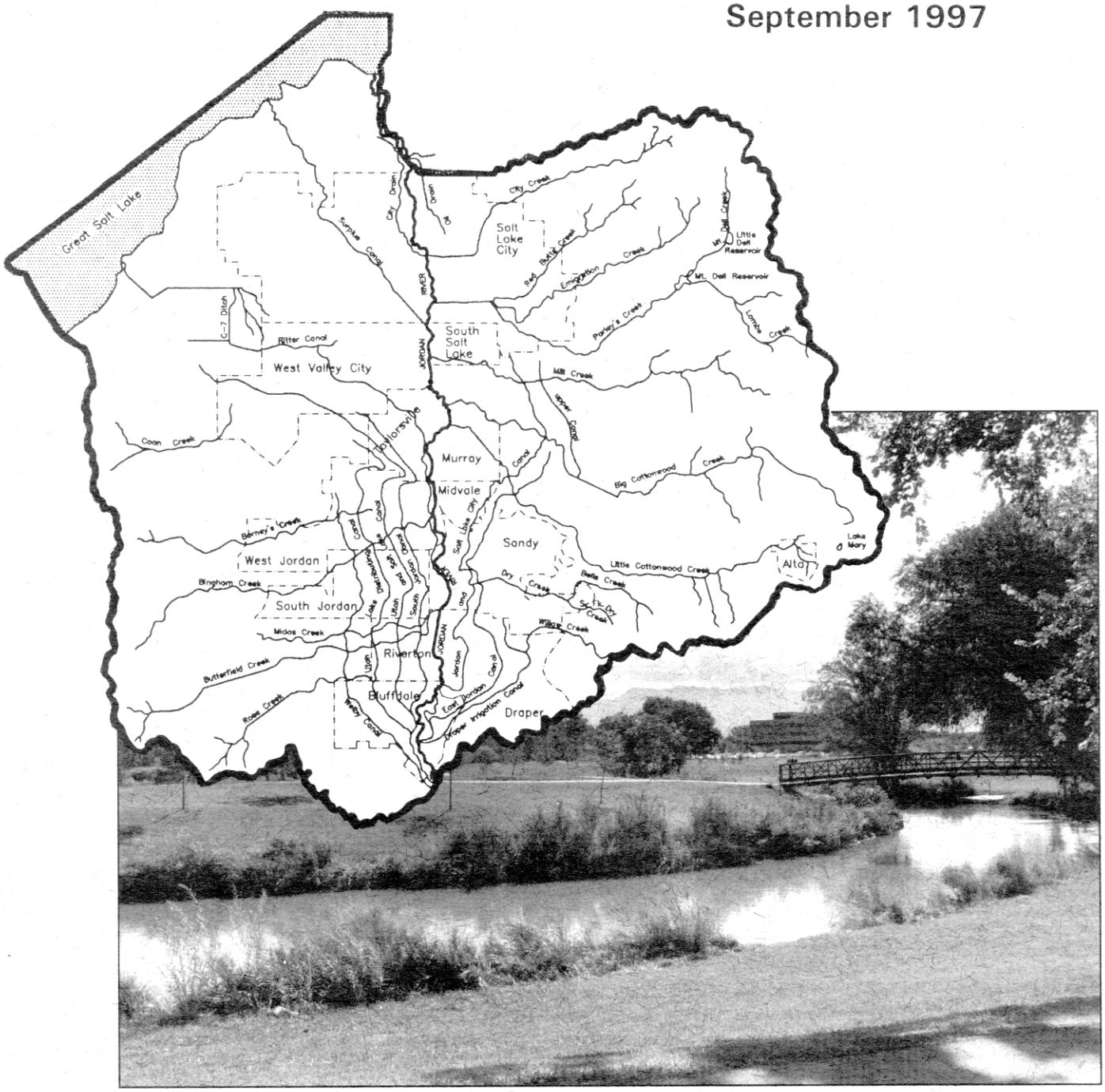
Utah
State Water Plan
Jordan River Basin

Utah Division of Water Resources ✦ Utah Department of Natural Resources

September 1997



State Water Plan - Jordan River Basin

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Utah Board of Water Resources
1594 West North Temple, Suite 310
Salt Lake City, UT 84114-6201

September 1997

FOREWORD

Utah's *State Water Plan*, prepared and distributed in early 1990, provided the foundation and overall direction for state water management and policies. It established policies and guidelines for statewide water planning, conservation and development. As a part of the state water planning process, more detailed plans are prepared for each of the hydrologic basins within the state. The *Jordan River Basin Plan* is one of 11 such reports. This plan covers all aspects of Utah's water resources in Salt Lake County. It identifies alternative ways to solve problems and meet demands. Final decisions on selecting alternatives for implementation will rest with local decision makers.

The *Jordan River Basin Plan* will disseminate valuable water-related public information; encourage community and economic growth; provide opportunity for local, state and federal cooperation; identify water supplies and needs; and promote local involvement in water planning. This basin plan will also help achieve the Department of Natural Resource mission to "conserve, protect and develop Utah's natural resources."

Acknowledgment

The Board of Water Resources gratefully recognizes the dedicated efforts of the State Water Plan Steering Committee and Coordinating Committee in preparing the *Jordan River Basin Plan.* Work was led by the planning staff of the Division of Water Resources, with valuable assistance from individual coordinating committee members representing state agencies with water-related missions. Their standards of professionalism and dedication to improve Utah's natural resources base are essential ingredients of this basin plan.

We also appreciate input from representatives of local, state and federal cooperating entities and especially the local Jordan River Basin planning advisory group. Individuals from these entities provided a broad spectrum of expertise from a wide variety of interests.

In addition, we extend a sincere thanks to the many people who attended meetings throughout the basin and provided oral and written comments to the *Jordan River Basin Plan.* Public input is imperative in the water planning process if a successful *State Water Plan* is to be obtained.

In endorsing this plan, as with previous basin plans, we reserve the right to consider individual water projects on their own merits. This basin plan is an important guide for water development in the Jordan River Basin. ■

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SECTION 2 CONTENTS

EXECUTIVE SUMMARY

This section summarizes the *Jordan River Basin Plan.* Like the *State Water Plan*, this document contains 19 sections. It also has Section A, Acronyms, Abbreviations, and Definitions, and Section B, Bibliographies. In addition to its 19 sections, the *State Water Plan* contains Section 20, River Basin Summaries, and Section 21, Status Reports. The following headings are titles of each of the sections summarized. The sections should be studied for more detailed information.

2.1 Foreword

Within the broad responsibility to enhance the quality of life and general welfare of its citizens, the state of Utah has the specific obligation to plan for and encourage the best use of its resources. The *State Water Plan (1990)* provides the statewide foundation and direction. More detailed plans are and will be prepared for each of the state's 11 hydrologic basins. The *Bear River Basin Plan* was published in January 1992, the *Kanab Creek/ /Virgin River Basin Plan* was published in August 1993, the *Cedar/Beaver Basin Plan* was published in April 1995, and the *Weber River Basin Plan* was published in May 1997. This plan for the Jordan River Basin is the fifth report to be completed.

The purpose of this plan is to identify potential conservation and development projects and describe alternatives to satisfy the problems, needs and demands. Final selection of alternatives will be made at the local level.

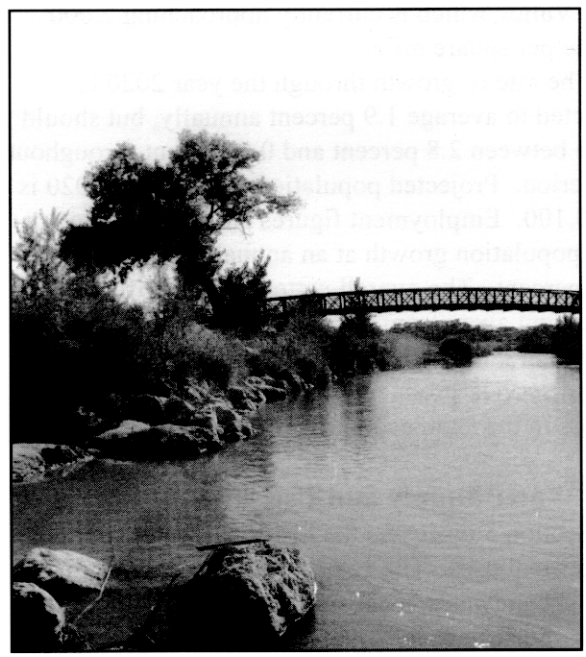
2.3 Introduction

Section 3 contains general planning guidelines used to insure continuity during plan preparation. Guidelines consist of the guiding principles, purpose, organizational structure and review process. The organizational arrangements provide contributions and review opportunities for state and federal agencies, special interest groups, and local entities, organizations and individuals. The planning process allows for review and approval of various stages of plan development. This section also discusses the settlement of the area, climate, general characteristics and land status of the Jordan River Basin.

The Jordan River is the lower portion of a larger Jordan River/Utah Lake Basin. The Jordan River conveys the outflow from Utah Lake northward some 44 miles and terminates in the Great Salt Lake. The Jordan River passes through the Salt Lake Valley draining approximately half a million acres, nearly half of which is mountainous and sparsely populated, while the remainder is a densely populated valley floor. The basin is home to just over 800,000 people, approximately 45 percent of Utah's total population.

Seasonal extreme temperatures in the valley range from -30°F in the winter to 110°F in the summer. Water surface evaporation in the valley averages 42 inches per year. The average frost-free season for the valley area is approximately 200 days from the middle of April to the end of October.

Most of the land in Salt Lake County is privately owned, especially in the the Salt Lake Valley.



Jordan River Parkway in Murray

Although Salt Lake City owns and manages 24,000 acres of the upper watershed, most of the lands in the watershed are managed by federal agencies. The biggest federal land manager is the Forest Service, which administers 91,933 acres of national forest lands in the Wasatch Range. The state of Utah has scattered land holdings of 9,778 acres. The state also owns the beds of all navigable streams and lakes. The land-use data shown reveals that residential lands are clustered primarily on the eastern and central portions of the valley. Industrial lands are fairly well scattered throughout the valley with the most significant cluster in the northwest. Agricultural use is located in the southern and southwestern portions of the valley with some irrigated acres in the northwest. Conversion of irrigated agricultural land to residential use, primarily at the southern end of the valley, is the current trend.

2.4 Demographics and Economic Future

Population, employment and the economy are discussed in this section. Salt Lake Valley, the major population and employment center in the state, is currently home to 805,000 residents. The population density for the county has grown from 900 people per square mile in 1990 to 995 people per square mile in 1995. Much of the county's rugged terrain, however, cannot be developed. Consequently it may be more appropriate to consider the population density of Salt Lake Valley which is currently approaching 2,000 people per square mile.

The rate of growth through the year 2020 is expected to average 1.9 percent annually, but should range between 2.8 percent and 0.5 percent throughout the period. Projected population for the year 2020 is 1,300,100. Employment figures are projected to outstrip population growth at an annual growth rate of 2.31 percent. The overall pattern is a significant movement away from dependence on the state's traditional goods-producing economic base and toward service-producing industries as the driving sectors in the Utah economy.

2.5 Water Supply and Use

Section 5 discusses the historical water supplies and present uses. The basin's water supply comes from groundwater, local surface water and imported water. Surface water sources include the Jordan River, Wasatch Range streams and Oquirrh Mountain streams. Imported water includes deliveries directly by pipeline from Deer Creek Reservoir, Central Utah Project (Bonneville Unit) deliveries from Jordanelle Reservoir, and Welby-Jacob Exchange water from Provo and Weber Rivers and Echo Reservoir and industrial supplies from Tooele County. On an average annual basis these sources provide 825,000 acre-feet of water, of which approximately 661,000 acre-feet has been developed for culinary, commercial, industrial, agricultural and environmental uses. However, the basin's reliable water supply (based upon 90 percent probability of availability) is 644,950 acre-feet and breaks down as follows: public drinking water systems - 333,150 acre-feet, private domestic systems - 24,600 acre-feet, self-supplied industrial systems - 39,700 acre-feet, agricultural water - 143,000 acre-feet, secondary non-potable water - 10,000 acre-feet, and developed wetlands - 94,500 acre-feet.

2.6 Management

This section describes the existing water management systems for irrigation, municipal, industrial and wetland use. Management organizations are listed and general recommendations are made. To a large extent, the flow of the Jordan River is controlled at the point of outflow from Utah Lake. For the most part, the flow regimes within the Jordan River Basin are natural. Many of the Jordan River's tributary mountain streams tend to be intermittent (and in many instances ephemeral, particularly on the west side of the valley) with flows ranging during the course of the year from zero to bank-full.

The Jordan River Basin has 10 active reservoirs, but they are relatively small and located high in the Wasatch Range. Their primary function is culinary water supply storage. Their size and location preclude their use as flood control or flow management facilities. The overall management of water in the entire Jordan River Basin is complex requiring the integration of municipal, industrial, agricultural, and recreational needs as well as fish and wildlife issues. One of the biggest problems in the Jordan River Basin is the many competing values and interested parties, with no single controlling body or agency.

Incorporated mutual irrigation companies serve the majority of irrigated land in the county. While these companies hold water rights for over 50,000 acres, recent land use surveys put existing irrigated

lands at 25,300 acres. The vast majority of drinking water supplies come from 32 approved community drinking water systems. The Jordan River Basin has an extensive system of developed wetlands which are intensively managed to promote desired waterfowl species and discourage the less desired species. Watershed management is used to protect drinking water supplies.

2.7 Regulation/Institutional Considerations

This section discusses the agencies responsible for water regulation in the Jordan River Basin. This includes consideration of water rights, water quality and environmental concerns. The two state agencies primarily responsible for the regulation of water in the Jordan River Basin are the Division of Water Rights and the Department of Environmental Quality.

The Division of Water Rights, under the direction of the State Engineer, regulates water allocation and distribution according to state water law. At the present time, the State Engineer has determined the surface water flows and groundwater in the Jordan River Basin are fully appropriated. This means the Division of Water Rights will not approve new applications to appropriate water. Because all surface water and groundwater in the Jordan River Basin are considered to be fully appropriated, the potential for new water rights appropriations is extremely limited. Applications which have been previously approved may be developed and perfected in the future. There is concern the groundwater basin has already been over-appropriated. If on-going studies confirm this, the division will undoubtedly set into effect policies and procedures designed to bring the groundwater rights into balance with the safe groundwater yield.

Water quality is regulated at the state level by the Department of Environmental Quality through two agencies, the Division of Water Quality and the Division of Drinking Water. The Drinking Water Board is responsible for assuring a safe water supply for domestic culinary uses. The board regulates any system defined as a public water supply which may be publicly or privately owned. Their standards govern bacteriologic quality, inorganic chemical quality, radiologic quality, organic quality and turbidity. Standards are also set for monitoring frequency and procedures.

2.8 Water Funding Programs

This section discusses the funding programs available. Funding can be either grants, loans at various interest rates, or matching funds. These funding resources are available for all kinds of water-related proposals. Over $157 million has been provided to the basin by state and federal agencies in the form of loans and grants in the last 50 years.

2.9 Water Planning and Development

Section 9 describes present water uses and supplies. Problems are also discussed along with future water needs, alternatives for meeting needs, and environmental, financial and economic considerations. The basin's water resources problems include water quality, meeting future municipal and industrial needs, groundwater mining, groundwater contamination, maintaining the existing infrastructure, and flooding problems. The trend of converting agricultural land to residential areas has freed up irrigation water for other uses. But the irrigation water being made available is Utah Lake and Jordan River water which is of poor quality and very expensive to treat for M & I use. Groundwater problems include concerns for groundwater quality and quantity. Both of these issues are addressed by the State Engineer through the *Salt Lake County Groundwater Management Plan.*

The Wasatch Front Water Demand/Supply Computer Model (WFCM) was used to predict the future water needs of Salt Lake County. Based upon the existing use patterns and the population growth projections provided by the Governor's Office of Planning and Budget, WFCM was used to project future water use needs at five-year intervals from years 2000 through 2020. The model predicts that over the next 25 years the demand for public water will increase an average of 1.6 percent per year. The 1995 demand for public water of 255,700 acre-feet per year will increase nearly 60 percent by the year 2020 to an annual demand of 419,300 acre-feet. The projected demands will begin to out-strip the existing supplies by the year 2010.

A number of potential water sources can be developed to meet the projected water needs, but development will be expensive. Alternatives for meeting future water needs can be classified in five basic groups:

- Develop Utah Lake/Jordan River water,
- Develop additional water from the Wasatch Range mountain streams,
- Develop additional groundwater,
- Bear River water development,
- Conservation

The potential for converting agricultural water to culinary water will be limited due to water quality concerns with Utah Lake and Jordan River water and the high cost of treatment to M&I standards.

Development of additional water from the Wasatch Range streams holds a limited potential for addressing the future needs. Plans are already in place to enlarge some of the water treatment facilities and put more of this high quality water to culinary use. Further development of these streams, however, is a very sensitive environmental issue.

Plans have been made to develop additional groundwater sources in the Salt Lake Valley, but this will be done on a very limited basis and monitored closely by the Division of Water Rights. At the present time, the State Engineer as well as many other groundwater experts believe the current level of groundwater withdrawals are approaching the safe yield levels for the valley.

The Bear River has long been viewed as an available water resource. A joint legislative/ gubernatorial Bear River task force was created in 1990 to look at water development options on the Bear River. The Bear River Task Force introduced legislation that defined the state's role in the development of the river. The 1991 Bear River Development Act states the Division of Water Resources shall construct a state project that may include the construction of reservoirs on the Bear River and a pipeline or canal to Willard Bay. Currently the Salt Lake County Water Conservancy District (SLCWCD) is purchasing land in central Weber County for a proposed water treatment plant. Also, in cooperation with the Weber Basin Water Conservancy District (WBWCD), the SLCWCD is investigating pipeline alignment alternatives to convey Bear River and/or Weber River water from the proposed plant south to Salt Lake County, This pipeline will deliver needed water to SLCWCD as well as alleviate an infrastructure problem for WBWCD in Davis County.

Potential exists to stretch existing water supplies through a number of conservation practices. Water users may be able to better manage their supplies thereby increasing efficiencies which in turn can reduce costs. This applies to all water uses including residential, commercial, industrial and agricultural. Water reuse is also a potential water conservation practice that might be employed in the near future.

2.10 Agriculture

As the Jordan River Basin population has grown, many of the agricultural areas have been converted to residential or commercial developments, significantly reducing the total irrigated acreage during the past 30 years. Historically, agriculture has been an important industry in the Jordan River Basin. Today, however, there are just over 43,800 acres of cultivated lands, of which approximately 25,300 acres are irrigated. Urbanization in the Jordan River Basin makes agriculture's role increasingly less significant in the socio-economic development of the Jordan River Basin. Still, agricultural water quantity and quality play an important role in overall water planning.

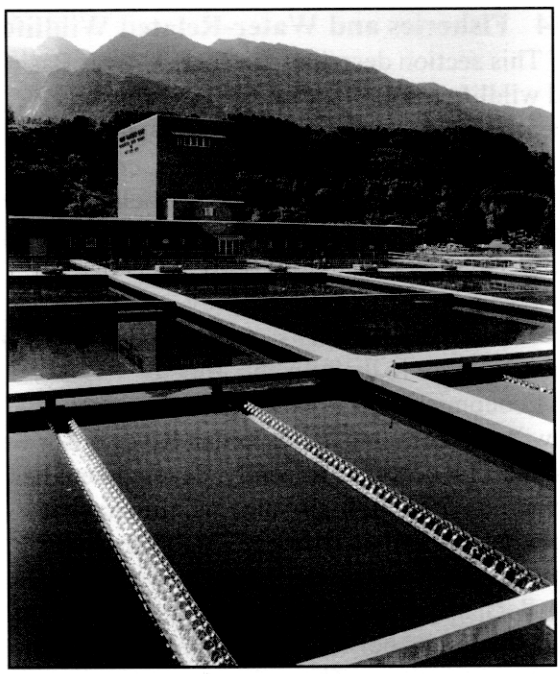
Virtually all of the surface water supplies used for agriculture come from the Jordan River. The cost of treating Jordan River/Utah Lake water to drinking water standards is currently prohibitive. Consequently, the quantity and quality of water available for agriculture is not a problem. With large tracts of formerly irrigated lands now converted to residential developments, more than enough water is available for the lands remaining in agricultural production.

2.11 Drinking Water

This section describes the present drinking water systems in the Jordan River Basin, discusses present and future problems, and presents estimated future requirements. At the present time, existing drinking water supplies are adequate and come from a rather complex mix of surface water and groundwater (including wells, springs and tunnels). Almost 99 percent of the public drinking water supplies comes from 32 approved community drinking water systems

The major water purveyors in the county are Salt Lake City, the Metropolitan Water District of Salt Lake City (MWD) and the Salt Lake County Water Conservancy District (SLCWCD). Most of the other approved water systems, despite having autonomous water sources, are dependent to some extent upon the purchase of water from one or more of these wholesalers. When planned development of current

water sources in the Jordan River Basin is completed, approximately 348,360 acre-feet of water will be available annually on a reliable basis to meet public water needs (see Table 9-2). Of this total, 125,410 acre-feet is from groundwater sources, 5,800 acre-feet from artificial groundwater recharge, 61,850 acre-feet from local mountain streams, 61,700 acre-feet from Deer Creek Reservoir, 84,000 acre-feet from CUP, and 9,600 acre-feet from the Welby/Jacob Exchange.



Little Cottonwood Water Treatment Plant, Metropolitan Water District of Salt Lake City

Salt Lake City has acquired an annual average water supply of approximately 167,000 acre-feet. This includes 61,700 acre-feet of storage in Deer Creek Reservoir controlled through the Metropolitan Water District of Salt Lake City. In addition, Salt Lake City obtains an average of 68,000 acre-feet each year from mountain streams, 20,000 acre-feet from the CUP, and 17,600 acre-feet from springs and wells and additional small quantities of water from miscellaneous sources. Salt Lake City's water supply can be characterized as "firm". The SLCWCD has a firm water supply at the present time of 98,600 to 102,800 acre-feet. In addition to the water it directly controls, the district has an agreement with the MWD (subject to availability) for an annual 10,000 acre-feet of treated Deer Creek Reservoir water. This agreement is valid through the year 2001, and may then terminate.

Water from the MWD has been sufficient in most recent years to meet Salt Lake City needs and fulfill conditional commitments to the SLCWCD, but continued growth in Salt Lake City service areas will reduce water currently delivered to SLCWCD. With this in mind, the SLCWCD has developed plans for other sources of water. The district's current supply of about 100,000 acre-feet should provide an adequate supply through the year 2010. Beyond that time SLCWCD intends to develop 25,000 acre-feet through conversion of Utah Lake irrigation water in Salt Lake County along with a major treatment plant expansion and improved treatment processes. The SLCWCD also expects to develop 50,000 acre-feet of Bear River water by the year 2015 as part of a state-sponsored Bear River project. It is anticipated that another 25,000 acre-feet of Utah Lake water will be converted to municipal use sometime after the year 2015.

2.12 Water Quality

This section presents data and information on existing levels of water quality in the Jordan River Basin. Sources of pollution are identified, problems and solutions are discussed, and recommendations for control and improvement by responsible agencies are given. The 44-mile stretch of the Jordan River from the outlet of Utah Lake to the Great Salt Lake is currently used for recreational, industrial, agricultural and wildlife purposes. The Jordan River represents a tremendous potential for even greater usage in all of these areas, as well as a potential source for domestic water, if the water quality could be improved to acceptable standards. It is generally acknowledged that water flowing from Utah Lake is of poor quality. Water quality data collected for the Jordan River, however, shows water quality continues to be degraded as the river makes its way through the Salt Lake Valley en route to the Great Salt Lake. At the present time, the basin has five wastewater treatment plants(WWTP). Four are public facilities. The fifth, privately owned and operated by Kennecott Corporation, is a self-contained facility. South Valley WWTP discharges directly to the Jordan River while Central Valley WWTP discharges to Mill Creek just above its confluence with Jordan River. The other two treatment plants, Salt Lake City WWTP and Magna WWTP, discharge almost directly into the

Great Salt Lake. Water quality studies of the Jordan River have documented high coliform counts, heavy metals and other toxic inorganic substances, depleted dissolved oxygen levels, and periodic high levels of total dissolved solids.

2.13 Disaster and Emergency Response

This section discusses flood hazard mitigation and drought response. It also briefly discusses programs now in place and additional programs that could be beneficial in dealing with flooding and drought problems. Reacting to a disaster or emergency after it has already occurred is generally inefficient, and a waste of time, money and resources. Pre-disaster activities, such as floodplain management, hazard mitigation and planning, are the preferred approaches. Many types of emergency situations are water-related, varying from disastrous flooding to extreme drought.

Because flows are regulated at the outlet from Utah Lake, flooding has not been a significant problem along the main stem of the Jordan River. Recent history, however, has given Salt Lake County residents cause for alarm along several tributaries to the Jordan River. Record snowpack and spring runoff in 1983 and 1984 resulted in numerous occurrences of local-flooding, landslides, and mud-flow problems throughout the valley, particularly along the Wasatch Front streams on the east side of the valley. Also, the rising level of the Great Salt Lake, caused by record runoff from 1983 to 1986, caused many millions of dollars in damages to Salt Lake County residents. Comprehensive Emergency Management assists the county to maintain its preparedness plans.

No single entity has sole authority for flood control management activities. Cities and counties have the necessary statutory authority to act, but at least six other state and federal agencies also have some degree of authority and responsibility. The state's emergency response and hazard mitigation coordination authority rests with CEM.

Droughts do not pose as great a threat to life and property as floods. This is primarily because existing reservoirs make it possible to provide water for essential life functions throughout the period of drought. The industry most impacted by drought is the agricultural community. In periods of extreme drought, when all users are required to cut back on water consumption, farmers can suffer significant financial losses if not total crop failure. Wildlife and waterfowl management areas adjacent to the Great Salt Lake are other water users significantly affected by drought.

Not all local governments are aware of their responsibilities as they relate to flood plain management, nor do all communities have a disaster response plan in place. Local communities should develop disaster response plans with the assistance of the Division of Comprehensive Emergency Management .

2.14 Fisheries and Water-Related Wildlife

This section describes the Jordan River Basin fish and wildlife resources, discusses existing and potential needs, and presents recommendations. Wildlife is still common along rivers, creeks, wetlands, wooded areas, abandoned fields and parks within many areas of the Jordan River Basin. It is one of the valued amenities of living along the Wasatch Front. In a recent survey, more than 95 percent of Salt Lake City residents said they enjoyed seeing wildlife in their neighborhoods.

Economic projections suggest that substantial growth will continue in the Jordan River Basin well into the 21st century. Recently, development has spread into areas of high-value wildlife habitat depleting the limited resource. Wildlife is still common along rivers and steams and in wetlands, woodlots, abandoned fields, parks and throughout residential neighborhoods within many Wasatch Front communities. Through proper planning and establishment of a system of wildlife areas throughout the basin, residents can capitalize on the unique wildlife resources and preserve the diversity of plants and wildlife. The *Jordan River Stability Study* recommends a river management plan that stresses non-structural management techniques, such as zoning restrictions and control of land use within the defined river meander corridor. Structural elements of the plan are intended to be used to enhance the natural on-going fluvial processes and reestablish a more natural channel pattern as well as protect existing development from erosion. Along with improving bank stability, erosion control and water quality, this approach should have a positive impact on fishery and wildlife habitat. Salt Lake County passed an ordinance in 1994 establishing a Jordan River Meander Corridor. The ordinance established the boundaries of the Jordan River's natural meander pattern, sets limits on the types of development and

land uses that can occur within the designated corridor, and requires developers to seek approval from Salt Lake County Flood Control. This effort follows closely on the heels of the county *Jordan River Stability Study*, published in December 1992. That study defined the Jordan River as "continually undergoing the processes of bank erosion, long-term channel bed degradation, bridge scour, sediment deposition and meander migration." In addition to reducing the flooding potential along the river, the establishment of a meander corridor should have a very positive impact upon wildlife and the environment, as the river is allowed to take a more natural sinuous course and the stream banks are allowed to stabilize.

Many of the cities that border the Jordan River (Salt Lake City, Midvale, Murray, Taylorsville, West Jordan, West Valley City, South Jordan, Riverton, and Bluffdale), are developing their own management plans for the Jordan River within their city boundaries. Many of these city plans reflect the county's efforts to establish a meander corridor and include parkways and trails. Existing wetlands and riparian habitat are being lost or impacted due to development. The Division of Wildlife Resources should identify wetlands and riparian areas with significant values to aid in their protection and preservation.

2.15 Water-Related Recreation

The purpose of this section is to describe the Jordan River Basin water-related recreational resources, identify problems and needs, and offer some recommendations. Aside from the Jordan River and the Great Salt Lake, Salt Lake County has no major lakes, rivers or reservoirs. Consequently, there are limited opportunities for recreational activities involving direct contact with water. At the north end of the county, the Great Salt Lake represents the largest recreational water attraction. Ever since the first settlers entered Salt Lake Valley, the Great Salt Lake has been a source of curiosity and a recreational attraction. Current recreational facilities on Great Salt Lake within Salt Lake County include the Great Salt Lake State Park and Saltair Resort, a privately developed facility.

Other water-related recreational activities include several privately owned and operated hunting clubs, a significant number of county- and city-owned swimming pools, as well as several privately-owned and operated water theme parks and swimming pools. Quite a few city and county parks offer picnicking and other day-use activities in the immediate proximity to ponds, small lakes and streams. The skiing industry is a major recreation activity in the Jordan River Basin that has a favorable economic impact upon the entire state.

The Utah Legislature created in 1957 what is today the Division of Parks and Recreation. Lawmakers instructed the division to develop parks and recreation areas and to preserve and protect historical sites and scenic treasures. The boating program was added in 1959 and the off-highway vehicle program started in 1971.

The major objectives for the state parks system are: 1) Provide a broad spectrum of high quality parks and recreational resources; 2) enhance the economic vitality of the state through increased tourist and vacationist traffic; 3) enforce state boating and off-highway vehicle laws; 4) regulate, protect and interpret the natural and historic resources in the park system; and 5) provide technical assistance and matching grants for outdoor recreation development.

The Division of Parks and Recreation provides matching grants for riverway and non-motorized trail enhancement. This program leverages state dollars with local dollars, requiring 50 percent local match. Since 1991, 260 requests totaling $10.2 million have been received statewide. To date, 107 projects have been awarded funds totaling $3.2 million. In the Jordan River Basin since 1991, these funds, amounting to more than $250,000, have been directed primarily at developing the Jordan River Parkway.

Within the Utah State Comprehensive Outdoor Recreation Planning (SCORP) process, surveys are conducted to determine the priority of recreational and environmental issues. The most desirable recreation activities are either water-based or water-related. Salt Lake County has passed an ordinance establishing a Jordan River Meander Corridor. The ordinance would establish the boundaries of the Jordan River's natural meander pattern, and set limits on the types of development and land uses that can occur within the designated corridor. In addition to addressing flooding concerns, water quality issues and having a positive impact upon wildlife, the creation of a meander corridor lends itself very well to the establishment of recreational facilities as one of the designated uses.

2.16 Federal Water Planning and Development

This section describes the involvement of federal agencies in Jordan River Basin water planning and development, including past and expected future involvement. In the past, federal agencies have played a big role in funding water development projects. This practice is currently in transition with federal agencies decreasing their funding for water development while increasing their regulatory responsibilities. Although the activities of federal agencies are changing, programs still are available to benefit basin residents. The primary concerns expressed by the various federal agencies in the *1990 Utah State Water Plan* are: 1) Reserved water rights, 2) interrelated planning (multiple-use planning), 3) stream and riparian habitat loss and 4) water rights filings. It is anticipated the state will be called upon to shoulder additional financial responsibilities to carry out a number of federally mandated programs. Funding these federal programs may impair the state's ability to respond to other local requests for project funding.

Federal programs most significant to the Jordan River Basin in the immediate future are: (1) The Central Utah Project (CUP) completion, under the Central Utah Project Completion Act, not only represents a culinary water source for the Wasatch Front but includes a considerable amount of environmental mitigation funding which will be used to rehabilitate streams in the Jordan River Basin; and (2) the EPA's authority under the Federal Safe Drinking Water Act and Clean Water Act. Further comprehensive federal studies in the Jordan River Basin and/or participation by the BOR, COE, or NRCS in future development would be welcomed, but they do not appear likely.

2.17 Water Conservation/Education

This section discusses water conservation needs, issues, and potential alternatives, plus gives some recommendations for conserving water. In the *State Water Plan,* water conservation is defined as "wise use," which is much wider in scope than merely reducing water consumption. State water policy on conservation presently requires project sponsors seeking financial assistance from the state to prepare a *Water Management and Conservation Plan.*

The 1992 Central Utah Project Completion Act (CUPCA) requires 39,325 acre-feet of water conservation within the project service area by the year 2007 and authorized the appropriation of $50 million. To date less than $4 million has been appropriated. This money is available on a 65-35 percentage cost share with the 65 portion being project funds.

This section includes a discussion of municipal and industrial conservation and agricultural water conservation practices. There is, however, sufficient agricultural irrigation water supply for the existing and projected demand. Also, because Jordan River water quality is poor, it is not presently economically feasible to treat it for municipal use. Consequently, no real incentive exists to conserve Jordan River irrigation water.

Conservation of municipal and industrial water is an appropriate and feasible way to meet part of the future water requirements. Numerous opportunities exist for conservation of residential water in Salt Lake Valley. Water-efficient appliances such as low flow toilets and low flow shower heads are only required in new construction. Most wholesale and retail price structuring provide little incentive for water conservation. The most inefficient use of residential water is over-watering of lawns and gardens. Education coupled with price incentives could help conserve a lot of residential water. Not as much opportunity for water conservation is in the commercial sector as in the residential. Studies do not suggest that commercial users are inefficient. A wide range of water conservation methods have been employed in various regions of the country including: wastewater reuse, public information/education, institutionalizing water conservation, restricting water use, conjunctive use, landscaping and home water savings, pricing, water measurement, and secondary or "dual" systems.

2.18 Industrial Water

This section discusses the present and future uses of water for industrial purposes in the Jordan River Basin. For this report, industrial water use is defined as water used in mining and manufacturing operations including the production of steel, chemicals, paper or any other product. It includes processing, washing and cooling operations as well as employee use. Also included, to the extent they can be identified, are such activities as gravel washing and ready-mix concrete.

No single agency or entity regulates the development or use of industrial water, although its

use must conform to existing state laws for water rights, pollution control and other regulations. The single biggest obstacle in identifying the county's total industrial water uses is that many industrial water users view their water-use data as classified information.

Industrial water use data for 1995 from the State Engineer's Office reports put the total industrial water use in the Jordan River Basin from privately held water rights at 29,700 acre-feet. The majority of the privately developed industrial water (26,500 acre-feet) comes from wells, with only 3,000 acre-feet coming from surface water, and 200 acre-feet from springs. In addition, an estimated 15,400 acre-feet of the public water supply is used for industrial purposes. Kennecott Utah Copper imports 10,000 acre-feet from Tooele county for industrial uses. That puts the basin's current industrial water use at 55,100 acre-feet. If industrial water use does grow at the same rate as the population over the next 25 years, demand will increase from 51,400 acre-feet to over 82,000 acre-feet in 2020.

2.19 Groundwater

This section describes groundwater conditions in the Jordan River Basin. Currently, groundwater provides approximately 168,500 acre-feet annually or 26 percent of the presently developed water supply for municipal, industrial, irrigation, domestic and stock-watering purposes. Groundwater in the valley's principal aquifer is generally of excellent quality on the east side of the valley, with the quality becoming poorer on the west side and towards the Great Salt Lake. The water quality of the shallow unconfined aquifer is generally poor. There is an upward gradient from the principal aquifer to the shallow aquifer over a large percentage of the valley. This helps maintain the high quality of the principal aquifer. Evidence indicates, however, that excessive pumping from the principal aquifer can reverse the upward gradient, allowing downward leakage of the poor quality water.

The *Salt Lake Valley Interim Groundwater Management Plan* was created to provide the necessary management guidelines until the USGS groundwater study is completed and incorporated into the groundwater regulations. One of the biggest concerns at the present time is the total volume of groundwater withdrawals. It is in the best interest of all water users that the groundwater not be mined. Groundwater mining can potentially result in the contamination of the principal aquifer by inducing inflow of poorer quality water.

Present groundwater withdrawals of 168,500 acre-feet are believed to be very close to the average annual yield of the principal aquifer. If unperfected water rights claims are developed, the total groundwater withdrawals would exceed 387,500 acre-feet, considerably higher than the estimated average annual recharge of the principal aquifer. Part of the U.S. Geological Survey groundwater study will provide more complete data and information about the affects of withdrawals on the water quality of the aquifer. The study will be used to establish the groundwater management plan for years to come.

Groundwater contamination can be a very serious problem with potentially long-term consequences. Throughout Salt Lake Valley, many differing types of toxic materials are stored directly on the ground or underground in containment structures. Unreported spills can go undetected for a considerable time while the contamination spreads throughout the aquifer resulting in a time consuming and expensive cleanup.

Two such spills which have been addressed in recent years are the contamination by leachate from uranium-mill tailings, and contamination of the Bingham Canyon and Bingham Creek area by seepage from reservoirs and evaporation ponds associated with mining activities. ■

SECTION 3 CONTENTS

INTRODUCTION

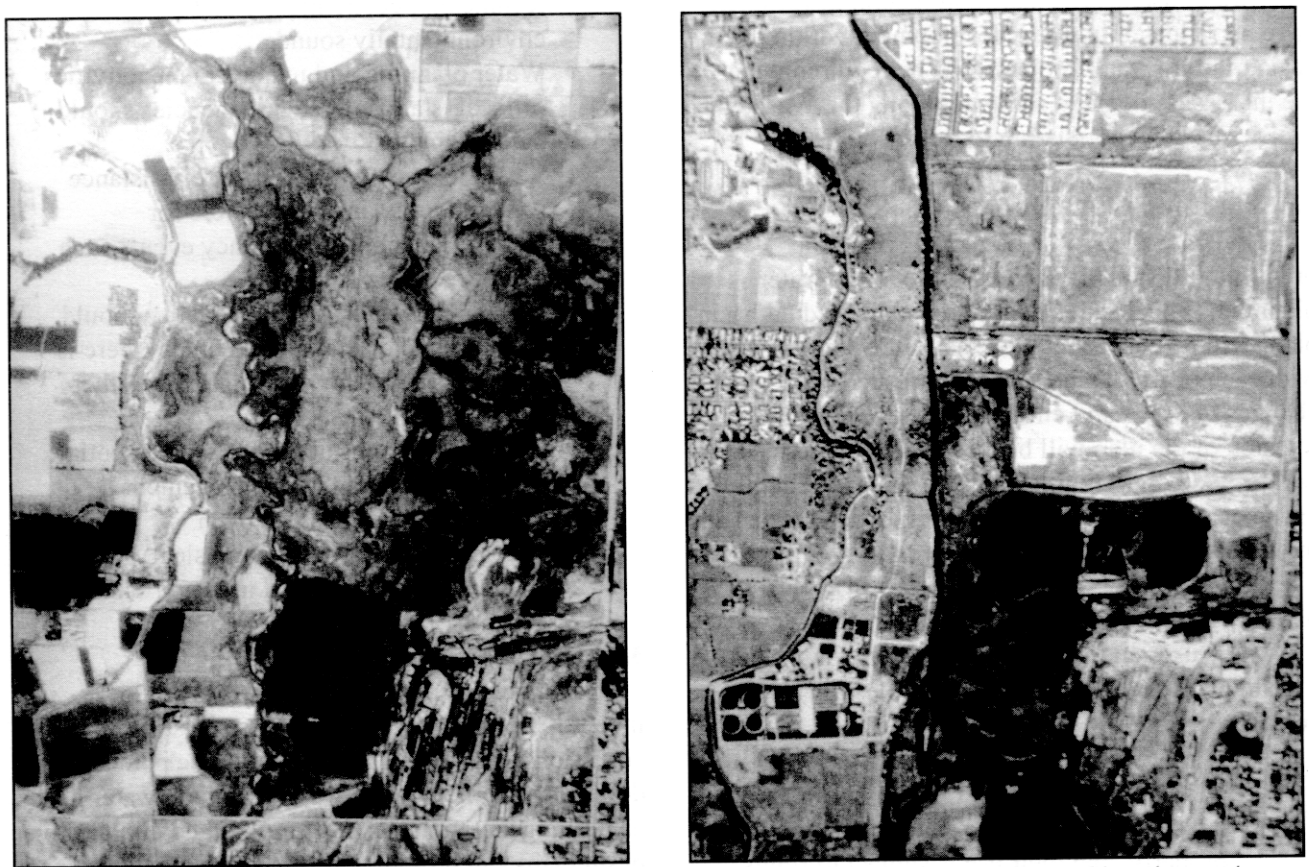
An orderly process is needed to describe the planning, conservation and development of water resources. It should provide the flexibility to adjust as future conditions change.

3.1 Background

This section includes some general planning guidelines and the organizational arrangements used in preparing the basin plan. It also includes a general physical description of the Jordan River Basin (Salt Lake County).

The Board of Water Resources and the Division of Water Resources have a leadership role in water planning and development, and in coordinating water planning activities with the other state and federal agencies. Formulation of basin plans fits within the state water policy framework which includes regulation, water rights, conservation, development, protection of water quality and management. Municipal and industrial (M&I), agricultural, fish and wildlife, and recreational uses are all included in the planning process. The inter-relationship of water resources demands and activities are recognized and incorporated.

The *Jordan River Basin Plan* includes a description of significant water problems, options available to resolve them and recommendations for future action. One main purpose is to identify problems which need early attention. Each



Aerial photos of the Jordan River between 6800 South and 7800 South, taken in 1937 (left) and in 1990, reveal how the river has been straightened and vast areas of wetlands filled in for agricultural and industrial developments. For further site reference, note the North Jordan Canal that appears on the left side of both photos.

recommendation addressing an identified need is consistent with the state water policies identified in the *1990 State Water Plan.*

Previous water-related studies conducted by state and federal agencies in the Jordan River Basin have provided important information on the resources and, in some cases, alternative water development plans. The studies used in preparing this report are listed by number in Section B.

The *Jordan River Basin Plan* is prepared at a reconnaissance level, with a general assessment of problems and demands, and their location. Basin planning is a continuous process, and the plan is flexible to allow for future revisions. Water management, protection of water quality, and conservation needs are delineated, and all potential uses are considered. It is intended that the formulation and implementation of a basin plan will provide a balance of environmental, economic, social and political factors.

Over the years, many water supply projects have been built by private individuals, (non-profit) irrigation companies, incorporated municipalities and other water users. The state and federal government have participated in water development within the basin. Future water projects will be required due to the increasing demand for water along the Wasatch Front caused by population increases.

3.2 Planning Guidelines

The *State Water Plan* describes the basic premises and lays the foundation for state water planning. This insures continuity so individual basin plans will be consistent with the statewide plan and with each other. To be flexible and accommodate changes in needs and circumstances, review and revision of the plan will be a continual process. This will provide opportunities for all state and federal agencies, local government entities, organizations and individuals to present their concerns.

3.2.1 Principles

Many uses and interests are involved in preparing a basin plan. Certain guiding principles are also considered, namely:

- All waters, whether surface or subsurface, are held in trust by the state as public property, and their use is subject to rights administered by the State Engineer. The prior appropriation doctrine has governed Utah water law since before statehood.
- Water is essential to life. Utah residents have the responsibility to maintain or improve water quality to meet the needs of the generations that will follow.
- The diverse present and future interests of Utah's residents should be protected through a balance of economic, social, aesthetic and ecological values.
- Public water uses for which it is difficult to identify specific beneficiaries, such as recreation and aesthetics, should be included in the water planning and development process.
- Public input is vital to water resource planning.
- All residents of the state are encouraged to conserve water and implement wise water use practices.
- Water rights owners are entitled to transfer their rights under free market conditions.
- Water resource projects should be technically, economically and environmentally sound.
- Water planning and management activities of local, state and federal agencies should be coordinated.
- Local governments, with state assistance as appropriate, are responsible for protecting against emergency events such as floods and droughts.
- Designated water uses and quality should be improved or maintained unless there is evidence the loss is outweighed by other benefits.
- Educating Utahns about water is essential. Effective planning and management requires a broad-based citizen understanding of water's physical characteristics, potential uses and scarcity.

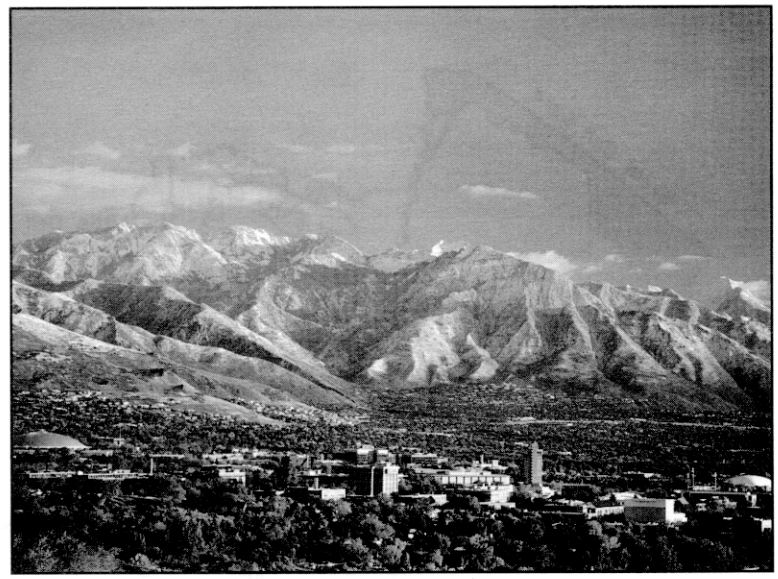
3.2.2 Purpose

The main purpose of this basin plan is to inventory existing resources, assess existing conditions, identify issues, and describe potential development alternatives for meeting the water needs of future generations. The *State Water Plan* and river basin plans can provide guidance and help coordinate

the planning efforts among all state, federal and local entities and be the vehicle to involve concerned parties.

3.2.3 Organization

State water planning is the responsibility of the Division of Water Resources under policy guidelines of the Board of Water Resources. With this in mind, a state water plan coordinating committee representing 12 state agencies facilitated preparation of the *Jordan River Basin Plan.* A steering committee consists of the chair and vice chair of the Board of Water Resources, the executive director of the Department of Natural Resources, and director and assistant director of the Division of Water Resources. The local board member is also invited to participate. This committee provided policy guidance, resolved issues, and approved this plan prior to acceptance by the Board of Water Resources.



Salt Lake Valley - University of Utah and Wasatch Mountains

In addition, federal and other state agencies participated as cooperating entities. These agencies have particular expertise in various fields to assist with plan development. Also, a statewide local advisory group representing various organizations and special interest groups has assisted with input and plan review. This group represents a spectrum of various interests and geographical locations.

A local basin planning advisory group for the Jordan River Basin provided input by way of advice, review and decision making. Most of the members of this group reside within or are directly involved in basin affairs. They represent various local water interests and provide geographical representation within the basin.

3.2.4 Process

During the review and approval process, four drafts of the *Jordan River Basin Plan* were prepared. They were 1) in-house, 2) committee, 3) advisory, and 4) public review drafts. After this process, the final basin planning report is distributed to the public for information and use. Public involvement is an important part of the planning process, and is necessary to assess actual viewpoints and conditions in the basin. The opportunity for public discussion and input has been and will continue to be provided at the local, state and federal levels as plan formulation moves through various phases.

3.3 Description of Basin

The Jordan River Basin is unique in Utah because of the number of people drawing from the existing water supply. To better understand the problems, alternatives and recommended actions, a brief description of the basin's physical characteristics is presented.

The total area drained by the Jordan River includes the Jordan River Basin and the Utah Lake Basin. The Jordan River/Utah Lake Basin, located in north central Utah, is shown in Figure 3-1. The Jordan River Basin as defined herein includes all of Salt Lake County. The Utah Lake Basin includes all lands draining to Utah Lake as well as the portion of the Jordan River from Utah Lake to the Salt Lake County line. This report only addresses water issues for the Jordan River Basin (See Figure 3-2).

3.3.1 Drainage Area and Topography

The Jordan River/Utah Lake Basin includes all of the rivers and streams tributary to Utah Lake and numerous tributary mountain streams which drain directly into the Jordan River. The largest of these tributary streams, and the major source of flow to Utah Lake and the Jordan River, are the Provo and Spanish Fork rivers.

The headwaters of the Provo River, and hence the primary headwaters for the Jordan River/Utah Lake

Figure 3–1

LOCATION MAP
Jordan River/Utah Lake Basin

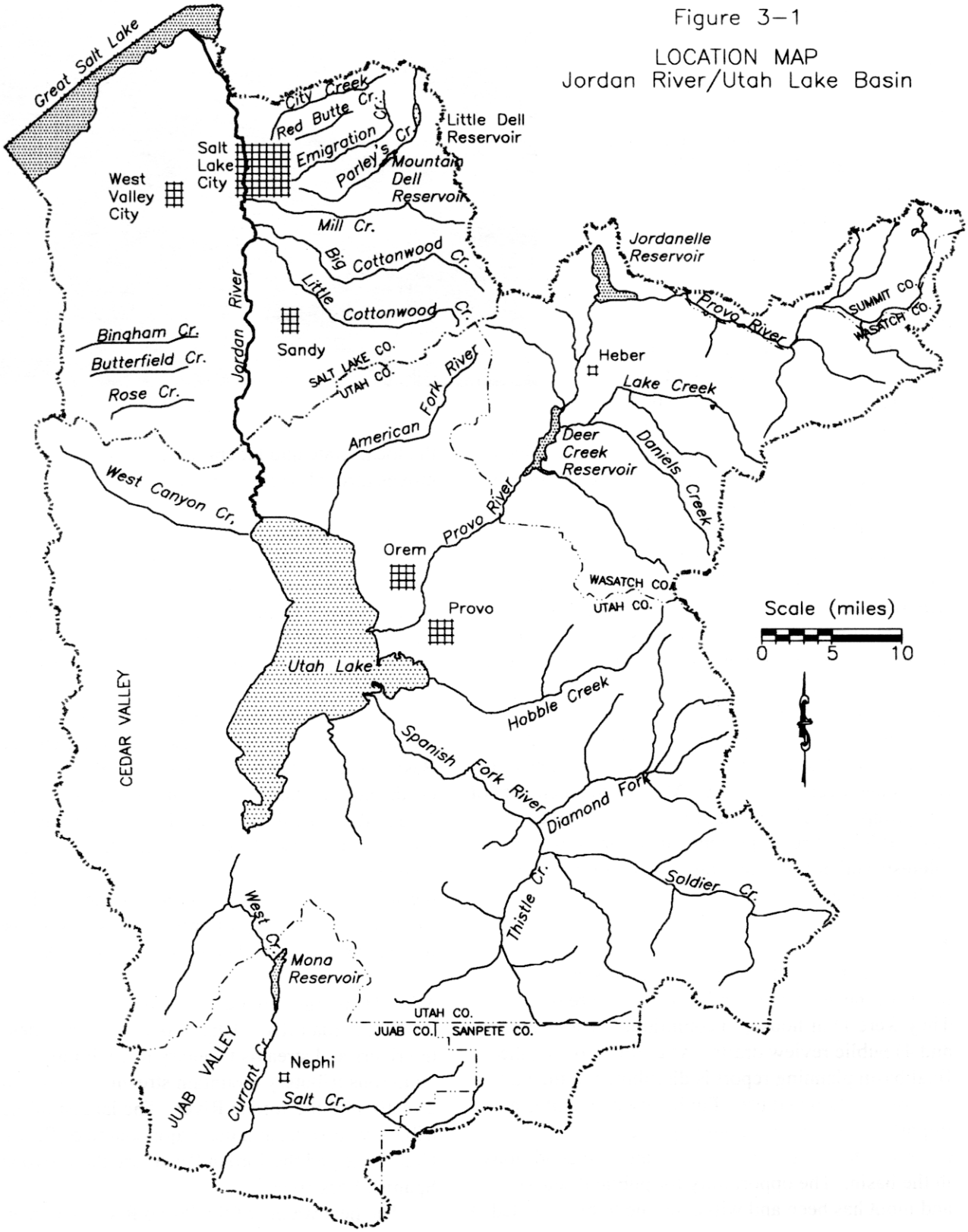
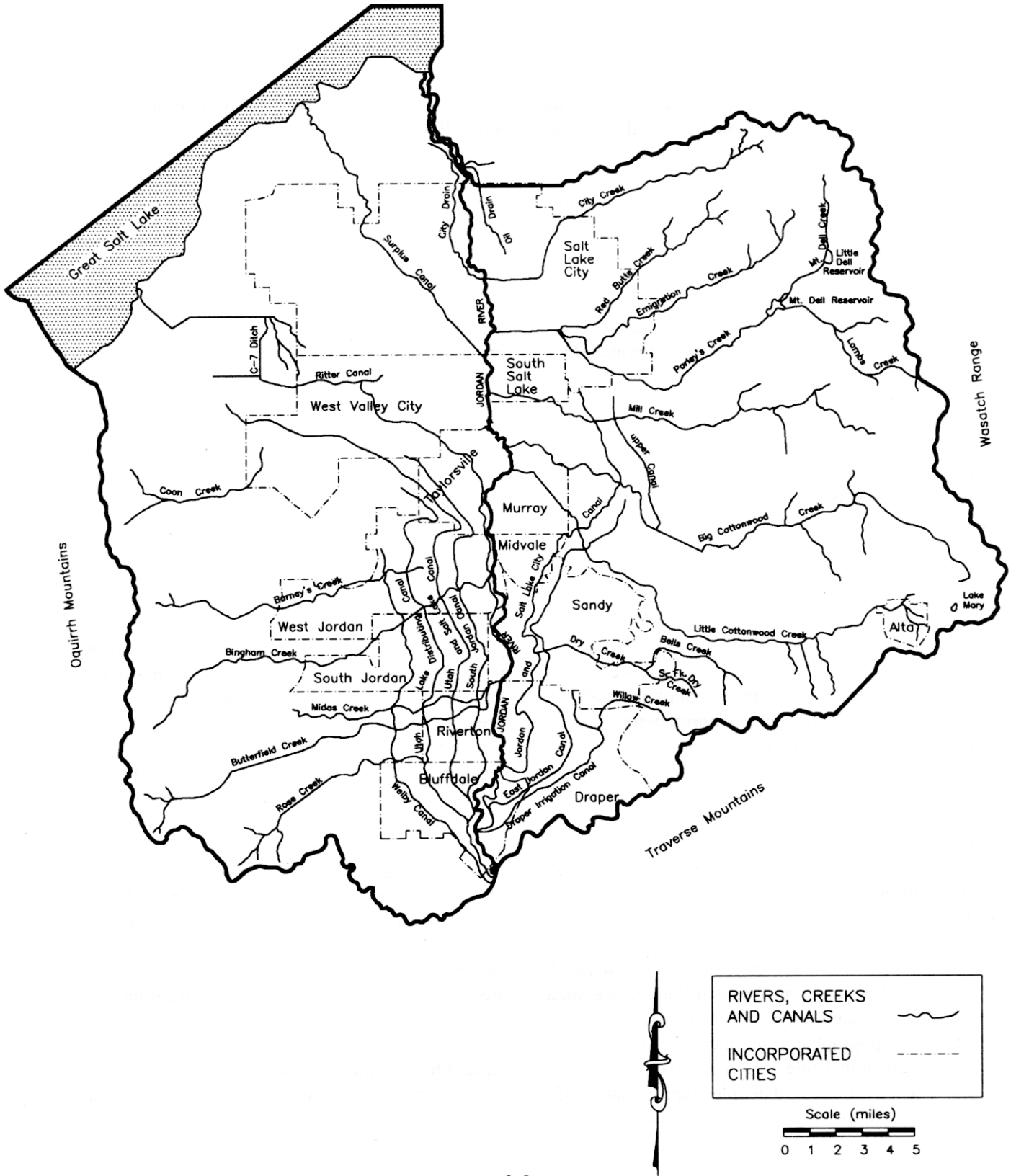


Figure 3-2

LOCATION MAP
Jordan River Basin



Basin, are located approximately 50 miles east of Salt Lake City in the western end of the Uinta Mountains in Wasatch County at elevations approaching 11,000 feet. In the upper reaches of the river, numerous small glacial lakes serve as catchment areas for the heavy snowfall and rain.

The Provo River drains approximately 673 square miles of primarily mountainous and forested land which, except for the settlements in Heber Valley and Utah Valley, is sparsely populated. The other major drainage which contributes significant flows to Utah Lake is the Spanish Fork River which drains 652 square miles of mountainous and forested region in the southeast corner of the basin. Small basins to the west and south of Utah Lake are Cedar Valley, northern Juab Valley and Goshen Valley. These areas, along with other Utah Lake tributary streams, are discussed in the *Utah Lake Basin Plan.*

The Jordan River is 44 miles long (not including meanders) and flows north from the outlet of Utah Lake to the Great Salt Lake. It is also fed by seven major tributary streams (Little Cottonwood Creek, Big Cottonwood Creek, Mill Creek, Parley's Creek, Emigration Creek, Red Butte Creek and City Creek) and 13 smaller streams which originate in the Wasatch Range on the east side of Salt Lake County. These furnish more than 97 percent of the surface water supply in the valley. Six other streams, which originate in the Oquirrh Mountains on the west side of the valley such as Bingham Creek and Butterfield Creek are intermittent and ephemeral in nature and supply less than 3 percent of the surface water.

Salt Lake County has a total area of about 805 square miles (515,200 acres). Approximately 370 square miles are in the extremely mountainous and heavily forested Wasatch Range, Oquirrh Mountains and Traverse Mountains. With the exceptions of Emigration, Big Cottonwood and Little Cottonwood canyons, the mountainous areas are almost entirely uninhabited. Although there is very little residential or agricultural land use in the mountainous portions of the county, there are significant mining interests (particularly in the Oquirrh Mountains) along with a tremendous amount of recreational activity (Wasatch Range). Additionally, the Wasatch Range watersheds provide a significant portion of the municipal water supply. A topographical summary of Salt Lake County is given in Table 3-1. Salt Lake County is home to just over 800,000 people, approximately 45 percent of Utah's total population, residing primarily in 14 incorporated cities (Salt Lake City, South Salt Lake City, West Valley City, Sandy, Taylorsville, Murray, Midvale, Taylorsville, Draper, West Jordan, South Jordan, Riverton, Bluffdale and Alta). A significant population also lives in the unincorporated areas of the county. Much of the residential expansion is occurring on irrigated agricultural lands in the southwest portions of the valley.

Utah Lake, which lies just south of the Jordan River Basin, is used as a reservoir. It has an active capacity of 710,000 acre-feet and a total capacity of 840,000 acre-feet at compromise. Utah Lake is nearly 300 feet higher than the Great Salt Lake, and the outflow from Utah Lake is the Jordan River.

3.3.2 Climate

The Jordan River Basin climate is typical of mountainous areas in the west; wide ranges in temperature between summer and winter, and between day and night. The high mountain regions experience long, cold winters and short, cool summers. The lower valleys are more moderate with less variance between maximum and minimum temperatures. As part of the Great Basin Region lowlands, the Jordan River Basin is classified as semi-arid.

The Jordan River Basin experiences four distinct seasons with a major portion of the precipitation occurring as snow during the winter months and producing high runoff during the spring snowmelt periods. Normal annual precipitation ranges from 12 to 16 inches on the valley floor to 60 inches in the high mountain areas of the Wasatch Range. Precipitation in the lower elevations during the May-September growing season is only 5 to 6 inches, compared to a crop water requirement of 20 to 30 inches. A portion of the precipitation on mountain ranges is absorbed into the soil and underlying bedrock during the runoff periods, providing recharge to the valley groundwater reservoir.

Temperatures in the valley have ranged from -30°F in the winter to 110°F in the summer. Water surface evaporation in the valley averages 42 inches per year. The average frost-free season for the valley area is approximately 200 days from the middle of April to the end of October.

3.3.3 Physiography and Geology

The Jordan River Basin forms part of the eastern edge of the Basin and Range Physiographic Province

Table 3-1
TOPOGRAPHY
Salt Lake County

	Area (square miles)
Mountains (>5200')	370
Water (including Great Salt Lake)	26
Valley (<5200')	409
Total	805

bounded on the east by the Wasatch Range of the Middle Rocky Mountains. The huge fault block mountains surrounding Salt Lake Valley stand as evidence of massive earth shifts in the past, and the Wasatch Fault exists today as a constant reminder of the areas turbulent past. In times of greater humidity and glacial activity, ancient Lake Bonneville covered over 20,000 square miles with a water level 1,000 feet above the present elevation of the Great Salt Lake. As the lake receded, it left wave cut terraces on the lower slopes of the mountains and deposits of sand and gravel in the valley.

The basin is bounded on the east by the Wasatch Range which rises abruptly from the valley's edge (approximately elevation 5,200) to 11,000+ feet above sea level. The Wasatch Range intercepts the moisture bearing westerly winds, providing the bulk of the valley's vital water supply. The Traverse Mountains form the valley's southern barrier. The western edge of the valley is bordered by the Oquirrh Mountains, whose peaks rise to 9,000-10,000 feet. To the northwest lies the Great Salt Lake, and beyond that the Great Salt Lake Desert.

3.3.4 Soils and Vegetation

The soils of the upper valleys, above elevation 5,200 (the highest level of ancient Lake Bonneville), have developed from alluvial sediments on flood plains, alluvial fans, and foot slope areas at the base of the mountains. Quartzite and sandstones are the predominant parent material for the alluvium found in the upper valleys. Being so near the source of parent materials, the valley fill in the upper valleys consists mainly of coarse sands and gravels, although there are areas of medium to fine textured topsoils.

Valley soils have developed from sediments deposited in ancient Lake Bonneville. Much of the soil is medium to coarse-textured material deposited at the edges of the valleys as fans. The lake terraces and finer materials widely distributed on the broader interior valley floor were deposited during Bonneville Lake and post-Bonneville Lake times. As a result, a complex pattern of highly stratified soils exists.

In general, arable lands of the basin have good water transmission properties and adequate moisture-holding capacity which, with other favorable physical and chemical properties, make them well- suited for irrigated agriculture.

As elevation varies from 4,200 to 11,000 feet, and precipitation varies from 12 inches to 60 inches, so also does vegetation vary. Heavy alpine forests above about 8,000 feet give way to oaks, mountain brush and juniper trees, then to sagebrush, sparse grasses, scattered vegetation and semi-desert conditions at lower elevations. About 30 percent of the county is forested with either alpine/conifer/aspen or oaks, with 27 percent falling into the closely related categories of mountain-brush, juniper, sagebrush, greasewood or native vegetation types. An additional 9 percent of the basin is classified as open water, riparian, marsh-land or wetlands. See Table 3-2 for a detailed breakdown of the various vegetative cover types and land use.

3.3.5 Land Ownership And Use

Most of the land in Salt Lake County, especially in the valley, is privately owned. Although Salt Lake City owns and manages 24,000 acres of the upper watershed, most of the lands in the upper watershed are managed by federal agencies. The biggest federal land manager is the Forest Service that administers 91,933 acres of national forest lands in the Wasatch Range. The next largest land holding federal agency is the U.S. Army which controls 13,988 acres around Camp Williams in the southern end of the valley. The only other significant federal land holding is

2,896 acres of public domain managed by the Bureau of Land Management (BLM). The state of Utah has scattered land holdings of 9,778 acres. The state also owns the beds of all navigable streams and lakes. See Table 3-3 and Figure 3-3 for the general pattern of Salt Lake County land ownership and administration.

The general pattern of land use as shown on Figure 3-4 reveals that lands for residential, commercial, industrial and agricultural uses are confined almost exclusively to the valley. The exceptions are industrial development in Bingham Canyon in the southwest portion of the valley, residential development in Emigration Canyon to the northeast, and limited residential development in Big and Little Cottonwood canyons in the southeast. Approximately 32 percent has been developed: residential, 17.2 percent; commercial and industrial, 4.5 percent; and agricultural, 10.3 percent. One detail not apparent from the land use map (Figure 3-4) is that recreational use is made of almost all of the canyon and mountainous areas on the valley's east side. Most heavily used are Big and Little Cottonwood canyons, both of which have world class ski resorts and spectacular vistas that attract people on a year-round basis. Also receiving heavy usage are Mill Creek Canyon with its developed day-use, and Emigration Canyon with its restaurants and lodging facilities. Parley's Canyon, which serves one of the valley's primary transportation corridors (I-80), also has golfing and camping facilities and is heavily used

Table 3-2
VEGETATIVE COVER AND LAND USE (1988)
Salt Lake County

Cover/Use		Area (acres)	Percent of Total Area
Barren rock		5,700	1.1
Alpine, conifer and aspen		76,500	14.8
Oak		87,700	15.3
Mountain brush, juniper, sagebrush and greasewood		62,400	12.1
Scattered native vegetation		79,700	15.5
Riparian, marshlands and wetlands		28,100	5.5
Open water (Incudes the Great Salt Lake)		15,000	2.9
Urban:	residential	92,800	18.0
	commercial and industrial	23,400	4.5
Agricultural:	irrigated	25,300	5.8
	dry-farm	18,600	4.5
	Total	515,200	100.00

Source: *Water-Related Land Use Inventories*, Division of Water Resources, 1994, and Division of Wildlife Resources data.

Table 3-3
LAND OWNERSHIP AND ADMINISTRATION

Status	Jordan River Basin (acres)	Utah Lake Basin (acres)	Jordan River/Utah Lake Basin Total (acres)
Private	372,800	866,400	1,239,200
State	33,600[a]	233,900[b]	267,500
Federal	108,800	844,800	953,600
Total	515,200	1,945,100	2,460,300

(a): Includes bed of the Great Salt Lake (b): Includes bed of Utah Lake

Figure 3-3

LAND OWNERSHIP

Jordan River Basin

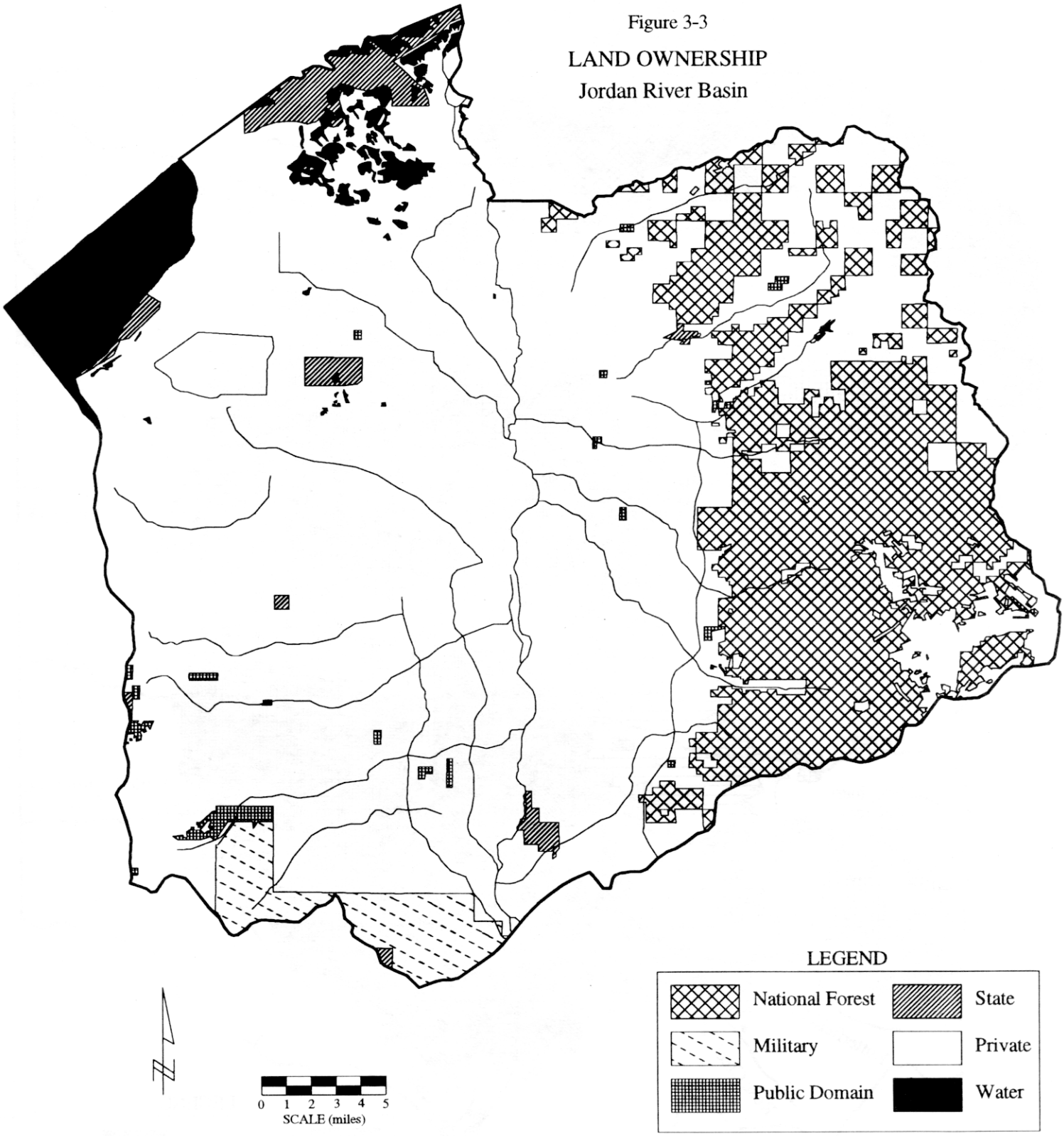
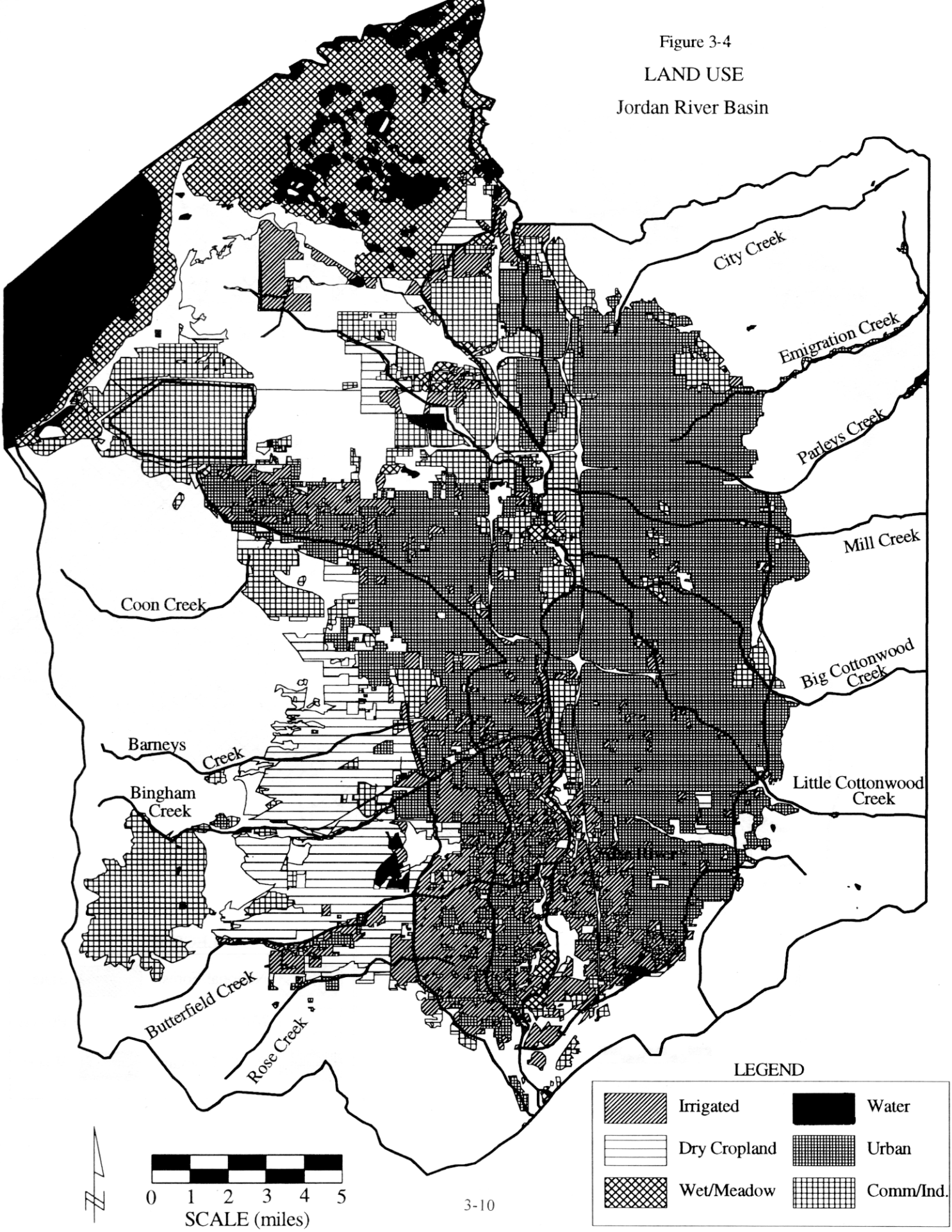


Figure 3-4

LAND USE

Jordan River Basin



for recreation and transportation. Most of the Wasatch Front Canyons as well as the mountainous areas, despite their rugged nature, receive fairly heavy usage for hiking, and other outdoor related activities on a year-round basis.

The land use data shown on Figure 3-4 reveals that residential lands are clustered primarily on the eastern half and central portions of the valley. Industrial lands are fairly well scattered throughout the valley with the most significant cluster in the northwest. Agricultural use is located in the southern and southwestern portions of the valley with some irrigated acres in the northwest. Conversion of irrigated agricultural ground to residential use, primarily at the southern end of the valley, is the current trend.

3.4 Water-Related History

The history of water development and use in the Jordan River Basin covers a period of nearly 150 years. Initial water use was primarily to irrigate land to grow crops; only small amounts were diverted for culinary or community use. This has changed over the years and now the major demand is for municipal and industrial uses. The changes that have occurred are very complex and only a brief summary is given here.

3.4.1 Pioneer Developments

The main body of Mormon Pioneers arrived in Salt Lake Valley on July 24, 1847. An advanced company of men arrived two days earlier to prepare land for planting crops. Water was diverted from City Creek and conveyed in ditches to irrigate land near where the Salt Lake City and County Building now stands. By the spring of 1848, over 5,000 acres had been brought under irrigation. By 1850, farming communities had been established on Big Cottonwood Creek, Mill Creek, Little Cottonwood Creek, Parley's Creek, Emigration Canyon and along the Jordan River. During this period, many ditches and canals were constructed to divert water from streams entering the valley from the east and from the Jordan River. Some of these are in use today. Ditches were financed and built by those who used the water and owned the land.

By 1860, practically all of the waters of the mountain streams had been appropriated for agricultural uses and by families dependent upon farming for their livelihood. Salt Lake City was almost entirely dependent upon City Creek, and the need for additional water resources was recognized. As early as 1864, Salt Lake City began looking into "boring artesian wells" and bringing water from Utah Lake and/or the Jordan River to the city.

Construction on the Jordan and Salt Lake City Canal was completed in 1882 and Jordan River water was brought to Salt Lake City. While this water was adequate for irrigation of crops, it was not suitable for domestic use. This led to the first "Exchange Agreement" in 1888 whereby Jordan River water was exchanged for a higher quality water from Emigration Canyon and Parley's Creek. Over the years, many other water exchange agreements were made in the valley. In 1892, Utah Lake was developed into a storage reservoir which made more water available in the Jordan River. From then, until about 1920, very little was done toward the direct acquisition of new water resources. Several small reservoirs were constructed including Mountain Dell Reservoir in Parley's Canyon which was enlarged in 1925 to a water capacity of 3,086 acre-feet.

3.4.2 Federal Projects

For many years the Bureau of Reclamation, in cooperation with the state of Utah, had been involved in the planning and development of water supplies for local sponsors in the Jordan River Basin. In 1931, the first complete report on the Provo River Project, which was the largest unit of this general plan, was presented by the bureau. Construction of the Provo River Project began in 1938 and the first water became available in 1941. Major features of the project eventually included completion of Deer Creek Dam and Reservoir (152,600 acre-feet) in 1941, construction of the Duchesne Tunnel, enlargement of the Weber-Provo Canal, enlargement of the Provo Reservoir Canal, and construction of the 42-mile Salt Lake Aqueduct in 1951. This aqueduct delivers water from Deer Creek Reservoir to Salt Lake City.

Construction began in 1967 on the Bonneville Unit of the Central Utah Project, and initial delivery to Salt Lake County began in 1990. This project is managed to provide a supply of 84,000 acre-feet of water in times of drought and an average annual 70,000 acre-feet of municipal and industrial water. The Corps of Engineers completed the Little Dell project in 1993. The Little Dell Reservoir has a water capacity of 20,500 acre-feet and serves as a flood control and municipal water supply.

3.4.3 Water Districts

The Metropolitan Water District of Salt Lake City was formed in 1935 by the Utah State Legislature as a "separate and independent" public agency. It is the primary wholesaler of water to Salt Lake City, which has a statutory preferential right to purchase all of the district's water for use within the city. The district participated in the Provo River Project and holds shares of stock in the Provo River Water Users Association which entitles it to receive 61,700 acre-feet of water annually from Deer Creek Reservoir. In 1990, Sandy City formally applied for annexation into the Metropolitan Water District of Salt Lake City. The MWDSLC's board of directors approved this request and increased the board membership from five to seven, adding two members to represent Sandy City. The Salt Lake County Water Conservancy District was organized in 1951 to supply water to the developing areas of the county. Water was first delivered in 1954. The district has grown over the years and now supplies water to 20 wholesale customers and over 7,500 retail connections which include all cities and fire improvement districts. Water sources include direct flow rights in the Provo and Weber rivers, local Wasatch mountain streams, groundwater and storage in Deer Creek, Jordanelle and Echo Reservoirs.

3.4.4 Jordan River History

Before settlement of the Salt Lake Valley, the Jordan River meandered from its entry into Salt Lake Valley at the Jordan Narrows across a broad floodplain to the Great Salt Lake. A forest of cottonwood trees traced its path along the valley floor. Numerous oxbows, marsh areas and riparian zones provided home to a diverse community of wildlife. The Jordan River reportedly was an excellent fishery in the early years following the first settlement of the valley. Since that time, the forest has been cut, the river channeled, the water polluted, the oxbows and wetlands filled, and much of the wildlife displaced. A considerable amount of pollution resulted from mining operations in the Wasatch Front canyons and the Oquirrh mountains. These mining activities have affected water Jordan River quality since before the turn of the century. But mining was at a peak from the early to middle part of this century. While some short sections of the Jordan River may have been straightened or channelized at an earlier date, the bulk of the Jordan River channelizing occurred during the 1950s and 1960s under the concept that a channelized river was the best method for handling flood flows. ■

SECTION 4 CONTENTS

DEMOGRAPHICS AND ECONOMIC FUTURE

Salt Lake Valley is the major population and employment center in the state. In addition to Salt Lake City, with a 1990 population of 159,936, Salt Lake County is home to three of the 10 largest cities in Utah. The population density for Salt Lake County has grown from 900 people per square mile in 1990 to 995 people per square mile in 1995. Much of the county's rugged terrain, however, cannot be developed. Consequently it may be more appropriate to consider the population density of Salt Lake Valley (lands at or below elevation 5200) which is currently approaching 2,000 people per square mile.

4.1 Introduction

The economy of the Salt Lake Valley is characterized by a commercial and industrial urban core in Salt Lake City with suburban communities expanding north, south and west. The Wasatch Mountains to the east provide part of the water supply and land for prestige residential and commercial developments in the foothills. Some limited agricultural production is still evident, mainly in the southwest part of the valley. A revived real estate market, however, is rapidly displacing all but the most tenacious farmers, and reducing the land base available to those that remain.

Population of Salt Lake County is expected to increase throughout the projection period, 1995-2020. The rate of growth is expected to average 1.96 percent annually, but should range between 2.8 percent and 0.5 percent throughout the period.

During the 1980s, services overtook trade to become the industry providing the most employment in Salt Lake County. The unemployment rate was 4.5 percent in 1995 compared to the state average rate of 4.9 percent.

As the basin's economy grows, planning at all levels of government will depend on reliable and consistent data on the demand for water. This section presents data to help local leaders anticipate the need for timely water resources development. Combining these data with the latest technology for delivering, using and conserving available water should result in coordinated planning and manageable economic growth.

4.2 Demographics

Salt Lake County's population in expected to grow by 1.96 percent average annual rate of change. This is slightly below the expected growth of the state which is 1.99 percent. Several communities within the county are expected to grow at a faster rate, at least in the short term. The population projections shown in Table 4-1 and Figure 4-1 are for cities and unincorporated areas in Salt Lake County. Taylorsville has recently become a city. Population estimates and projections for the new city are not available at this time.

The four largest cities in Salt Lake County, Salt Lake City, West Valley City, Sandy and West Jordan, are home to 408,162 people or 21 percent of the state's population (1994 census). Salt Lake City lost population during the 1970-1990 era, but it is expected to show steady growth in the future. The areas of Sandy, West Jordan and West Valley have seen tremendous growth in recent years. Kearns, West Valley and Taylorsville are close to being fully developed. Future population growth will likely concentrate in South Jordan, Draper and Riverton. Additional growth will occur in West Jordan, Sandy, Bluffdale and other communities as remaining open areas fill in. County population is expected to reach 1,301,094 by the year 2020.

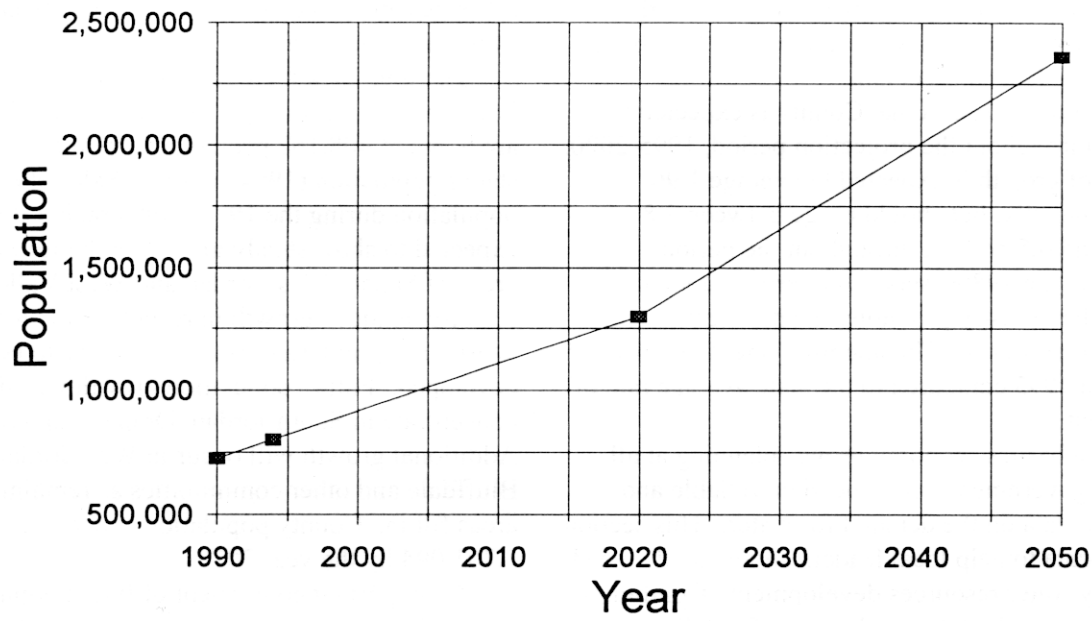
An important component of future population growth is in-migration. Net in-migration (total in-migration less total out-migration) in 1995 was estimated to be 4,800 persons in Salt Lake County,

Table 4-1
POPULATION PROJECTIONS
Salt Lake County

Cities	1990	1994	2020
Alta	397	396	397
Bluffdale	2,152	2,989	18,549
Draper	7,143	8,611	52,900
Midvale	11,886	12,083	24,811
Murray	31,274	33,361	53,206
Riverton	11,261	14,404	54,153
Salt Lake City	159,928	171,849	175,133
Sandy	75,240	90,959	135,916
South Jordan	12,215	16,911	96,879
South Salt Lake	10,129	11,196	16,124
West Jordan	42,915	50,691	107,885
West Valley City	86,969	94,663	144,298
Unincorporated[a]	274,447	293,493	420,843
County	725,956	801,606	1,301,094

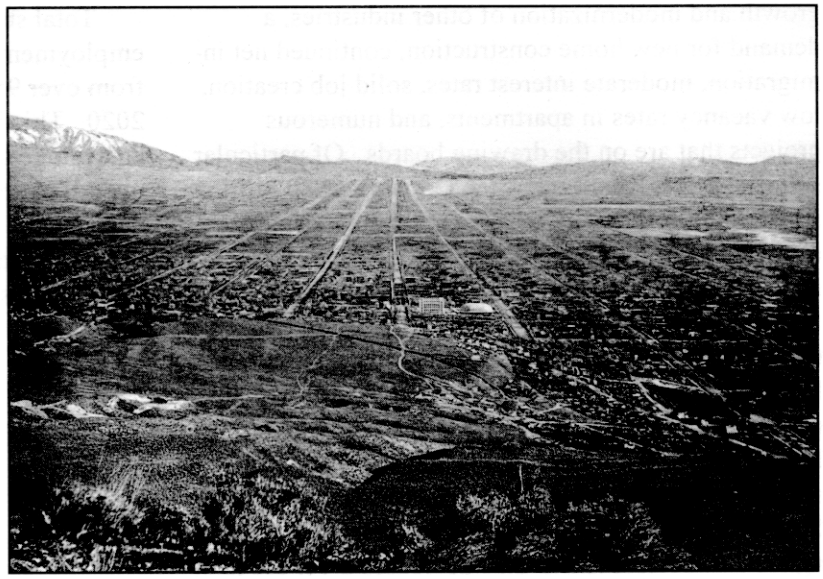
Source: Demographic and Economic Analysis, Governor's Office of Planning and Budget, August 1995
a: Includes recently incorporated Taylorsville City

Figure 4-1
Salt Lake County Population Projection



the highest of any county in the state. Reasons for Salt Lake County's net in-migration include healthy job growth relative to other nearby states and a cost of living that in recent years has been below the national average.

The Wasatch Front Regional Council prepares city-level projections for Salt Lake, Weber, Davis, Morgan and Tooele counties with extensive review and comment from local communities. These projections are controlled to county level projections prepared by the Governor's Office of Planning and Budget and voted on by the regional council's board of directors. Once approved, they are then used to meet transportation planning requirements of the metropolitan planning organization. Projections are only to the year 2020 because that is the long-term horizon from which transportation decisions are made and modeled. These city-level projections, coupled with the Governor's Office of Planning and Budget county-level projections, provide consistent, systematically reviewed data for infrastructure planning along the Wasatch Front.



Salt Lake Valley from Ensign Peak, circa 1890 (top) and in 1997.

Population projections from the Utah Process Economic Demographic (UPED) model are desegregated down to traffic zones within cities and unincorporated communities in Salt Lake County by the Wasatch Front Regional Council. Peer review involving local community representatives was used to even out the results of the mathematical process. Table 4-1 lists the federal census population counts of Salt Lake County's incorporated cities and unincorporated areas for 1990, and the OPB's population estimate for 1994 and projection figures for 2020.

Additional extrapolations were made by the Governor's Office of Planning and Budget to help estimate long-range municipal and industrial water demands. Assuming a constant annual growth rate beyond the year 2020 of about 2.0 percent, the population of Salt Lake County could increase to over 2.36 million by the year 2050.

4.3 Employment

Trade employment is projected to concentrate in Salt Lake City and the current growth areas of West Valley City, West Jordan and Sandy. Service job growth is expected to continue in these areas and to spread into future growth areas such as South Jordan, Riverton and Draper. Industrial employment is projected in West Valley City, West Jordan, western Salt Lake City and Salt Lake County.

The construction industry has recently registered the biggest gains. These gains have been fueled by

growth and modernization of other industries, a demand for new home construction, continued net in-migration, moderate interest rates, solid job creation, low vacancy rates in apartments, and numerous projects that are on the drawing boards. Of particular significance is Kennecott Utah Copper's $880 million smelter and refinery expansion. Manufacturing is expected to trail government as a source of employment during the projection period while finance, insurance and real estate (FIRE) are expected to provide additional jobs at a steady pace. Employment in transportation, communication and public utilities (TCPU) will more than double during the projection period. Irrigated acres and total agricultural acres are declining dramatically in the Salt Lake Valley (see Section 10). The projection for agricultural employment also decreases o ver the next 25 years. Table 4-2 shows present and projected employment in the nine major sectors. Figure 4-2 shows the expected growth and relationships between the six sectors that provide the most jobs

4.4 Economic Future

In Salt Lake County and cities along the Wasatch Front, population growth is projected to slow down in the upcoming years before resuming at a strong rate after the year 2000. A small baby boom occurred during the late 1970s, and many of these children crowded the junior high and high schools. Despite strong job growth, the Wasatch Front is expected to experience net out-migration when these people enter the labor market. In-migration is expected to resume after the year 2000.

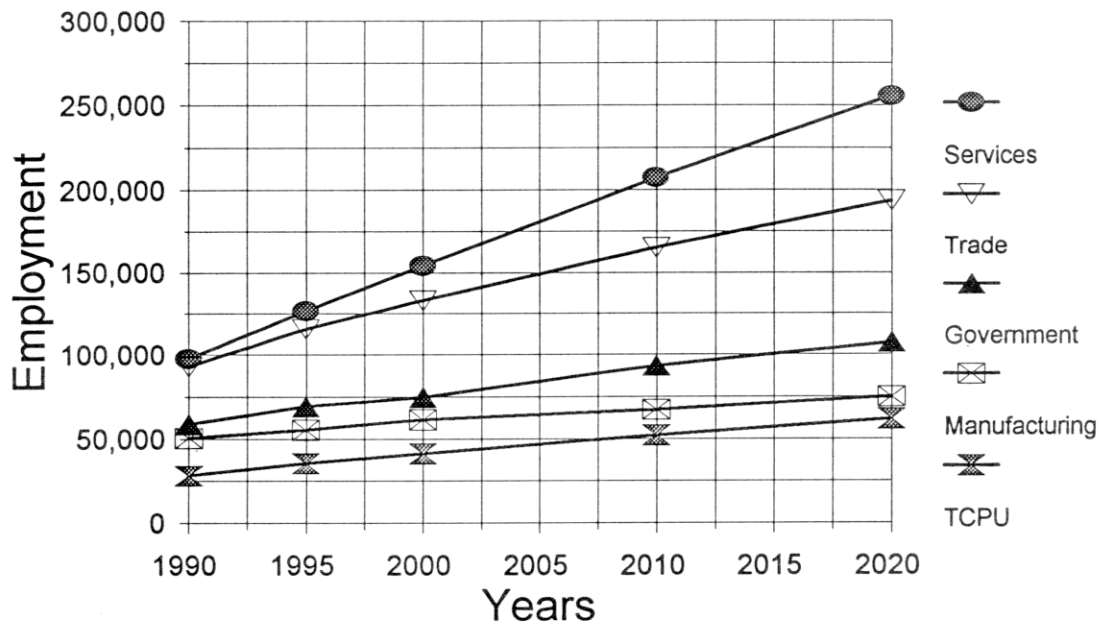
Total state employment (including self-employment and agriculture) is projected to increase from over 951,331 jobs in 1995 to 1,569,842 jobs by 2020. This increase of over 618,511 jobs represents an average annual growth rate of 2.31 percent. The overall pattern is a significant movement away from dependence on the state's traditional goods-producing economic base and toward service-producing industries as driving sectors in the Utah economy. ■

Table 4-2
EMPLOYMENT PROJECTIONS
Salt Lake County

Industry	1990	1995	2000	2010	2020
Agriculture[a]	1,092	1,084	1,109	1,049	966
Mining	2,754	2,967	3,101	3,020	3,113
Construction	14,885	26,498	30,687	33,714	40,045
Manufacturing	50,580	55,258	61,603	67,362	75,017
TCPU[b]	28,293	35,544	41,411	52,135	61,889
Trade	93,170	115,914	132,985	165,089	193,497
FIRE[c]	24,530	34,021	39,081	48,209	56,812
Services[d]	97,745	126,785	154,127	207,449	255,717
Government	58,878	69,332	74,547	93,479	107,547
Non-farm Proprietors[e]	65,140	75,053	86,463	111,796	133,064
TOTAL EMPLOYMENT	437,064	542,456	625,120	783,303	927,667
Non-Ag W & S Emp[a]	368,705	463,998	535,286	668,207	791,373

Source: State of Utah Economics & Demographics 1994
a: Includes agricultural-related services such as lawn care
b: Transportation, communications and public utilities
c: Finance, insurance and real estate
d: Includes private household employment; excludes agriculture service employment
e: Utah Department of Employment Security's definition

Figure 4-2
Salt Lake County Employment Projection



SECTION 5 CONTENTS

WATER SUPPLY AND USE

Salt Lake County is the most densely populated county in the state and relies heavily on groundwater and surface water sources within the valley as well as imported water to meet the growing demand.

5.1 Introduction

This section discusses historical flows, developed water supplies and present water use in the Jordan River Basin. Essentially all of the surface and groundwater sources are fully appropriated and developed. There is, however, a decreasing need for irrigation water and an increasing need for municipal and industrial water. As irrigated lands have gone out of production, the highest quality irrigation supplies have been converted to municipal and industrial uses. Irrigation water supplies that remain are poor quality and will require expensive treatment processes to be converted to M&I uses.

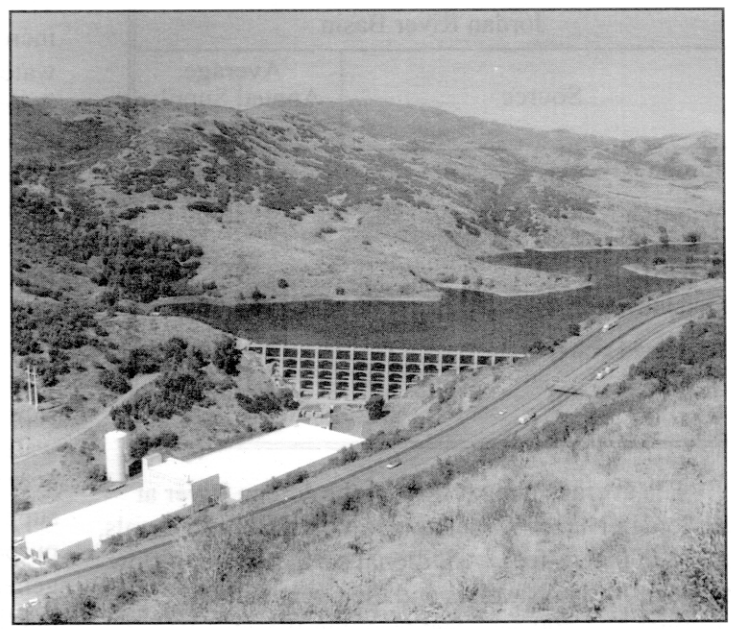
Imported water is playing an increasingly important role. The Metropolitan Water District of Salt Lake City (MWD) and the Salt Lake County Water Conservancy District (SLCWCD) import water from neighboring counties to the south and east to meet the municipal and industrial demands in the basin.

5.2 Background

From the time settlers first came into Salt Lake Valley and diverted local streams onto the land to irrigate their crops, organizations and agencies were established to develop and manage water. Now, nearly 150 years later, a large number of water organizations have evolved which hold water rights, serve a group of users or customers and have a stake in any future water development. These entities represent overlapping and layered jurisdictions which must be considered and incorporated into the water planning process.

Rapid population and economic growth along the Wasatch Front (from Provo on the south to Ogden on the north) is putting considerable pressure on the limited water resources of the region. This heavily urbanized area, roughly 100 miles long and from 10 to 20 miles wide, supports over 75 percent of the approximate two million residents of the state.

Within the Jordan River Basin, surface water supplies are already largely developed and water is being imported from outside the basin. A substantial amount of groundwater is also being develop. The Salt Lake Valley groundwater basin is considered over-appropriated, but not yet over-developed.



Mt. Dell Reservoir

Water agency planners and managers recognize that additional water supplies will undoubtedly be needed at some point in the future. There is some uncertainty as to what extent conservation and recycling measures may delay the development of new water sources, and whether or not arrangements among existing water rights holders can be made to improve the efficient use of existing supplies.

5.3 Water Supply

The Jordan River Basin's present water supplies come from three categories: groundwater, local surface water and imported surface water. An estimate of the total present water supply for the Jordan River Basin is presented in Table 5-1. Imported water, as shown in Table 5-2, includes deliveries directly by pipeline from Deer Creek Reservoir, Central Utah Project (Bonneville Unit) deliveries from Jordanelle Reservoir, and Welby-Jacob Exchange water from Provo and Weber rivers and Echo Reservoir and industrial supplies from Tooele County.

Table 5-1
TOTAL WATER SUPPLY
Jordan River Basin

Source	Average Annual Supply (acre-feet)
Jordan River	308,000
Wasatch Mountain streams	173,400
Oquirrh Mountain streams	4,400
Groundwater	168,500
Imported water	170,700
Total	825,000

The average annual flow of the Jordan River at the Jordan Narrows, including all diversions to canals, is 308,000 acre-feet. Additional surface water inflow between Jordan Narrows and the Great Salt Lake averages 173,400 acre-feet from the Wasatch Range mountain stream and 4,400 acre-feet from Oquirrh Mountain streams.

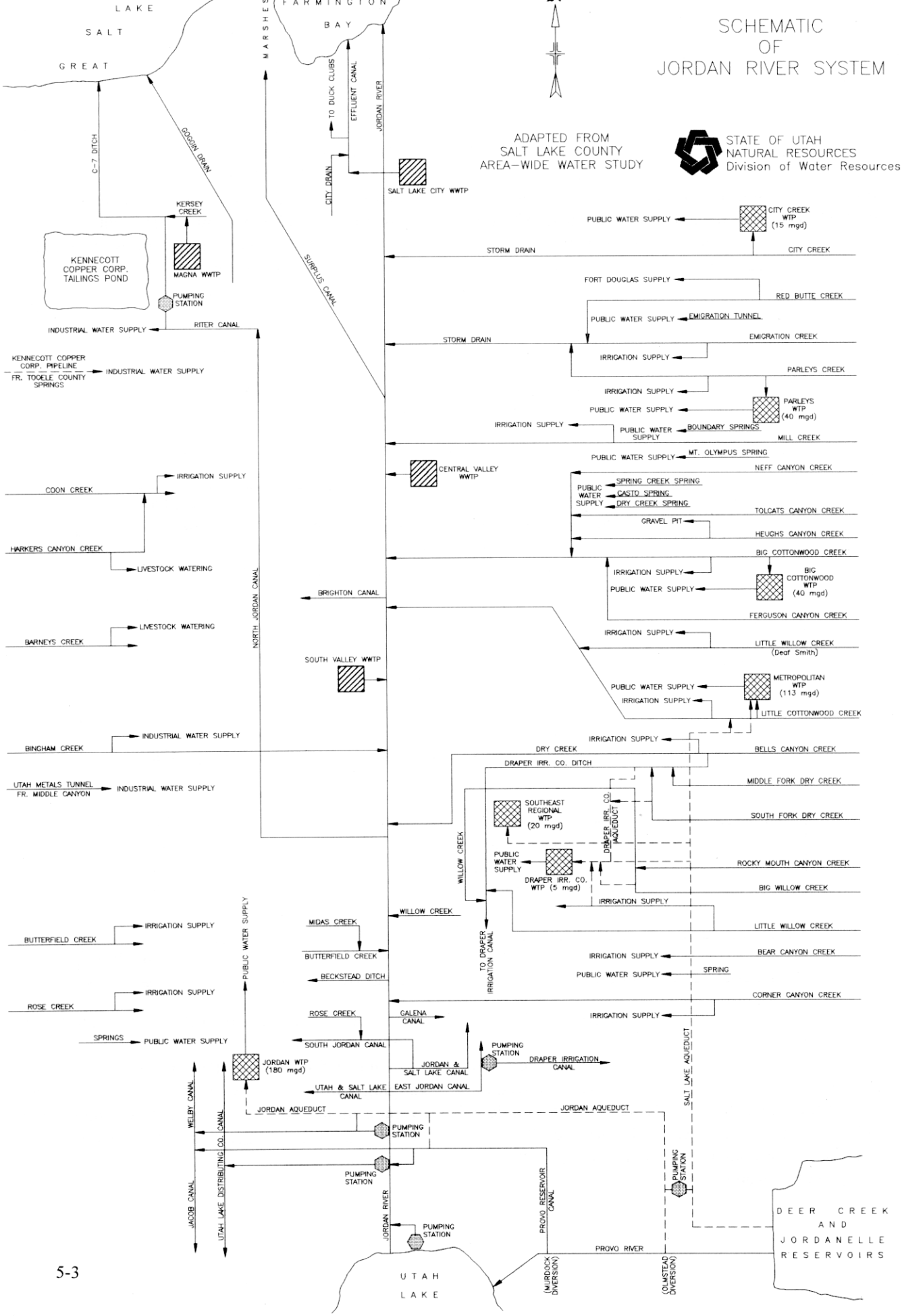
Figure 5-1 is a schematic of the Jordan River system. The horizontal line across the center of the page represents the Jordan River flowing from Utah Lake on the left to the Great Salt Lake on the right. Tributary flows from the Wasatch Range streams are represented by the vertical lines along the bottom of the figure. Irrigation withdrawals and culinary diversions for water treatment are shown. Despite irrigation and culinary withdrawals, the Wasatch Range streams are all shown as terminating at the Jordan River. On the other hand, the Oquirrh Mountain streams, except for Bingham Creek, are depicted as terminating short of the Jordan River (See the upper center of Figure 5-1). Because of the intermittent and ephemeral nature of these streams for much of the year, surface water flows often do not reach the Jordan River.

Water storage in Deer Creek and Jordanelle reservoirs is represented in the lower left hand corner of Figure 5-1. Water can be released from Deer Creek Reservoir to either the Provo River or the Salt Lake Aqueduct. The Salt Lake Aqueduct flow can be delivered to the Metropolitan Water Treatment Plant, the Southeast Regional Treatment Plant, the Draper Irrigation Company Treatment Plant, or diverted to the Jordan Aqueduct and conveyed to the Jordan Valley Water Treatment Plant. At the Olmsted Diversion, Provo River water can be diverted to the Jordan Aqueduct and conveyed to Jordan Valley Treatment Plant. A pump station gives the system increased flexibility, making it possible to pump water from the Jordan Aqueduct to the Salt Lake Aqueduct. Diversions from the Jordan River to various irrigation canals are shown. The figure also gives the location of the valley's water and wastewater treatment plants. Presently developed water supplies are summarized in Table 5-2 and discussed in the following subsections.

The valley's presently developed water supply is summarized by source in Table 5-3. The developed water is segregated into two parts: The public water supply is shown first, and the privately developed water supply second. For the public water supply, the average annual supply is given as well as the reliable supply for nine out of 10 years. For planning purposes the reliable supply for nine out of 10 years is generally accepted as the firm yield. The basin's public water supply comes primarily from nine sources: City Creek, Parley's Creek, Big Cottonwood Creek, Little Cottonwood Creek, other small mountain streams, Welby-Jacob Exchange, Central Utah Project, Deer Creek Reservoir and groundwater. Shown second in the table are the privately developed water supplies including private domestic wells, stockwatering wells, irrigation water and industrial water.

5.3.1 Surface Water

Surface water sources include flows from Wasatch Front mountain streams, Oquirrh Mountain streams and the Jordan River. Inflow to the Jordan River from Utah Lake averages 308,000 acre-feet.


SCHEMATIC
OF
JORDAN RIVER SYSTEM
ADAPTED FROM
SALT LAKE COUNTY
AREA-WIDE WATER STUDY
STATE OF UTAH
NATURAL RESOURCES
Division of Water Resources
GREAT
SALT
LAKE
FARMINGTON
BAY
MARSHES
TO DUCK CLUBS
EFFLUENT CANAL
JORDAN RIVER
CITY DRAIN
SALT LAKE CITY WWTP
C-7 DITCH
GODDIN DRAIN
KERSEY
CREEK
KENNECOTT
COPPER CORP.
TAILINGS POND
MAGNA WWTP
PUMPING
STATION
INDUSTRIAL WATER SUPPLY
RITER CANAL
SURPLUS CANAL
KENNECOTT COPPER
CORP. PIPELINE
FR. TOOELE COUNTY
SPRINGS
INDUSTRIAL WATER SUPPLY
PUBLIC WATER SUPPLY
CITY CREEK
WTP
(15 mgd)
STORM DRAIN
CITY CREEK
FORT DOUGLAS SUPPLY
RED BUTTE CREEK
PUBLIC WATER SUPPLY
EMIGRATION TUNNEL
STORM DRAIN
EMIGRATION CREEK
IRRIGATION SUPPLY
PARLEYS CREEK
IRRIGATION SUPPLY
PUBLIC WATER SUPPLY
PARLEYS
WTP
(40 mgd)
IRRIGATION SUPPLY
PUBLIC WATER
SUPPLY
BOUNDARY SPRINGS
MILL CREEK
PUBLIC WATER SUPPLY
MT. OLYMPUS SPRING
CENTRAL VALLEY
WWTP
NEFF CANYON CREEK
PUBLIC
WATER
SUPPLY
SPRING CREEK SPRING
CASTO SPRING
DRY CREEK SPRING
TOLCATS CANYON CREEK
GRAVEL PIT
HEUGHS CANYON CREEK
BIG COTTONWOOD CREEK
IRRIGATION SUPPLY
PUBLIC WATER SUPPLY
BIG
COTTONWOOD
WTP
(40 mgd)
FERGUSON CANYON CREEK
IRRIGATION SUPPLY
LITTLE WILLOW CREEK
(Deaf Smith)
PUBLIC WATER SUPPLY
METROPOLITAN
WTP
(113 mgd)
IRRIGATION SUPPLY
LITTLE COTTONWOOD CREEK
IRRIGATION SUPPLY
BELLS CANYON CREEK
DRY CREEK
DRAPER IRR. CO. DITCH
MIDDLE FORK DRY CREEK
SOUTHEAST
REGIONAL
WTP
(20 mgd)
DRAPER IRR. CO.
AQUEDUCT
SOUTH FORK DRY CREEK
PUBLIC
WATER
SUPPLY
DRAPER IRR. CO.
WTP (5 mgd)
WILLOW CREEK
ROCKY MOUTH CANYON CREEK
BIG WILLOW CREEK
IRRIGATION SUPPLY
LITTLE WILLOW CREEK
BEAR CANYON CREEK
IRRIGATION SUPPLY
PUBLIC WATER SUPPLY
SPRING
CORNER CANYON CREEK
IRRIGATION SUPPLY
GALENA
CANAL
ROSE CREEK
SOUTH JORDAN CANAL
PUMPING
STATION
DRAPER IRRIGATION
CANAL
JORDAN &
SALT LAKE CANAL
EAST JORDAN CANAL
UTAH & SALT LAKE
CANAL
JORDAN WTP
(180 mgd)
SALT LAKE AQUEDUCT
JORDAN AQUEDUCT
JORDAN AQUEDUCT
PUMPING
STATION
PUMPING
STATION
PUMPING
STATION
PUMPING
STATION
WELBY CANAL
UTAH LAKE DISTRIBUTING CO. CANAL
JACOB CANAL
JORDAN RIVER
PROVO RESERVOIR
CANAL
PROVO RIVER
(MURDOCK
DIVERSION)
(OLMSTEAD
DIVERSION)
DEER CREEK
AND
JORDANELLE
RESERVOIRS
UTAH
LAKE
NORTH JORDAN CANAL
BRIGHTON CANAL
SOUTH VALLEY WWTP
COON CREEK
IRRIGATION SUPPLY
HARKERS CANYON CREEK
LIVESTOCK WATERING
BARNEYS CREEK
LIVESTOCK WATERING
BINGHAM CREEK
INDUSTRIAL WATER SUPPLY
UTAH METALS TUNNEL
FR. MIDDLE CANYON
INDUSTRIAL WATER SUPPLY
BUTTERFIELD CREEK
IRRIGATION SUPPLY
ROSE CREEK
IRRIGATION SUPPLY
SPRINGS
PUBLIC WATER SUPPLY
PUBLIC WATER SUPPLY
MIDAS CREEK
BUTTERFIELD CREEK
BECKSTEAD DITCH
WILLOW CREEK
TO DRAPER
IRRIGATION CANAL

The average annual stream flow from the Wasatch Range is 173,400 acre-feet. The Oquirrh Mountain streams average only 4,400 acre-feet. See Table 5-4 for a detailed breakdown of these figures. The average annual flows in Table 5-4 for the Wasatch Range mountain streams and Oquirrh Mountain streams is taken from the *Salt Lake County Area-Wide Water Study*, published in 1982, and reflect data through 1981. Flows for the ungaged streams were estimated through comparison with gaged streams by use of the area-altitude-precipitation method.

The U.S. Geological Survey (USGS) currently maintains five streamflow gauging stations in the Jordan River Basin. In addition to the existing USGS stations, in the past stations have been located on the Jordan River and tributary streams. Although no longer in use, these discontinued stations are a valuable source of streamflow data. One station was located in the Jordan Narrows (10167000) downstream of the diversion structures for the East Jordan Canal and the Utah and Salt Lake Canal. This station, although discontinued in 1990, collected more than 75 years of streamflow data at the Jordan Narrows location.

Table 5-2
PRESENTLY DEVELOPED WATER SUPPLIES
Jordan River Basin

Source	Description	Average Annual (ac-ft/yr)
Surface Water	Irrigation	140,000
	Public supply - Wasatch Range streams	68,190
	Supply to wet/open areas	94,500
	Secondary	10,000
	Private industrial	3,200
	Subtotal	315,890
Groundwater	Public supply wells and springs	114,400
	Private domestic	24,600
	Self-supplied industrial	26,500
	Irrigation wells	3,000
	Artificial groundwater recharge	5,800
	Subtotal	174,300
Imported Water	Tooele County	10,000
	Deer Creek Reservoir	61,700
	Central Utah Project	70,000
	Welby-Jacob Exchange	29,400
	Subtotal	171,100
	Basin Total	661,290

Historically, surface water sources were first developed for irrigation, while groundwater provided for domestic and culinary needs. With the increasing population, a series of exchanges were employed to convert the highest quality surface water to municipal and industrial use. Consequently, Wasatch Range streams now provide an annual average 68,190 acre-feet for public water supplies.

Table 5-5 lists the past and present basin stream gauging stations along with the years of record and average annual flow. Figure 5-2 shows the location of the existing USGS gauging stations and the discontinued stations.

Table 5-3
EXISTING WATER SUPPLY (PUBLIC AND PRIVATE) - 1995
Jordan River Basin

PUBLIC WATER SUPPLY (ac-ft/yr)
(includes residential, commercial and industrial uses)

Source	Average Supply	Reliable Supply (90% probability)
Wasatch Range streams		
City Creek	8,310	6,080
Parley's Creek	8,890	5,210
Big Cottonwood Creek	25,920	20,020
Little Cottonwood Creek	21,670	17,340
Small mountain streams	3,400	1,100
Subtotal	68,190	49,750
Welby-Jacob Exchange	29,400	17,500
Central Utah Project	70,000	84,000 [b]
Deer Creek Reservoir	61,700	61,700
Groundwater	114,400	114,400
Artificial groundwater recharge	5,800	1,060
TOTAL	349,490	328,410

PRIVATELY DEVELOPED WATER SUPPLIES

Use	Description	Supply (ac-ft/yr)	
		Annual average	Subtotal
Private	Private domestic and stock wells	24,600	24,600
Self-supplied Industrial	Industrial wells	26,500	39,700
	Imported from Tooele County	10,000	
	Surface and springs	3,200	
Agricultural	Irrigation (primarily from Jordan River)	140,000	143,000
	Irrigation wells	3,000	
Secondary	Lawns and gardens	10,000	10,000
Environmental	Developed wetlands and open water areas	94,500	94,500
TOTAL			311,800

(a) Streamflow values are from the *Salt Lake County Area-Wide Study* and reflect 1940-1980 base time period.
(b) The Central Utah Project is managed to bring up to 84,000 acre-feet of water into the basin during times of drought.

The Jordan River has an average annual flow of about 308,000 acre-feet at the Jordan Narrows. As can be seen from Figure 5-3, that amount includes the extremely wet years of 1983 through 1986. A close examination of Figure 5-3 and Figure 5-4 reveals that the flow of the Jordan River can drop below 200,000 acre-feet per year for an extended period of time, as was the case in the early 1930s and 1960s. In recent years, over 90,000 acre-feet of water rights in Utah Lake have been purchased for securing the storage right for Jordanelle Reservoir. In addition, over 40,000 acre-feet of water rights have been purchased by the Salt Lake County Water Conservancy District for the Welby-Jacob Exchange. Of the sources available, it is estimated that the surface water supply presently developed for irrigation in Jordan River Basin is about 140,000 acre-feet per year. This amount is consistent with the most recently completed landuse survey for the valley. For more information on this topic see Section 10, Agricultural Water.

5.3.2 Groundwater

Groundwater is an important source of water supply in the Jordan River Basin. The current total groundwater supply is estimated to be 174,300 acre-feet per year. This includes all sources including public drinking water supplies (114,400 acre-feet), private domestic and stock watering wells (24,600 acre-feet), private agricultural wells (3,000 acre-feet), privately developed industrial wells (26,500 acre-feet) and 5,800 acre-feet of artificial groundwater recharge. Existing developed groundwater sources for each public water supplier are tabulated in Table 5-6. Current groundwater withdrawals (1986-1995) are

estimated to be around 134,500 acre-feet per year.

An estimated 145,800 acre-feet of the present 174,300 acre-feet of existing groundwater supply is suitable for culinary use without treatment. The remaining 28,500 acre-feet is of lesser quality (high salinity, i.e., high total dissolved solids) and suitable for culinary use only after treatment to lower the salinity or after blending with higher quality water. Water quality is discussed in more detail in Section 12, Water Quality and Section 19, Groundwater.

Table 5-4
MOUNTAIN STREAMS - ANNUAL FLOW
Jordan River Basin

Wasatch Range Streams	(acre-feet)
City	11,750
Red Butte	2,450
Emigration	4,440
Parley's	18,130
Mill	10,760
Neffs	4,280
Tolcats	650
Heughs	1,770
Big Cottonwood	51,240
Ferguson	1,450
Deaf Smith	4,520
Little Cottonwood	46,190
Bells	6,280
Middle Fork Dry	700
South Fork Dry	1,360
Rocky Mouth	910
Big Willow	2,080
Little Willow	1,660
Bear	1,260
Corner	1,520
Total	173,400
Oquirrh Mountain Streams	
Rose	540
Butterfield	820
Bingham	1,450
Barneys	330
Harkers	470
Coon	790
Total	4,400

Source: *Salt Lake County Area-wide Water Study, 1982* (base time period is 1940-1980)

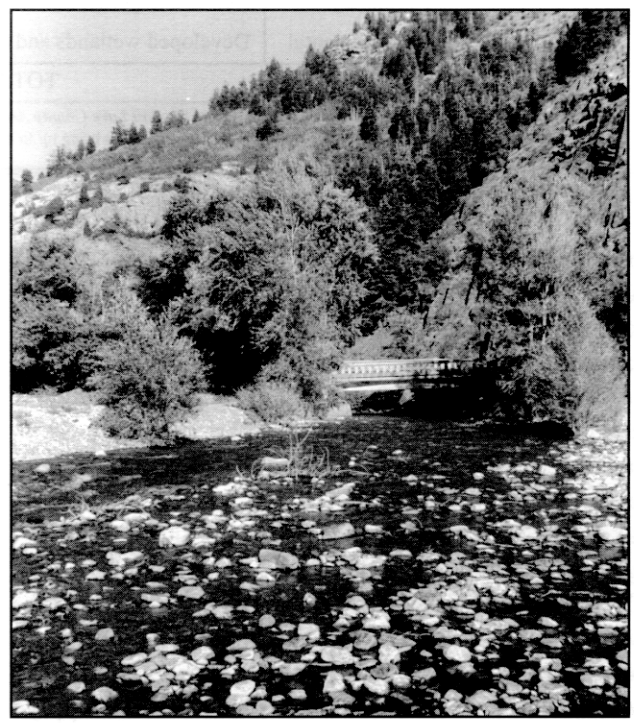
Plans are now in place to increase public water supplies from groundwater sources from 114,400 acre-feet to 125,410 acre-feet. These development plans are discussed in more detail in Section 9, Water Planning and Development. But restrictions are currently imposed by the State Engineer on applications to appropriate new groundwater. These restrictions,discussed in greater detail in Section 19, Groundwater, essentially close the county to new groundwater applications.

5.3.3 Imported Water

Salt Lake City can import as much as 61,700 acre-feet of water from the upper basin. This water is delivered from Deer Creek Reservoir through the Salt Lake Aqueduct and conveyed primarily to the MWD water treatment plant.

The Central Utah Project (CUP) currently delivers 20,000 acre-feet of municipal and industrial water to the Jordan River Basin. With the completion of Jordanelle Reservoir and other Central Utah Project elements, the CUP is now capable of delivering an annual average of 70,000 acre-feet. The Central Utah Project will be managed, however, to bring up to 84,000 acre-feet into the basin during times of drought.

The Welby-Jacob Exchange of Utah Lake water for higher quality Provo River water provides an average annual supply of 29,400 acre-feet. The



Big Cottonwood Creek

Table 5-5
STREAMFLOW GAGING STATIONS
Jordan River Basin

Number	Description	Years of record	Average Annual Flow
Gaging Stations on the main stem of the Jordan River:		(acre-feet)	
10167000	Jordan River at Narrows	1914 to 1989	295,200
10170500	Jordan River Surplus Canal	1942 to present	268,800
10171000	Jordan River (Below the Surplus Canal)	1942 to present	105,500
10170490	Jordan River + Surplus Canal	1942 to present	374,300
Gaging Stations on Tributary Streams:			
10167499*	Little Cottonwood Creek	1981-1991	22,730
10167500*	Little Cottonwood Creek (near Salt Lake City)	1964-1968,1980	35,910
10168000*	Little Cottonwood Creek (at Jordan River)	1980-1991	39,870
10168300	Big Cottonwood Creek (Tail race at Stairs Plant)	1925 to present	40,430
10168500*	Big Cottonwood Creek (near Salt Lake City)	1931-1990	44,380
10170000*	Mill Creek	1964-1968,1980	9,190
10172000*	Emigration Canyon	1964-1968,1980 1981,1983,1985	6,110
10172200	Red Butte Creek (Above Red Butte Reservoir)	1963 to present	3,110
10172200*	Red Butte Creek (Below Red Butte Reservoir)	1980-1991	2,100
10172500*	City Creek - (near Salt Lake City)	1964-1968,1980	10,370

* Salt Lake City Gaging Station

estimated amount available with a reliability of nine out of 10 years, however, is only 17,500 acre-feet. In addition, an estimated 10,000 acre-feet per year is brought into Salt Lake County from Tooele County by Kennecott Utah Copper for self-supplied industrial use.

5.4 Present Water Use

Water use can be separated into two general categories: potable and non-potable. Potable water satisfies most municipal and industrial demands while non-potable water supplies irrigation to agricultural lands and some residential lawns and gardens (secondary) and wetland areas. The present water use for the Jordan River Basin, potable and non-potable, is compared with the existing water supply in Table 5-7.

Potable water is divided into three water supply categories: public water systems, private domestic systems and self-supplied industrial. Public water systems deliver water to cities, towns and subdivisions. They are regulated by the Division of Drinking Water (See Section 11). Private domestic systems are individual residences not served by any

Figure 5-2

STREAM GAGE STATIONS
Jordan River Basin/Salt Lake County

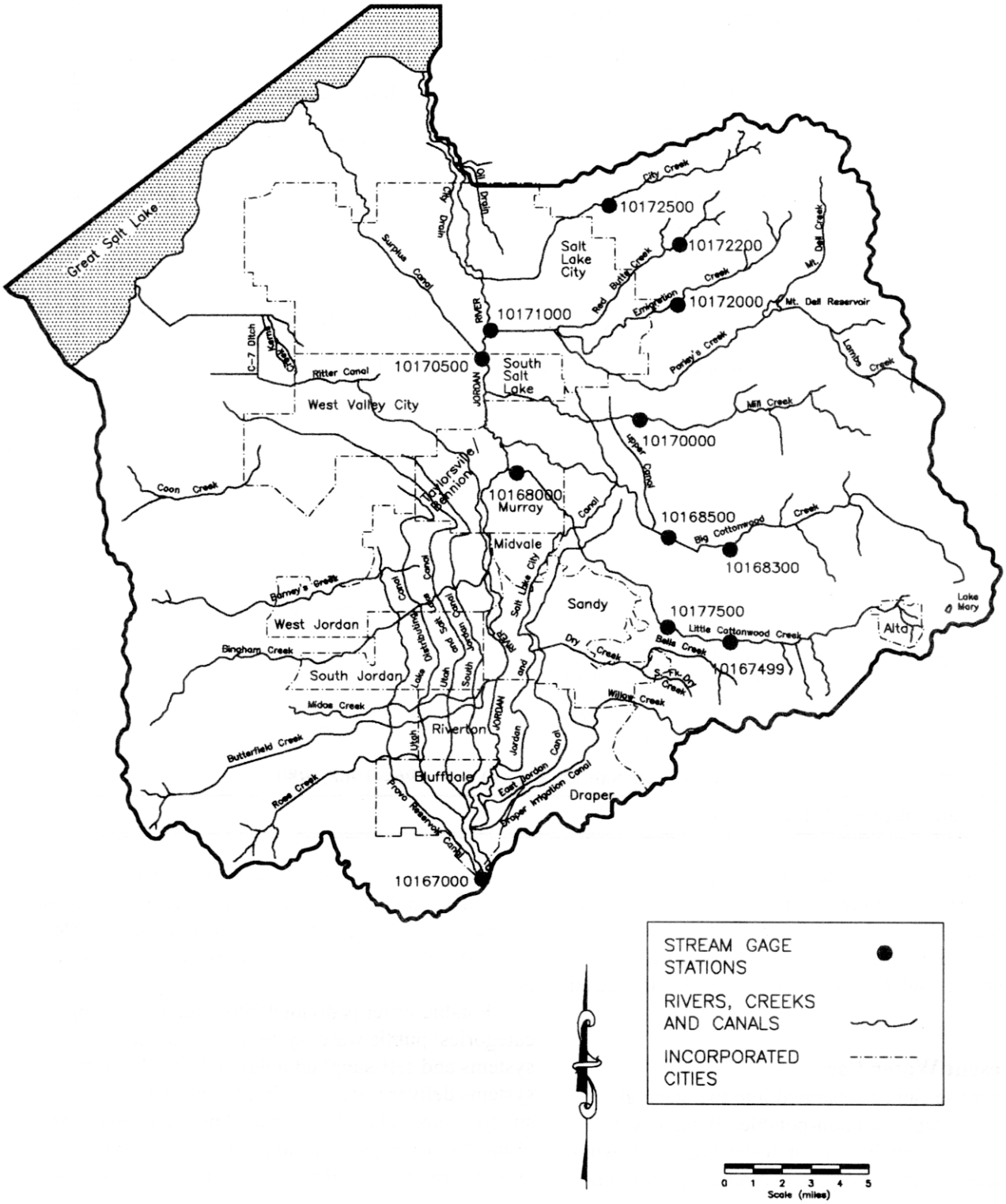


Figure 5-3
JORDAN RIVER AT NARROWS,
NEAR LEHI 1914-1990
(USGS 10167000)

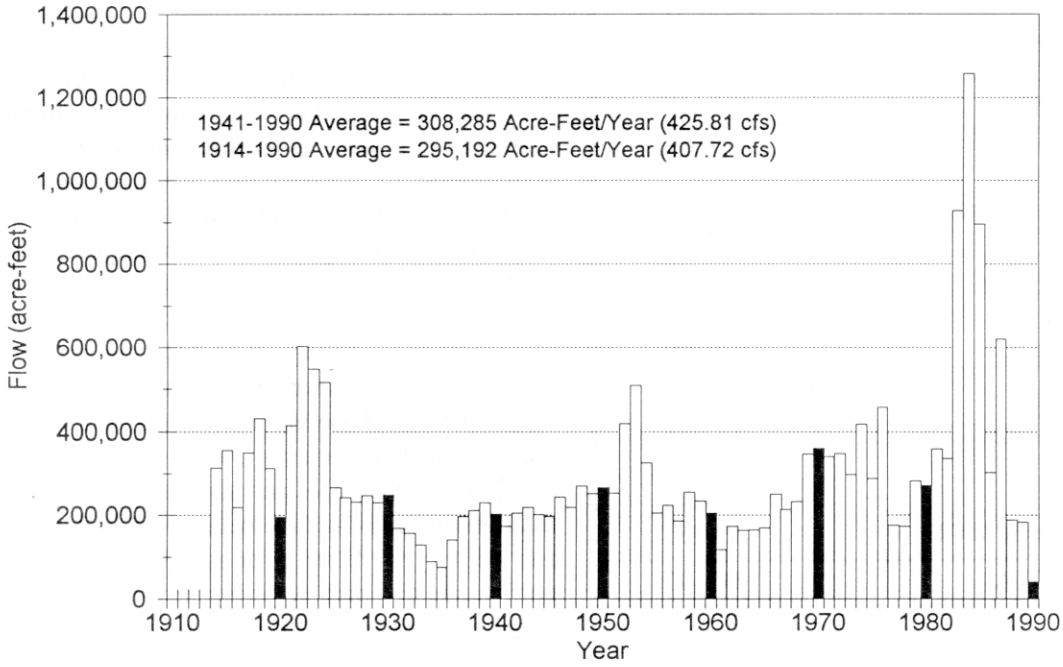


Figure 5-4
COMBINED FLOW JORDAN RIVER AND
SURPLUS CANAL 1944-1994 @ 21st SOUTH
(USGS 10170490)

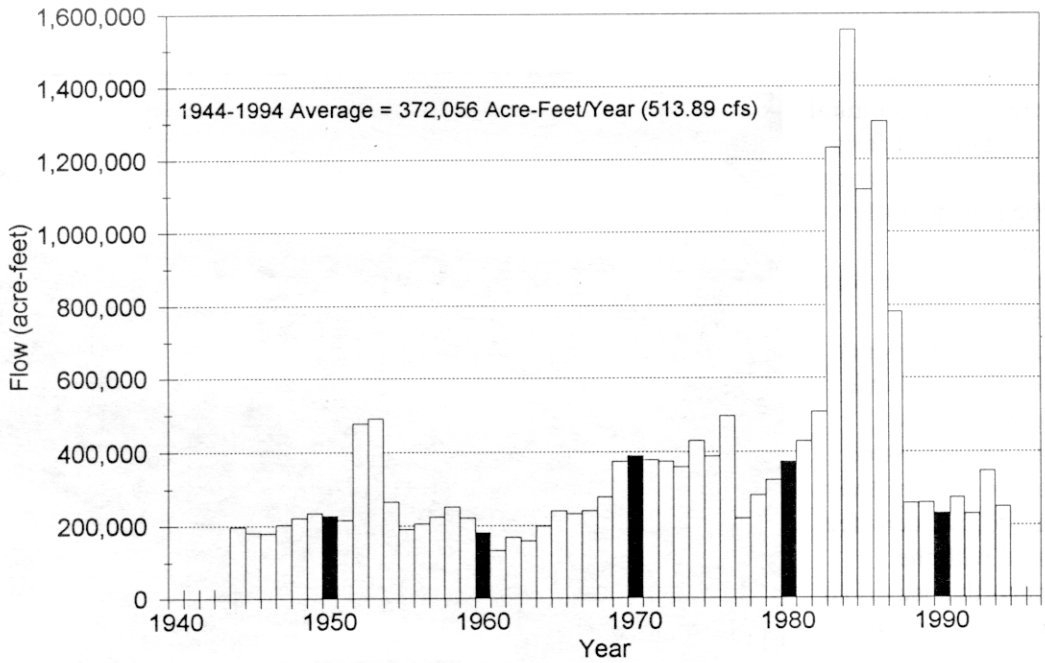


Table 5-6
PRESENTLY DEVELOPED PUBLIC GROUNDWATER SUPPLIES
Jordan River Basin

Public water supplier	Capacity (acre-feet/year)
Granger Hunter	7,340
Herriman	1,300
Holladay	3,520
Kearns	360
Magna	4,090
Midvale	740
Murray	11,590
Riverton	2,060
Salt Lake City	24,490
Sandy City	14,850
South Salt Lake	3,120
Taylorsville	12,700
West Jordan	5,650
White City	2,630
Salt Lake County WCD	19,960
TOTAL	114,400

public water system, and have their own wells. Similarly, self-supplied industrial users are industries not served by a public water system, but have their own private water source.

Non-potable water is divided into secondary, agricultural and developed wetlands water use categories. Secondary is non-potable water used for irrigation of residential lawns and gardens from either pressurized or ditch delivery systems. Agricultural is water used for irrigation of farm lands. Developed wetlands is water used to manage the private duck clubs and public water fowl management areas in the north west portion of the basin.

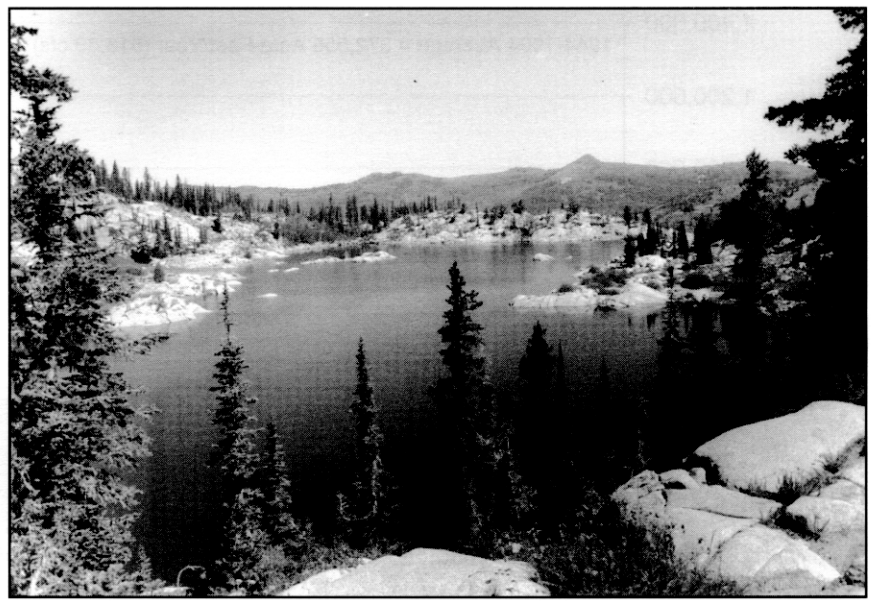
The 1995 total potable water use is 308,300 acre-feet while the 1995 total non-potable use is 244,200 acre-feet. The estimated total water use for the Jordan River Basin presently is 552,500 acre-feet per year. Compared with the present water supply, this leaves an unused supply of 92,450 acre-feet per year.

5.4.1 Municipal and Industrial Use

Municipal and industrial uses include all potable water along with non-potable water used in secondary irrigation systems. Total M&I water use for 1995 is 331,500 acre-feet, including 308,300 acre-feet of potable use and 23,200 acre-feet of non-potable secondary use. See Table 5-7. The majority of M&I water use is the treated water supplied by public water systems. This water is used for residential, commercial, institutional and industrial purposes.

Residential use of water includes drinking, food preparation, bathing, washing clothes and dishes, flushing toilets, watering lawns and gardens, and other household uses. The Wasatch Front Water Demand/Supply Model (WFCM) estimated the 1995 residential water use at 164,600 acre-feet.

Commercial use includes water used in business facilities such as hotels, motels, restaurants, office buildings, retail stores and service stations. Institutional uses include water used in government and military facilities, prisons, educational facilities, golf course and park watering, fire-fighting, and unmetered losses within water delivery systems. The WFCM estimated the 1995 commercial/institutional water use to be 77,200 acre-feet. Industrial use includes water to manufacture products such as steel, petroleum, chemicals, paper or dairy products. Mining and other related activities are included in the industrial use category. The WFCM estimated the



Lake Mary

Table 5-7
WATER USE vs SUPPLY (1995)
Jordan River Basin

	Present Use (acre-feet/year)	Present Supply* (acre-feet/year)	Unused Supply
Potable			
Public water system:			
Residential	164,600	-	-
Commercial/institutional	77,200	-	-
Industrial	15,400	-	-
Subtotal	257,200	328,410	75,950
Private domestic systems:	24,600	24,600	-
Self-supplied industrial	26,500	26,500	-
Subtotal	51,100	51,100	
Total potable	308,300	384,250	75,950
Non-Potable			
Secondary			
Residential	10,000	10,000	
Self-supplied industrial	13,200	13,200	-
Agricultural	126,500	143,000	16,500
Developed wetlands	94,500	94,500	-
Total non-potable	244,200	260,700	-
Total water	552,500	644,950	92,450

* Reliable supply for nine out of 10 years

1995 industrial use supplied by public water systems at 15,400 acre-feet.

Approximately 90,000 people within the basin are not supplied by a public water system. An estimated 24,600 acre-feet of water is pumped by individual wells and used in private domestic systems. Self-supplied industrial water use, from data supplied by the Division of Water Rights, is an estimated 39,700 acre-feet. Of that amount, 26,500 acre-feet is groundwater, 3,200 acre-feet is non-potable surface and spring water, and 10,000 acre-feet is water from Tooele County

Secondary water systems can reduce the demand for treated water by providing lower quality water for such uses as watering lawns and gardens and other outside uses. At the present time, there are few secondary water systems in the Jordan River Basin. Draper and South Jordan secondary irrigation systems are the most significant in size, although other small secondary systems are in Riverton, Bluffdale and West Jordan. Annual secondary water use is estimated at 10,000 acre-feet per year.

Reducing the demand for culinary water by retrofitting existing subdivisions with secondary water systems has potential. Studies indicate, however, that constructing a secondary system for existing urban subdivisions would be very expensive. Retrofitting existing subdivisions with a secondary system would cost as much or more than the savings associated with reduced water treatment. Information on conserving water through secondary water systems is in Section 17, Water Conservation/ Education.

5.4.2 Agricultural

The land use mapping by the Division of Water Resources in 1994 indicates the present active irrigated lands include about 25,300 acres. The irrigated cropland consists of about 27 percent alfalfa, 36 percent pasture/grass hay land, 16 percent grain and corn, and less than 2 percent orchard and vegetables. The balance is idle and fallow ground.

The total agricultural water supply for an average year is estimated to be 143,000 acre-feet. Only about 126,500 acre-feet was diverted in 1995. About 3,000 acre-feet of that amount is supplied from groundwater.

5.4.3 Wetland and Riparian Use

Water-related land-use data developed by the Division of Water Resources indicates there are about 43,100 acres of wet meadows, marsh lands and open water areas on the valley floor. Most of these wetlands are situated along the shoreline of the Great Salt Lake. They are developed and managed by either public agencies or private entities (duck clubs) to enhance wildlife habitat. The net evapotranspiration from these developed wetland areas is estimated to be 94,500 acre-feet per year. The water supply comes through a number of well-established water rights, primarily surface water flows directly from the Jordan River.

5.4.4 Instream Flow Requirements

Maintaining a minimum flow in a stream for fishery habitat has not been historically acknowledged as a beneficial use of the state's water resources. In recent years, however, it has not only gained acceptance but it can now be established under legislative authority. No minimum instream flows are required for the Jordan River or its tributaries. Although releases to satisfy down stream rights, return irrigation flows and unused agricultural water flows make it doubtful any instream flow requirements will be needed for the Jordan River, the *Salt Lake City Watershed Management Plan* does recommend instream flow requirements be established for Wasatch Range mountain streams to preserve aesthetic and ecological values. See Section 6, Management.

5.4.6 Hydropower

The use of water to generate hydropower is a non-consumptive use that can also be relatively non-polluting. Because the amount of hydropower that can be developed is a function of the change in elevation, hydropower facilities are usually associated with dams or other diversion structures and often result in the de-watering of a section of a stream. Utah Power generates power from facilities on Big Cottonwood Creek while Murray City generates power from a hydro-power plant on Little Cottonwood Creek. The Federal Energy Regulatory Commission (FERC) issues licenses for hydropower projects. Licensees are required to mitigate impacts to fish and wildlife resources. This often involves an obligation to maintain a minimum flow in the portion of the stream below the diversion. See Section 18 for more information. ■

SECTION 6 CONTENTS

Tables

MANAGEMENT

Management is the responsibility for control, augmentation and use of a water supply, including storage, diversion, distribution and treatment.

6.1 Introduction

This section describes the existing water management systems for irrigation, municipal, industrial and waterfowl use. Management organizations are listed and general recommendations are made. Management for water quality, fisheries, conservation and groundwater use are covered in other sections of this report. Local management of water supplies throughout the Jordan River Basin consists of a complex mix of cities, towns, irrigation companies and water conservancy districts.

6.2 Setting

To a large extent, the flow of the Jordan River is controlled at the point of outflow from Utah Lake. Also, a number of small reservoirs on tributary streams along the Wasatch Front add a limited management impact upon their outflow. For the most part, however, the flow regimes within the Jordan River Basin are natural. Many of the Jordan River's tributary mountain streams tend to be intermittent (and in many instances ephemeral, particularly on the west side of the valley) with flows ranging during the course of the year from zero to bank-full. Although much of the flow from Wasatch Range streams is diverted for municipal and industrial use, peak flows from Little Cottonwood Creek, Big Cottonwood Creek, Mill Creek, Emigration Creek, and City Creek can be, and have been in recent years, a substantial flooding threat to Salt Lake Valley communities.

The Jordan River Basin has 10 active reservoirs. But they are relatively small and located high in the Wasatch Range. Their primary function is culinary water supply storage, so their size and location preclude their use as flood control or flow management facilities. Table 6-1 lists the active reservoirs and pertinent data. Red Butte reservoir is included, although it is currently inactive.

6.3 Management Entities and Systems

Department of Natural Resources Building in Salt Lake City

6.3.1 Water Quality/Flood Control Management

The overall management of water in the entire Jordan River Basin is a very complex issue requiring the integration of municipal, industrial, agricultural and recreational needs as well as fish and wildlife issues. One of the biggest problems in the Jordan River Basin is the many competing values and interested parties, but no one controlling body or agency. Recognizing the need for increased communication and cooperation among the many federal, state and local governmental agencies and to promote efficient planning, implementation, and coordination of management and regulatory activities, the Salt Lake County Board of Commissioners created an

Table 6-1
EXISTING RESERVOIRS
Jordan River Basin

Name	Built	Stream	Owner	Total Storage (acre-feet)
Little Dell	1993	Dell Creek & Parley's Creek	Corp of Engineers	20,500
Mountain Dell	1925[a]	Dell Creek & Parley's Creek	Salt Lake City	3,514
Lake Mary-Phoebe	1915	Big Cottonwood Creek	Salt Lake City	85
Jordan Valley Water Purification				
Upper Pond	1981		Salt Lake County Water	550
Lower Pond	1982		Conservancy District	46
Twin Lakes	1914	Big Cottonwood Creek	Salt Lake City	486
Red Butte[b]	1930	Red Butte	U.S. Army	385
White Pine Lake	1933	Little Cottonwood Creek	South Despain Ditch Co.	315
Bell Canyon (Lower)	1907	Bells Canyon Creek	Bell Canyon Irr. Co.	25
Red Pine Lake	1929	Little Cottonwood Creek	Little Cottonwood	202
Secret Lake	1926	Little Cottonwood	Water Association	60

a. Mountain Dell Reservoir was originally built in 1917 and enlarged to its present capacity in 1925.
b. Red Butte is currently inactive with stream flows passing directly through the outlet works.

Table 6-2
JORDAN RIVER SUB-BASIN WATERSHED MANAGEMENT COUNCIL

Cities
- Alta
- Bluffdale City
- Draper
- Midvale
- Murray
- Riverton
- Salt Lake City
- Sandy
- South Jordan
- South Salt Lake City
- West Jordan
- West Valley City

Federal Agencies
- Fish and Wildlife Service
- Forest Service
- Army Corps of Engineers

State Agencies
- Department of Agriculture
- Division of Parks and Recreation
- Division of Water Quality
- Division of Water Resources
- Division of Water Rights
- Division of Forestry, Fire and State Lands
- Division of Wildlife Resources
- Salt Lake Soil Conservation District
- Utah State Extension Service

County Agencies
- City/County Health
- Salt Lake County Parks and Recreation
- Salt Lake County Public Works/Engineering and Operations divisions

inter-jurisdictional advisory council named the Jordan River Sub-Basin Watershed Management Council. It assists the Board of County Commissioners in fulfilling its responsibilities for area-wide water quality and flood control activities. Council members are representatives from local, state and federal agencies and entities listed in Table 6-2. Organized

in the summer of 1993, this council meets monthly to discuss Jordan River watershed management issues. Its duties, directed by the Board of County Commissioners, are:

A) Prepare an annual report of activities, in coordination with all governmental agencies represented on the council.
B) Review and evaluate development proposals within the flood channel, flood plain, meander corridor, wetlands, and other areas of important riparian resource values along the Jordan River, and evaluate potential impacts of proposals.
C) Recommend and prioritize planning activities to address or mitigate impacts of development proposals, and coordinate among the parties to effectively review, monitor and evaluate the progress of plan implementation.
D) Coordinate and integrate the interests of parties which may be impacted by proposals for development of mitigation, and assist local, state, and federal management agencies in the prioritization of proposals for potential funding and cost sharing.
E) Recommend priorities for acquisition of critical water related resources, including wetlands, riparian corridors, meander corridors, wildlife reserves, and park lands.

Table 6-3
IRRIGATION COMPANIES

Irrigation Company	Acres Served
Utah and Salt Lake Canal Company	9,300
East Jordan Irrigation Company	6,700
South Jordan Canal Company	5,930
Draper Irrigation Company	4,600
North Jordan Irrigation Company	3,170
Sandy Irrigation Company	2,500
North Point Consolidated Irrigation Company	2,400
Brighton and North Point Irrigation Company	2,000
Green Ditch Water Company	2,000
Union Jordan Irrigation Company	1,700
Little Cottonwood - Tanner Irrigation Co.	1,260
Nickel Irrigation Company	900
Union and East Jordan Irrigation Company	850
Lower Mill Creek Irrigation Company	800
Big Cottonwood Lower Canal Company	800
Sandy Canal Company	800
Richards Irrigation Company	500
Walker Ditch Company	500
McGhie Irrigation Company	480
East Mill Creek Irrigation Company	400
Hill Ditch Irrigation Company	320
Butler Ditch Irrigation Company	300
Little Cottonwood - Brown Ditch Company	300
Galena Canal Company	296
Spring Creek Irrigation Company	275
Rose Creek Irrigation Company	250
Total	49,331

This partial list of Salt Lake County's mutual irrigation companies only includes companies with water rights serving lands in excess of 250 acres.

F) Provide legislative and public education support for present and future stream and river corridor projects and programs, and encourage continuing review of new developments and considerations of innovative practices in technological, legal and administrative aspects of watershed management.

The service areas and the total irrigated acreage of 49,331 acres represents the water rights held by the 26 companies, not the actual acres irrigated. The 1994 water-related land use survey of the basin identified only 25,300 acres of irrigated lands. The current trend of reduced irrigated acreage is discussed in greater detail in Section 10.

6.3.2 Agricultural Water Management

Incorporated mutual irrigation companies serve the majority of irrigated land in the county. The Division of Water Right's *List of Water Companies in Utah* identifies 164 irrigation companies serving the Jordan River Basin. Only 26 of these companies are listed as having service areas exceeding 250 acres. Table 6-3 lists the largest irrigation companies and the acreage served along the Jordan River and contributory watersheds relating to water quality and pollution control, flood control, parkway and other developments, wildlife habitat and wetlands conservation, and proposed plans to effectively manage and regulate these activities.

6.3.3 Management of Municipal and Industrial Water Systems

If a drinking water system serves at least 15 connections, or 25 people at least 60 days per year, it is defined by law as a "public water supply." By this definition, Salt Lake County has at least 78 public drinking water systems. Many of these systems, however, are campground facilities, restaurants, or other similarly localized systems with a relatively small number of hookups and limited clientele. The vast majority of drinking water supplies come from 32 approved community drinking water systems. Although each of these 32 systems has its own independent water sources, many are reliant, at least in part, upon water purchases from one of the two largest wholesale suppliers: Metropolitan Water District of Salt Lake City and Salt Lake County Water Conservancy District. A list of public water suppliers can be found in Table 11-1. Drinking water issues, including a more detailed analysis of the management of the area's public water supplies, and a description of the Metropolitan Water District of Salt Lake City and Salt Lake County Water Conservancy District are included in Section 11, Drinking Water.

Some of the light industries use water delivered through the public water systems. It has been estimated about 5 percent of the public water supply is used for industrial purposes. Most of the industrial water use, however, is self-supplied from privately held water rights, primarily wells. See Section 18 for more detailed information on industrial water use.

6.3.4 Developed Wetlands Management

The Jordan River Basin has an extensive system of developed wetlands which are intensively managed to promote desired waterfowl species and discourage the less desired species. Surface gradients in the developed wetlands are so shallow that a one-inch change in water level can shift pond shorelines hundreds of yards. Because of the land's shallow gradient and because controlling water elevation is the primary means of managing vegetative growth, these wetlands have extensive and precise water control systems. One 3,346-acre duck club has 18 managed water levels, 88 water control structures, over 18 miles of channels and 21 miles of dikes.

Precise water control is also necessary to prevent botulism (which can kill tens of thousands of birds), minimize pond siltation, and control carp and other pests. Some developed wetlands systems allow necessary managed drying of units with minimal effect on surrounding units. Interconnecting systems allow cooperative transport, transfer and reuse of water between entities.

6.3.5 Watershed Management

The mountain streams flowing from the Wasatch Range are a primary source of municipal and industrial water. These streams were among the very first sources of water put to beneficial use by the pioneers in the 1840s and 1850s. Initially these streams were used for irrigation, but they were later changed to culinary use through a series of exchanges. Today these streams and their watersheds are managed primarily for municipal water with limited hydropower. Two documents promote proper management of these sensitive areas. They are: the *Salt Lake City Watershed Management Plan* and the *Salt Lake County Wasatch Canyons Master Plan.*

Salt Lake City has extraterritorial jurisdiction over its watershed areas based on state constitutional rights. Federal legislation in 1914 and 1934 gave further rights to Salt Lake City to protect the watershed areas. The city has recently initiated a review of the *1988 Watershed Master Plan.*

6.3.5.1 Salt Lake City Watershed Management Plan

The *Salt Lake City Watershed Management Plan* was published in 1988 by the planning division of the Salt Lake City Department of Public Works. The plan points out that Salt Lake City owns most of the water rights and a considerable amount of land within the canyons from City Creek Canyon on the north to Little Cottonwood Canyon on the south. The city, consequently, has a responsibility to manage the watersheds.

One of the primary concerns raised by the plan is that use of the canyons for recreational purposes in winter and summer threatens the long-term viability of the watersheds as a culinary water source. The plan maps the canyons, discusses water rights issues, and describes the physical and environmental characteristics of the canyons. The plan also identifies and discusses the various federal, state, county and city agencies that have watershed related jurisdictional and ownership concerns. The heart of the plan is its recommendations for watershed management. After more than a year of plan development and public involvement, the Salt Lake City Council adopted the plan with the following watershed management recommendations:

1. Salt Lake City should continue with existing watershed management policies, and electively increase city presence in some canyons for watershed protection.

2. The city should maintain its moratorium on contracts for sale of surplus water.

3. The city should work with other jurisdictions and private entities to develop a better system for coordinating information and a better public notification process on canyon issues.

4. Salt Lake City should work with canyon public and private entities to assure even enforcement of ordinances and regulations.

5. Salt Lake City should establish a formal program for canyon land and water rights acquisition in critical watershed areas.

6. The city should initiate and maintain an information campaign on the role of the canyons for watershed and water supply, including groundwater, activities in the watersheds, public responsibilities in the watersheds, and policies and jurisdictional responsibilities in the watersheds.

7. Recognizing the value of retention of minimum stream flows in the Wasatch canyons for aesthetic and ecological objectives, the city should review the potential for committing water rights to instream flows on a canyon-by-canyon and case-by-case basis.

8. Salt Lake City should update its watershed ordinance to give the city discretion to implement watershed protection measures in areas where it has water rights, but is not yet using the water.

9. Salt Lake City should review and update its land and water ownership records.

10. In order to invite more public participation on watershed issues, the city should provide broader notification of monthly meeting agendas, community newsletters and other public notices.

11. Salt Lake City should encourage more stream monitoring through the U.S. Geologic Survey and other efforts.

The plan makes the following canyon-by-canyon site specific recommendations:

City Creek - The *City Creek Master Plan (1986)* recommends maintaining instream flows for aesthetic and environmental reasons. This is consistent with the city recently re-establishing City Creek in an above ground channel through the downtown section of the stream. The City Creek watershed currently is managed primarily for culinary water use from the upper canyon.

Red Butte - Red Butte Canyon is the most pristine of all the Wasatch Front Canyons and it should be left in its present management scheme as a Natural Research Area of the Forest Service and that it serve as a benchmark for water quality in the other Wasatch Front canyons.

Emigration Canyon - Water quality in Emigration Canyon is the poorest of all the watersheds. Although Emigration Creek water is not currently used for culinary purposes, the city owns two-thirds of the water rights and its use in the future remains an option. The city has refused sewer line access because Emigration Canyon is outside city boundaries. Canyon annexation has been controversial and forestalled for more than a decade. The watershed management plan recommends the city make an exception to its policy and grant sewer access.

Parley's Canyon - The plan called for the city to restrict recreation at Little Dell Reservoir and denying public recreational use of Mountain Dell Reservoir in order to protect the public water supply. This has changed with the approval of the Army Corps of Engineers' low impact recreation plan around Little Dell Reservoir, which includes picnicking, non-motorized boating and fishing.

Millcreek Canyon - Plans to use Millcreek water for future public water supplies are referenced as the reason for recommending the city increase its watershed management presence in Millcreek Canyon. Watershed management in Millcreek Canyon could be increased if plans are changed. At the present time, however, Millcreek is not being considered for culinary use

Big Cottonwood Canyon - The plan attaches supreme importance to Big Cottonwood Canyon as a culinary water source and recommends the city not support any development not connected to the sewer. The plan also recommends the city work with the Forest Service and County Health Department to monitor water quality and conduct water quality mitigation measures.

Little Cottonwood Canyon - The plan recommends the development of an inter-local agreement with Sandy City and Alta to define the management roles and policies to insure Little Cottonwood Canyon, which has the best water quality of all the Wasatch Mountain canyons, continues to provide excellent water quality.

6.3.5.2 Salt Lake County Wasatch Canyons Master Plan

The purpose of the *Salt Lake County Wasatch Canyons Master Plan* is to guide and coordinate the allocation of future canyon usage in accordance with the present and future needs and resources within the seven major Wasatch Front canyons through the year 2010. The *Salt Lake County Wasatch Canyons Master Plan* is part of the *Salt Lake County Master Plan* and will be used to guide future land-use decisions. In addition to establishing county policy with regards to watershed and water quality issues, the plan addresses private land acquisition and exchanges, environmental issues, public safety, handicapped access, hunting, ski-area expansion, back-country skiing, helicopter skiing, single family development, off-road vehicle use, mining, livestock grazing, mountain biking, hiking, camping, and picnicking.

The watershed and water quality protection policy set forth in the general policies section of the *Wasatch Canyons Master Plan* states:

> "Salt Lake County will continue to cooperate with Salt Lake City- County Board of Health, the U.S. Forest Service and Salt Lake City to implement antidegradation standards, stream set-back and environment zones, monitoring programs, enforcement activities and other canyon watershed policies to maintain excellent water quality in the canyons. All stream segments in the plan area have been designated by the state under the clean water act for antidegradation, which means canyon policies must prevent any water quality degradation."

6.3.6 Cloud Seeding

Winter cloud seeding for augmentation of mountain snowpack is an accepted program in the water supply management community. Some projects in the western United States have been operated continuously for more than 30 years. This relatively long experience indicates that increases of 5-15 percent in seasonal precipitation can be achieved. Cloud seeding in Utah is regulated by the Department of Natural Resources through the Division of Water Resources.

A winter cloud-seeding program was started in the Jordan River Basin in March of 1988 following two years of below normal wintertime precipitation. The

normal operational period is November 15 to April 15 each year. Cloud seeding costs are shared by the state and local governments.

Project operations have used selective seeding which is the most efficient and cost effective and produces the most beneficial results. Selective seeding, which eliminates seeding storms in which natural precipitation has little or no chance of being enhanced, is based on several criteria which determine the seedability of the storm. These criteria deal with the air mass structure of the cloud mass (temperature, stability, wind flow and moisture content).

The Wasatch Front target areas have been Big and Little Cottonwood canyons, City Creek and Parley's Creek (See Figure 3-2). Ground-based seeding generator are used to seed the target area. The increase in precipitation in the target area has been seven to nine percent greater than might have been predicted from nearby control observations. This increase represents 1.5 inches (water equivalence) within the target area.

6.4 Management Problems and Needs

Developmental encroachment in the flood plain is recognized by many as one of the biggest flood control/water quality management problems along the Jordan River corridor. Development in the river's natural flood plain increases flood hazard problems, adversely affects wildlife, degrades water quality, reduces the recreational potential of the river and impedes the river's natural tendency to meander. In an attempt to address this issue, the county, in cooperation with various municipalities, has conducted a study to identify the bounds of the Jordan River's natural meander corridor.

Recreational use of the canyons in the Wasatch Range and Oquirrh mountains is increasing. Without adequate management, this can adversely impact these watersheds, particularly those on the east side of Salt Lake Valley. A good monitoring program is necessary to make sure water quality is not deteriorating.

6.5 Alternatives for Management Improvement

Management alternatives should be considered for potential improvements to the water supply system. Alternatives should be considered and selected on the basis of improving efficient use of the water resources. The concept of total management of surface and groundwater should be considered. Water conservation practices for all uses should also be considered.

6.6 Issues and Recommendations

The biggest management issue in the Jordan River Basin is inter-agency coordination between the many federal, state, county and local municipalities which have some regulatory responsibility pertaining to management of the Jordan Riverway. Closely related is the establishment of a Jordan River Meander Corridor. Establishment of a meander corridor likely will not occur without inter-agency coordination.

6.6.1 Inter-agency Coordination

Issue - Many controlling governmental agencies are involved with the Jordan River whose goals or objectives may differ or various planning efforts may be counter-productive.

Discussion - Local municipalities along with county, state, and federal agencies, need to better coordinate and cooperate their various regulatory and planning efforts, and development activities. With continuing growth and development along the Jordan River, it is increasingly important for various governmental agencies to work together to set common planning goals and establish consistent regulations. The state, Salt Lake City, Salt Lake County and other interested agencies should coordinate their activities to improve the monitoring of flows and water quality from Wasatch Mountain streams and the Jordan River. State regulatory agencies should assist local governmental entities in achieving common goals.

Recommendation - The federal, state and local municipalities should increase efforts to coordinate their activities through the Jordan River Sub-Basin Watershed Management Council. ■

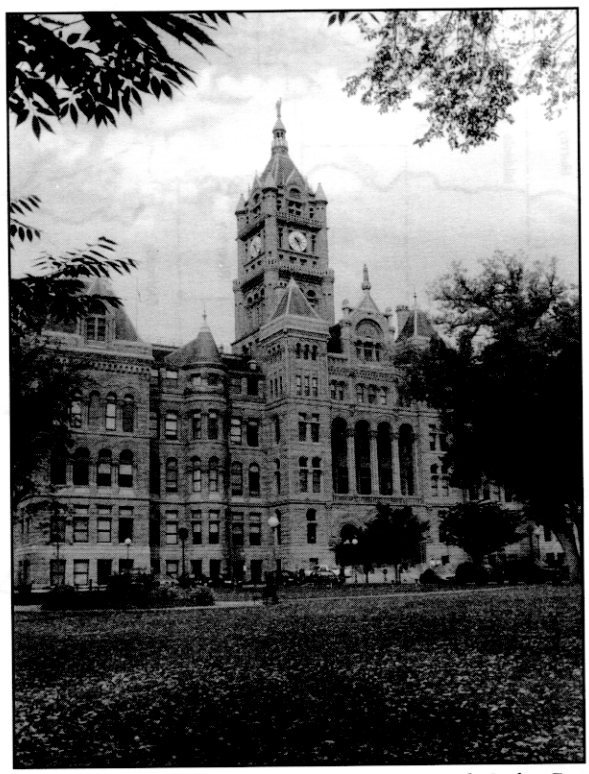
SECTION 7 CONTENTS

REGULATION/INSTITUTIONAL CONSIDERATIONS

The regulation of water resources is necessary to manage conflicts and to provide for orderly future planning and development.

7.1 Introduction

This section discusses the agencies responsible for water regulation in the Jordan River Basin. This includes consideration of water rights, water quality and environmental concerns.



Historic City and County Building in Salt Lake City

Two state agencies, the Division of Water Rights and the Department of Environmental Quality, are primarily responsible for the regulation of water in the Jordan River Basin. The Division of Water Rights, under direction of the State Engineer, regulates water allocation and distribution according to state water law. Water quality is regulated at the state level by the Department of Environmental Quality through two agencies, the Division of Water Quality and the Division of Drinking Water. These agencies operate in accordance with the Utah Water Quality Act and the Utah Safe Drinking Water Act. Water quality is also regulated by provisions of various federal acts.

7.2 Setting

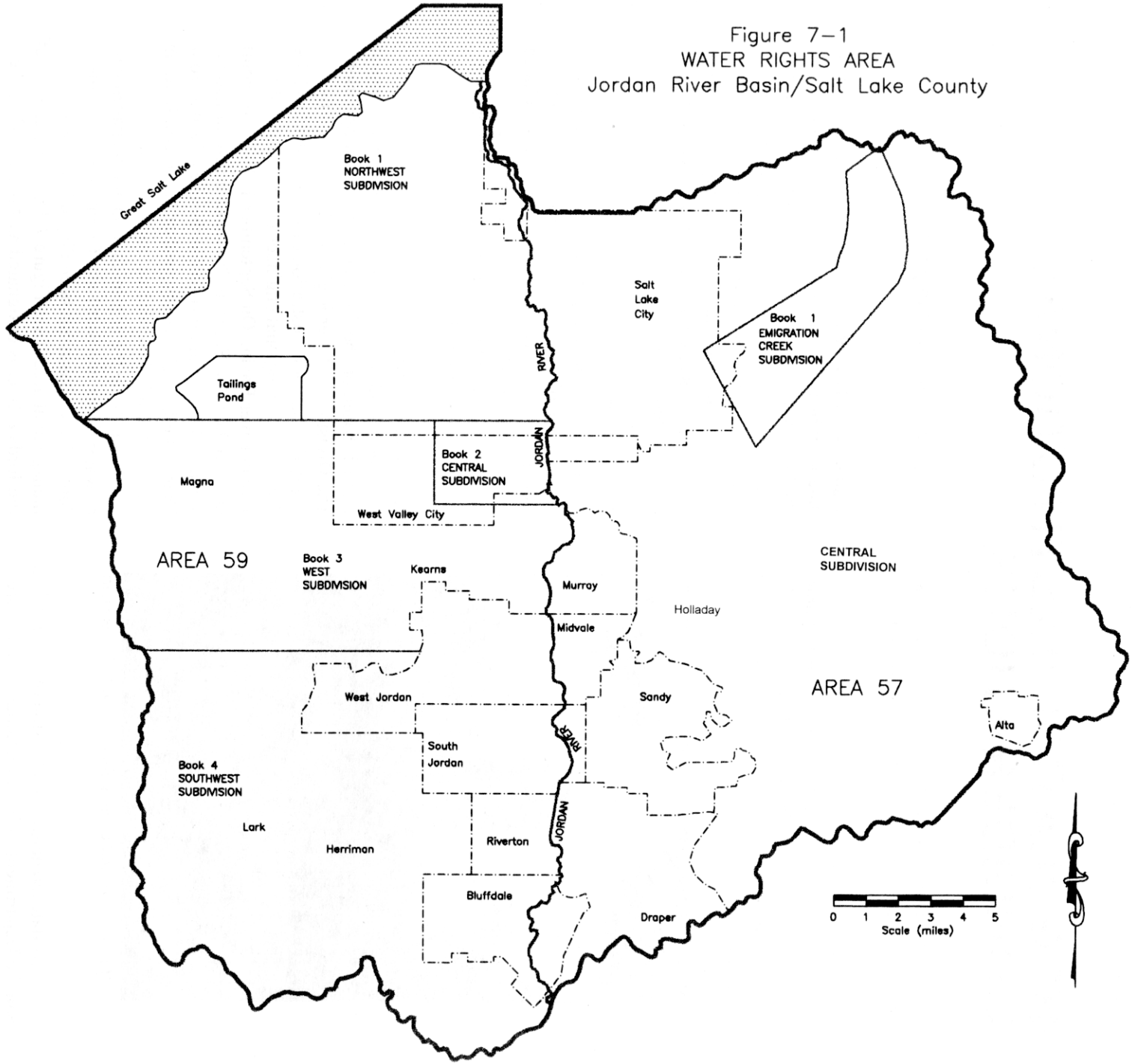
Water regulation is generally carried out under the direction of these state agencies, although some federal agencies become involved when it is included in their mandates. Local, public and private institutions and entities usually manage and operate the water systems at the basin level.

7.2.1 Current Regulations

Under Utah water law, the distribution and use of water is based on the doctrine of prior appropriation. The Division of Water Rights is charged with the regulation and administration of water rights, and the division has a regional engineer for the Utah Lake-Jordan River Basin. On September 1, 1944, the court ordered the State Engineer "to make a determination and adjudication of all rights to the use of water from Utah Lake in Utah County, and of the Jordan River in Utah and Salt Lake counties, and its tributaries."

To facilitate the administration and management of water rights, the Salt Lake County portion of the Jordan River Basin has been divided into two management areas (See Figure 7-1). The area west of the Jordan River is designated as Area 59, while the area east of the Jordan River is designated as Area 57. To date the only portion of Area 57 which has been adjudicated is Emigration Canyon. The Proposed

Figure 7–1
WATER RIGHTS AREA
Jordan River Basin/Salt Lake County



Determination of Water Rights for Emigration Canyon, Area 57, Book No.1, was distributed in November 1983. Area 59 has been adjudicated and the Proposed Determination Books have been completed. The four Proposed Determination Books for Area 59 are; Northwest Subdivision (Book 1) published in June 1975, Central Subdivision (Book 2) published in April 1977, West Subdivision (Book 3) published in September 1977; and the Southwest Subdivision (Book 4) published in January 1979. A supplement (Book 5) of indexes, disallowed claims and pending claims was also published in November 1979.

At the present time, the State Engineer has determined the surface water flows in the Jordan River Basin are fully appropriated. This means that the Division of Water Rights will not approve new applications to appropriate surface water in either Area 57 or 59. Groundwater is also considered fully appropriated. However, the Division of Water Rights will accept applications to appropriate up to one acre-foot per year of groundwater for domestic purposes where no adequate public water supply is available. These appropriations are temporary (limited to 10 years) and subject to cancellation if an adequate public water supply becomes available. The subject of groundwater is covered in more detail in Section 19. The general status of water right applications within Salt Lake County is summarized in Table 7-1.

7.2.2 Existing Local Institutions and Organizations

Local organizations generally carry out the distribution of water under water rights and rules and regulations administered by the State Engineer. These local institutions, entities and organizations have also completed most of the water development. Distribution systems along with local entities formed under specific enabling legislation are described below.

Water Conservancy Districts - These are created under Title 17A-2-1401 of the *Utah Code Annotated.* They are established by the district court in response to a formal petition and are governed by a board of directors appointed by the county commission when the district consists of a single county and by the governor when two or more counties are involved. Water conservancy districts have very broad powers. They include constructing and operating water systems, levying taxes and contracting with government entities. These districts include incorporated and unincorporated areas. The two districts in the basin are the Salt Lake County Water Conservancy District and the Central Utah Water Conservancy District.

Mutual Irrigation Companies - These are the most common water development and management entities in the basin. They may be either profit or non-profit. They are formed under the corporation code. In general, stockholders are granted the right to a quantity of water proportional to the number of shares they hold and assessments are levied similarly. Over 100 mutual irrigation companies are in the Salt Lake Valley.

Water Companies - These are entities, such as special service districts, formed to provide water to subscribers. Private water companies operated for profit are regulated by the Division of Public Utilities.

City Water Utilities - These are utilities operated by incorporated cities and towns to provide water to residents and subscribers. Municipalities can form corporations to deliver water inside all or any part of a city boundary. Counties have the same authority in unincorporated areas. The *Utah Code Annotated* and local ordinances provide the legal framework for water operation. Local entities may pass ordinances regulating water use.

Water User Associations - These organizations are formed to deliver water for various purposes. They are often informal groups, but they can also be incorporated under Utah law.

Other - The Metropolitan Water District of Salt Lake City was formed in 1935 by the Utah State Legislature as a "separate and independent" citizen-administered public agency which is concerned primarily with water planning for the city of Salt Lake. In addition to providing water and water resources planning for Salt Lake City, the district is also a wholesale provider of water for the Salt Lake County Water Conservancy District, various water companies and other city water utilities.

7.3 Water Rights and Regulations

The State Engineer is responsible for determining whether there is unappropriated water and if additional applications will be granted. This is accomplished through data analysis and consideration of public input.

Before approving an application to appropriate water, the State Engineer must find: (1) There is unappropriated water in the proposed source, (2) the

Table 7-1
GENERAL STATUS OF WATER RIGHTS
Jordan River Basin

County	Area	Subarea	General Policy
Salt Lake	57 East Salt Lake Valley	General	• Surface water appropriations are closed • Groundwater appropriations are generally closed valley-wide except for domestic wells limited to one acre-foot per year.
		Mountain and canyon areas	• Closed
		Jordan Narrows	• Some additional limitations may be applied to hot and cold water sources depending upon the intended use of the water
	59 West Salt Lake Valley	General	• Surface water appropriations are closed • Ground water appropriations are generally closed valley-wide except for domestic wells limited to one acre-foot per year
		Mountain and canyon areas	• Closed
		Rose Canyon	• The area is closed above Rose Canyon Irrigation Company diversion

proposed use will not impair existing rights, (3) the proposed plan is physically and economically feasible, (4) the applicant has the financial ability to complete the proposed works, and (5) the applicant has filed in good faith and not for the purpose of speculation or monopoly. The State Engineer shall withhold action on or reject an application if it is determined it will interfere with a more beneficial use of water or prove detrimental to the public welfare or the natural resources environment.

Utah water law allows changes in the point of diversion, place of use, and/or nature of use of an existing right. To accomplish such a change, the water user must file a change application with the Division of Water Rights. The approval or rejection of a change application depends largely on whether or not the proposed change will impair other vested rights; however, compensation can be made, or conflicting rights may be acquired. Pending applications and stock in mutual water companies are considered personal property. As such they can be bought and sold in the open market.

In the appropriation process, the State Engineer analyzes the available data and, in most cases, conducts a public meeting to present findings and receive input before adopting a final policy regarding future appropriation and administration of water within an area. Through regulatory authority, the State Engineer influences water management by establishing diversion limitations or duty of water (5.0 acre-feet per acre of irrigation in Salt Lake County) for various uses and by setting policies on water administration for surface water and groundwater supplies. The duty of water includes an allowance for reasonable distribution system and irrigation system inefficiencies.

The Division of Water Rights is responsible for a number of functions which include: (1) Distribution of water in accordance with established water rights, (2) adjudication of water rights under an order of a state district court, (3) approval of plans and specifications for the construction of dams and inspection of existing structures for safety, (4) licensing and regulating the activities of water well drillers, (5) regulation of geothermal development, (6) authority to control streamflow and reservoir storage or releases during a flooding emergency, and (7) regulation of stream channel alterations activities.

7.3.1 Utah Lake

Although Utah Lake is not located in Jordan River Basin, any discussion of management of the

Jordan River would be incomplete without a discussion of the lake and its role in regulating the river. Utah Lake, a natural occurring lake, currently operates as a regulating reservoir for the Jordan River and all releases to downstream canals. In November 1992, the Division of Water Rights published the *Interim Water Distribution Plan For the Utah Lake Drainage Basin* to clarify the relationship between storage rights in Utah Lake and storage rights on the upstream tributaries. In that document, the division identified a need to manage the water rights on the Provo River, Spanish Fork River, Utah Lake, Jordan River and other sources in the basin as one system. The discussion here of the *Interim Water Distribution Plan For the Utah Lake Drainage Basin* is limited to how the plan regulates the releases of water from Utah Lake to the Jordan River and related canals.

The interim plan identifies the water rights defined by the Morse decree (1901) as primary storage rights, and all subsequent rights established under applications to appropriate as secondary rights. The estimated average annual inflow to Utah Lake from surface and groundwater (for the 50-year period of 1941-1990) less agricultural and industrial uses is about 538,000 acre-feet. Of this, 308,000 acre-feet is discharged to the Jordan River and about 230,000 acre-feet is lost to net evaporation. The maximum legal storage elevation of the lake, called the Compromise Elevation, is 4,489.045. At this elevation, the lake's total storage capacity is approximately 870,000 acre-feet, of which 710,000 acre-feet is active storage and 160,000 acre-feet is inactive storage. Elevation 4480.345 is the point of demarcation between active and inactive storage. Water below that elevation cannot be taken from the lake. The first 125,000 acre-feet of active storage is referred to as primary storage. The balance of water stored in Utah Lake is called system storage. System storage water is used for primary and secondary water rights. Primary storage water is essentially held in reserve and dedicated solely for the use of the primary rights when all other active storage has been used.

7.3.2 New Water Rights Appropriations

Because all surface and groundwater in the Jordan River Basin are considered to be fully appropriated, the potential for new water rights appropriations is extremely limited. Applications which have been previously approved may be developed and perfected in the future. There may even be limitations imposed upon these claims such as the *Interim Groundwater Management Plan* recently developed by the Division of Water Rights.

There is concern the groundwater basin has already been over-appropriated. If on-going studies confirm this, the division will undoubtedly set into effect policies and procedures designed to bring the groundwater rights into balance with the safe groundwater yield.

Water rights can be sold or purchased much like any other property right. The dollar value or worth of individual water rights varies greatly for the following reasons: 1) Reliability of the water source, 2) priority of the water right, 3) water quality; 4) availability of other water sources, and 5) the existing demand. Although it is true that water rights have significant value, they may be lost if left unused for a sufficiently long period of time. Any water right can be lost by five consecutive years of non-use.

7.4 Water Quality Control

The quality of surface water is determined under standards for allowable contaminant levels according to the use designations. The use designations and the standards are published by the Utah Department of Environmental Quality in the *Standards of Quality for Waters of the State*. The Water Quality Board implements the regulations, policies and activities necessary to control water quality. This is carried out through the Division of Water Quality.

7.5 Drinking Water Regulations

The Drinking Water Board is responsible for assuring a safe water supply for domestic culinary uses. It regulates any system defined as a public water supply. This may be publicly or privately owned. The Drinking Water Board has adopted State of Utah Public Drinking Water Regulations to help assure pure drinking water. The Drinking Water Board is empowered to adopt and enforce rules establishing standards prescribing maximum contaminant levels in public water systems. This authority is given by Title 26, Chapter 12, Section 5 of the *Utah Code Annotated, 1953*. The rules and regulations setting drinking water standards were adopted after public hearings. These standards govern bacteriologic quality, inorganic chemical quality, radiologic quality, organic quality and turbidity. Standards are also set for monitoring frequency and procedures.

The Drinking Water Board, through the Division of Drinking Water, also operates under the federal Safe Drinking Water Act. This act sets federal drinking water standards and regulations. The recently amended bill now includes a revolving loan program to provide money to states to construct drinking water treatment plants. It also relaxes some Environmental Protection Agency requirements for setting standards for drinking water and provides more flexibility for small and rural systems.

The Division of Drinking Water serves as staff for the Drinking Water Board to assure compliance with the standards. At the local level, considerable reliance is placed on public water supply operators. Those operating systems serving over 800 people are currently required to have state certification. Water systems serving fewer than 800 people will only need to have a certified operator if the water system has some sort of treatment facility in place. The water systems are listed in Table 11-1.

The Division of Drinking Water also administers the Drinking Water Source Protection Program. This program is designed to protect groundwater quality. Owners of wells and springs are required to develop protection programs based on the areas of influence around the source. The outcome of the program is to develop controls for potential sources of pollution to the groundwater. The Drinking Water Source Protection Program includes monitoring delivered drinking water quality as well as water source protection.

7.6 Environmental Considerations

Although county and city planning documents have identified a need to establish minimum stream-flow requirements for the Wasatch Mountain streams, none have been any established. Some canyon streams on the east bench fall within the limits of federally declared wilderness areas. Consequently, the streams within wilderness areas will have federally imposed restrictions barring development, stream alterations and withdrawals. Also, the Corps of Engineers (COE) has a federally mandated responsibility to review and approve or disapprove any stream channel alterations or modification. This includes wetlands as well as stream systems. The COE is assisted in this review process by the Division of Water Rights, the Division of Water Quality, the Division of Wildlife Resources, and the Division of Forestry, Fire and State Lands.

7.7 Dam Safety

All dams in Utah which store in excess of 20 acre-feet of water or whose failure could cause loss of life or property damage are assigned a hazard rating. The hazard rating does not reflect the condition or reliability of the dam, but rather the potential for loss of life in the event of a dam failure. Hazard ratings are either high, moderate or low. The hazard rating is used to determine the frequency of inspections. High-hazard dams are inspected yearly; moderate hazard, every other year; and low hazard, every fifth year. Following the inspection, a letter from the State Engineer suggests maintenance needs and requests specific repairs. The State Engineer is empowered to declare a dam unsafe and order it breached or drained. But every effort is made to work with dam owners to schedule necessary actions.

The Division of Water Rights has design standards which are outlined in a publication entitled, *Rules and Regulations Governing Dam Safety in Utah*. Plans and specifications must be consistent with these standards. Dam safety personnel monitor construction to insure compliance with plans, specifications and design reports. Any problems are resolved before final approval is given.

Table 7-2 gives the hazard rating for each reservoir in the Jordan River Basin. See Table 6-1 for information on dam owners and stream locations. ■

Table 7-2
HAZARD RATING OF JORDAN RIVER BASIN RESERVOIRS

Name	Built	Total Storage (acre-feet)	Hazard Rating
Little Dell	1993	20,500	High
Mountain Dell	1925	3,514	High
Lake Mary-Phoebe	1915	85	High
Jordan Valley Water Treatment			
Upper Pond	1981	550	Moderate
Lower Pond	1982	46	Moderate
Twin Lakes	1914	486	High
Red Butte[a]	1930	385	High
White Pine Lake	1933	315	High
Bell Canyon (Lower)[b]	1907	25	High
Red Pine Lake	1929	202	High
Secret Lake	1926	60	Moderate

a) Red Butte is currently inactive with stream flows passing directly through the outlet works.
b) Lower Bell Canyon Dam has been breached, by order of the State Engineer.

SECTION 8 CONTENTS

Tables

WATER FUNDING PROGRAMS

Water development includes direct and indirect benefits, not only to the project owners and developers, but also to the surrounding communities and society as a whole.

8.1 Introduction

This section briefly describes many of the state, federal and local funding programs available to plan and implement water resources projects in the Jordan River Basin. Additional information can be found in the *State Water Plan (1990)*, Section 3, Introduction, and Section 8, State and Federal Water Resource Funding Programs. More specific information can also be found in other sections of the *State Water Plan* regarding specific agency programs.

8.2 Background

Over the years, citizens of Utah have spent millions of their own dollars to develop water resources. During early colonization, individuals, private irrigation companies and The Church of Jesus Christ of Latter-day Saints (Mormons) worked together to develop water facilities. Today, private citizens still play an important role in funding water development projects. The federal and state governments have developed numerous programs which make grants and low interest loan money available to water developers. Many of these funding programs require up-front cost sharing from individuals, groups or entities receiving benefits from the projects as well as complete repayment of revolving funds made available.

Water-related projects are a continuing need. In the past, significant funding assistance was made available through federal programs. In today's political climate, limited federal funding is still available, but it is becoming more scarce and carries with it restrictive federal regulations and guidelines. The issue of federal funding is discussed in more detail in the *State Water Plan.* Increasingly, more local and state funding is needed to offset the loss of federal assistance.

Since the turn of the century, some state funds have been available to construct water development projects. These were relatively minor amounts until 1947 when the legislature created the Utah Water and Power Board and established the Revolving Construction Fund. Since then, state funding programs have been established under various boards, commissions, and committees. Population expansion and cost increases have required project sponsors to seek additional funds from other sources. These state and federal programs have been used to fund projects in the Jordan River Basin in the past. Funding in recent years is shown in Tables 8-1 and 8-2.

8.3 State Water Funding Programs

Eight state entities have funding programs (See Table 8-1) to assist local communities for various community development projects. These funding programs include loan and grant monies. Although not all of these funding programs were created specifically for water development, each can be applied to water-related development projects. Though these programs are generally targeted for different purposes, there are cases where more than one program can assist with a particular project. State funding programs are briefly described in Table 8-3

8.4 Federal Water Funding Programs

Federal water-related grant and loan programs exist in various agencies in the Agriculture, Army, Commerce, Housing and Urban Development, and Interior departments, and the Environmental Protection Agency. Funding for these programs has fluctuated, but it has declined generally in recent years.

General funding programs are still a viable source of financial assistance. However, they are aimed more to protecting the environment rather than water development. These programs are briefly described in Table 8-4. ■

Table 8-1
STATE WATER-RELATED FUNDING EXPENDITURES

Funding Agency Program	Grants	Loans	Total Project	Time Period
Board of Water Resources				
Revolving Construction Fund	-	$ 3,087,119	$ 11,540,976	1948-1994
Cities Water Loan Fund	-	1,860,000	2,731,160	1979-1094
Conservation & Development Fund	-	15,087,000	74,506,550	1985-1994
Community Impact Fund Board				
Permanent Community Impact Fund	$ 1,159	-	-	-
Community Dev. Block Grants Policy Board				
Community Development Block Grants Program	1,301,850	-	-	1990-Present
Drinking Water Board				
Financial Assistance Program	185,561	1,470,444	-	1983-1996
Water Quality Board				
EPA 314 Clean Lakes Program	-	-	-	1996
Federal Construction Grants	1,000,000	-	-	1972-1981
Wastewater Treatment Facilities Financial Assistance Program	90,008,361	6,920,000	11,756,000	1984-Present
Utah Soil Conservation Commission				
Agricultural Resource Development Loans	-	45,000	-	1992-Present
Board of Parks and Recreation				
Land & Water Conservation Fund	12,732,400	-	-	1967-94
Wildlife Board				
Wallup/Breaux Bill	-	-	-	-
Totals	$105,229,331	$28,469,563		

Table 8-2
FEDERAL WATER-RELATED FUNDING EXPENDITURES

Funding Agency Program	Grants	Loans	Period
Department of Agriculture			
Farm Service Agency	$ 198,807	-	1990-1996
Rural Development	23,000	$587,000	1946-present
Natural Resources Conservation Service	98,300	-	1988
Department of the Army			
Corps of Engineers			
Civil Works	21,200,000	-	1952-1986
Emergency Works	1,250,000	-	1984
Department of the Interior			
Bureau of Reclamation	-	-	-
Federal Emergency Management Agency	-	-	-
Environmental Protection Agency[a]	-	-	-
Total	$22,770,107		

a: Funds are transmitted through the Department of Environmental Quality

Table 8-3
STATE FUNDING PROGRAMS

Entity/Program	Contact Agency	Purpose	Type
Board of Water Resources			
Revolving Construction Fund	Division of Water Resources	Small irrigation and culinary projects	Loans
Cities Water Loan Fund		Municipal culinary water systems	Loans
Conservation and Development Fund		Large water improvement projects	Loans
Dam Safety		Stabilize and repair dams	Loans & Grants
Community Impact Fund Board			
Permanent Community Impact Fund	Division of Community Development	Schools, roads, medical, and water improvements	Grants & Loans
Disaster Relief Board Fund		County or municipal flood repair	Grants
Community Dev. Block Grants Policy Board			Grants
Community Development Block Grants Program	Division of Community Development	Improved living environment for small communities and counties	
Drinking Water Board			
Financial Construction Program	Division of Drinking Water	Drinking water facilities	Loans
Water Quality Board			
Federal Commission Grants	Division of Water Quality	Wastewater treatment facilities	Loans
Wastewater Treatment Facilities Financial Assistance Program		Wastewater treatment facilities	Grants
Utah Soil Conservation Commission			
Agricultural Resource Development Loans	Department of Agriculture	Improvements of cropland and non-federal rangeland	Loans
		Watershed improvements	Grants
Board of Parks and Recreation			
Land and Water Conservation Fund	Division of Parks and Recreation	Swimming, boating, and other recreation-related facilities	50-50 Cost-Sharing Grants
Wildlife Board			
Wallup/Breaux Bill	Division of Wildlife Resources	Sport fishery management and boating access	Grants

Table 8-4
FEDERAL FUNDING PROGRAMS

Administering Agency	Program	Purpose	Type
Department of Agriculture			
Farm Service Agency	Agricultural Conservation Program	Soil, water and energy conservation.	Grants
	Emergency Conservation Program	Rehabilitation of farmland damaged by wind, floods or other natural disasters.	Grants
	Conservation Reserve Program	Reduce erosion and maintain wetlands.	Grants
Rural Development	Rural Development	Water supply and wastewater disposal.	Grants and Loans
	Resource Conservation and Development	Multiple purpose water and related-land conservation and other facilities.	Loans
Natural Resources Conservation Service	Wetland Conservation Program Environmental Quality Incentives Program Wildlife Habitat Incentive Program Wetland Reserve Program Farm Protection Program Forestry Incentive Program	1996 Farm Bill programs	
	Watershed Protection and Flood Prevention	Flood control, water supply, wildlife and recreation facilities.	Grants
	Resource Conservation and Development	Multiple purpose water and related-land conservation and other facilities.	Grants
Department of the Army			
Corps of Engineers	Civil Works Flood Plain Management Services	Flood control, water supply, navigation and recreation-related developments.	Cost Sharing
	Continuing Authorities Program	Flood control and protection.	Cost Sharing
	Emergency Activities	Flood control and protection.	Cost Sharing
Department of the Interior			
Bureau of Reclamation	Investigations Program	Water storage/delivery and related purposes.	Loans
	Loan Programs	Small multiple-purpose water developments.	Loans
Department of Housing and Urban Development	Community Development Block Grant Program	Water resources planning and development.	Grants
Federal Emergency Management Agency	Presidential Declared Disaster	Flood damage mitigation.	Grants
	Flood Plain Management	Acquisition of structures in flood plains.	Grants
Environmental Protection Agency		Water Quality.	Grants

SECTION 9 CONTENTS

Tables

WATER PLANNING AND DEVELOPMENT

In addition to being the state's political center and most densely populated county, the Jordan River Basin continues to be one of the fastest growing areas of the state. Consequently, the area's water resources are among the most extensively investigated.

9.1 Introduction

This section describes existing and potential alternatives for meeting the future water needs in the Jordan River Basin. Present water uses and supplies are discussed along with future water needs, alternatives for meeting needs, environmental, financial and economic considerations, water quality assessment and cost estimates. Many water-related planning and development studies have been completed, not only by the Division of Water Resources, but by numerous public agencies and private entities.

9.2 Background

Water development was an essential element of early settlements. The availability of water resources was critical as the pioneers realized successful settlement would occur only where water resources were available. Early Mormon church leaders stressed community development over individual ownership, especially with regards to natural resources. The early pioneer's approach was to develop cooperative water distribution systems. Those early ideals laid the foundation for many of the principles embodied in today's Utah water law, and the methods now employed to administer and manage the state's water resources. Community rights led to a standard of "beneficial use" as the basis for the establishment of an individual water right. The overriding principle of Utah's water law is that all water belongs to citizens of the state, and water planing and development through the years have been founded upon this principle.

9.2.1 Past Water Planning and Development

Water development in Salt Lake Valley began with the first settlements of pioneers in the late 1840s. Over the course of the next two decades, each of the valley's mountain streams was developed for irrigation use. During the same period of time, wells were dug to provide culinary water for the settlements. As early as 1864, Salt Lake City began searching for additional culinary water supplies. The search ultimately lead to the first "exchange agreement" in 1888. This agreement resulted in Jordan River water being applied to irrigated fields in exchange for higher quality Emigration Creek and Parley's Creek water which was made available for culinary use. Since that precedent, other exchanges have been enacted converting much of the valley's high quality water to culinary use while poorer quality water has been used for irrigation.

West Ridge Golf Course

Since 1947 a few reservoirs have been constructed on the mountain streams and in the Jordan River Basin to facilitate the development of water resources. See Table 6-1 for a listing of existing reservoirs. Other past water development projects included the construction of canals, canal lining, culinary water systems, culinary water storage tanks and ponds, and waste water treatment facilities.

Over the years the Board of Water Resources has provided technical assistance and funding for 36 projects in the Jordan River Basin totaling nearly $20 million. These projects are listed in Table 9-1. Table 8-1 shows a breakdown of the loaned amounts by fund.

9.2.2 Current Water Planning and Development

Most of the present water planning carried out by the state is through the Division of Water Resources. The division recently completed the Wasatch Front Water Demand/Supply Model (WFCM). To date, it is the most thorough investigation of the existing and future water supplies in the Jordan River Basin. The objective of the model was to improve the accuracy and geographic resolution of water demand projections for the rapidly growing four urban counties which are part of the Wasatch Front (Salt Lake, Davis, Weber, and Utah counties). The key objective of the effort was to make accurate water demand projections and match existing and future supplies with needs over time. The WFCM is used to make forecasts for specific geographic areas and water use sectors, and has the flexibility to analyze a range of possible future patterns. The model is interactive and is designed specifically to aid water agency managers to effectively forecast future needs, design water system facility improvements, and evaluate the impacts of drought and other conditions on the water systems. The WFCM was not only used to forecast future water use; it was the basis for the present water use data shown in Section 5 and Table 9-2. The present water use data generated by the WFCM are for the year 1995. Present water use and supply data and future water needs shown in this section were taken from the model.

The water supply shown in Table 9-2, consists of public water supplies which makes up the bulk of the municipal and industrial (M&I) water throughout the valley. It includes all water made available through the public water supply systems. These public water supplies are used for residential, commercial/ institutional and industrial uses.

The public water supply comes from nine sources: City Creek, Parley's Creek, Big Cottonwood Creek, Little Cottonwood Creek, other small mountain streams, Welby-Jacob Exchange, Central Utah Project, Deer Creek Reservoir, and groundwater. Table 9-2 shows the average annual supply and the reliable supply for nine out of 10 years. For planning purposes, the reliable supply for nine out of 10 years is often considered as the firm yield.

9.2.3 Environmental Considerations

Too often in the past, water has been viewed as a commodity for human use and consumption with little thought to the impact its development will have upon the environment. In today's world, instream flows and water quality issues are as essential to good planning and development as any other issue, and should be considered early and often in the planning process. Although no instream flow requirements have been established within the Jordan River Basin, several private and public bird refuges along the shores of the Great Salt Lake have established water rights. Currently these water rights insure that water flows continually in the Jordan River and many of its tributaries.

9.3 Water Resource Problems

The water resources problems include water quality, meeting future M&I needs, groundwater mining, groundwater contamination, maintaining the existing infrastructure and flooding. The trend of converting agricultural land to residential areas has freed up irrigation water for other uses. It is likely this trend will continue. Unfortunately, the irrigation water being made available is Utah Lake and Jordan River water which is of poor quality and very expensive to treat for M&I use.

The groundwater problems include concerns for groundwater quality and quantity. Both of these issues are addressed by the State Engineer through the *Salt Lake County Groundwater Management Plan.* In particular, the state has imposed restrictions upon new well permits. This action is aimed at protecting the principal aquifer from over-development and contamination. Refer to Section 19 for more information.

Table 9-1
BOARD OF WATER RESOURCES DEVELOPMENT PROJECTS

Sponsor	Type	Year
Alta Town	Cl-Tank	1977
Bell Canyon Irrigation Company	Pr-Pipe	1953
Bell Canyon Irrigation Company	Dual-Ws	1954
Bell Canyon Irrigation Company	Dual-Ws	1957
Bell Canyon Irrigation Company	Misc	1953
Bell Canyon/N Dry Creek Irr Companies	Dam-Enl	1948
Bell Canyon/N Dry Creek Irr Companies	Dam-Enl	1959
Bluffdale City	Cl-Pipe	1979
Brighton & North Point Irrigation Companies	Div-Dam	1986
Castro Springs Irrigation Company	Dual-Ws	1954
Central Utah Water Conservancy District	Cl-Trmt	1973
Central Utah Water Conservancy District	Cl-Tank	1994
Draper Irrigation Company	Div- Dam	1988
Draper Irrigation Company	Dual-Ws	1993
Granite Water Company	Cl-Pipe	1949
Herriman Irrigation Company	Pr-Pipe	1953
Herriman Irrigation Company	Pr-Pipe	1970
Herriman Pipeline & Dev Company	Cl-Tank	1987
Herriman Pipeline & Dev Company	Cl-Well	1993
Lark Water Users	Cl-Syst	1967
Mount Air Water Corp	Cl-Syst	1985
North Dry Creek Irrigation Company	Cl-Tank	1959
North Jordan Irrigation Company	Div-Dam	1986
Provo Reservoir Water Users Company	Cnl-Lng	1956
Richards Irrigation Company	Dual-Ws	1986
Riverton City	Cl-Pipe	1989
Rose Creek Irrigation Company	Pr-Pipe	1962
Salt Lake City Corporation	Cl-Tank	1982
Salt Lake City Metropolitan Water District	Dam	1986
Salt Lake County Water Conservancy District	Cl-Pipe	1993
Sandy Canal Company	Lh-Pipe	1994
South Despain Ditch Company	Dam-Res	1949
South Despain Ditch Company	Dam-Enl	1963
South Despain Ditch Company	Dual-Ws	1978
South Despain Ditch Company	Dam-Rep	1984
Spring Glen Water Company	Cl-Tank	1991
Total Salt Lake County Projects	36	

9.4 Water Use and Projected Demands

The Wasatch Front Water Demand/Supply Computer Model (WFCM) was used to predict the future water needs of Salt Lake County. Based on existing use patterns and the population growth projections provided by the Governor's Office of Planning and Budget (See Section 4), WFCM was used to project future water use needs at five-year intervals from years 2000 through 2020.

Table 9-2
CURRENT AND PROJECTED PUBLIC WATER SUPPLY BY SOURCE
Jordan River Basin

SOURCE	Currently Developed (1995)		Projected Development (2020)	
	Average	Reliable[a]	Average	Reliable[a]
	(acre-feet)			
City Creek	8,310	6,080	8,310	6,080
Parley's Creek	8,890	5,210	12,310	8,630
Big Cottonwood Creek	25,920	20,020	30,300	22,340
Little Cottonwood Creek	21,670	17,340	37,500	23,700
Small Mountain Streams	3,400	1,100	3,400	1,100
Welby-Jacob Exchange	29,400	17,500	21,500[b]	9,600[b]
Central Utah Project	70,000	84,000[c]	70,000	84,000[c]
Deer Creek Reservoir	61,700	61,700	61,700	61,700
Groundwater	114,400	114,400	125,410	125,410
Groundwater Recharge	5,800	1,060	5,800	1,060
TOTAL	349,490	328,410	376,230	343,620

a: Reliable nine out of 10 years
b: Excludes 7,900 acre-feet of yield that may be dedicated to the CUP Bonneville Unit water supply.
c: The Central Utah Project is managed to bring 84,000 acre-feet into the basin during times of drought.

A number of assumptions were made in the creation of the Wasatch Front Water Demand/Supply Model. They are:

- All existing developed water supplies will continue to be available for use in Salt Lake County.
- Municipal & industrial water supplies will be shared by all users in Salt Lake County.
- The Central Utah Project will be completed and deliver 50,000 acre-feet to the Salt Lake County Water Conservancy District and 20,000 acre-feet to the Metropolitan Water District of Salt Lake City.
- An additional 10,000 acre-feet of groundwater will be developed by the Salt Lake County Water Conservancy District. This will bring the groundwater development close to its safe yield for the valley (See Section 19, Groundwater). Also assumes 5,400 acre-feet will be developed by artificial groundwater recharge
- For all surface streams in Salt Lake County, it is assumed that up to 90 percent of the flow will be diverted as needed.
- City Creek, Parley's Creek, Little Cottonwood and Big Cottonwood water treatment plants will be enlarged.
- Little Dell Reservoir water will be treated and used at the expanded Parley's Creek water treatment plant.
- Water conservation measures were not included in the initial running of the model and the projecting of future water needs. This created a base line from which the impacts of the various conservation measures could best be evaluated. The model was then run including the various conservation measures. The projected effects of water conservation are expected to reduce the projected water use by about 11.4 percent (47,700 acre-feet) by the year 2020. Water conservation is discussed in Section 17.

Table 9-3
PROJECTED CULINARY M&I DEMAND AND SUPPLY FOR MAJOR WATER SUPPLIERS
Jordan River Basin

Year	Population Projection	Water Demand (acre-feet)	Water Supply (acre-feet)	Surplus Deficit ()
1995	805,000	255,700	348,360	92,660
2000	871,400	279,600	348,360	68,760
2005	958,000	308,500	348,360	39,860
2010	1,078,200	345,600	348,360	2,760
2015	1,199,800	384,100	348,360	(35,740)
2020	1,300,100	419,300	348,360	(70,940)

Source: Wasatch Front Demand/Supply Computer Model (February 1997)

Table 9-4
CURRENT USES AND PROJECTED WATER DEMANDS

Use Category	1995	2020
Municipal & Industrial:		
Culinary		
Residential	164,600	261,500
Commercial/Institutional	77,200	135,000
Industrial	15,400	25,300
Private Domestic	24,600	20,000
Self-Supplied Industrial	26,500	26,500
(sub-subtotal)	308,300	468,300
Secondary		
Municipal	10,000	15,000
Industrial	13,200	13,200
(sub-subtotal)	23,200	28,200
Total	331,500	496,500
Irrigated Agricultural	126,500	50,000
Developed Wetlands and Waterfowl Areas	94,500	94,500
Basin Total	552,500	641,000

Table 9-5
JORDAN RIVER BASIN TOTAL WATER DIVERSIONS AND DEPLETIONS

Use Category	1995		2020		2050	
	Diversions	Depletions	Diversions	Depletions	Diversions	Depletions
Municipal and Industrial						
Culinary	308,300	130.950	468,300	216,290	738,000	369,000
Secondary	23,200	14,900	28,200	17,690	35,000	21,000
Subtotal	331,500	145,850	496,500	233,980	773,000	390,000
Irrigated Agriculture	126,500	50,600	50,000	20,000	5,000	2,000
Wet/Open Water Areas	94,500	94,500	94,500	94,500	94,500	94,500
Basin Total	552,500	290,950	641,000	348,480	872,500	486,500

The model predicts that over the next 25 years the demand for public water will increase an average of 2.0 percent per year. The 1995 demand for major public water suppliers of 255,700 acre-feet per year will increase nearly 65 percent by the year 2020 to an annual demand of 419,300 acre-feet. Table 9-3 compares the projected water demand with the existing water supplies. As can be seen from the table, if the model's projected pattern is correct, Salt Lake County will begin experiencing public water supply shortages after the year 2010. These culinary M&I water projections do not include the effects of water conservation measures. The projected effects of water conservation are expected to reduce the projected water use by about 11.4 percent (47,700 acre-feet) by the year 2020. With conservation measures Salt Lake County will not begin experiencing shortages until after 2016. Table 9-4 summarizes 1995 and projected demands for various use categories. Since water sources are fully developed or at the very least fully appropriated, and the basin is closed to further water rights appropriations, it is assumed there will be virtually no new privately developed water supplies. It may turn out, however, that as agricultural lands continue to be converted to residential property, some of the privately developed agricultural water supplies will be converted to public water supplies. However, the potential for converting agricultural water to culinary water will be limited by water quality concerns with Utah Lake and Jordan River water and the high cost of treatment to M&I standards. Table 9-5 summarizes the total water diversions and depletions for the years 1995, 2020 and 2050.

9.5 Alternatives for Meeting Water Needs

Planning for Jordan River Basin's future water needs has become a complex issue. In the past, water planning primarily meant developing new water sources. In the future, there are a number of potential water sources that can be developed to meet the projected water needs. However, they are all expensive.

Ultimately, the citizens may be willing to absorb the cost of developing the new and expensive water sources rather than affecting a change in life-style. It is incumbent upon today's water planners to consider the supply-side approach and the demand-side approach to water planning. Although this section is devoted primarily to the discussion of supply-side alternatives (i.e. developing new water sources), effective demand-side water planning such as water conservation, reuse, reduced system losses, and improved efficiencies, can reduce the need for additional supplies. A brief discussion of water conservation alternatives is included in this section, but a more thorough discussion is included in Section 17, Water Conservation/Education.

Alternatives for meeting future water needs can be classified in six basic groups:

- Develop Utah Lake/Jordan River water,
- Develop additional water from the Wasatch Range streams,
- Develop additional groundwater,
- Groundwater recharge
- Bear River Water development,
- Conservation

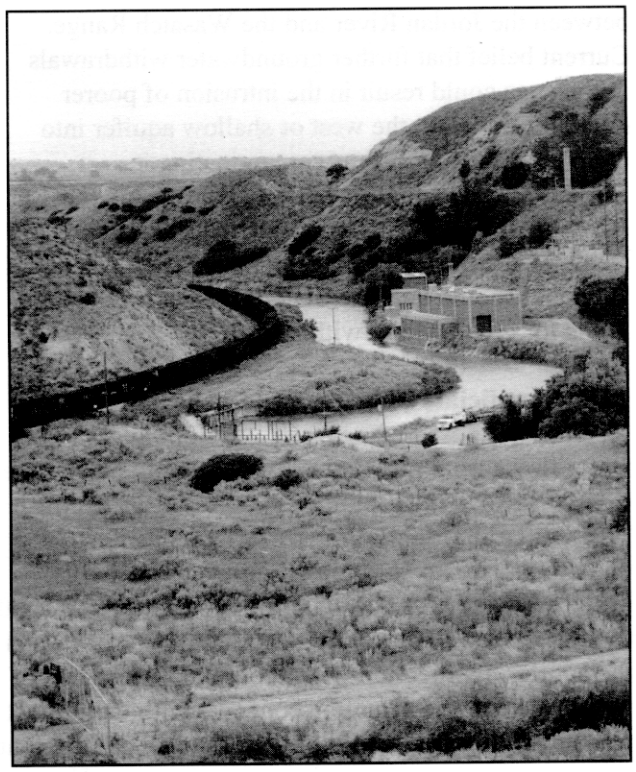
Given today's political and environmental climate, some of the alternatives listed above have more merit than others. Based upon current growth projections, meeting the future water demand will require some combination of the alternatives listed above. Possibly, each alternative may at one time or another play a part in the future. A discussion of each alternative along with its relative merits is included in the subsections that follow.

9.5.1 Develop Utah Lake/Jordan River Water

At the present time, a significant supply of water tributary to Utah Lake flows in the Jordan River. This supply source should continue to increase with time as more agricultural lands are converted to residential and commercial uses. Unfortunately, Jordan River water is of poor quality, and it will prove costly to treat it to M&I standards. Total dissolved solids (TDS) levels in Utah Lake are already so high that conventional treatment of Jordan River water is not economically feasible. As the Jordan River flows northward toward the Great Salt Lake, TDS levels are further increased along with other pollution parameters, including coliform bacteria, inorganics and heavy metals. These problems make the use of the Jordan River for M&I purposes very expensive. Despite these problems, in 1995 the Salt Lake County Water Conservancy District experimented with treating Jordan River water and blending it with high quality water to stretch existing water supplies. Many odor and taste

problems were reported by consumers, and at the present time this approach to developing Jordan River water has been discontinued.

There are, however, other methods by which Jordan River water could be developed. Secondary water systems could deliver Jordan River water for commercial and industrial and other non-culinary uses such as watering large grass areas, (i.e. parks and golf courses). This approach could reduce the amount of treatment required to meet culinary water needs and is being used to some extent by several cities. The capital expense of building an infrastructure to deliver secondary water would be considerable, and should be weighed against the cost of other alternatives.



Jordan Narrows Pumping Station

Another approach would be to use more advanced water treatment methods to treat Jordan River. Current state of the art treatment methods could be employed to render Jordan River water drinkable. These methods, however, are expensive (400-500 dollars per acre-foot) and could result in a significant cost increase to the water users.

Still another approach for the development of Jordan River water would be to buy Jordan River water rights, then leave the water in Utah Lake and transfer the water right to groundwater withdrawals in Utah County. While this approach is hydrologically sound and would probably meet with approval from the State Engineer, it would likely meet with stiff opposition from water user's in Utah County.

9.5.2 Develop Additional Water from Wasatch Range Streams

The development of additional water from the Wasatch Range streams holds a limited potential for addressing the future needs. Plans in place to enlarge some of the water treatment facilities and put more of this high quality water to culinary use. Further development of these streams, however, is a very sensitive environmental issue.

A significant quantity of high quality water flows from the mountain streams to the Jordan River and subsequently to the Great Salt Lake. The average annual flow into the Salt Lake Valley from Wasatch Range streams is 173,400 acre-feet. At the present time, approximately 68,000 acre-feet of that water is incorporated into public water supplies. Existing plans to enlarge and improve the management of existing water treatment facilities would increase this amount to 91,640 acre-feet. That still leaves a significant quantity of high quality water that could be developed from the Wasatch Range streams. It is estimated about 75 percent of the flow from these streams (about 130,000 acre-feet) comes during the spring runoff period from mid-April through mid-July. To fully develop this high quality water for culinary use, it will be necessary to either construct reservoir storage or provide treatment plant capacity equivalent to the peak runoff.

The feasibility of reservoir construction on Wasatch Range streams and within the Salt Lake Valley has been investigated. *The Salt Lake County Area-Wide Water Study* conducted jointly by the Metropolitan Water District of Salt Lake City, the Salt Lake City Corporation, the Salt Lake County Water Conservancy District and the Division of Water Resources in 1982, identified several potential reservoir sites in the Wasatch Range canyons as well as various locations within Salt Lake Valley. At the present time, however, it is widely held that for political, economical and environmental reasons, the construction of additional reservoirs within the Jordan River Basin is not a viable option.

Without additional surface reservoir storage, the

only way to increase culinary water use of Wasatch Range streams would be to provide treatment plant capacity equal to the peak runoff during periods of time when runoff flow rates can be absorbed by municipal water demands. The peak monthly runoff from all of the Wasatch Range streams is about 40,000 acre-feet. This translates to 435 million gallons per day (mgd). At the present time, the capacity of treatment plants on the east side of the valley is 233 mgd. These east-side treatment plants (City Creek, Parley's, Big Cottonwood, Metropolitan, Southeast Regional and Draper) are currently being used to treat the mountain stream runoff. In addition to these facilities, there is the Jordan Valley treatment plant located in Bluffdale. This facility currently has the capacity to treat 180 mgd with the potential to enlarge to 255 mgd in the future. The total current treatment capacity for the basin is 413 mgd with the potential to enlarge to 540 mgd (see Table 9-6). The valley's water treatment plants have sufficient capacity to treat and use more of the outflow from the Wasatch Range streams. But a tremendous cost would be incurred to convey the short duration flows across the valley to the Jordan Valley treatment plant. Furthermore, since the Wasatch Range's peak runoff occurs in May, it does not match up with the valley's peak demand which takes place in July and August. Consequently, substantial storage would still be necessary to effectively develop additional water from the Wasatch Range streams.

Table 9-6
WATER TREATMENT FACILITIES
Jordan River Basin

Treatment Plant	Current Capacity (mgd)	Planned Enlargement (mgd)
City Creek	15	-
Parley's	40	5
Big Cottonwood	40	-
Metropolitan	113	37
Southeast Regional	20	10
Draper Irrigation Co.	5	-
Jordan Valley	180	75
Total Capacity	413	127

9.5.3 Develop Additional Groundwater

It is generally believed the Salt Lake Valley groundwater basin is fully appropriated. (For more information on groundwater, See Section 19.)

Plans to develop additional groundwater sources in the Salt Lake Valley are being considered, but this will be done on a very limited basis and monitored closely by the Division of Water Rights. At the present time, the State Engineer as well as many other groundwater experts believe the current level of groundwater withdrawals is approaching the safe yield levels for the valley. Groundwater recharge data show significantly more water in the groundwater basin than is currently being withdrawn. The concern, however, is that much of the groundwater recharge is of poor quality. The high quality groundwater area designated in the state's *Interim Groundwater Management Plan* as "Management Area Number 1" (See Figure 19-3) is located on the east side of the valley, primarily between the Jordan River and the Wasatch Range. Current belief that further groundwater withdrawals in this area could result in the intrusion of poorer quality water from the west or shallow aquifer into the principal aquifer, thus contaminating it.

The U.S. Geological Survey, jointly with the Division of Water Rights, conducted a groundwater study for the Salt Lake Valley that was published in 1996 and should help the State Engineer set the final limits for groundwater withdrawals.

9.5.4 Artificial Groundwater Recharge

Another possible means of developing surface water flows from mountain streams would be to store excess flows in the groundwater aquifer for later use. The Salt Lake County Water Conservancy District undertook a demonstration groundwater recharge project in southeast Salt Lake County during the 1990 to 1994 period. The demonstration project recharged the aquifer by injection with about 2,650 acre-feet of water. One of the principle concerns with the project was protecting the quality of the principal aquifer that serves as a major source of municipal water. The approach taken is to treat the injectate to drinking water standards and conduct extensive water quality monitoring. The project was set up to determine how much of the injected water can be recovered.

Based on the success of the demonstration project, the Salt Lake County Water Conservancy District submitted a groundwater recharge proposal for funding under the Central Utah Project Completion Act. The proposal has been funded and construction is underway. When completed, the project will produce an average of 5,800 acre-feet of

water per year. The project will treat spring runoff water from the canyons in the southeast portion of Salt Lake County and inject the treated water into the aquifer. The water will be pumped from wells later in the year as needed to meet demand.

9.5.5 Bear River Development

The Bear River has long been viewed as an available water resource. An average annual flow of over a million acre-feet flows from the river to the Great Salt Lake. However, based on the river's flow pattern (water is available only during the winter and spring months) and poor water quality, it has remained an untapped resource. The Salt Lake County Water Conservancy District submitted an application in 1986 to the Board of Water Resources for assistance in developing 50,000 acre-feet of water from the Bear River.

During the flooding of the early 1980s, the Division of Water Resources was directed by the legislature to investigate Bear River water storage options that would help control the level of the Great Salt Lake. A joint legislative/gubernatorial Bear River task force was created in 1990 to look at water development options on the Bear River. This Bear River Task Force apportioned the state's Bear River water rights to Cache and Box Elder counties, Weber Basin Water Conservancy District and Salt Lake County Water Conservancy District. The task force provided that each county would get 60,000 acre-feet of water and each district would get 50,000 acre-feet of water.

The division was directed by the task force to prepare a plan for delivering the apportioned water rights. The *Bear River Pre-Design Report* was published in 1991. It identified a plan for development that had four major parts: First, development of a water storage reservoir in the upper basin to provide replacement for groundwater withdrawals; second, a diversion from the Bear River to move water via canal or pipeline to Willard Bay Reservoir; third, the construction of transmission facilities to move project water from Willard Bay south to Davis, Weber, and Salt Lake counties; and fourth, the construction of a reservoir on the lower Bear River. The current plan has been modified to constructing a pipeline or canal from the Bear River to Willard Bay Reservoir, a water treatment facility in Weber County, and the necessary conveyance facilities to get treated water to its point of use. The projected cost of that project is approximately $300 million.

The Bear River Task Force introduced legislation that further defines the state's role in the development of the river. The 1991 Bear River Development Act states the Division of Water Resources shall construct a state project that may include the construction of reservoirs on the Bear River and a pipeline or canal to Willard Bay Reservoir. All facilities constructed to deliver water to potential users from those facilities will be the responsibility of the water purchaser.

The Salt Lake County Water Conservancy District (SLCWCD), in cooperation with the Weber Basin Water Conservancy District (WBWCD), is proposing the construction of a water treatment plant in central Weber County. The SLCWCD is currently purchasing land for the plant. Also, in cooperation with the WBWCD, the SLCWCD is investigating pipeline alignment alternatives to convey Bear River water from the proposed plant south to Salt Lake County and the east shore area of Davis and Weber counties This pipeline will deliver needed water to SLCWCD as well as alleviate an infrastructure problem for WBWCD in the east shore area of Davis and Weber counties. These proposed facilities would provide the infrastructure to move water south from the Bear River to Salt Lake County and also the opportunity for various Weber Basin water suppliers to lease water to the SLCWCD.

9.5.6 Conservation

Stretching existing water supplies through a number of conservation practices has potential. Water users may be able to better manage their supplies thereby increasing efficiencies which in turn can reduce costs. This applies to all water uses including residential, commercial, industrial and agricultural.

Water reuse is also a potential water conservation practice that might be employed in the near future. One approach to water reuse currently being investigated is the delivery of wastewater effluent from the Central Valley Wastewater Treatment Plant to irrigation canals where it would be co-mingled with irrigation water before being applied to irrigated fields. This approach to water reuse and other conservation efforts are discussed in more detail in Section 17, Water Conservation/ Education. Water conservation will undoubtedly play an important role in addressing future water needs. It is not likely,

however, that water conservation will entirely replace the need to develop additional water supplies.

9.6 Issues and Recommendations

9.6.1 Local Planning

Issue - Not all communities are taking a long-range approach to water planning.

Discussion - With new water sources becoming limited in the never-ending search for additional water supply, water purveyors need to plan for their future growth. Water conservation sooner or later will need to be an integral part of the water agency's management plan. The present advice from water planners throughout the United States is to estimate the community's growth and plan a combination of water supply and water conservation strategies that will help provide an orderly structural and non-structural program to meet the community needs.

Various scenarios should be employed considering all the options available to the communities. Least-cost strategy should be used, with water conservation and environmental impacts given full consideration. Obviously, new reservoir and groundwater sources would be used, along with conversion of agricultural water and reduction of water demand through better efficiencies within and outside the home.

The plan should be revised as needed with a formal acceptance by the community council or water agency board. By updating the population projections, revising the future water sources and reducing the demand through conservation methods, the members of the board responsible for water delivery will be alerted to future problems that may be beyond their term of office, but require immediate action for the future quality of life of the community.

Recommendation - All communities and/or water utilities should prepare a long-term water management plan which includes proposed new water supply sources and water conservation programs. The plans should be revised and updated as needed.

9.6.2 Cooperative Inter-agency Planning

Issue - The Jordan River Basin's growth coupled with its multitude of governmental agencies present a complex planning picture.

Discussion - Many federal, state and local agencies are involved in water planning within the Jordan River Basin. All of these agencies have a vested interests in the development and the use of Jordan River water. But agencies' planning goals and strategies are often similar, or sometimes agencies have conflicting interests or goals. Therefore, interagency cooperation and coordination is needed to complete effective planning of the water resources.

Recommendation - Various federal, state and local agencies should take an active role in the development of the *Jordan River Basin Management Plan* to insure it addresses their water management goals. ■

West Jordan City Hall

SECTION 10 CONTENTS

AGRICULTURAL WATER

As the Jordan River Basin population has grown, many of the agricultural areas have been converted to residential or commercial developments, significantly reducing the total irrigated acreage during the past 30 years.

10.1 Introduction

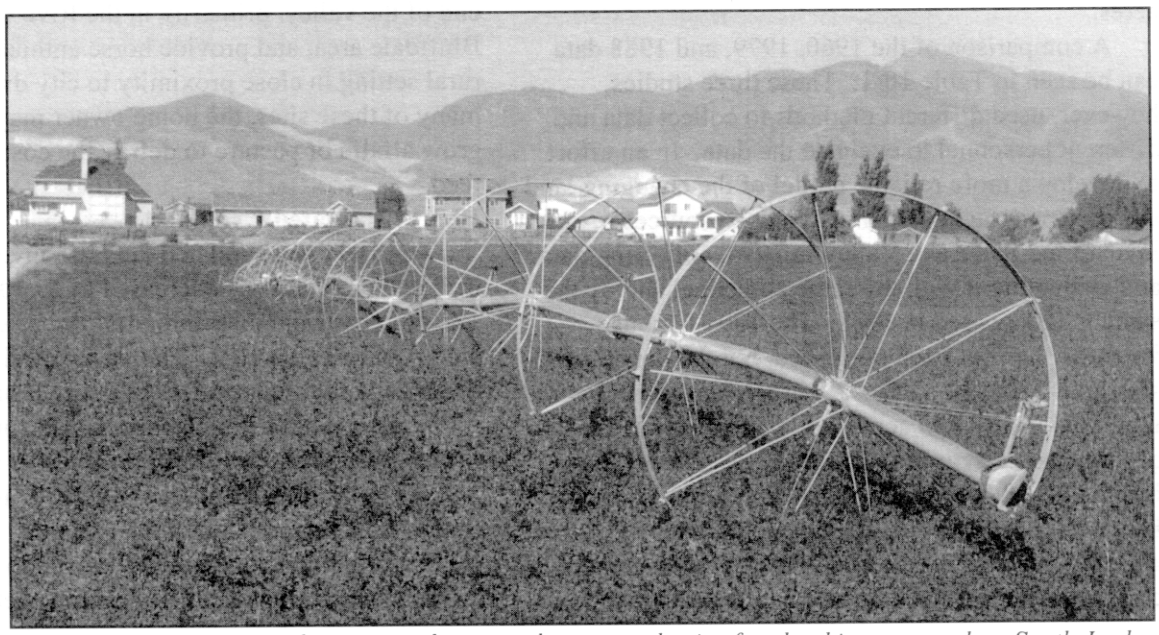
This section describes the agricultural water use in the Jordan River Basin. It also identifies and discusses key issues associated with agricultural water conservation. Also, some proposed solutions to the problems and needs of the area are presented.

10.2 Background

Historically, agriculture has been an important industry in the Jordan River Basin. Today, however, the basin has just over 43,800 acres of cultivated lands, of which approximately 25,300 acres are irrigated. Although agriculture continues to be an important part of the overall state economy, urbanization makes it's role increasingly less significant in the socio-economic development. Still, agricultural water use plays an important role in overall water planning in terms of quantity and quality.

In recent decades, the Salt Lake Valley has experienced widespread growth. Much of the residential expansion has been in what was predominately agricultural areas in the western, south-central, and southeast portions of the valley, primarily the West Valley City, West Jordan, South Jordan, Draper, Riverton and Bluffdale areas with considerable growth in the Sandy area. These are lands that have been served by canals on the west and east side of the valley.

Salt Lake County's master plan, titled *Salt Lake Valley 1965,* identified agricultural land use as a valuable asset to the valley's socio-economic welfare. The plan called for 80 square miles (51,200 acres) of highly productive farmland to be held in reserve against the encroachment of urban and commercial development. That county plan, however, was not mandatory but advisory. As a result, no steps were



Population growth encroaches on productive farmland in areas such as South Jordan

taken to insure the 51,200 acres of agricultural land were preserved. Although 43,800 acres of agricultural lands remain in the valley, present land use trends clearly indicate a continuing conversion of agricultural lands, primarily irrigated lands, to urban and commercial developments. Refer to Table 6-3 for the basin's largest irrigation companies and acreages.

10.3 Agricultural Lands

Salt Lake County's master plan, published in March of 1965 and using 1960 land use data, identified 93,000 acres of total agricultural lands and 57,000 acres of urban lands. The plan does not identify how much of the agricultural ground was irrigated or dry farmed.

A study for the Division of Water Resources, titled *Land Use Inventory of Salt Lake County 1982*, used 1979 infrared aerial photography to map various land use types. It identified 94,500 acres of urban ground, 51,200 acres of irrigated lands, and 27,400 acres of dry farm land. The total agricultural ground was 78,600 acres.

The Division of Water Resources mapped the Salt Lake Valley in 1988 from low altitude photography with field verification. The results of that inventory were published in March of 1994, titled *Water-Related Land Use Inventories - Lower Jordan River.* The study identified 29,800 acres of irrigated ground, 23,100 acres of dry cropland for a total of agricultural land of 52,900. Urban land had increased to 116,100 acres.

A comparison of the 1960, 1979, and 1988 data can be seen in Table 10-1. These three studies, however, used different methods to collect data and different personnel to evaluate the data. In an effort to develop a more reliable model of the changing land use patterns, the Division of Water Resources re-inventoried Salt Lake Valley in 1994, collecting data and evaluating it with the same personnel and by the same methods used in 1988. The 1994 land use inventory has not been published, but the data (also shown in Table 10-1) showed urban lands had increased to 127,300 acres while irrigated farm ground had decreased to 25,300 acres and dry farm land had decreased to 18,600 acres. Total agricultural land was 43,800 acres. The changing land use patterns reflected by the 1988 and 1994 inventories confirmed the trends indicated by the earlier studies.

Projected land use figures in Table 10-1 for the year 2020 were developed based upon the pattern established by the four studies. Land use data presented in Table 10-1 are also graphically illustrated in Figure 10-1. Total agricultural lands have diminished from 93,000 acres in 1960 to 43,800 acres in 1994, and are projected to decrease to about 15,000 acres by the year 2020. Over the same period of time, urban lands have increased from 57,000 acres in 1960 to 127,300 acres by 1994. At that pace, urban lands will increase to over 175,000 acres by the year 2020.

Despite the current trend of agricultural lands being converted to residential and commercial uses, a number of successful farming operations continue to flourish amidst the growing urban community. In the 1950s, a "nuisance" statute was passed. That law allows a resident, using his land for the same purpose for which it had been used historically, to remain on his land even though the uses of the land and population around have changed. This law allows the "urban" farmers to continue to operate their business. In the end, however, the "urban" farmer may quite possibly be doomed to extinction. The residential and commercial growth will ultimately escalate land and water values to the point that selling out to developers may prove to be the most financially prudent thing to do.

One exception to the growing urban trend is the creation of relatively small 5- to 10-acre "ranchettes." These home developments are popular in the southern end of the valley, primarily in the Riverton and Bluffdale area, and provide horse enthusiasts with a rural setting in close proximity to city dwelling. At many of these sites, the home owner may continue to grow alfalfa or pasture to defray the cost of horse feed.

10.3.1 Irrigated Cropland

The 1994 water-related land use inventory shows irrigated cropland has decreased to 25,300 acres. The crop type and distribution of the irrigated crops are given in Table 10-2. The vast majority of irrigated lands are used for the production of feed for cattle. Irrigated pasture lands account for 36 percent, while alfalfa makes up 27 percent of the irrigated ground. Various grains, corn, hay, idle and fallow ground make up much of what remains. Less than 2 percent of the irrigated ground is used to produce higher cash crops such as fruits and vegetables.

Table 10-1
URBAN/AGRICULTURAL LAND USE TRENDS

Land Use	1960[a]	1979[b]	1988[c] (acres)	1994[d]	2020[e]
Irrigated lands	-	51,200	29,800	25,300	10,000
Dry farm lands	-	27,400	23,100	18,600	5,000
Total agricultural lands	93,000	78,600	52,900	43,800	15,000
Urban Lands	57,000	94,500	116,100	127,300	175,000

a. Taken from Salt Lake County's master plan published in March 1965, titled *Salt Lake Valley 1985.*
b. *Land Use Inventory of Salt Lake County 1982*, by Kevin Price, Reynold Willie, and Merrill Ridd. (1979 color infrared aerial photography used)
c. *Water-Related Land Use Inventories - Lower Jordan River Area,* Utah Division of Water Resources, March 1994
d. Unpublished *Water-Related Land Use Inventories - Lower Jordan River Basin*, Utah Division of Water Resources,
e. Projected from current trends.

Figure 10-1
SALT LAKE COUNTY LAND USE

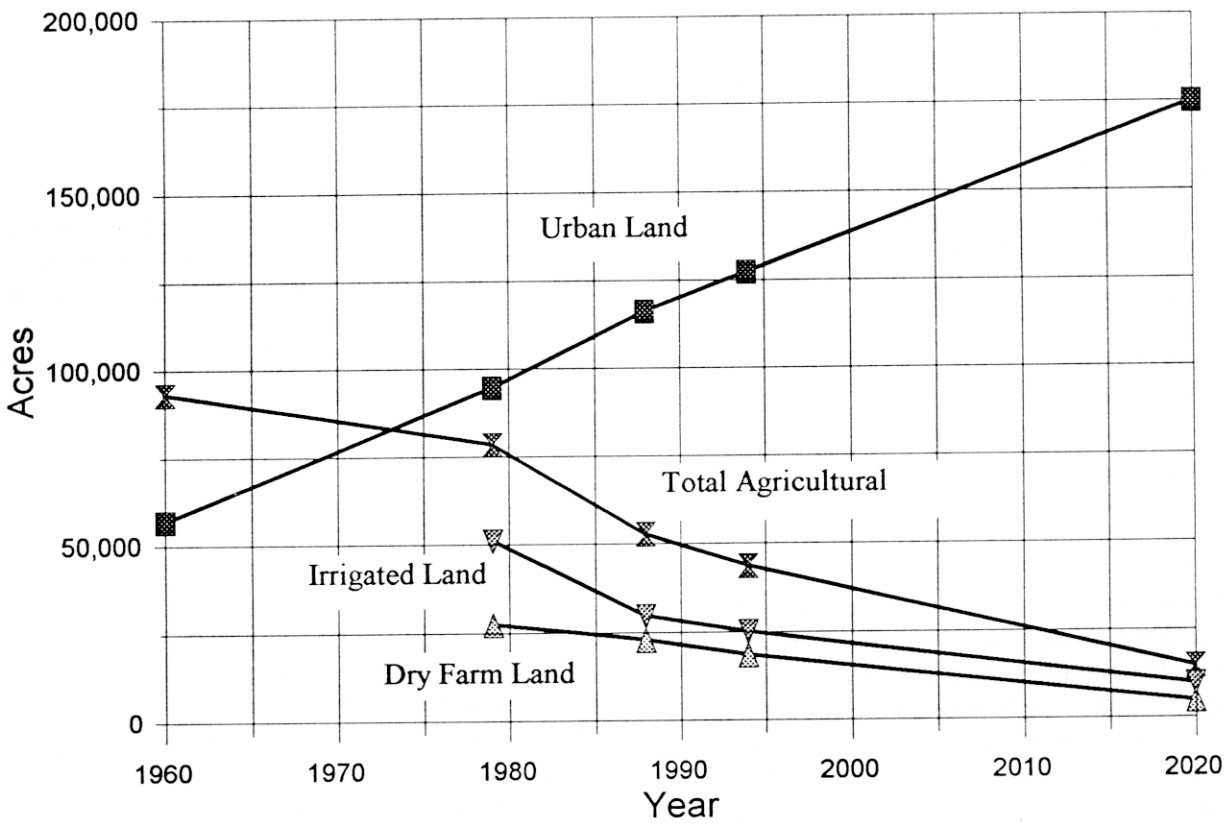


Table 10-2
IRRIGATED LAND BY CROP
Jordan River Basin

Crop Type	1994 acres
Alfalfa	6,858
Irrigated pasture	9,016
Grain	2,267
Corn	1,705
Grass/turf	115
Grass/hay	240
Idle	4,156
Fallow	561
Vegetables	122
Fruits	90
Beans	103
Potatoes	5
Other horticulture	77
Total irrigated acres	25,316

Water-Related Land Use Inventories - Lower Jordan River Area, Utah Division of Water Resources, March 1994, unpublished.

10.3.2 Dry Cropland

Over 40 percent of the agricultural ground is dry cropland. The majority of the dry cropland is located above the west side canals in the southwest portion of the valley, primarily the South Jordan and Riverton areas, extending west to Copperton and north to the Kearns and Magna area. As with the irrigated lands, dry croplands are primarily used for the production of feed grains With the ever-growing reduction in irrigated lands and the increasing availability of agricultural water, these dry croplands have potential for conversion to irrigated lands, the primary constraint being the pumping cost.

10.4 Agricultural Water Problems and Needs

Although agriculture continues to use a significant portion of the total water supply, farms and ranches are steadily being replaced by residential and commercial developments. The resulting loss of irrigated agricultural land is also the driving force currently changing basic water use. Irrigation supplies of high water quality have already been converted to municipal and industrial uses. Although adequate for irrigation, the basin's remaining irrigation supplies are of poor quality. Converting the water to municipal and industrial uses is expected to be quite expensive.

Farming, as an occupation, has undergone fundamental changes in recent years. This has resulted in many farmers leaving, or relying on off-farm employment to supplement their incomes. On the whole, however, these changes are a result of national and international political and economic restructuring.

10.4.1 Irrigation Water

Water is diverted from the Jordan River to the east and west sides of the valley through a series of parallel canals. The west side of the valley is served primarily by a system of four canals. From the uppermost to the lowest these are Welby Canal (starting at elevation 4700), Utah Lake Distributing Canal (4575), Utah and Salt Lake Canal (4480), and the South Jordan Canal (4425). The east side of the valley is primarily served by a system of three parallel canals: Draper Irrigation Company Canal (starting at elevation 4560), East Jordan Canal (elevation 4480), and Jordan and Salt Lake Canal (4425). See Figure 3-2 for canal locations. These parallel distribution systems are very complex with numerous inter-canal exchanges. Such a system allows for efficient use of water since surface water runoff from higher agricultural areas can be collected and distributed by lower canals.

Virtually all of the surface water supplies used for agriculture come from the Jordan River. The cost of treating Jordan River/Utah Lake water to drinking water standards is currently prohibitive. Consequently, the quantity and quality of water available for agriculture is not a problem. With large tracts of formerly irrigated lands now converted to residential developments, there is more than enough water available for the lands remaining in agricultural production. The average annual diversion for irrigated cropland is 143,000 acre-feet. In 1995, an estimated 126,000 acre-feet of water was diverted to irrigate about 25,300 acres of cropland.

10.4.2 Erosion

Watershed management is the protection, conservation and use of all the natural resources of a watershed in such a way as to keep the soil mantle in place and productive. It also assures water yield and water quality meet the existing and potential uses. If not properly protected, watershed lands are readily damaged from erosion, floods, sediment and fire.

In the Jordan River Basin, however, the primary concern with erosion is one of water quality. With the rapid conversion of agricultural lands to residential and commercial uses, the preservation of

topsoil is probably not as high a priority as it would be in more strictly agricultural communities. Moreover, because the valley is not heavily grazed, and for the most part the riparian areas along the Jordan Rivers and its tributary streams are in fair condition, erosion is not a big problem. A few localized areas where erosion problems exist are primarily a result of dry-farm activities. These areas would benefit from the development of a watershed management plan. The following are some of the treatment measures that can be used in the Jordan River Basin to keep, protect and enhance the watershed:

- Wildlife management.
- Vegetation improvement on cropland, rangeland, pastures, forest land, pasture land, wetlands, riparian zones and other areas.
- Conservation tillage protection on cropland in the lower watershed coordinated with grazing management. Improved cropping sequences, pasture and hay land management, and proved irrigation systems and management are important.
- Structural measures, such as contour trenching, debris basins, gully control, and stream channel stabilization, all in conjunction with vegetation improvement.
- Spring areas protected from wildlife by fencing. Watering facilities provided outside the fenced areas.

10.5 Conservation and Development Alternatives

A number of water conservation practices could be employed to increase water use efficiencies. These include improving diversion structures, lining high seepage loss canal sections, improved management and converting from flood irrigation to sprinkler or trickle applications. There is, however, no incentive to conserve Jordan River irrigation water. There is sufficient irrigation water for the existing demand and there is no foreseeable need for additional agricultural water. Also, at the present time the cost of treating Jordan River water precludes its use for municipal water. ■

SECTION 11 CONTENTS

Tables

DRINKING WATER

Throughout the Jordan River Basin, culinary water is used for all types of residential uses as well as for other municipal and industrial uses.

11.1 Introduction

This section describes the present drinking water systems in the Jordan River Basin, discusses present and future problems and presents estimated future requirements. For clarification purposes, this section, although titled "Drinking Water," addresses public water supplies distributed for public uses. Typical uses include indoor home use, lawn and garden watering, car washing, swimming pools, public parks and streets, fire protection, commercial enterprises, and schools. Many industries also receive water from municipal water systems. Industrial water use is discussed in Section 18.

11.2 Setting

At the present time, existing drinking water supplies are adequate and come from a rather complex mix of surface water and groundwater (including wells, springs and tunnels). Almost 99 percent of the public drinking water supplies come from 32 approved community drinking water systems (See Table 11-1 for listing). Approval of drinking water systems implies compliance with state regulations and water quality standards. In addition to the 32 primary community drinking water systems, there are an additional 46 small drinking water systems. These small systems, some approved and some unapproved, provide drinking water to a very limited clientele or service area such as a campground, a restaurant or a small subdivision.

The major water purveyors in the county are Salt Lake City, the Metropolitan Water District of Salt Lake City and the Salt Lake County Water Conservancy District. Most of the other approved water systems, despite having independent water sources, are dependent to some extent upon the purchase of water from one or more of these wholesalers.

The population served, total connections and monthly demand figures given in Table 11-1 show the relative size of the various drinking water systems. But the numbers are not additive. For instance, the Salt Lake County Water Conservancy District (SLCWCD) is shown as serving a population of 400,000. The SLCWCD, however, is primarily a wholesaler. The 400,000 figure incudes the populations served by their wholesale clients (e.g. Kearns Improvement District - 32,000, West Jordan City water system - 45,000, Granger Hunter Improvement District - 85,000 and others). In addition to domestic water users, the population served also includes estimates for commercial uses. Consequently, many individual users are counted two or more times in the table. For these reasons, any attempt to quantify domestic water usage by adding the population served, number of connections, or total monthly demands would be inappropriate. A summary of current uses and projected demands is shown in Table 9-4.

11.2.1 Background

The development of an urban water supply began with the arrival of the pioneers in 1847. City Creek, Red Butte Creek and Emigration Creek were put to immediate use for culinary and agricultural purposes. By 1860, nearly all of the nearby mountain streams were appropriated for agricultural uses with small communities established along their banks. Extensive use was also made of well water for household use. Early water rights were controlled through the hierarchy of The Church of Jesus Christ of Latter-day Saints (Mormons). As secular governmental structures emerged, control of water rights was shifted to city and territorial governments. Disputes concerning water rights were resolved by county water commissioners, and after statehood in 1896, through the Office of the State Engineer.

Table 11-1
COMMUNITY DRINKING WATER SYSTEMS
Jordan River Basin

Name	Population served	Total Connections	Monthly Demand (acre-feet)	Source	Treatment
Alta Town Water System	500	53	21.65	Tunnel	None
Bell Canyon Irrigation Co.	1,440	450	44.19	Wholesale	-
Bluffdale	1,400	517	29.46	Wholesale	-
Boundary Spring WUA	120	30	2.32	Spring	Chlorination
Copperton Improvement Dist.	800	277	51.36	Wells	Chlorination
Draper City Water System	200	75	9.04	Wholesale	None
Draper Irrigation Co.	5,200	1,850	243.04	Well/Stream	Complete
Foothill Water Co.	220	60	7.36	Wells	None
Granger-Hunter Imp. Dist.	85,000	22,000	184.12	Wells/Wholesale	None
Herriman Pipeline Co.	900	210	25.78	Spring/Well	Chlorination
Holladay Water Co.	14,900	3,705	434.53	Well/Spring/Wholesale	Chlorination
Kearns Imp. District	32,000	8,589	514.25	Wells/Wholesale	Chlorination
Magna Water Co & Imp Dist.	21,500	5,562	438.81	Wells/Wholesale	Chlorination
McDonald Condominiums	150	42	-	Wells	None
Metro Water Dist. of SLC	700,000	40	911.00	Surface	Complete
Midvale City Water System	10,142	2,632	324.05	Wells/Wholesale	None
Murray City Water System	31,000	7,956	125.24	Spring/Well/Wholesale	Chlorination
Riverton City Water System	12,000	3,028	206.22	Wells/Wholesale	None
Salt Lake City Water System	285,258	83,000	920.61	Surface/Wholesale/ Springs/Wells	Complete
Salt Lake County Water Conservancy District	400,000	7,706	718.07	Surface/Wholesale/ Springs/Wells	Complete
Sandy City Water System	82,000	23,500	589.19	Wells/Wholesale/Spring	Chlorination
Silver Fork Pipeline	200	192	5.90	Tunnel	None
Silver Lake Company	640	130	6.90	Tunnel	None
Salt Lake Co. Area #3	3,185	158	23.02	Springs\Tunnel	None
South Jordan City	14,000	3,768	312.12	Wholesale	None
South Salt Lake City	11,500	3,010	436.94	Wells	None
Spring Glen Water Co.	50	15	3.31	Wells	None
Taylorsville-Bennion WID	48,000	14,062	810.13	Wells/Wholesale	Chlorination
University of Utah	18,000	1,125	-	Well/Wholesale	None
Webb Well Water Users	75	38	3.68	Wells	None
West Jordan Water System	45,000	42,892	743.85	Wells/Wholesale	None
White City Water Co.	11,500	3,712	441.89	Wells/Wholesale	None

Source: Division of Drinking Water records.

Salt Lake City's population grew at a rapid pace, doubling between 1880 and 1888. The population doubled again between 1900 and 1920. City officials continued to acquire water rights during this period in the nearby canyon watersheds through court decrees and exchanges for Utah Lake water. Water rights in Little Cottonwood Creek and Parley's Creek were acquired in 1912, Mill Creek in 1913 and Big Cottonwood Creek in 1914. Just prior to the drought years of the early 1930s, Salt Lake City established a water advisory board to develop a long-range water program to meet its future needs. The 1931-1934 period of drought forced the city to drill more wells and to determine how best to increase its storage capacity. The Provo River Project was an outgrowth of these efforts. The Bureau of Reclamation initiated the project in the 1930s with its most notable feature, Deer Creek Reservoir, completed in 1941.

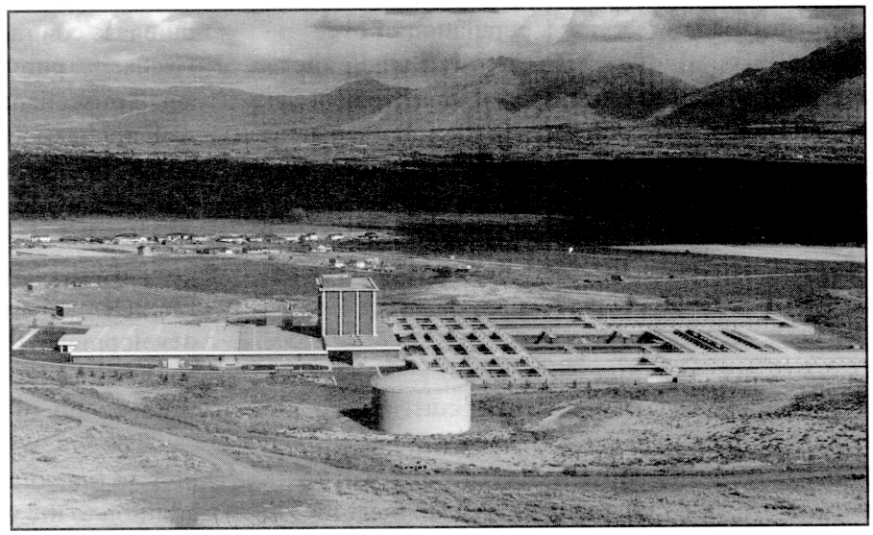
The Bureau of Reclamation required that a contracting entity be established to take responsibility for the repayment of project costs and to operate and maintain project facilities. The Provo Water Users Association was incorporated for these purposes in 1935. During the same year, the Metropolitan Water

District of Salt Lake City (MWD) was established to manage Salt Lake City's interests in the Provo River Project.

Salt Lake City established a policy in 1951 allowing the sale of water outside its corporate boundaries to retail customers in the growing suburbs along the east bench. With the addition of retail customers outside its boundaries, the population served doubled between 1940 and 1960. The metropolitan water district treatment plant was constructed in 1960 near the mouth of Little Cottonwood Canyon. At that time, Salt Lake City and the Metropolitan Water District served an equivalent population of 375,000 including residential customers in Salt Lake City and Salt Lake County.

Post World War II growth in the smaller municipalities and unincorporated communities (most notably the Kearns area), stimulated interest in developing a large-scale water supply for those areas. During the postwar years, most people in the Granger-Hunter area were served by individual or shared wells. When developers in the Kearns area proposed constructing a line to bring in water, several individuals in nearby areas asked to be included in the system. In response to petitions, the Salt Lake County Commission took action in the late 1940s to establish the Salt Lake County Water Conservancy District (SLCWCD), under the provisions of UCA Title 73, Chapter 9. The district came into existence in September 1951 and was charged with the responsibility for developing water sources and establishing a water conveyance system to serve communities south of 2100 South Street and west of Salt Lake City's suburban service area. The actual service area was defined partially through an unwritten agreement with the MWD.

Realizing early the development of local water sources would not keep up with the growth in population, the SLCWCD entered into an agreement in 1956 to participate in the Central Utah Project (CUP). During the 1960s, the SLCWCD continued to expand its conveyance systems, acquire and develop additional groundwater resources, and enter into agreements to purchase greater amounts of surplus water from the MWD. Because of delays in the construction of the CUP, originally scheduled for completion in the mid-1970s, the SLCWCD developed more groundwater sources and purchased increasing amounts of surplus water. The SLCWCD purchased as much as 25,000 acre-feet of surplus water from MWD in the early 1980s. In the past year, the SLCWCD purchased 10,000 acre-feet of water from the MWD and 20,000 acre-feet of water in Jordanelle Reservoir from the Central Utah Water Conservancy District. The Jordan Valley Water Treatment Plant was built in Bluffdale in 1974 and greatly improved the district's ability to serve areas on the west side of the valley.



Jordan Valley Water Treatment Plant

During the 1977 drought, MWD notified the SLCWCD the availability of surplus water could not be guaranteed throughout the high use period. The SLCWCD developed a contingency plan to restrict water use. When forced to implement the plan, the restrictions imposed on customers resulted in a 50 percent reduction in outside water use. Since the 1977 drought, the SLCWCD, in cooperation with the MWD and the Salt Lake City Public Works Department, has undertaken extensive efforts to locate new water resources and to increase water use efficiency. The *Area-Wide Water Study*, completed in April 1982, is a product of these efforts. Among other things, the study points out the need to develop additional storage facilities so that more of the local high quality waters lost in spring run-off can be

utilized. In 1989, the SLCWCD affected an exchange of Utah Lake water rights with the Provo Reservoir Water User's Company and in return obtained an average annual water supply of about 29,000 acre-feet consisting of 10,000 acre-feet of stored water in Deer Creek Reservoir and 19,000 acre-feet of direct flow water rights in the Provo and Weber rivers. It is apparent further development of other sources will be required even with full development of CUP water. The district is now serving a population of over 500,000. The SLCWCD is primarily a wholesale provider of water to cities, special improvement districts, and water companies in the suburban areas south and west of Salt Lake City's service area. Over 7,400 retail connections are also serving approximately 30,000 people. Through wholesale and retail deliveries, the district expects to serve an additional 300,000 people by the year 2005.

11.2.2 Current Water Supplies

When planned development of current water sources in the Jordan River Basin are in place, approximately 343,360 acre-feet of water will be available annually on a reliable basis to meet its public water needs (See Table 9-2). Of this total, 125,410 acre-feet is from groundwater sources, 1,060 acre-feet of artificial groundwater recharge, 61,850 acre-feet from local mountain streams, 61,700 from Deer Creek Reservoir, 84,000 acre-feet from the CUP and 9,600 acre-feet from the Welby/Jacob Exchange.

11.2.3 Metropolitan Water District of Salt Lake City

Salt Lake City has acquired an annual average water supply of approximately 167,000 acre-feet. This includes 61,700 acre-feet of storage in Deer Creek Reservoir controlled through the Metropolitan Water District of Salt Lake City. In addition, Salt Lake City obtains an average of 68,000 acre-feet each year from mountain streams, 20,000 acre-feet from the CUP, 17,600 acre-feet from springs and wells, and additional small quantities of water from miscellaneous sources. Salt Lake City's water supply can be characterized as "firm".

Salt Lake City's maximum daily demand coincides with the peak summer irrigation period and is 240 percent of the average daily demand. By the year 2020, it is estimated the Salt Lake City water system must be capable of delivering a maximum daily flow of 350 million gallons per day, an increase of 69 percent over the current peak flow of 220 million gallons per day.

11.2.4 Salt Lake County Water Conservancy District

The Salt Lake County Water Conservancy District obtains its water from 18 wells and two springs, from mountain streams in the southeast corner of Salt Lake Valley, the CUP through its water purchase contract with the CUWCD, the Welby-Jacob Exchange, purchases from MWD and additional small miscellaneous sources. The SLCWCD has filed well applications with the State Engineer for a total of 221.8 cfs of groundwater throughout the district. Of this amount, 46.74 cfs have been fully developed. Applications for the remaining 175.06 cfs of groundwater have been approved by the State Engineer and are being developed or held for future development. The district estimates that these applications represent a potential additional annual water supply of at least 10,000 acre-feet.

The SLCWCD has a firm water supply at the present time of approximately 100,000 acre-feet. In addition to the water it directly controls, the district has an agreement with the MWD (subject to availability) for an annual 10,000 acre-feet of treated Deer Creek Reservoir water. This agreement is valid through the year 2001, and may then terminate. Water from the MWD has been sufficient in most recent years to meet Salt Lake City needs and fulfill conditional commitments to the SLCWCD, but continued growth in Salt Lake City service areas will reduce water currently delivered to the SLCWCD. With this in mind, the SLCWCD has developed plans for other sources of water.

11.3 Organizations and Regulations

Although public drinking water supplies are subject to compliance with state and federal safe drinking water standards, it is the towns, cities and counties that have primary responsibility for drinking water supplies within their boundaries. Their responsibility and authority are spelled out in Sections 10, 11, 17, 19, and 73 of the *Utah Code Annotated, 1953, Amended.*

11.3.1 Local

As can be seen from Table 11-1, most of the incorporated cities (Alta, Bluffdale, Draper, Murray, Midvale, Salt Lake City, Sandy, South Jordan, South

Salt Lake, Riverton and West Jordan), have their own drinking water systems. Those that do not (Taylorsville and West Valley City) are served by the Taylorsville-Bennion Improvement District or the Granger-Hunter Improvement District. Additionally, many of the unincorporated communities also have their own drinking water systems either through the establishment of a water improvement district (i.e., Copperton, Kearns, Magna and White City) or through the establishment of a water company (i.e., Herriman and Holladay). Although most communities have constructed their own drinking water systems and have developed independent water sources, most rely heavily on the primary wholesale suppliers: Salt Lake County Water Conservancy District and the Metropolitan Water District of Salt Lake City.

11.3.2 State

The Division of Drinking Water is the state agency responsible for regulating and monitoring public drinking water systems. By action of the 1991 Utah Legislature, effective July 1, 1991, the Department of Environmental Quality was created, and the Bureau of Drinking Water/Sanitation was elevated to the Division of Drinking Water.

All public drinking water supplies are subject to the Utah Safe Drinking Water Act and Utah's Public Drinking Water Regulations. Laws and regulations are administered by the Department of Environmental Quality, Division of Drinking Water. In addition, the Utah Board of Health has regulatory control over public and individual drinking water systems and water well installation and construction. These responsibilities and duties are carried out through their staff. They work closely with the Department of Environmental Quality on related regulations. When private water systems are proposed to serve new developments, local planning commissions often ask the local health department to evaluate the feasibility of the water supply.

11.3.3 Federal

With the passage of the federal Safe Drinking Water Act (SDWA) in 1974, the federal government established national drinking water regulations to protect the public from water borne diseases. Congress expanded and strengthened the SDWA in 1986. The amended SDWA significantly increased the responsibility of the Environmental Protection Agency (EPA) to: 1) Establish maximum levels of contamination for established pollutants, 2) set compliance deadlines for owners/operators of treatment facilities in violation of federal regulations, 3) regulate surface water treatment associated with lead removal and wellhead disinfection, and 4) strengthen the enforcement of all regulations in the initial act.

Chemical, physical, radiological and bacteriological substances in drinking water which pose a health risk to the public are regulated by the EPA under provisions given in the SDWA. The EPA has established an extensive list of maximum contaminant levels (MCLs) for most common organic and inorganic contaminants.

The SDWA has also established a strict schedule to determine reasonable MCLs for a number of additional contaminants. As a result, additional contaminants are identified on a regular basis by the EPA and subject to new regulations.

To control and improve the aesthetic quality of drinking water supplies, the SDWA also includes a list of secondary maximum contamination levels (SMCLs) for water aesthetics such as taste, odor and color. Although the evaluation of these qualities is subjective, the measurement of SMCLs has allowed for a reasonable level of consistency in water aesthetics determinations from one supply to another.

The SDWA also requires state and local water provider agencies to monitor a specified list of regulated and unregulated contaminants. The selection of contaminants is dependant upon the number of people served, the water supply source and contaminants likely to be found. The standardized monitoring framework is administered over three, three-year compliance cycles for a nine-year total monitoring period beginning in 1992.

The 1986 SDWA amendments require all states to develop wellhead protection programs. The Division of Drinking Water has created the Drinking Water Source Protection Rule (DWSPR) outlining the general requirements to protect wellheads from outside surface contamination. Requirements of the DWSPR include preparing a *Drinking Water Source Protection* Plan for each groundwater source in all public water systems. Proof of ownership and maintenance of all land in and around wellheads where surface water contamination can occur is also required.

The 1996 amendments to the Safe Drinking Water Act created several new programs and included a total authorization of more than $12 billion in federal funds for various drinking water programs and activities nationwide from 1997 through 2003. The amendment provided $12.5 million to the Division of Drinking Water in a revolving fund program.

New capacity development provisions are added to the SDWA. The EPA must complete a review of existing state capacity development efforts and publish information to assist the states and public water suppliers with these efforts.

By August 6, 1998, the EPA must publish regulations requiring community water systems to prepare and distribute consumer confidence reports at least once a year. The governor of a state may decide not to apply the direct mailing requirement for consumer confidence reports to a community water system serving fewer than 10,000 people.

The EPA must publish a maximum contaminant level goal (MCLG) and promulgate a National Primary Drinking Water Regulation (NPDWR) for contaminants that: 1) may have an adverse effect on human health, 2) are known or are likely to occur in public water systems at a frequency and concentration of significance to public health, and 3) whose regulation offers a meaningful opportunity to reduce health risk for people served by public water systems.

The EPA must issue regulations establishing criteria for a monitoring program for unregulated contaminants. The regulations are to ensure that only a representative sample of systems serving 10,000 or fewer people are required to monitor. By August 6, 1999, and every five years thereafter, the EPA must issue a list of no more than 30 unregulated contaminants to be monitored by public water systems and included in the occurrence database.

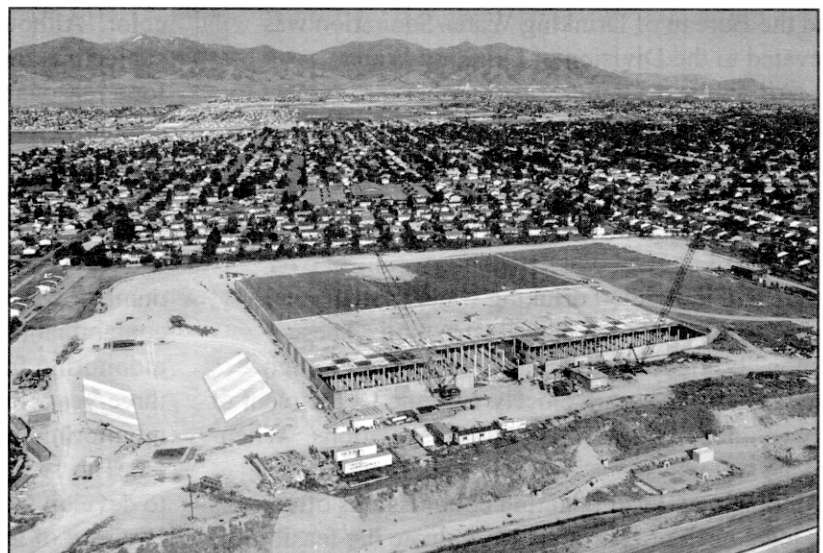
A new program is established authorizing the EPA to provide grants to states for the development and implementation of a state program to ensure the coordinated and comprehensive protection of groundwater resources within the state.

11.4 Culinary Water Use and Projected Demand

At the present time, approximately 255,700 acre-feet of high quality water is supplied annually by the major public water purveyors for various residential, commercial and industrial uses. By the year 2020, an estimated 419,300 acre-feet of water will be needed to meet the demands of population growth and increased commercial and industrial development.

Many small, unapproved water systems are located in the county, but they serve a very limited clientele. Virtually all of the delivered culinary water is treated at approved water treatment facilities. Table 11-2 lists the drinking water facilities and the plant capacity. Table 11-3 lists the major retail water providers along with the existing water use (1995) and the projected water demand (2020). These projections are based upon the existing water use pattern, anticipated population (See Table 4-1), and the Wasatch Front Water Demand/Supply Model.

In 1977, the state of Utah began a cooperative effort with the U.S. Geological Survey to quantify water use for public water suppliers and major self-supplied industries. The data are collected by the Division of Water Rights through questionnaires mailed each year to public water suppliers. The data for 1979 through 1993 are summarized in published reports. The 1994-95 data have not yet been published.



Jordan Aqueduct Terminal Reservoir under construction in West Valley

Table 11-2
WATER TREATMENT FACILITIES

Water Treatment Plant	Owner	Current Capacity (mgd)
City Creek	Salt Lake City	15
Parley's	Salt Lake City	40
Big Cottonwood	Salt Lake City	40
Metropolitan	M.W.D.	113
Southeast Regional	S.L.C.W.C.D.	20
Draper Irrigation Co.	Draper Irrigation Co.	5
Jordan Valley	C.U.W.C.D.*	180
Total Capacity		413

* Operated by the Salt Lake County Water Conservancy District. Ownership will pass to the SLCWCD (5/7) and the Metropolitan Water District of Salt Lake City (2/7).

Table 11-3
CURRENT AND PROJECTED CULINARY WATER DEMAND BY MAJOR WATER SUPPLIER
(acre-feet)

Water Supplier	1995	2020
Midvale	4,750	7,030
Magna	7,560	16,390
West Jordan	14,910	28,000
Murray	11,760	18,110
Holladay	3,920	5,150
Herriman	190	540
South Salt Lake City	5,620	9,070
Salt Lake City	100,020	142,990
Kearns	8,340	15,960
SL County WCD (retail)	12,570	18,190
Granger Hunter WID	26,750	49,800
Bluffdale	560	1,320
Sandy	25,500	42,600
Taylorsville-Bennion	15,640	25,080
Draper	3,320	7,760
Riverton	5,170	12,850
White City	3,840	5,420
South Jordan	5,280	13,040
Total	255,700	419,300

Source: Wasatch Front Water Demand/Supply Model, February 1996

11.5 Drinking Water Problems

11.5.1 Future Growth

Meeting the water needs of the growing population is probably the largest problem currently facing the culinary water providers. The rate of population increase for Salt Lake County is currently estimated to be 1.92 percent annually. This will yield a population of 1.28 million by the year 2020. It is anticipated that most of this growth will be centered in the south and southwestern portions of the valley; Draper, Riverton, South Jordan, Sandy, Taylorsville, West Jordan and West Valley City. The majority of these areas are serviced primarily by the Salt Lake County Water Conservancy District, and it is

anticipated the district will shoulder much of the responsibility to meet the increased water demands.

11.5.2 Deterioration of Facilities

Occasional repair, replacement, enlargement or upgrade of each system is necessary to maintain the level of service expected. The improvements cover a wide range of facilities, but they consist mainly of maintaining, operating and replacing wells, storage tanks and pipelines. Some communities have occasionally paid for these improvements without outside help, but most have made use of public funding programs. Specific funding programs are identified in Tables 8-3 and 8-4.

Salt Lake City has recently announced that it needs to upgrade its distribution system by replacing 50-year old deteriorated and undersized water mains. The cost estimates for this rehabilitation of existing infrastructure is in excess of $45 million.

11.5.3 Groundwater Contamination

Groundwater contamination has the potential of being a substantial problem. This is partly because groundwater makes up such a large part of the culinary water supply. An even larger concern is that groundwater contamination can go undetected until it becomes widespread and very expensive to mitigate. Even after detection it can be extremely difficult to quantify and contain.

At the present time, two groundwater contamination sites are identified in Salt Lake Valley; the Vitro tailings contamination site at about 700 West and 33rd South, and the Kennecott Utah Copper mineral tailings contamination site near Bingham/Herriman. Both sites are being monitored and slated for expensive clean-up and containment procedures. For more information on these two sites, see Section 19, Groundwater.

11.5.4 New Requirements

One problem faced by culinary water providers is the ever changing water quality standards and regulations. Today's water quality standards are more stringent than 20 years ago. It is likely standards will be even tougher 20 years from now. Several impending changes have already been mentioned in subsection 11.3 above. Changing standards and tougher regulations reflect society's growing awareness of the effects of pollution and the desire to better insulate itself from disease. The majority of the regulatory changes are beneficial to society.

The problem is that changing standards are not without cost. Any requirement to comply with higher water quality standards will result in higher water treatment costs. Sometimes new standards can be achieved with procedural changes resulting in minimal cost increases. Often, however, higher water quality standards will necessitate expensive infrastructural changes. This may well be the case for many water treatment facilities. It is quite possible that each of the treatment facilities will, over the next 20 years, face treatment cost increases that are in some way a result of regulatory changes.

11.5.5 Unapproved Systems

Although the vast majority of the public water supply comes from approved water systems, at any given time a number of public water supplies are not fully approved. Approval status is in a constant state of flux, with unapproved systems receiving approval as improvements take place, and occasionally approved systems lose approval status as violations occur. It is anticipated that water quality standards will become even more stringent in the future. The state regulatory agency, the Division of Drinking Water, and state funding agencies should work together to provide unapproved system owners with every possible assistance in achieving approval.

11.6 Alternative Solutions

The development of additional culinary water sources to meet the needs of an expanding population will be dependant upon rate of growth and the type of development that occurs. Additional culinary water could come from a number of sources, including further development of Wasatch Front Mountain streams, additional groundwater development, imported Bear River/Weber River water and treatment of Jordan River water. For a discussion of these development alternatives as well as the issues and recommendations associated with meeting future growing water needs, see Section 9, Water Planning and Development, and Section 19, Groundwater. ■

SECTION 12 CONTENTS

Tables

WATER QUALITY

Water quality is very important and often fragile. While natural environmental processes provide a means for removing pollutants from water, there are definite limits. It is up to society to provide safeguards to protect and maintain water quality.

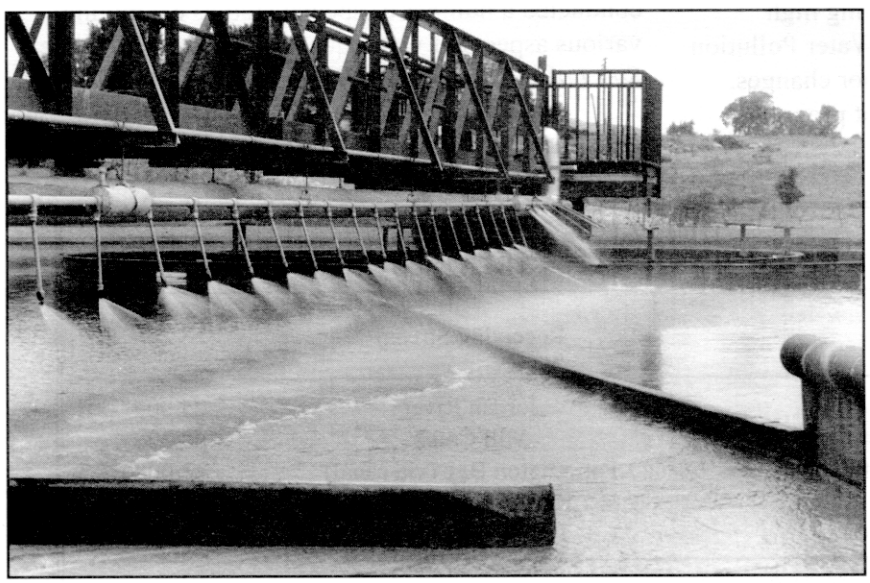
12.1 Introduction

This section presents data and information on existing levels of water quality in the Jordan River Basin. Sources of pollution are identified, problems and solutions are discussed, and recommendations for control and improvement by responsible agencies are given. Water pollution comes from natural and man-caused sources. Examples of naturally occurring pollution include such things as mineral springs, erosion, land-slides, wildlife waste materials, and dead and decaying animals. Man-caused pollution is categorized as being from either point or non-point sources. Point sources contribute pollution from a single definable point such as a pipe discharge from an industrial plant or municipal wastewater treatment facility. Non-point pollution comes from diffuse sources via overland flow and gully erosion. These include pollution from activities such as agricultural-related operations, rangeland uses, mining, urban runoff, construction, recreation and hydrologic modifications.

12.2 Setting

The 44-mile stretch of the Jordan River from the outlet of Utah Lake to the Great Salt Lake is currently used for recreational, industrial, agricultural and wildlife purposes. The Jordan River represents a tremendous potential for even greater usage in all of these areas, as well as a potential source for domestic water if the water quality could be improved to acceptable standards.

Significant water quality changes take place as the Jordan River flows through the urbanized Salt Lake County area. The characteristics of the impacts on the Jordan River change from agricultural to urban/ industrial as the river flows this course, and the impacts on the physical parameters are significant.



South Valley Water Reclamation Facility, West Jordan

As pointed out in the *Utah State Water Plan*, the Jordan River has been identified by the Division of Water Quality as one of the state's highest priorities for water pollution control efforts and activities. It is generally acknowledged that water flowing from Utah Lake is of poor quality. The water quality issues for Utah Lake and its tributaries will be addressed in the *Utah Lake Basin Plan.* Water quality data collected for the Jordan River, however, shows water quality continues to be degraded as the river makes its way through Salt Lake Valley enroute to the Great Salt Lake. The

Division of Water Quality recently completed intensive water quality monitoring on the Utah Lake and Jordan River sub-basins. The monitoring was done in conjunction with the division's watershed management initiative in the basin. The results of that monitoring are presented in the *Utah Lake-Jordan River Basin Stream Assessment.*

The Division of Water Quality, in conjunction with the Jordan River Sub-basin Watershed Management Council, is in the process of conducting a watershed management approach initiative in the Jordan River Basin. The watershed approach features a high level of stakeholder involvement, water quality monitoring and information gathering, problem targeting and prioritization, and integrated solutions that make use of multiple agencies and groups. The result of the process will be the completion and implementation of a watershed management plan.

At the present time, the basin has five wastewater treatment plants(WWTP). Four are public facilities, and the fifth is privately owned and operated by Kennecott Utah Copper as a self-contained facility. South Valley WWTP discharges directly to the Jordan River while Central Valley WWTP discharges to Mill Creek just above its confluence with Jordan River. The other two treatment plants, Salt Lake City WWTP and Magna WWTP, discharge almost directly into the Great Salt Lake (See Table 12-1).

12.3 Organizations and Regulations

Passage of the Utah Water Pollution Control Act of 1953 ushered the state into maintaining high quality water resources. The Federal Water Pollution Control Act in 1972 brought about major changes, particularly in the wastewater treatment program. The Safe Drinking Water Act of 1976 requires individual watersystems to collect data on various bacteriological parameters, inorganic chemicals, and organic chemicals that may be a hazard to public health. In general, analyses are required on delivered water and not raw water sources.

A number of federal, state and local agencies are currently involved in the management and monitoring of water quality. These agencies include the Salt Lake City-County Health Department, Salt Lake County Flood Control, Utah Department of Agriculture, Department of Environmental Quality (Division of Water Quality, and Division of Drinking Water), Bureau of Reclamation, U.S. Geological Survey, and Environmental Protection Agency.

12.3.1 Local

Towns, cities and counties have primary responsibilities for water pollution control within their respective entities. These responsibilities and authorities are contained in Sections 10, 11, 17, 19 and 73 of the *Utah Code Annotated, 1953, Amended.*

Salt Lake County Division of Flood Control and Water Quality - This agency has been designated the water quality planning agency for Salt Lake County.

Although the agency does not run its own water quality monitoring program, it uses the results of the monitoring programs conducted by other agencies to develop the water quality management plans for the county. In addition, this agency has sponsored or conducted a number of special studies examining various aspects of water quality. These include the *Salt Lake County Clean Water Act, Section 208 Study*

Table 12-1
MUNICIPAL AND INDUSTRIAL WASTEWATER TREATMENT FACILITIES

Treatment Facility	Receiving Stream	Discharge[a] (acre-feet/year)
South Valley Wastewater Treatment Plant	Jordan River	25,000
Central Valley Wastewater Treatment Plant	Mill Creek	68,000
Salt Lake City Wastewater Treatment Plant	Farmington Bay (via canal)	41,000
Magna Wastewater Treatment Plant	Kersey Creek/GSL	2,400
Kennecott Utah Copper Tailings Pond	Total Containment	17,000

a) From discharge records for 11/1/94-10/31/95

in conjunction with Hydroscience, Inc., an *Urban Runoff Study* with the EPA and USGS, and the *Jordan River Water Quality Study* with the USGS.

12.3.2 State

The state agency charged with the responsibility to regulate water quality issues is the Department of Environmental Quality/Division of Water Quality. Historically, water quality and water quantity have been under separate jurisdictions. Changing conditions will impact this relationship. Increasing populations will require more high quality water to meet their needs. More water quality problems will also be associated with increased urban growth and recreational activities. These conditions will require those concerned with water quality to work more closely with administrators of water rights. Eventually, close coordination will be required as one issue will directly influence the other.

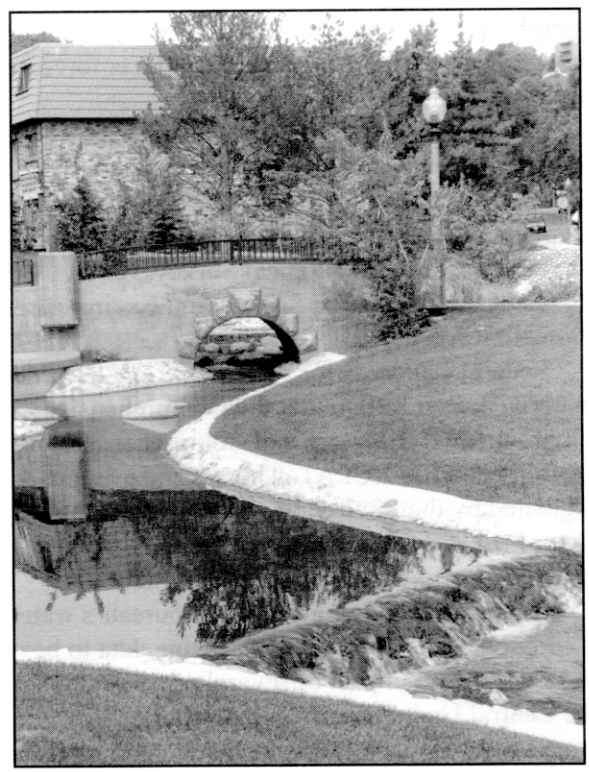
State programs are not comprehensive enough to cover all activities which can be sources of groundwater contamination. The many activities leading to pollution of groundwater suggest it will be difficult in the future to maintain the high quality of groundwater unless local governmental agencies take an active role in protecting wells, springs and the groundwater aquifer. This issue is discussed in more detail in Section 11, Drinking Water, and Section 19, Groundwater.

Utah Department of Agriculture - The Environmental Quality Section of the Department of Agriculture manages Utah's agricultural non-point source water pollution control and prevention program via contract from the Department of Environmental Quality (DEQ). This is partially funded through federal grants passed through DEQ from the Environmental Protection Agency (EPA) and partially supported by matching funds from state and local government agencies and private sources. The program is divided into several parts: watershed management projects, usually on-the-ground conservation efforts; groundwater monitoring, which is a combination of education and monitoring; and information and education, a combination of public information, including newsletters, brochures, videos and slide shows, and school and adult education.

Department of Environmental Quality - The Department of Environmental Quality has implemented the *Groundwater Quality Protection Strategy* for the state of Utah based on an Executive Order issued in 1984 by the governor of Utah.

Under the Utah Water Quality Act, the Division of Water Quality is responsible for establishing water quality standards and regulating impacts to the waters of the state. Additionally, the Environmental Protection Agency has delegated authority to Utah to administer its federal-based water quality regulatory programs. Facilities that produce, treat, dispose of or otherwise discharge waste water may need permits from the Division of Water Quality.

A Storm Water Discharge Permit is required for most industries and some municipalities that discharge storm water runoff to surface waters such as lakes or streams. Storm water pollution prevention plans must be in place prior to application. Any facility that discharges or may discharge pollutants to groundwater is required to obtain a Ground Water Discharge Permit. Major agricultural, municipal and industrial dischargers are regulated.



City Creek at City Creek Park

Discharging wastewater to surface waters, including storm drains, requires a permit prior to beginning operations. Utah Pollutant Discharge Elimination System (UPDES) Permits are required

for all industrial, municipal and federal facilities. Facilities treating wastewater may need construction permits unless they discharge into a municipal sanitary sewer system.

The Division of Water Quality has established surface stream classifications in Utah based on existing uses. Table 12-2 gives the classification for the Jordan River Basin streams. As can be seen from the table, stream reaches can fall under more than one classification.

12.3.3 Federal

To date, the role of the federal government has been to set national policy by passing laws such as the Safe Drinking Water Act and the Clean Water Act. The federal government's present approach is to allow states considerable leeway in enforcing and complying with these statutes. However, should states and local governments fail to act decisively to comply with the laws, the federal government may move towards a more active role in the enforcement of federal water quality standards.

The federal government has also been involved in funding numerous water quality projects through the Superfund Cleanup Program. The primary agencies involved in water quality issues are the Bureau of Reclamation, U.S. Geological Survey, Natural Resources Conservation Service and Environmental Protection Agency.

Federal standards for solid waste and hazardous material are set forth under the Comprehensive Environmental Response and Comprehensive Liability Act (CERCLA). These standards are regulated by the Environmental Protection Agency. Compliance is verified through the City-County Health Department Monitoring Program.

Bureau of Reclamation - The bureau's water quality objective is to collect baseline data to be used in assessing the impact of several projects (including the Central Utah Project) on the water quality of streams. In January 1986, the bureau completed a *Jordan River and Tributary System Water Quality Data Update and Study.*

U.S. Geological Survey - The U.S. Geological Survey (USGS) has an established data base on surface and groundwater quality in the study area. Although the major emphasis of the USGS program is flow measurement, some stations are routinely monitored for water quality. Within the Jordan River Basin (below Utah Lake), surface water quality data have only been collected at station number 1017100 (Jordan River at Salt Lake City) located at 1700 South near 1000 West in Salt Lake City. The USGS data can be accessed through either the EPA STORET system or the USGS WATSTORE system.

The U.S. Geological Survey started the *Great Salt Lake National Water Quality Assessment (NAWQA) Study* in 1996. The program is funded by the federal government and includes the drainage basins of the Bear, Weber, and Jordan rivers. The long-term goals of the NAWQA program are to describe the status of and trends in the quality of a large, representative part of the nation's surface and groundwater resources. The program is intended to produce a wealth of water-quality information that will be useful to policy makers and managers at the federal, state and local levels.

Environmental Protection Agency - The Environmental Protection Agency not only has responsibility to monitor compliance with the federal Clean Water Act, but it also oversees the national Superfund Cleanup Projects. In Salt Lake Valley, Superfund Cleanup Projects are currently underway to remove Kennecott Utah Copper tailings from Bingham Creek, remove and/or contain tailings at the old Sharon Steel Mill adjacent to the Jordan River, and cleanup of the groundwater contamination plume at the Vitro Chemical Company tailing site in South Salt Lake.

12.4 Water Quality Problems and Needs

12.4.1 Surface Water

The most recently completed water quality evaluation of the Jordan River was the *Utah Lake-Jordan River Basin Stream Assessment*, by the Utah Division of Water Quality, Department of Environmental Quality, June 1996. The Division of Water Quality monitored 24 stations (Table 12-3) in the Jordan River sub-basin bi-weekly from March 1994 to June 1995. Certain pollution parameters (Table 12-4) were monitored and compared against maximum water quality standards assigned to each of the beneficial use classifications listed in Table 12-2.

If the standards are met, the water body is "fully supporting." If many, but not all, of the standards are met most of the time, the water body is "partially supporting." If the standards are frequently not met, the water body is "not supporting." The following areas of concern were identified by the study:

Table 12-2

SURFACE WATER CLASSIFICATIONS

Streams	Classification
Jordan River (Farmington to North Temple)	2B 3B 3D 4
Jordan River (North Temple to Little Cottonwood Creek)	2B 3B 4
Surplus Canal (Great Salt Lake to Jordan River)	2B 3B 3D 4
Jordan River (Little Cottonwood Creek to Narrows)	2B 3A 4
Jordan River (Narrows to Utah Lake)	1C 2B 3B 4
City Creek (Memory Park to City Creek Water Treatment Plant)	2B 3A
City Creek (City Creek Water Treatment Plant to headwaters)	1C 2B 3A
Parley's Creek and tributaries (1300 East to Mountain Dell Reservoir)	2B 3C
Parley's Creek and tributaries (Mountain Dell Reservoir to headwaters)	1C 2B 3A
Emigration Creek and tributaries (Foothill Boulevard to headwaters)	2B 3A
Red Butte Creek and tributaries (Red Butte Reservoir to headwaters)	1C 2B 3A
Mill Creek (Jordan River to Interstate 15)	2B 3C 4
Mill Creek (Interstate 15 to headwaters)	2B 3A 4
Big Cottonwood Creek (Jordan River to Big Cottonwood Treatment Plant)	2B 3A 4
Big Cottonwood Creek (Big Cottonwood Treatment Plant to headwaters)	1C 2B 3A
Deaf Smith Canyon Creek and tributaries	1C 2B 3A 4
Little Cottonwood Creek (Jordan River to Metro Water Treatment Plant)	2B 3A 4
Little Cottonwood Creek (Metro Water Treatment Plant to headwaters)	1C 2B 3A
Bells Canyon Creek	1C 2B 3A
Little Willow Creek (above the Draper Irrigation Company diversion)	1C 2B 3A
Big Willow Creek (above the Draper Irrigation Company diversion)	1C 2B 3A
South Fork of Dry Creek (above the Draper Irrigation Company diversion)	1C 2B 3A
Oquirrh Streams (Coon, Barney's, Bingham, Butterfield and Rose creeks)	2B 3D 4
Kersey Creek	6
Decker Lake	2B 3B 3D 4
Lake Mary	1C 2B 3A
Mountain Dell Reservoir	1C
Great Salt Lake	5

Class 1	Culinary raw water source
Class 1C	Domestic use with prior treatment
Class 2	Instream recreational use and aesthetics
Class 2A	Primary human contact-swimming
Class 2B	Secondary human contact-boating, wading, etc
Class 3	Instream use by aquatic wildlife
Class 3A	Habitat maintenance for cold water game fish, water-related wildlife and food chain organisms
Class 3B	Habitat maintenance for warm water game fish, water-related wildlife and food chain organisms
Class 3C	Habitat for non-game, water-related wildlife and food chain organisms.
Class 3D	Habitat for waterfowl, shore birds, water-related wildlife and food chain organisms.
Class 4	Agricultural-livestock and irrigation water.
Class 5	Great Salt Lake general use-primary and secondary human contact, water-related wildlife and mineral extraction.
Class 6	General use restricted and/or governed by environmental and health standards and limitations.

Table 12-3
DIVISION OF WATER QUALITY SAMPLING SITES
JORDAN RIVER SUB-BASIN INTENSIVE MONITORING

STORET Number	Sampling Site
499182	Jordan River at Cudahy Lane (above South Davis WWTP)
499232	Jordan River at 1100 W 2100 S
499409	Jordan River below 6400 S at I-215 crossing
499417	Jordan River at 7800 S Crossing (above South Valley WWTP)
499460	Jordan River at Bluffdale Road Crossing
499195	City Creek above Filtration Plant
499210	RBII - Red Butte Creek (above Red Butte Reservoir)
499216	Emigration Canyon Creek (at switchback)
499220	Parleys Canyon Creek at Highway 65 crossing (above Mountain Dell)
499222	Lambs Canyon Creek
499217	Mountain Dell Creek at Highway 65 crossing (below Little Dell)
499219	Little Dell Creek at Highway 65 crossing (above Little Dell)
499254	Mill Creek above Central Valley WWTP at 300 W
499264	Mill Creek at U.S. Forest Service boundary
499278	Mill Creek at Elbow Fork
499297	Big Cottonwood Creek above Jordan River at 500 W
499310	BC1 Big Cottonwood Creek at U.S. Forest Service Boundary
499323	BC9 Big Cottonwood Creek above confluence with Mill Creek
499358	Little Cottonwood Creek above Jordan River at 600 West
499366	Little Cottonwood Creek at U.S. Forest boundary
499378	Little Cottonwood Creek above confluence with Red Pine Creek lc3
499444	Butterfield Creek at mouth of canyon
499418	Bingham Creek above confluence with Jordan River
499472	Utah Lake at Narrows - below pump station

- The lower miles of the Jordan River are partially supporting for aquatic life. Problems include heavy algal blooms caused by excessive amounts of nutrients and dissolved oxygen depletions due to high BOD levels. Sources identified were urban runoff and municipal wastewater treatment plants.

- Mill Creek has been impacted by phosphorus and sediments. Some of the stream's riparian habitat has been lost and stream banks have been de-stabilized by recreational uses. Salt Lake County and the Forest Service are using the fees they collect to rehabilitate the stream banks. Picnic tables and campground areas are being moved away from the stream so that the riparian habitat can be re-established.

- The lower part of Big Cottonwood Creek, from the Forest Service boundaries to the Jordan River, have been labeled non-supporting because copper levels exceed the levels for aquatic life. The source appears to be the historic canyon mining sites.

- Little Cottonwood Creek from Jordan River to the Forest Service Boundary has fairly high levels of total dissolved solids and doesn't support its agricultural use classification. This is largely due to urban runoff.

Table 12-4

DIVISION OF WATER QUALITY SAMPLING SITES
JORDAN RIVER SUB-BASIN INTENSIVE MONITORING
PARAMETERS ANALYZED

CHEMISTRY	METALS	NUTRIENTS
Bicarbonate	Aluminum	Ammonia
Calcium	Arsenic	Dissolved Nitrate&Nitrite
Carbonate	Barium	Total Phosphorus
Carbonate Solids	Cadmium	Dissolved Total Phosphorus
Carbon Dioxide	Chromium	
Chemical Balance	Copper	
Chloride	Iron	
Hydroxide	Lead	
Magnesium	Manganese	
pH	Mercury	
Potassium	Selenium	
Sodium	Silver	
Specific Conductance	Zinc	
Sulfate		
Total Alkalinity		
Total Dissolved Solids		
Total Hardness		
Total Suspended Solids		
Turbidity		

- Little Cottonwood Creek from the Forest Service boundary to the headwaters are impacted by elevated levels of zinc. Again, historic mining areas are the probable source. Zinc levels exceed the criteria for aquatic life classification.

- Bingham Creek, which is only used during spring runoff, has been labeled partially supporting of its aquatic life classification because of metals, primarily copper and zinc. It is also non-supporting of its agricultural designation because of high levels of total dissolved solids. The sources are mining sites in the Oquirrh Mountains and irrigation return flows.

- The Jordan River from Utah Lake to 6400 South has been impacted by Total Dissolved Solids (TDS). The primary sources of the TDS are water releases from Utah Lake and urban runoff. Of the pollution parameters monitored during this study, dissolved solids was the largest contributor to water quality impairment, followed closely by metals. Running a distant third was nutrient loads, followed by sediment, habitat alteration and dissolved oxygen. It should be noted that the study did not include evaluation of coliform counts, a pollution parameter previous studies had indicated as one of the Jordan River's biggest problems. Table 12-5 shows the greatest sources of water quality impairments to the Jordan River are resource extraction (erosion), urban runoff, reservoir releases, agriculture and recreation.

The *Jordan River and Tributary System Water Quality Update and Study* was published in January 1986. This study identified coliform counts in the Jordan River in the range of 10,000 to 50,000 organisms per 100 milliliters. Many sources are responsible for the high coliform counts including farm waste, irrigation return flows, and urban runoff (storm drain discharges). High levels of coliform organisms probably represent as much of a restriction to reclamation and reuse of Jordan River water as any other water quality parameter. Because there are so many sources of these indicator organisms, it follows that a clean-up program would be extensive and costly.

The minimum observed values for dissolved oxygen are generally below state standards throughout the entire lower reach of the Jordan River. These

Table 12-5
WATER QUALITY PROBLEM PARAMETERS AND POTENTIAL SOURCES

Parameter	Affected Segment	Potential Sources
Suspended Sediment	3300 - 4500 South 9000 - 14400 South	Hydrologic Modifications Bed/Bank Erosion Construction
Total Phosphorus	6400 South - 1800 North 2100 South - 1800 North	Agriculture Urban
Total Ammonia	2100 South - 1800 North	Urban/Irrigation
Total Nitrate	5400 South-1800 North	Urban/Irrigation
Total Zinc	6400 South - 3300 South	Hydrologic Modifications Urban/Mining
Total Lead	7800 - 3300 South North Temple - 1800 North	Hydrologic Modifications Mining/Urban
5-Day BOD	4500 South - 1800 North	Urban/Irrigation
Dissolved Oxygen	North Temple - 1800 North	Urban/Irrigation Hydrologic Modifications
Coliform Bacteria (Total and Fecal)	6400 South - 1800 North	Hydrologic Modifications Irrigation/Urban Agriculture

minimum levels are important because fish and other aquatic wildlife are extremely sensitive to low levels of dissolved oxygen, and their overall welfare may be more closely related to the minimum levels than to the average levels. Total dissolved solids for the Jordan River range from 800 to 1,200 milligrams per liter. The TDS levels, although relatively high and an indication that the water is unacceptable for culinary use, do not constitute a violation of water quality standards under the current use classification of Jordan River water.

Toxic Substances: - *A Reconnaissance of Toxic Substances* in the Jordan River was made during July 1980 to October 1982 as part of a larger study conducted by the U.S. Geological Survey and published in 1984. Samples for toxic substances were collected at five sites on the Jordan River, at three major tributaries, and at six storm conduits. The study showed the Jordan River, starting at about 90th South, has a diversity of toxic substances with concentrations large enough to be a problem and the concentrations of toxic substances and trace elements increases in a downstream direction. DDD, DDE, DDT, dieldrin, heptachlor, methoxychlor, PCB, and 2,4-d were detected in bottom-material samples from the Jordan River and tributaries. DDE, Silex. and 2,4-d were also detected in water samples. Only one of the 112 organic compounds, chloroform, was detected.

The toxic substance most frequently exceeding state standards was total mercury. About 75 percent of the 138 samples for total mercury exceeded the state standard of 0.05 micrograms per liter. Other toxic substances that exceeded state standards were: ammonia - 18 percent of samples taken, cadmium - nine percent, copper - nine percent, zinc - six percent, and lead - two percent. In addition to sampling river flows, this study also tested river bottom sediments for the trace elements arsenic, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, selenium, silver and zinc. With the exception of beryllium, all trace elements were detected one or more times. Copper, lead and zinc had the highest concentrations. Trace element concentrations in the bottom materials in the Jordan River increased in a downstream direction. Substantial increases first were observed at 5800 South Street, and they were sustained throughout the remainder of the downstream segment of the study area.

During the period of July 1980 through October 1982, the U.S. Geological Survey, in cooperation with the Salt Lake County Division of Flood Control and Water Quality, conducted a study of Jordan River water quality. The study focused on the following four areas: sanitary quality, toxic substances, dissolved oxygen and turbidity. The following summarizes the findings:

Sanitary Quality - Data collected from July 1980 through October 1982 showed a serious sanitary problem in the Jordan River. Concentrations of total coliform bacteria commonly exceeded 5,000 colonies per 100 milliliters and concentrations of fecal coliform bacteria commonly exceeded 2,000 colonies per 100 milliliters in downstream reaches of the river. The most conspicuous aspect of the bacteriological data was its extreme variability. Because of the variability, the sanitary quality of the Jordan River cannot be predicted at any given time. More recently acquired data indicates the sanitary conditions are unchanged with respect to fecal coliform and total coliform counts. Two wastewater treatment plants, seven major tributaries, numerous storm drains, irrigation-return flow and other sources all contribute to the dynamic system that determines the sanitary quality of the Jordan River. In general, concentrations of all three indicator bacteria increased in a downstream direction. The ratio of fecal coliform to fecal streptococci concentration indicated contamination from animal waste in 92 percent of the samples from the Jordan Narrows. Contamination from human waste was indicated in none of the samples at the Jordan Narrows and 90th South, but increased to 20 percent of the samples at 1700 South Street. But human sewage in many of the samples may be camouflaged by large concentrations of fecal streptococci bacteria.

With the exception of copper and zinc, concentrations of trace elements in bottom materials in Little Cottonwood, Big Cottonwood and Mill creeks were similar to concentration levels in the Jordan River downstream sampling sites.

At the present time, the Environmental Protection Agency, jointly with Kennecott Utah Copper and Sharon Steel, is conducting a superfund cleanup project to remove and dispose of mining tailings from the Bingham Creek channel, the Sharon Steel mine and mill site and surrounding lands in Midvale. This effort could have a significant impact on reducing the heavy metals concentrations in the Jordan River.

Dissolved Oxygen - Dissolved oxygen depletion in the Jordan River was identified as a major problem by two-thirds of the federal, state and local agencies responding to a request from the U.S. Geological Survey for comments on the study. Depletion of the dissolved oxygen concentrations to less than 5 to 6 milligrams per liter adversely affect fishery populations, benthic organisms and the natural oxidation of organic substances in the water. The intent of the study was to provide sufficient data and interpretation to understand the dissolved oxygen regime of the Jordan River. The study accomplished the following goals: 1) Historical data were tabulated and compared to current data to determine trends, 2) re-aeration rates and time-of-travel were determined for the Jordan River from 12300 South to 1800 North Streets, 3) algal productivity and its impact in the downstream part of the river (north of 5800 South Street) were calculated, and 4) loads of oxygen-demanding substances from storm runoff and wastewater treatment plants were determined.

The study concluded mean concentrations of dissolved oxygen decreased from 8.1 milligrams per liter at the Jordan Narrows to 4.7 milligrams per liter at 500 North Street during April 1981 to September 1982. Coincident with the decrease, the biochemical-oxygen demand increased from 5 to 7 milligrams per liter. About 50 percent of the dissolved oxygen concentrations and 90 percent of the five-day biochemical-oxygen demand measured downstream from 1700 South Street exceeded the state intended-use standards. An estimated 6 million pounds of oxygen-demanding substances, as measured by the five-day biochemical-oxygen demand, were discharged to the Jordan River during 1981 from point sources downstream from 9000 South Street. Wastewater treatment plants contributed 77 percent of this load, non-storm base flows contributed 22 percent, and storm flows less than 1 percent. The Surplus Canal diversion at 2100 South Street removed about 70 percent of this load, and travel time of about one day also decreased the actual effects of the load on the river.

Turbidity - Samples were collected at five sites on the Jordan River from January 1981 through August 1982 and analyzed for turbidity, suspended sediment concentration, suspended organic carbon and other properties. Correlation coefficients ranging from 0.71 to 0.83 indicated significant relationships

between suspended-organic carbon and turbidity at each of the five sites during June through October.

The primary sources of turbidity in the Jordan River are clay-sized particles and organic material, which probably originate in Utah Lake, and organic material discharged from wastewater treatment plants. Control of algal growth in Utah Lake and the Jordan River during the summer and reduction in the quantity of organic material discharged from wastewater treatment plants could reduce turbidity in the Jordan River.

Current Data - The most current data for the Jordan River has been collected by the Salt Lake City-County Health Department, which monitors the river monthly. In addition, sediment samples have been collected in conjunction with CERCLA assessments of the Jordan River, as well as wetland pond monitoring in conjunction with recent Clean Water Act, Section 319, project implementation, and Section 404, permit requirements.

The City-County Health Department has employed Equal Width-Integrated sampling on the Jordan River since 1989. This method provides more accurate data and is consistent with data collected by the U.S. Geological Survey during the Nationwide Urban Runoff Assessments of 1979-82. The method samples the entire water column across the channel width, as opposed to a point water sample. The parameters sampled include temperature, dissolved oxygen, pH, conductivity, total coliform, fecal coliform, fecal strep, biochemical oxygen demand, total suspended sediment, total nitrogen, ammonia, chloride, nitrate, sulfate, total dissolved phosphorus, hardness (CACO3), arsenic, chromium, copper, lead, selenium and zinc. Table 12-4 identifies the problem parameters as identified through current data collecting efforts.

During the course of CERCLA investigations conducted in support of the Sharon Steel, Bingham Creek and Midvale Slag Superfund remediation projects, sediment was sampled the entire length of the Jordan River for lead, zinc, copper, arsenic and cadmium. Total copper, cadmium and zinc are potential problems for food chain organisms and animals (fish and waterfowl). The principal sources appear to be urban and mining related activities.

12.4.2 Groundwater Pollution

Groundwater is one of Utah's most valuable resources. In the Jordan River Basin, groundwater accounts for roughly 45 percent of the municipal and industrial water supply. Magnifying the issue of groundwater quality is the concern with how easily an aquifer can be polluted and how difficult it can be to clean up. Additionally, groundwater contamination is not readily apparent or easily detected. Groundwater issues are discussed in detail in Section 19 of this report.

12.5 Alternative Solutions

Many federal and state agencies are charged with management or regulatory roles pertaining to water and water quality issues in the Jordan River Basin. A need existed to increase communication and cooperation among these government agencies to promote efficient planning, implementation and coordination of management and regulatory activities, as well as minimizing conflicts and preventing duplicated effort. Pursuant to that end, and in compliance with the Federal Clean Water Act, the Salt Lake County Board of Commissioners has been designated and approved as the area-wide water quality planning agency for Salt Lake County. The Salt Lake County Board of Commissioners established the Jordan River Sub-Basin Watershed Management Council. See Section 6-3 for details.

12.6 Issues and Recommendations

Only surface-water quality issues are discussed here. Groundwater quality issues are discussed in Section 19. Water quality issues in the Jordan River Basin are primarily associated with the continuing trend to convert agricultural lands to urban uses. Water quality problems are compounded because urbanization tends to degrade water quality and water quality of existing agricultural water supplies is too poor for direct conversion to municipal and industrial uses. Achieving a municipal water supply, however, is not the only worthy goal associated with improving Jordan River water quality. Today's society expects development and growth to be more in harmony with the environment. An important benefit associated with improving Jordan River water quality would be improved wildlife habitat within the streams, wetlands and adjacent riparian areas. The overall improvement of surface water quality will benefit human and wildlife users as well as aesthetics. ■

SECTION 13 CONTENTS

DISASTER AND EMERGENCY RESPONSE

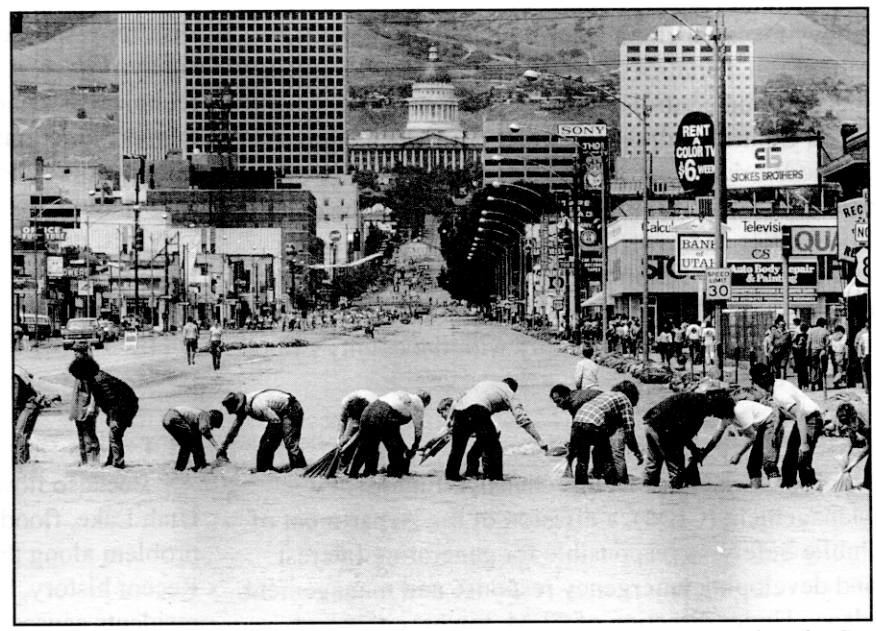
Reacting to a disaster or emergency after it has already occurred is not as efficient as pre-disaster activities, such as floodplain management, hazard mitigation and planning.

13.1 Introduction

This section discusses flood hazard mitigation and drought response. It also briefly discusses programs now in place and additional programs that could be beneficial in dealing with flooding and drought problems. The Division of Comprehensive Emergency Management (CEM) is responsible for disaster and emergency response at the state level. Many types of emergency situations are water-related, varying from disastrous flooding to extreme drought. Most disasters are naturally caused. A few, such as chemical or oil spills, are man-caused. Some situations, such as a dam failure, can have a complex combination of natural and man-made causes. When any emergency situation arises, a prearranged response plan provides a quick and effective coordinated response. Generally, the response plan emphasizes prevention of an emergency and, therefore, prevention of damages. The state maintains a hazard mitigation team to provide coordination with local governmental authority to establish measures and to lessen or eliminate the impact of a disaster. This team represents state agencies in hazard mitigation matters. The following paragraphs attempt to define the organizational responsibilities for emergency response in the Jordan River Basin, concentrating mainly on the two most common water-related emergencies: floods and drought.

13.2 Background

The history of water-related natural disasters in the Jordan River Basin includes a number of significant floods and drought events. The floods of the mid-1980s resulted in hundreds of millions of dollars in property damages to homes, businesses, public utilities and infrastructure. The extended drought years of the late 1980s significantly lowered reservoir storage levels and threatened restrictions for outdoor water use. Recent flooding and drought events experienced in the Jordan River Basin have been classified as 100-year events. Despite the tendency to believe the basin has experienced the worst case scenario, an event of equal or greater magnitude is possible. Dams and other large public utility structures are designed to withstand natural disasters that are 500- to 1,000-year events.



1983 flooding on State Street in Salt Lake City

The northern Utah region is considered a high seismic risk area. The region has numerous active faults that have been relatively quiet in recent geologic time. The last major seismic event in northern Utah occurred in 1962 in Cache Valley. It has been estimated the last significant seismic event in the Jordan River Basin was more than 1,000 years ago. Although we are still unable to accurately predict earthquake activity, a study of the frequency of quakes for this region suggests a rather large seismic event (up to 7.0 on the Richter Scale) could be expected in the future. Recent studies of earthquake preparedness along the Wasatch Front have shown local building codes inadequately address the potential for ground-shaking, and predict extensive property damage and loss of life in a major event. The basin's reservoirs, however, have been designed to withstand the shaking produced by a 7.0 earthquake and are expected to maintain their integrity despite sustaining some damage in such an event. It is likely that in the event of a major earthquake, localized flooding will occur because of ruptured canals and aqueducts.

13.3 Organizations and Regulations

13.3.1 Local

As a result of flooding in 1952, the Utah Legislature passed a law giving counties the responsibility for flood control operations. This responsibility was expanded in 1961 with the ability to levy taxes for flood control operations, bond for capital flood control improvements, and to establish special flood control districts. Salt Lake County Flood Control, a division of the Salt Lake County Public Works Department, has rights-of-way or clear title over most of the major streams within the county. Local cities and towns are responsible for planning and controlling runoff within city limits and outside of the county flood control's right-of-way. Their efforts, however, must comply with the county's flood control criteria.

13.3.2 State

The Division of Comprehensive Emergency Management (CEM), a division of the Department of Public Safety, is responsible for generating interest and developing emergency response and management plans. Under direction of CEM, towns, cities and counties prepare emergency response and management plans that are comprehensive in scope but allow for effective and close cooperation with state and federal agencies in the event of a major disaster beyond local capabilities. CEM also works closely with other state and federal agencies to assure needed manpower, equipment, materials and supplies reach the disaster areas.

The initial response to a natural disaster is the responsibility of the impacted city or county. Other agencies involved after the initial response and in the long-term management of a natural disaster have the responsibility to work within established procedural guidelines and organizational structures. These guidelines have been developed to assure needed help and assistance is rendered in a timely and effective manner. Other agencies and officials involved in emergency response include the Governor's Office and the heads of all state divisions and departments.

13.3.3 Federal

The federal government provides assistance in disaster response, recovery, preparedness and mitigation through the Federal Emergency Management Agency (FEMA). Following a natural disaster, FEMA assistance commences with a Presidential Declaration of Disaster. The presidential disaster declaration generally follows a request from the governor for federal assistance. A federal disaster declaration provides the state with financial assistance from the federal government, along with FEMA personnel experienced in handling various aspects of disaster response, recovery and mitigation. The *Federal Response Plan* (FRP) is set up to provide technical assistance in the following 12 emergency support functions: transportation, communications, public works and engineering, fire fighting, damage information, mass care, resources, health and medical services, urban search and rescue, hazardous materials, food, and energy. One of the overriding principles in the FRP puts state and local leadership in charge while FEMA personnel fulfil a supporting role.

13.4 Flooding Problems

Because flows are regulated at the outlet from Utah Lake, flooding has not been a significant problem along the main stem of the Jordan River. Recent history, however, has given Salt Lake County residents cause for alarm along several of the Jordan River's tributaries. Record snowpack and spring

runoff in 1983 and 1984 resulted in numerous occurrences of local-flooding, landslides and mud-flow problems throughout the valley and in particular along the Wasatch Front streams on the east side of the valley. Also, the rising level of the Great Salt Lake, caused by record runoff from 1983 to 1986 resulted in many millions of dollars in damages to Salt Lake County residents.

No single entity has sole authority for flood control management activities. Cities and counties have the necessary statutory authority to act, but at least six other state and federal agencies also have some degree of authority and responsibility. The state's emergency response and hazard mitigation coordination authority rests with CEM. Hazard mitigation planning is usually provided by the state hazard mitigation team following flood emergencies. Pre-emergency planning is also often conducted. CEM assists the county in maintaining their preparedness plans.

Thunderstorms are common during the summer and fall months. These produce localized cloudburst flooding. Although the total volume of water produced by these storms is comparatively small, the instantaneous and localized runoff rate can be high. Damage from thunderstorms most often takes the form of erosion and sediment transport and deposition. Significant landslides and mud-flows can also result from these storms. Typically, these events occur along the hillsides or at the canyon mouths and adjacent residential developments.

13.5 Drought Problems

Droughts do not pose as great a threat to life and property as floods. Droughts generally are more of a nuisance than a natural disaster. This is primarily because existing reservoirs make it possible to provide water for essential life functions throughout the period of drought. The industry most impacted by drought is the agricultural community. Ironically, the agricultural community usually has the senior water rights. In periods of extreme drought, when all users are required to cut back on water consumption, the farmer can suffer significant financial losses if not total crop failure. Another water use significantly impacted by drought is the wildlife and waterfowl management areas adjacent the Great Salt Lake. These water users are located at river's end and have come to rely heavily upon return flows as well as the natural flow of the river. Water shortages can result in disease and death for significant numbers of waterfowl and wildlife.

The municipal area's have weathered the recent periods of drought fairly well. This has been primarily because existing culinary supplies exceed the current demand and water purveyors have been willing to share surpluses. However, in 10 to 15 years, as the demand approaches the available supply, droughts will pose a much greater threat to the municipal community.

13.6 Other Water-Related Emergency Problems

Other disasters can impact water supplies. These generally are more localized in nature than flooding and drought. Included are such things as structural failure of water supply facilities (i.e. dams and aqueducts), toxic spills, landslides and earthquakes.

13.6.1 Toxic Spills

Toxic spills are most likely to occur along major highways such as I-15 and I-80, or along one of several railroad lines. This somewhat limits the potential for a toxic spill to threaten existing water supplies. Probably the greatest threat imposed by a toxic spill is the possibility of localized groundwater contamination. Groundwater contamination can be hard to detect, hard to quantify and difficult to clean up. For more on this subject, see Groundwater, Section 19. Any type of toxic spill into a river system can have a significant impact upon the waterfowl management areas along the shores of the Great Salt Lake.

13.6.2 Earthquakes

The Jordan River Basin, along with the entire Wasatch Front, is especially vulnerable to the effects of earthquakes. This is not only because of the high earthquake potential associated with the Wasatch Fault, but also because state and local building codes and construction methods do not reflect the high earthquake potential of the area. The Dam Safety Section of the State Engineer's Office (See Section 7 for more details) has been and still is monitoring and inspecting all of the states high hazard dams. High hazard dams are those whose failure would threaten loss of life and/or significant property damage.

Another threat imposed by earthquake is the potential rupture of the Jordan Aqueduct, the Salt Lake Aqueduct, or both. Such a failure would cause

local flooding in the immediate area of the rupture and loss of culinary water supplies for several weeks to many months. Structural damage to one or more of the valley treatment plants would have a similar effect. Severe ground shaking throughout the valley could result in numerous local breaks to water lines, again resulting in local flooding followed by potentially long periods of water shortages.

Another potential problem is ground subsidence in the northwest part of the valley in and around the airport and the Rose Park area. Geologic studies of the area show the potential for ground subsidence of several feet in the presence of severe ground shaking. Such an occurrence could result in the intrusion of Great Salt Lake waters into the area.

13.6.3 Landslides

Landslides are most likely to occur along the foothills of the Wasatch Range or up one of the many canyons. Landslides can cover streams and/or canals resulting in immediate flooding to areas upstream of the slide. Following such an event, there is also the threat that impounded water will overtop and wash out the slide material and result in severe flooding to areas immediately downstream.

13.7 Flood Prevention and Hazard Mitigation

Flood hazard mitigation includes structural and non-structural activities that either eliminates or greatly reduces the impacts of flooding. Examples of structural mitigation measures include debris basins, dams, levees, various types of control structures and pipelines. Examples of non-structural mitigation activities are flood forecasting, zoning, flood plain protection and flood insurance. To be effective, flood hazard mitigation activities should be completed prior to the occurrence of a disaster. Flood hazard mitigation can also be thought of as a post-event activity. Managing agencies should use the lessons learned from recent events to prepare for and mitigate against possible recurrence. Utah's unprecedented floods of 1983 resulted in damages of nearly $500 million, much of it in the Jordan River Basin. Higher flows in 1984, however, amounted to only about one-sixth of those experienced in 1983. This was due in part to the mitigation efforts conducted after the 1983 event and prior to the 1984 flood. In just one year, the mitigation improvements prevented damages that far exceeded planning and construction costs.

13.7.1 Forecasting

Peak flows in the Jordan River and its tributaries occur in the spring of the year and are primarily a function of snowmelt and runoff. These events can be forecasted with a fair degree of accuracy by monitoring the snow survey data. Forecasts can, in turn, be used to initiate flood preparations such as sandbagging. This process of forecasting and pre-flood preparations worked well to mitigate a great deal of potential flood damage in 1984 and 1986.

13.7.2 Flood Plain Zoning and Flood Insurance

One of the most effective methods of mitigating or minimizing the effects of future flooding is through creation of and strict adherence to a flood plain zoning plan. County and city governments should work through the state Community Assistance Program of the National Flood Insurance Program to evaluate flood hazard maps of identified flood plains, and to enact appropriate zoning regulations to prevent further encroachment and thereby reduce the potential for flood damages. Most communities already have current maps and ordinances. In additional areas where national flood insurance can be made available by the adoption of the associated flood plain standards, local governments should attempt to do so. Also, public education and promotion of flood awareness would be beneficial.

Salt Lake County and the various communities throughout the valley should be aggressive in regulating and limiting the construction of inappropriate and expensive developments in flood plains. Experiences nationwide have shown that when residential and commercial development takes place in the floodplain, catastrophic flooding leads to serious injuries, loss of life and significant economic impacts. The development of parks, golf courses, wetlands, wildlife preserves and other such uses within the flood plain can, however, be a beneficial use of those lands.

As a protection against monetary losses when flooding occurs, the National Flood Insurance Program is effective in areas where it is available. The Federal Emergency Management Agency (FEMA) has identified special hazard areas with flood insurance rate maps. Zoning and flood hazard reduction regulations have been adopted by these communities to direct future construction to minimize flood damage. A key benefit from local adoption of the floodplain standards has been the availability of

flood insurance through private companies at reduced rates.

13.7.3 Watershed Protection

Prevention is usually more cost-effective than damage repair and mitigation. Flooding can be significantly reduced by maintaining and protecting watershed vegetation and/or by building watershed flood storage. The Soil Conservation Commission, in conjunction with the Natural Resources Conservation Service and the Salt Lake Soil Conservation District, should continue its practice of re-evaluating the potential for small watershed projects in the Jordan River Basin.

Wildfires during dry summer months can significantly damage vegetation and greatly increase the potential for high runoff and debris flows. The occurrence of wildfire disasters should be quickly followed by efforts to mitigate against the increased flooding potential.

13.7.4 Flood Control Structures

The flow of the main stem of the Jordan River is controlled by releases from Utah Lake. Reservoirs above Utah Lake provide additional controls. Consequently, the potential for flooding along the main stem of the Jordan River is very low. The tributary streams of the Jordan River, however, have few controls. Parley's Creek has flood storage capacity in Mountain Dell and Little Dell reservoirs. Red Butte Reservoir, although currently being considered for removal, still offers limited flood storage capacity on Red Butte Creek. Big and Little Cottonwood canyons and Bells Canyon have a number of small ponds. But these are, for the most part, quite high in their respective drainages and relatively small, rendering them rather ineffective as flood control structures.

The county has routed several streams through retention basins such as the one in Sugarhouse Park on Parley's Creek and the one in Liberty Park where the flows from Parley's Creek, Emigration Creek, and Red Butte Creek come together. These retention basins are designed to attenuate the floods so that downstream pipes can adequately handle the outflows. The same approach is taken throughout the valley with numerous retention basins built to attenuate storm runoff from new commercial and residential developments. Many of these retention basins have been put to dual use being lined with grass and used regularly as parks and playground areas. This approach has worked well for the county and undoubtedly will continue to be the planning approach for future developments. Since the flooding of 1983, the county has also built mud and debris flow basins at the mouths of several canyons.

13.7.5 Improved Stream Channel Capacity

In the past, improving stream channel capacity has meant channel widening, straightening, dredging and/or concrete or riprap lining. Today's more environmentally sensitive society, however, requires that flood control planning be only part of a more holistic approach to stream management. Flood courses are seen by many as valuable riparian areas and corridors of wildlife habitat within the increasingly developed urban areas. Consequently, increasing stream channel capacity must be accomplished in a way that is sensitive to these other interests.

Due to relatively high sediment loads, slow velocities and raw stream banks, the lower Jordan River (below 2100 South) has required almost continual dredging to maintain flow capacity. If sediment loads cannot be controlled, then maintaining the flow capacity of this portion of the Jordan River will most likely mean continued dredging of the channel. At the current time, however, there are plans to spend a considerable amount of money as a part of the Central Utah Project wildlife mitigation efforts to rehabilitate the Jordan River. The habitat improvement and channel capacity issues need to be planned for in a cooperative way so as not to be counterproductive.

13.7.6 Jordan River Meander Corridor

Salt Lake County passed an ordinance in 1994 establishing a Jordan River Meander Corridor. The ordinance defined the boundaries of the Jordan River's natural meander pattern, and set limits on the types of development and land uses that can occur within the designated corridor. This effort follows closely on the heels of the county's *Jordan River Stability Study*, published in December 1992. That study defined the Jordan River as ". . . continually undergoing the processes of bank erosion, long-term channel bed degradation, bridge scour, sediment deposition and meander migration." The river's flood potential is directly related to the natural erosion and sedimentation processes as a part of the river's natural

dynamics. In order to better provide for the protection and use of the Jordan River channel for storm drainage and flood control, it is necessary and desirable to adopt a county-wide management plan designed to promote greater channel stability within the flood channel corridor.

Many of the cities that border the Jordan River (Salt Lake City, Midvale, West Valley City, Taylorsville, West Jordan, Riverton and Bluffdale) are developing their own management plans for the Jordan River within their city boundaries. Many of these city plans include the establishment of parkways and trails, not merely to address flooding concerns but also to resolve environmental and recreational issues. It is important that these cities' planning efforts are well coordinated, with each other, and with the county's effort to establish a meander corridor.

13.8 Drought Reduction Alternatives

In contrast to flooding, which tends to be more local in extent, drought is most often basin-wide, regional or statewide. Therefore, it has been dealt with in the past on a statewide basis. A drought response plan has been prepared and is now in place to provide an effective means for the state of Utah to assess and respond to drought impacts. The plan came into being as a result of experience gained during the severe drought of 1977.

13.9 Other Emergency Alternatives

The "other" water-related emergency problems described in subsection 13.6 are local in nature. Communities should have a disaster response plan. First response to any disaster should take place at the local level. Before any city, town or county appeals to the state or federal government for assistance, it should be certain that the event is beyond its capacity to handle the emergency. Local governments should develop disaster response plans with assistance from the Division of Comprehensive Emergency Management and they should be coordinated with neighboring communities.

13.10 Issues and Recommendations

The following recommendations deal with reducing damages from floods in the Jordan River Basin through studies, projects, management and regulations.

13.10.1 Flood Plain Management

Issue: Local governments need to be aware of their responsibilities as it relates to flood plain management and the National Flood Insurance Program.

Discussion: The National Flood Insurance Program (NFIP) was established by Congress in 1968 as a result of large federal outlays for structural measures and disaster relief. Its purpose is to reduce flood loses, prevent unwise development in flood plains, and provide affordable flood insurance for the public. Local entities should conduct education programs on flood hazard awareness and the benefits of participation in the NFIP.

Twelve separate participating NFIP communities are located in the basin. Approximately 436 policies are in force with a total dollar coverage of approximately $34,269,800. A community agrees to enact and enforce minimum flood plain management requirements as stated in the *Code of Federal Regulation* (CFR), part 60.3. In exchange for enforcing these regulations, flood insurance is made available within the participating community. These regulations apply to new construction and substantial improvements.

The Division of Comprehensive Emergency Management is the state coordinating agency for the NFIP. The office can assist local participating communities in the implementation of the flood plain management objectives defined by the NFIP.

The Corps of Engineers, through its Flood Plain Management Program, also can develop flood plain boundary maps at no cost for those communities which need one or update those which do not adequately reflect current conditions

Recommendation: Non-participating local entities should become qualified to participate in the National Flood Insurance Program. The Division of Comprehensive Emergency Management should identify the communities not participating in the (NFIP) and meet with them in an effort to help them qualify for the program.

13.10.2 Disaster Response Plans

Issue: Not all communities have a disaster response plan.

Discussion: Local governments need to increase their ability to respond to natural disasters and emergencies. Emergency Operations Plans (EOPs), also referred to as Disaster Response Plans, address

disaster response and recovery activities following a disaster. These plans should be prepared ahead of time allowing counties, cities and towns to coordinate efforts and define responsibilities. Decisions regarding leadership should be made and the process for the activation of response activities should be outlined.

The Division of Comprehensive Emergency Management has the statewide responsibility of planning for, responding to, recovering from and mitigating emergencies. This agency has developed statewide plans for disaster response, and it can assist local entities prepare response plans for emergency situations.

Recommendation: Local communities should develop disaster response plans with the assistance of the Division of Comprehensive Emergency Management. ■

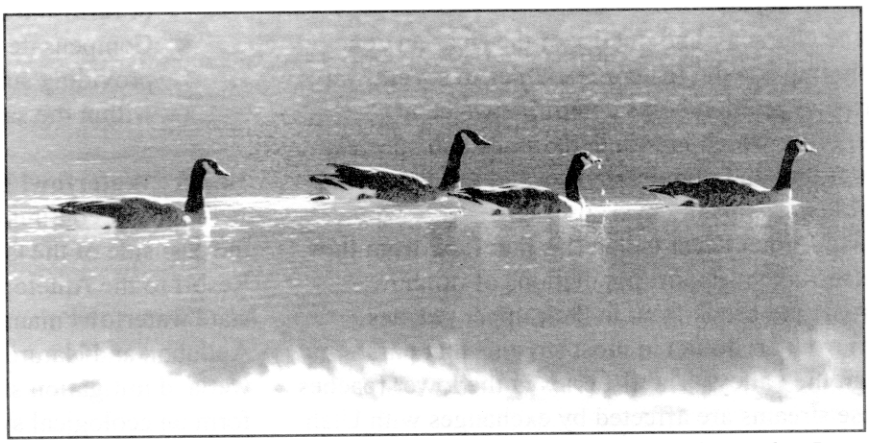
SECTION 14 CONTENTS

FISHERIES AND WATER-RELATED WILDLIFE

Wildlife is still common along rivers, creeks, wetlands, wooded areas, abandoned fields and parks within many areas of the Jordan River Basin. It is one of the valued amenities of living along the Wasatch Front. In a recent survey, more than 95 percent of Salt Lake City residents said they enjoyed seeing wildlife in their neighborhoods.

14.1 Introduction

This section describes the Jordan River Basin fish and wildlife resources, discusses existing and potential needs, and presents recommendations. It also describes associated problems and presents alternatives to improve wildlife resources. Preserving, restoring and creating wildlife habitat in the Jordan River Basin can provide benefits to all residents. Immediate and accessible green and growing habitat provides a welcome relief to the pavement and buildings of the urban environment. Habitat corridors along rivers, streams and canals offer coherence to the county landscape, providing a structure of open spaces that young and old alike can use for education as well as recreation. Property values near open spaces increase as urbanization consumes more land. Wildlife habitat also provides environmental benefits including cleaner air and water, reduced soil erosion, and the protection of natural plant and animal communities. In summary, preservation of urban wildlife areas can make a significant contribution toward the development of healthy, enjoyable and comfortable cities and towns.



Geese on the Jordan River

14.2 Setting

Before settlement of the Salt Lake Valley, the Jordan River meandered from its entry at the Jordan Narrows across a broad floodplain to the Great Salt Lake. A forest of cottonwood trees traced its path along the valley floor. Since that time, the forest has been cut, the river channeled, the water polluted and much of the wildlife displaced. Even though the Jordan River has been abused, it remains the backbone of the Salt Lake Valley's wildlife habitat resource. Recent efforts to preserve wetlands and riparian areas and improve water quality bode well for wildlife. The Jordan River delta, a mosaic of marshes, ponds, wet meadows, and uplands along with privately and state developed wetlands, is a significant habitat resource.

Economic projections suggest that substantial growth will continue in the Jordan River Basin well into the 21st century. Development has recently spread into areas of high-value wildlife habitat depleting the limited resource. Through responsible community planning with consideration given to

wildlife habitat as an important part of the urban environment, loss of habitat need not be a legacy of future development. Wildlife is still common along rivers and steams and in wetlands, woodlots, abandoned fields, parks and throughout residential neighborhoods within many Wasatch Front communities. Through proper planning and establishment of a system of wildlife areas throughout the basin, residents can capitalize on the unique wildlife resources and preserve the diversity of plants and wildlife.

The Jordan River Basin has about 28,100 acres of wetlands/riparian areas and about 15,000 acres of open water (includes the Great Salt Lake). See Table 3-2.

14.2.1 Fisheries

The character and quality of the riparian zone directly impacts the fishery resources in several ways. Riparian vegetation helps determine water temperature, which in turn determines fish species, composition, and population size and influences the available nutrients.

The Jordan River tributaries that flow from the Wasatch Range support populations of rainbow, cutthroat, and brook trout in their upper reaches. Brown trout are found in most streams that pass through the valley. The fisheries in the lower reaches of these streams are affected by exchanges with Utah Lake water and support populations of brown trout, carp, Utah sucker, mountain sucker, longnose dace and Utah chub. The section of the Jordan River between the county line and 90th South supports the greatest variety of game fish. Rainbow trout, brown trout, channel catfish, black bullhead, white bass, green sunfish, walleye, carp, and Utah sucker can all be found in this section. Downstream of 90th South, the fishery is dominated by warm water, sediment tolerant species such as carp and Utah sucker.

14.2.2 Wildlife Habitat

The Jordan River and its tributaries support riparian and wetland plant communities that offer critical habitat for wildlife. Although the width of these riparian zones is often greatly restricted through the valley due to development of adjacent upland areas, certain stream reaches can provide abundant food, cover, water and other special habitat requirements for wildlife. Wildlife use riparian zones disproportionately more than any other habitat type. Consequently, these areas are the most important wildlife habitat resource remaining along the Wasatch Front.

Habitat can be classified according to value. The four categories of habitat used in Utah are critical, high priority, substantial-value and limited-value. Mitigation goals vary with habitat value, wildlife species and project plans. Several approaches to mitigation are available. In their order of importance they are:

- Avoid the impact altogether by not taking a certain action.
- Minimize impacts by limiting the magnitude of an action or its implementation.
- Rectify the impact by repairing, rehabilitating or restoring the affected environment.
- Compensate for the impact by replacing or providing substitute resources or environment within the same area.

14.2.3 Waterfowl Habitat

Almost continuous preserved wetlands are along the east side of the Great Salt Lake from Saltair Resort to the Antelope Island causeway, containing a state waterfowl management area, private duck clubs, Audubon and Nature Conservancy preserves, and wetland mitigation sites These wetlands together form an ecological system of which the Jordan River Basin's 32,696 acres of developed managed wetlands are the major part, including 13 private duck clubs involving 16,791 acres. Many of these wetlands have been engineered or continually enhanced over the last 100 years, and these improvements are actively managed for wetland and wildlife values.

14.3 Organizations and Regulations

The Division of Wildlife Resources has responsibility for the management, protection, propagation and conservation of the state's wildlife resources. Some federal agencies have limited authority for wildlife management on lands they administer. The U.S. Fish and Wildlife Service has authority over management of threatened and endangered species on all lands.

14.3.1 Local

Although the county and local cities and towns do not have agencies specifically set up to perform wildlife and environmental roles, most have

demonstrated a growing interest to include these issues as part of their planning process. The following are examples of wildlife and environmental planning performed at the local level. The Central Valley Water Reclamation District contracted in 1988 with a consultant to conduct a four-year fishery study of the Jordan River in Salt Lake County. The primary objective was to monitor fish populations at several sampling stations established on the Jordan River, and determine if fish (especially game fish) abundance was related to differences in physical habitat or water quality. Four stations on the Jordan River were sampled: above Mill Creek (approximately 3300 South), below Mill Creek, 1700 South and 1000 North. Stations on the Surplus and Goggin canals were also sampled. From 1988 to 1991, 24 species of fish belonging to nine families were captured in the Jordan River. Carp, Utah sucker and fathead minnow were the most abundant species. Walleye, White Bass and Green Sunfish were the most common game fish. The study showed that fish abundance in the Jordan River is limited more by physical habitat than by water quality. Overall catch rates were highest where riprap covered the banks. Game fish appeared to prefer man-made structures and riprap cover types. The study concluded that until physical habitat is improved, assessing the effects of water quality on fish populations in the river will be difficult.

The preference of the game fish for manmade structures and rip-rapped areas is quite likely an indication of the natural channels degraded condition. The Jordan River has been straightened and channelized for much of its length. Much of the Jordan River channelization took place in the 1950s as a part of that era's efforts to stabilize the river. Since the 1950s, however, much has been learned about the dynamics of rivers and streams. Today's preferred approach is to work more closely with the river's natural sinuosity and meander patterns. A *1992 Jordan River Stability Study* conducted for Salt Lake County listed among the major findings and recommendations:

> "The channel stabilization work performed in the 1950s between 2100 South and 14600 South contributed to many of the river's existing stability problems. The channel slope increase induced by this channel straightening resulted in increased flow velocities and caused higher sediment transport rates. These factors acted to de-stabilize the channel bed and cause accelerated bank and bed erosion."

The Jordan River Stability Study recommends a river management plan that stresses non-structural management techniques, such as zoning restrictions and control of land use within the defined river meander corridor. Structural elements of the plan are intended to be used to enhance the natural on-going fluvial processes and re-establish a more natural channel pattern as well as protect existing development from erosion. Along with improving bank stability, erosion control and water quality, this approach should have a positive impact on fishery and wildlife habitat.

14.3.2 State

The Division of Wildlife Resources has general responsibility for the protection and management of fish and wildlife. Prior to 1973, wildlife management in Utah was almost entirely directed toward game species. The Division of Wildlife Resources began a non-game wildlife program in 1973. Early focus was on raising funds for research and management. The State Legislature funded a non-game biologist position in 1975, and Utah became the first western state and only the 17th state in the nation with a non-game specialist. The present urban wildlife program has grown out of these non-game activities.

The Division of Wildlife Resources has the lead role in determining potential impacts (positive and negative) to wildlife resources from water development projects. The role of the Division of Wildlife Resources in water planning is to:

1. Assess water development plans and specifically:
    a. Identify potential benefits to wildlife and their habitats,
    b. Identify potential adverse impacts to wildlife and their habitats,
    c. Recommend a course of action to mitigate project impacts to wildlife and their habitat for the public interest, and
    d. Recommend termination if mitigation is infeasible or not possible.
2. Provide factual information to decision makers regarding consequences of unmitigated and mitigated impacts to wildlife resources.

The Division of Wildlife Resources has prepared a *Wildlife Habitat Conservation Plan* to guide the actions of citizens, elected officials and state's governmental agencies. The proposed plan was prepared from satellite photographs of existing vegetation and land use patterns in the county. These images were processed by computer and field checked for accuracy. The habitat value of each area or "patch" was evaluated according to established criteria. The criteria used to determine habitat value included the size of vegetated patches, diversity of vegetation, level of disturbance, presence or proximity of water, and known use of the patch by wildlife.

The State Division of Forestry, Fire and State Lands also manages scattered tracts of land in the basin, some of which support fish and wildlife populations.

14.3.3 Federal

Primary federal responsibility for the protection and management of fish and wildlife populations rests with the U.S. Fish and Wildlife Service. The agency administers the requirements of federal acts relating to fish and wildlife, such as the Endangered Species Act of 1973.

Some of the basin's fish and wildlife are within national forest and public domain land managed by the Forest Service and Bureau of Land Management. These areas cover 94,800 acres or about 18 percent of the Jordan River Basin (See Figure 3-3).

14.4 Problems and Needs

Many people are attracted to live and play in this area because of the unique year-round attractions and facilities. This results in more pressure on the environment as a whole as well as the water resources in particular. Growing population in the valley increases pressure to develop lands currently serving as wildlife habitat. Most of the canyons are heavily used in both the summer and the winter for a variety of recreational activities. Many homes and businesses have been and are still being constructed in Emigration, Parley's, Big Cottonwood and Little Cottonwood canyons. These activities put a tremendous strain upon the environment and natural resources. There is also growing pressure to further develop areas in the Jordan River flood plain as well as along the many tributary streams. These areas represent the county's most valuable open spaces and wildlife habitat.

Conflicts will increase in the future due to the finite water resources and an expanding population. Some groups advocate preserving the resources from all development, while others rely upon the development of the resources for livelihood.

14.4.1 Minimum Flows

No minimum flow requirements have been established for the Jordan River. In general the flow in the Jordan River has been maintained in large part because of water rights held by public and private waterfowl management areas in the Jordan River Delta, but also because of irrigation return flows, and natural reach gains. The one section of river from Utah Lake to around 12300 South has been least affected by encroachment and channelization, but suffers from dewatering in the winter. Also, no minimum flows have been established for the Jordan River's tributary streams.

Water shortages create problems for the managed wetland areas by promoting disease epidemics and the intrusion of undesired plants. To maintain a healthy marshland, a spring flush is needed to wash out toxins and provide salinity control.

14.4.2 Reservoir Operations

Typically, releases from reservoirs are patterned after the reservoir owner's need. This has meant water is released from Utah Lake to meet irrigation schedules while water is released from Little Dell and Mountain Dell and the other small holding ponds in the Wasatch Range to meet culinary water needs.

14.4.3 Stream Channel Operations

Diversions of water for municipal and irrigation uses reduces the flow needed for fish habitat. In the winter, when no releases are made from Utah Lake, extreme low flow (or no flow) conditions exist and limit fish habitat from Utah Lake through Bluffdale. Most of the flow in the lower river during the fall and summer is poor quality return flows from irrigation or improved quality from sewage treatment facilities.

14.4.4 Wetlands and Riparian areas

Many of the valley wetlands and riparian areas have already been lost or impacted due to development over the past century and a half. Wetlands and riparian areas are important wildlife

habitats for many species. Such areas generally offer all four major habitat components: food, water, cover and living space. Where there is adequate water and deep soils, production of plant and animal biomass increases.

Only 2,000 acres of wetlands remain along the undeveloped reaches of the Jordan River between the Salt Lake County line and 2100 South. Pressure exists to develop along the Jordan River corridor, and it will undoubtedly increase in the coming years. The sensitivity and scarcity of wetlands, combined with the values and functions they provide (such as flood control, improved water quality and enhanced wildlife habitat), reflect the need for increased protection, conservation, management and restoration efforts by local, state and federal agencies. Improper development in the Jordan River corridor will result in loss of critical flood storage, increased nutrient and pollutant loading, loss of fish and wildlife habitat, and loss of recreational opportunities.

14.4.5 Fish Habitat

The primary cause of fish habitat loss in the Jordan River has been flood control practices such as dredging and straightening the river channel. Since the time of settlement, the Jordan River has been transformed from a richly diverse meandering river to essentially a uniform bottomed trapezoidal channel resulting in high uniform velocities and little cover for fish and other wildlife. Effects of channelization on stream communities, including fish, macroinvertabrates and riparian habitat, have proven to be extremely detrimental and long term. Channelized sections of the Jordan River are dominated by warm water, sediment tolerant fish such as carp and suckers that are not typically favored by local anglers. Less disturbed river sections support desirable game fishes such as trout, walleye, perch and bass. Recent changes in flood control philosophies along the Jordan River may provide opportunities for improving fish habitat in the future; but until floodplain encroachment by development is curbed, requests to dredge and straighten will continue.

14.5 Alternative Solutions or Actions

Water is an important part of nature in the city. In urban areas, water is often piped underground or diverted into concrete channels. A better alternative would be to determine where runoff water can be brought into open spaces. Designing on-site water drainage and retention can supply water to plant and animal life, at the same time decreasing the demand on drainage systems.

14.5.1 Central Utah Project Completion Act

Title III of the Central Utah Project Completion Act authorizes $145 million for specific environmental mitigation, conservation and recreation projects. More than $9 million dollars has been specified for wildlife mitigation issues and recreation facilities along the Jordan River. An additional $14 million has been designated to preserve, rehabilitate and enhance wetland areas around the Great Salt Lake. The improvements along the Jordan River corridor are intended to preserve fish and wildlife habitat and other functional wetland values and enhance urban wildlife recreational opportunities. The specified Jordan River Projects are:

Improve fish habitat - $1,150,000
Improve riparian habitat - $750,000
Acquire wetlands - $7,000,000
Jordan Parkway recreation - $500,000

14.5.2 Jordan River Meander Corridor

Salt Lake County passed an ordinance in 1944 that established a Jordan River Meander Corridor. The ordinance established the boundaries of the Jordan River's natural meander pattern, and sets limits on the types of development and land uses that can occur within the designated corridor. This effort follows closely on the heels of the county *Jordan River Stability Study*, published in December 1992. That study defined the Jordan River as "...continually undergoing the processes of bank erosion, long-term channel bed degradation, bridge scour, sediment deposition and meander migration." In addition to reducing the flooding potential along the river, the establishment of a meander corridor should have a very positive impact upon wildlife and the environment, as the river is allowed to take a more natural sinuous course and the stream banks are allowed to stabilize.

Many of the cities that border the Jordan River (Salt Lake City, Midvale, West Jordan, West Valley City, South Jordan, Riverton and Bluffdale), are developing their own management plans for the Jordan River within their city boundaries. Many of these city plans reflect the county's efforts to establish

a meander corridor and include the establishment of parkways and trails.

14.6 Issues and Recommendations

14.6.1 Wetlands and Riparian Habitat

Issue - Existing wetlands and riparian habitat are being lost or impacted due to development.

Discussion - The Jordan river Basin has about 28,100 acres of wetlands and riparian areas. The majority is contiguous with the Jordan River or its tributaries. Riparian areas include land directly influenced by sufficient water to sustain growth. Even though the wetlands/riparian areas account for a minor part of the total land area in the basin, the vast majority of wildlife species are associated with them at some point in their life cycle. As such, they are important areas to wildlife. When riparian areas are in good condition, they provide stream bank stability, maintain channel contours, regulate water flow and enhance water quality. A good riparian community has abundant and diverse plant life covering most of the soil and showing a spread in age distribution. Where spring areas have been impacted by wildlife and livestock, rehabilitation should be investigated and pursued.

Recommendation - The Division of Wildlife Resources should identify wetlands and riparian areas with significant values to aid in their protection and preservation. ■

SECTION 15 CONTENTS

WATER-RELATED RECREATION

Climatologically, Utah is one of the nation's driest states. Access and immediacy to water, in all its natural and man-made settings, is extremely important to Utah's recreating public.

15.1 Introduction

The purpose of this section is to describe the Jordan River Basin water-related recreational resources, to identify problems and needs, and to offer some recommendations. This evaluation includes passive and active recreational activities as well as resident and non-resident tourism and educational aspects (i.e. recreation programs, interpretive programs and skill training) performed in an outdoor water-related activity (streams, lakes, wetlands, rivers, reservoirs and swimming pools). Water-related recreational activities can be divided into two groups; those requiring direct contact with the water and those recreational activities which benefit from the water in a more indirect way. Activities which require direct contact with water include fishing, hunting, swimming, boating, sailing, wind surfing, scuba diving, water skiing, personal water craft uses, jet skiing and remote controlled model boats. Recreational activities which benefit indirectly from the presence of water include hunting, camping, picnicking, hiking, bicycle riding, mountain bike riding, ATV use and touring. Water-related activities (e.g. fishing, hunting camping, picnicking, water play and sunbathing, power boating, and swimming) typically rank among the top outdoor recreation activities.

15.2 Setting

Aside from the Jordan River, the Great Salt Lake and a few small reservoirs in the Wasatch Mountains, Salt Lake County has no major lakes, rivers or reservoirs. Consequently, opportunities for recreational activities involving direct contact with water are limited. At the north end of the county, the Great Salt Lake represents the largest recreational water attraction. Ever since the first settlers entered Salt Lake Valley, the Great Salt Lake has been a source of curiosity and a recreational attraction. Current recreational facilities on Great Salt Lake within Salt Lake County include the Great Salt Lake State Park and Saltair Resort, a privately developed facility.

Other water-related recreational activities include several privately owned and operated hunting clubs, a significant number of county and city owned swimming pools, as well as several privately owned and operated water theme parks and swimming pools. Quite a few city and county parks offer picnicking and other day-use activities in the immediate proximity to ponds, small lakes and streams.

One of the big uses of Jordan River water is the establishment of privately owned and operated duck clubs. These facilities use existing flows of the Jordan River to enhance marsh areas along the shoreline of the Great Salt Lake.

The skiing industry is a major recreation activity in the Jordan River Basin and has a favorable economic impact upon the entire state. The U. S. Forest Service manages approximately 95,500 acres of forested lands in the Wasatch Range including much of the lands used by alpine and cross-country ski enthusiasts. This gives the Forest Service responsibility and control over much of the skiing activities in the basin.

The federal government recently approved and partially funded a recreational component for the Little Dell Reservoir. This will make the little Dell Reservoir available for limited recreational activities in the future.

15.3 Organization and Regulations

15.3.1 State

The Utah Legislature created what is today the Division of Parks and Recreation in 1957. Lawmakers instructed the division to develop parks and recreation areas and preserve and protect

historical sites and scenic treasures. The boating program was added in 1959 and the off-highway vehicle program in 1971.

The major objectives for the state parks system are: 1) Provide a broad spectrum of high quality parks and recreational resources; 2) enhance the economic vitality of the state through increased tourist and vacationist traffic; 3) enforce state boating and off-highway vehicle laws; 4) regulate, protect and interpret the natural and historic resources in the park system; and 5) provide technical assistance and matching grants for outdoor recreation development.

The Division of Parks and Recreation provides matching grants for riverway and non-motorized trail enhancement. This program leverages state dollars with local dollars, requiring 50 percent local match. Since 1991, 260 requests totaling $10.2 million have been received statewide. To date, 107 projects have been awarded funds totaling $3.2 million. In the Jordan River Basin these funds, amounting to more than $250,000 since 1991, have been directed primarily at the development of the Jordan River Parkway,

15.4 Outdoor Recreational Facilities and Use

15.4.1 City and County Parks

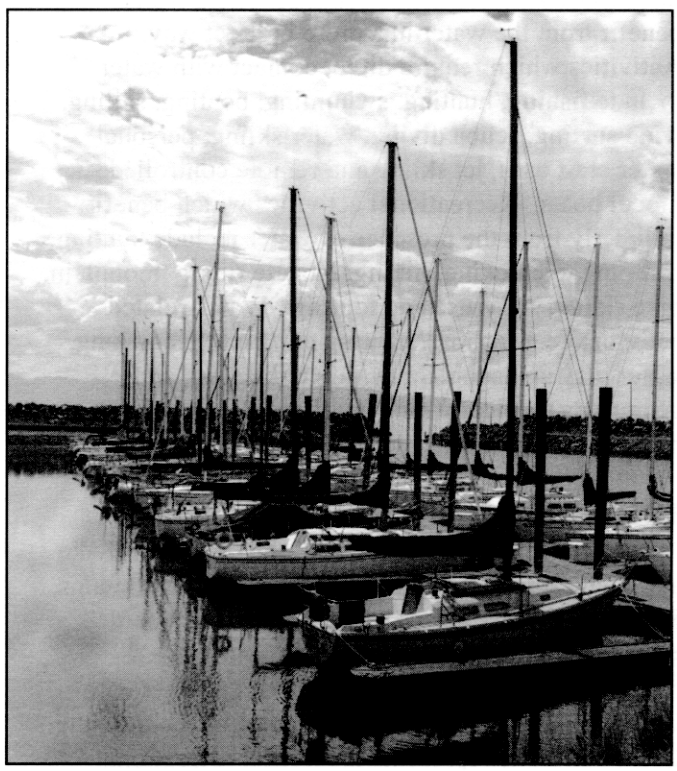
Numerous county and city parks are located throughout the basin. Many of these parks are not located near large bodies of water, though efforts have been made to incorporate direct and indirect water use when possible. Excellent examples include Liberty, Sugar House and Murray City parks. Water courses have been effectively used at each of these locations. The county and others are presently working to improve the facilities around Decker Lake in an effort to promote recreational activities at what is presently used as a storm drainage and flood control facility. City and county swimming pools and golf courses are located in virtually every community. In the past five years, a coordinated effort has been made to develop a Jordan River Parkway that runs from Bluffdale to Rose Park. The cities of Bluffdale, Riverton, South Jordan, West Jordan, Murray, Midvale, West Valley City, South Salt Lake and Salt Lake City, along with the county and state, are all involved in the planning and development of an integrated parkway that will eventually run the length of the river.

Salt Lake City and The Church of Jesus Christ of Latter-day Saints (Mormons) worked jointly to complete a downtown park which features City Creek. For years City Creek has flowed through the downtown area in underground pipes. Although flood flows will continue underground, the creation of a new park with some of the City Creek flow returned to the surface is a token of the public's desire to include water in their parks and living space.

15.4.2 State Parks

The Division of Parks and Recreation manages several state parks in the basin. Only two, however, are associated with a body of water. The Great Salt Lake State Park is located just north of U.S. Interstate 80 approximately 16 miles west of Salt Lake City. For the past couple of years, Great Salt Lake State Park has been visited annually by just over 500,000 people. The Great Salt Lake State Park offers swimming, boating and camping as well as a myriad of recreational day use activities.

The other state park that features water as an attraction is Jordan River Park in Salt Lake County.

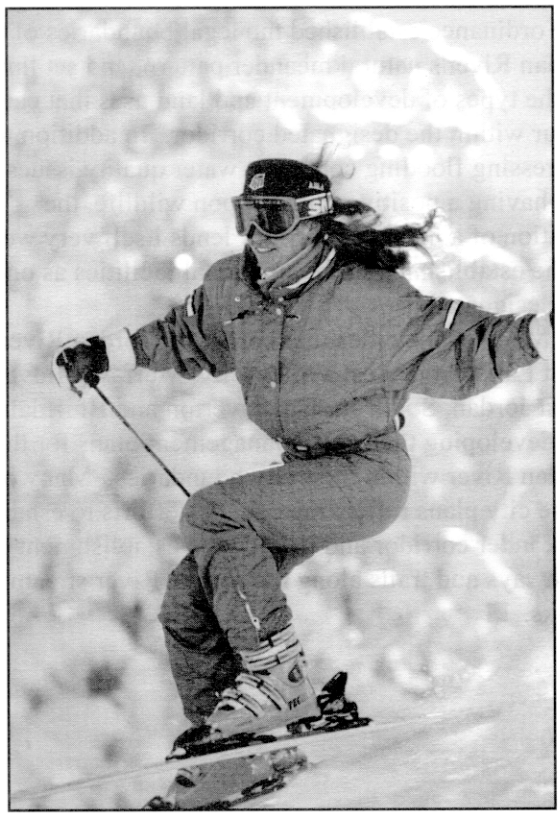


Great Salt Lake State Park Marina

The Jordan River Park is an eight-mile corridor along the Jordan River from 1700 South to the Davis County line. Although the Jordan River does not offer swimming, activities include canoe and float opportunities, picnic areas, a jogging and exercise course, a handicap exercise course, an off-road vehicle riding area, and a par-3 golf course.

15.4.3 Federal Parks

The basin has thousands of acres of federal lands, including Forest Service lands in the Wasatch Range and Bureau of Land Management land in the south end of the Salt Lake Valley, but no federal parks. In addition to managing these lands and controlling the recreational use on them, the federal government is involved in funding city, county and state recreational development through the National Park Service Land and Water Conservation Fund grants (LWCF). This program provides federal funds for outdoor recreation acquisition and development, and they are available to local governmental entities (cities, counties and states) as 50/50 matching grants. As shown in Table 15-1, $12.7 million in federal grants have been appropriated for various local, city, county and state projects in the Jordan River Basin since 1967. The total value of the projects, with matching funds, was nearly $26 million. Most have been city and county projects. Only two of the 72 projects have been state projects: Jordan River Parkway ($612,000) and Great Salt Lake Saltair Beach ($885,973).



Skiing is great along the Wasatch Front

Not all of the Land and Water Conservation Fund grants have been for water-related recreation. While some type of minor water feature on a site is nearly always preferable, only a small percent of the projects were in association with major water features; e.g., Jordan River Parkway, Great Salt Lake Saltair Beach. Many other funded projects included some type of water-related park amenity. Water features are highly desired by park users for many reasons including the usual presence of a variety of wildlife and visual amenities such as reflective values, change and visual relief from surroundings, the audio values of lapping and running water, and recreational opportunities such as swimming, sun bathing, beach play, fishing, boating, rafting, scuba diving, waterfowl hunting and ice skating.

A recreational component for Little Dell Reservoir has been approved and partially funded by Congress. This recreational component will include picnic and restroom facilities, interpretive nature trails, and facilities for small non-motorized water craft.

15.4.4 State River Way Enhancement Program

A state-wide river way enhancement program was set up by Senate Bill 143 in 1986 to reduce flood damage, enhance water quality, provide outdoor recreation, provide fishery and wildlife habitat, aid in water reclamation, protect cultural resources, and provide a non-consumptive amenity in terms of functional open space along important river corridors throughout the state. This program is intended to protect river corridors and provide pubic access, which is a major statewide issue and need according to the Utah SCORP planning process and public surveys.

15.4.5 Central Utah Project Completion Act

Section 311 (d) (1) authorizes $500,000 to construct recreation facilities within Salt Lake County as proposed by the state of Utah for the Provo/Jordan River Parkway.

15.5 Recreational Activity Problems and Needs

15.5.1 Outdoor Recreation Survey

It is important to know what kind of outdoor recreation is occurring in the basin. A major outdoor recreation survey was completed in 1991 on a statewide basis. It provided part of the data needed to update the *State Comprehensive Outdoor Recreation Plan* (SCORP). In the Jordan River Basin, 52 percent of the 300 random household questionnaires were returned.

The first question asked in the survey was: "What five (5) recreation activities do you most enjoy participating in as an individual?" Activities were selected from a prepared list. Figure 15-1 shows the 45 recreational activities selected by residents as their favored individual recreational activities. Fishing was the number one response of residents, followed by walking, camping, golfing and picnicking.

Another question asked was: "In order of preference, what five (5) recreation activities does your family as a whole most enjoy?" Developed camping becomes number one on the family chart (Figure 15-2); whereas, developed camping (camping in developed areas with services) was number 3 on the individual participation list. Picnicking turned up second on the "family activity" list followed by fishing, driving\ sightseeing and pool swimming.

Family outdoor recreation activity is significant to development, design and management decisions in terms of the types of activity and the magnitude or frequency of individual versus family/group activity. Park use information validates the importance of providing group-use facilities at recreation sites.

Another important aspect of the survey was its assessment of the need for improved recreational facilities. One question asked was: "...In my community, new opportunities/facilities should be developed for the following recreation activities:". Golf and bicycling facilities topped the list, followed by swimming pools, picnicking facilities and playgrounds (See Figure 15-3).

Another question asked in the survey was: "In my community, existing opportunities and/or facilities should be improved for which of the following recreation activities?" The responses, selected from an attached list, closely resembled those given for the new facilities question. The existing facilities listed as most needing enhancement were picnicking, bicycling, swimming pools and golfing (See Figure 15-4).

The final survey question asked: "What new facilities and opportunities are needed on a statewide basis (outside the community or immediate area)?" Fishing and developed camping topped the list followed by golf, wildlife and nature study, and picnicking, as shown on Figure 15-5. The first three also ranked high as local needs. Many of the preferred recreational activities and needed facilities involve direct contact with water and can be incorporated into future water development projects.

15.5.2 Jordan River Meander Corridor

Salt Lake County passed an ordinance in 1994 that established a Jordan River Meander Corridor. The ordinance established the legal boundaries of the Jordan River's natural meander pattern, and set limits on the types of development and land uses that can occur within the designated corridor. In addition to addressing flooding concerns, water quality issues and having a positive impact upon wildlife, the creation of a meander corridor lends itself very well to the establishment of recreational facilities as one of the designated uses.

Many of the cities that border the Jordan River (Salt Lake City, West Valley City, Murray, Midvale, West Jordan, South Jordan, Riverton and Bluffdale) are developing their own management plans for the Jordan River within their city boundaries. Many of these city plans reflect the county's efforts to establish a meander corridor and include the establishment of parkways and trails along the Jordan River stream banks. ■

Table 15-1
LAND AND WATER CONSERVATION FUND GRANTS
(1967-Present)

Project Sponsor	Number of Projects	Total Federal Funds ($1000)
State of Utah	2	
Great Salt Lake Saltair Beach		$ 886.0
Pioneer Trail - Rotary Glen		25.0
Salt Lake County	34	4088.4
Alta Canyon Recreation District	1	217.2
Provo-Jordan River Park Authority	2	1,705.9
Sugar House Park Authority	2	6.7
Midvale	1	42.8
Murray City	9	2,143.2
Riverton	1	99.7
Salt Lake City	8	1,751.5
Sandy	7	1,056.2
South Jordan	1	24.0
West Jordan	2	445.2
West Valley City	2	150.6
Total		$12,732.4

Figure 15-1

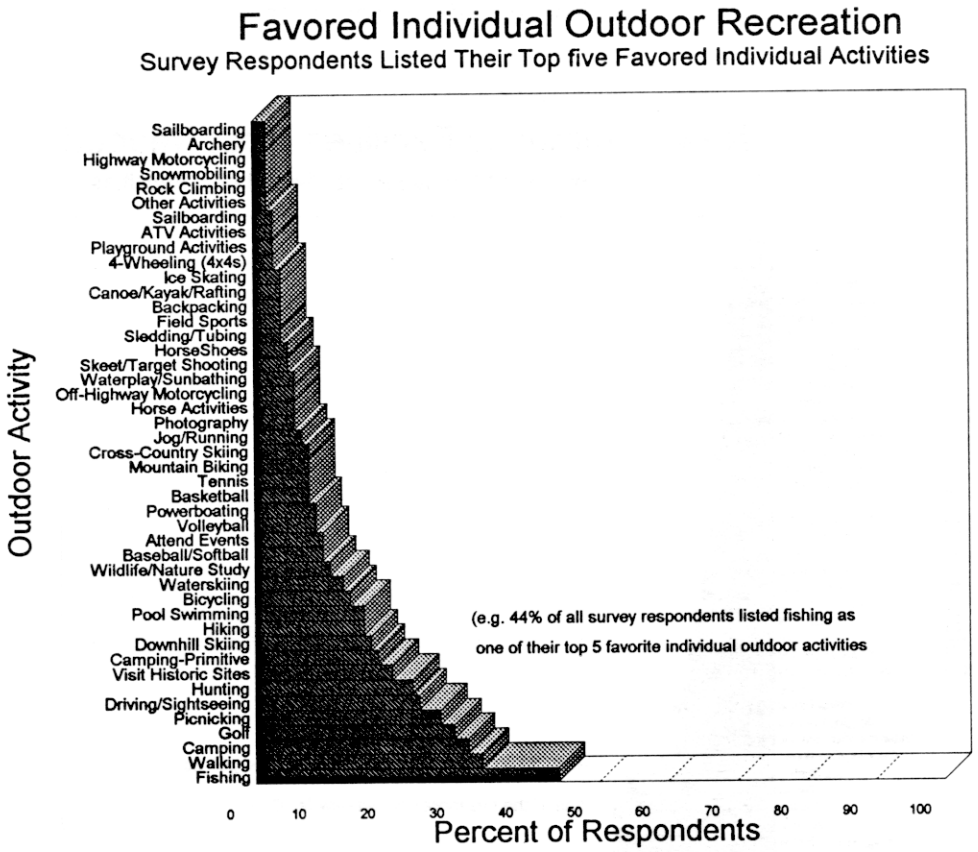


Figure 15-2

Favored Family Outdoor Recreation

Survey Respondents Listed Their Five Most Favored Family Activities

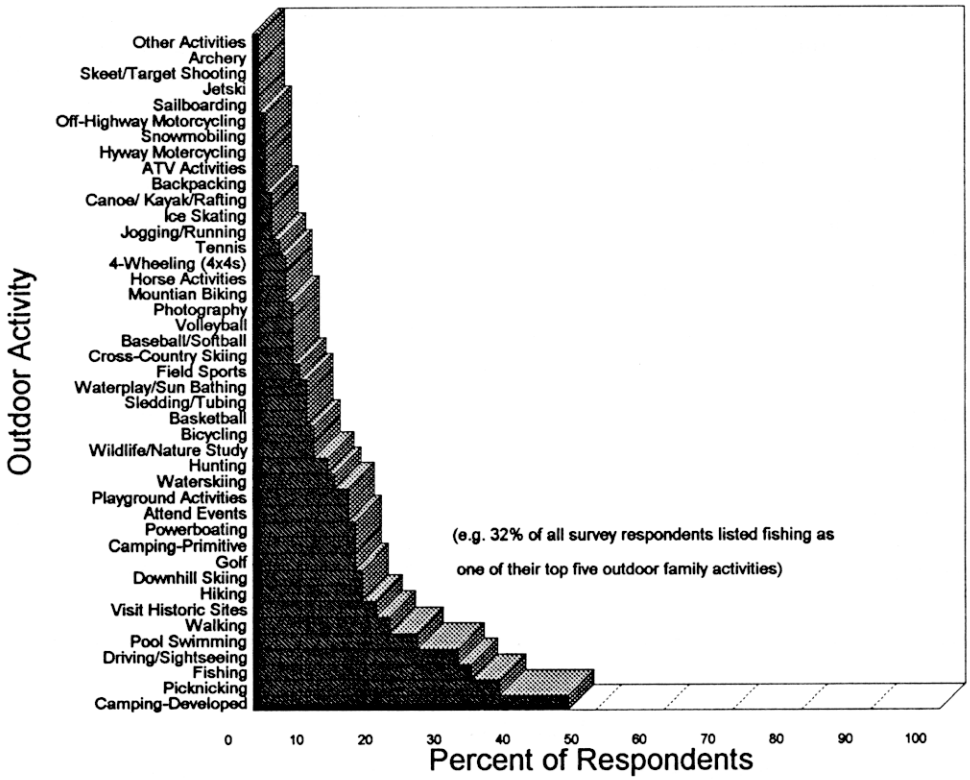


Figure 15-3

New Community Facilities Most Needed

Survey Responents listed the five most needed new Facilities

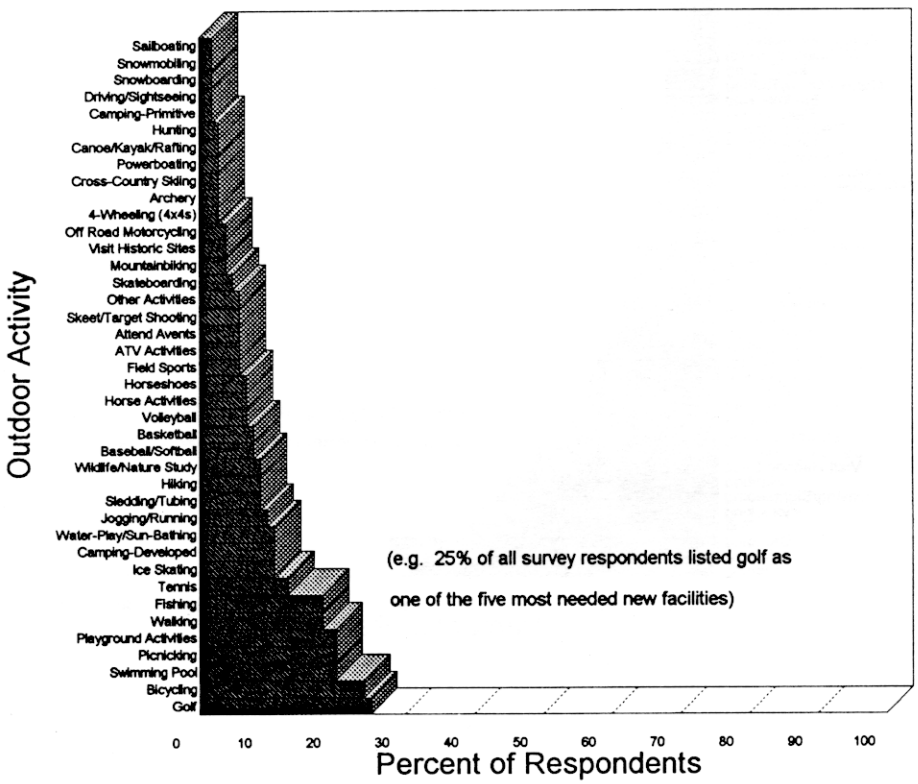


Figure 15-4

EXISTING FACILITIES ENHANCEMENT NEEDED

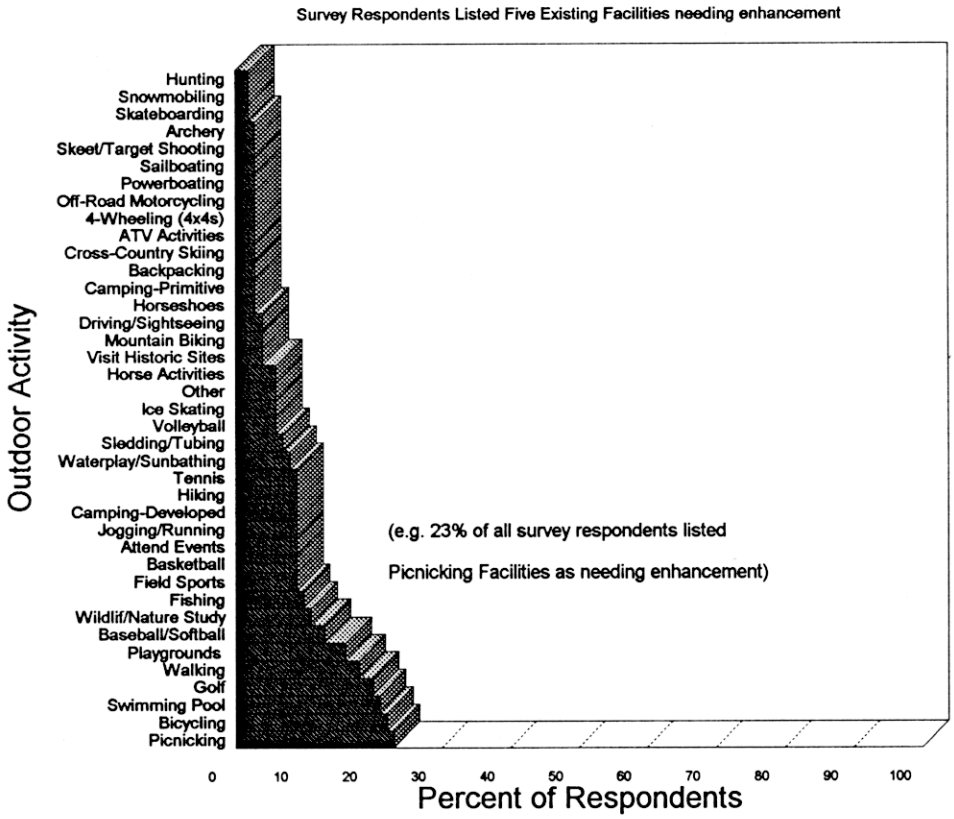
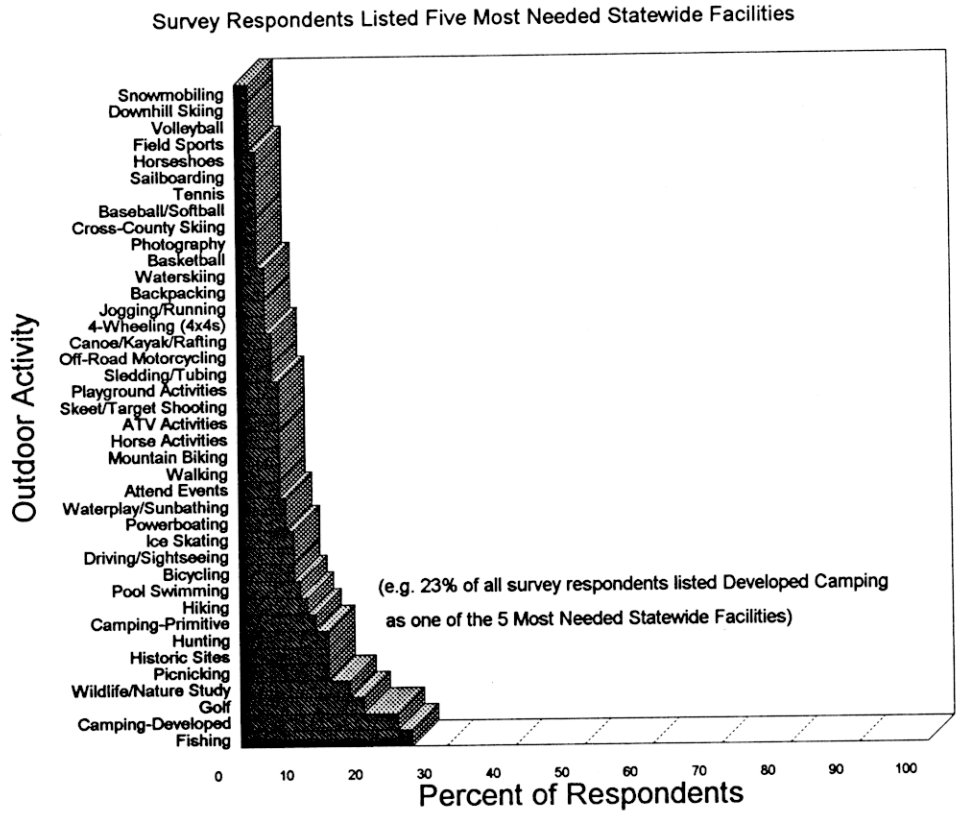


Figure 15-5

NEW STATEWIDE FACILITIES NEEDED



SECTION 16 CONTENTS

FEDERAL WATER PLANNING AND DEVELOPMENT

In the past, federal agencies have played a big role in funding water development projects. This practice is currently in transition with federal agencies decreasing their funding for water development while increasing their regulatory responsibilities.

16.1 Introduction

This section describes the involvement of federal agencies in Jordan River Basin water planning and development, including past and expected future involvement. Although the activities of federal agencies are changing, many programs are still available to benefit basin residents. To make the best use of these programs requires the local entities to be knowledgeable of ways to access these benefits. With this information, it is possible to develop better interagency and local working relationships.

16.2 Background

The role of the federal government is changing from one of construction and development to one of management, preservation, conservation and maintenance. Federal funding programs are decreasing while regulatory programs are on the increase. With the change in federal agency activities, the state is being called upon to take a more active role in the planning and funding of local water projects. Although the federal government has decreased many funding programs, several federal agencies still have management responsibilities and regulatory authorities that are expected to continue indefinitely. Consequently, cooperative participation with federal agencies will continue to be very helpful to the state.

The state is being called upon to shoulder additional financial responsibilities to carry out a number of federally mandated programs. Funding these federal programs may impair the state's ability to respond to local requests for project funding.

The primary concerns expressed by the various federal agencies in the *1990 Utah State Water Plan* are: 1) Reserved water rights, 2) interrelated planning (multiple-use planning), 3) stream and riparian habitat loss, and 4) water rights filings. An additional concern that has surfaced is coordination between federal, state and local officials. In recent years, progress has been made in each of these areas, particularly in the area of coordination between various federal, state and local agencies.

16.3 Federal Programs and Future Planning and Development

The various federal agencies and the programs they provide are briefly described on the following pages. Also see Section 8. Some project planning and implementation being considered by various agencies are also discussed. On October 20, 1994, the Secretary of Agriculture signed a memorandum implementing the reorganization authorities contained in HR 4217, the Federal Crop Insurance Reform Act of 1994, Public Law No. 103-354. This reorganization changed the name and activities of some federal agencies involved in the state water planning effort. These changes, as they effect the *State Water Plan*, are briefly discussed in the following subsections. Two of the listed agencies, Bureau of Reclamation (BOR) and the Corps of Engineers (COE), were primarily development oriented in the past, with emphasis on relatively large projects. At the present time, the BOR is in a transitional phase with increasing emphasis on management of existing infrastructure while the COE has been increasing it's regulatory responsibilities.

16.3.1 Bureau of Land Management

The Federal Land Policy and Management Act gives the Bureau of Land Management (BLM) authority for inventory and comprehensive planning

for all public lands and resources under its jurisdiction, including water quality considerations. Within the state as a whole, vast areas of land fall under BLM jurisdiction. In the Jordan River Basin, however, the BLM manages only 9,778 acres scattered throughout the valley in several small patches (See Figure 3-3 for locations). The largest block of BLM ground is located in Butterfield Canyon in the Oquirrh Mountains at the southwest portion of the Basin. The management of BLM ground is outlined in the bureau's *Pony Express Resource Management Plan.*

16.3.2 Bureau of Reclamation

The Bureau of reclamation programs for water resources fall into four broad categories: investigations, research, loans and service. All require close cooperation with the concerned entities.

Investigation Programs - General investigations are conducted for specific and multipurpose water resources projects, including an environmental assessment.

Research Programs - The bureau conducts research on water-related design; construction; materials; atmospheric management; and wind, geothermal and solar power. Most programs are conducted in cooperation with other entities.

Loan Programs - These programs have provided federal loans to qualified organizations wishing to construct or improve smaller and generally less complex water resources development. The bureau has recently reassessed its loan programs and concluded that they need major redirection. As a result, The bureau is no longer accepting applications for loans.

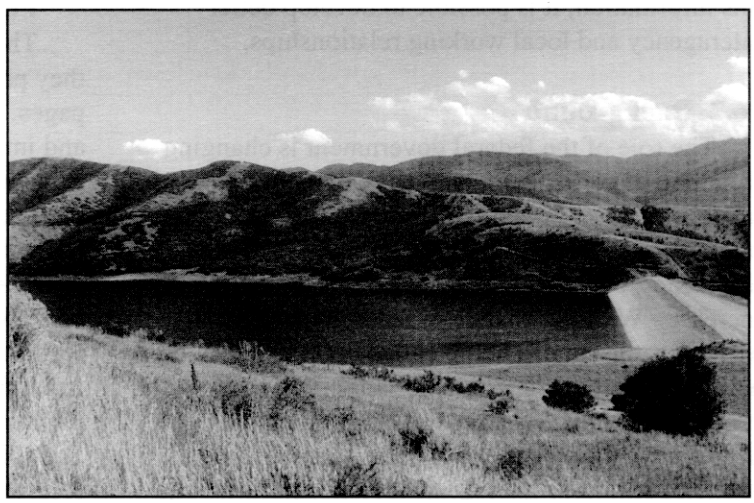
Service Programs - These are intergovernmental specialized technical service programs designed to provide data, technical knowledge and expertise to states and local government agencies to help avoid duplication of special service functions. Local governments pay for requested services.

16.3.3 Cooperative State Research, Education, and Extension Service

This new agency is assigned responsibility for all cooperative state and other research programs presently performed by the Cooperative State Research Service, all cooperative education and extension programs presently performed by the Extension Service, and such other functions related to cooperative research, education and extension as may be assigned.

16.3.4 Corps of Engineers

The Corps of Engineers (COE) was development oriented in the past, with emphasis on large flood control projects. The COE, jointly with the Utah Department of Natural Resources, completed the *Wasatch Front and Central Utah Flood Control Study* in 1984, a document with considerable pertinent flood-related data for the Jordan River Basin. Today's COE, though still involved with flood control and mitigation, has taken on the additional role, of regulating the nation's wetlands and waterways. As part of the federal permitting process (Section 404, Clean Water Act), the COE investigates the technical feasibility, environmental impacts and social acceptability of any channel improvement or development in wetlands and water courses.



Little Dell Reservoir

Local entities and interest groups can petition Congress for assistance if they are unable to cope with large water resource problems. Requests for assistance with smaller problems can be made directly to the Corps of Engineers. The COE can investigate economic and technical feasibility and social and environmental acceptability of remedial measures. When the problems cover an entire river basin, it is studied as a unit. Close coordination is maintained

with local interests, the state and other federal agencies. Existing COE projects are the Jordan River and Surplus Canal, completed in 1962, and Little Dell Reservoir, completed in 1993. Projects in progress are the Mill Creek flood diversion to Hillview Detention Basin (has been reauthorized by Congress and has received initial funding), and the Little Dell Lake Recreation Component (has been authorized by Congress and has received partial funding)

Recently completed Little Dell Reservoir is operated in cooperation with Salt Lake County for flood control and the Metropolitan Water District of Salt Lake for water supply.

16.3.5 Environmental Protection Agency

The Environmental Protection Agency (EPA) has regulatory responsibilities, particularly in water quality. The EPA programs dealing with water resources are the safe drinking water program under the Federal Safe Drinking Water Act (SDWA) of 1974, as amended in 1996, and water pollution control under the Clean Water Act (CWA). The SDWA substantially increased the number of regulated drinking water contaminants, added new required treatment methods and made other revisions. The 1996 amendment authorized more than $12 billion in federal funds for various drinking water programs and activities nationwide.

Several aspects of the Clean Water Act are:

National Pollutant Discharge Elimination System (NPDES) - The NPDES program (Clean Water Act, Section 402) regulates the discharge of point sources of pollutants to waters of the United States.

Construction Grants - This program originally provided grant funds for construction of needed municipal wastewater treatment facilities. It was phased out in 1990 and replaced with a revolving loan fund managed by the state.

Water Quality Management Planning and Non-point Source Pollution Control - Section 205 (j) of the Clean Water Act provides funds to states to carry out water quality management planning. Section 319 of the act authorizes funding for implementation of non-point source pollution control measures under state leadership.

16.3.6 Farm Service Agency

Farm Service Agency (FSA - formerly the Agricultural Stabilization and Conservation Service) administers farm commodity, crop insurance, and conservation programs for farmers and ranchers. As of October 1995, FSA also administers the farm ownership and operating loans formerly provided by the Farmers Home Administration.

The FSA's conservation programs include the Agricultural Conservation Program (ACP), the Emergency Conservation Programs (ECP), and the Conservation Reserve Program (CRP). The ACP is a comprehensive program designed to reduce soil erosion, mitigate water pollution, protect and improve the condition of both cropland and pastures, conserve water, preserve and enhance wildlife habitat, and where possible, encourage the conservation of energy. Projects are evaluated at the local level on a case-by-case basis to determine consistency with the overall ACP objectives. The ACP is administered by state and county committees that are made up of local farmers and ranchers.

The ECP provides emergency cost-share funding for a number of farm-related disasters that include, but are not limited to excessive wind erosion, floods and extended periods of extreme drought conditions. The CRP was established to encourage farmers through contracts and annual payments to reduce soil erosion. In addition, CRP eligibility has been expanded to promote the preservation and maintenance of wetlands, wildlife habitat and water quality.

The USDA-Natural Resources Conservation Service, USDA-Forest Service, and the Utah Division of Forestry, Fire and State Lands provides technical program guidance. The USU-Cooperative Extension Service provides educational support. (See Tables 8-2 and 8-3).

16.3.7 Federal Emergency Management Agency

Federal Emergency Management Agency (FEMA) programs are related to disaster preparedness, assistance and mitigation. They provide technical assistance, loans and grants.

Presidential Declared Disaster - Following a presidential declaration of a major disaster, usually in response to a state request, grants are available to the state and local governments for mitigation of disaster-related damage.

Assistance Grants - The FEMA can provide grants on a matching basis to help the state develop and improve disaster preparedness plans and develop effective state and local emergency management

organizations. Also, grants are available to develop earthquake preparedness capabilities.

Flood Plain Management - The FEMA provides technical assistance to reduce potential flood losses through flood plain management. This includes flood hazard studies to delineate flood plains, advisory services to prepare and administer flood plain management ordinances, and assistance in enrolling in the National Flood Insurance Program. The FEMA can also assist with the acquisition of structures in the flood plain subject to continual flooding.

16.3.8 Fish and Wildlife Service

The Fish and Wildlife Service (FWS) has jurisdictional responsibility over wildlife issues with national implications, such as migratory birds and threatened and endangered species. No land or water areas in the basin are directly managed by the FWS.

Table 16-1 lists the species considered threatened or endangered which may occur in the Jordan River Basin. The list changes over time as varies species are added when they become threatened or removed from the list as they recover. When any activity is planned which may impact a threatened or endangered species, it is the responsibility of the sponsor to take actions to protect them. The FWS compiles lists of native animal and plant species being reviewed for possible addition to the list of endangered and threatened species. Such species are generally referred to as candidates. While these species presently have no legal protection under the Endangered Species Act, it is within the spirit of the act to consider project impacts to potentially sensitive candidate species. From a planning perspective, it is also prudent to consider the possibility that a candidate species could, in the future, be added to the list of threatened and endangered species. The only candidate species listed for the Jordan River Basin is the spotted frog.

Table 16-1
THREATENED OR ENDANGERED SPECIES

Peregrine falcon	endangered
Whooping crane	endangered
Clay phacelia	endangered
Utah valvata Snail	endangered
Bald eagle	threatened
Ute ladies' tresses	threatened

When right-of-way permits are required on federal lands, the consultation requirement under the Fish and Wildlife Coordination Act is actuated. If federal funds are involved, Section 7 consultation with the FWS is required by the Federal Endangered Species Act (See Section 14). In either case, the permitting federal agency will review any proposed action and determine if the action would effect any listed species or their critical habitat. The Section 404 permitting process of the Clean Water Act administered by the Corps of Engineers also calls for Fish and Wildlife Service response on impacts to wetlands as well as threatened or endangered species.

Under the Migratory Bird Treaty Act, all migratory birds are protected with the exception of starlings, English sparrows and pigeons. The Endangered Species Act also prohibits the "taking" of a protected species. Any unpermitted activity on any land that results in "take" of federally listed species constitutes violation of Section 9 of the Endangered Species Act. "Take" under the act is defined as "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect or to attempt to engage in any such conduct." This can include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering.

16.3.9 Forest Service

The Forest Service manages the Wasatch-Cache National Forest, a total of 95,533 acres in the Wasatch Range on the east side of the Salt Lake Valley. These Forest Service lands include three wilderness areas: Mount Olympus, Twin Peaks and Lone Peak, which altogether comprise roughly a third of the Forest Service's jurisdictional lands in the county. All of the National Forest lands, except for Mill Creek Canyon, are designated as watershed areas and managed under the guidelines established by the Federal Wilderness Area regulations.

Water-related programs of the Forest Service include watershed management; special use authorization for water development projects; and coordination with local, state and federal agencies. They also manage wilderness areas located on national forest lands.

Watershed Management - Proper watershed management and protection can insure that activities will not cause undue soil erosion and stream

sedimentation, or result in reduced soil productivity or otherwise degrade water quality. Water yields can also be affected as a result of a well-planned timber harvest. Potential increases may approach one-half acre-foot per acre for some treated areas, but multiple-use considerations and specific on-site conditions may limit actual increases.

Special Use Authorization - Construction and operation of reservoirs, conveyance ditches, hydropower facilities and other water resources developments require special use authorization and usually an annual fee. Authorization contains conditions necessary to protect all other resource uses. Coordination of water developments by others require communication early in the planning process to guarantee environmental concerns are addressed.

16.3.10 Geological Survey

The U.S. Geological Survey (USGS) is mainly a data collection and research agency. Through its Water Resources Division, it investigates the occurrence, quantity, distribution and movement of surface water and groundwater and coordinates federal water data acquisition activities. The USGS performs continuing programs in cooperation (cost sharing) with various state and local agencies. These include water quality and water level changes in the groundwater, as well as surface water stream gages that are monitored and evaluated.

A new program which started in 1996 is the *Great Salt Lake National Water Quality Assessment (NAWQA) Study*. The program is entirely funded by the federal government and includes the drainage basins of the Bear, Weber, and Jordan rivers. The long-term goals of the NAWQA program are to describe the status of and trends in the quality of a large, representative part of the nation's surface and groundwater resources. The program is intended to produce a wealth of water-quality information that will be useful to policy makers and managers at the federal, state, and local levels.

16.3.11 Natural Resources Conservation Service

Formerly known as the Soil Conservation Service, the Natural Resources Conservation Service (NRCS) has been, and continues to be, a service agency providing technical and financial assistance to the agricultural industry. NRCS projects do not have to be approved by Congress, and are provided for by the Soil and Domestic Allotment Act of 1935. This act calls for the development and implementation of a continuing program of soil and water conservation on all lands, regardless of ownership. Over the years, additional programs have been added.

The NRCS snow survey program in the basin provides for and coordinates surveys and prepares forecasts of seasonal water supplies. This is a cooperative program with state and other federal agencies for the benefit of water users.

The Watershed Protection and Flood Prevention Act (Public Law 83-566), as amended, gives primary responsibility to NRCS for small, upstream watershed activities. There is a published soil survey report covering most of Salt Lake Valley.

16.3.12 Rural Development

Rural Development, through the Rural Utilities Service, is authorized to provide financial assistance for water and waste disposal facilities in rural areas and towns of up to 10,000 people. Priority is given to public entities in areas smaller than 5,500 people to restore, improve or enlarge a water facility. To be eligible for loan and grant funds, water waste disposal systems must be consistent with state or subdivision development plans and regulation. Loans for RC&D projects are also available.

16.4 Prospects for Future Federal Involvement

Federal programs most significant to the Jordan River Basin in the immediate future are the following: (1) The Central Utah Project (CUP) completion, under the Central Utah Project Completion Act, not only represents a culinary water source for the Wasatch Front but includes a considerable amount of environmental mitigation funding which will be used to rehabilitate streams in the Jordan River Basin; and (2) the EPA's authority under the Federal Safe Drinking Water Act and Clean Water Act. Further comprehensive federal studies in the Jordan River Basin and/or participation by the BOR, COE, or NRCS in future development would be welcomed, but they do not appear likely. ■

SECTION 17 CONTENTS

Tables

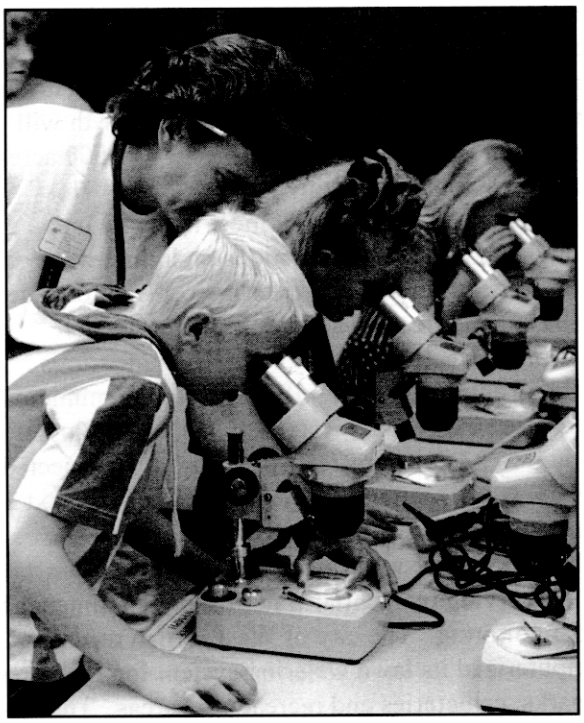
WATER CONSERVATION/EDUCATION

To guide the management of water development projects, the Board of Water Resources has issued a policy statement which supports conservation and the wise use of water. It states that water conservation will be examined as an alternative and a supplement to project proposals.

17.1 Introduction

This section discusses water conservation needs, issues, and potential alternatives, plus gives some recommendations for conserving water. Water conservation is defined in the *State Water Plan* as "wise use," which is much wider in scope than merely reducing water consumption. State water policy on conservation presently requires project sponsors seeking financial assistance from the state to prepare a *Water Management and Conservation Plan.*

Significant water use reductions can and have been achieved when people understand the reasons to conserve, especially in times of drought. It must be remembered, though, that reducing demand for water is less important if there are no cost savings or if the water cannot be used for other desirable purposes. However, in today's environmental-conscious society, implementing water conservation is deemed "the right thing to do."



Students see water close-up at water fairs

Water conservation can be pursued through three strategies: (1) Reducing the demand, (2) using the existing supply more efficiently, and (3) increasing the supply by operating the storage and delivery facilities more efficiently (including the elimination of conveyance losses), or through other means.

Examples of (1) are increasing crop irrigation efficiency, restricting outside use, change in landscaping practices, new efficient plumbing fixtures (i.e. low flow toilets and low flow shower nozzles), pricing and water education. Examples of (2) are secondary (dual) systems, wastewater reuse, water right transfers and conjunctive use. Examples of (3) are repairing and lining canals, leak detection programs and efficient release of water from storage facilities. All of these strategies are valid in the Jordan River Basin. Structural and non-structural measures apply to each.

17.2 Background

As determined by the Wasatch Front Water Demand/Supply Model, (See Table 17-1 and Table 9-4) the average annual diversion (1995) for municipal and industrial (M&I) water in Jordan River Basin was 331,500 acre-feet. This present M&I use is comprised of three components: a residential use of 164,600 acre-feet, a commercial/institutional use of 77,200 acre-feet and an industrial use of 15,400 acre-feet. Given the current population trends and existing water-use patterns, residential demand is expected to increase to 261,500 acre-feet by the year 2020. The commercial/ institutional use is projected to increase to 135,000 acre-feet by the year 2020. Institutional water uses include such items as park watering, fire hydrant testing, fire fighting and leakage losses. The industrial use is expected to increase to 25,300 acre-feet by he year 2020. Consequently, if existing water-

use patterns go unchanged, the existing total M&I use for Salt Lake County is expected to increase from 331,500 acre-feet in 1995 to 496,500 acre-feet in the year 2020.

The average annual irrigation diversion needs (1995) for the Jordan River Basin are 126,500 acre-feet. Due to the growing residential development and declining amount of agricultural land, it is anticipated that irrigation diversions and depletions will decrease to 71,000 acre-feet by the year 2020. (See Section 10)

17.3 Water Conservation Opportunities

The 1992 Central Utah Project Completion Act (CUPCA) requires 39,325 acre-feet of water conservation within the project service area by the year 2007. The CUPCA authorized the appropriation of $50 million of federal funds for conservation measures. To date, less than $4 million has been appropriated. This money is available on a 65-35 percentage cost share with the 65 coming from project funds.

This section includes a discussion of municipal and industrial (M&I) conservation and agricultural water conservation practices. Agricultural water is untreated water, usually of poorer quality used specifically for production of crops. By definition, M&I refers to all public water use. Therefore, untreated "secondary" water is included in the broad category of municipal and industrial water. The vast majority of M&I water is treated culinary water as a part of the public water systems. It is used for residential, commercial and industrial purposes, and is treated to meet the strict regulations of its highest use - drinking water. Consequently, M&I water is expensive, especially when compared with the price of agricultural water. Obviously, water conservation strategies for these two different types of water use are varied.

17.3.1 Agricultural Water Conservation

A land use inventory for Salt Lake Valley completed in 1994 determined irrigated agricultural lands covered 25,300 acres. The current water rights allotment is five acre-feet per acre. This means approximately 126,500 acre-feet of water are diverted annually for agricultural irrigation. Of the five acre-feet duty (allotment), about 2.3 acre-feet per acre is used for crop consumption. The remaining 2.7 acre-feet per acre is for conveyance and application losses. Clearly, there is potential to conserve agricultural irrigation water. Irrigation diversions can be reduced by eliminating conveyance losses such as canal seepage, and improving irrigation scheduling during the growing season. Canal operation and maintenance is a constant activity of irrigation companies. Sprinkler irrigation may improve on-farm efficiencies. But studies have shown that Utah Lake water, when sprinkled on leaves, creates a salt toxicity danger to crops. In addition, decreasing the Utah Lake duty on farmlands reduces the flushing in the root zone, which can create a salt toxicity build-up and damage crops.

Although there is a real potential to conserve Jordan River irrigation water, there is no real incentive to do so. As pointed out in previous sections (See sections 5, 7 and 10 for details), there is sufficient agricultural irrigation water supply for the existing demand. There is no foreseeable need for additional agricultural water. Also, because Jordan River water quality is poor, it is not presently economically feasible to treat it for municipal use.

17.3.2 Municipal and Industrial Water Conservation

Conservation of municipal and industrial water is an appropriate and feasible way to meet part of the future water requirements. However, satisfying all of the projected growth through conservation is not possible. The county population is projected to increase about 62 percent (495,100 people) by the year 2020 (See Section 4). Coupled with the current water consumption rate, this projected growth will increase the M&I water demand from 331,500 acre-feet to 496,500 acre-feet by the year 2020. This increased water demand will most likely be met through a combination of actions including water conservation, new wells, water import from outside the basin, and treating additional surface water.

Some effective water conservation measures could be employed to significantly reduce municipal water use. Unmetered water use and system losses amount to 21,400 acre-feet. This figure is projected to increase to about 40,000 acre-feet over the next 25 years. Although the unmetered uses include fire fighting and park watering, the potential still exists for conserving residential water through maintenance and monitoring. The city of West Jordan recently computerized its lawn watering system for 150 acres of parks, cemeteries and recreational areas. The city

Table 17-1
PRESENT AND PROJECTED MUNICIPAL AND INDUSTRIAL WATER USE

Water-use	1995 (acre-feet)	2020 (acre-feet)
Residential	164,600	261,500
Commercial/Institutional[a]	77,200	135,000
Industrial	15,400	25,300
Private Domestic	24,600	20,000
Self-Supplied Industrial	26,500	26,500
Secondary: Municipal	10,000	15,000
Industrial	13,200	13,200
Total M&I	331,500	496,500

Source: Wasatch Front Demand and Supply Model
a: Includes unmetered public use and losses (ie. watering parks and firefighting)

estimates it saves 75 acre-feet of water annually. For West Jordan parks, that represents a water savings of about 20 percent over the past few years. Consequently, programs that improve efficiency of large landscaping systems can have a positive impact on water consumption.

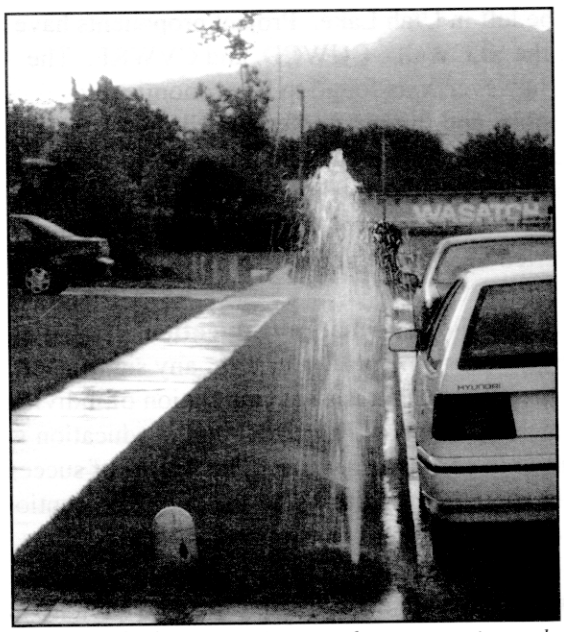
Residential Water Conservation - Residential water in Salt Lake Valley can be conserved in a number of ways. Water-efficient appliances such as low flow toilets and shower heads are only required in new construction. And most wholesale and retail price structuring provide little incentive for water conservation. The most inefficient use of residential water is over-watering of lawns and gardens. Education coupled with price incentives could accomplish a lot in terms of conserving residential water.

Commercial Water Conservation - Opportunity for water conservation in the commercial sector is limited. Studies suggest that commercial users are no less efficient than other industrial water users. In fact, some commercial endeavors, such as laundries, have already implemented water conservation to reduce energy costs. It is likely, however, water pricing incentives and pretreatment wastewater requirements would further motivate commercial businesses (users) to re-evaluate their water conservation efforts.

Industrial Water Conservation - Approximately half of the basin's industrial water is taken from public water systems with the balance coming from private sources. This is primarily because the largest industrial water user, Kennecott Utah Copper, has a self-supplied water system and an extensive water recycling program. Water pricing incentives will likely have a positive impact upon industries which receive water from public water systems.

17.4 Conservation Methods and Strategies

A wide range of water conservation methods have been employed in various regions of the country. The lessons learned in other states can be useful to Utah. However, it should be kept in mind the expected outcome can be affected by differing circumstances.



Wasteful municipal water use is costly

The following paragraphs provide a brief description and discussion of the conservation methods and

strategies expected to produce the most favorable impact in the Jordan River Basin.

17.4.1 Wastewater Reuse

One effective method of conserving existing water supplies would be to establish a system of reuse. To some extent, current water supplies are reused as return flows from irrigation fields and effluent from wastewater treatment plants return into the Jordan River. These supplies are re-diverted and reused downstream for additional agricultural or wildlife uses.

No direct reuse or recycling of wastewater for drinking water use has been universally accepted in the United States, except in emergency situations. However, reuse of wastewater for industrial, agricultural and other uses, such as golf course watering, is becoming more common. In the future, water reuse may become a more valuable tool in conserving the existing water supply.

The reuse of Central Valley Wastewater Treatment Plant (CVWRF) effluent for agricultural uses has been considered. This proposal would pump effluent from the plant to the south end of the valley where it would be discharged into existing irrigation ditches and co-mingled with irrigation water supplies. The water currently being diverted for irrigation could then be left in Utah Lake. Project proponents have been the SLCWCD, CUWCD, and CVWRF. The plan, however, was found to be economically infeasible, and further studies and EIS work were discontinued. This plan, which is on hold while further evaluations are made, may be inconsistent with the current trend of farm land rapidly being converted to residential property.

17.4.2 Public Information/Education

Since everyone is a water user, any significant gain in conservation is an accumulation of individual attitudes and efforts. Therefore, public education is essential in conserving water. The degree of success will be directly proportional to the public perception of the need for water conservation. Every public agency or private organization concerned with planning, developing or distributing water can make a difference through efforts in this regard. Water conservation material is currently being mailed to schools, water-user organizations and individuals (on request). These materials are part of a water education program by the Division of Water Resources. Other conservation objectives of the division's education program include water-efficient landscaping and gardening techniques and conversion to more efficient appliances such as low flush toilets and low flow showerheads.

Educational programs continue to be carried out with students in elementary and secondary schools assisted by the International Office of Water Education at Utah State University and Project Wet, a consortium of water education agencies throughout the United States. Successful "Water Fairs" were held in 1994 and 1996 at the Salt Lake Community College (SLCC) for students in Jordan, Salt Lake, Murray, and Granite School districts. At SLCC, students are actively involved in half-day workshops where water-related topics are taught by professionals from water-related organizations.

17.4.3 Institutionalizing Water Conservation

An effective water conservation program requires a cooperative effort by all segments of the public. One way to achieve this would be through an active water education program conducted by public water utilities.

Other efforts include the Utah Water Conservation Forum organized in 1993. This non-profit organization is comprised of concerned individuals and groups throughout the state whose long-range goal is to become more aware of the importance of managing, preserving and learning practical ways of incorporating water conservation into every part of their lives. Meeting quarterly, the forum has educational presentations about water conservation, including water-wise landscaping. The forum also serves as a clearinghouse where highly trained professionals evaluate new products, programs and concepts. Most attendees are from Salt Lake County.

Another interesting example are the results in California from a persistent five-year drought. Severe water shortages were experienced throughout the state. Water conservation, as well as re-allocation of supplies, was an absolute necessity. Conservation is now formally recognized as an important long-term component of water management and future growth. Dozens of cities and several public interest groups have signed a unique agreement called the Memorandum of Understanding Regarding Urban Water Conservation. "The pact commits the signatories to a multimillion dollar effort to reduce

water consumption whether the weather is wet or dry." Program participants represent about 90 percent of the state's urban population. Savings of 500,000 acre-feet by the year 2000 and 1,000,000 acre-feet by the year 2010 are estimated. A series of "best management practices" in the program include public information campaigns, school education programs, water audits for houses, new and retrofit plumbing to increase the use of efficient showerheads and toilets, and conservation pricing. These efforts are expected to use current supplies more fully in the future as the population grows. But in spite of the anticipated water savings, new water supplies will also be needed. One of the significant findings of the above efforts is that, "...by promoting greater conservation, many cities may become increasingly vulnerable to future droughts because there won't be a margin of safety in water use. This makes development of additional reliable supplies even more important."

17.4.4 Restricting Water Use

To make enough water available for necessary household and commercial use during periods of severe drought, the use of municipal water for lawn and garden watering and other outside uses has periodically been restricted in Utah as in 1977. One of the easiest restrictions to monitor and enforce is to prohibit outside use during times of the day or days of the week. In the most severe cases, all outside use has been temporarily prohibited. The public has accepted these restrictions when they understand the necessity and realize the situation is temporary. But it is doubtful the public would accept such restrictions if they are perceived to be unnecessary or artificially contrived.

Because of the loss of water to evaporation on hot summer days, some water districts prohibit lawn watering between the hours 10 a.m. to 6 p.m. The estimated loss from evaporation during the day is 10 to 15 percent of the applied water. Programs restricting the use of secondary water during daytime summer hours have been established by several cities. Water suppliers consider this program a large success and it has been well received by customers. Restriction of daytime watering is a recommendation of the Utah Water Conservation Advisory Board and could be implemented in the Jordan River Basin.

At the present time, the greatest threat imposed during extended hot, dry periods is not inadequate supply but rather a deficient infrastructure which is incapable of delivering a flow sufficient to meet peak demand. Consequently, during hot summer days, demand can result in insufficient flows, low water pressure, inadequate fire flow capacity, and back-syphoning or negative pressures that can cause structural damage to the system. Experience has shown outside watering restrictions to be an effective tool in reducing peak demand. In fact, even when watering restrictions have failed to reduce the total water use, they have still proven effective in reducing peak demand. Consequently, water purveyors will continued to implement outside watering restrictions or other measures to help deal with peak demand.

17.4.5 Conjunctive Use

Conjunctive use of water supplies (also called "joint use") most often refers to surface water and groundwater. Where both are available as a water supply, groundwater can be allowed to accumulate during wet years, and then pumped in dry years to supplement surface water supplies. This is an excellent example of wise use because it manages the total water supply, maximizing system efficiency.

Similarly, treated and untreated water can be used jointly to conserve water as well as reduce costs. A secondary system to distribute untreated water for lawns and gardens allows use of a smaller system capacity of expensive treated water. A substantial portion of high-quality treated water in public systems is customarily used for lawn and garden watering.

17.4.6 Landscaping and Home Water Savings

Reductions in per capita use of municipal water requires changes in personal habits and traditional practices inside and outside the home. This requires a public perception of need, but it can produce significant savings.

- Inside, users can install water-saving toilets and shower heads, check plumbing for leaks, take shorter showers, use automatic dishwashers and washing machines only for full loads, and avoid having faucets run long periods for shaving or rinsing vegetables, dishes and other items.
- Outside, users can avoid using a hose to clean driveways and stop letting water run constantly while washing a car. Landscaping practices can also be improved. The Division of Water Resources teaches and encourages

the installation and planting of water conserving landscaping. The principles include limiting lawn areas, using plants and trees with low water requirements, irrigating only when needed, watering during morning or evening hours, and improving soils in shrub and garden areas by using mulches.

17.4.7 Pricing

Pricing policies are suggested as a means of reducing per capita water use. Flat rates (same price for each unit of water) provide little incentive for consumers to conserve. Decreasing block rates (lower unit prices for larger volume) provide even less conservation incentive. "Take or pay" contracts, which provide water purveyors with the guaranteed revenue stream needed for bonding, do not promote any conservation below the contracted amount. Increasing block rates provide the greatest conservation incentive for consumers. Under this pricing policy, consumers experience an increasing unit price for higher water consumption. To be effective, the increasing block rate must be substantial and would probably require strong public support.

Beginning July 1, 1995, Salt Lake City Corporation implemented seasonal rates for its water customers. This new rate strategy cuts water rates for eight months during the spring, winter and fall, when water is plentiful. Water rates increase during the four months of summer when the cost of delivery increases because of high demand for outside watering. Titled the "Summer-Efficiency Rate," this rate restructuring is designed to be revenue-neutral and is intended to delay building new aqueducts and treatment plants. If successful, similar plans could be adopted by other water purveyors in the Jordan River Basin and throughout the state.

In November 1994, Kearns Improvement District initiated a progressive water rate structure for residential and municipal water users. For the first 10,000 gallons of water residential users are charged 90 cents per thousand gallons. The rate is then increased by 10 cents per thousand gallons with each additional 10,000 gallons of use. In other words: $1.00 per thousand gallons for the second 10,000 gallons of use, $1.10 per thousand gallons for the third 10,000 gallons, etc. The district has also established an increasing block rate for users that irrigate large lawn parcels. These irrigators are allotted 120 percent of the amount of water necessary to grow Kentucky Bluegrass, at $1.00 per thousand gallons. Anything exceeding that allotment is charged at $1.50 per thousand gallons. It has been estimated that although this program offers relatively inexpensive water at the lower block rate, it has been well received and resulted in a decrease in water use of 13 to 15 percent.

17.4.8 Water Measurement

Accurate measurement of water encourages water conservation in several ways. Not only is each user assured of fair and equitable distribution and financial assessments, it is also a more business-like way to operate a system and provide records. Where users pay according to the quantity of water they actually use, there is a built-in incentive to conserve, whether the use is irrigation, municipal or industrial. Most community water systems are metered. Properties like city parks, golf courses and cemeteries, however, do not have meters.

17.4.9 Secondary or "Dual" Systems

Secondary water systems, also known as "dual" water systems, provide untreated water of moderate quality for outdoor uses, primarily lawn-watering and gardening. Because these systems require the construction of an additional water conveyance infrastructure, they can be expensive. However, secondary water systems are economical if the construction costs are less than the cost of enlarging the M&I system to meet future needs and the costs associated with treating the water to drinking water standards. While there may be an economic incentive for building secondary water systems based on the cost of high quality treated water conserved, studies have shown that "secondary" systems do not promote overall water conservation. Since secondary water is less expensive than treated water and is seldom metered, consumers tend to use more of it when watering their lawns. Only a few secondary water systems are in place in the Jordan River Basin. Since retrofitting can be expensive, it is doubtful many new secondary water systems will be constructed in existing communities. In areas of new construction where an adequate secondary water supply exists, secondary systems may prove economical. Construction of these systems allows the use of lower quality (untreated) water on lawns and gardens freeing up the existing developed high quality water for meeting growth.

17.5 Water Conservation Impacts

The Wasatch Front Water Demand/Supply Model (WFCM) was used to project future demands with current conservation trends in Salt Lake County. Four individual scenarios and one combined scenario were made as follows:

1) Baseline for comparison - no conservation
2) Indoor conservation (low flow plumbing)
3) Outdoor conservation (water efficient landscaping)
4) Economic conservation (10 percent price increase in addition to inflation)
5) Combination of measures 2, 3 and 4.

Projected demand and the percentage reduction (or increase) due to various measures for the years 2000, 2010 and 2020 are shown in Table 17-2.

The plumbing conservation measure showed an increasing percentage reduction from base case projections over time as the fraction of the population using the new water efficient fixture increases. The percent reduction in the Jordan River Basin increases from 2.3 percent in the year 2000 to 7.2 percent in the year 2020.

Water conservation landscaping showed increasing water savings over time but the effect is minor. By the year 2020, the reduction of water use is projected to be 1.9 percent. This could be increased significantly without a major change of water use to irrigate lawns. Studies show people use 30-40 percent more water on their lawns than is necessary.

The 10 percent price increase simulation showed a nearly constant drop in demand of 2.60 percent. The combined effect of plumbing, water efficient landscaping and price increase results in a year 2020 savings of 11.4 percent. The combined effect of these conservation measures is only slightly less than the sum of these individual measures.

17.6 Water Conservation Credit Program

The purpose of the Central Utah Project Water Conservation Credit Program is to identify, evaluate and prioritize water conservation projects included in the *Water Management Improvement Plan.* The Central Utah Water Conservancy District will evaluate the effectiveness of the conservation credit program on an annual basis, and may adjust any section as necessary. Project requirements and valuations will not differ between proposed projects in any given period when two or more projects are being compared. The goal of the program is to conserve 39,325 acre-feet of water annually. Up to 65 percent of costs for each project accepted by the district may qualify for federal grants. The remaining 35 percent must come from local or state funds.

The district or a petitioner may retain any water they conserve to meet future uses or the petitioner may make saved water available to the Secretary of the Interior to be used as instream flows for the benefit of fish and wildlife. The secretary shall reduce the annual contractual repayment obligation of the district if this happens. The reduction will be equal to the project rate for delivered water, including operation and maintenance expense, for water saved for instream flow.

The district shall credit or rebate to each petitioner its proportionate share of the savings. This program contains several elements to provide a systematic approach to the accomplishment of these purposes and an objective basis for measuring their achievement. It allows the district to identify, evaluate, fund and carry out the conservation measures required to meet the district's goals.

Table 17-2
IMPACTS OF CONSERVATION ON M&I WATER DEMANDS

Year	1995	2000	2010	2020	2000	2010	2020
Conservation Scenarios:		Demand (Acre-feet/year)				Percent Change	
Base Case	255,737	279,572	345,573	419,316	9.32	35.13	63.96
Plumbing		273,075	327,455	388,913	-2.32	-5.24	-7.25
Xeriscaping		279,205	342,722	411,483	-0.13	-0.83	-1.87
Price+10%		272,299	336,548	408,450	-2.60	-2.61	-2.59
Combination (2-4)		265,670	316,341	371,613	-4.97	-8.46	-11.38

Source: Wasatch Front Water Demand/Supply Model, November 1996

Any person, group or organization with an idea for a project that conserves water may apply to participate in the Credit Program. Not all projects submitted will be selected for funding and implementation. All projects must complete all elements listed in the water conservation credit program document dated July 1993. A copy may be obtained from the Central Utah Water Conservancy district.

17.6.1 Public Education

Public education is recognized as an integral part of any conservation program. The purpose is to reduce the demand for water through education. With people educated about water and its many values, they will be better prepared to make decisions about efficient water use, conservation methods, water saving techniques and development opportunities. Education projects and programs approved under the credit program are also eligible for 65 percent funding with federal grant monies.

17.6.2 Utah Water Conservation Advisory Board

The Central Utah Project Completion Act (CUPCA) allowed the governor to establish a board consisting of nine members, known as the Utah Water Conservation Advisory Board. The Utah Board of Water Resources was designated to be the new board with the addition of one member from the environmental community. The duty of the board included investigating specific water conservation strategies and then developing water conservation standards and regulations aimed at reducing water demand. These standards and regulations were then recommended for promulgation by state or local authorities in the service area of each petitioner of project water.

Complete findings and recommendations are published in a report titled *Recommendations for Water Conservation Standards and Regulations in Utah.* The findings and recommendations of the Water Conservation Advisory Board are incorporated into subsection 17.3, Water Conservation Opportunities; subsection 17.4, Conservation Methods and Strategies; and subsection 17.7, Issues and Recommendations

17.6.3 Water Conservation Pricing Study

Under the CUPCA, the district studied wholesale and retail pricing as a means of encouraging water conservation. The *Report on Water Pricing Policy Study* was published in October 1995. This study focused on various pricing mechanisms to conserve water. The purposes of the study are to:

A) Design and evaluate potential rate designs and pricing policies for water supply and wastewater treatment within the district boundary;

B) Estimate demand elasticity for each of the principal categories of end use of water within the district boundary;

C) Quantify monthly water savings estimated to result from the various designs and policies to be evaluated; and

D) Identify a water pricing system that reflects the incremental scarcity value of water and rewards effective water conservation programs.

The study examined policies for irrigation water pricing, wastewater pricing, wholesale and retail pricing, and conservation pricing. The experiences of other water-constrained communities were also examined. The rate structures evaluated include: uniform rates, seasonal rates, drought year surcharges, increasing block rates, ratchet rates, marginal cost pricing and goal based rates. The study pointed out that changes in pricing policies are likely to gain greater public acceptance if they are phased in over time.

17.7 Issues and Recommendations

17.7.1 Water Pricing Incentives

Issue - Low water costs do not promote conservation

Discussion - Water pricing can be an effective tool in promoting water conservation by providing an incentive to decrease water consumption. Many water pricing structures currently incorporate a constant volume with the basic rate and constant overage charges for use above this rate. If rates are very low, water users will not feel the need to carefully use water because cost seems insignificant.

Some water providers fear that raising rates will decrease water sales and thus decrease revenues for

SECTION 18 CONTENTS

INDUSTRIAL WATER

Although the use of water by industry is small, it serves many uses and carries a high value. Water is used to generate power, as a solvent, for temperature control, for cleaning, to transport waste or other materials and for aesthetics.

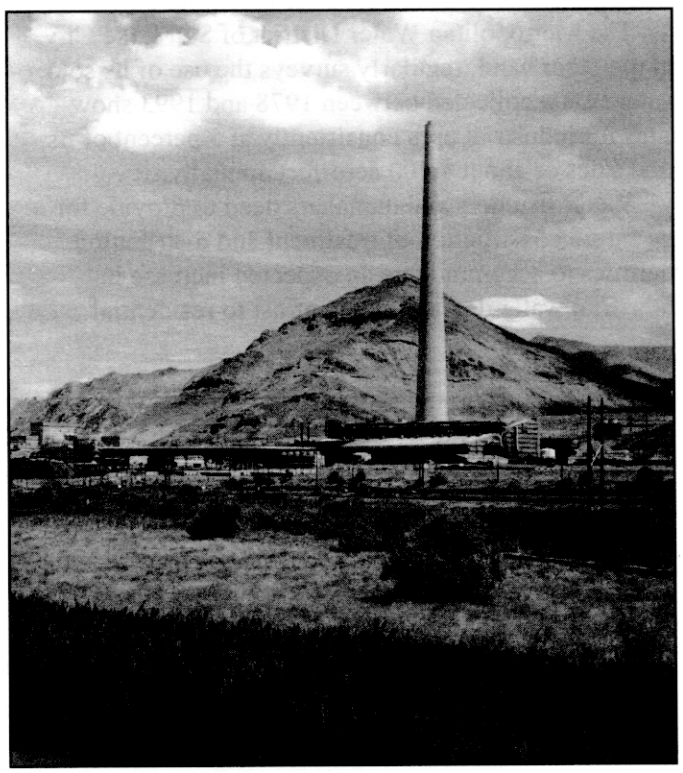
18.1 Introduction

This section discusses the present and future uses of water for industrial purposes in the Jordan River Basin. For this report, industrial water use is defined as water used in mining and manufacturing operations including the production of steel, chemicals, paper or any other product. It includes processing, washing, and cooling operations as well as employee use. Also included, to the extent they can be identified, are such activities as gravel washing and ready-mix concrete.

No single agency or entity regulates the development or use of industrial water, although its use must conform to existing state laws for water rights, pollution control and other regulations. The single biggest obstacle in identifying the county's total industrial water uses is that many industrial water users view their water-use data as classified information.

18.2 Background

One of the major industrial uses of water is for mining operations at the Kennecott Utah Copper Bingham Canyon mine. Because it is part of a patented mining process, the actual amount of water used in Kennecott's mining process is considered confidential information. This is typical of many industrial water uses. When the amount of water used is an intricate part of a patented process, then the water right is treated in a classified manner. Although the State Engineer's Office has a record of the water right, including the quantity of water used, these rights are treated with confidentiality. As a result, it is difficult to develop a detailed inventory of industrial water use.



Kennecott Utah Copper Corp.

18.3 Current and Projected Industrial Water Use

The State Engineer's Office has surveyed and published statewide industrial water-use data for several years. Although the State Engineer's Office will not divulge the quantity of water used by individual industrial water users, the office has reported the collective 1995 total industrial water use in the Jordan River Basin from privately held water rights as 29,700 acre-feet. The 1995 data on privately held industrial water rights are shown in Table 18-1. The majority of the privately developed industrial water, (26,500 acre-feet) comes from wells, with only

3,000 acre-feet coming from surface water, and 200 acre-feet from springs.

In addition to the privately held water rights used for industrial purposes, many industries use water purchased from wholesale suppliers, primarily the Lake County Water Conservancy District and Metropolitan Water District of Salt Lake City. The Lake County Water Conservancy District makes no effort to delineate how much of its sold water goes to industrial uses, as opposed to commercial or residential uses. The best estimate of district officials is that 5 to 10 percent of their total water sales are used for industrial purposes.

The Metropolitan Water District of Salt Lake City, on the other hand, regularly surveys the use of its sold water. Data collected between 1978 and 1993 show sales for industrial uses consistently at 5 percent of its total sales or about 4,400 acre-feet annually.

Water planners and managers need to provide for the future construction of treatment and distribution facilities to accommodate an expected increase in industrial water demand. In contrast to residential and commercial water uses which grow somewhat uniformly with population, future industrial use is difficult to predict. Future industrial uses could decline as industry types change or industries employ water conservation programs. In an effort to predict future water demands, it has been assumed industrial water use will grow with the increasing population. Without an accurate prediction of the new kinds of industries which will occur, it will not be possible to make an accurate prediction of industrial water growth.

Utah Power has two hydroelectric power plants in Big Cottonwood Canyon. The first is located approximately two miles up the canyon. The second is located near the mouth of the canyon. Water for both plants is diverted from a point near Storm Mountain picnic area approximately half-a-mile upstream from the first plant. Murray City has a hydroelectric power plant located near the mouth of Little Cottonwood Canyon, and the plant diverts water from the stream through a 30-inch penstock about one mile upstream (See Table 18-2). ■

Table 18-1
PRESENT INDUSTRIAL WATER USE

	Acre-feet/year
Privately held water rights[a]	3,000
Surface water	200
Springs	26,500
Wells	15,400
Public Water Supply - Culinary Systems[b]	10,000
Imported from Tooele County by Kennecott Utah Copper	55,100
TOTAL	

a. Water use data provided by State Engineer's Office.
b. Wasatch Front Water Demand/Supply Model, February 1997.
Note: This table does not include water used to generate hydropower.

Table 18-2
HYDROELECTRIC POWER PLANTS

Name	River	Capacity (kw)[(a)]	Owner
Stairs Power Plant #1	Big Cottonwood Creek	500	Utah Power
Stairs Power Plant #2	Big Cottonwood Creek	1000	Utah Power
Murray City Power Plant	Little Cottonwood Creek	1000	Murray City

(a) Department of Natural Resources, Energy office 1980, *A survey of small hydroelectric potential at existing sites in Utah.*

SECTION 19 CONTENTS

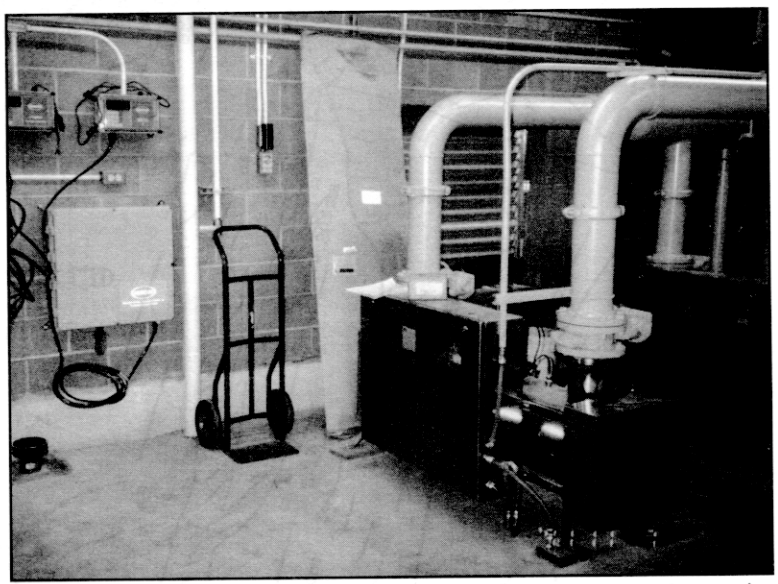
GROUNDWATER

Groundwater is an important source of water for municipal, industrial and agricultural uses in the Jordan River Basin.

19.1 Introduction

This section describes groundwater conditions in the Jordan River Basin. Average groundwater withdrawals (1986-1995) are currently estimated to be 134,500 acre-feet. The current developed groundwater supply is 168,500 acre-feet annually, or 26 percent of the presently developed water supply for municipal, industrial, irrigation, domestic and stock watering purposes. Groundwater in the valley's principal aquifer is generally of excellent quality on the east side of the valley, with the quality becoming poorer on the west side and towards the Great Salt Lake.

The U. S. Geological Survey (USGS), in cooperation with the Division of Water Rights, the Division of Water Quality, and the public water suppliers in the valley, is currently reporting on a study to determine the effects of groundwater withdrawals on water quality and to improve the existing groundwater model. The study was recently completed, but it is not yet published. Until this study is published, groundwater withdrawals will conform to the *Salt Lake Valley Interim Groundwater Management Plan*.



Ultraviolet sterilizers, Salt Lake County Water Conservancy District's Sandy Aquifer Storage Recovery System filtration building.

19.2 Subsurface Geology and Aquifer Characteristics

The Salt Lake Valley groundwater basin consists of a principal aquifer of deep, unconsolidated materials, confined by a relatively thin layer of impervious soils, which in turn is overlaid by a shallow unconfined aquifer. Figure 19-1 shows a cross-sectional view of the Salt Lake Valley groundwater regime. The confining layer of impervious soil is not continuous, more closely resembles a series of interlaced clay lenses, and does not extend to the edges of the valley fill. Thus, near the mountain fronts, the principal aquifer is unconfined.

19.2.1 Recharge

The main sources of Salt Lake Valley groundwater recharge are the Wasatch Range to the east, the Oquirrh Mountains to the west and the Traverse Mountains to the south. Lateral groundwater movement, depicted in Figure 19-2, is from the mountains towards the center of the valley, then northerly to the Great Salt Lake.

Sources of groundwater recharge include: (1) Seepage from mountain bedrock, (2) underflow in channel fill of mountain streams, (3) underflow from Utah Valley through the Jordan Narrows, (4) seepage from creek channels, (5) seepage from major canals, (6) seepage from irrigated fields, (7) seepage from lawns and gardens in urban and suburban areas,

Figure 19-1

CROSS-SECTIONAL SCHEMATIC

Salt Lake Valley Groundwater

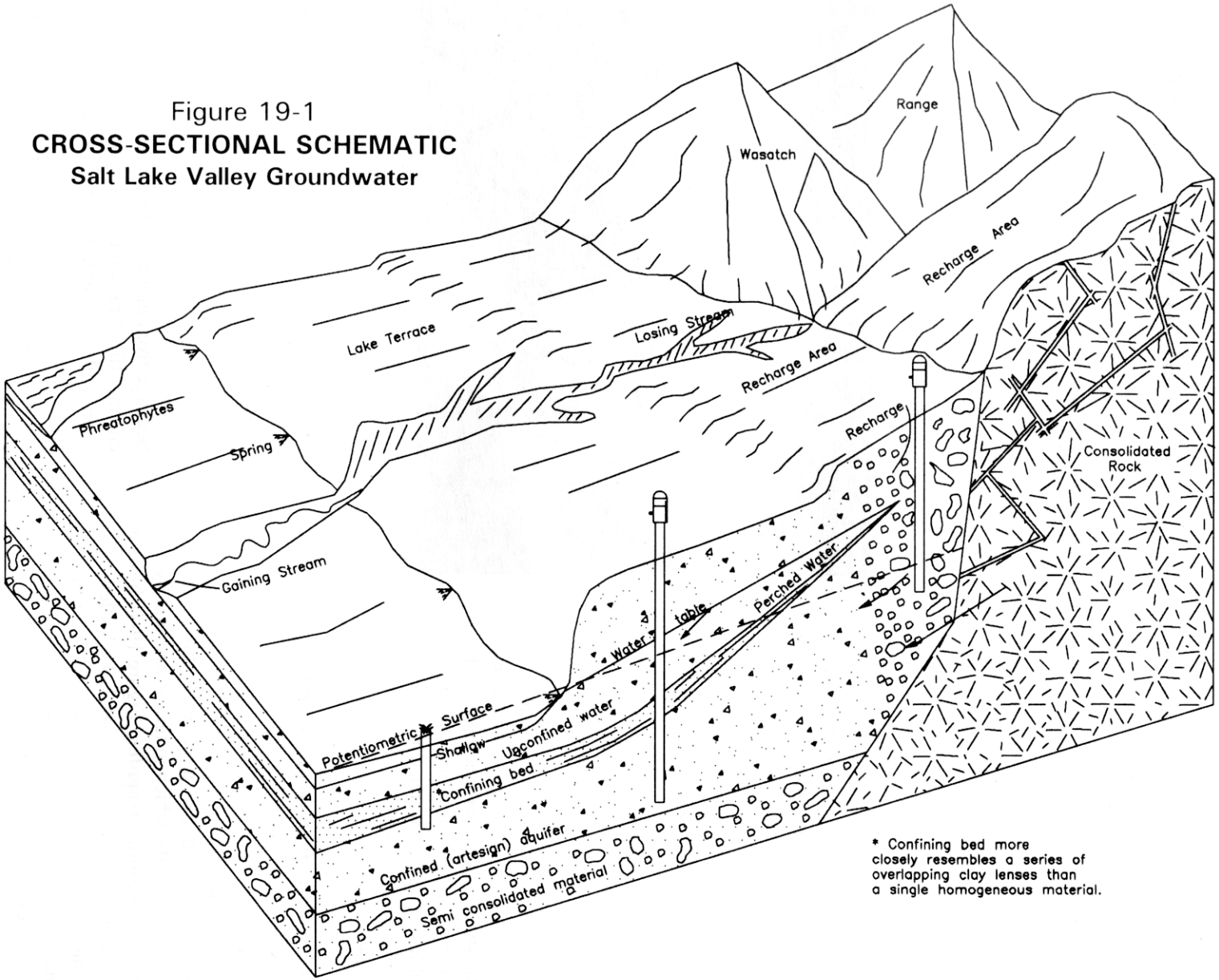


Figure 19-2
SALT LAKE VALLEY GROUNDWATER

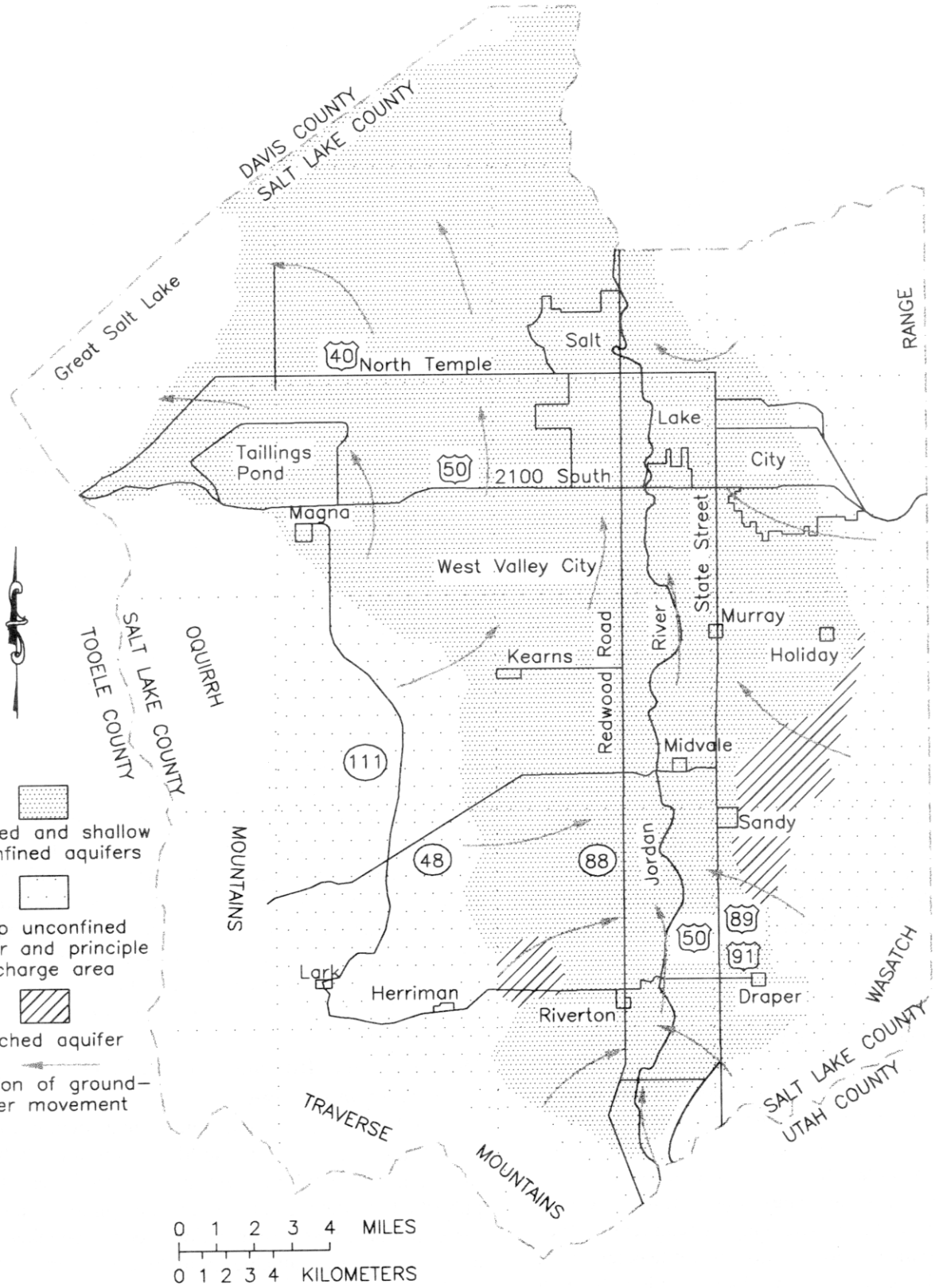


Table 19-1
SUMMARY OF GROUNDWATER RECHARGE
Jordan River Basin

Source	Annual Mean (acre-feet)
Seepage from mountain bedrock	135,000
Underflow in channel fill of mountain streams	1,500
Underflow through the Jordan Narrows	2,500
Seepage from creek channels	20,000
Seepage from major canals	48,000
Seepage from irrigated fields	81,000
Seepage from lawns and gardens	17,000
Seepage from tailings ponds	2,400
Seepage from precipitation onto the valley floor	60,000
Total (rounded)	367,000

Source: Technical Publication 31: *Water Resources of Salt Lake County,* State of Utah, Department of Natural Resources; 1971

(8) seepage from tailings ponds, and (9) seepage from precipitation on the valley floor (See Table 19-1).

19.2.2 Discharge

Although the deep or principal aquifer is the main source of withdrawals in the valley, groundwater is also taken from the shallow unconfined aquifer and locally from unconfined perched water aquifers. All the unconsolidated water-bearing materials in the valley are connected hydraulically to some degree. Although water in each part of the groundwater reservoir has its own important role in the hydrologic regimen, the ultimate source of most of the groundwater withdrawn is the principal aquifer consisting of the confined portion of the principal aquifer and the deep unconfined portions of the principal aquifer along the ancient Lake Bonneville benches. Withdrawals from the principal aquifer are estimated to be 168,500 acre-feet of water annually.

19.2.3 Water Quality

The water quality of the principal aquifer ranges from excellent on the eastern side of the valley to poor on the west. The water quality of the shallow, unconfined aquifer is generally poor. There is an upward gradient from the principal aquifer to the shallow aquifer over a large percentage of the valley. This helps maintain the high quality of the principal aquifer. Evidence indicates, however, that excessive pumping from the principal aquifer can reverse the upward gradient, allowing downward leakage of the poor quality water. This has happened locally in the past. Several portions of the principal aquifer are susceptible to contamination if the hydraulic gradient becomes reversed for a sufficient length of time.

In low-lying parts of the valley, including most of the northern part and along the Jordan River, the potentiometric surface (level at which water will stand in an open well) for the confined aquifer is above the land surface, causing wells to flow. The confined aquifer generally yields water readily to wells. The most productive wells are around the edge of the aquifer near the mountains where it contains thick, coarse-grained deposits. Most of the least productive wells are in the northern and central parts of the valley where the aquifer consists largely of fine-grained deposits. The confined aquifer attains a maximum thickness of more than 1,000 feet in the northern part of the valley. Underlying the confined aquifer are relatively impervious semi-consolidated and consolidated rocks of Tertiary and pre-Tertiary age. The hydraulic connection between different water-bearing beds in the confined aquifer has been demonstrated many times during aquifer tests.

19.3 Salt Lake Interim Groundwater Management Plan

The long-range planning and management of Salt Lake Valley's groundwater aquifer will ultimately be examined once the USGS groundwater study report is published. In the mean time, it is the opinion of the State Engineer that certain actions need to be taken now to ensure the valuable groundwater resources do not become contaminated as a result of excessive

withdrawals. *The Salt Lake Valley Interim Groundwater Management Plan* was created to provide the necessary management guidelines until the USGS groundwater study is completed. The stated objective of the interim plan is to allow full utilization of the resources, within the constraint that water quality is not unreasonably affected.

The *Interim Groundwater Management Plan* divides the valley into "management areas" and sets total groundwater withdrawals from the principal aquifer in each management area, as denoted on Figure 19-3. The plan provides for further limitations on withdrawals if the cumulative effects unreasonably affect the water quality in the principal aquifer. The plan also limits applications to appropriate water from the principal aquifer to single family use (1.0 acre-foot per year) where public water systems are not available. The various management restrictions as dictated by the interim plan are represented in Table 19-2.

19.4 Problems and Alternatives

19.4.1 Volume of Withdrawals

One of the biggest concerns at the present time is the total volume of groundwater withdrawals. It is in the best interest of all water users that groundwater not be mined. Mining groundwater as defined herein means the withdrawal of more water than is naturally replaced over a long period of time, thereby lowering the hydrostatic water surface. Salt Lake Valley has an additional problem. Groundwater mining can potentially result in the contamination of the principal aquifer by inducing inflow of poorer quality water.

Figure 19-4 shows a summary of Salt Lake Valley well withdrawals for all uses for the 1963-1995 period. Present groundwater withdrawals of 134,500 acre-feet (1986-1995 average) are believed to be very close to the average annual yield of the principal aquifer. But there is a large amount of approved, unperfected water rights claims on Salt Lake Valley groundwater. If all are developed, total groundwater withdrawals would exceed 387,500 acre-feet, much higher than the estimated average annual recharge of the principal aquifer.

19.4.2 Groundwater Quality

Groundwater contamination can be a very serious problem with potentially long-term consequences. Throughout Salt Lake Valley, many differing types of toxic materials are stored directly on the ground or underground in containment structures. These types of facilities can and have resulted in undetected or unreported hazardous material spills. Such spills can go undetected for a considerable time while the contamination spreads throughout the aquifer. Not only is the detection of such spills difficult but the clean up can be a very time-consuming and expensive process.

Two such spills addressed in recent years are: (1) Contamination by leachate from the uranium-mill tailings of the Vitro-Chemical Co. at approximately 3300 South and 700 West in Salt Lake City, and (2) contamination of the Bingham Canyon and Bingham Creek area by seepage from reservoirs and evaporation ponds associated with Kennecott's Bingham Canyon mining activities.

The Salt Lake Valley has been divided into five general areas of susceptibility to groundwater contamination based upon geology, the rate of groundwater movement and direction of vertical hydraulic gradients. These areas are shown on Figure 19-5. Areas 1 and 2, which have the greatest susceptibility, are areas where contaminants can infiltrate directly to the principal aquifer without appreciable impediment by fine-grained deposits. Area 1 is the major recharge area for the principal aquifer with rapid groundwater velocity. An undetected spill of contaminant in Area 1 might percolate to the water table at considerable depth below the land surface and spread throughout a large area within the principal aquifer before being detected. Areas 3 and 4 are areas of intermediate to least susceptibility to contamination where the shallow unconfined and principal aquifers are separated by a confining layer, and the downward migration of contaminants is impeded by the fine-grained materials in the confining layer. Also in Area 3, the vertical hydraulic gradient is either downward into the principal aquifer or is zero. In Area 4, the vertical hydraulic gradient is upward; therefore the susceptibility for vertical infiltration of contaminants under the present hydraulic regime is zero. Within each of the four areas, the presence or absence of confining layers may cause the classification shown to be in error; therefore, it is appropriate for use only as a general guideline. Area 5 denotes the areas of transition between areas of least susceptibility to contamination and the areas of intermediate

Figure 19-3

SALT LAKE VALLEY INTERIM GROUNDWATER MANAGEMENT PLAN'S DESIGNATED MANAGEMENT AREAS

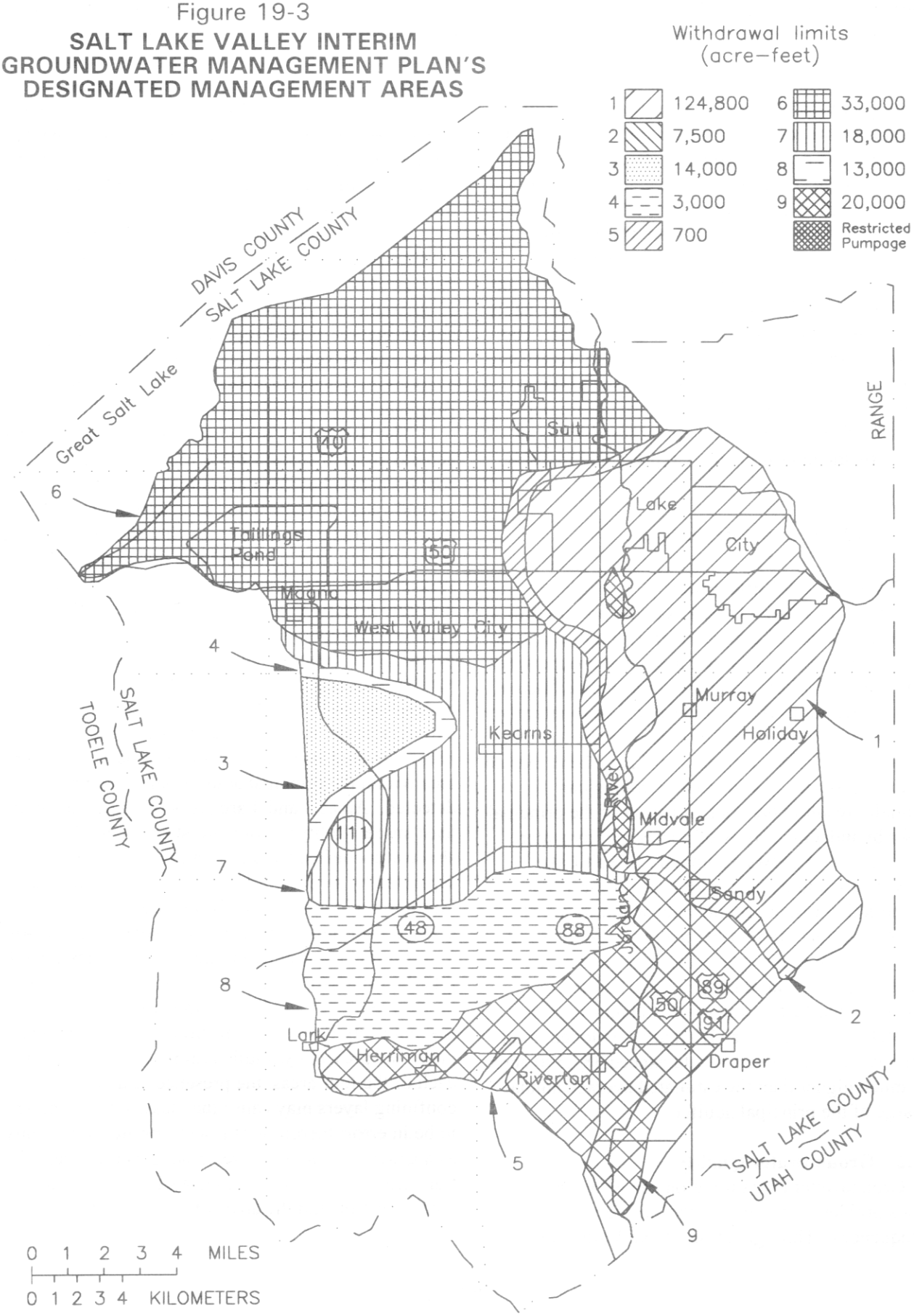


Figure 19 - 4

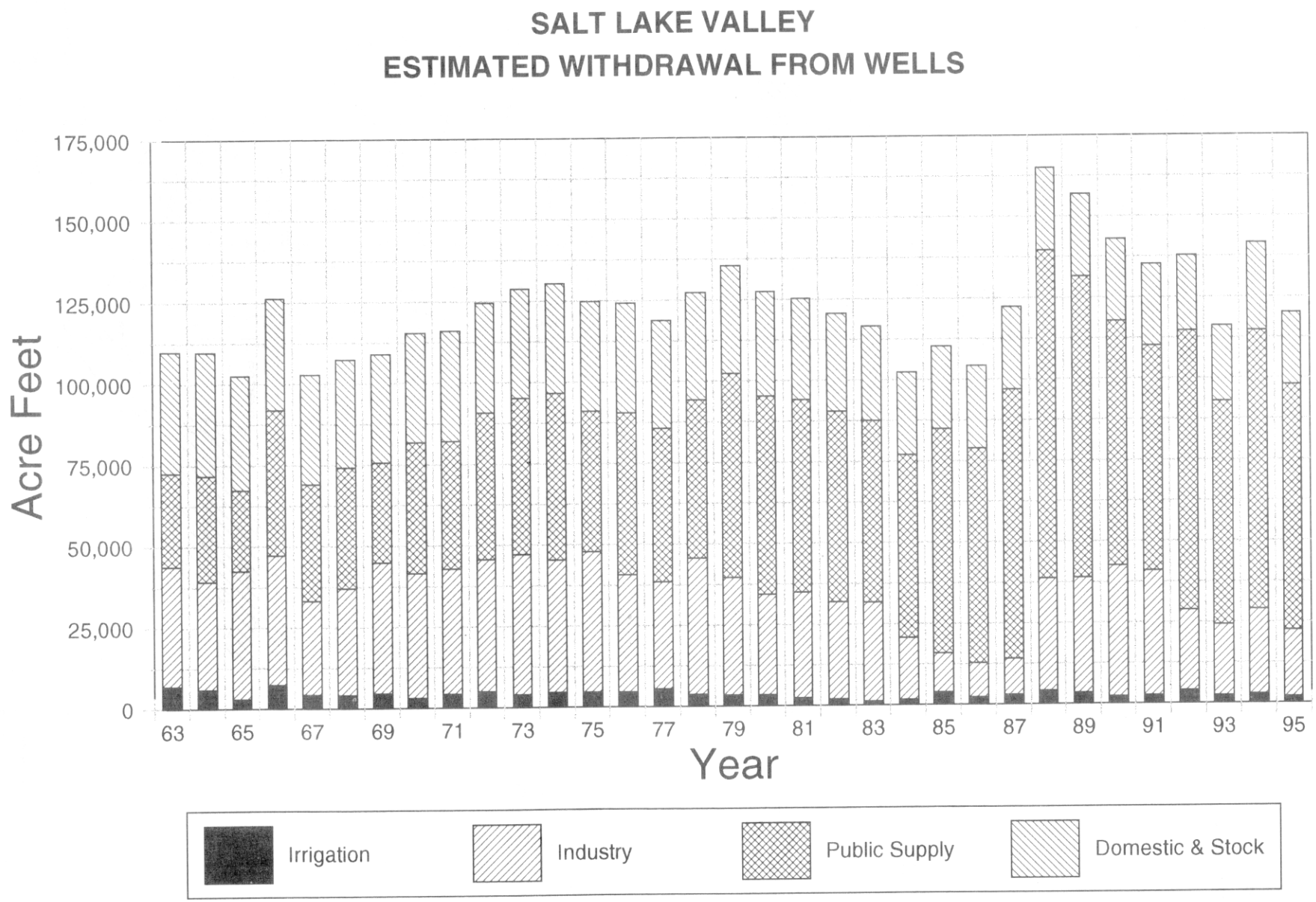

SALT LAKE VALLEY
ESTIMATED WITHDRAWAL FROM WELLS
Acre Feet
175,000
150,000
125,000
100,000
75,000
50,000
25,000
0
63
65
67
69
71
73
75
77
79
81
83
85
87
89
91
93
95
Year
Irrigation
Industry
Public Supply
Domestic & Stock

Figure 19-5

AREAS OF DIFFERING SUSCEPTIBILITY FOR CONTAMINATION OF WATER FOR SALT LAKE VALLEY PRINCIPAL AQUIFER

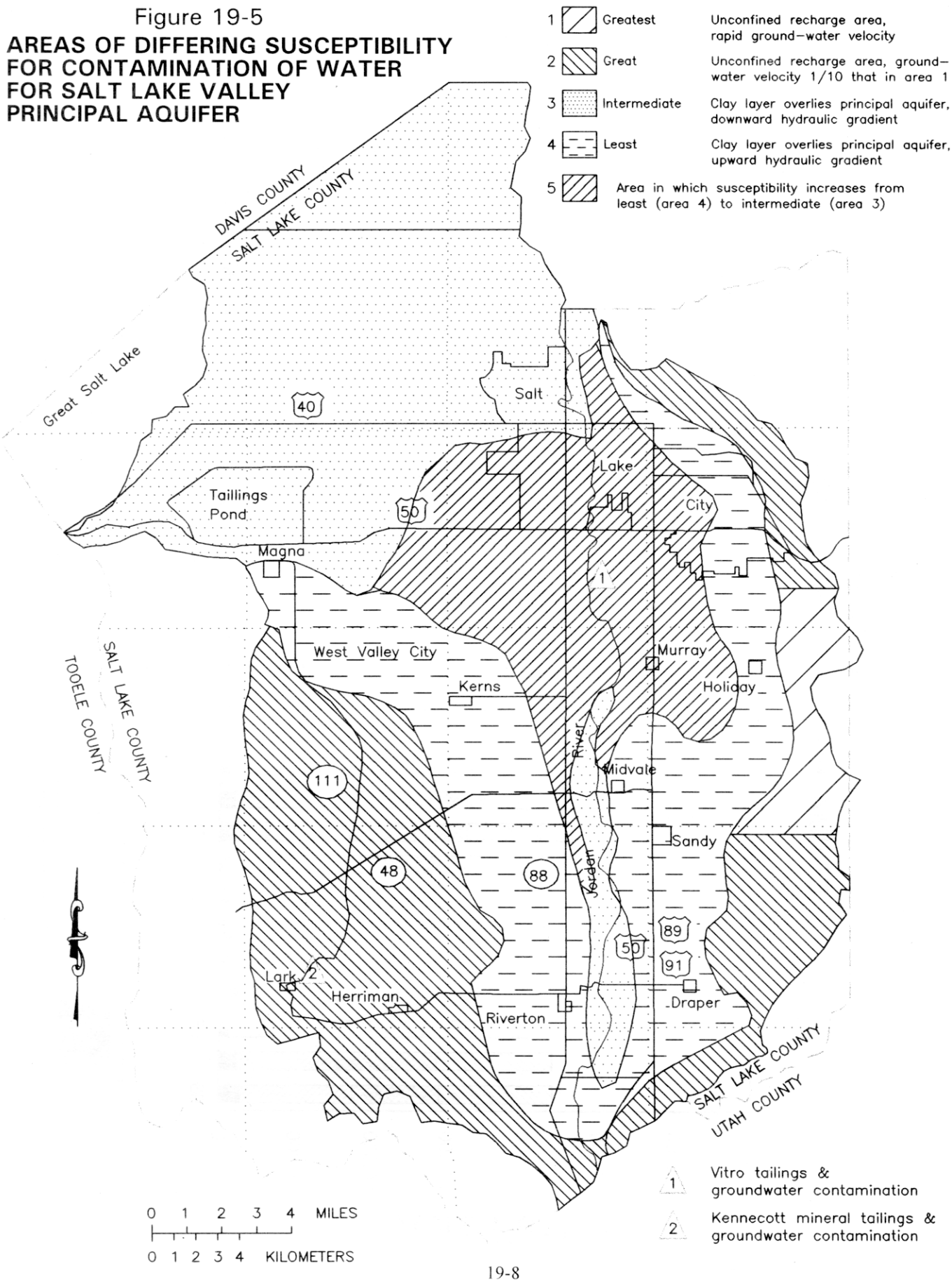


Table 19-2
INTERIM GROUNDWATER MANAGEMENT PLAN SUMMARY
Salt Lake Valley

Item	Limitation
Withdrawal Volume	• Total annual groundwater withdrawals will be limited to predetermined amounts based upon valley location. • Cumulative effects of withdrawals on quality and quantity will be considered. • Isolated wells may be approved regardless of total area or valley-wide withdrawals. • Shallow aquifer withdrawals above the recommended valley-wide limit may be authorized as long as no adverse effects are noted on other water rights.
Applications/ Segregation	• Limited rights (less than 1.0 ac-ft/yr) may be approved for single family use when a public water supply system is not available. These rights are renewable on a 10-year basis as long as no public water supply system is available at the time of extension. • Segregation will be reviewed according to their individual merits.
Time Extensions	• Extensions required due to unjustified delays or lack of diligence may be subject to a reduction in water right quantity, a reduction in the priority date or a denial of the extension of time request.
Change Applications	• Change applications will be considered based upon their individual merits which will now also include water quality. • Change applications proposing to transfer rights from the shallow to principal aquifer will not be approved. • Changes from a management area of poorer quality to a management area of better quality will not be approved.
Proof of Appropriation/ Change	• Only that amount of water that has been developed and placed to beneficial use can be certificated.
Well Spacing/Flow Rate	• Total groundwater declines or impacts on adjacent rights with an earlier priority date shall not exceed 12 feet.
Metering	• All wells capable of withdrawing in excess of 50 acre-feet per year will be equipped with an instantaneous flow and total volume meter. • All wells capable of withdrawing in excess of 250 acre-feet per year shall also submit an annual water quality report for total inorganics. • Water level data are also requested if available.
Reporting	• All wells capable of withdrawing in excess of 50 acre-feet per year shall submit to the State Engineer an annual report stating the total amount of water withdrawn for the year.

susceptibility. Change applications that consider moving water to a better quality zone will not be approved by the State Engineer.

The extent of contaminated groundwater in the Salt Lake Valley ranges from areas of less than 0.1 square mile to areas greater than five square miles. The contaminants include organic and inorganic constituents. Some have infiltrated only to the shallow unconfined aquifer, whereas others have caused deterioration of the water quality in the principal aquifer. Organic chemicals were detected in water from several wells completed in the shallow unconfined aquifer with the greatest concentrations near landfills or tailings areas. The greatest concentrations of trace elements in water in the shallow unconfined aquifer were from wells near landfills or tailings areas. ■

ACRONYMS, ABBREVIATIONS AND DEFINITIONS

A.1 Acronyms and Abbreviations

Many names, titles, programs, organizations, legislative acts, measurements and activities are abbreviated to reduce the volume of words and to simplify communications. A few of the abbreviations and acronyms used in the Jordan River Basin Plan are listed below.

A.1.1 State and Local Agencies and Organizations

CEM	Division of Comprehensive Emergency Management
CUWCD	Central Utah Water Conservancy District
DWQ	Division of Water Quality
MCD	Multi-County Planning District
SDCO	State Disaster Coordinating Office
SHMT	State Hazard Mitigation Team
UWQB	Utah Water Quality Board

A.1.2 Federal Agencies

BLM	Bureau of Land Management
COE	Corps of Engineers
EPA	Environmental Protection Agency
FSA	Farm Service Agency
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FWS	Fish and Wildlife Service
NRCS	Natural Resources Conservation Service
USDA	United States Department of Agriculture
USGS	Geological Survey

A.1.3 Programs/Acts

ACP	Agricultural Conservation Program
CERCLA	Comprehensive Environmental Response and Comprehensive Liability Act
CFR	Code of Federal Regulations
CRP	Conservation Reserve Program
CUP	Central Utah Project
CUPCA	Central Utah Project Completion Act
CWA	Clean Water Act
DWSPR	Drinking Water Source Protection Rule
ESA	Endangered Species Act
ECP	Emergency Conservation Program
NAWQA	National Water Quality Assessment
NFIP	National Flood Insurance Program
NPDES	National Pollution Discharge Elimination System
RPDWS	Rules for Public Drinking Water Systems

SCORP	State Comprehensive Outdoor Recreation Plan
SDWA	Safe Drinking Water Act
UPDES	Utah Pollution Discharge Elimination System
USDWA	Utah Safe Drinking Water Act
UWPCA	Utah Water Pollution Control Act
UWQA	Utah Water Quality Act

A.1.4 Measurements

Ac-Ft	Acre-feet
CFS(cfs)	Cubic Feet Per Second
GPCD	Gallons Per Capita Day
gpm	Gallons per minute
MCL	Maximum Contaminant Level
mgd	Million Gallons Per Day
mg/l	Milligrams Per Liter
mw	Megawatt
PMP	Probable Maximum Precipitation
SMCL	Secondary Maximum Contaminant Level
TDS	Total Dissolved Solids

A.1.5 Miscellaneous

EAP	Emergency Action Plan
EOP	Emergency Operations Plan
FIRE	Finance, Insurance and Real Estate
I&D	Irrigation and Drainage
M&I	Municipal and Industrial
OHV	Off-Highway Vehicle
RC&D	Resource Conservation and Development
RMP	Resource Management Plan
SFN	Spanish Fork/Nephi
TCPU	Transportation, Communications and Public Utilities
WCWEP	Wasatch County Water Efficiency Program
WFCM	Wasatch Front Water Demand/Supply Computer Model
WWTP	Wastewater Treatment Plant

A.2 Water Resource Definitions

Many terms used in the water business have different meanings depending on the source, and are sometimes confusing. Some words are used interchangeably. A few commonly used water terms are defined for use in this document.

A.2.1 Water Use Terms

Water is often said to be "used" when it is diverted, withdrawn, depleted, or consumed. But it is also "used" in place for such things as fish and wildlife habitat, recreation and hydropower production.

Commercial Use - Uses normally associated with small business operations which may include drinking water, food preparation, personal sanitation, facility cleaning and maintenance, and irrigation of landscapes.

Consumptive Use - Consumption of water for residential, commercial, institutional industrial, agricultural, power generation and recreational purposes. Naturally occurring vegetation and wildlife also consumptively use water. Water consumed is not available for other uses within the system.

Cropland Irrigation Use - Water used for irrigation of cropland. Residential lawn and garden uses are not included.

Depletion - Water lost or made unavailable for return to a given designated area, river system or basin. It is intended to represent the net loss to a system. The terms consumption and depletion are often used interchangeably but are not the same. For example, water exported from a basin is a loss or depletion to that system as it is not consumed within the basin.

Water diverted to irrigated crops in a given system, but not returned for later use, is depletion. Precipitation that falls on irrigated crops is not considered a part of the supply like surface water and groundwater diversions. For this reason, precipitation falling on and consumed by irrigated crops is not considered as being a depletion to the system.

Diversion/Withdrawal - Water diverted or withdrawn from supply sources such as streams, lakes, reservoirs, springs or wells for a variety of uses including cropland irrigation and residential, commercial, institutional, and industrial purposes. The terms diversion and withdrawal are often used interchangeably.

Industrial Use - Use associated with the manufacturing or assembly of products which may include the same basic uses as commercial business. However, the volume of water used by industrial businesses can be considerably greater than water use by commercial businesses.

Institutional Use - Uses normally associated with general operation of various public agencies and institutions including drinking water; personal sanitation; facility cleaning and maintenance; and irrigation of parks, cemeteries, play grounds, recreational areas and other facilities.

Municipal Use - This term is commonly used to include residential, commercial and institutional. It is sometimes used interchangeably with the term "public water use."

Municipal and Industrial (M&I) Use - This term is used to include municipal and industrial use.

Private-Domestic Use - Includes water from private wells or springs for use in individual homes, usually in rural areas not accessible to public water supply systems.

Residential Use - Water used for residential cooking; drinking; washing clothes; miscellaneous cleaning; personal grooming and sanitation; irrigation of lawns, gardens, and landscapes; and washing automobiles, driveways, and other outside facilities.

A.2.2 Water Supply Terms

Water is supplied by a variety of systems for many uses. Most water supply systems are owned by an irrigation company or a municipality, but in some cases the owner/operator is a private company, or is a state or federal agency. Thus, a "public" water supply may be either publicly or privately owned. Also, systems may supply treated or untreated water.

Culinary Water Supply - Water meeting all applicable safe drinking water requirements for residential, commercial and institutional uses. This is also known as potable water.

Municipal Water Supply - A supply that provides culinary grade water for residential, commercial, institutional and industrial uses. Municipal, community and city are often used interchangeably.

Public Water Supply - Includes culinary water supplied by either privately or publicly owned community systems which serve at least 15 service connections or 25 individuals at least 60 days per year. Water from public supplies may be used for residential, commercial, institutional, and industrial purposes, including irrigation of publicly and privately owned open areas.

Secondary Water Supply - Pressurized or open ditch water supplies of untreated water for irrigation of privately or publicly owned lawns, gardens, parks, cemeteries, golf courses and other open areas. These are sometimes called "dual" water systems. They provide water in addition to the culinary supply.

A.2.3 Groundwater Terms

Aquifer - A saturated body of rock or soil which will yield water to wells or springs

Groundwater - Water which is contained in the saturated portions of soil or rock beneath the land surface. Excludes "soil moisture" referring to water held by capillary action in upper unsaturated zones of soil or rock.

Mining - Long-term groundwater overdraft in excess of recharge.

Phreatophyte - A plant species which extends its roots to the saturated zone under shallow water table conditions and transpires groundwater. These plants are high water users and include such species as tamarisk, greasewood, willows and cattails.

Recharge - Water added to the groundwater reservoir or the process of adding water to the groundwater reservoir. Commonly occurs by infiltration of surface water into subsurface storage from precipitation, streamflow or irrigation.

Recoverable Reserves - The amount of water which could be reasonably recovered from the groundwater reservoir with existing technology.

Safe Yield - In general, it indicates the amount of water which can be withdrawn from an aquifer on a long-term basis without serious quality, environmental or social consequences, or seriously depleting the reservoir.

Total Water in Storage - A volume of water derived by estimating the total volume of saturated aquifer and multiplying by the porosity (intergranular space containing water).

A.2.4 Other Water Terms

Some water terms are peculiar to the water industry. These are briefly defined in order to better understand the information presented.

Call - The ability to order a quantity or flow of water at a given time and for a given period of time.

Carriage Water - Water needed for hydraulic operation of a delivery system.

Drinking Water - Water used or available for use as a culinary supply. The quality is typically the highest available in the locality.

Export Water - A man-made diversion of water from a river system or basin other than by the natural outflow of streams, rivers and groundwater. This is sometimes called a transbasin diversion.

Instream Flow - Water flow maintained in a stream for the preservation and propagation of habitat and for aesthetic values.

Non-Point Source Pollution - Pollution discharged over a wide land area, not from one specific location. These are forms of diffuse pollution caused by sediment, nutrients etc. carried to lakes and streams by surface runoff.

Open Water Areas - Includes lakes, ponds, reservoirs, streams and other areas completely or partially inundated.

Point Source Pollution - Pollutants discharged from any identifiable point, including pipes, ditches, channels and containers.

Potable - Water suitable for drinking or cooking purposes from both health and aesthetic considerations. The terms culinary and potable are often used interchangeably.

Reuse - The reclamation of water diverted from a wastewater conveyance system. The reuse can be either direct or indirect and may or may not be treated to bring it to acceptable standards. This water is recovered from municipal and industrial discharges. Irrigation runoff and hydroelectric power generation return flows are not included.

Riparian Areas - Land areas adjacent to rivers, streams, springs, bogs, lakes and ponds. They are ecosystems composed of plant and animal species highly dependent on water.

Watershed - The total area of land above a given point on a waterway that contributes runoff water to the flow at that point; a drainage basin or a major subdivision of a drainage basin.

Wetlands - Areas where vegetation is associated with open water and wet and/or high water table conditions.

Water Yield - Runoff from precipitation that reaches water courses and therefore may be available for use.

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State Water Plan - Jordan River Basin

Prepared by the State Water Plan Coordinating Committee

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