Planning for Water Quality in the Bear River System in the State of Utah

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Planning for Water Quality in the Bear River System in the State of Utah

a program for developing a comprehensive water quality management plan
PLANNING FOR WATER QUALITY IN THE BEAR RIVER SYSTEM IN THE STATE OF UTAH

March 1974

PRWG-142-1
Mr. Calvin K. Sudweeks  
Executive Secretary  
Utah State Division of Health  
Water Quality Section  
44 Medical Drive  
Salt Lake City, Utah 84113  

Dear Mr. Sudweeks:  

In accordance with the terms of the agreement for research services between the Utah State Department of Social Sciences, Division of Health, Bureau of Environmental Health, and the Utah Water Research Laboratory of the Utah State University dated the 25th of September 1973, it is a pleasure to submit this report which develops a functional planning program to aid in the development of comprehensive water quality management plans for the Bear River system in the State of Utah.

Cognizant of the intricacies involved in planning the various activities which directly relate to the water quality within a river basin, we have attempted to prepare a document that will point out the physical, chemical, economic, political, and demographic development activities which have an impact upon a river basin. We have also attempted to incorporate into this study an understanding for the general well-being of the people of the three states involved in the Bear River system, principally Utah, Wyoming, and Idaho. The overall goal of this report is to present a program designed to develop the management plan for the water quality of the Bear River in the State of Utah pursuant to the objectives of the Federal Water Pollution Control Act, including 1972 amendments.

The report should also serve as an important document in bringing together citizens, officials of local and county governments, and statewide officials involved in the planning process. An attempt has been made to present the information in such a manner that it will be useful by all segments of the public. We feel that active involvement by all of the public in the State of Utah is necessary if we are to develop a plan which will be of lasting value to orderly development and use of water in Utah.
It has been a distinct pleasure for all of us at UWRL to have the opportunity to work with you and your associates. We have appreciated very much the willing assistance of members of your staff, particularly Messrs. Keith Welch and Michael Miner.

If you have questions concerning the report, please do not hesitate to contact any of the UWRL personnel involved.

Sincerely yours,

E. Joe Middlebrooks, Dean
College of Engineering

EJM:bs
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CHAPTER I

WATER QUALITY MANAGEMENT PLANNING
IN THE BEAR RIVER BASIN

Water Quality Planning is Necessary

Utah's need for water
Throughout the west and particularly in Utah the history of development has been intertwined with the development of water. Towns and rivers were named "Sweetwater" reflecting the importance of high quality water. Large cities and farming communities have always been closely identified with adequate sources of water. As population continues to increase in Utah, the communities around the Wasatch Front where the water supply is concentrated, will require increasingly more high quality water. Competition for this water will increase, leading to confrontations between the different sectors of society, all of which have significantly different uses of the water.

These problems have been recognized within the State of Utah. Interest in water supply, water quality, and the ultimate fate of Utah's water has reached a peak in recent years. The Governor's Office has been concerned with Upper Colorado River Basin allocations and the Central Utah Water Project. The Legislature has been involved in these projects and a special legislative committee is concerned with the future use and development of the Great Salt Lake, the terminal sink for much of Utah's water. The Bureau of Environmental Health, Utah State Department of Health, bears planning responsibility for waste discharges and river basin water quality. The Department of Water Resources is concerned with the development and management of water supplies in Utah. The universities in the State of Utah, particularly Utah State
University spearheaded by its Utah Water Research Laboratory, have a long history in research on water planning problems and analyses of state water management programs. The Environmental Protection Agency, the Geological Survey, the Forest Service, the Bureau of Reclamation, The Department of Agriculture and myriad other federal agencies have programs in water quality and water resources which directly concern the people of Utah. At present these organizations are working separately in many areas, providing data and understanding which will be necessary for developing a water quality plan. The physical unit which binds the activities of all these agencies and groups together is the river basin. The river basin rarely follows political boundaries yet always has a great political significance which affects the lives of all the people living within its influence. Thus, the decisions which are necessary to devise a water quality plan for the Bear River will affect the economic and demographic development, and general well-being of the people of three states, Utah, Wyoming, and Idaho.

The overall goal of this report is to present a program design for developing a management plan for the water quality of the Bear River in the State of Utah pursuant to the objectives of the Federal Water Pollution Control Act, 1972 Amendments.

**Federal Water Pollution Control Act, 1972 Amendments**

The United States Congress has recognized the need for public involvement in the comprehensive planning of water quality management in the passage of a far reaching bill on water quality. In the 1972 Amendments, water quality planning for each river basin in each state must be accomplished within a specific period of time. This act has established a national goal of water quality suitable for fishing and swimming by mid-1983. This goal will be reached using a two stage process: Stage one--point sources will be required to meet effluent limitations
based on current water pollution control technology; stage two—higher prescribed control levels are to be achieved to meet 1983 requirements.

A major element in water pollution control in each state will be planning for each basin. Thus the point source control will be integrated into specific basin plans. These plans have been defined in the 1972 Amendments as Section 303(e) plans, and are referred to as "basin plans" or "water quality management plans." These plans will be an important part of implementing point source control and achieving the desired water quality programs. Each basin plan will provide for orderly water quality management by following these four steps:

1. Outlining a plan
2. Determining priorities
3. Scheduling action
4. Coordinating planning

The final 303(e) plan is a five-year plan which is continually updated to meet and describe changes in the basin. This report provides 1) a program design, 2) initial analysis of available data, and 3) priority listing of water pollution problems necessary for developing the 303(e) plans.

This document will also serve an important function in getting citizens, officials of local and county governments, and statewide officials involved together in the planning process. The compilation of information contained in this report is intended to be suitable for use by this wide range of public interests. Active involvement by all segments of Utah society is necessary to develop a plan which will be of lasting value to the orderly development and use of water in the state.

Objectives of this report

The overall objective of this report is twofold: (1) To develop the baseline information, both pre-existing and that specifically collected for the preparation of this report, which will allow the planning of a comprehensive water quality management plan for the Utah portion of
the Bear River system, and (2) To provide an initial source of background information and data to facilitate the participation of local public officials, community leaders and citizens in water quality planning for the basin.

In the compilation and analysis of the baseline information which is within the scope of this preliminary study, the following specific objectives were achieved.

1. Determination of availability of hydrological and water quality data including:
   a. Point sources and an assessment of their specific impact;
   b. A preliminary inventory of land uses in basin.

2. Assessment of water quality problems in the basin:
   a. A preliminary ranking of pollution problems within the Bear River basin;
   b. A gross assessment of economic and ecologic impacts on water quality;
   c. A definition of existing water quality problems throughout the subbasins of the Bear River Basin.

3. Collection of data according to sources which are local or basin wide, statewide, regional or federal.

4. Presentation of the collected data in a form useful to local, state, and regional planners and governmental officials and the exposition of this information in an illustrative and readily usable manner, including data listing and a bibliography of information and data sources.

5. Preliminary analysis of data problems and gaps and requirements for obtaining additional data.

6. Development of a preliminary basin analysis methodology and data retrieval and updating through use of computer systems.

Further phases of the water quality management plan will be forthcoming on a schedule and as directed by the Bureau of Environmental Health, State of Utah, Salt Lake City.
What is Water Quality?

The intermountain west is the fastest growing region in the United States and yet its development is controlled by one of the most basic resources—water. Water is present on the land surface as streams or lakes or below the land surface as groundwater. Artesian and pumped wells along with springs allow society to use groundwater. Surface waters are usually more accessible for use. This is reflected by the fact that almost all surface waters in Utah have been filed for as controlled water rights.

In this region the control and management of the quantity of water has always received a large amount of economic and political support because of the obvious tangible benefits. However, the increasing competition for use of the water resource and the increased leisure time which Americans have, is causing an evaluation of the quality of the water supply in addition to the old question of "how much water is there and how can I increase this amount?"

Many water supplies in the intermountain region are very good quality. Generally, this means that the water is high in dissolved oxygen, permitting successful sport fisheries; the water is clear or at least not clouded by water weeds, bacteria, plants or animals which would cause a passerby to conclude that the water cannot be used for other purposes. Just as people need pure oxygen and clean air to breathe so do the natural communities of streams and lakes need clean water and dissolved oxygen to function well. One of the more important contaminants found in water from man's standpoint is bacteria and viruses which cause diseases. It doesn't take an expert in water quality to observe the aesthetic value of a clean body of water or moving stream. This aesthetic value of water quality is often translated into an increase or decrease in recreational, agricultural, or commercial use of the water depending on the existing condition.
The highest quality water in Utah is found in the higher elevation mountain streams. These pristine waters are known for their clarity and high productivity of trout. As these streams move into the valleys of Utah, man's influence and natural erosion begins to affect the quality of the water. The various activities of man provide the pollutants and resulting pollution problems shown in Figure 1. Also the pollution problems can be controlled by the various methods noted in Figure 1.

These are qualitative judgments and in most cases sophisticated measurements are necessary to measure the clearness of water (turbidity), the presence of salt concentrations which affect agriculture and health (salinity), concentrations of toxic materials (poisons), bacterial public health problems (coliform bacteria which indicate the presence of disease causing bacteria), and the presence of substances which can reduce the dissolved oxygen (BOD) or lead to overproduction of plants (nutrients or fertilizers). These terms (turbidity, salinity, toxic materials, coliform bacteria, BOD, nutrients) are used to estimate or measure the degree of pollution and are called water quality parameters.

Pollution is a result of the discharge of water or runoff water entering streams and lakes carrying pollutants. The organic strength of sewage and runoff is principally a measure of its capacity to undergo bacterial decomposition. The standard criteria for determining the organic strength of sewage is called the Biochemical Oxygen Demand or BOD. The BOD analysis indirectly measures the bacteria food by measuring the amount of oxygen it uses in utilizing the organic matter for food. The BOD is simply a measure of the oxygen used in decomposing organic matter to a stable condition. Normally, the test is carried out in the laboratory at a temperature of 20°C over a period of five days with the results being reported in ppm or mg/l 5-day BOD (BOD₅). The results of the test show the amount of oxygen that particular waste would demand in five days if released into a stream.
Figure 1. Sources, types, effects, and controls of pollutants from societal activities in river basins.
Sewage collected directly from homes, businesses, hospitals, and schools, commonly referred to as raw sanitary sewage, will normally have a BOD$_5$ ranging between 150 mg/l and 250 mg/l. Industrial wastes added to sanitary sewage could significantly increase this amount of BOD$_5$. Primary waste treatment, which usually involves nothing more than settling of the solids and further treatment and disposal of those solids, usually removes all of the settleable material and 30 to 40 percent of BOD. Secondary waste treatment, which follows primary treatment, is designed to remove more of the BOD, up to 95 percent of the BOD. The final effluent in well designed properly operated plants should not contain more than 15 mg/l of BOD.

Sewage contains countless numbers of living organisms, most of them too small in size to be visible except with the use of a microscope. They are a natural living part of the organic matter found in sewage and are important because they are one of the reasons for the success of our present treatment processes. Generally, the microscopic living organisms in sewage are bacteria and other more complex higher forms of organisms. Many of these bacteria perform necessary functions in the large intestine of man, such as Vitamin B$_{12}$ production.

Fresh raw sewage may normally contain from 10 to 200 million bacteria per 100 milliliters. They may either be harmful or nonharmful to humans. Complete secondary treatment reduces these numbers by 80 to 95 percent, with effluent chlorination increasing the percent "kill" to 99.9 percent or better. The highest reductions are generally achieved only when the treatment plant is properly operated.

Bacteria found in the colon (large intestine) of man, which are not in themselves harmful, have been termed the coliform group. The coliform group of bacteria is more resistant to chlorine than the bacteria that cause enteric disease. In general, if all the coliforms are eliminated, then all the disease-bacteria have been destroyed; where coliforms can
still be found, some disease-producing bacteria may also have survived. The water must be considered unfit to drink until properly treated. So the coliform group of organisms is used as an indicator that proper treatment has been applied to the water. Also the coliform group of bacteria is used to indicate possible recent fecal contamination of a stream or lake. (Other indicator bacteria which are much more specific are also being used on a large scale, as tests for them are perfected.)

BOD and coliforms are the first and most important phase of water pollution control because changes in their concentrations bear directly on the health of society and environmental quality of our streams. Turbidity, salinity, toxicity, and nutrients become significant when other beneficial uses of water are considered. Treatment processes must first be upgraded to improve water quality from the health standpoint; further treatment will then be necessary to increase the economic utility of the water supply.

What are the sources of pollution?

Although natural activities contribute materials which affect water quality and there may be times and places where it makes sense to control these natural sources, the definition of pollution generally is oriented toward the activities of society and its subsequent effect on water quality. The first level of description of sources is directed toward control and so two generalized sources, point sources and diffuse sources, are defined. Point sources generally are smaller in volume than the receiving water, have very high concentrations of the pollutants, and enter the receiving stream or lake at a specific point. Diffuse sources enter the receiving water at many points and generally are much larger in flow and more dilute than point sources. Diffuse sources generally result from runoff waters being affected by various land use activities.

Specific activities which produce pollutants can be classified as point or diffuse sources (Table 1). Management techniques for the two
Table 1. Typical activities acting as pollution sources to receiving waters.

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<thead>
<tr>
<th>Point Sources</th>
<th>Diffuse Sources</th>
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<tr>
<td>Sewage effluents</td>
<td>Direct rainfall</td>
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<td>Municipal wastes</td>
<td>Watershed runoff areas</td>
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<tr>
<td>human wastes</td>
<td></td>
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<tr>
<td>garbage disposals, detergents, etc.</td>
<td>Agricultural</td>
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<tr>
<td>Industrial wastes</td>
<td>fertilized cropland</td>
</tr>
<tr>
<td>Irrigation drain tile effluents</td>
<td>irrigation tail waters</td>
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<tr>
<td>Mining activities</td>
<td>pasture lands</td>
</tr>
<tr>
<td>Animal wastes (non-pasture or grazing)</td>
<td>grazing lands</td>
</tr>
<tr>
<td>Mining spoils</td>
<td>Mining spoils</td>
</tr>
<tr>
<td>Urban areas</td>
<td>Urban areas</td>
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<td>Solid waste disposal</td>
<td>Solid waste disposal</td>
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<td>Managed forests</td>
<td>Managed forests</td>
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<td>Recreational developments</td>
<td>Recreational developments</td>
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<td>Natural lands</td>
<td>Natural lands</td>
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general types are quite different. Point sources are generally handled by wastewater treatment plants.

The control of diffuse sources is not as straightforward as the control of point sources. Various conservation and fertilizing techniques could be implemented to control agricultural sources. Various land use ordinances and zoning restrictions can be used to control diffuse urban sources. Thus, the relatively concentrated, low volume wastes produced by municipalities can be easily collected and treated with economical technology. Collection and treatment of diffuse source pollutants is difficult, and because of their relatively large volume these pollutants cannot be economically treated at the present time. Therefore, point sources generally have strict water quality standards applied to them. However, as point source pollution control begins to be effective and removes that source of pollutants and society finds that the quality of the water is still too low, it will be necessary to apply standards to streams and lakes so that diffuse sources will be controlled.

**What are water quality standards?**

Water quality standards are limits applied to the concentration of specific pollutants in water. If the standards are applied to discharges of treated domestic and industrial wastewaters, they are called effluent standards. If the standards are applied to the receiving water, they are called receiving water standards or ambient standards. For point sources it may be that the actual load of pollutant released to the stream will be controlled. This is called a loading standard and is calculated by multiplying the concentration by the flow to determine the actual weight of pollutant discharged per day or other unit of time. These kinds of standards are called mass emission rate standards. The application of standards to waste effluents and to streams and lakes will lead to their improvement only if monitoring of the waters occurs and if the standards are enforced.
In Utah, water quality standards reflect these considerations and are primarily effluent standards; but these effluent standards are oriented toward the effect of the designated effluents on the streams. Recently standards of all kinds have become somewhat confused and are being reoriented so that the state standards will be in line with the Federal Water Quality Amendments of 1972 (PL92-500) as directed by the Environmental Protection Agency (EPA). In all cases Utah's standards are at least as strict as those proposed by the EPA. Because the state water quality standards vary with each basin and within subbasins the specific standards as applicable to the studied basins will be described in the sections on general description of the basin.

The Bear River System

A general description of the Bear River system

The Bear River arises at an elevation of about 10,000 feet on the north slope of the Uintah Mountains, a unique mountain range with its major axis running east-west. Because much of this mountain land is wilderness area, the water is nearly pristine. Within the short distance of about 18 river miles and a 2,000 foot drop in elevation Stillwater Fork and East Fork join Hayden Fork from the east and West Fork from the west to form the Bear River.

Three miles further north the river crosses the Wyoming border and soon passes through the town of Evanston located on Interstate 80 at about 6,600 feet elevation. Up to this time some recreational use in the Uintah Wilderness area by hikers and grazing animals owned by the few ranchers in the area or others possessing grazing rights may have had some minimal effect but it was not possible to detect these effects in the sample analyses which were performed. The first noticeable effects apparently occur after the river passes through the Wyoming portion of Bear River Valley. Several large feedlots, an old oil-coal
mining development just north of Evanston, and other agricultural activities affect the quality of the Bear River significantly. The Woodruff Narrows Dam and Reservoir, completed in 1962, is located in a dry, sagebrush dominated, hilly area at 6,400 foot elevation. This is above the point where the river begins flowing west and back into Utah after a Wyoming journey of about 58 miles. A state park is located adjacent to the reservoir but the reservoir is primarily for irrigation and flood control, not recreation.

Just east of the town of Woodruff, Utah, the river again flows north through an agricultural area devoted primarily to cattle raising. It passes east of Randolph and Sage Junction being joined by Big Creek and Bridger Creek. There are several diversions from the river and several tributaries are diverted into canals prior to entering Bear River. The Bear River returns to Wyoming 42 miles after re-entering Utah.

The Bear River proceeds north and near Cokeville it is joined by its largest tributary to this point, Smiths Fork; it then proceeds northwesterly into Idaho beginning a long loop which will return it to Utah. Bear Lake, lying astride the Utah-Idaho border, was a terminal lake; but since 1912 it has had inflow from the Bear River via the Rainbow Canal and outflow via the Bear Lake Outlet Canal. Bear Lake is used as a reservoir for Bear River water and is primarily regulated by the Utah Power and Light Co. The high flow is received into Bear Lake during the spring and early summer and then water is returned to the Bear River in late summer and fall for use in irrigation and power generation.

Bear Lake has a surface area of 110 square miles, a mean depth of about 100 feet and maximum depth of 210 feet, and lies in a closed basin of 500 square miles. The water is high quality and this fact has led to its incipient development as a recreational area. Water quality management in the Bear Lake Basin will be significantly affected not
only by events occurring within its own watershed but by activities in
the upstream reaches of the Bear River.

The Bear River has already had an impact on Bear Lake. Until
1912 when diversion of the Bear River into Bear Lake began, Bear Lake
was becoming increasingly saline because it was a terminal lake.
Because the Bear River has a lower salinity than Bear Lake, it has been
diluting the lake's salt content and recent calculations indicate that dilution
is still occurring. However, the addition of pollutants such as BOD, nutrients,
pesticides, toxicants, and other materials, via Bear River or Bear Lake
basin streams has led to concern that the aesthetic quality of the lake
may be lost if action is not taken to control pollution. Management plans
similar to those instituted at Lake Tahoe, California-Nevada, may be
needed to prevent the loss of this recreational resource.

The Bear River begins a long loop west of Montpelier, Idaho,
passing through two power-irrigation reservoirs before entering Cache
Valley, Utah-Idaho, just southwest of the towns of Preston and Franklin,
Idaho, crossing the Utah border 205 miles downstream from where it
left Utah just north of Sage Junction, Utah. In this distance the Bear
River has fallen from about 6,200 feet elevation to the 4,500 foot elevation
of Cache Valley.

About 18 river miles from the Idaho border the Bear River is
joined by the Cub River. Most of the Cub River lies in Idaho in an area
of near-wilderness, but receives waste effluents and runoff waters from
agricultural activities as it flows southward. It flows on the west side
of Franklin, Idaho, picks up the flow from High Creek passing to the
west of Richmond, and joins the Bear River a few miles further
downstream.

The Bear River is joined by several small streams from the
slopes of the mountains on the east side of the valley as it meanders
past the several small towns north of Logan, Utah. Logan is the largest
town in Cache Valley (25,000 population). Cutler Reservoir, behind
Cutler Dam in the Wellsville Range, the western boundary of Cache Valley, Utah, is the terminus of the Bear River in Cache Valley. The Little Bear River which drains the southern and eastern watersheds of the mountains surrounding Cache Valley joins the Bear River at Cutler Reservoir. Newton Creek is a small stream flowing from Newton Reservoir, a eutrophic irrigation reservoir, and enters the north side of Cutler Reservoir after a short run of about 8 miles.

The Little Bear River is formed by the Logan River, Blacksmith Fork, and the Little Bear River as well as several small streams, intermittent streams, and lateral inflow or land runoff. Logan River is the most northerly tributary and arises in the mountains east of Logan in the Wasatch National Forest. At its origin it passes near the Beaver Mountain Ski Area and through mountain grazing lands and adjacent to an all weather highway from Logan to Bear Lake. The highway follows Logan River to the mouth of the Logan Canyon; the river itself passes through several camping, summer home, and picnic sites and three small reservoirs used for power generation and irrigation diversion. Logan River flows through Logan City and into the valley, passing through residential and then agricultural areas, principally cattle feedlot and dairying activities. It receives some effluent from the Logan Sewage Lagoons during the late spring, summer and early fall before it joins the Little Bear River. The sealed lagoons are designed for total containment in the winter months.

The next major tributary to the south is Blacksmith Fork which empties a drainage a little smaller than that of the Logan River. A large population of elk winter at Hardware Ranch, a Utah Fish and Game Reserve at the headwaters of Blacksmith Fork. Left Fork, a major tributary to Blacksmith Fork, drains an undeveloped area having a dirt road, some camping areas and considerable summer grazing activity. Most of the riparian land is privately owned but a few camping and picnic grounds occur in the canyon. A single small irrigation and power
reservoir is located near the mouth of the canyon and then the river flows through largely agricultural land to eventually join the Logan River just southwest of Logan within Cache Valley.

The Little Bear River has two drainages one of which, the South Fork, is intermittent because it has no source other than precipitation in low hills which accumulate a small snow pack. The East Fork drains a relatively extensive area and is stored in a large reservoir at Porcupine Dam. This outflow is regulated for irrigation and flood control. In the relatively short stretch between Porcupine Dam and Hyrum Reservoir there is considerable input of pollutants, mostly nutrients, by feedlots, dairies, and a trout farm. This has led to severe eutrophication and algal bloom problems in Hyrum Reservoir which have had some detrimental effects on uses of that water. The reservoir was originally constructed for irrigation and flood control and irrigation is still its principal use. However, a state park is on its shores and recreational uses such as fishing, boating, water skiing, and swimming are becoming more important and the algal bloom in the late summer interferes with these uses.

The Little Bear River is composed largely of irrigation return flows late in the summer; the spring and early summer mountain runoff provides the peak flow of the year. Downstream of Hyrum Reservoir, the Little Bear River drainage collects the flow from agricultural lands as well as urban runoff from Hyrum, Wellsville, and Mendon. Also, Wellsville's sewage enters the Little Bear drainage.

Flows in the Bear River downstream of Cutler Dam are highly variable because of release for power generation by Utah Power and Light. Because of such flow regulation within the entire Bear River system, it is not logical to consider low flows as affected by hydrological events. The critical low flow regulations are legal guarantees of flows.

For the last 44 miles of the Bear River its waters flow in a southerly direction through a rather narrow river valley having a gentle
slope. Significant diversions for irrigation waters occur in this area, especially into the Brigham City area.

About 20 miles south of Cutler Dam near the City of Corinne the Bear River is joined by the Malad River. The Malad arises in Idaho and flows through the Malad River Valley to join the Bear some 30 river miles downstream from the Utah-Idaho border. During its southerly progress the Malad accumulates a great amount of salt primarily from saline springs but also from agricultural runoff and return flows. Significant inputs of industrial and municipal waste waters occur in this valley.

The Bear River collects further runoff and waste waters and finally ends its journey in the Bear River Bird Refuge. From there the waters of the Bear River system eventually enter the Great Salt Lake.

In its 420 mile journey to the Bear River Bird Refuge, Bear River loses about 6,000 feet in elevation, achieves flow near 12,000 cfs, accumulates significant quantities of specific pollutants, and journeys through mountain lands, cold northern deserts and river valleys important to Utah’s economy. The Bear River accumulates flows from six major tributaries and forms four major reservoirs and many smaller ones along its route; in addition, Bear Lake is utilized as a reservoir.

Although other small stream systems exist within the basin defined by the Bear River system, some of these are diverted for irrigation and may never enter the Bear River system, such as Woodruff Creek near Woodruff, Utah. Others terminate naturally, for example, Blue Springs Creek, Utah, west of Corinne. Essentially these and other intermittent or seasonally diverted streams have little effect on the Bear River water quality.

Because the Bear River is in Wyoming and Idaho for 263 miles of its 420 mile length, it is important to consider effects of activities occurring in those states which may affect its water quality. Activities in these miles are minimal at the present time and probably have important but lesser effects than would be expected for the length of travel. Future developments along the out-of-Utah portion of the river may change this situation. Thus, it is important that any plan for control
of waste discharges and pollutants from diffuse sources be integrated with results and plans from Idaho and Wyoming to insure water quality suitable for beneficial uses in all three states. The results of careful planning and management would be negated if all the states involved in the Bear River Basin do not coordinate their implementation plans for improving the water quality of the Bear River.

**Bear River water quality standards**

The Utah State Division of Health has described standards (dated August 2, 1971) which have been applied to the Bear River system (June 23, 1972) and which have been accepted by the Environmental Protection Agency. These standards are defined as the class "C" Water Quality Requirements. The standards state:

"It shall be unlawful to discharge wastes resulting in:

- Objectionable deposits
- Floating debris, oil, scum, and other matters
- Objectionable color, odor, taste, turbidity
- Interference with class "C" water uses

Uses of class "C" waters:

- Municipal (following complete treatment)
- Aesthetics
- Irrigation
- Stock watering
- Fish propagation
- Wildlife
- Recreation (except swimming)
- Industrial supplies
- Other (as determined by the Utah State Board of Health and Utah Water Pollution Committee)

The standards listed in Table 2 shall not be violated." In addition specific reaches of the Bear River system have been further classified for thermal discharge to prevent undue heating of the water and the resultant significant effects on fish and other aquatic life. Also, these requirements further limit the minimum level of dissolved oxygen (DO) in the stream. The reader should be aware that the amount of oxygen capable of being held by water decreases as the temperature of the water...
Table 2. Utah class "C" stream standards for specific constituents and pollutants.

<table>
<thead>
<tr>
<th>Item</th>
<th>Recommended mg/l</th>
<th>Mandatory mg/l</th>
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</thead>
<tbody>
<tr>
<td>TDS</td>
<td>500</td>
<td>-</td>
</tr>
<tr>
<td>As</td>
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<td>0.05</td>
</tr>
<tr>
<td>Ba</td>
<td>-</td>
<td>1.0</td>
</tr>
<tr>
<td>CCE</td>
<td>0.2</td>
<td>-</td>
</tr>
<tr>
<td>Cd</td>
<td>-</td>
<td>0.01</td>
</tr>
<tr>
<td>Cl</td>
<td>250</td>
<td>-</td>
</tr>
<tr>
<td>Cr</td>
<td>-</td>
<td>0.05</td>
</tr>
<tr>
<td>Cu</td>
<td>1.0</td>
<td>-</td>
</tr>
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</tr>
<tr>
<td>F</td>
<td>1.0</td>
<td>2.0&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Fe</td>
<td>0.3</td>
<td>-</td>
</tr>
<tr>
<td>Pb</td>
<td>-</td>
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<tr>
<td>NO&lt;sub&gt;3&lt;/sub&gt;</td>
<td>45</td>
<td>-</td>
</tr>
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<td>-</td>
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<td>0.01</td>
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<td>-</td>
</tr>
<tr>
<td>MBAS</td>
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<td>-</td>
</tr>
<tr>
<td>Zn</td>
<td>5.0</td>
<td>-</td>
</tr>
</tbody>
</table>

MPN Coliforms 5000/100 upper limit (average)
BOD<sub>5</sub> 5 mg/l upper limit
DO 5.5 mg/l lower limit
Radionuclides not to exceed 1/30 of the MPC<sub>w</sub><sup>b</sup> values as defined in National Bureau of Standards Handbook 69

<sup>a</sup>Dependent on climate.
<sup>b</sup>Maximum Permissible Concentration in water.
increases. These modifications are noted by the appending of "C" for cold and "W" for warm waters as follows:

Class "CC"--$2^\circ$F incremental increase and not above $68^\circ$F;
DO is 6 mg/l minimum.

Class "CW"--$4^\circ$F incremental increase and not above $80^\circ$F;
DO is 6 mg/l minimum.

Class "CCR"--$2^\circ$F incremental increase and not above $68^\circ$F;
DO is 6 mg/l minimum; MPN coliforms 1000/100 ml upper limit (average).

As shown in the schematic drawing of the Bear River in Figure 2, reaches of the river have been defined to meet one or the other of these three classifications. Those reaches not so classified are in the general classification of "CI" which has no temperature requirement and a lower dissolved oxygen minimum of 5.5 mg/l. The downstream reaches are CW reflecting the greater warming of the water but not the quality degradation which has taken place with distance from the headwaters of the Bear in the Uintas.
Figure 2. Stream water quality classification in Utah's portion of the Bear River Basin.
CHAPTER II
WATER USES IN THE BEAR RIVER BASIN

Introduction

Uses and quality of water always must be considered in relation to the sources and quantities of water. Then various activities in the basin can be considered as affecting the quantity (flow) and quality (concentration of pollutants) of the surface flow. These activities would include agricultural uses of water, natural factors which affect water, urban uses of water including street runoff and municipal wastes, industrial, and recreational uses of water. In the discussion which follows specific pollution problems or activities will be described as an illustration of possible water quality problems in the Bear River Basin.

Although the principal pollutants in many river basins in the United States come from point sources, the basic quality of a surface or groundwater is dependent on basin geology, precipitation, and water flows. Suspended materials from erodible soils and rock, effects of various land uses, and the presence of large populations of domestic animals are also important factors affecting water quality.

Geology of the Bear River Basin

Although the Bear River Basin rock formations are not as spectacular as in other parts of Utah, they provide the basis of significant watersheds and wooded and recreational areas. The rocks in the mountains are largely sedimentary having been deposited predominantly in a marine environment 220 to 550 million years ago. Valleys contain alluvial materials deposited on the land surface, for example, in stream
beds or lakes. The marine depositional basin tended to be oriented in a relatively north-south direction with the sea to the west. Thus sandy sediments were deposited in the eastern part of the region and calcareous (limestones) sediments in the west.

The portions of the Bear River Basin near the Uintas and in Bear River Valley east of Bear Lake include conglomerates, shales, sandstone, quartzite, limestone, dolomite, and some phosphate rocks, and are quite different from the rest of Utah's Bear River Basin. This latter section occurs in the old Lake Bonneville Basin. At the upper levels of the old lake basin, alluvial deposits are obvious, forming terraces. The lowlands are old lake deposits of mostly dry clay. Salt deposits abound and may prohibit agriculture. The mountain ranges such as the Bear River Range east of Logan are composed of the older sedimentary rocks (see 1, Table 3). More detailed illustrations of these characteristics are shown in Figure 3.

The quality of the water draining these rock formations is moderately hard, typical of waters draining calcareous rocks. Phosphate concentrations are high relative to waters draining granitic rocks. High salinity is also observed; this problem is intensified by mineral springs. These mineral springs occur in approximately eight places within the basin and appear to be located along fault zones as the water rises from great depth heavily laden with minerals. The most notable spring in the area is Crystal Springs near Honeyville, Utah. This spring has a hot (130°F) and a cold portion (63°F). The flow is 9 cfs and carries a daily salt load of 450 tons.

Groundwater in the Bear River Basin

Groundwater that can be developed and used occurs principally in the alluvial materials that have been deposited along the stream channel and in the valleys formed by these streams. In past geologic history some of the valleys of the Bear River Drainage Basin were occupied by lakes.
<table>
<thead>
<tr>
<th>SEDIMENTARY ROCKS</th>
<th>Relative age is shown by numbers, where number 1 is the oldest.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Precambrian and Paleozoic sedimentary rocks</td>
<td>Marine and non-marine units of quartzite, sandstone, shale, limestone, and dolomite having a possible total thickness of at least 30,000 feet. Some phosphate rock is present along eastern edge in the Crawford Mountains.</td>
</tr>
<tr>
<td>2 Triassic and Jurassic sedimentary rocks</td>
<td>None exposed in western part. Included in eastern part near Bear Lake are exposures of sandstone, shale, and limestone with a maximum thickness of about 9,900 feet.</td>
</tr>
<tr>
<td>3 Cretaceous sedimentary rocks</td>
<td>None exposed in western part. Limited exposure of conglomerate along eastern edge.</td>
</tr>
<tr>
<td>4 Tertiary sedimentary rocks</td>
<td>A covering unit of conglomerate and sandstone in the eastern part, up to 1,000 feet or more in thickness, and thinning westward. Also includes an older unit of conglomerate and sandstone with volcanic ash in the western part, up to 2,000 feet thick.</td>
</tr>
<tr>
<td>5a Quarternary lake deposits and marshland</td>
<td>Mostly dry clay or dust, poorly drained and with enough salt to prohibit agriculture. Marshlands are mostly fresh water; some are salty or brackish.</td>
</tr>
<tr>
<td>5b Quarternary alluvial deposits</td>
<td>Includes stream-deposited material, hillwash, gravel surfaces, glacial deposits, wind-blown material, constructional lakeshore features (bars, spits, terraces), and landslide material.</td>
</tr>
</tbody>
</table>

**IGNEOUS ROCKS**

| 4, 5 Tertiary and Quarternary volcanic rocks | One exposure exists in the northwestern corner and consists of Tertiary basalt and non-basalt flows. |
Figure 3. Surficial geology of the Bear River Basin in Utah.
BEAR RIVER BASIN

Geology

- Quaternary alluvial deposits
- Stream-deposited and covering material
- Quaternary lake bed sediments and marshland
- Tertiary sedimentary rocks: conglomerate, sandstone, siltstone, shale, and limestone
- Igneous rocks
- Tertiary and Quaternary volcanic rocks: tuff (volcanic ash), welded tuff, basalt, and non-basalt flows
- Cretaceous sedimentary rocks: conglomerate, sandstone, siltstone, shale, limestone, and coal
- Triassic and Jurassic sedimentary rocks: sandstone, siltstone, shale, limestone, salt, and gypsum
- Precambrian and Paleozoic rocks: quartzite, limestone, dolomite, sandstone, and shale
- Phosphate rock
- Mineral springs
which left their deposits of sediment and created large underground storage reservoirs. The most probable groundwater reservoirs within the Bear River Drainage Basin are shown in Figure 4. According to the U.S. Bureau of Reclamation there are 4408 wells in the Bear River drainage area with 3510 of them existing in Cache, Malad, and Box Elder subareas.

Groundwater in Upper Bear River Valley

In subareas 1 and 2 the principal water bearing deposits are limited to the flood plain area of the Bear River. These alluvial deposits are deep and of coarse material. Development of groundwater has not been extensive but some of the better wells have a good yield (700-1500 gpm). Subareas 3 and 4 are similarly limited to the flood plain area of Bear River but some deep alluvial deposits occur in the Smith's Fork and Thomas Fork bottomlands. Most wells in the upper Bear River Valley are only 200 to 300 feet deep and do not penetrate the alluvium. Commonly, the material that is penetrated consists of alternating layers of gravel, sand, silt, and clay. It is estimated that the total depth of alluvium is near 1,000 feet. In the lower central parts of the valley the water in the gravel beds is under weak artesian pressure with some wells flowing at land surface. The depth to groundwater in the lower parts of the valley averages about 20 to 30 feet below land surface. Recharge to the aquifers is through direct precipitation, infiltration from canal losses, and infiltration through the outwash fans of the numerous small mountain streams tributary to the Bear River throughout this reach. About 340 wells are functioning in this valley.

Groundwater in Bear Lake Valley

In subarea 5, the valley fill is composed of stream and lake-deposited sediments which are relatively fine textured and possess low permeability. The depth to water table in the low lands varies from about 30 feet to
Figure 4. Probable groundwater reservoirs in the Bear River drainage area.
zero feet in the Dingle swamp area north of Bear Lake. There has been essentially no groundwater development. Yields are not expected to be great if development does occur because of the thin aquifers and low permeabilities. About 430 wells exist in Bear Lake Valley.

Groundwater in Cache Valley

Cache Valley was once occupied by Pleistocene Lake Bonneville and the alluvium which now fills the valley is deep and contains good permeable aquifers. The most productive aquifers extend between Hyrum and Richmond on the east side of the valley and between Dayton and Oxford on the west side. North and west of Richmond the alluvium is of low permeability and not likely to produce high yielding wells. Wells in the other areas often yield more than 3500 gpm. The annual recharge to the groundwater is from inflowing streams which cross the alluvium and from precipitation. The annual recharge exceeds the present withdrawals and there is good potential for additional groundwater development. A large portion of the valley bottomlands contains water under artesian pressure. Approximately 1900 wells have been constructed in this subarea.

Groundwater in Malad Valley

The alluvium in Malad Valley is also a remnant of the Lake Bonneville deposits and good yielding aquifers exist similar to those in Cache Valley. Since 1964 development of the groundwater has resulted in some lowering of the artesian pressure but the potential still exists for further development. The groundwater reservoir is full and discharging into surface marshlands where it is lost to the basin through evaporation and transpiration, and into several springs and seeps which make up the flow of Malad River at the Woodruff gaging station. Some mineralized hot springs also discharge water into the Malad River in this subarea. Wells in this subarea number about 350.
Groundwater in Box Elder subarea

The valley sediments in subarea 10 are generally fine textured and of low permeability. Although groundwater exists within the alluvium because of the low permeability the yield of wells should not be expected to be high. There has not been extensive groundwater development in this area. Several mineralized hot springs discharge water within the subarea and contribute a heavy salt concentration to the outflowing stream. Most of the wells in this subarea are domestic wells which constitute 1126 out of the total 1253 wells in the subarea.

Surface Flows

The surface flows which combine to form the Bear River Drainage Basin originate on the north slope of the Uinta Mountains and along the east and west slopes of the north portion of the Wasatch Range. The higher peaks in these two ranges range from 10,000 to over 12,000 feet in altitude. The Bear River terminates just slightly above the 4,200 foot level giving the surface water drainage of the Bear River system a drop in elevation of about 8,000 feet.

These surface flows reflect the precipitation, runoff, and groundwater patterns which occur in the basin as well as the evaporation and consumptive uses which remove water from the river system. Precipitation varies from low values at the lower elevations to higher values chiefly as shown in the mountain areas (see Figure 5).

Surface flow patterns for the entire Bear River including various tributary flows and consumptive uses in the Bear River drainage are shown in Figure 6. The river flows are highest in May or June and lowest in the fall or late winter. Flash floods may be significant on the tributaries but seldom cause problems on the main stem of the river. Snowmelt runoff or precipitation on snow causes the highest peaks in the flow of the river.
Figure 5. Annual precipitation in Utah's portion of the Bear River Basin.
BEAR RIVER BASIN

Precipitation

- 0-12 in. (Average inches/year)
- 12-16 in.
- 16-20 in.
- Above 20 in.
Figure 6. Surface flow diagram of mean annual water budget for the Bear River drainage area.
Flows of the Bear River are diverted primarily for agricultural use or impounded for power generation over most of the 500 mile course to the Great Salt Lake itself. Most municipalities divert culinary water from the upper reaches of the tributaries or from groundwater and do not tap the main stem of the Bear River. Also, surface waters are used for recreation (fishing, boating, swimming, diving, and hunting) over most of the length of the Bear River.

East Fork, West Fork, and Hayden Fork combine on the north slope of the Uinta Mountains to constitute the bulk of the surface flow crossing the Utah-Wyoming boundary. The average discharge at the USGS gage near the border for the 30 years of record is 192 cfs. The maximum discharge of 2,980 cfs at this gage occurred June 6, 1968; the 16 cfs minimum discharge was measured on four different occasions. The average annual discharge of the Bear River below the Woodruff Narrows Dam, just prior to reentering Utah, for the 12 years of record through 1972 is 242 cfs. Recorded instantaneous maximum and minimum flows are 3,000 and zero cfs. The average discharge leaving Utah near Randolph reflects the irrigation activity in the Woodruff-Randolph area by dropping to 199 cfs with maximum and minimum flows of 2,660 and 2 cfs.

The gage near the Utah-Idaho border was installed in 1970 so no average flows are given. However, a maximum discharge of 4,190 cfs has been recorded with a minimum daily discharge of 73 cfs. Near Smithfield the average flow is 1,380 cfs. Maximum and minimum discharges are 5,850 and 132 cfs respectively. The Bear River at this point is regulated to a large degree by reservoirs in Idaho for power generation. Four unregulated tributaries have entered the Bear River between this gage and the Oneida Reservoir. Four more tributaries enter the Bear River between Smithfield and Cutler Reservoir. The maximum flow below Cutler Dam is recorded at 11,600 cfs with a minimum flow of zero cfs. The flow at this point is regulated by power
development and irrigation diversions. Near Corinne the average discharge is 1,737 cfs based on records through 1972. The recorded maximum flow is 7,370 cfs while the minimum daily flow is 72 cfs. The peak flows on the lower portion of the Bear River would be considerably higher if there were no manmade storage facilities.

**Suspended Sediment**

Available measurements of the suspended sediment load in the Bear River have been taken during the runoff season to demonstrate the worst condition. These suspended sediments or clays and silt carried by the water flow cause turbidity and interfere with some basic uses of the water. The levels of sediment transport cited are taken from limited data and, as a result, are not extremely reliable as long term averages. These data do, however, give an indication of a range of values that might be expected. Sources of these suspended sediments primarily include land uses but reflect the potential for erosion as shown in Figure 7.

During the peak spring runoff, the suspended sediment load transported into Wyoming from the north slope of the Uinta Mountains is in the neighborhood of 100 tons per day. The rate of sediment return to Utah near Woodruff is somewhat higher but is controlled partially by the Woodruff Narrows Reservoir. Some additional pickup occurs between Woodruff and the Wyoming border below Sage Creek Junction. An estimated daily transport would be between 300 and 500 tons.

Near Smithfield, about 10 miles below the point of return to Utah, the sediment load has increased to an average of about 2,600 tons per day in April, to 400 tons per day in July. The sediment load in northern Utah is controlled to a large extent by the two reservoirs in Idaho. Below Cutler Reservoir in Utah, the sediment load is about 1,400 tons per day in April but drops to around 10 tons per day in July. Measurements for the other eight months are not available.
Figure 7. Erosion patterns for surface soils and rocks in the Bear River Basin in Utah.
Erosion

Condition of Soil

- Slightly Eroded
- Moderately Eroded
- Water
At the last station where measurements were taken near Honeyville, the sediment load is about 1100 tons per day in April and 150 tons per day in July. These measurements do not provide any indication of sediment loads created by flash floods during the summer season. However, the damping effect of the reservoirs would be significant.

Suspended sediments do not appear to be a major problem to water users in the Bear River Basin. However, there are sections of the river that would be very much improved recreationally and aesthetically if the suspended sediment load were eliminated. The most damage probably occurs where the sediment load is picked up by high or flooding water. The suspended sediment does cause extra wear on power generating equipment and must be reckoned with where agriculture employs sprinkling systems. Municipalities do not withdraw culinary water from the river and so are not concerned with the sediment load.

**Animal Wastes**

Historically, a major effort has been devoted to the control of pollutional problems caused by urban centers, such as industrial pollution, domestic liquid wastes, solid wastes, and stormwater runoff. Agricultural-related environmental quality problems have received little attention until the last 10 years, and perhaps this lack of attention is attributable to a point of view that control of pollution from agriculture was impossible, or that the contribution was insignificant and should not be considered along with the much more complex problems produced by the urban centers. It is possible that this rather naive observation would have allowed us to ignore the agricultural problem for many more years had agricultural practices remained static.

However, remarkable changes have taken place in the United States with respect to methods of agricultural production. Farm size and productivity per farm worker have increased significantly, and intensive crop and animal production have taken on essentially the same
characteristics of an industrial complex. Because of this increased efficiency of agricultural production, a variety of environmental problems have developed. It is now quite obvious that this increase in agricultural production has had detrimental effects on environmental quality. Also, the influx of suburbia into rural areas has made many more people aware of the problems generated by handling and disposing of agricultural wastes.

The intensive agricultural practices and the public awareness of the degradation of the environment caused by agricultural waste disposal practices has forced legislatures and the federal government to recognize these problems, and all of the recent legislation directs specific controls toward solving agricultural pollution problems. Most of the legislation has been prepared with the point in mind that control of agricultural sources of pollution must be carried out in a manner that will allow agriculture to continue to produce at a rate that is adequate to avert food shortages. The legislation also insists that adequate controls be provided to protect the environment, or provide an environment acceptable to the public.

Many attempts have been made in the past 10 years to evaluate the effect of the changes in agricultural production procedures on the environment. Many conflicts are apparent when one considers the alternatives that must be evaluated. However, it is essential that the agricultural producer be aware of the consequences of his waste disposal practices when new facilities are constructed. Many of the existing problems caused by agricultural practices could have been prevented if proper land use laws had been prepared many years ago. The construction of many of the feedlots and intensive agricultural activities could have been prohibited from developing in their present locations if proper planning had occurred.
The management of animal wastes would be much simpler if a significant proportion of the contribution were concentrated in large operations so that the wastes could be handled at one location. This is not the case in many sections of the U.S. where small dairy and beef cattle feeding operations are carried out in relatively isolated areas separated by great distances. The majority of these small dairy and beef feedlots are located along small streams and use the stream as a means of disposing of their excess manures. Many of these operations in the past used manure spreading as a means of disposing of a proportion of their manure, but with the advent of inexpensive artificial fertilizers, it is no longer advantageous to dispose of animal manures by spreading them on the ground. Also, as the operation becomes larger it is more difficult to utilize the entire production of manure on the land. This necessitates hauling the manure to other land disposal sites or attempting to sell the material as a soil conditioner. Little success has been achieved in commercial enterprises attempting to dispose of significant quantities of animal manures. All of the difficulties that are involved in disposing of excess manure have contributed significantly to the quantities of manure that eventually reach our watercourses, deplete the oxygen supply, and add excessive quantities of nitrogen and phosphorus which stimulate algal growth.

New recommended regulations developed by the Environmental Protection Agency make an attempt to control the contribution of all types of agricultural wastes. However, only feedlots or dairies with over 1,000 head of stock are placed under the jurisdiction of the EPA. It is a noble gesture on the part of the federal government and some of the state agencies to attempt to control the discharge of manures to our waterways. However, that these agencies will have success in enforcing these regulations is doubtful. The ability to monitor the waste discharges from industrial and municipal sources is limited in the majority of
the United States, and the federal government has little effort and manpower involved in monitoring activities when the entire picture is evaluated. Therefore, it appears that the only effective control that can be implemented will be the reduction of the waste materials that are discharged from concentrated feedlot and poultry raising operations.

These sources produce larger quantities of material that would exhibit a significant effect on the waterways that could easily be detected if the waste were indiscriminately discharged. Pollution resulting from land spreading and eventual runoff would be extremely difficult to identify, and the ability to monitor and control such activities is very limited. If effective control were to be accomplished, a force approximately the size of the production force would be required to insist that pollution or excess nutrients not be discharged to the environment by agricultural activities.

An excellent example of the difficulty that would be encountered in enforcing agricultural practices or agricultural pollution control legislation can be seen in the State of Utah. Here, the majority of the dairy and feedlot operations are relatively small, consisting of less than 50 cows per farm. These installations are located, in the majority of cases, along the shores of the many relatively small streams that emanate from the mountains. There may be 2 to 20 miles between each of these operations, and there are many hundreds located in the state. The manpower that would be required to periodically inspect and ensure that enforcement activities are carried out would be economically prohibitive. The situation in the State of Utah is similar to the problems that would be found in all of the Intermountain area and many other predominately rural areas of the USA.

Similar situations probably exist elsewhere in the United States even where the majority of the animal raising activities are concentrated in massive feedlots. In brief, it appears that the control of nutrients
and pollutants from small agricultural operations will have to rely on the integrity of the individual farmer. And as the majority of the small farms are at best marginal profit making operations, it is doubtful that the regulatory agencies can honestly expect a small farmer to devote a significant proportion of his time to managing water quality control facilities.

Considerable interest is being developed in using agricultural lands as a means of disposing of municipal sewages and sludges. If a significant quantity of sewage and sewage sludges are disposed of on agricultural lands, this will contribute significantly to the amount of material that would be classified as agricultural runoff. In general, this type of wastewater disposal will be subjected to far better control than is normally exercised in agricultural installations. The source of discharge of wastewater that has been used for irrigated agriculture could be classified more or less as a point source, and the contribution to the overall nutrient budget of a particular operation could easily be measured, and, in turn, more easily controlled.

Figure 8 shows the distribution of dairy and feedlot operations in the Bear River Basin. Both dairies and feedlots are located along the streams feeding the Bear River and are evenly distributed in the flatter topographic areas of the basin. With this concentrated activity, it is easily recognized that the impact of these operations on the water quality of Bear River is significant. For example, if each of the 450 dairies and 18 feedlots (Table 4) in the basin contained an average of 100 animals throughout the year, approximately 40,400 pounds of oxygen consuming materials would enter the river each day. This is equivalent to a city of 240,000 people discharging raw sewage into the river. These calculations are based upon an evenly distributed discharge rate which is unlikely to occur. In all probability, the total mass of materials would be discharged in two or three slugs which would cause considerable disruption of the aquatic community. The above example includes only
Figure 8. Dairy and feedlot operations in the Bear River Basin in Utah.
Cattle Operations

- Number of Dairy Operations
- Number of Feedlot Operations
Table 4. Dairy and feedlot operations located in the Bear River Basin (1972).

<table>
<thead>
<tr>
<th>County and City</th>
<th>Number of Operations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cache County</strong></td>
<td></td>
</tr>
<tr>
<td>Lewiston</td>
<td>40</td>
</tr>
<tr>
<td>Cove</td>
<td>13</td>
</tr>
<tr>
<td>Cornish</td>
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</tr>
<tr>
<td>Richmond</td>
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</tr>
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<td>Smithfield</td>
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<td>Hyrum</td>
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<td>Honeyville</td>
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Table 4. Continued.

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<th>Capacity</th>
<th>Yearly Total</th>
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<td>Logan</td>
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<td>100</td>
<td>200</td>
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<td></td>
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<td>500</td>
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<td></td>
<td></td>
<td>500</td>
<td>1000</td>
</tr>
<tr>
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<td>100</td>
<td>200</td>
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<td></td>
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<td>100</td>
<td>200</td>
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<tr>
<td>Rich County</td>
<td></td>
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<td>Pickleville</td>
<td>1</td>
<td>750</td>
<td>1500</td>
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<td>South Eden</td>
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<td>750</td>
<td>1500</td>
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<tr>
<td>Perry</td>
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<td>500</td>
<td>1000</td>
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<tr>
<td>TOTALS</td>
<td>18</td>
<td>4750</td>
<td>9300</td>
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Utah's potential for pollution from animal wastes. Including Idaho's and Wyoming's animal industry would at least increase the contribution of oxygen consuming materials to the Bear River by 50 percent of the above estimate.

If proper plans are made prior to the establishment of livestock operations, the contribution of pollution by runoff can easily be controlled with unsophisticated waste management practices. Diversion or proper diking and collection of rainfall runoff in holding ponds can
solve the majority of the problems that presently exist. The systems must be designed to prevent overflow except under unusual rainfall conditions, and the liquids and solids collected in the ponds should be disposed of by application to pastures and croplands. If properly operated, such a scheme should essentially eliminate the impact of feedlot runoff on the receiving streams in the vicinity of such an operation. It is unlikely that the expense of using conventional waste treatment techniques for feedlot runoff and animal wastes will be employed in the near future. The need for a simple, inexpensive method of control and treatment of animal wastes is urgent for existing facilities that need to be modified to meet new standards.

**Land Use in the Bear River Basin**

There is a close interrelation between patterns of land use and existing or potential water quality problems in a river basin. Land use patterns are a direct reflection of types and levels of human and economic activities which are the sources of pollution. Figure 9 shows the existing patterns of land uses for the Bear River Basin. A wide spectrum of uses is noted, from the mountain and forest lands which constitute the watershed from which most of the Bear River water arises to the populated cities and towns scattered throughout the basin. Table 5 provides a detailed breakdown of land use acreages in the basin. These data were compiled from county maps and statistics. Thus, in aggregating the data for the river basin there is a chance for some error in interpretation. In the table a federal-state land management category is shown to indicate government agencies role in management of basin lands. More importantly, however, is the breakdown of land uses by particular types. The various land uses in the basin represent relationships to or demands upon the water resources system both as various types of uses and activities which draw water from the basin, and as
Figure 9. Land uses in the Bear River Basin in Utah.
BEAR RIVER BASIN

Land Use

- NATIONAL FOREST LANDS
- RANGELANDS
- NON-IRRIGATED CROPLANDS
- IRRIGATED CROPLANDS
- MULTI-USE
- INDUSTRIAL SITES
- SWAMPY GRAZING LAND
- HIGH-USE WATER RECREATION
- WATER ORIENTATED RECREATION LANDS
- SALT FLATS
- RECREATION SITES WITH VAULT-TYPE SEWAGE STORAGE FACILITIES
Table 5. Area devoted to particular land use in the Bear River Basin (1970).

<table>
<thead>
<tr>
<th>Category</th>
<th>Sub-Totals</th>
<th>Total Acres</th>
<th>% of Basin Land Area</th>
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<tr>
<td>Federal-State Land Management</td>
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<tr>
<td>Total Federal</td>
<td>487,926</td>
<td>26.1</td>
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<tr>
<td>National Forests</td>
<td>416,597</td>
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<tr>
<td>Other</td>
<td>71,329</td>
<td></td>
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<tr>
<td>State Parks</td>
<td>802</td>
<td></td>
<td>-</td>
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<tr>
<td>Land Use Types</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Urban/Paved Land(^a)</td>
<td>48,895</td>
<td>2.6</td>
<td></td>
</tr>
<tr>
<td>Total Combined Cropland</td>
<td>650,735</td>
<td>35.9</td>
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</tr>
<tr>
<td>Close row field crops (^b)</td>
<td>(368,820)</td>
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<td></td>
</tr>
<tr>
<td>Irrigated</td>
<td>269,476</td>
<td></td>
<td></td>
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<tr>
<td>Non-irrigated</td>
<td>99,344</td>
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<tr>
<td>Field Cropland (^c)</td>
<td>(281,915)</td>
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<td></td>
</tr>
<tr>
<td>Irrigated</td>
<td>201,265</td>
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<td></td>
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<tr>
<td>Non-irrigated</td>
<td>80,650</td>
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<tr>
<td>Pastureland</td>
<td>151,676</td>
<td>8.1</td>
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<tr>
<td>Rangeland</td>
<td>834,503</td>
<td>44.7</td>
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<tr>
<td>Forested Land</td>
<td>344,082</td>
<td>18.4</td>
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</tr>
<tr>
<td>Water Covered (less than 40 acres)</td>
<td>1,187</td>
<td></td>
<td>-</td>
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<tr>
<td>Total Basin Acreage (^d)</td>
<td>1,867,175</td>
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</tbody>
</table>

\(^a\) Urban/Paved-Urban Development (Built up), paved highways, roads, railroads.

\(^b\) Close row crops--row and close grown crops requiring large amounts of fertilizer, tillage, and water application, i.e., vegetables (corn, peas, beets, etc.). Point: Need of tillage, fertilizer, irrigation causes direct irrigation return flow problem.

\(^c\) Field crops--field crops requiring less fertilizer and less irrigation, i.e., grain crops.

\(^d\) This is not a column total as some lands are included in several categories because of multiple use.
types of activities which generate pollutants that will enter water bodies with impacts upon water quality. The quantity and quality effects on water resources by various land uses is a key consideration in developing a basin water quality management plan.

Although the percentage of urban land in the basin is relatively small (2.6 percent), concentrations of population and economic activity represented by urban areas are associated with a substantial generation of waste by human activity and, usually, discharge back into the streams and rivers, often without significant treatment. Urbanization also results in increases of various forms of pollutants such as litter, organic wastes, oil, bacteria, nutrient, air pollution fallout, salts, and sediments which are carried with runoff to the river. Normally much of the runoff water from storms in a nonurban setting would be contained by the soil and vegetation. Urban land use policies and zoning, as a means for affecting population distributions and densities, become critical local decision factors with respect to the impact of urban areas on basin water quality.

Agricultural land use represents one of the largest land use activities in the basin, accounting for about 36 percent. Agricultural activity is a significant source of water quality problems resulting from pesticides, fertilizer, and dissolved mineral salts in irrigation return flows. Another major problem source in the basin is animal waste from feedlots and dairy operations, many of which are located in the immediate vicinity of the streams.

Pastural and rangeland represent less intensive agricultural land uses interfaced also with wildlife habitat and uses. These land use types figure importantly in the total basin land uses, being in excess of 50 percent. These areas can be large and diffuse sources of pollution which contribute nutrients and sediments to streams, particularly if areas are overgrazed or burned.

All in all, agricultural land use, particularly the use and management of lands adjacent to streams, is a most important consideration in water quality management for the basin.
The final land use category that should be mentioned is forest lands and parks. These lands generally make up the important watershed areas of the basin, and at the same time they are areas of fairly intense recreational use. These recreational activities on watershed lands can also become a source of water quality problems. The control and disposal of human wastes by recreationists and the increase in erodable watershed areas due to off-road recreation vehicles are becoming more serious sources of pollution with the rapid growth in recreation activity.

Municipal and Industrial Uses of Water (Point Sources of Wastes) in the Bear River Basin

Use of water for disposal of wastes, for waste carriage, for cooling waters, etc., is not as great a problem as in other more populated areas of Utah and in the USA. In many cases in the Bear River Basin these uses have no direct effect on the river quality because discharge is into the ground by septic tank and drain fields. For a point source to enter the stream a collection service is necessary even if it is a leaky pipe on the stream edge. Cities and towns which must have waste treatment will need adequate sewage collection in order to treat wastes and thus meet standards.

In cases where discharge does occur, the waste effluent after treatment usually enters the river adjacent to the high population areas shown in Figure 10. This is less true for industrial wastes than for municipal wastes as some industries are located away from the population centers; however, in general it can be concluded that the point sources will be concentrated around population centers. These sources are considered in detail in the following chapter because there is a control program for municipal and industrial pollution sources which is under the aegis of the Environmental Protection Agency.
Figure 10. Population distribution in Utah's Bear River Basin.
BEAR RIVER BASIN

Population and Sewage Disposal Method

- SEPTIC TANK DISPOSAL
- TREATMENT FACILITIES
  - TF = TRICKLING FILTER
  - L = LAGOON

POPULATION

- > 4000
- 1000-4000
- 100-9000
- < 100
CHAPTER III

WATER QUALITY AND POINT SOURCE POLLUTION
IN THE BEAR RIVER SYSTEM

Water Quality Problems

Although the inventory of factors affecting water quality in the Bear River Basin was presented in the previous chapter, no attempt to assess these problems was made. In this chapter a consideration of the relative importance of various pollutants, and in addition an analysis of the point sources of pollution will be made. Point sources are the easiest to control because they provide low volume-high concentration wastes at a single point. Thus, the most economical and feasible pollution control strategy is for the point source. In the Bear River Basin these point sources consist primarily of municipal wastes and some industrial wastes.

Status of Public Water and Sewage Systems

Community sanitation and public health are principally a function of the integrity and adequacy of its water supply and sewage disposal systems. These considerations are of primary concern at the local level of government and many small communities feel that a limited financial base and the inability to achieve the necessary economy of scale precludes affording adequate treatment plants so that minimum public health standards are attained. In most cases, however, the problem is basically one of a misconception of what the public thinks it can afford to pay for such services. This is because the attendant costs of excessive health and medical services are probably sufficient to pay for adequate facilities. State and federal programs providing technical and financial
assistance will hopefully stimulate and assure continuing progress toward achieving necessary levels of service and performance for all communities.

**Public water supply systems**

The status of community water supply systems in the Bear River Basin is summarized in Table 6. Eight of the forty-eight systems tabulated, serving a population of 41,880 out of a total of 69,535, are classified as "approved" by the Utah State Division of Health. Twelve systems serving a population of 2,830 are classified "not approved," and the balance are of intermediate status. Ten of the systems are privately owned, while 38 are publicly operated.

**Public sewerage systems**

Community sewage disposal systems may be broadly categorized as being either individual systems or community-wide systems. Individual systems are usually characterized by the use of septic tanks and subsurface drain fields, resulting in a relatively diffuse discharge of wastewater underground. This may lead to contamination of the groundwater resource as has occurred in other basins, particularly if population in the basin continues to increase. Community-wide systems, on the other hand, imply the collection of the individual discharges in a sewer system and the subsequent point discharge, following treatment, to a receiving water. In the past, community treatment systems in Utah have typically included the use of trickling filters, wastewater lagoons or ponds, and land disposal. In the future, the use of additional treatment technology will be necessary in many instances to meet state and federal water quality standards and objectives. Stream water quality standards, as promulgated by the Utah Water Pollution Committee in conjunction with the National Pollution Discharge Elimination System (NPDES) permit programs, are currently administered jointly by the
<table>
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<th>Community</th>
<th>County</th>
<th>Population (estimated)</th>
<th>Public Water System</th>
<th>Status of Water System</th>
<th>Sewage Collection</th>
<th>Sewage Treatment</th>
<th>Receiving Stream</th>
<th>NPDES Permit Status (where applicable)</th>
</tr>
</thead>
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<tr>
<td>Bothwell</td>
<td>Box Elder</td>
<td>300</td>
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<td>NA</td>
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<td>Subsurface</td>
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<td>Cache</td>
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<td>PA</td>
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<td>Septic tanks</td>
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<tr>
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<td>PA</td>
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<td>PA</td>
<td>Partial</td>
<td>None</td>
<td>Bear River</td>
<td>Permit No. UT-0020214, Expiration Date 10-1-76</td>
</tr>
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<td>Yes</td>
<td>A</td>
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</tr>
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<td>Mendon</td>
<td>Cache</td>
<td>365</td>
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<td>NA</td>
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<td>Subsurface</td>
<td></td>
</tr>
<tr>
<td>Millville</td>
<td>Cache</td>
<td>450</td>
<td>Yes</td>
<td>CP</td>
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<tr>
<td>Newton</td>
<td>Cache</td>
<td>470</td>
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<tr>
<td>Nibley</td>
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<td>180</td>
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<td>North Cove</td>
<td>Cache</td>
<td>50</td>
<td>Private</td>
<td>NA</td>
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<td>North Logan</td>
<td>Cache</td>
<td>1,500</td>
<td>Yes</td>
<td>CP</td>
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<td>Septic tanks</td>
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<td>Cache</td>
<td>420</td>
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<td>NA</td>
<td>No</td>
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<td>Providence</td>
<td>Cache</td>
<td>1,700</td>
<td>Yes</td>
<td>CP</td>
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<tr>
<td>Richmond</td>
<td>Cache</td>
<td>1,050</td>
<td>Yes</td>
<td>A</td>
<td>Yes</td>
<td>Lagoon</td>
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<td>Permit No. UT-0020907, Expiration Date 7-1-78</td>
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<tr>
<td>River Heights</td>
<td>Cache</td>
<td>1,050</td>
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<td>A</td>
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<tr>
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<tr>
<td>Trenton</td>
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<tr>
<td>Wellsville</td>
<td>Cache</td>
<td>1,300</td>
<td>Yes</td>
<td>CP</td>
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<td>None</td>
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<td>Permit No. UT-0020371, Expiration Date 9-10-78</td>
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<tr>
<td>Garden City</td>
<td>Rich</td>
<td>150</td>
<td>Yes</td>
<td>NA</td>
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<td></td>
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<tr>
<td>Laketown</td>
<td>Rich</td>
<td>240</td>
<td>Yes</td>
<td>PA</td>
<td>No</td>
<td>Septic tanks</td>
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<td></td>
</tr>
<tr>
<td>Pickieville</td>
<td>Rich</td>
<td>110</td>
<td>Yes</td>
<td>NA</td>
<td>No</td>
<td>Septic tanks</td>
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<td></td>
</tr>
<tr>
<td>Randolph</td>
<td>Rich</td>
<td>530</td>
<td>Yes</td>
<td>NA</td>
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<tr>
<td>Woodruff</td>
<td>Rich</td>
<td>180</td>
<td>Yes</td>
<td>NA</td>
<td>No</td>
<td>Septic tanks</td>
<td>Subsurface</td>
<td></td>
</tr>
</tbody>
</table>

*a Classified by Utah State Division of Health: A is approved, PA is provisionally approved, NA is not approved, CP is submitted—not acted upon.*
U. S. Environmental Protection Agency and the State of Utah Bureau of Environmental Health. These agencies will dictate specific treatment requirements and the associated timetables for compliance in order to meet stream water quality standards.

As presented in Table 6, of the 48 communities in the Bear River Basin having a formal water supply system, only 10 communities, serving a population of approximately 46,500, have public sewage collection systems. These sewered communities automatically become subject to regulation under the National Pollutant Discharge Elimination System. The status of unsewered communities may require changes in current disposal systems as water quality management plans are instituted.

**Status of industrial wastewater discharges:**

**Bear River Basin**

Table 7 presents a summary of industries within the Bear River Basin that generate wastewater discharges not accommodated by community collection and disposal systems. These data were obtained from a 1973 Inventory of Industrial Wastewater Facilities in Utah, compiled by the Utah State Division of Health and currently some differences may exist.

Industries generating point discharges of wastewaters are subject to regulation under the National Pollutant Discharge Elimination System. Almost all of the industries noted are involved with food packing and are high in BOD. Control of these wastes will remove a significant effect on the Bear River dissolved oxygen levels. Current plans for industrial development indicate that additional industries will be the non-polluting type and so industrial pollution in Utah's Bear River Basin may never achieve the level of importance that it has in other basins.

<table>
<thead>
<tr>
<th>Industry</th>
<th>Location</th>
<th>Type of Industry</th>
<th>Existing Treatment</th>
<th>Receiving Stream</th>
<th>NPDES Permit Status (where applicable)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A &amp; A Packing Co.</td>
<td>Brigham City</td>
<td>Meat packing</td>
<td>Septic tank</td>
<td>Subsurface</td>
<td>Permit No. UT-0000264, Expiration Date 9-30-78</td>
</tr>
<tr>
<td>Cache Valley Dairy Assoc.</td>
<td>Amalga</td>
<td>Cheese</td>
<td>Lagoon</td>
<td>Non-overflow</td>
<td>Permit No. UT-0000337, Expiration Date 7-1-78</td>
</tr>
<tr>
<td>Checketts Fur Farm</td>
<td>Perry</td>
<td>Animal by-products</td>
<td>Septic tank</td>
<td>Subsurface</td>
<td>Permit No. UT-0000032, Expiration Date 9-30-76</td>
</tr>
<tr>
<td>CUI International</td>
<td>Garland</td>
<td>Animal by-products</td>
<td>Septic tank</td>
<td>Subsurface</td>
<td>Permit No. UT-0000469, Expiration Date 12-31-75</td>
</tr>
<tr>
<td>Del Monte Corp.</td>
<td>Smithfield</td>
<td>Canning</td>
<td>Irrigation</td>
<td>Non-overflow</td>
<td>Permit No. UT-0000281, Expiration Date 9-30-75</td>
</tr>
<tr>
<td>Gossner Cheese Co.</td>
<td>Logan</td>
<td>Cheese</td>
<td>Lagoon-irrigation</td>
<td>Non-overflow</td>
<td>Permit No. UT-00002168, Expiration Date Not issued</td>
</tr>
<tr>
<td>Hi-land Dairyman's Assoc.</td>
<td>Richmond</td>
<td>Cheese</td>
<td>Aerated lagoons</td>
<td>Robinson Creek</td>
<td>Permit No. UT-0000604, Expiration Date 7-1-75</td>
</tr>
<tr>
<td>Lower Packing Co.</td>
<td>Smithfield</td>
<td>Meat packing</td>
<td>Septic tank</td>
<td>Little Bear River</td>
<td>Permit No. UT-0000264, Expiration Date 9-30-78</td>
</tr>
<tr>
<td>E. A. Miller and Sons</td>
<td>Hyrum</td>
<td>Meat packing</td>
<td>Lagoon-irrigation</td>
<td>Subsurface</td>
<td>Permit No. UT-0000281, Expiration Date 9-30-75</td>
</tr>
<tr>
<td>Parnell Packing Co.</td>
<td>Laketown</td>
<td>Meat packing</td>
<td>Septic tank</td>
<td>Subsurface</td>
<td>Permit No. UT-0000264, Expiration Date 9-30-78</td>
</tr>
<tr>
<td>Thiokol Chemical Corp.</td>
<td>Box Elder Co.</td>
<td>Meat packing</td>
<td>Extended aeration</td>
<td>Blue Spring Creek</td>
<td>Permit No. UT-00002168, Expiration Date Not issued</td>
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<tr>
<td>Tri-Miller Packing Co.</td>
<td>Hyrum</td>
<td>Meat packing</td>
<td>Lagoon</td>
<td>Non-overflow</td>
<td>Permit No. UT-0000604, Expiration Date 7-1-75</td>
</tr>
<tr>
<td>Utah-Idaho Sugar Co.</td>
<td>Garland</td>
<td>Sugar refining</td>
<td>Lagoon</td>
<td>Malad River</td>
<td>Permit No. UT-0000604, Expiration Date 7-1-75</td>
</tr>
<tr>
<td>Valley Rendering Corp.</td>
<td>Hyrum</td>
<td>Animal by-products</td>
<td>Lagoon</td>
<td>Non-overflow</td>
<td>Permit No. UT-0000604, Expiration Date 7-1-75</td>
</tr>
<tr>
<td>White's Trout Farm</td>
<td>Paradise</td>
<td>Trout farm</td>
<td>None</td>
<td>Little Bear River</td>
<td>Permit No. UT-0000540, Expiration Date 6-30-75</td>
</tr>
</tbody>
</table>
Current Pollution Problems in the Bear River Basin

Control of pollutant sources

Control of point source pollution is being instituted in the basin; however, obvious improvement in water quality in the river may not occur. When pollution develops from many varied activities as in the Bear River, it becomes necessary to control many sources of pollution before an effect can be observed. Point source control is necessary for better water quality in the basin but it will probably be inadequate by itself to control some of the serious pollution problems affecting many of the competitive but beneficial uses of water desired by the people of Utah.

The major water quality problems are \( \text{BOD}_5 \), coliform bacteria, nutrients, and salinity. Control of the municipal and industrial wastes will reduce the concentration of \( \text{BOD} \) and coliforms in the streams. This will better the quality of basin waters resulting in higher dissolved oxygen levels and lower levels of possible disease causing bacteria. Nutrient and salinity problems will be relatively unaffected by control of the municipal and industrial wastes.

In addition it will be necessary to control the possible toxicity resulting from the addition of toxic, chlorinated wastewaters. To reduce coliforms in wastewaters it has been common practice to chlorinate waste effluents. Many studies have shown that these chlorinated effluents have some residual toxicity. It may be necessary to remove this toxicity by dechlorinating the effluent after the bacteria have been killed or to achieve effluent disinfection by some other means.

Control of nutrients and salinity will require treatment and controls for specific sources (e.g., wastes or specific mineral springs) and changes in land management practices so that input of nutrients and salinity are minimized in runoff waters.
A last but very important area of concern is the dairy and feedlot industry. Disposal of wastes from small dairies and feedlots has commonly been achieved by dumping of manures into rivers and canals (eventually entering the rivers). This adds considerable BOD and nutrients to the river system and may need to be controlled to achieve stream quality standards. Management strategies exist for handling manures and other wastes which can economically minimize the effects of animal wastes on the river systems.

**Current water quality in the Bear River Basin**

The Bear River has been studied in detail in past years and these data have been placed in computer storage banks according to the STORET program of the Environmental Protection Agency. Because many of these older samples were not analyzed completely, analytical methods have improved, and the river and its uses have changed considerably, a sampling program was instituted for this study. The results of the first sampling run performed in October, 1973, are shown in Figure 11.

These results show that although dissolved oxygen is relatively constant throughout the basin except in the Malad River, there is a general degradation of river quality moving downstream from the headwaters to the Great Salt Lake. Dissolved oxygen remains high because of the low water temperatures in October which increases oxygen solubility and decreases microbial activity. Coliforms are a significant indicator of sewage pollution of the river. This is most obvious for the Malad River where high salinity from influent mineral springs and sewage effluents combined with low stream flow lead to low dissolved oxygen and high coliform, BOD, and salinity. The salinity in the Malad attains levels of 2000 ppm.
Figure 11. Decrease in downstream water quality in the Bear River, October 1973.
Prior to the achievement of the discharge levels described in the permit program (Tables 4 and 5), sewage discharges will be the most important problems. These cause BOD and resultant dissolved oxygen problems and high disease transmission potential (coliforms) even though the Bear River generally is not used for drinking water. The problem of nutrients causing eutrophication (high plant growth or algal blooms) is of importance to the development of the Bear River as a recreational system. Salinity is an important economic factor in agricultural uses, especially in the Malad River and downstream of the Malad confluence in the Bear River. High salinity interferes with possible irrigation usage for certain crop types in this area.

After control of point sources (municipal and industrial wastes) through the permit system, the nutrient and salinity problems will still be as great and they will be the most significant. Feedlot effects on these problems and the dissolved oxygen problem will be significant. Salinity control through isolation of mineral springs and agricultural management practices will be necessary to achieve good stream quality and increase the beneficial uses of the Bear River.
CHAPTER IV
FORMULATING AND IMPLEMENTING A WATER QUALITY MANAGEMENT PLAN FOR THE BEAR RIVER BASIN

Why a Water Quality Management Plan?

The preceding chapters have identified a number of areas of water quality problems in the Bear River basin. The river basin water quality management plan for the Bear River is the key to successfully attaining the objective to "restore and maintain the chemical, physical, and biological integrity of the nation's waters" set forth by the Federal Water Pollution Control Act Amendments of 1972. To accomplish this objective the Act establishes a national goal that discharges of pollutants be eliminated by 1985. To do this the new law creates a program based on three major elements: Uniform water quality standards and enforceable regulations, a program of permits to limit the effluents discharged from sources of pollution, and an expanded system of federal grants to plan and construct publicly owned waste treatment plants. Much of the responsibility for implementing these programs falls to the state.

The state must develop water quality standards for all interstate and intrastate surface water, establish maximum daily allowable discharges of pollutants so as to protect public health, the propagation of fish and wildlife, and in addition to administering and enforcing the permit program, it must also review applications for federal grants to municipalities for sewage treatment plants. All of these state responsibilities require a detailed knowledge of conditions in the basin,
including water quantity and quality, wastewater discharges from factories, municipalities and agricultural operations, and future changes in population, economy and land use in the region. To put all of these complex elements into their proper relation and perspective necessitates the preparation of a carefully worked out plan for managing the water quality of the basin.

Recognizing this important need for planning, the Federal Water Pollution Control Act Amendments designates that the state should institute a continuing planning process aimed at developing a program to attack water pollution where it is most serious, providing means to assemble and use data on water quality as a basis for issuing permits, and setting priorities for state manpower and funding. The river basin water quality management planning is the major tool for meeting these tasks in achieving desired levels of water quality.

**What is a Water Quality Management Plan?**

**What will it accomplish?**

The primary functional unit for planning to gather water quality data and to manage pollution abatement facilities and programs is the river basin. The plan for the Bear River basin will provide for orderly water quality management by:

- Examining and evaluating options—organizing information, analyzing alternatives, and selecting a cost effective plan.

- Determining priorities—assessing water quality and abatement problems and needs throughout the basin and establishing priorities, which will be the basis for awarding grant assistance, processing permits and taking other needed steps to achieve water quality goals.

- Scheduling action—setting forth compliance schedules or target abatement dates and indicating necessary state and local activities such as timely permit processing and construction grant awards.
Coordinating planning—establishing goals and identifying needs and priorities for other planning activities, i.e., local treatment facility decision plans and areawide plans for localities of high population density.

What will it contain?

The purpose of the plan, then, is to coordinate and direct the state's water quality decisions. The plan is not a broad water and related land resources plan. It is a document that identifies the basin's water quality problems including:

- Detailed and major descriptions of each body of water in the basin.
- Identification and analysis of all pollutant sources.
- A ranking of each segment of water in order of priority for improvement.
- An analysis of measures to be taken to improve or maintain water quality including effluent limitations or other controls.
- A setting of priorities for municipal facilities planning and construction grants, and for industrial permit processing.
- Establishment of timetables for state actions.

How will it be used?

In terms of scope and time period, the basin plan is a five-year water quality management plan for the streams, rivers, and tributaries, and the total land and surface water area.

However, basin management planning and actual water quality management in the basin are continuing integrated processes for taking immediate program actions as well as for making long-term program decisions. Of necessity, the initial plan will be based largely on existing and readily acquired new data and will derive its courses of action from existing plans and outlines of new alternatives. This initial plan will be periodically reviewed as additional and more current information and knowledge are obtained, initial objectives are accomplished,
other planning is completed and available resources and capabilities increase. The initial plan will be expanded and strengthened over time to produce sounder management decisions and to direct further abatement actions.

How does it relate to other planning decisions?

The water quality management plan for the Bear River basin is closely interrelated with other planning decisions regarding land use and the level of economic and other activities in the basin. Such activities include:

Urbanization--The impact of urban development on water quality and the availability of quality water for urban expansion are both important issues in future land use and community planning decisions. Increased urban development will likely require substantial withdrawals of water of a quality that can be treated for culinary use. On the other hand, the waste generated by human activity will have serious effects on water quality depending on how it is collected, treated, and discharged.

Urban development often increases sediment reaching the river. During storms the water which would have been contained by the soil and vegetation quickly runs off saturated building sites, parking lots, streets, and buildings. The water then enters the stream laden with litter, organic waste, oil, dirt and sand, air pollution fallout particles, bacteria, nutrients, salts, and other potentially harmful chemicals. Septic tank discharges may degrade water quality in some parts of the basin.

The development of the basin water quality management plan will become, then, an important factor in local decisions about where and how much urban development should take place. Specifically, it will address these questions concerning densities, lot sizes, construction
practices and sewage disposal, and finally what kind of burdens will be placed on the community for water supplies and sewage treatment facilities.

**Industrial location**—Planning for new industry or mining activities or expansion of present ones is another important planning decision that will affect the water quality management plan. The types of activities usually represent point sources of pollutant discharges to streams in the basin. Such industrial sources of pollution must obtain a permit under the approved state program before they can allow any effluents to enter streams. Determinations on the issuance of a permit and the levels of treatment required before effluent discharge are determinations that will be made in light of the analyses made within the water quality plan.

**Agriculture**—Agricultural activity is a little-recognized source of water quality problems. However, pesticides, fertilizer and dissolved minerals in irrigation return flows, and animal wastes are all sources of serious pollution in the Bear River. The basin has a considerable dairy and feedlot industry and several examples of streams flowing through barn and milk shed areas can be observed. This results in both organic and bacterial pollution.

Over the years extensive efforts have been made to control agricultural wastes and great advancements have been made in this area. Elements of the water quality plan will lead to implementation of modern farm waste disposal practices in areas where the achievement of standards has not been realized.

**Recreation**—Recreational activities are a source of water quality problems. Outdoor recreation pursuits have created waste and sewage disposal problems due to the annual incursions of campers, hunters, fishermen, hikers, skiers, snowmobilsists, boaters, swimmers, horseback riders, and so on. The area of erodable surface in mountainous
and hilly areas is rapidly increasing as a result of the destruction of vegetative cover by the growing use of off-road vehicles such as motorbikes, jeeps, and all-terrain vehicles. In addition, the development of mountain watersheds for summer cabins and parking of trailers and campers without adequate provisions for runoff control and sanitation, such as in Blacksmith Fork Canyon, are having serious water quality impacts. Again, local planning and control of these uses will be closely tied to water quality considerations in the management plan.

How Will the Planning be Done?

The preservation and enhancement of water quality is the responsibility of federal, state and local agencies. Reflecting the basic responsibility of the state for water pollution abatement, the Federal Water Pollution Control Act Amendments of 1972 directed the state to develop a continuing planning process for water quality management. The "basin plan" or "water quality management plan" is a key feature in coordinating water quality program decisions and achieving statewide water management, and as a prerequisite for future waste treatment grant-in-aid.

State of Utah authority for water quality management is contained in the Utah Water Pollution Control Act, Title 73, Chapter 14, Utah Code Annotated, as amended. The Utah State Legislature has authorized the Bureau of Environmental Health, Division of Health, Utah State Department of Social Services to develop implementation of the federal regulations for basin plans along with additional requirements of the state. The Water Pollution Committee has presently established water quality standards and classified each stream, and the Bureau is proceeding with a permit system. In developing the drainage basin water quality management plans, the Bureau of Environmental Health is employing qualified engineering consultants to devise programs for the development
of water quality management plans for particular basins in the state. The completion of a comprehensive water quality management plan for the basin will be based on the program design presented in this report.

**What are the planning procedures and tasks?**

The development of a basin plan involves a comprehensive effort in collection of water quality information, classification of stream segments, inventorying municipal and industrial waste discharges, assessing basin economic, demographic, and land use trends, and finally using this information to formulate and evaluate alternative management plans. The plans, as such, will guide specific near-term management decisions, such as permit and construction grant processing, and will also identify the basin's longer range planning needs. Thus, the written plan becomes a visible statement illustrating orderly analysis and a coherent program for immediate and continuing action in planning.

The basin plan itself, as a basis for future decisions related to water quality management, needs to be addressed to two major components: (1) The information and plans for the basin as a whole, and (2) specific analyses and plans for individual segments of the rivers in the basin. The specific content of these two major parts of the plan are briefly described in the following planning component tasks.

**Basinwide planning tasks.** For the basin as a whole, the planning includes the following general components (a detailed description of planning tasks is presented in a subsequent section):

1. **Assemble water quality data and standards:**

   Existing current water quality and related water resources data from state or federal permanent monitoring stations or fields surveys, from permit applications or other discharge-related data, or from other sources will be collected and assembled. Also, applicable water quality
standards will be noted. Much of the initial data inventory and collection has been accomplished as described in this report. Additional work in data development will be in terms of refinement and filling gaps.

2. Inventory of existing wastewater discharges:

The inventory of dischargers should identify and locate all significant municipal and industrial discharges causing serious or critical water quality problems in the basin's streams. Information as to the amount, characteristics, and treatment of the effluents from these sources should be described in the plan.

a. Inventory of industrial discharge: Careful identification of industrial dischargers in the basin and ranking in order of abatement priority.

b. Inventory of municipal discharge: Inventory and categorization of municipal dischargers and making of abatement priority. Determination of municipal facilities investment needs in the basin. Significant nonpoint sources will also be included. A description of effluents from minor sources will also be prepared in order to estimate the extent of their combined, total impact on the overall water quality situation.

3. Estimate population, employment and land use information:

a. Existing conditions: Population, employment, and land use in the basin will be estimated as a basis for assessing existing patterns of the generation of pollutants and as a basis for projecting the amounts and spatial distribution of future waste loads. Population data are available from the Bureau of Census; employment data are available from the Bureau of Labor Statistics (U.S. Department of Commerce). Land use data should be obtained from official planning agencies within the basin.

b. Alternative future conditions: To develop plans for management of water quality, a forecasting of future population, industries and employment, and land use information is needed. Rather than simply using an extrapolation of past trends, which are subject to the danger that the future cannot be relied on to follow past trends, a number of alternative futures will be detailed. Alternative futures describe a range of plausible future states of population, employment, and land use against which to develop an adequate plan for the management of water quality.
Using these futures and the best available estimates of waste load generation per unit of activity, projections of the incremental impact of a five-year growth in waste loads from residential, commercial, industrial, and nonpoint sources will be made. To assure that the plan is consistent with longer range development as well as providing for water quality management during the immediate five-year planning period, these projections will cover the next 20 years in five-year increments.

4. Other planning elements:

a. Discharge permits planning: Preparation of a list of target dates for processing permits for sources which have not been processed when the plan is completed.

b. Nonpoint or diffuse sources of pollution: Strategies for controlling pollution not specifically identifiable such as discharges from a pipe, ditch, channel, or conduits.

c. Land use and other plans: Identify water resources, water quality and other resource plans which are under way within the basin as related to the basin water quality management plan.

Segment planning tasks. To provide detailed planning necessary for management decisions, specific plans will be prepared for "segments" of the basin. A basin segment refers to a portion of the basin where the surface waters have common hydrologic characteristics or regulated flows, common natural, physical, chemical, or biological properties, or which have common reactions to external stress such as discharge of pollutants.

The information in segment plans will be particularly useful in enabling public interests and local government officials to review and to guide ongoing water quality management.

1. Assemble or disaggregate basin water quality, social, and economic data by segments.

For each river basin segment delineated by the criteria just defined, basic water quality and water resources data, as well as
population, industrial and employment, and land use data need to be assembled or disaggregated from basin data.

2. Reevaluation and refining of segment classifications:

   The initial classification of stream segments submitted to the Environmental Protection Agency by the State Division of Health will be reviewed and refined. Each segment will either be classified a "water quality" (WQ) or "effluent limitation" (EL) according to the following descriptions:

   a. **Water quality class**: Any segment where it is known that water quality does not meet applicable water quality standards and which is not expected to meet water quality standards even after the application of the effluent limitations required by the Water Pollution Control Act Amendments. WQ segments may be further classified as follows:

      Data Type I: Segments for which data are sufficient to execute load allocations without additional monitoring.

      Data Type II: Segments for which additional monitoring is needed to acquire sufficient data to classify the segment with certainty or to execute waste load allocations.

   b. **Effluent limitation class**: Any segment where water quality is meeting and will continue to meet applicable water quality standards or where there is adequate demonstration that water quality will meet applicable water quality standards after the application of the effluent limitations.

   Each segment will be analyzed and plans developed considering the discharger inventory, water quality data, alternative future growth trends and predictions of waste loads.

**Plan synthesis and evaluation tasks**

   The alternative approaches for water quality management for the individual stream segments will be synthesized into alternative plans for the basin and integrated with plans for the basin as a whole. Evaluation of the alternative water quality management systems will be made in terms of costs and effectiveness in meeting quality standards, as well as other economic, ecologic, and social effects. A preferred plan will be recommended. The plan itself will contain the following elements:

   1. The water quality management system for the basin and stream segments.
2. A facilities construction plan.
4. A program for implementation including timing and financial alternatives.
5. Procedures for continuous planning updating.

How Can Citizens Participate in the Planning Process?

In passing the new Water Pollution Control Act of 1972, Congress specifically provided mechanisms by which interested citizens could be involved in the Act's major programs. The U.S. Environmental Protection Agency (EPA), the states and local agencies are now required to provide for public participation in the "development, revision, and enforcement of regulations, standards, plans and programs."

In issuing guidelines to insure that public involvement is provided for by state and local authorities, EPA called for:

(a) Public meetings, information, and educational programs on water quality.
(b) Transmittal to citizens of timely and accurate information on significant agency decisions.
(c) Publication of a summary report on public participation in connection with promulgation of regulations, standards, and effluent limitations; the submission of planning recommendations.
(d) Required public hearing at specific junctures in the administration of the total program. In many instances, public hearings are made mandatory prior to important agency decision making.

While the four points establish something of a minimum program for public involvement, the regulations strongly emphasize the need for public participation in the early stages of planning and continuously through the planning process. They state that:

"Conferring with the public after an agency decision has been made will not meet the requirements" for obtaining citizens' views.

In the water quality management undertaken in the Bear River Basin the state and its consultants intend to actively promote substantive participation of local elected officials, community leaders, and citizens in the planning, rather than merely asking for an after-the-fact review and approval.
What is the purpose of local participation in planning?

Since the individual basin plan is the central decision-making mechanism for all water quality programs, citizen participation in these studies is essential. Citizen participation in the preparation of a water quality management plan for the Bear River basin would serve the following specific purposes:

1. To coordinate the water resource planning activities of the Division of Health and Division of Water Resources, and to solicit assistance in this planning effort from all local officials, public interest groups, and citizens.
2. To inform, and involve to the extent possible, citizens and elected officials in the basin in water quality management planning in order to obtain their views.
3. To provide local decision makers with management plans and information which will allow them to make decisions in the context of their impact on the water quality and environment of the basin.
4. To establish a common information and planning base for elected officials in the basin in order to provide cooperation and coordination in water quality management decisions.
5. To develop, at the state and local level in the basin, the capability to implement water quality management plans.
6. To implement the preferred program for water quality management, recognizing regional priorities within the basin.

What can the public contribute to planning?

"A Citizens Guide to Clean Water," a booklet published by the Environmental Protection Agency, states that the river basin water quality management plan "offers perhaps the most significant avenues for substantive public input into governmental decision making at the ground
level. " Some of the important planning areas where the contributions of local government officials, civic leaders, and private citizens are needed are:

1. Goals and objectives. Setting community goals and objectives for desired use of water and the water and related land environment--streams, lakes, reservoirs, marshes, and so on. This will have important bearing on the water quality levels that need to be maintained in order to protect these water uses and environments, and the health, safety, and welfare of the citizens that utilize them.

2. Alternative futures. Assisting in describing alternative futures for the basin, including population size and distribution, levels of economic and industrial activity, patterns of land use, life styles, recreation leisure time, and other social and economic factors. The factors described in various future conditions will affect the future pollution loadings on streams in the basin, and thus the kinds of basin management plans that will need to be implemented 5, 10, and 20 years in the future.

3. Priority problems. As an effective management tool a plan outlines the sequence or order in which problems should be dealt with and solved. Trying to solve all problems simultaneously spreads money and trained technical personnel too thin to be effective. Therefore, priority problems--those that are most seriously affecting citizens of communities--must be identified and then treated in a logical and efficient manner. The public's input and viewpoint as to the critical water quality problem areas are essential to making these planning determinations.

4. Information on related plans. Water quality management must be responsive to and compatible with other ongoing planning in the basin. This kind of coordination can be assured through local officials and
citizens' active participation in providing information on related community land use, zoning and master plans, transportation plans, potential industrial growth, and recreation developments.

5. **Preferences in selecting plans.** A number of alternative approaches to basin water quality management will be considered in the course of the planning study. The adoption of the plan which will best serve the basin needs in meeting stream quality standards and effluent discharge limitations requires an expression of public values and preferences. Public understanding of the alternatives and open discussion of their merits and demerits will aid in this process.

**What means are provided for public participation?**

The basin planning agencies are required by federal regulation implementing the Water Pollution Control Act to "encourage public participation at the earliest stages of the planning process." In order to assure that public participation is encouraged throughout the planning process and to insure that pertinent and timely information is provided to interested citizens, a number of means for planner-agency-citizen interaction will be employed during the study. Public involvement in the planning process must consist of two-way communication and not just a public information effort. Public input will be carefully considered in development of basin plans.

**Citizens committee.** A citizens committee will be established to promote and insure that a high degree of continuous public participation will be maintained throughout the basin study. In particular, the committee will be charged with three major functions:

- To provide fact supported suggestions or comments on various problems and issues that arise in the course of the planning study.
- To act as a sounding board to reflect community and subregional preferences in regard to problems, issues, and planning alternatives.
To act as a catalyst for obtaining broad-based participation of various public interests in segments of the basin through assistance in organizing public meetings, workshops, and forums, and advising on the needs and content of public information programs.

**Technical coordinating committee.** This committee, made up of elected officials and selected members of their staffs (e.g., planners, health officers, and engineers), and representatives from appropriate federal and state agencies, would represent local and regional government agencies in the basin. The function of the committee would be coordination of local plans with the basin program and organizing of task forces to deal with specific technical problems. The committee would be advisory to the project management. Following are some of the agencies which should be considered as participants:

- Cache, Rich, and Box Elder County commissions and planners
- Representatives of municipalities in the counties
- Representatives of other government agencies


State: State Engineer, Parks and Recreation, and Wildlife Resources

State Division of Health and EPA (ex offico)

Public meetings, forums, and workshops. Public meetings, forums, seminars, and workshops can serve as a highly effective means of achieving good two-way communication and exchange of information. In contrast to a public hearing, these types of meetings are characterized by their informal format and opportunity for open discussion. These informational and work-oriented meetings can be organized along the following lines depending on the purpose:

- Information seminars: Quality citizen participation in planning depends on getting and understanding information. Informational meetings and seminars provide a simple and direct way of keeping interested citizens up to date on the study and in providing information and data on specific technical questions, problems, and issues.
Community forums: Organized meetings of interested organizations such as service clubs, conservation groups, farmers organizations, water user associations, Chambers of Commerce, and others provide an excellent forum for discussion of various aspects of the water quality management plan that are appropriate.

Workshops: Workshops of interested citizens, representatives of public interests groups, and local officials are characterized by their orientation toward problem solving. Workshops may be organized for open participation of any interested citizen or may focus on particular technical issues and problem areas of interest to only specialized groups or geographical areas. The structure of the workshops will be task directed concentrating on the general content areas suggested under the section on "What can the public contribute?"

Public information programs. Public information programs are comprised of materials to be disseminated by the media (newspapers, radio, and TV) and materials directly for use of individuals and groups.

- Media information will consist of newspaper releases on the progress and findings of the study, as well as spots on radio and local TV outlets. These sources will also be used to announce public meetings of various types.

- Special materials for providing information directly to interested citizens will also be produced. These will include such items as summary fact sheets, informational pamphlets, brochures, and workbooks for obtaining reactions to problems and management plans, and direct correspondence on letters and inquiries.

Public hearing. A public hearing is required before the basin plan is approved. The public hearing is a formal meeting for documenting the comments and views of citizens on the proposed basin management plan. A record or transcript of the hearing is kept which includes both oral and written statements. The hearing on the planning recommendations will be conducted at the conclusion of the study prior to approval of the final plan.
CHAPTER V

PROGRAM DESIGN

Planning Strategy and Planning Tasks

The planning strategy detailed in this section describes the relationship and sequence of the specific tasks required to complete the comprehensive water quality management plan for the Bear River Basin required by Section 303 (E) of the Water Pollution Control Act Amendments of 1972. The contents of this report describe the basic information and data which can serve as a beginning point for more detailed planning. The planning strategy described in this section represents a logical process for refining this information, collecting additional data, and carrying through the planning and analysis needed to produce a comprehensive plan. Once the planning process is completed and a plan selected the preparation of a program for implementation should also be prepared.

The relationship of the major planning tasks is diagrammed in Figure 12. For those interested in detailed descriptions, the work elements within these tasks are described in the following sections. Some of the work of collecting, refining, and analyzing data (described in study task 300) is currently underway at the Utah Water Research Laboratory as a beginning for further detailed planning.

A detailed description of the study tasks to develop alternatives and select a preferred plan follows.

100 - Study team and task organization;
    budget programming

To begin the study, team organization and budget programming is required to effectively and efficiently acquire and manage funds,
Figure 12. Relationship of major study tasks in developing the basin water quality management plan.
costs, and task accomplishment for the purpose of completing the water quality management planning program within the limits of the resources (time and money) allocated.

110 - Study team and task management

Continuous management for all phases of the plan development, and periodic review of the study progress is expected in order to insure that due consideration has been given to all aspects of the problem. A project manager is expected to coordinate the work of the study team with the work of federal, state, and local agencies. The Bureau of Environmental Health will establish a technical coordination committee for resolving technical problems arising during the study.

The task management function is to organize the following elements for effective scheduling and control of work.

- Scheduling
- Task assignment
- Reporting, control, and status display
- Integration
- Documentation

The project manager will be responsible for exercising task management as defined above.

120 - Budget programming

Time and materials expended and other expenses must be accounted for and a monthly statement prepared showing contract items executed and payment claimed. All records must be maintained for at least five years from the completion of the project or until audit by the State of Utah, and records must be maintained so they can be readily reviewed.
200 - Set up data management systems

This major task is to design and implement a data system that will have the capability of storing and retrieving the large amounts of data required in developing the water quality management plan. These data will be used to describe the study area as it now exists, as a basis for forecasting changes in the area's features, and to describe the impacts of these forecast changes.

210 - Data types and system characteristics

Through coordination with the Utah State Bureau of Environmental Health, establish characteristics which are compatible with the State Data Retrieval System for the collection, processing, and storage of data. The following itemizes some of the desirable characteristics the system should have:

1. Should be capable of storing and retrieving large amounts of the following type data accurately and economically:
   a. Natural geography descriptions
   b. Environmental descriptions
   c. Demography descriptions
   d. Land use descriptions
   e. Economy descriptions
   f. Public works facility descriptions

2. Should provide a basis for forecast changes under various alternative futures within specified boundaries.

3. Should have the flexibility required to accept random boundary descriptions (including points and lines), such as various district, census tract, or subdrainage basin boundaries.

220 - Data system design

The data system design should be responsive to the characteristics specified, and at the same time provide for efficient and flexible data manipulation that can be adapted to future needs. Given the wide range of data to be managed, it is expected that some combination of
computerized and manual systems will prove most effective, the system mix depending on types of data and uses to be made of it.

230 - System implementation and operation

The data system will be placed in service through integrating the various components needed for handling data types and operating and testing storage and retrieval systems.

300 - Data base: Data collection, information gathering and stream sampling

This task aims at completing the necessary data base, which incorporates the wide range of physiographic, socio-economic, water resources, water quality, environmental and institutional data necessary for a basin description, problem analysis, and formulation of alternative plans. The data base will be developed to include the following elements:

310 - Physiographic data

The basin geography, geology, and geophysical characteristics must be examined in order to obtain an understanding of the basin construction. In defining the physical geography of the study area, the following data are relevant:

1. Location and limits of the study area
2. Major watersheds and hydrographic features
3. Geology, soils, and topography
4. Climatology

320 - Socio-economic data

Important aspects of the present and future water quality conditions in the basin are related to social and economic factors. The data to be developed in these areas includes:
321 - Demographic data

Determine current population levels, distribution, and characteristics for the basin. The smallest geographic units utilized will be census tracts subject to any constraints due to the data system. Source of information is the 1970 Census, updated with the State of Utah Planning Office population projections. Boundaries of the areas considered in these projections will be adjusted to coincide with the basin boundaries.

322 - Economic data

The economic data will establish the type, status, and trends of the existing economy of the basin. Those elements of the basin which contribute to its general economy at present will be reviewed and data collected on the following sectors as applicable:

1. Agricultural
2. Industrial
3. Recreational facilities and use
4. Government operations
5. Trade and commerce
6. Utilities (gas and electric)

330 - Water resources system data

The characteristics of all water resources in the study area must be described and data collected and stored in the data system.

331 - Hydrologic data

The quality of the water has a direct relationship to the amount of water. The minimum amount of water flowing in the streams must be determined with the related quality to form the basis for determining water quality problems. To do this for all rivers and streams in the study area, the hydrology for the low-flow year of record and for the statistical low flows occurring once in 10 years, 20 years, and 50 years respectively for durations of one month and one day will be determined as a basis for predicting the effect of existing and forecast waste discharges on water quality. For lakes and reservoirs, investigate and discuss the physical factors affecting their waste assimilative capacity and risk of eutrophication.
332 - Water uses and allocations

Present uses for each watercourse, including such things as domestic and culinary, recreational, industrial, waste assimilation, and agricultural will be determined. For each of these uses, measure or estimate the quantity of water used, seasonal or monthly variation of use, and quality constraints, if any.

340 - Water quality

This task will define and document present water quality and sources of waste which affect water quality and their corresponding method or system of collection, treatment, and disposal. Store collected data in the data system.

341 - Water quality monitoring stations and water sampling

To orient the water quality with the geography, location of sampling stations including those deemed necessary for the consultants' programs, as well as the Bureau of Environmental Health's, and those of the U.S. Geological Survey will be plotted. Using this base map, data on the different qualities of water which occur in the streams can be developed.

Where streams in the basin do not have sufficient existing data on water quality, a sampling program will be initiated to determine qualities associated with seasonal extremes of the water cycle. Some of this sampling has already been completed by UWRL under this project and is documented in this report.

342 - Municipal and industrial waste sources

Data on all existing municipal and industrial wastewater sources including the industrial sources whose waste is collected in municipal systems will be collected. Sources will be analyzed for the following characteristics:
1. Waste characteristics
   a. Dissolved oxygen concentration
   b. Temperature
   c. Biological oxygen demand (BOD)
   d. Coliform concentration
      1. Total
      2. Fecal
   e. Nutrient type(s) and concentration
   f. Heavy metal type(s) and concentration
   g. Type and concentration of any other cations and anions present

2. Quantity
3. Location of discharge to receiving water

343 - Municipal wastewater collection and treatment systems

Municipal wastewater collection and treatment systems within the basin or contributing to basin waters will be inventoried. Known and recorded sources of municipal discharge inventoried under this project are tabulated in this report. Additional information in the following areas should also be gathered:

1. Sewerage agencies. Provide a description of the municipalities actively providing sewer service within the study area. This will include a delineation of their boundaries, the location and extent of the existing sewerage system and service area, existing planning and the extent to which it has been implemented, and the requirements of the regulatory agencies which are applicable within the study area.

2. Sewer system description. For each of the municipal corporations identified, conduct an inventory to define the existing systems, including their size, type, physical condition and hydraulic capacity for both the sanitary system and for the combined system, if any. Lateral sewers will not be included. Tabulations should be made of gaging and infiltration tests, if any. A description of overflows should be given including a history of overflow frequency and an estimate of overflow quantity. The
inventory will utilize available information from the sewerage operating agencies; this task will not include field investigation.

Provide maps of present system showing:

a. Trunk, interceptor, and outfall sanitary sewers
b. Principal combined sewers
c. Overflows or bypasses for sanitary sewers
d. Sewage pump stations
e. Service areas for major sewers and individual treatment facilities
f. Drainage areas tributary to trunk and interceptor sewers

3. Storm drainage. Conduct an inventory of major storm drainage facilities within the study area. Prepare a map showing the boundaries of municipal corporations and their storm drainage service areas. Indicate type, size, physical conditions, and capacity for existing major storm drains in the study area. The map should indicate the natural stream or channel into which each system discharges and applicable water quality standards or water use by reach.

4. Treatment facilities description. Describe existing municipal and community waste treatment systems. Discuss location, degree and type of treatment, population served, design capacity, existing actual capacity, efficiency of treatment, and reliability. Include pertinent reports on operation and maintenance. Locate facilities on a map of the study area.

5. Summary classification. Based on the information developed above, prepare a summary classification of all waste collection, treatment, and disposal systems in the study area. The classification shall be prepared as follows:

a. Sewer systems
   1. Storm drainage systems
   2. Sanitary sewer systems
   3. Combined municipal-industrial systems
   4. Combined storm-sanitary sewer system, if any

b. Treatment facilities and effluent disposal
   1. Municipal treatment
   2. Industrial treatment
   3. Combined municipal and industrial treatment
344 - Nonpoint waste sources

Where nonpoint pollution sources exist, the type and intensity of the waste which enters the streams of the basin from these sources needs to be identified. Such sources as those listed below, which do not discharge into municipal collection systems and are not municipally treated, will be investigated:

1. Urban wastes, including storm runoff, drainage or leachate from solid waste disposal and individual sanitary discharges
2. Industrial wastes
3. Thermal power and cooling water discharges
4. Agricultural wastewater, including irrigation return flow and animal feedlot wastes
5. Mining wastes
6. Spills of any foreign substance
7. Recreation wastes
8. Dredging and dredging spoils
9. Hazardous wastes

A summary of miscellaneous and nonpoint waste sources should be included in the documentation to provide the following information:

1. Waste characteristics
   a. Dissolved oxygen concentration
   b. Temperature
   c. Biological oxygen demand (BOD)
   d. Coliform concentration
      1. Total
      2. Feca
   e. Nutrient type(s) and concentration
   f. Heavy metal type(s) and concentration
   g. Type and concentration of any other cations and anions present

2. Quantity
3. Method of collection, if any
4. Type of treatment, if any
5. Disposal method and locations, for controlled sources
6. Location of waste sources and water bodies which may be affected

350 - Environmental data

Inventories and descriptions of environmental aspects of the basin that will be affected by water quality must also be described.
Three primary areas of investigation are envisioned:

351 - Aquatic ecology

Two elements require analysis
1. Description of the major aquatic ecological zones
2. Inventory of "valued" aquatic organisms

352 - Terrestrial ecosystems contiguous to water bodies

Areas of analysis and data description here include:
1. Terrestrial ecosystems that closely are linked with the water courses
2. Identification of valued species that might be affected

353 - Aesthetics

The aesthetics of the surface waters and related shorelines will be documented by photograph and written descriptions. Aesthetic characteristics to be considered include:
1. Odors
2. Floating materials (other than natural origin)
3. Flow characteristics
   a. Free flowing
   b. Controlled
4. Visual characteristics
   a. Shoreline
   b. Water
   c. Bank vegetation
   d. Composite effect

360 - Institution information and data

Institution information with regard to political jurisdictions and authorities and land use patterns and zoning will affect waste discharges, and the development of management plans and their implementation. Information to be gathered includes:
361 - Political jurisdictions and their authorities as they affect water quality management

Information will be gathered on
1. Municipalities and counties
2. Irrigation and soil conservation districts
3. Forest and land management units
4. And so on

362 - Land use

The land use plans created by the counties and towns in the basin, which are important indications of the peoples' desires will be obtained. Once the land use programs of the various agencies have been obtained, the information shall be listed and plotted on a map where conflicts can be observed. Primary factors which will affect changes in land use will also be described.

400 - Basin system description

The purpose of this major task is to determine the conditions within which the water quality management system must function. These conditions result from land use patterns, life styles, and the various activities engaged in by the inhabitants of the river basin as well as the characteristics of the natural resources--land, water, and air. A basin description will be formulated from interpretation of the data collected in order to define baseline conditions. These baseline descriptions will aid in the development of forecasts of future waste production.

500 - Alternative futures descriptions

The planner has the ongoing responsibility of identifying the events and decisions that are having or might have serious and extensive impacts in the basin. These events and decisions might occur within the region, or they might occur outside the region as external influences.
Alternative futures will be used to describe a range of plausible future states affecting the natural and human environment against which water quality management plans for the region can be formulated. These descriptions of possible sets of future conditions should offer insight into likely levels or magnitudes of "demand" for activities that will affect water quality. Since shifts in demand are expected in response to such factors as changes in income, population, and leisure time, alternative descriptions of possible future levels of various demand determinants are essential when estimating the probable total magnitudes of change. The procedure will draw upon "futures concept" of the Utah Process. The previous futures work of the Utah Process will be analyzed and reviewed with the Planning Coordinator's Office. Various desired or possible futures will be developed for review by the Technical Coordinating Committee for the years 1980, 1990, and 2000.

510 - Economic and demographic futures

Probable population levels, and characteristics for the basin as a whole, will be developed based on the alternative futures described for the basin. Economic factors will be determined utilizing the same process.

520 - Physiographic futures

This task will deal with the future changes in the physical characteristics, in agricultural practices, and in range management. An example of such changes would be the leaching of salt from the soil from irrigation practices.

530 - Land use and distribution of activities

Expected land use patterns for alternative futures will be determined. This will include:
1. Review existing land use plans

2. Study the suitability of the land of the basin for various uses, considering impacts on water quality as one major set of suitability criteria.

3. Develop an alternative land use plan based on suitability criteria for land use and other policy constraints.

4. Develop methodology for distributing to sub-drainage basins (or other small analysis units) the totals of population, industrial activity, and of industrial, commercial and agricultural land requirements which are forecast for the study area for years 1980, 1990, and 2000.

600 - Future water uses and waste loadings

This task is to determine what the most probable water uses will be and their corresponding quantity and quality requirements for future years and to predict the quantity and types of future wastes which will be generated.

610 - Future water uses

Using the projected population and economic growth, the future demands of water for each beneficial use will be calculated. These values will form a base for the development of the basin plan. With the information from existing water standards and existing uses and quality constraints, the quality of water needed for each beneficial use must be identified and tabulated with the usage. The tabulation will eventually be used to develop different basin plans.

620 - Future waste generation

621 - Domestic waste loads

Domestic waste loads will be forecast using population projections and per capita waste production adjusted for future conditions. Forecasted loads will be used to predict water quality problems.

622 - Industrial waste loads

Prognosis of industrial waste loads is based on alternative future descriptions of economic growth in estimating the type
and number of industries anticipated. The quantity and character of those wastes are factors to be taken into account.

623 - Miscellaneous and nonpoint waste discharges

Even though nonpoint pollution loads can only be approximated, evaluation of this pollution will be an advancement over previous plans.

700 - Water quality standards

Document present applicable state standards and criteria for defining water quality in each separate water body or stream reach in the study area. Investigate unofficial criteria of other agencies concerned with waters of the basin. The State of Utah has classified stream segments and established water qualities for these segments. Allowable levels of various constituents for beneficial use should also be specified. These standards will be used to determine present and future water quality deficiencies.

800 - Current deficiencies and future problems

810 - Current deficiencies

811 - In-stream problems and deficiencies

Data on stream and shore conditions, and the hydrology, are used to determine the location and type of quality problems and quantity deficiencies that exist and their probable causes. Once these problems are delineated, the information will be used to determine future quality problems and quantity deficiencies of water.

812 - Point source problems

The quality of each wastewater discharge will be compared to quality under Utah's "no degradation" policy and the Environmental Protection Agency's effluent quality standards. The results of this comparison will identify existing problems and provide a base for projecting future problems.

820 - Future water quality problems

The magnitude of future water quality problems and deficiencies which would exist under alternative future conditions of economic activity, population, and land use, assuming that present levels of waste treatment
and present degree of control of miscellaneous wastes are maintained, will be analyzed. Existing water treatment facilities will be compared with forecasted loads to determine if construction or upgrading of facilities will be required. The "no degradation" policy of the state will be used as the basis for these forecasts.

900 - Alternative water quality management plans

The purpose of this major task is to develop alternative water quality management plans responsive to the conditions, problems, and requirements defined in the analysis of deficiencies and problems, and which will consider all realistic approaches to water quality management.

910 - Identify components of plans

Components of alternative water quality management plans that need to be considered are:

1. Treatment Alternatives
   a. Municipal waste treatment facilities
   b. Industrial waste treatment facilities
      1. Combined
      2. Specific problem industries
   c. Combined municipal and industrial (with or without pretreatment requirements)
   d. Miscellaneous wastes
      1. Solid waste leachate treatment
      2. Storm water runoff treatment
      3. Agricultural; field and feedlot runoff interception and treatment
   e. Individual domestic treatment facility; septic tanks

2. Transportation Alternatives
   a. Pipe conduits, with pumping as necessary
   b. Vehicular transport with storage

3. Nonfacility Management Alternatives
   a. Pretreatment requirements
   b. Selective waste discharge regulations
c. Permit systems
d. Allocations of assimilative capacity of receiving waters
e. Land-use control

920 - Develop alternative management plans

Feasible alternative water quality management plans will be described through integration of various components for control and management of pollution loads from point and nonpoint sources. The water quality management plans resulting from this task will be compared and evaluated for possible designation as the recommended plan.

1000 - Analysis of alternative plans

The purpose of this task is to analyze each of the alternative plans in such a manner that its operating and performance characteristics, capital and operating costs, impact on the ecosystems, and effectiveness for water quality management can be determined. The factors to be considered are:

1010 - Economic impact

The economic analysis must include an analysis of the costs and benefits of the individual projects, as well as the economy of the region. Project costs and benefits include:

1. Direct Costs
   a. Construction, land and rights of way, and engineering
   b. Operation, maintenance, and major replacement

2. Indirect Costs
   a. Agricultural
   b. Industrial
   c. Personal or individual
   d. Governmental services

Questions that need to be answered concerning the regional economy are:
How will the basin plan affect economic growth?
Will the basin plan eliminate certain industries and favor others?
Will the basin economy remain stable after the implementation of the plan?

1020 - Social impact

The plans must also be evaluated in terms of the impact on social structure and conditions in the basin. Some relevant questions include:

What changes, if any, will occur in the basin society as a result of changes in the economy?
What changes will occur in the life styles of the basin population?
What privileges will the basin population gain and lose?
Will the cost of the implementation create too great a burden on the residents?

1030 - System performance characteristics

Effluent quality will be determined for each alternative system and total resulting discharge of pollutants. Estimates of impact on stream water quality will be made, to the extent possible, for relevant parameters. Questions to be examined in analyzing performance include:

Will the plan accomplish the established goals?
What changes in the physical, chemical, and biological characteristics of the water, land, and air in the basin can be expected?
Will there be immediate improvements in water quality or will there be a delay in obtaining results?
1040 - Ecological impacts

The impact of each plan on each of the various relationships between man and his environment must be analyzed. Areas to be analyzed include:

1. Species and populations
2. Habitats and communities
3. Ecosystems
4. Biota

1050 - Aesthetic impacts

The impact of the appearance of any facilities required to be constructed as part of the plan must be thoroughly analyzed and compared with the benefits which the facility is intended to provide. The aesthetic benefits of the upgrading of water quality, both to the streams and aquatic life directly involved, as well as to the surrounding area will be evaluated in terms of the impact of the facilities which will accomplish the upgrading.

1100 - Evaluation and selection of preferred plan

The purpose of this major task is to evaluate and select, from the alternative water quality management plans, the system which will best meet the goals and objectives for water quality management in the basin. Multiple criteria evaluation techniques will be used to compare the benefits, costs, and social, environmental, and other consequences of alternative plans in order to weigh trade offs and determine preferences. Public involvement will be a key part of this process for selecting a preferred alternative. At a minimum, the selected plan must be capable of achieving water quality at levels specified in the Utah State Standards.

1200 - Public participation activities

The purpose of this major task is to develop and implement programs of public information and community involvement as means
of providing the general public, local government, and public private interest groups with knowledge of the water quality program and an opportunity to input public views into project activity. The technique and programs used will be those described in the previous section. These include:

1. Citizens committee
2. Technical coordinating committee
3. Public meetings, forums, and workshops
4. Public information programs
5. Public hearings

Public participation will be continuous throughout the planning process utilizing the communication methods noted above as appropriate.
BIBLIOGRAPHY

A complete and concise reference list will be contained in a following, more complete report. However, many readers may be interested in more detailed information on some of the data presented in this report. The following bibliography may help in this regard. Specific requests should be directed to the Utah Water Research Laboratory.


Hintze, Lehi F. 1963. Compiled geologic map of Southwestern Utah. Department of Geology, Brigham Young University. Authorized and financed by Utah State Land Board.


