ADDENDUM TO BLACKFOOT RIVER TMDL: WATERBODY ASSESSMENT AND TOTAL MAXIMUM DAILY LOAD

Margin of Safety and Seasonal Variation Associated with Sediment Targets

In general, targets for sediment do not lend themselves to seasonal variation. Sediment input into a stream is natural and streams can process sediment up to their assimilative capacity. Once above the loading capacity of a stream, sediment can affect aquatic communities when, for example, high levels of water column sediment can abrade fish gills or discourage feeding by salmonids. As sediment settles, filling interstitial spaces in the streambed, changes can occur in the aquatic macroinvertebrate community and habitat is degraded for salmonid spawning.

Most sediment input tends to be seasonal in association with high flows as one might see during spring runoff or episodic storm events. However, all potential detrimental effects on the aquatic community are not seasonal. In other words, the concern is not when input occurs but when that input impairs beneficial uses. For example, a summer thunderstorm in an upper watershed, which results in an influx of sediment, would affect those fish unable to find refuge outside the main stream channel. As the slug of sediment works its way downstream to a larger river, especially one which did not experience the episodic event, sediment may settle out on the streambed surface thus having the potential to impair cold water aquatic life and salmonid spawning at a later date. Thus, if at any time during the year sediment input has potential to impair beneficial uses at a later time - days, weeks, or possibly years - then it is understandable why sediment does not lend itself to seasonal variation.

One situation where it makes sense to account for seasonal variation is with water column sediment. We would naturally expect higher concentrations of sediment during spring runoff. Thus, targets for suspended sediment might include a higher concentration during the high flow period as compared to the low flow period.

Turbidity targets

Recommended turbidity targets for Dry Valley Creek include a margin of safety. The suspended sediment equivalents to the target turbidities are within or below the range of 25 to 80 mg/l of suspended solids required to maintain good to moderate fisheries (EIFAC 1964).

We did account for seasonal variation for turbidity targets at the upper site in Dry Valley Creek with a higher concentration recommended for high flows in the spring and a lower concentration for low flows at all other times. These recommendations are averages over a two-week or 28-day period to account for extreme fluctuations. Recommended targets in lower Dry Valley Creek are essentially no net increase values and therefore no seasonal variation was applied.

Streambank stability

The margin of safety (MOS) for the 80% streambank stability target is implicit as described by Tom Herron in the Little Lost River Subbasin TMDL (DEQ 2000), for which the sediment section was approved by EPA in 2000.

> "The MOS is the conservative assumptions used to develop existing sediment loads. Conservative assumptions made as part of the sediment loading analysis include . . . (d)esired bank erosion rates are representative of background conditions of 80% streambank stability . . ."

No seasonal variation is recommended for streambank stability as a surrogate to sediment input. The concept itself is of managing for stable streambanks within the understanding of stream dynamics. A seasonal variation factor thus would not work. For example, a target of 80% streambank stability could not be recommended for part of the year (e.g., spring runoff period) while 50% streambank stability is recommended for the rest of the year.

Depth fines

The recommended depth fines target for the Blackfoot River subbasin includes a 2% margin of safety. Based on work by Burton et al. (1990) in southern Idaho streams, a 27% target for depth fines would be appropriate for the Blackfoot River subbasin. Recommending a target of 25% thus allowed for a margin of safety.

There is an inherent seasonal variation associated with depth fines. Much of the work on establishing thresholds for fine sediment in subsurface of streambeds is coordinated with that time when salmonids spawn - generally from after spring runoff to fall, depending on species. Monitoring for depth fines is normally done during the summer field season, a time of lower flows in the Blackfoot River subbasin, which adequately characterizes conditions likely to be experienced by spawning salmonids, incubating eggs, and emerging fry. Summer sampling also includes the period of greatest insect production in this area. Thus, the time period for typical sampling for depth fines corresponds to the season that sediment is most likely to affect beneficial uses of salmonid spawning and cold water aquatic life.

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BLACKFOOT RIVER TMDL

WATERBODY ASSESSMENT AND TOTAL MAXIMUM DAILY LOAD

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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 waterbodies required by this section

µ micro, one-one thousandth

§ Section (usually a section of federal or state rules or statutes)

ab above

ac acre

ACP Agricultural Conservation Program

ADB assessment database

ag agriculture

aka also known as

Assoc. association

avg average

AWS agricultural water supply

BAG Basin Advisory Group

BEI Bechtel Environmental, Inc.

bel below

BLM United States Bureau of Land Management

BMP best management practice

BOD biochemical oxygen demand

BOR United States Bureau of Reclamation

BRWC Blackfoot River Watershed Council

Btu British thermal unit

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

Chl *a* chlorophyll a

cm centimeters

Cr creek

CRP Conservation Reserve Program

CWB cold water biota

CWA Clean Water Act

CWE cumulative watershed effects

DEQ Idaho Department of Environmental Quality

DO dissolved oxygen

DOI U.S. Department of the Interior

DWS domestic water supply

EMAP	Environmental Monitoring and Assessment Program
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
F	Fahrenheit
FPA	Idaho Forest Practices Act
FS	Forest Service
FSA	Food Security Act
ft	feet
FTU	formazin turbidity unit
FWS	U.S. Fish and Wildlife Service
GIS	Geographical Information Systems
hdwtrs	headwaters
hr	hour
HUC	Hydrologic Unit Code
I.C.	Idaho Code
IDAPA	Refers to citations of Idaho administrative rules
IDFG	Idaho Department of Fish and Game
IDL	Idaho Department of Lands
IDWR	Idaho Department of Water Resources
inc	including
INFISH	The federal Inland Native Fish Strategy
IRIS	Integrated Risk Information System
ISCC	Idaho Soil Conservation Commission
JTU	Jackson turbidity unit
km	kilometer
km^2	square kilometer
l	liter
LA	load allocation
LC	load capacity
ln	natural logarithm
m	meter
m^2	square meter
m^3	cubic meter
max	maximum
MBI	macroinvertebrate index
mg	milligram
mg/l	milligrams per liter
MGD	million gallons per day
mi	mile
mi^2	square miles
min	minimum
ml	milliliter

mm millimeter

MOS margin of safety

msl mean sea level

MWMT maximum weekly maximum temperature

n.a. not applicable

NA not assessed

NB natural background

ND no discharge; non detect

nda no date available

NFS not fully supporting

NPDES National Pollutant Discharge Elimination System

nr near

NRCS Natural Resources Conservation Service

NTU nephelometric turbidity unit

NWS National Weather Service

ORV off-road vehicle

ORW Outstanding Resource Water

PACFISH The federal Pacific Anadromous Fish Strategy

PCB polychlorinated biphenyl

PCR primary contact recreation

PFC proper functioning condition

ppm part(s) per million

QA quality assurance

QC quality control

R river

R^2 correlation index

R sq R squared, R^2

RBP rapid bioassessment protocol

RCRDP Resource Conservation and Rangeland Development Program

Rd road

RDI DEQ's river diatom index

Res reservoir

RFI DEQ's river fish index

RHCA riparian habitat conservation area

RMI DEQ's river macroinvertebrate index

RPI DEQ's river physiochemical index

SAWQP State Agricultural Water Quality Program

SBA subbasin assessment

SCD Soil Conservation District

SCR secondary contact recreation

SCS Soil Conservation Service

SD standard deviation, Secchi disk

SE standard error

SFI DEQ's stream fish index

SHI DEQ's stream habitat index

SMI DEQ's stream macroinvertebrate index

spp. species

SRP soluble reactive phosphorus

SS salmonid spawning

SSC suspended sediment concentration

SSOC stream segment of concern

STATSGO State Soil Geographic Database

STP sewage treatment plant

TDG total dissolved gas

TDS total dissolved solids

T&E threatened and/or endangered species

TIN total inorganic nitrogen

TKN total Kjeldahl nitrogen

TMDL total maximum daily load

TP total phosphorus

TS total solids

TSI trophic state index

TSS total suspended solids

t/y tons per year

µg/l micrograms/liter

um microns (micrometers)

U.S. United States

USC United States Code

USDA United States Department of Agriculture

USDI United States Department of the Interior

USFS United States Forest Service

USGS United States Geological Survey

WAG Watershed Advisory Group

WBAG *Water Body Assessment Guidance*

WBID waterbody identification number

WET whole effluence toxicity

WHIP Wildlife Habitat Incentive Program

WLA waste load allocation

WQLS water quality limited segment

WQMP water quality management plan

WQRP water quality restoration plan

WQS water quality standard

yr year

METRIC - ENGLISH UNIT CONVERSIONS

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

[1] 1 ft^3/sec = 0.65 million gallons per day; 1 million gallons per day is equal to 1.55 ft^3/sec.
[2] the ratio of 1 ppm = 1 mg/l is approximate and is only accurate for water

TMDL at a Glance

Subbasin:	*Blackfoot*
Key Resources:	*Cold Water Aquatic Life, Salmonid Spawning, Primary/Secondary Contact Recreation, Agricultural Water Supply*
Uses Affected:	*Cold Water Aquatic Life, Salmonid Spawning*
Pollutants:	*Sediment, Nutrients*
Sources Considered:	*PS - none* *NPS - agriculture, grazing, mining, recreation, roads*

1 Executive Summary

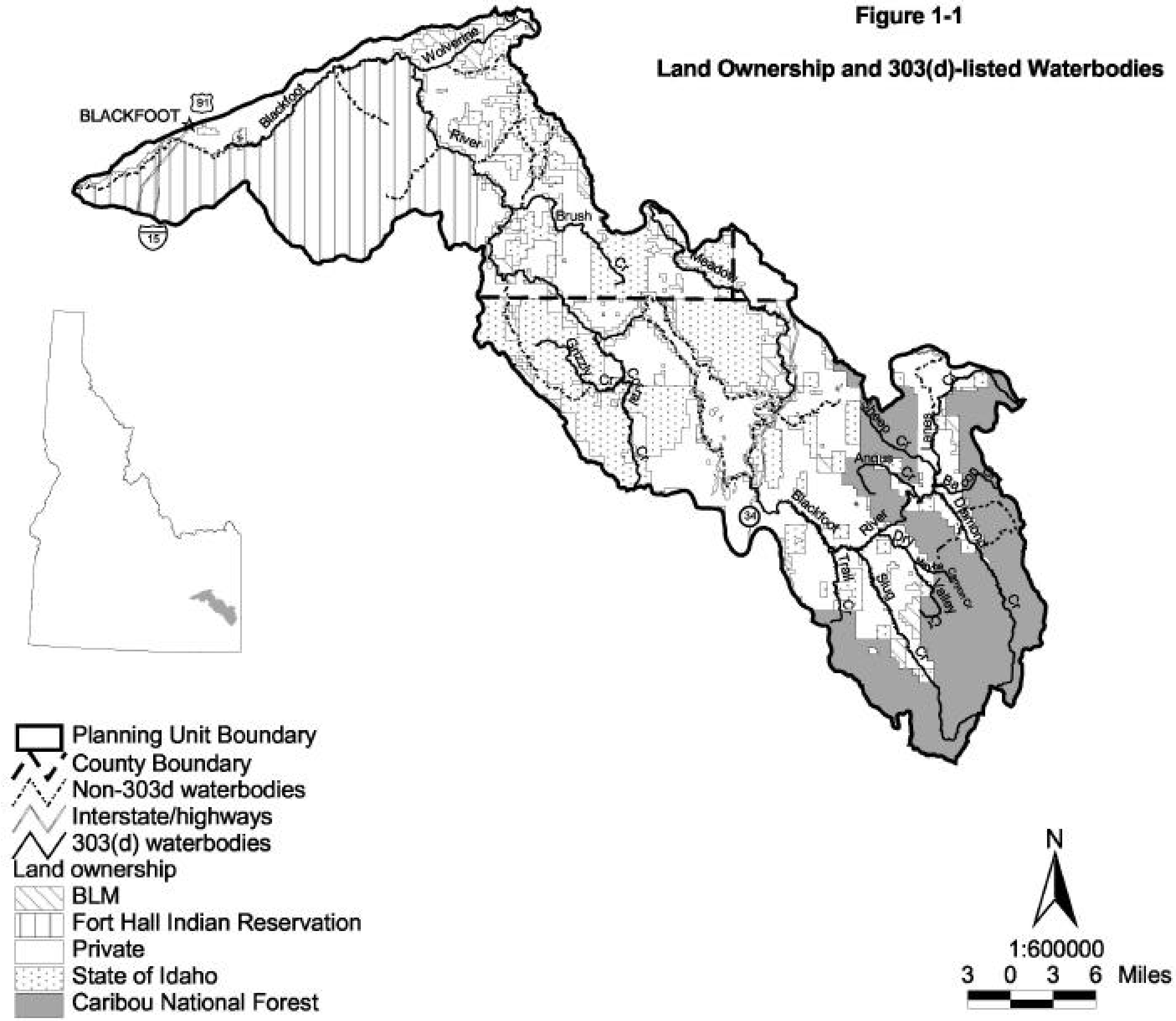
The federal Clean Water Act (CWA) requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters (33 USC § 1251.101). States and tribes, pursuant to section 303 of the CWA, are to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the waters whenever possible. Section 303(d) of the CWA establishes requirements for states and tribes to identify and prioritize waterbodies that are water quality limited (i.e., waterbodies that do not meet water quality standards). States and tribes must periodically publish a priority list of impaired waters, currently every two years. For waters identified on this list, states and tribes must develop a total maximum daily load (TMDL) for the pollutants, set at a level to achieve water quality standards. This document addresses the waterbodies in the Blackfoot River subbasin that have been placed on what is known as the "303(d) list."

This subbasin assessment and TMDL analysis has been developed by the Department of Environmental Quality (DEQ) to comply with Idaho's TMDL schedule. This assessment describes the physical, biological, and cultural setting; water quality status; pollutant sources; and recent pollution control actions in the Blackfoot River subbasin located in southeast Idaho. The first part of this document, the subbasin assessment, is an important first step in leading to the TMDL. The starting point for this assessment was Idaho's current 303(d) list of water quality limited waterbodies. Seventeen segments of the Blackfoot River subbasin are on this list. The subbasin assessment portion of this document examines the current status of 303(d)-listed waters, and defines the extent of impairment and causes of water quality limitation throughout the subbasin. The loading analysis quantifies pollutant sources and allocates responsibility for load reductions needed to return listed waters to a condition of meeting water quality standards.

The Blackfoot River subbasin has an area of just over 1,000 square miles in southeast Idaho (Figure 1-1). Chief activities within the subbasin are agriculture, both dryland and

Figure 1-1

Land Ownership and 303(d)-listed Waterbodies



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 waterbodies 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.

There are 17 listed water quality listed segments on the 1998 303(d) list (Table 1-1). Three of those segments include the mainstem Blackfoot River: Main Canal (equalizing dam) upstream to Wolverine Creek; Wolverine Creek to Blackfoot Dam; and Blackfoot Reservoir to headwaters. The Blackfoot River downstream of the equalizing dam is not on the 303(d) list.

The current list of water quality limited waterbodies includes streams from previous lists and those added to the 1998 list. All streams listed prior to 1998 had sediment listed as a pollutant of concern. These streams include Wolverine, Corral, Meadow, Trail, Slug, Angus, Dry Valley, Lanes, Bacon, Sheep, and Diamond creeks plus the three Blackfoot River segments (Table 1-1). Nutrients were listed as a problem in Wolverine Creek and the two Blackfoot River reaches below the dam. Also on the list were flow alteration in Blackfoot River from Wolverine Creek to Blackfoot Dam and organics in Blackfoot River above the reservoir. For the three streams added in 1998 - Brush, Grizzly, Maybe Canyon - pollutants of concern were listed as unknown. Beneficial uses affected by these pollutants are cold water aquatic life and salmonid spawning.

Sources of pollutant input above natural levels have been identified from various reports. Sediment input has been caused by agricultural and livestock practices; changes in the natural hydrograph; roads; mining activities; and mass wasting (e.g., landslides). Agriculture, grazing, and recreation (human wastes linked to camping areas) have been associated with nutrient input into Blackfoot River subbasin streams.

The amount and time frame of data varied by waterbody. Load allocations (quantity of pollutants a stream can assimilate without impairing beneficial uses) were thus based on available data. A quick overview of load allocations for each listed waterbody is as follows:

Blackfoot River - Main Canal to Wolverine Creek - This water quality limited segment is listed for sediment and nutrients. Beneficial uses affected are cold water aquatic life and salmonid spawning. Likely pollutant sources include agriculture and livestock grazing, recreation, mass wasting, and changes in the natural hydrograph from additional out-of-basin water and dam releases. As little data were available to estimate a

Table 1-1. Targets used to establish pollutant load allocations for 303(d)-listed streams in the Blackfoot River subbasin.

303(d)-listed waterbody	Reach[1]	Listed pollutants[2]	Turbidity (NTU)[3]				Depth fines[4]		Streambank stability[5]	Nutrients (mg/l)	
			High flow	Low flow	14-day avg	Daily max	< 6.25 mm	< 0.85 mm		Total inorganic nitrogen	Total phosphorus
Blackfoot River	Main canal to Wolverine Cr	Sed, Nut					25%	10%	80%	0.3	0.1
	Wolverine Cr to Blackfoot Dam	Sed, Nut, FA					25%	10%	80%	0.3	0.1
	Blackfoot Res to headwaters	Sed, Org					25%	10%	80%		
Wolverine Creek	Blackfoot R to headwaters	Sed, Nut					25%	10%	80%	0.3	0.1
Brush Creek	Blackfoot R to headwaters	Unk					25%		80%		
Corral Creek	Blackfoot R to headwaters	Sed					25%		80%		
Grizzly Creek	Corral Cr to headwaters	Unk					25%		80%		
Meadow Creek	Blackfoot Res to headwaters	Sed					25%	10%	80%		
Trail Creek	Blackfoot R to headwaters	Sed					25%	10%	80%		
Slug Creek	Blackfoot R to headwaters	Sed					25%		80%		
Dry Valley Creek	above mining activity	Sed	19.31	12.09			25%	10%	80%		
	below mining activity	Sed			4.6	20.15	25%	10%	80%		
Maybe Canyon Creek	Dry Valley Cr to waste dump	Unk					25%		80%		
Angus Creek	Blackfoot R to headwaters	Sed					25%	10%	80%		
Lanes Creek	Blackfoot R to headwaters	Sed					25%	10%	80%		
Bacon Creek	Lanes Cr to FS boundary	Sed					25%	10%	80%		
Sheep Creek	Lanes Cr to headwaters	Sed					25%	10%	80%		
Diamond Creek	Blackfoot R to headwaters	Sed					25%	10%	80%		

[1]Cr=creek, FS=Forest Service, R=River, Res=Reservoir

[2]FA=flow alteration, Nut=nutrients, Org=organics, Sed=sediment, Unk=unknown

[3]maximum water column turbidity: high flow 14-day average from April to May; low flow 28-day average from June to March. Avg=average, max=maximum

[4]maximum volumes of subsurface sediment based on a 5-year average of percent fines: < 6.25 mm in riffles; < 0.85 mm in riffles in streams with salmonid spawning as a benefical use

[5]for some streams the 80% stable streambank target was used as a surrogate load allocation for active eroding streambank

traditional mass per unit time sediment load allocation, a surrogate load allocation of 80% streambank stability was used (Table 1-1). Depth fines targets were recommended for support of both cold water aquatic life and salmonid spawning. Data were sparse for estimating nutrient loads although nutrient information has been collected at the U. S. Geological Survey (USGS) surface-water station near Blackfoot (13068500). This gage site is downstream of the main canal but nutrients from the water quality limited segment contribute to nutrient loads as measured at the gage. Data for both total inorganic nitrogen (TIN) and total phosphorus (TP) do not indicate excessive input of nutrients based on targets of 0.3 mg/l of TIN and 0.1 mg/l of TP and therefore no reductions are recommended at this time. Because of concerns about no net increase in loadings, allocations are set at current estimated levels of 32.6 tons per year (tons/yr) of TIN and 9.1 tons/yr of TP (Table 1-2).

Blackfoot River - Wolverine Creek to Blackfoot Dam - This water quality limited segment is listed for flow alteration, sediment, and nutrients. Beneficial uses affected are cold water aquatic life and salmonid spawning. Likely pollutant sources include agriculture and livestock grazing, recreation, tributary mass wasting, and changes in the natural hydrograph from dam releases. DEQ does not consider flow alteration a pollutant, thus the TMDL does not address flow alteration. As little data were available to estimate a traditional mass per unit time sediment load allocation, a surrogate load allocation of 80% streambank stability was used (Table 1-1). Depth fines targets were recommended for support of both cold water aquatic life and salmonid spawning. Some data collected by DEQ in the mid-1980s were available to estimate nutrient loads at the USGS surface-water station near Shelley (13066000), just downstream of Wolverine Creek. Data for total inorganic nitrogen do not indicate excess input of TIN based on a target of 0.3 mg/l. Therefore, a no net increase in loading of 87.9 tons of TIN per year is proposed (Table 1-2). Based on a target of 0.1 mg/l of total phosphorus, a load allocation at the Shelley gage site of 36.8 tons/yr of TP is recommended. This allocation requires a load reduction of 19.9 tons/yr of TP.

Blackfoot River - Blackfoot Reservoir to Headwaters - This water quality limited segment is listed for organics and sediment. Beneficial uses affected are cold water aquatic life and salmonid spawning. Likely pollutant sources include livestock grazing, recreation, and mining activities. No data were reviewed that pointed to organics as a problem in this segment of the river; therefore, organics were not addressed in the TMDL. As little data were available to estimate a traditional mass per unit time sediment load allocation, a surrogate load allocation of 80% streambank stability was used (Table 1-1). Depth fines targets were recommended for support of both cold water aquatic life and salmonid spawning.

Wolverine Creek - This water quality limited segment is listed for sediment and nutrients. Beneficial uses affected are cold water aquatic life and salmonid spawning. Likely pollutant sources include agriculture and livestock grazing, recreation, roads, and tributary mass wasting. As little data were available to estimate a traditional mass per unit time sediment load allocation, a surrogate load allocation of 80% streambank

Table 1-2. Water quality limited segments in the Blackfoot River subbasin on the 303(d) list including listed pollutants and mass per unit time (tons/year) pollutant load allocations and reductions.

			Suspended sediment (t/yr)[2]		Nutrients: Total inorganic nitrogen (t/yr)		Nutrients: Total phosphorus (t/yr)		
Waterbody	Reach[1]	Flow alteration	Allocation	Reduction	Allocation	Reduction	Allocation	Reduction	Organics
Blackfoot River	USGS gage nr Blackfoot (13068500)[3]				32.6	0	9.1	0	
	Main canal to Wolverine Cr					0		0	
	Wolverine Cr to Blackfoot Res Dam	None[4]			87.9	0	36.8	19.9	
	Blackfoot Res to headwaters								None[5]
Wolverine Creek	Blackfoot R to headwaters				2.9	0	1.6	6.7	
Jones Creek[6]					1.3		0.4		
Brush Creek	Blackfoot R to headwaters		1358.0	2058.7					
Corral Creek	Blackfoot R to headwaters								
Grizzly Creek	Corral Cr to headwaters								
Meadow Creek	Blackfoot Res to headwaters								
Trail Creek	Blackfoot R to headwaters								
Slug Creek	Blackfoot R to headwaters		74.2	0.0					
Dry Valley Creek[7]	Blackfoot R to headwaters		852.9	363.5					
Maybe Canyon Creek	Dry Valley Cr to waste dump								
Angus Creek	Blackfoot R to headwaters		8.5	0.0					
Lanes Creek	Blackfoot R to headwaters		445.9	392.4					
Bacon Creek	Lanes Cr to FS boundary								
Sheep Creek	Lanes Cr to headwaters								
Diamond Creek	Blackfoot R to headwaters		1304.7	755.1					

[1]Cr=creek, FS=Forest Service, R=River, Res=Reservoir

[2]data were insufficient for some streams to establish a sediment mass per unit time load allocation, so a surrogate load allocation based on a target for active eroding streambank of 80% streambank stability was used (see Table 1-1)

[3]the gage is located on the reach of the Blackfoot River below the listed water quality limited segments (i.e., below the main canal) but pollutant loads at this point would include contributions from the lower listed reach of the Blackfoot River from main canal to Wolverine Creek

[4]the state does not consider flow alteration a pollutant, therefore no TMDL was done

[5]no information was reviewed to indicate that organics were affecting beneficial uses

[6]although Jones Creek is not listed on the 303(d) list it does contribute nutrients to Wolverine Creek and so therefore nutrient loads were allocated

[7]Dry Valley Creek also has surrogate load allocations based on turbidity targets (see Table 1-1)

stability was used (Table 1-1). Depth fines targets were recommended for support of both cold water aquatic life and salmonid spawning. Information collected by DEQ in the mid-1980s was available to estimate nutrient loads in both Wolverine and Jones creeks. Data for total inorganic nitrogen do not indicate excess input of TIN based on a target of 0.3 mg/l. Therefore, a no net increase in loading of 2.9 tons of TIN per year is proposed (Table 1-2). Based on a target of 0.1 mg/l of total phosphorus, a load allocation of 1.6 tons/yr of TP is recommended, which requires a load reduction of 6.7 tons/yr of TP.

Jones Creek represents 45.5% and 25.2% of the average daily load of TIN and TP in Wolverine Creek, respectively. Applying these percentages to target loads in Wolverine Creek results in load allocations for Jones Creek of 1.3 tons/yr of total inorganic nitrogen and 0.4 tons/yr of total phosphorus (Table 1-2).

Brush Creek - This water quality limited segment is listed for unknown pollutants although sediment appears to be the principal pollutant. The primary beneficial use affected is cold water aquatic life. Likely pollutant sources include livestock grazing and recreation. From information collected as part of the Proper Functioning Condition evaluation by Idaho Soil Conservation Commission (ISCC), sediment loads were estimated with load allocations based on a target streambank stability of 80%. The sediment load allocation is 1,358.0 tons/yr, which results in a load reduction of 2,058.7 tons/yr from current estimated load (Table 1-2). A depth fines target was recommended for support of cold water aquatic life (Table 1-1).

Corral Creek - This water quality limited segment is listed for sediment. The primary beneficial use affected is cold water aquatic life with livestock grazing a likely pollutant source. As little data were available to estimate a traditional mass per unit time sediment load allocation, a surrogate load allocation of 80% streambank stability was used (Table 1-1). A depth fines target was recommended for support of cold water aquatic life.

Grizzly Creek - This water quality limited segment is listed for unknown pollutants although sediment appears to be the principal pollutant. The primary beneficial use affected is cold water aquatic life with livestock grazing a likely pollutant source. As little data were available to estimate a traditional mass per unit time sediment load allocation, a surrogate load allocation of 80% streambank stability was used (Table 1-1). A depth fines target was recommended for support of cold water aquatic life.

Meadow Creek - This water quality limited segment is listed for sediment. Beneficial uses affected are cold water aquatic life and salmonid spawning. Likely pollutant sources include livestock grazing and changes in the natural hydrograph from the addition of out-of-basin water. As little data were available to estimate a traditional mass per unit time sediment load allocation, a surrogate load allocation of 80% streambank stability was used (Table 1-1). Depth fines targets were recommended for support of both cold water aquatic life and salmonid spawning.

Trail Creek - This water quality limited segment is listed for sediment. Beneficial uses affected are cold water aquatic life and salmonid spawning with livestock grazing a likely pollutant source. As little data were available to estimate a traditional mass per unit time sediment load allocation, a surrogate load allocation of 80% streambank stability was used (Table 1-1). Depth fines targets were recommended for support of both cold water aquatic life and salmonid spawning.

Slug Creek - This water quality limited segment is listed for sediment. The primary beneficial use affected is cold water aquatic life with livestock grazing a likely pollutant source. From information collected as part of the ISCC's Proper Functioning Condition evaluation, sediment loads were estimated with load allocations based on a target streambank stability of 80%. The limited data (only the lower 1.7 miles were surveyed) do not indicate a sediment problem based on a target of 80% streambank stability. Therefore, a no net increase in loading of 74.2 tons of sediment per year is proposed (Table 1-2). A depth fines target was recommended for support of cold water aquatic life (Table 1-1).

Dry Valley Creek - This water quality limited segment is listed for sediment. Beneficial uses affected are cold water aquatic life and salmonid spawning with livestock grazing and mining likely pollutant sources. Sufficient data existed to establish both turbidity targets and sediment load allocations. Turbidity and total suspended solids data point to the area upstream of the mining activity as the major source of sediment into the stream. Thus, turbidity targets were established for two sites, above and below the mining activity. Above the mining activity, turbidity targets are not to exceed a 14-day average of 19.31 nephelometric turbidity units (NTU) at high flows and a 28-day average of 12.09 NTU at low flows (Table 1-1). Below the mining activity, recommendations were essentially no net increase targets of a 14-day average not to exceed 4.6 NTU with a daily maximum not to exceed 20.15 NTU for Dry Valley Creek and tributaries in the reach. From information collected as part of the ISCC's Proper Functioning Condition evaluation, sediment loads were estimated with load allocations based on a target streambank stability of 80%. The sediment load allocation is 852.9 tons/yr, which results in a load reduction of 363.5 tons/yr from current estimated load (Table 1-2). Depth fines targets were recommended for support of both cold water aquatic life and salmonid spawning (Table 1-1).

Maybe Canyon Creek - This water quality limited segment is listed for unknown pollutants although metals, primarily selenium, appear to be the principal pollutants. The primary beneficial use affected is cold water aquatic life with mining activities a likely pollutant source. As Maybe Canyon Creek is currently under Forest Service regulatory control and efforts are already underway to characterize the extent of hazardous substances effects on the environment with the intention of remediating the problem(s), no loading analysis is proposed. As sediment may be a problem and data were limited to estimate a traditional mass per unit time sediment load allocation, a surrogate load allocation of 80% streambank stability was used (Table 1-1). A depth fines target was recommended for support of cold water aquatic life.

Angus Creek - This water quality limited segment is listed for sediment. Beneficial uses affected are cold water aquatic life and salmonid spawning with livestock grazing and mining likely pollutant sources. From information collected as part of the ISCC's Proper Functioning Condition evaluation, sediment loads were estimated with load allocations based on a target streambank stability of 80%. The limited data (only the lower 0.4 miles were surveyed) do not indicate a sediment problem based on the 80% streambank stability target. Therefore, a no net increase in loading of 8.5 tons of sediment per year is proposed (Table 1-2). Depth fines targets were recommended for support of both cold water aquatic life and salmonid spawning (Table 1-1).

Lanes Creek - This water quality limited segment is listed for sediment. Beneficial uses affected are cold water aquatic life and salmonid spawning with livestock grazing a likely pollutant source. From information collected as part of the ISCC's Proper Functioning Condition evaluation, sediment loads were estimated with load allocations based on a target streambank stability of 80%. The sediment load allocation is 445.9 tons/yr which results in a load reduction of 392.4 tons/yr from current estimated load (Table 1-2). Depth fines targets were recommended for support of both cold water aquatic life and salmonid spawning (Table 1-1).

Bacon Creek - This water quality limited segment, from confluence with Lanes Creek to the Forest Service boundary, is listed for sediment. Beneficial uses affected are cold water aquatic life and salmonid spawning with livestock grazing a likely pollutant source. As little data were available to estimate a traditional mass per unit time sediment load allocation, a surrogate load allocation of 80% streambank stability was used (Table 1-1). Depth fines targets were recommended for support of both cold water aquatic life and salmonid spawning.

Sheep Creek - This water quality limited segment is listed for sediment. Beneficial uses affected are cold water aquatic life and salmonid spawning with livestock grazing a likely pollutant source. As little data were available to estimate a traditional mass per unit time sediment load allocation, a surrogate load allocation of 80% streambank stability was used (Table 1-1). Depth fines targets were recommended for support of both cold water aquatic life and salmonid spawning.

Diamond Creek - This water quality limited segment is listed for sediment. Beneficial uses affected are cold water aquatic life and salmonid spawning with livestock grazing a likely pollutant source. From information collected as part of the ISCC's Proper Functioning Condition evaluation, sediment loads were estimated with load allocations based on a target streambank stability of 80%. The sediment load allocation is 1304.7 tons/yr, which results in a load reduction of 755.1 tons/yr from current estimated load (Table 1-2). Depth fines targets were recommended for support of both cold water aquatic life and salmonid spawning (Table 1-1).

Data examined during preparation of the TMDL imply there are other pollutants of concern. Data were not conclusive due to time of samples, limited number of samples, or low percentage of samples exceeding state standards, to confidently list organics, dissolved oxygen, or bacteria as pollutants affecting beneficial uses in the Blackfoot River subbasin. However, data were, or will likely be, sufficient to list Blackfoot River subbasin waterbodies on the 2002 303(d) list as having metals or temperature problems. Those waterbodies for which metals are affecting beneficial uses will be determined following extensive monitoring currently underway in the upper Blackfoot River subbasin. Streams for which continuous temperature monitoring indicated exceedances of state standards are: Blackfoot River, Angus Creek, Spring Creek, and Diamond Creek.

Several aspects of the TMDL would be improved with additional data. These data would serve to better refine links between pollutants and beneficial uses, natural background levels, more appropriate targets, and better estimates of load allocations. The following is by no means an exhaustive list of all data needs in the Blackfoot River subbasin:

- natural background levels of sediment, nitrogen, and phosphorus,
- regular stream flow information throughout the year from tributaries,
  - link between streambank stabilization, and thus reduction in lateral recession rate, and reduction in depth fines,
- link between reduction in water column sediment and reduction in depth fines,
  - paired turbidity and total suspended solids/suspended sediment concentrations in Dry Valley Creek to refine the relationship between the parameters,
- streambank stabilization and Proper Functioning Condition status for all 303(d) streams,
  - depth fines data throughout listed streams through several water years realizing that riffle area sites are subject to change from hydraulic activity,
- refinement of nutrient levels necessary to support beneficial uses,
  - flow, sediment, and nutrient information from mainstem Blackfoot River below equalizing dam,
  - data to determine extent that organic loading is affecting beneficial uses in the lower Blackfoot River, and
  - hydraulic modeling of flows in Blackfoot River below Blackfoot Reservoir and possible influence on support of beneficial uses.

Several approaches were taken to involve the public in preparation of the Blackfoot River TMDL plan. In June of 2000, the first draft of the subbasin assessment was distributed to Blackfoot River Watershed Council (BRWC), which also serves as the Watershed Advisory Group, and other concerned members of the public. At the same time, the subbasin assessment was presented to the Upper Snake River Basin Advisory Group. In April of 2001 notices were placed in area newspapers announcing that the TMDL plan (subbasin assessment and loading analysis) were available for a 45-day public review. Copies of the plan were mailed to BRWC members and other interested parties. Two presentations of the TMDL plan were made to the BRWC in April and May 2001, in Blackfoot and Soda Springs, respectively. The plan was also made available on the DEQ Web site.

2 BLACKFOOT RIVER SUBBASIN DESCRIPTION

2.1 General

The Blackfoot River subbasin is located in southeast Idaho (Figure 2.1-1). The subbasin encompasses about 700,000 acres and over 1,700 miles of streams in Bingham, Caribou, and Bonneville counties. Diamond and Lanes creeks come together to form the Blackfoot River which wends its way west for 130 miles before reaching the Snake River west of the city of Blackfoot. In addition to Diamond and Lanes creeks, major tributaries include Wolverine, Brush, Corral, Meadow, Trail, Slug, Dry Valley, Angus, and Spring creeks and Little Blackfoot River. Blackfoot Reservoir, created in 1910 (Dion 1974) is the only major reservoir in the subbasin. The reservoir covers 17,300 surface acres and is operated by the U. S. Bureau of Indian Affairs (Idaho Department of Water Administration 1971).

The subbasin traverses three ecoregions. The upper end of the subbasin is in the Middle Rockies ecoregion. The middle section of the subbasin and the lower end are parts of the Northern Basin and Range and Snake River Basin/High Desert ecoregions, respectively. Characteristics of the ecoregions are summarized in Table 2.1-1. Elevation in the subbasin ranges from almost 9,000 feet above mean sea level (ft msl) in the Dry Valley Creek watershed to 4,410 ft msl at the confluence with the Snake River. Much of the area is at slopes greater than 20% (Figure 2.1-2).

Geologically, the subbasin is mostly of sedimentary origins. Generally, soils, at least in lower Blackfoot subbasin, are well-drained and deep, medium-textured silty loams (SCS 1973; SCS and BIA 1977). Drewes (1987) classified soils from below Wolverine Creek to about Miner Creek as highly erodible (Figure 2.1-3). The upper Blackfoot River subbasin is a historic and current mining area for phosphates and contains some of the largest reserves of phosphates in the United States (Powell 1974).

Most of the subbasin is located in Bingham and Caribou counties with a little area contained in Bonneville County. The only incorporated city or town in the subbasin is Blackfoot.

Fishes in the Blackfoot River subbasin are a mixture of native and introduced species. Native species include Yellowstone cutthroat trout (*Oncorhynchus clarki bouvieri*), mountain whitefish (*Prosopium williamsoni*), Utah chub (*Gila atraria*), longnose dace (*Rhinichthys cataractae*), speckled dace (*Rhinichthys osculus*), redside shiner (*Richardsonius balteatus*), Utah sucker (*Catostomus ardens*), mountain sucker (*Catostomus platyrhynchus*), bluehead sucker (*Catostomus discobolus*), mottled sculpin (*Cottus bairdi*), and Piute sculpin (*Cottus beldingi*) (Royer and Minshall 1998; Crist and Holden 1986; Platts et al. 1980; Thurow 1981; Don Chapman Consultants, Inc. 1986). Species that have been introduced in the subbasin are rainbow trout (*O. mykiss*), brown trout (*Salmo trutta*), brook trout (*Salvelinus fontinalis*), black bullhead (*Ictalurus melas*), fathead minnow (*Pimephales promelas*), and carp (*Cyprinus carpio*). Coho salmon (*O. kisutch*) were, at one time, stocked in Blackfoot Reservoir.

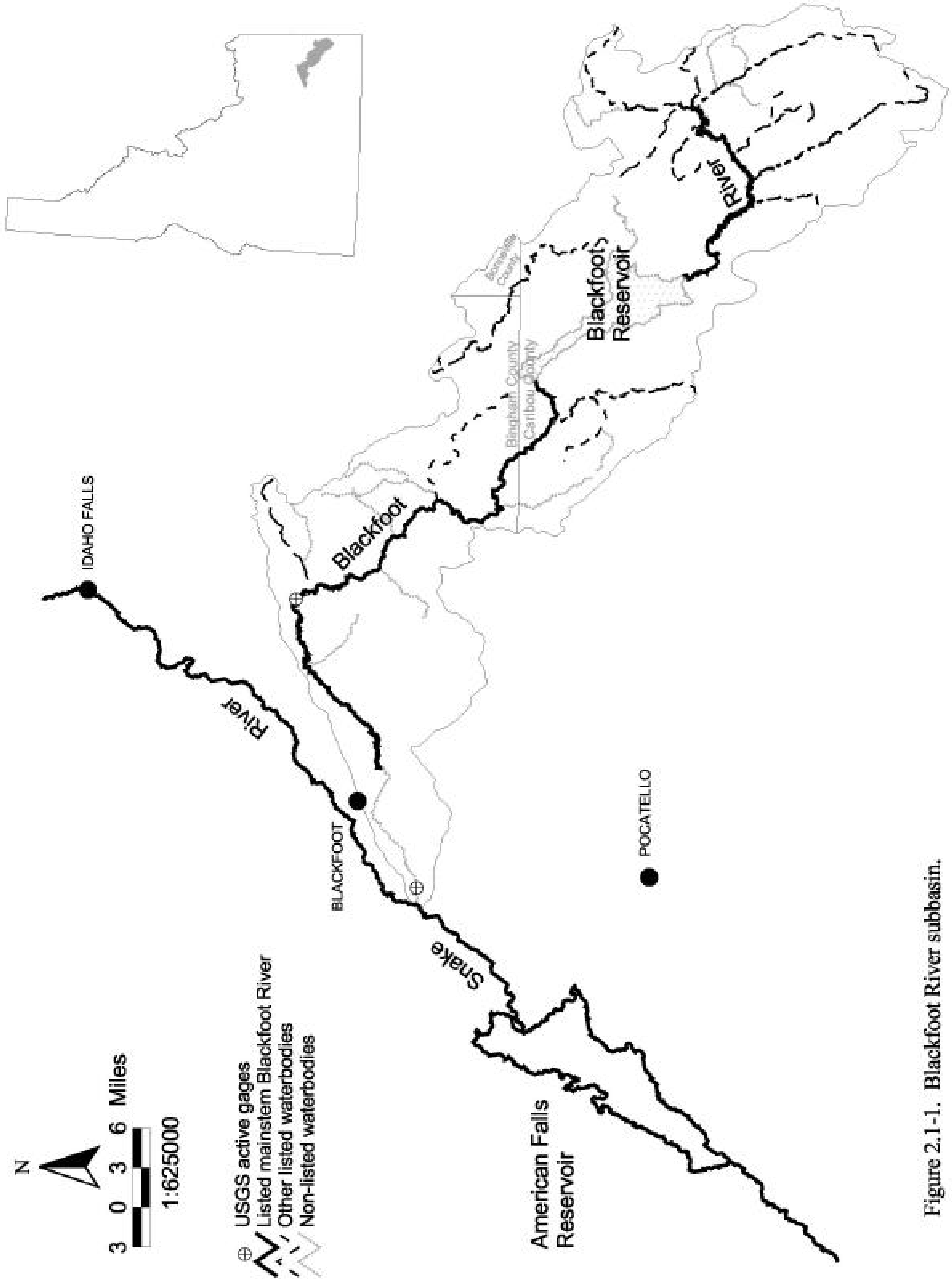


Figure 2.1-1. Blackfoot River subbasin.

Table 2.1-1. Characteristics of ecoregions in the Blackfoot River subbasin (modified from Maret et al. 1997 and Omernik and Gallant 1986).

Ecoregion	Percentage of surface area	Land surface form	Potential natural vegetation	Land use	Soils
Northern Basin & Range	77	Plains with low to high mountains; open high mountains	Great Basin sagebrush, saltbush, and greasewood	Desert shrubland, grazed	Aridisols
Middle Rockies	14	High mountains	Douglas-fir, western spruce and fir, alpine meadows (bentgrass, sedge, fescue, and bluegrass)	Grazed and ungrazed forest and woodland	Alfisols
Snake River Basin/High Desert	9	Tableland with moderate to high relief; plains with hills or low mountains	Sagebrush steppe (sagebrush, wheatgrass, saltbush, and greasewood)	Desert shrubland grazed; some irrigated agriculture	Aridisols, aridic millisols

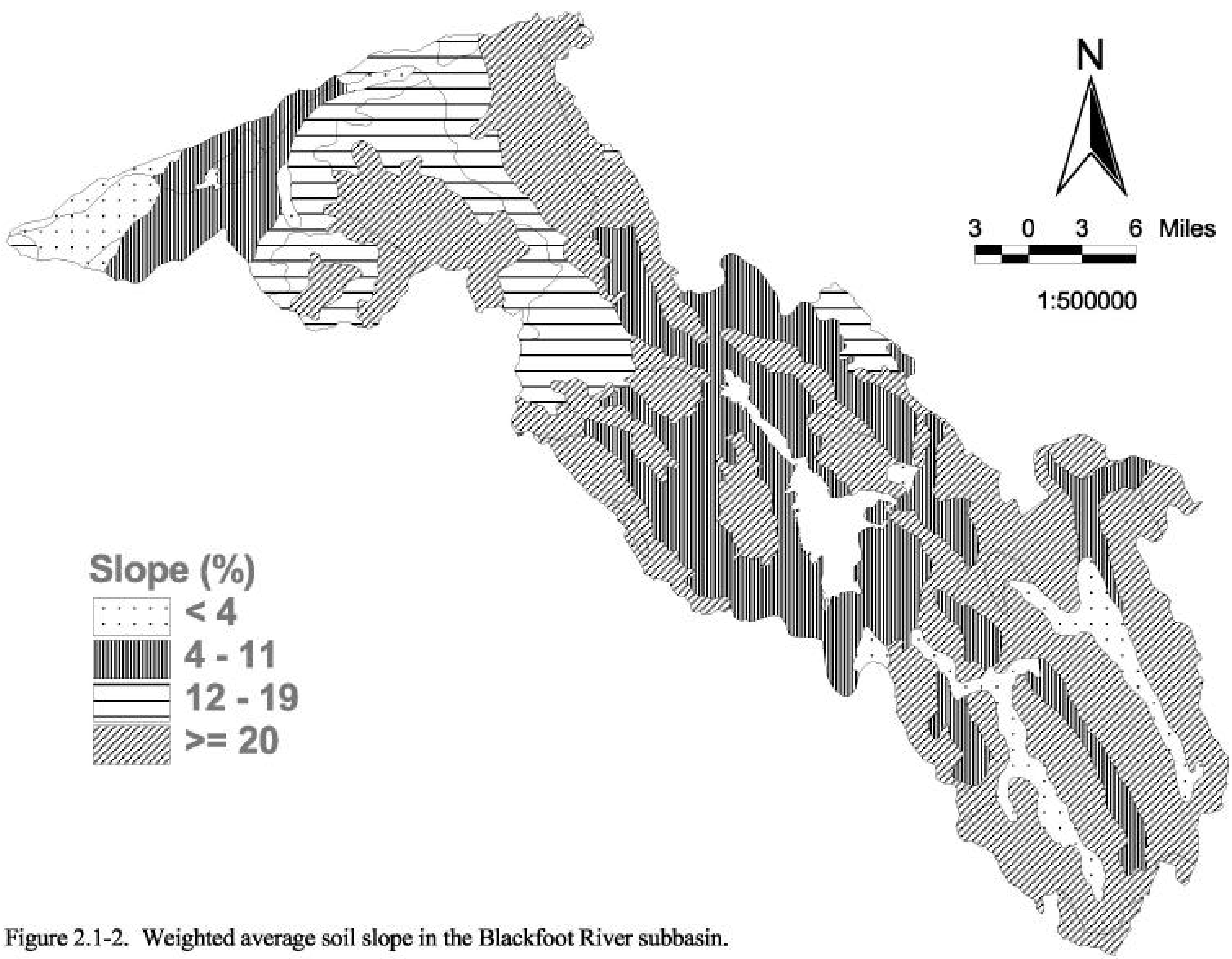


Figure 2.1-2. Weighted average soil slope in the Blackfoot River subbasin.

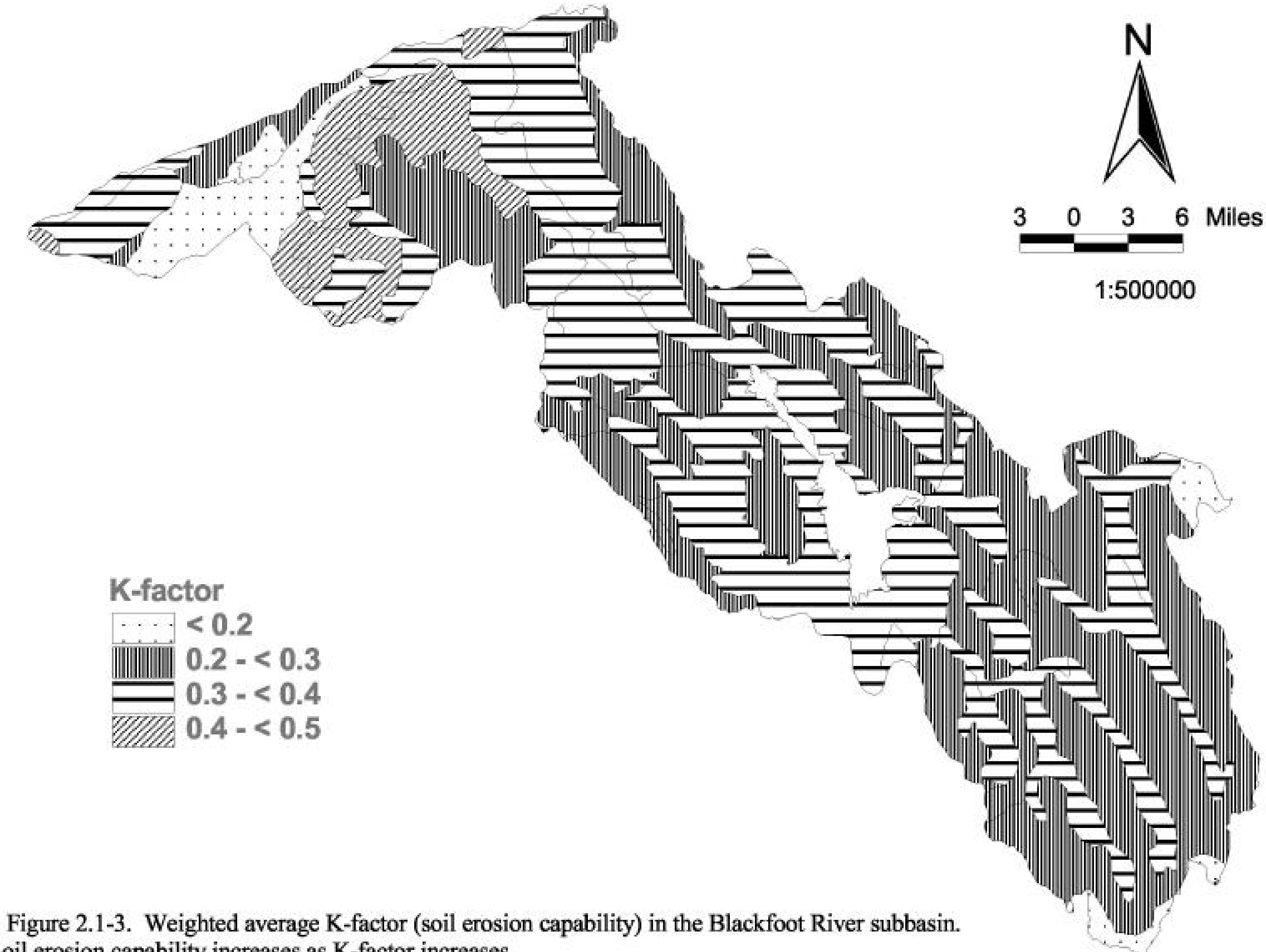


Figure 2.1-3. Weighted average K-factor (soil erosion capability) in the Blackfoot River subbasin. Soil erosion capability increases as K-factor increases.

Presently there are no threatened or endangered aquatic species in the Blackfoot River subbasin. The Yellowstone cutthroat trout is listed as a sensitive species by Bureau of Land Management (BLM) and species of special concern by Idaho Department of Fish and Game (IDFG). Further, U. S. Fish and Wildlife Service (USFWS) has been petitioned to list the Yellowstone cutthroat trout and Snake River fine-spotted cutthroat trout (*O. c.* ssp.), lumped as a single subspecies, as a potentially threatened or endangered species; the decision is pending. The Forest Service only lists the fine-spotted cutthroat trout as sensitive. However, since USFWS is considering the Yellowstone and fine-spotted as the same subspecies, the Yellowstone cutthroat trout would be included as a sensitive species by the Forest Service. On both the BLM and IDFG lists (sensitive and species of special concern), and possibly found in the Blackfoot River subbasin, is the leatherside chub (*G. copei*).

The climate in the subbasin is semi-arid. The mean temperature is 46.1°F at Blackfoot and 39.0°F at Henry (Table 2.1-2). Mean monthly temperatures for January and July range from 22.9°F to 69.5°F at Blackfoot and 15.5°F to 61.7°F at Henry, respectively. Precipitation also varies between stations (Table 2.1-3). Mean annual precipitation differs more than 10 inches between Blackfoot and Henry. Water yield (i.e., runoff) on national forest land, all located above the Reservoir, is about 0.62 feet/year.

Vegetation ranges from sagebrush and grasses at lower elevations to conifers and deciduous trees at higher elevations. On Caribou National Forest, major vegetation cover types are aspen - 25%, lodgepole pine - 23%, sage-grass - 21%, mountain brush - 12%, Douglas-fir - 11%, and other conifers - 8% (Caribou National Forest 1985).

As with most dammed rivers, the natural hydrograph in the Blackfoot River subbasin has been altered by the construction of Blackfoot Reservoir. Flow information from USGS surface-water station on the Blackfoot River above the reservoir near Henry indicates that flows increase substantially in April, peak in May at over 600 cubic feet per second (cfs), remain high in June, and then gradually decline (Table 2.1-4). Below the dam at Shelley gage site, discharge begins increasing about April, peaks around 750 cfs in June and July, remains relatively high in August and September before gradually declining through January. The natural hydrograph of Blackfoot River at the Shelley USGS gage site projected from flow data at the Henry gage is presented in Figure 2.1-4. A natural hydrograph would see a higher and more intense flow regime. Flows at Blackfoot gage site are lower than what is measured at Shelley site. Through the irrigation season, this difference is understandable as water is diverted into several irrigation canals (e.g., Little Indian Ditch, Just Canal, Hanson Ditch, Taylor Ditch, Fort Hall Main Canal, North Canal). During non-irrigation season, the stretch of river in the Snake River plain probably loses water to groundwater (Balmer and Noble 1979). The equalizing dam, near the City of Blackfoot, was built to help regulate water from Blackfoot Reservoir into the Fort Hall Irrigation Canal.

Agriculture is an important industry in the Blackfoot River subbasin. Crops grown include potatoes, wheat, hay, and pasture (Scott Engle, Natural Resources Conservation Service [NRCS]/Blackfoot, personal communication). Most crops in Bingham County are grown on Wolverine sands, Wapello sandy loam, Newdale silt loam, and Blackfoot loam soils. Very little dry cropland (318 acres) remains in the Blackfoot River subbasin in Bingham County. Most dry

Table 2.1-2. Monthly average temperatures (Fahrenheit) at Blackfoot and Henry National Weather Service stations (from Western Regional Climate Center, internet communication).

	Monthly average temperature												
	January	February	March	April	May	June	July	August	September	October	November	December	Annual
						Blackfoot (1948-1999)							
Mean	22.9	28.2	36.7	45.7	54.7	62.3	69.5	67.8	58.9	47.6	34.9	24.4	46.1
Maximum	31.4	37.8	48.2	59.6	69.5	78.2	86.6	85.7	76.0	62.8	45.7	33.2	59.6
Minimum	14.3	18.6	25.2	31.8	39.9	46.4	52.0	49.9	41.9	32.5	24.2	15.7	32.7
						Henry (1971-1987)							
Mean	15.5	21.0	27.9	36.9	47.3	56.1	61.7	60.6	51.7	41.2	27.4	20.3	39.0
Maximum	27.1	34.4	40.8	52.0	61.5	72.2	80.4	79.4	69.5	56.4	39.9	30.9	53.7
Minimum	3.9	7.6	14.5	22.8	33.1	39.9	43.6	41.9	34.4	26.0	15.6	7.6	24.2

Table 2.1-3. Monthly precipitation at Blackfoot and Henry National Weather Service stations (from Western Regional Climate Center, internet communication).

	Precipitation by month (in)												
	January	February	March	April	May	June	July	August	September	October	November	December	Annual
						Blackfoot (1948-1999)							
Mean	0.94	0.78	0.90	0.93	1.31	1.10	0.48	0.48	0.66	0.70	0.90	0.93	10.11
High	3.01	2.73	3.21	4.10	3.92	5.14	2.51	2.98	2.64	2.65	2.16	2.28	23.09
Low	0.03	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.78
						Henry (1971-1987)							
Mean	1.95	1.72	1.64	1.03	2.44	1.33	1.65	1.35	1.70	1.59	1.87	2.13	20.38
High	4.64	4.59	4.05	2.13	4.77	2.96	3.96	4.23	4.73	3.73	4.40	4.91	30.28
Low	0.69	0.50	0.17	0.07	0.85	0.13	0.02	0.27	0.00	0.03	0.09	0.10	17.65

Table 2.1-4. Flow information from USGS surface-water stations in the Blackfoot River subbasin (from USGS Water Resources Data reports).

Site	Station number	Time period	Measurement	Mean monthly discharge (cfs)											
				January	February	March	April	May	June	July	August	September	October	November	December
Mainstem nr Henry	13065500	1967-1982	Mean	59	61	81	290	623	343	144	100	88	90	83	67
			Maximum	100	145	309	1800	1890	1150	413	231	211	200	177	125
			Minimum	23	32	41	52	72	28	28	23	30	34	33	26
Mainstem nr Shelley	13066000	1909-1998	Mean	131	147	198	332	591	758	745	579	419	222	170	137
			Maximum	783	1065	966	1042	1832	1852	1349	959	827	626	563	760
			Minimum	40.6	45	69.1	93.9	132	138	89.1	188	116	64.3	49.7	43
Mainstem nr Blackfoot	13068500	1964-1998	Mean	109	121	157	203	245	188	121	140	138	204	180	115
			Maximum	302	345	386	428	587	469	288	323	263	314	318	314
			Minimum	20.1	21.9	57.5	54.6	66.9	32.6	23.2	0.26	1.11	37.2	45.1	22.3
Bypass + mainstem[1]	13068501	1913-1998	Mean	140	161	208	329	385	234	121	151	141	273	279	167
			Maximum	793	937	956	1085	1579	1411	635	834	444	674	789	825
			Minimum	17.7	21.6	31.4	57.3	0.77	0	0	0	0	0	27	22.3

[1]mainstem near Blackfoot

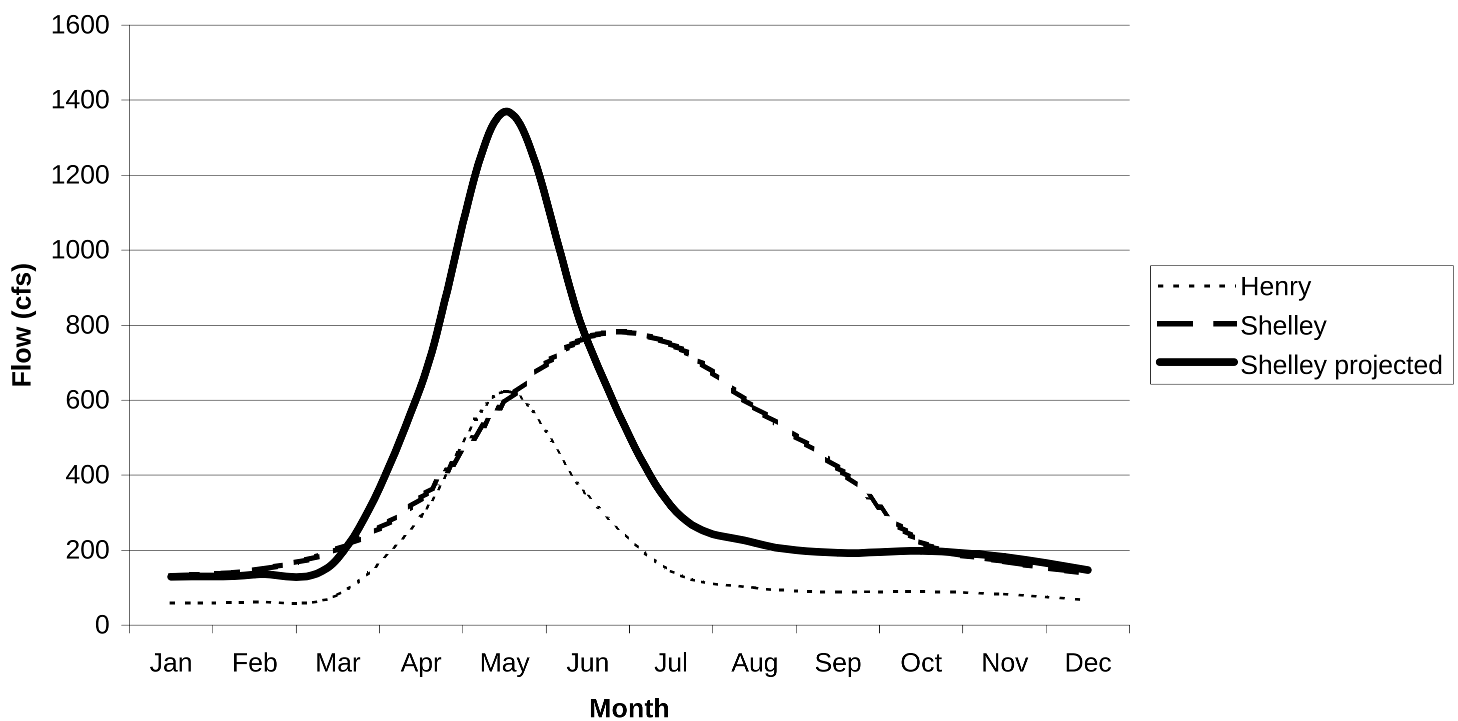


Figure 2.1-4. Hydrographs at USGS surface-water stations near Shelley (13066000) and Henry (13063000) and projected natural hydrograph near Shelley (from USGS Water Resources Data reports).

cropland present in the early 1980s is now under the Conservation Reserve Program or used as pasture or hayland. Approximately 16,000 acres are irrigated in the subbasin in Bingham County. Of this area, about 1,200 acres are located on slopes of 8% or greater (Scott Engle, NRCS/Blackfoot, personal communication).

2.1.1 Watershed Characteristics

Physical changes from higher to lower elevations are similar among streams. Most streams originate in montane areas, often state or Forest Service land. Based on site data from the Department of Environmental Quality's Beneficial Use Reconnaissance Program (BURP), the higher elevation stream sections tend toward higher gradient, lower sinuosity, and Rosgen A- or B-channel types (Table 2.1-5). At lower elevations, mostly private land, the streams decrease in gradient and increase in sinuosity. Channel types are usually Rosgen B or C within flat or trough shaped valleys. The percentage of smaller particle sizes (% fines) in stream substrate tended to be generally consistent within a stream with few exceptions (e.g., Brush, Meadow, and Slug creeks). The BURP effort recorded very few pools within many monitoring sites resulting in low pool to riffle ratios. Bank vegetation and stability varied by site with lower values, representing less protection or stability, observed at sites on Wolverine, Cedar, Brush, Rawlins, Horse, Poison, Corral, Meadow, Dry Valley, Angus, and Timothy creeks.

Human impacts, such as timber harvesting, roads, recreation, farming, ranching, livestock grazing, and mining (Lee Leffert, Caribou National Forest, personal communication), have resulted in changes in the Blackfoot River. As mentioned, construction of Blackfoot Dam resulted in changes in the annual hydrograph. Withdrawal of water for irrigation also affects flows especially during summer in low flow years. Water is delivered into the subbasin from Grays Lake, Willow Creek, and Snake River (USACE 1974). Water is transferred out of the subbasin via several diversions including the Fort Hall Main Canal. Water is also lost from the reservoir into underlying permeable lava formations (USACE 1974), possibly into Soda Creek in the Bear River Basin (Dion 1974). Lanes, Daves, Olsen, Sheep, and Angus creeks have been affected by farming, livestock grazing, or pasture irrigation while mining has impacted Angus and Maybe creeks (Lee Leffert, Caribou National Forest, personal communication). Angus Creek has also been affected by road construction.

Caribou National Forest (1985) evaluated streams that flow on the forest. Streambank stability within the Blackfoot Management Area was rated at an overall score of 78 that fell in the good category. Individual stream ratings are presented in Table 2.1-6.

Streams were also rated by the forest for water quality based on benthic macroinvertebrate indices and Instream Flow Incremental Methodology (IFIM) analysis (Lee Leffert, Caribou National Forest, personal communication). Generally, water quality as reflected in macroinvertebrate communities was good except in Maybe Canyon and lower reaches of Diamond Creek (Table 2.1-7). Additional macroinvertebrate analyses in Browns Canyon, Kendall, and Mill Canyon creeks indicated water quality and substrate to be in good to excellent overall condition while mainstem Blackfoot River and Lanes and Daves creeks were considered

Table 2.1-5. Watershed characteristics of 303(d)-listed tributaries in the Blackfoot River subbasin (from DEQ BURP data).

Waterbody	303(d) listed	Site	Date	Distance above mouth of Blackfoot (miles)	Elevation at mouth (ft msl)	Site elevation (ft msl)	Valley type	Sinuosity	Gradient (%)	Rosgen channel type	% fines	Pool: riffle ratio	Width: depth ratio	Bank vegetation protection (%)	Bank stability (%)
Blackfoot River	Y			750[1]	4410										
Wolverine Creek	Y			39.2	4700										
		Lower	18-Jul-94			4800	Flat bottom	Moderate	1	B	18.4	0	17.15	45	52.5
		Upper	18-Jul-94			5600	Flat bottom	Moderate	1	B	34.9	0.2	10.5	10	42.5
		Lower	1-Jul-97			4800	Trough-like	Moderate	2	B	NC[2]	NC	NC	NC	NC
		Upper	1-Jul-97			5680	V-shaped	Low	10	A	NC	NC	NC	NC	NC
Cedar Creek	N		19-Jul-94	44.8	4800	4880	Flat bottom	Low	4	C	44.5	0.19	7.39	77.5	37.5
Trail Creek	N		8-Aug-95	54.7	5520	5540	Box canyon	Low	3.5	A	43.5	0	12.75	100	100
Brush Creek	Y			56.7	5580										
		Lower	1-Jul-96			5800	Flat bottom	High	2	C	36.2	1.2	22.47	72.5	35
		Upper	1-Jul-96			6300	Trough-like	Moderate	1	C	100	0	15.07	100	100
Rawlins Creek	Y				5700										
		Lower	8-Aug-95			5958	U-shaped	Moderate	2	B	41.7	0.03	15.48	100	100
		Upper	10-Aug-95			6083	Flat bottom	Moderate	0.5	C	40.4	0.04	22.64	100	45
Horse Creek	N		2-Jul-96		5920	5960	U-shaped	Moderate	2.5	B	57	0.12	18.79	53.5	44
Poison Creek	N		10-Aug-95		5960	5961	Flat bottom	Moderate	2	B	46.6	0.1	21.22	95	65
Deadman Creek	N		1-Jul-97	60.3	5720	5720	Trough-like	Moderate	5	A	NC	NC	NC	NC	NC
Corral Creek	Y			75.1	5960										
		Lower	21-Jul-94			6040	Box canyon	Moderate	1	C	77.2	0	21.95	10	0
		Upper	20-Jul-94			6100	Trough-like	Moderate	0.5	F	73	0	16.08	85	5
		Lower	15-Jul-97			6040	Trough-like	Moderate	1.5	C	NC	NC	NC	NC	NC
		Upper	15-Jul-97			6100	Trough-like	Moderate	1	C	NC	NC	NC	NC	NC
Grizzly Creek	Y		3-Jul-96		6080	6080	Trough-like	High	1	C	56.8	7.15	35.91	93.69	80.58
Meadow Creek	Y			89.5	6120										
		Lower	7-Aug-95			6220	Trough-like	Moderate	0.5	C	11.9	1.86	29.67	40	100
		Upper	7-Aug-95			6348	Trough-like	Moderate	1	C	48.2	1.13	14.67	97.5	90
Trail Creek	Y		22-Jul-96	107.5	6300	6320	Trough-like	High	0.8	C	79.9	99	12.33	100	100
Slug Creek	Y			114.7	6320										
		Lower	14-Jul-94			6352	Flat bottom	Low	1	A	94.6	0	13.67	97.5	100
		Upper	14-Jul-94			6480	Trough-like	Moderate	1.5	B	45.7	0	24.25	95	85
		Lower	21-Jul-97			6460	U-shaped	High	1.5	C	NC	NC	NC	NC	NC
		Upper	21-Jul-97			6680	U-shaped	Moderate	1.5	F	NC	NC	NC	NC	NC
Johnson Creek	N				6360										
		Lower	22-Jul-96			6460	Flat bottom	Moderate	1.3	C	100	0	4.28	100	100
		Upper	22-Jul-96			6560	V-shaped	Low	2.2	B	82.4	0.1	5.63	98	98

Table 2.1-5. Continued.

Waterbody	303(d) listed	Site	Date	Distance above mouth of Blackfoot (miles)	Elevation at mouth (ft msl)	Site elevation (ft msl)	Valley type	Sinuosity	Gradient (%)	Rosgen channel type	% fines	Pool: riffle ratio	Width: depth ratio	Bank vegetation protection (%)	Bank stability (%)
Dry Valley Creek	Y			118.2	6340										
		Lower	2-Aug-95			6340	Trough-like	Moderate	1.5	C	95.1	0	5.08	100	92.5
		Upper	2-Aug-95			6420	Trough-like	NE[3]	1	C	72.2	0	8.38	100	0
Maybe Canyon Creek	Y		27-Jul-95		6460	6555	V-shaped	Low	5	A	34.4	0	4.47	100	100
Angus Creek	Y			126.0	6420										
		Lower	27-Jul-95			6500	Trough-like	Moderate	2	B	45.3	0	10.37	60	40
		Upper	26-Jul-95			6840	Trough-like	Moderate	2	B	46	0	6.7	100	100
Lanes Creek	Y			128.8	6420										
		Lower	16-Jul-97			6560	Trough-like	Moderate	2	B	NC	NC	NC	NC	NC
		Upper	16-Jul-97			7040	V-shaped	Low	4	A	NC	NC	NC	NC	NC
Bacon Creek	Y				6440										
		Lower	31-Jul-95			6476	Trough-like	Moderate	2	B	56.6	0	6.54	100	100
		Upper	31-Jul-95			6502	U-shaped	Moderate	4	A	68	1.24	10.57	100	100
Sheep Creek	Y		17-Jul-97		6440	6510	V-shaped	Moderate	3	B	NC	NC	NC	NC	NC
Daves Creek	N		22-Jul-97		6520	6720	V-shaped	Low	6	A	NC	NC	NC	NC	NC
Chippy Creek	N		16-Jul-97		6560	6560	Trough-like	Moderate	2	B	NC	NC	NC	NC	NC
Olsen Creek	N		22-Jul-97		6560	6760	V-shaped	Low	3.5	B	NC	NC	NC	NC	NC
Diamond Creek	Y			128.8	6420										
		Lower	17-Jul-97			6600	Flat bottom	Moderate	2	C	NC	NC	NC	NC	NC
		Upper	17-Jul-97			7160	V-shaped	Moderate	3	B	NC	NC	NC	NC	NC
Timothy Creek	Y				6480										
		Lower	1-Aug-95			6552	Trough-like	Moderate	2	B	36.8	0	5.26	98.5	80
		Upper	1-Aug-95			6620	V-shaped	Moderate	3	B	24.8	0	9.85	100	62.5
Kendall Creek	Y		2-Aug-95		6540	6640	V-shaped	Moderate	2	B	64.5	0	11.83	100	100
Cabin Creek	Y		1-Aug-95		6580	6772	Flat bottom	Low	3	B	56.1	0.07	3.87	98.5	80
Timber Creek	N		16-Jul-96		6900	7040	V-shaped	Low	7	A	30.1	0	8.13	100	100

[1] above mouth of Snake River
[2] NC=not calculated
[3] NE=not evaluated

Table 2.1-6. Stream channel stability rating for Blackfoot River subbasin streams on the Caribou National Forest (from Caribou National Forest 1985).

Waterbody	Stream channel stability rating[1]			
	Excellent	Good	Fair	Poor
Blackfoot River[2,3]			X	
Slug Creek[2]		X		
Johnson Creek		X		
Burchertt Creek				X
Goodheart Creek			X	
Dry Canyon Creek			X	
North Fork of Slug Creek			X	
Dry Valley Creek[2]		X		
Angus Creek[2]		X		
Mill Creek		X		
Sheep Creek[2]		X		
Daves Creek		X		
Browns Canyon Creek		X		
Olsen Creek		X		
Diamond Creek[2]			X	
Kendall Creek**		X		
Stewart Creek		X		

[1]based on Pfankuch 1975

[2]303(d)-listed

[3]near confluence of Lanes and Diamond creeks

Table 2.1-7. Water quality status based on benthic macroinvertebrate indices of Blackfoot River tributaries on the Caribou National Forest (from Lee Leffert, Caribou National Forest, personal communication).

Waterbody	Year evaluated	Station	DAT[1]		BCI[2]	
			Score	Rating	Score	Rating
Maybe Canyon Creek	1984	1	2.8	Poor	57	Poor
		2	14.2	Good	73	Poor to fair
Diamond Creek	1983	1	11.3	Good	86	Good
		2	11.3	Good	86	Good
	1991	1	7.7	Fair	67	Poor
		3	13.7	Good	81	Good
Campbell Creek	1984	1	7.7	Fair	82	Good
Bear Canyon Creek	1984	1	14.8	Good	96	Excellent
Timber Creek	1983	1	11	Good	77	Good
		2	14.9	Good	79	Good

[1]Dominance and Taxa Diversity Index (Fred Mangum, U. S. Forest Service, personal communication)

[2]Biotic Condition Index (Winget and Mangum 1979)

in fair to good condition. From IFIM analysis, conducted in 1989 and 1990, available fisheries habitat appeared to be in good condition in Browns Canyon Creek; fair to good condition in Lanes Creek; and below potential, but stable, in Bacon, Timothy, Cabin, and Yellowjacket creeks.

In 1990, the Forest Service collected fish habitat information on Diamond Creek near the forest boundary (Lee Leffert, Caribou National Forest, personal communication). Pools were in good overall condition but less than optimum quality: vegetative cover was below potential and pool bottoms were silt-covered. Riffles were, for the most part, highly embedded with silt. Bank vegetative cover was good to excellent consisting of willows, sedges, and grasses. Some lateral migration in the form of cut banks was noted. Ocular investigations of the channel and fisheries habitat above forest boundary indicated habitat to be in good overall condition. Below Forest Service boundary, habitat was in poor to very poor condition with downcutting channel, raw banks, large width to depth ratios, increased amounts of aquatic vegetation, and turbid water. Overall, the stream was in fair to good condition depending on location.

Thurow (1981), in his investigation of the upper Blackfoot River cutthroat trout fishery, examined habitat conditions of several streams. In general, streams were in good to fair condition with some poor condition sites primarily in Lanes and Diamond creeks (Table 2.1-8).

Numerous reports have been produced as a result of phosphate mining in upper Blackfoot River subbasin. Platts (1975) found high levels of nitrates and phosphates in Angus Creek that appeared to be natural. He also documented high turbidity and bedload sediment that are influenced by livestock grazing and mining in the watershed. Mariah Associates (1992a) sampled Angus and Sheep creeks for water quality from 1990 to 1992. They characterized water quality and habitat in Sheep Creek as good. Habitat conditions in Angus Creek were rated poor.

Idaho Department of Fish and Game has collected various data most of which relates to the fish community in the Blackfoot River subbasin. IDFG conducted spring (June) spawning ground surveys in the upper Blackfoot River subbasin for several years (Richard Scully, IDFG, personal communication). Between 1978 and 1993, these surveys have documented salmonid spawning in Spring, Diamond, Timothy, Kendall, Timber, Stewart Canyon, Lanes, Bacon, Sheep, and Browns Canyon creeks. A cutthroat trout tagging study in 1974 and 1975 found fish in upper Blackfoot River and Angus and Spring creeks. Sucker, rainbow trout, and carp have been trapped in upper Blackfoot River. In 1995, IDFG captured cutthroat trout, mountain whitefish, sculpins, suckers, and cutthroat trout x rainbow trout hybrids in lower Blackfoot River in the Reid Valley area. A 1991 sampling effort on mainstem Blackfoot River near Trail Creek bridge yielded rainbow and brook trout.

Much of the subbasin is relatively accessible. For example, within the national forest, about 25% of the area is within 0.5 miles of a road, 75% within 0.5 to 3 miles of a road, and less than 1% is farther than 3 miles from a road (Caribou National Forest 1985).

Table 2.1-8. Overall rating of stream reach inventory and channel stability in upper Blackfoot River tributaries, August 1980 (from Thurow 1981).

					Mean size composition (%)				Rating of sites[2]			
Waterbody	Reach evaluated	Number of sites	Mean width (m)	Mean depth (cm[1])	Sand	Gravel (0.1-3.0 in)	Cobble (3-12 in)	Boulder (>12 in)	Excellent	Good	Fair	Poor
Spring Creek	mouth to headwater spring	3	2.6	18.6	18	76	6	0	2	1	0	0
Lanes Creek	mouth to Lanes grave	8	3.4	61.1	32	42	24	2	0	1	4	3
Bacon Creek	mouth up 8.6 km to falls	6	2.7	21.1	37	46	14	3	1	2	3	0
Sheep Creek	mouth to forest boundary	4	2.9	20.2	26	56	17	1	0	1	2	1
Browns Canyon Creek	mouth up 3.5 km	4	2.1	15.0	26	31	40	3	1	1	1	1
Diamond Creek	mouth to headwaters (39.9 km)	11	4.0	17.7	29	51	19	1	0	2	6	3
Timothy Creek	mouth to upper electrofishing site	6	2.5	20.3	12	59	24	5	0	4	2	0

[1]mean depth assumed to be measured in centimeters

[2]modified from Pfankuch 1975

2.1.2 Cultural Characteristics

Land ownership includes private, federal, state, and tribal (Figure 2.1-5). About 36% of land within the subbasin is privately owned (Table 2.1-9). The largest landowners are the State of Idaho, Caribou National Forest, and Shoshone-Bannock Indian Tribes.

Agricultural, range, and forest are major land uses in the subbasin (Figure 2.1-6). Rangeland makes up over two-thirds of the area (Table 2.1-10). Much of forest and rangelands lie within the Caribou National Forest. The number of acres in dryland agriculture, over 100,000 in the early 1980s, have changed with advent of the Conservation Reserve Program (CRP) and movement of dryland acres into the program. In 1990, there were an estimated 35,860 acres withdrawing 177 million gallons of surface water per day for flood and sprinkler irrigation (USGS, internet communication). Major crops grown in the Blackfoot River subbasin include wheat, barley, potatoes, and hay. Beef cattle form the major livestock industry.

The majority of Blackfoot River subbasin is contained within Bingham and Caribou counties (Figure 2.1-1). Bingham County is the larger county in terms of population (Table 2.1-11). Both counties have shown an overall population increase since 1950 although Caribou County experienced a population decline in the 1980s. Bingham County has a higher proportion of rural population as compared to Caribou County. The City of Blackfoot, the only incorporated city, has an estimated population of 10,563 people as of mid-1999 (U. S. Census Bureau, Internet communication).

Overall per capita income measured as a percent of U.S. per capita income is lower in the area than the national average (Table 2.1-11). There are two explanations why Bingham and Caribou counties are below the national average: relatively low wages and large family size (Benson and Stegner 1995).

Employment and earnings within the subbasin vary. For example, employment in both counties in 1992 was relatively evenly spread among sectors with five or more sectors accounting for at least 10% of the employment within each county (Table 2.1-12). Sectors with highest earnings for Bingham county were farming, services, manufacturing, and government. In Caribou County, earnings are concentrated in mining and manufacturing accounting for almost half of the county's earnings.

Several land uses have been identified as adversely affecting fish production and water quality in the Blackfoot River subbasin. Livestock grazing, irrigation withdrawal, agricultural runoff, roads, railroads, logging, recreation, and surface mining operations have been mentioned as having possible negative effects (Rich 1999; TRC Mariah Associates 1996; Caribou National Forest 1992; Mariah Associates 1982, 1990; Thurow 1981; Singh and Ralston 1979; Hancock and Bybee 1978; Platts and Martin 1978; McSorley 1977; Platts 1975; Cuplin 1961). Streams that may have been affected by cattle grazing during the Thurow (1981) study included Trail, Slug, Lanes, Sheep, Browns Canyon, and Diamond creeks. Platts and Martin (1978) reported altered vegetation or bank structure in Angus and Diamond creeks due to livestock grazing.

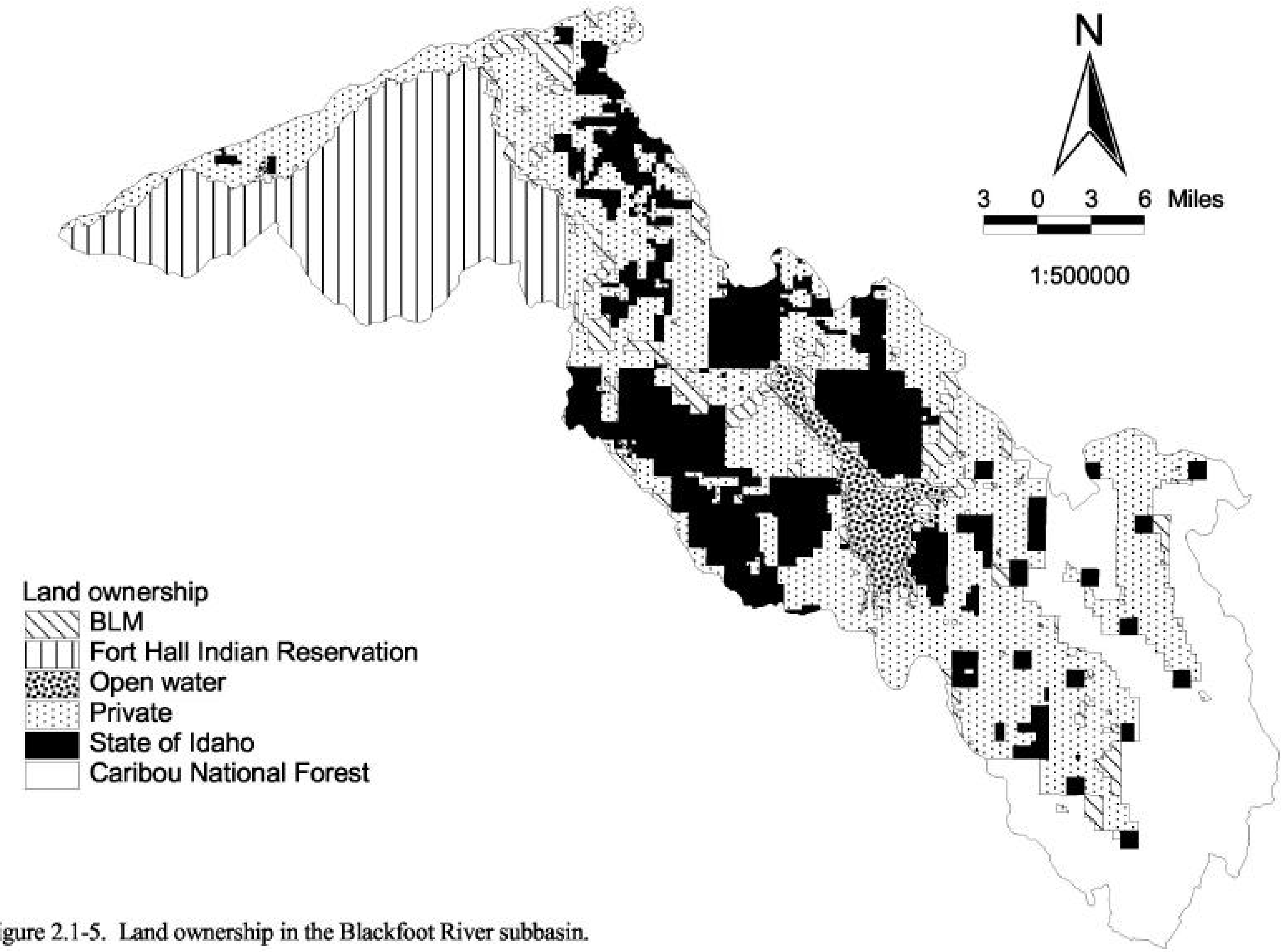


Figure 2.1-5. Land ownership in the Blackfoot River subbasin.

Table 2.1-9. Land ownership in the Blackfoot River subbasin.

Ownership	Acres	Percent of area
Private	254,157	36.8%
State of Idaho	129,389	18.7%
Shoshone-Bannock Tribes	124,682	18.1%
U. S. Forest Service	123,216	17.9%
Bureau of Land Management	41,226	6.0%
Other	17,530	2.5%
Total	690,200	

Table 2.1-10. Land use in the Blackfoot River subbasin (from Idaho Department of Water Resources Geographic Information System coverage, 1991).

Land use	Acres	Percent of area
Dryland agriculture	36,323	5.3%
Irrigated agriculture	32,204	4.7%
Rangeland	473,725	68.6%
Forest	58,700	8.5%
Sparse forest	66,194	9.6%
Non-forested wetland	6,043	0.9%
Forested wetland	114	0.0%
Water	14,767	2.1%
Barrenland	1,340	0.2%
Urban	1,234	0.2%
No data	110	0.0%
Total	690,754	

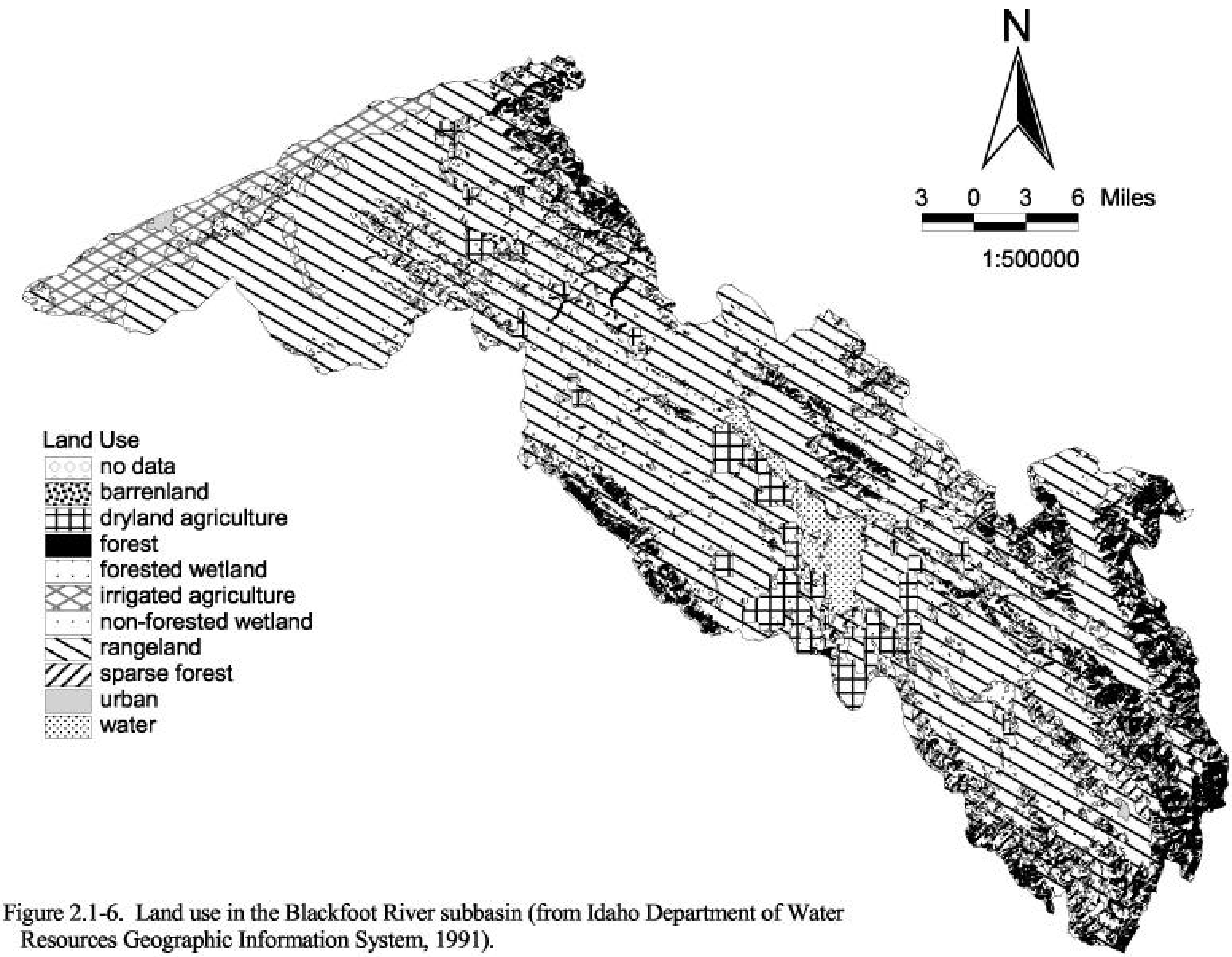


Figure 2.1-6. Land use in the Blackfoot River subbasin (from Idaho Department of Water Resources Geographic Information System, 1991).

Table 2.1-11. Demographic information for Bingham and Caribou counties, Idaho (summarized from Benson and Stegner 1995).

County/	Population		Percent population change					Avg annual pop growth	Percent of population classified as rural			Per capita income
state	1990	1999[1]	1960-1970	1970-1980	1980-1990	1990-2000	2000-2010	(1950-1990)	1970	1980	1990	1992[2]
Bingham	37,583	42,127	3.4%	25.1%	3.0%	22.7%	13.6%	1.2%	61.2%	63.4%	61.4%	73.8%
Caribou	6,963	7,273	9.3%	33.1%	-19.9%	27.4%	16.2%	0.6%	54.4%	53.4%	55.3%	74.6%
Idaho	1,006,749	1,251,700	6.8%	32.5%	6.7%	24.4%	14.1%	1.3%	45.9%	46.0%	42.6%	-

[1]US Census Bureau (internet communication) estimate as of 1 July 1999

[2]per capita income as a percent of U. S. per capita income

Table 2.1-12. Total employment and real earnings by sector for Bingham and Caribou counties, Idaho, 1992 (summarized from Benson and Stegner 1995).

County	Category	Farm	Agricultural services[1]	Mining	Construction	Manufacturing[2]	TCU[3]	Wholesale trade	Retail trade	FIRE[4]	Services	Government[5]
Bingham	Employment	11.7%	3.8%	0.7%	4.1%	14.2%	2.7%	9.4%	12.8%	3.1%	19.9%	17.6%
	Earnings	20.8%	2.0%	1.2%	3.1%	16.7%	2.6%	8.6%	7.0%	2.2%	19.6%	16.1%
Caribou	Employment	12.9%	2.0%	12.3%	8.6%	16.7%	3.9%	2.7%	12.0%	2.7%	11.4%	14.8%
	Earnings	2.6%	0.8%	23.0%	8.6%	33.6%	6.2%	2.0%	6.9%	0.7%	4.3%	11.2%

[1]includes forestry
[2]includes food processing
[3]transportation, communications, public utilities
[4]finance, insurance, real estate
[5]includes federal, both military and civilian, state, and local

Mining activities have also increased sediment and petroleum input into Angus Creek (Platts and Rountree 1973) and sediment in Lanes Creek (Thurow 1981).

Numerous groups are involved in the Blackfoot River subbasin (Table 2.1-13). They include government, quasi-government, civic, non-profit, and volunteer organizations in addition to private companies.

2.2 Water Quality Concerns & Status

The Environmental Protection Agency (EPA), through its Index of Watershed Indicators (IWI), rates the Blackfoot River subbasin at 5 on a scale of 1 to 6 with a score of 6 indicating subbasins with the most serious water quality problems (EPA, Internet communication). The most serious problems as identified by the IWI are wetland loss, aquatic species at risk, agricultural runoff potential, and hydrologic modification.

All pollutant problems with 303(d)-listed waterbodies in the Blackfoot River subbasin are considered non-point source problems. There are no traditional (end-of-pipe) point source National Pollution Discharge Elimination System (NPDES) permits on listed waterbodies. There are and have been NPDES permits associated with EPA Construction General Permit, Multi-Sector General Permit, and stormwater discharges.

There is one Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) site within the Blackfoot River subbasin. An Administrative Order of Consent for South Maybe Canyon Mine Site was entered into by the U. S. Forest Service and Nu-West Mining, Inc., in June 1998 (Jeff Jones, Caribou National Forest, personal communication). The primary reason for the order was the release of hazardous substances, including selenium, from the site.

2.2.1 Water Quality Limited Segments Occurring in the Subbasin

Sixteen waterbodies (streams) were listed on the 1994 and 1996 303(d) list (Table 2.2-1, Figure 2.2-1). On the list, Blackfoot River is divided into three water quality limited segments from the equalizing dam to the headwaters: Fort Hall Main Canal to Wolverine Creek, Wolverine Creek to Blackfoot Dam, upper end of the Reservoir to the headwaters. Blackfoot Reservoir is not listed on the 303(d) list. Tributaries on the list include: Wolverine, Rawlins, Corral, Meadow, Trail (above Blackfoot Reservoir), Slug, Dry Valley, Angus, Lanes, Bacon, Sheep, Diamond, Timothy, Kendall, and Cabin creeks. There are two Trail creeks in the subbasin. The Trail Creek on the 303(d) list is the stream that enters the Blackfoot River near Slug Creek.

The 1998 303(d) list included proposed changes to the list of water quality limited segments. Three waterbodies were added: Brush, Grizzly, and Maybe creeks. Proposed for removal were Rawlins, Timothy, Kendall, and Cabin creeks.

Table 2.1-13. Groups/organizations/agencies involved in the Blackfoot River subbasin.

Type	Organization
Civic/volunteer/nonprofit	Blackfoot River Watershed Council
	Trout Unlimited
	Greater Yellowstone Coalition
Grazing groups	Eastern Idaho Grazing Association
	Idaho Citizen's Grazing Association
	Grace Grazing Association
	Meadow Creek Grazing Association
	Enoch Valley Grazing Association
	Bear Lake Land & Livestock Company
	Chesterfield Land & Livestock Company
	Bear Lake Grazing Company
Quasi-government	Caribou Soil Conservation District
	Central Bingham Soil Conservation District
	North Bingham Soil Conservation District
	Southeast Idaho Council of Governments
Government	City of Blackfoot
	Bingham County
	Caribou County
	Idaho Division of Environmental Quality
	Idaho Department of Fish and Game
	Idaho Department of Lands
	Idaho Department of Water Resources
	Idaho Soil Conservation Commission
	Southeastern Idaho District Health Department
	Shoshone-Bannock Tribes
	Caribou National Forest
	Bureau of Land Management
	Natural Resources Conservation Service
	USDA Plant Materials Center
	Three Rivers Resource, Conservation, and Development
	U. S. Fish and Wildlife Service
	Bureau of Indian Affairs
	Army Corps of Engineers
Active mining interests	Agrium U. S., Inc.
	FMC Corporation
	J. R. Simplot Co.
	Rhodia, Inc.
	Solutia, Inc.

Table 2.2-1. Water quality limited segments in the Blackfoot River subbasin on the 303(d) list including listed pollutants and beneficial uses.

	Water quality limited segment boundary		Length		Source for	Beneficial uses[2]									
						Biota		Salmonid	Contact recreation		Water supply			Wildlife	
Waterbody	Lower	Upper	(mi)	Listed pollutants	listing[1]	Cold water	Warm water	spawning	Primary	Secondary	Domestic	Agricultural	Industrial	habitat	Aesthetics
Blackfoot River	Main Canal	Wolverine Creek	23.9	sediment, nutrients	DEQ, IDFG	Y		Y	Y	Y		Y	Y	Y	Y
	Wolverine Creek	Blackfoot Dam	40.4	sediment, nutrients, flow alteration	DEQ, IDFG	Y		Y	Y	Y		Y	Y	Y	Y
	Blackfoot Reservoir	Headwaters	41.2	sediment, organics	IDFG	Y		Y	Y	Y	Y	Y	Y	Y	Y
Wolverine Creek	Blackfoot River	Headwaters	9.7	sediment, nutrients	DEQ, IDFG	Y		Y		Y		Y	Y	Y	Y
Brush Creek[3]	Blackfoot River	Headwaters	15.3	unknown	DEQ	Y				Y		Y	Y	Y	Y
Rawlins Creek[4]				sediment	IDFG	Y		Y		Y		Y	Y	Y	Y
Corral Creek	Blackfoot River	Headwaters	18.5	sediment	IDFG	Y				Y		Y	Y	Y	Y
Grizzly Creek[3]	Corral Creek	Headwaters	7.4	unknown	DEQ	Y				Y		Y	Y	Y	Y
Meadow Creek	Blackfoot Reservoir	Headwaters	30.9	sediment	IDFG	Y		Y		Y		Y	Y	Y	Y
Trail Creek	Blackfoot River	Headwaters	8.0	sediment	IDFG	Y		Y		Y		Y	Y	Y	Y
Slug Creek	Blackfoot River	Headwaters	23.6	sediment	IDFG	Y				Y		Y	Y	Y	Y
Dry Valley Creek	Blackfoot River	Headwaters	11.1	sediment	IDFG	Y		Y		Y		Y	Y	Y	Y
Maybe Canyon Creek[3]	Dry Valley Creek	Maybe Canyon waste dump	2.9	unknown	DEQ	Y				Y		Y	Y	Y	Y
Angus Creek	Blackfoot River	Headwaters	8.0	sediment	IDFG	Y		Y		Y		Y	Y	Y	Y
Lanes Creek	Blackfoot River	Headwaters	11.3	sediment	IDFG	Y		Y					Y	Y	Y
Bacon Creek	Lanes Creek	Forest Service Boundary	3.0	sediment	IDFG	Y		Y		Y		Y	Y	Y	Y
Sheep Creek	Lanes Creek	Headwaters	7.9	sediment	IDFG	Y		Y				Y	Y	Y	Y
Diamond Creek	Blackfoot River	Headwaters	20.0	sediment	IDFG	Y		Y				Y	Y	Y	Y
Timothy Creek[4]				sediment	IDFG	Y		Y		Y		Y	Y	Y	Y
Kendall Creek[4]				sediment	IDFG	Y		Y		Y		Y	Y	Y	Y
Cabin Creek[4]				sediment	IDFG	Y				Y		Y	Y	Y	Y

[1]based on the 1992 Idaho Water Quality Status Report (Division of Environmental Quality 1992); BLM = Bureau of Land Management, DEQ = Division of Environmental Quality, IDFG = Idaho Department of Fish and Game
[2]beneficial use information from Idaho Water Quality Standards and Wastewater Treatment Requirements and Beneficial Use Reconnaissance Program monitoring
[3]added to 1998 303(d) list
[4]removed from 1998 303(d) list

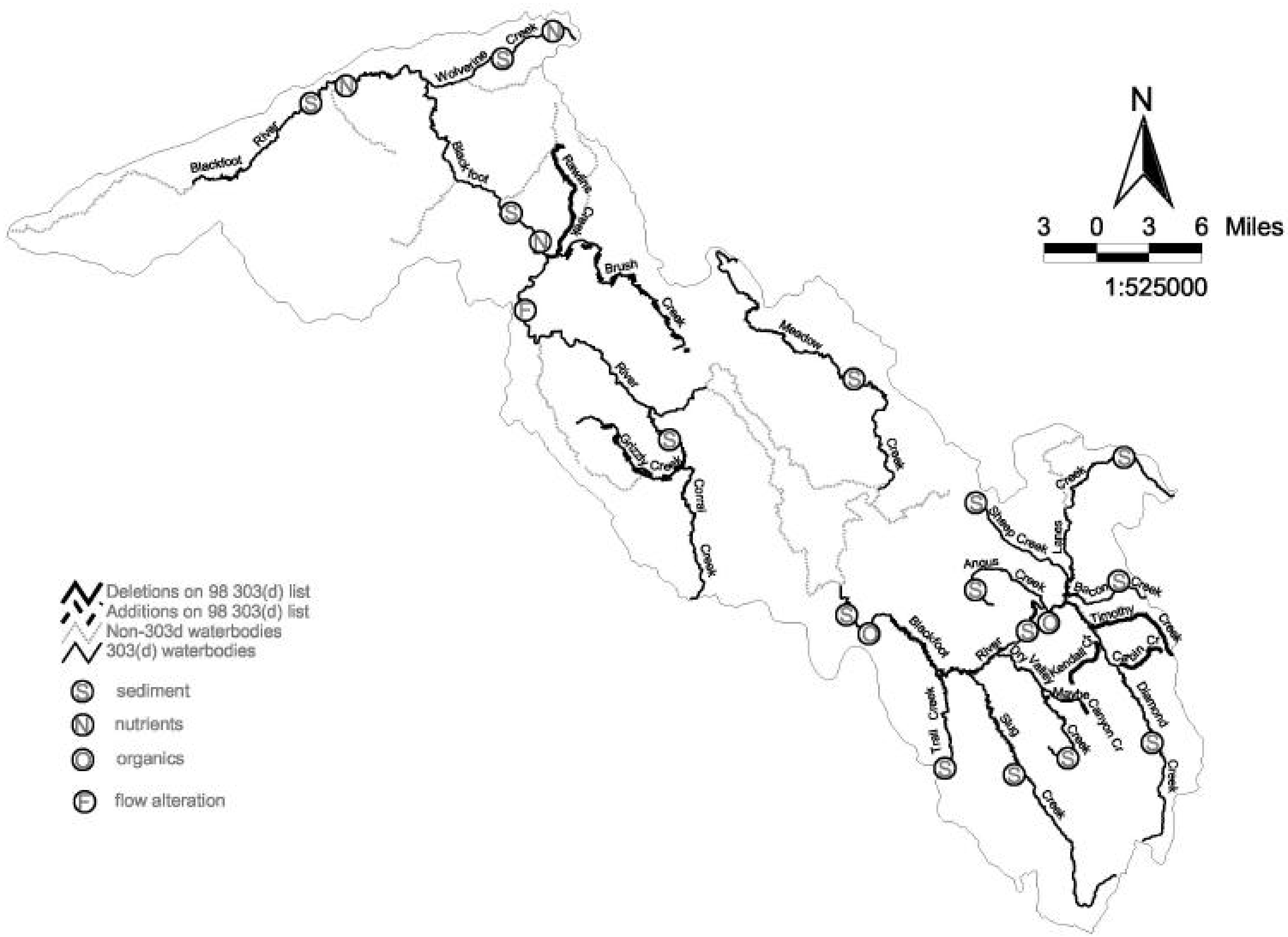


Figure 2.2-1. Blackfoot River subbasin 303(d)-listed waterbodies and pollutants.

Note that the reach of mainstem Blackfoot River below the Fort Hall Main Canal (equalizing dam) is not on the 303(d) list. This segment of river lies within the boundaries of the Fort Hall Reservation and is subject to evaluation by the Tribes.

Sediment is the predominant pollutant on the 303(d) list for the Blackfoot River subbasin (Table 2.2-1). All stream segments on the earlier lists identify sediment as a pollutant. Other recognized pollutants include nutrients, flow alteration, organics, and metals.

2.2.2 Applicable Water Quality Standards

Waterbodies are listed as water quality limited because they do not meet water quality standards. These standards consist of beneficial uses, water quality criteria, and an anti-degradation policy. There are 10 recognized beneficial uses by the State of Idaho: cold and warm water biota; salmonid spawning; primary and secondary contact recreation; domestic, agricultural, and industrial water supply; wildlife habitat; and aesthetics (Table 2.2-1). All waterbodies are considered to support industrial water supply, wildlife habitat, and aesthetics. Cold water biota, secondary contact recreation (e.g., fishing), and agricultural water supply are recognized and existing beneficial uses for all the 303(d)-listed waterbodies in the Blackfoot River subbasin.

Certain criteria are set to define water quality characteristic of a waterbody supporting its beneficial uses. These criteria are set forth by the State of Idaho as water quality standards (Idaho Department of Environmental Quality no date available [nda]). The criteria can be either numeric or narrative. Temperature, dissolved oxygen, turbidity, and fecal coliform are examples of parameters for which numeric criteria exist (Table 2.2-2). Standards may differ according to the beneficial use. For example, to meet the beneficial use for cold water biota, a stream should not exceed an instantaneous temperature of 71.6°F (22°C) or fall below a dissolved oxygen level of 6.0 mg/l. Other numeric standards have been established for pH, dissolved gas, chlorine, toxic substances, ammonia, intergravel dissolved oxygen, and radioactivity (Appendix Table A-1).

Narrative criteria exist for hazardous and deleterious materials; toxic substances; floating, suspended, or submerged matter; excess nutrients; oxygen-demanding materials; and sediment (Idaho Department of Environmental Quality nda). All narrative standards follow similar wording in that criteria exceedances occur when designated beneficial uses are impaired. Criteria for radioactive materials are based on federal regulations found in 10 CFR 20.

Sediment and nutrients are the two most recognized pollutants in southeast Idaho judging from the 303(d) list of water quality limited streams, yet neither has a numeric standard. How then can it be determined that the present level of sediment or nutrients is impacting beneficial use? Targets can be established based on literature that has examined the effect of various levels of sediment or nutrients on stream biota or salmonid spawning. As an example, Idaho Department of Environmental Quality (DEQ) has used concentrations of 50 mg/l and 80 mg/l suspended sediment as targets for both the Lower Boise River and Portneuf River Total Maximum Daily Load plans (Division of Environmental Quality 1998, 1999a). Although some

Table 2.2-2. State of Idaho water quality numeric standards (from Idaho Department of Environmental Quality Water Quality Standards and Wastewater Treatment Requirements). Max = maximum, avg = average, and min = minimum.

	Criteria			
Beneficial use	Dissolved oxygen[1]	Temperature	Turbidity[2]	*E. coli*
Cold Water Biota	>= 6.0 mg/l, instantaneous	<= 22°C, instantaneous; and, <= 19°C, max daily avg	<= 50 NTU, instantaneous; or, <= 25 NTU, for > 10 consecutive days	
Salmonid Spawning	1-day min >= the greater of 6.0 mg/l or 90% saturation	<= 13°C, instantaneous; and, <= 9°C, max daily avg		
Primary Contact Recreation				<= 406 organisms/100 ml, single sample; or, <= geometric mean of 126 organisms/100 ml in min of 5 samples taken every 3-5 days over 30-day period
Seconday Contact Recreation				<= 576 organisms/100 ml, single sample; or, <= geometric mean of 126 organisms/100 ml in min of 5 samples taken every 3-5 days over 30-day period
Domestic Water Supply			increase of <= 5 NTU, when background < 50 NTU; or increase of <= 10%, not to exceed 25 NTU when background > 50 NTU	

[1]criteria for streams only, critieria for lakes and reservoirs differ
[2]above background

targets (i.e., turbidity and intergravel dissolved oxygen) actually correspond to water quality standards, it should be stressed that most of the targets are not standards and thus not legally binding. For phosphorus, EPA (1986) recommended a level not to exceed 0.10 mg/l total phosphorus as a desired goal for the prevention of plant nuisances in streams not discharging directly to lakes or impoundments: total phosphates as phosphorus should not exceed 0.05 mg/l in any stream at the point where the stream enters a lake or reservoir (e.g., Snake River entering American Falls Reservoir).

To assist in the determination of beneficial use support by waterbodies, DEQ developed the Beneficial Use Reconnaissance Program (1996a) and Water Body Assessment Guidance (WBAG; 1996b). The BURP process provides direction for the collection of data. The WBAG uses these data to assess support of beneficial uses.

2.2.3 General Water Quality Summary

The Blackfoot River subbasin is an important trout fishery. Trout populations in the lower Blackfoot River, at one time an excellent fishery, are dependent on Blackfoot Reservoir for both recruitment of trout to the fishery and non-irrigation season (mid-fall to spring) releases of water to maintain trout habitat (Scully et al. 1993). Upper Blackfoot River subbasin tributaries that are important to the fishery include Diamond, Lanes, and Sheep creeks (Thurow 1981).

BLM (1987) surveyed streams within its grazing allotments as to condition of water quality, streambanks, and riparian vegetation. Aside from Wolverine Creek, generally water quality and streambanks were rated as good with riparian vegetation about evenly split between fair and good (Table 2.2-3). Wolverine Creek included poor ratings of both streambanks and riparian vegetation. Overall rating of Wolverine Creek was poor for three of four reaches surveyed.

Below Blackfoot Reservoir

Water quality problems exist in the lower Blackfoot River subbasin. The Bingham County Local Working Group (1997) recognized water quality as the highest priority for the conservation action plan for Bingham County. In addition to problems on streams recognized on the 303(d) list, the group also suggested problems may exist on Jones, Cedar, Lincoln, and Garden creeks. Possible causes of high turbidity observed by Balmer and Noble (1979) in Cold, Garden, Wood, and Deadman creeks were overgrazing, beaver activity, or geologic condition. A small landslide was noted as a contributor of turbidity into Garden Creek.

Crist and Holden (1986) monitored water quality at five stations from the mouth of the Blackfoot River to the Trail Creek bridge. They found generally good water quality in the upper section with increases in nutrient and turbidity levels observed at downstream sites leading to a degradation of water quality. Agricultural activities, primarily irrigation and subsequent return flows into the Blackfoot River, and City of Blackfoot municipal activities (e.g., storm water)

Table 2.2-3. Condition of water quality, streambank, and riparian vegetation of streams in the Blackfoot River subbasin on Bureau of Land Management grazing allotments (from BLM 1987).

			Parameter condition (miles of stream)												
			Water quality				Streambank				Riparian vegetation				Overall
Waterbody	Reach	Miles	Excellent	Good	Fair	Poor	Excellent	Good	Fair	Poor	Excellent	Good	Fair	Poor	rating
Blackfoot River	bel Wolverine Cr	1.1		1.1				1.1				1.1			Good
	ab Wolverine Cr	1		1				1				1			Good
	between Wolverine & Cedar creeks	0.9		0.9				0.9				0.9			Good
	between Wolverine & Cedar creeks	0.5		0.5				0.5					0.5		Fair
	just ab Cedar Cr	1.1		1.1				1.1				1.1			Good
	between Cedar & Miner creeks	3.7		3.7				3.7				3.7			Good
	between Cedar & Miner creeks	1.2		1.2				1.2				1.2			Good
	between Cedar & Miner creeks	0.1			0.1				0.1				0.1		Fair
	just bel Miner Creek	0.4		0.4				0.4				0.4			Good
	just ab Miner Creek	0.2		0.2				0.2					0.2		Fair
	Miner Creek to ab Grave Cr	2.3		2.3				2.3					2.3		Fair
	Miner Creek to ab Grave Cr	4.4		4.4				4.4				4.4			Good
	Miner Creek to ab Grave Cr	3		3				3					3		Fair
	Miner Creek to ab Grave Cr	1.9		1.9				1.9					1.9		Fair
	ab Grave Cr	2.7		2.7				2.7					2.7		Fair
	about Sagehen Campground	0.2		0.2				0.2				0.2			Good
	about Sagehen Campground to Res	0.3		0.3				0.3				0.3			Good
	about Sagehen Campground to Res	1.9		1.9				1.9					1.9		Fair
	about Sagehen Campground to Res	2.05		2.05				2.05				2.05			Good
Blackfoot River total		28.95		28.85	0.1			28.85	0.1			16.35	12.6		
Wolverine Creek		0.25			0.25					0.25				0.25	Poor
		0.75			0.75					0.75				0.75	Poor
		0.2			0.2					0.2			0.2		Poor
		1.2		1.2				1.2				1.2			Good
Wolverine Creek total		2.4		1.2	1.2			1.2	0	1.2		1.2	0.2	1	
Jones Creek		0.8			0.8				0.8				0.8		Fair
Beaver Creek		0.2		0.2				0.2				0.2			Good
Brush Creek		0.5		0.5				0.5				0.5			Good
Deadman Creek		0.25		0.25				0.25					0.25		Fair
Supon Creek		0.1			0.1			0.1					0.1		Fair
Grave Creek		0.4			0.4			0.4					0.4		Fair
Negro Creek		0.45		0.45				0.45					0.45		Fair
Meadow Creek		0.4		0.4					0.4				0.4		Fair
Caldwell Canyon		0.25			0.25				0.25			0.25			Good
Unnamed tributary		0.5			0.5				0.5				0.5		Fair
Dry Valley Creek		0.3		0.3				0.3				0.3			Good
Lanes Creek		0.3		0.3					0.3			0.3			Fair
Browns Canyon		0.6		0.6				0.6				0.6			Good
Corrailsen Creek		1.3		1.3				1.3				1.3			Good
Lander Creek		0.4		0.4					0.4				0.4		Fair

were attributed as the main cause of this downstream deterioration in water quality. Lower temperatures, turbidity, and sediment loads at upper sites resulted in higher support of salmonids.

Drewes (1987) monitored several streams near lower Trail Creek and Reid Valley for suspended sediment, bacteria, nitrogen, and phosphorus from November 1986 to July 1987. He noted three areas of mass wasting - Blackfoot River between the USGS gage site near Shelley and Reid Bridge; Jones Creek; and Cedar Creek - contributing to the sediment load in the Blackfoot River. Drewes quantified sediment input from mass wasting on Blackfoot River only at 6.17 tons. Contact recreation standards for fecal coliform were exceeded in Jones, Cedar, and Miner creeks. Total inorganic nitrogen (nitrate, nitrite, ammonia) exceeded 0.3 mg/l in all streams (Blackfoot River, Wolverine Creek, Jones Creek, and Cedar Creek) except Miner Creek. Exceedances were more prevalent at the lower rather than upper sites. All streams exceeded a concentration of 0.1 mg/l of total phosphorus during Drewes' study.

Idaho Department of Fish and Game evaluated substrate and habitat characteristics on four sites on both Brush and Rawlins creeks in 1991 (Scully et al. 1993). Pool/run to riffle ratio averaged 10.5:1 in Brush Creek and 3:1 in Rawlins Creek (Table 2.2-4). Sand represented less than 15% in riffles at all sites while in pool substrates sand ranged from 17% to 96% in Brush Creek and 9% to 47% in Rawlins Creek.

Royer and Minshall (1998) found high levels of surface fine sediment in the Blackfoot River below Blackfoot Dam. Mean substratum embeddedness averaged 71% at a mainstem Blackfoot River site, just above Morgan Bridge, in October 1996.

Information on fecal coliform numbers in lower Blackfoot River subbasin appears to be limited. The Southeastern District Health Department (personal communication) sampled water behind the equalizing dam in June and July of 1992. Fecal coliform values were less than 1 colony/100 ml of water on both dates. Fecal streptococcus numbered 17 colonies and 1 colony/100 ml, respectively.

Proper Functioning Condition (PFC) assessments have been done throughout the Blackfoot River subbasin. The BLM effort focused on its lands, mostly downstream of Blackfoot Reservoir. At the request of the Blackfoot River Watershed Council, the Idaho Soil Conservation Committee spearheaded a team of landowners and agency personnel (e.g., Idaho Department of Lands, Idaho Department of Fish and Game, Idaho Department of Environmental Quality, Natural Resources Conservation Service, Caribou National Forest) to do PFC surveys on various tributaries throughout the subbasin. These Proper Functioning Condition assessments indicate nonfunctioning, in terms of managing energy of flowing water, stream segments throughout the Blackfoot River subbasin (Appendix Table B-1). In addition to the mainstem Blackfoot River, stream reaches that were not properly functioning were found in Wolverine, Jones, Rawlins, Horse, Deadman, Grave, Dry Valley, Lanes, Corrailsen, and Diamond creeks. Not coincidentally, nonfunctioning stream reaches also tended to have a greater percentage of unstable streambanks than properly functioning reaches.

Table 2.2-4. Substrate and habitat characteristics of Brush and Rawlins creeks (from Scully et al. 1993).

Site	Mean depth (m)	Mean width (m)	Surface area (m^2)	Percent slope	Percent substrate type: Sand	Gravel	Rubble/ boulder	Bedrock	Percent habitat types: Run & pool	Riffle	Pocket water	Percent sand in riffle	Percent sand in pool
Brush													
Lower 1	0.16	5.3	539	0.9	19	8	15	58	42	5	8	2	17
Lower 2	0.22	6.0	526	0.0	96	4	0	0	100	0	0	4	96
Upper 3	0.22	5.8	564	0.2	54	38	8	0	100	0	0	0	54
Upper 4	0.14	3.4	330	0.9	69	15	16	0	75	25	0	13	57
Mean	0.19	5.1	490	0.5	60	16	10	15	79	7.5	2	5	56
Rawlins													
Lower 1	0.13	4.3	341	5.0	21	35	10	34	58	8	34	3	13
Lower 2	0.22	3.0	294	0.4	47	40	13	0	92	8	0	0	47
Upper 3	0.16	3.4	461	0.4	33	67	0	0	83	17	0	2	20
Upper 4	0.10	2.1	202	0.9	58	39	3	0	41	59	0	5	9
Mean	0.15	3.2	325	1.7	40	45	6.5	8.5	68.5	23	8.5	2.5	22

Analysis of diatom (algae) communities indicate that biological condition of the Blackfoot River deteriorates in a downstream direction. Two sites were sampled in 1997 (near Grave Creek campground and Slug Creek) and one in 1998 (just downstream of Reservation Canal). The campground and Slug Creek sites scored 22 and 28, respectively, in the River Diatom Index (RDI; Fore 2000). An RDI of 28 is well within the fair biological condition category while 22 is on the cusp of fair and poor. The lower site had an RDI rating of 16, well within the poor category of biological condition.

Above Blackfoot Reservoir

McSorley (1977) monitored water quality in the upper Blackfoot River subbasin from just below the dam to the confluence of Lanes and Diamond creeks, including one site on Diamond Creek. He concluded that overall the water quality in the area was excellent. He measured levels of phosphorus sufficient to support summer algal blooms in Blackfoot Reservoir. Singh and Ralston (1979) also concluded water quality of streams in the upper Blackfoot River was very good.

Several areas have been identified as having water quality problems. Platts and Primbs (1975) in their work on upper Angus Creek found, among other things, high temperatures, high amounts of suspended sediment, and high concentration of nutrients (i.e., phosphates, nitrates, nitrites). In the late 1970s, based on macroinvertebrate sampling, Platts and Andrews (1980) declared that the upper Blackfoot River and its tributaries (Mill, Angus, Diamond, and Kendall creeks) more closely resemble unpolluted streams of southeastern Idaho than polluted streams. Only Diamond Creek and lower Angus Creek had macroinvertebrate communities indicative of some stress. Reaches of Bacon Creek include high percentages of fines in the substrate (Appendix Table C-1) and degraded channel characteristics such as lack of riparian vegetation, channel braiding, and downcutting (IDFG, personal communication).

Recent sampling in the upper Blackfoot River subbasin has been associated with phosphate mining. Mariah Associates (1990) concluded that Dry Valley Creek and adjacent Blackfoot River showed signs of environmental disturbance. Sediment levels were high (Appendix Table C-1) and macroinvertebrate densities were low. Rich (1999) mentioned low stream flows, high water temperatures, and lack of spawning and rearing habitat in upper Dry Valley Creek as the main reasons behind lack of trout in the upper reaches. Salmonid spawning habitat is limited in Dry Valley Creek due to high levels of fine sediment in the stream substrate (Rich 1999). In their study of Spring and Mill creeks, Mariah Associates (1991a) reported good water quality but poor benthic invertebrate populations in Spring Creek associated with significant amounts of fine material in the substrate. They attributed the input of fine material to below normal precipitation (which can result in lower spring flows responsible for moving fine sediment) and streamflow and cattle grazing resulting in stream bank erosion and subsequent streambed sedimentation. In 1993, Mariah monitored two intermittent streams, NDR and Goodheart, concluding that water quality in NDR Creek was similar to that in Spring and Mill creeks, while water quality in Goodheart showed effects of mining in the drainage (Mariah Associates 1993a). In their 1992a report they noted good water quality in Angus, Rasmussen, No Name, and Sheep creeks. Turbidity measurements collected by Mariah Associates (1992a) from 1990 to 1992 in Angus and Sheep creeks were well within limits for trout. Only upper Angus Creek at a site located just downstream of a previously mined area showed degraded water quality.

Macroinvertebrate communities were also sampled in Dry Valley Creek and the adjacent Blackfoot River (Rich 1999). Various consultants concluded that macroinvertebrate communities in Dry Valley Creek were low in diversity due to habitat degradation. In upper Dry Valley Creek, macroinvertebrates were comprised of species associated with soft sediments, organic enrichment, and submerged aquatic macrophytes. Rich also found moderately low diversity values in the Blackfoot River indicating some disturbance, most likely erosion and organic and nutrient inputs associated with livestock grazing.

The Caribou National Forest has monitored several streams in the upper Blackfoot River subbasin that cross the forest. From a fish habitat perspective, the streams were generally in good overall condition (Table 2.2-5). Presence of macroinvertebrate species tolerant to sediment and organic enrichment were noted in most streams. Only Lanes and Browns Canyon creeks exhibited a good population of clean water species. Ratings of aquatic habitat resulted in most streams falling into either the very high or high category (Table 2.2-6).

Representatives from the Idaho Chapter of the American Fisheries Society looked at physical characteristics on state lands on three streams in the upper Blackfoot River subbasin in 1994 (Scully et al. 1998) and 1995 (IDFG, unpublished data). The Blackfoot River section (just upstream of Angus Creek) had only 51% of its streambanks considered stable. A high percentage of fine sediment on the streambed surface (Appendix Table C-1), low number of riffles, and actively eroding streambanks were also noted in this reach. In the Diamond Creek section of state land (just upstream of Kendall Creek), fine sediment represented 34% of stream substrate (Appendix Table C-1) and bank stability was 70%. This section of the stream had been influenced by human activity (channel straightening, livestock grazing) and displayed few undercut banks, shallow pool depth, and lack of cover. In Lanes Creek (state section that includes Corrailsen Creek), the percentage of surface fines was 33% (Appendix Table C-1) and bank stability averaged 70%.

Sampling by USGS indicates some organochlorine compound contamination in fish in the upper Blackfoot River near Henry. Although levels were not substantial enough for discussion in the narrative of the report, Maret and Ott (1997) did detect DDT breakdown products (p,p’-DDD and p,p’-DDE), dieldrin, and total DDT in carp.

Blackfoot Reservoir

Blackfoot Reservoir is located about in the middle of the subbasin and is an influence on lower Blackfoot River water quality. The reservoir can be classified as eutrophic based on clarity (Table 2.2-7; Perry 1977) and water quality (Thurow 1981). Chlorophyll *a* and nutrient levels indicate the reservoir is also highly productive (USACE 1974; Thurow 1981). Thurow found nitrogen to be the limiting factor in algal growth. Maximum temperature in the reservoir observed by Thurow in the reservoir in 1980 was 24°C (Table 2.2-7).

Table 2.2-5. Fish habitat ratings by Caribou National Forest (1992) of upper Blackfoot River subbasin streams on the forest.

Waterbody	Macroinvertebrate status (clean water species/species tolerant to sediment and organic enrichment)	Rating: Water quality	Aquatic habitat	Substrate	Riparian & stream channel	Biotic Condition Index[1]	Overall
Blackfoot River	impacted/dominant				unstable		fair to good
Slug Creek	some/dominant				not assessed		not assessed
Maybe Canyon Creek	absent/some				unstable	poor	fair
Angus Creek	scarce/dominant				unknown	good	unknown
Mill Canyon Creek	some/some				unknown		good
Lanes Creek	good/low	good		good	stable		fair to good
Daves Creek	low/low				unknown	fair	fair
Browns Canyon Creek	good/some	good		good	stable		good to excellent
Diamond Creek	present/dominant	good	improved	adequate	stable		fair to good
Kendall Creek	present/dominant				unknown		good
Campbell Creek	adequate/some				unknown	good	good
Bear Canyon Creek	some/sufficient to be of concern				unknown	excellent	good

[1]how close an aquatic ecosystem is to its own potential from Winget and Mangum 1979

Table 2.2-6. Aquatic habitat ratings by Caribou National Forest of upper Blackfoot River subbasin streams on the forest, 1999 (from unpublished data).

Waterbody	Site	Aquatic habitat conservation[1]
Blackfoot River	National Forest	Very high
Dry Valley Creek	National Forest	Moderate
Maybe Canyon Creek	National Forest	Moderate
Angus Creek	National Forest	High
Rasmussen Creek	National Forest	High
Mill Canyon Creek	National Forest	High
Mill Creek	National Forest	High
Lanes Creek	National Forest	High
Bacon Creek	National Forest	Very high
Sheep Creek	National Forest	Very high
Daves Creek	National Forest	High
Browns Canyon Creek	National Forest	Very high
Corrailsen Creek	National Forest	Very high
Olsen Creek	National Forest	High
Lander Creek	National Forest	High
Diamond Creek	National Forest	Very high
Timothy Creek	National Forest	Very high
Kendall Creek	National Forest	High
Cabin Creek	National Forest	High
Yellowjacket Creek	National Forest	High
Campbell Canyon Creek	National Forest	High
Terrace Canyon Creek	National Forest	High
Coyote Creek	National Forest	High
Hornet Canyon Creek	lower 0.25 miles	High
	upper	High
Bear Canyon Creek	lower	Moderate
	upper	Moderate
Timber Creek	National Forest	High
	South Fork	High
Stewart Creek	National Forest	High
South Stewart Creek	National Forest	High

[1]streams with a very high rating show the following characteristics: rich in native species biodiversity; used for spawning and rearing of native fishes, including trout; presesence of rare species or habitat; angling use common

streams with a high rating show the following characteristics: native fish species common, but diversity may be lacking; used for spawning or rearing of native fishes, including trout; occasional angling use

streams with a moderate rating show the following characteristics: native species uncommon; potential for a use by native or desirable introduced fishes exist

Table 2.2-7. Temperature and clarity data from Blackfoot Reservoir, July and October, 1980 (from Thurow 1981).

Area	Date	Site	Water depth (m)	Maximum temperature (^{o}C)	Clarity (Secchi disk - m)
South end (nr Dike Lake)	15-Jul	1	2.0	22	0.7
		2	3.3		1.1
		3	4.7		1.6
	21-Oct	1	2.2	9	2.2
		2	2.2		2.2
		3	3.9		2.6
Islands (Sheep to Cinder)	16-Jul	1	5.2	22	3.0
		2	3.2		2.1
		3	3.3		2.2
	22-Oct	1	6.9	7.8	1.1
		2	5.1		0.9
		3	3.2		1.0
East bay (nr Henry)	17-Jul	1	2.6	24	2.2
		2	2.2		1.6
		3	2.6		1.0
	23-Oct	1	1.3	9	0.9
		2	4.1		3.2
North end (nr dam)	18-Jul	1	1.4	21.5	0.7
	19-Jul	2	8.8		2.3
		3	9.4		2.2
	24-Oct	1	1.1	9	0.8
		2	9.7		1.2
		3	5.2		1.5

Scully et al. (1993) reported that water quality in Blackfoot Reservoir in summer of 1991 was poor for trout with surface temperatures generally too high and bottom dissolved oxygen concentrations too low to provide ‘usable’ trout habitat. Mid-day sampling on the 20^{th} and 21^{st} of August showed mean dissolved oxygen concentrations ranging from 5.0 to 6.4 mg/l at the surface and 3.2 to 4.7 mg/l near the bottom. Temperatures ranged from 21.1°C (70°F) to 23.8°C (75°F) at the water surface and 18.5°C (65°F) to 19.9°C (68°F) at the bottom. Scully et al. also noted a heavy plankton bloom of *Aphanizomenon*, a blue-green algae, in the upper reservoir area.

Blackfoot Reservoir has experienced some fish kills in recent years. According to Idaho Department of Fish and Game (Richard Scully, personal communication), the last reported fish kill was in 1993 just after ice-off. The previous fall the reservoir was drawn down to 6% volume that most likely resulted in depletion of oxygen in the shallow areas of the remaining pool.

2.2.4 Summary and Analysis of Existing Water Quality Data

Water quality standards consist of both uses and their criteria. Because of the narrative nature of sediment and nutrient criteria, many waterbodies appear on the 303(d) list because they are considered to not support their beneficial uses (Table 2.2-8). Few reports on the Blackfoot River speak directly to support of beneficial uses.

The following is a discussion by identified pollutant in the Blackfoot River subbasin. For each pollutant, a summary analysis of existing data and inventory of pollutant sources are presented. Data gaps are also identified.

Please note in the discussion of sediment and nutrients, an analysis is attempted to identify trends in the input of these pollutants in Blackfoot River subbasin. Some of the best data for trying to establish reductions, or increases, in pollutants are typically from USGS surface-water stations. The advantage of USGS data is that the information has been collected in the same way from the same site on a relatively consistent basis. Unfortunately, only one USGS surface-water station (13068500, Blackfoot River near Blackfoot) has been monitored on a relatively consistent basis with information dating back to 1971. This station is located below the listed waterbodies in the Blackfoot River subbasin and thus data represent not only the listed waterbodies but also any additional water (e.g., irrigation return water) entering the Blackfoot River between the equalizing dam and the gage site.

Flow Alteration

Summary Analysis

Flow alteration can have substantial impacts on water quality and aquatic biota. For example, water quality in lower Blackfoot River is a function of supply water from the reservoir, Snake River (via irrigation canals), and irrigation return flows (USACE 1974). Flow alteration occurs both as a result of the Blackfoot Dam and irrigation withdrawals. Such withdrawals have

Table 2.2-8. Status of 303(d)-listed waterbodies in the Blackfoot River subbasin as to support of their beneficial uses (from DEQ BURP data).

		Overall waterbody support status			Beneficial uses			Site support status		
Waterbody	Beneficial uses[1]	Full	Needs verification	Not full	not supported	Site	Year	Full	Needs verification	Not full
				303(d) Streams						
Blackfoot River	CWB, SS, PCR, SCR, DWS, AWS									
Wolverine Creek	CWB, SS, SCR, AWS		X		CWB	lower	1994		X	
						upper	1994	X		
					CWB	lower	1997		X[3]	
						upper	1997		X[3]	
Brush Creek	CWB, SCR, AWS			X	CWB	lower	1996			X
						upper	1996			X
Rawlins Creek	CWB, SS, SCR, AWS	X				lower	1995	X		
						upper	1995	X		
Corral Creek	CWB, SCR, AWS			X	CWB	lower	1994			X
						upper	1994			X
					CWB	lower	1997			X[3]
						upper	1997			X[3]
Grizzly Creek	CWB, SCR, AWS			X	CWB		1996			X
Meadow Creek	CWB, SS, SCR, AWS		X		CWB	lower	1995	X		
						upper	1995		X	
Trail Creek (nr Slug)	CWB, SS, SCR, AWS		X		CWB		1996		X	
Slug Creek	CWB, SCR, AWS			X	CWB	lower	1994			X
						upper	1994			X
						lower	1997		X[3]	
						upper	1997	X[3]		
Dry Valley Creek	CWB, SS, SCR, AWS			X	CWB	lower	1995		X	
						upper	1995			X
Maybe Canyon Creek	CWB, SCR, AWS		X		CWB		1995		X	
Angus Creek	CWB, SS, SCR, AWS			X	CWB	lower	1995			X
						upper	1995			X
Lanes Creek	CWB, SS, SCR, AWS					lower	1997	X[3]		
						upper	1997	X[3]		
Bacon Creek	CWB, SS, SCR, AWS		X		CWB	lower	1995		X	
						upper	1995		X	
Sheep Creek	CWB, SS, SCR, AWS						1997	X[3]		
Diamond Creek	CWB, SS, SCR, AWS					lower	1997	X[3]		
						upper	1997	X[3]		
Timothy Creek	CWB, SS, SCR, AWS	X				lower	1995	X		
						upper	1995	X		
Kendall Creek	CWB, SS, SCR, AWS	X					1995	X		
Cabin Creek	CWB, SCR, AWS	X					1995	X		
				Non-303(d) Streams						
Jones Creek	CWB, SCR, AWS						1998			
Cedar Creek	CWB, SCR, AWS		X		CWB		1994		X	
Trail Creek (nr Brush)	CWB, SCR, AWS			X	CWB		1995			X
Horse Creek	CWB, SCR, AWS		X		CWB		1996		X	
Poison Creek	CWB, SCR, AWS		X		CWB		1995		X	
Deadman Creek	CWB, SCR, AWS						1997		X[3]	
Johnson Creek	CWB, SCR, AWS			X	CWB	lower	1996			X
						upper	1996	X		
Goodheart Creek	CWB, SCR, AWS						1998			
Mill Canyon Creek	CWB, SCR, AWS						1998			
Mill Creek	CWB, SCR, AWS						1998			
Daves Creek	CWB, SCR, AWS						1997	X[3]		
Chippy Creek	CWB, SCR, AWS						1997		X[3]	
Olsen Creek	CWB, SCR, AWS						1997	X[3]		
Campbell Canyon Creek	CWB, SCR, AWS						1998			
Coyote Creek	CWB, SCR, AWS						1998			
Bear Canyon Creek	CWB, SCR, AWS						1998			
Timber Creek	CWB, SCR, AWS	X					1996	X		
Stewart Canyon Creek	CWB, SCR, AWS						1998			

[1]beneficial use information from the Idaho Water Quality Standards and Wastewater Treatment Requirements and Beneficial Use Reconnaisance Program monitoring. CWB=cold water biota, SS=salmonid spawning, PCR=primary contact recreation, SCR=secondary contact recreation, DWS=domestic water supply, AWS=agricutural water supply. Industrial water supply, wildlife habitat, and aesthetics are designated uses of all waterbodies.

[2]data inconclusive as to support, additional information needed

[3]1997 Macroinvertebrate Biotic Index score was calculated differently than 1994-1996 scores. Support status for 1997 sites was assessed the same as 1994-1996 sites.

at times dewatered lower portions of Diamond Creek (Richard Scully, IDFG, personal communication).

Flow alteration is a listed pollutant for the section of Blackfoot River from Blackfoot Dam downstream to Wolverine Creek (Table 2.2-1). However, DEQ's position is that flow alteration, while it may adversely affect beneficial uses, is not a pollutant per section 303(d) of the Clean Water Act. There are no Idaho water quality standards for flow, nor is it suitable for estimation of load capacity or load allocations. Because of these practical limitations, TMDLs will not be developed to address flow alteration.

For many water quality limited waters on Idaho's 303(d) list, this position will have little effect on implementation plans. This is because concerns that resulted in a listing for flow alteration are often reflected in listed pollutants - sediment or temperature, for example. In such cases, actions taken to address these related pollutants will likely address flow as well. In other cases, alternate control strategies would be applied outside the TMDL process.

The effects on support of beneficial uses and water quality in lower Blackfoot River due to flow alteration resulting from Blackfoot Reservoir are unknown. Confounding the quantification of any changes is the input of out-of-basin water via Reservation Canal.

Flow alteration changes the hydrology of channels causing severe erosion to the channel bottom and banks (Scott Engle, NRCS/Blackfoot, personal communication). The addition of irrigation water from the Snake River through the Reservation Canal to the Blackfoot River has caused severe down cutting and bank erosion in the segment between Wolverine Creek and the Equalizing Reservoir. This erosion has changed the channel and appears to have increased the sediment load in this segment dramatically. This type of erosion and subsequent sediment production is very difficult and expensive to correct.

Sediment

Summary Analysis

The majority of water quality limited streams include sediment as a pollutant affecting beneficial uses (Table 2.2-1). Both sediment suspended in the water column and deposited in stream substrate affect beneficial uses. Higher levels (> 100 mg/l) of suspended sediment have been observed in mainstem Blackfoot River and Wolverine, Jones, Cedar, Miner, Brush, Dry Valley, Maybe Canyon, Angus, and Timber creeks (Appendix Table D-1).

Heimer (1978) monitored turbidity and suspended sediment in the Blackfoot River in 1975 and 1976. He noted high turbidities (Table 2.2-9) at the lower Blackfoot River site and high (> 100 mg/l) suspended sediment (Appendix Table D-1) at both sites. In 1975 at the Interstate 15 bridge, he estimated mean daily suspended sediment discharge at 485 tons/day with a high of 53,067 tons/day in June and a low of 0 tons/day in September. In the upper Blackfoot River subbasin, at the Highway 34 bridge, mean daily suspended sediment discharge in 1975 was estimated at 47 tons/day with a high of 8,256 tons/day in May and a low of 0 tons/day in March,

Table 2.2-9. Turbidity concentrations in the Blackfoot River subbasin, 1975 and 1976 (from Heimer 1978).

			Turbidity concentrations (NTU[1]) by sampling event													
			March		April		May		June		July		August		September	
Waterbody	Site	Year	1	2	1	2	1	2	1	2	1	2	1	2	1	2
Blackfoot River	Interstate 15 bridge	1975	52	10	7	54	35	37			7	7	1	10	3	5
	Interstate 15 bridge	1976	75	275	60	48	40	59	20	20		10		27		
	Morgan Bridge	1975							5	8	3	2	3	8	6	2
	Government Dam bridge	1975				3	6	2	5	9	1	2	1	5	4	3
	Highway 34 bridge	1975	2	2	3	4	4	20	4	7	2	2	2	2	2	15
	Highway 34 bridge	1976					6	27	32	31	23	2	2		2	50
	Trail Creek bridge	1975						44	4	6	5	1	2	2	1	2
	Diamond Creek bridge	1975			5				12	4	2	1	1	2	1	1
Lanes Creek	Sheep Lane	1975						20	20	22	3	1	2		1	40
Diamond Creek	Diamond Creek bridge at lower crossing	1975			1					5	2	1	1	1	1	1
	Diamond Creek bridge at lower crossing	1976						16	15	17	3	3	2		1	60
	Bear Canyon	1975								8	2	1	2	1	3	1
	Scout Camp	1975			2					9	2	1	2	1	1	1

[1]nephelometric turbidity units

April, July, and August. It should be noted that the Interstate 15 bridge site is below the 303(d)-listed section of the Blackfoot River. However, the listed section of the Blackfoot River would contribute to these loads.

USGS has sampled suspended sediment at surface-water stations since 1970. In recent years monitoring has been limited to the gage near the City of Blackfoot. Since 1989, the average concentration of suspended sediment from measurements taken March to November has decreased from 179 mg/l to 142 mg/l (Table 2.2-10). This reduction, however, was not significant at the 95% level (Table 2.2-11).

Results from sampling in several streams in the Blackfoot River subbasin have pointed to high levels of streambed sediment. Streams with greater than 30% surface or subsurface sediment less than 6.3 mm include mainstem Blackfoot River, Wolverine, Brush, Rawlins, Horse, Poison, Deadman, Negro, Corral, Slug, Dry Valley, Angus, Rasmussen, No Name, Spring, Mill, Lanes, Bacon, Sheep, Lander, and Diamond creeks (Table 2.2-12, Appendix Table C-1).

Pollutant Sources

Various sources are responsible for additional, i.e., above natural, input of sediment into Blackfoot River subbasin streams. Drewes (1987) identified agricultural runoff, range and fenced cattle, and mass wasting as major contributors of sediment in the lower Blackfoot River (downstream of lower Trail Creek). McSorley (1977) reported most sediment input into the upper Blackfoot River was natural, although he did note degraded streambanks due to livestock grazing. Cattle grazing appears to have had a significant impact on fish habitat in Dry Valley Creek (Rich 1999). Heimer et al. (1987) proposed that construction of a large slurry line and maintenance road in Diamond Creek in the 1980's contributed to increased levels of sediment in historic cutthroat trout spawning areas. In a ten-mile stretch above the Equalizing Reservoir, the stream channel is at least 10 feet deep and is laterally cutting many raw banks. This is probably caused by large flows from the Reservation Canal entering the Blackfoot River. Below the Equalizing Reservoir, the channel has been straightened, incised, and part of the water diverted to a flood channel. The reduced flow causes much less channel erosion than is present in the area of the Equalizing Reservoir (Scott Engle, NRCS/Blackfoot, personal communication). Roads and stream channels are also contributors of sediment to streams (Scott Engle, NRCS/Blackfoot, personal communication). Some people have observed increased streambank erosion in the lower Blackfoot River in recent years, which has been attributed to winter and high runoff releases of water from Blackfoot Reservoir (Bingham County Local Working Group 1997).

Historically, agriculture was a substantial contributor of sediment to the Blackfoot River. Roberts (1977) reported that non-irrigated agriculture was the single largest contributor of sediment in Caribou County. In Bingham County, although acres of dry cropland have been reduced decreasing sediment input into Blackfoot River subbasin streams, remaining dry cropland and irrigated cropland still contribute some sediment to streams (Scott Engle, NRCS/Blackfoot, personal communication). Areas where livestock overwinter may also be contributing sediment to streams. USDA (1979) reported erosion rates for rangeland in the

Table 2.2-10. Descriptive statistics summary for sediment and nutrients monitored at USGS surface-water stations in the Blackfoot River subbasin.

Parameter	Time period	Number of samples	Mean (mg/l)	Standard error
near Blackfoot (13068500)				
Suspended sediment	1971-1981	16	179.313	48.070
	1989-1997	41	141.854	48.581
	1971-1997	57	152.368	37.302
Dissolved nitrite + nitrate	1971-1981	25	0.875	0.634
	1989-1997	49	0.196	0.033
	1971-1997	74	0.425	0.216
Dissolved ammonia	1990-1997	43	0.028	0.004
Total inorganic nitrogen	1990-1997	43	0.229	0.039
Total ammonia + organic nitrogen	1989-1997	52	0.387	0.028
Total nitrogen	1989-1997	49	0.586	0.040
Total phosphorus	1971-1981	24	0.123	0.023
	1989-1997	52	0.058	0.010
	1971-1997	76	0.079	0.010
Dissolved ortho phosphorus	1989-1997	52	0.011	0.002
near Henry (13065500)				
Dissolved nitrite + nitrate	1971-1981	23	0.209	0.067
Total phosphorus	1970-1981	23	0.114	0.029

Table 2.2-11. Results of an analysis of covariance (from Grabow et al. 1998) between early (1971-1981) and late (1989-1997) periods for sediment and nutrients monitored at USGS surface-water station 13068500, Blackfoot River near Blackfoot. The covariate with suspended sediment, dissolved nitrate/nitrite, and total phosphorus is flow.

Parameter	Observations	Test	Population parameters tested	*p* -value	Significant[1]
Suspended sediment	57	Y-intercept & slope	Y-intercept	0.527	No
			Slope	0.474	No
	57	Y-intercept only	Y-intercept	0.618	No
Dissolved nitrate/nitrite	74	Y-intercept & slope	Y-intercept	0.277	No
			Slope	0.183	No
	74	Y-intercept only	Y-intercept	0.220	No
Total phosphorus	76	Y-intercept & slope	Y-intercept	0.777	No
			Slope	0.426	No
	76	Y-intercept only	Y-intercept	0.007	Yes[2]

[1]significance determined at 95% level

[2]denotes a significant decrease from early to late period

Table 2.2-12. Percent by volume of sediment less than 6.3, 2.0, and 0.85 mm in streambeds in the Blackfoot River subbasin.

Stream	Site	Date	Percent by volume			Source
			< 6.3 mm	< 2.0 mm	< 0.85 mm	
Blackfoot River	bel Dry Valley Creek	Spring, 1989		17.3		Mariah Associates 1990
	bel Dry Valley Creek	Fall, 1989		13.6		Mariah Associates 1990
	ab Dry Valley Creek	Spring, 1989		6.4		Mariah Associates 1990
	ab Dry Valley Creek	Fall, 1989		37.3		Mariah Associates 1990
Wolverine Creek	Lower	Summer, 2000	36.3		16.2	DEQ, unpublished data
	Upper	Summer, 2000	41.5		16.1	DEQ, unpublished data
Brush Creek	Lower	Summer, 2000	44.9		14.6	DEQ, unpublished data
	Middle	Summer, 2000	24.4		9.5	DEQ, unpublished data
Horse Creek		Summer, 2000	24.8		7.6	DEQ, unpublished data
Poison Creek		Summer, 2000	43.8		14.8	DEQ, unpublished data
Corral Creek	Upper	Summer, 2000	23.1		9.1	DEQ, unpublished data
Grizzly Creek	Upper	Summer, 2000	28.1		9.1	DEQ, unpublished data
Meadow Creek		Summer, 2000	25.1		10.8	DEQ, unpublished data
Dry Valley Creek	lowest	Spring, 1989		3.7		Mariah Associates 1990
	lowest	Fall, 1989		6.9		Mariah Associates 1990
	lower	Spring, 1989		2.1		Mariah Associates 1990
	lower	Fall, 1989		36.8		Mariah Associates 1990
	Pit A	Summer, 2000	58.4		27.4	DEQ, unpublished data
	Maybe Canyon Creek	Summer, 2000	22.1		6.9	DEQ, unpublished data
	middle	Spring, 1989		46.3		Mariah Associates 1990
	Pit C	Summer, 2000	19.8		3.9	DEQ, unpublished data
	upper	Spring, 1989		66.3		Mariah Associates 1990
	upper	Fall, 1989		71.0		Mariah Associates 1990
	USFS boundary	Summer, 2000	76.3		39.8	DEQ, unpublished data
Angus Creek	near mouth	30-Sep-99	35.2			DEQ, unpublished data
	lower	Oct-90		7.0		Mariah Associates 1992a
	lower	May-91		1.0		Mariah Associates 1992a
	lower	May-92		7.0		Mariah Associates 1992a
	lower	Summer, 2000	31.9		11.8	DEQ, unpublished data
	middle	Oct-90		75.0		Mariah Associates 1992a
	middle	May-91		36.0		Mariah Associates 1992a
	middle	Oct-91		13.0		Mariah Associates 1992a
	middle	Summer, 2000	44.5		17.9	DEQ, unpublished data
	upper	Oct-90		41.0		Mariah Associates 1992a
	upper	May-91		24.0		Mariah Associates 1992a
	upper	Oct-91		16.0		Mariah Associates 1992a
	upper	May-92		23.0		Mariah Associates 1992a
Rasmussen Creek	middle	Oct-90		38.0		Mariah Associates 1992a
	middle	May-91		74.0		Mariah Associates 1992a
	middle	Oct-91		37.0		Mariah Associates 1992a
	middle	May-92		64.0		Mariah Associates 1992a
	upper	Oct-90		25.0		Mariah Associates 1992a
	upper	May-91		1.0		Mariah Associates 1992a
	upper	May-92		46.0		Mariah Associates 1992a
No Name Creek	lowest	May-91		18.0		Mariah Associates 1992a
	lower	May-91		<1		Mariah Associates 1992a
	lower	May-92		3.0		Mariah Associates 1992a
	middle	Oct-90		32.0		Mariah Associates 1992a
	middle	May-91		33.0		Mariah Associates 1992a
	middle	Oct-91		98.0		Mariah Associates 1992a
	middle	May-92		13.0		Mariah Associates 1992a
	upper	Oct-90		37.0		Mariah Associates 1992a
	upper	May-91		24.0		Mariah Associates 1992a
	upper	Oct-91		13.0		Mariah Associates 1992a

Table 2.2-12. Continued.

Stream	Site	Date	Percent by volume < 6.3 mm	< 2.0 mm	< 0.85 mm	Source
Spring Creek	lower	Oct-90		32.0		Mariah Associates 1991a
	lower	Oct-91		35.0		Mariah Associates 1993a
	lower	May-92		29.0		Mariah Associates 1993a
	upper	Oct-90		19.0		Mariah Associates 1991a
	upper	Oct-91		17.0		Mariah Associates 1993a
	upper	May-92		12.0		Mariah Associates 1993a
Mill Creek		Oct-91		1.0		Mariah Associates 1993a
		Oct-92		12.0		Mariah Associates 1993a
Sheep Creek	lowest	Oct-90		7.0		Mariah Associates 1992a
	lowest	Oct-91		15.0		Mariah Associates 1992a
	lowest	May-92		10.0		Mariah Associates 1992a
	lower	Summer, 2000	34.9		9.2	DEQ, unpublished data
	lower	Oct-90		87.0		Mariah Associates 1992a
	lower	Oct-91		67.0		Mariah Associates 1992a
	lower	May-92		13.0		Mariah Associates 1992a
	middle	Oct-90		9.0		Mariah Associates 1992a
	middle	Oct-91		10.0		Mariah Associates 1992a
	middle	May-92		16.0		Mariah Associates 1992a
	upper	Oct-90		14.0		Mariah Associates 1992a
	upper	Oct-91		20.0		Mariah Associates 1992a
	upper	May-92		7.0		Mariah Associates 1992a
	tributary	Oct-90		47.0		Mariah Associates 1992a
	tributary	Oct-91		15.0		Mariah Associates 1992a
	tributary	May-92		11.0		Mariah Associates 1992a

upper Snake River Basin, which includes the Blackfoot River subbasin, averaged less than 1 ton/acre/year. This erosion rate is quite low especially when compared to reported erosion rates from dryland agriculture in the area of up to 18 tons/acre/year before the cropland was converted to CRP and pasture (Scott Engle, NRCS/Blackfoot, personal communication).

Sediment input has been identified as the greatest pollutant on forest lands within the subbasin influencing channel stability and fisheries habitat (Lee Leffert, Caribou National Forest, personal communication). Soil erosion rates averaged 0.3034 tons/acre/year on the Caribou National Forest from 1981 to 1990 (Caribou National Forest 1992). In terms of sediment actually finding its way into a stream, the Caribou National Forest (1985) estimated 0.006 tons of sediment per acre per year, or a total of 775 tons, were delivered to stream channels from the 129,182 acres of forest land within the Blackfoot River subbasin. In the same report, increase in sediment yield above natural levels on the national forest was estimated at 15% with much of the increase attributed to mining activities.

Several reports speak to sediment yield by land use in the Blackfoot River subbasin. Mining activities and non-irrigated agriculture had the highest rate of estimated sediment input into subbasin streams (Table 2.2-13).

Data Gaps

Some very good sediment data exists especially for those streams within the phosphate mining area. Information for other streams is limited (e.g., Bacon Creek) or older (e.g., Meadow, Trail creeks). Many streams have no data regarding subsurface stream sediment (i.e., depth fines). Newer data related to sediment yield by land use would be preferred over existing information that is at least 20 years old.

Linkage of targets for sediment levels and support of beneficial uses is not easy. For example, Platts and Rountree (1973) found fines on the stream bottom in Angus Creek to be 63% and, despite this high percentage of fine material, Angus Creek still supported a high density of cutthroat trout at the time.

Nutrients

Summary Analysis

Only the Blackfoot River below Blackfoot Dam and Wolverine Creek are listed for nutrients (Table 2.2-1). Nutrient data have been collected throughout the subbasin although much of the information is prior to 1990 (Appendix Table E-1). Nitrate, nitrite, and ammonia are forms of nitrogen that are readily available for plant uptake and together represent the total amount of inorganic nitrogen present in a waterbody. Streams in which concentrations of total inorganic nitrogen greater than 0.3 mg/l have been documented since 1990 include mainstem Blackfoot River, primarily below the dam, and Wolverine, Cedar, Beaver, Deadman/Supon, Corral, Dry Valley, Chicken, Maybe Canyon, Caldwell, Stewart (Dry Valley Creek watershed), and Mill creeks. Other streams may have exceeded 0.3 mg/l of total inorganic nitrogen but have

Table 2.2-13. Erosion rates and sediment yield by land use applicable to the Blackfoot River subbasin.

Drainage area	Erosion rate (tons/acre/year)							Sediment yield (tons/acre/year)								Source
	Non-irrigated cropland	Irrigated cropland	Rangeland	Woodland	Mining	Other[1]	Channel	Non-irrigated cropland	Irrigated cropland	Rangeland	Woodland	Mining	Other[1]	Channel	Overall	
Upper Snake River								2.2	0.7	0.06						SCS 1974 (cited in Roberts 1977)
										0.26						IDECS 1973
	5.64	2.82	0.3					1.59	0.35	0.09	0.12					IDHW 1977
Blackfoot River in Caribou County bel dam	3.0	2.0	0.4	0.2		1.0		1.65	0.80	0.20	0.08		0.30			Roberts 1977
Blackfoot River dam to bel Trail Creek	3.0	1.0	0.3	0.1	5.0	3.0		1.80	0.43	0.15	0.03	3.50	1.50			Roberts 1977
Blackfoot River bel Trail Creek upstream	2.0	2.0	0.4	0.1	6.0	2.0		1.00	1.00	0.24	0.04	4.20	0.80			Roberts 1977
Blackfoot River at the Narrows			0.06[2]	0.06[2]											0.058	Kelly 1977
Maybe Canyon Creek[3]															0.139	Kelly 1977
Angus Creek[3]															0.042	Kelly 1977
Mill Creek[3]															0.025	Kelly 1977
Sheep Creek[3]															0.028	Kelly 1977
Diamond Creek[3]															0.076	Kelly 1977
Stewart Creek[3]															0.079	Kelly 1977

[1]includes urban, recreation, transportation, utilities, etc.
[2]combination of rangeland and woodland
[3]includes only national forest lands

not been sampled in the last 10 years. Total phosphorous levels greater than 0.1 mg/l, EPA's (1986) recommended level for prevention of plant nuisance in streams not directly discharging into a lake or reservoir, have occurred in almost all of the streams sampled.

Long term nutrient information is available only from USGS monitoring at their gage site near the City of Blackfoot. Mean concentration of total inorganic nitrogen (nitrate + nitrite + ammonia) from 49 samples taken from 1990 to 1997 was 0.229 mg/l (Table 2.2-10). Total nitrogen averaged 0.586 mg/l over the same time period. It appears that most of the total nitrogen monitored is organic in nature. Mean concentration of total phosphorous measured at the gage site was 0.058 mg/l from 1989-1997 (Table 2.2-10). Dissolved ortho phosphorous represented about 20% of total phosphorous.

Concentrations of both dissolved nitrate and nitrite and total phosphorous have declined between 1971-1981 and 1989-1997 (Table 2.2-10). Analysis of covariance (using nitrate/nitrite or phosphorus and flow as covariates) detected a significant decline for only total phosphorous between the two periods and then only when the Y-intercept was tested (Table 2.2-11).

The Blackfoot River subbasin is probably nitrogen limited. Perry (1977) stated that nitrogen:phosphorus ratios in Blackfoot Reservoir indicate nitrogen limitation. Comparison of nitrogen (dissolved nitrate and nitrite) and phosphorus (total phosphorous) concentrations at USGS gage sites near Blackfoot and Henry from 1971-1981 indicate greater difference in nitrogen levels between the two sites than phosphorous levels. If nitrogen were limiting, as theorized by Perry, then uptake of nitrogen, for example in the reservoir, would result in lower concentrations of nitrogen at downstream sites as seen at the gage site.

Pollutant Sources

Input sources for nitrogen are related to human activities. Rupert (1996) reported that, except for precipitation, there are no known sources of naturally occurring nitrate in the upper Snake River basin, which includes the Blackfoot River subbasin. It is assumed that Rupert was referring to geologic deposits of nitrates rather than potential nitrate sources associated with naturally occurring plants and animals. Primary sources of nitrogen in the upper Snake River basin are fertilizer (45%), cattle manure (29%), legume crops (19%), precipitation (6%), and domestic septic systems (< 1%).

McSorley (1977) noted possible sources of nitrogen and phosphorus in the Blackfoot River above Blackfoot Dam. Sources of nitrogen include livestock and human wastes from recreational camping areas. The main source of phosphorus is from the phosphoria formation in the area. Livestock and use of phosphate fertilizer also contribute to phosphorus input into the stream.

Data Gaps

Recently collected nutrient data is limited. More information from throughout the year would be beneficial. Although nutrients contribute to eutrophication of the reservoir (Perry

1977; Thurow 1981), data regarding the effects of nutrients in the mainstem Blackfoot River are minimal.

Organics

Summary Analysis

Only the segment of the Blackfoot River from the reservoir to the headwaters is listed as having problems with organics (Table 2.2-1). No information was reviewed that indicated organics were affecting beneficial uses in the Blackfoot River. It is unknown at this time what information led to listing organics as a pollutant of concern in the upper Blackfoot River or to exactly what organics the listing refers. Therefore, no loading analysis for organics was done.

Organics may be a problem in lower Blackfoot River. Periphyton analysis from a site in the lower Blackfoot River just downstream from Reservation Canal indicated that organic loading was a minor cause of impairment in this area (the Academy of Natural Sciences, letter to Idaho Department of Environmental Quality summarizing periphyton analysis at sampled sites).

Pollutant Sources

Source of organic input is unknown.

Data Gaps

Information is needed to determine the extent that organic loading is affecting beneficial uses in the lower Blackfoot River.

Metals

Summary Analysis

Metals are a problem in the Blackfoot River. Platts and Martin (1978) expressed concerns for levels of metals, especially iron and mercury, in upper Blackfoot River and tributaries.

Rich (1999) noted high levels of metals in Dry Valley Creek and adjacent Blackfoot River. Aluminum and selenium were consistently about EPA Acute Criteria. Metals consistently around EPA Chronic Criteria included aluminum, cadmium, copper, lead, mercury, selenium, and zinc. Although the ferrous and ferric forms of iron were not differentiated, levels indicate that iron could be a concern in the area streams. Examination of fish collected in Dry Valley Creek noted concentrations of several metals (i.e., cadmium, copper, selenium, vanadium, and zinc) in muscle tissue, liver, and kidneys that were high enough to be considered stressful to fish.

In June of 1998, the Forest Service decided that the South Maybe Canyon mine site fell under CERCLA rules (Jeff Jones, Caribou National Forest, personal communication). Presently, the Forest Service is working with Nu-West Industries on identifying the scope of any release or threatened release of hazardous substances to the environment at or from the site. Selenium has been identified as one of the hazardous substances emanating from the site. As Maybe Canyon Creek is currently under Forest Service regulatory control and efforts are already underway to characterize the extent of hazardous substances effects on the environment with the intention of remediating the problem(s), no loading analysis is proposed.

At present, although Maybe Canyon Creek is on the 303(d) list, pollutants that contribute to the water quality limited designation are unknown (2.2-1). It is expected the Remedial Investigation/Feasibility Study in Maybe Canyon will discover which pollutants contribute to exceedances of water quality standards and potential impairment of beneficial uses.

Pollutant Sources

Input of selenium, and other metals, above natural background levels into streams in the upper Blackfoot River can be attributed to phosphate mining activities. Other possible sources of metals input are unknown.

Data Gaps

Identification of all sources of metals input above natural levels is needed. Sampling of other Blackfoot River tributaries that are within the phosphate mining area is ongoing with a more extensive area-wide effort planned for field season 2001. The results will help identify if any pollutants are contributing to water quality problems in Blackfoot River and tributaries.

DEQ recommends that the TMDL for Maybe Canyon Creek (listed for unknown pollutant) be deferred until the year 2002. The reason this TMDL will be deferred is to allow for completion of the South Maybe Canyon Mine Site Investigation and the Southeast Idaho Phosphate Resource Area Wide Investigation. These investigations will be establishing the baseline data for existing conditions of the subject stream segments, and if necessary, for listing the appropriate contaminants of concern.

Presently, an Administrative Order on Consent established for the South Maybe mine site has resulted in early actions to identify the major sources of contamination. Because the quality of the surface water in the region has indicated elevated levels of selenium and, possibly, other metals, an Area Wide Investigation (AWI) led by DEQ is underway. The objectives of the AWI are to determine the focus of potential site-specific remedial actions and to evaluate the potential effects of site-related contamination on ecological receptors. This AWI will provide DEQ and other supporting agencies with the information needed to make further risk-management decisions.

Future monitoring of removal actions, water quality, sediment quality, and populations /communities of impacted ecological receptors will continue throughout the region. Assessment of the effectiveness of any subsequent removal actions, aimed at reducing threats to human health and the environment, will also continue. Non-time critical removal actions are planned for all impacted sites in the resource area to determine actions required to achieve acceptable protection of human health and the environment at the sites. Once completed, records of decision for each mine site will be issued by the appropriate lead agencies.

Upon issuance of the South Maybe Canyon mine site investigation and the area wide-investigation results, DEQ will reassess Maybe Canyon Creek to determine if water quality standards are being met with respect to listed or proposed pollutants. If it is determined that water quality standards are not being met, TMDLs will be completed for this waterbody to supplement the remedial action goals and objectives.

Temperature

Summary Analysis

Although no stream in the Blackfoot River subbasin is listed as having temperature problems, exceedances of state water quality standards have been observed. Long term monitoring of temperature at USGS surface-water station near Blackfoot has documented criteria exceedances for cold water biota (instantaneous temperature not to exceed 22°C [71.6°F]) over the last 10 years (Appendix Table F-1). Balmer and Noble (1979) documented temperatures higher than 22°C in Lincoln Creek in 1975 and 1976 and Deadman Creek in 1976. Other streams that have experienced high temperatures exceeding the instantaneous cold water biota standard include upper Blackfoot River and Wolverine, Dry Valley, Chicken, and Maybe Canyon creeks (Appendix Table D-1). Thurow (1981) measured a temperature of 24°C in Blackfoot Reservoir in 1980 (Table 2.2-7).

In his work on the upper Blackfoot River, Thurow (1981) determined that cutthroat trout spawn in May and June with fry emerging from July to October. Based on this life history, instantaneous temperature exceedances of 13°C for salmonid spawning were observed in virtually all streams for which there was even a modicum of information (Appendix Table D-1).

Continuous monitoring information is available for the upper Blackfoot River subbasin (Table 2.2-14). These data showed temperature exceedances for cold water biota and salmonid spawning in Blackfoot River, Angus Creek, and Spring Creek. Diamond Creek has experienced temperatures that exceed state water quality standards for salmonid spawning.

Pollutant Sources

Sources for these temperature exceedances in the Blackfoot River subbasin are unknown. High temperatures may be natural or may result from reduction of stream cover thereby increasing thermal input, or activities that lead to increased width to depth ratio thereby exposing more stream surface area to thermal input.

Table 2.2-14. Continuous temperature monitoring in the Blackfoot River subbasin.

				Number of exceedances				
				Cold water biota		Salmonid spawning		
Waterbody	Site	Begin date	End date	Instantaneous (22°C)	Daily average (19°C)	Instantaneous (13°C)	Daily average (9°C)	Source
Blackfoot River	bel confluence of Lanes & Diamond creeks	7-Jul-98	4-Oct-98	12	0	80	84	DEQ, unpublished data
Angus Creek	mouth	1-Jul-99	15-Oct-99	13	0	85	87	IDFG, unpublished data
	at Rasmussen Valley Road	18-Jun-99	24-Oct-99	0	0	92	100	IDFG, unpublished data
	bel haul road	18-Jun-99	29-Sep-99	0	0	98	85	IDFG, unpublished data
	Little Long Valley	18-Jun-99	29-Sep-99	0	0	97	84	IDFG, unpublished data
	bel pond spillway	18-Jun-99	29-Sep-99	13	50	100	104	IDFG, unpublished data
Spring Creek	mouth	7-Jul-98	4-Oct-98	15	0	75	82	DEQ, unpublished data
Diamond Creek	mouth	15-Aug-98	13-Oct-98	0	0	42	46	DEQ, unpublished data

Data Gaps

Causes for increased temperatures in the Blackfoot River and tributaries are unknown. Information is needed to evaluate the extent to which instantaneous temperatures of greater than 13°C affect salmonid spawning and incubation. Effects of exceedances of cold water biota criteria also need to be evaluated.

This information will be taken into account in the formulation of Idaho’s next 303(d) list. As no streams are currently 303(d)-listed for temperature and significant data gaps exist, no temperature TMDLs will be prepared at this time.

Dissolved Oxygen

Summary Analysis

No stream in the Blackfoot River subbasin has been listed on the 303(d) list for having dissolved oxygen problems. Little dissolved oxygen data are available. Sporadic violations of the dissolved oxygen minimum of 6.0 mg/l for cold water biota have occurred in Blackfoot Reservoir (Scully et al. 1993); mainstem Blackfoot and Little Blackfoot rivers (Appendix Table D-1); and Dry Valley, Chicken, Maybe Canyon, Caldwell, Stewart, and Timber creeks (Appendix Table D-1).

The magnitude of these exceedances varies. The water quality criterion of 6.0 mg/l dissolved oxygen was exceeded twice in the upper Blackfoot on 20 Nov 96 below Dry Valley Creek and 25 Jun 97 above Dry Valley Creek (Appendix Table D-1). The period of record for sampling Blackfoot River below and above Dry Valley Creek is 1989 to 1998 and includes a total of 59 sampling events below and 57 above. Documentation of exceedances in Little Blackfoot River, Stewart Creek, and Timber Creek are about 20 years old (Appendix Table D-1). Regarding Timber Creek, BURP monitoring indicates the creek is supporting its beneficial uses (Table 2.2-8). Dissolved oxygen does appear to be a chronic problem in reaches of Dry Valley Creek watershed (Appendix Table D-1). Exceedances have been observed in the late 1970s and again in mid-to-late 1990s. For lower Dry Valley Creek exceedances occurred only 7% of the time (7 exceedances/96 samples). At the upper Dry Valley Creek, only 2 exceedances, the last in 1989, were observed in 54 sampling events (4%). About 10% of the samples in lower Maybe Canyon Creek exceeded the dissolved oxygen criterion. In Chicken Creek 7 of 59 (12%) sampling events recorded dissolved oxygen exceedances while 1 of 2 samples in Caldwell Creek in 1998 had a dissolved oxygen concentration below 6 mg/l.

Pollutant Sources

Causes of these dissolved oxygen violations in the Blackfoot River subbasin are unknown. Low dissolved oxygen levels may be natural, but, more likely, result from increased oxygen demand for respiration by aquatic plants, decomposition of organic material, or reduction of chemical compounds. Higher water temperatures reduce the capacity of the water to retain oxygen. Thus, higher temperatures, potentially coupled with low flow in poor water years, could lead to lower levels of dissolved oxygen.

Data Gaps

Although exceedances of dissolved oxygen standards have been documented, the extent of exceedances varies. Information as to extent and cause of exceedances is especially needed in those streams where more consistent violations have occurred, such as Dry Valley, Chicken, Maybe Canyon, and Caldwell creeks.

This information will be taken into account in the formulation of Idaho's next 303(d) list. As no streams are currently 303(d)-listed for dissolved oxygen and significant data gaps exist, no dissolved oxygen TMDLs will be prepared at this time.

Bacteria

Summary Analysis

No stream in the Blackfoot River subbasin is listed for bacteria on the 303(d) list. However, exceedances of the primary or secondary contact recreation water quality standards of 500 and 800 colonies/100 ml, respectively, have been documented in Blackfoot River near Blackfoot (Appendix Table D-1, Appendix Table F-1). Drewes (1987) noted fecal coliform exceedances in Jones, Cedar, and Miner creeks (Appendix Table D-1). Although not specifically designated to support primary contact recreation, exceedances of instantaneous and geometric mean standards were documented by DEQ (unpublished data) in both Brush and Rawlins creeks (Table 2.2-15). Both creeks also exceeded the state secondary contact recreation standard of not more than 10% of total samples taken over a 30-day period shall exceed 400 colonies/100 ml.

Pollutant Sources

Fecal coliform bacteria originate in warm-blooded animals. Drewes (1987) attributed bacteria exceedances in his study to livestock and human sources.

Data Gaps

More data are needed to identify sources of bacterial contamination in both mainstem Blackfoot River and tributaries. Data should be gathered on *E. coli*, now the parameter upon which bacteria exceedances are determined (Idaho Department of Environmental Quality nda).

This information will be taken into account in the formulation of Idaho's next 303(d) list. As no streams are currently 303(d)-listed for bacteria and significant data gaps exist, no bacteria TMDLs will be prepared at this time.

Table 2.2-15. Recent fecal coliform monitoring by the Idaho Department of Environmental Quality.

				Fecal coliform (colonies/100 ml)	
Waterbody	Date	Use[1]	Site	Instantaneous	Geometric mean[2]
Blackfoot River	31-Aug-98	PCR/SCR	ab Reservation Canal	50	
	17-Sep-97	PCR/SCR	Grave Creek campground	5	
	17-Sep-97	PCR/SCR	Slug Creek bridge	30	
Wolverine Creek	8-Sep-99	SCR	Blackfoot River Road crossing	30	
Cedar Creek	8-Sep-99	SCR	nr Blackfoot River Road	170	
Brush Creek	Sep-99	SCR	Paradise Road		132[3]
Rawlins Creek	Sep-99	SCR	near mouth		82
Corral Creek	8-Sep-99	SF/SCR	nr Blackfoot Reservoir Road	10	
Corral Creek	8-Sep-99	SCR	between Bear and Indian creeks	160	
Meadow Creek	8-Sep-99	SCR	near mouth	50	
Little Blackfoot River	7-Sep-99	ND/SCR	between Long and Enoch valleys	< 10	
Trail Creek	7-Sep-99	SF/SCR	nr mouth	60	
Slug Creek	7-Sep-99	SCR	just ab Dry Canyon	50	
Slug Creek	7-Sep-99	SCR	bel Horseshoe Spring	110	
Goodheart Creek	7-Sep-99	ND/SCR	nr Forest Service boundary	70	
Angus Creek	7-Sep-99	SCR	nr State Land	20	
Rasmussen Creek	7-Sep-99	ND/SCR	nr Stocking Ranch	30	
Diamond Creek	16-Jul-98	SF/SCR	nr mouth	7	

[1]PCR=primary contact recreation, SCR=secondary contact recreation, ND=PCR not determined, SF=flow sufficient (i.e., > 5 cfs) to support PCR

[2]geometric mean of 5 samples within 30 days

[3]includes instantaneous samples that exceed primary contact recreation standard of 500 colonies/100 ml

Unknown

Streams added to the 1998 303(d) list did not identify a pollutant affecting beneficial uses (Table 2.2-1). As mentioned previously, Maybe Canyon Creek will be sampled extensively to determine pollutants affecting beneficial uses.

No extensive sampling is planned for Brush and Grizzly creeks. Based on land use and human activity in these two watersheds, possible pollutants could likely be sediment and temperature. Both streams would be required to meet targets identified in the sediment loading analysis that will dictate some action under the implementation plan. DEQ will monitor Brush and Grizzly creeks as to support of beneficial uses resulting from suggested changes in the implementation plan.

2.2.5 Summary

Various methods have been used to evaluate water quality and stream conditions in the Blackfoot River. Techniques used depended on goals of the evaluators. For example, land management agencies (e.g., Bureau of Land Management, Forest Service) tend to focus monitoring on stream bank stability, channel stability, and fish habitat. DEQ and consultants for mining companies have collected more water chemistry data.

Table 2.2-16 is an attempt to summarize findings from various entities that have worked in the Blackfoot River. Age of data vary and caution must be used in interpreting the table as conditions may have changed.

For the most part, information presented in the table confirm a stream's listing on the 303(d) list. For example, Wolverine Creek is on the 303(d) list for both nutrients and sediment (Table 2.2-1). Beneficial Use Reconnaissance Program indicates that information is insufficient to conclude that Wolverine Creek is supporting its beneficial uses. However, exceedances of temperature criteria have occurred for both cold water biota and salmonid spawning. Proper Functioning Condition surveys indicate all but one mile of the lower eight miles of Wolverine Creek are nonfunctioning or functional at risk and sections of Wolverine Creek on BLM allotments have been rated poor.

2.2.6 Streams Fully Supporting Beneficial Uses

Several streams within the Blackfoot River subbasin are fully supporting their beneficial uses (Table 2.2-8). From information gathered as part of BURP, the following streams from headwaters to mouth are fully supporting their beneficial uses: Rawlins, Timothy, Kendall, and Cabin creeks. Except for Rawlins Creek, additional sources of data confirm delisting these streams (Table 2.2-16). Fecal coliform sampling in 1999 in Rawlins Creek exceeded state water quality criteria for secondary contact recreation. In addition, although not directly related to

Table 2.2-16 . Evaluations of streams in the Blackfoot River subbasin by various agencies and methods. Exceedances of state standards - temperature, fecal coliform, dissolved oxygen - are noted only when criteria were exceeded.

Site	303(d) listed	Beneficial use support[1]	Exceedances of state water quality criteria: Temperature[2] CWB	Temperature[2] SS	Fecal coliform[3] PCR	Fecal coliform[3] SCR	Dissolved oxygen[4]	Proper functioning condition[5]	Stream channel stability rating[6]	DAT rating[7]	BCI rating[8]	Overall rating BLM allotment[9]	Percent depth fines[10]	Total phosphorus > 0.05 mg/l or > 0.1 mg/l[11]	Fish habitat rating[12]	Aquatic habitat conservation rating[13]	Historic support of migratory cutthroat trout spawning[14]
Blackfoot R - bel Main Canal			Yes	Yes	Yes	Yes								Yes			
Blackfoot R - Main Canal to Wolverine Cr	Yes			Yes				FAR/PF				Good		Yes			
Blackfoot R - Wolverine Cr to Blackfoot Dam	Yes			Yes				FAR/N/PF				Good/fair		Yes			
Blackfoot R - Blackfoot Res to headwaters	Yes		Yes	Yes			Yes	FAR	Fair				6.4-37.3	Yes	Good/fair	Very high	
Wolverine Creek	Yes	NV	Yes	Yes				N/FAR/PF				Good/poor	36.3-41.5	Yes			
Jones Creek						Yes		N				Fair		Yes			
Cedar Creek		NV				Yes								Yes			
Miner Creek						Yes								Yes			
Beaver Creek				Yes				PF				Good					
Trail Creek		NFS															
Brush Creek	Yes	NFS				Yes		FAR				Good	24.4-44.9				
Rawlins Creek	Yes	FS				Yes		FAR/N									
Horse Creek		NV						FAR/N					24.8				
Poison Creek		NV						PF/FAR					43.8				
Deadman Creek			Yes	Yes				N				Fair					
Supon Creek												Fair					
Grave Creek								N				Fair					
Negro Creek								FAR/PF				Fair					
Corral Creek	Yes	NFS						PF/FAR					23.1				
Grizzly Creek	Yes	NFS											28.1				
Blackfoot Reservoir			Yes														
Meadow Creek	Yes	NV		Yes								Fair	25.1	Yes			
Little Blackfoot River				Yes			Yes										Yes
Trail Creek	Yes	NV		Yes										Yes			
Slug Creek	Yes	NFS						PF	Good					Yes			
Caldwell Canyon												Good					
Johnson Creek		NFS							Good								
Burchertt Creek									Poor								
Goodheart Creek									Fair					Yes			
Dry Canyon Creek									Fair								
North Fork Slug Creek									Fair								
Dry Valley Creek	Yes	NFS	Yes	Yes			Yes	FAR/N/PF	Good			Good	2.1-76.3	Yes		Moderate	Yes
Chicken Creek			Yes	Yes			Yes							Yes			
Maybe Canyon Creek	Yes	NV	Yes	Yes			Yes	N/PF		Good/poor	Fair/poor				Fair	Moderate	
Caldwell Creek							Yes										
Angus Creek	Yes	NFS	Yes	Yes				PF/FAR	Good		Good		1-75	Yes		High	Yes
Rasmussen Creek				Yes				FAR					1-74	Yes		High	Yes
No Name Creek													<1-98	Yes			
Mill Canyon Creek								FAR	Good							High	
Spring Creek			Yes	Yes					Excellent/good				12-35	Yes			Yes
Mill Creek				Yes				FAR					1-12	Yes	Good	High	
Lanes Creek	Yes			Yes				N/PF/FAR	Good to poor			Fair		Yes	Good/fair	High	Yes
Bacon Creek	Yes	NV						FAR	Excellent to fair							Very high	Yes
Sheep Creek	Yes			Yes				FAR	Good to poor				7-87	Yes		Very high	Yes
Revelles Creek																	Yes
Daves Creek								FAR	Good		Fair				Fair	High	Yes
Browns Canyon Creek								FAR	Excellent to poor			Good			Excellent/good	Very high	Yes
Corrailsen Creek								N/FAR				Good				Very high	
Olsen Creek								FAR	Good							High	Yes
Lander Creek								FAR/PF				Fair				High	

Table 2.2-16. Continued

Site	303(d) listed	Beneficial use support[1]	Exceedances of state water quality criteria: Temperature[2] CWB	Temperature[2] SS	Fecal coliform[3] PCR	Fecal coliform[3] SCR	Dissolved oxygen[4]	Proper functioning condition[5]	Stream channel stability rating[6]	DAT rating[7]	BCI rating[8]	Overall rating BLM allotment[9]	Percent depth fines[10]	Total phosphorus > 0.05 mg/l or > 0.1 mg/l[11]	Fish habitat rating[12]	Aquatic habitat conservation rating[13]	Historic support of migratory cutthroat trout spawning[13]
Diamond Creek	Yes			Yes				PF/FAR/N	Good to poor	Good/fair	Good/poor			Yes	Good/fair	Very high	Yes
Timothy Creek	Yes	FS						FAR	Good/fair							Very high	Yes
Kendall Creek	Yes	FS						FAR	Good					Yes	Good	High	Yes
Cabin Creek	Yes	FS						PF								High	
Yellowjacket Creek								PF								High	
Campbell Canyon Creek								FAR		Fair	Good				Good	High	
Terrace Canyon Creek								PF								High	
Coyote Creek								PF								High	
Hornet Canyon Creek								PF/FAR								High	
Bear Canyon Creek								FAR/N		Good	Excellent				Good	Moderate	
Timber Creek		FS					Yes	FAR		Good	Good			Yes		High	
Stewart Creek							Yes	FAR	Good							High	Yes

[1]FS=full support, NV=needs verification, NFS=not full support, from Table 2.2-8

[2]CWB=cold water biota, SS=salmonid spawning, from Tables 2.2-7 and 2.2-14, Appendix Tables D-1 and F-1, and Balmer and Noble (1979)

[3]PCR=primary contact recreation, SCR=secondary contact recreation, from Table 2.2-15, Appendix Tables D-1 and F-1, and Southeastern District Health Department (personal communication)

[4]from Appendix Table D-1, exceedances of 6 mg/l dissolved oxygen for cold water biota

[5]PF=properly functioning, FAR=functional at risk, N=non functioning, from Table B-1. Order of conditions based on most to least prevalent condition in the stream/reach.

[6]from Tables 2.1-6 and 2.1-8

[7]from Table 2.1-7

[8]from Tables 2.1-7 and 2.2-5

[9]from Table 2.2-3

[10]from Table 2.2-12, range of values from sites sampled

[11]from Appendix Table E-1, thresholds based on EPA (1986) recommendation total phosphate as phosphorus (in this case total phosphorus concentration used) not exceed 0.05 mg/l for streams discharging to a reservoir (Meadow Creek, Little Blackfoot River, Black River - Reservoir to headwaters) and total phosphorus not exceed 0.1 mg/l for streams not discharging into a reservoir (all other streams)

[12]from Table 2.2-5

[13]from Table 2.2-6

[14]from Thurow 1980a, 1980b, 1981, spawning areas of fish which mature in Blackfoot Reservoir or mainstem Blackfoot River and spawn in upper Blackfoot River mainstem and tributaries

beneficial use support, a Proper Functioning Condition survey of Rawlins Creek indicated problems.

2.3 Summary of Past and Present Pollution Control Efforts

Most efforts to improve water quality in the Blackfoot River have been undertaken by the Natural Resources Conservation Service and Bingham and Caribou soil conservation districts. The projects have concentrated on erosion control from farm fields and reducing impacts of livestock on riparian areas and stream channels by encouraging enhanced use of upland feed areas and off-stream water sources.

Efforts in Caribou County through the Natural Resources Conservation Service and Soil Conservation District (SCD) within the Blackfoot River subbasin have been underway since the mid-1980s (Randy Franks, NRCS/Soda Springs, personal communication). Work accomplished under the Agricultural Conservation Program (ACP) from 1985 to 1996 includes:

- 10.5 miles of pipeline for water conveyance for livestock and wildlife,
- 7 wells to provide water for livestock and wildlife,
- 3 spring developments for livestock and wildlife,
- 54 troughs for watering livestock and wildlife,
- 4 ponds for watering livestock and wildlife,
- 700 acres of brush spraying to improve upland livestock and wildlife grazing on range land, and
- 2 miles of cross fencing to improve upland range for livestock and wildlife grazing.

In 1988, 10,500 acres were in the Conservation Reserve Program. Enrollment in CRP in 1999 was 11,380 acres. Approximately three miles of cross fence in Sawmill Canyon and on Warbonnet Creek were constructed in 1999 under the Wildlife Habitat Improvement Program (WHIP) to foster proper grazing use on about 5,000 acres of range land. On the mainstem Blackfoot River, 200 feet of streambank stabilization using barbs, willow plantings, and rip rap to repair damage caused by flooding was funded under Resource Conservation and Rangeland Development Program (RCRDP) in 1999.

In Bingham County, projects and reduction in dry farming have led to improvements in water quality (Scott Engle, NRCS/Blackfoot, personal communication). Projects include:

- 48,700 feet of pipeline for water conveyance for livestock and wildlife,
- 5 wells to provide water for livestock and wildlife,
- 3 spring developments for livestock and wildlife,
- 35 troughs for watering livestock and wildlife,
- planned grazing system implemented on 27,850 acres,
- development of proper grazing use on 28,090 acres,

- 6,525 acres of brush management to improve upland livestock and wildlife grazing on rangeland,
- 81,800 feet of cross fencing to improve upland range for livestock and wildlife grazing,
- 31,800 feet of streambank fencing built to manage livestock in riparian areas,
- 18,000 feet of streambank stabilized by tree revetments, and
- 600 feet of streambank stabilized by rock rip-rap.

Much of the historic dry cropland has been converted to CRP or pasture and hayland reducing sediment input into subbasin streams. In early 1980s, there were about 15,869 acres of dry cropland. Presently, 7,362 of those acres are in CRP and 8,179 acres are in pasture or hayland. Estimated erosion rates of dry cropland are 18 tons per acre per year (tons/ac/yr) compared to 2 tons/ac/yr or less from CRP and pasture/hayland. This nine-fold reduction in erosion rate translates into almost 250,000 tons/yr.

The North and Central Bingham soil conservation districts have prioritized several projects to reduce soil erosion in their five-year plans (North Bingham Soil Conservation District 1998, Central Bingham Soil and Water Conservation District 1998). These projects include reducing wind erosion through wind strip barriers, NO BLO, and fall cropping; introducing and promoting soil conservation technologies and practices (e.g., minimum tillage, mulching, planting grasses and legumes between row crops, cross slope chiseling or subsoiling); and livestock management in riparian areas (e.g., herding, fencing).

Several range improvement projects have been completed by Idaho Department of Lands (IDL) in cooperation with their grazing lessees (Pat Brown, IDL, personal communication) and with cost-share monies from NRCS. The goal of these projects has been improvement of riparian conditions through better livestock management. The following have been completed since 1987:

- 24.6 miles of pasture division fence to better regulate timing and duration of grazing and
- 12 new livestock water developments/improvements to improve livestock distribution including
  - 5.6 miles of pipeline,
  - 31 water troughs, and
  - 4 ponds.

Several other entities have also undertaken improvement projects in the Blackfoot River subbasin aimed primarily at reducing sediment input from unstable streambanks. The Caribou National Forest has placed log-revetment structures in Diamond Creek to narrow the stream channel and stabilize cut banks (Heimer et al. 1987). Idaho Department of Fish and Game has also placed tree revetments in the upper Blackfoot River. The forest also built a livestock exclosure on Diamond Creek (Caribou National Forest 1992). IDFG has constructed fish screens on irrigation diversions in the upper Blackfoot River to prevent fish mortality in the ditches (Heimer 1984).

2.3.1 Water Quality Improvement

The success of most of these programs and projects is unknown. However, these activities are an important first step in what is anticipated to be a suite of programs and projects necessary to achieve support of beneficial uses.

Whereas benefits of individual projects are not known, data are available to examine cumulative effects of these programs and projects on water quality in Blackfoot River. These data, subject to the caveat explained in Section 2.2.4, have been collected since 1971 at a USGS surface-water station (13068500, Blackfoot River near Blackfoot).

Although documentation of statistical significance is limited, data indicate a trend of improved water quality conditions in Blackfoot River since 1971 (Table 2.2-10). Comparisons of suspended sediment, dissolved nitrate+nitrite, and total phosphorus between early (1971-1981) and late (1989-1997) periods all show a decreasing trend in average concentrations. However, only total phosphorus concentrations were statistically different between periods (Table 2.2-11). Data were grouped according to early and late periods for two reasons: 1) monitoring did not occur between 1982 and 1989; and 2) implementation of the CRP began in the mid-1980s. Initiation of the CRP has likely been an important component to water quality improvement in the Blackfoot River subbasin.

It is not clear whether existing programs and projects are sufficient to lead to support of beneficial uses in a timely manner. Despite positive trends in reduction of pollutants, existing status of many of the listed waterbodies seems to indicate current practices will not improve water quality to the degree that all beneficial uses will be supported in the very near future. Therefore, loading analyses were performed for both sediment and nutrients.

3 BLACKFOOT RIVER LOADING ANALYSIS

3.1 General

To assist in support of beneficial uses and improvement of water quality in the Blackfoot River and its tributaries, the following recommendations are made to control pollutants of concern into 303(d)-listed streams. Pollutants identified on the 303(d) list for the Blackfoot River subbasin include sediment, nutrients, organics, and flow alteration. Brush, Grizzly, and Maybe Canyon creeks were placed on the 1998 303(d) list because data indicate an impairment of cold water aquatic life. However, at time of listing, DEQ's reconnaissance level data did not define causative pollutants.

Loading analyses are beneficial, especially for those pollutants for which no numerical water quality standards exist. Many of these pollutants are addressed in narrative standards, whereby, if beneficial uses are impaired, pollutant loads are too high. A load analysis helps establish a threshold at which a pollutant load impairs beneficial uses. Load allocations are proposed for sediment and nutrients only. A load analysis for organics was not initiated because a comprehensive review of the data did not indicate organics as a problem in the upper Blackfoot River subbasin. Flow alteration was not addressed, as the State of Idaho does not consider it a pollutant.

3.1.1 Reasonable Assurance

EPA requires that TMDLs, with a combination of point and nonpoint sources and with waste load allocations dependent on nonpoint source controls, provide reasonable assurance that the nonpoint source controls will be implemented and effective in achieving the load allocation (EPA 1991). If reasonable assurance that nonpoint source reductions will be achieved is not provided, the entire pollutant load will be assigned to point sources. Within the water quality limited segments listed in the Blackfoot River subbasin, there are no point source discharges. Nonpoint source reductions listed in the Blackfoot River TMDL will be achieved through state authority within the Idaho Nonpoint Source Management Program.

Section 319 of the Federal Clean Water Act requires each state to submit to EPA a management plan for controlling pollution from nonpoint sources to waters of the state. The plan must: identify programs to achieve implementation of best management practices (BMPs); furnish a schedule containing annual milestones for utilization of program implementation methods; provide certification by the state attorney general that adequate authorities exist to execute the plan for implementation of BMPs; and, include a listing of available funding sources for these programs. The current Idaho Nonpoint Source Management Plan has been approved by EPA (December 1999) as meeting the intent of section 319 of the Clean Water Act.

As described in the Idaho Nonpoint Source Management Plan, Idaho Water Quality Standards require that if monitoring indicates water quality standards are not met due to nonpoint source impacts, even with the use of current best management practices, the practices will be evaluated and modified as necessary by the appropriate agencies in accordance with provisions of the Administrative Procedure Act (IDAPA). If necessary, injunctive or other judicial relief may be initiated against the operator of a nonpoint source activity in accordance with authority of the Director of Environmental Quality provided in Section 39-108, Idaho Code (IDAPA 58.01.02.350). Idaho Water Quality Standards list designated agencies responsible for reviewing and revising nonpoint source BMPs based on water quality monitoring data generated through the state's water quality monitoring program. Designated agencies are: Department of Lands for timber harvest activities, oil and gas exploration and development, and mining activities; Soil Conservation Commission for grazing and agricultural activities; Transportation Department for public road construction; Department of Agriculture for aquaculture; and DEQ for all other activities (Idaho Code 39-3602). Existing authorities and programs for assuring implementation of BMPs to control nonpoint sources of pollution in Idaho are as follows:

State Agricultural Water Quality Program	Nonpoint Source 319 Grant Program
Wetlands Reserve Program	Conservation Reserve Program
Environmental Quality Improvement Program	Resource Conservation and Development
Idaho Forest Practices Act	Agricultural Pollution Abatement Plan
Water Quality Certification For Dredge and Fill	Stream Channel Protection Act

The Idaho Water Quality Standards direct appointed watershed advisory groups to recommend specific actions needed to control point and nonpoint sources affecting water quality limited waterbodies. Upon approval of this TMDL by EPA Region 10, the existing Blackfoot River Watershed Advisory Group, with the assistance of appropriate local, state, tribal, and federal agencies, will begin formulating specific pollution control actions for achieving water quality targets listed in the Blackfoot River TMDL. The plan is scheduled to be completed within 18 months of finalization and approval of the TMDL by EPA.

3.2 Pollutant Standards/Targets and Load Analysis

The following sections cover the load analyses for sediment and nutrients. The sections are organized into subsections: standards (found in the state's water quality rules and thus enforceable) and targets (recommendations to meet beneficial use support); discussion; and load analysis that also includes margin of safety and data gaps. Several aspects of sediment (i.e., turbidity, streambank stability, and depth fines) were used in the load analysis depending on available data and particular waterbody. Nutrient analysis concentrated on two nutrients – nitrogen and phosphorus.

3.2.1 Sediment

Standard (*Water Quality Standards and Wastewater Treatment Requirements* [Idaho Department of Environmental Quality nda])

Sediment - shall not exceed quantities specified in Section 250 and 252, or, in the absence of specific sediment criteria, quantities which impair designated beneficial uses. Determinations of impairment shall be based on water quality monitoring and surveillance and the information utilized as described in Subsection 350

Turbidity - below any applicable mixing zone set by the Department, shall not exceed background turbidity by more than fifty (50) NTU instantaneously or more than twenty-five (25) NTU for more than ten (10) consecutive days

Target

Turbidity (Dry Valley Creek only)
- Upper (above mining activities)
  - High flow - not to exceed a 14-day average of 19.31 NTU
  - Low flow - not to exceed a 28-day average of 12.09 NTU
- Lower (below mining activities)
  - 14-day average - not to exceed 4.6 NTU
  - Daily maximum - not to exceed 20.15 NTU

Streambanks (all streams)
- Equal or greater than 80% stability

Depth Fines (all streams)
- Subsurface streambed sediment less than 6.25 mm not to exceed a 5-year mean of greater than 25% by volume in riffles
- Subsurface streambed sediment less than 0.85 mm not to exceed a 5-year mean of greater than 10% by volume in streams with salmonid spawning as a beneficial use in riffles

Discussion

Sediment is listed as a pollutant in all streams in the Blackfoot River subbasin except those added in 1998 (Table 2.2-1). Little information exists on direct effects of sediment on support of beneficial uses in the subbasin. Nonetheless, based on periphyton community analysis, siltation has impaired aquatic life uses in the section of Blackfoot River immediately downstream of Reservation Canal (The Academy of Natural Sciences, letter to Idaho Department of Environmental Quality summarizing periphyton analysis at sampled sites). This impairment is in an area where percent fine sediment in the substrate was low. Percent fines in the stream substrate at this site ranged from 15% to 30% with a mean of 21%.

Information on sediment in the Blackfoot River subbasin varies, as does the quality of data in terms of number of sites sampled, both among and within streams, and longevity of sampling including any recent work. Some of the best information available, both in terms of quantity and timing, is from Proper Functioning Condition status surveys done for BLM and by the Idaho Soil Conservation Commission throughout Blackfoot River subbasin beginning in 1993. In addition to evaluating Proper Functioning Condition, surveyors also gathered information on streambank stability, gradient, channel type, percent surface fines, cobble embeddedness, and lateral recession rate.

Suspended Sediment

In evaluating and selecting appropriate suspended sediment targets necessary to protect fisheries in the Blackfoot River subbasin, several critical studies were reviewed. The European Inland Fisheries Advisory Commission (EIFAC 1964), in its review of suspended solids in relation to fisheries, concluded that concentrations less than 25 parts per million (ppm) have no harmful effect on fisheries; concentrations of 25-80 ppm will have some effect but it is possible to maintain good to moderate fisheries; concentrations of 80-400 ppm are unlikely to support good fisheries; and, concentrations greater than 400 ppm will at best result in poor fisheries. Newcombe and MacDonald (1991) argued that duration of the event must also be considered in addition to concentration of suspended sediment.

Evaluating recommended targets using models suggested by Newcombe and Jensen (1996) showed mixed results. The recommended targets fall below the lethal and paralethal range (Severity of Ill Effect ≤ 8) as determined by concentration-duration tables for juvenile and adult salmon (Models 1-3; Table 3.2-1). Both targets at the recommended duration of either 14 days or 28 days would fall within the lethal and paralethal range (Severity of Ill Effect > 8) for eggs and larvae of salmonids and non-salmonids and for adult freshwater nonsalmonids based on Newcombe's and Jensen's Models 4 and 6, respectively. The durations, which would have to be met to fall "below" the lethal/paralethal range (sublethal), are about 1 day at both 50 and 80 mg/l for eggs and larvae of salmonids and non-salmonids (Table 3.2-2). For adult freshwater nonsalmonids, the lethal range duration thresholds are less than 5 days at 50 mg/l and 4 days at 80 mg/l. It is unknown whether at certain times of the year (e.g., spring runoff or intense summer rainstorms) Dry Valley Creek may have naturally exceeded these concentrations of 50 and 80 mg/l for durations of greater than 5 days.

In addition to these studies which have linked excess sedimentation back to a use impairment, other "local" standards and targets were also considered in selecting an appropriate target for the Blackfoot River subbasin. Nevada (Internet communication) has state standards for suspended solids of 25 to 80 mg/l, depending on the waterbody classification. Targets have been set at 56 mg/l in tributaries and return drains in the Yakima River in Washington for total suspended sediment (Joy and Patterson 1997); 35 mg/l for smaller streams and 90 mg/l for larger streams in the Bear River in Utah for total suspended solids (Ecosystem Research Institute 1995); and 50 mg/l and 80 mg/l for total suspended solids in the lower Boise River (Division of Environmental Quality 1998).

Table 3.2-1. Severity of Ill Effect (SEV) from target loads of suspended sediment for high flows and low flows in Dry Valley Creek (based on Newcombe and Jensen 1996). Target loads at high flow are not to exceed a mean of 80 mg/l over a 14-day period. Target loads at low flow are not to exceed a mean of 50 mg/l over a 28-day period. Ranges of Severity of Ill Effect are nil effect (SEV=0), behavioral effects (SEV=1-3), sublethal effects (SEV=4-8), and lethal and paralethal effects (SEV=9-14).

	SEV by model[1]				
	1	2	3	4	6
High flow	8	8	8	11	9
Low flow	8	8	8	12	10

[1]models 1-3 are for juvenile and/or adult salmonids in streams where particle size ranges from fine (predominantly < 75 um) to coarse (75-250 um). Model 4 is for eggs and larvae of salmonids and nonsalmonids and fine particle sizes. Model 6 is for adult freshwater nonsalmonids and fine particle sizes.

Table 3.2-2. Duration of exposure (days) at suspended sediment concentrations of 50 and 80 mg/l which results in a Severity of Ill Effect (SEV) below the lethal and paralethal class (SEV<=8) for eggs and larvae of salmonids and nonsalmonids and adult freshwater nonsalmonids (based on Newcombe and Jensen 1996).

	Duration of exposure (days) for SEV <= 8	
	Model 4[1]	Model 6[2]
High flow	0.92	3.60
Low flow	1.05	4.34

[1]model 4 is for eggs and larvae of salmonids and nonsalmonids and fine particle sizes

[2]model 6 is for adult freshwater nonsalmonids and fine particle sizes

Several years of data collected in the Dry Valley Creek watershed allowed for a comparison of turbidity and total suspended solids (Appendix Table G-1). In Dry Valley Creek, regression analysis showed a significant relationship ($p < 0.001$) with turbidity explaining 84% of the variation in total suspended solids numbers (Appendix Figure G-1). In Maybe Canyon Creek, a significant relationship ($p < 0.001$) was also found. The R^2 value was 0.9, indicating a very strong relationship between total suspended solids (TSS) and turbidity (Appendix Figure G-2). Regression analysis of TSS and turbidity data from Chicken Creek did not show a significant relationship.

Based on all the above, target turbidities corresponding to seasonal levels of 50 and 80 mg/l of suspended sediment are recommended despite modeling that indicates these levels may have lethal or paralethal effects on the fish community in Dry Valley Creek. Considering that good to moderate fisheries can be maintained at such concentrations (EIFAC 1964) and that natural conditions may have exceeded sublethal durations at these levels, the decision was made to recommend target turbidities based on these concentrations. The targets will be subject to change as new information on natural concentrations of suspended sediment, effects of duration exposure on fish, or support of beneficial uses at proposed targets comes to light.

Streambanks

Streambank stability is a surrogate measure for sediment input into the stream. It appears that streambanks are a substantial source of sediment into streams in the Blackfoot River subbasin, although mass wasting has also been identified (Drewes 1987). Sediment input to streams from agriculture runoff has been reduced due to transfer of acreage into the Conservation Reserve Program. The use of surrogate measures is allowed by EPA as “other appropriate measures” for expressing loads (40CFR Part 130.2(I)).

A target of 80% or greater streambank stability is recommended for all 303(d)-listed waterbodies in the Blackfoot River subbasin. This surrogate measure was the target used in the draft South Steens TMDL (Oregon Department of Environmental Quality 1998) based on Riparian Management Objectives in Inland Native Fish Strategy (INFISH; U. S. Forest Service 1995). The same recommendation is made in PACFISH (U. S. Forest Service and BLM 1995). DEQ (1999b) citing Overton et al. (1995) set a similar target for streambank stability in the Lemhi River.

Depth Fines

No loads for volume of streambed subsurface sediment were estimated for lack of information. For TMDLs in the Blackfoot River subbasin, it is assumed that a reduction in water column sediment or improved bank stability would result in corresponding reductions in streambed subsurface sediment. To ensure such a decrease is occurring, the TMDL includes subsurface streambed sediment targets (depth fines) of less than 6.25 mm not to exceed a 5-year mean of 25% by volume, and less than 0.85 mm not to exceed a 5-year mean of 10% by volume in all streams supporting, or designated to support, salmonid spawning in the Blackfoot River subbasin. Both targets are recommended for riffle areas only, primarily those sections conducive to salmonid spawning.

Numerous agencies have set targets for depth fines to support primarily salmonid fisheries. The Salmon and Challis National Forest bases subsurface sediment levels on watershed geology (Betsy Rieffenberger, Salmon and Challis National Forest, personal communication). In granitic, volcanic, and sedimentary drainages, streams in good, fair, and poor condition will have less than 25%, 25 to 30%, and greater than 30% fines, respectively. Montana recognized a subsurface sediment standard in their Deep Creek TMDL of 30% fines less than 6.35 mm (Endicott and McMahon 1996). DEQ (1991) set two targets for the South Fork Salmon River: 1) for those streams with subsurface sediment less than 27%, maintain the existing sediment volume level; and 2) for streams that exceed the 27% threshold, reduce subsurface sediment to a 5-year mean not to exceed 27% with no individual year to exceed 29%. Based on Burton et al. (1990) work in southern Idaho (e.g., Rock Creek near Twin Falls), a 27% target for subsurface sediment would be applicable to the Blackfoot River. To include a margin of safety, the target was set at 25% for depth fines.

Several reports have proposed that smaller sediment (< 0.85 mm) is especially harmful to salmonids during the incubation and emergence period (Hall 1986; Reiser and White 1988). To support salmonid spawning, the depth fines less than 10% by volume of sediment fraction less than 0.85 mm target is recommended.

Due to variability of sediment transport in the Blackfoot River, targets are set over a 5-year time period. This recommendation is similar to the TMDL established in the South Fork of the Salmon River (Division of Environmental Quality 1991).

Loading Analysis

Turbidity/Total Suspended Solids

Mainstem Blackfoot River and Tributaries

Site-specific water column sediment targets in mainstem Blackfoot River and tributaries other than Dry Valley Creek were not attempted due to lack of available turbidity, suspended sediment, or total suspended solids data. To ensure no further degradation on the mainstem and tributaries, the Idaho state standard is set such that turbidity shall not exceed background by greater than 50 NTU instantaneously or greater than 25 NTU for more than 10 consecutive days. These criteria will be refined once additional water quality data are collected.

Dry Valley Creek

Information on concentrations of suspended sediment was limited in the Blackfoot River subbasin. However, total suspended solids and turbidity data were sufficient to develop a loading analysis for Dry Valley Creek (Appendix Table G-1). Loading, or assimilative, capacity on Dry Valley Creek was not estimated because of a paucity of data. For purposes of the loading analysis, assimilative capacity was considered to be equal to the target load.

Two sites in Dry Valley Creek are recommended for monitoring adherence to recommended targets. The upper site is DV-7, which is above mining activities and considers contribution from activities on national forest lands. The lower site (DV-1) is near the mouth and would be below any mixing zone from mining activity input. DV-1 would be affected by all upstream activities whether occurring on the national forest or associated with mining activities.

Total suspended sediment concentrations and turbidity were much higher at DV-7 than all downstream sites (Table 3.2-3). Only five sampling events recorded TSS concentrations greater than 50 mg/l downstream of DV-7 (Appendix Table G-1). At DV-1 no recorded monthly average was greater than 15 mg/l (Table 3.2-4). At DV-7, numbers from July through September showed mean concentrations greater than 50 mg/l. Despite low water column sediment observed at sites below DV-7, higher (> 30%) levels of fine sediment were seen in sampling for depth fines throughout Dry Valley Creek with levels generally decreasing in a downstream direction (Table 2.2-12).

Because of differences observed in turbidity and TSS concentrations between upstream (DV-7) and downstream sites, separate targets are recommended. At DV-7, turbidity shall not exceed a 14-day average of 19.31 NTU during high flows (April and May; Appendix Table H-1). The turbidity level of 19.31 NTU relates to a TSS concentration of 80 mg/l based on the relationship between turbidity and total suspended solids in Dry Valley Creek (Table 3.2-5). For all other times, i.e., low flow, turbidity at DV-7 shall not exceed a 28-day average of greater than 12.09 NTU. Estimated TSS at a turbidity of 12.09 NTU is 50 mg/l (Table 3.2-5).

For lower sites (i.e., DV-2 and DV-1) average and daily maximum turbidity targets are recommended. The targets are based on mean and 95th percentile numbers from sampling at all sites in Dry Valley Creek (Table 3.2-3). The recommended turbidity targets are a 14-day average not to exceed 4.61 NTU with a daily maximum of 20.15 NTU. Applying a 95% confidence interval around the estimate of total suspended solids using the target turbidity of 4.61 NTU yields a low and high TSS of 16.7 and 21.1 mg/l, respectively (3.2-5). The upper end of the confidence interval is within the range up to 25 mg/l suggested by EIFAC (1964) as having little, if any, effect on a fishery.

The same targets as in lower Dry Valley Creek, 14-day average not to exceed 4.61 NTU with a daily maximum of 20.15 NTU, are recommended for all tributaries entering Dry Valley Creek below DV-7. As measured at a site near the mouth of Maybe Canyon Creek, average turbidity was 5.91 NTU (SD = 15.02, n = 34) equivalent to a TSS value of 29.4 mg/l (Table 3.2-5). This TSS value is above the EIFAC (1964) threshold of 25 mg/l, below which there is little

Table 3.2-3. Mean, standard deviation, and 95th percentile for turbidity and total suspended solids from sites in Dry Valley Creek, 1977-1999 (data found in Appendix Table A-1).

	Turbidity				Total suspended solids			
Site	Number	Mean	Standard deviation	95th percentile	Number	Mean	Standard deviation	95th percentile
DV-1	58	2.45	1.93	6.12	58	9.5	11.46	30.0
DV-2	40	4.65	14.49	7.26	46	17.2	69.40	23.1
DV-3	13	1.53	1.28	3.50	13	8.6	8.39	24.4
DV-4	6	2.02	1.74	4.43	6	4.0	4.34	10.0
DV-4a	6	2.17	2.06	5.18	6	4.6	3.03	8.0
DV-6	46	2.60	3.61	9.15	46	10.6	15.66	49.2
DV-7	51	10.22	13.90	40.00	57	39.3	45.52	124.8
All	220	4.61	9.79	20.15	232	18.2	40.99	69.32

Table 3.2-4. Mean flow and concentration of total suspended solids (TSS) in Dry Valley Creek at sites DV-1 (near mouth), DV-2 (below mining activities), and DV-7 (approximately 0.8 miles upstream of Young Ranch Creek), 1989-1999.

	DV-1			DV-2			DV-7		
Month	Number of years sampled	Mean flow (cfs)	Mean TSS (mg/l)	Number of years sampled	Mean flow (cfs)	Mean TSS (mg/l)	Number of years sampled	Mean flow (cfs)	Mean TSS (mg/l)
May	7	16.34	8.59	4	14.25	3.20	7	2.36	21.77
Jun	11	7.59	7.19	7	5.45	4.54	11	1.27	24.45
Jul	8	3.27	12.90	2	1.51	1.05	7	1.60	71.89
Aug	8	2.91	11.34	1	0.05	2.10	8	1.15	56.70
Sep	8	2.79	8.14	1	0.05	0.80	7	0.60	57.87
Oct	6	3.35	14.78	2	0.78	9.95	6	0.78	18.68
Nov	2	3.00	5.35	1	2.40	0.70	3	0.68	22.73

Table 3.2-5. Turbidity and estimated total suspended solids (TSS) concentration from regression analyses of data collected in Dry Valley and Maybe Canyon creeks.

Waterbody	Turbidity category	Turbidity (NTU)	TSS (mg/l)[1]	95% confidence interval around estimated TSS value[2]	
				Lower limit	Upper limit
Dry Valley Creek	Average	4.61	18.9	16.7	21.1
	95th percentile	20.15	83.5	79.1	87.9
	Equivalent to 50 mg/l TSS	12.09	50.0	47.1	52.9
	Equivalent to 80 mg/l TSS	19.31	80.0	75.8	84.2
Maybe Canyon Creek[3]	Average	5.90	29.4	21.0	37.8
	95th percentile	34.00	155.8	138.1	173.5
	Equivalent to 50 mg/l TSS	10.49	50.0	41.3	58.7
	Equivalent to 80 mg/l TSS	17.16	80.0	69.6	90.4
	Dry Valley Cr average	4.61	23.5	15.1	32.0
	Dry Valley Cr 95th percentile	20.15	93.5	82.0	105.0

[1]based on the equations TSS=(4.1525*Turbidity)-0.2031 for Dry Valley Cr and TSS=(4.5*Turbidity)+2.8002 for Maybe Canyon Cr

[2]from Zar 1984

[3]at above mouth site

impact on a fishery. Total suspended solids at the average turbidity of Dry Valley Creek, 4.61 NTU, would equal 23.5 mg/l - below the 25 mg/l recommended by EIFAC. For Chicken Creek a good relationship between turbidity and TSS did not exist, but TSS and turbidity do not appear to be a problem as average TSS measured at the lower site was 8.1 mg/l (SD = 4.99, n = 22) and turbidity averaged 1.8 NTU (SD = 1.71, n = 22).

Streambank Stability

The recommended target for streambank stability is at least 80% stable streambanks. Streambank stability data collected since 1993 (Appendix Table B-1) indicated the majority of surveyed stream reaches have streambank stability of 80% or greater (Table 3.2-6). Streams on the 303(d) list which had substantial reaches of streambank at less than 80% stability were Blackfoot River and Wolverine, Brush, Corral, Dry Valley, Lanes, and Diamond creeks.

Lateral recession evaluations were done as part of the Proper Functioning Condition surveys in the Blackfoot River subbasin. Lateral recession rates (LRR) were not assessed on a site basis but corresponded to reaches. For some reaches lateral recession rates varied such that two different lateral recession rates were calculated (Table 3.2-7). In those cases, a weighted average was calculated based on length of stream reach (Table 3.2-8). For example, if 25% of a 100 ft section of stream had a lateral recession rate of 0.02 ft/yr and 75% of the section had a lateral recession rate of 0.06 ft/yr, the lateral recession rate for the 100 ft section of stream evaluated would be 0.05 ft/yr ([(25 ft x 0.02 ft/yr) + (75 ft x 0.06 ft/yr)] / 100 ft).

Data allowed, with varying degrees of confidence, for estimation of load allocations in Brush, Slug, Dry Valley, Angus, Lanes and Diamond creeks. Current loads were estimated using reach length, streambank height, bulk density, and lateral recession rate for those reaches for which information was available. Where data were insufficient to estimate current loading, values from adjoining reaches were extrapolated to the unsurveyed reach.

Calculation of target loads were based on the relationship between lateral recession rate and percent unstable streambank (Table 3.2-9). An 80% streambank stability, or 20% unstable streambank, is equivalent to an LRR of 0.114. The target LRR of 0.114 was used for those reaches where streambank stability was less than 80% and LRR was greater than 0.114. If streambank stability was 80% or greater, the corresponding measured LRR was used. When streambank stability was less than 80% and measured LRR was less than the target LRR of 0.114, the measured LRR was used. The sum of the target loads by reach represents the load allocation for the stream.

It should be noted that the target is set for streambank stability, not lateral recession rate. As the relationship between percent streambank stability and LRR was not perfect (R^2 = 0.59 instead of a perfect 1.00), a range of lateral recession rates would be expected for a given streambank stability. As seen in the Blackfoot River data, streambank stability might be less than 80% while LRR is less than the target of 0.114. In those situations, the goal is still 80% or greater streambank, regardless of the estimated LRR.

Table 3.2-6. Streambank stability and Proper Functioning Condition status of 303(d)-listed streams in the Blackfoot River subbasin (from Idaho Soil Conservation Commission and BLM, unpublished data).

Waterbody	Water quality limited segment boundary: Lower	Upper	Length (mi)	Length (mi) of stream by streambank stability: >= 95%	75-94%	55-74%	< 55%	Length (mi) of stream by streambank stability: >= 80%	50-79%	< 50%	Percent of stream with bank stability evaluation	Length (mi) of stream by PFC status[1]: PF	FAR	N	Percent of stream with PFC evaluation
Blackfoot River	Main Canal	Wolverine Creek	23.9	1.2	0.9	0.0	0.0				8.8%	0.6	1.5	0.0	8.8%
	Wolverine Cr	Blackfoot Dam	40.4	8.2	5.0	4.7	7.9				63.9%	5.1	10.5	10.2	63.9%
	Blackfoot Res	Headwaters	41.2								0.0%				0.0%
Wolverine Creek	Blackfoot River	Headwaters	9.7					2.0	5.7	2.0	100.0%	0.9	2.0	6.8	100.0%
Brush Creek	Blackfoot River	Headwaters	15.3					2.7	0.0	3.2	38.5%	2.7	3.2	0.0	38.5%
Corral Creek[2]	Blackfoot River	Headwaters	18.5					10.7	3.7	0.7	81.6%	10.5	4.6	0.0	81.6%
Grizzly Creek	Corral Creek	Headwaters	7.4								0.0%				0.0%
Meadow Creek	Blackfoot Res	Headwaters	30.9								0.0%				0.0%
Trail Creek	Blackfoot River	Headwaters	8.0								0.0%				0.0%
Slug Creek	Blackfoot River	Headwaters	23.6					1.7	0.0	0.0	7.2%	1.7	0.0	0.0	7.2%
Dry Valley Creek	Blackfoot River	Headwaters	11.1					6.6	3.3	0.0	88.9%	1.8	6.1	2.0	88.9%
Maybe Canyon Cr	Dry Valley Cr	Waste dump	2.9					0.8	0.0	0.0	28.1%	0.8	0.0	0.0	28.1%
Angus Creek	Blackfoot River	Headwaters	8.0					0.4	0.0	0.0	5.0%	0.4	0.0	0.0	5.0%
Lanes Creek[3]	Blackfoot River	Headwaters	11.3					2.8	4.4	4.1	100.0%	2.1	1.5	2.7	55.8%
Bacon Creek	Lanes Creek	FS Boundary	3.0								0.0%				0.0%
Sheep Creek	Lanes Creek	Headwaters	7.9								0.0%				0.0%
Diamond Creek[4]	Blackfoot River	Headwaters	20.0					2.3	5.3	2.5	50.4%	5.2	0.6	0.9	33.4%

[1]PF=properly functioning, FAR=functional at risk, N=non functioning

[2]site lengths not recorded for Corral Creek sites, so non-measured sites within a reach were considered of equal length

[3]lower 5 miles of Lanes Creek were evaluated for streambank stability but not as part of PFC status evaluation

[4]some site lengths in Diamond Creek not measured, so non-measured sites within a reach were considered of equal length; 2.2 miles of the lower 7 miles were evaluated for streambank stability but not as part of PFC status evaluation

Table 3.2-7. Stream channel characteristics of Blackfoot River tributaries (from Idaho Soil Conservation Commission, unpublished data).

Stream	Year	Reach	Reach length (miles)	Reach description	PFC status[1]	Site number	Site length (feet)	Habitat[2]	Gradient	Rosgen channel type	Percent unstable banks	Percent sand/silt substrate	Cobble embed-dedness
Brush Creek	2000	BC11	1.7	1.1 miles to 2.8 miles upstream	PF		8,976				3%	--	
		BC10	1.0	2.8 miles to 3.8 miles upstream	PF		5,280				10%	50%	
		BC7	1.3	7.1 miles to 8.4 miles upstream	FAR		6,864				80%	86%	
		BC6	0.6	8.4 miles to 9.0 miles upstream	FAR		3,168				75%	80%	
		BC4	1.3	9.2 miles to 10.5 miles upstream	FAR		6,864				90%	50%	
Slug Creek	1998	S1	0.8	mouth to 0.8 miles upstream	PF	1					0%	100%	
						2					10%	100%	
						3					0%	100%	
						reach		Run/G			3%	100%	
		S2	0.9	0.8 miles to 1.7 miles upstream	PF	1					0%	100%	
						2					0%	100%	
						reach		Run/G		E6	0%	100%	
Dry Valley Creek	1998	DVC1	2.0	mouth to 2.0 miles upstream	N	1	638				0%	0%	
						reach			0.5		0%	0%	
		DVC2	0.5	2.0 miles to 2.5 miles upstream	PF	1	1,430				0%	60%	
						reach		Run/G	0.2	E	0%	60%	
		DVC3	3.3	2.5 miles to 5.8 miles upstream	FAR	1	19,203				50%	60%	
						reach		Run/G	0.6		50%	60%	80%
		DVC4	1.9	5.8 miles to 7.7 miles upstream	FAR	1	5,016				0%	100%	
						2	5,016				30%	65%	
						reach		Run/G	0.3	C/E	15%	83%	
		DVC5	0.8	7.7 miles to 8.5 miles upstream	PF	1	927	G			0%	100%	
						reach		G	1	E	0%	100%	
						reach	3,709	BC			0%	--	
		DVC6	0.9	8.5 miles to 9.4 miles upstream	FAR	1	57				15%	0%	
						2	36				5%	50%	
						3	16				0%	0%	
						reach		Rif/Run	0.8	C3	9%	17%	
		DVC7	0.5	9.4 miles to 9.9 miles upstream	PF	1	2,883				0%	0%	
						reach		Run	2	B6	0%	0%	
Angus Creek	1998	AC1	0.4	mouth to 0.4 miles upstream	PF	1	31				0%	20%	
						2	50				20%	10%	
						3	37				25%	25%	
						reach					16%	17%	

Table 3.2-7. Continued.

Stream	Year	Reach	Reach length (miles)	Reach description	PFC status[1]	Site number	Site length (feet)	Habitat[2]	Gradient	Rosgen channel type	Percent unstable banks	Percent sand/silt substrate	Cobble embed-dedness
Lanes Creek	1998	LC1[3]	2.3	mouth to 2.3 miles upstream		1	273						
						2	72						
						3	708						
						4	159						
						5	204						
						reach					50%		
		LC2[3]	2.0	2.3 miles to 4.3 miles upstream		1	420						
						2	1,570						
						3	834						
						4	828						
						reach					88%		
		LC3[3]	0.7	4.3 miles to 5.0 miles upstream		1	675						
						2	708						
						3	594						
						4	339						
						reach					74%		
		LC4	0.8	5.0 miles from mouth to 5.8 miles upstream	FAR	1	18				0%	20%	
						2	90				50%	33%	
						3	150				15%	20%	
						4	26				20%	20%	
						reach		Run/P/Rif	0.5		26%	24%	45%
		LC5	0.7	5.8 miles to 6.5 miles upstream	FAR	1	76				10%	2%	
						2	125				5%	0%	
						3	200				0%	0%	
						reach		Rif/Run	0.9		3%	0%	18%
		LC6	1.2	6.5 miles to 7.7 miles upstream	N	1	500				60%	10%	
						reach		G	0.14	C4	60%	10%	80%
		LC 7.1	0.5	7.7 miles to 8.2 miles upstream	PF	1	60				20%	33%	
						2	45				0%	15%	
						reach		Run/Rif	0.9	C3/C4	11%	25%	26%
		LC 7.2	1.3	8.2 miles to 9.5 miles upstream	N	1	50				50%	70%	
						2	150				20%	40%	
						3	150				50%	75%	
						reach		Run/G/P	0.78	C4	37%	59%	60%

Table 3.2-7. Continued.

Stream	Year	Reach	Reach length (miles)	Reach description	PFC status[1]	Site number	Site length (feet)	Habitat[2]	Gradient	Rosgen channel type	Percent unstable banks	Percent sand/silt substrate	Cobble embed- dedness
Lanes Creek		LC 8.1	0.3	9.5 miles to 9.8 miles upstream	PF	1	65				0%	30%	
						2	70				0%	30%	
						3	65				0%	50%	
						4	105				0%	15%	
						reach		Run/Rif/P	0.9	C4	0%	29%	42%
		LC 8.2	0.2	9.8 miles to 10.0 miles upstream	N	1	500				70%	30%	
						reach		Run	0.9	C4	70%	30%	70%
		LC 8.3	1.3	10.0 miles to 11.3 miles upstream	PF	1	200				0%	20%	
						2	200				15%	25%	
						reach		G/Run	0.2	C4	8%	23%	40%
Diamond Creek	1998	DC1[3]	0.4	3.9 miles to 4.3 miles upstream		1	230						
						reach					43%		
		DC2[3]	1.4	4.3 miles to 5.7 miles upstream		1	82						
						2	121						
						3	492						
						4	1,230						
						5	1,138						
						reach					97%		
		DC3[3]	0.2	5.7 miles to 5.9 miles upstream		1	540						
						2	115						
						3	56						
						4	200						
						5	308						
						6	138						
						reach					71%		
		DC4	2.9	7.0 miles to 9.9 miles upstream	PF	1	31				30%	20%	
						2	54				30%	20%	
						3	46				25%	20%	
						4	67				45%	20%	
						5	52				40%	20%	
						6	61				40%	--	
						reach		P/Rif	0.75	C4	36%	16%	25%
						reach		BC	0.75				

Table 3.2-7. Continued.

Stream	Year	Reach	Reach length (miles)	Reach description	PFC status[1]	Site number	Site length (feet)	Habitat[2]	Gradient	Rosgen channel type	Percent unstable banks	Percent sand/silt substrate	Cobble embed-dedness
Diamond Creek		DC5	1.7	9.9 miles to 11.6 miles upstream	PF	1	19				0%	20%	
						2	39				0%	100%	
						3	27				0%	25%	
						4	20				0%	25%	
						5	45				20%	25%	
						6	27				0%	50%	
						7	37				35%	10%	
						reach		Run/Rif/P	0.85	C4	10%	39%	
		DC6.1	0.6	11.6 miles to 12.2 miles upstream	FAR	1	20				0%	10%	
						2	47				50%	10%	
						3	18				5%	10%	
						4	63				10%	15%	
						5	43				15%	10%	
						6	46				25%	10%	
						7	29				50%	20%	
						reach		Run/Rif/P		B4/C4	24%	12%	16%
		DC6.2	0.6	12.2 miles to 12.8 miles upstream	PF	8	100				0%	10%	
						9	59				10%	10%	
						10	26				20%	20%	
						11	70				0%	10%	
						reach		Run/Rif/P		B4/C4	4%	11%	19%
		DC7	0.9	12.8 miles to 13.7 miles upstream	N	1	261				30%	15%	
						2	--				75%	10%	
						3	--				100%	30%	
						reach		Run/G	0.8	G	68%	18%	25%
		DC9	1.4	14.9 miles to 16.3 miles upstream		1	15				70%	50%	
						2	5				0%	--	
						3	55				20%	65%	
						4	30				30%	15%	
						5	20				70%	50%	
						6	93				5%	0%	
						reach		Rif/P/Run	2.1		40%	36%	20%

[1]PFC=Proper Functioning Condition, PF=properly functioning, FAR=functional at risk, N=non functioning

[2]BC=beaver complex, G=glide, P=pool, Rif=riffle

[3]not part of the Idaho Soil Conservation Commission's PFC status evaluation

Table 3.2-8. Lateral recession rates and other stream channel characteristics of Blackfoot River tributaries (from Idaho Soil Conservation Commission, unpublished data).

Stream	Year	Reach	Reach length (miles)	Reach description	Erosion severity	Lateral recession rate (ft/yr)	Streambank length (ft)	Percent of reach evaluated for erosion[1]
Brush Creek	2000	BC11	1.7	1.1 miles to 2.8 miles upstream	moderate	0.100	17,952	100%
		BC10	1.0	2.8 miles to 3.8 miles upstream	moderate	0.140	10,560	100%
		BC7	1.3	7.1 miles to 8.4 miles upstream	severe	0.492	13,728	100%
		BC6	0.6	8.4 miles to 9.0 miles upstream	moderate	0.235	6,336	100%
		BC4	1.3	9.2 miles to 10.5 miles upstream	severe	0.292	13,728	100%
Slug Creek	1998	S1	0.8	mouth to 0.8 miles upstream	slight	0.005	7,876	93%
		S2	0.9	0.8 miles to 1.7 miles upstream	moderate	0.140	404	85%
					slight	0.005	7,674	
Dry Valley Creek	1998	DVC1	2.0	mouth to 2.0 miles upstream	moderate	0.175	21,426	100%
		DVC2	0.5	2.0 miles to 2.5 miles upstream	slight	0.000	5,174	98%
		DVC3	3.3	2.5 miles to 5.8 miles upstream	moderate	0.263	15,362	44%
		DVC4	1.9	5.8 miles to 7.7 miles upstream	moderate	0.263	1,510	8%
		DVC5	0.8	7.7 miles to 8.5 miles upstream	slight	0.000	9,272	100%
		DVC6	0.9	8.5 miles to 9.4 miles upstream	moderate	0.140	3,944	41%
		DVC7	0.5	9.4 miles to 9.9 miles upstream	slight	0.000	5,766	100%
Angus Creek	1998	AC1	0.4	mouth to 0.4 miles upstream	slight	0.002	4,040	96%
Lanes Creek	1998	LC1[2]	2.3	mouth to 2.3 miles upstream	moderate	0.140	2,832	12%
		LC2[2]	2.0	2.3 miles to 4.3 miles upstream	moderate	0.235	7,304	35%
		LC3[2]	0.7	4.3 miles to 5.0 miles upstream	severe	0.292	4,632	63%
		LC4	0.8	5.0 miles from mouth to 5.8 miles upstream	slight	0.002	6,596	100%
					moderate	0.209	2,200	
		LC5	0.7	5.8 miles to 6.5 miles upstream	slight	0.040	6,730	100%
					moderate	0.209	746	
		LC6	1.2	6.5 miles to 7.7 miles upstream	severe	0.353	9,862	100%
					slight	0.000	4,226	
		LC 7.1	0.5	7.7 miles to 8.2 miles upstream	slight	0.005	3,690	82%
					severe	0.292	650	
		LC 7.2	1.3	8.2 miles to 9.5 miles upstream	slight	0.005	6,420	94%
					severe	0.492	6,420	
		LC 8.1	0.3	9.5 miles to 9.8 miles upstream	slight	0.005	2,440	77%
		LC 8.2	0.2	9.8 miles to 10.0 miles upstream	slight	0.005	586	100%
					severe	0.492	1,366	
		LC 8.3	1.3	10.0 miles to 11.3 miles upstream	severe	0.650	2,076	100%
					slight	0.019	11,768	
Diamond Creek	1998	DC1[2]	0.4	3.9 miles to 4.3 miles upstream	slight	0.040	459	11%
		DC2[2]	1.4	4.3 miles to 5.7 miles upstream	severe	0.292	6,126	39%
		DC3[2]	0.2	5.7 miles to 5.9 miles upstream	moderate	0.185	2,714	86%
		DC4	2.9	7.0 miles to 9.9 miles upstream	slight	0.040	18,964	72%
				7.0 miles to 9.9 miles upstream			6,164	23%
		DC5	1.7	9.9 miles to 11.6 miles upstream	slight	0.011	17,952	100%
		DC6.1	0.6	11.6 miles to 12.2 miles upstream	slight	0.019	2,008	16%
		DC6.2	0.6	12.2 miles to 12.8 miles upstream	slight	0.019	6,502	51%
		DC7	0.9	12.8 miles to 13.7 miles upstream	slight	0.019	2,786	100%
					severe	0.492	7,856	
		DC9	1.4	14.9 miles to 16.3 miles upstream	moderate	0.161	3,788	85%
					slight	0.005	8,840	

[1]streambank length was divided by 2 to get the length of stream evaluated; this number was then divided by the reach length. If the length of stream ratedfor lateral recession rate exceeded the reach length, 100% of the reach length was considered evaluated.

[2]not part of the Idaho Soil Conservation Commission's PFC status evaluation

Table 3.2-9. Results of regression analysis to estimate lateral recession rate.

Analysis	Number	Independent variable(s)[1]	Dependent variable[2]	R-sq[3]	Adjusted R-sq	Degrees of freedom[4]	F-statistic	Significance of F	Equation[5]
Linear regression	35	%UB	LRR	0.59	0.58	1/33	47.2	7.59E-08	LRR = 0.0055 + (0.0895*%UB)
Multiple linear regression	28	%UB, PFC	LRR	0.76	0.74	2/25	39.9	1.67E-08	LRR = 0.0586 + (-0.1216*PFC) + (0.0755*%UB)

[1] %UB=percent unstable banks, PFC=proper functioning condition status

[2] LRR=lateral recession rate

[2] R-sq=R^2

[4] first number is numerator degrees of freedom, second number is denominator degrees of freedom

[5] LRR is lateral recession rate log transformed; PFC is recoded to proper functioning condition=3, functional at risk=2, nonfunctioning=1 and log transformed; %UB is percent unstable banks arcsin transformed

Load allocations and reductions by reach as calculated on an 80% streambank stability target are presented in Table 3.2-10. Highest loads were estimated in Brush Creek where most upstream reaches require some level of reduction (current load minus load allocation [sum of target loads by reach]). It appears that in other streams, sediment input tends to originate mainly in only a few reaches (e.g., Dry Valley Creek 3 and Diamond Creek 2 and 7).

To apportion sediment load, reaches within a waterbody were subdivided based on land ownership using known reach breakpoints and a Geographic Information System coverage of land ownership (Table 3.2-11). Most reaches of Brush, Slug, Dry Valley, and Lanes creeks fell within privately owned land. A typical pattern of private ownership in the lower watershed with public managed lands upstream was evident in all the streams. In Brush Creek, upstream reaches flow through state land while the Forest Service owns upstream areas of the other watersheds.

Overall contribution of sediment from unstable streambanks varied widely amongst streams where data were sufficient to estimate sediment load. Sediment input was highest in reaches of Brush Creek at 3,417 tons/yr with a load reduction of 2,059 tons/yr needed to meet the load allocation of 1,358 tons/yr (Table 3.2-12). Dry Valley, Lanes and Diamond creeks experienced sediment loads ranging from about 800 to 2,100 tons/yr with load reductions at 364, 392, and 755 tons/yr, respectively.

The lowest sediment inputs from streambanks were estimated to be in Slug and Angus creeks at less that 100 tons/yr (Table 3.2-12). At these levels of input, neither requires a load reduction at the present time.

Several stream reaches did not require a load reduction. In such cases the current load becomes the load allocation in keeping with the State of Idaho's antidegradation policy. For example, the load allocations for Slug and Angus creeks are their current loads of 81 tons/yr and 38 tons/yr, respectively.

Confidence in the estimated load reductions and allocations varied based on total amount of stream surveyed. For example, lengths of surveyed reaches in Slug, Angus, and Brush creeks were much less than in Dry Valley, Lanes, and Diamond creeks. Only small portions of Slug and Angus creeks were surveyed most likely accounting for estimated load reductions of zero.

Unfortunately, data were not available to estimate load allocations based on target streambank stability for other 303(d)-listed streams - Blackfoot River and Wolverine, Corral, Grizzly, Meadow, Trail, Maybe Canyon, Bacon, and Sheep creeks. However, these streams are still expected to attain streambank stability of at least 80%.

Data indicate that in the Blackfoot River 80% streambank stability corresponds to a Proper Functioning Condition status of functional at risk. An Analysis of Variance test of streambank stability by PFC status showed a significant difference between the three conditions (Table 3.2-13). The mean percent unstable streambank for properly functioning reaches was 5%, or 95% stable streambanks. Functional at risk reaches averaged 80% stable streambanks while non functioning reaches averaged only 54% stable streambanks. The range of streambank

Table 3.2-10. Load reduction and allocation for sediment input from streambanks on 303(d)-listed streams in the Blackfoot River subbasin (from Idaho Soil Conservation Commission, unpublished data). The load allocation is considered the same as the target erosion rate.

								Current		Target[1]		
Waterbody	Reach	Reach length (mi)	Reach description	Measured (M) or extrapolated (E)	Percent streambank stability	Streambank height (ft)	Bulk density (lbs/ft^3)	Lateral recession rate (ft/yr)	Erosion rate (tons/yr)	Lateral recession rate (ft/yr)	Erosion rate (tons/yr)	Load reduction (tons/yr)
Brush Creek		1.1	mouth to 1.1 mi upstream	E	97%	1.0	87.4	0.100	50.8	0.100	50.8	0.0
	BC11	1.7	1.1 mi to 2.8 mi upstream	M	97%	1.0	87.4	0.100	78.5	0.100	78.5	0.0
	BC10	1.0	2.8 mi to 3.8 mi upstream	M	90%	1.0	87.4	0.140	64.6	0.140	64.6	0.0
		3.3	3.8 mi to 7.1 mi upstream	E	55%	1.5	87.4	0.316	721.8	0.114	260.4	461.4
	BC7	1.3	7.1 mi to 8.4 mi upstream	M	20%	2.0	87.4	0.492	590.3	0.114	136.8	453.5
	BC6	0.6	8.4 mi to 9.0 mi upstream	M	25%	3.0	87.4	0.235	195.2	0.114	94.7	100.5
		0.2	9.0 mi to 9.2 mi upstream	E	18%	2.5	87.4	0.264	60.8	0.114	26.3	34.5
	BC4	1.3	9.2 mi to 10.5 mi upstream	M	10%	2.0	87.4	0.292	350.3	0.114	136.8	213.6
		4.8	10.5 mi upstream to hdwtrs	E	10%	2.0	87.4	0.292	1304.4	0.114	509.2	795.1
Slug Creek	S1	0.8	mouth to 0.8 mi upstream	M	97%	1.0	100	0.005	2.1	0.005	2.1	0.0
	S2	0.9	0.8 mi to 1.7 mi upstream	M	100%	0.5	100	0.012	2.9	0.012	2.9	0.0
		21.9	1.7 mi upstream to hdwtrs	E	100%	0.5	100	0.012	69.3	0.012	69.3	0.0
Dry Valley Creek	DVC1	2.0	mouth to 2.0 mi upstream	M	100%	1.0	100	0.175	184.8	0.175	184.8	0.0
	DVC2	0.5	2.0 mi to 2.5 mi upstream	M	100%	1.0	100	0.000	0.0	0.000	0.0	0.0
	DVC3	3.3	2.5 mi to 5.8 mi upstream	M	50%	1.4	100	0.263	641.5	0.114	278.1	363.5
	DVC4	1.9	5.8 mi to 7.7 mi upstream	M	85%	1.1	100	0.263	290.2	0.263	290.2	0.0
	DVC5	0.8	7.7 mi to 8.5 mi upstream	M	100%	1.0	100	0.000	0.0	0.000	0.0	0.0
	DVC6	0.9	8.5 mi to 9.4 mi upstream	M	91%	1.5	100	0.140	99.8	0.140	99.8	0.0
	DVC7	0.5	9.4 mi to 9.9 mi upstream	M	100%	1.0	100	0.000	0.0	0.000	0.0	0.0
		1.2	9.9 mi upstream to hdwtrs	E	100%	1.0	100	0.000	0.0	0.000	0.0	0.0
Angus Creek	AC1	0.4	mouth to 0.4 mi upstream	M	84%	1.0	100	0.002	0.4	0.002	0.4	0.0
		7.6	0.4 mi upstream to hdwtrs	E	84%	1.0	100	0.002	8.1	0.002	8.1	0.0
Lanes Creek	LC1[2]	2.3	mouth to 2.3 mi upstream	M	50%	4.3	115	0.140	842.7	0.114	686.2	156.5
	LC2[2]	2.0	2.3 mi to 4.3 mi upstream	M	12%	1.2	115	0.235	342.5	0.114	166.1	176.3
	LC3[2]	0.7	4.3 mi to 5.0 mi upstream	M	26%	2.2	115	0.292	273.0	0.114	106.6	166.4
	LC4	0.8	5.0 mi to 5.8 mi upstream	M	74%	1.3	100	0.054	28.5	0.054	28.5	0.0
	LC5	0.7	5.8 mi to 6.5 mi upstream	M	97%	2.0	105	0.057	44.2	0.057	44.2	0.0
	LC6	1.2	6.5 mi to 7.7 mi upstream	M	40%	1.0	100	0.247	156.5	0.114	72.2	84.3
	LC 7.1	0.5	7.7 mi to 8.2 mi upstream	M	89%	1.0	105	0.048	13.3	0.048	13.3	0.0
	LC 7.2	1.3	8.2 mi to 9.5 mi upstream	M	63%	1.0	100	0.249	170.9	0.114	78.2	92.7
	LC 8.1	0.3	9.5 mi to 9.8 mi upstream	M	100%	0.5	100	0.005	0.4	0.005	0.4	0.0
	LC 8.2	0.2	9.8 mi to 10.0 mi upstream	M	30%	2.0	100	0.346	73.1	0.114	24.1	49.0
	LC 8.3	1.3	10.0 mi upstream to hdwtrs	M	92%	1.0	100	0.114	78.2	0.114	78.2	0.0
Diamond Creek		3.9	mouth to 3.9 mi upstream	E	57%	0.6	100	0.040	49.4	0.040	49.4	0.0
	DC1[2]	0.4	3.9 mi to 4.3 mi upstream	M	57%	0.6	100	0.040	5.1	0.040	5.1	0.0
	DC2[2]	1.4	4.3 mi to 5.7 mi upstream	M	3%	1.1	100	0.292	237.4	0.114	92.7	144.7
	DC3[2]	0.2	5.7 mi to 5.9 mi upstream	M	29%	1.4	100	0.185	27.4	0.114	16.9	10.5
		1.1	5.9 mi to 7.0 mi upstream	E	47%	2.2	100	0.113	143.7	0.113	143.7	0.0
	DC4	2.9	7.0 mi to 9.9 mi upstream	M	64%	3.0	100	0.040	183.7	0.040	183.7	0.0
	DC5	1.7	9.9 mi to 11.6 mi upstream	M	90%	3.0	100	0.011	29.6	0.011	29.6	0.0
	DC6.1	0.6	11.6 mi to 12.2 mi upstream	M	76%	3.0	100	0.019	17.6	0.019	17.6	0.0
	DC6.2	0.6	12.2 mi to 12.8 mi upstream	M	96%	3.0	100	0.019	18.5	0.019	18.5	0.0
	DC7	0.9	12.8 mi to 13.7 mi upstream	M	32%	3.5	100	0.368	607.9	0.114	188.3	419.6
		1.2	13.7 mi to 14.9 mi upstream	E	55%	3.0	100	0.210	394.3	0.114	214.0	180.2
	DC9	1.4	14.9 mi to 16.3 mi upstream	M	77%	2.4	100	0.052	94.2	0.052	94.2	0.0
		3.7	16.3 mi upstream to hdwtrs	E	77%	2.4	100	0.052	250.9	0.052	250.9	0.0

[1]target is actual Lateral Recession Rate (LRR) if Percent Stable Streambank is >= 80% or LRR is <= 0.114; otherwise a LRR of 0.114 was used based on a Percent Stable Streambank value of 80% and the formula Log(LRR) =(0.0895 x Arcsine (Square Root (Percent Unstable Streambank))) + 0.0055

[2]not part of the Idaho Soil Conservation Commission's PFC status evaluation

Table 3.2-11. Length of reach by land ownership in Brush, Slug, Dry Valley, Angus, Lanes, and Diamond creeks.

		Private		State		BLM		Forest Service		Total
Waterbody	Reach	Length (m)	Percent of reach	Length (m)	Percent of reach	Length (m)	Percent of reach	Length (m)	Percent of reach	reach length (m)
Brush Creek	BC13	518	46.0%	0	0.0%	607	54.0%	0	0.0%	1,125
	BC12	701	100.0%	0	0.0%	0	0.0%	0	0.0%	701
	BC11	2,520	91.8%	224	8.2%	0	0.0%	0	0.0%	2,744
	BC10	43	2.5%	1,680	97.5%	0	0.0%	0	0.0%	1,723
	BC9	313	7.9%	3,642	92.1%	0	0.0%	0	0.0%	3,955
	BC8a	934	76.7%	284	23.3%	0	0.0%	0	0.0%	1,218
	BC7	2,128	100.0%	0	0.0%	0	0.0%	0	0.0%	2,128
	BC6	1,066	100.0%	0	0.0%	0	0.0%	0	0.0%	1,066
	BC5	307	100.0%	0	0.0%	0	0.0%	0	0.0%	307
	BC4	2,070	98.9%	22	1.1%	0	0.0%	0	0.0%	2,092
	BC3	0	0.0%	4,176	100.0%	0	0.0%	0	0.0%	4,176
	BC2	0	0.0%	2,252	100.0%	0	0.0%	0	0.0%	2,252
	BC1	0	0.0%	1,079	100.0%	0	0.0%	0	0.0%	1,079
Slug Creek	SC1[1]	672	47.6%	740	52.4%	0	0.0%	0	0.0%	1,412
	SC2	1,384	100.0%	0	0.0%	0	0.0%	0	0.0%	1,384
	SC-above	20,495	58.3%	2,062	5.9%	0	0.0%	12,605	35.8%	35,162
Dry Valley Creek	DVC1[1]	3,156	96.3%	0	0.0%	121	3.7%	0	0.0%	3,277
	DVC2	728	84.7%	0	0.0%	132	15.3%	0	0.0%	860
	DVC3	5,299	100.0%	0	0.0%	0	0.0%	0	0.0%	5,299
	DVC4	2,142	71.0%	875	29.0%	0	0.0%	0	0.0%	3,017
	DVC5	252	20.6%	136	11.1%	0	0.0%	838	68.4%	1,226
	DVC6	0	0.0%	0	0.0%	0	0.0%	1,495	100.0%	1,495
	DVC7	0	0.0%	0	0.0%	0	0.0%	807	100.0%	807
	DVC-above	0	0.0%	0	0.0%	50	2.5%	1,921	97.5%	1,971
Angus Creek	AC1	713	100.0%	0	0.0%	0	0.0%	0	0.0%	713
	AC-above	4,409	36.0%	441	3.6%	0	0.0%	7,402	60.4%	12,252
Lanes Creek	LC1	3,738	100.0%	0	0.0%	0	0.0%	0	0.0%	3,738
	LC2	3,364	100.0%	0	0.0%	0	0.0%	0	0.0%	3,364
	LC3	1,276	100.0%	0	0.0%	0	0.0%	0	0.0%	1,276
	LC4	1,328	100.0%	0	0.0%	0	0.0%	0	0.0%	1,328
	LC5	660	58.0%	477	42.0%	0	0.0%	0	0.0%	1,137
	LC6	93	4.7%	1,857	95.3%	0	0.0%	0	0.0%	1,950
	LC7.1	845	100.0%	0	0.0%	0	0.0%	0	0.0%	845
	LC7.2	2,023	100.0%	0	0.0%	0	0.0%	0	0.0%	2,023
	LC8.1	418	100.0%	0	0.0%	0	0.0%	0	0.0%	418
	LC8.2	389	100.0%	0	0.0%	0	0.0%	0	0.0%	389
	LC8.3[2]	6,635	51.0%	129	1.0%	423	3.3%	5,827	44.8%	13,014
Diamond Creek	DC-below	6,275	100.0%	0	0.0%	0	0.0%	0	0.0%	6,275
	DC1	644	100.0%	0	0.0%	0	0.0%	0	0.0%	644
	DC2	2,253	100.0%	0	0.0%	0	0.0%	0	0.0%	2,253
	DC3	322	100.0%	0	0.0%	0	0.0%	0	0.0%	322
	DC-mid	679	36.3%	1,001	53.5%	0	0.0%	191	10.2%	1,871
	DC4	801	16.4%	0	0.0%	0	0.0%	4,073	83.6%	4,874
	DC5	0	0.0%	0	0.0%	0	0.0%	2,832	100.0%	2,832
	DC6	0	0.0%	0	0.0%	0	0.0%	2,006	100.0%	2,006
	DC7	0	0.0%	0	0.0%	0	0.0%	1,623	100.0%	1,623
	DC8	0	0.0%	0	0.0%	0	0.0%	2,004	100.0%	2,004
	DC9	0	0.0%	0	0.0%	0	0.0%	2,175	100.0%	2,175
	DC-above	0	0.0%	0	0.0%	0	0.0%	5,445	100.0%	5,445

[1]includes reach downstream of this reach to mouth

[2]includes reach(es) upstream of this reach to headwaters

Table 3.2-12. Load allocation and reduction by reach based on land ownership for Brush, Slug, Dry Valley, Angus, Lanes, and Diamond creeks.

Waterbody	Length (mi)	Reach	Reach description	Current load[1] (tons/yr)	Load allocation[2] (tons/yr)	Load reduction[1] (tons/yr)	Private Percent of reach	Private Allocation	Private Reduction	State Percent of reach	State Allocation	State Reduction	BLM Percent of reach	BLM Allocation	BLM Reduction	Forest Service Percent of reach	Forest Service Allocation	Forest Service Reduction
Brush Creek			mouth to 1.1 mi upstream	50.8	50.8	0.0	67%	33.9	0.0	0%	0.0	0.0	33%	16.9	0.0	0%	0.0	0.0
		BC11	1.1 mi to 2.8 mi upstream	78.5	78.5	0.0	92%	72.0	0.0	8%	6.4	0.0	0%	0.0	0.0	0%	0.0	0.0
		BC10	2.8 mi to 3.8 mi upstream	64.6	64.6	0.0	2%	1.6	0.0	98%	63.0	0.0	0%	0.0	0.0	0%	0.0	0.0
			3.8 mi to 7.1 mi upstream	721.8	260.4	461.4	24%	62.8	111.2	76%	197.6	350.2	0%	0.0	0.0	0%	0.0	0.0
		BC7	7.1 mi to 8.4 mi upstream	590.3	136.8	453.5	100%	136.8	453.5	0%	0.0	0.0	0%	0.0	0.0	0%	0.0	0.0
		BC6	8.4 mi to 9.0 mi upstream	195.2	94.7	100.5	100%	94.7	100.5	0%	0.0	0.0	0%	0.0	0.0	0%	0.0	0.0
			9.0 mi to 9.2 mi upstream	60.8	26.3	34.5	100%	26.3	34.5	0%	0.0	0.0	0%	0.0	0.0	0%	0.0	0.0
		BC4	9.2 mi to 10.5 mi upstream	350.3	136.8	213.6	99%	135.3	211.3	1%	1.4	2.2	0%	0.0	0.0	0%	0.0	0.0
			10.5 mi upstream to hdwtrs	1304.4	509.2	795.1	0%	0.0	0.0	100%	509.2	795.1	0%	0.0	0.0	0%	0.0	0.0
	15.3		mouth to hdwtrs	3416.7	1358.0	2058.7		563.4	911.1		777.7	1147.6		16.9	0.0		0.0	0.0
Slug Creek		S1	mouth to 0.8 mi upstream	2.1	2.1	0.0	48%	1.0	0.0	52%	1.1	0.0	0%	0.0	0.0	0%	0.0	0.0
		S2	0.8 mi to 1.7 mi upstream	2.9	2.9	0.0	100%	2.9	0.0	0%	0.0	0.0	0%	0.0	0.0	0%	0.0	0.0
			1.7 mi upstream to hdwtrs	69.3	69.3	0.0	58%	40.4	0.0	6%	4.1	0.0	0%	0.0	0.0	36%	24.8	0.0
	23.6		mouth to hdwtrs	74.2	74.2	0.0		44.2	0.0		5.2	0.0		0.0	0.0		24.8	0.0
Dry Valley Creek		DVC1	mouth to 2.0 mi upstream	184.8	184.8	0.0	96%	178.0	0.0	0%	0.0	0.0	4%	6.8	0.0	0%	0.0	0.0
		DVC2	2.0 mi to 2.5 mi upstream	0.0	0.0	0.0	85%	0.0	0.0	0%	0.0	0.0	15%	0.0	0.0	0%	0.0	0.0
		DVC3	2.5 mi to 5.8 mi upstream	641.5	278.1	363.5	100%	278.1	363.5	0%	0.0	0.0	0%	0.0	0.0	0%	0.0	0.0
		DVC4	5.8 mi to 7.7 mi upstream	290.2	290.2	0.0	71%	206.1	0.0	29%	84.2	0.0	0%	0.0	0.0	0%	0.0	0.0
		DVC5	7.7 mi to 8.5 mi upstream	0.0	0.0	0.0	21%	0.0	0.0	11%	0.0	0.0	0%	0.0	0.0	68%	0.0	0.0
		DVC6	8.5 mi to 9.4 mi upstream	99.8	99.8	0.0	0%	0.0	0.0	0%	0.0	0.0	0%	0.0	0.0	100%	99.8	0.0
		DVC7	9.4 mi to 9.9 mi upstream	0.0	0.0	0.0	0%	0.0	0.0	0%	0.0	0.0	0%	0.0	0.0	100%	0.0	0.0
			9.9 mi upstream to hdwtrs	0.0	0.0	0.0	0%	0.0	0.0	0%	0.0	0.0	3%	0.0	0.0	97%	0.0	0.0
	11.1		mouth to hdwtrs	1216.4	852.9	363.5		662.1	363.5		84.2	0.0		6.8	0.0		99.8	0.0
Angus Creek		AC1	mouth to 0.4 mi upstream	0.4	0.4	0.0	100%	0.4	0.0	0%	0.0	0.0	0%	0.0	0.0	0%	0.0	0.0
			0.4 mi upstream to hdwtrs	8.1	8.1	0.0	36%	2.9	0.0	4%	0.3	0.0	0%	0.0	0.0	60%	4.9	0.0
	8.0		mouth to hdwtrs	8.5	8.5	0.0		3.3	0.0		0.3	0.0		0.0	0.0		4.9	0.0
Lanes Creek		LC1	mouth to 2.3 mi upstream	842.7	686.2	156.5	100%	686.2	156.5	0%	0.0	0.0	0%	0.0	0.0	0%	0.0	0.0
		LC2	2.3 mi to 4.3 mi upstream	342.5	166.1	176.3	100%	166.1	176.3	0%	0.0	0.0	0%	0.0	0.0	0%	0.0	0.0
		LC3	4.3 mi to 5.0 mi upstream	273.0	106.6	166.4	100%	106.6	166.4	0%	0.0	0.0	0%	0.0	0.0	0%	0.0	0.0
		LC4	5.0 mi to 5.8 mi upstream	28.5	28.5	0.0	100%	28.5	0.0	0%	0.0	0.0	0%	0.0	0.0	0%	0.0	0.0
		LC5	5.8 mi to 6.5 mi upstream	44.2	44.2	0.0	58%	25.7	0.0	42%	18.6	0.0	0%	0.0	0.0	0%	0.0	0.0
		LC6	6.5 mi to 7.7 mi upstream	156.5	72.2	84.3	5%	3.4	4.0	95%	68.8	80.3	0%	0.0	0.0	0%	0.0	0.0
		LC 7.1	7.7 mi to 8.2 mi upstream	13.3	13.3	0.0	100%	13.3	0.0	0%	0.0	0.0	0%	0.0	0.0	0%	0.0	0.0
		LC 7.2	8.2 mi to 9.5 mi upstream	170.9	78.2	92.7	100%	78.2	92.7	0%	0.0	0.0	0%	0.0	0.0	0%	0.0	0.0
		LC 8.1	9.5 mi to 9.8 mi upstream	0.4	0.4	0.0	100%	0.4	0.0	0%	0.0	0.0	0%	0.0	0.0	0%	0.0	0.0
		LC 8.2	9.8 mi to 10.0 mi upstream	73.1	24.1	49.0	100%	24.1	49.0	0%	0.0	0.0	0%	0.0	0.0	0%	0.0	0.0
		LC 8.3	10.0 mi upstream to hdwtrs	78.2	78.2	0.0	51%	39.9	0.0	1%	0.8	0.0	3%	2.5	0.0	45%	35.0	0.0
	11.3		mouth to hdwtrs	838.2	445.9	392.4		320.1	312.1		88.1	80.3		2.5	0.0		35.0	0.0
Diamond Creek			mouth to 3.9 mi upstream	49.4	49.4	0.0	100%	49.4	0.0	0%	0.0	0.0	0%	0.0	0.0	0%	0.0	0.0
		DC1	3.9 mi to 4.3 mi upstream	5.1	5.1	0.0	100%	5.1	0.0	0%	0.0	0.0	0%	0.0	0.0	0%	0.0	0.0
		DC2	4.3 mi to 5.7 mi upstream	237.4	92.7	144.7	100%	92.7	144.7	0%	0.0	0.0	0%	0.0	0.0	0%	0.0	0.0
		DC3	5.7 mi to 5.9 mi upstream	27.4	16.9	10.5	100%	16.9	10.5	0%	0.0	0.0	0%	0.0	0.0	0%	0.0	0.0
			5.9 mi to 7.0 mi upstream	143.7	143.7	0.0	36%	52.2	0.0	54%	76.9	0.0	0%	0.0	0.0	10%	14.7	0.0
		DC4	7.0 mi to 9.9 mi upstream	183.7	183.7	0.0	16%	30.2	0.0	0%	0.0	0.0	0%	0.0	0.0	84%	153.5	0.0
		DC5	9.9 mi to 11.6 mi upstream	29.6	29.6	0.0	0%	0.0	0.0	0%	0.0	0.0	0%	0.0	0.0	100%	29.6	0.0
		DC6.1	11.6 mi to 12.2 mi upstream	17.6	17.6	0.0	0%	0.0	0.0	0%	0.0	0.0	0%	0.0	0.0	100%	17.6	0.0
		DC6.2	12.2 mi to 12.8 mi upstream	18.5	18.5	0.0	0%	0.0	0.0	0%	0.0	0.0	0%	0.0	0.0	100%	18.5	0.0
		DC7	12.8 mi to 13.7 mi upstream	607.9	188.3	419.6	0%	0.0	0.0	0%	0.0	0.0	0%	0.0	0.0	100%	188.3	419.6
		DC8	13.7 mi to 14.9 mi upstream	394.3	214.0	180.2	0%	0.0	0.0	0%	0.0	0.0	0%	0.0	0.0	100%	214.0	180.2
		DC9	14.9 mi to 16.3 mi upstream	94.2	94.2	0.0	0%	0.0	0.0	0%	0.0	0.0	0%	0.0	0.0	100%	94.2	0.0
			16.3 mi upstream to hdwtrs	250.9	250.9	0.0	0%	0.0	0.0	0%	0.0	0.0	0%	0.0	0.0	100%	250.9	0.0
	20.0		mouth to hdwtrs	2059.8	1304.7	755.1		246.4	155.2		76.9	0.0		0.0	0.0		981.4	599.8

[1]from Table 3.2-10

[2]from target load in Table 3.2-10, may be considered load capacity for the stream reach

Table 3.2-13. Results of an ANOVA test comparing percent streambank stability based on Proper Functioning Condition status. Percent streambank stability was transformed as follows: Arcsine(Square Root(Percent Unstable Streambank)). Back transformed values were calculated by back transforming transformed values.

Variable	*N*	Mean unstable streambank (transformed)	Standard deviation (transformed)	*p*-value (between groups)	Mean unstable streambank (back transformed)	Median unstable streambank (back transformed)	Range (back transformed)	Bonferroni comparison tests (*p*-value)	
								Functional at risk	Non functioning
Properly functioning	69	0.235	0.276	1.39E-08	0.054	0.000	0.600	0.001	0.000
Functional at risk	55	0.458	0.349		0.196	0.150	0.900		0.003
Non functioning	18	0.748	0.376		0.463	0.500	1.000		

stability for the three conditions was quite high especially for functional at risk (90%) and non functioning (100%).

Depth Fines

Support of salmonid spawning and cold water biota beneficial uses are closely tied to sediment in the streambed surface and subsurface. Because it is difficult to establish a link between sediment in the water column (total suspended solids or suspended sediment) or streambank stability and fine sediment in streambed subsurface (i.e., depth fines), a depth fines target is needed. All 303(d)-listed streams that identify sediment as a pollutant are expected to meet the targets for subsurface streambed sediment - fines less than 6.25 mm not to exceed a 5-year mean of greater than 25% by volume in riffles. An additional target is recommended for those streams in which salmonid spawning is a recognized beneficial use - fines less than 0.85 mm not to exceed a 5-year mean of greater than 10% by volume in riffles where salmonid spawning could be expected.

Limited depth fines information indicates high levels in several 303(d)-listed streams. These data are limited in that they are from a minimum number of sites within a stream and do not include sufficient sampling to determine 5-year averages. Levels greater than 25% fine sediment less than 6.3 mm have been documented in upper Blackfoot River, and Wolverine, Brush, Grizzly, Dry Valley, Angus, and Sheep creeks (Table 2.2-12). Fines less than 0.85 mm appear to be a problem in Wolverine, Brush, Meadow, Dry Valley, and Angus creeks where they represent greater than 10% by volume.

Margin of Safety

The chosen turbidity targets allow for a margin of safety well within or below the range of 25 to 80 mg/l of suspended sediment required to maintain good to moderate fisheries (EIFAC 1964). For streambank stability, the recommended target of 80% is consistent with other TMDLs. As mentioned in the Palisades TMDL (Zaroban and Sharp 2000), 80% streambank stability represents conditions found in Idaho wilderness areas (Overton et al. 1995). As mentioned, a 25%, rather than 27%, target for subsurface sediment less than 6.25 mm by volume is recommended for depth fines.

Data Gaps

Several data gaps exist in sediment information presently available in the Blackfoot River subbasin. The link between streambank stabilization, and thus reduction in lateral recession rate, and reduction in depth fines is unknown. Nor is the relationship between reduction in water column sediment, as measured by suspended sediment or total suspended solids, and depth fines known. Monitoring of reductions in these parameters may help deduce such relationships. Additional paired turbidity and total suspended solids sampling will help to refine this relationship in Dry Valley Creek. More information is needed to accurately determine depth fines levels: data should be collected from riffle areas throughout listed streams through several water years.

Much of the information on water column sediment in the subbasin is expressed as total suspended solids. Total suspended solids and concentration of suspended sediment (SSC) are analyzed differently, and TSS tends to underestimate SSC (Gray et al. 2000). Turbidity targets relate to water column sediment as TSS. Paired data for TSS and SSC are needed to establish a site-specific relationship in the Blackfoot River subbasin.

3.2.2 Nutrients

Standard (*Water Quality Standards and Wastewater Treatment Requirements* [Idaho Department of Environmental Quality nda])

Un-ionized ammonia - not to exceed criteria for cold water biota and salmonid spawning (in streams with salmonid spawning as a designated or existing beneficial use)

Excess nutrients - surface waters of the state shall be free from excess nutrients that can cause visible slime growths or other nuisance aquatic growths impairing designated beneficial uses

Target

Nitrogen not to exceed 0.3 mg/l of nitrogen as total inorganic nitrogen
Phosphorus not to exceed 0.1 mg/l of phosphorus as total phosphorus

Discussion

Nutrients have been identified as being a problem in the Blackfoot River subbasin. Although plants depend on a wide variety of nutrients, we have chosen to address excessive input of nutrients by concentrating on two - nitrogen and phosphorus.

Waterbodies in the Blackfoot River subbasin that have nutrients listed as pollutants of concern are Wolverine Creek and mainstem Blackfoot River from Blackfoot Reservoir to the equalizing dam (Table 2.2-1). Periphyton analysis from a Blackfoot River site just downstream from where Reservation Canal enters the mainstem indicated that nutrient enrichment was a minor cause of impairment in this area and the site may be subject to dissolved oxygen sags (The Academy of Natural Sciences, letter to Idaho Department of Environmental Quality summarizing periphyton analysis at sampled sites). Aquatic vegetation can affect levels of dissolved oxygen resulting in concentrations below the state standard of 6.0 mg/l. Data do not indicate any incidences of dissolved oxygen levels below state standards (Appendix Tables D-1, F-1). However, we reviewed no data that was collected continuously through any 24-hour period or longer.

As part of the BURP monitoring effort, periphyton density and aquatic macrophyte abundance were evaluated in the mainstem Blackfoot River both above and below Blackfoot Reservoir (Table 3.2-14). Periphyton abundance was considered sparse at the Reservation Canal

Table 3.2-14. Results of river assessment on mainstem Blackfoot River, 1997 and 1998 (from DEQ BURP data).

Site	Location	Transect	Periphyton abundance[1]	Aquatic macrophyte abundance[2]	Percent fines (<= 6 mm)	Percent sand/silt (<= 2 mm)
Lower	0.75 miles downstream of Reservation Canal	1	Sparse	NM[3]	15%	
		2	Sparse	NM	19%	
		3	Sparse	NM	30%	
		Overall	Sparse		21%	
Middle	nr Grave Creek campground	1	Dense	75%		30%
		2	Dense	35%		0%
		3	Dense	85%		30%
		Overall	Dense	65%		20%
Upper	nr confluence of Slug Creek	1	Dense	10%		20%
		2	Dense	0%		15%
		3	Dense	0%		35%
		Overall	Dense	3%		23%

[1]abundance classified as dense, moderate, sparse, or none

[2]presence or absence of aquatic macrophytes were tallied for each measurement point along the transect. The number of points where aquatic macrophytes were recorded divided by the total number of points equaled abundance.

[3]NM=not measured

site and dense at the two upper sites - near Grave Creek campground and Slug Creek. Overall abundance of aquatic macrophytes was much less (mean 3% vs. 65%) on the Blackfoot River near Slug Creek than near Grave Creek campground.

Targets are recommended for both nitrogen and phosphorus. Generally, the ratio of nitrogen to phosphorus within phytoplankton is somewhere in the range of 10:1 to 17:1 (Mackenthun 1973). In Clark Fork River above Missoula, Montana, the voluntary nutrient reduction program called for maintenance of nitrogen to phosphorus at a 15:1 ratio to control for *Cladophora*, a filamentous algae (Tri-State Implementation Council 1998). Data were available to examine the ratio of total inorganic nitrogen to ortho phosphorus (forms of nitrogen (N) and phosphorus (P) more readily available for nutrient uptake than total nitrogen or total phosphorus). In the lower Blackfoot River, a median N:P ratio of 14.5 indicates that nitrogen may be limiting (Table 3.2-15). Phosphorus appears to be limiting in Wolverine Creek where the median N:P ratio was 65.6 (Table 3.2-16).

In addition to problems of beneficial use support within a subbasin, the effect of nutrients on downstream subbasins is of further concern. Both American Falls Reservoir and Snake River near Twin Falls have been identified as having nutrient problems.

Site-specific targets for nitrogen and phosphorus in the Blackfoot River were not attempted. No information for either nutrient was reviewed on site-specific levels necessary to support beneficial uses. In addition, loading, or assimilative, capacity was not estimated due to lack of data. For purposes of the loading analysis, assimilative capacity was considered to be equal to the target load.

The nitrogen target was set for total inorganic nitrogen because it represents nitrogen most readily available for algae and plant uptake. As total inorganic nitrogen includes nitrate plus nitrite and ammonia, the target accounts for those forms of nitrogen most often measured. The 0.3 mg/l threshold for TIN is much less than the State of Utah's 4.0 mg/l for nitrates as an indicator of water quality impairment (Division of Water Quality, State of Utah, internet communication). The proposed total inorganic nitrogen target is also less than the 0.3 mg/l total nitrogen target adopted by Clark Fork River Voluntary Nutrient Reduction Program (Tri-State Implementation Council 1998). The TIN target was based on work by Sawyer (1947), who reported 0.3 mg/l of inorganic nitrogen as the threshold value for nuisance aquatic plant growth problems in lakes around Madison, Wisconsin. Imhoff (1955) cited Muller (1953), who stated that excessive plant growth in streams and lakes does not occur if total nitrate nitrogen is below 0.3 mg/l, or total nitrogen is below 0.6 mg/l.

As a margin of safety, a target of 0.3 mg/l for total inorganic nitrogen, per Sawyer (1947), was chosen over 0.3 mg/l of total nitrate as recommended by Muller (1953). Furthermore, a target of 0.3 mg/l of TIN increases the assurance that levels of available nitrogen to phosphorus stay below 10:1.

Even a level of 0.3 mg/l of TIN may be too high to control nuisance aquatic growth. Bothwell (1992) reported that in a nitrogen-limited stream, kraft mill effluent with a dissolved

Table 3.2-15. Total inorganic nitrogen and ortho phosphorus concentrations in lower Blackfoot River since 1981.

Date	Site	Nitrate + nitrite (mg N/l)	Ammonia (mg N/l)	Total inorganic nitrogen (mg N/l)	Total ortho phosphate (mg/l PO_4)	Total ortho phosphate (mg P/l)[1]	Ortho phosphate (mg P/l)	Dissolved ortho phosphate (mg/l PO_4)	Dissolved ortho phosphate (mg P/l)	Ortho phosphorus (mg P/l)	Ratio of nitrogen to phosphorus	Median ratio by site and sampling period	Source
7-Oct-81	nr Blackfoot	0.010 <	0.16				0.01 <						DEQ, unpublished data
9-Nov-81	nr Blackfoot	0.300	0.038	0.338			0.08			0.080	4.2		DEQ, unpublished data
1-Dec-81	nr Blackfoot	0.340	0.032	0.372			0.1			0.100	3.7		DEQ, unpublished data
12-Jan-82	nr Blackfoot	0.251	0.07	0.321			0.12			0.120	2.7		DEQ, unpublished data
3-Feb-82	nr Blackfoot	0.518	0.064	0.582			0.16			0.160	3.6		DEQ, unpublished data
16-Mar-82	nr Blackfoot	0.081	0.042	0.123			0.08			0.080	1.5		DEQ, unpublished data
29-Apr-82	nr Blackfoot	0.527	0.106	0.633			0.07			0.070	9.0		DEQ, unpublished data
11-May-82	nr Blackfoot	0.207	0.048	0.255			0.033			0.033	7.7		DEQ, unpublished data
8-Jun-82	nr Blackfoot	0.073	0.031	0.104			0.07			0.070	1.5		DEQ, unpublished data
13-Jul-82	nr Blackfoot	0.028	0.079	0.107			0.03			0.030	3.6		DEQ, unpublished data
9-Aug-82	nr Blackfoot	0.108	0.053	0.161			0.03			0.030	5.4		DEQ, unpublished data
21-Sep-82	nr Blackfoot	0.041	0.033	0.074			0.008			0.008	9.3	3.7	DEQ, unpublished data
22-Nov-88	nr Blackfoot	0.260	0.023	0.283					0.001 <				DEQ, unpublished data
19-Dec-88	nr Blackfoot	0.445	0.036	0.481					0.005	0.005	96.2		DEQ, unpublished data
21-Mar-89	nr Blackfoot	0.344	0.058	0.402					0.01	0.010	40.2		DEQ, unpublished data
18-Apr-89	nr Blackfoot	0.724	0.047	0.771					0.022	0.022	35.0		DEQ, unpublished data
17-May-89	nr Blackfoot	0.059	0.066	0.125					0.001 <				DEQ, unpublished data
21-Jun-89	nr Blackfoot	0.008	0.066	0.074					0.006	0.006	12.3	37.6	DEQ, unpublished data
28-Sep-99	at Rich Lane bridge	0.050 <	0.05 <				0.05 <						DEQ, unpublished data
19-Nov-86	Reid Bridge	0.240	0.027	0.267	0.002	0.001				0.001	404.5		Drewes 1987
17-Feb-87	Reid Bridge	0.553	0.025	0.578				0.025	0.008 *	0.008	70.1		Drewes 1987
2-Mar-87	Reid Bridge	0.334	0.119	0.453				0.061	0.020 *	0.020	22.5		Drewes 1987
16-Mar-87	Reid Bridge	0.275	0.053	0.328				0.038	0.013 *	0.013	26.2		Drewes 1987
30-Mar-87	Reid Bridge	0.124	0.032	0.156				0.057	0.019 *	0.019	8.3		Drewes 1987
13-Apr-87	Reid Bridge	0.014	0.018	0.032				0.019	0.006 *	0.006	5.1		Drewes 1987
4-May-87	Reid Bridge	0.156	0.055	0.211				0.039	0.013 *	0.013	16.4		Drewes 1987
2-Jun-87	Reid Bridge	0.005	0.014	0.019	0.008	0.003				0.003	7.2		Drewes 1987
15-Jun-87	Reid Bridge	0.041	0.053	0.094	0.006	0.002				0.002	47.5		Drewes 1987
6-Jul-87	Reid Bridge	0.041	0.04	0.081				0.005 <				22.5	Drewes 1987
19-Nov-86	USGS gage site nr Shelley	0.342	0.041	0.383	0.002	0.001				0.001	580.3		Drewes 1987
17-Feb-87	USGS gage site nr Shelley	0.498	0.084	0.582				0.018	0.006 *	0.006	98.0		Drewes 1987
2-Mar-87	USGS gage site nr Shelley	0.328	0.111	0.439				0.023	0.008 *	0.008	57.8		Drewes 1987
16-Mar-87	USGS gage site nr Shelley	0.267	0.052	0.319				0.031	0.010 *	0.010	31.2		Drewes 1987
30-Mar-87	USGS gage site nr Shelley	0.173	0.041	0.214				0.018	0.006 *	0.006	36.0		Drewes 1987
13-Apr-87	USGS gage site nr Shelley	0.023	0.023	0.046				0.008	0.003 *	0.003	17.4		Drewes 1987
4-May-87	USGS gage site nr Shelley	0.130	0.057	0.187				0.034	0.011 *	0.011	16.7		Drewes 1987
2-Jun-87	USGS gage site nr Shelley	0.010	0.018	0.028	0.008	0.003				0.003	10.6		Drewes 1987
15-Jun-87	USGS gage site nr Shelley	0.037	0.038	0.075	0.008	0.003				0.003	28.4		Drewes 1987
6-Jul-87	USGS gage site nr Shelley	0.042	0.073	0.115				0.008	0.003 *	0.003	43.6	33.6	Drewes 1987
28-Sep-99	at The Cove	0.930	0.05 <				0.05 <						DEQ, unpublished data
30-Mar-87	at Trail Creek	0.207	0.076	0.283				0.019	0.006 *	0.006	45.1		Drewes 1987
13-Apr-87	at Trail Creek	0.034	0.034	0.068				0.025	0.008 *	0.008	8.2		Drewes 1987
4-May-87	at Trail Creek	0.026	0.089	0.115				0.027	0.009 *	0.009	12.9		Drewes 1987
2-Jun-87	at Trail Creek	0.025	0.028	0.053	0.011	0.004				0.004	14.6		Drewes 1987
15-Jun-87	at Trail Creek	0.014	0.051	0.065	0.001 <								Drewes 1987
6-Jul-87	at Trail Creek	0.012	0.045	0.057				0.012	0.004 *	0.004	14.4	14.4	Drewes 1987
28-Sep-99	Trail Creek bridge	0.890	0.05 <				0.05 <						DEQ, unpublished data
28-Sep-99	at Morgan Bridge	0.970	0.05 <				0.05 <						DEQ, unpublished data
29-Oct-98	at Government Dam bridge	0.017	0.03	0.047			0.009			0.009	5.2	5.2	DEQ, unpublished data
28-Sep-99	at Government Dam bridge	0.910	0.18	1.09			0.05 <						DEQ, unpublished data
Median											14.5		

[1]calculated by multiplying mg PO_4/l by 33% to get mg P/l
<below detection limit

Table 3.2-16. Total inorganic nitrogen and ortho phosphorus concentrations in Wolverine Creek.

Waterbody	Date	Site	Flow (cfs)	Number of samples	Nitrate + nitrite (mg N/l)	Ammonia (mg N/l)	Total inorganic nitrogen (mg N/l)	Total phosphorus (mg P/l)	Total ortho phosphate (mg/l PO_4)	Ortho phosphate (mg P/l)	Dissolved ortho phosphate (mg/l PO_4)	Ortho phosphorus (mg P/l)	Ratio of nitrogen to phosphorus	Source
Wolverine Creek	28-Sep-99	nr mouth	10.83	1	0.880	0.05 <		0.05 <		0.05 <				DEQ, unpublished data
	19-Nov-86	Blackfoot River Road		1	0.153	0.014	0.167	0.1 <	0.005			0.002	101.2	Drewes 1987
	17-Feb-87	Blackfoot River Road	7.8	1	0.245	0.058	0.303	0.17			0.014	0.005	65.6	Drewes 1987
	2-Mar-87	Blackfoot River Road	19.2	1	0.194	0.088	0.282	3.47			0.012	0.004	71.2	Drewes 1987
	16-Mar-87	Blackfoot River Road	13.5	1	0.151	0.023	0.174	0.38			0.003	0.001	175.8	Drewes 1987
	30-Mar-87	Blackfoot River Road	9.6	1	0.130	0.026	0.156	0.35			0.01	0.003	47.3	Drewes 1987
	13-Apr-87	Blackfoot River Road	20.9	1	0.091	0.024	0.115	0.32			0.005	0.002	69.7	Drewes 1987
	4-May-87	Blackfoot River Road	10.6	1	0.075	0.059	0.134	0.19			0.027	0.009	15.0	Drewes 1987
	19-May-87	Blackfoot River Road	15.1	1	0.136	0.033	0.169	0.25						Drewes 1987
	2-Jun-87	Blackfoot River Road	16.3	1	0.066	0.017	0.083	0.16	0.009			0.003	27.9	Drewes 1987
	15-Jun-87	Blackfoot River Road	6.3	1	0.119	0.064	0.183	0.21	0.017			0.006	32.6	Drewes 1987
	6-Jul-87	Blackfoot River Road	0.3	1	0.055	0.107	0.162	0.05 <			0.005 <			Drewes 1987
Median													65.6	

<below detection limit

inorganic nitrogen concentration of about 0.25 mg/l almost doubled the specific growth rate of algae. In setting any target it must be remembered that the TMDL is a dynamic process, i.e., targets can be changed, either higher or lower, based on monitoring.

The target for phosphorus is based on the EPA "Gold Book" (1986), which makes recommendations of thresholds for total phosphorus and total phosphates as phosphorus. EPA recommended that total phosphorus (based on Mackenthun 1973) not exceed a concentration of 0.1 mg/l for prevention of nuisance aquatic growth in streams or flowing waters that do not discharge directly into lakes or reservoirs. The State of Utah uses a level of 0.05 mg/l of total phosphorus as an indicator of water quality impairment (Division of Water Quality, State of Utah, Internet communication). The recommended target of 0.1 mg/l total phosphorus follows the EPA "Gold Book."

Some evidence indicates that these phosphorus recommendations may not be low enough to limit algal production via phosphorus. Bothwell (1989) reported that phosphorus was no longer limiting to the peak areal biomass of periphytic diatom communities in experimental troughs in the South Thompson River, British Columbia, at phosphate concentrations of greater than 0.03-0.05 mg/l. Diatom peak areal biomass was 70% of the maximum attainable biomass from phosphorus enrichment at only 0.001 mg/l of ortho phosphate. The Clark Fork River Voluntary Nutrient Reduction Program recommended total phosphorus targets of 0.02 and 0.039 mg/l depending on location in the river above or below Missoula, Montana (Tri-State Implementation Council 1998). Sonzogni et al. (1982) argued that reducing total phosphorus may have little impact, especially in lotic waters, when the portion of phosphorus reduced is not bioavailable (e.g., land runoff is often high in particulate phosphorus, significant portions of which cannot be immediately utilized in the growth of algae and aquatic macrophytes).

Natural levels of nitrogen and phosphorus are not known. The natural input of nitrogen into the Blackfoot River is assumed to be low, except for precipitation and mineralization of organic nitrogen from detritus there are no known major sources of naturally occurring nitrate (Rupert 1996).

The extent to which either nitrogen or phosphorus exceeds seasonal load capacity is unknown. The tendency for the uptake of phosphorus as phosphates by sediment allows phosphorus availability throughout the growing season regardless of the time of input. Nitrogen, on the other hand, tends to remain dissolved and will "flow through" in lotic, or stream, systems. If only the Blackfoot River was to be considered, seasonal variation in nutrient concentrations would be applied. However, the Blackfoot River flows into the Snake River not far upstream from American Falls Reservoir. Lentic waters (e.g., lakes and reservoirs) act as sinks for both phosphorus and nitrogen, increasing the availability time for uptake by aquatic vegetation. Thus, nitrogen or phosphorus that entered the stream in February could be bioavailable to aquatic vegetation in the reservoir in July when conditions are conducive to algal or macrophytic growth. Due to concern about American Falls Reservoir, which is on the 303(d) list for nutrients, no allowance for seasonal variation in nutrient loading is made.

Loading Analysis

Wolverine Creek

Data on nutrient concentrations in Wolverine Creek are inconclusive. Total inorganic nitrogen and total phosphorus concentrations from 1986 and 1987 (Drewes 1987) at Blackfoot River Road averaged 0.175 and 0.507 mg/l, respectively (Table 3.2-17). These numbers would indicate that TIN is below the target concentration, while TP is over the target concentration. One sampling event in 1999, however, indicated the opposite with a TIN concentration of around 0.9 mg/l and TP at less 0.05 mg/l (Table 3.2-18). As mentioned, it appears that phosphorus is limiting in Wolverine Creek (Table 3-2.16).

Nutrient loading in Wolverine Creek was based on the 1986-1987 data because it included multiple samples covering much of the year (February to July). At the same time it must be realized that although representing only one sampling event, the 1999 nutrient concentrations may be more typical of present conditions in Wolverine Creek. Regardless, the target loading concentrations of 0.3 mg/l of TIN and 0.1 mg/l of TP remain the same. The 1986-1987 data result in an estimated load of 2.9 tons/yr of TIN and 8.3 tons/yr of TP (Table 3.2-19). Target loads are 4.9 tons/yr and 1.6 tons/yr for TIN and TP, respectively. Based on these numbers, there would be no need for a load reduction of TIN in Wolverine Creek. However, until more data are collected to better quantify the current load of TIN into the creek, the load allocation for TIN in Wolverine Creek is 2.9 tons/yr - a no net increase of total inorganic nitrogen. The target load of 1.6 tons/yr of TP is the recommended load allocation and requires a load reduction of 6.7 tons/yr. The load allocation and reduction both apply throughout the year.

These recommendations, because there is load reduction for total phosphorus and not for total inorganic nitrogen, might indicate that phosphorus is the limiting nutrient in Wolverine Creek. The discrepancy lies in the small percentage that ortho phosphorus represents of total phosphorus (Table 3.2-16). Thus, the N:P ratio can be small while there still exists a need to reduce total phosphorus into the system. Any additional sampling in Wolverine Creek should include sampling for ortho phosphorus in addition to total phosphorus.

It would appear from1986-1987 sampling that Jones Creek is a major contributor of nutrients into Wolverine Creek (Table 3.2-20). Thus, to achieve recommended load reductions in Wolverine Creek will likely require reductions in nutrient input from Jones Creek. From the data collected over the six-month period the average daily load from Jones Creek into Wolverine Creek was 0.003 tons of TIN per day and 0.006 tons of TP per day. These figures represented 45.5% and 25.2% of the average daily load in Wolverine Creek, respectively. Applying these percentages to target loads in Wolverine Creek results in load allocations for Jones Creek of 1.3 tons/yr of total inorganic nitrogen and 0.4 tons/yr of total phosphorus.

Table 3.2-17. Total inorganic nitrogen and total phosphorus concentrations in Blackfoot River subbasin below Blackfoot Reservoir and at Henry (see Appendix Table E-1 for sources of data).

Waterbody	Site	Period of sampling	Number of samples	Total inorganic nitrogen (mg N/l)		Total phosphorus (mg P/l)	
Blackfoot River	USGS gage at Blackfoot	1971-1982	25			0.127	
	USGS gage at Blackfoot	1989-1997	52	0.205		0.057	
	nr Blackfoot	1981-1989	18	0.298		0.146	
	Rich Lane bridge	1999	1	--	[1]	0.05	<
	Reid Bridge	1986-1987	11	0.226		0.205	
	USGS gage nr Shelley	1986-1987	11	0.239		0.154	
	at the Cove	1999	1	0.955	[2]	0.05	<
	Trail Creek area	1987, 1999	7	0.222		0.082	
	Morgan Bridge	1999	1	0.995	[2]	0.05	<
	at Gov't Dam Bridge	1998, 1999	2	0.569		0.053	
	at Henry	1982	2	0.054		0.130	
	USGS gage nr Henry	1968-1981	29	0.195			
	USGS gage nr Henry	1970-1981	23			0.114	
Wolverine Creek	nr mouth	1999	1	0.905	[2]	0.05	<
	at Blackfoot River Rd	1986-1987	11	0.175		0.507	
	upstream nr A-frame	1987	10	0.147		0.125	
	Jones Creek	1986-1987	11	0.608		1.257	
Cedar Creek	at Blackfoot River Rd	1986-1987	11	0.343		1.522	
	at Blackfoot River Rd	1999	1	0.895		0.05	<
	Cattlemen's Assoc. gate	1987	8	0.075		0.484	
	Cattlemen's Assoc. cabin	1987	2	0.118		0.190	
Miner Creek	nr mouth	1986-1987	9	0.070		0.172	
	at Blackfoot River Road	1999	1	--	[1]	0.05	<
Beaver Creek	nr mouth	1999	1	0.945	[2]	0.05	<
Trail Creek	nr Trail Cr Bridge	1999	1	--	[1]	0.05	<
Brush Creek	bel confluence with Rawlins Cr	1999	1	--	[1]	0.05	<
Deadman/Supon creeks	bel confluence of two creeks	1999	1	0.955	[2]	0.05	<
Grave Creek	at road crossing west of campground	1999	1	--	[1]	0.05	<
Corral Creek	bel bridge crossing	1999	1	1.105	[2]	0.05	<

[1]below detection limits for both nitrate+nitrite and ammonia

[2]concentration for ammonia was below detection limit of 0.05 mg/l so 0.025 mg/l was added to nitrate+nitrite concentration

<below detection limit

Table 3.2-18. Nutrient information from monitoring in Wolverine Creek watershed.

Waterbody	Date	Site	Flow (cfs)	Number of samples	Nitrate + nitrite (mg N/l)	Ammonia (mg N/l)		Revised ammonia[1] (mg N/l)	Total inorganic nitrogen (mg N/l)	Total phosphorus (mg P/l)		Revised total phosphorus[1] (mg P/l)	Source
Wolverine Creek	28-Sep-99	nr mouth	10.83	1	0.880	0.05	<	0.025	0.905	0.05	<	0.025	DEQ, unpublished data
	19-Nov-86	Blackfoot River Road			0.153	0.014		0.014	0.167	0.1	<	0.05	Drewes 1987
	17-Feb-87	Blackfoot River Road	7.8		0.245	0.058		0.058	0.303	0.17		0.17	Drewes 1987
	2-Mar-87	Blackfoot River Road	19.2		0.194	0.088		0.088	0.282	3.47		3.47	Drewes 1987
	16-Mar-87	Blackfoot River Road	13.5		0.151	0.023		0.023	0.174	0.38		0.38	Drewes 1987
	30-Mar-87	Blackfoot River Road	9.6		0.130	0.026		0.026	0.156	0.35		0.35	Drewes 1987
	13-Apr-87	Blackfoot River Road	20.9		0.091	0.024		0.024	0.115	0.32		0.32	Drewes 1987
	4-May-87	Blackfoot River Road	10.6		0.075	0.059		0.059	0.134	0.19		0.19	Drewes 1987
	19-May-87	Blackfoot River Road	15.1		0.136	0.033		0.033	0.169	0.25		0.25	Drewes 1987
	2-Jun-87	Blackfoot River Road	16.3		0.066	0.017		0.017	0.083	0.16		0.16	Drewes 1987
	15-Jun-87	Blackfoot River Road	6.3		0.119	0.064		0.064	0.183	0.21		0.21	Drewes 1987
	6-Jul-87	Blackfoot River Road	0.3		0.055	0.107		0.107	0.162	0.05	<	0.025	Drewes 1987
Average									0.175			0.507	
	17-Feb-87	HH A-Frame Home	7		0.140	0.151		0.151	0.291	0.05	<	0.025	Drewes 1987
	2-Mar-87	HH A-Frame Home	11.5		0.193	0.024		0.024	0.217	0.98		0.98	Drewes 1987
	16-Mar-87	HH A-Frame Home	9.1		0.132	0.019		0.019	0.151	0.05	<	0.025	Drewes 1987
	30-Mar-87	HH A-Frame Home	10.2		0.133	0.036		0.036	0.169	0.04		0.04	Drewes 1987
	13-Apr-87	HH A-Frame Home	18.8		0.128	0.017		0.017	0.145	0.05	<	0.025	Drewes 1987
	4-May-87	HH A-Frame Home	19.1		0.038	0.034		0.034	0.072	0.05	<	0.025	Drewes 1987
	19-May-87	HH A-Frame Home	5.3		0.119	0.014		0.014	0.133	0.05		0.05	Drewes 1987
	2-Jun-87	HH A-Frame Home	6.9		0.088	0.014		0.014	0.102	0.05	<	0.025	Drewes 1987
	15-Jun-87	HH A-Frame Home	6.1		0.040	0.076		0.076	0.116	0.05	<	0.025	Drewes 1987
	6-Jul-87	HH A-Frame Home	6.2		0.018	0.052		0.052	0.070	0.05	<	0.025	Drewes 1987
Average									0.147			0.125	
Jones Creek	19-Nov-86	mouth			0.251	0.014		0.014	0.265	0.41		0.41	Drewes 1987
	17-Feb-87	mouth	2.9		0.494	0.547		0.547	1.041	0.37		0.37	Drewes 1987
	2-Mar-87	mouth	2.6		0.468	0.075		0.075	0.543	1.37		1.37	Drewes 1987
	16-Mar-87	mouth	1.7		0.398	0.801		0.801	1.199	4.77		4.77	Drewes 1987
	30-Mar-87	mouth	0.4		2.370	0.032		0.032	2.402	0.4		0.4	Drewes 1987
	13-Apr-87	mouth	1.2		0.362	0.034		0.034	0.396	2.48		2.48	Drewes 1987
	4-May-87	mouth	3.8		0.167	0.019		0.019	0.186	0.59		0.59	Drewes 1987
	19-May-87	mouth	1.7		0.229	0.04		0.04	0.269	2.8		2.8	Drewes 1987
	2-Jun-87	mouth	0.9		0.128	0.027		0.027	0.155	0.43		0.43	Drewes 1987
	15-Jun-87	mouth	0.6		0.093	0.035		0.035	0.128	0.11		0.11	Drewes 1987
	6-Jul-87	mouth	0.7		0.029	0.077		0.077	0.106	0.1		0.1	Drewes 1987
Average									0.608			1.257	

[1]minimum detection limit divided by 2 for analysis purposes
<below detection limit

Table 3.2-19. Estimated nutrient loads in Wolverine Creek.

Month	Average daily flow (cfs)[1]	Total inorganic nitrogen Load (tons/month)[2]	Total inorganic nitrogen Target load (tons/month)[3]	Total inorganic nitrogen Reduction (tons/month)	Total phosphorus Load (tons/month)[2]	Total phosphorus Target load (tons/month)[4]	Total phosphorus Reduction (tons/month)
January	10.1	0.148	0.254	-0.106	0.429	0.085	0.344
February	10.5	0.140	0.240	-0.100	0.405	0.080	0.325
March	13.0	0.190	0.325	-0.136	0.550	0.108	0.441
April	23.5	0.333	0.570	-0.238	0.963	0.190	0.773
May	49.5	0.726	1.244	-0.518	2.102	0.415	1.687
June	36.1	0.512	0.878	-0.366	1.484	0.293	1.192
July	12.1	0.178	0.305	-0.127	0.516	0.102	0.414
August	9.6	0.141	0.241	-0.100	0.408	0.080	0.327
September	8.7	0.123	0.211	-0.088	0.357	0.070	0.286
October	8.6	0.126	0.217	-0.090	0.366	0.072	0.294
November	8.9	0.127	0.217	-0.091	0.367	0.072	0.295
December	9.0	0.132	0.227	-0.095	0.384	0.076	0.308
Total		2.875	4.929	-2.054	8.331	1.643	6.688

[1]from mean daily flows, 1 Oct 1979 to 31 July 1983 and 1 January 1984 to 30 June 1986 (from USGS Water Resources Data reports)

[2]from mean concentrations 1986-1987 (Drewes 1987)

[3]target load of 0.3 mg/l of total inorganic nitrogen

[4]target load of 0.1 mg/l of total phosphorus

Table 3.2-20. Estimated nutrient loads in Wolverine and Jones creeks (from Drewes 1987).

	Flow (cfs)		Total inorganic nitrogen			Total phosphorus		
Month	Wolverine Cr at Blkft R Rd	Jones Cr	Wolverine Creek load at Blkft R Rd (tons/day)	Jones Creek load (tons/day)	Jones Cr as % of Wolverine Cr	Wolverine Creek load at Blkft R Rd (tons/day)	Jones Creek load (tons/day)	Jones Cr as % of Wolverine Cr
17-Feb-87	7.8	2.9	0.00638	0.00815	127.7%	0.00358	0.00290	80.9%
2-Mar-87	19.2	2.6	0.01462	0.00381	26.1%	0.17988	0.00962	5.3%
16-Mar-87	13.5	1.7	0.00634	0.00550	86.8%	0.01385	0.02189	158.1%
30-Mar-87	9.6	0.4	0.00404	0.00259	64.2%	0.00907	0.00043	4.8%
13-Apr-87	20.9	1.2	0.00649	0.00128	19.8%	0.01806	0.00804	44.5%
4-May-87	10.6	3.8	0.00384	0.00191	49.8%	0.00544	0.00605	111.3%
19-May-87	15.1	1.7	0.00689	0.00123	17.9%	0.01019	0.01285	126.1%
2-Jun-87	16.3	0.9	0.00365	0.00038	10.3%	0.00704	0.00104	14.8%
15-Jun-87	6.3	0.6	0.00311	0.00021	6.7%	0.00357	0.00018	5.0%
6-Jul-87	0.3	0.7	0.00013	0.00020	152.7%	0.00002	0.00019	933.3%
Average			0.006	0.003	45.5%	0.025	0.006	25.2%

Blackfoot River

Generally, except for sampling in 1999, concentrations of TIN measured in lower Blackfoot River have been less than the target concentration (Table 3.2-17). Concentrations of total phosphorus have been more mixed in terms of above and below target concentration.

Nutrient loading in lower Blackfoot River was estimated at two sites - USGS surface-water stations near Blackfoot (13068500) and near Shelley (13066000). The Blackfoot River gage site near Blackfoot is below the equalizing dam and therefore not within 303(d)-listed waters, but water quality at the gage site is influenced by the water quality limited segments. Monthly flows at both sites are listed in Table 3.2-21.

No nutrient data have been collected by USGS at the Shelley gage site. However, nutrient data were collected at the site in 1986 and 1987 (Appendix Table E-1). Drewes (1987) found average concentrations of 0.239 mg/l of TIN and 0.154 mg/l of TP (Table 3.2-17). Using average monthly flows from Table 3.2-21, these concentrations result in annual loads of 87.9 tons/yr of TIN and 56.6 tons/yr of TP at the gage site (Table 3.2-22). With target loads of 110.3 tons/yr and 36.8 tons/yr for TIN and TP, respectively, no load reductions are required for TIN while the load reduction for TP is 20 tons/yr. In keeping with the State of Idaho's antidegradation policy, the TIN load allocation for Blackfoot River at Shelley is 87.9 tons/yr. The TP load allocation is the same as the target load of 36.8 tons/yr.

USGS has collected data at the Blackfoot River gage site near Blackfoot since 1967 (Table 3.2-23 and Appendix Table I-1). Concentrations of nutrients measured at the gage site from 1989 to 1997 averaged 0.205 mg/l for total inorganic nitrogen and 0.057 mg/l for total phosphorus (Table 3.2-17), both levels less than the target concentrations in the 303(d)-listed segment of the river. Combined with flow data from the gage site (Table 3.2-21), these concentrations result in annual loads of 32.6 tons/yr of TIN and 9.1 tons/yr of TP, well below loads based on the target concentrations (Table 3.2-24). Until more data are collected to better quantify the current load of TIN and TP in this section of the Blackfoot River, a no net increase of total inorganic nitrogen (at or below 32.6 tons/yr) and total phosphorus (at or below 9.1 tons/yr) is allowed.

Margin of Safety

Both targets include a margin of safety. The nitrogen target of 0.3 mg/l for TIN, per Sawyer (1947), allows for less nitrogen than a target of 0.3 mg/l of total nitrate as recommended by Muller (1953), because TIN also includes other forms of nitrogen (e.g., nitrite and ammonia). The margin of safety for total phosphorus is inherent in EPA's recommended target concentration of 0.1 mg/l.

Table 3.2-21. Flows in Blackfoot River near Blackfoot (13068500) and near Shelley (13066000) USGS surface-water stations (from USGS Water Resources Data reports).

	Average daily flow (cfs)	
Month	near Blackfoot[1]	near Shelley[2]
January	109	131
February	121	147
March	159	203
April	204	339
May	246	593
June	191	768
July	122	749
August	140	581
September	139	420
October	206	222
November	180	170
December	114	137

[1]for WY 1964-1998

[2]for WY 1909-1999

Table 3.2-22. Estimated nutrient loads at USGS surface-water station near Shelley (13066000).

Month	Average daily flow (cfs)[1]	Total inorganic nitrogen			Total phosphorus		
		Load (tons/month)[2]	Target load (tons/month)[3]	Reduction (tons/month)	Load (tons/month)[2]	Target load (tons/month)[4]	Reduction (tons/month)
January	131	2.621	3.289	-0.669	1.689	1.096	0.592
February	147	2.680	3.364	-0.684	1.727	1.121	0.605
March	203	4.061	5.097	-1.036	2.617	1.699	0.918
April	339	6.563	8.238	-1.675	4.229	2.746	1.483
May	593	11.863	14.890	-3.028	7.644	4.963	2.680
June	768	14.868	18.662	-3.795	9.580	6.221	3.359
July	749	14.983	18.807	-3.824	9.654	6.269	3.385
August	581	11.622	14.589	-2.966	7.489	4.863	2.626
September	420	8.131	10.206	-2.075	5.239	3.402	1.837
October	222	4.441	5.574	-1.133	2.862	1.858	1.003
November	170	3.291	4.131	-0.840	2.121	1.377	0.744
December	137	2.741	3.440	-0.699	1.766	1.147	0.619
Total		87.863	110.289	-22.425	56.615	36.763	19.852

[1]from mean daily flows, WY 1909-1999 (from USGS Water Resources Data reports)

[2]from mean concentrations 1986-1987 (Drewes 1987)

[3]target load of 0.3 mg/l of total inorganic nitrogen

[4]target load of 0.1 mg/l of total phosphorus

Table 3.2-23. Nutrient information from Blackfoot River at USGS surface-water station near Blackfoot (13068500), 1971-1997 (from USGS Water Resources Data reports).

Year	Date	Discharge (cfs)	Nitrite + nitrate (mg N/l)	Ammonia (mg N/l)	Total inorganic nitrogen (mg N/l)	Total phosphorus (mg P/l)
1971	12-Jan	95				0.190
1971	23-Jun	311				0.050
1972	27-Apr	412				0.270
1972	30-May	240				0.260
1972	29-Jun	263				0.390
1972	31-Aug	200				0.120
1973	24-May	130				0.200
1973	19-Oct	242				0.170
1974	4-Oct	123				0.050
1975	31-Aug	170				0.060
1976	2-Jul	126				0.040
1976	10-Nov	323				0.040
1977	15-Jul	7.8				0.040
1977	18-Oct	142				0.150
1978	9-Jun	37				0.020
1978	2-Aug	178				0.050
1978	20-Sep	265				0.010
1979	13-Jun	72				0.040
1979	12-Sep	64				0.030
1979	9-Oct	130				0.030
1979	21-Nov	101				0.030
1980	1-May	186				0.360
1980	8-Oct	128				0.200
1981	16-Jul	59				0.160
1982	19-May					0.220
1989	17-Jul	174	0.023 [1]	0.018 [2]	0.041	0.050
1989	30-Aug	37	0.009 [1]	0.037 [2]	0.046	0.013
1989	19-Sep	172	0.017 [1]	0.05 [2]	0.067	0.013
1989	20-Nov	124	0.1 [1]	0.01 [2]	0.110	0.050
1990	26-Jan	93	0.5 [1]	0.0025 [2]	0.503	0.040
1990	19-Mar	70	0.2 [1]	0.02 [2]	0.220	0.060
1990	15-May	116	0.025 [1]	0.01 [2]	0.035	0.040
1990	24-Jul	63	0.025 [1]	0.0025 [2]	0.028	0.040
1990	11-Sep	32	0.025 [1]	0.01 [2]	0.035	0.030
1990	15-Nov	73	0.1 [1]	0.05 [2]	0.150	0.020
1991	17-Jan	58	0.7 [1]	0.05 [2]	0.750	0.020
1991	12-Mar	77	0.29 [1]	0.06 [2]	0.350	0.080
1991	13-May	168	0.14 [1]	0.02 [2]	0.160	0.100
1991	9-Jul	58	0.0125 [1]	0.02 [2]	0.033	0.030
1991	18-Sep	83	0.0125 [1]	0.02 [2]	0.033	0.030
1991	22-Nov	50	0.34 [3]	0.0025 [2]	0.343	0.020

Table 3.2-23. Continued.

Year	Date	Discharge (cfs)	Nitrite + nitrate (mg N/l)	Ammonia (mg N/l)	Total inorganic nitrogen (mg N/l)
1992	17-Jan	49	0.61 [3]	0.03 [2]	0.640
1992	18-Mar	64	0.11 [3]	0.02 [2]	0.130
1992	15-May	50	0.0125 [3]	0.01 [2]	0.023
1992	30-Jul	3	0.0125 [3]	0.05 [2]	0.063
1992	29-Sep	3.7	0.0125 [3]	0.02 [2]	0.033
1992	18-Nov	51	0.49 [3]	0.02 [4]	0.510
1993	13-Jan	19	0.81 [3]	0.11 [4]	0.920
1993	19-Mar	128	0.33 [3]	0.13 [4]	0.460
1993	21-May	227	0.022 [3]	0.03 [4]	0.052
1993	21-Jul	142	0.0125 [3]	0.04 [4]	0.053
1993	24-Sep	97	0.0125 [3]	0.02 [4]	0.033
1993	23-Nov	80	1 [3]	0.03 [4]	1.030
1994	18-Jan	67	0.46 [3]	0.03 [4]	0.490
1994	23-Mar	90	0.14 [3]	0.02 [4]	0.160
1994	17-May	70	0.0125 [3]	0.0025 [4]	0.015
1994	26-May	56	0.0125 [3]	0.02 [4]	0.033
1994	12-Jul	37	0.0125 [3]	0.03 [4]	0.043
1994	20-Sep	29	0.06 [3]	0.0025 [4]	0.063
1994	18-Nov	73	0.46 [3]	0.02 [4]	0.480
1995	16-Jan	94	0.48 [3]	0.03 [4]	0.510
1995	24-Mar	126	0.28 [3]	0.02 [4]	0.300
1995	18-May	118	0.0125 [3]	0.00375 [4]	0.016
1995	14-Jul	54	0.0125 [3]	0.00375 [4]	0.016
1995	19-Sep	45	0.0125 [3]	0.00375 [4]	0.016
1996	25-Apr	221	0.21 [3]	0.00375 [4]	0.214
1996	23-May	309	0.21 [3]	0.04 [4]	0.250
1996	20-Jun	159	0.06 [3]	0.03 [4]	0.090
1996	18-Jul	137	0.06 [3]	0.03 [4]	0.090
1996	22-Aug	103	0.0125 [3]	0.00375 [4]	0.016
1996	19-Sep	198	0.12 [3]	0.04 [4]	0.160
1997	24-Apr	391	0.336 [3]	0.047 [4]	0.383
1997	21-May	260	0.13 [3]	0.00375 [4]	0.134
1997	9-Jun	282	0.083 [3]	0.00375 [4]	0.087
1997	28-Jul	241	0.0125 [3]	0.00375 [4]	0.016
1997	16-Sep	250	0.123 [3]	0.00375 [4]	0.127
1997	8-Oct	208	0.097 [3]	0.016 [4]	0.113

[1]total nitrate + nitrite

[2]total ammonia

[3]dissolved nitrate + nitrite

[4]dissolved ammonia

Table 3.2-24. Estimated nutrient loads at USGS surface-water station near Blackfoot (13068500).

Month	Average daily flow (cfs)[1]	Total inorganic nitrogen Load (tons/month)[2]	Total inorganic nitrogen Target load (tons/month)[3]	Total inorganic nitrogen Reduction (tons/month)	Total phosphorus Load (tons/month)[2]	Total phosphorus Target load (tons/month)[4]	Total phosphorus Reduction (tons/month)
January	109	1.870	2.737	-0.867	0.520	0.912	-0.392
February	121	1.892	2.769	-0.877	0.526	0.923	-0.397
March	159	2.728	3.992	-1.264	0.759	1.331	-0.572
April	204	3.387	4.957	-1.570	0.942	1.652	-0.711
May	246	4.221	6.177	-1.956	1.174	2.059	-0.885
June	191	3.172	4.641	-1.470	0.882	1.547	-0.665
July	122	2.093	3.063	-0.970	0.582	1.021	-0.439
August	140	2.402	3.515	-1.113	0.668	1.172	-0.504
September	139	2.308	3.378	-1.070	0.642	1.126	-0.484
October	206	3.535	5.173	-1.638	0.983	1.724	-0.741
November	180	2.989	4.374	-1.385	0.831	1.458	-0.627
December	114	1.956	2.863	-0.906	0.544	0.954	-0.410
Total		32.554	47.640	-15.086	9.052	15.880	-6.828

[1]from mean daily flows, WY 1964-1998 (from USGS Water Resources Data reports)

[2]from mean concentrations 1989-1997 (from USGS Water Resources Data reports)

[3]target load of 0.3 mg/l of total inorganic nitrogen

[4]target load of 0.1 mg/l of total phosphorus

Data Gaps

Additional nutrient data is needed to better define nutrient load allocations. Necessary information includes linkage between targets and support of beneficial uses, natural background levels, limiting nutrient analysis, and nutrient concentrations and flow from Blackfoot River and the equalizing dam and tributaries.

More information is needed to determine the effect of Jones Creek on water quality in Wolverine Creek. Land in the Jones Creek watershed, which was dry-farmed in mid-1980s, is now used for hay or pasture (Scott Engle, NRCS/Blackfoot, personal communication). Current contribution of Jones Creek to nutrient loading in Wolverine Creek is unknown, but likely less than mid-1980 levels.

3.3 Summary of Data Needs

Data are needed which would allow for a better understanding of pollutant inputs into waterbodies in Blackfoot River subbasin and their effects on support of beneficial uses. The following is by no means an exhaustive list of all data needs in the Blackfoot River subbasin:

- natural background levels of sediment, nitrogen, and phosphorus,
- regular stream flow information throughout the year from tributaries,
- link between streambank stabilization, and thus reduction in lateral recession rate, and reduction in depth fines,
- link between reduction in water column sediment and reduction in depth fines,
- paired turbidity and total suspended solids/suspended sediment concentrations in Dry Valley Creek to refine the relationship between the parameters,
- streambank stabilization and Proper Functioning Condition status for all 303(d) streams,
- depth fines data throughout listed streams through several water years realizing that riffle area sites are subject to change from hydraulic activity,
- refinement of nutrient levels necessary to support beneficial uses,
- flow, sediment, and nutrient information from mainstem Blackfoot River below equalizing dam,
- data to determine extent that organic loading is affecting beneficial uses in the lower Blackfoot River, and
- hydraulic modeling of flows in Blackfoot River below Blackfoot Reservoir and possible influence on support of beneficial uses

Glossary

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

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

Acre-Foot — A volume of water that would cover an acre to a depth of one foot. Often used to quantify reservoir storage and the annual discharge of large rivers.

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

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

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

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

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

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

Algae	Non-vascular (without water-conducting tissue) aquatic plants that occur as single cells, colonies, or filaments.
Alluvium	Unconsolidated recent stream deposition.
Ambient	General conditions in the environment. In the context of water quality, ambient waters are those representative of general conditions, not associated with episodic perturbations, or specific disturbances such as a wastewater outfall (Armantrout 1998; EPA 1996).
Anadromous	Fish, such as salmon and sea-run trout, that live part or the majority of their lives in the salt water but return to fresh water to spawn.
Anaerobic	Describes the processes that occur in the absence of molecular oxygen and describes the condition of water that is devoid of molecular oxygen.
Anoxia	The condition of oxygen absence or deficiency.
Anthropogenic	Relating to, or resulting from, the influence of human beings on nature.
Anti-Degradation	Refers to the U.S. Environmental Protection Agency's interpretation of the Clean Water Act goal that states and tribes maintain, as well as restore, water quality. This applies to waters that meet or are of higher water quality than required by state standards. State rules provide that the quality of those high quality waters may be lowered only to allow important social or economic development and only after adequate public participation (IDAPA 58.01.02.051). In all cases, the existing beneficial uses must be maintained. State rules further define lowered water quality to be 1) a measurable change, 2) a change adverse to a use, and 3) a change in a pollutant relevant to the water's uses (IDAPA 58.01.02.003.56).
Aquatic	Occurring, growing, or living in water.
Aquifer	An underground, water-bearing layer or stratum of permeable rock, sand, or gravel capable of yielding of water to wells or springs.
Assemblage (aquatic)	An association of interacting populations of organisms in a given waterbody; for example, a fish assemblage, or a benthic macroinvertebrate assemblage (also see Community) (EPA 1996).

Assessment Database (ADB)	The ADB is a relational database application designed for the U.S. Environmental Protection Agency for tracking water quality assessment data, such as use attainment and causes and sources of impairment. States need to track this information and many other types of assessment data for thousands of waterbodies, and integrate it into meaningful reports. The ADB is designed to make this process accurate, straightforward, and user-friendly for participating states, territories, tribes, and basin commissions.
Assimilative Capacity	The ability to process or dissipate pollutants without ill effect to beneficial uses.
Autotrophic	An organism is considered autotrophic if it uses carbon dioxide as its main source of carbon. This most commonly happens through photosynthesis.
Batholith	A large body of intrusive igneous rock that has more than 40 square miles of surface exposure and no known floor. A batholith usually consists of coarse-grained rocks such as granite.
Bedload	Material (generally sand-sized or larger sediment) that is carried along the streambed by rolling or bouncing.
Beneficial Use	Any of the various uses of water, including, but not limited to, aquatic biota, recreation, water supply, wildlife habitat, and aesthetics, which are recognized in water quality standards.
Beneficial Use Reconnaissance Program (BURP)	A program for conducting systematic biological and physical habitat surveys of waterbodies 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 waterbody.
Benthic Organic Matter	The organic matter on the bottom of a waterbody.
Benthos	Organisms living in and on the bottom sediments of lakes and streams. Originally, the term meant the lake bottom, but it is now applied almost uniformly to the animals associated with the lake and stream bottoms.
Best Management Practices (BMPs)	Structural, nonstructural, and managerial techniques that are effective and practical means to control nonpoint source pollutants.

Best Professional Judgment	A conclusion and/or interpretation derived by a trained and/or technically competent individual by applying interpretation and synthesizing information.
Bio accumulate	When the concentration of a substance (e.g., organic compound, metal) increases in organisms at increasingly higher levels of the food chain.
Bioavailable	When a substance (e.g., organic compound, metal) is available for uptake by an organism.
Biochemical Oxygen Demand (BOD)	The amount of dissolved oxygen used by organisms during the decomposition (respiration) of organic matter, expressed as mass of oxygen per volume of water, over some specified period of time.
Biological Integrity	1) The condition of an aquatic community inhabiting unimpaired waterbodies of a specified habitat as measured by an evaluation of multiple attributes of the aquatic biota (EPA 1996). 2) The ability of an aquatic ecosystem to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to the natural habitats of a region (Karr 1991).
Biomass	The weight of biological matter. Standing crop is the amount of biomass (e.g., fish or algae) in a body of water at a given time. Often expressed as grams per square meter.
Biota	The animal and plant life of a given region.
Biotic	A term applied to the living components of an area.
Char	A member of the salmon family closely related to the trouts. Lake trout, brook trout, bull trout, and Dolly Varden are all char.
Clean Water Act (CWA)	The Federal Water Pollution Control Act (Public Law 92-50, commonly known as the Clean Water Act), as last reauthorized by the Water Quality Act of 1987 (Public Law 100-4), establishes a process for states to use to develop information on, and control the quality of, the nation's water resources.

Coliform Bacteria	A group of bacteria predominantly inhabiting the intestines of humans and animals but also found in soil. Coliform bacteria are commonly used as indicators of the possible presence of pathogenic organisms (also see Fecal Coliform Bacteria).
Colluvium	Material transported to a site by gravity.
Community	A group of interacting organisms living together in a given place.
Conductivity	The ability of an aqueous solution to carry electric current, expressed in micro ( ) mhos/cm at 25 °C. Conductivity is affected by dissolved solids and is used as an indirect measure of total dissolved solids in a water sample.
Cretaceous	The final period of the Mesozoic era (after the Jurassic and before the Tertiary period of the Cenozoic era), thought to have covered the span of time between 135 and 65 million years ago.
Criteria	In the context of water quality, numeric or descriptive factors taken into account in setting standards for various pollutants. These factors are used to determine limits on allowable concentration levels, and to limit the number of violations per year. EPA develops criteria guidance; states establish criteria.
Cubic Feet per Second	A unit of measure for the rate of flow or discharge of water. One cubic foot per second is the rate of flow of a stream with a cross-section of one square foot flowing at a mean velocity of one foot per second. At a steady rate, once cubic foot per second is equal to 448.8 gallons per minute and 10,984 acre-feet per day.
Cultural Eutrophication	The process of eutrophication that has been accelerated by human-caused influences. Usually seen as an increase in nutrient loading (also see Eutrophication).
Culturally Induced Erosion	Erosion caused by increased runoff or wind action due to the work of humans in deforestation, cultivation of the land, overgrazing, and disturbance of natural drainages; the excess of erosion over the normal for an area (also see Erosion).
Debris Torrent	The sudden down slope movement of soil, rock, and vegetation on steep slopes, often caused by saturation from heavy rains.
Decomposition	The breakdown of organic molecules (e.g., sugar) to inorganic molecules (e.g., carbon dioxide and water) through biological and nonbiological processes.

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

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

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

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

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

E. coli Short for *Escherichia coli*, *E. coli* are a group of bacteria that are a subspecies of coliform bacteria. Most *E. coli* are essential to the healthy life of all warm-blooded animals, including humans. Their presence is often indicative of fecal contamination.

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).

Ecology The scientific study of relationships between organisms and their environment; also defined as the study of the structure and function of nature.

Ecosystem The interacting system of a biological community and its non-living (abiotic) environmental surroundings.

Effluent A discharge of untreated, partially treated, or treated wastewater into a receiving waterbody.

Embeddedness The extent to which space between streambed cobble or rock is filled by finer sediments. A low level of embeddedness results in greater interstitial space conducive to the production of macroinvertebrates preferred by salmonid and other fish species for food.

Endangered Species Animals, birds, fish, plants, or other living organisms threatened with imminent extinction. Requirements for declaring a species as endangered are contained in the Endangered Species Act.

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

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

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

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

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

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

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

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

Existing Beneficial Use or Existing Use A beneficial use actually attained in waters on or after November 28, 1975, whether or not the use is designated for the waters in Idaho's *Water Quality Standards and Wastewater Treatment Requirements* (IDAPA 58.01.02).

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

Extrapolation	Estimation of unknown values by extending or projecting from known values.
Fauna	Animal life, especially the animals characteristic of a region, period, or special environment.
Fecal Coliform Bacteria	Bacteria found in the intestinal tracts of all warm-blooded animals or mammals. Their presence in water is an indicator of pollution and possible contamination by pathogens (also see Coliform Bacteria).
Fecal Streptococci	A species of spherical bacteria including pathogenic strains found in the intestines of warm-blooded animals.
Feedback Loop	In the context of watershed management planning, a feedback loop is a process that provides for tracking progress toward goals and revising actions according to that progress.
Fixed-Location Monitoring	Sampling or measuring environmental conditions continuously or repeatedly at the same location.
Flow	See Discharge.
Fluvial	In fisheries, this describes fish whose life history takes place entirely in streams but migrate to smaller streams for spawning.
Focal	Critical areas supporting a mosaic of high quality habitats that sustain a diverse or unusually productive complement of native species.
Fully Supporting	In compliance with water quality standards and within the range of biological reference conditions for all designated and exiting beneficial uses as determined through the *Water Body Assessment Guidance* (Grafe et al. 2000).
Fully Supporting Cold Water	Reliable data indicate functioning, sustainable cold water biological assemblages (e.g., fish, macroinvertebrates, or algae), none of which have been modified significantly beyond the natural range of reference conditions (EPA 1997).
Fully Supporting but Threatened	An intermediate assessment category describing waterbodies that fully support beneficial uses, but have a declining trend in water quality conditions, which if not addressed, will lead to a "not fully supporting" status.

Geographical Information Systems (GIS)	A georeferenced database.
Geometric Mean	A back-transformed mean of the logarithmically transformed numbers often used to describe highly variable, right-skewed data (a few large values), such as bacterial data.
Grab Sample	A single sample collected at a particular time and place. It may represent the composition of the water in that water column.
Gradient	The slope of the land, water, or streambed surface.
Ground Water	Water found beneath the soil surface saturating the layer in which it is located. Most ground water originates as rainfall, is free to move under the influence of gravity, and usually emerges again as stream flow.
Growth Rate	A measure of how quickly something living will develop and grow, such as the amount of new plant or animal tissue produced per a given unit of time, or number of individuals added to a population.
Habitat	The living place of an organism or community.
Headwater	The origin or beginning of a stream.
Hydrograph	How the flow of a stream changes over the year. The hydrograph of a typical undammed Idaho stream is high flow in the spring associated with snow melt followed by decreasing flow through the early fall after which flow increases due to increased precipitation.
Hydrologic Basin	The area of land drained by a river system, a reach of a river and its tributaries in that reach, a closed basin, or a group of streams forming a drainage area (also see Watershed).
Hydrologic Cycle	The cycling of water from the atmosphere to the earth (precipitation) and back to the atmosphere (evaporation and plant transpiration). Atmospheric moisture, clouds, rainfall, runoff, surface water, ground water, and water infiltrated in soils are all part of the hydrologic cycle.

Hydrologic Unit	One of a nested series of numbered and named watersheds arising from a national standardization of watershed delineation. The initial 1974 effort (USGS 1987) described four levels (region, subregion, accounting unit, cataloging unit) of watersheds throughout the United States. The fourth level is uniquely identified by an eight-digit code built of two-digit fields for each level in the classification. Originally termed a cataloging unit, fourth field hydrologic units have been more commonly called subbasins. Fifth and sixth field hydrologic units have since been delineated for much of the country and are known as watershed and subwatersheds, respectively.
Hydrologic Unit Code (HUC)	The number assigned to a hydrologic unit. Often used to refer to fourth field hydrologic units.
Hydrology	The science dealing with the properties, distribution, and circulation of water.
Impervious	Describes a surface, such as pavement, that water cannot penetrate.
Influent	A tributary stream.
Inorganic	Materials not derived from biological sources.
Instantaneous	A condition or measurement at a moment (instant) in time.
Intergravel Dissolved Oxygen	The concentration of dissolved oxygen within spawning gravel. Consideration for determining spawning gravel includes species, water depth, velocity, and substrate.
Intermittent Stream	1) A stream that flows only part of the year, such as when the ground water table is high or when the stream receives water from springs or from surface sources such as melting snow in mountainous areas. The stream ceases to flow above the streambed when losses from evaporation or seepage exceed the available stream flow. 2) A stream that has a period of zero flow for at least one week during most years.
Interstate Waters	Waters that flow across or form part of state or international boundaries, including boundaries with Indian nations.
Irrigation Return Flow	Surface (and subsurface) water that leaves a field following the application of irrigation water and eventually flows into streams.

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

Knickpoint Any interruption or break of slope.

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

Lentic Very low to non-flowing water (e.g., lakes and reservoirs).

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

Limnology The scientific study of fresh water, especially the history, geology, biology, physics, and chemistry of lakes.

Load(ing) The quantity of a substance entering a receiving stream, usually expressed in pounds or kilograms per day or tons per year. Loading is the product of flow (discharge) and concentration.

Load Allocation (LA) A portion of a waterbody's load capacity for a given pollutant that is given to a particular nonpoint source (by class, type, or geographic area).

Loading Capacity (LC) A determination of how much pollutant a waterbody can receive over a given period without causing violations of state water quality standards. Upon allocation to various sources, and a margin of safety, it becomes a total maximum daily load.

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

Loess A uniform wind-blown deposit of silty material. Silty soils are among the most highly erodible.

Lotic An aquatic system with flowing water such as a brook, stream, or river where the net flow of water is from the headwaters to the mouth.

Luxury Consumption A phenomenon in which sufficient nutrients are available in either the sediments or the water column of a waterbody, such that aquatic plants take up and store an abundance in excess of the plants' current needs.

Macroinvertebrate An invertebrate animal (without a backbone) large enough to be seen without magnification and retained by a 500 m mesh (U.S. #30) screen.

Macrophytes Rooted and floating vascular aquatic plants, commonly referred to as water weeds. These plants usually flower and bear seeds. Some forms, such as duckweed and coontail (*Ceratophyllum sp.*), are free-floating forms not rooted in sediment.

Margin of Safety (MOS) An implicit or explicit portion of a waterbody's loading capacity set aside to allow the uncertainly about the relationship between the pollutant loads and the quality of the receiving waterbody. This is a required component of a total maximum daily load (TMDL) and is often incorporated into conservative assumptions used to develop the TMDL (generally within the calculations and/or models). The MOS is not allocated to any sources of pollution.

Mass Wasting A general term for the down slope movement of soil and rock material under the direct influence of gravity.

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

Median The middle number in a sequence of numbers. If there are an even number of numbers, the median is the average of the two middle numbers. For example, 4 is the median of 1, 2, 4, 14, 16; and 6 is the median of 1, 2, 5, 7, 9, 11.

Mesotrophic A term referring to waterbodies that are characterized by levels of nutrients and biotic productivity somewhere between eutrophic and oligotrophic.

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

Milligrams per Liter (mg/l) A unit of measure for concentration in water, essentially equivalent to parts per million (ppm).

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

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

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

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

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

Natural Condition A condition indistinguishable from that without human-caused disruptions.

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

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

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

Not Assessed (NA) A concept and an assessment category describing waterbodies that have been studied, but are missing critical information needed to complete an assessment.

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

Not Fully Supporting	Not in compliance with water quality standards or not within the range of biological reference conditions for any beneficial use as determined through the *Water Body Assessment Guidance* (Grafe et al. 2000).
Not Fully Supporting Cold Water	At least one biological assemblage has been significantly modified beyond the natural range of its reference condition (EPA 1997).
Nuisance	Anything which is injurious to the public health or an obstruction to the free use, in the customary manner, of any waters of the state.
Nutrient	Any substance required by living things to grow. An element or its chemical forms essential to life, such as carbon, oxygen, nitrogen, and phosphorus. Commonly refers to those elements in short supply, such as nitrogen and phosphorus, which usually limit growth.
Nutrient Cycling	The flow of nutrients from one component of an ecosystem to another, as when macrophytes die and release nutrients that become available to algae (organic to inorganic phase and return).
Oligotrophic	The Greek term for "poorly nourished." This describes a body of water in which productivity is low and nutrients are limiting to algal growth, as typified by low algal density and high clarity.
Organic Compound	Carbon-based compounds that can be natural (e.g., fecal material) or human made (e.g., PCB) in origin.
Organic Matter	Compounds manufactured by plants and animals that contain principally carbon.
Organochlorine Compound	Organic compounds that include chlorine most of which are human made (e.g., PCB)
Orthophosphate	A form of soluble inorganic phosphorus most readily used for algal growth.
Oxygen-Demanding Materials	Those materials, mainly organic matter, in a waterbody which consume oxygen during decomposition.
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.

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

Pathogens — Disease-producing organisms (e.g., bacteria, viruses, parasites).

Perennial Stream — A stream that flows year-around in most years.

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

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

pH — The negative $\log_{10}$ of the concentration of hydrogen ions, a measure which in water ranges from very acid (pH=1) to very alkaline (pH=14). A pH of 7 is neutral. Surface waters usually measure between pH 6 and 9.

Phased TMDL — A total maximum daily load (TMDL) that identifies interim load allocations and details further monitoring to gauge the success of management actions in achieving load reduction goals and the effect of actual load reductions on the water quality of a waterbody. Under a phased TMDL, a refinement of load allocations, waste load allocations, and the margin of safety is planned at the outset.

Phosphorus — An element essential to plant growth, often in limited supply, and thus considered a nutrient.

Physiochemical — In the context of bioassessment, the term is commonly used to mean the physical and chemical factors of the water column that relate to aquatic biota. Examples in bioassessment usage include saturation of dissolved gases, temperature, pH, conductivity, dissolved or suspended solids, forms of nitrogen, and phosphorus. This term is used interchangeable with the terms "physical/chemical" and "physicochemical."

Plankton — Microscopic algae (phytoplankton) and animals (zooplankton) that float freely in open water of lakes and oceans.

Point Source — A source of pollutants characterized by having a discrete conveyance, such as a pipe, ditch, or other identifiable "point" of discharge into a receiving water. Common point sources of pollution are industrial and municipal wastewater.

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

Pollution — A very broad concept that encompasses human-caused changes in the environment which alter the functioning of natural processes and produce undesirable environmental and health effects. This includes human-induced alteration of the physical, biological, chemical, and radiological integrity of water and other media.

Population — A group of interbreeding organisms occupying a particular space; the number of humans or other living creatures in a designated area.

Pretreatment — The reduction in the amount of pollutants, elimination of certain pollutants, or alteration of the nature of pollutant properties in wastewater prior to, or in lieu of, discharging or otherwise introducing such wastewater into a publicly owned wastewater treatment plant.

Primary Contact Recreation — Water-related activities (e.g., swimming) where ingestion of water is common.

Primary Productivity — The rate at which algae and macrophytes fix carbon dioxide using light energy. Commonly measured as milligrams of carbon per square meter per hour.

Protocol — A series of formal steps for conducting a test or survey.

Qualitative — Descriptive of kind, type, or direction.

Quality Assurance (QA) — A program organized and designed to provide accurate and precise results. Included are the selection of proper technical methods, tests, or laboratory procedures; sample collection and preservation; the selection of limits; data evaluation; quality control; and personnel qualifications and training. The goal of QA is to assure the data provided are of the quality needed and claimed (Rand 1995; EPA 1996).

Quality Control (QC) Routine application of specific actions required to provide information for the quality assurance program. Included are standardization, calibration, and replicate samples. QC is implemented at the field or bench level (Rand 1995; EPA 1996).

Quantitative Descriptive of size, magnitude, or degree.

R^2 A measurement of the relationship between two variables in a correlation analysis. R^2 ranges from 0 to 1 with the values closest to 1 indicating the strongest relationship.

Reach A stream section with fairly homogenous physical characteristics.

Reconnaissance An exploratory or preliminary survey of an area.

Reference A physical or chemical quantity whose value is known, and thus is used to calibrate or standardize instruments.

Reference Condition 1) A condition that fully supports applicable beneficial uses with little affect from human activity and represents the highest level of support attainable. 2) A benchmark for populations of aquatic ecosystems used to describe desired conditions in a biological assessment and acceptable or unacceptable departures from them. The reference condition can be determined through examining regional reference sites, historical conditions, quantitative models, and expert judgment (Hughes 1995).

Reference Site A specific locality on a waterbody that is minimally impaired and is representative of reference conditions for similar waterbodies.

Regression The comparison of two parameters to determine if a relationship exists. For example, a comparison of graduating seniors would most likely show an overall positive relationship between an individual's height and weight.

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

Resident A term that describes fish that do not migrate.

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

Riffle	A relatively shallow, gravelly area of a streambed with a locally fast current, recognized by surface choppiness. Also an area of higher streambed gradient and roughness.
Riparian	Associated with aquatic (stream, river, lake) habitats. Living or located on the bank of a waterbody.
Riparian Habitat Conservation Area (RHCA)	A U.S. Forest Service description of land within the following number of feet up-slope of each of the banks of streams: - 300 feet from perennial fish-bearing streams - 150 feet from perennial non-fish-bearing streams - 100 feet from intermittent streams, wetlands, and ponds in priority watersheds.
River	A large, natural, or human-modified stream that flows in a defined course or channel, or a series of diverging and converging channels.
Runoff	The portion of rainfall, melted snow, or irrigation water that flows across the surface, through shallow underground zones (interflow), and through ground water to creates streams.
Salmonids	Fish that are members of the salmon family including trout, char, salmon, and whitefish.
Secondary Contact Recreation	Water-related activities (e.g., fishing) where ingestion of water is unlikely.
Sediment(s)	Deposits of fragmented materials from weathered rocks and organic material that were suspended in, transported by, and eventually deposited by water or air.
Sediment Delivery Rate	Rate (percentage) of erosion that is deposited in a body of water.
Sediment yield	Amount of sediment lost from an area of land or length of stream that is deposited in a waterbody expressed in mass per area, or length, per time (e.g., tons/acre/year, tons/mile/year).
Settleable Solids	The volume of material that settles out of one liter of water in one hour.
Sinuosity	The curving back and forth of a stream (i.e., deviation from a straight line), usually quantified as the ratio of actual length to point-to-point length.

Species	1) A reproductively isolated aggregate of interbreeding organisms having common attributes and usually designated by a common name. 2) An organism belonging to such a category.
Spring	Ground water seeping out of the earth where the water table intersects the ground surface.
Stagnation	The absence of mixing in a waterbody.
Standard	See Water Quality Standard**.**
Stenothermal	Unable to tolerate a wide temperature range.
Storm Water Runoff	Rainfall that quickly runs off the land after a storm. In developed watersheds the water flows off roofs and pavement into storm drains that may feed quickly and directly into the stream. The water often carries pollutants picked up from these surfaces.
Stratification	An Idaho Department of Environmental Quality classification method used to characterize comparable units (also called classes or strata).
Stream	A natural water course containing flowing water, at least part of the year. Together with dissolved and suspended materials, a stream normally supports communities of plants and animals within the channel and the riparian vegetation zone.
Stream Order	Hierarchical ordering of streams based on the degree of branching. A first-order stream is an unforked or unbranched stream. Under Strahler's (1957) system, higher order streams result from the joining of two streams of the same order.
Stressors	Physical, chemical, or biological entities that can induce adverse effects on ecosystems or human health.
Subbasin	A large watershed of several hundred thousand acres. This is the name commonly given to 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 605 mm depending on the observer and methodology used. Results are typically expressed as a percentage of observation points with fine sediment.

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

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

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

Target An amount of pollutant or other measurable characteristic of a waterbody set as a goal for restoration of uses. A target is not an official state rule or regulation. Targets are often associated with narrative water quality standards and reflect the most current scientific understanding.

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

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

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

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

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

Total Inorganic Nitrogen (TIN) — The inorganic component (nitrate, nitrite, ammonia) of nitrogen in a system that is most readily available for uptake by plants.

Total Maximum Daily Load (TMDL) — A TMDL is a waterbody's loading capacity after it has been allocated among pollutant sources. It can be expressed on a time basis other than daily if appropriate. Sediment loads, for example, are often calculated on an annual bases. TMDL = Loading Capacity = Load Allocation + Waste Load Allocation + Margin of Safety. In common usage, a TMDL also refers to the written document that contains the statement of loads and supporting analyses, often incorporating TMDLs for several waterbodies and/or pollutants within a given watershed.

Total Suspended Solids (TSS) — The dry weight of material retained on a filter after filtration. Filter pore size and drying temperature can vary. American Public Health Association Standard Methods (Greenborg, Clescevi, and Eaton 1995) call for using a filter of 2.0 micron or smaller; a 0.45 micron filter is also often used. This method calls for drying at a temperature of 103-105 °C.

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

Tributary — A stream feeding into a larger stream or lake.

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

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

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

Waste Load Allocation (WLA)	The portion of receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution. Waste load allocations specify how much pollutant each point source may release to a waterbody.
Water Body Identification Number (WBID)	A number that uniquely identifies a waterbody in Idaho, ties into the Idaho Water Quality Standards and GIS information.
Water Column	Water between the interface with the air at the surface and the interface with the sediment layer at the bottom. The idea derives from a vertical series of measurements (oxygen, temperature, phosphorus) used to characterize water.
Water Pollution	Any alteration of the physical, thermal, chemical, biological, or radioactive properties of any waters of the state, or the discharge of any pollutant into the waters of the state, which will or is likely to create a nuisance or to render such waters harmful, detrimental, or injurious to public health, safety, or welfare; to fish and wildlife; or to domestic, commercial, industrial, recreational, aesthetic, or other beneficial uses.
Water Quality	A term used to describe the biological, chemical, and physical characteristics of water with respect to its suitability for a beneficial use.
Water Quality Criteria	Levels of water quality expected to render a body of water suitable for its designated uses. Criteria are based on specific levels of pollutants that would make the water harmful if used for drinking, swimming, farming, or industrial processes.
Water Quality Limited	A label that describes waterbodies 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 EPA-approved ambient standards for waterbodies. The standards prescribe the use of the waterbody 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.
Waterbody	A stream, river, lake, estuary, coastline, or other water feature, or portion thereof.
Watershed	1) All the land which contributes runoff to a common point in a drainage network, or to a lake outlet. Watersheds are infinitely nested, and any large watershed is composed of smaller "subwatersheds." 2) The whole geographic region which contributes water to a point of interest in a waterbody.
Wetland	An area that is at least some of the time saturated by surface or ground water so as to support with vegetation adapted to saturated soil conditions. Examples include swamps, bogs, fens, and marshes.
Young of the Year	Young fish born the year captured, evidence of spawning activity.

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