0	0.0	0.0	
41	0.0	0.0	0.0	
42	0.0	0.0	0.0	
43	0.0	0.0	0.0	
44	0.0	0.0	0.0	
45	0.0	0.0	0.0	
46	0.0	0.0	0.0	
47	0.0	0.0	0.0	
48	0.0	0.0	0.0	
49	0.0	0.0	0.0	
50	0.0	0.0	0.0	
	0.1	32.8	1870.1	1902.9
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Raw Data

Bank #	Erosive Bank Ht (m)	Erosive Bank Length (m)	Stable Bank Length (m)	
1			80	
2			22	
3	0.1	1		
4			32	
5			58	
6			50	
7			100	
8			70	
9			52	
10			20	
11	1.1	8		
12			10	
13	0.1	1		
14			46	
15			30	
16				
17				
18				
19				
20				
21				
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45				
46				
47				
48				
49				
50				
	0.433333333	10	570	580
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Table C-27. Warbonnet Creek Reach 2 (ID17040207SK005_02b) streambank erosion inventory worksheet.

STREAMBANK EROSION INVENTORY WORKSHEET

		Stream Segment Location (DD)			Elevation (ft)
Stream:	Warbonnet Creek SK005_02b		Latitude	Longitude	
Reach:	2	*Beginning:*	43.00097	111.91049	
Date Collected:	9/30/2011	*Ending:*	42.99936	111.91563	
Field Crew:	JS, DG, GM	**Landuse and Notes:**		State land, Grazing	
Data Reduced By:	DG	**Soil Type:**		Silt	

Streambank Erosion Calculations

Average Erosive Bank Height	1.38779528	ft
Total Inventoried Bank Length	1998.0315	ft
Inventoried Bank to Bank Length	3996.063	ft
Erosive Bank Length	1981.6273	ft
Bank to Bank Eroding Segment Length	3963.2546	ft
Percent Eroding Bank	99%	%
Eroding Area	5500.18602	ft^2
Recession Rate	0.27	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	66.8272601	tons/year/sample reach
Erosion Rate (Er)	176.597783	tons/mile/year
Feet of similar stream type	13366	ft
Eroding Bank Extrapolation	30475.7801	ft
Total Streambank Erosion (existing load)	513.873845	tons/year

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	1109.143	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	13.47609	tons/yr/sample
Allowed Erosion Rate	35.61194	tons/mile/year
Eroding Bank Extrapolation (with reduction)	6095.156	ft
Total Streambank Erosion	103.6256	tons/year

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	3
Bank Stability Condition (0-3)	2.5
Bank Cover/Vegetation (0-3)	3
Lateral Channel Stablity (0-3)	0
Channel Bottom Stability (0-3)	1.5
In-Channel Deposition (0-1)	0
Total = Slight (0-4); Moderate (5-8); Severe (9+)	10
Recession Rate	**0.27**

Summary for Load Reductions

Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
176.5977831	513.873845	35.61193706	103.625554	79.83443709

Converted Data

Bank #	Erosive Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1	0.5	328.1	0.0	
2	3.9	150.9	0.0	
3	10.2	85.3	0.0	
4	3.0	131.2	0.0	
5	0.3	72.2	0.0	
6	0.0	0.0	3.3	
7	3.6	32.8	0.0	
8	4.9	164.0	0.0	
9	24.6	39.4	0.0	
10	3.9	124.7	0.0	
11	0.0	0.0	13.1	
12	3.6	229.7	0.0	
13	2.6	72.2	0.0	
14	2.0	131.2	0.0	
15	2.3	223.1	0.0	
16	3.9	196.9	0.0	
17	0.0	0.0	0.0	
18	0.0	0.0	0.0	
19	0.0	0.0	0.0	
20	0.0	0.0	0.0	
21	0.0	0.0	0.0	
22	0.0	0.0	0.0	
23	0.0	0.0	0.0	
24	0.0	0.0	0.0	
25	0.0	0.0	0.0	
26	0.0	0.0	0.0	
27	0.0	0.0	0.0	
28	0.0	0.0	0.0	
29	0.0	0.0	0.0	
30	0.0	0.0	0.0	
31	0.0	0.0	0.0	
32	0.0	0.0	0.0	
33	0.0	0.0	0.0	
34	0.0	0.0	0.0	
35	0.0	0.0	0.0	
36	0.0	0.0	0.0	
37	0.0	0.0	0.0	
38	0.0	0.0	0.0	
39	0.0	0.0	0.0	
40	0.0	0.0	0.0	
41	0.0	0.0	0.0	
42	0.0	0.0	0.0	
43	0.0	0.0	0.0	
44	0.0	0.0	0.0	
45	0.0	0.0	0.0	
46	0.0	0.0	0.0	
47	0.0	0.0	0.0	
48	0.0	0.0	0.0	
49	0.0	0.0	0.0	
50	0.0	0.0	0.0	
	1.4	1981.6	16.4	1998.0
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Raw Data

Bank #	Erosive Bank Ht (m)	Erosive Bank Length (m)	Stable Bank Length (m)	
1	0.15	100		
2	1.2	46		
3	3.1	26		
4	0.9	40		
5	0.1	22		
6			1	
7	1.1	10		
8	1.5	50		
9	7.5	12		
10	1.2	38		
11			4	
12	1.1	70		
13	0.8	22		
14	0.6	40		
15	0.7	68		
16	1.2	60		
17				
18				
19				
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46				
47				
48				
49				
50				
	1.510714286	604	5	609
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Table C-28. Wood Creek (ID17040207SK005_02c) streambank erosion inventory worksheet.

STREAMBANK EROSION INVENTORY WORKSHEET

			Stream Segment Location (DD)		Elevation (ft)
Stream:	Wood Creek SK005_02c			Latitude	Longitude
Reach:		1	*Beginning:*	42.98486	111.89079
Date Collected:		10/14/2011	*Ending:*	42.98215	111.89334
Field Crew:	DG, GM		**Landuse and Notes:**	Grazing	
Data Reduced By:	DG, GM		**Soil Type:**	Silt	

Streambank Erosion Calculations

Average Erosive Bank Height	0.19247594	ft
Total Inventoried Bank Length	1771.65355	ft
Inventoried Bank to Bank Length	3543.30709	ft
Erosive Bank Length	613.517061	ft
Bank to Bank Eroding Segment Length	1227.03412	ft
Percent Eroding Bank	35%	%
Eroding Area	236.174547	ft^2
Recession Rate	0.035	
Bulk Density	90	lb/ft^3
Bank Erosion over Sampled Reach (E)	0.37197491	tons/year/sample reach
Erosion Rate (Er)	1.10858443	tons/mile/year
Feet of similar stream type	15124	ft
Eroding Bank Extrapolation	11701.8045	ft
Total Streambank Erosion (existing load)	3.54739743	tons/year

Streambank Erosion Reduction Calculations

Desired future conditions for sample segment(Eroding area with load redu	136.4003	ft^2
Allowed Erosion over sampled reach (with load reduction (20%)	0.21483	tons/yr/sample
Allowed Erosion Rate	0.640252	tons/mile/year
Eroding Bank Extrapolation (with reduction)	2340.361	ft
Total Streambank Erosion	2.048764	tons/year

Recession Rate Calculation Worksheet

Slope Factor	Rating
Bank Erosion Evidence (0-3)	0.5
Bank Stability Condition (0-3)	0.5
Bank Cover/Vegetation (0-3)	0.5
Lateral Channel Stablity (0-3)	0
Channel Bottom Stability (0-3)	1
In-Channel Deposition (0-1)	0
Total = Slight (0-4); Moderate (5-8); Severe (9+)	2.5
Recession Rate	**0.035**

Summary for Load Reductions

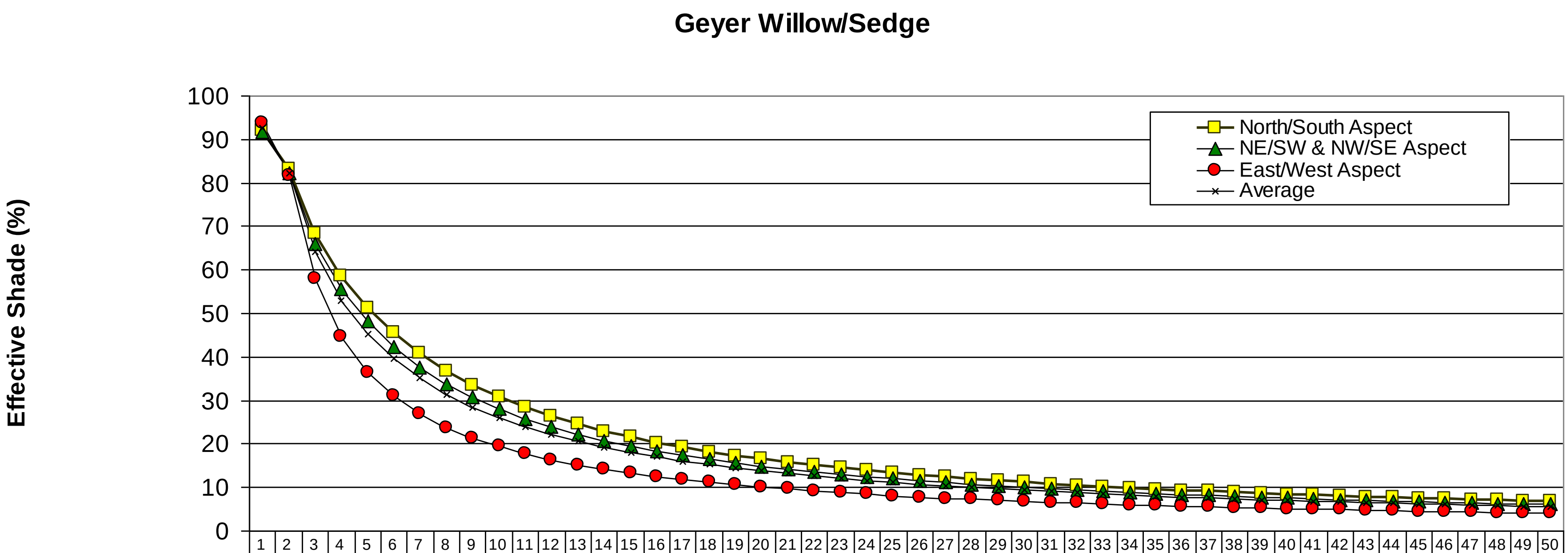
Existing		Proposed		
Erosion Rate (t/mi/yr)	Existing Load/Total Erosion (t/y)	Erosion Rate (ton/mi/yr)	Total Erosion (t/yr)	% reduction
1.108584429	3.54739743	0.640251969	2.04876429	42.2459893

Converted Data

Bank #	Erosive Bank Ht (ft)	Erosive Bank Length (ft)	Stable Bank Length (ft)	
1	0.0	0.0	6.6	
2	0.7	32.8	0.0	
3	0.0	0.0	6.6	
4	1.0	65.6	0.0	
5	0.0	0.0	6.6	
6	0.7	45.9	0.0	
7	0.0	0.0	6.6	
8	0.7	65.6	0.0	
9	0.0	0.0	29.5	
10	0.7	39.4	0.0	
11	0.0	0.0	13.1	
12	1.3	16.4	0.0	
13	0.0	0.0	32.8	
14	1.3	13.1	0.0	
15	0.0	0.0	6.6	
16	0.7	32.8	0.0	
17	0.0	0.0	6.6	
18	0.7	78.7	0.0	
19	0.0	0.0	13.1	
20	1.0	6.6	0.0	
21	0.0	0.0	6.6	
22	1.0	6.6	0.0	
23	0.0	0.0	39.4	
24	1.0	9.8	0.0	
25	0.0	0.0	45.9	
26	1.0	6.6	0.0	
27	0.0	0.0	32.8	
28	1.0	6.6	0.0	
29	0.0	0.0	19.7	
30	0.3	6.6	0.0	
31	0.0	0.0	26.2	
32	0.7	13.1	0.0	
33	0.0	0.0	52.5	
34	1.0	6.6	0.0	
35	0.0	0.0	13.1	
36	1.0	13.1	0.0	
37	0.0	0.0	13.1	
38	0.3	6.6	0.0	
39	0.0	0.0	45.9	
40	0.7	6.6	0.0	
41	0.0	0.0	13.1	
42	1.3	6.6	0.0	
43	0.0	0.0	124.7	
44	1.3	19.7	0.0	
45	0.0	0.0	82.0	
46	2.3	16.4	0.0	
47	0.0	0.0	55.8	
48	3.3	13.1	0.0	
49	0.0	0.0	187.0	
50	0.7	6.6	0.0	
51	0.0	0.0	6.6	
52	0.3	6.6	0.0	
53	0.0	0.0	16.4	
54	1.0	16.4	0.0	
55	0.0	0.0	39.4	
56	0.7	6.6	0.0	
57	0.0	0.0	26.2	
58	1.0	16.4	0.0	
59	0.0	0.0	72.2	
60	0.3	9.8	0.0	
61	0.0	0.0	29.5	
62	0.3	16.4	0.0	
63	0.0	0.0	82.0	
150	0.0	0.0	0.0	
	0.2	613.5	1158.1	1771.7
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**

Raw Data

Bank #	Erosive Bank Ht (m)	Erosive Bank Length (m)	Stable Bank Length (m)	
1			2	
2	0.2	10		
3			2	
4	0.3	20		
5			2	
6	0.2	14		
7			2	
8	0.2	20		
9			9	
10	0.2	12		
11			4	
12	0.4	5		
13			10	
14	0.4	4		
15			2	
16	0.2	10		
17			2	
18	0.2	24		
19			4	
20	0.3	2		
21			2	
22	0.3	2		
23			12	
24	0.3	3		
25			14	
26	0.3	2		
27			10	
28	0.3	2		
29			6	
30	0.1	2		
31			8	
32	0.2	4		
33			16	
34	0.3	2		
35			4	
36	0.3	4		
37			4	
38	0.1	2		
39			14	
40	0.2	2		
41			4	
42	0.4	2		
43			38	
44	0.4	6		
45			25	
46	0.7	5		
47			17	
48	1	4		
49			57	
50	0.2	2		
51			2	
52	0.1	2		
53			5	
54	0.3	5		
55			12	
56	0.2	2		
57			8	
58	0.3	5		
59			22	
60	0.1	3		
61			9	
62	0.1	5		
63			25	
150				
	0.283870968	187	353	540
	Ave Bank Ht	**Total Erosive**	**Total Stable**	**Total Bank Length**



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
North/South Aspect	92	83	68	59	51	45	41	37	33	31	28	26	24	23	21	20	19	18	17	16	16	15	14	14	13
NE/SW & NW/SE Aspect	92	82	66	56	48	42	38	34	31	28	26	24	22	21	19	18	17	16	16	15	14	14	13	12	12
East/West Aspect	94	82	58	45	37	31	27	24	21	19	18	16	15	14	13	12	12	11	11	10	10	9	9	8	8
Average	93	82	64	53	45	40	35	31	29	26	24	22	21	19	18	17	16	15	14	14	13	13	12	12	11

	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
North/South Aspect	13	12	12	11	11	11	10	10	10	10	9	9	9	9	8	8	8	8	8	7	7	7	7	7	7
NE/SW & NW/SE Aspect	12	11	11	10	10	10	9	9	9	9	8	8	8	8	8	7	7	7	7	7	7	6	6	6	6
East/West Aspect	8	8	7	7	7	7	6	6	6	6	6	6	5	5	5	5	5	5	5	5	4	4	4	4	4
Average	11	10	10	10	9	9	9	8	8	8	8	8	7	7	7	7	7	7	6	6	6	6	6	6	6

"Vegetation" Channel Width (meters)

Figure C-1. Shade curve for the Geyer willow/sedge community vegetation type.

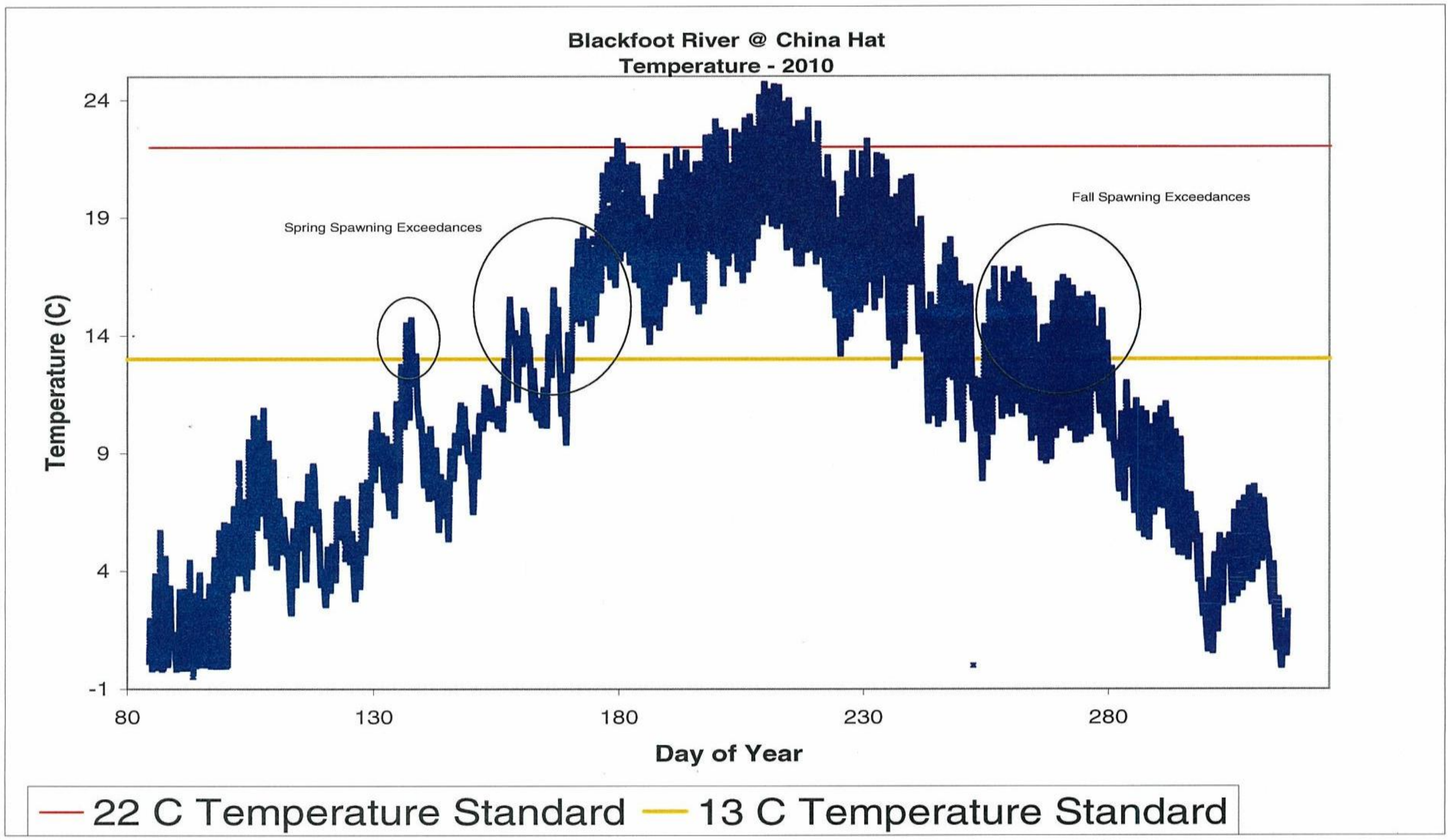


Figure C-2. Temperature data for the Blackfoot River at China Hat Bridge in 2010.

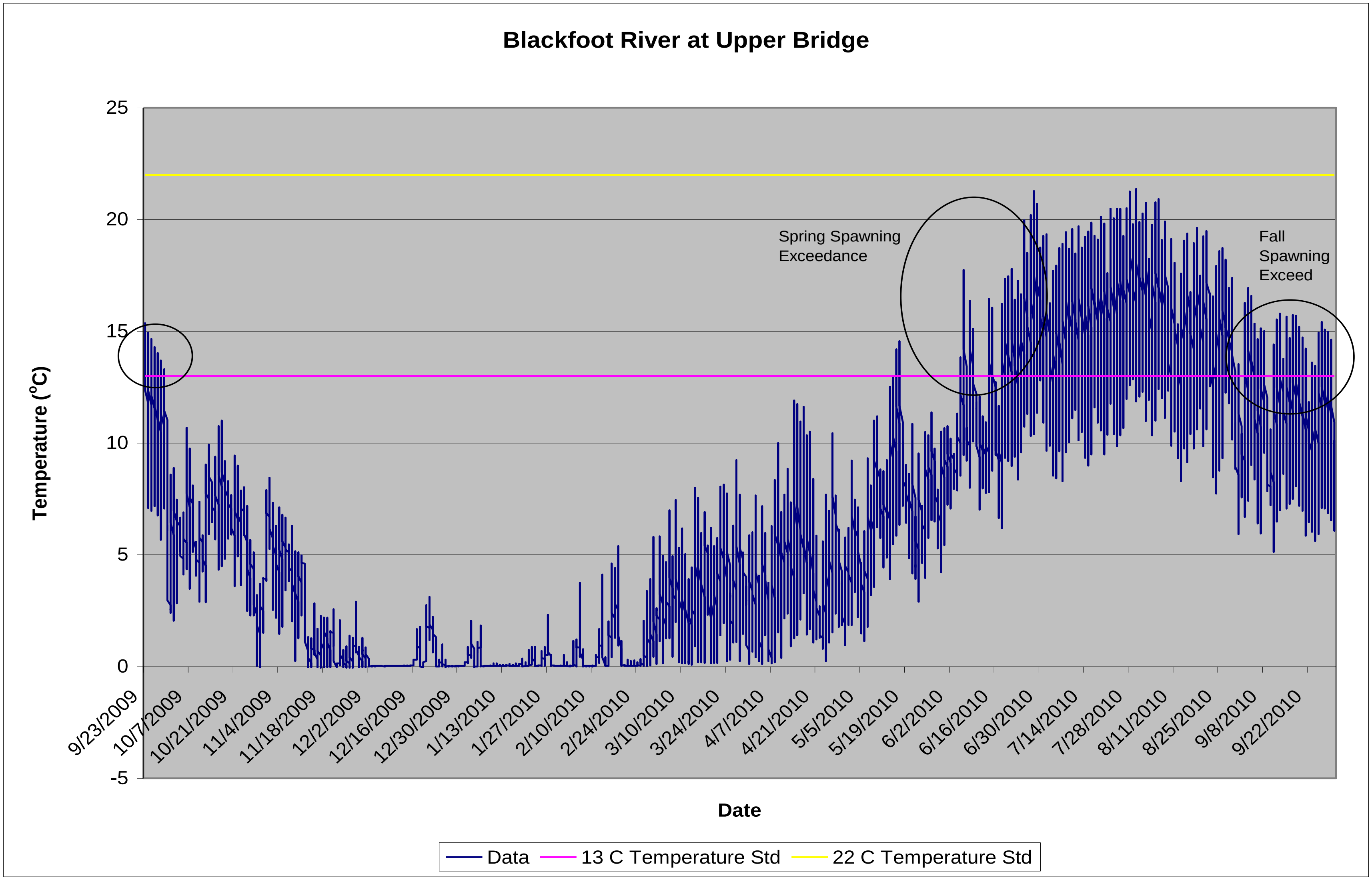


Figure C-3. Temperature data for the Blackfoot River at Upper Bridge in 2009–2010.

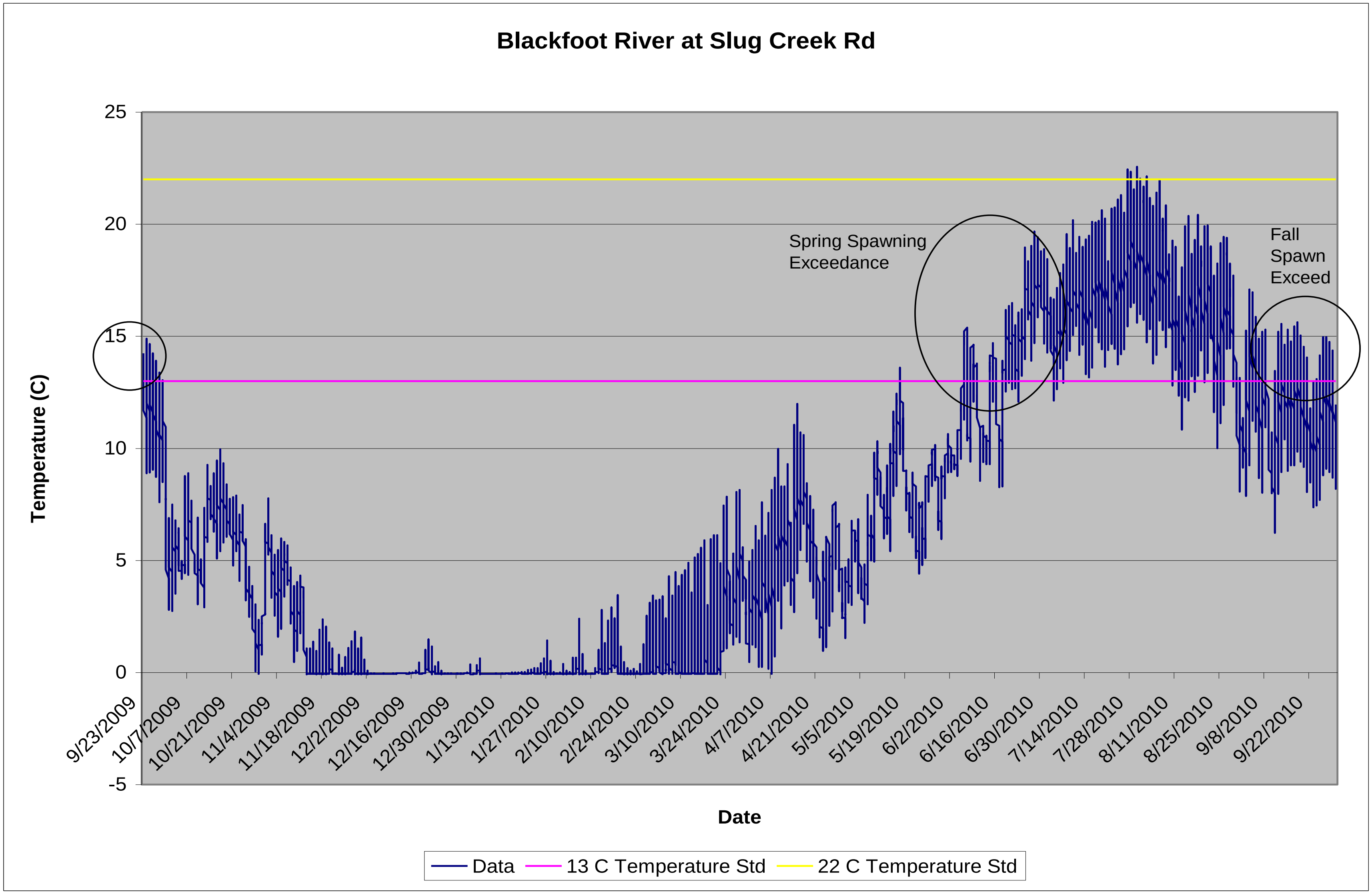


Figure C-4. Temperature data for the Blackfoot River at Slug Creek Road in 2009–2010.

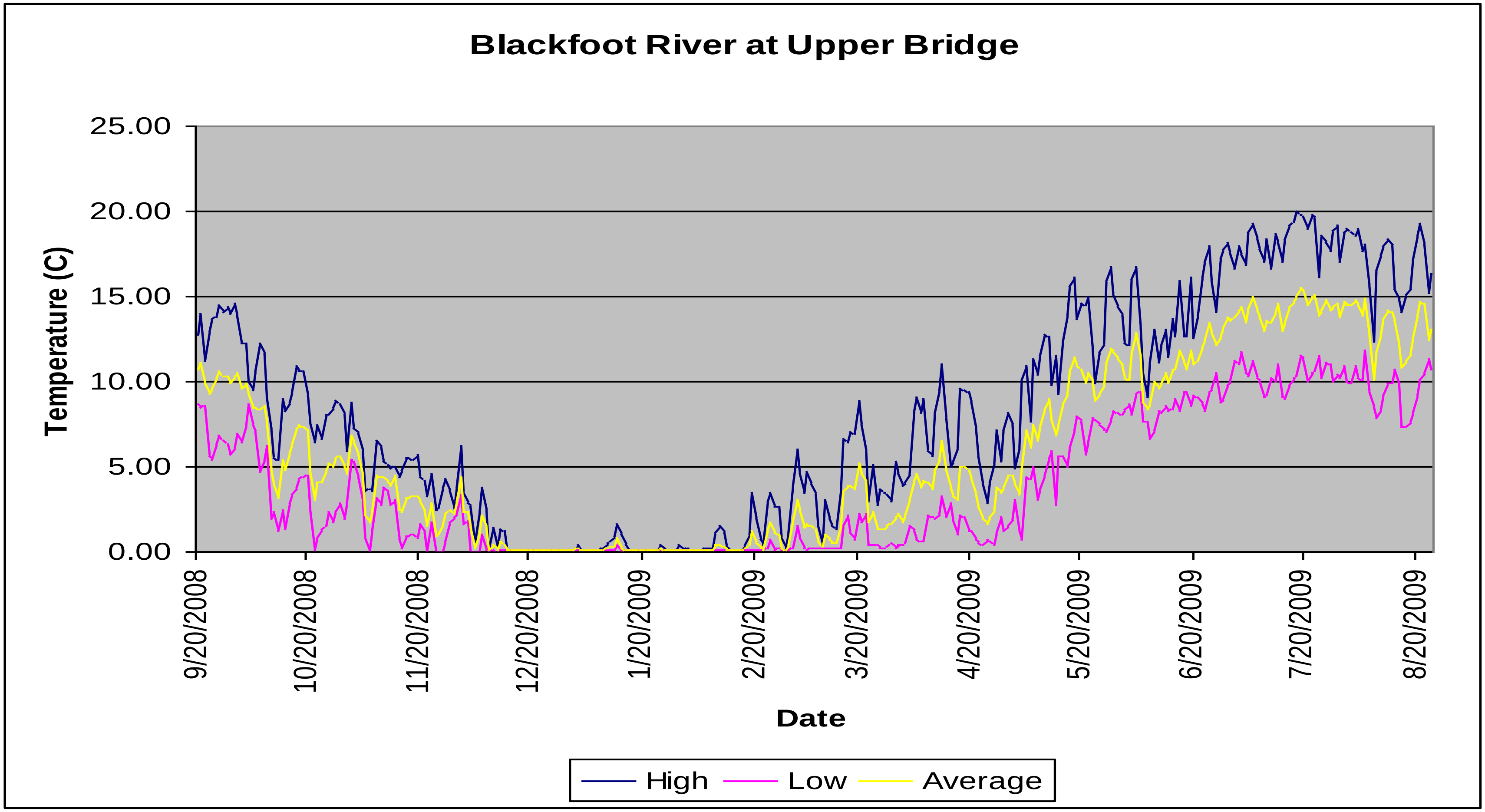


Figure C-5. Temperature data for the Blackfoot River at Upper Bridge in 2008–2009.

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Appendix D—Distribution List

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Appendix E—Public Comments and Public Participation

To be completed after public comment period.