FINAL

BEAR RIVER/MALAD RIVER SUBBASIN ASSESSMENT AND TOTAL MAXIMUM DAILY LOAD PLAN

for HUCs 16010102, 16010201, 16010202, 16010204

Submitted by:
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Abbreviations

BMP .... best management practice
cfs .... cubic feet per second
GIS .... geographical information system
HUC .... hydrologic unit code
kg/day .... kilograms per day
LBR .... Lower Basin Runoff
mg/L .... milligrams per liter
MR .... Management Reach
NPDES .... National Pollutant Discharge Elimination System
Rm .... river mile
RW .... Receiving Waters Reach
SBF .... Summer Base Flow
TDS .... total dissolved solids
TMDL .... total maximum daily load
TP .... total phosphorus
TSS .... total suspended solids
UBR .... Upper Basin Runoff
WBF .... Winter Base Flow
WWTP .... waste water treatment plant

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Cross Reference for Water Body Identification

(NOTE: assessment units may include more than the specified water body.)

HUC	Water body	Water quality limited segment boundary		Water quality standards unit	Water quality limited segment number	Assessment unit
		Upper	Lower			
16010102	Bear River	Wyoming border	Railroad bridge (T14N, R45E, Sec 21)	B-1	2273	BR001_05
	Thomas Fork	Wyoming border	Bear River	B-3	2274	BR003_04
	Dry Creek	Headwaters	Thomas Fork	B-5	2276	BR001_02; BR005_02, 02a
	Preuss Creek	Forest Service boundary	Thomas Fork	B-6	2275	BR006_02
	Pegram Creek			B-2		BR002_02, 03; BR001_02
	Sheep Creek			B-8		BR008_02, 03
16010201	Bear River	Railroad bridge (T14N, R45E, Sec 21)	Wardboro	B-2	2273	BR001_0L; BR002_05
	Bear River	Wardboro	Alexander Reservoir	B-2	2253	BR002_05, 06
	Alexander Reservoir			B-1	2252	BR001_0L
	St. Charles Creek	Lower Idaho Dept of Lands boundary	Refuge	B-16	2268	BR016_03, 03b
	Paris Creek			B-13		BR013_02, 02b
	Sleight Canyon					BR013_02a
	Indian Creek					BR018_0La
	Bear River old channel					BR002_05
	Little Beaver Creek					BR020_02a
	Snowslide Canyon	Headwaters	Montpelier Creek	B-21	2265	BR021_02; BR020_02f
	Ovid Creek	Confluence North & Mill creeks	Bear River	B-9	2261	BR009_04
	North Creek	Unnamed trib 3.2 km bel Mill Hollow	Ovid Creek	B-10	5251	BR010_02d, 03
	Meadow Creek	Headwaters	North Creek		5121	BR010_02c
	Liberty Creek					BR011_02a
	Georgetown Creek			B-22		BR022_02b, 03a
	Stauffer Creek			B-6		BR006_02c, 02d, 03
	Co-Op Creek	Forest Service boundary	Stauffer Creek	B-8	2259	BR008_02, 02a; BR007_02
	Skinner Creek			B-7		BR007_02a; BR002_02c
	Pearl Creek	North Fork Pearl Creek	Bear River	B-5	2257	BR005_02, 02a
	Eightmile Creek			B-4		BR004_02, 03, 03a
	Wilson Creek					BR004_02a
	Sulpher Canyon Creek					BR002_02a
	Bailey Creek			B-3		BR003_02, 02a
	Soda Creek			B-23, -25		BR025_02; BR024_02; BR023_02a, 02b

HUC	Water body	Water quality limited segment boundary		Water quality standards unit	Water quality limited segment number	Assessment unit
		Upper	Lower			
16010202	Bear River	Alexander Reservoir	Cove Power Plant	B-9	2236	BR009_06
	Bear River	Cove Power Plant	Oneida Dam	B-9	2235	BR009_06, 06a
	Bear River	Oneida Dam	Mink Creek	B-6	2233	BR006_06
	Bear River	Mink Creek	Highway 91	B-6	2232	BR006_06
	Bear River	Highway 91	Utah border	B-6	2231	BR006_06
	Oneida Narrows Reservoir			B-8	2234	BR008_0L
	Densmore Creek	Headwaters	Bear River	B-13	2249	BR013_02
	Smith Creek					BR009_02a
	Alder Creek					BR009_02b
	Whiskey Creek	Headwaters	Bear River	B-12	2248	BR012_02
	Burton Creek					BR009_02, 02c
	Trout Creek			B-11		BR011_02, 03
	Williams Creek	Right Fork Williams Creek	Bear River	B-10	2246	BR010_02
	Cottonwood Creek:	Tributary 6.4 km upstream	Bear River	B-14	2245	BR014_04
	Mink Creek			B-7		BR007_02, 03
	Strawberry Creek	Forest Service boundary	Mink Creek		5256	BR007_02
	Battle Creek	Headwaters	Bear River	B-15	2240	BR015_02, 03, 04
	Deep Creek	Oxford Slough	Bear River		5252	BR006_02
	Swan Lake Creek			B-18		BR018_02b
	Stockton Creek			B-18		BR018_03a
	Fivemile Creek	Headwaters	Bear River	B-19	5253	BR019_02, 02a
	Weston Creek	Headwaters	Bear River	B-20	2238	BR020_02, 02c, 02d, 03, 04
	Trail Hollow					BR020_02d
	Black Canyon					BR020_02a
	Cub River	Sugar Creek	Utah border	B-2, -3	2237	BR003_03; BR002_04
	Maple Creek	Left Fork Maple Creek	Cub River		5255	BR003_02, 03
	Worm Creek	Glendale Reservoir	Utah border	B-5	5254	BR005_02
	Jenkins Hollow			B-21		BR021_02
	Steel Canyon					BR021_02a

HUC	Water body	Water quality limited segment boundary		Water quality standards unit	Water quality limited segment number	Assessment unit
		Upper	Lower			
16010204	Malad River	Headwaters	Pleasant View	B-12	2285	BR008_02; BR012_02
	Malad River	Pleasant View	Little Malad River	B-12		BR012_02
	Malad River	Little Malad River	Utah border	B-1		BR001_04
	Little Malad River	Headwaters	Malad River	B-8	2292	BR009_02; BR008_02, 04
	Wright Creek	Headwaters	Daniels Reservoir	B-10	2294	BR010_02b, 03, 04
	Dairy Creek	Headwaters	Wright Creek	B-11	5259	BR011_02, 03
	Indian Mill Creek					BR010_02a
	Elkhorn Creek	Forest Service boundary	Little Malad River		5258	BR008_02
	Samaria Creek	Headwaters	Malad River	B-13	2289	BR013_02, 03
	Devil Creek	Devil Creek Reservoir	Malad River	B-2	2290	BR002_02d, 03
	Campbell Creek					BR002_02a
	Evans Creek					BR002_02c
	Deep Creek	Headwaters	Mouth	B-5, -7	5257	BR007_02, 03; BR006_03; BR005_03; BR001_02
	Susan Hollow					BR006_02
	Four Mile Canyon					BR001_02b
	West Cherry Creek					BR001_02c
	Henderson Creek					BR001_02d

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1 Executive Summary

The federal Clean Water Act (CWA) requires that states and tribes restore and maintain the chemical, physical, and biological integrity of the nation's waters. 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 water bodies that are water quality limited (i.e., water bodies that do not meet water quality standards). States and tribes must periodically publish a priority list of impaired waters, currently every two years. For waters identified on this list, states and tribes must develop a total maximum daily load (TMDL) for the pollutants, set at a level to achieve water quality standards. This document addresses the water bodies in the Central Bear, Bear Lake, Middle Bear, and Lower Bear-Malad subbasins 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 Bear Lake Basin located in southeast Idaho. The first part of this document, the subbasin assessment, is an important first step leading to the TMDL. The starting point for this assessment was Idaho's current §303(d) list of water quality limited water bodies. Thirty-nine segments in the Bear River Basin, which includes Central Bear, Bear Lake, Middle Bear, and Lower Bear-Malad subbasins, were listed. The subbasin assessment portion of this document examines current status of §303(d)-listed waters, and defines the extent of impairment and causes of water quality limitation throughout the subbasin. The loading analysis quantifies pollutant sources and allocates responsibility for load reductions needed to return listed waters to a condition of meeting water quality standards.

The Bear River spans over 550 miles, draining a 470,000-acre watershed (Figure 1-1), which encompasses portions of three states. The river's flow and irrigation diversions are under the control of the Bear River Compact and regulated by the Bear River Commission. Water quality within the river falls under the jurisdiction of the states of Idaho, Utah and Wyoming. This investigation focused on the Idaho portion of the Bear River from the Idaho-Wyoming (Rm 267) down to the Idaho-Utah state line (Rm 96.6).

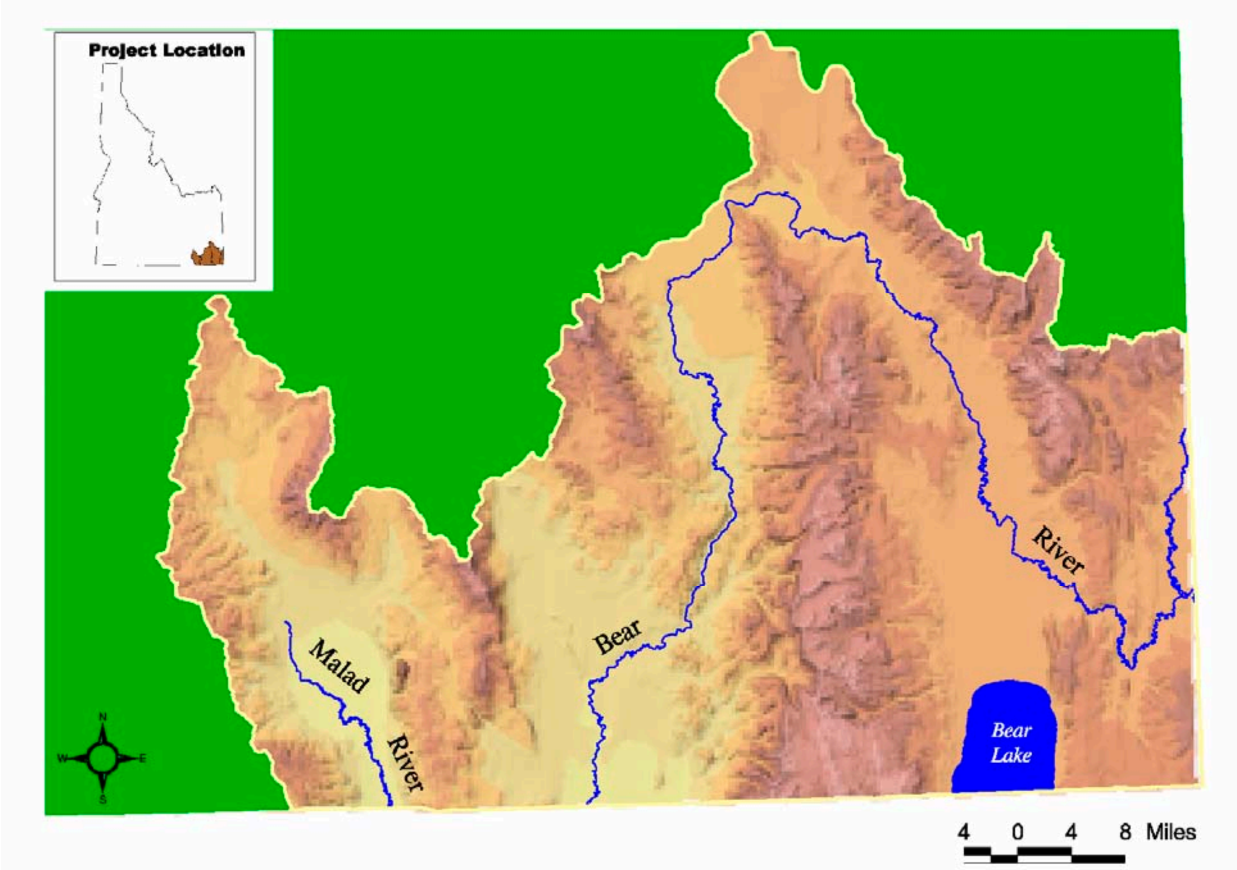

Figure 1-1. Bear River Watershed.

The Bear River Basin encompasses over 2,800 square miles in southeast Idaho (Figure 1-2). Mainstem Bear River is 170 miles long and Malad River is 42 miles in length. Although part of Bear River Basin, Malad River does not enter Bear River in Idaho. The Basin supports both dryland and irrigated agriculture, and livestock grazing. Mining was also present historically. Major urban areas include Montpelier, Soda Springs, Grace, Preston, and Malad. Bear Lake, straddling the Idaho-Utah border, is a major water body in the Basin. Mainstem Bear River reservoirs include both Alexander and Oneida Narrows.

There are five subbasins that make up Bear River Basin in Idaho (Figure 1-3). These include: Central Bear (HUC #16010102); Bear Lake ((HUC #16010201); Middle Bear (HUC #16010202); Little Bear-Logan (HUC #16010203); and, Lower Bear-Malad (HUC #16010204). There are no §303(d)-listed water bodies in the Little Bear-Logan subbasin. (These subbasins are shown in Figure 1-4 through Figure 1-8.)

Historically, Bear River water bodies sustained several beneficial uses (Table 1-1) streams supported coldwater aquatic life and agriculture water supply as well as secondary contact recreation, with the larger streams also supporting primary contact recreation.

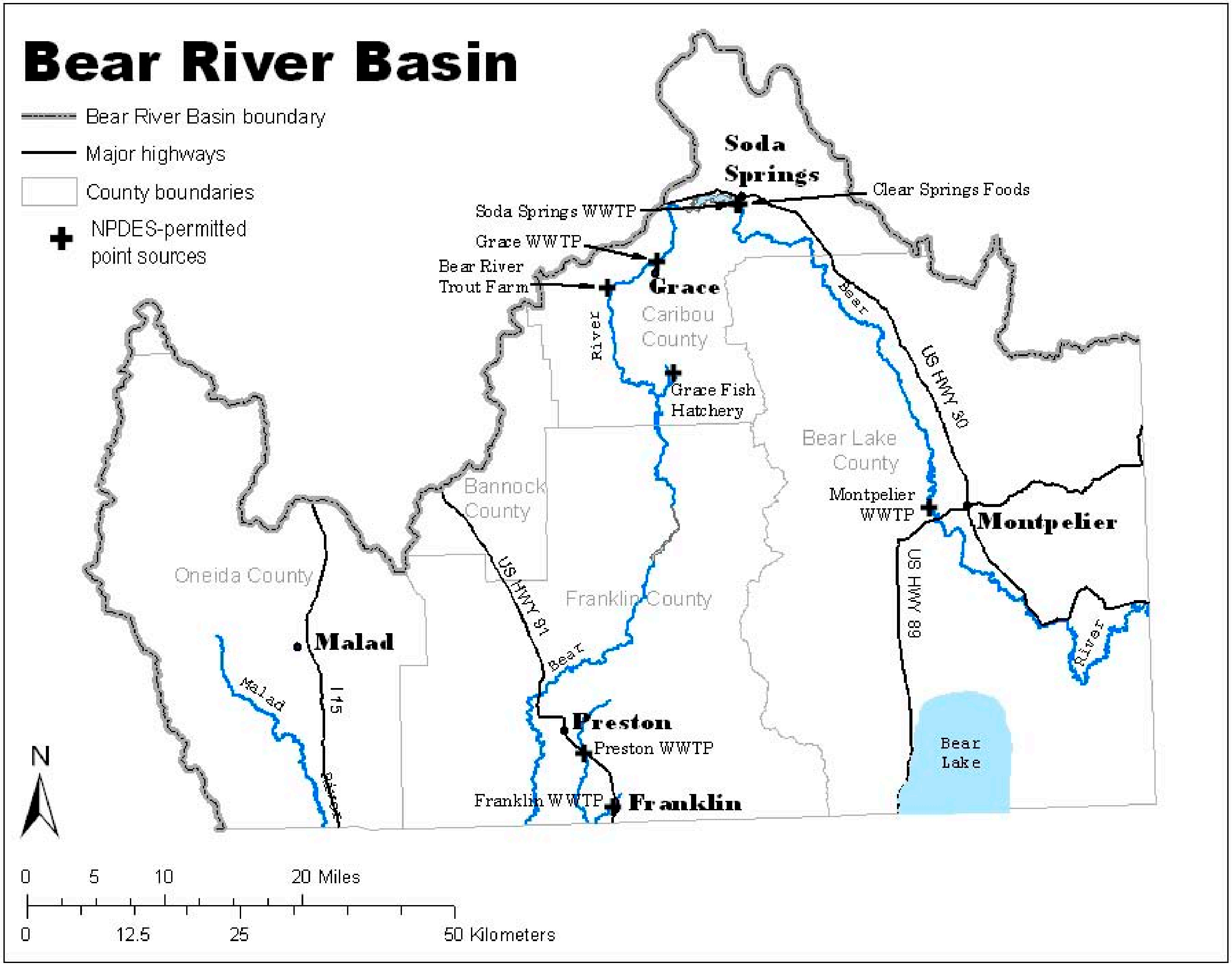

Figure 1-2. Bear River Basin in Idaho.

Table 1-1. Bear River Basin 303(d)-listed water bodies and their respective beneficial uses.

HUC#	Water body	Water quality limited segment boundary		Riverine management reach	Listed pollutants[1]	Beneficial uses[2]									
		Upper	Lower			ND	CWAL	SS	PCR	SCR	DWS	AWS	IWS	WH	Ae
16010102	Bear River	Wyoming border	Wardboro	MR1	Flow, Nut, Sed		D	D	D			A	A	A	A
	Thomas Fork	Wyoming border	Bear River		Nut, Sed		D	D	D			A	A	A	A
	Dry Creek	Headwaters	Thomas Fork		Nut, Sed		D	D		D		A	A	A	A
	Preuss Creek	Forest Service boundary	Thomas Fork		Habitat, Sed		D	D		D		A	A	A	A
16010201	Bear River	Wardboro	Alexander Reservoir	MR1, MR2	Nut, Sed		D	D	D			A	A	A	A
	Alexander Reservoir				Sed		D	D	D			A	A	A	A
	Snowslide Canyon	Headwaters	Montpelier Creek		Sed	X	P			P		A	A	A	A
	St. Charles Creek	Lower Idaho Dept of Lands boundary	Refuge		Nut, Sed	X	P	E		P		A	A	A	A
	Ovid Creek	Confluence North & Mill creeks	Bear River		Sed	X	P			P		A	A	A	A
	North Creek	Unnamed trib 3.2 km blw Mill Hollow	Ovid Creek		Unknown	X	P			P		A	A	A	A
	Meadow Creek	Headwaters	North Creek		Metals Unk, Sed	X	P			P		A	A	A	A
	Co-Op Creek	Forest Service boundary	Stauffer Creek		Nut, Sed		D	D		D		A	A	A	A
	Pearl Creek	North Fork Pearl Creek	Bear River		Nut, Sed		D	D		D		A	A	A	A
16010202	Bear River	Alexander Reservoir	Cove Power Plant	MR3	Flow		D	D	D			A	A	A	A
	Bear River	Cove Power Plant	Oneida Dam	MR3	Flow, Nut, Sed		D	D	D			A	A	A	A
	Bear River	Oneida Dam	Mink Creek	MR4	Nut, Sed		D	D	D			A	A	A	A
	Bear River	Mink Creek	Highway 91	MR4	Flow, Nut, Sed		D	D	D			A	A	A	A
	Bear River	Highway 91	Utah border	MR4	Flow, Sed		D	D	D			A	A	A	A
	Oneida Narrows Reservoir				Sed		D	D	D			A	A	A	A
	Densmore Creek	Headwaters	Bear River		Nut, Sed	X	P			P		A	A	A	A
	Whiskey Creek	Headwaters	Bear River		Nut, Sed	X	P			P		A	A	A	A
	Williams Creek	Right Fork Williams Creek	Bear River		Nut, Sed	X	P	E		P		A	A	A	A
	Cottonwood Creek	Tributary 6.4 km upstream	Bear River		Sed	X	P			P		A	A	A	A
	Strawberry Creek	Forest Service boundary	Mink Creek		Unknown	X	P			P		A	A	A	A
	Battle Creek	Headwaters	Bear River		Nut, Sed		D			D		A	A	A	A
	Deep Creek	Oxford Slough	Bear River		Unknown	X	P			P		A	A	A	A
	Fivemile Creek	Headwaters	Bear River		Unknown	X	P			P		A	A	A	A

Table 1-1, continued															
HUC#	Water body	Water quality limited segment boundary		Riverine management reach	Listed pollutants[1]	Beneficial uses[2]									
		Upper	Lower			ND	CWAL	SS	PCR	SCR	DWS	AWS	IWS	WH	Ae
16010202	Weston Creek	Headwaters	Bear River		Flow, Nut, Sed	X	P			P		A	A	A	A
	Cub River	Sugar Creek	Utah border		Flow, Nut, Sed		D	E	D	D	D	A	A	A	A
	Maple Creek	Left Fork Maple Creek	Cub River		Bact, Unknown	X	P	E		P		A	A	A	A
	Worm Creek	Glendale Reservoir	Utah border		Unknown		D			D		A	A	A	A
16010204	Malad River	Headwaters	Utah border[3]		Sed		D		D		D	A	A	A	A
	Little Malad River	Headwaters	Malad River		Sed		D		D			A	A	A	A
	Wright Creek	Headwaters	Daniels Reservoir		Sed		D	D	D			A	A	A	A
	Dairy Creek	Headwaters	Wright Creek		Unknown	X	P			P		A	A	A	A
	Elkhorn Creek	Forest Service boundary	Little Malad River		Unknown	X	P			P		A	A	A	A
	Samaria Creek	Headwaters	Malad River		Nut, Sed	X	P			P		A	A	A	A
	Devil Creek	Devil Creek Reservoir	Malad River		Nut, Sed	X	P			P		A	A	A	A
	Deep Creek	Headwaters	Mouth		Unknown	X	P			P		A	A	A	A

(1)Bact: bacteria; DO: dissolved oxygen; Flow: flow alteration; Habitat: habitat alteration; Metals Unk: metals unknown; Nut: nutrients; Sed: sediment.
(2)ND=Non-designated; CWAL=Coldwater Aquatic Life; SS=Salmonid Spawning; PCR=Primary Contact Recreation; SCR=Secondary Contact Recreation; DWS=Domestic Water Supply; AWS=Agricultural Water Supply; IWS=Industrial Water Supply; WH=Wildlife Habitat; Ae=Aesthetics; D=designated in State Water Quality Standards; A=applies to all surface waters; P=use not designated so presumed to support use; E=existing use.
(3)downstream boundary originally listed as Pleasant View even though stream miles for the reach listed at 30.62 miles, which would be headwaters to Utah border. In addition, Idaho needs to comply with Utah targets at the border, so entire mainstem was evaluated.

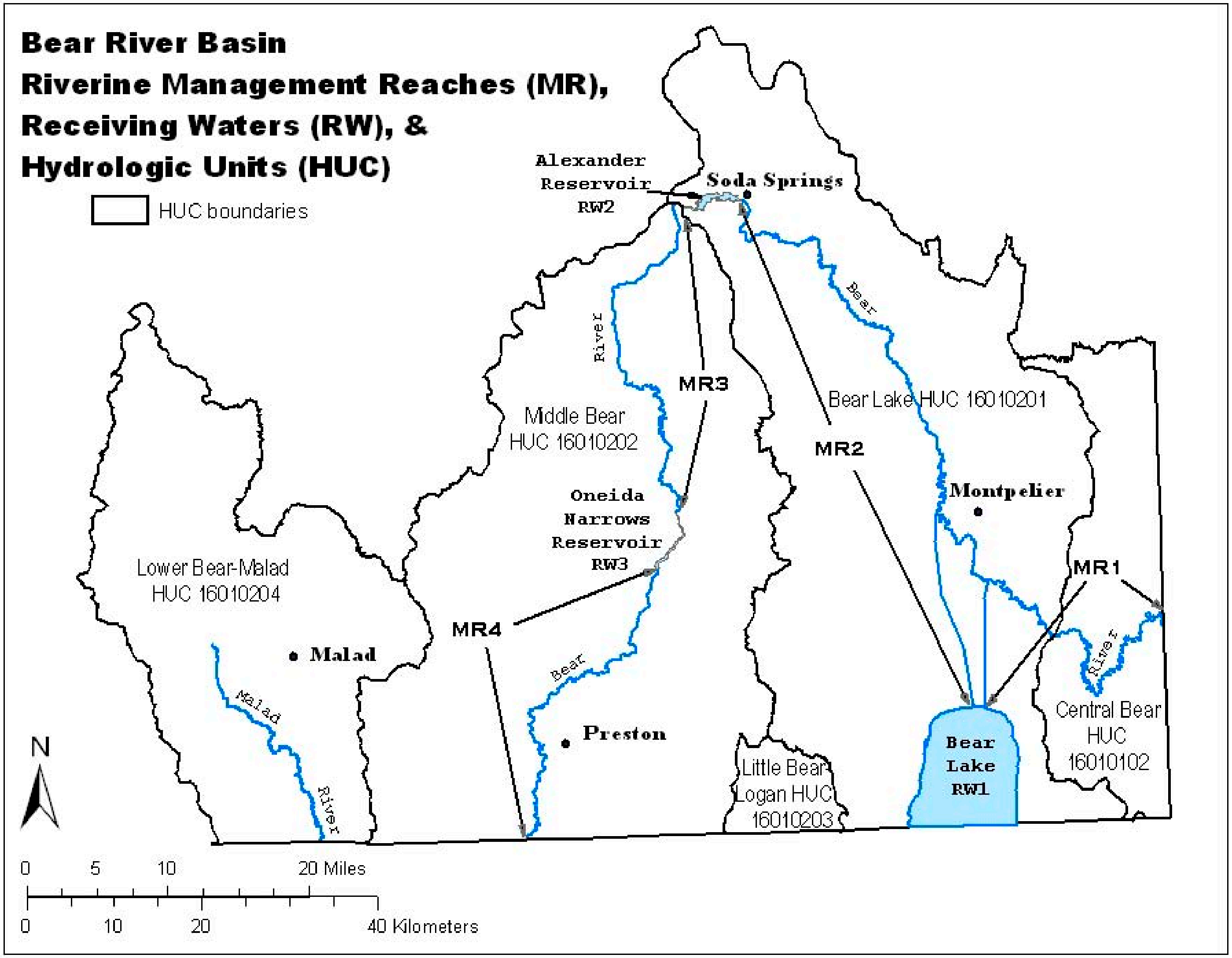

Figure 1-3. Hydrologic features of Bear River Basin in Idaho.

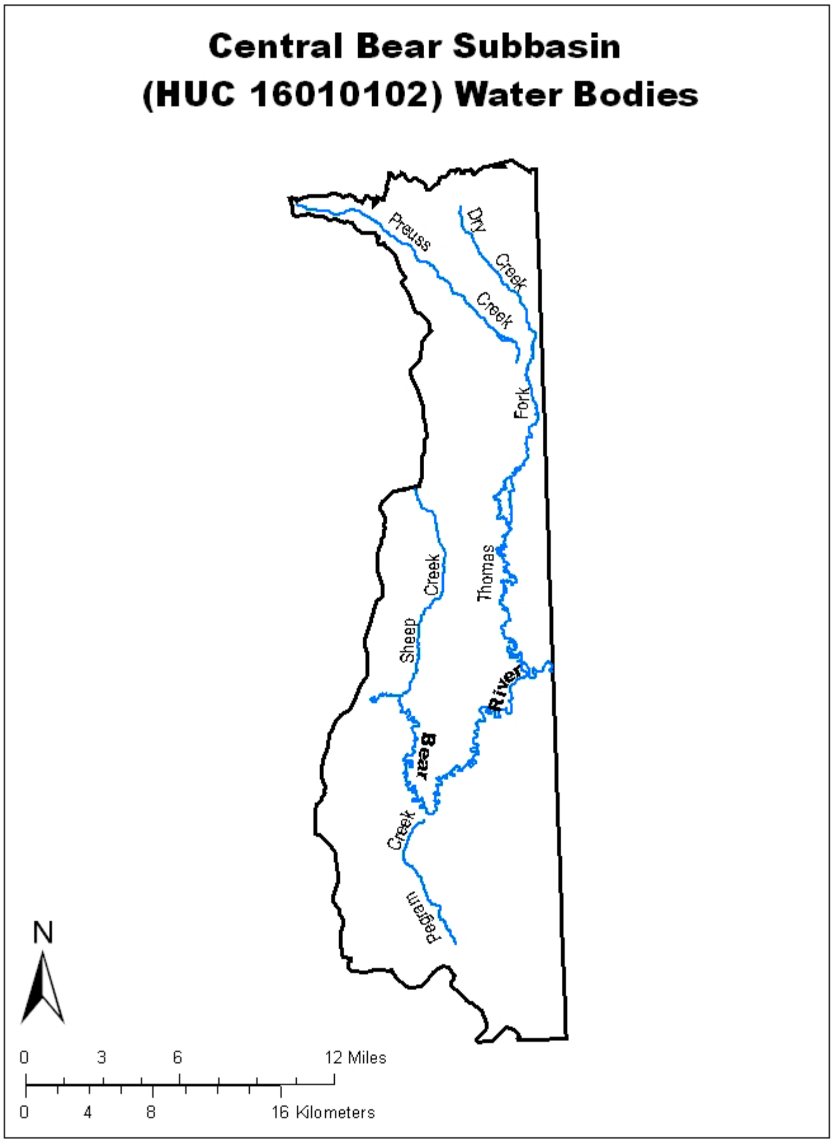

Figure 1-4. Water bodies in Central Bear Subbasin (Hydrologic Unit Code 16010102).

Most streams also maintained spawning populations of salmonids. Domestic water supply has been officially declared a designated use in Cub and Malad rivers. Current information suggests some beneficial uses, such as coldwater aquatic life and salmonid spawning, are impaired and are not fully supported in several subbasin streams.

There are 39 water quality segments listed on the 1998 §303(d) list (Table 1-1). Seven of those segments include the mainstem Bear River encompassing its entire length in Idaho from the Wyoming border to the Utah border. In addition to the various tributaries, Alexander and Oneida Narrows reservoirs are listed.

The current list of water quality limited water bodies includes streams from previous lists and those added to the 1998 list. All streams listed prior to 1998 generally had sediment, nutrients, or both, listed as a pollutant of concern (Table 1-1). Also on the list were flow alteration in Bear River, Cub River, and Weston Creek; habitat alteration for Preuss Creek; unknown metals in

Meadow Creek; and bacteria in Maple Creek. For streams added in 1998 – North, Strawberry, Deep (Bear), Fivemile, Maple, Worm, Dairy, Elkhorn, Deep (Malad) - pollutants of concern were listed as unknown. Beneficial uses affected by these pollutants are coldwater aquatic life, salmonid spawning, and contact recreation.

Several sources of pollutants above natural levels have been identified in Bear River Basin. Agriculture has been positively related to the suspended sediment loading. Other likely contributors are livestock practices; changes in the natural hydrograph; degraded stream channels and banks; roads; mining activities; and mass wasting (e.g., landslides). Waste water treatment plants are a source of nutrients in the basin. Possible other sources are agriculture, grazing, and recreation.

There are nine NPDES dischargers within Bear River Basin (Figure 1-2). Five are waste water treatment plants (WWTP) at Montpelier, Soda Springs, Grace, Preston, and Franklin. Three permit holders are fish hatcheries – Clear Springs Foods at Soda Springs, Idaho Department of Fish and Game at Grace, and Bear River Trout Farm near Grace. P4 Production (not shown in Figure 1-2 but just north of Soda Springs) has a permit for thermal discharge into Soda Creek. Additional NPDES permits are required for the control of storm water from construction activities that disturb greater than one acre.

As part of this investigation, a watershed approach was undertaken to fully define and quantify the characteristics of the basin including geology, geomorphology, landform, land use and valley bottom types. In addition, water quality data were collected in almost all perennial streams in the Idaho portion of the Bear River over an entire hydrologic cycle. Mass loads were calculated for these data sets. Statistical analysis was conducted on these data in order to develop regression relationships, which might explain the mass loadings of critical pollutants based upon watershed characteristics. This methodology met with mixed success in that significant predictive relationships for total suspended solids (TSS) and total phosphorus (TP) loadings were found using geology, landform and land use characteristics. Predictive parameters selected through the step wise multiple regression process appeared to be explainable when evaluated through independent analyses.

A systematic review of all available water quality data within the Idaho portion of the Bear River was also undertaken. The accumulation of this information included both tributaries and mainstem station. Data were evaluated for completeness in that both parameter concentrations as well as flows were needed for a mass balance analysis. After the data were qualified a summarization of the data relative to the designated beneficial uses was undertaken. This evaluation calculated the percent exceedances of the numeric criteria, water quality targets, or possible impairment indicators established for the tributaries and Bear River. This analysis indicated that phosphorus and suspended solids exceeded targets the most often with exceedances being found throughout the watershed. It was therefore determined that the loading analysis and total maximum daily load (TMDL) calculations would focus upon these two parameters. On a more site-specific level, load analyses for bacteria in Maple Creek and nitrogen in Thomas Fork were also done.

Load allocations were based on target concentrations or water quality standards chosen such that attainment of the target or standard would result in meeting beneficial uses (Table 1-2). The water quality standard of a geometric mean of 126 *E. coli* organisms/100 ml of water was used for bacteria. Data indicated that except for Thomas Fork phosphorus was the limiting nutrient in the system, so TP targets were set based on the receiving waters. If the receiving water from a stream reach was another stream reach, the TP target was set at 0.075 mg/L. Should the receiving water be a lake or reservoir, the target was set at 0.05 mg/L TP. In Thomas Fork, nitrogen may be limiting at times so, in addition to a TP target, a total nitrogen target of 0.085 mg/L was set. Like phosphorus, targets for suspended solids were chosen based on receiving water. In addition, suspended solids targets also varied based on hydrologic time period – runoff versus base flow. Sites for which the receiving waters were other stream reaches, TSS targets were 80 mg/L during runoff and 60 mg/L at base flow. Runoff and base flow targets for stream reaches which flow into lakes or reservoirs were 60 and 35 mg/L, respectively.

Every TMDL must incorporate a margin of safety. In the TMDLs for the Bear River Basin, the choice of conservative targets results in an implicit margin of safety when estimating load and wasteload allocations.

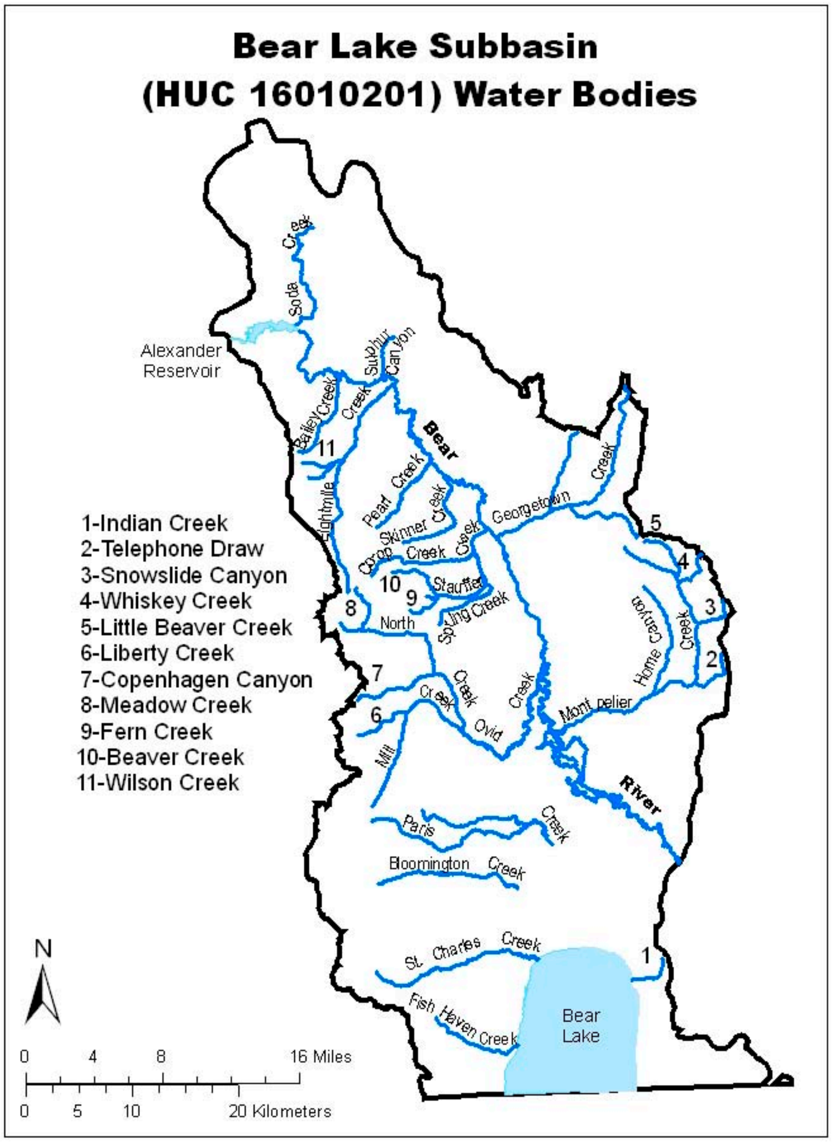

Figure 1-5. Water bodies in Bear Lake Subbasin (Hydrologic Unit Code 16010201).

Table 1-2. Standards criteria and targets used to establish pollutant load allocations for 303(d)-listed streams in Bear River Basin.

Site	Target concentration (mg/L)			
	Total phosphorus	Total nitrogen	Total suspended solids (runoff/base flow)	State standard criteria – *E. coli* geomean (organisms/100 ml water)
Bear River mainstem				
at ID-WY state line	0.075		80/60	
Stewart Dam	0.05		60/35	
Causeway	0.05		60/35	
Lifton	0.075		80/60	
Bear Lake outlet	0.075		80/60	
ab Alexander Res	0.05		60/35	
bel Alexander Res	0.075		80/60	
ab Oneida Res @ hwy	0.05		60/35	
bel Oneida Res	0.075		80/60	
at ID-UT state line	0.05		80/60	
Tributaries				
Thomas Fork	0.075	0.85	68	
Soda Creek, Cottonwood Creek	0.05		45	
Cub River	0.05		68	
Worm Creek	0.05		35	
Maple Creek				126
All other tributaries	0.075		68	
Point sources				
Montpelier WWTP	0.075		30	
Soda Springs WWTP	0.05		30	
Grace WWTP	0.075		30	
Preston WWTP	0.05		30	
Franklin WWTP	0.05		30	
Clear Springs Foods	0.05		5	
Grace Fish Hatchery	0.075		2	
Bear River Trout Farm	0.075		5	

Seasonality is also considered when establishing TMDLs. To facilitate load analyses, the year was divided into four hydrologic periods – winter base flow when most of the watershed is locked in ice (November to February), lower basin runoff, generally melting of the snowpack below 6500 feet (March, April), upper basin runoff, generally melting of the snowpack above 6500 feet (May to July), and summer base flow with no runoff conditions mostly dominated by irrigation withdrawal in the tributaries and downstream mainstem Bear River irrigation delivery below Bear Lake (August to October). An examination of figure 2-13 helps explain the various hydrologic regime in the Bear River in Idaho. The hydrograph at the Wyoming line to Bear Lake is a more typical snowmelt dominated regime with high flows occurring April through June/July and marked low flows during rest of the year. Mainstem flows below Bear Lake generally follow a high flow pattern April through June/July but flows are elevated in summer and fall over historic flow levels because of contracted releases out of Bear Lake to fulfill downstream irrigation demands, primarily inUtah.

Several streams in Bear River Basin enter Utah from Idaho and thus must comply with any TMDLs written by Utah for the water bodies. The recommended TSS and TP targets match or exceed State of Utah targets for Bear River, Cub River, Worm Creek, and Malad River in Utah. The Utah targets are 0.05 mg/L TP for mainstem Bear River, Cub River, and Worm Creek; 0.075 mg/L TP for Malad River; 90 mg/L TSS for mainstem Bear River, Cub River, and Malad River; and, 35 mg/L TSS for Worm Creek.

The natural hydrograph of Bear River has been modified by human manipulation, primarily to deliver irrigation water and produce electricity. These modifications include diversion of Bear River into Bear Lake, creation of Alexander and Oneida Narrows reservoirs, and operation of the river for irrigation and hydroelectric purposes. Several water quality limited segments in Bear River Basin list flow alteration as a pollutant affecting beneficial uses. However, flow alteration is not considered a pollutant and as such no TMDLs were written to address flow alteration.

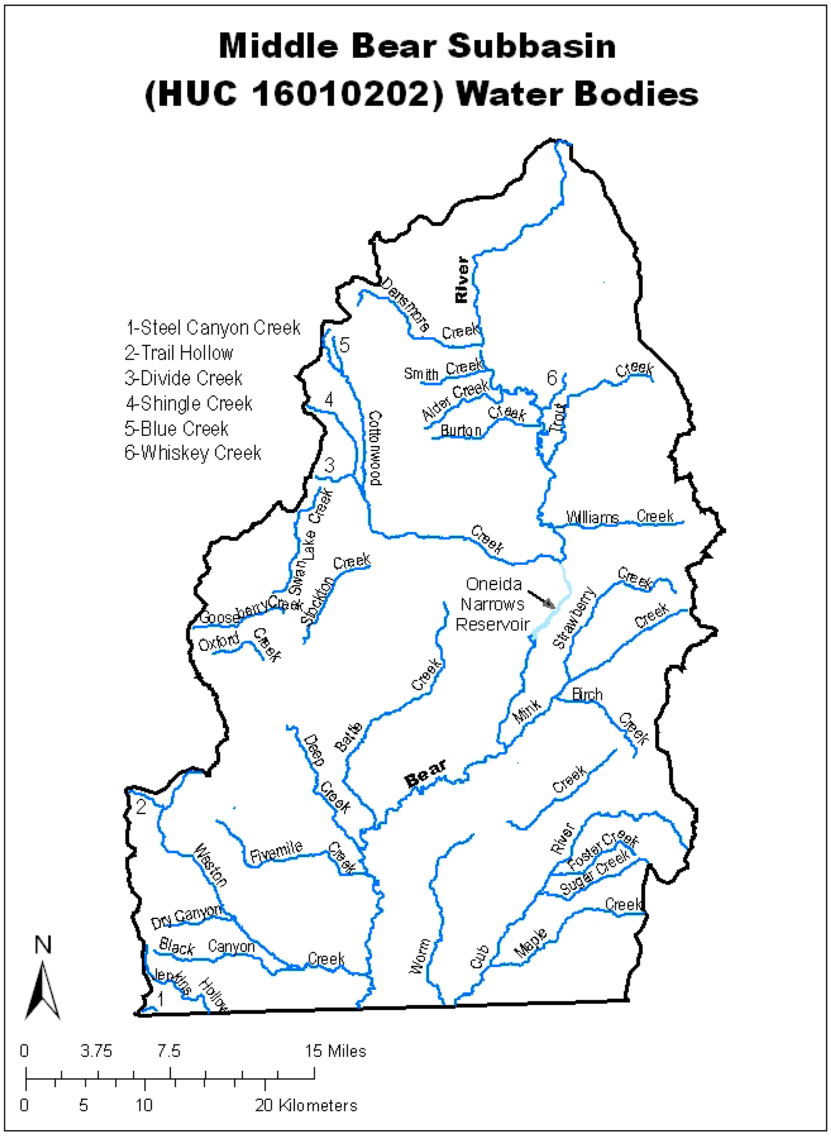

Figure 1-6. Water bodies in Middle Bear Subbasin (Hydrologic Unit Code 16010202).

The amount and periodicity of data varied by water body. Load allocations (quantity of pollutants a stream can assimilate without impairing beneficial uses) were thus based on available data. Ecosystem Research Institute (ERI) collected most of the data used to calculate loads in two sampling efforts from 1994-1996 and 1999-2000. Discharge Monitoring Reports provided the basis for estimating wasteload from NPDES permit holders.

1.1 Loading Analysis

In order to conduct a load allocation analysis and a TMDL calculation, the Bear River was divided into four riverine management reaches (MR) and three receiving water reaches (RW; Figure 1-3). Using a mass balance approach, mainstem Bear River, tributary, point source, and diversion data were used to calculate pollutant source gains or losses. This load allocation allowed for a better understanding of the causes for the excess TSS and TP masses observed in the delineated reaches of the Bear River. The TMDL analysis indicated that TSS exceeded the state of Idaho target only sporadically, both spatially and temporally in tributaries, as well as the mainstem Bear River. However, TP exceedances were extensive, occurring throughout the hydrologic cycle and basin-wide.

The TMDL 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 load capacity (LC) is determined, and then LC is broken down into its components: the necessary margin of safety (MOS) is determined and subtracted; then natural background (NB), if relevant, is quantified and subtracted; and then the remainder is allocated among point (WLA=wasteload allocation) and nonpoint (LA=load allocation) pollutant sources. When the breakdown and allocation is completed, a TMDL results, which must equal LC. There are several ways to implement an MOS. For Bear River Basin, it was decided to choose conservative targets, which convey an implicit MOS when estimating load and wasteload allocations. NB is unknown in Bear River Basin: it is assumed that natural background levels are included in target concentrations chosen for nutrients and sediment. Based on the decisions on how to deal with MOS and NB, the equation can be rewritten thusly, LC = LA + WLA = TMDL.

A quick overview of load allocations for riverine management reaches, receiving water reaches, and tributaries follows (see Figure 1-3 through Figure 1-8 for water body location). Note that for several mainstem reaches and tributaries, current estimated loads were below target loads. For such cases, load allocations were set at current loads and thus no load reductions are required.

MR1 – Bear River – Wyoming-Idaho state line to Causeway at Bear Lake – This water quality limited segment is listed for flow, nutrients, and sediment (Table 1-1). As mentioned earlier, no TMDLs were written for stream reaches affected by flow alteration. Assessment of Beneficial Use Reconnaissance Program (BURP) data indicates the stream is not supporting its beneficial uses. Limited core sampling showed higher than optimum levels of sediment within the streambed. Beneficial uses affected are coldwater aquatic life and salmonid spawning. Pollutant sources include background loads received from Wyoming.

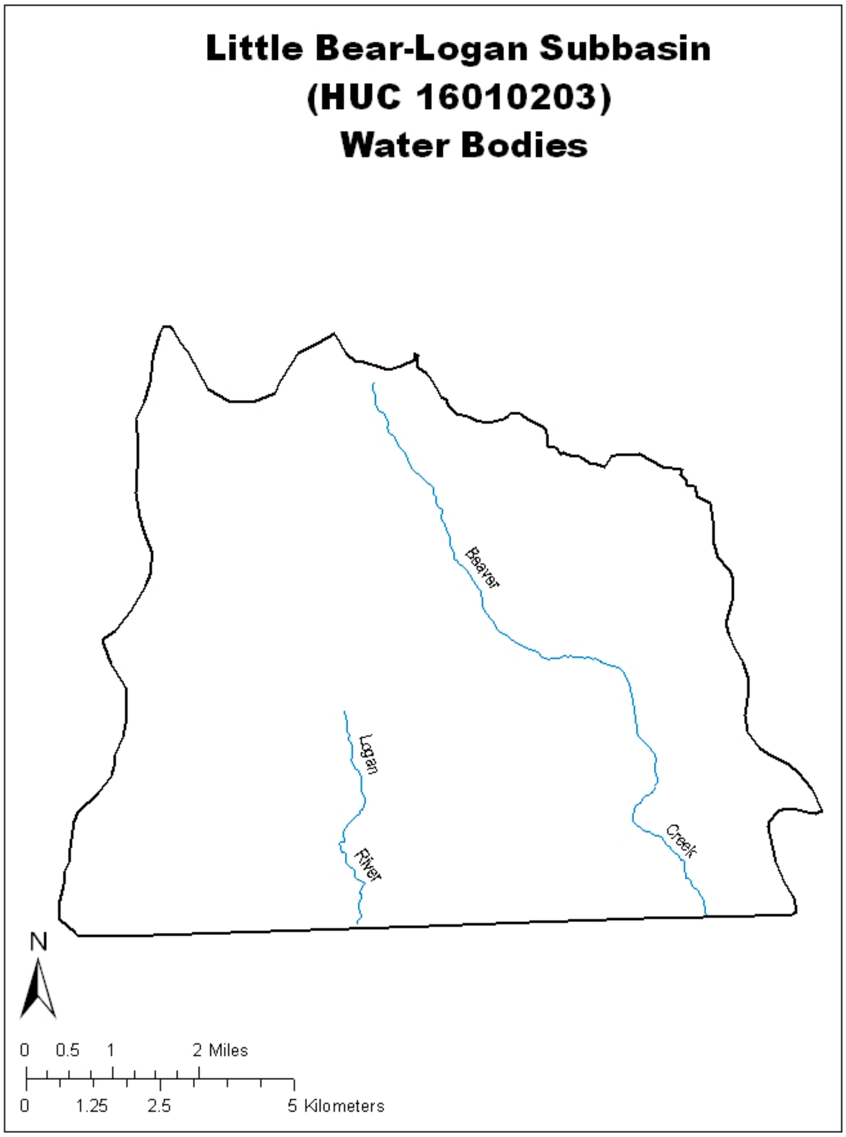

Figure 1-7. Water bodies in Little Bear-Logan Subbasin (Hydrologic Unit Code 16010203).

Thomas Fork is a source of excess (above target) phosphorus, and also contributes nitrogen and suspended solids to this mainstem reach (Table 1-3). Sheep Creek adds phosphorus and suspended solids, but not excessive amounts. Other possible sources are agriculture and livestock grazing. Additional sediment sources may include the in-stream channel and excessively eroding stream banks.

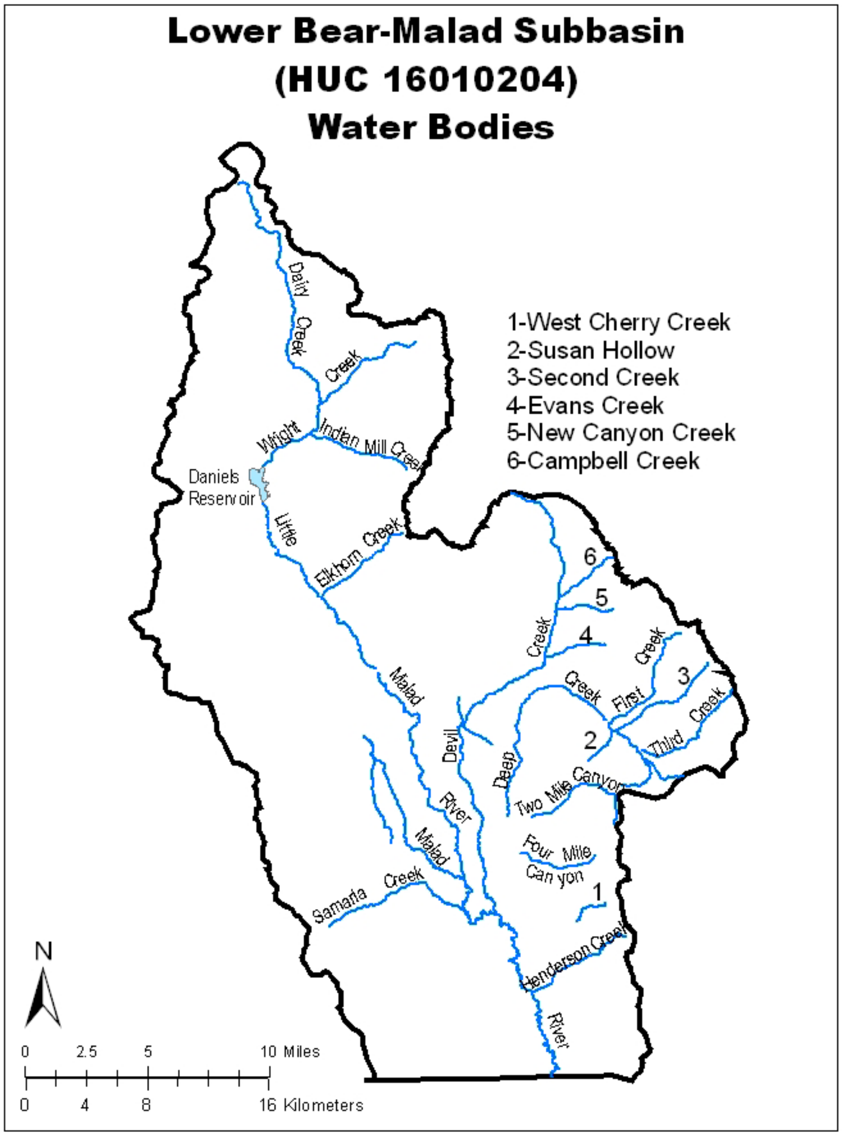

Figure 1-8. Water bodies in Lower Bear-Malad Subbasin (Hydrologic Unit Code 16010204).

Table 1-3. Load and wasteload allocations for total phosphorus, total suspended solids, total nitrogen, and bacteria (E. coli) for Bear River Basin tributaries, waste water treatment plants (WWTP), and fish hatcheries. Data found in Table 3 14, Table 3 16, Table 3 24, Table 3 28, Table 3 31, Table 3 33.

	Total phosphorus				Total suspended solids				Total nitrogen			
	Annual load (kg/yr)		Annual wasteload (kg/yr)		Annual load (kg/yr)		Annual wasteload (kg/yr)		Annual load (kg/yr)		*E. coli* (organisms/100 ml)	
Water body	Allocation[1]	Reduction	Allocation	Reduction	Allocation	Reduction	Allocation	Reduction	Allocation	Reduction	Monthly geomean[2]	Annual load[3]
Tributaries												
Thomas Fork	3,879	139			2,668,996	0			30,270	0		
Sheep Creek	27	0			7,807	0						
Bear River Old Channel	6,859	1,687			6,253,000	117,043						
Ovid Creek	631	0			104,468	0						
Georgetown Creek	1,562	160			376,986	0						
Stauffer Creek	709	0			218,122	0						
Skinner Creek	281	0			74,487	0						
Pearl Creek	227	0			86,061	0						
Eightmile Creek	482	0			230,891	0						
Sulphur Canyon Creek	8	0			2,551	0						
Bailey Creek	197	0			96,307	0						
Soda Creek	2,085	3,045			250,662	0						
Densmore Creek	141	265			85,198	0						
Smith Creek	401	0			209,382	0						
Alder Creek	622	0			372,464	0						
Whiskey Creek	848	4			134,419	0						
Burton Creek	380	0			289,756	0						
Trout Creek	1,112	75			586,581	0						
Williams Creek	334	0			95,413	0						
Cottonwood Creek	1,028	0			479,447	0						
Mink Creek	2,765	0			413,677	0						
Battle Creek	284	1,632			259,202	1,360,661						
Deep Creek	2,145	2,945			1,955,567	1,928,952						
Fivemile Creek	152	162			64,708	0						
Weston Creek	577	701			432,441	0						
Cub River	3,086	4,256			2,313,413	0						
Maple Creek											126	821,289,820,442
Worm Creek	632	3,900			442,486	506,719						
Malad River at 3700 South	373	45			218,098	0						
Malad R at ID-UT state line	5,535	436			5,045,955	1,229,836						
Little Malad River	214	133			88,118	0						
Wright Creek	175	191			147,213	0						
Elkhorn Creek	46	0			60,495	0						
Devil Creek	67	31			11,854	0						
Deep Creek	23	0			4,335	0						

Table 1-3, continued												
	Total phosphorus				Total suspended solids				Total nitrogen			
	Annual load (kg/yr)		Annual wasteload (kg/yr)		Annual load (kg/yr)		Annual wasteload (kg/yr)		Annual load (kg/yr)		*E. coli* (organisms/100 ml)	
Water body	Allocation[1]	Reduction	Allocation	Reduction	Allocation	Reduction	Allocation	Reduction	Allocation	Reduction	Monthly geomean[2]	Annual load[3]
Point sources												
Montpelier WWTP			17	227			6,790	0				
Soda Springs WWTP			54	844			32,217	0				
Grace WWTP			4	69			1,409	0				
Preston WWTP			50	1,501			30,142	0				
Franklin WWTP			4	165			2,255	0				
Clear Springs Foods			550	0			78,824	0				
Grace Fish Hatchery			135	0			70,548	0				
Bear River Trout Farm			848	0			89,301	0				

(1)applying the TMDL equation to phosphorus in Thomas Fork, for example, would yield the following: LC (includes NB & MOS) = 3,879 kg/yr = LA (for Thomas Fork) = TMDL. Note: there are no point sources (WLAs) in Thomas Fork.
(2)minimum of five samples per month
(3)based on average flow at USGS Maple Creek near Franklin gage (10096500), Apr 1946-Sep 1952

Three mainstem sites are found within this riverine management reach – Idaho-Wyoming state line, Stewart Dam, and Causeway. Based on site-specific suspended solids target concentrations (Table 1-2), total annual load allocations of TSS for this reach are 28,291,869 kg at the state line, 28,004,255 kg at Stewart Dam, and 8,544,488 kg at the Causeway (Table 1-4). The two upper sites, state line and Stewart Dam, require a reduction in suspended solids. The critical time period for load reduction was during upper basin runoff at the state line, and during upper and lower basin runoff and summer base flow at Stewart Dam. For TP, annual load allocations are 35,297, 26,701, and 12,466 kg/yr at the state line, Stewart Dam, and Causeway sites, respectively (Table 1-4). Winter base flow was the only hydrologic period when phosphorus did not exceed target concentrations.

MR2 – Bear River – Wardboro to Alexander Reservoir – This water quality limited segment is listed for nutrients and sediment (Table 1-1). BURP data and beneficial use support evaluations were not available for this management reach. Beneficial uses affected are coldwater aquatic life and salmonid spawning. Within this reach, the old Bear River channel is the major contributor of both phosphorus and suspended solids (Table 1-3). Two tributaries, Georgetown and Skinner creeks, within this reach supply excess amounts of phosphorus. None of the other tributaries appear to be sources of excess phosphorus or suspended solids. Other possible pollutant sources are agriculture, livestock grazing, and urban activities. Additional sediment sources may include the in-stream channel and excessively eroding stream banks. This reach includes two mainstem sites for which load allocations were defined: Bear Lake outlet, and above Alexander Reservoir. Annual TSS load allocations for these sites are 28,264,092, and 27,001,537 kg/yr, respectively (Table 1-4). Load reductions are required only at the above Alexander site. Critical periods for suspended solids above Alexander Reservoir are upper basin runoff and summer base flow. Mud Lake and Bear Lake are most likely acting as “reservoirs” for suspended solids, thus reducing loads. The two sites have TP load allocations of 34,518, and 33,493 kg/yr, respectively. Both sites require some reduction in phosphorus load. Generally, the critical hydrologic seasonal periods for phosphorus loading were lower and upper basin runoff and summer base flow.

MR3 – Bear River – below Alexander Reservoir to above Oneida Reservoir – This water quality limited segment is listed for flow, nutrients, and sediment (Table 1-1). As mentioned earlier, no TMDLs were written for stream reaches affected by flow alteration. BURP data and beneficial use support evaluations were not available for this management reach. Beneficial uses affected are coldwater aquatic life and salmonid spawning. Except for Williams Creek, the other monitored tributaries within this reach supply excess amounts of phosphorus: Densmore, Smith, Alder, Whiskey, Burton, and Trout creeks (Table 1-3). The Grace waste water treatment plant is also a source of excess phosphorus within this reach. Bear River Trout Farm does not appear to contribute excess phosphorus to Bear River. Alder and Burton creeks are sources of excess suspended solids. None of the other tributaries, or point sources, appears to add excess suspended solids. Other possible pollutant sources are agriculture, livestock grazing, urban activities, impacts (e.g., ramping practices) associated with power production, and an altered hydrograph. Additional sediment sources may include the in-stream channel and excessively eroding stream banks.

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Table 1-4. Load allocations for total phosphorus and total suspended solids for mainstem Bear River. Data in this table can also be found in Table 3-19 to Table 3-22.

RMR[1]	Site	Hydrologic period loads (kg/day)								Annual load (kg/yr)	
		Winter baseflow load		Lower basin runoff load		Upper basin runoff load		Summer baseflow load			
		Allocation	Reduction	Allocation	Reduction	Allocation	Reduction	Allocation	Reduction	Allocation[2]	Reduction
Total phosphorus											
MR1	at ID-WY state line	44	0	109	173	215	258	39	13	35,297	35,485
	Stewart Dam	27	0	89	262	152	293	44	79	26,701	50,206
	Causeway	12	0	42	22	86	51	6	0	12,466	6,034
MR2	Bear Lake outlet	42	0	70	15	103	43	171	123	34,518	16,187
	ab Alexander Res	71	28	61	104	124	319	107	219	33,493	59,200
MR3	bel Alexander Res	27	0	88	0	135	0	122	4	32,252	368
	ab Oneida Res @ hwy	56	7	95	124	111	142	90	72	31,007	28,092
MR4	bel Oneida Res	42	0	91	18	93	14	77	4	26,231	2,754
	at ID-UT state line	104	84	117	350	138	199	112	88	42,617	57,834
Total suspended solids											
MR1	at ID-WY state line	8,385	0	59,701	0	229,736	144,486	27,263	0	28,291,869	13,292,712
	Stewart Dam	15,165	0	107,187	174,265	182,643	138,280	30,901	56,768	28,004,255	28,574,581
	Causeway	7,464	0	26,252	0	62,387	0	3,346	0	8,544,488	0
MR2	Bear Lake outlet	31,302	0	50,040	0	98,523	0	134,688	0	28,264,092	0
	ab Alexander Res	25,585	0	54,769	0	148,776	2,340	75,033	27,961	27,001,537	2,787,692
MR3	bel Alexander Res	2,433	0	23,039	0	35,391	0	33,852	0	8,067,695	0
	ab Oneida Res @ hwy	21,596	0	72,587	0	86,115	0	58,841	0	20,355,279	0
MR4	bel Oneida Res	6,997	0	18,464	0	19,028	0	6,997	0	4,360,244	0
	at ID-UT state line	76,365	0	134,181	0	104,582	0	82,353	0	34,546,861	0

(1)RMR=Riverine Management Reach
(2)applying the TMDL equation to phosphorus in Bear River above Oneida Reservoir, for example, would yield the following: LC (includes NB & MOS) = 31,007 kg/yr = LA (for Bear River ab Oneida Res @ hwy) = 3,838 kg/yr (LA for tributaries) + 852 kg/yr (WLA for Bear River Trout Farm & Grace WWTP) + 26,317 kg/yr (LA from other sources primarily Bear River reach immediately above) = TMDL.

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Two mainstem sites for which load allocations were estimated occur within this reach, below Alexander Reservoir and above Oneida Reservoir at Highway 34 sites. Load allocations below Alexander are 32,252 kg/yr for TP and 8,067,695 kg/yr for TSS (Table 1-4). A reduction, albeit small, is required only for phosphorus. Excess phosphorus loading at this site occurred during summer base flow. At the above Oneida site, load allocations were 31,007 kg/year for TP and 20,355,279 kg/yr for TSS. Only phosphorus requires a load reduction, and excess loads were documented throughout the year. Although, load reductions of suspended solids are not recommended, more data, such as bedload sediment information, volume of subsurface sediment (depth fines) estimates, and BURP assessment, are needed prior to concluding sediment is not a problem in this reach.

MR4 – Bear River – Oneida Reservoir to Idaho-Utah state line – This water quality limited segment is listed for flow, nutrients, and sediment (Table 1-1). As mentioned earlier, no TMDLs were written for stream reaches affected by flow alteration. Assessment of BURP data indicates the stream is not supporting its beneficial uses. Limited core sampling showed higher than optimum levels of sediment within the streambed. Beneficial uses affected are coldwater aquatic life and salmonid spawning. Excess loads of phosphorus and suspended solids were observed in Battle and Deep creeks (Table 1-3). Fivemile and Weston creeks contributed excess phosphorus. Mink Creek does not appear to be a source of either excess phosphorus or suspended solids. Other possible pollutant sources are agriculture, livestock grazing, and urban activities. Additional sediment sources may include the in-stream channel and excessively eroding stream banks. This reach has two mainstem sites, below Oneida Narrows Reservoir and at Idaho-Utah state line, for which load allocations were estimated. Load allocations at the below Oneida site are 28,985 kg/yr for TP and 4,360,244 kg/yr for TSS (Table 1-4). Due to the 'sink' effect of the reservoir, neither phosphorus nor suspended solids exceeded target concentrations. At the state line site, load allocations are 64,048 kg/yr and 34,546,861 kg/yr for TP and TSS, respectively (Table 1-4). Only phosphorus requires a load reduction at the state line site, and excess loads were documented throughout the year. Although, load reductions of suspended solids are not recommended, more data (e.g., additional sites, more sampling events throughout the year, estimates of bedload sediment) are needed in this reach to better assess total sediment load and determine its contribution to beneficial use impairment.

RW1 – Bear Lake – This water body is not listed on the §303(d) list. Bear River is diverted into Bear Lake for irrigation storage, and can be a significant source of phosphorus to the lake. Outflowing water quality at the Causeway site, into the lake, exceeded the TMDL target for phosphorus during both upper and lower basin runoff. Load allocations set at the Causeway site will help reduce input of phosphorus, and suspended solids, into the lake.

RW2 – Alexander Reservoir – This water body is listed on the §303(d) list for sediment (Table 1-1). Beneficial uses affected are coldwater aquatic life and salmonid spawning. Within the reservoir, Soda Creek is the only major tributary. Point sources include Soda Springs WWTP and Clear Springs Foods fish hatchery. None of the three appear to be a source of excess suspended solids (Table 1-3). Although not listed for nutrients, Soda Creek and Soda Springs WWTP are sources of excess phosphorus to the reservoir, and, by extension, Bear River. Excess loads of suspended solids in inflowing Bear River occurred in during upper basin runoff and summer base flow. Inflowing Bear River exceeded the phosphorus target in each of the four hydrologic periods. It is anticipated that attainment of the suspended solids load and wasteload allocations for the mainstem Bear River site immediately upstream of the reservoir, Soda Creek, and the two point sources will result in support of beneficial uses (Table 1-1) in the reservoir. The phosphorus load allocations at the same mainstem site and Soda Creek, and wasteload allocations for Soda Springs WWTP and Clear Springs Foods, are expected to improve water quality conditions in the reservoir and river.

RW3 – Oneida Narrows Reservoir – This water body is listed on the §303(d) list for sediment (Table 1-1). Beneficial uses affected are coldwater aquatic life and salmonid spawning. Within the reservoir, Cottonwood Creek is the only major tributary. Neither inflowing Bear River nor Cottonwood Creek appear to be sources of excess suspended solids to the reservoir. Although not listed for nutrients, inflowing Bear River exceeded the phosphorus target in each of the four hydrologic periods. It is anticipated that attainment of the suspended solids load allocations for the mainstem Bear River site above Oneida Narrows Reservoir and Cottonwood Creek will result in support of beneficial uses (Table 1-1) in the reservoir. The phosphorus load allocations at the same sites are expected to improve water quality conditions in the reservoir and river.

Thomas Fork – This stream is listed on the §303(d) list for nutrients and sediment (Table 1-1), and also contributes excess phosphorus to Bear River. Assessment of BURP data indicates the stream is not supporting its beneficial uses, and limited core sampling showed higher than optimum levels of sediment within the streambed. High densities of aquatic macrophytes have been reported in lower Thomas Fork. The primary beneficial uses affected are coldwater aquatic life and salmonid spawning. Possible pollutant sources are agriculture and livestock grazing. Additional sediment sources may include the in-stream channel and excessively eroding stream banks. The most critical time period for phosphorus and sediment problems in Thomas Fork was during upper basin runoff. Load allocations were set for both TP and total nitrogen at 3,879 and 30,270 kg/year, respectively (Table 1-3). The recommended TSS load allocation is 2,668,996 kg/year. Data were insufficient to recommend load allocations for hydrologic periods, which might indicate excess loads during one or more periods followed by extremely low loads that, when averaged over the year, results in a low annual load estimate. More data (e.g., additional sites, more sampling events throughout the year) are needed to refine nitrogen and sediment (both suspended and bedload) load allocations to determine their contribution to beneficial use impairment.

Dry Creek – This tributary to Thomas Fork is listed on the §303(d) list for nutrients and sediment (Table 1-1). Data were not sufficient for a load analysis of either sediment or nutrients; therefore no TMDLs were done. To develop a load analysis, data will be collected in 2006 after which a TMDL will be written in 2007.

Preuss Creek – This tributary to Thomas Fork is listed on the §303(d) list for habitat alteration and sediment (Table 1-1). Assessment of BURP data indicates the stream is not supporting its beneficial uses. Like flow alteration, habitat alteration is not considered a pollutant and no TMDL was written for it. Data were not sufficient for a load analysis of sediment; therefore no TMDL was done. To develop a load analysis, data will be collected in 2006 after which a TMDL will be written in 2007.

Sheep Creek – This stream is not on the §303(d) list, but does contribute to the phosphorus and suspended sediment loads in Bear River. Load allocations are 27 kg/year for TP and 7,807 kg/year for TSS (Table 1-3).

Snowslide Canyon – This tributary to Montpelier Creek is listed on the §303(d) list for sediment (Table 1-1). Data were not sufficient for a load analysis of sediment; therefore no TMDL was done. To develop a load analysis, data will be collected in 2006 after which a TMDL will be written in 2007.

Bear River Old Channel – This stream is not on the §303(d) list, but appears to be a significant source of excess suspended solids and phosphorus into mainstem Bear River. Montpelier waste water treatment plant is a source of nutrients into Bear River Old Channel. Other possible pollutant sources are agriculture and livestock grazing. Additional sediment sources may include the in-stream channel and excessively eroding stream banks. The most critical periods for contributions of phosphorus and suspended solids were winter base flow and lower basin runoff. Load allocations are 6,859 kg/year for TP and 6,253,000 kg/year for TSS (Table 1-3).

St. Charles Creek – This stream is listed on the §303(d) list for nutrients and sediment (Table 1-1). Assessment of BURP data indicates that the stream supports its beneficial uses, therefore no TMDL was written. It will be recommended that St. Charles Creek be removed from future §303(d) lists.

Ovid Creek – This stream is listed on the §303(d) list for sediment (Table 1-1). Assessment of BURP data confirms that the stream is not supporting beneficial uses. The primary beneficial uses affected are coldwater aquatic life and salmonid spawning. Possible pollutant sources are agriculture and livestock grazing. Additional sediment sources may include the in-stream channel and excessively eroding stream banks. Data indicate that during summer base flow, the stream did exceed suspended solids targets. On an annual basis, however, the stream does not exceed the target concentration for suspended solids. Data were insufficient to recommend load allocations for hydrologic periods, which might indicate excess loads during one or more periods followed by extremely low loads that, when averaged over the year, results in a low annual load estimate. More data (e.g., additional sites, more sampling events throughout the year, estimates of bedload sediment) are needed to refine sediment load allocations. The stream is a source of phosphorus and suspended solids to Bear River. Load allocations are 631 kg/year for TP and 104,468 kg/year for TSS (Table 1-3).

North Creek – This tributary to Ovid Creek is listed on the §303(d) list for unknown pollutants (Table 1-1). Assessment of BURP data indicates that the stream supports its beneficial uses, therefore no TMDL was written. It will be recommended that North Creek be removed from future §303(d) lists.

Meadow Creek – This tributary to North Creek is listed on the §303(d) list for sediment and unknown metals (Table 1-1). Assessment of BURP data confirms that the stream is not supporting beneficial uses. Further investigation of the stream showed it to be intermittent in flow. The water body assessment protocol based on BURP data was designed only for streams with perennial flow. State water quality standards require intermittent streams to meet beneficial uses during optimum flow periods, which for cold water aquatic life is equal to or greater than one cfs. According to Dave Hull (BURP

Coordinator, DEQ/Pocatello), flow in Meadow Creek is less than one cfs. No data were reviewed to indicate metals are any problem in the creek and there is no reason to believe metals might be a concern (Dave Hull, BURP Coordinator, DEQ/Pocatello, personal communication). It will be recommended that Meadow Creek be removed from future §303(d) lists.

Georgetown Creek – This stream is not on the §303(d) list, but appears to be a source of excess phosphorus into mainstem Bear River. Possible pollutant sources are agriculture, livestock grazing, and historic mining activities. The most critical periods for contributions of phosphorus are upper basin runoff and summer base flow. Although not as significant as phosphorus, the stream is a contributor of suspended solids to Bear River, and so the load allocation is set at its current estimated load. Load allocations are 1,562 kg/year for TP and 376,986 kg/year for TSS (Table 1-3).

Stauffer Creek – This stream is not on the §303(d) list, but does contribute to the phosphorus and suspended sediment loads in Bear River, and so the load allocations are set at current estimated loads. Load allocations are 709 kg/year for TP and 218,122 kg/year for TSS (Table 1-3).

Co-op Creek – This tributary to Stauffer Creek is listed on the §303(d) list for nutrients and sediment (Table 1-1). Assessment of BURP data confirms that the stream is not supporting beneficial uses. The primary beneficial uses affected are coldwater aquatic life and salmonid spawning. Possible pollutant sources are agriculture and livestock grazing. Additional sediment sources may include the in-stream channel and excessively eroding stream banks. Data were not sufficient for a load analysis of either sediment or nutrients; therefore no TMDLs were done. To develop a load analysis, data will be collected in 2006 after which a TMDL will be written in 2007.

Skinner Creek – This stream is not on the §303(d) list and assessment of BURP data indicated it is supporting its beneficial uses although the level of phosphorus loading into Bear River exceeded recommended target levels. As it appears that current levels of phosphorus and sediment are not affecting beneficial uses, load allocations are set at current estimated loads – 281 kg/year for TP and 74,487 kg/year for TSS (Table 1-3).

Pearl Creek – This stream is listed on the §303(d) list for nutrients and sediment (Table 1-1). No data were analyzed that indicate in-stream beneficial uses are impaired. More data (e.g., BURP assessment) are needed in this creek to determine if beneficial uses are being supported. The stream is also a source of phosphorus and suspended solids to Bear River. Load allocations are 227 kg/year for TP and 86,061 kg/year for TSS (Table 1-3).

Eightmile Creek – This stream is not on the §303(d) list, but does contribute to the phosphorus and suspended solids loads in Bear River. Load allocations are 482 kg/year for TP and 230,891 kg/year for TSS (Table 1-3).

Sulphur Canyon Creek – This stream is not on the §303(d) list, but does contribute to the phosphorus and suspended solids loads in Bear River. Load allocations are 8 kg/year for TP and 2,551 kg/year for TSS (Table 1-3).

Bailey Creek – This stream is not on the §303(d) list, but does contribute to the phosphorus and suspended solids loads in Bear River. Load allocations are 197 kg/year for TP and 96,307 kg/year for TSS (Table 1-3).

Soda Creek – This stream is not on the §303(d) list, but appears to be a significant source of excess phosphorus into Alexander Reservoir and, by extension, mainstem Bear River throughout the year. Possible pollutant sources are agriculture, livestock grazing, and P4 Production. Although not as significant as phosphorus, the stream is a contributor of suspended solids to the reservoir. Load allocations are 2,085 kg/year for TP and 250,662 kg/year for TSS (Table 1-3).

Densmore Creek – This stream is listed on the §303(d) list for nutrients and sediment Table 1-1). Assessment of BURP data indicates the stream is not supporting its beneficial uses, although the lower end of the stream is intermittent. The primary beneficial use affected is coldwater aquatic life. Possible pollutant sources are agriculture and livestock grazing. Additional sediment sources may include the in-stream channel and excessively eroding stream banks. The only time period when Densmore Creek did not exceed target concentrations for either phosphorus or suspended solids was during summer base flow. On an annual basis, however, the stream does not exceed the target concentration for suspended solids. Data were insufficient to recommend load allocations for hydrologic periods, which might indicate excess loads during one or more periods followed by extremely low loads that, when averaged over the year, results in a low annual load estimate. More data (e.g., additional sites, more sampling events throughout the year, estimates of bedload) are needed to refine sediment load allocations. The stream is also a source of phosphorus and suspended solids to Bear River. Load allocations are 141 kg/year for TP and 85,198 kg/year for TSS (Table 1-3).

Smith Creek – This stream is not on the §303(d) list and assessment of BURP data indicated it is supporting its beneficial uses although the level of phosphorus loading into Bear River exceeded recommended target levels. As it appears that current levels of phosphorus and sediment are not affecting beneficial uses, load allocations are set at current estimated loads – 401 kg/year for TP and 209,382 kg/year for TSS (Table 1-3).

Alder Creek – This stream is not on the §303(d) list and assessment of BURP data indicated it is supporting its beneficial uses although the levels of phosphorus and suspended solids loading into Bear River exceeded recommended target levels. As it appears that current levels of phosphorus and sediment are not affecting beneficial uses, load allocations are set at current estimated loads – 622 kg/year for TP and 372,464 kg/year for TSS (Table 1-3).

Whiskey Creek – This stream is listed on the §303(d) list for nutrients and sediment (Table 1-1). Assessment of BURP data indicates the stream is not supporting its beneficial uses. The primary beneficial use affected is coldwater aquatic life. Grace Fish Hatchery does not appear to contribute excess phosphorus to Whiskey Creek. Possible pollutant sources are agriculture and livestock grazing. Additional sediment sources may include the in-stream channel and excessively eroding stream banks. Data indicate that Whiskey Creek did not exceed suspended solids target concentrations during any hydrologic period, and phosphorus was elevated above target levels only slightly during winter base flow. More data (e.g., additional sites, more sampling events throughout the year, riparian condition, bank stability) are needed in this creek to better refine phosphorus and total sediment (both suspended and bedload) loads, and determine their contribution to beneficial use impairment. The stream is also a source of phosphorus and suspended solids to Bear River. Load allocations are 848 kg/year for TP and 134,419 kg/year for TSS (Table 1-3).

Burton Creek – This stream is not on the §303(d) list and assessment of BURP data indicated it is supporting its beneficial uses although the levels of phosphorus and suspended solids loading into Bear River exceeded recommended target levels. As it appears that current levels of phosphorus and sediment are not affecting beneficial uses, load allocations are set at current estimated loads – 380 kg/year for TP and 289,756 kg/year for TSS (Table 1-3).

Trout Creek – This stream is not on the §303(d) list, but appears to be a source of excess phosphorus into mainstem Bear River. Possible pollutant sources are agriculture and livestock grazing. Additional sediment sources may include the in-stream channel and excessively eroding stream banks. The only time period when Trout Creek was not contributing either phosphorus or suspended solids into mainstem Bear River was during summer base flow. On an annual basis, however, the stream does not exceed the target concentration for suspended solids. Data were insufficient to recommend load allocations for hydrologic periods, which might indicate excess loads during one or more periods followed by extremely low loads that, when averaged over the year, results in a low annual load estimate. More data (e.g., additional sites, more sampling events throughout the year, estimates of bedload) are needed to refine sediment load allocations. Load allocations are 1,112 kg/year for TP and 586,581 kg/year for TSS (Table 1-3).

Williams Creek – This stream is listed on the §303(d) list for nutrients and sediment (Table 1-1). Assessment of BURP data indicates the stream is not supporting its beneficial uses. The primary beneficial use affected is coldwater aquatic life. Possible pollutant sources are agriculture and livestock grazing. Additional sediment sources may include the in-stream channel and excessively eroding stream banks. Data indicate that Williams Creek did not exceed the target concentration for total phosphorus or suspended solids either by hydrologic period or on an annual basis. More data (e.g., additional sites, more sampling events throughout the year, riparian condition, bank stability) are needed in this creek to better refine phosphorus and total sediment (both suspended and bedload) loads, and determine their contribution to beneficial use impairment. The stream is also a source of phosphorus and suspended solids to Bear River. Load allocations are 334 kg/year for TP and 95,413 kg/year for TSS (Table 1-3).

Cottonwood Creek – This stream is listed on the §303(d) list for sediment (Table 1-1). Assessment of BURP data confirms that the stream is not supporting beneficial uses. The primary beneficial use affected is coldwater aquatic life. Possible pollutant sources are agriculture and livestock grazing. Additional sediment sources may include the in-stream channel and excessively eroding stream banks. Data indicate that Cottonwood Creek did not exceed suspended solids target concentrations during any hydrologic period. More data (e.g., additional sites, more sampling events throughout the year, estimates of bedload sediment, riparian condition, bank stability) are needed in this creek to better refine total sediment load and determine its contribution to beneficial use impairment. The stream is also a source of phosphorus and suspended solids to Bear River. Load allocations are 1,028 kg/year for TP and 479,447 kg/year for TSS (Table 1-3).

Mink Creek – This stream is not on the §303(d) list, but does contribute to the phosphorus and suspended solids loads in Bear River. Load allocations are 2,765 kg/year for TP and 413,677 kg/year for TSS (Table 1-).

Strawberry Creek – This tributary to Mink Creek is listed on the §303(d) list for unknown pollutants (Table 1-1). Assessment of BURP data indicates the stream is not supporting its beneficial uses. The primary beneficial use affected is coldwater aquatic life. Possible pollutant sources are agriculture and livestock grazing. Additional sediment sources may include the in-stream channel and excessively eroding stream banks. However, data were not sufficient for a load analysis of sediment, nutrients, or any other possible pollutant; therefore, no TMDL was done. To develop a load analysis, data will be collected in 2006 after which a TMDL will be written in 2007.

Battle Creek – This stream is listed on the §303(d) list for nutrients and sediment (Table 1-1). Assessment of BURP data indicates the stream is not supporting its beneficial uses. The primary beneficial use affected is coldwater aquatic life. Possible pollutant sources are agriculture and livestock grazing. Additional sediment sources may include the in-stream channel and excessively eroding stream banks. Data indicate Battle Creek exceeded target concentrations for suspended solids and phosphorus throughout the year. The stream is also a source of phosphorus and suspended solids to Bear River. Load allocations are 284 kg/year for TP and 259,202 kg/year for TSS (Table 1-3).

Deep Creek – This stream is listed on the §303(d) list for unknown pollutants (Table 1-1). Assessment of BURP data indicates the stream is not supporting its beneficial uses. Limited core sampling showed higher than optimum levels of sediment within the streambed. The primary beneficial use affected is coldwater aquatic life. Possible pollutant sources are agriculture and livestock grazing. Additional sediment sources may include the in-stream channel and excessively eroding stream banks. Data indicate Deep Creek exceeded target concentrations for suspended solids and phosphorus throughout the year. The stream is also a source of phosphorus and suspended solids to Bear River. Load allocations are 2,145 kg/year for TP and 1,955,567 kg/year for TSS (Table 1-3).

Fivemile Creek – This stream is listed on the §303(d) list for unknown pollutants (Table 1-1). Assessment of BURP data indicates the stream is not supporting its beneficial uses. Limited core sampling showed higher than optimum levels of sediment within the streambed. The primary beneficial use affected is coldwater aquatic life. Possible pollutant sources are agriculture and livestock grazing. Additional sediment sources may include the in-stream channel and excessively eroding stream banks. Data indicate Fivemile Creek exceeded target concentrations for phosphorus throughout the year. Suspended solids did not exceed target concentrations during any hydrologic period. More data (e.g., additional sites, more sampling events throughout the year) are needed in this creek to determine if suspended solids loads are contributing to impairment of beneficial uses. The stream is also a source of phosphorus and suspended solids to Bear River. Load allocations are 152 kg/year for TP and 64,708 kg/year for TSS (Table 1-3).

Weston Creek – This stream is listed on the §303(d) list for flow, nutrients, and sediment (Table 1-1). As mentioned earlier, no TMDLs were written for stream reaches affected by flow alteration. Assessment of BURP data indicates the stream is not supporting its beneficial uses. Limited core sampling showed higher than optimum levels of sediment within the streambed. The primary beneficial use affected is coldwater aquatic life. Possible pollutant sources are agriculture and livestock grazing. Additional sediment sources may include the in-stream channel and excessively eroding stream banks. The only time period when Weston Creek did not exceed target concentrations for either phosphorus or suspended solids was during lower basin runoff. On an annual basis, the stream exceeded the target concentration for phosphorus, but not for suspended solids. More data (e.g., additional sites, more sampling events throughout the year, estimates of bedload sediment, riparian condition, bank stability) are needed in this creek to better refine total sediment load and determine its contribution to beneficial use impairment. The stream is also a source of phosphorus and suspended solids to Bear River. Load allocations are 577 kg/year for TP and 432,441 kg/year for TSS (Table 1-3).

Cub River – This stream from Sugar Creek to Idaho-Utah state line is listed on the §303(d) list for flow, nutrients, and sediment (Table 1-1). As mentioned earlier, no TMDLs were written for stream reaches affected by flow alteration. Assessment of BURP data indicates the stream is not supporting its beneficial uses. Limited core sampling showed higher than optimum levels of sediment within the streambed. The primary beneficial uses affected are coldwater aquatic life and salmonid spawning. Franklin waste water treatment plant is a source of nutrients in Cub River. Other possible pollutant sources are agriculture and livestock grazing. Additional sediment sources may include the in-stream channel and excessively eroding stream banks. Load allocations are 3,086 kg/year for TP and 2,313,413 kg/year for TSS (Table 1-3).

Maple Creek – This tributary to Cub River is listed on the §303(d) list for unknown pollutants and bacteria (Table 1-1). Assessment of BURP data indicates that the stream supports its beneficial uses except contact recreation, therefore a TMDL was written only for E. coli. It will be recommended that on future §303(d) lists Maple Creek be listed only for bacteria. Based on the state water quality standard for *E. coli* (Table 1-2), the annual load allocation is 821,289,820,442 organisms per year (Table 1-3), not to exceed a monthly geometric mean of 126 organisms/100 ml.

Worm Creek – This stream is listed on the §303(d) list for unknown pollutants (Table 1-1). Assessment of BURP data indicates the stream is not supporting its beneficial uses. Limited core sampling did not show higher than optimum levels of sediment within the streambed at an upstream site on the national forest. The primary beneficial use affected is coldwater aquatic life. Preston waste water treatment plant is a source of nutrients in Worm Creek. Other possible pollutant sources are agriculture and livestock grazing. Additional sediment sources may include the in-stream channel and excessively eroding stream banks. Load allocations are 632 kg/year for TP and 442,486 kg/year for TSS (Table 1-3).

Malad River – This stream is listed on the §303(d) list for sediment (Table 1-1). Assessment of BURP data confirms that the stream is not supporting beneficial uses. The primary beneficial use affected is coldwater aquatic life. Possible pollutant sources are agriculture and livestock grazing. Additional sediment sources may include the in-stream channel and excessively eroding stream banks. Data indicate Malad River exceeded target concentrations for both suspended solids and phosphorus (in compliance with Utah's target concentration) at various times of the year. Load allocations were recommended for mainstem Malad River at two sites (Table 1-3) – 3700 South (373 kg/year for TP and 218,098 kg/year for TSS) and at the Idaho-Utah state line (5,535 kg/year for TP and 5,045,955 kg/year for TSS).

Little Malad River – This tributary to Malad River is listed on the §303(d) list for sediment (Table 1-1). Assessment of BURP data confirms that the stream is not supporting beneficial uses. The primary beneficial use affected is coldwater aquatic life. Possible pollutant sources are agriculture and livestock grazing. Additional sediment sources may include the in-stream channel and excessively eroding stream banks. Data indicate Little Malad River did not exceed the target concentration for suspended solids. More data (e.g., additional sites, more sampling events throughout the year, estimates of bedload sediment, riparian condition, bank stability) are needed in this river to better refine total sediment load and determine its contribution to beneficial use impairment. The stream is also a source of phosphorus and suspended solids to Malad River. Load allocations are 214 kg/year for TP and 88,118 kg/year for TSS (Table 1-3).

Wright Creek – This tributary of Little Malad River is listed on the §303(d) list for sediment (Table 1-1). Assessment of BURP data confirms that the stream is not supporting beneficial uses. The primary beneficial uses affected are coldwater aquatic life and salmonid spawning. Possible pollutant sources are agriculture, livestock grazing, and mining activity. Additional sediment sources may include the in-stream channel and excessively eroding stream banks. Data indicate Wright Creek exceeded the target concentration for suspended solids only during lower basin runoff. On an annual basis, however, the stream does not exceed the target concentration for suspended solids. More data (e.g., additional sites, more sampling events throughout the year, estimates of bedload sediment, riparian condition, bank stability) are needed in this creek to better refine total sediment load and determine its contribution to beneficial use impairment. The stream is also an indirect source of phosphorus and suspended solids to Malad River. Load allocations are 175 kg/year for TP and 147,213 kg/year for TSS (Table 1-3).

Dairy Creek – This tributary to Wright Creek is listed on the §303(d) list for unknown pollutants (Table 1-1). Assessment of BURP data confirms that the stream is not supporting beneficial uses. The primary beneficial use affected is coldwater aquatic life. Possible pollutant sources are agriculture and livestock grazing. Additional sediment sources may include the in-stream channel and excessively eroding stream banks. However, data were not sufficient for a load analysis of sediment, nutrients, or any other possible pollutant; therefore, no TMDL was done. To develop a load analysis, data will be collected in 2006 after which a TMDL will be written in 2007.

Elkhorn Creek – This tributary to Little Malad River is listed on the §303(d) list for unknown pollutants (Table 1-1). Assessment of BURP data confirms that the stream is not supporting beneficial uses. The primary beneficial use affected is coldwater aquatic life. Possible pollutant sources are agriculture and livestock grazing. Additional sediment sources may include the in-stream channel and excessively eroding stream banks. Data indicate Elkhorn Creek exceeded target concentrations for both phosphorus and suspended solids during winter base flow. On an annual basis, however, the stream does not exceed the target concentration for either phosphorus or suspended solids. Thus, it would appear that if phosphorus or suspended solids levels contribute to impairment of beneficial uses in Elkhorn Creek, the critical time period is winter base flow. More data (e.g., additional sites, more sampling events throughout the year) are needed in this creek to determine factors leading to impairment of beneficial uses. The stream is also an indirect source of phosphorus and suspended solids to Malad River. Load allocations are 46 kg/year for TP and 60,495 kg/year for TSS (Table 1-3).

Samaria Creek – This tributary to Malad River is listed on the §303(d) list for nutrients and sediment (Table 1-1). Because the stream was dry when the BURP protocol was attempted, the resultant assessment of that data not surprisingly indicated the stream was not supporting its beneficial uses. Assessment of BURP data to establish support of beneficial uses was designed for streams with perennial flow. Samaria Creek could at best be considered intermittent in flow. State water quality standards require intermittent streams to meet beneficial uses during optimum flow periods, which for cold water aquatic life is equal to or greater than one cfs. According to Dave Hull (BURP Coordinator, DEQ/Pocatello, personal communication), flow in Samaria Creek is less than one cfs and so it is recommended the stream be removed from future §303(d) lists.

Devil Creek – This tributary to Malad River is listed on the §303(d) list for nutrients and sediment (Table 1-1). Assessment of BURP data confirms that the stream is not supporting beneficial uses. The primary beneficial use affected is coldwater aquatic life. Possible pollutant sources are agriculture and livestock grazing. Additional sediment sources may include the in-stream channel and excessively eroding stream banks. Data indicate Devil Creek exceeded the target concentration for phosphorus, but not suspended solids. More data (e.g., additional sites, more sampling events throughout the year, estimates of bedload sediment, riparian condition, bank stability) are needed in this creek to better refine total sediment load and determine its contribution to beneficial use impairment. The stream is also a source of phosphorus and suspended solids to Malad River. Load allocations are 67 kg/year for TP and 11,854 kg/year for TSS (Table 1-3).

Deep Creek – This tributary to Malad River is listed on the §303(d) list for unknown pollutants (Table 1-1). Assessment of BURP data confirms that the stream is not supporting beneficial uses. The primary beneficial use affected is coldwater aquatic life. Possible pollutant sources are agriculture, livestock grazing, and urban activities. Additional sediment sources may include the in-stream channel and excessively eroding stream banks. Data indicate that target concentrations for either phosphorus or suspended solids were not exceeded during any hydrologic period. Thus, it would appear that neither phosphorus nor suspended solids levels contribute to impairment of beneficial uses in Deep Creek. More data (e.g., additional sites, more sampling events throughout the year) are needed in this creek to determine factors leading to impairment of beneficial uses. The stream is also a source of phosphorus and suspended solids to Malad River. Load allocations are 23 kg/year for TP and 4,335 kg/year for TSS (Table 1-3).

1.2 Point Sources

Phosphorus and suspended solids wasteload allocations were recommended for point sources. It is also expected that these point sources meet other water quality standards requirements (e.g., ammonia).

Montpelier waste water treatment plant – This point source contributes nutrients to Bear River. Based on phosphorus and suspended solids target concentrations (Table 1-2), wasteload allocations are 17 kg/yr and 6,790 kg/yr, respectively (Table 1-3). At the current wasteload allocation, a wasteload reduction of 227 kg/yr of TP is required. No reduction in suspended solids is necessary at this time.

Soda Springs waste water treatment plant – This point source contributes nutrients to Bear River. Based on TP and TSS target concentrations (Table 1-2), wasteload allocations are 54 kg/yr and 32,217 kg/yr, respectively (Table 1-3). At the current wasteload allocation, a wasteload reduction of 844 kg/yr of TP is required. No reduction in suspended solids is necessary at this time.

Clear Springs Foods – This point source does not appear to contribute phosphorus or suspended solids to the Bear River at levels above target concentrations (Table 1-2). Annual wasteload allocations for TP and TSS are 550 kg and 78,824 kg, respectively (Table 1-3). Seasonal wasteload allocations for phosphorus are: 188 kg for winter (Jan-Mar); 84 kg for spring (Apr-Jun); 85 kg for summer (Jul-Sep); and, 193 kg for fall (Oct-Dec).

Grace waste water treatment plant – This point source contributes nutrients to Bear River. Based on TP and TSS target concentrations (Table 1-2), wasteload allocations are 4 kg/yr and 1,409 kg/yr, respectively (Table 1-3). At the current wasteload allocation, a wasteload reduction of 69 kg/yr of TP is required. No reduction in suspended solids is necessary at this time.

Bear River Trout Farm – This point source does not appear to contribute phosphorus or suspended solids to the Bear River at levels above target concentrations (Table 1-2). Annual wasteload allocations for TP and TSS are 848 kg and 89,301 kg, respectively (Table 1-3). Seasonal wasteload allocations for phosphorus are: 220 kg for winter (Jan-Mar); 330 kg for spring (Apr-Jun); 149 kg for summer (Jul-Sep); and, 149 kg for fall (Oct-Dec).

Grace Fish Hatchery – This point source does not appear to contribute phosphorus or suspended solids to Whiskey Creek at levels above target concentrations (Table 1-2). Annual wasteload allocations for TP and TSS are 135 kg/yr and 70,548 kg/yr, respectively (Table 1-3). Seasonal wasteload allocations for phosphorus are: 54 kg for winter (Jan-Mar); 41 kg for spring (Apr-Jun); 21 kg for summer (Jul-Sep); and, 19 kg for fall (Oct-Dec).

Preston waste water treatment plant – This point source contributes nutrients to Worm Creek. Based on TP and TSS target concentrations (Table 1-2), wasteload allocations are 50 kg/yr and 30,142 kg/yr, respectively (Table 1-3). At the current wasteload allocation, a wasteload reduction of 1,501 kg/yr of TP is required. No reduction in suspended solids is necessary at this time.

Franklin waste water treatment plant – This point source contributes nutrients to Cub River. Based on TP and TSS target concentrations (Table 1-2), wasteload allocations are 4 kg/yr and 2,255 kg/yr, respectively (Table 1-3). At the current wasteload allocation, a wasteload reduction of 165 kg/yr of TP is required. No reduction in suspended solids is necessary at this time.

1.3 Water bodies Recommended for Delisting

Assessment of BURP data indicate several streams currently on the §303(d) list are meeting their beneficial uses for coldwater aquatic life. These streams include North, St. Charles, and Maple creeks. We recommend that North and St. Charles creeks be removed from future §303(d) lists. Although Maple Creek supports coldwater aquatic life, it still has bacteria problems. Thus, it is recommended that Maple Creek be listed only for bacteria problems on future §303(d) lists. As both Meadow and Samaria creeks are intermittent streams with optimum flows less than one cfs, and no data were reviewed to suggest that metals are affecting beneficial uses in Meadow Creek, it is suggested that these streams be removed from future §303(d) lists.

1.4 Possible Additions to §303(d) List

Water quality data examined during preparation of the TMDL imply there are other water bodies which may be experiencing impairment of beneficial uses due to levels of phosphorus and suspended solids above target levels recommended for Bear River Basin. These streams include: Georgetown, Soda, and Trout creeks. Assessment of BURP data indicated that Georgetown and Soda creeks are not supporting beneficial uses. Data are not available to indicate whether pollutants are impairing beneficial uses within Trout Creek.

BURP data assessment indicated that several other non §303(d)-listed streams are not supporting their beneficial uses. The following did not support coldwater aquatic life and/or salmonid spawning in at least a portion of the watershed and should be considered for inclusion on future §303(d) lists: Pegram Creek, Sheep Creek, Sulphur Canyon, Wilson Creek, Eightmile Creek, Liberty Creek, Paris Creek, Indian Creek, Little Beaver Creek, Jenkins Hollow, Swan Lake Creek, West Cherry Creek, Susan Hollow, and Indian Mill Creek.

Several streams exceeded water quality standards for bacteria and are recommended for inclusion on future §303(d) lists. These water bodies include: Mill Creek, Whiskey Creek, Georgetown Creek, Stockton Creek, Swan Lake Creek, Alder Creek, Smith Creek, Malad River, Devil Creek, Little Malad River, Wright Creek, and Dairy Creek.

Other streams for which assessment of BURP data indicated non-support of beneficial uses include: Sleight Canyon, Steel Canyon, Trail Hollow, Black Canyon, Four Mile Canyon, Henderson Creek, Campbell Creek, and Evans Creek. Further investigation of these streams showed them to be dry, and thus they would be considered intermittent (Dave Hull, BURP Coordinator, DEQ/Pocatello, personal communication). The assessment process for BURP data in determining support of beneficial uses was designed for perennial, not intermittent, streams. These streams will not be listed until an appropriate protocol for assessing intermittent streams indicates non-support of beneficial uses.

1.5 Data Gaps

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

- Natural background levels of sediment and phosphorus
- Regular stream flow information throughout the year from tributaries
- Link between reduction in water column sediment and reduction in depth fines
- Depth fines data throughout listed streams through several water years realizing that riffle area sites are subject to change from hydraulic activity
- Bedload sediment data, which would supplement suspended (water column) sediment data
- Refinement of nutrient levels necessary to support beneficial uses
- Depth fines and BURP sampling in Bear River reaches with no such data

1.6 Implementation Strategies

Any implementation plan will concentrate on reducing suspended sediment and phosphorus. For point sources such as waste water treatment plants, it is expected that future NPDES permits will include recommended reductions in nutrients (i.e., phosphorus). Reduction in pollutant loadings for nonpoint sources will most likely require a mix of policy changes, program initiatives, and implementation of Best Management Practices.

Certain state agencies have been designated to work with particular industries with the potential for contributing nonpoint source pollutants. For example, the Idaho Soil Conservation Commission has the responsibility to work with agriculture and the livestock industry on development of their implementation plan to meet recommendations set out in the Bear River Basin TMDL.

No timelines are presented as to when water quality will improve to the point of supporting beneficial uses. Such dates are dependent on a myriad of things such as financial support, landowner cooperation, and geological processes (e.g., sufficient stream flows to mobilize sediment and move it out of the system). The hope would be to see significant changes toward meeting goals of the TMDL within ten years.

Three different load reduction strategies for phosphorus are presented. Each strategy would require an increasing amount of effort to reduce incoming phosphorus to the system. The strategies concentrate on reducing phosphorus associated with agricultural and feedlot activities.

In this analysis, we have chosen to illustrate the results graphically as well as in a tabular format.

1.7 Advisory Group Concurrence

The Bear River/Malad River Subbasin Assessment and Total Maximum Daily Load Plan was begun and essentially finished prior to passage of legislation amending Idaho Code §39-3611 requiring concurrence of the local Watershed Advisory Group (WAG) prior to submittal of the plan. Unfortunately, establishment of any WAG in the Bear River Basin was unsuccessful. In the absence of a WAG, such responsibilities fell to the Basin Advisory Group (BAG). During the development of the TMDL, the BAG was kept apprised as the plan progressed. Although the BAG did not formally approve the plan, at no time did BAG members object to the plan as it went through the various stages required for submittal to EPA. Any questions put forth by BAG members, and other concerned citizens, were answered either through the public meetings held in conjunction with local soil and water conservation districts or via response to public comments found as an appendix to the plan. This page intentionally left blank for correct doubled-sided printing

2 Subbasin Assessment

The Bear River spans over 550 miles, draining a 470,000 acre watershed that encompasses parts of three states (Figure 2-1). The river's headwaters are in the Uinta mountains in Utah. From there, the river travels north into Wyoming, moving back into Utah once before returning to Wyoming. The Smiths Fork located in Wyoming, enters the river about 290 river miles above the Great Salt Lake (the final destination for Bear River water). This tributary approximately doubles the discharge of the Bear River to an average flow of 450 cfs. The Thomas Fork, which is partially located in Idaho, enters the Bear River about 23 river miles (Rm) farther downstream, just after the river flows into Idaho. At Stewart Dam, northeast of Bear Lake (Rm 227), the river is diverted into Bear Lake, where water is stored for irrigation use and used for power generation as a secondary benefit. During runoff or extended high water periods, water may short circuit through Mud Lake north of Bear Lake, and re-enter the Bear River without actually entering Bear Lake. When water is released from Bear Lake it travels northwest through Idaho to Alexander Reservoir, near the town of Soda Springs. From that point, the river veers south, traveling through the agricultural lands of Gem Valley and passing through Oneida Reservoir before entering Cache Valley. Within Cache Valley, several major tributaries enter the river, including the Cub River, the Logan River, the Blacksmith River and the Little Bear River. These tributaries increase the flow in the river from an average annual discharge at the state line of 1,150 cfs to 1,500 cfs below Cutler Reservoir. After passing through Cutler Reservoir, the Bear leaves Cache Valley, entering the northern end of the Great Salt Lake Valley. It travels south from that point, collecting discharge from the Malad River before flowing into the Bear River Bird Refuge and ultimately into the Great Salt Lake, with an average annual discharge of 1,760 cfs.

The river's flow and irrigation diversions are under the control of the Bear River Compact and regulated by the Bear River Commission. Water quality within the river falls under the jurisdiction of the states of Idaho, Utah, and Wyoming. This investigation focused on the Idaho portion of the Bear River from the Idaho-Wyoming state line (Rm 267) down to the Idaho-Utah state line (Rm 96.6). We refer to this section of the Bear River in Idaho as the Idaho Bear River basin. This reach of the Bear River has over 2,814 square miles of watershed. Additionally, it contains a stream network that is 5,087 linear miles, of which 1,469 miles (2 %) are perennial. The overall goal of this study was as follows:

> ***Conduct a quantitative characterization of the lower portion of the Idaho Bear River basin and to evaluate water quality limited segments of the mainstem and perennial streams.***

To that end, a number of objectives were established. These objectives represented specific areas of data collection and analysis. The objectives were:

1) Determine the physical and biological characteristics of the watershed;

2) Summarize historical water quality studies and determine water quality limited segments in the subbasin; and

3) Conduct a pollution source inventory utilizing a mass balance approach.

The activities associated with each objective will be described in the following.

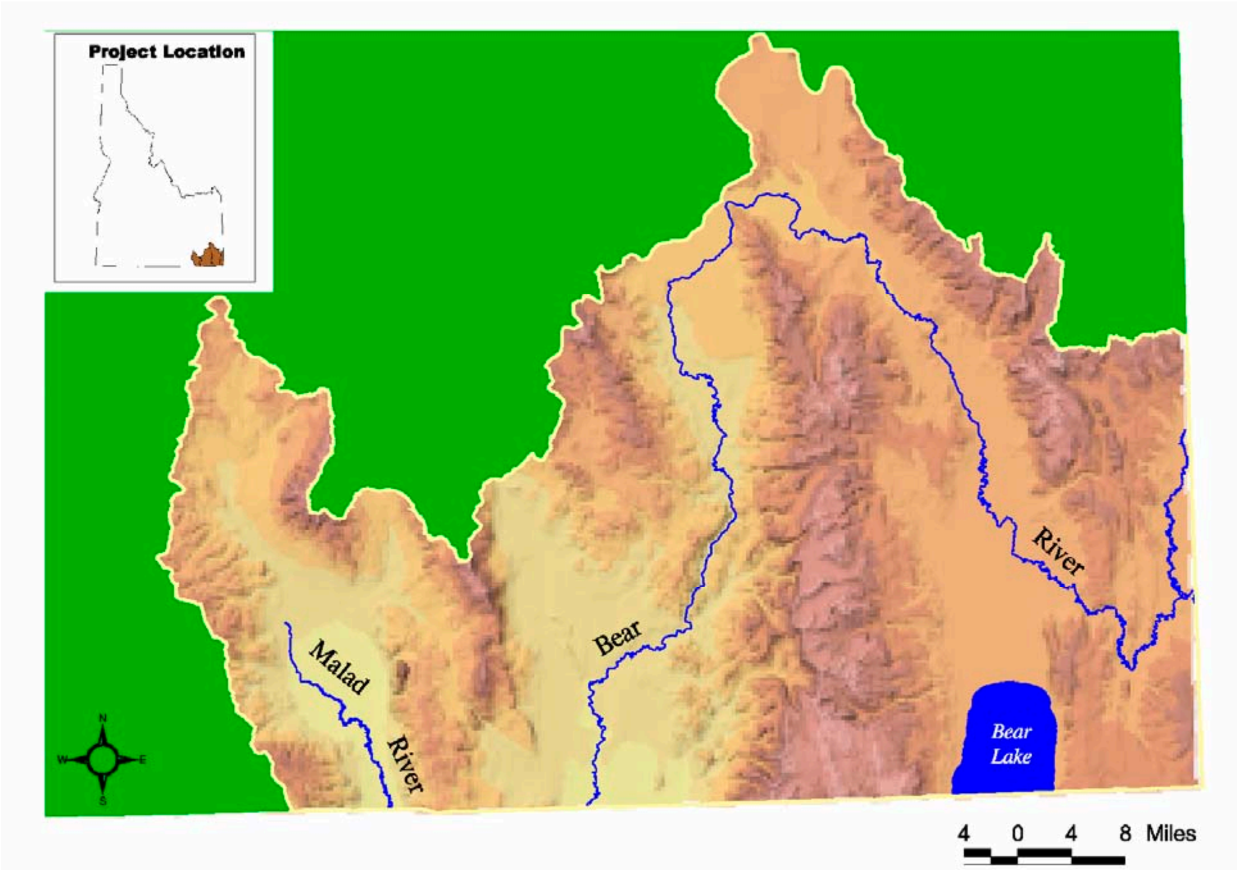


Figure 2-1. Bear River Watershed.

2.1 Characterization of the Watershed

A large number of data sources were used to characterize Idaho's Middle Bear River watershed. These data included drainage area, hydrology, precipitation, topography, vegetation, soils, and geology.

2.1.1 Physical and Biological Characteristics

Climate

The climate within the Bear River basin has been characterized as semiarid continental in that the winters are cold, summers are hot, and precipitation is very low (USGS 1969). The mean annual temperature at the five climatological stations in the basin averages 5.9 ° Celsius (47 °F). Typically, the frost-free growing season lasts for about 100 days between late May and early September (Figure 2-2). Maximum temperatures occur in July (approximately 20°C) with the lows in December, January and February (-7.5°C). Montpelier, located in the upper drainage basin is usually 2.5°C cooler than Preston, located at the lower end of the basin.

Precipitation within the Bear River basin is distributed unevenly with regards to both time and area. Most of the water within the basin is derived from winter snowfall. Data obtained at the U. S. Weather Bureau stations at Preston, Grace, and Montpelier show that the average monthly precipitation ranges from a high of 1.93 inches in April to a low of 0.65 inches in July (Figure 2-3). The range in precipitation at these stations is from about 8.5 inches to about 23 inches (Figure 2-4). The 50 percent exceedance value for Preston, meaning half the time one could expect total precipitation to exceed this value, is 16 inches per year while Grace and Montpelier are close to 14 inches annually. Over 50 percent of the surface area of the Idaho Bear River basin receives between 10-20 inches of annual precipitation (Figure 2-5). The areal distribution of precipitation is influenced by elevation and ranges from 10 inches at low elevations to over 50 inches at higher altitudes (Figure 2-6). Average precipitation over the entire Idaho Bear River basin is 3.3 million acre-feet annually.

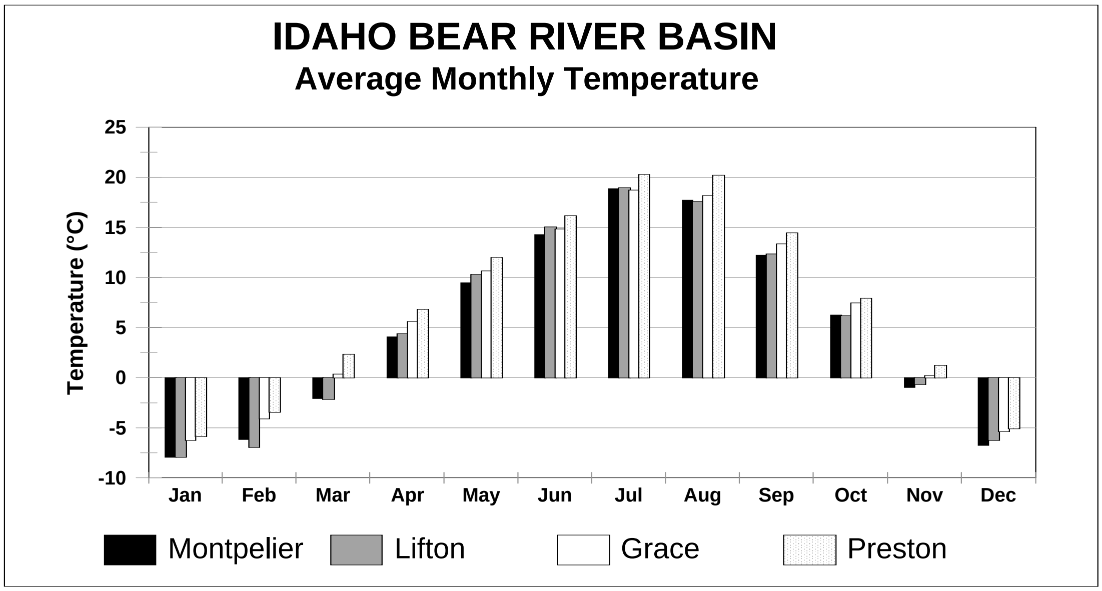


Figure 2-2. Average monthly temperatures for representative stations in the Idaho Bear River basin.

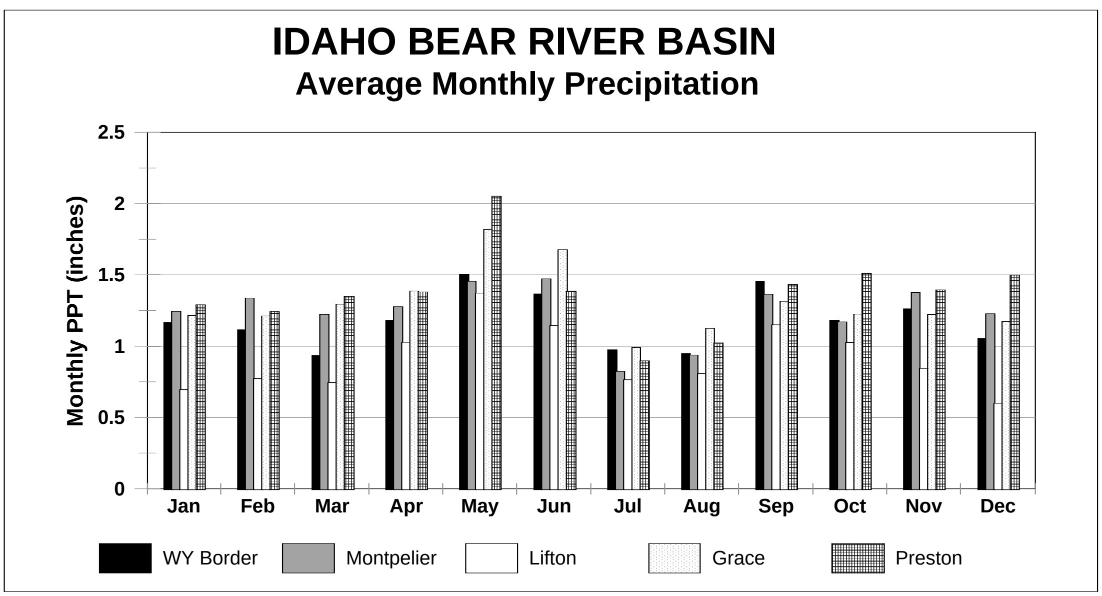


Figure 2-3. Average monthly precipitation at five historical stations in the Idaho Bear River basin.

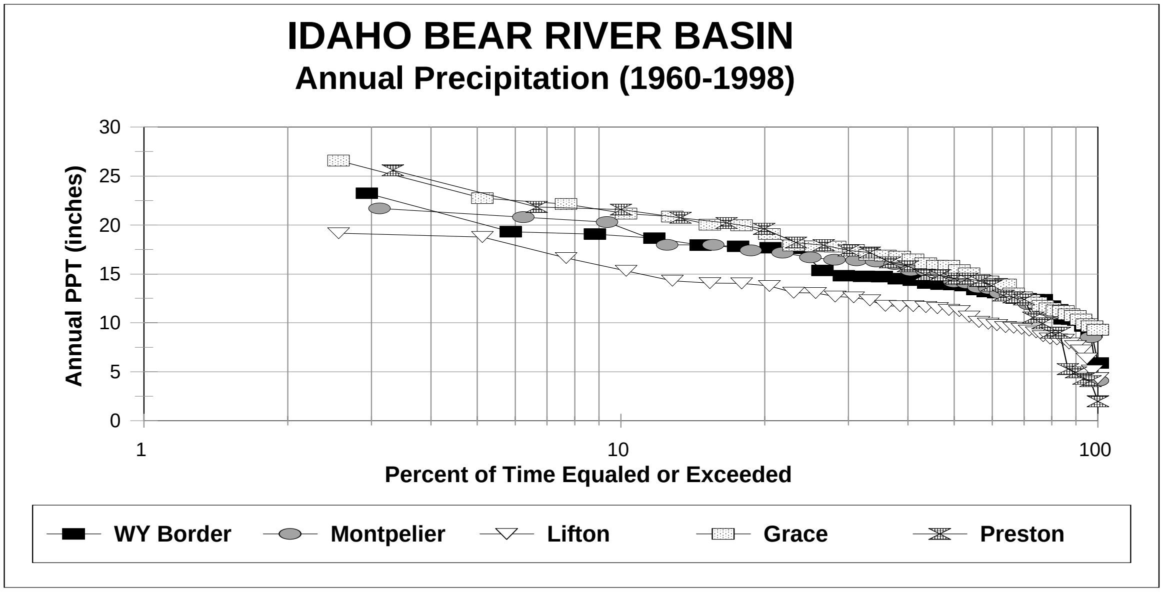


Figure 2-4. Annual precipitation for five stations in the Idaho Bear River basin.

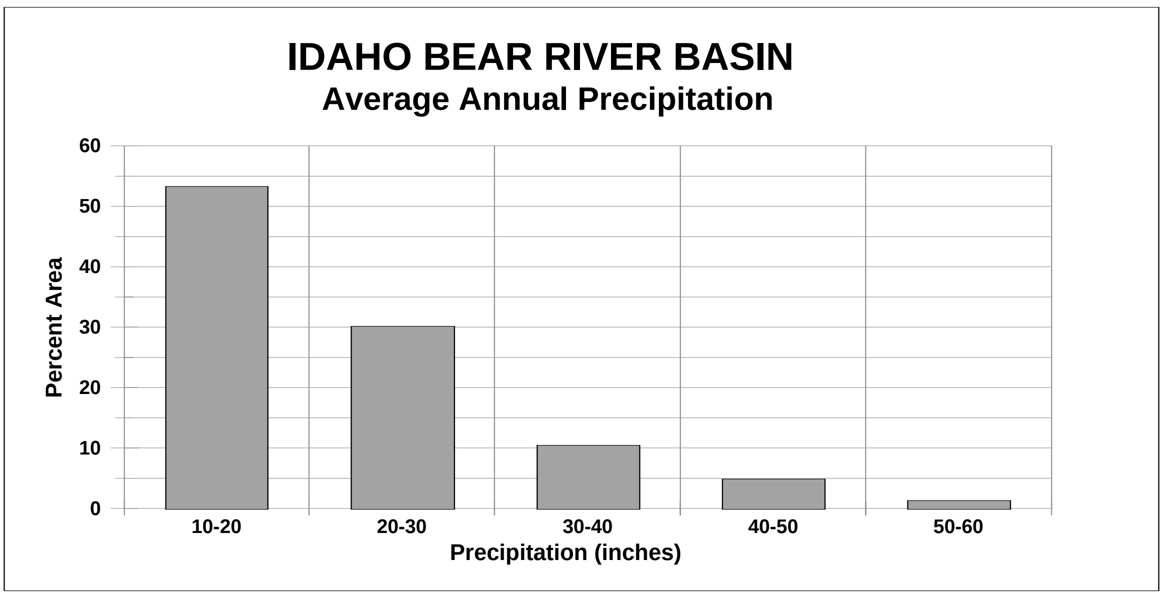


Figure 2-5. Distribution of precipitation classes in the Idaho Bear River basin.

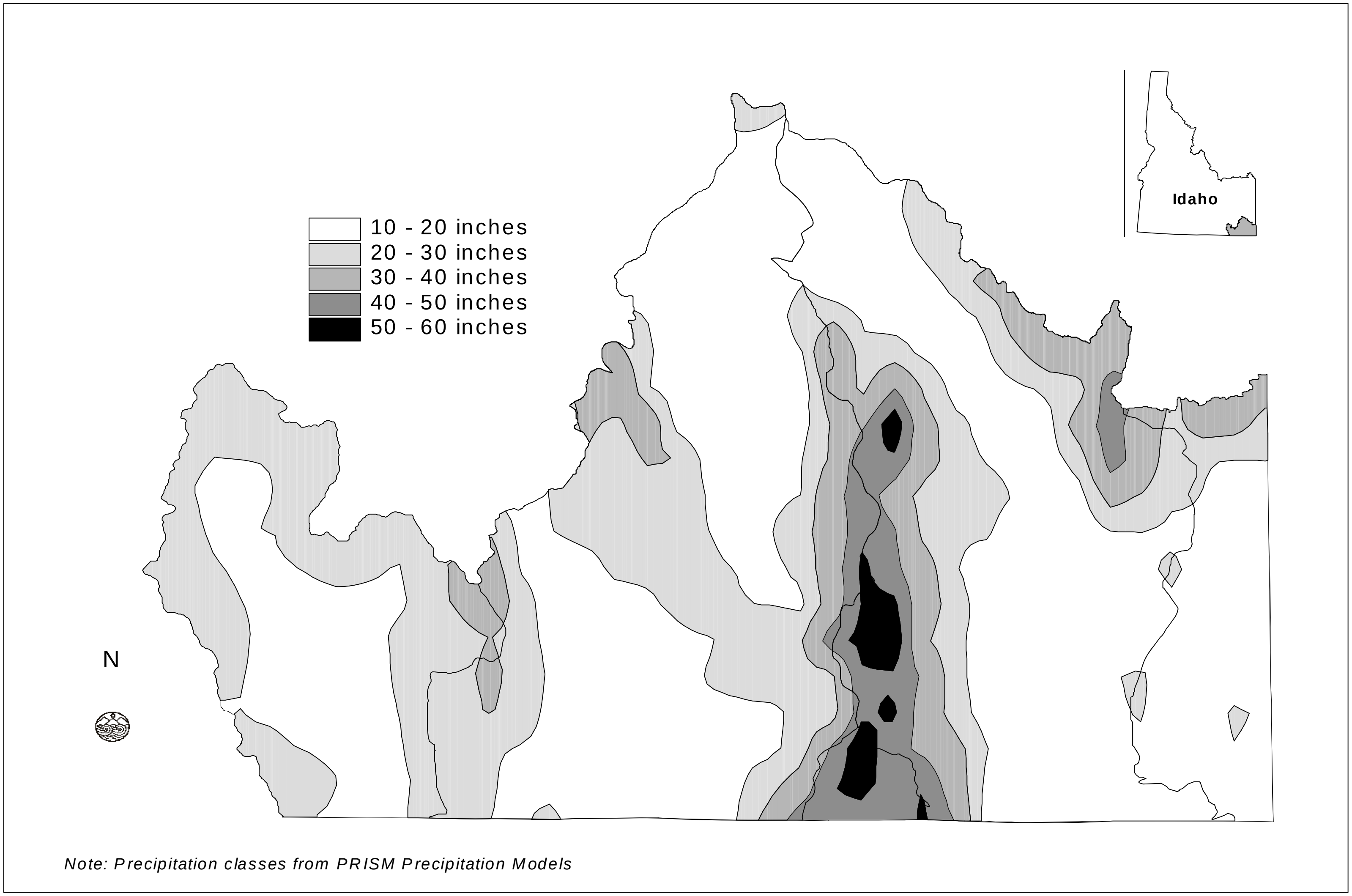


Figure 2-6. Geographical distribution of average annual precipitation.

Geology, Landform and Land Use Watershed Classification

Watershed characteristics were determined using a geographic information systems (GIS) based ecological classification system proposed by Jensen et al., 1989 and described in detail in the companion document by White Horse Associates, Inc. The ecological classification consisted of seven levels, ranging from broad classes based upon landscape characteristics to very refined classes of valley-bottom land form and riparian vegetation types.

Broad classes (ecoregion, geologic district, and subsection) were applied to the entire project area, whereas land type and valley bottom type were applied only to the target watersheds which were third order and greater. The valley-bottoms for some streams less than Order 3 in 303(d) watersheds were also identified. The most refined class (state) was applied only to the main course of the Bear River. The entire data set is available in the companion document. Summaries of all characteristics used in the statistical analysis described later in this section are provided in the following tables.

Geologic districts are areas of distinctive rock types or parent materials that are often associated with major structural forms. Six geologic districts were identified in the Bear River in Idaho. Sedimentary calcareous materials comprised mainly of limestone made up the largest material type (34%), followed by sedimentary sandstone (26%), unconsolidated alluvium and lake deposits (21%), volcanic (12%), metamorphic (5%), and water (0.2%). The geologic districts for the entire Idaho Bear River basin are shown in Figure 2-7.

Watersheds for monitoring stations on tributaries of the Bear River (T01 through T10, T14 through T22 and T24 through T28) were delineated and results summarized. Delineations of the tributary watersheds can be seen in the companion document produced by White Horse Associates. The following three tables of summarized data will be for these tributary watersheds. It should be emphasized that these tables include data for the tributary watersheds, not for the entire Idaho Bear River basin. Table 2-1 lists acreages for geologic districts within the tributary watersheds.

Subsections are areas with distinctive geomorphic character that often correspond with geologic districts. Four subsections were defined in the Idaho Bear River basin. The four subsections (geomorphic classes) were intersected with the five geologic districts to produce seven combinations that define the subsections. A map of resulting subsections in the entire Idaho Bear River basin can be seen in Figure 2-8. Within the 1.8 million acre watershed, fluvial lands (mountain valleys) made up 57.8 percent of the entire watershed followed by alluvial lands (broad valleys filled with eroded sediments) with 22.8 percent of the watershed area. The third subsection (lacustrine lands), which are valleys filled with Pleistocene Lake Bonneville sediments, comprised 12.9 percent of the watershed. The last category was Alpine glaciated lands with only 6.5 percent of the area. The spatial distribution of the subsections by tributary watershed can be seen in Table 2-2.

The valley bottomland types correspond to the site-specific characteristics associated with the drainage network. Site-specific characteristics included stream channels, flood plains, levees, stream terraces, and alluvial fans. The valley-bottom land types comprised about 168,642 acres (9.4%) of the Bear River basin in Idaho (Figure 2-9). For the entire Idaho Bear River basin, alluvial unconfined valley (59.1 %), Bear Lake (20.7%), and sedimentary V-shaped depositional canyons (10%) made up the largest categories of the valley bottom types encountered. The areas of the valley-bottom types for each tributary watershed are summarized in Table 2-3.

In addition to the ecological classification of the watershed characteristics, land uses within the immediate floodplain (valley bottoms) were also determined. General (Table 2-4) and specific land uses (Table 2-5, Table 2-6) for each tributary watershed were quantified.

As noted above, target watersheds were classified relative to the defined geology, subsection, valley bottom type and land use. In a similar manner, the watersheds between stations on the mainstem Bear River were summarized. The results of this summary can be seen in Table 2-7 through Table 2-10.

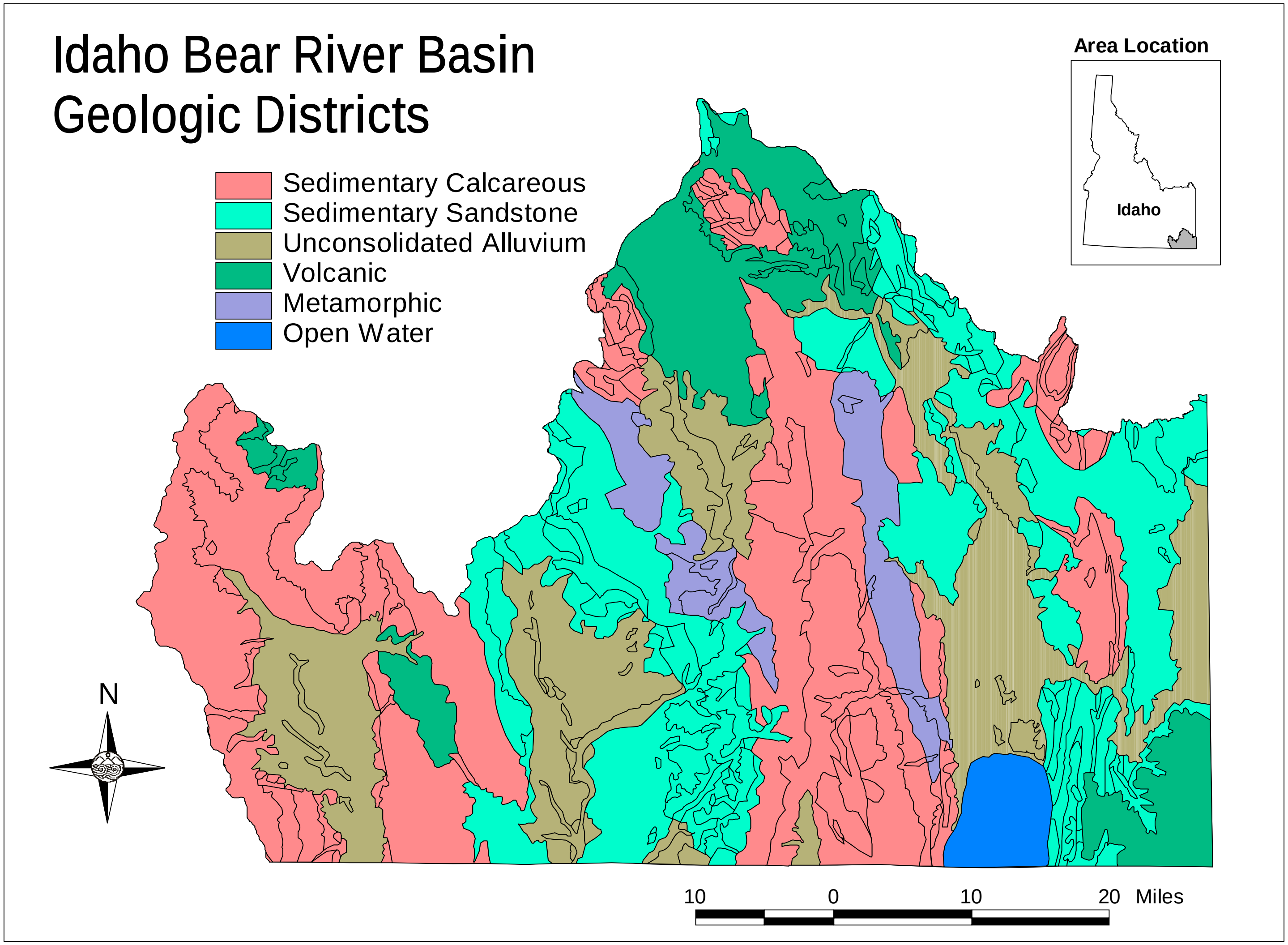


Figure 2-7. Geologic district areas for the Idaho Bear River basin.

Table 2-1. Areas (acres) of geologic districts for watersheds of tributary monitoring stations. See Figure 1-4 to Figure 1-8 for tributary location and Figure 2-16 for site location.

Site ID	Station Name	Sedimentary Calcareous	Sedimentary Sandstone	Unconsolidated Alluvium	Volcanic	Metamorphic	TOTAL
MR01	Malad River at 3700 S		8,162	7,079			15,241
MT01	Wright Creek	5,340			8,183		13,523
MT02	Elkhorn Creek	1,404		108			1,512
MT03	Deep Creek	14,854		4,772	10,258		29,884
MT04	Devil Creek	27,737		15,002	361		43,099
MT05	Little Malad River	102,588		17,506	2,917		123,011
T01	Thomas Fork	1,316	39,482	18,604			59,402
T02	Sheep Creek	4,819	9,581	1,069			15,469
T03	Ovid Creek	27,098	15,694	10,022		17,749	70,563
T04	Georgetown Creek	15,851	7,132	1,358			24,340
T05	Stauffer Creek	4,449	8,046	4,115		6,106	22,716
T06	Skinner Creek	2,994	276	1,530		2,316	7,116
T07	Pearl Creek	134	577	248		4,692	5,652
T08	Eightmile Creek	12,249	6,017	123		4,152	22,541
T09	Sulphur Canyon Creek		5,478		833		6,312
T10	Bailey Creek	1,547	3,109	45			4,702
T14	Soda Creek	1,281			17,052		18,333
T15	Densmore Creek	5,720		954		4,435	11,109
T16	Smith Creek			1,436		259	1,696
T17	Alder Creek			1,404		1,953	3,358
T18	Whiskey Creek			1,305	368		1,673
T19	Burton Creek		605	2,210		4,021	6,836
T20	Trout Creek	16,510		7,063	955		24,528
T21	Williams Creek	12,465		618			13,083
T22	Cottonwood Creek	12	33,200	235		13,767	47,215
T24	Mink Creek	20,564	13,418	5		6,691	40,679
T25	Battle Creek		15,645	23,671		2,013	41,329
T26	Deep Creek	6,984	46,625	33,238			86,848
T27	Fivemile Creek	5,260	2,547	4,376			12,183
T28	Weston Creek	25,567	13,766	3,202	6,538		49,073
TOTAL (ACRES)		**316,743**	**229,360**	**161,298**	**47,465**	**68,154**	**823,026**

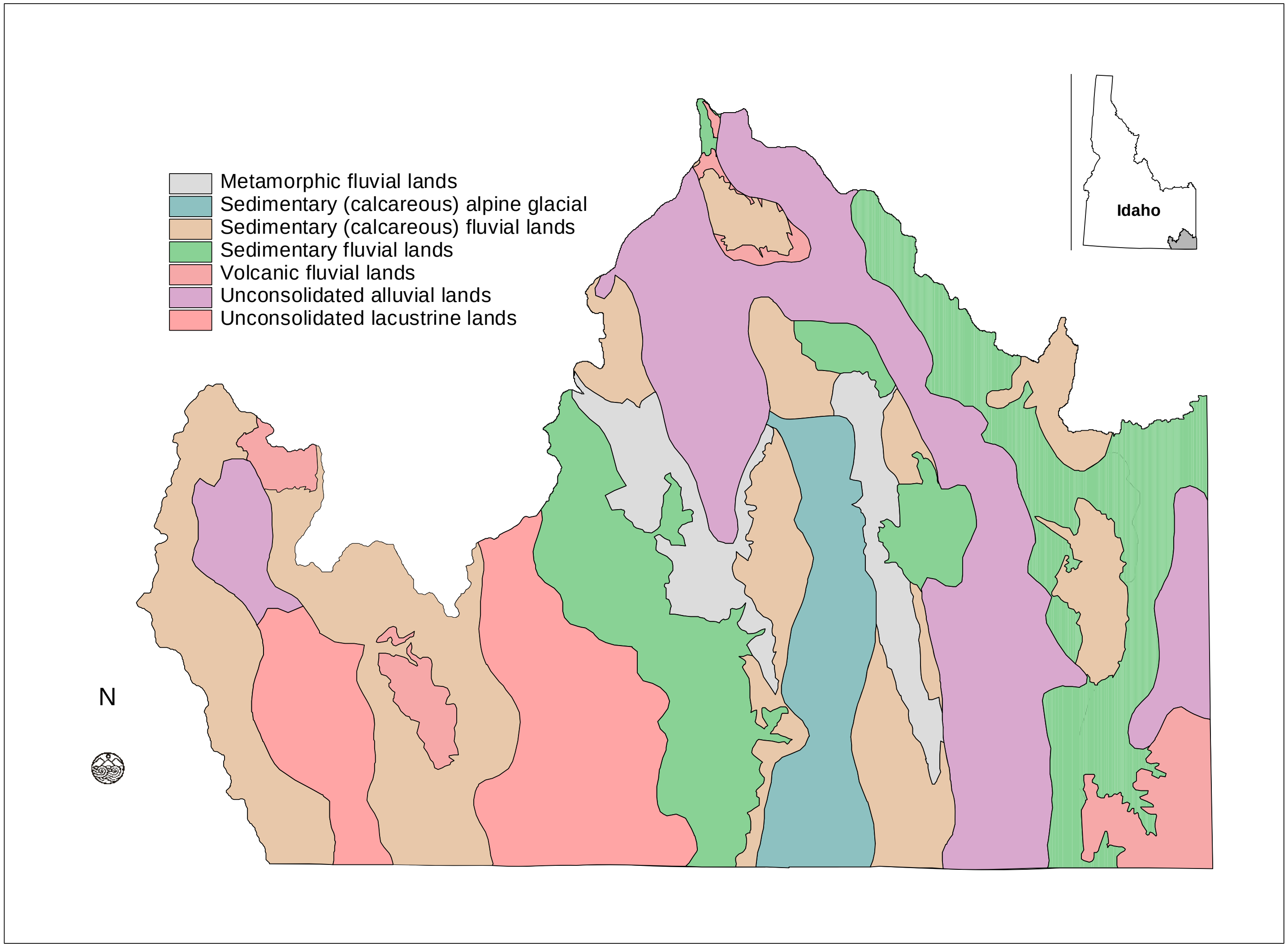


Figure 2-8. Subsection areas for the Idaho Bear River basin.

Table 2-2. Areas (acres) of subsections for watersheds of tributary monitoring stations. See Figure 1-4 to Figure 1-8 for tributary location and Figure 2-16 for site location.

Site ID	Station Name	Metamorphic fluvial lands	Sedimentary fluvial lands	Sedimentary (calc) alpine glacial	Sedimentary (calc) fluvial lands	Volcanic fluvial lands	Unconsolidated alluvial lands	Unconsolidated lacustrine lands	TOTAL AREA
MR01	Malad River at 3700 S				7,654			7,586	15,241
MT01	Wright Creek				4,416	8,504	603		13,523
MT02	Elkhorn Creek				843		669		1,512
MT03	Deep Creek				18,000	10,258		1,626	29,884
MT04	Devil Creek				30,617	361		12,122	43,099
MT05	Little Malad River				70,085	2,813	32,772	17,340	123,011
T01	Thomas Fork		35,175		1,558		22,669		59,402
T02	Sheep Creek		10,330		4,819		320		15,469
T03	Ovid Creek	16,518	16,261	26,095	1,775		9,914		70,563
T04	Georgetown Creek		6,994		15,853		1,493		24,340
T05	Stauffer Creek	5,464	6,321	676	5,507		4,748		22,716
T06	Skinner Creek	1,852		463	3,185		1,615		7,116
T07	Pearl Creek	4,664	573	96	128		192		5,652
T08	Eightmile Creek	3,029	5,345	6,297	7,076		795		22,541
T09	Sulphur Canyon Creek		5,425				886		6,311
T10	Bailey Creek		2,615		1,547		539		4,701
T14	Soda Creek				958	1,619	15,756		18,333
T15	Densmore Creek	5,236			5,720		153		11,109
T16	Smith Creek	1,435					261		1,696
T17	Alder Creek	2,877					480		3,358
T18	Whiskey Creek						1,673		1,673
T19	Burton Creek	5,196	605				1,034		6,836
T20	Trout Creek	2,205		8,040	8,498		5,785		24,528
T21	Williams Creek	443		4,424	8,042		174		13,083
T22	Cottonwood Creek	14,001	33,213						47,214
T24	Mink Creek	6,691	13,424	7,628	12,936				40,679
T25	Battle Creek	2,013	20,552					18,764	41,329
T26	Deep Creek		21,796		13,496			51,555	86,847
T27	Fivemile Creek				4,941			7,242	12,183
T28	Weston Creek				24,696	6,538		17,838	49,073
TOTAL (ACRES)		**71,623**	**178,631**	**53,719**	**252,349**	**30,094**	**102,532**	**134,072**	**823,020**

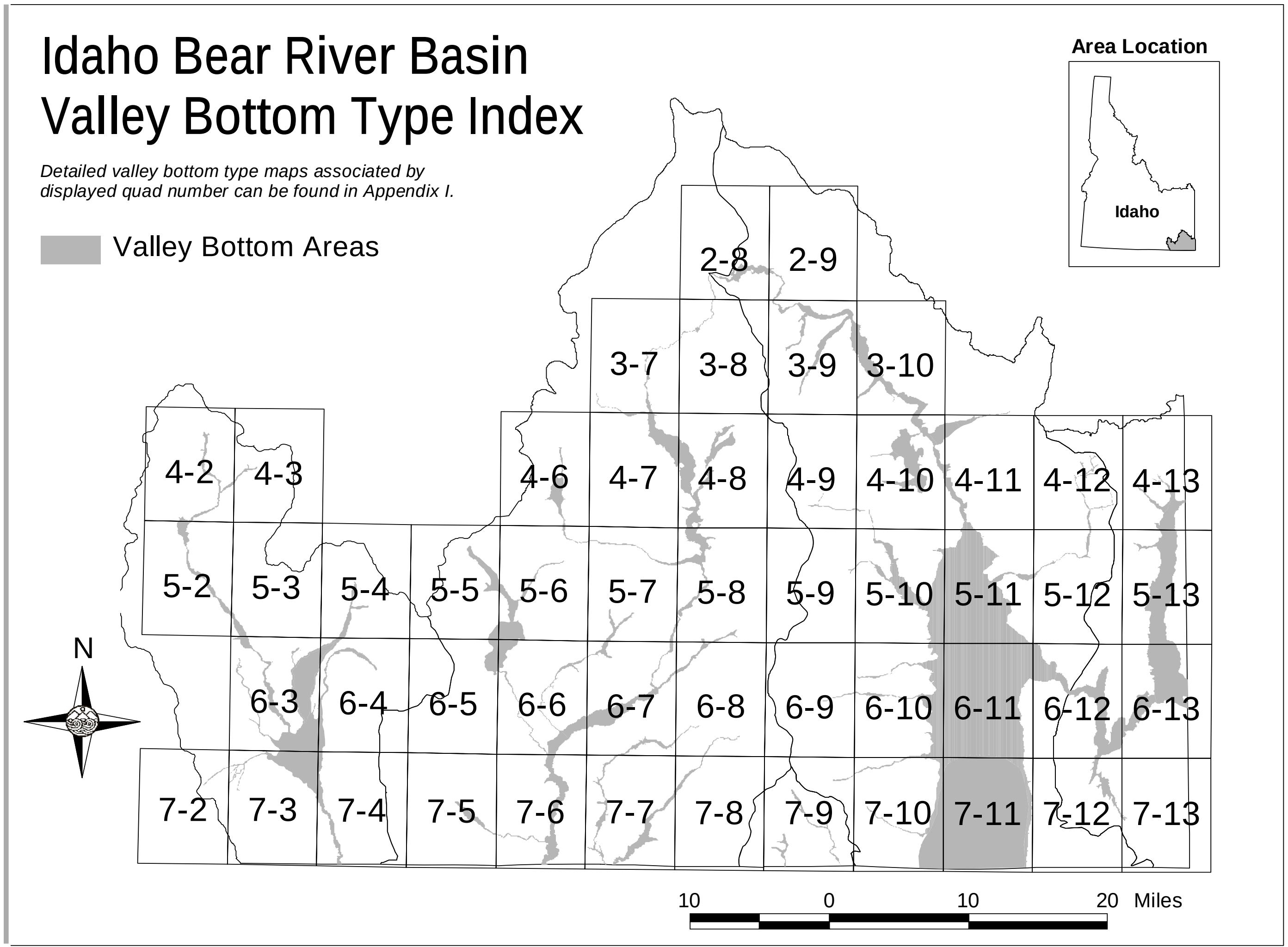


Figure 2-9. Map index for valley bottoms types in the Idaho Bear River basin.

Table 2-3. Areas of valley bottom types for watersheds of tributary monitoring stations. See Figure 1-4 to Figure 1-8 for tributary location and Figure 2-16 for site location.

Site ID	Station Name	Metamorphic		Sedimentary		Sedimentary (calc)		Volcanic	Alluvial		Lacustrine			TOTAL
		VE[1]	VD[1]	VE[1]	VD[1]	VE[1]	VD[1]	VD[1]	CV[1]	UV[1]	CD[1]	CV[1]	UV[1]	
MR01	Malad River at 3700 S										365.63			365.63
MT01	Wright Creek						165.47	138.36						303.83
MT02	Elkhorn Creek						2.71							2.71
MT03	Deep Creek						277.36	235.03				449.6	65.02	1027.01
MT04	Devil Creek						923.94				1154.2		2730.73	4808.86
MT05	Little Malad River					146.35	2759.52				290.39	1385	710.36	5291.62
T01	Thomas Fork				673.99					10663.94				11337.93
T02	Sheep Creek				582.24									582.24
T03	Ovid Creek	235.08		38	841.81	121.94				7354.15				8590.98
T04	Georgetown Creek			40.39	130.51				38.37	1231.51				1440.78
T05	Stauffer Creek				762.48	19.13	27.18		4.23	3165.28				3978.3
T06	Skinner Creek								44.87					44.87
T07	Pearl Creek				125.9				164.33					290.23
T08	Eightmile Creek				941.22	110.71			51.41					1103.34
T09	Sulphur Canyon Creek								0.92					0.92
T10	Bailey Creek			118.59	287.35				73.62					479.56
T14	Soda Creek							0.45						0.45
T15	Densmore Creek	35.99	18.99			18.64				221.53				295.15
T16	Smith Creek									45.95				45.95
T17	Alder Creek									11.22				11.22
T18	Whiskey Creek									20.27				20.27
T19	Burton Creek									204.48				204.48
T20	Trout Creek								1735.2					1735.18
T21	Williams Creek									143.74				143.74
T22	Cottonwood Creek	84.21	97.58	459.5						1558.8				2200.09
T24	Mink Creek				835.29				5.11					840.4
T25	Battle Creek			23.04	833.97				257.81		150.43	246.59		1511.84
T26	Deep Creek			106.85	270.12						362.43	2173.33	4123.24	7035.97
T27	Fivemile Creek											28.25		28.25
T28	Weston Creek									545.64	252.88	57.64		856.16
TOTAL (ACRES)		**355.28**	**116.57**	**786.37**	**6284.88**	**416.77**	**4156.18**	**373.84**	**2375.85**	**25166.51**	**2575.95**	**4340.41**	**7629.35**	**54577.96**

(1)VE: V-erosional canyon, VD: V-depositional canyon, CV: confined valley, UV: unconfined valley, CD: confined draw, calc: calcareous

Table 2-4. General land use for watersheds of tributary monitoring stations. See Figure 1-4 to Figure 1-8 for tributary location and Figure 2-16 for site location.

Site ID	Station Name	GENERAL LAND USE CATEGORY							
		Urban	Agriculture	Rangeland	Forest	Water	Wetland	Barren	TOTAL
MR01	Malad River at 3700 S	51	8,692	6,458		28		11	15,241
MT01	Wright Creek	21	3,368	10,110				24	13,523
MT02	Elkhorn Creek		449	1,063					1,512
MT03	Deep Creek	590	8,246	21,016		33			29,884
MT04	Devil Creek	1,339	23,457	18,066	90	136		11	43,099
MT05	Little Malad River	231	57,291	64,607	496	189	174	22	123,011
T01	Thomas Fork	18	2,056	44,145	10,354		2,828		59,401
T02	Sheep Creek		1,972	13,227			270		15,469
T03	Ovid Creek	157	17,700	21,308	30,035	74	1,287		70,563
T04	Georgetown Creek	236	1,780	8,309	13,133			335	23,793
T05	Stauffer Creek	23	4,745	9,465	8,423		59		22,716
T06	Skinner Creek	11	1,155	2,511	2,992	376	70		7,116
T07	Pearl Creek		108	1,644	861	3,039			5,652
T08	Eightmile Creek		1,388	4,249	6,989	9,494	422		22,541
T09	Sulphur Canyon Creek		855	2,328	3,063		45	20	6,311
T10	Bailey Creek	76	542	1,119	1,047	1,917			4,701
T14	Soda Creek	297	11,059	5,776	281	205	557	159	18,335
T15	Densmore Creek		2,222	4,185	4,664			37	11,109
T16	Smith Creek		804	608	284				1,696
T17	Alder Creek		1,376	1,298	683				3,357
T18	Whiskey Creek		1,544	129					1,673
T19	Burton Creek		1,889	1,878	3,069				6,836
T20	Trout Creek		6,626	8,315	9,587				24,528
T21	Williams Creek		478	1,569	11,036				13,083
T22	Cottonwood Creek		5,292	18,819	23,088	15			47,214
T24	Mink Creek		8,289	11,272	21,119				40,679
T25	Battle Creek	10	26,657	11,888	2,373	401			41,329
T26	Deep Creek	174	42,429	39,724	2,643	589	1,288		86,847
T27	Fivemile Creek	69	6,916	5,156	27			15	12,183
T28	Weston Creek	181	23,566	24,705	454	97	69		49,073
TOTAL (ACRES)		**3,485**	**272,951**	**364,949**	**156,791**	**16,594**	**7,070**	**634**	**822,474**

Table 2-5. Specific land use for watersheds of tributary monitoring stations—urban or built-up, agricultural, rangeland. See Figure 1-4 to Figure 1-8 for tributary location and Figure 2-16 for site location.

Site ID	Station Name	Urban or Built Up Land						Agricultural Land		Rangeland		
		Residential	Com-mercial	Industrial	Transpor-tation	Mixed urban	Other urban	Crop/pas-ture	Other agriculture	Herba-ceous rangeland	Shrub rangeland	Mixed rangeland
MR01	Malad River at 3700 S		13	24	15			8,692			3,202	3,256
MT01	Wright Creek			21				3,368			9,097	1,013
MT02	Elkhorn Creek							449			851	212
MT03	Deep Creek	279	74		225	7	6	8,246			13,441	7,575
MT04	Devil Creek	335	66	20	819	88	11	23,457			16,785	1,281
MT05	Little Malad River		45	33	113	40		57,274	18		57,672	6,934
T01	Thomas Fork					18		2,018	38	190	41,432	2,523
T02	Sheep Creek							1,972		213	10,652	2,362
T03	Ovid Creek	91	15			51		17,682	18	757	19,188	1,363
T04	Georgetown Creek	220	16					1,780			7,711	598
T05	Stauffer Creek					23		4,741	4	252	8,789	424
T06	Skinner Creek					11		1,155		14	2,489	9
T07	Pearl Creek							108			1,622	22
T08	Eightmile Creek							1,388			3,709	541
T09	Sulphur Canyon Creek							855			2,015	313
T10	Bailey Creek	76						542			1,027	93
T14	Soda Creek	242	55					11,059			5,037	739
T15	Densmore Creek							2,222			3,865	321
T16	Smith Creek							804			581	27
T17	Alder Creek							1,376			1,298	
T18	Whiskey Creek							1,532	12		129	
T19	Burton Creek							1,889			1,842	36
T20	Trout Creek							6,626			8,314	1
T21	Williams Creek							478			1,569	
T22	Cottonwood Creek							5,292		48	15,528	3,243
T24	Mink Creek							8,278	11		11,272	
T25	Battle Creek				10			26,647	10		11,888	
T26	Deep Creek	86	12			61	16	42,397	31		32,739	6,985
T27	Fivemile Creek		27			42		6,916			4,884	271
T28	Weston Creek	119	19			37	7	23,566			21,410	3,295
TOTAL (ACRES)		**1,447**	**340**	**99**	**1,180**	**379**	**40**	**272,809**	**143**	**1,472**	**320,039**	**43,438**

Table 2-6. Specific land use for watersheds of tributary monitoring stations—forest land, water, wetland, barren land. See Figure 1-4 to Figure 1-8 for tributary location and Figure 2-16 for site location.

		Forest Land			Water		Wetland		Barren Land			
Site ID	**Station Name**	**Deciduous forest**	**Evergreen forest**	**Mixed forest**	**Lakes**	**Reservoirs**	**Forested wetland**	**Nonforest-ed wetland**	**Sandy barren land**	**Rock**	**Mine/quarry**	**TOTAL**
MR01	Malad River at 3700 S					28					11	597,986
MT01	Wright Creek										24	586,064
MT02	Elkhorn Creek											573,578
MT03	Deep Creek					33						572,311
MT04	Devil Creek	90				136					11	550,271
MT05	Little Malad River		496			189		174			22	509,572
T01	Thomas Fork	1,791	4,155	4,408			187	2,642				407,559
T02	Sheep Creek							270				364,133
T03	Ovid Creek	783	20,664	8,587		74	219	1,069				382,694
T04	Georgetown Creek		702	12,431						63	272	358,359
T05	Stauffer Creek	1,039	4,766	2,618				59				357,114
T06	Skinner Creek		2,630	362		376		70				346,744
T07	Pearl Creek	102	759			3,039						346,976
T08	Eightmile Creek	92	6,364	532		9,494	190	232				362,150
T09	Sulphur Canyon Creek		100	2,963				45			20	360,182
T10	Bailey Creek		518	529		1,917						360,275
T14	Soda Creek			281	45	160		557	60		99	359,834
T15	Densmore Creek		928	3,736						37		348,142
T16	Smith Creek			284								342,339
T17	Alder Creek	1		683								341,638
T18	Whiskey Creek											338,963
T19	Burton Creek			3,069								340,359
T20	Trout Creek	226	7,470	1,891								346,215
T21	Williams Creek	2,769	5,042	3,224								342,310
T22	Cottonwood Creek	2,555	785	19,748		15						363,366
T24	Mink Creek	4,976	3,183	12,960								363,617
T25	Battle Creek	911	673	789		401						346,831
T26	Deep Creek		2,361	282	105	484		1,288				312,796
T27	Fivemile Creek		27								15	237,496
T28	Weston Creek		454			97		69				226,247
TOTAL (ACRES)		**15,336**	**62,079**	**79,376**	**150**	**16,444**	**595**	**6,475**	**60**	**100**	**475**	**11,646,122**

Table 2-7. Areas (acres) of geologic districts for watersheds of mainstem monitoring stations. See Figure 2-16 for site location.

Site ID	Station Name	Sedimentary Calcereous	Sedimentary Sandstone	Unconsolidated	Volcanic	Metamorphic	TOTAL
BR01	BR at ID WY state line	0	609	2,485	12,340	0	15,435
BR02	BR at Dingle Marsh	15,961	78,306	37,795	37,947	0	170,010
BR03	Stewart Dam	15,961	78,440	39,102	37,947	0	171,451
BR04	BR Old Channel	16,033	19,450	3,901	0	0	39,383
BR05	BR at Pescadero	44,070	47,632	28,213	0	17,085	136,999
BR06	BR at Nounan Bridge	44,740	60,259	36,793	0	17,085	158,875
BR07	BR at Stauffer Creek	60,590	69,241	40,038	0	17,085	186,954
BR08	BR above Alexander	83,946	124,928	64,321	12,254	35,753	321,202
BR09	BR below Alexander	91,662	130,981	65,667	53,402	35,753	377,465
BR10	BR at Last Chance	1,543	0	0	3,024	0	4,567
BR11	BR at Black Canyon	25,696	3,058	2,677	73,124	29	104,585
BR12	BR at Cheeseplant Bridge	34,554	3,058	10,040	75,977	4,233	127,862
BR13	BR at Thatcher Church	34,554	3,058	17,896	75,977	10,431	141,916
BR14	BR at Thatcher Bridge	34,554	4,880	29,769	76,273	15,045	160,521
BR15	BR abv Oneida	81,422	7,700	47,457	83,719	18,584	238,882
BR16	BR blw Oneida	0	7,165	241	0	511	7,917
BR17	BR west of Preston	33,355	99,069	72,102	0	13,540	218,066
TOTAL (ACRES)		**618,641**	**737,834**	**498,497**	**541,984**	**185,134**	**2,582,090**

Table 2-8. Areas (acres) of subsections for watersheds of mainstem monitoring stations. See Figure 2-16 for site location.

Site ID	Station Name	Metamorphic fluvial land	Sedimentary fluvial land	Sedimentary (calc) glacial	Sedimentary (calc) fluvial	Volcanic fluvial land	Unconsolidated alluvial land	Unconsolidated lacustrine land	TOTAL
BR01	BR at ID WY state line	0	0	0	0	12,328	3,106	0	15,435
BR02	BR at Dingle Marsh	0	73,748	0	16,293	38,914	41,055	0	170,010
BR03	Stewart Dam	0	73,748	0	16,293	38,914	42,496	0	171,452
BR04	BR Old Channel	0	20,190	0	16,033	0	3,160	0	39,383
BR05	BR at Pescadero	15,849	48,017	26,059	18,690	0	28,384	0	136,999
BR06	BR at Nounan Bridge	15,849	59,667	26,059	19,360	0	37,941	0	158,875
BR07	BR at Stauffer Creek	15,849	66,962	26,059	35,213	0	42,873	0	186,955
BR08	BR above Alexander	15,849	66,962	26,059	35,213	0	42,873	0	186,955
BR09	BR below Alexander	32,264	127,315	34,389	59,972	3,184	120,340	0	377,465
BR10	BR at Last Chance	0	0	0	982	0	3,585	0	4,567
BR11	BR at Black Canyon	29	2,216	0	23,802	4,996	73,541	0	104,585
BR12	BR at Cheeseplant Bridge	5,857	2,216	0	33,008	4,996	81,785	0	127,862
BR13	BR at Thatcher Church	15,973	2,216	0	33,008	4,996	85,722	0	141,916
BR14	BR at Thatcher Bridge	23,282	4,038	0	33,008	4,996	95,196	0	160,521
BR15	BR abv Oneida	35,083	6,858	14,234	64,397	4,999	113,312	0	238,882
BR16	BR blw Oneida	511	7,406	0	0	0	0	0	7,917
BR17	BR west of Preston	13,540	71,603	7,943	31,635	0	0	93,346	218,066
TOTAL (ACRES)		**189,935**	**633,162**	**160,802**	**436,907**	**118,323**	**815,369**	**93,346**	**2,447,845**

Table 2-9. Areas (acres) of valley bottom types for watersheds of mainstem monitoring stations. See Figure 2-16 for site location.

Site ID	Metamorphic		Sedimentary		Sedimentary (calc)		Volcanic		Alluvial		Lacustrine			TOTAL
	VE[1]	VD[1]	VE[1]	VD[1]	VE[1]	VD[1]	VE[1]	VD[1]	CV[1]	UV[1]	CD[1]	CV[1]	UV[1]	
BR01	0	0	0	0	0	0	0	0	0	2,051	0	0	0	2,051
BR02	0	0	0	9,164	0	0	0	0	0	15,749	0	0	0	24,913
BR03	0	0	0	9,164	0	0	0	0	0	17,191	0	0	0	26,355
BR04	0	0	546	310	399	97	0	0	0	1,714	0	0	0	3,066
BR05	235	0	584	1,152	521	97	0	0	371	14,703	0	0	0	17,663
BR06	235	0	584	1,152	521	97	0	0	1,428	14,703	0	0	0	18,719
BR07	235	0	624	1,283	521	97	0	0	1,755	16,332	0	0	0	20,846
BR08	235	0	743	4,636	650	125	0	0	6,047	19,300	0	0	0	31,736
BR09	235	0	743	4,636	650	125	220	1,274	6,239	19,300	0	0	0	33,422
BR10	0	0	0	0	0	0	119	0	0	0	0	0	0	119
BR11	0	0	0	0	0	0	327	61	0	0	0	0	0	388
BR12	36	19	0	0	19	0	343	61	100	448	0	0	0	1,026
BR13	36	19	0	0	19	0	343	61	100	1,577	0	0	0	2,154
BR14	36	19	0	0	19	0	343	61	126	4,750	0	0	0	5,353
BR15	36	19	0	0	19	0	343	61	2,211	6,399	0	0	0	9,087
BR16	12	0	123	363	0	0	0	0	0	0	0	0	0	497
BR17	12	0	252	2,304	0	0	0	0	3,846	0	513	3,576	4,123	14,627
TOTAL	**1,343**	**76**	**4,199**	**34,164**	**3,338**	**638**	**2,038**	**1,579**	**22,223**	**134,217**	**513**	**3,576**	**4,123**	**212,022**

(1)VE: V-erosional canyon, VD: V-depositional canyon, CV: confined valley, UV: unconfined valley, CD: confined draw, calc: calcareous

Table 2-10. General land use (acres) for watersheds of mainstem monitoring stations. See Figure 2-16 for site location.

Site ID	Station Name	Urban	Agriculture	Range	Forest	Water	Wetland	Barren	TOTAL
BR01	BR at ID WY state line	0	522	14,151	0	0	761	0	15,435
BR02	BR at Dingle Marsh	19	12,004	138,292	10,798	5	8,874	45	170,038
BR03	Stewart Dam	19	12,699	138,292	10,798	5	9,550	116	171,479
BR04	BR Old Channel	883	2,678	26,156	9,166	119	254	127	39,383
BR05	BR at Pescadero	1,201	35,690	56,885	40,536	192	2,351	143	136,999
BR06	BR at Nounan Bridge	1,201	42,725	67,129	45,015	201	2,452	152	158,875
BR07	BR at Stauffer Creek	1,452	46,475	77,154	58,148	201	2,489	487	186,407
BR08	BR above Alexander	1,717	73,863	127,675	95,087	16,284	5,362	667	320,655
BR09	BR below Alexander	2,736	101,632	144,383	99,520	19,118	6,343	3,185	376,918
BR10	BR at Last Chance	0	3,781	334	452	0	0	0	4,567
BR11	BR at Black Canyon	577	71,590	29,021	3,231	29	35	102	104,585
BR12	BR at Cheeseplant Bridge	657	79,692	39,438	7,817	45	35	177	127,862
BR13	BR at Thatcher Church	657	85,565	44,116	11,321	45	35	177	141,916
BR14	BR at Thatcher Bridge	657	96,458	47,739	15,410	45	35	177	160,520
BR15	BR abv Oneida	678	123,686	67,729	46,474	45	35	235	238,882
BR16	BR blw Oneida	31	1,786	1,705	4,394	0	0	0	7,917
BR17	BR west of Preston	338	104,550	76,404	34,323	990	1,288	174	218,066

Hydrologic Resources

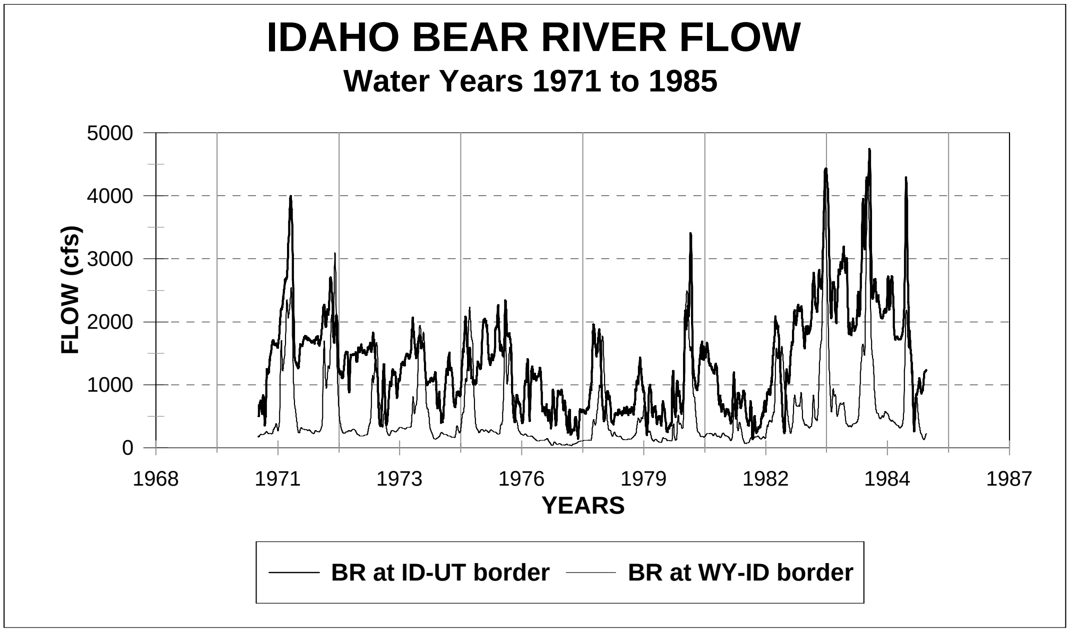
On the mainstem Bear River in Idaho, there are six gaging stations (not including the two on the inlet and outlet to Bear Lake). By utilizing the historical gaged flows in this section of the Bear River, an overall picture of the hydrology of the basin can be obtained. In Figure 2-10, two stations (Bear River at the Idaho-Wyoming [USGS gage site 10039500] and Idaho-Utah [USGS gage site 10092700] state lines) provide both above and below basin perspectives. These data are further summarized as annual flows expressed in acre-feet (ac-ft) per year in Figure 2-11.

Inspection of these data indicates that for a 30-year period (1970-2000), maximum flows (1.75 to 2.0 million ac-ft) occurred in 1993, 1994 and 1996. Between 1988 and 1995, flows throughout the basin were low (less than 0.50 million ac-ft per year; Figure 2-12). For this 30-year period of record, an average of 432,000 ac-ft of water entered the Middle Bear River from Wyoming and 850,000 ac-ft exited at the Utah border. The Idaho portion of the Bear River yielded an average of 517,000 ac-ft of water from 1970 to 2000. Although a large portion is produced within the watershed, the majority of the water entering Utah in the summer is from Bear Lake storage released for downstream irrigation in Utah. This is clearly evident when looking at the average monthly flows for the 30-year record (Figure 2-13). The hydrograph for the Bear River at the Wyoming border is typical of western rivers with peak flows during snowmelt (May-June) and low summer to winter base flows. The lower station (Utah state line) has significantly elevated summer flows (average 1,000 cfs) compared to the upper station (averages of less than 250 cfs).

In addition to the storage of 1.42 million ac-ft of water in Bear Lake, there are two additional prominent mainstem reservoirs in the Middle Bear River (Figure 1-3). A summary of those reservoirs as well as the nine additional reservoirs on tributaries can be seen in Table 2-11.

The principle uses of water in the Bear River basin, in order of quantities used, are for hydroelectric power, irrigation, domestic, stock, and industrial purposes (USGS 1969). The Bear River is highly developed for hydroelectric power, with nearly all water downstream of Bear Lake used non-consumptively in power plants. A summary of the existing hydroelectric power plants within the Idaho Bear River basin can be seen in Table 2-12. A total of over 90,000 kilowatts are produced at these plants.

The second greatest water use is irrigation and represents the single largest consumptive use in the basin. A total of 90 irrigation companies serve 177,800 acres of irrigated land in the Middle Bear River (Table 2-13). Bear Lake County has the largest number of companies (47) and the largest amount of acreage (75,680 acres), followed by Caribou, Franklin, and Oneida counties. Irrigation return flows are undefined.



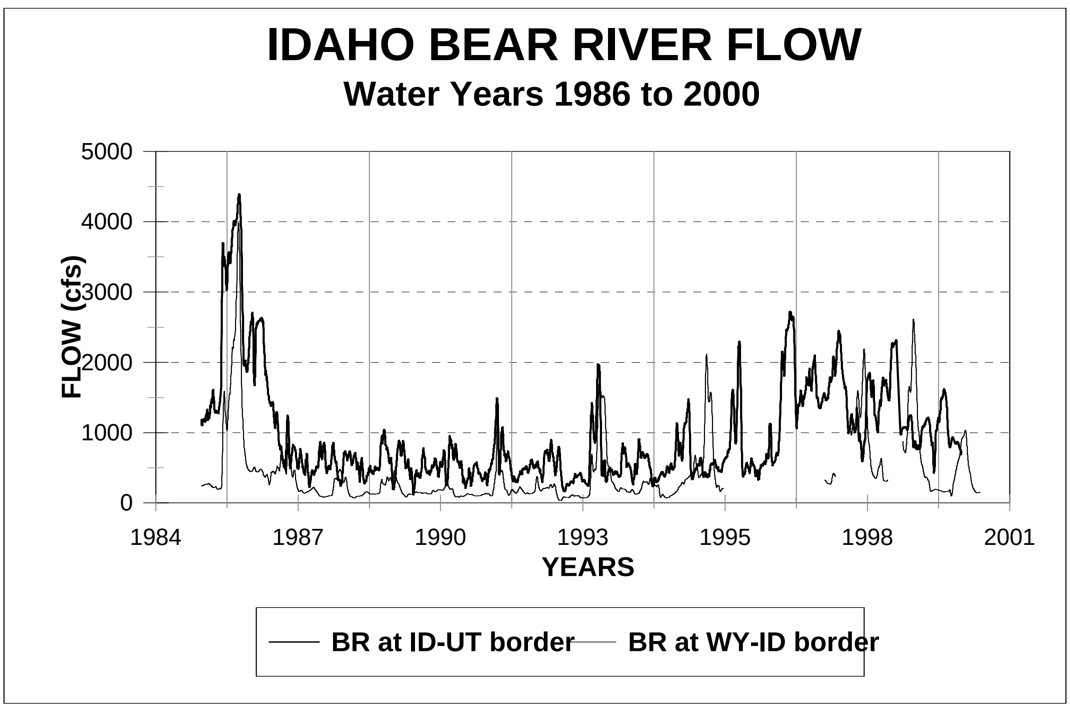


Figure 2-10. The daily flows from 1970-2000 at two stations (USGS #10039500 and 10092700) on the middle Bear River.

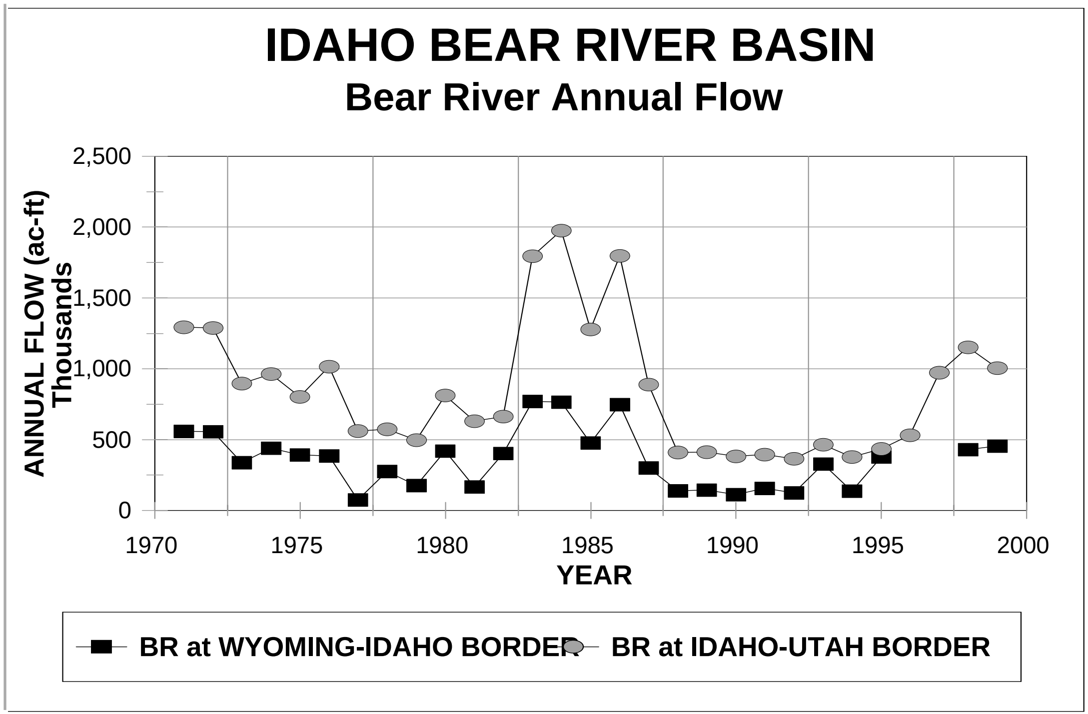


Figure 2-11. The annual flow from 1970 to 2000 for two stations (USGS#10092700 & 10039500) on the middle Bear River in Idaho.

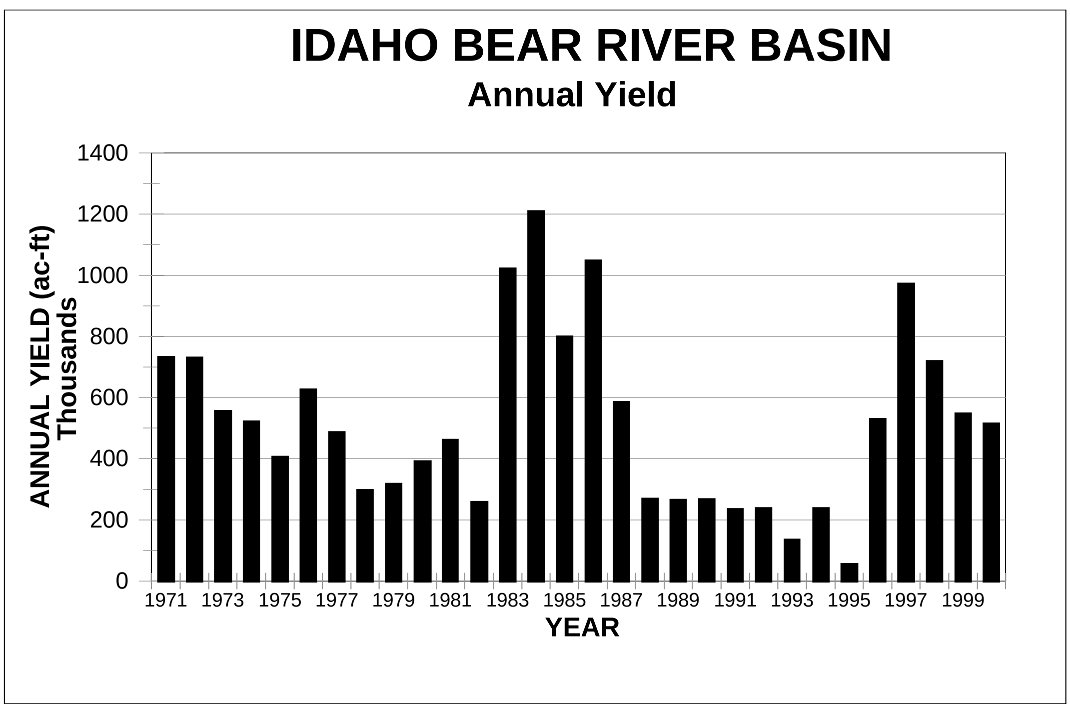


Figure 2-12. The yield of water (ac-ft/year) from the Idaho portion of the Bear River from 1970 to 2000.

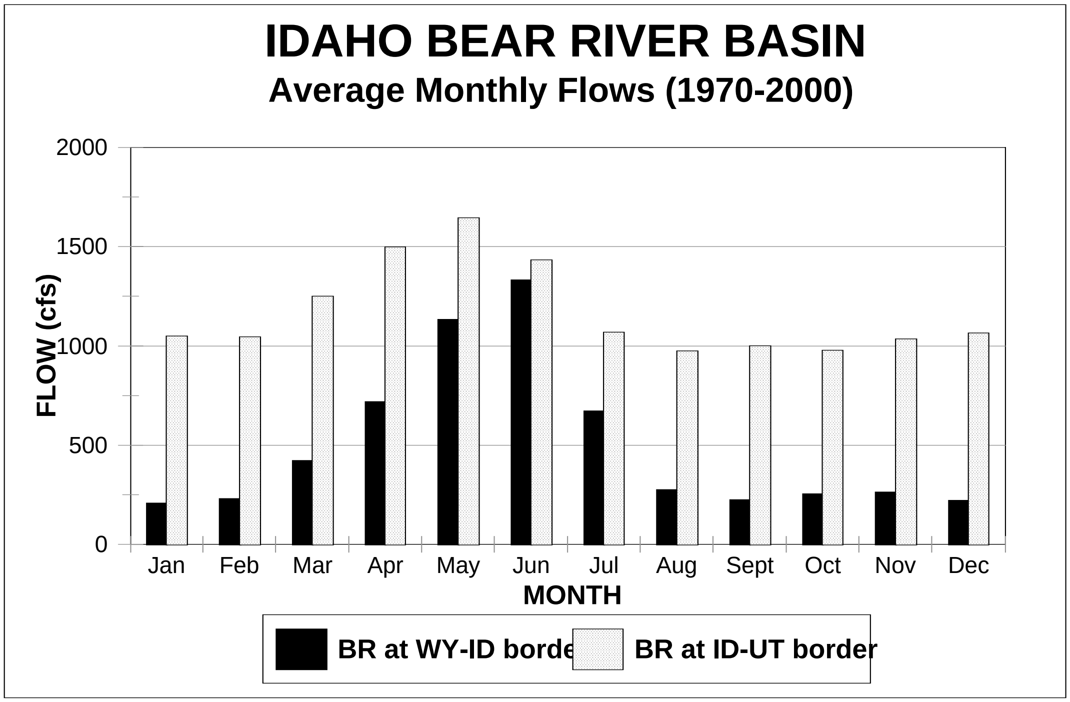


Figure 2-13. The average monthly flows from 1970 to 2000 for two stations (USGS# 10092700 & 10039500) in Idaho.

Table 2-11. A summary of reservoirs over 4000 ac-ft in the Idaho portion of the Bear River.

Name	County	Stream	Owner or Operator	Total Storage (Ac-ft)
Bear Lake[1]	Bear Lake	Bear River	UP&L[2]	1,452,000
Montpelier	Bear Lake	Montpelier Creek		4,050
Soda Point	Caribou	Bear River		15,500
Oneida Narrows	Franklin	Bear River	UP&L[2]	11,500
Twin Lakes[1]	Franklin	Mink Creek	UP&L[2]	14,000
Glendale	Franklin	Worm Creek		11,000
Strong Arm	Franklin	Battle Creek		4,500
Treasureton	Franklin	Battle Creek		7,000
Daniels	Oneida	Little Malad River		11,900
Deep Creek	Oneida	Deep Creek		5,400
Devil Creek	Oneida	Devil Creek		4,450
St. Johns	Oneida	Davis Creek		4,450

(1)off-channel
(2)Utah Power & Light

Table 2-12. A summary of the existing hydroelectric power plants in the Idaho Bear River basin in Idaho.

Hydro Plant	Stream	Owner	Static Head (ft)	Installed Capacity (kW)
Soda	Bear River	UP&L[1]	79	14,000
Last Chance	Last Chance Canal	UP&L[1]	40	1,500
Grace	Bear River	UP&L[1]	526	33,000
Cove	Bear River	UP&L[1]	98	7,500
Oneida	Bear River	UP&L[1]	145	30,000
Mink Creek	Mink Creek	Private	430	3,075
Paris Creek	Paris Creek	UP&L[1]	346	650
Soda Springs #1	Soda Creek	Soda Springs City	50	120
Soda Springs #2	Soda Creek	Soda Springs City	20	50
Soda Springs #3	Soda Creek	Soda Springs City	84	400

(1)Utah Power & Light

Table 2-13. A general summary by county of the number of irrigation companies and areas served in the Idaho portion of the Bear River (USDA 1976).

County	Acres in County	Number of Irrigation Companies
Bear Lake	75,680	47
Caribou	45,022	23
Franklin	42,105	12
Oneida	14,991	8
TOTAL	**177,798**	**90**

Fisheries

Within the Bear River basin watershed, there is only one endemic aquatic species of concern, the Bonneville cutthroat trout (*Oncorhynchus clarki utah*), which is currently under status review by the U.S. Fish and Wildlife Service (USFWS) pursuant to the federal Endangered Species Act of 1973 (Gourley, 2000). In addition, both the U.S. Forest Service (USFS) and U.S. Bureau of Land Management (BLM) recognize Bonneville cutthroat trout as "Sensitive" and as such the species is afforded special management considerations (Mizzi, 1998).

Based on 1996 data, the petitioner estimated that, historically, the species occupied 90 percent of the streams within the Bonneville Basin but is currently restricted to 3.7 percent of the historic stream miles. In addition, a lengthy list of specific factors jeopardizing the continued existence of the Bonneville cutthroat trout and contributing to the species' decline that were identified by the petitioner include issues from the competition and predation from exotic species to the lack of accountability of pro-active programs among agencies and an inadequacy of existing regulatory mechanisms (Mizzi 1998).

Resource agencies identified habitat degradation and the threats from nonnative species as the most detrimental factors threatening the Bonneville cutthroat trout's continued existence. Other threats influencing the continued existence of the Bonneville cutthroat trout have been previously recognized by the USFWS, other federal management agencies, and affected state agencies. These threats have been identified in current management plans, notices of review, the Utah Conservation agreement, and the USFS Conservation Assessment for Inland Cutthroat Trout, as well as other literature. In 1994, a draft Habitat Conservation Assessment and Strategy for Bonneville Cutthroat Trout was prepared by the State of Idaho and is currently being implemented through a 1995 conservation agreement among the USFWS, USFS, Idaho Department of Fish and Game, Idaho Natural Resources Conservation Service, and the Caribou Cattlemen’s Association. Several mitigation activities such as fencing of riparian areas, modifying grazing practices, and connectivity restoration efforts have been implemented as a result of the agreements. Additional restoration and mitigation efforts are currently in progress to eliminate threats to the continued existence of the species (Mizzi 2000).

In February of 1998, the Biodiversity Legal Foundation of Boulder, Colorado, petitioned the USFWS to list the Bonneville cutthroat trout as threatened in the United States river and lake ecosystems where it exists and to designate its occupied habitat as critical habitat within a reasonable period of time following the listing (Mizzi 1998). In October of 2001, USFWS issued a news release with the findings from their comprehensive review of the species which determined that the Bonneville cutthroat trout did not warrant listing as a threatened or endangered species under the Endangered Species Act. During the review, biologists established that there are 291 populations of Bonneville cutthroat trout currently inhabiting 852 miles of stream habitat and 70,059 acres of lake habitat. It was further determined that viable, self-sustaining Bonneville cutthroat trout populations remain widely distributed throughout their historic range and are being restored or protected where feasible. (USFWS 2001)

Even so, genetically pure populations of Bonneville cutthroat trout in Idaho are entirely restricted to a very limited number of small tributaries to the Bear River and a Bear Lake population which is considered to be an Evolutionary Significant Unit (ESU) of the species (Behnke 1994). Until 30 or 40 years ago, pure strains of the Bonneville cutthroat trout were believed to be extinct having been replaced as a result of hybridization from other trout species previously stocked in Bear River basin. Scientific analysis carried out in the 1980's by Behnke and others dispelled this belief with convincing evidence substantiating that current populations of the species within the Bear River basin are, in fact, relatively pure phenotypes of *Oncorhynchus clarki utah*. In fact, the studies showed that the Bear Lake variation appears to be highly resistant to hybridization with other cutthroat and rainbow trout, a trait unique among cutthroat trout species (Behnke 1992).

In 1993, an analysis performed by Behnke and Proebstel (Behnke et al1994) on 15 populations representing 129 specimens of cutthroat trout in the Bear River basin indicated a predominant native trout phenotype and assumed genotype. Samples from Eight-Mile Creek were judged to be the “most ideal (probably pure) native population” sampled, but other samples also indicated several pure or virtually pure populations. Eightmile Creek, Pearl Creek and North Canyon Creek were found to contain pure or essentially pure strains. In addition, their research revealed that the remainder of the populations sampled were predominantly native cutthroat trout. In the late 1970s, the species was documented in the Thomas Fork tributaries of Giraffe, Dry, and Preuss creeks. The species is also known to occupy several reaches of the mainstem of the Bear River and many of its numerous tributaries (Mizzi 1998).

2.1.2 Cultural Characteristics

Land Use/Land Ownership

Land ownership is predominantly privately controlled within the four HUCs of the Bear River basin comprising approximately 1,021,867 acres. The U.S. Forest Service owns 462,350 acres and the U.S. Bureau of Land Management owns 165,692 followed by the State of Idaho, the U.S. Bureau of Reclamation, and the U.S. Fish and Wildlife Service. There are 39,362 acres of water within Idaho's portion of the basin. Figure 2-14 is a map of land ownership in the basin. Table 2-14 lists significant landowners and their respective acreage.

Rangeland and agriculture account for the majority of land use comprising 751,420 and 599,180 acres, respectively, with forestland at 300,324 acres. Water takes up 61,902 acres with wetlands found in 44,774 acres followed by urban uses at 10,964 acres. Figure 2-15 is a map of land use in the basin.

Demographics

Idaho's section of the Bear River basin is located in the southeastern counties of Bear Lake, Caribou, Franklin, and Oneida. Census data compiled by the Idaho Department of Commerce shows the region's population at 29,122 in 1998. Of the communities recognized by the statistics, only five had populations over 1,000 with the Preston community in Franklin County having the largest at 4,191 people.

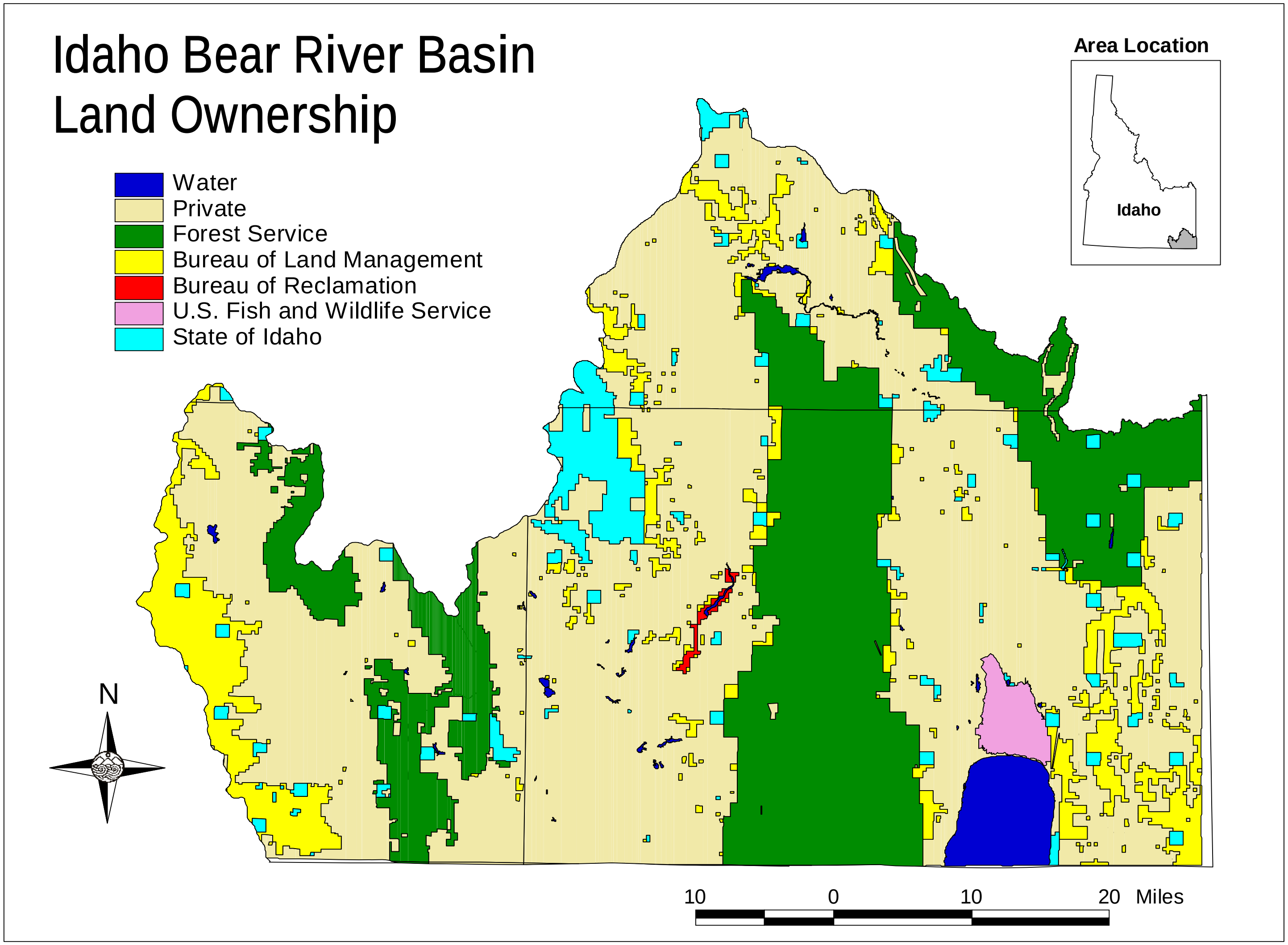


Figure 2-14. Land ownership in the Idaho portion of the Idaho Bear River basin.

Table 2-14. Land use (acres) within each hydrologic unit in the study area (Idaho portion of the Idaho Bear River basin).

LAND OWNER	AREA (acres)
US Forest Service	
Cache National Forest	262,989
Caribou National Forest	199,360
Total U.S. Forest Service	462,350
Bureau of Land Management	
Burley District	64,823
Idaho Falls District	100,869
Total Bureau of Land Management	165,692
Bureau of Reclamation	2,543
U.S. Fish and Wildlife Service	16,960
State of Idaho	76,607
Private Landowners	1,021,867
Water	39,362
TOTAL ACREAGE:	**1,785,380**

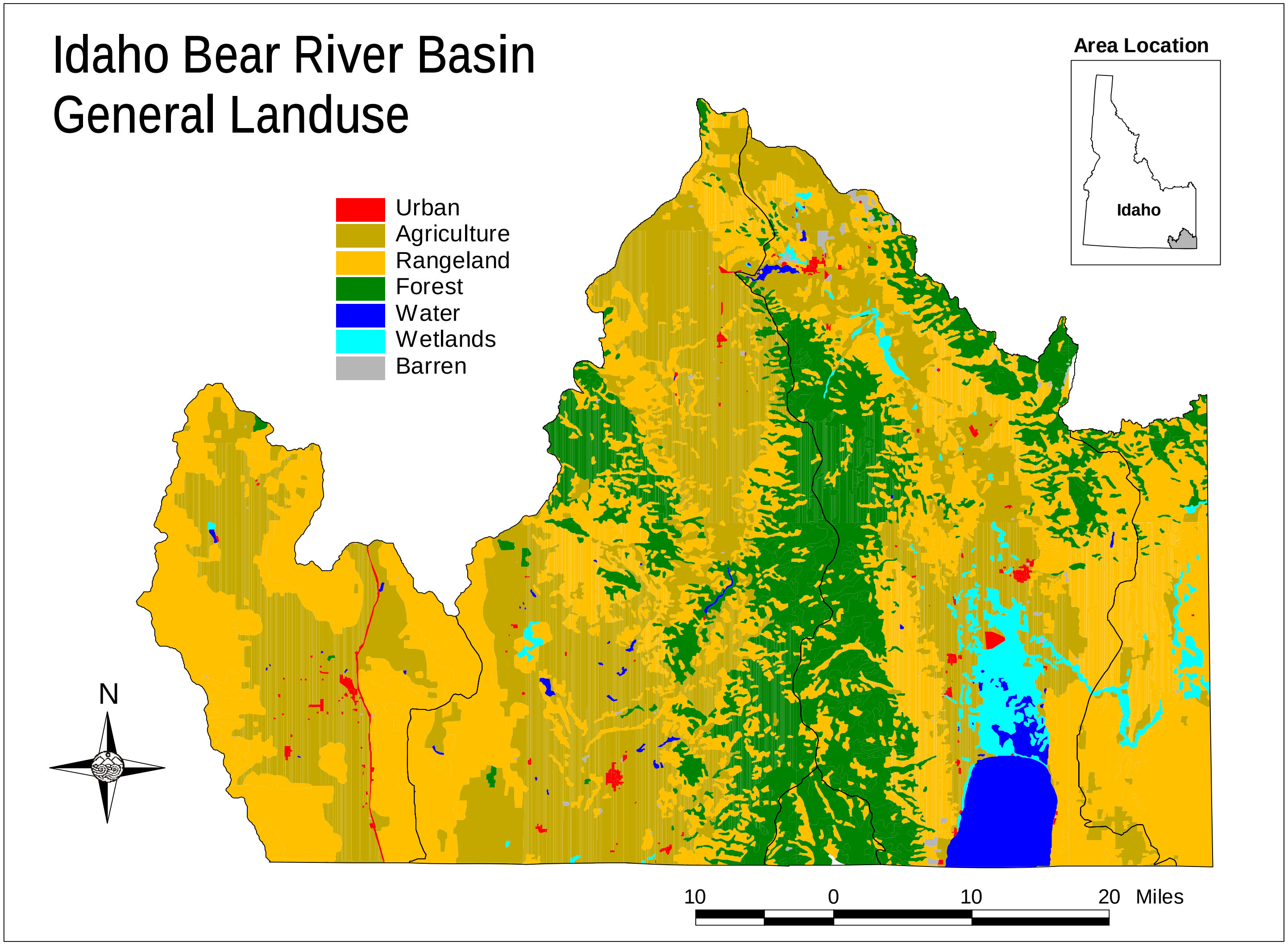


Figure 2-15. Land use in the Idaho portion of the Idaho Bear River basin.

The top industries in the region in order of total individuals employed are agriculture, state and local government, retail trade, service industry, manufacturing and mining. Government employment greatly influences Bear Lake County where the federal government manages 46 percent of the land, while mining and mineral industries are important economic factors in Caribou County and agriculture is the most important component of the economy in Franklin and Oneida counties.

2.2 Water Quality Concerns and Status

2.2.1 Water Quality Limited Segments Occurring in the Basin

The Idaho Bear River basin has four major subbasins, or hydrologic units, all within the state of Idaho (Figure 2-1). The uppermost subbasin (HUC#16010102) has seven tributaries and a reach of the Bear River, which starts at the Wyoming-Idaho state line (Table 2-15). Of the seven tributaries, three are on the 303(d) list. In addition, the mainstem of the Bear River in this subbasin is also on the 303(d) list. All of the stream segments have coldwater community and salmonid spawning aquatic life beneficial use designations. The tributaries also have primary or secondary contact as their recreation designations. Sheep, Raymond, and Pegram creeks do not have identified beneficial uses and would, by default, be considered supporting coldwater aquatic life and secondary contact recreation. All of the 303(d) listed streams were designated because of nutrients and sediments.

The next downstream subbasin (HUC#16010201) defined as the Bear Lake Subbasin, includes 21 tributaries, the mainstem of the Bear River, an on-stream reservoir, three point sources and Bear Lake (Table 2-16). Ten tributaries are designated to support coldwater aquatic life and salmonid spawning beneficial uses, while 10 are non-designated. As mentioned earlier, non-designated tributaries are presumed to support coldwater aquatic life and secondary contact recreation. One tributary (Soda Creek) has no designation. The mainstem Bear River and Alexander Reservoir have coldwater aquatic life and salmonid spawning designations. The same tributaries that were non-designated for aquatic life were also non-designated for recreation contact. The remaining tributaries were designated for either primary or secondary contact recreation. Excessive sediments and nutrients were the reasons for impaired water quality.

Moving further downstream, the next basin (HUC#16010202) extends from below Alexander Reservoir to the Idaho-Utah border. This subbasin has 18 tributaries (four are on the 303(d) list) of which 15 are non-designated, and thus presumed to support coldwater aquatic life and secondary contact recreation. The remaining three are coldwater and salmonid spawning designated. Recreation contact is primary or secondary for these three streams. The Bear River in this subbasin has five reaches, all of which are on the 303(d) list. The entire Bear River in this reach has a coldwater and salmonid spawning designation for aquatic life and primary contact recreation. In addition to tributaries and the mainstem of the Bear River there is also one on-channel reservoir. Oneida Reservoir has the same designated beneficial uses as the river. Nutrients, sediment and flow alteration are the reasons given for the 303(d) listing of the river, reservoir and tributaries in this subbasin (Table 2-17).

Table 2-15. Waters within the Central Bear Subbasin (HUC# 16010102) and their designated beneficial uses. ERI water quality monitoring site stations are identified in the leftmost column.

ERI ID	WATERS INCLUDED:	303(d) LIST	BENEFICIAL USES[1]								
			ND	DWS	AWS	COLD	WARM	SS	PCR	SCR	SRW
BR01	Bear River @ ID/WY border	X			X	X		X	X		
	Pegram Creek		X								
T01	Thomas Fork	X			X	X		X	X		
	Raymond Creek		X								
	Dry Creek	X			X	X		X		X	
	Preuss Creek	X			X	X		X		X	
	Salt Creek					X		X		X	
T02	Sheep Creek		X		X						

(1)ND: Non-designated; DWS: Domestic Water Supply; AWS: Agricultural Water Supply; COLD: Cold Water Communities; WARM: Warm Water Communities; SS: Salmonid Spawning; PCR: Primary Contact Recreation; SCR: Secondary Contact Recreation; SRW: Special Resource Water.

Table 2-16. Waters within the Bear Lake Subbasin (HUC# 16010201) and their designated beneficial uses. ERI water quality monitoring site stations are identified in the leftmost column.

ERI ID	WATERS INCLUDED:	303(d) LIST	BENEFICIAL USES[1]								
			ND	DWS	AWS	COLD	WARM	SS	PCR	SCR	SRW
	Alexander Reservoir	X			X	X		X	X		
	Bear River	X			X	X		X	X		
	Co-Op Creek	X			X	X		X		X	
	Snowslide Canyon	X	X		X						
	St. Charles Creek	X	X		X						
	Meadow Creek	X	X		X						
	North Creek	X	X		X						
T03	Ovid Creek	X	X		X						
T04	Georgetown Creek			X	X	X		X	X		X
T05	Stauffer Creek				X	X		X		X	
T06	Skinner Creek				X	X		X		X	
T07	Pearl Creek	X			X	X		X		X	
T08	Eightmile Creek				X	X		X		X	
T09	Sulphur Canyon Creek		X		X						
T10	Bailey Creek				X	X		X		X	
T11	Clear Spring Fish Hatchery		X		X						
T12	Soda Springs WWTP - West Side Crk		X		X						
T13	Soda Springs WWTP		X		X						
T14	Soda Creek		X		X					X	

(1)ND: Non-designated; DWS: Domestic Water Supply; AWS: Agricultural Water Supply; COLD: Cold Water Communities; WARM: Warm Water Communities; SS: Salmonid Spawning; PCR: Primary Contact Recreation; SCR: Secondary Contact Recreation; SRW: Special Resource Water.

Table 2-17. Waters within the Middle Bear River Subbasin (HUC# 16010202) and their designated beneficial uses. ERI water quality monitoring site stations are identified in the leftmost column.

ERI ID	WATERS INCLUDED:	303(d) LIST	BENEFICIAL USES[1]								
			ND	DWS	AWS	COLD	WARM	SS	PCR	SCR	SRW
	Bear River - Alexander Dam to Utah Border	X			X	X		X	X		
	Strawberry Creek	X	X		X						
T15	Densmore Creek	X	X		X						
T16	Smith Creek		X		X						
T17	Alder Creek		X		X						
T18	Whiskey Creek	X	X		X						
T19	Burton Creek		X		X						
T20	Trout Creek		X		X						
T21	Williams Creek	X	X		X						
T22	Cottonwood Creek:	X	X		X						
T23	Maple Hot Springs		X		X						
T24	Mink Creek				X	X		X	X		
T25	Battle Creek	X			X	X				X	
T26	Deep Creek	X	X		X						
T27	Fivemile Creek	X	X		X						
T28	Weston Creek	X	X		X						

(1)ND: Non-designated; DWS: Domestic Water Supply; AWS: Agricultural Water Supply; COLD: Cold Water Communities; WARM: Warm Water Communities; SS: Salmonid Spawning; PCR: Primary Contact Recreation; SCR: Secondary Contact Recreation; SRW: Special Resource Water

The final subbasin (HUC#16010204) is located in the Idaho portion of the Malad River which enters the lower Bear River near Corrine, Utah (Rm 15.8). This subbasin contains the Malad River and seven tributaries (Table 2-18). The Malad River, designated as coldwater and secondary contact recreation, is on the 303(d) list. It should be noted that the Malad River at Portage, Utah site was considered close enough to the Idaho-Utah border to serve as a surrogate for a state line site. Of the seven tributaries, only three are on the 303(d) list and only one of the three has a designation. The Little Malad River has a coldwater and primary contact recreation designation. The others are non-designated, and thus considered to support coldwater aquatic life and secondary contact recreation.

2.2.2 Applicable Water Quality Standards

As noted in section 2.2.1, the tributaries and mainstem of the Bear River as well as the on-stream reservoirs have either coldwater, salmonid spawning or are undesignated relative to surface water beneficial use designations (aquatic life). Recreation designations are either primary or secondary contact. The specific numeric water quality standards are described in Table 2-19.

According to Idaho Administrative Code 58.01.02.101.01(a), non-designated surface waters in the state are assumed to support cold water aquatic life and primary or secondary contact recreation beneficial uses and the department will apply coldwater aquatic life and primary and secondary recreation criteria to undesignated waters unless the department determines that other criteria are appropriate.

In addition to enforceable numeric criteria within the water quality standards, the state has narrative criteria for pollutants such as nutrients (e.g. phosphorus and nitrate) and sediment. Therefore, numeric limits established for nutrients or sediment are targets and not criteria. Targets, like criteria, do serve as a guidance to indicate possible pollution problems. When the concentrations are exceeded, further study is typically recommended. This may include more frequent water quality monitoring, biological monitoring, riparian assessment or additional studies to identify and quantify point and nonpoint sources.

Generally, one nutrient, usually phosphorus, is the limiting factor in aquatic environments. Nitrogen to phosphorus ratios in aquatic vegetation range from about 10 to 17 parts nitrogen to 1 part phosphorus (Mackenthun 1973). It appears the limiting factor for most of the year in the Bear River is phosphorus. A comparison of readily available (i.e., the form of nutrient in the water column is such that its uptake by plants is easy) phosphorus and nitrogen indicates that phosphorus is the limiting factor with the possible exception at the Idaho-Wyoming border (BR01). The ratio of total inorganic nitrogen (nitrate + nitrite + ammonia) to orthophosphorus ranges from about 10:1 to almost 40:1 with an increasing trend from the Idaho-Wyoming border to Alexander Reservoir (BR08; Table 2-20).

Water quality targets for sediment and total phosphorus differed based on location within a riverine management reach (MR), depending on whether water flowing past that site discharges into a lake or impoundment (reservoir). For example, Wyoming-Idaho border site (BR01) would be considered a river site with receiving water being the river. The Stewart Dam site (BR03) would be a river site with receiving waters being, in this case, Bear Lake.

Table 2-18. Waters within the Lower Bear-Malad Subbasin (HUC# 16010204) and their designated uses. ERI water quality monitoring site stations are identified in the leftmost column.

ERI ID	WATERS INCLUDED:	303(d) LIST	BENEFICIAL USES[1]								
			ND	DWS	AWS	COLD	WARM	SS	PCR	SCR	SRW
MR01	MR01: Malad River	X			X	X				X	
MR04	MR04: Malad River at Portage, UT	X			X	X				X	
MT01	MT01: Wright Creek	X			X	X		X	X		
MT02	MT02: Elkhorn Creek	X	X		X						
MT03	MT03: Deep Creek	X	X		X						
MT04	MT04: Devil Creek:	X	X		X						
MT05	MT05: Little Malad River	X			X	X			X		
	Samaria Creek	X	X		X						
	Dairy Creek	X	X		X						

(1)ND: Non-designated; DWS: Domestic Water Supply; AWS: Agricultural Water Supply; COLD: Cold Water Communities; WARM: Warm Water Communities; SS: Salmonid Spawning; PCR: Primary Contact Recreation; SCR: Secondary Contact Recreation; SRW: Special Resource Water.

Table 2-19. Idaho water quality criteria for the mainstem Bear River and its tributaries.

CRITERIA	IDAHO
RECREATION USE DESIGNATIONS	
E. coli: primary contact (May 1-Sept 30)	Maximum: 406/100 ml and or geometric mean >126/100 ml from 5 samples taken 3 to 5 days over 30 days.
secondary contact	Maximum: 576/100 ml or a geometric mean >126/100 ml from 5 samples taken 3 to 5 days over 30 days.
AQUATIC LIFE USE DESIGNATIONS (COLDWATER)	
Dissolved Oxygen	≥6 mg/L
pH	6.5 - 9.5
Turbidity increase	≤ 50 NTUs from background instantaneously
	≤ 25 NTUs from background for 10 days
Temperature	≤ 22°C instantaneous maximum & daily average maximum ≤ 19°C
Total Dissolved Gas	≤110%
Ammonia	dependent on pH and temp
AQUATIC LIFE USE DESIGNATIONS (SALMONID SPAWNING)	
Dissolved Oxygen (water column)	≥6 mg/L
Dissolved Oxygen (intergravel)	one day min ≥5 mg/L & 7 day avg ≥6 mg/L
Temperature	≤ 13°C instantaneous maximum & daily average maximum ≤ 9°C

Table 2-20. A comparison of total inorganic nitrogen and orthophosphorus concentrations in the Bear River. WBF=winter base flow, LBR=lower basin runoff, UBR=upper basin runoff, SBF=summer base flow.

Site	Season	NH_3 + NH_4 (mg N/L)	NO2 (mg N/L)	NO3 (mg N/L)	Total inorganic nitrogen (TIN; mg N/L)	Ortho-phosphorus (OP; mg P/L)	Ratio of TIN to OP
Management Reach 1							
BR01	WBF	0.058	0.014	0.166	0.238	0.042	5.67
	LBR	0.056	0.007	0.094	0.157	0.019	8.26
	UBR	0.035	0.006	0.101	0.142	0.015	9.47
	SBF	0.027	0.006	0.270	0.303	0.011	27.55
BR01 Average:		0.044	0.008	0.158	0.210	0.022	9.66
BR03	WBF	0.037	0.000	0.383	0.420	0.006	70.00
	LBR	0.065	0.000	0.205	0.270	0.017	15.88
	UBR	0.038	0.000	0.083	0.121	0.015	8.07
	SBF	0.029	0.001	0.064	0.094	0.008	11.75
BR03 Average:		0.042	0.000	0.184	0.226	0.012	19.67
MR1 Season Average:		**0.043**	**0.004**	**0.171**	**0.218**	**0.017**	**13.12**
Management Reach 2							
BR05	WBF						
	LBR	0.129	0.006	0.425	0.560	0.019	29.47
	UBR	0.039	0.003	0.116	0.158	0.012	13.17
	SBF	0.03	0.012	0.057	0.099	0.007	14.14
BR05 Average:		0.066	0.007	0.199	0.272	0.013	21.50
BR06	WBF						
	LBR	0.058	0.006	0.56	0.624	0.003	208.00
	UBR						
	SBF	0.007	0.01	0.111	0.128	0.003	42.67
BR06 Average:		(1)	(1)	(1)	(1)	(1)	(1)
BR07	WBF						
	LBR	0.039	0.004	0.424	0.467	0.008	58.37
	UBR						
	SBF	0.005	0.008	0.312	0.325	0.013	25.00
BR07 Average:		(1)	(1)	(1)	(1)	(1)	(1)
BR08	WBF	0.038	*(2)*	0.467	0.505	0.005	101.00
	LBR	0.094	0.022	0.359	0.475	0.012	39.58
	UBR	0.053	0.032	0.122	0.207	0.009	23.00
	SBF	0.049	0.045	0.167	0.261	0.012	21.75
BR08 Average:		*0.059*	*0.033*	*0.279*	*0.362*	*0.010*	*38.11*
MR2 Season Average:		**(1)**	**(1)**	**(1)**	**(1)**	**(1)**	**(1)**

Table 2-20, continued

Site	Season	NH_3 + NH_4 (mg N/L)	NO2 (mg N/L)	NO3 (mg N/L)	Total inorganic nitrogen (TIN; mg N/L)	Ortho-phosphorus (OP; mg P/L)	Ratio of TIN to OP
Management Reach 3							
BR09	WBF	0.066	*(2)*	0.558	0.624	0.008	78.00
	LBR	0.096	0.008	0.565	0.669	0.011	60.82
	UBR	0.076	0.006	0.203	0.285	0.016	17.81
	SBF	0.058	0.013	0.19	0.261	0.018	14.50
BR09 Average:		*0.074*	*0.009*	*0.379*	*0.460*	*0.013*	*34.70*
BR10	WBF	0.056	*(2)*	0.466	0.522	0.006	87.00
	LBR	0.088	0.009	0.538	0.635	0.011	57.73
	UBR	0.065	0.006	0.17	0.241	0.012	20.08
	SBF	0.056	0.015	0.176	0.247	0.02	12.35
BR10 Average:		*0.066*	*0.010*	*0.338*	*0.411*	*0.012*	*33.57*
BR11	WBF	0.056	*(2)*	1.6	1.656	0.055	30.11
	LBR	0.044	0.008	1.327	1.379	0.046	29.98
	UBR	0.033	0.005	0.798	0.836	0.031	26.97
	SBF	0.032	0.008	0.971	1.011	0.036	28.08
BR11 Average:		*0.041*	*0.007*	*1.174*	*1.221*	*0.042*	*29.06*
BR12	WBF						
	LBR	0.148	0.008	0.727	0.883	0.022	40.14
	UBR	0.04	0.006	0.321	0.367	0.016	22.94
	SBF	0.005	0.012	0.663	0.680	0.022	30.91
BR12 Average:		*0.064*	*0.009*	*0.570*	*0.643*	*0.020*	*32.17*
BR13	WBF						
	LBR	0.055	0.008	0.807	0.870	0.024	36.25
	UBR	0.04	0.005	0.225	0.270	0.01	27.00
	SBF	0.005	0.007	0.423	0.435	0.006	72.50
BR13 Average:		*0.033*	*0.007*	*0.485*	*0.525*	*0.013*	*39.38*
BR14	WBF						
	LBR	0.077	0.008	0.809	0.894	0.027	33.11
	UBR	0.072	0.005	0.355	0.432	0.022	19.64
	SBF	0.053	0.01	0.416	0.479	0.017	28.18
BR14 Average:		*0.067*	*0.008*	*0.527*	*0.602*	*0.022*	*27.35*

Table 2-20, continued							
Site	**Season**	**NH_3 + NH_4 (mg N/L)**	**NO2 (mg N/L)**	**NO3 (mg N/L)**	**Total inorganic nitrogen (TIN; mg N/L)**	**Ortho-phosphorus (OP; mg P/L)**	**Ratio of TIN to OP**
BR15	WBF	0.069	*(2)*	0.694	0.763	0.013	58.69
	LBR	0.097	0.007	0.653	0.757	0.02	37.85
	UBR	0.055	*(2)*	0.263	0.318	0.015	21.20
	SBF	0.047	0.011	0.314	0.372	0.018	20.67
BR15 Average:		*0.067*	*0.009*	*0.481*	*0.553*	*0.017*	*33.48*
MR3 Season Average:		**0.060**	**0.008**	**0.569**	**0.635**	**0.020**	**31.65**
Management Reach 4							
BR16	WBF	0.113	*(2)*	0.732	0.845	0.007	120.71
	LBR	0.095	0.009	0.682	0.786	0.017	46.24
	UBR	0.059	0.006	0.213	0.278	0.012	23.17
	SBF	0.066	0.012	0.328	0.406	0.024	16.92
BR16 Average:		*0.083*	*0.009*	*0.489*	*0.579*	*0.015*	*38.58*
BR17	WBF	0.145	*(2)*	0.588	0.733	0.009	81.44
	LBR	0.115	0.009	0.699	0.823	0.02	41.15
	UBR	0.06	0.005	0.195	0.260	0.012	21.67
	SBF	0.06	0.01	0.174	0.244	0.013	18.77
BR17 Average:		*0.095*	*0.008*	*0.414*	*0.515*	*0.013*	*38.15*
BR18 (Idaho-Utah state line)	WBF	0.065	0.03	0.913	1.008	0.033	30.55
	LBR		0.038	0.919	*(1)*	0.048	*(1)*
	UBR		0.02	0.559	*(1)*	0.031	*(1)*
	SBF		0.018	0.386	*(1)*	0.032	*(1)*
BR18 Average:		*(1)*	*0.027*	*0.694*	*(1)*	*0.036*	*(1)*
MR4 Season Average:		**0.086**	**0.016**	**0.532**	**0.598**	**0.022**	**27.82**

(1)insufficient data
(2)nitrate assumed to be 0.0 mg/L

Total suspended solids (TSS) and total phosphorus (TP) targets were applied to mainstem Bear River reaches in this TMDL analysis. The targets for total suspended solids changed with hydrologic time period as well as type of receiving water body. Separating sites based on downstream receiving waters corresponds to phosphorus targets recommended in the 1986 EPA "Gold Book" to prevent the "development of biological nuisances and to control accelerated or cultural eutrophication." The Gold Book recommends for sections of stream that do not discharge into a lake or impoundment (reservoir) a total phosphorus target of 0.1 mg/L. For those reaches that discharge into a lake or reservoir, the Gold Book suggests a threshold of total phosphorus of 0.05 mg/L. The 0.05 mg/L target was used for sites that discharge into Bear Lake, Alexander Reservoir, and Oneida Reservoir. All other sites, which are considered riverine, were assigned a target of 0.075 mg/L of total phosphorus. However, the 0.05 mg/L total phosphorus target was also used for the Bear River below Oneida Reservoir, Cub River, and Worm Creek to the state line, based on the same target set by the State of Utah in their Lower Bear River Water Quality Management Plan (Ecosystems Research Institute 1995). Table 2-21 lists TSS and TP targets by reach and hydrologic period.

It is possible that nitrogen is limiting in the Bear River from the Idaho-Wyoming border to Stewart Dam. Although Thomas Fork does not exceed a 4 mg/L indicator of nitrate pollution, it has been identified as a major contributor of nitrogen to Bear River (Soil Conservation Service 1992, Hull 1996). Hull (1996) reported a downstream increase in aquatic macrophytes in Thomas Fork that coincided with increased nitrogen loading to the stream, suggesting that nitrogen may be the limiting factor to vegetative growth in Thomas Fork. Due to effects of nitrogen both in Thomas Fork and ultimately Bear River, a total nitrogen target of 0.85 mg/L is recommended. This value falls within the range of 0.22 to 0.90 mg/L of total nitrogen concentrations EPA (2000) found for the upper 25th percentile of all streams considered for their ambient water quality criteria recommendations for the Xeric West Ecoregion.

These water quality endpoints for nutrients are similar to those used in other TMDLs. For the lower Bear River TMDL, Utah chose TP targets of 0.05 and 0.075 mg/L (Ecosystem Research Institute 1995). A 0.075 mg/L endpoint for TP was used in the Portneuf River TMDL (DEQ 2001a) and the Mid-Snake River TMDL (Division of Environmental Quality 1997). In the American Falls Subbasin TMDL, target concentrations of 0.05 mg/L for TP and 0.85 mg/L for total nitrogen were used (DEQ 2004).

Due to the interstate nature of the Bear River Basin, Idaho must be aware of work done in both Wyoming and Utah. At this point, Wyoming has not prepared a TMDL for their portion of Bear River. Utah does have a TMDL (Ecosystems Research Institute 1995) for lower Bear River beginning at the Utah-Idaho border. Four streams leave Idaho and flow into Utah - Bear River, Cub River, Malad River, and Worm Creek. Idaho's recommended target for total phosphorus of 0.05 mg/L at the border falls in line with the same target in the Utah section of these streams, except for Malad River where Utah has a 0.075 mg/L total phosphorus target. In Utah, the TSS target is 90 mg/L for Bear, Cub, and Malad rivers, and 35 mg/L for all other tributaries. Idaho's targets for Bear, Cub, and Malad rivers are below Utah's. To recognize Utah's target for Bear River tributaries, a target of 35 mg/L is recommended for Worm Creek.

Targets for total suspended solids fall within guidelines outlined by the European Inland Fisheries Advisory Commission (EIFAC 1964) for maintaining good to moderate fisheries. To reduce sediment loads into Bear Lake and Alexander and Oneida Narrows reservoirs, a 35 mg/L target of TSS is recommended for sites, including Soda and Cottonwood creeks, just upstream of the lake or reservoirs. This value falls on the lower end of the range of concentrations, 25 to 80 mg/L, needed to maintain good to moderate fisheries. Sites discharging into riverine reaches, both mainstem and tributaries (except

Worm Creek), were assigned a total suspended solids target of 60 mg/L during base flow conditions. Typically sediment loads increase during runoff. To allow for expected escalation in sediment during runoff, TSS targets were set at 60 mg/L for sites that discharge into lakes or reservoirs and 80 mg/L for sites that discharge into riverine reaches.

In addition to the EIFAC (1964) report, which linked excess sedimentation to use impairment, the 60 mg/L suspended sediment target is in line with other "local" standards and targets. Nevada (NDEP Web site) has state standards for suspended solids in rivers and creeks that range from 25 to 80 mg/L. Joy and Patterson (1997) set targets at 56 mg/L in tributaries and return drains in the Yakima River in Washington for TSS. In Bear River in Utah, TSS targets were 35 mg/L for smaller streams and 90 mg/L for larger streams (Ecosystem Research Institute 1995). DEQ has established seasonal targets of 50 mg/L and 80 mg/L for TSS in several subbasins (Boise River [Division of Environmental Quality 1999], Portneuf River [DEQ 2001a], Blackfoot River [DEQ 2001b]).

Because of the affinity for phosphorus to adsorb to sediment particles, there is often a relationship between total suspended solids and total phosphorus. One river reach and one site were examined for such a relationship – near the Idaho-Wyoming border and at Stewart Dam (Table 2-22). Analysis of ERI data from Stewart Dam showed a weak relationship ($r2 = 0.49$, $p < 0.001$, $n = 115$) between concentration of total suspended solids (TSS) and total phosphorus. Paired data collected near the border indicated a stronger correlation between the two parameters ($r2 = 0.64$, $p < 0.001$, $n = 118$). From this TSS-TP relationship near the Idaho-Wyoming border, inserting the total phosphorus target of 0.075 mg/L for water bodies discharging to riverine reaches into the equation TSS=(567*TP)-14.6 equates to 28 mg/L of TSS. Thus, by achieving total phosphorus targets in mainstem Bear River, total suspended sediment targets should also be reached.

Margin of Safety

To account for uncertainty associated with insufficient or even unknown data, and the relationship between pollutant loads and beneficial use impairment, a margin of safety is included in development of load analyses. There are several ways to implement a margin of safety. For the Idaho portion of the Bear River, we chose conservative targets, which convey an implicit margin of safety when estimating load and wasteload allocations.

As mentioned, the recommended targets (i.e., 35, 60, or 80 mg/L) for suspended solids all fall within values of 25-80 mg/L recommended by the European Inland Fisheries Advisory Commission (EIFAC 1964) for maintaining good to moderate fisheries. The 80 mg/L target only applies during runoff, when higher suspended solids concentrations would be expected. Most of the year maximum concentrations will be in the 35 or 60 mg/L in the middle or lower end of the EIFAC recommendations. Thus, it is felt that the chosen targets implicitly include a margin of safety for support of beneficial uses.

EPA has issued several documents providing guidance on phosphorus in aquatic systems. The 1986 "Gold Book" recommended for streams that do not discharge into lakes or reservoirs a target of 0.1 mg/L of total phosphorus. Hence, the 0.075 target for similar reaches in Bear River Basin is a 25% reduction in the EPA recommended target. Further, EPA approved the total phosphorus target in the Blackfoot River TMDL (an adjacent watershed) at 0.1 mg/L with the assumption of that value having an implicit margin of safety (DEQ 2001b).

In 2000, EPA published Ambient Water Quality Criteria Recommendations, Rivers and Streams in Nutrient Ecoregion III (Xeric West). Streams in the lower 25th percentile of all streams examined had total nitrogen ranging from 0.22 to 0.90 mg/L. The recommended target concentration for Thomas Fork of 0.85 mg/L total nitrogen is about a 6% reduction from the high end of the range. Total phosphorus in reference sites, based on the 25th percentile, ranged from 0.010 to 0.055 mg/L. The recommended target of 0.05 for stream reaches that discharge into Bear River reservoirs is a 9% reduction from the upper end of the reference site range. It also is in line with the "Gold Book" recommendation of total phosphorus not to exceed 0.05 mg/L for reaches discharging into lakes or reservoirs.

Table 2-21. Total suspended solids and total phosphorus targets applied to mainstem Bear River reaches in this TMDL analysis. The targets for total suspended solids changed with hydrologic time period as well as presence or absence of a receiving water body.

Mgmt Reach	Location	Total Phosphorus (mg/L) Target	Total Suspended Solids (mg/L)	
			Runoff Target	Base flow Target
MR1	BR01	0.075	80	60
	BR03	0.050	60	35
	CSWY/LFT	0.050	60	35
MR2	LFT-OUT	0.075	80	60
	BL03	0.075	80	60
	BR08	0.050	60	35
MR3	BR09	0.075	80	60
	BR15	0.050	60	35
MR4	BR16	0.050	80	60
	BR17	0.050	80	60

For point sources, recommended targets followed those for nonpoint sources or were based on the facility's NPDES permit. For example, the suspended solids target for waste water treatment plants was 30 mg/L based on the permit requirements for Soda Springs, Grace, Preston, and Franklin WWTPs. The assumption was made whenever targets were based on the NPDES permit, that requirements in the permit already included a margin of safety.

Seasonality and Critical Periods

Loads are calculated on a mass per unit time basis. An actual total maximum daily load is too refined (i.e., daily basis) to be practical for non-point source pollutants. On the other hand, a total maximum annual load may mask short, intense periods (i.e., spring runoff or episodic storm events), when loads are excessive and need to be controlled, followed by longer periods of relative inactivity. Therefore, some time period between daily and annual loads is needed. For Bear River, loads were calculated based on hydrologic periods, when one would expect that at least hydrologic conditions are similar. For the tributaries, data were insufficient to calculate loads by hydrologic periods so only annual loads are presented. More data are needed so tributary loads can be established for the four hydrologic periods.

Sediment

Two targets are specified for each site, one or the other of which applies at all times; which one applies depends on the runoff season. Knowing that naturally higher sediment loads are observed during times of runoff, it makes sense to have a seasonal adjustment to the recommended targets. Thus, the higher target concentration of 60 or 80 mg/L during the historic spring runoff period allows for normal seasonal increases in suspended sediment while still within concentrations needed to maintain good to moderate fisheries. During periods of lower flows, the target concentration is lowered to 35 and 60 mg/L to further enhance and protect fisheries. These targets are assumed to represent average values over the sampling period (e.g., hydrologic period). Targets can be adjusted as additional information is collected.

Nutrients

The critical period for nutrients in terms of affecting beneficial uses in Bear River Basin is the warmer months of summer and early fall. Nutrients promote growth of aquatic vegetation, which usually is at highest density in late summer - a time of high demand by river recreationists. Summer also means warmer water temperatures, and because saturation levels of gases decline as temperature increases, decreased concentrations of dissolved oxygen result. These conditions stress aquatic biota when oxygen levels are low and respiration of dense aquatic vegetation pushes dissolved oxygen concentrations lower.

The tendency for the uptake of phosphorus as phosphates by sediment allows phosphorus availability throughout the growing season regardless of time of input. If Bear River was the only concern, seasonal variation in nutrient concentrations would be considered. However, Bear River flows into Bear Lake, Alexander Reservoir, and Oneida Reservoir. Lentic waters (e.g., lakes and reservoirs) act as sinks for phosphorus, increasing the availability time for uptake by aquatic vegetation. Thus, phosphorus, which entered the stream in the winter when vegetative growth is low or nil, could be bioavailable to aquatic vegetation in the reservoir in July when conditions are conducive to algal or macrophytic growth. Due to concern about the lake and reservoirs, no allowance for seasonal variation in nutrient loading is made.

Little is known of seasonal effects of nitrogen in Thomas Fork or Bear River. Our analysis of available data indicates that nitrogen may be more of a problem at certain times of the year (Hull 1996). Until more data are available to suggest there is a limited time period in which nitrogen contributes to water quality problems, no seasonal variation in nutrient loading is recommended.

Table 2-22. Total suspended solids as a function of total phosphorus from regression analysis of data (Appendix B) collected in Bear River at and above Stewart Dam.

Site	Sampling period (years)	Sample size	r2	*p*-value	Y-intercept	Regression coefficient
Idaho-Wyoming Border[1]	1974-1991	118	0.64	< 0.001	-14.6	567
Stewart Dam	1982-1998	115	0.49	< 0.001	14.3	506

(1)Total phosphorus concentration (2.4 mg/L) collected October 7, 1980 considered an outlier and not used.

Compliance with neighboring states' TMDLs for the Bear River watershed

Only Utah has written TMDLs for Bear River. To comply with Utah's Lower Bear River Water Quality Management Plan (Ecosystem Research Institute 1995) water flowing from Idaho to Utah must meet a total phosphorus target of 0.05 mg/L and a total suspended solids target of 90 mg/L in both mainstem Bear and Cub rivers. Worm Creek, which also crosses the state line, must not exceed a TSS target of 35 mg/L or total phosphorus target of 0.05 mg/L. Utah has set total phosphorus and TSS targets for Malad River at 0.075 mg/L and 90 mg/L, respectively (UDEQ 2002). In all cases, Idaho's Bear River TMDL complies with Utah's Bear River TMDL.

Reasonable Assurance

The U. S. Environmental Protection Agency (EPA) requires that Total Maximum Daily Loads (TMDL) with a combination of point and nonpoint sources and with wasteload allocations dependent on nonpoint source controls, provide reasonable assurance that the nonpoint source controls will be implemented and effective in achieving the load allocation (EPA 1991). If reasonable assurance that nonpoint source reductions will be achieved is not provided, the entire pollutant load will be assigned to point sources. Nonpoint source reductions listed in the Bear River TMDL will be achieved through state authority within the Idaho Nonpoint Source Management Program.

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

As described in the Idaho Nonpoint Source Management Plan, Idaho Water Quality Standards require that if monitoring indicates water quality standards are not met due to nonpoint source impacts, even with the use of current best management practices, the practices will be evaluated and modified as necessary by the appropriate agencies in accordance with provisions of the Administrative Procedure Act (IDAPA). If necessary, injunctive or other judicial relief may be initiated against the operator of a nonpoint source activity in accordance with authority of the Director of Environmental Quality provided in Section 39-108, Idaho Code (IDAPA 58.01.02.350). Idaho Water Quality

Standards list designated agencies responsible for reviewing and revising nonpoint source BMPs based on water quality monitoring data generated through the state's water quality monitoring program. Designated agencies are: Department of Lands for timber harvest activities, oil and gas exploration and development, and mining activities; Soil Conservation Commission for grazing and agricultural activities; Transportation Department for public road construction; Department of Agriculture for aquaculture; and the Department of Environmental Quality for all other activities (Idaho Code 39-3602). Existing authorities and programs for assuring implementation of BMPs to control nonpoint sources of pollution in Idaho are as follows:

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

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

2.2.3 Summary of Existing Water Quality Data

Water quality studies on the Bear River date back to the 1950s. Table 2-23 summarizes these studies by author, year of data collection, area covered by the study and the parameters measured during the study. The Idaho Bear River reach (that portion downstream of the Wyoming-Idaho border) has been the subject of water quality investigations starting as early as 1953 (Clyde 1953).

Table 2-23. A summary of studies completed on the Bear River basin.

Author	Data date	LOCATIONS				PARAMETERS						
		BR UT	BR ID	BR WY		Flow	Nutrients	TSS	Salts	Metals	Bacteria	Biological
Thorne & Thorne 1951	1949	X				X			X			
Clyde 1953	1953	X	X			X		X				
Ward & Skoubye 1959	1958-59	X				X	X	X	X	X	X	
Bangerter 1965	1963-67	X										X
Waddell 1970	1952-68	X	X	X		X		X	X			
Hill et al. 1973	1971-72	X	X	X		X			X			
Israelson et al. 1975	1973-74	X					X					
UWRL 1974a	1974	X					X				X	
UWRL 1974b	1974	X					X				X	
Drury et al. 1975	1972-73	X					X					
UWRL 1976	1975-76	X	X	X		X	X	X	X	X	X	
Perry 1978	1978		X					X	X		X	X
Heimer 1978	1975-76		X					X				
Lamarra 1979	1977-78	X					X					
Lamarra & Adams 1980	1980	X				X	X	X			X	
Wienecke et al. 1980	1976-77	X					X	X				
Messer et al. 1981	1980	X	X			X		X				
Rupp & Adams 1981	1979-80	X				X						
UBWPC 1982	1975-82	X					X	X	X		X	
Messer et al. 1984	1979-84	X				X	X					
Montgomery 1984	1984	X				X		X				
Sorensen et al. 1984	1977-83	X					X	X	X			
UBWPC 1984	1982-84	X					X	X	X		X	X
Grenney et al. 1985	1976-82	X					X					
UDPC 1985	1985	X										X
Sorensen et al. 1986	1984-85	X	X				X	X	X	X		
UBWPC 1986a	1984-86	X					X	X	X		X	
UBWPC 1986b	1986	X										X
Sorensen et al. 1987	1985-86	X	X			X	X					
UBWPC 1987	1987	X										X
UBWPC 1988	1986-88	X					X	X	X		X	
Barker et al. 1989	1987	X	X			X	X		X			
UBWPC 1990	1988-90	X					X	X	X		X	
ERI 1991	1990-91	X	X			X	X	X	X		X	
PacifiCorp Electric Operations	1991	X										X
UBWPC 1991a	1988-89	X										X
UBWPC 1991b	1889-90	X										X
UDWQ 1992a	1990-92	X					X	X	X		X	
BLRC & ERI 1993	1991			X		X	X	X	X			X
UDWQ 1993a	1990-91	X										X

Table 2-23, continued												
UDWQ 1993b	1991-92	X										X
UDWQ 1993c	1990-91	X										X
UDWQ 1993d	1991-92	X										X
UDWQ 1994a	1992-93	X										X
UDWQ 1994b	1992-93	X										X
UDWQ 1995	1993-94	X										X
ERI 1995	1992-93	X				X	X	X		X	X	X
ERI 1998	1994-96	X	X			X	X	X		X	X	X

The studies focused on suspended sediments and flow. Several studies have also been conducted on the current condition of and influences on water quality in the reach above Bear Lake, extending as far as Woodruff Reservoir in Wyoming down to the Idaho-Utah state line. Of the studies that have been conducted on Bear River water quality in the project reach (Wyoming-Idaho state line to the Utah-Idaho state line) the most extensive has been completed by ERI (1998) and will be described in detail later in this section. Prior to that discussion, a brief summary of historical water quality investigations on the Bear River system will be completed. The following section summarizes those studies.

Early water quality studies focused on sediments and salinity in the river. Clyde (1953) evaluated sedimentation patterns in the Bear River between Oneida and Cutler reservoirs. Between 1910 and 1950, the riverbed raised six feet due to the deposition of over 110,000,000 tons of sediment. He attributed the source to rapid erosion in tributaries below Oneida Reservoir, caused by the natural soil conditions in the upland areas, exacerbated by irrigation and other land use practices. He concluded that fluctuating flows from Oneida had not greatly affected deposition of sediment in the channel. Heimer (1978) measured turbidity and suspended sediments at sites from below Bear Lake to the Utah-Idaho state line. Based on his 1975 data, sediment loads in the river increased from 98 tons/month (3,000 kg/day) at Soda Springs to 351 tons/month (10,600 kg/day) near Preston, then decreased to 171 tons/month (5,180 kg/day) at the state line. Waddell (1970), Haws and Hughes (1973), and Hill et al (1973) all summarized water quality data collected in the late 1960s and early 1970s. Most analyses were for major anions and cations only. Over this time period, total dissolved solids (TDS) averaged about 375 mg/L at the Bear Lake outlet, with little change throughout the Idaho reach.

The first extensive water quality study of the Idaho portion of the Bear River was conducted in 1975 and 1976 (Perry 1978), with samples collected every two weeks at 15 stations. Perry concluded that total suspended solids (TSS) and TDS concentrations responded differently in the reaches above and below Oneida. From Bear Lake to above Oneida, TSS and TDS decreased at higher flows due to a dilution effect. However, below Oneida, solids increased during runoff. He attributed this to high sediment inputs from tributaries below Oneida. High nitrate concentrations in Black Canyon, possibly from Grace waste water treatment plant (WWTP), and fecal coliform contamination in the river near Preston were also identified as water quality problems.

In the late 1970s, the emphasis shifted to nutrient contamination in the river, with most data collected below Oneida Reservoir by Utah State University Water Research Laboratory. Sorensen et al. (1984, 1986) found increasing TSS and total phosphorus (TP) loads below Oneida to be associated with inputs from tributaries. Most of the phosphorus was associated with the sediment, rather than in dissolved form. A study of the impact of power peaking below Oneida Reservoir demonstrated that total phosphorus increased during peaking events. Sorensen et al. also investigated bio available phosphorus at the sites they monitored. They indicated that the amount of bio-available phosphorus in the system was related to anthropomorphic sources.

Barker et al. (1989) summarized nutrient data collected from Bear Lake outlet to the Idaho-Utah state line during 1987 and 1988. Average TP concentrations increased from 0.06 mg/L at Bear Lake outlet to 0.100 mg/L at state line. Average orthophosphorus increased from 0.008 to 0.037 mg/L over the same reach, although on most dates the concentrations were low and relatively constant from site to site. Nitrate concentrations ranged from 0.140 mg/L at the outlet to 0.860 mg/L at the state line.

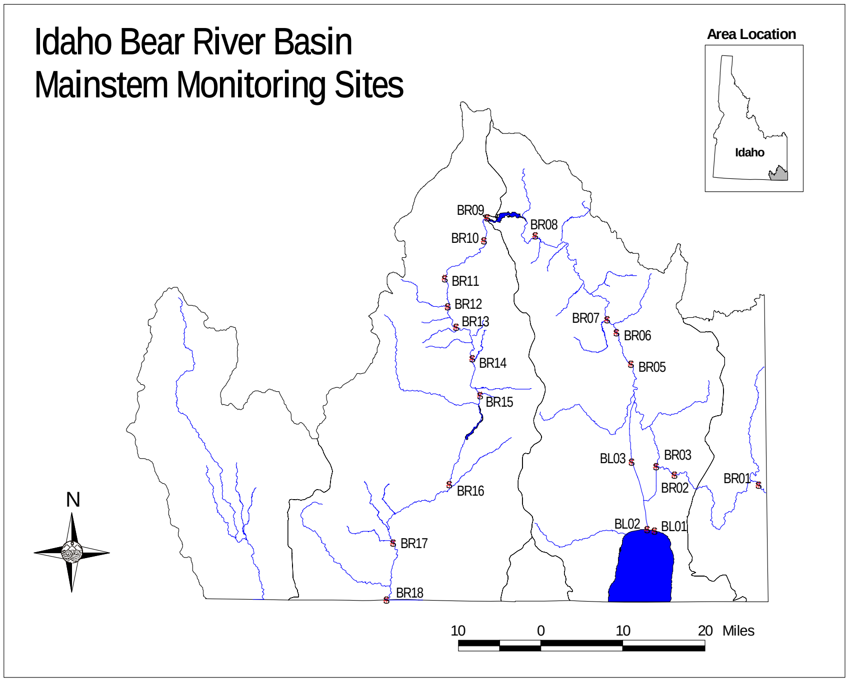
ERI (1991) reported on data collected in the lower basin during 1990, a low flow year, which included a site below Oneida Reservoir and sites from the Idaho-Utah state line to below Cutler Reservoir. In this study, the average daily load of TSS increased from 7,000 kg/day below Oneida Reservoir to 24,000 kg/day at the state line and to 53,000 kg/day below Cutler Reservoir. The average TSS concentration increased from 6 to 50 mg/L over this reach. Nutrient concentrations were relatively constant or decreased from Oneida to the state line, but increased from that point to a site below Cutler. Phosphorus in particular increased substantially.

ERI (1998) conducted the most current and extensive water quality investigation on the mainstem Bear River. Twelve sites on the mainstem Bear River were sampled from April 1994 through September 1996 and in 1999-2000 including the inlet and outlet to Bear Lake as well as the outlet to Black Canyon below Grace, Idaho (Figure 2-16; Table 2-24). In addition, several point sources, including the Soda Springs WWTP, the Clear Springs fish hatchery and Preston WWTP were also sampled. Several monitoring sites on the mainstem and tributaries were also monitored by PacifiCorp as part of their relicensing effort on three hydroelectric facilities in Idaho. Data from several of these sites have also been included in this review of available information. This study represents the basis for the summary and analysis of water quality conditions in the Middle Bear River watershed.

ERI's (1998) investigation sampled only a limited number of tributaries. In order to more fully define the nonpoint source component of the source inventory, detailed tributary and mainstem synoptic surveys were conducted during 1999-2000, using the same protocol as the 1998 study. These surveys will be discussed in the context of the more extensive 1998 study.

Samples for both studies were collected as subsurface grabs within the mixed zone and in the main channel of the stream. Field parameters (temperature, pH, conductivity, dissolved oxygen) were measured at the site and water samples were collected for nutrient, sediment and salinity analyses and returned to the laboratory for analysis. Flows were measured at the sites where water quality samples were collected. Flows on most of the mainstem Bear River in Idaho, and Soda Creek were obtained from PacifiCorp. Discharge data for the Utah-Idaho state line were obtained from the U.S. Geological Survey (USGS).

Data collected by IDEQ and others are utilized to determine support of beneficial uses of wadeable streams and larger water bodies (e.g., Bear River). Although data collection and assessment techniques vary based on stream size or stream vs. lake or reservoir, monitoring is performed through DEQ's Beneficial Use Reconnaissance Program (BURP). BURP looks at the aquatic community (macroinvertebrate, diatom, fish) and stream habitat (IDEQ 1999). In addition, bacteria data are collected for selected streams.



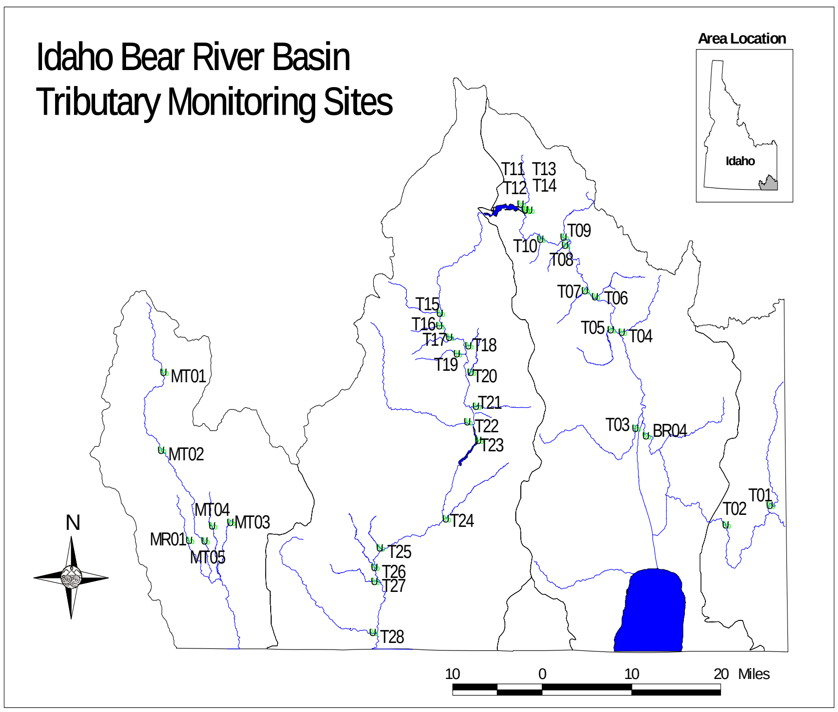


Figure 2-16. Locations of mainstem sites (above) and tributary sites (below) monitored during the 1999-2000 season.

Table 2-24. A summary of water quality sites by HUC used in the Middle Bear River analysis.

TYPE	HUC	SITEID	STATION DESCRIPTION
mainstem	16010102	BR01	Bear River at Border WY
mainstem	16010102	BR01A	Bear R Ab Cnfl W/Thomas Fk
mainstem	16010102	BR01B	Bear River at Harer Idaho
tributary	16010102	T01	Thomas Fork
tributary	16010102	T02	Sheep Creek
mainstem	16010201	BL01	Causeway
mainstem	16010201	BL02	Lifton
mainstem	16010201	BL03	BL Outlet
mainstem	16010201	BR02	Bear River 1 Mi NE of Dingle
mainstem	16010201	BR03	Bear River at Stewart Dam
mainstem	16010201	BR04	Bear River Old Channel
mainstem	16010201	BR05	Bear River at Pescadero Idaho
mainstem	16010201	BR06	Br at Nounan Bridge
mainstem	16010201	BR07	Br at Stauffer Creek
mainstem	16010201	BR08	Bear River at Soda Springs Idaho
mainstem	16010201	BR08A	Bear R @ Soda Spgs @ Head of Alexander Res
mainstem	16010201	BR09	Br below Alexander
tributary	16010201	T02A	St Charles C Ab Div Nr St Charl Ida
tributary	16010201	T03	Ovid Creek
tributary	16010201	T04	Georgetown Creek
tributary	16010201	T05	Stauffer Creek
tributary	16010201	T06	Skinner Creek
tributary	16010201	T07	Pearl Creek
tributary	16010201	T08	Eightmile Creek
tributary	16010201	T09	Sulphur Canyon Creek
tributary	16010201	T10	Bailey Creek
tributary	16010201	T11	Clear Springs Fish Hatchery
tributary	16010201	T12	Soda Springs WWTP West Side Creek
tributary	16010201	T13	Soda Springs WWTP
tributary	16010201	T14	Soda Creek
tributary	16010201	T14A	Soda Creek in Soda Springs
mainstem	16010202	BR10	Br at Last Chance
mainstem	16010202	BR11	Br at Black Canyon
mainstem	16010202	BR11A	Bear R Nr Grace Ida
mainstem	16010202	BR11B	Bear River above Cove
mainstem	16010202	BR11C	Bear River below Cove
mainstem	16010202	BR12	Br at Cheeseplant Bridge
mainstem	16010202	BR13	Br at Thatcher Church
mainstem	16010202	BR14	Br at Thatcher Bridge
mainstem	16010202	BR15	Bear River above Oneida
mainstem	16010202	BR15A	Bear R @ Br 1 Mi Blw Oneida Dam
mainstem	16010202	BR16	Br Blw Oneida
mainstem	16010202	BR16A	Bear R at Riverdale Id Old Brd up R Fr Id34 Brd
mainstem	16010202	BR16B	Bear River near Preston Idaho
mainstem	16010202	BR16C	Bear River above Preston
mainstem	16010202	BR17	Bear R @ Hwy 91 Br N of Preston
mainstem	16010202	BR18	Bear River at Idaho Utah State line
tributary	16010202	T15	Densmore Creek
tributary	16010202	T16	Smith Creek
tributary	16010202	T17	Alder Creek
tributary	16010202	T18	Whiskey Creek
tributary	16010202	T19	Burton Creek
tributary	16010202	T20	Trout Creek
tributary	16010202	T21	Williams Creek
tributary	16010202	T22	Cottonwood Creek
tributary	16010202	T23	Maple Hot Springs
tributary	16010202	T24	Mink Creek
tributary	16010202	T25	Battle Creek

Table 2-24, continued

tributary	16010202	T26	Deep Creek
tributary	16010202	T27	5 Mile Creek
tributary	16010202	T27A	Preston WWTP
tributary	16010202	T28	Weston Creek
tributary	16010204	MR01	Malad River at 3700 South
tributary	16010204	MR01A	Malad River at Gwenford
tributary	16010204	MR01B	Malad River above Woodruff
tributary	16010204	MR01C	Malad River at Woodruff Id
tributary	16010204	MR02	Malad River Blw Riverside
tributary	16010204	MR03	Malad River Abv Confluence
tributary	16010204	MR04	Malad River at Portage
tributary	16010204	MR05	Malad River at Aqueduct
tributary	16010204	MT00A	Dairy Ck at Mouth
tributary	16010204	MT00B	Wright Ck Ab Pumice Mine
tributary	16010204	MT00C	Wright Ck Blw Pumice Mine
tributary	16010204	MT00D	Wright Creek below Perlite Plant
tributary	16010204	MT01	Wright Creek
tributary	16010204	MT01A	Wright Creek below Indian Mill Creek
tributary	16010204	MT01B	Wright Creek at Mouth
tributary	16010204	MT01C	Little Malad Spgs at Mouth
tributary	16010204	MT01D	Little Malad River Ab Elkhorn Res Nr Malad City
tributary	16010204	MT01E	Little Malad River at Sublette Rd Bridge
tributary	16010204	MT01F	Little Malad River Below Daniels Dam
tributary	16010204	MT02	Elkhorn Creek
tributary	16010204	MT02A	Little Malad R Ab St Jn ca Div Nr Malad City
tributary	16010204	MT02B	Little Malad R below Sandridge Dam Site Nr Malad City
tributary	16010204	MT02C	Malad River below Springs Nr Malad City Idaho
tributary	16010204	MT03	Deep Creek
tributary	16010204	MT04	Devil Creek
tributary	16010204	MT04A	Devils Creek at Hwy 37 Bridge
tributary	16010204	MT05	Little Malad River
tributary	16010204	MT06	Tributary to Malad River at Riverside

Evaluations of BURP data are based primarily on three facets of wadeable streams: macroinvertebrate community, stream habitat, and, for most streams, fish community (IDEQ 2002a). Information on diatom communities is generally limited. These data are used to derive various metrics (numeric values that describe data such as number of species represented or ratio of stream width to stream depth) that are unique to the three categories of evaluation. Individual metrics within each category are combined to create a multimetric index score for macroinvertebrate community, fish community, and stream habitat. It is from these scores that support or impairment of beneficial uses is determined for cold water aquatic life and salmonid spawning (IDEQ 2002b). At least two scores (most always macroinvertebrate and habitat) are needed to evaluate beneficial use support; and those scores must average 2 or greater (on a scale of 0 to 3) before the water body is considered to support cold water aquatic life. The protocol is to be used for perennial streams.

High levels of bacteria can affect both primary and secondary contact recreation beneficial uses. Any violation of state water quality standards results in non-support of the water body for primary or secondary contact recreation, or both.

Some of the most extensive and intensive tributary monitoring has been carried out via the Beneficial Use Reconnaissance Program. Most of the tributaries on the 303(d) list have been “BURPed” along with many non-listed streams (Table 2-25). Streams for which BURP data show full support of beneficial uses include North and St. Charles creeks. Thus, we recommend that both North Creek and St. Charles Creek be removed from the 303(d) list. BURP data for other listed streams validate continuation of the water body on the 303(d) list. Several streams, not currently on the 303(d) list exhibited low multimetric scores signifying non-support of beneficial uses. Listing of those streams, which are perennial, is expected to occur as part of the first 303(d) list submitted by the State of Idaho subsequent to the approval of this TMDL. Scheduling for the TMDLs will be identified at the time of listing.

The general pattern of assessment of BURP data from large rivers is similar to that of wadeable streams with scores based on macroinvertebrate, diatom, and fish communities (IDEQ 2002c). Three of the four sites sampled on mainstem Bear River did not support cold water aquatic life (Table 2-26). For the fourth site (Turner Property), only macroinvertebrate data were collected so no assessment was made.

Table 2-25. Assessment of data from DEQ Beneficial Use Reconnaissance Project monitoring of tributaries in Bear River Basin.

HUC	Water Body	303 (d) List?	Sample Year	Site	Score[1]			Avg. Score[2]	Beneficial Use Support Status[3]			Comments
					SMI	SFI	SHI		Coldwater Aquatic Life (CAL)[4]	CAL, Salmonid Spawning[5]	Contact Recreation[6]	
16010102	Pegram Creek		1997	mainstem	1		1	1	NS		NA	
	Thomas Fork	X	1995	upper mainstem	2		1	1.5	NS	NA	NA	older data, not used in beneficial support assessment, support status carryover from 1996 303(d) list
			1995	lower mainstem	0		1	0	NS	NA	NA	
	Preuss Creek	X	1995	mainstem blw FS boundary	0		1	0	NS	NA	NA	
	Sheep Creek		1998	mainstem	3		1	2	FS		NA	
			1999	West Fork	1		1	1	NS		NA	
16010201	Sulphur Canyon		1999	South Sulphur Canyon	2		1	1.5	NS		NA	
	Wilson Creek		1999	South Wilson Creek	0		1	0	NS	NS[7]	NA	
	Eightmile Creek		1997	upper mainstem	1		3	2	FS	FS[7]	FS	
			1994	upper mainstem	3		1	2				
			1997	lower mainstem	2	1	1	1.33	NS	NS	FS	
			1994	lower mainstem	3		1	2				
	Bailey Creek		1994	upper mainstem	2		1	1.5	NA	FS	NA	older data, not used in beneficial support; 1999 DEQ electrofish resulted in 3 age-classes of trout including YOY
	Spring Creek		1998	mainstem	3		1	2	FS	FS[7]	NA	
	Fern Creek		1998	mainstem	3		3	3	FS	FS[7]	NA	
	Beaver Creek		1998	mainstem	3		3	3	FS	FS[7]	NA	
	Co-op Creek	X	1995	lower mainstem	0		1	0	NS	NA	NA	
	Skinner Creek		1997	upper mainstem	0		3	0	FS	FS	NA	assessment overturned as 2001 Forest Service electrofishing showed excellent fish community
			1994	upper mainstem	3		3	3				
	Ovid Creek	X	1996	confl, of North and Mill creeks to mouth	0		1	0	NS		NA	support status carryover from 1996 303(d) list
	Copenhagen Canyon		1998	mainstem	3		3	3	FS		NA	
	Meadow Creek	X	1998	mainstem	2		1	1.5	NS		NA	Intermittent
	North Creek	X[8]	1997	upper mainstem	3		3	3	FS	FS[7]	NA	
			1994	upper mainstem	3		3	3				
			1997	lower mainstem	3	1	2	2	FS	FS[9]	NA	
			1994	lower mainstem	0		1	0				

Table 2-25, continued

16010201	Liberty Creek		1998	mainstem	3	0	3	3	FS	NS	NA	2000 DEQ electrofishing resulted in no fish
	Mill Creek		1998	mainstem	3	3	3	3	FS	FS	NS	
	Paris Creek		1997	mainstem	1	1	3	1.67	NS	NS	FS	
			1994	upper mainstem	3		1	2				
			1994	lower mainstem	3		2	2.5				
	Sleight Canyon		1998	upper mainstem	1		2	1.5	NS	FS[7]	NA	Intermittent
			1998	lower mainstem	3		2	2.5	FS		NA	
	Bloomington Creek		1997	upper mainstem	2	3	3	2.5	FS	FS	FS	2000 Forest Service electrofishing data yielded an SFI rating of 3
			1994	upper mainstem	3		2	2.5				
			1997	lower mainstem	3	1	2	2	FS	FS[9]	FS	
			1994	middle mainstem	3		1	2				
			1994	lower mainstem								no flow in creek at this site
	St. Charles Creek	X	1997	upper mainstem	3		3	3	FS	FS[7]	FS	
			1994	upper mainstem	3		3	3				
			1994	lower mainstem	3		1	2				
			1997	north branch lower mainstem	3		2	2.5	FS	FS[7]	FS	this reach also known as Big St. Charles Creek
	Indian Creek		1997	mainstem	0		1	0	NS	NS[7]	NA	
	Fish Haven Creek		1997	mainstem	3	1	3	3	FS	FS	NA	2001 Forest Service electrofishing data yielded an SFI rating of 1, although 5 year classes of brook trout were represented
			1994	mainstem	3		3	3				
	Little Beaver Creek		1998	mainstem	2		1	1.5	NS	NS[7]	NA	
	Whiskey Creek		1998	mainstem	2		1	1.5	NS	NA	NS	2000 FS electrofishing data yielded an SFI rating of 3, salmonids may originate in Montpelier Crk, need clarification
	Home Canyon		1998	mainstem	3		2	2.5	FS	FS[7]	FS	
	Telephone Draw		1998	mainstem	3		1	2	FS	FS[7]	NA	
	Georgetown Creek		1997	upper mainstem	3		2	2.5	FS	FS	NA	assessment overturned as 2000 Forest Service electrofishing at two sites showed excellent fish community
			1994	upper mainstem	3		1	2				
			1997	middle mainstem	2	0	1	0	FS	FS	NA	assessment overturned as 2000 Forest Service electrofishing at two sites showed excellent fish community
			1994	lower mainstem	3		1	2				
			1997	lower mainstem	0	1	2	0	NS	NS	NS	
			1999	Right Hand Fork	0		2	0	NS		NA	
	Soda Creek		1999	upper mainstem	1		3	2	FS	FS[7]	NA	
			1999	lower mainstem	0	0	2	0	NS	NS	FS	

Table 2-25, continued

16010202	Steel Canyon Creek		1998	mainstem	0		2	0	NS		NA	Intermittent
	Jenkins Hollow		1998	upper mainstem	0		1	0	NS		NA	
	Weston Creek	X	1995	upper mainstem	1	2	3	2	NS		NA	older data, not used in beneficial support assessment, support status carryover from 1996 303(d) list
			1998	unnamed tributary	0		1	0	NS		NA	
	Trail Hollow		1998	mainstem	0		1	0	NS		NA	Intermittent
	Dry Canyon		1998	mainstem	2		2	2	FS		NA	
	Black Canyon		1998	mainstem	1		1	1	NS		NA	Intermittent
	Fivemile Creek	X[8]	1996	upper mainstem	0		2	0	NS		NA	older data, not used in beneficial support assessment, support status carryover from 1996 303(d) list
			1998	lower mainstem	0		1	0	NS		FS	DEQ core sampling indicates excess sediment
	Stockton Creek		1998	mainstem	3	3	3	3	FS	FS	NS	
	Swan Lake Creek		1998	mainstem	0	0	2	0	NS	NS	NS	2000 DEQ electrofishing resulted in no fish
	Gooseberry Creek		1998	mainstem	3		3	3	FS		FS	
	Oxford Creek		1998	mainstem	3		3	3	FS		NA	
	Battle Creek	X	1995	upper mainstem	0		1	0	NS		NA	
			1995	lower mainstem	0		1	0	NS		NA	
	Cottonwood Creek	X	1995	upper mainstem	1	3	3	2.33	NS		NA	older data, not used in beneficial support assessment, support status carryover from 1996 303(d) list
			1995	lower mainstem	0	1	1	0	NS		NA	
	Shingle Creek		1998	mainstem	3		3	3	FS	FS[7]	NA	
	Blue Creek		1998	mainstem	3		3	3	FS		NA	
	Divide Creek		1998	mainstem	3		3	3	FS		NA	
	Densmore Creek	X	1995	upper mainstem	0		1	0	NS		NA	older data, not used in beneficial support assessment, support status carryover from 1996 303(d) list
			1995	lower mainstem	0		1	0	NS		NA	
	Whiskey Creek	X	1995	mainstem	0		1	0	NS		NA	older data, not used in beneficial support assessment, support status carryover from 1996 303(d) list
	Williams Creek	X	1995	upper mainstem	1		3	2	NS		NA	older data, not used in beneficial support assessment, support status carryover from 1996 303(d) list
			1995	lower mainstem	0		1	0	NS		NA	
	Burton Creek		1998	mainstem	3		2	2.5	FS		FS	
	Alder Creek		1998	mainstem	3		3	3	FS		NS	Low flow to intermittent
	Smith Creek		1998	mainstem	2		3	2.5	FS		NS	
	Mink Creek		1995	upper mainstem	2		2	2	FS	NA	NA	
	Strawberry Creek	X[8]	1996	upper mainstem	1	1	1	1	NS	NS	NA	

Table 2-25, continued

16010202	Strawberry Creek		1996	lower mainstem	1		1	1	NS	NA	NA	
	Birch Creek		1996	mainstem	3	1	3	2.33	FS	FS[9]	NA	
	Deep Creek	X[8]	1995	mainstem	0	3	1	0	NS	NS[9]	NA	
	Worm Creek	X[8]	1996	upper mainstem	3		2	2.5	NS		NA	
			1996	lower mainstem	0		1	0	NS		NA	
	Foster Creek		1998	mainstem	3	3	2	2.5	FS	FS	NA	2001 Forest Service electrofishing data yielded an SFI rating of 3
	Maple Creek	X[8]	1995	upper mainstem (10)	3	3	3	3	FS	FS	NA	
			1995	lower mainstem (10)	3		3	3	FS		NS	
	Sugar Creek		1996	mainstem	3		3	3	FS		NA	
	Cub River	X	1996	lower mainstem	2	1	2	1.67	NS	NS	NA	
16010204	Two Mile Canyon		1998	mainstem	2		3	2.5	FS	FS[7]	FS	
	Four Mile Canyon		1998	mainstem	1		1	1	NS		NA	Intermittent
	West Cherry Creek		1998	mainstem	0		3	0	NS	NS[7]	NA	
	Henderson Creek		1998	mainstem	1		2	1.5	NS		NA	Intermittent
	Malad River	X	1997	lower mainstem	0	2	1	0	NS	NS[9]	NS	2001 Forest Service electrofishing data yielded an SFI rating of 2
			1995	lower mainstem	0		1	0				
	Campbell Creek		1998	mainstem	2		1	1.5	NS	NS[7]	NS	Intermittent
	New Canyon Creek		1998	mainstem	2		3	2.5	FS		FS	
	Evans Creek		1998	mainstem	2		1	1.5	NS		NA	Intermittent
	Devil Creek	X	1997	upper mainstem (10)	3	3	2	2.67	FS	FS	NA	2001 Forest Service electrofishing data yielded an SFI rating of 3
			1994	upper mainstem	3		1	2				
			1997	lower mainstem (10)	0		1	0	NS	NS[7]	NS	
	Deep Creek	X[8]	1996	mainstem	0		1	0	NS		NA	older data, not used in beneficial support assessment, support status carryover from 1996 303(d) list
	Susan Hollow		1998	mainstem	1		1	1	NS		NA	
	First Creek		1998	mainstem	3		3	3	FS	FS[7]	FS	
	Second Creek		1998	mainstem	3		2	2.5	FS	FS[7]	FS	
	Third Creek		1998	mainstem	3		3	3	FS	FS[7]	FS	
	Elkhorn Creek	X[8]	1996	upper mainstem [10]	3		2	2.5	FS		NA	
			1996	lower mainstem[10]	0		1	0	NS		NA	
	Little Malad River	X	1997	lower mainstem	0	2	1	0	NS	NS[9]	NS	
			1995	lower mainstem	0		1	0				
	Indian Mill Creek		1998	mainstem	3	0	3	3	FS	NS	NA	2000 DEQ and 2001 USFS electrofishing resulted in no fish

Table 2-25, continued

16010204	Wright Creek	X	1997	upper mainstem								creek was dry at this site, 2001 Forest Service electrofishing resulted in no fish
			1997	middle mainstem	0	3	1	0	NS	NS[9]	NS	
			1994	middle mainstem	1	2	1	1.33				
			1994	lower mainstem	1		1	1	NS	NA	NA	
	Dairy Creek	X[8]	1997	lower mainstem	0		1	0	NS	NS[7]	NS	
			1994	lower mainstem	0		1	0				
	Samaria Creek	X	1996	mainstem			1	1	NS		NA	older data, not used in beneficial support assessment, support status carryover from 1996 303(d) list, most of creek dry

(1)SMI=stream macroinvertebrate index, SFI=stream fish index, SHI=stream habitat index
(2)if any score is 0 the average defaults to 0
(3)other beneficial uses are assumed to be not assessed or fully supporting unless noted in comments; FS=fully supporting, NS=not supporting, NA=needs assessed
(4)an average score from at least two indexes of 2 or more is considered fully supporting beneficial uses; if more than two sites assessed, support status for entire stream, if not split, based on score from the lowest scoring site; sites assessed since 1997 take precedence over earlier site assessments
(5)not all sites would include salmonid spawning as a beneficial use, in other words, the streams are so small salmonid spawning would not be expected
(6)includes either primary or secondary contact recreation
(7)support of salmonid spawning defaults to cold water aquatic life support
(8)added to 1998 list
(9)salmonid spawning support status based on overall support status rather than just SFI score
(10)upstream site above 303(d)-listed segment, downstream site within listed segment

Table 2-26. Results of DEQ Beneficial Use Reconnaissance Project monitoring in Bear River, 1998.

Site	Latitude	Longitude	SCORE[1]			Average score	Beneficial use support status[2]
			RMI	RDI	RFI		
Wyoming border (1 river mile below Thomas Fork)	N42° 11' 49.48"	W111° 04' 49.56"	2	1	-	1.5	Not supporting
Rocky Point (700 meters above Dingle bridge)	N42° 14' 50.02"	W111° 16' 11.31"	2	2	1	1.67	Not supporting
Turner Property (3.6 Rm abv Caribou-Franklin county line)	N42° 26' 26.76"	W111° 43' 57.39"	2	-	-	-	
Highway 36 (100 meters below Highway 36 bridge)	N42° 05' 48.80"	W111° 54' 59.12"	2	1	-	1.5	Not supporting

(1)RMI=river macroinvertebrate index, RDI=river diatom index, RFI=river fish index
(2)an average score from at least two indexes of 2 or more is considered fully supporting beneficial uses

Hydrology

The hydrology of the Idaho Bear River system has been described in section 2.1.1.3 for the time period 1970-1999. For the years used in this specific water quality analysis (1994, 1995, 1999, and 2000), the total water yields from this basin were considered below average for 1994 to 1995 and above average for 1996 and1999. The seasonal hydrograph (Figure 2-11), has been divided into four hydrologically similar periods. These periods, which will be used throughout the following analysis in this report are: winter base flow or WBF (November, December, January, and February); lower basin runoff or LBR (March and April); upper basin runoff or UBR (May, June, and July); and summer base flow or SBF (August, September, and October). The averages, minimum and maximum values by location for each hydrologic time period can be seen in Figure 2-17.

Temperature, Dissolved Oxygen and pH

Temperature and dissolved oxygen are important water quality parameters relative to aquatic life. Within the Bear River system in Idaho, both parameters have numeric criteria associated with the coldwater aquatic life beneficial use designated for this segment of the Bear River and its tributaries.

During winter base flow, the average temperature in the upper most HUC was 0.6 to1.7° C, while the downstream values were 2.0 to 2.5° C with the temperatures in and around Grace, Idaho (the middle segment of the Idaho portion of the Bear River) being influenced by groundwater discharge into the Bear River from Black Canyon (Figure 2-18). Temperatures can be elevated by as much as 3 to 5° C in this middle segment of the river. During the other three hydrologic periods, mainstem river temperatures were on average relatively constant from the top of the river system to the Idaho-Utah border. Average river-wide temperatures, however, were cooler during LBR (4.3-9.0° C) but were similar in UBR and SBF (14-16° C) as can be seen. Exceedances of water quality limits for coldwater biota for each station over all hydrologic time periods (annual) are shown in Table 2-27.

Over every time period for the mainstem Bear River, the temperature criterion was exceeded in 3 to 8 percent of the observations at Lifton, Causeway, and Bear Lake Outlet stations; 3 to 5 percent of the observations at Pescadero and Alexander; 3 percent of the observations below Oneida Reservoir; a 5 to 7 percent of the observations west of Preston. At the Idaho-Utah state line, the temperature criterion was exceeded in 7 percent of the observations.

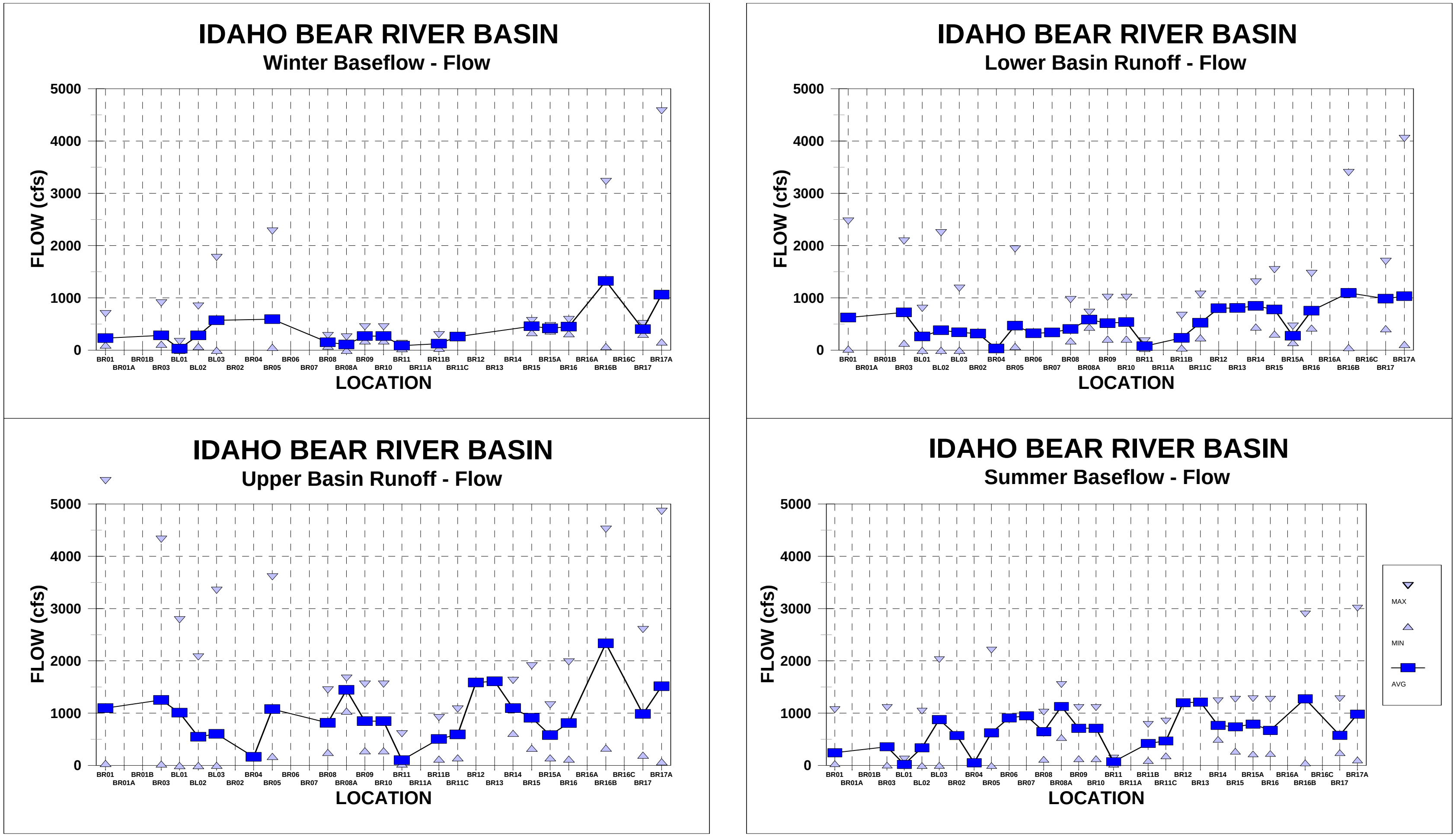


Figure 2-17. Averages, minimum and maximum values for flow on the mainstem Bear River by hydrologic period.

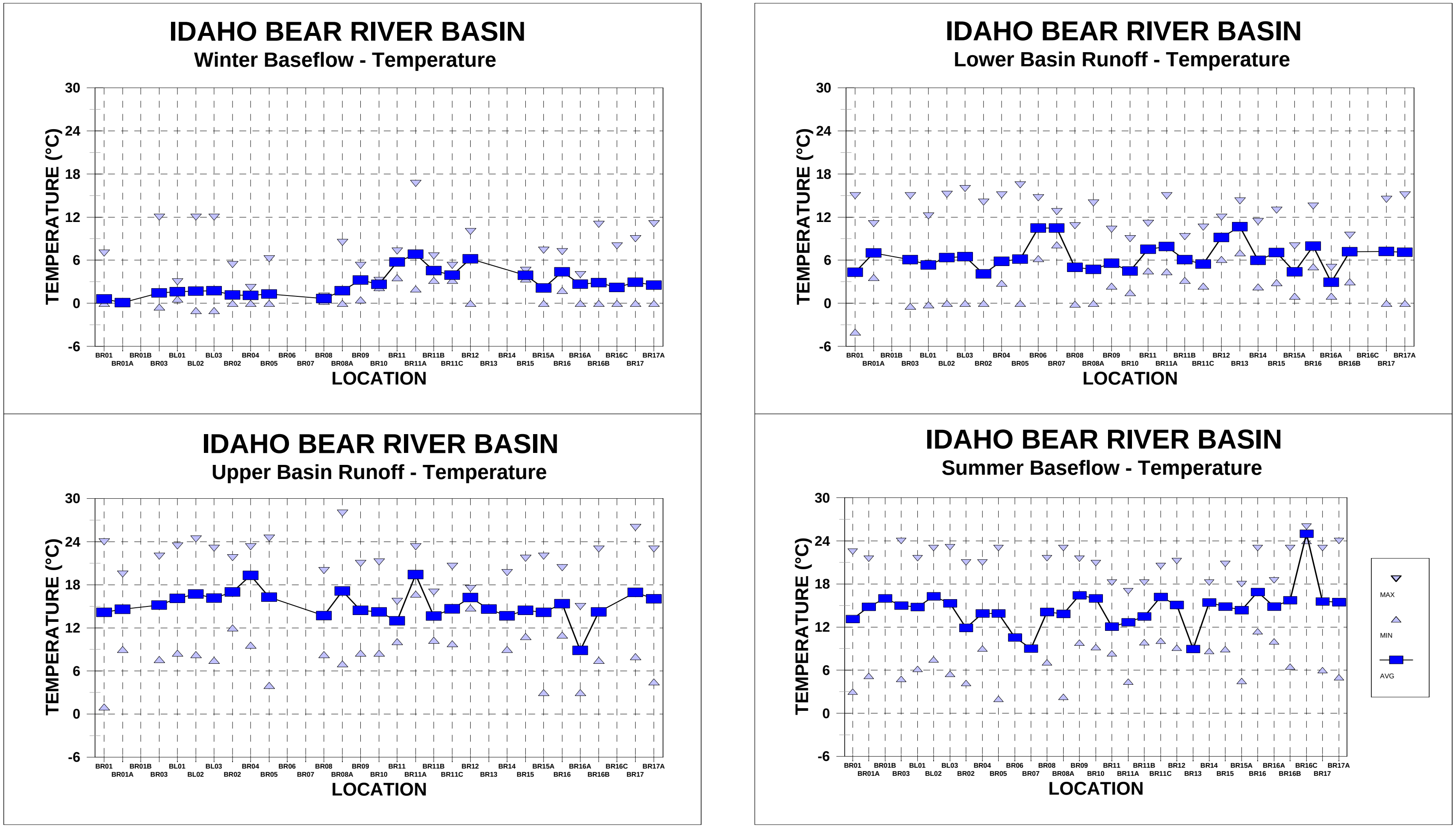


Figure 2-18. Averages, minimum and maximum values for temperature on the mainstem Bear River by hydrologic period.

Table 2-27. Exceedances of state water quality criteria, targets, and impairment indicators in mainstem Bear River sites.

				PHYSICAL			SOLIDS	NITROGEN		PHOSPHORUS	
303(d)	HUC	SITE ID	DESCRIPTION	DO (mg/L) <6	pH (SU) <6.5 or >9.5	Temp (°C) >22	TSS (mg/L) >80	NH3 (mg/L) >4	NO3 (mg/L) >4	OP (mg/L) >0.075	TP (mg/L) >0.075
x	16010102	BR01	BR at ID WY state line	2%	0%	1%	30.1%	0%	1%	3.1%	42.5%
x	16010102	BR01A	BR abv confl w Thomas Fork	5%	0%	0%	58.3%		0%	36.4%	58.3%
x	16010102	BR01B	BR at Harer ID		0%	0%					
x	16010201	BR02	BR at Hunter Hill Road bridge	0%	0%	0%	25.0%	0%	0%	0.0%	54.2%
	16010201	BR03	Stewart Dam	6%	0%	2%	37.8%	0%	0%	0.0%	62.7%
	16010201	BL01	Causeway	8%	0%	3%	2.7%	1%	0%	0.0%	20.5%
	16010201	BL02	Lifton	16%	0%	8%	3.0%	0%	0%	0.5%	20.2%
	16010201	BL03	BL outlet	13%	1%	3%	11.5%	0%	0%	0.0%	42.0%
	16010201	BR04	Bear River Old Channel	4%	0%	8%	40.0%	0%	0%	0.0%	66.7%
x	16010201	BR05	BR at Pescadero	12%	0%	3%	5.7%	0%	0%	0.0%	61.1%
x	16010201	BR06	BR at Nounan Bridge	0%	0%	0%	0.0%	0%	0%	0.0%	0.0%
x	16010201	BR07	BR at Stauffer Creek	0%	0%	0%	0.0%	0%	0%	0.0%	0.0%
x	16010201	BR08	BR above Alexander	0%	0%	0%	8.1%	0%	0%	0.0%	56.8%
x	16010201	BR08A	BR at head of Alexander Res	0%	0%	5%	10.3%				68.3%
x	16010201	BR09	BR below Alexander	5%	2%	0%	0.0%	0%	0%	0.0%	25.0%
x	16010202	BR10	BR at Last Chance	3%	0%	0%	0.0%	0%	0%	2.9%	36.8%
x	16010202	BR11	BR at Black Canyon	0%	0%	0%	0.0%	0%	0%	2.9%	37.1%
x	16010202	BR11A	BR nr Grace ID	0%	0%	4%	0.0%				50.0%
x	16010202	BR11B	BR abv Cove powerplant	0%	0%	0%	0.0%	0%		3.2%	12.9%
x	16010202	BR11C	BR blw Cove powerplant	6%	0%	0%	0.0%	0%		0.0%	30.3%
x	16010202	BR12	BR at Cheeseplant Bridge	0%	0%	0%	3.4%	0%	0%	0.0%	73.3%
x	16010202	BR13	BR at Thatcher Church	0%	0%	0%	0.0%	0%	0%	0.0%	0.0%

Table 2-27, continued

x	16010202	BR14	BR at Thatcher Bridge	13%	0%	0%	0.0%	0%	0%	7.7%	81.3%
x	16010202	BR15	BR abv Oneida at Highway Bridge	3%	0%	0%	0.0%	0%	0%	2.9%	72.2%
x	16010202	BR15A	BR 1 mile blw Oneida	0%	0%	0%	0.0%		15%	0.0%	40.0%
x	16010202	BR16	BR blw Oneida	2%	1%	3%	0.0%	0%	0%	0.0%	5.9%
x	16010202	BR16A	BR at Riverdale	0%		0%	0.0%		14%	4.8%	20.0%
x	16010202	BR16B	BR near Preston	0%	0%	7%	0.0%				0.0%
x	16010202	BR17	BR west of Preston	1%	0%	5%	2.8%	0%	0%	0.0%	53.5%
x	16010202	BR18	BR at ID UT state line	2%	0%	7%	7.9%	0%	1%	9.1%	41.8%

A review of the available temperature data for the tributaries to the Bear River indicates that there is a wide range of temperatures by both hydrologic time period, and location in the basin (HUC). Tables in Appendix A provide the mean, minimum, and maximum observed temperatures for each tributary and mainstem Bear River site where data are available. The percent exceedance of temperature for Bear River tributaries and Malad River and tributaries are shown in Table 2-28 and Table 2-29, respectively.

Dissolved oxygen varied widely from station to station on the Bear River in each hydrologic time period. The average, minimum, and maximum recorded values by hydrologic time period can be seen in Figure 2-19. In general, the highest dissolved oxygen concentrations were found during the winter base flow period, followed by lower basin runoff. Upper basin runoff and summer base flow had the lowest overall oxygen levels. This is believed to be the result of the combination of the influences of temperature and flow on the oxygen concentrations in the Bear River system. The number of exceedances of the coldwater concentrations in the tributaries were found to follow the same pattern as observed for the mainstem Bear River with winter base flow and lower basin runoff having the highest concentrations followed by upper basin runoff and summer base flow. The number of dissolved oxygen exceedances by Bear River tributary can be seen in Table 2-28 with exceedances for dissolved oxygen in Malad River and tributaries shown in Table 2-29.

The average pH values for the mainstem Bear River stations did not demonstrate large changes with location or seasonality (Figure 2-20). There was, however, variability at any given station, as shown by the minimum and maximum values for all hydrologic periods except summer base flow. Exceedances of the pH criterion (6.5 to 9.0) were rare in the Bear River Basin water bodies (Table 2-27, Table 2-28, and Table 2-29).

Suspended Solids

The concentrations of total suspended solids were far more variable than for other parameters throughout the study reach (Figure 2-21). During winter base flow, the average concentration of total suspended solids entering Idaho from the state of Wyoming was found to be 47 mg/L. After entering and leaving the Bear Lake-Mud Lake complex, the average concentration was reduced to 17 mg/L. From the Bear Lake outlet to Pescadero, the concentrations doubled to 32 mg/L. After passing through Alexander, the average concentration of TSS in the Bear River was reduced to 4 mg/L. From below Alexander to the headwaters of Oneida Reservoir, the river again gained about 14 mg/L. This gain is lost in the reservoir (3 mg/L). Exiting the reservoir to the Utah-Idaho state line, the river has its highest gain in concentration (61 mg/L) during the winter base flow period.

(Continued on page 104)

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Table 2-28. Exceedances in Bear River tributary sites of state water quality criteria, targets, and impairment indicators.

303(d)	HUC	SITE ID	DESCRIPTION	PHYSICAL			SOLIDS	NITROGEN		PHOSPHORUS	
				DO (mg/L) <6	pH (SU) <6.5 or >9.5	Temp (°C) >22	TSS (mg/L) >80	NH_3 (mg/L) >4	NO_3 (mg/L) >4	OP (mg/L) >0.075	TP (mg/L) >0.075
x	16010102	T01	Thomas Fork	0%	0%	3%	5.3%	0%	0%	0.0%	58.1%
	16010102	T02	Sheep Creek	0%	0%	0%	0.0%	0%	0%	0.0%	0.0%
x	16010201	T02A	St Charles Creek		0%	0%					
	16010201	T03	Ovid Creek	0%	0%	0%	0.0%	0%	0%	0.0%	0.0%
	16010201	T04	Georgetown Creek	0%	0%	0%	0.0%	0%	0%	0.0%	60.0%
	16010201	T05	Stauffer Creek	0%	0%	0%	0.0%	0%	0%	0.0%	20.0%
	16010201	T06	Skinner Creek	0%	0%	0%	0.0%	0%	0%	0.0%	50.0%
	16010201	T07	Pearl Creek	0%	0%	0%	0.0%	0%	0%	0.0%	0.0%
	16010201	T08	Eightmile Creek	0%	0%	0%	0.0%	0%	0%	0.0%	0.0%
	16010201	T09	Sulphur Canyon Creek	0%	0%	0%	0.0%	0%	0%	0.0%	0.0%
	16010201	T10	Bailey Creek	0%	0%	0%	0.0%	0%	0%	0.0%	0.0%
	16010201	T11	Clear Springs Fish Hatchery	0%	0%	0%	0.0%	0%	100%	0.0%	0.0%
	16010201	T12	Soda Springs WWTP West Side Creek	3%	0%	0%	0.0%	0%	75%	0.0%	40.6%
	16010201	T13	Soda Springs WWTP	31%	4%	0%	0.0%	74%	50%	100.0%	100.0%
	16010201	T14	Soda Creek	0%	0%	0%	0.0%	0%	0%	0.0%	100.0%
	16010201	T14A	Soda Creek in Soda Springs	0%	13%	0%	3.2%	0%		16.1%	100.0%
	16010202	T15	Densmore Creek	0%	0%	25%	50.0%	0%	0%	25.0%	75.0%
	16010202	T16	Smith Creek	0%	0%	50%	33.3%	0%	0%	0.0%	66.7%
	16010202	T17	Alder Creek	0%	0%	25%	50.0%	0%	0%	0.0%	75.0%
	16010202	T18	Whiskey Creek	0%	0%	0%	18.5%	0%	0%	25.0%	88.9%
	16010202	T19	Burton Creek	0%	0%	25%	50.0%	0%	0%	0.0%	75.0%
	16010202	T20	Trout Creek	0%	0%	3%	28.6%	0%	0%	0.0%	85.7%
	16010202	T21	Williams Creek	0%	0%	4%	3.6%	0%	0%	0.0%	14.3%
	16010202	T22	Cottonwood Creek	0%	0%	1%	0.0%	0%	0%	0.0%	0.0%
	16010202	T23	Maple Hot Springs	100%	33%	75%	0.0%	0%	0%	0.0%	0.0%
	16010202	T24	Mink Creek	0%	0%	3%	7.9%	0%	0%	6.3%	56.8%
x	16010202	T25	Battle Creek	3%	0%	2%	75.0%	0%	13%	33.3%	100.0%
x	16010202	T26	Deep Creek	0%	0%	13%	46.7%	0%	7%	46.7%	100.0%
	16010202	T27	5 Mile Creek	0%	0%	7%	6.7%	0%	7%	93.3%	100.0%
	16010202	T27A	Preston WWTP	73%	4%	0%	31.8%	26%		95.7%	100.0%
x	16010202	T28	Weston Creek	0%	0%	7%	13.3%	0%	13%	0.0%	73.3%

Table 2-29. Exceedances in Malad River and tributary sites of state water quality criteria, targets, and impairment indicators.

303(d)	HUC	SITE ID	DESCRIPTION	PHYSICAL			SOLIDS	NITROGEN		PHOSPHORUS	
				DO (mg/L) <6	**pH (SU)** <6.5 or >9.5	**Temp (^oC)** >22	**TSS (mg/L)** >80	**NH_3 (mg/L)** >4	**NO_3[1] (mg/L)** >4	**OP (mg/L)** >0.075	**TP (mg/L)** >0.075
X	16010204	MR01	Malad River at 3700 South	0%	0%	0%	20%	0%	0%	0%	40%
X	16010204	MR02	Malad River blw Riverside	0%	0%	0%	100%	0%	0%	0%	100%
X	16010204	MR03	Malad River abv Confluence	0%	0%	25%	100%	0%	25%	100%	100%
X	16010204	MR04	Malad River at Portage	0%	0%	0%	50%	0%	0%	0%	50%
X	16010204	MR05	Malad River at Aquaduct	0%	0%	25%	50%	0%	0%	0%	50%
X	16010204	MT01	Wright Creek	0%	0%	0%	20%	0%	0%	100%	100%
X	16010204	MT02	Elkhorn Creek	0%	0%	0%	33%	0%	0%	0%	33%
X	16010204	MT03	Deep Creek	0%	0%	0%	0%	0%	0%	0%	0%
X	16010204	MT04	Devil Creek	0%	0%	0%	0%	0%	0%	67%	67%
X	16010204	MT05	Little Malad River	0%	0%	20%	0%	0%	0%	40%	100%
	16010204	MT06	Tributary to Malad R at Riverside	0%	0%	0%	40%	0%	0%	20%	80%

(1)includes nitrite

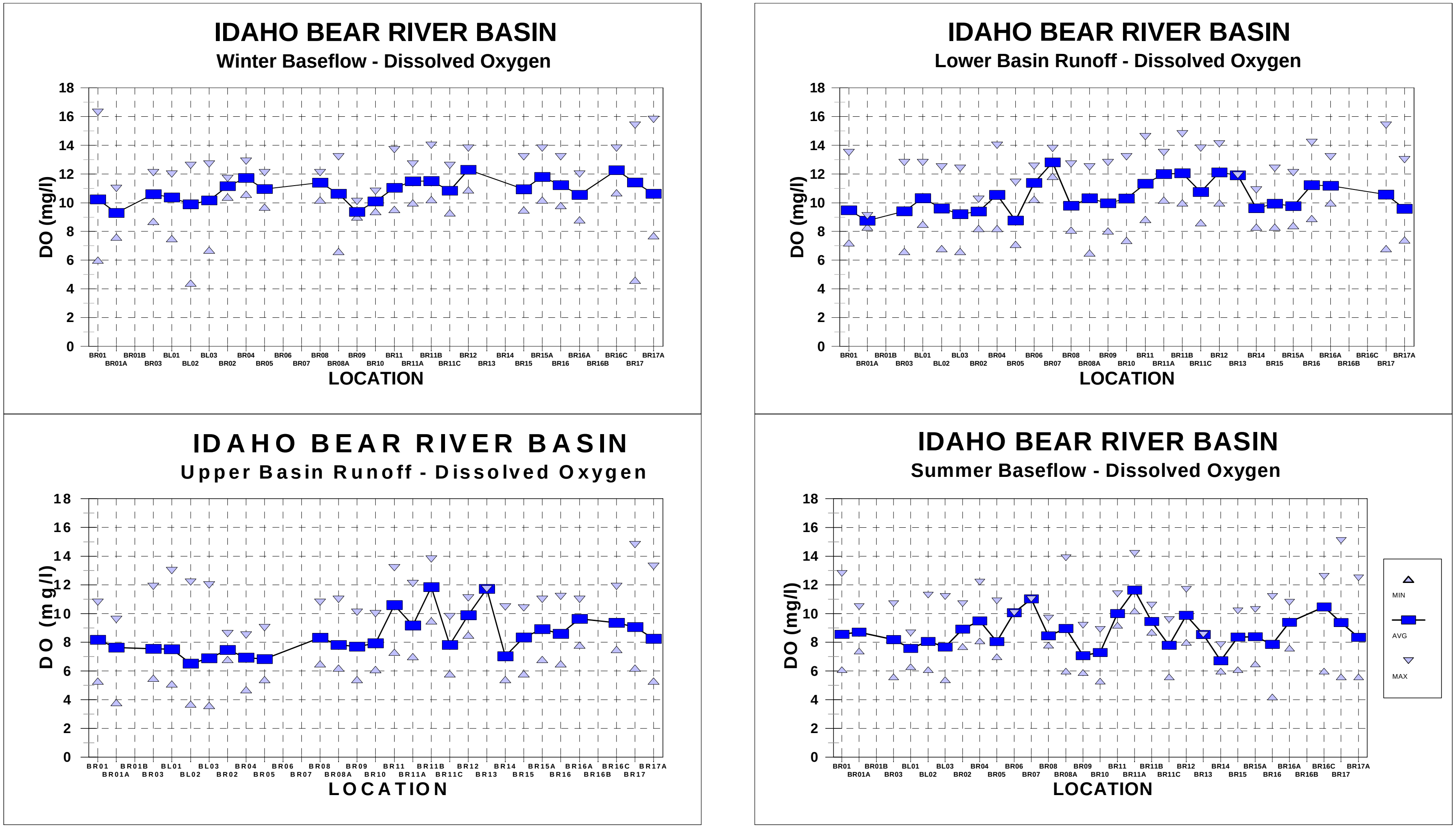

Figure 2-19. Averages, minimum and maximum values for dissolved oxygen on the mainstem Bear River by hydrologic period.

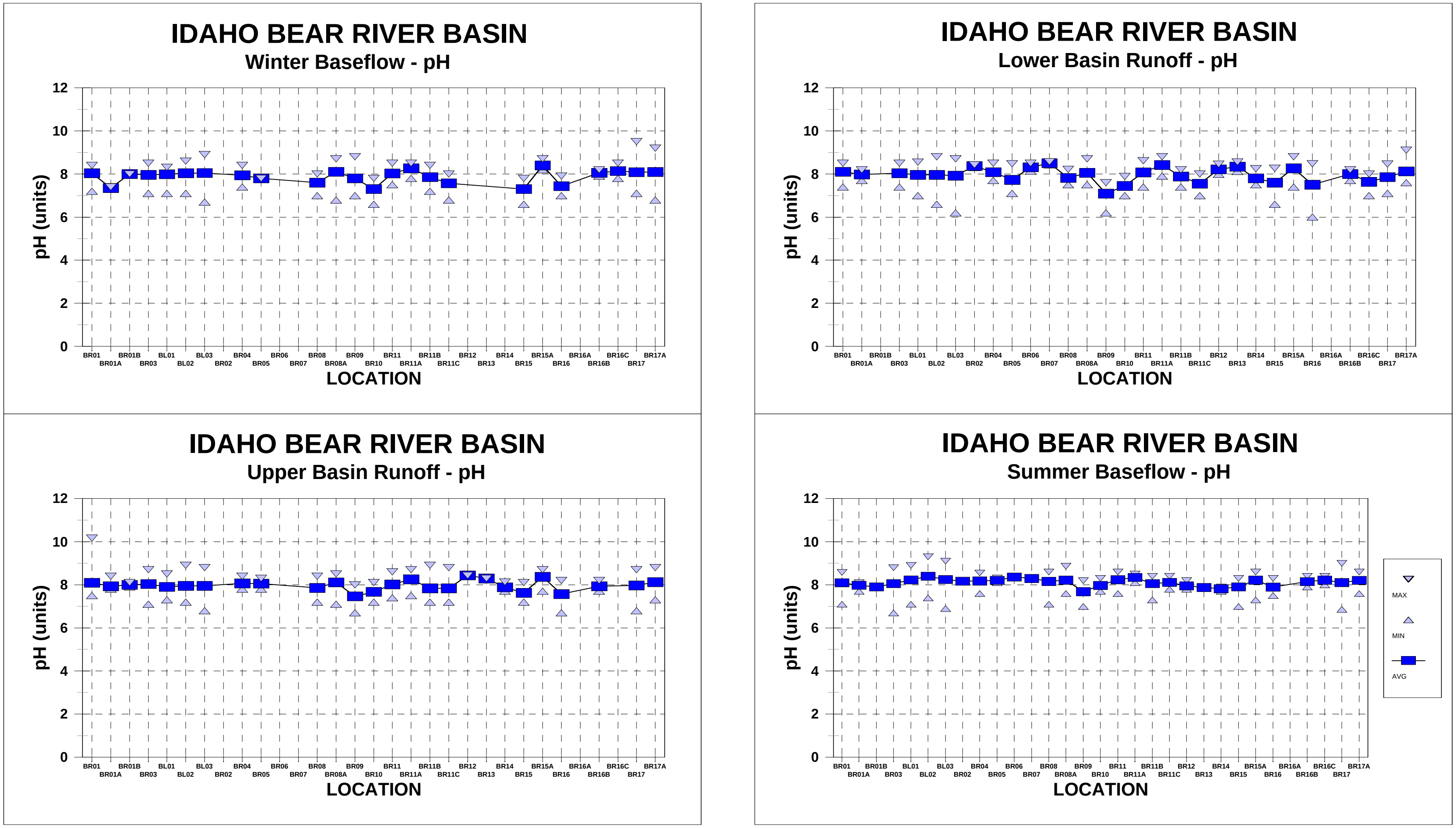

Figure 2-20. Averages, minimum and maximum values for pH on the mainstem Bear River by hydrologic period.

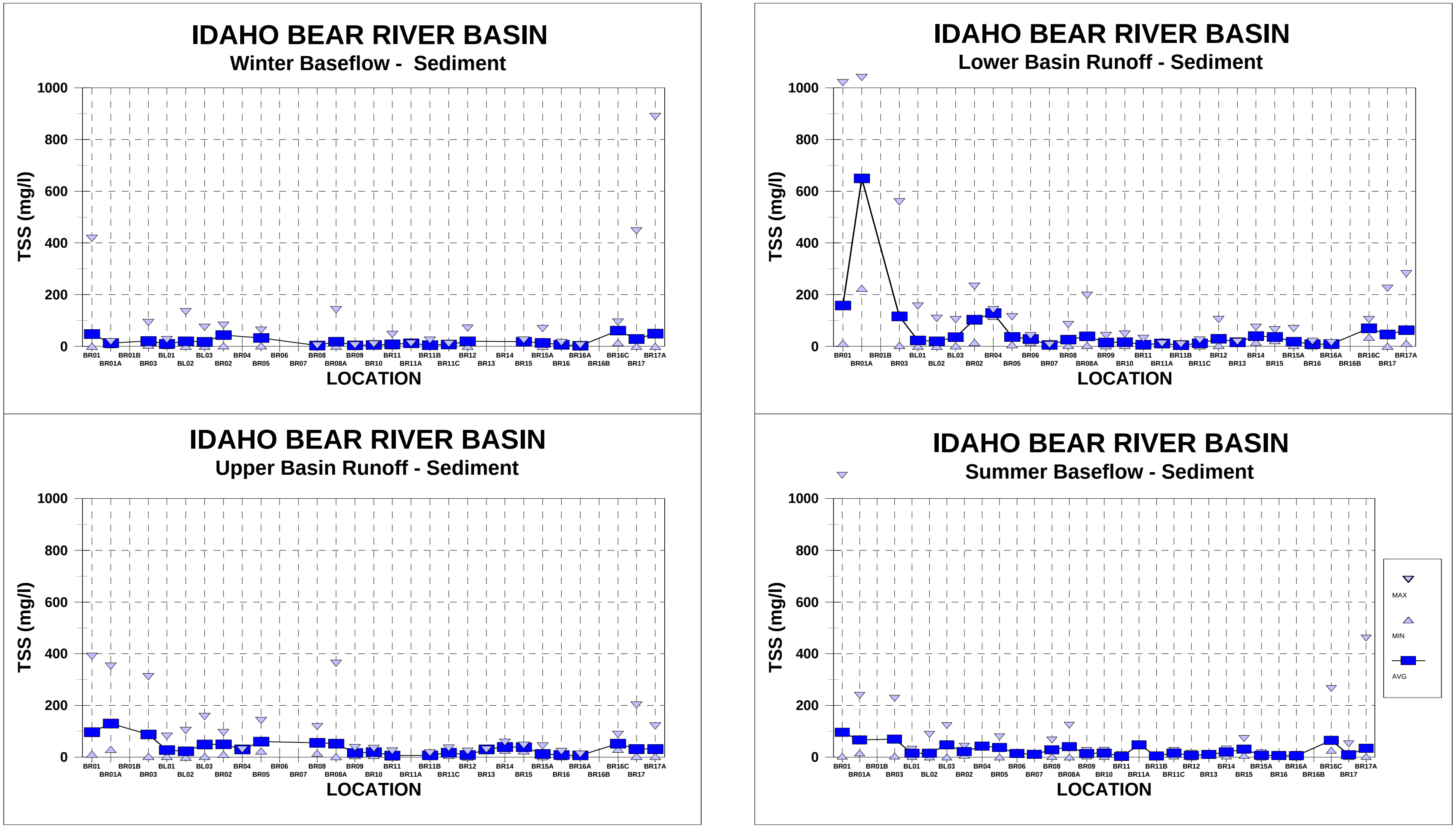

Figure 2-21. Averages, minimum and maximum values for suspended solids on the mainstem Bear River by hydrologic period.

The same spatial pattern was evident in the concentration of TSS in the three other hydrologic periods. As in the winter base flow period, high concentrations occurred above Bear Lake, were reduced in the movement of water through the lake, again increased before Alexander only to be removed by this reservoir. The same pattern was repeated from Alexander to Oneida. Large increases occurred from Oneida outlet to the Utah state line. The data collected in 1999-2000 indicated the major differences between the hydrologic time period was one of magnitude. Lower basin runoff had the highest concentrations of TSS, followed by upper basin runoff, summer, and winter base flow (Figure 2-21). Using a target of 80 mg TSS/L, there are widespread and numerous exceedances for suspended sediments in the mainstem Bear River. For example, above Bear Lake, 38 percent of the recorded values at Stewart Dam are above this target value. A summary of the percent exceedances for the Bear River mainstem sites can be seen in Table 2-27.

The water quality trends for total suspended solids noted above have verified the long term trends observed at key sampling sites within the Bear River in Idaho. The seasonal trends in total suspended solids (expressed as average monthly concentrations from 1971-2000) for seven locations along the Bear River can be seen in Figure 2-22 through Figure 2-28. The sites represent the Bear River flowing into (Bear River at Idaho-Wyoming state line) and out of (Bear River at Idaho-Utah state line) the state of Idaho. In addition, the Bear River flowing into each major receiving water body (Bear Lake Marsh, Bear Lake, Alexander Reservoir and Oneida Reservoir) are also summarized. The target for TSS is referred on the graphs as “base flow targets” and “runoff targets” (Table 2-21).

The Bear River entering Idaho from Wyoming did not exceed the base flow target on average, but did exceed the runoff target of 80 mg/L TSS four out of the five months. Data were averaged over the time period from 1971 to 1993. May (upper basin runoff) had the highest concentration (143 mg/L), followed by April and June (114 and 96 mg/L, respectively). The lowest average concentrations (<10 mg/L) occurred in the winter base flow period.

The total suspended solids concentrations in the Bear River entering the Bear Lake Marsh (a site also known as Stewart Dam) can be seen in Figure 2-23. Although concentrations were similar to those observed at the state line, exceedances in the runoff and base flow targets happened more often. The runoff target of 60 mg/L TSS was exceeded in all five months and the base flow target (35 TSS mg/L) was exceeded in three of the remaining seven months. Highest concentrations were recorded in April (147 mg/L) and May (111 mg/L). Lowest values occurred during winter base flow (5 to 29 mg/L).

The flows of the Bear River during the non-irrigation season are stored in Bear Lake via a water diversion structure at a location called the Bear Lake Causeway (Bear Lake Marsh inflow to Bear Lake). Inspection of Figure 2-24 reveals that the average monthly concentration of TSS did not exceed either the runoff or the base flow target (60 and 35 mg/L, respectively) for any month. Concentrations ranged between 31 mg/L (March) and 6 mg/L (February).

Due to the hydrologic manipulation of the Bear River and Bear Lake as an irrigation reservoir, the flows in the river are augmented by water releases during the summer and fall months. Average TSS concentrations by month can be seen in Figure 2-25. Generally, highest suspended solids concentrations occurred when water was being delivered downstream (July and August). The highest average concentration was 71 mg/L (August), and was the only month in which the TSS target was exceeded.

Alexander Reservoir, located downstream of the Bear Lake Marsh Outlet, receives Bear River water year round. TSS concentrations above Alexander Reservoir were similar to concentrations observed at the Bear Lake Marsh outlet (Figure 2-26), though there were more exceedances of the TSS target. Two out of the five runoff months exceeded the 60 mg/L target. There was only one base flow target exceedance, occurring during August. Highest concentrations occurred in June, July and August (73, 62, and 60 mg/L, respectively). Lowest concentrations occurred in December, January and February (17, 8.8 and 7.0 mg/L, respectively).

After passing through Alexander Reservoir, the Bear River enters a long canyon reach with multiple hydroelectric diversions. Concentrations of suspended solids decreased during peak flow (June and July) above Oneida Reservoir, ranging from 34 to 53 mg/L between March and August, and 15 to 20 mg/L between September and December. Average runoff concentrations did not exceed the 60 mg/L target, however, a base flow target exceedance occurred during August, similar to Alexander Reservoir (Figure 2-27).

The last detailed site investigated for temporal patterns in total suspended solids concentrations was the Bear River at the Utah-Idaho state line (Figure 2-28). Exceedances in total suspended solids concentrations (relative to base flow target) occurred only in January (92 mg/L). There were no runoff target exceedances. Lowest concentrations (15-21 mg/L) occurred between September and December.

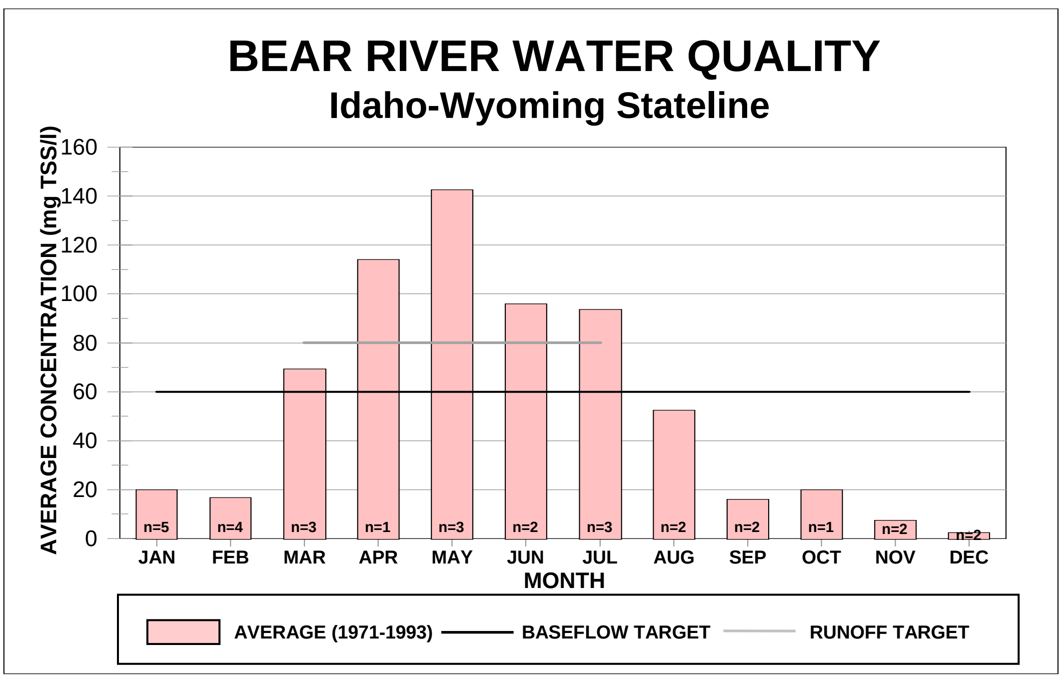

Figure 2-22. The average TSS concentrations at the Idaho-Wyoming state line.

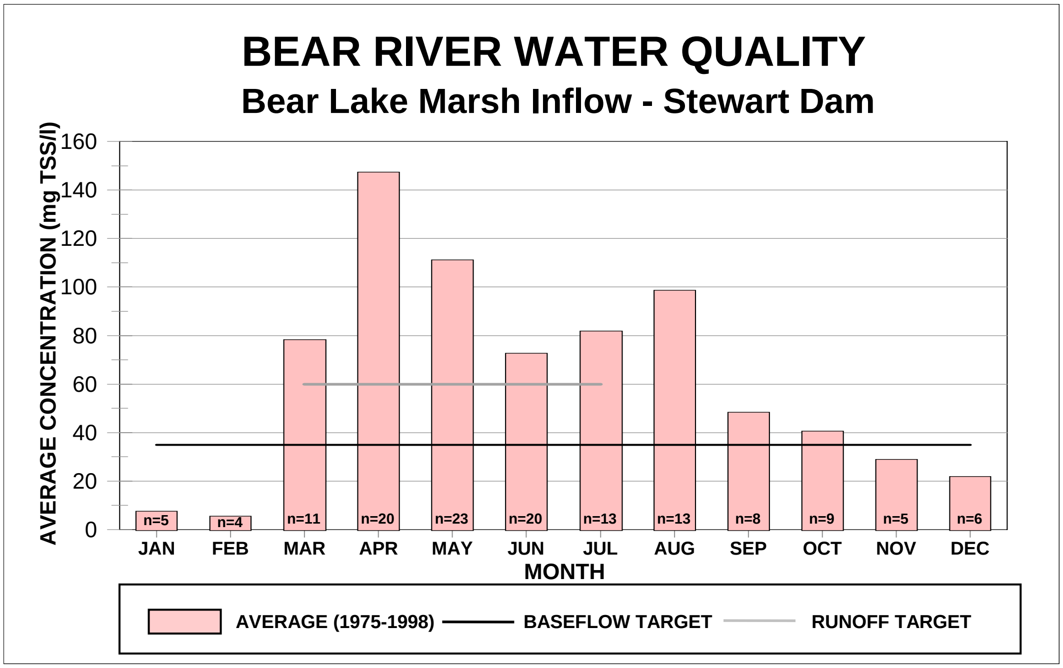

Figure 2-23. The average TSS concentrations at Stewart Dam (entering the Bear Lake Marsh).

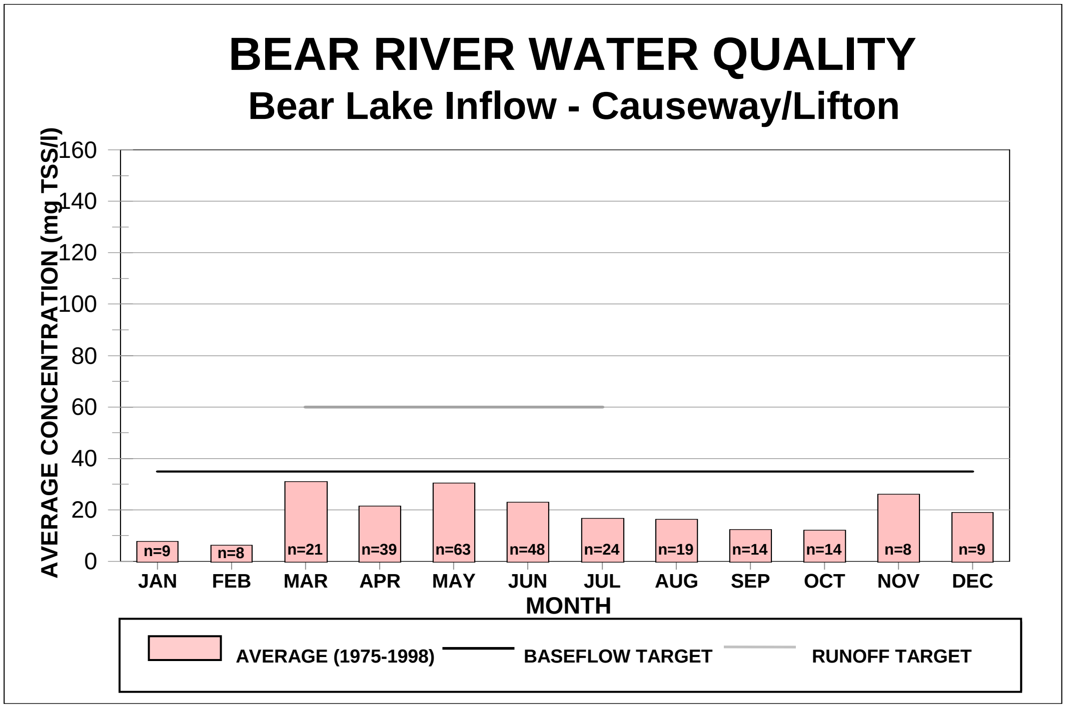

Figure 2-24. The average TSS concentrations at the Bear Lake Causeway (entering Bear Lake).

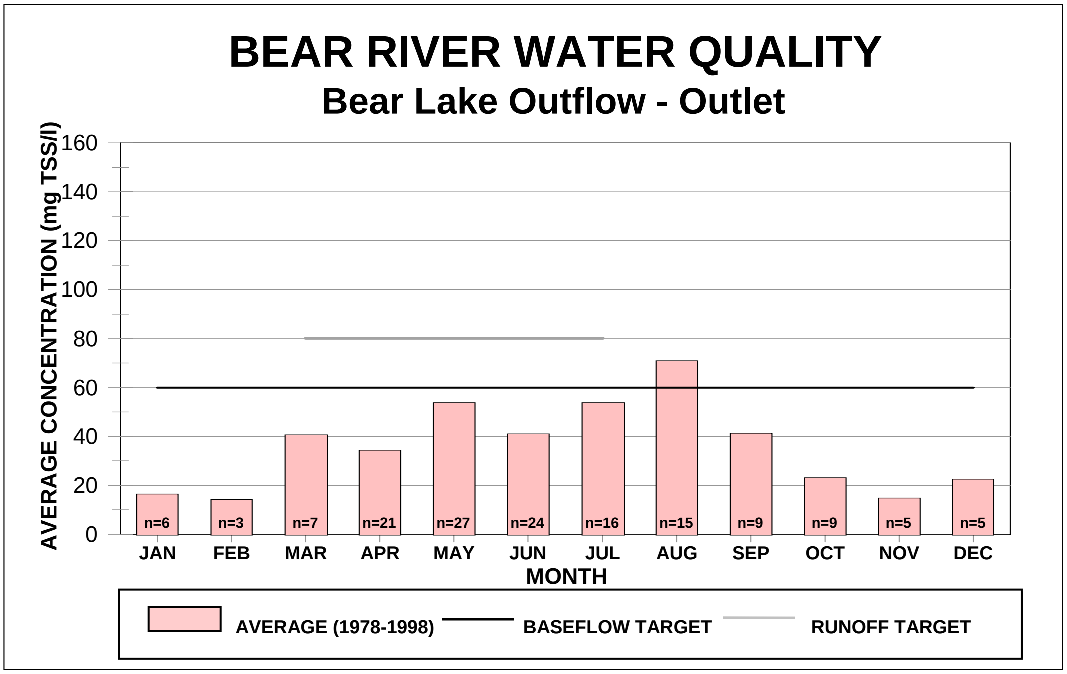

Figure 2-25. The average TSS concentrations at the Bear Lake Marsh outlet.

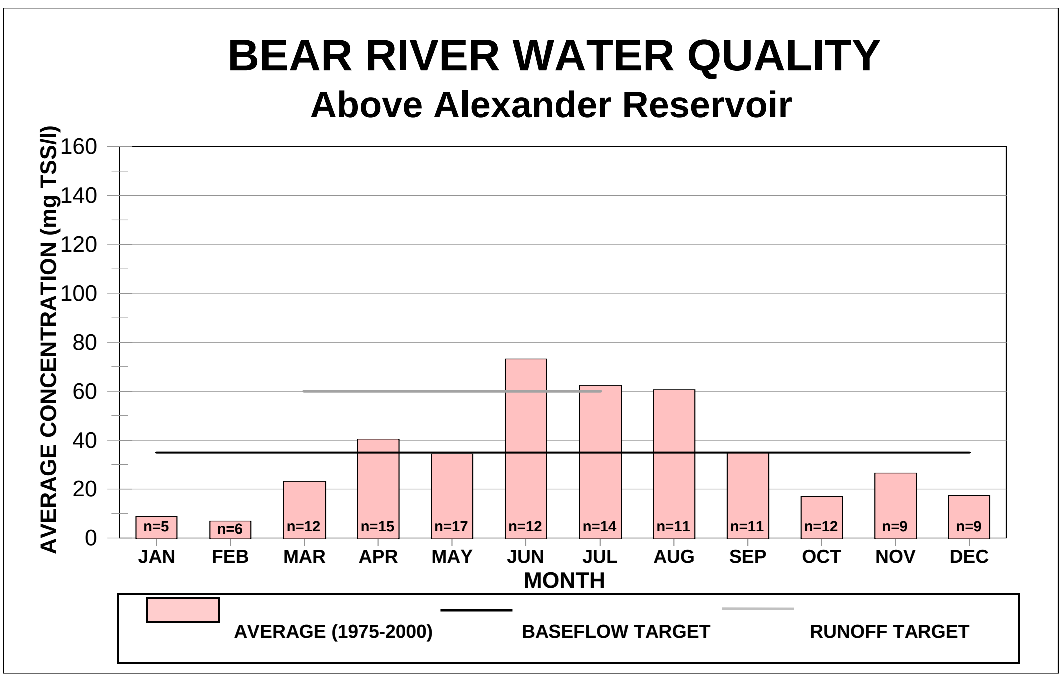

Figure 2-26. The average TSS concentrations at Bear River above Alexander Reservoir.

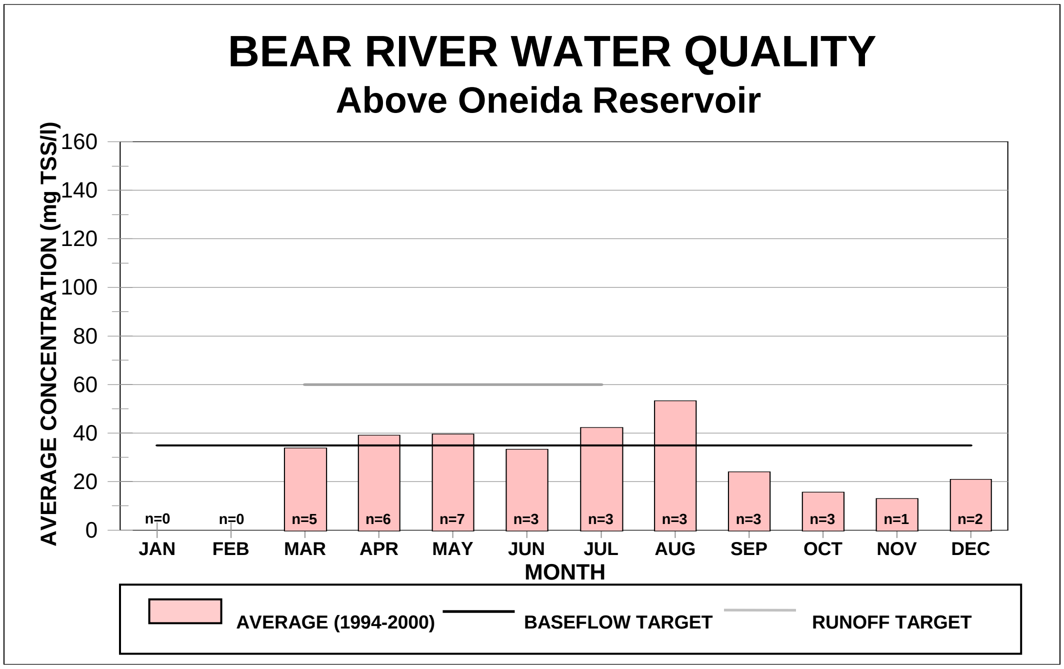

Figure 2-27. The average TSS concentrations at Bear River above Oneida Reservoir.

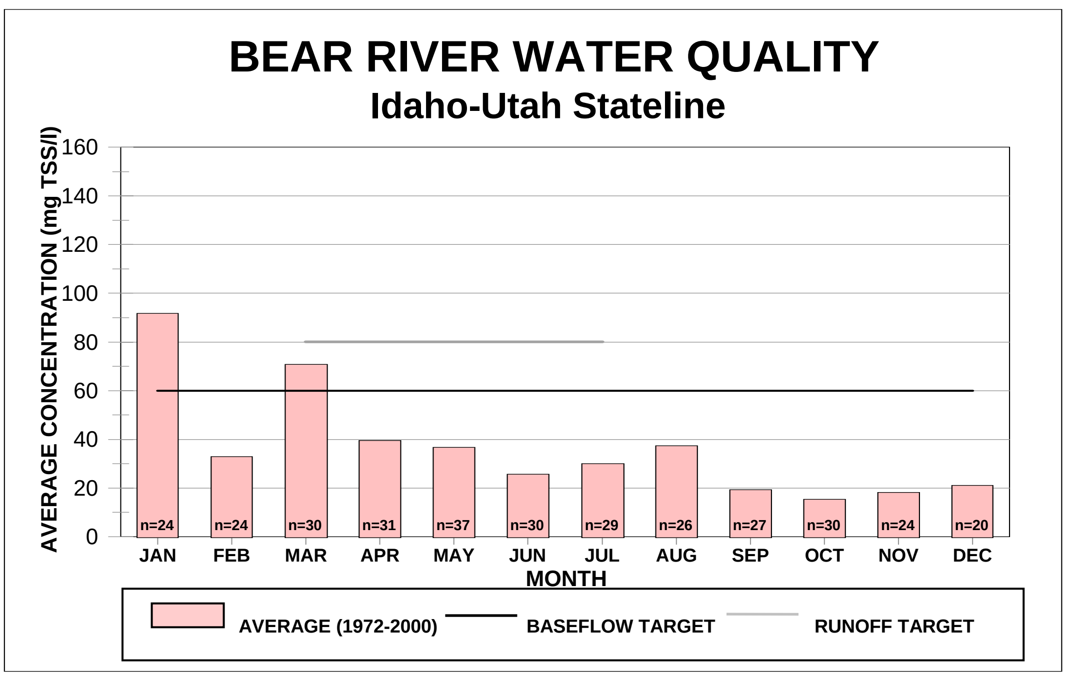

Figure 2-28. The average TSS concentrations at Bear River at the Utah-Idaho state line.

Utilizing the total suspended sediment concentrations from all seven detailed sites noted above, exceedance vs. concentration curves were developed (Figure 2-29). The sites were first divided into riverine vs. receiving water body and then further divided into runoff and base flow sets. For both sets of data, the 50 percent exceedance value was found to be 14 mg/L during base flow periods and 32 mg/L during runoff. Reaches with a receiving water body had the base flow and runoff target exceeded 11.4 and 12.0 percent of the time, respectively. Riverine reaches had base flow and runoff target exceeded 25 and 27.6 percent of the time, respectively. The data spans the time period from 1971 to 2000 and includes 930 individual observations. In 2000, DEQ core sampled sites on both Bear River and tributaries to determine distribution by volume of streambed sediment (depth fines). Streambed sediment directly relates to conditions conducive to salmonid spawning. Generally, salmonid spawning is not affected if percentages of sediment less than 6.3 mm are about 25% or less, and fine sediment less than 0.85 mm is no greater than about 10%. At each site, three core samples were taken and the individual results averaged. The cumulative average of the six sites sampled in mainstem Bear River was 29.9% less than 6.3 mm (range 20.3-41.7%) and 17.1% less than 0.85 mm (range 10.8-26.7%; Table 2-30).

Between the major reservoirs, the tributary streams entering the Bear River in the reaches where increased sediments were observed also had elevated concentrations of sediments. Thomas Fork (located above Bear Lake) exceeded the target 5.3 percent of the observations. In the middle reach, Alder, Whiskey, Burton, and Trout creeks exceeded target 18 to 50 percent of the observations. In the reach below Oneida Reservoir, Deep, Battle, and Weston creeks were in excess of the target between 32 and 75 percent of the observations (Table 2-28).

High levels of sediment were observed in Malad River and several tributaries (Table 2-29). Only Little Malad River, Devil Creek, and Deep Creek showed TSS levels below 80 mg/L for all of the limited sampling events. Highest overall concentrations were found in mainstem Malad River ranging from 20-100%.

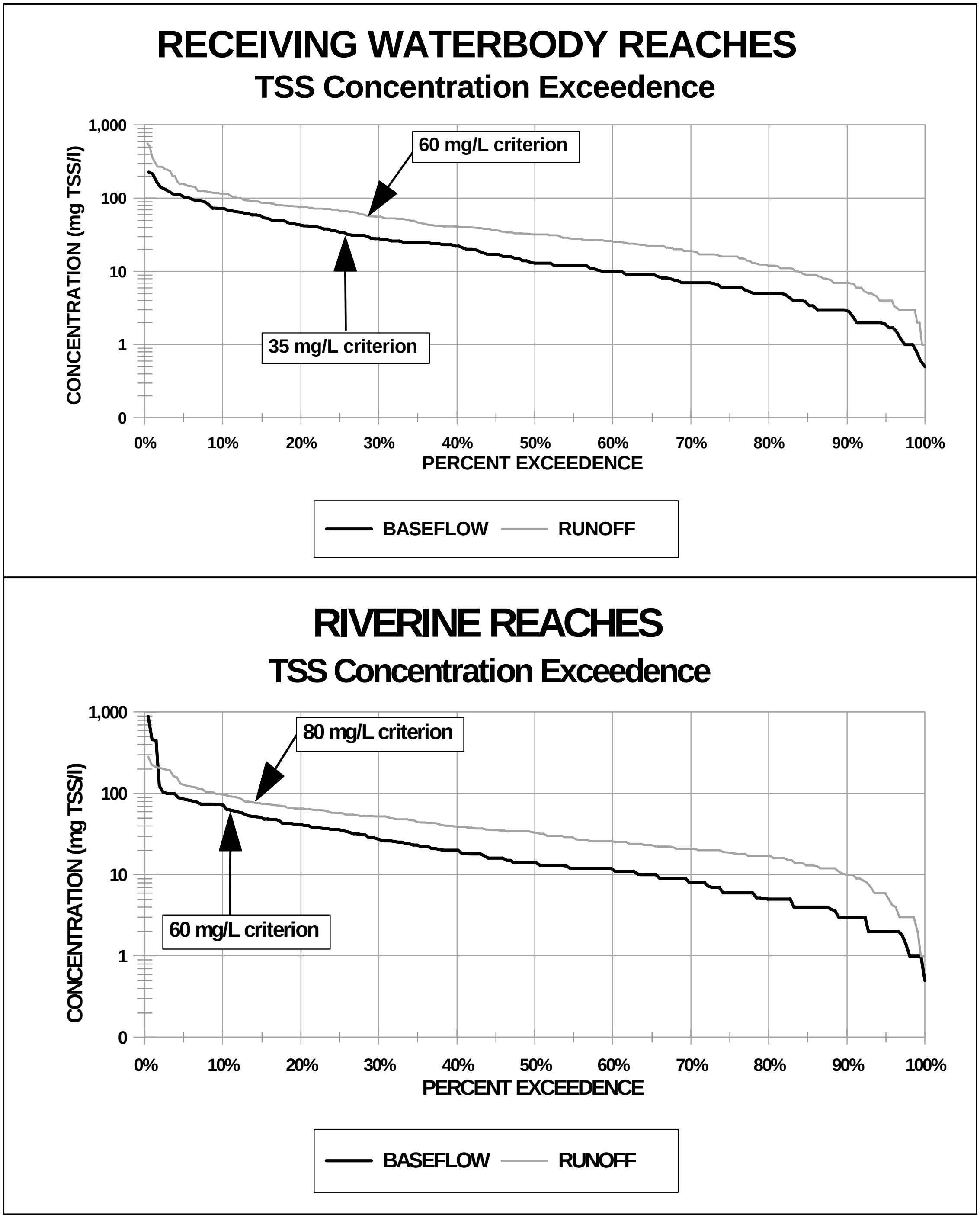

Figure 2-29. The percent exceedance concentrations for total suspended solids in the Bear River taken over the time period 1971-2000 at seven sites in Idaho.

Table 2-30. Percentage (average of 3 core samples/site) by volume of streambed subsurface sediment.

HUC	Water body	Site Name	Date Sampled	Percent >= sieve size (mm)						Percent < 6.3 mm	Percent < 0.850 mm
				25.000	6.300	4.750	0.850	0.250	0.106		
16010102	Thomas Fork	at confluence with Dry Creek	25-Jul-00	29.0	32.7	4.0	16.9	14.8	2.6	38.3	17.4
	Thomas Fork	3/4 mi upstream of Hwy 89	25-Jul-00	39.7	26.9	3.8	18.4	8.5	2.8	33.4	11.3
	Thomas Fork	just downstream of Hwy 89	25-Jul-00	47.7	25.8	3.0	11.8	8.8	2.8	26.5	11.6
	Thomas Fork	at Skyline Road bridge	26-Jul-00	7.9	38.9	6.4	20.7	20.7	5.4	53.2	26.1
	Bear River	within 1 mi of WY-ID border	26-Jul-00	13.0	46.2	6.1	8.0	24.6	2.1	40.8	26.7
	Bear River	1.5 mi downstream of Thomas Fork	26-Jul-00	54.6	21.1	1.9	7.8	11.8	2.7	24.2	14.5
16010201	Bear River	by east Dingle bridge	9-Aug-00	43.8	27.3	3.3	11.2	13.3	1.1	28.8	14.4
16010202	Deep Creek	approx. 2/3 mi above confluence w/Bear River	24-Jul-00	0.0	0.2	0.2	6.7	79.4	13.6	99.8	92.9
	Cub River	1 mi below Cub Canal diversion	24-Jul-00	58.1	22.7	3.3	10.7	3.5	1.6	19.1	5.1
	Cub River	approx. 1 mi upstream of Hwy 91	31-Jul-00	55.3	24.3	2.6	9.6	6.0	2.2	20.5	8.2
	Cub River	just upstream of E 4800 S bridge	27-Jul-00	16.4	64.2	3.6	7.8	5.4	2.6	19.4	8.0
	Cub River	1/2 mi downstream of E 4800 S bridge	27-Jul-00	4.0	46.5	5.7	20.9	21.1	1.7	49.5	22.9
	Weston Creek	just upstream of Kohler Road crossing	31-Jul-00	39.1	31.1	3.0	17.5	7.1	2.2	29.8	9.3
	Worm Creek	at Forest Service Boundary	21-Aug-00	62.6	18.3	2.1	9.4	6.4	1.1	19.0	7.5
	Fivemile Creek	approx. 1.5 mi above confluence w/Bear River	21-Aug-00	0.0	0.3	0.1	1.3	39.6	58.6	99.7	98.3
	Bear River	1 mi downstream of Dayton bridge	20-Jul-00	30.1	28.2	3.9	14.5	13.9	9.4	41.7	23.3
	Bear River	1/4 mi downstream of Deep Creek confluence	27-Sep-00	56.9	19.6	2.3	8.4	7.5	5.3	23.5	12.8
	Bear River	approx. 3 mi upstream of UT-ID border	27-Sep-00	46.2	33.5	2.5	7.0	3.6	7.2	20.3	10.8
Cumulative average	Bear River			40.8	29.3	3.3	9.5	12.4	4.6	29.9	17.1
	Thomas Fork			31.1	31.1	4.3	16.9	13.2	3.4	37.8	16.6
	Cub River			33.4	39.4	3.8	12.3	9.0	2.0	27.1	11.1

DEQ core sampling in 2000 included sites on six tributaries. Four sites were monitored on both Cub River and Thomas Fork. Thomas Fork averaged 37.8% fines less than 6.3 mm and 16.6% less than 0.85 mm. The lowest Thomas Fork site had the highest volume of sediment at 53.2% of the volume less than 6.3 mm and 26.1% less than 0.85 mm. In Cub River, depth fines do not appear to be a problem in the upper sites. Only the lowest site had high volumes of fine sediment (49.5% less than 6.3 mm and 22.9% less than 0.85 mm) in the streambed substrate. Of the four tributaries in which only one site was sampled, highest volumes of fine sediment were seen in Deep and Five mile creeks at over 90%. Weston and Worm creeks had volumes of sediment less than 6.3 mm of 29.8% and 19.0%, respectively. Sediment less than 0.85 mm were less than 10% for both creeks.

TSS was significantly correlated with flow at all sites from the Bear Lake inlet to the Bear River near Preston, with the exception of the site near Thatcher, which had only 10 observations (ERI 1998). A detailed short-term investigation by Lamarra (unpublished data 1992) indicated that the relationship between changing flows and suspended sediments below Oneida Reservoir was related to diel short term altered flows during the winter base flow period (Figure 2-30).

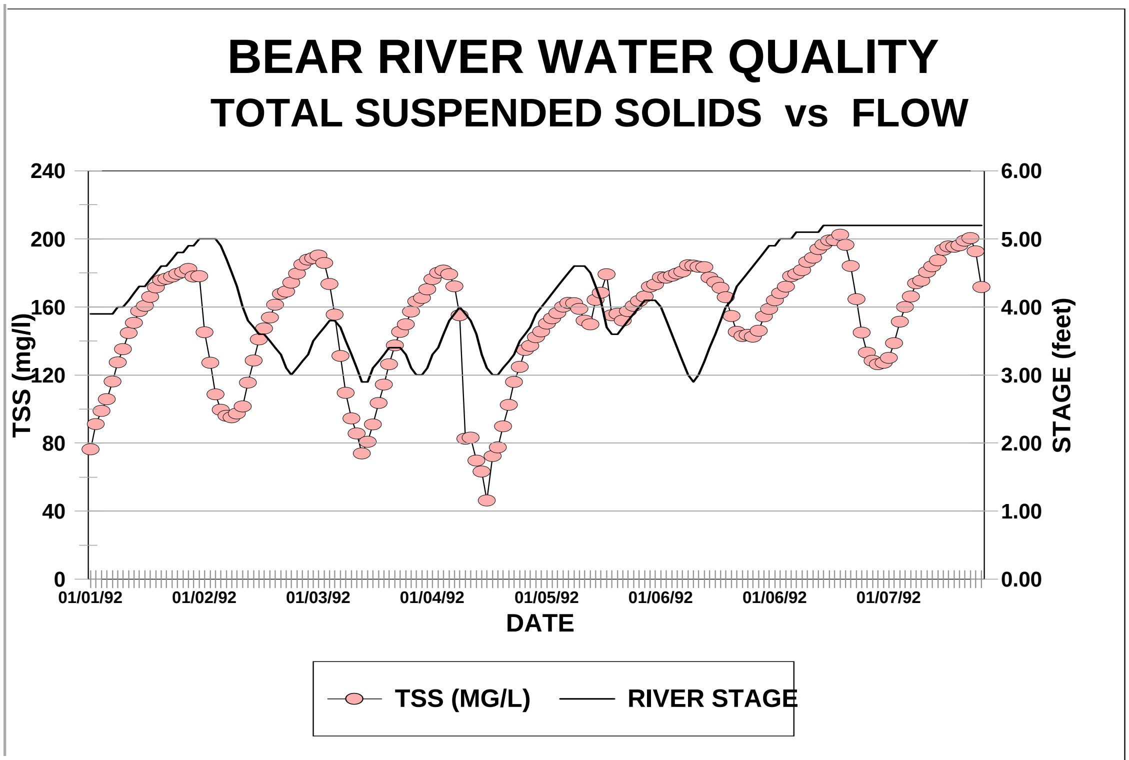

Figure 2-30. A comparison between total suspended solids and flow below Oneida Reservoir in the Bear River.

Nutrients

Inspection of the four synoptic sampling events indicated that ammonia concentrations during all four hydrologic periods were low (<0.30 mg/L) and highly variable (Figure 2-31).

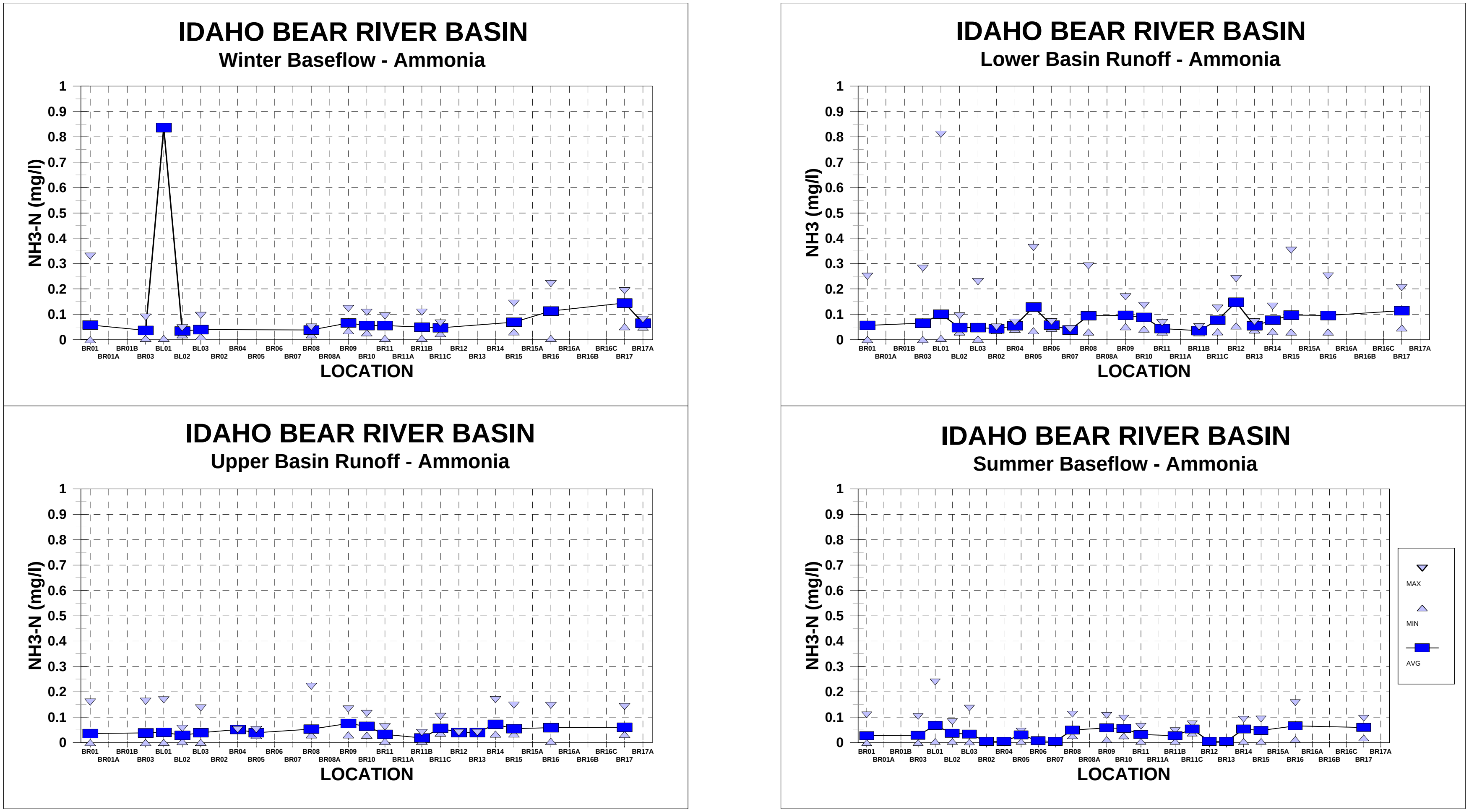

Figure 2-31. Averages, minimum and maximum values for ammonia on the mainstem Bear River by hydrologic period.

The average concentrations during winter base flow and lower basin runoff tended to increase with distance downstream. This confirms the pattern observed in the long term water quality data. In the upper basin runoff the trend was similar showing increasing concentrations with downstream distance. Summer base flow concentrations were unchanged with stream location. The ammonia criterion is a calculated value based upon concentration, temperature and pH. No exceedances were found in the mainstem Bear River. Nitrate, a pollution indicator, also had the same trend as ammonia with high concentrations in the winter base flow and lower basin runoff hydrologic periods, and lower concentrations in upper basin runoff (Figure 2-32). During summer base flow, high nitrate concentrations were found from Grace (BR11A) to the Utah-Idaho border (BR18). Using a 4 mg/L concentration as a pollution indicator, the mainstem Bear River stations below Oneida (BR15A and BR16A) exceeded the limit up to 15 percent of the observations (Table 2-27). BR16 and BR17 had no exceedances. In this reach of the river, Battle, Deep, Five Mile and Weston creeks exceeded the indicator in 7 to 13 percent of the observations (Table 2-28).

Total phosphorus and orthophosphorus are also pollution indicators. The mainstem Bear River has high levels of both. The Bear River has three receiving waters in this system including Bear Lake, Alexander Reservoir and Oneida Reservoir. Receiving waters, such as reservoirs, have a more stringent limits of 0.05 mg P/L applied (EPA 1986). Utilizing the four synoptic sampling events during winter base flow river-wide, 48 percent of the sites (where data are available) had concentrations of total phosphorus over 0.05 mg/L. There was a 28 percent exceedance of the target 0.075 mg P/L during winter base flow (Figure 2-33). During lower basin runoff, this percentage increased to 93 percent and 55 percent for exceedances of 0.05 mg P/L and 0.075 mg P/L, respectively and in upper basin runoff increased to a maximum of 96 percent and 59 percent for exceedances of the 0.05 mg/L target and 0.075 mg/L target, respectively. During the summer base flow period, exceedances of the 0.05 mg P/L target happened at 79 percent of the sites, while exceedances of the 0.075 mg P/L target happened at 52 percent of the sites. The spatial distributions of average, minimum, and maximum concentrations of total phosphorus and orthophosphorus by station and hydrologic period can be seen in Figure 2-33 and Figure 2-34. Specific sampling exceedances by site are included in Table 2-27.

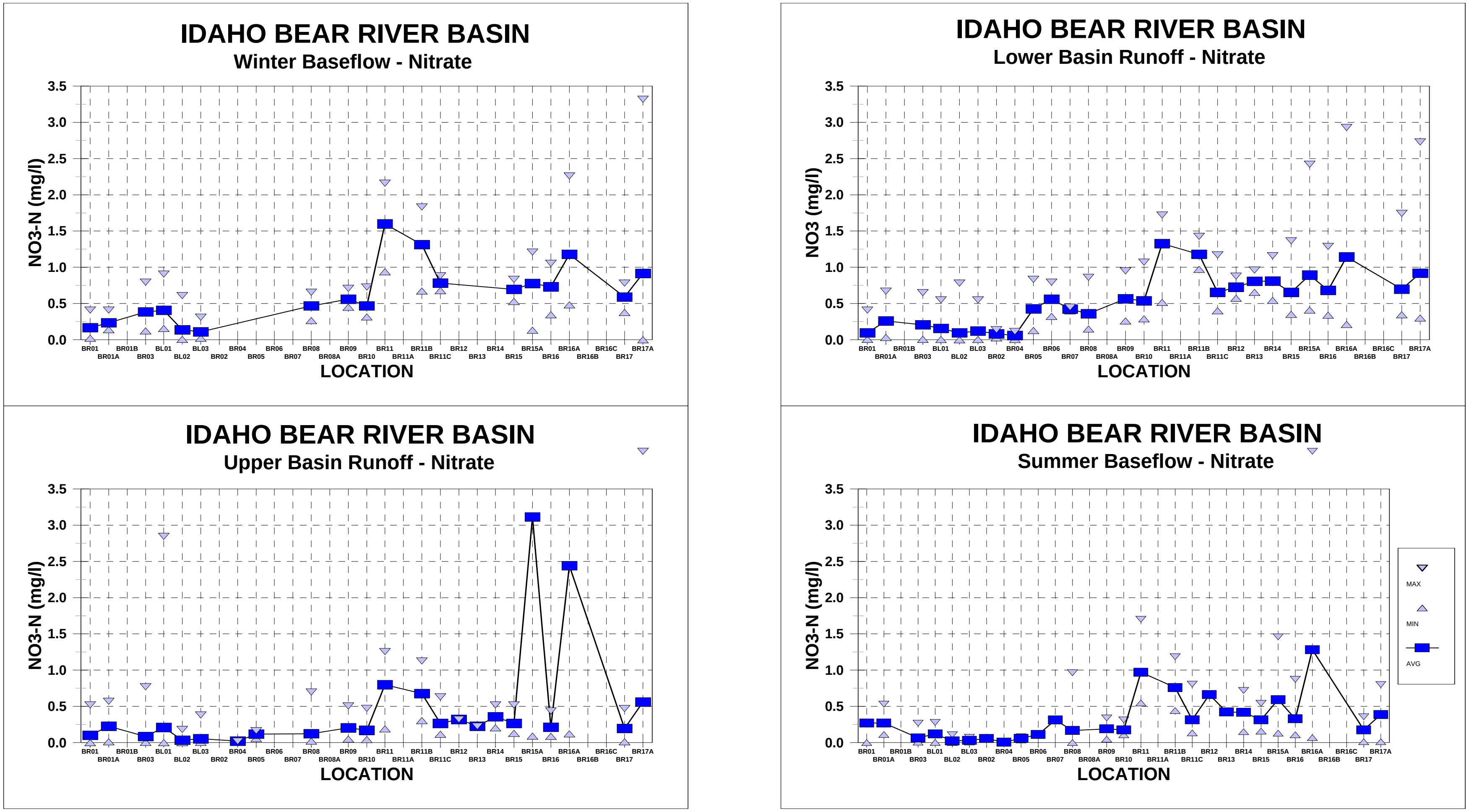

Figure 2-32. Averages, minimum and maximum values for nitrate on the mainstem Bear River by hydrologic period.

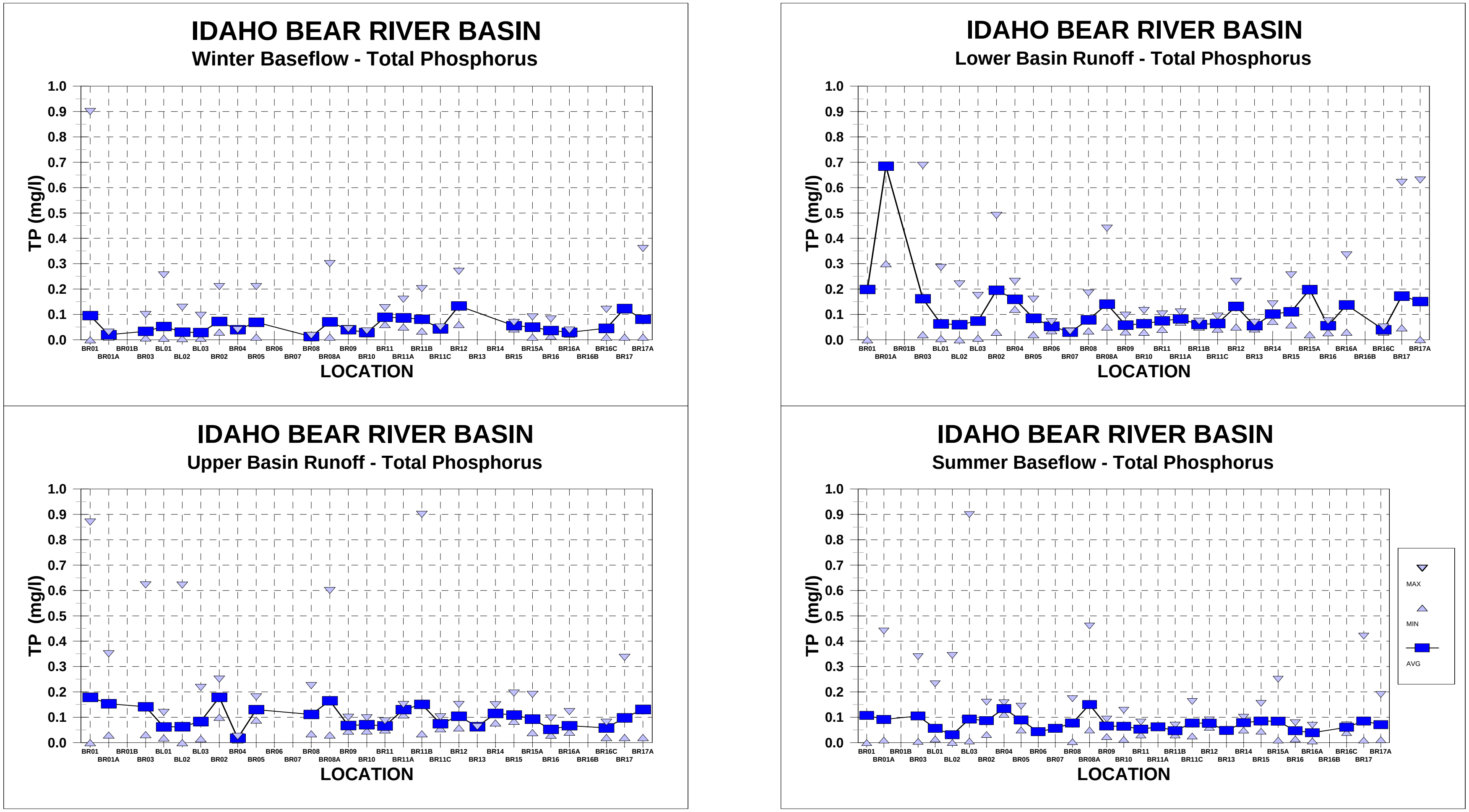

Figure 2-33. Averages, minimum and maximum values for total phosphorus on the mainstem Bear River by hydrologic period.

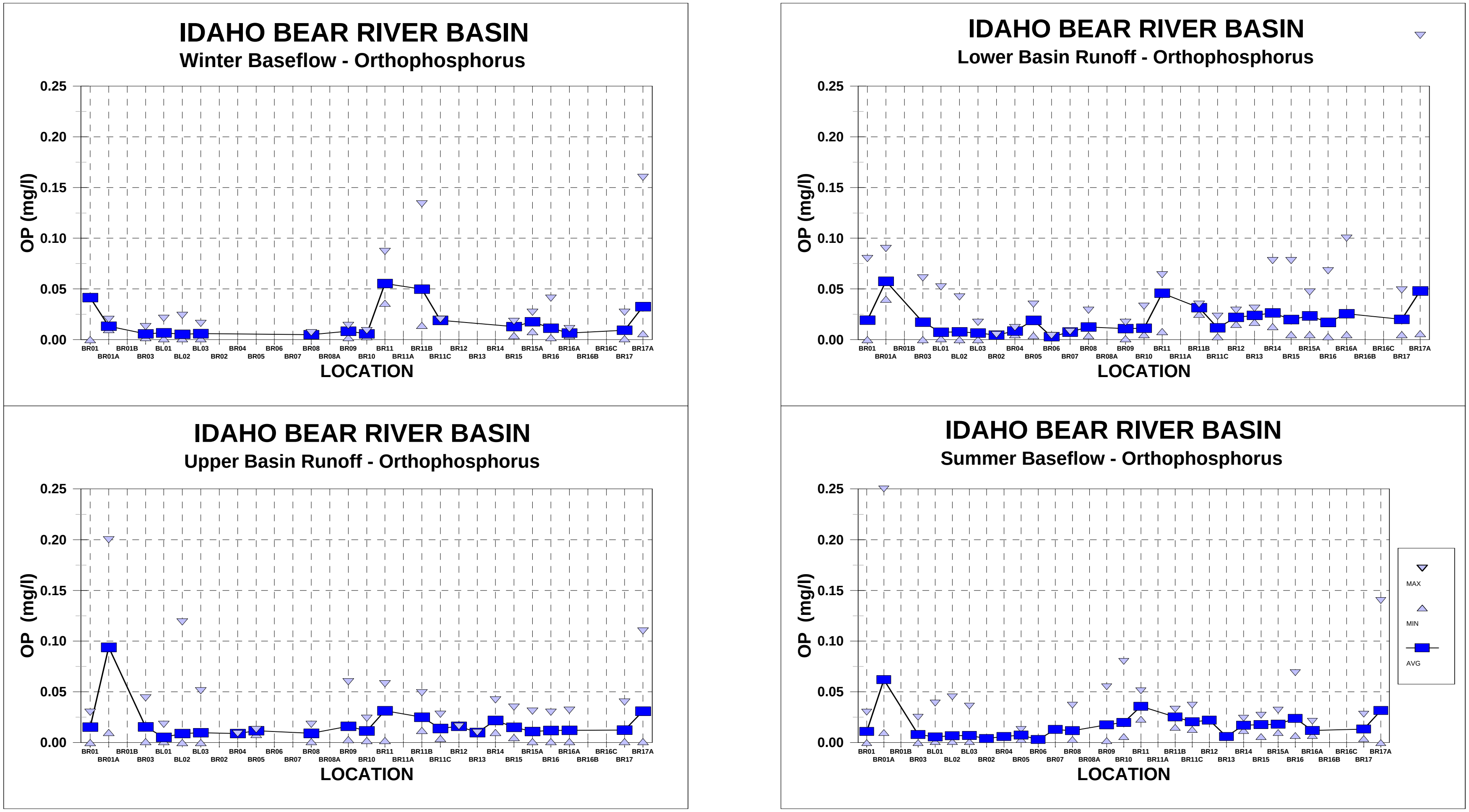

Figure 2-34. Averages, minimum and maximum values for orthophosphorus on the mainstem Bear River by hydrologic period.

As with the additional analysis of total suspended solids, seven locations within the Bear River between the states of Wyoming and Utah were investigated in detail relative to average concentrations of total phosphorus on a monthly time step. The analysis included the inflow locations to the major reservoirs in the Middle Bear River in Idaho.

The results of this analysis for the first site, representing the Bear River flowing into the state of Idaho from Wyoming, can be seen in Figure 2-35, and are compared to the phosphorus target of 0.075 mg/L. The average monthly concentrations were exceeded in eight of the twelve months. The highest average concentration (0.220 mg/L) occurred in October. In general, the lower and upper basin runoff months (March to July) were elevated (0.119-0.183 mg/L) more than the base flow months of August to February (0.031-0.124 mg/L), with the exception of October.

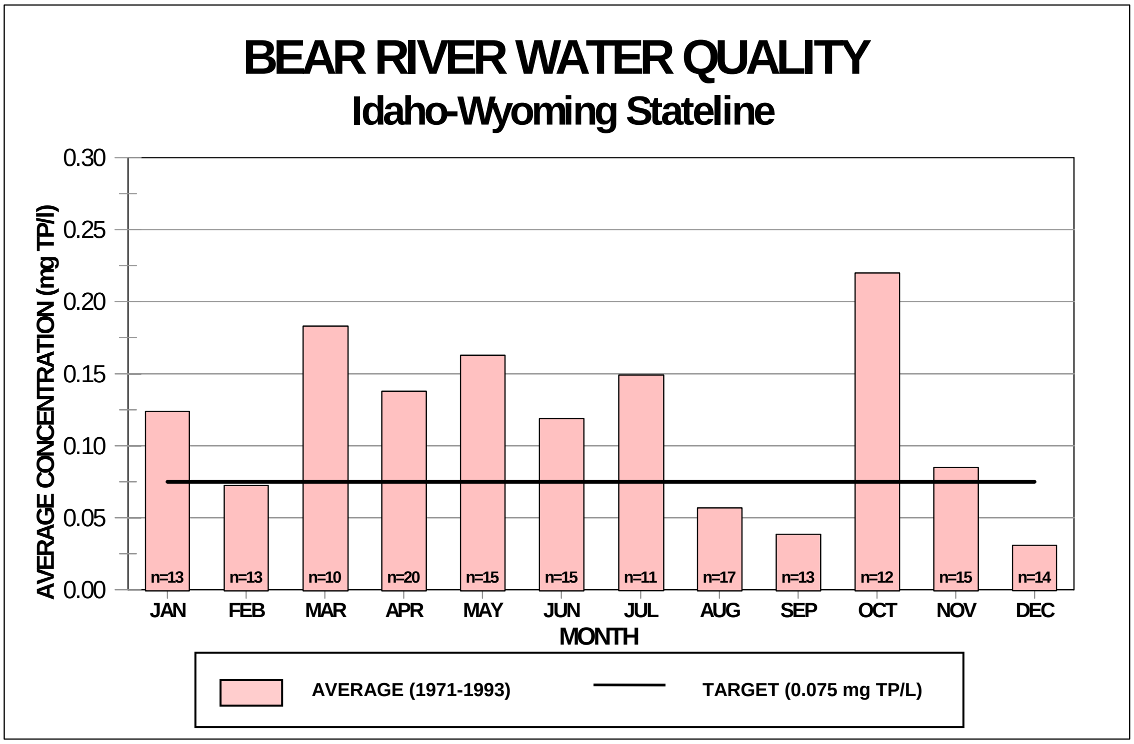

Figure 2-35. The average concentrations of total phosphorus (mg/L) at the Idaho-Wyoming state line.

The Bear River flowing into the Bear Lake Marsh (Figure 2-36) had a similar temporal pattern as observed at the Idaho-Wyoming state line. Although somewhat reduced in concentrations, the levels exceeded the receiving waters target of 0.05 P mg/L in all months except those during winter base flow (November through February). April had the highest average concentration (corresponding to lower basin runoff) at 0.188 mg/L. There was a steady decline in phosphorus levels entering the marsh from April to October. Lowest concentrations occurred during the winter base flow period, and ranged between 0.028 and 0.038 mg/L.

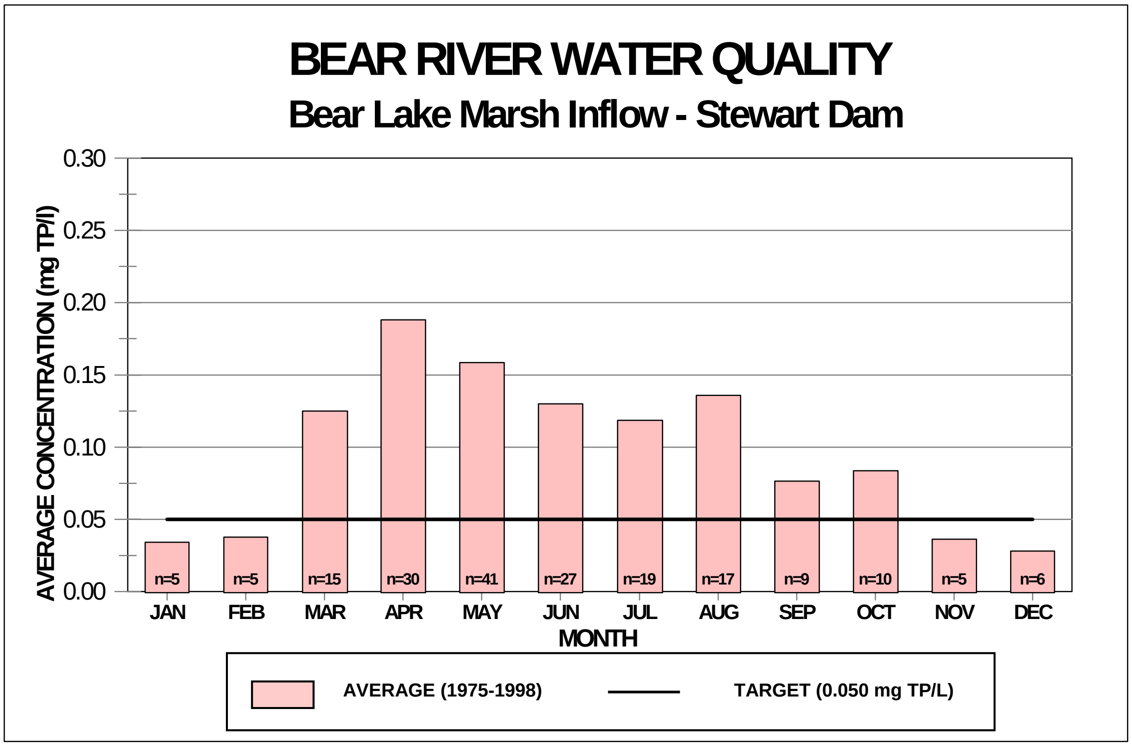

Figure 2-36. The average concentrations of total phosphorus (mg/L) for the Bear River flowing into the Bear Lake Marsh.

Average total phosphorus concentrations of Bear River water flowing into Bear Lake can be seen in Figure 2-37. The comparison between Figure 2-36 and Figure 2-37 demonstrates the impact of the Bear Lake Marsh upon Bear River total phosphorus concentrations. Although six of the twelve months are still elevated over the phosphorus target, the overall average concentration of total phosphorus is reduced to below 0.046 mg/L. March, April, May and June (upper and lower basin runoff periods) still exhibit the highest concentrations. This reflects the higher flows and lower retention times within the marsh.

The average monthly concentration of total phosphorus leaving the Bear Lake Marsh and flowing downstream is shown in Figure 2-38. The total phosphorus target at this point in the system is 0.075 mg/L and is in exceedance six out of 12 months with August and October exhibiting the highest exceedances.

The Bear River flowing into Alexander Reservoir exceeded the 0.050 mg/L target eleven of the twelve months (Figure 2-39). For nine of those exceedances, average concentrations are two to more than three times the allowable level. Concentrations in June and July, for example, were 0.179 and 0.174 mg/L, respectively. The lowest average monthly concentrations are near the 0.050 mg/L level (January and December).

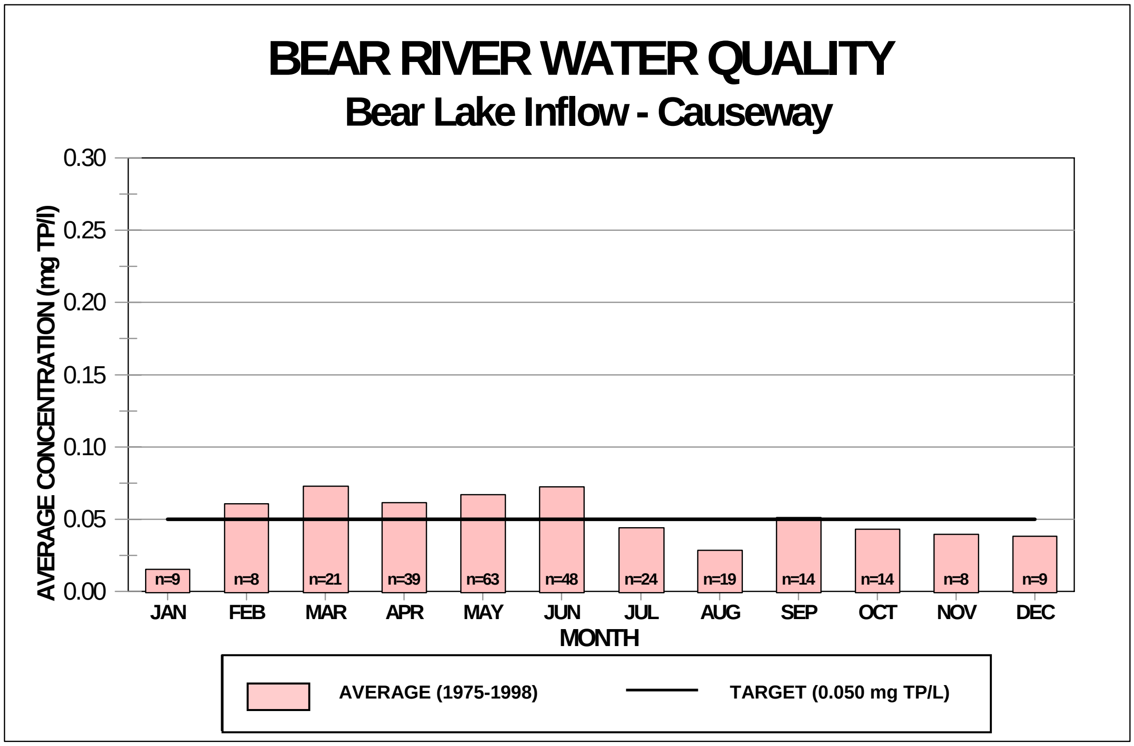

Figure 2-37. The average concentrations of total phosphorus (mg/L) for the Bear River inflow into Bear Lake.

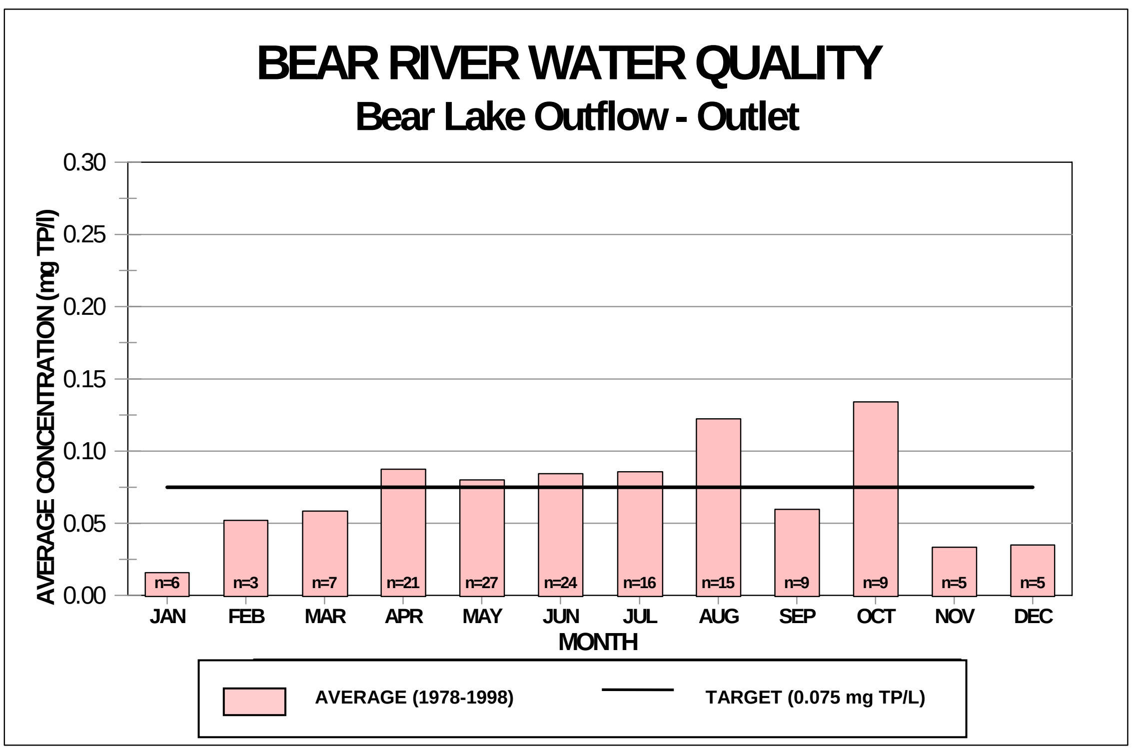

Figure 2-38. The average concentrations of total phosphorus (mg/L) for the Bear River flowing out of the Bear Lake Marsh.

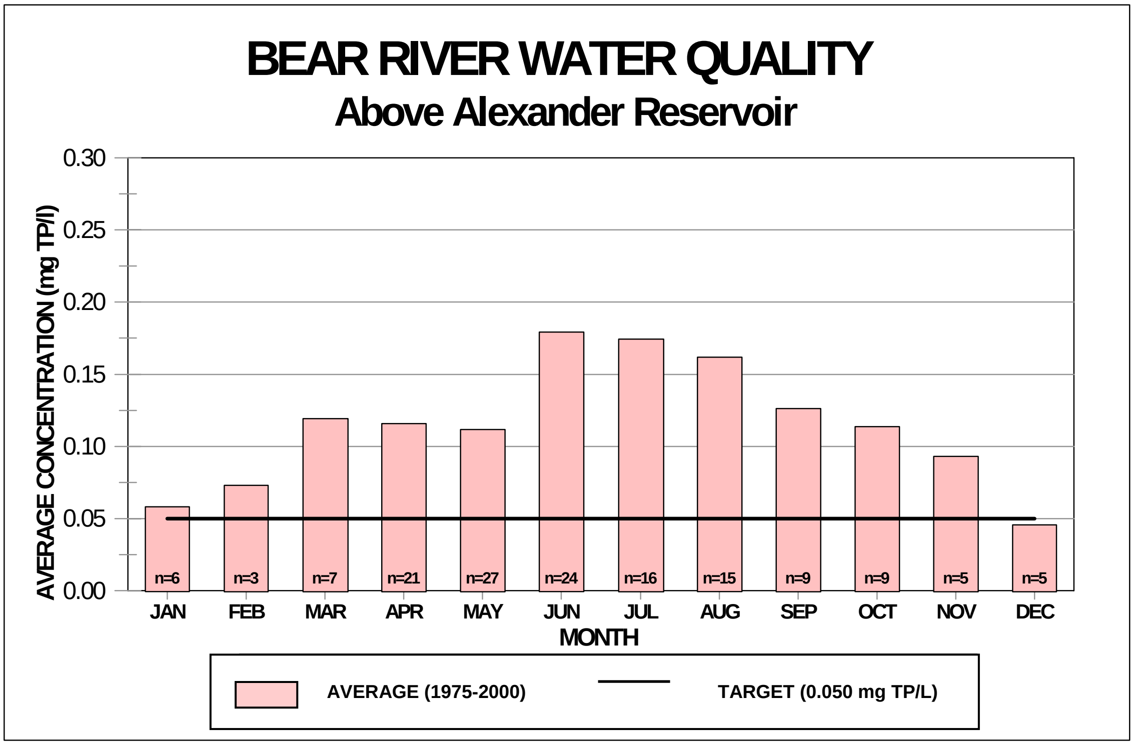

Figure 2-39. The average concentrations of total phosphorus (mg/L) for the Bear River flowing into Alexander Reservoir.

In a similar manner, the Bear River immediately above Oneida Reservoir had exceedances for eight out of ten months where average concentrations were calculated. No data exists for this site for the months of January and February. Limited data exists for the remaining months (1994-2000). The time period from April to September exceeded target concentrations by 1.5 to two times. Fall and winter concentrations were near the 0.050 mg/L target level (Figure 2-40).

The monthly average concentration of total phosphorus leaving the state of Idaho can be seen in Figure 2-41. The 0.050 mg/L target is exceeded during all twelve months. Because this reach is below Oneida Reservoir, the elevated concentrations at the border reflect mostly watershed contributions. This is evident from the elevated concentrations in March and April (lower basin runoff), as well as July and August (irrigation season). March, April and July showed levels that were more than twice the target concentration.

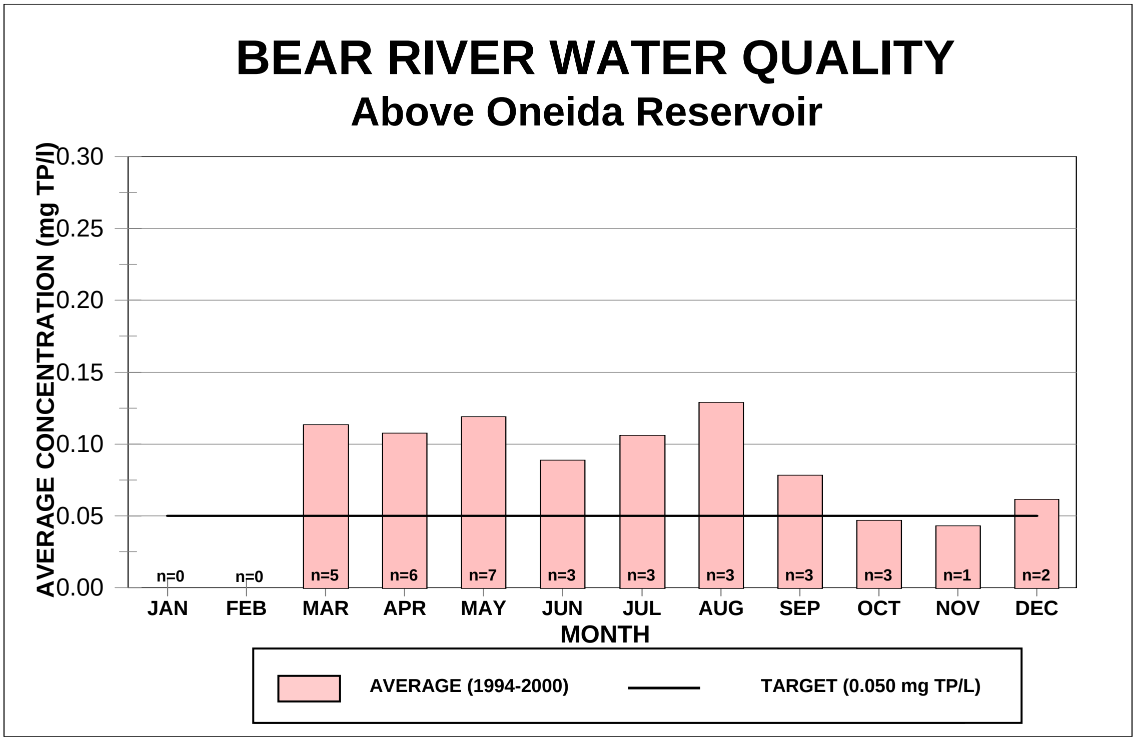

Figure 2-40. The average concentrations of total phosphorus (mg/L) for the Bear River flowing into Oneida Reservoir.

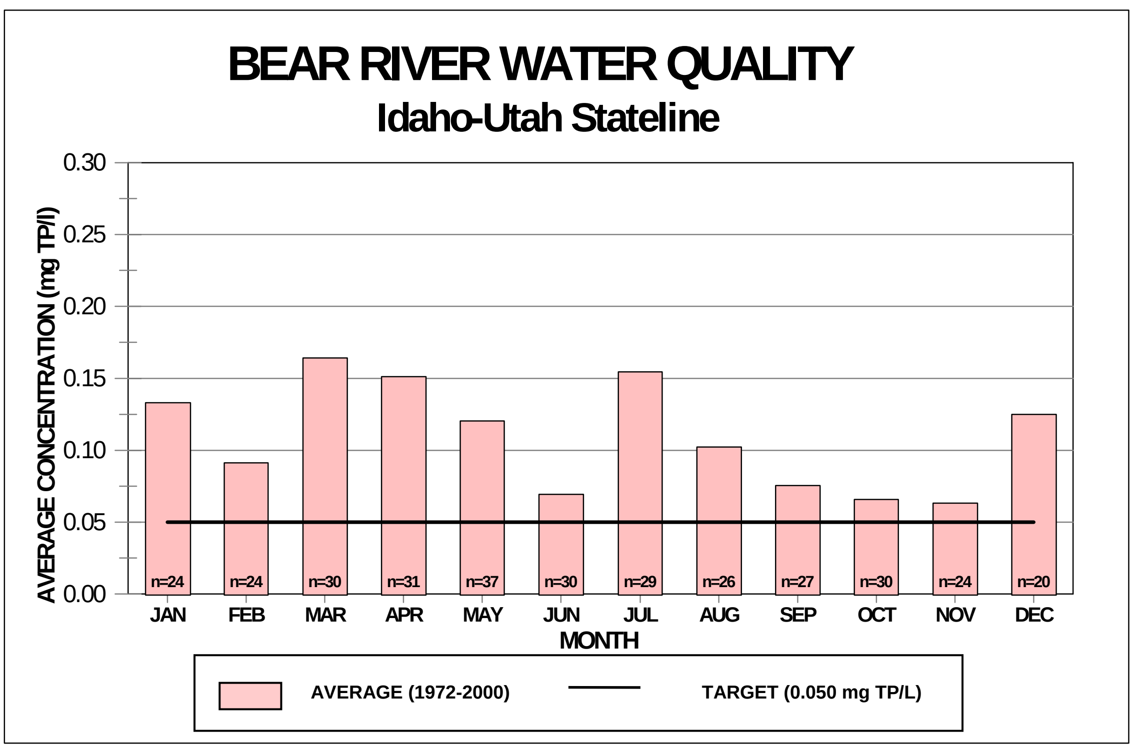

Figure 2-41. The average concentrations of total phosphorus (mg/L) for the Bear River at the Utah-Idaho state line.

As noted previously, the total phosphorus concentrations from all seven of the detailed sites were analyzed as cumulative exceedance values vs. concentration. The results can be seen in Figure 2-42. A total of 1,270 individual data points was used in the analysis. The data indicates that the 50 percent exceedance concentration is 0.070 mg/L and 0.055 mg/L for receiving water body reaches (including the reach which enters Utah) and riverine reaches, respectively. The target of 0.050 mg/L is exceeded in 69.2 percent of the receiving water body samples (including the reach which enters Utah) and the target of 0.075 mg/L is exceeded in 37.7 percent of the riverine samples.

Tributary concentrations of total and orthophosphorus demonstrated the same pattern as the mainstem river. Highest concentrations occurred during the two runoff periods and were lower during base flows. However, even at base flows, the concentrations exceeded the target of 0.050 mg/L in 75 percent of the streams where data are available. In those streams, the range of exceedance was between 25 and 100 percent of the observations. For most streams, concentrations higher than the 0.050 mg/L target were in excess of 75 percent of the observations (Table 2-28). The Malad River and tributaries show similar results with higher levels of phosphorus observed in most of the streams (Table 2-29). It is apparent from both the synoptic (mainstem and tributaries), as well as the detailed analysis (period of record, 1977-1998), that total phosphorus, and to a certain extent, total suspended solids, are the contaminants of concern.

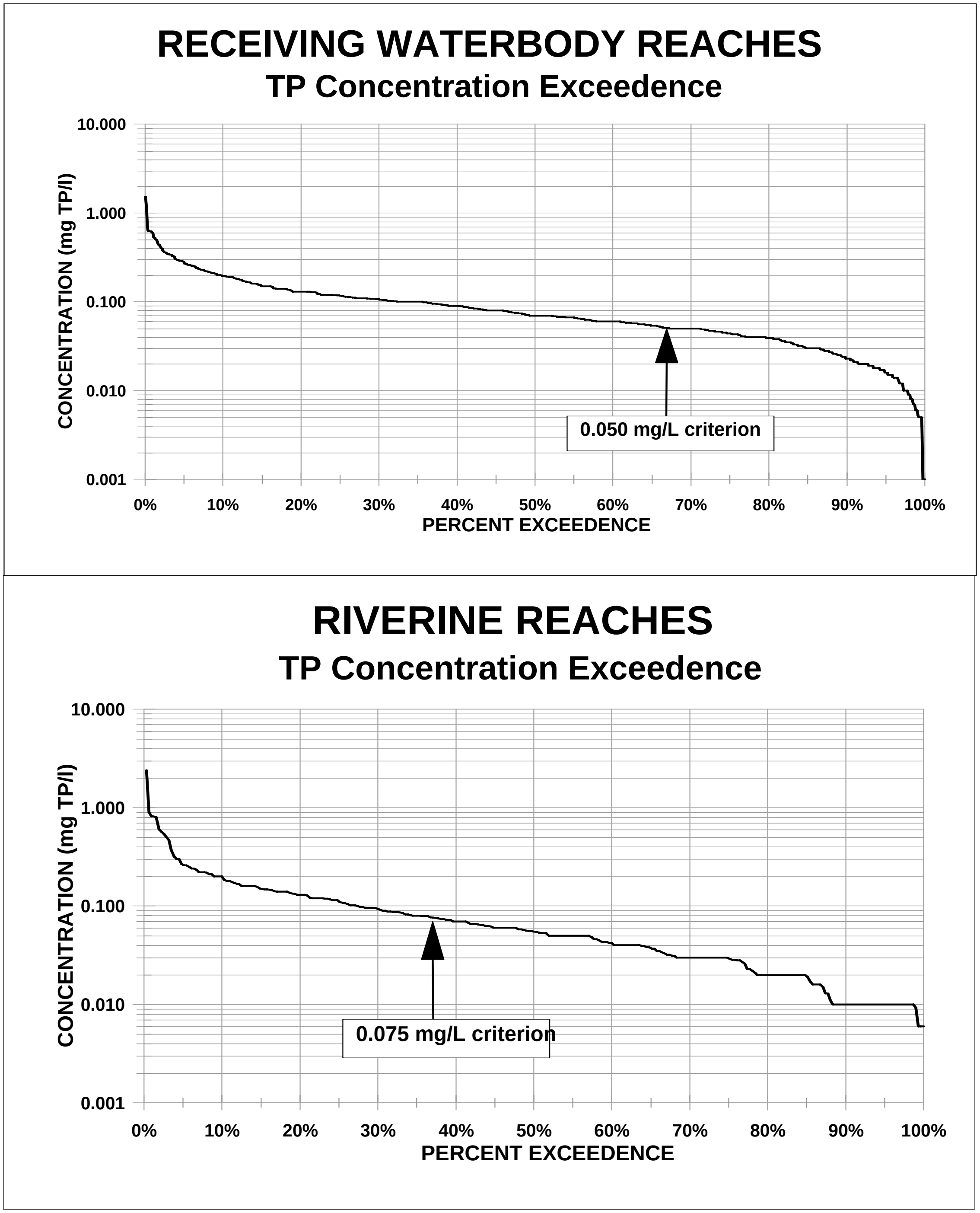

Figure 2-42. The percent exceedance concentrations for the total phosphorus in the Bear Rive taken over the time period 1977-1998 at seven sites in Idaho.

2.2.4 Analysis of Existing Water Quality Data & Implications for TMDLs

Bear River

Bear River throughout all its water quality limited segments is listed on the 303(d) list for flow alteration, sediment, and nutrients. There is no doubt that construction of mainstem dams and operation of Bear River to provide irrigation water has affected the historic flow regime in the system. However, EPA considers certain unnatural conditions, such as flow alteration or lack of flow, that are not the result of the discharge of a specific pollutant as “pollution.” TMDLs are not required for water bodies impaired by pollution, but not specific pollutants.

Listing of sediment as a concern in Bear River appears to be justified (Table 2-31). Core sampling, though limited to only seven sites, indicate higher than desired percentages of streambed sediment especially for fine sediment less than 0.85 mm (Table 2-30). Evaluation of BURP data indicates support, or non-support, of various beneficial uses. The evaluation does not identify a responsible pollutant when lack of support has been established. Analysis of BURP data showed non-support of coldwater aquatic life (Table 2-26). Finally, as compared to literature values considered sufficient to support beneficial uses, Bear River has experienced sediment concentrations above these targets (Table 2-27).

Data indicate that nutrients also are a problem in Bear River (Table 2-31). Dense stands of aquatic macrophytes occur in mainstem Bear River especially below the Grace area (Dave Hull, BURP Coordinator, DEQ/Pocatello, personal communication). Dissolved oxygen levels below the state water quality standard of 6 mg/L have been documented in mainstem Bear River over 10% of the time at Pescadero and Thatcher Bridge (Table 2-27). The extent to which aquatic vegetation contributes to these low DO concentrations is unclear. Based strictly on recommended numeric targets or impairment indicators, nitrate and total phosphorus appear to be elevated in mainstem Bear River. BURP data indicate non-support of coldwater aquatic life at three sites on mainstem Bear River although no cause of the non-support was determined (Table 2-26). Excessive loads of nutrients may, or may not, influence this lack of support of coldwater aquatic life, but to be on the safe side, and along with other evidence of possible nutrient problems, it makes sense to establish targets for Bear River.

Other than the fact that reservoirs, by virtue of slowing down water act as sinks for sediment, there were no data discovered to indicate that sediment was a problem in either Alexander or Oneida reservoirs. Therefore, no TMDLs will be written for sediment in the reservoirs. It is expected that by limiting input of sediment and nutrients in Bear River at the point of entry into the reservoir, beneficial uses will be supported in both river and reservoir.

Table 2-31. Data used to justify writing TMDLs for listed pollutants in 303(d) streams. A "Yes" indicates sampling results exceeded the threshold for that analysis, "No" means the threshold was not exceeded, and a blank means the site was not sampled.

	Water quality limited segment boundary			Exceedance of recommended literature values				Exceedance of water quality standards criteria		BURP data analysis[6]	Possible excessive aquatic vegetative growth[7]
Water body	Lower	Upper	Listed pollutants[1]	Core sampling	Sediment[2]	Nitrogen[3]	Phosphorus[4]	DO violations	Bacteria violations[5]		
Bear River	Wardboro	Wyoming border	Flow, Nut, Sed	Yes	Yes	Yes	Yes	Yes		NS	
Bear River	Alexander Res	Wardboro	Nut, Sed		Yes	No	Yes	Yes			
Alexander Res			Sed								
Bear River	Cove Plant	Alexander Res	Flow		No	No	Yes	Yes			
Bear River	Oneida Dam	Cove Power Plant	Flow, Nut, Sed		Yes	No	Yes	Yes			
Oneida Narrows Res			Sed								
Bear River	Mink Creek	Oneida Dam	Nut, Sed		No	Yes	Yes	Yes			
Bear River	Highway 91	Mink Creek	Flow, Nut, Sed		No	Yes	Yes	No			
Bear River	Utah border	Highway 91	Flow, Sed	Yes	Yes	Yes	Yes	Yes		NS	
Thomas Fork	Bear River	Wyoming border	Nut, Sed	Yes	Yes	No	Yes	No		NS	Yes
Dry Creek	Thomas Fork	Headwaters	Nut, Sed								
Preuss Creek	Thomas Fork	USFS boundary	Habitat, Sed							NS	
Snowslide Canyon	Montpelier Cr	Headwaters	Sed								
St. Charles Creek	Refuge	Lower IDL boundary	Nut, Sed							FS	
Ovid Creek	Bear River	Confl North & Mill crks	Sed		No	No	No	No		NS	
North Creek	Ovid Creek	Trib 3.2 km blw Mill Hollow	Unknown							FS	
Meadow Creek	North Creek	Headwaters	Metals Unk, Sed							NS	
Co-Op Creek	Stauffer Creek	USFS boundary	Nut, Sed							NS	
Pearl Creek	Bear River	North Fork Pearl Cr	Nut, Sed		No	No	No	No			
Densmore Creek	Bear River	Headwaters	Nut, Sed		Yes	No	Yes	No		NS	
Whiskey Creek	Bear River	Headwaters	Nut, Sed		Yes	No	Yes	No		NS	
Williams Creek	Bear River	Right Fk Williams Cr	Nut, Sed		Yes	No	Yes	No		NS	
Cottonwood Creek	Bear River	Trib 6.4 km upstream	Sed		No	No	No	No		NS	
Strawberry Creek	Mink Creek	USFS boundary	Unknown							NS	
Battle Creek	Bear River	Headwaters	Nut, Sed		Yes	Yes	Yes	Yes		NS	
Deep Creek	Bear River	Oxford Slough	Unknown	Yes	Yes	Yes	Yes	No		NS	
Fivemile Creek	Bear River	Headwaters	Unknown	Yes	Yes	Yes	Yes	No		NS	
Weston Creek	Bear River	Headwaters	Flow, Nut, Sed	Yes	Yes	Yes	Yes	No		NS	
Cub River	Utah border	Sugar Creek	Flow, Nut, Sed	Yes					No	NS	
Maple Creek	Cub River	Left Fork Maple Cr	Bact, Unknown						Yes	FS	
Worm Creek	Utah border	Glendale Res	Unknown	No						NS	
Malad River	Pleasant View	Headwaters	Sed						Yes	NS	
Little Malad River	Malad River	Headwaters	Sed						Yes	NS	
Wright Creek	Daniels Res	Headwaters	Sed						Yes	NS	
Dairy Creek	Wright Creek	Headwaters	Unknown						Yes	NS	
Elkhorn Creek	Little Malad R	USFS boundary	Unknown							NS	
Samaria Creek	Malad River	Headwaters	Nut, Sed							NS	
Deep Creek	Mouth	Headwaters	Unknown							NS	
Devil Creek	Malad River	Devil Creek Res	Nut, Sed						Yes	NS	

[1]Bact=bacteria; DO=dissolved oxygen; Flow=flow alteration; Habitat=habitat alteration; Metals Unk=metals unknown; Nut=nutrients; Sed=sediment.
[2]>80 mg/L
[3]>4 mg/L ammonia (NH_3) or nitrate (NO_3)
[4]>0.075 mg/L orthophosphorus or total phosphorus
[5]includes sampling through 1999
[6]FS=full support, NS=non-support
[7]documentation indicating possible excessive levels of aquatic vegetation

Tributaries

Several tributaries are listed for flow or habitat alteration. EPA considers certain unnatural conditions (e.g., flow alteration, lack of flow, habitat alteration) that are not the result of the discharge of a specific pollutant as "pollution." TMDLs are not required for water bodies impaired by pollution, but not specific pollutants. Thus, TMDLs will not be written for flow alteration in Cub River or Weston Creek, or for habitat alteration in Preuss Creek.

Maple Creek is the only water body hindered by bacteria problems. Sampling by DEQ in 1999 confirmed a contact recreation water quality standard violation for *E. coli*. Other streams with bacteria violations are expected to be listed on the first 303(d) list submitted by the State of Idaho subsequent to the approval of this TMDL. Scheduling for the bacteria TMDL will be identified at the time of listing.

Meadow Creek is listed for unknown metals affecting beneficial uses. No data were discovered to indicate any problems associated with metals and therefore it is recommended that this pollutant be removed from future 303(d) lists for Meadow Creek. Dave Hull (BURP Coordinator, DEQ/Pocatello, personal conversation) knew of no reason for listing Meadow Creek for unknown metals.

As with the evaluation of Bear River as to those listed pollutants, which warrant TMDLs, the same data are available for listed tributaries (Table 2-31). Data have been collected as part of DEQ's core sampling and BURP effort, and ERI's tributary monitoring.

Analysis of BURP data shows non-support of cold water aquatic life for all listed 303(d) tributaries except Dry, St. Charles, North, and Pearl creeks and Snowslide Canyon (Table 2-25). No assessment was made for Dry Creek or Snowslide Canyon and no other data exist (Table 2-31); therefore, TMDLs will be written for both creeks for the pollutants listed. Pearl Creek was also not assessed (Table 2-25), however, data indicate that neither sediment nor nutrients exceeded recommended thresholds (Table 2-28). Until assessment of BURP data is completed, it is assumed that nutrients and sediment are affecting beneficial uses in Pearl Creek. Both St. Charles and North creeks show full support of their beneficial uses and are recommended for removal from future 303(d) lists (Table 2-25). Maple Creek also shows full support for coldwater aquatic life, but has experienced bacteria violations (Table 2-31). Therefore, a TMDL will be written for bacteria in Maple Creek and it is recommended all other pollutants listed for Maple Creek be removed in future 303(d) lists. TMDLs will be written for all 303(d) listed streams for which assessment of BURP data indicated non-support of coldwater aquatic life (Table 2-25). Generally, the data confirm possible problems with the listed pollutants. For example, Thomas Fork, Densmore Creek, Whiskey Creek, Williams Creek, Battle Creek, and Weston Creek all are listed as having both nutrient and sediment problems, which the ERI data confirm (Table 2-31). Core sampling results justify listing of sediment in Thomas Fork and Weston Creek. Deep and Fivemile creeks are both listed for unknown pollutants. From ERI data, it appears that sediment and nutrients could very well be problems in both water bodies. It is interesting to note that ERI documented no exceedances of the 80 mg/L sediment threshold for either Ovid or Cottonwood creeks even though both are listed as having sediment problems.

2.3 Pollutant Source Inventory

The mainstem Bear River and its tributaries represent a major aquatic resource in the state of Idaho. An analysis of water quality limited segments in this watershed indicated that for certain river segments and tributaries, temperature, and dissolved oxygen were at times impacting the coldwater beneficial use designation. However, the major impact to beneficial use has been caused by suspended sediments and nutrients, primarily phosphorus.

In the mainstem Bear River, sources of these pollutants can be from the adjacent watersheds (e.g. tributaries), stream bank condition, or the immediate floodplain (valley bottoms and point sources). This section of the watershed assessment will inventory these sources and qualify the data necessary for each source to be quantified.

2.3.1 Sources for Pollutants of Concern

There are a number of permitted point sources in the Bear River basin in Idaho. These sources are defined by hydrologic unit code (HUC) in Table 2-32. As can be seen from this table there is only one water discharge permit for the Central Bear River (HUC #16010102) and no water discharge permits for the Lower Bear-Malad (HUC# 16010204). However, for the Bear Lake unit (HUC#16010201) there are nine permits issued. Inspection of the nine permits indicated that data are available on two of the sites (ID0020818 and IDG130034). For these two sites, parameters include flow, bacteria, TSS, TDS, nutrients, dissolved oxygen, pH, and temperature. Inspection of the remaining sites indicated that they discharge only periodically, if at all. In the Middle Bear unit (HUC #16010202) there are six discharge permits. Data are available for two sites (ID0026085 and IDG130113). Data availability is the same as the sites noted earlier.

2.3.2 Nonpoint Sources

For over 30 years, reductions in point source pollution have been the focus of the resource agencies responsible for the protection of water quality. However, during the last decade, reduction of nonpoint source pollution has been the targeted goal of these agencies. The institutional mechanism for reducing these loads is through the quantitative process of establishing total maximum daily loads (TMDL) for those parameters that cause a stream not to meet its designated beneficial uses.

Table 2-32. A summary of water discharge permit holders by hydrologic unit as of August 2002. Sites which were sampled as part of this report are identified in the rightmost column.

FACILITY ID	NAME	SIC DESCRIPTION[2]	LOADING CALCULATION[3]
HUC# 16010102 - CENTRAL BEAR			
WY0021032	Cokeville, Town of	Sewerage Systems	e
HUC# 16010201 - BEAR LAKE			
ID0025143[1]	Georgetown, City of	Sewerage Systems	e
ID0020818	Soda Springs WWTP	Sewerage Systems	S
ID0025585[1]	Montpelier, City of	Sewerage Systems	e
ID0001198	P4 Production L L C	Industrial Inorganic Chemicals	e
IDG130034	Clear Springs Foods Inc	Fish Hatcheries and Preserves	S
IDR05A188	J R Simplot Co Smoky Canyon Mine	Phosphate Rock	e
IDR05A313	Astaris Production LLC	Phosphate Rock	e
IDR05A170	P4 Production LLC	Phosphate Rock	e
IDR05A321	Agrium U.S. Inc	Phosphate Rock	e
HUC#16010202 - MIDDLE BEAR			
ID0026085	Riverdale Resort	RV Parks and Campgrounds	S
ID0023825	Grace, City of	Sewerage Systems	e
ID0020214	Preston, City of	Sewerage Systems	e
IDG130113	Bear River Trout Farm	Fish Hatcheries and Preserves	S
ID0025569	Franklin, City of	Sewerage Systems	e
IDG130035	ID-Fish & Game	Fish Hatcheries and Preserves	e
HUC# 16010204 - LOWER BEAR-MALAD			
No Permit Compliance Stations found			

(1)discharge is infrequent
(2)principal activity causing the discharge at the facility as defined by the 1987 Standard Industrial Classification (SIC) Manual.
(3)S=Sampled; e=estimated

Because of climatic conditions (most moisture falls as snow with associated spring melting) and vegetation types (sparse rangeland and forest cover), large areas of the west are susceptible to erosion and therefore non-point source loadings. The Idaho Bear River basin is a good example of this problem. Associated with this erosion potential are land use practices that accelerate the erosion process. Removal of vegetative cover from uplands and the reduction of riparian cover within bottomlands have resulted in significant sediment yields from denuded or modified watersheds. As noted in the previous section of this report, the established beneficial uses in both the mainstem Bear River as well as the major tributaries have been impacted by excess suspended sediments as well as particulate and dissolved phosphorus.

It was expected that the quantity of sediment exported from a watershed would vary spatially across southeastern Idaho in response to differences in localized hydrology, soils, and vegetation, which in turn are a function of differences in climate (precipitation), geology, and geomorphology. Given the anticipated spatial variance in the export of sediments and nutrients from watersheds in the Middle Bear River in Idaho, the approach taken in this analysis was to select watersheds in the Idaho Bear River basin that have similar climate, geology and geomorphology, such that these watersheds would have the same potential background sediment and phosphorus yields independent of land use. The GIS-based ecological classification of these watersheds as well as the entire Idaho Bear River basin is described in the companion volume entitled "Ecological Classification, Bear River Basin Idaho" provided by White Horse Associates, Inc, which was included as part of this assessment.

Once the watersheds were selected (see Table 2-28 and Table 2-29 for list of tributaries), water quality sites were established at the point of discharge into the Bear River on each stream. On each monitoring trip, the sites were sampled for total suspended solids, total phosphorus, orthophosphate, total inorganic nitrogen, and flow.

Sampling began in 1999 and corresponded to the four hydrologic periods previously discussed in this report. A total of five dates (May, October 1999; March, April, June 2000) were sampled. Dates represented the four major hydrologic periods and included lower basin runoff, upper basin runoff, summer base flow and winter base flow.

In addition to tributary investigations, mainstem sites along the Bear River were also sampled at the same time as the watersheds. Watershed data were summarized for not only the individual watersheds but also for the inter-reach portions of the mainstem monitoring sites. This allowed for an analysis of watershed characteristics relative to the change in water quality parameters for the mainstem Bear River.

Two critical new databases were needed in order to complete this analysis. They were: 1) the hierarchical classification of the target watersheds; and 2) the quantitative estimate of phosphorus and suspended solids yields (loadings as kg/day) from these target watersheds. A description of each of these databases is provided below.

Watershed Classification and Statistical Analysis

The ecological classification consisted of seven levels, ranging from broad classes based upon landscape characteristics to very refined classes of valley bottom land form and specific land use. Broad classes (ecoregion, geologic district, and subsection) were applied to all watersheds, whereas land type and valley bottom type and specific land use were applied only to the valley bottoms. Summaries of all characteristics used in the statistical analysis were provided in Table 2-1 through Table 2-6 for tributaries, and in Table 2-7 through Table 2-10 for the Bear River sites. (Please refer to section 2.1.1 [Geology, Landform and Land Use Classification] for a more detailed exploration of the analysis.)

In order to infer the possible relationship between characteristics of the watersheds in the Middle Bear River and the mass export of nitrogen, phosphorus and suspended sediments, a multiple regression approach was selected. Because the twenty-nine watersheds monitored and mapped are in the same general climatic area, differences in the export of the parameters of choice, may be the result of landform or land use features. The regression analysis used the hierarchical system previously described. The analysis initially used the broad categories and systematically increased the resolution by the addition of greater subcategories. The results of this analysis can be seen in Table 2-33 through Table 2-37 for the tributary regressions and Table 2-38 through Table 2-43 for the mainstem Bear River. In each case the significant (P-value ≤ 0.05) regression equations are described and the n, r^2 and P values provided. In all cases the dependent variable (y) is expressed as a mass (kg/day) for each hydrologic time period investigated.

The first set of analyses was completed on the broad class of the geologic types only (Table 2-33). Of the four water quality parameters used in the regressions, all had significant relationships with geology type except during trip 2 (summer 1999 base flow). The range in r^2 values were 0.22 to 0.82, with the best prediction being the export during upper basin runoff of total inorganic nitrogen based upon the surface area of volcanic materials. Total phosphorus and total inorganic nitrogen had four of five periods with significant predictions.

As noted in section 2.2.3.4, total phosphorus was a contaminant of concern, especially during lower and upper basin runoff. Significant relationships ($r^2 = 0.69$ and 0.65) were found for geologic type alone. The amount of sedimentary materials in the watershed appears to be an important factor in the export of total phosphorus from the watershed.

The second analysis (Table 2-34) added the complexity of subsections, which are distinctive geomorphic features. The results were similar to geologic type. While some dependent parameters decreased in predictability (e.g. total phosphorus in lower basin runoff), others increased dramatically. For example, TSS and TP daily loadings during upper basin runoff increased the r^2 to 0.77 and 0.82. In addition, TSS loading during winter base flow had an r^2 of 0.91, $p<0.001$, based upon unconsolidated lacustrine and sedimentary fluvial lands.

The final level of resolution was to add the valley bottom types to the watershed descriptions. The results can be seen in Table 2-35. Upper basin runoff total phosphorus continued to increase in predictability with an increased r^2 of 0.88. Suspended solids also continued to increase in predictability of loading. As with geology, four of the five dates for total phosphorus and total suspended solids had significant predictive equations with watershed characteristics.

Table 2-33. The results of the multiple regression analysis using geology for the tributaries to the Bear River. The dependent variable is loading (kg/day) by parameter and trip. The trips are 1) Upper Basin Runoff, 2) Summer Base flow, 3) Winter Base flow, 4) Lower Basin Runoff and 5) Summer Base flow.

Loading (kg/day)[1]	Multiple Linear Equation[2]	N	r2	P
OP-1 =	1.158 + 0.000127(GT2000) + 0.000454(GT5000)	23	0.41	0.004
OP-2 =	*NOT SIGNIFICANT*			
OP-3 =	0.266 + 0.000263(GT5000)	29	0.50	<.001
OP-4 =	0.257 + 0.000135(GT5000) + 4.13E-005(GT2000)	27	0.39	0.004
OP-5 =	*NOT SIGNIFICANT*			
TP-1 =	1.336 + 0.00105(GT2000) + 0.00286(GT5000)	23	0.69	<.001
TP-2 =	*NOT SIGNIFICANT*			
TP-3 =	0.213 + 0.000651(GT5000) + 0.000311(GT6000) - 7.31E-005(GT3000)	29	0.59	<.001
TP-4 =	-0.154 + 0.000267(GT2000) + 0.00047(GT3000)	27	0.65	0.001
TP-5 =	0.312 + 0.245(GT6000)	26	0.22	0.012
TSS-1 =	1940 + 0.915(GT2000) - 1.04(GT1000)	23	0.69	<.001
TSS-2 =	*NOT SIGNIFICANT*			
TSS-3 =	-134 + 0.325(GT6000) - 0.0523(GT3000)	29	0.70	<.001
TSS-4 =	283.6 + 0.206(GT2000) - 0.138(GT1000)	27	0.78	0.03
TSS-5 =	*NOT SIGNIFICANT*			
TIN-1 =	20.84 + 0.0207(GT5000)	23	0.82	<.001
TIN-2 =	*NOT SIGNIFICANT*			
TIN-3 =	8.612 + 0.00775(GT5000)	29	0.45	<.001
TIN-4 =	77.32 + 0.014(GT6000) - 0.00323(GT3000)	28	0.38	<.001
TIN-5 =	37 + 0.023(GT5000)	25	0.41	0.038

(1)OP=Orthophosphorus, TP=Total phosphorus, TSS=Total Suspended Sediments, TIN=Total Inorganic Nitrogen
(2)variables entered (surface area-acres)

Geology Type (GT)

1000 Metasedimentary
2000 Sedimentary
3000 Sedimentary (calc)
5000 Volcanic
6000 Unconsolidated

Table 2-34. The results of the multiple regression analysis using geology and subsection for the tributaries to the Bear River. The dependent variable is loading (kg/day) by parameter and trip. The trips are 1) Upper Basin Runoff, 2) Summer Base flow, 3) Winter Base flow, 4) Lower Basin Runoff and 5) Summer Base flow.

Loading (kg/day)[1]	Multiple Linear Equation[2]	N	r2	P
OP-1 =	1.65 + 0.000411(GSS6300)	23	0.46	<.001
OP-2 =	*NOT SIGNIFICANT*			
OP-3 =	*NOT SIGNIFICANT*			
OP-4 =	*NOT SIGNIFICANT*			
OP-5 =	*NOT SIGNIFICANT*			
TP-1 =	2.73 + 0.00284(GSS6300) + 0.000821(GSS6500)	23	0.77	<.001
TP-2 =	*NOT SIGNIFICANT*			
TP-3 =	1.21 + 0.000205(GSS6500)	29	0.27	0.003
TP-4 =	0.19 + 9.7E-006(GSS6500)	26	0.15	0.045
TP-5 =	0.73 + 0.000191(GSS2200) + 0.000154(GSS6500)	27	0.42	0.017
TSS-1 =	1846 + 1.05(GSS2200) - 1.46(GSS1200) + 0.759(GSS6300)	23	0.82	<.001
TSS-2 =	*NOT SIGNIFICANT*			
TSS-3 =	422 + 0.298(GSS6500) - 0.084(GSS3200)	29	0.91	<.001
TSS-4 =	0.36 + 1.91E-005(GSS6500)	26	0.23	0.01
TSS-5 =	-12.01 + 0.165(GSS2200) + 0.116(GSS6500)	27	0.69	<.001
TIN-1 =	24.71 + 0.00644(GSS6300)	23	0.19	0.034
TIN-2 =	*NOT SIGNIFICANT*			
TIN-3 =	*NOT SIGNIFICANT*			
TIN-4 =	84.48 + 0.00738(GSS6500)	26	0.20	0.018
TIN-5 =	*NOT SIGNIFICANT*			

(1)OP=Orthophosphorus, TP=Total phosphorus, TSS=Total Suspended Sediments, TIN=Total Inorganic Nitrogen
(2)variables entered (surface area-acres)

Geology and Subsections (GSS)

1200	Metamorphic fluvial lands
2200	Sedimentary fluvial lands
3100	Sedimentary (calc)glacial lands
3200	Sedimentary (calc) fluvial lands
5200	Volcanic fluvial lands
6300	Unconsolidated alluvial lands
6500	Unconsolidated lacustrine lands

Table 2-35. The results of the multiple regression analysis using geology, subsection and valley bottom type for the tributaries to the Bear River. The dependent variable is loading (kg/day) by parameter and trip. The trips are 1) Upper Basin Runoff, 2) Summer Base flow, 3) Winter Base flow, 4) Lower Basin Runoff and 5) Summer Base flow.

Loading (kg/day)[1]	Multiple Linear Equation[2]	N	r2	P
OP-1 =	2.41 + 1.4E-007(GSV6330)	23	0.28	0.044
OP-2 =	*NOT SIGNIFICANT*			
OP-3 =	*NOT SIGNIFICANT*			
OP-4 =	*NOT SIGNIFICANT*			
OP-5 =	*NOT SIGNIFICANT*			
TP-1 =	9.09 + 1.57E-006(GSV6330) - 4.73E-005(GSV1220) + 1.99E-005(GSV6410) - 0.000199(GSV3230)	23	0.88	<.001
TP-2 =	*NOT SIGNIFICANT*			
TP-3 =	1.53 + 1.47E-006(GSV6420) - 7.63E-007(GSV3230)	29	0.77	<.001
TP-4 =	0.5 + 0.00647(GSV2220) + 0.000728(GSV6420)	27	0.42	0.038
TP-5 =	0.2 + 0.000156(GSV6430)	26	0.19	0.02
TSS-1 =	5281 + 0.00132(GSV6330) - 0.0418(GSV1220) + 0.00329(GSV6420) - 0.184(GSV6410)	23	0.90	<.001
TSS-2 =	*NOT SIGNIFICANT*			
TSS-3 =	487 + 0.00163(GSV6420) - 0.000933(GSV3230)	29	0.88	<.001
TSS-4 =	1.58 + 0.00622(GSV6420) + 0.000864(GSV6330) - 0.0467(GSV3220)	26	0.54	0.007
TSS-5 =	0.39 + 2.69(GSV6430)	26	0.24	0.009
TIN-1 =	*NOT SIGNIFICANT*			
TIN-2 =	*NOT SIGNIFICANT*			
TIN-3 =	*NOT SIGNIFICANT*			
TIN-4 =	750 + 4.97(GSV6420) - 2.56(GSV3230) + 0.442(GSV6330)	26	0.68	0.002
TIN-5 =	*NOT SIGNIFICANT*			

(1)OP=Orthophosphorus, TP=Total phosphorus, TSS=Total Suspended Sediments, TIN=Total Inorganic Nitrogen
(2)variables entered (surface area-acres)

Geology, subsection, valley bottom type (GSV)

1220	Metamorphic V Erosional Canyon
1230	Metamorphic V Depositional Canyon
2220	Sedimentary V Erosional Canyon
2230	Sedimentary V Depositional Canyon
3220	Sedimentary(calc) V Erosional Canyon
3230	Sedimentary(calc) V Depositional Canyon
5230	Volcanic V depositional Canyon
6320	Alluvial Confined Valley
6330	Alluvial unconfined Valley
6410	Lacustrine Confined Draw
6420	Lacustrine Confined valley
6430	Lacustrine Unconfined valley

In an attempt to better understand the human influences to watershed loadings, the land use in valley bottoms adjacent to the streams was regressed against daily loading for the four water quality parameters. The results can be seen in Table 2-36. It is remarkable that of the 20 possible combinations of parameters and sample dates, only three did **not** have significant predictive equations. The most significant equation for all parameters occurred during upper basin runoff with an r^2 ranging from 0.98 for total phosphorus and 0.90 for total inorganic nitrogen. Total phosphorus export (kg TP/day) was significantly predicted for all five dates.

Utilizing all the available watershed data (geology, subsection, valley bottom type, as well as specific land use), multiple regressions were developed to once again predict nutrient and sediment yield from the watersheds. The results can be seen in Table 2-37. The results are similar to specific land use, with only two of 20 equations being not significant. The r^2 values continued to improve, with values greater than 0.75 being common. It is interesting to note that upper basin runoff for total phosphorus (r^2 =0.89) loading was best predicted by the positive amount of shrub rangeland and volcanic V-depositional canyon, while negatively related to the amount of metamorphic V-erosional canyon. During this same flow period, suspended sediment loading was positively related to the amount of agricultural and shrub rangeland and negatively related to metamorphic V-erosional canyon. This may indicate that the mass loading of the two materials from the watersheds may be from different sources and/or processes, depending upon the hydrologic time period.

The second set of regression analyses was conducted on data from the 19 mainstem Bear River sites. Two separate sets of equations were developed. The first was based upon daily loadings at a location, while the second was a reach gain/loss load from the reach immediately above the site. Both datasets used the same watershed descriptive data in the development of the equations.

Geology, subsection and valley bottom type (Table 2-38) yields significant equations for only 45 percent of the comparisons, with mainstem total suspended solids and total inorganic nitrogen loads during summer base flow having an r^2 of 0.76 and 0.78, respectively. Table 2-39 and Table 2-40 are the results of the regression analysis for the instantaneous loadings (kg/day). Using general land use increased the number of significant predictive equations to 55 percent (Table 2-39) with no r^2 being greater than 0.72 (TIN during summer base flow). When combining the two datasets (Table 2-40), 70 percent of the equations were found to be significant, although r^2 values remained low. Most of the significant equations had an r^2 of less than 0.50.

As stated previously, mainstem water quality parameters were also expressed as a reach gain/loss mass load (kg/day). The results of this regression analysis can be seen in Table 2-41, Table 2-42, and Table 2-43. In Table 2-41, only geology, subsection and valley bottom type were used as predictive variables. Three of the four water quality parameters had significant relationships in four of five dates, with the last parameter (TIN) having significant relationships for all five dates.

Table 2-36. The results of the multiple regression analysis using specific land use categories for the tributaries to the Bear River. The dependent variable is loading (kg/day) by parameter and trip. The trips are 1) Upper Basin Runoff, 2) Summer Base flow, 3) Winter Base flow, 4) Lower Basin Runoff and 5) Summer Base flow.

Loading (kg/day)[1]	Multiple Linear Equation[2]	N	r2	P
OP-1 =	0.446 + 0.00171(LU41) + 0.118(LU73) + 0.00256(LU62) + 0.0191(LU75)	23	0.91	<.001
OP-2 =	0.381 + 0.0112(LU75)	29	0.43	<.001
OP-3 =	0.386 + 0.117(LU73) + 1.28(LU53)	29	0.92	<.001
OP-4 =	0.312 + 0.0456(LU73) + 9.72E-005(LU43) + 0.0229(LU52)	26	0.68	<.001
OP-5 =	*NOT SIGNIFICANT*			
TP-1 =	-2.26 + 0.00204(LU32) + 0.797(LU73) - 0.00442(LU33)	23	0.98	<.001
TP-2 =	0.985 + 0.0259(LU75)	29	0.41	<.001
TP-3 =	1.104 + 0.129(LU52) + 0.189(LU73)	29	0.87	<.001
TP-4 =	1.06 + 0.11(LU52) + 0.00347(LU62) + 0.097(LU73)	26	0.85	<.001
TP-5 =	0.412 + 0.0111(LU52) - 0.0147(LU73)	25	0.29	0.03
TSS-1 =	1771 + 398(LU24) - 29.9(LU31) + 17.8(LU62) + 1800(LU41)	23	0.93	<.001
TSS-2 =	188 + 29.8(LU13)	29	0.23	0.009
TSS-3 =	524 + 144(LU52) - 100(LU73)	29	0.82	<.001
TSS-4 =	782 + 83(LU52) + 2.12(LU62) - 83.9(LU73)	26	0.71	<.001
TSS-5 =	*NOT SIGNIFICANT*			
TIN-1 =	13.63 + 6.48(LU73) + 4.87(LU17) + 1.35E+020(LU41)	23	0.90	<.001
TIN-2 =	13.19 + 1.55(LU24)	29	0.15	<.001
TIN-3 =	8.28 + 3.75(LU73) + 1.08(LU24)	29	0.85	0.038
TIN-4 =	31.55 + 11.5(LU73) + 4(LU24)	27	0.76	<.001
TIN-5 =	*NOT SIGNIFICANT*			

(1)OP=Orthophosphorus, TP=Total phosphorus, TSS=Total Suspended Sediments, TIN=Total Inorganic Nitrogen
(2)variables entered (surface area-acres)

	Land use (LU)		
11	Residential	42	Evergreen Forest
12	Commercial	43	Mixed Forest
13	Industrial	52	Lakes
14	Transportation	53	Reservoir
16	Mixed Urban	61	Forested Wetland
17	Other Urban	62	Nonforested Wetland
21	Crop/Pasture	73	Sandy Barren Land
24	Other Agricultural	74	Rock
31	Herbaceous Vegetation	75	Mine/Quarry
32	Shrub Rangeland		
33	Mixed Rangeland		
41	Deciduous Forest		

Table 2-37. The results of the multiple regression analysis using geology, subsection, valley bottom type and specific land use categories for the tributaries to the Bear River. The dependent variable is loading (kg/day) by parameter and trip. The trips are 1) Upper Basin Runoff, 2) Summer Base flow, 3) Winter Base flow, 4) Lower Basin Runoff and 5) Summer Base flow.

Loading (kg/day)[1]	Multiple Linear Equation[2]	N	r2	P
OP-1 =	0.807 + 0.001601(LU41) + 19.352(GSV5230) + 0.002419(LU62)	26	0.82	<.001
OP-2 =	0.381 + 0.01127(LU75)	27	0.43	0.007
OP-3 =	0.386 + 0.177(LU73) + 0.01277(LU52)	27	0.91	<.001
OP-4 =	0.353 + 0.06255(LU73) + 0.00687(GSV2220) + 0.000806(GSV6420)	27	0.84	0.001
OP-5 =	0.203 + 0.000154(GSV6430)	27	0.19	0.05
TP-1 =	-0.957 + 0.0016(LU32) + 100.99(GSV5230) - 0.0985(GSV1220)	27	0.89	<.001
TP-2 =	0.985 + 0.0259(LU75)	27	0.41	0.005
TP-3 =	0.732 + 0.128(LU52) + 0.192(LU73) + 0.00174(GSV2230)	27	0.89	<.001
TP-4 =	1.063 + 0.11(LU52) + 0.00347(LU62) + 0.09699(LU73)	27	0.85	<.001
TP-5 =	0.488 + 0.000395(GSV6430) - 7.82E-005(LU33)	27	0.35	0.009
TSS-1 =	-890.2 + 719(LU24) - 86.6(GSV1220) + 0.64(LU32)	27	0.88	<.001
TSS-2 =	80.99 + 68.09(LU13) - 1.015(GSV3230) + 0.08243(LU33)	27	0.61	0.001
TSS-3 =	524.9 + 144.47(LU52) - 100.47(LU73)	27	0.82	<.001
TSS-4 =	385.2 + 57.74(LU52) + 2.275(LU62) + 12.51(GSV2220)	27	0.76	<.001
TSS-5 =	*NOT SIGNIFICANT*			
TIN-1 =	12.35 + 6.5(LU73) + 0.188(GSV6410) + 0.0134(LU41)	27	0.90	<.001
TIN-2 =	13.197 + 1.55(LU24)	27	0.15	0.038
TIN-3 =	5.35 + 3.79(LU73) + 1.176(LU24) + 0.0299(GSV6320)	27	0.89	<.001
TIN-4 =	38.37 + 11.33(LU73) + 4.77(LU24) - 0.738(GSV3220)	27	0.79	<.001
TIN-5 =	*NOT SIGNIFICANT*			

(1)OP=Orthophosphorus, TP=Total phosphorus, TSS=Total Suspended Sediments, TIN=Total Inorganic Nitrogen
(2)variables entered (surface area-acres)

Geology, subsection, valley bottom type (GSV)

1220	Metamorphic V Erosional Canyon
1230	Metamorphic V Depositional Canyon
2220	Sedimentary V Erosional Canyon
2230	Sedimentary V Depositional Canyon
3220	Sedimentary(calc) V Erosional Canyon
3230	Sedimentary(calc) V Depositional Canyon
5230	Volcanic V depositional Canyon
6320	Alluvial Confined Valley
6330	Alluvial unconfined Valley
6410	Lacustrine Confined Draw
6420	Lacustrine Confined Valley
6430	Lacustrine Unconfined valley

Land use (LU)

11	Residential	41	Deciduous Forest
12	Commercial	42	Evergreen Forest
13	Industrial	43	Mixed Forest
14	Transportation	52	Lakes
16	Mixed Urban	53	Reservoir
17	Other Urban	61	Forested Wetland
21	Crop/Pasture	62	Nonforested Wetland
24	Other Agricultural	73	Sandy Barren Land
31	Herbaceous Vegetation	74	Rock
32	Shrub Rangeland	75	Mine/Quarry
33	Mixed Rangeland		

Table 2-38. The results of the multiple regression analysis using geology, subsection and valley bottom types for the mainstem Bear River. The dependent variable is loading (kg/day) by parameter and trip. The trips are 1) Upper Basin Runoff, 2) Summer Base flow, 3) Winter Base flow, 4) Lower Basin Runoff and 5) Summer Base flow.

Loading (kg/day)[1]	Multiple Linear Equation[2]	N	r2	P
OP-1 =	56.76 - 0.103(GSV2220)	12	0.30	0.042
OP-2 =	15.5 + 2.587(GSV1230)	15	0.53	0.001
OP-3 =	15.226 + 2.19(GSV1230) + 0.06414(GSV6410)	14	0.46	0.014
OP-4 =	*NOT SIGNIFICANT*			
OP-5 =	*NOT SIGNIFICANT*			
TP-1 =	*NOT SIGNIFICANT*			
TP-2 =	*NOT SIGNIFICANT*			
TP-3 =	*NOT SIGNIFICANT*			
TP-4 =	*NOT SIGNIFICANT*			
TP-5 =	*NOT SIGNIFICANT*			
TSS-1 =	*NOT SIGNIFICANT*			
TSS-2 =	14971 + 167(GSV1220) + 10.1(GSV6320) - 68.7(GSV6410)	13	0.76	<.001
TSS-3 =	16780 + 108(GSV6410)	15	0.49	0.002
TSS-4 =	21912 + 6.64(GSV2230)	15	0.24	0.044
TSS-5 =	*NOT SIGNIFICANT*			
TIN-1 =	758 + 0.43(GSV6320)	12	0.55	0.002
TIN-2 =	*NOT SIGNIFICANT*			
TIN-3 =	*NOT SIGNIFICANT*			
TIN-4 =	259 + 0.0804(GSV6320)	15	0.23	0.048
TIN-5 =	292 + 0.55(GSV6320) - 3.375(GSV6410) + 44.668(GSV1230)	13	0.78	<.001

(1)OP=Orthophosphorus, TP=Total phosphorus, TSS=Total Suspended Sediments, TIN=Total Inorganic Nitrogen
(2)variables entered (surface area-acres)

Geology, subsection, valley bottom type (GSV)

1220	Metamorphic V Erosional Canyon
1230	Metamorphic V Depositional Canyon
2220	Sedimentary V Erosional Canyon
2230	Sedimentary V Depositional Canyon
3220	Sedimentary(calc) V Erosional Canyon
3230	Sedimentary(calc) V Depositional Canyon
5230	Volcanic V depositional Canyon
6320	Alluvial Confined Valley
6330	Alluvial unconfined Valley
6410	Lacustrine Confined Draw
6420	Lacustrine Confined valley
6430	Lacustrine Unconfined valley

Table 2-39. The results of the multiple regression analysis using general land use categories for the mainstem Bear River. The dependent variable is loading (kg/day) by parameter and trip. The trips are 1) Upper Basin Runoff, 2) Summer Base flow, 3) Winter Base flow, 4) Lower Basin Runoff and 5) Summer Base flow.

Loading (kg/day)[1]	Multiple Linear Equation[2]	N	r2	P
OP-1 =	62.8 - 0.078(LU10) + 0.0271(LU70)	11	0.51	0.02
OP-2 =	NOT SIGNIFICANT			
OP-3 =	NOT SIGNIFICANT			
OP-4 =	NOT SIGNIFICANT			
OP-5 =	28.26 + 0.03844(LU50)	15	0.29	0.027
TP-1 =	495.5 - 0.492(LU10)	12	0.32	0.034
TP-2 =	97.79 + 0.008108(LU50)	15	0.25	0.04
TP-3 =	NOT SIGNIFICANT			
TP-4 =	38.76 + 0.009293(LU60)	15	0.24	0.044
TP-5 =	NOT SIGNIFICANT			
TSS-1 =	NOT SIGNIFICANT			
TSS-2 =	13131 + 0.88(LU40)	15	0.46	0.003
TSS-3 =	12400 + 0.379(LU20)	15	0.30	0.024
TSS-4 =	19847 + 8.26(LU60)	15	0.29	0.026
TSS-5 =	NOT SIGNIFICANT			
TIN-1 =	803.6 + 0.158(LU50)	12	0.63	0.001
TIN-2 =	740.1 + 0.12(LU50)	15	0.32	0.018
TIN-3 =	NOT SIGNIFICANT			
TIN-4 =	*NOT SIGNIFICANT*			
TIN-5 =	457.5 + 0.153(LU50)	15	0.72	<.001

(1)OP=Orthophosphorus, TP=Total phosphorus, TSS=Total Suspended Sediments, TIN=Total Inorganic Nitrogen
2)variables entered (surface area-acres)

General Land use (LU)
10 Urban
20 Agriculture
30 Rangeland
40 Forest
50 Water
60 Wetland
70 Barren Land

Table 2-40. The results of the multiple regression analysis using geology, subsection, valley bottom types and land use for the mainstem Bear River. The dependent variable is loading (kg/day) by parameter and trip. The trips are 1) Upper Basin Runoff, 2) Summer Base flow, 3) Winter Base flow, 4) Lower Basin Runoff and 5) Summer Base flow.

Loading (kg/day)[1]	Multiple Linear Equation[2]	N	r2	P
OP-1 =	56.76 - 0.103(GSV2220)	12	0.30	0.042
OP-2 =	13.69 + 2.68(GSV1230) + 0.00144(LU50)	14	0.65	0.001
OP-3 =	15.226 + 2.19(GSV1230) + 0.06414(GSV6410)	14	0.46	0.014
OP-4 =	*NOT SIGNIFICANT*			
OP-5 =	28.26 + 0.003844(LU50)	15	0.29	0.027
TP-1 =	495 - 0.492(LU10)	12	0.32	0.034
TP-2 =	97.79 + 0.008108(LU50)	15	0.25	0.04
TP-3 =	*NOT SIGNIFICANT*			
TP-4 =	38.769 + 0.009293(LU60)	15	0.24	0.044
TP-5 =	*NOT SIGNIFICANT*			
TSS-1 =	*NOT SIGNIFICANT*			
TSS-2 =	13131 + 0.88(LU40)	15	0.46	0.003
TSS-3 =	16780 + 108.03(GSV6410)	15	0.49	0.002
TSS-4 =	19847 + 8.26(LU60)	15	0.29	0.026
TSS-5 =	*NOT SIGNIFICANT*			
TIN-1 =	803 + 0.158(LU50)	12	0.63	0.001
TIN-2 =	740 + 0.12(LU50)	15	0.32	0.018
TIN-3 =	*NOT SIGNIFICANT*			
TIN-4 =	259 + 0.08048(GSV6320)	15	0.24	0.048
TIN-5 =	406.7 + 0.157(LU50) + 41.42(GSV1230)	14	0.79	<.001

(1)OP=Orthophosphorus, TP=Total phosphorus, TSS=Total Suspended Sediments, TIN=Total Inorganic Nitrogen
(2)variables entered (surface area-acres)

Geology, subsection, Valley Bottom Type (GSV)

1220	Metamorphic V Erosional Canyon
1230	Metamorphic V Depositional Canyon
2220	Sedimentary V Erosional Canyon
2230	Sedimentary V Depositional Canyon
3220	Sedimentary(calc) V Erosional Canyon
3230	Sedimentary(calc) V Depositional Canyon
5230	Volcanic V depositional Canyon
6320	Alluvial Confined Valley
6330	Alluvial unconfined Valley
6410	Lacustrine Confined Draw
6420	Lacustrine Confined valley
6430	Lacustrine Unconfined valley

General Land use (LU)

10	Urban
20	Agriculture
30	Rangeland
40	Forest
50	Water
60	Wetland
70	Barren Land

Table 2-41. The results of the multiple regression analysis, which predicts reach gain or loss in the Bear River using geology, subsection, and valley bottom types by parameter and trip. The trips are 1) Upper Basin Runoff, 2) Summer Base flow, 3) Winter Base flow, 4) Lower Basin Runoff and 5) Summer Base flow.

Loading (kg/day)[1]	Multiple Linear Equation[2]	N	r2	P
OP-1 =	8.09 - 0.165(GSV2220)	11	0.47	0.009
OP-2 =	-2.676 + 2.706(GSV1230)	14	0.41	0.008
OP-3 =	0.119 + 2.163(GSV1230)	14	0.62	<.001
OP-4 =	*NOT SIGNIFICANT*			
OP-5 =	-12.207 + 3.886(GSV1230) + 0.0117(GSV6320)	13	0.61	0.002
TP-1 =	42.79 - 1.42(GSV2220)	11	0.68	0.001
TP-2 =	-17.66 + 0.546(GSV1220) + 0.0891(GSV5230) + 4.411(GSV1230)	12	0.67	0.003
TP-3 =	*NOT SIGNIFICANT*			
TP-4 =	-21.34 + 0.01439(GSV6320) + 3.59(GSV1230)	13	0.58	0.003
TP-5 =	-7.96 + 1.362(GSV1220) - 0.175(GSV5230)	13	0.55	0.005
TSS-1 =	3283 - 6429(GSV3230)	11	0.92	<.001
TSS-2 =	-5830 + 218(GSV1220) + 31(GSV5230)	13	0.59	0.003
TSS-3 =	119.1 + 14.196(GSV6430)	14	0.52	0.001
TSS-4 =	*NOT SIGNIFICANT*			
TSS-5 =	-8576 + 1000(GSV1220) - 110.5(GSV5230)	13	0.60	0.002
TIN-1 =	-147.1 + 2.394(GSV5230)	11	0.56	0.003
TIN-2 =	-85.95 + 1.592(GSV5230)	14	0.37	0.013
TIN-3 =	14.07 + 0.681(GSV5230) + 39.227(GSV1230)	13	0.66	0.001
TIN-4 =	-141 + 32(GSV1230) + 0.0984(GSV6320) + 0.0223(GSV6330)	12	0.76	0.001
TIN-5 =	-51.23 - 1.83(GSV5230) + 0.314(GSV6320)	13	0.65	0.001

(1)OP=Orthophosphorus, TP=Total phosphorus, TSS=Total Suspended Sediments, TIN=Total Inorganic Nitrogen
(2)variables entered (surface area-acres)

Geology, subsection, valley bottom type (GSV)

1220	Metamorphic V Erosional Canyon
1230	Metamorphic V Depositional Canyon
2220	Sedimentary V Erosional Canyon
2230	Sedimentary V Depositional Canyon
3220	Sedimentary(calc) V Erosional Canyon
3230	Sedimentary(calc) V Depositional Canyon
5230	Volcanic V depositional Canyon
6320	Alluvial Confined Valley
6330	Alluvial unconfined Valley
6410	Lacustrine Confined Draw
6420	Lacustrine Confined valley
6430	Lacustrine Unconfined valley

Table 2-42. The results of the multiple regression analysis, which predicts reach gain or loss in the Bear River using general land use categories by parameter and trip. The trips are 1) Upper Basin Runoff, 2) Summer Base flow, 3) Winter Base flow, 4) Lower Basin Runoff and 5) Summer Base flow.

Loading (kg/day)[1]	Multiple Linear Equation[2]	N	r2	P
OP-1 =	*NOT SIGNIFICANT*			
OP-2 =	*NOT SIGNIFICANT*			
OP-3 =	*NOT SIGNIFICANT*			
OP-4 =	*NOT SIGNIFICANT*			
OP-5 =	-3.226 + 3.726(LU50)	14	0.26	0.046
TP-1 =	*NOT SIGNIFICANT*			
TP-2 =	*NOT SIGNIFICANT*			
TP-3 =	*NOT SIGNIFICANT*			
TP-4 =	-21.213 + 0.001272(LU40)	14	0.25	0.049
TP-5 =	*NOT SIGNIFICANT*			
TSS-1 =	*NOT SIGNIFICANT*			
TSS-2 =	*NOT SIGNIFICANT*			
TSS-3 =	-6173 + 0.465(LU20)	14	0.41	0.007
TSS-4 =	*NOT SIGNIFICANT*			
TSS-5 =	*NOT SIGNIFICANT*			
TIN-1 =	-200.94 + 1.242(LU70)	11	0.57	0.003
TIN-2 =	-148.66 + 0.843(LU70)	14	0.38	0.01
TIN-3 =	40.387 + 0.333(LU70)	14	0.36	0.013
TIN-4 =	-99.343 + 0.01081(LU40)	14	0.36	0.014
TIN-5 =	89.856 - 1.101(LU70) + 0.161(LU50)	13	0.82	<.001

(1)OP=Orthophosphorus, TP=Total phosphorus, TSS=Total Suspended Sediments, TIN=Total Inorganic Nitrogen
(2)variables entered (surface area-acres)

General Land use (LU)

10	Urban
20	Agriculture
30	Rangeland
40	Forest
50	Water
60	Wetland
70	Barren Land

The use of generalized valley bottom type land use was not a good indicator of reach gain/loss loads for phosphorus or suspended solids along the mainstem Bear River (Table 2-42). It is interesting to note that barren land and forested land were the best predictors of reach gain/loss for total inorganic nitrogen. During summer base flow, barren land, combined with open water, had an $r^2=0.82$, relative to the prediction of TIN gain or loss by reach in the mainstem Bear River.

The final analysis conducted with the watershed data was to combine geology, subsection and valley bottom type with general land use to predict mainstem reach gain or loss (Table 2-43). Eighty-five percent of the equations were found to be significant, with orthophosphorus, total phosphorus and total suspended solids having four of five dates with significant equations and total inorganic nitrogen have significant equations on all five dates.

In summary, it is apparent from the regression approach that watershed characteristics can be used to predict watershed contributions of sediment and nutrients for certain hydrologic periods. In addition, these watershed characteristics can also be used to predict mainstem instantaneous loads as well as reach gains or losses. It appears that the most influential and accurate dataset that can be used to predict watershed contributions of nitrogen, phosphorus and total suspended solids is valley bottom type and specific land use. These parameters had an 85 percent efficiency with the overall highest predictability (r^2).

2.3.3 Waste Water Treatment Plants

Five municipalities discharge effluent from their waste water treatment plants into Bear River or tributaries. Montpelier, Soda Springs, and Grace discharge directly to Bear River while Preston and Franklin discharge to Worm Creek and Cub River, respectively. Releases from Soda Springs, Grace, and Preston plants are continuous throughout the year. Montpelier discharges irregularly throughout the year. Franklin discharges periodically from October to April and land applies from May to September.

Data collection varied from facility to facility (Appendix C). Sampling for total suspended solids, a requirement on all the NPDES permits, has been greater than sampling for nutrients (Table 2-44). Neither Grace nor Franklin has performed any sampling for nutrients and limited data from Montpelier do not seem to reflect expected concentrations of nutrients as found in other southeast Idaho waste water treatment plants. To compensate for this lack of information, data from similar waste water treatment plants were extrapolated to these facilities to estimate current nutrient wasteloads (Table 2-45). Preston data were used for estimating Grace wasteloads and data from Lava Hot Springs (just north of Bear River Basin in the Portneuf River subbasin) were used for wasteload estimates for Montpelier and Franklin.

Table 2-43. The results of the multiple regression analysis, which predicts reach gain or loss in the Bear River using geology, subsection, valley bottom types and land use by parameter and trip. The trips are 1) Upper Basin Runoff, 2) Summer Base flow, 3) Winter Base flow, 4) Lower Basin Runoff and 5) Summer Base flow.

Loading (kg/day)[1]	Multiple Linear Equation[2]	N	r2	P
OP-1 =	8.09 - 0.165(GSV2220)	11	0.47	0.009
OP-2 =	-2.676 + 2.706(GSV1230)	14	0.41	0.008
OP-3 =	0.119 + 2.163(GSV1230)	14	0.62	<.001
OP-4 =	*NOT SIGNIFICANT*			
OP-5 =	-15.19 + 3.85(GSV1230) + 0.00174(LU40) - 0.000409(LU20)	12	0.73	0.001
TP-1 =	42.79 - 1.42(GSV2220)	11	0.68	0.001
TP-2 =	-21.11 + 0.558(GSV1220) + 0.04614(LU70) + 4.388(GSV1230)	12	0.67	0.003
TP-3 =	*NOT SIGNIFICANT*			
TP-4 =	-21.34 + 0.01439(GSV6320) + 3.59(GSV1230)	13	0.58	0.003
TP-5 =	-7.96 + 1.362(GSV1220) - 0.175(GSV5230)	13	0.55	0.005
TSS-1 =	3283 - 6429(GSV3230)	11	0.92	<.001
TSS-2 =	-5830 + 218(GSV1220) + 31(GSV5230)	13	0.59	0.003
TSS-3 =	119.1 + 14.196(GSV6430)	14	0.52	0.001
TSS-4 =	*NOT SIGNIFICANT*			
TSS-5 =	-8576 + 1000(GSV1220) - 110.5(GSV5230)	13	0.60	0.002
TIN-1 =	-200.94 + 1.242(LU70)	11	0.57	0.003
TIN-2 =	-148.66 + 0.843(LU70)	14	0.38	0.01
TIN-3 =	-10.837 + 0.353(LU70) + 39.15(GSV1230)	13	0.66	0.001
TIN-4 =	-157.383 + 0.01259(LU40) + 30.9(GSV1230)	13	0.76	<.001
TIN-5 =	-55.76 - 2.127(GSV5230) + 0.159(LU50) + 59.69(GSV1230)	12	0.94	<.001

(1)OP=Orthophosphorus, TP=Total phosphorus, TSS=Total Suspended Sediments, TIN=Total Inorganic Nitrogen
(2)variables entered (surface area-acres)

Geology, subsection, Valley Bottom Type (GSV)		General Land use (LU)	
1220	Metamorphic V Erosional Canyon	10	Urban
1230	Metamorphic V Depositional Canyon	20	Agriculture
2220	Sedimentary V Erosional Canyon	30	Rangeland
2230	Sedimentary V Depositional Canyon	40	Forest
3220	Sedimentary(calc) V Erosional Canyon	50	Water
3230	Sedimentary(calc) V Depositional Canyon	60	Wetland
5230	Volcanic V depositional Canyon	70	Barren Land
6320	Alluvial Confined Valley		
6330	Alluvial unconfined Valley		
6410	Lacustrine Confined Draw		
6420	Lacustrine Confined valley		
6430	Lacustrine Unconfined valley		

Table 2-44. Effluent water quality data from waste water treatment plants (WWTP) in Bear River Basin, from 2000 to 2004 DMRs.

HUC	WWTP	Receiving water	Mean Flow 2000-2004 (cfs)	Total ammonia (mg N/L)			Total nitrate/nitrite (mg N/L)			Total phosphorus (mg P/L)			Total suspended solids (mg/L)		
				Count	Mean	SD[1]	Count	Mean	SD[1]	Count	Mean	SD[1]	Count	Mean	SD[1]
16010201	Montpelier[2]	Bear River	1.85	9	0.73 [(3)]	0.73	9	1.38 [(3)]	1.07	9	1.08	0.23	10	6.13	4.97
	Soda Springs	Bear River	1.20	60	3.32	1.55	11	2.49 [(3)]	1.52	12	0.84	0.18	60	12.28	4.11
16010202	Grace[4]	Bear River	0.05		1.29			1.68			1.54		59	5.69	6.89
	Preston[5]	Worm Creek	1.13	46	1.29	0.45	11	1.68	0.83	11	1.54	0.81	59	17.24	4.50
	Franklin[6]	Cub River	0.19		6.06			0.44			2.24		25	16.32	7.36

(1)SD=standard deviation
(2)lagoon system, intermittent discharge; average number of days of discharge per year is 50
(3)one-half of method detection limit (mdl) used for analysis when concentration less than mdl
(4)operation of Grace plant considered similar to Preston so Preston numbers used for total ammonia, total nitrate/nitrite, and total phosphorus
(5)average concentrations prior to ammonia upset in August of 2002 to August 2003
(6)operation of Franklin plant considered similar to Lava Hot Springs so mean concentrations from data collected during ten sampling events at Lava Hot Springs in February, October, November of 2002 and February of 2003 used for total ammonia, total nitrate/nitrite, and total phosphorus

Table 2-45. Estimated wasteloads from waste water treatment plants (WWTP) in Bear River Basin.

WWTP	Flow (cfs)	Days of discharge per year	Total ammonia		Total nitrate/nitrite		Total phosphorus		Total suspended solids	
			Average concentration (mg/L)	Annual load (kg/yr)	Average concentration (mg/L)	Annual load (kg/yr)	Average concentration (mg/L)	Annual load (kg/yr)	Average concentration (mg/L)	Annual load (kg/yr)
Montpelier [(1)]	1.85	50	0.73	166	1.38	312	1.08	244	6.13	1,387
Soda Springs	1.20	365	3.32	3,565	2.49	2,676	0.84	898	12.28	13,191
Grace	0.05	365	1.29	61	1.68	79	1.54	72	5.69	267
Preston	1.13	365	1.29	1,297	1.68	1,686	1.54	1,551	17.24	17,322
Franklin	0.19	164	6.06	456	0.44	33	2.24	169	16.32	1,227

(1)sampling data for nutrients were insufficient to fully characterize effluent, so mean concentrations from Lava Hot Springs were used

Two facilities, Soda Springs and Preston, monitored receiving water of the plant discharge (Table 2-46). Ambient monitoring (2000-2002) for total ammonia in Bear River above and below the Soda Springs WWTP indicated an increase downstream from a mean of 1.12 mg/L upstream to 1.20 mg/L downstream. This difference was significant based on a paired t-test (t statistic = -4.01, p value (one-tail) = 0.0003, n = 21). Worm Creek also experienced an increase from upstream to downstream for total ammonia (0.71 mg/L to 2.08 mg/L), nitrate (1.05 mg/L to 1.80 mg/L), and total phosphorus (1.17 mg/L to 1.81 mg/L). Downstream values were significantly greater at the 95% level for total ammonia (t statistic = -2.21, p value (one-tail) = 0.020, n = 20), nitrate (t statistic = -2.34, p value (one-tail) = 0.015, n = 20), and total phosphorus (t statistic = -3.24, p value (one-tail) = 0.002, n = 20).

2.3.4 Fish Hatcheries

Three fish hatcheries have NPDES permits to discharge to waters in Bear River Basin. Two of the hatcheries – Clear Springs Foods at Soda Springs and Bear River Trout Farm (BRTF) near Grace – are privately owned and discharge to Bear River. Grace Fish Hatchery near Grace is owned and operated by Idaho Department of Fish and Game and discharges to Whiskey Creek. Both influent and effluent data for the hatcheries are presented in Table 2-47. The extent of recent, since 2000, information for total phosphorus and total suspended solids from Clear Springs Foods and Grace is good (Appendix C). Data from BRTF are much less extensive.

Several other hatcheries are located in Bear River Basin, but production is low enough that an NPDES permit is not required. Hatcheries currently in operation or which have only recently ceased production include Black Canyon Trout Farms (George Kimball, owner), Bosen Land and Livestock (Clair Bosen, owner), Smith Creek Hatchery (John Lambregts, operator), Ben Forsgren, and Wright's Rainbows (Sherman Wright, owner). Receiving water for Black Canyon Trout Farms is Bear River. The Bosen Land and Livestock facility is in the Stockton Creek drainage, while the Smith Creek drainage is home to the Smith Creek Hatchery. Both the Forsgren and Wright's Rainbows operations are located in the Spring Creek drainage.

Table 2-46. Ambient monitoring in Bear River above and below Soda Springs waste water treatment plant outfall and Worm Creek above and below Preston WWTP outfall since January 2000.

Year - month	Bear River - above & below Soda Springs WWTP			Worm Creek - above & below Preston WWTP									
	Flow (cfs)	Ammonia (mg N/L)		Flow (cfs)		Ammonia (mg N/L)		Nitrate (mg N/L)		Total phosphorus (mg/L)		Total suspended solids (mg/L)	
	Upstream	Upstream	Downstream	Upstream	Downstream	Upstream	Downstream	Upstream	Downstream	Upstream	Downstream	Upstream	Downstream
2000 - Jan	1442												
Feb	353												
Mar	550	2.5	2.7	4.5	6.3	0.038	0.096	2.77	3.31	0.397	0.521	367	247
Apr	330	2.5	2.5										
May	857	2.6	2.8										
Jun	1210	2.3	2.5	1.4		0.039	0.097	0.053	0.93	1.36	1.45		
Jul	1350	2.5	2.6										
Aug	1140	2.5	2.6										
Sep	363	2.4	2.6	1.1		0	0	0	0	0.9	0.9		
Oct	127	2.7	2.8										
Nov	114	2.7	2.9										
Dec	371			1.0		0	1	7.3	4.2	2.06	1.54		
2001 - Jan	195												
Feb	132												
Mar	95.4	0.09	0.11	1.3		0	0.5	0	0.613	2.69	2.75		
Apr	227	0.05	0.21										
May	681	0.16	0.34										
Jun	1110	<0.05	<0.05	1.4		3.47	3.28	1.9	2.1	2.654	2.718		
Jul	1265	<0.05	0.06										
Aug	1074	0.09	0.11										
Sep	422	<0.05	<0.05	1.1		1	0.33	0	1	0.56	0.87		
Oct	39.5	0.14	0.07										
Nov	105.5	<0.05	<0.05										
Dec	197	0.05	<0.05	1.0		1	1	1.23	1.46	0.84	0.86		
2002 - Jan	315												
Feb	192												
Mar	160			1.5		1.4	1.58	0	0.02	0.76	1.24		
Apr		0.07	0.09										
May	154	0.08	0.12										
Jun				1.1		0.142	0.847	1.8	1.95	0.54	1.34		
Sep				1.1		1	6.33	1.39	1.93	2.75	2.84		
Dec				1.0		1.1	5.31	1.39	2.09	2.75	2.91		
2003-Mar				0.96		0	4.66	1.3	5.77	0.06	2.73		
June				0.99		0.66	11	0.1	2.2	2.19	4.21		
Sep				0.55		0	0	1	3.89	0.5	3.12		
Dec				0.56		0.33	1.25	0	0.9	1.46	2.07		
2004-Mar				0.72		0	1	0	0.1	0	0.91		
June				0.75		4	2	0.24	0.54	0.43	0.54		
Sep				0.61		0	0.66	0	1.5	0.5	1.66		
Dec				0.77		0	0.66	0.5	1.4	0	1		

Table 2-47. Water quality data from NPDES permitted fish hatcheries in Bear River Basin, from 2000 to 2004 DMRs.

Hatchery	Source	Flow 2000-2004 (cfs)	Total ammonia (mg N/L)			Total nitrate/nitrite (mg N/L)			Total phosphorus (mg P/L)			Total suspended solids (mg/L)		
			N	Mean	SD[1]	N	Mean	SD[1]	N	Mean	SD[1]	N	Mean	SD[1]
HUC 16010201														
Clear Springs Foods	Influent		1	2.00		1	4.39		37	0.04	0.01	36	1.00 (2)	0.00
	Effluent	15.0	1	1.83		1	4.30		37	0.06	0.02	36	2.09 (2)	1.63
HUC 16010202														
Grace Fish Hatchery[3]	Influent		2	0.09	0.09	2	2.99	0.23	21	0.10	0.01	21	1.06 (2,3)	0.26
	Effluent	11.60 (4)	2	0.13	0.09	2	2.86	0.16	21	0.10	0.01	21	1.35 (2,3)	1.29
Bear River Trout Farm[4]	Influent		4	0.16 (2)	0.26	20	1.93 (5)	0.65	20	0.11 (2)	0.06	20	1.55 (2)	2.47
	Effluent	7.66	4	0.32 (2)	0.52	20	2.29 (5)	0.67	20	0.12 (2)	0.07	20	1.55 (2)	2.11

(1)SD=standard deviation, no standard deviation can be calculated for only one sample
(2)one-half of method detection limit (mdl) used for analysis when concentration less than mdl
(3)data from Janueary 2002 (following renovation) to Dec 2004
(4)flow from January 2002 to December 2004 daily maximum considered average monthly flow for analysis
(5)nitrate only, nitrite considered nil

2.4 Summary of Past and Present Pollution Control Efforts

The unique and regional significance of the Bear River basin watershed and its value to the environmental health of the region cannot be overstated. Recently conducted forums on water quality management practices have revealed the urgent need of educating and informing the public on the innumerable issues pertaining to water quality within the basin - especially with regards to non-point source water pollution which is described as essentially any type of pollution entering a waterway but not traceable to a pipe.

Grass roots efforts to improve the watershed's overall health have been underway for a number of years with various levels of success. Stakeholders in the major industries, with assistance from various government agencies, have initiated many water quality projects within the watershed. However, agencies and private citizens working in one area of the basin have often been unaware of other projects elsewhere in the basin. Because the basin encompasses nine counties in three states, each with numerous affected agencies, coordination of water quality efforts has been difficult historically.

In the 1970s, citizens in the Bear River watershed became concerned about the effects of development along Bear Lake. Public meetings were held, and the governors of Utah and Idaho established the Bear Lake Regional Commission (BLRC) to address development impacts along Bear Lake. Representatives from counties and municipalities, the states of Idaho, Utah and Wyoming and a local citizens group, Friends of Bear Lake, participate on the Commission. The BLRC initially focused on improving sewage treatment facilities in the area and later expanded its area of concern to broader water quality issues. The Commission's activities encompass the geographical area affecting Bear Lake, which includes parts of Idaho and Utah.

Bear River Resource Conservation and Development (Bear River RC&D) is another important organization in the Bear River watershed. The Bear River RC&D encompasses seven counties located in southeastern Idaho and northern Utah. Because the Bear River flows through three states, many projects undertaken by the Bear River RC&D involve three state governments and two or more regional offices of federal agencies such as the U.S. Environmental Protection Agency (EPA), the U.S. Bureau of Reclamation (BOR), and the U.S. Bureau of Land Management (BLM).

Another important organization is the Western Wyoming Resource Conservation and Development (Western Wyoming RC&D), which includes that portion of the Bear River watershed in Wyoming. Wyoming has shown a willingness to be a partner by funding efforts to determine water quality in several Wyoming streams that are tributaries of the Bear River.

In 1993, the BLRC, the Bear River RC&D and the Western Wyoming RC&D organized a Bear River Water Quality Symposium to bring together all the interested governmental agencies and citizens in the Bear River watershed. The symposium participants, including the BLRC and the two RC&Ds, formed the Bear River basin Water Quality Task Force (Task Force). The Task Force is an *ad hoc* organization created in an effort to help "establish a path and direction for cooperation and coordination of water quality work across all jurisdictions for the Bear River basin." Specifically, the Task Force provides a coordinated, basin-wide water quality planning approach which champions strong local involvement and leadership designed as a means to help measurably improve the overall water quality and stream integrity of the Bear River and its tributaries, lakes and reservoirs, as well as support multiple beneficial uses and development.

Towards this effort, the Task Force has recognized a number of goals which are: 1) identify all major stakeholders in water quality issues within the basin and develop a means to solicit their involvement, and a method to keep them informed of activities in the basin; 2) initiate and facilitate local public involvement in water quality issues in the basin to identify the primary water quality related issues; 3) establish a broad-based local involvement and leadership role in the planning process through public involvement activities and information dissemination, based in the offices of the Bear River and Western Wyoming's Resource Conservation & Developments; and 4) establish and coordinate a data gathering system and assessment, including historical, current and future data needs, and water quality standards in the basin to address water quality issues in the watershed.

The Task Force focuses on water quality issues. Agricultural practices within the basin have been shown to contaminate the water with high levels of nutrients and cause excessive soil erosion. In Wyoming, riparian vegetation removal, stream channelization, stream bank modification and petroleum activities contribute to water quality issues. Other land use practices in the watershed that affect the river system include logging, urbanization and recreation.

The Bear River RC&D and Western Wyoming RC&D serve as co-chairs for the Task Force. With the assistance of the BLRC serving as Secretary, they coordinate the quarterly meetings and activities of the Task Force. Three committees (Technical, Planning and Development, and Information and Education) serve on the Task Force. Representatives from these three committees, as well as private citizens representing the interests of federal , industry, environment and recreation serve as the Steering Committee.

Since its inception in 1993, Task Force members have met regularly to discuss mutual goals in improving water quality and coordinate efforts. Cooperation and communication have increased because of this forum between the three states. The Task Force has completed a comprehensive water quality database and management plan, as well as a public information video, brochure, slide show and World Wide Web site. A steering committee, composed of private landowners and interested citizens, has been formed to help guide the local, state and federal leaders in their decision making processes. In 1997, the Task Force sponsored and organized the second Bear River Water Quality Forum, which provided an opportunity for the sharing of water quality information, both historical and current, for the Bear River basin and also provided a forum for open discussion to identify current and future water quality issues.

The Task Force has experience in water quality studies and local grass roots involvement, as well as project development, administration and fund accounting. It also has available the professional and technical expertise of three state Departments of Water Quality, private consultants, federal personnel (EPA, BOR, NRCS, BLM, USFS), regional councils and commissions (BLRC, RC&Ds) and local government (counties and soil and water conservation districts).

The U.S. Bureau of Reclamation supplied the initial funding for the Task Force, along with assistance from the three states and local volunteers. The EPA has also supplied funding to the Task Force through its Community Outreach and Education programs.

In an effort to address water quality issues, the Bear River Resource Conservation and Development (Bear River RC&D) has initiated the production of "A River Runs Through Us," an Internet web site and resource center dedicated to the recognition and advancement of water quality improvement projects throughout the Bear River basin watershed. The project is intended to 1) enhance existing partnerships between agencies and citizens; 2) educate the public about water quality problems in the basin and about existing programs and opportunities; 3) provide information about high priority areas so that reclamation efforts, basin-wide, can be the most effective; 4) educate the public on appropriate technology and successes in improving water quality; 5) enhance ongoing implementation projects by providing an education and information component that is often missing and has the potential to initiate volunteer efforts and new projects; 6) demonstrate the successes in water quality implementation projects in such a way that citizens can learn about pollution sources and types of solutions; and 7) bring information to the public throughout the basin about existing projects and the water quality issues they address.

Resource agencies in the region have identified habitat degradation and the threats from nonnative species as the most detrimental factors threatening the environmental viability of the watershed as well as the continued existence of the Bonneville cutthroat trout (a species of concern) found within the Bear River basin. These threats have been identified in current management plans, notices of review, the Utah Conservation agreement, and the U.S. Forest Service’s (USFS) Conservation Assessment for Inland Cutthroat Trout, as well as other literature. In 1994, a draft Habitat Conservation Assessment and Strategy for Bonneville Cutthroat Trout was prepared by the state of Idaho and is currently being implemented through a 1995 conservation agreement among the USFWS, USFS, Idaho Department of Fish and Game, Idaho Natural Resources Conservation Service, and the Caribou Cattlemen’s Association. Several mitigation activities such as fencing of riparian areas, modifying grazing practices, and connectivity restoration efforts have been implemented as a result of the agreements. Additional restoration and mitigation efforts are currently in progress to eliminate threats to the continued existence of the Bonneville cutthroat trout (Mizzi 2000).

Innumerable restoration and mitigation measures, designed to bolster pollution control efforts, have been successfully implemented by many governmental agencies, resource organizations and private individuals. Millions of dollars and thousands of man hours have poured into numerous endeavors including the implementation of best management practices (BMP) - methods, measures and practices designed to reduce or prevent water pollution that are usually applied as a system rather than a single practice. These cost effective, practicable means were developed to prevent or reduce pollutants generated from nonpoint sources to a level compatible with water quality goals. The majority of the BMP’s being utilized in Idaho’s stretch of the Bear River are animal waste management, stream bank and riparian restoration, in-stream reconstruction, upland management, and wetland restoration.

An ideal example of successful BMP implementation is provided through the Thomas Fork watershed in Bear Lake County, Idaho where several projects are dealing with soluble nitrogen and sediment loadings. These loadings have resulted from a combination of snow melt characteristics, a high density of livestock and other agricultural land practices adjacent to the streams riparian zone. Manure deposited from winter feeding cattle on the watershed's valley floor is then picked up by the flood waters and carried to Thomas Fork River, Bear River and eventually deposited into nearby Bear Lake, a unique natural resource of concern. Another area of concern in this project area is a man made channel that was dug by farmers many years ago to bypass the natural meanderings of the Thomas Fork River. Without the buffering effects of the river's natural meanders, unimpeded flood waters gathered speed and energy, battering this channel into a deep trench. Eventually the erosion began to exhibit a domino-like effect that inevitably worked its way up and down the stream into the remaining meanders to cause down-cutting, bank slumping, loss of crop land and sediment loading.

Restoration efforts began by shaping stream banks to a 3:1 grade. The excavated earth was removed and dumped in low spots in the landowner's adjacent fields. Over 100 pine trees 15 to 20 feet long were cut, transported to the site and placed along the stream bank in an overlapping fashion to serve as a flow deflector. The trees were lashed together with cable and fastened to the bank with specialized anchors and metal posts. Large rocks were also placed in the stream as riprap and to act as flow deflectors.

Strategic placement of willow clumps and willow cuttings were planted along the stream bank for stability enhancement. The excavated stream banks were then sown with grass seed. Straw was placed over the seeded area to help maintain moisture and prevent the diminutive grass seeds from being washed away with precipitation or spring runoff. A temporary electric fence was placed around those sites that needed protection to allow rejuvenation from livestock grazing for three years.

Benefits from grading the stream-banks, planting the willow clumps and seeded grass enhanced stream bank stability. Suspended solids were significantly reduced within the watershed which also helped address the problems with Bear River and Bear Lake downstream.

The project was also successful in increasing environmental awareness among other landowners along the Thomas Fork, fostering an interest for them to implement similar BMPs on their own land (Thomas 1998).

Another example is EPA’s requirement of an NPDES permit for controlling stormwater from construction activities. All projects that will disturb more than one acre are required to have the permit. The goal is to prevent off-site runoff of sediment, and thus protect nearby surface water.

Water quality improvements within the Bear River basin are the combined achievements of a vast network of local, state, and nationwide partnerships. This partnering philosophy has provided an instrumental as well as positive influence in conservation accomplishments and their substantial benefits to the Bear River watershed.

The partnering of local efforts with state and federal agencies has reinforced the idea that local people know the most about local needs. It has also empowered them to do collectively what would otherwise be difficult, if not impossible, individually.

To list all participating partners cooperating within Idaho's portion of the Bear River basin would be a monumental undertaking. There are literally tens of thousands of individuals and scores of private and governmental organizations and agencies endeavoring to improve, rehabilitate, conserve, and protect the natural resources of the basin.

Funding, for instance, in the millions of dollars has been donated by the private sector; technical assistance and grant funding has come from local, state and federal government agencies; court imposed sentencing of inmates has provided community service work toward water quality improvements; memorandums of understanding for resource conservation implementation strategies have been initiated; and information and education efforts to help foster and further encourage environmental awareness has enlightened literally every school, university and service organization within the Bear River basin.

Below is a partial listing of agencies and organizations currently involved with the Bear River basin watershed improvement measures:

Idaho Department of Agriculture	Natural Resource Conservation Service
Idaho Fish and Game	Cooperative Extension Service
Idaho Department of Environmental Quality	US Forest Service
Idaho Department of Lands	Farm Service Agency
Idaho Department of Water Resources	United States Department of the Interior
Idaho Grain Producers	Bureau of Reclamation
Idaho Soil Conservation Commission	US Geological Survey
Idaho Association of Soil Conservation Districts	US Fish and Wildlife Service
University of Idaho Cooperative Extension System	US Bureau of Land Management
Idaho Forest, Wildlife & Range Policy Analysis	National Park Service
Bear Lake Regional Commission	United States Environmental Protection Agency
Bear River RC&D	Trout Unlimited
United States Department of Agriculture	

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3 Loading Analysis

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.

Natural background in Bear or Malad rivers is unknown: data were not available to make such estimates. To account for the lack of information on natural background levels, load capacities were calculated such their attainment would result in support of beneficial uses, thus including natural background.

In some situations, a certain load capacity is held in reserve for future growth. This reserve capacity reduces overall load capacity so none was recommended for Bear or Malad rivers. It is anticipated that any new pollutant source would have to meet load or wasteload allocations inline with current sediment and nutrient targets. Should future monitoring indicate water quality goals are being met and/or beneficial uses are being supported in certain river or tributary reaches, DEQ will look at load capacity for new sources on an individual basis.

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 following section of this report will discuss the calculated mass loadings entering the Bear River from perennial tributaries and point sources. In addition, reach gains or losses due to non-point sources within the reaches of the mainstem Bear River will be discussed. Previous sections of this report have summarized the water quality data from the tributaries, point sources and mainstem Bear River sites. Concurrent with this water quality data, flow data were obtained for each tributary site, point sources and the mainstem Bear River stations. Because of the completeness of the data collected from the tributaries during the synoptic studies from 1999 to 2000, those data were used as reach input data in this analysis. A larger and more comprehensive (temporal) data set is available for the mainstem sites. This historical mainstem data set, as well as the new synoptic studies (1999-2000), were averaged by hydrologic time period. These data (combined with point source data, tributary data and water diversion data) provided an opportunity to calculate mass balances between reaches, as well as mass loadings at each mainstem Bear River site

In review, a loading calculation is based upon two data sets which include flow and concentration of the parameter of choice. Typically, flow is given as an instantaneous measurement (i.e. cubic feet per second, or cfs) while concentration is based upon weight per volume (i.e. milligrams per liter, or mg/L). On an instantaneous basis, the two data points are multiplied together (with appropriate constants) to obtain mass per time (i.e. kilograms per day, or kg/day). In our evaluation of the database, we inspected the completeness of both data sets and utilized those data which represented the most complete spatial and temporal coverages of the Bear River watershed in Idaho. Data which were missing either a flow value or concentration value were not included.

The analysis of the water quality data presented in the previous sections indicated that total phosphorus was the primary pollutant of concern, followed by total suspended solids and inorganic nitrogen. Although phosphorus concentrations were elevated throughout the Idaho portion of the Bear River basin, other exceedances occurred infrequently and varied spatially within the basin. Inspection of available data indicated that numeric standards for dissolved oxygen, temperature, and bacteria were also exceeded. Acknowledging that there are other parameters which exceed the state of Idaho water quality standards, the total maximum daily load analysis on the Bear River in Idaho focused upon total phosphorus and total suspended solids because of their widespread exceedance of the limits established as part of this investigation.

3.1 Water Quality Targets/Endpoints

The water quality targets or endpoints for the mainstem Bear River and its tributaries are limits established by the state of Idaho for total phosphorus (TP) and total suspended solids (TSS). These targets were established centered on the site-specific (receiving waters) data as well as hydrologic (seasonal) data. The targets are assumed to represent average values over the sampling period (e.g., hydrologic period).

The water quality target for phosphorus is based upon the receiving waters with streams being 0.075 mg/L TP while the target for water flowing into lakes and reservoirs being 0.050 mg/L TP. The one exception is the reach of the Bear River below Oneida Reservoir and entering Utah. In 1997, a TMDL target endpoint of 0.05 mg P/L was approved for the Bear River from Cutler Reservoir to the Utah-Idaho state line. The same target value is used for this analysis.

Thomas Fork is the only water body for which a nitrogen load was recommended. The endpoint for total nitrogen was set at 0.85 mg/L. Although nitrogen input from point sources was not addressed, these facilities are still required to meet water quality standards for ammonia.

The target for TSS is based upon the hydrologic time period. A concentration of 60 mg/L TSS was used during lower and upper basin runoff and 35 mg/L TSS during summer and winter base flow for sites with lakes or reservoirs as receiving waters. For reaches with streams as receiving waters, a concentration of 80 mg/L TSS was used during lower and upper basin runoff and 60 mg/L TSS during summer and winter base flow was used. These targets were previously summarized in Table 2-21.

The margin of safety regarding all three targets is implicit in the chosen endpoints. The 0.075 mg/L target concentration is below EPA's (1986) recommendation that TP concentration not exceed 0.1 mg/L in stream reaches where the receiving water is another stream. For stream reaches where receiving waters are lakes or reservoirs, the target concentration of 0.05 mg P/L is in line with that recommended by EPA although neither Alexander nor Oneida Narrows reservoir are listed for nutrients. The total nitrogen target is within the range (up to 0.9 mg/L) of total nitrogen values for higher quality rivers and streams in the Xeric West examined by EPA (2000) for their report on water quality criteria recommendations. The sediment endpoints (35, 60, 80 mg TSS/L) fall within the range of concentrations (25-80 mg/L) necessary to maintain a good to moderate fishery (EIFAC 1964).

Seasonality is considered only for sediment. Sediment endpoints vary to account for higher sediment loads naturally carried by streams during runoff periods. Due to its affinity for adsorbing to sediment and thus the potential for "release" back into the stream during periods of vegetative growth, no change in total phosphorus endpoints are recommended based on season. The seasonal effects of excessive nitrogen in Thomas Fork are unknown and until more information becomes available, no seasonality consideration is given to nitrogen.

3.2 Tributary Analysis

The following data analysis is based upon mass loadings calculated from water quality data collected during different hydrologic periods. These data are the most comprehensive in that they document the concentrations of total phosphorus, total suspended solids, and flow in almost all the perennial streams in the middle Bear River in Idaho. An analysis of the exceedances for total phosphorus and total suspended solids in the tributaries to the Bear River is based upon these instantaneous mass loadings compared to the water quality endpoints noted in Section 2.2.2 as well as Section 3.1. It should be noted that for several tributaries loads may be less than the TMDL targets, which is not to imply that an increase in loading might be allowed.

The results from the tributary analysis for total phosphorus can be seen in Figure 3-1 through Figure 3-5. Each graph displays the instantaneous mass and the amount exceeding the target of 0.075 or 0.05 mg TP/L for each sample period. The endpoint of 0.075 mg/L TP is for those streams entering the Bear River while 0.05 mg/L TP for streams entering directly into a reservoir or lake.

Figure 3-1 corresponds to upper basin runoff. The amount of total phosphorus daily load that exceeded the target is also provided in tabular form (Table 3-1). Basin wide, upper basin runoff had the highest count of exceedances with 13 of 27 tributaries having excess loads above the target mass. The Thomas Fork (49.8 kg TP/day), followed by Soda Creek (38.2 kg TP/day), Deep Creek (27.3 kg TP/day), Battle Creek (25.2 kg TP/day) and Weston Creek (24.4 kg TP/day) had the highest excess loads of total phosphorus.

The two summer base flow periods had only eight tributaries which exceeded the total phosphorus target. The highest loading exceedances came from the Old Bear River Channel (4.5 kg TP/day), Soda Creek (2.6 kg TP/day) and Deep Creek (1.3 kg TP/day).

Winter base flow and lower basin runoff each had 10 and 12 exceedances, respectively. Although differing in magnitude, the same tributaries exceeded target during the two sample periods. The Old Bear River Channel, Soda Creek, Battle Creek, and Deep Creek all had elevated loadings.

It is apparent from this analysis of the tributary loads that several tributaries within the Middle Bear River in Idaho had not only high exceedances, but these exceedances occurred frequently. For example, Battle Creek and Five Mile Creek each had 100 percent exceedance, while Burton, Soda, Deep and Alder creeks had an 80 percent exceedance frequency. With the possible exception of Burton and Five Mile creeks, these tributaries that frequently exceeded targets also had high magnitudes of loading.

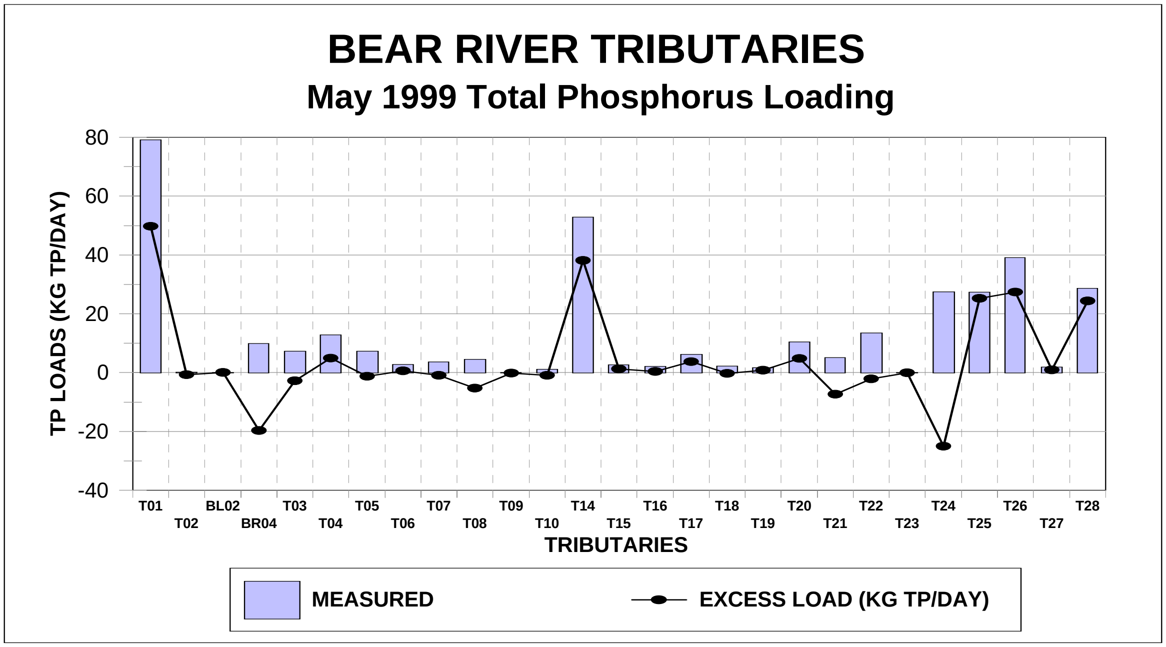


Figure 3-1. The total phosphorus loading for the Bear River tributaries in May 1999 (upper basin runoff). The tributary names are defined in the text of the report. Negative excess values indicate that loads did not exceed the target value.

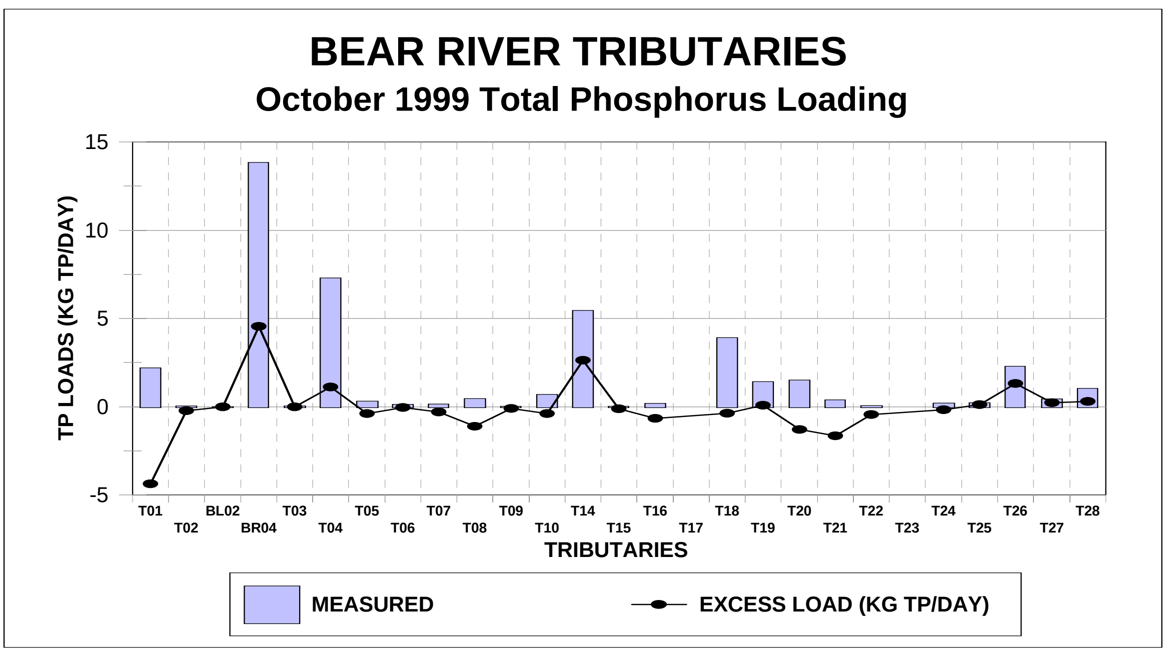


Figure 3-2. The total phosphorus loading for the Bear River tributaries in October 1999 (summer base flow). The tributary names are defined in the text of the report. Negative excess values indicate that loads did not exceed the target value.

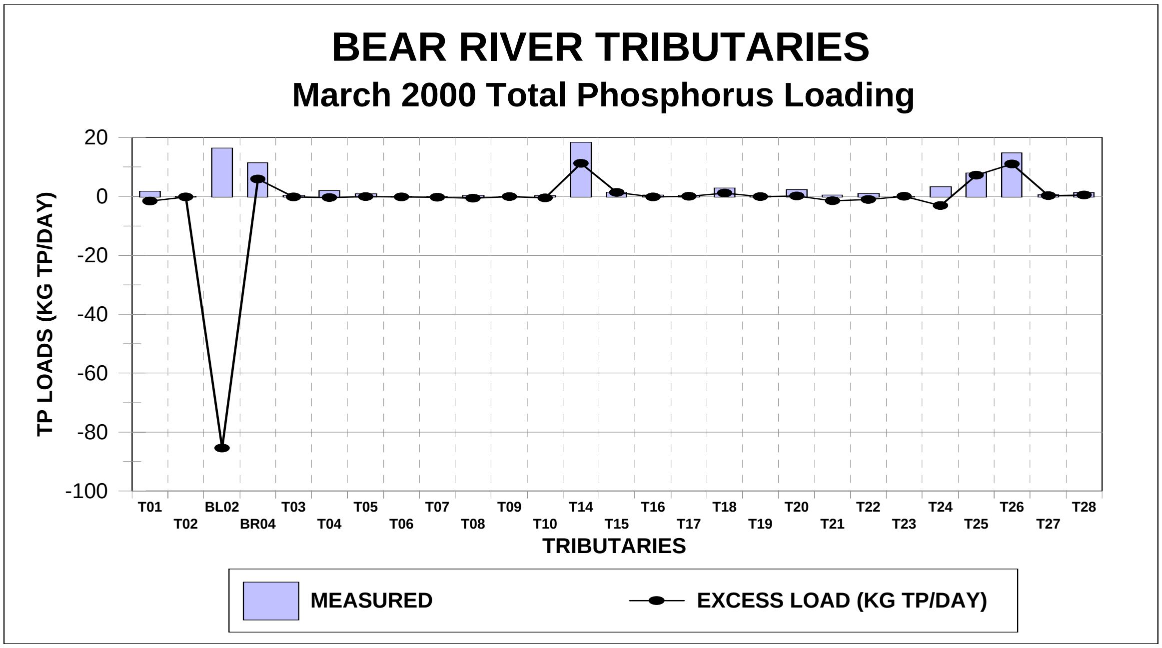


Figure 3-3. The total phosphorus loading for the Bear River tributaries in March 2000 (winter base flow). The tributary names are defined in the text of the report. Negative excess values indicate that loads did not exceed the target value.

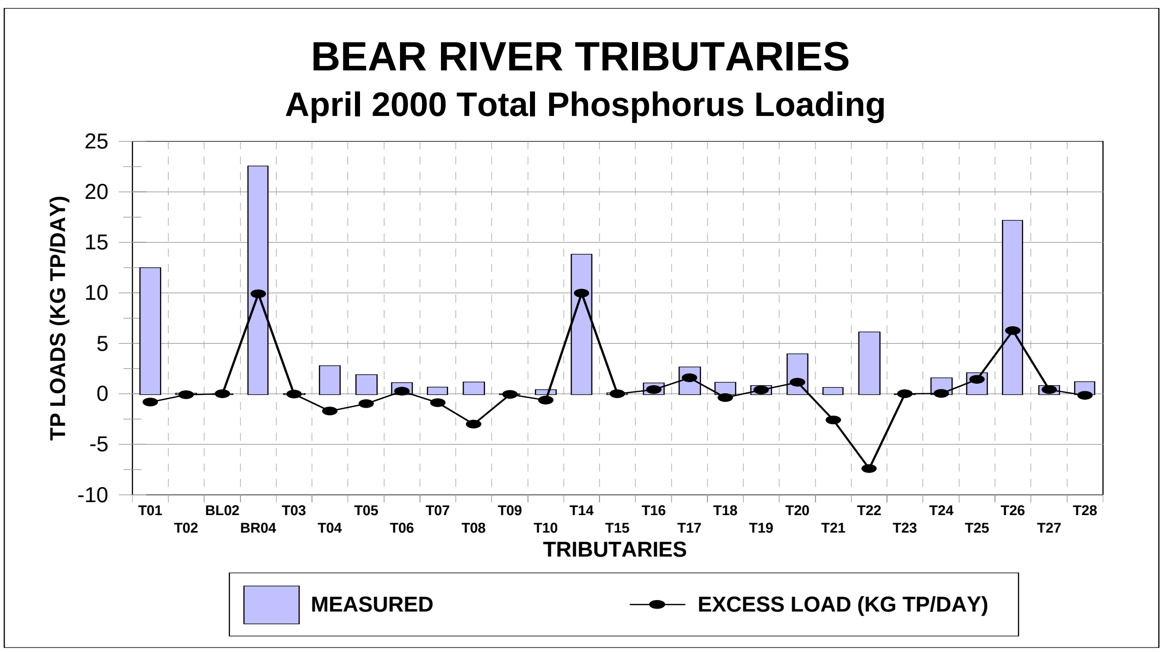


Figure 3-4. The total phosphorus loading for the Bear River tributaries in April 2000 (lower basin runoff). The tributary names are defined in the text of the report. Negative excess values indicate that loads did not exceed the target value.

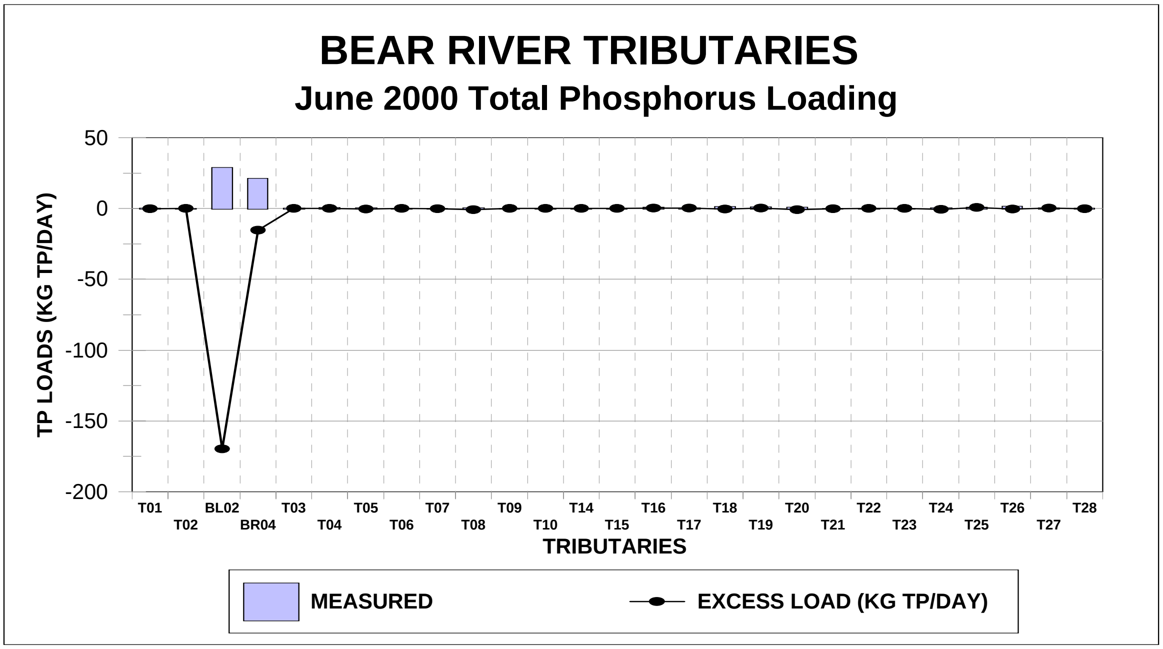


Figure 3-5. The total phosphorus loading for the Bear River tributaries in June 2000 (upper basin runoff). The tributary names are defined in the text of the report. Negative excess values indicate that loads did not exceed the target value.

Table 3-1. The quantity of total phosphorus (kg/day) exceeding target (0.075 or 0.05 mg TP/L) for tributaries in the Bear River in Idaho.

Site#	Description	Upper Basin Runoff	Summer Base Flow	Winter Base Flow	Lower Basin Runoff	Summer Base Flow
		May 1999	October 1999	March 2000	April 2000	June 2000
T01	Thomas Fork	49.8	0	0	0	0
T02	Sheep Creek	0	0	0	0	0
BL02	Lifton	0	0	0	0	0
BR04	Bear River Old Channel	0	4.5	5.9	9.9	0
T03	Ovid Creek	0	0	0	0	0.1
T04	Georgetown Creek	5.0	1.1	0	0	0.2
T05	Stauffer Creek	0	0	0	0	0
T06	Skinner Creek	0.6	0	0	0.2	0.0
T07	Pearl Creek	0	0	0	0	0
T08	Eightmile Creek	0	0	0	0	0
T09	Sulphur Canyon Creek	0	0	0	0	0
T10	Bailey Creek	0	0	0	0	0
T14	Soda Creek	38.2	2.6	11.2	10.0	0
T15	Densmore Creek	1.2	0	1.3	0.0	0
T16	Smith Creek	0.4	0	0	0.4	0.2
T17	Alder Creek	3.7	ND	0	1.6	0.2
T18	Whiskey Creek	0	0	1.1	0	0
T19	Burton Creek	0.8	0.1	0	0.4	0.4
T20	Trout Creek	4.9	0	0.1	1.1	0
T21	Williams Creek	0	0	0	0	0
T22	Cottonwood Creek	0	0	0	0	0
T23	Maple Hot Springs	0	ND	0	0	0
T24	Mink Creek	0	0	0	0.0	0
T25	Battle Creek	25.2	0.1	7.2	1.4	0.8
T26	Deep Creek	27.3	1.3	10.9	6.3	0
T27	Five Mile Creek	0.9	0.2	0.2	0.4	0.3
T28	Weston Creek	24.4	0.3	0.5	0	0

The total suspended solids data followed the same patterns as the phosphorus loadings described above. The data are plotted by sample period (Figure 3-6 through Figure 3-10) and in tabular form (Table 3-2). Inspection of the data indicates that only nine tributaries exceeded the TSS target. During upper and lower basin runoff, Thomas Fork, Old Bear River channel, as well as Alder, Battle, Deep and Weston creeks exceeded the target by more than 1,000 kg/day. Only the Old Bear River channel, Deep Creek, and Battle Creek exceeded target by more than 1,000 kg/day during either winter or summer base flow. Deep and Battle creeks exceeded target 80 and 100 percent of the time, respectively. These two creeks also had the highest magnitudes of total suspended solids loading.

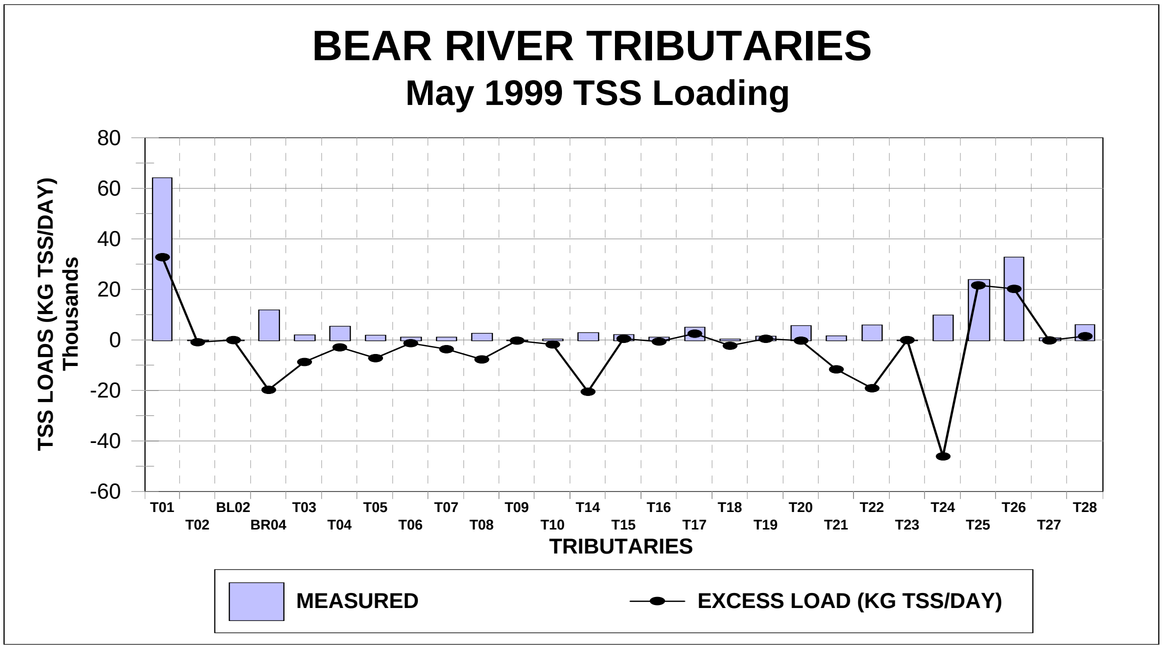


Figure 3-6. The total suspended solids loading for the Bear River tributaries in May 1999 (upper basin runoff). The tributary names are defined in the text of the report. Negative excess values indicate that loads did not exceed the target value.

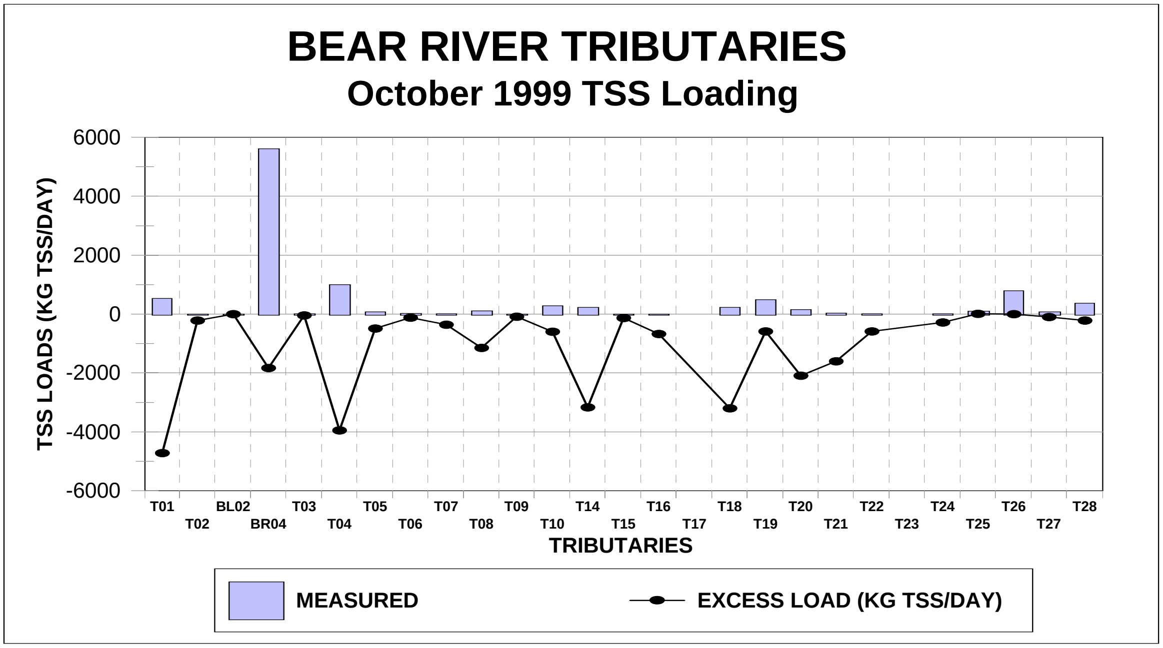


Figure 3-7. The total suspended solids loading for the Bear River tributaries in October 1999 (summer base flow). The tributary names are defined in the text of the report. Negative excess values indicate that loads did not exceed the target value.

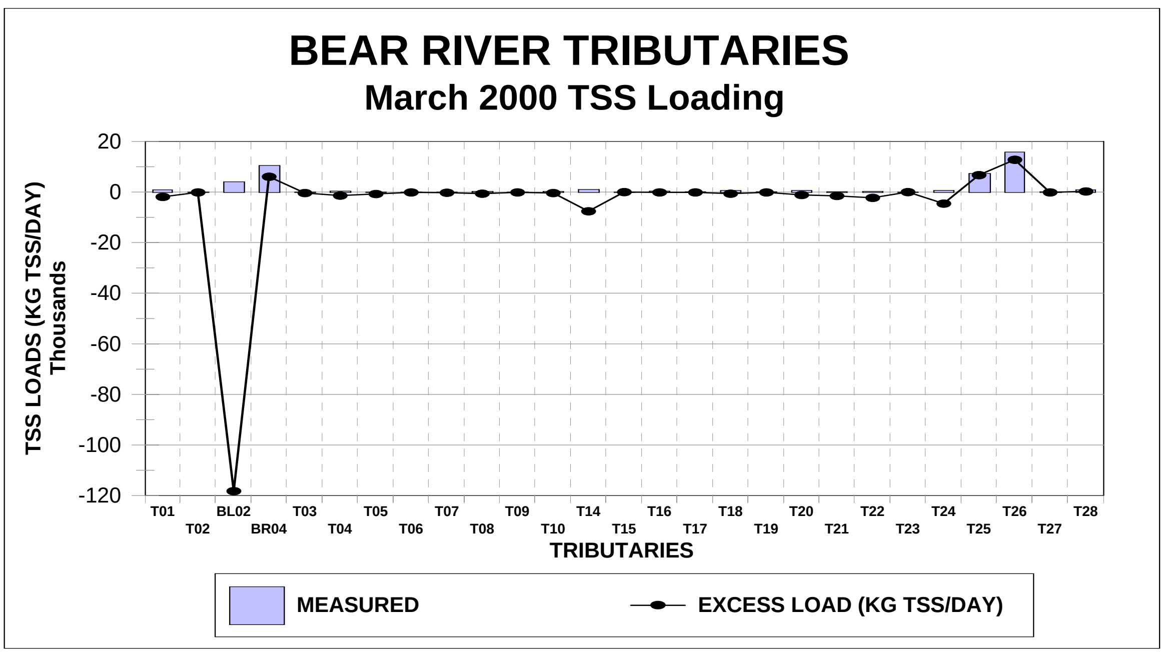


Figure 3-8. The total suspended solids loading for the Bear River tributaries in March 2000 (winter base flow). The tributary names are defined in the text of the report. Negative excess values indicate that loads did not exceed the target value.

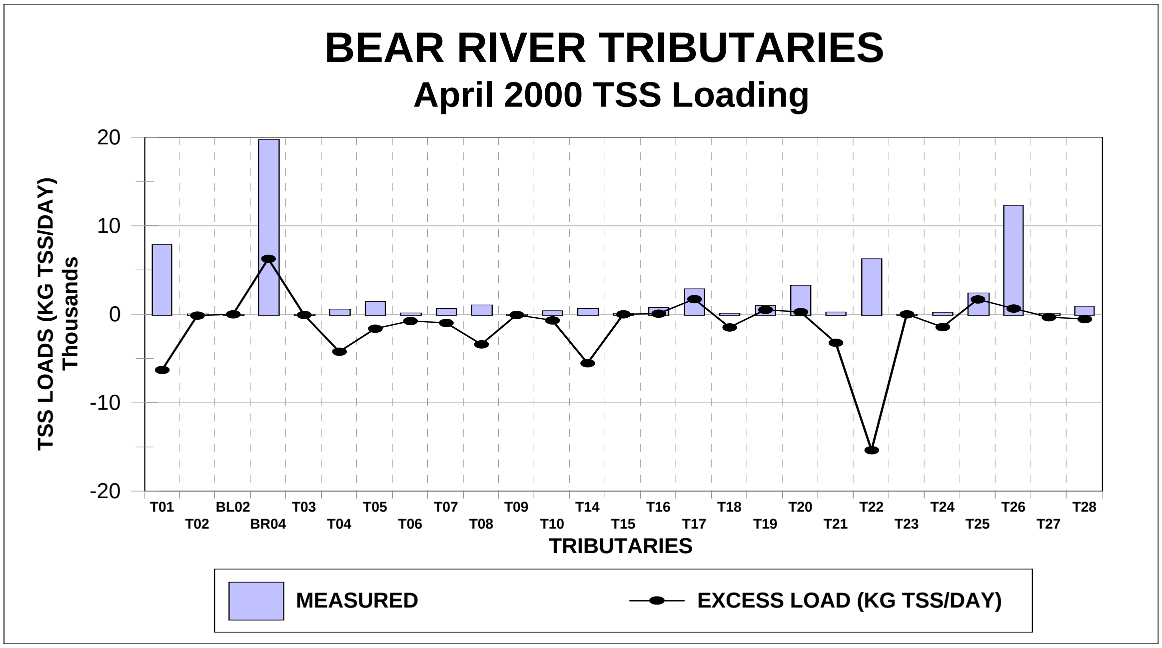


Figure 3-9. The total suspended solids loading for the Bear River tributaries in April 2000 (lower basin runoff). The tributary names are defined in the text of the report. Negative excess values indicate that loads did not exceed the target value.

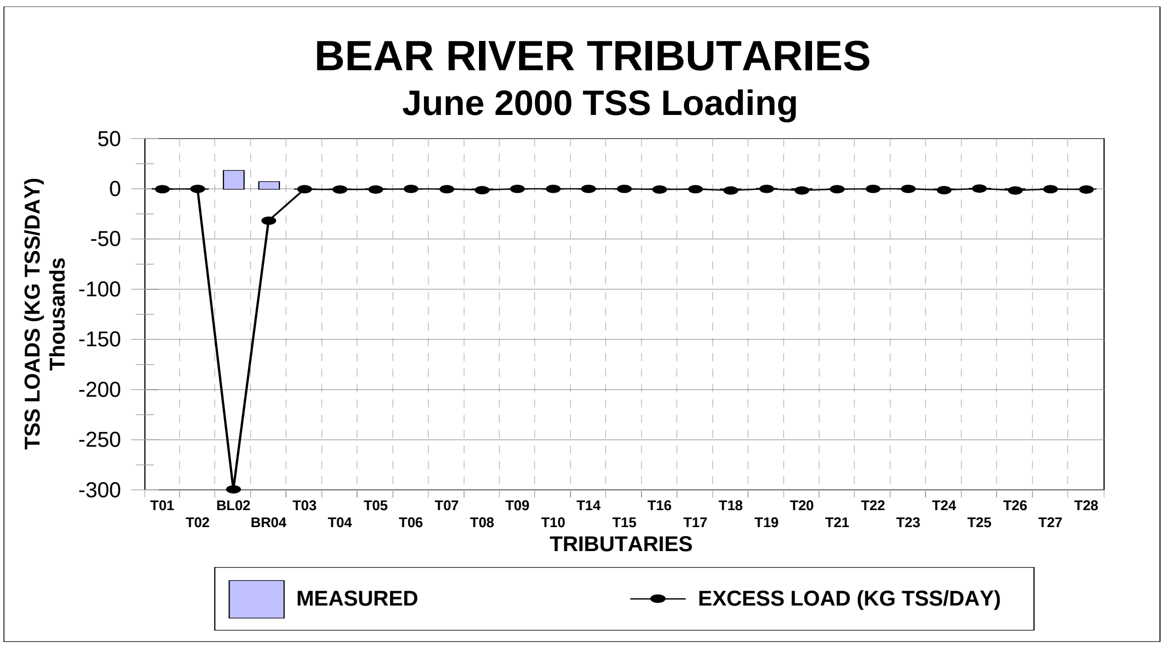


Figure 3-10. The total suspended solids loading for the Bear River tributaries in June 2000 (upper basin runoff). The tributary names are defined in the text of the report. Negative excess values indicate that loads did not exceed the target value.

Table 3-2. The quantity of total suspended solids (kg/day) exceeding target (80/60 and 60/35 mg TSS/L, depending on hydrologic time period and site location) for tributaries in the Bear River in Idaho.

		Upper Basin Runoff	Summer Base Flow	Winter Base Flow	Lower Basin Runoff	Summer Base Flow
Site#	**Description**	**May 1999**	**October 1999**	**March 2000**	**April 2000**	**June 2000**
T01	Thomas Fork	32,840	0	0	0	0
T02	Sheep Creek	0	0	0	0	0
BL02	Lifton	0	0	0	0	0
BR04	Bear River Old Channel	0	0	6,076	6,239	0
T03	Ovid Creek	0	0	0	0	0
T04	Georgetown Creek	0	0	0	0	0
T05	Stauffer Creek	0	0	0	0	0
T06	Skinner Creek	0	0	0	0	0
T07	Pearl Creek	0	0	0	0	0
T08	Eightmile Creek	0	0	0	0	0
T09	Sulphur Canyon Creek	0	0	0	0	0
T10	Bailey Creek	0	0	0	0	0
T14	Soda Creek	0	0	0	0	0
T15	Densmore Creek	533	0	0	6	0
T16	Smith Creek	0	0	0	56	0
T17	Alder Creek	2,487	ND	0	1,715	0
T18	Whiskey Creek	0	0	0	0	0
T19	Burton Creek	485	0	0	500	0
T20	Trout Creek	0	0	0	250	0
T21	Williams Creek	0	0	0	0	0
T22	Cottonwood Creek	0	0	0	0	0
T23	Maple Hot Springs	0	ND	0	0	0
T24	Mink Creek	0	0	0	0	0
T25	Battle Creek	21,609	15	6,703	1,671	432
T26	Deep Creek	20,253	4	12,733	653	0
T27	5 Mile Creek	0	0	0	0	0
T28	Weston Creek	1,566	0	230	0	0

The Malad River, although not entering the Bear River in Idaho, is within the Bear River basin. During the synoptic surveys, the Malad River was also studied. The results of the loading analysis can be seen in Table 3-3. This table lists the amount of mass exceeding the target of 0.075 mg TP/L and 80 mg TSS/L.

The Malad River at the Utah-Idaho state line (MR04) as well as the site in Idaho (MR01) exceeded the total phosphorus target in nearly all samples collected (winter and summer base flow and lower basin runoff). Exceedances had the highest magnitude during winter base flow (0.4-20.2 kg TP/day). Total suspended sediments were exceeded only slightly during winter base flow, and were also exceeded in summer base flow.

Both Wright and Elkhorn creeks exceeded total phosphorus and total suspended solids target whereas Little Malad River and Devil Creek exceeded only the total phosphorus target. Deep Creek did not exceed either target.

Table 3-3. The exceedance masses for each Malad River and tributary sample site during 1999-2000.

Site#	Description	Upper Basin Runoff	Summer Base Flow	Winter Base Flow	Lower Basin Runoff	Summer Base Flow
		May 1999	October 1999	March 2000	April 2000	June 2000
Total Phosphorus Exceedance Loading (kg/day)						
MR01	Malad River at 3700 South	ND	5.4	0.4	0.0	0.0
MR04	Malad River at Portage	ND	ND	20.2	0.3	1.6
MT01	Wright Creek	ND	1.5	0.7	0.4	0.2
MT02	Elkhorn Creek	ND	0.0	0.1	0.0	0.0
MT03	Deep Creek	ND	0.0	0.0	0.0	0.0
MT04	Devil Creek	ND	0.4	0.1	0.0	0.0
MT05	Little Malad River	ND	0.8	0.5	1.3	0.1
MT06	Trib to Malad R at Riverside	ND	ND	0.2	0.0	0.4
Total Suspended Solids Exceedance Loading (kg/day)						
MR01	Malad River at 3700 South	ND	0.0	188	0.0	0.0
MR04	Malad River at Portage	ND	ND	0.0	0.0	983
MT01	Wright Creek	ND	0.0	0.0	219	0.0
MT02	Elkhorn Creek	ND	0.0	186	0.0	ND
MT03	Deep Creek	ND	0.0	0.0	0.0	0.0
MT04	Devil Creek	ND	0.0	0.0	0.0	ND
MT05	Little Malad River	ND	0.0	0.0	0.0	0.0
MT06	Trib to Malad R at Riverside	ND	ND	0.0	0.0	0.0

3.3 Mainstem Analysis

Analysis of the mainstem Bear River sites followed the same approach described in section 3.2 of this report. The major difference in the mainstream analysis is that instantaneous loads were calculated at numerous locations along the Bear River corridor. The loading analysis described within this section was undertaken at seven mainstem sites where the synoptic water quality data were collected and where the stations selected had good long-term water quality data sets. The mainstem Bear River loading analysis will be described for the synoptic study (1999-2000) followed by an analysis utilizing all of the available historical data for those same stations. These sites were previously described in section 2.3. It should be noted that for several sites within the management reaches loads may be less than the TMDL targets, which is not to imply that an increase in loading might be allowed.

3.3.1 Synoptic Investigation (1999-2000)

The data for the Bear River stations for total phosphorus can be seen in Figure 3-11 through Figure 3-15, corresponding to the four hydrologic periods. During upper basin runoff, lower basin runoff and early summer base flow, the phosphorus target was exceeded 6 to 8 times (Table 3-4). The highest magnitude of exceedance occurred during upper basin runoff in the Bear River from the Idaho-Wyoming state line to Stewart Dam.

During upper basin runoff, six sites (Table 3-4) exceeded the target for total phosphorus by over 150 kg TP/day. These mainstem Bear River sites included Bear River at Idaho-Wyoming state line (603 kg TP/day); Stewart Dam (550 kg TP/day); Bear River at Thatcher Bridge (298 kg TP/day); Bear River at the Utah-Idaho state line (328 kg TP/day); and Bear River above Alexander Reservoir (189 kg TP/day). Only two sites exceeded the target by 100 kg TP/day during summer and winter base flow. Three sites, the Bear River at Thatcher Bridge, the Bear River at the Utah-Idaho state line, and the Bear River above Alexander, exceeded the target 80 percent of the time.

The synoptic water quality data for total suspended solids in the Bear River is shown in Figure 3-16 through Figure 3-20 and in Table 3-5. There were only two sites exceeding target by a substantial amount and only during upper basin runoff. The excess load was approximately 350,000 kg TSS/day for the Idaho-Wyoming state line, increasing to 380,000 kg TSS/day at Stewart Dam, just prior to its entrance into the Bear Lake Marsh. The water quality data used in the detailed temporal loading analysis has been described in section 2.2.

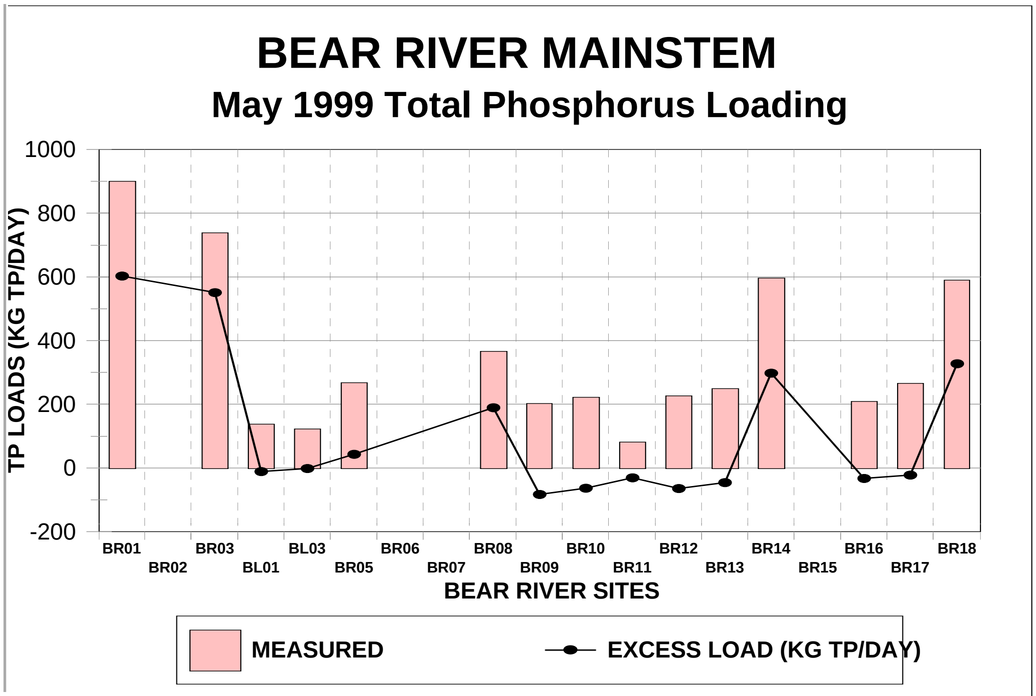


Figure 3-11. The instantaneous total phosphorous loading (kg/day) and the mass exceeding target for samples collected in May 1999 (upper basin runoff).

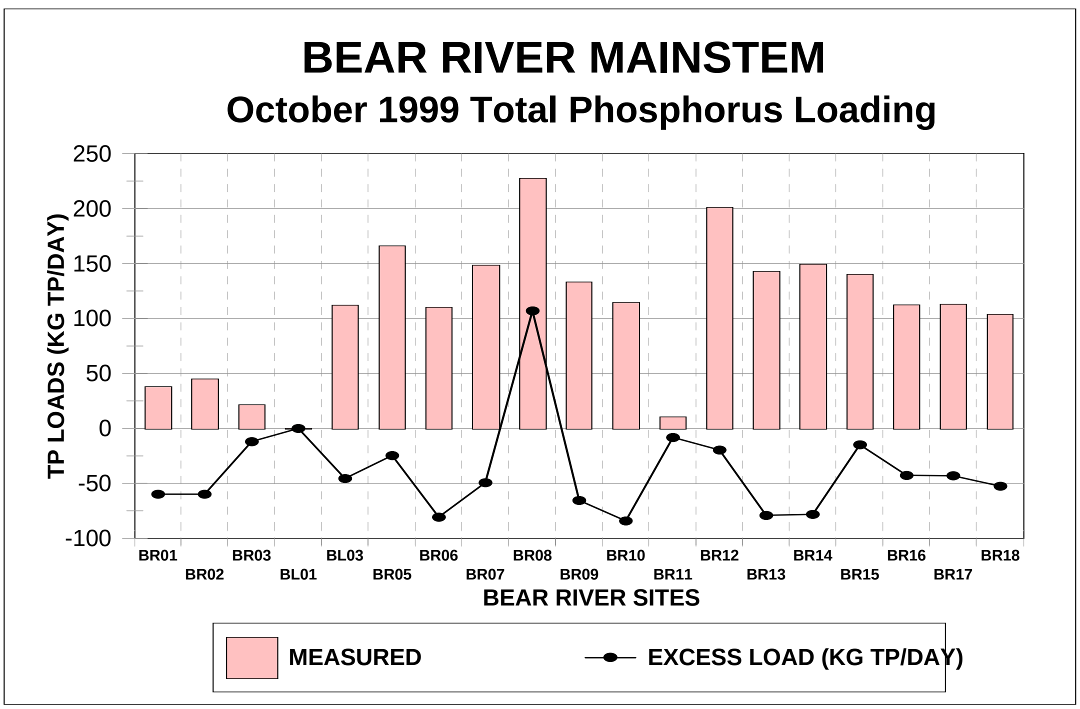


Figure 3-12. The instantaneous total phosphorous loading (kg/day) and the mass exceeding target for samples collected in October 1999 (summer base flow).

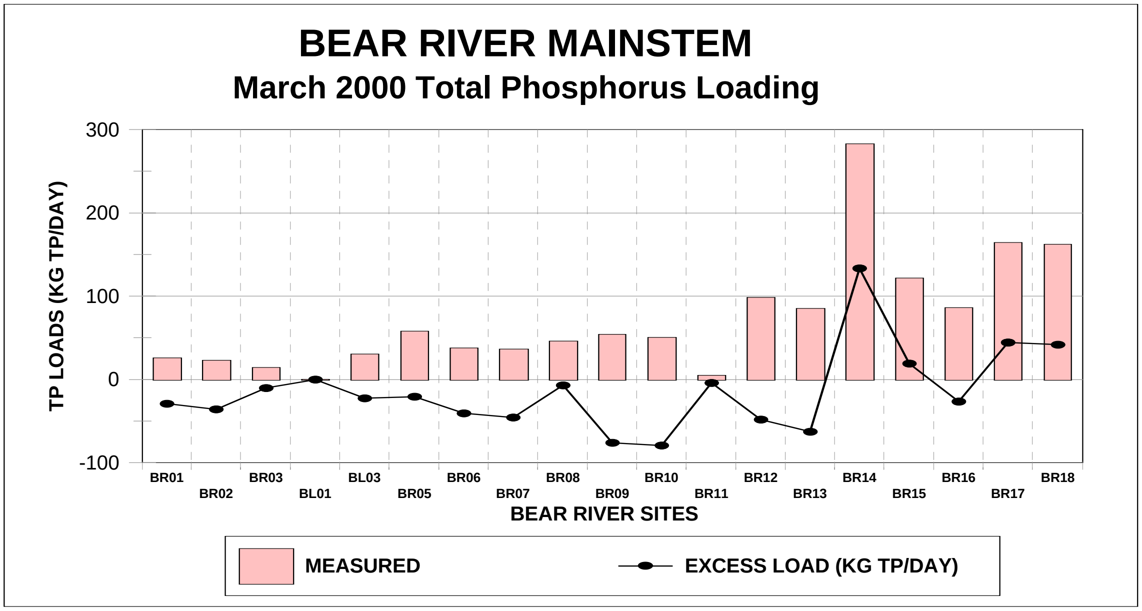


Figure 3-13. The instantaneous total phosphorous loading (kg/day) and the mass exceeding target for samples collected in March 2000 (winter base flow).

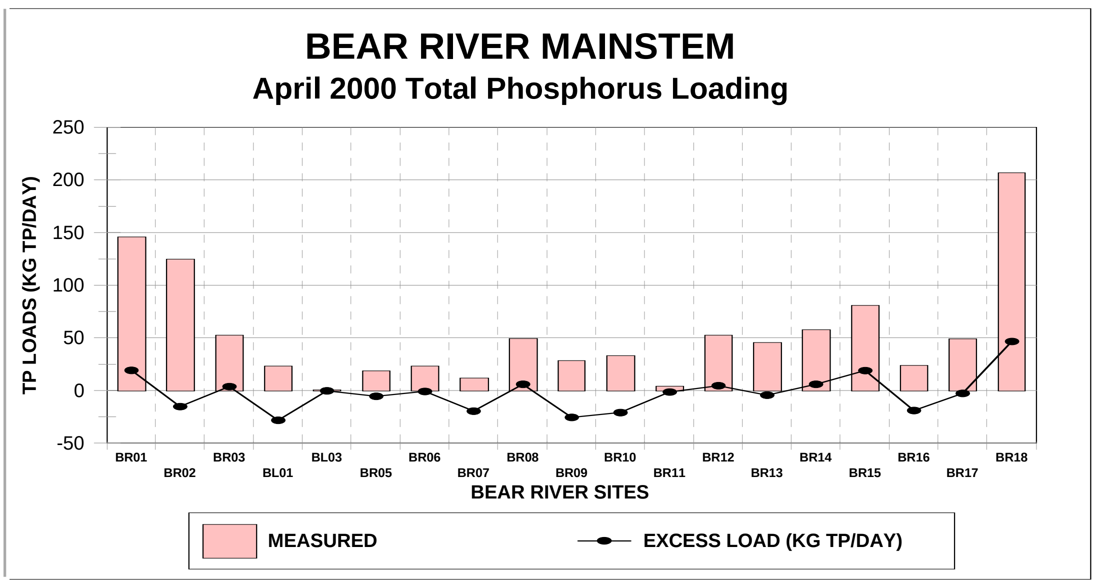


Figure 3-14. The instantaneous total phosphorous loading (kg/day) and the mass exceeding target for samples collected in April 2000 (lower basin runoff).

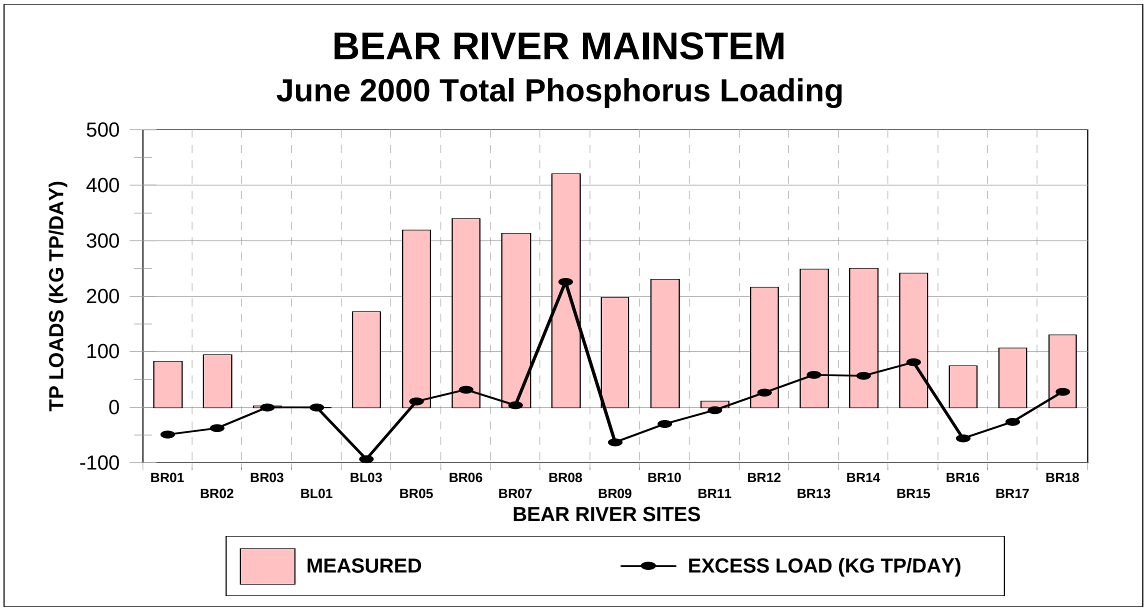


Figure 3-15. The instantaneous total phosphorous loading (kg/day) and the mass exceeding target for samples collected in June 2000 (Summer Base Flow).

Table 3-4. The quantity of total phosphorus (kg/day) exceeding target (0.075 or 0.050 mg TP/L) for selected mainstem sites in the Bear River in Idaho.

Site#	Description	Upper Basin Runoff	Summer Base Flow	Winter Base Flow	Lower Basin Runoff	Summer Base Flow
		May 1999	October 1999	March 2000	April 2000	June 2000
BR01	BR at ID WY state line	603.4	0	0	19.3	0
BR02	BR at Hunter Hill Road	ND	0	0	0	0
BR03	Stewart Dam	550.3	0	0	3.6	0
BL01	Causeway	0	0	0	0	0
BL03	BL outlet	0	0	0	0	0
BR05	BR at Pescadero	43.2	0	0	0	10.9
BR06	BR at Nounan Bridge	ND	0	0	0	31.8
BR07	BR at Stauffer Creek	ND	0	0	0	3.6
BR08	BR above Alexander	189.2	107.1	0	5.9	226.0
BR09	BR below Alexander	0	0	0	0	0
BR10	BR at Last Chance	0	0	0	0	0
BR11	BR at Black Canyon	0	0	0	0	0
BR12	BR at Cheeseplant Bridge	0	0	0	4.4	26.2
BR13	BR at Thatcher Church	0	0	0	0	58.2
BR14	BR at Thatcher Bridge	297.7	0	133.3	5.8	57.1
BR15	BR abv Oneida at Hwy	ND	0	19.1	18.9	81.1
BR16	BR blw Oneida	0	0	0	0	0
BR17	BR west of Preston	0	0	44.2	0	0
BR18	BR at UT-ID state line	327.8	0	41.8	46.7	27.8

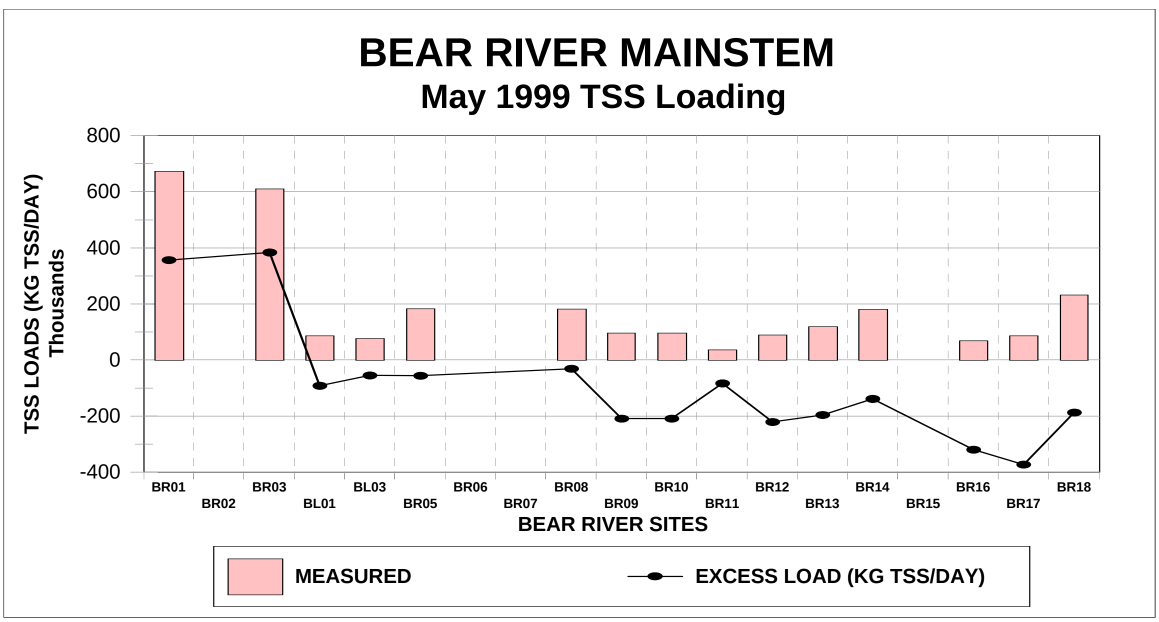


Figure 3-16. The instantaneous total suspended solids loading (kg/day) and the mass exceeding target for samples collected in May 1999 (upper basin runoff).

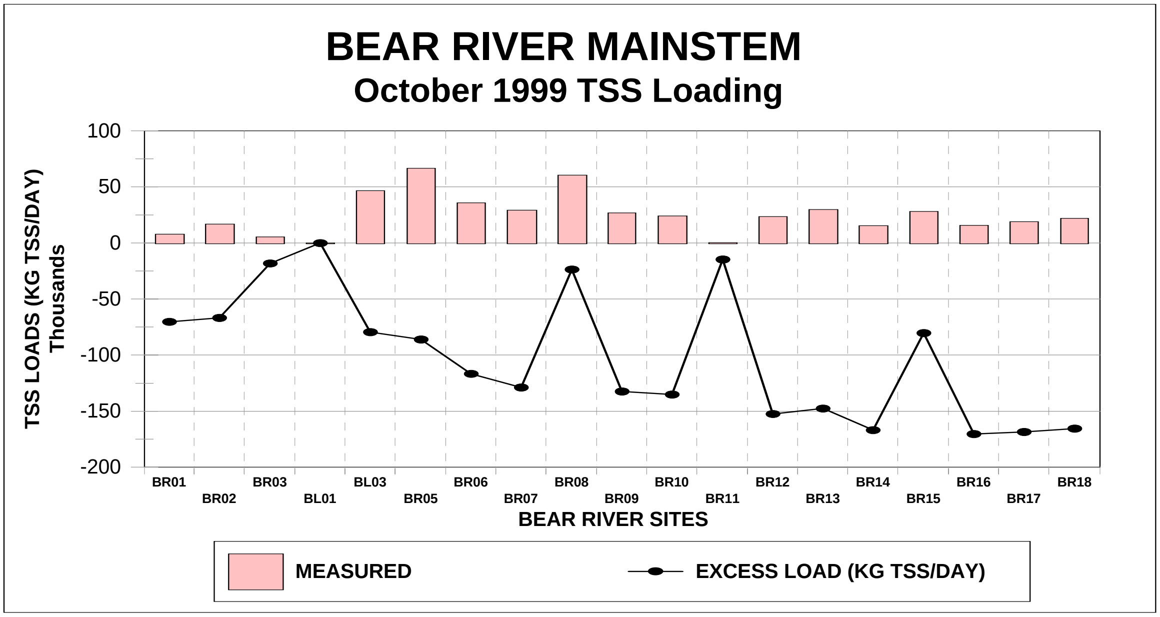


Figure 3-17. The instantaneous total suspended solids loading (kg/day) and the mass exceeding target for samples collected in October 1999 (summer base flow).

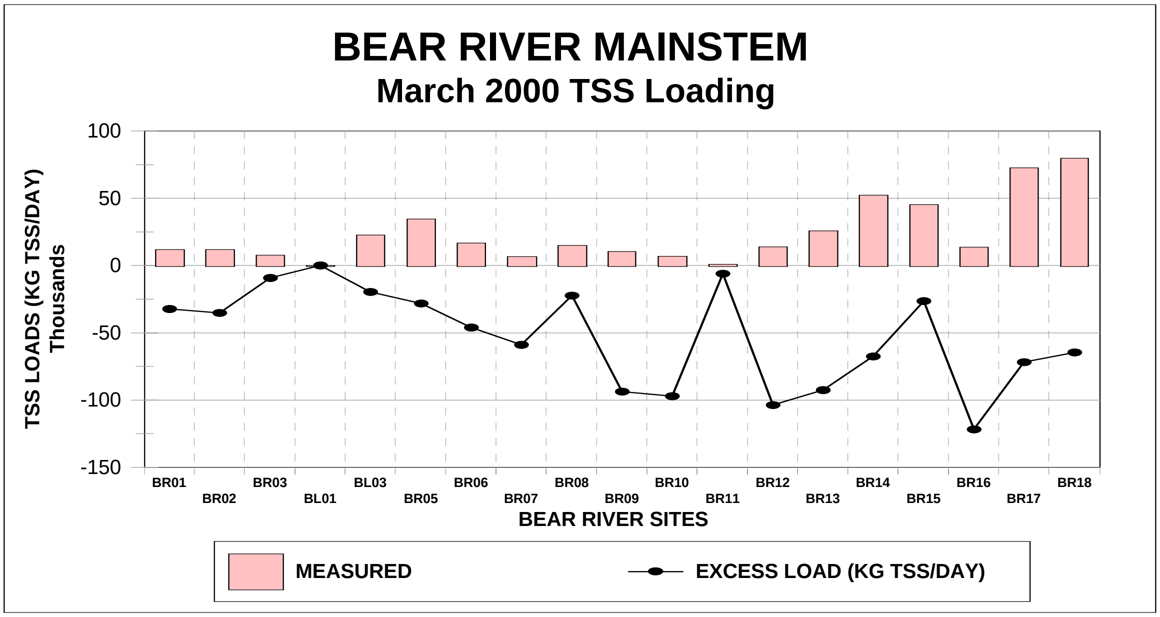


Figure 3-18. The instantaneous total suspended solids loading (kg/day) and the mass exceeding target for samples collected in March 2000 (winter base flow).

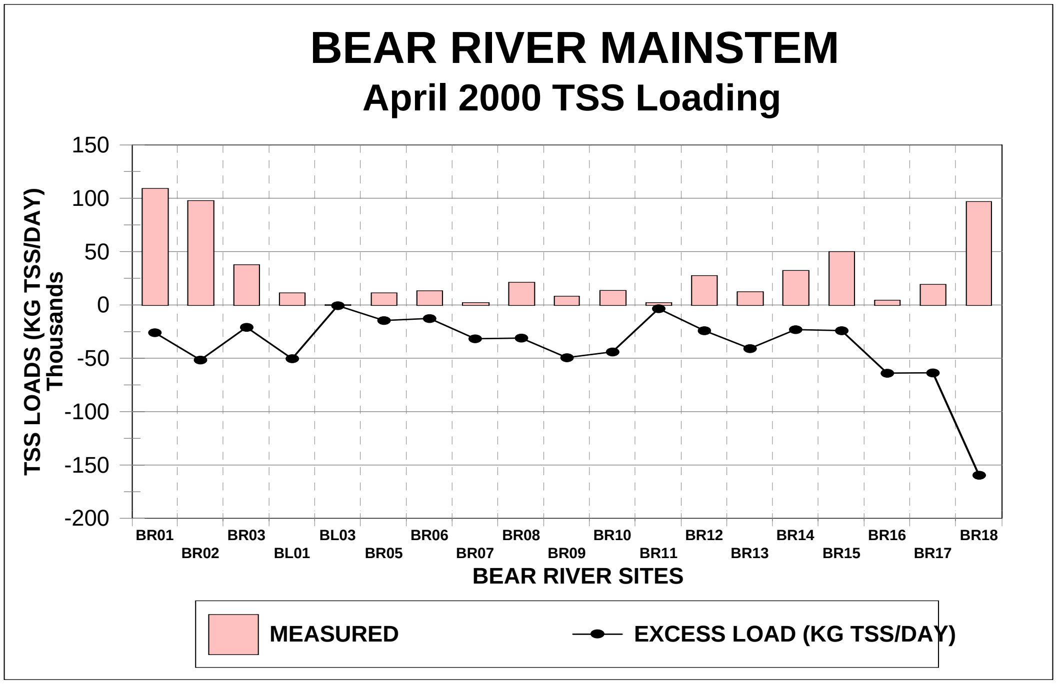


Figure 3-19. The instantaneous total suspended solids loading (kg/day) and the mass exceeding target for samples collected in April 2000 (lower basin runoff).

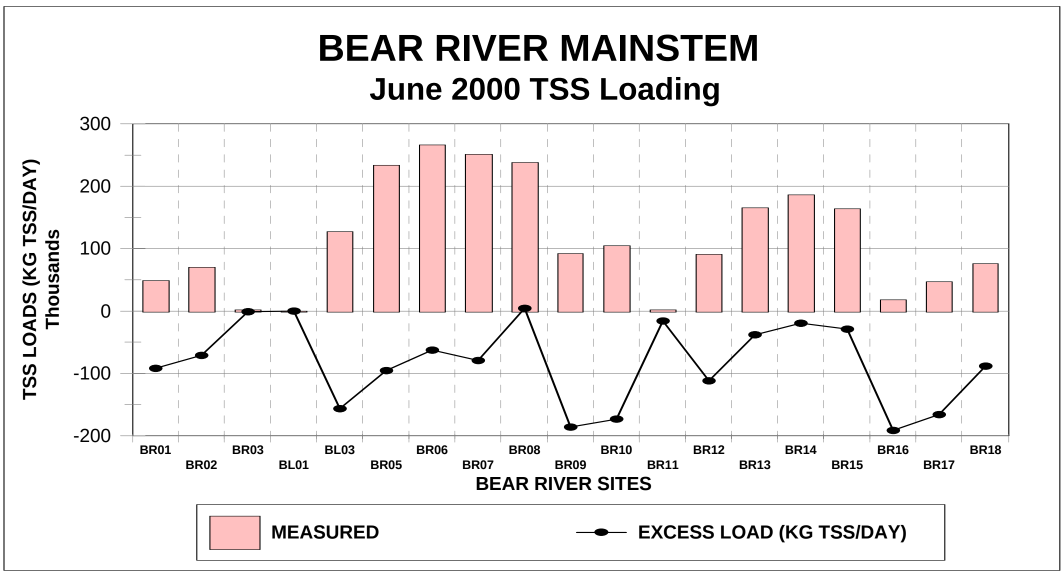


Figure 3-20. The instantaneous total suspended solids loading (kg/day) and the mass exceeding target for samples collected in June 2000 (Summer Base Flow).

Table 3-5. The quantity of total suspended solids (kg/day) exceeding target (80/60 and 60/35 mg TSS/L, depending on hydrologic time period and site location) for selected mainstem sites in the Bear River in Idaho.

Site#	Description	Upper Basin Runoff	Summer Base Flow	Winter Base Flow	Lower Basin Runoff	Summer Base Flow
		May 1999	October 1999	March 2000	April 2000	June 2000
BR01	BR at ID WY state line	356,419	0	0	0	0
BR02	BR at Hunter Hill Road	ND	0	0	0	0
BR03	Stewart Dam	383,867	0	0	0	0
BL01	Causeway	0	0	0	0	0
BL03	BL outlet	0	0	0	0	0
BR05	BR at Pescadero	0	0	0	0	0
BR06	BR at Nounan Bridge	ND	0	0	0	0
BR07	BR at Stauffer Creek	ND	0	0	0	0
BR08	BR above Alexander	0	0	0	0	3,897
BR09	BR below Alexander	0	0	0	0	0
BR10	BR at Last Chance	0	0	0	0	0
BR11	BR at Black Canyon	0	0	0	0	0
BR12	BR at Cheeseplant Bridge	0	0	0	0	0
BR13	BR at Thatcher Church	0	0	0	0	0
BR14	BR at Thatcher Bridge	0	0	0	0	0
BR15	BR abv Oneida at Hwy	ND	0	0	0	0
BR16	BR blw Oneida	0	0	0	0	0
BR17	BR west of Preston	0	0	0	0	0
BR18	BR at UT-ID state line	0	0	0	0	0

3.3.2 Historical Data (1974-1998)

Previous sampling efforts from the mid-1970s to the late 1990s collected both flow and parameter concentrations, the two factors needed to estimate parameter loading. The following analysis used calculated average daily loads (kg/day) for each month where data were available. As with the synoptic study, seven stations were evaluated.

The Bear River entering the state of Idaho (Idaho-Wyoming state line) exceeded the loading limit proposed for phosphorus in eight out of 12 months and exceeded the loading limit for total suspended solids four out of 12 months as shown in Figure 3-21 through Figure 3-24 and Table 3-6. Historical loadings and excess loading are shown in Figure 3-21 and Figure 3-22. Although 70 percent of all the total phosphorus observations were less than the target, the distribution of the remaining 30 percent of observations showed significant differences in the excess loadings (Figure 3-23 and Figure 3-24). For example, the average excess for total phosphorus was 150 kg/day, with a range between 7 and 294 kg/day.

The next detailed site is Stewart Dam, where the Bear River enters the Bear Lake Marsh. For the period of record analyzed (1975-1998), a total of 189 individual data points were averaged. The historical loadings and excess loadings can be seen, averaged by month, in

Table 3-7 and graphed individually in Figure 3-25 and Figure 3-26. When averaged by month, the total phosphorus and total suspended solids loadings resemble normal distributions, with the highest magnitude occurring in April, May and June (Figure 3-27 and Figure 3-28). The amount of excess contaminants also follow the same distribution, with maximum excess total phosphorus occurring in May (355 kg TP/day) and maximum excess total suspended solids occurring in May as well (440,000 kg TSS/day). Phosphorus was in excess in eight of the twelve months averaged, while suspended sediments was over the target during nine of the twelve months.

The analysis of the entire data set indicated that 22 percent of the individual loading data points were less than the total phosphorus TMDL target (0.050 mg TP/L), while 45 percent of the TSS loading data points were less than the TSS TMDL target (60 mg TSS/L during runoff and 35 mg/L during base flow). The highest count of excess loads occurred in categories greater than 40 kg TP/day, as noted in Figure 3-27. This indicates that significant mass will need to be removed to attain the total maximum daily load limit at this station for total phosphorus.

During normal water years in the non-irrigation season, Bear River water enters Bear Lake through the Causeway or Lifton Pumping Station. When irrigation demand downstream requires water, withdrawals from Bear Lake reverse the flows and evacuate Bear Lake to supplement the Bear River. The data presented in Figure 3-29 through Figure 3-32 and Table 3-8 are for those periods when the Bear River was flowing into Bear Lake. Figure 3-29 and Figure 3-30 are the mass loadings into Bear Lake for total phosphorus and total suspended solids. Excess loadings are based upon a target of 0.05 mg TP/L and 60 mg TSS/L during runoff season and 35 mg TSS/L during base flows. A total of 276 data points are represented in these figures.

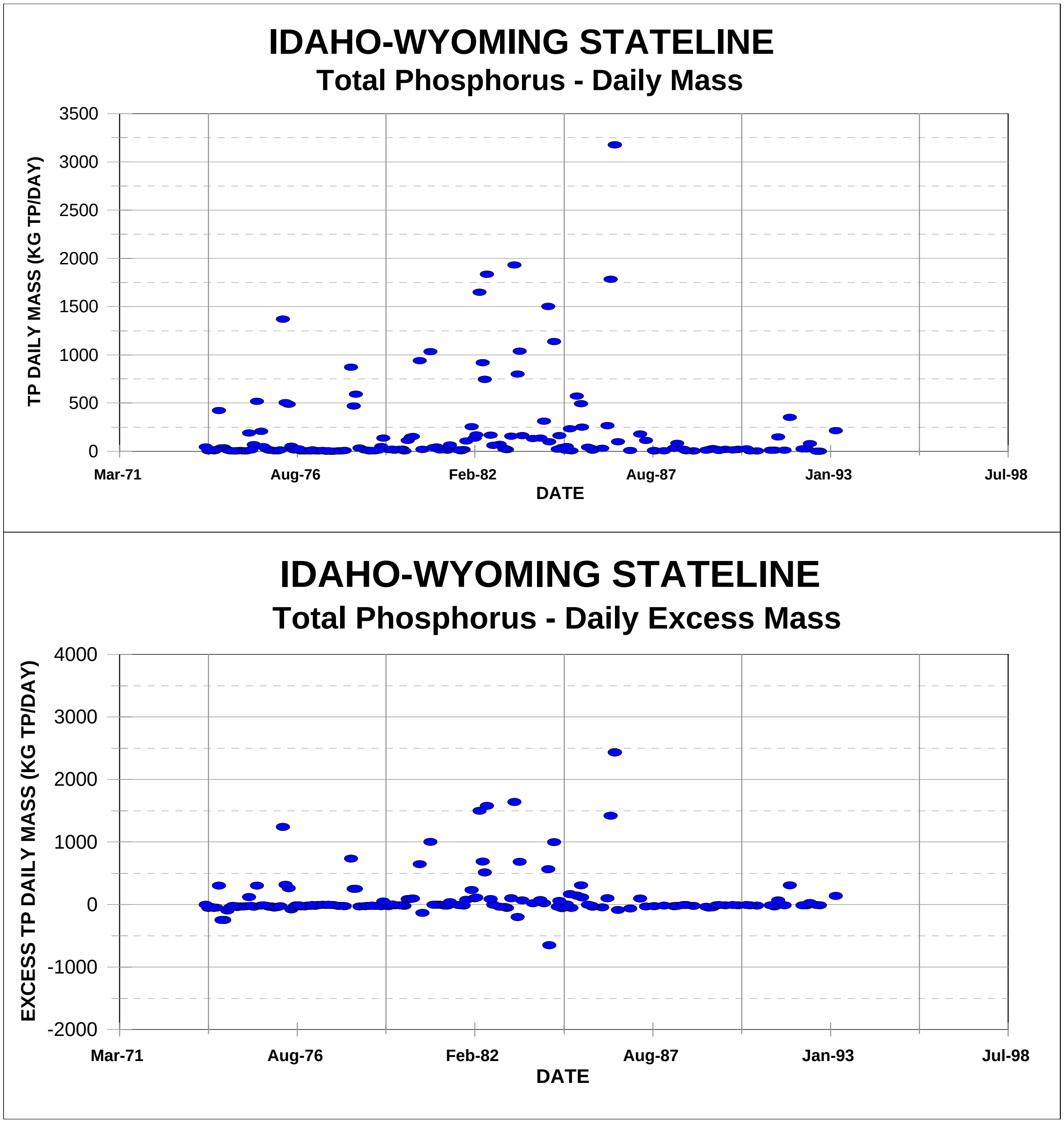


Figure 3-21. The mass loading (kg/day) for total phosphorus (above) and the excess loading (below) at the Idaho-Wyoming state line.

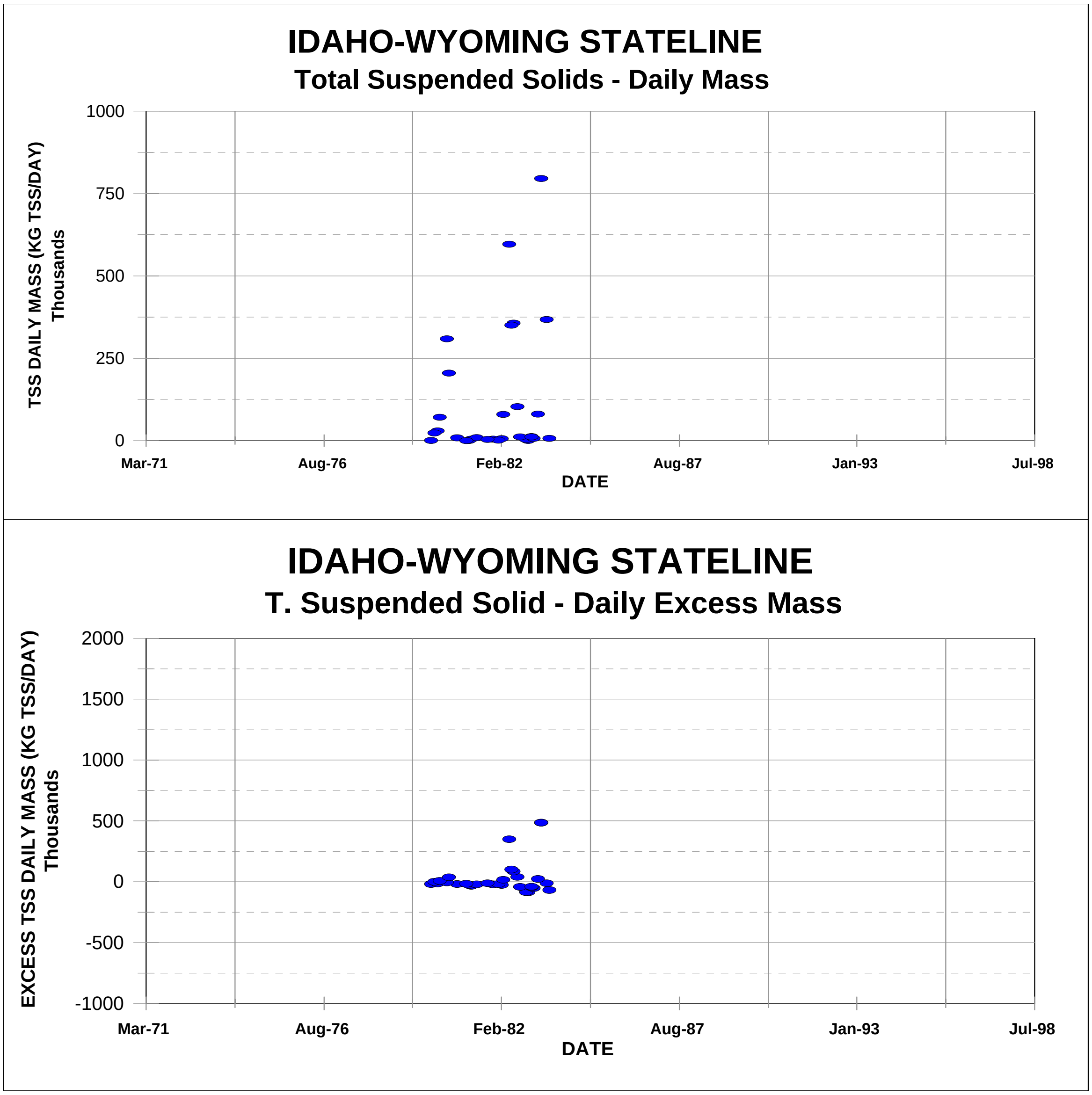
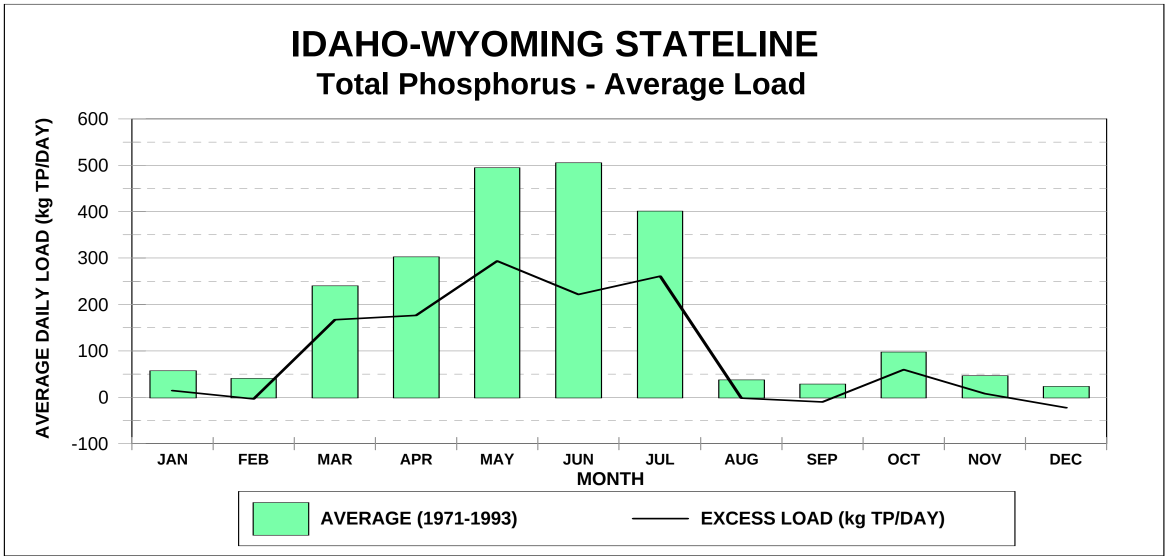


Figure 3-22. The mass loading (kg/day) for total suspended solids (above) and the excess loading (below) at the Idaho-Wyoming state line.



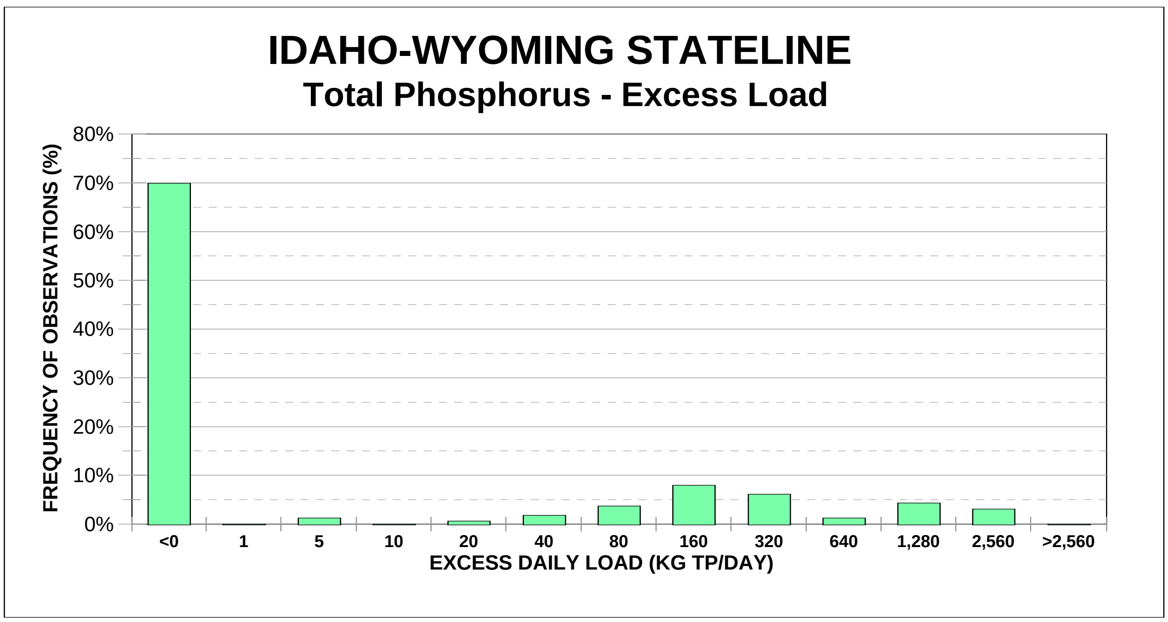
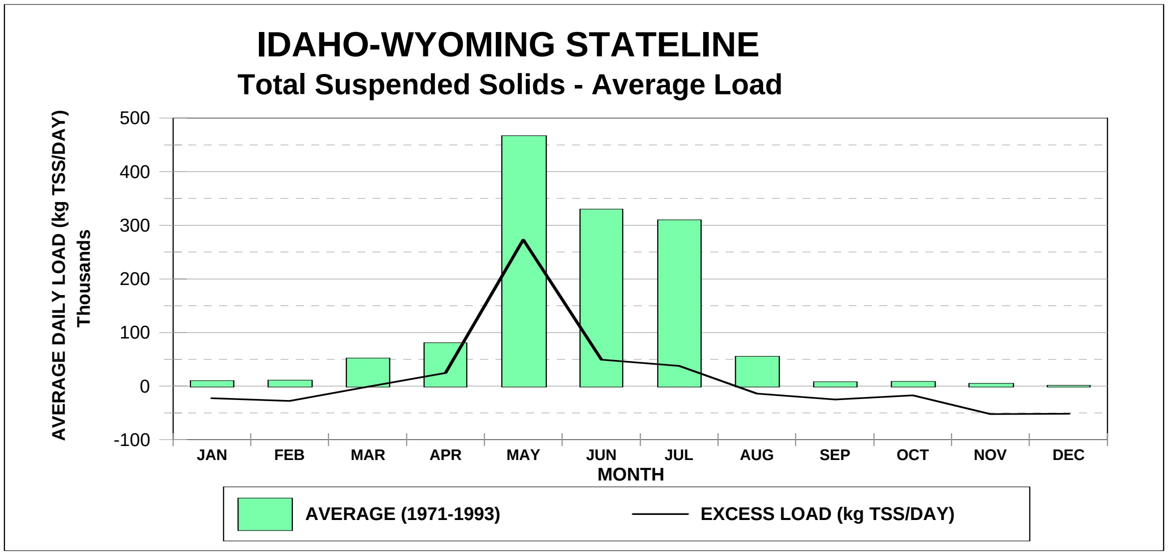


Figure 3-23. The distribution of total phosphorus loads by month (above) and the frequency distribution of excess total phosphorus for the Bear River at the Idaho-Wyoming state line.



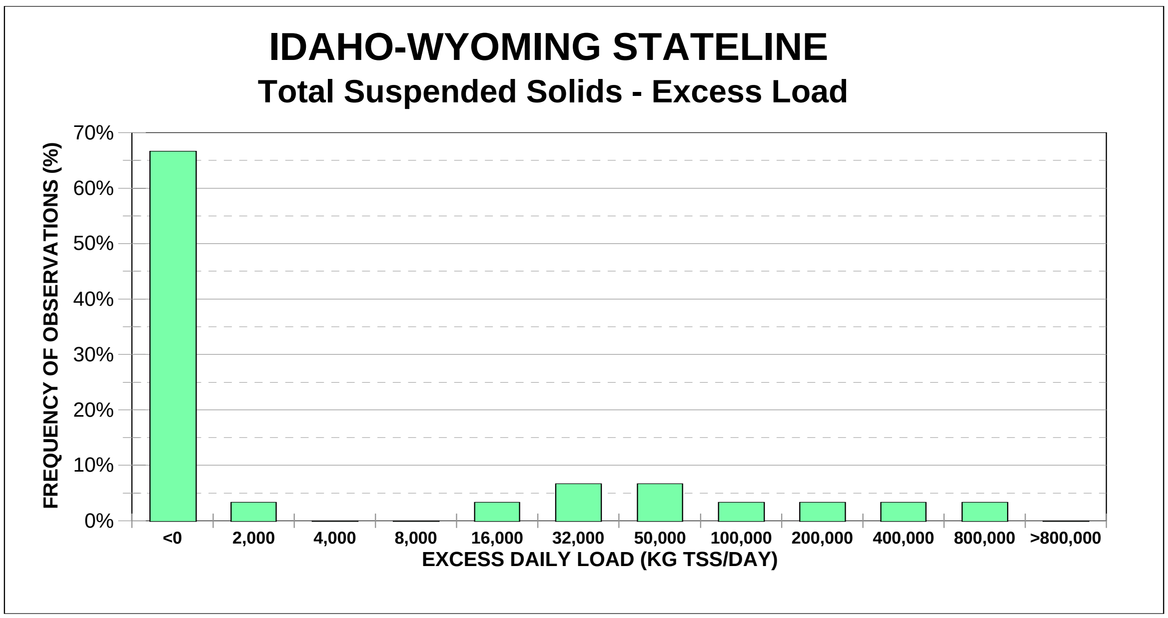


Figure 3-24. The distribution of total suspended solids loads by month (above) and the frequency distribution of excess TSS for the Bear River at the Idaho-Wyoming state line.

Table 3-6. The average (1971-1993) water quality data for selected parameters at the Idaho-Wyoming state line.

MONTH	Average Concentration (mg/L)	Average Mass (kg/day)	Excess Mass over Targets (kg/day)
Total Phosphorus			
January	0.124	57.2	14.2
February	0.073	40.5	-3.41
March	0.183	240	167
April	0.138	303	176
May	0.163	495	294
June	0.119	505	222
July	0.149	401	261
August	0.057	37.2	-1.82
September	0.038	28.6	-10.4
October	0.220	97.3	59.3
November	0.085	46.3	7.36
December	0.031	23.3	-22.9
Total Suspended Solids			
January	20	10,300	-22,400
February	16.8	11,300	-27,600
March	69.3	52,500	-953
April	114	81,200	24,200
May	143	468,000	273,000
June	96	330,000	49,300
July	93.7	310,000	37,800
August	52.5	55,600	-13,600
September	16	8,240	-25,000
October	20	8,610	-17,200
November	7.5	4,790	-52,200
December	2.5	1,360	-51,600

Table 3-7. The average (1977-1998) water quality data for selected parameters at Stewart Dam (Bear River entering Bear Lake Marsh).

MONTH	Average Concentration (mg/L)	Average Mass (kg/day)	Excess Mass over Targets (kg/day)
Total Phosphorus			
January	0.034	20.8	-12.4
February	0.038	15.8	-6.11
March	0.125	180	119
April	0.188	437	333
May	0.158	505	355
June	0.130	480	287
July	0.118	267	169
August	0.136	159	112
September	0.076	66.9	25.8
October	0.084	113	70.4
November	0.036	41.9	-2.83
December	0.028	28.7	-8.32
Total Suspended Solids			
January	7.66	5,450	-17,800
February	5.53	2,810	-13,200
March	78.3	129,000	50,500
April	147	365,000	229,000
May	111	440,000	234,000
June	72.8	256,000	7,250
July	81.8	210,000	75,000
August	98.7	144,000	106,000
September	48.4	50,700	21,900
October	40.6	43,800	12,300
November	28.9	34,000	2,730
December	21.9	15,600	-10,300

Table 3-8. The average (1975-1998) water quality data for selected parameters at the Bear Lake Causeway and Lifton (Bear River entering Bear Lake).

MONTH	Average Concentration (mg/L)	Average Mass (kg/day)	Excess Mass over Targets (kg/day)
Total Phosphorus			
January	0.015	8.16	-20.6
February	0.061	14.7	-3.51
March	0.073	41.7	21.5
April	0.061	74.9	22.9
May	0.067	128	39.9
June	0.072	188	82.4
July	0.044	33.7	6.12
August	0.029	1.15	-10.3
September	0.051	0.001	0
October	0.043	10.4	-3.04
November	0.04	10.8	-1.57
December	0.038	14.1	-7.3
Total Suspended Solids			
January	7.74	7,880	-9,470
February	6.31	1,230	-11,300
March	30.9	16,000	-6,110
April	21.4	31,400	-19,000
May	30.4	75,700	-31,700
June	23	64,700	-52,900
July	16.7	12,500	-17,400
August	16.3	0.363	0
September	12.4	0.3	0
October	12.1	6,690	-5,260
November	26.1	5,910	-2,740
December	19	13,000	-1,920

Table 3-9. The average (1978-1998) water quality data for selected parameters at the Bear Lake Outlet.

MONTH	Average Concentration (mg/L)	Average Mass (kg/day)	Excess Mass over Targets (kg/day)
Total Phosphorus			
January	0.016	21.9	-94.6
February	0.052	28.5	-42.4
March	0.058	115	-5.3
April	0.087	74.9	21.3
May	0.080	66.6	20.9
June	0.084	171	58.7
July	0.086	241	55.2
August	0.122	344	151
September	0.060	143	-30.1
October	0.134	363	232
November	0.033	72.4	-84.8
December	0.035	44.9	-17.3
Total Suspended Solids			
January	16.4	26,200	-66,900
February	14.2	3,570	-53,100
March	40.7	81,100	-68,900
April	34.5	39,000	-31,600
May	53.9	54,600	-7,620
June	41	99,900	-42,800
July	53.8	167,000	-36,100
August	71	209,000	51,700
September	41.3	112,000	-26,500
October	23.1	50,500	-54,800
November	14.8	51,700	-74,100
December	22.5	33,700	-16,000

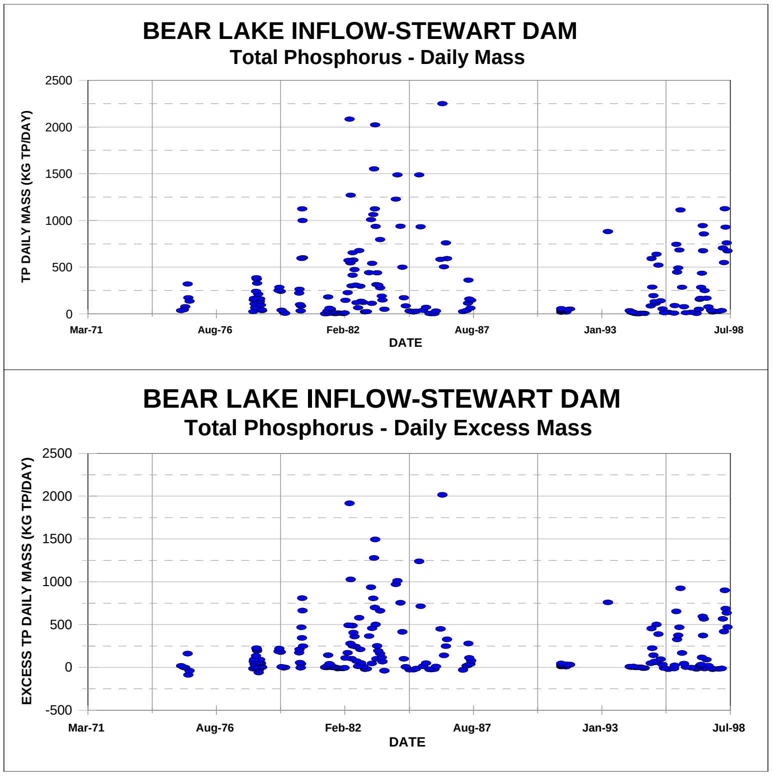


Figure 3-25. The mass loading (kg/day) for total phosphorus (above) and the excess loading (below) at Stewart Dam.

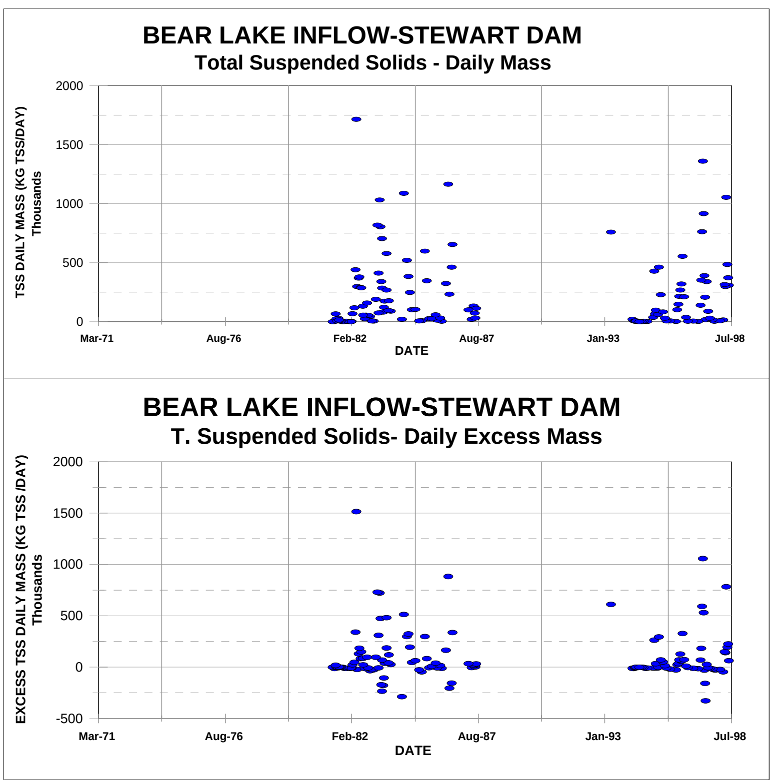


Figure 3-26. The mass loading (kg/day) for total suspended solids (above) and the excess loading (below) at Stewart Dam.

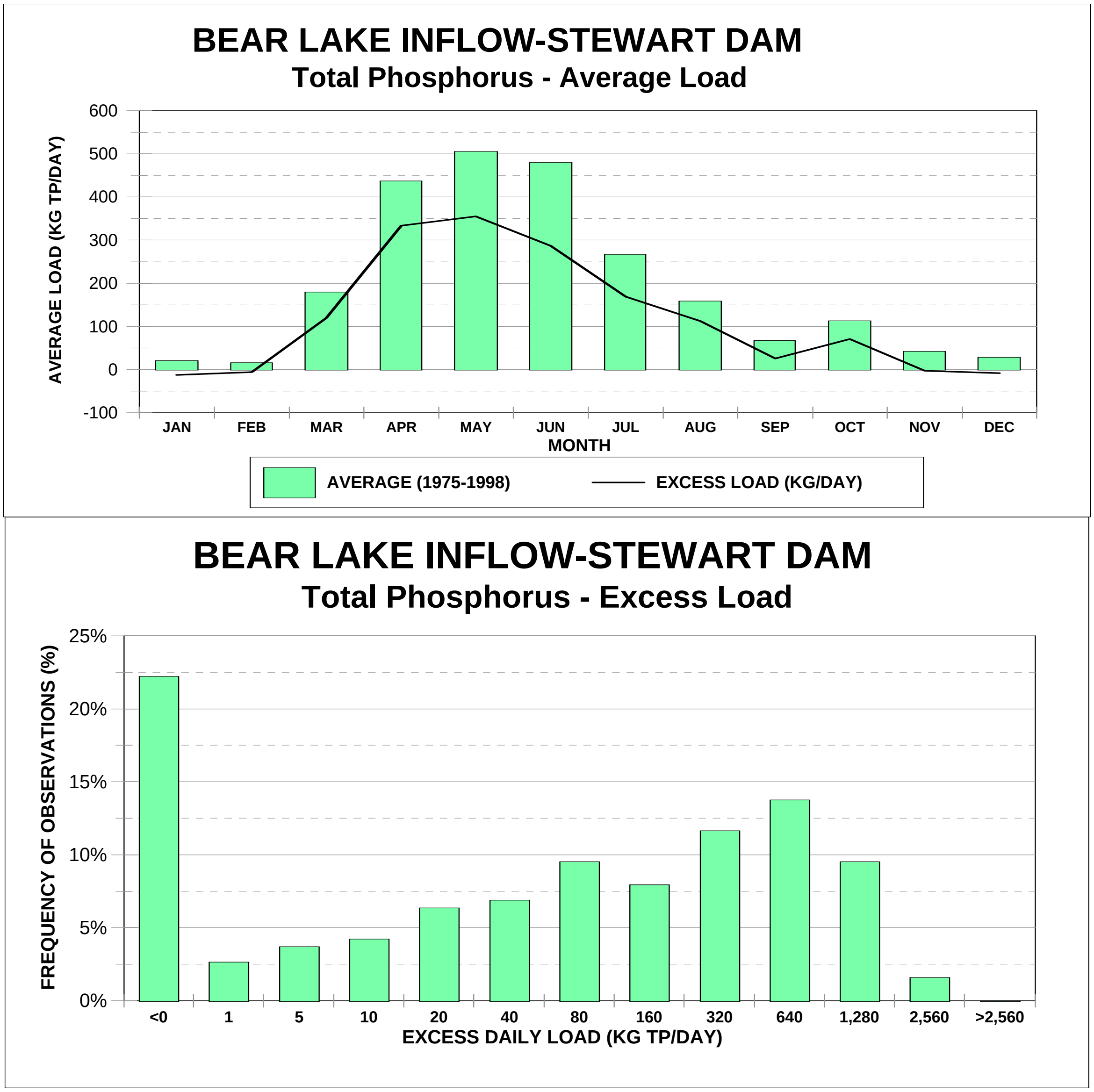


Figure 3-27. The distribution of total phosphorus loads by month (above) and the frequency distribution of excess total phosphorus for the Bear River at Stewart Dam.

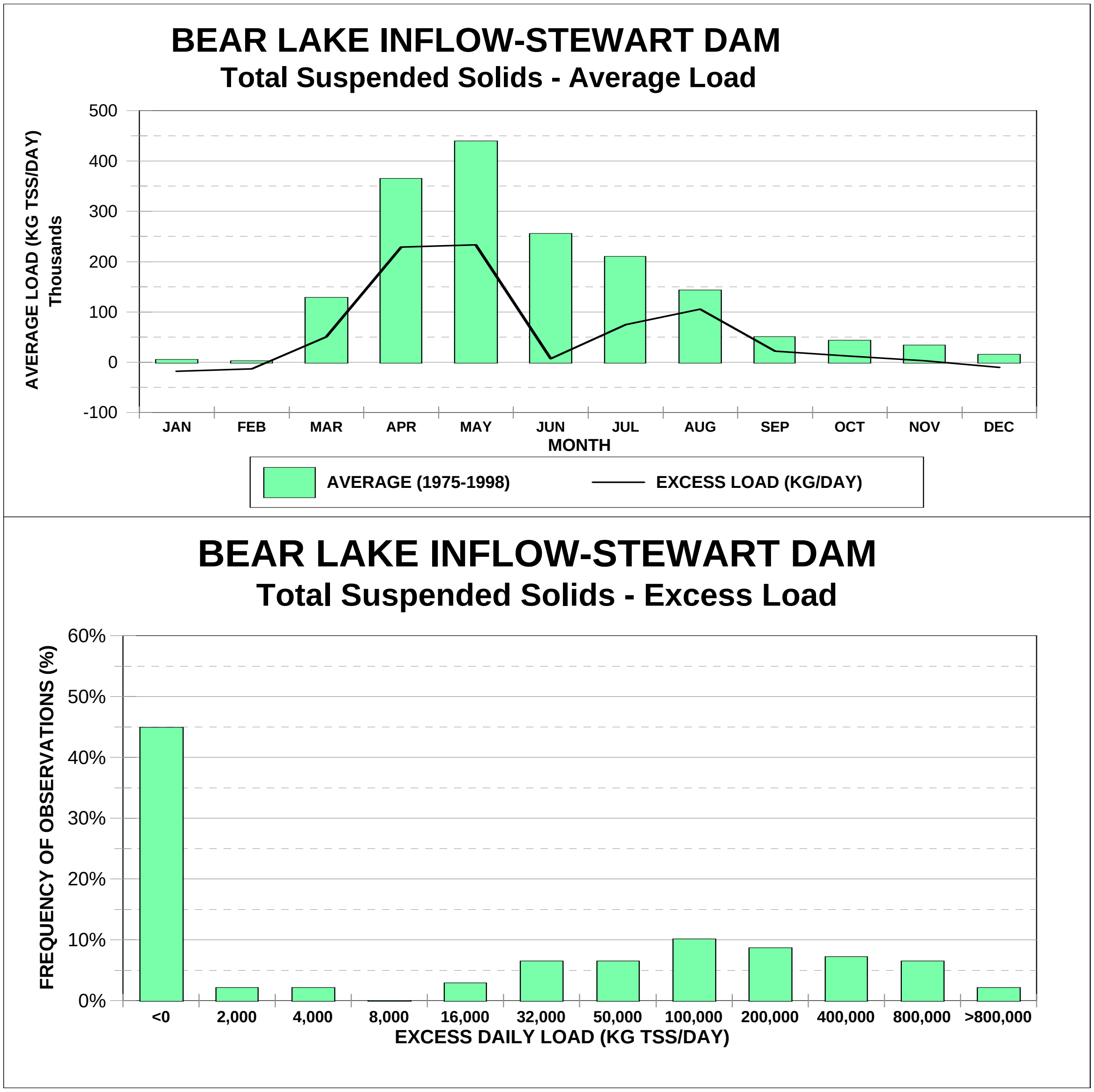
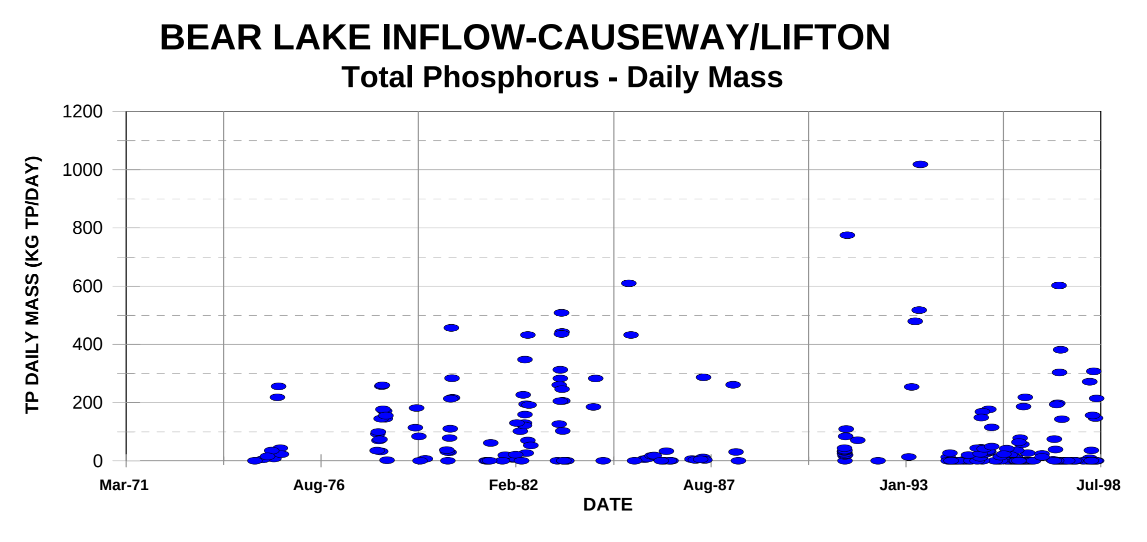


Figure 3-28. The distribution of total suspended solids loads by month (above) and the frequency distribution of excess TSS for the Bear River at Stewart Dam.



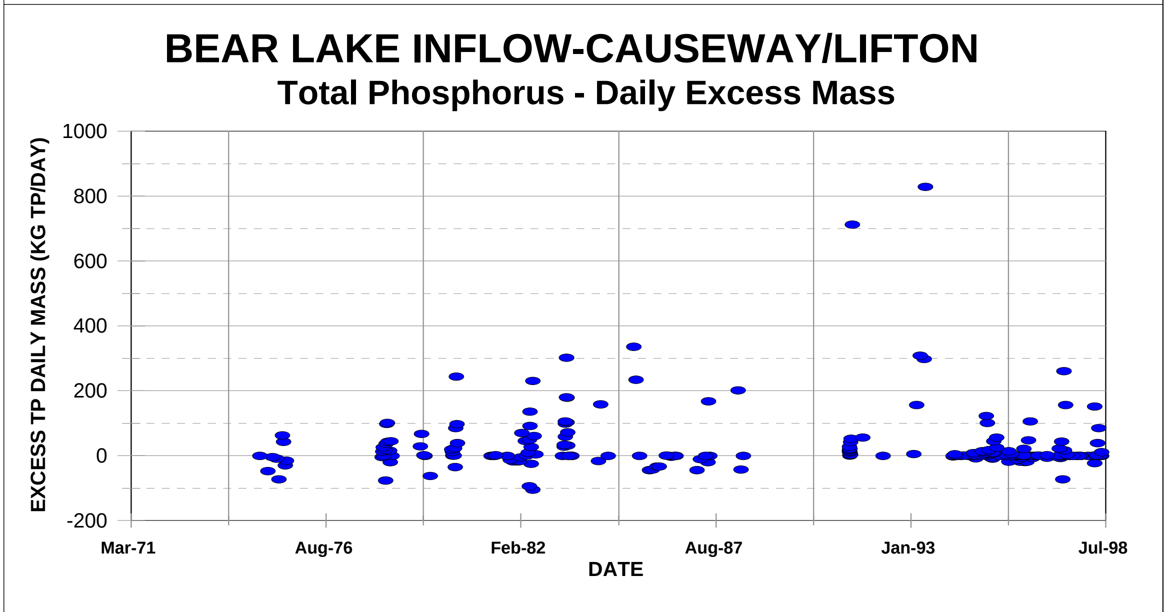


Figure 3-29. The mass loading (kg/day) for total phosphorus (above) and the excess loading (below) for all inflows into Bear Lake.

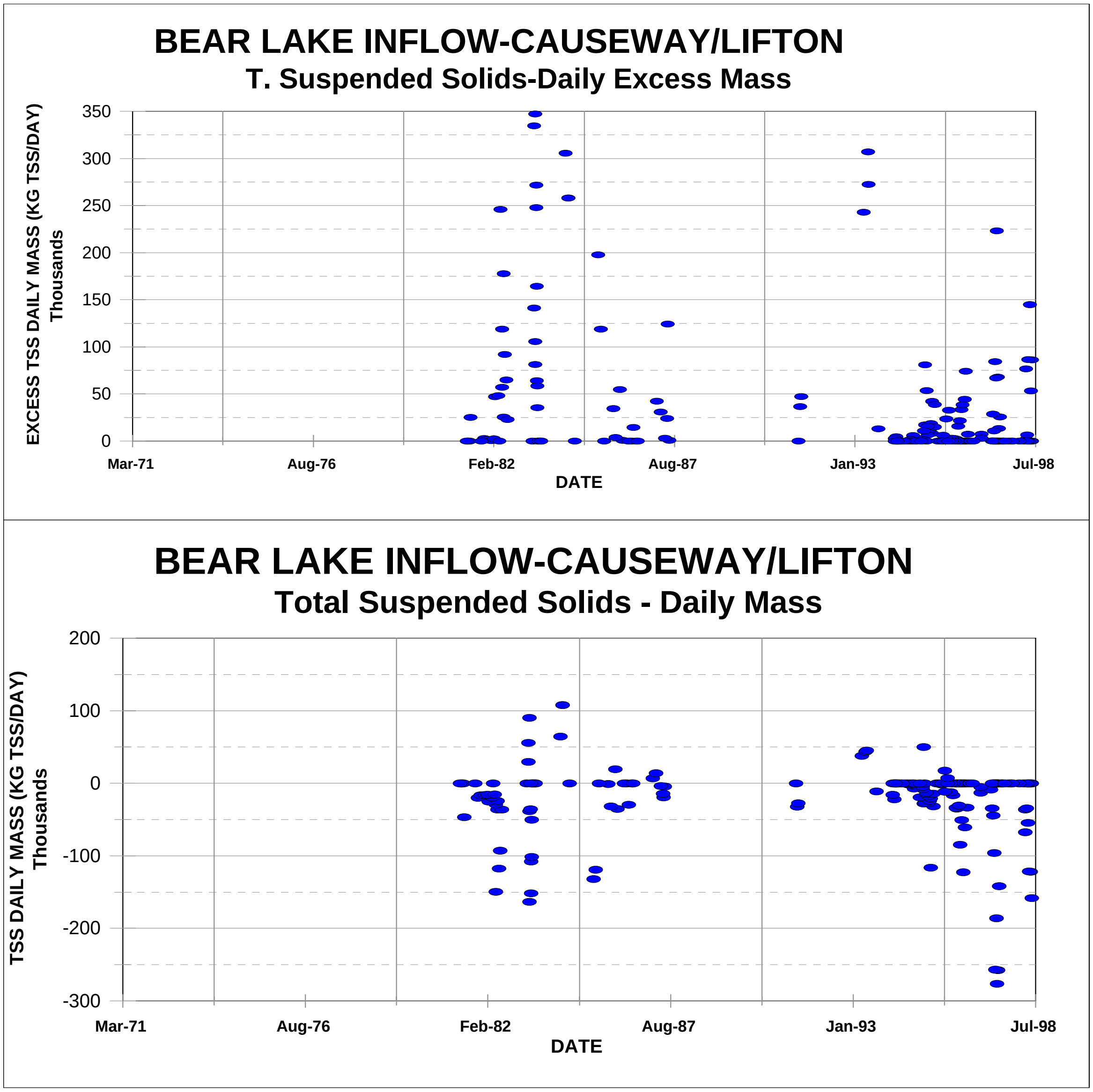


Figure 3-30. The mass loading (kg/day) for total suspended solids (above) and the excess loading (below) for all inflows into Bear Lake.

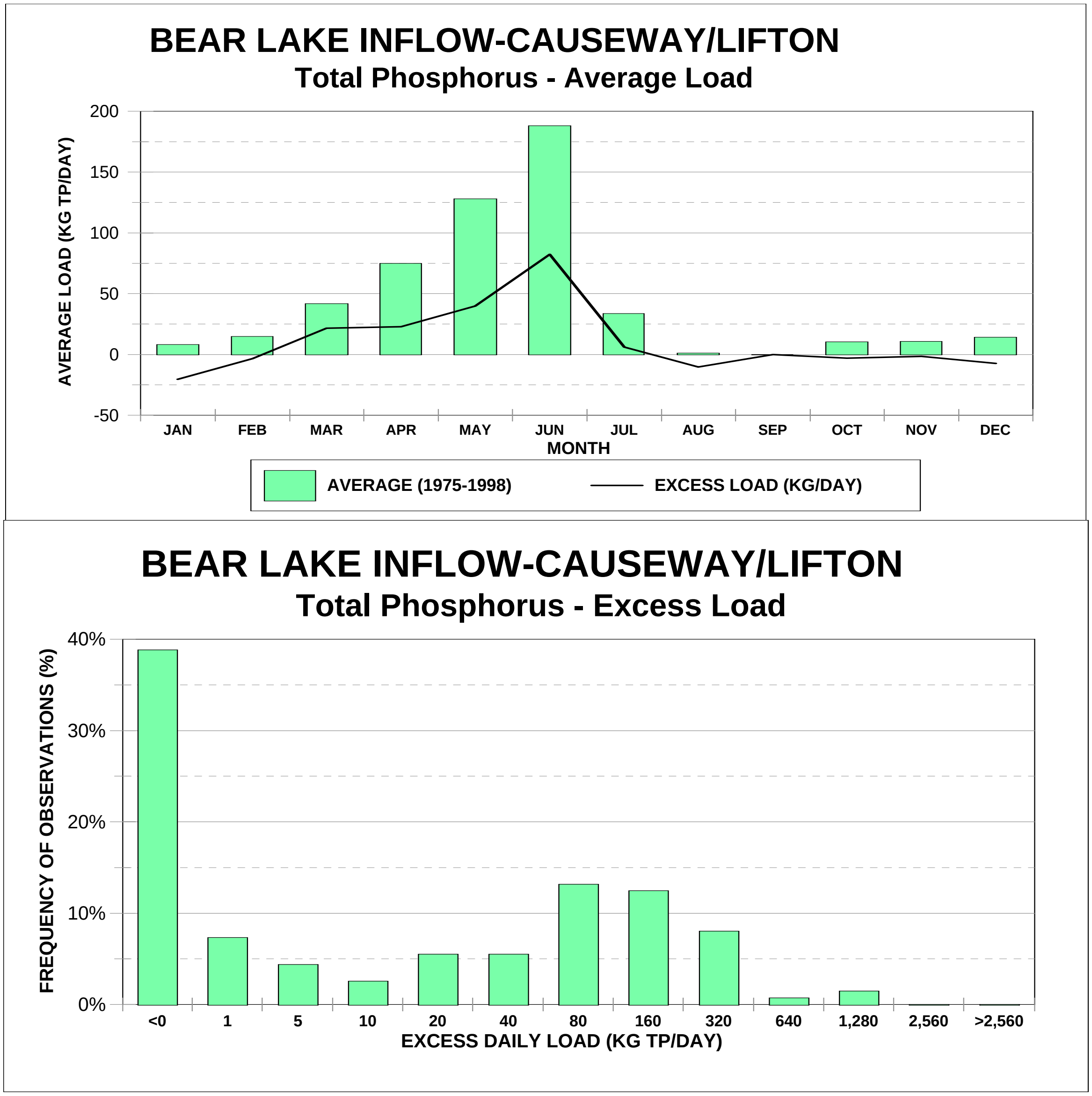


Figure 3-31. The distribution of total phosphorus loads by month (above) and the frequency distribution of excess total phosphorus for all inflows into Bear Lake.

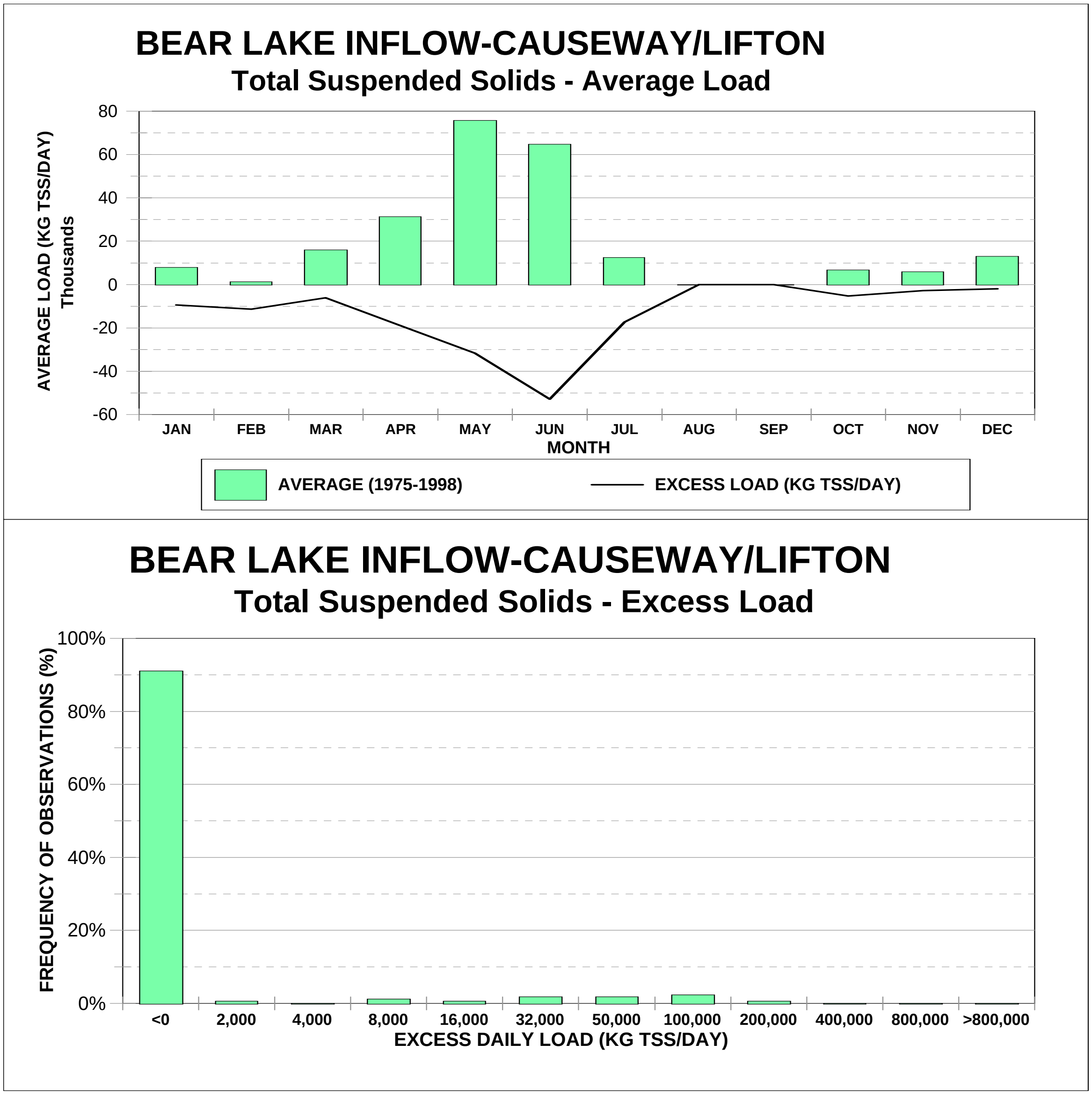


Figure 3-32. The distribution of total suspended solids loads by month (above) and the frequency distribution of excess total suspended solids for all inflows into Bear Lake.

Table 3-10. The average (1975-2000) water quality data for selected parameters at Bear River above Alexander Reservoir.

MONTH	Average Concentration (mg/L)	Average Mass (kg/day)	Excess Mass over Targets (kg/day)
Total Phosphorus			
January	0.058	94.6	13.5
February	0.073	90.2	19.9
March	0.119	194	134
April	0.116	142	80.3
May	0.112	221	126
June	0.179	504	372
July	0.174	660	507
August	0.162	430	292
September	0.126	307	204
October	0.114	248	165
November	0.093	140	66.3
December	0.046	66.8	3.84
Total Suspended Solids			
January	8.8	15,700	-41,000
February	7	13,200	-43,500
March	23.1	56,200	-21,300
April	40.3	53,600	-27,600
May	34.4	70,500	-37,600
June	73.1	250,000	87,400
July	62.4	174,000	-9,480
August	60.6	193,000	99,600
September	34.9	90,300	18,100
October	17	33,800	-17,900
November	26.6	36,700	-14,800
December	17.3	26,900	-17,200

Unlike the upstream site at Stewart Dam (Bear Lake marsh inflow), the peak and excess mass total phosphorus loading occurred in June rather than April or May. However, March through May exhibited elevated loadings and excess total phosphorus mass when compared to the summer or fall/winter months. Forty percent of the total phosphorus loading data points were less then the TMDL (based on target of 0.05 mg TP/L) and resulted in no excess loading of total phosphorus into Bear Lake. The distribution of the remaining 70 percent can be seen in Figure 3-31.

The Bear Lake Outlet represents a combination of Bear River at Stewart Dam and any outflows from Bear Lake. It is not surprising that the temporal pattern in loading is reflective of these two sources. Figure 3-33 and Figure 3-34 are plots of total phosphorus and total suspended solids daily mass and daily mass in excess of 0.075 mg TP/L and 80 or 60 mg TSS/L targets, respectively. Table 3-9 lists the average water quality by month. Figure 3-35 and Figure 3-36 are plots of the monthly average daily mass loadings for total phosphorus and suspended sediments and include the frequency distribution of loading categories. Highest daily mass loadings for total phosphorus occurred during the summer months (June-August), as well as October. During August and October, total phosphorus was in excess of target by over 150 kg TP/day. A total of 147 individual data points were used in calculating the average monthly data. Nearly 85 percent of the total suspended solids loading never exceeded targets at this station, resulting in no excess loading of sediment at this reach of the river.

It has been demonstrated in the synoptic data analysis that there is a significant gain in total phosphorus between the Bear Lake Outlet and the Bear River above Alexander Reservoir (Figure 2-38 and Figure 2-39). Inspection of Figure 3-37 through Figure 3-40 as well as Table 3-10 verifies this previous analysis. The mass loadings of total phosphorus expressed as daily averages are significantly greater when compared to the previous site (Bear Lake Outlet).

This data set indicates that the phosphorus target was exceeded for every month with the greatest exceedance occurring in July (507 kg TP/day; Table 3-10). Seven of the twelve months had excess phosphorus greater than 100 kg TP/day. As noted in Figure 3-39, only 20 percent of the loading observations (N=133) were less than the TMDL (0.05 mg TP/L). The remaining 80 percent had a symmetric frequency distribution centered on the average of 160 mg TP/day. Monthly average total suspended solids loadings exceeded the TMDL during June, August and September (Figure 3-40).

The dataset used for the site above Oneida Reservoir had the smallest number of samples (N=34) when compared to the other sites. Additionally, the data are from 1994-2000 only (Figure 3-41 and Figure 3-42). Even given this limited data set, the pattern evident throughout the sites above Oneida Reservoir held true for this site as well. March through August exhibited elevated total phosphorus mass loading levels, as well as excessive phosphorus loading (Figure 3-43 and Figure 3-44; Table 3-11) Only 11 percent of the observations were less than the 0.05 mg TP/L target (Figure 3-43). The frequency distribution of the amount of excess total phosphorus loadings was similar to the distributions observed at the above Alexander Reservoir site. TSS loading exceeded the TMDL only during the month of August.

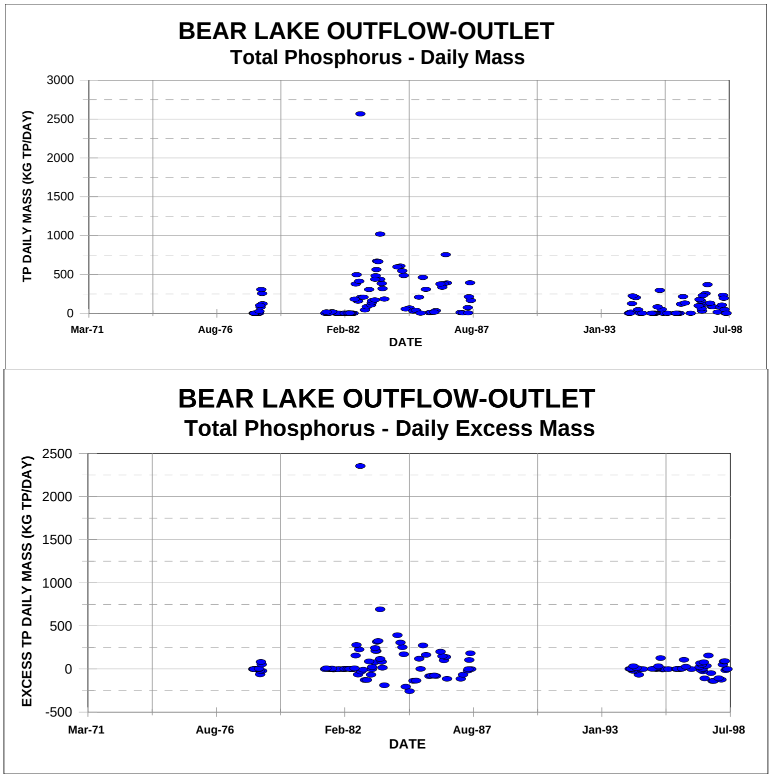


Figure 3-33. The mass loading (kg/day) for total phosphorus (above) and the excess loading (below) for the Bear Lake Outlet.

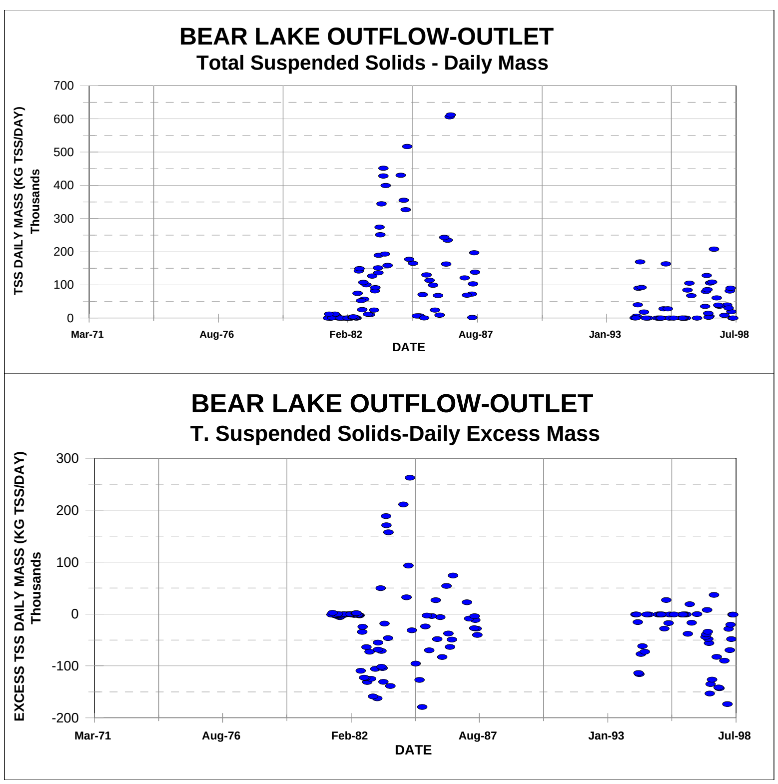


Figure 3-34. The mass loading (kg/day) for total suspended solids(above) and the excess loading (below) for the Bear Lake Outlet.

Table 3-11. The average (1994-2000) water quality data for selected parameters at Bear River above Oneida Reservoir.

MONTH	Average Concentration (mg/L)	Average Mass (kg/day)	Excess Mass over Targets (kg/day)
Total Phosphorus			
January	ND		
February	ND		
March	0.113	197	106
April	0.108	237	139
May	0.119	290	177
June	0.089	220	95.4
July	0.106	201	105
August	0.129	279	172
September	0.078	134	48.1
October	0.047	71.4	-6.13
November	0.043	35.3	-5.75
December	0.062	76.9	13.7
Total Suspended Solids			
January	ND		
February	ND		
March	33.8	60,700	-49,000
April	39.2	82,500	-36,100
May	39.6	88,900	-46,300
June	33.3	82,900	-66,400
July	42.3	83,000	-31,500
August	53.3	116,000	41,000
September	24	41,200	-19,100
October	15.7	19,500	-34,800
November	13	10,700	-18,100
December	21	27,100	-17,200

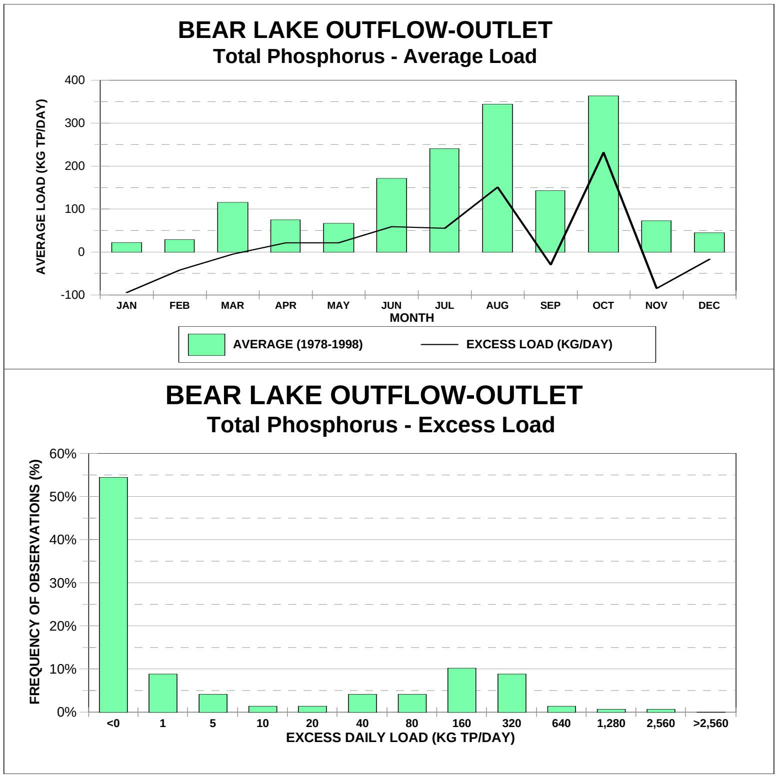


Figure 3-35. The distribution of total phosphorus loads by month (above) and the frequency distribution of excess total phosphorus for the Bear Lake Outlet.

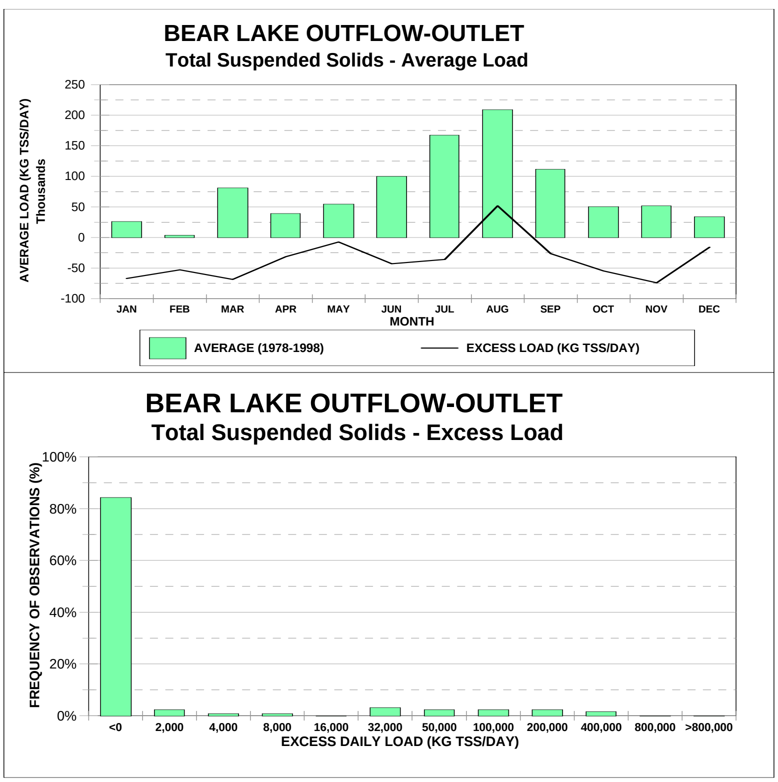


Figure 3-36. The distribution of total suspended solids loads by month (above) and the frequency distribution of excess total suspended solids for the Bear Lake Outlet.

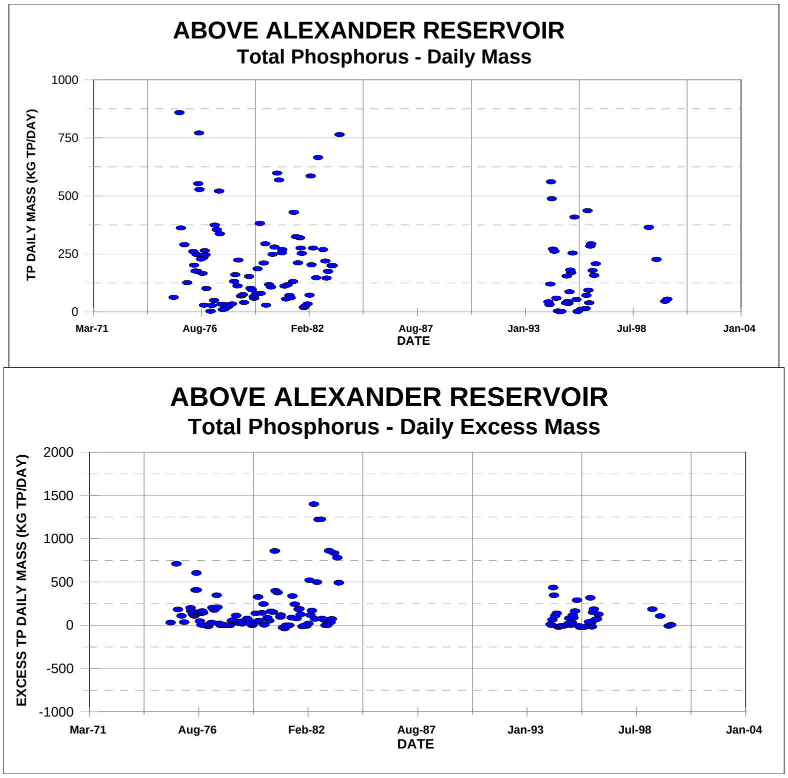


Figure 3-37. The mass loading (kg/day) for total phosphorus (above) and the excess loading (below) for the Bear River above Alexander Reservoir.

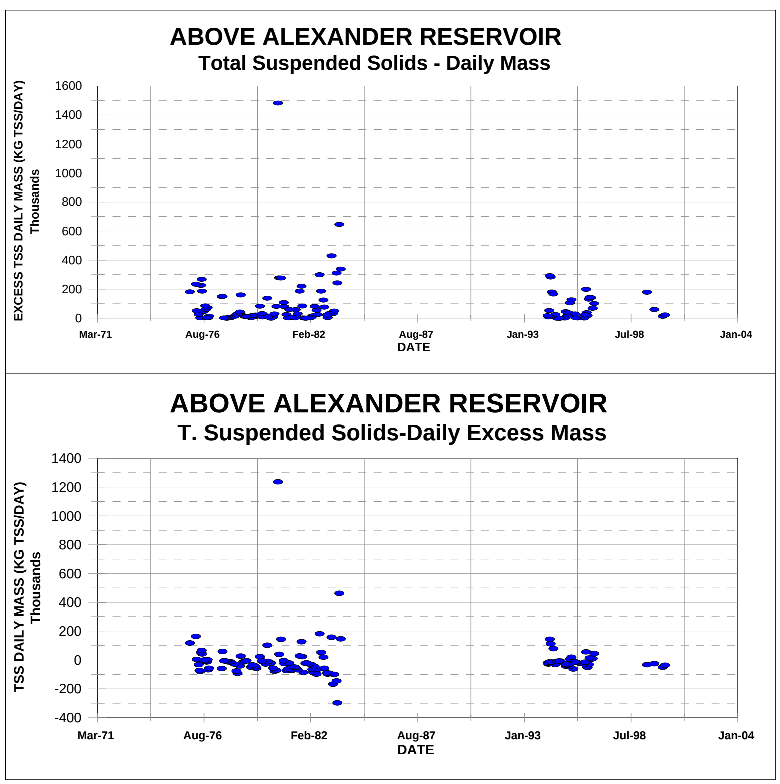


Figure 3-38. The mass loading (kg/day) for total suspended solids (above) and the excess loading (below) for the Bear River above Alexander Reservoir.

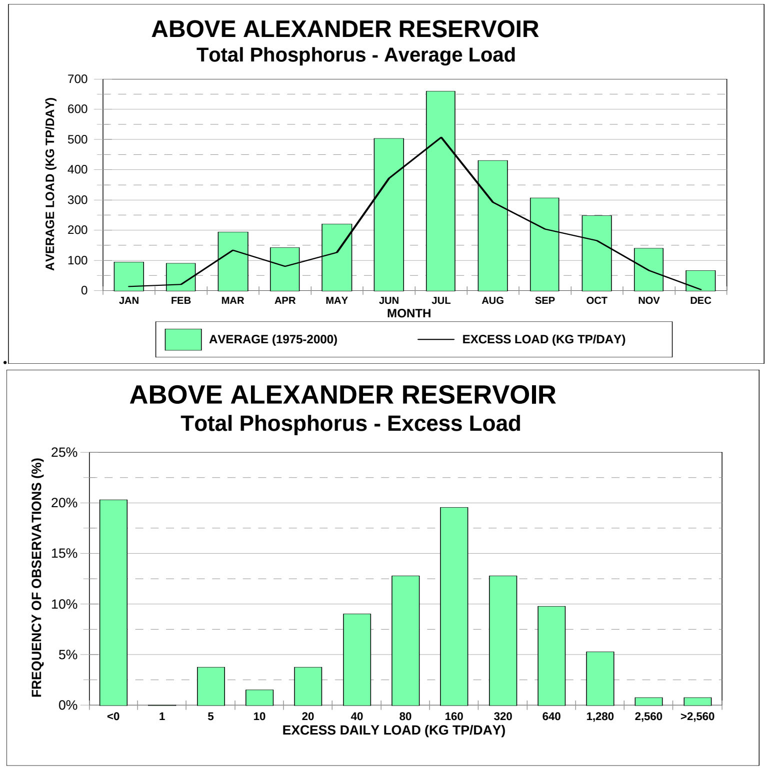


Figure 3-39. The distribution of total phosphorus loads by month (above) and the frequency distribution of excess total phosphorus for the Bear River above Alexander.

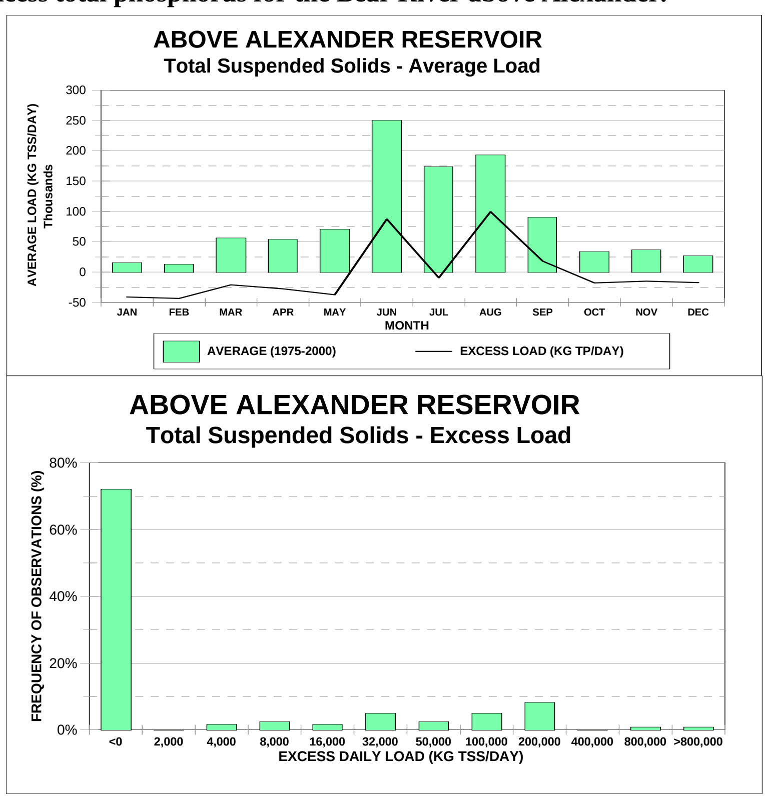


Figure 3-40. The distribution of total suspended solids loads by month (above) and the frequency distribution of excess total suspended solids for the Bear River above Alexander.

Table 3-12. The average (1972-2000) water quality data for selected parameters at Bear River at the Idaho-Utah state line.

MONTH	Average Concentration (mg/L)	Average Mass (kg/day)	Excess Mass over Targets (kg/day)
Total Phosphorus			
January	0.133	245	150
February	0.091	184	66
March	0.164	357	261
April	0.151	581	448
May	0.120	420	261
June	0.069	197	71
July	0.154	373	246
August	0.102	233	126
September	0.075	187	71
October	0.066	185	72
November	0.063	158	46
December	0.125	158	70
Total Suspended Solids			
January	91.7	127,000	30,200
February	32.9	71,300	-52,700
March	70.8	134,000	-16,100
April	39.6	134,000	-69,900
May	36.7	134,000	-91,500
June	25.7	83,100	-118,200
July	30	92,500	-107,800
August	37.4	164,000	44,000
September	19.3	51,800	-82,400
October	15.3	47,300	-94,000
November	18.2	71,300	-78,700
December	21.1	47,100	-58,200

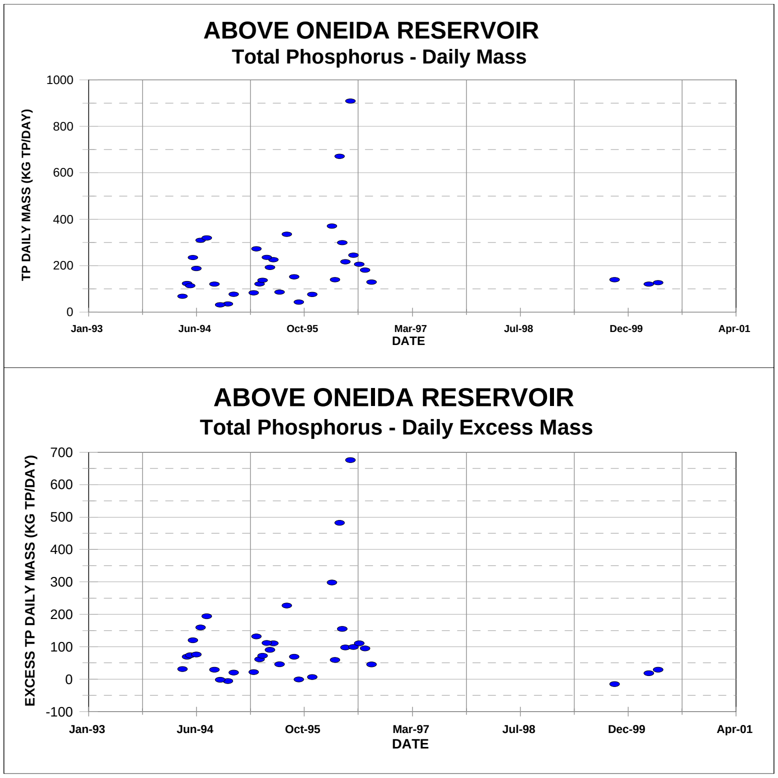


Figure 3-41. The mass loading (kg/day) for total phosphorus (above) and the excess loading (below) for the Bear River above Oneida Reservoir.

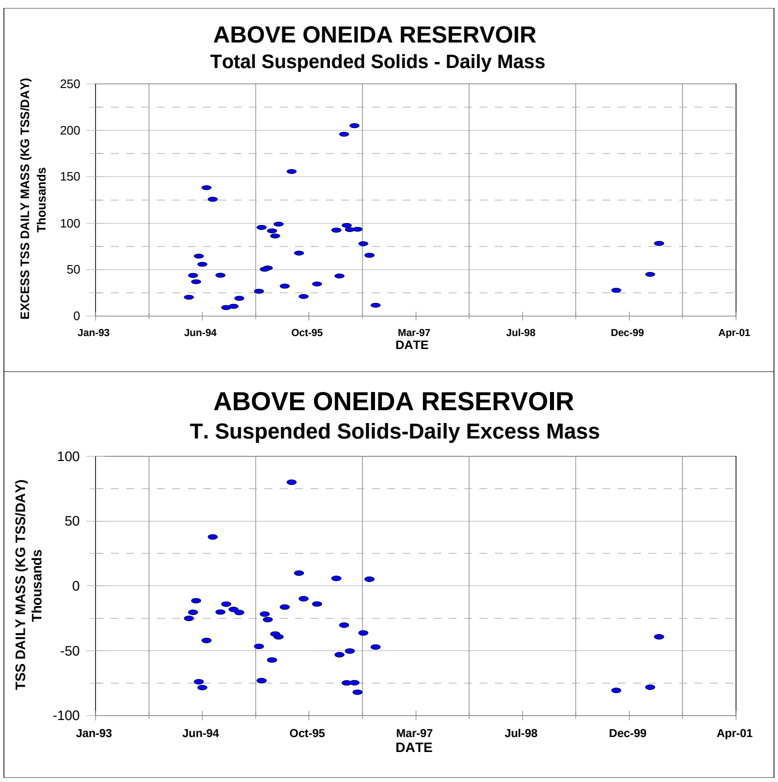


Figure 3-42. The mass loading (kg/day) for total suspended solids (above) and the excess loading (below) for the Bear River above Oneida Reservoir.

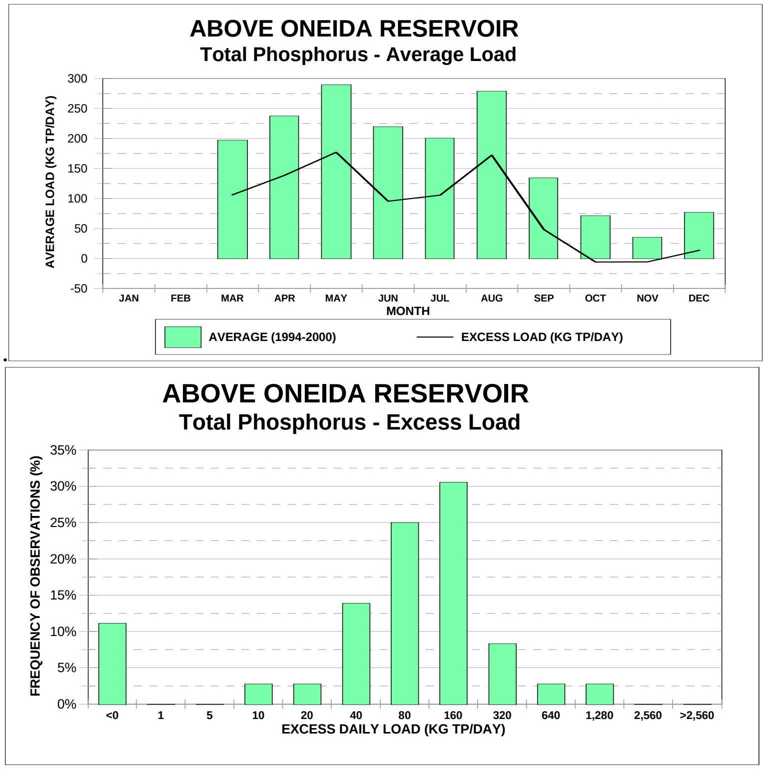


Figure 3-43. The mass loading (kg/day) for total suspended solids (above) and the excess loading (below) for the Bear River above Oneida Reservoir.

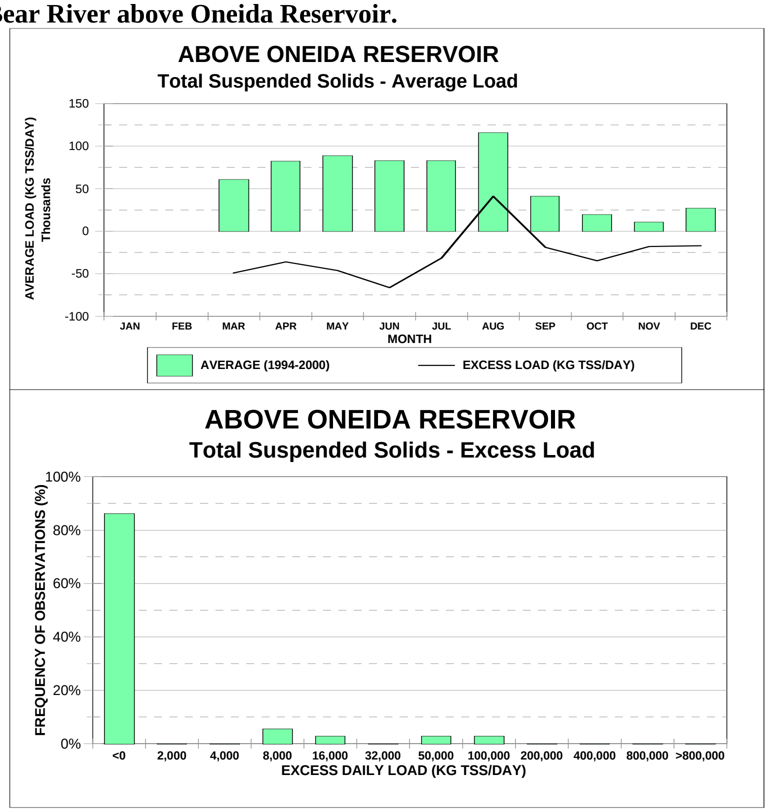


Figure 3-44. The distribution of total suspended solids loads by month (above) and the frequency distribution of excess total suspended solids for the Bear River above Oneida.

The final detailed site was located at the Idaho-Utah state line. This dataset was one of the most extensive, with 332 individual data points. Data for mass loadings can be seen in Figure 3-45 and Figure 3-46. The percent of samples below the 0.050 mg TP/L target was 20 percent. This target was exceeded every month of the year (Figure 3-47; Table 3-12). Six of the twelve months had average total phosphorus loading excesses greater than 100 kg TP/day, with a maximum excess loading of 448 kg TP/day occurring in April. Monthly total suspended solids loading averaged 96,500 kg TSS/day, with only January and August having excess loadings beyond the TSS targets (80 mg TSS/L during runoff and 60 mg TSS/L during base flow). The frequency distribution of these excess loadings can be seen in Figure 3-47 and Figure 3-48.

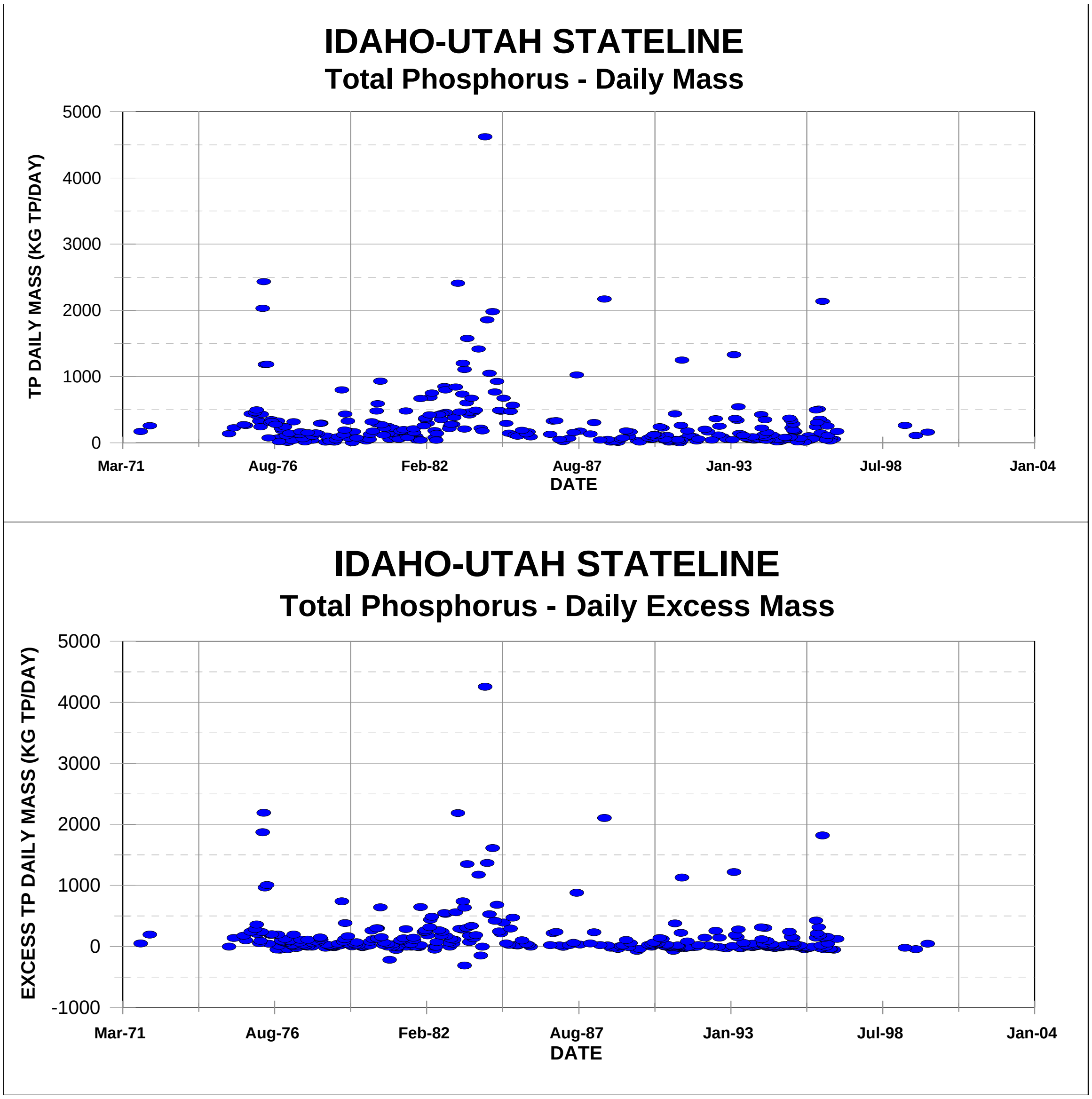


Figure 3-45. The mass loading (kg/day) for total phosphorus (above) and the excess loading (below) for the Bear River at the Idaho-Utah state line.

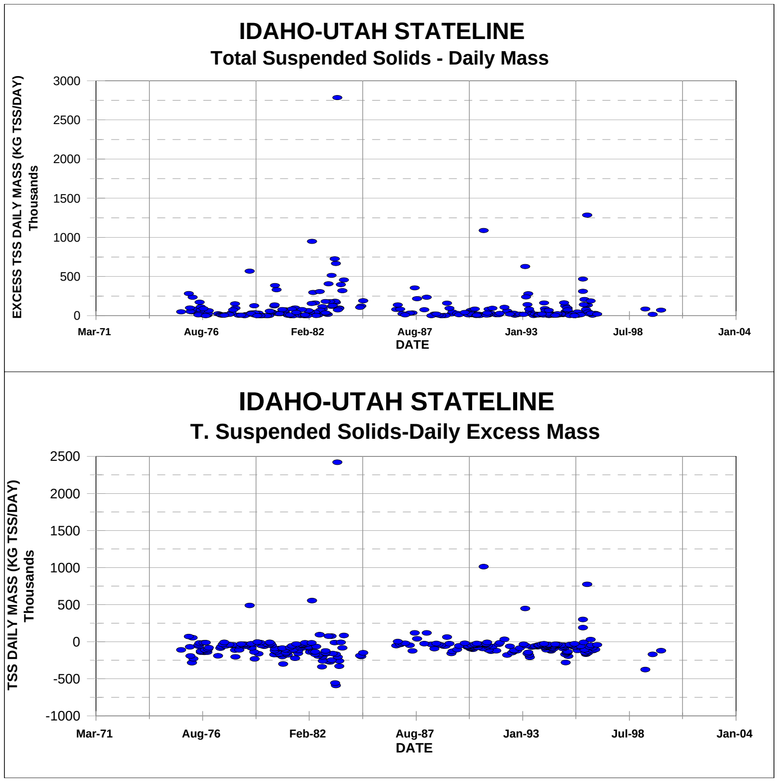


Figure 3-46. The mass loading (kg/day) for total suspended solids (above) and the excess loading (below) for the Bear River at the Idaho-Utah state line.

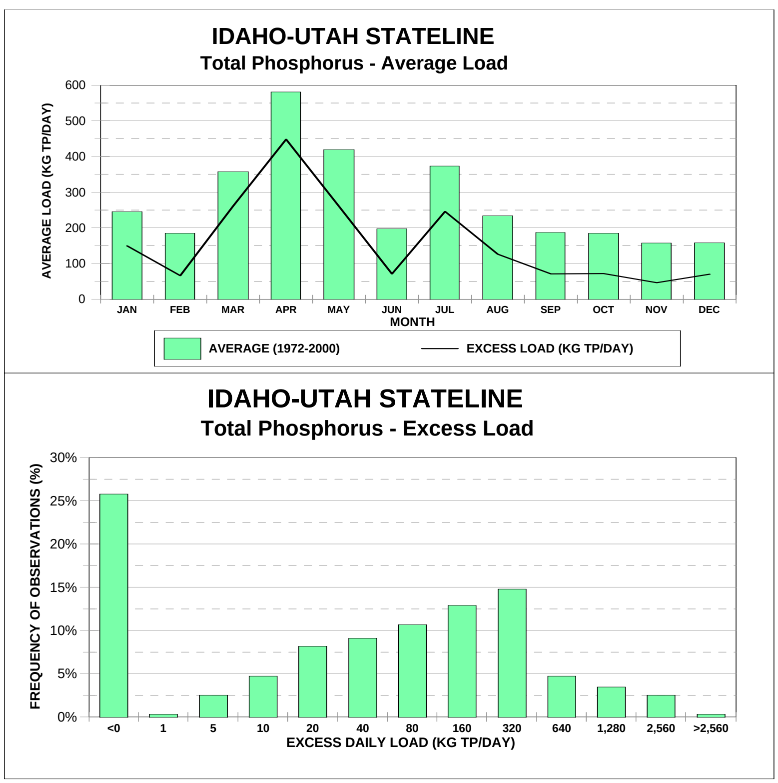


Figure 3-47. The distribution of total phosphorus loads by month (above) and the frequency distribution of excess total phosphorus for the Bear River at the Idaho-Utah state line.

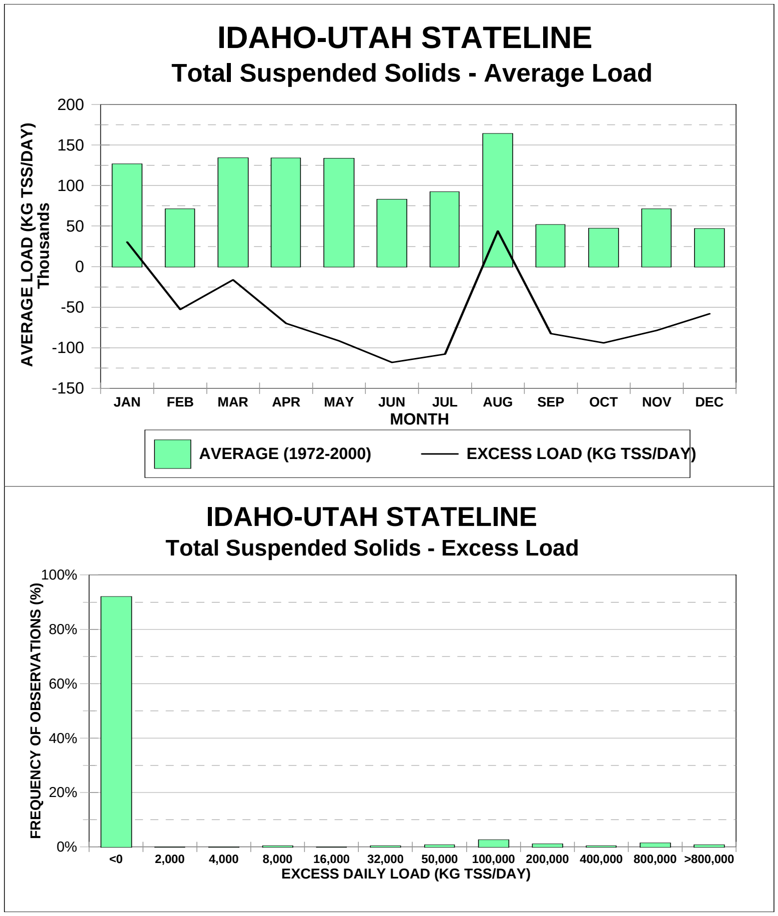


Figure 3-48. The distribution of total suspended solids loads by month (above) and the frequency distribution of excess total suspended solids for the Bear River at the Idaho-Utah state line.

3.4 Point Sources

NPDES-permitted point sources within the Idaho Bear River Basin include both waste water treatment plants (WWTPs) and fish hatcheries. Three WWTPs (Montpelier, Soda Springs, Grace) and the three fish hatcheries (Clear Springs Foods, Grace Fish Hatchery, Bear River Trout Farm) contribute both nutrients and solids to Bear River. Preston and Franklin WWTPs discharge nutrients and solids into Worm Creek and Cub River, respectively.

In addition to data contained in Discharge Monitoring Reports (DMRs), which are submitted periodically to EPA, several of these point sources were monitored (five sampling events) during the synoptic investigation (Table 3-13). Although all exceeded the target for phosphorus at some point, the Soda Springs waste water treatment plant had the highest and most consistent excess discharge into the system. No point source exceeded the TSS targets.

In general, although instances can occur as evidenced by the synoptic investigation, Bear River Basin fish hatcheries are below the targets for both phosphorus and solids. WWTPs are consistently above the phosphorus targets, but well below the TSS targets.

Table 3-13. The excess total phosphorus (>0.05 mg/L) and total suspended solids (>60/35 mg/L, runoff/base flow) loading from point sources in the Idaho Bear River basin during five sampling events.

Site#	Description	Upper Basin Runoff	Summer Base Flow	Winter Base Flow	Lower Basin Runoff	Summer Base Flow
		May 1999	October 1999	March 2000	April 2000	June 2000
Total Phosphorus (kg/day)						
T11	Clear Springs Fish Hatchery	0.67	0.25	0.00	0.16	0.12
T12	Soda Springs WWTP West Side Creek	0.15	0.00	0.09	0.03	0.00
T13	Soda Springs WWTP	4.22	3.60	3.10	3.84	4.68
Total Suspended Solids (kg/day)						
T11	Clear Springs Fish Hatchery	0	0	0	0	0
T12	Soda Springs WWTP West Side Creek	0	0	0	0	0
T13	Soda Springs WWTP	0	0	0	0	0

3.4.1 Waste Water Treatment Plants

Based on DMR data, WWTPs failed to meet total phosphorus targets in their wasteloads. Measured mean concentrations exceeded total phosphorus targets of either 0.05 or 0.075 mg/L ranging from 0.84 to 1.54 (Table 2-44). The targets vary based on discharge point, from 0.075 mg/L for Montpelier and Grace to 0.05 mg/L for Soda Springs, whose discharge is immediately upstream of Alexander Reservoir. A 0.05 mg/L total phosphorus target was also used for Franklin and Preston, whose discharges into Cub River and Worm Creek, respectively, are just upstream of the Utah-Idaho border, based on the same target set by the State of Utah in their Lower Bear River Water Quality Management Plan (Ecosystems Research Institute 1995). Resultant wasteload allocations are presented (Table 3-14) with greatest reductions from current wasteloads predicted for Preston at 1,501 kg/year and Soda Springs at 844 kg/year. Montpelier's estimated reduction requirement is 227 kg/year while Franklin and Grace would have to reduce phosphorus 165 and 69 kg/year, respectively.

Concentrations of total suspended solids from DMR data easily met both the NPDES requirements (not to exceed a monthly average of 30 mg/L for all but Montpelier) and target concentrations (35-80 mg/L depending on location and season) at all facilities (Table 2-44). Recommended total suspended solids wasteload allocations of less than 1,500 kg/year (Grace) to over 30,000 kg/year (Soda Springs and Preston) are based on the NPDES requirements of a monthly average no greater than 30 mg/L (Table 3-14). At these wasteload allocations, no reductions are necessary.

Contributions of phosphorus and suspended solids from waste water treatment plants to overall loads in Bear River, Cub River, or Worm Creek were generally low. Preston WWTP was a source of 34% of the phosphorus load and 2% of the suspended solids load in Worm Creek. Phosphorus from Franklin WWTP was 2% of the total phosphorus load in Cub River. All other phosphorus or suspended solids contributions from WWTPs were 1% or less.

In the next 20 years, several changes are expected and include population growth and facilities upgrades in association with renewal of NPDES permits. To account for projected growth and upgrade in facilities, wasteload allocations for total phosphorus (total suspended solids are expected to remain low) were recalculated using an annual population growth rate of 2 percent and a per capita gallons/day of 100 unless better data were available (Table 3-15). For Soda Springs, expected wasteload allocation ten years hence is less than the current allocation. This discrepancy is a result of projected reduction in per capita usage from 230 to 100 gallons/person/day. Thus, either population growth or facilities upgrades would constitute a need for reexamination of the recommended allocations for waste water treatment facilities in the Bear River Basin, and Table 3-15 provides guidance on expected changes.

Table 3-14. Estimated wasteload allocations and reductions from waste water treatment plants (WWTP) in Bear River Basin.

	Total phosphorus				Total suspended solids			
WWTP	Current wasteload (kg/yr)	Target load/WLA[1,2] (kg/yr)	Wasteload reduction (kg/yr)	Percent reduction	Current wasteload (kg/yr)	Target load/WLA[1,3] (kg/yr)	Wasteload reduction (kg/yr)	Percent reduction
Montpelier	244	17	227	93%	1,387	6,790	0	0%
Soda Springs	898	54	844	94%	13,191	32,217	0	0%
Grace	75	4	69	95%	267	1,409	0	0%
Preston	1,551	50	1,501	97%	17,322	30,142	0	0%
Franklin	169	4	165	98%	1,227	2,255	0	0%

(1)WLA=wasteload allocation
(2)based on current discharge and 0.075 mg/L target concentration for Montpelier, Grace, and Preston, and 0.05 mg/L for Soda Springs and Franklin
(3)based on current NPDES permit limits for Soda Springs, Grace, Preston, and Franklin not to exceed a monthly average of 30 mg/L and extending that value to Montpelier

Table 3-15. Wasteload allocations for total phosphorus based on change in facilities management plans and growth (2% per year) for waste water treatment plants (WWTP) in Bear River Basin.

	Current			10 years hence		20 years hence	
WWTP	Population estimate (2000 census)	Daily flow (gal/day)	Per capita usage (gal/person /day)	Population estimate	Wasteload allocation (kg/yr)	Population estimate	Wasteload allocation (kg/yr)
Montpelier[1,2]	2,785		100	3,395	35	4,138	43
Soda Springs[1]	3,381		100	4,121	28	5,024	35
Grace[1]	990		100	1,207	13	1,471	15
Preston	4,682	727,167	155	5,707	61	6,957	75
Franklin[2]	641	43,500	68	781	4	952	4

(1)there is an assumption that near future changes in the facility will result in changes in reported flows thus the use of a generic 100 gal/person/day
(2)assuming operations change from batch discharge to continuous year around discharge

3.4.2 Fish Hatcheries

Discharge Monitoring Report data were used to estimate wasteloads from the three NPDES permitted fish hatcheries in Bear River Basin. In the case of Clear Springs hatchery, much more information was available from the DMRs as compared to the five synoptic sampling events (Table 3-13).

Phosphorus and suspended solids wasteload allocations were figured differently as compared to the method used for wastewater treatment plants. Instead of calculating wasteloads at different flows as was done for the WWTPs, the recent highest average annual flow (1997 for Bear River Trout Farm, 1999 for Clear Springs Foods, and 2000 for Grace Fish Hatchery) was used in the analysis for both phosphorus and suspended solids.

For a total phosphorus concentration, rather than an average concentration to estimate wasteloads, a maximum monthly average was used; phosphorus concentration still averaged less than target concentrations for all three hatcheries (Table 3-16). Resulting wasteload allocations are 550 kg/year for Clear Springs Foods, 135 kg/year for Grace Fish Hatchery, and 848 kg/year for Bear River Trout Farm. The total phosphorus wasteload allocation for the three hatcheries will be seasonally administered. Maximum wasteload allocations by season are presented in Table 3-17.

Although average concentrations of suspended solids were low (less than 2 mg/L), wasteload allocations were based on the NDPES permit limit of a monthly average of 5 mg/L. Annual TSS wasteload allocations are 78,824 kilograms for Clear Springs Foods, 70,548 kilograms for Grace Fish Hatchery, and 89,301 kilograms for Bear River Trout Farm (Table 3-16).

Table 3-16. Wasteload allocations for NPDES permitted fish hatcheries in Bear River Basin.

Hatchery	Maximum average annual flow[1] (cfs)	Total phosphorus[2]						Total suspended solids[2]						
		Maximum Monthly												
		Count	Average (mg/L)	SD[3]	Current wasteload/ wasteload allocation[4] (kg/yr)	Wasteload reduction (kg/yr)	Percent reduction	Count	Average (mg/L)	SD[3]	Current wasteload (kg/yr)	Wasteload allocation[5] (kg/yr)	Wasteload reduction (kg/yr)	Percent reduction
Clear Springs Foods	17.7	12	0.035	0.018	550	0	0%	36	1.09	1.63	17,210	78,824	0	0%
Grace Fish Hatchery (6)	15.8	12	0.010	0.01	135	0	0%	21	0.30	1.25	4,206	70,548	0	0%
Bear River Trout Farm	20.0	8	0.048	0.04	848	0	0%	20	0.55	1.16	9,823	89,301	0	0%

(1)for Clear Springs Foods 1999 (period of record: 1989-2004); for Grace Fish Hatchery 2000 (period of record: 1994-2004); for Bear River Trout Farm 1997 (period of record: 1992-2004)
(2)from DMR data since January 2000
(3)SD=standard deviation
(4)wasteload allocation=current wasteload
(5)based on current NPDES permit limit of no greater than 5 mg/L monthly average; daily wasteloads equal 216 kg/day for Clear Springs Foods, 193 kg/day for Grace Fish Hatchery, 245 kg/day for Bear River Trout Farm
(6)data since January 2002 following renovation

Table 3-17. Seasonal phophorus wasteload allocations for NPDES permitted fish hatcheries in Bear River Basin.

Hatchery	Parameter[1]	Season[2]			
		Winter	Spring	Summer	Fall
Clear Springs Foods	Flow (cfs)	17.7	17.7	17.7	17.7
	Concentration (mg/L)	0.048	0.021	0.021	0.048
	WLA (kg/day)	2.09	0.93	0.93	2.09
	WLA (kg/period)	188	84	85	193
Grace Fish Hatchery	Flow (cfs)	13.3	11.8	17.7	13.6
	Concentration (mg/L)	0.018	0.016	0.005	0.006
	WLA (kg/day)	0.60	0.45	0.23	0.21
	WLA (kg/period)	54	41	21	19
Bear River Trout Farm	Flow (cfs)	20.0	20.0	20.0	20.0
	Concentration (mg/L)	0.05	0.074	0.0331	0.0331
	WLA (kg/day)	2.45	3.62	1.62	1.62
	WLA (kg/period)	220	330	149	149

(1)WLA=wasteload allocation
(2)Winter (Jan-Mar), 90 days; Spring (Apr-Jun), 91 days; Summer (Jul-Sep), 92 days; Fall (Oct-Dec), 92 days

3.5 Loading Summary

Studies documented in this report, as well as an analysis of historical water quality data, have indicated that total phosphorus, total suspended sediments, inorganic nitrogen, dissolved oxygen, temperature, and bacteriological standards or criteria have been exceeded for both the mainstem Bear River and tributaries to the Bear River. Total phosphorus and, to a lesser extent, total suspended solids, were widespread in their exceedance of water quality targets. In order to fully address the sources of the excess phosphorus and TSS observed in the water quality data, nonpoint loads must be calculated and evaluated relative to the other sources. The Bear River was divided into four management riverine reaches (MR1-MR4) and three reservoir/lake reaches (RW1-RW3) to calculate nonpoint loading.

3.5.1 Load Allocation Analysis - Bear River

During the analysis process of this project, the Bear River was sampled at 17 sites and divided into 18 separate river reaches. In order to effectively analyze and ultimately manage pollutant control, we are proposing combining these smaller reaches into larger, river sections defined as Management Reaches (MR). These four reaches in the middle Bear River coincidently correspond to the inter-reservoir stream segments. The major receiving water bodies in the basin are treated as management units as well. They are defined as Receiving Waters (RW). Figure 3-49 is a diagram of the management reaches for the Bear River in relation to the 17 sampling sites. Table 3-18 is a list of the sampling sites and the tributaries contributing to each reach.

Utilizing the historical water quality data at seven key sites on the Bear River in Idaho, as well as data for point sources, tributaries, and diversion sites, a mass balance approach was undertaken to quantify the nonpoint sources of TP and TSS loading. The loadings from all sources were compared for each hydrologic period (lower and upper basin runoff, summer and winter base flow), encompassing an entire year. The Total Maximum Daily Load (TMDL) was calculated using the appropriate targets for that parameter and the associated measured flow. The following discussion will include the exceedances within the four river management reaches and the three receiving water reaches. It should be noted that for several sites within the management reaches loads may be less than the TMDL targets. In such cases, TMDL load allocations were set at current estimated loads.

Riverine Management Reaches

The location of the riverine management reaches are shown below for the middle Bear River in Idaho. The load allocations by sources for TP and TSS will be described for each Management Reach followed by the TMDL calculations for that reach.

MR1	Wyoming-Idaho state line to Causeway at Bear Lake
MR2	Bear Lake Marsh Outlet to Above Alexander Reservoir
MR3	Below Alexander Reservoir to Above Oneida Reservoir
MR4	Below Oneida Reservoir to Idaho-Utah state line

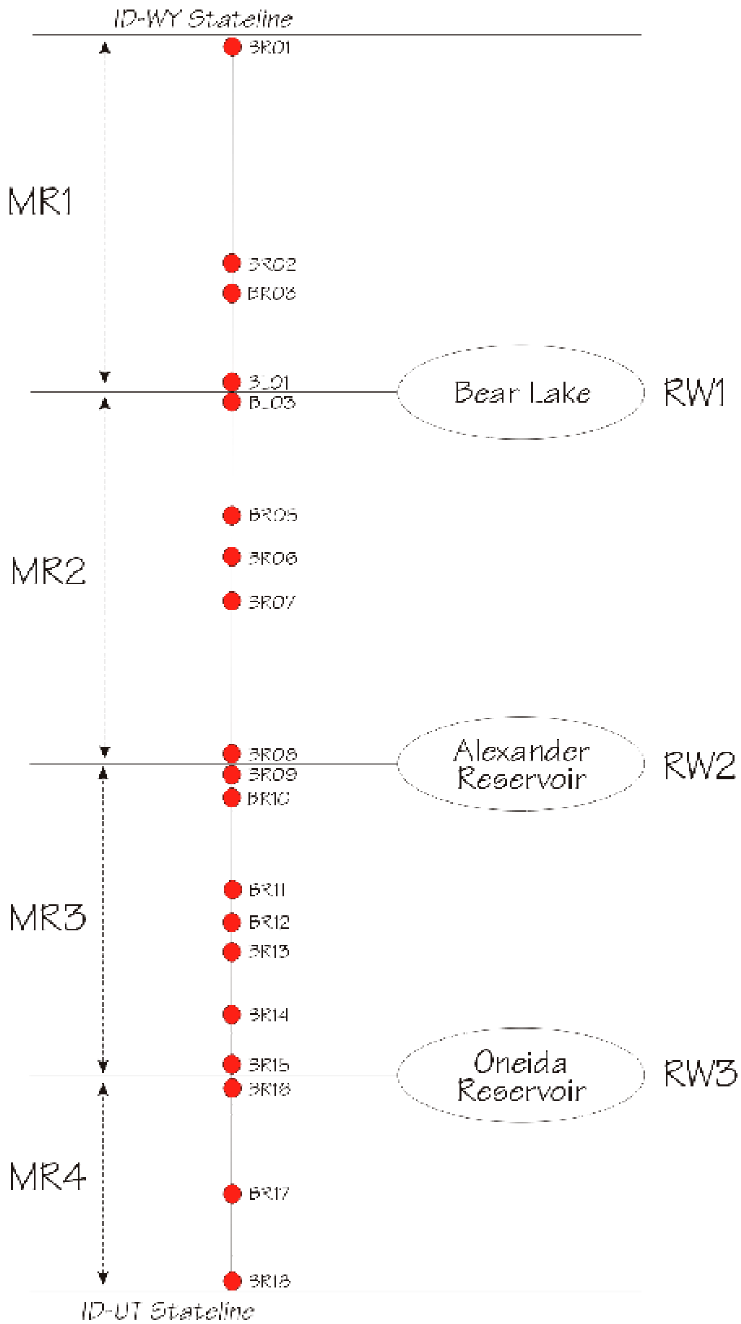


Figure 3-49. A schematic of this study's sampling sites within the Bear River in Idaho as compared to the reaches used in the loading analysis.

Table 3-18. Sampling sites for mainstem and tributaries by name and description for the four Bear River riverine management reaches.

REACH	SITE	DESCRIPTION	TRIBUTARIES INCLUDED WITHIN REACH
MR1	BR01	BR at ID WY state line	
MR1	BR02	BR at Hunter Hill Road bridge	T01 Thomas Fork T02 Sheep Creek
MR1	BR03	Stewart Dam	
MR1	BL01	Causeway	
MR2	BL03	BL outlet	BL02 Lifton
MR2	BR05	BR at Pescadero	BR04 Bear River Old Channel T03 Ovid Creek
MR2	BR06	BR at Nounan Bridge	
MR2	BR07	BR at Stauffer Creek	T04 Georgetown Creek
MR2	BR08	BR above Alexander	T05 Stauffer Creek T06 Skinner Creek T07 Pearl Creek T08 Eightmile Creek T09 Sulphur Canyon Creek T10 Bailey Creek
MR3	BR09	BR below Alexander	T11 Clear Springs Fish Hatchery T12 Soda Springs WWTP West Side Creek T13 Soda Springs WWTP T14 Soda Creek
MR3	BR10	BR at Last Chance	
MR3	BR12	BR at Cheeseplant Bridge	BR11 BR at Black Canyon INT1 Last Chance Canal INT3 Penstock
MR3	BR13	BR at Thatcher Church	T15 Densmore Creek T16 Smith Creek
MR3	BR14	BR at Thatcher Bridge	T17 Alder Creek T18 Whiskey Creek T19 Burton Creek
MR3	BR15	BR abv Oneida at Highway Bridge	T20 Trout Creek T21 Williams Creek
MR4	BR16	BR blw Oneida	T22 Cottonwood Creek T23 Maple Hot Springs
MR4	BR17	BR west of Preston	INT2 West Cache Canal T24 Mink Creek T25 Battle Creek T26 Deep Creek T27 5 Mile Creek
MR4	BR18	BR at UT-ID state line	T28 Weston Creek

MR1: Wyoming-Idaho state line to Causeway at Bear Lake

The uppermost reach within the Bear River in Idaho starts at the Idaho-Wyoming state line and continues downstream to Stewart Dam. Flows in the Bear River are diverted at Stewart Dam into the Bear Lake marsh complex and enter Bear Lake through the Causeway station. The Causeway station represents the end of Management Reach 1 (MR1). This reach contains two tributaries, the largest being the Thomas Fork. Instantaneous individual loads for the Thomas Fork and Sheep Creek were described in Section 3.0 of this report.

Inspection of both the synoptic and historical TP and TSS data at the state line station (Idaho-Wyoming) indicates that the Bear River entering the state of Idaho exceeded the TP and TSS targets 30 and 33 percent of the time, respectively. Within the reach in Idaho, the total phosphorus and total suspended solids mass has a net decrease (Table 3-19 through Table 3-22) for each of the hydrologic periods. Total phosphorus loading within this reach decreases an average of 32 kg/day during winter base flow and 424 kg/day during upper basin runoff. The reason for this decrease is the inclusion of the Bear Lake Marsh within this Management Reach. Wetland vegetation within the marsh acts as a substantive filter for the system. It should be noted that an increase in loading does occur within the area between the Idaho-Wyoming state line station and Stewart Dam, but are offset by the marsh complex prior to the water's entrance into Bear Lake.

The allocations of loads within MR1 is shown in Figure 3-50 through Figure 3-53. These figures demonstrate, as described above, that the upstream load is the major source of TP and TSS within the Management Reach, even during upper basin runoff where tributary inputs are measurable.

Given the riverine and marsh dynamics within this reach, the excess load leaving the reach (the **outflow** of the Management Reach is defined as the target endpoint) is in excess of the TMDL targets for TP during lower and upper basin runoff. This excess load is 22 and 51 kg TP/day, respectively (Table 3-19 through Table 3-22; Figure 3-54 through Figure 3-57).

MR2: Bear Lake Marsh Outlet to Above Alexander Reservoir

Within this reach of the Bear River, there are nine tributaries entering the river (Table 3-18). Three point sources and the tributary Soda Creek enter Alexander Reservoir directly. Georgetown and Eightmile creeks are major contributors of phosphorus and total suspended solids. In addition, the mainstem Bear River had a significant amount of nonpoint source total phosphorus gain, especially between the outlet of Bear Lake Marsh and Pescadero station. Within MR2, the tributaries contributed between 5 and 25 percent of the load gain. The remainder was defined as nonpoint sources (Table 3-19 through Table 3-22). There are no point sources within this management reach.

Inspection of the inflow and outflow mass for MR2 compared to the TMDL limits for each hydrologic period (Figure 3-54 through Figure 3-57, indicates that at the compliance point (leaving MR2), total phosphorus exceeded target mass during all four hydrologic periods. This excess ranges from 21 kg TP/day during winter base flow to 319 kg TP/day during upper basin runoff. For total suspended solids, the TMDL was exceeded in half of the hydrologic periods. Excesses of 2,300 kg TSS/day and 27,900 kg TSS/day occurred in upper basin runoff and summer base flow, respectively. It should be noted that during summer base flow, water is released from Bear Lake downstream into the Bear River. This time period represents the high flow period for this section of the Bear River.

MR3: Below Alexander Reservoir to Above Oneida Reservoir

There are seven tributaries entering the reach between Alexander and Oneida reservoirs. All tributaries, except for Williams Creek, exceeded the phosphorus target two to five times in five synoptic sample periods (Table 3-1). These tributary TP loads account for 6 to 35 percent of the total sources within this management reach. The source of the majority of the TP loading gain in MR3 has been calculated to be from nonpoint sources (Table 3-19 through Table 3-22), with the largest TP gain during lower basin runoff (124 kg TP/day) followed by upper basin runoff (77 kg TP/day). Nonpoint gains in the two base flow periods were 30 to 40 kg TP/day. As with phosphorus, the total suspended solids gains were from tributaries, as well as nonpoint sources. The nonpoint source gains ranged between 19,000 and 47,000 kg TSS/day, with tributaries ranging between 0 and 23,000 kg TSS/day. During upper basin runoff, the tributary and nonpoint loads were equal in magnitude at 23,000 to 27,000 kg TSS/day.

Relative to the MR3 TMDL, total phosphorus is the pollutant of concern given that it exceeded the MR3 endpoint targets for each of the hydrologic periods while total suspended solids does not exceed targets in any time period (Figure 3-54 through Figure 3-57. Highest TP exceedances occurred during lower basin runoff (124 kg TP/day) and upper basin runoff (142 kg TP/day) and lowest exceedances occurred during summer base flow (72 kg TP/day) and winter base flow (7 kg TP/day) periods.

MR4: Below Oneida Reservoir to Idaho-Utah State line

This lowest reach of the Bear River from below Oneida Reservoir to the Idaho-Utah state line contained tributaries (Table 3-18), which exceeded the phosphorus target most frequently and with a high magnitude. The tributary load varies depending upon the hydrologic time period. During upper basin runoff, the tributaries accounted for 75 percent of the TP sources within this management reach. In the remaining periods, tributaries were 6 to 30 percent of the total TP load entering the river (Table 3-19 through Table 3-22). As in MR3, the highest nonpoint loads occurred during lower basin runoff (272 kg TP/day) and the lowest loads occurred during upper basin runoff (62 kg TP/day).

An inspection of the loadings of TP and TSS entering the state of Utah (endpoint of MR4) in Figure 3-54 through Figure 3-57 indicates that TSS does not exceed the TMDL target load for any hydrologic time period while TP exceeded the target (0.050 mg P/L) at all times. The exceedances were highest during lower basin runoff (350 kg TP/day), followed by upper basin runoff (199 kg TP/day). The base flow periods were about 80 kg/day in excess of target load for total phosphorus.

Table 3-19. The load allocation and TMDL analysis for the management reaches (MR) and receiving water reaches (RW) during winter base flow.

TOTAL SUSPENDED SOLIDS LOADING (kg/day)					
REACH	**STATION**	**MAINSTEM**	**POINT SRC**	**TRIBUTARIES**	**NPS GAIN/LOSS**
MR1	BR01	8,385			
	CSWY/LFT	7,464		0	-921
RW1					23,838
MR2	BL03	31,302			
	BR08	25,585		0	-5,717
RW2			203	0	-23,355
MR3	BR09	2,433			
	BR15	21,596		0	19,163
RW3				0	-14,599
MR4	BR16	6,997			
	BR17	76,365	357	1,010	68,001
TOTAL PHOSPHORUS LOADING (kg/day)					
REACH	**STATION**	**MAINSTEM**	**POINT SRC**	**TRIBUTARIES**	**NPS GAIN/LOSS**
MR1	BR01	44			
	CSWY/LFT	12		0	-32
RW1					30
MR2	BL03	42			
	BR08	99		0	57
RW2			6	0	-79
MR3	BR09	27			
	BR15	63		0	37
RW3				0	-21
MR4	BR16	42			
	BR17	188	3	9	134

STATION	TSS LOAD (kg/day)	TSS TMDL (kg/day)	PERCENT REDUCTION	TP LOAD (kg/day)	TP TMDL (kg/day)	PERCENT REDUCTION
BR01	8,385	35,149	0%	44	44	0%
BR03	15,165	24,042	0%	27	34	0%
CSWY/LFT	7,464	14,343	0%	12	20	0%
LFT-OUT	11,097	105,271	0%	21	132	0%
BL03	31,302	84,562	0%	42	106	0%
BR08	25,585	49,613	0%	99	71	28%
BR09	2,433	39,782	0%	27	50	0%
BR15	21,596	39,076	0%	63	56	11%
BR16	6,997	65,725	0%	42	55	0%
BR17	76,365	124,927	0%	188	104	45%

Table 3-20. The load allocation and TMDL analysis for the management reaches (MR) and receiving water reaches (RW) during lower basin runoff.

TOTAL SUSPENDED SOLIDS LOADING (kg/day)					
REACH	**STATION**	**MAINSTEM**	**POINT SRC**	**TRIBUTARIES**	**NPS GAIN/LOSS**
MR1	BR01	59,701			
	CSWY/LFT	26,252		871	-34,320
RW1					23,788
MR2	BL03	50,040			
	BR08	54,769		956	3,772
RW2			265	998	-32,992
MR3	BR09	23,039			
	BR15	72,587		2,275	47,273
RW3				0	-54,123
MR4	BR16	18,464			
	BR17	134,181	153	18,412	97,152
TOTAL PHOSPHORUS LOADING (kg/day)					
REACH	**STATION**	**MAINSTEM**	**POINT SRC**	**TRIBUTARIES**	**NPS GAIN/LOSS**
MR1	BR01	282			
	CSWY/LFT	64		1	-219
RW1					21
MR2	BL03	85			
	BR08	165		4	77
RW2			7	17	-101
MR3	BR09	88			
	BR15	219		8	124
RW3				0	-110
MR4	BR16	109			
	BR17	467	3	83	272

STATION	TSS LOAD (kg/day)	TSS TMDL (kg/day)	PERCENT REDUCTION	TP LOAD (kg/day)	TP TMDL (kg/day)	PERCENT REDUCTION
BR01	59,701	115,884	0%	282	109	61%
BR03	281,452	107,187	62%	351	89	75%
CSWY/LFT	26,252	49,860	0%	64	42	34%
LFT-OUT	3,902	148,753	0%	22	139	0%
BL03	50,040	75,062	0%	85	70	18%
BR08	54,769	73,148	0%	165	61	63%
BR09	23,039	96,624	0%	88	91	0%
BR15	72,587	114,528	0%	219	95	57%
BR16	18,464	145,771	0%	109	91	17%
BR17	134,181	187,565	0%	467	117	75%

Table 3-21. The load allocation and TMDL analysis for the management reaches (MR) and receiving water reaches (RW) during upper basin runoff.

TOTAL SUSPENDED SOLIDS LOADING (kg/day)					
REACH	**STATION**	**MAINSTEM**	**POINT SRC**	**TRIBUTARIES**	**NPS GAIN/LOSS**
MR1	BR01	374,222			
	CSWY/LFT	62,387		63,855	-375,690
RW1					36,135
MR2	BL03	98,523			
	BR08	151,116		14,679	37,914
RW2			380	2,936	-119,041
MR3	BR09	35,391			
	BR15	86,115		23,460	27,264
RW3				10	-67,097
MR4	BR16	19,028			
	BR17	104,582	153	15,423	69,978

TOTAL PHOSPHORUS LOADING (kg/day)					
REACH	**STATION**	**MAINSTEM**	**POINT SRC**	**TRIBUTARIES**	**NPS GAIN/LOSS**
MR1	BR01	473			
	CSWY/LFT	137		87	-424
RW1					9
MR2	BL03	146			
	BR08	443		37	260
RW2			10	50	-368
MR3	BR09	135			
	BR15	253		42	77
RW3				0	-146
MR4	BR16	107			
	BR17	337	3	165	62

STATION	TSS LOAD (kg/day)	TSS TMDL (kg/day)	PERCENT REDUCTION	TP LOAD (kg/day)	TP TMDL (kg/day)	PERCENT REDUCTION
BR01	374,222	229,736	39%	473	215	55%
BR03	320,923	182,643	43%	445	152	66%
CSWY/LFT	62,387	103,223	0%	137	86	37%
LFT-OUT	40,638	177,103	0%	108	166	0%
BL03	98,523	109,961	0%	146	103	29%
BR08	151,116	148,776	2%	443	124	72%
BR09	35,391	154,670	0%	135	145	0%
BR15	86,115	133,663	0%	253	111	56%
BR16	19,028	148,175	0%	107	93	13%
BR17	104,582	220,813	0%	337	138	59%

Table 3-22. The load allocation and TMDL analysis for the management reaches (MR) and receiving water reaches (RW) during summer base flow.

TOTAL SUSPENDED SOLIDS LOADING (kg/day)					
REACH	**STATION**	**MAINSTEM**	**POINT SRC**	**TRIBUTARIES**	**NPS GAIN/LOSS**
MR1	BR01	27,263			
	CSWY/LFT	3,346		528	-24,445
RW1					131,342
MR2	BL03	134,688			
	BR08	102,994		1,487	-33,180
RW2			178	226	-69,547
MR3	BR09	33,852			
	BR15	58,841		931	24,059
RW3				0	-51,844
MR4	BR16	6,997			
	BR17	82,353	122	1,527	73,706
TOTAL PHOSPHORUS LOADING (kg/day)					
REACH	**STATION**	**MAINSTEM**	**POINT SRC**	**TRIBUTARIES**	**NPS GAIN/LOSS**
MR1	BR01	52			
	CSWY/LFT	6		6	-52
RW1					289
MR2	BL03	294			
	BR08	326		8	23
RW2			8	5	-213
MR3	BR09	126			
	BR15	162		7	29
RW3				0	-80
MR4	BR16	81			
	BR17	200	3	35	81

STATION	TSS LOAD (kg/day)	TSS TMDL (kg/day)	PERCENT REDUCTION	TP LOAD (kg/day)	TP TMDL (kg/day)	PERCENT REDUCTION
BR01	27,263	30,995	0%	52	39	25%
BR03	87,669	30,901	65%	123	44	64%
CSWY/LFT	3,346	7,931	0%	6	11	0%
LFT-OUT	19,797	90,933	0%	52	114	0%
BL03	134,688	136,765	0%	294	171	42%
BR08	102,994	75,033	27%	326	107	67%
BR09	33,852	97,509	0%	126	122	3%
BR15	58,841	63,120	0%	162	90	44%
BR16	6,997	92,167	0%	81	77	5%
BR17	82,353	134,970	0%	200	112	44%

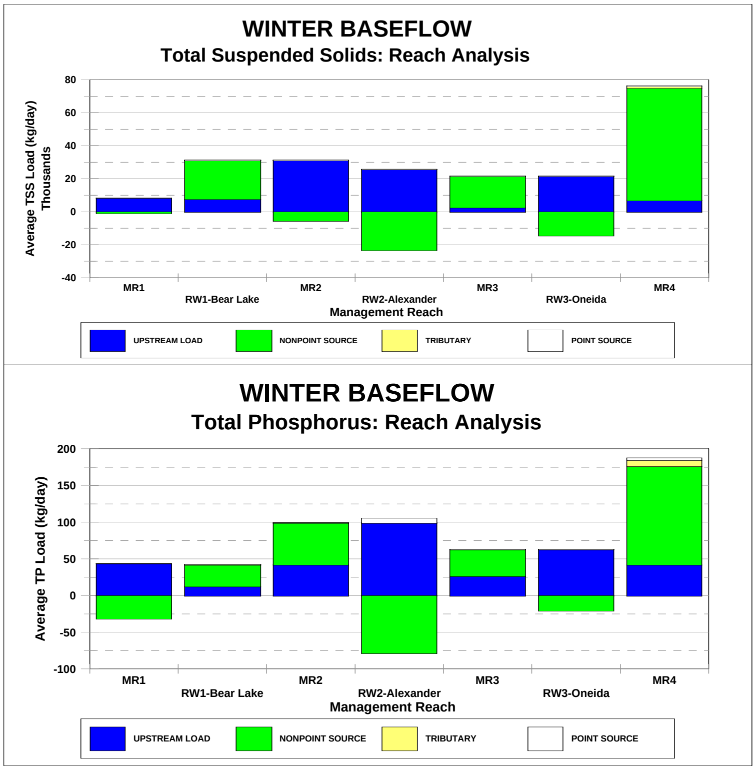


Figure 3-50. Analysis of total suspended solids (above) and total phosphorus (below) loading allocations by management reach during winter base flow.

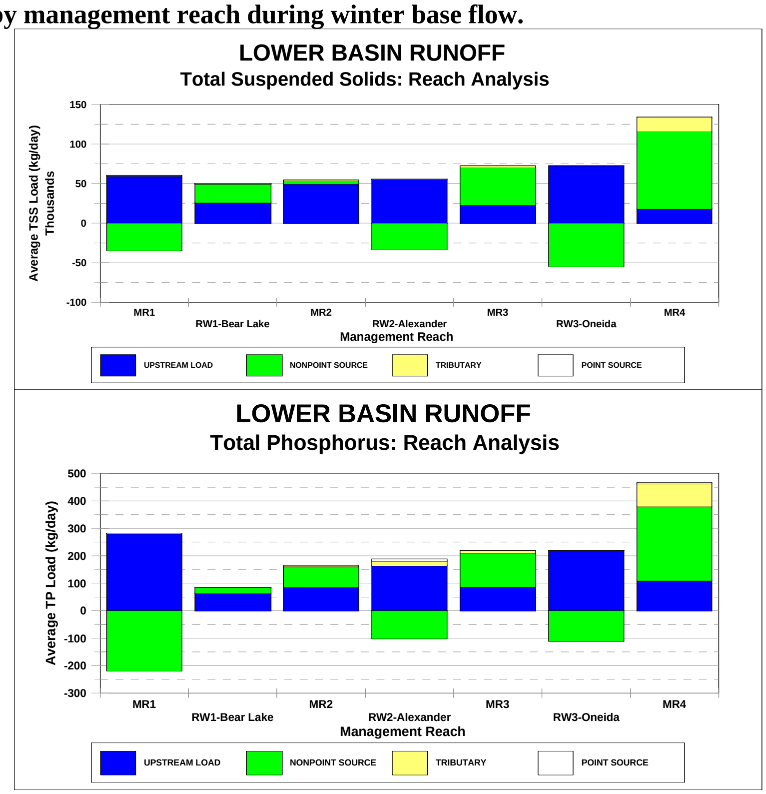


Figure 3-51. Analysis of total suspended solids (above) and total phosphorus (below) loading allocations by management reach during lower basin runoff.

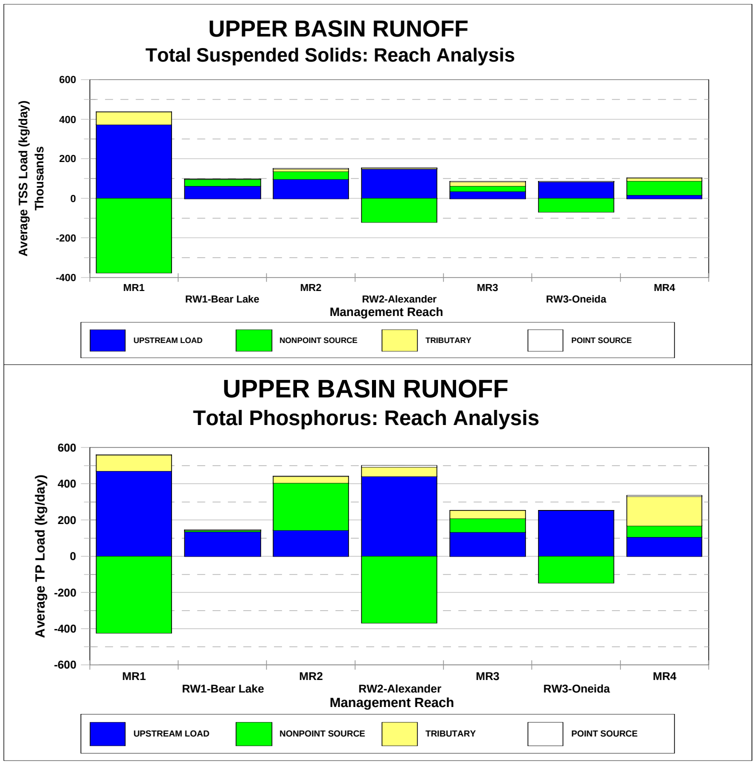


Figure 3-52. Analysis of total suspended solids (above) and total phosphorus (below) loading allocations by management reach during upper basin runoff.

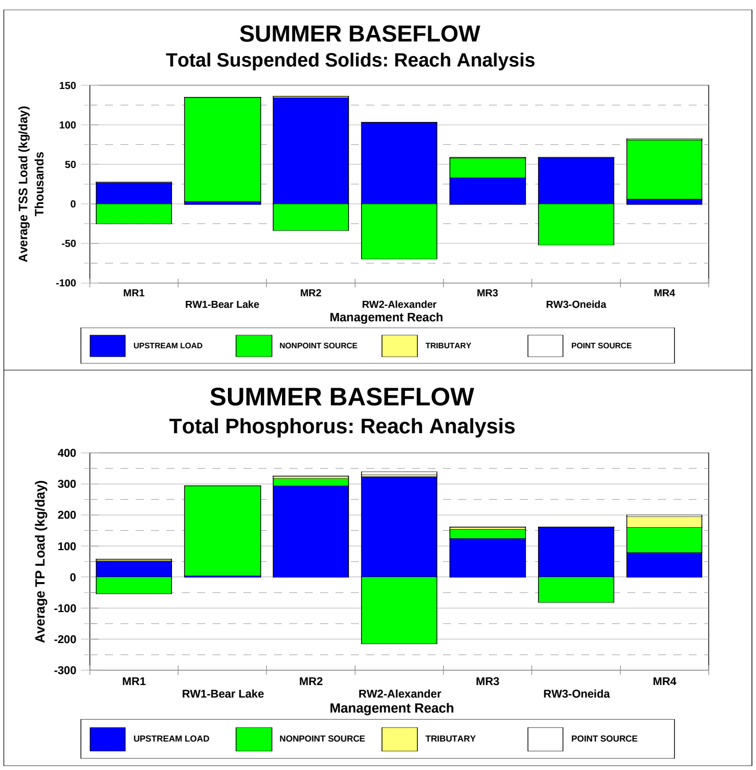


Figure 3-53. Analysis of total suspended solids (above) and total phosphorus (below) loading allocations by management reach during summer base flow.

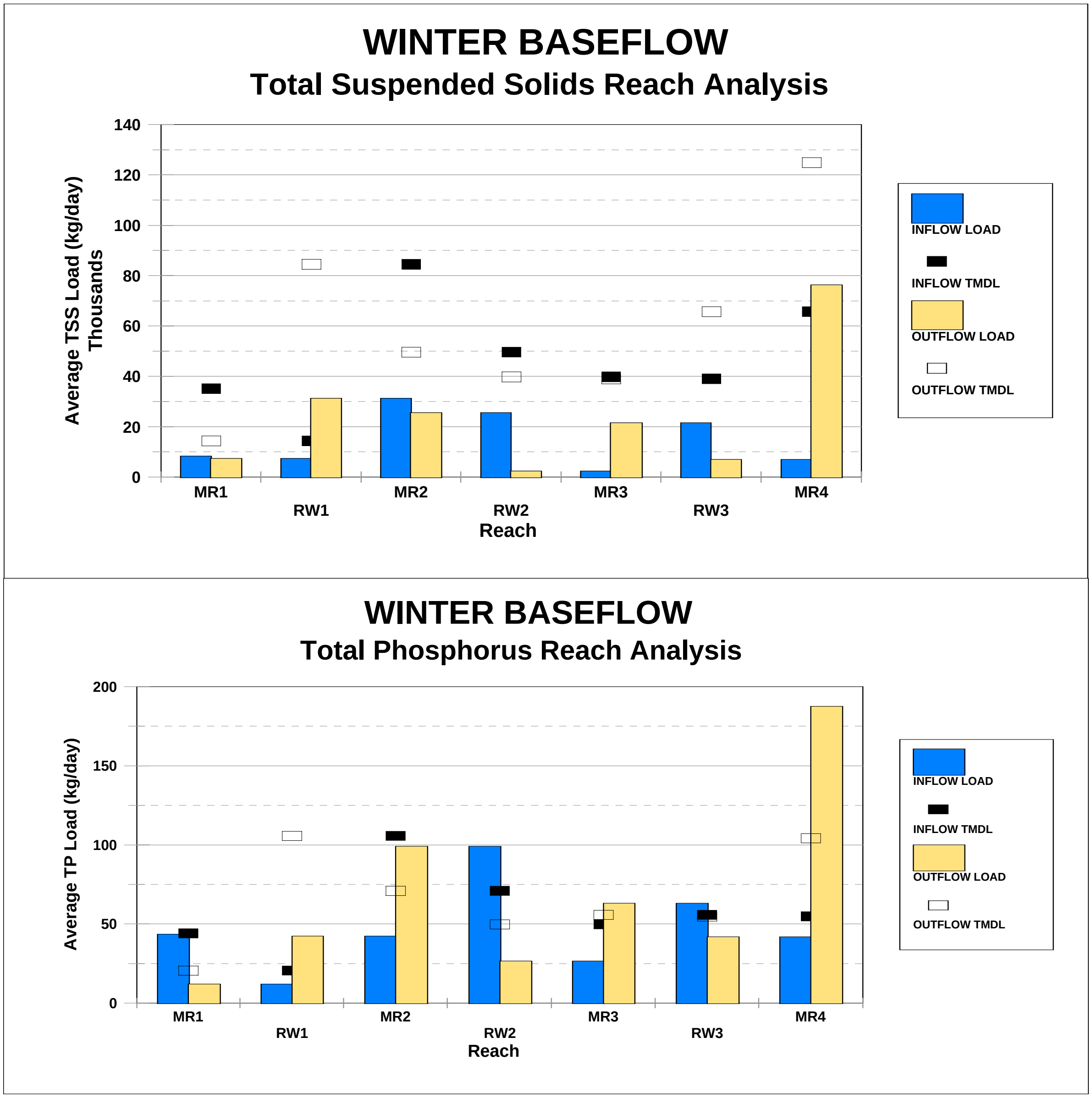
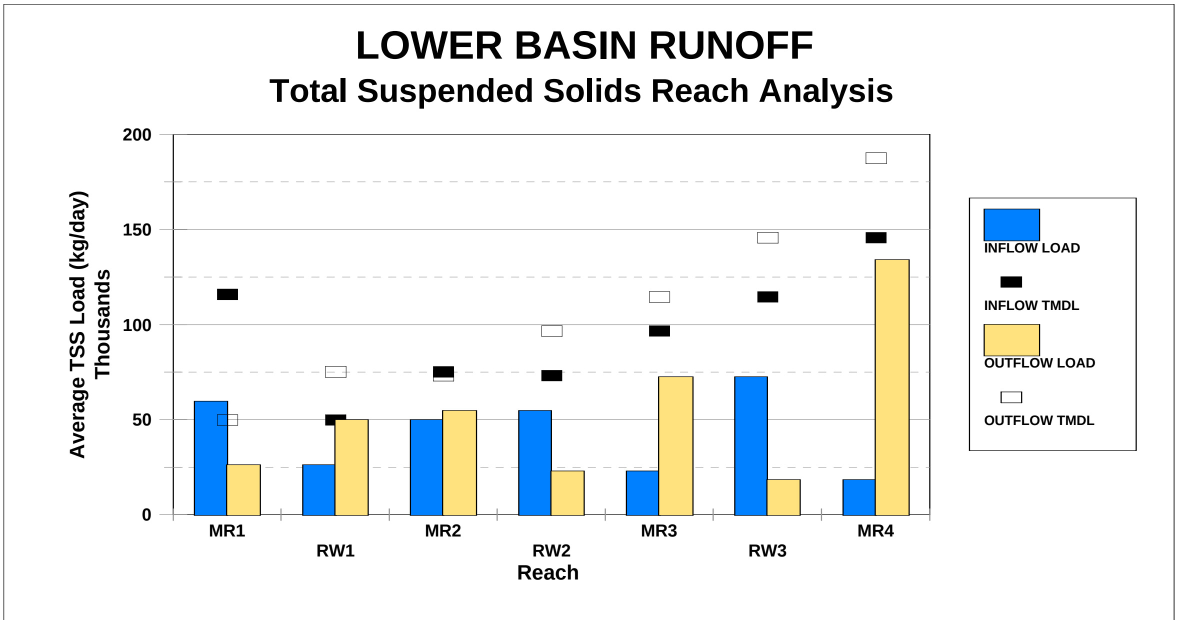


Figure 3-54. The total suspended solids loading (above) and total phosphorus loading (below) for the inflow and outflow stations in each management reach (MR) and receiving waters reach (RW) on the Bear River during winter base flow. TMDL targets are also given.



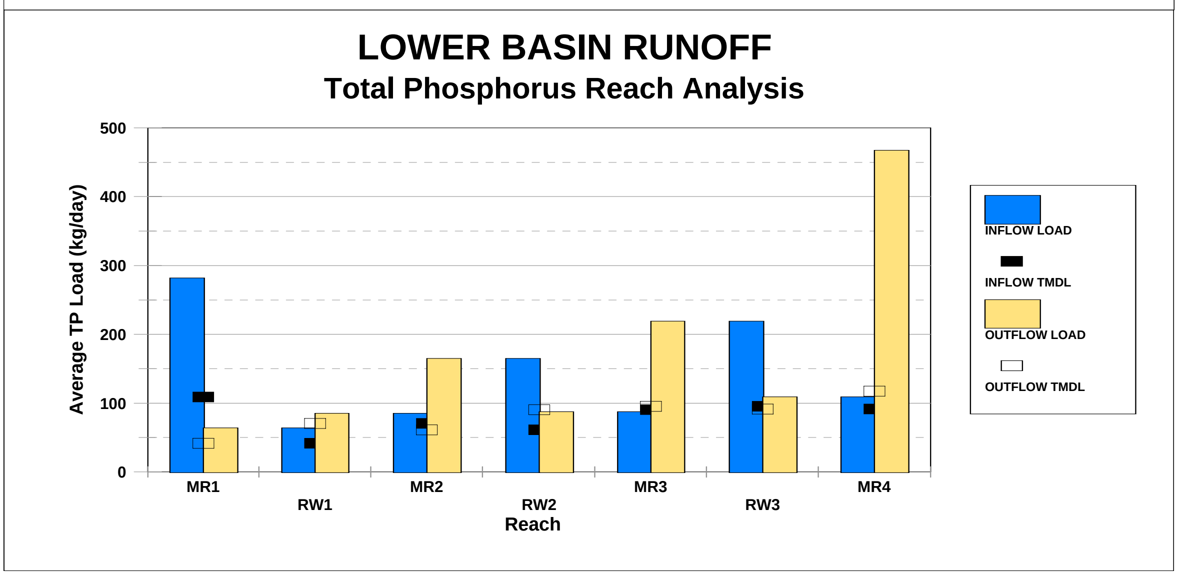
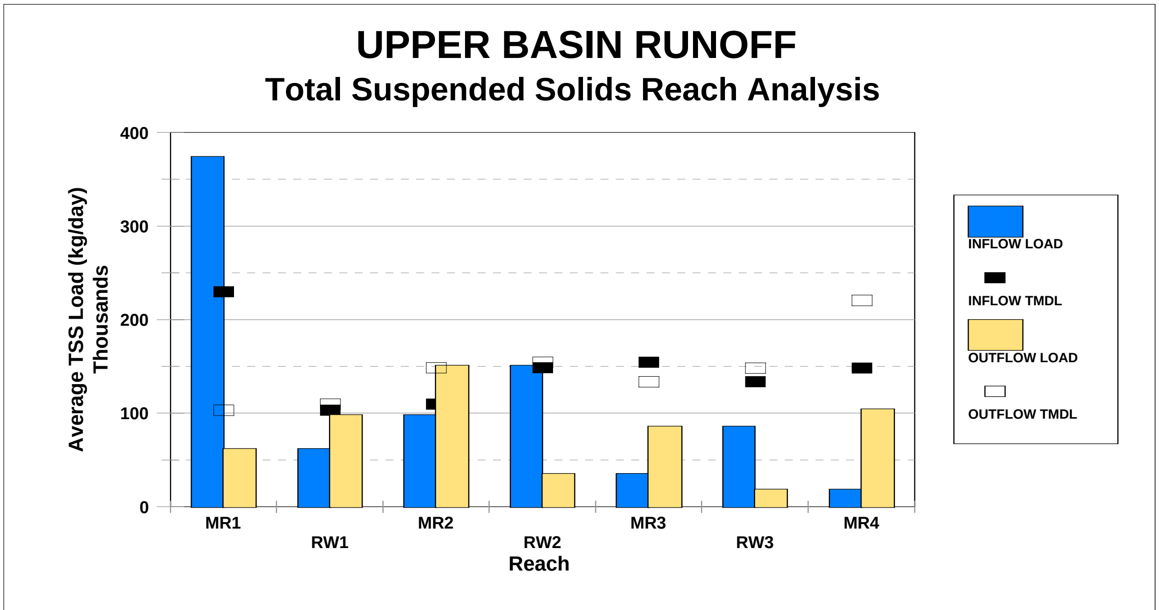


Figure 3-55. The total suspended solids loading (above) and total phosphorus loading (below) for the inflow and outflow stations in each management reach (MR) and receiving waters reach (RW) on the Bear River during lower basin runoff. TMDL targets are also given.



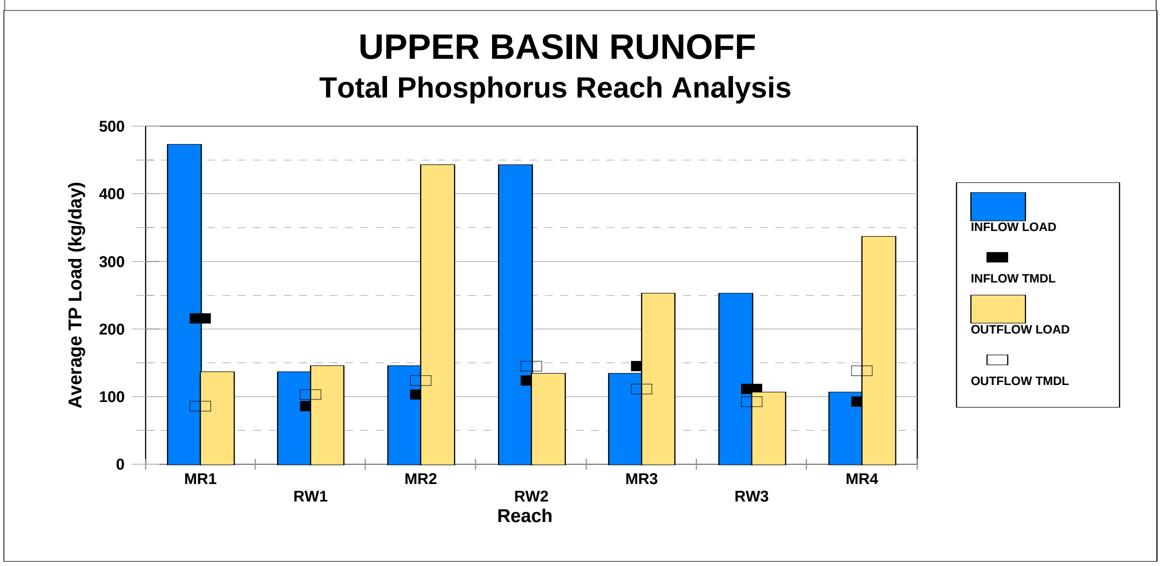


Figure 3-56. The total suspended solids loading (above) and total phosphorus loading (below) for the inflow and outflow stations in each management reach (MR) and receiving waters reach (RW) on the Bear River during upper basin runoff. TMDL targets are also given.

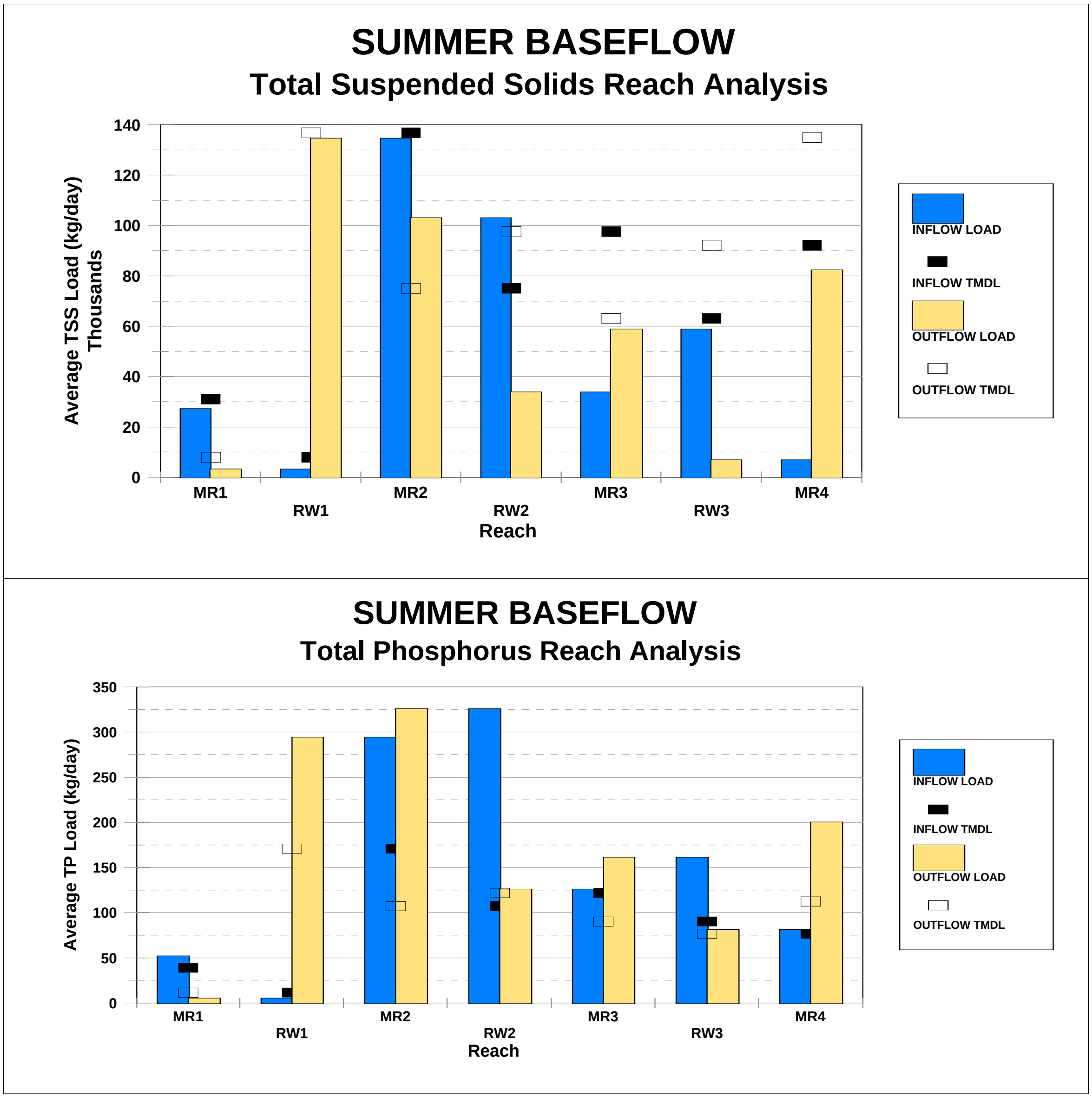


Figure 3-57. The total suspended solids loading (above) and total phosphorus loading (below) for the inflow and outflow stations in each management reach (MR) and receiving waters reach (RW) on the Bear River during summer base flow. TMDL targets are also given.

Receiving Waters Management Reaches

The location of the Receiving Waters Management Reaches (reservoirs and lakes) are listed below for the middle Bear River in Idaho. The load allocations by sources for TP and TSS will be described for each Receiving Waters Reach (RW) followed by the TMDL calculations for that reach. It should be noted that because we are interested in protecting the receiving waters, the compliance point for the Receiving Waters Management Reaches is the **inflowing** station within the reach.

RW1	Bear Lake
RW2	Alexander Reservoir
RW3	Oneida Reservoir

RW1: Bear Lake

Bear Lake is the largest and furthest upstream receiving water in the Bear River in Idaho. Bear Lake has an endemic watershed independent of the Bear River which was diverted into Bear Lake in the early 1900s for irrigation storage. This storage system still exists today with the majority of annual inflow into Bear Lake coming from the Bear River. As discussed for MR1, the outflowing water quality at the Causeway station exceeded the TMDL targets for total phosphorus in two of the four hydrologic periods. Because these periods occur during the filling cycle for the lake, these exceedances represent a significant source of phosphorus to Bear Lake. The largest exceedance occurs during upper basin runoff (51 kg TP/day) followed by lower basin runoff (22 kg TP/day). In the summer and winter base flow periods, no excess phosphorus enters Bear Lake. The total suspended solids mass does not exceed the TMDL limits established at the Causeway station.

It should be noted that the Bear Lake Marsh located immediately upstream from this station is responsible for removing upwards of 70 percent of the TSS and TP prior to reaching this station and entering Bear Lake. During periods when water is flowing out of Bear Lake downstream, the marsh acts as a source for both sediment and phosphorus. This can be seen in Table 3-19 through

Table 3-22 where nonpoint gains are shown for this reach (RW1). The mass is gained when water moves downstream from Bear Lake into the Bear River through the marsh. As noted before, this results in a maximum exceedance over the TMDL targets for both TSS and TP at the inflowing station to MR2 (excess mass of 219 kg TP/day and 27,900 kg TSS/day).

RW2: Alexander Reservoir

RW2 is located between MR2 and MR3. As discussed in the analysis of MR2, this reservoir is receiving excess loadings of both TP and TSS. Excess phosphorus loading occurs over the entire year with maximum exceedances in upper basin runoff and summer base flow when water is leaving Bear Lake. The excess loads calculated for the inflowing station at Alexander Reservoir was the highest measured excess load into any receiving water in the Middle Bear River in Idaho (Table 3-19 through Table 3-22). TSS demonstrated a similar pattern of excesses with the exception that maximum TSS excess loading occurred in summer base flow and not during upper basin runoff as noted for TP.

Unlike the dynamics observed in the Bear Lake Marsh, both TP and TSS mass decreased with movement through the Alexander Reservoir at all times including the summer and winter base flow periods. Maximum losses of both TP and TSS occurred in upper basin runoff (368 kg TP/day and 120,000 kg TSS/day) followed by summer base flow (213 kg TP/day and 69,500 kg TSS/day). Summer and winter base flow periods exhibited smaller reductions.

RW3: Oneida Reservoir

The furthest downstream Receiving Waters Reach (RW3) in the Bear River in Idaho is Oneida Reservoir, which is located between RM3 and RM4. The inflowing Bear River in this reach exceeded the total phosphorus targets during each hydrologic time period. TSS does not exceed targets. The temporal pattern of excess phosphorus loading follows the pattern observed throughout the Bear River system, with lower basin runoff (124 kg TP/day) and upper basin runoff (142 kg TP/day) having greater magnitude excesses than summer base flow (72 kg TP/day) or winter base flow (7 kg TP/day).

As with Alexander Reservoir, Oneida Reservoir also represented a sink for both TSS and TP mass throughout the entire hydrologic cycle. Greatest losses occurred during the periods of highest inputs (upper and lower basin runoff). These reductions in mass loadings with movement through the reservoir enabled the uppermost station of MR4 to be within the TMDL target mass for both TP and TSS for all hydrologic periods (Figure 3-54 through Figure 3-57.)

3.5.2 Loading Allocation Analysis - Tributaries

Maple Creek

Extant flow data for Maple Creek are limited. USGS operated a gage on Maple Creek just below the confluence of Deep Creek from April 1946 to September 1952 (Table 3-23). Only four years had complete annual data – 1947 and 1949-1951. Average flow per month ranged from 1.9 cfs in September to 100.0 cfs in May.

Total precipitation was above average for the four years for which full-year flow was available. As measured at Grace weather station all four years ranked in the top 50% and both 1949 and 1950 ranked in the top 20% of all data collected.

Although the gage was not located at the mouth of Maple Creek, little inflow occurs below the gage site (Dave Hull, BURP Coordinator, DEQ/Pocatello, personal communication). Thus, flow at the old gage site is considered adequate to characterize discharge from the Maple Creek watershed.

Table 3-23. Flow at USGS Maple Creek near Franklin gage (10096500).

Year	Mean flow (cfs)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual flow	Percent rank[1]
1946				102	77.7	49.1	7.35	4.57	2.69	4.71	4.71	11.3		
1947	4.94	10.7	24.6	54.9	82.3	37.5	7.74	2.85	1.91	2.02	2.07	3.69	19.6	0.535
1948	5.5	2.89	6.81	65	120	41.6	8.01	2.48		1.85	1.78	1.94		
1949	2.02	1.75	13.7	66.4	83.3	25.9	5.27	2.12	1.53	2.16	2.78	2.8	17.5	0.892
1950	7.95	8.73	26.8	78.5	138	86.5	17.2	4.25	2.48	2.19	2.71	3.78	31.6	0.821
1951	2.82	11.1	11.5	73	89.6	24.4	6.2	2.71	1.46	1.75	1.46	1.48	19.0	0.559
1952	1.54	1.93	4.44	95.2	109	33.6	6.11	2.29	1.28					

(1)percent rank in precipitation as measured at Grace weather station (1907-2002) from Western Regional Climate Center accessed on 23 Dec 03 at http://www.wrcc.dri.edu/

State water quality standards require that streams not exceed a monthly geometric mean (minimum of five samples) of 126 *E. coli* organisms/100 ml of water. Bacteria standards apply regardless of flow conditions. As an example, load allocations of *E. coli* based on average monthly flows for Maple Creek would range from 5,831,413,515 colonies in September to 308,224,517,475 colonies in May (Table 3-24).

Table 3-24. Monthly load allocation for *E. coli* based on average flow (April 1946 to September 1952) at USGS Maple Creek gage (10096500) and state water quality standard of 126 organisms/100 ml water.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean monthly flow (cfs)	4.1	6.2	14.6	76.4	100.0	42.7	8.3	3.0	1.9	2.4	2.6	4.2	
Load allocations (million organisms)	12,726	19,061	45,136	235,605	308,225	131,499	25,489	9,367	5,831	7,542	7,969	12,839	821,290

Cub River

Cub River is listed for flow alteration, nutrients, and sediment. The EPA considers certain unnatural conditions (e.g., flow alteration, lack of flow, habitat alteration), which do not result from the discharge of specific pollutants, as “pollution.” TMDLs are not required for water bodies impaired by pollution, but not specific pollutants. Thus, 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 for water bodies impaired by pollution but not pollutants, a TMDL has not been established for Cub River for flow alteration.

Both flow and water quality data from lower Cub River, near the Idaho-Utah state line, have been collected by USGS and the State of Utah. Historical flows were available from three USGS gaging stations on Cub River, but more recent (within the last 25 years) data were limited to the near Preston and near Richmond gages (Table 3-25). Annual flows at these two gages averaged 74 and 87 cfs, respectively. Only the USGS Cub River near Richmond gage has had more recent, since 1990, water quality sampling associated with it. Thirty-two sampling events occurred from October 1998 to August 2001. Suspended sediment concentrations were high averaging 97.4 mg/L and ranging from 26 to 416 mg/L (Table 3-26). The median concentration of suspended sediment was 75 mg/L. Stratifying sediment sampling by hydrologic period yielded average concentrations of 139 mg/L (n=9, standard deviation=112.8, range=34-416 mg/L) during runoff and 81 mg/L (n=23, standard deviation=44.9, range=26-184 mg/L) during base flow. Average concentration for total phosphorus was 0.20 mg/L with a median value of 0.18 mg/L. Total phosphorus ranged from 0.066 to 0.39 mg/L.

Utah Department of Environmental Quality monitored water quality in the Cub River at the state line from 1992 to 2003 (Appendix D). Mean annual flow was 69 cfs (Table 3-27). Base flow (August to February) averaged 15.7 cfs while mean flow for the runoff period (March to July) was 114.2 cfs.

Concentrations measured at the Idaho border by the State of Utah were less than those observed by USGS near Richmond. Suspended sediment concentrations were much lower averaging 54.6 mg/L during runoff and 19.5 mg/L during base flow for an annual mean of 37.5 mg/L (Table 3-27). Although these means were below the target levels of 60/80 mg/L (base flow/runoff), episodic events can result in loads higher than the targets as evidenced by maximum concentrations of around 260 mg/L.

Utah DEQ found that total phosphorus averaged 0.12 mg/L on an annual basis with a median value of 0.061 mg/L (Table 3-27). Mean concentration of phosphorus for runoff events was 0.09 mg/L (range=0.01-0.574 mg/L, median=0.067 mg/L). Base flow concentrations averaged 0.15 mg/L (range=0.01-0.853 mg/L, median= 0.049 mg/L). Although average concentrations were higher during base flow, using median values the greater period of concern would be during runoff.

Based on State of Utah data, only phosphorus exceeded Cub River target loads at the state line. Estimated annual load of total phosphorus for Cub River is 7,341 kilograms (Table 3-28). A target load (load allocation) of 3,086 kilograms requires a 4,256 kilogram reduction in total phosphorus in Cub River in Idaho. In contrast, the estimated suspended sediment load of 2,313,413 kilograms was below the target load of 4,196,462 kilograms. The fact that the current suspended sediment load is less than the target load does not imply that there is excess load capacity in the system. The goal is to maintain or improve conditions in the stream and therefore the suspended sediment load allocation is set at the current load.

Table 3-25. Flow data from USGS gaging stations on Bear River Basin tributaries in Idaho and Utah.

Station	Gage #	Period of record	Drainage area (mi²)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual total (cfs)
Thomas Fk nr Raymond	10042500	1942-1952	202	15.8	14	19.1	147	275	110	39.5	25.2	15.7	14.5	16.8	16.6	21,657
Montpelier Cr nr Montpelier	10047000	1939-1944	28.2	4	3.89	4.9	31.1	30.5	23.9	12.8	7.43	5.88	6.23	5.34	4.48	4,277
St. Charles Cr ab div nr St. Charles	10054600	1961-1966	17.4	26.7	27.1	25.5	56.7	149	150	69.3	48.4	41.3	35.8	33	29.6	21,109
Bloomington Cr at Bloomington	10058600	1960-1986	24	16.3	16.1	17.1	27.4	63.4	82	43.5	28.6	23.8	20.8	19	17.6	11,447
Paris Cr nr Paris	10060500	1942-1947	18.6	2.22	2.48	2.97	9.13	41.6	33.9	8.34	3.44	4.28	9.76	2.72	2.52	3,767
Mill Cr nr Liberty	10063000	1943-1947	27.2	4.03	3.78	4.51	23.8	56.3	36	10.5	7.76	6.05	6.1	5.48	4.82	5,161
Skinner Cr nr Nounan	10071500	1939-1944	5.41	1.64	1.62	1.95	7.33	14.5	10.3	3.01	1.59	1.39	1.63	1.8	1.71	1,477
Stauffer Cr nr Nounan	10072000	1939-1944	ND[1]	4.47	5.07	12.1	41	37.9	25	3.14	1.76	2	3.34	4.18	4.41	4,389
Eightmile Cr nr Soda Springs	10072800	1981-1986	22.6	4.26	5.48	9.5	30.5	90.1	115	32.9	14.3	9.49	6.99	6.09	4.78	10,035
Soda Cr at 5mile Meadows nr Soda Springs	10076400	1981-1986	51.7	14.5	15.8	22.3	38.4	36.5	34.8	32.3	30.5	29.8	22.6	21	15.4	9,563
Soda Cr at Lau ranch nr Soda Springs	10076500	1923-1926	ND[1]	0.98	2.15	11.6	28	10.6	8.64	7.52	5.94	4.69	4.43	4.84	3.9	2,840
Soda Cr nr Soda Springs	10077000	1913-1929	52	52.1	51.3	58.9	92.3	74.6	66.8	64.3	60.3	60.4	59.1	58.7	54.4	22,930
Cottonwood Cr nr Swan Lake	10084000	1939-1946	42.6	7.95	8.36	17	114	63.7	21.5	4.88	4.19	3.87	5.67	7.16	7.12	8,058
Cottonwood Cr nr Cleveland	10084500	1981-1986	61.7	17.2	27.9	66.5	177	229	90.7	26.2	17	17.3	17.5	18	16.3	21,959
Mink Cr bel Dry Fk nr Mink Creek	10087500	1947-1962	19.3	31.3	32.7	36.8	86.3	245	214	66.7	33	25.3	37.5	36.2	33.7	26,782
Mink Cr nr Mink Creek	10089500	1943-1951	58.7	42.7	39.7	20.9	71.8	198	142	9.45	4	4.86	12.5	32.1	43.4	18,904
Cub R nr Preston	10093000	1940-1986	31.6	21.2	21.4	28.7	79.7	291	331	109	48.7	34.4	28.9	25.5	23.1	31,791
Cub R ab Maple Cr nr Franklin	10096000	1939-1952	53.7	25.5	29.4	43.4	153	281	153	8.32	3.71	4.8	9.58	8.46	19.3	22,523
Cub R nr Richmond, UT	10102200	1962-1963, 1998-2000	200	42.8	84.1	115	200	421	278	32.4	28	40.7	54	38.3	39.6	41,803
Maple Cr nr Franklin	10096500	1946-1952	21.2	4.13	6.18	14.6	76.4	100	42.7	8.27	3.04	1.89	2.45	2.58	4.17	8,118
Little Malad R ab Elkhorn Res nr Malad City	10119000	1911-1969	120	14.5	19.9	20.5	21.9	20	18	16.6	14.9	14.1	13.6	13.6	14.1	6,130
Little Malad R bel Elkhorn Res nr Malad City	10120000	1940-1952	153	8.07	8.13	6.23	13.2	21.4	19.2	16.5	14.9	14.3	13.7	12.7	8.97	4,795
Little Malad R bel Sand Ridge dam site nr Malad City	10120500	1945-1951	223	6.69	9.5	7.84	7.45	2.43	1.09	0.6	0.42	0.39	2.31	6.74	7.6	1,603
Devil Cr ab Evans dividers nr Malad City	10123000	1940-1953	36	9.85	11	17.5	40.2	26.4	15.3	9.49	7.74	7.3	9.12	9.77	9.91	5,278
Devil Cr nr Malad City	10123500	1931-1940	39	2.09	2.01	3.41	10.4	11.2	6.14	3.28	3.48	3.87	3.44	2.27	2.13	1,637
Malad R nr Woodruff	10125500	1938-1982	472	76.6	110	135	111	67.4	38.7	23.5	22.9	23.9	38.8	59.7	68.4	23,517

(1)ND=no data

Table 3-26. Descriptive statistics from USGS water quality sampling at Cub River near Richmond, UT gaging station (10102200), August 1998 to August 2001 (from USGS web site).

Statistic	Discharge (cfs)	Turbidity (NTU)	Ammonia (mg/L as N)	Total Kjeldahl nitrogen - unfiltered (mg/L as N)	Nitrite+ nitrate (mg/L as N)	Total phosphorus - unfiltered (mg/L)	Ortho-phosphate (mg/L as P)	Suspended sediment concentration (mg/L)	Suspended sediment (%<0.0625 ml)
Average	168.0	26.1	0.09	0.69	1.19	0.20	0.06	97.4	84.1
Count	33	22	32	32	32	32	32	32	23
St Dev	226.9	25.7	0.14	0.36	0.68	0.10	0.05	73.7	20.4
Minimum	6.7	1.7	0.01	0.18	0.22	0.066	0.01	26	28
Maximum	960	110	0.68	1.9	3.26	0.39	0.21	416	100
Median	65	20	0.04	0.65	1.15	0.18	0.05	75	92

Table 3-27. Descriptive statistics for total phosphorus and suspended sediment data from Cub River and Worm Creek (from Utah Department of Environmental Quality data, Appendix D). For use in analysis, values below minimum detection limit were considered ½ mdl.

Water body	Parameter[1]	Period[2]	Mean	Standard deviation	Count	Maximum	Minimum	Median
Cub River	Flow (cfs)	Annual	69.1	99.69	59	423	3.3	31.1
		Runoff	114.2	117.71	32	423	4.1	88.45
		Base flow	15.7	13.47	27	45.4	3.3	10
	Total phosphorus (mg/L)	Annual	0.12	0.161	73	0.853	0.01	0.061
		Runoff	0.09	0.100	38	0.574	0.01	0.067
		Base flow	0.15	0.206	35	0.853	0.01	0.049
	Suspended sediment (mg/L)	Annual	37.5	55.77	76	264	0	17.5
		Runoff	54.6	57.94	39	264	2	30
		Base flow	19.5	47.79	37	258	0	7
Worm Creek	Flow (cfs)	Annual	14.2	16.52	63	101	0.1	10
		Runoff	19.5	19.59	36	101	1	15.2
		Base flow	7.1	6.57	27	29	0.1	6
	Total phosphorus (mg/L)	Annual	0.36	0.201	76	1.02	0.01	0.35
		Runoff	0.34	0.180	38	0.79	0.01	0.32
		Base flow	0.37	0.221	38	1.02	0.05	0.38
	Suspended sediment (mg/L)	Annual	75.1	73.59	78	323.3	2	51.6
		Runoff	109.0	87.49	39	323.3	2	95
		Base flow	41.2	31.03	39	119	2	33.2

(1)period of record: Cub River, 1992-2003; Worm Creek, 1992-2004
(2)runoff - Mar to Jul; base flow - Aug to Feb

Table 3-28. Load analyses for Cub River and Worm Creek. Note that although the current estimated load may be less than the target load, it is not implied that there is excess load capacity in the stream, which is why the load allocation is set at the current estimated load.

Water body	Flow (cfs)	Total phosphorus						Total suspended sediment					
		Average concen-tration (mg/L)	Current load (kg/yr)	Target load (kg/yr)[1]	Load allo-cation (kg/yr	Load reduc-tion (kg/yr)	Per-cent reduc -tion	Average concen-tration (mg/L)	Current load (kg/yr)	Target load (kg/yr)[2]	Load allocation (kg/yr)	Load reduc-tion (kg/yr)	Per-cent reduc-tion
Cub River	69.1	0.12	7,341	3,086	3,086	4,256	58%	37	2,313,413	4,196,462	2,313,413	0	0%
Worm Creek	14.2	0.36	4,533	632	632	3,900	86%	75	949,205	442,486	442,486	506,719	53%

(1)based on target concentration for total phosphorus of 0.05 mg/L
(2)based on target concentration for total suspended solids of 68 mg/L for Cub River and 35 mg/L for Worm Creek

Worm Creek

Water quality data from Worm Creek have been collected by the City of Preston in the vicinity of the waste water treatment plant and near the Idaho-Utah state line by the Utah Department of Environmental Quality. The WWTP discharges over 7 river miles above the point where Worm Creek enters Utah. Although the WWTP contributes to nutrient loads in Worm Creek, background levels (i.e., concentrations as measured above the WWTP discharge) are also high as evidenced by an average total phosphorus concentration of 1.4 mg/L upstream of the facilities discharge (Table 3-29).

Data from Worm Creek at the state line span the period from 1992 to 2004 (Appendix D). Annual average flow was 14.2 cfs with mean runoff and base flow at 19.5 and 7.1 cfs, respectively (Table 3-27). Average total phosphorus concentration was 0.36 mg/L and differed little between runoff and base flow periods. Suspended sediment concentration exceeded the target of 35 mg/L (defined by the State of Utah as the sediment target for Bear River tributaries [Ecosystems Research Institute 1995]) both as an annual average and by hydrologic period.

Load allocations for Worm Creek were established at the Idaho-Utah state line based on State of Utah data (Table 3-28). The target load/load allocation for total phosphorus is 632 kg/year requiring a reduction of 3,900 kilograms from the current estimated load of 4,533 kilograms. A reduction of 506,719 kilograms of suspended sediment is required to meet the annual target load/load allocation of 442,486 kilograms.

Dry Creek, Preuss Creek, Snowslide Canyon, Co-op Creek, Strawberry Creek, and Dairy Creek

Information on these streams is restricted to BURP data. As BURP sites on these streams were limited and sampling events were often separated by several years, data (e.g., flow, sediment, nutrients) are inadequate to attempt to establish load allocations. Sampling of these streams, at least at the mouth, needs to be included as part of any monitoring plan to be implemented in Bear River. Data sufficient to develop load analyses for each of these streams should be collected in 2006 for completion of a TMDL in 2007.

Meadow Creek and Samaria Creek

Information on these streams is limited to BURP data, which indicated non-support of cold water aquatic life. However, the Samaria Creek BURP site was dry as was Meadow Creek during a subsequent revisit to the BURP site (Dave Hull, BURP Coordinator, DEQ/Pocatello, personal communication). At best, these streams would be classified as intermittent. The water body assessment protocol based on BURP data was designed only for streams with perennial flow. State water quality standards require intermittent streams to meet beneficial uses during optimum flow periods, which for cold water aquatic life is equal to or greater than one cfs (IDAPA 58.01.02.070.06). According to Dave Hull (BURP Coordinator, DEQ/Pocatello), flow from both of these intermittent streams is less than one cfs, so it is recommended the streams be removed from future §303(d) lists.

Table 3-29. Results of ambient monitoring in Worm Creek above and below the Preston waste water treatment plant.

Statistic	Flow (cfs)		Ammonia (mg N/L)		Nitrate+nitrite (mg N/L)		Total phosphorus (mg/L)	
	Upstream	Downstream[1]	Upstream	Downstream	Upstream	Downstream	Upstream	Downstream
Average	1.36	2.49	0.66	2.40	1.35	2.10	1.40	2.00
Standard deviation	0.89		0.93	3.17	1.86	1.62	1.00	1.09
Count	15		15	15	15	15	15	15

(1)downstream flow value based on average upstream flow value and average discharge of 1.13 cfs (n=47, standard deviation=0.19) from Preston wastewater treatment plant, Jan 2000-Nov 2003

Thomas Fork

Thomas Fork is on the 303(d) list for nutrient and sediment problems. Load allocations were estimated for total phosphorus, total suspended solids, and total nitrogen.

From data collected as part of the synoptic survey in 1999 and 2000 (Table 3-30), current estimated load for total phosphorus exceeded the target load while sediment did not (Table 3-31). The annual load reduction necessary to meet the load allocation of 3,879 kg is 139 kg. The load allocation for Thomas Fork is set at the current estimated load of 2,668,996 kg/year.

The average concentration of total nitrogen does not exceed the target concentration of 0.85 mg/L on an annual basis (Table 3-32). Therefore, the load allocation for Thomas Fork is 30,270 kilograms (Table 3-33).

More data are needed on Thomas Fork. Additional sampling (e.g., increased events throughout the year, expanding the number of sites) would allow for load allocations by hydrologic period – base flow vs. runoff at a minimum. These data would assist in the evaluation of the possibility for seasonal variation in load allocations, especially for nitrogen. For example, average annual total nitrogen is substantially below the target concentration, but on a monthly basis, average concentration may exceed the target concentration (e.g., October 1999 and March 2000; Table 3-32). Estimates of bedload would help refine total sediment load. Apart from direct estimates of suspended and bedload sediment loads, assessment of riparian condition and bank stability might indicate erosion problems also contributing to sediment loads.

Bear River Old Channel, Ovid Creek, Pearl Creek, Densmore Creek, Whiskey Creek, Williams Creek, Cottonwood Creek, Battle Creek, Deep Creek, Fivemile Creek, and Weston Creek

Most of Bear River tributaries on the 303(d) list are listed for both nutrients and sediment. Ovid and Cottonwood creeks are listed as having only sediment problems. Deep and Fivemile creeks have unknown pollutants. Weston Creek is also listed for flow alteration in addition to nutrients and sediment.

Regarding the listing of Weston Creek for flow alteration, the EPA considers certain unnatural conditions (e.g., flow alteration, lack of flow, habitat alteration), which do not result from the discharge of specific pollutants, as "pollution." TMDLs are not required for water bodies impaired by pollution, but not specific pollutants. Thus, 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 for water bodies impaired by pollution but not pollutants, a TMDL has not been established for Weston Creek for flow alteration.

Data collected as part of the synoptic survey in 1999 and 2000 are presented in Table 3-30. As data were limited, load allocations were established on an annual basis rather than calculated by hydrologic period.

For Densmore Creek, it should also be noted that 1995 when BURP data were first collected and 1999 and 2000 during the synoptic survey were higher water years in southeast Idaho. Further investigation of the lower end of Densmore Creek in 2001 revealed the stream to be dry (Dave Hull, BURP Coordinator, DEQ/Pocatello, personal communication).

Several tributaries do not require a load reduction as their current average concentrations of total phosphorus (TP) and total suspended solids (TSS) are below the target concentrations (Table 3-31). Therefore load allocations are set at current estimated annual loads for these creeks: Ovid – 631 kg for TP and 104,468 kg for TSS; Pearl – 227 kg for TP and 86,061 kg for TSS; Williams – 334 kg for TP and 95,413 kg for TSS; and, Cottonwood – 1,028 kg for TP and 479,447 kg for TSS.

Table 3-30. Descriptive statistics from Bear River tributary water quality sampling, 1999-2000.

Water body	Statistic	Flow (cfs)	Total phosphorus (mg/L)	Total suspended solids (mg/L)
Thomas Fork	Average	57.9	0.078	51.6
	Count	5	5	5
	Standard deviation	62.7	0.071	63.8
	Range	2.5-160	0.025-0.201	6-163
	Median	35.7	0.053	25.8
Sheep Creek	Average	1.7	0.018	5.1
	Count	5	5	5
	Standard deviation	1.8	0.007	5.5
	Range	0.3-4.8	0.012-0.03	1-14.7
	Median	1.0	0.013	3.8
Bear River Old Channel	Average	102.3	0.093	69.7
	Count	5	5	5
	Standard deviation	74.3	0.057	56.1
	Range	30-200	0.025-0.155	15-142
	Median	69.0	0.111	45.0
Ovid Creek	Average	11.9	0.059	9.8
	Count	5	5	5
	Standard deviation	24.0	0.022	3.8
	Range	0.3-54.8	0.038-0.096	5-15
	Median	1.4	0.054	9.3
Georgetown Creek	Average	23.3	0.083	18.1
	Count	5	5	5
	Standard deviation	15.9	0.030	19.4
	Range	3-42.6	0.046-0.122	2.9-52
	Median	24.5	0.088	12.0
Stauffer Creek	Average	15.2	0.052	16.1
	Count	5	5	5
	Standard deviation	18.2	0.014	12.8
	Range	3.9-46.6	0.034-0.069	4-37.1
	Median	5.4	0.049	14.2
Skinner Creek	Average	3.7	0.085	22.5
	Count	5	5	5
	Standard deviation	4.9	0.050	20.7
	Range	0-11.9	0.021-0.155	1-50.2
	Median	1.0	0.094	13.2
Pearl Creek	Average	7.9	0.032	12.2
	Count	5	5	5
	Standard deviation	9.9	0.016	13.5
	Range	1.7-25	0.016-0.059	1-32.4
	Median	2.5	0.028	7.4
Eightmile Creek	Average	19.5	0.028	13.3
	Count	5	5	5
	Standard deviation	19.9	0.006	6.5
	Range	5.7-53	0.021-0.034	5-20

Table 3-30, continued				
Eightmile Creek	Median	8.6	0.028	14.0
Sulphur Canyon Creek	Average	0.6	0.015	4.8
	Count	5	5	5
	Standard deviation	0.3	0.005	1.6
	Range	0.3-1.1	0.009-0.021	3-7
	Median	0.6	0.015	4.2
Bailey Creek	Average	5.3	0.041	20.2
	Count	5	5	5
	Standard deviation	3.9	0.016	7.6
	Range	0.4-11	0.024-0.065	10.9-30.2
	Median	5.6	0.041	19.0
Soda Creek	Average	46.7	0.123	6.0
	Count	5	5	5
	Standard deviation	45.9	0.061	3.8
	Range	0.4-120	0.034-0.179	0.5-10
	Median	31.6	0.128	7.0
Densmore Creek	Average	2.1	0.216	45.3
	Count	5	5	5
	Standard deviation	3.4	0.335	47.9
	Range	0.2-8.2	0.016-0.81	1-106
	Median	0.7	0.082	33.0
Smith Creek	Average	4.9	0.092	48.0
	Count	5	4	4
	Standard deviation	2.4	0.028	29.0
	Range	3.5-9.1	0.054-0.122	15.9-86
	Median	3.6	0.095	45.0
Alder Creek	Average	5.1	0.136	81.7
	Count	5	5	5
	Standard deviation	5.0	0.063	90.0
	Range	0.9-13.4	0.056-0.188	3-199.8
	Median	3.9	0.171	41.0
Whiskey Creek	Average	12.7	0.075	11.9
	Count	5	5	5
	Standard deviation	6.4	0.029	11.1
	Range	8.2-23.4	0.056-0.126	4-31
	Median	9.1	0.067	7.0
Burton Creek	Average	4	0.106	80.5
	Count	5	5	5
	Standard deviation	2.4	0.035	59.1
	Range	1-7.3	0.062-0.139	27-162.2
	Median	4.3	0.110	66.1
Trout Creek	Average	16.6	0.080	39.6
	Count	5	5	5
	Standard deviation	7.9	0.044	39.0
	Range	10-30.2	0.038-0.14	4-86.2
	Median	15.3	0.078	21.0
Williams Creek	Average	21.8	0.017	4.9

Table 3-30, continued				
Williams Creek	Count	5	5	5
	Standard deviation	26.5	0.008	3.3
	Range	1.4-68	0.009-0.031	1-10
	Median	11.1	0.015	4.0
Cottonwood Creek	Average	51.9	0.022	10.3
	Count	5	5	5
	Standard deviation	62.1	0.014	10.0
	Range	0.2-128	0.006-0.043	1-23
	Median	16.9	0.023	5.0
Maple Hot Springs	Average	0.1	0.028	5.4
	Count	4	4	4
	Standard deviation	0.2	0.008	4.5
	Range	0-0.3	0.019-0.037	2.5-12
	Median	0.1	0.029	3.5
Mink Creek	Average	67.7	0.046	6.8
	Count	5	5	5
	Standard deviation	122.7	0.017	5.3
	Range	2-286	0.034-0.076	0.5-14
	Median	8.5	0.039	7.0
Battle Creek	Average	4.2	0.505	427.3
	Count	5	5	5
	Standard deviation	4.5	0.344	326.6
	Range	0.6-11.8	0.162-0.944	70-824
	Median	3.7	0.411	261.2
Deep Creek	Average	32.0	0.178	135.8
	Count	5	5	5
	Standard deviation	27.8	0.093	119.9
	Range	5.4-64.1	0.062-0.289	18.1-309
	Median	20.8	0.173	84.0
5 Mile Creek	Average	2.3	0.155	31.9
	Count	5	5	5
	Standard deviation	1.6	0.023	21.4
	Range	1.2-5	0.13-0.193	20.6-70
	Median	1.8	0.150	22.1
Weston Creek	Average	8.6	0.166	56.2
	Count	5	5	5
	Standard deviation	8.3	0.190	38.2
	Range	3.5-23.2	0.042-0.502	7.5-107
	Median	4.8	0.105	49.7
Malad River at 3700 South	Average	5.6	0.084	43.9
	Count	5	5	5
	Standard deviation	8.8	0.061	47.3
	Range	0.7-21.3	0.032-0.154	8.2-122
	Median	1.8	0.055	24.9
Malad River blw Riverside	Average	112	0.172	174
	Count	1	1	1
	Standard deviation			

Table 3-30, continued

Malad River blw Riverside	Range			
	Median	112	0.172	174
Malad River abv Confluence	Average	61.2	0.275	183.6
	Count	4	4	4
	Standard deviation	54.6	0.085	70.6
	Range	5.9-112	0.151-0.338	81.4-244
	Median	63.5	0.307	204.4
Malad R at ID-UT state line (Portage)	Average	82.6	0.081	85.0
	Count	4	4	4
	Standard deviation	66.9	0.034	23.4
	Range	10.3-149	0.051-0.115	68.5-118.7
	Median	85.5	0.079	76.5
Malad River at Aqueduct	Average	68.3	0.091	103.4
	Count	4	4	4
	Standard deviation	62.9	0.038	48.2
	Range	12.7-130	0.059-0.137	59-162.9
	Median	65.2	0.084	95.8
Wright Creek	Average	2.6	0.157	63.0
	Count	5	5	5
	Standard deviation	1.8	0.050	25.4
	Range	0.6-4.6	0.086-0.219	38-99.4
	Median	3.4	0.173	62.0
Elkhorn Creek	Average	1.1	0.047	61.4
	Count	3	3	3
	Standard deviation	0.4	0.048	93.2
	Range	0.9-1.6	0.014-0.102	7-169
	Median	0.9	0.025	8.1
Deep Creek	Average	1.0	0.025	4.6
	Count	5	5	5
	Standard deviation	0.8	0.015	2.3
	Range	0.5-2.3	0.011-0.048	2-8.1
	Median	0.6	0.019	4.9
Devil Creek	Average	1.0	0.109	13.2
	Count	3	3	3
	Standard deviation	0.7	0.035	3.5
	Range	0.4-1.7	0.07-0.136	10-17
	Median	0.9	0.122	12.7
Little Malad River	Average	3.2	0.122	30.9
	Count	5	5	5
	Standard deviation	2.2	0.022	14.4
	Range	0.6-5.1	0.092-0.154	16.1-48.2
	Median	4.5	0.118	34.0
Tributary to Malad R at Riverside	Average	1.4	0.164	79.3
	Count	5	5	5
	Standard deviation	1.0	0.087	70.2
	Range	0.4-2.6	0.036-0.279	8-195.8
	Median	1.2	0.176	58.0

Table 3-31. Load analyses for Bear River tributaries. Note that although the current estimated load is less than the target load, it is not implied that there is excess load capacity in the stream, which is why the load allocation is set at the current estimated load.

Water body	Flow (cfs)	Total phosphorus						Total suspended solids					
		Average concentration (mg/L)	Estimated load (kg/yr)	Target load (kg/yr)	Load allocation (kg/yr)	Load reduction (kg/yr)	Percent reduction	Average concentration (mg/L)	Estimated load (kg/yr)	Target load (kg/yr)	Load allocation (kg/yr)	Load reduction (kg/yr)	Percent reduction
Thomas Fork	57.9	0.078	4,018	3,879	3,879	139	3%	51.609	2,668,996	3,536,201	2,668,996	0	0%
Sheep Creek	1.7	0.018	27	115	27	0	0%	5.104	7,807	104,585	7,807	0	0%
Bear River Old Channel	102.3	0.093	8,545	6,859	6,859	1,686	20%	69.658	6,370,043	6,253,000	6,253,000	117,043	2%
Ovid Creek	11.9	0.059	631	796	631	0	0%	9.840	104,468	725,914	104,468	0	0%
Georgetown Creek	23.3	0.083	1,722	1,562	1,562	160	9%	18.104	376,986	1,423,842	376,986	0	0%
Stauffer Creek	15.2	0.052	709	1,019	709	0	0%	16.058	218,122	928,778	218,122	0	0%
Skinner Creek	3.7	0.085	281	281	281	0	0%	22.480	74,487	226,573	74,487	0	0%
Pearl Creek	7.9	0.032	227	530	227	0	0%	12.169	86,061	483,576	86,061	0	0%
Eightmile Creek	19.5	0.028	482	1,306	482	0	0%	13.258	230,891	1,190,792	230,891	0	0%
Sulpher Canyon Creek	0.6	0.015	8	40	8	0	0%	4.789	2,551	36,418	2,551	0	0%
Bailey Creek	5.3	0.041	197	357	197	0	0%	20.212	96,307	325,806	96,307	0	0%
Soda Creek	46.7	0.123	5,130	2,085	2,085	3,045	59%	6.012	250,662	1,895,946	250,662	0	0%
Densmore Creek	2.1	0.216	406	141	141	265	65%	45.323	85,198	128,538	85,198	0	0%
Smith Creek	4.9	0.092	401	401	401	0	0%	47.994	209,382	298,309	209,382	0	0%
Alder Creek	5.1	0.136	622	622	622	0	0%	81.662	372,464	372,464	372,464	0	0%
Whiskey Creek	12.7	0.075	852	848	848	4	0.5%	11.885	134,419	773,330	134,419	0	0%
Burton Creek	4.0	0.106	380	380	380	0	0%	80.459	289,756	289,756	289,756	0	0%
Trout Creek	16.6	0.080	1,187	1,112	1,112	75	6%	39.552	586,581	1,014,079	586,581	0	0%
Williams Creek	21.8	0.017	334	1,458	334	0	0%	4.909	95,413	1,329,131	95,413	0	0%
Cottonwood Creek	51.9	0.022	1,028	2,321	1,028	0	0%	10.329	479,447	2,110,743	479,447	0	0%
Maple Hot Springs	0.1	0.028	3	8	3	0	0%	5.351	606	7,745	606	0	0%
Mink Creek	67.7	0.046	2,765	4,537	2,765	0	0%	6.839	413,677	4,136,241	413,677	0	0%
Battle Creek	4.2	0.505	1,916	284	284	1,632	85%	427.321	1,619,864	259,202	259,202	1,360,662	84%
Deep Creek	32.0	0.178	5,090	2,145	2,145	2,945	58%	135.825	3,884,519	1,955,567	1,955,567	1,928,952	50%
Fivemile Creek	2.3	0.155	314	152	152	162	52%	31.927	64,708	138,583	64,708	0	0%
Weston Creek	8.6	0.166	1,278	577	577	701	55%	56.244	432,441	525,737	432,441	0	0%
Malad R at 3700 South	5.6	0.084	418	373	373	45	11%	43.880	218,098	339,860	218,098	0	0%
Malad R at ID-UT state line (Portage)	82.6	0.081	5,971	5,535	5,535	436	7%	85.043	6,275,791	5,045,955	5,045,955	1,229,836	20%
Little Malad River	3.2	0.122	347	214	214	133	38%	30.906	88,118	194,958	88,118	0	0%
Wright Creek	2.6	0.157	366	175	175	191	52%	63.021	147,213	159,725	147,213	0	0%
Elkhorn Creek	1.1	0.047	46	74	46	0	0%	61.357	60,495	67,418	60,495	0	0%
Devil Creek	1.0	0.109	98	67	67	31	32%	13.221	11,854	61,308	11,854	0	0%
Deep Creek	1.0	0.025	23	70	23	0	0%	4.629	4,335	64,037	4,335	0	0%

Table 3-32. Nitrogen sampling in Thomas Fork.

Date	Concentration (mg/L)			
	Ammonia (NH_3)	Nitrate (NO_3)	Nitrite (NO_2)	Total inorganic nitrogen[1]
5/20/99	0.04	0.025	0.002	0.067
10/6/99	0.13	1.1	0.015	1.128
3/15/00	0.042	1.156	0.011	1.209
4/27/00	0.204	0.169	0.002	0.375
6/20/00	0.033	0.108	0.006	0.148
Average				0.585
Standard deviation				0.545

(1)total inorganic nitrogen=ammonia (NH_3) + nitrate (NO_3) + nitrite (NO_2)

Table 3-33. Load analysis for total nitrogen in Thomas Fork. Note that although the current estimated load is less than the target load, it is not implied that there is excess load capacity in the stream, which is why the load allocation is set at the current estimated load.

Flow (cfs)	Total nitrogen					
	Average concentration (mg/L)	Current load (kg/yr)	Target load (kg/yr)	Load allocation (kg/yr)	Load reduction (kg/yr)	Percent reduction
57.9	0.585	30,270	43,958	30,270	0	0%

Four streams require a load reduction for total phosphorus, but not total suspended solids (Table 3-31). Annual load allocations for total phosphorus are 141 kg/year for Densmore, 848 kg/year for Whiskey, 152 kg/year for Fivemile, and 577 kg/year for Weston. Load reductions necessary to meet these allocations are 265, 4, 162, and 701 kg/year, respectively. Total suspended sediment load allocations are set at current estimated loads, which are 85,198 kg/year for Densmore, 134,419 kg/year for Whiskey, 64,708 kg/year for Fivemile, and 432,441 kg/year for Weston.

Bear River Old Channel, Battle Creek, and Deep Creek require reductions in annual loads of both total phosphorus and total suspended solids (Table 3-31). To meet annual load allocations for TP of 6,859 kg and TSS of 6,253,000 kg in Bear River Old Channel, which can be considered a tributary since diversion of Bear River into Bear Lake, will necessitate decreasing current loads of TP by 1,687 kg/year and TSS by 117,043 kg/year. Load allocations in Battle Creek are 284 kg/year for TP and 259,202 kg/year for TSS requiring reductions of 1,632 kg/year and 1,360,661 kg/year, respectively. Reductions needed in Deep Creek to meet load allocations of 2,145 kg/year for TP and 1,955,567 kg/year for TSS are 2,945 kg/year and 1,928,952 kg/year, respectively.

Many of these streams are on the 303(d) list, yet do not exceed the recommended target concentrations for total phosphorus or total suspended solids, or both. More data are needed as to why these streams are not supporting beneficial uses, especially those listed for unknown pollutants. Sampling on these streams was limited to at most five events at one site. Increasing the number of events and sites would help refine both phosphorus and sediment loads, especially during spring runoff when streams historically experience the movement of large amounts of sediment and attached phosphorus. In addition, sediment might be moving as bedload, which was not measured when sampling for suspended sediment. Apart from water column sampling, assessment of riparian condition and bank stability might indicate erosion problems also contributing to sediment loads.

Malad River, Little Malad River, Wright Creek, Elkhorn Creek, Deep Creek, and Devil Creek

Malad River and tributaries are listed on the 303(d) list for sediment, nutrients, or unknown pollutants. Malad River, Little Malad River, and Wright Creek are considered to have only sediment problems. Devil Creek is listed for both sediment and nutrients. Beneficial uses in Elkhorn and Deep creeks are impaired by unknown pollutants.

Data collected as part of the synoptic survey in 1999 and 2000 are presented in Table 3-30. As data were limited, load allocations were established on an annual basis rather than calculated by hydrologic period.

For the mainstem Malad River, the 3700 South site does not require a reduction to meet its load allocation for total suspended sediment whereas the state line site does (Table 3-31). The load allocation at 3700 South is the current estimated load of 218,098 kg/year. Allocation at the ID-UT state line (using the Portage site as a surrogate) is 5,045,955 kg/year requiring a load reduction of 1,229,836 kg/year.

None of the five tributaries (Little Malad River, Wright Creek, Elkhorn Creek, Deep Creek, Devil Creek) requires a load reduction for total suspended sediment (Table 3-31). Therefore, load allocations were set at current estimated loads: Little Malad River – 88,118 kg/year; Wright Creek – 147,213 kg/year; Elkhorn Creek – 60,495 kg/year; Deep Creek – 4,335 kg/year; and, Devil Creek – 11,854 kg/year.

Although only Devil Creek is listed for nutrients on the 303(d) list, total phosphorus load allocations are also recommended for other watershed streams to meet the Utah target concentration of 0.075 mg/L of TP target for Malad River. The two mainstem Malad River sites necessitate a load reduction of 45 kg/year at the 3700 South site and 436 kg/year at the ID-UT state line (Table 3-31). Total phosphorus load allocations range from 373 to 5,535 kg/year at the 3700 South and state line sites, respectively. As other water bodies contribute phosphorus to Malad River either directly (Little Malad River, Devil and Deep creeks) or indirectly via the Little Malad River (Wright and Elkhorn creeks), phosphorus load allocations were also recommended for these tributaries. Load allocations for TP are 214 kg/year for Little Malad River, 175 kg/year for Wright Creek, and 67 kg/year for Devil Creek. Load reductions to meet these allocations are 133, 191, and 31 kg/year, respectively. Presently, Elkhorn and Deep creeks are below the target concentration and no load reductions are required. Load allocations are set at current estimated loads of 46 kg/year for Elkhorn Creek and 23 kg/year for Deep Creek.

Many of these streams on the 303(d) list do not exceed the recommended target concentration for total suspended solids, or total phosphorus for those streams listed as having unknown pollutants. More data are needed as to why these streams are not supporting beneficial uses. Sampling on these streams was limited to at most five events at one site. Increasing the number of events and sites would help refine both sediment and phosphorus loads, especially during spring runoff when streams historically experience the movement of large amounts of sediment and attached phosphorus. In addition, sediment might be moving as bedload, which was not measured when sampling for suspended sediment. Apart from water column sampling, assessment of riparian condition and bank stability might indicate erosion problems also contributing to sediment loads.

Sheep Creek, Georgetown Creek, Stauffer Creek, Skinner Creek, Eightmile Creek, Sulphur Canyon Creek, Bailey Creek, Soda Creek, Smith Creek, Alder Creek, Burton Creek, Trout Creek, and Mink Creek

None of these streams are on the 303(d) list but they do contribute sediment and nutrients to Bear River or one of its reservoirs. Data collected as part of the synoptic survey in 1999 and 2000 are presented in Table 3-30. As data were limited, load allocations were established on an annual basis rather than calculated by hydrologic period.

Load reductions in total phosphorus are recommended for three of the surveyed streams (Table 3-31). Allocations of 1,562 kg/year for Georgetown Creek, 2,085 kg/year for Soda Creek, and 1,112 kg/year for Trout Creek require load reductions of 160, 3,045, and 75 kg/year, respectively. Four creeks, despite excess loads into Bear River, still support their instream beneficial uses so current estimated loads are recommended for load allocations: Skinner – 281 kg/year; Smith – 401 kg/year; Alder – 622 kg/year; and Burton – 380 kg/year. The other streams do not require a load reduction so allocations are set at current estimated loads: Sheep – 27 kg/year; Stauffer – 709 kg/year; Eightmile – 482 kg/year; Sulphur Canyon – 8 kg/year; Bailey – 197 kg/year; and Mink – 2,765 kg/year.

Alder and Burton creeks are the only two creeks whose current estimated sediment loads exceed Bear River target levels (Table 3-31). However, as both streams meet their beneficial uses, load allocations are set at current estimated loads – Alder Creek at 372,464 kg/year and Burton Creek by 289,756 kg/year. Annual TSS load allocations for the other eleven creeks are also fixed at their current estimated loads: Sheep – 7,807 kg; Georgetown – 376,986 kg; Stauffer – 218,122 kg; Skinner – 74,487 kg; Eightmile – 230,891 kg; Sulphur Canyon Creek – 2,551 kg; Bailey – 96,307 kg; Soda – 250,662 kg; Smith – 209,382 kg; Trout – 586,581 kg; and Mink – 413,677 kg.

4 Implementation Strategies

To meet load and wasteload allocations discussed in this TMDL requires implementation of various policies, programs, and projects aimed at improving water quality in the Bear River and its tributaries. These policies, programs, and projects would be in addition to, or replacement of, current efforts (e.g., Bear River Water Quality Task Force work, EPA's construction stormwater permit). Like the TMDL, the goal of the implementation plan is to reduce pollutant loading so as to support beneficial uses. DEQ recognizes that implementation strategies for TMDLs may need to be modified if monitoring shows that the TMDL goals are not being met or significant progress is not being made toward achieving the goals. On the other hand, should monitoring show that beneficial uses are being supported prior to the attainment of TMDL targets, less restrictive load and wasteload allocations will be considered.

4.1 Time Frame

No time frame is proposed for attainment of beneficial uses in Bear River Basin as it would be highly dependent on many factors. Modification of government policies requires changes in current agency operations. These changes often necessitate some type of legislative action and diffusion down to the local level where the programs resulting from such policies are determined and carried out. On-the-ground projects in addition to proper planning require willing landowners and often some type of financial help.

Adding to the problem of predicting when beneficial uses might be obtained are the vagaries of nature. For example, streams which maintain high levels of subsurface sediment are dependent on geofluvial processes to mobilize the smaller sediment and move it out of the system. Flows required for such mobilization are dependent on winter snow levels and resultant spring runoff, neither of which can be predicted with any certainty next year, let alone any years after that.

Despite the above, there is no reason not to see substantial progress within 10 years of the discharge of the implementation plan. Development of a proper monitoring plan should allow a statistical evaluation of that progress.

4.2 Approach

Idaho Water Quality Standards list designated agencies responsible for reviewing and revising nonpoint source BMPs based on water quality monitoring data generated through the state's water quality monitoring program (Idaho Code 39-3602). Department of Lands is responsible for timber harvest activities, oil and gas exploration and development, and mining activities. The grazing and agricultural aspects of the implementation plan will be written and developed by the Soil Conservation Commission. Public road construction activities fall under the auspices of the Transportation Department. Department of Agriculture has responsibility for aquaculture. All other activities are the responsibility of DEQ.

Gathering of new information may indicate federal lands as a source of nonpoint pollutant loading in the Bear River Basin. It is expected that federal agencies will write their own implementation plans as to how they intend to reduce pollutant loading from land under their jurisdiction.

Point sources will also be asked to write their own implementation plan on how they will meet TMDL wasteload allocations. In addition, it is expected that any allocations set forth in this TMDL will eventually be incorporated into the point sources' NPDES permits.

4.3 Load Reduction Analysis

It has been shown in the previous section that total phosphorus is a major element of concern in that it exceeded the TMDL target load during all seasons at multiple sites throughout the Bear River in Idaho. In this section, several load reduction scenarios are discussed that, if implemented, will reduce phosphorus loading in the river.

4.3.1 Load Reduction Strategies

The mass balance approach used in the TMDL analysis calculated nonpoint source loads for total phosphorus and total suspended solids. The loads from tributaries, which drain mostly agricultural and forested land, can be considered functionally as nonpoint sources. Combined with the main stem nonpoint source loads, this source (nonpoint) accounts for over 97 percent of the total load. The reduction of this load in both the tributaries as well as in the mainstem Bear River will be mandatory if compliance to the phosphorus TMDL is to be attained.

The potential reduction of the excess phosphorus loadings through the implementation of various remediations was evaluated. These nutrient reduction activities were focused on the implementation of various best management practices (BMPs), including agricultural lands and feedlots. Table 4-1 lists a wide range of remediation activities and BMPs, the effectiveness of each of the activities in reducing nutrients and solids input into waterways and, when available, typical costs associated with each activity. The ability to reduce pollutant inputs is largely a function of the amount of effort and money available for the task. Because of this, a range in nutrient reductions were calculated based upon a low, medium and high effort (Table 4-2).

Table 4-1. A literature review of remediations and their effectiveness.

Potential Sources of Pollution	Remediation	Percent Reduction	Cost	Impact
Feedlots (manure management)				
	Structural			Reduce runoff of nutrients, fecal coliform and total suspended solids from animal waste into adjacent waterways
	Holding Ponds	50-70%	$25,000	
	Lagoons	75-100%	$25,000-$85,000	
	Bunkers	*	$10,000-$50,000	
	Tanks	*		
	Composting			
	Operational			
	Total animal waste management			
	Hook into MWWTF	*		
Agriculture	Structural			These practices reduce soil erosion and therefore, decrease the transport of sediments and associated nutrients (soluble and insoluble) into adjacent waterways
	Sprinkler systems			
	Operational (BMPs)			
	Conservation tillage	full strip 40-90% (1) wide strip 40-60% (1) narrow strip 50-95% (1)		
	Contour farming	50% max (1)		
	Strip cropping	75% max (1)		
	Cover crops	40-60% (1)		
	Terrace	95-98% (1)		
	Grade stabilization	75-90% (1)		
	Water sediment control	40-60% (1) 60-80% (1)		
	Filter strips (10-25 m width)	35-40% (general) (2) 70% (nutrients) (1) 80-90% (feedlots) (1)	0.18-1.92/m2 (2)	
	Nutrient Management			
	Livestock Management			Reduce stream bank erosion, reduce the transport of animal waste and associated pollutants (nutrients, fecal coliform and total suspended solids) into adjacent waterways
	Exclusion	*		
	Rest-rotation	*		
	Mgmt + reveg	groundcover >30% (1)		
	Mgmt w/o reveg	groundcover >10% (1)		
	Fencing	*	$2-$2.50/ft (1)	
	Constructed wetlands	?	$5,000 and up	
Stream bank	Non-structural			These practices stabilize stream banks and reduce soil and stream bank erosion.
	Revegetation			
	Trees	15-50%	$1-$2/ft for willows (1)	
	Brush	50-60%	0.18-1.92/m2 (2)	
	Grass	up to 90% (2)	$55 and up/acre (1); $1.50-$3.50/ft (1)	
	Snag removal and clearing	*	$1/ft (1)	
	Structural			

Table 4-1, continued				
	Flow regulation		Up to $5,000 depend. on size, length	
	Drop structures	*		
	Rock Pools	*	up to $20-placed rock	
	Wire structures		$500/ea	
	Revetments			
	Conifer	** (1)	$12/ft (3)	
	Rock	** (1)	$200-$400/ft	
	Deflectors			
	Single	75% (1)	$500/ea	
	Irrigation management (offsite watering, pipelines)	25-75% (1)	$400/trough + $?/pump + $2/ft for pipe (1)	
Open Channel	Meander Reconstruction	** (1)	$50/ft (2)	Reduce stream bank erosion

			COST PER MGD		
			Construction (4)	Maintenance (4)	
Waste water	Hook into MWWTF				Reduce total phosphorus
	Land treatment option	80-90% (3)	$980,000-1,200,000	$44,000-64,000	
	Rapid infiltration (underdrained or not)	80-90% (3)	$34,000-44,000	$25,000-47,000	
	Overland flow	30-60% (3)			
	Activated sludge	>90% (3)	$160,000-820,000	$10,000-64,000	
	Alum	94% (3)	$18,000-48,000	$40,000-55,000	
	Ferric chloride	56-97% (3)	$16,000-46,000	$28,000-40,000	
	Lime clarification of raw waste water	75% (3)	$21,000-47,000	$20,000	
	Primary treatment				Reduce total suspended solids
	With mineral addition	60-75% (3)			
	Without mineral addition	40-70%			
	Secondary treatment				
	Trickling filter				
	With mineral addition	85-95% (3)			
	Without mineral addition	70-92%			
	Activated sludge				
	With mineral addition	85-95% (3)			
	Without mineral addition	85-95%			

(1) Utah Little Bear Hydrologic Unit Plan 1992
(2) Water Quality Investigations – Lower Bear River and Hyrum Reservoir; ERI 1991
(3) Process Design Manual for Phosphorus Removal; 625/1-76-0019
(4) Barker et al. 1989

Table 4-2. The potential percent reductions in phosphorus loads based upon an estimated level of effort.

SOURCE	ESTIMATED LEVEL OF EFFORT		
	LOW	MEDIUM	HIGH
Nonpoint	40%	50%	90%
Point	50%	75%	90%
Feedlots	50%	75%	90%

4.3.2 Load Reduction

The data used to calculate the effect of the three levels of effort on the removal of phosphorus mass from the Bear River within the four management reaches is shown in Table 3-19 through Table 3-22. Using the loads by source for each hydrologic time period, and the percent reductions by effort, load reductions expressed as kg TP/day were calculated and compared to the TMDL target load. The results are presented in Table 4-3, Table 4-4, and Table 4-5. Depending upon the management reach, attainment of the TMDL phosphorus mass targets will take a low to medium/high level of effort. The highest level of effort needed to meet the targets was in MR4 during runoff (75% reduction). The lowest levels (no remediation necessary) were in MR1 during base flows. System wide, less effort or remediation would be necessary for winter base flow, followed by summer base flow. Highest system wide effort would be needed to reduce phosphorus load during the runoff periods (56-57%). These data are summarized in Table 4-6. Although one can assume that common sources occur within each hydrologic period, the magnitude of the source may differ over time, and thus the impact of the remediation may influence the ultimate amount of mass removed.

Table 4-3. The estimated reduction in total phosphorus load that would be realized with a low level of effort. Shaded cells indicate where effort has resulted in meeting the TMDL target.

REACH	INPUT	TRIBS	POINT SRC	NPS	OUTPUT	TMDL	
						TARGET	EXCESS
LOWER BASIN RUNOFF							
MR1	169.2	0.6	0	-131.4	38.4	42	**-3.6**
MR2	51	2.4	0	45.6	99	61	38.0
MR3	52.8	4.8	0	73.8	131.4	95	36.4
MR4	65.4	49.8	1.5	163.2	279.9	117	162.9
UPPER BASIN RUNOFF							
MR1	283.8	52.2	0	-253.8	82.2	86	**-3.8**
MR2	87.6	22.2	0	156	265.8	124	141.8
MR3	81	25.2	0	45.6	151.8	111	40.8
MR4	64.2	99	1.5	37.2	201.9	138	63.9
SUMMER BASE FLOW							
MR1	31.2	3.6	0	-31.2	3.6	11	**-7.4**
MR2	176.4	4.8	0	14.4	195.6	107	88.6
MR3	75.6	4.2	0	17.4	97.2	90	7.2
MR4	48.6	21	1.5	48.6	119.7	112	7.7
WINTER BASE FLOW							
MR1	26.4	0	0	-19.2	7.2	20	**-12.8**
MR2	25.2	0	0	34.2	59.4	71	**-11.6**
MR3	16.2	0	0	21.6	37.8	56	**-18.2**
MR4	25.2	5.4	1.5	80.4	112.5	104	8.5

Table 4-4. The estimated reduction in total phosphorus load that would be realized with a medium level of effort. Shaded cells indicate where effort has resulted in meeting the TMDL target.

REACH	INPUT	TRIBS	POINT SRC	NPS	OUTPUT	TMDL	
						TARGET	EXCESS
LOWER BASIN RUNOFF							
MR1	141	0.5	0	-109.5	32	42	**-10.0**
MR2	42.5	2	0	38	82.5	61	21.5
MR3	44	4	0	61.5	109.5	95	14.5
MR4	54.5	41.5	0.75	136	232.75	117	115.8
UPPER BASIN RUNOFF							
MR1	236.5	43.5	0	-211.5	68.5	86	**-17.5**
MR2	73	18.5	0	130	221.5	124	97.5
MR3	67.5	21	0	38	126.5	111	15.5
MR4	53.5	82.5	0.75	31	167.75	138	29.8
SUMMER BASE FLOW							
MR1	26	3	0	-26	3	11	**-8.0**
MR2	147	4	0	12	163	107	56
MR3	63	3.5	0	14.5	81	90	**-9.0**
MR4	40.5	17.5	0.75	40.5	99.25	112	**-12.8**
WINTER BASE FLOW							
MR1	22	0	0	-16	6	20	**-14.0**
MR2	21	0	0	28.5	49.5	71	**-21.5**
MR3	13.5	0	0	18	31.5	56	**-24.5**
MR4	21	4.5	0.75	67	93.25	104	**-10.8**

Table 4-5. The estimated reduction in total phosphorus load that would be realized with a high level of effort. Shaded cells indicate where effort has resulted in meeting the TMDL target.

REACH	INPUT	TRIBS	POINT SRC	NPS	OUTPUT	TMDL	
						TARGET	EXCESS
LOWER BASIN RUNOFF							
MR1	28.2	0.1	0	-21.9	6.4	42	**-35.6**
MR2	8.5	0.4	0	7.6	16.5	61	**-44.5**
MR3	8.8	0.8	0	12.3	21.9	95	**-73.1**
MR4	10.9	8.3	0.3	27.2	46.7	117	**-70.3**
UPPER BASIN RUNOFF							
MR1	47.3	8.7	0	-42.3	13.7	86	**-72.3**
MR2	14.6	3.7	0	26	44.3	124	**-79.7**
MR3	13.5	4.2	0	7.6	25.3	111	**-85.7**
MR4	10.7	16.5	0.3	6.2	33.7	138	**-104.3**
SUMMER BASE FLOW							
MR1	5.2	0.6	0	-5.2	0.60	11	**-10.4**
MR2	29.4	0.8	0	2.4	32.6	107	**-74.4**
MR3	12.6	0.7	0	2.9	16.2	90	**-73.8**
MR4	8.1	3.5	0.3	8.1	20	112	**-92.0**
WINTER BASE FLOW							
MR1	4.4	0	0	-3.2	1.2	20	**-18.8**
MR2	4.2	0	0	5.7	9.9	71	**-61.1**
MR3	2.7	0	0	3.6	6.3	56	**-49.7**
MR4	4.2	0.9	0.3	13.4	18.8	104	**-85.2**

Table 4-6. A summary of estimated effort needed to attain the TMDL target mass in the management reaches of the Bear River. Values in the table reflect the remaining mass (kg/day) to be removed to attain compliance. Negative values indicate excess mass removal for that level of effort. The percent reduction needed column reflects the exact level of reduction necessary for compliance. Shaded cells indicate where effort has resulted in meeting the TMDL target.

REACH	LEVEL OF EFFORT			LEVEL NEEDED	% REDUCTION NEEDED
	LOW	MEDIUM	HIGH		
LOWER BASIN RUNOFF					
MR1	**-3.6**	**-10**	**-35.6**	L	34
MR2	38.0	21.5	**-44.5**	M-H	63
MR3	36.4	14.5	**-73.1**	M-H	57
MR4	162.9	115.8	**-70.3**	M-H	75
UPPER BASIN RUNOFF					
MR1	**-3.8**	**-17.5**	**-72.3**	L	37
MR2	141.8	97.5	**-79.7**	M-H	72
MR3	40.8	15.5	**-85.7**	M-H	56
MR4	63.9	29.8	**-104.3**	M-H	59
SUMMER BASE FLOW					
MR1	**-7.4**	**-8**	**-10.4**	L	0
MR2	88.6	56	**-74.4**	M-H	67
MR3	7.2	**-9**	**-73.8**	M	44
MR4	7.7	**-12.8**	**-92**	M	44
WINTER BASE FLOW					
MR1	**-12.8**	**-14**	**-18.8**	L	0
MR2	**-11.6**	**-21.5**	**-61.1**	L	28
MR3	**-18.2**	**-24.5**	**-49.7**	L	11
MR4	8.5	**-10.8**	**-85.2**	M	45

4.4 Responsible Parties

The implementation of a plan to improve water quality in the Bear River Basin will require the cooperation of many folk. These may include, but not be limited to, the following.

Federal Government – Natural Resources Conservation Service, U. S. Forest Service, Bureau of Land Management, U. S. Fish and Wildlife Service

State Government – Departments of Environmental Quality, Lands, Transportation, Fish and Game, and Agriculture, Soil Conservation Commission; Bear Lake, Caribou, Franklin, and Oneida Soil Conservation districts

County Government – Bear Lake, Caribou, Franklin, Oneida counties

Local Government – Cities of Montpelier, Soda Springs, Grace, Preston, Franklin

Quasi-Government – Bear Lake Regional Commission, Bear River Commission, Bear River Resource Conservation and Development, Bear River Tri-State Water Quality Committee

Companies – PacifiCorp

Irrigation Companies – West Cache Irrigation Company, Bear River Canal Company, Cub River Canal Company, Last Chance Canal Company

Fish Hatcheries – Clear Springs Food (Clear Springs Foods), Grace Fish Hatchery (Idaho Department of Fish and Game), Bear River Trout Farm and Black Canyon Trout Farms (George Kimball), Bosen Land and Livestock (Clair Bosen), Smith Creek Hatchery (John Lambregts, Edwin Smith), Ben Forsgren, and Wright's Rainbows (Sherman Wright).

Grazing Associations – Samaria Grazing Association, Pleasantview Livestock and Grazing Association, Cottonwood Grazing Association, Cub River Stockmen's Association, Fish Haven Stockmen's Association, Gem Valley Stockmen's Association, Main Canyon Stockmen's Association, Paris-Liberty Cattle Association, Bloomington Cattle Association, Cherryville Cattle Association, Maple Canyon Cattle Association, Caribou Cattlemen's Association, Bear Lake Cattlemen's Association, Mink Creek Cattlemen's Association

Numerous private individuals

4.4.1 Reasonable Assurance

EPA requires that TMDLs with a combination of point and nonpoint sources and with wasteload allocations dependent on nonpoint source controls, provide reasonable assurance that the nonpoint source controls will be implemented and effective in achieving the load allocation (EPA 1991). If reasonable assurance that nonpoint source reductions will be achieved is not provided, the entire pollutant load will be assigned to point sources. Nonpoint source reductions listed in the Bear River TMDL will be achieved through state authority within the Idaho Nonpoint Source Management Program.

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

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

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

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

4.5 Monitoring Strategy

DEQ will monitor BMP implementation through annual reports submitted as part of any implementation program. Due to constraints of money, time, and personnel, DEQ does not expect to directly monitor BMP effectiveness. The hope would be that the funding agency include monitoring as part of the project funding request. Tributary monitoring at the point the stream enters the mainstem would allow some determination of watershed BMP effectiveness.

DEQ is responsible for monitoring both mainstem and tributaries as to compliance with TMDL allocations and as to progress toward supporting beneficial uses. The Beneficial Use Reconnaissance Program monitoring will help determine support of beneficial uses for coldwater aquatic life, salmonid spawning, and contact recreation. Ambient water quality monitoring will be dependent on money, time, and personnel available to DEQ. Point sources will be monitored through their Discharge Monitoring Reports submitted to DEQ monthly.

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Appendix A: Water Quality Summary Data

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Mainstem Bear River: Winter Base Flow

SITE ID	STATION DESCRIPTION	TEMPERATURE (°C)					FLOW (CFS)				
		AVG	N	MAX	MIN	STD	AVG	N	MAX	MIN	STD
BR01	BR at ID WY state line	0.6	112	7.0	0.0	1.4	229.4	77	700.0	99.0	123.3
BR01A	BR abv confl w Thomas Fork	0.1	2	0.1	0.1	0.0					
BR01B	BR at Harer ID										
BR03	Stewart Dam	1.4	20	12.0	-0.5	2.8	281.0	21	907.0	114.0	206.3
BL01	Causeway	1.6	10	3.0	0.6	0.8	26.6	10	166.0	0.0	58.2
BL02	Lifton	1.7	23	12.0	-1.0	2.7	283.0	20	847.0	72.0	174.9
BL03	BL outlet	1.7	24	12.0	-1.0	2.8	570.1	24	1775.0	1.0	555.8
BR02	BR at Hunter Hill Road bridge	1.1	8	5.4	0.0	2.0					
BR04	Bear River Old Channel	1.1	5	2.2	0.0	0.8					
BR05	BR at Pescadero	1.3	36	6.2	0.0	1.5	590.6	26	2280.0	54.0	577.4
BR06	BR at Nounan Bridge										
BR07	BR at Stauffer Creek										
BR08	BR above Alexander	0.7	3	1.0	0.3	0.4	149.4	3	282.7	77.7	115.5
BR08A	BR at head of Alexander Res	1.8	36	8.5	0.0	2.3	106.5	4	253.0	0.0	106.3
BR09	BR below Alexander	3.3	4	5.3	0.5	2.0	271.0	3	449.0	180.0	154.2
BR10	BR at Last Chance	2.6	3	3.2	2.2	0.5	271.0	3	449.0	180.0	154.2
BR11	BR at Black Canyon	5.8	8	7.3	3.6	1.1	87.0	8	130.0	33.0	36.1
BR11A	BR nr Grace ID	6.9	6	16.7	2.0	5.5					
BR11B	BR abv Cove powerplant	4.6	8	6.6	3.2	1.0	122.5	8	298.0	40.0	80.0
BR11C	BR blw Cove powerplant	3.9	3	5.3	3.2	1.2	257.3	3	272.0	238.0	17.5
BR12	BR at Cheeseplant Bridge	6.2	9	10.0	0.0	3.4					
BR13	BR at Thatcher Church										
BR14	BR at Thatcher Bridge										
BR15	BR abv Oneida at Highway Bridge	3.9	3	4.6	3.4	0.6	456.3	3	569.0	336.0	116.7
BR15A	BR 1 mile blw Oneida	2.1	15	7.4	0.0	2.2	417.3	4	472.0	370.0	47.5
BR16	BR blw Oneida	4.4	11	7.2	1.8	2.0	447.7	11	587.0	319.0	100.1
BR16A	BR at Riverdale	2.7	3	4.0	0.0	2.3					
BR16B	BR near Preston	2.9	19	11.0	0.0	2.8	1322.5	11	3230.0	72.0	1281.1
BR16C	BR above Preston	2.2	5	8.0	0.0	3.3					
BR17	BR west of Preston	2.9	48	9.0	0.0	2.6	401.0	3	513.0	307.0	104.2
BR18	BR at ID UT state line	2.5	61	11.1	0.0	2.6	1061.7	43	4580.0	160.0	1066.9

Mainstem Bear River: Lower Basin Runoff

SITE ID	STATION DESCRIPTION	TEMPERATURE (°C)					FLOW (CFS)				
		AVG	N	MAX	MIN	STD	AVG	N	MAX	MIN	STD
BR01	BR at ID WY state line	4.3	79	15.0	-4.0	4.3	623.5	51	2470.0	25.0	604.4
BR01A	BR abv confl w Thomas Fork	7.0	4	11.1	3.6	3.2					
BR01B	BR at Harer ID										
BR03	Stewart Dam	6.1	30	15.0	-0.4	4.6	723.9	46	2090.0	135.0	542.3
BL01	Causeway	5.3	15	12.2	-0.2	3.7	263.5	15	804.0	0.0	226.0
BL02	Lifton	6.4	31	15.2	0.0	4.5	381.2	47	2247.0	0.0	489.1
BL03	BL outlet	6.5	29	16.0	0.0	4.0	343.0	34	1188.0	1.0	413.1
BR02	BR at Hunter Hill Road bridge	4.1	6	14.1	0.0	5.6	319.6	1	319.6	319.6	
BR04	Bear River Old Channel	5.8	9	15.1	2.8	5.0	30.0	1	30.0	30.0	
BR05	BR at Pescadero	6.1	33	16.5	0.0	5.2	470.5	28	1940.0	73.0	475.1
BR06	BR at Nounan Bridge	10.5	2	14.7	6.2	6.0	321.5	1	321.5	321.5	
BR07	BR at Stauffer Creek	10.5	2	12.8	8.2	3.3	339.5	1	339.5	339.5	
BR08	BR above Alexander	5.0	11	10.8	-0.1	3.5	406.5	10	969.3	179.7	245.9
BR08A	BR at head of Alexander Res	4.7	22	14.0	0.0	4.0	582.5	2	726.0	439.0	202.9
BR09	BR below Alexander	5.6	12	10.3	2.4	2.2	515.2	10	1013.0	215.0	300.6
BR10	BR at Last Chance	4.5	10	9.0	1.5	2.4	536.1	9	1013.0	215.0	311.0
BR11	BR at Black Canyon	7.5	10	11.2	4.5	2.2	75.2	9	179.0	36.0	44.8
BR11A	BR nr Grace ID	7.9	8	15.0	4.4	3.6					
BR11B	BR abv Cove powerplant	6.1	8	9.3	3.2	2.1	232.5	8	668.0	45.0	194.2
BR11C	BR blw Cove powerplant	5.5	9	10.6	2.4	2.6	524.6	9	1073.0	237.0	338.2
BR12	BR at Cheeseplant Bridge	9.2	6	12.0	6.1	2.4	800.7	1	800.7	800.7	
BR13	BR at Thatcher Church	10.7	2	14.3	7.0	5.1	805.9	1	805.9	805.9	
BR14	BR at Thatcher Bridge	6.0	6	11.4	2.3	3.3	846.5	5	1306.5	442.8	363.9
BR15	BR abv Oneida at Highway Bridge	7.1	11	13.0	2.9	3.0	778.2	10	1540.0	309.0	390.0
BR15A	BR 1 mile blw Oneida	4.4	11	8.0	1.0	2.4	272.7	6	459.0	145.0	113.7
BR16	BR blw Oneida	7.9	17	13.6	5.1	2.3	754.6	18	1470.0	424.0	342.3
BR16A	BR at Riverdale	2.9	6	5.0	1.0	1.7					
BR16B	BR near Preston	7.2	11	9.5	3.0	1.8	1094.8	9	3400.0	52.0	1423.6
BR16C	BR above Preston										
BR17	BR west of Preston	7.2	38	14.5	0.0	3.4	986.7	10	1700.0	415.0	468.3
BR18	BR at ID UT state line	7.1	48	15.1	0.0	3.3	1031.0	35	4050.0	113.0	954.1

Mainstem Bear River: Upper Basin Runoff

SITE ID	STATION DESCRIPTION	TEMPERATURE (°C)					FLOW (CFS)				
		AVG	N	MAX	MIN	STD	AVG	N	MAX	MIN	STD
BR01	BR at ID WY state line	14.2	119	24.0	1.0	4.7	1095.9	73	5450.0	40.0	1068.6
BR01A	BR abv confl w Thomas Fork	14.6	10	19.5	9.0	3.6					
BR01B	BR at Harer ID										
BR03	Stewart Dam	15.1	51	22.0	7.6	4.0	1252.2	88	4330.0	29.0	1047.2
BL01	Causeway	16.1	26	23.4	8.5	3.8	1007.8	39	2788.0	0.0	835.7
BL02	Lifton	16.7	47	24.4	8.3	4.3	548.9	86	2076.0	0.0	606.3
BL03	BL outlet	16.1	56	23.1	7.5	4.4	602.7	74	3350.0	5.0	715.9
BR02	BR at Hunter Hill Road bridge	17.0	6	21.8	12.0	3.9					
BR04	Bear River Old Channel	19.3	6	23.3	9.6	5.1	162.0	1	162.0	162.0	
BR05	BR at Pescadero	16.3	43	24.5	4.0	5.1	1075.3	36	3610.0	175.0	859.3
BR06	BR at Nounan Bridge										
BR07	BR at Stauffer Creek										
BR08	BR above Alexander	13.7	16	20.0	8.3	3.6	815.7	14	1444.0	251.5	363.8
BR08A	BR at head of Alexander Res	17.1	32	28.0	7.0	5.1	1446.7	3	1670.0	1040.0	352.8
BR09	BR below Alexander	14.4	21	21.0	8.5	3.8	845.0	14	1557.0	282.0	393.1
BR10	BR at Last Chance	14.2	14	21.2	8.5	3.9	845.0	14	1557.0	282.0	393.1
BR11	BR at Black Canyon	13.0	10	15.7	10.1	2.2	100.0	10	607.0	26.0	179.1
BR11A	BR nr Grace ID	19.4	5	23.3	16.7	2.7					
BR11B	BR abv Cove powerplant	13.7	9	17.0	10.3	2.4	504.8	9	916.0	122.0	272.1
BR11C	BR blw Cove powerplant	14.6	13	20.6	9.8	3.6	593.0	13	1080.0	147.0	278.9
BR12	BR at Cheeseplant Bridge	16.2	6	17.5	14.8	1.2	1585.2	1	1585.2	1585.2	
BR13	BR at Thatcher Church	14.6	1	14.6	14.6		1607.7	1	1607.7	1607.7	
BR14	BR at Thatcher Bridge	13.7	5	19.7	9.0	4.4	1096.0	5	1626.4	613.8	445.7
BR15	BR abv Oneida at Highway Bridge	14.4	13	21.7	10.8	3.3	910.5	13	1905.0	330.0	419.1
BR15A	BR 1 mile blw Oneida	14.2	15	22.0	3.0	6.2	578.7	6	1160.0	145.0	338.9
BR16	BR blw Oneida	15.4	23	20.4	11.0	3.3	810.2	23	1980.0	123.0	447.7
BR16A	BR at Riverdale	8.9	7	15.0	3.0	4.6					
BR16B	BR near Preston	14.2	26	23.0	7.5	4.9	2336.1	18	4520.0	334.0	1121.4
BR16C	BR above Preston										
BR17	BR west of Preston	16.9	50	26.0	8.0	4.5	985.9	14	2600.0	199.0	742.4
BR18	BR at ID UT state line	16.1	75	23.0	4.5	4.6	1514.2	54	4860.0	73.0	1437.4

Mainstem Bear River: Summer Base Flow

SITE ID	STATION DESCRIPTION	TEMPERATURE (°C)						FLOW (CFS)				
		AVG	N	MAX	MIN	STD		AVG	N	MAX	MIN	STD
BR01	BR at ID WY state line	13.1	112	22.5	3.0	5.0		242.2	72	1070.0	36.0	202.8
BR01A	BR abv confl w Thomas Fork	14.8	5	21.5	5.2	6.2						
BR01B	BR at Harer ID	16.0	1	16.0	16.0							
BR03	Stewart Dam	15.0	28	24.0	4.8	5.7		358.0	37	1110.0	8.0	286.9
BL01	Causeway	14.8	10	21.6	6.2	5.4		20.0	13	125.0	0.0	41.7
BL02	Lifton	16.3	33	23.0	7.5	4.8		338.8	16	1041.0	0.0	359.1
BL03	BL outlet	15.3	39	23.1	5.5	5.8		877.9	43	2027.0	4.0	581.5
BR02	BR at Hunter Hill Road bridge	11.9	5	21.0	4.2	6.2		570.3	1	570.3	570.3	
BR04	Bear River Old Channel	13.9	6	21.0	9.0	4.3		50.7	1	50.7	50.7	
BR05	BR at Pescadero	13.9	38	23.0	2.0	5.6		622.2	33	2210.0	0.0	630.7
BR06	BR at Nounan Bridge	10.6	1	10.6	10.6			911.0	1	911.0	911.0	
BR07	BR at Stauffer Creek	9.0	1	9.0	9.0			948.6	1	948.6	948.6	
BR08	BR above Alexander	14.1	10	21.6	7.1	4.7		646.5	9	1020.0	120.0	325.3
BR08A	BR at head of Alexander Res	13.8	33	23.0	2.3	5.6		1129.3	3	1550.0	538.0	527.1
BR09	BR below Alexander	16.4	16	21.5	9.9	3.2		710.9	9	1107.0	131.0	363.6
BR10	BR at Last Chance	16.0	12	20.9	9.2	4.0		710.9	9	1107.0	131.0	363.6
BR11	BR at Black Canyon	12.1	7	18.2	8.3	3.6		73.4	7	141.0	23.0	39.3
BR11A	BR nr Grace ID	12.7	6	17.0	4.4	4.5						
BR11B	BR abv Cove powerplant	13.5	6	18.2	9.9	3.1		422.8	6	785.0	95.0	290.9
BR11C	BR blw Cove powerplant	16.2	8	20.5	10.1	3.9		466.8	8	850.0	185.0	233.3
BR12	BR at Cheeseplant Bridge	15.1	8	21.2	9.1	4.4		1200.9	1	1200.9	1200.9	
BR13	BR at Thatcher Church	9.0	1	9.0	9.0			1209.3	1	1209.3	1209.3	
BR14	BR at Thatcher Bridge	15.4	6	18.2	8.7	3.4		766.5	3	1240.1	498.8	411.3
BR15	BR abv Oneida at Highway Bridge	14.9	9	20.8	8.9	4.4		737.2	9	1266.4	274.0	306.3
BR15A	BR 1 mile blw Oneida	14.4	13	18.0	4.5	4.4		789.0	3	1280.0	223.0	532.5
BR16	BR blw Oneida	16.9	15	23.0	11.4	3.4		670.5	15	1268.0	231.0	309.5
BR16A	BR at Riverdale	14.8	3	18.5	10.0	4.4						
BR16B	BR near Preston	15.7	28	23.0	6.5	4.7		1275.5	23	2900.0	51.0	1140.4
BR16C	BR above Preston	25.0	2	26.0	24.0	1.4						
BR17	BR west of Preston	15.6	54	23.0	6.0	4.1		575.5	9	1277.2	247.0	288.7
BR18	BR at ID UT state line	15.5	72	24.0	5.0	5.1		982.9	50	3010.0	106.0	916.1

Mainstem Bear River: Winter Base Flow

SITE ID	STATION DESCRIPTION	DISSOLVED OXYGEN (mg/L)					pH (SU)				
		AVG	N	MAX	MIN	STD	AVG	N	MAX	MIN	STD
BR01	BR at ID WY state line	10.2	64	16.3	6.0	1.7	8.0	93	8.4	7.2	0.2
BR01A	BR abv confl w Thomas Fork	9.3	2	11.0	7.6	2.4	7.4	2	7.4	7.3	0.1
BR01B	BR at Harer ID						8.0	1	8.0	8.0	
BR03	Stewart Dam	10.6	12	12.1	8.7	1.2	8.0	20	8.5	7.1	0.3
BL01	Causeway	10.4	10	12.0	7.5	1.3	8.0	10	8.3	7.1	0.4
BL02	Lifton	9.9	15	12.6	4.4	2.0	8.0	22	8.6	7.1	0.4
BL03	BL outlet	10.2	18	12.7	6.7	1.7	8.0	23	8.9	6.7	0.4
BR02	BR at Hunter Hill Road bridge	11.2	7	11.7	10.4	0.6					
BR04	Bear River Old Channel	11.7	5	12.9	10.6	1.0	7.9	8	8.4	7.4	0.3
BR05	BR at Pescadero	10.9	9	12.1	9.7	0.8	7.8	1	7.8	7.8	
BR06	BR at Nounan Bridge										
BR07	BR at Stauffer Creek										
BR08	BR above Alexander	11.4	3	12.1	10.2	1.0	7.6	4	8.0	7.0	0.4
BR08A	BR at head of Alexander Res	10.6	31	13.2	6.6	1.5	8.1	25	8.7	6.8	0.5
BR09	BR below Alexander	9.4	3	10.1	9.0	0.6	7.8	5	8.8	7.0	0.7
BR10	BR at Last Chance	10.1	2	10.8	9.4	1.0	7.3	3	7.8	6.6	0.6
BR11	BR at Black Canyon	11.0	7	13.7	9.5	1.4	8.0	8	8.5	7.5	0.3
BR11A	BR nr Grace ID	11.5	6	12.7	10.0	1.1	8.3	5	8.5	7.8	0.3
BR11B	BR abv Cove powerplant	11.5	8	14.0	10.2	1.3	7.9	8	8.4	7.2	0.5
BR11C	BR blw Cove powerplant	10.8	3	12.6	9.3	1.7	7.6	3	8.0	6.8	0.7
BR12	BR at Cheeseplant Bridge	12.3	9	13.8	10.9	0.9					
BR13	BR at Thatcher Church										
BR14	BR at Thatcher Bridge										
BR15	BR abv Oneida at Highway Bridge	10.9	3	13.2	9.5	2.0	7.3	3	7.8	6.6	0.6
BR15A	BR 1 mile blw Oneida	11.8	12	13.8	10.2	1.3	8.4	8	8.7	8.2	0.2
BR16	BR blw Oneida	11.2	9	13.2	9.8	1.1	7.4	11	7.9	7.0	0.3
BR16A	BR at Riverdale	10.6	4	12.0	8.8	1.4					
BR16B	BR near Preston						8.1	9	8.2	7.9	0.1
BR16C	BR above Preston	12.3	3	13.8	10.7	1.6	8.1	19	8.5	7.8	0.2
BR17	BR west of Preston	11.4	45	15.4	4.6	1.9	8.1	36	9.5	7.1	0.5
BR18	BR at ID UT state line	10.6	46	15.8	7.7	1.6	8.1	43	9.2	6.8	0.4

Mainstem Bear River: Lower Basin Runoff

SITE ID	STATION DESCRIPTION	DISSOLVED OXYGEN (mg/L)					pH (SU)				
		AVG	N	MAX	MIN	STD	AVG	N	MAX	MIN	STD
BR01	BR at ID WY state line	9.5	46	13.5	7.2	1.4	8.1	67	8.5	7.4	0.2
BR01A	BR abv confl w Thomas Fork	8.8	4	9.1	8.3	0.4	8.0	4	8.2	7.7	0.2
BR01B	BR at Harer ID										
BR03	Stewart Dam	9.4	27	12.8	6.6	1.6	8.0	30	8.5	7.4	0.3
BL01	Causeway	10.3	15	12.8	8.5	1.2	8.0	15	8.6	7.0	0.4
BL02	Lifton	9.6	29	12.5	6.8	1.5	8.0	31	8.8	6.6	0.5
BL03	BL outlet	9.2	28	12.4	6.6	1.6	7.9	32	8.7	6.2	0.5
BR02	BR at Hunter Hill Road bridge	9.4	4	10.3	8.2	0.9	8.4	2	8.4	8.3	0.1
BR04	Bear River Old Channel	10.6	9	14.0	8.2	2.0	8.1	7	8.5	7.7	0.3
BR05	BR at Pescadero	8.8	8	11.4	7.1	1.7	7.7	6	8.5	7.1	0.5
BR06	BR at Nounan Bridge	11.4	2	12.5	10.2	1.6	8.3	2	8.5	8.1	0.3
BR07	BR at Stauffer Creek	12.8	2	13.8	11.8	1.4	8.5	2	8.6	8.4	0.1
BR08	BR above Alexander	9.8	11	12.7	8.1	1.3	7.8	11	8.2	7.5	0.3
BR08A	BR at head of Alexander Res	10.3	21	12.5	6.5	1.5	8.1	16	8.7	7.5	0.4
BR09	BR below Alexander	10.0	11	12.8	8.0	1.3	7.1	12	7.6	6.2	0.4
BR10	BR at Last Chance	10.3	10	13.2	7.4	1.6	7.4	10	7.9	7.0	0.3
BR11	BR at Black Canyon	11.3	10	14.6	8.8	1.8	8.1	10	8.6	7.4	0.3
BR11A	BR nr Grace ID	12.0	9	13.5	10.2	1.2	8.4	5	8.8	7.9	0.3
BR11B	BR abv Cove powerplant	12.0	8	14.8	10.0	1.8	7.9	8	8.2	7.4	0.3
BR11C	BR blw Cove powerplant	10.7	9	13.8	8.6	1.8	7.5	9	8.0	7.0	0.4
BR12	BR at Cheeseplant Bridge	12.1	5	14.1	10.0	1.7	8.2	2	8.5	8.0	0.3
BR13	BR at Thatcher Church	11.9	2	11.9	11.9	0.0	8.3	2	8.6	8.1	0.3
BR14	BR at Thatcher Bridge	9.6	6	10.9	8.3	0.9	7.8	6	8.2	7.5	0.3
BR15	BR abv Oneida at Highway Bridge	9.9	10	12.4	8.3	1.2	7.6	11	8.3	6.6	0.4
BR15A	BR 1 mile blw Oneida	9.8	7	12.1	8.4	1.2	8.3	6	8.8	7.4	0.5
BR16	BR blw Oneida	11.2	17	14.2	8.9	1.5	7.5	19	8.5	6.0	0.5
BR16A	BR at Riverdale	11.2	5	13.2	10.0	1.3					
BR16B	BR near Preston						8.0	3	8.2	7.7	0.3
BR16C	BR above Preston						7.6	8	8.0	7.0	0.3
BR17	BR west of Preston	10.6	35	15.4	6.8	1.5	7.9	31	8.5	7.1	0.4
BR18	BR at ID UT state line	9.6	31	13.0	7.4	1.3	8.1	24	9.1	7.6	0.3

Mainstem Bear River: Upper Basin Runoff

SITE ID	STATION DESCRIPTION	DISSOLVED OXYGEN (mg/L)					pH (SU)				
		AVG	N	MAX	MIN	STD	AVG	N	MAX	MIN	STD
BR01	BR at ID WY state line	8.2	73	10.8	5.3	1.3	8.1	98	10.2	7.5	0.3
BR01A	BR abv confl w Thomas Fork	7.6	10	9.6	3.8	1.6	7.9	10	8.4	7.8	0.2
BR01B	BR at Harer ID						8.0	2	8.1	7.9	0.1
BR03	Stewart Dam	7.5	40	11.9	5.5	1.3	8.0	56	8.7	7.1	0.3
BL01	Causeway	7.5	25	13.0	5.1	1.7	7.9	27	8.5	7.3	0.3
BL02	Lifton	6.5	45	12.2	3.7	1.7	7.9	55	8.9	7.2	0.4
BL03	BL outlet	6.9	52	12.0	3.6	1.6	7.9	64	8.8	6.8	0.4
BR02	BR at Hunter Hill Road bridge	7.5	6	8.6	6.8	0.6					
BR04	Bear River Old Channel	6.9	5	8.5	4.7	1.5	8.1	6	8.4	7.8	0.2
BR05	BR at Pescadero	6.8	10	9.0	5.4	1.2	8.1	6	8.3	7.8	0.2
BR06	BR at Nounan Bridge										
BR07	BR at Stauffer Creek										
BR08	BR above Alexander	8.3	13	10.8	6.5	1.5	7.9	16	8.4	7.2	0.4
BR08A	BR at head of Alexander Res	7.8	31	11.0	6.2	1.2	8.1	22	8.5	7.1	0.3
BR09	BR below Alexander	7.7	13	10.1	5.4	1.4	7.5	23	8.0	6.7	0.3
BR10	BR at Last Chance	7.9	13	10.0	6.1	1.3	7.7	14	8.1	7.2	0.3
BR11	BR at Black Canyon	10.6	10	13.2	7.3	1.7	8.0	10	8.6	7.4	0.4
BR11A	BR nr Grace ID	9.2	5	12.1	7.0	2.0	8.3	4	8.7	7.5	0.5
BR11B	BR abv Cove powerplant	11.9	9	13.8	9.5	1.5	7.8	9	8.9	7.2	0.5
BR11C	BR blw Cove powerplant	7.8	12	9.8	5.8	1.4	7.8	13	8.8	7.2	0.4
BR12	BR at Cheeseplant Bridge	9.9	6	11.1	8.5	1.0	8.4	1	8.4	8.4	
BR13	BR at Thatcher Church	11.7	1	11.7	11.7		8.3	1	8.3	8.3	
BR14	BR at Thatcher Bridge	7.0	5	10.5	5.4	2.1	7.9	5	8.1	7.7	0.2
BR15	BR abv Oneida at Highway Bridge	8.3	13	10.4	5.8	1.4	7.6	13	8.1	7.2	0.3
BR15A	BR 1 mile blw Oneida	8.9	15	11.0	6.8	1.3	8.4	13	8.7	7.7	0.3
BR16	BR blw Oneida	8.6	23	11.2	6.5	1.3	7.6	23	8.2	6.7	0.4
BR16A	BR at Riverdale	9.6	7	11.0	7.8	1.2					
BR16B	BR near Preston						7.9	7	8.2	7.7	0.2
BR16C	BR above Preston	9.4	3	11.9	7.5	2.3					
BR17	BR west of Preston	9.1	50	14.8	6.2	1.7	8.0	42	8.7	6.8	0.4
BR18	BR at ID UT state line	8.2	49	13.3	5.3	1.7	8.1	45	8.8	7.3	0.3

Mainstem Bear River: Summer Base Flow

SITE ID	STATION DESCRIPTION	DISSOLVED OXYGEN (mg/L)						pH (SU)				
		AVG	N	MAX	MIN	STD		AVG	N	MAX	MIN	STD
BR01	BR at ID WY state line	8.6	68	12.8	6.1	1.5		8.1	87	8.6	7.1	0.2
BR01A	BR abv confl w Thomas Fork	8.7	4	10.5	7.4	1.6		8.0	4	8.1	7.7	0.2
BR01B	BR at Harer ID							7.9	1	7.9	7.9	
BR03	Stewart Dam	8.2	19	10.7	5.6	1.5		8.1	31	8.8	6.7	0.4
BL01	Causeway	7.6	9	8.7	6.3	0.9		8.2	10	8.9	7.1	0.5
BL02	Lifton	8.1	24	11.3	6.1	1.2		8.4	34	9.3	7.4	0.3
BL03	BL outlet	7.7	32	11.2	5.4	1.4		8.2	38	9.1	6.9	0.4
BR02	BR at Hunter Hill Road bridge	8.9	5	10.7	7.7	1.1		8.2	1	8.2	8.2	
BR04	Bear River Old Channel	9.5	6	12.2	8.1	1.5		8.2	7	8.6	7.6	0.3
BR05	BR at Pescadero	8.0	7	10.9	7.0	1.4		8.2	4	8.3	8.1	0.1
BR06	BR at Nounan Bridge	10.1	1	10.1	10.1			8.4	1	8.4	8.4	
BR07	BR at Stauffer Creek	11.0	1	11.0	11.0			8.3	1	8.3	8.3	
BR08	BR above Alexander	8.4	9	9.7	7.8	0.8		8.2	11	8.6	7.1	0.4
BR08A	BR at head of Alexander Res	9.0	32	13.9	6.0	1.8		8.2	25	8.9	7.6	0.3
BR09	BR below Alexander	7.1	13	9.2	5.9	1.0		7.7	17	8.2	7.0	0.3
BR10	BR at Last Chance	7.3	10	8.9	5.3	1.3		8.0	10	8.3	7.7	0.2
BR11	BR at Black Canyon	10.0	7	11.4	9.2	0.8		8.2	7	8.6	7.6	0.3
BR11A	BR nr Grace ID	11.6	6	14.2	10.2	1.5		8.3	5	8.5	8.1	0.2
BR11B	BR abv Cove powerplant	9.5	6	10.6	8.7	0.7		8.1	6	8.4	7.3	0.5
BR11C	BR blw Cove powerplant	7.8	8	9.6	5.6	1.4		8.1	8	8.4	7.8	0.2
BR12	BR at Cheeseplant Bridge	9.9	7	11.7	8.0	1.6		8.0	3	8.2	7.8	0.2
BR13	BR at Thatcher Church	8.6	1	8.6	8.6			7.9	1	7.9	7.9	
BR14	BR at Thatcher Bridge	6.7	4	7.9	6.0	0.8		7.8	5	7.9	7.7	0.1
BR15	BR abv Oneida at Highway Bridge	8.4	9	10.2	6.1	1.3		7.9	9	8.3	7.0	0.4
BR15A	BR 1 mile blw Oneida	8.4	11	10.3	6.5	1.1		8.2	16	8.6	7.3	0.4
BR16	BR blw Oneida	7.9	14	11.2	4.2	1.7		7.9	15	8.3	7.5	0.3
BR16A	BR at Riverdale	9.4	4	10.8	7.6	1.3						
BR16B	BR near Preston							8.2	6	8.4	7.9	0.2
BR16C	BR above Preston	10.5	6	12.6	6.0	2.6		8.2	5	8.4	8.0	0.1
BR17	BR west of Preston	9.4	50	15.1	5.6	2.1		8.1	47	9.0	6.9	0.4
BR18	BR at ID UT state line	8.4	41	12.5	5.6	1.6		8.2	40	8.6	7.6	0.2

Mainstem Bear River: Winter Base Flow

SITE ID	STATION DESCRIPTION	TOTAL SUSPENDED SOLIDS (mg/L)					NH_3+NH_4-N (mg/L)				
		AVG	N	MAX	MIN	STD	AVG	N	MAX	MIN	STD
BR01	BR at ID WY state line	47	19	418	1	96	0.058	23	0.330	0.000	0.066
BR01A	BR abv confl w Thomas Fork	12	3	18	6	6					
BR01B	BR at Harer ID										
BR03	Stewart Dam	21	15	92	5	26	0.037	16	0.089	0.005	0.020
BL01	Causeway	10	10	26	3	7	0.836	10	5.925	0.005	1.900
BL02	Lifton	20	19	134	0	32	0.034	5	0.047	0.019	0.013
BL03	BL outlet	17	19	74	1	21	0.040	15	0.096	0.012	0.026
BR02	BR at Hunter Hill Road bridge	44	8	82	2	33					
BR04	Bear River Old Channel										
BR05	BR at Pescadero	32	9	63	2	23					
BR06	BR at Nounan Bridge										
BR07	BR at Stauffer Creek										
BR08	BR above Alexander	3	3	4	3	1	0.038	3	0.050	0.019	0.017
BR08A	BR at head of Alexander Res	19	25	141	1	33					
BR09	BR below Alexander	4	3	5	3	1	0.066	3	0.123	0.035	0.050
BR10	BR at Last Chance	5	3	9	3	3	0.056	3	0.108	0.027	0.045
BR11	BR at Black Canyon	8	8	46	2	15	0.056	8	0.094	0.005	0.025
BR11A	BR nr Grace ID	12	1	12	12						
BR11B	BR abv Cove powerplant	5	8	24	1	8	0.049	8	0.109	0.005	0.031
BR11C	BR blw Cove powerplant	7	3	10	5	3	0.047	3	0.066	0.024	0.021
BR12	BR at Cheeseplant Bridge	20	9	71	1	28					
BR13	BR at Thatcher Church										
BR14	BR at Thatcher Bridge										
BR15	BR abv Oneida at Highway Bridge	18	3	25	13	6	0.069	3	0.144	0.031	0.065
BR15A	BR 1 mile blw Oneida	13	16	69	1	21					
BR16	BR blw Oneida	6	11	15	2	4	0.113	11	0.221	0.005	0.077
BR16A	BR at Riverdale	3	4	5	1	2					
BR16B	BR near Preston										
BR16C	BR above Preston	61	25	94	14	25					
BR17	BR west of Preston	29	36	447	1	74	0.145	3	0.193	0.051	0.081
BR18	BR at ID UT state line	49	37	889	0	143	0.065	2	0.080	0.050	0.021

Mainstem Bear River: Lower Basin Runoff

SITE ID	STATION DESCRIPTION	TOTAL SUSPENDED SOLIDS (mg/L)						NH_3+NH_4-N (mg/L)				
		AVG	N	MAX	MIN	STD		AVG	N	MAX	MIN	STD
BR01	BR at ID WY state line	158	16	1020	12	261		0.056	24	0.250	0.001	0.066
BR01A	BR abv confl w Thomas Fork	650	4	1040	225	337						
BR01B	BR at Harer ID											
BR03	Stewart Dam	116	29	559	4	115		0.065	39	0.282	0.001	0.065
BL01	Causeway	23	16	156	1	37		0.101	14	0.810	0.005	0.209
BL02	Lifton	20	28	108	0	24		0.048	6	0.094	0.030	0.024
BL03	BL outlet	35	25	103	2	23		0.048	25	0.229	0.002	0.047
BR02	BR at Hunter Hill Road bridge	103	5	233	15	93		0.043	2	0.050	0.036	0.010
BR04	Bear River Old Channel	129	2	142	116	18		0.055	2	0.069	0.041	0.020
BR05	BR at Pescadero	37	9	114	6	31		0.129	6	0.364	0.035	0.126
BR06	BR at Nounan Bridge	29	2	41	16	18		0.058	2	0.071	0.045	0.018
BR07	BR at Stauffer Creek	6	2	6	5	1		0.039	2	0.041	0.036	0.004
BR08	BR above Alexander	26	11	84	4	22		0.094	11	0.291	0.030	0.082
BR08A	BR at head of Alexander Res	39	13	198	4	55						
BR09	BR below Alexander	15	11	42	2	11		0.096	11	0.169	0.051	0.042
BR10	BR at Last Chance	17	10	48	4	14		0.088	10	0.135	0.042	0.025
BR11	BR at Black Canyon	6	10	31	2	9		0.044	10	0.067	0.030	0.012
BR11A	BR nr Grace ID	11	1	11	11							
BR11B	BR abv Cove powerplant	4	8	8	1	2		0.036	8	0.051	0.027	0.010
BR11C	BR blw Cove powerplant	12	9	25	2	8		0.077	9	0.125	0.031	0.027
BR12	BR at Cheeseplant Bridge	29	6	104	4	39		0.148	2	0.241	0.054	0.132
BR13	BR at Thatcher Church	16	2	18	13	4		0.055	2	0.071	0.038	0.023
BR14	BR at Thatcher Bridge	40	6	74	16	20		0.077	6	0.132	0.032	0.041
BR15	BR abv Oneida at Highway Bridge	37	11	64	22	13		0.097	11	0.353	0.030	0.091
BR15A	BR 1 mile blw Oneida	18	13	69	3	20						
BR16	BR blw Oneida	9	19	19	2	4		0.095	19	0.251	0.030	0.066
BR16A	BR at Riverdale	9	6	14	4	4						
BR16B	BR near Preston											
BR16C	BR above Preston	70	7	103	36	27						
BR17	BR west of Preston	46	24	225	1	54		0.115	11	0.206	0.046	0.041
BR18	BR at ID UT state line	63	25	281	12	68						

Mainstem Bear River: Upper Basin Runoff

SITE ID	STATION DESCRIPTION	TOTAL SUSPENDED SOLIDS (mg/L)					$NH3+NH_4$-N (mg/L)				
		AVG	N	MAX	MIN	STD	AVG	N	MAX	MIN	STD
BR01	BR at ID WY state line	97	25	390	12	83	0.035	33	0.160	0.000	0.033
BR01A	BR abv confl w Thomas Fork	131	11	352	30	86					
BR01B	BR at Harer ID										
BR03	Stewart Dam	88	47	311	3	60	0.038	76	0.163	0.000	0.034
BL01	Causeway	28	35	81	3	19	0.040	35	0.168	0.001	0.038
BL02	Lifton	23	55	103	0	23	0.029	11	0.056	0.004	0.015
BL03	BL outlet	49	55	157	3	33	0.039	61	0.137	0.001	0.028
BR02	BR at Hunter Hill Road bridge	50	6	95	11	34					
BR04	Bear River Old Channel	30	1	30	30		0.052	1	0.052	0.052	
BR05	BR at Pescadero	61	10	142	24	32	0.039	5	0.052	0.028	0.009
BR06	BR at Nounan Bridge										
BR07	BR at Stauffer Creek										
BR08	BR above Alexander	56	14	118	16	29	0.053	14	0.222	0.030	0.051
BR08A	BR at head of Alexander Res	52	25	363	2	70					
BR09	BR below Alexander	17	14	37	6	8	0.076	14	0.133	0.030	0.029
BR10	BR at Last Chance	20	14	34	7	7	0.065	14	0.115	0.029	0.023
BR11	BR at Black Canyon	6	10	24	1	7	0.033	10	0.062	0.005	0.021
BR11A	BR nr Grace ID										
BR11B	BR abv Cove powerplant	7	9	17	3	5	0.019	9	0.040	0.005	0.016
BR11C	BR blw Cove powerplant	17	13	36	7	8	0.056	13	0.103	0.037	0.021
BR12	BR at Cheeseplant Bridge	9	6	23	1	8	0.040	1	0.040	0.040	
BR13	BR at Thatcher Church	30	1	30	30		0.040	1	0.040	0.040	
BR14	BR at Thatcher Bridge	40	5	58	27	13	0.072	5	0.169	0.033	0.055
BR15	BR abv Oneida at Highway Bridge	39	13	46	25	7	0.055	13	0.148	0.034	0.030
BR15A	BR 1 mile blw Oneida	13	17	44	2	13					
BR16	BR blw Oneida	9	23	22	2	5	0.059	23	0.147	0.005	0.034
BR16A	BR at Riverdale	7	7	12	3	3					
BR16B	BR near Preston										
BR16C	BR above Preston	52	8	88	31	20					
BR17	BR west of Preston	31	43	202	3	33	0.060	14	0.142	0.032	0.036
BR18	BR at ID UT state line	32	40	121	3	24					

Mainstem Bear River: Summer Base Flow

SITE ID	STATION DESCRIPTION	TOTAL SUSPENDED SOLIDS (mg/L)					NH3+NH_4-N (mg/L)				
		AVG	N	MAX	MIN	STD	AVG	N	MAX	MIN	STD
BR01	BR at ID WY state line	96	23	1090	4	238	0.027	24	0.110	0.000	0.027
BR01A	BR abv confl w Thomas Fork	66	6	239	17	86					
BR01B	BR at Harer ID										
BR03	Stewart Dam	70	28	228	5	58	0.029	30	0.103	0.000	0.024
BL01	Causeway	15	12	31	3	10	0.067	13	0.239	0.005	0.073
BL02	Lifton	15	31	88	1	18	0.036	5	0.083	0.005	0.034
BL03	BL outlet	48	32	122	1	32	0.034	27	0.136	0.002	0.031
BR02	BR at Hunter Hill Road bridge	21	5	42	8	13	0.005	1	0.005	0.005	
BR04	Bear River Old Channel	43	2	45	40	4	0.005	1	0.005	0.005	
BR05	BR at Pescadero	38	7	79	1	24	0.030	3	0.045	0.005	0.022
BR06	BR at Nounan Bridge	14	1	14	14		0.007	1	0.007	0.007	
BR07	BR at Stauffer Creek	11	1	11	11		0.005	1	0.005	0.005	
BR08	BR above Alexander	28	9	67	3	24	0.049	9	0.112	0.027	0.025
BR08A	BR at head of Alexander Res	41	24	124	1	30					
BR09	BR below Alexander	15	14	26	5	7	0.058	9	0.107	0.012	0.030
BR10	BR at Last Chance	16	11	27	3	9	0.056	9	0.097	0.026	0.019
BR11	BR at Black Canyon	3	7	10	1	3	0.032	7	0.064	0.005	0.026
BR11A	BR nr Grace ID	48	1	48	48						
BR11B	BR abv Cove powerplant	5	6	7	3	1	0.027	6	0.047	0.005	0.018
BR11C	BR blw Cove powerplant	16	8	26	5	8	0.053	8	0.074	0.037	0.011
BR12	BR at Cheeseplant Bridge	7	8	15	1	5	0.005	1	0.005	0.005	
BR13	BR at Thatcher Church	10	1	10	10		0.005	1	0.005	0.005	
BR14	BR at Thatcher Bridge	20	5	32	5	11	0.053	3	0.092	0.005	0.044
BR15	BR abv Oneida at Highway Bridge	31	9	72	7	21	0.047	9	0.093	0.005	0.023
BR15A	BR 1 mile blw Oneida	7	13	17	1	4					
BR16	BR blw Oneida	7	15	11	4	2	0.066	15	0.157	0.013	0.041
BR16A	BR at Riverdale	5	4	11	1	4					
BR16B	BR near Preston										
BR16C	BR above Preston	65	17	265	27	56					
BR17	BR west of Preston	10	42	52	2	9	0.060	9	0.096	0.018	0.025
BR18	BR at ID UT state line	34	37	461	3	75					

Mainstem Bear River: Winter Base Flow

SITE ID	STATION DESCRIPTION	DISSOLVED NITRITE (mg/L)					DISSOLVED NITRATE (mg/L)				
		AVG	N	MAX	MIN	STD	AVG	N	MAX	MIN	STD
BR01	BR at ID WY state line	0.014	10	0.050	0.010	0.013	0.166	27	0.410	0.020	0.092
BR01A	BR abv confl w Thomas Fork	0.010	3	0.010	0.010	0.000	0.233	3	0.410	0.140	0.153
BR01B	BR at Harer ID										
BR03	Stewart Dam	0.000	8	0.000	0.000	0.000	0.383	8	0.795	0.122	0.251
BL01	Causeway	0.000	3	0.000	0.000	0.000	0.407	3	0.906	0.156	0.432
BL02	Lifton	0.000	15	0.000	0.000	0.000	0.137	17	0.608	0.005	0.160
BL03	BL outlet	0.000	13	0.000	0.000	0.000	0.107	13	0.310	0.019	0.081
BR02	BR at Hunter Hill Road bridge										
BR04	Bear River Old Channel										
BR05	BR at Pescadero										
BR06	BR at Nounan Bridge										
BR07	BR at Stauffer Creek										
BR08	BR above Alexander						0.467	3	0.657	0.263	0.197
BR08A	BR at head of Alexander Res										
BR09	BR below Alexander						0.558	3	0.709	0.448	0.135
BR10	BR at Last Chance						0.466	3	0.729	0.313	0.229
BR11	BR at Black Canyon						1.600	8	2.160	0.938	0.338
BR11A	BR nr Grace ID										
BR11B	BR abv Cove powerplant						1.311	8	1.832	0.673	0.351
BR11C	BR blw Cove powerplant						0.780	3	0.880	0.677	0.102
BR12	BR at Cheeseplant Bridge										
BR13	BR at Thatcher Church										
BR14	BR at Thatcher Bridge										
BR15	BR abv Oneida at Highway Bridge						0.694	3	0.833	0.529	0.154
BR15A	BR 1 mile blw Oneida	0.015	4	0.022	0.010	0.005	0.775	4	1.210	0.130	0.483
BR16	BR blw Oneida						0.732	11	1.054	0.346	0.253
BR16A	BR at Riverdale	0.014	4	0.020	0.010	0.005	1.178	4	2.260	0.480	0.780
BR16B	BR near Preston										
BR16C	BR above Preston										
BR17	BR west of Preston						0.588	3	0.780	0.375	0.203
BR18	BR at ID UT state line	0.030	21	0.200	0.000	0.044	0.913	21	3.320	0.000	0.613

Mainstem Bear River: Lower Basin Runoff

SITE ID	STATION DESCRIPTION	DISSOLVED NITRITE (mg/L)					DISSOLVED NITRATE (mg/L)				
		AVG	N	MAX	MIN	STD	AVG	N	MAX	MIN	STD
BR01	BR at ID WY state line	0.007	17	0.010	0.001	0.004	0.094	21	0.410	0.005	0.090
BR01A	BR abv confl w Thomas Fork	0.010	4	0.010	0.010	0.000	0.258	4	0.670	0.030	0.297
BR01B	BR at Harer ID										
BR03	Stewart Dam	0.000	32	0.003	0.000	0.001	0.205	33	0.650	0.005	0.150
BL01	Causeway	0.000	7	0.001	0.000	0.000	0.157	7	0.551	0.004	0.228
BL02	Lifton	0.000	41	0.001	0.000	0.000	0.095	43	0.782	0.001	0.132
BL03	BL outlet	0.000	22	0.002	0.000	0.000	0.120	22	0.550	0.004	0.113
BR02	BR at Hunter Hill Road bridge	0.003	2	0.003	0.003	0.000	0.082	2	0.138	0.025	0.080
BR04	Bear River Old Channel	0.003	2	0.004	0.001	0.002	0.059	2	0.114	0.003	0.078
BR05	BR at Pescadero	0.006	2	0.007	0.004	0.002	0.425	6	0.835	0.127	0.317
BR06	BR at Nounan Bridge	0.006	2	0.006	0.005	0.001	0.560	2	0.796	0.323	0.334
BR07	BR at Stauffer Creek	0.004	2	0.004	0.003	0.001	0.424	2	0.450	0.397	0.037
BR08	BR above Alexander	0.022	2	0.024	0.020	0.003	0.359	11	0.861	0.148	0.228
BR08A	BR at head of Alexander Res										
BR09	BR below Alexander	0.008	2	0.008	0.007	0.001	0.565	11	0.950	0.259	0.208
BR10	BR at Last Chance	0.009	2	0.010	0.008	0.001	0.538	10	1.071	0.290	0.258
BR11	BR at Black Canyon	0.008	2	0.008	0.007	0.001	1.327	10	1.720	0.514	0.394
BR11A	BR nr Grace ID										
BR11B	BR abv Cove powerplant						1.177	8	1.426	0.971	0.191
BR11C	BR blw Cove powerplant						0.654	9	1.169	0.400	0.277
BR12	BR at Cheeseplant Bridge	0.008	2	0.008	0.007	0.001	0.727	2	0.879	0.574	0.216
BR13	BR at Thatcher Church	0.008	2	0.008	0.007	0.001	0.807	2	0.962	0.652	0.219
BR14	BR at Thatcher Bridge	0.008	2	0.008	0.007	0.001	0.809	6	1.159	0.543	0.257
BR15	BR abv Oneida at Highway Bridge	0.007	2	0.007	0.007	0.000	0.653	11	1.364	0.349	0.294
BR15A	BR 1 mile blw Oneida	0.013	6	0.016	0.009	0.002	0.893	6	2.420	0.410	0.764
BR16	BR blw Oneida	0.009	2	0.009	0.008	0.001	0.682	19	1.287	0.339	0.245
BR16A	BR at Riverdale	0.009	6	0.013	0.004	0.003	1.142	6	2.930	0.210	0.961
BR16B	BR near Preston										
BR16C	BR above Preston										
BR17	BR west of Preston	0.009	2	0.009	0.008	0.001	0.699	11	1.743	0.344	0.388
BR18	BR at ID UT state line	0.038	16	0.200	0.000	0.063	0.919	16	2.730	0.300	0.585

Mainstem Bear River: Upper Basin Runoff

SITE ID	STATION DESCRIPTION	DISSOLVED NITRITE (mg/L)					DISSOLVED NITRATE (mg/L)				
		AVG	N	MAX	MIN	STD	AVG	N	MAX	MIN	STD
BR01	BR at ID WY state line	0.006	22	0.010	0.001	0.004	0.101	34	0.520	0.000	0.113
BR01A	BR abv confl w Thomas Fork	0.010	10	0.010	0.010	0.000	0.225	10	0.570	0.010	0.208
BR01B	BR at Harer ID										
BR03	Stewart Dam	0.000	54	0.002	0.000	0.000	0.083	54	0.770	0.003	0.111
BL01	Causeway	0.000	23	0.001	0.000	0.000	0.209	23	2.847	0.000	0.585
BL02	Lifton	0.000	71	0.001	0.000	0.000	0.032	81	0.182	0.000	0.036
BL03	BL outlet	0.000	49	0.002	0.000	0.000	0.053	49	0.380	0.002	0.068
BR02	BR at Hunter Hill Road bridge										
BR04	Bear River Old Channel	0.002	1	0.002	0.002		0.020	1	0.020	0.020	
BR05	BR at Pescadero	0.003	1	0.003	0.003		0.116	5	0.164	0.056	0.048
BR06	BR at Nounan Bridge										
BR07	BR at Stauffer Creek										
BR08	BR above Alexander	0.032	1	0.032	0.032		0.122	14	0.698	0.019	0.170
BR08A	BR at head of Alexander Res										
BR09	BR below Alexander	0.006	1	0.006	0.006		0.203	14	0.506	0.048	0.125
BR10	BR at Last Chance	0.006	1	0.006	0.006		0.170	14	0.472	0.043	0.122
BR11	BR at Black Canyon	0.005	1	0.005	0.005		0.798	10	1.257	0.188	0.363
BR11A	BR nr Grace ID										
BR11B	BR abv Cove powerplant						0.674	9	1.126	0.304	0.233
BR11C	BR blw Cove powerplant						0.263	13	0.632	0.114	0.171
BR12	BR at Cheeseplant Bridge	0.006	1	0.006	0.006		0.321	1	0.321	0.321	
BR13	BR at Thatcher Church	0.005	1	0.005	0.005		0.225	1	0.225	0.225	
BR14	BR at Thatcher Bridge	0.005	1	0.005	0.005		0.355	5	0.519	0.204	0.150
BR15	BR abv Oneida at Highway Bridge						0.263	13	0.521	0.127	0.116
BR15A	BR 1 mile blw Oneida	0.008	7	0.011	0.004	0.003	3.113	7	11.600	0.090	4.240
BR16	BR blw Oneida	0.006	1	0.006	0.006		0.213	23	0.437	0.085	0.092
BR16A	BR at Riverdale	0.005	7	0.008	0.003	0.002	2.441	7	10.190	0.120	3.873
BR16B	BR near Preston										
BR16C	BR above Preston										
BR17	BR west of Preston	0.005	1	0.005	0.005		0.195	14	0.470	0.011	0.123
BR18	BR at ID UT state line	0.020	27	0.100	0.000	0.023	0.559	26	4.020	0.030	0.864

Mainstem Bear River: Summer Base Flow

SITE ID	STATION DESCRIPTION	DISSOLVED NITRITE (mg/L)						DISSOLVED NITRATE (mg/L)				
		AVG	N	MAX	MIN	STD		AVG	N	MAX	MIN	STD
BR01	BR at ID WY state line	0.006	17	0.010	0.001	0.004		0.270	34	5.900	0.000	1.008
BR01A	BR abv confl w Thomas Fork	0.010	6	0.010	0.010	0.000		0.268	6	0.530	0.110	0.154
BR01B	BR at Harer ID											
BR03	Stewart Dam	0.001	19	0.010	0.000	0.002		0.064	19	0.267	0.006	0.075
BL01	Causeway	0.001	5	0.007	0.000	0.003		0.119	5	0.278	0.003	0.117
BL02	Lifton	0.000	27	0.005	0.000	0.001		0.023	29	0.108	0.000	0.027
BL03	BL outlet	0.001	19	0.013	0.000	0.003		0.030	19	0.073	0.009	0.018
BR02	BR at Hunter Hill Road bridge	0.010	1	0.010	0.010			0.056	1	0.056	0.056	
BR04	Bear River Old Channel	0.024	1	0.024	0.024			0.005	1	0.005	0.005	
BR05	BR at Pescadero	0.012	1	0.012	0.012			0.057	3	0.082	0.037	0.023
BR06	BR at Nounan Bridge	0.010	1	0.010	0.010			0.111	1	0.111	0.111	
BR07	BR at Stauffer Creek	0.008	1	0.008	0.008			0.312	1	0.312	0.312	
BR08	BR above Alexander	0.045	1	0.045	0.045			0.167	9	0.965	0.001	0.304
BR08A	BR at head of Alexander Res											
BR09	BR below Alexander	0.013	1	0.013	0.013			0.190	9	0.340	0.046	0.099
BR10	BR at Last Chance	0.015	1	0.015	0.015			0.176	9	0.314	0.108	0.069
BR11	BR at Black Canyon	0.008	1	0.008	0.008			0.971	7	1.700	0.547	0.396
BR11A	BR nr Grace ID											
BR11B	BR abv Cove powerplant							0.758	6	1.184	0.441	0.274
BR11C	BR blw Cove powerplant							0.313	8	0.807	0.133	0.224
BR12	BR at Cheeseplant Bridge	0.012	1	0.012	0.012			0.663	1	0.663	0.663	
BR13	BR at Thatcher Church	0.007	1	0.007	0.007			0.423	1	0.423	0.423	
BR14	BR at Thatcher Bridge	0.010	1	0.010	0.010			0.416	3	0.721	0.150	0.287
BR15	BR abv Oneida at Highway Bridge	0.011	1	0.011	0.011			0.314	9	0.542	0.158	0.114
BR15A	BR 1 mile blw Oneida	0.014	4	0.022	0.009	0.006		0.593	3	1.460	0.130	0.751
BR16	BR blw Oneida	0.012	1	0.012	0.012			0.328	15	0.873	0.109	0.220
BR16A	BR at Riverdale	0.008	4	0.014	0.005	0.004		1.283	4	4.020	0.070	1.862
BR16B	BR near Preston											
BR16C	BR above Preston											
BR17	BR west of Preston	0.010	1	0.010	0.010			0.174	9	0.357	0.012	0.110
BR18	BR at ID UT state line	0.018	24	0.050	0.000	0.016		0.386	26	0.800	0.010	0.233

Mainstem Bear River: Winter Base Flow

SITE ID	STATION DESCRIPTION	TOTAL PHOSPHORUS (mg/L)						ORTHOPHOSPHORUS (mg/L)				
		AVG	N	MAX	MIN	STD		AVG	N	MAX	MIN	STD
BR01	BR at ID WY state line	0.095	66	0.900	0.000	0.179		0.042	19	0.460	0.000	0.105
BR01A	BR abv confl w Thomas Fork	0.020	3	0.030	0.010	0.010		0.013	3	0.020	0.010	0.006
BR01B	BR at Harer ID											
BR03	Stewart Dam	0.034	21	0.099	0.007	0.024		0.006	15	0.013	0.002	0.004
BL01	Causeway	0.053	10	0.256	0.006	0.076		0.007	10	0.021	0.001	0.008
BL02	Lifton	0.030	27	0.128	0.005	0.028		0.005	21	0.024	0.001	0.005
BL03	BL outlet	0.028	24	0.096	0.006	0.021		0.006	19	0.016	0.001	0.004
BR02	BR at Hunter Hill Road bridge	0.073	8	0.210	0.030	0.058						
BR04	Bear River Old Channel	0.040	1	0.040	0.040							
BR05	BR at Pescadero	0.069	9	0.210	0.010	0.058						
BR06	BR at Nounan Bridge											
BR07	BR at Stauffer Creek											
BR08	BR above Alexander	0.013	3	0.017	0.008	0.005		0.005	3	0.007	0.004	0.002
BR08A	BR at head of Alexander Res	0.071	28	0.300	0.010	0.058						
BR09	BR below Alexander	0.040	3	0.043	0.037	0.003		0.008	3	0.014	0.002	0.006
BR10	BR at Last Chance	0.028	3	0.035	0.024	0.006		0.006	3	0.009	0.003	0.003
BR11	BR at Black Canyon	0.089	8	0.126	0.060	0.022		0.055	8	0.087	0.036	0.018
BR11A	BR nr Grace ID	0.087	3	0.160	0.050	0.064						
BR11B	BR abv Cove powerplant	0.081	8	0.202	0.034	0.055		0.050	8	0.134	0.014	0.036
BR11C	BR blw Cove powerplant	0.044	3	0.050	0.039	0.006		0.019	3	0.020	0.018	0.001
BR12	BR at Cheeseplant Bridge	0.133	9	0.270	0.060	0.059						
BR13	BR at Thatcher Church											
BR14	BR at Thatcher Bridge											
BR15	BR abv Oneida at Highway Bridge	0.055	3	0.068	0.043	0.013		0.013	3	0.018	0.004	0.008
BR15A	BR 1 mile blw Oneida	0.050	14	0.090	0.010	0.023		0.018	4	0.027	0.008	0.009
BR16	BR blw Oneida	0.037	11	0.082	0.014	0.018		0.011	11	0.041	0.002	0.012
BR16A	BR at Riverdale	0.029	4	0.038	0.022	0.007		0.007	4	0.011	0.004	0.003
BR16B	BR near Preston											
BR16C	BR above Preston	0.046	9	0.120	0.010	0.037						
BR17	BR west of Preston	0.123	44	1.150	0.010	0.196		0.009	7	0.027	0.001	0.009
BR18	BR at ID UT state line	0.081	52	0.360	0.010	0.065		0.033	25	0.160	0.006	0.033

Mainstem Bear River: Lower Basin Runoff

SITE ID	STATION DESCRIPTION	TOTAL PHOSPHORUS (mg/L)						ORTHOPHOSPHORUS (mg/L)				
		AVG	N	MAX	MIN	STD		AVG	N	MAX	MIN	STD
BR01	BR at ID WY state line	0.199	46	1.3	0.000	0.261		0.019	21	0.080	0.000	0.021
BR01A	BR abv confl w Thomas Fork	0.685	4	1.4	0.300	0.488		0.058	4	0.090	0.040	0.022
BR01B	BR at Harer ID											
BR03	Stewart Dam	0.162	47	0.688	0.020	0.135		0.017	42	0.061	0.000	0.016
BL01	Causeway	0.063	16	0.285	0.005	0.066		0.007	16	0.052	0.001	0.012
BL02	Lifton	0.059	52	0.220	0.000	0.041		0.008	47	0.042	0.000	0.009
BL03	BL outlet	0.074	35	0.175	0.006	0.042		0.006	30	0.017	0.000	0.005
BR02	BR at Hunter Hill Road bridge	0.195	5	0.490	0.029	0.185		0.005	2	0.005	0.004	0.001
BR04	Bear River Old Channel	0.160	4	0.230	0.120	0.049		0.009	2	0.012	0.005	0.005
BR05	BR at Pescadero	0.085	9	0.160	0.020	0.045		0.019	6	0.035	0.004	0.013
BR06	BR at Nounan Bridge	0.054	2	0.071	0.036	0.025		0.003	2	0.004	0.002	0.001
BR07	BR at Stauffer Creek	0.031	2	0.033	0.028	0.004		0.008	2	0.008	0.007	0.001
BR08	BR above Alexander	0.079	11	0.184	0.035	0.042		0.012	11	0.029	0.004	0.009
BR08A	BR at head of Alexander Res	0.141	17	0.440	0.050	0.101						
BR09	BR below Alexander	0.058	11	0.097	0.031	0.022		0.011	11	0.017	0.001	0.005
BR10	BR at Last Chance	0.064	10	0.115	0.029	0.029		0.011	10	0.033	0.005	0.008
BR11	BR at Black Canyon	0.075	10	0.102	0.041	0.018		0.046	10	0.064	0.008	0.018
BR11A	BR nr Grace ID	0.083	4	0.110	0.070	0.019						
BR11B	BR abv Cove powerplant	0.060	8	0.073	0.050	0.008		0.032	8	0.035	0.025	0.004
BR11C	BR blw Cove powerplant	0.064	9	0.093	0.042	0.017		0.012	9	0.023	0.003	0.006
BR12	BR at Cheeseplant Bridge	0.132	6	0.230	0.050	0.064		0.022	2	0.029	0.015	0.010
BR13	BR at Thatcher Church	0.056	2	0.068	0.043	0.018		0.024	2	0.031	0.017	0.010
BR14	BR at Thatcher Bridge	0.102	6	0.141	0.073	0.024		0.027	6	0.078	0.013	0.025
BR15	BR abv Oneida at Highway Bridge	0.110	11	0.256	0.059	0.058		0.020	11	0.078	0.005	0.020
BR15A	BR 1 mile blw Oneida	0.198	13	1.082	0.020	0.285		0.023	6	0.047	0.005	0.017
BR16	BR blw Oneida	0.055	19	0.075	0.028	0.014		0.017	19	0.068	0.003	0.015
BR16A	BR at Riverdale	0.137	6	0.334	0.030	0.146		0.026	6	0.100	0.005	0.037
BR16B	BR near Preston											
BR16C	BR above Preston	0.040	6	0.050	0.030	0.011						
BR17	BR west of Preston	0.173	34	0.620	0.047	0.147		0.020	13	0.049	0.005	0.013
BR18	BR at ID UT state line	0.151	29	0.630	0.001	0.153		0.048	20	0.300	0.006	0.063

Mainstem Bear River: Upper Basin Runoff

SITE ID	STATION DESCRIPTION	TOTAL PHOSPHORUS (mg/L)					ORTHOPHOSPHORUS (mg/L)				
		AVG	N	MAX	MIN	STD	AVG	N	MAX	MIN	STD
BR01	BR at ID WY state line	0.179	70	0.870	0.000	0.171	0.015	31	0.030	0.000	0.010
BR01A	BR abv confl w Thomas Fork	0.154	11	0.350	0.030	0.092	0.094	10	0.200	0.010	0.075
BR01B	BR at Harer ID										
BR03	Stewart Dam	0.141	88	0.622	0.032	0.088	0.015	74	0.044	0.001	0.011
BL01	Causeway	0.062	39	0.119	0.018	0.024	0.005	39	0.018	0.001	0.004
BL02	Lifton	0.063	101	0.621	0.000	0.069	0.009	85	0.119	0.000	0.014
BL03	BL outlet	0.083	73	0.218	0.015	0.042	0.010	68	0.051	0.000	0.009
BR02	BR at Hunter Hill Road bridge	0.178	6	0.250	0.100	0.053					
BR04	Bear River Old Channel	0.018	2	0.025	0.010	0.011	0.009	1	0.009	0.009	
BR05	BR at Pescadero	0.130	11	0.180	0.089	0.036	0.012	4	0.013	0.008	0.002
BR06	BR at Nounan Bridge										
BR07	BR at Stauffer Creek										
BR08	BR above Alexander	0.112	14	0.225	0.035	0.049	0.009	13	0.018	0.001	0.006
BR08A	BR at head of Alexander Res	0.165	30	0.600	0.030	0.117					
BR09	BR below Alexander	0.068	16	0.100	0.045	0.017	0.016	15	0.060	0.003	0.014
BR10	BR at Last Chance	0.071	14	0.098	0.046	0.016	0.012	13	0.024	0.002	0.007
BR11	BR at Black Canyon	0.066	10	0.086	0.050	0.011	0.031	10	0.058	0.002	0.017
BR11A	BR nr Grace ID	0.130	2	0.150	0.110	0.028					
BR11B	BR abv Cove powerplant	0.151	9	0.900	0.035	0.281	0.025	9	0.049	0.012	0.012
BR11C	BR blw Cove powerplant	0.075	13	0.102	0.055	0.014	0.014	12	0.028	0.004	0.007
BR12	BR at Cheeseplant Bridge	0.104	7	0.150	0.058	0.037	0.016	1	0.016	0.016	
BR13	BR at Thatcher Church	0.063	1	0.063	0.063		0.010	1	0.010	0.010	
BR14	BR at Thatcher Bridge	0.115	5	0.149	0.078	0.030	0.022	4	0.042	0.010	0.015
BR15	BR abv Oneida at Highway Bridge	0.109	13	0.195	0.084	0.030	0.015	12	0.035	0.005	0.008
BR15A	BR 1 mile blw Oneida	0.093	16	0.190	0.040	0.040	0.011	7	0.031	0.001	0.010
BR16	BR blw Oneida	0.052	23	0.097	0.029	0.018	0.012	22	0.030	0.001	0.009
BR16A	BR at Riverdale	0.066	6	0.122	0.041	0.032	0.012	7	0.032	0.001	0.010
BR16B	BR near Preston										
BR16C	BR above Preston	0.058	5	0.080	0.020	0.024					
BR17	BR west of Preston	0.097	48	0.336	0.020	0.062	0.012	16	0.040	0.001	0.011
BR18	BR at ID UT state line	0.131	49	1.530	0.020	0.224	0.031	27	0.110	0.001	0.028

Mainstem Bear River: Summer Base Flow

SITE ID	STATION DESCRIPTION	TOTAL PHOSPHORUS (mg/L)					ORTHOPHOSPHORUS (mg/L)				
		AVG	N	MAX	MIN	STD	AVG	N	MAX	MIN	STD
BR01	BR at ID WY state line	0.107	65	2.400	0.000	0.320	0.011	25	0.030	0.000	0.008
BR01A	BR abv confl w Thomas Fork	0.092	6	0.440	0.010	0.171	0.062	5	0.250	0.010	0.105
BR01B	BR at Harer ID										
BR03	Stewart Dam	0.104	37	0.339	0.005	0.083	0.008	34	0.025	0.000	0.007
BL01	Causeway	0.056	13	0.232	0.014	0.057	0.006	13	0.039	0.001	0.010
BL02	Lifton	0.031	38	0.344	0.001	0.054	0.007	35	0.045	0.001	0.009
BL03	BL outlet	0.093	44	0.899	0.006	0.135	0.007	34	0.036	0.001	0.007
BR02	BR at Hunter Hill Road bridge	0.086	5	0.160	0.032	0.048	0.004	1	0.004	0.004	
BR04	Bear River Old Channel	0.134	2	0.157	0.111	0.033	0.006	1	0.006	0.006	
BR05	BR at Pescadero	0.089	7	0.144	0.050	0.030	0.007	3	0.013	0.003	0.005
BR06	BR at Nounan Bridge	0.043	1	0.043	0.043		0.003	1	0.003	0.003	
BR07	BR at Stauffer Creek	0.056	1	0.056	0.056		0.013	1	0.013	0.013	
BR08	BR above Alexander	0.077	9	0.173	0.004	0.056	0.012	9	0.037	0.003	0.011
BR08A	BR at head of Alexander Res	0.150	26	0.460	0.050	0.100					
BR09	BR below Alexander	0.065	14	0.093	0.024	0.020	0.018	11	0.055	0.002	0.015
BR10	BR at Last Chance	0.064	11	0.128	0.013	0.030	0.020	9	0.080	0.006	0.023
BR11	BR at Black Canyon	0.053	7	0.081	0.030	0.019	0.036	7	0.051	0.023	0.010
BR11A	BR nr Grace ID	0.062	1	0.062	0.062						
BR11B	BR abv Cove powerplant	0.047	6	0.069	0.030	0.015	0.025	6	0.033	0.015	0.006
BR11C	BR blw Cove powerplant	0.077	8	0.162	0.026	0.042	0.021	8	0.037	0.013	0.009
BR12	BR at Cheeseplant Bridge	0.076	8	0.090	0.060	0.011	0.022	1	0.022	0.022	
BR13	BR at Thatcher Church	0.048	1	0.048	0.048		0.006	1	0.006	0.006	
BR14	BR at Thatcher Bridge	0.078	5	0.100	0.049	0.020	0.017	3	0.024	0.012	0.006
BR15	BR abv Oneida at Highway Bridge	0.085	9	0.155	0.045	0.039	0.018	9	0.027	0.006	0.007
BR15A	BR 1 mile blw Oneida	0.084	12	0.250	0.010	0.060	0.018	4	0.032	0.010	0.010
BR16	BR blw Oneida	0.047	15	0.079	0.014	0.018	0.024	15	0.069	0.007	0.015
BR16A	BR at Riverdale	0.039	4	0.068	0.006	0.025	0.012	4	0.021	0.007	0.006
BR16B	BR near Preston										
BR16C	BR above Preston	0.060	6	0.070	0.040	0.013					
BR17	BR west of Preston	0.085	46	0.420	0.010	0.076	0.013	10	0.028	0.004	0.009
BR18	BR at ID UT state line	0.071	47	0.190	0.012	0.039	0.032	27	0.140	0.000	0.036

Tributaries to the Bear River: Winter Base Flow

SITE ID	STATION DESCRIPTION	TEMPERATURE (°C)					FLOW (CFS)				
		AVG	N	MAX	MIN	STD	AVG	N	MAX	MIN	STD
T01	Thomas Fork	1.48	10	6	0	2.30					
T02	Sheep Creek	1.00	1	1	1						
T02A	St Charles Creek										
T03	Ovid Creek										
T04	Georgetown Creek	2.00	1	2	2						
T05	Stauffer Creek										
T06	Skinner Creek										
T07	Pearl Creek										
T08	Eightmile Creek	2.56	27	4.5	0.5	1.06	4.04	26	9	1	1.95
T09	Sulphur Canyon Creek										
T10	Bailey Creek										
T11	Clear Springs Fish Hatchery										
T12	Soda Springs WWTP West Side Creek	6.26	7	7.4	5	0.73	20.03	4	37.8	5.5	13.43
T13	Soda Springs WWTP	10.00	3	10.8	9.4	0.72	1.20	2	1.28	1.11	0.12
T14	Soda Creek	5.00	1	5	5						
T14A	Soda Creek in Soda Springs	5.10	8	6	4.29	0.50	40.36	8	63	10.4	20.79
T15	Densmore Creek										
T16	Smith Creek										
T17	Alder Creek										
T18	Whiskey Creek	5.30	10	10	0	3.87					
T19	Burton Creek										
T20	Trout Creek	2.00	9	5.5	0	2.19					
T21	Williams Creek	2.54	9	6.4	0	2.57					
T22	Cottonwood Creek	2.45	31	7	0	1.69	14.07	30	34	5	7.29
T23	Maple Hot Springs										
T24	Mink Creek	2.01	8	5	0	1.78					
T25	Battle Creek	1.81	16	5.5	0	1.89	0.60	5	1	0	0.55
T26	Deep Creek	0.72	18	4	0	1.14	5.75	16	13	1	4.07
T27	5 Mile Creek	1.00	1	1	1						
T27A	Preston WWTP	10.73	3	12.6	8.6	2.01	0.79	2	0.8	0.78	0.01
T28	Weston Creek	2.00	1	2	2		1.00	1	1	1	

Tributaries to the Bear River: Lower Basin Runoff

SITE ID	STATION DESCRIPTION	TEMPERATURE (°C)						FLOW (CFS)				
		AVG	N	MAX	MIN	STD		AVG	N	MAX	MIN	STD
T01	Thomas Fork	5.58	8	12.66	0	3.49		18.64	1	18.64	18.64	
T02	Sheep Creek	12.84	2	19.97	5.7	10.09		0.98	1	0.983	0.983	
T02A	St Charles Creek											
T03	Ovid Creek	9.06	2	14.75	3.37	8.05		2.49	1	2.49	2.49	
T04	Georgetown Creek	9.23	2	10.79	7.66	2.21		12.69	1	12.69	12.69	
T05	Stauffer Creek	6.39	2	9.3	3.47	4.12		5.36	1	5.36	5.36	
T06	Skinner Creek	6.56	2	9.44	3.67	4.08		0.98	1	0.98	0.98	
T07	Pearl Creek	5.67	2	7.38	3.95	2.43		1.74	1	1.74	1.74	
T08	Eightmile Creek	4.67	18	10	1	2.06		8.34	17	44	2	10.20
T09	Sulphur Canyon Creek	5.82	2	8.24	3.39	3.43		0.55	1	0.55	0.55	
T10	Bailey Creek	6.44	2	7.11	5.76	0.95		3.76	1	3.76	3.76	
T11	Clear Springs Fish Hatchery	9.00	2	9.36	8.64	0.51		14.68	1	14.677	14.677	
T12	Soda Springs WWTP West Side Creek	7.32	10	9.42	3.9	1.60		15.30	5	25.7	0.79	9.53
T13	Soda Springs WWTP	8.94	7	10.7	6.6	1.24		1.37	6	1.64	1.21	0.15
T14	Soda Creek	7.51	2	9.01	6	2.13		58.25	1	58.25	58.25	
T14A	Soda Creek in Soda Springs	7.63	8	11.19	4.9	1.95		45.84	8	74.1	17.5	17.86
T15	Densmore Creek	11.03	2	11.17	10.89	0.20		0.72	1	0.72	0.72	
T16	Smith Creek	19.44	2	19.72	19.15	0.40		3.64	1	3.64	3.64	
T17	Alder Creek	8.36	2	11.78	4.94	4.84		1.53	1	1.53	1.53	
T18	Whiskey Creek	9.24	6	14.05	1	4.80		9.09	1	9.09	9.09	
T19	Burton Creek	9.94	2	11.58	8.3	2.32		1.04	1	1.04	1.04	
T20	Trout Creek	5.73	6	13.27	0	4.54		12.20	1	12.2	12.2	
T21	Williams Creek	6.03	6	10.48	0	3.79		10.64	1	10.64	10.64	
T22	Cottonwood Creek	4.77	28	13	0	2.89		124.03	27	513	9	126.05
T23	Maple Hot Springs	46.48	2	46.7	46.26	0.31		0.00	1	0.003	0.003	
T24	Mink Creek	4.41	8	14.13	0	4.51		19.56	2	35.12	4	22.01
T25	Battle Creek	6.51	15	15.55	0	4.27		4.90	9	20	1	6.07
T26	Deep Creek	7.29	19	14.5	0.5	4.64		53.67	16	130	12	37.36
T27	5 Mile Creek	7.55	4	15.39	3	5.40		3.39	2	5	1.78	2.28
T27A	Preston WWTP	9.36	5	10.2	8.6	0.73		0.97	5	1.12	0.89	0.10
T28	Weston Creek	8.11	4	13.41	5.51	3.59		2.92	2	4.83	1	2.71

Tributaries to the Bear River: Upper Basin Runoff

SITE ID	STATION DESCRIPTION	TEMPERATURE (°C)						FLOW (CFS)				
		AVG	N	MAX	MIN	STD		AVG	N	MAX	MIN	STD
T01	Thomas Fork	15.97	12	23	9	4.35		160.00	1	160	160	
T02	Sheep Creek	8.30	1	8.3	8.3			4.84	1	4.84	4.84	
T02A	St Charles Creek	5.50	2	7	4	2.12						
T03	Ovid Creek	13.70	1	13.7	13.7			54.80	1	54.8	54.8	
T04	Georgetown Creek	9.40	2	11.8	7	3.39		42.60	1	42.6	42.6	
T05	Stauffer Creek	14.40	1	14.4	14.4			46.56	1	46.56	46.56	
T06	Skinner Creek	14.80	1	14.8	14.8			11.90	1	11.9	11.9	
T07	Pearl Creek	11.40	1	11.4	11.4			25.00	1	25	25	
T08	Eightmile Creek	10.27	44	15.5	1	3.36		61.56	41	165	4	41.32
T09	Sulphur Canyon Creek	16.10	1	16.1	16.1			1.14	1	1.14	1.14	
T10	Bailey Creek	12.70	1	12.7	12.7			11.00	1	11	11	
T11	Clear Springs Fish Hatchery	11.70	1	11.7	11.7			19.55	1	19.55	19.55	
T12	Soda Springs WWTP West Side Creek	10.07	9	18	7.5	3.27		23.17	7	36.8	0.76	11.42
T13	Soda Springs WWTP	12.19	10	14.2	10.3	1.35		1.37	10	1.61	1.24	0.12
T14	Soda Creek	13.00	1	13	13			120.00	1	120	120	
T14A	Soda Creek in Soda Springs	12.37	9	14.6	9.1	1.88		52.77	9	81.2	15.4	23.12
T15	Densmore Creek	67.80	1	67.8	67.8			8.20	1	8.2	8.2	
T16	Smith Creek	72.60	1	72.6	72.6			9.10	1	9.1	9.1	
T17	Alder Creek	61.70	1	61.7	61.7			13.40	1	13.4	13.4	
T18	Whiskey Creek	13.96	7	16.9	12	1.70		13.70	1	13.7	13.7	
T19	Burton Creek	63.70	1	63.7	63.7			5.00	1	5	5	
T20	Trout Creek	18.18	8	57.2	10	15.95		30.20	1	30.2	30.2	
T21	Williams Creek	17.90	6	52.8	9	17.18		68.00	1	68	68	
T22	Cottonwood Creek	12.36	45	51	4	7.05		121.21	43	580	4	131.66
T23	Maple Hot Springs	128.80	1	128.8	128.8			0.33	1	0.334	0.334	
T24	Mink Creek	11.59	14	47.4	0	11.59		43.00	7	286	1	107.16
T25	Battle Creek	15.42	18	51.6	4	10.22		2.89	11	11.8	0	3.12
T26	Deep Creek	18.21	24	52.6	5	9.58		16.06	20	64.1	0	15.71
T27	5 Mile Creek	13.11	7	49.8	5	16.27		3.83	6	5	2	0.98
T27A	Preston WWTP	13.78	9	15.8	11.9	1.55		0.89	9	0.92	0.85	0.02
T28	Weston Creek	16.20	7	50.4	7	15.44		5.89	7	23.2	1	8.14

Tributaries to the Bear River: Summer Base Flow

SITE ID	STATION DESCRIPTION	TEMPERATURE (°C)					FLOW (CFS)				
		AVG	N	MAX	MIN	STD	AVG	N	MAX	MIN	STD
T01	Thomas Fork	11.86	10	20.2	4.4	5.22	35.74	1	35.74	35.74	
T02	Sheep Creek	15.00	2	16	14	1.41	1.51	1	1.51	1.51	
T02A	St Charles Creek	6.00	1	6	6						
T03	Ovid Creek	15.79	2	21	10.57	7.38	0.33	1	0.33	0.33	
T04	Georgetown Creek	11.24	4	17.8	9	4.37	33.68	1	33.68	33.68	
T05	Stauffer Creek	13.49	2	20.5	6.47	9.92	3.87	1	3.87	3.87	
T06	Skinner Creek	6.46	1	6.46	6.46		0.96	1	0.96	0.96	
T07	Pearl Creek	7.10	1	7.1	7.1		2.51	1	2.51	2.51	
T08	Eightmile Creek	9.01	28	17	4	3.05	7.42	25	18	1	4.48
T09	Sulphur Canyon Creek	8.48	1	8.48	8.48		0.65	1	0.65	0.65	
T10	Bailey Creek	5.94	1	5.94	5.94		5.95	1	5.95	5.95	
T11	Clear Springs Fish Hatchery	7.51	1	7.51	7.51		16.87	1	16.87	16.87	
T12	Soda Springs WWTP West Side Creek	8.39	6	9.4	7.02	1.02	25.13	6	43.4	0.96	14.08
T13	Soda Springs WWTP	14.96	7	17.5	13.1	1.48	1.28	7	1.48	1.15	0.13
T14	Soda Creek	13.20	3	15.9	8.69	3.93	23.10	1	23.1	23.1	
T14A	Soda Creek in Soda Springs	14.22	6	19.3	9.9	3.72	41.23	6	56.3	25.7	13.06
T15	Densmore Creek	8.78	1	8.78	8.78		0.88	1	0.878	0.878	
T16	Smith Creek	22.39	1	22.39	22.39		4.60	1	4.6	4.6	
T17	Alder Creek	7.78	1	7.78	7.78		3.87	1	3.87	3.87	
T18	Whiskey Creek	12.11	6	15	8.78	2.68	23.37	1	23.37	23.37	
T19	Burton Creek	7.78	1	7.78	7.78		7.34	1	7.34	7.34	
T20	Trout Creek	10.77	7	18	4.2	4.71	15.28	1	15.28	15.28	
T21	Williams Creek	10.87	6	16.5	5.6	4.07	11.09	1	11.09	11.09	
T22	Cottonwood Creek	9.64	25	16	4	3.10	10.34	24	30	2	8.06
T23	Maple Hot Springs	13.00	1	13	13						
T24	Mink Creek	12.18	9	22	2.8	5.56	2.68	3	3	2.04	0.55
T25	Battle Creek	9.79	12	16	1.5	4.59	1.37	7	3	0.58	0.84
T26	Deep Creek	14.13	18	26	2	7.08	2.40	16	5.38	0	1.46
T27	5 Mile Creek	9.04	3	13	2	6.11	2.40	3	3	1.2	1.04
T27A	Preston WWTP	16.77	6	19.5	14.7	1.81	0.86	6	0.91	0.8	0.04
T28	Weston Creek	13.75	2	15	12.5	1.77	4.00	1	4	4	

Tributaries to the Bear River: Winter Base Flow

SITE ID	STATION DESCRIPTION	DISSOLVED OXYGEN (mg/L)					pH (SU)				
		AVG	N	MAX	MIN	STD	AVG	N	MAX	MIN	STD
T01	Thomas Fork	10.59	9	11.3	10.1	0.43	8.00	1	8	8	
T02	Sheep Creek						8.10	1	8.1	8.1	
T02A	St Charles Creek										
T03	Ovid Creek										
T04	Georgetown Creek						7.70	1	7.7	7.7	
T05	Stauffer Creek										
T06	Skinner Creek										
T07	Pearl Creek										
T08	Eightmile Creek						7.90	1	7.9	7.9	
T09	Sulphur Canyon Creek										
T10	Bailey Creek										
T11	Clear Springs Fish Hatchery										
T12	Soda Springs WWTP West Side Creek	9.47	7	10.4	8.3	0.88	7.20	7	7.5	6.7	0.29
T13	Soda Springs WWTP	6.60	3	7.3	5.6	0.89	7.17	3	7.5	6.9	0.31
T14	Soda Creek										
T14A	Soda Creek in Soda Springs	9.52	8	10.5	8.59	0.71	6.75	8	7.1	6.2	0.29
T15	Densmore Creek										
T16	Smith Creek										
T17	Alder Creek										
T18	Whiskey Creek	10.59	9	12.5	9.4	1.17	7.90	1	7.9	7.9	
T19	Burton Creek										
T20	Trout Creek	11.68	9	13.5	10.8	0.82	7.70	1	7.7	7.7	
T21	Williams Creek	11.60	9	12.4	10.6	0.53					
T22	Cottonwood Creek						8.00	1	8	8	
T23	Maple Hot Springs										
T24	Mink Creek	12.06	7	12.5	11.5	0.33	7.40	1	7.4	7.4	
T25	Battle Creek	11.43	10	12.1	10.5	0.54	7.60	1	7.6	7.6	
T26	Deep Creek	11.20	1	11.2	11.2		7.70	2	7.7	7.7	0.00
T27	5 Mile Creek	10.80	1	10.8	10.8						
T27A	Preston WWTP	4.20	2	4.5	3.9	0.42	7.13	3	7.4	6.9	0.25
T28	Weston Creek	12.20	1	12.2	12.2						

Tributaries to the Bear River: Lower Basin Runoff

SITE ID	STATION DESCRIPTION	DISSOLVED OXYGEN (mg/L)						pH (SU)				
		AVG	N	MAX	MIN	STD		AVG	N	MAX	MIN	STD
T01	Thomas Fork	8.94	5	10.9	7.3	1.35		7.91	4	8.24	7.5	0.31
T02	Sheep Creek	10.51	2	10.94	10.07	0.62		8.02	2	8.14	7.9	0.17
T02A	St Charles Creek											
T03	Ovid Creek	8.69	2	9.83	7.55	1.61		8.19	2	8.49	7.89	0.42
T04	Georgetown Creek	10.32	2	10.46	10.17	0.21		8.52	2	8.55	8.48	0.05
T05	Stauffer Creek	10.12	2	10.22	10.01	0.15		7.92	2	7.96	7.88	0.06
T06	Skinner Creek	9.81	2	10.45	9.17	0.91		7.83	1	7.83	7.83	
T07	Pearl Creek	10.00	2	10.11	9.88	0.16		8.15	2	8.24	8.05	0.13
T08	Eightmile Creek	10.65	2	11.04	10.25	0.56		8.46	2	8.49	8.42	0.05
T09	Sulphur Canyon Creek	8.26	2	8.96	7.56	0.99		7.73	2	7.82	7.64	0.13
T10	Bailey Creek	10.29	2	10.39	10.18	0.15		8.40	2	8.46	8.33	0.09
T11	Clear Springs Fish Hatchery	9.48	2	9.66	9.3	0.25		7.82	2	7.92	7.72	0.14
T12	Soda Springs WWTP West Side Creek	10.13	10	12.4	8.6	1.09		7.38	10	7.6	7.1	0.13
T13	Soda Springs WWTP	7.82	7	10.6	6.62	1.44		7.44	7	7.76	7	0.30
T14	Soda Creek	9.61	2	10.2	9.01	0.84		7.25	2	7.3	7.2	0.07
T14A	Soda Creek in Soda Springs	10.03	8	12.6	7.33	1.43		6.86	8	7.2	6.5	0.26
T15	Densmore Creek	9.26	2	9.33	9.18	0.11		8.23	2	8.23	8.22	0.01
T16	Smith Creek	7.87	2	9.08	6.66	1.71		7.56	2	7.69	7.42	0.19
T17	Alder Creek	10.83	2	12.35	9.3	2.16		8.33	2	8.48	8.17	0.22
T18	Whiskey Creek	9.73	5	10.4	9.08	0.51		8.50	2	8.64	8.36	0.20
T19	Burton Creek	7.42	2	8.83	6	2.00		8.25	2	8.25	8.24	0.01
T20	Trout Creek	10.91	5	12	10.3	0.66		8.40	2	8.6	8.19	0.29
T21	Williams Creek	11.02	5	12.7	10.06	1.02		8.41	2	8.48	8.33	0.11
T22	Cottonwood Creek	10.69	2	11.66	9.71	1.38		8.40	2	8.46	8.34	0.08
T23	Maple Hot Springs	4.70	2	4.78	4.61	0.12		8.04	2	8.09	7.98	0.08
T24	Mink Creek	11.25	7	13.3	9.29	1.23		8.66	2	8.89	8.42	0.33
T25	Battle Creek	10.34	5	12.6	8.92	1.50		8.41	2	8.59	8.22	0.26
T26	Deep Creek	9.49	3	10.21	9.05	0.63		8.11	3	8.41	7.8	0.31
T27	5 Mile Creek	9.41	3	9.85	8.78	0.56		8.22	2	8.38	8.05	0.23
T27A	Preston WWTP	8.46	5	10.1	7	1.11		7.14	5	7.5	6.6	0.45
T28	Weston Creek	9.73	4	10.59	9.1	0.70		8.25	2	8.45	8.04	0.29

Tributaries to the Bear River: Upper Basin Runoff

SITE ID	STATION DESCRIPTION	DISSOLVED OXYGEN (mg/L)					pH (SU)				
		AVG	N	MAX	MIN	STD	AVG	N	MAX	MIN	STD
T01	Thomas Fork	7.05	6	8	6.2	0.58	7.81	9	8	7.5	0.21
T02	Sheep Creek						8.00	1	8	8	
T02A	St Charles Creek						7.85	2	7.9	7.8	0.07
T03	Ovid Creek						8.10	1	8.1	8.1	
T04	Georgetown Creek						8.10	2	8.4	7.8	0.42
T05	Stauffer Creek						7.76	1	7.76	7.76	
T06	Skinner Creek						7.74	1	7.74	7.74	
T07	Pearl Creek						8.02	1	8.02	8.02	
T08	Eightmile Creek						7.84	4	8.34	7.5	0.38
T09	Sulphur Canyon Creek						7.77	1	7.77	7.77	
T10	Bailey Creek						8.39	1	8.39	8.39	
T11	Clear Springs Fish Hatchery						7.50	1	7.5	7.5	
T12	Soda Springs WWTP West Side Creek	10.17	7	11.6	8.6	1.13	7.43	9	7.9	6.7	0.43
T13	Soda Springs WWTP	6.68	9	8.8	4.5	1.33	7.07	10	7.6	6.4	0.45
T14	Soda Creek						7.28	1	7.28	7.28	
T14A	Soda Creek in Soda Springs	9.12	9	11	7.5	1.36	6.80	9	7.3	6.2	0.42
T15	Densmore Creek										
T16	Smith Creek										
T17	Alder Creek										
T18	Whiskey Creek	11.83	6	12.9	9.3	1.31	8.00	2	8	8	0.00
T19	Burton Creek										
T20	Trout Creek	9.88	6	10.6	9.3	0.43	7.90	2	8	7.8	0.14
T21	Williams Creek	9.88	6	10.2	9.7	0.18					
T22	Cottonwood Creek						7.60	3	7.8	7.4	0.20
T23	Maple Hot Springs										
T24	Mink Creek	9.49	12	11.8	7.4	1.17	7.55	2	7.7	7.4	0.21
T25	Battle Creek	8.74	12	11.4	5.7	1.98	8.00	2	8.1	7.9	0.14
T26	Deep Creek	10.27	6	12	8.8	1.18	7.95	4	8	7.9	0.06
T27	5 Mile Creek	9.72	6	10.8	9.1	0.67					
T27A	Preston WWTP	4.33	9	7.2	2.1	1.68	7.10	9	8	6.4	0.50
T28	Weston Creek	10.32	5	12	9	1.25					

Tributaries to the Bear River: Summer Base Flow

SITE ID	STATION DESCRIPTION	DISSOLVED OXYGEN (mg/L)					pH (SU)				
		AVG	N	MAX	MIN	STD	AVG	N	MAX	MIN	STD
T01	Thomas Fork	9.52	5	10.6	8.6	0.76	7.93	7	8.14	7.7	0.15
T02	Sheep Creek	9.24	1	9.24	9.24		8.01	2	8.41	7.6	0.57
T02A	St Charles Creek						8.00	1	8	8	
T03	Ovid Creek	7.99	1	7.99	7.99		8.15	2	9.1	7.2	1.34
T04	Georgetown Creek	8.77	2	9.63	7.9	1.22	8.08	4	8.51	7.6	0.41
T05	Stauffer Creek	10.45	2	10.6	10.3	0.21	8.12	2	8.44	7.8	0.45
T06	Skinner Creek	9.96	1	9.96	9.96		8.52	1	8.52	8.52	
T07	Pearl Creek	9.04	1	9.04	9.04		8.41	1	8.41	8.41	
T08	Eightmile Creek	9.23	2	9.85	8.6	0.88	7.89	4	8.54	7.5	0.45
T09	Sulphur Canyon Creek	6.91	1	6.91	6.91		8.11	1	8.11	8.11	
T10	Bailey Creek	10.70	1	10.7	10.7		8.47	1	8.47	8.47	
T11	Clear Springs Fish Hatchery	7.10	1	7.1	7.1		7.84	1	7.84	7.84	
T12	Soda Springs WWTP West Side Creek	8.37	6	11.9	4.9	2.33	7.48	6	7.7	7.3	0.20
T13	Soda Springs WWTP	6.06	7	8.4	5	1.16	7.61	7	7.9	7	0.30
T14	Soda Creek	8.59	2	9.2	7.98	0.86	6.97	2	7.33	6.6	0.52
T14A	Soda Creek in Soda Springs	8.34	5	9.9	7.5	1.04	7.00	6	7.3	6.3	0.37
T15	Densmore Creek										
T16	Smith Creek										
T17	Alder Creek										
T18	Whiskey Creek	10.67	3	11.8	8.8	1.63	7.80	2	8	7.6	0.28
T19	Burton Creek										
T20	Trout Creek	11.60	4	14.6	8.4	2.69	7.65	2	7.7	7.6	0.07
T21	Williams Creek	9.98	4	11.1	7	1.99	7.70	1	7.7	7.7	
T22	Cottonwood Creek						8.20	1	8.2	8.2	
T23	Maple Hot Springs						15.90	1	15.9	15.9	
T24	Mink Creek	10.28	5	11.5	8.4	1.24	7.90	2	7.9	7.9	0.00
T25	Battle Creek	9.80	6	11	8.6	0.94	8.10	1	8.1	8.1	
T26	Deep Creek	10.40	2	12.2	8.6	2.55	8.15	2	8.3	8	0.21
T27	5 Mile Creek	9.35	2	10.2	8.5	1.20					
T27A	Preston WWTP	4.37	6	5.9	3	1.12	7.30	6	7.6	6.9	0.24
T28	Weston Creek	9.60	1	9.6	9.6						

Tribuaries to the Bear River: Winter Base Flow

SITE ID	STATION DESCRIPTION	TOTAL SUSPENDED SOLIDS (mg/L)						NH3+NH4-N (mg/L)				
		AVG	N	MAX	MIN	STD		AVG	N	MAX	MIN	STD
T01	Thomas Fork	19.0	5	47	2	17.2						
T02	Sheep Creek											
T02A	St Charles Creek											
T03	Ovid Creek											
T04	Georgetown Creek											
T05	Stauffer Creek											
T06	Skinner Creek											
T07	Pearl Creek											
T08	Eightmile Creek											
T09	Sulphur Canyon Creek											
T10	Bailey Creek											
T11	Clear Springs Fish Hatchery											
T12	Soda Springs WWTP West Side Creek	3.9	7	5	2	1.1		1.91	7	2.704	1.352	0.47
T13	Soda Springs WWTP	19.7	3	24	14	5.1		4.11	3	4.571	3.712	0.43
T14	Soda Creek											
T14A	Soda Creek in Soda Springs	5.4	8	6	5	0.5		0.22	8	0.45	0.128	0.11
T15	Densmore Creek											
T16	Smith Creek											
T17	Alder Creek											
T18	Whiskey Creek	49.2	9	109	1	40.4						
T19	Burton Creek											
T20	Trout Creek	101.2	9	358	4	109.5						
T21	Williams Creek	22.9	9	80	2	31.6						
T22	Cottonwood Creek											
T23	Maple Hot Springs											
T24	Mink Creek	13.1	7	51	1	17.0						
T25	Battle Creek	733.0	1	733	733							
T26	Deep Creek	93.0	1	93	93							
T27	5 Mile Creek	78.0	1	78	78							
T27A	Preston WWTP	196.7	3	262	105	81.7		2.46	3	4.445	0.629	1.91
T28	Weston Creek	41.0	1	41	41							

Tributaries to the Bear River: Lower Basin Runoff

SITE ID	STATION DESCRIPTION	TOTAL SUSPENDED SOLIDS (mg/L)						NH3+NH4-N (mg/L)				
		AVG	N	MAX	MIN	STD		AVG	N	MAX	MIN	STD
T01	Thomas Fork	27.3	3	44	19	14.4		0.123	2	0.204	0.042	0.115
T02	Sheep Creek	8.5	2	15	2	9.2		0.152	2	0.273	0.03	0.172
T02A	St Charles Creek											
T03	Ovid Creek	8.5	2	12	5	4.9		0.068	2	0.084	0.051	0.023
T04	Georgetown Creek	12.0	2	14	10	2.8		0.226	2	0.422	0.03	0.277
T05	Stauffer Creek	20.5	2	37	4	23.3		0.070	2	0.078	0.061	0.012
T06	Skinner Creek	7.0	2	13	1	8.5		0.032	2	0.033	0.03	0.002
T07	Pearl Creek	16.5	2	32	1	21.9		0.032	2	0.033	0.03	0.002
T08	Eightmile Creek	16.5	2	19	14	3.5		0.035	2	0.039	0.03	0.006
T09	Sulphur Canyon Creek	4.0	2	4	4	0.0		0.103	2	0.106	0.099	0.005
T10	Bailey Creek	27.5	2	30	25	3.5		0.042	2	0.052	0.032	0.014
T11	Clear Springs Fish Hatchery	3.5	2	5	2	2.1		1.358	2	1.359	1.356	0.002
T12	Soda Springs WWTP West Side Creek	3.3	10	9	1	2.8		1.484	10	2.166	0.699	0.471
T13	Soda Springs WWTP	20.1	7	28	5	7.4		6.640	7	9.591	4.828	1.869
T14	Soda Creek	8.0	2	9	7	1.4		0.122	2	0.17	0.074	0.068
T14A	Soda Creek in Soda Springs	28.5	8	189	2	64.9		0.080	8	0.174	0.005	0.056
T15	Densmore Creek	58.5	2	84	33	36.1		0.380	2	0.729	0.03	0.494
T16	Smith Creek	63.5	2	86	41	31.8		0.216	2	0.348	0.084	0.187
T17	Alder Creek	120.5	2	200	41	112.4		0.076	2	0.122	0.03	0.065
T18	Whiskey Creek	73.0	6	164	5	59.2		0.056	2	0.081	0.03	0.036
T19	Burton Creek	95.0	2	162	28	94.8		0.040	2	0.041	0.039	0.001
T20	Trout Creek	76.7	6	120	21	36.1		0.249	2	0.466	0.032	0.307
T21	Williams Creek	20.7	6	87	2	32.9		0.031	2	0.032	0.03	0.001
T22	Cottonwood Creek	14.0	2	23	5	12.7		0.032	2	0.033	0.03	0.002
T23	Maple Hot Springs	3.5	2	4	3	0.7		0.743	2	0.845	0.64	0.145
T24	Mink Creek	37.0	8	102	7	39.7		0.041	2	0.049	0.032	0.012
T25	Battle Creek	475.3	4	721	261	208.4		0.075	2	0.118	0.031	0.062
T26	Deep Creek	159.5	4	309	84	102.4		0.067	2	0.102	0.032	0.049
T27	5 Mile Creek	28.0	4	41	21	9.2		0.121	2	0.153	0.088	0.046
T27A	Preston WWTP	65.0	5	133	39	38.7		4.199	5	6.078	0.224	2.328
T28	Weston Creek	62.8	4	103	19	36.3		0.043	2	0.047	0.039	0.006

Tributaries to the Bear River: Upper Basin Runoff

SITE ID	STATION DESCRIPTION	TOTAL SUSPENDED SOLIDS (mg/L) AVG	N	MAX	MIN	STD		NH3+NH4-N (mg/L) AVG	N	MAX	MIN	STD
T01	Thomas Fork	50.0	5	163	7	64.0		0.040	1	0.04	0.04	
T02	Sheep Creek	4.0	1	4	4			0.040	1	0.04	0.04	
T02A	St Charles Creek											
T03	Ovid Creek	15.0	1	15	15			0.040	1	0.04	0.04	
T04	Georgetown Creek	52.0	1	52	52			0.040	1	0.04	0.04	
T05	Stauffer Creek	17.0	1	17	17			0.040	1	0.04	0.04	
T06	Skinner Creek	38.0	1	38	38			0.040	1	0.04	0.04	
T07	Pearl Creek	19.0	1	19	19			0.040	1	0.04	0.04	
T08	Eightmile Creek	20.0	1	20	20			0.040	1	0.04	0.04	
T09	Sulphur Canyon Creek	7.0	1	7	7			0.040	1	0.04	0.04	
T10	Bailey Creek	16.0	1	16	16			0.040	1	0.04	0.04	
T11	Clear Springs Fish Hatchery	4.0	1	4	4			1.641	1	1.641	1.641	
T12	Soda Springs WWTP West Side Creek	3.8	9	16	1	4.6		1.403	9	1.8	0.611	0.376
T13	Soda Springs WWTP	22.3	10	30	17	4.3		7.582	10	13.993	3.505	3.794
T14	Soda Creek	10.0	1	10	10			0.082	1	0.082	0.082	
T14A	Soda Creek in Soda Springs	5.8	9	8	4	1.5		0.076	9	0.123	0.005	0.031
T15	Densmore Creek	106.0	1	106	106			0.040	1	0.04	0.04	
T16	Smith Creek	49.0	1	49	49			0.040	1	0.04	0.04	
T17	Alder Creek	155.0	1	155	155			0.040	1	0.04	0.04	
T18	Whiskey Creek	5.6	7	16	1	5.9		0.040	1	0.04	0.04	
T19	Burton Creek	119.0	1	119	119			0.040	1	0.04	0.04	
T20	Trout Creek	41.7	7	77	16	24.0		0.052	1	0.052	0.052	
T21	Williams Creek	9.1	7	13	2	4.0		0.040	1	0.04	0.04	
T22	Cottonwood Creek	19.0	1	19	19			0.040	1	0.04	0.04	
T23	Maple Hot Springs	12.0	1	12	12			0.956	1	0.956	0.956	
T24	Mink Creek	14.4	14	40	0	12.9		0.040	1	0.04	0.04	
T25	Battle Creek	451.5	8	1067	22	392.1		0.070	1	0.07	0.07	
T26	Deep Creek	69.9	7	208	8	75.6		0.050	1	0.05	0.05	
T27	5 Mile Creek	39.1	7	111	3	38.0		0.072	1	0.072	0.072	
T27A	Preston WWTP	70.9	9	258	16	76.7		1.281	9	6.706	0.03	2.355
T28	Weston Creek	35.6	7	107	7	34.1		0.040	1	0.04	0.04	

Tributaries to the Bear River: Summer Base Flow

SITE ID	STATION DESCRIPTION	TOTAL SUSPENDED SOLIDS (mg/L)						NH3+NH4-N (mg/L)				
		AVG	N	MAX	MIN	STD		AVG	N	MAX	MIN	STD
T01	Thomas Fork	15.2	6	33	6	9.9		0.013	1	0.013	0.013	
T02	Sheep Creek	5.5	2	10	1	6.4		0.040	1	0.04	0.04	
T02A	St Charles Creek											
T03	Ovid Creek	7.0	2	8	6	1.4		0.010	1	0.01	0.01	
T04	Georgetown Creek	20.0	2	28	12	11.3		0.010	1	0.01	0.01	
T05	Stauffer Creek	17.0	2	26	8	12.7		0.018	1	0.018	0.018	
T06	Skinner Creek	10.0	1	10	10			0.017	1	0.017	0.017	
T07	Pearl Creek	1.0	1	1	1			0.005	1	0.005	0.005	
T08	Eightmile Creek	5.5	2	6	5	0.7		0.005	1	0.005	0.005	
T09	Sulphur Canyon Creek	3.0	1	3	3			0.012	1	0.012	0.012	
T10	Bailey Creek	19.0	1	19	19			0.005	1	0.005	0.005	
T11	Clear Springs Fish Hatchery	1.0	1	1	1			0.827	1	0.827	0.827	
T12	Soda Springs WWTP West Side Creek	5.0	6	22	1	8.3		1.386	6	2.381	0.181	0.727
T13	Soda Springs WWTP	12.0	7	21	5	5.0		4.658	7	8.514	1.263	2.765
T14	Soda Creek	24.7	3	57	4	28.4		0.150	1	0.15	0.15	
T14A	Soda Creek in Soda Springs	5.5	6	9	1	2.9		0.128	6	0.221	0.075	0.059
T15	Densmore Creek	1.0	1	1	1			0.005	1	0.005	0.005	
T16	Smith Creek											
T17	Alder Creek	3.0	1	3	3			0.005	1	0.005	0.005	
T18	Whiskey Creek	5.4	5	8	2	2.4		0.005	1	0.005	0.005	
T19	Burton Creek	27.0	1	27	27			0.009	1	0.009	0.009	
T20	Trout Creek	7.3	6	13	4	3.8		0.005	1	0.005	0.005	
T21	Williams Creek	4.8	6	9	1	3.5		0.005	1	0.005	0.005	
T22	Cottonwood Creek	1.0	1	1	1			0.005	1	0.005	0.005	
T23	Maple Hot Springs	2.0	1	2	2							
T24	Mink Creek	13.7	9	87	0	27.8		0.008	1	0.008	0.008	
T25	Battle Creek	97.7	3	143	70	39.6		0.041	1	0.041	0.041	
T26	Deep Creek	31.3	3	60	7	26.8		1.030	1	1.03	1.03	
T27	5 Mile Creek	47.7	3	72	26	23.1		0.087	1	0.087	0.087	
T27A	Preston WWTP	58.0	5	89	22	29.6		0.086	6	0.189	0.048	0.052
T28	Weston Creek	23.0	3	38	10	14.1		0.005	1	0.005	0.005	

Tributaries to the Bear River: Winter Base Flow

SITE ID	STATION DESCRIPTION	DISSOLVED NITRITE (mg/L)					DISSOLVED NITRATE (mg/L)				
		AVG	N	MAX	MIN	STD	AVG	N	MAX	MIN	STD
T01	Thomas Fork										
T02	Sheep Creek										
T02A	St Charles Creek										
T03	Ovid Creek										
T04	Georgetown Creek										
T05	Stauffer Creek										
T06	Skinner Creek										
T07	Pearl Creek										
T08	Eightmile Creek										
T09	Sulphur Canyon Creek										
T10	Bailey Creek										
T11	Clear Springs Fish Hatchery										
T12	Soda Springs WWTP West Side Creek						4.871	7	5.715	2.413	1.126
T13	Soda Springs WWTP						2.918	3	3.638	1.584	1.156
T14	Soda Creek										
T14A	Soda Creek in Soda Springs						1.278	8	1.563	1.069	0.164
T15	Densmore Creek										
T16	Smith Creek										
T17	Alder Creek										
T18	Whiskey Creek										
T19	Burton Creek										
T20	Trout Creek										
T21	Williams Creek										
T22	Cottonwood Creek										
T23	Maple Hot Springs										
T24	Mink Creek	0.004	1	0.004	0.004		1.240	1	1.24	1.24	
T25	Battle Creek	0.026	1	0.026	0.026		4.350	1	4.35	4.35	
T26	Deep Creek	0.033	1	0.033	0.033		4.540	1	4.54	4.54	
T27	5 Mile Creek	0.022	1	0.022	0.022		4.980	1	4.98	4.98	
T27A	Preston WWTP						4.401	3	9.432	1.856	4.357
T28	Weston Creek	0.017	1	0.017	0.017		4.630	1	4.63	4.63	

Tributaries to the Bear River: Lower Basin Runoff

SITE ID	STATION DESCRIPTION	DISSOLVED NITRITE (mg/L) AVG	N	MAX	MIN	STD	DISSOLVED NITRATE (mg/L) AVG	N	MAX	MIN	STD
T01	Thomas Fork	0.007	2	0.011	0.002	0.006	0.663	2	1.156	0.169	0.698
T02	Sheep Creek	0.007	2	0.008	0.006	0.001	0.578	2	0.746	0.409	0.238
T02A	St Charles Creek										
T03	Ovid Creek	0.004	2	0.005	0.002	0.002	0.162	2	0.315	0.009	0.216
T04	Georgetown Creek	0.003	2	0.003	0.002	0.001	0.275	2	0.288	0.262	0.018
T05	Stauffer Creek	0.004	2	0.004	0.003	0.001	0.097	2	0.157	0.037	0.085
T06	Skinner Creek	0.002	2	0.002	0.002	0.000	0.057	2	0.094	0.019	0.053
T07	Pearl Creek	0.002	2	0.003	0.001	0.001	0.027	2	0.039	0.015	0.017
T08	Eightmile Creek	0.002	2	0.002	0.002	0.000	0.074	2	0.074	0.074	0.000
T09	Sulphur Canyon Creek	0.003	2	0.004	0.002	0.001	0.555	2	0.58	0.53	0.035
T10	Bailey Creek	0.002	2	0.002	0.001	0.001	0.153	2	0.169	0.136	0.023
T11	Clear Springs Fish Hatchery	0.147	2	0.15	0.143	0.005	5.233	2	5.335	5.13	0.145
T12	Soda Springs WWTP West Side Creek	0.120	2	0.144	0.095	0.035	5.257	10	5.677	4.546	0.369
T13	Soda Springs WWTP	0.259	2	0.31	0.207	0.073	0.963	7	1.559	0.762	0.282
T14	Soda Creek	0.020	2	0.027	0.013	0.010	1.306	2	1.452	1.159	0.207
T14A	Soda Creek in Soda Springs						1.319	8	2.542	0.978	0.510
T15	Densmore Creek	0.040	2	0.074	0.005	0.049	0.578	2	0.754	0.401	0.250
T16	Smith Creek	0.006	2	0.009	0.003	0.004	0.333	2	0.373	0.292	0.057
T17	Alder Creek	0.003	2	0.003	0.003	0.000	0.105	2	0.142	0.067	0.053
T18	Whiskey Creek	0.024	2	0.029	0.019	0.007	2.889	2	3.198	2.58	0.437
T19	Burton Creek	0.004	2	0.004	0.004	0.000	0.461	2	0.719	0.202	0.366
T20	Trout Creek	0.013	2	0.016	0.009	0.005	1.283	2	1.551	1.015	0.379
T21	Williams Creek	0.002	2	0.002	0.001	0.001	0.131	2	0.136	0.125	0.008
T22	Cottonwood Creek	0.002	2	0.002	0.001	0.001	0.018	2	0.019	0.016	0.002
T23	Maple Hot Springs	0.040	2	0.043	0.037	0.004	0.240	2	0.265	0.214	0.036
T24	Mink Creek	0.006	4	0.007	0.003	0.002	0.329	4	0.51	0.19	0.133
T25	Battle Creek	0.009	4	0.011	0.006	0.002	0.618	4	1.021	0.27	0.317
T26	Deep Creek	0.013	4	0.024	0.007	0.008	1.161	3	2.29	0.477	0.985
T27	5 Mile Creek	0.022	4	0.033	0.005	0.012	2.483	4	3.265	1.54	0.733
T27A	Preston WWTP						2.892	5	5.682	0.812	1.849
T28	Weston Creek	0.017	4	0.031	0.01	0.010	2.633	4	4.21	1.188	1.522

Tributaries to the Bear River: Upper Basin Runoff

SITE ID	STATION DESCRIPTION	DISSOLVED NITRITE (mg/L)					DISSOLVED NITRATE (mg/L)				
		AVG	N	MAX	MIN	STD	AVG	N	MAX	MIN	STD
T01	Thomas Fork	0.002	1	0.002	0.002		0.025	1	0.025	0.025	
T02	Sheep Creek	0.004	1	0.004	0.004		0.238	1	0.238	0.238	
T02A	St Charles Creek										
T03	Ovid Creek	0.002	1	0.002	0.002		0.005	1	0.005	0.005	
T04	Georgetown Creek	0.002	1	0.002	0.002		0.186	1	0.186	0.186	
T05	Stauffer Creek	0.003	1	0.003	0.003		0.017	1	0.017	0.017	
T06	Skinner Creek	0.002	1	0.002	0.002		0.009	1	0.009	0.009	
T07	Pearl Creek	0.003	1	0.003	0.003		0.003	1	0.003	0.003	
T08	Eightmile Creek	0.001	1	0.001	0.001		0.023	1	0.023	0.023	
T09	Sulphur Canyon Creek	0.004	1	0.004	0.004		0.352	1	0.352	0.352	
T10	Bailey Creek	0.002	1	0.002	0.002		0.198	1	0.198	0.198	
T11	Clear Springs Fish Hatchery	0.138	1	0.138	0.138		8.136	1	8.136	8.136	
T12	Soda Springs WWTP West Side Creek	0.126	1	0.126	0.126		5.140	9	6.98	0.298	2.029
T13	Soda Springs WWTP	0.390	1	0.39	0.39		2.549	10	6.699	0.898	1.684
T14	Soda Creek	0.010	1	0.01	0.01		1.279	1	1.279	1.279	
T14A	Soda Creek in Soda Springs						0.678	9	1.023	0.003	0.285
T15	Densmore Creek	0.006	1	0.006	0.006		0.288	1	0.288	0.288	
T16	Smith Creek	0.004	1	0.004	0.004		0.225	1	0.225	0.225	
T17	Alder Creek	0.004	1	0.004	0.004		0.181	1	0.181	0.181	
T18	Whiskey Creek	0.032	1	0.032	0.032		2.916	1	2.916	2.916	
T19	Burton Creek	0.004	1	0.004	0.004		0.221	1	0.221	0.221	
T20	Trout Creek	0.008	1	0.008	0.008		0.891	1	0.891	0.891	
T21	Williams Creek	0.002	1	0.002	0.002		0.137	1	0.137	0.137	
T22	Cottonwood Creek	0.002	1	0.002	0.002		0.026	1	0.026	0.026	
T23	Maple Hot Springs	0.056	1	0.056	0.056		0.108	1	0.108	0.108	
T24	Mink Creek	0.003	7	0.006	0.001	0.002	0.735	7	3.4	0.09	1.184
T25	Battle Creek	0.013	7	0.021	0.007	0.005	1.586	7	4.33	0.19	1.604
T26	Deep Creek	0.018	7	0.055	0.007	0.017	0.634	7	0.99	0.41	0.205
T27	5 Mile Creek	0.030	7	0.047	0.023	0.008	1.233	6	1.98	0.78	0.417
T27A	Preston WWTP						3.445	9	6.285	0.449	2.476
T28	Weston Creek	0.009	7	0.016	0.003	0.005	1.232	7	2.79	0.13	0.914

Tributaries to the Bear River: Summer Base Flow

SITE ID	STATION DESCRIPTION	DISSOLVED NITRITE (mg/L)						DISSOLVED NITRATE (mg/L)				
		AVG	N	MAX	MIN	STD		AVG	N	MAX	MIN	STD
T01	Thomas Fork	0.015	1	0.015	0.015			1.100	1	1.1	1.1	
T02	Sheep Creek	0.011	1	0.011	0.011			0.430	1	0.43	0.43	
T02A	St Charles Creek											
T03	Ovid Creek	0.010	1	0.01	0.01			0.005	1	0.005	0.005	
T04	Georgetown Creek	0.009	1	0.009	0.009			0.371	1	0.371	0.371	
T05	Stauffer Creek	0.011	1	0.011	0.011			0.055	1	0.055	0.055	
T06	Skinner Creek	0.015	1	0.015	0.015			0.105	1	0.105	0.105	
T07	Pearl Creek	0.007	1	0.007	0.007			0.010	1	0.01	0.01	
T08	Eightmile Creek	0.008	1	0.008	0.008			0.041	1	0.041	0.041	
T09	Sulphur Canyon Creek	0.008	1	0.008	0.008			0.654	1	0.654	0.654	
T10	Bailey Creek	0.006	1	0.006	0.006			0.140	1	0.14	0.14	
T11	Clear Springs Fish Hatchery	0.245	1	0.245	0.245			5.780	1	5.78	5.78	
T12	Soda Springs WWTP West Side Creek	0.090	1	0.09	0.09			5.995	6	6.786	5.2	0.587
T13	Soda Springs WWTP	0.402	1	0.402	0.402			3.339	7	4.39	1.625	0.948
T14	Soda Creek	0.018	1	0.018	0.018			1.300	1	1.3	1.3	
T14A	Soda Creek in Soda Springs							0.748	6	1.386	0.236	0.378
T15	Densmore Creek	0.010	1	0.01	0.01			0.794	1	0.794	0.794	
T16	Smith Creek											
T17	Alder Creek	0.009	1	0.009	0.009			0.696	1	0.696	0.696	
T18	Whiskey Creek	0.016	1	0.016	0.016			3.190	1	3.19	3.19	
T19	Burton Creek	0.011	1	0.011	0.011			0.321	1	0.321	0.321	
T20	Trout Creek	0.011	1	0.011	0.011			1.060	1	1.06	1.06	
T21	Williams Creek	0.005	1	0.005	0.005			0.115	1	0.115	0.115	
T22	Cottonwood Creek	0.005	1	0.005	0.005			0.005	1	0.005	0.005	
T23	Maple Hot Springs											
T24	Mink Creek	0.005	3	0.007	0.003	0.002		0.490	3	1.03	0.06	0.494
T25	Battle Creek	0.020	3	0.035	0.011	0.013		0.913	3	1.36	0.34	0.522
T26	Deep Creek	0.096	3	0.2	0.042	0.090		1.537	3	1.75	1.27	0.244
T27	5 Mile Creek	0.044	3	0.051	0.04	0.006		1.923	3	2.75	1.45	0.718
T27A	Preston WWTP							5.512	6	6.764	2.708	1.534
T28	Weston Creek	0.013	3	0.02	0.008	0.006		1.917	3	3.4	0.9	1.314

Tributaries to the Bear River: Winter Base Flow

SITE ID	STATION DESCRIPTION	TOTAL PHOSPHORUS (mg/L)					ORTHOPHOSPHORUS (mg/L)				
		AVG	N	MAX	MIN	STD	AVG	N	MAX	MIN	STD
T01	Thomas Fork	0.091	9	0.21	0.04	0.051					
T02	Sheep Creek										
T02A	St Charles Creek										
T03	Ovid Creek										
T04	Georgetown Creek										
T05	Stauffer Creek										
T06	Skinner Creek										
T07	Pearl Creek										
T08	Eightmile Creek										
T09	Sulphur Canyon Creek										
T10	Bailey Creek										
T11	Clear Springs Fish Hatchery										
T12	Soda Springs WWTP West Side Creek	0.086	7	0.116	0.061	0.019	0.047	7	0.068	0.019	0.018
T13	Soda Springs WWTP	0.989	3	1.146	0.877	0.140	0.550	3	0.65	0.487	0.087
T14	Soda Creek	0.190	1	0.19	0.19						
T14A	Soda Creek in Soda Springs	0.219	8	0.562	0.127	0.141	0.062	8	0.163	0.031	0.043
T15	Densmore Creek										
T16	Smith Creek										
T17	Alder Creek										
T18	Whiskey Creek	0.216	9	0.32	0.14	0.064					
T19	Burton Creek										
T20	Trout Creek	0.243	9	0.8	0.04	0.221					
T21	Williams Creek	0.044	9	0.07	0.03	0.015					
T22	Cottonwood Creek										
T23	Maple Hot Springs										
T24	Mink Creek	0.196	7	1	0.03	0.355	0.023	1	0.023	0.023	
T25	Battle Creek	0.525	10	0.85	0.2	0.204	0.095	1	0.095	0.095	
T26	Deep Creek	0.216	1	0.216	0.216		0.090	1	0.09	0.09	
T27	5 Mile Creek	0.194	1	0.194	0.194		0.105	1	0.105	0.105	
T27A	Preston WWTP	1.612	3	1.668	1.553	0.058	0.795	3	0.984	0.632	0.178
T28	Weston Creek	0.107	1	0.107	0.107		0.048	1	0.048	0.048	

Tributaries to the Bear River: Lower Basin Runoff

SITE ID	STATION DESCRIPTION	TOTAL PHOSPHORUS (mg/L)					ORTHOPHOSPHORUS (mg/L)				
		AVG	N	MAX	MIN	STD	AVG	N	MAX	MIN	STD
T01	Thomas Fork	0.150	6	0.41	0.039	0.145	0.004	2	0.004	0.003	0.001
T02	Sheep Creek	0.022	2	0.03	0.013	0.012	0.003	2	0.003	0.002	0.001
T02A	St Charles Creek										
T03	Ovid Creek	0.046	2	0.053	0.038	0.011	0.018	2	0.027	0.009	0.013
T04	Georgetown Creek	0.054	2	0.062	0.046	0.011	0.015	2	0.016	0.013	0.002
T05	Stauffer Creek	0.059	2	0.069	0.049	0.014	0.026	2	0.029	0.022	0.005
T06	Skinner Creek	0.059	2	0.096	0.021	0.053	0.034	2	0.059	0.009	0.035
T07	Pearl Creek	0.024	2	0.032	0.016	0.011	0.011	2	0.016	0.006	0.007
T08	Eightmile Creek	0.025	2	0.028	0.021	0.005	0.010	2	0.013	0.007	0.004
T09	Sulphur Canyon Creek	0.010	2	0.011	0.009	0.001	0.008	2	0.009	0.007	0.001
T10	Bailey Creek	0.027	2	0.029	0.024	0.004	0.014	2	0.015	0.012	0.002
T11	Clear Springs Fish Hatchery	0.048	2	0.054	0.041	0.009	0.031	2	0.032	0.029	0.002
T12	Soda Springs WWTP West Side Creek	0.071	10	0.102	0.044	0.021	0.027	10	0.043	0.012	0.011
T13	Soda Springs WWTP	1.067	7	1.278	0.753	0.185	0.576	7	0.799	0.377	0.190
T14	Soda Creek	0.212	3	0.33	0.128	0.105	0.055	2	0.056	0.053	0.002
T14A	Soda Creek in Soda Springs	0.352	8	1.226	0.137	0.357	0.061	8	0.088	0.037	0.017
T15	Densmore Creek	0.446	2	0.81	0.082	0.515	0.350	2	0.675	0.024	0.460
T16	Smith Creek	0.088	2	0.122	0.054	0.048	0.027	2	0.031	0.023	0.006
T17	Alder Creek	0.134	2	0.186	0.082	0.074	0.045	2	0.053	0.037	0.011
T18	Whiskey Creek	0.285	6	0.52	0.056	0.171	0.064	2	0.079	0.049	0.021
T19	Burton Creek	0.100	2	0.138	0.062	0.054	0.034	2	0.034	0.034	0.000
T20	Trout Creek	0.214	6	0.36	0.078	0.113	0.030	2	0.033	0.026	0.005
T21	Williams Creek	0.047	6	0.08	0.015	0.027	0.007	2	0.007	0.006	0.001
T22	Cottonwood Creek	0.024	2	0.024	0.023	0.001	0.012	2	0.014	0.01	0.003
T23	Maple Hot Springs	0.029	2	0.033	0.025	0.006	0.006	2	0.007	0.005	0.001
T24	Mink Creek	0.143	8	0.32	0.038	0.107	0.037	4	0.047	0.013	0.016
T25	Battle Creek	1.391	8	3.52	0.228	1.357	0.045	4	0.074	0.033	0.020
T26	Deep Creek	0.236	4	0.374	0.117	0.117	0.059	4	0.1	0.019	0.038
T27	5 Mile Creek	0.159	4	0.208	0.13	0.034	0.105	4	0.115	0.091	0.010
T27A	Preston WWTP	1.247	5	1.382	1.152	0.119	0.551	5	0.723	0.414	0.137
T28	Weston Creek	0.090	4	0.13	0.046	0.040	0.019	4	0.043	0.007	0.016

Tributaries to the Bear River: Upper Basin Runoff

SITE ID	STATION DESCRIPTION	TOTAL PHOSPHORUS (mg/L)						ORTHOPHOSPHORUS (mg/L)				
		AVG	N	MAX	MIN	STD		AVG	N	MAX	MIN	STD
T01	Thomas Fork	0.145	9	0.23	0.09	0.051		0.030	3	0.04	0.02	0.010
T02	Sheep Creek	0.012	1	0.012	0.012			0.002	1	0.002	0.002	
T02A	St Charles Creek											
T03	Ovid Creek	0.054	1	0.054	0.054			0.017	1	0.017	0.017	
T04	Georgetown Creek	0.122	1	0.122	0.122			0.055	1	0.055	0.055	
T05	Stauffer Creek	0.064	1	0.064	0.064			0.030	1	0.03	0.03	
T06	Skinner Creek	0.094	1	0.094	0.094			0.045	1	0.045	0.045	
T07	Pearl Creek	0.059	1	0.059	0.059			0.017	1	0.017	0.017	
T08	Eightmile Creek	0.034	1	0.034	0.034			0.008	1	0.008	0.008	
T09	Sulphur Canyon Creek	0.020	1	0.02	0.02			0.005	1	0.005	0.005	
T10	Bailey Creek	0.041	1	0.041	0.041			0.017	1	0.017	0.017	
T11	Clear Springs Fish Hatchery	0.064	1	0.064	0.064			0.031	1	0.031	0.031	
T12	Soda Springs WWTP West Side Creek	0.075	9	0.129	0.052	0.028		0.025	7	0.045	0.015	0.013
T13	Soda Springs WWTP	1.090	10	1.37	0.821	0.176		0.563	10	0.821	0.237	0.196
T14	Soda Creek	0.185	2	0.19	0.179	0.008		0.037	1	0.037	0.037	
T14A	Soda Creek in Soda Springs	0.184	9	0.242	0.142	0.034		0.061	9	0.089	0.045	0.015
T15	Densmore Creek	0.133	1	0.133	0.133			0.018	1	0.018	0.018	
T16	Smith Creek	0.093	1	0.093	0.093			0.032	1	0.032	0.032	
T17	Alder Creek	0.188	1	0.188	0.188			0.047	1	0.047	0.047	
T18	Whiskey Creek	0.141	7	0.26	0.067	0.069		0.030	1	0.03	0.03	
T19	Burton Creek	0.139	1	0.139	0.139			0.040	1	0.04	0.04	
T20	Trout Creek	0.183	7	0.29	0.09	0.071		0.027	1	0.027	0.027	
T21	Williams Creek	0.083	7	0.19	0.03	0.059		0.013	1	0.013	0.013	
T22	Cottonwood Creek	0.043	1	0.043	0.043			0.014	1	0.014	0.014	
T23	Maple Hot Springs	0.037	1	0.037	0.037			0.010	1	0.01	0.01	
T24	Mink Creek	0.112	14	0.25	0.039	0.060		0.043	8	0.11	0.015	0.030
T25	Battle Creek	1.250	13	5.5	0.19	1.347		0.089	7	0.147	0.032	0.040
T26	Deep Creek	0.234	7	0.345	0.14	0.082		0.072	7	0.138	0.015	0.042
T27	5 Mile Creek	0.199	7	0.294	0.151	0.048		0.101	7	0.129	0.03	0.035
T27A	Preston WWTP	1.419	9	2.307	0.883	0.490		0.427	9	0.85	0.01	0.292
T28	Weston Creek	0.147	7	0.502	0.066	0.157		0.018	7	0.04	0.001	0.013

Tributaries to the Bear River: Summer Base flow

SITE ID	STATION DESCRIPTION	TOTAL PHOSPHORUS (mg/L)					ORTHOPHOSPHORUS (mg/L)				
		AVG	N	MAX	MIN	STD	AVG	N	MAX	MIN	STD
T01	Thomas Fork	0.052	7	0.07	0.025	0.014	0.001	2	0.002	0	0.001
T02	Sheep Creek	0.022	2	0.03	0.013	0.012	0.002	1	0.002	0.002	
T02A	St Charles Creek										
T03	Ovid Creek	0.043	2	0.056	0.03	0.018	0.003	1	0.003	0.003	
T04	Georgetown Creek	0.139	2	0.19	0.088	0.072	0.037	1	0.037	0.037	
T05	Stauffer Creek	0.057	2	0.08	0.034	0.033	0.009	1	0.009	0.009	
T06	Skinner Creek	0.059	1	0.059	0.059		0.018	1	0.018	0.018	
T07	Pearl Creek	0.025	1	0.025	0.025		0.009	1	0.009	0.009	
T08	Eightmile Creek	0.031	2	0.04	0.022	0.013	0.008	1	0.008	0.008	
T09	Sulphur Canyon Creek	0.015	1	0.015	0.015		0.005	1	0.005	0.005	
T10	Bailey Creek	0.048	1	0.048	0.048		0.015	1	0.015	0.015	
T11	Clear Springs Fish Hatchery	0.056	1	0.056	0.056		0.042	1	0.042	0.042	
T12	Soda Springs WWTP West Side Creek	0.052	6	0.063	0.039	0.008	0.037	6	0.055	0.025	0.011
T13	Soda Springs WWTP	1.003	7	1.206	0.851	0.131	0.473	7	0.692	0.195	0.208
T14	Soda Creek	0.252	3	0.5	0.096	0.217	0.045	1	0.045	0.045	
T14A	Soda Creek in Soda Springs	0.171	6	0.26	0.082	0.059	0.059	6	0.082	0.048	0.014
T15	Densmore Creek	0.016	1	0.016	0.016		0.003	1	0.003	0.003	
T16	Smith Creek						0.017	1	0.017	0.017	
T17	Alder Creek	0.056	1	0.056	0.056		0.027	1	0.027	0.027	
T18	Whiskey Creek	0.106	5	0.13	0.068	0.027	0.052	1	0.052	0.052	
T19	Burton Creek	0.079	1	0.079	0.079		0.014	1	0.014	0.014	
T20	Trout Creek	0.067	6	0.09	0.04	0.020	0.022	1	0.022	0.022	
T21	Williams Creek	0.021	6	0.03	0.01	0.008	0.009	1	0.009	0.009	
T22	Cottonwood Creek	0.006	1	0.006	0.006		0.002	1	0.002	0.002	
T23	Maple Hot Springs	0.050	1	0.05	0.05						
T24	Mink Creek	0.068	8	0.1	0.041	0.025	0.035	3	0.056	0.022	0.018
T25	Battle Creek	0.290	7	0.39	0.162	0.075	0.051	3	0.073	0.027	0.023
T26	Deep Creek	0.192	3	0.245	0.159	0.046	0.060	3	0.067	0.048	0.010
T27	5 Mile Creek	0.236	3	0.296	0.149	0.077	0.106	3	0.131	0.088	0.022
T27A	Preston WWTP	1.436	6	1.703	1.147	0.221	0.827	6	0.943	0.672	0.098
T28	Weston Creek	0.090	3	0.105	0.07	0.018	0.030	3	0.051	0.016	0.019

Appendix B: Regression of Total Suspended Solids on Total Phosphorus

Table B-1. Total phosphorus and total suspended solids data collected in Bear River at Stewart Dam by Ecosystems Research Institute, 1982-1998.

Sample date	Total phosphorus (mg/L)	Total suspended solids (mg/L)
07/06/82	0.168	85
07/21/82	0.207	125
08/13/82	0.240	103
08/22/82	0.129	59
09/16/82	0.063	25
10/03/82	0.339	28
10/21/82	0.170	91
11/04/82	0.080	32
12/09/82	0.055	20
01/01/83	0.027	9
02/01/83	0.029	8
03/07/83	0.288	124
04/04/83	0.688	559
04/18/83	0.084	56
04/20/83	0.322	245
05/10/83	0.207	201
05/20/83	0.282	146
06/02/83	0.132	40
06/10/83	0.191	67
06/14/83	0.108	33
06/29/83	0.073	19
07/11/83	0.116	33
07/28/83	0.135	77
08/24/83	0.293	213
08/27/83	0.119	115
09/21/83	0.130	64
09/29/83	0.092	111
10/28/83	0.028	50
04/23/84	0.240	4
05/21/84	0.156	114
07/08/84	0.254	141
08/06/84	0.296	228
08/28/84	0.117	168
09/25/84	0.054	65
11/23/84	0.026	92
01/22/85	0.022	7
03/05/85	0.032	9
04/22/85	0.298	120
05/18/85	0.213	79
06/24/85	0.077	51
08/06/85	0.163	59
10/04/85	0.009	111
10/29/85	0.005	24
12/16/85	0.007	73

Table B-1, continued		
01/13/86	0.076	10
03/21/86	0.219	122
04/22/86	0.479	248
05/13/86	0.069	32
06/15/86	0.074	45
07/02/86	0.112	124
03/09/87	0.023	91
04/30/87	0.094	53
05/26/87	0.063	74
05/31/87	0.214	70
06/14/87	0.166	76
06/30/87	0.129	66
07/11/87	0.108	85
05/10/93	0.361	311
04/13/94	0.064	41
05/03/94	0.062	29
05/17/94	0.076	27
05/31/94	0.106	41
06/14/94	0.128	55
07/05/94	0.068	35
08/02/94	0.139	72
09/06/94	0.058	23
10/04/94	0.054	25
11/08/94	0.023	5
12/05/94	0.018	8
03/07/95	0.113	49
03/20/95	0.216	156
04/03/95	0.230	53
04/17/95	0.186	93
05/08/95	0.103	53
05/22/95	0.108	59
06/05/95	0.231	167
07/05/95	0.197	87
08/07/95	0.159	96
09/11/95	0.119	68
10/02/95	0.031	18
12/04/95	0.023	9
03/04/96	0.020	6
03/18/96	0.068	79
04/08/96	0.404	80
04/22/96	0.187	90
05/06/96	0.211	115
05/28/96	0.158	74
06/11/96	0.297	148
07/08/96	0.123	92
08/05/96	0.112	53
09/03/96	0.065	22

Table B-1, continued

12/01/96	0.041	12
02/16/97	0.009	5
03/24/97	0.043	119
04/08/97	0.056	126
04/20/97	0.058	269
04/30/97	0.056	269
05/13/97	0.068	143
05/22/97	0.135	56
06/02/97	0.111	34
06/12/97	0.149	3
06/26/97	0.048	65
07/23/97	0.109	57
08/19/97	0.067	27
09/30/97	0.041	17
10/28/97	0.025	5
11/13/97	0.031	8
01/27/98	0.030	10
03/18/98	0.037	15
04/07/98	0.255	114
04/21/98	0.211	115
05/06/98	0.250	234
05/19/98	0.192	100
06/02/98	0.313	154
06/16/98	0.166	76

Table B-2. Total phosphorus and total suspended solids data collected in Bear River near Idaho-Wyoming border, 1974-1991.

Sample date	Location	Total phosphorus (mg/L)	Total suspended solids (mg/L)
08/29/74	1/4 mile west of border	0.06	15
04/01/75	1/4 mile west of border	0.19	34
12/09/75	at border from bridge	0.07	62
12/09/75	1 mile northeast of Dingle	0.04	56
12/22/75	at border from bridge	0.63	418
12/22/75	1 mile northeast of Dingle	0.07	69
01/07/76	at border from bridge	0.16	122
01/07/76	1 mile northeast of Dingle	0.04	81
01/29/76	at border from bridge	0.90	81
01/29/76	1 mile northeast of Dingle	0.03	82
02/19/76	at border from bridge	0.12	29
03/18/76	1 mile northeast of Dingle	0.14	48
04/01/76	at border from bridge	0.21	134
04/01/76	1 mile northeast of Dingle	0.25	167
04/15/76	at border from bridge	0.50	332
04/15/76	1 mile northeast of Dingle	0.49	233
05/18/76	1 mile northeast of Dingle	0.22	87
06/03/76	at border from bridge	0.20	60
06/03/76	1 mile northeast of Dingle	0.25	95
06/16/76	at border from bridge	0.16	38
06/16/76	1 mile northeast of Dingle	0.17	29
07/01/76	at border from bridge	0.11	40
07/01/76	1 mile northeast of Dingle	0.15	33
07/16/76	at border from bridge	0.14	27
07/16/76	1 mile northeast of Dingle	0.10	11
07/27/76	at border from bridge	0.11	22
07/27/76	1 mile northeast of Dingle	0.18	47
08/25/76	at border from bridge	0.09	26
08/25/76	1 mile northeast of Dingle	0.10	42
09/23/76	at border from bridge	0.11	29
09/23/76	1 mile northeast of Dingle	0.08	24
10/05/76	at border from bridge	0.07	16
10/05/76	1 mile northeast of Dingle	0.16	20
10/21/76	at border from bridge	0.07	4
10/21/76	1 mile northeast of Dingle	0.06	8
11/04/76	1 mile northeast of Dingle	0.07	16
11/18/76	at border from bridge	0.08	2
11/18/76	1 mile northeast of Dingle	0.07	2
12/02/76	1 mile northeast of Dingle	0.05	4
12/16/76	1 mile northeast of Dingle	0.21	42
09/07/77	1/4 mile west of border	0.08	23
09/08/77	1/4 mile west of border	0.06	22
12/19/79	at border	0.01	4

Table B-2, continued			
01/23/80	at border	0.30	64
02/28/80	at border	0.21	43
03/24/80	at border	0.20	92
04/24/80	at border	1.30	1020
06/11/80	at border	0.24	79
07/08/80	at border	0.01	98
10/07/80	at border	2.40	20
01/21/81	at border	0.06	2
03/18/81	at border	0.04	12
05/07/81	above confluence with Thomas Fork	0.03	30
05/13/81	at border	0.18	27
05/21/81	above confluence with Thomas Fork	0.10	32
06/04/81	above confluence with Thomas Fork	0.08	94
06/16/81	above confluence with Thomas Fork	0.05	113
07/14/81	above confluence with Thomas Fork	0.15	123
08/11/81	above confluence with Thomas Fork	0.03	23
08/27/81	above confluence with Thomas Fork	0.01	17
09/09/81	above confluence with Thomas Fork	0.02	43
09/16/81	at border	0.03	18
09/22/81	above confluence with Thomas Fork	0.02	23
10/14/81	above confluence with Thomas Fork	0.03	53
11/17/81	at border	0.25	12
11/24/81	above confluence with Thomas Fork	0.03	18
01/13/82	at border	0.81	6
01/19/82	above confluence with Thomas Fork	0.02	13
02/10/82	above confluence with Thomas Fork	0.01	6
02/18/82	at border	0.27	13
03/10/82	at border	0.22	104
03/18/82	above confluence with Thomas Fork	0.49	608
04/01/82	above confluence with Thomas Fork	0.30	225
04/15/82	above confluence with Thomas Fork	1.40	1040
04/29/82	above confluence with Thomas Fork	0.55	725
05/11/82	above confluence with Thomas Fork	0.22	352
05/19/82	at border	0.30	195
05/25/82	above confluence with Thomas Fork	0.21	178
06/09/82	at border	0.24	113
06/10/82	above confluence with Thomas Fork	0.12	123
06/22/82	above confluence with Thomas Fork	0.35	144
07/07/82	at border	0.54	105
07/08/82	above confluence with Thomas Fork	0.19	110
07/20/82	above confluence with Thomas Fork	0.19	137
08/03/82	above confluence with Thomas Fork	0.44	239
08/18/82	at border	0.16	99
09/14/82	at border	0.07	14
10/13/82	at border	1.10	491
11/24/82	at border	0.05	3
01/20/83	at border	0.03	14
01/21/83	at border	0.03	14

Table B-2, continued			
02/16/83	at border	0.02	8
04/06/83	at border	0.22	114
04/20/83	at USGS gage at border	0.73	458
05/09/83	at border	0.50	206
05/10/83	at USGS gage at border	0.48	390
06/03/83	at USGS gage at border	0.15	69
06/15/83	at USGS gage at border	0.07	12
07/12/83	at border	0.22	78
07/28/83	at USGS gage at border	0.16	77
08/10/83	at border	0.13	6
08/30/83	at USGS gage at border	0.14	68
09/29/83	at USGS gage at border	0.04	92
10/28/83	at USGS gage at border	0.04	39
03/18/91	at USGS gage at border	0.07	39
04/03/91	at USGS gage at border	0.09	35
04/15/91	at USGS gage at border	0.15	27
04/29/91	at USGS gage at border	0.47	16
05/06/91	at USGS gage at border	0.14	36
05/20/91	at USGS gage at border	0.36	144
06/03/91	at USGS gage at border	0.37	182
06/17/91	at USGS gage at border	0.13	106
07/01/91	at USGS gage at border	0.45	57
07/15/91	at USGS gage at border	0.26	82
07/29/91	at USGS gage at border	0.08	19
08/12/91	at USGS gage at border	0.11	16
08/26/91	at USGS gage at border	0.10	15
09/09/91	at USGS gage at border	0.24	18
10/07/91	at USGS gage at border	0.05	21

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Appendix C: Data from NPDES Discharge Monitoring Reports

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Table C-1. Data from Discharge Monitoring Reports as submitted by NPDES permitted waste water treatment plants (WWTP) in Bear River Basin since 2000.

Site	Year	Month	Avg monthly flow (cfs)	Daily max influent flow (cfs)	Days of dis-charge[6]	# sampling events	Total ammonia[1] (mg N/L)	Total nitrate (mg N/L)	Total nitrite (mg N/L)	Total nitrate/ nitrite[2] (mg N/L)	Total phos-phorus[3,4] (mg P/L)	# sampling events	Total sus-pended solids[5] (mg/L)
Montpelier WWTP	2000	3/29-4/28	2.2		31	1	2.1	2.6	0.6		0.95	4	18
		10/11-11/3	1.9		24	1	<0.05	<1.0	<0.1		0.74	3	6.3
	2001	3/30-4/16	1.6		18							4/4,11	7.5
		10/5-10/15	1.5		10.5	10/10	<0.05	<0.1	<0.1		0.9	10/10	18
		10/22-11/9	2.0		19							10/24,31 11/7,8	6.6
	2002	5/13-5/31	2.1		19	5/29	0.23	1.9	0.6		0.83	5/15,22,29	2.5
		10/8	1.7		0.5								
		10/15-11/8	1.9		25	10/30	1.48	<1.0	<0.1		1.31	10/16,23, 30, 11/6	3.5
	2003	5/5-5/26	1.9		22	5/21	0.38			1.65	1.37	5/7,14,21	3.7
		10/15-11/7	1.7		24	10/29	1.32	1.2	0.57		1.18	10/23,29, 11/5	2.7
	2004	5/3-5/28	1.5		26	5/12	0.58	1.4	0.4		1.26	5/4,12,19, 26	4.8
		10/1-11/1	1.9		31.5	10/13	0.47				1.16	10/6,13,20, 27	1.8
Soda Springs WWTP	2000	January	1.21		YR		2.3						16
		February	1.27		YR		2.6						16
		March	1.28		YR		2.6						16
		April	1.21		YR		2.7						14
		May	1.19		YR		2.6						15
		June	1.24		YR		2.4						15
		July	1.27		YR		2.5						15
		August	1.38		YR		2.7						15
		September	1.32		YR		2.5						15
		October	1.28		YR		2.9						15
		November	1.19		YR		2.7						17
		December	1.14		YR		4.9						19

Table C-1, continued													
Soda Springs WWTP	2001	January	1.18		YR		5.8						20
		February	1.24		YR		6.4						11
		March	1.39		YR		6.2						23
		April	1.33		YR		6.4						19
		May	1.16		YR		5.9						15
		June	1.19		YR		2.7						15
		July	1.24		YR		0.72						13
		August	1.25		YR		1.8						12
		September	1.18		YR		0.76						12
		October	1.05		YR		3.95						17
		November	1.05		YR		3.17						15
		December	1.05		YR		7.83						8
	2002	January	1.08	1.18	YR		1.55						10
		February	1.10	1.24	YR		2.9						12
		March	1.27	1.44	YR		2.3			2.1	0.86		14
		April	1.24	1.36	YR		3.1						13
		May	1.16		YR		4.1						10
		June		1.24	YR		3.7			5.03	1.22		12
		July		1.35	YR		3.9						9
		August		1.39	YR		4.5			1.35	1.09		15
		September		1.49	YR		4.1						20
		October		1.28	YR		4.4						12
		November		1.21	YR		3.6			<0.05	0.62		10
		December		1.24	YR		4						11
	2003	January		1.25	YR		4						15
		February		1.38	YR		4.4						15
		March		1.27	YR		7			1.33	1.02		14
		April		1.19	YR		3.6						12
		May		1.28	YR		4.1						7
		June		1.24	YR		2.2						5
		July		1.35	YR		1.2						6
		August		1.27	YR		0.88			2.18	0.79		5
		September		1.22	YR		2						10
		October		1.08	YR		2						5

Table C-1, continued													
Soda Springs WWTP	2003	November		1.08	YR		1.2			3.1	0.79		8
		December		1.11	YR		3.3				0.76		7
	2004	January		1.19	YR		4.1						12
		February		1.14	YR		4						8
		March		1.53	YR		3.6			2.9	0.7		9
		April		1.39	YR		2.6						12
		May		1.70	YR		1.4						12
		June		1.53	YR		3.1			5	0.79		11
		July		1.32	YR		3.8						7
		August		1.38	YR		3.2						10
		September		1.38	YR		4.2			1.62	0.71		9
		October		1.70	YR		1.4						5
		November		1.36	YR		2.1						7
		December		1.35	YR		2.6			2.8	0.68		10
Grace WWTP	2000	January	0.06		YR								51.75
		February	0.12		YR								10.5
		March	0.05		YR								5.2
		April	0.04		YR								21
		May	0.06		YR								5.5
		June	0.08		YR								10
		July	0.10		YR								5.75
	2000	August	0.11		YR								7.4
		September	0.07		YR								3.75
		October	0.08		YR								8
		November	0.06		YR								15.25
		December	0.03		YR								5.2
	2001	January	0.04		YR								10.25
		February	0.03		YR								7
		March	0.06		YR								6.2
		April	0.05		YR								3.25
		May	0.10		YR								2.6
		June	0.08		YR								4.75
		July	0.09		YR								5
		August	0.09		YR								4.4

Table C-1, continued													
Grace WWTP	2001	September	0.08		YR								4
		October	0.03		YR								3
		November	0.07		YR								4
		December	0.02		YR								3.25
	2002	January	0.01		YR								3.8
		February	0.01		YR								4
		March	0.05		YR								6
		April	0.04		YR								2
		May	0.06		YR								4.2
		June	0.09		YR								4.25
		July	0.09		YR								4
		August	0.08		YR								2.75
		September	0.08		YR								3.5
		October	0.05		YR								2.6
		November	0.02		YR								4
		December	0.02		YR								5.75
	2003	January	0.04		YR								3.4
		February	0.02		YR								3.5
		March	0.03		YR								3.5
		April	0.03		YR								5.25
		May	0.06		YR								3.2
		June	0.07		YR								2.5
		July	0.07		YR								5
		August	0.08		YR								7.25
		September	0.04		YR								2.25
		October	0.03		YR								3.6
		November			YR								
		December	0.01		YR								2.8
	2004	January	0.01		YR								4.5
		February	0.03		YR								4
		March	0.04		YR								2.6
		April	0.03		YR								2.75
		May	0.06		YR								2.75
		June	0.07		YR								4.25

Table C-1, continued

Grace WWTP	2004	July	0.06		YR								4.2
		August	0.07		YR								4.75
		September	0.03		YR								3.2
		October	0.03		YR								1.75
		November	0.02		YR								2.5
		December	0.02		YR								2.2
Preston WWTP	2000	January	1.24		YR		1.38			0.92	2.03		17.13
		February	1.38		YR		1.45			0.87	1.83		13.13
		March	1.64		YR								10.55
		April	1.45		YR		1.42			1.76	2.48		9.63
		May	1.41		YR		1.61			2.11	2.17		7.5
		June	1.45		YR		1.05			1.56	2.41		9.88
		July	1.49		YR		0.58			1.07	2.44		19.21
		August	1.42		YR		0.726			1.33	0.80		8.94
		September	1.16		YR		1.28			1.56	0.80		12.83
		October	1.19		YR		1.09			0.97	0.74		14.25
		November	1.07		YR		1.07			3.29	0.42		12.86
		December	1.01		YR		1.28			3.03	0.86		14.38
	2001	January	0.99		YR		1.32						15.72
		February	1.02		YR		1.515						18.69
		March	1.19		YR		1.5						22.78
		April	1.39		YR		1.18						15.69
		May	1.28		YR		1.824						20.72
		June	1.33		YR		1.9						19.57
		July	1.27		YR		1.632						18.13
		August	1.14		YR		0.87						17.81
		September	1.05		YR		0.58						22.69
		October	0.97		YR		1.24						15.28
		November	0.96		YR		0.42						15.19
		December	1.02		YR		0.332						13.25
	2002	January	0.97		YR		1.51						22.62
		February	1.01		YR		1.56						21.75
		March	1.30		YR		1.47						22.61
		April	1.24		YR		1.49						24.62

Table C-1, continued													
Preston WWTP	2002	May	1.19		YR		1.32						24.35
		June	1.18		YR		1.39						14.93
		July	1.13		YR		1.56						19.62
		August	1.07		YR		4.82						18.9
		September	1.24		YR		15.15						18.37
		October	1.04		YR		17.66						19.11
		November	0.99		YR		19.36						21.37
		December	0.93		YR		18.8						25.71
	2003	January	0.96		YR		19.08						25.15
		February	1.02		YR		16.4						25.25
		March	0.94		YR		15.13						21.43
		April	0.90		YR		15.18						22.5
		May	0.96		YR		17.06						23.16
		June	0.97		YR		16.59						10.87
		July	0.94		YR		17.47						14.38
		August	0.99		YR		14.39						17.44
		September	0.93		YR		0.39						15.87
		October	0.85		YR		0.6						
		November	0.87		YR		0.88						16.87
		December	0.88		YR		1.36						19
	2004	January	0.85		YR		1.75						20.22
		February	0.96		YR		1.91						17.06
		March	1.45		YR		1.93						16.88
		April	1.25		YR		1.82						14
		May	1.18		YR		1.91						16.56
		June	1.24		YR		0.91						10.5
		July	1.04		YR		1.11						12.22
		August	0.97		YR		0.93						13.06
		September	0.97		YR		1.22						15.33
		October	1.21		YR		2						17.22
		November	1.22		YR		1.2						17.44
		December	1.13		YR		1.91						15

Table C-1, continued													
Franklin WWTP	2000	January	0.06		EM								11
		February	0.07		EM								18
		March	0.07		EM								10
		April	0.06		EM								14
		November	0.03		EM								22
		December	0.05		EM								22
	2001	January	0.05		EM								20
		February	0.06		EM								6
		March	0.06		EM								4
		April	0.06		EM								19
	2002	January	0.06		EM								22.09
		March	0.07		EM								13
		April	0.06		EM								5.5
		May	0.05		EM								
		June	0.02		EM								
		July	0.10		EM								
		August	0.11		EM								
		December	0.04		EM								14
	2003	January	0.04		EM								24
		February	0.05		EM								28
		March	0.05		EM								28
		April	0.04		EM								8.5
		July	1.52		EM								
		August	1.07		EM								
		November	0.04		EM								11
	2004	January	0.04		EM								18
		February	0.05		EM								4.5
		March	0.08		EM								15.5
		April	0.06		EM								22
		July	1.22		EM								
		August	0.76		EM								
		November	0.04		EM								24
		December	0.06		EM								24

Table C-1, continued

(1)Total ammonia sampling frequency: Soda Springs Jan 00 - Jan 01, Mar 01 2/week, Feb 01, Apr 01 - Mar 03 1/week; Preston 1/week

(2)Nitrate/nitrite sampling frequency: Soda Springs 1/quarter; Preston 1/week

(3)Montpelier documents indicate phosphorus sampled, which was assumed to be total phosphorus

(4)Total phosphorus sampling frequency: Soda Springs 1/quarter; Preston 1/week

(5)Total suspended solids sampling frequency: Soda Springs 2/week; Grace 1/week; Preston 2/week; Franklin 1/month except Mar 00 2/month

(6)YR=year round, EM=entire month

Table C-2. Data from Discharge Monitoring Reports as submitted by NPDES permitted fish hatcheries in Bear River Basin since 2000.

Year	Month	Average monthly flow (cfs)	Ammonia[1] (mg N/L)		Nitrate/nitrite[1,2] (mg N/L)		Total Kjeldahl nitrogen[1] (mg/L)		Total phosphorus[3] (mg/L)		Total suspended solids[4] (mg/L)	
			Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent
CLEAR SPRINGS FOODS												
2000	April	17.0							0.039	0.046	<2	<2
	May	16.0							0.048	0.058	<2	<2
	June	16.0							0.038	0.04	<2	<2
	October	14.5							0.044	0.091	<2	<2
	November	14.5							0.038	0.083	<2	2.3
	December	14.5							0.034	0.096	<2	6
2001	January	14.2	2	1.83	4.39	4.3	1.97	2.27	0.07	0.11	<2	3
	February	14.2							0.04	0.088	<2	4.8
	March	14.0							0.038	0.079	<2	3.6
	April	14.9							0.034	0.057	<2	2
	May	14.70							0.035	0.046	<2	2.1
	June	14.72							0.038	0.06	<2	<2
	July	13.18							0.046	0.055	<2	<2
	August	13.37							0.055	0.053	<2	<2
	September	13.85							0.038	0.051	<2	<2
	October	13.18							0.034	0.06	<2	<2
	November	13.42							0.043	0.079	<2	<2
	December	13.40							0.038	0.083	<2	4.5
2002	January	13.5							0.033	0.067	<2	2.5
	February	13.4							0.038	0.069	<2	5
	March	13.2							0.044	0.08	<2	4.1
	April	15.4							0.034	0.041	<2	<2
	May	15.2							0.035	0.043	<2	<2
	June	15.0							0.046	0.036	<2	<2
	July	15.1							0.034	0.038	<2	<2
	August	14.3							0.038	0.057	<2	<2
	September	13.9							0.037	0.062	<2	<2
	October	12.9							0.041	0.063	<2	<2
	November	13.4										
	December	13.2										
2003	January	13.2							0.035	0.086	<2	5
	February	13.4										
	March	13.9										
	April	14.2							0.043	0.048	<2	<2
	May	14.2										
	June	13.7										
	July	13.2							0.038	0.053	<2	<2

Table C-2, continued												
CLEAR SPRINGS FOODS												
2003	August	13.3										
	September	12.6										
	October	11.7							0.036	0.071	<2	2.6
	November	11.5										
	December	11.7										
2004	January	11.7							0.035	0.096	<2	5.8
	February	11.7										
	March	13.7										
	April	13.7							0.059	0.061	<2	<2
	May	14.4										
	June	14.9										
	July	14.4							0.037	0.046	<2	<2
	August	12.4										
	September	11.7										
	October	11.3							0.039	0.059	<2	<2
	November	11.6										
	December	11.5										
GRACE FISH HATCHERY[5]												
2000	January	16.01									1.4	2
	February	14.23										
	March	13.15									0.6	1.1
	April	10.68										
	May	8.97									0.3	1.4
	June	12.07										
	July	13.15									1.4	3
	August	14.70										
	September	15.63									0.5	2
2002	January	13.30 (6)										
	February	11.90 (6)	0.158	0.065	2.83	2.75	0.136	0.209	0.124	0.088	<2	<2
	March	9.57 (6)										
	April	9.40 (6)							0.097	0.1	<2	<2
	May	9.40 (6)							0.09	0.112	<2	<2
	June	9.70 (6)							0.09	0.109	<2	<2
	July	10.40 (6)	<0.05	0.192	3.15	2.97	0.11	0.208	0.101	0.094	<2	<2
	August	11.10 (6)							0.107	0.092	<2	<2
	September	11.30 (6)							0.098	0.085	<2	<2
	October	13.60 (6)							0.103	0.102	<2	<2
	November	13.20 (6)							0.096	0.096	<2	<2
	December	11.80 (6)							0.097	0.09	<2	<2
2003	January	11.10 (6)							0.102	0.098	<2	<2
	February	10.40 (6)							0.097	0.098	<2	<2
	March	9.73 (6)										
	April	9.40 (6)							0.098	0.112	<2	<2
	May	9.89 (6)										

Table C-2, continued												
GRACE FISH HATCHERY[5]												
2003	June	8.59 (6)										
	July	10.06 (6)							0.104	0.104	2.17	2.68
	August	12.30 (6)										
	September	13.60 (6)										
	October	13.60 (6)							0.101	0.107	<2	<2
	November	13.60 (6)										
	December	13.00 (6)										
2004	January	11.5 (6)							0.098	0.135	<2	6.75 (7)
	February	10.06 (6)							0.097	0.114	<2	<2
	March	10.06 (6)							0.097	0.085	<2	<2
	April	9.4 (6)							0.103	0.09	<2	<2
	May	8.91 (6)										
	June	11.6 (6)										
	July	10.06 (6)							0.098	0.085	<2	<2
	August	8.43 (6)										
	September	13.6 (6)										
	October	13.6 (6)							0.096	0.086	<2	<2
	November	13.2 (6)										
	December	12.9 (6)										
BEAR RIVER TROUT FARM												
2000	February				1.12	1.26			<0.01	<0.01	<1	<1
	March	11.0										
	June	10.0			2.16	2.42			0.17	0.3	<1	1
	September	10.2			1.8	1.87			0.19	0.26	<1	<1
	December	10.1			1.96	2.12			0.3	0.12	1	1
2001	March	10.0			1.93	2.26			0.092	0.102	<1	<1
	June	10.0			2.08	2.46			0.075	0.118	2	3
	September	8.0			1.64	2.7			0.075	0.07	2	2
	December	10.1										
2002	January				1.72	2			0.103	0.148	1	<1
	March	8.5										
	April				1.93	2.3			0.063	0.101	<1	1
	June	5.1										
	July				2.8	3.29			0.122	0.144	<1	<1
	September	6.2			4.19	4.49			0.097	0.093	<1	1
	December	5.7	<0.05	0.08	2.01	2.35	0.5	0.57	0.112	0.064	1	1
2003	March	5.3										
	April		<0.05	0.07	2.17	2.5	0.27	0.36	0.114	0.157	<1	<1
	June	7.0			1.92	2.08			0.052	0.06	<1	<1
	September	6.2			1.52	2.52			0.165	0.079	11	<1
	December	5.6	<0.05	<0.05	1.88	1.98	0.1	0.28	0.07	0.13	5	10
2004	March	5.6			1.46	1.75			0.104	<0.005	<1	2
	June	4.9			1.16 (8)	1.81			0.111	0.19	2	2
	September	7.7			1.62	1.84			0.067	0.084	<1	1

Table C-2, continued												
BEAR RIVER TROUT FARM												
2004	December	6.0	0.55	1.09	1.59	1.86			0.09	0.1	<1	2

(1)values are from a single sampling event
(2)only nitrate measured by Bear River Trout Farm
(3)Total Phosphorus sampling frequency: Clear Springs 1/month; Grace 1/month; Bear River 1/quarter
(4)Total Suspended Solids sampling frequency: Clear Springs 1/month; Grace 1/month; Bear River 1/quarter
(5)only data since Jan 02 (following renovation) used
(6)daily maximum
(7)represents average of two samples taken - 12.5 mg/L and <2 mg/L (considered 1 mg/L for analysis purposes)
(8)reported as 11.6, but based on other data considered 1.16

Appendix D: Utah Department of Environmental Quality Data from Cub River and Worm Creek

Table D-1. Water quality data from the Cub River near the Idaho-Utah state line (from Utah Department of Environmental Quality).

Date	Flow (cfs)	Dissolved total phosphorus (mg/L)	Total phosphorus (mg/L)	Total suspended solids (mg/L)	Total phosphorus load (kg/day)
11/3/76			0.09	60	
1/25/77			0.15	15	
3/1/77				15	
5/3/77			0.06	15	
7/5/77			0.07	30	
9/7/77				680	
11/3/77	350		0.07	10	59.94
1/4/78			0.03	5	
2/28/78				25	
5/2/78			0.05	10	
7/5/78				10	
8/30/78			0.31	30	
10/25/78			0.09	5	
1/3/79			0.05	2	
3/7/79			0.07	2	
5/1/79			0.15	4	
8/1/79			0.39		
10/30/79			0.42		
2/5/80			0.1	0	
5/8/80			0.08	191	
8/7/80			0.24	89	
9/30/80			2.5	0	
12/2/80			0.15	9	
2/5/81			0.6		
2/5/81			0.06		
6/2/81			0.01		
2/3/82			0.15	12	
2/16/82			0.09	16	

Table D-1, continued					
3/31/82			0.1	27	
3/31/82			0.2	72	
6/9/82			0.1	43	
7/7/82			0.15	15	
9/1/82			0.4	18	
10/26/82			0.15	0	
12/20/82			0.06	17	
4/16/83			0.02	27	
6/7/83			0.08	194	
7/5/83			0.02	82	
8/2/83	22.8		0.28	17	15.62
9/6/83			0.4	6	
10/4/83	74.1		0.1	38	18.13
11/7/83			0.07	26	
11/29/83	32.9		0.06	22	4.83
1/4/84	127.6		0.07	29	21.85
1/4/84	127.6		0.07		21.85
2/1/84			0.06		
2/1/84			0.06	63	
2/29/84	70		0.08		13.70
2/29/84	70		0.08	89	13.70
4/3/84	227.9		0.19		105.94
4/3/84	227.9		0.19	107	105.94
5/1/84	213		0.08		41.69
5/1/84	213		0.08	46	41.69
5/30/84	552		0.12		162.06
5/30/84	552		0.12	147	162.06
7/10/84	84		0.07		14.39
7/10/84	84		0.07	16	14.39
8/7/84	36.2		0.18		15.94
8/7/84	36.2		0.18	0	15.94
9/5/84	51		0.16		19.96
9/5/84	51		0.16	39	19.96
10/2/84	73.2		0.08		14.33
10/2/84	73.2		0.08	14	14.33
10/23/84	86		0.06		12.62
10/23/84	86		0.06	3	12.62
11/27/84	142		0.08		27.79

Table D-1, continued					
11/27/84	142		0.08	7	27.79
1/2/85			0.08	10	
2/5/85			0.09	14	
3/5/85	49.8		0.13	13	15.84
4/2/85	261		0.23	63	146.87
4/30/85	191.5		0.08	69	37.48
6/4/85	177.6		0.06	0	26.07
9/10/92		0.494	0.494	27	
9/29/92		0.132	0.198	12	
10/20/92	20	0.027	0.044	7	2.15
11/10/92	40	0.028	0.028	3	2.74
12/8/92		0.017	0.017	4	
1/13/93		0.031	0.039	4	
2/22/93	20	0.036	0.041	6	2.01
3/22/93	87	0.211	0.231	38	49.17
4/6/93	65	0.047	0.073	20	11.61
4/19/93	124	0.03	0.055	20	16.69
5/3/93	112	0.016	0.025	22	6.85
5/17/93	423	0.028	0.248	264	256.65
6/2/93	311	0.016	0.088	114	66.96
6/14/93	388	0.023	0.094	104	89.23
7/12/93	21.1	0.055	0.174	12	8.98
8/16/93	3.4	0.184	0.19	9	1.58
9/14/93	3.3	0.23	0.392	11	3.16
10/18/93		0.022	0.024	4	
11/17/93		0.023	0.04	3	
1/25/94		0.453	0.711	157	
2/22/94		0.061	0.061	9	
3/10/94	96	0.055	0.082	27	19.26
3/22/94	45.6	0.026	0.049	27	5.47
4/7/94	68	0.043	0.084	27	13.97
4/19/94	100	0.025	0.095	185	23.24
5/5/94	83.7	0.016	0.044	44	9.01
5/18/94	104	0.036	0.054	34	13.74
6/7/94	14.9	0.025	0.038	6	1.39
7/20/94	4.1	0.507	0.574	13	5.76
8/30/94	3.5	0.766	0.853	11	7.30
10/12/94	8	0.038	0.057	10	1.12

Table D-1, continued					
11/17/94	10	0.057	0.058	10	1.42
1/18/95	5	0.092	0.111	7	1.36
3/1/95	90	0.031	0.063	30	13.87
3/16/95		0.043	0.01	34	
3/28/95	72	0.044	0.047	17	8.28
4/12/95	95	0.025	0.046	18	10.69
4/25/95	50.9	0.012	0.02	11	2.49
5/11/95	250	0.014	0.079	87	48.32
5/24/95	400	0.01	0.098	120	95.91
6/6/95	200	0.02	0.13	173	63.61
6/13/97		0.0577		102	
10/28/97	35	0.01702		0	0.00
7/16/98	19	0.01	0.033	20	1.53
8/19/98			0.42	20.4	
9/22/98	45.4		0.022	20.4	2.44
10/21/98	17.5	0.01	0.01	0	0.43
12/8/98	25	0.024	0.028	6.4	1.71
1/27/99	37.5	0.045	0.049	8	4.50
2/23/99	35	0.035	0.059	5.6	5.05
4/1/99	150	0.028	0.035	19.2	12.84
4/21/99	130	0.027	0.063	87.6	20.04
5/5/99		0.045	0.07	50.8	
5/26/99		0.026	0.063	110.4	
6/9/99		0.025	0.063	54.4	
6/22/99		0.087	0.064	46.8	
8/17/99		0.171	0.183	8.8	
11/3/99	6.1	0.01	0.01	0	0.15
1/5/00		0.051	0.143	6	
2/15/00	35	0.157	0.402	258	34.42
4/11/00	89.9	0.021	0.024	35.6	5.28
6/22/00	14.9	0.035	0.041	7.2	1.49
8/10/00	10.3	0.212	0.206		5.19
9/27/00	7.2	0.037		0	0.00
11/2/00	11.3	0.01		4.4	0.00
1/24/01			0.031	0	
5/1/01		0.023	0.281	2	
7/25/01	5	0.056	0.1	28.4	1.22
10/3/01	7.5	0.025	0.025	28	0.46

Table D-1, continued					
11/7/01	5.28	0.01	0.025	26	0.32
1/16/02	4.5	0.025	0.027	28	0.30
3/20/02	4.5	0.098	0.115	5.6	1.27
5/8/02		0.01	0.079	110	
6/26/02	4.5	0.048	0.07	2	0.77
8/14/02	3.8	0.02	0.022	2	0.20
10/30/02	9				0.00
12/11/02	10.5	0.01	0.01	2	0.26
2/5/03	4	0.021	0.052	2	0.51
3/12/03	31.1				

Table D-2. Water quality data from Worm Creek near Idaho-Utah state line (from Utah Department of Environmental Quality).

Date	Flow (cfs)	Total Kjeldahl nitrogen (mg/L)	Dissolved nitrate as NO_3 (mg/L)	Dissolved nitrite as NO_2 (mg/L)	Dis-solved nitrite+ nitrate as N (mg/L)	Total ammonia as NH_3 (mg/L)	Total phosphorus (mg/L)	Dissolved phos-phorus (mg/L)	Dissolved ortho-phos-phate (mg/L)	Total suspended solids (mg/L)
9/10/92		1.380	0.123	0.180		0.023	0.472	0.136	0.101	82
9/29/92			0.310	0.010		0.008	1.015	0.284	0.253	86
10/20/92	8	1.170	1.469	0.039		0.024	0.386	0.218	0.190	49
11/10/92	8	1.070	1.724	0.029		0.06	0.700	0.553	0.055	33
12/8/92		0.980	3.713	0.021		0.237	0.641	0.633	0.626	19
1/13/93		2.396	2.367	0.039		1.054	0.624	0.560	0.543	19
2/22/93	12	3.110	3.049	0.047		0.83	0.682	0.583	0.479	43
3/22/93	23.2	2.120	5.981	0.085		0.368	0.792	0.631	0.528	214
4/6/93	19	1.370	5.507	0.073		0.584	0.583	0.411	0.342	95
4/19/93	32	1.460	3.342	0.116		0.471	0.457	0.284	0.255	76
5/3/93	36	1.860	2.774	0.206		0.248	0.463	0.140	0.106	55
5/17/93	11.8	1.670	4.575	0.150		0.285	0.478	0.293	0.265	139
6/2/93	11.6	0.750	1.046	0.040		0.09	0.200	0.123	0.110	107
6/14/93	12.6	0.630	1.023	0.043		0.07	0.086	0.086	0.075	156
7/12/93	3.6	0.880	0.886	0.059		0.106	0.352	0.155	0.137	93
8/16/93	8	0.880	0.970	0.039		0.035	0.212	0.116	0.116	64

Table D-2, continued

9/14/93	10	0.430	0.754	0.016		0.047	0.148	0.064	0.046	31
10/18/93		0.820	2.381	0.040		0.149	0.263	0.195	0.177	34
11/17/93			5.193	0.041		0.157	0.512	0.423	0.394	22
1/24/94		0.530								
1/25/94			3.987	0.025		0.065	0.046	0.043	0.024	3
2/22/94		1.440	4.111	0.055		0.018	0.458	0.349	0.308	77
3/10/94	18	1.270			4.903	0.169	0.393	0.248		26
3/22/94	16.1	0.840			4.369	0.072	0.314	0.250		48
4/7/94	8	1.670			3.395	0.142	0.716	0.259		300
4/19/94	7	1.330			2.882	<0.05 [1]	0.478	0.222		308
5/5/94	20	0.230			2.171	<0.05 [1]	0.056	0.229		113
5/18/94	8.5	0.750			1.321	<0.05 [1]	0.246	0.094		106
6/7/94	14.7	0.500			0.749	<0.05 [1]	0.208	0.099		90
7/20/94	3.2	1.110			0.522	0.061	0.393	0.189		129
8/30/94	1	1.600			0.614	0.054	0.351	0.163		119
10/12/94	3	0.670			3.651	<0.05 [1]	0.416	0.276		58
11/17/94	8	1.990			3.618	0.426	0.449	0.340		33
1/18/95	10.5	2.260			3.456	0.904	0.189	0.382		59
3/1/95	30	1.030			4.884	0.333	0.274	0.216		36
3/16/95		2.260			4.339	0.299	<0.01 [1]	0.365		184
3/28/95	20	1.240			5.974	0.303	0.311	0.222		52
4/12/95	18	1.460			4.935	0.309	0.255	0.148		25
4/25/95	8	1.700			4.790	0.342	0.243	0.151		31
5/11/95	18.5	1.460			2.730	0.313	0.379	0.153		153
5/24/95	18	1.440			3.460	0.3	0.327	0.208		50
6/6/95	35	2.000			2.600	0.25	0.470	0.200		138
6/13/97		1.177			1.630	0.325		0.239		114.7
10/28/97	20				3.890	0.303		0.035		68.8
7/16/98	3.5				0.600	0.211	0.308	0.192		62
8/19/98	3.4				0.770	0.21	0.256			50.4
9/22/98	8				1.190	<0.05 [1]	0.128			87.3
10/21/98	29				1.360	<0.05 [1]	0.232	0.056		78.4
12/8/98	6				2.225	0.0821	0.173	0.047		109.2
1/27/99	8				7.172	0.38	0.180	0.131		29.2

Table D-2, continued

2/23/99	12				6.619	0.185	0.204	0.128		51.2
4/1/99	13.7				2.700	0.531	0.306	0.165		126.7
4/21/99	10				2.850	0.37	0.157	0.058		77.2
5/5/99	65.7				2.367	0.167	0.531	0.197		323.3
5/26/99	26.3				1.604	0.211	0.191	0.043		161.3
6/9/99	49.9				1.500	<0.05 [1]	0.463	0.040		313
6/22/99	5				1.106		0.461	0.233		150.7
3/13/01					4.820	<0.05 [2]	0.593			111
8/1/01					<0.1	<0.05 [2]	0.387	0.293		25.3
10/3/01	0.1				0.260	<0.05 [2]	0.236	0.066		38
11/7/01	3.2				1.160	<0.05 [2]	0.131	0.086		30
1/16/02	3				3.620	<0.05 [2]	0.569	0.052		4.8
2/12/02					3.424	<0.05 [2]	0.405	0.371		5
3/20/02	3				4.000	<0.05 [2]	0.501	0.403		12
5/8/02					1.900	<0.05 [2]	0.160	0.180		49.3
6/26/02	1				0.250	<0.05 [2]	0.202	0.187		18
8/14/02	1.3				0.350	<0.05 [2]	0.396	0.136		16
10/30/02	2				2.860	<0.05 [2]	0.552	0.475		<4 [2]
12/11/02	15.7				2.320	<0.05 [2]	0.826	0.309		<4 [2]
2/4/03					3.700	<0.05 [2]	0.468	0.273		<4 [2]
2/5/03	2									
3/12/03	11.6				3.840	<0.05 [2]	0.461	0.282		<4 [2]
5/13/03	15.7				0.630	<0.05 [2]	0.112	0.038		<4 [2]
7/16/03	1				0.160	<0.05 [2]	0.138	0.098		<4 [2]
8/20/03	2				0.960	<0.05 [2]	0.147	0.110		<4 [2]
9/24/03	2				0.460	<0.05 [2]	0.126	0.082		41.3
10/29/03	1.5				1.896	<0.05 [2]	0.101	0.021		33.2
12/3/03	4				3.180	<0.05 [2]	0.505	0.204		70
1/14/04					4.340	<0.05 [2]	0.372	0.346		14
2/18/04					3.480	<0.05 [2]	0.226	0.204		16
3/18/04	101									

(1)minimum detection limit
(2)minimum quantifiable limit

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Appendix E: Public Participation & Comments

In addition to distribution of hard and electronic copies of the draft Bear River/Malad River Subbasin Assessment and Total Maximum Daily Load Plan, five public meetings were held in early 2005 throughout the Bear River Basin. Meetings were arranged in association with local soil and water conservation districts at Montpelier (7 March), Soda Springs (16 February), Preston (2 March), Malad (10 March), and Pocatello (9 March). Attendees with questions which could not be answered at the meetings were contacted soon thereafter with responses to their questions.

Other comments and questions to the Bear River/Malad River Subbasin Assessment and Total Maximum Daily Load Plan – January 2005 were received and our responses to those are as follows. **Questions or comments are in bold** with responses in regular font. Similar questions and comments were pooled where there was a common theme and one response given. Comments which were editorial in nature are not listed here, but the changes were made as identified.

Fish Hatcheries

There was concern about the wasteloads, both annual and seasonal, assigned to the fish hatcheries.

Annual wasteloads were recalculated based on highest observed monthly concentrations. Overall phosphorus concentrations were below target concentrations. Seasonal wasteload allocations were made in consultation with fish hatchery personnel.

Kenton Fredrickson and Eric Bastian (landowners on Jenkins Hollow)

It is a mistake to recommend Jenkins Hollow for listing on the 303(d) list.

The DEQ mandate is to examine all perennial streams in the state as to their support of beneficial uses. If the stream is not meeting those beneficial uses (coldwater aquatic life and secondary contact recreation for a non-designated stream such as Jenkins Hollow), it is to be listed on the 303(d) list.

According to the letters received from residents on the stream, the terminus for Jenkins Hollow is a small pond at the mouth of Harris Canyon. Flow is erratic with occasions when the stream runs only 1.5 miles of its 6.0 mile length. Intermittent streams and application of water quality standards to intermittent waters as defined in the state's Water Quality Standards and Wastewater Treatment Requirements are as follows.

58.01.02.003.55 Intermittent Waters. A stream, reach, or water body which has a period of zero (0) flow for at least one (1) week during most years. Where flow records are available, a stream with a 7Q2 hydrologically-based flow of less than one-tenth (0.1) cfs is considered intermittent. Streams with natural perennial pools containing significant aquatic life uses are not intermittent.

58.01.02.070.06 Application of Standards to Intermittent Waters. Numeric water quality standards only apply to intermittent waters during optimum flow periods sufficient to support the uses for which the water body is designated. For recreation, optimum flow is equal to or greater than five (5) cubic feet per second (cfs). For aquatic life uses, optimum flow is equal to or greater than one (1) cfs.

Data are not available to determine if the 7Q2 flow (lowest consecutive 7 day streamflow that is likely to occur in a two year period) is below 0.1 cfs. Idaho Department of Environmental Quality as part of its Beneficial Use Reconnaissance Program measured flow in Jenkins Hollow in July of 1998 and 2003. In 2003 flow was only 0.1 cfs at a site 130 yards downstream of the road crossing below a fenced off spring/wetland area. In 1998 flow at the 0.25 miles upstream of the Forest Service cabin was 0.5 cfs.

Based on these limited data, it appears that at least part of Jenkins Hollow is perennial and thus should be listed on the 303(d) list for non-support of coldwater aquatic life. However, this listing does not preclude the present landowners from continuing their efforts to improve water quality in the creek, which should lead to beneficial use support and removal of Jenkins Hollow from the 303(d) list.

Lincoln Conservation District

The targeted water quality criterion for phosphorus of 0.075 mg/L seems a little low especially in light of EPA's 1986 Water Quality Criteria recommendation of 0.100 mg/L.

Subsequent work by EPA published in 2000 looked at various nutrient ecoregions to develop more 'site-specific' criteria. Bear River is in the Xeric West ecoregion where the top 25% of streams studied had ranges of total phosphorus from 0.01 to 0.055 mg/L. Based on these new criteria, one could argue that a 0.075 mg/L target is too low.

The targeted water quality criterion for phosphorus of 0.075 mg/L seems low considering the phosphoria formations found throughout the Bear River Basin including upstream areas.

The Western Phosphate Field includes eastern Idaho, western Wyoming, northeastern Utah, and a band of Montana from Helena south (Jasinski et al. 2004). Much of the exposure of the formation is concentrated along the Wyoming-Idaho state line (Hein et al. 2004). In addition to Bear River, other larger streams which flow through this area include Snake River (WY-ID), Blackfoot River (ID), Portneuf River (ID), and Beaverhead River (MT). Based on USGS data downloaded from the web (USGS website), average total phosphorus concentrations in these streams are as follows:

Stream	Site	Period of record	Number of sampling events	Mean	Standard deviation	Median
Snake R	nr Shelley	1990-2004	61	0.027	0.0107	0.025
Blackfoot R	nr Blackfoot	1989-2004	82	0.055	0.0622	0.04
Portneuf R	at Pocatello	1990-2003	42	0.074	0.0597	0.052
Beaverhead R	nr Twin Bridges	1999-2003	19	0.057	0.0659	0.041

Although not as extensive as the databases used for the Bear River TMDL, USGS was chosen as a data source as it is a consistent source of data for examination of interstate comparisons.

We also looked at USGS data available for Bear River at the Idaho-Wyoming border and below Smiths Fork. Data, which are presented in the table below, include all data in the database and recent data. We arbitrarily considered data from 1989 onward as 'recent' data. This decision is based on implementation of the Conservation Reserve Program in the mid-1980's, after which, it is believed, water quality improved substantially.

Parameter	Period of record	Average	Count	Std Dev	Maximum	Minimum	Median
Bear River at ID-WY border							
Suspended sediment (mg/L)	1978-2001	150	113	309.1	3010	6	76
	1989-2001	84	29	57.2	235	6	71
	1998-2001	39	2	31.8	61	16	39
Phosphorus, unfiltered (mg/L)	1973-2001	0.118	186	0.2469	2.400	0.000	0.040
	1989-2001	0.075	27	0.1178	0.570	0.005	0.040
	1998-2001	0.026	2	0.0085	0.032	0.020	0.026
Orthophosphate, filtered (mg/L as P)	1971-2001	0.02	73	0.055	0.46	0.00	0.01
	1989-2001	0.028	27	0.0868	0.460	0.005	0.005
	1998-2001	0.010	2	0.0000	0.010	0.010	0.010
Bear River below Smiths Fork							
Suspended sediment (mg/L)	1998-2004	53	56	47.8	252	0	40.5
	1998-2001	65	36	53.0	252	0	50.5
Phosphorus, unfiltered (mg/L)	1998-2004	0.058	57	0.0640	0.280	0.005	0.033
	1998-2001	0.071	36	0.0733	0.280	0.005	0.037
Orthophosphate, filtered (mg/L as P)	1998-2004	0.009	57	0.0080	0.060	0.003	0.010
	1998-2001	0.010	36	0.0096	0.060	0.005	0.008

Recent data indicate that overall average of total phosphorus (TP) at the border meets the 0.075 mg/L target concentration. Even of more interest is that average TP at Bear River below Smiths Fork is only 0.058 mg/L. Thus, it would appear that there is a substantial increase in phosphorus between Smiths Fork and the border.

Loading of phosphorus into streams from phosphoria rock can occur in two ways – weatherization of rock or solubility in water. Based on conversations within the DEQ/Pocatello office, phosphorus within the phosphoria rock formation is relatively insoluble. Berner and Berner (1987) note that ". . . phosphorus in rocks and sediments is in a relatively insoluble form as the calcium phosphate mineral, apatite. Even when released as soluble phosphate (PO4---) by weathering, phosphorus is usually quickly tied up in the soil as iron, aluminum, and calcium phosphates or by clay minerals to produce insoluble forms not accessible to plants."

Weatherization within the phosphate field might be the greater source of phosphorus. Regression analyses of data since 1989 were run between sediment and phosphorus at both the below Smiths Fork and border sites, R^2 values (Smiths Fork = 0.63, border = 0.16) showed a much greater relationship at Smiths Fork indicating that much of the phosphorus measured at the border by USGS was not necessarily associated with sediment. Thus, although weatherization of phosphoria rock may contribute to some of the loading of phosphorus at the border, it appears that there are other sources as well. Additionally, although phosphorus may be associated with sediment naturally, human activities that result in greater sediment loads would unnaturally increase phosphorus into the system even when the sediment has 'naturally' higher levels of phosphorus.

We feel that the data used to set the phosphorus TMDL standard was too small of a representative sample.

From Appendix A in the TMDL, data for total phosphorus in Bear River at the ID-WY border are as follows.

Hydrologic period	at ID-WY border (BR01)		above confluence with Thomas Fork (BR01A)	
	Number of sampling events	Avg total phosphorus (mg/L)	Number of sampling events	Avg total phosphorus (mg/L)
Winter base flow (WBF)	66	0.095	3	0.020
Lower basin runoff (LBR)	46	0.199	4	0.685
Upper basin runoff (UBR)	70	0.179	11	0.154
Summer base flow (SBF)	65	0.107	6	0.092

Additional data are always nice to have, but we feel that almost 250 sampling events are adequate to estimate the phosphorus loads.

There appear to be errors between stations as phosphorus loading changes could not be explained by distance alone. The length of move was quite short when the station was relocated downstream and phosphorus loading was not the same.

We assume that the downstream site to which the questions refers is BR01A, Bear River above the Thomas Fork confluence. The number of sampling events differed drastically between the two sites, 247 vs 24 (see table above): it would not be unexpected to see distinctly different phosphorus levels which would naturally lead to differential loadings. Besides load allocations were in the loading analysis were calculated only for BR01 and BR08 (Tables 3-19 to 3-22, January 2005 draft).

The marsh which intercepts Bear River water entering Bear Lake plays a big role in reducing the amount of phosphorus that enters the lake, and therefore the target concentration of 0.05 mg/L at Stewart Dam may be too low.

This is correct. The data indicate that the marsh, Mud Lake, plays a big role in reducing phosphorus loading into the lake. EPA (1986) Water Quality Criteria recommend that phosphorus should not exceed 0.05 mg/L in any stream at the point where it enters any lake or reservoir. Total phosphorus concentrations at the Causeway site by hydrologic period are all above the recommended 0.05 mg/L criterion, averaging 0.053 mg/L during WBF, 0.063 mg/L during LBR, 0.062 mg/L during UBR, and 0.056 mg/L during SBF. Except for WBF, phosphorus concentrations at Stewart dam for the hydrologic periods are substantially greater than concentrations measured at the Causeway. Thus, to help maintain water quality in Bear Lake, it makes sense to reduce Causeway concentrations to less than 0.05 mg/L threshold by reducing concentrations at Stewart Dam. Should concentrations at Causeway consistently meet the 0.05 mg/L criterion prior to concentrations at Stewart Dam meeting the same target, the 0.05 mg/L criterion at Stewart Dam can be revisited.

The 'generic' sediment targets do not take into consideration a stream's classification and type. Such all encompassing targets do not allow for streams that are currently reforming due to a degradation event which has resulted in flows with higher sediment nor does it account for the fact that all streams naturally erode. Some type of stream classification (e.g., Rosgen) needs to be done before setting a TMDL for the stream.

We agree. Unfortunately, we did not have the time, staff, or money to adequately characterize Bear River and all its tributaries. Conversely, we have seen no data to indicate that the proposed sediment targets are unreasonable for Bear River Basin streams. In fact, many of these streams, albeit based on limited data, currently meet the proposed criteria as evidence by zero reduction needed to attain their sediment load allocation (see Table 1-3, January 2005 draft).

PacifiCorp

PacifiCorp voiced concern about TMDL targets for sediment and phosphorus placing unreasonable restrictions on Cove decommissioning.

The TMDL targets for sediment and phosphorus for the Bear River are estimated loads which should be met to restore beneficial uses. DEQ along with the majority of Settlement Agreement partners have agreed that decommissioning of the Cove Hydro facility will provide a net benefit to water quality and riverine ecology in this reach of Bear River. DEQ has provided draft 401 water quality certification conditions to PacifiCorp whereby it is felt that should PacifiCorp comply with these conditions during decommissioning, water quality standards will not be violated and short-term increases in sediment and phosphorus will be heavily outweighed by the long-term benefits of a free-flowing, re-watered river reach.

Wyoming Department of Environmental Quality

The TMDL is not very clear on what and how much data were used in the TMDL analyses.

Information used to estimate current loads and establish load allocations included both historical and synoptic data as follows.

- BR01 – 1973-1993
- BR03 – 1975-1998
- CSWY/LFT – 1974-1998
- LFT-OUT – 1975-1998
- BL03 – 1978-1998
- BR08 – 1975-2000
- BR09 – 1994-1996
- BR15 – 1994-2000
- BR16 – 1994-1996
- BR17 – 1971-2000

Data used in the load analyses for most tributaries were collected during the synoptic sampling (1999-2000). Maple Creek bacteria load allocation was based on USGS historic flows from 1946 to 1952. Cub River loading analyses used USGS data for flow from 1962 to 1963 and 1998 to 2000, and water quality from 1998 to 2001. Worm Creek loads were generated from data collected by the Preston wastewater treatment plant from 2000 to 2003. Generally, only data from Discharge Monitoring Reports since 2000 were used for wasteload allocations from point sources.

Existing water quality data on Bear River at the ID-WY border and on Thomas Fork appear limited.

We agree that data on Thomas Fork were limited and the loading analysis for the waterbody would profit from more years of data. Water quality targets can be revisited should more data become available.

We do not agree that data at the ID-WY border were limited. Please see the Lincoln Conservation District section.

Possible lack of sufficient data is demonstrated on Bear River where data sets at BR01 and BR01A exhibit some significant differences in constituent concentrations when their close proximity would suggest otherwise.

Please see our response in the Lincoln Conservation District section.

The State of Wyoming would like to be directly involved in any amendment or modification of the TMDL, and is willing to share its data to help formulate a more accurate TMDL for both Bear River and Thomas Fork.

Although the State of Idaho would have preferred to work with Wyoming at the start of this TMDL, we welcome Wyoming's offer on future TMDL efforts for Bear River and Thomas Fork.

A high flow target 33% greater than the low flow target for sediment may not reflect typical natural conditions where TSS concentrations at higher flows may be many times greater than those observed at low flow.

This is possibly true. We have not seen data for natural background levels, and, unfortunately, know of no 'reference' stream to which we can compare Bear River. The literature is limited in terms of fisheries support and suspended sediment. The EIFAC (1964) report stated that a good fishery can be maintained at concentrations less than 80 mg/L. Additionally, load allocations are based on a hydrologic period, a time span which should help 'level' out perturbations.

Total phosphorus endpoints may not reflect naturally higher phosphorus due to alluvium and colluvium developed in phosphorus-rich geology.

Please see our response in the Lincoln Conservation District section.

Total suspended solids endpoints are picked from what is purported to be protective of Bonneville cutthroat trout, yet primary natural spawning areas were most likely in the tributaries. TSS endpoints that ensure pool quality and frequency for cutthroat over-wintering may be more appropriate on the mainstem.

TSS endpoints are based primarily on fish with the assumption that such endpoints would also lead to support of coldwater aquatic life beneficial uses. DEQ's limited BURP monitoring showed that coldwater aquatic life was not supported at three Bear River sites (see Table 2-26, January 2005 draft). That said, it is an excellent suggestion for future TMDLs to look closely at establishing endpoints for over-wintering pool quality and frequency.

Wyoming encourages Idaho to continue to collect and analyze data gathered through this TMDL process to revise the TMDL as needed.

Idaho will to the extent possible, continue to collect data for future revision of the Bear River TMDL. As mentioned earlier, we look forward to working with Wyoming on such work.

Utah Department of Environmental Quality

Figures 2-6 through 2-8 would benefit from the addition of political or geographic labels and place/formation names.

We have added additional maps in Section 1 which should help the reader orient to the Basin. We have not added anything to the figures in question because of concern for map clutter and amount of time required to redo the maps to show the intended message while including political or geographic labels and place/formation names.

Addition of a map of hydropower facilities and mainstem and tributary impoundments and dams would be helpful to the reader.

Maps have been added to the document that show some of the impoundments, i.e., the major reservoirs discussed in the plan. Other reservoirs that do figure prominently in the TMDL are not presented due to time constrains.

Figures 2-14 and 2-15 would benefit from the addition of political or geographic labels and place/formation names.

We have added additional maps in Section 1 which should help the reader orient to the Basin. We have not added anything to the figures in question because of concern for map clutter and amount of time required to redo the maps to show the intended message while including political or geographic labels and place/formation names.

Is the mainstem Bear River monitoring site at Stewart Dam above or below the dam? Does the impoundment affect total suspended solids or phosphorus?

Stewart Dam is not a dam but a diversion that routes Bear River water through a gate into the Rainbow Canal. Water is not impounded at Stewart Dam.

What are the retention times for the reservoirs within the system? Are the seasonal retention times long enough to support the conclusion that there should be no allowance for seasonal nutrient loading?

Average retention times in Alexander and Oneida reservoirs from 1997 to 2004 were 7.5 and 5 days, respectively (Connely Baldwin, PacifiCorp, personal communication). These short retention times mean these reservoirs are more river-like than lake-like. Regardless, a comparison of suspended solids and phosphorus entering the reservoirs versus what is leaving the reservoirs, leaves no doubt that these waterbodies act as sinks for both pollutants. Therefore, we conservatively assigned a lower suspended solids and phosphorus targets to be observed throughout the year rather than on any seasonal basis.

Figure 2-16 would benefit from the addition of political or geographic labels and place/formation names.

We have added additional maps in Section 1 which should help the reader orient to the Basin. We have not added anything to the figure in question because of concern for map clutter.

Tables 2-1 through 2-6. A map of named tributaries as specified in Tables 2-1 through 2-6 inserted near Table 2-1 would be helpful in establishing a spatial and locational reference for the tributary specific information provided.

Please refer to Figure 2-16 and Figures 1-2 through 1-8.

A map of the tributary monitoring stations inserted near Table 2-1 would be helpful in establishing a spatial and locational reference for the information provided specific to tributary monitoring sites.

Please refer to Figure 2-16 and Figures 1-2 through 1-8.

A map of the mainstem monitoring stations inserted near Table 2-7 would be helpful in establishing a spatial and locational reference for the information provided specific to mainstem monitoring sites.

Please refer to Figure 2-16 and Figures 1-2 through 1-8.

Page 51 Hydrologic Resources Paragraph 4 (from header) and Tables 2-11 and 2-12. Addition of a map of hydropower facilities and mainstem and tributary impoundments and dams would be helpful to the reader.

Please refer to Figures 1-2 through 1-8.

Data curves in Figure 2-10 are distinguishable as distinct but are difficult to identify based on the lines in the key for ID-UT and WY-ID in a black and white print out. The lines in the key look very similar to one another.

The lower of the two lines (on the Y-axis) is for the WY-ID border site. This site is higher up in the watershed and represents less discharge than the ID-UT site.

Figures 2-14 and 2-15 would benefit from the addition of political or geographic labels and place/formation names.

Please refer to Figure 1-2.

Figure 2-16 would benefit from the addition of political or geographic labels and place/formation names.

Please refer to Figure 1-2.

Figures 2-17 through 2-34 list BR17A as a monitoring site. No location information for this site was found in any of the preceding tables. Location information (or reference to such) for this site would be helpful to the reader.

Bear River site 17A is the same as Bear River site 18 (Idaho/Utah border).

Figures 2-18 through 2-21. The addition of target or standard values to these plots would be helpful for comparison purposes.

We agree. However, to keep the graphs less busy we have opted to refer the reader to Table 1-2 (water quality targets) and Table 2-19 (water quality standards) for comparison purposes.

Page 144 Watershed Classification and Statistical Analysis Paragraph 2 (from header). The software package and/or mechanism used to complete the statistical analyses should be identified.

We refer the reader to the following reference. White Horse Associates. 2000. Ecological Classification. Bear River Basin, Idaho. Report to IDHW, Division of Environmental Quality, Pocatello, Idaho.

Page 145 Paragraph 1 (from top). A description of the criteria used to determine significance here and in the following paragraphs should be included. A description of any assumptions made or data interpolated for areas where data were incomplete should also be added.

The significance level for the regression analyses was set at 5% (i.e., α=0.05). Thus, any multiple regression analysis with a *p*-value less than 0.05 was considered significant. Classification data were complete. Some sites lacked a full contingent of sampling events, which was reflected in the analysis by a reduced N (number of samples). For more information about the assumptions in regard to the classification system, please see White Horse Associates. 2000. Ecological Classification. Bear River Basin, Idaho. Report to IDHW, Division of Environmental Quality, Pocatello, Idaho.

Tables 2-32 through 2-39 and pages 149 and 157. Is there some reasoning that could be offered as to why the predictive ability of this approach is consistently lower on tributary summer baseflows than on tributary UBR, WBF, or LBR as observed for most parameters in Tables 2-32, and 2-34 through 2-36? This phenomenon is very consistent for tributary TP and only slightly less consistent for tributary TSS but is not observed in the mainstem analyses.

Our best guess is that tributary summer base flow is highly altered (particularly in the lower reaches) by irrigation withdrawals which may significantly change water quality in relation to sediment and phosphorus transport.

Tables 2-32 through 2-42 and pages 149 and 157. Is there some information that could be added to explain the observed differences in predictive capability between the first summer baseflow monitoring set and the second (#1 vs. #5)?

It is likely that the summer base flow event in October 1999 differed somewhat from the June 2000 event. The June 2000 event may be somewhat anomalous in that in average water years this would be an upper basin runoff period and the watershed would be experiencing much different flow conditions than would be predicted.

Page 149 Paragraph 2 (from top) and Page 157 Paragraph 1 (from top). Identification is made of "best predictors" but no possible explanation is advanced to support the relative level of identification. If available, supporting information or conclusions as to why the identified "best predictors" have emerged would be helpful to the reader.

The goal of the analysis was to see if readily available watershed-level data could be used to help predict pollutant loading data collected on tributary and mainstem sites. The analysis was limited to the classification system, which included broad classes (e.g., ecoregion, geologic district) and more refined classes (e.g., valley bottom type and land uses). Data which allow categorization of watersheds by these classes are available via geographic information system software. Multiple regression analysis was used to determine which classes best predict pollutant loading with the idea that the greater the relationship (i.e., higher r^2), the better predictor that suite of classes would be in such predictions.

Figures 3-3, 3-5, 3-8 and 3-10. It is difficult to determine whether measured values are at or very near the zero value in these plots or if measured data were not available for some stations. A change in scale would be helpful if possible.

It is our intent to primarily show the magnitude of differences in these graphs. We feel this displays the data in an informative manner.

Figures 3-21 through 3-48. The relative mass loading of total phosphorus to total suspended solids changes quite dramatically from above Bear Lake to the mainstem sites below Bear Lake, and is generally consistent downstream of the Lake. Is there some explanation that could be included as to why this change occurs? Is there dissolved phosphorus data available that may help to explain this transition? This information has the potential to be critical in the identification of best management practices to effectively control or reduce phosphorus loading in and to the mainstem Bear River as part of the implementation of this TMDL.

An examination of the data most likely indicates there is not a very strong predictive relationship between TSS/total phosphorus and orthophosphorus, particularly below Bear Lake. This indicates to us that from Bear Lake outlet canal downstream through Alexander and Oneida to the Idaho/Utah border sediment-borne phosphorus may not tell the entire story. It is likely that control of dissolved phosphorus, which is derived from industrial sources, fertilizers or animal wastes, may be key to reducing phosphorus loading in the watershed.

Table 4-1. Identification of the source of the information provided in this table would be helpful. The endnotes did not carry through the pdf version.

This has been corrected and the endnotes added.

Tables 4-3 through 4-6. It is not clear how the percent reductions (or range of percent reductions) for the remedies identified in Table 4-1 were applied to determine the estimated reductions identified in Tables 4-3 through 4-6. Additional detail on this process and the assumptions made would be helpful to the reader.

Percent reductions for the practices shown in Table 4-1 are taken from the references cited in that table. We refer the reader to those references for process and assumptions that go with those respective practices.

Table 3-31. A wide range of total phosphorus reductions (~85% to 0.5%) is identified for the tributaries listed in this table. In the course of this research, was there any correlation between relative percent reductions required and the characteristics of the watershed (type or level of land use, geology, slope, hydrology, etc) identified that could be summarized here? This information may be helpful during the implementation phase of this TMDL in identifying management practices best suited to achieving the necessary total phosphorus reductions.

Yes, good relationships were shown between certain watershed characteristics and sediment and nutrient contributions (please refer to Watershed Classification and Statistical Analysis in Section 2.3). Overall, valley bottom type and specific land use were the best predictors of watershed contributions of suspended solids, phosphorus, and nitrogen.

Franklin County Soil & Water Conservation District

Did the non-listed streams (i.e., Smith, Alder, Burton creeks) support their beneficial uses? If so, then why were load allocations developed for these streams?

Six streams which support their beneficial uses based on evaluation by the Beneficial Use Reconnaissance Program were assigned phosphorus or suspended solids loads because of potential impact on Bear River, the receiving water body. These six creeks included: Sheep, Skinner, Smith, Alder, Burton, and Mink. Sheep and Mink creeks were assigned load allocations that correspond to current estimated loads, i.e., to meet recommended loads no load reductions are required. Limited data from the other four streams showed average concentrations of either phosphorus or suspended solids, or both, exceeded recommended targets for Bear River. To be in compliance with recent legislation and consistent with recommendations for Sheep and Mink creeks, load allocations for Skinner, Smith, Alder and Burton creeks were changed to current estimated loads with the assumption that current loads at least allow for support of beneficial uses within the tributaries themselves.

If nuisance vegetation is a problem in the subbasin and the subbasin assessment states that TP concentrations often exceed DEQ's target, then why is 4 mg/L used as a threshold for detecting exceedances of nitrogen? Restricting nitrogen levels on Bear River and tributaries would help minimize nuisance aquatic vegetation.

The 4 mg/L threshold used to express exceedances of nitrogen (i.e., ammonia and nitrate) corresponds to the State of Utah's pollution indicator level for nitrate (State of Utah website). In Utah, when a pollution indicator level is exceeded, an investigation is conducted. This allows for a direct comparison to conditions of Bear River in Utah. We agree that based on other information (e.g., EPA ambient water quality criteria [EPA 2000]), 4 mg/L is too high to recommend as a target concentration which is why we recommended a 0.85 mg/L target concentration for total nitrogen in Thomas Fork.

Our rudimentary analysis of the ratio of nitrogen to phosphorus points to phosphorus as the limiting nutrient in Bear River with the possible exception of the upper river reach in the vicinity of Thomas Fork. Information also indicates that high levels of nitrogen in Thomas Fork contribute to aquatic macrophyte growth in the stream. Therefore, we felt that controlling nitrogen input in Thomas Fork would benefit both the Thomas Fork itself and this upper reach of Bear River.

At this point we feel that restricting nitrogen loading in Thomas Fork is sufficient to improving water quality in Bear River. If future monitoring indicates it is not, then we will consider expanding the nitrogen target concentration to more waterbodies.

Will data be collected for all point sources in the future so that it is not necessary to extrapolate nutrient wasteloads (e.g., wasteloads estimated from wastewater treatment plants)?

Yes, we expect new NDPES permits for the wastewater treatment plant facilities to include requirements for ambient monitoring of the waterbody receiving the WWTP discharge.

There is a concern that only five data points were used to evaluate water quality and to calculate loads for the tributaries. Are there plans to continue monitoring all of the tributaries to have a more reliable database with which to work?

We wish we would have had more information for those tributaries where only data from only five sampling events were available. Some monitoring of these streams will be done by the Idaho Association of Conservation Districts. At this time, DEQ has neither the money nor time to adequately monitor Bear River tributaries on a regular basis.

No mention is made of the possible impact of mining on water quality in Bear River.

During the preparation of the TMDL, no information was noted that indicated possible contributions of pollutants attributable to mining. However, as the potential certainly exists for contribution of sediment and/or nutrients to Bear River waterbodies, additional language was added to reflect the possibility of mining impacts.

Will Stockton Creek be added to the 303(d) list?

Yes, it will be recommended for future listing along with other streams with bacteria levels that exceeded state water quality standards. Those streams will be identified in the TMDL.

There is an overall lack of information pertaining to the Malad River subbasin. A table of percent exceedance of state water quality criteria information for Bear River tributaries was presented, but a similar table for Malad River subbasin water bodies was not. We recommend adding an additional management reach specific to HUC 16010204.

Data for water bodies in the Malad River subbasin were not as plentiful as for the Bear River mainstem and tributaries. Most of the information for Malad River and tributaries was collected as part of the TMDL effort. A table of state water quality criteria exceedances for Malad River subbasin water bodies was added to the plan. The Bear River lends itself to designation of management reaches because of the significant impact of the lake and two reservoirs have on the system. We do not feel there is anything to gain by designating the Malad River as a management reach.

The discrepancy in TP and TSS targets above and below reservoirs and at the Utah state line seems impractical. For example, how can you expect phosphorus to decline from 0.075 to 0.05 mg/L from below Oneida Reservoir to the state line when you are allowing tributaries to exceed the 0.05 mg/L target?

This may be true. However, at this point we are willing to try separate targets based on the type of receiving water (lake or reservoir vs river). Should future monitoring indicate we are not meeting beneficial uses, we will consider a consistent target concentration for all Bear River Basin water bodies, most likely at the lower concentrations recommended in this plan.

Why single out Maple Creek for *E. coli*? If there was a problem, why wasn't anyone contacted earlier? Were other streams sampled for *E. coli* and if so, where are their data?

Maple Creek was the only stream on the 303(d) list with bacteria identified as a problem, which is why it was the only water body for which a load allocation for bacteria was recommended. It was our understanding that bacteria problems in Maple Creek were known prior to undertaking the TMDL. Maple Creek was added to the 1998 303(d) list for bacteria. Many other streams in the Bear River Basin have been sampled for bacteria. These data are housed at the Pocatello DEQ office and are available upon request. See the assessment of BURP data table in the TMDL for a list of those monitored streams. As mentioned earlier in regards to the question of bacteria in Stockton Creek, streams which showed levels of *E. coli* above state water quality standards will be recommended for inclusion on future 303(d) lists.

Why do some streams (e.g., Cottonwood Creek) that meet their load allocations not support their beneficial uses?

Let's look at Cottonwood Creek, which is listed as having sediment problems. Sites in both upper and lower Cottonwood Creek have been evaluated with the BURP protocol, although the lower sites probably need to be revisited as the sampling was done in 1995. So, why might a stream that does not support its beneficial uses 'meet' its load allocation?

- Data used to estimate sediment load in Cottonwood Creek were limited (i.e., five sampling events). Maybe the five sampling events did not adequately characterize sediment load in Cottonwood Creek and additional sampling would show this.
- Data used to estimate current sediment load in Cottonwood Creek were collected near its confluence with Bear River. Conditions at the lower end of the creek may not reflect conditions further upstream.
- There might be other factors which are affecting beneficial uses. In such cases where those factors are known, the 303(d) list should reflect this new knowledge.
- Sediment target concentrations may be set too high such that Cottonwood Creek is meeting its load allocation, but not supporting its beneficial uses.
- Historic activities have contributed to high levels of sediment in the stream substrate, which could result in non-support of beneficial uses. As these activities have ceased, current water column sampling in the

creek would not show the high levels of sediment which contributed to the high deposition on the streambed.

Have Utah and Wyoming been made aware of targets set by Idaho DEQ?

Yes, both Utah and Wyoming were provided copies of the TMDL, and both states have commented.

Are there differences in beneficial uses at state lines?

Utah use designations for water bodies in the Bear River Basin (State of Utah website) are as follows.

Bear River and tributaries are protected for

- Secondary contact recreation,
- Warmwater species of game fish and other warmwater aquatic life,
- Waterfowl, shore birds and other water-oriented wildlife, and
- Agricultural uses including irrigation of crops and stock watering.

Malad River and tributaries are protected for

- Secondary contact recreation and
- Nongame fish and other aquatic life.

Cub River and tributaries are protected for

- Secondary contact recreation,
- Warmwater species of game fish and other warmwater aquatic life, and
- Agricultural uses including irrigation of crops and stock watering.

Wyoming use designations for water bodies in the Bear River Basin (State of Wyoming website) are as follows.

Bear River and Thomas Fork are protected for

- Drinking water supply,
- Coldwater game fisheries,
- Non-game fisheries,
- Fish consumption,
- Aquatic life (other than fish),
- Primary contact recreation,
- Wildlife,
- Agriculture uses,
- Industry uses, and
- Scenic value.

Why don't we see a significant relationship between TP and TSS? TP levels in Bear River are high relative to TSS levels, which is different than in the rest of the state.

We did see significant relationships between TP and TSS near the Idaho-Wyoming state line (R^2=0.49, n=118, p<0.001) and at Stewart Dam (R^2=0.64, n=115, p<0.001). These data were compared with suspended sediment (SSC) and TP data collected at USGS gage sites in the Portneuf River Subbasin since 1989. Similar significant relationships were found for SSC and TP at the Portneuf River gage at Topaz (R^2=0.62, n=57, p<0.001 with one data point [23 April 1998] considered an anomaly and not used in the analysis) and the Marsh Creek gage (R^2=0.52, n=30, p<0.001).

We don't know if TP levels in Bear River are high relative to TSS levels as compared to the rest of the state. Again, comparing the Bear and Portneuf rivers, formulas to calculate TP based on TSS (or SSC) concentration are as follows.

- Bear River - state line to Stewart Dam reach, TP=(0.0011*SSC)+0.0913
- Bear River at Stewart Dam, TP=(0.0010*SSC)+0.0549

- Portneuf River at Topaz gage, TP=(0.0005*SSC)+0.0157
- Marsh Creek, TP=(0.0002*SSC)+0.0558

Using a value of 25 mg/L of TSS/SSC would yield the following concentration of TP based on the above equations.

- Bear River - state line to Stewart Dam reach, TP=0.120
- Bear River at Stewart Dam, TP=0.079
- Portneuf River at Topaz gage, TP=0.028
- Marsh Creek, TP=0.062

It appears that TP levels in Bear River are high relative to TSS levels as compared to Portneuf River indicating that phosphorus in Bear River is more closely associated (adsorbed) with sediment than in the Portneuf River.

Amy Jenkins, Idaho Association of Soil Conservation Districts (also participating - Caribou Soil Conservation District, Franklin Soil and Water Conservation District (SWCD), Oneida SWCD, Bear Lake SWCD, Portneuf SWCD, and Idaho Soil Conservation Commission)

NOTE: many of the questions from Ms. Jenkins were similar to those submitted individually by the Franklin Soil and Water Conservation District and will not be repeated here.

Is DEQ investigating other habitat characteristics in streams like Cottonwood Creek that meet their load allocations, but do not support their beneficial uses to determine why beneficial uses are not supported in these streams?

No, due to time and money constraints, DEQ is not looking at why these streams that appear to be meeting their load allocations are not supporting their beneficial uses. As time and money allow, DEQ will consider additional sampling (e.g., increase sampling events, increase number of sites sampled, sample streambed subsurface sediment via core sampling) of Bear River tributaries, such as Cottonwood Creek, to identify stream characteristics which limit beneficial use support.

How do differences in beneficial uses at state lines influence water quality targets in the different states?

Beneficial uses in Wyoming and Idaho for Bear River and Thomas Fork are similar. For example, both states consider the waterbodies as supporting coldwater communities. Primary contact recreation is designated as a beneficial use in Bear River and Thomas Fork by both states. Wyoming also designates domestic water supply as a beneficial use for both waterbodies. Thus, in general, one could surmise that Wyoming is more protective of Bear River and Thomas Fork than Idaho.

The opposite is true for Idaho and Utah. Idaho designates coldwater aquatic life as a beneficial use for Bear, Cub, and Malad rivers. Utah designates both Bear and Cub rivers as supportive of warmwater aquatic life and warmwater gamefish with Malad River only designated for nongame fish and other aquatic life. Idaho is more protective of Bear River waterbodies in that the water quality (e.g., water temperature, dissolved oxygen) needed to support coldwater aquatic life is more restrictive than warmwater.

Regardless, all (coldwater, warmwater, and other designated) aquatic communities require similar levels of certain parameters. Thus, meeting either Idaho or Utah water quality criteria for TSS and TP at the border should result in support of beneficial uses in both states.

Excess TP is a chronic problem in Bear River Basin.

We agree which is why the TMDL proposes load and wasteload allocations for total phosphorus.

Could the high TP concentrations observed in the Bear River Basin be the result of natural phosphate deposits? If so, has DEQ taken into account the naturally occurring phosphorus levels when developing their TMDLs?

Please see our response in the Lincoln Conservation District section.

Environmental Protection Agency

An adequate analysis of current sources is lacking, leaving the reader to infer how and where actual load reductions would occur.

We assume that current sources are sources presently contributing to pollutant loads in Bear River Basin. Certainly more work (i.e., monitoring and data collection) needs to be done in this area, but we feel, to the extent possible, that we have acknowledged possible pollutant sources in the Idaho portion of Bear River. It was mentioned that substantial loads of both sediment and phosphorus in mainstem Bear River originate from out-of-state. Point sources contribute nutrients to Bear River and tributaries. Although specific sources have not been identified, monitoring has indicated which tributaries contribute pollutant loads to the mainstem rivers. Additionally, general sources in the Basin responsible for increased nutrient and sediment loading have been shown through regression analysis of watershed characteristics used to predict such contributions to include both valley bottom type and specific land use.

Load reductions are expected to occur at both mainstem and tributary compliance points. Monitoring points for documenting load reductions have been proposed at nine sites on the mainstem, including sites just upstream of lentic (lake/reservoir) water bodies and in river reaches. Tributary monitoring points are generally considered to be near the mouth of the stream.

The margin of safety is described as being inherent. A better word would be implicit. The MOS discussion should include more detail as to the nature of the implicit margin of safety, and why they are conservative. More details regarding explicit margins of safety should also be given.

Inherent will be changed to implicit in the document. We feel that we have adequately made our case as to why the targets chosen include a margin of safety. Recommended targets for suspended solids (i.e., 35, 60, or 80 mg/L) all fall within values of 25-80 mg/L recommended by the European Inland Fisheries Advisory Commission (EIFAC 1964) for maintaining good to moderate fisheries with the 80 mg/L target only applying during runoff, when higher suspended solids concentrations would naturally be expected. The target of 0.85 mg/L for total nitrogen is 6% less than the upper limit (0.9 mg/L) of the lower 25th percentile range for all streams examined by EPA (2000) as part of their Ambient Water Quality Criteria Recommendations, Rivers and Streams in Nutrient Ecoregion III (Xeric West). The type of receiving water determines the phosphorus targets: 0.05 mg/L when receiving waters are lakes or reservoirs and 0.075 mg/L when the receiving waters are streams. The higher target is 25% less than what was recommended in the EPA (1986) "Gold Book." Although 0.05 mg/L target is the same as recommended in the "Gold Book," it should be pointed out that no Bear River Basin lake (i.e., Bear) or reservoir (i.e., Alexander and Oneida) are on the 303(d) list for nutrients. We do acknowledge that the 0.75 mg/L target for total phosphorus is outside the range (0.01-0.055 mg/L) identified by Ambient Criteria study, but we also understand that these targets can change as monitoring data indicate support, or lack of support of beneficial uses.

EPA review of delisting recommendations will be made under a separate EPA evaluation and approval process.

DEQ understands that formal listing/delisting actions will be undertaken as part of the review and approval of Idaho's 303(d)/305(b) Integrated Report.

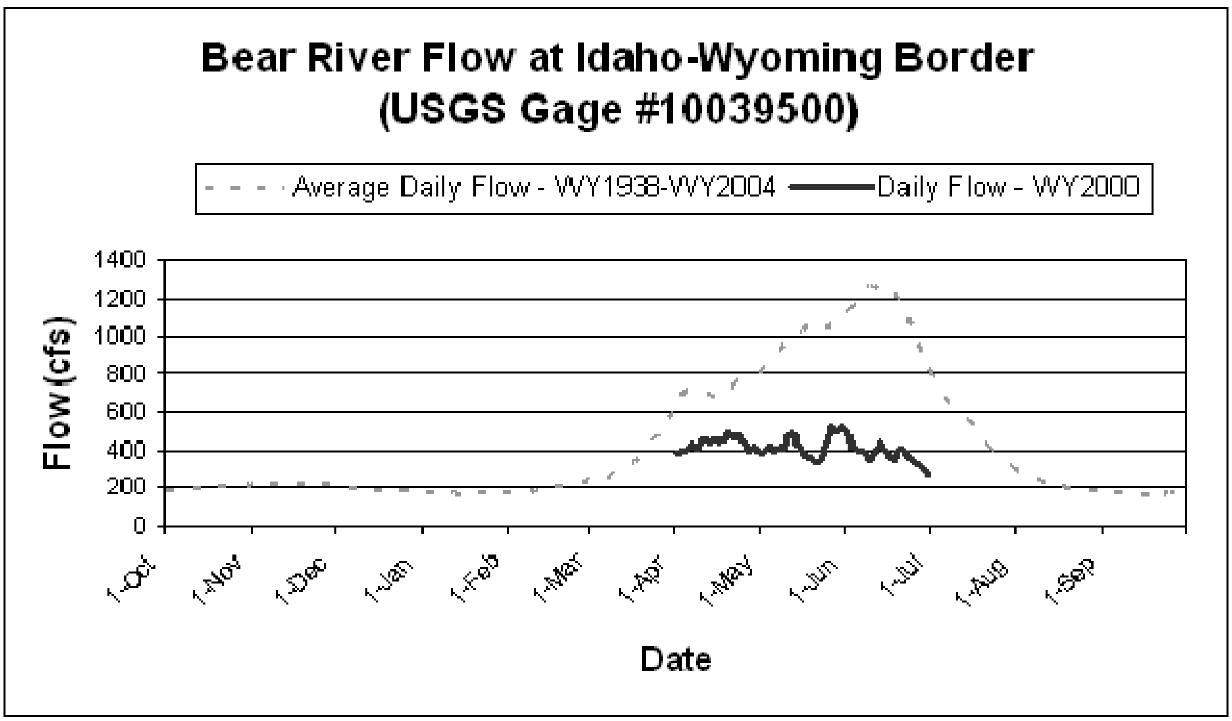
It would be helpful if a more detailed source analysis were presented. It is unclear from the document and analysis presented what the sources of the pollutants are and their relative contributions to each segment. Sediment sources such as bank instability, agricultural runoff, and resuspension should each be evaluated as well as nutrient sources such as CAFO's, septic systems, agricultural runoff and aquaculture. Unless

potential sources are identified, it may be difficult for landowners in the watershed to understand where needed reductions will come from and to whom specific load and wasteload allocations will be assigned.

We agree that identification of specific sources would be the ideal. However, our approach has been to identify those point and non-point source gross pollutants loads by river/tributary reach. It is our thought that identification of specific sources will be narrowed down during the implementation planning process with the help from our designated management agency partners who are intimate with the stakeholders and their needs. At this juncture, problem areas as identified by gross load allocations with needed pollutant reductions will help our implementation partners prioritize needed improvements.

The Executive Summary defines summer baseflow as August to October while June is considered upper basin runoff but Table 3-3 presents a summer base flow for both October 1999 and June 2000.

An examination of the long-term hydrograph (see figure presented below) for the Bear River at the Idaho-Wyoming border would indicate that June typically represents the time period when the watershed is experiencing upper basin runoff. For purposes of the load analysis and utilizing data that were available to us the synoptic monitoring event undertaken in June 2000 was considered a summer base flow period based on the drought condition and lack of runoff for water year 2000 (see graph below). This June 2000 monitoring event is considered throughout the TMDL analysis as a summer base flow event.



Presenting reductions in terms of % annual or seasonal reductions required to meet the targets would be useful for the implementing agencies. As presented, Tables 3-19 to 3-22 are confusing and the use of negative values lead to the impression that load capacity exists.

We have added a column in the referenced tables to include percent reductions in each management reach.

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