LOWER BEAR RIVER WATER QUALITY MANAGEMENT PLAN

Prepared By
ECOSYSTEMS RESEARCH INSTITUTE
and
BEAR RIVER RC&D

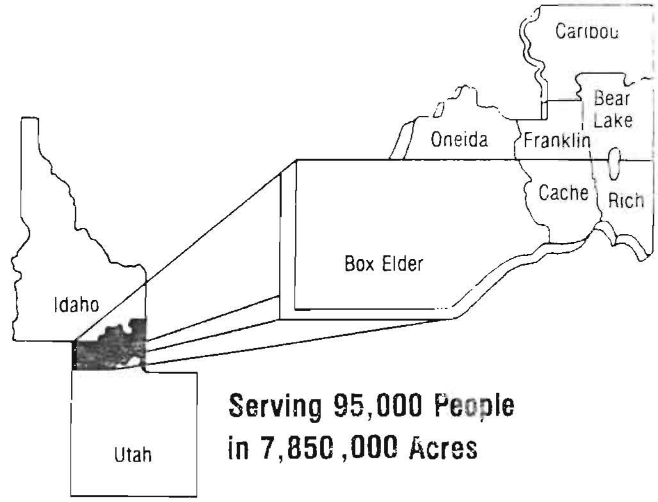
Prepared For
DEPARTMENT OF ENVIRONMENTAL QUALITY/ DIVISION OF WATER QUALITY

and
DEPARTMENT OF NATURAL RESOURCES/ DIVISION OF WATER RESOURCES

Funded in part by
the Utah Division of Water Resources and
the U.S. Environmental Protection Agency.

November 1995

BEAR RIVER RC&D



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TO: Department of Environmental Quality
Division of Water Quality

Department of Natural Resources
Division of Water Resources

A Bear River Water Quality Management Plan was recently completed by Ecosystems Research Institute and Bear River RC&D. This monitoring study and management plan has much local support.

The initial project came about because of the concerns of the Cache County Water Quality Taskforce. At the start of the study a Lower Bear River RC&D Water Quality Steering Committee was organized. This committee helped to develop the initial proposal. They reviewed the project as it was underway. Later they helped to prioritize and target problems.

As the project came to a close, public meetings were held to review the draft and get public comments.

This study has also been reviewed by Utah State University and Federal and State Water Quality experts. The study document was also given to Industry Stake Holders for review. These agencies and stake holders feel that the study has accurately identified problem areas in the Lower Bear River.

We would like to add our support for the management plan and encourage the implementation of this plan.

Sincerely,

Lower Bear River RC&D
Water Quality Steering Committee

CACHE COUNTY
CORPORATION

M. LYNN LEMON
COUNTY EXECUTIVE/SURVEYOR
120 NORTH 100 WEST
LOGAN, UTAH 84321
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November 16, 1995

Barbara Hoffman, Coordinator
Bear River Resource Conservation & Development
1260 North 200 East, Suite 4
Logan, UT 84321

Reference: Bear River Water Quality Plan

Dear Barbara,

On October 10, 1995, the Cache County Council passed a motion in support of the Bear River Water Quality Plan.

A copy of the minutes reflecting that support is enclosed.

Sincerely,

M. Lynn Lemon
County Executive

enclosure

COUNCIL MEETING
MINUTES 10/10/95

BEAR RIVER WATER QUALITY: RECOMMENDATIONS

Vice Chairman Anhder told the Council that the County Water Policy Board are supporting water quality recommendations for the Bear River and are asking the Council to support the recommendations.

Vice Chairman Anhder moved that the Council support the recommendations of the Water Policy Board. It was seconded and carried unanimously.

ACKNOWLEDGEMENTS

The Bear River Water Quality Management Plan, conducted by Ecosystems Research Institute under contract to the Bear River RC&D, is a product of technical assistance and support of a large number of people, not all of whom are mentioned below.

The support and insights of Jim Christensen, Mike Reichert, Tom Toole, Bill Moellmer and others in the Utah Division of Water Quality is greatly appreciated. The monitoring program conducted during this project was a cooperative effort between ERI and the Utah Division of Water Quality. We wish to extend a special thanks to Richard Denton for guidance in establishing monitoring sites and parameters and the help of his staff in conducting a monitoring program of high standards and for providing us with the data in a timely manner. Thanks in particular to Arni Hoelquist for cheerfully fielding countless data requests.

Thanks to Ken Short, Craig Miller and others in the Utah Division of Water Resources for guidance throughout this process. Staff at the U.S. Geological Survey, in particular David Allen, were very helpful in providing flow and sediment data and Tom Pettingill and Kent Sorenson of the Utah Division of Wildlife Resources provided useful fisheries data and expertise. Lee Baxter of the Bureau of Reclamation has been an extremely helpful participant in this project.

A special thanks is extended to Don Huber and Mike Allred of Cache County Extension, as well as Bob Clark, Brock Benson, Jeff Barnes, Karl Kler and many others in the U.S. Soil Conservation Service for their time and expertise. A special thanks to Barbara Hoffman, Jay Bankhead and Kent Hortin of the Bear River RC&D for help in moving the document to the public. For their support and technical assistance, thanks to Mike O'Neill, Kitt Farrell-Poe, Richard Peralta, Howard Deer and Steve Poe of the Utah State University Extension Office. Much appreciation is extended to Nick Galloway of the Bear River Health Department, who provided technical and monitoring support. Thanks to Ron Ryel, Cindy Johnson of NR Systems and Ramona Rukavina for invaluable technical help.

A very special thank you is extended to Sherm Jensen and Ted Dean of White Horse Associates who spent countless hours and silently suffered through short deadlines to provide among many other items, technical maps and landuse statistics.

We recognize and appreciate the interest and support of Bruce Zander and Doug Lofstedt (U.S. Environmental Protection Agency, Region VIII) and other USEPA and Utah Division of Water Quality staff for their guidance and general support of a project aimed at improving the quality of water within the lower Bear River basin. Finally, a sincere thank you to all the private citizens and agency personnel who gave freely of their time to serve on the steering committee, to comment on the draft document, and to offer suggestions and insights into water quality problems in the lower basin. This is a much improved document because you cared enough to spend the time.

EXECUTIVE SUMMARY

Introduction

As water resources become increasingly scarce in the Bear River basin, concerns have increased about the quality of the river's water. This document is a water quality management plan for the lower Bear River in Cache and Box Elder Counties, Utah. Objectives of the plan are:

1) To serve as a tool for local officials to improve or protect water quality;
2) To provide a mechanism for implementing water quality improvement projects;
3) To develop long-term monitoring plan to determine the effectiveness of the plan; and
4) To serve as a model in using a watershed based approach to water quality planning.

Project Area

The Bear River originates in the Uinta Mountains in northeastern Utah and travels through parts of Wyoming and Idaho before returning to Utah. The basin area encompasses 4.8 million acres, of which 1.7 million acres are in the project area. Much of the upper basin flow is diverted into Bear Lake and released throughout the summer for irrigation needs. The average annual discharge as the river re-enters Utah is 750,000 acre-feet. The Cub, Blacksmith Fork, Logan and Little Bear rivers enter the Bear River in the Cache Valley. The Malad River enters the Bear River below Cutler Reservoir, a large shallow reservoir located in Cache Valley.

About 30 percent of the project area is privately held agricultural lands, concentrated in the valley bottoms, with rangelands in the upland areas. Almost half of the project area is public land.

Cache and Box Elder counties had a combined 1990 population of over 100,000 with a projected 2020 population of over 150,000. Manufacturing accounts for one-third of the employment in the local economy. Agriculture accounts for less than 10 percent of the employment, although many of the businesses are agricultural-related. Tourism is an increasingly important part of the local economy.

Water quality studies on the Bear River date back to the 1940s. The Utah Division of Water Quality has monitored sites in the basin since 1976. Work in the 1970s concentrated on municipal and industrial effluent entering the river. More recently studies have concentrated on nonpoint pollutants, particularly nutrients, bacteria and sediments.

Impoundments in the basin include Cutler, Hyrum, Newton and Porcupine reservoirs. The first three are eutrophic, impacted by high nutrient and sediment loadings. In addition, modeling on the proposed Honeyville Reservoir downstream of Cutler predicted very poor water quality in this reservoir under current conditions.

Macroinvertebrates in rivers and streams provide information on long-term conditions in those waterbodies. Samples collected in the Bear River since the 1960s have had poor macroinvertebrate diversity and were dominated by sediment and organic tolerant species.

The Logan and Blacksmith Fork rivers are high quality fisheries, the Little Bear River drainage is considered a good fishery, while the Cub and Bear rivers have average to poor fishery resource value. High sediment concentrations affect both feeding and spawning in these rivers, and are the primary factor limiting fishery potential.

Current Water Quality Status

An intensive water quality monitoring program was conducted from October 1992 through 1993 to determine the current water quality status in the lower Bear River basin. Thirty-seven river sites and seven point sources were sampled routinely and analyzed for nutrients, bacterial contamination, field oxygen, temperature and pH. Metals were analyzed quarterly.

Flows in the Bear River in 1993 were lower than the period of record mean flows. Average sediment loads increased from 107,000 kg/day at the stateline to 277,000 kg/day near Corinne. Concentrations were highest during early runoff, and were higher during the irrigation season than during winter baseflows. Total phosphorus (TP) concentrations on the mainstem Bear River averaged 0.105 mg/liter at the stateline, increasing to 0.211 mg/liter at Corinne.

The Cub River contributed substantial sediment, phosphorus and inorganic nitrogen loads to the Bear River. Sediment concentrations were closely associated with flow, with Idaho contributing the largest portion, while nutrients entered disproportionately from the Utah portion of the drainage.

As the river passed through Cutler Reservoir, phosphorus and inorganic nitrogen increased significantly.

The Logan Lagoons contributed substantial loads of dissolved total phosphorus (DTP) and ammonia (NH_3). Spring Creek, a tributary of the Little Bear River, accounted for just six percent of the flow entering the Bear River as it passes through Cutler Reservoir, but accounted for over 25 percent of the increased TP and DTP loads and almost 50 percent of the increase in nitrate (NO_3) and NH_3 loads in this reach. Coliform concentrations were extremely high. This subdrainage is impacted by heavy inputs from both point and nonpoint sources.

The Little Bear drainage showed signs of water quality deterioration both above and below Hyrum Reservoir. Hyrum Reservoir acted as a sink for total suspended solids (TSS), TP and nitrate, but functioned as a substantial source of DTP.

The Logan River and the Blacksmith Fork River had very good water quality as they left U.S. Forest Service lands. Concentrations of TSS and nutrients increased as the Logan River moved across the valley to Cutler Reservoir, although water quality remained relatively good. On average, water quality in the Blacksmith Fork River remained high throughout the valley.

Hopkins Slough had extremely poor water quality, with high nutrients and high coliform concentrations. Clay Slough had high conductivity and extremely high phosphorus and nitrate concentrations.

Macroinvertebrate samples from the Bear River above Cutler Reservoir had few taxa and were dominated by sediment and organic tolerant species. Samples from the Little Bear had fair to good diversity, indicating a fair fishery potential due to limited substrate. The Cub River at the stateline, Worm Creek, and Hopkins Slough were dominated by pollution tolerant species while the Cub River above the Bear River, the Logan River and the Blacksmith Fork River had good abundance, high number of taxa and high diversity indices.

Beneficial Uses, Standards and the TMDL Process.

The beneficial uses supported by lakes, reservoirs and rivers in Utah include domestic water supplies, recreation and aesthetics, wildlife habitat, and irrigation and other agricultural use. Low dissolved oxygen, high ammonia concentrations and excessive sediments impact fisheries. Nutrients (phosphorus and nitrate) cause increased plant growth, creating aesthetic problems, low dissolved oxygen, and taste and odor problems. Bacterial contamination is a human health concern. Instream standards for various water quality parameters and an anti-degradation policy have been established by the state to protect these beneficial uses.

Water quality concerns arise directly from loss of beneficial uses. From 1976 through 1992 the greatest number of violations were due to high bacterial concentrations. Violations of the dissolved oxygen standard have occurred within the Little Bear River drainage. Phosphorus concentrations exceeded the pollution indicator concentration at almost all the sites, except those very high in the mountains.

The current study found similar patterns in addition to ammonia violations and very high nitrate concentrations at several sites in the Spring Creek drainage. Again, TP and DTP frequently exceeded the indicator concentration at all sites except those high in the drainage.

Total Maximum Daily Loads (TMDLs) are a means of evaluating and protecting waters based on mass loads of pollutants to the water bodies, rather than just concentrations of pollutants. Using this approach, all point and nonpoint sources can be compared according to their relative contributions, and impacts throughout the entire watershed can be estimated. Similarly, improvements in water quality can be evaluated in terms of their impacts throughout the drainage. Total maximum daily loads for nutrients and suspended and dissolved solids were established for specific reaches of the Bear River, and for each of the major tributaries entering the Bear River above Cutler Reservoir. In addition, a phosphorus TMDL was calculated for Cutler and Hyrum reservoirs. Dissolved total phosphorus loads from the 1993 monitoring found the lower Bear River, the Cub River and Spring Creek all far exceeded the TMDL for DTP and TP. The Cub and Spring Creek loads exceeded the nitrate TMDL. Total suspended solids loads exceeded the TMDLs at all Bear River sites except at the stateline.

Ranking and Targeting Problem Areas

Nonpoint and point sources entering each reach of the Bear River, and all tributary inputs were ranked according to the magnitude of TSS, TP and DTP loads entering from each source. Other factors were considered in ranking, but total magnitude was given the most weight. These targeted areas, agreed upon by the Bear River Water Quality Monitoring Plan (BRWQMP) steering committee, are:

1) Spring Creek drainage;

2) The Utah portion of the Cub River;

3) Sources in Cutler Reservoir from Benson to Cutler Dam; and

4) The Bear River corridor from Richmond to Benson.

Each targeted area was evaluated separately and sources of nutrients and sediments were identified. In the Spring Creek drainage, manure management is a critical issue. Runoff from fields spread with manure during the winter and direct runoff from feedlots are serious problems in this subdrainage. Point sources also contribute substantially to nutrient loadings. In the Cub River drainage, impacted riparian areas and stormwater runoff from a fertilizer distributor appear to be the major problems. Work is already underway in the reach of the Bear River through Cutler to stabilize banks and improve grazing practices. This work must be continued as well as restoration of riparian areas currently being overgrazed. Sediment problems in the Bear River corridor below the stateline arise from exposed banks, irrigation return flows and several severely degraded riparian areas.

The potential for reducing pollutant loadings by various remediation activities was evaluated and specific recommendations were made for each of these targeted subdrainages. It was predicted that with a medium to high level of remediation effort in the four targeted areas, TP and DTP loads can be reduced substantially, and the TMDL for DTP could be met in the mainstem Bear River.

Recommendations

Following meetings with the BRWQMP steering committee and a comment period on the draft plan, the following set of recommendations were set forth in this plan.

1. Establish target TMDLs for dissolved total phosphorus through voluntary compliance with established time frames. These TMDLs will be refined at the end of this period. The TMDLs are calculated for specific reaches of the mainstem Bear River and tributaries to the Bear River.

2. Use the TMDLs calculated for suspended solids and nitrates as nonenforceable guidelines. Use existing enforceable standards for dissolved oxygen, ammonia and coliforms.

3. Develop Project Implementation Plans for improving water quality in the following subwatersheds:

a) Spring Creek (tributary to Little Bear)

b) The Cub River in Utah. Work with Idaho on that portion of the drainage in Idaho

c) The Bear River from Benson to below Cutler Dam, including Cutler Reservoir

d) The Bear River above Benson to the site near Richmond.

4. Encourage those wastewater treatment plants (WWTPs) in the lower Bear River basin with significant phosphorus loading impacts to determine if changes in operations are possible which would reduce dissolved phosphorus loads from these sources. If operational changes are not possible, tertiary treatment for phosphorus removal may be necessary. To increase the existing database on phosphorus concentrations in the effluent, Utah Division of Water Quality (UDWQ) should add DTP analysis to the samples they collect at regular intervals.

5. Develop a long-range monitoring program to document water quality improvements during and after project implementation plan (PIP) implementations. Integrate water quality sampling and biomonitoring programs. Continued water quality monitoring will determine whether TMDLs are being met. Monitoring of riparian areas, macroinvertebrate populations and fisheries will help determine the true health of these areas, and more directly evaluate the gains in beneficial uses as water quality improves with improved landuse practices.

6. Continue working with existing local agencies and extension services to encourage best management practices (BMPs) in all agricultural lands in the valley. In addition, increase awareness on urban contributions to water pollution and educate the public on measures that can be taken to reduce this problem. There is a need for a coordinator to oversee the existing and new efforts in the lower basin. The existing BRWQMP steering committee will continue to function in an advisory capacity.

7. Work with Idaho and Wyoming to develop an integrated water quality plan for the entire Bear River basin.

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LIST OF ABBREVIATIONS/ACRONYMS

BMP	best management practice
BRWQMP	Bear River Water Quality Management Plan
CAFO	confined animal feeding operation
CFS	cubic feet per second
DLG	digital line graphs
DTP	dissolved total phosphorus
kg/day	kilograms/day
LA	load allocation
mg/l	milligrams/liter
NH_3	ammonia
NO_3	nitrate
PIP	project implementation plan
QA/QC	quality assurance/quality control
TDS	total dissolved solids
TMDL	total maximum daily load
TP	total phosphorus
TSS	total suspended solids
VBT	valley bottom vegetation
WLA	waste load allocation
WWTP	wastewater treatment plant
°C	degrees Celcius

1.0 INTRODUCTION

The Bear River drainage encompasses areas of northeastern Utah, southeastern Idaho, and southwestern Wyoming. It originates in Utah and travels approximately 500 miles before emptying into the northern end of the Great Salt Lake.

There is a long history of water resource studies on the Bear River. Many of the early studies dealt with the development of water resources and allocating water between different users. In 1991, the General Session of the Utah Legislature passed the "Bear River Development Act" which directs the Utah Division of Water Resources to develop the surface water of the Bear River and its tributaries through the planning and construction of reservoirs and associated facilities. Developed water is to be allocated among various regions and entities.

As water resources have become increasingly scarce in the Bear River basin, concerns have increased about the quality of the river's water as well. The purpose of the current project was to prepare a water quality management plan for the Bear River in Cache and Box Elder Counties using the TMDL (total maximum daily load) process as described in U.S. Environmental Protection Agency's (USEPA) Water Quality Planning and Management Regulations (40 CFR Part 130). The TMDL is a tool for implementing state water quality standards based on the relationship between pollution sources and in-stream water quality conditions. TMDLs establish the basis for water quality controls (pollution reductions) necessary for streams and reservoirs to meet state water quality standards generally based on USEPA developed water quality criteria. The ultimate goal is for the waters of the Bear River drainage to fully support their designated beneficial uses including fish and wildlife, agriculture, recreation, aesthetics and culinary water supply.

The objectives of this plan are:

1) **To serve as a tool for local officials to improve or protect water quality for designated beneficial uses.**

2) **To provide a mechanism for the implementation of TMDL based water quality improvement projects.**

3) **To develop a long-term monitoring program to determine the effectiveness of the plan.**

4) **To serve as a model in developing and implementing a watershed based approach to water quality planning.**

Specific tasks conducted during the course of this study include:

- **Review historic water quality conditions including a determination of water quality exceedences and target contaminants.**

- **Conduct an intensive monitoring program to identify the current water quality problems, their magnitude and location.**

- **Determine which water bodies within the basin are currently not supporting their designated beneficial uses.**

- **Develop TMDLs for water bodies within the lower Bear River basin. These TMDLs will serve as the basis for waste load allocations (WLAs) for point sources and load allocations (LAs) for nonpoint sources.**

- **Compile a point source and landuse database to help identify sources of water pollution relative to target contaminants.**

- **Prioritize the identified impaired reaches based upon the magnitude of impact.**

- **Develop a database for Project Implementation Plans (PIPs) to secure funding for the correction of nonpoint source pollution problems in the prioritized reaches.**

2.0 PROJECT AREA

The project area is part of the Bear River basin, which encompasses 4.8 million acres including parts of Utah, Wyoming and Idaho (Figure 2-1). The Bear River begins at about 13,000 feet in the Uinta Mountains in northeastern Utah. It flows north into Wyoming, crosses into Utah and back into Wyoming before entering Idaho northeast of Bear Lake. A canal has linked the Bear River and Bear Lake since 1911. Prior to the canal construction, the river and lake had been separated for approximately 11,000 years (since the Pleistocene). About three-fourths of the annual flow of the upper Bear River (300,000 acre-feet) is diverted into Bear Lake for storage and is released throughout the summer for irrigation with power generation as a secondary benefit. From Bear Lake, the river flows northwest towards Soda Springs, Idaho. Until about 34,000 years ago, the upper Bear River continued northward to the Snake River (Morrison 1965). When a volcanic debris slide blocked the northward course, the river turned south, overtopped the southern edge of Gem Valley, cut through a narrow basalt canyon (Oneida Narrows) and entered Cache Valley.

Average annual discharge is about 750,000 acre-feet at the Utah-Idaho border. The Cub, Blacksmith Fork, Logan and Little Bear rivers converge with the Bear River near the middle of Cache Valley, augmenting its flow by about 50 percent. Before leaving Cache Valley, the Bear River is impounded in Cutler Reservoir, located in the gap between the Clarkston and Wellsville mountain ranges. The reservoir has a surface area of over 7,000 acres and a mean depth of only three feet. The height of Cutler dam is 110 feet, but the reservoir has filled with sediment over the last 70 years and has a current depth of only 15 feet at the dam. The storage capacity of Cutler Reservoir has been reduced to about 10,000 acre-feet at elevation 4406.63 since construction in the 1920s. Cutler Reservoir sustains over 1,700 acres of emergent wetland vegetation. After leaving Cache Valley through Cutler Reservoir, the Bear River then turns south into Salt Lake Valley and meets with the Malad River before ending in the Great Salt Lake. The Bear River contributes about 1.2 million acre-feet per year to the Great Salt Lake.

The Bear River drops almost 9,000 feet along its 500 mile course from the Uinta Mountains to the Great Salt Lake, a distance of only 75 air miles. Throughout its main course, the Bear is impounded in five reservoirs, completely diverted in three reaches and generates electricity for six hydroelectric plants.

The project area (Figure 2-2) is the lower Bear River basin between Oneida Reservoir in the upper part of Oneida Narrows and the Bear River Migratory Bird Refuge near the shore of the Great Salt Lake, encompassing about 1.7 million acres. Major tributaries include the Cub, Little Bear, Logan, and Blacksmith Fork rivers in Cache Valley and the Malad River in Salt Lake Valley.

2.1 Climate

Average annual precipitation in Cache Valley from 1968-1992 was 18.23 inches (Ashcroft et al. 1992). This area is typical of much of the intermountain west, where precipitation is highly seasonal, mostly falling as snow. The average annual snowfall from 1968-1992 was 50.9 inches with an average water content of 10 percent. Snowmelt runoff is a major source of river flow. Typically, runoff in the lower Bear River basin is bimodal with the first peak correlating with snow melt from the valley bottoms and the second peak from snowmelt in the higher parts of the basin. The typical growing season is May through September. Average temperatures are -13°C to -1°C in the winter and 3°C to 11°C in the summer. The frost free period is 40 to 140 days.

2.2 Geology/Geomorphology

The Bear River project area straddles two physiographic provinces. The Bear River Range on the east is the western extent of the Middle Rocky Mountain Physiographic Province. Extending west from the base of the Bear River Range to the Sierra-Nevada Mountains is the Great Basin Section of the Basin and Range Physiographic Province (Hunt 1974), which is characterized by nearly parallel, north-south trending, fault-block mountain ranges separated by broad basins, many of which lack external drainage and held extensive lakes in Pleistocene time. This topography is the result of block faulting and the accompanying deposition of mineral debris. An east-to-west cross-section through the Great Basin Section resembles a broad, partially collapsed arch (Morrison 1965), having its highest part in eastern Nevada and dipping towards both the east and west. To the north of the Bear River project area lies the Columbia-Snake River Plateau Physiographic Province, a broad lava plateau separating the Great Basin from the Northern Rocky Mountains.

The geology of the Bear River, Wellsville and Bannock mountain ranges consists primarily of

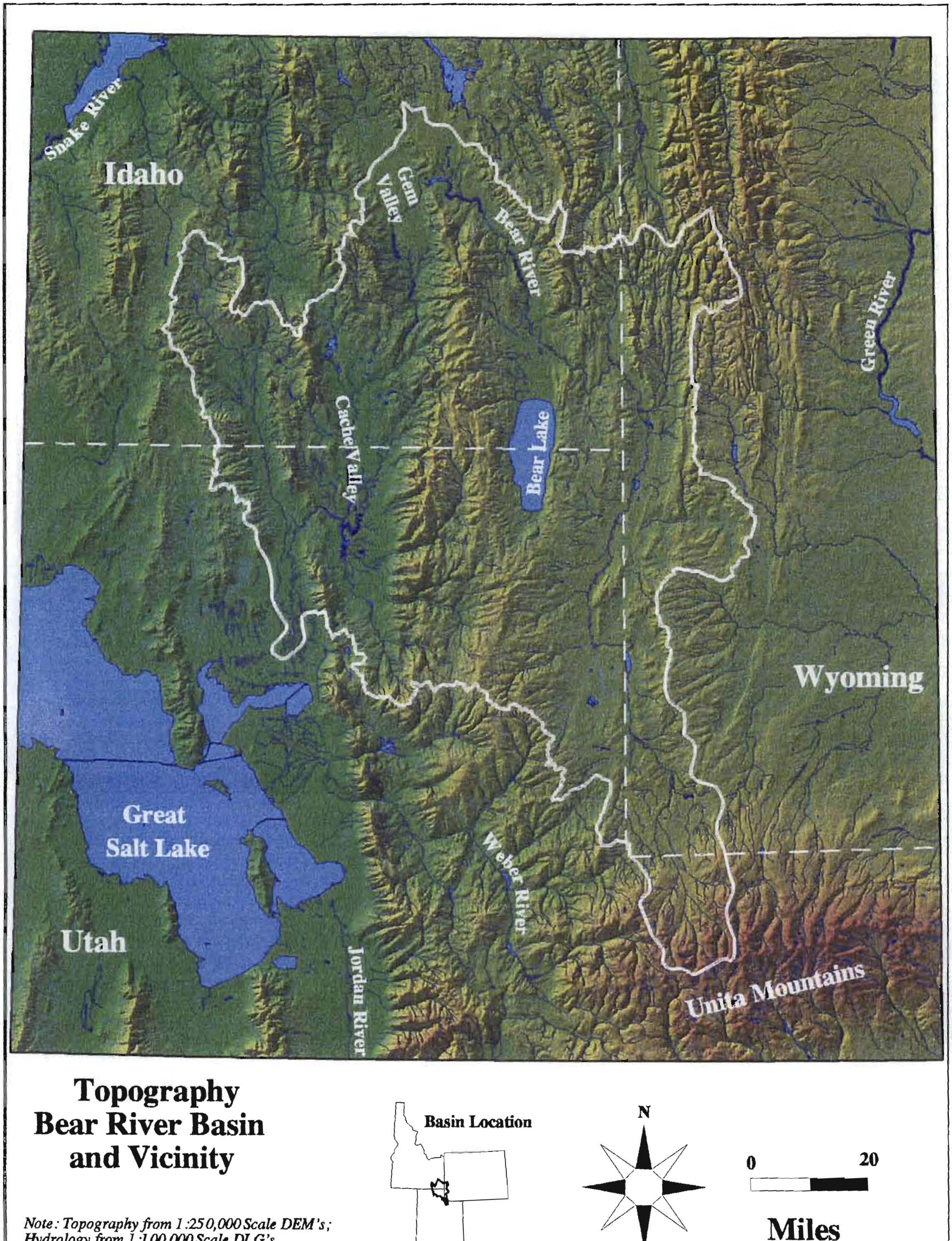

FIGURE 2-1. The entire Bear River basin.

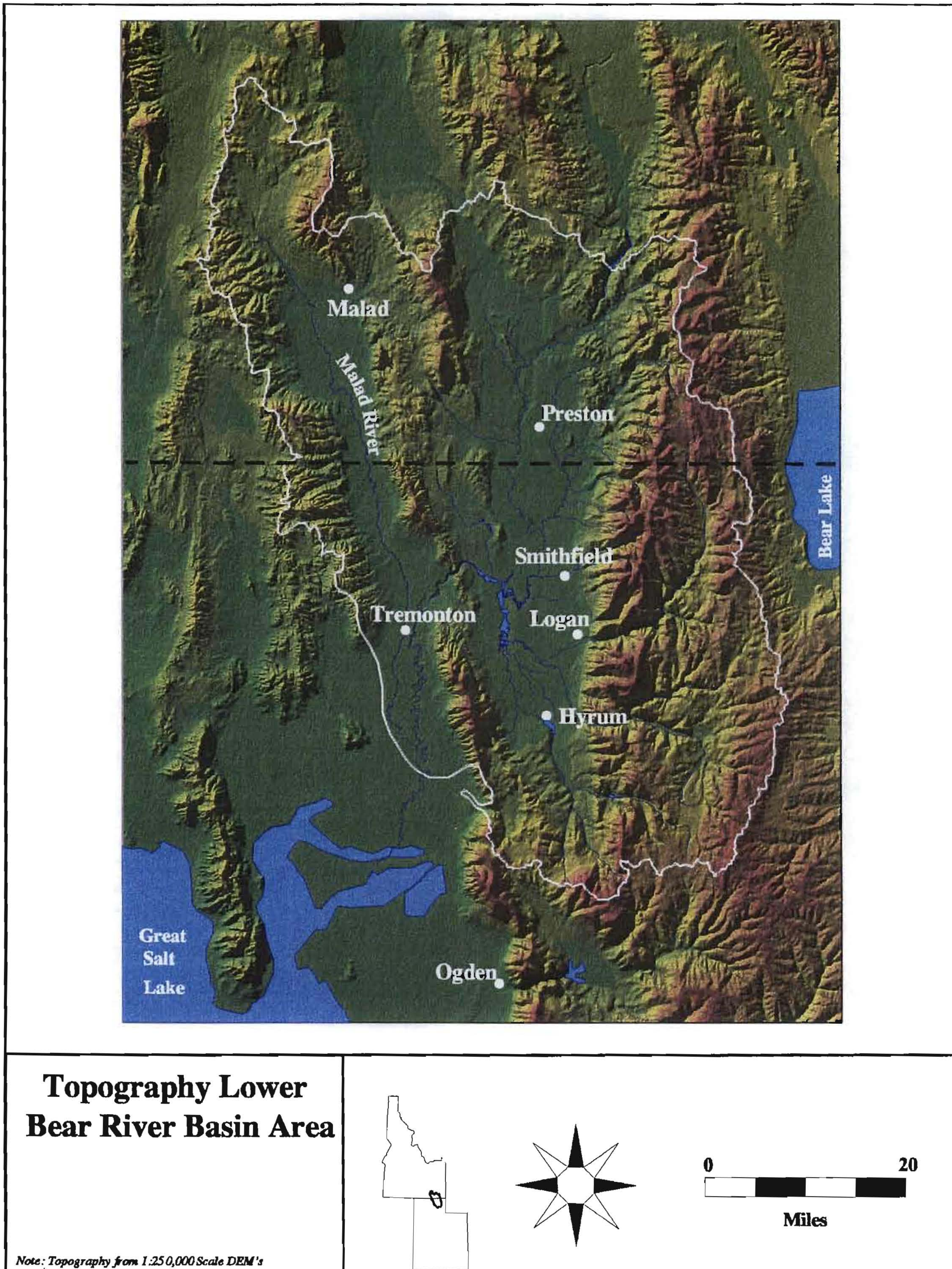

Figure 2-2. Project Area, lower Bear River Basin

Paleozoic marine sedimentary rocks overlying a core of Precambrian quartzite. Volcanic rocks are common along the footslopes of ranges in the northern part of the Bear River project area adjacent to the Snake River Plain. Valleys are filled with Tertiary deposits overlayed by Quaternary lake sediments.

Mountain ranges of the Bear River project area are mostly dissected by V-shaped, fluvial canyons. U-shaped, glacial valleys are also present in the Bear River Range and, to a much more limited extent, the Wellsville Range. Glacial features are most evident along the upper part of the Logan River (Figure 2-2). Major streams discharging from canyons have typically dissected into broad alluvial deltas remnant of Lake Bonneville. Terraces denoting relatively stable levels of Lake Bonneville follow the perimeter of both Cache and Salt Lake valleys. While short reaches of contemporary alluvial valley-bottoms are common along the flanks of the valleys, streams meandering through the middle of both Cache and Salt Lake Valleys are confined by high terraces reflecting lacustrine origin.

Valley bottom types (VBTs) are portions of the valley bottom distinguished by mode of genesis and consequent geomorphic attributes. Major VBTs associated with major tributaries of the lower Bear River watershed include:

Fluvial Canyons: V-shaped canyons formed by fluvial processes in mountainous areas. Fluvial canyons can be further divided as V-shaped erosional canyons, characterized by narrow bottoms confined by steep residual slopes, and V-shaped depositional canyons, characterized by wider bottoms and flanked by more gentle mountain slopes. Substrates are typically boulder and rubble and stream grades are relatively steep.

Alluvial Canyons: Formed at the mouths of canyons draining from mountain fronts. Alluvial valleys can be further divided as confined, where narrow bottoms are abruptly confined by alluvial slopes, and unconfined, characterized by wider bottoms. Substrates are typically gravel and stream grades are moderate.

Lacustrine Basins: Formed in nearly level lake sediments remnant of Lake Bonneville. Lacustrine basins can be further divided as confined, where bottoms are relatively narrow and confined by lake terraces, and unconfined, characterized by very wide bottoms. Substrates are typically sand/silt and stream grades are very low.

2.3 Soils

In the mountain ranges, slopes are typically steep and soils formed in residuum, colluvium, or alluvium derived from the mixed Paleozoic parent materials. These soils are generally deep to very deep and well to somewhat excessively drained. Runoff is moderate-to-rapid and the water erosion hazard is moderate-to-high. Lake terraces flanking Cache and Salt Lake Valleys are well drained, very deep, and formed in alluvium. Slopes are low-to-moderate and the water erosion hazard is moderate-to-low. Downcutting by the Bear River and its tributaries, resulting from the lowering of the hydrologic base level as Lake Bonneville receded, have resulted in massive erosion from these deltaic deposits where they are adjacent to stream channels. In particular, Battle Creek, Weston Creek, and Fivemile Creek are characterized by high sediment yields due to erosion of the terrace deposits (ERI 1991).

Soils on old lake bottoms in the middle of Cache and Salt Lake Valleys are nearly level, moderately well to poorly drained, very deep, and derived from lacustrine and alluvial deposits. They include silt loam to silty clay loam texture with finer textures more prevalent towards the middle of the valleys. Saline/sodic soils are also common. Runoff is slow and in low gradient areas the hazard of water erosion is slight.

2.4 Landuse

Over 1.7 million acres drain into the Bear River and its tributaries from Oneida dam to the Great Salt Lake. Of this area, 45 percent is public land, administered by the Bureau of Land Management (BLM) or the U.S. Forest Service (USFS) and almost 30 percent of the land is in agricultural use on private lands. Irrigated lands in the project area typically are used for grains or hay production or for pastureland. Irrigation has traditionally been by flooding, but many fields have converted to sprinkler systems over the past 20 years. In 1994, 57 percent of the irrigated land in Cache Coutny and 20 percent in Box Elder County were in sprinkler systems. Rangelands are typically in upland areas away from valley bottoms. Conditions of these lands range from poor to good, with a few areas considered excellent. Generalizations about rangeland conditions are difficult because conditions are extremely dependant on individual management by landowners. Portions of the public lands and the areas without an identified landuse are probably also used for grazing or other dryland agricultural purposes. Urban development comprises less than 1.5 percent of the total area in the lower Bear River basin. Most of this urban development in the lower basin occurs within Utah (Table 2-1). The major landuses within the lower basin are shown in Figure 2-3 and summarized in Table 2-1. Contained animal feeding operations (CAFOs) are typically clustered along waterways in the valleys of the project area. Over 200 CAFOs, averaging about 65 animals, are identified in the portion of the project area above Cutler Dam (Figure 2-4).

About 16 percent of the total watershed drains to the Bear River before it crosses the Utah-Idaho stateline. Approximately half of the total watershed (890,000 acres) drains to the Bear River as it moves through Cache Valley from the Utah-Idaho stateline to Cutler dam. Almost two-thirds of this land is National Forest, and about 22 percent is in identified agricultural uses. About 543,000 acres drain to the Bear River below Cutler dam, most of which enters through the Malad River drainage.

The corridor of the mainstem Bear River passes through broad floodplains dominated by grazing, pasture lands and dairy operations. About 50 percent of the land is in agricultural use, of which two-thirds are irrigated. Throughout the entire reach, irrigation return flows drain back to the river. Point sources along the mainstem Bear River include seasonal effluent from a cannery just north of the Utah-Idaho border, and effluent from Logan's wastewater treatment facility, which discharges into a slough upstream of Cutler Reservoir. The towns of Logan, Smithfield, Hyde Park, North Logan, Providence and River Heights send sewage to this facility, representing 70 percent of the population in the valley. In addition, all septic tanks in the county are hauled to the lagoons. Current capacity is expected to handle demands until approximately 2007 (Logan City Engineering Office).

The Cub River drains 142,000 acres, most of which are National Forest lands. About one-third of the drainage is in agricultural land, of which 80 percent is irrigated. As it flows southward, the Cub receives agricultural return flows and waste effluent from Franklin, Idaho and Richmond, Utah and several small industries. As the Cub enters Utah, it is joined by Worm Creek, which drains an area to the north and receives the effluent from the Preston, Idaho wastewater treatment plant (WWTP). Within Utah, several tributaries join the Cub River from the east, including High Creek, Spring Creek and Cherry Creek.

Summit Creek drains an area of approximately 16,500 acres, south of the High Creek drainage. Almost 70 percent of the area is National Forest lands, and only two percent is identified as being in agricultural use. The stream is diverted at the mouth of Smithfield canyon and below this point is

TABLE 2-1. Summary of major landuses (in acres) in the lower Bear River basin. Landuses within major subdrainages and reaches of the Bear River are identified. Data were collected in 1986 (Utah Division of Water Resources 1991; Idaho Department of Water Resources; Idaho Geographic Information Center).

	PUBLIC LANDS		PRIVATE LANDS									
	Bureau of Land Mgmt *	Forest Service **	Irrigated Agriculture	Non-irrigated Agriculture	Open Spaces	Other	Unknown	Urban	Water	Wetlands	TOTAL	PERCENT OF TOTAL BASIN
MAINSTEM BEAR RIVER												
below Cutler	0	35,026	19,147	7,471	18,229	337	2,951	2,844	2,380	4,534	**92,921**	**5.4%**
Utah above Cutler	0	18,080	47,906	29,883	15,510	7,203	16,795	6,616	7,524	5,287	**154,804**	**9.1%**
Idaho	3,293	67,643	44,690	63,577	813	89,872	1,232	572	644	4,103	**276,439**	**16.2%**
TRIBUTARIES												
Cub River	1,021	53,781	37,507	9,112	976	26,177	8,236	2,221	677	2,441	**142,150**	**8.3%**
Logan River	0	153,597	2,572	543	488	130	2,409	2,734	85	89	**162,648**	**9.5%**
Blacksmith River	0	177,325	2,928	491	331	25	1,349	902	13	308	**183,672**	**10.7%**
Little Bear River	0	121,923	21,024	13,837	1,470	2,066	16,701	2,443	923	1,767	**182,155**	**10.7%**
Spring Creek	0	369	10,328	513	647	455	531	1,491	66	157	**14,558**	**0.9%**
Summit Creek	0	11,408	852	282	112	11	3,177	608	11	0	**16,460**	**1.0%**
Hopkins Slough	0	5,488	6,019	2,165	785	333	2,817	1,609	1	181	**19,398**	**1.1%**
Clay Slough	0	0	6,677	438	1,164	1,075	0	233	268	1,669	**11,524**	**0.7%**
Malad River	66,774	81,668	76,000	82,566	0	72,903	64,144	3,740	617	5,189	**453,599**	**26.5%**
TOTAL	**71,088**	**726,307**	**275,649**	**210,877**	**40,527**	**200,586**	**120,344**	**26,013**	**13,210**	**25,725**	**1,710,327**	**100.0%**
% of Total Basin	**4.2%**	**42.5%**	**16.1%**	**12.3%**	**2.4%**	**11.7%**	**7.0%**	**1.5%**	**0.8%**	**1.5%**	**100.0%**	

* *Landuses include watershed protection, recreational, livestock grazing, wildlife habitat, hunting, mining, logging*

** *Landuses include watershed protection, recreational, livestock grazing, wildlife habitat*

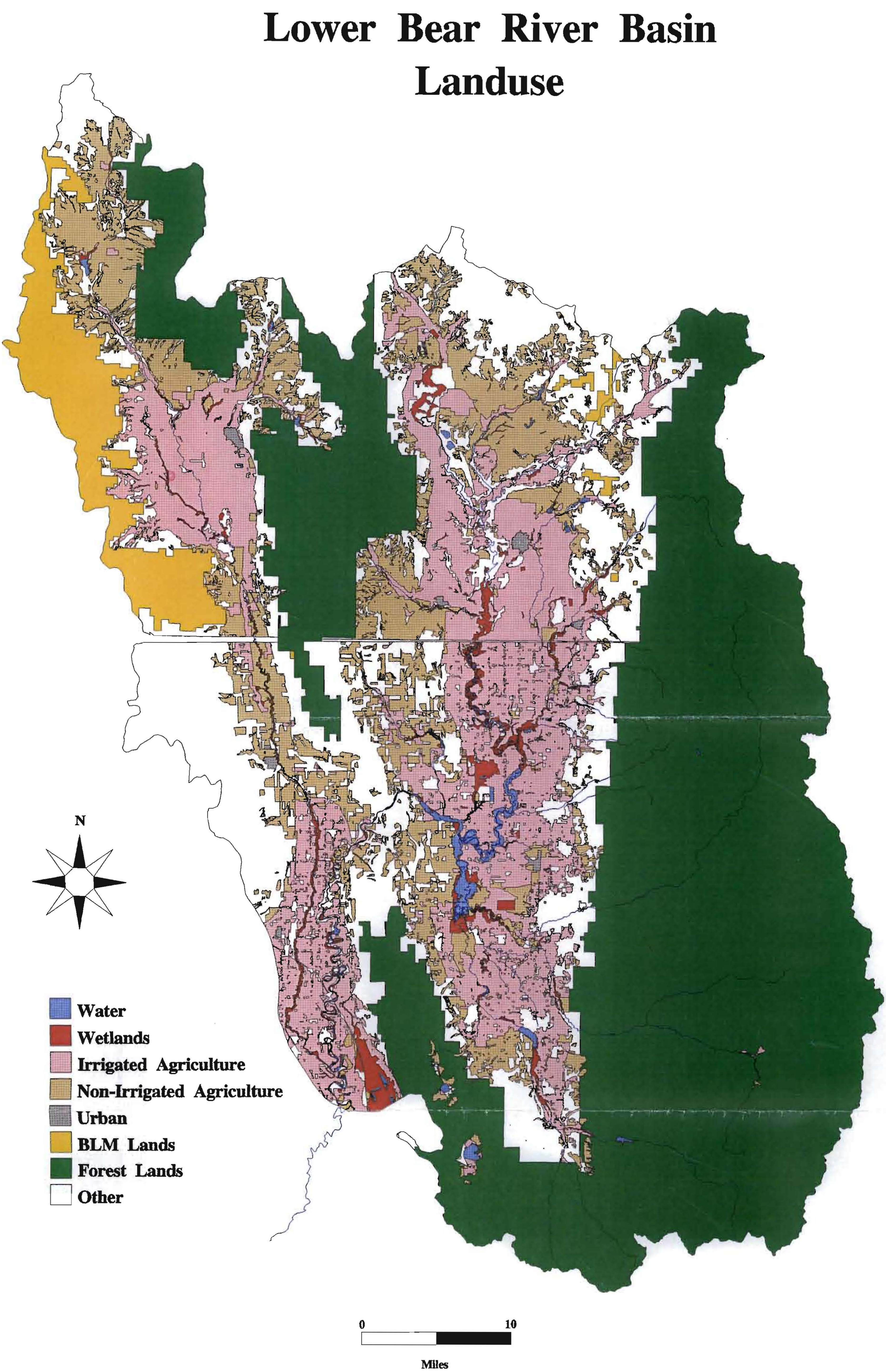

FIGURE 2-3. Lower Bear River basin landuse.

during early runoff, and were higher during summer baseflows (the irrigation season) than during winter baseflows. Total suspended solids loads increased from 107,000 kg/day at the stateline to 277,000 kg/day near Corinne. Total phosphorus (TP) concentrations on the mainstem averaged 0.105 mg/liter at the stateline, increasing to 0.211 mg/liter at Corinne. Dissolved total phosphorus (DTP) averaged 0.039 mg/liter above Cutler and 0.107 mg/liter below the reservoir. Phosphorus loads showed large increases at the Cub River confluence and as the river passed through Cutler Reservoir. Similar patterns were seen for nitrate (NO_3) and ammonia (NH_3). The increases as the river passed through Cutler were due in part to ungaged flows entering within the Cutler reach. Spring Creek and the Logan Lagoons, however, contributed disproportionately to the DTP and NH_3 load compared to their flow inputs.

The Logan River and the Blacksmith Fork River had very good water quality as they left Forest Service lands. Concentrations of TSS and nutrients increased as the Logan River moved across the valley to Cutler Reservoir, although water quality remained relatively good. On average, water quality in the Blacksmith Fork remained high throughout the valley.

The Little Bear drainage showed signs of water quality deterioration both above and below Hyrum Reservoir. Sediment loads increased in both reaches, entering primarily from nonpoint sources. Nonpoint sources of TP and NO_3 also caused increased loads above Hyrum Reservoir. Below Hyrum reservoir, Wellsville lagoons were responsible for most of the increase in TP loads, while nonpoint inputs accounted for NO_3 increases. Hyrum Reservoir acted as a sink for TSS, TP and NO_3, but functioned as a substantial source of DTP.

Spring Creek is a tributary of the Little Bear, entering just above Cutler Reservoir although all sample sites were above the confluence of the two. Spring Creek accounted for just six percent of the increased flow entering the Bear River as it passes through Cutler Reservoir, but accounted for over 25 percent of the increased TP and DTP loads and almost 50 percent of the increase in NO_3 and NH_3 loads in this reach. Within this drainage, South Fork Spring Creek and Hyrum Slough were the most impacted, from a combination of high point source and nonpoint inputs of nutrients. Total phosphorus and DTP averaged 12 and 7.9 mg/liter respectively at the most upstream site on the South Fork. Nitrate concentrations averaged 3.2 mg/liter. In these tributaries, coliform concentrations were extremely high and dissolved oxygen fell below coldwater standards.

3.0 CURRENT WATER QUALITY STATUS

An intensive water quality monitoring program was conducted from October 1992 through 1993 to determine the current water quality status in the lower Bear River basin. This section is a summary of the results of that monitoring program. A complete writeup of the monitoring results is included in Appendix I of this document. A complete listing of all water quality data collected is included in Appendix II. Macroinvertebrate data is listed in Appendix III, and quality assurance/quality control results are included in Appendix IV.

The intent of the monitoring program was as follows:

1) **Determine current loadings within the lower Bear River and its tributaries.**
2) **Distinguish between point and nonpoint sources.**
3) **Determine where within the local watershed the current loads exceed criteria or standards for total maximum daily loads (TMDL).**
4) **Recommend where reductions to the loads can be made to achieve the TMDL in the most cost effective manner possible.**

Sample collection and analysis was a cooperative effort between the Monitoring Section of the Utah Division of Water Quality and Ecosystems Research Institute. Thirty-seven river sites and seven point sources were sampled routinely. Sample locations are shown in Figure 3-1. Tables 3-1 and 3-2 list each site, and include a description, river mile location, and identification of who sampled each site. Point sources in the project area are identifed in Table 3-3 by their UPDES permit number and discharge location. Site numbers are also given for those sampled as part of this project. Table 3-4 lists all water quality parameters that were evaluated, including the methods, detection limits, and the labs used for the analyses.

3.1 Monitoring Results

Unless otherwise stated, results refer to samples collected during the 1993 water year (October 1992 through September 1993). Average flows in the Bear River increased from 720 cfs at the stateline to 1,410 cfs at the most downstream site (near Corinne), compared to historic mean flows of 1,239 and 1,837 cfs, respectively. Average suspended solids (TSS) concentrations were 57 mg/liter at the stateline, fell to 38 mg/liter below Cutler and increased to 72 mg/liter at Corinne. Concentrations were highest

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whitefish (Table 2-3). Both rivers are stocked throughout the summer with catchable trout, and the Logan River is stocked annually with fingerling brown trout.

The Little Bear River is a Class II river, except for a short Class III reach near Cutler Reservoir and a short dewatered reach above Hyrum Reservoir. The tributaries are all rated Class III. Rainbow, cutthroat and brown trout, redside shiner, speckled dace, Utah sucker, mottled sculpin and Utah chub have been sampled throughout the Little Bear drainage (Table 2-3). Leatherside chub and mountain whitefish have been collected only above Hyrum Reservoir and sockeye occur only above Porcupine Reservoir on the East Fork. Black bullhead, carp, black crappie and walleye have been found only in the Class II reach near Cutler Reservoir.

The Cub River is a Class IV fishery from the Bear River confluence to the Idaho stateline. Spring Creek, a tributary to the Cub River, is considered a Class V fishery. Fish sampled within the Cub include brown trout, black bullhead, carp, Utah chub, Utah sucker, largemouth bass, green sunfish, yellow perch and mountain whitefish (Table 2-3).

TABLE 2-3 (continued). Historical fisheries data for the lower Bear River basin.

RIVER Reach	MILES	CLASS *	RATING *	YEAR	FISH SAMPLED (SEE KEY AT END OF TABLE) 1	2	3	6	7	8	12	14	15	17	18	21	22	26	28	36	38	40	41	42	43	58
LITTLE BEAR RIVER (continued)																										
Wellsville Cr to Hyrum res	6.0	2	25	93	X	X	X								X	X	X	X	X		X		X		X	
Hyrum res to WTF outfall	2.5	2	25	91	X	X	X							X	X	X		X							X	X
WTF inflow to outfall	1.0	6	7	78																						
WTF inflow to EFK/SFK	3.0	2	27	91	X	X	X											X							X	X
Spring Creek	9.0	3	20	75	X		X				X	X						X			X					X
East Fk to Porcupine	4.0	2	27	92	X	X	X																		X	
East Fk frm Porcupine to HW	7.0	3R	24	71	X	X	X	X												X					X	
South Fk to HW	3.0	3B	21	91	X	X	X													X					X	X
Davenport to HW	3.0	3	20	85		X	X																		X	
BLACKSMITH FORK																										
Logan R to Ballard Spr	1.0	2	25	87	X	X	X																		X	X
Ballard Spr to Nibley Div	5.0	6	12	87		X	X																		X	X
Nibley Div to 1st dam	3.5	3	24	87	X	X	X												X						X	X
1st dam to Hyrum Power	3.2	1	31	87		X	X												X						X	X
Hyrum Power to 2nd dam	0.8	3	32	87	X	X	X																		X	X
2nd dam to Anderson ranch	9.5	1B	35	91		X	X																		X	X
Anderson ranch to HW	2.5	1	31	91			X																		X	

1 rainbow trout (*Oncorhynchus mykiss*)
2 cutthroat trout (*Oncorhynchus clarkii bouvieri*)
3 brown trout (*Salmo trutta*)
6 kokanee (sockeye) (*Oncorhynchus nerka*)
7 channel catfish (*Ictalurus punctatus*)
8 black bullhead (*Ictalurus melas*)
12 albino rainbow trout (*Oncorhynchus mykiss*)
14 carp (*Cyprinus carpio*)
15 Utah chub (*Gila atraria*)
17 leather side chub (*Gila copei*)
18 redside shiner (*Richardsonius balteatus*)
21 speckled dace (*Rhinichthys osculus*)
22 longnose dace (*Rhinichthys cataractae*)
26 Utah sucker (*Catostomus ardens*)
28 mountain sucker (*Catostomus platyrhinchus*)
36 largemouth bass (*Micropterus salmoides*)
38 green sunfish (*Lepomis cyanellus*)
40 black crappie (*Pomoxis nigromaculatus*)
41 yellow perch (*Perca flavescens*)
42 walleye (*Stizostedion vitreum*)
43 mottled sculpin (*Cottus bairdi*)
58 mountain whitefish (*Prosopium williamsoni*)

* Rating is the weighted sum of three individual ratings, based on aesthetics, availability and productivity. The individual ratings are weighted by 1, 2 and 4, respectively. Classes range from I to VI, with Class I being the highest quality fishery to Class V, with no fishery value. Class VI is dewatered for part of the year.

TABLE 2-3. Historical fisheries data for the lower Bear River basin (SOURCE: Stream Inventory File Reports, Utah Division of Wildlife Resources and Kent Sommers, pers. comm).

RIVER	MILES	CLASS	RATING	YEAR	FISH SAMPLED (SEE KEY AT END OF TABLE)																					
Reach		*	*		1	2	3	6	7	8	12	14	15	17	18	21	22	26	28	36	38	40	41	42	43	58
BEAR RIVER																										
Refuge to Cutler	61.0	3	18	62			X		X	X			X					X		X	X	X		X		
Cutler to stateline	39.0	4	17	64						X	X	X						X			X	X	X	X		
NEWTON CREEK																										
BR confl to res	5.0	4	14	71														X								
CLARKSON CREEK																										
Res to HW	7.8	3	16	78	X		X									X			X						X	
BOX ELDER CREEK																										
BR confl to res	8.1	5	11	72			X																			
Res to HW	3.0	3	21	92	X		X												X						X	
MALAD RIVER	45.0	4	12	73					X			X	X		X		X	X			X				X	
SWIFT SLOUGH	3.5	4	14	81								X														
HOPKINS RIVER	4.0	4	13	81								X									X					
LOGAN RIVER																										
Cutler to BS Fk	9.5	3	20	87			X					X						X							X	X
BS Fk to Little Logan Div	3.2	2	25	91	X		X					X													X	X
1st dam to 2nd dam	3.0	3	23	87	X		X				X														X	X
2nd dam to 3rd dam	2.5	2B	28	91	X	X	X																		X	X
3rd dam to RH Fk	6.0	1B	34	91	X	X	X																		X	X
RH Fk to Temple Fk	6.0	2B	30	91		X	X																		X	X
Temple Fk to ID SL	11.5	2B	30	91		X	X																		X	X
CUB RIVER																										
BR confl to stateline	15.0	4	12	63			X			X		X	X					X		X	X		X			X
LITTLE BEAR RIVER																										
Cutler to Wellsville Cr	25.5	3	21	54	X		X			X		X	X		X		X	X		X	X	X	X	X	X	

IV are waters with limited fishery habitat. In both cases, the strategy of the UDWR is to enhance the fisheries when possible. Sampling on the mainstem Bear River in the 1960s by the UDWR found Utah sucker, green sunfish, black crappie and walleye, both above and below Cutler Reservoir. Brown trout, channel catfish and largemouth bass were only found below Cutler, while albino rainbow trout, carp and yellow perch were only collected above the reservoir (Table 2-3). The river is stocked every other year with channel catfish, but is otherwise not managed very closely for fisheries. Fisheries problems in the mainstem Bear River derive primarily from the high sediment load, which interferes with visual feeding fish, destroys spawning habitat, and negatively impacts macroinvertebrates. Accurately sampling the fish population is also complicated by the extreme turbidity of the water (Tom Pettingill, UDWR, pers. comm.).

Bangerter (1965) found a fishery in Cutler Reservoir dominated by carp but with moderate species richness. In the 1970s, carp appeared to become less abundant and largemouth bass percentages increased. Black bullhead numbers also increased in the 1970s. Fathead minnows appeared for the first time in the 1970s (Helms unpub. 1977), representing an important new forage fish in the reservoir. Sampling of fish and habitat was conducted throughout the reservoir in the spring and summer of 1990 (Pacificorp Electric Operations 1991). Spring surveys indicated carp were dominant throughout the reservoir, in addition to high numbers of fathead minnows and green sunfish. Channel catfish were sampled sporadically. Summer samples were also dominated by carp and higher abundances of black crappies, largemouth and smallmouth bass than were seen in the spring. Species richness in 1990 was lower than 1965 in the Bear River above the marsh, below the dam and in Spring Creek and the Little Bear just above the reservoir. Rainbow trout, walleye and sculpin were all sampled in 1965 but not in 1990, while smallmouth bass, channel catfish and bluehead sucker were found only in 1990. A single logperch was found in 1990 below the dam. The reduced richness was attributed to poor habitat, eroded streambanks, unstable substrates and poor water quality (Pacificorp Electric Operations 1991). Species richness in the canyon section of Cutler Reservoir and in the Benson area were greater in 1990 than in 1965.

The Logan and Blacksmith Fork rivers contain Class I and Class II reaches. Tributaries to these rivers are in general categorized Class III, primarily because of the lower flows in these smaller streams. Fish sampled in these rivers include rainbow, cutthroat and brown trout, mottled sculpin, and mountain substrate was noted (UDPC 1985; UBWPC 1986b, 1987, 1990, 1991a, 1991b; UDWQ 1993a, 1993b).

Samples collected near Corinne also found low biomass, with dominance by sediment tolerant taxa and few cleanwater species (UDPC 1985; UBWPC 1986b, 1987, 1990, 1991a, 1991b). The highest abundance and diversity has been observed below Cutler, and attributed to good substrate, the high productivity of Cutler and good dissolved oxygen (UWRL 1974b). Samples from Cutler Reservoir itself, however, have found low macroinvertebrate numbers, dominated by chironomids and oligochaetes (Bangerter 1965, ERI 1991).

In 1974, the Cub River had low diversity, species richness and abundance. The Logan River had good macroinvertebrate indicators at upstream sites, with some deterioration in lower stream segments, apparently due to increased sediments (UWRL 1974b).

The Little Bear River has shown similar trends to the Logan river. Above Hyrum Reservoir, samples had good diversity and biomass, with the presence of cleanwater taxa (UWRL 1974; UDWQ 1993c, 1993d). Since 1990, samples at sites above Hyrum Reservoir have shown some evidence of stress conditions. Below Hyrum Reservoir, conditions are more stressed, with macroinvertebrate communities indicative of high organic loading and sediment intolerance.

2.10 Fisheries

Fisheries data in the lower Bear River basin have been collected infrequently and at varying intensities in different reaches. The mainstem Bear River and several tributaries were evaluated for fish, macroinvertebrates, and habitat in the early 1960s (Bangerter 1965). This remains the most recent fisheries work conducted on portions of the mainstem Bear River. More recent sampling has been conducted on most of the other reaches of fishable waters in the lower drainage, with emphasis on those rivers which are able to support or be stocked with game fish.

The Utah Division of Wildlife Resources (UDWR) has categorized streams in Utah into six general categories, ranging from top quality fishing streams (Class I) to streams with no fishery resource value (Class V). Class VI streams are dewatered for some portion of the year. The mainstem Bear River has been classified by the UDWR as Class III from the Bear River refuge to Cutler Reservoir and Class IV from Cutler to the Idaho stateline. Class III waters are considered of average quality as a fishery, while Class

2.8 Trends in Historic Water Quality

Long-term water quality trends were evaluated at five sites in the lower Bear River basin: Bear River at Corinne (490110), Bear River below Cutler Dam (490198), Bear River at the Utah-Idaho stateline (490610), Little Bear River above Cutler Dam (490500) and Little Bear River above Avon (490570). These sites were chosen because they had an adequate long-term data set. Sampling began in 1983 at site 490500 and dates back to 1976 at the other sites. Total suspended solids, total phosphorus, orthophosphorus, and nitrate were evaluated. At each site, flow was regressed against each parameter and the residuals of predicted to actual values were determined. An ANOVA was then conducted on the residuals to look for differences between years with the effects of flow removed. No significant trends were seen at the Bear River sites at the stateline and below Cutler Dam and no trends were seen for orthophosphorus or TSS at the other sites. A significant year effect was seen for nitrate at site 490110 near Corinne ($P<0.0079$). The Student-Neuman-Keuls multiple comparison test, used to evaluate which years were significantly different, found that 1981 was significantly different from all other years. While concentrations appeared to be lowest in the late 1970s and since the mid-1980s, no obvious trends by year were seen.

ANOVAs of total phosphorus residuals against year were significant at both sites on the Little Bear ($P<0.0191$ at site 490500 and $P<0.0088$ at site 490570). In both cases, total phosphorus appears to have decreased in recent years. At the upper site near Avon, years 1989 through 1991 and 1983 clustered and were significantly lower than the other years. At the lower site, 1987 through 1991 were significantly lower than the other years.

2.9 Macroinvertebrates

Macroinvertebrate samples have been collected throughout the Bear River basin since the early 1960s. Samples collected in the 1960s and the early 1970s in the Bear River near Cornish showed the lowest abundances in the Bear River basin (Bangerter 1965, UWRL 1974b). Annelids and chironomids dominated. The low abundance and poor diversity was attributed to silt and poor habitat. The Utah Division of Water Quality has monitored this site since 1977. Most samples have been categorized as fair, with good biomass but dominance by sediment and organic tolerant taxa. Again, poor spawning primarily from watershed and streambank erosion. Approximately 20 percent of the total phosphorus (TP) entering Cutler Reservoir was estimated to be from point sources. It was noted, however, that this portion was more likely to be available for algal uptake, and thus have more potential for degrading water quality.

A study in 1990-91 (ERI 1991) on the Bear River below Oneida Reservoir found similar patterns to those seen in other studies. The Cub River had very poor water quality, as did small tributaries above the Utah-Idaho border. Phosphorus was highest below Cutler Reservoir, although substantial increases occurred within the valley above Cutler as well.

Herbicides and pesticides were evaluated by the UDWR in 1989-1990 and were found to be below detection limits. No information on herbicides or pesticides in river sediments is available.

Reservoirs within the lower basin are impacted by the high sediment and nutrient loadings in the area. A Trophic State Index (TSI) combines data about phosphorus concentrations, water transparency and algal abundance in a lake or reservoir into a single value which allows different waterbodies to be compared (Carlson 1977). A TSI greater than 50 indicates a eutrophic (over-enriched) waterbody (Cooke et al. 1993). Cutler Reservoir, with its high phosphorus concentrations and very low visibility, has a mean TSI of 73.6 (Pacificorp Electric Operations 1991; UDHW 1982). In 1990-91, Cutler appeared to function as a nitrogen and sediment sink for most of the year. Hyrum Reservoir has a history of high nutrients, leading to algal blooms, floating mats of debris and low dissolved oxygen with associated fisheries problems (Lynn & Murray 1972; ERI 1994). Newton Reservoir is also eutrophic, with a TSI of 67.7, based on 1980 data (UDHW 1982). Small impoundments along the Logan River have not experienced eutrophication problems, but do receive substantial sediment loads which can be delivered downstream under drawdown conditions. Porcupine Reservoir on the east fork of the Little Bear River is relatively high in the drainage, with little development in its watershed, and a mean TSI of 48.9 based on 1978-1979 data (UDHW 1982). Mechanistic modeling conducted on seven proposed reservoirs in the lower basin predicted moderate to poor water quality in all reservoirs except for those located high in the Little Bear drainage (ERI 1991). The proposed Honeyville Reservoir was predicted to have the most impaired water quality and to be nitrogen limited, thus leading to potential blue-green algal blooms.

variable, averaging 238,000 kg/day. Maximum loads occurred in March from 1987 through 1989 and were associated with runoff events, while peak loads from 1990 through 1992 occurred in June or July and were associated with Bear Lake releases. Sediment loads below Cutler dam ranged from 103,000 kg/day in 1990 to 325,000 kg/day in 1991. While mean daily TSS concentrations are correlated with mean daily flow at both sites, the TSS data were only collected twice daily and are therefore not at a fine enough resolution to evaluate the impacts on TSS of flow fluctuations resulting from power peaking. Daily fluctuations at the Utah-Idaho stateline in stage averaged 2.5 feet and may contribute to maintaining exposed vertical banks along the Bear River.

The Utah Division of Water Quality (UDWQ) has been monitoring the Bear River basin since 1976. Baseline monitoring at several sites has continued uninterrupted since that time, while more intensive monitoring associated with individual water quality programs has been conducted for shorter periods, These data have been used in the biannual assessments produced since 1975 (Utah Div. of Health 1975; Utah Dept. of Health 1982, 1984, 1986, 1988, 1990; UDWQ 1992a, 1994). In addition, a series of studies evaluated water quality in the Bear River below Oneida Reservoir with the intent of developing a management plan for the lower basin (Thomas et al. 1971; Renk et al. 1973; Hill et al. 1973; UWRL 1974b; Drury et al. 1975; Israelson et al. 1975; UWRL 1976). The 1979 Water Quality Management Plan (BRAG 1982) identified the following primary concerns on the mainstem Bear River: coliform bacteria contamination, high biochemical oxygen demand (BOD) associated with some of the wastewater dischargers, and high phosphorus concentrations. Total dissolved solids (TDS) was only considered a problem in the Malad River. Nonpoint sources identified at the time included erosion from irrigated and dry cropland, runoff from dairies, inappropriate disposal of animal waste and construction activities. Point sources consisting primarily of municipal and industrial effluent were identified as the most significant contributors to water quality problems. In most cases, these point sources were subsequently treated in order to be in compliance with Utah discharge permit requirements. At the time, it was noted, however, that primary and secondary treatment for compliance with discharge requirements would have no bearing on nutrient loadings to the system (UWRL 1974a).

Sorenson et al. (1984, 1986, 1987) and Barker (1989) studied phosphorus dynamics in the lower basin. These studies characterized most of the phosphorus entering the system as nonpoint in source,

TABLE 2-2 (continued). A summary of water quality investigations conducted on the Bear River.

		LOCATIONS			PARAMETERS						
Author	**Data date**	**BR UT**	**BR ID**	**BR WY**	**Flow**	**Nutrients**	**TSS**	**Salts**	**Metals**	**Bacteria**	**Biological**
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
UDWQ 1993b	1991-92	X									X
UDWQ 1993c	1990-91	X									X
UDWQ 1993d	1991-92	X									X
ERI 1994	1992-93	X			X	X	X		X	X	X
UDWQ 1994a	1992-93	X									X
UDWQ 1994b	1992-93	X									X
UDWQ 1995	1993-94	X									X

TABLE 2-2. A summary of water quality investigations conducted on the Bear River.

		LOCATIONS			PARAMETERS						
Author	**Data date**	**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

area occur on the mainstem Bear River near the Utah-Idaho stateline and below Cutler dam, below Porcupine and Hyrum dams on the Little Bear River, below Newton dam on Clarkston Creek, and near the Forest Service boundary on the Logan River, Blacksmith Fork and Summit Creek. In Cache County, more than 70 irrigation companies provide water to over 120,000 acres of irrigated land. In Box Elder County, over 105,800 acres are irrigated, with about 100 irrigation companies and private users involved in delivering the water. The Bear River Canal Company alone maintains over 120 miles of canals and laterals in Box Elder County (UDWR 1992).

2.7 Historic Water Quality

Water quality studies on the Bear River date back to the 1940s. Most of the early work focused on salinity and sediments. Within the past 20 years, concerns over nutrient and bacterial problems have dominated most of the water quality investigations. Table 2-2 summarizes the water quality studies which have been conducted on the Bear River.

Salinity was found by Waddell (1970) to increase from about 100 mg/liter near the headwaters to an average of 560 mg/liter as the river re-enters Utah from Idaho. Water below Cutler dam averaged between 800 and 900 mg/liter, increases associated with spring inputs and the Malad River. The highest salinity in the basin occurred in the Malad River, which averaged over 1,600 mg/liter from 1977-1992 (UDWQ unpublished data).

Changes in the geomorphology of the Bear River were noted in a study by Clyde (1953), which documented an increase in bed elevation of over six feet near the Utah-Idaho stateline from 1920 to 1948. This was attributed to massive inputs of sediments in the reach below Oneida Reservoir. In subsequent studies, large increases in sediment concentrations within that reach have been identified (Waddell 1970; Heimer 1978). Waddell (1970) noted mean total suspended solids (TSS) increased from 35 to 100 mg/liter from Oneida to Cutler reservoirs. Heimer (1978) determined sediment loads increased from an average of 68 tons/day (69,000 kg/day) below Oneida to over 350 tons/day (360,000 kg/day) near Preston, Idaho.

The USGS measured sediment concentrations in the Bear River at the Utah-Idaho border and below Cutler dam from 1987 through 1992. Their data at the stateline shows average daily sediment loads ranging from 6,600 kg/day in 1987 to 3,500,000 kg/day in 1989. The remaining four years were less

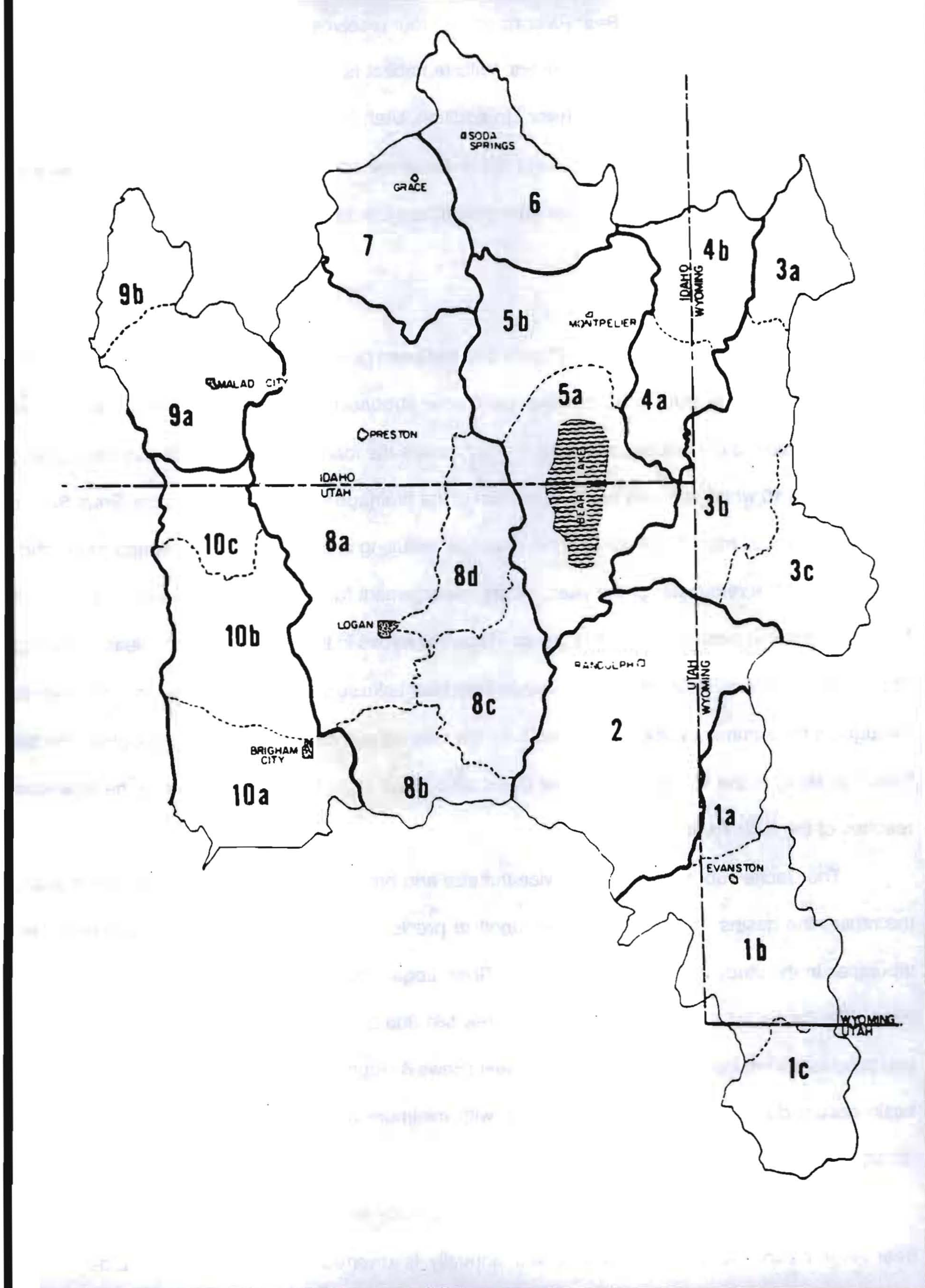

FIGURE 2-5. Hydrologic subbasins within the Bear River basin (from Hawes & Hughes 1973).

(UDWR 1992). Within the lower Bear River basin, the four reservoirs provide fishing opportunities, as do the Blacksmith, Little Bear and Logan rivers. Wildlife habitat is currently managed by the state of Utah along portions of the mainstem Bear River. In addition, Utah Power and Light is engaged in substantial recreation and habitat development around Cutler Reservoir and surrounding wetland areas as a result of the recent FERC relicensing of Cutler dam (PacifiCorp Electric Operations 1991).

2.6 Hydrology

The Bear River drainage basin (Figure 2-5) has been divided into ten hydrologic subbasins (Haws & Hughes 1973). The study area includes the Cache subbasin (number 8) which extends from below Oneida Reservoir to Cutler dam, subbasin 9 which drains the Idaho portion of the Malad River drainage, and subbasin 10 which includes the Utah portion of the drainage from Cutler dam to the Great Salt Lake. Snowmelt provides most of the water in the drainage, resulting in peak flows during spring runoff and low base flows for the remainder of the year. Water management for irrigation has somewhat altered these historic hydrologic patterns. Runoff is stored in four reservoirs in the study area and released during the growing season. In addition, irrigation releases from Bear Lake supplement the mainstem Bear River flows throughout the summer. Water is removed from the river via pumps and diversions throughout the basin. Power peaking at the Oneida and Cutler dams also result in highly variable flows in the downstream reaches of the Bear River.

The Cache subbasin is almost twice the size and produces more than twice the runoff of any of the other nine basins. It has the highest runoff to precipitation ratio, and includes most of the major tributaries in the study area, including the Cub River, Logan River, Blacksmith Fork River and Little Bear River. The Cache subbasin receives approximately 561,800 acre-feet of inflow water from the Bear River, and produces a net outflow of 1,129,000 acre-feet (Haws & Hughes 1973). The peak net outflow from this basin occurs during May (159,000 acre-feet), with minimum outflows in July, August and September (61,000 to 64,000 acre-feet).

Almost all of the water used for irrigation in the study area is surface water, originating within the Bear River basin. About 709,200 acre-feet annually is diverted in Cache and Box Elder counties, representing a depletion of about 422,600 acre-feet annually (UDWR 1992). Major diversions in the study

Creek, which enters the Little Bear just above Cutler Reservoir. Much of the runoff from Hyrum drains into this creek and the area is heavily used for agricultural activities. About 75 percent of the drainage is agricultural, of which 95 percent is irrigated. In addition, several agricultural-related industries (feedlots, rendering plants and packing plants) are located within this drainage. The southern fork of Spring Creek receives the effluent from Hyrum's WWTP, a meat packing plant and a large feedlot operation. Effluent from a small trout farm enters the northern fork of Spring Creek.

Several additional small tributaries to the Bear River in Cache Valley include Clarkston Creek and several sloughs which drain the low gradient areas surrounding Cutler Reservoir.

A number of springs enter the Bear River below Cutler dam, and account for much of its summer flow. Box Elder Creek enters the river near the town of Brigham City. Brigham City effluent discharges into this creek. The only other major tributary below Cutler Dam is the Malad River, which enters the Bear River about 20 miles above the Great Salt Lake. The Malad River originates in Idaho and drains about 480,000 acres to the west of Cache Valley. This subdrainage accounts for about 26 percent of the entire lower Bear River basin area and almost 90 percent of the area draining to the river below Cutler Reservoir. The Malad River originates in the lower elevation Malad ranges and the basin is heavily used for grazing and agriculture.

2.5 Demographics and Recreation

The 1990 census determined the population in Cache County to be 70,183, with a projected population of 102,431 by the year 2020 (BRAG 1990). Box Elder County had a 1990 population of 36,485 and a projected population of 53,300. These growth rates are typical of much of the Wasatch Front. Within Cache and surrounding counties, 31 percent of the population is employed in manufacturing, 19 percent in government, 14 percent in trades and 13 percent as proprietors. Agriculture accounts for 7.6 percent of the employment within the local economy, although many of the businesses in the project area are also agriculture related. The highest projected growth areas are construction and management, with projected significant increases in all other sectors except agriculture and mining.

Tourism is an increasingly important factor in the local economy. Water related recreational activities are important to the Utah economy, usually ranking in the top 12 of outdoor recreation activities ephemeral. It runs through the town of Smithfield, then through low gradient agricultural lands before draining into the Bear River above Cutler Reservoir. Most of the flow that reaches the Bear River occurs during runoff.

The Logan River subdrainage is approximately 163,000 acres. It leaves the Wasatch National Forest as it enters the city of Logan, then passes through residential and agricultural areas comprised mainly of cattle feed lots and dairy operations before reaching Cutler Reservoir. About 95 percent of the drainage is in the National Forest. The Logan River receives the storm drainage from the town of Logan. Irrigation diversions at the mouth of Logan Canyon divert a large percentage of the flow during summer months.

The Blacksmith Fork River has a drainage area of 184,000 acres, of which 97 percent is in the Wasatch National Forest. Once the river leaves the mountain canyon, it flows through agricultural land to eventually join the Logan River just southwest of the city of Logan. During the growing season, the Blacksmith Fork is diverted for irrigation purposes at a point near the National Forest boundary. Flows in the lower valley during the summer and fall are from local accrual and return flows.

The Little Bear River drains 182,000 acres and has two main subdrainages. The South Fork originates in the low elevation foothills of the Wellsville Mountains and the Bear River range. The East Fork drains a relatively extensive area of National Forest land, and is stored in the upper basin behind Porcupine Reservoir. Porcupine Reservoir's outflow is regulated for irrigation and flood control. Only about two percent of the area above the confluence of the two rivers is agricultural. Below their confluence, about 40 percent is agricultural. In the relatively short stretch between the confluence of the two streams and Hyrum Reservoir there are considerable inputs of pollutants, mostly nutrients from agricultural activities, a trout farm, and erosion from unstable streambanks. Hyrum Reservoir was originally constructed for irrigation and flood control. The Little Bear River below Hyrum dam conveys mainly irrigation return flow in the summer, but may receive high flushing flows in the spring and early summer during runoff events. About 52 percent of the drainage below Hyrum Reservoir is in agricultural use. The river passes through the towns of Hyrum, Wellsville and Mendon, and receives the effluent from the Wellsville Sewage Lagoons.

A small area (approximately 14,600 acres) in the southern portion of Cache Valley drains to Spring

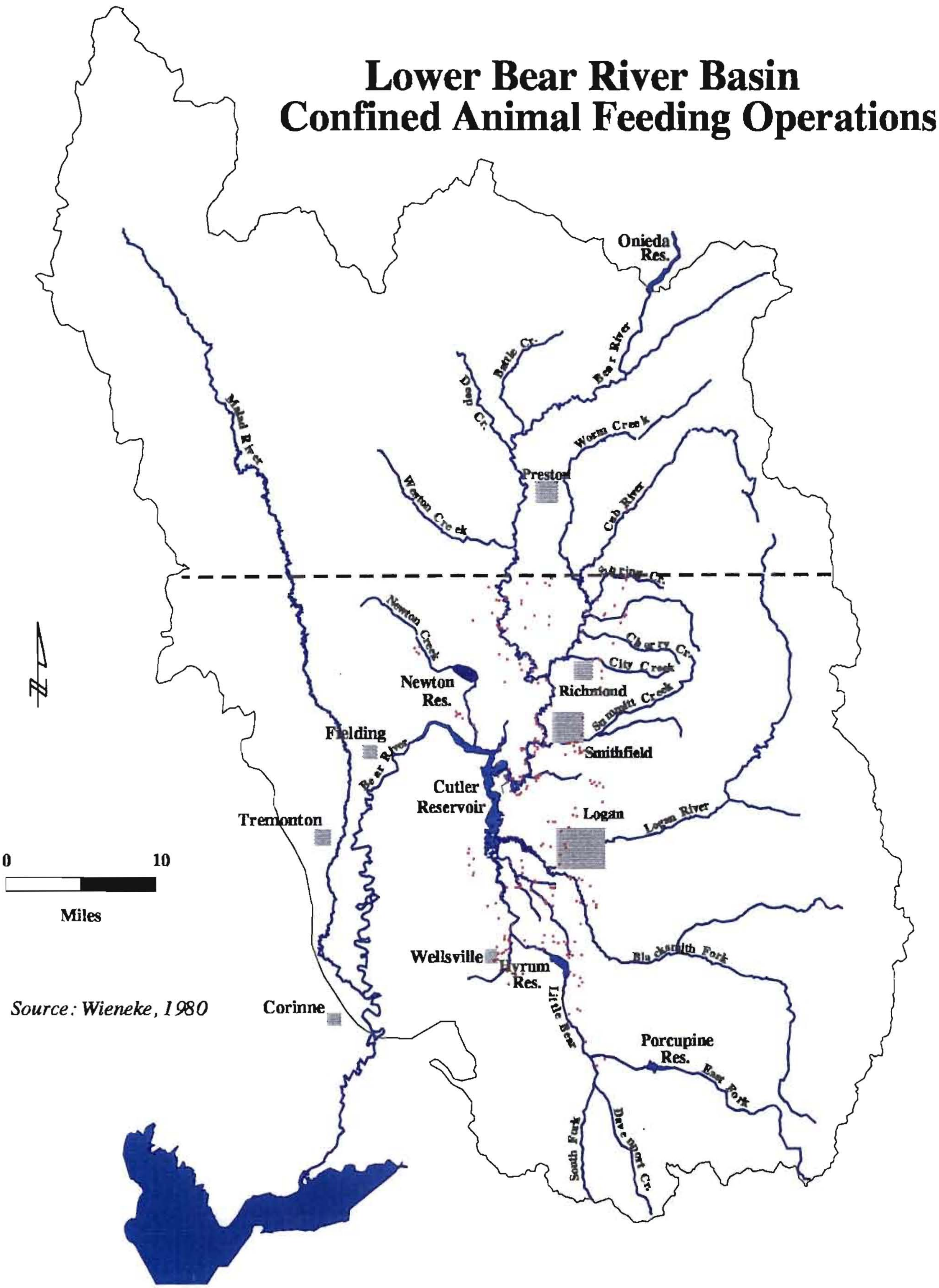

FIGURE 2-4. Lower Bear River CAFOs.

Lower Bear River Basin Monitoring Sites

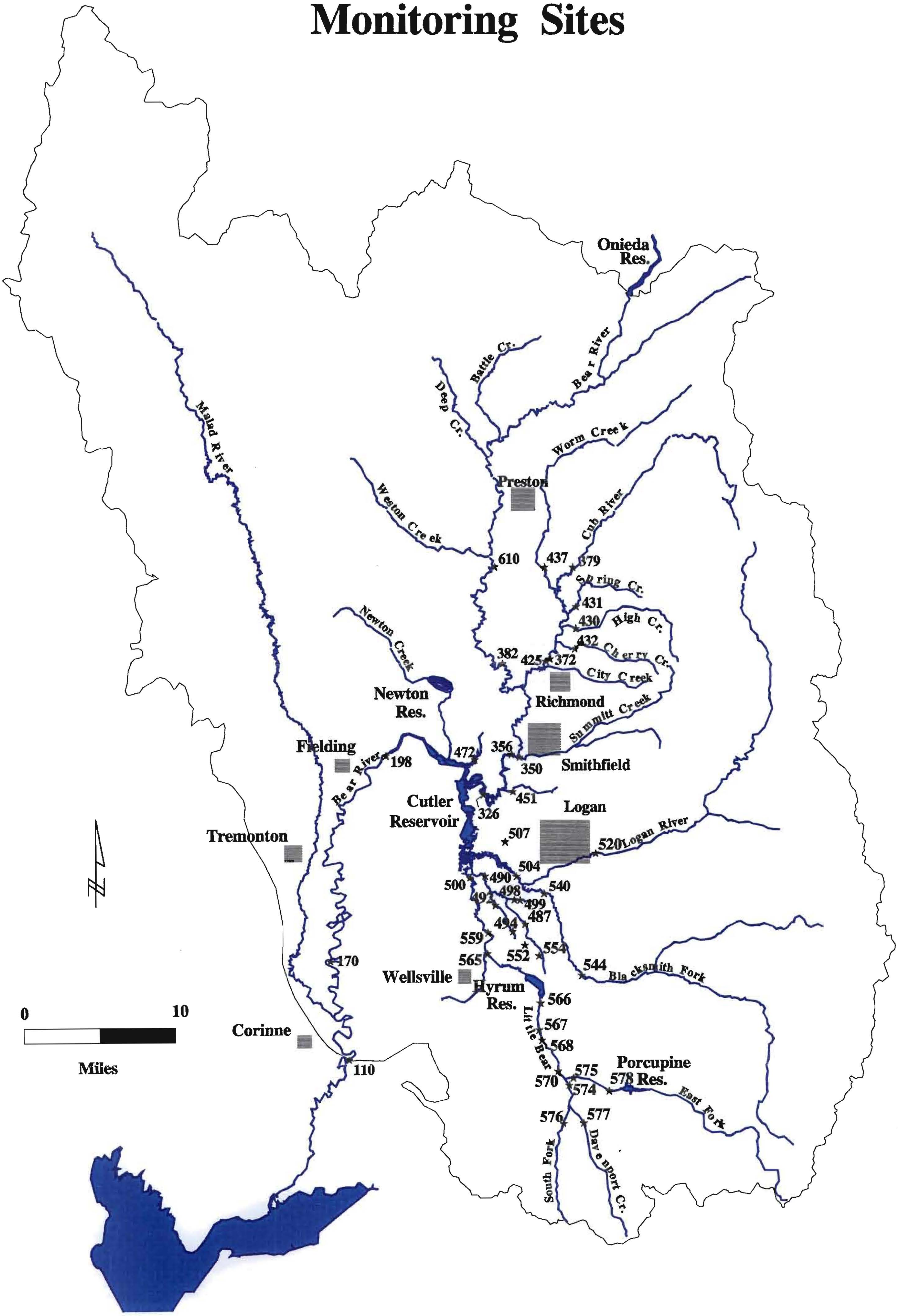

FIGURE 3-1. Lower Bear River basin monitoring sites. All numbers indicate the last three digits of the six digit STORET sample site number assigned by the state of Utah, UDWQ. All site numbers in the lower Bear River basin begin with the basin number 490.

TABLE 3-1. Location of each sample site on the mainstem Bear River and its tributary confluences. All distances are given in river miles above the Bear River Bird Refuge. The site numbers are STORET numbers assigned by the Utah Division of Water Quality. The first three numbers (490) are the basin code and are the same for all river and tributary sites in this study. To save space, these first three numbers are not included in many of the tables and figures. (SOURCE: 1:100K DLGs)

SITE NUMBER	DESCRIPTION	DISTANCE (river miles)	SAMPLER
Mainstem Bear River (miles above the Bear River Bird Refuge)			
490110	Bear River at Corinne at U83 xing	16.7	UDWQ
490170	Bear River below Honeyville on I-15	31.8	UDWQ
490198	Bear River below Cutler at UPL bridge	61.1	UDWQ
490326	Bear River above Cutler at Benson bridge	71.9	UDWQ
490356	Bear River at Amalga	79.3	ERI
490382	Bear River at Richmond	92.5	ERI
490610	Bear River west of Fairview, ID	106.4	UDWQ
Tributary Confluences (miles above the Bear River Bird Refuge)			
490119	Box Elder Creek	11.9	ERI
	Malad River	24.7	Not sampled
490310	Newton Creek	66.8	UDWQ
490472	Clay slough	68.1	ERI
490451	Hopkins Slough	75.8	ERI
490490	Spring Creek at south end of Cutler Reservoir	76.5	UDWQ
490500	Little Bear at south end of Cutler Reservoir	77.1	UDWQ
490350	Summit Creek	79.6	ERI
490504	Logan River above Little Bear River	85.1	UDWQ
490540	Blacksmith Fork above Logan River	86.1	ERI
490425	Cub River	87.0	ERI

TABLE 3-2. Location of each sample site in the Bear River tributary confluences. All distances on the mainstem Bear River are given in river miles above a reference point given in the table. For an explanation of the site numbers, see Table 3-1. (SOURCE: 1:100K DLGs)

SITE NUMBER	DESCRIPTION	DISTANCE (river miles)	SAMPLER
Little Bear River Drainage (distance from south end of Cutler - Mendon Road)			
490500	Little Bear above Logan River	0.0	UDWQ
490559	Little Bear above Wellsville	7.5	UDWQ
490565	Little Bear one mile below Hyrum Reservoir	9.7	UDWQ
490165	Hyrum Reservoir	13.6	ERI
490566	Little Bear above Hyrum Reservoir	16.7	ERI
490567	Little Bear below Trout of Paradise fish hatchery	18.7	ERI
490570	Little Bear west of Avon	22.1	ERI
490574	South Fork Little Bear above East Fork	23.4	ERI
490576	South Fork Little Bear above Davenport Creek	26.2	ERI
490577	Davenport Creek above South Fork Little Bear	26.6	ERI
490585	Davenport Creek above Wellsville	32.6	ERI
490575	East Fork Little Bear above South Fork	23.5	ERI
490578	East Fork Little Bear below Porcupine Reservoir	26.2	ERI
Spring Creek Drainage (distance from south end of Cutler - Mendon Road)			
490490	Spring Creek at Mendon Road	0.0	UDWQ
490499	Spring Creek 1.3 miles north of College Ward	4.2	UDWQ
490487	Hyrum Slough at Nibley/College Ward	5.6	UDWQ
490492	South Fork Spring Creek west of Pelican Pond	2.8	UDWQ
490494	South Fork Spring Creek at US89 Xing	5.1	UDWQ
Logan River Drainage (distance above south end of Cutler Reservoir - Mendon Road)			
490504	Logan River above Little Bear River	0.0	UDWQ
490520	Logan River at mouth of canyon	7.2	UDWQ
Blacksmith Fork Drainage (distance above confluence with the Logan River)			
490540	Blacksmith Fork above Logan River	0.0	ERI
490544	Blacksmith Fork at mouth of canyon	9.7	UDWQ

TABLE 3-2 (continued). Location of each sample site in the Bear River tributary confluences. All distances on the mainstem Bear River are given in river miles above a reference point given in the table. For an explanation of the site numbers, see Table 3-1. (SOURCE: 1:100K DLGs)

SITE NUMBER	DESCRIPTION	DISTANCE (river miles)	SAMPLER
Cub River Drainage (distance above confluence with the Bear River)			
490425	Cub River	4.4	ERI
490432	Cherry Creek confluence	6.2	ERI
490430	High Creek confluence	7.6	ERI
490431	Spring Creek confluence	9.0	ERI
490437	Worm Creek confluence	11.6	ERI
490379	Cub River at Utah-Idaho stateline	15.5	ERI

TABLE 3-3. Facilities discharging into state waters in the Lower Bear River basin. All sites were sampled by the Utah Division of Water Quality.

DISCHARGER	UPDES #	STORET #	DISCHARGE LOCATION
Logan Lagoons	UT0021920	490507	Cutler Reservoir
Gossner Foods	UT0024309		Blue Springs above Cutler
Brigham City	UT0022365		Box Elder Creek
Richmond Lagoons	UT0020907	490372	Cub River
Wellsville Lagoons	UT0020371	490560	Little Bear River
Trout of Paradise 001	UTG130015	490568	Little Bear River
Trout of Paradise 002	UTG130015	490571	Little Bear River
Hyrum WWTP	UT0023205	490552	Spring Creek (Little Bear)
EA Miller effluent	UT0000281	490554	Spring Creek (Little Bear)
Magic Valley effluent	UT0024872	490562	Wellsville Creek above Little Bear
Whites College Ward fish Hatchery	UTG130015	490562	North Fork Spring Creek
Silicone Plastics	UT0025186		Mill Creek
Silicone Plastics	UT0025160		Mill Creek

TABLE 3-4. Water quality parameters evaluated for the Bear River Water Quality Management Plan.

Parameter	Units	Method *	Detection Limit	Labs [B]
pH	S.U.	Hydrolab	0.1	ERI/UT SHL
Conductivity	µmhos/cm	Hydrolab	1.0	ERI/UT SHL
Dissolved Oxygen	mg/l	Hydrolab	0.1	ERI/UT SHL
Temperature	°C	Hydrolab	0.1	ERI/UT SHL
Nitrate	mg/l	353.3	0.005	ERI/UT SHL
Nitrite	mg/l	354.1	0.0005	ERI/UT SHL
Ammonia	mg/l	350.3	0.01	ERI/UT SHL
Orthophosphorus	mg/l	365.2	0.001	ERI/UT SHL
Dissolved Total Phosphorus	mg/l	354.2	0.002	ERI/UT SHL
Total Phosphorus	mg/l	354.2	0.002	ERI/UT SHL
Alkalinity	mg/l as $CaCO_3$	310.1	5	ERI/UT SHL
Volatile Total Suspended Solids	mg/l	160.4		ERI/UT SHL
Residual Total Suspended Solids	mg/l	160.1	1	ERI/UT SHL
Calcium	mg/l	215.2	1	ERI/UT SHL
Magnesium	mg/l	[A]	1	ERI/UT SHL
Hardness	mg/l	130.2	3	ERI/UT SHL
Chloride	mg/l	325.3	2	ERI/UT SHL
Sulfate	mg/l	375.4	0.001	ERI/UT SHL
Potassium	mg/l	200.7	1	UT SHL
Sodium	mg/l	200.7	1	UT SHL
Fecal Strep [C]	#100/ml	9230C		ERI/UT SHL
Total Coliforms	#100/ml	9222B		BRHD/UT SHL
Fecal Coliforms	#100/ml	9222D		BRHD/UT SHL
Chlorophyll *a*	µg/l	1002G		ERI/UT SHL
Arsenic (dissolved)	µg/l	200.9	5	UT SHL
Barium (dissolved)	µg/l	200.7	5	UT SHL
Cadmium (dissolved)	µg/l	200.9	1	UT SHL
Chromium (dissolved)	µg/l	200.9	5	UT SHL
Copper (dissolved)	µg/l	200.7	20	UT SHL
Iron (dissolved)	µg/l	200.7	20	UT SHL
Lead (dissolved)	µg/l	200.9	3	UT SHL
Manganese (dissolved)	µg/l	200.7	5	UT SHL
Selenium (dissolved)	µg/l	200.9	2	UT SHL
Silver (dissolved)	µg/l	200.9	2	UT SHL
Mercury (dissolved)	µg/l	245.1	0.2	UT SHL

(A) Magnesium hardness calculated by ERI as a difference between total hardness and calcium hardness.
(B) ERI: Ecosystems Research Institute Laboratory; UT SHL: Utah State Health Laboratory; BRHD: Bear River Health Department
(C) ERI does not maintain USEPA certification for fecal strep. The analyses was conducted at ERI's lab for all samples collected by ERI because all certified labs were too far away to deliver samples within the required holding times. All normal microbiological QA/QC procedures were followed by ERI.

* APHA et al. 1981, USEPA 1979

The Cub River accounted for 100 percent of the increase in NO_3 load as the Bear River passed from Richmond to Amalga. The Cub River contributed substantial loads of sediments and other nutrients as well. The major sources within the Cub River are Worm Creek, the Cub entering from Idaho, and drainage directly to the Cub River within Utah. Sediment inputs were closely associated with flow, with Idaho contributing the largest load, while nutrient inputs came disproportionately from the Utah portion of the drainage.

Other Bear River tributaries sampled in 1993 included Summit Creek, Hopkins Slough, Clay Slough and Newton Creek. Summit Creek was sampled only during runoff and during this time showed no evidence of impaired water quality. Hopkins Slough had extremely poor water quality, with high nutrients and high coliform concentrations. Hopkins Slough has a minor impact on Bear River water quality only because of its low average flows. Clay Slough had high conductivity and extremely high phosphorus concentrations. It accounted for five percent of the total and dissolved phosphorus increases in Cutler and over nine percent of the increased nitrate. Because Newton Reservoir did not spill during the monitoring period, Newton Creek had very low or no flows through most of the monitoring period.

Metals were measured quarterly. All concentrations were low, with no violations of state standards.

3.2 Biological Monitoring

Total coliform concentrations were elevated at four of the five sites in the Spring Creek drainage, in the Little Bear River below a fish hatchery and below the Wellsville sewage lagoons, in Hopkins Slough and Worm Creek (Figure 3-2). Violations of state standards for fecal coliform were more frequent, occurring sporadically along the mainstem Bear River and within each of the subdrainages except the Blacksmith Fork (Figure 3-3). Again, the highest concentrations occurred in the Spring Creek drainage, in Worm Creek and Hopkins Slough. The ratio of fecal coliform to fecal streptococcus was used to identify sources of fecal contamination. The site at Worm Creek above the Cub River had the highest ratios, suggesting a possible human source of contamination at this site.

Macroinvertebrates were sampled at 13 sites in the drainage in late summer. Samples from the Bear River at the stateline and near Richmond had few taxa and were dominated by sediment and organic

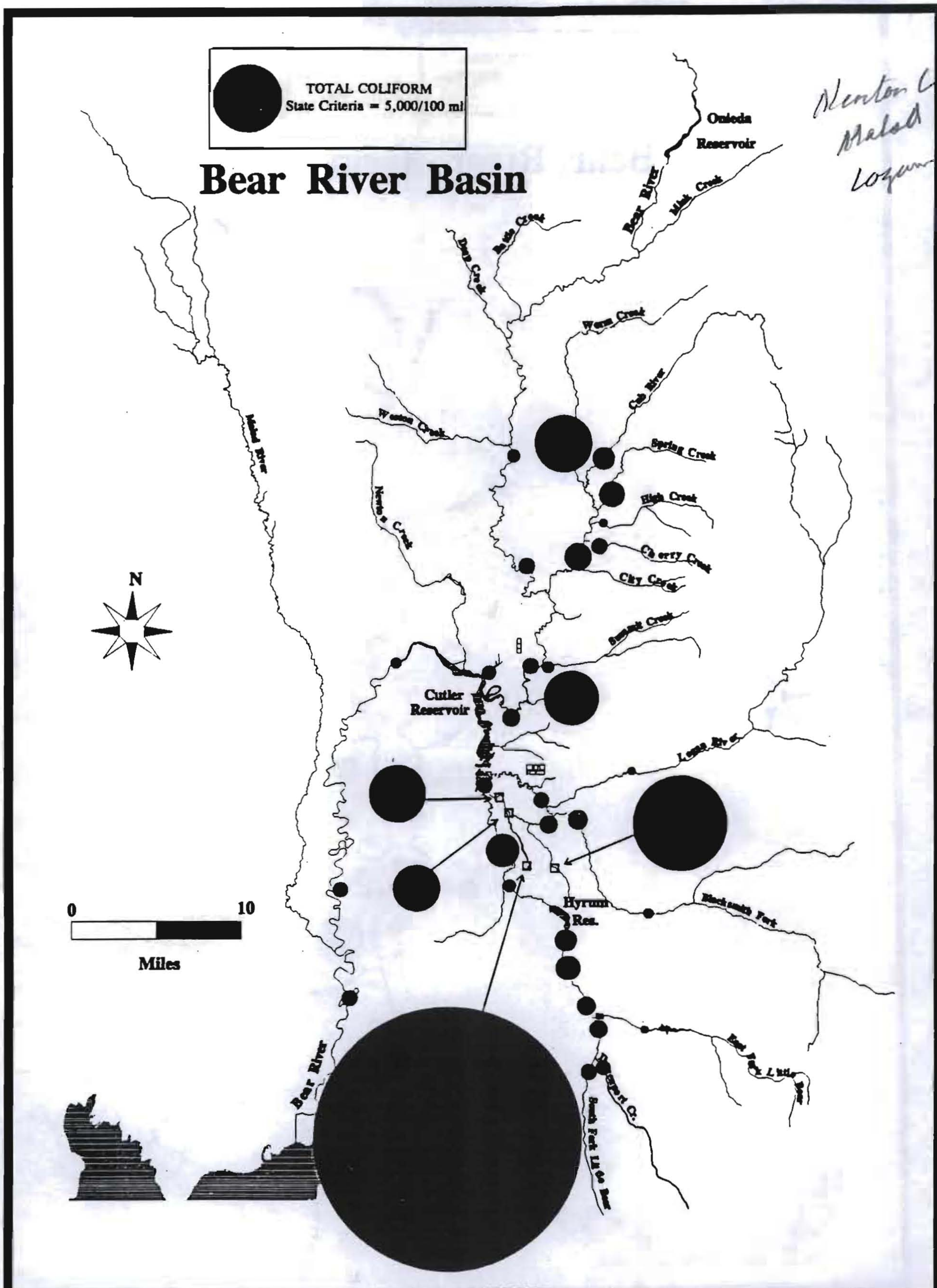

FIGURE 3-2. Total coliform concentrations from October 1992 through September 1993 at each sample location. The area of the circle is proportional to the geometric mean concentration.

Newton Creek
Malad River
Logan

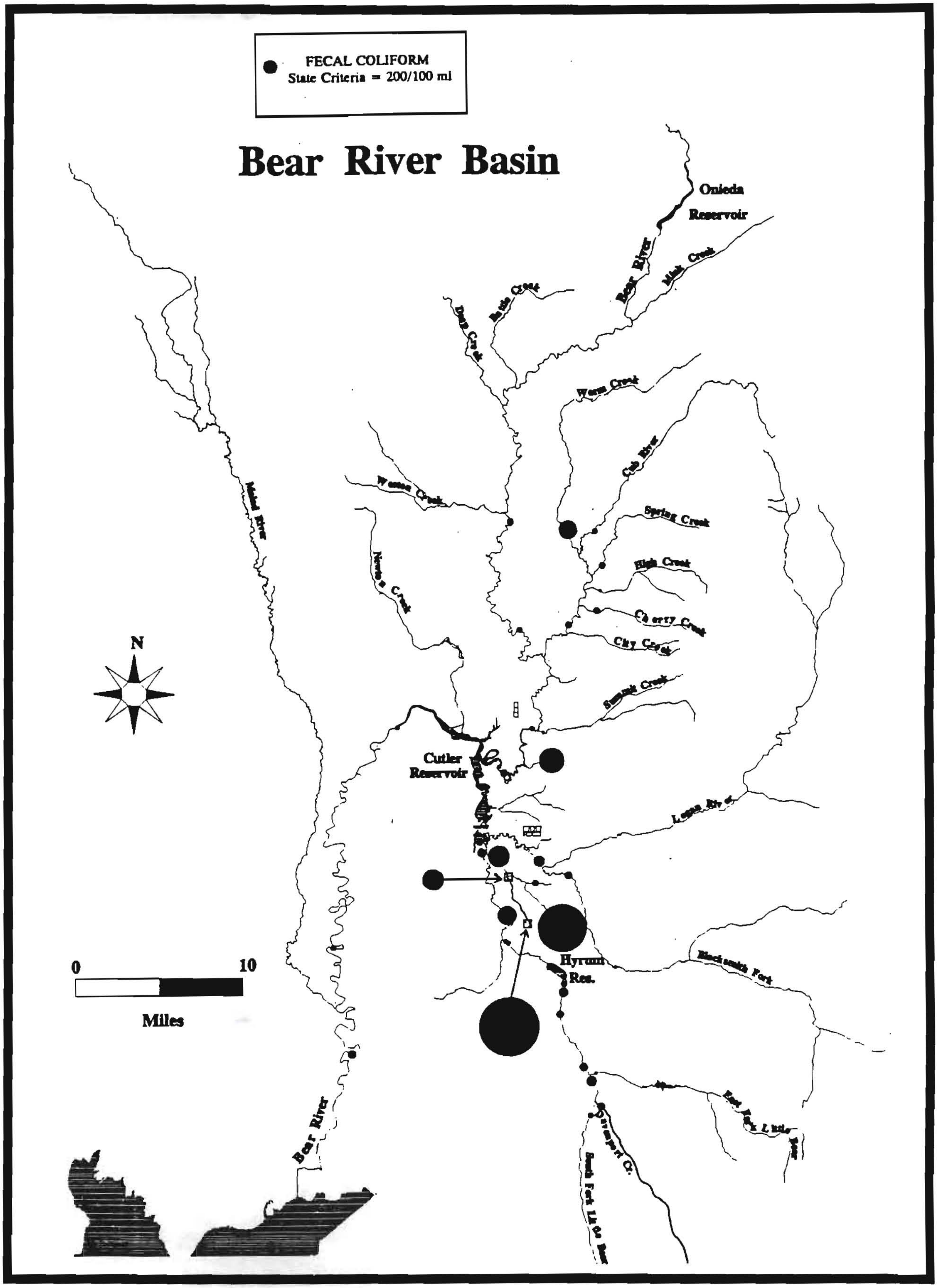

FIGURE 3-3. Fecal coliform concentrations from October 1992 through September 1993 at each sample location. The area of the circle is proportional to the geometric mean concentration.

tolerant species. More species were found at the site near Corinne, but the fishery potential at all these sites was considered low due to poor substrate. The site below Cutler had greater diversity and species richness, with the species present indicative of improved substrate.

Sites in the Little Bear drainage indicated fair to good diversity with a fair fishery potential due to limited substrate. Spring Creek was only sampled at a point high in the drainage and the samples were dominated by amphipods. The Cub at the stateline, Worm Creek, and Hopkins Slough were dominated by pollution tolerant species. The Cub above the Bear River had higher diversity and species richness, possibly because of microhabitat formed in the hard clay substrate from hoof prints. The Logan River and the Blacksmith Fork had good abundance, high number of taxa and high diversity indices.

3.3 Basin Wide Water Quality Patterns

Utilizing the mainstem and tributary data for average daily mass loadings, a comprehensive picture can be obtained for the water quality conditions within the Bear River watershed relative to the TMDL process. Figures 3-4 through 3-6 present annual average daily loadings of TSS, TP and DTP throughout the lower Bear River drainage. The width of the line in these figures is proportional to the loading. Point source inputs are shown, as are reach gains and losses. Reach gains which are not attributable to point sources are assumed to be nonpoint in origin.

The general patterns are different for particulate and dissolved pollutants. The Bear River entered the state with an annual average TSS load almost half the size of the load at Cutler (Figure 3-4). Large gains were recorded along all but one of the Bear River reaches. Tributaries and point sources were, by comparison, relatively small contributors to the total TSS load.

In contrast to TSS, the DTP loads at the stateline were relatively small. Major inputs occurred from the Cub River, and again within Cutler Reservoir. The high relative inputs of Spring Creek and the point sources are apparent (Figure 3-5).

Total phosphorus is a combination of dissolved and particulate phosphorus (Figure 3-6). The loading patterns for total phosphorus reflect the combination of these two forms. The TP load crossing the stateline was about one third of the TP load observed at Cutler. Point and tributary inputs were significant for TP as well.

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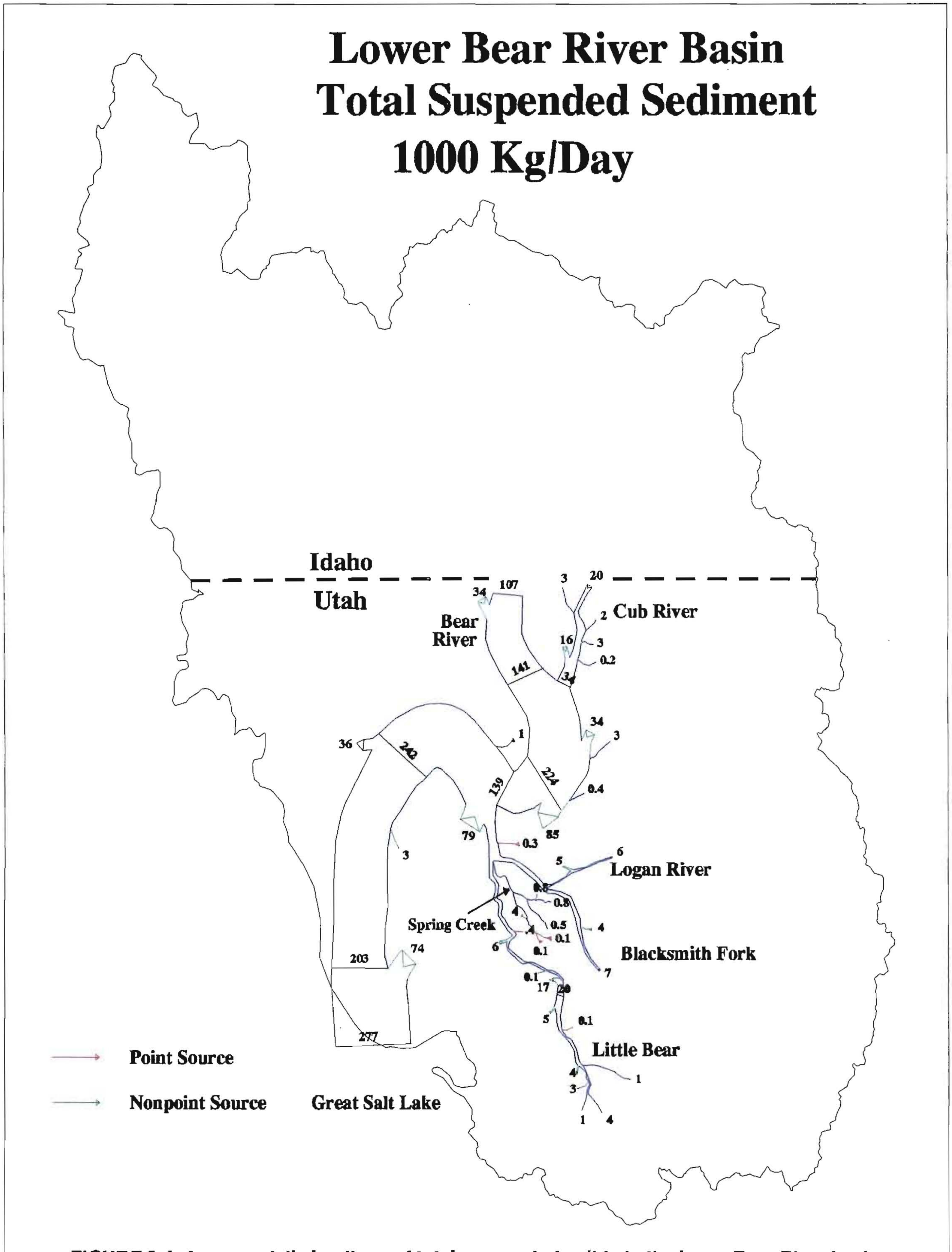

FIGURE 3-4. Average daily loadings of total suspended solids in the lower Bear River basin.

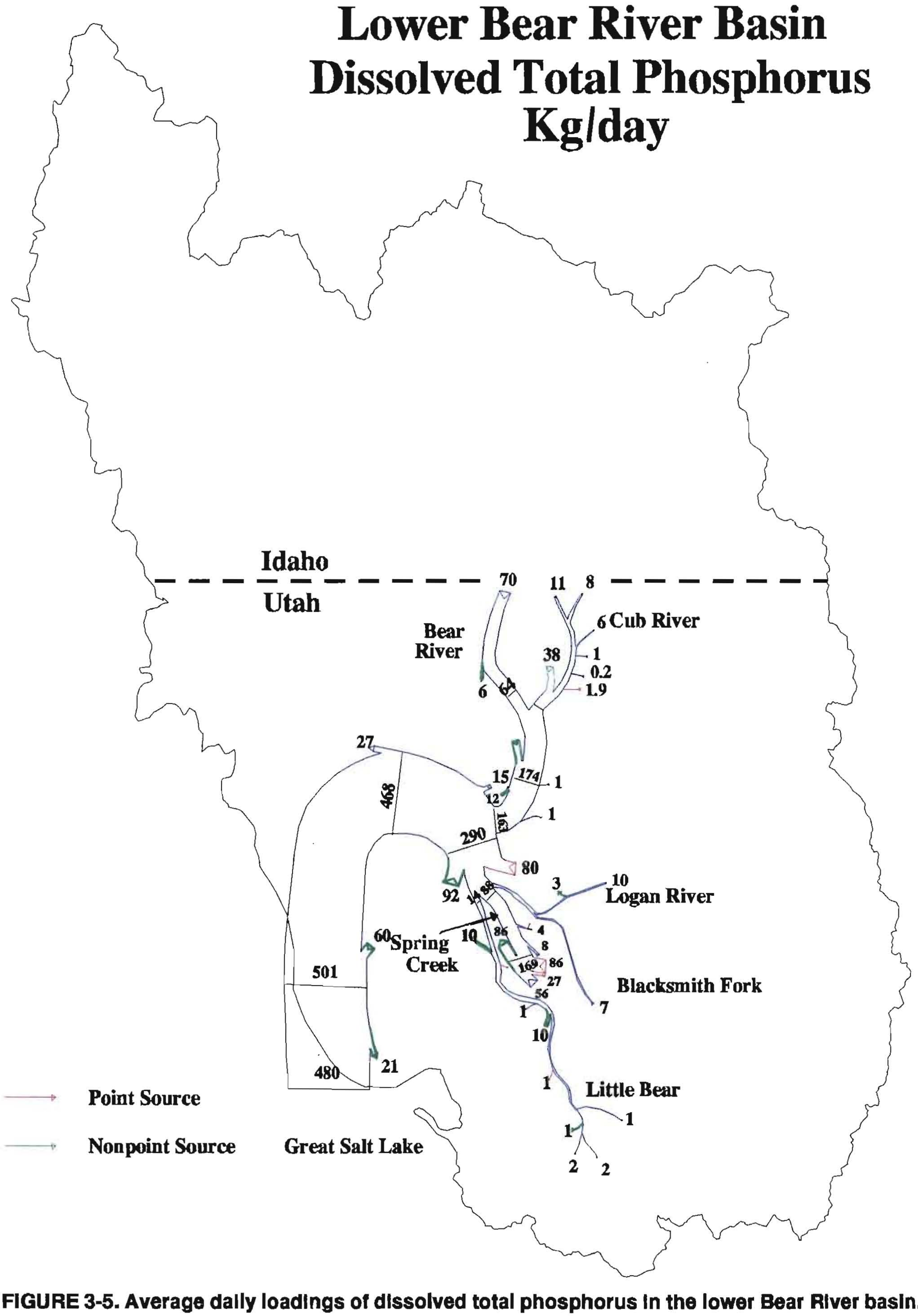

FIGURE 3-5. Average daily loadings of dissolved total phosphorus in the lower Bear River basin.

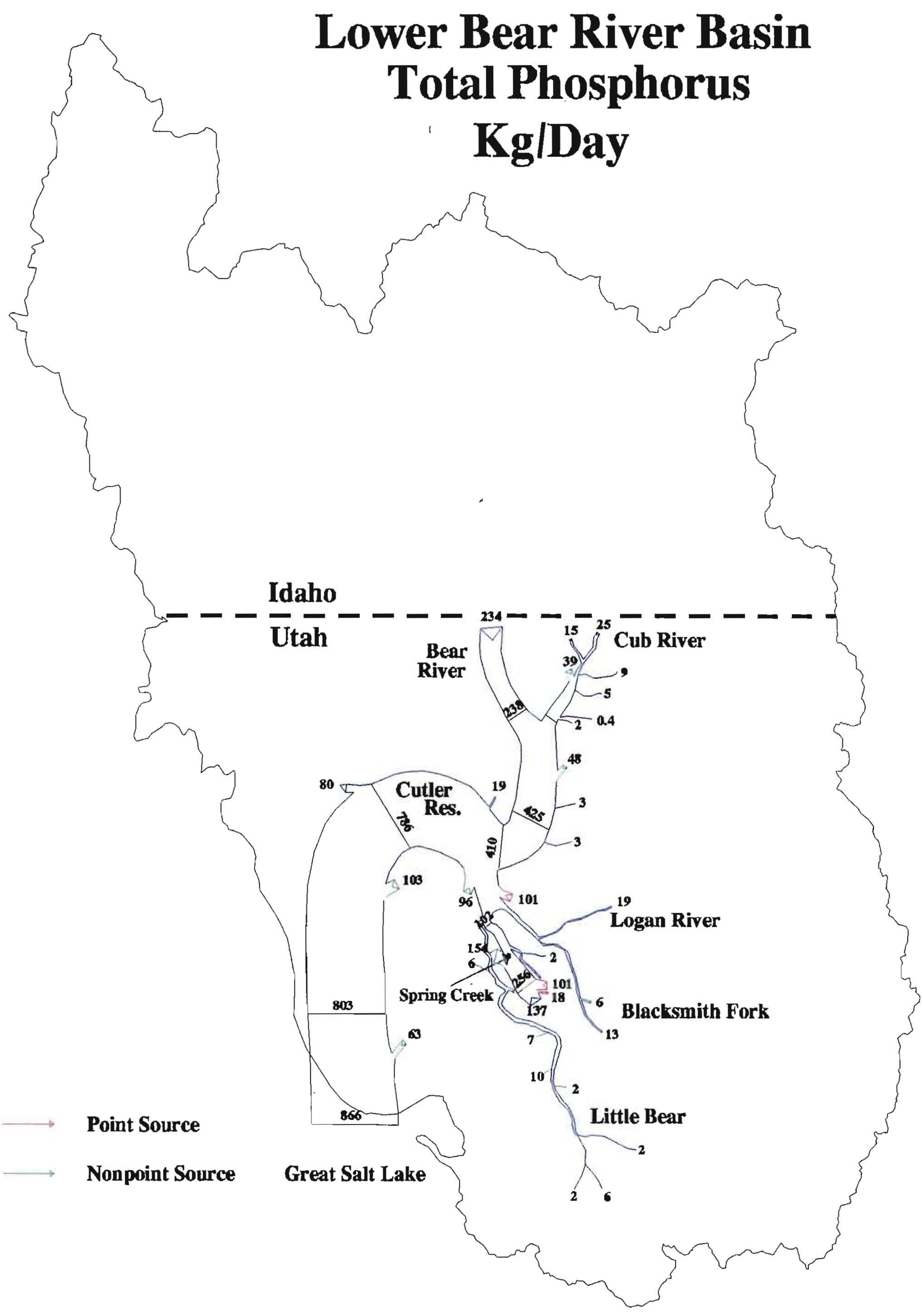

FIGURE 3-6. Average daily loadings of total phosphorus in the lower Bear River basin.

4.0 BENEFICIAL USES, STANDARDS AND THE TMDL PROCESS

This plan is intended to be used as a tool for local officials to help protect and improve the many beneficial uses provided by our local waterbodies. This plan is also to be used as a guide by UDWQ in carrying out its water quality program in the Bear River basin. All existing programs, tools and regulations now available to UDWQ would be used in this process.

The Bear River Water Quality Plan is being developed as part of a consensus process. Granting the plan sufficient authority to focus the use of program resources, influence internal planning, and exercise the agency's mandate to manage the resource is a direct extension of UDWQ's commitment to the consensus process.

The rational for watershed plans is to consolidate and fulfill as many requirements as is possible within one product. This has significant efficiency and effectiveness ramifications for the agency. Giving sufficient recognition to the plan is also consistent with guidance from several state and federal statutes, including but not limited to the following:

Utah Code 19-5 Water Quality Act contains adequate authority to carry out this process. Section 19-5-104(m) states: "***(The Board shall) establish and conduct a continuing planning process for control of water pollution including the specification and implementation of maximum daily loads of pollutants.***" Other specific statements in Powers and Duties of the Board related to the Watershed Approach are 19-5-104(a), (b), (c), (d), and (j).

Clean Water Act, Section 303(e) (1) states: "***Each State shall have a continuing planning process approved under paragraph (2) of this subsection which is consistent with this Act.***" Section 303(e)(3) states: "***The Administrator shall approve any continuing planning process submitted...which will result in plans for all navigable waters within such State, which include...(A) effluent limitations and schedules of compliance...(B) the incorporation of all elements of any applicable areawide waste management plans under section 208, and applicable basin plans under section 209 of this Act.***"

4.1 Public Involvement

A local steering committee for the Bear River Water Quality Management Plan (BRWQMP) was formed at the initiation of this project. This committee is composed of representatives of local user groups, communities, agencies and private entities concerned with water quality. The committee has met four times for updates on the plan, and has supplied valuable insights on local concerns. Issues addressed by the public steering committee were the criteria to be used in setting total maximum daily loads, ranking problem reaches and reservoirs, targeting specific reaches for additional work and review of draft plans.

As part of this project, a symposium on Bear River Water Quality was held in Logan, Utah on April 6-8, 1993. The symposium was an attempt to pull together policy makers and researchers to discuss water quality concerns, research results and policy issues in the Bear River basin. Panel sessions included elected government and agency representatives from Utah, Idaho and Wyoming as well as representatives from the U.S. Environmental Protection Agency, U.S. Geological Survey,and U.S. Forest Service. In addition, a total of 31 technical papers were presented. The symposium was attended by over 200 people. Out of this symposium, a tri-state committee was formed to address water quality issues throughout the entire Bear River basin.

Information about the current project has been presented to a number of different local groups. These include Box Elder County and Cache County mayor's associations, the steering committee for the Little Bear Hydrologic Project, the Bear River tri-state water quality committee, the Cache County water quality committee, a Utah State University (USU) sponsored symposium on nonpoint issues, and the local Audubon Society. In addition, articles have appeared in the local daily and weekly newspapers about the Bear River project. A public meeting presenting preliminary results was held June 15, 1994. At this meeting, comments were solicited and a questionnaire was distributed. Responses were incorporated into the final draft plan.

Several other projects are also underway in the lower Bear River basin. The Soil Conservation Service (SCS) began a demonstration nonpoint project (Little Bear Hydrologic Unit Project) in 1992. There has been considerable interest by local farmers and property owners in the project area, and there has been good media coverage and reporting to various sectors of the local government. Within the Little

Bear watershed, the SCS has spent over $175,000 on BMPs (fencing, off-river watering, riparian revegetation and bank stabilization, manure bunkering) by the end of 1994, as well as disseminating information of no-till agriculture, fertilizer management and other management issues. Other public concerns in the basin have included a highly visible effort by citizens in Box Elder County to initiate garbage cleanup along the shores of the Bear River below Cutler Reservoir.

4.2 Designated Beneficial Uses of the Bear River and its Tributaries

The beneficial uses supported by lakes, reservoirs and rivers in Utah are broken down into several general categories (UDWQ 1992b). These include uses for domestic water supplies, recreation and aesthetics, providing an adequate habitat for aquatic wildlife and providing irrigation waters for agriculture (Table 4-1). The state of Utah has determined uses and classifications of each of the rivers, lakes and reservoirs in the state. All waterbodies in the lower Bear River basin are protected for boating, wading and other light-contact recreation, for agricultural uses and for aquatic wildlife. The Little Bear River, Blacksmith Fork, Logan River and several smaller streams and their tributaries are considered cold water fisheries, while the remainder of the waterways are protected for warm water fisheries. Table 4-2 summarizes the beneficial use designations for the lower Bear River and its tributaries.

Instream standards for various water quality parameters are established by the state to protect these specific designated uses (UDWQ 1992b). Table 4-3 is a partial summary of these standards and Appendix V includes a complete listing of all standards and classifications for all lower Bear River waters. In addition to the enforceable criteria, the state of Utah has established several water quality indicators. As the name suggests, high concentrations of these parameters (e.g. total phosphorus) indicate potential water quality problems and the need for additional information.

Several non-numeric standards also exist to protect water quality (UDWQ 1992b). The anti-degradation policy states that when water quality is better than the state standard, it should be maintained at that higher quality unless there are compelling economic or social reasons to allow it to deteriorate, although at no time may water quality deteriorate to below the water quality standard. Narrative standards written into the code further state that no discharges may be made which would result in deteriorated conditions or would adversely affect desirable aquatic life.

TABLE 4-1. Designated use classifications for waters in the state of Utah. (From State of Utah Water Quality Assessment for 1992, Section 305b).

BENEFICIAL USE CLASSIFICATIONS FOR WATER IN THE STATE OF UTAH	
Class 1	Protected for use as a raw water source for domestic water systems.
Class 1A	Reserved.
Class 1B	Reserved.
Class 1C	Protected for domestic purposes with prior treatment processes as required by the Utah Department of Health.
Class 2	Protected for in-stream recreational use and aesthetics.
Class 2A	Protected for recreational bathing (swimming).
Class 2B	Protected for boating, water skiing, and similar uses, excluding recreational bathing (swimming).
Class 3	Protected for in-stream use by aquatic life.
Class 3A	Protected for cold water species of game fish and other warm water aquatic life, including the necessary aquatic organisms in their food chain.
Class 3B	Protected for warm water species of game fish and other warm water aquatic life, including the necessary aquatic organisms in their food.
Class 3C	Protected for nongame fish and other aquatic life, including the necessary aquatic organisms in their food chain.
Class 3D	Protected for waterfowl, shore birds, and other water-oriented wildlife not included in Classes 3A, 3B, or 3C, including the necessary aquatic organisms in their food chain.
Class 4	Protected for agricultural uses including irrigation of crops and stockwatering.
Class 5	Reserved.
Class 6	Water requiring protection when conventional uses as identified in Section 2.6.1 through 2.6.5 do not apply. Standards for this class are determined on a case-by-case basis.

TABLE 4-2. Designated use classification of river sections in the Bear River drainage.

LOCATIONS	Domestic Source	Recreation & Aesthetics		Aquatic Wildlife				Agricultural
	(1C)	(2A)	(2B)	(3A)	(3B)	(3C)	(3D)	(4)
Mainstem Bear and tributaries, except where listed below			X		X			X
Blacksmith Fork and tributaries with Logan River			X	X				X
Cub River, except High Creek from confluence with Cub River to headwaters			X		X			X
Little Bear and tributaries from Cutler Reservoir to headwaters			X	X			X	X
Logan River and tributaries from Cutler Reservoir to headwaters			X	X				X
Spring Creek			X	X				X
Cutler			X		X		X	X
Hyrum Reservoir		X	X	X				X
Newton Reservoir			X		X			X
Porcupine Reservoir			X	X				X

TABLE 4-3. State water quality standards and pollution indicator values for water quality parameters evaluated in the historical data set.

PARAMETER	Domestic Source	Recreation & Aesthetics		Aquatic Wildlife				Agricultural
-	(1C)	(2A)	(2B)	(3A)	(3B)	(3C)	(3D)	(4)
<u>BACTERIOLOGICAL</u>								
Maximum Total Coliforms	5,000	---	5,000	---	---	---	---	---
Maximum Fecal Coliforms	2,000	---	200	---	---	---	---	---
<u>PHYSICAL</u>								
Minimum Dissolved Oxygen (mg/l)	5.5	---	5.5					
30-day average dissolved oxygen				6.5	5.5	5.0	5.0	
2-day average dissolved oxygen				9.5/5.0	6.0/4.0			
1-day average dissolved oxygen				8.0/4.0	5.0/3.0	3.0	3.0	
pH (units)	6.5-9.0	---	6.5-9.0	6.5/9.0	6.5/9.0	6.5/9.0	6.5/9.0	6.5/9.0
Turbidity increase (NTU)				10	10	15	15	
Temperature (°C)								
Maximum				20	27	27		
Maximum temperature change				2	4	4		
<u>INORGANICS (mg/l)</u>								
Ammonia (NH_3)								
4-day average				***	***	***	***	
1-hour average				***	***	***	***	
Nitrates	10							
Total Dissolved Solids								1200
<u>POLLUTION INDICATORS (mg/l)</u>								
Nitrate (mg N/l)			4	4	4	---	---	---
Phosphate (mg P/l)			0.05	0.05		---	---	---

*** *Dependent upon temperature and pH.*

An important part of the water quality regulations of the state is the UPDES program. Those responsible for point sources which discharge into a waterbody are required to obtain a State of Utah discharge permit. The state determines the maximum allowable discharges of various pollutants from each source, and establishes a monitoring and reporting program for these different sources.

Many of the enforceable criteria are for hazardous substances such as metals and organic pesticides and are intended to protect human health. Bacterial contamination is controlled because it represents possible fecal contamination and thus is also a health hazard. Additional standards such as dissolved oxygen, pH, temperature and NH_3 are established to protect fisheries and other aquatic wildlife.

Limits on nutrients (phosphorus and nitrates) are suggested because of the secondary impact these can have in waterbodies. Just as on land, these function as plant foods and can cause increased growth of large aquatic plants, periphyton (mats of small plants attached to rocks and other surfaces) or microscopic algae. In many cases, the primary concern is algal growth in reservoirs. Excessive plant growth leads to reduced dissolved oxygen and increased pH, due in part to plant respiration at night and to decay of dead plant materials. In rivers, dissolved oxygen sags can impact fisheries, restricting spawning areas and altering macroinvertebrate communities. Excessive nutrients in reservoirs result in algal blooms, and ultimately low dissolved oxygen, which again leads to fish kills or altered fish and macroinvertebrate communities. In addition, some types of algae may form floating mats of debris, causing noxious odors and other aesthetic problems. In extreme cases, noxious algal blooms are toxic to cattle and other mammals.

Suspended solids are not controlled by numeric criteria, but fall within the non-degradation clauses of the Utah code. Apart from an aesthetics problem, silts cover spawning areas and adversely affect aquatic food chains and fisheries. Turbidity can greatly limit the feeding and survival of many fish (Newcombe 1986). Sediments can fill reservoirs to the point that storage capacity is greatly reduced, limiting the usefulness of the reservoirs for all beneficial uses.

4.3 Exceedences of Historic Water Quality Standards as They Relate to Beneficial Uses

The State of Utah Division of Water Quality (UDWQ) maintains a monitoring program on waters of the state to determine whether the designated beneficial uses for these waters are being supported.

Water quality monitoring within the Bear River basin has been conducted since the mid-1970s, and several stations have continuous databases since that time. Since 1988, the monitoring has typically been every six weeks, except when special studies such as this one called for more frequent sampling. The UDWQ has defined full and partial support of beneficial uses (UDWQ 1992b). Conventionals (dissolved oxygen, temperature, pH, total dissolved solids) are defined as fully supporting when standards were exceeded in less than 10 percent of the samples, as partially supporting when 25 percent or fewer of the samples exceed standards, and as non-supporting when standards are exceeded in more than 25 percent of the samples. For priority pollutants (e.g. un-ionized ammonia), full support is defined as two or fewer exceedences over three years of quarterly samples.

Table 4-4 lists all historic water quality stations and the percent of samples which have exceeded criteria over the sampling period. Because of the variable sampling periods, comparisons between sites are difficult. In summary, dissolved oxygen exceedences have been a problem in the Spring Creek, Little Bear, Logan and Blacksmith Fork drainages. Ammonia, temperature, pH, and TDS have not been consistent problems at any sites. Coliform contamination has occurred throughout the basin, although at several sites (e.g. the Blacksmith Fork sites) these data were collected only during the late 1970s, and do not reflect more recent conditions. Total phosphorus has exceeded the pollution indicator concentration throughout the lower Bear River, the Cub drainage, the lower Little Bear drainage, and the Spring Creek drainage. Nitrate concentrations have exceeded the indicator level far less frequently, and in general appear to have been a problem only in the Spring Creek drainage.

The Bear and Cub rivers have historically had high concentrations of suspended solids. Concentrations have exceeded 40 mg/liter in over half of all samples collected since the 1970s. In 20 percent of all samples TSS was greater than 100 mg/liter (Figure 4-1). In contrast, the Logan and Blacksmith Fork drainages have had very low TSS concentrations most of the time, with concentrations exceeding 35 mg/liter in only 10 percent of the samples. The Little Bear and Spring Creek drainages have intermediate suspended solids concentrations. Over 70 percent of all samples collected in the Little Bear had TSS concentrations less than 25 mg/liter. Spring Creek had higher TSS, with 70 percent of the samples greater than 55 mg/liter. During low flow periods, Spring Creek TSS concentrations were twice those of the Little Bear River.

TABLE 4-4. Percent of historic water quality samples which exceeded state standards or water quality indicator concentrations from 1976 to 1992. The state considers sites where more than 25 percent of the samples exceed the standard as non-supporting. These cases are in bold.

			Enforceable Standards								Water Quality Indicators	
LOCATION	DATES	# OF SAMPLES	TDS	Temp	DO	pH	NH_3		COLIFORMS**		TP*	NO_3*
							4-day	1-hour	Total	Fecal		
Mainstem Bear River												
610 - west of Fairview	1976-92	126-170	0	0	0	2	<1	0	3	**38**	72	0
382 - west of Richmond	1982-92	14-38	0	0	0	4	3	0	0	14	79	0
326 - above Cutler	1982-92	13-71	0	0	3	3	1	0	0	15	79	0
198 - below Cutler	1977-92	30-121	<1	0	<1	0	2	0	6	**30**	92	0
110 - near Corinne	1976-92	126-146	20	<1	2	2	2	0	10	**44**	100	0
Cub Drainage												
379 - at stateline	1977-92	31-59	0	0	6	0	0	0	3	**48**	89	0
425 - U142 Xing	1976-92	31-94	0	4	13	4	3	0	0	0	94	0
Spring Creek												
487 - Hyrum slough	1992	10	ND	0	20	0	20	10	**60**	**80**	80	0
490 - Mendon xing	1992	9-11	ND	9	**36**	0	9	0	**60**	**89**	100	45
492 - west of Pelican Pond	1992	11	ND	0	ND	0	9	9	**64**	**73**	100	76
494 - US 89 xing	1992	11	ND	9	**64**	0	18	9	**82**	**73**	100	82
499 - n. of College Ward	1992	1-13	0	0	23	0	0	0	0	17	38	0
Logan River												
520 - mouth of canyon	1977-92	12-116	0	<1	11	0	0	0	0	25	19	0

TABLE 4-4 (continued). Percent of historic water quality samples which exceeded state standards or water quality indicator concentrations from 1976 to 1992. The state considers sites where more than 25 percent of the samples exceed the standard as non-supporting. These cases are in bold.

			Enforceable Standards								Water Quality Indicators	
LOCATION	DATES	# OF SAMPLES	TDS	Temp	DO	pH	NH_3		COLIFORMS**		TP*	NO_3*
							4-day	1-hour	Total	Fecal		
Logan River (continued)												
504 - abv. conf. with LB	1976-92	19-23	0	4	22	0	0	0	ND	ND	23	0
Blacksmith Fork												
544 - mouth of canyon	1977-92	15-117	0	0	20	4	0	0	0	**30**	27	0
540 - above Logan River	1977-92	18-44	0	3	25	0	3	3	**28**	**94**	44	0
Little Bear												
576 - above Davenport Crk	1990-92	9-27	ND	11	**26**	0	0	0	4	11	8	0
577 - Davenport abv S. Fork	1990-92	11-26	ND	8	15	4	0	0	4	14	8	0
578 - below Porcupine	1976-79,	15-40	0	0	8	0	0	0	4	14	18	0
575 - above conf. w/S. Fork	1990-92	7-23	ND	9	4	0	0	0	0	0	0	0
574 - above conf. w/E. Fork	1990-92	8-25	ND	12	12	0	0	0	0	25	17	0
570 - west of Avon	1977-92	40-120	0	3	14	5	0	0	3	7	31	0
567 - below White Trout farm	1977-92	22-48	9	2	17	0	0	0	**35**	**48**	80	0
565 - below Hyrum reservoir	1976-92	17-63	0	11	8	0	0	0	7	**37**	61	0
559 - below Wellsville	1992	1-15	ND	9	**36**	0	0	0	**27**	**55**	88	0
500 - above Logan River	1977-92	45-131	<1	7	**37**	0	2	0	20	**57**	66	2

* *TP and NO_3 are non-enforceable pollution indicator levels.*
** *In general, coliform samples were collected far less frequently than other parameters and represent the low end of the range.*

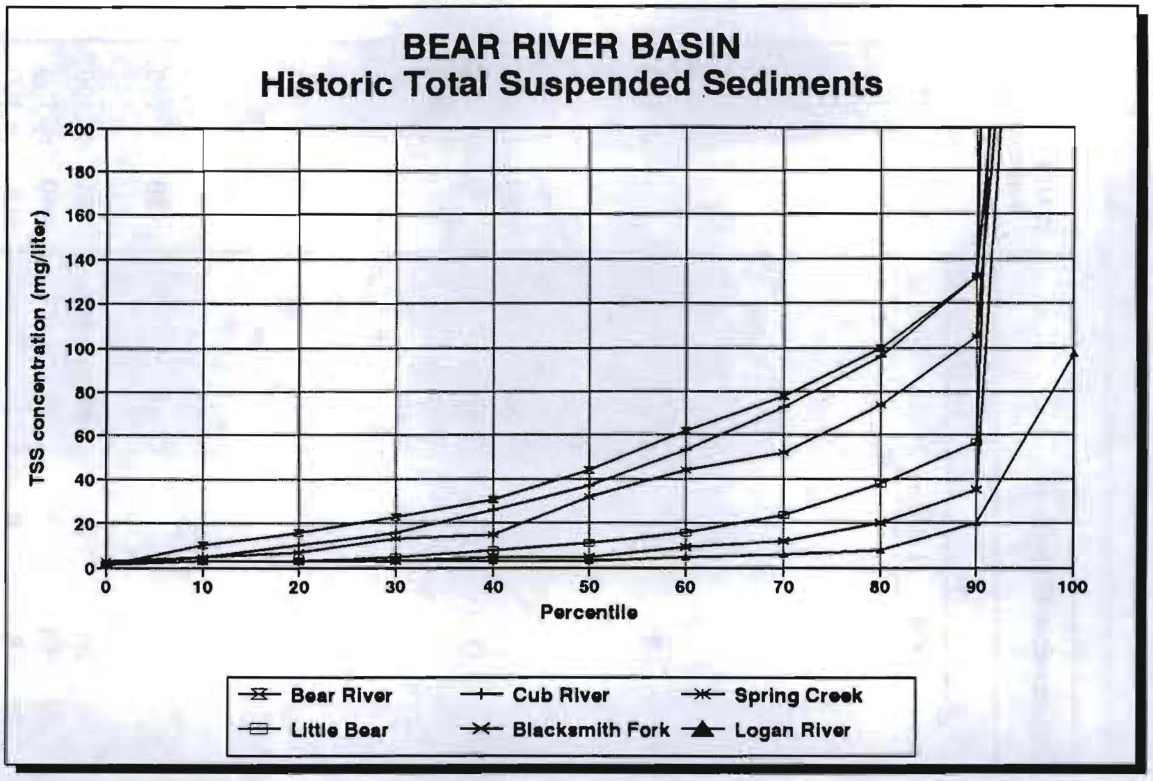

FIGURE 4-1. Total suspended sediments concentrations in all samples taken in the lower Bear River basin since 1970.

4.4 Standards Exceedences In Current Study

Table 4-5 summarizes the percentage of state of Utah's water quality standards violations seen in the water quality data collected during the 1993 water year. Impacts are described separately for streams and reservoirs in the system.

4.4.1 River and Stream Impacts

Violations of conventional criteria (dissolved oxygen, pH, temperature) and four-day ammonia standards were observed throughout the basin, but were seen at higher frequencies in the Little Bear and Spring Creek drainages (Table 4-5). Coliform violations also occurred throughout the Bear River basin, but were most frequent in the Spring Creek drainage, the Cub drainage and portions of the Little Bear drainage.

The Spring Creek drainage south of Cutler Reservoir had the most frequent and severe violations observed during the monitoring program. Ammonia concentrations violated 4-day criteria in eight of 14

TABLE 4-5. Percent of samples collected during the 1993 water year in the Lower Bear River basin which exceeded conventional water quality standards or water quality indicator concentrations. Cases with more than 25 percent of samples exceeding the standard are considered non-supporting and are shown in bold.

		Enforceable Standards							Water Quality Indicators	
					NH_3		Coliforms			
LOCATION	# of samples	Temp	DO	pH	4-day	1-hour	Total	Fecal	NO_3	TP
Mainstem Bear River										
610 - at UT-ID border	15			8						58
382 - west of Richmond	15							25		53
356 - near Amalga	15							8		73
326 - near Benson	15									100
198 - below Cutler	15									100
170 - near Honeyville	15			9	9			14		100
110 - near Corinne	15							20		100
Tributaries to the Bear River										
350 - Summit Creek	6									17
451 - Hopkins slough	15		13				20	**89**	20	100
472 - Clay slough	15		13	13	7		11		7	100
310 - Newton Creek *	2									100
119 - Box Elder Creek	15						14	**71**		100
Cub Drainage										
379 - at stateline	15							22		60
425 - above BR confluence	15						10	22		100
430 - High Creek	6									17
431 - Spring Creek	15							12	9	100
432 - Cherry Creek	6									17
437 - Worm Creek	15			7	13		**42**	**73**	20	100
Spring Creek										
487 - Hyrum slough	15		21		21		**56**	**100**	21	100
490 - Mendon xing	15		**53**		13		**33**	**78**	**40**	100
492 - S. Fork, near Pelican Pond	15	23	**38**		8	8			8	100

TABLE 4-5 (continued). Percent of samples collected during the 1993 water year in the Lower Bear River basin which exceeded conventional water quality standards or water quality indicator concentrations. Cases with more than 25 percent of samples exceeding the standard are considered non-supporting and are shown in bold.

		Enforceable Standards							Water Quality Indicators	
					NH_3		Coliforms			
LOCATION	# of samples	Temp	DO	pH	4-day	1-hour	Total	Fecal	NO_3	TP
Spring Creek (continued)										
494 - S. Fork at US 89 xing	15	7	**86**		57	14	100	100	**64**	100
499 - N. Fork near College Ward	15		**28**					12		43
Logan River										
520 - mouth of canyon	15									8
504 - abv. conf. with Little Bear	15		8					14		38
Blacksmith Fork										
544 - mouth of canyon	15		8							17
540 - above Logan River	15									33
Little Bear										
576 - above Davenport Crk	15							**36**		22
577 - Davenport abv S. Fork	15							8		26
578 - E. Fork below Porcupine Dam	15									5
575 - E. Fork abv conf. w/S. Fork	15									5
574 - above conf. w/E. Fork	15		6				8	25		25
570 - west of Avon	15		6					18		24
567 - below White Trout farm	15						19	12		39
566 - above Hyrum Reservoir	15						5	**44**		90
165 - Hyrum reservoir outflow	15	20	10							30
565 - 1 mile below Hyrum reservoir	15	8	15						8	62
559 - below Wellsville	15	9	**36**							100
500 - above Logan River	15		**28**							100

** Newton Creek did not flow through most of the year (no spills from reservoir)* samples in the most upstream site on the South Fork (490494), and violations occurred less frequently at all of the sites in the southern drainage. Acute 1-hour ammonia violations were recorded at two locations in the South Fork. Coliform violations were common and the concentrations of bacteria were much higher than recorded elsewhere in the study area. At site 490494 (upstream on the South Fork), the geometric means of total and fecal coliforms were over 77,000 and 4,000 colonies/100 ml. At this same site, dissolved oxygen (DO) averaged 5.7 mg/liter for the water year, well below the 30-day coldwater fishery standard of 6.5 mg/liter. During April and May, three of four samples were less than 4 mg/liter. At the site directly above Cutler, eight of 15 samples had DO concentrations less than 8 mg/liter. It should be stressed these samples were collected during the day, when DO concentrations are generally highest in streams. Night time concentrations were probably lower during much of the year.

Two of the state's pollution indicator parameters, total phosphorus and nitrate, were analyzed in this monitoring program. At most sites nitrate concentrations never exceeded the pollution indicator concentration of 4 mg/liter (Table 4-5). Frequent violations only occurred in the Spring Creek drainage, Worm Creek in the Cub drainage, Hopkins Slough and Clay Slough. Total phosphorus exceeded the pollution indicator concentration of 0.05 mg/liter 100 percent of the time at 16 of the sampling sites and over 50 percent of the time at an additional eight sites (Table 4-5). In all cases, these sites were lower in the basin. Water leaving the National Forest land or high in the basin had far fewer violations, although at every site in the monitoring program at least one sample exceeded the TP pollution indicator concentration.

4.4.2 Reservoir Impacts

Lakes and reservoirs are often where the loss of beneficial uses in a drainage are most apparent. Work conducted in Cutler Reservoir in 1990 (Pacificorp Electric Operations 1991) and in Hyrum Reservoir in the 1970s (Drury et al. 1975) and in 1992-1993 (ERI 1994) indicate that both reservoirs have deteriorated water quality which has affected fisheries, aesthetics and recreational uses of the reservoir.

Water quality sampling in Cutler Reservoir has been conducted infrequently. Available data (ERI 1991; Pacificorp Electric Operations 1991; UDHW 1982) show phosphorus concentrations much higher than the state's pollution indicator level. Total phosphorus concentrations ranged from a summer mean of 0.24 mg/liter in the canyon section to 0.5 mg/liter throughout the shallow portions of the reservoir. No violations of enforceable water quality criteria in Cutler were recorded in these two surveys. A study of fisheries in 1990, however, reported that poor water quality has limited the potential of Cutler as a warm water fishery (PacifiCorp Electric Operations 1991). Specifically cited was heavy sedimentation, leading to reservoir filling, high turbidity, loss of habitat and poor macroinvertebrate populations.

Hyrum Reservoir has a long history of low dissolved oxygen, leading to periodic fish kills. High nutrient loading has been cited as responsible for this condition, leading to blooms of noxious blue-green algae, and subsequent low dissolved oxygen as well as aesthetic problems (Drury et al. 1975). In the 1992-1993 study (ERI 1994), water quality was found to be poor but showing signs of improvement, specifically in improved algal species composition, slightly better dissolved oxygen and better water clarity. This was attributed to a decline in point source loading from a fish hatchery upstream, which in previous studies was shown to contribute up to 60 percent of the dissolved total phosphorus loading to the reservoir (Luce 1974; Lynn & Murray 1972). The 1993 study, however, showed total phosphorus loading to the reservoir had not declined, suggesting that nonpoint sources have increased in relative importance over the past years. Until these sources are reduced, the potential for deteriorated water quality continues.

4.5 The TMDL Process

The framework for the Bear River Water Quality Management Plan is a watershed based approach called the Total Maximum Daily Load (TMDL) process. A TMDL is a measure of how much of a given pollutant a waterbody (or reach of river) can accommodate without exceeding its water quality standards or causing a loss of a beneficial use (USEPA 1991). The TMDL is expressed as a load, or mass, of a particular pollutant. By using a total mass instead of concentration of pollutant, easier comparisons can be made between different points in a river and the relative importance of different sources of the pollutant. A TMDL can be expressed as an allowable load for an entire drainage, for different reaches within a drainage, or for a receiving waterbody (reservoir). Once an allowable load is determined (the TMDL), the actual loadings can be compared to this value. If the actual measured loadings are in excess of the TMDL, reductions must be made to attain the TMDL and the intended beneficial use.

Pollutant loadings are divided into several broad categories (USEPA 1991). Waste load allocations (WLAs) are pollutant loads from point sources. In the lower Bear River drainage, these point sources are municipal WWTPs, several cheese or other dairy associated industries, animal processing plants, runoff from large, concentrated agricultural operations, several fish hatcheries, and a small number of other industrial dischargers. Load allocations (LA) are pollutant loads from nonpoint sources. In this basin, these sources include agricultural runoff and irrigation return flows, stormwater inputs from urban areas, unstable streambanks, and runoff from construction and road activities. The TMDL also contains an estimate of background pollutants, defined either as the upstream load of a pollutant entering a reach controlled by a TMDL, or as an estimate of undisturbed or "natural" loadings. Finally, the TMDL contains a margin of safety to assure protection of the resource over varying conditions.

The TMDL process is intended to be cyclical. The first loop involves the state's biennial report of their 303D list. This list contains the rivers or drainages which are not expected to achieve their water quality standards after the implementation of technology based controls. The lower Bear River was placed on this list in 1992 (UDWQ 1992a). The second loop has been conducted over the past year. This has involved a comprehensive investigation of river reaches and subdrainages within the lower Bear River basin. Specifically, monitoring has aided in identifying problem pollutants, the magnitude of the problems that exist, and which portions of the rivers are impacted or have impaired water quality and subsequent loss of beneficial uses. Identifying sources (WLAs and LAs) is part of this process, as well as developing initial TMDLs for different pollutants. The second loop focuses on the targeted subdrainages or reaches by developing specific implementation plans for reducing pollutants discovered in the first loop. This process also involves ranking the different plans according to criteria such as long and short term effectiveness, point of control, cost, and overall benefit to the entire drainage.

With implementation of water quality improvements, continued monitoring and a refining of the TMDLs will be an ongoing process. Because the approach is basin-wide, benefits from reduced loadings in one portion of the basin are related to downstream improvements. Using this TMDL approach throughout the planning process should result in a more coherent and well integrated plan for improving and maintaining water quality throughout the lower Bear River basin.

4.6 Developing TMDLs for the Lower Bear River Basin

A load for a given pollutant in a river is calculated by multiplying the concentration of that pollutant by the flow, resulting in units of mass per unit time. In cases with well defined numeric criteria for a given pollutant, the criteria concentrations can be used. In the case of the Bear River drainage, the pollutants of primary concern are nutrients (nitrate and phosphorus), suspended solids, bacterial contamination and total dissolved solids (TDS). The water quality standard for TDS in rivers classified for agricultural use (1,200 mg/liter) has been used for the Bear River TDS TMDL. Neither phosphorus nor nitrate have enforceable numeric criteria but the state has assigned specific concentrations as indicators of water quality problems. The criterion for phosphorus is 0.05 mg/liter of total phosphorus (TP). An additional TMDL for dissolved total phosphorus (DTP) has also been calculated. Dissolved total phosphorus is far more likely to be biologically available and thus have a more significant impact on eutrophication problems. It is also less associated with sediments and more tightly associated with animal waste and fertilizer runoff. The concentration of 0.05 mg/liter has been used for the DTP TMDL.

The pollution level indicator concentration of 4 mg/liter was used to calculate TMDLs for nitrate. Although sporadic problems exist for ammonia, a TMDL for ammonia is hard to calculate because ammonia criteria depend on both pH and temperature. Rather than develop a TMDL for ammonia, concentrating on the few specific hotspots in the lower drainage seems more appropriate. The sources of excessive phosphorus and nitrate in these areas are probably primarily the same sources as for ammonia, and therefore improvements which target reductions in phosphorus and nitrate should achieve reductions in ammonia as well. A similar approach was taken for coliforms. Rather than develop a TMDL, areas with problems will be targeted. Again, coliforms will probably decline as the sources of DTP and nitrate are treated, since animal waste runoff contributes to both problems.

No numeric standard exists in Utah for suspended solids. Of the six states in the intermountain west (Utah, Idaho, New Mexico, Colorado, Nevada and Arizona), only Nevada has a numeric standard for TSS, set at 80 mg/liter for most of their waterways. All other states, including Utah, have statements of non-degradation and narrative standards which should protect streams and rivers from excessive sediment inputs. These non-quantified standards, however, cannot be incorporated into a TMDL. Nevada established their numeric standards based on the 95th percentile of TSS in their historic monitoring record

(NDWQ pers. comm.).

A statistical approach was used to evaluate TSS in the Bear River basin as well. The 95th percentile concentration of all combined TSS samples collected from the lower Bear River basin since 1970 is 140 mg/liter. Very high TSS concentrations are correlated with high flow periods. Setting a standard based on these high flows sets a very relaxed standard for the remainder of the year. Because of this, the TMDLs in the Bear River basin will be based on the 75th percentile concentration. As Figure 4-1 indicates, the different subdrainages have very different TSS concentrations. Therefore, a separate concentration has been used for the TMDLs for the Bear River and the Cub River than for the other subdrainages. The Bear and Cub River TMDLs will be based on a concentration of 90 mg/liter. This acknowledges the lacustrine nature of the sediments through which these rivers run while in Utah, but establishes a standard that should result in attainable improvements. The TMDL for the other subdrainages will be based on the 75th percentile (35 mg/liter) of these combined sites. This should not only result in reduced sediment loading to the mainstem Bear River itself, but should protect the high quality fisheries in the Logan and Blacksmith Fork drainages and set a target for enhanced fisheries in the Little Bear drainage (Newcombe 1986).

The second component of the TMDL is flow. Choosing an appropriate flow is difficult for several reasons. Most point sources do not vary much with natural flows and therefore they have a greater impact at low flows. Nonpoint inputs, however, often are greatest during high flow runoff periods. Several approaches were considered, including developing separate TMDLs for the runoff and baseflow periods, and developing a single TMDL based on some annual flow estimate. Of concern with a seasonal approach is that the TMDLs be useable management tools. A seasonal TMDL would require increased monitoring during runoff periods. In addition, the runoff period flows are often the least well defined on the non-gaged streams, so additional uncertainty would be involved in establishing runoff TMDLs.

Several choices of flows for an annual TMDL could be made. One approach is to use an average flow. This could result in a TMDL for a waterbody being exceeded on average half the time, although conversely, average conditions over several years should equal the TMDL. Another approach would be to use a reasonable low flow estimate which would protect the water body under most conditions. Typically, TMDLs established for acutely toxic pollutants use a 7-day, 10-year low flow calculated from the historic flow record for a drainage (USEPA 1992). This flow is calculated by determining the minimum of consecutive 7-day averages for each year of record, then calculating a 10-year return time frequency for each of those flows. A slightly less conservative approach is to take the 10th percentile flow from the historic record. These flows are available for USGS gaged stations at several locations in the lower Bear River drainage. A summary of historic flows in the lower Bear River basin is presented in Table 4-6. Also listed are the mean flows for the current monitoring program.

4.7 TMDL Estimates

This section evaluates potential TMDLs based on different flows, and compares these to historic and 1993 water quality conditions. TMDLs have been established for both the river reaches and receiving waters (reservoirs). These TMDLs give reasonable target pollutant loadings which should lead to improved beneficial uses of these waterbodies. A tiered approach will be taken, however, to implement mitigation activities and achieve these TMDLs. The river reach TMDLs are more closely tied to landuse in specific subdrainages. Therefore, the river TMDLs will be those enforced in the first cycle of the TMDL process. Improvements in reservoirs should follow from reduced external loadings. If river TMDLs are reached and the reservoirs have not responded adequately, additional reservoir implementation activities can be initiated, based on the reservoir TMDLs.

4.7.1 Riverine Systems

Because of the distinct nature of the several drainages which contribute to the lower Bear River basin, TMDLs have been calculated for each of these major drainages and have been calculated using 10th percentile flows and median flows for comparative purposes. Tables 4-7 through 4-11 present calculated TMDLs for the main subdrainages for total phosphorus, dissolved total phosphorus, nitrate, total suspended solids and total dissolved solids. Also listed in these tables for comparison are the median, maximum, and minimum average daily loadings from the Utah Division of Water Quality historic record, and the more comprehensive 1993 water year average daily loadings from this study. The 1993 flows were in general lower than the median flows. In contrast, the 1993 loads were generally higher than the historic median loads. This is in part because the loadings from the historic water quality record

TABLE 4-6. Summary flows for Bear River basin.

		HISTORIC FLOWS						THIS STUDY
	SOURCE	MEAN	MEDIAN	MIN	MAX	10TH PERCENTILE	ANNUAL 7-DAY MIN	1993 MEAN
Bear River								
Stateline	USGS	1,215	993	505	2,728	326	69	**720**
Smithfield	USGS	1,236	1,110	559	2,209	430	157	**969**
Collinston *	USGS	1,541	1,260	442	4,379	26	7.5	**1,608**
Corinne	USGS	1,821	1,500	435	5,050	138	50	**1,233**
Logan River	USGS	144	106	22	441	39		**234**
Blacksmith Fork	USGS	129	95	53	295	56	35	**129**
Cub River	UDWQ	100	72	10	331	10		**191**
Spring Creek **	UDWQ		26					**42**
Little Bear River								
Above Cutler	UDWQ	84	76	36	181	23		**77**
Above Hyrum	UDWQ	78	49	21	175	18		**98**

* *Includes Bear River below Cutler Dam (1,285 cfs) and irrigation releases from the reservoir (323 cfs).*
** *Spring Creek is a tributary of the Little Bear River.*

are not time-weighted (each value is weighted equally), while in the current study mean values are time-weighted (before the mean is calculated, each value is weighted by the period of time it represents). The current loadings may therefore be more representative of truly average conditions because they are not skewed toward months when samples were more easily collected (for example, low flow summer and fall).

The 1993 TP loads were five to 10 times greater than the 10th percentile flow TMDLs at most sites, and were over 50 times higher at three of the four mainstem Bear River sites (Table 4-7). Historic median and 1993 loadings also exceeded TMDLs based on median flows in all cases. At the Bear River site near the stateline, the 1993 loads were about twice the median flow TMDL. Lower in the basin, however, TP loadings increased substantially more than the TMDLs and the measured TP load below Cutler Reservoir was four times the median flow TMDL. Measured loads in the Logan and Blacksmith Fork rivers were close to the median flow TMDL and the Little Bear loads were over two times the median flow TMDL. Both the Cub River and Spring Creek carried loads much higher than their TMDLs. A similar pattern was seen for DTP as for TP (Table 4-8). The lower Bear River, the Cub and Spring Creek all far exceeded the TMDL based on median flows.

Nitrate loads in general fell well below the TMDL based on median flow and in many cases fell below the 10th percentile flow TMDL (Table 4-9). Sites on the Bear River below Cutler exceeded the 10th percentile TMDL, while the Cub and Spring Creek exceeded the median flow TMDL.

All TSS loads calculated from the 1993 data exceeded the TMDLs based on median flow, except the Bear River at the stateline. Of the median historic loads, only the Logan River and the mainstem Bear River above Corinne fell below the median flow TMDL (Table 4-10).

Total dissolved solids (TDS) were not measured during the current monitoring program. The historic median TDS loads in general fell well below the median flow TMDL (Table 4-11). Only the Bear River sites below Cutler and the Cub River had median loads well over the 10th percentile TMDL.

4.7.2 Reservoir Systems

Another approach to TMDLs is to establish an acceptable load to the reservoirs within the system. This is reasonable in this drainage, because much of the loss in beneficial use occurs within the reservoirs. It should be noted, however, that pollutant reductions in upstream waters would be necessary

TABLE 4-7. Summary total phosphorus loads for Bear River basin. TMDLs chosen for the Lower Bear River basin are based on median flows (shaded values).

	TMDL (kg/day) based on 0.05 mg/liter concentration		HISTORIC LOADS (kg/day) *			THIS STUDY (kg/day)	Exceedence of 1993 load over recommended TMDL (kg/day)
	10th Percentile Flow	Median Flow	Median	Minimum	Maximum	1993 Mean	
Bear River							
Stateline	40	121	162	67	2,500	**234**	113
Smithfield	53	136				**425**	289
Collinston	3	154	335	174	3,770	**786**	632
Corinne	17	183	509	206	4,020	**866**	683
Logan River	5	13	16	4	116	**19**	6
Blacksmith Fork	7	12				**14**	2
Cub River	1	9	40	14	199	**136**	127
Spring Creek **		3	46			**102**	99
Little Bear River							
Above Cutler	3	9	24	7	76	**24**	15
Above Hyrum	2	6	8	1	44	**15**	9

* *Calculated from UDWQ long-term monitoring data (1970 - 1992).*
** *Spring Creek is a tributary of the Little Bear River.*

TABLE 4-8. **Summary dissolved total phosphorus loads for Bear River basin. TMDLs chosen for the Lower Bear River basin are based on median flows (shaded values).**

	TMDL (kg/day) based on 0.05 mg/liter concentration		HISTORIC LOADS (kg/day) *			THIS STUDY (kg/day)	Exceedence of 1993 load over recommended TMDL (kg/day)
	10th Percentile Flow	Median Flow	Median	Minimum	Maximum	1993 Mean	
Bear River							
Stateline	40	121	51	14	17,900	**70**	-51
Smithfield	53	136				**174**	33
Collinston	3	154	139	38	2,680	**468**	314
Corinne	17	183	188	45	3,240	**480**	297
Logan River	5	13	7	2	28	**10**	-3
Blacksmith Fork	7	12				**7**	-5
Cub River	1	9	18	12	198	**68**	59
Spring Creek **		3				**89**	86
Little Bear River							
Above Cutler	3	9	7	4	59	**13**	4
Above Hyrum	2	6	2.5	0.4	10	**7**	1

** Calculated from UDWQ long-term monitoring data (1970 - 1992).*
*** Spring Creek is a tributary of the Little Bear River.*

TABLE 4-9. Summary nitrate loads for Bear River basin. TMDLs chosen for the Lower Bear River basin are based on median flows (shaded values).

	TMDL (kg/day) based on 4.0 mg/liter concentration		HISTORIC LOADS (kg/day) *			THIS STUDY (kg/day)	Exceedence of 1993 load over recommended TMDL (kg/day)
	10th Percentile Flow	Median Flow	Median	Minimum	Maximum	1993 Mean	
Bear River							
Stateline	3,190	9,720	1,250	260	10,400	**970**	-8,750
Smithfield	4,210	10,900				**2,010**	-8,890
Collinston	254	12,300	1,600	647	8,560	**3,600**	-8,700
Corinne	1,350	14,700	2,810	375	10,500	**4,810**	-9,890
Logan River	382	1,040	93	48	260	**100**	-940
Blacksmith Fork	548	930				**113**	-817
Cub River	98	705	198	75	800	**835**	130
Spring Creek **		254	318			**535**	281
Little Bear River							
Above Cutler	225	744	172	52	610	**128**	616
Above Hyrum	176	480	36	7	157	**63**	417

* *Calculated from UDWQ long-term monitoring data (1970 - 1992).*
** *Spring Creek is a tributary of the Little Bear River.*

TABLE 4-10. Summary total suspended solids loads for Bear River basin. TMDLs chosen for the Lower Bear River basin are based on median flows (shaded values).

	TMDL (kg/day) *		HISTORIC LOADS (kg/day) **			THIS STUDY (kg/day)	Exceedence of 1993 load over recommended TMDL (kg/day)
	10th Percentile Flow	Median Flow	Median	Minimum	Maximum	1993 Mean	
Bear River							
Stateline	44,900	136,000	74,600	23,100	2,790,000	**107,000**	-29,000
Smithfield	59,200	153,000				**224,000**	71,000
Collinston	3,580	173,000	118,000	5,710	2,910,000	**241,000**	68,000
Corinne	1,900	207,000	229,000	19,500	3,130,000	**277,000**	70,000
Logan River	1,490	4,030	2,500	740	25,600	**11,700**	6,060
Blacksmith Fork	2,150	3,620				**6,970**	1,900
Cub River	1,370	9,910	16,600	860	142,000	**43,100**	33,190
Spring Creek ***		994	2,810			**3,680**	2,290
Little Bear River							
Above Cutler	878	2,910	6,240	940	21,000	**8,150**	4,080
Above Hyrum	688	1,870	3,200	208	28,800	**12,000**	9,380

* *Based on 90 mg/liter in the mainstem Bear River and Cub River drainages and 35 mg/liter in other drainages*
** *Calculated from UDWQ long-term monitoring data (1970-1992).*
*** *Spring Creek is a tributary of the Little Bear River.*

TABLE 4-11. Summary total dissolved solids loads for Bear River basin. TMDLs chosen for the Lower Bear River basin are based on median flows (shaded values).

	TMDL (kg/day) based on 1200 mg/liter concentration		HISTORIC LOADS (kg/day) *			THIS STUDY (kg/day)
	10th Percentile Flow	Median Flow	Median	Minimum	Maximum	1993 Mean
Bear River						
Stateline	957	2,920	1,230	561	2,810	NO DATA
Smithfield	1,260	3,260				
Collinston	76	2,700	1,530	477	3,960	
Corinne	405	4,400	2,610	937	5,950	
Logan River	115	311	114	42	259	
Blacksmith Fork	164	279				
Cub River	29	211	74	18	175	
Spring Creek **		76	40			
Little Bear River						
Above Cutler	68	223	54	18	114	
Above Hyrum	53	144	39	7	97	

* *Calculated from UDWQ long-term monitoring data (1970 - 1992).*
** *Spring Creek is a tributary of the Little Bear River.*

to achieve these reservoir TMDLs. This approach would, in effect, incorporate the reach and subbasin TMDLs discussed above.

Cutler Reservoir currently has an average water transparency of about 0.2 meters. The bottom of the reservoir is covered with fine, unconsolidated sediments with few submerged aquatic plants. As a result, the macroinvertebrates which normally live in lake sediments and support fish and duck populations are almost absent from Cutler. Improvements to the littoral community of the reservoir (the submerged plants and insects which live on the bottom of a lake) would result in improved fisheries, a better resident duck population, and more stabilized sediments. Hyrum Reservoir has also historically had severely deteriorated water quality. High phosphorus loadings, low dissolved oxygen and blooms of blue-green algae have resulted in an impaired fishery and reduced aesthetic and recreational values.

Phosphorus TMDLs for both these reservoirs are listed in Table 4-12. These TMDLs are based on average annual flows into the reservoirs, using a steady state phosphorus mass balance model (Dillon & Rigler 1974; Canfield & Bachmann 1979). Two alternatives are offered. One is based on the state of Utah's 0.025 mg/liter reservoir criterium, and the other is based on the state's 0.050 mg/liter pollution indicator concentration for rivers. Although the state currently uses total phosphorus as the parameter of concern, dissolved total phosphorus may be more appropriate, since it is more closely tied to the trophic state of the reservoir. Current (1993) loads in Cutler and Hyrum reservoirs are also listed. Hyrum's 1993 TP loading was about four times the TMDL based on the 0.025 mg/liter criterium. In contrast, Cutler loadings were about 15 times the TMDL. A TMDL based on 0.025 mg/liter may be an unreasonably low target in a reservoir such as Cutler, with its very short residence time. A criterion of 0.050 mg/liter raises the TMDL to over 100 kg/day.

Predicted chlorophyll-*a* and transparency in the reservoirs were calculated as a function of phosphorus loading, using the following models (USEPA 1990):

$$\text{Chlorophyll } a \text{ (ppb)} = 0.068\ P^{1.46}$$

$$\text{Secchi (meters)} = 7.7\ \text{chlorophyll } a^{-0.68}$$

TABLE 4-12. Phosphorus TMDLs for Cutler and Hyrum reservoirs.

CUTLER RESERVOIR	
TMDL:	
based on 0.025 mg/liter criterium	53 kg/day
based on 0.050 mg/liter criterium	106 kg/day
1993 LOADS:	
Total phosphorus	786 kg/day
Dissolved total phosphorus	468 kg/day

HYRUM RESERVOIR	
TMDL:	
based on 0.025 mg/liter criterium	6 kg/day
based on 0.050 mg/liter criterium	12 kg/day
1993 LOADS:	
Total phosphorus	25 kg/day
Dissolved total phosphorus	20 kg/day

The response in Cutler Reservoir is shown in Figure 4-2. Current water transparency is about 0.2 meters. A decrease in loading to 100 kg/day would improve the transparency to over one meter (Figure 4-2). A decrease to just 400 kg/day would result in a transparency of about 0.4 meters. In a shallow reservoir such as Cutler, this would represent a significant increase in the portion of the reservoir which could support submerged aquatic plants.

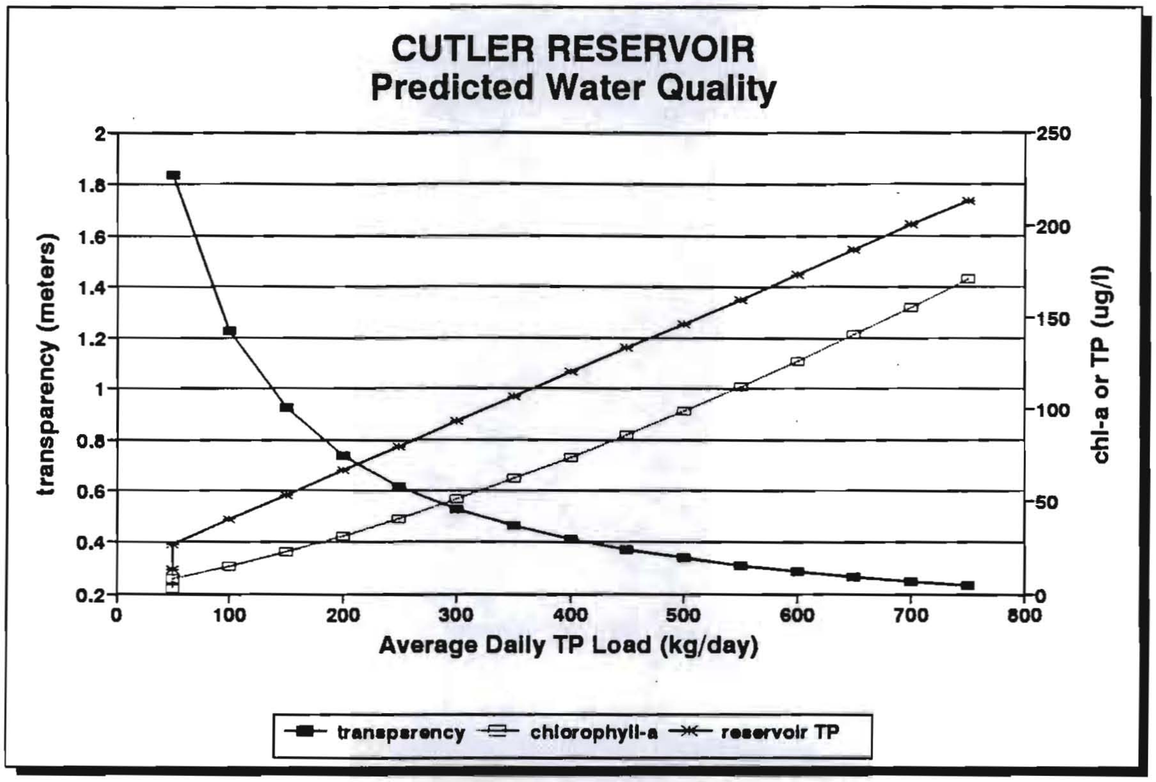

FIGURE 4-2. Predicted water quality for Cutler Reservoir.

Using these models for Hyrum Reservoir based on a TMDL of 6 kg/day results in a predicted chlorophyll-*a* concentration of 7.5 μg/liter and a secchi transparency of 2.0 meters. These values are slightly higher than the chlorophyll and transparency observed in Hyrum Reservoir in 1993, suggesting that other factors such as the timing and magnitude of the spring flushing period in the reservoir also affect the final water quality in the reservoir. The reservoir is now considered eutrophic/mesotrophic, and reducing loading to the proposed TMDL would protect the reservoir at a mesotrophic state.

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5.0 RANKING AND TARGETING PROBLEM AREAS

To effectively address the water quality problems in the lower Bear River basin, the pollutant sources need to be ranked and targeted for mitigation activities. Each of the identified reaches along the mainstem Bear River, the point sources and the tributaries which enter directly into the Bear River were ranked by a number of different criteria.

First, the average annual loads (kg/day) of sediments and nutrients were calculated for each sampled site in the lower basin. Each reach, point source and tributary was then ranked by the magnitude of pollutant loads entering from that source or within that reach. The mainstem Bear River reaches represent the nonpoint loadings entering from an upstream to a downstream site, and have had all identified tributary and point source inputs subtracted. Table 5-1 lists the reaches of the Bear River drainage which were highest ranked in terms of magnitude of pollutant inputs. Note, however, that the Bear River at the Idaho border is the total load entering from Idaho, rather than a specific reach gain.

All rankings by phosphorus loading (both TP and DTP) resulted in the same five sources in the top five positions, with the reach across Cutler Reservoir and the Spring Creek Drainage having the highest overall ranking. Rankings by TSS loading again gave the Cutler reach the highest ranking, followed by the other Bear River reaches and the Cub River. Because of the Cub River's position in the basin, its total ranking was increased.

Several of these sites were dropped from additional ranking, either because they are very low in the drainage (the Bear River below Cutler), or are not within the jurisdiction of this management plan (the Bear River and Cub River watersheds above the Idaho border). A number of other approaches to ranking these reaches is possible. Table 5-2 gives rankings by concentration (load/flow), by load/subdrainage area, and by position in the watershed. Ranking by concentration is important to consider, because flows can be quite variable. A high load may result from a high flow with relatively low pollutant concentrations. In such cases, high loads do not necessarily indicate a nonpoint pollution problem. The load/contributing area is also relevant, because it indicates the intensity of nonpoint pollutant inputs from the drainage. Ranking by the relative position in the watershed attempts to incorporate the watershed based approach to this management plan. Improving pollutant sources higher in the drainage will have a greater beneficial impact throughout the drainage.

TABLE 5-1. Highest pollutant ranked reaches of the Bear River.

	TOTAL PHOSPHORUS		DISSOLVED TOTAL PHOSPHORUS		TOTAL SUSPENDED SOLIDS	
	RANK	AVG ANNUAL LOAD (kg/day)	RANK	AVG ANNUAL LOAD (kg/day)	RANK	AVG ANNUAL LOAD (kg/day)
Bear River at Idaho Border	1	264	4	70	1	107,000
Cub River	2	136	5	68	4	43,100
Cutler Reservoir	3	130	1	119	2	78,300
Spring Creek	4	102	2	89	9	3,630
Logan Lagoons [(a)]	5	101	3	80	10	351
Bear River at Honeyville	6	97	6	60	11	-2,500
Bear River at Corinne	7	62	11	-21	3	7,410
Bear River from Richmond to Amalga	8	48	7	42	5	36,100
Logan River	9	34	8	14	7	11,700
Little Bear River	10	24	9	14	8	8,150
Bear River from Idaho to Richmond	11	3.7	10	-5.9	6	34,200

[(a)] *This is end-of-pipe value*

TABLE 5-2. Rankings of reaches and subbasins in the lower Bear River basin.

REACH	LOAD	LOAD/FLOW	LOAD/AREA	POSITION IN BASIN
TOTAL PHOSPHORUS RANKING				
Cub River in Utah	1	4	4	3
Cutler (Benson to Cutler Dam)	2	1	3	5
Spring Creek	3	3	1	4
Logan Lagoons	4	2	NA	4
BR from Richmond to Benson	5	5	2	2
Logan River	6	8	7	4
Little Bear River	7	7	5	4
BR from stateline to Richmond	8	6	6	1
DISSOLVED TOTAL PHOSPHORUS RANKING				
Cub River in Utah	4	4	4	3
Cutler (Benson to Cutler dam)	1	1	3	5
Spring Creek	2	3	1	4
Logan Lagoons	3	2	NA	4
BR from Richmond to Benson	5	5	2	2
Logan River	6	7	6	4
Little Bear River	7	8	5	4
BR from stateline to Richmond	8	9	7	1
TOTAL SUSPENDED SOLIDS RANKING				
Cub River in Utah	2	4	4	3
Cutler (Benson to Cutler dam)	1	1	3	5
Spring Creek	7	5	5	4
Logan Lagoons	8	8	NA	4
BR from Richmond to Benson	3	3	1	2
Logan River	5	7	7	4
Little Bear River	6	6	6	4
BR from stateline to Richmond	4	2	2	1

Other variables can be incorporated into ranking. These include the population size contributing to the pollutant load, the willingness of citizens in a targeted area to pay or be involved in mitigation activities, the cost of mitigation, and the ease of instituting different types of implementations. These were all considered by the BRWQMP steering committee. The committee, however, decided to rank targeted subdrainages based only on the magnitude of the pollutant load. Other factors may be included in ranking individual projects within targeted subdrainages.

Other water quality problems such as coliform contamination and violation of conventional or toxic standards were not formally incorporated into the ranking system, but were considered in the final ranking decisions. In particular, the high frequency of criteria violations in the Spring Creek basin was of concern and was responsible for this drainage being given the highest ranking.

The final ranking agreed upon by the BRWQMP steering committee was:

1) **Spring Creek drainage**
2) **The Utah portion of the Cub River corridor**
3) **Nonpoint sources in Cutler Reservoir from Benson to Cutler dam**
4) **Bear River corridor from Richmond to Benson.**

Figure 5-1 shows the areas represented by prioritized drainages.

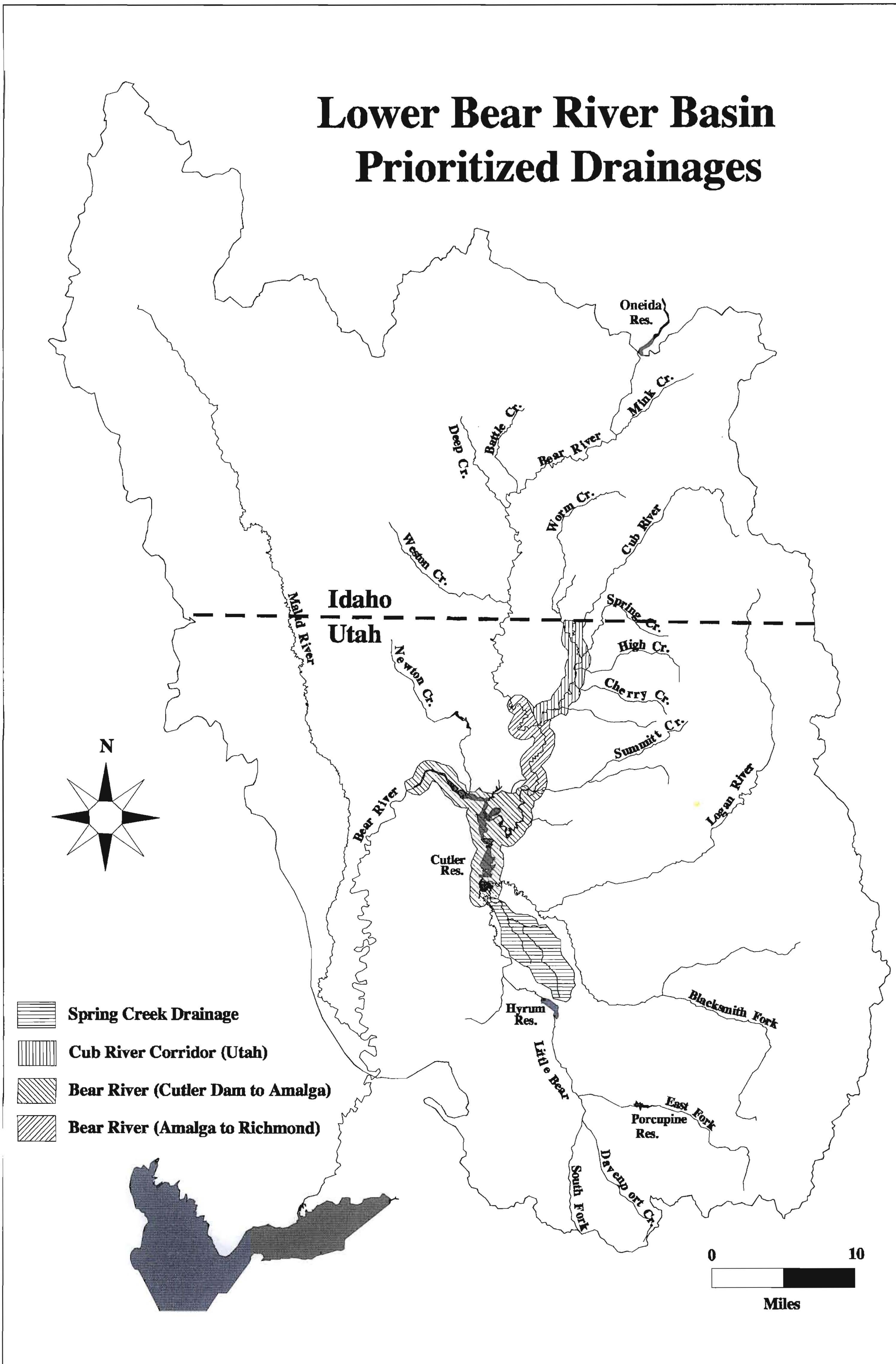

FIGURE 5-1. Lower Bear River prioritized drainages.

5.1 Targeted Watersheds for Project Implementation Plans (PIPs)

The following section describes specific conditions in each of the targeted subdrainages. Each section covers the current water quality and landuse conditions in that targeted subdrainage. The sources of pollutant loads in each of the targeted subdrainages are identified in as much detail as possible. In most cases, point sources were measured directly. The relative importance of pollutant loads from nonpoint sources was estimated by applying nutrient export coefficients to the areas of different landuses in a specific subdrainage. Literature values for these export coefficients were used (Table 5-3). Typically, a range of coefficients are available, arising from different studies in different geographic areas and under different conditions. When available, coefficients meeting mountain west conditions were used. To estimate nonpoint loadings, an average loading coefficient was chosen, along with a high and low value to provide a range. Once the pollutant sources under current conditions were evaluated, the potential reduction in these nutrient loads through various remediations was calculated. These nutrient reduction activities range from changes in treatment processes in the wastewater treatment facilities to additional best management practices (BMPs) in agricultural fields and feedlots. Table 5-4 lists a wide range of remediation activities and BMPs, the effectiveness of each of these actions in reducing nutrient or sediment inputs to waterways and, when available, typical costs associated with each practice.

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 of nutrient reductions were calculated assuming low, medium and high levels of effort. Table 5-5 summarizes the percent reduction of pollutants assumed for these different levels of effort.

TABLE 5-3. A range of phosphorus loading coefficients for different landuses. Rates used in loading calculations compiled from Reckhow et al. 1980.

	TOTAL PHOSPHORUS (KG/ACRE/DAY)		
	LOW	MEDIUM	HIGH
Nonpoint Source:			
Irrigated agriculture	0.00100	0.00243	0.00588
Nonirrigated agriculture	0.00011	0.000832	0.00177
Open/unknown	0.00011	0.000889	0.00294
Urban	0.00011	0.00122	0.00299
Public lands	0.00011	0.00022	0.00033
Feedlots	0.177	0.277	0.471
Cows (kg/cow/day)	0.0008	0.018	0.032

	DISSOLVED TOTAL PHOSPHORUS (KG/ACRE/DAY)		
	LOW	MEDIUM	HIGH
Nonpoint Source:			
Irrigated agriculture	0.000240	0.000583	0.00141
Nonirrigated agriculture	0.0000561	0.000424	0.000903
Open/unknown	0.0000726	0.000587	0.00194
Urban	0.0000715	0.000793	0.00194
Public lands	0.0000737	0.000147	0.000221
Feedlots	0.0797	0.125	0.212
Cows (kg/cow/day)	0.00036	0.0081	0.0144

TABLE 5-4. 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/m^2 (2)	

TABLE 5-4 (continued). Literature review of remediations and their effectiveness.

POTENTIAL SOURCES OF POLLUTION	REMEDIATION	PERCENT REDUCTION	COST	IMPACT
Agriculture (cont.)	Nutrient Management			
	Livestock Management			Reduce streambank 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	
Streambank	Non-structural			These practices stabilize streambanks and reduce soil and streambank erosion.
	Revegetation			
	Trees	15-50%	$1-$2/ft for willows [1]	
	Brush	50-60%	0.18-1.92/m^2 [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			
	Flow regulation		Up to $5,000 depending on size, length, etc.	
	Drop structures	*		
	Rock Pools	*	up to $20-placed rock	
	Wire structures		$500/ea	
	Revetments			
	Conifer	** [1]	$12/ft [3]	
	Rock	** [1]	$200-$400/ft	

TABLE 5-4 (continued). Literature review of remediations and their effectiveness.

POTENTIAL SOURCES OF POLLUTION	REMEDIATION	PERCENT REDUCTION	COST		IMPACT
Streambank	Structural (continued)				
	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 streambank erosion
			COST PER MGD		
			CONSTRUCTION (4)	MAINTENANCE (4)	
Wastewater	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 wastewater	75% (3)	$21,000-47,000	$20,000	

TABLE 5-4 (continued). Literature review of remediations and their effectiveness.

POTENTIAL SOURCES OF POLLUTION	REMEDIATION	PERCENT REDUCTION	COST	IMPACT
Wastewater (cont.)	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 River Hydrologic Unit Plan 1992
(2) Water Quality Investigations - Lower Bear River and Hyrum Reservoir; ERI 1991
(3) Process Design Manual for Phosphorus Removal; USEPA 625/1-76-0019
(4) Barker et al. 1989

TABLE 5-5. Percent reductions in predicting phosphorus loads in this report.

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

** *Calculate load based on a 5 mg/liter effluent standard.*

5.1.1 Spring Creek Drainage

Landuse in the Spring Creek subbasin is illustrated in Figure 5-2. Valley bottom vegetation and bank conditions are illustrated in Figures 5-3 and 5-4, respectively. Attributes of the Spring Creek subbasin are summarized in Table 5-6.

The Spring Creek subdrainage includes three small tributaries: 1) North Fork Spring Creek; 2) South Fork Spring Creek; and 3) Hyrum Slough. Table 5-7 summarizes nutrient and sediment loadings and flows from each of these subdrainages. Evaluating the drainage is complicated by irrigation diversions and return flows. Both South Fork Spring Creek and Hyrum Slough are entirely channelized and diverted for irrigation water. Ditches allow point sources and irrigation return flow to move in several directions, which complicates determining sources within a subdrainage. In addition, diversions may result in lower flows downstream than upstream on a given day, which can distort calculated loading patterns and may not be representative of the total loading within the drainage.

The North Fork of Spring Creek originates in a small spring/wetlands area near Young Ward, Utah. This stream drains about 840 acres and had an average flow of about 14 cfs which remained relatively constant throughout the 1993 water year. This portion of Spring Creek had the best water quality in the subdrainage. Total phosphorus averaged about 0.052 mg/liter and DTP averaged 0.029 mg/liter. In both cases, concentrations did not vary much throughout the sample year. A small fish hatchery above this sample site appeared to have no measurable impact on water quality.

In contrast, Hyrum Slough and South Fork Spring Creek had impaired water quality. Hyrum Slough drains into the North Fork of Spring Creek (Figure 5-3). The slough drains about 4,700 acres south of the North Fork subdrainage. Nutrient concentrations in Hyrum Slough were high throughout much of the year. Total phosphorus averaged 1.45 mg/liter, DTP averaged 0.72 mg/liter and nitrate averaged 2.8 mg/liter. Flows averaged 5.3 cfs and were highest in the mid to late summer.

Most of the impacts to Spring Creek occurred in the upper portion of the South Fork drainage (above Highway 89/91). Site 490494 drains approximately 1,030 acres, and collects drainage from Hyrum WWTP, EA Millers WWTP, and a large (over 3,000 head) feedlot. Winter land application of manure is widespread and intense, due to the high concentration of animals throughout this relatively small area, and runoff of manure directly into the waterways is also a problem. Flows were erratic in the stream, but

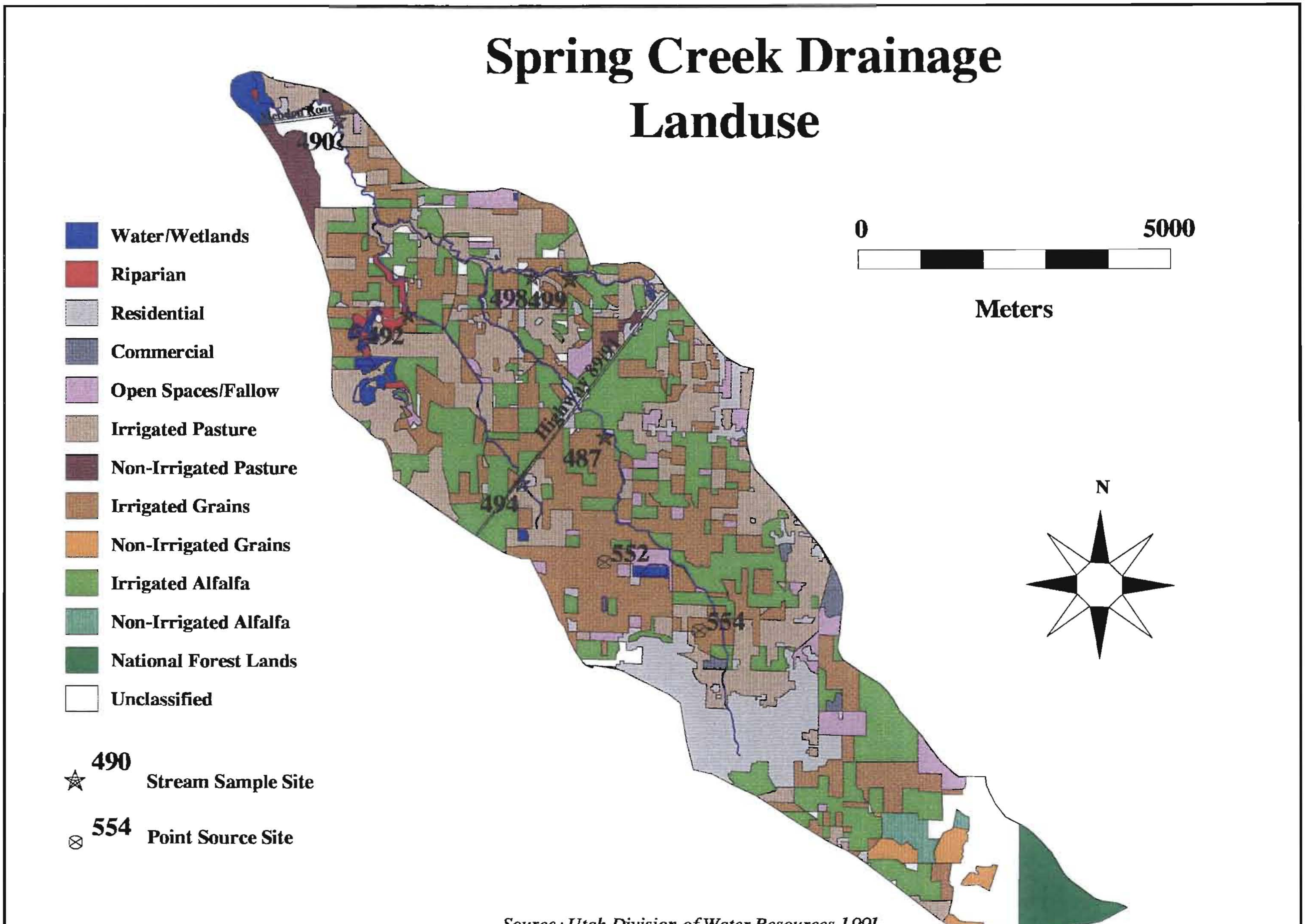

Figure 5.2. Spring Creek Drainage landuse.

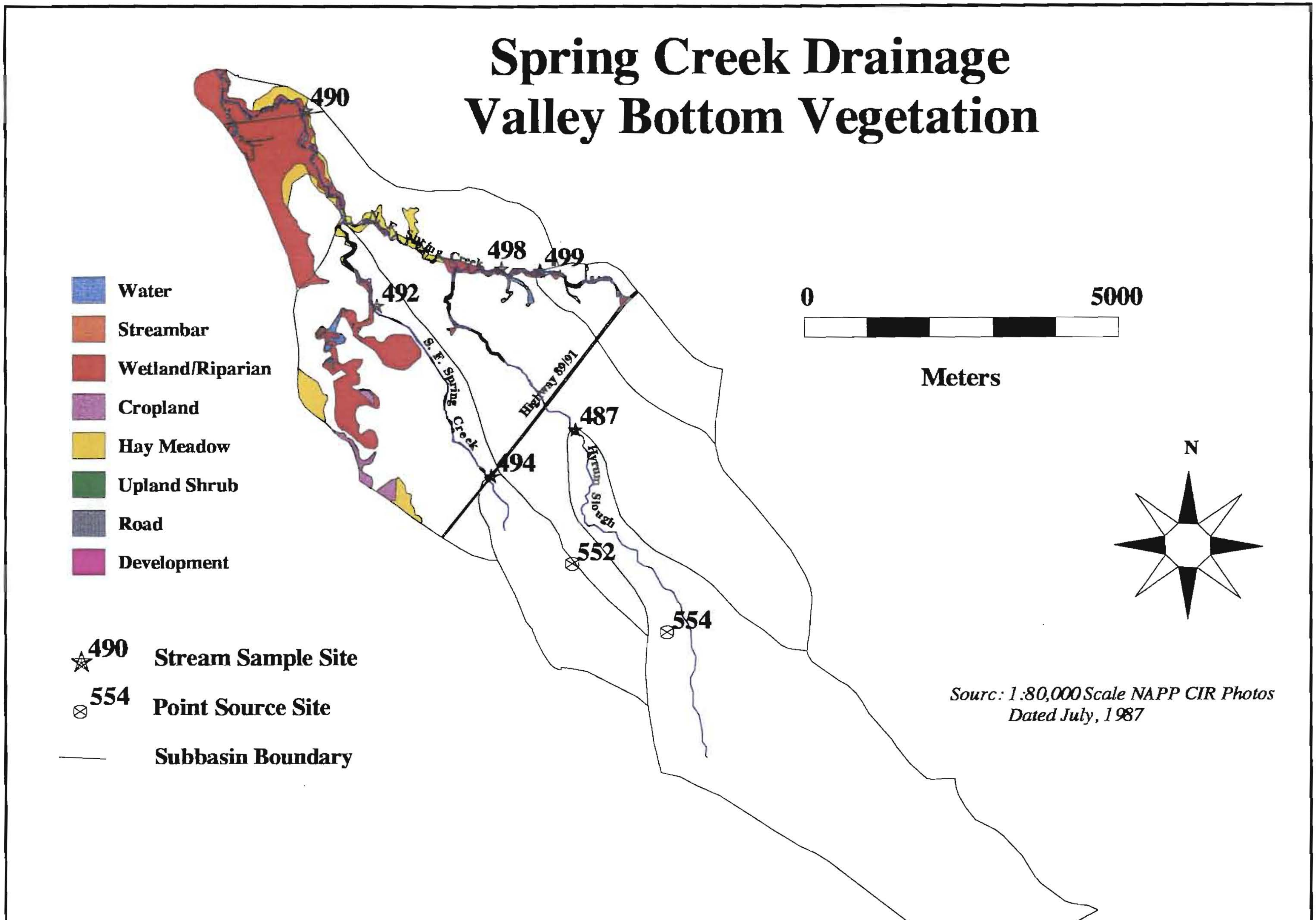

FIGURE 5-3. Spring Creek Drainage valley bottom vegetation.

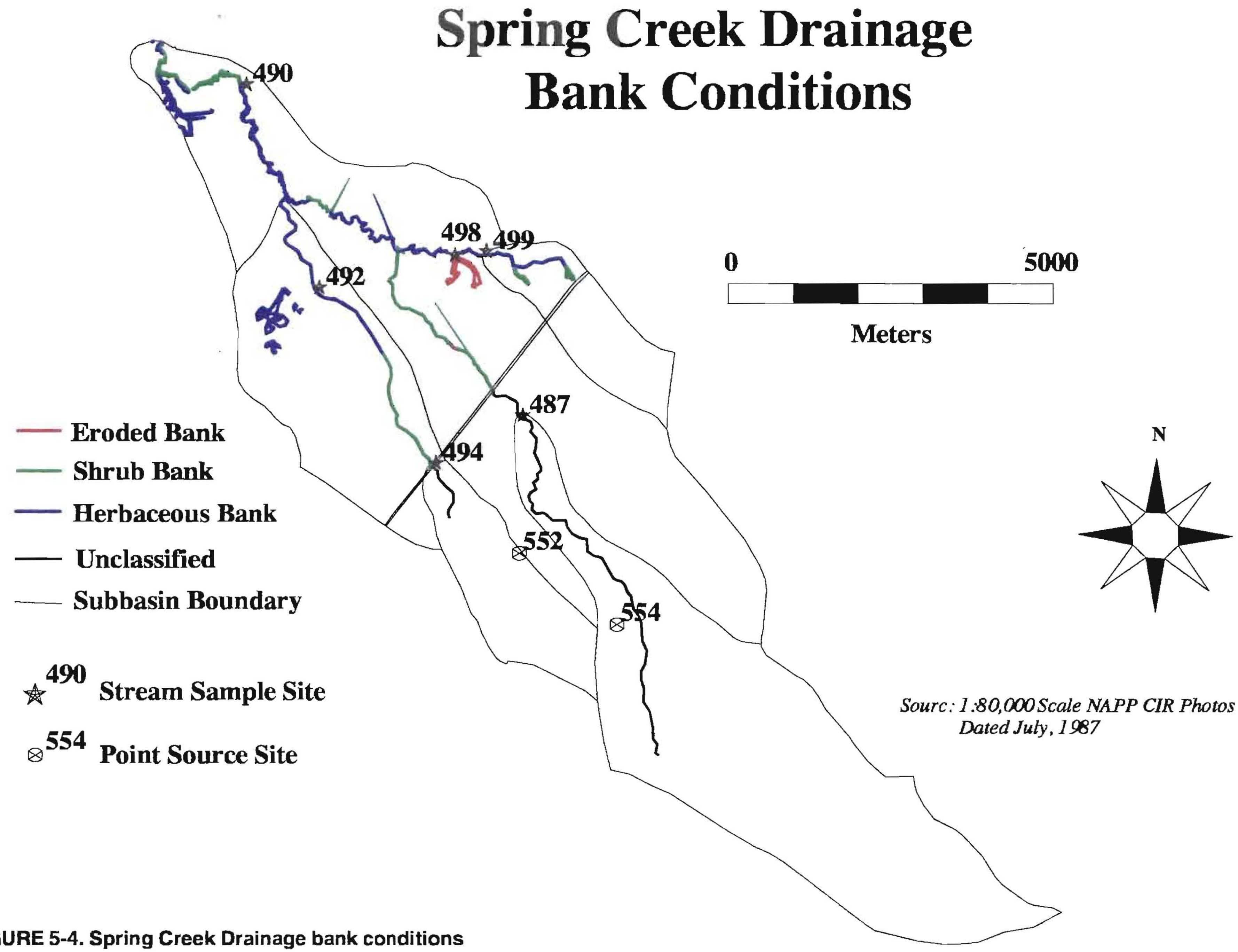

FIGURE 5-4. Spring Creek Drainage bank conditions

TABLE 5-6. Attributes of Spring Creek basin.

		ACRES	PERCENT
UPLAND LANDUSES			
irrigated agriculture		10,328	71
non-irrigated agriculture		513	4
open/unknown		1,637	11
urban		1,490	10
water/wetlands		222	2
National Forest		369	2
	TOTAL	**14,559**	**100**
VALLEY BOTTOM VEGETATION TYPES *			
cropland		216	16
hay meadow		107	8
road/development		47	3
water		87	6
wetland		938	67
	TOTAL	**1,395**	**100**

		METERS	PERCENT
VALLEY BOTTOM TYPE *			
alluvial confined		19,036	76
lacustrine unconfined		5,913	24
	TOTAL	**24,949**	**100**
VALLEY BOTTOM STATE *			
graded, stable banks		15,044	60
impounded		5,015	20
channelized		4,865	20
	TOTAL	**24,949**	**100**
BANK CONDITION *			
exposed		873	2
herbaceous		16,630	33
shrub		32,395	65
	TOTAL	**49,898**	**100**

* *These values for the portion of the drainage area northwest of Highway 89/91.*

TABLE 5-7. Pollutant loads and flows contributed from different sources within Spring Creek drainage.

	SITE NUMBER	Basin Area Acres	AVERAGE WATER YEAR LOADS (kg/day)					
			TP	DTP	TSS	NH_3	NO_3	FLOW (cfs)
Spring Creek above Cutler	490490	12,244	102	89	3,630	134	532	41
Contributions from subdrainages								
North Fork Spring Creek	490499	836	1.9	1.1	856	1.7	44	14
Hyrum Slough	490487	4,682	11	8	513	19	30	5.3
Upper South Fork Spring Creek	490494	1,028	256	169	4,470	183	723	9.5
Lower S. Fork Spring Creek, w. of Pelican Pond	490492	2,314	11	10	100	14	32	1.0
Point source inputs:								
Within Upper South Fork subdrainage								
EA Miller	490554		101	86	147	17.5	707	2.3
Hyrum WWTP	490552		18	16	35	3	27	1.1
Within North Fork subdrainage								
College Ward fish hatchery	490498		0.7	0.4	80	0.7	4.1	3.2
TOTAL:			**119.7**	**102.4**	**262**	**21.2**	**738.1**	**6.6**

were highest in the late summer due to irrigation flows. As stated in Section 4.4, numerous violations of state water quality standards were recorded at this site, including coliforms, ammonia and dissolved oxygen. Phosphorus concentrations at this site exceeded 10 mg/liter on four sample dates and averaged 21.0 mg/liter during the winter and early spring, but were lower during late summer, averaging 2.1 mg/liter. Dissolved total phosphorus showed a similar pattern, with peak concentrations in the winter and during runoff. During the winter, DTP averaged 14.7 mg/liter, while late summer concentrations averaged 1.2 mg/liter. These patterns were similar to those recorded in the previous year. On average, DTP accounted for 75 percent of the TP at this site, higher than observed through much of the study area. Nitrate exceeded 30 mg/liter on seven occasions, and exceeded the state water quality pollution indicator on all but three dates.

Below Highway 89/91, the South Fork drains into an area edging a substantial wetlands complex (Figure 5-3). This was the location of the downstream sample site on the South Fork (490492). Measured flows at this site were lower than those measured upstream (490494) or downstream (490490), and did not vary with season, suggesting that flows in the South Fork may disperse through the wetland, making it impossible to measure total water movement past this point. Nutrient concentrations measured at this site were also considerably lower than either the upstream or downstream sites.

Both Hyrum Slough and North Fork join the South Fork below site 490492. Local drainage in this lowest part of the Spring Creek basin drainage is from about 5,700 acres. By the time Spring Creek reached Cutler Reservoir, it had extremely large nutrient loads which could only be accounted for by loadings from the upper portion of the South Fork. With an average flow of 41 cfs, Spring Creek represented about six percent of the average annual accrual of the Bear River as it moved through the Cutler reach, but accounted for 27 percent of the TP, 29 percent of the DTP and 47 and 49 percent of NO_3 and NH_3 respectively.

As mentioned above, the biggest pollutant problems appear to be within the upper South Fork Spring Creek subbasin (above Highway 89/91). Major landuses and sources in this subbasin are listed in Table 5-8. Total phosphorus and DTP loads measured from point sources in 1993 and calculated nonpoint loads for given landuses are also presented. Potential loads under improved operations or following implementation of mitigation measures are listed in Table 5-9. Nonpoint sources to the stream

TABLE 5-8. Allocation of total phosphorus and dissolved total phosphorus loads to different sources in the upper South Fork Spring Creek drainage.

	AREA (acres)	TOTAL PHOSPHORUS LOADS (kg/day) RATE OF LOADING * MEDIUM	RANGE (Low-High)
Point Source:			
EA Miller		101	
Hyrum WWTP		18	
Miller Brothers Feedlot **		54	
Nonpoint Source:			
Irrigated agriculture	756	1.8	0.8-4.5
Nonirrigated agriculture	0	0	0
Open/unknown	84	0.08	0.01-0.25
Urban	187	0.23	0.02-0.56
Public lands	0	0	0
Feedlots	0.5	0.14	0.09-0.24
Unidentified nonpoint		81	134-36
TOTAL 1993 Load:		**256**	**256**
TMDL (Target Load):		**3**	**3**

	AREA (acres)	DISSOLVED TOTAL PHOSPHORUS LOADS (kg/day) RATE OF LOADING * MEDIUM	RANGE (Low-High)
Point Source:			
EA Miller		86	
Hyrum WWTP		16	
Miller Brothers Feedlot **		24	
Nonpoint Source:			
Irrigated agriculture	756	0.44	0.18-1.1
Nonirrigated agriculture	0	0	0
Open/unknown	84	0.05	0.01-0.16
Urban	187	0.15	0.01-0.36
Public lands	0	0	0
Feedlots	0.5	0.06	0.04-0.11
Unidentified nonpoint		42	66-22
TOTAL 1993 Load:		**169**	**169**
TMDL (Target Load):		**3**	**3**

* *Rates used in loading calculations can be found in Table 5-3.*
** *Assumes 3,000 head of cattle*

TABLE 5-9. Potential reduction in phosphorus loads in the upper South Fork Spring Creek drainage given different levels of remediation intensity. Reductions are applied to medium loads reported in Table 5-8.

	TOTAL PHOSPHORUS POTENTIAL LOADS (kg/day)		
	LEVEL OF REMEDIATION EFFORT *		
	LOW	MEDIUM	HIGH
Point Source:			
EA Miller	51	28	10
Hyrum WWTP	13	9.0	1.8
Miller Bros Feedlot	27	14	5.4
Nonpoint Source:			
Irrigated agriculture	1.1	0.92	0.18
Nonirrigated agriculture	0	0	0
Open/unknown	0.04	0.04	0.01
Urban	0.14	0.11	0.02
Public lands	0	0	0
Feedlots	0.07	0.03	0.01
Unidentified nonpoint	48	40	8.1
TOTAL Potential Load:	**141**	**92**	**26**
TMDL (Target Load):	**3**	**3**	**3**

	DISSOLVED TOTAL PHOSPHORUS POTENTIAL LOADS (kg/day)		
	LEVEL OF REMEDIATION EFFORT *		
	LOW	MEDIUM	HIGH
Point Source:			
EA Miller	28	43	8.6
Hyrum WWTP	13	8.0	1.6
Miller Bros Feedlot	12	6.1	2.4
Nonpoint Source:			
Irrigated agriculture	0.26	0.22	0.04
Nonirrigated agriculture	0	0	0
Open/unknown	0.03	0.02	0.005
Urban	0.09	0.07	0.01
Public lands	0	0	0
Feedlots	0.04	0.03	0.01
Unidentified nonpoint	25	21	4.2
TOTAL Potential Load:	**79**	**78**	**17**
TMDL (Target Load):	**3**	**3**	**3**

** See Table 5-4 for percent reductions assumed for different levels of remediation effort* appear to be primarily from agricultural activities. As mentioned above, most of the South Fork and Hyrum Slough are channelized, although the banks are vegetated through most of the reach. The proximity to fields covered with manure during winter appears to be a serious problem, with manure entering the stream directly during spring runoff. Manure bunkering would allow manure to be spread after the ice is off the fields, when the manure can be worked into the soil. Improved riparian areas would result in slowing down or trapping the runoff, and incorporating these nutrients ultimately into vegetation, rather than transporting the nutrients downstream. A 10-25 meter green belt has been shown to remove up to 90 percent of dissolved total phosphorus in runoff from a field or feed lot (Vought et al. 1994). In cases where the runoff cannot be contained by improved riparian areas, holding ponds may help to reduce spring runoff. Alternate uses for the manure, such as composting may also reduce the problem.

This subdrainage is also impacted more than any other subdrainage by point source inputs. Two permitted dischargers account for almost half the total phosphorus and almost two-thirds of the DTP which were measured in the upstream South Fork site (Table 5-7). These are both secondary wastewater treatment facilities, which do not typically remove much phosphorus under traditional operating procedures. Revisions in operations and better management of sludge and flow through the plants may greatly improve nutrient removal without costly capital improvements. It is recommended that these facilities be evaluated to determine if they are adequately sized for their current loads. If they are appropriately sized, an additional evaluation of treatment processes may be advisable, to determine what modifications could be made to improve nutrient removal. Although both facilities currently have Utah discharge permits, phosphorus discharge is not controlled. The state can, however, require the plants to remove phosphorus if there is a demonstrated water quality and beneficial use impairment. A review of operations and potential improvements prior to this move by the state is recommended.

A third point source in the valley is a large feedlot (Miller Brothers feedlot) in the South Fork subdrainage. Under conditions of a Notice of Violation and administrative order issued by the Utah Department of Environmental Quality in 1993 and again in 1995, this facility is currently building retention basins to contain runoff (Nathan Gwin, UDWQ, pers. comm). The existing plan for this facility is for solids and liquids to be land-applied. Of concern in this basin, however, is the current overapplication of surrounding lands with manure. Exchanging a point source with an increase in nonpoint source loadings will not improve water quality in the basin. Alternative uses for manure, such as composting, have great potential in this subbasin. A concentrated source of manure exists, some lands currently being used for land application could be converted to a composting operation, and a waste product could be converted into a resource.

Finally, it is recommended that Pelican Pond or the wetlands surrounding this area be evaluated as a location for wetland treatment of the stream. The higher water quality that was recorded at this site may come from springs near the pond, but also may result from some removal of nutrients within the wetlands. By routing more of the South Fork flow through the area, or by generating additional wetlands in the low lying areas near the existing complex, significant seasonal nutrient removal may be possible. Wetland treatment is complex, however, because many of the nutrients (especially phosphorus) which are removed during the growing season can reenter a system as plants decompose in the fall and winter (USEPA 1988; Hammer 1992). Harvesting some of the vegetation is one solution to this. A full evaluation of wetland treatment is not within the scope of this document, but it is recommended that this be evaluated.

Recommendations: Concentrate efforts in the South Fork subdrainage southwest of Highway 89/91.

- Improve manure management, reduce winter manure spreading, develop holding ponds to reduce direct spring runoff from manure covered fields.
- Improve and expand riparian areas to provide green belts to filter runoff.
- Evaluate EA Miller's and Hyrum's wastewater treatment processes to determine whether changes or improvements in operations can reduce nutrient concentrations in the effluent. Recommend continued monitoring of DTP in their effluent.
- Continue monitoring below the Miller Brothers feedlot to evaluate success of this new facility. Pursue alternatives to land application of waste such as composting operations.
- Evaluate potential wetland development in the Pelican Pond area to treat South Fork Spring Creek before it reaches Cutler Reservoir.

5.1.2 Utah Portion of the Cub River Basin

Landuse in the Cub River subbasin is illustrated in Figure 5-5. Valley bottom vegetation and bank conditions are illustrated in Figures 5-6 and 5-7, respectively. Attributes of the area draining directly to the Cub River below the Utah-Idaho border are summarized in Table 5-10.

The Cub River is a major contributor of dissolved nutrients and TSS to the Bear River system.

The major contributions of TSS, however, occur in Idaho (Table 5-11) and therefore are not within the scope of this document. This discussion emphasizes those nutrient remediations possible in the Utah portion of the Cub River. Reductions of TSS are secondary benefits of any improvements in agricultural runoff or in riparian areas.

Sources of water and contaminants to the Cub River which were evaluated in this study include Worm Creek and the Cub River entering from Idaho, three streams (Cherry, High and Spring creeks) draining lands to the east in Utah, and the Richmond sewage lagoons (Table 5-11). Local accrual is the difference between what was measured at the site above the Bear River (490425) and all other sources, and represents local drainage along the corridor of the Cub River in Utah (Figure 5-6). Local accrual accounted for about 24 percent of the total flow during the year of sampling, but accounted for 46 percent of the TSS load and about 58 percent of the nutrient loads (Table 5-11). Flows at site 490425 peaked twice, first in late March and later in late May and early June. Flows during early runoff peaked at almost 570 cfs, of which 65 percent was contributed by local runoff. The peak runoff from tributaries and the upper reach of the Cub River occurred in May. During this later runoff, only 20 to 25 percent of the flow at 490425 was contributed by local runoff.

In contrast to flow, local accrual accounted for about 58 percent of the nutrient loading. Concentrations of all nutrients were highest at 490425 in late March. At that time, the concentration of TP increased from 0.231 mg/liter at the stateline to 0.756 mg/liter at the Bear River confluence, a three-fold increase. Dissolved total phosphorus concentrations doubled to a peak concentration of 0.409 mg/liter over the same reach, NO_3 increased from 3.61 mg/liter to 5.1 mg/liter, and NH_3 increased from 0.103 to 0.321 mg/liter. A second peak in the concentrations of TP and TSS was seen at the stateline during the second peak flow period, but no further increases occurred from that point to the confluence with the Bear River. These patterns resulted in extremely high nutrient loadings during early runoff, which accounted for almost 80 percent of the annual loading. Furthermore, almost all DTP, TP, and NO_3 which entered during the peak early runoff loading event entered from local accrual (Table 5-11).

Total suspended solids concentrations and loads showed a different pattern. While about 80 percent of the annual TSS load at 490425 entered during runoff, the largest percentage entered from Idaho, especially during the later May runoff. The highest TSS concentrations in the drainage were

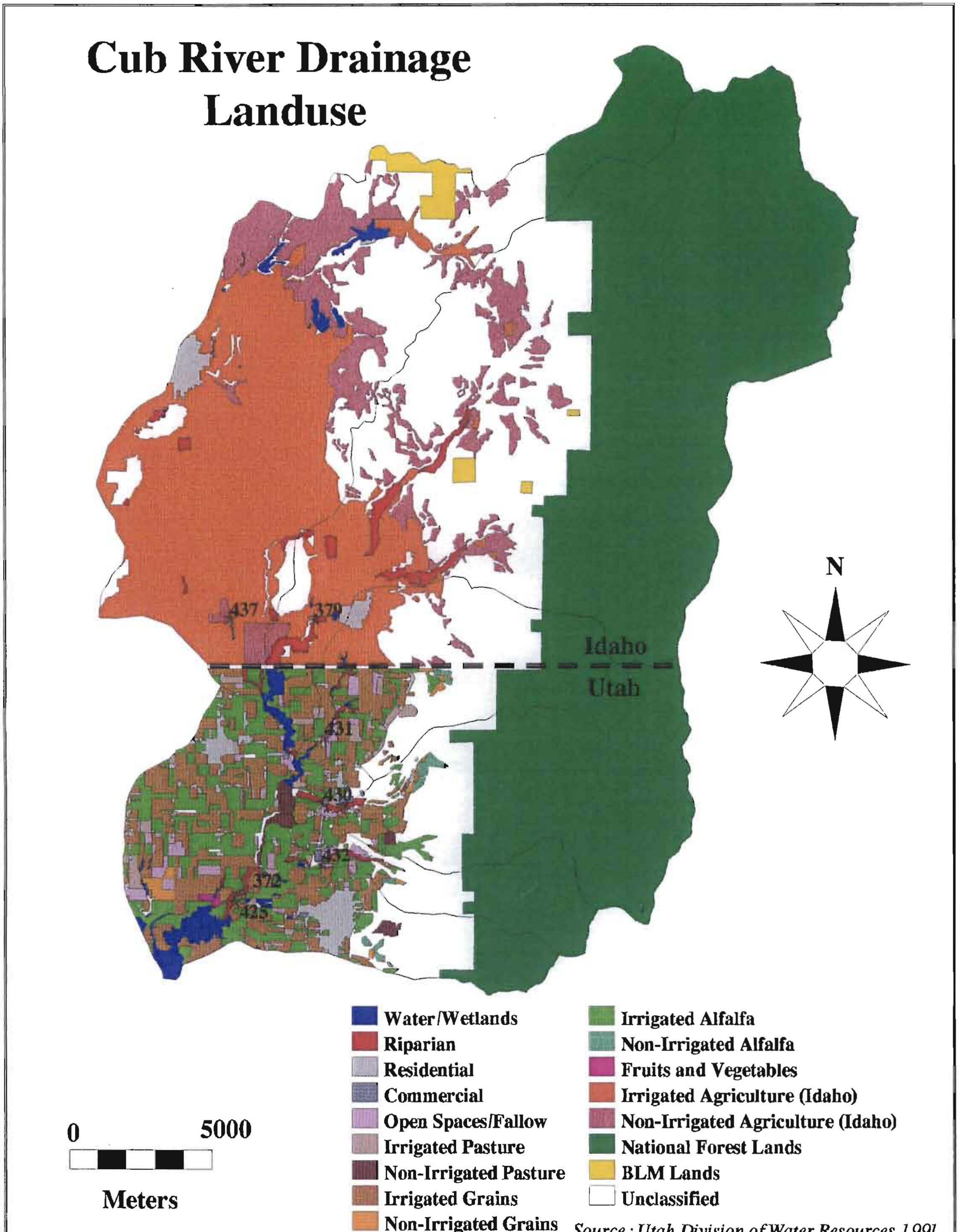

FIGURE 5-5. Cub River Drainage landuse.

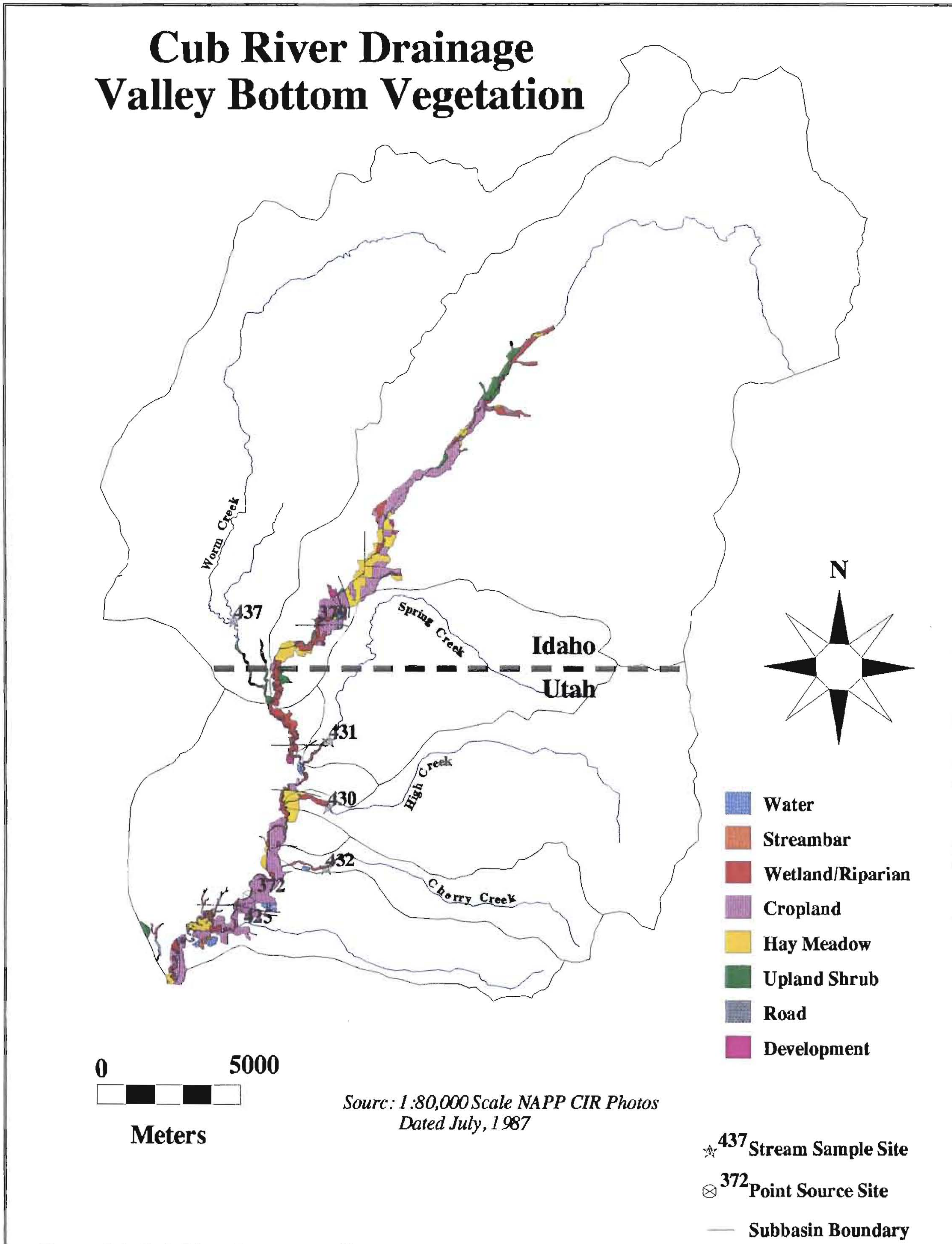

Figure 5-6. Cub River Drainage valley bottom vegetation.

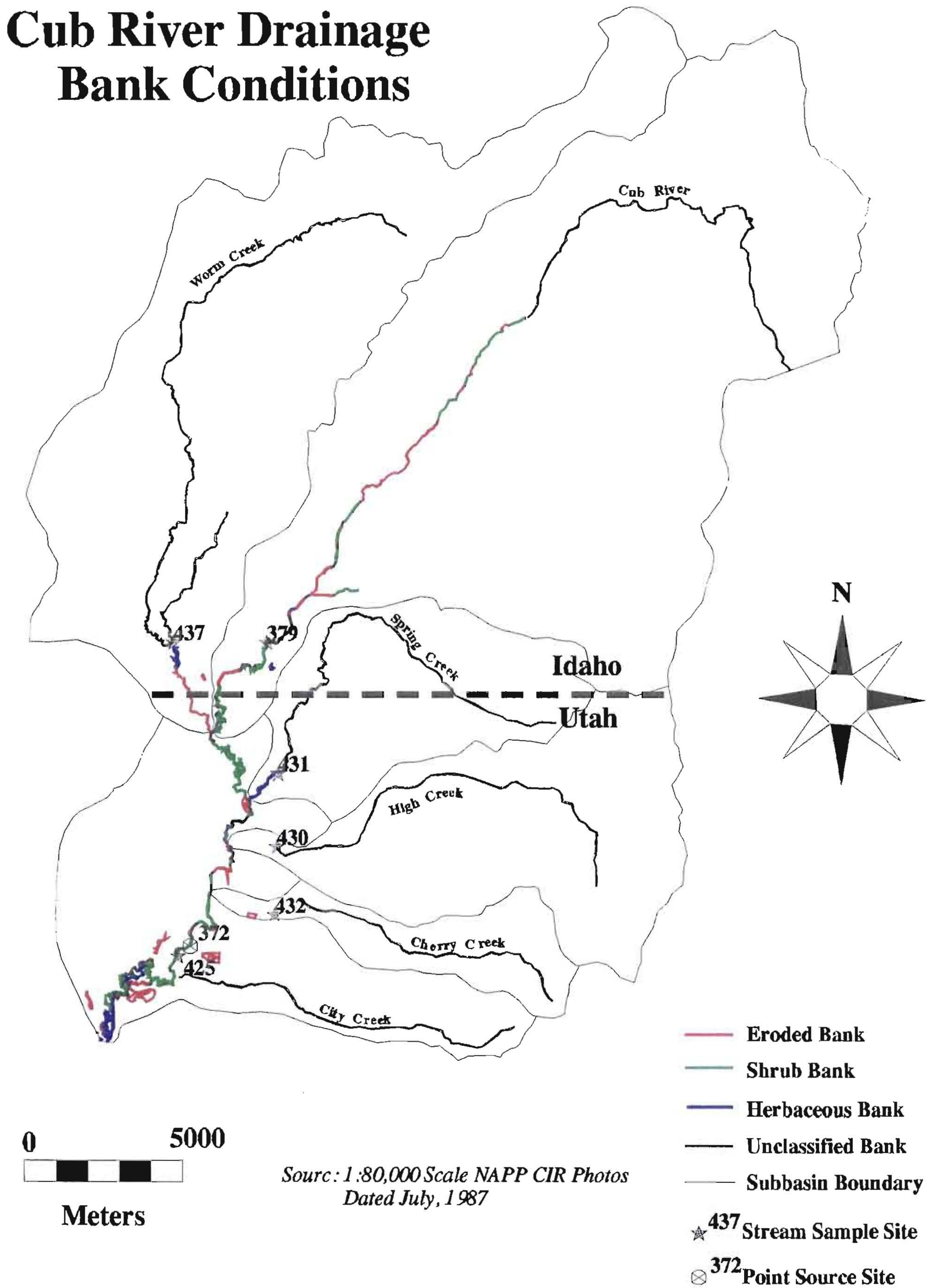

FIGURE 5-7. Cub River drainage bank conditions.

TABLE 5-10. Attributes of the localized Cub River drainage area in Utah. This area includes lands draining directly to the Cub River from the Idaho stateline to the Bear River confluence.

		ACRES	PERCENT
UPLAND LANDUSES			
irrigated agriculture		11,011	60
non-irrigated agriculture		533	3
open/unknown		2,910	16
urban		1,375	7
water/wetlands		1,165	6
National Forest		1,480	8
	TOTAL	**18,474**	**100**
VALLEY BOTTOM VEGETATION TYPES			
cropland		809	46
haymeadow		161	9
upland		142	8
roads/development		55	3
water/wetlands/streambar		598	34
	TOTAL	**1,765**	**100**

		METERS	PERCENT
VALLEY BOTTOM TYPE			
lacustrine confined		16,452	46
lacustrine unconfined		19,236	54
	TOTAL	**35,688**	**100**
VALLEY BOTTOM STATE			
graded		22,382	62
eroded bank		2,536	7
incised		935	3
channelized		9,836	28
	TOTAL	**35,688**	**100**
BANK CONDITION			
eroded		21,928	31
shrubs		35,792	50
grass covered		13,656	19
	TOTAL	**71,376**	**100**

TABLE 5-11. Average water year and runoff pollutant loads contributed within the Cub River basin.

	SITE NUMBER	AVERAGE WATER YEAR LOADS (kg/day)						AVERAGE SPRING RUNOFF LOADS (kg/day)					
		TP	DTP	TSS	NH_3	NO_3	FLOW (cfs)	TP	DTP	TSS	NH_3	NO_2	FLOW (cfs)
Cub River above Bear River	490425	136	68	43,100	58	835	191	455	223	139,000	183	2,940	457
Contributions from subbasins:													
Cub River in Idaho	490379	24.7	8.4	19,900	6.6	132	78.9	65	23.3	49,300	14	413	150
Worm Creek	490437	15.4	10.9	2,580	10.4	97	13	34.6	22.2	7,060	22.6	270	24
Spring Creek	490431	8.9	6.4	2,090	2	93	16	19.9	14.1	4,690	4.4	204	33
High Creek	490430	5	1	2,560	3	25	33	8.7	2	6,560	3.7	37.6	76
Cherry Creek	490432	0.4	0.2	230	0.3	7.5	5	0.76	0.3	589	0.5	11.2	11
Point source inputs:													
Richmond Lagoons	490372	2.3	1.9	5.6	2.9	0.3	0.3						
Lewiston Lagoons		contained with occasional overflow											
Local accrual along Utah corridor:													
Cub within Utah		80	38.7	15,800	33.3	481	46.4	65	23.3	49,300	14	413	150

recorded at the stateline site, reaching more than 250 mg/liter during the later runoff. Peak concentrations downstream at site 490425 were about 150 mg/liter, which occurred during both runoff periods. This resulted in two peaks in TSS loading, unlike the other parameters.

These loading patterns indicate that the Utah corridor is an important source of nutrients and a secondary source of TSS. The disparity between patterns in TSS loading and dissolved nutrient loading suggest that the primary sources of particulate and dissolved pollutants are not the same. Agricultural field runoff may be partially responsible for both TSS and nutrient loading within this reach. The area draining directly to the Cub within Utah is mostly agricultural and 60 percent of the area is irrigated (Table 5-10). About half of the valley bottom is used for agriculture, with most of that in croplands (Figure 5-6 and Table 5-10). Field surveys from the stateline to site 490425 revealed few agriculture return channels or pipes entering the river from fields. Other impacts include animal operations in the riparian zone and slumping of river banks (Figure 5-8). Most of the riparian areas in those reaches evaluated in the field were vegetated, verifying mapping work, which indicated that about 50 percent of the banks in this entire reach were shrub or tree covered, and another 20 percent were covered with herbaceous vegetation. Even where the river has been channelized, a healthy riparian zone exists, with stable stream banks. These vegetated riparian zones should provide a good filter strip between field runoff and the river.

Increased TSS loading during both the low basin and high basin runoff peaks suggests that high flows directly cause localized bank erosion and resuspension of bedload sediments. About one-third of the stream banks along the Cub River within Utah were characterized as eroded (Table 5-10). In addition, at several locations in this reach, animal and agricultural operations have directly impacted the riparian area and caused erosion into the river. Field observations, however, did not locate any extensive bank erosion problems. Much of the sediment moving in this portion of the river may be resuspended sediments that were delivered from upstream sites in earlier runoff events. Mapping of the Cub River above the stateline indicates a higher percentage of eroded banks, which may account for the increased sediment yield from this reach.

Table 5-12 summarizes total phosphorus and dissolved total phosphorus loadings from point sources and major landuses. Because of the different loading patterns of TSS and dissolved nutrients, it appears that cropland runoff is not the primary source of the large runoff peaks of dissolved nutrients

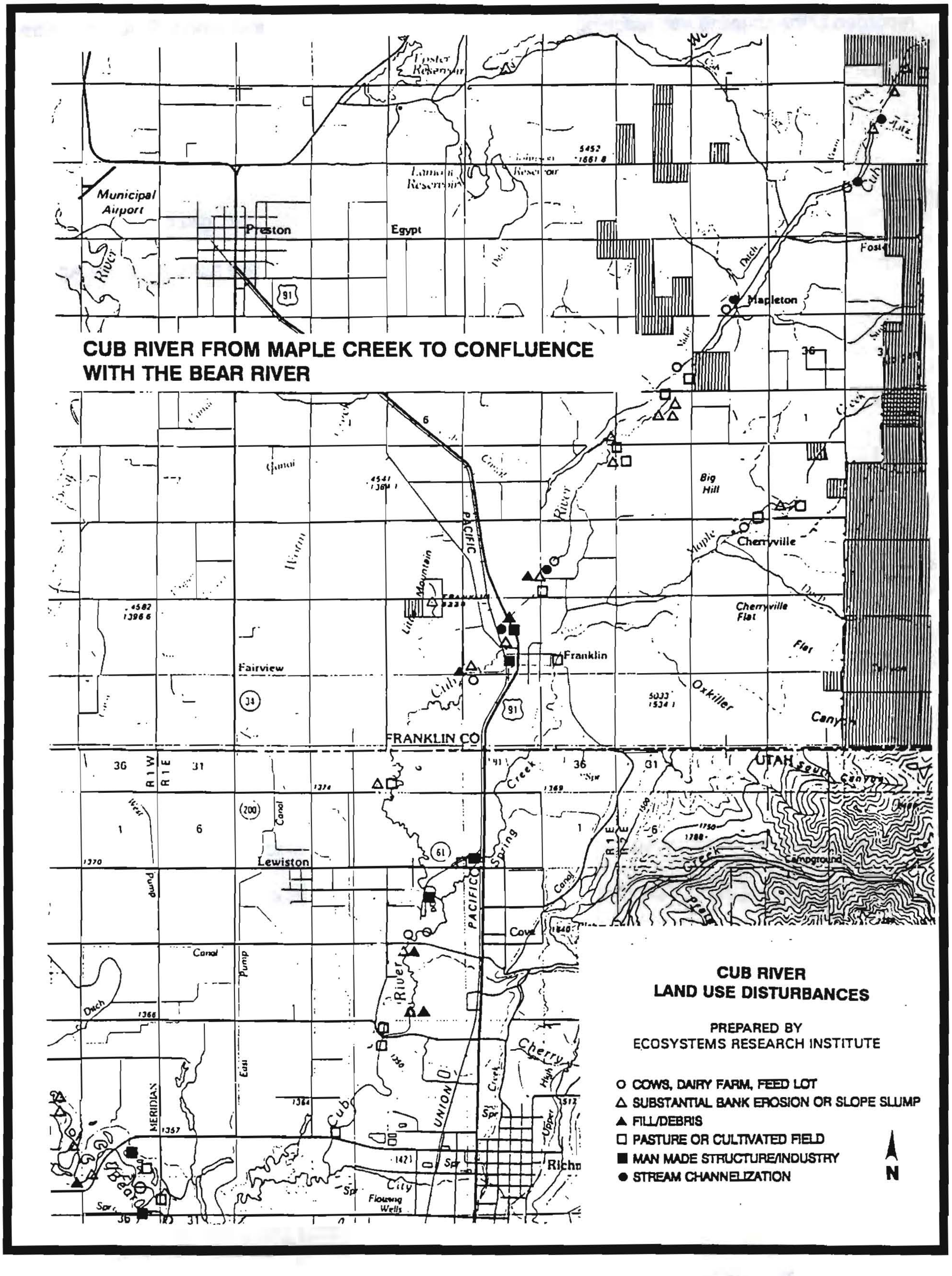

FIGURE 5-8. Landuse disturbances affecting streambank or riparian areas of the Cub River (ERI 1991).

TABLE 5-12. Allocation of total phosphorus and dissolved total phosphorus loads to different sources in the Cub River localized drainage in Utah.

	AREA (acres)	TOTAL PHOSPHORUS LOADS (kg/day) RATE OF LOADING *	
		MEDIUM	RANGE (Low-High)
Point Source:			
Richmond WWTP		2.3	2.3
Lewiston Lagoons			
Nonpoint Source:			
Irrigated agriculture	11,011	27	11-65
Nonirrigated agriculture	533	0.44	0.06-0.94
Open/unknown	2,910	2.6	0.32-8.6
Urban	1,375	1.7	0.15-4.1
Public lands	1,480	0.33	0.16-0.49
Feedlots	3.2	0.88	0.56-1.5
Unidentified nonpoint (includes runoff from fertilizer distributor)		47	68-(0.34)
TOTAL 1993 Load:		**82**	**82**
TMDL (Target Load):		**9**	**9**

	AREA (acres)	DISSOLVED TOTAL PHOSPHORUS LOADS (kg/day) RATE OF LOADING *	
		MEDIUM	RANGE (Low-High)
Point Source:			
Richmond WWTP		1.9	
Lewiston Lagoons			
Nonpoint Source:			
Irrigated agriculture	11,011	6.4	2.6-16
Nonirrigated agriculture	533	0.23	0.03-0.48
Open/unknown	2,910	1.7	0.21-5.7
Urban	1,375	1.1	0.10-2.7
Public lands	1,480	0.22	0.11-0.33
Feedlots	3.2	0.40	0.25-0.67
Unidentified nonpoint (includes runoff from fertilizer distributor)		29	35-13
TOTAL 1993 Load:		**41**	**41**
TMDL (Target Load):		**9**	**9**

** Rates used in loading calculations can be found in Table 5-3.*

observed within the Utah reach. Several animal feeding operations occur about 2.4 river miles above the 490425 site. These sites also have degraded riparian areas, with little or no vegetative buffer between animal operations and the river. Throughout the corridor, however, there are few major animal operations or other practices such as intensive winter manure spreading which could result in a greater increase in dissolved nutrients than in sediment runoff.

Potential point sources in the Cub drainage include the following permitted dischargers: Richmond sewage lagoons, Lewiston sewage lagoons, Presto Products, Preston WWTP, and the Del Monte cannery in Idaho. Non-permitted sources include a small dairy products operation, storm runoff from the towns of Richmond and Lewiston, and a fertilizer distributor on Highway 61 near Lewiston. Effluent from the Richmond lagoons was sampled regularly and found to be a small contributor (Table 5-11). The Lewiston lagoons are contained and may spill briefly during high flow periods, but no overflows during the study period could account for the nutrient gains seen in this study. Preston WWTP discharges into Worm Creek and the Del Monte cannery discharges into the Cub River above the state line. While the Preston WWTP may be a substantial contributor to Worm Creek, this source would not be included in the large increases seen in the Utah reach. Presto Products discharges into the Cub River, but occasional effluent samples evaluated for nutrients indicate very low concentrations.

The fertilizer distributor was not evaluated during this study, so its influence has not been quantified. A site visit in mid-summer found substantial amounts of what appeared to be granular fertilizer in small piles and drifts in the parking and loading areas, apparently from spills during loading. This parking area drains directly into Spring Creek below the Spring Creek sample site, and only a few hundred feet above the Cub River. Vegetation in the ditch downgradient from the parking area appeared "burned", which may indicate a big pulse of intense nutrients during snowmelt or early runoff. There is no way to evaluate an actual load from this site without additional monitoring. Assuming that typical phosphate fertilizer is about 45 percent P_2O_5 by weight, over 2,000 kilograms of fertilizer would have to enter the river to account for the entire runoff peak in DTP of 430 kg/day. Existing evidence suggests that substantial amounts of dissolved nutrients may enter from this source but the site needs to be monitored closely during the next runoff to determine the actual magnitude of inputs. In any case, operations need to be improved to contain any spills and to keep these nutrients from entering the river. Table 5-13 summarizes potential reduced TP and DTP loads under a range of remediation intensity.

TABLE 5-13. Potential reduction in phosphorus loads in the Cub River localized drainage given different levels of remediation intensity. Reductions are applied to the medium loads reported in Table 5-12.

	TOTAL PHOSPHORUS POTENTIAL LOADS (kg/day)		
	LEVEL OF REMEDIATION EFFORT *		
	LOW	MEDIUM	HIGH
Point Source:			
Richmond WWTP	3.8	1.2	0.23
Lewiston Lagoons			
Nonpoint Source:			
Irrigated agriculture	16	13	2.7
Nonirrigated agriculture	0.27	0.22	0.04
Open/unknown	1.6	1.3	0.26
Urban	1.0	0.84	0.17
Public lands	0.20	0.16	0.03
Feedlots	0.53	0.44	0.09
Unidentifed nonpoint **	28	24	4.7
TOTAL Potential Load:	**52**	**41**	**8.2**
TMDL (Target Load):	**9**	**9**	**9**

	DISSOLVED TOTAL PHOSPHORUS POTENTIAL LOADS (kg/day)		
	LEVEL OF REMEDIATION EFFORT *		
	LOW	MEDIUM	HIGH
Point Source:			
Richmond WWTP	3.8	0.95	0.19
Lewiston Lagoons			
Nonpoint Source:			
Irrigated agriculture	3.9	3.2	0.64
Nonirrigated agriculture	0.14	0.11	0.02
Open/unknown	1.0	0.85	0.17
Urban	0.65	0.55	0.11
Public lands	0.13	0.11	0.02
Feedlots	0.20	0.10	0.04
Unidentifed nonpoint **	17	14	9
TOTAL Potential Load:	**27**	**20**	**4.1**
TMDL (Target Load):	**9**	**9**	**9**

** See Table 5-3 for percent reductions assumed for different levels of remediation effort*

*** A larger proportion of the unaccounted for phosphorus may be removed if the source is the fertilizer distributor.*

Recommendations:

- Evaluate Intermountain Farmers Association in Lewiston as a source of high nutrient runoff. Help develop a plan to contain spills and reduce runoff to public waterways.

- Improve riparian areas in the reach from 2.4 to 4.3 miles above site 490425. Parts of site 490425 are heavily grazed. Implement a wider buffer zone between the fields and river and plant willows and other vegetation to help revegetate and stabilize the shoreline in this area.

- Educate agricultural users on fertilizer application and other techniques to reduce nutrient and sediment runoff.

- Work with Idaho to reduce incoming TSS.

5.1.3 Nonpoint Sources in Cutler Reservoir

Landuse in the vicinity of Cutler Reservoir is illustrated in Figure 5-9. Valley bottom vegetation and bank conditions are illustrated in Figures 5-10 and 5-11, respectively. Attributes of the Cutler Reservoir subbasin are summarized in Table 5-14. About 45 percent of the land draining to Cutler is identified as agricultural, with another 35 percent either open or in public use (Table 5-14). Of the valley bottom about 25 percent is either cropland or haymeadow.

From the site near Benson, the Bear River flows about 2.6 miles before entering Cutler Reservoir proper. This reach above Cutler Reservoir is greatly influenced by reservoir water levels. As mentioned earlier, Cutler Reservoir covers a surface area of about 7,000 acres within Cache Valley. Upstream from the dam, the reservoir is wide and shallow, and deepens only in the canyon section. The valley area north of the reservoir, draining into Clay Slough and the reservoir itself, is low gradient, highly saline, and in part consists of salt barrens. South of the Bear River channel, the reservoir is quite shallow and sustains over 1,700 acres of emergent wetlands. At the south end of the reservoir, the Logan River, Bear River and Spring Creek enter. The Logan Lagoons also discharge into the southern portion of the reservoir, except when the effluent is diverted for irrigation purposes.

The influence of tributaries on Cutler water quality was discussed in Chapter 3. Inputs are summarized in Table 5-15. Total phosphorus and dissolved total phosphorus loadings from point sources and major landuses in the immediate Cutler drainage are summarized in Table 5-16. Flows entering Cutler Reservoir and along the Bear River below Benson were responsible for about 40 percent of the

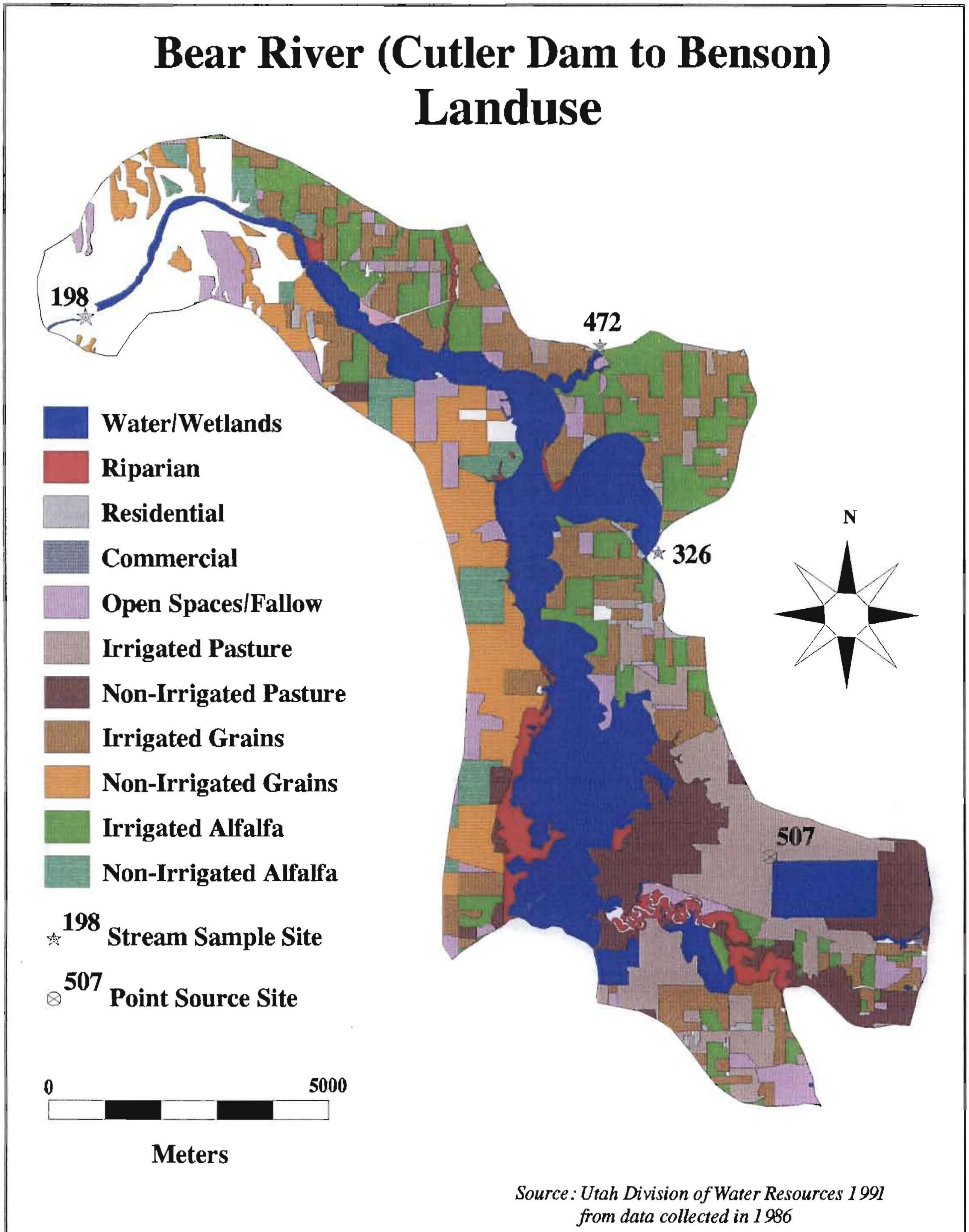

FIGURE 5-9. Bear River (Cutler Dam to Benson) landuse.

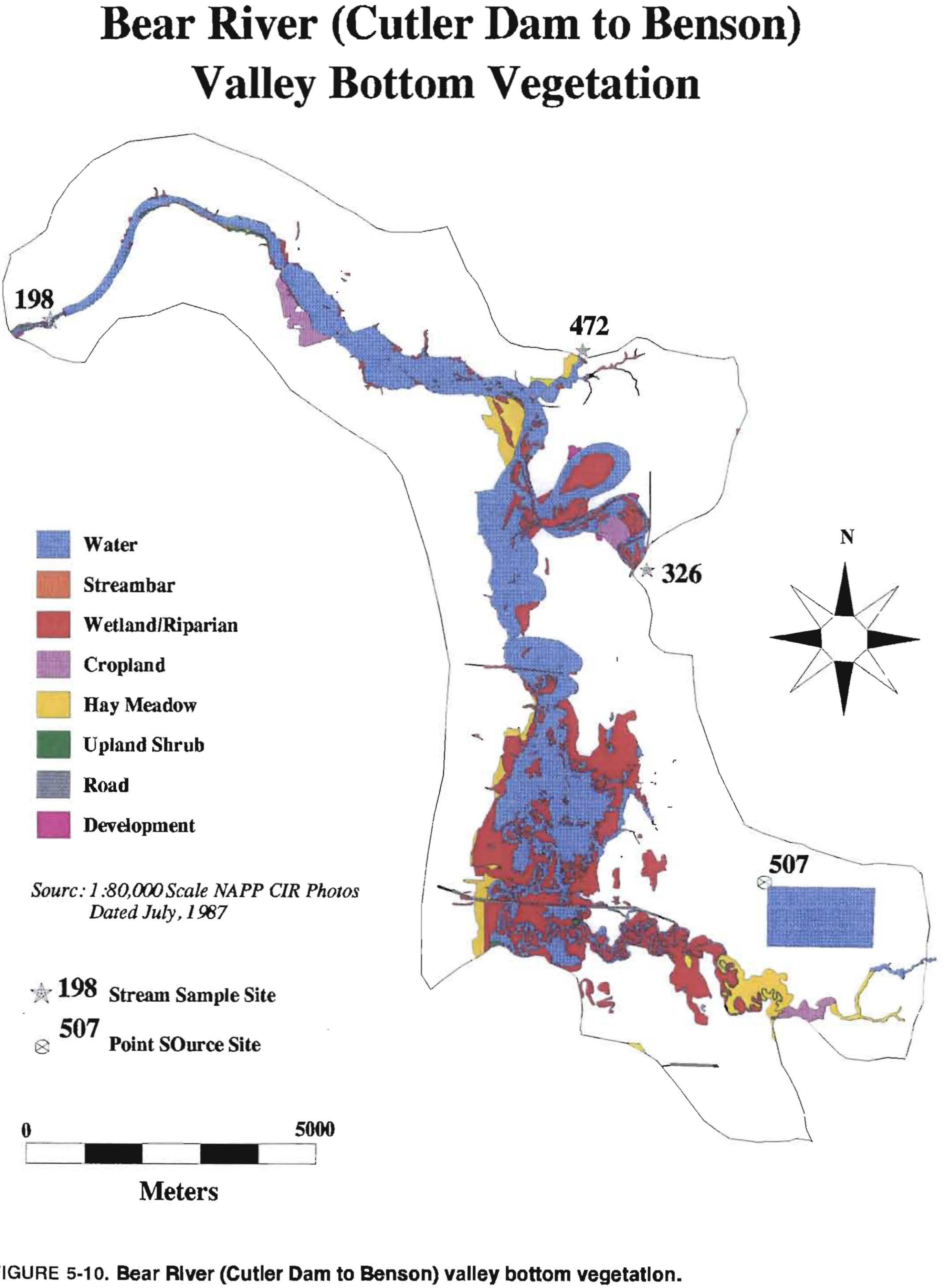

FIGURE 5-10. **Bear River (Cutler Dam to Benson) valley bottom vegetation.**

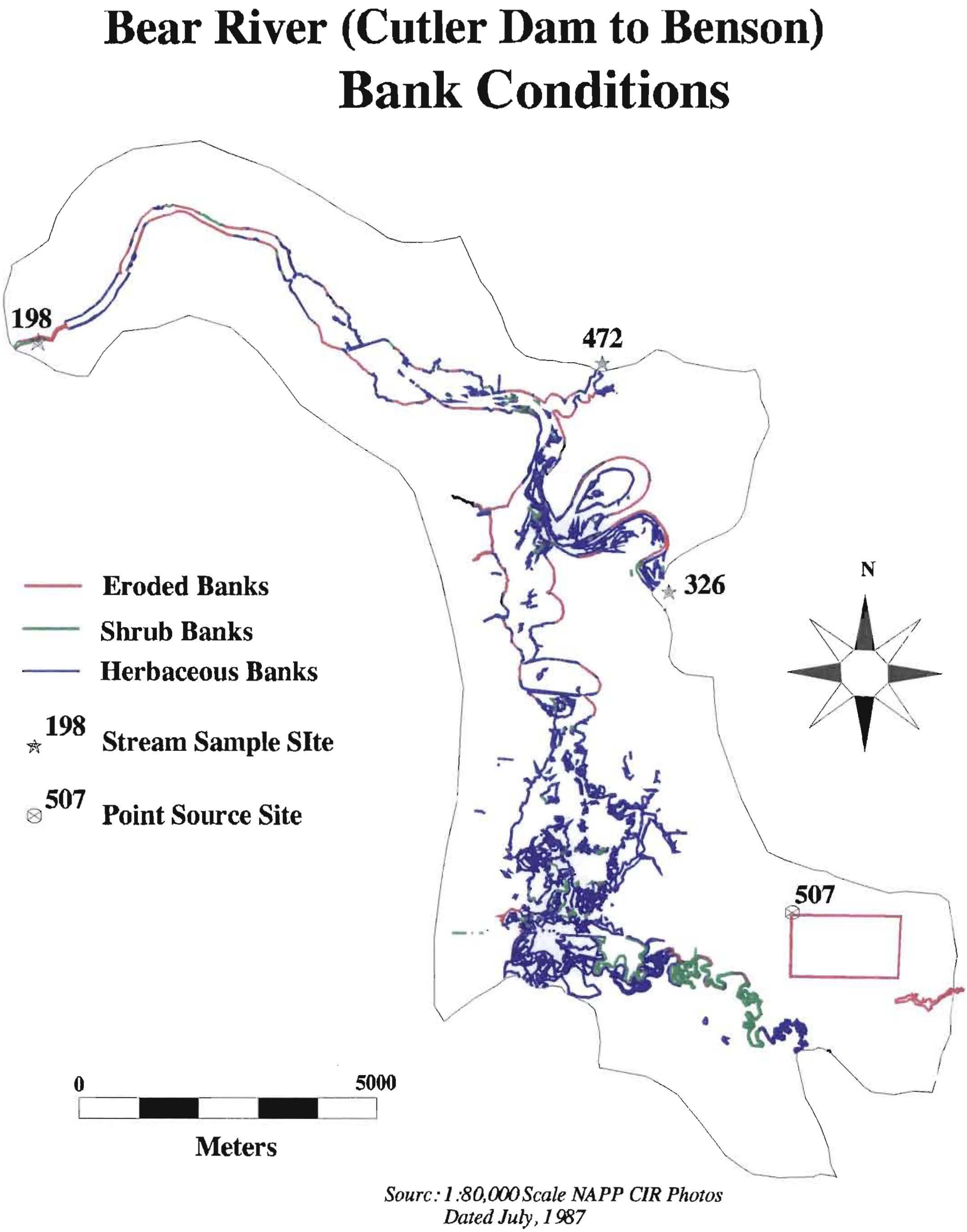

FIGURE 5-11. **Bear River (Cutler Dam to Benson) bank conditions.**

TABLE 5-14. Landuses and conditions in the local drainage area within Cutler Reservoir. This includes the area west of the Mendon Road crossing and downstream of site 490326 near Benson to below Cutler Dam.

		ACRES	PERCENT
UPLAND LANDUSES			
irrigated agriculture		8,505	37
non-irrigated agriculture		4,697	20
open/unknown		3,555	15
urban		216	0.9
water/wetlands		6,001	26
	TOTAL	**22,975**	**100**
VALLEY BOTTOM VEGETATION TYPES			
cropland		1,557	20
haymeadow		335	4
upland		0	0
roads/development		70	1
water		3,584	47
wetlands		2,047	27
other		25	0
	TOTAL	**7,618**	**100**

		METERS	PERCENT
VALLEY BOTTOM TYPE			
alluvial confined		11,766	10
lacustrine unconfined		111,792	90
	TOTAL	**123,588**	**100**
VALLEY BOTTOM STATE			
graded		11,766	10
impounded		111,792	90
	TOTAL	**123,588**	**100**
BANK CONDITION			
eroded		31,509	13
grass covered		184,525	75
shrubs		31,083	12
	TOTAL	**247,117**	**100**

TABLE 5-15. Pollutant loads and flows contributed from different sources within Cutler Reservoir.

	SITE NUMBER	AVERAGE WATER YEAR LOADS (kg/day)					
		TP	DTP	TSS	NH_3	NO_3	FLOW (cfs)
Bear River at Collinston	490198	786	468	241,871	497	3,553	1,608
Contributions from subdrainages							
Bear River at Benson	490326	410	163	138,644	223	2,477	969
Spring Creek	490490	102	89	3,629	134	533	41
Little Bear	490500	24	14	8,147	14	128	77
Logan River	490504	34.4	14	11,674	38	288	248
Clay Slough	490472	18.6	15.4	1,248	10.6	104.9	8
Point source inputs:							
Logan Lagoons	490507	68	54	235	55	22	8
Local accrual within the Cutler Reach		129	119	78,294	22.4	0.1	257

TABLE 5-16. Allocation of total phosphorus and dissolved total phosphorus loads to different sources in the Cutler localized drainage in Utah.

	ACRE (acres)	TOTAL PHOSPHORUS LOADS (kg/day)	
		RATE OF LOADING *	
		MEDIUM	RANGE (Low-High)
Point Source:			
Logan Lagoons		68	
Nonpoint Source:			
Irrigated agriculture	8,505	21	8.7-50
Nonirrigated agriculture	4,697	3.9	0.6-8.4
Open/unknown	3,555	3.2	0.4-5.6
Urban	216	0.3	0.02-0.6
Feedlots	8	2.2	1.4-3.8
Unidentified nonpoint		98.4	191-61
TOTAL 1993 Load:		**197**	**197**
TMDL (Target Load):		**18**	**18**

	ACRE (acres)	DISSOLVED TOTAL PHOSPHORUS LOADS (kg/day)	
		RATE OF LOADING *	
		MEDIUM	RANGE (Low-High)
Point Source:			
Logan Lagoons		54	54
Nonpoint Source:			
Irrigated agriculture	8,505	5.0	2.0-12.0
Nonirrigated agriculture	4,697	2.0	0.3-4.3
Open/unknown	3,555	2.1	0.3-6.9
Urban	216	0.2	0.02-0.4
Feedlots	8	1.0	0.64-1.7
Unidentified nonpoint		109	116-94
TOTAL 1993 Load:		**173**	**173**
TMDL (Target Load):		**18**	**18**

* *Rates used in loading calculations can be found in Table 5-3*

annual gain in flow within this reach. The proportion of DTP and TP loadings from within the reach were similar to that for flow. TSS entering within this reach, however, accounted for about 75 percent of the total TSS gain in the reservoir. Three-quarters of the TSS entering the reservoir within Cutler entered during spring runoff, associated with high flows and high flushing rates. The unconsolidated sediments in the shallow reservoir and eroded banks are probable sources. Bank conditions throughout the reservoir and the river above the reservoir are in poor condition. Almost 90 percent of the banks in this reach are either grass covered or eroded, and of the eroded banks, 75 percent are in the reservoir itself. Wave action contributes to constant deterioration of banks. Agricultural activities near the reservoir have contributed to erosion, and also have eliminated much needed vegetation at the water's edge which would stabilize the banks, and provide filter strips for surface runoff.

Field surveys of the riverine portion of this reach indicate intensive agricultural activity in the immediate floodplain (Figure 5-12). This has contributed in some cases to exposed banks, susceptible to erosion with increased flows or surface runoff. In addition, during spring runoff much of this land is submerged, which literally flushes loose sediment and animal waste into the river and reservoir.

It is interesting that of the DTP that enters in this reach, less than one percent enters during spring and only about five percent enters during the summer. High fall and winter loadings of dissolved nutrients suggest that die off of submerged and emergent vegetation and decay of organic materials in the sediments are responsible for much of the dissolved phosphorus loading in this reach. Anoxic release of phosphorus from the sediments may also occur when the reservoir is ice covered. Carp activity has been suggested as a major factor in the deteriorated condition of Cutler Reservoir and the Bear River in this reach. Carp probably contribute to the instability of the river and reservoir bottom, both directly and indirectly by not allowing plants to become established in shallow areas. Summer partial drawdowns of the reservoir to fulfill irrigation needs, and late fall and early spring power peaking at the dam both result in water level fluctuations, which can contribute to bank erosion. Any relationship between these water level fluctuations and the sediment loading observed in this study is unclear, however, because most of the sediment entered the river during spring runoff, rather than during periods when irrigation withdrawals or power peaking occurred.

Some shoreline restoration work in this reach has already begun as proposed in PacifiCorp's

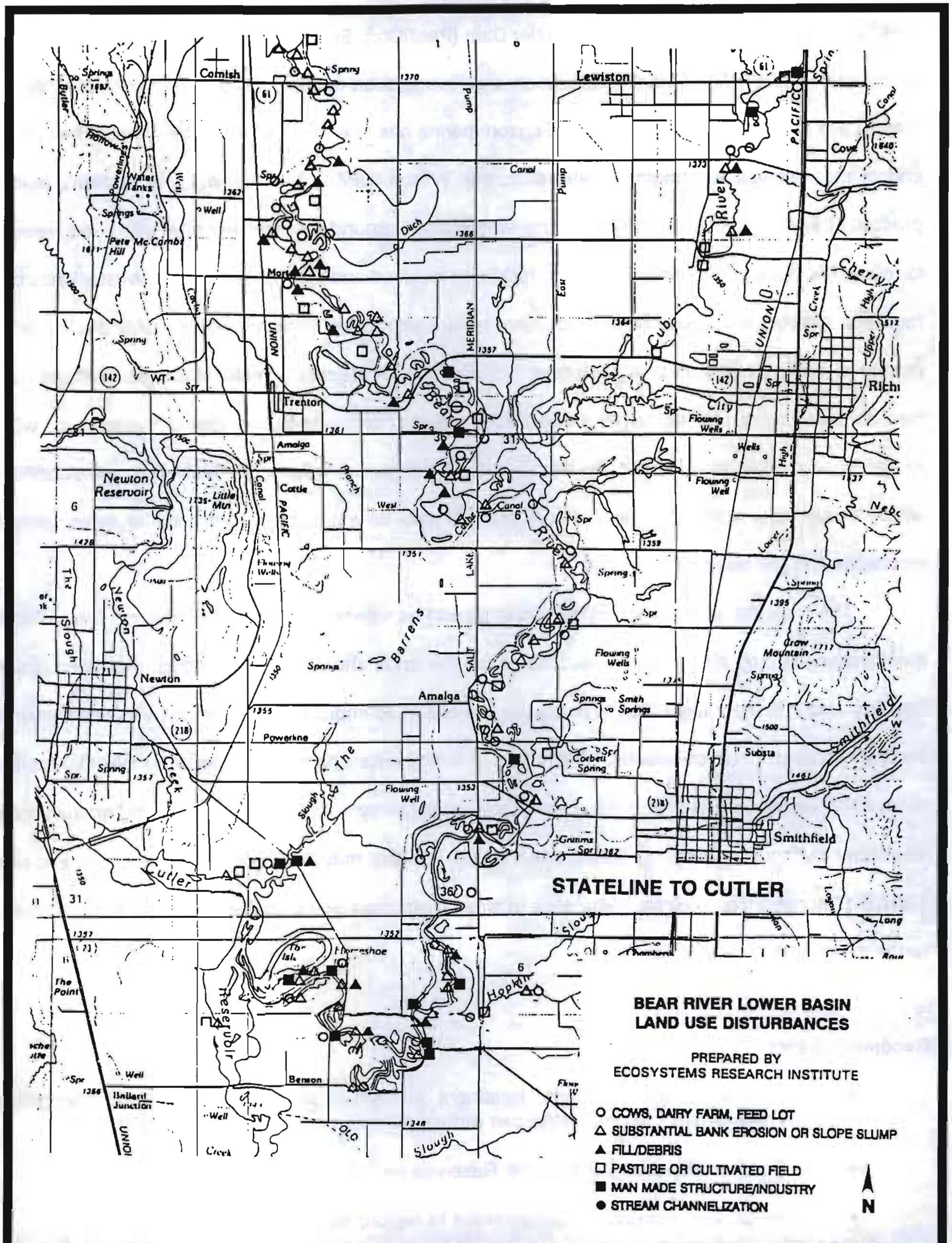

FIGURE 5-12. Landuse disturbances affecting riverbank or riparian areas of Bear River from the stateline to Cutler Reservoir (ERI 1991).

FERC application for the relicensing of Cutler Dam (PacifiCorp Electric Operations 1991). Work includes approximately two miles of bank stabilization and revegetation at several sites in the reservoir. Work at the first two sites north and south of the Benson marina has been completed, while work at the northern end of the reservoir will begin in 1995 (Maureen Wilson, UP&L, pers comm.). In addition, landuse practices have been modified on PacifiCorp owned lands around the reservoir area which are leased to farmers. The number of agricultural leases has been reduced and the management of livestock has been modified. Grazing areas have been divided into more manageable pastures, with portable electric fences utilized to subdivide pastures. A short-term intensive rotational grazing system has been initiated rather than continuous grazing over larger areas. Finally, tilling of cropland to the edge of the reservoir will no longer be allowed, in an attempt to let deeper rooted, permanent woody vegetation become established which should help stabilize banks. PacifiCorp will also be establishing grass buffer strips between croplands and the reservoir shoreline.

The work that is underway in this areas should be viewed as an excellent starting point. Similar modifications in crop and grazing practices on private lands should be encouraged. Reduced grazing intensity and improved vegetation in floodplain areas should improve the ability of these areas to retain sediment during runoff conditions. Trampling of river banks and direct impacts by livestock can be reduced by establishing and improving watering facilities away from the river and fencing riparian areas. Vegetative buffers between crop lands and the river will also reduce runoff into the reservoir and river. Table 5-17 summarizes potential reductions in total phosphorus and dissolved total phosphorus given a range of remediation activities.

Recommendations:

- Evaluate Logan Lagoons' treatment processes to determine whether changes or improvements in operations can reduce nutrient concentrations in effluent.
- Continue work begun in Cutler Reservoir by PacifiCorp.
- Fence and revegetate riparian areas to restore severely degraded sites.
- Stabilize banks in the reservoir.

TABLE 5-17. Potential reduction in phosphorus loads in the Cutler localized drainage given different levels of remediation intensity. Reductions are applied to the medium loads in Table 5-16.

	TOTAL PHOSPHORUS POTENTIAL LOADS (kg/day)		
	LEVEL OF REMEDIATION EFFORT *		
	LOW	MEDIUM	HIGH
Point Source:			
Logan Lagoons	98	34	6.8
Nonpoint Source:			
Irrigated agriculture	30	25	5.0
Nonirrigated agriculture	13	11	2.2
Open/unknown	16	13	2.7
Urban	3.8	3.1	0.63
Public lands	2.3	1.9	0.38
Feedlots	1.3	1.1	0.22
Unidentified nonpoint	11	9.3	1.9
TOTAL Potential Load:	**175**	**99**	**20**
TMDL (Target Load):	**18**	**18**	**18**

	DISSOLVED TOTAL PHOSPHORUS POTENTIAL LOADS (kg/day)		
	LEVEL OF REMEDIATION EFFORT *		
	LOW	MEDIUM	HIGH
Point Source:			
Logan Lagoons	98	27	5.4
Nonpoint Source:			
Irrigated agriculture	7.2	6.0	1.2
Nonirrigated agriculture	6.7	5.6	1.1
Open/unknown	11	8.8	1.8
Urban	2.4	2.0	0.41
Public lands	1.5	1.3	0.26
Feedlots	0.50	0.25	0.10
Unidentifed nonpoint	42	35	7.1
TOTAL Potential Load:	**169**	**86**	**17**
TMDL (Target Load):	**18**	**18**	**18**

** See Table 5-4 for percent reductions assumed for different levels of remediation effort*

- Improve grazing management throughout the area, emphasizing short-term, intense rotation grazing rather than continuous contact.

- Improve riparian areas in low gradient lands along the Bear River above Cutler Reservoir. Restore and improve vegetation in these areas to allow them to function more effectively as sediment and nutrient traps during high water periods.

- Inventory and quantify unregulated pipe drainage along the Bear River immediately above Cutler Reservoir.

- Evaluate inputs from Newton Reservoir (low flows in 1993 resulted in little data from this drainage).

5.1.4 Bear River Corridor from Utah-Idaho Border to Benson

Landuse in the Bear River subbasin from the Utah-Idaho border to the Benson site is illustrated in Figure 5-13. Valley bottom vegetation and bank conditions are illustrated in Figures 5-14 and 5-15, respectively. Attributes of this Bear River subbasin are summarized in Table 5-18.

The water quality concerns in the Bear River above Benson are primarily sediment inputs (Table 5-19). Nutrient loads are associated mostly with sediment loads. On average, over 70,000 kg/day of suspended solids entered the river between the stateline (490610) and Amalga (490356) during the 1993 water year. A little more than this dropped from the water column between Amalga and the site near Benson (490326). In a 1991 study of the Bear River, however, this lower reach also contributed significant sediment to the river. During the present study, Cutler Reservoir elevations were such that the reach below Amalga functioned as part of the reservoir system. In contrast, Cutler Reservoir was drawn down in 1991, resulting in an increased river gradient with subsequent headcutting and resuspension of previously deposited sediments.

This process of deposition and resuspension occurs throughout any river. In the mainstem Bear River, whose bottom is characterized by fine-grained sediment, the task of distinguishing outside nonpoint inputs from resuspension of bedload is, therefore, complicated. The river can carry heavier loads of TSS at higher velocities, and thus suspended solids increase during runoff, or when changes in reservoir elevations change river gradients. Accounting for the movement and redistribution of bedloads throughout the mainstem river would require an intensive study covering more than a single water year, and is not within the scope of this management plan. It is clear from the increased load in the river as it travels from the stateline to the Great Salt Lake that external loading of sediments to the river occurs,

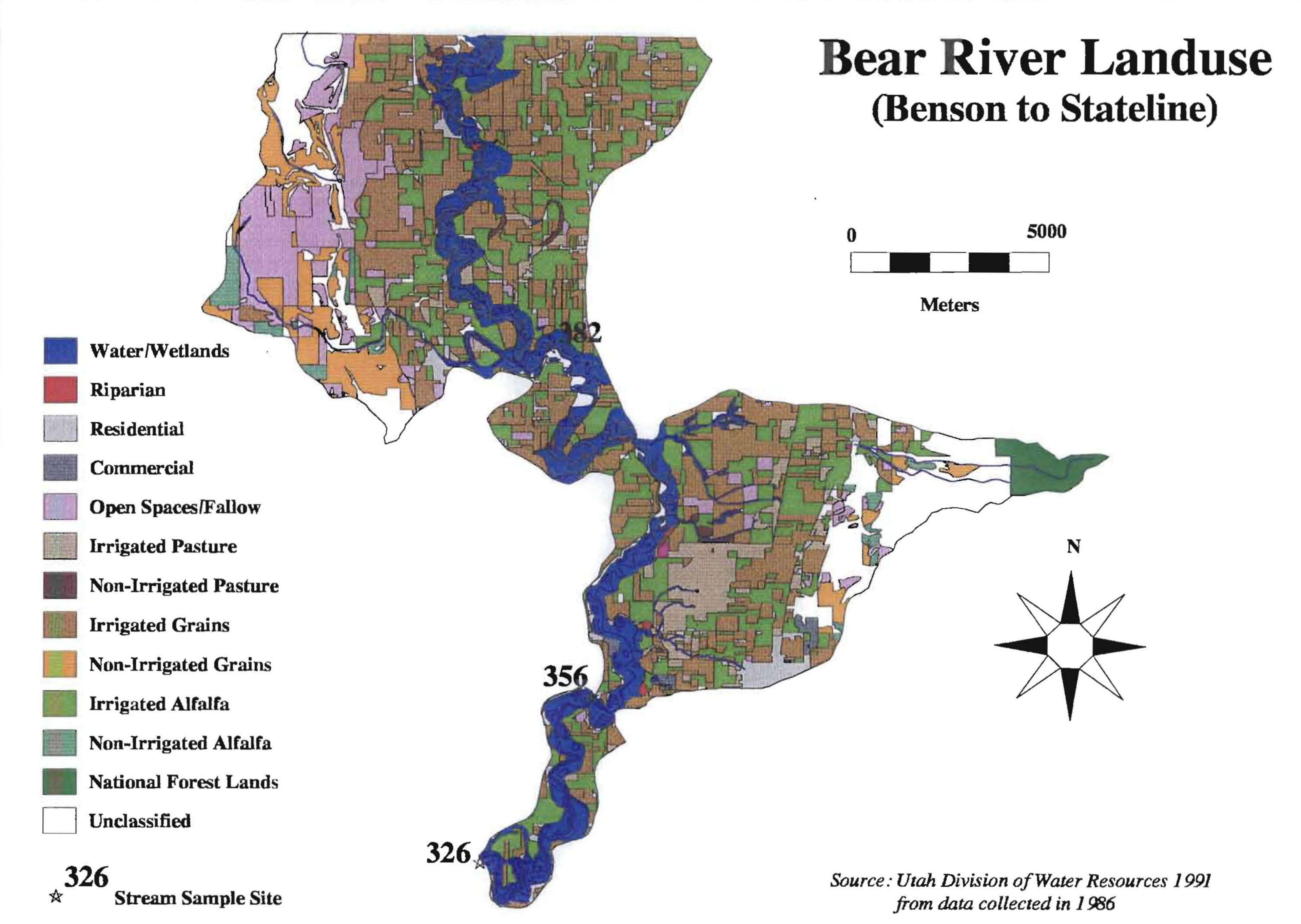

FIGURE 5-13. Bear River (Benson to stateline) landuse.

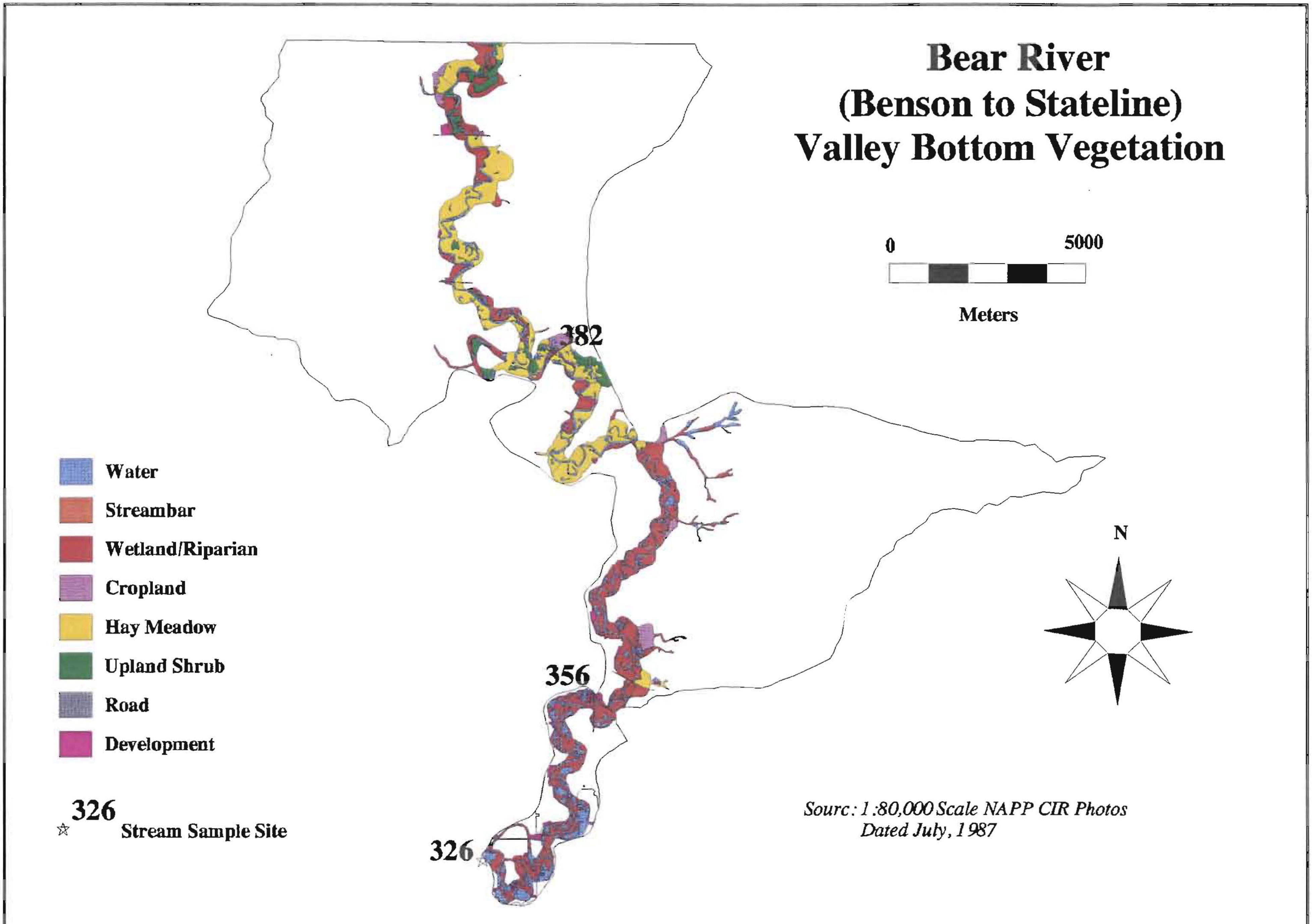

FIGURE 5-14. Bear River (Benson to stateline) valley bottom vegetation.

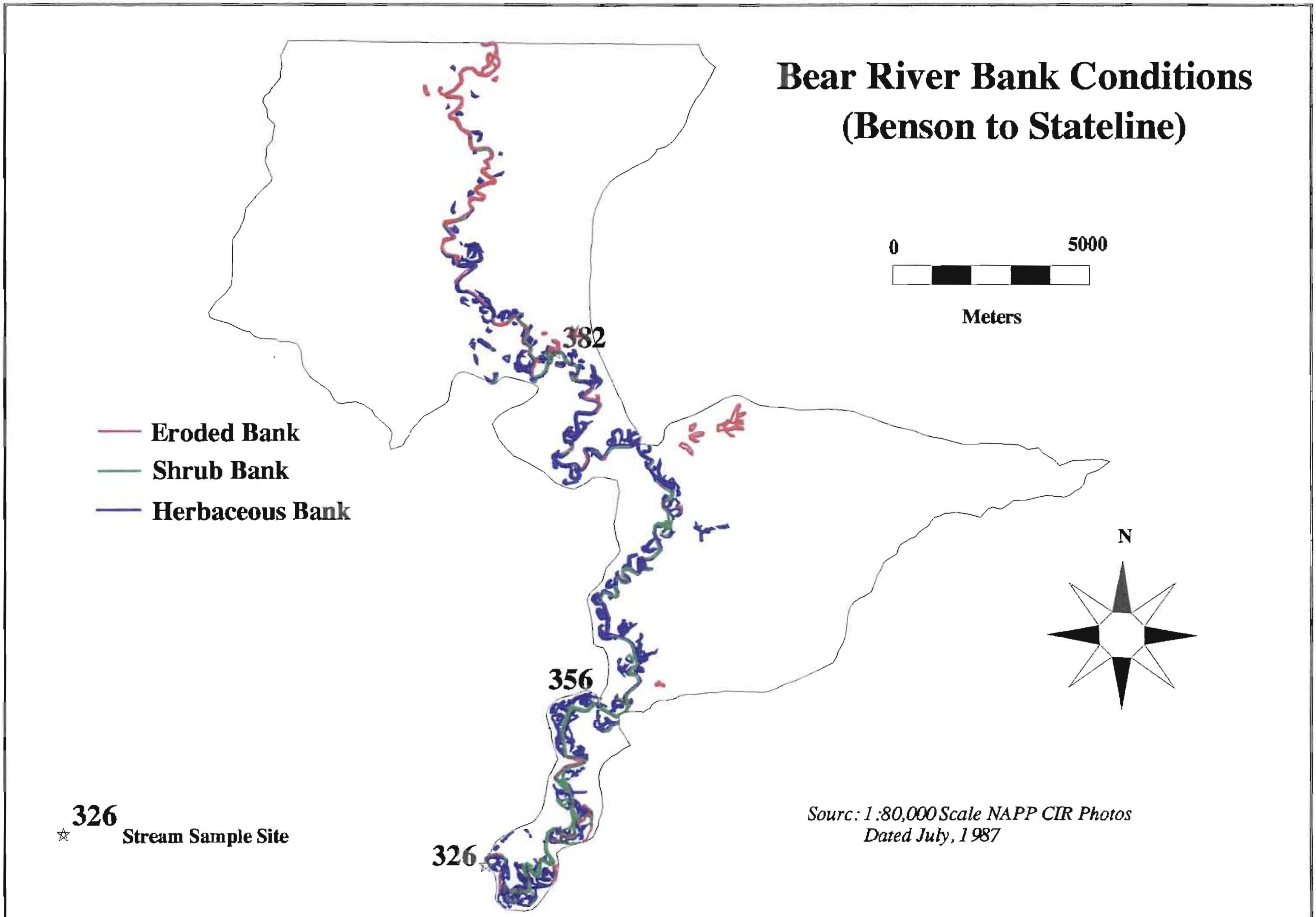

FIGURE 5-15. Bear River (Benson to stateline) bank conditions.

TABLE 5-18. Attributes of the Bear River, from stateline to Benson.

		ACRES	PERCENT
UPLAND LANDUSES			
irrigated agriculture		27,369	56
non-irrigated agriculture		3,573	7
open/unknown		9,560	20
urban		1,485	3
water/wetlands		6,376	13
National Forest		637	1
	TOTAL	**49,000**	**100**
VALLEY BOTTOM VEGETATION TYPES			
cropland		228	4
hay meadow		1,648	27
road/development		159	3
water		1,513	25
wetland		2,486	41
	TOTAL	**6,033**	**100**

		METERS	PERCENT
VALLEY BOTTOM TYPE			
lacustrine unconfined		77,480	100
	TOTAL	77,480	100
VALLEY BOTTOM STATE			
graded, stable banks		26,553	34
graded, unstable banks		26,868	35
incised		5,495	7
impounded		18,562	24
	TOTAL	**77,480**	**100**
BANK CONDITION			
exposed		38,729	25
herbaceous		73,849	48
shrub		42,381	27
	TOTAL	**154,959**	**100**

TABLE 5-19. Average daily loads for the 1993 water year at Bear River sites and tributaries above Cutler Reservoir.

	SITE NUMBER	AVERAGE WATER YEAR LOADS (kg/day)					
		TP	DTP	TSS	NH_3	NO_3	FLOW (cfs)
Bear River at stateline	490610	234	70	107,000	185	970	720
Bear River at Richmond	490382	238	64	141,000	164	1,180	720
Cub River	490425	136	68	43,100	58	835	191
Summitt Creek	490350	3	1	3,320	1	23	21
Bear River at Amalga	490356	425	174	224,000	271	2,010	969
Hopkins slough	490451	3	1	395	2	44	9
Bear River at Benson	490326	410	164	139,000	224	2,480	969
Local accrual within the Bear River Corridor							
Stateline to Richmond		4	-6	34,153	-22	211	0
Richmond to Amalga		48	42	36,118	49	-27	36
Amalga to Benson		-18	-12	-85,420	-50	421	-4

and that the sediment loads cannot be entirely accounted for by redistribution of existing bedload. The aim of this management plan is to reduce as much of the external loading of sediments as possible.

The main external sources of sediment to the Bear River are direct erosion of banks and runoff from surrounding lands, which occurs during spring snowmelt and from irrigation return flows. Bank conditions in this reach were mapped from aerial photos. Only one percent of the banks were designated as exposed below Richmond (490382) using this approach. Field verification determined, however, that this is a low estimate. Many banks are cut vertically, with herbaceous vegetation up to the edge of the vertical exposed banks. From Richmond to Amalga, almost 15 percent of the banks were cut, with three to four feet of exposed banks during late summer flows (approximately 700 cfs in 1993). In some cases, slumping and revegetation on the more graded banks has occurred. From Amalga to Benson, about 10 percent of the banks are cut, with one to two feet of exposed banks during late summer flows. These cut banks probably represent typical high water elevations during runoff flows. Most of the cut banks occurred on the outer curves in bends. In these cases, the presence of grazing animals or other agricultural activity was not necessarily associated with the bank erosion. Rather, it appears to result from natural shear forces of river flows acting on the erodible lacustrine soils in the lower Bear River valley. High flows during runoff result in increased shear forces on the river banks. In addition, daily fluctuations occur in the river as a result of power peaking from Oneida Reservoir. River elevations at the stateline vary by two or more feet on a daily basis. This daily change in flow may also contribute to bank instability, increased sloughing, and increased sediment load to the river.

Other areas of streambank erosion are caused by using the riparian area for intense grazing or for feedlot operations. This has caused several areas with severely degraded vegetation, trampling of the banks and erosion problems. At several sites, the riparian area has been completely denuded and severe erosion continues to occur. In these cases, direct inputs of animal waste is an exacerbating problem (Figure 5-14).

The contribution of runoff from agricultural lands to sediment loading is also difficult to determine. The land draining directly to the Bear River from the stateline to the site near Amalga (490356) is mostly in agricultural use (Table 5-18). Downriver from Amalga to the site near Benson (490326), slightly more than 40 percent of the local drainage area is agricultural land, while over 50 percent is wetlands or open water. Vegetation mapping of the valley bottom from the stateline to Benson also indicates a shift in landuses along the river (Figure 5-12). From the stateline to the site near Richmond (490382), 44 percent of the valley bottom is hay meadow and 12 percent is upland shrublands, while just 22 percent was mapped as wetlands. In contrast, almost 60 percent of the valley bottom from Richmond to Benson was mapped as wetlands. It should be noted that these wetland areas are often used for grazing and other agricultural purposes. Seasonal patterns in sediment loading suggest that direct bank erosion from vertical banks and flooded valley bottom areas is most important in the lower gradient reach of the river from Amalga to Benson. Almost 60 percent of the sediment carried in the water column at the site near Benson was transported during runoff, and only 9 percent of the sediment was transported during the summer irrigation season. In contrast, only 40 percent of the sediment carried in the river at the upstream sites was transported during runoff, with about 15 percent carried during the irrigation season. This suggests that irrigation return flows may have a greater impact on total sediment loading in the reach from the stateline to Amalga than in the reach below Amalga. The reach below Amalga contains greater valley bottom areas which may be flooded during runoff. The impact of runoff flows on sediment loading, therefore, is probably more important in this reach.

Much of the sediment loading in the upper portion of this reach appears to be a result of natural actions of the river on the erodible soils of the Bear River basin. Attempting to target a specific reduction in sediment loading, therefore, is impractical. Recommendations in this reach are to improve agricultural practices to reduce sediment runoff and sediment loss during irrigation and to reduce the flushing of animal waste and soil from agricultural areas in the floodplain. These best management practices (BMPs) include conservation tillage (leaving 30% of the soil surface covered with crop residue after planting), establishing no-till agriculture, establishing greenbelts, wetland complexes or sedimentation basins to filter irrigation return flows prior to re-entering the Bear River, and optimizing the volumes of irrigation water used to reduce return flows. In several areas, feedlot activities have seriously impacted the riparian areas. These sites should be restored. Improved operations would include fencing, rotation of animal access sites, and development of off-river watering so riparian areas are not constantly impacted by grazing and trampling. Overgrazing in low-lying valley bottom areas leaves little vegetation to trap sediments during flooding and runoff events. A reduction in the intensity of grazing in these areas would improve vegetation and allow these areas to return to their role as sediment filters.

Recommendations:

- Continue implementing BMPs to reduce sediment inputs from agricultural lands. These include no-till agriculture, greenbelts, sedimentation basins or wetland complexes to filter return flows, optimizing fertilizer and irrigation water use.
- Improve the isolated areas where severe overgrazing and trampling in the riparian area has led to serious erosion problems. Fence areas, restrict animal access, provide off-stream watering facilities, restore and revegetate the banks.
- Evaluate the effects of water level fluctuations on exposed, vertical banks.

5.2 Potential Reduction in Phosphorus Loadings

Phosphorus loads following improvements in the targeted subdrainages were calculated using percent reductions chosen to represent medium and high levels of effort. In Table 5-20, these predicted loads are compared to the 1993 loads (assumed to be a no action alternative) and to the TMDL for total phosphorus and dissolved total phosphorus.

It is difficult to accurately predict changes in phosphorus loading following improvements in management practices. Uncertainty exists in all elements of the predicted values. The 1993 water year loads contain uncertainty in measurement and in extrapolating from discrete samples to an annual average value. The estimated loadings from nonpoint sources contain uncertainty in the areas of different landuses and in the loading coefficients for those landuses. In addition, no adjustments were made for specific soil types, slope of the land, distance from a waterbody and other factors which affect nonpoint source loadings. Finally, the amount of improvement possible from different remediations is compiled from other studies under a number of different conditions and thus is not an exact prediction. Whenever possible, coefficients and remediation studies which fit the conditions in the Bear River basin were used. The coefficients used and the assumed percent improvement are summarized in Table 5-3.

Given the uncertainty of these predictions, the predicted loads have interesting management implications. Even with an intense level of remediation, predicted TP would remain almost three times the TMDL for TP below Cutler dam. This reflects the high concentrations of TP associated with sediment loads in the Bear River system. Because this sediment-bound phosphorus is fairly non-reactive (not biologically available), this management plan is proposing to regulate DTP, rather than TP. This dissolved

TABLE 5-20. A summary of the total phosphorus and dissolved total phosphorus TMDLs, 1993 loads and predicted loads at four lower Bear River sites assuming medium and high remediation effort in the four targeted subdrainages. Reduced loads are detailed in Tables 5-9, 5-13, and 5-17.

TOTAL PHOSPHORUS

BEAR RIVER SITES	TMDL (kg/day)	1993 LOAD (kg/day)	PREDICTED LOAD (kg/day) MEDIUM REMEDIATION EFFORT	PREDICTED LOAD (kg/day) HIGH REMEDIATION EFFORT
Utah-Idaho stateline	121	234	234	234
Above Cutler (Smithfield)	136	425	366	317
Below Cutler (Collinston)	154	786	564	408
Above the Bear River Bird Refuge (Corinne)	183	866	644	489

DISSOLVED TOTAL PHOSPHORUS

BEAR RIVER SITES	TMDL (kg/day)	1993 LOAD (kg/day)	PREDICTED LOAD (kg/day) MEDIUM REMEDIATION EFFORT	PREDICTED LOAD (kg/day) HIGH REMEDIATION EFFORT
Utah-Idaho stateline	121	70	70	70
Above Cutler (Smithfield)	136	174	140	116
Below Cutler (Collinston)	154	468	291	172
Above the Bear River Bird Refuge (Corinne)	183	480	303	184

portion of the TP in the Bear River is more biologically available and thus more tightly coupled to the water quality problems which arise from increased nutrients.

Predicted DTP above Cutler dam was reduced to the TMDL load (136 kg/day) with a medium effort. This same level of effort, however, reduced DTP at the site below Cutler by 35 percent (from almost 470 kg/day to 290 kg/day) which is still two times the proposed TMDL for this point in the Bear River drainage (154 kg/day). Downriver DTP was predicted to be quite close to the TMDL from Collinston to Corinne following a high level of effort in reducing sources.

5.3 Future Monitoring

Water quality and other monitoring will be necessary to determine the effectiveness of any remediation activities in the project area. Utah's Division of Water Quality will continue their long-term ambient monitoring program in the Bear River basin. They are currently sampling the Bear River at the stateline and above Cutler Reservoir. The Little Bear River drainage is being monitored at the site above Cutler Reservoir, at sites above and below the town of Wellsville, and two sites above Hyrum Reservoir. Sampling sites in the Spring Creek drainage will be the same as those in this study. Finally, the Logan River will be monitored at the mouth of Logan Canyon. Several point sources (Logan Lagoons, Richmond WWTP, Hyrum WWTP, EA Miller WWTP and White's Trout Farm) will also be sampled on a regular basis. In addition to water samples, the state will continue to collect macroinvertebrate samples at several sites in the Bear River and the Little Bear River drainage.

As water quality projects are developed in the targeted subdrainages, additional monitoring will be necessary. Specifics of these monitoring plans will be included in the specific project plans. In general, upstream and downstream water quality sites must be monitored and downstream macroinvertebrate samples collected before and after project implementations. When projects begin in targeted subdrainages, water quality monitoring for TMDL parameters at the TMDL locations must also be conducted. For example, monitoring on the Cub River above the Bear River confluence and at the stateline should be reinstated once projects in this subdrainage begin. Finally, in project areas involving restoration of streambanks and riparian areas, an assessment of the riparian community both before and after implementation should be conducted.

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6.0 CONCLUSIONS

Water quality problems in the lower Bear River basin arise primarily from high phosphorus and total suspended sediment concentrations. In particular, DTP contributes to eutrophication of existing reservoirs, and will certainly cause any additional reservoirs in the basin to be eutrophic. Eutrophication causes diminished recreational and fisheries benefits in reservoirs. Other impacts on fisheries arise from violations of state criteria for dissolved oxygen and ammonia, especially in the Spring Creek portion of the Little Bear drainage. High sediment loads in the Cub River and the mainstem Bear River also restrict fisheries in these rivers. Periodic high sediment concentrations in other tributaries stress the coldwater fisheries in these waters. Violations of coliform criteria occurred throughout the basin, but were most severe in the Spring Creek subdrainage and indicate potential public health concerns.

Total maximum daily loads were calculated for nutrients, total dissolved phosphorus and total suspended solids within specific reaches of the mainstem Bear River and its tributaries. These target loads are intended to protect beneficial uses within the rivers and to ultimately attain the TMDLs in the reservoirs in the system.

This project identified specific reaches and tributaries whose contributions to these problems were particularly significant. These include the Spring Creek drainage, entering the Bear River at the south end of Cutler Reservoir, the Cub River within Utah, and the mainstem Bear River from the stateline to below Cutler Reservoir. Cutler Reservoir itself was a major contributor of sediments and phosphorus. Although the Little Bear River did not appear to be among the most serious contributors to the Bear River, problems within this drainage exist as well. As a result, water quality in Hyrum Reservoir is compromised.

Recommendations specific to the top four targeted subdrainages or reaches appear in Section 5.1. In general, these recommendations include improving riparian areas, removing feedlots and other intensive grazing activity from the river corridors, implementing nontill agriculture to reduce sediment inputs from croplands, and improving manure management throughout the watershed. Although most point sources in the drainage are permitted and in general meet their permit requirements, several point sources are significant contributors of phosphorus. To obtain real improvements in dissolved total phosphorus in this drainage, point sources will have to reduce their phosphorus loadings.

6.1 Recommendations

Because much of this drainage is currently agricultural, many of the nonpoint problems are attributed to agricultural activities. The large nutrient inputs from the Logan WWTP are the most significant identified source of pollutants from urbanized areas. Stormwater runoff from the towns in Cache Valley were not identified as a major problem in this study. As this valley becomes more urbanized, however, nonpoint inputs from lawns, parking lots and other urban sources will be an increasing problem. It is important that all citizens in the lower Bear River basin understand their individual roles in reducing water pollution. Fertilizer use on lawns, inappropriate dumping and washing household chemicals down drains all contribute to water quality problems and without good educational efforts, these problems will increase over time.

Recommendations approved by BRWQMP Steering Committee, May 10, 1995

1. Establish target TMDLs for dissolved total phosphorus through voluntary compliance with established time frames. These TMDLs will be refined at the end of this period. The TMDLs are calculated for specific reaches of the mainstem Bear River and tributaries to the Bear River.

2. Use the TMDLs calculated for suspended solids and nitrates as nonenforceable guidelines. Use existing enforceable standards for dissolved oxygen, ammonia and coliforms.

3. Develop Project Implementation Plans for improving water quality in the following subwatersheds:
   a) Spring Creek (tributary to Little Bear)
   b) The Cub River in Utah. Work with Idaho on that portion of the drainage in Idaho
   c) The Bear River from Benson to below Cutler Dam, including Cutler Reservoir
   d) The Bear River above Benson to the site near Richmond.

4. Encourage those WWTPs in the lower Bear River basin with significant phosphorus loading impacts to determine if changes in operations are possible which would reduce dissolved phosphorus loads from these sources. If operational changes are not possible, tertiary treatment for phosphorus removal may be necessary. To increase the existing database on phosphorus concentrations in the effluent, UDWQ should add DTP analysis to the samples they collect at regular intervals.

5. Develop a long-range monitoring program to document water quality improvements during and after PIP implementations. Integrate water quality sampling and biomonitoring programs. Continued water quality monitoring will determine whether TMDLs are being met. Monitoring of riparian areas, macroinvertebrate populations and fisheries will help determine the true health of these areas, and more directly evaluate the gains in beneficial uses as water quality improves with improved landuse practices.

6. Continue working with existing local agencies and extension services to encourage BMPs in all agricultural lands in the valley.. In addition, increase awareness on urban contributions to water pollution and educate the public on measures that can be taken to reduce this problem. There is a need for a coordinator to oversee the existing and new efforts in the lower basin. The existing BRWQMP steering committee will continue to function in an advisory capacity.

7. Work with Idaho and Wyoming to develop an integrated water quality plan for the entire Bear River basin.

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APPENDIX I

1992-1993 Monitoring Results

I.0 1992-1993 MONITORING RESULTS

In 1992, an intensive water quality monitoring program was initiated. The intent of this monitoring was as follows:

1) **Determine current loadings within the lower Bear River (defined as the area from the Utah-Idaho stateline to the Bear River Bird Refuge) and its tributaries.**
2) **Distinguish between point and nonpoint sources.**
3) **Determine where within the local watershed the water quality parameters exceed state standards and total maximum daily loads (TMDL) for subject parameters.**
4) **Recommend where reductions to the loads can be made to achieve the TMDL in the most cost effective manner possible.**

I.1 Methods

Thirty-seven river sites were sampled routinely throughout the 1993 water year, from October 1992 to September 1993 (Figure I-1 and Tables I-1 and I-2). Monitoring has continued at some of these sites but this report focuses on the twelve months of data. These sites were established to isolate and identify inputs from tributaries and changes in gradient or landuse. River sites were sampled monthly except during the runoff period (April through June), when samples were collected bimonthly. In addition, the effluent from seven of the UPDES permitted dischargers in the lower basin was sampled monthly (Table I-3).

All river samples were collected below the surface in the thalweg of the stream. Dissolved oxygen, temperature, conductivity and pH were measured in the field, using a calibrated Hydrolab unit. At sites without a USGS gaging station, flow was calculated on each date by measuring average velocities and depths along established cross-sections. During high flow periods, flows at several sites were estimated from surface velocities and water depth at known cross-sections. Table I-4 lists all parameters which were analyzed, USEPA method numbers, and method detection limits. Twenty-one of the river sites were sampled by Ecosystems Research Institute (ERI). Personnel from the Utah Division of Water Quality (UDWQ) collected samples at the remaining 16 sites and at seven of the UPDES sites. Coliforms were analyzed at the Bear River Health Department laboratory or the Utah State Health laboratory. Metals (collected quarterly), sodium and potassium were analyzed at the Utah State Health Laboratory, and all other analyses were conducted at either the ERI laboratory or the Utah State Health laboratory, depending on who collected the sample.

All water samples were stored in cool, dark conditions while being transported to the laboratory. Total phosphorus samples were preserved in the field. Metals and dissolved total phosphorus were filtered in ERI's lab within four hours of collection, then preserved. Samples collected by the UDWQ were filtered in the field before being transported to the laboratory. Except when noted on Table I-4, all laboratories were USEPA certified for the parameters being analyzed and all analyses were conducted within USEPA established holding times. All analytical quality assurance and quality control (QA/QC) measures required by the USEPA and the State of Utah were followed. At two sites in the monitoring plan, QA/QC duplicate samples were collected. The duplicate samples were analyzed for all parameters in the sampling program.

In addition to chemical samples, macroinvertebrates were sampled in the fall of 1993 at 13 sites. These samples were collected in triplicate with a modified Hess sampler in a representative substrate.

I.2 Results

All raw water quality data collected during this project are listed in Appendix II. QA/QC results and summary statistics are given in Appendix IV.

I.2.1 Hydrology, Nutrients and Sediments

This section includes the nutrient, sediment and water flow results from the 1993 water year. Flows are important because of the direct hydrologic impacts on rivers and streams, but also because flows are utilized in calculating mass quantities of nutrients, sediments and other pollutants in a waterbody. When sample collection on the mainstem Bear River spanned several days, USGS flows for the Bear River were averaged over that period. Concentrations of pollutants indicate the immediate threat to beneficial uses in a waterbody, but masses of the same pollutants can be used to determine where the pollutants are entering and leaving the system, and the relative importance of different sources. The

Lower Bear River Basin Monitoring Sites

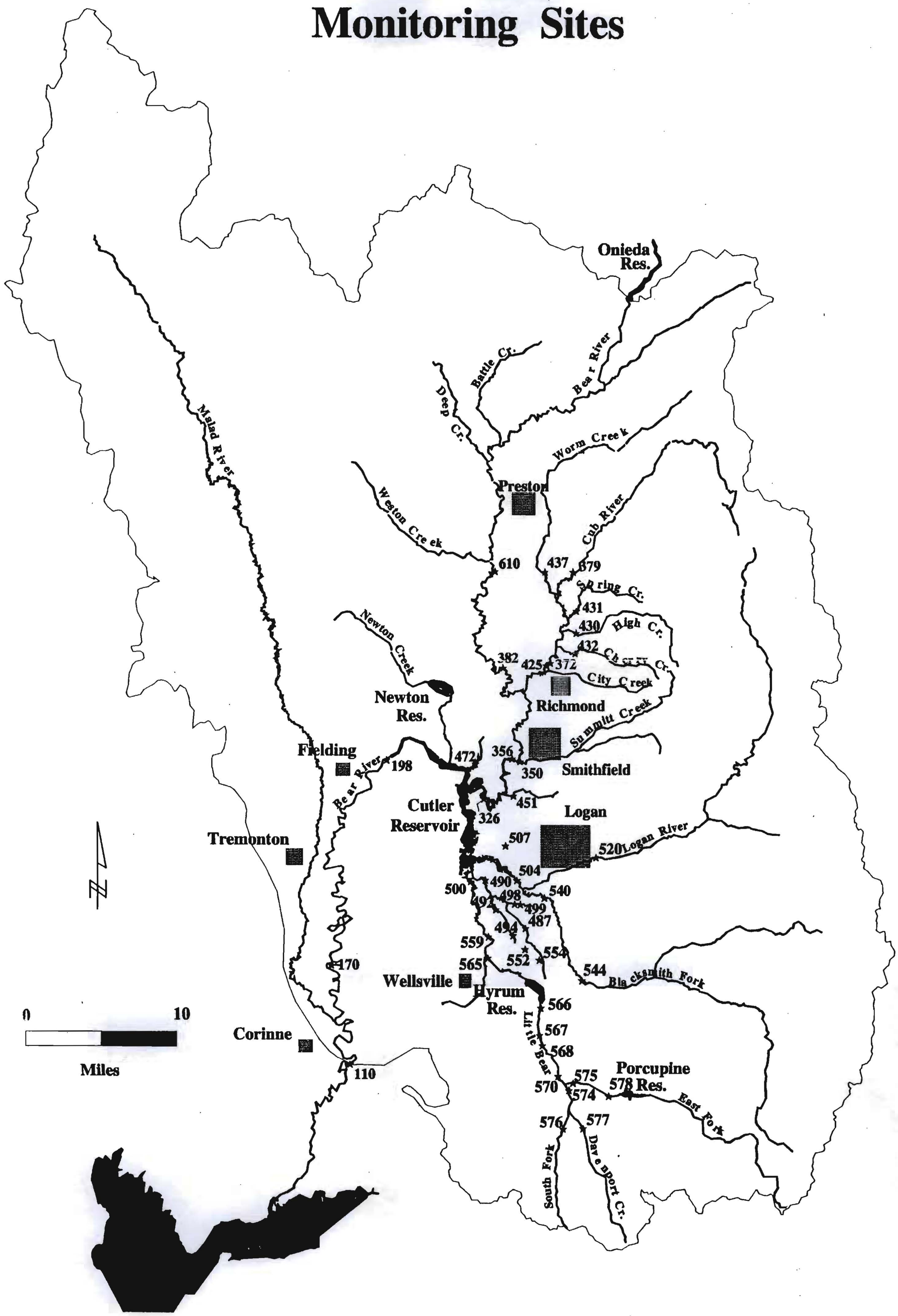

FIGURE I-1. Lower Bear River basin monitoring sites. All numbers indicate the last three digits of the six digit STORET sample site number assigned by the state of Utah, UDWQ. All site numbers in the lower Bear River basin begin with the basin number 490.

TABLE I-1. Location of each sample site on the mainstem Bear River and its tributary confluences. All distances are given in river miles above the Bear River Bird Refuge. The site numbers are STORET numbers assigned by the Utah Division of Water Quality. The first three numbers (490) are the basin code and are the same for all river and tributary sites in this study. To save space, these first three numbers are not included in many of the tables and figures. (SOURCE: 1:100K DLGs)

SITE NUMBER	DESCRIPTION	DISTANCE (river miles)	SAMPLER
Mainstem Bear River (miles above the Bear River Bird Refuge)			
490110	Bear River at Corinne at U83 xing	16.7	UDWQ
490170	Bear River below Honeyville on I-15	31.8	UDWQ
490198	Bear River below Cutler at UPL bridge	61.1	UDWQ
490326	Bear River above Cutler at Benson bridge	71.9	UDWQ
490356	Bear River at Amalga	79.3	ERI
490382	Bear River at Richmond	92.5	ERI
490610	Bear River west of Fairview, ID	106.4	UDWQ
Tributary Confluences (miles above the Bear River Bird Refuge)			
Not sampled	Malad River	24.7	--
490119	Box Elder Creek		UDWQ
490310	Newton Creek	66.8	ERI
490472	Clay slough	68.1	ERI
490451	Hopkins Slough	75.8	ERI
490490	Spring Creek at south end of Cutler Reservoir	76.5	UDWQ
490500	Little Bear at south end of Cutler Reservoir	77.1	UDWQ
490350	Summit Creek	79.6	ERI
490504	Logan River above Little Bear River	85.1	UDWQ
490540	Blacksmith Fork above Logan River	86.1	ERI
490425	Cub River	87.0	ERI

TABLE I-2. Location of each sample site in the Bear River tributary confluences. All distances on the mainstem Bear River are given in river miles above a reference point given in the table. For an explanation of the site numbers, see Table I-1. (SOURCE: 1:100K DLGs)

SITE NUMBER	DESCRIPTION	DISTANCE (river miles)	SAMPLER
Little Bear River Drainage (distance from south end of Cutler - Mendon Road)			
490500	Little Bear above Logan River	0.0	UDWQ
490559	Little Bear above Wellsville	7.5	UDWQ
490565	Little Bear one mile below Hyrum Reservoir	9.7	UDWQ
490165	Hyrum Reservoir	13.6	ERI
490566	Little Bear above Hyrum Reservoir	16.7	ERI
490567	Little Bear below Trout of Paradise fish hatchery	18.7	ERI
490570	Little Bear west of Avon	22.1	ERI
490574	South Fork Little Bear above East Fork	23.4	ERI
490576	South Fork Little Bear above Davenport Creek	26.2	ERI
490577	Davenport Creek above South Fork Little Bear	26.6	ERI
490585	Davenport Creek above Wellsville		
490575	East Fork Little Bear above South Fork	23.5	ERI
490578	East Fork Little Bear below Porcupine Reservoir	26.2	ERI
Spring Creek Drainage (distance from south end of Cutler - Mendon Road)			
√490490	Spring Creek at Mendon Road	0.0	UDWQ
√490499	Spring Creek 1.3 miles north of College Ward	4.2	UDWQ
490487	Hyrum Slough at Nibley/College Ward	5.6	UDWQ
√490492	South Fork Spring Creek west of Pelican Pond	2.8	UDWQ
√490494	South Fork Spring Creek at US89 Xing	5.1	UDWQ
Logan River Drainage (distance south end of Cutler Reservoir - Mendon Road)			
490504	Logan River above Little Bear River	0.0	UDWQ
490520	Logan River at mouth of canyon	7.2	UDWQ
Blacksmith Fork Drainage (distance above confluence with the Logan River)			
490540	Blacksmith Fork above Logan River	0.0	ERI
490544	Blacksmith Fork at mouth of canyon	9.7	UDWQ

TABLE I-2 (continued). Location of each sample site in the Bear River tributary confluences. All distances on the mainstem Bear River are given in river miles above a reference point given in the table. For an explanation of the site numbers, see Table I-1. (SOURCE: 1:100K DLGs)

SITE NUMBER	DESCRIPTION	DISTANCE (river miles)	SAMPLER
Cub River Drainage (distance above confluence with the Bear River)			
490425	Cub River	4.4	ERI
490432	Cherry Creek confluence	6.2	ERI
490430	High Creek confluence	7.6	ERI
490431	Spring Creek confluence	9.0	ERI
490437	Worm Creek confluence	11.6	ERI
490379	Cub River at Utah-Idaho stateline	15.5	ERI

TABLE I-I. Facilities discharging into state waters in the Lower Bear River basin. All sites were sampled by the Utah Division of Water Quality.

DISCHARGER	UPDES #	STORET #	DISCHARGE LOCATION
Logan Lagoons	UT0021920	490507	Cutler Reservoir
Gossner Foods	UT0024309		Blue Springs above Cutler
Brigham City	UT0022365		Box Elder Creek
Richmond Lagoons	UT0020907	490372	Cub River
Wellsville Lagoons	UT0020371	490560	Little Bear River
Trout of Paradise 001	UTG130015	490568	Little Bear River
Trout of Paradise 002	UTG130015	490571	Little Bear River
Hyrum WWTP	UT0023205	490552	Spring Creek (Little Bear)
EA Miller effluent	UT0000281	490554	Spring Creek (Little Bear)
Magic Valley effluent	UT0024872	490562	Wellsville Creek above Little Bear
Whites College Ward fish Hatchery	UTG130015	490562	North Fork Spring Creek
Silicone Plastics	UT0025186		Mill Creek
Silicone Plastics	UT0025160		Mill Creek

TABLE I-4. Water quality parameters evaluated for the Bear River Water Quality Management Plan.

Parameter	Units	Method *	Detection Limit	Labs (B)
pH	S.U.	Hydrolab	0.1	ERI/UT SHL
Conductivity	µmhos/cm	Hydrolab	1.0	ERI/UT SHL
Dissolved Oxygen	mg/l	Hydrolab	0.1	ERI/UT SHL
Temperature	°C	Hydrolab	0.1	ERI/UT SHL
Nitrate	mg/l	353.3	0.005	ERI/UT SHL
Nitrite	mg/l	354.1	0.0005	ERI/UT SHL
Ammonia	mg/l	350.3	0.01	ERI/UT SHL
Orthophosphorus	mg/l	365.2	0.001	ERI/UT SHL
Dissolved Total Phosphorus	mg/l	354.2	0.002	ERI/UT SHL
Total Phosphorus	mg/l	354.2	0.002	ERI/UT SHL
Alkalinity	mg/l as $CaCO_3$	310.1	5	ERI/UT SHL
Volatile Total Suspended Solids	mg/l	160.4		ERI/UT SHL
Residual Total Suspended Solids	mg/l	160.1	1	ERI/UT SHL
Calcium	mg/l	215.2	1	ERI/UT SHL
Magnesium	mg/l	(A)	1	ERI/UT SHL
Hardness	mg/l	130.2	3	ERI/UT SHL
Chloride	mg/l	325.3	2	ERI/UT SHL
Sulfate	mg/l	375.4	0.001	ERI/UT SHL
Potassium	mg/l	200.7	1	UT SHL
Sodium	mg/l	200.7	1	UT SHL
Fecal Strep (C)	#100/ml	9230C		ERI/UT SHL
Total Coliforms	#100/ml	9222B		BRHD/UT SHL
Fecal Coliforms	#100/ml	9222D		BRHD/UT SHL
Chlorophyll *a*	µg/l	1002G		ERI/UT SHL
Arsenic (dissolved)	µg/l	200.9	5	UT SHL
Barium (dissolved)	µg/l	200.7	5	UT SHL
Cadmium (dissolved)	µg/l	200.9	1	UT SHL
Chromium (dissolved)	µg/l	200.9	5	UT SHL
Copper (dissolved)	µg/l	200.7	20	UT SHL
Iron (dissolved)	µg/l	200.7	20	UT SHL
Lead (dissolved)	µg/l	200.9	3	UT SHL
Manganese (dissolved)	µg/l	200.7	5	UT SHL
Selenium (dissolved)	µg/l	200.9	2	UT SHL
Silver (dissolved)	µg/l	200.9	2	UT SHL
Mercury (dissolved)	µg/l	245.1	0.2	UT SHL

(A) Magnesium hardness calculated by ERI as a difference between total hardness and calcium hardness.
(B) ERI: Ecosystems Research Institute Laboratory; UT SHL: Utah State Health Laboratory; BRHD: Bear River Health Department
(C) ERI does not maintain USEPA certification for fecal strep. The analyses was conducted at ERI's lab for all samples collected by ERI because all certified labs were too far away to deliver samples within the required holding times. All normal microbiological QA/QC procedures were followed by ERI.

* APHA et al. 1981, USEPA 1979

mass results given in this section were calculated from flows multiplied by concentrations, and are expressed in kilograms/day, unless otherwise stated. Annual and seasonal averages were time-weighted. Results from each sample event were weighted by the period of time between sampling events before the mean was calculated. This was done to avoid biasing results toward the runoff period, when samples were collected more frequently.

I.2.1.1 Mainstem Bear River

This section discusses the mainstem Bear River results. Table I-2 indicates the names and site numbers along the mainstem Bear River, with river miles from the Bear River Bird Refuge, located at the confluence of the Bear River with the Great Salt Lake.

Hydrology

Within the lower Bear River, there are gaged sites at the Utah-Idaho stateline, and at river miles 78 (near Smithfield), 61.1 (below Cutler) and 16.7 (near Corinne). Annual average daily flows increased from 720 cfs at the stateline to 1,410 cfs at the most downstream site (Corinne). These flows are lower than the USGS measured mean flows at the stateline of 1,239 cfs (1971-92) and 1,837 cfs at Corinne (1950-92). The spatial pattern of average annual accrual can be seen in Figure I-2. Tributary inputs accounted for most of the increases in the average daily flow from Richmond to Amalga. About one-third of the increase in flow as the river moved across Cutler was ungaged and may result from irrigation return flows. Return channels exist throughout the east side of the Cutler drainage. The drop in flows below Collinston is due to irrigation diversions below Cutler dam.

Flows in the mainstem Bear River showed the typical pattern of two peak runoff periods, associated with lower basin and high basin snow melt (Figure I-3). Runoff flows in 1993 averaged 1,485 cfs at the stateline, and increased to 3,050 cfs below Cutler. In the summer, Bear River flows are supplemented by irrigation releases from Bear Lake. Below Cutler, irrigation diversions resulted in very low flows from July through October (averaging 25 cfs), and winter base flows of 700 cfs. Bear River flows at Corinne averaged about 450 cfs from July through February, ranging from 100 to 800 cfs.

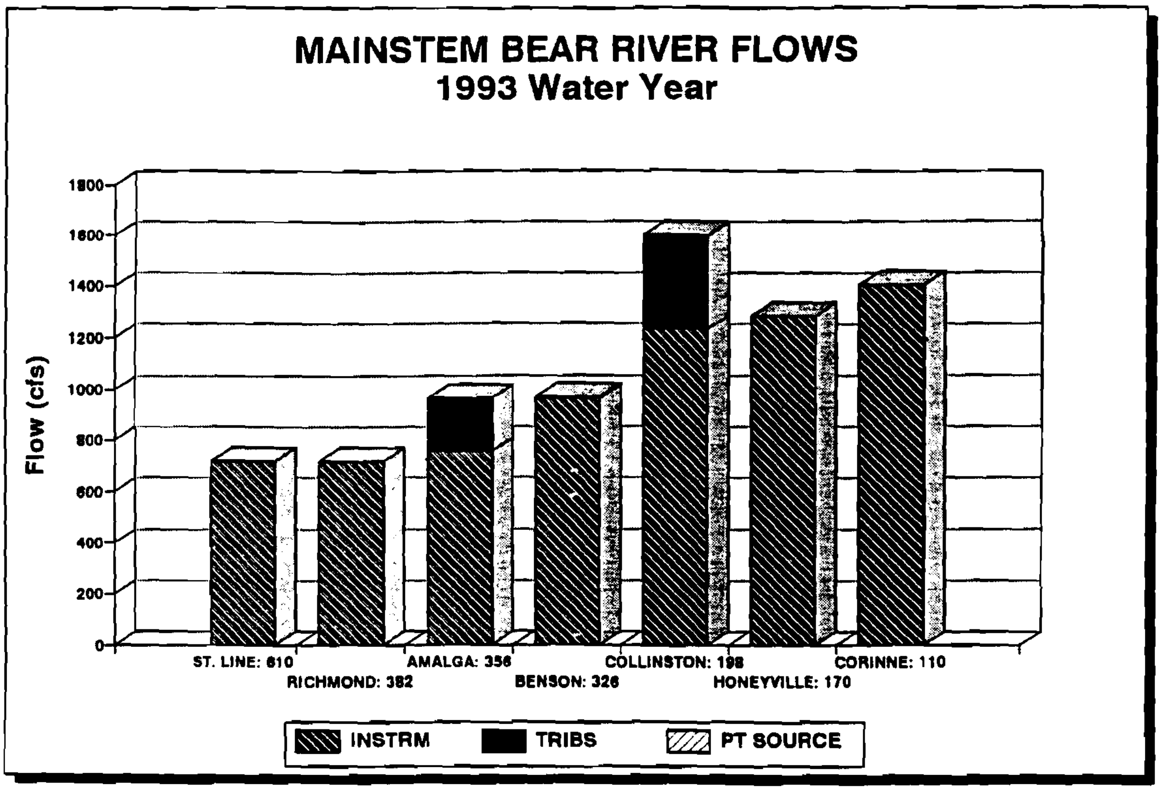

FIGURE I-2. Annual average flows at each of the mainstem Bear River sites. Values were weighted by the period of time between samples before calculating an annual mean. Each bar shows the identified sources for the reach upstream of the sample site. Tributaries and point sources are measured flows entering within the upstream reach. The only point source entering the Bear River directly is the Logan Lagoons and these flows were too small to be distinguished on the graph. "Instream" represents flows carried within the river and any other sources entering within the upstream reach. Site locations are identified in Figure I-1 and Tables I-1 and I-2.

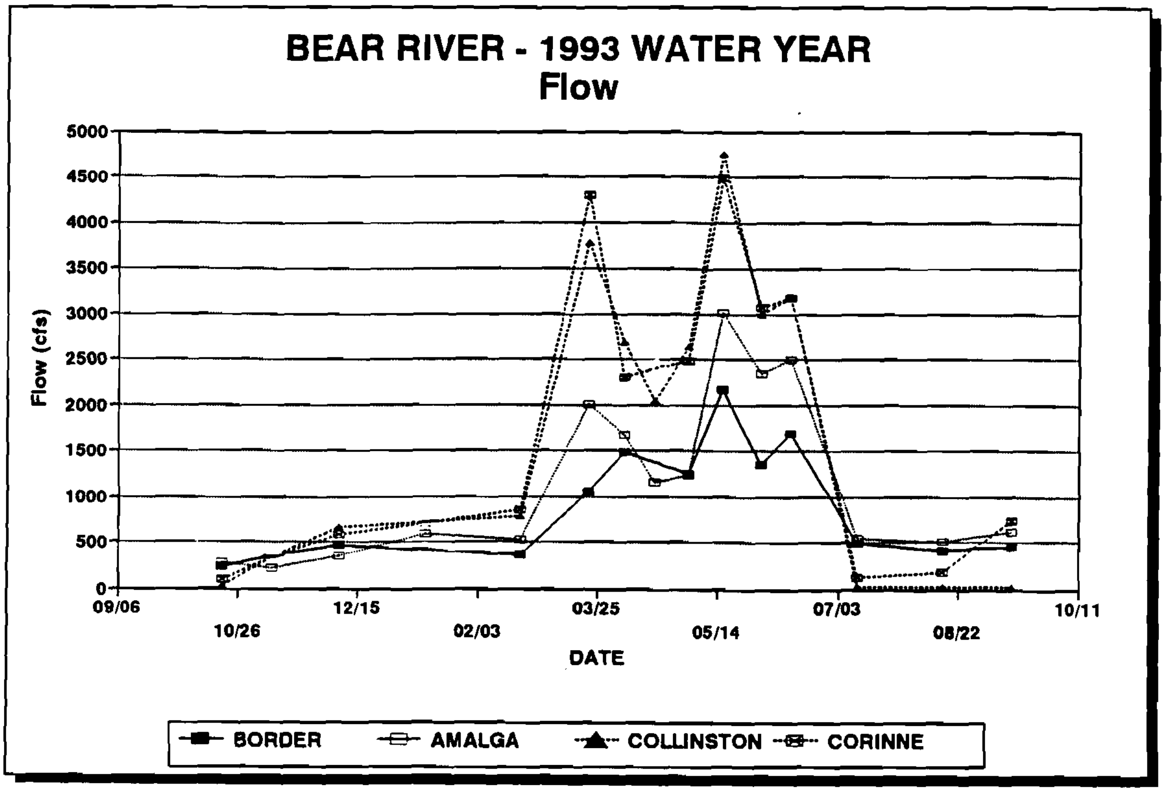

FIGURE I-3. Daily flows from October 1992 through September 1993 at four sites on the Bear River.

Total Suspended Solids

Total suspended solids (TSS) were high in the mainstem Bear River from spring through autumn, compared to winter baseflow (Figure I-4). The annual average concentration was 57 mg/liter at the stateline, fell to 38 mg/liter below Cutler, and increased to 72 mg/liter at the most downstream site. In general, concentrations peaked at the beginning of runoff, with concentrations as high as 280 mg/liter at the sites above Cutler. During the late summer, concentrations remained higher than during winter baseflow, which may have been due to irrigation return flows. All sites below Cutler and within the influence of Cutler's water level had elevated TSS throughout the irrigation return flow period. For example, TSS in the Bear River at Corinne averaged 72 mg/liter annually, but averaged 120 mg/liter during the late summer. Except for the initial spring runoff period when high suspended solids concentrations were found at the Utah-Idaho border, concentrations tended to increase from upstream to downstream sites.

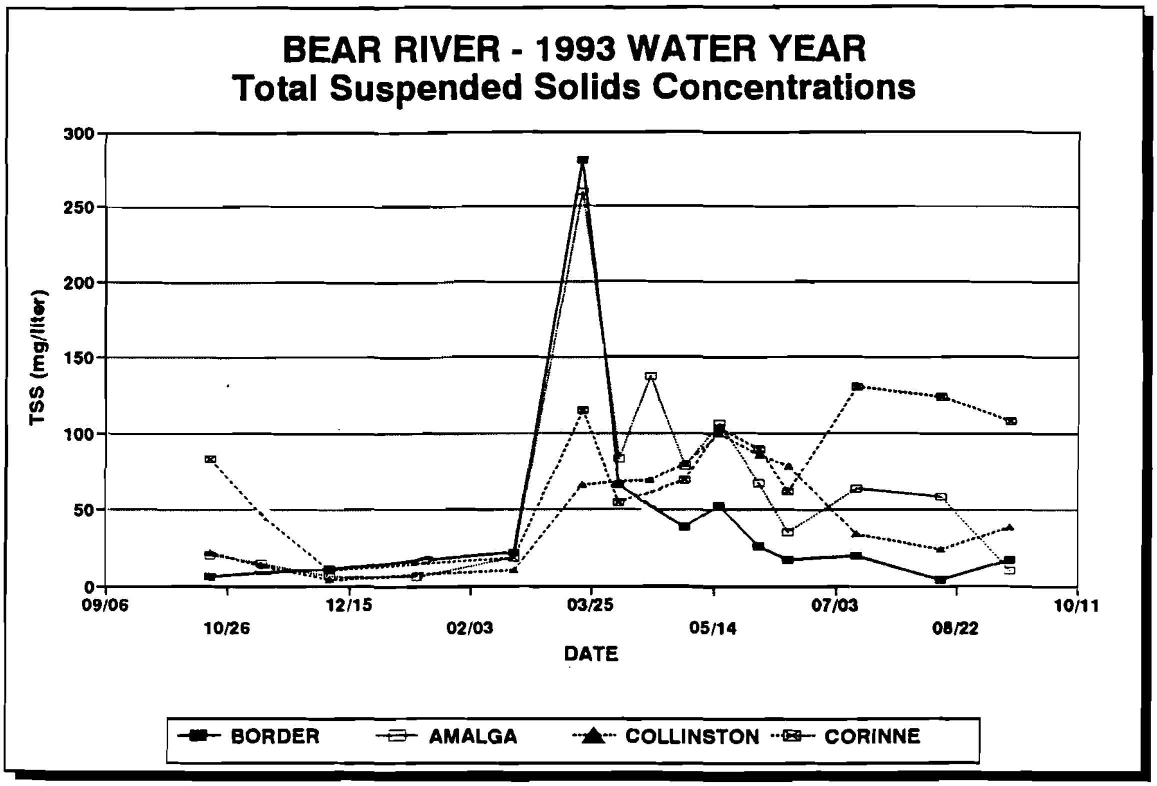

FIGURE I-4. Total suspended solids concentrations from October 1992 through September 1993 at four sites on the Bear River.

TSS concentrations were multiplied by flows to obtain mass loadings on each date. TSS loads on the mainstem Bear River sites showed pronounced peaks associated with both peak flow periods (Figure I-5). Average daily TSS loads at the stateline were almost 107,000 kg/day (Figure I-6). These loads increased from the stateline to the site near Amalga, then dropped at the site near Benson. Water elevations in Cutler Reservoir for most of the 1993 water year caused a reduction in stream gradient near the Benson station, causing sediments to drop out of the water column. While sediment loads increased substantially as the river moved through Cutler Reservoir, this reflects an increase in flow since the annual average TSS concentration was lower below Cutler Reservoir than above. The total suspended solids load leaving Cutler Reservoir averaged 240,000 kg/day and 277,000 kg/day near Corinne, the monitoring study's farthest downstream site (Figure I-6).

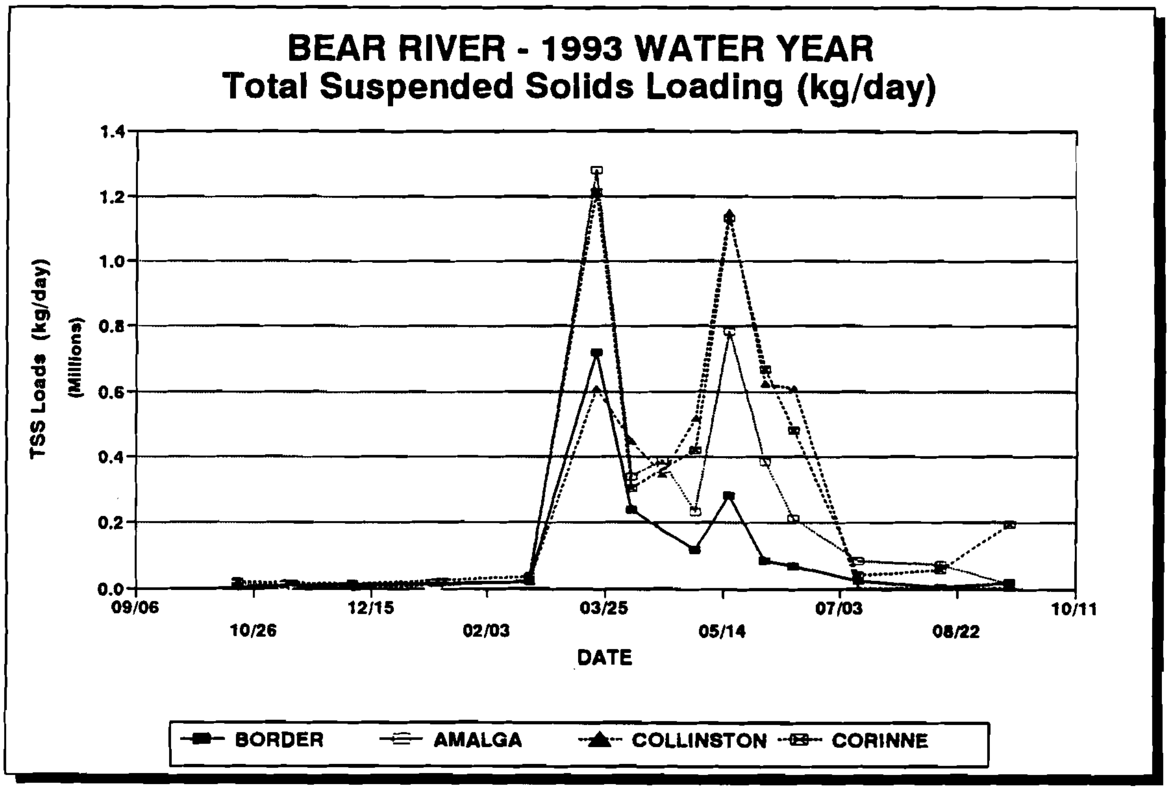

FIGURE I-5. Total suspended solids loads from October 1992 through September 1993 at four sites on the Bear River.

Most of the sediment loading occurred during high flow periods. At sites above the influence of Cutler Reservoir, 90 percent of the annual TSS load occurred from March through June, and over 80 percent occurred from March through May. At sites below Cutler, up to 96 percent of the annual load occurred from March through June.

As Figure I-6 indicates, over 50 percent of the annual average reach gains from Richmond to Amalga were attributable to tributary inputs, with the remaining inputs attributable to nonpoint sources along the Bear River. The Cub River enters within this reach, carrying an average annual load of 43,000 kg/day. While total daily loads were higher during runoff, the relative inputs from the Cub and the Bear River were about the same during the runoff period as during the entire year (from sites 490326 to 490198).

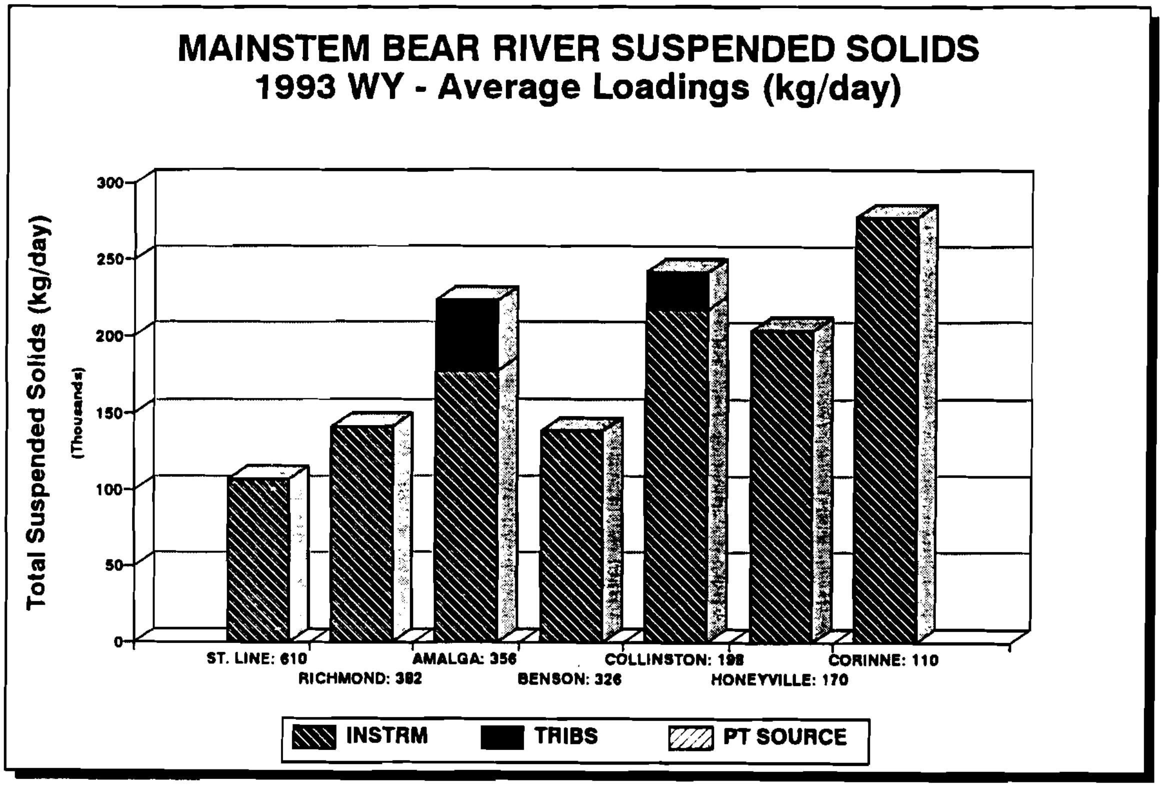

FIGURE I-6. Annual average total suspended solids load at each of the mainstem Bear River sites. All averages were time-weighted. Each bar shows the identified sources for the reach upstream of the sample site, including tributaries and point sources which entered within the upstream reach. The only point source entering the Bear River directly is the Logan Lagoons and in this and several of the following figures, the load contributed by this source was too small to appear on the graph. The instream portion of each bar represents load entering the upstream reach and all other sources from within the reach. Site locations are identified in Figure I-1 and Tables I-1 and I-2.

About 25 percent of the average annual daily gain in sediments across Cutler Reservoir was attributable to tributaries, although tributaries accounted for almost 60 percent of the increase in average daily flows. Inputs within the Cutler reach itself accounted for 76 percent of the sediments entering the river within this reach (Figure I-7).

A substantial gain in TSS was seen from Honeyville to Corinne (Figure I-4). The Malad River enters within this reach. Although this river was not sampled during the 1993 water year, historic data from 1982-1992 indicate an average daily load of approximately 100,000 kg/day. This suggests the Malad River is responsible for most of the gain seen in this reach.

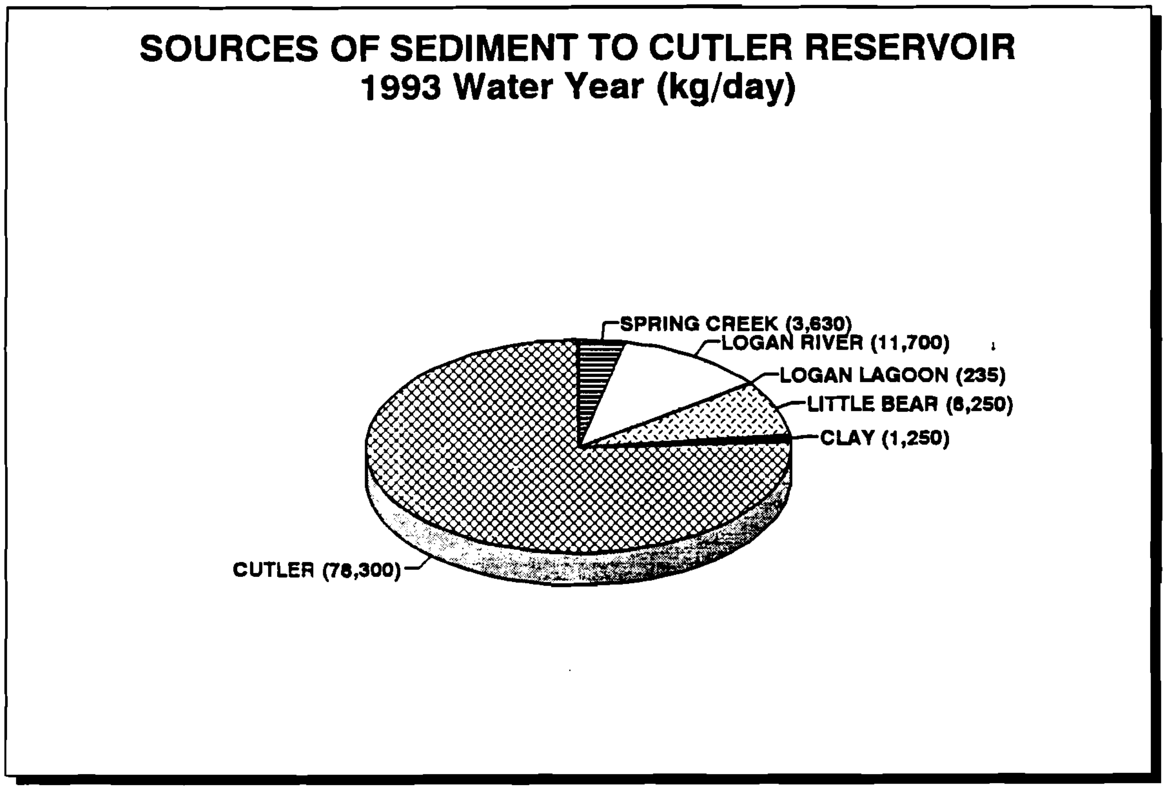

FIGURE I-7. Sources of the increase in the total suspended solids load in the Bear River as it crossed Cutler Reservoir (from Bear River at Benson to Bear River at Collinston). The calculations are based on annual average loadings. All values are in kg/day.

Total phosphorus

Total phosphorus (TP) concentrations were high throughout the mainstem Bear River. Annual average concentrations increased from 0.105 mg/liter at the stateline to 0.175 mg/liter below Cutler and 0.211 mg/liter at Corinne. Concentrations peaked during the early, lower basin runoff, with values ranging between 0.40 and 0.60 mg/liter (Figure I-8). Baseflow (August through February) concentrations averaged 0.047 mg/liter at sites above the influence of Cutler Reservoir. Below Cutler, baseflow concentrations were higher, averaging 0.170 mg/liter.

Loadings calculated along the mainstem Bear River showed two peaks associated with the early and late runoff periods (Figure I-9). On average, the river carried over 200 kg/day at the stateline and over 800 kg/day at Corinne. Major gains occurred between Richmond and Amalga and through Cutler Reservoir (Figure I-10). The phosphorus load carried during runoff (March through May) accounted for almost 80 percent of the total annual load at sites above Cutler. Below Cutler at the Corinne station, runoff accounted for only 53 percent of the total annual TP load.

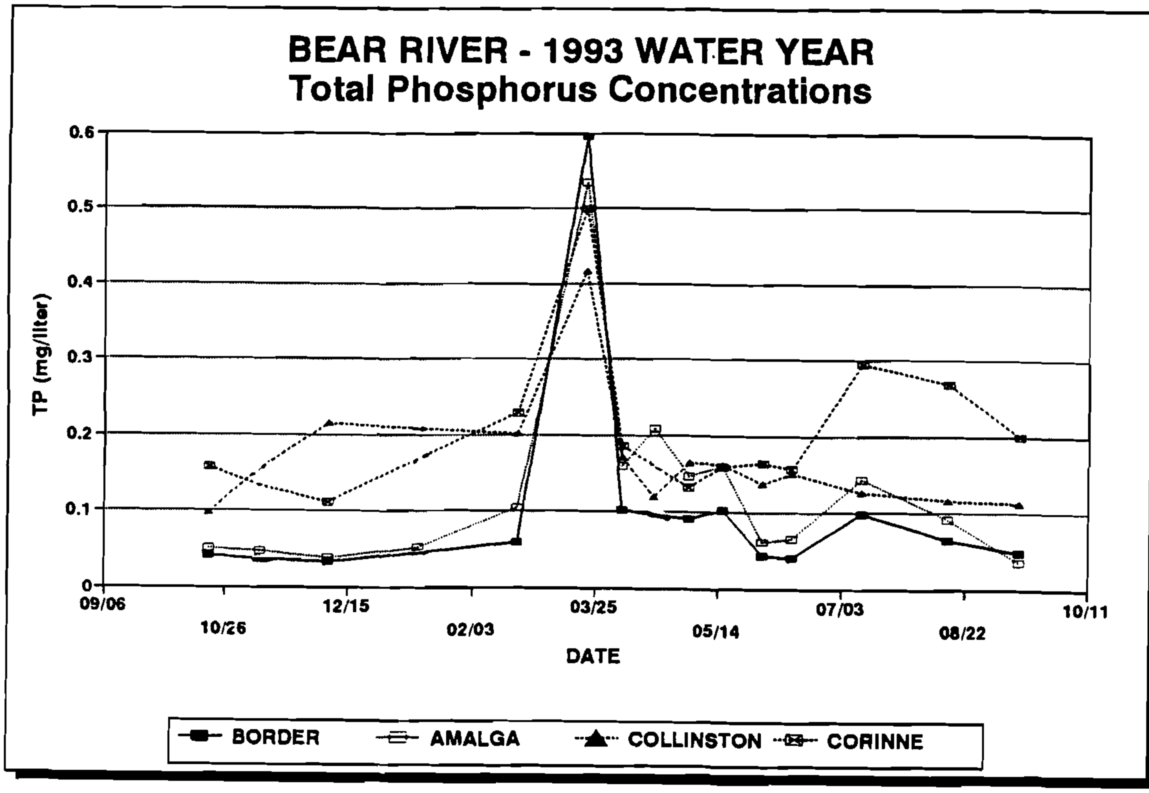

FIGURE I-8. Total phosphorus concentrations from October 1992 through September 1993 at four sites on the Bear River.

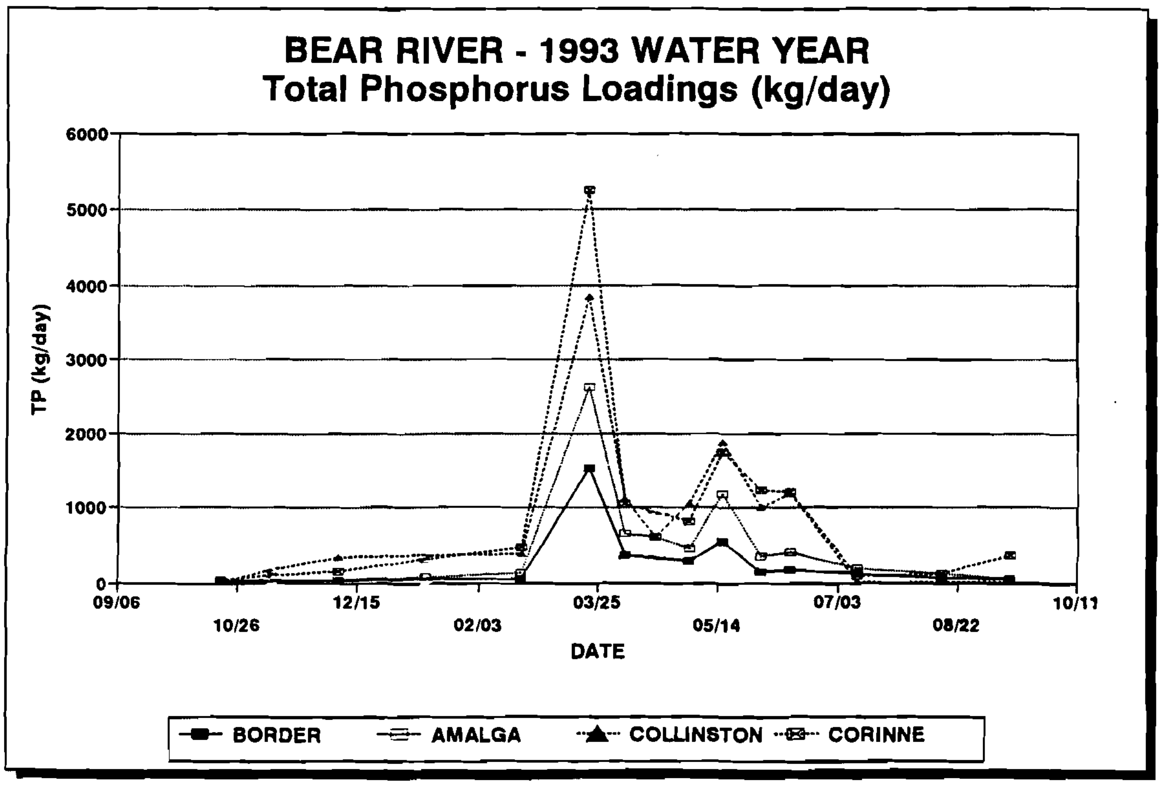

FIGURE I-9. Total phosphorus loadings from October 1992 through September 1993 at four sites on the Bear River.

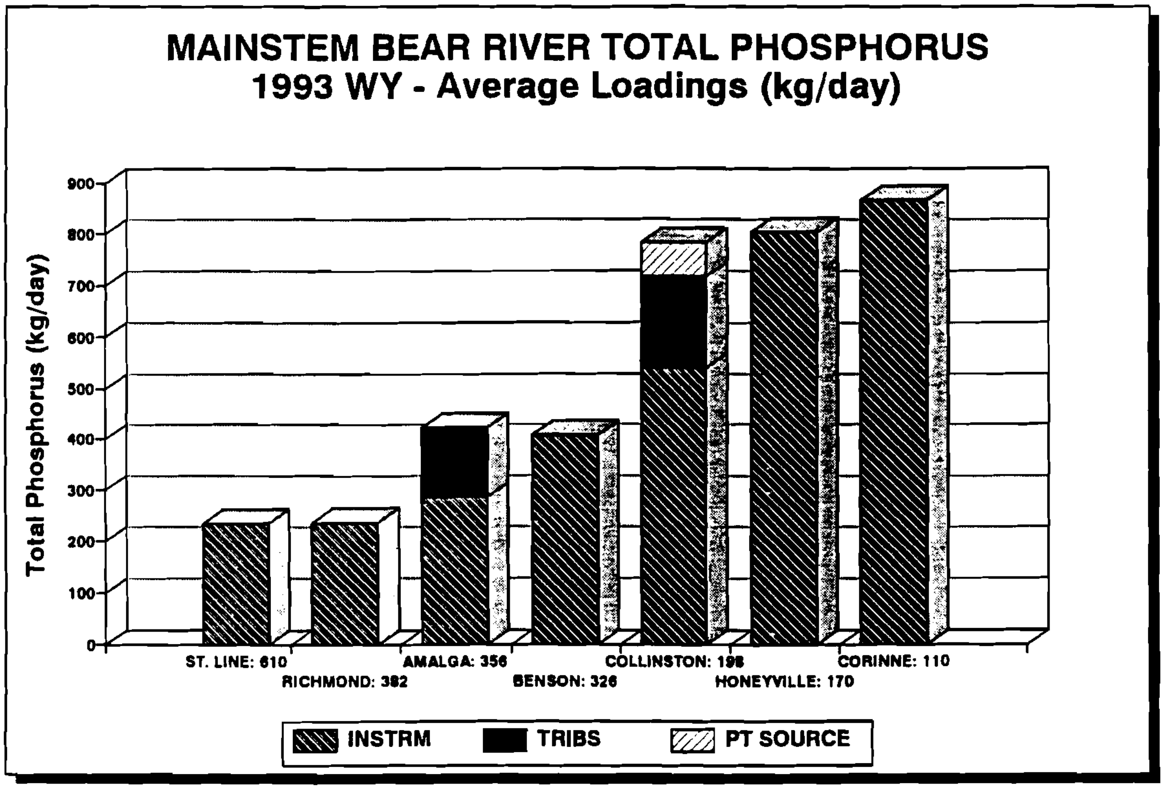

FIGURE I-10. Annual average total phosphorus loads at each of the mainstem Bear River sites. See Figure I-6 for further explanation of figure.

Seventy-five percent of the average annual gains from Richmond to Amalga were attributable to the Cub River (Figure I-10). Gains across Cutler (from Benson to Collinston) were mostly attributable to tributaries and point sources, although nonpoint inputs within the Cutler reach accounted for 28 percent of the increase. Figure I-11 shows the relative contribution of different tributaries and point sources entering the Bear River within the Cutler Reach. Because most of the Logan Lagoon effluent is diverted during the irrigation season, the loading from this source was assumed to be two-thirds of the total annual end-of-pipe discharge. Given this assumption, effluent from the lagoons accounted for approximately 20 percent of the total phosphorus entering within this reach. The Logan and Little Bear rivers contributed phosphorus loads proportionally lower than their flows. Spring Creek, however, contributed almost 30 percent of the total phosphorus entering the Bear River within this reach, compared to about six percent of the flow.

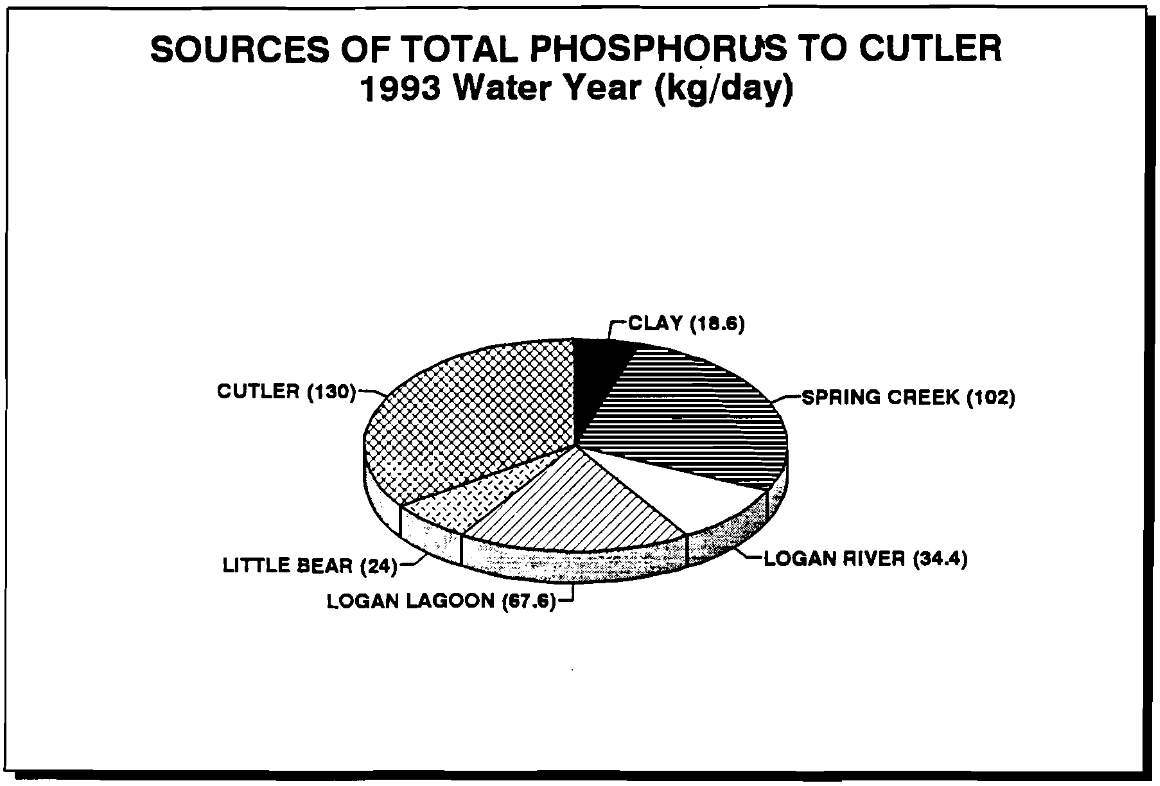

FIGURE I-11. Sources of the increase in total phosphorus load in the Bear River as it crossed Cutler Reservoir (from Bear River at Benson to Bear River at Collinston). The calculations are based on annual average loadings. All values are in kg/day.

Dissolved total phosphorus

Dissolved total phosphorus (DTP) is the fraction of total phosphorus which can pass through a 0.45 micron filter. This phosphorus fraction includes orthophosphorus, which in the Bear River system comprises almost 90 percent of the DTP. The remaining DTP is dissolved organic phosphorus or colloidal forms of inorganic phosphorus. All of this phosphorus is potentially available for biological uptake. Particulate phosphorus, much of which is associated with suspended solids, tends to be less biologically available within the water column. The dissolved fraction of TP varied between subdrainages. On average, DTP accounted for about 30 to 40 percent of the TP in the mainstem Bear River.

On an annual basis, DTP averaged 0.039 mg/liter at sites above Cutler and 0.107 mg/liter at sites below Cutler. Concentrations peaked during early runoff, ranging from 0.12 mg/liter near the stateline to 0.33 mg/liter below Cutler Reservoir (Figure I-12). Winter concentrations were high at sites below Cutler. In contrast to TP, DTP loadings showed one main peak, associated with the low basin runoff (Figure I-13). Runoff loads contributed between 60 percent and 75 percent of the total annual loads.

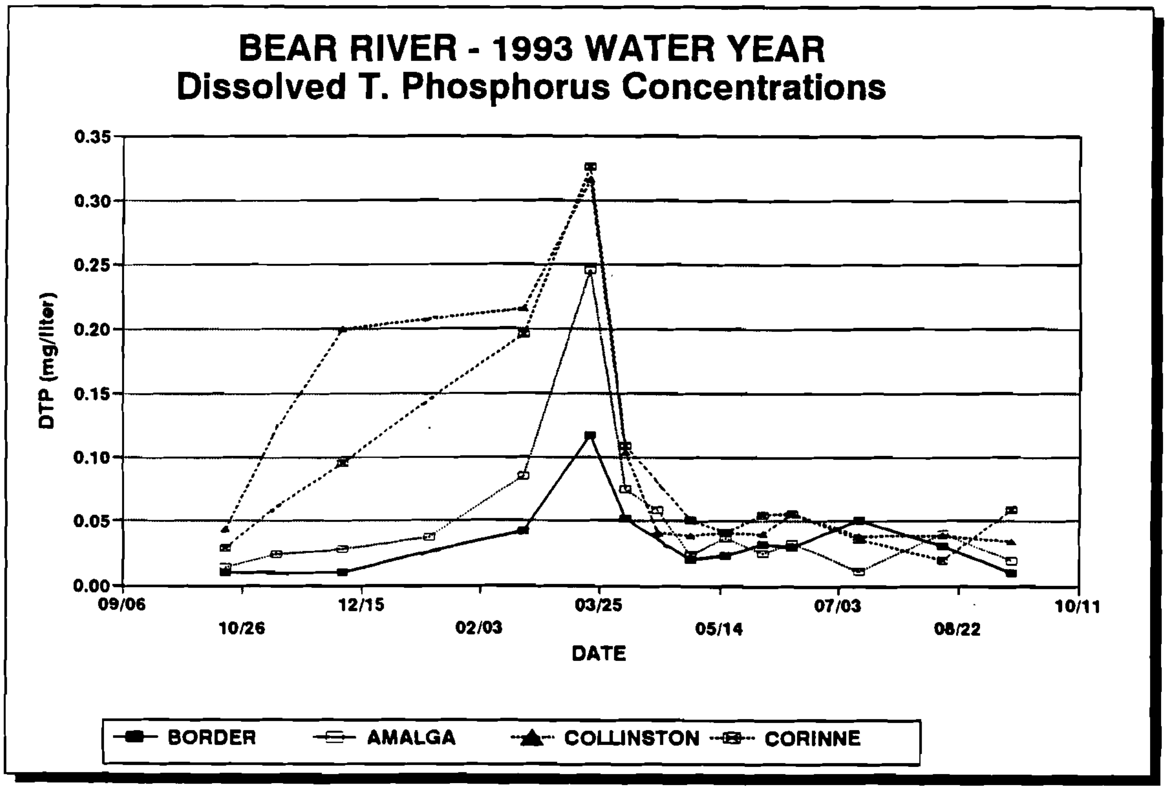

FIGURE I-12. Dissolved total phosphorus concentrations from October 1992 through September 1993 at four sites on the Bear River.

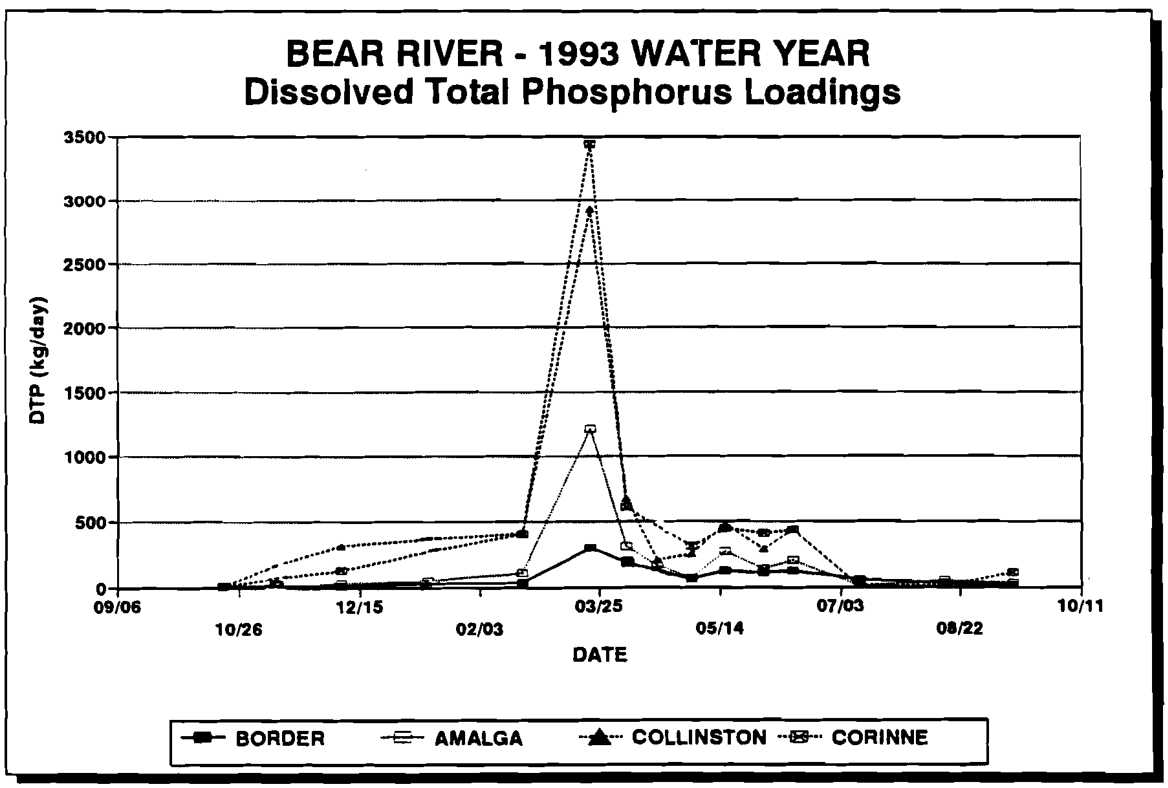

FIGURE I-13. Dissolved total phosphorus loading from October 1992 through September 1993 at four sites on the Bear River.

Substantial reach gains in the average annual DTP load occurred from Richmond to Amalga (Figure I-14). While over half of this increase was due to the Cub River, about 38 percent of the gain occurred from nonpoint sources along the Bear River itself. The largest reach gains along the Bear River occurred within Cutler Reservoir. As with TP, the Logan and Little Bear rivers contributed very little DTP compared to their flow inputs. Spring Creek, however, contributed almost 30 percent of the DTP reach gain within Cutler (Figure I-15), while accounting for only six percent of the flow entering Cutler. The Logan Lagoons contributed an estimated 18 percent of the DTP reach gain. Over one-third of the DTP gains across Cutler entered from within the reservoir itself.

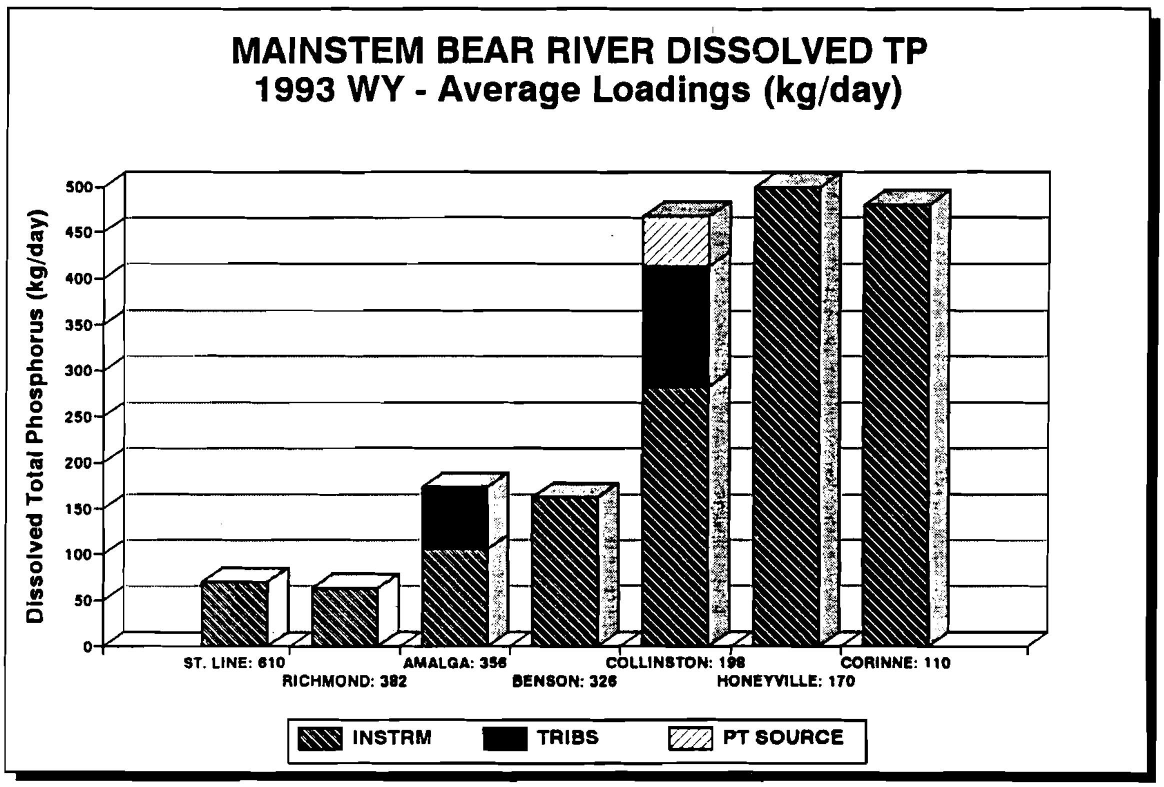

FIGURE I-14. Annual average dissolved total phosphorus load at each of the mainstem Bear River sites. See Figure I-6 for further explanation of figure.

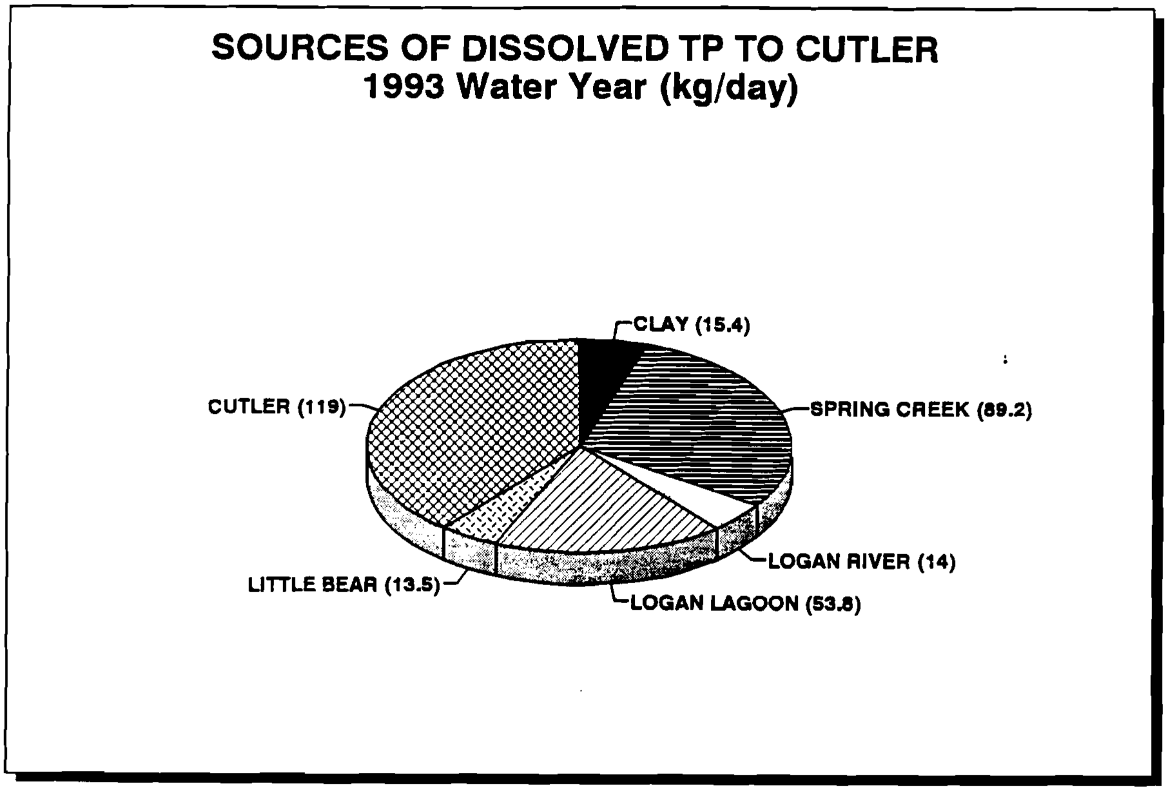

FIGURE I-15. Sources of the increase in dissolved total phosphorus load in the Bear River as it crossed Cutler Reservoir (from Bear River at Benson to Bear River at Collinston). The calculations are based on annual average loadings. All values are in kg/day.

Nitrates

At all sites throughout the year, nitrate concentrations increased as the river moved downstream. The average annual concentration was 0.426 mg/liter at the stateline, 0.54 mg/liter below Cutler, and 0.59 mg/liter at Corinne. Concentrations were highest at all sites during early runoff, with peak concentrations ranging from 1.63 mg/liter to 3.71 mg/liter (Figure I-16).

Seasonal patterns in nitrate loadings were similar to DTP, with a main peak in loadings associated with lower basin snowmelt (Figure I-17). Average annual nitrate loads were 970 kg/day at the stateline, 3,500 kg/day below Cutler and 4,800 kg/day at Corinne (Figure I-18). At most sites, about 70 percent of the total annual load occurred from March through May, although at the site below Cutler, runoff loads accounted for only 44 percent of the annual load.

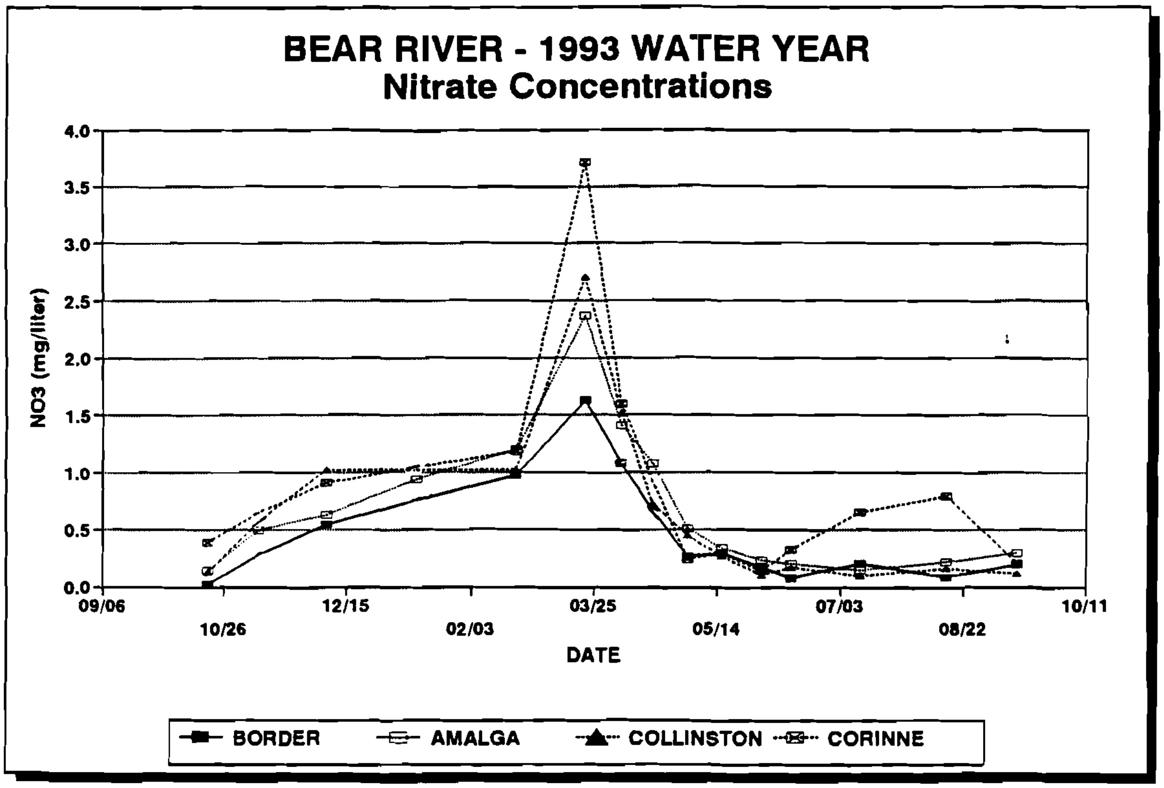

FIGURE I-16. Nitrate concentrations from October 1992 through September 1993 at four sites on the Bear River.

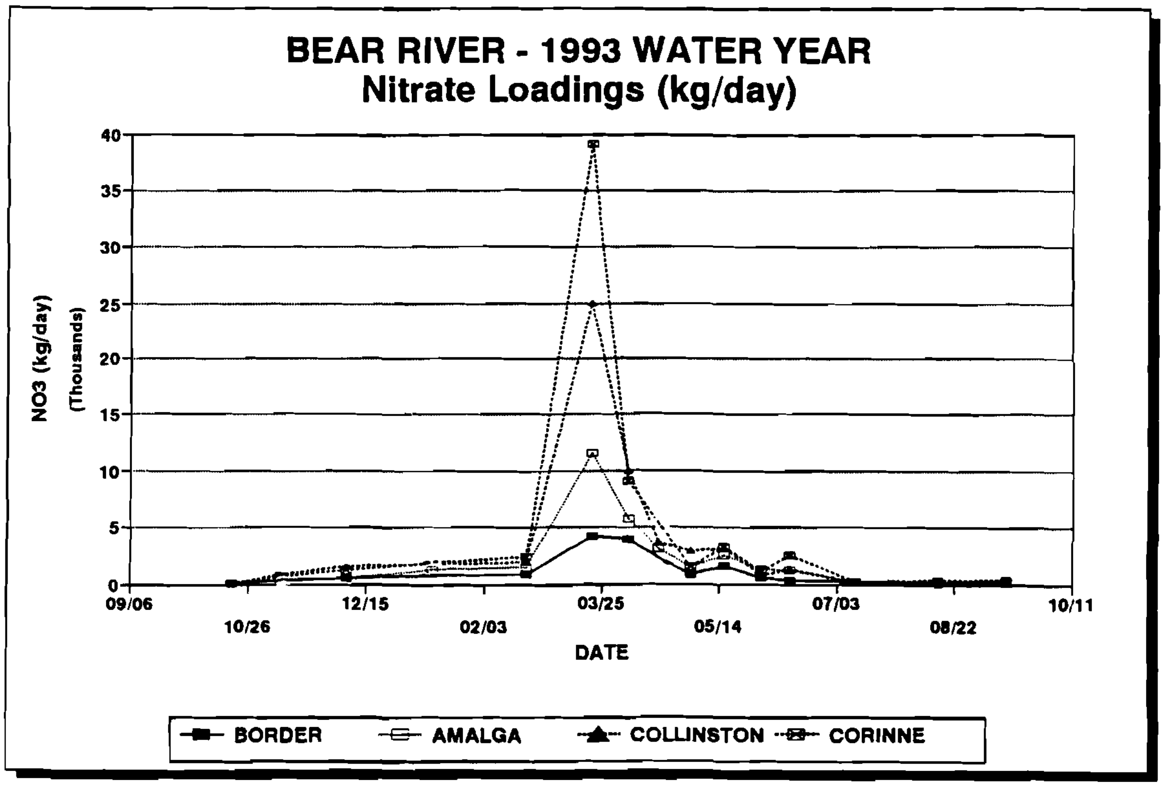

FIGURE I-17. Nitrate loadings from October 1992 through September 1993 at four sites on the Bear River.

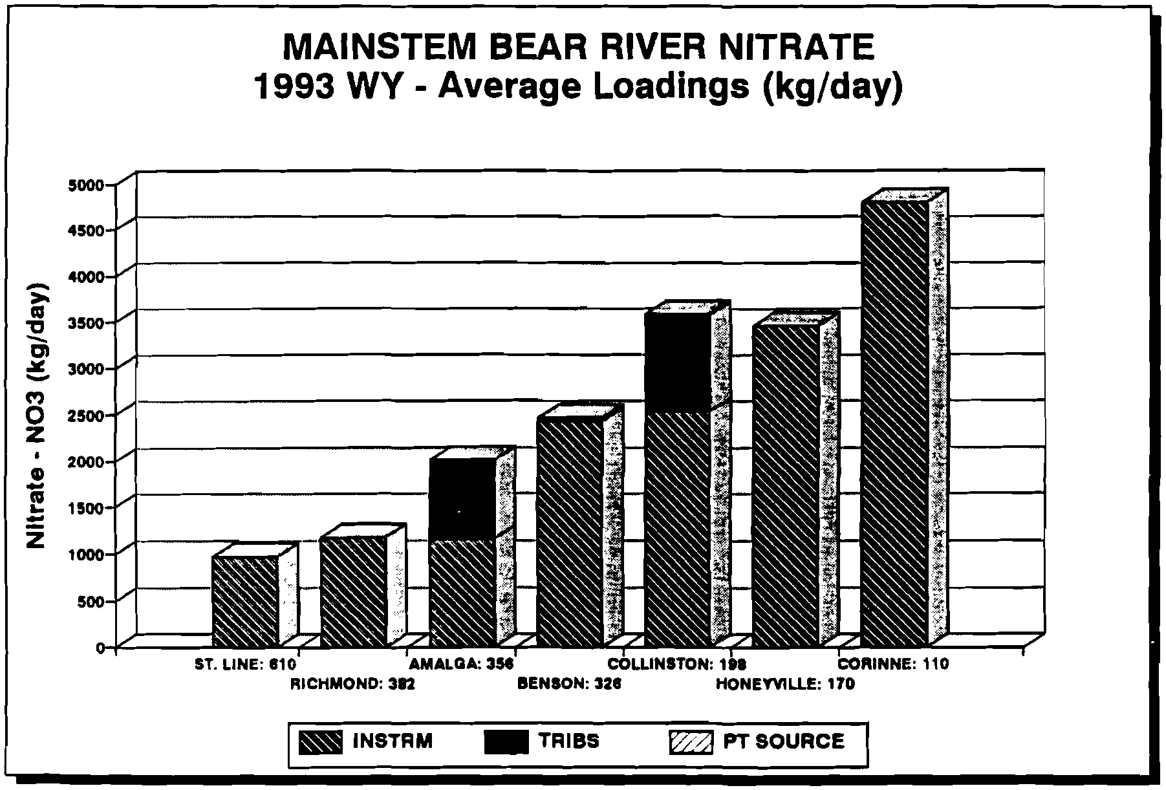

FIGURE I-18. Annual average nitrate loads at each of the mainstem Bear River sites. See Figure I-6 for further explanation of figure. Point source loads are too small to appear on the graph.

Reach gains from Richmond to Amalga and across Cutler Reservoir were accounted for entirely by tributary inputs. Logan Lagoons was a small contributor of nitrates relative to other sources. The major source was Spring Creek, which accounted for 48 percent of the annual load. The Logan and Little Bear rivers accounted for 37 percent of the nitrate load (Figure I-19), proportionately lower than their relative flow contributions, which accounted for 51 percent of the gain in flow.

A substantial gain in the annual average nitrate loading was observed from Honeyville to Corinne (Figure I-18). Historic loadings from the Malad River are difficult to determine, because flows and nitrates were rarely measured on the same dates. Average concentrations from 1976 to 1985 measured 13.7 mg/liter, and the nitrate load calculated from average concentration and average flow was 14,000 kg/day. These high values suggest the Malad is responsible for the increases between Honeyville and Corinne.

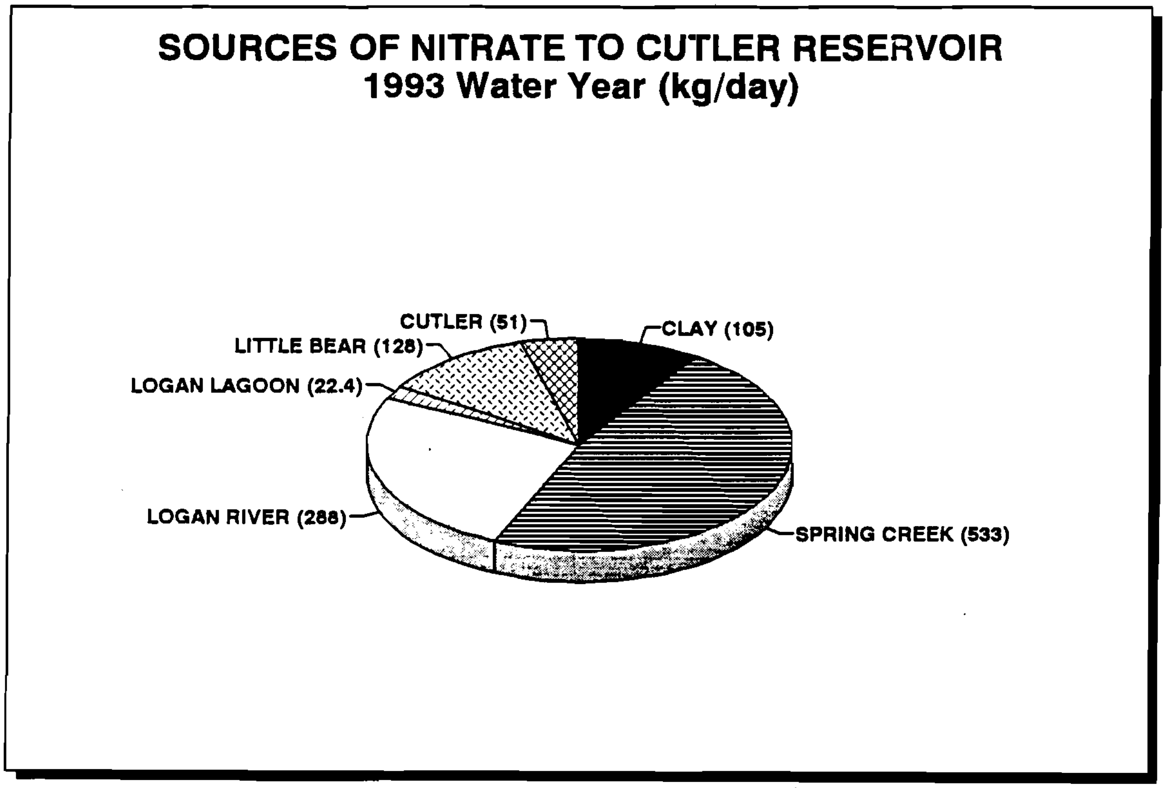

FIGURE I-19. Sources of the increase in nitrate load in the Bear River as it crossed Cutler Reservoir (from Bear River at Benson to Bear River at Collinston). The calculations are based on annual average loadings. All values are in kg/day.

Ammonia

Ammonia (NH_3) accounted for between nine and 16 percent of the total annual inorganic nitrogen load. Concentrations were near the detection limit for much of the year at all sites, with peaks occurring during runoff (Figure I-20). A maximum concentration of 0.40 mg/liter was observed at the Corinne site. As with the other dissolved nutrients, ammonia loading had a single maximum concentration during the early spring runoff (Figure I-21).

Average annual ammonia loadings tended to be more variable than for other parameters (Figure I-22). In general, tributaries accounted for a similar proportion of the reach gains as seen for other dissolved nutrients. Within the Cutler reach, the Logan Lagoons contributed a larger proportion of ammonia than nitrate to the river, accounting for 26 percent of the total increase (Figure I-23). Spring Creek contributed over 50 percent of the increase in ammonia across Cutler Reservoir.

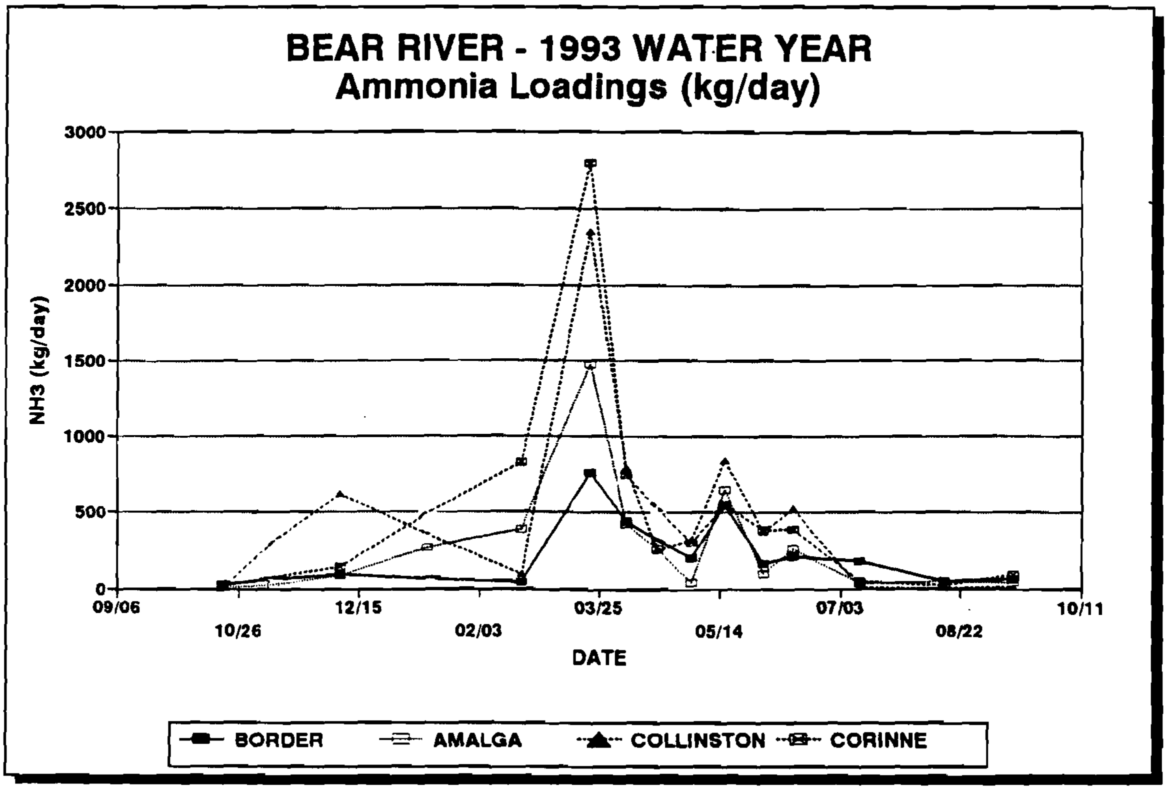

FIGURE I-20. Ammonia concentrations from October 1992 through September 1993 at four sites on the Bear River.

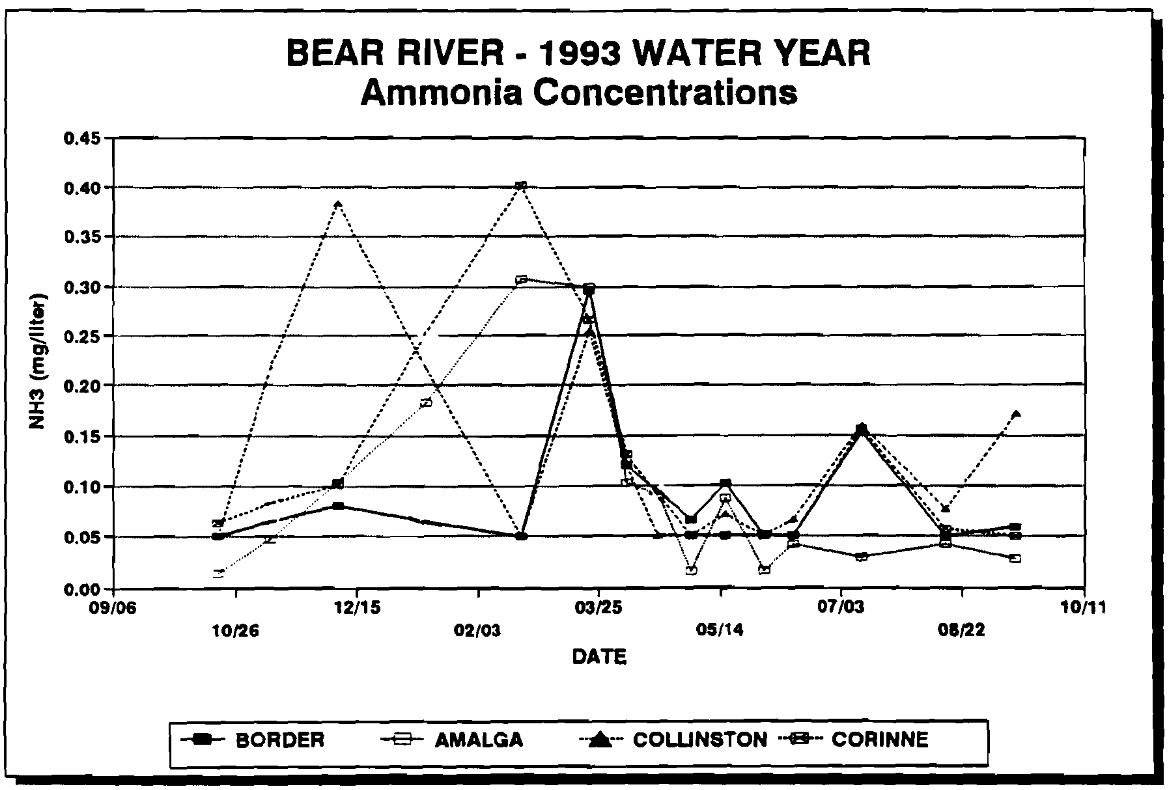

FIGURE I-21. Ammonia loadings from October 1992 through September 1993 at four sites on the Bear River.

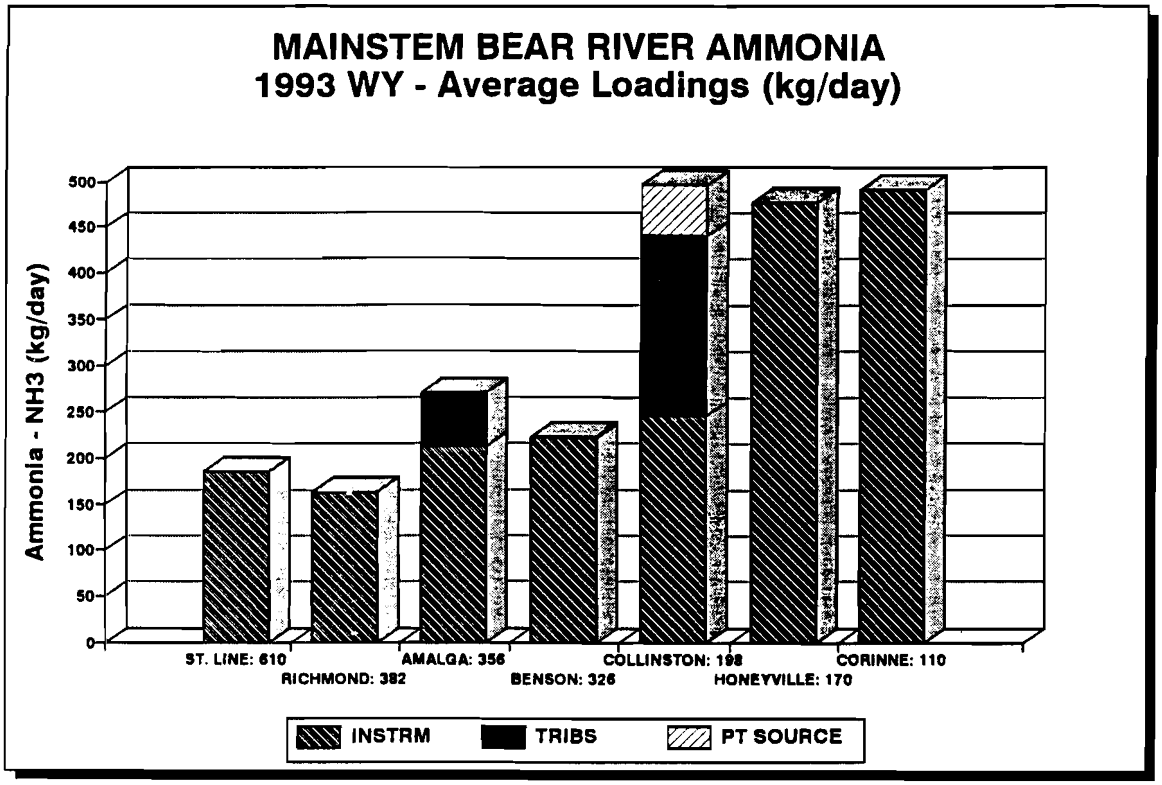

FIGURE I-22. Annual average ammonia loads at each of the mainstem Bear River sites. See Figure I-6 for further explanation of figure.

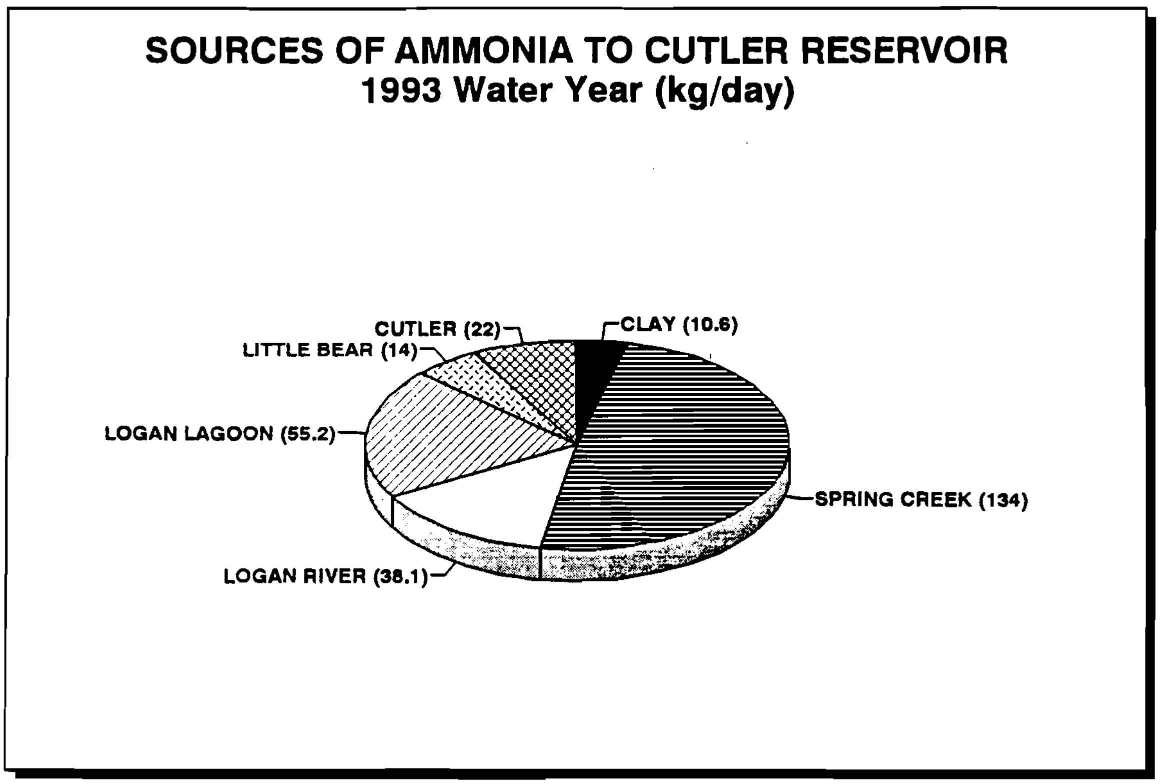

FIGURE I-23. Sources of the increase in ammonia load in the Bear River as it crossed Cutler Reservoir (from Bear River at Benson to Bear River at Collinston). The calculations are based on annual average loadings. All values are in kg/day.

I.2.1.2 Tributaries

This section discusses nutrient, sediment and flow results from the tributaries of the Bear River. Table I-2 lists each tributary sample site by number and description, and gives the distance from the confluence to the mainstem Bear River.

Logan River

The Logan River carried an average of 250 cfs annually, making it the largest tributary to the Bear River within the lower drainage. Although it accounted for almost 40 percent of the flow entering the Bear River within Cutler Reservoir, it contributed only 11 percent of the TSS and nine percent of the total phosphorus.

The Logan River had very good water quality as it left Logan Canyon and entered the Cache Valley. Total phosphorus exceeded 0.050 mg/liter only once during the year of sampling and averaged 0.026 mg/liter. Dissolved total phosphorus averaged 0.015 mg/liter and TSS never exceeded 28 mg/liter, averaging 6 mg/liter. No state standards or pollution indicator levels were exceeded in this reach.

As the river moved across the valley to Cutler Reservoir there was a slight degradation of water quality. Mean TSS increased to 11 mg/liter, but no samples exceeded 35 mg/liter. Total phosphorus averaged 0.050 mg/liter at the site above Cutler, and exceeded the state pollution indicator concentration four times, with a high of 0.098 mg/liter. Nitrate increased on average from 0.20 mg/liter at the mouth of the canyon to 0.53 mg/liter above Cutler.

Influences on the Logan River's water quality within the valley include storm drainage from the town of Logan. One of the two main storm drains from the town of Logan enters the river within this reach. The river passes through a small amount of agricultural land, past a golf course, and receives the inflow from the Blacksmith Fork. Inputs from the Blacksmith Fork accounted for most of the gains seen in TSS and about half the TP increases.

Blacksmith Fork

Like the Logan River, the Blacksmith Fork left U.S. Forest Service land with good water quality. Total suspended solids never exceeded 45 mg/liter, and averaged 13 mg/liter. Total phosphorus averaged 0.030 mg/liter, and dissolved total phosphorus averaged 0.016 mg/liter. There were no exceedences of state standards. Much of the river is diverted throughout the irrigation season, and the water which reaches the Logan River is primarily from local accrual or irrigation return flows. On average, water quality remained high throughout this reach. Total phosphorus and TSS increased slightly, and average DTP was unchanged. Nitrate increased from 0.30 mg/liter at the National Forest boundary to an average of 0.45 mg/liter above the Logan River.

Little Bear

The Little Bear drainage contains two impoundments, Porcupine and Hyrum reservoirs. Hyrum Reservoir receives all the upper basin flow from the East and South Forks of the Little Bear River and from Davenport Creek. A Clean Lakes study of Hyrum Reservoir was conducted during water year 1993 (ERI 1994). Below Hyrum Reservoir, the Little Bear River flows through a lower gradient valley before entering the southern end of Cutler Reservoir. Irrigation water is diverted from Hyrum Reservoir throughout the summer, resulting in lower annual flows below Hyrum than above (Figure I-24). The reservoir functioned as a sink for TSS, TP and nitrates, but functioned as a substantial source of dissolved total phosphorus, apparently due to internal loading during the winter and early spring with a subsequent flush during spring runoff.

Concentrations increased from the most upstream site to the site below the town of Wellsville (490559), where the highest concentrations of all nutrients were recorded. Total phosphorus averaged almost 0.300 mg/liter and DTP averaged 0.240 mg/liter at this site. Coliform concentrations were also highest at this site, and six of seven fecal coliform samples collected violated the state standard. Suspended solids concentrations increased from the most upstream tributaries to above Hyrum Reservoir, decreased to an average of 10 mg/liter below Hyrum Reservoir, then increased again at sites downstream.

Gains in flows in the Little Bear were generally attributable to tributary inputs (Figure I-24) although sediment and nutrient gains throughout the drainage were due in part to nonpoint sources within the river corridor itself and not totally accounted for by tributary inputs. Substantial nonpoint gains of TSS were seen from the confluence of the East and South Forks to Hyrum Reservoir, and again from below Hyrum

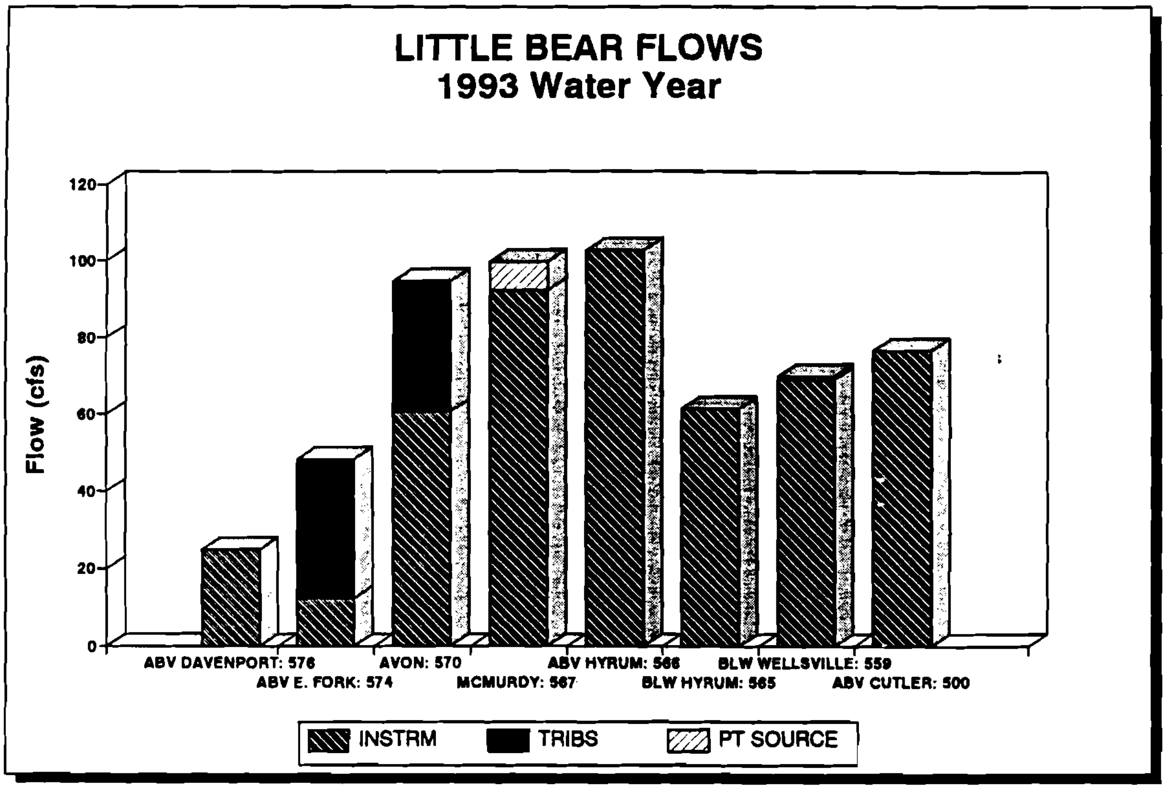

FIGURE I-24. Daily flows for the Little Bear and its tributaries from October 1992 to September 1993. The contributions of different sources within each upstream reach are shown.

Reservoir to below Wellsville (Figure I-25). Most of the nonpoint total phosphorus gains occurred above Hyrum Reservoir between the site near Avon and the site at McMurdie Hollow (Figure I-26). Nitrate gains were seen in this reach as well as the reach below Hyrum Reservoir (Figure I-27).

Point sources in this drainage include a trout farm located above Hyrum Reservoir, and sewage lagoons for the town of Wellsville. Production at the trout farm was low during the monitoring period, and loadings from this point source are reflected in the data. Inputs from the Wellsville lagoons accounted for all of the gains in total phosphorus and dissolved total phosphorus observed over that reach spanning the town of Wellsville.

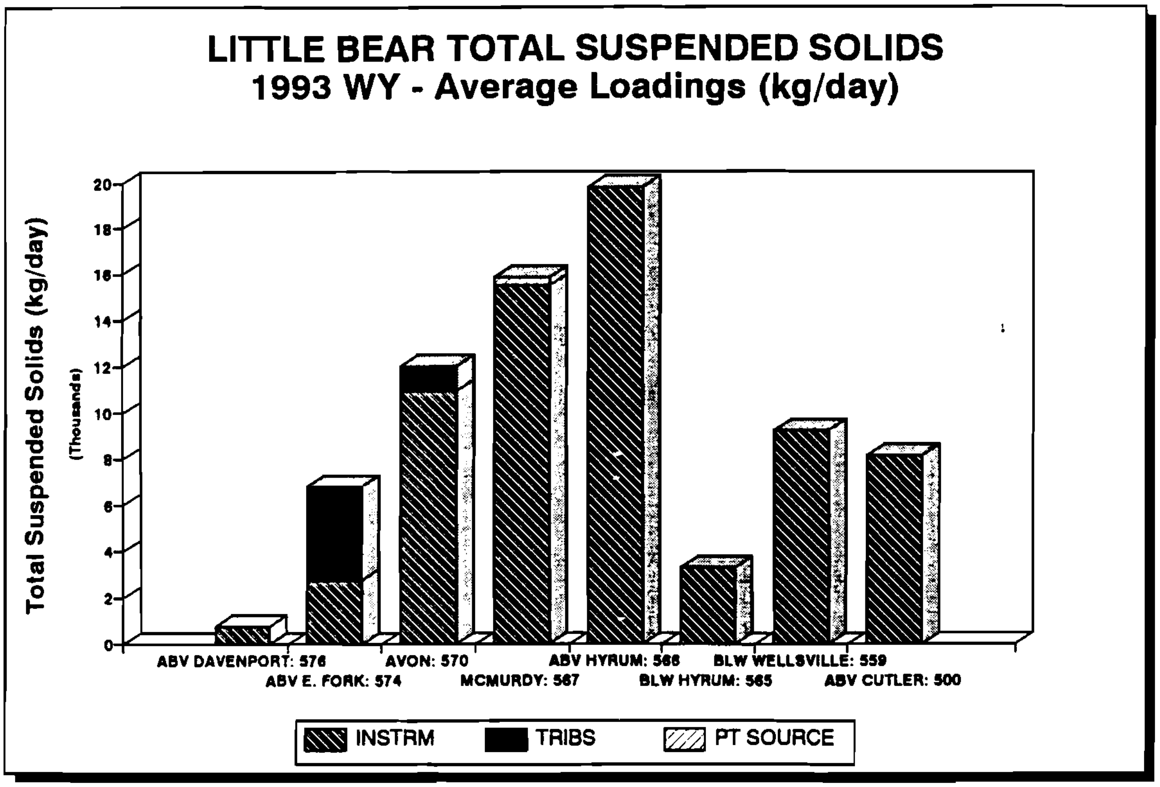

FIGURE I-25. Total suspended solids loads from October 1992 through September 1993 for the Little Bear River.

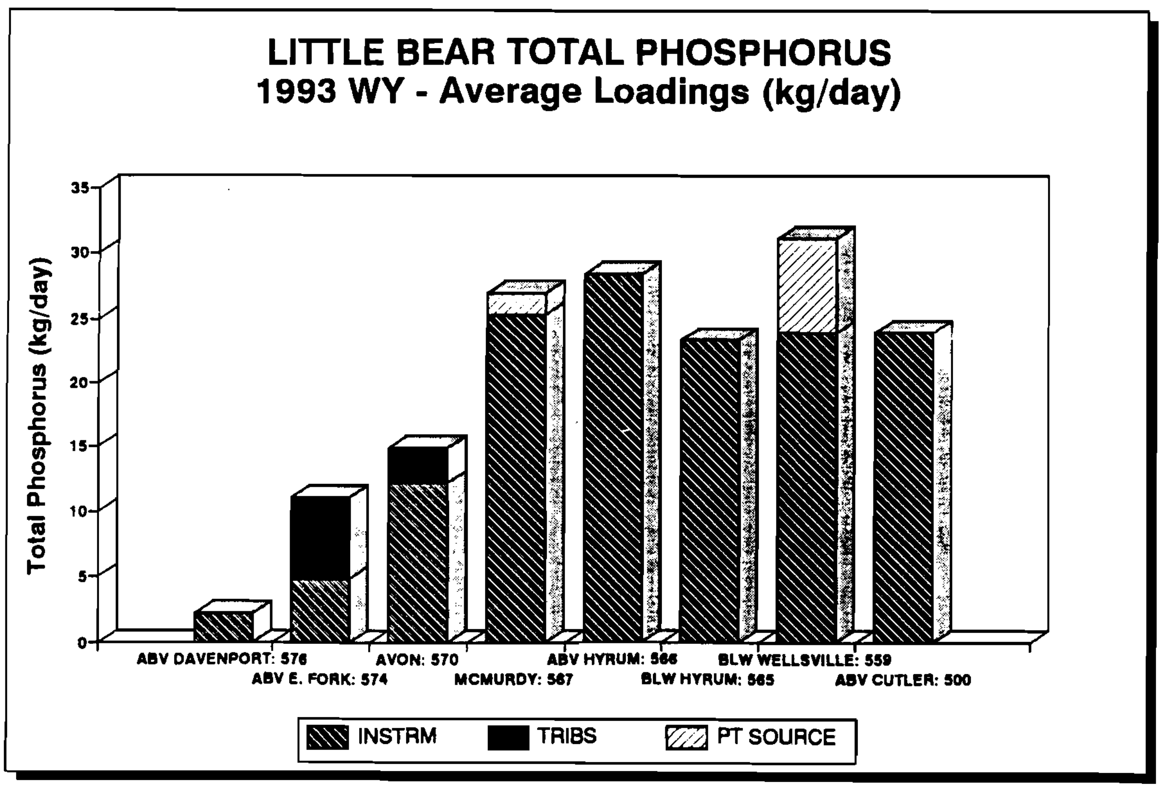

FIGURE I-26. Total phosphorus loads from October 1992 through September 1993 for the Little Bear River.

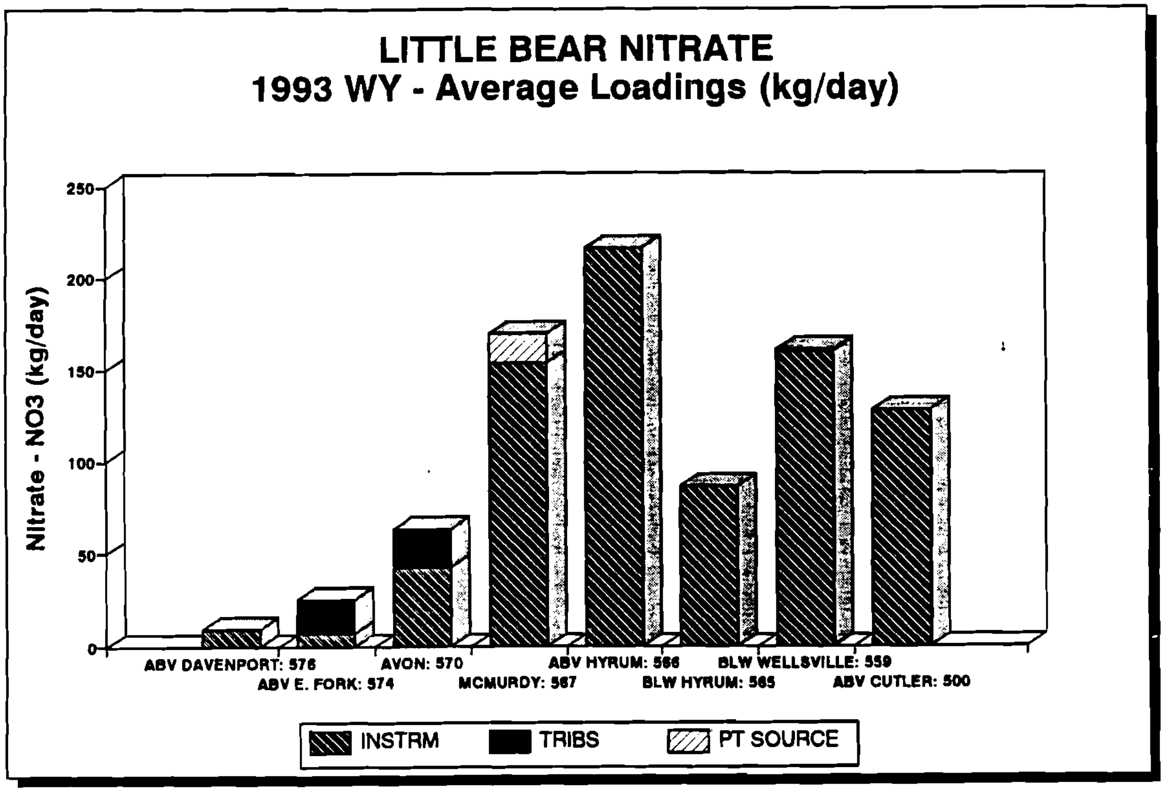

FIGURE I-27. Nitrate loads from October 1992 through September 1993 for the Little Bear River.

Spring Creek

Spring Creek joins the Little Bear River just before it enters Cutler Reservoir. Spring Creek contributed an average of six percent of the flow which entered the Bear River from Benson to below Cutler. Its nutrient inputs, however, were disproportionately high relative to flow. Spring Creek contributed over 25 percent of the TP and DTP and almost 50 percent of the NO_3 and NH_3 which entered the Bear River within this reach (Figures I-11, I-15, I-19 and I-23).

The Spring Creek drainage is composed of several subdrainages. The main fork drains the northern portion of the basin. The South Fork drains the area north of the town of Hyrum. Water quality was the best at the most upstream site in the main fork. Total phosphorus averaged over 0.050 mg/liter, and DTP averaged 0.032 mg/liter. Nitrates were relatively constant throughout the year, averaging 1.33 mg/liter. Total phosphorus had increased to an average of over 1.0 mg/liter and DTP averaged 0.87 mg/liter by the time the stream reached the confluence with the Little Bear.

Inputs from the South Fork of Spring Creek and Hyrum Slough entering from the south were responsible for most of the degradation of Spring Creek. Hyrum Slough had poor water quality, with average TP and DTP of 2.39 mg/liter and 0.715 mg/liter, respectively. Nitrate concentrations averaged 1.078 mg/liter, with three of the 14 samples exceeding the 4 mg/liter pollution indicator concentrations. The most upstream site on the South Fork (490494) had severely degraded water quality. This is a channelized portion of stream which receives effluent from the Hyrum WWTP, EA Miller WWTP and runoff from several large feedlots in addition to other nonpoint inputs. Total phosphorus concentrations at this point averaged 12 mg/liter, and DTP concentrations averaged 7.9 mg/liter. Nitrates averaged 32 mg/liter, exceeding the 4 mg/liter pollution indicator concentration on eleven of 14 dates. The concentration exceeded 30 mg/liter on seven dates. Coliforms averaged 77,000/100 ml, with fecal coliform geometric means of over 4,000/100 ml. A second site on this southern fork was sampled (490492). Water quality was improved at this site relative to the upstream site but still was significantly degraded. Total phosphorus and DTP concentrations averaged 2.0 and 1.9 mg/liter respectively, and nitrate concentrations averaged 6.7 mg/liter. Nitrates violated the state indicator concentration on only one date at this site.

Cub River

The Cub River accounted for over 50 percent of the TSS, TP, DTP and NH_3 gains, 100 percent of the nitrate gain and about 70 percent of the flow gain in the Bear River from Richmond to Amalga. The Cub River was sampled at the Utah-Idaho stateline and again above the confluence with the Bear River. Within this reach, four tributaries and one point source were also sampled.

Figure I-28 identifies the relative contribution of different sources to the average annual flow in the Cub River above the Bear River. All sources were measured except the Utah portion of the Cub, which was calculated by difference. About 40 percent of the flow the Cub delivered to the Bear River originated in Idaho (Figure I-28). Tributaries contributed about 30 percent of the total flow, and local accrual along the corridor of the Cub in Utah accounted for the other 30 percent. The relative contribution of sediments from these sources showed a similar pattern, with slightly lower inputs from the tributaries (Figure I-29). About 45 percent of the sediment loading came from Idaho, and about 40 percent entered from the river corridor in Utah. Tributaries accounted for only about 15 percent of the total sediment load.

Nutrient inputs showed a very different pattern (Figures I-30 through I-33). The corridor of the

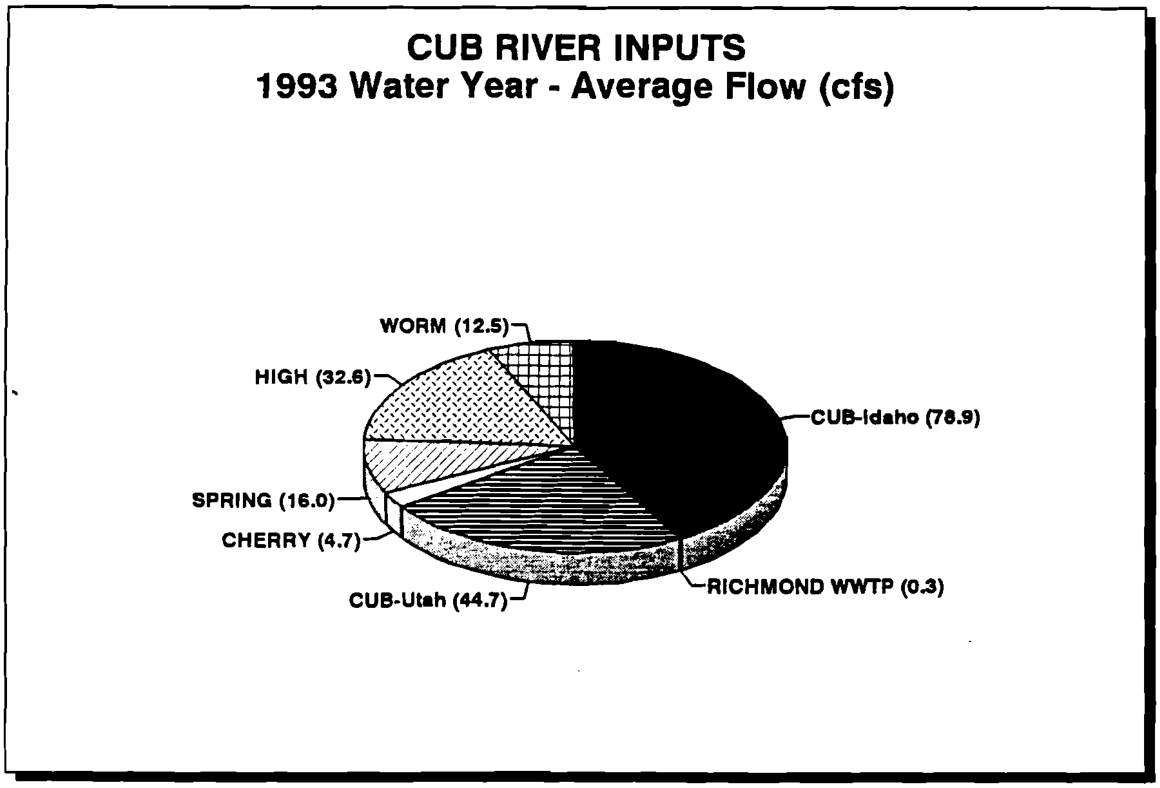

FIGURE I-28. Relative contribution of different sources to the total Cub River flow at site 490425 (above the Bear River confluence).

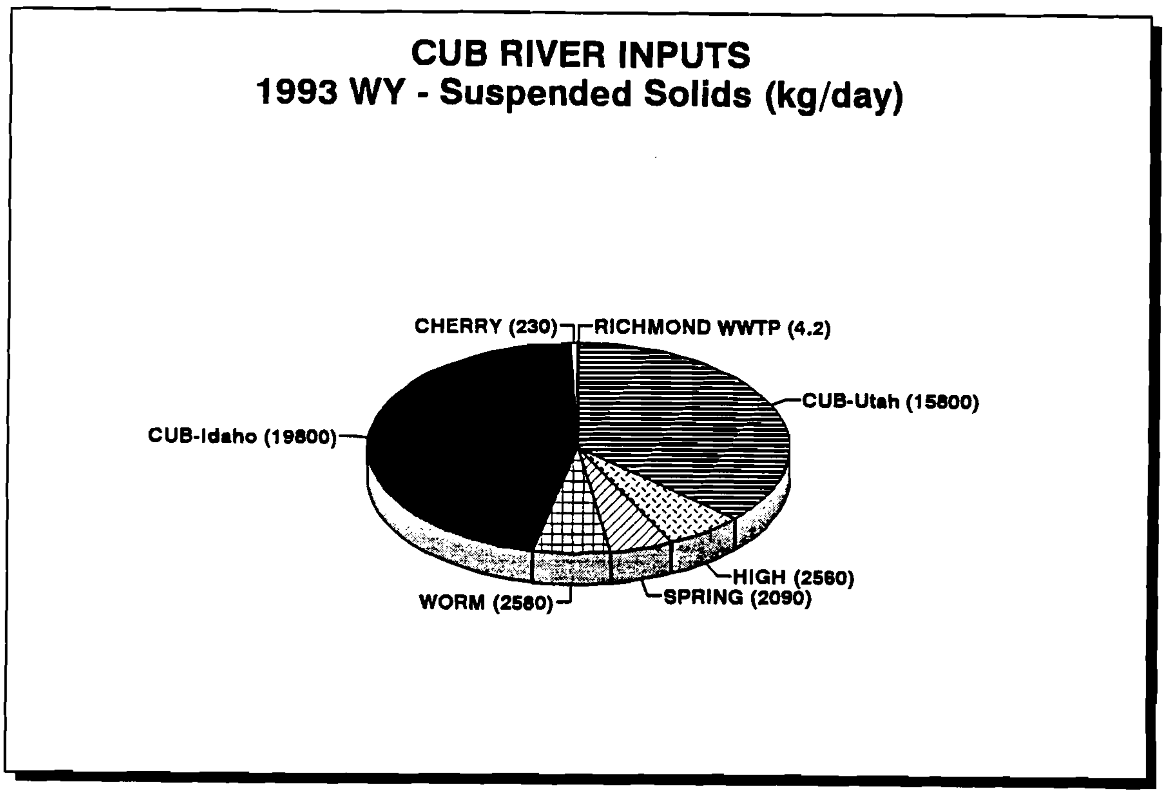

FIGURE I-29. Relative contribution of different sources of total suspended solids to the Cub River at site 490425 (above the Bear River confluence).

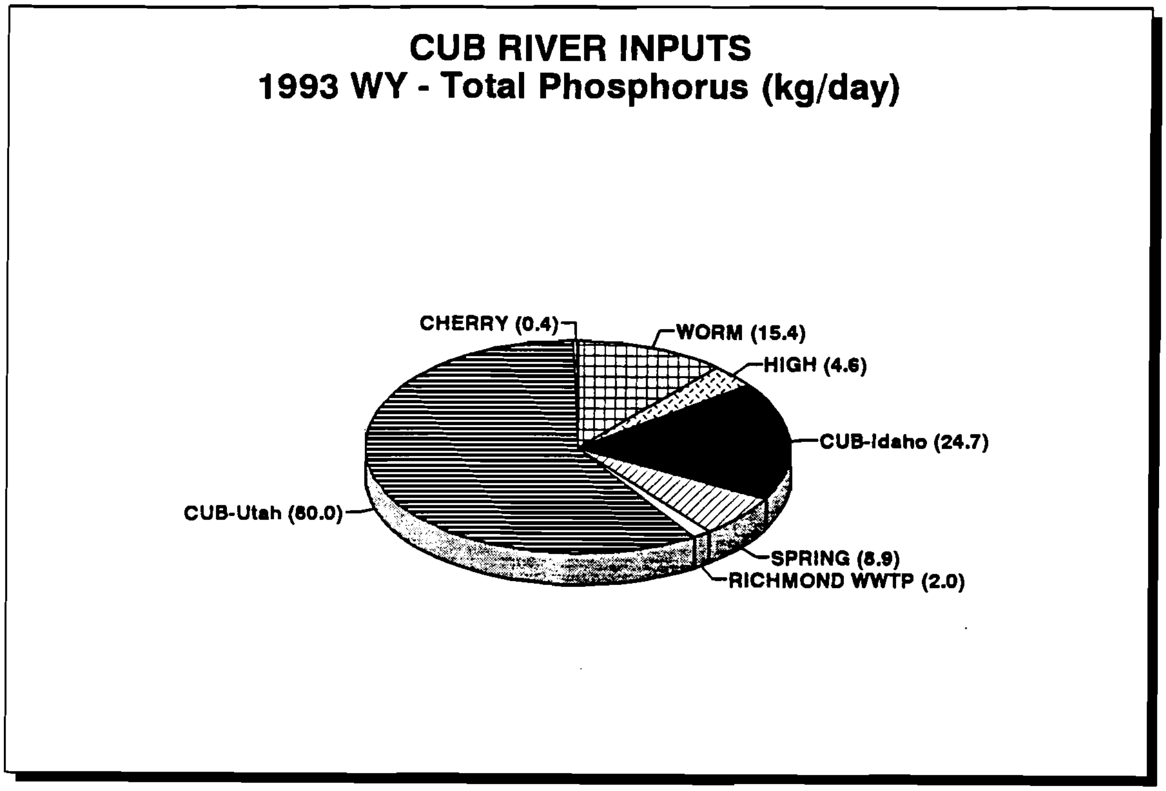

FIGURE I-30. Relative contribution of different sources of total phosphorus to the Cub River at site 490425 (above the Bear River confluence).

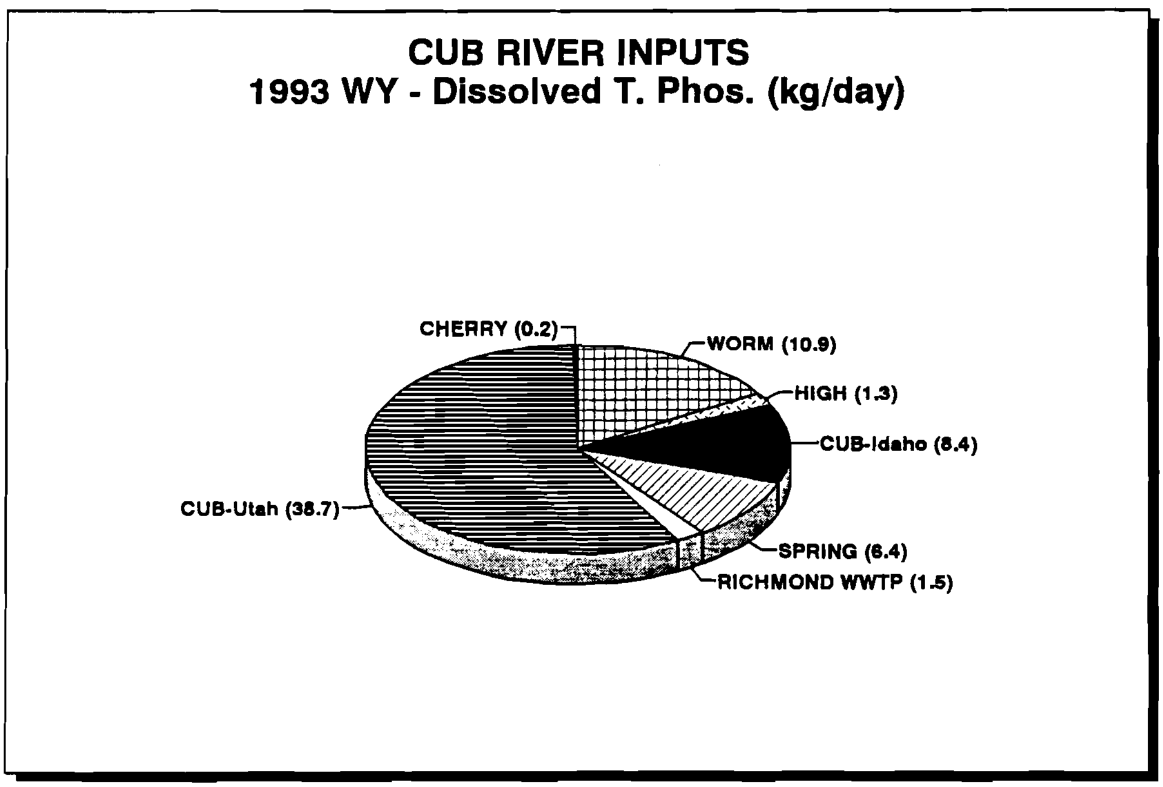

FIGURE I-31. Relative contribution of different sources of dissolved total phosphorus to the Cub River at site 490425 (above the Bear River confluence).

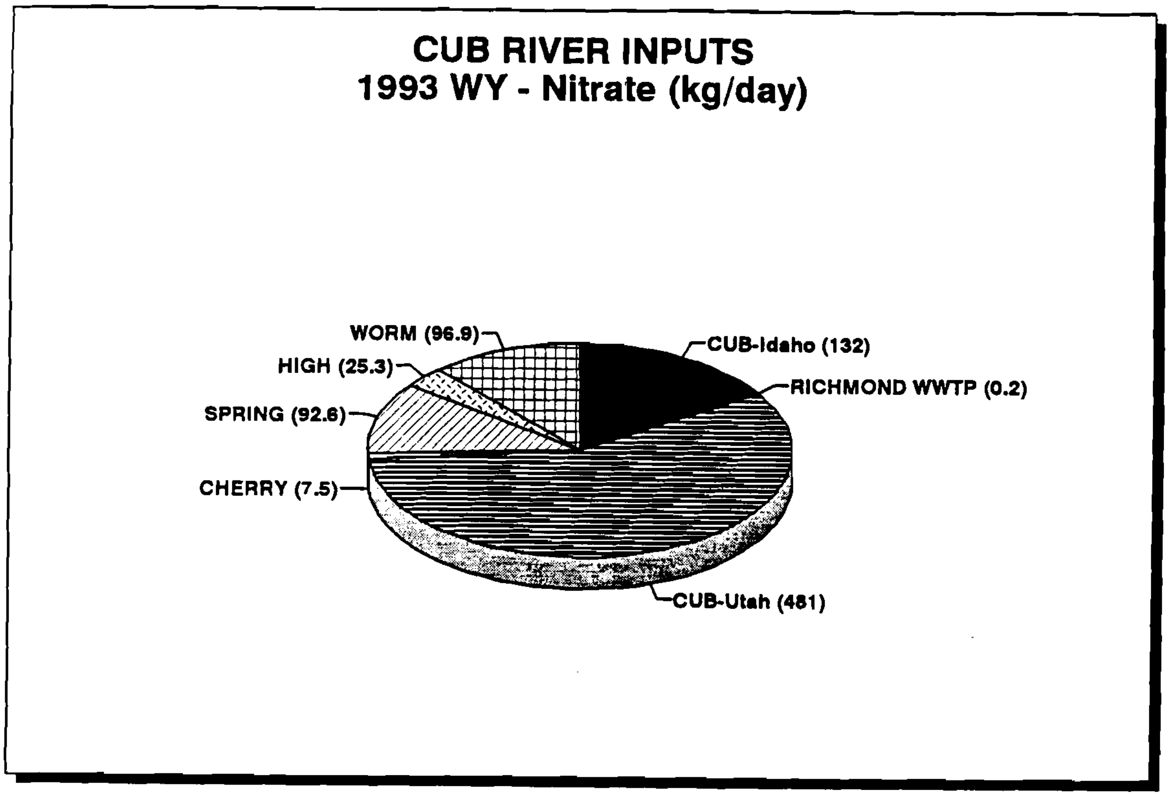

FIGURE I-32. Relative contribution of different sources of nitrate to the Cub River at site 490425 (above the Bear River confluence).

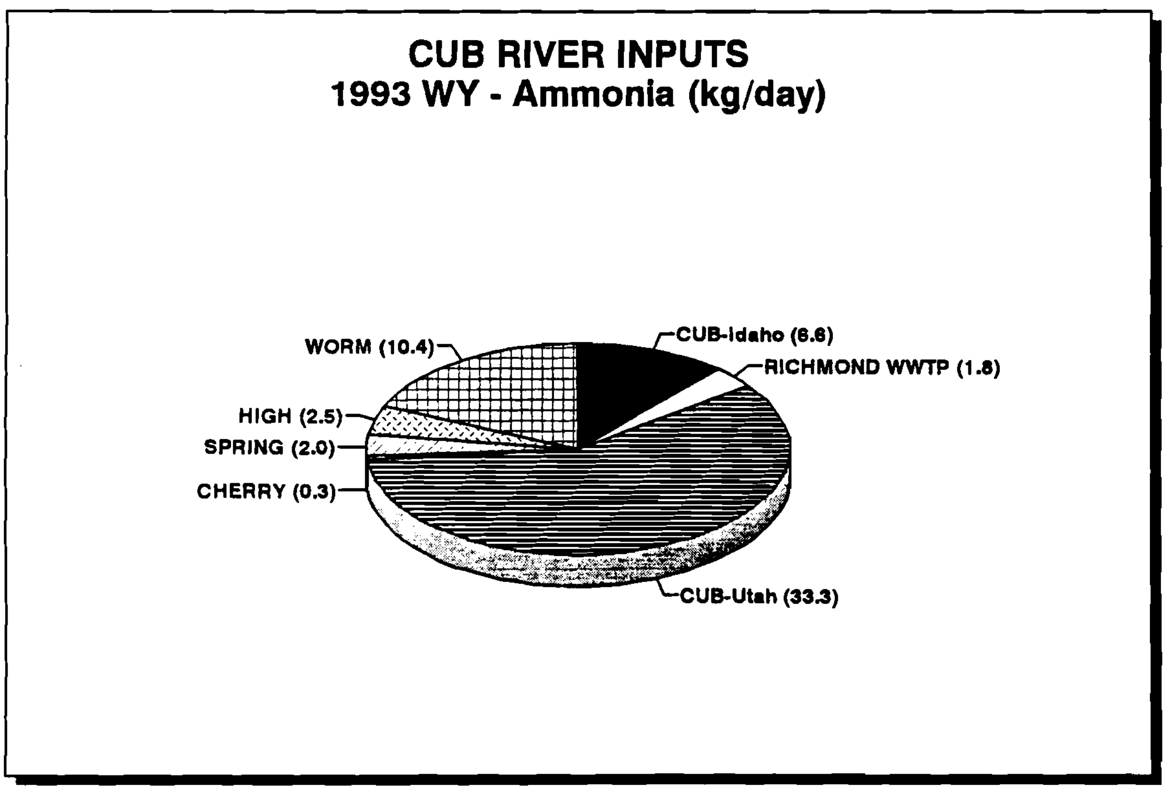

FIGURE I-33. Relative contribution of different sources of ammonia to the Cub River at site 490425 (above the Bear River confluence).

river within Utah contributed almost 60 percent of the average annual TP, DTP, NO_3, and NH_3 load which reached the Bear River. In contrast, the Idaho portion of the river contributed between 12 and 18 percent of the nutrient loads. Worm Creek also contributed nutrients disproportionately to its flow. While contributing only 7 percent of the total flow in the Cub, Worm Creek accounted for 17 percent of the DTP and 18 percent of the NH_3 in the river.

Minor Tributaries

Summit Creek drains from the east into Cache Valley in the town of Smithfield and enters the Bear River upstream of Cutler Reservoir. The average annual flow above the Bear River was 20 cfs which represented just nine percent of the increase in flow in the Bear River from Amalga to Benson, and only two percent of the total flow in the river. Summit Creek was only sampled from April through June, during which there was no evidence of impaired water quality. Average TP was 0.030 mg/liter, with the high of 0.071 mg/liter being the only sample that exceeded the state's pollution indicator level. Total suspended solids averaged 34 mg/liter, with a high of 135 mg/liter. At other sites in the drainage, the highest concentrations of phosphorus and suspended solids were observed during early runoff in March, while the highest concentrations of coliforms were recorded in late summer and fall. The actual inputs from Summit Creek may, therefore, be underestimated.

Hopkins Slough enters the Bear River downstream of the confluence with Summit Creek. This stream had a low average flow (4 cfs) and consequently resulted in small mass inputs into the Bear River itself. Water quality in this stream was extremely impaired, however. All samples had total phosphorus concentrations greater than 0.050 mg/liter, with an annual average of 0.209 mg/liter. Dissolved total phosphorus averaged 0.089 mg/liter, and nitrate concentrations were as high as 17 mg/liter, with an annual average exceeding the state pollution indicator concentration of 4 mg/liter. Five of 15 samples contained total coliforms concentrations greater than 5000/100 ml, and 13 of the 14 fecal coliform samples exceeded 200/100 ml.

Clay Slough enters the Bear River from the north of Cutler Reservoir, draining an area of high salinity wetlands known as "the barrens". Conductivity concentrations were an order of magnitude higher than observed anywhere else in the lower drainage, with an average of over 3,000 μmhos/centimeter.

Phosphorus concentrations were also extremely high at this site. Total phosphorus ranged from 0.343 to 2.05 mg/liter, with an average of 0.972 mg/liter. Dissolved total phosphorus averaged 0.504 mg/liter. Although Clay Slough represented only 1.3 percent of the total flow entering the Bear River in this reach, it contributed five percent of the total and dissolved phosphorus, and over nine percent of the nitrate load.

I.2.2 Metals

Dissolved metals were analyzed quarterly at each of the sampling sites in the Lower Bear River basin. All metals results are listed with the raw data in Appendix II. Dissolved iron was low throughout the basin, averaging between 25 and 100 μg/liter. Hazardous metals concentrations were low at all sites. Arsenic, cadmium, copper, chromium, lead, mercury, selenium, silver and zinc were all near or at the detection limit at all times. Copper had a detection limit of 20 to 30 μg/liter, which is greater than the 4-day average criteria for aquatic wildlife in waters with a hardness of less than 300 mg/liter. Therefore, although copper may have exceeded criteria, the analytical methods could not detect it. Of those metals whose detection limits were less than the state criteria, no violations were seen.

I.2.3 Microbiology

Patterns in bacteria abundance were somewhat sporadic, and did not vary systematically with time or flow at any of the sites. Total coliform concentrations fell below the state criteria of 5000/100 ml at most sites throughout the study (Figure I-34). No violations were seen at any sites on the mainstem Bear River, the Logan River or the Blacksmith Fork. Hopkins Slough above the Bear River (490451) had an annual geometric mean of over 3000/100 ml, but only one violation. Worm Creek also had elevated coliform concentrations, and violated the state criteria on five dates. In the Little Bear River drainage, the highest concentrations were seen at a site below a fish hatchery (490567) and below the Wellsville sewage lagoons (490559). In contrast to other areas in the basin, the Spring Creek subdrainage had extremely high coliform concentrations at four of the five sites. At site 490494, every sample exceeded the criteria, and the geometric mean was over 77,000/100 ml.

Fecal coliform concentrations exceeded the state criteria of 200/100 ml more frequently than did total coliforms, although again seasonal patterns were not apparent (Figure I-35). Sporadic violations

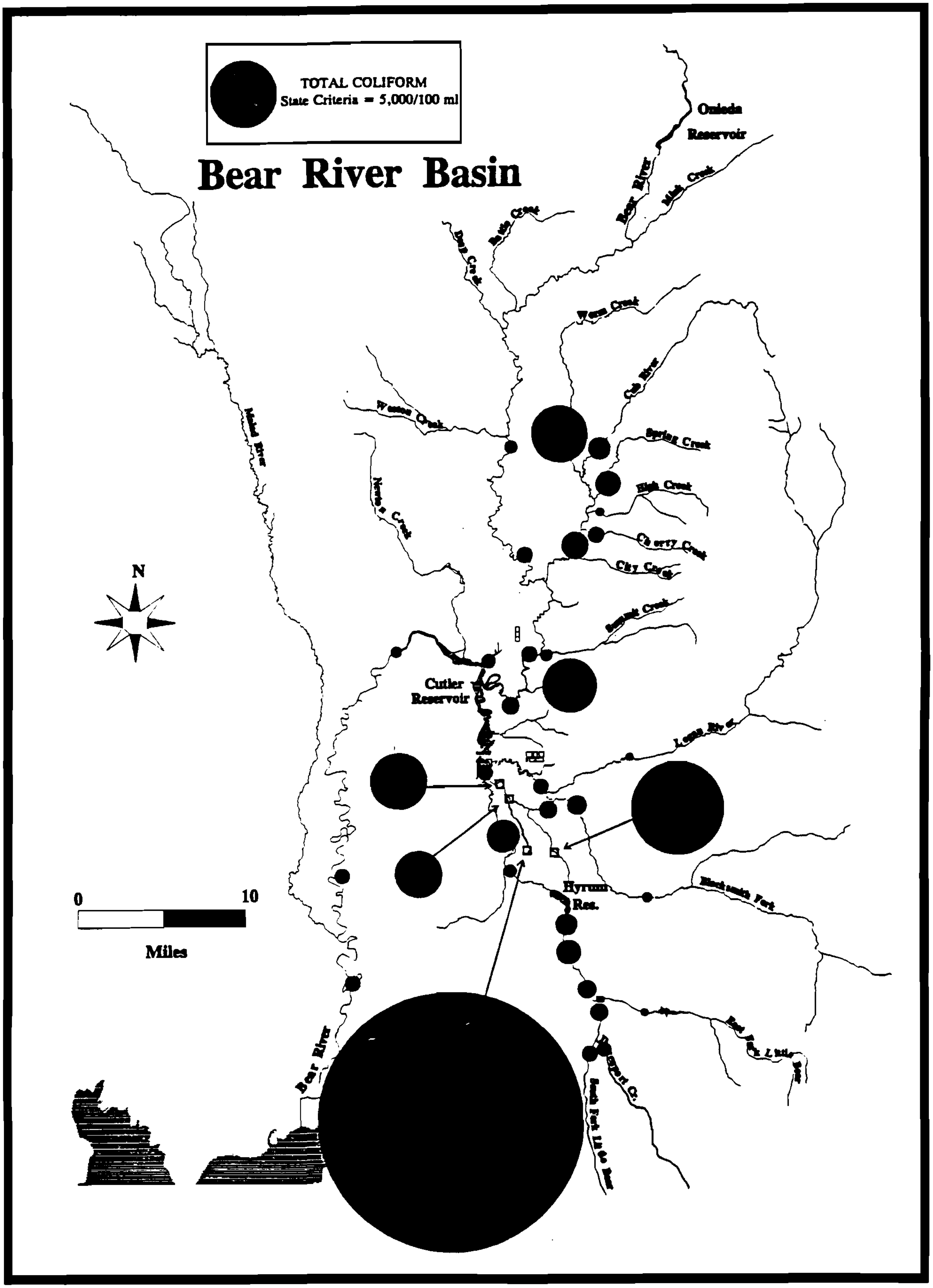

FIGURE I-34. Total coliform concentrations from October 1992 through September 1993 at each sample location. The area of the circle is proportional to the geometric mean concentration.

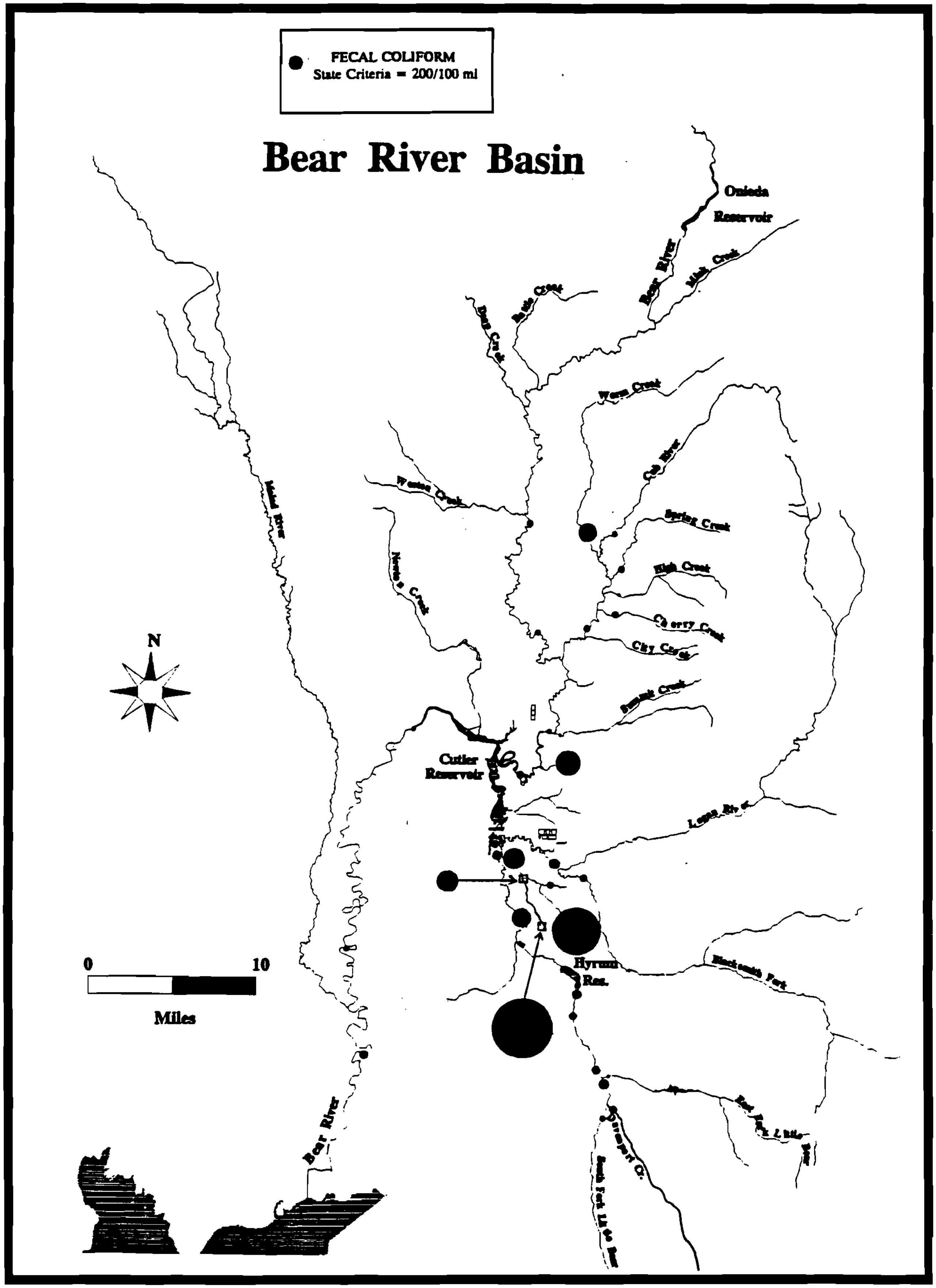

FIGURE I-35. Fecal coliform concentrations from October 1992 through September 1993 at each sample location. The area of the circle is proportional to the geometric mean concentration.

occurred along the mainstem Bear River and within each of the subdrainages, except the Blacksmith Fork which had no violations. As with total coliforms, higher concentrations and more frequent violations were recorded at Worm Creek and Hopkins Slough. The Little Bear had occasional violations throughout the subdrainage, with the most frequent at the site below the Wellsville sewage lagoons and directly above Hyrum Reservoir (490566). Spring Creek again had much higher concentrations than were observed at any other sites. All samples exceeded the state criteria at two sites and more than half the samples violated the criteria at two other sites. The annual geometric mean at site 490494 was greater than 4,000/100 ml.

The ratio of fecal coliforms to fecal streptococcus has been used to identify the source of fecal contamination (APHA 1980). In general, ratios greater than one may indicate a human source, while ratios less than one indicate nonhuman sources. This approach can be used as a general indicator but may be unreliable because of the relatively short survival of fecal streptococci in the environment. To evaluate the data from this study, no fecal streptococcus samples below 100/100 ml were used (APHA 1980). Ratios were low throughout the study area. The average ratios at each site ranged between 0.1 and 4.2, while the average of all sites combined was 1.0. Only a small number of ratios could be calculated at each site because fecal streptococcus numbers were often less than 100/100 ml. This makes comparisons between sites difficult. The site at Worm Creek above the Cub River had the highest ratios, as well as the most dates for which ratios could be calculated. Seven of the 12 ratios were greater than 1.0, suggesting a possible human source of fecal contamination at this site. Worm Creek receives the effluent from the Preston wastewater treatment plant, which may be a source. The creek is slow moving at this sample site, however, and the higher values may simply be an artifact of a long travel time from the source to the sample site.

I.2.4 Macroinvertebrates

Macroinvertebrates were collected at 13 sites in the lower Bear River drainage in August, 1993. In addition, UDWQ collected samples in the Little Bear River drainage in October and March and on the mainstem Bear River in December and May (UDWQ 1994a, 1994b). Triplicate samples were collected at each site. These samples were preserved, sorted and identified to genus or species when the distinction was important.

Four sites were sampled in the mainstem Bear River: at the stateline (490610), near Richmond, Utah (490372), below Cutler dam (490198) and near Corinne (490110). The Cub River was sampled at the Utah-Idaho stateline (490379) and above the confluence with the Bear River (490425). Blacksmith Fork was sampled near the U.S. Forest Service boundary (490544) and above the confluence with the Logan River (490540). The Logan River was sampled at the mouth of Logan canyon (490520), Spring Creek was sampled near its headwaters (490499), Worm Creek was sampled above its confluence with the Cub River (490437) and Hopkins Slough was sampled above Cutler Reservoir (490451). The Little Bear was sampled above Hyrum Reservoir near Avon (490570), below a trout farm above Hyrum Reservoir (490567), and below Hyrum Reservoir (490563).

Summary statistics are listed in Table I-5, and the full dataset is presented in Appendix III. Abundance in Table I-5 represents the average number of individuals/m^2 identified at a site. Richness indicates the number of taxa found at a site. The Shannon-Weiner diversity index provides an indication of the numeric evenness of the different taxa found at the site (Platts et al. 1983). The higher the number, the more evenly distributed the individuals in the sample are between the different taxa.

The Bear River at the stateline had relatively high macroinvertebrate abundance but poor biodiversity. Just seven taxa were recorded in September, and the samples were dominated by organic and sediment tolerant species. Very few cleanwater species were present, and the site showed signs of stress conditions. Lack of spawning substrate gave the site only fair fishery potential. The Bear River near Richmond has a sandy, unconsolidated substrate. This area had very few insects (low abundance) and only eight taxa identified in the samples. Most of the taxa present were pollution-tolerant, such as Chironomids and leeches. Just below Cutler dam, the substrate in the Bear River is more cobbled. Twenty-one taxa were found, but average diversity for this location was low (1.18) because the samples were dominated by two caddisflies, *Hydropsyche* sp. and *Cheumatopsyche* sp., and one mayfly, *Baetis* sp. These genera are more pollution-tolerant than other caddis and mayflies. The presence of species like the algae-scraper *Petrophil* sp., a Lepidoptera and riffle beetles (*Elmidae*) indicates rocky, periphyton-rich substrates were available. These results indicate the increased richness is due to improved substrate below Cutler dam, but in both sites pollution-tolerant species dominate. Samples from the Bear River near Corinne had sediment and organic tolerant species, fair biodiversity and poor fishery potential, due to a

TABLE I-5. Abundance, richness and diversity of macroinvertebrates in Bear River basin. All samples were collected in August 1993 except stations 490610 and 490110, which were collected in September and May of 1993.

SAMPLE SITE #	SITE DESCRIPTION	SAMPLER	AVERAGE ABUNDANCE (#/m²) Mean	AVERAGE ABUNDANCE (#/m²) STD	TOTAL RICHNESS	AVERAGE DIVERSITY Mean	AVERAGE DIVERSITY STD
MAINSTEM BEAR RIVER							
490110	Bear River at Corrinne at U83 xing	UDWQ	3,888		21	1.981	
490198	Bear River below Cutler dam	ERI	7,130	735	21	1.18	0.06
490382	Bear River near Richmond	ERI	127	7.79	8	1.24	0.22
490610	Bear River west of Fairview, ID	UDWQ	852,509		7	0.456	
TRIBUTARIES							
Little Bear River							
490563	Below Hyrum Reservoir	UDWQ	13,724		25	1.763	
490567	Little Bear below Trout of Paradise fish hatchery	UDWQ	24,531		36	2.190	
490570	Little Bear west of Avon	UDWQ	37,717		25	1.443	
Cub River							
490437	Worm Creek above Cub River	ERI	1,210	30.7	17	1.05	0.32
490379	Cub River at Utah-Idaho stateline	ERI	9,360	289	27	0.78	0.31
490425	Cub River above Bear river confluence	ERI	774	27.3	20	1.64	0.33

TABLE I-5 (continued). Abundance, richness and diversity of macroinvertebrates in Bear River basin. All samples were collected in August 1993 except stations 490610 and 490110, which were collected in September and May of 1993.

SAMPLE SITE #	SITE DESCRIPTION	SAMPLER	AVERAGE ABUNDANCE (#/m^2) Mean	AVERAGE ABUNDANCE (#/m^2) STD	TOTAL RICHNESS	AVERAGE DIVERSITY Mean	AVERAGE DIVERSITY STD
Blacksmith Fork							
490544	Blacksmith Fork at Forest Service boundary	ERI	3,300	362	28	1.49	0.10
490540	Blacksmith Fork above confluence with Logan River	ERI	399	6.18	18	1.97	0.29
Others							
490451	Hopkins Slough above Bear River	ERI	98	9.88	7	1.06	0.37
490520	Logan River above First dam	ERI	2,220	80.9	37	1.78	0.42
490499	Spring Creek near headwaters	ERI	1,030	60.2	8	0.62	0.02

Average Abundance = individuals/m^2.
Total Richness = number of taxa present in the three samples combined.
Average Diversity = number of taxa relative to the number of individuals in a sample.
STD = standard deviation

lack of biomass and limited substrate.

The Cub River at the Utah-Idaho stateline has a cobble substrate mixed with fine sediment. This site was dominated by one taxa, Simulidae, or blackflies. Simulids filter the water column for food. The large numbers found at this site indicate an abundance of both dissolved and suspended organic matter in the water column. The two other most dominant taxa, *Cheumatopsyche* sp. and *Hydropsyche* sp., caddisflies, are also both filter feeders. Because blackflies attach to rocky substrate and live in swift currents, the presence of Simulidae indicates the Cub River is not too embedded at this site. The presence of several algae-scraping taxa (e.g. Rhrithrogena) also indicates sediment-free rocks are available.

Despite the poor water quality noted in Section I.2.1.2, the Cub River above the confluence with the Bear River had surprisingly high diversity (1.64) and richness indices (20 taxa). At the sample location, the hard clay substrate was pock-marked and broken up by hundreds of hoof prints. These holes may have acted like rocks, creating low velocity areas where organic matter could collect and insects would be protected from the current. No rocks or soft, depositional sediments were in evidence where samples were collected.

Near the stateline, Worm Creek is slow moving and relatively deep, with soft, fine sediments. This site had low diversity and was dominated by two groups: Simulidae and Chironomidae. As with the Cub River, the Simulidae indicate high dissolved organic load, as well as patches of rocky substrate. Chironomids are very tolerant of a wide variety of water quality conditions. High numbers of Chironomids combined with low diversity suggest a system too polluted for other more specialized insects. Corixids (*Sigara* sp.) were also present in Worm Creek. These insects are found in stagnant areas and are extremely tolerant of polluted water and warm temperatures.

Hopkins Slough samples had a very low abundance of macroinvertebrates. The species composition varied from the extremely pollution-tolerant Chironomidae to a riffle beetle, *Duberaphia* sp., which is less pollution-tolerant, but feeds on fine organic matter. An amphipod, *Hyallella azteca*, was also present at this site.

Spring Creek was sampled at a point high in the drainage. These samples were dominated by amphipods, mostly *Hyallella azteca*, probably from a small impoundment upstream of this site. Other than

Hyallella, very few macroinvertebrates were found. The Little Bear River sites showed fair to good diversity with a fair fishery potential due to limited substrate. The number of taxa ranged from 25 to 36 and abundance ranged from 37,000/m^2 at the most upstream site to 13,724/m^2 near Wellsville. Organic and sediment tolerant taxa were evident at all three sites. Simuliids at two sites above Hyrum Reservoir indicate a watershed with high loading of organic nutrients, possibly associated with overgrazing. Few cleanwater species were seen at site 490567 and no cleanwater species were found at the site near Wellsville.

The Blacksmith Fork River near the Forest Service boundary contains cobble and small boulders and is fast moving. This site had an average abundance of over 3,300 individuals/m^2, with 28 taxa identified. Diversity was low because 75 percent of the samples were dominated by two taxa, *Baetis*, a mayfly, and the blackflies (Simulidae). The Blacksmith Fork above the confluence with the Logan River has a gravel and small cobble substrate. At this site fewer individuals were found compared to the upstream site (average abundance of 400 individuals/m^2), but the diversity index of 1.97 was the highest of all the locations sampled. The presence of stoneflies, mayflies, riffle beetles, Dipternas and caddisflies indicates a wide variety of available habitat in both sites.

The Logan River also had good abundance, the highest number of taxa (37), and a high diversity index (1.78). As with the upper Blacksmith Fork site, the substrate is characterized by large cobble and small boulders and taxa indicative of very good water quality.

Diversity indices were in the same range in 1974 (UWRL 1974a) as in the present study, with the highest diversity richness and abundance in the Logan River (Blacksmith Fork was not sampled), the upper Little Bear River, and the Bear River below Cutler Reservoir. A similar trend of increased filter feeders at downstream sites was seen in both studies. The species present in 1974 were very similar to those found in 1993. One exception was *Chematopsyche*, an extremely pollution-tolerant caddis which was not present in the 1974 study but was quite abundant at several sites in 1993.

I.2.5 Basin Wide Water Quality Patterns

Utilizing the mainstem and tributary data for average daily mass loadings, a comprehensive picture can be obtained for the water quality conditions within the Bear River watershed relative to the

TMDL process. Figures I-36 through I-38 present annual average daily loadings of total suspended solids, total phosphorus and dissolved total phosphorus throughout the lower Bear River drainage. The width of the line in these figures is proportional to the loading. Point source inputs are shown, as are reach gains and losses. Reach gains which are not attributable to point sources are assumed to be nonpoint in origin.

The general patterns are different for particulate and dissolved pollutants. The Bear River entered the state with an annual average TSS load almost half the size of the load at Cutler (Figure I-36). Large gains were recorded along all but one of the Bear River reaches. Tributaries and point sources were, by comparison, relatively small contributors to the total TSS load.

In contrast to TSS, the DTP loads at the stateline were relatively small. Major inputs occurred from the Cub River, and again within Cutler Reservoir. The high relative inputs of Spring Creek and the point sources are apparent (Figure I-37).

Total phosphorus is a combination of dissolved and particulate phosphorus (Figure I-38). The loading patterns for total phosphorus reflect the combination of these two forms. The TP load crossing the stateline was about one-third of the TP load observed at Cutler. Point and tributary inputs were significant for TP as well.

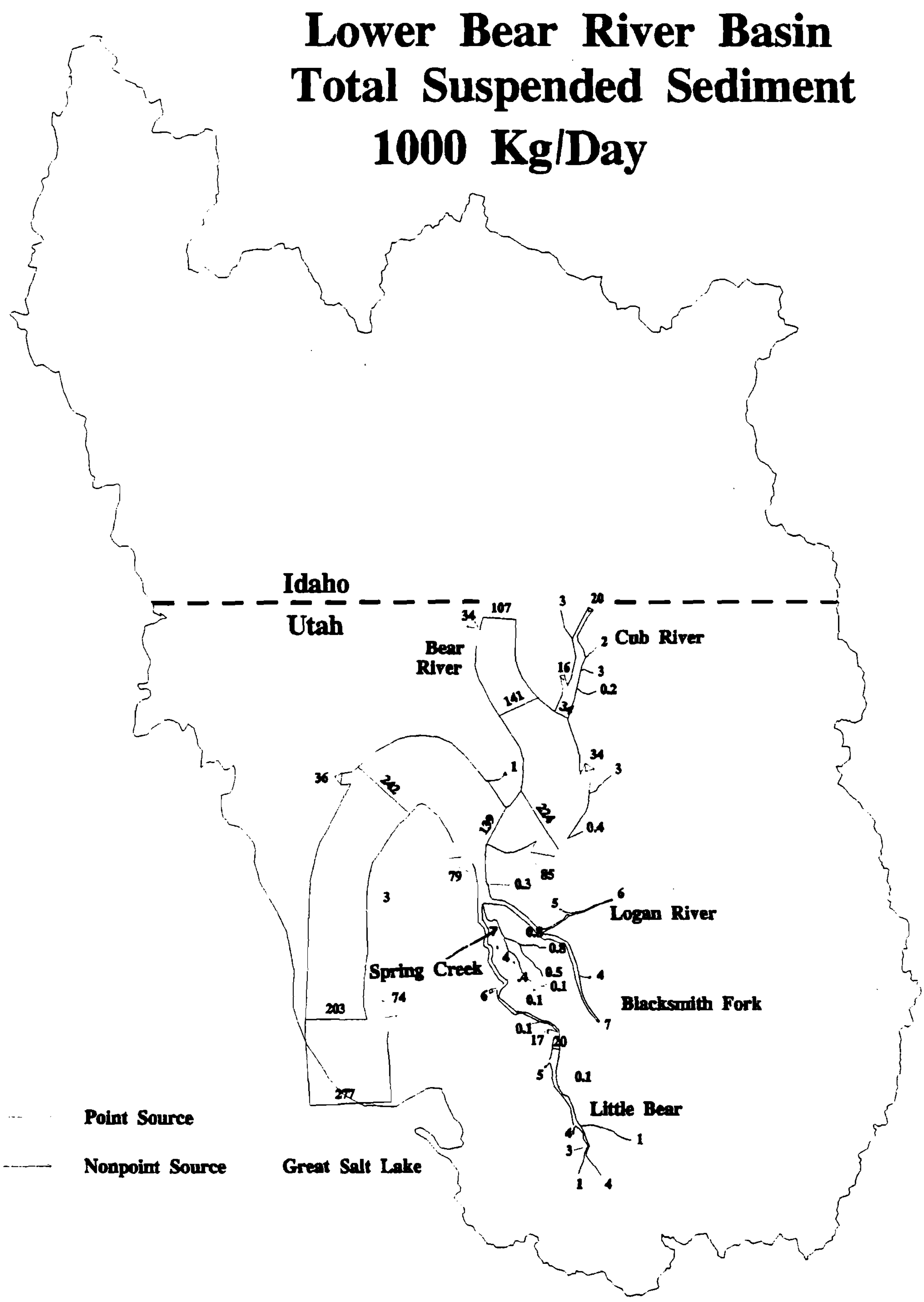

FIGURE I-36. Average daily loadings of total suspended solids in the lower Bear River basin.

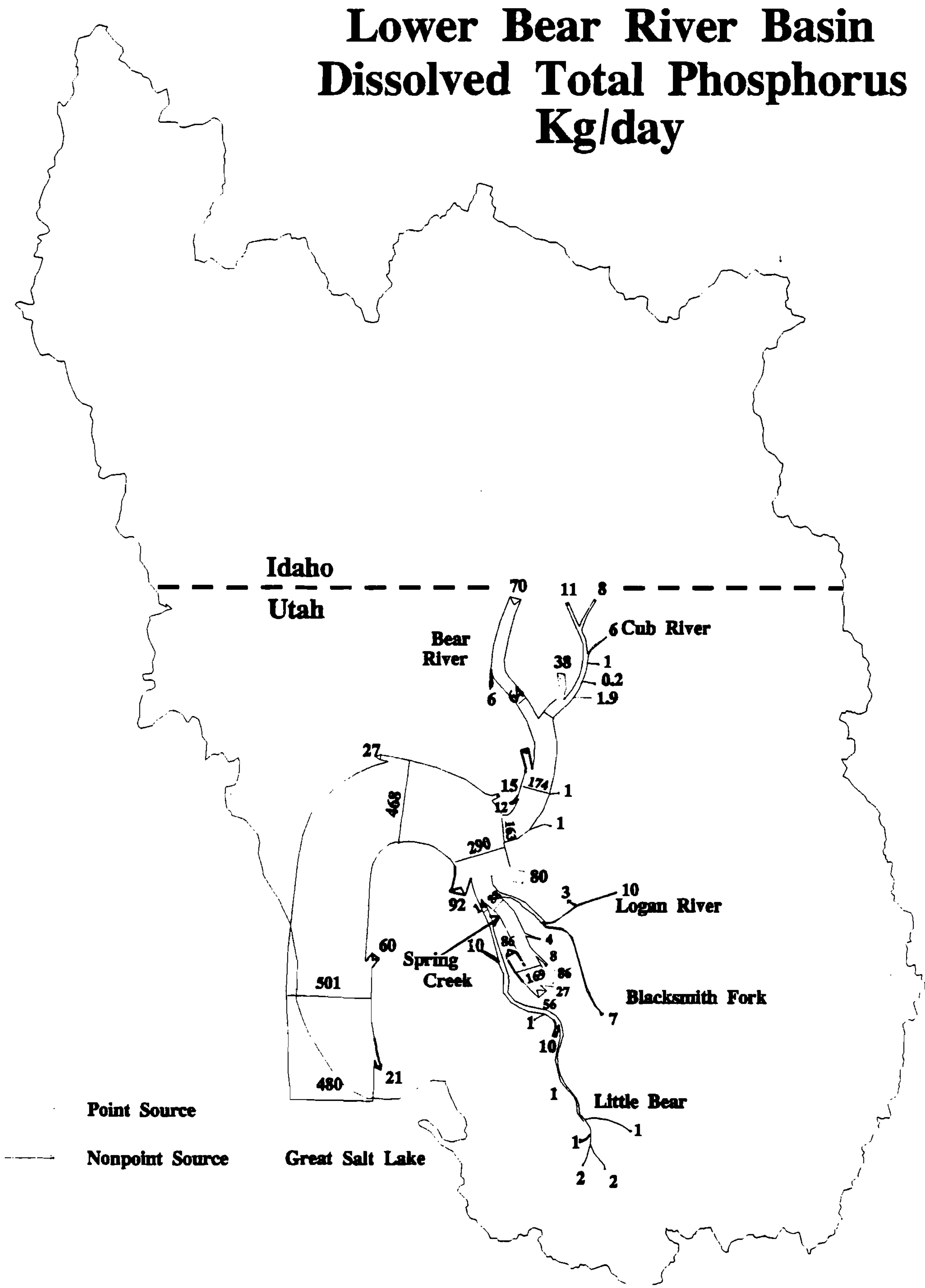

FIGURE I-37. Average daily loadings of dissolved total phosphorus in the lower Bear River basin.

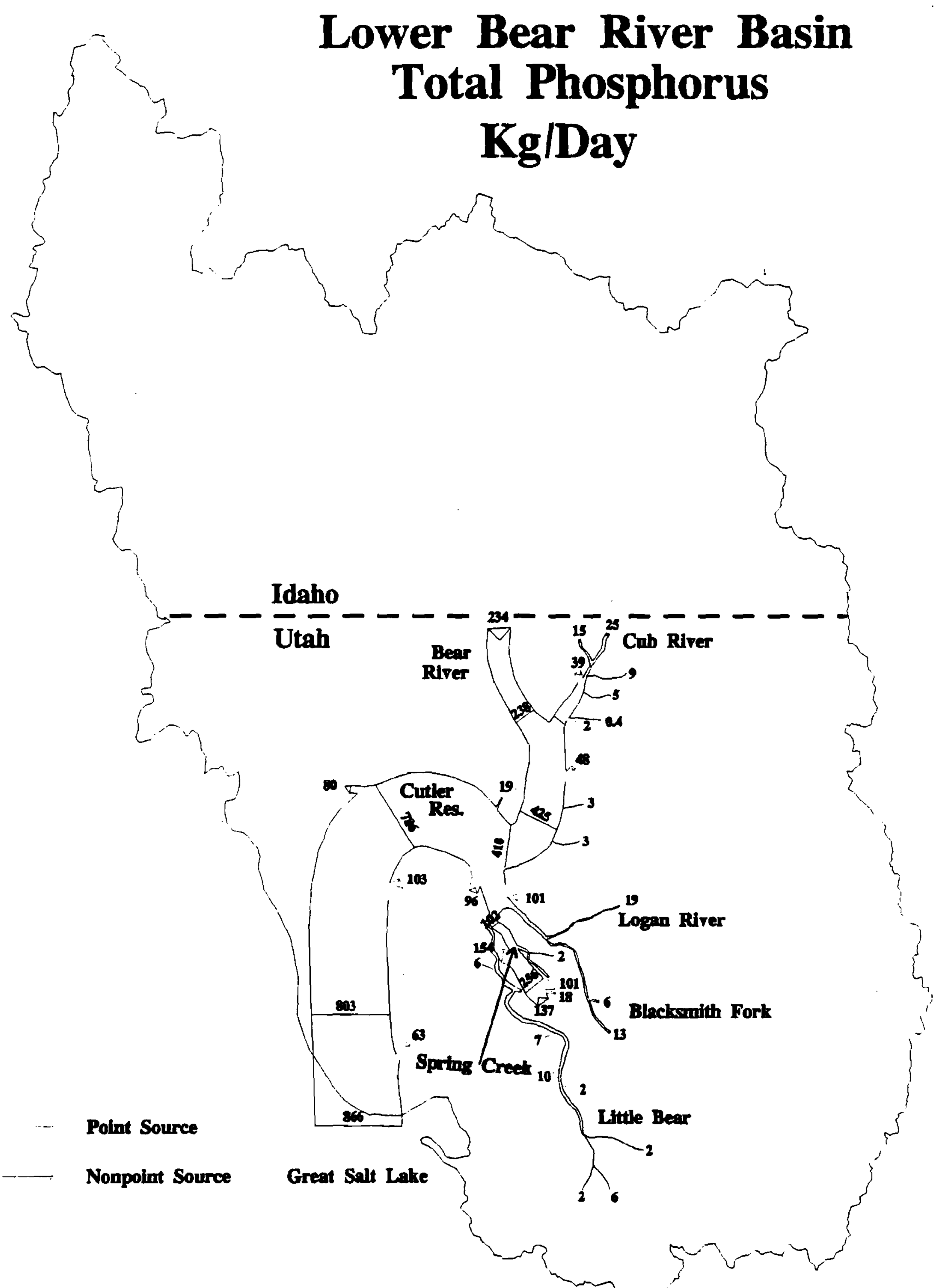

FIGURE I-38. Average daily loadings of total phosphorus in the lower Bear River basin.

APPENDIX II

Water Quality data

TABLE II-1. List of sample site numbers, locations and sampling agency.

SITE NUMBER	DESCRIPTION	SAMPLER
Bear River Drainage		
490110	Bear River at Corinne at U83 xing	UDWQ
490119	Box Elder Creek above Brigham City WWTP	UDWQ
490165	Hyrum Reservoir outlet	ERI
490170	Bear River below Honeyville on I-15	UDWQ
490198	Bear River below Cutler at UPL bridge	UDWQ
490310	Newton Creek at U142 xing in Newton	ERI
490326	Bear River above Cutler at Benson bridge	UDWQ
490350	Summit Creek above Bear River bridge	ERI
490356	Bear River at Amalga	ERI
490379	Cub River at Utah-Idaho stateline	ERI
490382	Bear River at Richmond	ERI
490425	Cub River above Bear River	ERI
490430	High Creek above Cub River	ERI
490431	Spring Creek above Cub River	ERI
490432	Cherry Creek above Cub River	ERI
490437	Worm Creek above Cub River	ERI
490451	Hopkins Slough above Bear River	ERI
490472	Clay Slough above Bear River	ERI
490487	Hyrum Slough at Nibley/College Ward	UDWQ
490490	Spring Creek at Mendon Road	UDWQ
490492	South Fork Spring Creek west of Pelican Pond	UDWQ
490494	South Fork Spring Creek at US89 Xing	UDWQ
490499	Spring Creek 1.3 miles north of College Ward	UDWQ
490500	Little Bear above Logan River	UDWQ
490504	Logan River above Little Bear River	UDWQ
490520	Logan River at mouth of canyon	UDWQ
490540	Blacksmith Fork above Logan River	ERI
490544	Blacksmith Fork at mouth of canyon	UDWQ
490559	Little Bear above Wellsville	UDWQ
490565	Little Bear one mile below Hyrum Reservoir	UDWQ

TABLE II-1 (continued). List of sample site numbers, locations and sampling agency.

SITE NUMBER	DESCRIPTION	SAMPLER
490566	Little Bear above Hyrum Reservoir	ERI
490567	Little Bear below Trout of Paradise fish hatchery	ERI
490570	Little Bear west of Avon	ERI
490574	South Fork Little Bear above East Fork	ERI
490575	East Fork Little Bear above South Fork	ERI
490576	South Fork Little Bear above Davenport Creek	ERI
490577	Davenport Creek above South Fork Little Bear	ERI
490578	East Fork Little Bear below Porcupine Reservoir	ERI
490585	Davenport Creek above Wellsville Creek	ERI
490587	Bear River near Trenton	ERI
490590	Little Bear at mouth of Hyrum Canyon	ERI
490610	Bear River west of Fairview, ID	UDWQ
Point Sources		
490372	Richmond Lagoons	UDWQ
490498	Whites College Ward fish hatchery	UDWQ
490507	Logan Lagoons	UDWQ
490552	Hyrum WWTP	UDWQ
490554	EA Miller effluent	UDWQ
490560	Wellsville Lagoon discharge	UDWQ
490562	Magic Valley effluent	UDWQ
490568	Trout of Paradise 001	UDWQ
490569	Little Bear in canal above Whites Trout Farm	UDWQ
490571	Trout of Paradise 002	UDWQ

TABLE II-2. List of abbreviations and notations in database.

Data from Utah Department of Environmental Quality

TEMP	temperature
°C	degrees celcius
DO	dissolved oxygen
umhos/cm	μmhos per centimeter
cfs	cubic feet per second
RTSS	residual total suspended solids
mg/l	milligrams per liter
TKN	total kjedahl nitrogen
F.STREP	fecal strep
#/100 ml	number per 100 milliliters
MF TOT	membrane filtered total coliform
MF FEC	membrane filtered fecal coliform
NH_3	ammonia
TP	total phosphorus
TURB	turbidity
ntu	nephelometric turbidity unit
TDS	total dissolved solids
F-pH	field pH
DTP	dissolved total phosphorus
D-NO_2+NO_3	nitrate and nitrite

Data from Ecosystems Research Institute

TEMP	temperature
DO	dissolved oxygen
COND	conductivity
NO_3-N	nitrate as nitrogen
NO_2-N	nitrite as nitrogen
NH_3-N	ammonia as nitrogen
PO_4-P	orthophosphorus as phosphate
DTP-P	dissolved total phosphorus as phosphate
TP-P	total phosphorus as phosphate
ALK	alkalinity
VTSS	volatile total suspended solids
RTSS	residual total suspended solids
CA	calcium
MG	magnesium
HARD	hardness
SI	silica
SO_4	sulfate
F.STREP	fecal strep
TC	total coliform
FC	fecal coliform
-999	no data

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - DATA COURTESY OF UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

DATE	TEMP oC	DO umhos/cm	FLOW cfs *	pH units	RTSS mg/l	TKN mg/l	F.STREP #/100ml	MF TOT #/100ml	MF FEC #/100ml	NH3 mg/l	TP mg/l	TURB ntu	TDS mg/l	F-pH units	DTP mg/l	D-NO2+NO3 mg/l
92-10-20	9.5	9.3	103	8.3	83	1.360		216	126	0.064	0.156	44	1942	8.4	0.029	0.391
92-12-08	0.1	10.8	580	7.9	10	1.060		212	26	0.101	0.111	6.6	1040	8.0	0.095	0.905
93-02-23	0.6	10.9	840	7.8	18	0.920				0.402	0.228				0.196	1.185
93-03-23	7.8	9.5	4310	7.9	115	1.670	472	624	76	0.265	0.498				0.326	3.710
93-04-06	7.8	6.6	2310	8.0	54	1.870				0.131	0.186				0.109	1.604
93-05-04	14.2	9.4	2480	8.3	69	0.760	370	580	358	0.050	0.132				0.051	0.244
93-05-18	18.5	6.5	4490	7.9	103	0.610	160	500	180	0.050	0.159				0.041	0.300
93-06-02	18.6	6.7	3070	8.3	89	0.800	64	80	20	0.051	0.164				0.055	0.147
93-06-15	19.3	7.4	3180	8.2	62	0.750	192	470	62	0.050	0.156				0.056	0.323
93-07-20	19.9	8.4	127	8.0	130	1.930	160	440	154	0.157	0.294	69	2102	8.1	0.036	0.659
93-08-24	21.9	9.8	186	8.3	124	0.920	570	120	40	0.057	0.268	62	1576	8.4	0.019	0.799
93-09-21	16.5	11.9	742	7.9	108	1.110				0.050	0.200	58	792	8.5	0.059	0.203

STATION 490110 - Bear River at Corinne at U83 xing

* Flows from USGS site near Corinne (10126000)

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - DATA COURTESY OF UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

DATE	TEMP oC	DO umhos/cm	FLOW cfs	pH units	RTSS mg/l	TKN mg/l	F.STREP #/100ml	MF TOT #/100ml	MF FEC #/100ml	NH3 mg/l	TP mg/l	TURB ntu	TDS mg/l	F-pH units	DTP mg/l	D-NO2+NO3 mg/l
93-02-23	4.7	11.4	18.5	8.2	6	0.100	50	300	50	0.050	0.062				0.069	0.807
93-03-23	8.4	10.4	35.6	8.2	10	0.580	684	2160	664	0.050	0.097				0.100	1.980
93-05-04	11.6	10.0	52.2	8.4	18	0.460	740	1850	730	0.050	0.155				0.057	0.448
93-06-02	13.2	8.8	1.1	8.5	8	0.550	2780	2300	2160	0.085	0.207				0.113	0.805
93-06-15	17.5	8.3	12	8.6	4	0.540	1650	5700	2700	0.050	0.117				0.101	0.367
93-07-20	15.4	8.8	1	8.1	4	0.630	650	400	1300	0.050	0.074				0.029	0.975
93-08-24	15.7	9.2	17.2	8.2	4	0.590	1000	2300	150	0.050	0.067	1.4	280	8.6	0.048	0.788

STATION 490119 - Box Elder Creek above Brigham City WWTP

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - ECOSYSTEMS RESEARCH INSTITUTE

LOG	DATE	FLOW cfs	TEMP oC	pH units	DO mg/l	COND umhos/cm	NO3-N mg/l	NO2-N mg/l	NH3-N mg/l	PO4-P mg/l	DTP-P mg/l	TP-P mg/l	ALK mg/l
NOFLOW	921022	0.0											
NOFLOW	921111	0.0											
NOFLOW	921209	0.0											
NOFLOW	930112	0.0											
NOFLOW	930223	0.0											
93-0441	930309		1.6	6.9	10.3	463	0.609	0.003	0.131	0.028	0.028	0.028	235
93-0471	930322		7.5	6.9	9.9	325	0.983	0.029	0.113	0.066	0.088	0.181	148
93-0705	930405		6.0	6.8	8.8	341	0.679	0.002	0.032	0.050	0.069	0.082	125
93-0807	930419		7.6	7.2	9.7	370	0.542	0.004	0.016	0.031	0.044	0.056	164
93-0885	930503		11.6	8.2	10.9	355	0.143	0.012	0.030	0.005	0.023	0.037	164
93-0967	930517		15.7	7.5	9.3	324	0.249	0.005	0.051	0.010	0.015	0.031	152
93-1085	930603		15.3	8.2	9.6	302	0.093	0.008	0.018	-999.000	0.010	0.026	136
93-1144	930615		17.2	8.1	10.2	317	0.266	0.010	0.012	0.004	0.006	0.016	152
93-1203	930629		20.2	8.3	7.7	333	0.238	0.011	0.066	0.010	0.010	0.042	144
93-1295	930712		20.3	8.1	9.2	339	0.190	0.016	0.025	0.005	0.005	0.009	165
NOFLOW	930728	0.0											
NOFLOW	930816												
NOFLOW	930830												
NOFLOW	930913												
NOFLOW	930927												

STATION 490165 - Little Bear directly below Hyrum

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - ECOSYSTEMS RESEARCH INSTITUTE

LOG	DATE	VTSS mg/l	RTSS mg/l	CA mg/l	MG mg/l	HARD mg/l	SI mg/l	CHLORIDE mg/l	SO4 mg/l	F. STREP #/100ml	TC #/100ml	FC #/100ml
NOFLOW	921022											
NOFLOW	921111											
NOFLOW	921209											
NOFLOW	930112											
NOFLOW	930223											
93-0441	930309	1	2	65.4	16.8	232	15.6	15.1	14.4	< 1	30	< 1
93-0471	930322	2	50	53.9	4.9	155	-999.0	11.5	10.9	194	200	90
93-0705	930405	-999	24	54.5	6.3	162	-999.0	11.5	11.8	26	700	140
93-0807	930419	1	7	56.7	4.2	88	15.7	10.6	10.6	< 1	170	-999
93-0885	930503	1	8	49.7	13.0	177	12.5	8.9	10.3	< 1	20	< 1
93-0967	930517	1	5	4.9	10.7	156	9.5	7.2	8.1	< 1	10	< 1
93-1085	930603	2	4	52.6	6.3	157	7.5	4.5	6.6	< 1	100	< 1
93-1144	930615	1	4	109.3	1.0	117	9.3	6.3	5.5	0	20	< 1
93-1203	930629	1	3	57.6	5.1	165	9.1	5.4	6.7	0	< 1	< 1
93-1295	930712	2	4	47.9	18.6	196	8.5	5.4	6.4	0	< 1	< 1
NOFLOW	930728											
NOFLOW	930816											
NOFLOW	930830											
NOFLOW	930913											
NOFLOW	930927											

STATION 490165 - Little Bear directly below Hyrum

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - DATA COURTESY OF UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

DATE	TEMP oC	DO umhos/cm	FLOW cfs *	pH units	RTSS mg/l	TKN mg/l	F.STREP #/100ml	MF TOT #/100ml	MF FEC #/100ml	NH3 mg/l	TP mg/l	TURB ntu	TDS mg/l	F-pH units	DTP mg/l	D-NO2+NO3 mg/l
93-01-26					4					0.308	0.160					
93-02-23	0.3	12.0	777	7.7	12	0.843	252	304	16	0.176	0.215				0.236	1.077
93-02-26	0.5		734	9.2	32					0.430	0.224					
93-03-23	6.6	9.5	3780	8.0	92	1.850	532	590	28	0.278	0.474				0.361	2.790
93-04-06	8.1	6.9	2680	8.1	69	0.770			4	0.117	0.183				0.097	1.431
93-04-22	11.8	10.0	2040	8.4	76	0.430	20	170		0.052	0.208				0.058	0.626
93-04-24	11.2		2040	8.2	72					0.050	0.171					
93-05-05	11.5	8.6	2640	8.5	80	0.250				0.050	0.168				0.042	0.310
93-05-16	14.3		4350	8.9	52					0.050	0.154					
93-05-18	18.7	6.5	4750	8.1	55	1.140	188	370	166	0.126	0.161				0.065	0.213
93-06-02	16.9	7.5	3000	8.4	92	0.450	570	380	12	0.050	0.169				0.043	0.105
93-06-11	18.6		3220	7.6	54					0.050	0.153					
93-06-15	20.7	2.4	3190	8.2	46	0.520	230	350	184	0.050	0.179				0.085	0.194
93-07-17	25.8		25	8.6	102					0.131	0.186					
93-07-20	21.0	8.7	25	8.2	104	1.830	64	110	450	0.394	0.210				0.026	0.124
93-08-21	17.5		26	8.4	82					0.050	0.184	38	684	8.7		
93-08-24	20.4	8.8	26	8.3	108	1.200	370	100	20	0.050	0.209	51	764	8.5	0.025	0.056
93-09-15	14.2		27	8.2	90					0.050	0.187	3.8	548	8.8		
93-09-21	14.1	10.6	27	8.1	27	0.710				0.050	0.139	17	546	8.5	0.049	0.022

STATION 490170 - Bear River at Honeyville at I-15

* Flows from USGS site near Collinston (10118000)

EAR RIVER WATER QUALITY MANAGEMENT PLAN - DATA COURTESY OF UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

DATE	TEMP oC	DO umhos/cm	FLOW cfs	pH units	RTSS mg/l	TKN mg/l	F.STREP #/100ml	MF TOT #/100ml	MF FEC #/100ml	NH3 mg/l	TP mg/l	TURB ntu	TDS mg/l	F-pH units	DTP mg/l	D-NO2+NO3 mg/l
2-10-21	11.8	9.0	25	8.3	22	0.440				0.050	0.097	14	916	8.7	0.044	0.120
2-12-08	0.4	11.2	657	8.0	4	0.830				0.384	0.214	4.3	566	8.0	0.200	1.027
3-02-23	2.3	11.2	777	8.3	10	0.623	348	340	2	0.050	0.201				0.216	1.021
3-03-23	7.5	10.1	3780	7.9	66	1.540	590	640	32	0.254	0.416				0.316	2.710
3-04-06	8.4	6.8	2680	8.1	68	2.040			46	0.120	0.170				0.104	1.519
3-04-22	12.4	10.6	2040	8.6	69	0.360	40	230		0.050	0.120				0.041	0.724
3-05-05	11.6	8.4	2640	8.3	80	0.250			66	0.050	0.163				0.039	0.448
3-05-18	17.4	7.3	4750	8.3	99	0.800	80	190		0.072	0.162				0.041	0.274
3-06-02	17.3	7.7	3000	8.4	85	0.570	88	120	20	0.050	0.137				0.040	0.107
3-06-15	19.5	8.0	3190	8.3	78	0.800	76	96	24	0.067	0.151				0.056	0.173
3-07-20	21.3	7.9	26	8.2	34	1.470	24	32	14	0.160	0.126				0.039	0.094
3-08-24	23.2	9.8	26	8.1	24	0.920	528	24	8	0.077	0.115	13	726	8.6	0.039	0.159
3-09-21	14.1	11.2	27	8.0	38	0.690				0.172	0.112	25	440	8.9	0.034	0.118

ATION 490198 - Bear River below Cutler at UPL bridge

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - ECOSYSTEMS RESEARCH INSTITUTE

LOG	DATE	FLOW cfs	TEMP oC	pH units	DO mg/l	COND umhos/cm	NO3-N mg/l	NO2-N mg/l	NH3-N mg/l	PO4-P mg/l	DTP-P mg/l	TP-P mg/l	ALK mg/l
93-0715	930406	0.1	7.6	7.3	11.8	1125	1.650	0.026	0.247	0.038	0.104	0.104	176
93-0886	930503	0.1	22.5	8.2	8.3	864	4.046	0.051	0.535	0.350	0.409	1.003	422

STATION 490310 - Newton Creek at U142 xing in Newton

LOG	DATE	VTSS mg/l	RTSS mg/l	CA mg/l	MG mg/l	HARD mg/l	SI mg/l	CHLORIDE mg/l	SO4 mg/l	F. STREP #/100ml	TC #/100ml	FC #/100ml
93-0715	930406	-999	8	157.1	3.9	408.1	-999.0	118.8	115.5	96	1200	< 1
93-0886	930503	4	218	162.7	32.3	538.5	-999.0	130.3	110.9	> 1000	35000	> 5000

STATION 490310 - Newton Creek at U142 xing in Newton

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - DATA COURTESY OF UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

DATE	TEMP oC	DO umhos/cm	FLOW cfs *	pH units	RTSS mg/l	TKN mg/l	F.STREP #/100ml	MF TOT #/100ml	MF FEC #/100ml	NH3 mg/l	TP mg/l	TURB ntu	TDS mg/l	F-pH units	DTP mg/l	D-NO2+NO3 mg/l
92-10-21	11.0	9.0	284	8.3	29	0.620				0.050	0.059	16	670	8.7	0.010	0.153
92-12-09	0.5	10.4	354	7.9	78	0.350				0.111	0.167	26	650	8.1	0.089	0.759
93-02-24	1.3	11.6	522	7.8	13	0.547	1050	720	60	0.137	0.084	7.3	610	8.2	0.063	2.412
93-03-23	7.8	10.4	2010	7.9	61	1.540	920	2000	104	0.201	0.438	100	472	8.0	0.212	3.090
93-04-06	6.1	7.5	1670	7.9	86	0.120				0.105	0.149	37	410	8.0	0.059	1.449
93-05-05	10.6	8.9	1230	8.0	76	0.240				0.050	0.159	36	380	8.3	0.028	0.522
93-05-18	15.7	7.1	3020	7.9	89	0.940	140	700	72	0.065	0.148	38	290	8.3	0.030	0.274
93-06-02	15.9	7.6	2350	7.5	44	0.220	110	160	18	0.054	0.097	27	250	8.4	0.031	0.170
93-06-15	18.3	8.0	2495	7.8	39	0.260	52	290	66	0.050	0.084	18	274	8.3	0.037	0.141
93-07-20	22.0	8.2	550	8.1	60	1.120	60	60	32	0.056	0.115	21	438	8.3	0.016	0.225
93-08-24	23.6	8.5	514	8.3	40	0.640	800	164	138	0.050	0.098	0.1	552	8.6	0.027	0.216
93-09-17	14.2	7.3	614	8.2	36	0.440				0.050	0.072	17	512	8.1	0.016	0.331

STATION 490326 - Bear River above Cutler at Benson Bridge

* Flows from USGS site near Smithfield (10102250)

LOG	DATE	FLOW cfs	TEMP oC	pH units	DO mg/l	COND umhos/cm	NO3-N mg/l	NO2-N mg/l	NH3-N mg/l	PO4-P mg/l	DTP-P mg/l	TP-P mg/l	ALK mg/l
93-0716	930406	25.0	7.2	7.6	10.7	355	0.931	0.007	0.039	0.006	0.006	0.027	187
93-0820	930419	20.0	11.5	8.9	10.4	368	0.285	0.004	0.043	0.007	0.011	0.020	184
93-0887	930503	24.0	14.0	8.6	9.1	353	0.299	0.003	0.018	0.005	0.009	0.015	192
93-0995	930518	135.0	9.0	6.7	10.5	324	0.219	0.001	0.005	0.008	0.020	0.071	182
93-1072	930602	48.0	10.3	8.1	9.3	314	0.175	0.001	0.009	0.003	0.008	0.024	166
93-1131	930614	47.0	11.4	8.0	10.2	323	0.163	0.002	0.011	0.007	0.007	0.020	165

STATION 490350 - Summitt Creek above Bear River

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - ECOSYSTEMS RESEARCH INSTITUTE

LOG	DATE	VTSS mg/l	RTSS mg/l	CA mg/l	MG mg/l	HARD mg/l	SI mg/l	CHLORIDE mg/l	SO4 mg/l	F. STREP #/100ml	TC #/100ml	FC #/100ml
93-0716	930406	-999	10	57.7	9.2	181.8	-999.0	6.2	6.2	0	66	1
93-0820	930419	3	13	56.7	30.6	196.0	6.2	7.1	6.1	38	250	-999
93-0887	930503	2	15	53.7	14.6	193.8	-999.0	4.4	5.5	50	100	0
93-0995	930518	-999	138	47.3	10.2	159.8	-999.0	0.9	2.8	130	200	80
93-1072	930602	3	13	55.9	7.8	171.4	-999.0	1.8	4.1	45	290	80
93-1131	930614	3	15	48.6	14.4	180.2	-999.0	1.8	3.4	60	100	40

STATION 490350 - Summitt Creek above Bear River

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - ECOSYSTEMS RESEARCH INSTITUTE

LOG	DATE	FLOW cfs *	TEMP oC	pH units	DO mg/l	COND umhos/cm	NO3-N mg/l	NO2-N mg/l	NH3-N mg/l	PO4-P mg/l	DTP-P mg/l	TP-P mg/l	ALK mg/l
356-0910	920910	293.0	16.5	8.7	7.4	1077	0.134	0.004	0.015	0.008	0.020	0.052	296
356-0929	920929	256.0	13.9	8.1	9.1	1291	0.126	0.003	< 0.005	0.007	0.013	0.041	308
356-1020	921020	284	10.0	7.8	9.7	1182	0.143	0.004	0.014	0.007	0.014	0.050	316
356-1110	921110	225	4.2	8.0	11.2	1115	0.490	0.014	0.047	0.021	0.024	0.046	321
356-1208	921208	354	0.2	7.8	10.3	1050	0.623	0.010	0.103	0.019	0.028	0.038	313
93-0086	930113	589	0.0	7.5	10.2	1033	0.899	0.039	0.183	0.036	0.037	0.052	339
93-0354	930222	522	1.5	7.9	11.0	1035	1.178	0.021	0.307	0.059	0.085	0.104	310
93-0472	930322	2010	7.0	7.7	8.4	845	2.319	0.051	0.300	0.228	0.246	0.535	288
93-0717	930406	1670	7.1	7.2	9.3	704	1.391	0.018	0.103	0.042	0.075	0.159	225
93-0821	930419	1160	10.0	8.4	8.6	-999	1.067	0.016	0.091	0.041	0.058	0.209	228
93-0888	930503	1230	14.0	8.4	9.9	675	0.498	0.009	0.016	0.008	0.023	0.147	227
93-0978	930517	3020	16.5	8.2	7.0	499	0.334	0.008	0.087	0.027	0.037	0.160	188
93-1073	930602	2350	15.0	7.7	7.6	469	0.233	0.004	0.017	0.018	0.025	0.061	180
93-1132	930614	2495	15	7.7	9.3	472	0.203	0.004	0.042	0.022	0.033	0.066	181
93-1285	930712	550	22.0	8.3	-999	755	0.142	0.012	0.030	0.008	0.011	0.143	273
93-1493	930816	514	21	8.1	8.2	833	0.204	0.009	0.043	0.034	0.040	0.092	283
93-1589	930914	614	15	-999	8.4	-999	0.291	0.007	0.028	0.019	0.019	0.035	280
93-1771	931018	-999	11.3	7.8	8.6	1024	0.723	0.016	0.042	0.028	0.035	0.129	295
93-2008	931117	-999	2.3	7.8	-999	862	0.779	0.008	0.066	0.015	0.021	0.237	298
94-0165	940125	-999	3.2	6.7	11.8	910	1.229	0.014	0.113	0.010	0.027	0.065	328
94-0270	940222	-999	2.2	8	11	893	1.105	0.013	0.189	0.021	0.080	0.119	328

STATION 490356 - Bear River near Amalga, Utah

* Flows from USGS site near Smithfield (10102250)

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - ECOSYSTEMS RESEARCH INSTITUTE

LOG	DATE	VTSS mg/l	RTSS mg/l	CA mg/l	MG mg/l	HARD mg/l	SI mg/l	CHLORIDE mg/l	SO4 mg/l	F. STREP #/100ml	TC #/100ml	FC #/100ml
356-0910	920910	2	16	72.1	34.3	320.4	6.9	145.4	62.3	-999	500	100
356-0929	920929	2	15	77.0	34.3	332.6	6.0	189.7	74.7	-999	800	30
356-1020	921020	3	20	75.4	37.9	-999.0	9.6	147.1	90.3	-999	200	100
356-1110	921110	2	15	45.6	464.0	304.0	10.9	125.8	91.9	80	100	6
356-1208	921208	2	6	91.4	32.2	360.0	15.9	110.8	78.9	1	40	8
93-0086	930113	2	6	93.0	148.0	380.0	22.0	104.6	69.5	20	120	14
93-0354	930222	3	18	110.1	20.5	358.6	35.1	104.6	63.7	4	50	1
93-0472	930322	4	260	81.8	20.9	289.8	18.5	75.3	48.9	250	1500	250
93-0717	930406	-999	83	81.8	14.3	262.6	-999.0	50.5	53.2	42	1100	10
93-0821	930419	4	137	66.4	21.1	252.0	-999.0	59.4	58.7	80	3000	-999
93-0888	930503	4	78	68.9	21.4	259.5	-999.0	51.4	52.9	5	600	50
93-0978	930517	4	106	55.3	19.7	218.6	-999.0	27.9	27.0	150	400	60
93-1073	930602	4	67	65.6	9.9	204.1	-999.0	26.1	24.2	20	300	70
93-1132	930614	2	35	59.92	13.05	203.0	-999.0	25.2	18.29	70	300	150
93-1285	930712	3	64	92.6	20.7	315.8	-999.0	54.9	43.3	44	300	30
93-1493	930816	3	58	60.5	34.9	294.0	-999.0	70.2	48.8	138	110	40
93-1589	930914	1	10	60.4	34.7	292.8	-999.0	58.4	58.4	134	< 1000	60
93-1771	931018	1	10	65.6	35.6	309.6	-999.0	115.2	64.5	318	10	< 10
93-2008	931117	2	8	59.2	37.6	301.6	-999.0	70.2	50.8	77	100	< 1
94-0165	940125	1	18	80.3	38.5	357.6	-999.0	66.2	59	16	40	< 1
94-0270	940222	1	29	51.9	47	322.4	-999.0	72	44.4	189	800	0

STATION 490356 - Bear River near Amalga, Utah

* Flows from USGS site near Smithfield (10102250)

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - ECOSYSTEMS RESEARCH INSTITUTE

LOG	DATE	FLOW cfs	TEMP oC	pH units	DO mg/l	COND umhos/cm	NO3-N mg/l	NO2-N mg/l	NH3-N mg/l	PO4-P mg/l	DTP-P mg/l	TP-P mg/l	ALK mg/l
379-0910	920910	-999.0	14.0	7.9	-999.0	927	0.025	0.015	0.643	0.411	0.494	0.494	236
379-0929	920929	-999.0	12.0	7.5	6.2	543	0.047	0.012	0.254	0.108	0.132	0.198	202
379-1020	921020	20.0	8.2	7.4	9.1	441	0.053	0.004	0.072	0.020	0.027	0.044	202
379-1110	921110	40.0	1.1	7.9	11.8	454	0.187	0.002	0.018	0.015	0.028	0.028	216
379-1208	921208	-999.0	0.2	7.3	9.6	465	0.490	0.003	0.031	0.011	0.017	0.017	216
93-0083	930113	-999.0	0.1	7.3	10.3	467	0.449	0.008	0.041	0.028	0.031	0.039	225
93-0355	930222	20.0	0.3	7.6	11.8	458	0.995	0.014	0.086	0.025	0.036	0.041	197
93-0473	930322	87.0	4.0	7.7	9.6	391	3.576	0.031	0.103	0.171	0.211	0.231	150
93-0719	930406	65.0	3.6	7.3	10.2	292	1.410	0.004	0.071	0.030	0.047	0.073	130
93-0822	930419	124.0	6.0	8.4	10.8	282	0.827	0.005	0.026	0.021	0.030	0.055	127
93-0890	930503	112.0	9.0	8.4	12.4	315	0.347	0.002	0.009	0.006	0.016	0.025	148
93-0979	930517	423.0	10.0	8.3	9.0	309	0.353	0.002	0.018	0.021	0.028	0.248	170
93-1074	930602	311.0	6.5	7.8	10.4	262	0.231	0.001	0.016	0.016	0.016	0.088	135
93-1133	930614	388.0	7.2	7.1	10.1	268	0.192	0.003	0.027	0.023	0.023	0.094	141
93-1286	930712	21.1	15.0	8.29	-999	434	0.541	0.007	0.023	0.049	0.055	0.174	211
93-1494	930816	3.4	16.4	7.7	8.4	546	1.253	0.015	0.052	0.163	0.184	0.190	250
93-1590	930914	3.3	11	-999	6.9	-999	0.774	0.031	0.396	0.211	0.230	0.392	245
93-1772	931018	-999	9	7.4	11.9	390	0.176	0.003	0.030	0.022	0.022	0.024	196
93-2009	931117	-999	0.5	7.7	-999	472	0.521	0.004	0.044	0.015	0.023	0.040	234
94-0166	940125	-999	3.1	7.8	11.2	727	4.776	0.075	0.365	0.405	0.453	0.711	357
94-0271	940222	-999	0.9	8	12.5	505	0.939	0.005	0.099	0.034	0.061	0.061	260

STATION 490379 - Cub River at stateline

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - ECOSYSTEMS RESEARCH INSTITUTE

LOG	DATE	VTSS mg/l	RTSS mg/l	CA mg/l	MG mg/l	HARD mg/l	SI mg/l	CHLORIDE mg/l	SO4 mg/l	F. STREP #/100ml	TC #/100ml	FC #/100ml
379-0910	920910	3	24	57.7	15.1	206.0	10.8	159.5	10.1	-999	1700	270
379-0929	920929	2	10	64.1	8.2	193.7	8.3	42.5	9.5	-999	< 10	< 10
379-1020	921020	2	5	64.1	9.3	-999.0	18.5	14.2	10.7	-999	500	15
379-1110	921110	1	2	56.6	14.3	200.0	18.8	132.9	25.3	38	280	38
379-1208	921208	3	1	64.2	14.6	220.0	22.5	12.4	11.9	6	700	20
93-0083	930113	2	2	77.0	28.0	220.0	24.1	15.1	13.7	8	2500	24
93-0355	930222	2	4	72.9	5.4	204.0	19.3	15.9	13.1	30	90	30
93-0473	930322	2	36	57.3	3.9	159.2	11.2	16.8	15.2	110	700	30
93-0719	930406	-999	20	43.3	6.2	133.3	-999.0	11.5	8.5	56	400	1
93-0822	930419	2	18	42.9	6.5	132.0	-999.0	8.0	8.0	38	540	-999
93-0890	930503	4	18	44.1	10.4	152.8	-999.0	3.6	5.1	5	300	30
93-0979	930517	6	258	48.1	7.8	151.8	-999.0	13.5	1.8	30	500	200
93-1074	930602	4	110	54.3	1.3	140.8	-999.0	1.8	2.6	20	70	20
93-1133	930614	5	99	49.4	4.7	142.6	-999.0	2.7	3.1	20	500	40
93-1286	930712	2	10	68.6	7	200.0	-999.0	7.2	8.43	112	400	270
93-1494	930816	2	7	30.7	42.6	250.9	-999.0	21.6	9.96	585	3000	470
93-1590	930914	1	10	54.2	17.8	208.0	-999.0	8.9	8.9	262	> 4000	100
93-1772	931018	2	2	52.2	13.7	186.0	-999.0	5.4	5.6	42	800	100
93-2009	931117	2	1	57.9	37.4	297.6	-999.0	28.8	9	33	1000	350
94-0166	940125	1	156	80.2	29.9	322.4	-999.0	24.3	19	884	13000	1100
94-0271	940222	1	8	59	18.2	221.6	-999.0	15.3	11.7	439	130	0

STATION 490379 - Cub River at stateline

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - ECOSYSTEMS RESEARCH INSTITUTE

LOG	DATE	FLOW cfs	TEMP oC	pH units	DO mg/l	COND umhos/cm	NO3-N mg/l	NO2-N mg/l	NH3-N mg/l	PO4-P mg/l	DTP-P mg/l	TP-P mg/l	ALK mg/l
		*											
587-0910	920910	232.0	15.0	8.1	8.1	1100	0.053	0.003	0.027	0.009	0.025	0.093	294
587-0929	920929	196.0	13.4	8.1	9.2	1296	0.055	0.002	0.035	0.008	0.024	0.031	302
587-1020	921020	236	9.7	7.5	9.7	1256	0.065	0.003	0.021	0.006	0.013	0.027	332
587-1110	921110	282	3.6	8.1	11.2	1180	0.308	0.015	0.031	0.010	0.012	0.026	321
587-1208	921208	462	0.3	6.6	10.8	1065	0.572	0.011	0.270	0.008	0.015	0.020	212
93-0085	930113	449	0.1	7.6	10.8	1134	0.771	0.019	0.192	0.024	0.026	0.033	362
93-0361	930222	360	1.7	7.8	11.2	1125	1.275	0.018	0.245	0.034	0.045	0.083	349
93-0480	930322	1047	7.5	7.7	9.4	917	2.158	0.033	0.241	0.078	0.102	0.470	335
93-0728	930406	1490	7.0	7.2	9.2	731	1.059	0.015	0.104	0.036	0.054	0.115	231
93-0829	930419	951	9.5	8.4	8.5	765	0.571	0.011	0.059	0.022	0.037	0.186	237
93-0907	930503	1252	14.5	8.4	8.8	706	0.382	0.007	0.035	0.005	0.023	0.108	234
93-0988	930517	2165	17.0	8.1	6.5	610	0.347	0.008	0.016	0.018	0.029	0.140	207
93-1084	930602	1350	16.9	7.8	7.4	532	0.203	0.004	0.005	0.011	0.016	0.039	194
93-1143	930614	1700	16.4	7.9	8.6	525	0.119	0.005	0.016	0.010	0.025	0.068	193
93-1294	930712	487	21.5	8.2	-999.0	1096	0.310	0.017	0.046	0.015	0.026	0.211	302
93-1502	930816	408	21.3	8	8.1	917	0.231	0.006	0.035	0.026	0.026	0.037	285
93-1598	930914	453	15.5	-999	9.7	-999	0.207	0.003	0.085	0.012	0.012	0.024	262
93-1800	931018	-999	11.5	7.9	8.9	932	0.539	0.010	0.022	0.014	0.062	0.064	297
93-2017	931117	-999	2	7.8	-999	907	0.672	0.007	0.035	0.012	0.016	0.048	292
94-0174	940125	-999	3.6	6.8	11.4	1097	0.904	0.012	0.109	0.007	0.031	0.036	317
94-0279	940222	-999	3	8	11.8	1072	0.908	0.011	0.205	0.010	0.053	0.068	332

STATION 490382 - Bear River west of Richmond, Utah

* Flows from USGS site at Utah-Idaho stateline (10092700)

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - ECOSYSTEMS RESEARCH INSTITUTE

LOG	DATE	VTSS mg/l	RTSS mg/l	CA mg/l	MG mg/l	HARD mg/l	SI mg/l	CHLORIDE mg/l	SO4 mg/l	F. STREP #/100ml	TC #/100ml	FC #/100ml
587-0910	920910	3	33	56.1	45.0	324.5	7.0	154.2	67.5	-999	130	30
587-0929	920929	1	9	125.1	4.0	328.4	5.6	191.4	83.5	-999	< 100	< 10
587-1020	921020	2	7	84.9	37.9	-999.0	9.5	159.5	97.6	-999	200	60
587-1110	921110	1	5	66.8	46.2	356.0	10.9	138.3	102.6	46	200	4
587-1208	921208	2	5	45.6	33.1	260.0	10.9	93.9	54.2	10	100	4
93-0085	930113	2	5	107.0	132.0	400.0	11.7	125.8	80.9	4	180	18
93-0361	930222	2	21	114.9	26.1	393.9	22.6	118.8	77.8	2	60	1
93-0480	930322	3	345	99.8	22.9	342.9	20.6	75.3	69.9	50	400	80
93-0728	930406	-999	91	80.2	18.2	274.7	-999.0	50.5	62.8	10	600	1
93-0829	930419	4	84	81.0	16.1	268.0	-999.0	62.9	67.6	30	900	-999
93-0907	930503	4	50	83.4	16.6	275.9	-999.0	52.3	57.7	15	20	10
93-0988	930517	3	71	63.3	22.1	248.7	-999.0	37.8	40.3	70	2000	600
93-1084	930602	3	36	80.2	7.2	229.6	-999.0	32.4	33.2	45	400	100
93-1143	930614	2	22	58.3	17.7	217.8	-999.0	30.6	26.9	110	100	100
93-1294	930712	3	79	130.6	5.3	347.4	-999.0	135.9	51.2	18	700	500
93-1502	930816	3	36	58.2	36.4	294.1	-999.0	94.5	50.3	720	1200	800
93-1598	930914	1	8	56.4	34.3	281.2	-999.0	65.8	65.84	116	400	175
93-1800	931018	2	4	66.1	39.2	325.6	-999.0	81	73.9	10	200	10
93-2017	931117	2	7	67.8	37.6	323.2	-999.0	82.8	58.8	100	100	< 1
94-0174	940125	2	5	76.6	35.9	338.4	-999.0	120.6	51	30	20	< 1
94-0279	940222	2	24	75.7	34	328.0	-999.0	118.8	60.9	120	160	0

STATION 490382 - Bear River west of Richmond, Utah

* Flows from USGS site at Utah-Idaho stateline (10092700)

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - ECOSYSTEMS RESEARCH INSTITUTE

LOG	DATE	FLOW cfs	TEMP oC	pH units	DO mg/l	COND umhos/cm	NO3-N mg/l	NO2-N mg/l		NH3-N mg/l	PO4-P mg/l	DTP-P mg/l	TP-P mg/l	ALK mg/l
425-0910	920910	-999.0	15.0	8.4	-999.0	518	0.067	0.001		0.031	0.008	0.024	0.226	242
425-0919	920929	30.0	12.7	7.8	10.1	678	0.530	0.041	<	0.005	0.092	0.113	0.236	283
425-1020	921020	30.0	8.9	7.5	8.9	540	0.564	0.020		0.068	0.044	0.058	0.186	251
425-1110	921110	50.0	2.4	7.8	10.8	565	1.744	0.009		0.005	0.168	0.178	0.261	260
425-1208	921208	-999.0	0.5	7.5	9.3	594	1.783	0.013		0.230	0.198	0.223	0.244	259
93-0081	930113	-999.0	0.1	6.9	8.7	540	1.261	0.018		0.374	0.191	0.198	0.260	249
93-0357	930222	30.9	2.3	7.6	10.0	576	1.839	0.029		0.721	0.245	0.274	0.321	231
93-0477	930322	569.3	5.0	7.6	8.9	500	5.042	0.058		0.324	0.338	0.409	0.756	222
93-0720	930406	268.4	6.4	7.3	8.7	400	2.330	0.012		0.150	0.076	0.091	0.171	196
93-0824	930419	191.5	9.0	8.5	9.5	376	1.004	0.019		0.092	0.053	0.073	0.125	160
93-0891	930503	252.5	11.5	8.4	8.8	338	0.605	0.012		0.011	0.021	0.032	0.103	161
93-0981	930517	892.4	13.0	8.2	7.1	321	0.454	0.007		0.022	0.031	0.040	0.178	154
93-1076	930602	637.6	9.8	7.8	8.6	294	0.203	0.004		0.019	0.022	0.030	0.063	145
93-1135	930614	686.7	10.7	7.7	9.2	290	0.178	0.004		0.020	0.025	0.028	0.092	144
93-1288	930712	30	18	8.16	-999	550	1.022	0.024		0.021	0.049	0.057	0.151	246
93-1496	930816	34.3	17.3	7.6	7.7	561	1.349	0.032		0.031	0.097	0.107	0.172	259
93-1592	930914	28	12	-999	8	-999	1.219	0.031		0.085	0.102	0.102	0.183	243
93-1774	931018	-999	10.9	7.9	9.5	502	1.267	0.031		0.091	0.119	0.138	0.218	233
93-2011	931117	-999	2	8	-999	569	1.819	0.018		0.134	0.133	0.153	0.185	272
94-0168	940125	-999	2.7	6.8	-999	609	2.412	0.027		0.220	0.135	0.180	0.233	257
94-0273	940222	-999	2	8.1	12.9	573	2.167	0.037		0.421	0.132	0.220	0.273	267

STATION 490425 - Cub River west of Richmond, Utah (U142 xing)

LOG	DATE	VTSS mg/l	RTSS mg/l	CA mg/l	MG mg/l	HARD mg/l	SI mg/l	CHLORIDE mg/l	SO4 mg/l	F. STREP #/100ml	TC #/100ml	FC #/100ml
425-0910	920910	3	72	57.7	20.1	226.5	5.9	37.2	20.4	-999	300	60
425-0919	920929	2	41	73.8	17.8	256.8	6.3	46.1	10.4	-999	20	10
425-1020	921020	3	61	88.2	1.5	-999.0	15.5	26.6	13.8	-999	200	50
425-1110	921110	3	19	61.3	19.3	232.0	16.8	24.8	14.7	100	300	18
425-1208	921208	3	9	67.4	21.5	256.0	18.5	23.0	12.5	26	1000	230
93-0081	930113	4	39	74.0	64.0	248.0	19.5	31.9	14.0	140	2500	100
93-0357	930222	2	22	64.8	17.3	232.3	18.4	35.5	16.8	18	400	10
93-0477	930322	3	146	57.3	8.9	179.6	17.0	27.5	20.6	440	3000	500
93-0720	930406	-999	79	52.9	7.2	161.6	-999.0	16.8	14.1	112	3000	-999
93-0824	930419	3	47	50.2	9.4	164.0	-999.0	15.1	13.6	-999	9500	-999
93-0891	930503	4	61	48.9	9.5	161.0	-999.0	8.9	7.5	10	200	10
93-0981	930517	5	144	48.1	7.8	151.8	-999.0	3.6	3.2	50	2000	500
93-1076	930602	3	53	51.8	5.8	153.1	-999.0	4.5	3.6	50	110	10
93-1135	930614	3	46	47.0	8.1	150.5	-999.0	3.6	2.9	85	200	70
93-1288	930712	2	32	83.5	7.2	237.9	-999.0	22.5	9.04	-999	1000	150
93-1496	930816	4	59	35.4	43.5	266.7	-999.0	24.3	7.18	140	1000	200
93-1592	930914	2	28	54.9	21.4	224.8	-999.0	7.2	7.2	106	1000	210
93-1774	931018	3	13	55.2	20.3	220.8	-999.0	16.2	7.45	681	7000	3100
93-2011	931117	2	11	59.8	26.3	256.8	-999.0	19.8	10.4	694	24000	3100
94-0168	940125	2	9	62.9	24.8	258.4	-999.0	22.5	12	62	600	10
94-0273	940222	1	24	61.1	21.4	240.0	-999.0	25.2	11.2	767	800	10

STATION 490425 - Cub River west of Richmond, Utah (U142 xing)

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - ECOSYSTEMS RESEARCH INSTITUTE

LOG	DATE	FLOW cfs	TEMP oC	pH units	DO mg/l	COND umhos/cm	NO3-N mg/l	NO2-N mg/l	NH3-N mg/l	PO4-P mg/l	DTP-P mg/l	TP-P mg/l	ALK mg/l
93-0721	930406	37.0	4.8	7.8	10.9	225	0.736	0.001	0.026	0.006	0.009	0.033	172
93-0825	930419	7.0	7.5	8.6	10.2	267	0.262	0.001	0.032	0.009	0.011	0.017	134
93-0892	930503	12.4	9.0	8.6	10.6	303	0.291	0.001	0.015	0.005	0.008	0.011	152
93-0982	930517	201.0	9.0	8.4	-999.0	311	0.191	0.001	0.028	0.007	0.016	0.092	160
93-1077	930602	105.0	7.2	7.9	10.9	299	0.124	0.001	0.009	0.003	0.006	0.006	159
93-1136	930614	93	8.2	8	12.2	297	0.082	0.001	0.011	0.005	0.006	0.007	158

STATION 490430 - High Creek at Highway 92

LOG	DATE	VTSS mg/l	RTSS mg/l	CA mg/l	MG mg/l	HARD mg/l	SI mg/l	CHLORIDE mg/l	SO4 mg/l
93-0721	930406	-999	6	38.5	4.2	113.1	-999.0	4.4	3.4
93-0825	930419	2	4	43.7	7.5	140.0	6.4	3.6	4.2
93-0892	930503	2	4	51.3	8.1	161.0	-999.0	2.7	3.7
93-0982	930517	4	72	48.9	8.2	155.8	-999.0	-999.0	3.1
93-1077	930602	2	9	64.8	1.4	167.4	-999.0	4.5	3.0
93-1136	930614	2	4	51.01	8.57	162.4	-999.0	1.8	2.86

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - ECOSYSTEMS RESEARCH INSTITUTE

LOG	DATE	FLOW cfs	TEMP oC	pH units	DO mg/l	COND umhos/cm	NO3-N mg/l	NO2-N mg/l	NH3-N mg/l	PO4-P mg/l	DTP-P mg/l	TP-P mg/l	ALK mg/l
93-0352	930222	-999.0	0.0	7.2	5.4	366	1.731	0.022	0.383	0.267	0.309	0.403	140
93-0475	930322	88.0	6.0	7.6	9.4	373	4.125	0.022	0.078	0.207	0.265	0.366	141
93-0722	930406	56.0	4.4	7.0	9.0	308	0.427	0.010	0.050	0.065	0.083	0.093	150
93-0826	930419	13.0	9.5	8.8	11.2	315	1.194	0.014	0.027	0.047	0.063	0.102	132
93-0893	930503	16.4	12.0	8.7	9.2	230	0.770	0.011	0.027	0.044	0.062	0.105	94
93-0983	930517	67.0	13.0	8.3	8.6	148	0.703	0.008	0.010	0.056	0.070	0.127	57
93-1078	930602	22.3	11.5	8.0	7.7	290	1.161	0.019	0.024	0.059	0.066	0.083	130
93-1137	930614	14.2	12.2	8	11.8	-999	1.112	0.015	0.009	0.043	0.043	0.056	153
93-1289	930712	5.6	17.5	8.2	-999.0	462	0.846	0.019	0.031	0.063	0.088	0.089	265
93-1497	930816	0.5	19.8	7.6	7.7	517	0.120	0.002	0.041	0.072	0.093	0.109	272
93-1593	930914	0.5	10.5	-999	7.3	-999	0.151	0.001	0.033	0.046	0.052	0.065	244
93-1775	931018	-999	9.4	7.8	9.4	502	0.430	0.014	0.032	0.066	0.104	0.157	248
93-2012	931117	-999	0.7	7.5	-999	568	0.939	0.012	0.061	0.047	0.052	0.066	303
94-0169	940125	-999	2.1	7.6	10.9	583	1.136	0.021	0.615	0.335	0.388	0.531	245
94-0274	940222	-999	0.2	7.8	10.8	467	1.073	0.013	0.443	0.038	0.101	0.186	252

STATION 490431 - Spring Creek east of Lewiston (Hwy 91 xing)

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - ECOSYSTEMS RESEARCH INSTITUTE

LOG	DATE	VTSS mg/l	RTSS mg/l	CA mg/l	MG mg/l	HARD mg/l	SI mg/l	CHLORIDE mg/l	SO4 mg/l	F. STREP #/100ml	TC #/100ml	FC #/100ml
93-0352	930222	3	33	50.2	6.4	151.5	17.1	14.2	17.8	54	1300	10
93-0475	930322	1	79	53.9	3.9	151.0	17.6	13.3	12.1	100	300	-999
93-0722	930406	-999	32	41.7	5.0	129.3	-999.0	11.5	10.4	78	500	90
93-0826	930419	1	29	40.5	10.5	144.0	-999.0	13.3	13.0	50	500	-999
93-0893	930503	3	34	27.2	8.7	103.6	-999.0	8.0	8.3	45	200	40
93-0983	930517	2	38	17.6	4.7	63.3	-999.0	2.7	4.4	40	1200	70
93-1078	930602	2	21	57.1	0.1	142.9	-999.0	6.3	5.9	90	800	90
93-1137	930614	2	15	46.96	9.58	156.4	-999.0	5.4	4.42	165	1000	320
93-1289	930712	2	7	71.9	16.3	246.3	-999.0	7.2	5.0	210	4000	190
93-1497	930816	2	17	36.9	49.3	294.1	-999.0	9.9	3.2	60	1000	40
93-1593	930914	1	5	48.6	25.9	227.2	-999.0	6.1	6.1	200	300	5
93-1775	931018	3	4	58	25	247.2	-999.0	12.6	9.02	50	300	100
93-2012	931117	1	8	67.3	28.3	284.0	-999.0	12.6	10.6	20	900	< 1
94-0169	940125	1	87	58.0	23.4	240.8	-999.0	15.3	12.0	755	1000	140
94-0274	940222	2	84	58.5	21.4	233.6	-999.0	15.3	6.3	260	400	30

STATION 490431 - Spring Creek east of Lewiston (Hwy 91 xing)

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - ECOSYSTEMS RESEARCH INSTITUTE

LOG	DATE	FLOW cfs	TEMP oC	pH units	DO mg/l	COND umhos/cm	NO3-N mg/l	NO2-N mg/l	NH3-N mg/l	PO4-P mg/l	DTP-P mg/l	TP-P mg/l	ALK mg/l
93-0723	930406	22.7	5.4	7.7	10.2	190	0.767	0.003	0.037	0.006	0.014	0.023	123
93-0827	930419	3.8	8.0	8.9	9.6	203	0.449	0.001	0.012	0.005	0.009	0.013	101
93-0894	930503	3.7	10.5	8.7	9.2	231	0.413	0.001	0.017	0.005	0.010	0.020	109
93-0984	930517	18.0	12.0	8.4	5.5	244	0.264	0.001	0.004	0.009	0.015	0.057	120
93-1079	930602	5.4	8.4	7.9	10.6	273	0.104	0.001	0.015	0.003	0.003	0.023	144
93-1138	930614	11.4	8.9	7.9	10.4	269	0.118	0.001	0.009	0.006	0.006	0.006	139

STATION 490432 - Cherry Creek

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - ECOSYSTEMS RESEARCH INSTITUTE

LOG	DATE	VTSS mg/l	RTSS mg/l	CA mg/l	MG mg/l	HARD mg/l	SI mg/l	CHLORIDE mg/l	SO4 mg/l	F. STREP #/100ml	TC #/100ml	FC #/100ml
93-0723	930406	-999	7	35.3	1.2	92.9	-999.0	4.4	3.6	98	500	230
93-0827	930419	1	5	34.0	5.7	108.0	6.5	3.6	4.7	64	320	-999
93-0894	930503	3	12	38.5	3.8	111.8	-999.0	2.7	3.5	75	400	50
93-0984	930517	4	59	39.3	6.2	123.6	-999.0	1.8	3.9	25	200	10
93-1079	930602	3	17	59.1	0.9	151.0	-999.0	0.9	2.5	32	240	70
93-1138	930614	2	6	45.34	8.15	146.5	-999.0	1.8	2.62	20	200	70

STATION 490432 - Cherry Creek

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - ECOSYSTEMS RESEARCH INSTITUTE

LOG	DATE	FLOW cfs	TEMP oC	pH units	DO mg/l	COND umhos/cm	NO3-N mg/l	NO2-N mg/l	NH3-N mg/l	PO4-P mg/l	DTP-P mg/l	TP-P mg/l	ALK mg/l
437-0910	920910	-999.0	14.0	8.8	-999.0	543	0.123	0.018	0.023	0.101	0.136	0.472	266
437-0929	920929	-999.0	12.3	7.5	11.2	640	0.310	0.010	0.008	0.253	0.284	1.015	302
437-1020	921020	8.0	8.6	7.7	9.6	560	1.469	0.039	0.024	0.190	0.218	0.386	268
437-1110	921110	8.0	3.0	8.1	10.6	638	1.724	0.029	0.060	0.553	0.553	0.700	286
437-1208	921208	-999.0	0.2	7.6	10.2	640	3.713	0.021	0.237	0.626	0.633	0.641	295
93-0082	930113	-999.0	0.1	7.2	10.6	669	2.367	0.039	1.054	0.543	0.560	0.624	313
93-0353	930222	12.0	0.3	7.4	11.0	1044	3.049	0.047	0.830	0.479	0.583	0.682	321
93-0476	930322	23.2	5.0	7.7	9.6	649	5.981	0.085	0.368	0.528	0.631	0.792	254
93-0724	930406	19.0	5.8	7.4	8.8	942	5.507	0.073	0.584	0.342	0.411	0.583	406
93-0828	930419	32.0	9.0	8.5	10.2	910	3.342	0.116	0.471	0.255	0.284	0.457	384
93-0895	930503	36.0	13.5	8.4	10.8	773	2.774	0.206	0.248	0.106	0.140	0.463	340
93-0985	930517	11.8	15.2	9.0	6.8	766	4.575	0.150	0.285	0.265	0.293	0.478	322
93-1080	930602	11.6	13.6	7.7	7.5	411	1.046	0.040	0.090	0.110	0.123	0.200	182
93-1139	930614	12.6	13.2	7.5	8	355	1.023	0.043	0.070	0.075	0.086	0.086	168
93-1290	930712	3.6	17.0	7.8	-999.0	472	0.886	0.059	0.106	0.137	0.155	0.352	231
93-1498	930816	8	16.7	7.7	7	497	0.970	0.039	0.035	0.116	0.116	0.212	248
93-1594	930914	10	10.5	-999	8.4	-999	0.754	0.016	0.047	0.046	0.064	0.148	222
93-1776	931018	-999	10.5	7.3	8.6	575	2.381	0.040	0.149	0.177	0.195	0.263	262
93-2013	931117	-999	1.2	7.7	-999	725	5.193	0.041	0.157	0.394	0.423	0.512	335
94-0170	940125	-999	2.5	7.7	11.5	479	3.987	0.025	0.065	0.024	0.043	0.046	225
94-0275	940222	-999	1.8	8.1	13.3	699	4.111	0.055	0.018	0.308	0.349	0.458	324

STATION 490437 - Worm Creek at stateline (C.R. xing)

LOG	DATE	VTSS mg/l	RTSS mg/l	CA mg/l	MG mg/l	HARD mg/l	SI mg/l	CHLORIDE mg/l	SO4 mg/l	F. STREP #/100ml	TC #/100ml	FC #/100ml
437-0910	920910	4	78	64.1	20.2	242.9	9.8	28.4	15.0	-999	400	200
437-0929	920929	3	83	72.1	19.8	261.1	9.8	30.1	10.6	-999	< 100	< 10
437-1020	921020	4	45	64.1	19.1	-999.0	18.5	23.0	16.1	-999	200	1
437-1110	921110	4	29	61.3	24.2	252.0	20.4	29.2	17.4	290	3200	222
437-1208	921208	2	17	69.0	24.4	292.0	29.7	21.3	15.1	120	3100	730
93-0082	930113	3	16	88.0	76.0	296.0	26.7	26.6	15.9	207	3300	730
93-0353	930222	3	40	77.7	27.1	305.1	26.0	136.5	19.3	148	1900	240
93-0476	930322	4	210	70.3	14.9	236.7	22.1	38.1	19.4	430	14400	2700
93-0724	930406	-999	95	133.1	11.7	379.8	-999.0	50.5	31.9	200	10000	2400
93-0828	930419	3	73	115.0	25.2	390.0	-999.0	46.1	31.6	400	9000	-999
93-0895	930503	4	51	107.4	17.8	341.0	-999.0	38.1	24.4	55	1000	140
93-0985	930517	4	135	80.2	29.1	319.1	-999.0	36.0	21.4	360	600	90
93-1080	930602	4	103	68.0	10.9	214.3	-999.0	12.6	9.4	300	1300	900
93-1139	930614	4	152	59.11	9.92	188.1	-999.0	9.9	6.72	320	6000	800
93-1290	930712	3	90	62.3	41.2	331.6	-999.0	9.9	6.2	2900	5000	2000
93-1498	930816	2	62	51.1	16.8	196.1	-999.0	13.5	6.4	1320	10000	600
93-1594	930914	2	29	47.8	17.9	192.8	-999.0	6.6	6.6	1160	42000	925
93-1776	931018	4	30	60.9	23.8	249.6	-999.0	16.2	6.13	950	10000	2700
93-2013	931117	2	20	71.8	36.5	328.8	-999.0	32.4	12.8	240	3000	4000
94-0170	940125	1	2	62.2	16.2	221.6	-999.0	12.6	11	280	200	10
94-0275	940222	1	76	65.6	29.6	284.8	-999.0	35.1	13.3	2190	11000	400

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - ECOSYSTEMS RESEARCH INSTITUTE

LOG	DATE	FLOW cfs	TEMP oC	pH units	DO mg/l	COND umhos/cm	NO3-N mg/l	NO2-N mg/l	NH3-N mg/l	PO4-P mg/l	DTP-P mg/l	TP-P mg/l	ALK mg/l
451-0910	920910	14.0	-999.0	8.3	-999.0	663	0.244	0.016	0.071	0.173	0.203	0.235	314
451-0929	920929	11.8	1.4	8.1	4.4	666	0.659	0.044	0.066	0.071	0.086	0.138	306
451-1020	921020	2.8	8.1	7.7	10.7	578	1.234	0.019	0.039	0.033	0.044	0.068	279
451-1110	921110	3.0	2.8	8.0	12.4	772	2.486	0.022	0.054	0.035	0.049	0.071	356
451-1208	921208	-999.0	0.2	6.6	7.8	771	2.791	0.030	0.124	0.056	0.067	0.081	355
93-0088	930113	-999.0	0.1	7.4	9.7	816	2.568	0.031	0.112	0.063	0.072	0.081	392
93-0358	930222	5.4	1.6	7.8	12.0	873	3.524	0.025	0.872	0.131	0.200	1.073	384
93-0478	930322	6.6	13.0	7.9	8.5	841	6.962	0.033	0.100	0.114	0.160	0.271	346
93-0725	930406	9.0	8.7	7.4	8.3	923	4.892	0.009	0.088	0.139	0.183	0.267	393
93-0808	930419	8.5	11.2	7.5	10.0	942	3.827	0.021	0.324	0.076	0.108	0.218	405
93-0896	930503	3.0	18.0	8.6	9.7	767	17.330	0.037	0.035	0.026	0.043	0.120	365
93-0986	930517	4.0	21.0	8.4	7.6	570	2.644	0.025	0.043	0.059	0.070	0.154	267
93-1081	930602	1.5	15.2	7.9	9.1	590	2.199	0.016	0.036	0.043	0.050	0.066	266
93-1140	930614	3.8	16.3	7.7	10.1	702	3.600	0.027	0.065	0.063	0.075	0.134	363
93-1291	930712	2.7	21.5	8.0	-999	753	2.098	0.061	0.076	0.074	0.092	0.194	360
93-1499	930816	2.8	19.6	7.9	8.7	709	3.835	0.036	0.054	0.053	0.069	0.126	350
93-1595	930914	9	11	-999	-999	-999	3.009	0.023	0.052	0.046	0.046	0.061	334
93-1777	931018	-999	11.3	7.8	10.3	775	4.179	0.021	0.046	0.064	0.076	0.125	356
93-2014	931117	-999	4	7.8	-999	739	5.555	0.019	0.063	0.104	0.112	0.127	342
94-0171	940125	-999	4.8	6.4	11.2	799	0.751	0.026	0.054	0.026	0.042	0.064	367
94-0276	940222	-999	3.2	8	12.6	780	4.815	0.021	0.092	0.041	0.091	0.097	361

STATION 490451 - Hopkins slough above Bear River

LOG	DATE	VTSS mg/l	RTSS mg/l	CA mg/l	MG mg/l	HARD mg/l	SI mg/l	CHLORIDE mg/l	SO4 mg/l	F. STREP #/100ml	TC #/100ml	FC #/100ml
451-0910	920910	1	8	89.8	15.6	287.8	6.1	33.7	16.0	-999	15000	8000
451-0929	920929	2	40	77.0	25.1	294.7	6.5	26.6	15.1	-999	1200	< 10
451-1020	921020	2	7	67.3	25.1	-999.0	10.9	15.9	14.8	-999	2300	550
451-1110	921110	2	6	70.7	39.9	340.0	19.1	30.1	24.4	640	2200	316
451-1208	921208	3	8	94.6	28.3	352.0	20.7	31.9	24.1	1376	3400	2900
93-0088	930113	1	4	79.0	184.0	380.0	23.4	35.5	20.5	1260	2100	960
93-0358	930222	3	16	132.8	10.4	373.7	19.1	44.3	24.2	680	2200	350
93-0478	930322	3	78	81.8	32.9	338.8	18.6	50.5	29.9	60	700	60
93-0725	930406	-999	75	139.5	6.8	375.8	-999.0	52.3	28.8	310	3000	300
93-0808	930419	3	66	153.8	11.3	430.0	-999.0	52.3	27.3	600	10000	-999
93-0896	930503	5	60	121.0	17.0	371.8	-999.0	32.8	18.8	70	3700	570
93-0986	930517	3	64	64.1	29.0	278.9	-999.0	16.2	13.4	330	3000	1500
93-1081	930602	3	38	111.7	4.2	295.9	-999.0	16.2	9.5	100	6000	1500
93-1140	930614	3	38	81.78	29.94	326.7	-999.0	24.3	11.84	1500	700	570
93-1291	930712	3	50	119.8	20.8	384.2	-999.0	26.1	13.6	700	5000	700
93-1499	930816	4	53	73.9	31.6	313.7	-999.0	23.4	11.8	2200	9000	3700
93-1595	930914	1	5	69.3	38.3	329.6	-999.0	12.9	12.9	1640	10000	975
93-1777	931018	3	5	71.4	41.4	354.4	-999.0	28.8	17.69	1570	1800	1800
93-2014	931117	2	5	75.1	40.6	353.6	-999.0	20.7	12.4	320	22000	150
94-0171	940125	1	7	79	43	373.6	-999.0	28.8	17	670	3000	110
94-0276	940222	2	9	72.5	39	340.8	-999.0	31.5	13.6	420	1400	20

STATION 490451 - Hopkins slough above Bear River

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - ECOSYSTEMS RESEARCH INSTITUTE

LOG	DATE	FLOW cfs	TEMP oC	pH units	DO mg/l	COND umhos/cm	NO3-N mg/l	NO2-N mg/l	NH3-N mg/l	PO4-P mg/l	DTP-P mg/l	TP-P mg/l	ALK mg/l
472-0910	920910	16.0	-999.0	10.6	-999.0	1416	0.042	0.002	0.030	0.011	0.074	0.853	288
472-0929	920929	15.8	0.0	10.4	-999.0	2290	0.094	0.004	0.027	0.005	0.094	1.303	323
472-1020	921020	-999.0	9.1	8.8	12.3	3110	0.066	0.006	0.044	0.008	0.109	1.668	390
472-1110	921110	-999.0	5.0	9.3	17.7	2290	0.062	0.002	0.012	0.016	0.091	1.308	328
472-1208	921208	-999.0	1.3	8.1	8.8	5760	0.077	0.017	1.407	0.565	0.622	1.106	113
93-0089	930113	-999.0	0.2	6.7	3.4	2670	0.346	0.060	2.322	0.975	0.975	1.092	481
93-0359	930222	1.5	0.2	6.8	3.9	3130	0.913	0.064	2.517	1.231	2.047	2.047	496
93-0479	930322	75.0	10.0	7.6	7.2	1435	6.618	0.100	0.628	0.901	0.901	1.035	217
93-0726	930406	11.0	8.3	7.7	9.6	3330	0.955	0.055	0.108	0.279	0.326	0.354	413
93-0809	930419	9.1	10.9	7.9	9.2	3880	0.500	0.037	0.085	0.161	0.207	0.648	446
93-0897	930503	9.0	18.5	8.9	10.6	4494	0.239	0.002	0.011	0.031	0.090	0.519	493
93-0987	930517	6.9	25.0	8.5	7.7	4170	0.005	0.004	0.001	0.363	0.439	0.719	467
93-1082	930602	0.8	18.3	8.1	7.4	4810	0.016	0.003	0.009	0.556	0.601	0.723	516
93-1141	930614	1.0	21.8	8.2	8.3	3980	0.006	0.004	0.015	0.243	0.323	0.607	514
93-1292	930712	0.1	22.5	9.1	-999	1524	0.018	0.025	0.236	0.136	0.215	0.419	262
93-1500	930816	0.1	21.2	8.9	-999	1435	0.021	0.002	0.035	0.022	0.079	0.865	265
93-1596	930914	0.1	19	-999	-999	-999	0.014	0.001	0.025	0.009	0.019	0.343	217
93-1778	931018	-999	13.3	8.6	-999	-999	0.019	0.016	0.056	0.641	0.734	2.034	492
93-2015	931117	-999	4.5	8.5	-999	389	0.323	0.054	0.129	0.011	0.040	0.257	477
94-0172	940125	-999	0.9	8.1	-999	-999	0.429	0.048	2.468	0.199	0.240	0.331	405
94-0277	940222	-999	0	7.8	5	265	0.133	0.020	6.111	1.080	1.241	1.685	342

STATION 490472 - Clay slough above Bear River

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - ECOSYSTEMS RESEARCH INSTITUTE

LOG	DATE	VTSS mg/l	RTSS mg/l	CA mg/l	MG mg/l	HARD mg/l	SI mg/l	CHLORIDE mg/l	SO4 mg/l	F. STREP #/100ml	TC #/100ml	FC #/100ml
472-0910	920910	6	118	59.3	37.1	300.0	2.9	246.4	119.2	-999	100	< 10
472-0929	920929	6	259	44.9	47.7	307.4	6.5	489.2	117.0	-999	400	100
472-1020	921020	5	317	64.1	38.8	-999.0	10.7	673.6	180.7	-999	1000	40
472-1110	921110	4	142	38.5	62.4	352.0	7.8	522.9	72.5	300	700	20
472-1208	921208	8	46	86.6	157.1	860.0	15.2	1489.0	85.9	1	100	1
93-0089	930113	4	15	112.0	240.0	520.0	22.3	584.9	86.2	20	70	1
93-0359	930222	3	11	145.7	51.8	575.8	28.3	709.0	94.6	160	2800	60
93-0479	930322	3	45	60.5	17.9	224.5	18.3	275.6	79.7	20	100	1
93-0726	930406	-999	113	168.3	20.8	505.1	-999.0	784.3	170.5	110	100	1
93-0809	930419	3	187	174.9	35.0	580.0	-999.0	966.0	186.6	80	20	-999
93-0897	930503	5	90	171.5	56.4	659.0	-999.0	1072.4	210.8	15	400	130
93-0987	930517	3	215	88.2	83.0	560.3	-999.0	1035.0	173.3	140	400	10
93-1082	930602	4	84	182.2	12.3	505.1	-999.0	1098.0	189.4	150	-999	20
93-1141	930614	5	75	123.5	69.8	594.1	-999.0	972.0	133.2	60	100	20
93-1292	930712	-999	78	84.7	13.9	268.4	-999.0	301.5	53.1	75	10000	1
93-1500	930816	5	186	17.7	58.6	284.3	-999.0	315	62.4	160	20	< 1
93-1596	930914	4	135	27.3	37.1	220.0	-999.0	38.1	39.1	40	< 100	< 10
93-1778	931018	7	15	44.5	133	656.0	-999.0	1494	134	300	5000	30
93-2015	931117	3	97	49.3	117.4	604.0	-999.0	972	101.7	130	10	< 1
94-0172	940125	2	17	44.5	88.1	472.0	-999.0	702	55	30	200	< 1
94-0277	940222	1	57	38.1	60.8	344.0	-999.0	459	50.9	1190	8000	4300

STATION 490472 - Clay slough above Bear River

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - DATA COURTESY OF UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

DATE	TEMP oC	DO umhos/cm	FLOW cfs	pH units	RTSS mg/l	TKN mg/l	F.STREP #/100ml	MF TOT #/100ml	MF FEC #/100ml	NH3 mg/l	TP mg/l	TURB ntu	TDS mg/l	F-pH units	DTP mg/l	D-NO2+NO3 mg/l
92-10-22	9.2	7.5	0.6		18	0.80	4600	12000	3200	0.059	0.141			8.0	0.139	1.134
92-12-09	0.2	10.3			96	30.33	53800	216000	47600	8.147	3.064			8.2	1.760	2.788
93-02-24	0.1	8.5		7.4	42	6.30	59000	30000	14000	2.083	1.152	25	806	7.8	0.900	2.005
93-03-10	2.6	9.4	4.0	7.2	116	11.02	43000	30000	14500	6.111	2.144	34	800	8.1	1.526	2.176
93-03-24	5.4	8.9	2.7	7.5	24	2.45	23000	121000	9000	0.510	0.515	13	692	7.6	0.494	7.640
93-04-06	8.6	10.2	1.9	7.8	18	0.68				0.522	0.430	10	690	8.1	0.439	6.417
93-04-22	13.5	14.0	1.2	8.3	18	1.07	1000	2000	200	0.050	0.310	8	672	8.6	0.256	3.809
93-05-06	7.1	6.8	11.4	7.5	162	24.06	87000	47600	25600	10.350	3.784	100	812	8.1	2.734	1.913
93-05-18	22.0	13.4	1.4	8.6	12	1.01	17000	10000	6200	0.141	0.410	8.8	364	9.0	0.358	1.621
93-06-02	13.2	10.1	12.0	8.0	13	0.10	2500	1000	800	0.066	0.147	10	254	8.6	0.125	0.730
93-06-16	16.0	8.6	22.5	7.8	36	0.71	7000	3200	1300	0.106	1.028	15	328	8.4	0.995	5.848
93-07-20	18.3	9.0	3.4	8.2	5	0.90	2200	1700	700	0.050	0.235	4.1	276	8.5	0.186	1.252
93-08-25	17.2	8.3	16.4	7.9	12	0.40	11600	500	20	0.050	0.163	3.6	274	8.4	0.126	1.086
93-09-16	12.4	7.9		8.1	32	0.75				0.050	0.087	12	270	8.2	0.045	0.973

STATION 490487 - Hyrum slough at Nibley/College Ward

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - DATA COURTESY OF UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

DATE	TEMP oC	DO umhos/cm	FLOW cfs	pH units	RTSS mg/l	TKN mg/l	F.STREP #/100ml	MF TOT #/100ml	MF FEC #/100ml	NH3 mg/l	TP mg/l	TURB ntu	TDS mg/l	F-pH units	DTP mg/l	D-NO2+NO3 mg/l
92-10-22	9.9	7.5	41.1		14	1.04	750	8900	1000	0.427	1.735			7.8	1.624	10.730
92-12-09	3.4	9.8			13	6.33	10850	7100	3450	3.961	1.891			7.9	1.767	8.431
93-02-24	4.4	10.2	27.0	7.5	42	7.80	10700	13300	3850	5.449	1.747	18	544	7.7	1.043	5.638
93-03-10	6.9	6.7	48.2	7.2	50	7.62	12200	10600	1300	1.165	0.710	21	498	8.0	0.566	1.943
93-03-23	11.2	9.8	66.8	7.8	60	2.28	2400	3000	200	0.333	0.971	25	604	7.8	0.846	8.410
93-04-03	9.9	7.5	46.5	7.7	52	0.64				0.397	0.824	20	596	7.9	0.657	9.691
93-04-22	12.7	8.9	40.2	7.9	69	0.20	200	3900	100	0.064	0.452	24	446	8.0	0.323	2.344
93-05-06	9.2	7.6	52.9	7.8	15	1.01	3220	11900	4140	0.346	0.480	10	454	8.0	0.396	2.060
93-05-18	17.5	6.9	60.0	7.8	39	1.21	700	1000	100	0.366	1.020	17	444	8.1	1.498	7.096
93-06-02	15.1	7.6	36.9	7.6	24	0.55	800	2400	340	0.180	0.229	11	332	8.2	0.197	1.004
93-06-16	17.3	7.3	41.3	7.5	84	0.62	640	2300	210	0.124	0.341	32	304	8.0	0.215	0.944
93-07-20	19.8	8.6	50.5	7.9	44	1.14	720	800	360	0.127	0.347	14	362	8.0	0.252	1.091
93-08-25	17.9	7.3	56.2	7.9	41	0.76	1440	650	130	0.096	0.400	14	356	8.0	0.285	1.658
93-09-17				8.0	18	0.41				0.050	0.106	6.5	312		0.069	1.002
93-09-22	14.6	12.0	4.0	8.0	7	0.55				0.050	0.029	2.9	296	8.9	0.010	0.922

STATION 490490 - Spring Creek at Mendon Road

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - DATA COURTESY OF UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

DATE	TEMP oC	DO umhos/cm	FLOW cfs	pH units	RTSS mg/l	TKN mg/l	F.STREP #/100ml	MF TOT #/100ml	MF FEC #/100ml	NH3 mg/l	TP mg/l	TURB ntu	TDS mg/l	F-pH units	DTP mg/l	D-NO2+NO3 mg/l
92-10-22	9.1		0.2		64	1.48	2300	5000	1300	0.132	0.612			7.6	0.487	2.791
92-12-09	2.7		2.5		49	20.73	27700	20800	17700	15.750	8.129			7.7	7.923	31.560
93-02-24	2.1	9.9	1.4	7.4	9	1.28	1000	5000	200	0.470	0.574	2	608	7.5	0.548	2.911
93-03-10	4.1	8.3	1.4	7.4	8	2.85	1000	6400	100	0.273	0.433	2.8	594	7.9	0.415	1.564
93-03-24	4.4	8.3	2.3	7.5	3	1.05	800	600	20	0.080	0.345	2.3	516	7.4	0.309	2.260
93-04-06	9.5	7.6	1.6	7.7	14	0.10				0.050	0.382	5.5	618	7.8	0.330	1.889
93-04-22	15.0	10.6	1.5	8.0	36	0.84	160	750	80	0.057	0.428	12	536	8.2	0.325	1.104
93-05-06	7.8	6.2	1.4	7.8	16	0.79	810	3820	952	0.093	0.546	6.3	564	7.8	0.552	0.257
93-05-18	25.4	6.8	1.2	7.9	6	1.01	300	1200	390	0.105	0.395	3.3	492	7.8	0.372	0.547
93-06-02	14.5	5.8	5.7	7.6	20	0.94	1680	4450	590	0.151	1.459	7.8	428	8.1	1.394	1.165
93-06-16	20.9	9.3	0.9	7.9	19	0.82	1850	5900	720	0.143	0.629	10	418	8.4	0.606	0.982
93-07-20	19.4	5.8	4.3	7.7	14	1.17	9900	2800	4000	0.067	2.421	3.4	560	7.7	2.239	0.640
93-08-25	22.1	8.4	0.5	8.0	29	1.04	10700	100	1500	0.157	0.575	10	484	7.7	0.447	1.676

TATION 490492 - South Fork Spring Creek west of Pelican Pond

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - DATA COURTESY OF UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

DATE	TEMP oC	DO umhos/cm	FLOW cfs	pH units	RTSS mg/l	TKN mg/l	F.STREP #/100ml	MF TOT #/100ml	MF FEC #/100ml	NH3 mg/l	TP mg/l	TURB ntu	TDS mg/l	F-pH units	DTP mg/l	D-NO2+NO3 mg/l
92-10-22	11.2	4.2	5.6		20	8.82	20600	111000	6400	6.686	20.030			7.8	19.340	106.100
92-12-09	3.4	6.8	10.0		668	92.68	120500	546000	8100	2.947	31.230			7.9	13.610	30.730
93-02-24	5.5	8.3	12.2	7.5	81	40.65	22000	70000	100	36.050	11.660	23	1192	7.7	11.210	34.040
93-03-10	5.7	5.6	5.7	7.2	558	9.27	74000	226000	14200	4.768	3.762	58	822	8.0	2.854	9.155
93-03-24	6.9	8.9	9.7	7.8	59	5.08	700	30000	1400	1.807	8.627	23	1046	7.4	6.280	45.960
93-04-06	10.6	6.1	9.9	7.3	43	4.78				1.306	5.277	16	1200	7.9	4.618	63.650
93-04-22	15.2	1.7	4.1	7.6	53	7.69	4200	189000	8000	0.967	4.499	18	822	7.9	3.831	11.160
93-05-06	8.0	3.7	9.0	7.5	366	32.91	37400	478000	51400	10.180	7.785	140	986	7.9	4.935	12.470
93-05-18	23.8	3.7	7.0	7.6	62	11.99	1000	10000	1000	10.020	13.930	25	1828	7.8	12.220	83.570
93-06-02	5.3	6.2	7.2	7.4	49	2.57	5400	70000	22400	1.359	2.106	20	410	8.1	1.958	2.566
93-06-16	17.2	6.2	6.3	7.5	107	1.61	2400	16000	3500	0.340	2.367	34	598	8.0	1.042	3.428
93-07-20	21.0	6.3	21.3	7.8	75	1.62	7200	42000	6000	0.207	1.151	14	370	7.9	1.040	1.190
93-08-25	26.0	6.4	8.1	7.6	111	3.68	25600	36000	1000	1.673	2.284	27	996	8.3	0.179	32.290
93-09-16	14.0	5.6		7.1	32	3.40				0.113	2.414	11.5	608	7.7	1.878	11.830

STATION 490494 - South Fork Spring Creek at U.S. 89 xing

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - DATA COURTESY OF UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

DATE	TEMP oC	DO umhos/cm	FLOW cfs	pH units	RTSS mg/l	TKN mg/l	F.STREP #/100ml	MF TOT #/100ml	MF FEC #/100ml	NH3 mg/l	TP mg/l	TURB ntu	TDS mg/l	F-pH units	DTP mg/l	D-NO2+NO3 mg/l
92-10-22	10.0	6.4	14.9		6	0.18	208	430	42	0.050	0.075			7.6	0.051	0.937
92-12-09	5.8	8.0	13.0		12	0.38	590	1160	500	0.050	0.075			7.9	0.036	1.705
93-02-24	8.6	8.5	18.0	7.5	52	0.25	170	280	20	0.050	0.068	20	332	7.5	0.061	1.321
93-03-10	8.3	6.3	17.1	7.4	70	1.70	224	2180	48	0.072	0.119	30	342	8.0	0.046	1.303
93-03-24	8.8	10.3	9.7	7.7	28	0.22	50	440	44	0.050	0.082	15	370	7.6	0.048	2.340
93-04-06	12.5	7.5	14.9	7.9	17	0.10				0.050	0.034	7.6	356	7.9	0.036	2.168
93-04-22	13.9	10.7	12.6	8.0	10	0.10	36	460	2	0.050	0.036	5.6	316	7.9	0.017	1.424
93-05-06	9.5	8.4	15.5	7.8	10	0.16	336	1200	82	0.050	0.028	5.9	334	7.8	0.026	1.284
93-05-18	18.1	11.0	11.2	8.1	34	0.34	30	220	24	0.050	0.084	8.3	274	8.4	0.017	1.015
93-06-02	15.0	12.4	12.0	7.9	10	0.10	744	1250	276	0.050	0.033	4	304	8.4	0.019	0.862
93-06-16	16.2	13.7	17.4	6.1	94	0.10	100	340	80	0.050	0.017	18	468	8.4	0.010	1.028
93-07-20	18.3	9.1	8.3	7.9	10	0.32	140	60	28	0.061	0.043	6.6	326	8.2	0.014	1.331
93-08-25	16.8	10.1	12.5	8.0	8	0.20	68	12	62	0.050	0.036	1.1	304	8.3	0.012	1.029
93-09-16	12.3	5.5		7.7	14	0.38				0.050	0.023	2	302	7.3	0.013	1.049

STATION 490499 - Spring Creek 1.3 miles north of College Ward

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - DATA COURTESY OF UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

DATE	TEMP oC	DO umhos/cm	FLOW cfs	pH units	RTSS mg/l	TKN mg/l	F.STREP #/100ml	MF TOT #/100ml	MF FEC #/100ml	NH3 mg/l	TP mg/l	TURB ntu	TDS mg/l	F-pH units	DTP mg/l	D-NO2+NO3 mg/l
92-10-22	9.7	8.1	16.3	7.9	47	0.45	380	260	190	0.050	0.140	20	374	8.0	0.061	0.478
92-12-09	1.3	10.8		8.0	10	0.27	1180	870	140	0.107	0.108	6.5	364	8.0	0.070	1.032
93-02-24	3.0	9.6	19.8	7.7	28	0.67	400	280	24	0.126	0.238	8.9	424	7.6	0.204	1.118
93-03-10	3.8	9.1	104.9	7.6	35	1.77	530	300	18	0.117	0.107	14	318	8.1	0.072	0.790
93-03-23	7.3	11.3	140.7	7.8	49	0.76	480	660	42	0.077	0.187	40	280	7.9	0.154	1.444
93-04-06	7.3	8.8	165.8	8.0	39	0.54				0.132	0.171	20	314	8.0	0.133	1.404
93-04-22	10.4	9.8	175.2	8.1	42	0.28	30	150	56	0.050	0.108	16	272	8.3	0.057	0.890
93-05-06	9.3	8.6		8.0	50	0.26	284	176	116	0.050	0.081	17	226	8.3	0.037	0.301
93-05-18	17.5	8.1		7.9	47	0.62	260	570	164	0.070	0.109	17	180	8.3	0.037	0.162
93-06-02	15.6	7.5	83.0	7.8	39	0.54	280	740	132	0.050	0.064	14	212	8.3	0.035	0.346
93-06-16	16.3	7.9	117.4	7.6	36	0.26	170	440	144	0.050	0.086	14	228	8.1	0.040	0.503
93-07-20	19.7	8.7	35.9	8.0	81	0.58	416	80	240	0.083	0.276	22	386	8.1	0.104	1.278
93-08-25	18.3	7.7	27.9	7.9	47	0.45	180	10	184	0.053	0.198	13	374	7.8	0.114	1.085
93-09-16	11.4	6.2		7.7	30	0.62				0.050	0.110	7.5	368	7.9	0.080	0.781

STATION 490500 - Little Bear River above Logan River

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - DATA COURTESY OF UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

DATE	TEMP oC	DO umhos/cm	FLOW cfs	pH units	RTSS mg/l	TKN mg/l	F.STREP #/100ml	MF TOT #/100ml	MF FEC #/100ml	NH3 mg/l	TP mg/l	TURB ntu	TDS mg/l	F-pH units	DTP mg/l	D-NO2+NO3 mg/l
92-10-21	9.8	8.1	55.6	8.0	4	0.450				0.050	0.040	3.1	258	7.9	0.017	0.265
92-12-09	3.8	10.4		7.9	6	0.130				0.050	0.098	3.4	284	8.1	0.015	0.293
93-02-24	3.4	11.9	94.3	7.6	7	0.239	120	160	10	0.050	0.015	2	246	7.8	0.019	1.292
93-03-23	10.3	10.9	489.8	8.0	23	0.550	16	340	28	0.050	0.096	9	240	8.1	0.029	0.972
93-04-06	8.3	8.6	328.2	8.1	18	0.240				0.050	0.030	7.4	246	8.2	0.023	0.535
93-04-22	9.9	10.2	337	8.2	25	0.100	76	250	88	0.050	0.052	12	200	8.4	0.016	0.434
93-05-06	6.8	9.7	644	7.9	24	0.270	616	790	284	0.105	0.068	12	188	8.2	0.041	0.436
93-05-18	11.5	9.4	1153	7.9	34	1.010	350	1020	136	0.080	0.073	15	168	8.7	0.027	0.261
93-06-02	9.4	9.3	661	7.7	16	0.240	120	260	128	0.050	0.042	5.9	174	8.4	0.017	0.196
93-06-16	12.0	9.4		7.8	11	0.100	84	600	164	0.050	0.025	4	180	8.3	0.010	0.211
93-07-20	14.6	9.6	207.4	8.0	8	0.110	56	220	132	0.050	0.021	2.2	216	8.1	0.010	0.368
93-08-25	16.9	8.4	34.4	8.1	4	0.160	184	10	100	0.050	0.031	1.4	244	8.2	0.023	0.614
93-09-16	10.9	7.8		8.0	6	0.230				0.050	0.026	1.6	254	7.9	0.010	0.440

STATION 490504 - Logan River above confluence with Little Bear River

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - DATA COURTESY OF UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

DATE	TEMP oC	DO umhos/cm	FLOW cfs	pH units	RTSS mg/l	TKN mg/l	F.STREP #/100ml	MF TOT #/100ml	MF FEC #/100ml	NH3 mg/l	TP mg/l	TURB ntu	TDS mg/l	F-pH units	DTP mg/l	D-NO2+NO3 mg/l
92-10-21	10.3	9.0	76	8.1	3	0.220				0.050	0.045	0.43	206	8.4	0.010	0.231
92-12-09	5.4	10.7	42	7.8	7	0.100				0.050	0.027	2.3	234	8.1	0.010	0.237
93-02-24	6.1	12.3	63	7.8	3	0.187	10	160	10	0.050	0.010	0.45	220	8.1	0.010	0.214
93-03-23	6.7	10.6	127	7.9	3	0.100	20	40	12	0.050	0.011	2.8	220	7.9	0.014	0.324
93-04-06	6.8	9.9	149	7.9	3	0.150				0.050	0.015	1.5	236	8.7	0.018	0.319
93-05-06	5.9	9.7	342	7.9	9	0.620	24	96	2	0.050	0.058	4.4	176	7.9	0.032	0.229
93-05-18	9.4	9.0	894	8.0	28	0.440	16	140	10	0.050	0.045	10	150	8.7	0.012	0.239
93-06-02	8.5	9.5	979	7.7	14	0.100	76	128	2	0.050	0.039	4	152	8.4	0.020	0.053
93-06-16	10.3	9.4	863	7.9	7	0.640	24	124	2	0.410	0.033	0.15	160	8.4	0.010	0.062
93-07-20	9.5	9.8	347	7.9	3	0.100	12	44	10	0.050	0.027	1.1	190	8.2	0.034	0.200
93-08-25	13.6	9.6		8.1	4	0.100	56	12	10	0.050	0.011	0.9	194	8.2	0.010	0.222
93-09-16	9.2	8.6		8.1	3	0.210				0.050	0.014	0.45	196	8.2	0.010	0.146

STATION 490520 - Logan River at mouth of canyon

LOG	DATE	FLOW cfs	TEMP oC	pH units	DO mg/l	COND umhos/cm	NO3-N mg/l	NO2-N mg/l	NH3-N mg/l	PO4-P mg/l	DTP-P mg/l	TP-P mg/l	ALK mg/l
540-0910	920910	14.5	-999.0	7.9	-999.0	605	0.078	0.002	0.034	0.024	0.029	0.037	293
540-0929	920929	12.2	8.3	8.2	8.6	555	0.301	0.005	0.016	0.015	0.017	0.036	245
540-1020	921020	27.3	9.7	7.8	10.2	482	0.196	0.002	0.013	0.007	0.011	0.023	224
540-1112	921110	50.0	5.3	8.0	10.0	470	0.201	0.002	0.008	0.009	0.010	0.020	220
540-1208	921208	-999.0	4.7	8.0	9.4	472	0.233	0.002	0.020	0.003	0.016	0.023	216
93-0084	930113	-999.0	1.5	7.4	12.4	467	0.276	0.004	0.030	0.007	0.007	0.017	237
93-0360	930222	66.9	4.9	7.6	10.6	459	0.401	0.005	0.042	0.009	0.019	0.023	201
93-0461	930322	198.0	8.0	6.9	10.1	396	1.017	0.005	0.035	0.030	0.033	0.077	182
93-0727	930406	210.0	8.3	7.4	9.2	386	0.897	0.002	0.018	0.014	0.025	0.085	181
93-0810	930419	360.0	7.1	7.3	9.8	364	0.383	0.002	0.021	0.017	0.024	0.066	167
93-0898	930503	380.0	11.1	7.7	10.6	367	0.461	0.002	0.027	0.017	0.030	0.064	172
93-0968	930517	465.0	13.3	7.2	9.3	341	0.417	0.003	0.017	0.027	0.032	0.147	161
93-1083	930602	120.1	11.8	8.1	9.3	412	0.354	0.002	0.014	0.011	0.011	0.019	191
93-1142	930614	134	13.9	7.9	8.6	429	0.324	0.004	0.021	0.009	0.009	0.016	208
93-1293	930712	26.7	18.0	8.1	-999.0	503	0.625	0.008	0.014	0.014	0.016	0.017	244
93-1501	930816	47	19.3	8	8.4	466	0.487	0.006	0.033	0.007	0.026	0.030	233
93-1597	930914	59	12.5	8	10.6	460	0.468	0.002	0.015	0.006	0.006	0.007	219
93-1779	931018	-999	8.7	7.6	9.9	453	0.339	0.003	0.026	0.014	0.030	0.034	218
93-2016	931117	-999	5.5	7.9	-999	447	0.358	0.003	0.027	0.010	0.011	0.022	209
94-0173	940125	-999	6.4	7.4	11.4	457	0.378	0.003	0.056	0.008	0.018	0.037	215
94-0278	940222	-999	5	8.1	-999	460	0.400	0.000	0.038	0.007	0.029	0.038	204

STATION 490540 - Blacksmith Fork above Logan River (Hwy 89)

LOG	DATE	VTSS mg/l	RTSS mg/l	CA mg/l	MG mg/l	HARD mg/l	SI mg/l	CHLORIDE mg/l	SO4 mg/l	F. STREP #/100ml	TC #/100ml	FC #/100ml
540-0910	920910	1	1	105.8	11.8	312.2	5.8	19.5	21.8	-999	110	10
540-0929	920929	1	5	73.8	22.4	277.9	4.6	9.8	41.9	-999	220	< 10
540-1020	921020	3	5	67.3	16.2	-999.0	7.5	8.9	34.1	-999	1700	760
540-1112	921110	1	3	62.1	19.8	236.0	8.8	8.0	27.5	690	1400	492
540-1208	921208	2	4	64.2	27.3	252.0	8.0	8.9	31.5	14	200	90
93-0084	930113	3	14	71.0	80.0	256.0	8.5	7.1	31.0	22	600	68
93-0360	930222	2	7	69.6	14.3	232.3	8.5	10.6	26.2	38	160	100
93-0461	930322	2	34	57.3	12.9	195.9	5.2	11.5	20.6	10	500	40
93-0727	930406	-999	20	54.5	13.2	189.9	-999.0	9.7	15.6	18	100	1
93-0810	930419	4	37	59.9	7.4	180.0	-999.0	8.9	15.3	28	1800	-999
93-0898	930503	2	33	60.9	9.2	189.7	-999.0	7.1	12.9	100	600	150
93-0968	930517	2	123	49.7	10.7	167.8	-999.0	3.6	8.5	0	200	140
93-1083	930602	3	13	82.6	5.5	228.6	-999.0	4.5	12.8	58	130	20
93-1142	930614	2	11	63.16	16.63	225.7	-999.0	6.3	14.72	225	300	70
93-1293	930712	2	4	100.8	10.5	288.4	-999.0	7.2	19.3	150	1000	50
93-1501	930816	2	4	39.3	46.9	290.2	-999.0	9.45	15.8	140	300	60
93-1597	930914	1	5	58.5	21.6	234.4	-999.0	15.3	15.2	140	300	80
93-1779	931018	2	2	58.2	21.4	232.8	-999.0	5.4	18.8	33	500	20
93-2016	931117	2	3	57.7	21.3	231.2	-999.0	5.9	20.4	68	200	50
94-0173	940125	2	2	62.7	22.9	250.4	-999.0	5.4	22	195	300	60
94-0278	940222	2	14	56.4	21.3	228.0	-999.0	6.8	22.6	28	310	200

STATION 490540 - Blacksmith Fork above Logan River (Hwy 89)

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - DATA COURTESY OF UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

DATE	TEMP oC	DO umhos/cm	FLOW cfs	pH units	RTSS mg/l	TKN mg/l	F.STREP #/100ml	MF TOT #/100ml	MF FEC #/100ml	NH3 mg/l	TP mg/l	TURB ntu	TDS mg/l	F-pH units	DTP mg/l	D-NO2+NO3 mg/l
92-10-21	9.9	8.6		8.1	5	0.100				0.050	0.018	1.7	236	8.6	0.010	0.141
92-12-09	3.4	10.6		7.8	5	0.200				0.050	0.032	2.5	236	8.1	0.010	0.285
93-02-24	3.9	12.4		7.9	6	0.100	10	40	10	0.050	0.012	1.4	220	8.2	0.010	0.278
93-03-24	5.3	10.3		7.7	39	0.590	200	1090	20	0.050	0.103	23	190	8.0	0.049	0.689
93-04-06	6.9	7.8		8.3	16	1.830				0.050	0.025	6.8	208	8.7	0.028	0.394
93-05-06	6.8	9.6		7.9	33	0.540	108	560	34	0.050	0.042	12	192	8.4	0.020	0.392
93-05-18	12.6	8.6		8.1	45	0.280	24	120	2	0.050	0.075	17	180	8.9	0.027	0.313
93-06-02	9.7	9.0		7.9	24	0.100	52	480	36	0.050	0.042	6.9	218	8.5	0.016	0.198
93-06-16	11.5	9.1		7.9	8	0.320	80	280	74	0.050	0.017	2.5	222	8.5	0.010	0.147
93-07-21	12.6	9.4		8.0	6	0.230	800	30	36	0.050	0.012	1.5	234	8.3	0.013	0.268
93-08-25	12.6	9.9		8.1	6	0.250	40	4	2	0.050	0.012	1.6	216	8.7	0.010	0.248
93-09-16	10.6	8.6		8.2	3	0.100				0.050	0.010	0.77	218	8.3	0.010	0.224

STATION 490544 - Blacksmith Fork at mouth of canyon

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - DATA COURTESY OF UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

DATE	TEMP oC	DO umhos/cm	FLOW cfs	pH units	RTSS mg/l	TKN mg/l	F.STREP #/100ml	MF TOT #/100ml	MF FEC #/100ml	NH3 mg/l	TP mg/l	TURB ntu	TDS mg/l	F-pH units	DTP mg/l	D-NO2+NO3 mg/l
92-10-22	10.2	7.4	9.4		11	0.27	800	4500	250	0.050	0.175			7.8	0.802	12.170
92-12-09	2.8	9.9			29	2.04	9100	11000	5650	0.382	0.532			7.9	0.456	0.901
93-03-24	4.6	10.4	137.5	7.7	50	0.74	400	200	100	0.078	0.206	32	242	7.7	0.147	1.508
93-04-06	7.1	9.1	150.0	7.9	12	0.41				0.266	0.309	17	258	8.0	0.253	1.288
93-04-22	13.0	10.0		8.2	60	0.63	80	1200	280	0.057	0.140	15	214	8.2	0.072	0.508
93-05-06	9.8	9.3		8.1	65	0.73	870	3750	620	0.068	0.140	28	212	8.5	0.054	0.381
93-05-18	17.2	7.2		7.9	76	0.61	200	800	380	0.050	0.109	21	186	8.3	0.060	0.430
93-06-02	16.0	7.6	100.0	7.9	35	0.17	220	1050	310	0.050	0.057	6.8	202	8.5	0.035	0.282
93-06-16	15.2	7.0	70.0	7.5	48	0.48	930	1200	420	0.099	0.369	14	282	8.0	0.319	0.596
93-07-20	20.1	8.1	11.9	7.9	16	0.36	900	900	410	0.059	0.268	4.4	404	8.0	0.249	1.358
93-08-25	16.4	8.0	14.7	7.8	15	1.22	1660	180	210	0.134	0.541	4	358	8.2	0.251	1.040

STATION 490559 - Little Bear River above Wellsville

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - DATA COURTESY OF UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

DATE	TEMP oC	DO umhos/cm	FLOW cfs	pH units	RTSS mg/l	TKN mg/l	F.STREP #/100ml	MF TOT #/100ml	MF FEC #/100ml	NH3 mg/l	TP mg/l	TURB ntu	TDS mg/l	F-pH units	DTP mg/l	D-NO2+NO3 mg/l
92-10-22	11.5	5.4	1.4		8	0.18	484	940	220	0.050	0.078			7.6	0.058	0.188
92-12-09	2.8	9.9			3	0.58	1560	860	100	0.065	0.063			7.7	0.043	0.501
93-02-24	3.6	11.1		7.4	8	0.58	200	900	148	0.050	0.049	2.7	358	7.6	0.029	1.346
93-03-24	4.2	11.7	131.7	7.7	30	0.48	170	120	32	0.050	0.128	30	216	8.1	0.131	1.231
93-04-06	7.1	8.6	150.0	8.1	18	0.66				0.050	0.082	17	220	8.1	0.076	0.978
93-04-22	9.9	10.3	133.6	7.9	31	0.79	36	136	62	0.050	0.901	5.2	214	8.2	0.847	0.421
93-05-06	10.7	9.7		8.2	20	0.26	24	116	46	0.050	0.123	13	202	8.6	0.050	0.258
93-05-18	13.1	9.3	570.0	7.8	22	0.50	24	92	26	0.079	0.056	7.7	174	8.5	0.019	0.272
93-06-02	16.0	8.2	86.0	7.9	8	0.40	96	136	40	0.050	0.031	4.4	180	8.6	0.018	0.227
93-06-16	14.7	9.4	24.0	7.6	3	0.16	36	72	52	0.050	0.040	2.2	238	8.2	0.030	0.405
93-07-20	20.7	9.1	2.5	7.8	6	0.75	176	128	100	0.065	0.070	0.93	344	7.9	0.033	1.400
93-08-25	17.2	8.6	6.2	7.8	3	0.19	272	24	18	0.050	0.036	0.8	328	8.2	0.100	4.887
93-09-16	14.9	6.8		7.9	3	0.75				0.050	0.030	1.2	264	7.9	0.031	0.586

STATION 490565 - Little Bear River one mile below Hyrum Reservoir

LOG	DATE	FLOW cfs	TEMP oC	pH units	DO mg/l	COND umhos/cm	NO3-N mg/l	NO2-N mg/l	NH3-N mg/l	PO4-P mg/l	DTP-P mg/l	TP-P mg/l	ALK mg/l
566-1022	921022	15.0	10.5	7.8	10.2	526	1.154	0.033	0.047	0.049	0.055	0.089	264
566-1112	921112	20.0	4.1	8.1	10.8	529	1.102	0.007	0.016	0.007	0.033	0.106	253
566-1209	921209	25.0	2.6	7.8	11.1	497	1.093	0.007	0.045	0.024	0.031	0.068	241
93-0146	930120	35.0	1.3	7.8	9.4	480	0.828	0.006	0.185	0.030	0.041	0.081	224
93-0362	930223	41.3	3.7	7.5	10.3	458	0.654	0.008	0.070	0.020	0.025	0.096	210
93-0442	930309	43.1	7.3	7.6	10.5	441	0.657	0.003	0.033	0.019	0.019	0.079	215
93-0462	930322	180.7	7.8	7.3	9.4	348	1.498	0.007	0.051	0.056	0.066	0.165	141
93-0707	930405	188.8	6.8	7.3	9.1	309	0.936	0.003	0.049	0.041	0.052	0.164	114
93-0811	930419	153.5	5.7	7.3	-999.0	292	0.514	0.003	0.051	0.018	0.027	0.065	169
93-0899	930503	550.0	10.9	7.7	9.2	330	0.516	0.002	0.029	0.007	0.017	0.068	159
93-0969	930517	660.0	13.0	6.7	8.5	302	0.458	0.003	0.017	0.013	0.019	0.153	139
93-1086	930603	61.0	9.0	7.8	9.4	328	0.506	0.003	0.020	0.017	0.029	0.063	135
93-1145	930615	23.0	12.9	7.9	10.3	348	0.668	0.006	0.047	0.013	0.013	0.043	168
93-1204	930629	31.0	19.0	7.9	7.5	487	1.257	0.026	0.079	0.037	0.070	0.070	224
93-1296	930712	19.3	15.4	7.5	9.9	552	2.025	0.043	0.057	0.044	0.044	0.069	266
93-1345	930728	37.6	16.3	7.5	9.0	538	1.896	0.046	0.064	0.048	0.048	0.061	258
93-1503	930817	26.1	14.1	7.0	9.4	588	2.036	0.041	0.029	0.037	0.046	0.064	280
93-1546	930830	43.4	13.4	6.9	8.9	551	2.560	0.084	0.033	0.032	0.040	0.055	259
93-1613	930913	49.8	12.7	8.2	11.7	552	2.442	0.020	0.035	0.033	0.033	0.048	270
93-1718	930927	39.4	10.8	7.8	11.4	571	2.110	0.020	0.040	0.035	0.035	0.063	286

STATION 490566 - Little Bear above Hyrum Reservoir

LOG	DATE	VTSS mg/l	RTSS mg/l	CA mg/l	MG mg/l	HARD mg/l	SI mg/l	CHLORIDE mg/l	SO4 mg/l	F. STREP #/100ml	TC #/100ml	FC #/100ml
566-1022	921022	3	21	73.7	22.1	-999	13.6	14.2	16.8	-999	800	300
566-1112	921112	1	14	71.5	18.9	256	13.4	13.3	17.3	40	300	18
566-1209	921209	2	29	72.2	3.9	-999	14.8	14.2	14.5	40	1400	70
93-0146	930120	3	22	66.0	72.0	236	13.7	30.1	15.8	-999	-999	-999
93-0362	930223	6	43	69.6	12.3	224	13.9	14.2	14.4	46	30	< 1
93-0442	930309	4	30	67.1	12.9	220	12.7	13.3	14.1	10	300	8
93-0462	930322	-999	103	53.9	6.9	163	-999.0	11.5	18.7	40	60	40
93-0707	930405	-999	132	40.1	8.1	133	-999.0	9.7	9.8	140	900	280
93-0811	930419	3	33	55.1	8.4	172	12.0	9.8	11.4	10	400	-999
93-0899	930503	3	45	55.3	66.0	165	9.9	6.7	8.2	10	200	10
93-0969	930517	2	136	41.7	10.7	148	8.6	4.5	6.0	30	1000	50
93-1086	930603	3	27	51.0	9.8	167	9.8	5.4	6.0	110	1000	530
93-1145	930615	4	21	51.8	12.4	180	10.3	5.9	5.8	10	120	90
93-1204	930629	2	18	96.0	0.2	240	15.8	9.0	10.6	376	400	330
93-1296	930712	2	21	98.3	12.6	297	18.0	13.5	13.2	TNTC	1000	400
93-1345	930728	1	15	100.8	7.5	282	16.0	11.7	12.9	142	4000	300
93-1503	930817	2	16	71.0	25.3	281	17.5	14.4	8.5	TNTC	18000	1500
93-1546	930830	1	10	68.6	23.0	266	17.7	12.1	12.1	100	1000	80
93-1613	930913	1	9	69.9	24.8	276	15.9	11.9	11.9	230	300	110
93-1718	930927	2	13	69.6	26.2	281	-999.0	13.1	13.1	158	1000	300

STATION 490566 - Little Bear above Hyrum Reservoir

LOG	DATE	FLOW cfs	TEMP oC	pH units	DO mg/l	COND umhos/cm	NO3-N mg/l	NO2-N mg/l	NH3-N mg/l	PO4-P mg/l	DTP-P mg/l	TP-P mg/l	ALK mg/l
567-1209	921209	20.0	2.6	7.6	10.1	504	0.379	0.003	0.063	0.013	0.016	0.031	215
NOACCESS	930112												
93-0364	930223	35.0	4.2	7.7	10.7	428	0.347	0.005	0.026	0.011	0.014	0.035	190
93-0443	930309	15.7	6.2	7.8	11.0	416	0.388	0.003	0.019	0.007	0.007	0.025	201
93-0463	930322	179.6	4.8	7.2	10.9	314	1.388	0.007	0.077	0.056	0.069	0.147	110
93-0708	930405	279.0	5.0	6.7	10.8	273	0.695	0.005	0.109	0.055	0.065	0.150	136
93-0812	930419	177.0	5.5	7.4	10.9	346	0.414	0.003	0.089	0.024	0.032	0.065	158
93-0900	930503	536.0	10.4	7.3	9.1	323	0.319	0.002	0.070	0.009	0.020	0.048	153
93-0970	930517	657.0	12.9	7.1	9.6	297	0.317	0.003	0.019	0.012	0.020	0.115	137
93-1087	930603	61.0	8.6	7.7	9.3	310	0.473	0.002	0.014	0.014	0.033	0.070	139
93-1146	930615	23.0	11.8	7.5	10.2	330	0.485	0.002	0.008	0.011	0.011	0.027	160
93-1205	930629	31.4	19.1	8.0	8.1	459	0.904	0.006	0.096	0.028	0.033	0.039	223
93-1297	930712	17.1	15.1	8.1	8.3	525	1.421	0.017	0.068	0.037	0.040	0.044	263
93-1346	930728	24.2	16.0	7.5	8.7	500	0.457	0.012	0.052	0.031	0.031	0.033	240
93-1504	930817	19.1	13.8	7.4	8.7	541	0.896	0.033	0.119	0.030	0.036	0.046	259
93-1547	930830	15.2	13.5	7.5	9.2	511	1.110	0.075	0.047	0.044	0.049	0.059	240
93-1614	930913	30.9	13.3	8.3	11.8	491	1.009	0.006	0.031	0.016	0.016	0.016	248
93-1719	930927	32.5	11.1	8.0	12.2	505	0.639	0.007	0.051	0.015	0.015	0.019	265

STATION 490567 - Little Bear below Trout of Paradise (McMurdie Hollow)

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - ECOSYSTEMS RESEARCH INSTITUTE

LOG	DATE	VTSS mg/l	RTSS mg/l	CA mg/l	MG mg/l	HARD mg/l	SI mg/l	CHLORIDE mg/l	SO4 mg/l	F. STREP #/100ml	TC #/100ml	FC #/100ml
567-1209	921209	2	7	73.8	11.7	-999	12.8	14.2	12.9	36	500	56
NOACCESS	930112											
93-0364	930223	3	26	59.9	14.3	208	12.7	12.4	12.8	-999	-999	-999
93-0443	930309	2	10	62.2	13.9	212	11.5	13.3	12.9	14	200	2
93-0463	930322	2	57	50.7	4.9	147	-999.0	9.8	16.6	240	50	20
93-0708	930405	-999	114	44.9	3.2	125	-999.0	6.2	6.3	190	70	40
93-0812	930419	3	24	47.0	12.4	168	11.8	8.9	9.7	10	-999	-999
93-0900	930503	2	22	60.9	2.2	161	9.6	8.9	7.7	32	300	20
93-0970	930517	4	125	40.1	10.7	144	8.2	5.4	4.5	5	400	60
93-1087	930603	3	33	47.0	10.3	159	9.1	4.5	5.6	115	5000	540
93-1146	930615	2	15	48.6	11.0	166	9.5	5.4	5.4	40	40	20
93-1205	930629	1	6	84.8	3.9	228	14.5	9.9	9.3	276	300	100
93-1297	930712	3	3	88.4	16.0	286	17.8	12.6	12.3	-999	3000	200
93-1346	930728	1	4	86.8	16.5	284	15.7	10.8	9.3	115	700	90
93-1504	930817	2	4	64.3	41.5	330	15.8	10.8	11.7	235	5000	190
93-1547	930830	1	4	65.4	22.8	257	16.9	9.7	9.7	480	2000	300
93-1614	930913	2	2	59.2	20.8	233	14.5	11.4	11.4	135	900	90
93-1719	930927	2	1	60.7	22.3	242	-999.0	10.8	11.9	80	2000	100

STATION 490567 - Little Bear below Trout of Paradise (McMurdie Hollow)

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - ECOSYSTEMS RESEARCH INSTITUTE

LOG	DATE	FLOW cfs	TEMP oC	pH units	DO mg/l	COND umhos/cm	NO3-N mg/l	NO2-N mg/l	NH3-N mg/l	PO4-P mg/l	DTP-P mg/l	TP-P mg/l	ALK mg/l
NODATA	921021												
NODATA	921112												
570-1209	921209	15.0	2.1	7.2	11.8	395	0.215	0.001	0.020	0.004	0.008	0.033	194
93-0077	930112	20.0	0.9	7.5	12.4	402	0.198	0.002	0.015	0.004	0.005	0.023	204
93-0363	930223	37.0	4.0	7.5	10.8	380	0.164	0.002	0.004	0.005	0.008	0.030	170
93-0444	930309	28.9	5.7	7.6	10.7	382	0.113	0.001	0.026	0.002	0.002	0.015	191
93-0464	930322	163.6	3.5	6.8	11.0	302	0.634	0.007	0.031	0.107	0.117	0.117	112
93-0706	930405	275.0	7.8	7.4	9.7	284	0.305	0.003	0.019	0.056	0.058	0.141	114
93-0813	930419	174.6	4.7	7.6	11.1	337	0.192	0.002	0.005	0.013	0.045	0.045	162
93-0901	930503	530.0	9.5	7.3	9.3	310	0.146	0.001	0.008	0.004	0.013	0.037	150
93-0971	930517	650.0	11.7	7.0	10.0	287	0.245	0.002	0.012	0.009	0.013	0.073	137
93-1088	930603	60.0	8.0	7.4	9.2	290	0.315	0.002	0.022	0.012	0.040	0.081	129
93-1147	930615	20.0	10.9	7.2	10.5	307	0.296	0.002	0.008	0.009	0.009	0.021	150
93-1206	930629	31.1	17.0	8.0	8.0	404	0.589	0.002	0.021	0.027	0.030	0.034	201
93-1298	930712	18.2	13.6	7.6	9.3	458	0.752	0.003	0.023	0.018	0.018	-999.000	229
93-1347	930728	36.3	13.9	7.4	9.7	445	0.462	0.002	0.012	0.015	0.015	0.015	220
93-1505	930817	47.1	13.0	7.1	8.5	482	0.594	0.003	0.028	0.008	0.017	0.021	234
93-1548	930830	23.6	12.5	7.8	8.9	451	0.484	0.010	0.023	0.008	0.011	0.018	217
93-1615	930913	29.4	13.0	8.1	9.6	447	0.353	0.001	0.047	0.011	0.011	0.011	228
93-1720	930927	25.8	10.6	7.8	4.0	458	0.162	0.002	0.035	0.023	0.023	0.039	239

STATION 490570 - Little Bear west of Avon

LOG	DATE	VTSS mg/l	RTSS mg/l	CA mg/l	MG mg/l	HARD mg/l	SI mg/l	CHLORIDE mg/l	SO4 mg/l	F. STREP #/100ml	TC #/100ml	FC #/100ml
NODATA	921021											
NODATA	921112											
570-1209	921209	4	23	57.8	15.6	-999	10.8	12.4	10.6	104	500	80
93-0077	930112	3	15	59.0	64.0	212	11.5	11.5	11.5	24	500	50
93-0363	930223	7	28	56.7	11.3	188	11.2	8.9	10.5	14	50	40
93-0444	930309	2	10	73.6	2.0	192	10.6	13.3	10.6	4	200	2
93-0464	930322	3	105	52.3	1.0	135	-999.0	11.5	10.4	30	200	40
93-0706	930405	-999	107	41.7	6.2	129	-999.0	9.7	8.7	110	800	190
93-0813	930419	2	22	50.2	9.4	164	11.2	8.0	9.5	8	270	-999
93-0901	930503	3	15	44.9	11.0	157	9.3	5.8	7.1	22	70	10
93-0971	930517	3	81	40.1	9.7	140	8.7	4.5	4.8	> 100	600	270
93-1088	930603	3	31	50.2	6.3	151	8.3	4.1	4.5	90	1000	300
93-1147	930615	2	13	47.0	10.1	158	8.3	5.4	4.6	70	600	70
93-1206	930629	1	2	74.3	0.5	187	12.0	6.3	5.6	62	300	120
93-1298	930712	2	4	71.9	14.3	238	13.8	9.9	7.4	-999	1000	140
93-1347	930728	1	5	84.3	6.7	238	13.6	8.1	6.1	90	300	80
93-1505	930817	2	12	58.7	20.3	230	12.6	11.7	6.4	70	2000	90
93-1548	930830	1	3	56.1	22.6	233	12.7	5.7	5.7	80	1000	800
93-1615	930913	1	3	54.7	20.6	221	11.8	6.3	6.3	60	300	50
93-1720	930927	2	3	58.0	21.9	234	-999.0	9.9	6.7	115	280	40

STATION 490570 - Little Bear west of Avon

LOG	DATE	FLOW cfs	TEMP oC	pH units	DO mg/l	COND umhos/cm	NO3-N mg/l	NO2-N mg/l	NH3-N mg/l	PO4-P mg/l	DTP-P mg/l	TP-P mg/l	ALK mg/l
574-1022	921022	20.0	9.9	7.6	9.6	435	0.035	0.001	0.010	0.003	0.004	0.016	217
574-1111	921111	25.0	3.6	8.1	10.4	425	0.075	0.001	0.018	0.007	0.007	0.021	205
574-1209	921209	15.0	2.1	7.3	10.6	369	0.152	0.001	0.011	0.005	0.007	0.032	185
93-0074	930113	10.0	0.9	8.1	12.5	374	0.145	0.002	0.011	0.004	0.006	0.013	192
93-0365	930223	28.5	3.0	7.8	10.6	347	0.088	0.002	0.002	0.004	0.006	0.022	156
93-0445	930309	10.2	3.8	8.1	11.1	344	0.042	0.001	0.023	0.004	0.004	0.013	170
93-0465	930322	133.5	3.9	7.6	10.7	216	0.369	0.004	0.024	0.036	0.051	0.157	108
93-0709	930405	124.9	3.9	7.8	10.6	211	0.159	0.002	0.042	0.026	0.032	0.068	99
93-0814	930419	68.2	4.1	7.3	10.4	240	0.070	0.002	0.013	0.009	0.019	0.034	114
93-0902	930503	73.3	8.4	8.0	10.1	273	0.090	0.001	0.041	0.004	0.014	0.030	131
93-0972	930517	200.0	8.7	6.9	10.6	236	0.254	0.002	0.033	0.026	0.026	0.160	111
93-1089	930603	150.0	7.2	7.0	10.4	251	0.225	0.001	0.010	0.011	0.052	0.102	115
93-1148	930615	77.5	9.7	7.9	10.8	273	0.198	0.002	0.014	0.009	0.009	0.038	137
93-1207	930629	15.1	15.2	8.2	8.6	353	0.240	0.001	0.021	0.012	0.012	0.016	176
93-1299	930712	2.7	12.5	7.4	9.5	396	0.221	0.002	0.053	0.012	0.012	0.013	211
93-1348	930728	0.1	14.1	7.0	7.8	505	0.226	0.005	0.031	0.013	0.013	0.037	250

STATION 490574 - South Fork Little Bear River above East Fork

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - ECOSYSTEMS RESEARCH INSTITUTE

LOG	DATE	VTSS mg/l	RTSS mg/l	CA mg/l	MG mg/l	HARD mg/l	SI mg/l	CHLORIDE mg/l	SO4 mg/l	F. STREP #/100ml	TC #/100ml	FC #/100ml
574-1022	921022	1	5	59.3	17.1	-999	8.7	8.9	8.4	-999	890	650
574-1111	921111	2	10	47.2	18.2	192	10.4	11.5	11.4	62	500	54
574-1209	921209	2	12	53.0	26.1	-999	10.5	10.6	8.8	-999	400	80
93-0074	930113	2	8	61.0	44.0	196	11.1	14.2	9.4	62	150	32
93-0365	930223	1	20	48.6	12.3	172	11.3	10.6	9.1	10	70	60
93-0445	930309	1	8	49.1	14.0	180	10.8	9.8	9.3	670	320	90
93-0465	930322	2	73	39.3	2.0	106	-999.0	6.7	5.1	40	300	110
93-0709	930405	-999	26	36.9	1.2	97	-999.0	6.2	5.7	8	5400	1500
93-0814	930419	1	13	37.3	5.6	118	9.9	6.2	7.3	4	300	-999
93-0902	930503	2	11	37.7	10.4	136	8.8	5.3	6.1	8	100	30
93-0972	930517	3	156	33.7	7.7	116	7.5	5.4	3.9	10	300	110
93-1089	930603	3	47	38.9	8.2	131	7.3	4.5	3.9	52	100	70
93-1148	930615	3	21	39.7	9.7	139	7.9	3.6	3.5	25	500	100
93-1207	930629	1	7	71.4	2.2	187	9.1	4.5	5.2	64	200	30
93-1299	930712	2	3	84.3	5.7	234	10.1	6.3	4.6	130	3000	1000
93-1348	930728	2	16	85.9	12.9	267	15.4	9.0	4.5	185	300	200

STATION 490574 - South Fork Little Bear River above East Fork

LOG	DATE	FLOW cfs	TEMP oC	pH units	DO mg/l	COND umhos/cm	NO3-N mg/l	NO2-N mg/l	NH3-N mg/l	PO4-P mg/l	DTP-P mg/l	TP-P mg/l	ALK mg/l
575-1022	921022	5.0	9.9	7.5	9.0	489	0.004	0.001	0.021	0.002	0.003	0.003	240
575-1111	921111	5.0	3.8	7.9	9.9	476	0.106	0.001	0.001	0.005	0.005	0.005	246
575-1209	921209	3.0	2.3	7.3	10.6	446	0.141	0.001	0.001	0.002	0.004	0.006	226
93-0075	930112	2.0	0.2	8.0	13.3	462	0.159	0.002	0.006	0.002	0.002	0.002	236
93-0367	930223	4.1	3.1	7.3	10.7	459	0.227	0.002	0.018	0.003	0.009	0.033	223
93-0446	930309	4.5	5.0	7.8	10.7	450	0.205	0.001	0.017	0.002	0.002	0.002	232
93-0466	930322	14.5	4.6	7.7	10.6	457	1.765	0.005	0.024	0.028	0.036	0.046	202
93-0710	930405	17.8	7.6	7.9	10.4	407	0.890	0.001	0.056	0.031	0.031	0.064	161
93-0815	930419	63.0	4.6	7.4	11.4	406	0.287	0.001	0.010	0.010	0.016	0.031	204
93-0903	930503	235.4	9.2	7.3	9.3	315	0.175	0.001	0.011	0.004	0.013	0.042	154
93-0973	930517	240.0	11.7	7.0	9.7	311	0.164	0.002	0.019	0.002	0.004	0.034	150
93-1090	930603	88.2	9.7	7.1	9.2	353	0.186	0.002	0.010	0.003	0.025	0.025	164
93-1149	930615	64.3	10.9	7.1	10.4	345	0.138	0.002	0.011	0.007	0.007	0.012	174
93-1208	930629	24.5	15.6	8.1	8.6	370	0.146	0.001	0.021	0.007	0.007	0.007	178
93-1300	930712	8.2	10.0	8.0	9.6	342	0.136	0.001	0.003	0.005	0.005	0.021	187
93-1349	930728	5.6	11.5	7.8	9.1	408	0.150	0.002	0.004	0.004	0.004	0.004	204
93-1506	930817	2.0	10.4	7.3	8.5	394	0.238	0.003	0.040	0.005	0.013	0.016	203
93-1549	930830	15.8	10.7	7.2	9.0	380	0.209	0.007	0.020	0.008	0.012	0.018	188
93-1616	930913	14.1	12.5	8.1	9.2	396	0.128	0.002	0.025	0.017	0.017	0.017	200
93-1721	930927	9.8	10.8	7.9	10.8	419	0.082	0.002	0.031	0.006	0.006	0.010	224

STATION 490575 - East Fork Little Bear River above South Fork

LOG	DATE	VTSS mg/l	RTSS mg/l	CA mg/l	MG mg/l	HARD mg/l	SI mg/l	CHLORIDE mg/l	SO4 mg/l	F. STREP #/100ml	TC #/100ml	FC #/100ml
575-1022	921022	1	1	75.4	14.3	-999	8.4	7.1	13.3		500	100
575-1111	921111	1	1	46.4	28.4	232	8.7	8.0	15.0	80	40	26
575-1209	921209	1	1	59.4	10.7	-999	8.7	8.9	13.2	64	140	80
93-0075	930112	2	1	74.0	68.0	252	8.8	8.9	14.6	36	300	170
93-0367	930223	1	12	68.0	16.3	236	8.9	10.6	15.4	2	50	10
93-0446	930309	1	1	63.8	19.8	240	8.9	8.0	14.8	4	20	4
93-0466	930322	1	10	73.6	12.0	233	-999.0	9.8	20.2	20	40	10
93-0710	930405		15	75.4	3.4	202	-999.0	7.9	15.9	16	30	< 1
93-0815	930419	2	30	58.3	16.2	212	9.7	6.2	10.4	2	74	-999
93-0903	930503	1	9	46.5	14.0	173	9.1	4.4	6.2	12	30	0
93-0973	930517	3	23	46.5	9.7	156	8.5	5.4	6.3	0	100	20
93-1090	930603	1	6	63.2	7.4	188	7.9	5.4	6.3	16	130	30
93-1149	930615	1	5	59.1	8.5	182	9.0	4.5	6.0	8	200	< 1
93-1208	930629	1	1	71.0	1.8	184	9.5	4.5	7.9	165	100	70
93-1300	930712	1	1	71.1	4.5	196	8.9	5.4	5.7	92	300	90
93-1349	930728	1	1	81.0	7.2	232	8.7	5.4	6.4	30	200	80
93-1506	930817	1	1	53.6	15.2	196	9.8	4.5	5.6	8	2000	10
93-1549	930830	1	5	52.8	16.1	198	9.3	4.8	4.8	70	200	50
93-1616	930913	2	2	52.1	16.3	197	7.9	4.7	4.7	62	700	10
93-1721	930927	1	1	51.9	18.0	203	-999.0	6.3	7.7	52	50	0

STATION 490575 - East Fork Little Bear River above South Fork

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - ECOSYSTEMS RESEARCH INSTITUTE

LOG	DATE	FLOW cfs	TEMP oC	pH units	DO mg/l	COND umhos/cm	NO3-N mg/l	NO2-N mg/l	NH3-N mg/l	PO4-P mg/l	DTP-P mg/l	TP-P mg/l	ALK mg/l
576-1022	921022	12.0	9.0	7.9	9.7	351	0.006	0.001	0.017	0.003	0.003	0.007	169
576-1111	921111	15.0	0.8	7.9	12.8	314	0.108	0.001	0.016	0.007	0.007	0.010	140
NOACCESS	921209												
NOACCESS	930112												
93-0369	930223	12.0	3.2	7.5	9.7	327	0.124	0.002	0.040	0.007	0.015	0.019	140
93-0447	930309	22.4	5.9	7.5	10.2	347	0.101	0.001	0.019	0.004	0.004	0.010	159
93-0467	930322	72.1	3.8	7.4	10.0	170	0.356	0.003	0.034	0.033	0.051	0.082	87
93-0711	930405	87.1	3.8	7.6	11.0	166	0.152	0.002	0.035	0.039	0.039	0.061	172
93-0816	930419	55.8	4.6	7.6	10.8	201	0.081	0.002	0.006	0.011	0.023	0.023	87
93-0904	930503	39.8	8.8	7.7	9.7	247	0.079	0.001	0.011	0.006	0.022	0.030	112
93-0974	930517	61.1	10.1	7.4	9.8	256	0.161	0.002	0.005	0.011	0.018	0.035	113
93-1091	930603	40.2	8.9	7.7	10.3	240	0.134	0.002	0.014	0.013	0.048	0.066	102
93-1150	930615	25.9	11.8	7.8	10.2	282	0.135	0.002	0.002	0.013	0.013	0.028	129
93-1209	930629	23.7	16.2	7.5	8.7	321	0.152	0.001	0.018	0.014	0.014	0.023	150
93-1301	930712	9.5	12.9	7.8	8.3	366	0.167	0.001	0.020	0.014	0.014	0.019	180
93-1350	930728	9.9	12.7	7.7	8.6	388	0.187	0.001	0.010	0.013	0.013	0.017	182
93-1507	930817	13.0	12.1	6.7	9.7	425	0.144	0.002	0.028	0.005	0.006	0.011	207
93-1550	930830	8.5	11.3	7.8	8.4	410	0.124	0.004	0.020	0.020	0.056	0.059	196
93-1617	930913	19.7	11.0	8.0	10.3	427	0.142	0.001	0.026	0.009	0.009	0.009	208
93-1722	930927	16.6	11.0	7.9	10.5	436	0.111	0.001	0.029	0.006	0.006	0.016	221

STATION 490576 - South Fork Little Bear River above Davenport

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - ECOSYSTEMS RESEARCH INSTITUTE

LOG	DATE	VTSS mg/l	RTSS mg/l	CA mg/l	MG mg/l	HARD mg/l	SI mg/l	CHLORIDE mg/l	SO4 mg/l	F. STREP #/100ml	TC #/100ml	FC #/100ml
576-1022	921022	1	1	49.7	121.0	-999	8.2	8.9	4.9	-999	130	80
576-1111	921111	1	2	39.3	13.2	152	9.9	12.4	9.2	10	100	46
NOACCESS	921209											
NOACCESS	930112											
93-0369	930223	1	1	46.9	9.4	156	12.3	12.4	10.1	8	50	10
93-0447	930309	1	7	47.4	12.0	168	11.5	13.3	9.9	4	200	< 1
93-0467	930322	1	25	31.1	1.0	82	-999.0	8.0	4.9	10	100	10
93-0711	930405	-999	22	27.3	1.2	73	-999.0	6.2	5.2	6	300	10
93-0816	930419	1	10	30.8	4.7	96	10.9	6.2	7.5	4	140	-999
93-0904	930503	1	9	36.1	7.3	120	10.5	8.0	6.8	2	60	0
93-0974	930517	3	15	37.7	7.2	124	10.3	6.3	6.7	0	300	0
93-1091	930603	2	31	38.1	4.2	112	9.8	7.2	5.1	124	2000	400
93-1150	930615	2	12	38.9	9.2	135	10.9	8.1	5.6	10	100	70
93-1209	930629	1	5	62.6	0.5	154	11.0	8.1	7.3	25	1600	700
93-1301	930712	1	7	59.5	13.6	204	11.0	8.1	6.2	50	300	240
93-1350	930728	2	8	70.2	7.6	206	11.4	9.0	6.2	5	2000	200
93-1507	930817	2	4	52.9	17.4	203	11.7	12.6	7.7	72	200	50
93-1550	930830	2	6	51.3	18.5	204	11.2	7.2	7.2	134	2000	300
93-1617	930913	2	3	50.7	19.3	206	11.3	8.0	8.0	216	900	80
93-1722	930927	2	4	56.0	20.6	224	-999.0	9.9	8.5	220	500	180

STATION 490576 - South Fork Little Bear River above Davenport

LOG	DATE	FLOW cfs	TEMP oC	pH units	DO mg/l	COND umhos/cm	NO3-N mg/l	NO2-N mg/l	NH3-N mg/l	PO4-P mg/l	DTP-P mg/l	TP-P mg/l	ALK mg/l
577-1022	921022	5.0	8.6	7.9	9.6	416	0.002	0.001	0.014	0.003	0.003	0.009	216
577-1111	921111	6.0	0.1	8.1	11.8	408	0.090	0.001	0.001	0.006	0.006	0.056	211
577-1209	921209	8.0	0.3	7.1	11.4	352	0.178	0.008	0.019	0.006	0.008	0.023	178
NOACCESS	930112												
93-0370	930223	6.5	1.5	7.3	10.3	352	0.133	0.001	0.019	0.003	0.006	0.019	164
93-0448	930309	12.9	3.1	7.9	11.0	351	0.055	0.001	0.025	0.003	0.003	0.017	181
93-0468	930322	57.7	3.1	7.5	10.4	263	0.291	0.003	0.034	0.028	0.042	0.094	135
93-0712	930405	58.7	3.0	8.0	11.3	249	0.123	0.001	0.022	0.020	0.045	0.053	130
93-0817	930419	44.2	3.2	8.0	11.5	297	0.264	0.001	0.011	0.007	0.012	0.022	147
93-0905	930503	70.2	7.6	7.9	10.6	286	0.174	0.001	0.006	0.004	0.014	0.038	143
93-0975	930517	140.0	7.8	7.0	11.7	229	0.271	0.002	0.008	0.015	0.020	0.215	111
93-1092	930603	110.0	6.2	7.9	9.6	244	0.243	0.001	0.007	0.009	0.020	0.057	118
93-1151	930615	116.3	8.5	8.0	11.1	270	0.180	0.001	0.013	0.008	0.008	0.035	137
93-1210	930629	47.1	13.6	8.4	8.5	340	0.092	0.001	0.008	0.009	0.009	0.013	176
93-1302	930712	29.3	10.4	8.3	9.3	378	0.168	0.001	0.021	0.008	0.008	0.017	209
93-1351	930728	9.9	9.9	7.9	10.3	398	0.194	0.001	0.006	0.007	0.007	0.010	210
93-1508	930816	25.8	9.3	7.4	10.4	422	0.172	0.002	0.023	0.003	0.011	0.027	215
93-1552	930830	5.6	10.7	7.2	9.0	380	0.196	0.003	0.020	0.007	0.007	0.011	193
93-1618	930913	19.7	7.3	8.2	11.0	411	0.150	0.001	0.029	0.006	0.006	0.006	211
93-1723	930927	17.1	6.7	8.1	13.2	424	0.119	0.001	0.029	0.001	0.001	0.004	235

STATION 490577 - Davenport Creek above South Fork Little Bear River

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - ECOSYSTEMS RESEARCH INSTITUTE

LOG	DATE	VTSS mg/l	RTSS mg/l	CA mg/l	MG mg/l	HARD mg/l	SI mg/l	CHLORIDE mg/l	SO4 mg/l	F. STREP #/100ml	TC #/100ml	FC #/100ml
577-1022	921022	1	3	57.8	18.1	-999	6.9	1.8	4.8	-999	1400	380
577-1111	921111	3	37	53.4	18.2	208	9.2	7.1	9.8	-999	400	70
577-1209	921209	2	12	51.4	27.1	-99	9.2	7.1	7.6	66	500	230
NOACCESS	930112											
93-0370	930223	3	21	63.2	5.4	180	10.2	7.1	8.2	6	150	130
93-0448	930309	2	15	52.3	13.9	188	9.8	8.0	7.9	8	1100	350
93-0468	930322	1	29	50.7	1.0	131	-999.0	6.2	4.4	10	250	100
93-0712	930405	-999	21	40.1	4.2	117	-999.0	6.2	6.2	8	90	< 1
93-0817	930419	2	10	40.5	10.5	146	9.2	6.2	3.5	2	220	-999
93-0905	930503	2	19	44.1	9.4	149	7.8	5.3	5.0	2	300	60
93-0975	930517	7	179	33.7	7.7	116	7.0	3.6	4.5	10	90	20
93-1092	930603	2	35	42.9	5.7	131	6.6	1.8	3.3	8	80	60
93-1151	930615	3	19	41.3	9.2	141	6.4	2.7	3.0	8	220	70
93-1210	930629	1	3	69.7	2.1	182	7.6	3.6	3.9	10	100	30
93-1302	930712	2	13	62.8	5.9	181	8.0	2.2	3.6	14	200	50
93-1351	930728	2	10	86.6	2.2	225	8.3	2.7	3.6	30	400	60
93-1508	930816	2	7	50.7	20.7	211	8.4	7.2	-999.0	62	400	90
93-1552	930830	2	11	44.1	22.9	204	8.6	4.3	4.3	90	100	60
93-1618	930913	1	4	47.8	23.2	214	8.1	0.6	0.6	168	100	30
93-1723	930927	2	2	51.6	24.2	228	-999.0	5.4	5.8	108	200	40

STATION 490577 - Dávenport Creek above South Fork Little Bear River

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - ECOSYSTEMS RESEARCH INSTITUTE

LOG	DATE	FLOW cfs	TEMP oC	pH units	DO mg/l	COND umhos/cm	NO3-N mg/l	NO2-N mg/l	NH3-N mg/l	PO4-P mg/l	DTP-P mg/l	TP-P mg/l	ALK mg/l
578-1022	921022	3.0	8.5	7.5	9.2	477	0.092	0.001	0.018	0.004	0.004	0.006	238
578-1111	921111	3.0	2.1	7.9	9.2	470	0.105	0.001	0.001	0.006	0.006	0.007	234
578-1209	921209	2.0	2.2	7.1	9.8	435	0.181	0.001	0.007	0.005	0.010	0.010	220
NOACCESS	930112												
93-0368	930223	3.7	4.6	7.6	11.2	431	0.183	0.002	0.013	0.002	0.004	0.016	212
93-0449	930309	2.9	4.3	7.9	10.7	430	0.175	0.001	0.033	0.003	0.004	0.004	226
93-0469	930322	6.4	4.7	8.0	11.1	401	0.397	0.001	0.022	0.018	0.025	0.064	202
93-0713	930405	10.3	6.8	7.4	10.5	367	0.246	0.001	0.045	0.025	0.036	0.048	172
93-0818	930419	62.1	4.6	7.2	11.4	392	0.228	0.001	0.023	0.013	0.017	0.030	204
93-0906	930503	209.2	8.5	7.4	10.1	307	0.134	0.001	0.015	0.005	0.016	0.030	148
93-0976	930517	220.0	10.4	6.6	10.5	306	0.160	0.002	0.043	0.002	0.010	0.025	148
93-1093	930603	86.0	9.7	7.5	10.7	340	0.177	0.002	0.004	0.003	0.024	0.025	157 <
93-1152	930615	64.1	7.0	9.6	10.9	327	0.151	0.002	0.011	0.007	0.008	0.020	166
93-1211	930629	24.9	12.1	8.0	8.9	333	0.169	0.001	0.019	0.006	0.010	0.013	164
93-1303	930712	30.3	8.7	7.9	10.8	333	0.182	0.002	0.010	0.005	0.005	0.005	175
93-1352	930728	14.8	10.8	7.3	10.1	376	0.199	0.002	0.006	0.007	0.007	0.007	184
93-1509	930817	35.1	10.1	6.8	11.4	378	0.221	0.003	0.030	0.006	0.012	0.017	191
93-1551	930830	46.8	10.7	7.1	8.9	367	0.213	0.007	0.020	0.011	0.013	0.019	182
93-1619	930913	43.1	13.0	8.0	9.3	388	0.159	0.001	0.018	0.013	0.013	0.013	193
93-1724	930927	17.3	12.7	7.9	11.2	396	0.082	0.005	0.026	0.006	0.006	0.010	223

STATION 490578 - East Fork Little Bear below Porcupine Reservoir

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - ECOSYSTEMS RESEARCH INSTITUTE

LOG	DATE	VTSS mg/l	RTSS mg/l	CA mg/l	MG mg/l	HARD mg/l	SI mg/l	CHLORIDE mg/l	SO4 mg/l	F. STREP #/100ml	TC #/100ml	FC #/100ml
578-1022	921022	1	1	57.0	24.0	-999	7.3	7.1	11.9	-999	200	20
578-1111	921111	1	1	59.7	21.2	236	9.0	7.1	11.5	0	40	2
578-1209	921209	1	1	64.2	8.8	-999	8.4	6.2	10.0	16	110	10
NOACCESS	930112											
93-0368	930223	2	15	56.7	18.2	216	8.1	7.1	10.1	< 1	10	10
93-0449	930309	1	2	62.2	16.9	224	8.5	6.2	9.7	< 1	10	< 1
93-0469	930322	1	7	60.5	14.9	212	-999.0	6.2	10.4	6	20	< 1
93-0713	930405	-999	21	54.5	12.2	186	-999.0	6.2	9.1	2	40	< 1
93-0818	930419	2	12	61.5	11.3	200	9.4	7.1	7.8	0	82	-999
93-0906	930503	2	5	50.5	9.6	165	9.1	5.3	6.0	4	30	0
93-0976	930517	3	10	44.9	10.7	156	8.5	4.5	6.3	0	40	0
93-1093	930603	1	3	61.5	6.4	180	5.0	2.7	6.2	10	40	< 1
93-1152	930615	1	5	49.4	12.5	174	8.8	5.4	5.3	0	60	< 1
93-1211	930629	1	2	67.2	0.2	169	9.1	3.6	6.0	45	200	< 1
93-1303	930712	1	2	66.9	6.0	189	9.4	4.5	4.7	0	150	< 1
93-1352	930728	1	1	62.8	13.1	211	9.3	5.0	4.9	2	200	10
93-1509	930817	1	2	50.2	14.9	186	9.2	6.3	-999.0	6	300	< 1
93-1551	930830	1	2	51.8	15.7	194	9.0	4.1	4.1	10	1000	20
93-1619	930913	1	2	52.6	15.0	193	7.6	3.9	3.9	16	20	0
93-1724	930927	2	2	47.5	18.9	196	-999.0	5.4	6.0	32	70	0

STATION 490578 - East Fork Little Bear below Porcupine Reservoir

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - ECOSYSTEMS RESEARCH INSTITUTE

LOG	DATE	FLOW cfs	TEMP oC	pH units	DO mg/l	COND umhos/cm	NO3-N mg/l	NO2-N mg/l	NH3-N mg/l	PO4-P mg/l	DTP-P mg/l	TP-P mg/l	ALK mg/l
93-1212	930629	35.0	13.9	7.7	9.1	339	0.194	0.001	0.017	0.010	0.010	0.017	176

STATION 490585 - Davenport Creek below Wellsville Creek

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - ECOSYSTEMS RESEARCH INSTITUTE

LOG	DATE	VTSS mg/l	RTSS mg/l	CA mg/l	MG mg/l	HARD mg/l	SI mg/l	CHLORIDE mg/l	SO4 mg/l	F. STREP #/100ml	TC #/100ml	FC #/100ml
93-1212	930629	1	2	85.6	0.5	212	7.0	1.8	3.6	0	300	30

STATION 490585 - Davenport Creek below Wellsville Creek

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - ECOSYSTEMS RESEARCH INSTITUTE

LOG	DATE	FLOW cfs *	TEMP oC	pH units	DO mg/l	COND umhos/cm	NO3-N mg/l	NO2-N mg/l	NH3-N mg/l	PO4-P mg/l	DTP-P mg/l	TP-P mg/l	ALK mg/l
587-0910	920910	232.0	15.0	8.1	8.1	1100	0.053	0.003	0.027	0.009	0.025	0.093	294
587-0929	920929	196.0	13.4	8.1	9.2	1296	0.055	0.002	0.035	0.008	0.024	0.031	302
587-1020	921020	232.0	9.7	7.5	9.7	1256	0.048	0.003	0.026	0.005	0.013	0.027	328
587-1110	921110	282.0	3.6	8.1	11.2	1180	0.236	0.015	0.032	0.010	0.020	0.023	321
587-1208	921208	452.0	0.3	6.6	10.8	1065	0.502	0.010	0.181	0.007	0.014	0.025	261
93-0085	930113	449.0	0.1	7.6	10.8	1134	0.815	0.020	0.203	0.023	0.023	0.034	357
93-0361	930222	381.0	1.7	7.8	11.2	576	1.220	0.018	0.229	0.035	0.043	0.043	338
93-0480	930322	1180.0	7.5	7.7	9.4	920	3.806	0.034	0.234	0.092	0.104	0.442	346
93-0728	930406	1490.0	7.0	7.2	9.2	731	0.967	0.014	0.108	0.037	0.054	0.127	183
93-0829	930419	951.0	9.5	8.4	8.5	765	0.629	0.012	0.035	0.018	0.035	0.156	239
93-0907	930503	955.0	14.5	8.4	8.8	721	0.352	0.007	0.017	0.006	0.023	0.115	236
93-0988	930517	2170.0	17.0	8.2	6.5	617	0.274	0.008	0.011	0.018	0.030	0.093	209
93-1084	930602	1350.0	16.9	7.8	7.4	532	0.221	0.004	0.003	0.011	0.011	0.056	190
93-1143	930614	1700	16.4	7.9	8.6	525	0.193	0.005	0.012	0.012	0.020	0.074	196
93-1294	930712	495.0	21.5	8.3	-999.0	1098	0.330	0.017	0.042	0.016	0.027	0.184	301
93-1502	930816	344	21.3	8	8.1	917	0.182	0.006	0.028	0.013	0.029	0.073	285
93-1598	930914	-999	15.5	-999	9.7	-999	0.196	0.003	0.031	0.009	0.009	0.021	266
93-1800	931018	-999	11.5	7.9	8.9	932	0.539	0.010	0.022	0.014	0.062	0.064	297
93-2017	931117	-999	2	7.8	-999	907	0.672	0.007	0.035	0.012	0.016	0.048	292
94-0174	940125	-999	3.6	6.8	11.4	1097	0.904	0.012	0.109	0.007	0.031	0.036	317
94-0279	940222	-999	3	8	11.8	1072	0.908	0.011	0.205	0.010	0.053	0.068	332

STATION 490587 - Bear River east of Trenton (QA/QC site)

* Flows from USGS site at UT-ID stateline (10092700)

LOG	DATE	VTSS mg/l	RTSS mg/l	CA mg/l	MG mg/l	HARD mg/l	SI mg/l	CHLORIDE mg/l	SO4 mg/l	F. STREP #/100ml	TC #/100ml	FC #/100ml
587-0910	920910	3	33	56.1	45.0	324.5	7.0	154.2	67.5	-999	130	30
587-0929	920929	1	9	125.1	4.0	328.4	5.6	191.4	83.5	-999	< 100	< 10
587-1020	921020	2	6	92.9	31.1	-999.0	9.4	159.5	92.2	-999	200	40
587-1110	921110	2	5	67.6	45.7	356.0	12.4	138.3	105.7	36	40	6
587-1208	921208	2	6	72.2	29.3	300.0	12.9	106.4	72.4	12	200	< 1
93-0085	930113	1	5	115.0	172.0	460.0	23.4	124.1	83.9	10	500	10
93-0361	930222	3	20	93.9	34.0	373.7	22.7	117.0	70.2	8	40	< 1
93-0480	930322	4	334	96.5	25.9	346.9	20.6	77.1	73.6	100	200	50
93-0728	930406	-999	87	81.8	21.2	290.9	-999.0	54.1	59.7	2	400	< 1
93-0829	930419	3	81	81.0	21.5	290.0	-999.0	62.9	68.9	20	3800	-999
93-0907	930503	4	50	93.8	111.2	689.7	-999.0	53.2	53.8	10	110	40
93-0988	930517	3	79	68.1	14.3	228.6	-999.0	42.3	39.2	30	1000	100
93-1084	930602	3	43	84.2	7.3	239.8	-999.0	31.5	28.8	80	400	90
93-1143	930614	2	25	63.16	11.08	203.0	-999.0	32.4	26.8	120	1000	130
93-1294	930712	5	59	109.9	15.3	336.8	-999.0	136.8	49.3	210	1000	500
93-1502	930816	3	30	78.6	7.2	225.5	-999.0	93.6	52.1	600	3000	500
93-1598	930914	1	4	55.6	36.4	288.0	-999.0	66.3	66.3	160	100	100
93-1800	931018	2	4	66.1	39.2	325.6	-999.0	81	73.9	10	200	10
93-2017	931117	2	7	67.8	37.6	323.2	-999.0	82.8	58.8	100	100	< 1
94-0174	940125	2	5	76.6	35.9	338.4	-999.0	120.6	51	30	20	< 1
94-0279	940222	2	24	75.7	34	328.0	-999.0	118.8	60.9	120	160	0

STATION 490587 - Bear River east of Trenton (QA/QC site)

* Flows from USGS site at UT-ID stateline (10092700)

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - ECOSYSTEMS RESEARCH INSTITUTE

LOG	DATE	FLOW cfs	TEMP oC	pH units	DO mg/l	COND umhos/cm	NO3-N mg/l	NO2-N mg/l	NH3-N mg/l	PO4-P mg/l	DTP-P mg/l	TP-P mg/l	ALK mg/l
590-1022	921022	20.0	9.9	7.6	9.6	435	0.108	0.001	0.008	0.003	0.003	0.013	214
590-1111	921111	25.0	3.6	8.1	10.4	425	0.070	0.001	0.012	0.005	0.006	0.020	206
590-1209	921209	15.0	2.1	7.3	10.6	369	0.162	0.001	0.003	0.004	0.009	0.024	178
93-0076	930113	10.0	0.9	8.1	12.5	374	0.128	0.002	0.007	0.004	0.004	0.013	183
93-0366	930223	28.5	3.0	7.8	10.6	347	0.153	0.002	0.017	0.005	0.006	0.028	156
93-0450	930309	10.2	3.8	8.1	11.1	344	0.055	0.001	0.015	0.004	0.004	0.016	181
93-0470	930322	133.3	3.9	7.6	10.7	216	0.424	0.004	0.022	0.035	0.051	0.110	114
93-0714	930405	124.9	3.9	7.8	10.6	211	0.177	0.004	0.034	0.020	0.048	0.052	107
93-0819	930419	68.2	4.1	7.3	10.4	240	0.059	0.002	0.011	0.009	0.021	0.032	116
NODATA	930503												
93-0977	930517	200.0	8.7	6.9	10.6	236	0.259	0.002	0.001	0.015	0.022	0.182	112
93-1094	930603	150.0	7.2	7.0	10.4	251	0.244	0.001	0.012	0.011	0.036	0.058	111
93-1153	930615	77.5	9.7	7.9	10.8	273	0.156	0.002	0.009	0.009	0.014	0.037	136
93-1213	930629	15.1	15.2	8.2	8.6	353	0.147	0.001	0.023	0.011	0.013	0.021	178
93-1304	930712	2.7	12.5	7.4	9.5	396	0.193	0.002	0.018	0.012	0.014	0.035	209
93-1353	930728	0.1	14.1	7.0	7.8	505	0.198	0.004	0.028	0.013	0.013	0.198	250
NOFLOW	930817	0.0											
NOFLOW	930830	0.0											
NOFLOW	930913	0.0											
NOFLOW	930927	0.0											

STATION 490590 - Little Bear at mouth of Hyrum Canyon (QA/QC site)

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - ECOSYSTEMS RESEARCH INSTITUTE

LOG	DATE	VTSS mg/l	RTSS mg/l	CA mg/l	MG mg/l	HARD mg/l	SI mg/l	CHLORIDE mg/l	SO4 mg/l	F. STREP #/100ml	TC #/100ml	FC #/100ml
590-1022	921022	1	4	59.3	16.2	-999	8.9	7.1	7.5	-999	900	600
590-1111	921111	2	10	53.4	17.3	204	10.1	11.5	11.8	-999	1000	54
590-1209	921209	2	12	51.4	25.4	-999	10.5	10.6	8.8	110	400	70
93-0076	930113	3	7	56.0	56.0	196	11.0	11.5	9.6	4	110	44
93-0366	930223	1	1	48.6	11.3	168	11.5	10.6	10.0	12	70	50
93-0450	930309	1	8	49.1	13.0	176	10.8	11.1	8.6	26	500	60
93-0470	930322	4	67	37.6	1.9	102	-999.0	6.2	6.3	< 1	130	110
93-0714	930405	-999	28	35.3	3.2	101	-999.0	6.2	5.7	14	3700	130
93-0819	930419	2	15	38.1	5.6	116	9.9	9.8	7.0	0	200	-999
NODATA	930503											
93-0977	930517	6	140	34.5	7.2	116	7.2	3.6	7.9	10	100	50
93-1094	930603	2	41	48.6	2.8	133	7.4	3.6	3.4	44	2000	300
93-1153	930615	3	22	41.3	8.7	139	8.1	4.5	3.8	30	100	80
93-1213	930629	2	6	76.0	0.5	186	9.2	3.6	4.5	28	200	70
93-1304	930712	1	3	76.0	8.7	225	10.1	5.4	4.8	108	2000	600
93-1353	930728	1	3	93.4	7.4	267	15.0	9.0	4.6	110	2000	700
NOFLOW	930817											
NOFLOW	930830											
NOFLOW	930913											
NOFLOW	930927											

STATION 490590 - Little Bear at mouth of Hyrum Canyon (QA/QC site)

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - DATA COURTESY OF UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

DATE	TEMP oC	DO umhos/cm	FLOW cfs *	pH units	RTSS mg/l	TKN mg/l	F.STREP #/100ml	MF TOT #/100ml	MF FEC #/100ml	NH3 mg/l	TP mg/l	TURB ntu	TDS mg/l	F-pH units	DTP mg/l	D-NO2+NO3 mg/l
92-10-21	9.0	6.9	236	8.1	6	0.400				0.050	0.041	2.8	696	8.3	0.010	0.020
92-12-09	0.3	11.3	462	7.9	11	0.350				0.080	0.032	6.3	580	7.8	0.010	0.547
93-02-24	2.4	12.2	360	7.8	22	0.421	170	420	50	0.050	0.058	6.5	650	8.2	0.042	0.974
93-03-23	7.1	10.1	1047	7.9	281	1.550	1650	1220	72	0.295	0.595	190	566	7.9	0.117	1.630
93-04-06	6.1	7.5	1490	6.0	66	0.780				0.121	0.101	27	428	8.0	0.052	1.082
93-05-05	9.6	8.6	1252	7.9	38	0.240				0.066	0.091	20	426	8.0	0.020	0.260
93-05-18	14.4	8.0	2165	7.8	53	1.510	20	460	100	0.102	0.103	26	380	8.3	0.023	0.301
93-06-02	14.9	10.3	1350	8.0	26	0.400	120	340	44	0.050	0.043	9.2	280	8.7	0.032	0.170
93-06-15	17.6	13.3	1700	8.2	17	0.230	16	190	32	0.050	0.041	6.9	340	8.8	0.030	0.075
93-07-20	19.8	8.0	487	8.0	20	1.050	76	8	42	0.153	0.099	7.1	556	8.1	0.051	0.208
93-08-24	21.8	9.8	408	8.2	4	6.700	904	52	78	0.050	0.064	3.3	500	8.4	0.031	0.091
93-09-17	14.6	5.6	453	8.1	17	0.600				0.060	0.047	7.5	462	7.9	0.010	0.197

STATION 490610 - Bear River west of Fairview, Idaho

* Flows from USGS site at Utah-Idaho stateline (10092700)

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - DATA COURTESY OF UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

DATE	TEMP oC	DO umhos/cm	FLOW cfs	pH units	RTSS mg/l	TKN mg/l	F.STREP #/100ml	MF TOT #/100ml	MF FEC #/100ml	NH3 mg/l	TP mg/l	TURB ntu	TDS mg/l	F-pH units	DTP mg/l	D-NO2+NO3 mg/l
92-12-08	1.7	9.2	0.1	8.8	3.0	3.060		<10	<2	0.731	3.008			8.8	2.755	0.095
93-03-23	4.8	7.0	0.5		10	9.380	1032	1216	524	8.055	3.526	9	246	7.8	3.293	0.131
93-03-23	4.8	7.0	0.5	7.8	10	9.380	1032	1216	524	8.055	3.526				3.293	0.131
93-05-05	12.6	7.2	0.5	9.0	9	3.520				0.506	2.472				1.814	1.424
93-06-02	20.6	3.5	0.1	8.2	4	3.620	240	380	50	1.858	3.349				0.286	0.020
93-06-15	23.4	8.2	0.3	9.0	3	2.300	180	30	4	0.217	3.155				3.021	0.466
93-07-20	20.9	5.4	0.2	9.3	3	2.160	184	36	40	0.084	1.799				1.304	0.065
93-08-24	24.3	8.8		9.7	3	1.990	272	4	2	0.050	0.634	1.3	388	10.1	0.578	0.072

STATION 490372 - Richmond Lagoons

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - DATA COURTESY OF UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

DATE	TEMP oC	DO umhos/cm	FLOW cfs	pH units	RTSS mg/l	TKN mg/l	F.STREP #/100ml	MF TOT #/100ml	MF FEC #/100ml	NH3 mg/l	TP mg/l	TURB ntu	TDS mg/l	F-pH units	DTP mg/l	D-NO2+NO3 mg/l
92-10-22	10.2	7.0	3.5			0.29				0.076	0.248			8.0	0.229	0.502
92-12-09	5.1	8.4	3.5			0.87				0.205	0.189			7.9	0.075	0.197
93-02-24	6.7	8.4	2.2	7.7	20	0.46	160	300	20	0.256	0.061	9.6	326	7.9	0.018	0.314
93-03-10	8.6	7.0	3.0	7.5	37	1.76	92	110	42	0.053	0.106	22	330	8.1	0.038	0.574
93-03-24	10.1	9.4	0.5	7.8	17	0.41	36	290	20	0.050	0.096	11	378	7.5	0.075	1.214
93-04-06	12.1	8.1	4.0	8.1	11	0.10				0.050	0.038	6.2	368	8.0	0.023	1.421
93-04-22	14.4	11.7	1.4	8.0	7	0.10	8	90	2	0.050	0.068	4.5	316	8.2	0.038	0.514
93-05-06	9.8	9.1	5.1	7.8	4	0.10	148	296	54	0.050	0.032	3.9	324	7.9	0.016	0.705
93-05-18	19.5	11.9	2.1	8.1	4	0.40	24	160	2	0.050	0.057	3.9	296	8.5	0.055	0.426
93-06-02	15.9	10.6	2.6	7.7	10	0.47	64	176	18	0.107	0.056	5.8	298	8.6	0.042	0.181
93-06-16	17.9	14.1	4.8	7.8	3	0.18	12	50	2	0.050	0.037	2.6	292	8.6	0.027	0.318
93-07-20	18.6	8.4	6.0	8.1	6	0.98	28	8	2	0.086	0.076	2.6	304	8.4	0.027	0.321
93-08-25	18.1	8.9	3.5	7.7	11	0.53	108	4	46	0.050	0.084	3	322	7.9	0.044	0.460
93-09-16	12.4	7.5		7.9	21	0.68				0.062	0.053	5	306	7.8	0.034	0.429

STATION 490498 - White's College Ward fish hatchery

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - DATA COURTESY OF UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

DATE	TEMP oC	DO umhos/cm	FLOW cfs	pH units	RTSS mg/l	TKN mg/l	F.STREP #/100ml	MF TOT #/100ml	MF FEC #/100ml	NH3 mg/l	TP mg/l	TURB ntu	TDS mg/l	F-pH units	DTP mg/l	D-NO2+NO3 mg/l
92-10-20	12.9	10.0	11.6	8.7	4.0			32	1	0.050				8.7	3.402	1.748
92-12-08	1.5	8.5	13.0	7.6	3.0	4.700		388	1	4.332	4.046			7.6	4.072	2.105
93-02-23	0.9	5.9	13.5	7.1	19	16.910	44	112	2	0.050	4.087	8	456	7.3	1.045	0.626
93-03-23	6.0	8.1	13	7.9	31	11.180	4	56	2	8.319	3.243	8.5	410	8.1	2.845	0.480
93-05-06	12.1	6.6		7.5	7	3.310	4	8	2	0.655	2.965	5	422	8.1	2.524	0.809
93-06-02	21.1	6.1		7.6	7	1.730	156	236	46	0.840	2.351	5	444	8.2	0.229	0.405
93-06-16	21.4	5.2		7.6	3	1.340	28	10	2	0.385	2.438	3.5	464	7.8	2.423	2.301
93-07-20	21.9	6.1	8	7.8	3	1.620	4	4	12	0.419	2.368	2.1	452	7.9	2.327	1.392
93-08-25	23.9	4.9	13	7.5	7	5.750	800	56	2	2.528	2.868	2.5	412	8.2	2.683	0.645

STATION 490507 - Logan Lagoons

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - DATA COURTESY OF UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

DATE	TEMP oC	DO umhos/cm	FLOW cfs	pH units	RTSS mg/l	TKN mg/l	F.STREP #/100ml	MF TOT #/100ml	MF FEC #/100ml	NH3 mg/l	TP mg/l	TURB ntu	TDS mg/l	F-pH units	DTP mg/l	D-NO2+NO3 mg/l
92-10-22	15.7	5.3	0.9	7.3	3	0.60		20	2	0.050	6.781				5.873	
92-12-08	8.1	5.7	1.2	7.2	21	4.39		1280	14	2.126	6.804				6.605	
93-02-23	6.2	5.5		6.8	10	1.94	28	160	2	0.588	5.382	5	890	7.2	1.045	22.050
93-03-24	9.9	5.4		7.6	3	1.55	30	1430	4	0.111	5.168	2.8	862	7.3	5.124	16.540
93-05-06	11.2	5.4				1.88	4	20	2	0.053	4.255			7.3	4.302	15.410
93-06-02	16.3	4.4		7.0	28	10.37	44	670	4	7.783	8.667	11	1022	7.4	0.815	4.562
93-06-16	17.2	5.1		7.2	3	0.88	4	20	2	0.050	5.975	1.3	1142	7.4	5.543	3.672
93-07-21	17.9	5.4		7.7	3	0.75	4	10	2	0.057	5.040	1.1	920	7.4	4.709	0.185
93-08-25	18.1	5.7		7.5	3	0.83	288	64	14	0.050	4.715	1.8	934	7.8	4.623	10.920
93-09-16	15.2	4.5		7.6	3	1.04				0.050	4.586	1.2	878	7.4	5.217	15.970

STATION 490552 - Hyrum WWTP

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - DATA COURTESY OF UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

DATE	TEMP oC	DO umhos/cm	FLOW cfs	pH units	RTSS mg/l	TKN mg/l	F.STREP #/100ml	MF TOT #/100ml	MF FEC #/100ml	NH3 mg/l	TP mg/l	TURB ntu	TDS mg/l	F-pH units	DTP mg/l	D-NO2+NO3 mg/l
92-10-22	10.5	11.3			25	9.27		2950	510	8.230	28.600			7.9	1.361	173.000
92-12-08	12.8	9.0	2.0	7.5	19	48.65		4850	300	4.262	25.930				21.740	110.760
93-02-23	1.7	6.1	1.5	7.5	17	102.80	330	50	10	0.050	31.040		1864		27.520	66.060
93-03-24	11.6	9.2	2.3	8.2	60	8.23	110	100	4	7.370	21.640		1966		18.550	131.500
93-05-06	11.3	4.3	4.5	8.9	16	4.68	48	160	76	2.014	6.062				4.194	145.000
93-06-16	26.1	5.8	1.3	6.8	19	3.68	688	700	62	0.881	21.430				21.200	128.300
93-08-25	19.5	7.0		8.7	34	8.55	24		176	6.290	5.439	20	2390	9.1	5.275	98.150

STATION 490554 - EA Miller effluent

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - DATA COURTESY OF UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

DATE	TEMP oC	DO umhos/cm	FLOW cfs	pH units	RTSS mg/l	TKN mg/l	F.STREP #/100ml	MF TOT #/100ml	MF FEC #/100ml	NH3 mg/l	TP mg/l	TURB ntu	TDS mg/l	F-pH units	DTP mg/l	D-NO2+NO3 mg/l
92-12-09	3.5	6.9	1.3	8.5	5	2.21		540	10	0.152	5.310				5.150	
93-03-24	3.6	3.2	1.2	7.1	15	13.73	2550	5240	482	9.535	8.149	25	498	7.1	7.099	0.424
93-04-22	12.4	17.8	0.6	8.5	35	9.91	50	2500	10	3.440	6.008				3.224	0.181
93-05-06	12.3	3.7	1.9	8.4	4	3.52	80	500	8	1.819	3.702				3.694	0.447
93-06-16	20.2	2.9	1.5	8.4	3	1.32	380	80	14	0.181	3.930				3.763	0.084
93-07-20	21.7	4.1	0.3	8.3	3	2.01	60	110	22	0.312	3.803				3.733	0.066
93-08-25	19.9	3.2	1.5	7.6	6	3.29	108	8	28	0.596	4.827	4.9	532	7.5	4.438	0.049
93-09-16	15.3	7.3		7.7	3	2.55				0.483	3.807	2.5	572	7.7	3.509	0.020

TATION 490560 - Wellsville Lagoon discharge

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - DATA COURTESY OF UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

DATE	TEMP oC	DO umhos/cm	FLOW cfs	pH units	RTSS mg/l	TKN mg/l	F.STREP #/100ml	MF TOT #/100ml	MF FEC #/100ml	NH3 mg/l	TP mg/l	TURB ntu	TDS mg/l	F-pH units	DTP mg/l	D-NO2+NO3 mg/l
92-12-09	8.7	8.0	0.1	7.5	3	0.27				0.067	0.081			7.5	0.080	1.327
93-02-24	9.6	6.9	0.4	7.4	6	2.27	20	300	20	0.050	0.052	1.2	326	7.4	0.138	1.677
93-03-24	16.7	7.9		7.3	3	0.12	110	340	10	0.050	0.062	2	334	7.3	0.083	1.621
93-06-16	15.7	6.8	1.1	7.7	3	0.25	72	30	4	0.056	0.114				0.096	1.451
93-08-25	18.4	7.7		7.7	4	0.20	84	800	206	0.050	0.053	1.4	312	8.2	0.040	0.967

STATION 490562 - Magic Valley effluent

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - DATA COURTESY OF UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

DATE	TEMP oC	DO umhos/cm	FLOW cfs	pH units	RTSS mg/l	TKN mg/l	F.STREP #/100ml	MF TOT #/100ml	MF FEC #/100ml	NH3 mg/l	TP mg/l	TURB ntu	TDS mg/l	F-pH units	DTP mg/l	D-NO2+NO3 mg/l
92-10-22	10.9	8.9	6.5		3	0.80				0.315	0.120			8.0	0.100	0.638
92-12-09	2.5	10.6	13.6		4	0.49				0.101	0.047			8.0	0.010	0.459
93-02-24	3.6	11.4	7.7	8.1	10	0.37	60	480	10	1.068	0.044	2.8	250	8.1	0.025	0.502
93-03-24	7.7	11.4	8.8	7.8	86	1.00	48	660	136	0.145	0.221	45	184	7.8	0.059	1.184
93-04-06	7.9	7.7	9.0	8.1	27	0.75			704	0.244	0.099				0.067	1.084
93-04-22	8.9	9.1	5.6	8.3	52	1.41	524	3620		0.355	0.158				0.085	0.526
93-05-06	10.5	9.6	7.1	8.2	14	0.63	180	300	150	0.119	0.076				0.050	0.577
93-06-16	11.3	8.8	7.1	7.9	4	0.75	92	340	36	0.440	0.051				0.053	0.618
93-07-20	13.9	7.0	5.4	7.8	6	0.70	232	420	86	0.305	0.095				0.077	1.534
93-08-25	13.4	8.9	5.0	7.9	13	0.58	80		48	0.238	0.095	4	330	8.4	0.059	1.353
93-09-16	12.1	7.3	8.0	7.9	3	0.71				0.232	0.040	1	304	8.0	0.033	1.581

STATION 490568 - Trout of Paradise 001

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - DATA COURTESY OF UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

DATE	TEMP oC	DO umhos/cm	FLOW cfs	pH units	RTSS mg/l	TKN mg/l	F.STREP #/100ml	MF TOT #/100ml	MF FEC #/100ml	NH3 mg/l	TP mg/l	TURB ntu	TDS mg/l	F-pH units	DTP mg/l	D-NO2+NO3 mg/l
92-10-22	11.5	11.6	7.8		3	0.13	44	1300	64	0.050	0.014			8.3	0.016	0.303
92-12-09	3.3	11.9	12.8		6	0.22	160	800	36	0.050	0.020			8.3	0.010	0.309
93-02-24	4.1	11.8	11.6	7.9	14	0.10				0.050	0.029	4	254	8.1	0.020	0.394
93-03-24	5.0	11.1	8.5	7.7	86	0.68	92	320	76	0.050	0.170	50	178	7.8	0.056	1.017
93-04-06	6.0	6.9	12.3	7.9	25	0.65				0.050	0.048	13	204	8.1	0.035	0.908
93-05-06	8.6	9.2	13.1	7.9	66	0.41	128	320	112	0.050	0.082	22	178	8.4	0.025	0.323
93-05-18	13.5	8.2	18.2	7.9	88	0.52	24	300	42	0.050	0.081	31	162	8.6	0.012	0.287
93-06-02	8.9	9.2	18.4	7.8	39	0.59	156	490	104	0.050	0.048	10	176	8.3	0.018	0.463
93-06-16	9.9	9.4	18.3	7.8	17	0.18	68	1120	124	0.050	0.034	5.5	204	8.3	0.010	0.442
93-07-21	12.0	9.3	17.8	8.0	8	0.11	184	520	388	0.050	0.030	2.4	304	8.1	0.021	1.477
93-08-25	12.0	9.9	13.5	8.0	3	0.10	296	380	164	0.050	0.010	0.9	310	8.5	0.015	1.165
93-09-16	13.3	8.1		8.2	3	0.41				0.050	0.015	0.8	296	8.6	0.011	1.396

STATION 490569 - Little Bear River in canal above White's Trout Farm

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - DATA COURTESY OF UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

DATE	TEMP oC	DO umhos/cm	FLOW cfs	pH units	RTSS mg/l	TKN mg/l	F.STREP #/100ml	MF TOT #/100ml	MF FEC #/100ml	NH3 mg/l	TP mg/l	TURB ntu	TDS mg/l	F-pH units	DTP mg/l	D-NO2+NO3 mg/l
92-10-22	10.7	6.4	2.2	7.6	3	1.27				0.518	0.166			7.6	0.292	2.451
92-12-09	3.4	9.7	2.1	7.3	6	0.73				0.297	0.092			7.3	0.051	0.996
93-02-24	6.0	10.0	3.8	7.6	12	0.46				0.175	0.101	2.7	284	7.6	0.072	1.218
93-03-24	8.1	9.9	2.2	7.6	59	1.21	80	140	40	0.372	0.215	31	248	7.6	0.103	2.713
93-04-06	7.9	7.8	3.3	7.9	44	0.77				0.302	0.129				0.071	1.842
93-05-06	9.1	8.3	5.2	7.9	50	1.03	112	488	274	0.413	0.168				0.090	1.310
93-06-02	10.0	8.8	14.7	8.0	14	0.54	148	1380	244	0.129	0.086				0.039	1.272
93-06-16	11.2	8.7	15.2	7.9	4	0.48				0.375	0.067				0.046	1.933
93-07-21	12.9	7.7	9.2	7.7	3	0.75	370	820	140	0.328	0.089				0.073	2.314
93-08-25	13.0	8.6	8.2	7.7	4	0.55	180	1580	28	0.288	0.075	1.1	336	8.5	0.057	1.852
93-09-16	12.2	7.3	10.0	8.0	3	0.68				0.244	0.047	1.2	302	8.1	0.033	1.587

STATION 490571 - Trout of Paradise 002

APPENDIX III

Macroinvertebrate data

STATION 490540 - Blacksmith Fork above Logan River

CLASS-SUBCLASS/ORDER/FAMILY/Genera			average num. indivs./taxa (3 sites)	std. dev.
INSECTA				
PLECOPTERA (Stoneflies)				
	NEMOURIDAE	Malenka	0.33	
		Zapada	1.00	
	PERLIDAE	Calineuria	0.67	
	PERLODIDAE	Skwala	0.33	
COLEOPTERA (Beetles)				
	ELMIDAE	Ampumixis?	0.67	
		Cleptelmis	0.33	
		Dubiraphia	0.67	
		Optioservus	1.67	
EPHEMOPTERA (Mayflies)				
	BAETIDAE	Baetis	14.00	3.56
	EPHEMERELLIDAE	Ephemerella	1.00	
	HEPTAGENIIDAE	Rhrithrogena	1.67	
TRICHOPTERA (Caddisflies)				
	BRACHYCENTRIDAE	Brachycentrus	0.33	
	HYDROPSYCHIDAE	Cheumatopsyche	5.33	
		Hydropsyche	12.33	
DIPTERA (True Flies)				
	CHIRONOMIDAE	--	5.00	
	SIMULIDAE	--	3.00	
MISC.				
	unk. pupae	--	1.67	
HIRUDINEA		--	0.33	

AVERAGE ABUNDANCE =	50.33
std. dev. =	6.18
AVERAGE RICHNESS =	11.00
std. dev. =	2.16
AVERAGE DIVERSITY =	1.97
std. dev. =	0.29

STATION 490504 - Logan River above Little Bear

CLASS-SUBCLASS/ORDER/FAMILY/Genera			average num. indivs./taxa (3 sites)
INSECTA			
PLECOPTERA			
	CHLOROPERLIDAE	unk. gen.	0.33
	NEMOURIDAE	Malenka	2.00
		Zapada	1.33
	PERLODIDAE	Skwala	0.37
		unk. gen.	0.33
COLEOPTERA			
	ELIMIDAE	Ampumixis	1.00
		Cleptelmis	1.33
		Heterelimnius	7.00
		Narpus	0.33
		Optioservus	2.00
	HALIPLIDAE	Brychius	0.67
EPHEMOPTERA			
	BAETIDAE	Baetis	148.67
	EPHEMERELLIDAE	Drunella	0.33
		Ephemerella	2.33
		Seratella	0.33
	LEPTOPHLEBIDAE	Paraleptophlebia	7.33
TRICHOPTERA			
	BRACHYCENTRIDAE	Amniocentrus	10.00
		Micrasema	1.33
	HYDROPSYCHIDAE	Arctopsyche	2.33
	HYDROPTILIDAE	Ochotrichia	0.33
		unk. gen.	0.33
	LEPIDOSTOMATIDAE	Lepidostoma	25.67
	RHYACOPHILIDAE	Rhyacophila	1.33
	unk. pupae	--	0.67
DIPTERA			
	ATHERICIDAE	Atherix	0.33
	CHIRONOMIDAE		35.00
	SIMULIDAE		6.67
	TIPULIDAE	Antocha	2.67
		Cryptolabis?	0.33
		Hexatoma	1.33
MISC.			
	unk. pupae	--	6.00
HOMOPTERA		--	0.33

ARACHNOIDEA		
HYDRACARINA	--	2.00
HIRUDINIA	--	2.33
GASTROPODA	--	3.67
OSTROCODA	--	0.33
CRUSTACEA		
AMPHIPODA		
TALITRIDAE	Hyallella azteca	0.67

AVERAGE ABUNDANCE =	50.33
std. dev. =	80.90
AVERAGE RICHNESS =	22.67
std. dev. =	3.30
AVERAGE DIVERSITY =	1.78
std. dev. =	0.42

STATION 490425 - Cub River

CLASS-SUBCLASS/ORDER/FAMILY/Genera			average num. indivs./taxa (3 sites)
INSECTA			
PLECOPTERA			
	PTERONARCYDAE	Pteronarcys	0.33
COLEOPTERA			
	ELMIDAE	Duberaphia	13.67
		Optioservus	0.33
	HALIPLIDAE	Haliplus	0.33
EPHEMOPTERA			
	BAETIDAE	Baetis	1.00
	EPHEMERIDAE	Hexagenia	0.33
TRICHOPTERA			
	HYDROPSYCHIDAE	Cheumatopsyche	0.33
		Hydropsyche	1.67
	POLYCENTROPODIDA	Polycentropus	3.33
	RHYACOPHILIDAE	Rhyacophila	0.67
DIPTERA			
	CERATOPOGONIDAE	Dashylea?	1.00
	CHIRONOMIDAE	--	44.00
	SIMULIDAE	--	4.00
HEMIPTERA			
	CORIXIDAE	unk. gen.	0.33
HOMOPTERA		--	1.33
unk. pupae		--	13.33
ARACHNOIDEA			
HYDRACARINA		--	10.33
HIRUDINEA		--	0.33
CRUSTACEA			
AMPHIPODA			
	TALITRIDAE	Hyallella azteca	0.33
NEMATODA			0.67
	AVERAGE ABUNDANCE =		97.67
	std. dev. =		27.34
	AVERAGE RICHNESS =		12.00

std. dev. =	1.63
AVERAGE DIVERSITY =	1.64
std. dev. =	0.33

STATION 490544 - Blacksmith Fork at mouth of Canyon

CLASS-SUBCLASS/ORDER/FAMILY/Genera		average num. indivs./taxa (3 sites)
INSECTA		
PLECOPTERA (Stoneflies)		
CHLOROPERLID	unk.	1.00
PERLIDAE	Claasinia	0.33
PERLODIDAE	Rickera	0.33
PTERONARCYDA	Pteronarcys	2.00
	Pteronarcella	1.00
unk. fam.	--	0.67
COLEOPTERA		
ELMIDAE	Cleptelmis	0.67
	Optioservus	10.33
	Stenelmis	4.00
EPHEMOPTERA		
BAETIDAE	Baetis	225.67
EPHEMERELLIDA	Ephemerella	8.00
HEPTAGENIIDAE	Rhithrogena	2.67
TRICHOPTERA		
BRACHYCENTRI	Brachycentrus	2.67
GLOSSOSOMATI	Glossosoma	0.33
HYDROPSYCHID	Arctopsyche	5.33
	Cheumatopsych	0.33
	Hydropsyche	4.33
RHYACOPHILIDA	Rhyacophila	1.33
DIPTERA		
ATHERICIDAE	Atherix	1.33
CHIRONOMIDAE	--	36.00
SIMULIDAE	--	101.00
SYRPHIDAE	unk. gen.	0.33
TABANIDAE	Atylotus?	0.33
TIPULIDAE	Antocha	0.67
unk. pupae	--	1.33
HOMOPTERA	--	1.00
ARACHNOIDEA		
HYDRACARINA	--	2.67
HIRUDINEA	--	0.33
AVERAGE ABUNDANCE =		416.33
std. dev. =		362.02

AVERAGE RICHNESS =	17.33
std. dev. =	4.19
AVERAGE DIVERSITY =	1.49
std. dev. =	0.10

STATION 490382 - Bear River at Richmond

CLASS-SUBCLASS/ORDER/FAMILY/Genera		average num. indivs./taxa (3 sites)
INSECTA		
EPHEMOPTERA		
BAETIDAE	Baetis	0.33
EPHEMERELLIDAE	unk. gen.	0.33
DIPTERA		
CHIRONOMIDAE	--	7.67
SIMULIDAE	--	3.67
HOMOPTERA	--	3.00
ARACHNOIDEA		
HYDRACARINA	--	0.33
HIRUDINIA	--	0.33
NEMATODA	--	0.33

AVERAGE ABUNDANCE =	16.00
std. dev. =	7.79
AVERAGE RICHNESS =	4.33
std. dev. =	0.47
AVERAGE DIVERSITY =	1.24
std. dev. =	0.22

STATION 490198 - Bear River at Collinston (below Cutler dam)

CLASS-SUBCLASS/ORDER/FAMILY/Genera		average num. indivs./taxa (3 sites)	STD. DEV
INSECTA			
PLECOPTERA			
unk. fam.		0.67	
COLEOPTERA			
ELMIDAE	Microcylloepus	9.33	
	Ordobrevia	6.67	
	Stenelmis	5.67	
EPHEMOPTERA			
BAETIDAE	Baetis	61.00	41.82
EPHEMERELLIDAE	unk. gen.	0.33	
TRICORYTHODAE	Tricorythodes	8.67	
TRICHOPTERA			
BRACHYCENTRIDAE	unk. gen.	2.67	
HYDROPSYCHIDAE	Arctopsyche	0.33	
	Cheumatopsyche	73.33	57.19
	Hydropsyche	628.67	521.03
unk. fam. (pupae)		4.00	
DIPTERA			
ATHERICIDAE	Atherix	0.33	
CHIRONOMIDAE	--	69.00	78.96
SIMULIDAE	--	3.67	
ZYGOPTERA			
COENAGRIONIDAE	Argia	0.33	
	unk. gen.	0.33	
LEPIDOPTERA			
PYRALIDAE	Petrophila	7.33	
unk. pupae	--	0.67	
ARACHNOIDEA			
HYDRACARINA	--	8.33	
OSTRACODA	--	7.33	
AVERAGE ABUNDANCE =		898.67	
std. dev. =		734.72	
AVERAGE RICHNESS =		12.67	
std. dev. =		3.40	

AVERAGE DIVERSITY =	1.18
std. dev. =	0.06

STATION 490451 - Hopkins slough

CLASS-SUBCLASS/ORDER/FAMILY/Genera				average num indivs./taxa (3 sites)
INSECTA				
	COLEOPTERA			
		ELMIDAE	Duberaphia	0.33
	TRICHOPTERA			
		HYDROPSYCHIDAE	Cheumatopsyche	1.00
			Hydropsyche	8.67
		RHYACOPHILIDAE	Rhyacophila	0.33
	DIPTERA			
		CHIRONOMIDAE	--	1.33
	HOMOPTERA		--	0.33
CRUSTACEA				
	AMPHIPODA			
		TALITRIDAE	Hyallella azteca	0.33

AVERAGE ABUNDANCE =	12.33
std. dev. =	9.88
AVERAGE RICHNESS =	4.00
std. dev. =	0.82
AVERAGE DIVERSITY =	1.06
std. dev. =	0.37

STATION 490437 - Worm Creek

CLASS-SUBCLASS/ORDER/FAMILY/Genera		average num. indivs./taxa (3 sites)	std. dev.
INSECTA			
COLEOPTERA			
ELMIDAE	Optioservus	0.67	
	Zaitzeva	0.33	
HALIPLIDAE	Haliplus	0.33	
EPHEMOPTERA			
BAETIDAE	Baetis	0.67	
EPHEMERELLIDA	Seratella	0.33	
TRICHOPTERA			
HYDROPSYCHID	Cheumatopsyche	2.33	
	Hydropsyche	2.67	
DIPTERA			
CERATOPOGONI	unk. gen.	0.67	
CHIRONOMIDAE	--	86.00	26.70
SIMULIDAE	--	44.33	34.92
MEGALOPTERA			
SIALIDAE	Sialis	0.33	
unk. pupae		0.33	
HEMIPTERA			
CORIXIDAE	Sigara	10.00	
HOMOPTERA		1.33	
COLLEMBOLA		1.00	
CRUSTACEA			
AMPHIPODA			
TALITRIDAE	Hyallella azteca	0.67	
NEMATODA		0.33	

AVERAGE ABUNDANCE =	151.33
std. dev. =	30.68
AVERAGE RICHNESS =	10.00
std. dev. =	1.63
AVERAGE DIVERSITY =	1.05
std. dev. =	0.32

STATION 490610 - Bear River at UT-ID stateline

CLASS-SUBCLASS/ORDER/FAMILY/Genera				average num. indivs./taxa (3 sites)	std. dev.
INSECTA					
	PLECOPTERA				
		CHLOROPERLIDAE	unk. gen.	1.67	
		NEMOURIDAE	Zapada	0.33	
		PERLODIDAE	Skwala	4.00	
			unk. gen.	0.33	
	COLEOPTERA				
		ELMIDAE	Cleptelmis	2.67	
			Heterlimnus	0.33	
			Narpus	0.67	
			Optioservus	1.67	
			Ordobrevia?	0.33	
			Stenelmis	11.67	5.50
			Zaitzeva	4.67	
	EPHEMOPTERA				
		BAETIDAE	Baetis	1.00	
		EPHEMERELLIDAE	unk. gen.	0.33	
		HEPTEGENIIDAE	Rhrithrogena	1.33	
		TRICORYTHODAE	Tricorythodes	0.33	
	TRICHOPTERA				
		HYDROPSYCHIDAE	Cheumatopsyche	48.33	36.59
			Hydropsyche	59.00	34.54
		RHYACOPHILIDAE	Rhyacophila	0.33	
		unk. fam. pupae	--	1.33	
	DIPTERA				
		CHIRONOMIDAE	--	37.33	18.87
		SIMULIDAE	--	985.33	358.76
		TIPULIDAE	Hexatoma	0.33	
			Ormosia?	0.33	
	HOMOPTERA		--	0.33	
	unk. pupae		--	5.00	
ARACHNOIDEA					
	HYDRACARINA		--	0.33	
HIRUDINEA			--	11.00	

AVERAGE ABUNDANCE = 1180.33
std. dev. = 288.60

AVERAGE RICHNESS =	14.67
std. dev. =	4.50
AVERAGE DIVERSITY =	0.78
std. dev. =	0.31

STATION 490490 - Spring Creek

CLASS-SUBCLASS/ORDER/FAMILY/Genera				average num. indivs./taxa (3 sites)	std. dev.
INSECTA					
	EPHEMOPTERA				
		BAETIDAE	Baetis	4.33	
		EPHEMERELLIDAE	unk. gen.	0.33	
	DIPTERA				
		CHIRONOMIDAE	--	0.67	
		SIMULIDAE	--	4.67	
	ZYGOPTERA				
		COENAGRIONDIAE	Argia	0.33	
CRUSTACEA					
	AMPHIPODA				
		TALITRIDAE	Hyallella azteca	111.00	53.75
		GAMMARIDAE	Gammarus	5.67	
	ISOPODA				
		ASELLIDAE	Asellus	2.67	

AVERAGE ABUNDANCE =	129.67
std. dev. =	60.22
AVERAGE RICHNESS =	7.33
std. dev. =	0.94
AVERAGE DIVERSITY =	0.62
std. dev. =	0.15

APPENDIX IV

QA/QC data

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - ECOSYSTEMS RESEARCH INSTITUTE

LOG	DATE	FLOW cfs	TEMP oC	pH units	DO mg/l	COND umhos/cm	NO3-N mg/l	NO2-N mg/l	NH3-N mg/l	PO4-P mg/l	DTP-P mg/l	TP-P mg/l	ALK mg/l
590-1022	921022	20.0	9.9	7.6	9.6	435	0.108	0.001	0.008	0.003	0.003	0.013	214
590-1111	921111	25.0	3.6	8.1	10.4	425	0.070	0.001	0.012	0.005	0.006	0.020	206
590-1209	921209	15.0	2.1	7.3	10.6	369	0.162	0.001	0.003	0.004	0.009	0.024	178
93-0076	930113	10.0	0.9	8.1	12.5	374	0.128	0.002	0.007	0.004	0.004	0.013	183
93-0366	930223	28.5	3.0	7.8	10.6	347	0.153	0.002	0.017	0.005	0.006	0.028	156
93-0450	930309	10.2	3.8	8.1	11.1	344	0.055	0.001	0.015	0.004	0.004	0.016	181
93-0470	930322	133.3	3.9	7.6	10.7	216	0.424	0.004	0.022	0.035	0.051	0.110	114
93-0714	930405	124.9	3.9	7.8	10.6	211	0.177	0.004	0.034	0.020	0.048	0.052	107
93-0819	930419	68.2	4.1	7.3	10.4	240	0.059	0.002	0.011	0.009	0.021	0.032	116
NODATA	930503												
93-0977	930517	200.0	8.7	6.9	10.6	236	0.259	0.002	0.001	0.015	0.022	0.182	112
93-1094	930603	150.0	7.2	7.0	10.4	251	0.244	0.001	0.012	0.011	0.036	0.058	111
93-1153	930615	77.5	9.7	7.9	10.8	273	0.156	0.002	0.009	0.009	0.014	0.037	136
93-1213	930629	15.1	15.2	8.2	8.6	353	0.147	0.001	0.023	0.011	0.013	0.021	178
93-1304	930712	2.7	12.5	7.4	9.5	396	0.193	0.002	0.018	0.012	0.014	0.035	209
93-1353	930728	0.1	14.1	7.0	7.8	505	0.198	0.004	0.028	0.013	0.013	0.198	250
NOFLOW	930817	0.0											
NOFLOW	930830	0.0											
NOFLOW	930913	0.0											
NOFLOW	930927	0.0											

STATION 490590 - Little Bear at mouth of Hyrum Canyon (QA/QC site)

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - ECOSYSTEMS RESEARCH INSTITUTE

LOG	DATE	VTSS mg/l	RTSS mg/l	CA mg/l	MG mg/l	HARD mg/l	SI mg/l	CHLORIDE mg/l	SO4 mg/l	F. STREP #/100ml	TC #/100ml	FC #/100ml
590-1022	921022	1	4	59.3	16.2	-999	8.9	7.1	7.5	-999	900	600
590-1111	921111	2	10	53.4	17.3	204	10.1	11.5	11.8	-999	1000	54
590-1209	921209	2	12	51.4	25.4	-999	10.5	10.6	8.8	110	400	70
93-0076	930113	3	7	56.0	56.0	196	11.0	11.5	9.6	4	110	44
93-0366	930223	1	1	48.6	11.3	168	11.5	10.6	10.0	12	70	50
93-0450	930309	1	8	49.1	13.0	176	10.8	11.1	8.6	26	500	60
93-0470	930322	4	67	37.6	1.9	102	-999.0	6.2	6.3	< 1	130	110
93-0714	930405	-999	28	35.3	3.2	101	-999.0	6.2	5.7	14	3700	130
93-0819	930419	2	15	38.1	5.6	116	9.9	9.8	7.0	0	200	-999
NODATA	930503											
93-0977	930517	6	140	34.5	7.2	116	7.2	3.6	7.9	10	100	50
93-1094	930603	2	41	48.6	2.8	133	7.4	3.6	3.4	44	2000	300
93-1153	930615	3	22	41.3	8.7	139	8.1	4.5	3.8	30	100	80
93-1213	930629	2	6	76.0	0.5	186	9.2	3.6	4.5	28	200	70
93-1304	930712	1	3	76.0	8.7	225	10.1	5.4	4.8	108	2000	600
93-1353	930728	1	3	93.4	7.4	267	15.0	9.0	4.6	110	2000	700
NOFLOW	930817											
NOFLOW	930830											
NOFLOW	930913											
NOFLOW	930927											

STATION 490590 - Little Bear at mouth of Hyrum Canyon (QA/QC site)

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - ECOSYSTEMS RESEARCH INSTITUTE

LOG	DATE	FLOW cfs	TEMP oC	pH units	DO mg/l	COND umhos/cm	NO3-N mg/l	NO2-N mg/l	NH3-N mg/l	PO4-P mg/l	DTP-P mg/l	TP-P mg/l	ALK mg/l
574-1022	921022	20.0	9.9	7.6	9.6	435	0.035	0.001	0.010	0.003	0.004	0.016	217
574-1111	921111	25.0	3.6	8.1	10.4	425	0.075	0.001	0.018	0.007	0.007	0.021	205
574-1209	921209	15.0	2.1	7.3	10.6	369	0.152	0.001	0.011	0.005	0.007	0.032	185
93-0074	930113	10.0	0.9	8.1	12.5	374	0.145	0.002	0.011	0.004	0.006	0.013	192
93-0365	930223	28.5	3.0	7.8	10.6	347	0.088	0.002	0.002	0.004	0.006	0.022	156
93-0445	930309	10.2	3.8	8.1	11.1	344	0.042	0.001	0.023	0.004	0.004	0.013	170
93-0465	930322	133.5	3.9	7.6	10.7	216	0.369	0.004	0.024	0.036	0.051	0.157	108
93-0709	930405	124.9	3.9	7.8	10.6	211	0.159	0.002	0.042	0.026	0.032	0.068	99
93-0814	930419	68.2	4.1	7.3	10.4	240	0.070	0.002	0.013	0.009	0.019	0.034	114
93-0902	930503	73.3	8.4	8.0	10.1	273	0.090	0.001	0.041	0.004	0.014	0.030	131
93-0972	930517	200.0	8.7	6.9	10.6	236	0.254	0.002	0.033	0.026	0.026	0.160	111
93-1089	930603	150.0	7.2	7.0	10.4	251	0.225	0.001	0.010	0.011	0.052	0.102	115
93-1148	930615	77.5	9.7	7.9	10.8	273	0.198	0.002	0.014	0.009	0.009	0.038	137
93-1207	930629	15.1	15.2	8.2	8.6	353	0.240	0.001	0.021	0.012	0.012	0.016	176
93-1299	930712	2.7	12.5	7.4	9.5	396	0.221	0.002	0.053	0.012	0.012	0.013	211
93-1348	930728	0.1	14.1	7.0	7.8	505	0.226	0.005	0.031	0.013	0.013	0.037	250
	930817	0.0											
	930830	0.0											
	930913	0.0											
	930927	0.0											

STATION 490574 - South Fork Little Bear River above East Fork

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - ECOSYSTEMS RESEARCH INSTITUTE

LOG	DATE	VTSS mg/l	RTSS mg/l	CA mg/l	MG mg/l	HARD mg/l	SI mg/l	CHLORIDE mg/l	SO4 mg/l	F. STREP #/100ml	TC #/100ml	FC #/100ml
574-1022	921022	1	5	59.3	17.1	-999	8.7	8.9	8.4	-999	890	650
574-1111	921111	2	10	47.2	18.2	192	10.4	11.5	11.4	62	500	54
574-1209	921209	2	12	53.0	26.1	-999	10.5	10.6	8.8	-999	400	80
93-0074	930113	2	8	61.0	44.0	196	11.1	14.2	9.4	62	150	32
93-0365	930223	1	20	48.6	12.3	172	11.3	10.6	9.1	10	70	60
93-0445	930309	1	8	49.1	14.0	180	10.8	9.8	9.3	670	320	90
93-0465	930322	2	73	39.3	2.0	106	-999.0	6.7	5.1	40	300	110
93-0709	930405	-999	26	36.9	1.2	97	-999.0	6.2	5.7	8	5400	1500
93-0814	930419	1	13	37.3	5.6	118	9.9	6.2	7.3	4	300	-999
93-0902	930503	2	11	37.7	10.4	136	8.8	5.3	6.1	8	100	30
93-0972	930517	3	156	33.7	7.7	116	7.5	5.4	3.9	10	300	110
93-1089	930603	3	47	38.9	8.2	131	7.3	4.5	3.9	52	100	70
93-1148	930615	3	21	39.7	9.7	139	7.9	3.6	3.5	25	500	100
93-1207	930629	1	7	71.4	2.2	187	9.1	4.5	5.2	64	200	30
93-1299	930712	2	3	84.3	5.7	234	10.1	6.3	4.6	130	3000	1000
93-1348	930728	2	16	85.9	12.9	267	15.4	9.0	4.5	185	300	200
	930817											
	930830											
	930913											
	930927											

STATION 490574 - South Fork Little Bear River above East Fork

Comparison of stations 474 and 590 Little Bear above East Fork

Percent deviation for dups

date	no3	no2	nh3	po4	tfp	tp	alk	vol TSS	res tss	ca	mg	hard	si	chloride	so4
921022	102.1		22.2	0.0	28.6	20.7	1.4	0.0	22.2	0.0	5.4		2.3	22.5	11.3
921111	6.9	0.0	40.0	33.3	18.2	4.9	0.5	0.0	0.0	12.3	5.1	6.1	2.6	0.0	3.4
921209	6.4	0.0	114.3	22.2	25.0	28.6	3.6	0.0	0.0	3.1	2.7		0.0	0.0	0.0
930113	12.5	0.0	44.4	0.0	40.0	0.0	4.8	40.0	13.3	8.5	24.0	0.0	1.6	21.0	2.1
930223	53.9	0.0	157.9	22.2	0.0	24.0	0.0	0.0	181.0	0.0	8.5	2.4	1.8	0.0	9.4
930309	26.8	0.0	42.1	0.0	0.0	20.7	6.4	0.0	0.0	0.0	7.4	2.2	0.0	12.8	7.8
930322	13.9	0.0	8.7	2.8	0.0	35.2	6.1	66.7	8.6	4.4	5.1	3.9		7.0	21.1
930405	10.7	66.7	21.1	26.1	40.0	26.7	8.5		7.4	4.4	90.9	4.1		0.0	0.0
930419	17.1	0.0	16.7	0.0	10.0	6.1	1.9	66.7	14.3	2.3	0.0	1.7	0.2	44.5	5.0
930503															
930517	1.9	0.0	188.2	53.7	25.6	12.9	1.0	66.7	10.8	2.3	6.7	0.0	4.8	40.0	69.4
930603	8.1	0.0	18.2	0.0	36.4	55.0	3.6	40.0	13.6	22.2	98.5	1.5	0.4	22.2	13.6
930615	23.7	0.0	43.5	0.0	54.5	2.7	0.8	0.0	4.7	4.0	10.8	0.0	3.3	22.2	7.2
930629	48.1	0.0	9.1	8.7	60.0	27.0	1.2	66.7	15.4	6.2	75.0	0.5	0.8	22.2	13.7
930712	13.5	0.0	98.6	0.0	33.3	91.7	1.1	66.7	0.0	10.4	41.7	3.7	0.1	15.4	5.5
930728	13.2	22.2	10.2	0.0	9.5	137.0	0.2	66.7	136.8	8.4	54.2	0.0	2.5	0.0	2.2
Average	23.9	6.3	55.7	11.3	25.4	32.9	2.7	34.3	28.5	5.9	29.1	2.0	1.6	15.3	11.5

f strep	tc	fc
	1.1	8.0
	66.7	0.0
	0.0	13.3
175.8	30.8	31.6
18.2	0.0	18.2
185.1	43.9	40.0
190.2	79.1	0.0
54.5	37.4	168.1
120.0	40.0	
0.0	100.0	75.0
16.7	181.0	124.3
18.2	133.3	22.2
78.3	0.0	80.0
18.5	40.0	50.0
50.8	147.8	111.1
77.2	60.1	53.0

Calculated Confidence intervals based on WP performance evaluation studies (EPA)

Little Bear above East Fork
490590 vs 490574

	date	574 ~~590~~ ~~587~~	590 ~~574~~ ~~382~~	95% confidence Intervals lower	upper	pass/fail	99% confidence Intervals lower	upper	pass/fail
	no3								
NO3	921022	0.035	0.108	-0.003	0.070	fail	-0.007	0.083	fail
	921111	0.075	0.070	0.031	0.116	pass	0.027	0.131	pass
	921209	0.152	0.162	0.097	0.204	pass	0.091	0.223	pass
	930113	0.145	0.128	0.091	0.196	pass	0.086	0.214	pass
	930223	0.088	0.153	0.042	0.131	fail	0.038	0.146	fail
	930309	0.042	0.055	0.003	0.078	pass	-0.001	0.092	pass
	930322	0.369	0.424	0.283	0.452	pass	0.274	0.482	pass
	930405	0.159	0.177	0.103	0.212	pass	0.097	0.231	pass
	930419	0.070	0.059	0.027	0.110	pass	0.023	0.125	pass
	930503	0.090		0.044	0.133		0.039	0.149	
	930517	0.254	0.259	0.184	0.321	pass	0.177	0.344	pass
	930603	0.225	0.244	0.159	0.287	pass	0.153	0.310	pass
	930615	0.198	0.156	0.136	0.257	pass	0.130	0.278	pass
	930629	0.24	0.147	0.172	0.305	fail	0.166	0.328	fail
	930712	0.221	0.193	0.156	0.283	pass	0.150	0.305	pass
	930728	0.226	0.198	0.160	0.289	pass	0.154	0.311	pass
	nh3								
NH3	921022	0.010	0.008	-0.060	0.098	pass	-0.068	0.125	pass
	921111	0.018	0.012	-0.054	0.107	pass	-0.062	0.135	pass
	921209	0.011	0.003	-0.059	0.099	pass	-0.067	0.127	pass
	930113	0.011	0.007	-0.059	0.099	pass	-0.067	0.127	pass
	930223	0.002	0.017	-0.067	0.089	pass	-0.075	0.116	pass
	930309	0.023	0.015	-0.049	0.113	pass	-0.057	0.141	pass
	930322	0.024	0.022	-0.048	0.114	pass	-0.057	0.142	pass
	930405	0.042	0.034	-0.033	0.134	pass	-0.042	0.163	pass
	930419	0.013	0.011	-0.058	0.101	pass	-0.066	0.129	pass
	930503	0.041		-0.034	0.133		-0.042	0.162	
	930517	0.033	0.001	-0.041	0.124	pass	-0.049	0.153	pass
	930603	0.01	0.012	-0.060	0.098	pass	-0.068	0.125	pass
	930615	0.014	0.009	-0.057	0.102	pass	-0.065	0.130	pass
	930629	0.021	0.023	-0.051	0.110	pass	-0.059	0.138	pass
	930712	0.053	0.018	-0.024	0.147	pass	-0.032	0.176	pass

	930728	0.031	0.028	-0.042	0.122	pass	-0.051	0.150	pass
PO4	921022	0.003	0.003	-0.011	0.017	pass	-0.012	0.022	pass
	921111	0.007	0.005	-0.007	0.022	pass	-0.009	0.027	pass
	921209	0.005	0.004	-0.009	0.019	pass	-0.011	0.024	pass
	930113	0.004	0.004	-0.010	0.018	pass	-0.012	0.023	pass
	930223	0.004	0.005	-0.010	0.018	pass	-0.012	0.023	pass
	930309	0.004	0.004	-0.010	0.018	pass	-0.012	0.023	pass
	930322	0.036	0.035	0.018	0.054	pass	0.017	0.060	pass
	930405	0.026	0.020	0.010	0.043	pass	0.008	0.048	pass
	930419	0.009	0.009	-0.006	0.024	pass	-0.007	0.029	pass
	930503	0.004		-0.010	0.018		-0.012	0.023	
	930517	0.026	0.015	0.010	0.043	pass	0.008	0.048	pass
	930603	0.011	0.011	-0.004	0.026	pass	-0.005	0.031	pass
	930615	0.009	0.009	-0.006	0.024	pass	-0.007	0.029	pass
	930629	0.012	0.011	-0.003	0.027	pass	-0.004	0.032	pass
	930712	0.012	0.012	-0.003	0.027	pass	-0.004	0.032	pass
	930728	0.013	0.013	-0.002	0.028	pass	-0.004	0.034	pass
DTP	921022	0.004	0.003	-0.010	0.038	pass	-0.012	0.046	pass
	921111	0.005	0.006	-0.009	0.039	pass	-0.012	0.047	pass
	921209	0.007	0.009	-0.008	0.041	pass	-0.010	0.049	pass
	930113	0.006	0.004	-0.008	0.040	pass	-0.011	0.048	pass
	930223	0.006	0.006	-0.008	0.040	pass	-0.011	0.048	pass
	930309	0.002	0.002	-0.012	0.035	pass	-0.014	0.043	pass
	930322	0.051	0.051	0.029	0.091	pass	0.026	0.102	pass
	930405	0.032	0.048	0.013	0.069	pass	0.011	0.079	pass
	930419	0.019	0.021	0.003	0.055	pass	-0.000	0.064	pass
	930503	0.014		-0.002	0.049		-0.004	0.058	
	930517	0.017	0.022	0.001	0.052	pass	-0.002	0.061	pass
	930603	0.052	0.036	0.030	0.092	pass	0.027	0.103	pass
	930615	0.008	0.014	-0.007	0.042	pass	-0.009	0.051	pass
	930629	0.007	0.013	-0.008	0.041	pass	-0.010	0.049	pass
	930712	0.010	0.014	-0.005	0.044	pass	-0.007	0.053	pass
	930728	0.01	0.011	-0.005	0.044	pass	-0.007	0.053	pass

TP	921022	0.016	0.013	0.000	0.051	pass	-0.003	0.060	pass
	921111	0.021	0.020	0.004	0.057	pass	0.002	0.066	pass
	921209	0.032	0.024	0.013	0.069	pass	0.011	0.079	pass
	930113	0.013	0.013	-0.002	0.048	pass	-0.005	0.057	pass
	930223	0.022	0.028	0.005	0.058	pass	0.002	0.067	pass
	930309	0.013	0.016	-0.002	0.048	pass	-0.005	0.057	pass
	930322	0.157	0.110	0.118	0.211	fail	0.114	0.227	fail
	930405	0.068	0.052	0.044	0.110	pass	0.040	0.122	pass
	930419	0.034	0.032	0.015	0.072	pass	0.012	0.081	pass
	930503	0.030		0.012	0.067		0.009	0.077	
	930517	0.160	0.182	0.121	0.214	pass	0.116	0.231	pass
	930603	0.102	0.058	0.072	0.149	fail	0.068	0.162	fail
	930615	0.038	0.037	0.019	0.076	pass	0.016	0.086	pass
	930629	0.016	0.021	0.000	0.051	pass	-0.003	0.060	pass
	930712	0.013	0.035	-0.002	0.048	pass	-0.005	0.057	pass
	930728	0.037	0.198	0.018	0.075	fail	0.015	0.085	fail

alk	921022	217	214	206.302	223.360	pass	205.449	226.345	pass
	921111	205	206	194.798	211.160	pass	193.980	214.024	pass
	921209	185	178	175.435	190.625	pass	174.675	193.283	pass
	930113	192	183	182.145	197.741	pass	181.365	200.471	pass
	930223	156	156	147.827	161.347	pass	147.151	163.713	pass
	930309	170	181	161.056	175.376	fail	160.340	177.882	fail
	930322	108	114	101.344	112.052	fail	100.809	113.926	fail
	930405	99	107	92.803	102.994	fail	92.294	104.777	fail
	930419	114	116	107.662	118.751	pass	107.107	120.692	pass
	930503	131		123.670	135.729		123.067	137.839	
	930517	111	112	104.594	115.498	pass	104.049	117.406	pass
	930603	115.15	111.11	108.668	119.819	pass	108.111	121.770	pass
	930615	137.4	136.29	129.997	142.438	pass	129.375	144.615	pass
	930629	176.1	178.2	167.095	181.781	pass	166.360	184.351	pass
	930712	211	209	200.837	217.565	pass	200.001	220.492	pass
	930728	249.63	250.16	237.581	256.531	pass	236.633	259.848	pass

Ca	921022	59.3	59.3	53.795	64.908	pass	53.239	66.853	pass
	921111	47.2	53.4	42.807	51.704	fail	42.362	53.261	fail
	921209	53	51.4	48.074	58.033	pass	47.576	59.776	pass
	930113	61	56	55.338	66.764	pass	54.767	68.763	pass
	930223	48.6	48.6	44.078	53.231	pass	43.620	54.833	pass
	930309	49.1	49.1	44.532	53.777	pass	44.070	55.395	pass
	930322	39.3	37.6	35.633	43.082	pass	35.260	44.386	pass
	930405	36.9	35.3	33.453	40.463	pass	33.103	41.690	pass
	930419	37.25	38.1	33.771	40.845	pass	33.417	42.083	pass
	930503	37.7		34.180	41.336		33.822	42.589	
	930517	33.7	34.5	30.547	36.971	pass	30.226	38.095	pass
	930603	38.87	48.58	35.242	42.613	fail	34.874	43.903	fail
	930615	39.68	41.29	35.978	43.497	pass	35.602	44.813	pass
	930629	71.4	76	64.783	78.113	pass	64.116	80.446	pass
	930712	84.3	76	76.497	92.191	fail	75.712	94.937	pass
	930728	85.9	93.4	77.950	93.937	pass	77.151	96.735	pass

Mg	921022	17.1	16.2	15.372	18.832	pass	15.199	19.438	pass
	921111	18.2	17.3	16.363	20.041	pass	16.179	20.685	pass
	921209	26.1	25.4	23.480	28.722	pass	23.218	29.640	pass
	930113	44.0	56.0	39.606	48.393	fail	39.166	49.930	fail
	930223	12.3	11.3	11.047	13.557	pass	10.922	13.997	pass
	930309	14.0	13.0	12.579	15.426	pass	12.436	15.924	pass
	930322	2.0	1.9	1.768	2.239	pass	1.744	2.321	pass
	930405	1.2	3.2	1.047	1.360	fail	1.032	1.414	fail
	930419	5.6	5.6	5.047	6.239	pass	4.988	6.447	pass
	930503	10.4		9.336	11.470		9.229	11.843	
	930517	7.7	7.2	6.903	8.503	pass	6.823	8.782	pass
	930603	8.21	2.79	7.363	9.063	fail	7.278	9.361	fail
	930615	9.67	8.68	8.678	10.667	pass	8.578	11.016	pass
	930629	2.2	1	1.948	2.459	fail	1.923	2.548	fail
	930712	5.7	8.7	5.101	6.305	fail	5.041	6.515	fail
	930728	12.9	7.4	11.588	14.217	fail	11.456	14.677	fail

Hard	921022	ND	ND
	921111	192	204
	921209	ND	ND
	930113	196	196
	930223	172	168

930309	180	176
930322	106	102
930405	97	101
930419	118	116
930503	136	
930517	116	116
930603	130.61	132.65
930615	138.61	138.61
930629	187.3	186.3
930712	234	225.3
930728	267.4	267.4

Chloride	921022	8.9	7.1	7.846	11.118	fail	7.682	11.690	fail
	921111	11.5	11.5	10.303	13.829	pass	10.127	14.446	pass
	921209	10.6	10.6	9.453	12.890	pass	9.281	13.492	pass
	930113	14.2	11.5	12.855	16.645	fail	12.666	17.308	fail
	930223	10.6	10.6	9.491	12.932	pass	9.318	13.534	pass
	930309	9.8	11.1	8.649	12.004	pass	8.482	12.591	pass
	930322	6.7	6.2	5.719	8.771	pass	5.567	9.306	pass
	930405	6.2	6.2	5.294	8.302	pass	5.143	8.829	pass
	930419	6.2	9.8	5.294	8.302	fail	5.143	8.829	fail
	930503	5.3		4.462	7.384		4.316	7.896	
	930517	5.4	3.6	4.538	7.468	fail	4.391	7.981	fail
	930603	4.5	3.6	3.687	6.529	fail	3.545	7.027	pass
	930615	3.6	4.5	2.836	5.591	pass	2.699	6.073	pass
	930629	4.5	3.6	3.687	6.529	fail	3.545	7.027	pass
	930712	6.3	5.4	5.388	8.406	pass	5.237	8.935	pass
	930728	9	9	7.940	11.222	pass	7.776	11.796	pass

Sulfate	921022	8.4	7.5	6.503	9.914	pass	6.333	10.510	pass
	921111	11.4	11.8	9.164	13.156	pass	8.964	13.855	pass
	921209	8.8	8.8	6.858	10.346	pass	6.684	10.956	pass
	930113	9.4	9.6	7.390	10.994	pass	7.210	11.625	pass
	930223	9.1	10.0	7.124	10.670	pass	6.947	11.291	pass
	930309	9.3	8.6	7.301	10.886	pass	7.122	11.514	pass
	930322	5.1	6.3	3.576	6.347	pass	3.438	6.831	pass
	930405	5.7	5.7	4.109	6.995	pass	3.964	7.500	pass
	930419	7.3	7.0	5.545	8.746	pass	5.385	9.306	pass
	930503	6.1		4.481	7.449		4.333	7.969	
	930517	3.9	7.9	2.468	4.995	fail	2.341	5.438	fail

930603	3.86	3.37	2.477	5.006	pass	2.350	5.449	pass
930615	3.5	3.76	2.157	4.617	pass	2.034	5.048	pass
930629	5.21	4.54	3.674	6.465	pass	3.534	6.954	pass
930712	4.6	4.83	3.106	5.774	pass	2.973	6.241	pass
930728	4.52	4.62	3.062	5.720	pass	2.929	6.185	pass

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - ECOSYSTEMS RESEARCH INSTITUTE

LOG	DATE	FLOW cfs *	TEMP oC	pH units	DO mg/l	COND umhos/cm	NO3-N mg/l	NO2-N mg/l	NH3-N mg/l	PO4-P mg/l	DTP-P mg/l	TP-P mg/l	ALK mg/l
587-0910	920910	232.0	15.0	8.1	8.1	1100	0.053	0.003	0.027	0.009	0.025	0.093	294
587-0929	920929	196.0	13.4	8.1	9.2	1296	0.055	0.002	0.035	0.008	0.024	0.031	302
587-1020	921020	232.0	9.7	7.5	9.7	1256	0.048	0.003	0.026	0.005	0.013	0.027	328
587-1110	921110	282.0	3.6	8.1	11.2	1180	0.236	0.015	0.032	0.010	0.020	0.023	321
587-1208	921208	452.0	0.3	6.6	10.8	1065	0.502	0.010	0.181	0.007	0.014	0.025	261
93-0085	930113	449.0	0.1	7.6	10.8	1134	0.815	0.020	0.203	0.023	0.023	0.034	357
93-0361	930222	381.0	1.7	7.8	11.2	576	1.220	0.018	0.229	0.035	0.043	0.043	338
93-0480	930322	1180.0	7.5	7.7	9.4	920	3.806	0.034	0.234	0.092	0.104	0.442	346
93-0728	930406	1490.0	7.0	7.2	9.2	731	0.967	0.014	0.108	0.037	0.054	0.127	183
93-0829	930419	951.0	9.5	8.4	8.5	765	0.629	0.012	0.035	0.018	0.035	0.156	239
93-0907	930503	955.0	14.5	8.4	8.8	721	0.352	0.007	0.017	0.006	0.023	0.115	236
93-0988	930517	2170.0	17.0	8.2	6.5	617	0.274	0.008	0.011	0.018	0.030	0.093	209
93-1084	930602	1350.0	16.9	7.8	7.4	532	0.221	0.004	0.003	0.011	0.011	0.056	190
93-1143	930614	1700	16.4	7.9	8.6	525	0.193	0.005	0.012	0.012	0.020	0.074	196
93-1294	930712	495.0	21.5	8.3	-999.0	1098	0.330	0.017	0.042	0.016	0.027	0.184	301
93-1502	930816	344	21.3	8	8.1	917	0.182	0.006	0.028	0.013	0.029	0.073	285
93-1598	930914	-999	15.5	-999	9.7	-999	0.196	0.003	0.031	0.009	0.009	0.021	266
93-1800	931018	-999	11.5	7.9	8.9	932	0.539	0.010	0.022	0.014	0.062	0.064	297
93-2017	931117	-999	2	7.8	-999	907	0.672	0.007	0.035	0.012	0.016	0.048	292
94-0174	940125	-999	3.6	6.8	11.4	1097	0.904	0.012	0.109	0.007	0.031	0.036	317
94-0279	940222	-999	3	8	11.8	1072	0.908	0.011	0.205	0.010	0.053	0.068	332

STATION 490587 - Bear River east of Trenton (QA/QC site)

* Flows from USGS site at UT-ID stateline (10092700)

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - ECOSYSTEMS RESEARCH INSTITUTE

LOG	DATE	VTSS mg/l	RTSS mg/l	CA mg/l	MG mg/l	HARD mg/l	SI mg/l	CHLORIDE mg/l	SO4 mg/l	F. STREP #/100ml	TC #/100ml	FC #/100ml
587-0910	920910	3	33	56.1	45.0	324.5	7.0	154.2	67.5	-999	130	30
587-0929	920929	1	9	125.1	4.0	328.4	5.6	191.4	83.5	-999	< 100	< 10
587-1020	921020	2	6	92.9	31.1	-999.0	9.4	159.5	92.2	-999	200	40
587-1110	921110	2	5	67.6	45.7	356.0	12.4	138.3	105.7	36	40	6
587-1208	921208	2	6	72.2	29.3	300.0	12.9	106.4	72.4	12	200	< 1
93-0085	930113	1	5	115.0	172.0	460.0	23.4	124.1	83.9	10	500	10
93-0361	930222	3	20	93.9	34.0	373.7	22.7	117.0	70.2	8	40	< 1
93-0480	930322	4	334	96.5	25.9	346.9	20.6	77.1	73.6	100	200	50
93-0728	930406	-999	87	81.8	21.2	290.9	-999.0	54.1	59.7	2	400	< 1
93-0829	930419	3	81	81.0	21.5	290.0	-999.0	62.9	68.9	20	3800	-999
93-0907	930503	4	50	93.8	111.2	689.7	-999.0	53.2	53.8	10	110	40
93-0988	930517	3	79	68.1	14.3	228.6	-999.0	42.3	39.2	30	1000	100
93-1084	930602	3	43	84.2	7.3	239.8	-999.0	31.5	28.8	80	400	90
93-1143	930614	2	25	63.16	11.08	203.0	-999.0	32.4	26.8	120	1000	130
93-1294	930712	5	59	109.9	15.3	336.8	-999.0	136.8	49.3	210	1000	500
93-1502	930816	3	30	78.6	7.2	225.5	-999.0	93.6	52.1	600	3000	500
93-1598	930914	1	4	55.6	36.4	288.0	-999.0	66.3	66.3	160	100	100
93-1800	931018	2	4	66.1	39.2	325.6	-999.0	81	73.9	10	200	10
93-2017	931117	2	7	67.8	37.6	323.2	-999.0	82.8	58.8	100	100	< 1
94-0174	940125	2	5	76.6	35.9	338.4	-999.0	120.6	51	30	20	< 1
94-0279	940222	2	24	75.7	34	328.0	-999.0	118.8	60.9	120	160	0

STATION 490587 - Bear River east of Trenton (QA/QC site)

* Flows from USGS site at UT-ID stateline (10092700)

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - ECOSYSTEMS RESEARCH INSTITUTE

LOG	DATE	FLOW cfs *	TEMP oC	pH units	DO mg/l	COND umhos/cm	NO3-N mg/l	NO2-N mg/l	NH3-N mg/l	PO4-P mg/l	DTP-P mg/l	TP-P mg/l	ALK mg/l
587-0910	920910	232.0	15.0	8.1	8.1	1100	0.053	0.003	0.027	0.009	0.025	0.093	294
587-0929	920929	196.0	13.4	8.1	9.2	1296	0.055	0.002	0.035	0.008	0.024	0.031	302
587-1020	921020	236	9.7	7.5	9.7	1256	0.065	0.003	0.021	0.006	0.013	0.027	332
587-1110	921110	282	3.6	8.1	11.2	1180	0.308	0.015	0.031	0.010	0.012	0.026	321
587-1208	921208	462	0.3	6.6	10.8	1065	0.572	0.011	0.270	0.008	0.015	0.020	212
93-0085	930113	449	0.1	7.6	10.8	1134	0.771	0.019	0.192	0.024	0.026	0.033	362
93-0361	930222	360	1.7	7.8	11.2	1125	1.275	0.018	0.245	0.034	0.045	0.083	349
93-0480	930322	1047	7.5	7.7	9.4	917	2.158	0.033	0.241	0.078	0.102	0.470	335
93-0728	930406	1490	7.0	7.2	9.2	731	1.059	0.015	0.104	0.036	0.054	0.115	231
93-0829	930419	951	9.5	8.4	8.5	765	0.571	0.011	0.059	0.022	0.037	0.186	237
93-0907	930503	1252	14.5	8.4	8.8	706	0.382	0.007	0.035	0.005	0.023	0.108	234
93-0988	930517	2165	17.0	8.1	6.5	610	0.347	0.008	0.016	0.018	0.029	0.140	207
93-1084	930602	1350	16.9	7.8	7.4	532	0.203	0.004	0.005	0.011	0.016	0.039	194
93-1143	930614	1700	16.4	7.9	8.6	525	0.119	0.005	0.016	0.010	0.025	0.068	193
93-1294	930712	487	21.5	8.2	-999.0	1096	0.310	0.017	0.046	0.015	0.026	0.211	302
93-1502	930816	408	21.3	8	8.1	917	0.231	0.006	0.035	0.026	0.026	0.037	285
93-1598	930914	453	15.5	-999	9.7	-999	0.207	0.003	0.085	0.012	0.012	0.024	262
93-1800	931018	-999	11.5	7.9	8.9	932	0.539	0.010	0.022	0.014	0.062	0.064	297
93-2017	931117	-999	2	7.8	-999	907	0.672	0.007	0.035	0.012	0.016	0.048	292
94-0174	940125	-999	3.6	6.8	11.4	1097	0.904	0.012	0.109	0.007	0.031	0.036	317
94-0279	940222	-999	3	8	11.8	1072	0.908	0.011	0.205	0.010	0.053	0.068	332

STATION 490382 - Bear River west of Richmond, Utah

* Flows from USGS site at UT-ID stateline (10092700)

BEAR RIVER WATER QUALITY MANAGEMENT PLAN - ECOSYSTEMS RESEARCH INSTITUTE

LOG	DATE	VTSS mg/l	RTSS mg/l	CA mg/l	MG mg/l	HARD mg/l	SI mg/l	CHLORIDE mg/l	SO4 mg/l	F. STREP #/100ml	TC #/100ml	FC #/100ml
587-0910	920910	3	33	56.1	45.0	324.5	7.0	154.2	67.5	-999	130	30
587-0929	920929	1	9	125.1	4.0	328.4	5.6	191.4	83.5	-999	< 100	< 10
587-1020	921020	2	7	84.9	37.9	-999.0	9.5	159.5	97.6	-999	200	60
587-1110	921110	1	5	66.8	46.2	356.0	10.9	138.3	102.6	46	200	4
587-1208	921208	2	5	45.6	33.1	260.0	10.9	93.9	54.2	10	100	4
93-0085	930113	2	5	107.0	132.0	400.0	11.7	125.8	80.9	4	180	18
93-0361	930222	2	21	114.9	26.1	393.9	22.6	118.8	77.8	2	60	1
93-0480	930322	3	345	99.8	22.9	342.9	20.6	75.3	69.9	50	400	80
93-0728	930406	-999	91	80.2	18.2	274.7	-999.0	50.5	62.8	10	600	1
93-0829	930419	4	84	81.0	16.1	268.0	-999.0	62.9	67.6	30	900	-999
93-0907	930503	4	50	83.4	16.6	275.9	-999.0	52.3	57.7	15	20	10
93-0988	930517	3	71	63.3	22.1	248.7	-999.0	37.8	40.3	70	2000	600
93-1084	930602	3	36	80.2	7.2	229.6	-999.0	32.4	33.2	45	400	100
93-1143	930614	2	22	58.3	17.7	217.8	-999.0	30.6	26.9	110	100	100
93-1294	930712	3	79	130.6	5.3	347.4	-999.0	135.9	51.2	18	700	500
93-1502	930816	3	36	58.2	36.4	294.1	-999.0	94.5	50.3	720	1200	800
93-1598	930914	1	8	56.4	34.3	281.2	-999.0	65.8	65.84	116	400	175
93-1800	931018	2	4	66.1	39.2	325.6	-999.0	81	73.9	10	200	10
93-2017	931117	2	7	67.8	37.6	323.2	-999.0	82.8	58.8	100	100	< 1
94-0174	940125	2	5	76.6	35.9	338.4	-999.0	120.6	51	30	20	< 1
94-0279	940222	2	24	75.7	34	328.0	-999.0	118.8	60.9	120	160	0

STATION 490382 - Bear River west of Richmond, Utah

* Flows from USGS site at UT-ID stateline (10092700)

Comparison of stations 587 and 382 Bear River near Richmond

Percent deviation for dups

date	no3	no2	nh3	po4	tfp	tp	alk	vol TSS	res tss	ca	mg	hard	si	chloride	so4
920910	17.2	0.0	16.9	20.0	17.4	8.2	1.5	28.6	64.0	6.9	7.9	1.3	4.3	1.1	54.5
920929	19.7	0.0	37.3	22.2	46.2	14.9	2.0	0.0	36.4	2.5	64.7	0.0	1.3	0.9	3.3
921020	30.1	0.0	21.3	18.2	0.0	0.0	1.2	0.0	15.4	9.0	19.7		0.4	0.0	5.7
921110	26.5	0.0	3.2	0.0	50.0	12.2	0.0	66.7	0.0	1.2	1.1	0.0	12.6	0.0	3.0
921208	13.0	9.5	39.5	13.3	6.9	22.2	20.7	0.0	18.2	45.2	12.2	14.3	16.8	12.5	28.8
930113	5.5	5.1	5.6	4.3	12.2	3.0	1.2	66.7	0.0	7.2	26.3	14.0	66.8	1.4	3.6
930222	4.4	0.0	6.8	2.9	4.5	63.5	3.2	40.0	4.9	20.1	26.3	5.3	0.8	1.5	10.3
930322		3.0	2.9	16.5	1.9	6.1	3.3	28.6	3.2	3.4	12.3	1.2	0.0	2.3	5.2
930406	9.1	6.9	3.8	2.7	0.0	9.9	23.5		4.5	2.0	15.2	5.7		6.9	5.1
930419	9.7	8.7	51.1	20.0	5.6	17.5	0.7	28.6	3.6	0.0	28.7	7.9		0.0	1.8
930503	8.2	0.0	69.2	18.2	0.0	6.3	0.9	0.0	0.0	11.7	148.0	85.7		1.7	7.1
930517	23.5	0.0	37.0	0.0	3.4	40.3	1.1	0.0	10.7	7.3	42.9	8.4		11.2	2.8
930602	8.5	0.0	50.0	0.0	37.0	35.8	2.1	0.0	17.7	4.9	0.4	4.4		2.8	14.2
930614	47.4	0.0	28.6	18.2	22.2	8.5	1.6	0.0	12.8	8.0	45.8	7.1		5.7	0.4
930712	6.3	0.0	9.1	6.5	3.8	13.7	0.4	50.0	29.0	17.2	97.1	3.1		0.7	3.6
930816	23.7	0.0	22.2	66.7	10.9	65.6	0.0	0.0	18.2	29.8	133.9	26.4		1.0	3.5
930914	5.5	0.0	93.1	28.6	82.4	13.3	1.3	0.0	66.7	1.4	5.9	2.4		0.8	0.8
931018	7.0	0.0	0.0	6.9	81.8	17.1	1.5	0.0	22.2	0.8	5.8	2.2		2.2	4.1
931117	0.6	0.0	18.2	18.2	6.5	11.0	0.0	0.0	25.0	1.2	0.8	1.0		2.2	5.6
940125	11.3	8.0	0.0	35.3	34.0	17.7	4.5	66.7	18.2	10.4	11.5	1.4		0.7	1.9
940222	11.5	0.0	8.1	18.2	7.8	4.3	7.1	66.7	47.6	4.8	1.5	3.4		3.9	14.1
Average	14.4	2.0	24.9	16.0	20.7	18.6	3.7	22.1	19.9	9.3	33.7	9.7	12.9	2.8	8.5

f strep	tc	fc
	26.1	40.0
	163.6	0.0
	0.0	40.0
24.4	133.3	40.0
18.2	66.7	120.0
85.7	94.1	57.1
120.0	40.0	0.0
66.7	66.7	46.2
133.3	40.0	0.0
40.0	123.4	
40.0	138.5	120.0
80.0	66.7	142.9
56.0	0.0	10.5
8.7	163.6	26.1
168.4	35.3	0.0
18.2	85.7	46.2
31.9	120.0	54.5
127.3	138.5	160.0
68.5	107.7	0.0
3.3	40.0	0.0
17.2	43.9	163.6
61.5	80.7	53.4

Calculated Confidence intervals based on WP performance evaluation studies (EPA)

Bear River near Richmond
490382 vs 490587

	date	587	382	95% confidence Intervals lower	95% confidence Intervals upper	pass/fail	99% confidence Intervals lower	99% confidence Intervals upper	pass/fail
	no3								
NO3	920910	0.053	0.063	0.012	0.091	pass	0.008	0.105	pass
	920929	0.055	0.067	0.014	0.093	pass	0.010	0.107	pass
	921020	0.048	0.065	0.008	0.085	pass	0.004	0.099	pass
	921110	0.236	0.308	0.169	0.300	fail	0.162	0.323	pass
	921208	0.502	0.572	0.396	0.604	pass	0.386	0.640	pass
	930113	0.815	0.771	0.664	0.961	pass	0.649	1.013	pass
	930222	1.220	1.275	1.011	1.424	pass	0.990	1.496	pass
	930322	3.806	2.158	3.223	4.378	fail	3.165	4.581	**fail**
	930406	0.967	1.059	0.794	1.135	pass	0.777	1.195	pass
	930419	0.629	0.571	0.505	0.749	pass	0.493	0.792	pass
	930503	0.352	0.382	0.268	0.433	pass	0.260	0.461	pass
	930517	0.274	0.347	0.201	0.343	fail	0.194	0.368	pass
	930602	0.221	0.203	0.156	0.283	pass	0.150	0.305	pass
	930614	0.193	0.119	0.132	0.251	fail	0.126	0.272	**fail**
	930712	0.330	0.310	0.249	0.407	pass	0.241	0.435	pass
	930816	0.182	0.231	0.123	0.238	pass	0.117	0.259	pass
	930914	0.196	0.207	0.134	0.254	pass	0.129	0.275	pass
	931018	0.539	0.578	0.428	0.646	pass	0.417	0.684	pass
	931117	0.672	0.668	0.542	0.798	pass	0.529	0.843	pass
	940125	0.904	1.012	0.740	1.063	pass	0.724	1.120	pass
	940222	0.908	1.019	0.744	1.068	pass	0.727	1.124	pass
	nh3								
NH3	920910	0.027	0.032	-0.046	0.117	pass	-0.054	0.146	pass
	920929	0.035	0.024	-0.039	0.126	pass	-0.047	0.155	pass
	921020	0.026	0.021	-0.047	0.116	pass	-0.055	0.144	pass
	921110	0.032	0.031	-0.042	0.123	pass	-0.050	0.152	pass
	921208	0.181	0.270	0.085	0.292	pass	0.074	0.328	pass
	930113	0.203	0.192	0.104	0.317	pass	0.093	0.354	pass
	930222	0.229	0.245	0.126	0.347	pass	0.115	0.385	pass
	930322	0.234	0.241	0.130	0.352	pass	0.119	0.391	pass
	930406	0.108	0.104	0.023	0.209	pass	0.014	0.242	pass
	930419	0.035	0.059	-0.039	0.126	pass	-0.047	0.155	pass
	930503	0.017	0.035	-0.054	0.106	pass	-0.062	0.134	pass
	930517	0.011	0.016	-0.059	0.099	pass	-0.067	0.127	pass
	930602	0.003	0.005	-0.066	0.090	pass	-0.074	0.117	pass
	930614	0.012	0.016	-0.059	0.100	pass	-0.067	0.128	pass
	930712	0.042	0.046	-0.033	0.134	pass	-0.042	0.163	pass

	930816	0.028	0.035	-0.045	0.118	pass	-0.053	0.147	pass
	930914	0.031	0.085	-0.042	0.122	pass	-0.051	0.150	pass
	931018	0.022	0.022	-0.050	0.111	pass	-0.058	0.140	pass
	931117	0.035	0.042	-0.039	0.126	pass	-0.047	0.155	pass
	940125	0.109	0.109	0.024	0.210	pass	0.014	0.243	pass
	940222	0.205	0.189	0.105	0.319	pass	0.094	0.357	pass
	PO4								
PO4	920910	0.009	0.011	-0.006	0.024	pass	-0.007	0.029	pass
	920929	0.008	0.010	-0.007	0.023	pass	-0.008	0.028	pass
	921020	0.005	0.006	-0.009	0.019	pass	-0.011	0.024	pass
	921110	0.010	0.010	-0.005	0.025	pass	-0.006	0.030	pass
	921208	0.007	0.008	-0.007	0.022	pass	-0.009	0.027	pass
	930113	0.023	0.024	0.007	0.039	pass	0.005	0.045	pass
	930222	0.035	0.034	0.018	0.053	pass	0.016	0.059	pass
	930322	0.092	0.078	0.068	0.115	pass	0.066	0.124	pass
	930406	0.037	0.036	0.019	0.055	pass	0.018	0.061	pass
	930419	0.018	0.022	0.002	0.034	pass	0.001	0.039	pass
	930503	0.006	0.005	-0.008	0.021	pass	-0.010	0.026	pass
	930517	0.018	0.018	0.002	0.034	pass	0.001	0.039	pass
	930602	0.011	0.011	-0.004	0.026	pass	-0.005	0.031	pass
	930614	0.012	0.010	-0.003	0.027	pass	-0.004	0.032	pass
	930712	0.016	0.015	0.001	0.032	pass	-0.001	0.037	pass
	930816	0.013	0.026	-0.002	0.028	pass	-0.004	0.034	pass
	930914	0.009	0.012	-0.006	0.024	pass	-0.007	0.029	pass
	931018	0.014	0.015	-0.001	0.029	pass	-0.003	0.035	pass
	931117	0.012	0.01	-0.003	0.027	pass	-0.004	0.032	pass
	940125	0.007	0.01	-0.007	0.022	pass	-0.009	0.027	pass
	940222	0.01	0.012	-0.005	0.025	pass	-0.006	0.030	pass
	dtp								
DTP	920910	0.025	0.021	0.008	0.061	pass	0.005	0.071	pass
	920929	0.024	0.015	0.007	0.060	pass	0.004	0.070	pass
	921020	0.013	0.013	-0.002	0.048	pass	-0.005	0.057	pass
	921110	0.020	0.012	0.003	0.056	pass	0.001	0.065	pass
	921208	0.014	0.015	-0.002	0.049	pass	-0.004	0.058	pass
	930113	0.023	0.026	0.006	0.059	pass	0.003	0.068	pass
	930222	0.043	0.045	0.023	0.082	pass	0.020	0.092	pass
	930322	0.104	0.102	0.074	0.151	pass	0.070	0.164	pass
	930406	0.054	0.054	0.032	0.094	pass	0.029	0.105	pass
	930419	0.035	0.037	0.016	0.073	pass	0.013	0.083	pass
	930503	0.023	0.023	0.006	0.059	pass	0.003	0.068	pass
	930517	0.030	0.029	0.012	0.067	pass	0.009	0.077	pass
	930602	0.011	0.016	-0.004	0.045	pass	-0.007	0.054	pass
	930614	0.02	0.025	0.003	0.056	pass	0.001	0.065	pass
	930712	0.027	0.026	0.009	0.064	pass	0.007	0.073	pass
	930816	0.029	0.026	0.011	0.066	pass	0.008	0.075	pass
	930914	0.005	0.012	-0.009	0.039	pass	-0.012	0.047	pass
	931018	0.062	0.026	0.039	0.103	fail	0.035	0.115	fail
	931117	0.016	0.015	0.000	0.051	pass	-0.003	0.060	pass
	940125	0.031	0.022	0.013	0.068	pass	0.010	0.078	pass
	940222	0.053	0.049	0.031	0.093	pass	0.028	0.104	pass

TP	920910	0.093	0.101	0.065	0.138	pass	0.061	0.151	pass
	920929	0.031	0.036	0.013	0.068	pass	0.010	0.078	pass
	921020	0.027	0.027	0.009	0.064	pass	0.007	0.073	pass
	921110	0.023	0.026	0.006	0.059	pass	0.003	0.068	pass
	921208	0.025	0.020	0.008	0.061	pass	0.005	0.071	pass
	930113	0.034	0.033	0.015	0.072	pass	0.012	0.081	pass
	930222	0.043	0.083	0.023	0.082	fail	0.020	0.092	pass
	930322	0.442	0.470	0.358	0.534	pass	0.349	0.565	pass
	930406	0.127	0.115	0.093	0.177	pass	0.089	0.192	pass
	930419	0.156	0.186	0.118	0.210	pass	0.113	0.226	pass
	930503	0.115	0.108	0.083	0.163	pass	0.079	0.177	pass
	930517	0.093	0.140	0.065	0.138	fail	0.061	0.151	pass
	930602	0.056	0.039	0.034	0.096	pass	0.030	0.107	pass
	930614	0.074	0.068	0.049	0.117	pass	0.045	0.129	pass
	930712	0.184	0.211	0.141	0.242	pass	0.136	0.259	pass
	930816	0.073	0.037	0.048	0.116	fail	0.044	0.128	fail
	930914	0.021	0.024	0.004	0.057	pass	0.002	0.066	pass
	931018	0.064	0.076	0.040	0.106	pass	0.037	0.117	pass
	931117	0.048	0.043	0.027	0.087	pass	0.024	0.098	pass
	940125	0.036	0.043	0.017	0.074	pass	0.014	0.084	pass
	940222	0.068	0.071	0.044	0.110	pass	0.040	0.122	pass

alk	920910	294	290	280.401	301.943	pass	279.324	305.712	pass
	920929	302	296	287.783	309.771	pass	286.683	313.618	pass
	921020	328	332	312.706	336.202	pass	311.531	340.314	pass
	921110	321	321	305.996	329.086	pass	304.841	333.127	pass
	921208	261	212	248.288	267.887	fail	247.308	271.316	fail
	930113	357	362	340.601	365.785	pass	339.342	370.192	pass
	930222	338	349	322.292	346.368	fail	321.088	350.581	pass
	930322	346	335	330.133	354.684	pass	328.906	358.980	pass
	930406	183	231	173.422	188.490	fail	172.668	191.127	fail
	930419	239	237	227.007	245.318	pass	226.092	248.522	pass
	930503	236	234	224.323	242.472	pass	223.416	245.648	pass
	930517	209	207	198.345	214.922	pass	197.516	217.823	pass
	930602	190	194	180.314	195.799	pass	179.540	198.509	pass
	930614	195.9	193	186.075	201.909	pass	185.283	204.680	pass
	930712	301	302	286.536	308.449	pass	285.441	312.284	pass
	930816	285	285	271.486	292.488	pass	270.436	296.164	pass
	930914	265.6	262.3	252.889	272.766	pass	251.896	276.245	pass

	931018	297.1	301.5	283.085	304.789	pass	282.000	308.587	pass
	931117	291.7	291.69	277.909	299.300	pass	276.839	303.043	pass
	940125	317	303	302.162	325.020	pass	301.019	329.020	pass
	940222	331.8	356.3	316.349	340.065	fail	315.163	344.216	fail

Ca	920910	56.1	60.1	50.898	61.427	pass	50.371	63.270	pass
	920929	125.1	128.3	113.502	136.661	pass	112.344	140.714	pass
	921020	92.9	84.9	84.307	101.576	pass	83.443	104.598	pass
	921110	67.6	66.8	61.332	73.966	pass	60.700	76.177	pass
	921208	72.2	45.6	65.509	78.986	fail	64.835	81.345	fail
	930113	115.0	107.0	104.376	125.694	pass	103.310	129.424	pass
	930222	93.9	114.9	85.215	102.667	fail	84.342	105.722	fail
	930322	96.5	99.8	87.576	105.505	pass	86.680	108.642	pass
	930406	81.8	80.2	74.227	89.463	pass	73.465	92.129	pass
	930419	81.0	81.0	73.473	88.557	pass	72.719	91.197	pass
	930503	93.8	83.4	85.124	102.558	fail	84.252	105.609	fail
	930517	68.1	63.3	61.786	74.512	pass	61.150	76.739	pass
	930602	84.2	80.2	76.415	92.093	pass	75.632	94.836	pass
	930614	63.16	58.3	57.300	69.121	pass	56.709	71.189	pass
	930712	109.9	130.6	99.744	120.128	fail	98.725	123.695	fail
	930816	78.6	58.2	71.321	85.970	fail	70.588	88.534	fail
	930914	55.6	56.4	50.435	60.871	pass	49.913	62.697	pass
	931018	66.1	66.6	59.970	72.329	pass	59.352	74.492	pass
	931117	67.8	67	61.513	74.184	pass	60.880	76.402	pass
	940125	76.6	85	69.505	83.788	fail	68.791	86.287	pass
	940222	75.7	79.4	68.687	82.806	pass	67.982	85.276	pass

Mg	920910	45.0	41.6	40.525	49.513	pass	40.075	51.087	pass
	920929	4.0	2.1	3.579	4.448	fail	3.535	4.600	fail
	921020	31.1	37.9	27.984	34.217	fail	27.673	35.307	fail
	921110	45.7	46.2	41.137	50.261	pass	40.681	51.857	pass
	921208	29.3	33.1	26.363	32.239	fail	26.069	33.267	pass
	930113	172.0	132.0	154.921	189.052	fail	153.214	195.025	fail
	930222	34.0	26.1	30.597	37.404	fail	30.256	38.595	fail
	930322	25.9	22.9	23.300	28.503	fail	23.039	29.413	fail
	930406	21.2	18.2	19.065	23.338	fail	18.852	24.085	fail
	930419	21.5	16.1	19.336	23.667	fail	19.119	24.425	fail
	930503	111.2	16.6	100.146	122.239	fail	99.042	126.105	fail

	930517	14.3	22.1	12.849	15.755	fail	12.704	16.264	fail
	930602	7.3	7.2	6.498	8.008	pass	6.422	8.272	pass
	930614	11.08	17.7	9.948	12.217	fail	9.835	12.614	fail
	930712	15.3	5.3	13.750	16.854	fail	13.595	17.397	fail
	930816	7.2	36.4	6.453	7.953	fail	6.378	8.216	fail
	930914	36.4	34.3	32.759	40.041	pass	32.395	41.315	pass
	931018	39.2	37	35.281	43.118	pass	34.890	44.489	pass
	931117	37.6	37.3	33.840	41.360	pass	33.464	42.676	pass
	940125	35.9	32	32.309	39.492	fail	31.949	40.749	pass
	940222	34	34.5	30.597	37.404	pass	30.256	38.595	pass

Hard	920910	324.5	320.4
	920929	328.4	328.4
	921020	ND	ND
	921110	356.0	356.0
	921208	300.0	260.0
	930113	460.0	400.0
	930222	373.7	393.9
	930322	346.9	342.9
	930406	290.9	274.7
	930419	290.0	268.0
	930503	689.7	275.9
	930517	228.6	248.7
	930602	239.8	229.6
	930614	202.97	217.8
	930712	336.8	347.4
	930816	225.5	294.1
	930914	288	281.2
	931018	325.6	318.4
	931117	323.2	320
	940125	338.4	343.2
	940222	328	339.2

Chloride	920910	154.2	156.0	145.193	162.647	pass	144.320	165.701	pass
	920929	191.4	189.7	180.373	201.460	pass	179.319	205.150	pass
	921020	159.5	159.5	150.193	168.163	pass	149.294	171.308	pass
	921110	138.3	138.3	130.155	146.056	pass	129.360	148.839	pass
	921208	106.4	93.9	100.003	112.791	fail	99.363	115.029	fail
	930113	124.1	125.8	116.733	131.248	pass	116.007	133.788	pass
	930222	117.0	118.8	110.013	123.834	pass	109.321	126.253	pass
	930322	77.1	75.3	72.309	82.237	pass	71.812	83.974	pass
	930406	54.1	50.5	50.569	58.252	fail	50.185	59.597	pass
	930419	62.9	62.9	58.906	67.450	pass	58.478	68.945	pass
	930503	53.2	52.3	49.699	57.293	pass	49.320	58.622	pass
	930517	42.3	37.8	39.416	45.947	fail	39.089	47.090	fail

	930602	31.5	32.4	29.207	34.685	pass	28.934	35.644	pass
	930614	32.4	30.6	30.058	35.624	pass	29.780	36.597	pass
	930712	136.8	135.9	128.737	144.492	pass	127.949	147.249	pass
	930816	93.6	94.5	87.904	99.443	pass	87.327	101.462	pass
	930914	66.3	65.8	62.100	70.974	pass	61.657	72.527	pass
	931018	81	79.2	75.995	86.304	pass	75.479	88.108	pass
	931117	82.8	81	77.696	88.181	pass	77.172	90.015	pass
	940125	120.6	121.5	113.425	127.598	pass	112.716	130.079	pass
	940222	118.8	114.3	111.723	125.721	pass	111.023	128.171	pass
Sulfate	920910	67.5	38.6	58.919	73.795	fail	58.175	76.398	fail
	920929	83.5	80.8	73.109	91.089	pass	72.210	94.236	pass
	921020	92.2	97.6	80.825	100.493	pass	79.842	103.935	pass
	921110	105.7	102.6	92.799	115.085	pass	91.684	118.985	pass
	921208	72.4	54.2	63.265	79.091	fail	62.473	81.861	fail
	930113	83.9	80.9	73.464	91.522	pass	72.561	94.682	pass
	930222	70.2	77.8	61.314	76.713	fail	60.544	79.408	pass
	930322	73.6	69.9	64.329	80.388	pass	63.526	83.199	pass
	930406	59.7	62.8	52.001	65.364	pass	51.333	67.702	pass
	930419	68.9	67.6	60.134	75.276	pass	59.377	77.925	pass
	930503	53.8	57.7	46.751	58.965	pass	46.140	61.102	pass
	930517	39.2	40.3	33.793	43.173	pass	33.324	44.814	pass
	930602	28.8	33.2	24.587	31.953	fail	24.219	33.242	pass
	930614	26.8	26.9	22.822	29.802	pass	22.473	31.024	pass
	930712	49.3	51.2	42.804	54.155	pass	42.236	56.141	pass
	930816	52.1	50.3	45.261	57.149	pass	44.666	59.229	pass
	930914	66.3	65.8	57.855	72.498	pass	57.123	75.060	pass
	931018	73.9	70.96	64.595	80.713	pass	63.789	83.533	pass
	931117	58.8	62.2	51.203	64.391	pass	50.544	66.699	pass
	940125	51	52	44.285	55.960	pass	43.701	58.003	pass
	940222	60.9	52.9	53.065	66.661	fail	52.386	69.040	pass

APPENDIX V

Water Quality Standards for the Bear River

R317. Environmental Quality, Water Quality.
R317-2. Standards of Quality for Waters of the State.
R317-2-1A. Statement of Intent.

Whereas the pollution of the waters of this state constitute a menace to public health and welfare, creates public nuisances, is harmful to wildlife, fish and aquatic life, and impairs domestic, agricultural, industrial, recreational and other legitimate beneficial uses of water, and whereas such pollution is contrary to the best interests of the state and its policy for the conservation of the water resources of the state, it is hereby declared to be the public policy of this state to conserve the waters of the state and to protect, maintain and improve the quality thereof for public water supplies, for the propagation of wildlife, fish and aquatic life, and for domestic, agricultural, industrial, recreational and other legitimate beneficial uses; to provide that no waste be discharged into any waters of the state without first being given the degree of treatment necessary to protect the legitimate beneficial uses of such waters; to provide for the prevention, abatement and control of new or existing water pollution; to place first in priority those control measures directed toward elimination of pollution which creates hazards to the public health; to insure due consideration of financial problems imposed on water polluters through pursuit of these objectives; and to cooperate with other agencies of the state, agencies of other states and the federal government in carrying out these objectives.

R317-2-1B. Authority.

These standards are promulgated pursuant to Sections 19-5-104 and 19-5-110.

R317-2-2. Scope.

These standards shall apply to all waters of the state and shall be assigned to specific waters through the classification procedures prescribed by Sections 19-5-104(5) and 19-5-110 and R317-2-6.

R317-2-3. Antidegradation Policy.

3.1 Maintenance of Water Quality

Waters whose existing quality is better than the established standards for the designated uses will be maintained at high quality unless it is determined by the Board, after appropriate intergovernmental coordination and public participation in concert with the Utah continuing planning process, allowing lower water quality is necessary to accommodate important economic or social development in the area in which the waters are located. However, existing instream water uses shall be maintained and protected. No water quality degradation is allowable which would interfere with or become injurious to existing instream water uses.

In those cases where potential water quality impairment associated with a thermal discharge is involved, the antidegradation policy and implementing method shall be consistent with Section 316 of the Federal Clean Water Act.

3.2 High Quality Waters - Category 1

Waters of high quality which have been determined by the Board to be of exceptional recreational or ecological significance or have been determined to be a State or National resource requiring protection, shall be maintained at existing high quality through designation, by the Board after public hearing, as High Quality Waters - Category 1. New point source discharges of wastewater, treated or otherwise, are prohibited in such segments after the effective date of designation. Protection of such segments from pathogens in diffuse, underground sources is covered in R317-5 and R317-7 and the Regulations for Individual Wastewater Disposal Systems (R317-501 through R317-515). Other diffuse sources (nonpoint sources) of wastes shall be controlled to the extent feasible through implementation of best management practices or regulatory programs.

Projects such as, but not limited to, construction of dams or roads will be considered where pollution will result only during the actual construction activity, and where best management practices will be employed to minimize pollution effects.

Waters of the state designated as High Quality Waters - Category 1 are listed in R317-2-12.1.

3.3 High Quality Waters - Category 2

High Quality Waters - Category 2 are designated surface water segments which are treated as High Quality Waters - Category 1 except that a point source discharge may be permitted provided that the discharge does not degrade existing water quality. Waters of the state designated as High Quality Waters - Category 2 are listed in R317-2-12.2.

R317-2-4. Colorado River Salinity Standards.

In addition to quality protection afforded by these regulations to waters of the Colorado River and its tributaries, such waters shall be protected also by requirements of "Proposed Water Quality Standards for Salinity including Numeric Criteria and Plan of Implementation for Salinity Control, Colorado River System, June 1975" and a supplement dated August 26, 1975, entitled "Supplement, including Modifications to Proposed Water Quality Standards for Salinity including Numeric Criteria and Plan of Implementation for Salinity Control, Colorado River System, June 1975", as approved by the seven Colorado River Basin States and the U.S. Environmental Protection Agency, as updated by the 1978 Revision and the 1981, 1984, 1987, 1990, and 1993 Reviews of the above documents.

R317-2-5. Mixing Zones.

A mixing zone is a limited portion of a body of water, contiguous to a discharge, where dilution is in progress but has not yet resulted in concentrations which will meet certain standards for all pollutants. At no time, however, shall concentrations within the mixing zone be allowed which are acutely lethal as determined by bioassay or other approved procedure. Mixing zones may be delineated for the purpose of guiding sample collection procedures. The zone shall be small in extent and must not form a barrier to migrating aquatic life. Domestic wastewater effluents discharged to mixing zones shall meet effluent requirements specified in R317-1-3.

R317-2-6. Use Designations.

The Board as required by Section 19-5-110, shall group the waters of the state into classes so as to protect against controllable pollution the beneficial uses designated within each class as set forth below. Surface waters of the state are hereby classified as shown in R317-2-13.

6.1 Class 1 -- Protected for use as a raw water source for domestic water systems.

a. Class 1A -- Reserved.

b. Class 1B -- Reserved.

c. Class 1C -- Protected for domestic purposes with prior treatment by treatment processes as required by the Utah Department of Health.

6.2 Class 2 -- Protected for in-stream recreational use and aesthetics.

a. Class 2A -- Protected for primary contact recreation such as swimming.

b. Class 2B -- Protected for secondary contact recreation such as boating, wading, or similar uses.

6.3 Class 3 -- Protected for in-stream use by aquatic wildlife.

a. Class 3A -- Protected for cold water species of game fish and other cold water aquatic life, including the necessary aquatic organisms in their food chain.

b. Class 3B -- Protected for warm water species of game fish and other warm water aquatic life, including the necessary aquatic organisms in their food chain.

c. Class 3C -- Protected for nongame fish and other aquatic life, including the necessary aquatic organisms in their food chain.

d. Class 3D -- Protected for waterfowl, shore birds and other water-oriented wildlife not included in Classes 3A, 3B, or 3C, including the necessary aquatic organisms in their food chain.

6.4 Class 4 -- Protected for agricultural uses including irrigation of crops and stock watering.

6.5 Class 5 -- The Great Salt Lake. Protected for primary and secondary contact recreation, aquatic wildlife, and mineral extraction.

6.6 Class 6 -- waters requiring protection when conventional uses as identified in R317-2-6.1 through 6.5 do not apply. Standards for this class are determined based on environmental and human health concerns.

R317-2-7. Water Quality Standards.

7.1 Application of Standards

The numeric criteria listed in R317-2-14 shall apply to each of the classes assigned to waters of the State as specified in R317-2-6. It shall be unlawful and a violation of these regulations for any person to discharge or place any wastes or other substances in such manner as may interfere with designated uses protected by assigned classes or to cause any of the applicable standards to be violated, except as provided in R317-1-3.1. The Board may allow site specific modifications based upon bioassay or other tests performed in accordance with standard procedures determined by the Board.

7.2 Narrative Standards

It shall be unlawful, and a violation of these regulations, for any person to discharge or place any waste or other substance in such a way as will be or may become offensive such as unnatural deposits, floating debris, oil, scum or other nuisances such as color, odor or taste; or cause conditions which produce undesirable aquatic life or which produce objectionable tastes in edible aquatic organisms; or result in concentrations or combinations of substances which produce undesirable physiological responses in desirable resident fish, or other desirable aquatic life, or undesirable human health effects, as determined by bioassay or other tests performed in accordance with standard procedures.

R317-2-8. Protection of Downstream Uses.

All actions to control waste discharges under these regulations shall be modified as necessary to protect downstream designated uses.

R317-2-9. Intermittent Waters.

Failure of a stream to meet water quality standards when stream flow is either unusually high or less than the 7-day, 10-year minimum flow shall not be cause for action against persons discharging wastes which meet both the requirements of R317-1 and the requirements of applicable permits.

R317-2-10. Laboratory and Field Analyses.

10.1 Laboratory Analyses

All laboratory examinations of samples collected to determine compliance with these regulations shall be performed in accordance with standard procedures as approved by the Utah Division of Water Quality by the Utah Office of State Health Laboratory or by a laboratory certified by the Utah Department of Health.

10.2 Field Analyses

All field analyses to determine compliance with these regulations shall be conducted in accordance with standard procedures specified by the Utah Division of Water Quality.

R317-2-11. Public Participation.

Public hearings will be held to review all proposed revisions of water quality standards, designations and classifications, and public meetings may be held for consideration of discharge requirements set to protect water uses under assigned classifications.

R317-2-12. High Quality Waters

12.1 High Quality Waters - Category 1.

In addition to assigned use classes, the following surface waters of the State are hereby designated as High Quality Waters - Category 1:

12.1.1 All surface waters geographically located within the outer boundaries of U.S. National Forests whether on public or private lands with the following exceptions:

Deer Creek, a tributary of Huntington Creek, in the Green River Drainage, from the outer boundary of the U.S. National Forest to 4800 feet upstream.

Weber River, a tributary to the Great Salt Lake, in the Weber River Drainage from Uintah to Mountain Green.

12.1.2 Other surface waters, which may include segments within U.S. National Forests as follows:

12.1.2.1 Colorado River Drainage

Calf Creek and tributaries, from confluence with Escalante River to headwaters.

Sand Creek and tributaries, from confluence with Escalante River to headwaters.

Mamie Creek and tributaries, from confluence with Escalante River to headwaters.

Deer Creek and tributaries, from confluence with Boulder Creek to headwaters (Garfield County).

Indian Creek and tributaries, through Newspaper Rock State Park to headwaters.

12.1.2.2 Green River Drainage

Fish Creek from confluence with White River to Scofield Dam.

Range Creek and tributaries, from confluence with Green River to headwaters.

Strawberry River and tributaries, from confluence with Red Creek to headwaters.

Avintaquin Creek, from confluence with Strawberry River to confluence with Cottonwood Creek.

Ashley Creek and tributaries, from Steinaker diversion to headwaters.

Jones Hole Creek and tributaries, from confluence with Green River to headwaters.

Green River, from state line to Flaming Gorge Dam.

Tollivers Creek, from confluence with Green River to headwaters.

Allen Creek, from confluence with Green River to headwaters.

12.1.2.3 Virgin River Drainage

North Fork Virgin River and tributaries, from confluence with East Fork Virgin River to headwaters.

East Fork Virgin River and tributaries from confluence with North Fork Virgin River to headwaters.

12.1.2.4 Kanab Creek Drainage

Kanab Creek and tributaries, from irrigation diversion at confluence with Reservoir Canyon to headwaters.

12.1.2.5 Bear River Drainage

Swan Creek and tributaries, from Bear Lake to headwaters.

North Eden Creek, from Upper North Eden Reservoir to headwaters.

Big Creek and tributaries, from Big Ditch diversion to headwaters.

Woodruff Creek and tributaries, from Woodruff diversion to headwaters.

12.1.2.6 Weber River Drainage

Burch Creek and tributaries, from Harrison Boulevard in Ogden to headwaters.

Hardscrabble Creek and tributaries, from confluence with East Canyon Creek to headwaters.

Chalk Creek and tributaries, from U.S. Highway 189 to headwaters.

Weber River and tributaries, from U.S. Highway 189 to headwaters.

12.1.2.7 Jordan River Drainage

City Creek and tributaries, from City Creek Water Treatment Plant to headwaters (Salt Lake County).

Emigration Creek and tributaries, from Hogle Zoo to headwaters (Salt Lake County).

Red Butte Creek and tributaries, from Foothill Boulevard in Salt Lake City to headwaters.

Parley's Creek and tributaries, from 13th East in Salt Lake City to headwaters.

Mill Creek and tributaries, from Wasatch Boulevard in Salt Lake City to headwaters.

Big Cottonwood Creek and tributaries, from Wasatch Boulevard in Salt Lake City to headwaters.

Little Willow Creek and tributaries, from diversion to headwaters (Salt Lake County.)

Bell Canyon Creek and tributaries, from Lower Bells Canyon Reservoir to headwaters (Salt Lake County).

South Fork of Dry Creek and tributaries, from Draper Irrigation Company diversion to headwaters (Salt Lake County).

12.1.2.8 Provo River Drainage

3.3 High Quality Waters - Category 2

High Quality Waters - Category 2 are designated surface water segments which are treated as High Quality Waters - Category 1 except that a point source discharge may be permitted provided that the discharge does not degrade existing water quality. Waters of the state designated as High Quality Waters - Category 2 are listed in R317-2-12.2.

R317-2-4. Colorado River Salinity Standards.

In addition to quality protection afforded by these regulations to waters of the Colorado River and its tributaries, such waters shall be protected also by requirements of "Proposed Water Quality Standards for Salinity including Numeric Criteria and Plan of Implementation for Salinity Control, Colorado River System, June 1975" and a supplement dated August 26, 1975, entitled "Supplement, including Modifications to Proposed Water Quality Standards for Salinity including Numeric Criteria and Plan of Implementation for Salinity Control, Colorado River System, June 1975", as approved by the seven Colorado River Basin States and the U.S. Environmental Protection Agency, as updated by the 1978 Revision and the 1981, 1984, 1987, 1990, and 1993 Reviews of the above documents.

R317-2-5. Mixing Zones.

A mixing zone is a limited portion of a body of water, contiguous to a discharge, where dilution is in progress but has not yet resulted in concentrations which will meet certain standards for all pollutants. At no time, however, shall concentrations within the mixing zone be allowed which are acutely lethal as determined by bioassay or other approved procedure. Mixing zones may be delineated for the purpose of guiding sample collection procedures. The zone shall be small in extent and must not form a barrier to migrating aquatic life. Domestic wastewater effluents discharged to mixing zones shall meet effluent requirements specified in R317-1-3.

R317-2-6. Use Designations.

The Board as required by Section 19-5-110, shall group the waters of the state into classes so as to protect against controllable pollution the beneficial uses designated within each class as set forth below. Surface waters of the state are hereby classified as shown in R317-2-13.

6.1 Class 1 -- Protected for use as a raw water source for domestic water systems.

a. Class 1A -- Reserved.

b. Class 1B -- Reserved.

c. Class 1C -- Protected for domestic purposes with prior treatment by treatment processes as required by the Utah Department of Health.

6.2 Class 2 -- Protected for in-stream recreational use and aesthetics.

a. Class 2A -- Protected for primary contact recreation such as swimming.

b. Class 2B -- Protected for secondary contact recreation such as boating, wading, or similar uses.

6.3 Class 3 -- Protected for in-stream use by aquatic wildlife.

a. Class 3A -- Protected for cold water species of game fish and other cold water aquatic life, including the necessary aquatic organisms in their food chain.

b. Class 3B -- Protected for warm water species of game fish and other warm water aquatic life, including the necessary aquatic organisms in their food chain.

c. Class 3C -- Protected for nongame fish and other aquatic life, including the necessary aquatic organisms in their food chain.

d. Class 3D -- Protected for waterfowl, shore birds and other water-oriented wildlife not included in Classes 3A, 3B, or 3C, including the necessary aquatic organisms in their food chain.

6.4 Class 4 -- Protected for agricultural uses including irrigation of crops and stock watering.

6.5 Class 5 -- The Great Salt Lake. Protected for primary and secondary contact recreation, aquatic wildlife, and mineral extraction.

6.6 Class 6 -- waters requiring protection when conventional uses as identified in R317-2-6.1 through 6.5 do not apply. Standards for this class are

Upper Falls drainage above Provo City diversion (Utah County).
Bridal Veil Falls drainage above Provo City diversion (Utah County).
Lost Creek and tributaries, above Provo City diversion (Utah County).
12.1.2.9 Sevier River Drainage
Chicken Creek and tributaries, from diversion at canyon mouth to headwaters.
Pigeon Creek and tributaries, from diversion to headwaters.
East Fork of Sevier River and tributaries, from Kingston diversion to headwaters.
Parowan Creek and tributaries, from Parowan City to headwaters.
Summit Creek and tributaries, from Summit City to headwaters.
Braffits Creek and tributaries, from canyon mouth to headwaters.
Right Hand Creek and tributaries, from confluence with Coal Creek to headwaters.
12.1.2.10 Raft River Drainage
Clear Creek and tributaries, from state line to headwaters (Box Elder County).
Birch Creek (Box Elder County), from state line to headwaters.
Cotton Thomas Creek from confluence with South Junction Creek to headwaters.
12.1.2.11 Western Great Salt Lake Drainage
All streams on the South slope of the Raft River Mountains above 7000' mean sea level.
Donner Creek (Box Elder County), from irrigation diversion to Utah-Nevada state line.
Bettridge Creek (Box Elder County), from irrigation diversion to Utah-Nevada state line.
Clover Creek, from diversion to headwaters.
All surface waters on Public land on the Deep Creek Mountains.
12.1.2.12 Farmington Bay Drainage
Holmes Creek and tributaries, from Highway US-89 to headwaters (Davis County).
Shepard Creek and tributaries, from Height Bench diversion to headwaters (Davis County).
Farmington Creek and tributaries, from Height Bench Canal diversion to headwaters (Davis County).
Steed Creek and tributaries, from Highway US-89 to headwaters (Davis County).
12.2 High Quality Waters - Category 2.
In addition to assigned use classes, the following surface waters of the State are hereby designated as High Quality Waters - Category 2:
12.2.1 Green River Drainage
Deer Creek, a tributary of Huntington Creek, from the forest boundary to 4800 feet upstream.

R317-2-13. Classification of Waters of the State.

a. Bear River Drainage

TABLE

Bear River and tributaries, from Great Salt Lake to Utah-Idaho border, except as listed below:		2B		3B		3D	4
Willard Creek, from Willard Bay Reservoir to headwaters		2B	3A				4
Perry Canyon Creek from U.S. Forest boundary to headwaters		2B	3A				4
Box Elder Creek from confluence with Black Slough to Brigham City Reservoir (the Mayor's Pond)		2B			3C		4
Box Elder Creek, from Brigham City Reservoir (the Mayor's Pond) to headwaters		2B	3A				4
Malad River and tributaries, from confluence with Bear River to state line		2B			3C		
Little Bear River and tributaries, from Cutler Reservoir to headwaters		2B	3A			3D	4
Logan River and tributaries, from Cutler Reservoir to headwaters		2B	3A			3D	4
Blacksmith Fork and tributaries, from confluence with Logan River to headwaters		2B	3A				4
Newton Creek and tributaries, from Cutler Reservoir to Newton Reservoir		2B		3B			4
Clarkston Creek and tributaries, from Newton Reservoir to headwaters		2B		3B			4
Birch Creek and tributaries, from confluence with Clarkston Creek to headwaters		2B	3A				4
Summit Creek and tributaries, from confluence with Bear River to headwaters		2B	3A				4
Cub River and tributaries, from confluence with Bear River to state line, except as listed below:		2B		3B			4
High Creek and tributaries, from confluence with Cub River to headwaters		2B	3A				4
Swan Springs, tributary to Swan Creek	1C	2B					
All tributaries to Bear Lake from Bear Lake to headwaters		2B	3A				4

Swan Creek and tributaries, from Bear Lake to headwaters	2B 3A	4
Big Creek and tributaries, from Bear Lake to headwaters	2B 3A	4
Bear River and tributaries in Rich County	2B 3A	4
Bear River and tributaries, from Utah-Wyoming state line to headwaters (Summit County)	2B 3A	4
Mill Creek and tributaries, from state line to headwaters (Summit County)	2B 3A	4

TABLE 2.14.1
NUMERIC CRITERIA FOR DOMESTIC,
RECREATION, AND AGRICULTURAL USES

Parameter	Domestic Source	Recreation and Aesthetics		Agri-culture
	1C	2A	2B	4
BACTERIOLOGICAL (30-DAY GEOMETRIC MEAN) (NO.)/100 ML) (7)				
Max. Total Coliforms	5000	1000	5000	
Max. Fecal Coliforms	2000	200	200	
PHYSICAL				
Min. Dissolved Oxygen(MG/L)(1)	5.5	5.5	5.5	
pH (RANGE)	6.5-9.0	6.5-9.0	6.5-9.0	6.5-9.0
Turbidity Increase (NTU)		10	10	
METALS (DISSOLVED, MAXIMUM MG/L) (2)				
Arsenic	0.05			0.1
Barium	1.0			
Cadmium	0.01			0.01
Chromium	0.05			0.10
Copper				0.2
Lead	0.05			0.1
Mercury	0.002			
Selenium	0.01			0.05
Silver	0.05			
INORGANICS (MAXIMUM MG/L)				
Boron				0.75
Fluoride (3)	1.4-2.4			
Nitrates as N	10			
Total Dissolved Solids (4)				1200
RADIOLOGICAL (MAXIMUM pCi/L)				
Gross Alpha	15			15
Radium 226, 228 (Combined)	5			
Strontium 90	8			
Tritium	20000			
ORGANICS (MAXIMUM UG/L)				
Chlorophenoxy Herbicides				
2,4-D	100			
2,4,5-TP	10			
Endrin	0.2			
Hexachlorocyclohexane (Lindane)	4			
Methoxychlor	100			
Toxaphene	5			
POLLUTION INDICATORS (5)				
Gross Beta (pCi/L)	50			50

BOD (MG/L)	5	5	5
Nitrate as N (MG/L)	4	4	
Phosphate as P (MG/L)(6)	0.05	0.05	

FOOTNOTES:

(1) These limits are not applicable to lower water levels in deep impoundments.

(2) The dissolved metals method involves filtration of the sample in the field, acidification of the sample in the field, no digestion process in the laboratory, and analysis by atomic absorption or inductively coupled plasma (ICP) spectrophotometry.

(3) Maximum concentration varies according to the daily maximum mean air temperature.

TEMP (C)	MG/L
12.0	2.4
12.1-14.6	2.2
14.7-17.6	2.0
17.7-21.4	1.8
21.5-26.2	1.6
26.3-32.5	1.4

(4) Total dissolved solids (TDS) limits may be adjusted if such adjustment does not impair the designated beneficial use of the receiving water.

(5) Investigations should be conducted to develop more information where these pollution indicator levels are exceeded.

(6) Phosphate as P (mg/l) limit for lakes and reservoirs shall be 0.025.

(7) Exceedences of bacteriological numeric criteria from nonhuman nonpoint sources will generally be addressed through appropriate Federal, State, and Local nonpoint source programs.

TABLE 2.14.2
NUMERIC CRITERIA FOR AQUATIC WILDLIFE

Parameter	Aquatic Wildlife 3A	3B	3C	3D
PHYSICAL				
Total Dissolved Gases	(1)	(1)		
Dissolved Oxygen (MG/L) (2)				
30 Day Average	6.5	5.5	5.0	5.0
7 Day Average	9.5/5.0	6.0/4.0		
1 Day Average	8.0/4.0	5.0/3.0	3.0	3.0
Max. Temperature (C)	20	27	27	
Max. Temperature Change (C)	2	4	4	
pH (Range)	6.5-9.0	6.5-9.0	6.5-9.0	6.5-9.0
Turbidity Increase (NTU)	10	10	15	15
METALS (3) (DISSOLVED, UG/L) (4)				
Aluminum				
4 Day Average	87	87	87	87
1 Hour Average	750	750	750	750
Arsenic (Trivalent)				

4 Day Average	190	190	190	190
1 Hour Average	360	360	360	360
Cadmium (5)				
4 Day Average	1.1	1.1	1.1	1.1
1 Hour Average	3.9	3.9	3.9	3.9
Chromium (Hexavalent)				
4 Day Average	11	11	11	11
1 Hour Average	16	16	16	16
Chromium (Trivalent) (5)				
4 Day Average	210	210	210	210
1 Hour Average	1700	1700	1700	1700
Copper (5)				
4 Day Average	12	12	12	
1 Hour Average	18	18	18	18
Cyanide (Free)				
4 Day Average	5.2	5.2	5.2	
1 Hour Average	22	22	22	22
Iron (Maximum)	1000	1000	1000	1000
Lead (5)				
4 Day Average	3.2	3.2	3.2	3.2
1 Hour Average	82	82	82	82
Mercury				
4 Day Average	0.012	0.012	0.012	0.012
1 Hour Average	2.4	2.4	2.4	2.4
Nickel (5)				
4 Day Average	160	160	160	160
1 Hour Average	1400	1400	1400	1400
Selenium				
4 Day Average	5.0	5.0	5.0	5.0
1 Hour Average	20	20	20	20
Silver				
4 Day Average	0.12	0.12	0.12	
1 Hour Average (5)	4.1	4.1	4.1	4.1
Zinc (5)				
4 Day Average	110	110	110	110
1 Hour Average	120	120	120	120
INORGANICS (MG/L) (3)				
Ammonia as N (Un-ionized) (6)				
4 Day Average	(6a)	(6a)		
1 Hour Average	(6b)	(6b)	(6b)	(6b)
Chlorine (Total Residual) (7)				
4 Day Average	0.011	0.011		
1 Hour Average	0.019	0.019	0.2	(8)
Hydrogen Sulfide (Undissociated, Max. UG/L)	2.0	2.0	2.0	2.0
Phenol (Maximum)	0.01	0.01	0.01	0.01
RADIOLOGICAL (MAXIMUM pCi/L)				
Gross Alpha (9)	15	15	15	15
ORGANICS (UG/L) (3)				
Aldrin (Maximum)	1.5	1.5	1.5	1.5
Chlordane				

4 Day Average	0.0043	0.0043	0.0043	0.0043
1 Hour Average	1.2	1.2	1.2	1.2
DDT and Metabolites				
4 Day Average	0.0010	0.0010	0.0010	0.0010
1 Hour Average	0.55	0.55	0.55	0.55
Dieldrin				
4 Day Average	0.0019	0.0019	0.0019	0.0019
1 Hour Average	1.25	1.25	1.25	1.25
Endosulfan				
4 Day Average	0.056	0.056	0.056	0.056
1 Hour Average	0.11	0.11	0.11	0.11
Endrin				
4 Day Average	0.0023	0.0023	0.0023	0.0023
1 Hour Average	0.09	0.09	0.09	0.09
Guthion (Maximum)	0.01	0.01	0.01	0.01
Heptachlor				
4 Day Average	0.0038	0.0038	0.0038	0.0038
1 Hour Average	0.26	0.26	0.26	0.26
Hexachlorocyclohexane (Lindane)				
4 Day Average	0.08	0.08	0.08	0.08
1 Hour Average	1.0	1.0	1.0	1.0
Methoxychlor (Maximum)	0.03	0.03	0.03	0.03
Mirex (Maximum)	0.001	0.001	0.001	0.001
Parathion (Maximum)	0.04	0.04	0.04	0.04
PCB's				
4 Day Average	0.014	0.014	0.014	0.014
1 Hour Average	2.0	2.0	2.0	2.0
Pentachlorophenol (10)				
4 Day Average	13	13	13	13
1 Hour Average	20	20	20	20
Toxaphene				
4 Day Average	0.0002	0.0002	0.0002	0.0002
1 Hour Average	0.73	0.73	0.73	0.73
POLLUTION INDICATORS (9)				
Gross Beta (pCi/L)	50	50	50	50
BOD (MG/L)	5	5	5	5
Nitrate as N (MG/L)	4	4	4	
Phosphate as P (MG/L) (11)	0.05	0.05		

FOOTNOTES:

(1) Not to exceed 110% of saturation.

(2) These limits are not applicable to lower water levels in deep impoundments. First number in column is for when early life stages are present, second number is for when all other life stages present.

(3) Where criteria are listed as 4-day average and 1-hour average concentrations, these concentrations should not be exceeded more often than once every three years on the average.

(4) The dissolved metals method involves filtration of the sample in the field, acidification of the sample in the field, no digestion process in the laboratory, and analysis by atomic absorption spectrophotometry [or inductively coupled plasma (ICP).

(5) Hardness dependent criteria. 100 mg/l used. See Table 2.14.3 for complete equation.

(6) Un-ionized ammonia toxicity is dependent upon the temperature and pH of the waterbody. For detailed explanation refer to Federal Register, vol. 50, 30784, July 29, 1985.

The following equations are used to calculate criteria concentrations:

(6a) The 4-Day average (chronic) concentration of un-ionized ammonia in mg/l as N is (0.80/FT/FPH/RATIO) * 0.822, where

FT = $10^{0.03(20-TCAP)}$; T is greater than or equal to TCAP and less than or equal to 30

= 1; T is greater than or equal to 0 and less than or equal to TCAP.

FPH = 1; pH is treater than or equal to 8.0 and less than or equal to 9.0.

= $1+10^{7.4-pH}/1.25$ pH is greater than or equal to 6.5 and less than or equal to 8.0

T = degrees C, and

TCAP = 20 C for salmonids or other sensitive coldwater species, or

= 25 C for salmonids and other sensitive coldwater species absent.

RATIO = 13.5; pH is greater than or equal to 7.7 and less than or equal to 9.0.

= $20(10^{7.7-pH})/1+10^{7.4-pH})$; pH is greater than or equal to 6.5 and less than or equal to 9.0.

(6b) The 1-Hour average (acute) concentration of un-ionized ammonia in mg/l as N is (0.52/FT/FPH/2) * 0.822

FT = $10^{0.03(20-TCAP)}$; T is greater or equal to TCAP and less than or equal to 30.

= 1; T is greater than or equal to 0 and less than or equal to TACP.

FPH = 1; pH is greater than or equal to 8.0 and less than or equal to 9.0.

= $1+10^{7.4-pH}/1.25$ pH is greater than or equal to 6.5 or less than or equal to 7.7.

T = degrees C, and

TCAP = 15 C for salmonids or other sensitive coldwater species, or

TCAP = 20 C for salmonids and other sensitive coldwater species absent.

(6c) Total Ammonia in mg/l as N is Un-ionized Ammonia in mg/l as N x $(1+10^{pKa-pH})$, where:

pKa = 0.09018 + 2729.92/T

T = Temperature (C) + 273.2

For Tables of values, see following page.

(7) Special case segments and maximum TRC concentrations as follows:

Mill Race from Interstate Highway 15 to the Provo City wastewater treatment plant discharge 0.2 mg/l

Ironton Canal (Utah County), from Utah Lake (Provo Bay) to East boundary of Denver and Rio Grande Western

Railroad right-of-way 0.05 mg/l

Beer Creek (Utah County) from 4850 West (in NE1/4NE1/4 sec. 36, T.8 S., R.1 E.) to headwaters 0.3 mg/l

(8) Numeric criteria will be established based on a site-specific assessment of potential impacts to aquatic wildlife.

(9) Investigations should be conducted to develop more information where these levels are exceeded.

(10) pH dependent criteria. pH 7.8 used in table. See Table 2.14.4 for equation.

(11) Phosphate as P (mg/l) limit for lakes and reservoirs shall be 0.025.

TABLE
1-HOUR AVERAGE (ACUTE) CONCENTRATION OF
UN-IONIZED AMMONIA AS N (MG/L)
FOR CLASS 3A WATERS
TEMPERATURE (C)

pH	0.00	5.00	10.00	15.00	20.00	25.00	30.00
6.50	0.008	0.011	0.015	0.021	0.030	0.030	0.030

7.00	0.019	0.027	0.038	0.054	0.076	0.076	0.076
7.50	0.037	0.053	0.075	0.105	0.149	0.149	0.149
8.00	0.054	0.076	0.107	0.151	0.214	0.214	0.214
8.50	0.054	0.076	0.107	0.151	0.214	0.214	0.214
9.00	0.054	0.076	0.107	0.151	0.214	0.214	0.214

TABLE
1-HOUR AVERAGE (ACUTE) CONCENTRATION OF
TOTAL AMMONIA AS N (MG/L)
FOR CLASS 3A WATERS
TEMPERATURE (C)

pH	0.00	5.00	10.00	15.00	20.00	25.00	30.00
6.50	28.7	26.8	25.4	24.4	23.8	16.6	11.8
7.00	23.1	21.6	20.5	19.7	19.2	13.4	9.52
7.50	14.3	13.4	12.7	12.3	12.0	8.42	5.99
8.00	6.55	6.14	5.86	5.68	5.59	3.97	2.87
8.50	2.11	1.99	1.93	1.90	1.92	1.40	1.05
9.00	0.70	0.68	0.68	0.70	0.75	0.59	0.48

TABLE
4-DAY AVERAGE (CHRONIC) CONCENTRATION OF
UN-IONIZED AMMONIA AS N (MG/L)
FOR CLASS 3A WATERS
TEMPERATURE (C)

pH	0.00	5.00	10.00	15.00	20.00	25.00	30.00
6.50	0.001	0.001	0.001	0.002	0.002	0.002	0.002
7.00	0.002	0.003	0.004	0.006	0.006	0.006	0.006
7.50	0.006	0.009	0.013	0.018	0.018	0.018	0.018
8.00	0.012	0.017	0.024	0.034	0.034	0.034	0.034
8.50	0.012	0.017	0.024	0.034	0.034	0.034	0.034
9.00	0.012	0.017	0.024	0.034	0.034	0.034	0.034

TABLE
4-DAY AVERAGE (CHRONIC)CONCENTRATION OF
TOTAL AMMONIA AS N (MG/L)
FOR CLASS 3A WATERS
TEMPERATURE (C)

pH	0.00	5.00	10.00	15.00	20.00	25.00	30.00
6.50	2.49	2.33	2.21	2.12	1.46	1.02	0.72
7.00	2.49	2.33	2.21	2.13	1.47	1.03	0.73
7.50	2.50	2.34	2.22	2.14	1.48	1.04	0.74
8.00	1.49	1.40	1.33	1.29	0.90	0.64	0.46
8.50	0.48	0.45	0.44	0.43	0.31	0.23	0.17
9.00	0.16	0.16	0.16	0.16	0.12	0.10	0.08

TABLE
1-HOUR AVERAGE (ACUTE) CONCENTRATION OF
UN-IONIZED AMMONIA AS N (MG/L)
FOR CLASS 3B, 3C, AND 3D WATERS
TEMPERATURE (C)

pH	0.00	5.00	10.00	15.00	20.00	25.00	30.00
6.50	0.008	0.011	0.015	0.021	0.030	0.042	0.042
7.00	0.019	0.027	0.038	0.054	0.076	0.107	0.107

7.50	0.037	0.053	0.075	0.105	0.149	0.210	0.210
8.00	0.054	0.076	0.107	0.151	0.214	0.302	0.302
8.50	0.054	0.076	0.107	0.151	0.214	0.302	0.302
9.00	0.054	0.076	0.107	0.151	0.214	0.302	0.302

TABLE
1-HOUR AVERAGE (ACUTE)CONCENTRATION OF
TOTAL AMMONIA AS N (MG/L)
FOR CLASS 3B, 3C, 3D WATERS
TEMPERATURE (C)

pH	0.00	5.00	10.00	15.00	20.00	25.00	30.00
6.50	28.7	26.8	25.4	24.4	23.8	23.5	16.6
7.00	23.1	21.6	20.5	19.7	19.2	19.0	13.5
7.50	14.3	13.4	12.7	12.3	12.0	11.9	8.47
8.00	6.55	6.14	5.86	5,68	5.59	5.61	4.05
8.50	2.11	1.99	1.93	1.90	1.92	1.98	1.49
9.00	0.70	0.68	0.68	0.70	0.75	0.83	0.68

TABLE
4-DAY AVERAGE (CHRONIC) CONCENTRATION OF
UN-IONIZED AMMONIA AS N (MG/L)
FOR CLASS 3B WATERS
TEMPERATURE (C)

pH	0.00	5.00	10.00	15.00	20.00	25.00	30.00
6.50	0.001	0.001	0.001	0.002	0.003	0.003	0.003
7.00	0.002	0.003	0.004	0.006	0.008	0.008	0.008
7.50	0.009	0.009	0.013	0.018	0.024	0.026	0.026
8.00	0.012	0.017	0.024	0.034	0.049	0.041	0.041
8.50	0.012	0.017	0.024	0.034	0.049	0.049	0.049
9.00	0.012	0.017	0.024	0.034	0.049	0.049	0.049

TABLE
4-DAY AVERAGE (CHRONIC) CONCENTRATION OF
TOTAL AMMONIA AS N (MG/L)
FOR CLASS 3B WATERS
TEMPERATURE (C)

pH	0.00	5.00	10.00	15.00	20.00	25.00	30.00
6.50	2.49	2.33	2.21	2.12	2.07	1.44	1.02
7.00	2.49	2.33	2.21	2.13	2.07	1.45	1.03
7.50	2.50	2.34	2.22	2.14	2.09	1.47	1.04
8.00	1.49	1.14	1.33	1.29	1.27	0.90	0.65
8.50	0.48	0.45	0.44	0.43	0.44	0.32	0.24
9.00	0.16	0.16	0.16	0.16	0.17	0.13	0.11

TABLE 2.14.3a
EQUATIONS FOR PARAMETERS WITH
HARDNESS (1) DEPENDENCE

Parameter	4-Day Average (Chronic) Concentration (UG/L)
CADMIUM	$e^{(0.7852(\ln(\text{hardness}))-3.490)}$
CHROMIUM	$e^{(0.8190(\ln(\text{hardness}))+1.561)}$

(TRIVALENT)	
COPPER	$e^{(0.8545(\ln(\text{hardness}))-1.465)}$
LEAD	$e^{(1.273(\ln(\text{hardness}))-4.705)}$
NICKEL	$e^{(0.8460(\ln(\text{hardness}))+1.1645)}$
SILVER	N/A
ZINC	$e^{(0.8473(\ln(\text{hardness}))+0.7614)}$

TABLE 2.14.3b
EQUATIONS FOR PARAMETERS WITH
HARDNESS (1) DEPENDENCE

Parameter	1-Hour Average (Acute) Concentration (UG/L)
CADMIUM	$e^{(1.128(\ln(\text{hardness}))-3.828)}$
CHROMIUM (TRIVALENT)	$e^{(0.8190(\ln(\text{hardness}))+3.688)}$
COPPER	$e^{(0.9422(\ln(\text{hardness}))-1.464)}$
LEAD	$e^{(1.273(\ln(\text{hardness}))-1.460)}$
NICKEL	$e^{(0.8460(\ln(\text{hardness}))+3.3612}$
SILVER	$e^{(1.72(\ln(\text{hardness}))-6.52}$
ZINC	$e^{(0.8473(\ln(\text{hardness}))+0.8604}$

FOOTNOTE:
(1) Hardness as mg/l $CaCO_3$.

TABLE 2.14.4
EQUATIONS FOR PENTACHLOROPHENOL
(pH DEPENDENT)

4-Day Average (Chronic) Concentration (UG/L)	1-Hour Average (Acute) Concentration (UG/L)
$e^{(1.005(pH))-5.290}$	$e^{(1.005(pH))-4.830}$

TABLE 2.14.5
SITE SPECIFIC CRITERIA FOR UN-IONIZED AMMONIA AND
DISSOLVED OXYGEN FOR JORDAN RIVER AND SURPLUS CANAL SEGMENTS
(SEE SECTION 2.13)

DISSOLVED OXYGEN:	
May-July	
7-day average	5.5 mg/l
30-day average	5.5 mg/l
Instantaneous minimum	4.5 mg/l
August-April	
30-day average	5.5 mg/l

Instantaneous minimum 4.0 mg/l

Un-ionized Ammonia as N:

(1) Maximum concentration should not exceed the numerical value given by the following:

0.15 X (f(T) / f(pH)) X 2.989

where:

f(T) = 1; T greater than or equal to 10C

= $(1 + 10^{(9.73-pH)} / 1 + 10^{(pKt - pH)}$; T less than 10C

f(pH) = $1 + 10^{(1.03(7.32-pH))}$

pkt = 0.090 + (2730 / (T + 273.2))

(2) The average concentration over any 30 consecutive days should be less than the value given by the following:

0.031 X (f(T) / f(pH)) X 2.10

where:

f(pH) = 1; pH greater than or equal to 7.7

= $10^{(0.74(7.7-pH))}$; pH less than 7.7

f(T) = 1; T greater than or equal to 10C

= $(1 + 10^{(9.73-pH)}) / (1 + 10^{(pKt - pH)})$; T less than 10C

(3) Total Ammonia in mg/l as N is Un-ionized Ammonia in mg/l as N x $(1+10^{pKa-pH})$, where:

pKa = 0.09018 + 2729.92/T

T = Temperature (C) + 273.2

TABLE
MAXIMUM CONCENTRATION (ACUTE)
UN-IONIZED AMMONIA AS N (MG/L)
TEMPERATURE (C)

pH	0.00	5.00	10.00	15.00	20.00	25.00	30.00
6.50	0.025	0.038	0.056	0.056	0.056	0.056	0.056
6.75	0.041	0.062	0.092	0.092	0.092	0.092	0.092
7.00	0.064	0.096	0.143	0.143	0.143	0.143	0.143
7.25	0.091	0.138	0.206	0.206	0.206	0.206	0.206
7.50	0.121	0.183	0.271	0.271	0.271	0.271	0.271
7.75	0.147	0.222	0.330	0.330	0.330	0.330	0.330
8.00	0.168	0.253	0.374	0.374	0.374	0.374	0.374
8.25	0.183	0.274	0.404	0.404	0.404	0.404	0.404
8.50	0.194	0.289	0.423	0.423	0.423	0.423	0.423
8.75	0.203	0.301	0.434	0.434	0.434	0.434	0.434
9.00	0.214	0.312	0.440	0.440	0.440	0.440	0.440

TABLE
MAXIMUM CONCENTRATION (ACUTE)
TOTAL AMMONIA AS N (MG/L)
TEMPERATURE (C)

pH	0.00	5.00	10.00	15.00	20.00	25.00	30.00
6.50	95.3	95.3	95.3	64.9	44.7	31.2	22.1
6.75	88.1	88.1	88.1	60.0	41.4	28.9	20.4
7.00	76.9	76.9	76.9	52.4	35.1	25.3	17.9
7.25	62.3	62.3	62.3	42.4	29.3	20.5	14.6
7.50	46.3	46.3	46.3	31.6	21.9	15.4	10.9
7.75	31.8	31.8	31.8	21.7	15.1	10.6	7.60
8.00	20.5	20.5	20.4	14.0	9.79	6.94	5.01
8.25	12.6	12.6	12.6	8.70	6.12	4.40	3.22
8.50	7.60	7.60	7.60	5.30	3.79	2.77	2.08
8.75	3.75	3.75	3.75	2.69	1.99	1.52	1.20
9.00	2.80	2.80	2.80	2.05	1.55	1.21	0.99

TABLE
30-DAY AVERAGE CONCENTRATION (CHRONIC)
UN-IONIZED AMMONIA AS N (MG/L)

pH	TEMPERATURE (C) 0.00	5.00	10.00	15.00	20.00	25.00	30.00
6.50	0.004	0.006	0.008	0.008	0.008	0.008	0.008
6.75	0.006	0.009	0.013	0.013	0.013	0.013	0.013
7.00	0.009	0.013	0.020	0.020	0.020	0.020	0.020
7.25	0.013	0.020	0.030	0.030	0.030	0.030	0.030
7.50	0.021	0.031	0.046	0.046	0.046	0.046	0.046
7.75	0.029	0.044	0.065	0.065	0.065	0.065	0.065
8.00	0.029	0.044	0.065	0.065	0.065	0.065	0.065
8.25	0.029	0.044	0.065	0.065	0.065	0.065	0.065
8.50	0.030	0.045	0.065	0.065	0.065	0.065	0.065
8.75	0.031	0.045	0.065	0.065	0.065	0.065	0.065
9.00	0.032	0.046	0.055	0.065	0.065	0.055	0.065

TABLE
30-DAY AVERAGE CONCENTRATION (CHRONIC)
TOTAL AMMONIA AS N (MG/L)

pH	TEMPERATURE (C) 0.00	5.00	10.00	15.00	20.00	25.00	30.00
6.50	14.3	14.3	14.3	9.74	6.72	4.69	3.32
6.75	12.3	12.3	12.3	8.40	5.79	4.05	2.86
7.00	10.6	10.6	10.6	7.24	5.00	3.49	2.47
7.25	9.17	9.72	9.16	6.24	4.31	3.02	2.14
7.50	7.91	7.91	7.91	5.40	3.73	2.62	1.86
7.75	6.29	6.29	6.28	4.30	2.98	2.10	1.50
8.00	3.56	3.56	3.56	2.44	1.71	1.21	0.87
8.25	2.03	2.03	2.03	1.40	0.99	0.71	0.52
8.50	1.17	1.17	1.17	0.82	0.58	0.43	0.32
8.75	0.56	0.56	0.56	0.40	0.30	0.23	0.18
9.00	0.41	0.41	0.41	0.30	0.23	0.18	0.15

TABLE 2.14.6
NUMERIC CRITERIA FOR THE
PROTECTION OF HUMAN HEALTH

Pollutant	Maximum Concentration (micrograms/L) Class 1C (1)	Class 3 (2)
Acenapthene	20 (4)	
Acrolein	320	780
Acrylonitrile (3)	0.058	0.65
Aldrin (3)	0.000074	0.000079
Antimony	146	45000
Arsenic (3)	0.002	0.017
Benzene (3)	0.66	40.0
Benzidene (3)	0.00012	0.00053
Beryllium (3)	0.0037	0.064
Cadmium	10 (5)	
Carbon Tetrachloride (3)	0.40	6.94
Chlordane (3)	0.00046	0.00048
Chlorinated Benzenes		

Hexachlorobenzene (3)	0.00072	0.00074
Chlorobenzene	20 (4)	
Chlorinated Ethanes		
1,2-Dichloroethane (3)	0.94	243
1,1,1-Trichloroethane	200 (5)	1030000
1,1,2-Trichloroethane (3)	0.60	41.8
1,1,2,2-Tetrachloroethane (3)	0.17	10.7
Hexachloroethane (3)	1.9	8.74
Chlorinated Phenols		
2,4,6-Trichlorophenol (3)	1.2	3.6
p-Chloro-m-cresol	3000 (4)	
Chloroalkyl ethers		
Bis(2-chloroethyl) ether (3)	0.03	1.36
Bis(2-Chloroisopropyl) ether	34.7	4360
Chloroform (3)	0.19	15.7
2-Chlorophenol	0.1 (4)	
Chromium (III)	50 (5)	3433000
Chromium (VI)	50 (5)	
Copper	1000 (4)	
Cyanide (total)	200 (5)	
DDT and Metabolites		
4,4'-DDT (3)	0.0000024	0.0000024
4,4'-DDE (3)	0.0000024	0.0000024
4,4'-DDD (3)	0.0000024	0.0000024
Dichlorobenzenes		
1,2-Dichlorobenzene	400	2600
1,3-Dichlorobenzene	400	2600
1,4-Dichlorobenzene	75 (5)	2600
Dichlorobenzidenes		
3,3'-Dichlorobenzidine (3)	0.01	0.02
Dichloroethylenes		
1,1-Dichloroethylene (3)	0.033	1.85
2,4-Dichlorophenol	0.3 (5)	
Dichloropropanes/ Dichloropropenes		
1,3-Dichloropropylene	87	14100
Dieldrin (3)	0.000071	0.000076
2,4-Dimethylphenol	400 (4)	
2,4-Dinitrotoluene (3)	0.11	9.1
1,2-Diphenylhydrazine (3)	0.042	0.56
Dioxin (2,3,7,8-TCDD) (3)	1.3×10^{-8}	1.4×10^{-8}
Endosulfan		
alpha-Endosulfan	74	159
beta-Endosulfan	74	159
Endosulfan sulfate	74	159
Endrin	0.2 (5)	
Endrin aldehyde	0.2 (5)	
Ethylbenzene	1400	3260
Fluoroanthene	42	54
Halomethanes		
Methylene chloride (3)	0.19	15.7
Methyl chloride (3)	0.19	15.7
Methyl bromide (3)	0.19	15.7
Bromoform (3)	0.19	15.7
Dichlorobromomethane (3)	0.19	15.7
Chlorodibromomethane (3)	0.19	15.7
Heptachlor (3)	0.00028	0.00029
Heptachlor epoxide (3)	0.00028	0.00029
Hexachlorobutadiene (3)	0.45	50
Hexachlorocyclohexane		
Hexachlorocyclohexane-alpha (3)	0.0092	0.031
Hexachlorocyclohexane-beta (3)	0.016	0.055
Hexachlorocyclohexane-gamma (3)	0.019	0.063
Hexachlorocyclopentadiene	1.0 (5)	
Isophorone	5200	520000

Lead		50 (5)
Mercury	0.144	0.146
Nickel		13.4100
Nitrobenzene	30 (5)	
Nitrophenols		
4,6-Dinitro-o-cresol	13.4	765
2,4-Dinitrophenol	70	14300
Nitrosamines		
N-Nitrosodimethylamine (3)	0.0014	16
N-Nitrosodiphenylamine (3)	4.9	16.1
Pentachlorophenol	30 (5)	
Phenol	300 (5)	
Phthalate Esters		
Dimethyl phthalate	313000	2900000
Diethyl phthalate	350000	1800000
Di-n-butyl phthalate	34000	154000
Bis(2-ethylhexyl) phthalate (3)	15000	50000
Polychlorinated Biphenyls		
PCB 1242 (3)	0.000079	0.000079
PCB 1254 (3)	0.000079	0.000079
PCB 1221 (3)	0.000079	0.000079
PCB 1232 (3)	0.000079	0.000079
PCB 1248 (3)	0.000079	0.000079
PCB 1260 (3)	0.000079	0.000079
PCB 1016 (3)	0.000079	0.000079
Polynuclear Aromatic Hydrocarbons		
Benzo(a)anthracene (3)	0.0028	0.0311
Benzo(a)pyrene (3)	0.0028	0.0311
Benzo(b)fluoranthene (3)	0.0028	0.0311
Benzo(k)fluoranthene (3)	0.0028	0.0311
Chrysene (3)	0.0028	0.0311
Acenaphthylene (3)	0.0028	0.0311
Anthracene (3)	0.0028	0.0311
Benzo(g,h,i)perylene (3)	0.0028	0.0311
Fluorene (3)	0.0028	0.0311
Phenanthrene (3)	0.0028	0.0311
Dibenzo(a,h)anthracene (3)	0.0028	0.0311
Indeno(1,2,3-cd) pyrene (3)	0.0028	0.0311
Pyrene (3)	0.0028	0.0311
Selenium	10 (5)	
Silver		50 (5)
Tetrachloroethylene (3)	0.80	8.85
Thallium	13	48
Toluene	14300	424000
Toxaphene (3)	0.00071	0.00073
Trichloroethylene (3)	2.7	80.7
Vinylchloride (3)	2.0 (5)	525
Zinc		5000 (4)
Asbestos (3)	30000 (6)	30000 (6)

FOOTNOTES:

(1) Human health criteria will be applied to all class 1C waterbodies to protect for the consumption of water and aquatic organisms.

(2) Human health criteria will be applied to all class 3 waterbodies (i.e. 3A, 3B, 3C, 3D) to protect for the consumption of aquatic organisms only.

(3) Carcinogenic compound. Human health criteria have been calculated using a 10^{-6} incremental risk factor.

(4) Criterion based on organoleptic data to control undesirable taste and odor quality of ambient waters.

(5) Criteria based on drinking water maximum contaminant levels (MCL).

(6) Concentration in fibers/L.