Idaho Falls Subbasin Assessment and Total Maximum Daily Load

Diversion structure at Dry Bed along the South Fork Snake River, DEQ file photo

Final

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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)

ADB assessment database

AWS agricultural water supply

BAG Basin Advisory Group

BLM United States Bureau of Land Management

BMP best management practice

BOD biochemical oxygen demand

BOR United States Bureau of Reclamation

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

cm centimeters

CWA Clean Water Act

CWAL cold water aquatic life

DEQ Department of Environmental Quality

DO dissolved oxygen

DOI U.S. Department of the Interior

DWS domestic water supply

EPA United States Environmental Protection Agency

ESA Endangered Species Act

F Fahrenheit

FWS U.S. Fish and Wildlife Service

GIS Geographical Information Systems

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

km kilometer

km^2 square kilometer

LA load allocation

LC	load capacity
m	meter
m^3	cubic meter
mi	mile
mi^2	square miles
MBI	macroinvertebrate index
MGD	million gallons per day
mg/L	milligrams per liter
mm	millimeter
MOS	margin of safety
MRCL	multiresolution land cover
MWMT	maximum weekly maximum temperature
n.a.	not applicable
NA	not assessed
NB	natural background
nd	no data (data not available)
NFS	not fully supporting
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NTU	nephlometric turbidity unit
PCR	primary contact recreation
PFC	proper functioning condition
ppm	part(s) per million
QA	quality assurance
QC	quality control
RFI	DEQ's river fish index
RHCA	riparian habitat conservation area
RMI	DEQ's river macroinvertebrate index
RPI	DEQ's river physiochemical index
SBA	subbasin assessment
SCR	secondary contact recreation
SFI	DEQ's stream fish index
SHI	DEQ's stream habitat index
SMI	DEQ's stream macroinvertebrate index
SS	salmonid spawning
STATSGO	State Soil Geographic Database
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

TSS total suspended solids

t/y tons per year

U.S. United States

U.S.C. United States Code

USDA United States Department of Agriculture

USDI United States Department of the Interior

USFS United States Forest Service

USGS United States Geological Survey

WAG Watershed Advisory Group

WBAG *Waterbody Assessment Guidance*

WBID waterbody identification number

WET whole effluence toxicity

WLA wasteload allocation

WQLS water quality limited segment

WQMP water quality management plan

WQRP water quality restoration plan

WQS water quality standard

Executive Summary

The federal Clean Water Act (CWA) requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters. States and tribes, pursuant to Section 303 of the CWA are to adopt water quality standards necessary to protect fish, shellfish, and wildlife while providing for recreation in and on the 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 Idaho Falls Subbasin that have been placed on what is known as the "§303(d) list."

This subbasin assessment and TMDL analysis has been developed 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 Idaho Falls 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. Three segments of the Idaho Falls Subbasin were listed 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.

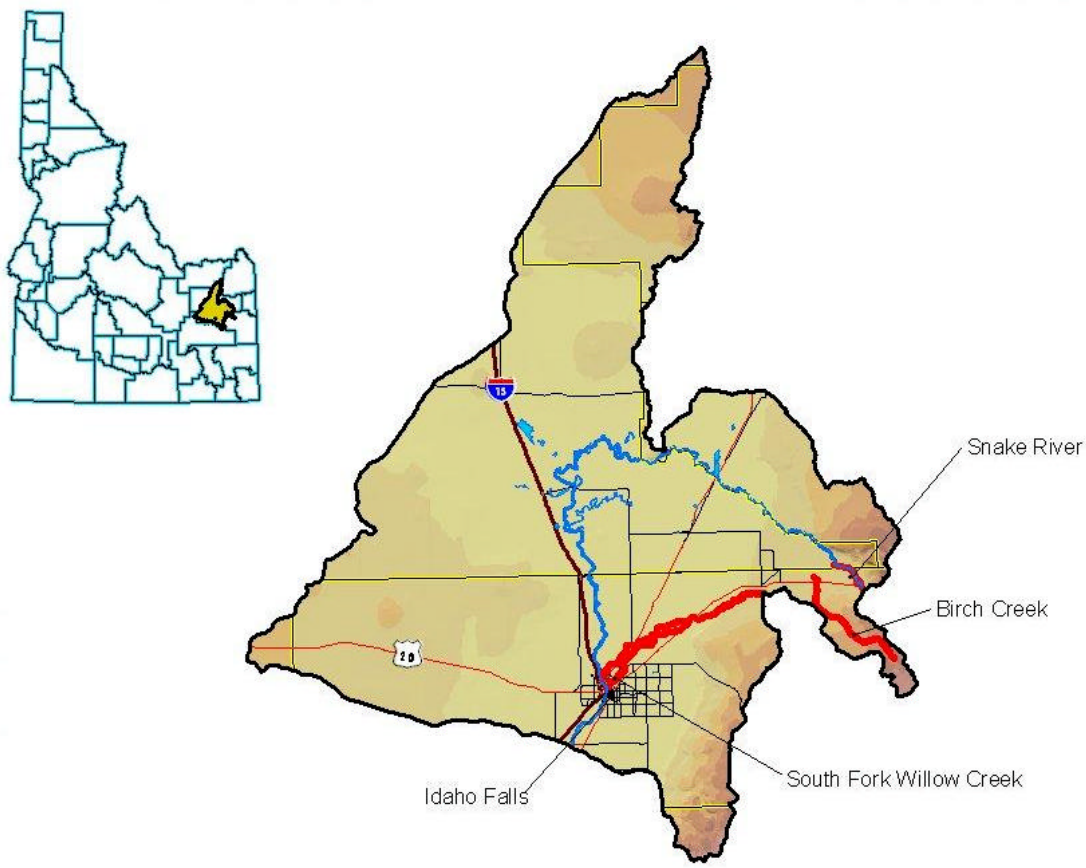
Key Findings

The hydrology of the Idaho Falls subbasin is dominated by the Snake River and its associated diversion structures for irrigation of farmland on the Snake River plain. A small section of the South Fork Snake River at the eastern most border of the subbasin is 303(d) listed for flow alteration. Flow in the South Fork Snake River is controlled upstream of this subbasin by the Palisades Reservoir. Additionally, there are numerous diversion structures in this reach as well as elsewhere on the Snake River in this subbasin. Because flow alteration is not a pollutant that renders itself to total maximum daily load calculations, no TMDL has been completed for the South Fork Snake River, but it is recommended that this stream reach remain on the 303d list for flow alteration.

The South Fork Willow Creek has been 303(d) listed for sediment; however, this stream no longer exists as a natural watercourse. Since the construction of Ririe Dam in the 1970's the flow in the Willow Creek/Sand Creek complex has been controlled for irrigation. Willow Creek, including both the North Fork and the South Fork have been converted to canal conveyance structures with straightened channels and riprap style bank reinforcement. No water flows in these channels during the non-irrigation season. Therefore, it is recommended that South Fork Willow Creek be "delisted" from the 303(d) list.

Birch Creek was added to the 1998 303(d) list form unknown pollutants by DEQ. A subsequent inspection of the water body revealed that the primary water quality problem is likely sediment from bank erosion. Birch Creek is in a predominantly dryland agricultural region where it is constrained between a road and agricultural fields. No data was available for Birch Creek; hence a TMDL for sediment was constructed by using the adjacent Antelope Creek TMDL as a proxy. Because of similar geology, soils and land use, loading analysis from Antelope Creek will suffice until such time that erosion surveys can be completed for Birch Creek.

Figure A. Subbasin-at-a-glance - Idaho Falls Subbasin (17040201)



303(d) listed streams	Pollutants	Beneficial Uses of Concern
Birch Creek	Sediment	Cold Water Aquatic Life
South Fork Snake River	Flow Alteration	Salmonid Spawning
South Fork Willow Creek		

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

Stream	Pollutant(s)
Birch Creek	Sediment

Table B. Summary of assessment outcomes.

Waterbody Segment	Assessment Unit of HUC 17040201	Pollutant	TMDL(s) Completed	Recommended Changes to §303(d) List	Justification
Snake River	SK013_06	Flow	No	List as Flow Alteration	Flow altered
SF Willow Cr. (includes NF and Willow Creek to Eagle Rock canal)	SK001_05 SK002_02 SK002_05 SK003_05	Sediment	No	De-list	Canal
Birch Creek	SK008_02 SK008_03	Sediment	Yes	none	TMDL developed

1. Subbasin Assessment – Watershed Characterization

The federal Clean Water Act (CWA) requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters. 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 Idaho Falls Subbasin that have been placed on what is known as the "§303(d) list."

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

1.1 Introduction

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

Background

The federal government, through the U.S. Environmental Protection Agency (EPA), assumed the dominant role in defining and directing water pollution control programs across the country. The Department of Environmental Quality (DEQ) implements the CWA in Idaho, while the EPA oversees Idaho and certifies the fulfillment of CWA requirements and responsibilities.

Section 303 of the CWA requires DEQ to adopt, with EPA approval, water quality standards and to review those standards every three years. Additionally, DEQ must monitor waters to identify those not meeting water quality standards. For those waters not meeting standards, DEQ must establish TMDLs for each pollutant impairing the waters. Further, the agency must set appropriate controls to restore water quality and allow the waterbodies to meet their designated uses. These requirements result in a list of impaired waters, called the "§303(d) list." This list describes waterbodies not meeting water quality standards. Waters identified on this list require further analysis. A subbasin assessment and TMDL provide a summary of the water quality status and allowable TMDL for waterbodies on the §303(d) list. The *Idaho Falls Subbasin Assessment and Total Maximum Daily Load* provides this summary for the currently listed waters in the Idaho Falls Subbasin.

The subbasin assessment section of this report (Chapters 1 – 4) includes an evaluation and summary of the current water quality status, pollutant sources, and control actions in the Idaho Falls Subbasin to date. While this assessment is not a requirement of the TMDL, DEQ performs the assessment to ensure impairment listings are up to date and accurate. The TMDL is a plan to improve water quality by limiting pollutant loads. Specifically, a TMDL is an estimation of the maximum pollutant amount that can be present in a waterbody and still allow that waterbody to meet water quality standards (Water quality planning and management, 40 CFR 130). Consequently, a TMDL is waterbody- and pollutant-specific. The TMDL also includes individual pollutant allocations among various sources discharging the pollutant. The EPA considers certain unnatural conditions, such as flow alteration, a lack of flow, or habitat alteration, that are not the result of the discharge of a specific pollutants as "pollution." TMDLs are not required for waterbodies impaired by pollution, but not specific pollutants. In common usage, a TMDL also refers to the written document that contains the statement of loads and supporting analyses, often incorporating TMDLs for several waterbodies and/or pollutants within a given watershed.

Idaho's Role

Idaho adopts water quality standards to protect public health and welfare, enhance the quality of water, and protect biological integrity. A water quality standard defines the goals of a waterbody by designating the use or uses for the water, setting criteria necessary to protect those uses, and preventing degradation of water quality through antidegradation provisions.

The state may assign or designate beneficial uses for particular Idaho waterbodies to support. These beneficial uses are identified in the Idaho water quality standards and include:

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

The Idaho legislature designates uses for waterbodies. Industrial water supply, wildlife habitat, and aesthetics are designated beneficial uses for all waterbodies in the state. If a waterbody is unclassified, then cold water and primary contact recreation are used as additional default designated uses when waterbodies are assessed.

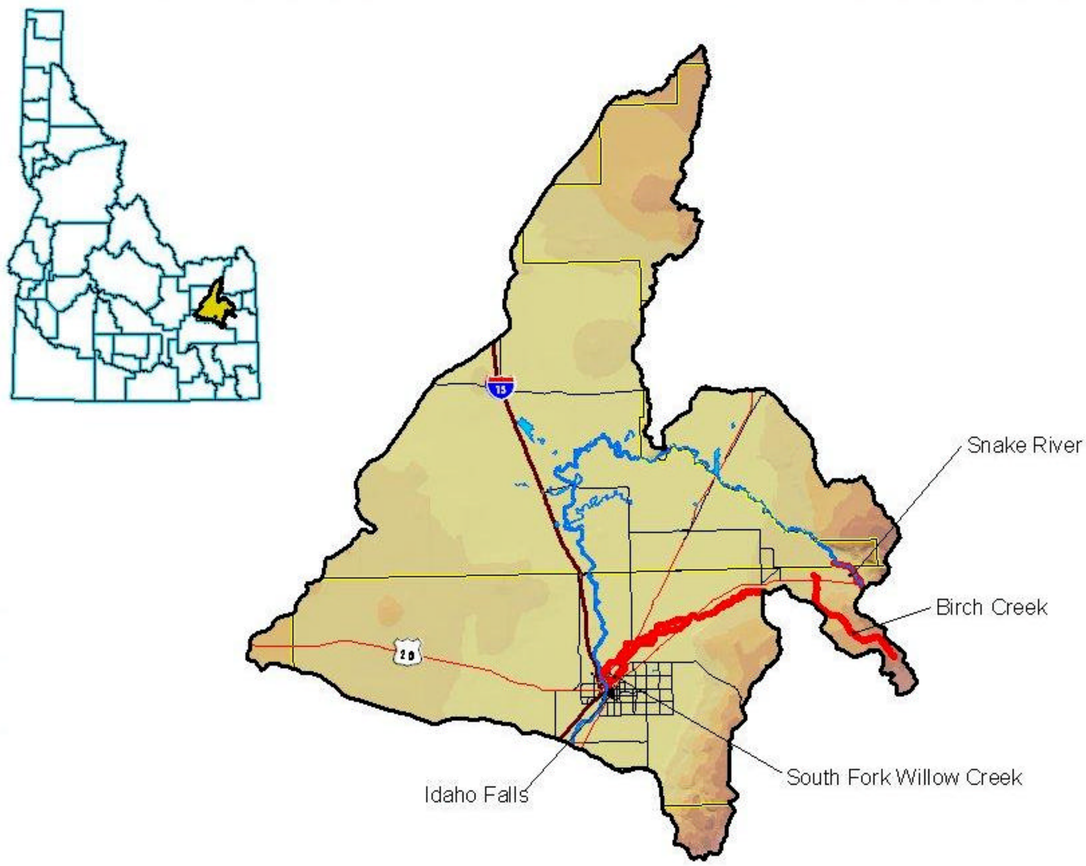
A subbasin assessment entails analyzing and integrating multiple types of waterbody data, such as biological, physical/chemical, and landscape data to address several objectives:

- Determine the degree of designated beneficial use support of the waterbody (i.e., attaining or not attaining water quality standards).
- Determine the degree of achievement of biological integrity.
- Compile descriptive information about the waterbody, particularly the identity and location of pollutant sources.
- When waterbodies are not attaining water quality standards, determine the causes and extent of the impairment.

1.2 Physical and Biological Characteristics

The Idaho Falls subbasin (17040201) is located in eastern Idaho around the city of Idaho Falls (Figure A). The subbasin is comprised of a portion of the South Fork Snake River from Heise to the Henry's Fork, and a section of the main Snake River from the Henry's Fork confluence down to the diversion dams south of Idaho Falls. Other than the Snake River, there are very few natural waterways in the subbasin. Birch Creek, a natural drainage from the eastern foothills north of the Willow Creek subbasin, is considered water quality-limited for unknown reasons. Willow Creek, including the North Fork and the South Fork, below Ririe dam is listed as water quality-limited for sediment pollution; however, this waterway is an irrigation canal in this subbasin. More than three and one-half miles of the South Fork Snake River near Heise are listed as water quality-limited for flow alteration, a continuation of the listing of this river in the Palisades subbasin.

Figure A. Subbasin-at-a-glance - Idaho Falls Subbasin (17040201)



Climate

The climate of the Idaho Falls subbasin is classified as semiarid high desert characterized by warm to hot dry summers and long, cool winters. The Upper Snake River basin is primarily influenced by air masses moving inland from the Pacific Ocean during the winter months. In summer months, rainfall, cloud cover, and relative humidity are at a minimum due to the weakening of the westerly winds allowing continental climate conditions to prevail (Abramovich et al., 1998).

Precipitation throughout the subbasin varies widely (Table 1). The average is about 12.4 inches with a maximum of 27 inches along the Eastern Caribou Mountains, and a minimum of nine inches in western region of the subbasin (Figure 1). The majority of the precipitation in the basin occurs during the spring and fall months. The eastern boundary of the subbasin received the majority of the precipitation originating from orographic lifting along the edge of the Caribou Mountains along the Middle Rockies Mountain Range (USBR, 2001). The western portion of the subbasin is relatively flat, and precipitation in this region is mainly from low-pressure systems during late spring and autumn. Convection thunderstorms during spring and summer months also contribute to precipitation in the subbasin.

The annual average snowfall for the subbasin is approximately 38 inches, with majority of the snowfall occurring in December and January (see Table 1). Snow-pack tends to be greatest along the eastern boundary of the subbasin and decreases towards the West. Light snowfall begins in September in the higher elevations, but the lower elevations in the subbasin generally do not receive snow until October.

Maximum monthly temperatures climb to 87° F in July, the average warmest month, while minimum monthly winter temperatures drop to 4°F in January, the average coldest month (Table 2). The annual average maximum temperature is 58.6°F and the average minimum temperature is 26.4°F for the region. The growing season ranges from late May to early September with an average of 119 days (SCS, 1979).

Winds in the subbasin are mainly from the south-southwest (SCS, 1979). The highest average wind speed occurs in spring during March, April, and May with speeds of 20 to 30 mph for days at a time. The lowest wind speeds occur in the late summer during July, August, and September.

Table 1. Summary of precipitation data from three stations within the subbasin.

	Average Total Precipitation (in.)			Average Total Snowfall (in.)		
	Rexburg 7/77-12/00	Idaho Falls 5/52 – 12/00	Hamer 10/48-12/00	Rexburg 7/77-12/00	Idaho Falls 5/52 – 12/00	Hamer 10/48-12/00
January	1.09	1.03	0.58	13.3	8.3	6.9
February	1.10	0.94	0.49	11.1	5.3	5.2
March	1.09	1.03	0.59	4.1	3.2	2.7
April	1.15	1.10	0.74	2.4	0.5	1.1
May	2.02	1.68	1.41	0.6	0.4	0.4
June	1.47	1.30	1.25	0.0	0.0	0.0
July	0.97	0.59	0.75	0.0	0.0	0.0
August	0.72	0.76	0.73	0.0	0.0	0.0
September	0.81	0.84	0.60	0.2	0.0	0.1
October	1.05	0.94	0.60	0.9	0.4	0.8
November	1.17	1.00	0.66	8.0	3.3	3.5
December	1.05	1.04	0.63	16.2	7.1	7.8
Annual	13.71	12.25	9.03	56.9	28.5	28.5

Source: Western Regional Climate Center at http://wrcc.dri.edu/summary/climsid.html

Figure 1. Idaho Falls Subbasin Precipitation.

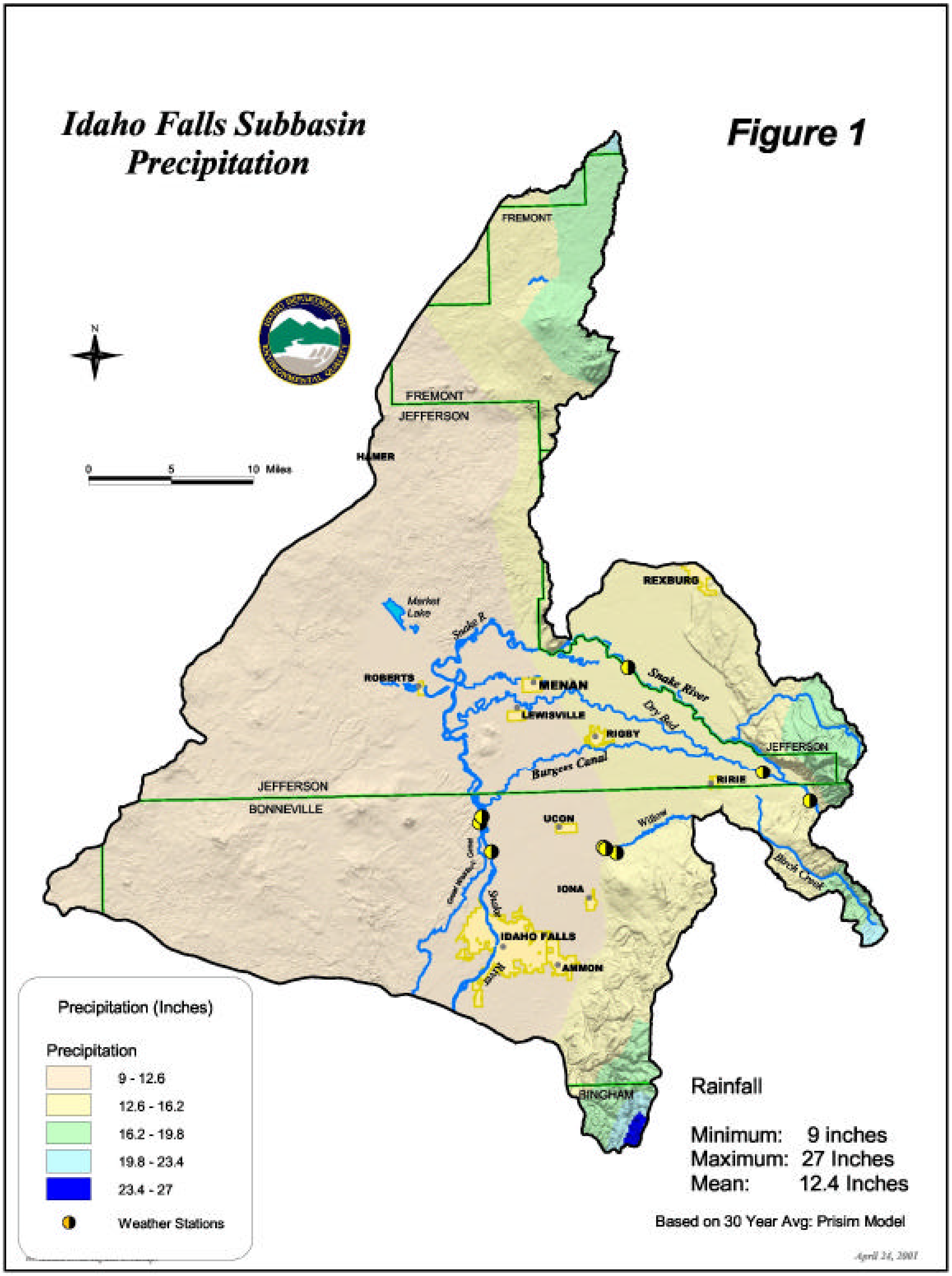


Table 2. Summary of temperature data from three stations within the subbasin.

	Average Max. Temperature (F)			Average Min. Temperature (F)		
	Rexburg 7/77-12/00	Idaho Falls 5/52 – 12/00	Hamer 10/48-12/00	Rexburg 7/77-12/00	Idaho Falls 5/52 – 12/00	Hamer 10/48-12/00
January	29.5	30.1	28.3	10.6	12.8	4.1
February	34.8	37.4	34.8	15.5	17.9	9.9
March	46.3	47.0	45.7	23.4	24.3	18.4
April	57.8	58.2	59.3	30.6	31.6	26.9
May	66.1	68.4	69.6	38.8	39.5	36.0
June	75.0	77.5	78.3	45.1	46.6	42.9
July	83.6	86.4	87.6	49.3	52.0	47.5
August	84.4	85.5	86.2	47.4	50.2	45.5
September	74.3	75.2	75.7	38.7	41.5	36.8
October	60.5	61.5	62.1	29.7	32.0	26.6
November	41.4	43.9	43.1	20.2	23.3	16.4
December	29.8	32.0	30.3	10.1	14.1	6.0
Annual	56.9	58.6	58.4	30.0	32.2	26.4

Source: Western Regional Climate Center at http://wrcc.dri.edu/summary/climsid.html

Subbasin Characteristics

Geology/Topography

The Idaho Falls subbasin is located on the eastern most edge of the Snake River Plain. The geology of the subbasin is generally comprised of Pleistocene lava flows on the western side and Pleistocene outwash flood and terrace gravels on the eastern side (Figure 2). The Snake River Plain consists of rhyolite erupting from a series of volcanoes beginning approximately 13 million years ago in the Western part of the state (Alt and Hyndman, 1989). Traveling eastward, the Snake River basalt gets progressively younger in age. The Snake River Plain ends at the Yellowstone Volcano, which is presently active. The surface of the Snake River Plain is covered with basalt, ranging from 10 to 50 feet thick, and is visible throughout the subbasin. Much of the Snake River basalt flows in this subbasin are overlain from soil blown into the region or from alluvium from the Snake River and its tributaries.

The Western portion of the subbasin is almost entirely the Snake River Plain basalt flows with moderately deep soils overlain (SCS, 1981). Among the vast basalt plain within the subbasin are several small buttes such as Kettle Butte, Shadduck Butte, and Butterfly Butte. Ephemeral drainage within this region of the subbasin sink through the porous lava into the Snake River Plain Aquifer.

The northern portion of the subbasin is dominated by the St. Anthony sand dunes. The St. Anthony dunes are the largest areas of sand dunes in Idaho, which spreads over approximately 175 square miles (Alt and Hyndman, 1989). The active portion trends northeast and is 35 miles long and five miles wide. The surrounding older portions are grass covered and stable. The dunes originate from quartz sand brought into the region by the

Snake River and blown from the floodplain into the dunes. During the winter months, the stiff southwesterly winds drive the horns and crests of the sand dunes consistently toward the northeast direction.

The topography of the subbasin is relatively flat as compared to other areas in Idaho. Elevations range from 4623 feet to 7252 feet with an average of 5030 feet (Figure 3). The highest elevations are located in the Southeastern Portion of the subbasin in the Willow Creek Hills along the Caribou Range.

The Caribou Range is located along the western flank of the Middle Rocky Mountains and is one of the basin and range complexes throughout Idaho and originated from the Jackson thrust fault along the Idaho-Wyoming border (Maley, 1987). Ascending along the Caribou Range is the Willow Creek Hills. The Willow Creek Hills are almost entirely made up of loess blown into the region. Soils in this area are very deep, well drained soils and are erosive (SCS, 1981). The soils are underlain with rhyolite, basalt, and a variety of sandstones and shales. Iona Hill, located East of Idaho Falls, is the major landmark of the Willow Creek Hills in this subbasin.

A corner of the Snake River Range falls within the Idaho Falls subbasin northwest of the Caribou Range. The Snake River Range is also part of the basin and range complex. Kelly Canyon, above the Snake River near Heise, is a part of this range.

Northwest of the Snake River Range is a large rhyolitic caldera called the Rexburg Caldera. It is believed to overlie granite crystallized from rhyolite magma that never reached the surface (Alt and Hyndman, 1989). On the edge of the Rexburg caldera where Henry’s Fork and the Snake River join are the two Menan Buttes. The Menan Buttes are remnant of once active volcanoes. The largest is approximately 800 feet high with a crater 300 feet deep. It appears that the Buttes formed within a floodplain because of the presence of rounded pebbles mixed within the basalt cinders from the volcanoes. The buttes are younger than the Rexburg Caldera, indicating that they were associated with Basin and Range faulting that occurred in the surrounding areas.

Figure 2. Idaho Falls Subbasin Geology.

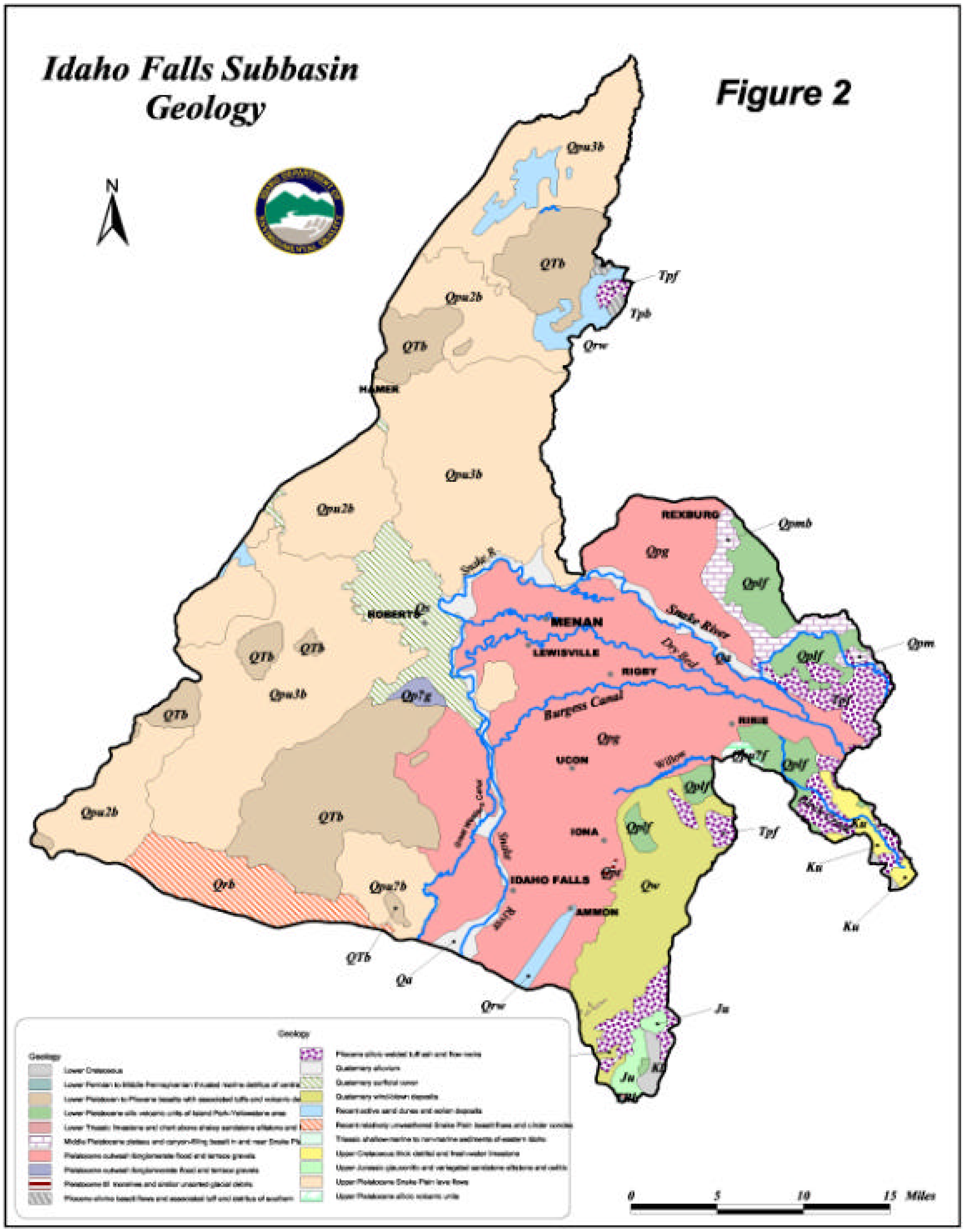
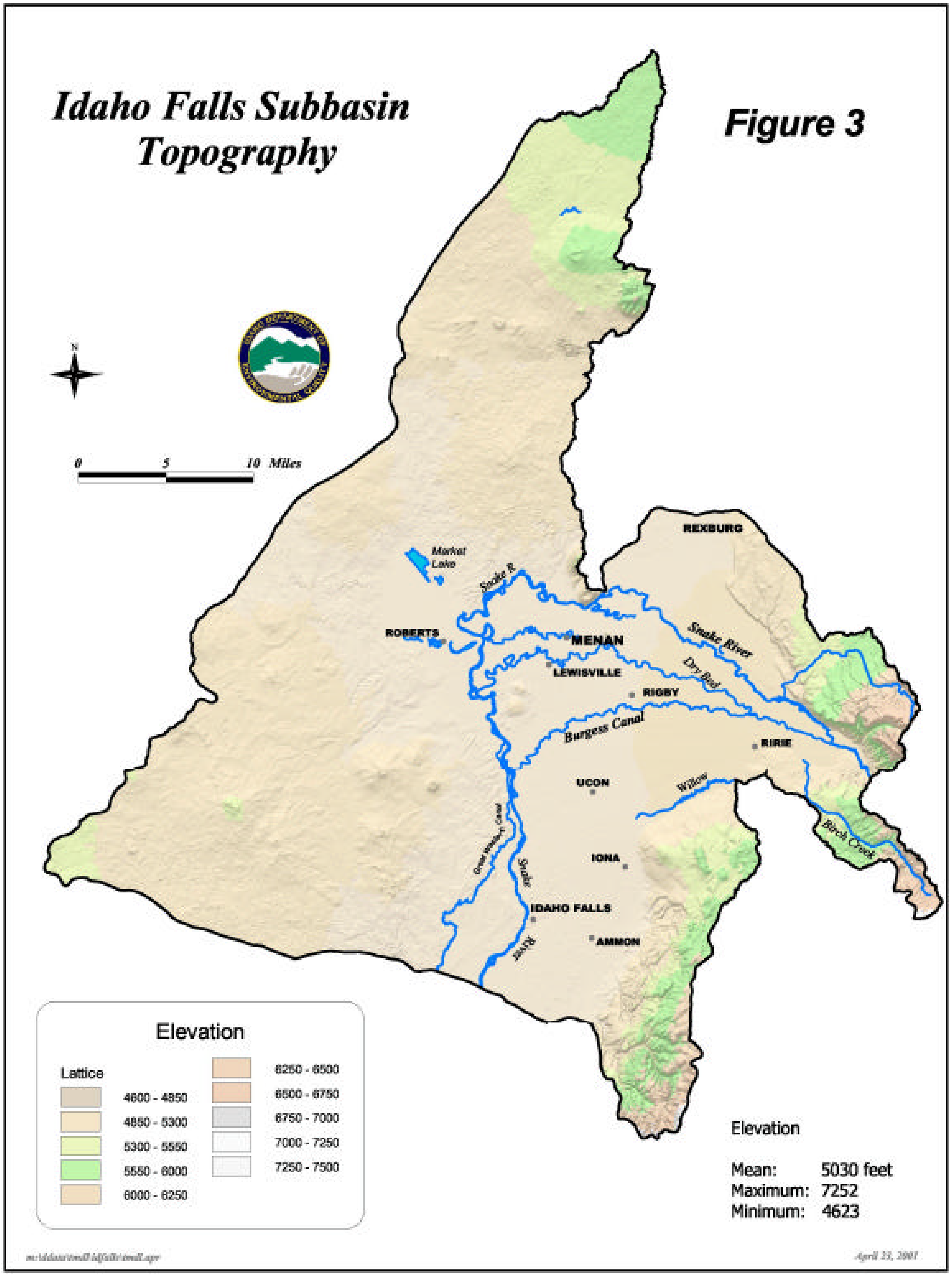


Figure 3. Idaho Falls Subbasin Topography.



Vegetation

The Idaho Falls subbasin is largely an agricultural subbasin, the majority of which occurs in the southern two-thirds of the subbasin (Figure 4). However, the northern and western most extents of the subbasin are predominantly sagebrush shrublands (Figure 5). The shrublands are primarily made up of sagebrush-bunchgrass communities where Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*) and bluebunch wheatgrass (*Psuedoroegneria spicata*) predominate. Locally, other shrubs and grasses may predominate, including three-tip sagebrush (*A. tripartita*), winterfat (*Krascheninnikovia lanata*), green rabittbrush (*Chrysothamnus viscidiflorus*), thickspike wheatgrass (*Elymus lanceolatus*), Indian ricegrass (*Oryzopsis hymenoides*), needle-and-thread grass (*Stipa comata*), crested wheatgrass (*Agropyron desertorum*) and various bluegrasses (*Poa sp.*) (Anderson and Inouye, 1999). These areas once had abundant herbaceous species and wildflowers. Much of the species diversity has been reduced by many years of livestock grazing, altered fire cycles, and the invasion of annual exotic grasses.

This subbasin includes two vastly different features on the landscape, recent (Pleistocene) lava flows and sand dunes. Areas where lava flows are still evident are usually vegetated slowly as soil forms in the cracks and crevasses. Dominant vegetation on these flows include junipers (*Juniperus sp*.), fernbush (*Chamaebatiaria millifolium*), and Wyoming big sagebrush. The St. Anthony sand dunes are sparsely vegetated with grasses and a globally rare, but not imperiled (global priority 3 or G3) species of evening primrose (O*enothera psammophila*) known only in Idaho at these sand dunes in Fremont County.

There are a few pieces of coniferous forest vegetation in the upper Birch Creek drainage, the upper Kelly Canyon area, and on the slopes of Mount Taylor at the very southern tip of the subbasin. Also, in these same areas are isolated clumps of deciduous forest, primarily made up of quaking aspen (*Populus tremuloides*). Along the Snake River, especially in the Heise area, are areas of narrow-leaf cottonwood (*P. angustifolia*) gallery forest.

Riparian vegetation consists of a variety of facultative and obligate wetland plants including, willows (*Salix sp.*), red-osier doqwood (*Cornus stolonifera*), sedges (*Carex sp.*), and water birch (*Betula occidentalis*) and alders (*Alnus incana*) at higher elevations. The South Fork Snake River floodplain and possibly other floodplain areas are notable habitat for the rare orchid Ute Ladies' Tresses (*Spiranthes diluvialis*). This particular plant is ranked global priority 2 (G2), imperiled due to rarity or other factors that make it vulnerable to extinction. The US Fish and Wildlife Service has listed this species of orchid as "threatened."

Figure 4. Idaho Falls Subbasin Land Use.

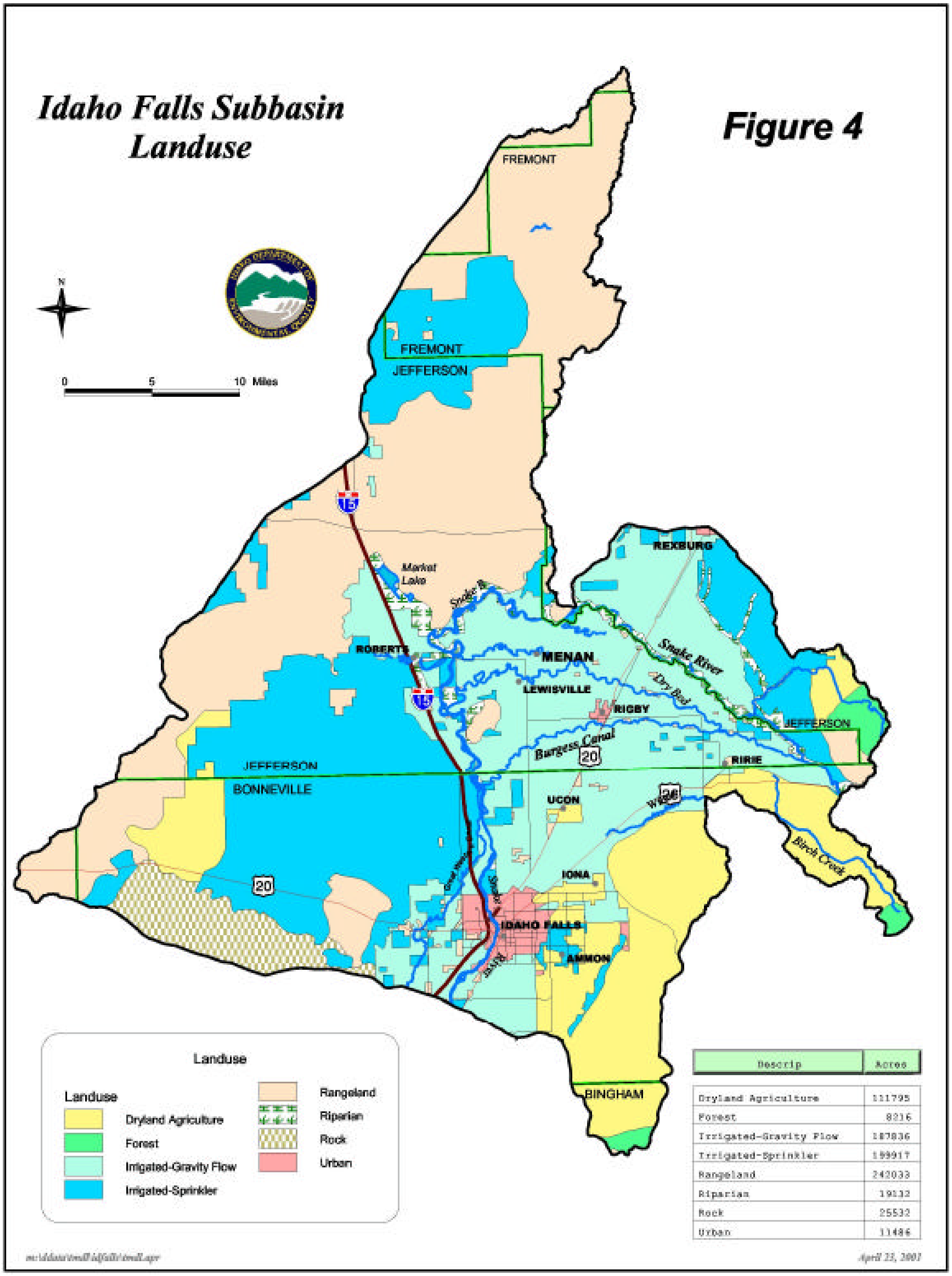
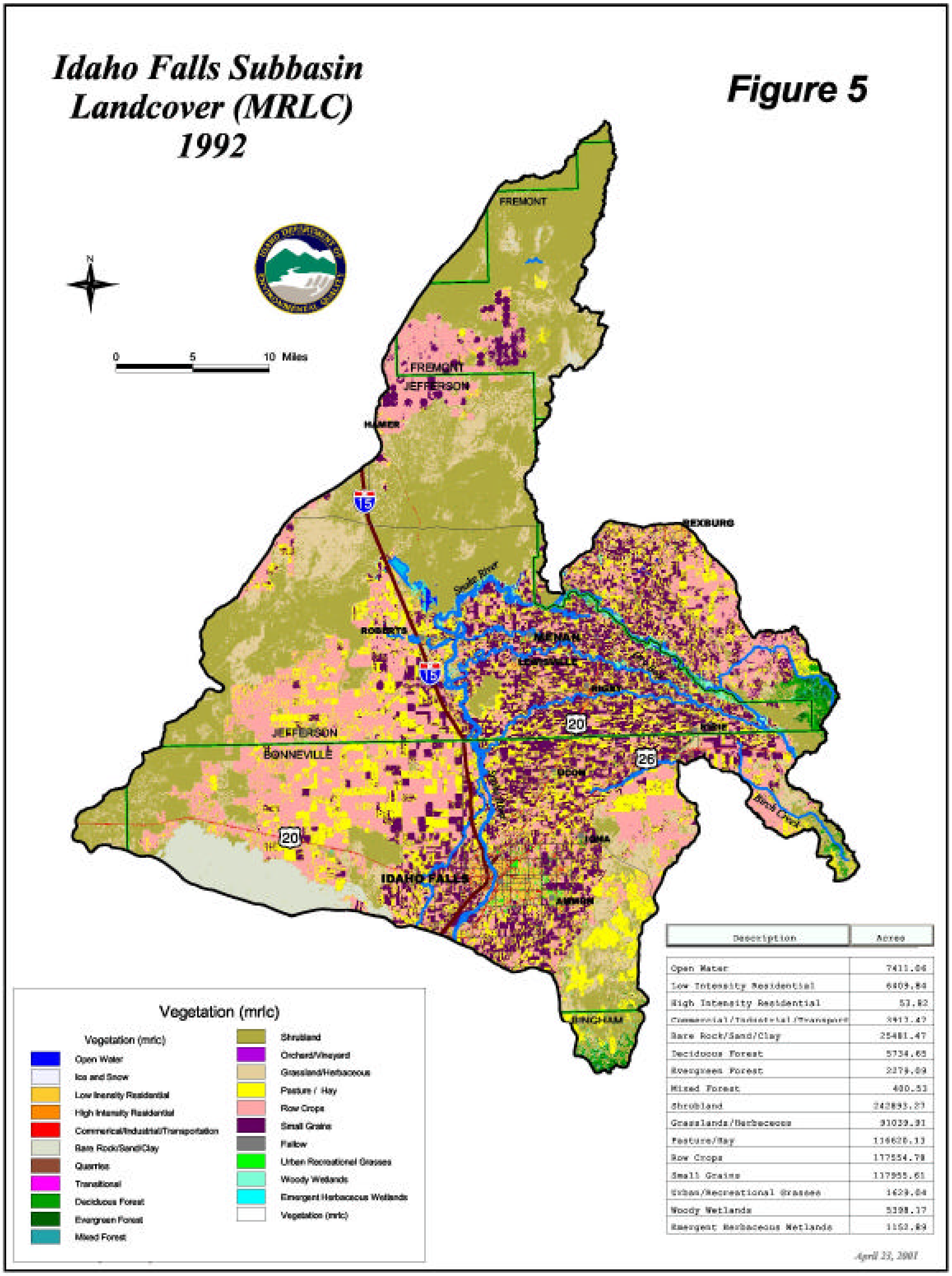


Figure 5. Idaho Falls Subbasin Land Cover.



Description	Acres
Open Water	7411.06
Low Intensity Residential	6409.84
High Intensity Residential	53.82
Commercial/Industrial/Transport	3913.47
Bare Rock/Sand/Clay	25481.47
Deciduous Forest	5734.65
Evergreen Forest	2279.09
Mixed Forest	400.53
Shrubland	242893.27
Grasslands/Herbaceous	91039.31
Pasture/Hay	116620.13
Row Crops	177554.78
Small Grains	117955.61
Urban/Recreational Grasses	1629.04
Woody Wetlands	5398.17
Emergent Herbaceous Wetlands	1152.89

Hydrology

Because major portions of the subbasin are piled thick with lava flows and sand dunes, very little surface drainage exists in the western and northern portions of the subbasin (Figure 8). The bulk of the hydrology results from the Snake River and an extensive network of canal systems that bring water to the agricultural fields of the central and southern portion of the subbasin. Additionally, several small drainages result from eastern mountains, including Lyons Creek, Kelly Canyon, Birch Creek, Taylor Creek, and Henry Creek. The Willow Creek drainage is a larger 6th order subbasin that discharges to the Idaho Falls subbasin below Ririe Reservoir.

Tables 3 and 4 show flow statistics for the major gages on the Snake River in and near the Idaho Falls subbasin. The average annual flow in the South Fork Snake River above Heise is about 7,500 cfs. After the major diversions of irrigation water near Heise, average annual flows have been reduced to about 4,500 cfs at Lorenzo. The most prominent diversion is Dry Bed, which carries flows throughout the year (Table 5).

The Henry's Fork contributes an average annual flow of about 2,100 cfs as measured at Rexburg. This added flow sends the Snake River average annual flow back up to about 6,500 cfs at Eagle Rock. Some additional diversions occur between Eagle Rock and Shelley so that average annual flow in the Snake River is about 6,000 cfs at Shelley.

Table 3. Annual flow (cfs) statistics for Snake River USGS gaging stations in and around the Idaho Falls subbasin.

Station Name and Number	Avrg. Annual Mean	Highest Annual Mean	Lowest Annual Mean	Highest Daily Mean	Lowest Daily Mean	Annual 7-day Min	Annual Runoff (Ac-Ft)
Snake River near Heise 13037500	7496	11590 (1997)	5188 (1993)	42900 (6/14/97)	902 (3/12/77)	932 (3/9/77)	5.431 million
Snake River at Lorenzo 13038500	4467	8813 (1997)	2431 (1989)	37800 (6/22/97)	110 (12/23/90)	118 (3/29/93)	3.236 million
Henry's Fork near Rexburg 13056500	2123	4134 (1984)	829 (1934)	79000 (6/5/76)	183 (3/24/34)	190 (3/22/34)	1.538 million
Snake River above Eagle Rock 13057155	6504	12880 (1997)	4004 (1988)	47900 (6/16/97)	950 (12/22/90)	1210 (12/19/90)	4.712 million
Snake River near Shelley 13060000	6024	12330 (1997)	1998 (1934)	50500 (6/7/76)	350 (11/5/34)	412 (11/2/34)	4.364 million

Table 4. Monthly mean flow (cfs) statistics for Snake River USGS gaging stations in and around the Idaho Falls subbasin.

Station #*	Stat.	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
13037500 (1971 to 2000)	Ave.	4022	2740	2824	2990	3150	5021	8225	13650	16590	14010	9287	7218
	Max.	8179	5758	6270	6233	10520	13760	16800	20550	31690	18690	11610	10160
	Min.	1666	1183	1064	1084	1040	983	1858	3951	11050	10230	6831	4341
13038500 (1924 to 2000)	Ave.	1490	1373	2003	2256	2283	3805	5755	8625	10260	7622	4361	3094
	Max.	3028	4277	5707	5976	9132	12900	13850	16750	26720	12220	6797	6213
	Min.	405	243	497	431	433	426	788	1761	4017	4297	2154	744
13056500 (1909 to 2000)	Ave.	1752	1904	1774	1706	1763	1772	2297	4113	3958	1679	1311	1521
	Max.	3071	3282	2663	2972	2701	2805	4847	10600	10220	5133	3986	2896
	Min.	377	440	1073	1100	1064	340	388	390	434	358	446	561
13057155 (1988 to 2000)	Ave.	3470	3706	3492	3672	4533	5860	7285	11990	14180	8634	6318	4866
	Max.	5884	6308	6560	7901	12100	16040	16260	24050	35400	14050	9863	7203
	Min.	2491	2323	1990	2034	2127	1987	2297	5642	6620	6061	4866	3703
13060000 (1915 to 2000)	Ave.	3165	3564	3662	3580	3827	4776	7663	12710	13420	7444	4773	3719
	Max.	9465	7841	8334	8210	11460	15150	19620	28240	34380	19650	9073	7682
	Min.	646	827	1584	1515	1599	1401	1559	3261	2432	2213	1342	1119

*Station names are in Table 1.

The Willow Creek/Sand Creek complex, once a volatile system prone to flooding, has now been reduced to a system of canals that receive water from Ririe Reservoir and the Snake River. The Ririe Dam was authorized by the Flood Control Act of 1962 after a devastating flood that same year covered an extensive area on the East Side of Idaho Falls (COE, 1972; BOR, 2001). Construction on the dam began in 1970 and was completed in 1977.

The dam controls the flow of water to Willow Creek and Sand Creek, which have been re-enforced with rip-rap and in many places straightened to function as irrigation canals. Water released from Ririe Reservoir into the Willow Creek/Sand Creek system is completely controlled (BOR, 2001). Additionally, a floodway bypass was built from a point on Willow Creek just downstream of the Willow Creek/Sand Creek diversion. The bypass canal takes excess floodwater straight west to the Snake River above the City of Idaho Falls.

Table 5 shows monthly flows from gaging stations on Willow Creek, Sand Creek, and the floodway bypass in 2000. During the non-irrigation season (December through March) no flows are recorded in these waterways. During the irrigation season (May through September) Sand Creek averaged from 300 to 500 cfs and Willow Creek averaged 100 to 150 cfs at respective gaging sites. The bypass carried some excess water (20-60 cfs) in spring (April – May), and then again (130-400 cfs) in fall (September – November).

Water rights information was obtained from the Idaho Department of Water Resources (IDWR), Idaho Falls Office (B. Contor. Personal Communication). Water rights for the Willow Creek and Sand Creek canal system are in Appendix A. Prior to adjudication, the database contained five decreed and licensed rights for 8.57 cfs of Birch Creek flow (Table 6). Currently, IDWR has received claims as part of the adjudication process for 4.95 cfs of Birch Creek from three parties.

Table 5. Monthly mean flow (cfs) statistics for canal USGS gaging stations for the 2000 water year (October 1999 to September 2000).

Station #*	Stat.	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
13038000	Ave.	1850	667	448	328	393	415	322	3841	4364	3975	3047	2500
	Max.	2360	730	582	346	402	470	1100	5070	4640	4440	3180	2790
	Min.	1130	571	333	219	320	227	0	1300	4130	3470	2750	1880
13057132	Ave.	162	0	0	0	0	0	96	122	102	144	163	184
	Max.	228	0	0	0	0	0	262	179	134	179	181	211
	Min.	0	0	0	0	0	0	0	75	77	114	144	154
13058510	Ave.	247	4	0	0	0	0	41.7	319	590	509	370	381
	Max.	341	101	0	0	0	0	145	557	665	624	415	402
	Min.	153	0	0	0	0	0	0	158	545	376	314	326
13058520	Ave.	367	133	0.03	0	0	0	25	52.1	0.1	0.2	0.3	193
	Max.	410	341	0.8	0	0	0	78	134	2.3	3.3	1.5	319
	Min.	329	4	0	0	0	0	0	0	0	0	0	0.1
13058529	Ave.	401	147	0.03	0	0	0	19	60	5	3	4	189
	Max.	451	367	0.9	0	0	0	90	175	13	7.7	11	310
	Min.	340	10	0	0	0	0	0	1.3	0.02	0	0.3	7.3
13058530	Ave.	65.7	0.4	0	0	0	0	16.6	98.9	149	159	138	134
	Max.	106	13	0	0	0	0	61	139	172	187	158	159
	Min.	30	0	0	0	0	0	0	60	133	130	130	100

*13038000 = Dry Bed near Ririe.
13057132 = Great Western Spillback canal near Idaho Falls.
13058510 = Sand Creek above Willow Creek diversion near Ucon.
13058520 = Willow Creek floodway channel near Ucon.
13058529 = Willow Creek floodway channel at mouth near Idaho Falls.
13058530 = Willow Creek below floodway channel near Ucon.

Table 6. Original database and adjudication claims water rights for Birch Creek.

Sequence No.	Basis	Status	Priority Date	Diversion (cfs)
Original Database				
1	Decreed	Active	6/1/1876	2
2056	License	Active	1/25/1915	0.5
2073	License	Active	n.d.	4
2155	License	Active	n.d.	n.d.
7141	License	Active	2/3/1978	2.05
12734	Decreed	Active	4/1/1910	0.02
Claims				
1	Decreed	Active	6/1/1876	2
7141	Permit	Active	2/3/1978	2.88
12734	Beneficial Use	Active	4/1/1910	0.07

Ririe Reservoir

The following has been excerpted from the Ririe Dam section of the US Bureau of Reclamation Pacific Northwest Region website:

http://dataweb.usbr.gov/dams/id00344.htm

General Description

"The Ririe Project was constructed to impound and control the waters of Willow Creek, a Snake River tributary in eastern Idaho, for flood control, irrigation, and recreation. Significant fish and wildlife protection measures also are included. Major features of the project include Ririe Dam and Lake, and a floodway bypass outlet channel."

Plan

"Ririe Lake, formed by the construction of Ririe Dam, serves a principal purpose of flood control on the lower reaches of Willow and Sand Creeks. Out of a total reservoir capacity of 100,500 acre-feet, 10,000 acre-feet is dead and inactive space, 80,500 acre-feet serves both flood control and irrigation, and the top 10,000 acre-feet is held exclusively for emergency flood control operations. Principal facilities of the Ririe Project include one storage dam with a total active capacity of 90,500 acre-feet and one floodway or outlet channel."

Ririe Dam and Lake

"Ririe Dam is located on Willow Creek, a minor tributary of the Snake River, in Bonneville County of eastern Idaho about 15 miles northeast of the city of Idaho Falls and about 4 miles southeast of the town of Ririe. The Corps of Engineers constructed the dam during the period 1970-1977. The dam is a zoned earth and rockfill structure with a structural height of 253 feet, a hydraulic height of 169 feet, and a crest length of 1,076 feet. The reservoir impounded by the dam has a total capacity of 100,500 acre-feet (active 90,500 acre-feet)."

"The outlet works consists of an intake structure, gate controlled outlet conduit, stilling basin, and service bridge. The water from the intake structure is discharged into a reinforced concrete conduit, and the conduit carries the water through the main dam to the stilling basin on the downstream side of the dam."

"The spillway is a gated two-bay concrete gravity structure. Each bay contains a 40.5-foot wide by 27.32-foot high radial (tainter) gate with no provisions for stoplogs. The spillway contains an ogee crest at elevation 5093 feet. The ogee crest is located immediately downstream from the bottom of the radial gates. The spillway is divided into three monoliths with construction joints at the centerline of the ogee crest."

"The Ririe Dam Project is a multiple-purpose development involving irrigation, flood control, and recreation. Significant fish and wildlife protection measures are also included. Major features include Ririe Dam, Ririe Reservoir, and an outlet channel which serves as a flood way to control project flood releases."

Floodway or Outlet Channel

"The floodway or outlet channel is a structure to control the water flow in Willow Creek below the dam, especially that section flowing through Idaho Falls and the area northeast of the city. Also controlled is Sand Creek as it flows east and southeast of Idaho Falls. Required releases of 1,900 cubic feet per second from Ririe Lake can be carried adequately in the natural channel to the point where the stream divides into Willow and Sand Creeks. The floodway bypass begins on Willow Creek just downstream from the point where Sand Creek branches from Willow Creek and extends directly west 7.8 miles to enter the larger natural channel of the Snake River 4.5 miles north of Idaho Falls. The bypass is gated at the Willow Creek intake to control initial inflow. The north bank of the channel was constructed at ground level to permit surface inflow of floodwaters along its course. Sand Creek can adequately carry 1,000 cubic feet per second and the floodway bypass channel was designed to carry 900 cubic feet per second, thereby providing the required additional capacity to control water flows."

Early History

"Since 1911, at least eight spring floods and nine winter floods have caused considerable damage in the area of Ririe and Idaho Falls. The largest known floods were those of 1917 and 1962. The 1917 flood was a spring snowmelt flood augmented by rainfall peaking at 4,200 cubic feet per second in Willow Creek near Ririe. Some 3,000 acres of land were inundated for 2 to 3 weeks. The 1962 flood was a winter rain flood augmented by frozen ground and snowmelt, peaking at 5,080 cubic feet per second in Willow Creek above its confluence with Sand Creek. About 54,000 acres were inundated for 2 to 3 days. Flows above 2,000 cubic feet per second that occur about 3.5 miles below the present damsite cause flooding conditions."

Investigations

"The review report on "Columbia River and Tributaries," dated June 1949, prepared by the Corps of Engineers and printed as House Document 531, 81st Congress, 2nd session, summarized field studies for storage and channel works on Willow Creek and indicated that flood control works were not economically feasible at that time. The Upper Snake River Basin report of 1961, prepared jointly by the Corps of Engineers and the Bureau of Reclamation, indicated that Ririe Dam and Reservoir warranted early construction. Interim Report No. 3, dated March 1962 and prepared by the Corps, presented additional information on structures and costs, economic analysis, and operating procedures. This report included a brief summary of the February 1962 flood, with comments on the control of such a flood by storage at the Ririe site."

Authorization

"Construction of Ririe Dam and Reservoir was authorized by the Flood Control Act of October 23, 1962 (76 Stat. 1193, Public Law 87-874). House Document No. 562 served as the basis for that authorization. Project purposes are irrigation, flood control, and recreation."

Construction

"Project construction was performed under the jurisdiction of the Corps of Engineers. Construction of the dam began in January 1970 and was completed in November 1977. Floodway channel work began in June 1975, and was completed in February 1978. Recreation area work was started in May 1977, and was completed in June 1979."

Flood Control

"Coordinated operation of Ririe Dam and the floodway bypass channel will control the flows in Willow and Sand Creeks to help alleviate flood damages such as those previously experienced in the city of Idaho Falls and on surrounding farmlands. The devastating floods of 1917 and 1962 were created by flows more than double the 2,000-cubic-foot-per-second capacity of Willow Creek. With the present control structures, Willow Creek can be contained at 1,900 cubic feet per second."

Irrigation

"In 1994, the United States entered into a contract with Mitigation, Inc., which provided that entity with noncontracted irrigation storage and space in Palisades (18,980 acre-feet) and Ririe (80,500 acre-feet) Reservoirs in order to protect existing non-Indian water users from adverse effects that might result from implementation of the 1990 Fort Hall Indian Water Rights Agreement and Fort Hall Indian Water Rights Act of 1990."

Recreation and Fish and Wildlife

"Four recreation areas have been developed to meet projected initial demands. Juniper Park, adjacent to the project headquarters visitor center, is the major recreation site. Both overnight camping and day-use facilities are available, including a floating fishing dock and a boat-launching ramp. Blacktail Park, on the lake, includes a swimming area and other day-use facilities. Benchland Park is also on the lake, but is accessible only by boat and has limited day-use facilities. Creekside Park has day-use facilities and access to Willow Creek just downstream from the dam. Ririe Lake is stocked annually with rainbow trout and the minimum reservoir pool provides winter habitat for fish survival and growth. A minimum flow of 25 cubic feet per second is maintained downstream in Willow Creek to provide stream fishing habitat. Deer and elk use the area as winter range, so a large area around the south half of Ririe Lake is developed as rangeland for support of these animals during the critical winter months."

"The loss of wildlife habitat associated with the construction of Ririe Dam and Teton Dam led to the establishment of the Tex Creek Wildlife Management Area. In 1976 and 1977, the U.S. Army Corps of Engineers and the Bureau of Reclamation purchased 11,000 acres of critical big game winter range in the Tex Creek area just east of Idaho Falls, Idaho. The Idaho Department of Fish and Game eventually assumed additional critical acres."

"Also, a cooperative agreement with the Bureau of Land Management resulted in the inclusion of 9,600 acres of land, and today, the Tex Creek Wildlife Management Area encompasses more than 28,700 acres. The entire area is managed for wildlife, with emphasis on big game."

Fisheries

Salmonids are found in the Snake River and in natural tributary drainages in the Idaho Falls subbasin. The Idaho Department of Fish and Game (IDFG) conducted creel census and population sampling through electrofishing in the mid-1980s on various sections of the Snake River (Lukens, 1988a; 1988b). In general, the most abundant salmonid below Henry's Fork is mountain whitefish followed by brown trout, cutthroat trout, wild rainbow trout, and some hatchery rainbow trout around the City of Idaho Falls (Lukens, 1988a). The lower South Fork and the main Snake River in the Idaho Falls subbasin are considered a brown trout fishery (W. Schrader, Personal Communication). Put and take hatchery rainbow trout are locally important around the City of Idaho Falls. Additionally, miscellaneous game fish were found in the section nearest the mouth of the Henry's Fork. These included yellow perch escaped from Market Lake, lake trout escaped from Palisades Reservoir, and rainbow x cutthroat hybrids (Lukens, 1988a). In the lower South Fork Snake River above Henry's Fork brown trout are again the predominant game fish (Lukens, 1988b). Lukens (1988a, 1988b) concluded that catch rates were lower in this subbasin of the Snake River as compared to upper Henry's Fork or upper South Fork, but growth rates were good suggesting that the area could be a productive game fishery if recruitment could be enhanced.

In 1999, the USGS (Maret, 1999) sampled a location on the South Fork Snake River just upstream from the Idaho Falls subbasin boundary. This electrofishing sampling effort obtained numerous mountain whitefish, as well as Yellowstone cutthroat trout, rainbow trout, rainbow x cutthroat hybrids, and brown trout. Also caught were some Utah sucker, longnose dace, speckled dace, and shorthead sculpin. IDFG has also sampled four sections of the South Fork Snake River (Palisades, Conant, Twin Bridges, and Lorenzo) periodically since 1986 (Schrader and Gamblin, 2001). The Lorenzo section within the Idaho Falls subbasin was last sampled in late September-early October of 1999. Of the 1,431 trout individuals caught by electrofishing, 76% were wild brown trout, 23% were wild cutthroat trout, and the remaining trout (<1%) were wild rainbow trout and hybrid trout. IDFG performed some recent (2000) sampling for cutthroat trout population estimates in the Menan section of the Snake River below Henry's Fork to compare to 1988 sampling data from the same area (W. Schrader, Personal Communication). These data have not been published yet, although raw data appear similar between the two years.

IDFG electrofished Birch Creek on November 11, 1980 (W. Schrader, Personal Communication). An actively spawning population of brook trout was found in the upper eight kilometers (5 miles) of that stream. Piute sculpin was the only other fish species found in Birch Creek during that sampling event. No fish were found in the lower sections of Birch Creek.

Although not in this subbasin, Corsi (1984) reported electrofishing data for tributaries in the Willow Creek drainage above Ririe Reservoir. He found cutthroat trout to be the most abundant salmonid in that drainage. Brown trout were also abundant and brook trout were locally important. Rainbow trout and rainbow x cutthroat hybrids were infrequently observed. Mountain whitefish are also present in the Willow Creek drainage along with a number of nongame species such as mottled sculpin, longnose dace, speckled dace, redside shiners, Utah chubs, Utah suckers, and mountain suckers. Because water is shut off to lower Willow Creek below Ririe Reservoir during the non-irrigation season (November -–April), it is unlikely that these populations of fish extend into the Idaho Falls subbasin. However, other natural drainages in the subbasin (Lyon Creek, Kelly Canyon Creek, Taylor/Henry Creeks) may have some of these fish species present.

Subwatershed Characteristics

The Idaho Falls subbasin is divided into ten fifth field sub-watersheds on Figure 8. Half of these sub-watersheds (17040201-01, -02, -03, -05, -07) include some portion of the Snake River. We have named the ten sub-watersheds below based on the most prominent feature on the landscape (city, waterbody, mountain, etc.).

Idaho Falls Sub-watershed (17040201-01)

This sub-watershed includes the City of Idaho Falls and that portion of the Snake River from the power plant below Payne to the southern boundary of the subbasin. This sub-watershed includes the upper portion of Sand Creek and associated canals on the East Side of the Snake River, and the Great Western Canal and the Oakland Canal/Martin Canal complex on the western side of the river. Also included are the 303d listed Willow Creek, including the North Fork and the South Fork, from its divergence with Sand Creek to the Snake River.

Watershed protection projects under PL-566 were completed for Upper Sand Creek (SCS and East Side SCD, 1984) and Lower Sand Creek (SCS, East Side SCD, and North Bingham SCD, 1985). The purposes of these plans were to provide effective land treatment plans for the control of soil erosion and sedimentation in agricultural fields above the Sand Creek Canal.

Rigby/Shattuck Butte (17040201-02)

This sub-watershed includes that portion the Snake River from where the Butte Market Lake Canal returns to the river near Bassett to the power plant near Payne. Drainages included in this sub-watershed are some minor (probably ephemeral) drainages southeast of Butterfly Butte and below Shattuck Butte, the Osgood Canal, the origin of the Great Western Canal and the Idaho Canal, and the Burgess, Wilkins, Randall, and Rudy Canals below Rigby.

Menan/Roberts (17040201-03)

This sub-watershed includes that portion of the Snake River from the confluence with the Henry's Fork to Bassett. The sub-watershed boundary slices southeast across Annis and Scotts Sloughs, Dry Bed, and other canals to an area just east of Rigby. Also on the East Side of the Snake River, Spring Creek, the Dry Bed return flow, and the towns of Menan and Lewisville are located in this sub-watershed. On the western side of the Snake River the sub-watershed includes the town of Roberts, Market Lake Wildlife Management Area, Kettle Butte and associated drainages, and Kettle Butte Drain. Also included are the Butte Market Lake Canal, Taylor Slough, Bell Larsen Canal, Poitevin Ditch, and McCarthy Ditch.

Sand Dunes (17040201-04)

This sub-watershed includes an area of lava rock and sand dunes north of the Menan Buttes. There are practically no surface waters associated with this sub-watershed with the exception of some minor drainage (probably intermittent or ephemeral) associated with Big Grassy Ridge.

South Fork Snake River (17040201-05)

This sub-watershed includes that portion of the South Fork Snake River from an area south of Sunnydell to the Henry's Fork. Included are portions of Dry Bed and various other canals and sloughs on the south side of the Snake River. On the north side of the Snake River are Texas Slough, Liberty Park Canal, Spring Slough, Bannock Jim Slough, and other canal works.

Sunnydell Canal (17040201-06)

This sub-watershed includes minor drainages to the Sunnydell Canal in an area south of Rexburg to Byrne.

Heise (17040201-07)

The Heise sub-watershed includes that portion of the South Fork Snake River from the HUC boundary (near Stinking Spring Canyon) to Sunnydell. This region contains the primary diversions for Dry Bed, Enterprise Canal, Farmers Friend Canal, Eagle Rock Canal, and Anderson Canal. On the north side of the Snake River are the natural drainages of Kelly Canyon and Lyon Creek.

Birch Creek (17040201-08)

The Birch Creek sub-watershed contains only the 303d-listed Birch Creek and associated tributary drainage. Birch Creek originates near the divide between Antelope Creek and Meadow Creek north of Mt. Baldy of the Caribou Range. Birch Creek ends as a sink on most maps just south of the Anderson Canal. Spring high flows probably reach and discharge to the canal. The upper watershed is predominantly mountain brush vegetation that is used for grazing purposes (see photographs in Appendix B). Birch Creek passes through two sections of state lands in the upper watershed. The lower watershed is predominantly dryland agricultural usage. The majority of the lands surrounding Birch Creek are privately owned.

Ririe/Ucon (17040201-09)

This sub-watershed includes the major canals of Enterprise, Harrison, Farmers Friend, Eagle Rock, Anderson, and Willow Creek from Ririe to an area southwest of Ucon. Also included are drainages (probably ephemeral or intermittent) from an area known as Iona Hill. On Figure 8 this sub-watershed is shown to terminate at the divide of the North Fork and South Fork Willow Creek. In actuality the boundary is at the division of Willow Creek and Sand Creek, both of which are now controlled exclusively as irrigation water canal structures.

Taylor Mountain (17040201-10)

This sub-watershed includes Taylor Creek and Henry Creek that drain from the Taylor Mountain area to an area of irrigation diversion south of Ammon. Also included are a number of smaller (ephemeral or intermittent) drainages, such as Black Canyon, Eucher Valley, and Rock Hollow, which drain Galbraith Hill and the south side of Iona Hill. Canal works such as Gardner Canal and Hillside Canal captures most if not all of these drainages.

Stream Characteristics

The Snake River in this subbasin exists on a Pliestocene outwash floodplain of flood and terrace gravels. As such, the floodplain is very porous and probably includes substantial ground water flow. Very few surface tributary streams exist in this subbasin. Kelly Creek, Birch Creek, and, at one time, the lower end of Willow Creek were the primary perennial streams resulting from higher elevations. BLM assessments and proper functioning condition ratings for streams in this subbasin are found in Appendix C.

Birch Creek is a low order, moderately sinuous perennial stream with predominantly a Rosgen channel type B. Although, the lower portion of this stream is deeply incised as a result of increased hydrology from constriction between dryland agricultural fields and a road, as well as increased runoff from both (see Photographs in Appendix D).

1.3 Cultural Characteristics

The northern and western portions of this subbasin are in sagebrush-steppe rangeland. Because of the nature of the geology and soils (wind blown deposits over basalt lava flows many feet thick) in this area, no surface drainage exists. The remaining portions of the subbasin are largely flat Snake River plain that has been converted to agriculture. Its predominance as an agricultural center is what makes Idaho Falls the third largest city in the state.

Land Use

The land use in the subbasin is primarily agriculture (see Figure 4), with the central region adjacent to the Snake River utilizing gravity flow irrigation (23% of total land area), surrounded by sprinkler type irrigation (25%) and dryland farming (14%). Thirty percent (30%) of the land area is used for rangeland, and 1.4% is in urban uses. The remaining lands (6.6%) are in forest, riparian or bare rock (lava flows). [Note: urban area east of Idaho Falls on Figure 4 is a typographical error, and does not exist.]

Land Ownership, Cultural Features, and Population

The majority (69%) of the land in the Idaho Falls subbasin is in private ownership (Figure 6). The Bureau of Land Management (BLM) manages the majority of the western and northern shrubland areas, constituting 25% of the subbasin. A small portion of the Idaho National Engineering and Environmental Laboratory (INEEL) managed by the Department of Energy (DOE) occurs at the westernmost point of the subbasin. Additionally, there is one very small piece of land in the upper Kelly Canyon area that is administered by the USDA Forest Service (Caribou-Targee National Forest).

The State of Idaho owns several section 16 blocks throughout the BLM lands as well as the Market Lake Wildlife Management Area, the upper Lyons Creek watershed north of Kelly Canyon, upper Birch Creek, and a large number of sections north of the St. Anthony Sand Dunes.

The Idaho Falls subbasin extends from Fremont County to the north, through Jefferson and Madison Counties, and then Bonneville County in the southern portion. Small portions of Bingham County occur at the southern and western tips, and small portions of Clark County occur at the northern tip. The Idaho Falls subbasin includes the cities and towns of Idaho Falls, Roberts (647)[1], Menan (707), Lewisville (467), Rigby (2,998), Ririe (545), Ucon (943), Iona (1,201), Ammon (6,187), and a portion of Rexburg. The city of Idaho Falls had a population of 50,730 in 2000 (IDC, 2001). Population densities by county vary from 0.46 –

[1] Numbers in parentheses are 2000 population estimates from the Idaho Department of Commerce (IDC, 2001).

10.41 population per square mile (pop/sq mi) in Fremont County to 40 – 50 pop/square miles in Bonneville County (Figure 7).

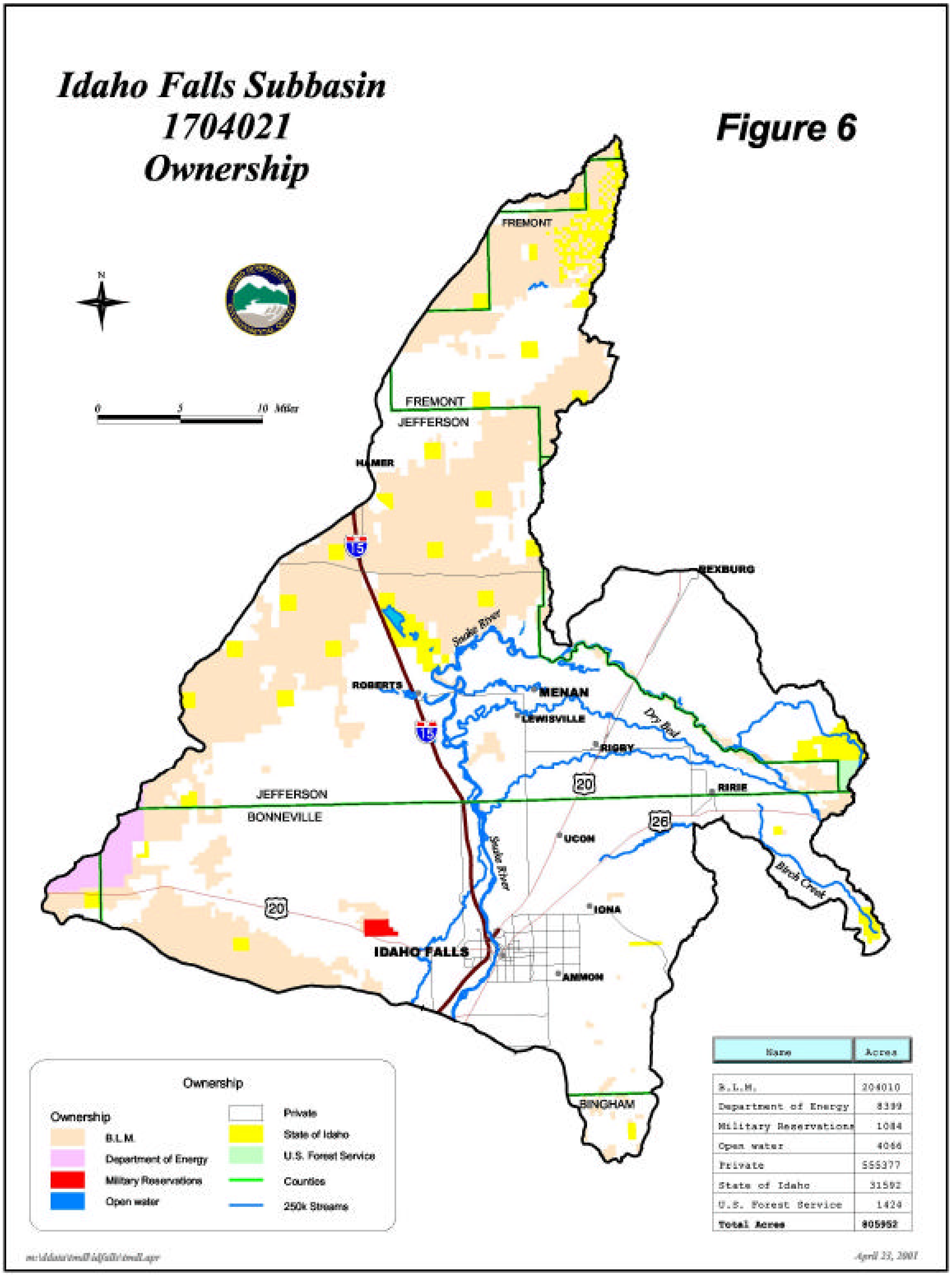
History and Economics

The history and economics of this subbasin are closely tied to its major city Idaho Falls. Idaho Falls is the state's third largest city and a major center for agricultural products, farm service, and, because of it's proximity to the Idaho National Engineering and Environmental Laboratory (INEEL), science and technology. The U.S. Department of Energy and its contractors at INEEL all maintain office complexes in the city. Most of the state's major universities maintain branch campuses in Idaho Falls. Idaho Falls also has an important recreational and tourist economy due to its proximity to Yellowstone and Grand Teton National Parks.

Idaho Falls' roots are closely tied to the surrounding farmland on the upper Snake River plain. This area is well known for its production of russet potatoes, livestock, wheat and other small grains. Most of the lowlands are irrigated with water from the Snake River and surrounding wells. Higher elevations that receive sufficient snowfall are largely in dryland agriculture. The major diversion structures and canals include Sunnydell Canal, Dry Bed, Burgess Canal, Rudy Canal, Harrison Canal, Anderson Canal, and Willow/Sand Creek Canal on the east side, and Market Lake Canal, McCarthy Ditch, and Great Western Canal on the west side of the subbasin. Many of these irrigation systems have been in place since the turn of the Twentieth Century, although probably modified, repaired and replaced several times throughout that century.

A dam near the falls in Idaho Falls is used to shunt a portion of the Snake River through a powerhouse to generate electricity for the city. The subbasin also contains four municipal NPDES wastewater discharges, two of which discharge to the Snake River and two discharge to the Dry Bed canal system (see Section 3).

Figure 6. Idaho Falls Subbasin Land Ownership.



Name	Acres
B.L.M.	204010
Department of Energy	8399
Military Reservations	1084
Open water	4066
Private	555377
State of Idaho	31592
U.S. Forest Service	1424
Total Acres	**805952**

Figure 7. Idaho Falls Subbasin Population Estimates.

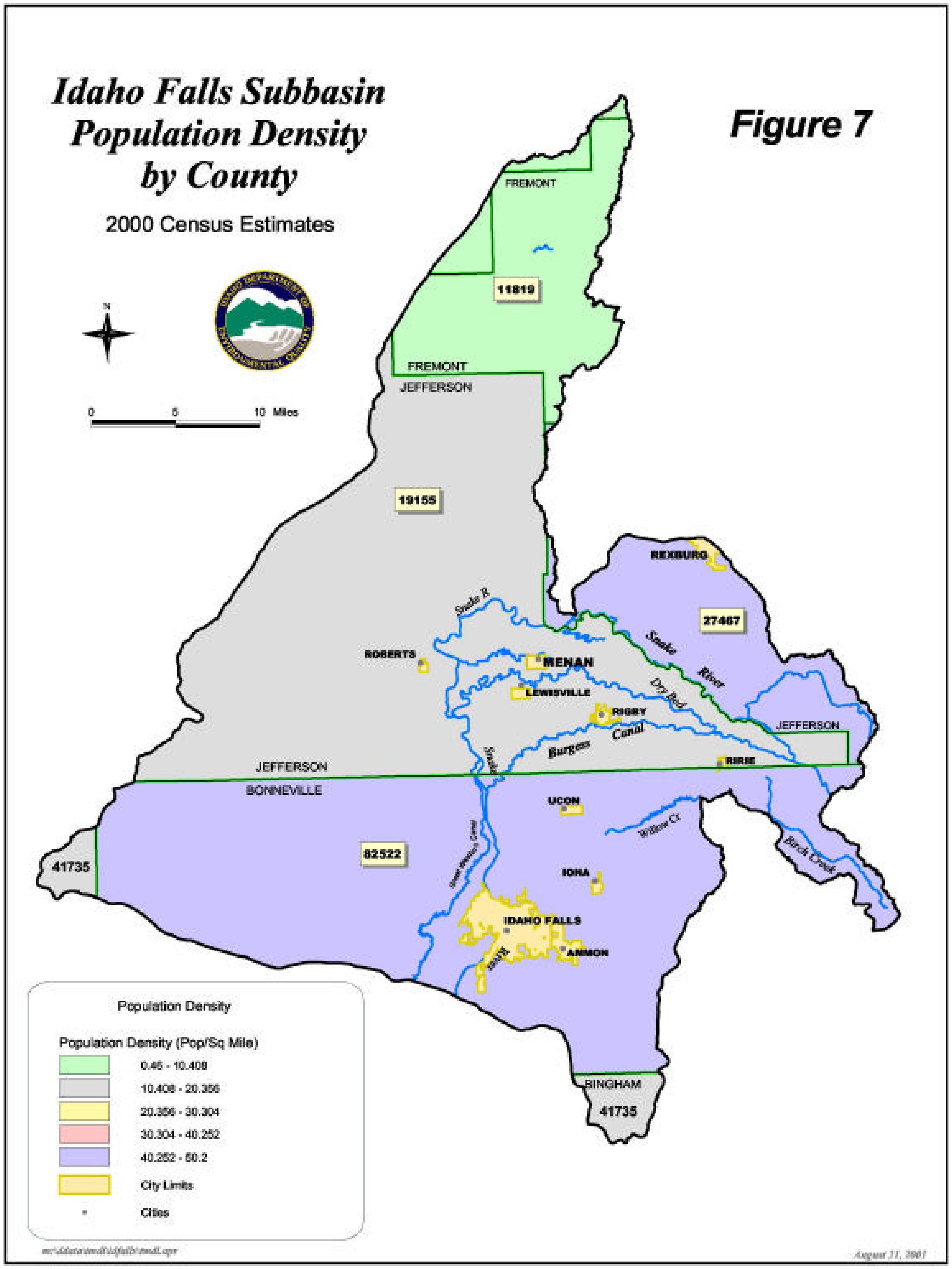
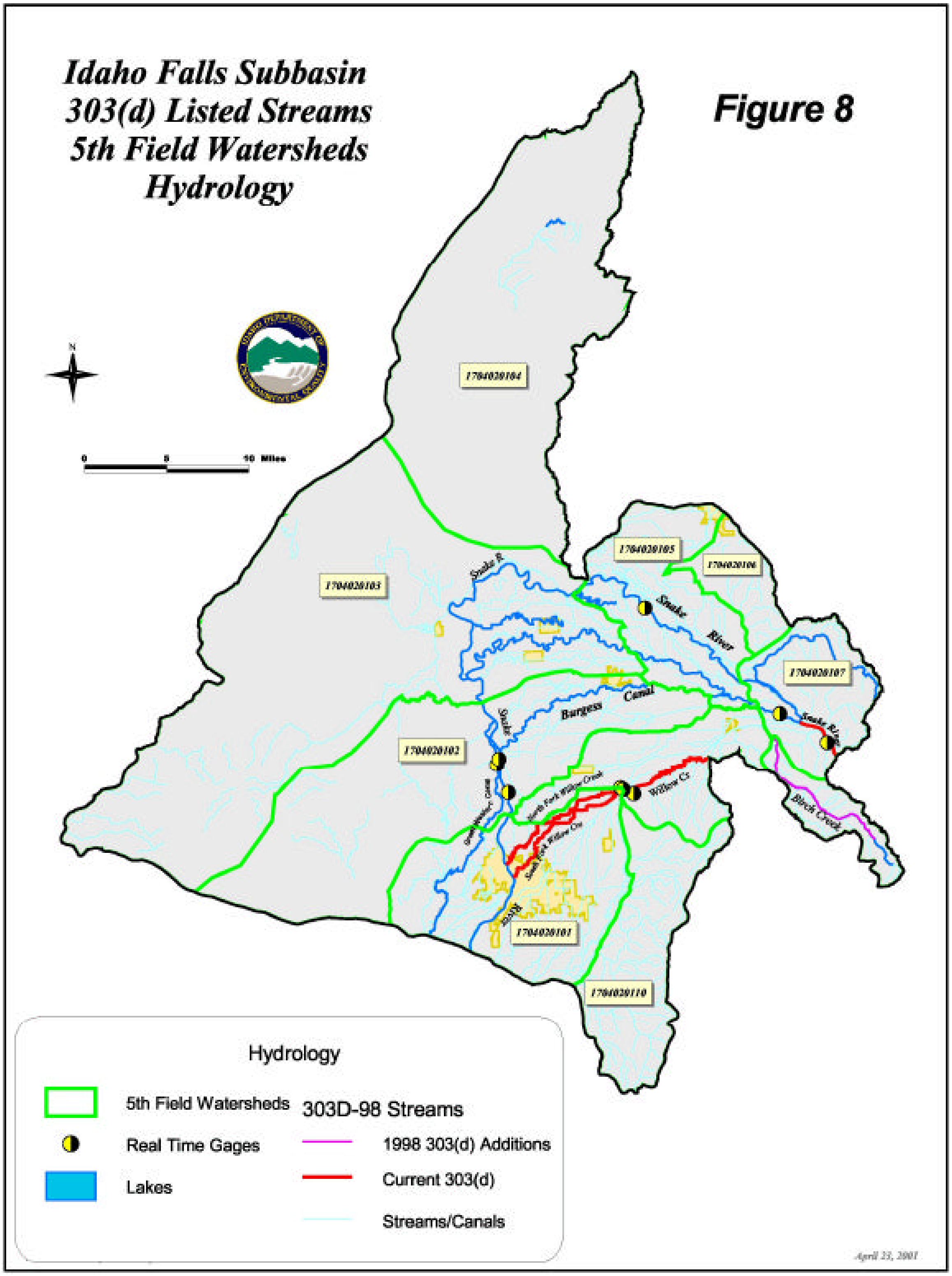


Figure 8. Idaho Falls Subbasin Hydrology.



2. Subbasin Assessment – Water Quality Concerns and Status

In 1998, DEQ established a new 303(d) list based on 1993-1996 assessments performed through the Beneficial Use Reconnaissance Project (BURP) and other pertinent material regarding beneficial use status and water quality standards violations. Waters monitored through BURP after 1996 have not been assessed for 303(d) listing purposes. The 1998 303(d) list included three (3) stream segments in the Idaho Falls subbasin (Table 7 and Figure 8). The EPA approved that list in May 2000.

2.1 Water Quality Limited Segments Occurring in the Subbasin

It is not entirely clear where is the HUC boundary on the Snake River between this subbasin and the Palisades subbasin (17040104). We have chosen river mile 854.6 because Heise is generally at river mile 851 and it is a site above most canal diversions. The first drainage to the Snake River within the Idaho Falls subbasin is Stinking Spring Canyon. The HUC boundary for Willow Creek is where Willow Creek merges with the Eagle Rock Canal. Although identified on the 303d list as the South Fork Willow Creek, Willow Creek originally did not divide into the South Fork and the North Fork until approximately nine miles downstream of the HUC boundary. Currently, the entire Willow Creek drainage in this subbasin is used as irrigation canals. Flow to the original beds of the South Fork results from diversion of water from the North Fork down the Payne Lateral, and then diverted again into the area of the original South Fork. The original South Fork Willow Creek was only about four to five miles long.

Table 7. §303(d) Segments in the Idaho Falls Subbasin.

Waterbody Name (and Segment ID Number)	AU of HUC 17040201	1998 §303(d)[1] Boundaries	Pollutants	Listing Basis
South Fork Snake River (2003)	SK013_06	Subbasin boundary to Heise	Flow alteration	Carry over from 1996
Birch Creek (5250)	SK008_02 SK008_03	Unnamed tributary in T2N, R41E, Section 2 to sink	unknown	Added to 1998, Low metric scores
South Fork Willow Creek (5655)	SK001_05 SK002_02 SK002_05 SK003_05	Subbasin boundary to Snake River	sediment	Carry over from 1996

[1]Refers to a list created in 1998 of waterbodies in Idaho that did not fully support at least one beneficial use. This list is required under section 303 subsection “d” of the Clean Water Act.

2.2 Applicable Water Quality Standards

Water Quality standards are legally enforceable rules and consist of three parts: the designated uses of waters, the numeric or narrative criteria to protect those uses, and an antidegradation policy. Water quality criteria used to protect these beneficial uses include narrative "free from" criteria applicable to all waters (IDAPA 58.01.02.200), and numerical criteria, which vary according to beneficial uses (IDAPA 58.01.02.210, 250, 251, & 252). Typical numeric criteria include bacteriological criteria for recreational uses, physical and chemical criteria for aquatic life [e.g. pH, temperature, dissolved oxygen (DO), ammonia, toxics, etc.], and toxics and turbidity criteria for water supplies. Idaho's water quality standards are published in the State's rules at *IDAPA 58.01.02 Water Quality Standards and Wastewater Treatment Requirements.* Designated beneficial uses for waters in the Idaho Falls subbasin are listed in Table 8.

Beneficial Uses

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

Existing Uses

Existing uses under the CWA are "those uses actually attained in the waterbody on or after November 28, 1975, whether or not they are included in the water quality standards." The existing in stream water uses and the level of water quality necessary to protect the uses shall be maintained and protected (IDAPA 58.01.02.003.35, .050.02, and 051.01 and .053). Existing uses include uses actually occurring, whether or not the level of quality to fully support the uses exists. Practical application of this concept would be when a water could support salmonid spawning, but salmonid spawning is not yet occurring.

Designated Uses

Designated uses under the CWA are "those uses specified in water quality standards for each waterbody or segment, whether or not they are being attained." Designated uses are simply uses officially recognized by the state. In Idaho these include things like aquatic life support, recreation in and on the water, domestic water supply, and agricultural use. Water quality must be sufficiently maintained to meet the most sensitive use. Designated uses may be added or removed using specific procedures provided for in state law, but the effect must not be to preclude protection of an existing higher quality use such as cold water aquatic life or salmonid spawning. Designated uses are specifically listed for waterbodies in Idaho in tables in the Idaho water quality standards (see IDAPA 58.01.02.003.22 and .100, and IDAPA 58.01.02.109-160 in addition to citations for existing uses.)

Presumed Uses

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

Table 8. Idaho Falls Subbasin designated beneficial uses.

Waterbody	Designated Uses[1]	1998 §303(d) List[2]
Snake River	CW, SS, PCR, AWS, DWS	Yes

[1]CW – Cold Water, SS – Salmonid Spawning, PCR – Primary Contact Recreation, SCR – Secondary Contact Recreation, AWS – Agricultural Water Supply, DWS – Domestic Water Supply
[2]Refers to a list created in 1998 of waterbodies in Idaho that did not fully support at least one beneficial use. This list is required under section 303 subsection "d" of the Clean Water Act.

Table 9. Idaho Falls Subbasin existing/presumed beneficial uses.

Waterbody	Existing/Presumed Uses[1]	1998 §303(d) List[2]
Birch Creek	CW, SS, PCR or SCR	Yes
South Fork Willow Creek	Canal, water conveyance	Yes

[1]CW – Cold Water, SS – Salmonid Spawning, PCR – Primary Contact Recreation, SCR – Secondary Contact Recreation, AWS – Agricultural Water Supply, DWS – Domestic Water Supply
[2]Refers to a list created in 1998 of waterbodies in Idaho that did not fully support at least one beneficial use. This list is required under section 303 subsection "d" of the Clean Water Act.

The Snake River throughout this subbasin is designated for cold water aquatic life, salmonid spawning, primary contact recreation, agricultural and domestic water supplies (Table 8). All other streams in this subbasin are undesignated waters. Birch Creek is presumed to be protected for cold water aquatic life and primary or secondary contact recreation because it is an undesignated water. Salmonid spawning is considered an existing use in Birch Creek as reproducing brook trout were discovered there in 1980 (Table 9). It is not known whether or not that population still exists. The South Fork Willow Creek, as well as the North Fork, are no longer perennial streams, but are used as conveyance systems for irrigation water coming from Ririe Reservoir and the Snake River (via Eagle Rock Canal). Flow only occurs in the South Fork Willow Creek canal during the irrigation season. Flow in the lower section of the South Fork Willow Creek canal where it enters the Snake River in the city of Idaho Falls, is intermittent daily depending on water diversion schedules and field irrigation demand (see Photos in Appendix).

Of particular importance regarding listed water bodies in this subbasin are the criteria for sediment. The narrative criterion for sediment is as follows:

> "Sediment shall not exceed quantities specified in sections 250 and 252, or, in the absence of specific sediment criteria, quantities which impair designated beneficial uses. Determination of impairment shall be based on water quality monitoring and surveillance and the information utilized in section 350.02.b."

Quantities specified in Section 250 refer to turbidity criteria identified for cold water biota use and small public domestic water supplies. Turbidity must be measured upstream and downstream from a sediment input in order to determine violation of criteria. Indirectly, specific sediment criteria also include intergravel dissolved oxygen measures for salmonid spawning uses. Intergravels filled with sediment cannot hold enough dissolved oxygen for successful incubation. Intergravel dissolved oxygen measurement requires the placement of special apparatus in spawning gravels. Turbidity and intergravel DO are rarely measured as part of routine reconnaissance-level monitoring and assessment. These measurements are usually conducted in special cases during higher-level investigations of potential problems.

Because of the lack of specific numerical criteria for sediment, surrogate measures are often used as a mechanism to reflect potential sediment problems. Often the percentage of depth fine sediments found in spawning gravels is used as an indicator of sediment problems that will affect salmonid species. Generally, depth fines greater than 28-30% is considered unhealthful for spawning gravels. Bank stability can be another indicator of sediment problems in streams. When bank stability falls below 80%, these banks may be contributing unhealthy levels of sediment to aquatic habitats. There are other surrogate measures for sediment, however, caution is advised as specific levels can be highly variable depending on stream morphology and geology of the area, and it may be difficult to pinpoint levels that are universally acceptable.

2.3 Summary and Analysis of Existing Water Quality Data

Very little water quality data exists for the 303d listed stream segments in this subbasin.

Flow Characteristics

There are a series of diversion structures along the South Fork Snake River in the vicinity of Heise. These canals take water from the river and deliver it to the farming regions on the East Side of Idaho Falls. Diversions include Riley Ditch, Anderson Canal, Eagle Rock Canal, Farmers Friend Canal, Enterprise Canal, and Dry Bed Canal. Photographs of some of these diversions are in Appendix D. Dry Bed is the largest diversion in this area.

The basis for the 303d listing for flow alteration of 3.6 miles of the South Fork Snake River in the Idaho Falls subbasin is presumably related to control by Palisades Dam. The diversions in the Heise area are side channel diversions, which do not preclude river flow in this area.

Willow Creek in the Idaho Falls subbasin has not been assessed, as its current use is an irrigation canal. Progressive Irrigation is responsible for and distributes all the water in the Willow Creek canal system (Steve Smith, Personal Communication) (see photographs in Appendix). Gaging station flow records indicate that all the water is shut off to this section of the Willow Creek canal during the non-irrigation season (Table 5).

Water Column Data

To our knowledge, no water column data exist for listed streams in this subbasin.

Biological and Other Data

Birch Creek was listed for unknown pollutants in the 1998 303d list. However, because the primary activities in the drainage are grazing, roads, and dryland agriculture, it is likely that sediment is the pollutant of concern. Percent fine particles were fairly high in the two BURP samples (37% in upper site, 69% in lower site). Photographs taken in July 2001 (Appendix D) show evidence of downcutting, bank sloughing, and siltation in the lower watershed. Steve Smith (Personal Communication) of the Soil Conservation Commission indicated that a single event, locally heavy thunderstorm in the recent past caused much of the present downcutting to Birch Creek.

Status of Beneficial Uses

During the development of DEQ's large river assessment protocol, the South Fork of the Snake River near Heise was selected by researchers at Idaho State University as a reference site for testing their assessment metrics (Royer and Minshall, 1996). Additionally, this site on the South Fork had a DEQ River Fish Index (RFI) of 83 out of a possible 100, a score symbolic of least-disturbed reference river sites (Grafe, 2000).

Only two streams in the subbasin were assessed through the Beneficial Use Reconnaissance Program (BURP) [see Appendix E]. Birch Creek was assessed as not supporting cold water biota aquatic life, and was added by DEQ to the 1998 303d list for Idaho (Table 10). Kelly Canyon Creek was visited twice through BURP, but only the lower site visited in 1996 was assessed (Table 11). Kelly Canyon Creek was not included on the 1998 303d list presumably because of the reasonably high (4.84) macroinvertebrate (MBI) score used at that time. Both Birch Creek and Kelly Canyon Creek have very low flows, generally less than one cubic foot per second at the time of sampling. It is questionable whether these streams are perennial or intermittent.

Table 10. Birch Creek BURP Assessment

BURP Site Location	1998 303d Assessment	MBI Score	SMI Score	SHI Score	Flow (cfs)	Year
Upper Birch Creek – near headwaters	CWB – not fully supported	3.73	47.19 (2)	39 (1)	0.7	1994
Lower Birch Creek – 2+ miles upstream of Highway 26	CWB – not fully supported	1.98	26.24 (Min. Threshold)	51 (1)	0.6	1994

Table 11. Kelly Canyon Creek BURP Assessment

BURP Site Location	1998 303d Assessment	MBI Score	SMI Score	SHI Score	Flow (cfs)	Year
Lower Kelly Canyon – below reservoir near canyon mouth	CWB – needs verification	4.84	57.91 (2)	48 (1)	1.1	1996
Upper Kelly Canyon – above reservoir	NA	3.55	20.7 (Min. Threshold)	65 (3)	0.3	1997

Conclusions

The Snake River between the eastern boundary of the subbasin and the Dry Bed diversion structure is listed for flow alteration, presumably because of the presence of the diversion and flow control from Palisades Reservoir to the east. Flow alteration is not a conventional pollutant for which TMDLs are written. Idaho DEQ and EPA have agreed that TMDLs cannot be written for such “pollution,” however, flow altered streams will remain on the 303d list maintained by the state.

Other than Beneficial Use Reconnaissance Program (BURP) assessments, no data exists on the water quality of Birch Creek. Listed for unknown pollutants, it is assumed that sediment from bank erosion is the primary concern in Birch Creek. Birch Creek is very similar to the adjacent Antelope Creek in the Palisades subbasin. The Antelope Creek sediment TMDL will form the basis for the Birch Creek sediment TMDL as a surrogate until such data are collected for Birch Creek.

The South Fork of Willow Creek (which included the North Fork and Willow Creek proper from Eagle Rock Canal to the forks), currently listed for sediment, is a water conveyance system maintained by a local canal company. No water quality data exists for this canal. Water is conveyed through portions of the old stream system during the irrigation season, although the majority of this system has been altered, straightened, and rip-rapped. No TMDLs will be performed for this canal.

2.4 Data Gaps

The hydrology of the Idaho Falls subbasin is predominantly associated with the Snake River and its associated diversions and canal systems. Very few natural streams exist within the subbasin. Of those few streams, Birch Creek is a very small perennial stream draining through an area that is largely in dryland agriculture land use. Because of its small size (less than 1 cfs when assessed through BURP) there has been little interest in doing water quality monitoring. Birch Creek also does not discharge to a natural water body but terminates at the Anderson Canal. Thus any excess sediment delivery from Birch Creek only impacts the maintenance of that canal.

Birch Creek probably carries a substantial (compared to its low flow conditions) snowmelt runoff flow for several weeks in spring. The bulk of its sediment erosion from incised banks probably occurs during these spring runoff events. It is unlikely that sediment delivery can be adequately monitored from the water column at such times. However, because of easy access to the stream, good information can be obtained from bank erosion surveys in the future.

3. Subbasin Assessment – Pollutant Source Inventory

3.1 Sources of Pollutants of Concern

Because TMDLs will not be constructed for the listed segment of the Snake River and for the South Fork Willow Creek canal, the majority of the discussion from hereon will address Birch Creek.

Point Sources

There are five NPDES permitted discharge facilities in the subbasin (Table 12) according to EPA's Permit Compliance System (PCS). Likewise, there are three NPDES permitted feedlots and one tanks/components facility (INEEL) in the subbasin, which do not list effluent limits or receiving streams in PCS.

To our knowledge, none of these facilities are located on 303d listed segments, nor do they specifically discharge the listed pollutants of concern (i.e. sediment, flow alteration).

Table 12. NPDES permitted facilities in the Idaho Falls subbasin.

NPDES ID	Facility ID	Name	Receiving Water
ID0021261	IDD092027010	City of Idaho Falls	Snake River
ID0020010	ID0000552950	City of Rigby	Dry Bed
ID0026174	ID0002378719	City of Ririe	Dry Bed (Great Feeder Canal)
ID0026913	IDD984672261	City of Roberts	Roberts Slough
ID0026565	IDD000602631	Pacificorp/DBA Utah Power & Light	Snake River
IDR05A60F	110000600467	U.S. DOE, INEEL	n.a.
IDU000075	000008966680	Robert Swanson Feedlot	n.a.
IDU000072	000008966650	Boyle Land & Livestock	n.a.
IDG010020	000008483410	Skaar Livestock	n.a.

Nonpoint Sources

The majority of sediment delivery to Birch Creek is assumed to be from streambanks. Birch Creek has an incised channel in places, and is especially deep compared to its width in the dryland agricultural region. Presumably, this situation has been exacerbated by increased spring runoff as a result of land use changes. Birch Creek is also paralleled for more than half its distance by a road, which likely also contributes to its increased hydrology.

Pollutant Transport

Nothing is currently known about the transport of sediment through Birch Creek. However, it is likely that the bulk of the sediment comes from streambank erosion during several weeks of high spring flow. Birch Creek terminates at Anderson Canal, thus, no sediment is delivered to another natural waterbody.

3.2 Data Gaps

Point Sources

There are no point sources on listed waterbodies in this subbasin.

Nonpoint Sources

In addition to streambank erosion surveys for Birch Creek, additional information should be gathered on the possibility of overland flow or road contributions of sediment in the area.

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

To our knowledge, there have been no public pollution control efforts in the Birch Creek watershed. However, because a large portion of the watershed is privately owned, there may be private or public-private efforts that have not been documented by us.

5. Total Maximum Daily Load

A TMDL prescribes an upper limit on discharge of a pollutant from all sources so as to assure water quality standards are met. It further allocates this load capacity (LC) among the various sources of the pollutant. Pollutant sources fall into two broad classes: point sources, each of which receives a wasteload allocation (WLA); and nonpoint sources, which receive a load allocation (LA). Natural background (NB), when present, is considered part of the load allocation, but is often broken out on its own because it represents a part of the load not subject to control. Because of uncertainties regarding quantification of loads and the relation of specific loads to attainment of water quality standards, the rules regarding TMDLs (Water quality planning and management, 40 CFR 130) require a margin of safety (MOS) be a part of the TMDL.

Practically, the MOS is a reduction in the load capacity that is available for allocation to pollutant sources. The natural background load is also effectively a reduction in the load capacity available for allocation to human made pollutant sources. This can be summarized symbolically as the equation: LC = MOS + NB + LA + WLA = TMDL. The equation is written in this order because it represents the logical order in which a loading analysis is conducted. First the LC is determined. Then the LC is broken down into its components: the necessary MOS is determined and subtracted; then NB, if relevant, is quantified and subtracted; and then the remainder is allocated among pollutant sources. When the breakdown and allocation is completed we have a TMDL, which must equal the LC.

Another step in a loading analysis is the quantification of current pollutant loads by source. This allows the specification of load reductions as percentages from current conditions, considers equities in load reduction responsibility, and is necessary in order for pollutant trading to occur. Also a required part of the loading analysis is that the LC be based on critical conditions – the conditions when water quality standards are most likely to be violated. If protective under critical conditions, a TMDL will be more than protective under other conditions. Because both LC and pollutant source loads vary, and not necessarily in concert, determination of critical conditions can be more complicated than it may appear on the surface.

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

The Snake River is impaired due to a lack of flow; however, EPA does not believe that flow (or lack of flow) is a pollutant as defined by CWA Section 502(6). Since TMDLs are not required to be established for waterbodies impaired by pollution but not pollutants, a TMDL has not been established for the Snake River for flow.

The South Fork Willow Creek has been altered from its natural state to be a canal. The land surrounding this canal is principally privately owned, as is the water in the canal privately allocated. The South Fork Willow Creek shall be "delisted" from the 303d list.

5.1 Instream Water Quality Targets

The goal of the TMDL is to restore "full support of designated beneficial uses" (Idaho Code 39.3611, 3615) on Birch Creek within the Idaho Falls subbasin and to bring this water into compliance. In this case, Birch Creek is a undesignated water and is presumed to be protective of cold water aquatic life and secondary contact recreation. Birch Creek had a reproducing population of brook trout in the early 1980s, and thus, has salmonid spawning as an existing use. The water quality pollutant of concern for Birch Creek is sediment.

The current state of science does not allow identification of a specific and precise sediment load or loading capacity to meet the narrative criterion for sediment or to fully support beneficial uses of cold water aquatic life and salmonid spawning. All that can be said is that the loading capacity lies somewhere between current loading and levels that relate to natural streambank erosion. We presume that beneficial uses were, or would be, fully supported at natural background sediment loading rates that are assumed to result from at least 80% bank stability. In order to attain beneficial use support, 80% bank stability will determine the erosion conditions to be used as the sediment target for this TMDL. Streambank erosion estimates can be derived from NRCS methodologies.

To improve the quality of spawning substrate and rearing habitat in Birch Creek, it is necessary to reduce the component subsurface fine sediment (<6.35 mm) to below 28% for improved survival and emergence of trout eggs and fry. Less than 28% subsurface fines in spawning gravel will also be a sediment target for this TMDL. This can be measured by using a modified McNeil sediment sampling procedure (McNeil and Ahnell 1964).

Design Conditions

This sediment loading analysis characterizes sediment loads using average annual rates determined from empirical characteristics that develop over time within the influence of peak and base flow conditions. Annual erosion and sediment delivery are functions of climatic variability where above average water years typically produce higher erosion and subsequently higher sediment loads from unstable streambanks. Stable streambanks that provide access of peak flows to floodplains are able to withstand extreme hydrologic events without becoming unstable. Additionally, the annual average sediment load is not distributed equally throughout the year. To quantify the seasonal and annual variability and critical timing of sediment loading, climate and hydrology must be considered. Erosion typically occurs during a few critical months during spring runoff when bankfull flows occur.

Target Selection

Target selection of sediment is supported by existing narrative criteria in water quality standards [IDAPA 58.01.02.200.08].

Sediment targets for this subbasin are based on streambank erosion related to streambank stability of 80%. Loading rates are quantitative estimates expressed in tons/mile/year. Reduction in streambank erosion prescribed in this TMDL is directly linked to the improvement of streambank stability and to riparian vegetation vigor and density adequate to armor streambanks thereby reducing lateral recession. Over time stream channels are expected to regain equilibrium and provide natural mechanisms for trapping sediment and reducing stream energy which in turn reduces stream erosivity and sediment loading.

It is assumed that natural background sediment loading rates from bank erosion equate to 80% bank stability as described by Overton et al. (1995), where banks are expressed as a percentage of the total estimated bank length. Natural condition streambank stability potential is generally 80% or greater for Rosgen A, B, and C channel types in plutonic, volcanic, metamorphic, and sedimentary geology. Therefore, an 80% bank stability target based on streambank erosion inventories shall be the target for sediment load reduction.

Stream substrate size composition can directly impair spawning success, egg survival to emergence, rearing habitat, and fish escapement from spawning gravels. It is necessary to reduce the component of subsurface fine sediment (<6.35 mm) to below 28% to achieve typical salmonid spawning management objectives.

Monitoring Points

No monitoring for streambank erosion or subsurface fines has occurred in Birch Creek. Therefore, monitoring points should be established in spawning gravel or potential spawning gravel presumably in the upper portions of the watershed. Streambank erosion inventories/assessments should be conducted throughout the watershed to evaluate overall bank stability.

5.2 Load Capacity

No data exists for Birch Creek, therefore, a sediment TMDL for Birch Creek must be constructed from another water body used as proxy. In this case, Antelope Creek, which has a sediment TMDL completed in the Palisades Subbasin Assessment and TMDL (Zaroban & Sharp 2001), will provide a useful proxy. Birch Creek and Antelope Creek are nearly adjacent on the same hillside at the tip of the Caribou Range. Both Birch Creek and Antelope Creek share a common geology. The higher elevations of both streams are in Upper Cretaceous thick detrital and fresh-water limestone. With mid- and lower elevations in Pliocene silicic welded tuff ash and flow rocks and Lower Pliestocene silic volcanic units of Island Park-Yellowstone area (Figure 2).

Birch Creek soils are very similar to Antelope Creek soils. Below is a comparison of soils between the two creeks from headwaters to mouth. Those soil names in Italics are common between the two streams.

Birch Creek Soils (headwaters to mouth)	Antelope Creek Soils (headwaters to mouth)
Cryoborolls-Rock outcrop, very steep	*Judkins ext. stony loam, 8-30%*
Judkins extremely stony loam, 8-30%	*Paulson-Nielsen complex, 5-35%*
Lanark silt loam, 4-20%	*Cryoborolls-Rock outcrop, very steep*
Tetonia silt loam, 12-20%	*Dranyon ext. stony silt loam, 4-45%*
Rin silt loam, 12-45%	*Tetonia silt loam, 12-20%*
Paulson-Nielsen complex, 5-35%	*Aquic Cryoborolls-Typic Cryaquolls*
Dranyon ext. stony silt loam, 4-45%	*Araveton ext. stony loam, 4-30%*
Cryoborolls-Rock outcrop, very steep	*Ririe silt loam, 12-20%*
Ririe silt loam, 12-20%	Paulson silt loam, 4-12%
Aquic Cryoborolls-Typic Cryaquolls	
Araveton ext. stony loam, 4-30%	
Ririe silt loam, 12-20%	
Torriorthents-Rock outcrop, very steep	
Ririe silt loam, 4-12%	
Bock loam	

Aspects are slightly different with Birch Creek flowing northwest and Antelope Creek flowing north and then northwest. However, landuses are very similar, both having shrub/forest grazing lands at higher elevations and dryland farming at lower elevations.

Thus, because no sediment or erosion data are available for Birch Creek, erosion surveys from Antelope Creek will be used as a surrogate loading analysis for Birch Creek. The Palisades Subbasin Assessment and TMDL reported an existing bank stability of 62% and a sediment load for Antelope Creek of 62 tons/mile/year. The loading capacity for that stream was 14.3 tons/miles/year based on an 80% bank stability target. These same loads will be applied to Birch Creek until such time that erosion surveys are complete and more accurate loads can be generated for Birch Creek.

5.3 Estimates of Existing Pollutant Loads

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

There are no known point source discharges in the Birch Creek watershed. Existing nonpoint source load of sediment in Birch Creek is expected to be similar to that of adjacent Antelope Creek as explained in the Loading Capacity section above.

Table 13. Wasteloads from point sources in Birch Creek.

Wasteload Type	Location	Load	NPDES[1] Permit Number
n.a.	n.a.	n.a.	n.a.

[1]National Pollutant Discharge Elimination System

Table 14. Loads from nonpoint sources in Birch Creek.

Wasteload Type	Location	Load	Estimation Method
Sediment Load Reduction Based on Average Annual Loading Rate: tons/mile/year	Birch Creek, headwaters to mouth	62 tons/mile/year	Based on 62% bank stability rating for Antelope Creek TMDL

5.4 Load Allocation

The entire sediment load appropriate for Birch Creek (loading capacity) is dedicated to nonpoint sources of pollution. In this case, those nonpoint sources include natural erosion from streambanks that are at least 80% stable.

Margin of Safety

The margin of safety (MOS) factored into sediment load allocations is implicit. The MOS includes the conservative assumptions used to develop existing sediment loads. Conservative assumptions made as part of the sediment loading analysis include: 1) desired bank erosion rates are representative of assumed natural background conditions; 2) water quality targets for percent depth fines are consistent with values measured and set by local land management agencies based on established literature values and incorporate an adequate level of fry survival to provide for stable salmonid production.

Seasonal Variation

Seasonal variability was built-in to this TMDL by developing sediment loads using annual average rates determined from empirical characteristics that developed over time within the influence of runoff events and peak and base flow conditions. Streambank erosion inventories take into account that most bank recession occurs during peak flow events, when the banks are saturated. The estimated annual average sediment delivery is a function of bankfull discharge. It is assumed that the accumulation of sediment within dry channels is continuous until flow resumes and the accumulated sediment is transported and deposited.

Background

Natural background loading rates are assumed to be the natural sediment loading capacity of 80% or greater streambank stability and 28% or less subsurface fine sediment. Therefore natural background is accounted for in the load capacity.

Reserve

An additional 10% of the LC will be allocated as reserve for future nonpoint source sediment activities. No WLA reserve will be imposed.

If it is determined that full beneficial use support is achieved and standards are being met at sediment loading rates higher that those set forth in this TMDL then the reserve and TMDL will be revised accordingly. Conversely, within a reasonable time after full implementation of best management practices, if it is determined that full beneficial use support is not forthcoming and or standards are not being met then additional best management practices will be required and reserve amounts will need to be re-evaluated.

Table 15. Wasteload point source allocations for Birch Creek.

Source	Pollutant	Allocation	Time Frame for Meeting Allocations
NA	NA	NA	NA

Table 16. Load nonpoint source allocations for Birch Creek.

Source	Current Load	Loading Capacity/Load Allocation	Reduction#
Birch Creek streambank sediment	62 tons/mile/year	14.3 tons/mile/year	-49.2 tons/mile/year (79% reduction)

10% of the LC is held in reserve, thus an additional 1.43 tons/mile/year are required to be reduced.

5.5 Implementation Strategies

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

Time Frame

DEQ is currently working with private landowners to gain access and establish locations for streambank measurements. These data should be compiled before run-off 2005. The Idaho Soil Conservation Commission will also conduct effectiveness monitoring during and after implementation of sediment reductions on Birch Creek. DEQ anticipates an implementation plan within the next 18 months and on the ground projects throughout the next 3 to 5 years. Beneficial use restoration is expected to be complete in 2013.

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

Approach

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

Monitoring Strategy

Streambank erosion inventories are intended for rapid assessment, but will allow for the evaluation of streambank condition in the absence of more rigorous evaluation by established federal land management assessment protocol. Stream subsurface fine sediment should continue to be assessed through McNeil sediment core sampling at established intervals to identify trends toward meeting sediment targets. Beneficial Use Reconnaissance Program monitoring will continue to be conducted by DEQ and should also provide insight regarding steam conditions.

5.6 Conclusions

The Snake River and the South Fork Willow Creek are flow altered systems. The Snake River has often been described as a working river, and that is clear in this subbasin. The Snake River flow is controlled above at Palisades Dam, and there are a number of diversion structures in this subbasin for delivering water to the vast fields of the Snake River plain. Willow Creek on the other hand, was converted to be a canal years ago. Flow only occurs during the irrigation season in portions of the old streambed that have been modified, straightened and rip-rap stabilized.

Birch Creek is also affected by flow, in this case natural flow regimes are very low. Birch Creek flow typically drops below one cubic foot per second during summer months. Birch Creek also terminates in a canal and has flow allocated for agricultural diversion.

There are a number of mechanisms by which the full support of aquatic life can be extended to areas that are marginal due to natural variability of flowing water. An important consideration is to create viable refuge in key tributaries for fish and other aquatic species when the flow regime is naturally altered in mainstream waters. In other cases man manages flow for agricultural production and this management has been the established priority over many years prior to the laws that govern environmental quality. The right to divert water for economic benefit is protected as a property right in the laws of the state of Idaho. The potential synergism between natural and anthropogenic flow alteration can severely limit the potential for fisheries and aquatic life in natural systems. The potential also exists, however, for voluntary and cooperative projects to enhance water quality and aquatic life beneficial uses, while concurrently enhancing the availability of water for economic use. This is the overall optimum scenario that should be sought in areas that are today marginal for both uses.

The direct relationship between stream erosion and stream temperatures is apparent with the coupling of sediment and temperature 303(d) listings. Stream channel migration is a natural process that occurs at a slow rate under conditions of sediment equilibrium. Lateral recession is a natural process accompanied by depositional mechanisms that are balanced in a system that is stable and in equilibrium. Streambank erosion, however, can be accelerated by reducing/eliminating riparian vegetation and the detachment of bank material (clumping and sloughing), all of which disrupt the natural stream system contributing to elevated stream sediment and elevation of stream temperature.

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Glossary

305(b)	Refers to section 305 subsection "b" of the Clean Water Act. 305(b) generally describes a report of each state's water quality, and is the principle means by which the U.S. Environmental Protection Agency, Congress, and the public evaluate whether U.S. waters meet water quality standards, the progress made in maintaining and restoring water quality, and the extent of the remaining problems.
§303(d)	Refers to section 303 subsection "d" of the Clean Water Act. 303(d) requires states to develop a list of 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.
Acre-Foot	A volume of water that would cover an acre to a depth of one foot. Often used to quantify reservoir storage and the annual discharge of large rivers.
Adsorption	The adhesion of one substance to the surface of another. Clays, for example, can adsorb phosphorus and organic molecules
Aeration	A process by which water becomes charged with air directly from the atmosphere. Dissolved gases, such as oxygen, are then available for reactions in water.
Aerobic	Describes life, processes, or conditions that require the presence of oxygen.
Assessment Database (ADB)	The ADB is a relational database application designed for the U.S. Environmental Protection Agency for tracking water quality assessment data, such as use attainment and causes and sources of impairment. States need to track this information and many other types of assessment data for thousands of 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.
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).
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.
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.

Clean Water Act (CWA) The Federal Water Pollution Control Act (commonly known as as the Clean Water Act), as last reauthorized by the Water Quality Act of 1987, establishes a process for states to use to develop information on, and control the quality of, the nation's water resources.

Coliform Bacteria A group of bacteria predominantly inhabiting the intestines of humans and animals but also found in soil. Coliform bacteria are commonly used as indicators of the possible presence of pathogenic organisms (also see Fecal Coliform Bacteria).

Colluvium Material transported to a site by gravity.

Community A group of interacting organisms living together in a given place.

Conductivity The ability of an aqueous solution to carry electric current, expressed in micro (μ) mhos/cm at 25 °C. Conductivity is affected by dissolved solids and is used as an indirect measure of total dissolved solids in a water sample.

Cretaceous The final period of the Mesozoic era (after the Jurassic and before the Tertiary period of the Cenozoic era), thought to have covered the span of time between 135 and 65 million years ago.

Criteria In the context of water quality, numeric or descriptive factors taken into account in setting standards for various pollutants. These factors are used to determine limits on allowable concentration levels, and to limit the number of violations per year. 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.
Ecology	The scientific study of relationships between organisms and their environment; also defined as the study of the structure and function of nature.
Ecological Indicator	A characteristic of an ecosystem that is related to, or derived from, a measure of a biotic or abiotic variable that can provide quantitative information on ecological structure and function. An indicator can contribute to a measure of integrity and sustainability. Ecological indicators are often used within the multimetric index framework.
Ecological Integrity	The condition of an unimpaired ecosystem as measured by combined chemical, physical (including habitat), and biological attributes (EPA 1996).
Ecosystem	The interacting system of a biological community and its non-living (abiotic) environmental surroundings.
Effluent	A discharge of untreated, partially treated, or treated wastewater into a receiving waterbody.
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. 2002).
Fully Supporting Cold Water	Reliable data indicate functioning, sustainable cold water biological assemblages (e.g., fish, macroinvertebrates, or algae), none of which have been modified significantly beyond the natural range of reference conditions (EPA 1997).
Fully Supporting but Threatened	An intermediate assessment category describing 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.
Hydrologic Basin	The area of land drained by a river system, a reach of a river and its tributaries in that reach, a closed basin, or a group of streams forming a drainage area (also see Watershed).

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

Key Watershed	A watershed that has been designated in Idaho Governor Batt's *State of Idaho Bull Trout Conservation Plan* (1996) as critical to the long-term persistence of regionally important trout populations.
Knickpoint	Any interruption or break of slope.
Land Application	A process or activity involving application of wastewater, surface water, or semi-liquid material to the land surface for the purpose of treatment, pollutant removal, or ground water recharge.
Limiting Factor	A chemical or physical condition that determines the growth potential of an organism. This can result in a complete inhibition of growth, but typically results in less than maximum growth rates.
Limnology	The scientific study of fresh water, especially the history, geology, biology, physics, and chemistry of lakes.
Load Allocation (LA)	A portion of a waterbody's load capacity for a given pollutant that is given to a particular nonpoint source (by class, type, or geographic area).
Load(ing)	The quantity of a substance entering a receiving stream, usually expressed in pounds or kilograms per day or tons per year. Loading is the product of flow (discharge) and concentration.
Loading Capacity (LC)	A determination of how much pollutant a 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 500µm mesh (U.S. #30) screen.

Macrophytes	Rooted and floating vascular aquatic plants, commonly referred to as water weeds. These plants usually flower and bear seeds. Some forms, such as duckweed and coontail (*Ceratophyllum sp.*), are free-floating forms not rooted in sediment.
Margin of Safety (MOS)	An implicit or explicit portion of a 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.
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. 2002).
Not Fully Supporting Cold Water	At least one biological assemblage has been significantly modified beyond the natural range of its reference condition (EPA 1997).
Nuisance	Anything which is injurious to the public health or an obstruction to the free use, in the customary manner, of any waters of the state.
Nutrient	Any substance required by living things to grow. An element or its chemical forms essential to life, such as carbon, oxygen, nitrogen, and phosphorus. Commonly refers to those elements in short supply, such as nitrogen and phosphorus, which usually limit growth.
Nutrient Cycling	The flow of nutrients from one component of an ecosystem to another, as when macrophytes die and release nutrients that become available to algae (organic to inorganic phase and return).
Oligotrophic	The Greek term for "poorly nourished." This describes a body of water in which productivity is low and nutrients are limiting to algal growth, as typified by low algal density and high clarity.
Organic Matter	Compounds manufactured by plants and animals that contain principally carbon.

Orthophosphate A form of soluble inorganic phosphorus most readily used for algal growth.

Oxygen-Demanding Materials Those materials, mainly organic matter, in a waterbody that consume oxygen during decomposition.

Parameter A variable, measurable property whose value is a determinant of the characteristics of a system, such as temperature, dissolved oxygen, and fish populations are parameters of a stream or lake.

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

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

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

Periphyton Attached microflora (algae and diatoms) growing on the bottom of a 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, wasteload allocations, and the margin of safety is planned at the outset.

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

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

Plankton	Microscopic algae (phytoplankton) and animals (zooplankton) that float freely in open water of lakes and oceans.
Point Source	A source of pollutants characterized by having a discrete conveyance, such as a pipe, ditch, or other identifiable “point” of discharge into a receiving water. Common point sources of pollution are industrial and municipal wastewater.
Pollutant	Generally, any substance introduced into the environment that adversely affects the usefulness of a resource or the health of humans, animals, or ecosystems.
Pollution	A very broad concept that encompasses human-caused changes in the environment which alter the functioning of natural processes and produce undesirable environmental and health effects. This includes human-induced alteration of the physical, biological, chemical, and radiological integrity of water and other media.
Population	A group of interbreeding organisms occupying a particular space; the number of humans or other living creatures in a designated area.
Pretreatment	The reduction in the amount of pollutants, elimination of certain pollutants, or alteration of the nature of pollutant properties in wastewater prior to, or in lieu of, discharging or otherwise introducing such wastewater into a publicly owned wastewater treatment plant.
Primary Productivity	The rate at which algae and macrophytes fix carbon dioxide using light energy. Commonly measured as milligrams of carbon per square meter per hour.
Protocol	A series of formal steps for conducting a test or survey.
Qualitative	Descriptive of kind, type, or direction.
Quality Assurance (QA)	A program organized and designed to provide accurate and precise results. Included are the selection of proper technical methods, tests, or laboratory procedures; sample collection and preservation; the selection of limits; data evaluation; quality control; and personnel qualifications and training. The goal of QA is to assure the data provided are of the quality needed and claimed (Rand 1995, EPA 1996).
Quality Control (QC)	Routine application of specific actions required to provide information for the quality assurance program. Included are standardization, calibration, and replicate samples. QC is implemented at the field or bench level (Rand 1995, EPA 1996).
Quantitative	Descriptive of size, magnitude, or degree.
Reach	A stream section with fairly homogenous physical characteristics.

Reconnaissance An exploratory or preliminary survey of an area.

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

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

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

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.

Sediments Deposits of fragmented materials from weathered rocks and organic material that were suspended in, transported by, and eventually deposited by water or air.

Settleable Solids	The volume of material that settles out of one liter of water in one hour.
Species	1) A reproductively isolated aggregate of interbreeding organisms having common attributes and usually designated by a common name. 2) An organism belonging to such a category.
Spring	Ground water seeping out of the earth where the water table intersects the ground surface.
Stagnation	The absence of mixing in a waterbody.
Stenothermal	Unable to tolerate a wide temperature range.
Stratification	A Department of Environmental Quality classification method used to characterize comparable units (also called classes or strata).
Stream	A natural water course containing flowing water, at least part of the year. Together with dissolved and suspended materials, a stream normally supports communities of plants and animals within the channel and the riparian vegetation zone.
Stream Order	Hierarchical ordering of streams based on the degree of branching. A first-order stream is an unforked or unbranched stream. Under Strahler's (1957) system, higher order streams result from the joining of two streams of the same order.
Storm Water Runoff	Rainfall that quickly runs off the land after a storm. In developed watersheds the water flows off roofs and pavement into storm drains that may feed quickly and directly into the stream. The water often carries pollutants picked up from these surfaces.
Stressors	Physical, chemical, or biological entities that can induce adverse effects on ecosystems or human health.
Subbasin	A large watershed of several hundred thousand acres. This is the name commonly given to 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 6^{th} field hydrologic units.
Surface Fines	Sediments of small size deposited on the surface of a streambed or lake bottom. The upper size threshold for fine sediment for fisheries purposes varies from 0.8 to 605 mm depending on the observer and methodology used. Results are typically expressed as a percentage of observation points with fine sediment.

Surface Runoff	Precipitation, snow melt, or irrigation water in excess of what can infiltrate the soil surface and be stored in small surface depressions; a major transporter of nonpoint source pollutants in rivers, streams, and lakes. Surface runoff is also called overland flow.
Surface Water	All water naturally open to the atmosphere (rivers, lakes, reservoirs, streams, impoundments, seas, estuaries, etc.) and all springs, wells, or other collectors that are directly influenced by surface water.
Suspended Sediments	Fine material (usually sand size or smaller) that remains suspended by turbulence in the water column until deposited in areas of weaker current. These sediments cause turbidity and, when deposited, reduce living space within streambed gravels and can cover fish eggs or alevins.
Taxon	Any formal taxonomic unit or category of organisms (e.g., species, genus, family, order). The plural of taxon is taxa (Armantrout 1998).
Tertiary	An interval of geologic time lasting from 66.4 to 1.6 million years ago. It constitutes the first of two periods of the Cenozoic Era, the second being the Quaternary. The Tertiary has five subdivisions, which from oldest to youngest are the Paleocene, Eocene, Oligocene, Miocene, and Pliocene epochs.
Thalweg	The center of a stream's current, where most of the water flows.
Threatened Species	Species, determined by the U.S. Fish and Wildlife Service, which are likely to become endangered within the foreseeable future throughout all or a significant portion of their range.
Total Maximum Daily Load (TMDL)	A TMDL is a 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 + Wasteload Allocation + Margin of Safety. In common usage, a TMDL also refers to the written document that contains the statement of loads and supporting analyses, often incorporating TMDLs for several waterbodies and/or pollutants within a given watershed.
Total Dissolved Solids	Dry weight of all material in solution in a water sample as determined by evaporating and drying filtrate.

Total Suspended Solids (TSS) The dry weight of material retained on a filter after filtration. Filter pore size and drying temperature can vary. American Public Health Association Standard Methods (Greenborg, Clescevi, and Eaton 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.

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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.

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

Waterbody	A stream, river, lake, estuary, coastline, or other water feature, or portion thereof.
Water Column	Water between the interface with the air at the surface and the 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.

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.
Waterbody Identification Number (WBID)	A number that uniquely identifies a waterbody in Idaho ties in to the Idaho Water Quality Standards and GIS information.
Wetland	An area that is at least some of the time saturated by surface or ground water so as to support with vegetation adapted to saturated soil conditions. Examples include swamps, bogs, fens, and marshes.
Young of the Year	Young fish born the year captured, evidence of spawning activity.

Appendix A. Unit Conversion Chart

Table 17. Metric - English unit conversions.

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

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

Appendix B. State and Site-Specific Standards and Criteria

IDAPA 58.01.02. 200.08

> "Sediment shall not exceed quantities specified in sections 250 and 252, or, in the absence of specific sediment criteria, quantities which impair designated beneficial uses. Determination of impairment shall be based on water quality monitoring and surveillance and the information utilized in section 350.02.b."

IDAPA 58.01.02.250.02.e.

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

IDAPA 58.01.02.250.f.i.(1)

> "Interggravel Dissolved Oxygen.
> (a) One (1) day minimum of not less than five point zero (5.0) mg/l.
> (b) Seven (7) day average mean of not less than six point zero (6.0) mg/l."

Quantities specified in Section 250 refer to turbidity criteria identified for cold water biota use and small public domestic water supplies. Turbidity must be measured upstream and downstream from a sediment input in order to determine violation of criteria. Indirectly, specific sediment criteria also include intergravel dissolved oxygen measures for salmonid spawning uses. Intergravels filled with sediment cannot hold enough dissolved oxygen for successful incubation. Intergravel dissolved oxygen measurement requires the placement of special apparatus in spawning gravels. Turbidity and intergravel DO are rarely measured as part of routine reconnaissance-level monitoring and assessment. These measurements are usually conducted in special cases during higher-level investigations of potential problems.

Appendix C. BLM Assessments in the Subbasin

The Bureau of Land Management (BLM) has conducted Riparian and Wetland Research Program (RWRP) Lotic Health Assessment for Large River Systems surveys (see http://rwrp60.rwrp.umt.edu/Lasso/action) on several sections of the Snake River in this subbasin. Below are comments and Proper Functioning Condition ratings from these surveys.

Record ID Number 9800143 (T5N, R38E, Section 22)

Comments: "This polygon starts at the confluence of the Henry's Fork and the South Fork, goes downstream to the Menan Bridge, and includes public land on both banks and islands. Past cottonwood clear cutting and other riparian vegetation removal, pasture development, unauthorized livestock grazing and supplemental feed, and the Menan boat ramp have reduced riparian vegetation, increased bare ground, increased non-native forbs, grasses, and noxious weeds, and impacted river banks. The flood control levee limits natural river dynamics on public land for about one-half mile above the Menan Bridge."

Vegetation Rating: 72% - Functional at Risk (Healthy, but with problems)
Soils/Hydrology: 58% - Nonfunctional (Unhealthy)
Total Rating: 64% - Functional at Risk (Healthy, but with problems)

Record ID Number 9800144 (T5N, R38E, Section 17)

Comments: "This polygon starts at the Menan Bridge, goes to the downstream end of Kellers Island, and includes public land on both banks and islands. The riparian vegetation is degraded in several areas due to unauthorized livestock grazing and supplemental feeding. One area has been cleared. One area has many roads and dispersed camping areas, which are eliminating some riparian vegetation. Noxious weed invasion is widespread and dominates the understory in areas. ATV activity on new gravel bar is eliminating cottonwood seedlings in areas. This polygon was severely impacted by the 1976 Teton Dam Flood, as well as the 1997 flood."

Vegetation Rating: 69% - Functional at Risk (Healthy, but with problems)
Soils/Hydrology: 60% - Functional at Risk (Healthy, but with problems)
Total Rating: 64% - Functional at Risk (Healthy, but with problems)

Record ID Number: 9800145 (T5N, R37E, Section 13)

Comments: "This polygon starts at the downstream end of Kellers Island, goes downstream to the section 14/23 line, and includes public land on both banks and islands. This polygon contains the Deer Park bald eagle winter roost. The riparian vegetation is degraded in several areas due to unauthorized livestock grazing and supplemental feeding. Noxious weed invasion is widespread and dominates the understory in areas.

This polygon was severely impacted by the 1976 Teton Dam Flood as well as the 1997 flood."

Vegetation Rating: 67% - Functional at Risk (Healthy, but with problems)
Soils/Hydrology: 60% - Functional at Risk (Healthy, but with problems)
Total Rating: 63% - Functional at Risk (Healthy, but with problems)

Record ID Number: 9800146 (T5N, R37E, Section 28)

Comments: "This polygon starts at the section 14/23 line, goes downstream to the Roberts Bridge, and includes public land on both banks and islands. This polygon contains one bald eagle nesting territory. Some areas have been cleared of riparian vegetation and overgrazed. These areas are completely infested with noxious weeds. The river in this polygon is one main channel with little bar development. Banks are unconsolidated sands and are highly erodable. This polygon contains the Point Allotment 04390."

Vegetation Rating: 36% - Nonfunctional (Unhealthy)
Soils/Hydrology: 53% - Nonfunctional (Unhealthy)
Total Rating: 46% - Nonfunctional (Unhealthy)

Record ID Number: 9800147 (T5N, R37E, Section 15)

Comments: "This polygon starts at the Roberts Bridge, goes downstream to the confluence with the Butte Market Lake Canal, and includes public land on both banks and islands. The river in this polygon forms one wide, deep channel with eroding sand banks. Even though some banks are armored with willow, the land adjacent to the banks has lots of thistle and knapweed. Public lands in this polygon have a long history of unauthorized grazing, supplemental feeding, and vegetation clearing. Noxious weed infestation is severe throughout the polygon."

Vegetation Rating: 31% - Nonfunctional (Unhealthy)
Soils/Hydrology: 42% - Nonfunctional (Unhealthy)
Total Rating: 37% - Nonfunctional (Unhealthy)

In addition to the Large River Systems, BLM has completed RWRP Lotic Inventory Forms for several smaller streams in the subbasin (Table 11). None of these streams are 303d listed.

Table 11. Proper Functioning Condition (Health) Assessments for selected streams in the Idaho Falls Subbasin.

Name	Record ID	Scores*		
Cress Creek	9800111 (T4N,R40E, Section 23)	Vegetation	83%	PFC
		Soil/Hydrology	67%	FAR
		Total	73%	FAR
Kelly (Canyon) Creek	9800109 (T4N,R41E, Section 32)	Vegetation	63%	FAR
		Soil/Hydrology	24%	NF
		Total	38%	NF
Kelly (Canyon) Creek	9800108 (T4N,R41E, Section 32)	Vegetation	75%	FAR
		Soil/Hydrology	62%	FAR
		Total	67%	FAR
Kelly (Canyon) Creek	9800107 (T4N,R41E, Section 32)	Vegetation	79%	FAR
		Soil/Hydrology	52%	NF
		Total	62%	FAR
Little Kelly Creek	9800106 (T4N,R41E, Section 29)	Vegetation	79%	FAR
		Soil/Hydrology	52%	NF
		Total	62%	FAR
Little Kelly Creek	9800105 (T4N,R41E, Section 29)	Vegetation	75%	FAR
		Soil/Hydrology	52%	NF
		Total	61%	FAR
Henry Creek	9600034 (T1S,R39E, Section 4)	Vegetation	63%	FAR
		Soil/Hydrology	76%	FAR
		Total	71%	FAR
Henry Creek	9600033 (T1S,R39E, Section 4)	Vegetation	71%	FAR
		Soil/Hydrology	43%	NF
		Total	53%	NF
Dry Fork of Henry Creek	9600032 (T1S,R39E, Section 7)	Vegetation	83%	PFC
		Soil/Hydrology	52%	NF
		Total	64%	FAR
Dry Fork of Henry Creek	9600031 (T1S,R39E, Section 7)	Vegetation	76%	FAR
		Soil/Hydrology	100%	PFC
		Total	81%	PFC
Dry Fork of Henry Creek	9600030 (T1S,R39E, Section 20)	Vegetation	88%	PFC
		Soil/Hydrology	71%	FAR
		Total	77%	FAR

*PFC = Proper Functioning Condition (Healthy)
FAR = Functioning At Risk (Healthy, but with Problems)
NF = Nonfunctional (Unhealthy)

Appendix D. Photographs

Photo B-1. Birch Creek watershed above main road. T3N, R41E, section 34

Photo B-2. Birch Creek downstream view from Photo #1.

Photo B-3. Birch Creek downstream view near beginning of dryland farming.

Photo B-4. Birch Creek downstream view upper dryland farming area.

Photo B-5. Birch Creek streambed at road crossing (T3N, R41E, section 32).

Photo B-6. Birch Creek downstream view in dryland farming area.

Photo B-7. Birch Creek in dryland farming area evidence of bank sloughing.

Photo B-8. Birch Creek channel view in dryland farming area.

Photo B-9. Birch Creek evidence of bank sloughing in dryland farming area.

Photo B-10. Birch Creek upstream view lower section near Highway 26 (T3N, R40E, section 11).

Photographs of Willow Creek – July 2001

Photo C-1. Willow Creek canal upstream view of confluence of Ririe Reservoir flow (right) and Eagle Rock Canal (left) (T3N, R40E, section 7).

Photo C-2. Willow Creek Canal downstream view from Photo #1.

Photo C-3. Willow Creek Canal upstream view above Sand Creek Canal diversion (T3N, R39E, section 21).

Photo C-4. Floodway downstream view below diversion from Willow Creek Canal.

Photo C-5. Willow Creek Canal below floodway diversion.

Photo C-6. Willow Creek Canal downstream view above North Fork-South Fork split.

Photo C-7. North Fork Willow Creek Canal downstream view (T3N, R38E, section 33).

Photo C-8. South Fork Willow Creek Canal near Photo #7.

Photo C-9. North Fork Willow Creek Canal (dry) in Russ Freeman Park near confluence with the Snake River.

Photo C-10. South Fork Willow Creek Canal (dry) in the City of Idaho Falls near confluence with the Snake River.

Photographs of South Fork Snake River Diversions – July 2001

Photo D-1. South Fork Snake River above Eagle Rock Canal diversion.

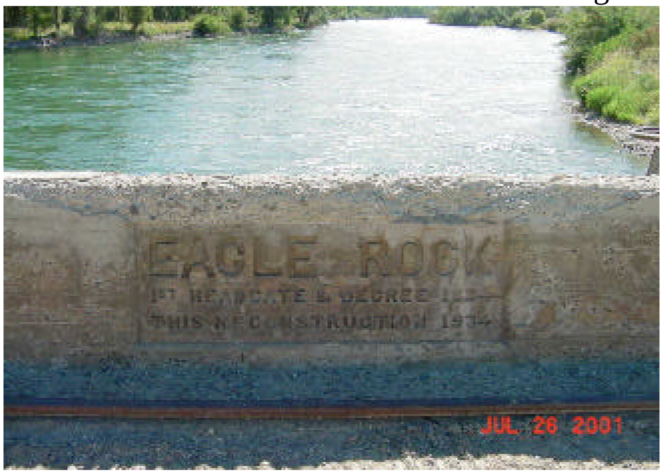
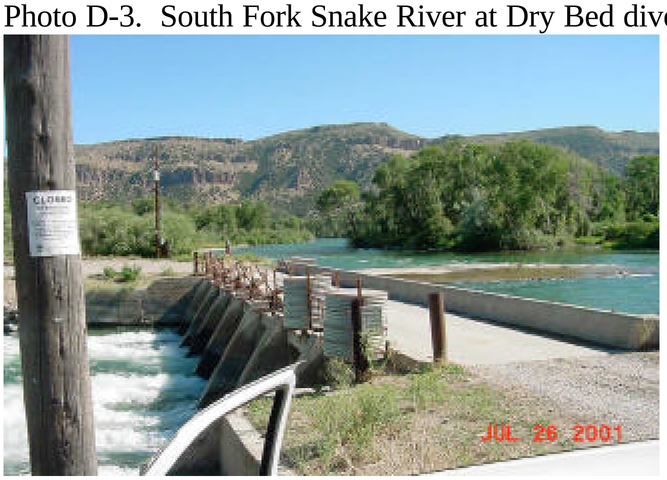


Photo D-2. South Fork Snake River downstream view below Eagle Rock Canal diversion.

Photo D-3. South Fork Snake River at Dry Bed diversion.



Appendix E. BURP Assessments

Table E-1. Macroinvertebrate Indices for BURP Sites in the Idaho Falls Subbasin.

BURPID	STREAM	ECOREGION	DATE SAMPLING	HUC	Total Abundance	Taxa Richness	% Domce Top Taxa	% Domnce Top 3
1994SIDFA011	BIRCH CREEK	SRB/HD	07/05/1994	17040201	953	26	27.18	67.16
1994SIDFA012	BIRCH (L)	SRB/HD	07/05/1994	17040201	311	17	71.7	84.24
1996SIDFZ035	KELLY CANYON CREEK	MIDDLE ROCKIES	06/20/1996	17040201	557	27	25.67	53.32
1997SIDFM009	KELLY CANYON CREEK	MIDDLE ROCKIES	06/16/1997 8:48	17040201	59	10	40.68	74.58

BURPID	STREAM	% Scrapers	% EPT	Sum EPT Taxa	HBI	H'	% Ephem	% Plec
1994SIDFA011	BIRCH CREEK	18.05	23.82	11	3.95	0.89	19.31	0.42
1994SIDFA012	BIRCH (L)	7.07	4.82	2	4.99	0.53	2.25	0
1996SIDFZ035	KELLY CANYON CREEK	57.81	54.4	11	3.58	1.04	32.68	12.39
1997SIDFM009	KELLY CANYON CREEK	49.15	55.93	4	4.71	0.75	49.15	0

BURPID	STREAM	Count Ephem Taxa	Count Plec Taxa	Count Trich Taxa	Sum Obligate CWB	% Obligate CWB	# Clinger Taxa	# Long Lived Taxa
1994SIDFA011	BIRCH CREEK	3	3	5	1	0.31	8	4
1994SIDFA012	BIRCH (L)	1	0	1	0	0	3	3
1996SIDFZ035	KELLY CANYON CREEK	3	2	6	0	0	14	10
1997SIDFM009	KELLY CANYON CREEK	2	0	2	0	0	2	3

BURPID	STREAM	% Clingers	% Long Lived	# Elmidae Taxa	# Predator Taxa	% Elmidae	% Predator	# Scrapers Taxa
1994SIDFA011	BIRCH CREEK	7.03	17.84	2	6	23.5	5.04	3
1994SIDFA012	BIRCH (L)	6.75	5.79	2	3	4.18	2.25	4
1996SIDFZ035	KELLY CANYON CREEK	53.5	58.53	6	5	25.31	13.29	7
1997SIDFM009	KELLY CANYON CREEK	13.56	45.76	0	3	0	10.17	2

BURPID	STREAM	MBI	SMI	Draft Temp Index
1994SIDFA011	BIRCH CREEK	3.73	47.19	4.94
1994SIDFA012	BIRCH (L)	1.98	26.24	4
1996SIDFZ035	KELLY CANYON CREEK	4.84	57.91	5.13
1997SIDFM009	KELLY CANYON CREEK	3.55	20.7	5.29

Table E-2. Habitat Indices for BURP Sites in the Idaho Falls Subbasin.

BURPID	STREAM	ECOREGION	DATESAMPLING	HUC	TYPE HAB	POOL SUB	STREAM CO	EM BED	
1994SIDFA011	BIRCH CREEK	SRB/HD	12:00:00 AM	17040201	R	0	4	3	
1994SIDFA012	BIRCH (L)	SRB/HD	12:00:00 AM	17040201	R	0	5	1	
1996SIDFZ035	KELLY CANYON CREEK	MIDDLE ROCKIES	12:00:00 AM	17040201	R	0	7	2	
1997SIDFM009	KELLY CANYON CREEK	MIDDLE ROCKIES	12:00:00 AM	17040201	R	0	8	6	
BURPID	STREAM	POOL VAR	DIS PRES	ZONE INFL	% FINES	VELDEP SCORE	POOLRIFFLE SCORE	WDRATIO SCORE	BANKCOVER SCORE
1994SIDFA011	BIRCH CREEK	0	3	2	3	15	3	15	6
1994SIDFA012	BIRCH (L)	0	7	4	10	5	0	15	5
1996SIDFZ035	KELLY CANYON CREEK	0	4	3	10	9	0	15	5
1997SIDFM009	KELLY CANYON CREEK	0	9	7	7	15	4	12	3
BURPID	STREAM	BANKSTAB SCORE	CANOPY SCORE	SINU SCORE	C SHAPE	Total HAB Score	Wolman	LOD	SHI
1994SIDFA011	BIRCH CREEK	6	0	10	2	69	6	10	39
1994SIDFA012	BIRCH (L)	0	7	0	2	60	0	10	51
1996SIDFZ035	KELLY CANYON CREEK	7	9	10	3	76	0	5	48
1997SIDFM009	KELLY CANYON CREEK	2	10	2	6	94	5	4	65

Table E-3. Stream Characteristics of BURP Sites in the Idaho Falls Subbasin.

BURPID	Stream Name	Map Elevation	Stream Gradient	Rosgen Code	Stream Order	Sinuosity	Left Bank %Stable	Covered %Unstable	Left Bank %Stable	Uncovered %Unstable	Right Bank %Stable	Covered %Unstable	Right Bank %Stable	Uncovered %Unstable
1994SIDFA011	BIRCH CREEK	1883.6	0.04		2	Moderate	80	10	10	0	60	10	0	30
1994SIDFA012	BIRCH (L)	1621	4				5	70	5	20	5	75	5	15
1996SIDFZ035	KELLY CANYON CREEK	1584	4	B	1	Moderate	77	0	5	18	70	0	6	24
1997SIDFM009	KELLY CANYON CREEK	1624.5	4.5	A	2	Low	40	34	11	15	24	17	14	45

Appendix F. Distribution List

All state and federal resource agencies were notified of online posting of TMDL. Additionally, hard copies were provided to the South Fork Snake River Watershed Advisory Group and the Idaho Falls Public Library. The public was notified through published public notice.

Appendix G. Public Comments

A public comment period, published in local newspapers and on DEQ's website, was conducted from June 28, 2004 to August 9, 2004. Public meetings were held on June 24, 2004 in front of the South Fork Snake River Watershed Advisory Group, and on July 8, 2004 at the DEQ Regional Office building in Idaho Falls. The Document was available online at DEQ's website, at the DEQ regional office in Idaho Falls, and at the Idaho Falls Public Library. Comments were received from US EPA on August 5, 2004. Those comments are available for review at the DEQ Idaho Falls Regional Office during normal business hours. No other comments were received on the proposal.