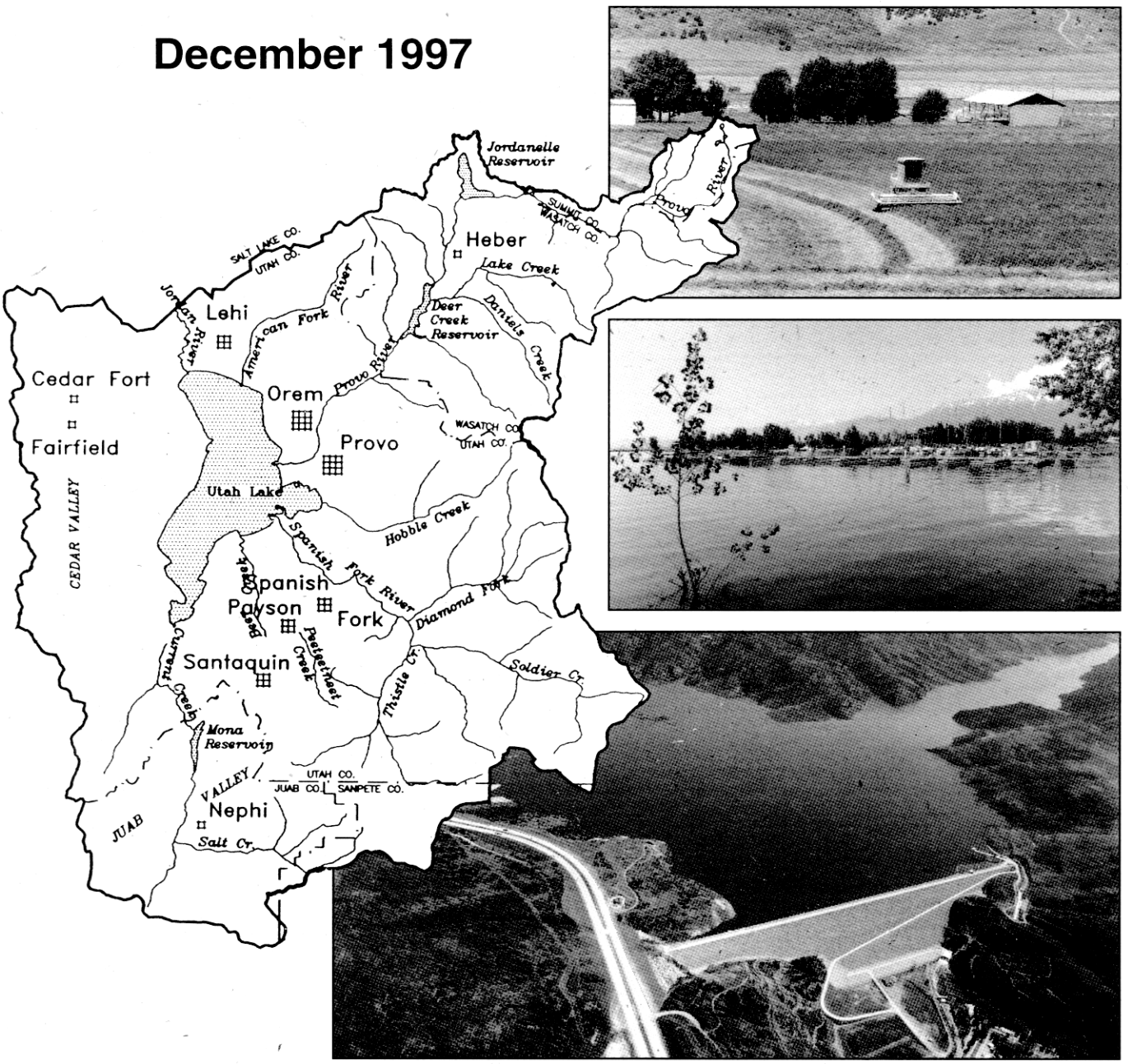
Utah
State Water Plan
Utah Lake Basin

December 1997



Utah Division of Water Resources
Utah Department of Natural Resources

State Water Plan - Utah Lake Basin

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State Water Plan
Utah Lake Basin

Utah Board of Water Resources
1594 West North Temple, Suite 310
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December 1997

Foreword

The *State Water Plan* distributed in early 1990 established the foundation for state water policy. As part of the state water planning process, more detailed plans are prepared for each of the 11 hydrologic basins in the state. The *Utah Lake Basin Plan* is one of these. Originally it was called the *Upper Jordan River Basin Plan*. To clarify the descriptions of location and geography, the Jordan River Basin, which includes the Utah Lake drainage and the Jordan River, has been divided into two planning units. The other one is known as the *Jordan River Basin Plan*, which covers all of Salt Lake County.

This plan covers all aspects of the basin's water resources. It identifies alternative ways to solve problems and meet demands. Final decisions on selecting alternatives for implementation will rest with local decision makers.

The *Utah Lake 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 Resources mission to "conserve, protect and develop Utah's natural resources."

Planning requires the active participation of people who have a stake in how the plan is carried out. The voices of local and regional publics have been heard in all stages of this plan's development.

Acknowledgement

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

We also appreciate ideas, information and opinions from representatives of state and federal cooperating agencies, and from local and basin planning advisory groups. These individuals brought expertise from a broad spectrum of Utah's population.

In addition, we extend sincere thanks to those who attended meetings and provided oral and written comments on the plan. In endorsing this plan, as with previous basin plans, we reserve the right to consider water projects on their own merits. This plan is an important guide for water conservation and development in the Utah Lake Basin.

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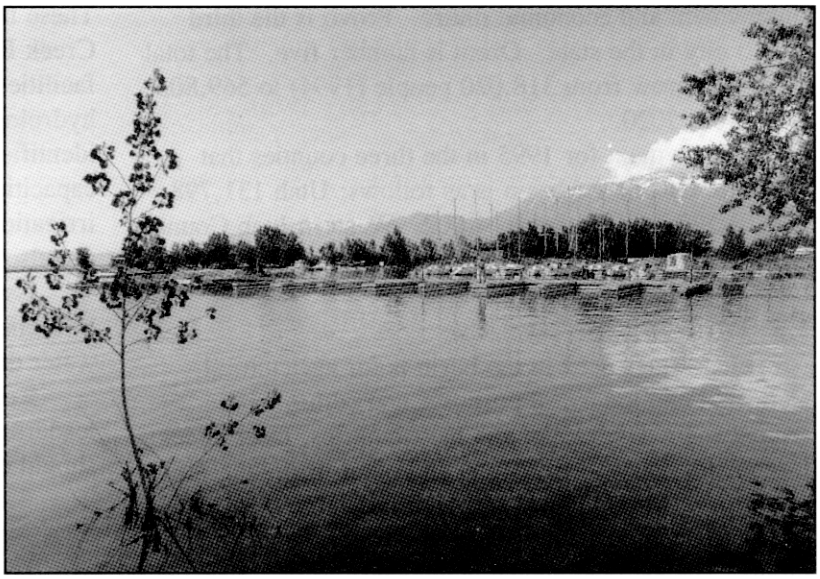
Executive Summary

The State Water Plan, published in 1990, contains 19 original sections plus two additional sections: "River Basin Summaries" and "Annual Status Report." The reader of this basin plan should refer to that document if more detail is needed on any of the subjects presented here. Headings used in the Executive Summary coincide with those used in the body of this plan and to those used in the *State Water Plan*. A glossary of acronyms, abbreviations, and definitions and a bibliography are also provided.



Utah Lake State Park

2.1 Foreword

The *State Water Plan (1990)* provides the foundation and general direction for managing waters of the state. More detailed plans are being prepared for the 11 hydrologic basins. Plans for the Bear River, Kanab Creek/Virgin River, Cedar/Beaver, Weber River, and Jordan River basins were completed between 1992 and 1997. This plan is number six.

The *Utah Lake Basin Plan* identifies the principles that guide the water planning process. In addition, it forecasts water demands through population projections then describes problems related to providing adequate water supplies, reducing shortages, improving instream flow for fish and wildlife, increasing recreation opportunities, and maintaining or improving water quality. Local, state and federal agencies have reviewed several drafts of the basin plan, as have local political and private sector leaders. Important issues are identified in this review process and solutions are recommended.

2.3 Introduction

Section 3 contains guidelines, i.e., principles and purposes, needed to insure continuity in the basin plans. It explains the organizational structure and process for reviews and for making comments at various stages. This section also describes the settlement, climate, physical characteristics and land ownership in the basin. Settled in 1849 by a few Mormon pioneers from the Salt Lake Valley, Utah County is now among the most urbanized places in Utah.

The basin sets at the base of historic Lake Bonneville in the Great Basin. It is bounded on the east by the Uinta Mountains and the Wasatch Plateau, on the west by the Oquirrh Mountains and East Tintic Mountains, and on the north by the Traverse Mountains, Wasatch Range and Uinta Mountains. The south side is bounded by the Wasatch Plateau and the Wasatch Mountains. This basin covers 1,945,100 acres of which 43 percent is owned by the federal government, 12 percent by state government. Forty-five percent is privately owned. The U.S. Forest Service is the major land management agency with 631,470 acres under its jurisdiction. Total land area managed by agencies of the federal government is 844,800 acres.

Annual precipitation ranges from 11.5 inches at Utah Lake to 25.9 inches at Timpanogos Cave and goes to 60 inches on the mountain peaks. The monthly maximum mean temperature reaches 92.7 degrees in July and a minimum mean 3.1 degrees in January.

Elevations vary between 4,475 and 11,928 feet above sea level.

Water development in this basin dates from the mid-1800s. A short history of local communities' land and water development is presented in Section 3.

2.4 Demographics and Economic Future

This section discusses the basin's population, employment and economic future. Provo is the third largest city in the state. Orem is number five. The total basin will grow from 318,020 people (1994) to 569,803 in the year 2020.

Employment for 1995 in the three counties that make up most of the basin is as follows: Utah 131,798; Juab, 2,592; and Wasatch, 4,002. Western Juab County and part of eastern Wasatch County are not in the basin.

2.5 Water Supply and Use

Most water used in the basin is for agricultural, municipal and industrial purposes and comes from groundwater, Utah Lake and its tributaries, Deer Creek, Jordanelle, Strawberry, Mona and other upstream reservoirs. Mine tunnels and high mountain lakes ornament and supplement the water supply. The average annual developed supply is 790,300 acre-feet of which 62 percent is surface water.

Jordanelle, Deer Creek and Mona reservoirs are the principal man-made features that provide regulation of the hydrologic system. The Strawberry Project, Provo River Project, and the Bonneville Unit of the Central Utah Project have greatly improved the availability of surface water for human and ecological uses. Groundwater, a growing portion of the total supply, is discussed in Section 19. Agricultural irrigation uses most of the developed water supply with 453,700 acre-feet diverted annually. Municipal and industrial users divert 141,345 acre-feet in the average year. Lawn and garden irrigation, wetlands and riparian, and instream flow uses are all discussed in Section 5. Exports from the basin and imports to the basin are also covered.

2.6 Management

Water is generally well-managed to serve the various uses. Central Utah Water Conservancy District (CUWCD), Strawberry Water Users, Provo River Water Users Association, and the Provo Reservoir Water Users Company are the primary water managers. Jordanelle Reservoir, the main municipal and industrial feature of the Bonneville Unit of the Central Utah Project, was recently completed. The Wasatch County Water Efficiency Project is nearing start of construction. Planning for the Spanish Fork Canyon-Nephi Irrigation System of the Central Utah Project is moving forward. These new projects, along with Mona Reservoir, Deer Creek Reservoir and Utah Lake, round out the major facilities providing management control of the hydrologic system. In all, 65 lakes and reservoirs are identified in Section 6 along with owners, storage capacities and uses. Names of the 52 providers of irrigation water, acres they serve and the water sources are also shown. One policy issue is discussed.

Issue - A forum does not exist for creating awareness and coordinating the planning for future water development.

Recommendation - State, district and local leaders, along with representatives of the private sector, should explore Integrated Resource Planning and evaluate its applicability to water management problems. The Central Utah Water Conservancy District should take the leading role.

Jordanelle Reservoir

2.7 Regulation/Institutional Considerations

Responsibility for water regulation rests primarily

with the Utah Division of Water Rights, and the state Department of Environmental Quality, Division of Water Quality. The State Engineer has completed a report entitled *Interim Water Distribution Plan for the Utah Lake Drainage Basin* that establishes a general framework within which that office can administer water rights in the Utah Lake Basin.

Water quality is a major concern in the highly urbanized part of the basin. Consequently, vigilance and expanded quality monitoring programs are necessary.

Dam safety has become a concern. All dams storing more than 20 acre-feet of water, and where failure may cause loss of life or significant property damage, are rated and inspected by the State Engineer. Twenty-one high hazard dams are listed in Section 7.

Agencies and organizations which fund and manage water systems are described and basin water problems and needs are explored. Water rights regulation, water quality control laws and drinking water regulations are presented along with environmental considerations.

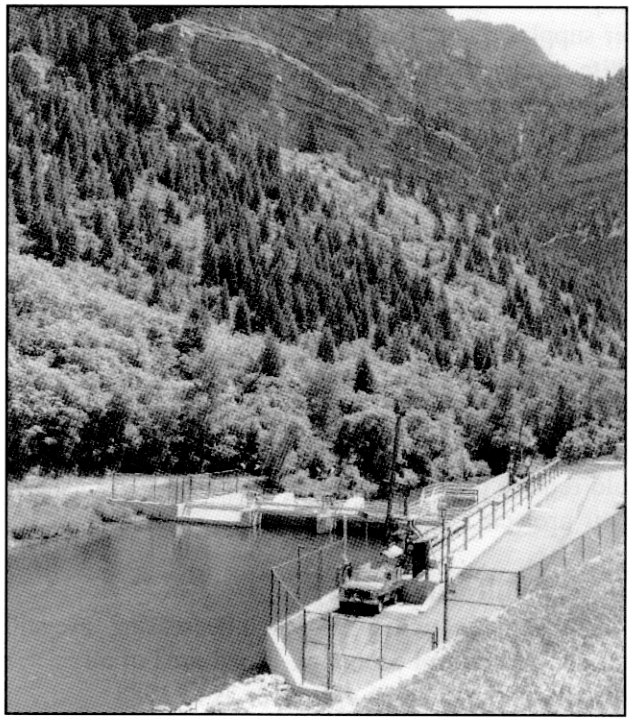
2.8 Water Funding Programs

Funding programs are available to provide both loans and grants for many types of water-related projects. Federal, state and private funding programs are described. When the Central Utah Project is completed, over $2 billion will have been spent on water projects by the Bureau of Reclamation. Agencies of state government have provided almost $113,500,000 to water system development and improvements.

2.9 Water Planning and Development

A list of the 121 water projects receiving financial assistance from the Board and Division of Water Resources is provided in Section 9. Past planning and development by irrigation, municipal and industrial water providers, including watershed planning, are presented. Several cities in the basin will receive additional water once the Bonneville Unit of the Central Utah Project is completed. Projects and programs authorized by the 1992 Central Utah Project Completion Act (CUPCA) are discussed. Matching requirements of federal CUPCA funds may dictate that a significant amount of state and local funds could be spent over the next several years.

Due to rapid urban expansion, land and water are being transferred from agriculture to urban uses. Court cases, local government decisions and state agencies' protocol have an influence on how efficiently the transition from agriculture to urban uses occurs. Development around the new Jordanelle Reservoir poses special problems for supplying water and sewer services in Wasatch County.



Olmsted diversion on the Provo River

Water use and projected demands are shown for irrigation, culinary, secondary (lawn and garden) irrigation, and wet and open areas. Alternative measures for making surface storage facilities operate more efficiently are discussed along with groundwater recharge and cloud seeding.

Environmental water needs are now a prominent element of water planning and development. The Endangered Species Act, and the presence of several endangered fishes in basin water sources, present specific problems for water suppliers. The Recovery Implementation Program is covered in detail in Section 9. Four issues of concern to the water supply community are discussed and policy recommendations provided.

Issue - Prices for water rights and shares of irrigation company stock have increased dramatically due to requirements imposed on new development and restrictions on moving water between prior use and where it is needed.

Recommendation - Local government officials should assess the long-term effects of requiring developers to donate water for new development. New water demand should be served with water acquired

from the CUP, through conservation and by interlocal agreements with nearby systems.

Issue - Utah Lake is perceived by many to have great potential for economical development of municipal water supply, recreation, transportation, fish and wildlife management, real estate and other uses.

Recommendation - Utah County should take the lead in establishing an interagency entity to oversee the preparation of a management plan for Utah Lake.

Issue - Many communities are not adequately planning for future growth.

Recommendation - All communities and/or water utilities should prepare a long-term water management plan which includes new water supply sources and water conservation programs. The plans should be reviewed and updated periodically. To encourage management and conservation planning, water funding agencies should require plans as a condition of state participation in their projects.

2.10 Agricultural Water

Agriculture activities, although decreasing, are still important to the local economy. Total area of all irrigated crop land is 166,400 acres as of 1988. Farmers produce fruit crops on nearly 10,000 acres. They produce vegetable crops, other than corn and potatoes, on 350 acres. Alfalfa is the largest crop with 37,340 acres. Dry land crops are also grown, particularly in the Juab County part of the basin.

Over 200,000 acres of arable land are not irrigated. A portion of it may be irrigated under the Bonneville Unit of the CUP. Water shortages affect agricultural production in other parts of the basin.

Farmers and ranchers have a large stake in how water rights are administered in the state. Lack of incentives for conserving water, inconsistency between how irrigators and municipalities are treated under current water law, and well metering are concerns discussed in this section.

Decisions concerning developments around Utah Lake will affect agriculture. Since the United States granted Utah ownership of the lake bed, work has been underway to decide ownership boundaries.

Issue - The ownership boundary between sovereign lands of Utah Lake and private upland is not certain.

Recommendation - The Department of Natural Resources has made the boundary negotiation a high priority. The Division of Forestry, Fire and State Lands should continue to expedite negotiations around the lake.

2.11 Drinking Water

Section 11 covers current problems and future needs of public and private water systems. Of the 140 public drinking water systems in the basin, 128 are approved by the Utah Division of Drinking Water, 10 are not approved, and two need corrective action. Towns, cities and counties all have a primary responsibility for drinking water quality control in their jurisdictions.

Verification that a public water system is meeting state and federal quality standards is made through monitoring programs established by regulations. Rules for Public Drinking Water Systems (RPDWS) outline procedures for local treatment plant operators to follow and the state's responsibilities in water quality testing. The Utah Safe Drinking Water Act and the Federal Safe Drinking Water Act, with all its amendments, are discussed as are drinking water problems associated with facility operations and groundwater contamination. Forty-seven public water systems are tabulated showing the population served, treatment type, total water use and per capita water use. Current and projected culinary water diversions for major public systems are also presented. Maintaining water quality requires the cooperation of a wide range of private and public interests. The responsibility for leadership falls mostly on local government agencies, subject to state and federal regulations.

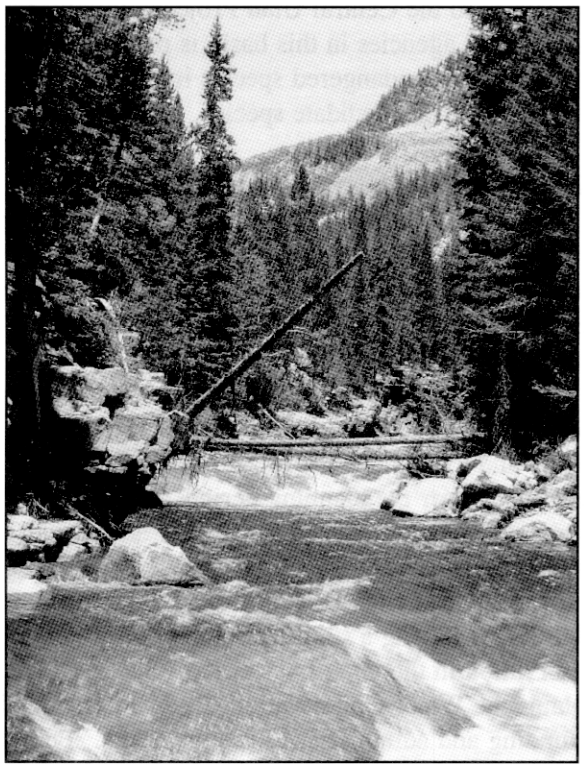
Per capita water use ranges from 110 gallons per day to 448. Heavier per capita use rates usually indicate the absence of a secondary irrigation system for lawn and garden watering or the presence of water intensive industries.

2.12 Water Quality

Five streams in the Provo River Drainage are class 1 for water quality. These streams are protected for domestic, secondary contact recreation such as boating and wading, cold water fisheries, and agricultural uses. All other streams in the drainage are class 2B. Ponds, lakes, and reservoirs in the basin have ratings of 1C at Deer Creek and Jordanelle Reservoirs (protected for domestic uses and primary contact recreation) to 2B at Utah Lake (not protected for domestic uses and primary contact recreation).

The Utah Division of Water Quality, under the Utah Water Quality Act, is responsible to adopt, enforce

and administer state and federal regulations. Limits on loading rates of various pollutants are established by state agencies using EPA guidelines.



Upper Provo River

Wastewater treatment facilities are adequate for present demand. Total design capacity is 59.63 mgd. Current average flow through these facilities is 38+ mgd. One plant at Nephi uses total containment. The Heber Valley facility disposes of waste by land application while the rest discharge effluent into streams or other water bodies. Eighteen point sources of pollution to surface water are identified as are types and sources of impairments. Four alternative measures for reducing phosphorous pollution to Utah Lake are listed. The price tag is $228 million to make significant improvement.

Issue - Runoff from urbanizing areas contributes increasing amounts of pollutants to irrigation canals.

Recommendation - Those entities responsible for storm runoff should create urban storm drain utilities or districts with authority to deal successfully with urban runoff problems.

2.13 Disaster and Emergency Response

Governments, communities and families all have a part to play in responding to emergencies. Being prepared may prevent an emergency from becoming a disaster. Local agencies are responsible for initial responses to emergencies. The National Flood Insurance Program (NFIP) makes flood insurance available to municipalities as a protection against monetary loses when flooding occurs. The Utah Division of Comprehensive Emergency Management encourages and coordinates emergency response and management planning.

Section 13 addresses flood plain zoning, watershed protection and flood control structures. Responses to drought, earthquakes and landslides are suggested. Federal, state and local organization responsibilities for responding to emergency events are given. Damages from the 1983-84 flooding are also shown.

Issue - Not all local governments have plans for managing flood plains to prevent flood damages, and some plans need to be updated.

Recommendation - Communities participating in the National Flood Insurance Program should review their local flood damage prevention ordinance to ensure they are meeting the minimum requirements for participation in the program.

Issue - Not all communities have hazard mitigation plans.

Recommendation - Local governments should prepare hazard mitigation plans with assistance from the Division of Comprehensive Emergency Management.

Issue - Not all communities have a disaster response plan.

Recommendation - 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 fish and other water-related wildlife currently found in the Utah Lake Basin. Several Class I fisheries for cold water and warm water sport fishes are available. Wildlife habitat is also abundant in the basin, but continued economic growth is in direct conflict with the needs of some species. The Utah Division of Wildlife Resources has the primary responsibility for managing the state's wildlife resources. Responsibilities of the Central Utah Water Conservancy District to augment water supplies and support fish and wildlife interests are briefly explained. The federal Fish and Wildlife Service and Bureau of Reclamation roles are also discussed. Minimum instream flows, watershed protection, stream bank

erosion and wetlands protection are the greatest needs for wildlife.

Issue - Conversion of land and water from agriculture to municipal and industrial uses impacts fish and wildlife.

Recommendation - The Division of Wildlife Resources should work closely with county and other local officials to provide programs to protect stream flows and sensitive wildlife areas from urbanization.

2.15 Water-Related Recreation

Section 15 takes the reader on a tour of the Utah Lake Basin to introduce the wealth of opportunities presented by state, federal and private recreation providers. Wasatch Mountain State Park is the most popular state park in the basin. Jordanelle State Park was booked solid for weekends when it opened in July of 1995. Nearly two million visits were recorded in five state parks in the basin in 1995. The Utah Division of Parks and Recreation is responsible for making Utah's natural resource heritage and recreation opportunities available to resident and non-resident users. Major state parks cover nearly 29,000 acres of land, 102,000 acres of water, provide 579 camping units and supported 1,899,885 visitations in 1995.

Issue - Increased recreation demand on existing facilities underscores the need for additional funding.

Recommendation - Funding recommendations provided in "Frontiers 2000" should be pursued.

Issue - Many conflicts are exacerbated by unethical behavior in recreation settings.

Recommendation - The Division of Parks and Recreation, in cooperation with other recreation agencies, should organize focus groups with recreationists and managers from throughout the state to obtain ideas and support from all members of the recreation community. People who create the conflicts should be represented and encouraged to participate.

Issue - Comprehensive planning for allocation of resources in this basin is vital.

Recommendation - The Division of Parks and Recreation should continue to implement findings of the *Deer Creek Resource Management Plan* to balance and sustain resources used for recreation.

2.16 Federal Water Planning and Development

The role of the federal government is changing from construction and development to preservation, conservation and maintenance. Federal funding is decreasing while regulatory programs are increasing.

A major reorganization has occurred in the U.S. Department of Agriculture. These changes, and the duties of new agencies are presented in Section 16. The new role of the Bureau of Reclamation is also discussed as it relates to the Central Utah Project. Involvement of other federal agencies in this basin is presented also. Threatened and endangered species in the basin are listed, along with candidate species.

2.17 Water Conservation/Education

For two generations, water has run from our taps as if by magic. Shortages in some systems, environmental problems, social values and competing uses now require us to find ways to stretch current supplies.

The Wasatch Front Demand/Supply computer model was used to project future water use in Utah County and to estimate the effect of conservation measures. Over the planning period 1995 to 2020, water usage can be reduced by 12 percent through conservation.

The Central Utah Project Completion Act (CUPCA) is having a significant effect on water conservation in the Utah Lake Basin. Section 17 explains the Water Conservation Credit Program with its funding and administrative requirements. Public education and its role in preparing Utahans for future water shortages is presented.

The Utah Water Conservation Advisory Board was created by the governor. It examined several specific policies for encouraging water education and conservation in the state. The CUPCA also required a water conservation pricing study be done to focus on ways to conserve water by reducing demand via pricing mechanisms.

Issue - Efforts to conserve water may reduce the water providers' ability to maintain adequate cash flows if precautions are not taken.

Recommendation - Agencies responsible for providing water should implement pricing practices that provide an incentive to conserve water and are revenue neutral.

Issue - Conservation strategies are only effective when water providers understand users' habits and practices.

Recommendation - Before choosing water conservation measures, water providers should conduct sufficient studies to discern and understand water users' responses to climatic and social events and conditions.

2.18 Industrial Water

Most industrial water is delivered through municipal systems. The primary exception to this is Geneva Steel where a large portion is taken from its own sources. Hydroelectric plants in the basin are listed, along with installed capacity and annual generation. Average flow through power generating facilities is 364,075 acre-feet. Over 112 Gwh of electricity are produced annually. Current industrial water use is estimated to be just over 30,000 acre-feet. This is projected to increase to over 47,000 acre-feet by the year 2020.

2.19 Groundwater

Groundwater is an important element of the hydrologic system and provides most of the drinking water. Five groundwater basins are described in Section 19. Aquifer characteristics are presented in tabular form. All groundwater basins are closed to new appropriations by the State Engineer. This should result in static water levels where groundwater withdrawals are matched over time by recharge. The State Engineer has completed a groundwater management plan for Utah and Goshen valleys. This plan, which complements the existing distribution plan and coordinated operation agreements, will provide a unified water management system.

Issue - Demand for groundwater development in Utah Valley is increasing as population expands. Because of the relationship between the groundwater and Utah Lake, this development could affect lake inflow.

Recommendation - Major water suppliers, with funding and guidance from the Central Utah Water Conservancy District and permits from the State Engineer, should aggressively pursue the possibility of large groundwater recharge projects and exchanges.

Issue - When the Wasatch County Water Efficiency Project is constructed, changes in the historic pattern of irrigation return flows to the groundwater, and to Provo River water right holders will occur.

Recommendation - The State Engineer, in consultation with local water users, the Bureau of Reclamation, and the Central Utah Water Conservancy District, should continue to insure that prior water rights on the Provo River are protected and factored into project plans. ✤ ✤

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Introduction

This plan describes a process for planning, conserving and developing water resources. The process has the flexibility to change elements of the plan as future conditions require.

3.1 Background

Utahns have always understood the importance of their water resources. Specific legislation to begin state water planning was passed in 1963. The Division of Water Resources published a series of documents, titled *State of Utah Water*, for the years 1962 to 1985. These contained basin inventories and descriptions of local and statewide problems.

The Division of Water Resources published the *State Water Plan* in January 1990. Sections 4 through 19 provide the foundation upon which Utah will build future water resources conservation and development programs and projects. Section 20 contains summaries of individual basin plans. Section 21 contains status reports, showing major changes and progress on resolving issues.

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.

3.2.1 Principles

Many principles, values, uses and interests are considered when preparing a basin plan. Prominent ones are:

- 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 doctrine of prior appropriation has governed Utah water law since statehood.

- Water is essential to life. It is our responsibility to leave good quality water to meet the needs of the generations to follow.

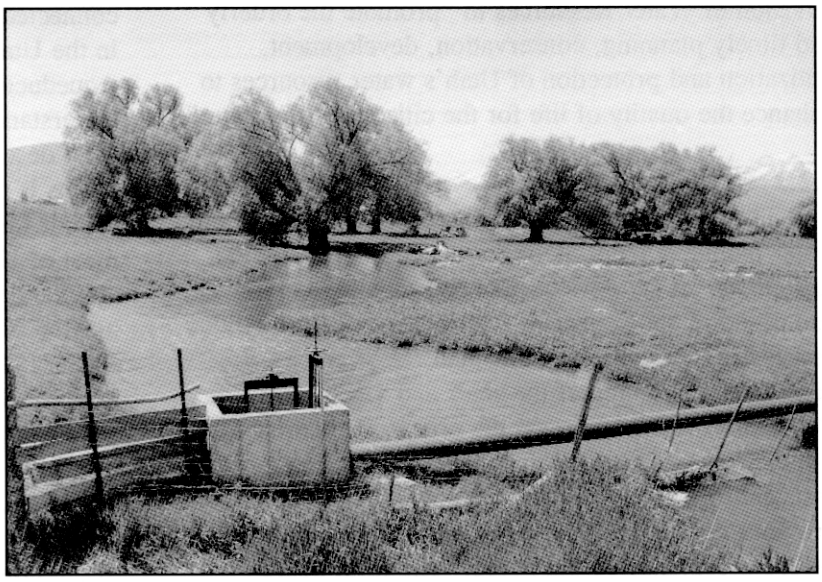
- The diverse present and future interests of Utah's residents should be protected through a balance of economic, social, aesthetic and ecological values.

- Water uses for which beneficiaries are difficult to identify, such as recreation and aesthetics, should be included in program evaluation.

- Public participation is vital to water resources planning.

- All residents of the state are encouraged to practice water conservation and implement wise use practices.

- Water rights owners are entitled to transfer their rights under free market conditions.



Creek west of Heber City

- Water resources 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 appropriate state assistance, 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 require a broad-based citizen understanding of water's physical characteristics, potential uses and scarcity value.

3.2.2 Purpose

This basin plan will help coordinate the water-related activities of local, state and federal agencies. It also provides a framework to help local water managers prepare long term water conservation and management plans. It includes current basic information to help in prioritizing and making decisions. This plan will help legislative and executive policy makers understand the broad and intricate aspects of water management. It addresses policy issues and, where appropriate, makes specific recommendations to resolve them. The *Utah Lake Basin Plan* will help accomplish the mission of the Division of Water Resources to "promote the orderly and timely planning, conservation, development, utilization and protection of Utah's water resources to enhance the quality of life for the citizens of the state."

3.2.3 Organization

The Division of Water Resources carries out state water planning under authority of the Board of Water Resources. A state water plan coordinating committee, composed of state agencies with water-related missions assisted in preparation of this plan. A steering committee consisting of the chair and vice chair of the Board of Water Resources, the executive director of the Department of Natural Resources, and the director and assistant director of the Division of Water Resources provides policy, resolves issues and approves plans before acceptance by the board. The local board member is invited to participate with the steering committee. In addition, other state and federal agencies participate as cooperating agencies. They have expertise in various fields to help with plan development.

A statewide local advisory group provides information on various aspects of planning and helps with plan review. This group represents various interests and geographic locations. Section 3.4, The introduction of the *1990 State Water Plan,* lists members of the steering committee, coordinating committee, cooperating state and federal agencies, and the statewide local advisory group.

A local basin planning advisory group provides advice, review and decision-making. The group represents various local water interests and geographical areas within the basin.

3.2.4 Process

Four drafts of the *Utah Lake Basin Plan* were prepared for review and approval: 1) In-house, 2) committee, 3) advisory, and 4) public review drafts. Revised drafts may occur whenever warranted. After the division receives comments from all reviewers, it prepares the final report and distributes it to the public. The final report provides information to help state and local agencies and the people they serve.

3.3 Basin Description

Figure 3-1 shows the Jordan River Basin and the Utah Lake Basin. These basins are unique in Utah because of the density and number of people drawing from the water supply. They are also hydrologically connected by the Jordan River whose source of water is in the Utah Lake Basin, and by the Salt Lake and Jordan Aqueducts and the Provo Reservoir Canal. To better understand the problems and alternative solutions, a brief description of the Jordan River and Utah Lake basins is presented. The Jordan River Basin includes all of Salt Lake County. The Utah Lake Basin consists of most of Utah and Wasatch counties, parts of Summit and Sanpete counties, and eastern Juab County. A tiny portion of Carbon County is also in the Utah Lake Basin. Salt Lake and Utah counties are part of the Wasatch Front Metropolitan Area where most of the state's population is found. Salt Lake City, Provo and Orem are the largest commercial centers in the two basins. Land status for both basins is shown in Table 3-1 along with acreages in both basins. The remaining discussion will apply only to the Utah Lake Basin.

Figure 3-1

LOCATION MAP
Jordan River/Utah Lake Basin

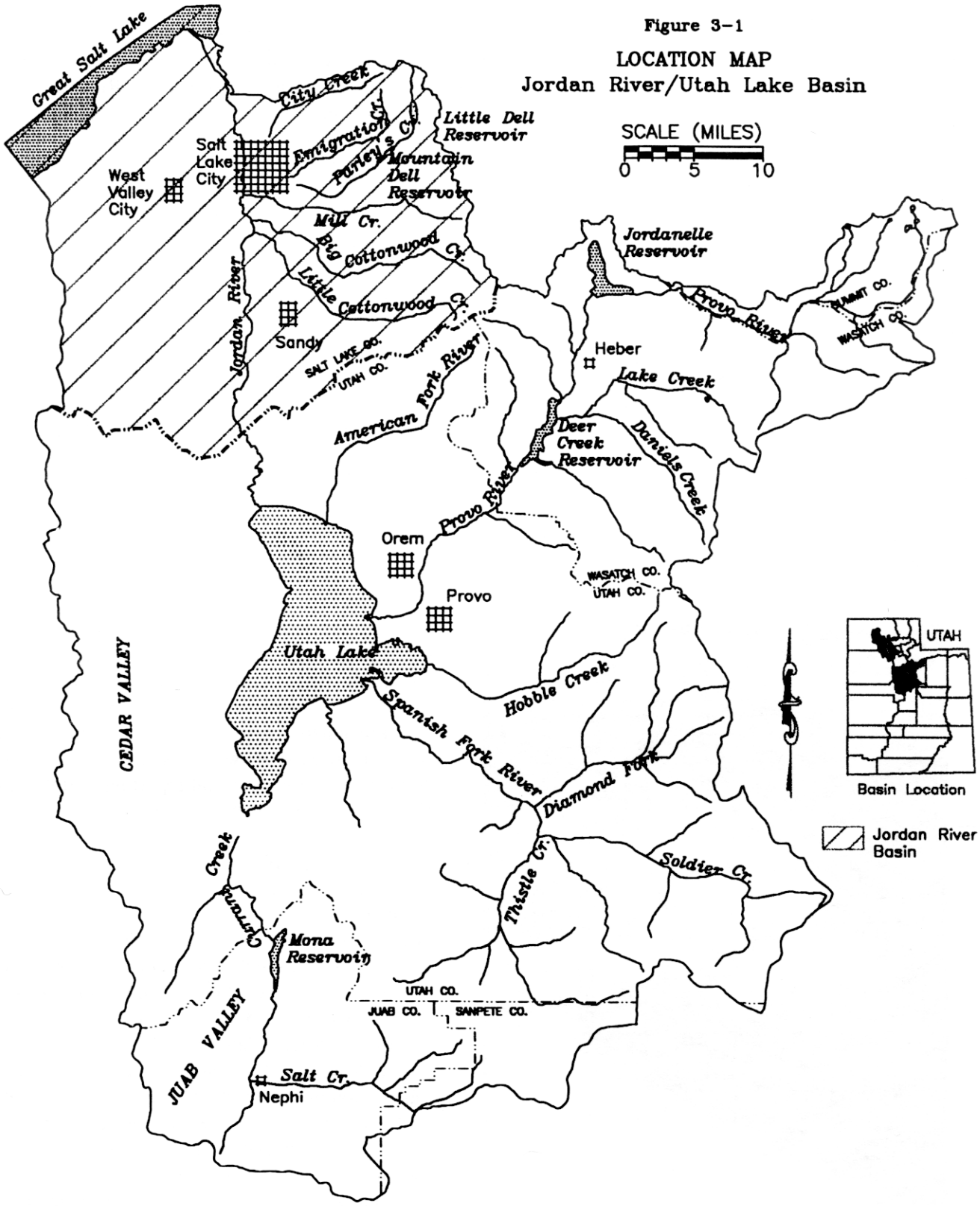
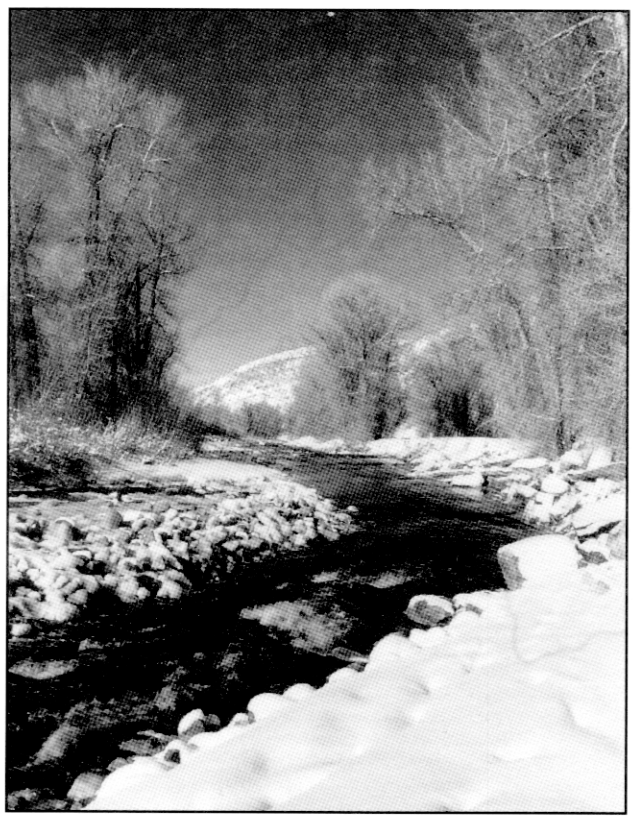


Table 3-1 BASIN LAND OWNERSHIP AND ADMINISTRATION			
Status	Jordan (acres)	Utah Lake (acres)	Total (acres)
Private	372,730	866,400	1,239,130
State	33,640	233,900	267,540
Federal	108,830	844,800	953,630
Total	515,200	1,945,100	2,460,300

3.3.1 Drainage Area and Topography

Utah Lake is the destination of nearly all rivers and streams in the drainage, and the source of the Jordan River. Provo River, with headwaters on the western slopes of the Uinta Mountains, is the primary tributary of Utah Lake. Jordanelle and Deer Creek reservoirs provide on-stream storage for municipal, industrial, irrigation and recreational purposes. Mona Reservoir provides storage for irrigation in Goshen Valley. Utah Lake provides storage for Jordan River irrigators.

Water is imported from the Weber River Basin through the Weber-Provo Canal. Water is imported from the Uinta Basin through the Duchesne Tunnel and from the enlarged Strawberry Reservoir through Syar Tunnel. Water from Syar Tunnel enters Sixth Water Creek, a tributary of Diamond Fork. Diamond Fork is a tributary of the Spanish Fork River which empties into Utah Lake. Soldier Creek and Thistle Creek also contribute water to the Spanish Fork River. Water is also imported from the Strawberry River drainage to Daniels Creek by the Hobble Creek and Strawberry ditches. This will end in two to three years when the Daniels Replacement Project and the Wasatch County Water Efficiency Project are complete.



Provo River near Woodland

Hobble Creek (not Hobble Creek Ditch) enters Utah Lake near the Provo Airport. Beer Creek is a minor tributary which feeds into the lake south of the mouth of Spanish Fork River.

The Utah Lake Basin is bounded on the north by the Traverse Mountains, Wasatch Range and Uinta Mountains (see Figure 3-2). The Uinta Mountains and the Wasatch Plateau bound the east side of the basin. The Wasatch Plateau and the Wasatch Range bound the south side, while the west boundary is formed by the East Tintic and Oquirrh mountains.

3.3.2 Climate

Mean annual temperatures range from 37.8 to 52.2°F. Mean monthly maximum temperatures reach 92.8°F in July and the mean monthly minimum is as low as 3.1°F in January. Elevations vary between 4,475 feet above sea level at Jordan Narrows to 11,928 feet at Mt. Nebo. Frost free days are from 32 at Thistle to 184 near Geneva Steel in Orem. See Table 3-2.

Precipitation goes to 60 inches on high mountain peaks. Figure 3-3 shows the National Oceanic and Atmospheric climatological reporting stations, and Figure 3-4 shows annual precipitation.

3.3.3 Physiography and Geology

The Utah Lake Basin is unique among drainage basins in the state in that it includes portions of three physiographic provinces: the Basin and Range, Middle Rocky Mountains and Colorado Plateau provinces.

All areas in the Utah Lake Basin that are west of the Wasatch Range (Cedar Valley, Utah-Goshen Valley, and Northern Juab Valley) are included in the Basin and Range Province. The distinguishing characteristics of this portion of the Basin and Range Province are typical of the province as a whole. These characteristics include the occurrence of isolated, subparallel mountain ranges which rise abruptly above the adjacent valleys. The ranges are typically block faulted, being bounded

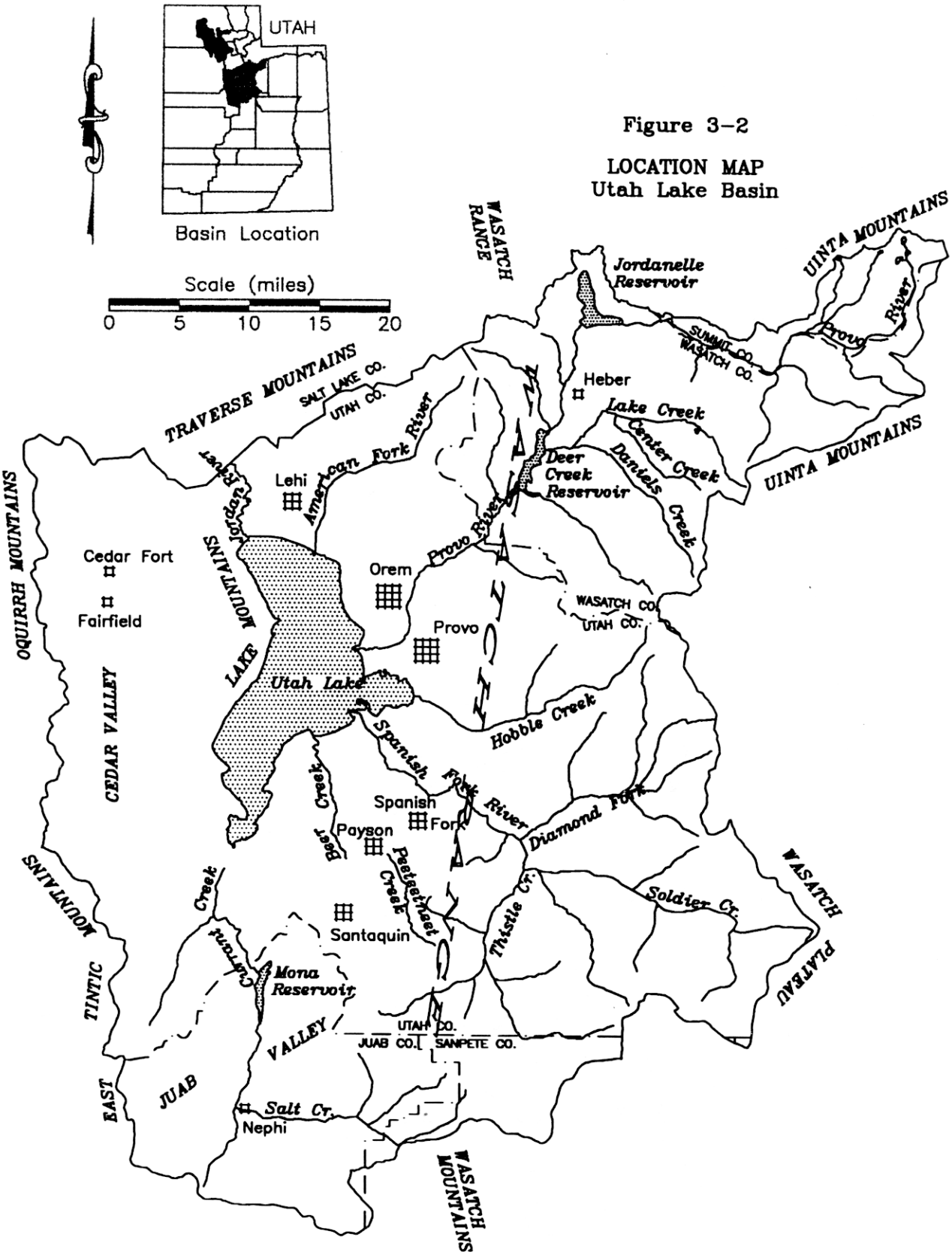
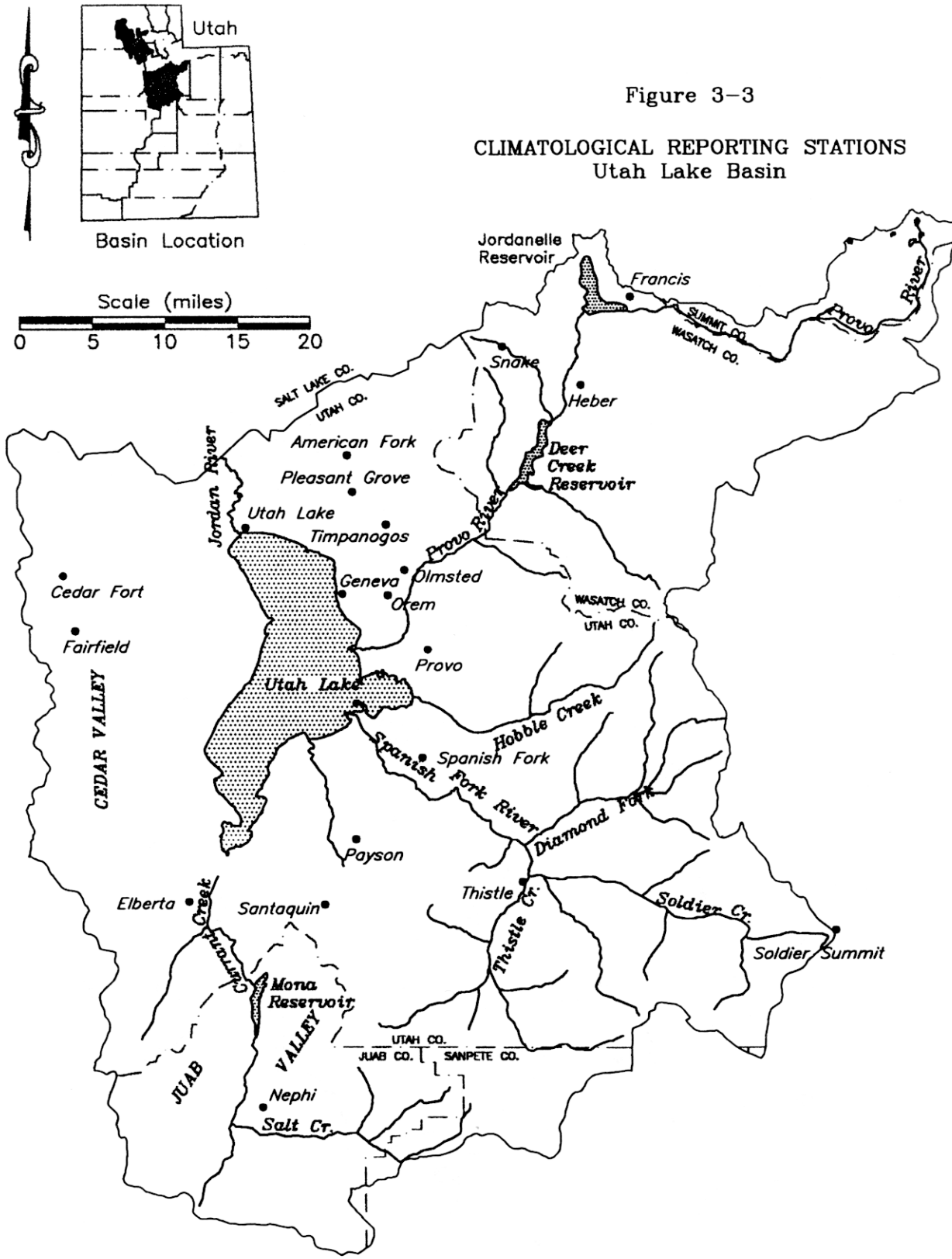


Figure 3-2

LOCATION MAP
Utah Lake Basin

Figure 3-3

CLIMATOLOGICAL REPORTING STATIONS
Utah Lake Basin



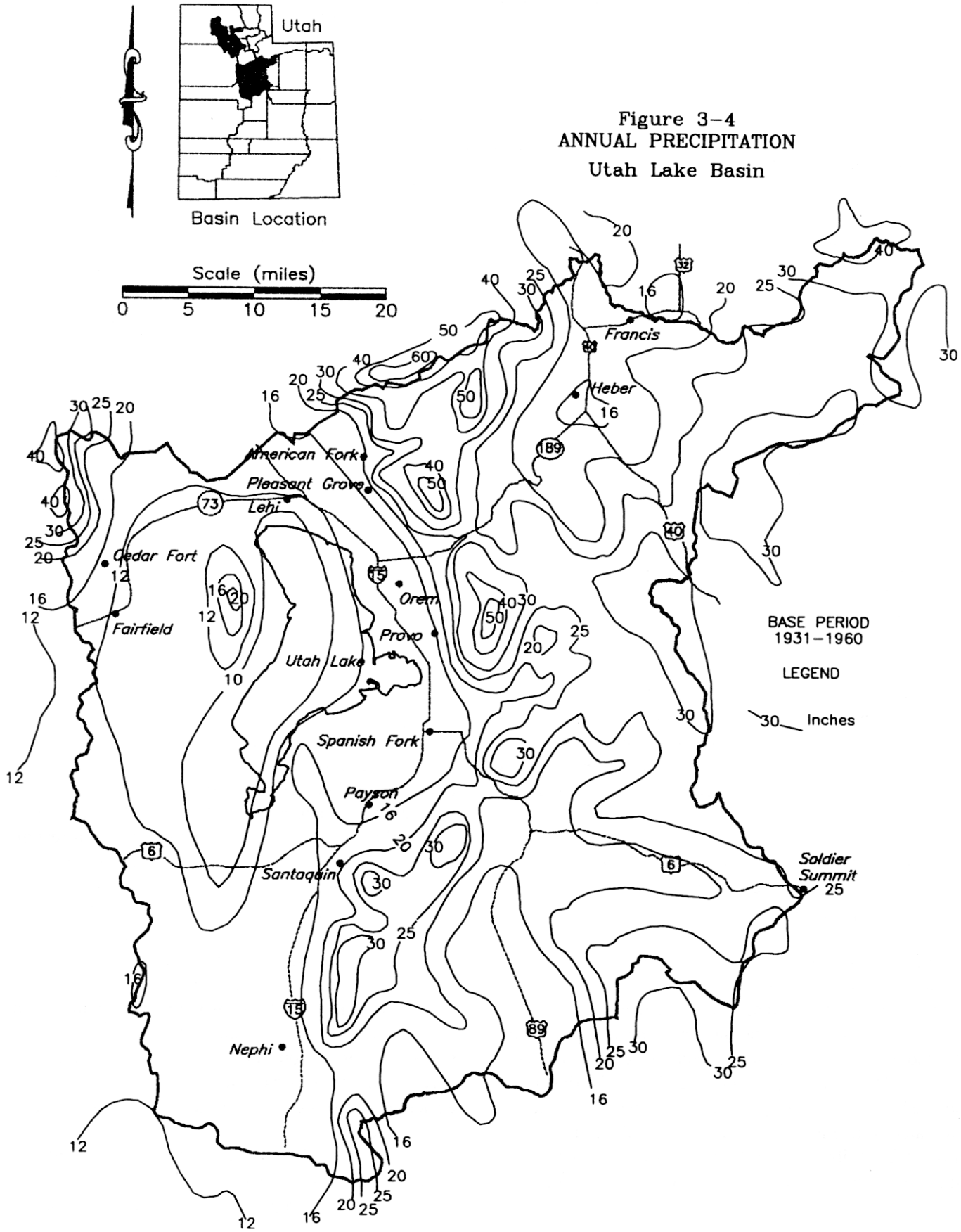


Figure 3–4
ANNUAL PRECIPITATION
Utah Lake Basin

Table 3-2
MEAN TEMPERATURES AND PRECIPITATION

Station	January Max. (°F)	January Min. (F°)	July Max. (°F)	July Min. (°F)	Mean Annual (°F)	Frost Free Days	Annual Precipitation (inches)
Lower American Fork	37.8	20.3	90.5	62.6	52.2	173	16.25
Elberta	36.8	15.8	92.7	58.3	44.9	134	11.41
Fairfield	37.1	10.2	88.9	50.9	46.7	94	12.39
Geneva Steel	38.2	21.8	90.7	62.9	51.9	184	8.98
Nephi	39.1	16.0	92.8	57.6	50.5	138	14.53
Heber	34.0	8.4	86.5	48.4	44.5	90	16.01
Olmsted Power	37.3	18.7	91.0	59.0	51.4	165	20.72
Orem Treatment	33.3	15.4	89.2	61.0	50.8	178	13.17
Pleasant Grove	37.8	18.5	90.2	58.2	50.7	151	17.10
Provo BYU	37.1	18.6	92.5	59.8	49.6	173	13.15
Santaquin	37.9	15.8	90.4	59.5	49.9	144	18.46
Snake Creek Power	33.3	9.7	84.5	45.9	43.1	86	22.01
Soldier Summit	28.2	3.1	80.0	41.2	37.8	48	10.97
Spanish Fork	41.6	18.7	92.7	58.2	51.4	148	13.16
Thistle	36.7	3.5	89.8	42.4	43.1	32	15.58
Timpanogos Cave	33.0	19.1	90.6	57.2	48.9	154	25.87
Utah Lake Lehi	35.6	14.6	89.7	55.7	48.5	133	11.51

Source: Utah Climate, 1992

by normal high angle faults. Internal drainage characterizes the basins so that the valley floors represent the local base level which is sometimes occupied by a lake or playa. Geologically, the ranges exhibit mostly Paleozoic rocks while the valleys contain Quaternary age sediment eroded from the surrounding mountains.

The Wasatch Range and Uinta Mountains are part of the Middle Rocky Mountain Province. These mountains have the highest elevations in the Utah Lake Basin. The high and heavier snow packs found here give rise to the Provo River, which is one of the major drainages, and is the major source of water to Utah Lake. Geologically, this part of the Middle Rocky Mountain Province is made up of Paleozoic and Pre-Cambrian rocks, while the intermontane valleys (Heber, Round and Thistle) contain Quaternary age sediments.

The remaining area of the Utah Lake Basin located south of the Uinta Mountains and east of the Wasatch Range is part of the Colorado Plateau Province. Tributaries to the Spanish Fork River head in this area, made up mostly of the Wasatch Plateau. Geologically, the area is mostly composed of Tertiary and Mesozoic rocks, see Figure 3-5.

3.3.4 Soil and Land Use

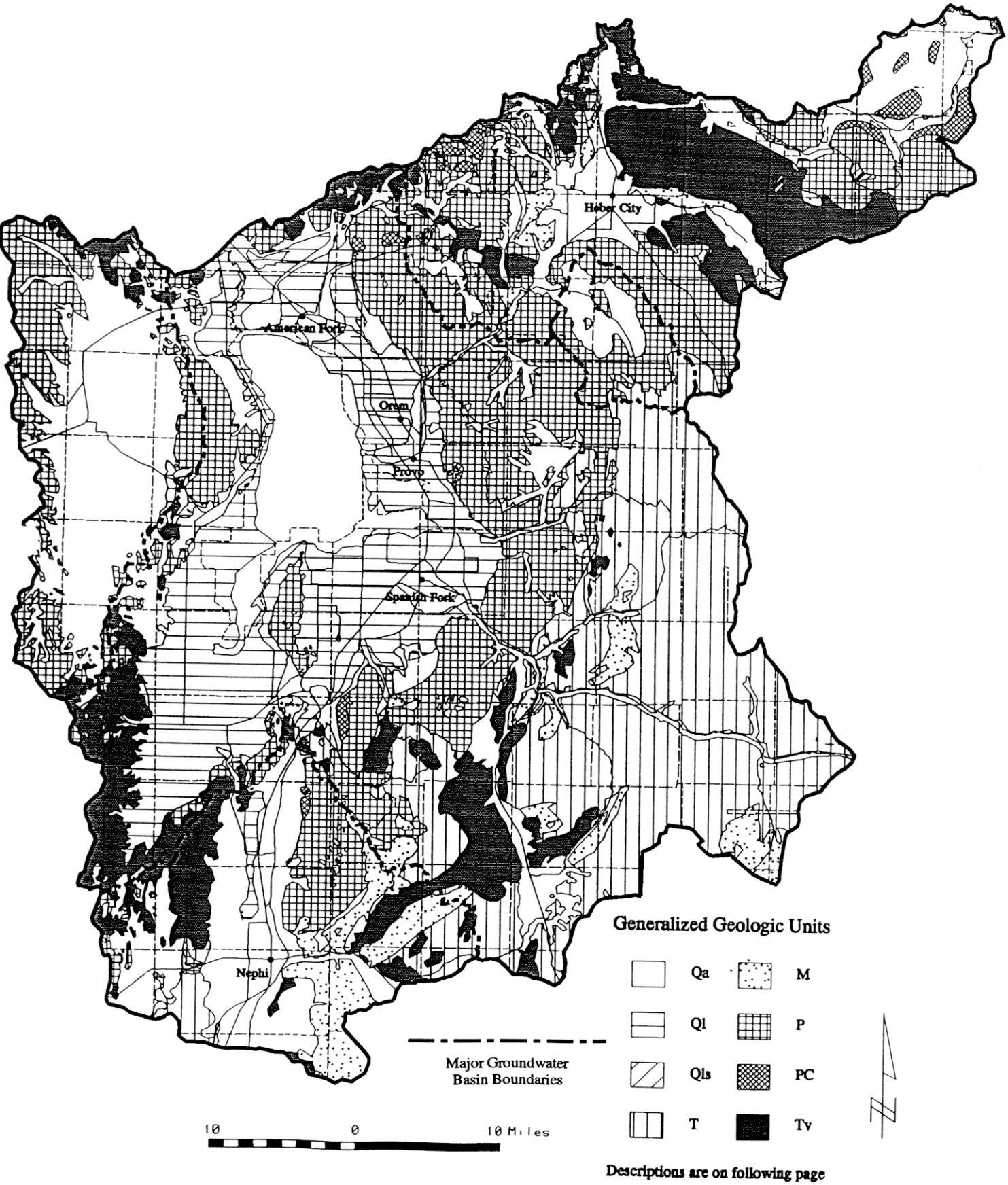
The basin covers approximately 1,945,100 acres. Land uses include irrigated and dry land agriculture, open water and riparian, residential, industrial, and other urban uses. The rest of the basin is in forest and range lands with vegetative cover shown in Table 3-3.

Soils in Heber and Round valleys are mostly formed in alluvium from mixed sedimentary rocks on foothills, mountain slopes and alluvial fans. Most are well drained. Some are poorly drained and are used mostly for summer pastures.

Utah Valley and Goshen Valley soils range from well drained to poorly drained on the lake terraces. Soil types here range from fertile loams to saline-alkali clays. Most soils at the lower elevations support agricultural crops except for the lowest areas around Utah Lake.

Soils in the Fairfield to Nephi area vary widely in their potential for major land uses. About 5 percent are used for irrigated crops, mainly alfalfa, wheat, barley,

Figure 3-5
GENERAL GEOLOGY
Utah Lake Basin



Descriptions are on following page

UTAH LAKE BASIN
GENERALIZED GEOLOGIC UNITS

Quaternary

Qa — Unconsolidated deposits of alluvium, colluvium, wind blown, and glacial origin.

Ql — Unconsolidated deposits of lake or playa origin.

Qls — Landslides

Tertiary

T — Weakly to semi-consolidated sedimentary basin-filling rocks of the Salt Lake, Duchesne River, Unita, and Green River Formations and the Flagstaff Limestone.

Tv — Igneous rocks of Tertiary age; includes the Little Cottonwood and east Tintic intrusives, also the Keetley, Traverse Mountain, Tintic and Long Ridge area volcanics.

Mesozoic

M — Consolidated sedimentary rocks; locally includes the North Horn, Price River, Indianola, Morrison, Arapien Shale, Nugget, Ankareh, and Thaynes Formations.

Paleozoic

P — Consolidated sedimentary rocks locally includes the following formations; Park City, Diamond Creek Sandstone, Kirkman Limestone, Oquirrh Group, Manning Canyon Shale, Great Blue Limestone, Humbug, Deseret Limestone, Gardison Limestone, Fitchville, Pinyon Peak, Victoria, Bluebell Dolomite, Fish Haven Dolomite, Opohonga Limestone, Ajax Dolomite, Maxfield Limestone, Ophir, and Tintic Quartzite.

Precambrian

PC — Precambrian sedimentary and metamorphic rocks locally includes the following formations; Mutual, Mineral Fork Tillite, Inkom, Uinta Mountain Group, and metamorphic complex of Mt. Nebo.

corn silage and a few orchards. This irrigated land is scattered throughout the area, but it is concentrated mainly around Nephi. About 3 percent of the land is used for dry crops, 1 percent is for woodlands, and about 85 percent is used as rangeland. See Figure 3-6.

3.3.5 Land Status

The federal government administers about 43 percent of the 1,945,100 acres of total land area in theUtah Lake Basin. The state administers 12 percent and 45 percent is privately owned.

Table 3-4 shows land ownership and administration for the Utah Lake Basin by county. Table 3-5 shows the breakdown of federal ownership, by agency, in each county.

Federally administered land is under the jurisdiction of five agencies, the Forest Service, Bureau of Land Management, National Park Service, U.S. Army and the Bureau of Reclamation.

3.4 Water-Related History

The history of the Utah Lake Basin provides an interesting backdrop for existing conditions. The first recorded history of white men to explore this basin begins with the Dominguez-Escalante Expedition. Led by New Mexico-based Catholic priests, the purpose of the journey in 1776 was to find a new route from Santa Fe to California. Journal entries in September 1776 find the group reaching the present site of Strawberry Reservoir and descending by way of Sixth Water Creek

Table 3-3
VEGETATIVE COVER AND LAND USE

Cover/Use	Acres	Area (percent)
Barren rock, sand playas and misc.	14,300	.74
Alpine, conifer and aspen	400,600	20.6
Oak	311,800	16.0
Mountain brush, juniper, sagebrush and greasewood	681,900	35.1
Scattered native vegetation	129,800	6.7
Riparian, marshlands and wetlands	49,700	2.6
Open water (includes Utah Lake)	91,200	4.7
Urban	50,400	2.6
Agricultural	215,400	11.1
Total	1,945,100	100.0

Table 3-4
LAND OWNERSHIP AND ADMINISTRATION

	COUNTY						
Status	Carbon	Juab	Sanpete	Utah	Summit	Wasatch	Total
				(acres)			
Private	400	107,900	45,100	547,900	7,000	158,100	866,400
State	0	17,300	600	180,400	500	35,100	233,900
Federal	300	84,600	9,700	576,800	42,000	131,400	844,800
Total	700	209,800	55,400	1,305,100	49,500	324,600	1,945,100

Figure 3-6

LAND USE
Utah Lake Basin

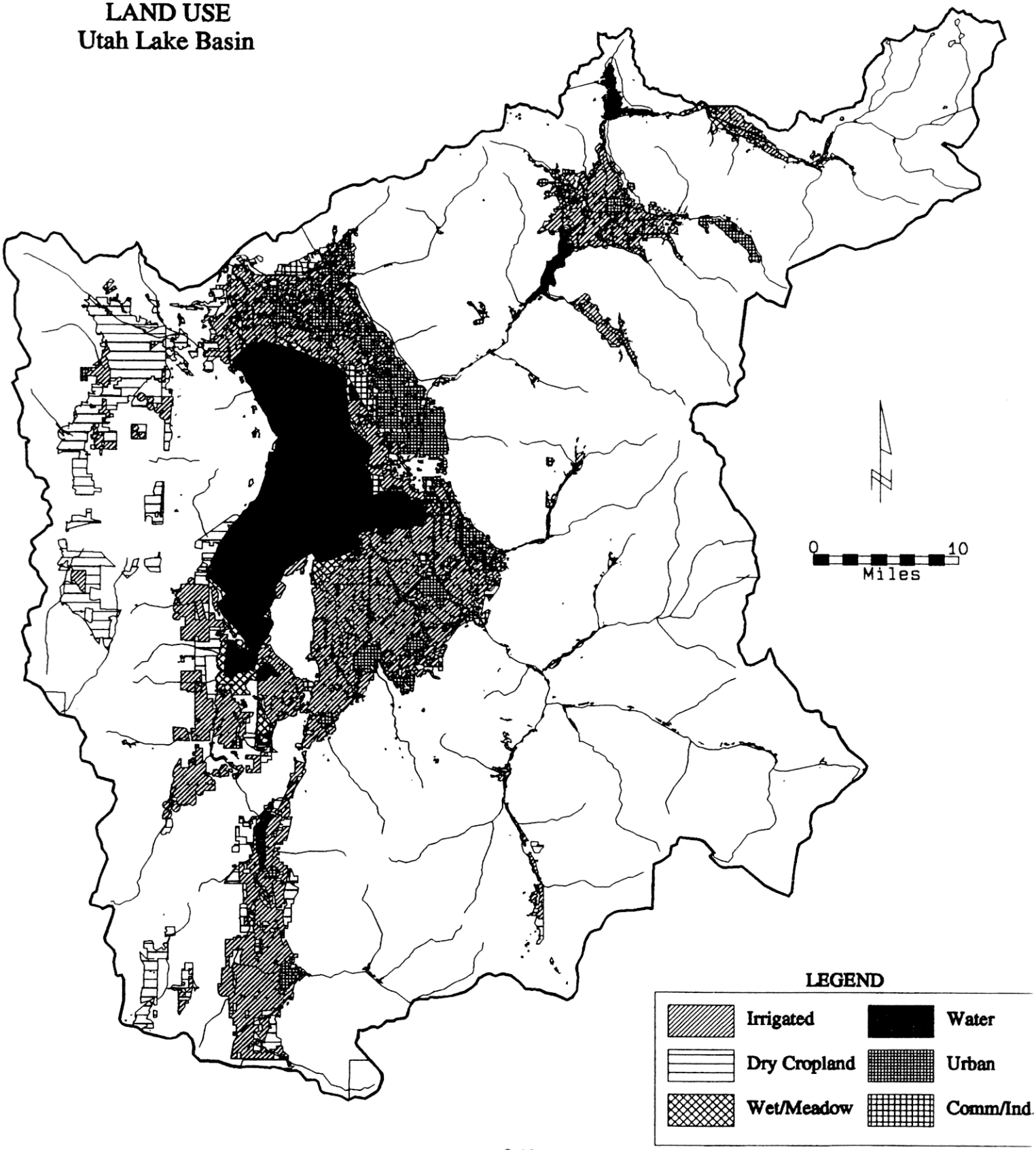


Table 3-5
FEDERAL LAND ADMINISTRATION

Agency	Carbon	Juab	Sanpete (acres)	Utah	Summit	Wasatch	Total
	COUNTY						
Bureau of Land Management	0	29,250	1,760	95,000	200	4,050	130,260
Forest Service	300	37,150	7,940	425,430	41,800	118,850	631,470
Wilderness Areas[a]	0	18,200	0	38,550	0	0	56,750
National Park Service	0	0	0	230	0	0	230
U.S. Army	0	0	0	17,590	0	0	17,590
Bureau of Reclamation	0	0	0	0	0	8,500	8,500
Total	300	84,600	9,700	576,800	42,000	131,400	844,800

[a] Administered by U.S. Forest Service.

into Diamond Fork, the Spanish Fork River, and eventually to Utah Lake. Escalante's journal describes the four rivers (later named American Fork, Provo, Hobble Creek, Spanish Fork), the excellent soil, the timber in the nearby mountains, and the abundant waterfowl and fish in and around the lake. Also described is the "other lake" (Great Salt Lake) to the north. "Its waters are harmful and extremely salty, for the Timpanois assured us that anyone who wet some part of the body with them immediately felt a lot of itching in the part moistened."

3.4.1 Pioneer Development

Utah County was one of six counties in the provisional State of Deseret. On March 10, 1849, Brigham Young sent 30 men from Salt Lake Valley to begin settlement in Utah Valley. They named this county after the Ute Indians who lived here at the time of settlement. A low dam was placed across Utah Lake's outlet to the Jordan River in 1872, creating the first storage reservoir. They built a pumping plant in 1902 so that the lake water could be lowered below the outlet elevation. The pumping plant has been modified and enlarged several times. Its present capacity is about 1,050 cfs, and it can lower the lake level eight to 10 feet below the compromise elevation (4,489.045 feet).

Wasatch County was settled in 1858 when William M. Wall, George W. Bean and Aaron Daniels built ranches in Heber Valley. Wasatch County was established in 1862. Heber City, elevation 5,593, is the county seat.

Three canals diverted water from the Strawberry River drainage to Daniels Creek. Two canals, Strawberry River Canal and Willow Creek Canal, were commingled in 1954 to form a single canal entering Daniels Creek. Hobble Creek Ditch is the third diversion. They will all be abandoned when water becomes available to this area from the Jordanelle Reservoir under the Central Utah Project. Fifteen small reservoirs at the headwaters of the Provo River were constructed about 1910 by several different interests, including the Provo Reservoir Water Users Company, Provo City, and upper basin irrigation companies located in the Francis and Heber Valley areas. And several small reservoirs were built in Heber Valley.

The Deseret Legislature established Juab County in 1849, but it was not officially organized until 1852. Juab County originally extended to the present western boundary of the state of Nevada. Nephi is the population center and county seat. Most of the farms and ranches in this part of the basin are in Juab Valley around Nephi. Near Eureka, miners extracted large deposits of

gold, silver, lead, copper and zinc from the East Tintic Mountains. Little mining activity remains.

The first permanent settlers in the Nephi area of Juab County arrived in 1851 when the Timothy Bradley Foote family settled on the banks of Salt Creek. In the spring of 1852, a diversion dam was constructed on Salt Creek and ditches were dug to convey the water to the fields.

The Mt. Nebo Land and Irrigation Company constructed Mt. Nebo Dam on Currant Creek in 1895 to form Mona Reservoir. Surplus water from Currant Creek was stored for irrigation of 15,000 acres of land in Goshen Valley. Subsequent droughts drove most of the farmers into receivership by 1903. The reservoir eventually filled again, and in 1905 the irrigation company was sold and the name changed to the Utah Lake Land, Water, and Power Company.

The Mosida area was opened for settlement in 1909 by farmers from Utah County and several Midwestern states. They pumped water from Utah Lake for up to 50,000 fruit trees planted between 1910 and 1913. They planted several thousand acres of alfalfa and small grains.

3.4.2 Federal Water Projects

During the 20th century, three major water projects constructed by the Bureau of Reclamation have had a major impact on this basin. They are the Strawberry Valley Project, the Provo River Project and the Central Utah Project.

The Strawberry Valley Project, which diverts water from the Uinta Basin to the Bonneville Basin, is one of the earliest federal reclamation developments. Construction began in 1906 and water was first used in 1915. Water was collected in a reservoir with 270,000 acre-feet active capacity. The reservoir sits behind the Strawberry Dam constructed on the Strawberry River, a tributary of the Duchesne River. Indian Creek Dike and Currant Creek Feeder Canal were also constructed. Soldier Creek Dam, now the main storage facility of the Central Utah Project, enlarged Strawberry Reservoir to 1.1 million acre-feet.

Deer Creek Reservoir, the principal feature of the Provo River Project, was completed in 1941. It has an active storage capacity of 152,560 acre feet. Approximately 120,800 acre-feet of Provo River water is stored in Deer Creek Reservoir, which includes 17,400 acre-feet by exchange of return flows to Utah Lake from imported water. The remaining normal flows and flood flows are required for prior rights on the Provo River and in Utah Lake. Deer Creek Reservoir also stores water imported from the Weber and Duchesne rivers.

The Weber River Project, constructed in 1928-31, includes the nine-mile long Weber-Provo Diversion Canal that was built to a capacity of 210 cubic feet per second (cfs). It was enlarged to 1,000 cfs under the Provo River Project. It conveys surplus high flows and some exchange waters from the Weber River nine miles south through Kamas Valley, delivering it to the Provo River near Francis. The Weber-Provo Canal is a facility of the Provo River Project. Provo River Project water is also imported to the Provo River from the Uinta Basin through the Duchesne Tunnel for storage in Deer Creek Reservoir. This tunnel, completed in 1953, diverts water from the North Fork of the Duchesne River, a tributary of the Green River which is tributary to the Colorado River. The tunnel is six miles long and is under a spur of the Uinta Mountains. It discharges into the main stem of the Provo River upstream from Woodland. Its capacity is 600 cfs.

The Provo Reservoir Canal was enlarged under the Provo River Project to 550 cfs at the diversion and 350 cfs at the point-of-the-mountain. This canal is used to convey agricultural and municipal water to northern Utah County and to Salt Lake County. The Salt Lake Aqueduct was constructed as part of the Provo River Project and transports water from the Provo River Basin to the Salt Lake Valley. It went into operation in 1952, and is used to convey water stored in Deer Creek Reservoir for urban purposes to Utah County users, the Metropolitan Water District of Salt Lake City, and the Salt Lake County Water Conservancy District.

The Bonneville Unit of the Central Utah Project is located in central and northeastern Utah. For planning and coordination purposes, the Bonneville Unit is divided into six systems according to location and function. These systems are: 1) the Starvation Collection System, 2) the Strawberry Collection System, 3) the Ute Indian Tribal Development, 4) the Diamond Fork System, 5) the Municipal and Industrial (M&I) System, and 6) the Spanish Fork Canyon-Nephi Irrigation(SFN)System. The Bonneville Unit includes facilities to develop and more fully utilize waters tributary to the Duchesne River in the Uinta Basin. This unit also facilitates a transbasin diversion from the Colorado River Basin to the Bonneville Basin. It also includes features to better use local water resources and facilities to distribute project water in the Bonneville Basin. The project water supply will be used for

municipal and industrial purposes and irrigation in both basins. The project will also provide flood control, recreation, fish and wildlife measures and, potentially, power generation.

3.4.3 Water Districts

All land in the Utah Lake Basin is within the boundaries of the Central Utah Water Conservancy District except a small piece of Carbon County. Five metropolitan water districts provide part of the water supplies for some incorporated cities, and several water improvement districts serve some unincorporated areas. Section 6 provides more information on water management institutions. ✤ ✤

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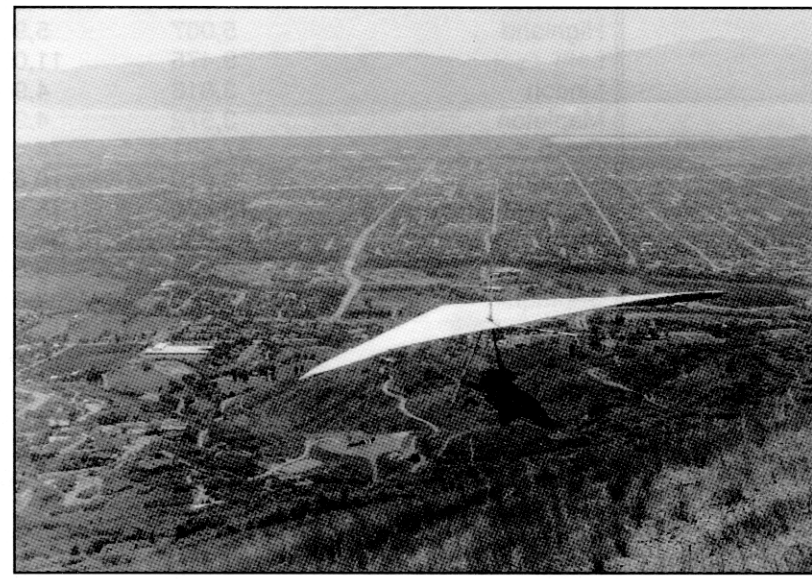
Demographics and Economic Future

Contrasts mark basin demographics. Provo and Orem are part of the Wasatch Front Metropolitan Area where most of the state's population and commercial/industrial activity are found. Nephi City, at the southern tip of the basin, is rural with a stable population and agricultural economic base. This part of the basin is becoming more economically integrated with Utah County as people employed in the metropolitan area move there for the rural atmosphere. Heber and other Wasatch County communities are becoming urbanized and adjusting to recreation pressures from the recently constructed Jordanelle Reservoir.

4.1 Introduction

This section discusses the population, employment and economic future of the Utah Lake Basin. Basin population for 1994 is 318,020. By the year 2020, the total is projected to be 569,803, an increase of 251,783 people or 79 percent. The annual rate of growth in population is expected to be 2.40 percent. The employment pattern will probably change moderately, with services and trade gaining at a more rapid rate while agriculture remains steady and other sectors show steady growth. Overall employment will increase by 90,000 jobs. This is an average annual rate of growth of 1.62 percent.



Orem/Provo area from Squaw Peak

The Governor's Office of Planning and Budget prepared the projected population estimates. The Division of Water Resources then used these estimates as a basis for estimating the culinary water supply requirements shown in Section 11, Drinking Water. Basin population consists of Utah County and portions of Juab, Wasatch and Summit counties. The major population centers in Juab and Wasatch counties are in this basin.

4.2 Demographics

Nephi and Mona have 70 percent of the total Juab county population. Charleston, Heber, Midway and Wallsburg hold 76 percent of the Wasatch County population. Woodland and Francis are the only communities in Summit County in the basin and have only 3 percent of the county population. Provo and Orem, in Utah County, are the largest cities and are the third and fifth largest cities in the state respectively.

Between 1990 and 1994, Francis, in Summit County, had the most rapid growth of the two communities in that county. The fastest growing community in Utah County for the same period was Woodland Hills at 148.2 percent. All basin communities in Wasatch County, Charleston, Heber, Midway and Wallsburg, grew between 11.1 percent and 29.2 percent. Nephi and Mona in Juab County had growth of five and 19 percent respectively. The unincorporated portions of Utah County increased in

Table 4-1
POPULATION PROJECTIONS
Utah Lake Basin

City	1990	1994	2000
Juab County			
Nephi	3,515	3,691	5,937
Mona	584	699	1,881
County Total	4,099	4,390	7,818
Summit County			
Francis	381	532	716
Woodland	175	185	210
County Total	556	717	926
Utah County			
Alpine	3,492	4,547	8,069
American Fork	15,722	18,194	32,286
Cedar Fort	284	286	508
Cedar Hill	769	1,465	2,600
Elk Ridge	771	1,036	1,838
Genola	803	1,069	1,897
Goshen	578	610	1,082
Highland	5,007	5,909	10,486
Lehi	8,475	11,069	19,643
Lindon	3,818	4,989	8,853
Mapleton	3,572	4,203	7,458
Orem	67,561	74,402	132,031
Payson	9,510	10,837	19,231
Pleasant Grove	13,476	15,813	28,061
Provo	86,835	98,244	174,340
Salem	2,284	3,091	5,485
Santaquin	2,386	2,676	4,749
Spanish Fork	11,272	13,522	21,996
Springville	13,950	15,762	27,971
Vineyard	151	166	295
Woodland Hills	301	747	1,326
Unincorporated	12,573	12,872	22,842
County Total	263,590	301,509	535,047
Wasatch County			
Charleston	336	392	849
Heber	4,782	5,613	12,330
Midway	1,554	2,007	7,287
Wallsburg	252	280	493
Unincorporated	3,165	3,113	5,053
County Total	10,089	11,404	26,012
Basin Total	278,334	318,020	569,803

Source: Governor's Office of Planning and Budget, State of Utah, Economic and Demographic Projections, 1994.

population only 2.4 percent. Unincorporated Wasatch County had a slight decrease in population during the 1990-1994 period. Unincorporated Juab County grew by 16.2 percent. See Table 4-1 for community populations and projections.

Data for 1990 reflect the April 1 Census counts after correcting for geography mistakes and or changes since the 1990 Census. Data for 1994 are the official estimates of the Bureau of the Census and include official revisions in Lehi, Provo and Woodland Hills.

Data for the year 2020 in Juab, Summit and Wasatch counties are extrapolations based on weighted growth rates for three periods. These periods and the associated weights are 1970-1980 (.10), 1980-1990 (.40), and 1990-1994 (.50). These extrapolations are also controlled to the provisional county level projections prepared by the Governor's Office of Planning and Budget. Data for 2020 in Utah County, with the exception of Lehi and Lindon, are simply the 1994 population estimate shares applied to the GOPB's provisional Utah County projection released in 1997. In Lehi and Lindon the 2020 population projection is based on input from the Mountainland Association of Government regarding annexations and current and expected permitted construction.

Utah County includes two cities that are not shown: Eagle Mountain, which incorporated in 1996 with approximately 160 people, and Draper, which currently has no population outside of Salt Lake County. A large housing development in Draper which extends into Utah County has recently been proposed. These extrapolations have not been subject to local review, nor do they incorporate information about current or anticipated land use patterns, capacity constraints, relationship to the urban system, anticipated infrastructure changes, and other important issues affecting the size and location of populations.

The Governor's Office of Planning and Budget made additional extrapolations to aid in estimating long-range municipal and industrial water demands. Assuming a constant annual growth rate beyond 2020 of about 2.3 percent, the population of the basin would increase to over 1.1 million by 2050. See Table 4-1a. Figure 4-1 presents the information for 1990 to 2020 in graphic form. Figure 4-1a shows population projections for the portions of Wasatch, Juab and Summit counties within the basin.

4.3 Employment

In Juab County, agriculture lost 13 jobs between 1990 and 1995, but it is expected to maintain about 290 jobs throughout the projection period. Mining lost 62 jobs during this five-year period and will only show slow growth of five to six jobs during the 25-year projection period. Construction lost 16 jobs since 1990, but it will grow slowly during the projection period. All other sectors have shown significant growth with services increasing at the most rapid rate.

In Utah County, all sectors are expected to grow throughout the protection period to 2020. Mining and construction employment will grow slowly. Agriculture is expected to add 450 jobs by 2020. High technology firms are expected to increase employment significantly. Not all these jobs will be filled by basin residents. In Wasatch County, mining jobs went to zero during the 1980s and no change is expected. Construction and manufacturing lost a combined 223 jobs during that decade, but construction and manufacturing will slowly increase employment during the projection period. Agriculture is expected to increase slowly to 440 jobs. Total employment in Wasatch County showed a net increase of 695 jobs during the 1990-1995 period and is expected to grow an additional 2,705 by the year 2020. Basin employment will increase at an annual rate of 1.62 percent. See Table 4-2 and Figure 4-2.

The reason agriculture is maintaining or increasing in employment while land is being converted to urban uses is that growing service sector jobs in lawn care, soil preparation, veterinary and animal services, landscaping, and horticultural are included as agricultural services.

4.4 Economic Future

The long-term outlook for the economy of the basin is very positive. Provo and Orem consistently rank very high nationally on various business magazines' lists of best places to live and do business. The state is expected to experience continued growth of about 2 percent annually in population and 2.3 percent in employment through the 90s and into the next century. Utah county is an integral part of the Wasatch Front metropolitan area where most of the projected growth will occur. Growth, however, will not be evenly distributed throughout the basin. ✤ ✤

Table 4-1a
LONG-RANGE POPULATION ESTIMATES
Utah Lake Basin

County	Year 1990	2020	2050
Juab	4,100	7,820	16,500
Utah	263,590	535,050	1,029,300
Summit	560	930	2,540
Wasatch	10,090	26,010	63,040
Total	278,340	569,810	1,111,380

Figure 4-1
POPULATION PROJECTIONS

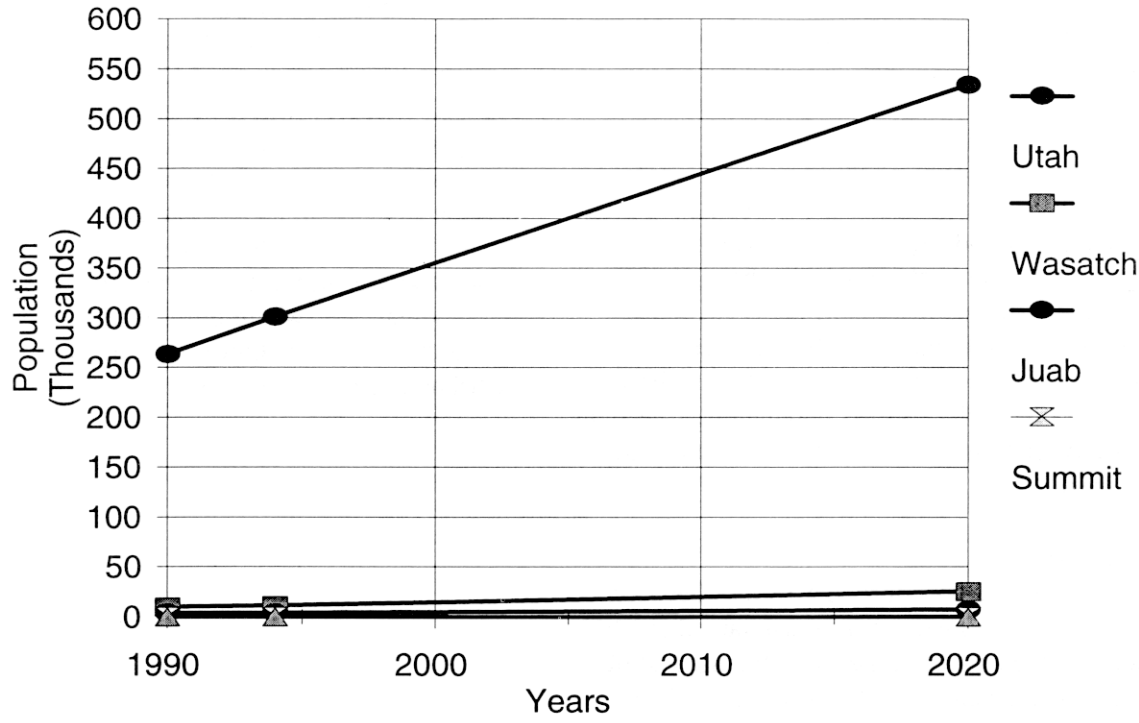


Figure 4-1a
3 COUNTY POPULATION PROJECTIONS

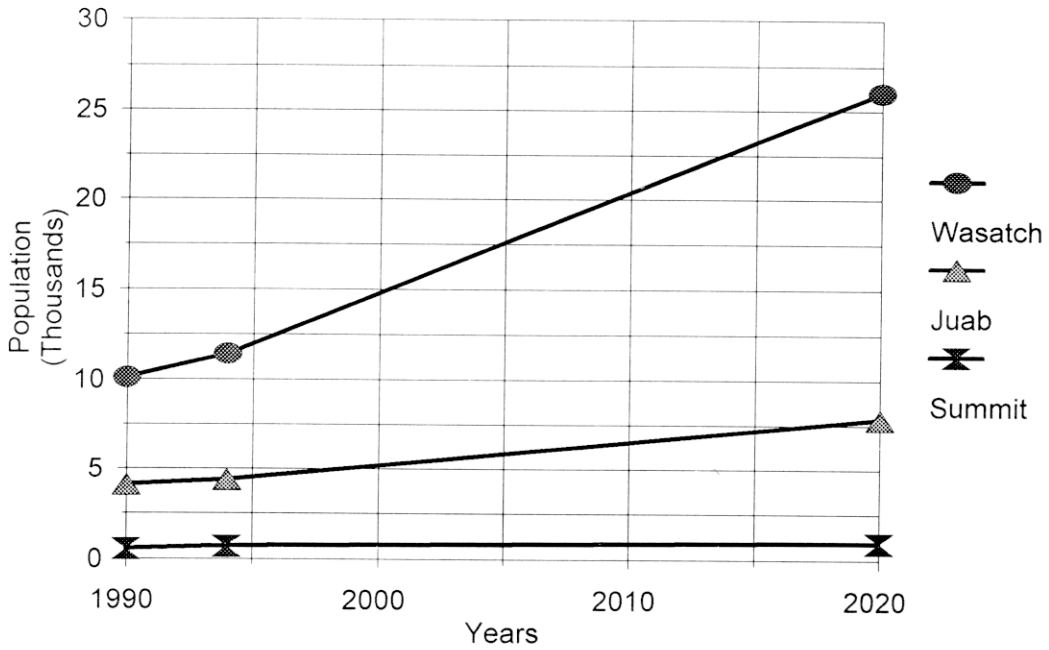


Figure 4-2
EMPLOYMENT PROJECTIONS

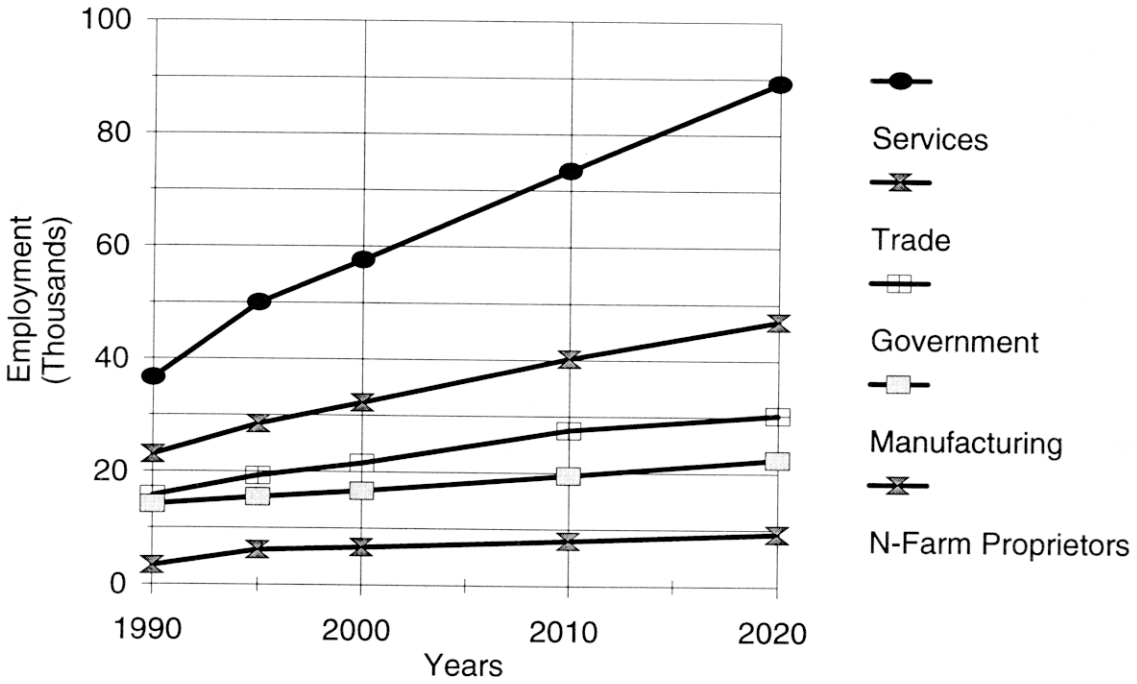


Table 4-2
EMPLOYMENT PROJECTIONS
Utah Lake Basin

County	1990	1995	2000	2010	2020
Juab County					
Agriculture	297	284	288	289	289
Mining	107	45	45	49	51
Construction	109	93	98	117	133
Manufacturing	250	338	353	375	391
TCPU	28	58	64	74	84
Trade	489	555	591	667	705
FIRE	27	41	42	47	48
Services	293	473	521	632	714
Government	462	545	519	569	592
Non-Farm Proprietors	139	160	171	196	204
County Total	2,201	2,592	2,692	3,015	3,211
Utah County					
Agriculture	2,625	2,866	3,034	3,215	3,314
Mining	40	81	83	89	95
Construction	2,989	5,781	6,210	7,481	8,679
Manufacturing	14,089	15,012	16,131	18,966	21,854
TCPU	2,518	2,356	2,683	3,320	3,945
Trade	21,929	27,040	30,730	38,379	44,763
FIRE	2,275	3,032	3,405	4,149	4,669
Services	35,640	48,595	55,986	71,486	86,628
Government	14,660	17,972	20,236	25,898	28,592
Non-Farm Proprietors	7,243	9,063	10,490	13,342	15,467
County Total	104,008	131,798	148,988	186,325	218,006
Wasatch County					
Agriculture	435	426	434	438	441
Mining	0	0	0	0	0
Construction	276	322	349	424	502
Manufacturing	121	146	163	203	242
TCPU	90	103	118	144	170
Trade	602	859	987	1,247	1,488
FIRE	71	57	65	79	91
Services	703	899	1,090	1,469	1,872
Government	674	772	849	1,082	1,162
Non-Farm Proprietors	335	418	486	624	739
County Total	3,307	4,002	4,541	5,710	6,707
Basin Total	109,516	138,392	156,221	195,050	227,924

[1]Source: Governor's Office of Planning and Budget, State of Utah, Economic and Demographic Projections, 1994.

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Water Supply and Use

The primary feature of this hydrologic system is Utah Lake. It receives flows from nearly all streams in the basin and from tributary groundwater.

5.1 Introduction

Most of the water used in the basin is for agricultural, municipal and industrial purposes. It comes from groundwater, Utah Lake and its tributaries, Deer Creek, Jordanelle, Strawberry, Mona, and other upstream reservoirs. Figure 5-1 shows the major rivers, streams and water impoundments. Figure 5-2 shows the quantity of flows into, through and out of the Utah Lake Basin.

5.2 Background

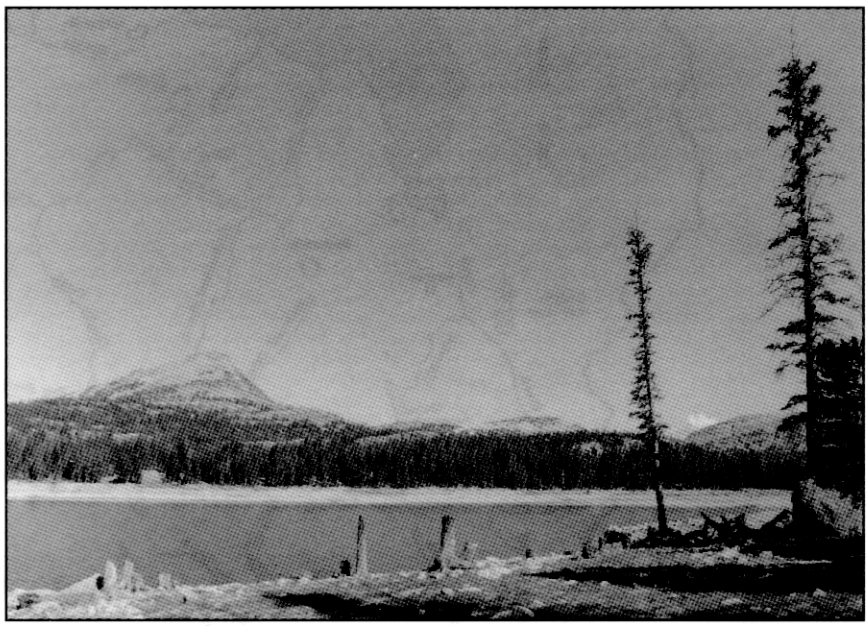
Population growth and development of the basin's natural resources have brought a dramatic increase in water demand. Professional staffs of irrigation companies, cities, water conservancy districts and metropolitan water districts are meeting this demand. Federal agencies have played a prominent role in constructing Strawberry, Deer Creek and Jordanelle reservoirs and conveyance facilities to import water from the Weber and Uinta basins. As the Central Utah Project moves to completion, the basin's surface water supply will soon be fully developed. Maintenance and expansion of groundwater delivery systems will mark the next phase of water supply history. Conservation and water education will also be essential elements in meeting needs of the next generations.

5.3 Water Supply

The developed water delivery systems range from simple to complex. Major aqueducts and large storage reservoirs enhance most irrigation and municipal systems. Small systems are also operating, consisting of a spring, a well or earthen ditches.

5.3.1 Surface Supply

Utah Lake became a storage reservoir in 1872 when a low dam was placed across the lake's outlet to the Jordan River. Water released from Utah Lake to the Jordan River is diverted mostly for irrigation and other uses in northern Utah County and Salt Lake County. At compromise level, Utah Lake can store approximately 870,000 acre-feet of water. Compromise level is the lake surface elevation (4,489.045 feet) at which gates releasing water to the Jordan River must be fully opened. About 710,000 acre-feet of water can be considered active capacity since it is within a 12-foot draw down below compromise, and 160,000 acre-feet is inactive. The first 125,000 acre-feet of active storage is called primary storage. The balance is called system storage.



Washington Lake

Provo River is the largest tributary to Utah Lake. In the upper Provo drainage, the Ontario Tunnel was

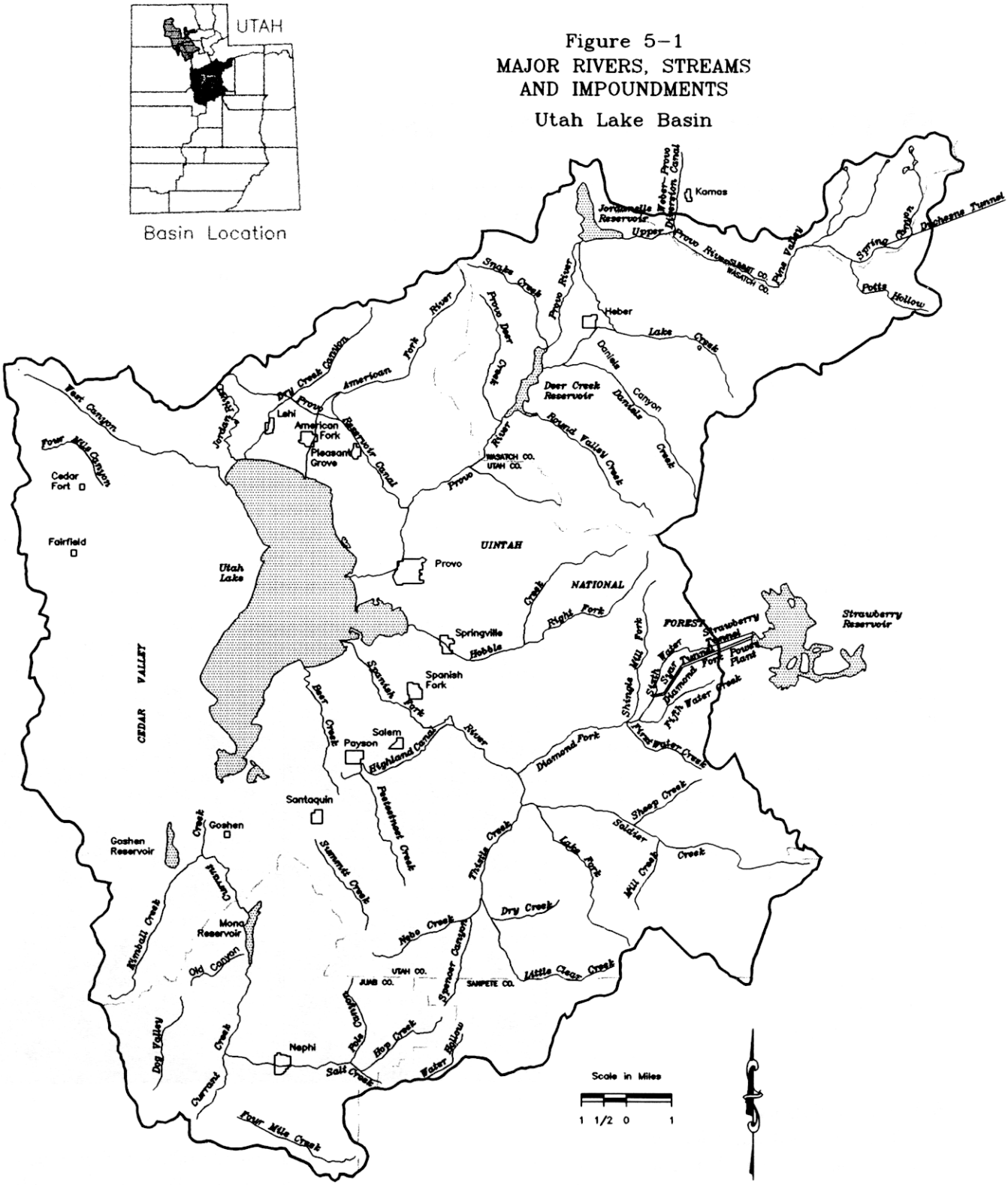
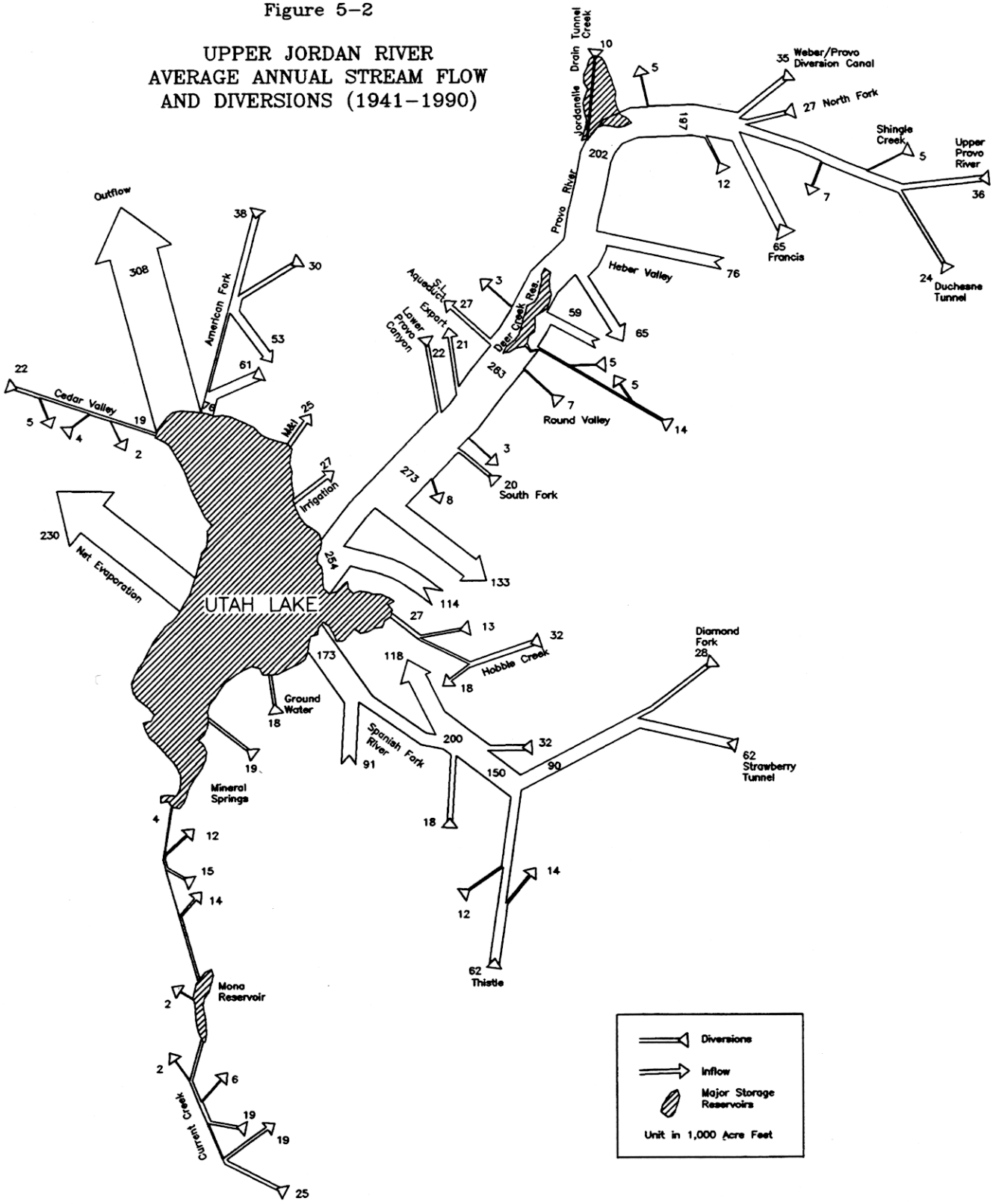


Figure 5-1
MAJOR RIVERS, STREAMS
AND IMPOUNDMENTS
Utah Lake Basin

Figure 5-2

UPPER JORDAN RIVER
AVERAGE ANNUAL STREAM FLOW
AND DIVERSIONS (1941-1990)



constructed in 1891 for draining the lower levels of the Ontario, Daly, West and Silver King mines. These mines are near Park City in the Weber River drainage. The tunnel drains water from the lower levels of the mines in a southeasterly direction, crosses the divide between the Provo and Weber River basins and discharges on the Provo side some two miles below the summit. Throughout the greater part of its length of four miles, the tunnel also receives water from underground sources. Consequently, the volume discharged at its mouth is more than the amount drained from the mines. The mean annual flow from this tunnel is about 10,000 acre-feet.

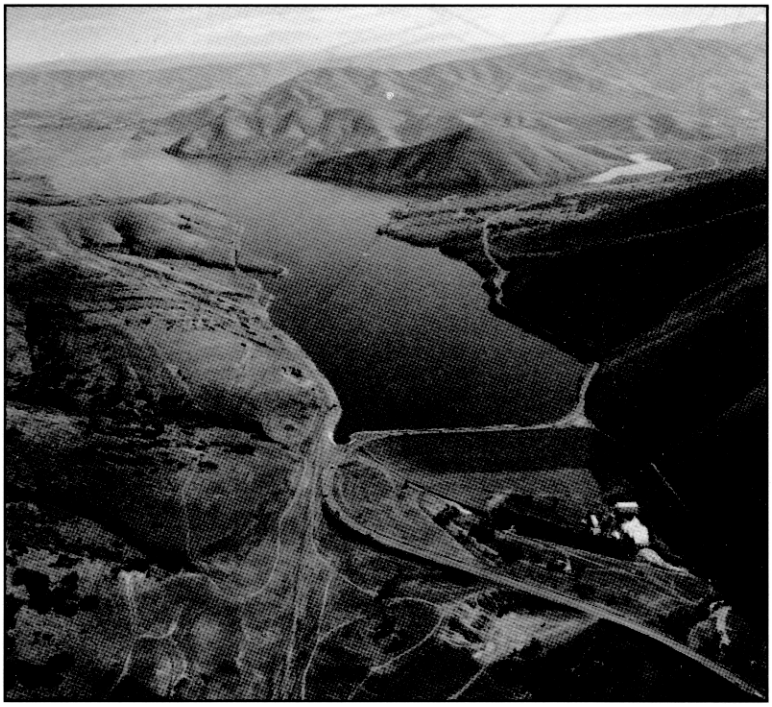
Fifteen lakes are clustered at the headwaters of the Provo River near the crest of the Uinta Mountains. North Fork, the only large tributary that enters this river from the north, also heads in a group of small lakes near the crest of the range. Soapstone Creek, South Fork and Little South Fork drain a part of the Rhodes Plateau which separates the drainage of the Provo River from the Duchesne River. These tributaries enter the Provo River above the gaging station near Woodland. No perennial tributaries exist between the gaging station and Hailstone. Ross Creek enters the Jordanelle Reservoir at the former site of Keetly and is intermittent upstream from the mouth of the Ontario No. 2 Drain Tunnel.

The 15 small lakes at the head of the main stem of the Provo River, and at the head of North Fork, have been fitted with dams and outlet works and function as storage reservoirs. The combined regulated capacity of these reservoirs is about 14,200 acre-feet. They were constructed around 1910 by the Provo Reservoir Water Users Company, Provo City, and upper basin irrigation companies located in the Francis and Heber Valley areas. Though each reservoir is separately owned, the group is operated as a unit. Storage of 4,200 acre-feet belongs to the Provo Reservoir Water Users Company. The company is stabilizing 12 of these lakes with funding from Section 308 of the Central Utah Project Completion Act, and they will be used for recreation, fish and wildlife purposes. Storage previously provided in those reservoirs is now available in Jordanelle. The remaining three lakes, Trial, Washington and Lost, have undergone major rehabilitation and will continue storing water for irrigation and CUP purposes.

Main (Round Valley) Creek and its south branch, Little Hobble Creek, drain Round Valley and the surrounding mountains. Main Creek discharges into Deer Creek Reservoir.

In addition, several small reservoirs regulate the discharge of the Lake Creek-Center Creek drainage. The storage capacity of these small reservoirs is not reported.

The average discharge (1953-67) of the Provo River above Deer Creek Dam is 256,000 acre-feet. Of this amount, about 200,000 acre-feet originates within the drainage basin. About 56,000 acre-feet of this water is imported from other basins.



Deer Creek Reservoir

Deer Creek reservoir, the second largest major reservoir in the basin, is the main feature of the Provo River Project. It is located in Provo Canyon, west of Heber Valley. The reservoir has an active capacity of 152,560 acre-feet and stores water imported from the Weber and Duchesne rivers as well as the Provo River. Power production, irrigation, and municipal are the primary uses of reservoir water. Previously constructed canals and the enlarged Provo Reservoir Canal distributes the irrigation water.

The Salt Lake Aqueduct takes water from Provo River to Salt Lake City through the Traverse Mountains. It is also part of the Provo River Project. It begins at Deer Creek Dam, runs along the north side of Provo

Canyon, then along the northeast side of Utah Valley. It ends at a treated water reservoir at 3500 South in Salt Lake City. Water can be treated along the way at one of four treatment plants. The Metropolitan Water District of Salt Lake City operates and maintains the aqueduct which went into operation in 1952. It presently conveys 27,000 acre-feet of water, and has the potential for 61,700 acre-feet of municipal and industrial water to Salt Lake County. The Salt Lake Aqueduct also serves areas in north Utah County when space is available.

In Utah Valley, most surface water supplies are produced in mountains on the valley's east side. Table 5-1 shows average annual stream flows produced by basin sources. The second largest major stream is the Spanish Fork River, with its tributaries Diamond Fork and Thistle Creek. Other significant streams in Utah County are Dry Creek, American Fork River and Hobble Creek. Currant Creek and Salt Creek are the major streams in Juab County. Currant Creek originates in Juab County and flows into Utah County. Other small streams, many of which are ephemeral, drain the western face of the Wasatch Range and other mountainous areas. Developed supplies in the Utah Lake Basin are 790,300 acre-feet per year, which includes the Provo River outflow from Wasatch County. Table 5-2 shows presently developed surface and groundwater supplies by county. Under the CUPCA, an additional 101,900 acre-feet of water will be supplied to the Utah Lake Basin from the enlarged Strawberry Reservoir in the Uinta Basin. The water will be delivered for irrigation use in southern Utah and eastern Juab counties, and for municipal and industrial use in southern Utah County. Water will also be delivered to Utah Lake for northern Utah and Salt Lake counties in exchange for water retained in Jordanelle Reservoir. Delivery of water in the Utah Lake Basin will be managed to provide minimum flows in Diamond Fork Creek and the Spanish Fork River to enhance fish and riparian habitat. This water comes to the Utah Lake Basin by transbasin diversion from Strawberry Reservoir. Several smaller reservoirs are part of this water supply system. See Section 6 for specific data.

5.3.2 Groundwater Supplies

Most of the groundwater in the basin originates in the mountains. See Section 19 for a more detailed explanation of groundwater conditions.

5.4 Water Use

About 61,700 acre-feet of municipal water from Deer Creek Reservoir may be exported annually to Salt Lake City by the Metropolitan Water District of Salt Lake City (MWD). The MWD will receive 20,000 acre-feet of Central Utah Project water from Jordanelle Reservoir. The Salt Lake County Water Conservancy District will receive 50,000 acre-feet from the CUP.

Jordanelle Reservoir in Wasatch County was completed in 1993 and filled in 1996 with active capacity of 314,000 acre-feet. With this reservoir in operation, some additional consumptive use is taking place in the upper Provo River Basin. About 15,100 acre-feet of supplemental irrigation water will be provided annually to irrigators in the Francis, Daniels and Heber areas as follows: Francis, 3,000; Daniels, 2,900; Wasatch County, 9,200. Irrigators have experienced shortages ranging from three to 51 percent, averaging about 17,000 acre-feet annually usually in July and August. Supplemental water provided by Jordanelle Reservoir helps alleviate these shortages.

Jordanelle Reservoir also provides 2,400 acre-feet per year of municipal water annually for Wasatch County. Jordanelle will provide about 70,000 acre-feet yearly for municipal uses in Salt Lake County and 20,000 acre-feet in north Utah County. This water is diverted from the Provo River at the Olmsted diversion to the Jordan and Alpine aqueducts. Annual evaporation from Jordanelle Reservoir is about 4,900 acre-feet.

When the Bonneville Unit of the CUP is fully operational, additional water from Strawberry Reservoir will flow to southern Utah and eastern Juab counties. The CUWCD has purchased Utah Lake water rights equivalent to approximately 25,000 acre-feet of primary and 57,000 acre-feet of secondary water rights.

Historically, these rights have yielded an average annual water supply of approximately 50,200 acre-feet. Water associated with the acquired water rights would remain in Utah Lake and be used to offset the decreased inflow to the lake under Bonneville Unit operation. In east Juab County, 12,525 acres of presently irrigated land and 10,835 acres of non-irrigated land are eligible for project water. In south Utah County, 50,320 acres of irrigated land may receive supplemental water along with 1,890 acres near Elberta. Approximately 17,920 acres of irrigated land in Heber Valley and 4,820 acres in the Francis area of Summit County may receive project water. Municipalities in southern Utah County may petition for 11,200 acre-feet of municipal and industrial water annually from the increased imports of

Table 5-1
AVERAGE ANNUAL STREAM FLOWS AT GAGING STATIONS

Gage No.		Years	Acre-feet
10146400	Currant Creek near Mona	1978-93	21,713
10147000	Summit Creek near Santaquin	1911-66	9,003
10147500	Peteetneet Creek near Payson	1948-62	9,167
10148400	Nebo Creek near Thistle	1964-74	10,091
10150500	Spanish Fork at Castilla	1919-93	163,053
10149500	Diamond Fork near Thistle	1954-93	76,954
10152500	Hobble Creek near Springville	1909-74	31,244
10152900	Maple Creek near Mapleton	1965-73	1,510
10155100	Provo River below Jordanelle	1992-93	60,726
10155500	Provo River near Charleston	1939-93	127,081
10159500	Provo River below Deer Creek	1953-93	251,387
10154500	Weber-Provo Canal near Woodland	1943-93	37,100
10153800	North Fork Provo River near Kamas	1963-73	9,620
10154000	Shingle Creek near Kamas	1963-93	26,641
10156000	Snake Creek near Charleston	1939-50	30,623
10158500	Main Creek near Wallsburg	1939-50	9,615
10160000	Deer Creek near Wildwood	1939-50	26,641
10161500	South Fork Provo River at Vivian Park	1912-62	9,620
10164500	American Fork above Power Plant	1928-89	40,863
10165500	Dry Creek near Alpine	1948-55	5,426
10166000	Fort Creek near Alpine	1948-55	6,073
10166430	West Canyon Creek near Cedar Fort	1965-93	2,204
10167000	Jordan River at Narrows	1936-91	310,000
10145500	Salt Creek near Nephi	1951-81	18,756
09272500	Duchesne Tunnel near Kamas	1953-69	31,123
09282000	Strawberry Tunnel near Thistle	1922-68	61,523

Source: USGS Daily Values by Earthinfo Inc. Westone-1994

Table 5-2 PRESENTLY DEVELOPED WATER SUPPLIES					
Source	Juab	Summit	Utah (ac-ft/yr)	Wasatch	Total
Groundwater	25,290	1,830	263,105	8,340	298,560
Surface Water	20,840	13,600	386,130	71,170	491,740
TOTAL	46,130	15,430	649,235	79,510	790,300

Strawberry Reservoir water. In addition, imported Strawberry Reservoir water and purchased Utah Lake water will replace a portion of what is diverted from the Provo River for municipal and industrial use in Salt Lake, Utah and Wasatch counties. Increased diversions to the Jordan and Alpine aqueducts will reduce flow to the Olmsted hydroelectric plant, making its operation infeasible by about the year 2016.

5.4.1 Agricultural Water Use

The largest consumptive use of surface water is for irrigation. Annual diversions have averaged about 453,700 acre-feet, of which over half becomes part of surface or subsurface return flow. Approximately 166,400 acres of crops receive irrigation water from basin wells, streams and reservoirs. Table 5-3 summarizes irrigation water use. Section 10 provides more detail.

Table 5-3 IRRIGATION WATER USE (1988)		
County	Area (acres)	Diversions[1] (acre-feet)
Juab	18,510	42,000
Sanpete	2,920	9,100
Summit	2,910	7,400
Utah	120,590	333,200
Wasatch	21,470	62,000
Total	166,400	453,700

[1] Some diversions consist of return flows from other diversions

5.4.2 Municipal and Industrial Water Use

Municipal and industrial culinary water diversions average about 141,345 acre-feet per year. This category of use includes water used in homes, businesses and industry. It also includes culinary water used to irrigate lawns and gardens, golf courses, parks, school yards and other outdoor areas. Table 5-4 shows the 1995 usage.

5.4.3 Secondary Water Use

People also use water from secondary systems to irrigate lawns and gardens, parks, cemeteries and golf courses. These systems use untreated water and may be owned and operated by municipalities, irrigation companies, special service districts and others. Lehi, Lindon, Payson and Nephi currently have pressurized secondary systems. Most other cities have ditch systems serving some or all of their residents. Some have pressurized irrigation only on specific areas such as golf courses or large parks. Estimated diversions for 1995 are shown in Table 5-5.

5.4.4 Water Use in Wet/Open Water Areas

Wetlands occur around Utah Lake, along rivers, and near other streams, springs, bogs, wet meadows, lakes, and ponds. Riparian lands display a great diversity of vegetation and wildlife species. These areas account for about 7.3 percent of the total land area. Table 5-6 shows water used by wet/open areas. Water use (depletions) from these wet/open water areas in Utah Lake Basin is about 256,700 acre-feet per year. Net evaporation from Utah Lake is about 230,000 acre-feet per year.

5.4.5 Minimum Instream Flow Requirements

Instream flows are primarily non-consumptive and contribute to the ecology and quality of life. Figure 5-3 shows instream flow requirements for the Utah Lake Basin.

Provo River - Section 303 of the CUPCA requires instream flows in the Provo River be supplied with water from the Bonneville Unit of the CUP according to the Deer Creek Reservoir/Jordanelle Reservoir Operating Agreement. Bonneville Unit water may be released from either Deer Creek Reservoir or Jordanelle

Figure 5-3
INSTREAM FLOW REQUIREMENTS
Utah Lake Basin

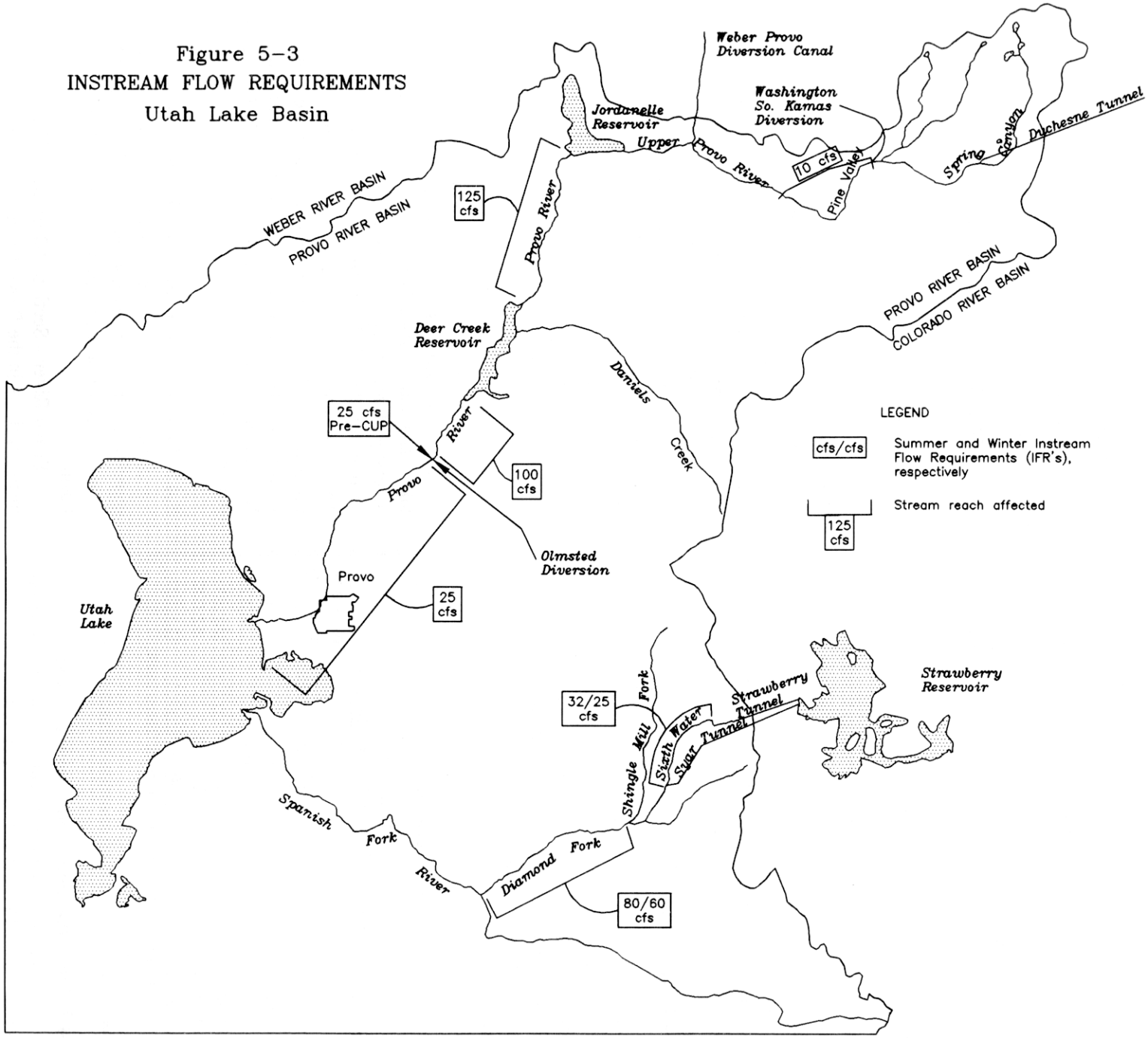


Table 5-4
1995 MUNICIPAL AND INDUSTRIAL CULINARY WATER USE

Description	County Juab	Summit	Utah	Wasatch	Total
	(acre-feet)				
Residential					
Public Community Systems	855	350	62,925	2,130	66,260
Public Non-Community Systems	0	5	75	5	85
Private Domestic Systems	15	25	20,400	100	20,540
Total	870	380	83,400	2,235	86,885
Commercial/Institutional					
Public Community Systems	455	0	25,690	465	26,610
Public Non-Community Systems	5	5	100	40	150
Total	460	5	25,790	505	26,760
Industrial					
Public Community Systems	205	0	20,920	60	21,185
Self-Supplied Industries	435	0	6,080	0	6,515
Total	640	0	27,000	60	27,700
Total Municipal and Industrial Use	1,970	385	136,190	2,800	141,345

Table 5-5
1995 ESTIMATED MUNICIPAL SECONDARY WATER USE[a]

County	Diversions (acre-feet)
Juab	550
Summit	0
Utah	3,200
Wasatch	1,350
Total	5,100

a Does not include industrial use.

Table 5-6
WET/OPEN AREA WATER USE

County	Depletions (acre-feet)
Juab	4,360
Sanpete	440
Summit	0
Utah	239,400
Wasatch	12,500
Total	256,700

Source: Water Budget Report of the Upper Jordan River Study Area (Utah Lake Basin), Unpublished.

Reservoir to meet the following instream flow requirements. Flow is measured in cubic feet per second or cfs.

- 125 cfs from Jordanelle Reservoir to Deer Creek Reservoir,
- 100 cfs from Deer Creek Reservoir to Olmsted Diversion, and
- 25 cfs from Olmsted Diversion to Utah Lake. This increases to 75 cfs when the district has acquired sufficient water rights in the Provo River Drainage.

The 25 cfs from Olmsted Diversion to Utah Lake is required in the final Environmental Impact Statement for the M&I system. These amounts will be supplied from the Bonneville Unit of the CUP. Since the instream flow requirements are primarily non-consumptive uses, part of these releases can be used to meet other water demands.

Diamond Fork Creek/Spanish Fork River - The CUPCA also mandates certain flow requirements in Diamond Fork Creek and its tributaries. Upon completion of facilities to permit re-diversion of water from Diamond Fork Creek, the following flows are required. In Sixth Water Creek, minimum required flows are 32 cfs May through October and 25 cfs November through April. Minimum instream flow requirements in Diamond Fork Creek are 80 cfs May through September and 60 cfs October through April. Current proposed uses of Strawberry Reservoir and CUP water provides an average annual delivery of 21,300 acre-feet to Utah Lake through the Spanish Fork River. About 17,000 acre-feet is required to maintain instream flows in Diamond Fork Creek and Sixth Water Creek.

Excess Flows in Provo River - With the introduction of additional water to the Provo River, there is an accompanying concern for excess flows during late summer and early fall. These higher flows will occur on the Provo River between Deer Creek Reservoir and the Olmsted diversion under full delivery of Bonneville Unit water. The CUPCA authorized additional study of this concern, and $500,000 has been earmarked for study of mitigation measures. No studies of excess flows above Jordanelle Reservoir are required.

5.4.6 Other Use

A major non-consumptive use of water in the Utah Lake Basin is recreation. State parks are at Utah Lake, Deer Creek Reservoir and Jordanelle Reservoir. Boating, waterskiing, fishing and camping opportunities draw thousands of visitors. This aspect of water use is explained in detail in Section 15. Hydroelectric power generation also uses basin water. Fifteen hydroelectric power plants with installed capacity of about 22 megawatts turn falling water into energy. Section 18 provides additional information on hydropower.

5.5 Interbasin Diversions

Water is imported to the Utah Lake Basin from the Weber and Uinta basins. Water is exported from this basin north to the Jordan River Basin, i.e., Salt Lake County.

5.5.1 Imports

Two canals divert water from the Strawberry River drainage to Daniels Creek. Each canal has two points of diversion. The Strawberry River Canal and Willow Creek Canal were commingled in 1954 to form a single canal entering Daniels Creek. And the Upper and Lower Hobble Creek canals were also combined to form one canal. Water diverted to canals is distributed by the Daniels Creek Irrigation Company in Heber Valley, but it will end when the Wasatch County Water Efficiency Project and Daniel Replacement Project are completed.

The Strawberry Valley Project, operated by the Strawberry Water Users Association and which diverts water from the Uinta Basin into the Bonneville Basin, is one of the earliest federal reclamation developments. Water was collected in the 270,000 acre-foot active capacity Strawberry Reservoir formed by a dam on the Strawberry River, a tributary of the Duchesne River. Figure 5-4 shows major import facilities. Feeder canals brought additional water to the reservoir from Indian and Currant creeks. The Strawberry Tunnel, which is 3.7 miles long, extends from Strawberry Reservoir to Sixth Water Creek. Sixth Water Creek is tributary to Diamond Fork which empties into the Spanish Fork River. Historically, 62,000 acre-feet of water has been delivered annually through the Strawberry Tunnel to the Spanish Fork River for irrigation purposes, primarily in southern Utah Valley. A small amount of the stored water is also conveyed to Goshen Valley. Two small hydroelectric power plants are just below the project's point of diversion from the Spanish Fork River. The initial Weber-Provo Diversion canal, with a capacity of 210 cfs, was constructed in 1928-31 as one feature of the Weber River Project. Water diversions for the 1932 to 1942 period ranged from a low of 2,500 acre-feet to a

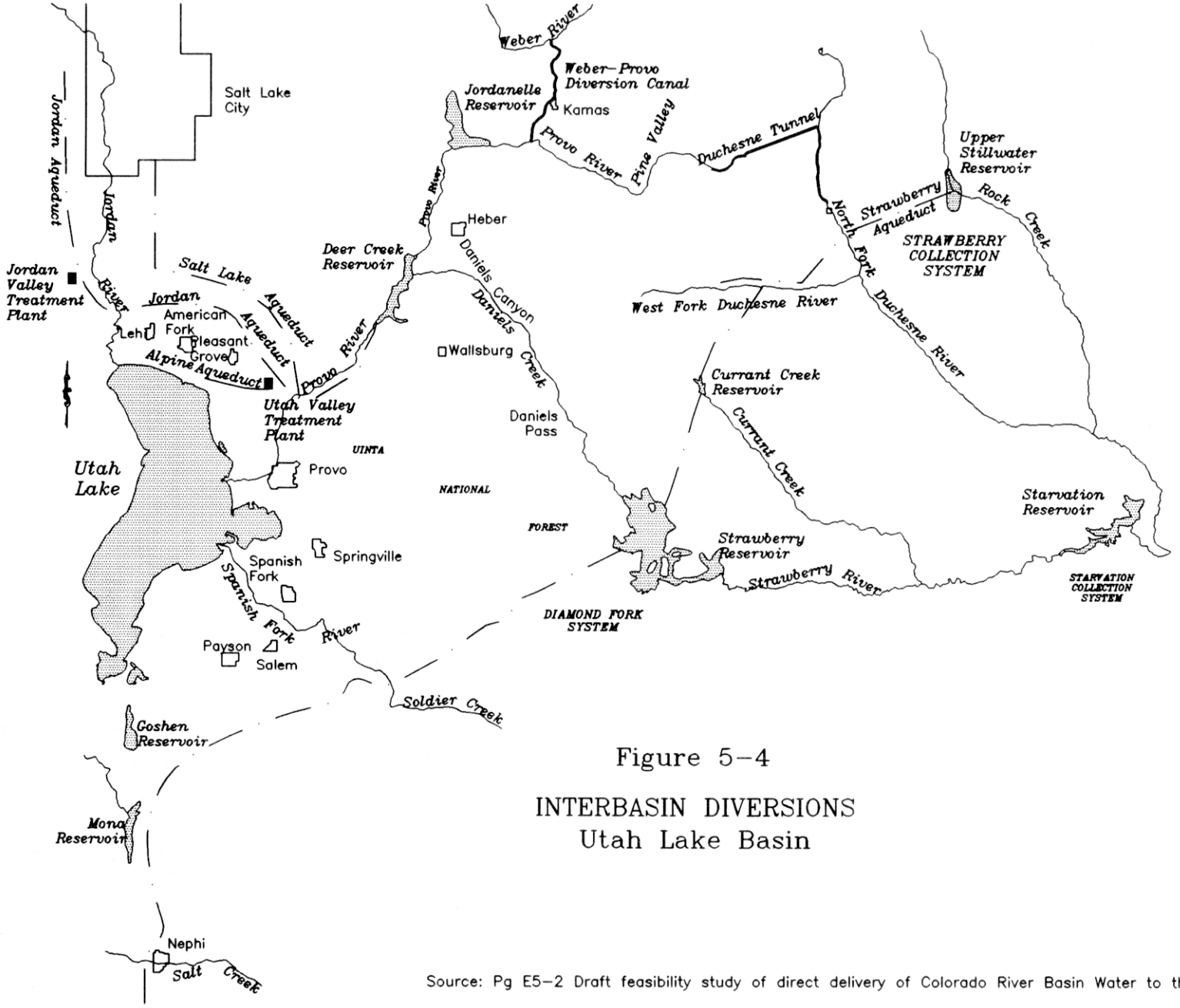


Figure 5-4

INTERBASIN DIVERSIONS
Utah Lake Basin

Source: Pg E5-2 Draft feasibility study of direct delivery of Colorado River Basin Water to the Provo River Basin

high of 17,300 acre-feet and averaged 9,900 acre-feet. The Weber-Provo Diversion Canal was enlarged after 1942 to 1,000 cfs under the Provo River Project. The canal diverts water from the Weber River near Oakley, transports it nine miles southward through Kamas Valley, and delivers it to the Provo River near Francis, upstream of the Jordanelle Reservoir. Water is diverted under an existing water right appropriated to the Provo River Water Users Association. This water right allows for a maximum annual diversion from the Weber River and Beaver Creek of 136,500 acre-feet for storage in Deer Creek Reservoir. An additional water right allows for diversion of up to 37,200 acre-feet from the Weber River Basin for storage in Utah Lake in years when Deer Creek Reservoir is full and capacity is available in Utah Lake. Between 1943 and 1993, a 51- year period, the enlarged canal water diversions have ranged from a low of 5,294 acre-feet to a high of 88,440 acre-feet, averaging 35,000 acre-feet.

The Duchesne Tunnel, also part of the Provo River Project, diverts water from the North Fork of the Duchesne River, a tributary of the Green and Colorado Rivers. The tunnel intake is 21 miles east of Woodland. This tunnel, located under a spur of the Uinta Mountains, has a capacity of 600 cfs, is six miles long and discharges into the main stem of the Provo River upstream from Woodland. Completed in 1953, the tunnel began delivering water for the 1954 irrigation season. Flow is dependent upon rights to surplus water for its diversions, because it has a 1936 water right and there are many prior rights on the Duchesne River. At the North Fork Duchesne River diversion, more than 70 percent of annual flow occurs during May and June. Water diversions have ranged from 0 to 57,750 acre-feet, averaging about 24,000 acre-feet annually.

When the CUP Bonneville Unit fully operates, annual imports from Strawberry Reservoir will increase by 101,900 acre-feet. Communities in south Utah County anticipate using 11,200 acre-feet for municipal use and 27,700 acre-feet for irrigation. East Juab County will receive 36,300 acre-feet for irrigation and, 4,400 acre-feet is planned for delivery to Mona Reservoir. Diamond Fork Creek will receive 21,300 acre-feet for instream flow needs and for exchange to Utah Lake. These numbers do not include return flows to Elberta and the area west of Mona Reservoir.

5.5.2 Exports and Outflow

Approximately 61,700 acre-feet of water will eventually be exported to the Metropolitan Water District of Salt Lake City from the Deer Creek Project. Utah Lake presently discharges 308,000 acre-feet at the Jordan River Narrows to the Jordan River Basin, including 140,000 for agricultural uses. The Welby-Jacob Exchange of Utah Lake water for higher quality Provo River water provides 29,400 acre-feet to Salt Lake County Water Conservancy District for treatment. But in drought years the amount is 17,500 acre-feet. The CUP Bonneville Unit in recent years delivered 20,000 acre-feet of municipal water to Salt Lake County. Eventually, the CUP may deliver up to 84,000 acre-feet to Salt Lake County during times of drought.

A small irrigation canal near Kamas diverts water from the Provo River drainage to the Weber River Basin. The amount of water exported is not known because there is no gaging station. Another small amount of water is imported from Fish Creek on the Price River system to Thistle Creek on the Spanish Fork River. The Indianola Irrigation Company can divert up to 3 cfs. Table 5-7 lists major imports and exports from the Utah Lake Basin. ✣ ✣

Table 5-7
INTERBASIN DIVERSIONS

Source Basin	Source/Stream	Conveyance	Receiving Stream/Facility	Operator	Flow Capacity (cfs)	Developed Supply (acre-feet)
Imports						
Uinta	Strawberry River	Strawberry/Willow Crk.Canal, Hobble Crk. Ditch	Daniels Creek	Daniels Irr. Co.	30/12	2,900[a]
Uinta	Strawberry River	Strawberry Tunnel	Sixth Water (Diamond Fork) Spanish Fork	Strawberry Water Users Assoc.	460	62,000
Uinta	Duchesne Tributaries	Strawberry Collection System	Diamond Fork	CUWCD	600	101,900[b]
Weber	Weber River	Weber-Provo Diversion Canal	Provo River	Provo River Water Users Assoc.	1,000	35,000
Uinta	Duchesne River (North Fork)	Duchesne Tunnel	Provo River	Provo River Water Users Assoc.	600	24,000
Total Imports						225,800
Exports/Outflow to SL County	Deer Creek Res.	Salt Lake Aqueduct	Salt Lake City MWD Treatment Plant	Salt Lake City MWD		61,700[b]
	Utah Lake	Jordan River	Jordan River			308,000
	Welby-Jacob Exchange	Provo Reservoir Canal	Jordan Treatment Plant	SL County WCD		29,000
	Central Utah Project	Jordan Aqueduct	Jordan Treatment Plant	SL County WCD		70,000[b]
	Provo River	Wash. and S. Kamas Irr. Canals	Beaver Creek	Wash. and S. Kamas Irr. Co's		NA
Total Exports/ Outflows						468,700

a Will end when CUP is completed.
b Total potential diversion when CUP is completed and demand requires.

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Management

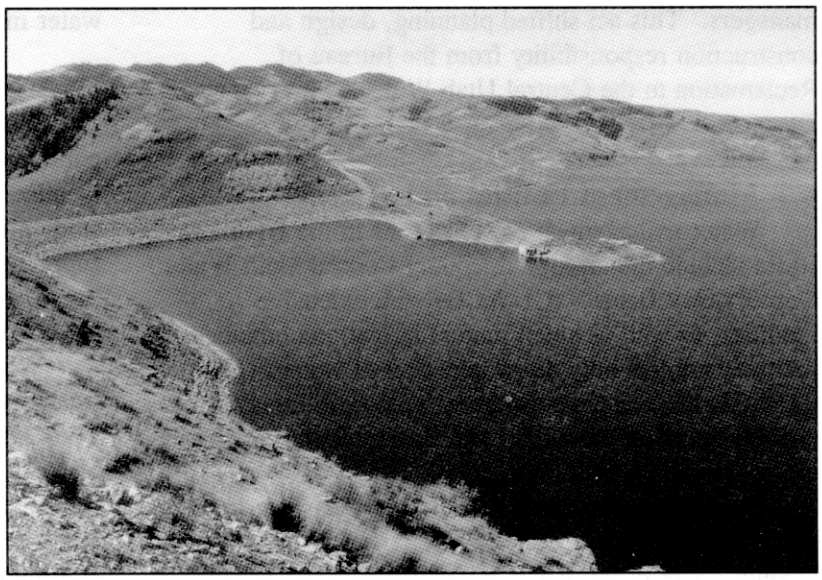
The Utah Lake Basin provides a microcosm of water-related issues which can be viewed in isolation or as part of a broader exercise in ecosystem management.

6.1 Introduction

This section describes the water management functions of private and government entities. Water management is the art of delivering water to people and places at the optimum time and in the optimum condition. One present challenge facing water managers in the Utah Lake Basin is transferring agricultural water to urban uses. This is particularly true for the Strawberry Valley Project, which is one of the earliest federal reclamation projects constructed. It supplies irrigation water to south Utah County. But much of the service area is now urbanizing and all the water is no longer needed for agriculture. This is a paid-out project, and the Strawberry Water Users Association (SWUA), who manages the project, would like to convert some of the water to municipal and industrial use. The Bureau of Reclamation and SWUA, however, have differing opinions on how this transfer of use can be accomplished. Outside of federal project juisdictions, this transformation from agricultural to urban use has been gradual, occurring within the framework of the doctrines of prior appropriation and beneficial use. Judicial approval of markets as the vehicle for transferring water to its highest economic use has kept the process orderly and efficient. State legislative action has broadened the scope of beneficial use to include instream flows for recreation and fish and wildlife purposes.

6.2 Setting

Water management has historically been the responsibility of local water using agencies such as mutual irrigation companies, water user associations and cities. They operate within the rules and guidelines established by state statute which is enforced and administered by the State Engineer. Since pioneer times in the mid 1800s, most water originating in the basin has been used for agricultural crops locally and in Salt Lake County. The Reclamation Service constructed the Strawberry Project in 1906 to bring water from the Uinta Basin to farmers in the Utah Lake drainage. Construction of the Provo River Project began in 1939. This project enabled water users to import water from the Weber and Duchesne rivers and provide water to north Utah County and Salt Lake County metropolitan areas. As Wasatch Front urbanization increased the demand for municipal and industrial water during the 1940s and 1950s, water managers began looking for additional supplies. Congress approved the Central Utah Project (CUP) in 1956 and construction began on facilities to import more Uinta Basin water to communities in Central Utah. The Central Utah Water Conservancy District is the local sponsor.



Soldier Creek Dam, Strawberry Reservoir

Meanwhile, in eastern Juab County, farming continued as the primary water user and economic activity. In picturesque Wasatch County, small irrigated farms and a few small towns reflected the heritage and lifestyle of the original Scandinavian and European settlers. Mining near neighboring Park City influenced the culture and economy of early Wasatch County life. In the 1970s, urbanizing of Utah and Salt Lake counties began to spill over into Heber and nearby towns. Condominiums, mountain summer homes, ski resorts and golf courses characterized this urban growth.

Passage of the Central Utah Project Completion Act (CUPCA) in 1992 authorized completion of the CUP, but brought significant changes for water managers. This act shifted planning, design and construction responsibility from the Bureau of Reclamation to the Central Utah Water Conservancy District.

6.3 Management Entities and Systems

Water management organizations in the Utah Lake Basin include the large multicounty Central Utah Water Conservancy District (CUWCD) with extensive facilities, as well as small mutual irrigation companies that may control only a few acre-feet of water. The CUWCD has water management responsibilities that encompass all of the Utah Lake Basin. Its headquarters are at Orem, Utah County.

Smaller conservancy districts serve eastern Juab County, north Utah County and Charleston in Wasatch County. The Provo River Water Users Association operates and maintains the Provo River Project. This includes Deer Creek Dam and Reservoir, the Duchesne Tunnel, the Weber-Provo Diversion Canal, the Provo Reservoir Canal and other facilities. The Strawberry Water Users Association operates the Strawberry Valley Project.

The primary tool for managing water in the basin is storage reservoirs. Table 6-1 and Figure 6-1 show existing lakes and reservoirs in the drainage. Only reservoirs with high and moderate hazard dams are shown on the figure.

6.3.1 Agricultural

Many mutual irrigation companies and water conservancy districts provide management of agricultural water. Table 6-2 shows irrigation companies and water user groups with management responsibilities in delivering water to land areas larger than 350 acres.

The three major water management entities delivering federal reclamation project water are the Strawberry Water Users Association for the Strawberry Valley Project, Provo River Water Users Association for the Provo River Project, and Central Utah Water Conservancy District for the Central Utah Project.

Many of these organizations provide water for M&I uses to cities and districts which own shares of stock. Some cities use this untreated water for lawn and garden irrigation. In some cases, following an approved change in point of diversion and place and nature of use, cities pump their water from wells. Two drainage districts assist in managing water in the Benjamin area of Utah County. More information on agricultural water management can be found in Section 10.

6.3.2 Municipal and Industrial

Most M&I water is managed by cities and their public works departments. Figure 6-2 shows the location of all public community water suppliers in the study area. More data on public and private water suppliers can be found in sections 5 and 11.

6.3.3 Wholesalers

Wholesalers are those agencies that deliver raw or treated water to other agencies for resale to final users. The Central Utah Water Conservancy District is the primary water wholesaler in the Utah Lake Basin. Metropolitan water districts are associated with specific cities to deliver raw or treated water which is then sold at a higher price to residential, commercial and industrial users. Water user associations and most mutual irrigation companies also deliver water to retail entities that own shares of stock. Table 6-3 lists water wholesalers.

6.3.4 Waterfowl

Wildlife management areas at Powell's Slough and Goshen Warm Springs are managed for the benefit of waterfowl. Benjamin Slough and Goshen Bay are proposed as wetland preserves under the Central Utah Project Completion Act. For more information on waterfowl and wildlife-related water management, see Section 14.

6.4 Problems and Needs

With completion of the Central Utah Project, the large dam and reservoir sites have developed most of the available water supply. Chances to import water from adjacent basins will also be nearly exhausted.

Table 6-1
EXISTING LAKES AND RESERVOIRS

Name	County	Owner	Storage (acre-feet)	Use
Bigelow Debris Basin	Juab	Nephi City	65	FC
Miller Canyon Debris	Juab	Nephi City	50	FC
Mona	Juab	Current Creek Irrigation Co.	21,078	IR
Big Elk Lake	Summit	Washington Irrg. Co.	1,000	IR
Duck Lake	Summit	U.S. Forest Service	300	IR
Fire Lake	Summit	U.S. Forest Service	94	IR
Island Lake	Summit	U.S. Forest Service	98	IR
Long Lake I	Summit	Provo Res. Water Users Co.	824	IR
Lost Lake	Summit	US Bureau of Reclamation	1,080	IR
Marjorie Lake	Summit	Timpanogos Canal	285	IR
North Fork Lake #5	Summit	Provo Reservoir Water Users Co.	108	IR
North Fork Lake #6	Summit	Timpanogos Irrigation Co.	420	IR
Star Lake	Summit	Provo Reservoir Co.	314	IR
Teapot Lake	Summit	Provo Reservoir Co.	140	IR
Trial Lake	Summit	Central Utah Water Consv. Dist.	1,660	IR
Wall Lake	Summit	Timpanogos Irrigation Co.	1,015	IR
Washington Lake	Summit	USBR	2,355	IR
Weir Lake	Summit	Provo Res. Water Users Co.	116	IR
American Fork Debris Basin	Utah	Utah County	90	FC
Battle Creek Debris Basin	Utah	N. Utah County Water Consv. Dist.	44	FC
Big East	Utah	Payson City Corp.	670	IR
Box Lake	Utah	Payson City Corp.	160	IR
Dry Creek Debris Basin	Utah	N. Utah. County Water Cons. Dist.	226	FC
Dry Lake	Utah	Payson City Corp.	328	IR
Forest Lake	Utah	Undetermined	220	FC
Goshen Reservoir	Utah	Goshen Irrigation Co.	400	FC IR
Grove Creek Debris Basin	Utah	N. Utah. County Water Consv. Dist.	90	FC
Hobble Creek Debris Basin	Utah	Utah County	120	FC
Maple Lake	Utah	Payson City Corp.	130	IR
McClellan Lake	Utah	Payson City Corp.	20	IR
Mill Pond	Utah	Lehi Spring Creek Irrg. Co.	210	IR
Payson Canyon Debris Basin	Utah	Utah County.	42	FC

Table 6-1 Continued - -
EXISTING LAKES AND RESERVOIRS

Name	County	Owner	Storage[b] (acre-Feet)	Use
Payson Lake	Utah	Payson City	300	WS
Pittsburg	Utah	Am. Fork, Pleasant Grove et.al.	300	IR
Rock Canyon Debris Basin	Utah	Stormwater Service District	102	FC
Salem Pond	Utah	Salem Irrigation Co.	410	IR
Santaquin Debris Basin	Utah	Utah County	75	FC
Silver Lake flat	Utah	N. Utah County Water Cons. Dist.	1,040	WS
Slate Canyon No.2 Debris Basin	Utah	Stormwater Service District	23	FC
Smiths	Utah	Lake Fork Cattle Co.	320	WS
Spring Lake	Utah	Undetermined	140	NA
Summit Creek	Utah	Summit Creek Irrg. Co.	841	IR
Thistle Creek Debris	Utah	Utah County	125	FC
Tibble Fork	Utah	N. Ut .County Water Cons. Dist.	259	IR,RE
Utah Lake[a]	Utah	State of Utah	870,000	IR,RE
Winward	Utah	Payson City Corp.	73	IR
Anderson	Wasatch	Mable Anderson	132	IR
Atkinson No. 1	Wasatch	Brent Hill	20	IR
Center Creek No. 1	Wasatch	Center Creek Irrig. Co.	267	IR
Center Creek No.2	Wasatch	Center Creek Irrig. Co.	161	IR
Center Creek No. 3	Wasatch	Center Creek Irrig. Co.	86	IR
Center Creek No. 5	Wasatch	Center Creek Irrig. Co.	166	IR
Christensen	Wasatch	Heber Power and Light	80	IR
Clyde Lake	Wasatch	Cook Development	75	IR
Deer Creek	Wasatch	USBR	152,560	WS, M&I
Deer Valley	Wasatch	Lake Creek Irrg. Co.	172	IR
Duck Lake	Wasatch	Undetermined	420	IR
Hecla Mining	Wasatch	Stichting Mayflower	134	MI
Jones	Wasatch	Russ Wall, Dee Mills, et. al.	176	IR
Jordanelle	Wasatch	USBR	314,000	WS, M&I
Lindsay	Wasatch	Paul Cook	179	IR
Mill Hollow	Wasatch	Division of Wildlife Resources	317	RE
Three Lakes	Wasatch	Prestige Pictures Ind.	24	IR
Wasatch	Wasatch	Undetermined	1000	FC
Witt Lake	Wasatch	Lake Creek Irrig. Co.	853	IR

Key to Use Categories:
FC - Flood Control
WS - Water Storage
MI - Mining
IR - Irrigation
RE - Recreation
M&I - Municipal/Industrial

a Capacity at compromise elevation.
b Storage capacity shown may not equal actual amount stored.

Figure 6-1
EXISTING MAJOR LAKES AND RESERVOIRS
Utah Lake Basin

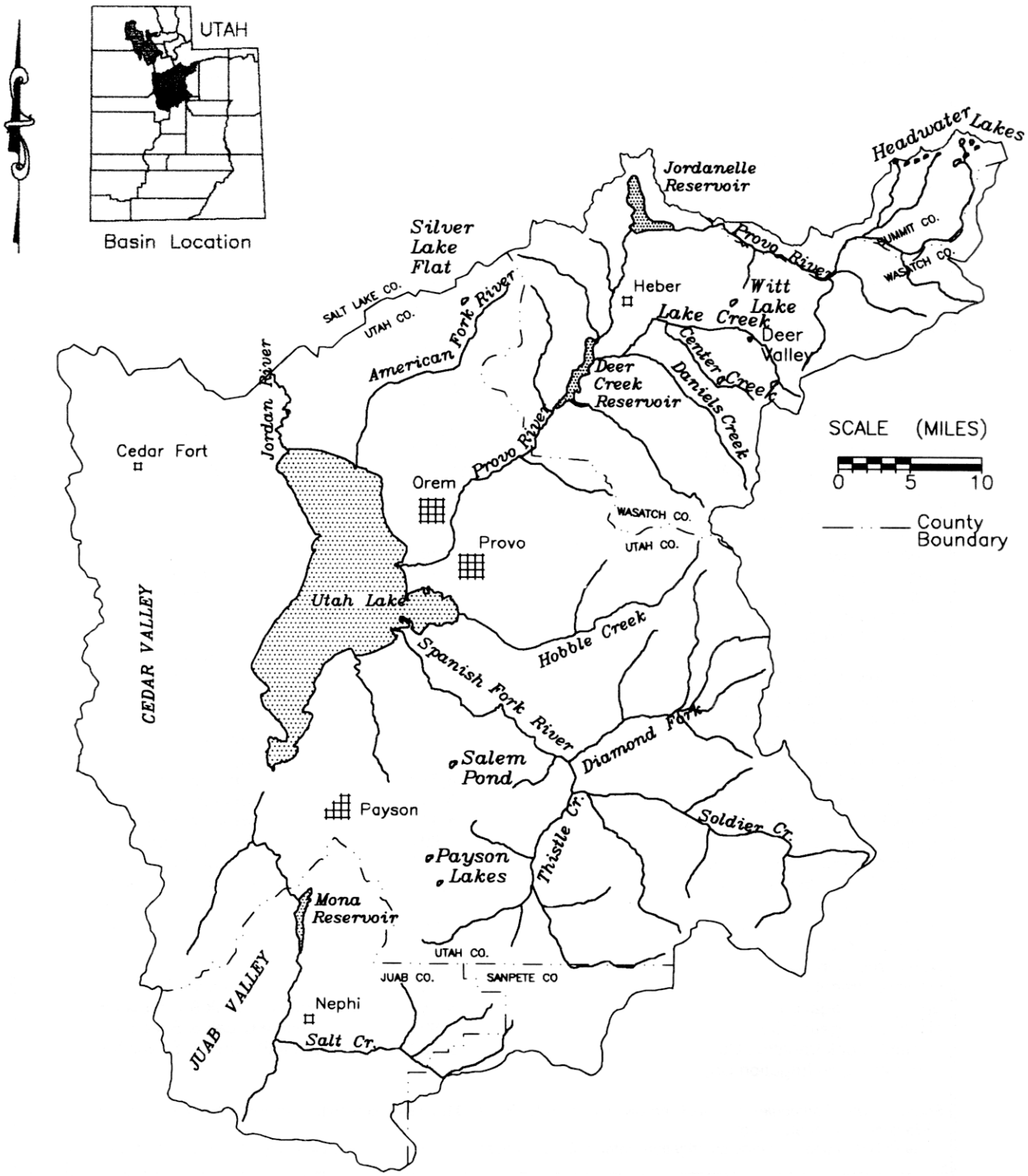


Table 6-2
IRRIGATION WATER PROVIDER ORGANIZATIONS

Organization	Acres served	River Area
Alpine Irrigation Co.	1,750	Provo
American Fork Irrigation Co.	5,253	Provo
Bench Creek Irrigation Co.	512	Provo
Center Creek Irrigation Co.	1,600	Provo
Central Utah WCD[a]	5,253	Provo
Charleston Irrigation Co.	894	Provo
Daniel Irrigation Co.	1,800	Provo
Fort Field Little Dry Creek. Irrg. Co.	502	Provo
Highland Conservation District	2,500	Provo
Hobble Creek Irrigation Co.	1,031	Provo
Lake Creek Irrigation Co.	1,141	Provo
Lehi Irrigation Co.	588	Provo
Main Creek Irrigation Co.	907	Provo
Midway Irrigation Co.	380	Provo
North Bench Irrigation Co.	749	Provo
North Fields Irrigation Co.	2,655	Provo
Utah Lake Distributing co.	8,630	Provo
North Union Irrigation Co.	1,792	Provo
Pleasant Grove Irrigation Co.	3,799	Provo
Provo Bench Canal & Irrigation. Co.	4,500	Provo
Provo City Corp.	6,400	Provo
Provo Reservoir Water Users Co.	19,900	Provo
Provo River Water Users Assoc.	53,400	Provo
Rock Canyon Water Co.	530	Provo
Sagebrush Irrigation Co.	499	Provo
Spring Creek Irrigation Co.	653	Provo
Sunrise Irrigation Co.	402	Provo
Timpanogos Irrigation Co.	2,249	Provo
Upper E. Union Irrig. Co.	623	Provo
Wallsburg Irrigation Co.	2,038	Provo
Wasatch Extension	800	Provo
Wasatch Irrigation Co.	1,200	Provo
Big Hollow Irrigation Co.	1,000	Spanish Fork
Washington Irrigation Co.	2,476	Spanish Fork
Lake Shore Irrigation Co.	4,540	Spanish Fork
Salem Irrigation & Canal Co.	2,615	Spanish Fork
Salem Pond Co.	600	Spanish Fork
Spanish Fork W. Field Irrig. Co.	6,613	Spanish Fork
Spanish Fork S. Irrigation Co.	6,500	Spanish Fork
Spanish Fork East Bench Irrg. Co.	4,446	Spanish Fork
Spanish Fork S.E. Irrigation	891	Spanish Fork
Strawberry Water Users Assoc.	45,000	Spanish Fork
Currant Creek Irrigation Co.	2,100	N. Juab & Goshen Valleys
Mona Irrigation Co.	1,460	N. Juab & Goshen Valleys
North Canyon Irrigation Co.	1,580	N. Juab & Goshen Valleys
Warm Springs Irrigation co.	1,300	Goshen Valley
Nephi Irrigation Co.	11,945	N. Juab Valley
Indianola Irrigation Co.	2,180	Spanish Fork
Springville Irrigation Co.	4,050	Hobble Creek & Spanish Fork
Mapleton Irrigation Co.	3,800	Hobble Creek & Spanish Fork
Summit Creek Irrigation Co.	3,500	Summit Creek & Spanish Fork
East Santaquin Irrigation Co.		

Source: *Water Companies of Utah,* Utah Division of Water Rights, May 1990, and phone conversations with Jack Young, Wasatch County SCD et al.

[A] The CUWCD does not provide irrigation water directly to irrigator, but water for irrigation may be delivered to district facilities.

Figure 6-2

PUBLIC MUNICIPAL WATER PROVIDERS
Utah Lake Basin

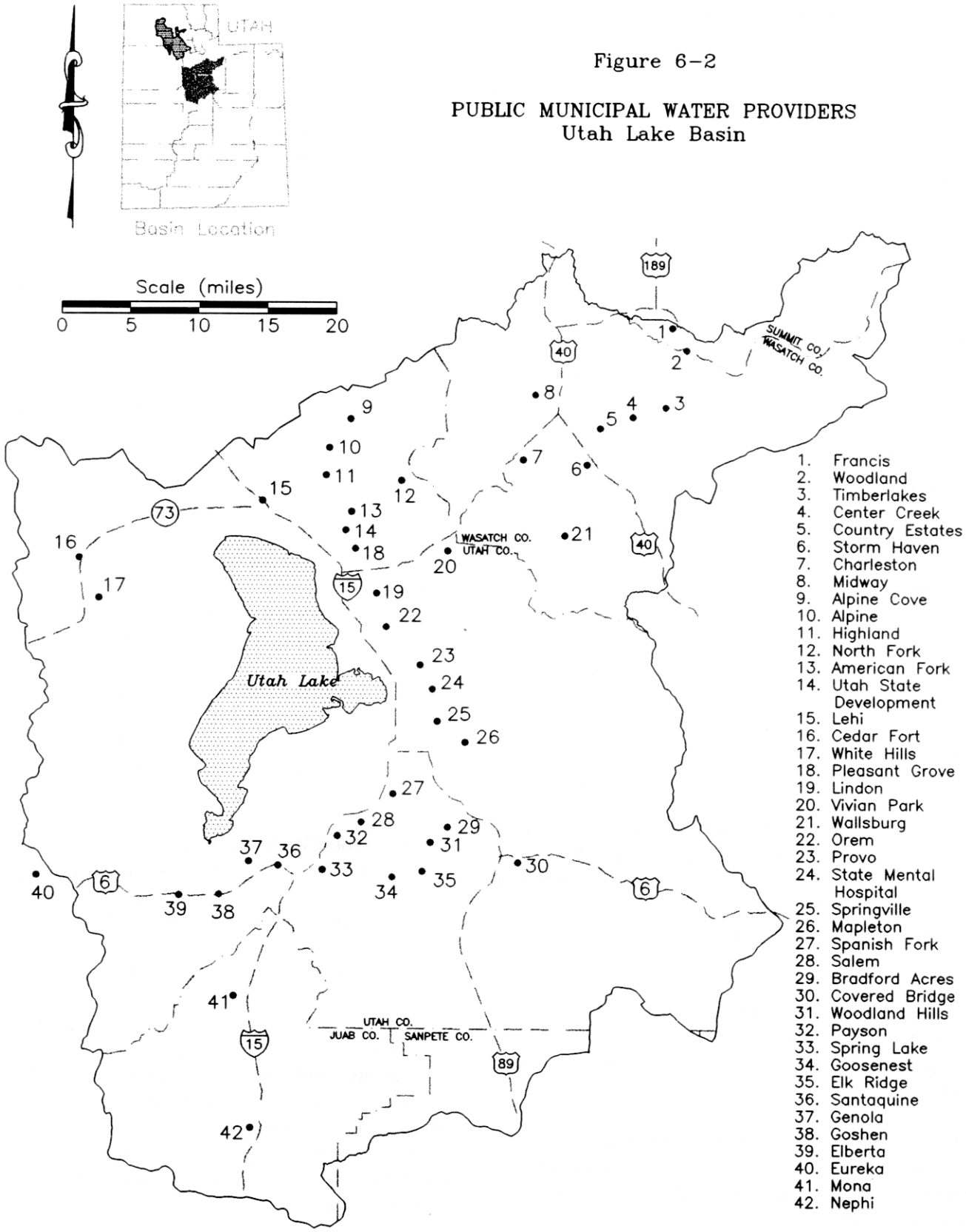


Table 6-3 WATER WHOLESALERS
Metropolitan Water Districts
American Fork
Lehi
Orem
Pleasant Grove
Provo
Conservancy Districts
East Juab
Central Utah
North Utah County
Charleston
Source: Utah League of Cities & Towns, *Directory of Local Government Officials*. Salt Lake City, Utah, 1996.

Future growth may result in smaller, less economically feasible dam sites being reconsidered for construction.

Following the current large water project development period, long-range planning will become more crucial. Public involvement and collaboration between competing water interests will be required. There is a growing need for education programs to prepare present and future leaders to make informed choices about how water is managed. Tradeoffs between economic and environmental values can best be made by people who understand the nature of water and the role it plays in natural ecosystems and in economic growth.

6.5 Issues and Recommendations

One policy issue is discussed for improving the management of water resources: Coordinated long-range planning.

6.5.1 Coordinated Long-Range Planning

Issue - A forum does not exist for creating an awareness and coordinating the planning for future water development.

Discussion - The Central Utah Project Completion Act has required planning teams to be formed and extensive studies performed to facilitate long-range planning for remaining project facilities. This may serve as a model for coordinated long-range planning between CUWCD, the state and local water management agencies. Subsequent planning effort should begin with the premise that a wide range of traditional and innovative approaches will be considered. The process must encompass a variety of techniques to help water suppliers determine the appropriate mix of resources for meeting customer needs. It should provide information on potential consequences and aid in judging the value of tradeoffs among resource strategies. It must lead to better long-term decisions that strike a balance between often competing objectives. The electric utility industry has developed a process called Integrated Resource Planning to deal with environmental concerns, risks arising from future uncertainties, and the emergence of conservation requirements.

Integrated Resource Planning is being used in other states to find solutions to difficult water supply and quality problems. As shown below, it may guide state water planning through the next phase of basin plan reports.

- **Traditional Supply Planning**: minimize risks and maintain high degree of reliability.

- **Integrated Resource Planning**: a more inclusive approach where environmental, engineering, public health, financial, pricing, social and economic considerations all feed into the planning process.

- **Total Water Management**: seeks to inspire the industry by encouraging stewardship, unified policies, ecosystem management, conservation, public and political support.

These planning approaches are not mutually exclusive. Each should build on the preceding approaches, i.e., we have done the first one, now it is time to advance to the next step.

Recommendation - State, district and local governments, along with representatives of the private sector, should explore Integrated Resource Planning and evaluate its applicability to water management problems. The Central Utah Water Conservancy District should take the leading role. ✤ ✤

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Regulation/Institutional Considerations

Institutional arrangements within which water management takes place have grown out of the needs, values, beliefs and attitudes of people who created them.

7.1 Introduction

This section discusses enforcement of several regulations to protect and manage water resources in the Utah Lake Basin. It also discusses some environmental concerns.

Local, state and federal governments have formalized the institutional arrangements we now have by passing laws. Laws create government agencies empowered with the authority and responsibility to carry out specific missions. The mission of Utah's water agencies is to provide orderly water rights administration, adequate good quality water supplies, and a quality environment to meet the needs of its people.

In the Department of Natural Resources, the Division of Water Rights is responsible for water allocation, distribution, dam safety and stream alteration. The Division of Water Resources regulates the cloud seeding program, is responsible for state water planning and manages three water development funding programs.

Two divisions within the Department of Environmental Quality bear the major responsibility for water quality. They are the Division of Drinking Water and the Division of Water Quality. The *State Water Plan* explains these state agencies' regulatory functions in sections 7, 9, 11, and 12.

Federal agencies are also part of the regulatory picture (see Section 16). The U.S. Fish and Wildlife Service has a prominent role in protecting the endangered June sucker inhabiting Utah Lake. The Environmental Protection Agency and the Army Corps of Engineers also have significant roles in protecting water quality and wetlands.

7.2 Setting

The doctrine of prior appropriation is the basis of Utah water law administered by the State Engineer. The regional engineer for the Utah Lake Basin is in the State Engineer's office (Division of Water Rights) in Salt Lake City.

Utah County is the most populous county in the Utah Lake Basin, and is part of the Wasatch Front metropolitan area. Significant growth in this urbanized area means water use is shifting from agricultural to municipal uses. The most common example of this shift occurs when a city purchases shares in an irrigation company. Occasionally, a city buys all the irrigation stock and takes over operation of the company's delivery system.

The State Engineer is currently addressing issues that significantly affect water distribution on the Utah Lake System. On November 1, 1992, planning began to address the issue of water rights and storage in Utah Lake and their relationship to storage in upstream reservoirs. This plan sets forth the conditions and timing under which upstream reservoirs may store water while protecting senior water rights in Utah Lake. The Division of Water Rights participated in negotiations which led to an agreement for the joint operation of Deer Creek and Jordanelle reservoirs on November 1, 1994.

The State Engineer has set up groundwater management plans for Utah and Goshen valleys, Heber Valley and the northern part of Juab Valley. These plans set conditions under which groundwater can be developed while protecting existing water rights in the area. In combination, the operating agreement and management plans will serve to bring much of the basin's water distribution under a more unified system.

7.2.1 Current Regulation

Water Rights - The earliest established water right has priority over later rights. Beneficial use is the basis, measure and limit of the right. Often, irrigation water users will mutually agree to modify the "first-in-time, first-in-right principle." Water rights within a range of priority dates may be classified as primary

rights, class A rights, or another designation. They share any shortages equally among them. This basin has been closed to further appropriation of water rights.

Water Quality - The Utah Department of Environmental Quality, Division of Water Quality, is responsible for water quality regulation. Quality of a specific body of water is determined using a set of standards for allowable contaminant levels. The state's antidegradation policy says in part: "Waters whose existing quality is better than the established standards for the designated uses will be maintained at high quality unless it is decided by the board, after appropriate intergovernmental coordination and public participation, in concert with the Utah continuing planning process, that allowing lower water quality is necessary to accommodate important economic or social development in the area in which the waters are located."

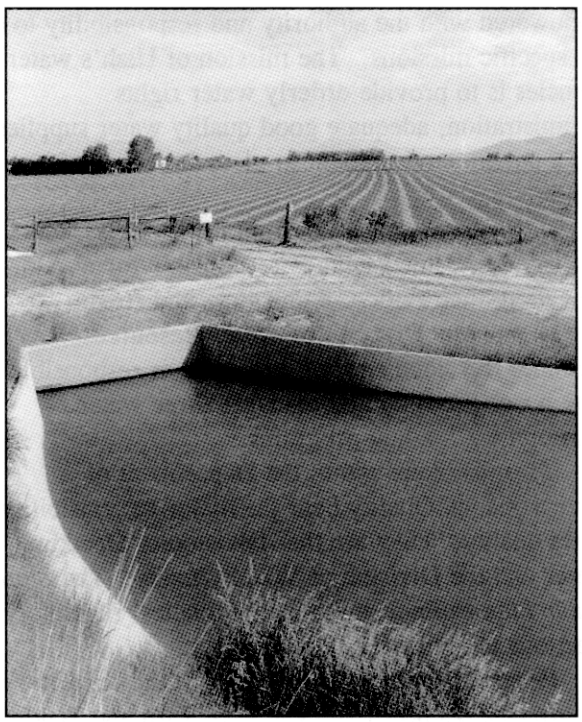
Drinking Water Regulations - The Drinking Water Board is responsible for assuring a safe water supply for domestic culinary uses. The board regulates any system defined as a public water supply. This may be publicly or privately owned. The Drinking Water Board has adopted State of Utah Public Drinking Water Regulations to help assure pure drinking water. The Drinking Water Board is empowered to adopt and enforced 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 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 standards. At the local level, considerable reliance is placed on public water supply operators. Those operating systems serving more than 800 people are currently required to have state certification. Water systems serving fewer than 800 people will only need a certified operator if the system has a 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 drinking water quality and source protection.

7.2.2 Agencies and Organizations

In the mid-19th century, the Church of Jesus Christ



Irrigated farmland in Lehi

of Latter-day Saints (Mormons) and local communities sponsored water development in Utah. In the early 20th century, with enactment of the federal reclamation law, the Bureau of Reclamation, the Soil Conservation Service (now Natural Resources Conservation Service), Corps of Engineers, Geological Survey, Environmental Protection Agency, and the U.S. Fish and Wildlife Service have all come to play major roles. Their roles

have been to provide regulatory and financial assistance to water users through state and local organizations. The organizations formed by specific enabling state legislation are:

Water Conservancy Districts - The District Court establishes these districts in response to a formal petition. A board of directors, appointed by the county commission, governs when the district consists of a single county. The governor appoints directors for multicounty districts.

Conservancy districts have very broad powers. They include constructing and operating water systems, levying taxes and contracting with government entities. Districts include incorporated and unincorporated areas. Those in this basin are the Central Utah, North Utah County, East Juab and Charleston water conservancy districts. The Salt Lake County Water Conservancy District extended its boundaries into Utah County in the 1970s and serves Camp Williams and the Jordan Narrows area.

Metropolitan Water Districts - These are similar to water conservancy districts, but they can encompass only incorporated areas. American Fork, Lehi, Lindon, Orem, Pleasant Grove/Lindon and Provo all have metropolitan water districts in Utah County.

Special Service Districts - The basin has 17 special service districts. These districts have many of the same duties and authorities of other districts and can be created by either counties or municipalities. They can be established to provide water, sewer, drainage, flood control, and non-water-related service.

Water Improvement Districts - This organization was established to accomplish water development, financing and management similar to the districts described above. Their activities are confined to unincorporated areas within a single county.

Drainage District - These districts deal with problems created by a high water table in areas where natural drainage conditions inhibit farming or other operations. Four drainage districts are located in southern Utah County and are known as the Benjamin Drainage District, the Lake Shore and Benjamin Drainage District, the Utah Westfield Drainage District and the Spring Creek Drainage District.

City Water Departments - Municipalities establish these to provide water service to residents.

Mutual Irrigation Companies - These companies are responsible for most early water development. They are formed under the corporation code, and the majority are nonprofit. Stockholders have the right to a quantity of water proportional to the number of shares they hold. Stockholders pay expenses of their company's operations according to the number of shares they each own.

Private Water Companies - Organized as corporations, these companies intend to earn a profit. Regulated by the Public Service Commission, they must provide service on request rather than only to shareholders.

Utah County has more than 110 water organizations, including mutual and private water companies and water users associations. Juab County has 20 water organizations, but not all are in the basin. Wasatch County has 41 and Summit County has two water organizations in the basin. A more complete list of special service districts can be found in the *Directory of Local Government Officials* which is published annually by the Utah League of Cities and Towns.

7.3 Problems and Needs

Major projects such as transportation causeways and residential and commercial developments on and around Utah Lake are hampered primarily by man's inability to control its surface elevation. Floods occurring in 1983-86 caused serious concern about the lake's potential for destroying property values. Some longtime residents believe control of the lake's surface elevation is a prerequisite for any serious development projects.

Reservoirs in the Utah Lake Basin attract large crowds of flat-water recreationists i.e., boaters, water skiers and campers. Pollution of the drinking water flowing from these reservoirs is an increasing problem. Overcrowding and associated safety issues, especially at Deer Creek Reservoir, are also concerns. See sections 12 and 15 for additional details.

The listing of the June sucker as endangered under the Endangered Species Act (ESA) of 1973, as amended, has increased the amount of federal regulatory responsibilities in the Utah Lake Basin. Any project that could affect critical habitat of the June sucker must be evaluated under Section 9 and 10 of the ESA and Section 7 if federal funds are involved. This causes project proponents to prepare a more thorough analysis of the effects their projects will have. Because the June sucker is endangered, a recovery plan has been developed to address problems that threaten its continued existence. The June Sucker Recovery Team has worked cooperatively with all interested parties in the overall management of Utah Lake. Many actions,

such as improving water quality, are consistent with current and future Utah Lake uses.

Ownership of land around Utah Lake is a significant problem. When the U.S. Supreme Court awarded the State of Utah ownership of the lake bottom in 1989, it became necessary to decide where the boundary lies. They are working on this problem, but it may take years to resolve. See Section 10 for additional discussion.

Drains designed to take irrigation return flows in south Utah County to Utah Lake frequently fail to function properly. This creates a high water table which lowers, and sometimes eliminates, crop yields. The problem could be increased when the Spanish Fork Canyon/Nephi Irrigation System is fully operational, delivering more water to the Utah Lake Basin.

7.4 Water Rights Regulation

Since 1903, the only manner in which one can obtain the right to use water is by filing an application with and securing approval from the State Engineer, or purchasing existing rights. In part, the State Engineer bases this approval upon there being unappropriated water that can be put to beneficial use without impairing existing rights. When the State Engineer approves an application, the applicant has a specific time to divert the water and put it to beneficial use. For good cause, this time may be extended. The applicant does the work and submits proof of appropriation. Then the State Engineer issues a certificate of appropriation as evidence of a perfected water right.

An owner of a perfected water right may lose the right if beneficial use ceases for longer than five years. The owner may file for, and be granted, an extension of time to resume use to protect a right that is not being used. A provision in the state constitution (Article XI, Section 6) prohibits municipalities from selling or otherwise disposing of any water rights they hold. An exception is if they trade for other water rights of equal value.

7.5 Water Quality Control

The Utah Water Quality Act (UWQA) regulates discharge of pollutants. The Utah Water Quality Board carries out the regulations, policies and continuous planning to prevent, control and abate water pollution. Surface water and groundwater are covered. The Division of Water Quality, Department of Environmental Quality, provides staff to carry out this work.

The Utah Water Quality Board (UWQB) developed and carries out the Utah Water Quality Rules under authority of *Utah Code Annotated*, 26-11-1 through 20. They are described in Section 7 of the *State Water Plan*.

Water quality certification by the state is covered under Section 401 of the federal Water Pollution Control Act, 1977. This act requires state certification on any application for a federal license or permit resulting in discharge into waters and/or wetlands of the United States. These activities include, but are not limited to, the construction or operation of the discharging facilities. Any discharges will comply with applicable state water quality standards and the applicable provisions of the Clean Water Act(CWA). In addition, the UWQB adopted and enforces *Ground Water Protection Regulations*. These regulations are building blocks in a formal program to protect beneficial uses of groundwater in Utah.

Three main regulatory concepts are provided. They are: (1) Prohibit the reduction of groundwater quality, (2) prevent groundwater contamination rather than clean up after the fact, and (3) provide protection based on the differences in existing groundwater quality. There are five significant components: (1) Groundwater quality standards, (2) groundwater classification, (3) groundwater protection levels, (4) aquifer classification procedures, and (5) a groundwater discharge permit system. Statutory authority for the regulations is contained in Chapter 19-5 of the *Utah Code Annotated*.

The *Ground Water Protection Regulations* contain a groundwater discharge permitting system which will control activities that may affect groundwater quality. A groundwater discharge permit will be required if, under normal circumstances, there may be a release to groundwater. Owners of existing facilities will not be obligated to apply for a groundwater discharge permit immediately. An existing facility is a facility or activity that was in operation or under construction before February 10, 1990. Owners of these facilities would have to notify the executive secretary of the UWQB about the nature and location of their discharge.

These regulations provide for a permit by rule for certain facilities or activities. Many operations pose little or no threat to groundwater quality. Some are already adequately regulated by other agencies. These are automatically given a permit and need not go through the formal permitting requirements. Therefore, facilities qualifying under provisions of Section R448-6-6.2 will administratively be extended a groundwater discharge permit (permit by rule). However, these

operations are not exempt from the applicable TDS limits or groundwater quality standards.

The authority for 401 Water Quality Certification is carried out by the Division of Water Quality. Whether administering a CWA program directly or delegating it to a state, the Environmental Protection Agency retains the oversight role to insure compliance with all rules, regulations and policies.

Local communities are encouraged to set up and carry out a *Local Aquifer Protection Management Plan*. If so, they can contact the Division of Water Quality for information. Provo and Springville have adopted watershed ordinances to protect their water supplies.

7.6 Drinking Water Regulation

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*. These standards govern bacteriologic, inorganic chemical, radiologic and organic chemical quality, and turbidity. Standards are also set for monitoring frequency and procedures.

7.7 Environmental Considerations

Water is often viewed as a commodity for people's use with little thought to other purposes of the hydrologic cycle. Adequate quantity and quality of water are crucial to maintaining healthy wildlife habitats and populations. This includes providing instream flows where prudent and possible, and maintaining critical wetland areas.

Providing instream flow as a beneficial use to maintain fish and wildlife populations, riparian vegetation, and stream channels is widely recognized as important. The Utah Legislature recognized this through recent legislation allowing the Division of Wildlife Resources or Division of Parks and Recreation to file an application for permanent or temporary changes for providing water for instream flows. Adequate water resources planning considers instream flow needs early in project design to resolve problems before construction or operation of the project.

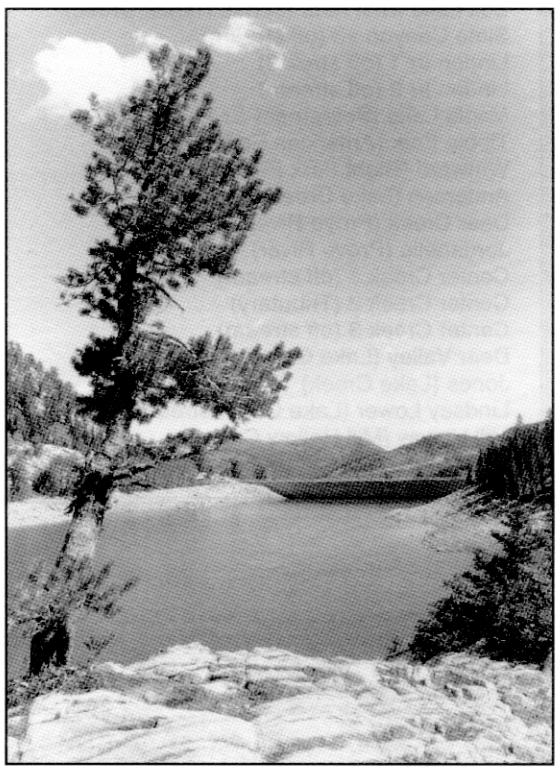
Wetlands are extremely important for groundwater recharge and discharge, flood storage, shoreline stabilization, sediment trapping, water purification and pollution control, food chain support, habitat for fish and wildlife, and active and passive recreation. Stream channelization and draining and filling of wet areas can all impact wetlands.

Many potential sources of pollution may adversely affect the quality of groundwater. These sources include agriculture, on-site waste treatment systems, solid wastes, hazardous wastes, oil and gas exploration and production, mining, surface impoundments, and urban runoff. The importance of groundwater as a resource should always be considered. Development activities should emphasize protection of recharge areas of the major aquifers and management of supplies to prevent degradation.

The Utah Lake Basin has several environmentally sensitive areas. These areas are shown and discussed in the *Resource Management Plans* prepared by the Bureau of Land Management. These should be considered for protection and/or mitigation when water development is contemplated.

The basin also has some of the state's best remaining agricultural land. Open space is becoming a public environmental concern, valued more by everyone as it becomes more scarce. A loss of open space correlates with the loss of agricultural land. A perceived correlation exists between these losses and increases in traffic congestion, water shortages, power outages and other infrastructure inadequacies.

SB 48, The Land and Water Conservation Commission Act passed by the 1996 Legislature provides assistance for open space planning to local



Dam safety work is finished at Twin Lakes

governments. The Utah Reclamation Mitigation and Conservation Commission have identified several environmental enhancement projects associated with Provo River, Diamond Fork River and Utah Lake. Water regulators and institutions could explore opportunities to support the objectives of this law.

7.8 Dam Safety

All dams that store over 20 acre-feet of water, and where failure may cause loss of life or significant property damage, are assigned a hazard rating. Hazard ratings measuring the potential effects of failure are either high, moderate or low. This determines the frequency of inspection. High-hazard dams are inspected yearly; moderate, every other year; and low, every fifth year. Following the inspection, a letter from the State Engineer suggests maintenance needs and requests specific repairs. He may declare the dam unsafe and order it breached or drained. Efforts are always made to work with dam owners to schedule necessary actions. The State Engineer has outlined design standards 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 dam construction to insure compliance with plans, specifications and design reports. Any problems are resolved before final approval. The State Engineer is currently assessing the ability of all high hazard dams to pass the Probable Maximum Precipitation (PMP) flood. The assessment also includes the ability of the dam to withstand earthquakes. Table 7-1 shows the reservoir dams classified as high hazard in the Utah Lake Basin. The Division of Water Rights rates federal dams, but they are exempt from requirements of the State Dam Safety Program. The Bureau of Reclamation inspects dams constructed under its programs. ✤ ✤

Table 7-1
HIGH HAZARD DAMS

Dam Name and (Stream)	County	Height (feet)	Capacity (acre-feet)
Mona (Currant Cr.)	Juab	33	19,190
No. Utah County (Battle Creek)	Utah	47	44
Big East (Wimmer Cr.)	Utah	29	670
Box Lake East Fork (Jones Ranch Creek)	Utah	28	160
Slate Canyon #3 (off stream)	Utah	18	15
Lindon Irr 1 (off stream)	Utah	24	10
Lindon Irr 2 (off stream)	Utah	23	18
Maple Lake (Peteetneet Cr.)	Utah	25	130
Tibble Fork (American Fork River)	Utah	44	166
Winward (Right Fork Peteetneet Creek)	Utah	37	73
Anderson (Lake Creek offstream)	Wasatch	30	132
Deer Creek (Provo River)	Wasatch	235	152,560
Jordanelle (Provo River)	Wasatch	300	314,000
Center Creek 1 (off stream)	Wasatch	38	400
Center Creek 2 (Tributary)	Wasatch	38	150
Center Creek 3 (off stream)	Wasatch	33	86
Deer Valley (Lake Creek)	Wasatch	26	138
Jones (Lake Creek)	Wasatch	36	176
Lindsey Lower (Lake Cr. Offstream)	Wasatch	32	179
Mill Hollow (Mill Hollow Cr.)	Wasatch	36	176
Witt Lake	Wasatch	44	1,226

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Water Funding Programs

Federal, state and local governments are part of the water program funding process. In recent years, however, the Central Utah Water Conservancy District has emerged as a major participant.

8.1 Introduction

This section describes the funding sources and their activities and responsibilities for developing and conserving water resources in the Utah Lake Basin. Local, state and federal sources are funding planning studies and programs. The Utah Division of Water Resources does river basin planning and provides project construction funding. The divisions of Water Resources and Water Rights provide funding support for groundwater and related hydrologic studies. The U.S. Geological Survey provides matching funds for stream gaging and groundwater measuring and modeling. The Bureau of Land Management and Forest Service help with watershed management and planning. The Natural Resources Conservation Service also does river basin and watershed planning. See Sections 3 and 8 in the *State Water Plan (1990)* for additional information on state and federal water resources funding programs.

8.2 Background

Water development funding in this basin began with the sweat equity of the pioneers. Near the start of the 20th century, federal government water development started with the Strawberry Valley Project.

Most of the water developed in the early years was for agriculture. Most of the money spent on water development in the last 40 years has been for municipal and industrial uses. The Bonneville Unit of the Central Utah Project was initiated during the 1950s to bring water from the Duchesne River in the Colorado River Basin to the Bonneville Basin. Although some of this water was allocated to agricultural irrigation, most of it is likely to end up in municipal and industrial uses. Costs of constructing the remaining facilities of the Bonneville Unit of the Central Utah Project will be shared between federal and local entities. State help is available for local project sponsors when necessary. Table 8-1 shows expenditures on large federal projects in the Utah Lake Basin by the Bureau of Reclamation.

8.3 State Funding Programs

Tables 8-2 and 8-3 show current funding programs and the funding provided by state agencies for water-related projects. Funding can be grants and loans, and can be provided by more than one agency. These programs can accelerate water resources development by providing sufficient funds to construct projects that are otherwise not affordable to water suppliers.

8.4 Federal Water Funding Programs

Seven federal agencies are administering water project funding programs. Programs and historical expenditures are shown in Tables 8-4 and 8-5.

8.5 Local Water Funding Programs

The largest water provider in the Utah Lake Basin is the Central Utah Water Conservancy District. The district is primarily responsible for the administration, operation and maintenance of the Central Utah Project. These responsibilities include the sale of project water to a number of cities, towns, communities and some smaller water providers. Because of their significant involvement in the use and distribution of project water, the district participates with water users (primarily water retailers) to improve and/or expand existing storage and distribution facilities. Sometimes, funding is provided to other agencies to provide facilities for CUP purposes. However, these funds are made available on a case by case basis and subject to approval by the district's board of directors.

Several Utah County cities have metropolitan water districts to provide funding for projects within their respective boundaries. Private financial institutions may fund water projects when sponsors have adequate repayment ability and bonding capacity. Table 8-6 shows entities that may provide funding from local sources, along with project purpose and type of program. ✤ ✤

Table 8-1
BUREAU OF RECLAMATION FUNDING OF WATER PROJECTS

Projects	Year Completed	Cost($)
Strawberry Valley	1922	3,349,000
Provo River	1941	39,521,000
Central Utah	1993	2,003,929,000[a]

[a]Total project cost estimated September 30, 1995.

Table 8-2
STATE FUNDING PROGRAMS

Entity/Program	Contact	Purpose	Type
Board of Parks & Recreation			
Land & Water Cons. Fund	Div. of Parks and Rec.	Recreation facilities	Cost-share
Riverway Enhancement Program			
Board of Water Resources			
Revolving Const. Fund	Div. of Water Res.	Small irr. & cul. projects	Loans
Cities Water Loan Fund		Municipal cul. systems	Loans
Cons.. and Development Fund		Large water projects	Loans
Dam Safety		Stabilize & repair dams	Grants/Loans[a]
Comm. Dev. Block Grants	Div. of Community Dev.	Rural living environ. imp.	Grants
Perm. Comm. Impact Board			
Perm. Comm. Impact Fund	Div. of Community Dev.	Rural living environ. imp.	Grants/loans
Disaster Relief Board Fund		Disaster repair	Grants
Drinking Water Board			
Financial Assist. Program	Div. of Drinking Water	Drinking water systems	Loans
Soil Conservation Commission			
Agr. Resource Dev. Loan	Dept. of Agriculture	Improve private agr. land	Loans
Non-point Source Program		Watershed improvement	Grants
		Improve water quality	Loans
Utah Wildlife Board			
Wallup-Breaux Bill[b]	Div. of Wildlife Res.	Fish hab. restoration/dev.	Grants
Habitat Authorization Fund		Aquatic habitat improv.	Grants
Water Quality Board			
Revolving Const. Loan Program.	Div. of Water Quality	Wastewater treat. facil.	Loans
Federal Const. Grants		Wastewater treat. facil.	Grants
State Loan Program		Wastewater treat. facil.	Loans

a Grants are given for studies of high hazard dams. Loans and grants provided for dam repair.
b Federal funds are received under the Wallups/Breaux Bill authorizing sport fishery management and boating access.

Table 8-3
STATE WATER FUNDING EXPENDITURES

Funding Agency/Program	Period	Juab	Summit ($1,000)	Utah	Wasatch	Total
Board of Parks and Recreation						
Land & Water Conservation Fund				1,600.0	18,200.a	19,800.0
Riverway Enhancement Program	1991-96					
Board of Water Resources						
Cities Water Loan Fund	1978-94	654.0	75.0	4,060.0	0	4,789.6
Conservation & Development Fund	1987-94	873.8	0	11,761.8	2,518.0	15,153.6
Revolving Construction Fund	1948-92	168.9	232.7	3,242.6	1,606.0	5,250.2
Community Dev. Block Grants	1986-96	182.5	192.0	4,304.1	1,962.9	6,641.5
Permanent Community Impact Board						
Permanent Community Impact Fund	0	0	0	0	0	0
Disaster Relief Board Fund (Inactive since 1991)						
Drinking Water Board						
Financial Assistance Program	1983-96	0	0	8,878.7	251.0	9,129.7
Soil Conservation Commission						
Agr. Resource Dev. Loan	1991-96	155.4	0	966.3	84.2	1,205.9
Non-Point Source Program (Inactive)						
Water Quality Board						
State Loan Program						
State Revolving Loan Program	1988-95	0	0	19,258.0	151.0	19,409.0
Federal Construction Grants	1972-91	70.1	921.2	20,206.6	10,918.9	32,116.9
EPA 314 Clean Lakes Program						
Total Expenditures		2,104.7	1,420.9	74,278.1	35,692.0	113,495.3

[a] $18,000,000 was direct grant from U.S. Bureau of Reclamation for park facilities at Jordanelle Reservoir.

Table 8-4
FEDERAL FUNDING PROGRAMS

Agency	Program	Purpose	Type
Department of Agriculture			
Farm Service Agency	Agricultural Consv. Program	Soil, water energy Consv.	Grants
	Emergency Consv. Program	Rehab. of farmland damaged by disasters	Grants
		Reduce erosion, maintain wetlands	
	Cons.. Reserve Program		Grants
Rural Development	Rural Development	Water supply, wastewater disposal	Grants, Loans
	Resource Consv. & Development	Multipurpose water, land Consv. facilities	Loans
Natural Res. Conservation Service	Watershed Protection and Flood Prevention	Flood control and water	Grants, Cost-Share
	Resource Consv. and Development	Multipurpose water and related facilities	Grants, Cost-Share
	Emergency Watershed Program	Reduce sedimentation and flooding, facility protection	Grants
Department of the Army			
Corps of Engineers	Civil Works	Flood control, water supply, recreation	Cost-share
		Flood control & protection	
	Continuing Auth. Program	Flood control & protection	Cost-share
	Emergency Activities	Flood Plain Delineation	Grants
	Flood Plain Management Program		Grants
Environmental Protection Agency	Non-point Source Program	Water Quality	Grants
Department of Interior			
Bureau of Reclamation	Investigation Program	Water storage, delivery	Loans
	Loan Programs	Small multipurpose project	Loans
Fed. Emergency Mgt. Agency	Presidential Declared Disaster	Damage mitigation	Grants
	Flood Plain Management	Structure acquisition-flood plains	Grants

Table 8-5
FEDERAL WATER FUNDING EXPENDITURES

Funding Agency/Program	Period	Juab	Summit	Utah	Wasatch
			($1,000)		
Farm Services Agency					
Agr. Conservation Program	1990-96	43.5		792.4	175.4
Conservation Reserve Program					
Emergency Conservation Program					
Corps of Engineers[a]					
Civil Works	1996-97				150.0
Emergency Activities	1952-84	44.0		3,386.0	
Continuing Authorities	1985-88			230.0	
Rural Development					
Rural Development Loans	1946-present	90.0	50.0	2,418.0	100.0
Rural Development Grants	1946-present		198.0	565.6	
Federal Emergency Management Agency	1983-86			8,639.0	938.1
Presidential Declared Disaster		2,439.9			
Flood Plain Management					
Natural Resources Conservation Service					
Watershed Protect & Flood Prevention	1965-1973	269.1		3,644.3	
Resource Conservation & Development					
Emergency Watershed Program	1990			250.0	70.0

a An additional $1,020,000 was spent by the Corps of Engineers on activities with basin-wide application.

Table 8-6
LOCAL FUNDING PROGRAMS

Entity	Purpose	Type
Private financial institutional	Any approved water-related project	Loan
Cities, districts, and towns	Water systems	Bonding, cash flow
Western Farm Credit Bank	Agricultural water projects	Loan

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Section 9

State Water Plan, Utah Lake Basin

Water Planning and Development

With most developable water already put to beneficial use, conversions to non-agricultural uses and more intensive conservation measures will be the major focus of future water planning.

9.1. Introduction

This section describes the major past, present and proposed water planning and development activities in the Utah Lake Basin. State, federal and local agencies will be interacting with the private sector in putting Central Utah Project (CUP) water to its most beneficial uses and turning Utah Lake into a more valuable asset.

Water planning and development in Juab, Utah and Wasatch counties are progressing as the Central Utah Project moves into its final stages. The Central Utah Water Conservancy District's *Wasatch County Water Efficiency Study* is completed, and the final environmental impact statement has been reviewed. The Record of Decision was received in March, 1997. Construction of the water efficiency project is anticipated to begin in 1998.

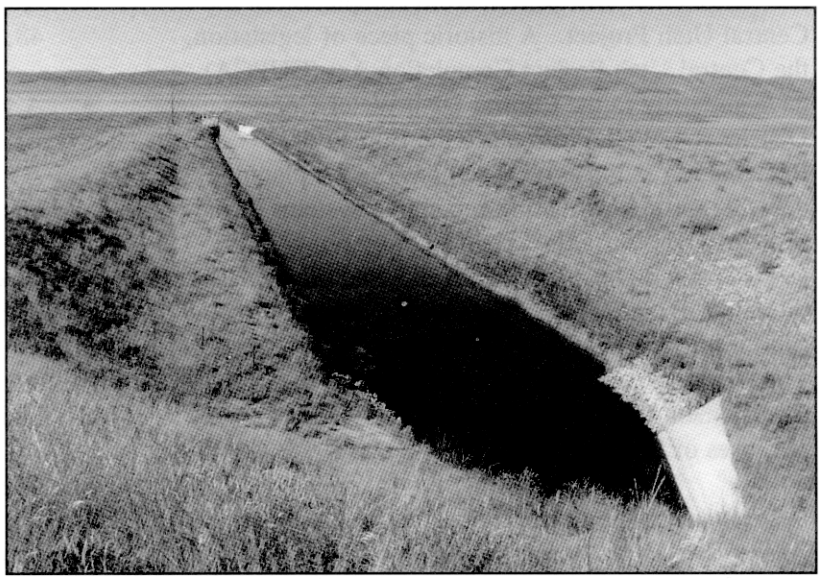
Southern Utah County and eastern Juab County are participating in the Spanish Fork Canyon/Nephi Irrigation System, pending completion of final feasibility studies and environmental reviews. Diversion, storage and conveyance facilities in Utah and Salt Lake counties are part of the district's preparation to receive additional water from Jordanelle Reservoir and other features of the CUP.

9.2 Background

Utah's history is filled with examples of public participation in water resources planning and development. Mormon pioneers received aid from church headquarters when it was needed and available. The federal government began water development activities in the early 20th century with the Strawberry Valley Project, one of its first. The Utah Water and Power Board began the present tradition of state funding in 1947. The Utah Legislature created the Board of Water Resources and Division of Water Resources in 1967 to continue providing state support.

9.2.1 Past Water Planning and Development

Major water providers have used state support sparingly. The Central Utah Water Conservancy District received funding for the Jordan Water Treatment Plant in 1972 and recently received funding for a diversion dam and storage tank. This freed up its funds for planning studies incident to the Central Utah Project Completion Act. Provo City and Orem City have never applied to the Board of Water Resources for state water funding. Both have metropolitan water districts through which they received federal water development funds. Smaller providers have been the major benefactors of state funding. Table 9-1 displays the projects funded by the Board of Water Resources.



Strawberry Aqueduct outlet to Strawberry Reservoir

A work plan for the American Fork-Dry Creek Watershed was prepared in 1958 by the Alpine Soil

Conservation District and the North Utah County Water Conservancy District; the cities of American Fork, Pleasant Grove, Lehi and Alpine; four irrigation companies and Utah County. Technical assistance was provided by several federal agencies, primarily the Soil Conservation Service. The purpose of the plan was to reduce sediment and floodwater damage to urban property, irrigation systems, farmland, recreational facilities, roads and bridges. The project also reduced water losses in canals and ditches, improved irrigation efficiency on farms, and provided additional late season irrigation water. The Santaquin Canyon Pilot Watershed Project was completed in 1955. Its primary purpose was flood control. The Miller-Bigelow Watershed Project was constructed in 1964. Located above Nephi, it provided flood protection from summer cloudburst storms which produce high, short duration flows.

9.2.2 Current Water Planning and Development

Most cities will benefit from completion of the Central Utah Project. A historic piece of legislation, the Central Utah Project Completion Act (CUPCA), gave authority to the Central Utah Water Conservancy District (CUWCD) to replace the Bureau of Reclamation as the agency responsible for planning, designing and constructing remaining systems of the project.

Section 207(b) of CUPCA directed the district to prepare a *Water Management Improvement Plan*, and submit it to the Secretary of Interior. It includes a water conservation goal and an inventory of management improvement measures. The six stated purposes of Section 207 are:

- encourage the conservation and wise use of water;
- reduce the probability and duration of periods requiring extraordinary curtailment of water use;
- achieve beneficial reductions in water use and system costs to prevent or eliminate unnecessary depletion of waters to assist in the improvement and maintenance of water quantity, quality and streamflow conditions necessary to augment water supplies and support fish, wildlife, recreation and other public benefits;
- make prudent and efficient use of currently available water before any importation of Bear River water into Salt Lake County;
- provide a systematic approach to the accomplishment of these purposes and an objective basis for measuring their achievements.

To carry out these purposes, the following activities are mandated:

- prepare a water management plan,
- undertake a water pricing policy study,
- conduct a study of coordinated operations of water management facilities,
- form a Utah Water Conservation Advisory Board.

The CUPCA also requires the water management plan include the following elements:

- A water conservation goal. The district's goal is 48,389 acre-feet per year.
- A water management improvement inventory.
- A comparative analysis of each cost-effective and environmentally acceptable measure.
- A schedule of implementation for the following five years.
- An assessment of the performance of previously implemented conservation measures.

The Diamond Fork System, a component of the Bonneville Unit of the CUP, is expected to be completed under the CUPCA. Its purpose is to transport water from the enlarged Strawberry Reservoir in the Uinta Basin to the confluence of the Diamond Fork and Spanish Fork rivers. This water will be available for municipal, industrial and agricultural uses. Besides water supply benefits, the project will also provide recreation, fish and wildlife measures and water quality control. Physical features of this system include the Syar Tunnel, Sixth Water Aqueduct, Tanner Ridge Tunnel, Diamond Fork Siphon, Red Mountain Tunnel, Red Hollow Pipeline and the Diamond Fork Pipeline.

The Diamond Fork Pipeline was completed in the fall of 1997. The other features of this system are in the final planning stage and will not be built until the

Table 9-1

BOARD OF WATER RESOURCES PROJECTS

Sponsor	Type	
JUAB COUNTY		
Eureka City	CL-WELL	Feb-82
Mona Irrigation Co	IR-WELL	Apr-62
Mona Irrigation Co	LH-PIPE	Jan-84
Mona Town	CL-TANK	Nov-83
Nephi Irrigation Company	DAM-REP	Jul-49
Nephi Irrigation Company	IR-WELL	May-54
Nephi Irrigation Company	IR-WELL	Apr-60
Nephi Irrigation Company	IR-WELL	Jul-63
Nephi Irrigation Company	IR-WELL	Jun-66
Nephi Irrigation Company	CNL-LNG	May-68
Nephi Irrigation Company	DUAL-WS	Dec-83
North Canyon Irrigation Co	PR-PIPE	May-74
JUAB COUNTY TOTAL 12		
SUMMIT COUNTY		
Francis Town	CL-TANK	Aug-79
Woodland Mutual Water Co	CL-SYST	Apr-75
Woodland Mutual Water Co	CL-WELL	Jan-95
SUMMIT COUNTY TOTAL 3		
UTAH COUNTY		
Alpine Irrigation Company	DIV-DAM	Oct-59
Alta Ditch & Canal Co	PR-PIPE	Aug-56
American Fork Irrigation Co	CNL-LNG	Nov-60
American Fork Irrigation Co	IR-WELL	Sep-70
American Fork Irrigation Co	PR-PIPE	Mar-82
American Fork Irrigation Co	LH-PIPE	Mar-92
Alp Irrigation Assn/No Utah County WCD	DAM-RES	Feb-67
Cedar Fort Irrigation Co	IR-WELL	May-73
Cedar Fort Irrigation Co	PR-PIPE	Aug-78
Cedar Fort Irrigation Co	REG-PON	Jan-84
Central Utah WCD	DIV-DAM	Oct-94
Covered Bridge Canyon POA	CL-SYST	Sep-87
Currant Creek Irrigation Co	IR-WELL	May-54
East Santaquin Irrigation Co	IR-WELL	May-60
East Warm Creek Irrigation Co	CNL-LNG	Oct-60
Elberta Water Company	CL-WELL	Dec-76
Elberta Water Company	CL-TANK	Mar-89
Eldon Money	STOCKWR	Apr-78
Elk Ridge Town	CL-TANK	Aug-83
Fairfield Irrigation Co	CNL-LNG	Aug-61
Fort Field Water Users Assn	PR-PIPE	Aug-61
Genola Town Goshen Irrigation & Canal Co	CL-TANK	Nov-81
Goshen Irrigation & Canal Co	CNL-LNG	Jan-66
Goshen Irrigation & Canal Co	DAM-REP	Apr-82

UTAH COUNTY (continued)		
Goshen Irrigation & Canal Co	LH-PIPE	Dec-87
Goshen Town	CL-PIPE	Apr-84
Highland Water Company	CL-SYST	Oct-58
Highland City	DUAL WS	Jul-96
Lake Bottom Irrigation Co	CNL-LNG	May-57
Lake Bottom Irrigation Co	LH-PIPE	Nov-92
Lakeside Irrigation Company	DIV-DAM	Dec-90
Lehi City	DUAL-WS	May-89
Lehi Irrigation Company	IR-WELL	Jul-56
Lehi Irrigation Company	CNL-LNG	May-60
Lehi Irrigation Company	CNL-LNG	Apr-62
Lehi Irrigation Company	LH-PIPE	Apr-95
Lehi-New Survey Well Co	IR-WELL	Jun-61
Lindon City	CL-PUMP	Aug-80
Lindon City	DUAL-WS	Jul-92
Lindon City	CL-TANK	Aug-94
Mapleton Irrigation Co	CNL-LNG	Feb-61
Matson Springs Irrigation Co	IR-WELL	Oct-61
Mt Loafer Irrigation Co	IR-WELL	May-61
North Fork Special Service District	CL-TANK	Oct-80
North Union Irrigation Co	CNL-LNG	Jun-59
North Union Irrigation Co	CNL-LNG	Dec-87
Olsen Brothers Irrigation Co	IR-WELL	Nov-61
Orem Fruit Growers Water Corp	IR-WELL	Aug-61
Payson City	DAM-REP	Apr-87
Payson City	DUAL-WS	Mar-91
Payson City	CL-PIPE	Aug-95
Pleasant Grove Irrigation Co	PR-PIPE	Apr-51
Pleasant Grove Irrigation Co	IR-WELL	Jun-55
Pleasant Grove Irrigation Co	CNL-LNG	Apr-60
Salem City	CL-TANK	May-78
Salem City	CL-TANK	Aug-86
Salem Irrigation & Canal Company	CNL-LNG	Oct-75
Salem Irrigation & Canal Company	CNL-LNG	Jun-85
Santaquin City	CL-PIPE	Sep-91
Salem Pond Company	CNL-LNG	Jul-59
Santaquin City	CL-SYST	Oct-84
Smith Ditch Company	PR-PIPE	Jul-61
Spanish Fork South Irrigation Co	CNL-LNG	Oct-60
Spanish Fork South Irrigation Co	CNL-LNG	Oct-61
Spanish Fork South Irrigation Co	CNL-LNG	Apr-66
Spanish Fork South Irrigation Co	CNL-LNG	Apr-76
Spanish Fork South Irrigation Co	CNL-LNG	Apr-83
Spanish Fork Southeast Irrigation Co	IR-WELL	Aug-70
Spring Lake Water Company	CL-SYST	Jun-76
Spring Lake Waterworks Co	CL-TANK	Oct-89
Summit Creek Irrigation & Canal Co	DAM-RES	Sep-48
Summit Creek Irrigation & Canal Co	DAM-REP	Jan-59
Summit Creek Irrigation & Canal Co	IR-WELL	Feb-61
Summit Creek Irrigation & Canal Co	IR-WELL	May-70
Summit Creek Irrigation & Canal Co	PR-PIPE	Dec-70
Summit Creek Irrigation & Canal Co	PR-PIPE	Oct-72
Summit Creek Irrigation & Canal Co	PR-PIPE	Dec-85
Utah Lake Distributing Co	LH-PIPE	May-84
West Union Canal Company	CNL-LNG	Dec-53
West Union Canal Company	IR-WELL	Jun-61
Woodland Hills Town	CL-PIPE	Dec-83
UTAH COUNTY TOTAL 81		

WASATCH COUNTY

Center Creek Irrigation Co	DAM-REP	Aug-73
Center Creek Irrigation Co	SPRINKL	May-85
Center Creek Water System	CL-SYST	Oct-68
Charleston WCD	CL-SYST	Jun-49
Charleston WCD	CL-TANK	Apr-83
Daniel Domestic Water Co	CL-SYST	Oct-67
Daniel Domestic Water Co	CL-PIPE	Apr-72
Daniel Domestic Water Co	CL-PIPE	May-87
Daniel Irrigation Company	DIV-DAM	Jun-53
Daniel Irrigation Company	DIV-DAM	Oct-68
Daniel Irrigation Company	SPRINKL	Oct-77
Extension Irrigation Co	CNL-LNG	Nov-58
Jones Reservoir & Irrigation Co	DAM-ENL	Oct-56
Lake Creek Irrigation Co	CNL-LNG	Sep-57
Lake Creek Irrigation Co	LH-PIPE	Jun-66
Lake Creek Irrigation Co	LH-PIPE	Dec-67
Lake Creek Irrigation Co	LH-PIPE	Sep-72
Lake Creek Irrigation Co	DAM-REP	Oct-80
Lake Creek Irrigation Co	PR-PIPE	Apr-83
Lake Creek Irrigation Co	SPRINKL	Aug-85
Lake Creek Irrigation Co	DAM-REP	Nov-88
Lake Creek Irrigation Co	PR-PIPE	Jun-92
Oak Haven Water Users Assoc	CL-TANK	Jul-93
Twin Creeks SSD	CL-SYST	Feb-95

WASATCH COUNTY TOTAL 24

GRAND TOTAL 121

CODE DESCRIPTION

CL-CLOR	Culinary Chlorinator
CL-PIPE	" Pipe
CL-PUMP	" Pump
CL-SPRI	" Spring
CL-SYST	" New System
CL-TANK	" Storage Tank
CL-TRMT	" Treatment Plant
CL-WELL	" Well
Canal	Canal
CNL-ENL	Canal Enlargement
CNL-LNG	Canal Lining
CNL-REP	Canal Repair
DAM-ENL	Dam Enlargement
DAM-REP	Dam Repair
DAM-RES	Dam & Reservoir (New)
DIV-DAM	Diversion Dam
DUAL-WS	Lawn & Garden Irrigation
EQ-WELL	Equip. Well - Irrigation
IR-PUMP	Irrigation Pump
IR-WELL	Irrigation Well
LH-PIPE	Low Head Pipe
MISCELL	Miscellaneous
PR-PIPE	Pressure - Pipe Irrigation
REG-PON	Regulating Pond - Irrigation
SPRINRL	Sprinkle Irrigation System
STOCKWR	Stockwater Facilities
TUNNEL	Tunnel
TUN-ENL	Tunnel Enlargement
TUN-REP	Tunnel Repair

environmental review is completed for the SFN System and a record of decision insured by the Secretary of the Interior. This is expected late in 1998.

The CUPCA, Section 202(a)(2-5) mandates the following special studies to identify ways to use water more efficiently:

- A conjunctive use of surface water and groundwater which will allow for groundwater recharge and management,

- A feasibility study to determine efficiency improvements in the management, delivery and treatment of water in Wasatch County to provide for the construction of the Wasatch County Water Efficiency Project,

- A Utah Lake salinity study to determine the feasibility of reducing salinity in Utah Lake,

- A hydrologic study of the Provo River Basin that includes a hydrologic model of the river system. Also, a feasibility study of the direct delivery of Colorado River Basin water from the Strawberry Reservoir or elsewhere in the Strawberry Collection System to the Provo River Basin.

The objectives of these studies are to determine ways to more efficiently use agricultural, municipal and industrial water; restore and improve wetlands; maintain groundwater recharge and maintain or enhance other environmental resources.

The Daniels Replacement Project requires the district to replace water currently diverted from the Strawberry River drainage to the Daniels Creek Irrigation Company in Heber Valley. This replacement is necessary because of the completion act's requirement that flows in the upper Strawberry River be restored, and that the Daniels Creek diversion be terminated. The irrigation water flowing to the Daniels Creek Irrigation Company must be replaced with water at least equal in quality and reliability to that historically received through transbasin diversion. The plan will deliver replacement water from Jordanelle Reservoir. An alternative source for replacing Strawberry water is pumping from groundwater in the Daniels area. This would require test pumping to prove that groundwater is available.

The Spanish Fork Canyon/Nephi Irrigation System (SFN) will provide supplemental irrigation and M&I water by a transbasin diversion from Strawberry Reservoir to southern Utah County and eastern Juab County. The main conveyance system is a gravity pipeline extending from the mouth of Diamond Fork River to the Nephi area.

Preliminary studies show that an annual water supply of about 79,600 acre-feet will be available for delivery through this system. Of this amount 11,200 acre-feet is for M&I use and the balance is for irrigation purposes. This does not include return flows or the 21,300 acre-feet used for instream flows and exchange to Jordanelle Reservoir. Central Utah Project water will be used to meet crop deficiencies which occur during mid to late season, particularly during dry years. It will also be used to provide a full supply to some new lands in eastern Juab County. The amount of CUP water would vary from year to year with little or no water being imported during wet years and large amounts during dry years. Construction of the SFN System is expected to begin in 1999. System completion is scheduled for the year 2007.

Water conservation measures that could be developed within the SFN System service area include, but are not limited to:

- lining existing canals,
- on-farm irrigation improvements,
- conjunctive use of surface and groundwater.

The CUPCA also requires a study to improve coordination between all water systems in the district's area. It looked at individual and interagency conservation programs and coordinating projects. Objectives of the study are to:

- improve the availability and reliability of the water supply;

- coordinate the timing of reservoir releases under existing water rights to improve instream flows for fisheries, wildlife, recreation and other environmental values, if possible;

- assist in managing drought emergencies by making more efficient use of facilities;

- encourage the maintenance of existing wells and other facilities which may be placed on standby status when water deliveries from the project become available;

- allow for the development, protection and sustainable use of groundwater resources within the district's boundaries;

- not reduce the benefits that would be generated in the absence of the joint operating procedures;

- integrate management of surface and groundwater supplies and storage capability.

The district has helped develop technical models of the CUP and related features that show water users can benefit from coordinated operations. Possibilities for coordination will be integrated into the engineering phase of the SFN System. The district has developed an operations model of the Provo River system, called PROSIM, which was also used as part of the *Wasatch County Water Efficiency Study*. This model aids the district in simulating different operating conditions of the Provo River system including Jordanelle and Deer Creek reservoirs. The district is also developing a "water balance" model of the Uinta Basin as part of the Uinta Basin Replacement Project. This is not in the Utah Lake Basin, but it will affect this area. The CUPCA activities that deal strictly with conservation issues are explained in Section 17.

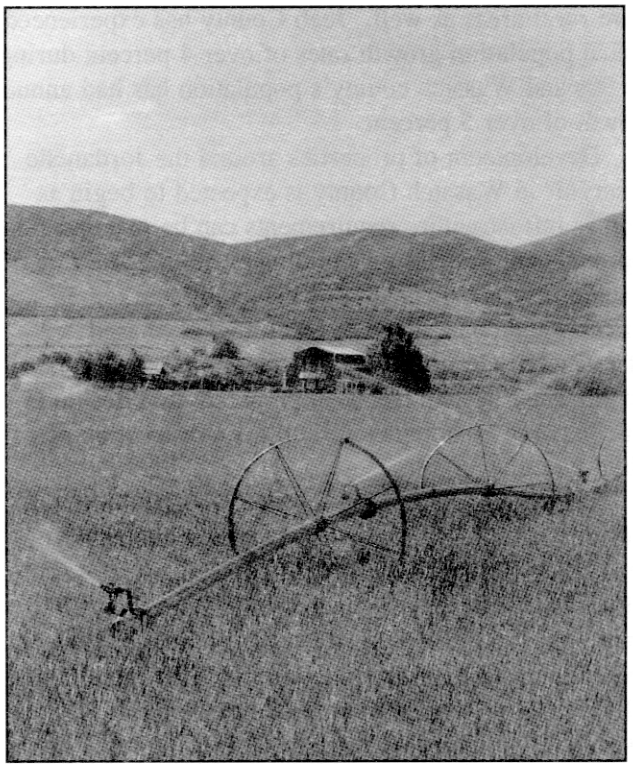
In Wasatch County, a watershed work plan has been prepared for Heber Valley as part of the Tri-Valley Watershed Project. The first priority will be on-farm practices, sprinkler irrigation systems, etc. This program assists local entities in planning and constructing improvements to reduce erosion and prevent flood water and sediment damages in their watersheds.

9.2.3 Environmental Considerations

Section 301 of the Central Utah Project Completion Act establishes the Utah Reclamation Mitigation and Conservation Commission to coordinate the implementation of mitigation and conservation provisions. In addition, the commission is to administer the expenditure of funds for the implementation of the fish, wildlife and recreation mitigation and conservation projects and features authorized in the act. Projects receiving federal funds from the Water Management Improvement Program (Section 207 in CUPCA) must satisfy requirements of the National Environmental Policy Act (NEPA).

9.3 Water Resources Problems

Water resources in parts of the basin are in transition from irrigated agriculture to urban uses. When comparing the present total basin water use with total supply, there appears to be adequate water beyond the year 2020. However, there are several problems in specific communities. Rapid urban growth in northern and southern Utah County, and the closure of this basin to further appropriation, has sent water prices upward by 1,000 percent or more over 10 years. Local cities require water rights and/or shares of irrigation stock be turned over when adjacent land is annexed. This has created a seller's market where it is profitable to hold water rights in anticipation of a larger payoff down the road.



Sprinkler irrigated land near Nephi

Another problem lies in the cost of time and uncertainty necessitated by current water rights change application protocol. Since most changes in the place and nature of use of water requires official application notices, waiting periods, expensive legal assistance (in some cases) and engineering consultation, transaction costs may be high and the outcome uncertain. Legislative action is required to change protocol.

A Utah Supreme Court case (East Jordan Irrigation Company vs. Payson City) overturned the State

Engineer's decision to allow a stockholder to submit a change application for its water shares without approval of the company board of directors. This decision placed more power in the hands of irrigation company officials to control the movement of water yielded from a company's water right. A slowing of the transfer of the resource to different uses or locations that command higher prices in the market could result.

In addition, commercial farmers who hold existing water rights are content to continue with the present use. They are located close to their markets and enjoy the farm and ranch lifestyle. They anticipate ever-increasing prices for their land and water to ensure a secure retirement for them and an endowment for their children. Problems associated with transferring water from agricultural to urban uses are occurring in the more rural areas as well. Juab County has experienced annual population growth rates of over 4 percent during the 90s and Wasatch county's population has had annual growth of over 5 percent.

Development of properties around the Jordanelle Reservoir in Wasatch County is expected to begin as soon as infrastructure requirements can be met and final approvals are granted for building permits. The rate of development is expected to be driven by market demands and constrained by the limits of phased infrastructure design and construction. A master plan for the water system has been prepared, and design is anticipated to be completed soon for construction of initial facilities.

The Jordanelle Special Service District (JSSD) currently includes land west and north of the reservoir. Developers have plans to develop their properties with 5,124 equivalent residential units (ERUs). One ERU corresponds to an average residential home. Other developments (hotels, commercial facilities, etc.) are individually rated at a determined number of ERU's based on the anticipated water/waste water flow rates.

Development of properties served by the JSSD is expected to begin in 1998 with projected construction rates of approximately 275 ERUs per year through 2003. Following these initial years of fast-paced construction, development is projected to slow to approximately 125 ERUs per year.

Development of additional properties east and south of the reservoir will be based on similar constraints, but the number of planned ERU's has not been finalized. Water to meet demands of the real estate development around Jordanelle Reservoir may come from the reservoir and/or Ontario Tunnel.

Closely associated with this urban growth is the need to expand the water infrastructure. The Central Utah Project Completion Act (CUPCA) authorizes a significant amount of federal funds to bring more water into the basin through the SFN System, and encourage conservation. Funding must be found for the local share of the project cost. Funding the non-project cost of pipelines and other facilities to get project water to its end user is an additional challenge.

9.4 Water Use and Projected Demands

Water uses and projected demand for culinary (M&I), secondary, agricultural, recreational and environmental needs are discussed.

9.4.1 Culinary Water (M&I)

The Wasatch Front Water Demand/Supply Computer Model (WFCM) was used to predict the future water needs of the major water suppliers in Utah County. Based on the existing use patterns and the population growth projections provided by the Governor's Office of Planning and Budget (See Section 4), the WFCM was used to project future water use needs at five year intervals from 1995 to 2020. The following assumptions, used with the WFCM, are central to the conclusion for Utah County.

- The slower increase in municipal water demand relative to population increase results from assumed construction of secondary water systems in several Utah county cities (Alpine, Lehi, Highland, Lindon, Payson and Salem). It is believed these systems will begin to operate between 2000 and 2010. The water supply for the secondary system is assumed to come from the conversion of agricultural water. All other Utah County cities except Woodland Hills and Elk Ridge have secondary irrigation systems, but water is delivered in open ditches.

- Current developed supplies will continue to be available.

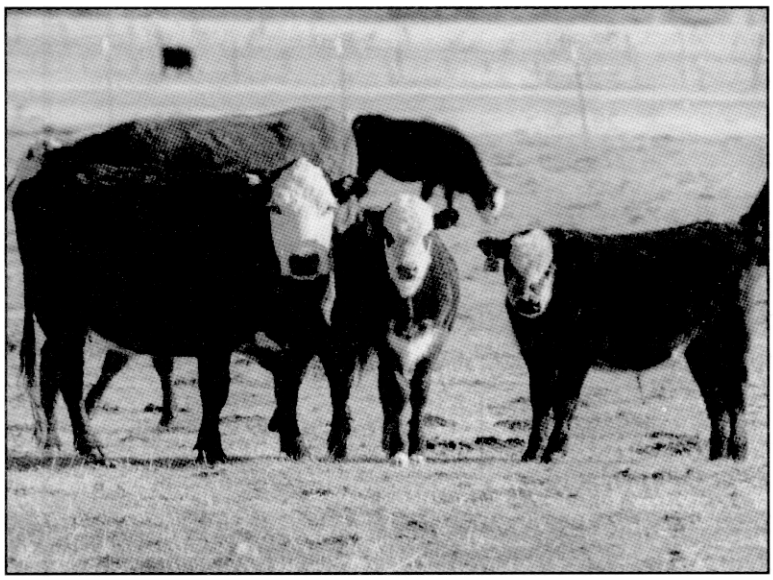
- The State Engineer's *Utah/Goshen Valley Groundwater Management Plan* (See Section 19) estimates an additional 169,000 acre-feet of groundwater could be developed in Utah County by exchange for surface water rights and /or Utah Lake water rights. Opposition from downstream water right holders has been expressed. Part of the

169,000 acre-feet will be developed for use in Salt Lake County. It has been estimated that approximately 75,000 acre-feet of additional groundwater will be developed from present and new wells for M&I uses in Utah County.

- The Central Utah Project will be completed and deliver 31,200 acre-feet of municipal water to communities in Utah County.

Table 9-2 compares the projected M&I water demands of major water suppliers in Utah County with the projected M&I water supplies. Smaller systems are not included. Utah County has sufficient water supplies to meet anticipated demands well beyond the year 2020. The 20,000 acre-feet of M&I water for north Utah County can be delivered now. This water comes from the M&I system, and it would require an exchange out of Strawberry Reservoir.

The water use data for the other counties (Juab, Summit, and Wasatch) that are part of the basin were obtained from meetings with all of the community water system managers. This data is summarized in the Division of Water Resources' *M&I Water Supply, Use and Rights in the Upper Jordan River Basin.* Table 9-3 summarizes culinary M&I water use and projects water demand.



The ranch lifestyle is still cherished in the basin

9.4.2 Secondary Water

Thirty-two basin communities have secondary systems for delivering water to lawns, gardens and other landscaping. Water use in these systems is presented in Table 9-4. Secondary use is projected as a percentage of culinary use. New secondary water systems will likely be installed as more communities approach the limits of their culinary water supplies.

9.4.3 Agricultural Irrigation Water

Approximately 166,400 acres of land are irrigated in the Utah Lake Basin. This may use 453,700 acre-feet of water for crop production. Table 9-5 shows the projected needs. Section 10 provides additional detail on agricultural water use.

9.4.4 Recreational Demands

Some of the state's most popular water-based recreation is located in this basin. The new Jordanelle Reservoir, Deer Creek Reservoir, and Utah Lake provide about 102,000 acres of reservoir recreation opportunities. Crowding has been a problem at Deer Creek Reservoir for many years. Jordanelle State Park was fully reserved for weekend use for the season before it officially opened on July 1, 1995. Recreational demand for water is expected to be very strong. More detail is provided in Section 15.

9.4.5 Environmental Needs

Water is needed for riparian vegetation, wetland maintenance and instream flows for fish and wildlife. Phreatophytes, deep rooted plants that obtain water from the water table or the soil just above, occupy approximately 2.6 percent of the basin. Many of the phreatophyte areas, such as Provo Bay at Utah Lake, are considered valuable for wildlife. They also act as natural filters, removing some nutrients and other pollutants from the waters which flow through them.

The Central Utah Project Completion Act (303)(b)(4)(c) requires operating plans for the Bonneville Unit of the Central Utah Project be established or adjusted to provide minimum streamflows discussed in Subsection 5.4.5.

Since the passage of the Endangered Species Act (ESA) in 1973, four Colorado River fishes have been listed as endangered. These are the Colorado squawfish, humpback chub, bonytail chub, and the razorback sucker. All of these fish have or do inhabit areas of the Green River and some have or do inhabit areas of the lower Duchesne River.

Table 9-2
UTAH COUNTY PROJECTED M&I DEMAND & SUPPLY FOR MAJOR SUPPLIERS

Year	1995 Population Projection	Water Demand (acre-feet)	Water Supply (acre-feet)	Surplus(+) Deficit(-)
1995	292,700	107,500	190,000	+ 82,500
2000	329,900	120,100	190,000	+ 69,900
2010	426,000	151,800	190,000	+ 38,200
2020	512,400	183,000	190,000	+ 7,000

Source: Wasatch Front Water Demand/Supply Model, February, 1997.

Table 9-3
1995 CULINARY WATER USE AND PROJECTED DEMAND[a]

Year	Juab	Summit	County Utah (acre-feet)	Wasatch	Total Diversion
1995					
Residential	870	300	83,400	2,240	868,890
Commercial/Institutional	460	10	25,790	500	26,760
Industrial	640	0	27,000	60	27,700
Total	1,970	390	136,190	2,800	141,350
2000					
Residential	930	430	92,300	2,530	96,190
Commercial/Institutional	490	10	27,700	570	28,770
Industrial	680	0	29,000	70	29,750
Total	2,100	440	149,000	3,170	154,710
2010					
Residential	1,070	500	109,830	3,050	114,470
Commercial/Institutional	560	10	32,600	680	33,850
Industrial	790	0	35,500	80	36,370
Total	2,420	510	177,950	3,810	184,690
2020					
Residential	1,230	590	125,900	3,480	131,200
Commercial/Institutional	650	10	38,870	780	40,310
Industrial	900	0	39,940	90	40,930
Total	2,780	600	204,710	4,350	212,440

a Includes Public Systems, Private Domestic and Self-Supplied Industries.

Table 9-4 1995 SECONDARY RESIDENTIAL WATER USE AND PROJECTED DEMAND					
Year	Juab	County Summit	Utah (acre-feet)	Total Wasatch	Diversion
1995	550	0	3,200	1,350	5,100
2000	660	0	3,600	1,530	5,690
2010	680	0	4,100	1,850	6,630
2020	780	0	4,500	2,100	7,380

Table 9-5 IRRIGATION WATER USE AND PROJECTED DEMAND						
Year	Juab	Sanpete	Summit (acre-feet)	Utah	Wasatch	Total Diversion
1988	42,000	9,100	7,400	333,200	62,000	453,700
1995	42,100	9,100	7,400	332,100	63,000	453,700
2000	42,100	9,100	7,200	325,400	62,700	446,500
2010	84,600[a]	9,100	7,100	334,800[a]	62,100	497,700
2020	84,300	9,100	6,900	324,900	61,800	487,000

[a] Assumes SFN project completion by 2010.

A Recovery Implementation Program (RIP) for the Endangered Fish Species in the upper Colorado River Basin was developed in 1987 cooperatively by the Secretary of Interior; the Governors of Wyoming, Colorado and Utah; and the Administrator of the Western Area Power Administration. The objective of the RIP was to provide a way to recover the four endangered fish and at the same time allow for the continued development of water by the upper basin states. The RIP is intended to provide the reasonable and prudent alternative (RPA) for projects undergoing Section 7 consultation in the upper basin. Section 7(a)(2) of the Endangered Species Act applies to federal agencies and requires them to insure that activities they authorize, fund or accomplish are not likely to destroy or adversely modify critical habitat. To identify the specific actions needed, the *Recovery Action Plan* (RAP) was developed. The RAP identifies those actions believed necessary to recovery of the fish. The RIP serves as the RPA. The RAP must be adaptive because new information, changing priorities and the development of the states' water entitlement requires modifications to the RAP. The RAP is reviewed and updated annually. The *Recovery Action Plan* is referred to as RIPRAP in program documents and correspondence.

The RIP requires consensus among the Implementation and Management Committees and Technical Committees. Issues are significant and often controversial. One difficult issue the RIP is addressing is the fundamental definition of "recovery." This has made defining objectives difficult. In spite of the difficulties, the RIP has facilitated water development in the Upper Basin and keeps all interested parties working together.

A 1980 biological opinion (amended in 1990) identified modifying operation of Flaming Gorge as the RPA for the completion of the Strawberry Aqueduct and Collection System. Coincident with the issuance of this biological opinion, Section 7 consultation began on the

continued operation of the Flaming Gorge Dam. After completion of the Strawberry opinion, the Fish and Wildlife Service (FWS) determined that insufficient data existed on flow requirements of the endangered fish, and that a biological opinion on the continued operation of Flaming Gorge Dam should not be issued until further studies were conducted. Between 1980 and 1991, a series of agreements delayed the issuance of a biological opinion. The FWS issued a biological opinion in 1992 which, among other things, called for a five-year research program to determine flow requirements. The final biological opinion on the operation of Flaming Gorge Dam is scheduled to be issued in December 1997. It may also address how operating Flaming Gorge Dam may impact development on the Duchesne River, and thus the diversion of water from the Duchesne River Drainage to the Utah Lake Basin. The razorback sucker was listed as endangered in 1991, and the lower 2.5 miles of the Duchesne River was designated as critical habitat in 1994. These actions resulted in the reinitiation of Section 7 consultation on the Bonneville Unit. A new action item was added to the RAP and funded by the RIP to do a three- to five-year study to determine flow requirements on the Duchesne River. The FWS issued a preliminary draft biological opinion in 1997 on the depletion effects on the Colorado River endangered fishes, and their critical habitats, in the Duchesne River Basin. This opinion should be completed in early 1998. It could affect the diversion of water for the Bonneville Unit.

One of the RAP activities recently completed was the *Duchesne River Hydrology and Water Availability Study*. The objectives of the study were to quantify the amount of water currently in the lower Duchesne River, compare this with the preliminary recommended flows determined by the Fish and Wildlife Service, and identify potential sources of water that could be used to augment flows in the lower Duchesne. The study concludes that there is a significant difference between existing flows in the lower Duchesne River and the preliminary recommended flows. Some potential sources of water are listed, but they are well short of the preliminary recommended flows.

Other action plans for the Duchesne River have yet to be written. Once written, it will be the responsibility of the RIP to implement the RPAs. Once the biological needs have been identified and evaluated, plans will be devised by the RIP to provide conditions for recovery of the endangered fish.

The service is writing a new biological opinion for the lower Provo River that will list new RPAs to protect the endangered June sucker and associated 4.9 miles of critical habitat. Unlike the Duchesne, there is no recovery program on the Provo River. Completion of the RPAs will be the responsibility of the project proponents and the Bureau of Reclamation.

Existing RPAs on the Provo River include: 1) Identify, store, deliver, and protect water necessary for minimum annual flushing, spawning and nursery flows in the Provo River. Studies will be conducted for a Three-year period to refine these flow recommendations; 2) ensure that storage flexibility in Deer Creek Reservoir occurs to assist with flow requests during June sucker spawning; 3) install a water quality monitoring system and use the system to maintain adequate riverine water quality during June sucker residence in the Provo River; and 4) ensure full discussion and action for June sucker flow and habitat needs through the interagency/interdisciplinary Provo River Resource Team.

Studies are required and funded by the CUPCA to identify mitigation and conservation opportunities. Specifically, effects of peak flows in the Provo River on fisheries and recreational use, along with mitigation and conservation opportunities possible through habitat or stream bed modification, will be investigated. Opportunities associated with water acquisitions and other aspects of the CUPCA will also be studied.

9.4.6 Water Use and Projected Demand Summary

In general the demand for M&I water parallels population growth. Although population growth may require more water than is presently developed, conversion of agricultural water to M&I use will offset the deficit. This trend is expected to continue into the long-term future. The overall projected water demands are summarized by use category in Table 9-6.

9.5 Alternatives for Meeting Water Needs

Nearly all water sources in the Utah Lake Basin will be developed if the Central Utah Project is completed in its entirety. Numerous opportunities have been identified by district consultants in a study on ways to coordinate operation of planned and present facilities and systems. Engineering and cost analyses have not been done for most of them as of this writing. Implementing the feasible opportunities will provide maximum benefit from the use of the scarce water supply.

Table 9-6
SUMMARY OF CURRENT WATER USE AND PROJECTED DIVERSIONS AND DEPLETIONS

Use	Year 1995 Diversion	1995 Depletion	2020 Diversion	2020 Depletion	2050 Diversion	2050 Depletion
	(acre-feet)					
Municipal & Industrial	150,700	60,830	226,620	96,020	386,000	169,640
Culinary	141,345	55,100	212,440	87,080	368,000	158,240
Secondary	9,340	5,730	14,180	8,940	18,000	11,700
Irrigation	453,700	253,660	487,000	282,460	395,000	237,000
Wet/Open Water Areas[1]	16,700	16,700	16,700	16,700	16,700	16,700
Net Evaporation (Major Reservoirs)	240,000	240,000	240,000	240,000	240,000	240,000
Basin Total	861,100	571,190	970,320	635,180	1,037,700	663,000

[1] No water diverted to these areas. Diversions = Depletions

9.5.1 Water Supply Management

Several opportunities were identified by the CUPCA mandated study of coordinating operations (Section 207(d))to improve management of existing supplies. Contractual arrangements between municipalities and local farmers can be structured to transfer irrigation water to cities during serious drought periods. This would provide municipalities with supplemental water when needed most without having to carry excess water rights that may be rarely needed. Irrigators would be compensated for any profit lost by the arrangement, and participation would be voluntary. Irrigation water used for raising alfalfa, small grains and pasture would more likely be made available than water used to produce orchard or other specialty crops. An approved water right change application would be required.

Construction of small surface water treatment plants at strategic locations could offer the ability to use currently untreatable surface water supplies. These plants could treat winter season flows not currently used for public supply. Treated water could be used directly for groundwater injection. Multiple small facilities could make conjunctive use on smaller mountain streams practical without lengthy collection systems. Two promising locations for new surface water treatment plants are American Fork and Spanish Fork rivers. The American Fork River location could use supplemental supplies from the Jordan or Alpine Aqueduct or even the Salt Lake Aqueduct. The Spanish Fork River plant could use stored supplies from Strawberry Reservoir through the Syar Tunnel and associated facilities. Conjunctive use can also be carried out by exchanging surface supplies with wells.

A wastewater total containment lagoon at Nephi utilizes evaporation. It may be possible to use this water for land application, i.e., growing selected crops or supplementing downstream supplies with treated effluent. This is a small facility and would require additional treatment to allow discharge. Advanced treatment to limit phosphorus and nitrate discharges would likely be required. With proper blending and treatment, it may be possible to utilize certain other low quality water sources such as Utah Lake for municipal use. Advanced treatment would probably be required to eliminate TDS and odor concerns. Effluent from all wastewater treatment facilities is being reused, directly or indirectly, mostly for agricultural. All of the above options would present water rights issues that need to be addressed.

Three reaches of the Alpine Aqueduct have been constructed. Reach 1 delivers water from the Provo River in the Olmsted flowline to the Utah Valley Water Treatment Plant (UVWTP), and is the upstream section of the Jordan Aqueduct Reach 4. Alpine Aqueduct Reach 2 delivers treated water from the UVWTP to

Orem and Provo cities. Alpine Aqueduct Reach 3 is constructed, but it has not been put into operation. The original plan was to deliver treated water from the UVWTP to northern Utah County. As an alternative, if a bypass around the treatment plant were to be constructed, this aqueduct could be used to supply raw water to secondary systems in north Utah County, reducing the demand for culinary water. Figure 9-1 shows the major aqueducts.

9.5.2 Surface Water Storage Facilities.

When the Central Utah Project is completed, most feasible surface storage sites will be developed. Upstream storage capacity is increasing the flexibility in the system. Keeping as much water as possible in the upper reservoirs allows these supplies to be released on an "as called for" basis to a broader service area. Lower reservoirs can be used to provide supplemental capacity. Demands would be met from the lowest possible source, maximizing the flexibility. An added benefit may be reduced system-wide evaporation losses since upstream reservoirs are located where there are lower temperatures. These reservoirs are generally deeper and have higher retention efficiencies. Utah Lake, by comparison, is very inefficient due to its broad surface area, shallow depth and low elevation. More aggressive operation of reservoirs using real time data and better modeling of storage systems may increase usable surface water supplies. In some areas, multiple upstream reservoirs feed lower downstream rights. Downstream water demands are met more efficiently when the multiple reservoirs are operated as a single system to fulfill the downstream rights rather than relying on the specific water rights.

Operation of the multiple reservoirs as a single system improves flexibility. A current example is the Deer Creek/Jordanelle Operating Agreement which went into effect November 1, 1994, and governs the operation of the two reservoirs.

The current system of water rights continues to be a determinant in river system operation. To operate outside the current water right priority system is not possible without impacting holders of water rights. The above concept also conflicts with long-term storage of CUP water in facilities specifically built for supplemental deliveries in drought years.

Diking Goshen Bay and/or Provo Bay in Utah Lake has been studied and rejected by the Bureau of Reclamation and not recommended by the state in its 1989 review of the CUP. Several development schemes have been put forward for highway causeways and man-made peninsulas for real estate development. Alternative development scenarios that result in reducing the lake surface area and increasing its depth would reduce evaporation and may improve water quality. However, modifications would be expected to have significant impacts on fish and wildlife populations.

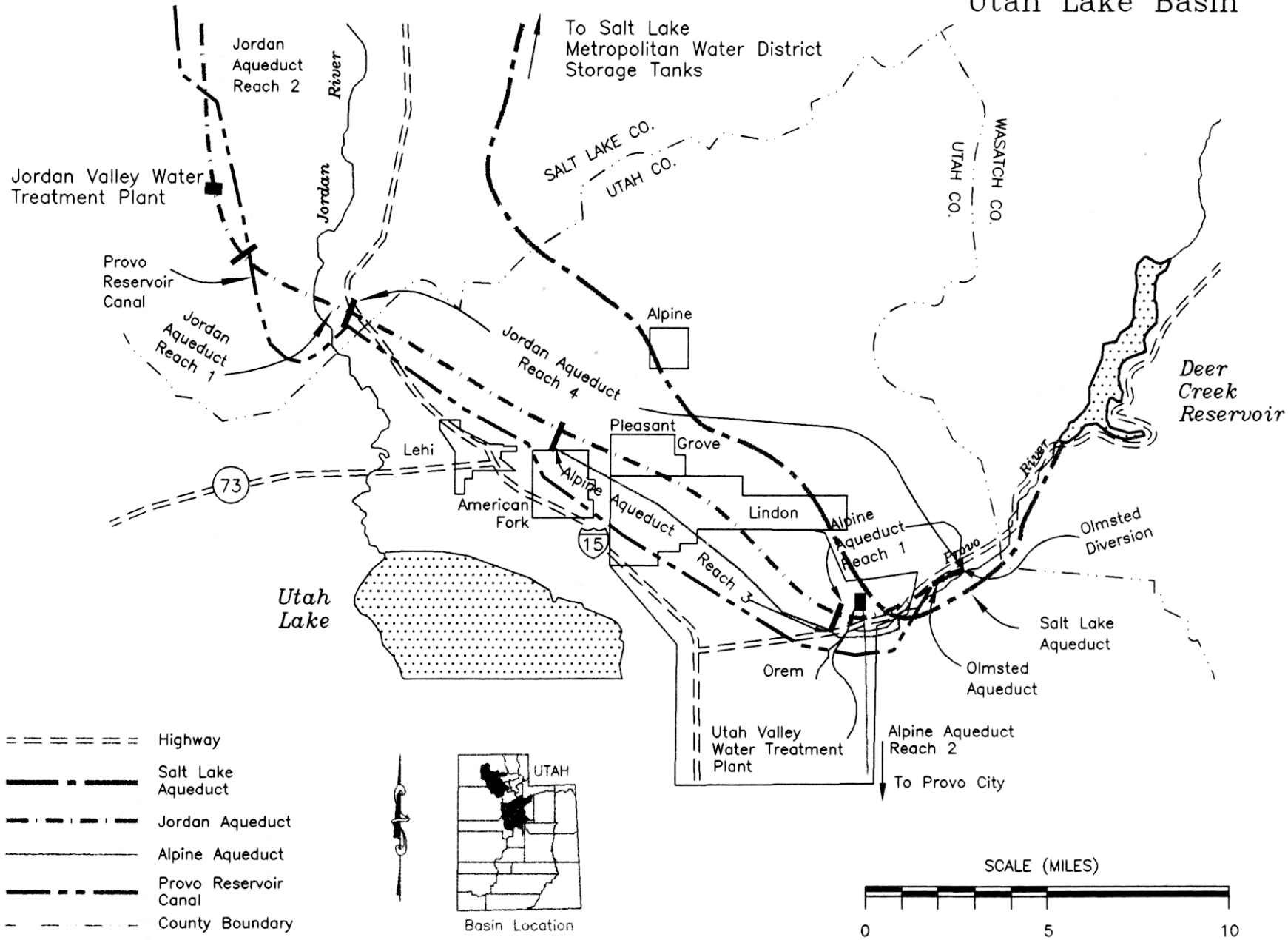
In the 1930s, the Bureau of Reclamation and the State of Utah investigated possible reservoir sites on Salt Creek above Nephi. One site, Blacks Narrow, was given considerable attention. The investigations were discontinued when it was determined that the Salt/Currant Creek system was fully appropriated. With the construction of the Spanish Fork Canyon-Nephi Irrigation System and the importation of water into Juab Valley, the question of water rights could likely be overcome by exchanges. During a scoping meeting at Nephi in 1984 for the Irrigation and Drainage (I&D) System (replaced by the Spanish Fork Canyon/Nephi Irrigation System), renewed interest was expressed for a dam and reservoir on Salt Creek. Possible benefits for constructing the reservoir at Blacks Narrow include recreation, improved water quality during spring runoff, delivery of a supplemental irrigation supply to the Nephi area, and flood control. In addition, Mona Pumping Plant and irrigation peaking features of the SFN system could be downsized, thus reducing their construction, operating and maintenance costs.

9.5.3 Groundwater Recharge and Management

The potential for artificial recharge of groundwater along the Wasatch Front was studied by the State Engineer in 1978. A groundwater recharge demonstration project has recently been completed by the Salt Lake County Water Conservancy District. The demonstration project is located in southeast Salt Lake County. The lessons learned, and technology acquired, may be applied to groundwater management in the Utah Lake drainage area.

Groundwater could be used more efficiently in some instances by managing it in conjunction with winter surface water flows. Although summer flows are appropriated for irrigation, winter season treatment is a possibility in some cases. These winter flows could also be treated in new treatment plants and used directly in place of groundwater pumpage by local cities. Opportunities may exist to do this with water from American Fork River and Spanish Fork River in Utah County and Snake Creek in Wasatch County. The

Figure 9–1
MAJOR AQUEDUCTS
Utah Lake Basin



possibility exists during winter months to leave water in those unlined irrigation canals which are located in natural recharge zones. Flood detention basins are located at the mouths of several creeks which could be used during the non-irrigation season for supplemental groundwater recharge. Some of these facilities are on highly permeable alluvial sand where recharge to the deep aquifer can be accomplished.

Surface water can be left in stream channels and exchanged from new wells. Provo City is currently constructing a new well to exchange water from Spring Creek, allowing it to flow to Utah Lake by exchange. Any groundwater recharge and management options chosen would have to account for possible effects on downstream storage rights.

9.5.4 Cloud Seeding

The Utah Cloud Seeding Program has the goal of increasing winter precipitation within targeted mountain watersheds. Enhanced winter snowpack leads to additional surface streamflow runoff and underground water storage during spring and summer months. Analyses made suggest this goal is being achieved.

Upper portions of the Provo River are in the target area of the Western Uinta Mountains Cloud Seeding Program. Evaluations indicate cloud seeding added 5-15 percent of precipitation each year over the past five years.

Eastern Juab County is on the northern tip of the Southern Utah Cloud Seeding Program. This area has been seeded for 17 years and adds between 5 and 15 percent to the precipitation in the area.

9.5.5 Conservation

Numerous programs are available for promoting water conservation. These programs include, but are not limited to, rebates to water users for reducing their lawn sizes, low-flow shower heads, secondary irrigation systems, wastewater reuse, and conservation-inducing price structures. These and other programs are explored in detail in Section 17.

9.6 Issues and Recommendations

Issues addressed are the dramatic increase in prices in the Utah County water market, improving Utah Lake, and local water planning.

9.6.1 Water Rights Markets

Issue: Prices for water rights and shares of irrigation company stock are increasing dramatically due to population growth requirements imposed on new development and restrictions on moving water between prior use and where it is needed.

Discussion - Most of the cities in Utah Valley have passed ordinances requiring developers to provide rights for water needed to serve their new subdivisions. This has set off a flurry of activity in the local water market and prices for irrigation company shares and well rights have spurted upward.

These local ordinances create a temporary shortage in the local water market for irrigation company shares and groundwater rights. In theory, prices increase until local share and well owners are induced to sell enough water to balance supply with demand. With the price at an all-time high, irrigators have an incentive to sell their water with the land or let the land sit unused. The consequence is that water and land once employed for crop irrigation is moving to municipal uses.

In the meantime, the Central Utah Water Conservancy District is finishing the Central Utah Project (CUP). The CUP water is coming on line at the same time developers are scurrying to find water to turn over to cities. The CUP water, however, is not available for private developers to purchase. Cities have less need for CUP supplies because water provided by developers comes at no cost. Therefore, high prices for irrigation shares and groundwater rights are drawing water from agriculture to municipal use at the same time CUP is developing municipal water supplies to meet future growth. Rising prices have also made it difficult for the Central Utah Water Conservancy District to acquire the 75 cfs required by the CUPCA for instream flow in the Lower Provo River.

Data presented in Table 9-2 and in Section 11 show that with the CUP completed, water supplies will be adequate in most areas of Utah Valley well into the next century. While some cities will have difficulty meeting future demand there is no general water shortage to justify the high prices that are currently being paid. New home buyers are paying higher prices, and are the ones who bear the cost of high prices being paid for water rights. Cities and other water providers benefit because their cost of acquiring water is less.

The price charged by a city for committing water to a new development should be equal to the cost of water from the next best alternative source. The price charged by a city in southern Utah County may be the capitalized cost per acre-foot of water to be delivered by the SFN system of the CUP. For cities in northern Utah County, it may be the capitalized cost of water

from Alpine Aqueduct Reaches II and III. This policy would send the price signal on what future water supplies will cost. Developers and annexes, along with city officials, would be required to make decisions based on the cost of the next increment of water supply. Meanwhile, the cities would be building a reserve fund with which to pay for construction and other costs of bringing in the future supply.

Recommendation - Local government officials should assess the long-term effects of requiring developers to donate water for new development. New water demand should be served with water acquired from CUP through conservation and by interlocal agreements with nearby systems.

9.6.2 Utah Lake Improvement

Issue - Utah Lake is perceived by many to have great potential for economical development of municipal water supply, recreation, transportation, fish and wildlife management, real estate, and other uses.

Discussion - On two occasions, task forces have been created to study issues surrounding development of Utah Lake and make recommendations for legislative or other action. At present, no progress has been made. In 1989, the Utah Legislature considered S.B. 77, the Utah Lake Authority Act. It would provide for a Utah Lake Authority and governing board to establish and coordinate programs for development of Utah Lake. Disagreement over the distribution of power on the authority board prevented the act from being passed.

A recommendation from the most recent Utah Lake Task Force was to create a Utah Lake Commission/ Coordinating Council. This organization would have the power to coordinate all aspects of Utah Lake development, maintenance and management. A full time director and staff were recommended.

The objectives of Utah Lake improvement must be to increase the efficiency of the lake for water storage, enhance the quality of lake water, and gain control of its fluctuating surface while protecting wildlife values and established water rights. Several schemes have been discussed for doing this, but none has gained widespread approval. An obstacle to improving Utah Lake is the lack of solid proposals for large-scale development projects that demand the attention of public officials. Since the 1987 Supreme Court ruling, the Division of Forestry, Fire and State Lands has not received applications for any of the various development proposals. Yet rumors abound of developers who would like to invest in Utah Lake development.

A management plan would help develop the potential of Utah Lake. It should address the role of the county and cities in zoning for the orderly development of uplands and in coordinating the permitting process for development of the lake bed. A technical task force could be formed to explore ways to increase control of the lake's surface elevation. A coordinating council, made up of representatives from water right holders and from state and federal agencies having lake-related missions, would set broad policies to coordinate and expedite permitting on Utah Lake consistent with the plan.

Recommendation - Utah County should take the lead in establishing an interagency entity to oversee the preparation of a management plan for Utah Lake.

9.6.3 Local Water Planning

Issue - Many communities are not adequately planning for future growth.

Discussion - Water purveyors need to plan their future growth. Water conservation will should be an integral part of each agency's water management plan. The present advice from water planners throughout the U.S. is to estimate a community's growth for the next 50 years. Community leaders can plan a combination of water supply, water quality and conservation strategies that will provide an integrated structural and non-structural program to meet their needs.

Various scenarios can be employed, considering all options available to communities. Least-cost analysis may be used, with water conservation and environmental impacts given full consideration. Groundwater sources, converting agricultural water and reducing water demand should be considered for inside and outside a community's homes.

The plan can be reappraised periodically. By updating population projections, re-evaluating water source quality and capacities, and incorporating newly-developed conservation methods, individuals responsible for water delivery can be alerted to problems beyond their term of office that require timely action for the future quality of life.

Recommendation - All communities and/or water utilities should prepare a long-term water management plan which includes new water supply sources and water conservation programs. The plans should be reviewed and updated periodically. To encourage management and conservation planning, water funding agencies should require plans as a condition of state participation in the projects. ✤ ✤

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Agricultural Water

Agriculture is a major industry in the basin and the largest user of land and water. It is a significant component of the local economy.

10.1 Introduction

This section describes the agricultural industry in the basin, along with its problems and future destiny. Agriculture is slowly giving way to urban land uses in Utah County. This county ranks number two in the state in agriculture income with over $87 million. Eastern Juab County continues with agriculture as the primary generator of economic activity. Western Wasatch County is also becoming more urbanized but agriculture remains economically important. The Summit and Sanpete counties portion of the basin are primarily agricultural. Most of the irrigated lands have a substantial water supply, with resulting good crop yields.

10.2 Background

Farmers in Juab County are primarily dependent upon beef production for their income. More than 50 percent of the farms are devoted to this type of agriculture. Farmers in northern Juab Valley base their present farm management practices on a water supply that is insufficient for the available land. Consequently, the Nephi Irrigation Company, along with many individual farmers, have drilled wells to supplement the irrigation water supply from Salt Creek.

Southern Utah County is still mostly rural, but only a few farms and ranches provide full-time employment for farmers. Several dairies with 100 to 500 milking cows are the exception. Fruit is also a major income producer. Many farms in Utah County are part-time operations with the farmers working full-time at other employment. Western Wasatch County also has few full-time farmers.

10.3 Agricultural Lands

The Utah Lake Basin has suitable climatic and soil conditions for diversified irrigated and dry farm agriculture. Dairy farming, beef and fruit production are the principal farm enterprises.

Harvesting alfalfa near Nephi

10.3.1 Irrigated Cropland

Alfalfa is the crop grown most extensively, followed by pasture and small grains. Most of these three crops are grown for dairy and beef cattle feed. Fruit is the major cash crop, occupying nearly 10,000 acres. Orchards are located mostly on bench lands in Utah County and produce apples, peaches, pears, cherries and apricots. The basin contains approximately 166,400 acres of irrigated land, including land that is fallow, idle or sub-irrigated. This land may use 453,700 acre-feet of water for crop production. See Table 9-5 for irrigation water use and projected demand. Table 10-1 shows the 1988 acreage for each crop. Cash crop farms usually include livestock to use soil conserving crops, i.e., alfalfa and pasture.

Table 10-1 IRRIGATED LAND BY CROP-1988						
Crop	Juab	Sanpete	Summit (acres)	Utah	Wasatch	Total
Fruit	25	0	0	9,850	0	9,875
Other Horticulture	5	20	0	85	0	110
Grain	2,945	440	35	22,655	1,290	27,365
Corn	700	0	0	12,140	0	12,840
Vegetables	65	0	0	200	80	345
Alfalfa	6,420	590	220	24,320	5,790	37,340
Grass Hay	560	1,250	660	9,210	2,470	14,150
Grass/Turf	0	0	0	650	20	670
Pasture	3,270	500	1,490	22,950	6,680	34,890
Sub-irrigated Hay/Grass	1,950	35	250	4,530	3,930	10,695
Idle and Fallow	2,570	90	260	13,980	1,220	18,120
Total	18,510	2,925	2,915	120,570	21,480	166,400

10.3.2 Dry Cropland

Dry farm production of wheat is moderately successful, particularly in Juab County, when the land is fallowed every other year. Some alfalfa is also grown without irrigation, but yields are low and farmers only harvest one cutting annually. Approximately 2,900 acres in dry cropland are harvested each year.

10.3.3 Other Lands

In 1995 there were 114,200 acres of wet/open water areas and 56,900 acres in urban uses. Most of the remaining land area consists of rangeland and national forests. According to *Utah Conservation Needs Inventory Report* issued in 1970, Juab County has 252,700 acres of private rangeland, Utah County has 325,000 acres, and Wasatch County has 126,800 acres. Additional rangeland is used for grazing livestock and wildlife. The Forest Service and Bureau of Land Management administer these lands, as well as the Utah Division of Parks and Recreation and Division of Wildlife Resources.

10.4 Agricultural Water Problems and Needs

Water problems in the agricultural sector are centered in supply shortages and conversion of cropland to municipal and industrial uses.

10.4.1 Irrigation Water Shortages

More than 200,000 acres of arable land in the study area are not irrigated. Most of this arable land is south or west of Utah Lake in Utah County and eastern Juab County. About 13,000 acres of this land could be irrigated as part of the Bonneville Unit of the Central Utah project.

Some presently irrigated lands in Heber Valley, southern Utah County and eastern Juab County experience water shortages in normal or dry years. Supplemental irrigation from the Bonneville Unit will alleviate most but not all these shortages.

Future demands for irrigation water in non-urbanizing areas are not projected to be different from present demands. The exception will be in urbanizing areas where future demand will decrease and some of the irrigation water will be converted to other uses.

10.4.2 Erosion

Soil loss through erosion occurs on lands in the upper watershed, on dry farm lands and on irrigated

Table 10-2 HISTORICAL AND PROJECTED IRRIGATED CROPLAND UTAH LAKE BASIN						
Year	Juab	Sanpete	Summit (acres)	Utah	Wasatch	Total
1966	13,440	2,670	1,550	135,180	22,450	175,290
1988	18,510	2,925	2,915	120,570	21,480	166,400
1995	18,400	2,900	2,900	118,200	21,000	163,400
2000	18,400	2,900	2,800	115,800	20,900	160,800
2010	28,200(a)	2,900	2,800	111,600	20,700	166,200
2020	28,100	2,900	2,700	108,300	20,600	162,600

[a] Assumes SFN project completion by 2010.

cropland. The most critical erosion problems are occurring on flood irrigated row crops where soil losses approach 10 tons per acre in some areas.

10.4.3 Cropland Conversion

Table 10-2 shows the historical and projected irrigated cropland. The amount of water needed for irrigation of crops to the year 2020 is estimated in Section 9, Table 9-5.

Irrigated cropland acreage has decreased in the basin as land has been converted to residential and commercial developments. Water-related land use mapping in 1966 and 1988 show a decline during this period. This rate of decline will likely continue until presently dry-farmed land in east Juab County receives irrigation water under the Spanish Fork Canyon/Nephi irrigation system of the CUP. By the year 2020, 162,600 acres are expected to remain in irrigated cropland.

10.4.4 Water Right Concerns

Some farmers are concerned with lack of incentive to conserve water through improved irrigation practices. These farmers believe the water they save should belong to them and they should be allowed to irrigate additional land or sell it to other users in the open market. But Utah water law gives an irrigator the right to use only as much water as is needed to produce a crop, up to the duty specified by the State Engineer, i.e., four acre-feet. In the Utah Lake Basin, water being diverted by irrigators from streams or aquifers but not consumed by crops returns to the hydrologic system. Usually, it returns to Utah Lake or a groundwater aquifer. Others have appropriated this previously "wasted" water and acquired vested rights to its use. Therefore, "saved water," already appropriated by others, is not available to the one who saves it for new uses.

Also, farmers whose water needs are met by pumping large wells worry that the State Engineer's requirement for metering may lead to a loss of part of their water right. They reason that if they are allowed to pump up to four acre-feet, but metering proves only three acre-feet are needed to fully meet crop requirements, the other acre-foot will be lost through non-use. As with "saved" water, the excess water allowed under the State Engineer's duty is not a vested property right unless actually needed and used for the production of crops. Downstream users have already appropriated the excess amount.

Another problem is the perceived inequity between how municipalities and irrigators are treated under Utah law. Some irrigators contend that municipalities are not subject to the same forfeiture penalty as they are. The water rights forfeiture statute provides that when an appropriator abandons or ceases to use water for a period of five years, the water right ceases and the water reverts to the public unless, before the expiration of the five-year period, the appropriator files a verified application for an extension of time with the State Engineer. Agriculture water users and municipalities are bound equally by the five-year period.

The distinction between the agricultural user and the municipality lies in the statutory basis upon which the State Engineer is authorized to approve and grant an

extension of time for nonuse. Applications for extension shall be granted by the State Engineer under *Utah Code Annotated* and 73-1-4(3)(a)(1996). Reasonable cause for non-use is shown by (1) financial crisis; (2) industrial depression; (3) operation of legal proceedings or other unavoidable cause; and (4) the holding of a water right without use by any municipality, metropolitan water district, or other public agency to meet the reasonable future requirements of the public. (*Utah Code Annotated* and 73-1-4(3)1996). Under this provision, the State Engineer will likely give an extension of time to a municipality in almost every case based on future development needs. This policy choice adopted by the legislature was likely created to allow cities to plan for and encourage development by obtaining water well in advance of its use. Obviously, to demand that growth occur before obtaining water needed for such development would be a detriment to communities. Nevertheless, an agricultural user also has the right to file an extension under 73-1-4.

Another distinction between agricultural and municipal water rights is that forfeiture is more difficult to prove against a municipality. In regards to an agricultural water user, it is generally apparent whether the water has been put to beneficial use by irrigating crops during the previous five-year period. The question is much more difficult for municipal use. For example, would diverting the water right once for domestic use restart the five-year period? Does a municipality need to use the entire water right or is partial use enough to restart the five-year period? If so, how much use is enough? No case law is available on this subject in Utah and these issues are yet undecided. Even so, a municipality should consider filing an extension every five years for water that is not being used or only partially being used to avoid forfeiture. Approval is almost always granted by the State Engineer on timely filed extensions.

10.4.5 Title To Land Around Utah Lake

When the State of Utah acquired ownership of the bed of Utah Lake, the boundaries of the lake bed were defined only as the ordinary high water mark. The state is presently negotiating with landowners over where the lake bed ends and private property begins.

10.5 Conservation and Development Alternatives

Where urbanization is reducing the amount of agricultural land, upgrading old irrigation systems to serve remaining farms and new lawn and garden systems is the major conservation and development objective. In southern Utah, eastern Juab, and western Wasatch counties, significant work is being done to improve irrigation systems with state financial assistance and funding provided under the Central Utah Project Completion Act.

10.5.1 Conveyance Systems

Pipeline projects are replacing old concrete ditches in several areas taking water from the High Line Canal in southern Utah County. This will save water and reduce labor costs for farmers. Additional water will become available in southern Utah County and in the Nephi area when the Spanish Fork Canyon-Nephi (SFN) project pipeline is completed by the Central Utah Water Conservancy District. Conveyance systems in Wasatch County will also be improved when the Wasatch County Water Efficiency Project (WCWEP) is completed.

10.5.2 Application Methods

Major changes will also occur in on-farm application efficiency in Wasatch County when the WCWEP is installed. This project will replace open ditches and flooding with pipelines and sprinkler systems. The WCWEP will receive $10,000,000 for project costs from the federal government under the Central Utah Project Completion Act's Section 207, Conservation Credit Program. An additional $20,000,000 will be provided under Section 202 and 303. Local cost of $10,769,000 will also be needed to complete this $40,769,000 project.

10.5.3 Watershed Management

The Santaquin Canyon Pilot Watershed Project (1955), the American Fork-Dry Creek Watershed Project and the Miller-Bigelow Watershed Project (1964) have been completed. They addressed floodwater and sediment damage and agricultural water management problems in their respective areas. Watershed work plan applications are being prepared in eastern Juab County and southern Utah County to improve irrigation water management and reduce erosion. A watershed work plan for Heber Valley, Round Valley and the Francis/Woodland area, has been prepared. An inventory of sedimentation problems along Salt Creek in Juab County is planned by the NRCS.

10.6 Issues and Recommendations

One water policy issue affecting agriculture is discussed: Land ownership around Utah Lake.

10.6.1 Land Ownership Around Utah Lake

Issue - The ownership boundary between sovereign lands of Utah Lake and private upland is not certain.

Discussion - When the U.S. Supreme Court reaffirmed the state's ownership of the bed of Utah Lake in Utah v. U.S. (1987), the location of the "ordinary high water mark" at statehood, which is the public ownership boundary, was not addressed by the court. Due to human-caused influences on the lake level and the gradual slope of much land around the lake, the location of the "ordinary high water mark" is difficult to determine with certainty.

In order for the public to exercise its right to use public trust lands and for private landowners to exercise their rights, the Division of Forestry, Fire and State Lands is negotiating with upland owners to establish the boundary around the lake. Substantial progress is being made as the division and landowners gain experience in negotiating the complex issues concerning title and ownership of lands.

Recommendation - The Department of Natural Resources has made the boundary negotiation a high priority. The Division of Forestry, Fire and State Lands should continue to expedite negotiations around the lake. ✤ ✤

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Drinking Water

Constant vigilance is required to assure high quality drinking water will always be available for a growing population.

11.1 Introduction

This section discusses public and private water supplies in the basin and reviews their present status. A public water system, as defined by the Utah Division of Drinking Water, is one serving at least 15 connections or 25 people 60 days per year. Water from public systems may be used for culinary, lawn and garden, car washing, and many other uses. Industrial firms use water from public water systems also, but Section 18 deals specifically with this use.

11.2 Setting

In 1995, people and their activities in the Utah Lake Basin used 190 gallons of residential culinary water per day. The statewide average for all public supplied culinary use is estimated to be 270 gallons per capita day (gpd). Use in cities and towns varied between 110 gpd in Bradford Acres Water Association in Utah County and Timber Lakes Subdivision in Wasatch County to 448 gpd in Goshen. Most of the variability between communities can be attributed to the amount of culinary water used for outside lawn and garden irrigation, leaking pipelines and high water-using industries.

11.3 Organizations and Regulations

All public drinking water supplies are subject to the Utah Safe Drinking Water Act and Utah Public Drinking Water Regulations. The Utah Department of Environmental Quality, Division of Drinking Water, administers the laws and regulations. In addition, the Division of Water Rights and the Board of Health have responsibility for controlling how drinking water wells are constructed.

11.3.1 Local

Towns, cities, and counties all have primary responsibilities for drinking water quality control within their respective jurisdictions. In administering state drinking water regulations, drinking water facilities are categorized as community water systems, non-transient and non-community systems. Of the 140 public drinking water systems in the basin, 128 are approved, 10 are unapproved and two need corrective action as shown in Table 11-1. Community water systems are treatment and/or distribution facilities serving a minimum of 15 connections used by year-around residents. Non-community systems provide seasonal water service and are usually owned and operated by small public organizations. Non-community systems provide commercial and industrial drinking water.

All public water systems have their own drinking water sources. Many receive additional water from districts such as the Central Utah Water Conservancy District. In the cases of Orem and Provo, metropolitan water districts subscribe for water from the CUWCD treatment plant.

11.3.2 State

Verification that a public water system is meeting state and federal standards is made through monitoring programs established by state and federal regulations. The Rules for Public Drinking Water Systems (RPDWS) outline the procedures local plant operators must follow when taking water samples. The rules also outline the documentation requirements of subsequent water quality analyses for submission to the Division of Drinking Water.

In an extreme emergency where danger to public health is imminent, the scope and nature of the threat must be reported to the Utah Division of Drinking Water. Upon receiving a report of a significant decline in the quality of a public water supply, the division will take immediate action to eliminate the initial and ongoing cause of the problem. System operating policies are then revised to prevent similar problems from occurring in the future.

Table 11-1 PUBLIC DRINKING WATER SYSTEM RATINGS				
Rating	Juab	Utah	Wasatch	Total
Approved	11	74	43	128
Not Approved	0	3	7	10
Corrective Action	0	1	1	2
Total	11	78	51	140

The RPDWS outline the state's responsibility to administer programs designed to monitor existing drinking water quality by testing and analyzing water samples. They also set minimum contaminant levels and provide a source of funding for the design, construction, and operation of drinking water treatment and distribution facilities.

The Utah Safe Drinking Water Act (USDWA) created the Utah Safe Drinking Water Board with the power to regulate and protect the quality of Utah's drinking water. The USDWA includes regulations designed to: 1) Establish standards for drinking water quality, 2) establish standards and regulations for the design and construction of new and expanded water treatment and conveyance facilities, 3) protect watersheds and other sources of raw public water supplies, 4) provide technical and financial assistance to train operators, construct new treatment and distribution facilities and renovate existing ones, 5) administer federal programs that provide technical and financial assistance to local water agencies, 6) carry out emergency plans when natural disasters contaminate public drinking water supplies; and 7) provide enforcement of state and federal drinking water regulations.

State safe drinking water regulations reflect the same standards as federal regulations. State regulations can be more stringent than federal regulations where the Board and Division of Drinking Water feel federal regulations do not adequately protect the health of people in a certain area.

Maximum contaminant levels (MCLs) have been established by the Utah Division of Drinking Water in setting treatment standards. MCLs have been established for primary and secondary standards and treatment processes. Primary standards apply to treatment requirements to protect public health and safety, while secondary standards apply to the maintenance of water aesthetics such as taste, odor and turbidity. Primary standards must be followed by all public drinking water systems. Secondary standards, however, are only recommended for compliance and clientele satisfaction.

The Division of Drinking Water also administers and promotes other programs. Construction funding is provided from a state revolving fund. This fund is used to construct new treatment and distribution facilities or repair existing facilities. Construction funds are awarded in four ways: low interest loans, direct grants, interest buy-downs and credit enhancements.

The *Drinking Water Source Protection Plan* is to be submitted by system owners to the Division of Drinking Water for general review and assessment of compliance with RPDWS. However, an exception may be granted to an operator of a public water system in the event the operator cannot afford the costs associated with the preparation of such a plan.

11.3.3 Federal

With passage of the federal Safe Drinking Water Act (SDWA) in 1974, the federal government established national drinking water regulations to protect the public health 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 deadlines for owners/operators of treatment facilities to comply with federal regulations, 3) regulate lead and copper source protection, and 4) strengthen enforcement of all regulations in the act.

Chemical, physical, radiological and bacteriological substances in drinking waters that pose a health risk to the public are regulated by the EPA under provisions given in the SDWA. The EPA has established MCLs for drinking water. An extensive list of MCLs has been established for the most common organic and inorganic contaminants. In addition, the SDWA established a strict schedule for the EPA to set MCLs for additional contaminants. As a result, additional contaminants are regularly identified and subjected to new regulations.

To control the aesthetic quality of drinking water supplies, the SDWA has also established a list of secondary maximum contamination levels (SMCLs).

The SMCLs were established to improve taste, odor and color.

The SDWA also requires state and local water providers to monitor a specified list of both regulated and unregulated contaminants. Selection of contaminants is dependant on 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. Completion of the first nine-year monitoring period will be followed by a second nine-year period.

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.

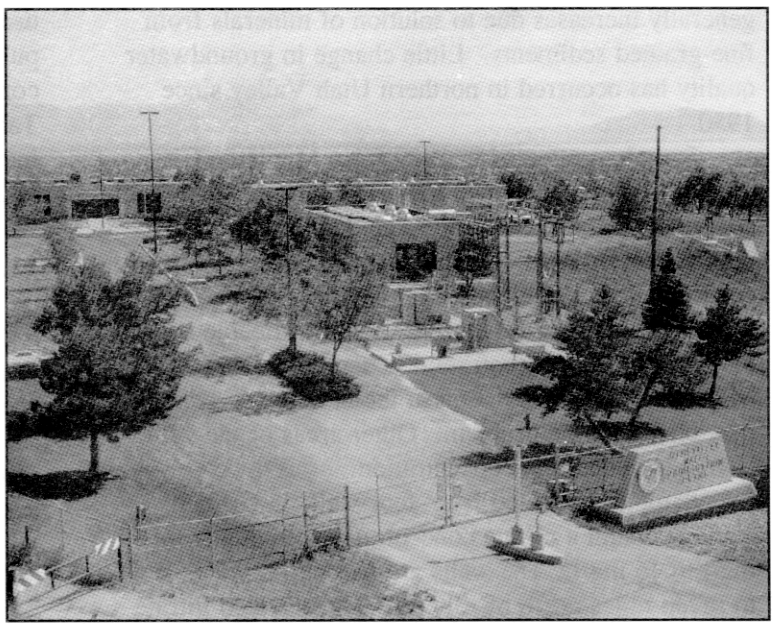
New capacity development provisions are added to the SDWA. The EPA must complete a review of existing state capacity development efforts and publish information to assist the states and public water suppliers with these efforts.

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 and promulgate a National Primary Drinking Water Regulation 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) 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.



Utah Valley Water Purification Plant

11.4 Drinking Water Problems

Demand for high quality water and the potential for contamination of drinking water supplies has increased along with population growth. Natural geologic conditions, as well as human activities like landfill operation, agriculture, mining, construction and hazardous waste spills, all contribute to drinking water problems. Contamination also comes from watershed and alluvial fan recharge areas where pollutants enter the aquifers.

11.4.1 Operation of Facilities

Water quality in the upper reaches of the basin is considered good to excellent. Occasional repair,

replacement, enlargement, or upgrading of each system is required to maintain adequate levels of service. Investments in wells, storage tanks and pipelines can be expected.

11.4.2 Groundwater Contamination

Most groundwater is acceptable for use in municipal, industrial, and agricultural operations with some restrictions because of isolated areas of poorer quality.

In northern Utah Valley, Total Dissolved Solids (TDS) concentrations are generally between 100 and 1,000 mg/l, with most wells containing between 150 and 500 mg/l. The smallest concentrations are found near Alpine and Lehi, and the largest are found near Saratoga Springs. As deeper water moves upward, the TDS generally increases due to solution of minerals from fine-grained sediments. Little change in groundwater quality has occurred in northern Utah Valley since 1950.

Samples collected in 1989 from Mapleton City municipal wells contained 5 mg/l of nitrate. A possible source of the nitrate is a nitric acid spill that occurred up-gradient in 1986. Private testing shows the concentrations are highest near the spill with some samples containing 50 mg/l. Another probable source of nitrate is the concentration of septic tanks in Mapleton. The installation of the new sewer system may eliminate the problem. Other areas of the valley have a lower nitrate concentration.

Samples collected from four wells in Goshen Valley contain a nitrate concentration ranging from 9 mg/l to 46 mg/l. The wells are from three miles south to seven miles north of Elberta. The elevated nitrate concentrations are in a north-south line, with the highest concentration occurring near Elberta. The source of the nitrate has not been determined.

11.5 Culinary Water Use and Projected Demands

Population projections for all communities in the basin are presented in Section 4. These projections are used to forecast municipal and industrial water needs. Most public water suppliers expect an increased demand throughout the projection period to the year 2020. Culinary water use and projected demand are shown in Table 9-3.

The effects of water conservation are expected to reduce projected water use by about 13 percent (24,000 acre-feet) by the year 2020. Water conservation is discussed in Section 17.

11.5.1 Water Treatment

All surface water delivered for culinary use is treated. Well water requires no treatment in most cases. Spring water is usually chlorinated. Table 11-2 lists the only two treatment plants in this basin and their current capacities and treatment method.

11.5.2 Water Supply and Use

Culinary water treatment and distribution systems provide drinking water to about 318,000 people (1994). The balance of the population is served by small or single family domestic systems. Table 11-3 shows the water suppliers, population served, total connections, sources, treatment types, the present use and per capita use rates. Water use and projected demands on major public drinking water systems, including most commercial and some industrial uses, are shown in Table 11-4. Total culinary water use is expected to increase from 141,345 acre-feet in 1995 (see Table 5-4) to 212,440 acre-feet by the year 2020 (see Table 9-6).

11.6 Issues and Recommendations

Drinking water issues revolve around water quality and the contamination of streams, reservoirs and groundwater aquifers by waste effluent and poor land use practices. These issues are discussed in other sections of the *State Water Plan*. Section 12 deals with water quality in streams and reservoirs, and Section 19 addresses groundwater issues. ✣ ✣

Table 11-2
WATER TREATMENT FACILITIES

Plant Name	Owner	Treatment Method	Current Capacity (Mgd)
Utah Valley Water Purification	Central Utah Water Cons. Dist.	direct filtration	42.00
Camp Cloud Rim	Utah Girl Scouts	conventional	.03
	Total Capacity		42.03

Table 11-3
PUBLIC COMMUNITY SYSTEMS CULINARY WATER SUPPLY AND USE-1995

Water Supplier	Pop. Served	Total Connections	Source	Treatment Type	M&I Water Use (acre-feet)	Per Capita Use (gpcd)
JUAB COUNTY						
Eureka [a]	562	292	Wells	None	79	119
Mona	800	215	Springs	Chlorination	227	241
Nephi	3,800	1,436	Springs/Well	Chlorination	1,209	270
SUMMIT COUNTY						
Francis Town System	530	222	Spring/Wells	Chlorination	271	434
Woodland Mutual Water Co.	196	68	Spring/Well	Chlorination	82	355
UTAH COUNTY						
Alpine	4,694	1,019	Springs/Wells	Chlorination	1,469	279
Alpine Cove Subdivision	80	24	Wells	None	27	303
American Fork City	18,754	4,675	Springs/Wells	Chlorination	4,460	212
Bradford Acres Water Assn.	50	10	Well	None	6	110
Cedar Fort	360	126	Springs	Chlorination	112	278
Covered Bridge Canyon	215	57	Well	None	63	261
Elberta	250	47	Wells	None	121	433
Elk Ridge and Woodland	1,474	251	Wells	None	360	218
Genola	800	200	Well/Wholesale	None	370	413
Goosenest Water Co.	110	22	Spring/Well	None	36	288
Goshen	635	265	Spring	None	319	448
Highland	6,633	1,258	Wells	None	1,965	264
Lehi	9,786	2,750	Springs/Wells	Chlorination	2,369	216
Lindon	4,594	950	Spring/Well	Chlorination	1,120	218
Manila Culinary Water	3,752	460	Springs/Well	None	731	174
Mapleton	4,095	1,150	Springs/Wells	Chlorination	1,270	277
North Fork Special Service Dist.	413	230	Springs	Chlorination	106	229
Orem	87,925	17,200	Springs/Wells/Wholesale	Chlorination	26,797	272
Payson	11,480	2,850	Springs/Wells	Chlorination	4,295	334
Pleasant Grove	14,054	3,500	Springs/Wells	Chlorination	3,865	246
Provo	93,567	15,000	Springs/Wells	Chlorination	29,861	285
Salem	2,823	866	Springs/Wells	Chlorination	702	222
Santaquin	2,841	800	Spring/Wells	Chlorination	805	255
Spanish Fork	12,705	4,092	Springs/Wells	Chlorination	4,343	305
Springdell	62	26	Springs	Chlorination	14	207
Springville	15,792	4,045	Springs/Wells	Chlorination	5,309	300
Spring Lake Water Works	133	128	Springs/Wells	Chlorination	26	175
Utah State Hospital	567	25	Springs/Wells	None	95	150
Vineyard (b)	182		Well		18,374	NA
Vivian Park Homeowners	68	67	Spring/Well	Chlorination	19	277
White Hills Subdivision	60	17	Well	None	24	363

Table 11-3 - - - - Continued

PUBLIC COMMUNITY SYSTEMS CULINARY WATER SUPPLY AND USE (1995)

Water Supplier	Pop. Served	Total Connections	Source	Treatment Type	M&I Water Use (acre-feet)	Per Capita Use (gpcd)
Woodland Hills	790	127	Wells	None	250	282
WASATCH COUNTY						
Center Creek Water System	330	67	Springs	Chlorination	86	222
Charleston Water Cons. Dist.	552	176	Springs/Well	None	186	285
Country Estates Mobile Homes	180	52	Wells	None	24	112
Daniel Domestic Water Co.	500	105	Springs	Chlorination	75	126
Daniel-Bethers Water Co.	58	21	Spring	None	7	115
Heber City Water System	6,000	1,500	Springs/Wells	Chlorination	1,330	188
Interlaken Mutual Water Co.	240	106	Wells	None	32	112
Midway City Water System	1,730	678	Spring	None	754	371
Storm Haven	125	38	Well	None	21	142
Timber Lakes Subdivision	157	133	Springs	None	20	110
Wallsburg Town Water System	275	102	Spring	Chlorination	114	353

Notes: [a] Eureka is outside the Utah Lake Basin but receives it's water from Santaquin.
[b] Vineyard includes industrial water use by Geneva Steel, Inc.

Table 11-4
CURRENT AND PROJECTED CULINARY WATER DIVERSIONS
FOR MAJOR PUBLIC WATER SYSTEMS

Water Supplier	1995	2020
	(acre-feet)	
Juab County		
Mona	230	250
Nephi City	1,210	1,640
Summit County		
Francis	270	390
Utah County		
Alpine	1,470	2,700
American Fork	4,460	6,630
Elk Ridge	360	750
Highland	1,970	3,530
Lehi	2,370	3,580
Lindon	1,120	1,890
Mapleton	1,270	1,960
Orem	26,800	47,700
Payson	4,300	6,470
Pleasant Grove	3,870	6,430
Provo	29,870	42,500
Salem	700	1,100
Santaquin	810	1,210
Spanish Fork	4,340	6,160
Springville	5,310	7,450
Wasatch County		
Charleston	190	190
Heber	1,130	1,580
Midway	750	1,220
Wallsburg	110	140

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Section 12
State Water Plan, Utah Lake Basin

Water Quality

With some exceptions, groundwater in the Utah Lake Basin is good quality and suitable for culinary use with little treatment. Most surface water is also of high quality if diverted before it reaches Utah Lake.

12.1 Introduction

This section presents data and information on existing levels of water pollution throughout the Utah Lake Basin. Sources of pollution are identified, problems and solutions are discussed, and a recommendation is given for control and improvement by responsible agencies.

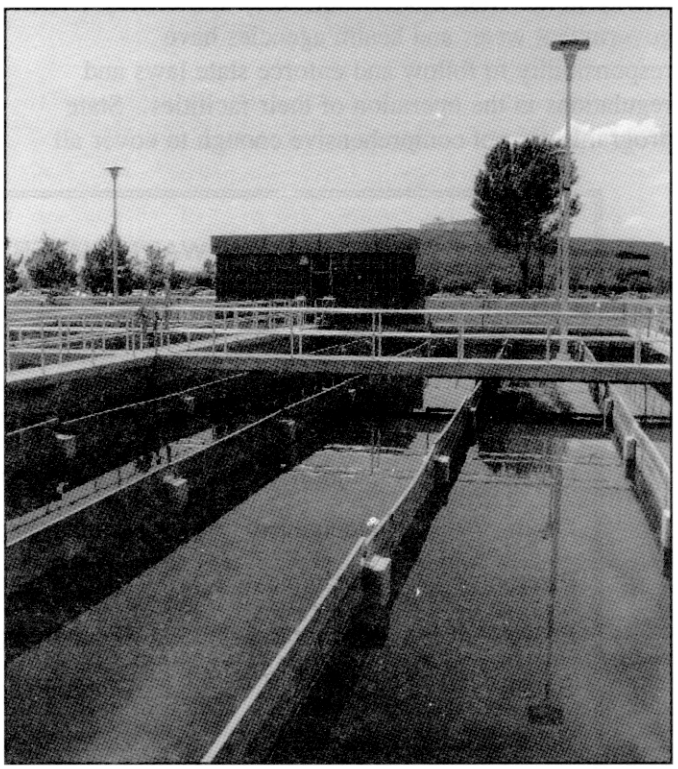
12.2 Setting

Above the mouths of their respective canyons, American Fork River, Provo River and Hobble Creek have TDS concentrations averaging less than 300 mg/l. Standards for coliforms, iron and manganese are sometimes violated in the Provo River. The Spanish Fork River above the canyon mouth has lower water quality than the others. Standards are occasionally not met for iron and manganese but TDS is generally less than 500 mg/l.

Diamond Fork has better quality water than the Spanish Fork River above their confluence. Water in the upper part of Diamond Fork is of excellent quality, as is the water imported through the Strawberry Tunnel, both with an average TDS of around 200 mg/l. In the lower reaches of Diamond Fork, TDS averages less than 300 mg/l, although secondary standards for iron and manganese are occasionally exceeded. Farther to the south in Juab County, Salt Creek has TDS values more than 600 mg/l and Currant Creek, which flows out of Mona Reservoir into Goshen Valley, has TDS values of about 950 mg/l.

As streams progress farther out into the valley and toward Utah Lake, their water quality deteriorates because of return flows and outflow from shallow aquifers. In northern Utah Valley (from Hobble Creek northward), TDS levels of the streams and return flows range from 300 to 600 mg/l where they enter Utah Lake. The Spanish Fork River has TDS values between 280 and 2,760 mg/l with an average of 600 mg/l at its mouth. Inflows to Utah Lake from Goshen Valley (White Lake) average about 4,000 mg/l. TDS values measured for mineralized springs discharging into Utah Lake have ranged from 1,000 to 28,000 mg/l. The average TDS of all inflows to Utah Lake is about 625 mg/l.

Evaporation from Utah Lake further increases salinity and lowers water quality. Because the lake is shallow, waves disturb the bottom sediments and keep the water turbid. Many water quality standards are consistently exceeded.



Provo City Water Reclamation Plant

The Jordan River, which drains Utah Lake into Salt Lake County and the Great Salt Lake, has TDS values ranging from 800 to 1,200 mg/l and average about

1,125 mg/l. This is not suitable for culinary uses without expensive treatment. It is only suitable without treatment for most agricultural uses. The Salt Lake County Water Conservancy District has studied this water and plans to treat it for M&I use by year 2010.

12.3 Organizations and Regulations

Maintaining water quality requires the cooperation of a wide range of public and private interests. The responsibility for providing leadership falls mostly on local government agencies, subject to state and federal regulatory programs.

12.3.1 Local

The Mountainlands Association of Governments plays a key role in coordinating local initiatives to improve water quality, but it has no regulatory powers. Currently it is participating with the Division of Water Quality (DWQ) in a watershed study to improve water quality in the Utah Lake Basin. City and county government water and health agencies have responsibility to follow and enforce state laws and regulations in the operation of their facilities. State programs are not comprehensive enough to cover all sources of groundwater contamination. The many activities leading to groundwater pollution make it difficult to maintain high quality water supplies. Local government agencies take an active role in protecting wells, springs and recharge areas, and in treating waste water. Table 12-1 shows the major wastewater facilities operated by local agencies.

12.3.2 State

Under the Utah Water Quality Act, the Division of Water Quality (DWQ), Department of Environmental Quality (DEQ) is responsible for adopting, enforcing and administering state and federal water quality regulations. Their charge is to maintain acceptable levels of water quality since population growth will require more high quality water. Increasing numbers of people mean more recreational activity will add pollution to surface streams and storage reservoirs. This will require water quality agencies to work closely with water rights administrators.

The Clean Water Act gives responsibility to the state DEQ for the enforcement of regulations dealing with point source discharges. These regulations

Table 12-1
WASTEWATER TREATMENT FACILITIES

City	Type	Disposal Method	Design Capacity (mgd)	Design Capacity (ac-ft/day)	Current Average Flow (mgd)	Volume (ac-ft/day)
Nephi	Lagoon	Total Containment	2.00	6.14	0.26	0.80
Orem	Mechanical	Discharging	12.30	37.75	7.94	24.37
Payson	Mechanical	Discharging	1.25	3.84	0.81	2.49
Provo	Mechanical	Discharging	21.00	64.45	15.66	48.06
Salem	Lagoon	Discharging	1.50	4.60	0.71	2.18
Spanish Fork	Mechanical	Discharging	5.00	15.34	2.64	8.10
Springville	Mechanical	Discharging	6.48	19.89	3.03	9.30
Heber Valley	Lagoon	Land Application	2.50	7.67	1.22	3.74
Timpanogos	Mechanical	Discharging	7.60	23.32	5.91	18.14
Total			59.63	183.00	38.18	117.18

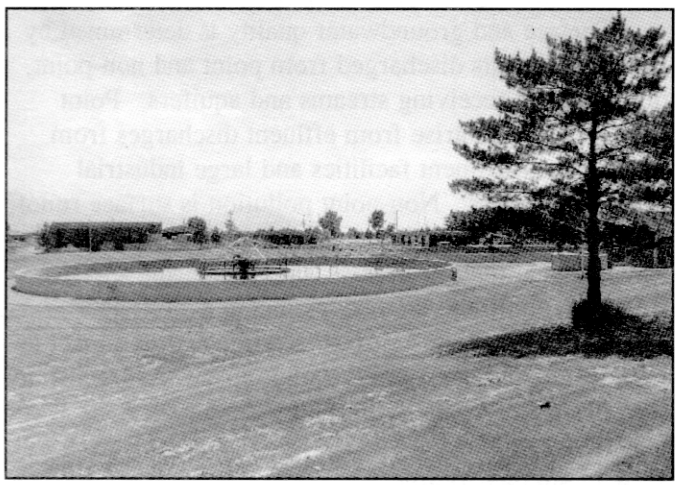
require: "... the discharge of any pollutant directly into the waters of the United States from a new or existing point source is prohibited unless the point source has a valid and active National Pollutant Discharge Elimination System (NPDES) permit."

Limits on loading rates of various pollutants are usually established by state agencies with consideration given to Environmental Protection Agency (EPA) guidelines. However, state agencies can adopt more stringent limits. Wastewater treatment plants and/or industrial businesses discharging pollutants into Utah waters are issued a Utah Pollutant Discharge Elimination System (UPDES) permit. These permits are valid for five years and must be renewed with a re-evaluation of pollutant limitations.

Enforcement of NPDES/UPDES permit requirements is accomplished by effluent monitoring programs supervised by the Division of Water Quality. Seven wastewater treatment facilities currently discharge secondary effluent to surface water systems. Besides domestic wastewater, there are 18 industrial firms requiring UPDES permits to discharge point source pollutants into surface waters.

A *Clean Lakes Diagnostic Feasibility Study* has recently been completed for Utah Lake. The study, funded under Section 314 of the Water Quality Act, assesses the lake's water quality and suggests what can be done to improve it.

Department of Agriculture - The Environmental Quality Section of the Utah Department of Agriculture carries out Utah's non-point water pollution control and prevention program administered by the Division of Water Quality. This is partially funded through federal grants from the EPA and partially supported by matching funds from state and local agencies and private sources. The program is divided into several parts: watershed management projects, groundwater monitoring, and information and education. Public information programs use newsletters, brochures, videos and slide shows, and extend to public schools and adult education.



Payson Water Reclamation Plant

Department of Environmental Quality - The DEQ developed a Groundwater Quality Protection Strategy for the State of Utah based on an executive order issued in 1984 by the governor. Groundwater discharge permits are required for activities that may affect these waters. The DWQ has also established stream classifications for surface streams in Utah based on anticipated uses. Table 12-2 shows the current water quality classes for the major water storage facilities. Table 12-3 shows the classification of streams in the Utah Lake Basin. Stream reaches can have more than one classification.

12.3.3 Federal

Congress passed the federal Water Pollution Control Act in 1972 to establish regulatory programs to improve the quality of the nation's waters. The act was amended in 1977 and became known as the Clean Water Act (CWA). Additional amendments were made in 1987.

The CWA amendments provide regulations to deal with the growing national toxic water pollutant problem, and further to refine the EPA's enforcement priorities. The amendments substantially increased the EPA's authority to enforce all water quality regulations associated with new federal mandates to clean up the nation's streams, rivers, reservoirs and lakes.

In the mid-1950s, the federal government began offering funding programs to state water pollution control agencies to help in the ongoing construction of wastewater treatment facilities. These early grants provided funding to pay for 30 to 55 percent of the total construction costs. This source of federal funds, along with monies provided through the Utah Water Pollution Control Act (UWPCA), helped to finance most wastewater treatment facilities.

From 1972 to 1989, more than $50 million in EPA grants have been spent to construct or enlarge wastewater treatment and collection facilities throughout the Utah Lake Basin. Towns, cities, rural communities

Table 12-2
SURFACE STORAGE CLASSIFICATIONS

Lakes	Classes				
Deer Creek Reservoir	1C	2A	2B	3A	4
Mona Reservoir		2B	3B	4	
Salem Pond		2B	3A	4	
Silver Lake Flat Reservoir		2B	3A	4	
Tibble Fork Reservoir		2B	3A	4	
Utah Lake		2B	3B	3D	4
Jordanelle Reservoir(Preliminary)	1C	2A	3A	4	

1C Protected for domestic purposes with prior treatment by processes as required by the Utah Department of Health.
2A Protected for primary contact recreation such as swimming.
2B Protected for secondary contact recreation such as boating, wading or similar uses.
3A Protected for cold water species of game fish and other cold water aquatic life, including the necessary aquatic organisms in their food chain.
3B Protected for warm water species of fish and other warm water aquatic life, including the necessary aquatic organisms in their food chain.
3D Protected for waterfowl, shore birds and other water oriented wildlife not included in 3A, 3B or 3C, including the necessary aquatic organism in their food chain.
4 Protected for agriculture uses, including irrigation of crops and stock watering.

and some sewer improvement districts have all benefited from this federal funding.

By 1990, federal expenditures for public works drastically decreased and most grant programs for construction and upgrades were eliminated. Now, federal wastewater treatment funding is only available through revolving loan programs administered by the Division of Water Quality (DWQ). Expenditures in the Utah Lake Basin have averaged nearly $2.8 million per year for new construction.

The federal government also funds many 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 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). The EPA regulates these standards, and compliance is verified through local health department monitoring programs.

The U.S. Geological Survey started the Great Salt Lake National Water Quality Assessment (NAWQA) study in October 1996. The federal government funds the program 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 useful to policy makers and managers at the federal, state and local levels.

12.4 Water Quality Problems

Surface and groundwater quality is determined by the contaminants discharged from point and non-point discharges to receiving streams and aquifers. Point source problems arise from effluent discharges from wastewater treatment facilities and large industrial processing plants. Non-point pollution is surface runoff generated from agricultural, municipal and industrial activities and other sources. Runoff entering surface streams from urban land development is no longer considered non-point source discharge and is subject to UPDES regulations. Boats dumping sewage are also a significant water quality problem.

12.4.1 Surface Water

Urbanization of the Utah Lake Basin has increased the discharge of domestic and industrial wastewater to local streams. Table 12-4 lists the point sources in the

Table 12-3
SURFACE WATER CLASSIFICATIONS

Streams	Classification				
Jordan R. Utah Lake to Jordan Narrows/Turner Dam	1C				
Provo R. and tributaries, Utah Lake to Murdock Diversion		2B	3A		4
Provo R. and tributaries, Murdock Diversion to headwaters	1C	2B	3A		4
Upper Falls above Provo City Diversion	1C	2B	3A		
Bridal Veil Falls above Provo City Diversion	1C	2B	3A		
Lost Creek and tributaries, above Provo City Diversion	1C	2B	3A		
American Fork R. and tributaries, mouth of American Fork R. to headwaters		2B	3A		4
Spanish Fork R. and tributaries, Utah Lake to Moark Diversion		2B	3B	3D	4
Spanish Fork R. and tributaries, Moark Junction to headwaters		2B	3A		4
Spring Creek and tributaries, Utah Lake. near Lehi to headwaters		2B	3A		4
Lindon Hollow Creek and tributaries, Utah Lake to headwaters		2B	3B		4
Mill Race and tributaries from Utah Lake to headwaters		2B	3B		4
Mill Race, Interstate 15 to Provo City WWTP discharge		2B	3B		4
Spring Creek and tributaries, Utah Lake to Industrial Parkway Road		2B	3B		4
Spring Creek tributaries, Springville WWTP, w/effluent		2B		3D	4
Spring Creek and tributaries, 50' from Industrial Parkway to headwaters		2B	3A		4
Ironton Canal, Utah Lake to D&RGW RR right-of-way		2B	3C		4
Ironton Canal, D&RGW to diversion from Spring Creek		2B	3		4
Hobble Creek and tributaries, Utah Lake to headwaters		2B	3A		4
Dry Creek and tributaries, Utah Lake to Interstate 15		2B	3C		4
Benj. Slough and tributaries (ex. Beer Creek), Utah Lake to headwaters		2B	3B		4
Beer Creek from 4850 West to headwaters		2B	3C		4
All other permanent streams entering Utah Lake		2B	3B		4
Salt Creek, Nephi diversion to headwaters		2B	3A		4
Currant Creek, Mona Reservoir to mouth of Goshen Canyon		2B	3A		4
Burriston Creek, Mona Reservoir to headwaters		2B	3A		4
Peteetneet Creek and tributaries, irrigation diversion Maple Dell to headwaters		2B	3A		4
Summit Creek and tributaries, USNF boundary to headwaters		2B	3A		4
Rock Canyon and tributaries, USNF boundary to headwaters	1C	2B	3A		4
Dry Creek and tributaries, USNF boundary to headwaters		2B	3A		4

Utah Lake watershed that have discharge permits and are monitored by the Division of Water Quality.

One great concern is the pollution occurring at sites associated with water-based recreation. Deer Creek and Jordanelle reservoirs are primary examples. Activities at these sites that pollute the drinking water include vehicles parked on the beaches, boats that leak oil, dogs, inadequate sanitary facilities, and cattle and wildlife grazing in nearby watersheds.

A second concern is the increase in volume of storm water into the Provo Reservoir Canal and other streams, along with sediment deposition and other pollutants. Provo has created a storm drainage district to control storm runoff and mitigate water quality deterioration from these sources. Orem is doing the same. The primary concern is with phosphorus exceeding standards basin-wide. The Provo River Water Users Association, Bureau of Reclamation and Utah Division of Parks and Recreation are working together to minimize these water quality impacts.

Table 12-5 shows the current impairments to water quality in the Utah Lake Basin and the percentage for each. Table 12-6 shows sources of impairments.

Utah Lake is a shallow lake which averages 9.4 feet in depth. Sediments on the bottom of the lake are very fine particles, principally calcium carbonate, which are stirred from the bottom as the wind blows. This causes the lake to exhibit a noticeable turbidity which the public perceives as a serious pollution problem.

Table 12-4 POINT SOURCES
Source
Payson
Salem
Spanish Fork
Springville
Provo
Springdell
Orem
Timpanogos Special Service District
West Utah Lake SSD
Pacific States
Reilly Industries
Geneva Steel
A.P. Green Refractories
Payson Power
Springville Fish Hatcheries
United Park City Mines
Midway Fish Hatchery
Nephi Rubber
Source: *Phase I: EPA Clean Lakes Study*, June 1996.

Table 12-5 IMPAIRMENTS T0 WATER QUALITY	
Cause of Impairment	Percent
Nutrients	43.6
Sediment	22.2
Metals	9.5
Total Dissolved Solids	8.8
Habitat Alterations	8.2
Flow Alterations	6.4
Dissolved Oxygen	1.3

Table 12-6 SOURCES OF IMPAIRMENT TO WATER QUALITY	
Source of Impairment	Percent
Agriculture	45.0
Habitat Modification	10.9
Hydrologic Modification	10.2
Resource Extraction	9.4
Urban Runoff	8.4
Recreation	6.4
Others	6.2
Point Sources	3.5

Eighteen point sources, which include eight municipal sewage treatment plants, have discharges that enter Utah Lake and its tributaries. Those discharges contribute the largest percentage of phosphorus to the lake. Non-point sources of pollution which also contribute to the lake include agriculture, urban runoff, hydrologic modification, construction activities, recreation, habitat modification and natural background sources. Although the phosphorous concentrations in Utah Lake are of no direct health concern, it is the controlling factor in the eutrophic condition found in the system.

12.4.2 Groundwater

Most groundwater pollution is from natural geologic sources. Samples collected by the Division of Water Quality during 1989-1993 have shown significant nitrate concentrations in the Mapleton and Eureka areas. A possible source of the pollution near Mapleton is a nitric acid spill that occurred up-gradient at an explosives manufacturing site. Groundwater pollution at Eureka is likely originating from area mines. Nitrate concentrations are also a problem in Goshen Valley near Elberta, but the source has not been determined.

12.5 Alternative Solutions

The Division of Water Quality is implementing a watershed protection program in the Utah Lake and Jordan River Basins. It includes a high level of stake holder involvement, water quality monitoring and

information gathering, problem targeting and prioritization, and integrated solutions that use multiple agencies and groups.

An *EPA Clean Lakes Study, Phase I: Diagnostic/Feasibility Study for Utah Lake* was completed in 1996. Utah Lake is a hyper-eutrophic lake that is subject to excessive algae growth from year to year due to high levels of nutrients, primarily phosphorus, which enter the lake from mostly agricultural and municipal sources.

Water in Utah Lake is used for irrigation, fishing, boating, water supply, waterfowl, and may become a future source of drinking water as the population continues to grow along the Wasatch Front. As the lake begins to exhibit excessive algae and odor problems, recreators migrate to Deer Creek, Jordanelle and Strawberry reservoirs to seek a higher quality of water.

The clean lakes study identified possible reductions of phosphorus and the percent of reduction possible in each category as follows:

1. Modification to waste water treatment plant (65 percent reduction)
2. Urban runoff (10 percent reduction)
3. Animal Concentration (10 percent reduction)
4. Erosion and sediment control (10 percent reduction)

Estimated cost to carry out a significant water quality improvement program in Utah Lake is $228 million. It is not feasible at this time to initiate such an undertaking. Some work could be done in the watershed to improve water quality in the tributaries and protect the beneficial uses of those streams. Farmers and ranchers can change agricultural practices to minimize the animal waste entering streams. Stream bank erosion can be reduced. Information and education programs can be developed to teach the citizens about protecting water quality and thus reduce urban runoff pollution. Cities and counties can be zoned to protect water quality, and raise awareness of land developers about how construction activities can impact water quality.

A Utah Lake Steering Committee will continue to work on water quality issues of concern in the Utah Lake watershed. That committee will be under the direction of the Mountainland Association of Governments. Several technical advisory committees will support and report to the steering committee.

Funding was recently made available by the water districts and cities to look at a section of the Provo River between Murdock Diversion and Deer Creek Reservoir. A technical advisory committee has been formed to give guidance on dealing with increasing recreation use. Rapidly increasing traffic on the highway through this area is being investigated as a potential source of toxic chemical spills and other hazards. A similar group may be created to find solutions to similar problems in the Spanish Fork River watershed.

The Jordanelle/Deer Creek Water Quality Technical Advisory Committee is addressing problems associated with these two major reservoirs. The Tri-Valley Watershed, a PL-566 funded erosion control activity, will enable water quality studies and resource inventories. Upland and stream bank erosion, a significant source of sediment loading of the reservoirs, is being studied.

Wasatch County's general planning process, aided by urbanization, is reducing pollution. As dairy farmers have been crowded out of Heber Valley by urbanization, alfalfa production, along with phosphorus pollution, have decreased. Erosion from construction sites is one principal target of two new soil erosion ordinances.

12.6 Issues and Recommendations

Water quality issues are primarily associated with the continuing trend to convert agricultural land to urban uses. While reduction of the agricultural sector has reduced non-point source pollution, i.e. phosphorous, urbanization has led to increasing pollution from point sources.

12.6.1 Urbanization Impacts on Water Quality

Issue - Runoff from urbanizing areas contribute an increasing amount of pollutants to irrigation canals.

Discussion - This issue pertains to many canals, primarily in Utah and Wasatch counties. One in Utah County is discussed to provide an example. The Provo Reservoir Canal is 23 miles long. At the Jordan Narrows it delivers irrigation water to the Jacob and Welby canals and the Utah Lake Distributing Canal, and municipal water via the Jordan Aqueduct to the Salt Lake County Water Conservancy District. The Welby Canal and the Jordan Aqueduct convey water into Salt Lake County, while the Jacob Canal and South Branch of the Utah Lake Distributing Canal convey water to north Utah County west of the Jordan River. The Provo River Water Users Association operates and maintains

the Provo Reservoir Canal which is a Provo River Project facility. The Bureau of Reclamation holds title for the United States.

Over the past several years, lands adjacent to the canal have been undergoing a conversion from agricultural use and undeveloped hillsides to urban uses. The pace of this conversion has increased markedly in the past several years. With this urbanization, the bureau and the Provo River Water Users Association have noted a marked increase in the volume of storm water runoff, sediment deposition and other contaminants entering the canal.

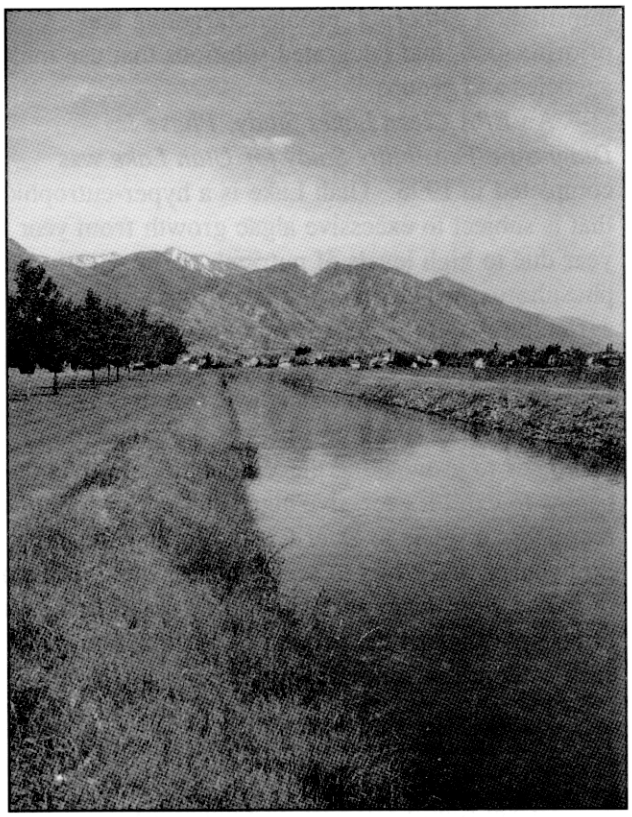
The authorized use of Provo River Project water is also changing from agricultural to culinary. Since 1974, water from the Provo Reservoir Canal has been diverted to the Salt Lake County Water Conservancy District for culinary use in communities in Salt Lake County. The bureau and water using entities now have the following concerns:

- Deterioration of water quality: Runoff entering the canal from urban areas is no longer considered non-point source discharge and is subject to regulation under the Clean Water Act. Cities that annex these formerly agricultural lands must make appropriate arrangements for storm water drainage. Urban runoff commonly contains oils and grease from city streets, nutrient from lawn fertilizers, industrial runoff, heavy metals, and pesticides.

- Structural integrity: Impervious surfaces encountered in urbanized watersheds cause more frequent runoff events and higher peak flows than agricultural watersheds. The Provo Reservoir Canal was not designed to handle the higher discharge volume experienced during major storm events. Runoff for a six hour, 100-year storm event from an orchard is negligible. Runoff from the same area and same event would be ½ inch under urban conditions.

- Increased operation and maintenance costs: Increased sediment from subdivision development intercepted by the canal decreases canal capacity and is costly to remove.

Because the Provo Reservoir Canal is a culinary water conveyance, the Bureau of Reclamation and the Provo River Water Users Association (PRWUA) will not accept storm water discharge from adjacent urban areas into the canal. Cities that have and are annexing formerly agricultural lands, are subject to the Clean Water Act and must arrange for storm water drainage from these lands. All existing discharge into the canal must be terminated and other arrangements made to provide for storm runoff prior to allowing urban development above the canal. The PRWUA's master plan calls for piping the entire 23-mile length of the canal to protect its water quality and reduce right-of-way conflicts and safety concerns.



Provo Reservoir Canal

With construction of the Daniels Replacement and Wasatch County Water Efficiency projects, many existing canals will be abandoned. These canals could act as a conduit for highly concentrated storm water to enter Deer Creek Reservoir.

Recommendation - Entities responsible for storm runoff should create urban storm drain utilities/districts with authority to protect all water supply canals, in particular, those carrying water for culinary uses. ✤ ✤

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Disaster and Emergency Response

Government, communities and families all have a part to play in responding to emergencies. Being prepared may prevent an emergency from becoming a disaster.

13.1 Introduction

This section discusses flood hazard mitigation and drought response. It also briefly discusses programs presently in place and additional programs that could be beneficial in dealing with flooding and drought problems. The Division of Comprehensive Emergency Management (SEM.) is the designated state coordinating agency for disaster and emergency response. Many emergencies 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 a state emergency arises, a response plan, maintained by SEM., provides quick and effective coordination of state resources. The state also maintains a State Hazard Mitigation Team (SHMT) to provide hazard mitigation planning assistance to local jurisdictions and counties. The SHMT may focus on either pre-hazard mitigation planning or post-hazard mitigation planning. Both planning efforts focus on measures that may lessen or eliminate the impact of future disasters. The following paragraphs define the organizational responsibilities for emergency response in the Utah Lake Basin, concentrating mainly on the two most common water-related emergencies: floods and drought.

13.2 Background

Federal, state and local governments have statutory authority to plan for, and respond to, disasters. No one entity has enough authority to make and carry out all decisions necessary to mitigate a specific hazard or respond to a disaster. The *Utah State Water Plan* (1990) presents the specific authorities and programs vested in the various agencies. See Sections 13 and 16.

13.3 Organizations and Regulations

Local, state and federal agencies are encouraged to work together in preparing for and mitigating damages from disaster events. Each level of government can contribute ideas and resources from their unique perspective.

13.3.1 Local

Local agencies are responsible for initial responses to emergencies. The National Flood Insurance Program (NIP) makes flood insurance available as a protection against monetary losses when flooding occurs. The Federal Emergency Management Agency (FEMA) administers the NIP. More detail is given in 13.6.1.

Local governments are required to carry out the following tasks to provide an effective first response to emergencies:

- Prepare an emergency operations plan for the coordination of local and county emergency responses, and link it to potential assistance from appropriate federal and state agencies.
- Provide necessary resources (including special supplies and equipment) to support emergency relief operations and list these resources. Procedures to be followed for obtaining assistance and use of resources in the emergency operation plans should be included.
- Assign and train personnel needed to do disaster relief functions.
- Provide the State Disaster Coordinating Officer with copies of current emergency operations plans.
- Recommend changes to state and local emergency disaster relief procedures and assigned functions as needed.

Cities and counties have primary responsibility for disaster response. This is particularly pointed out in Titles 10 and 17 of the *Utah Code Annotated, 1953, Amended*. Most entities have delegated disaster responsibilities to specific individuals in their respective organizations. The agency responsible for disaster response in Utah County is the Division of Emergency Management. In Wasatch County, it is Wasatch County Emergency Services. In Juab County, Juab County Civil Defense has this responsibility. Summit County Emergency Services is the designated agency for disaster responses there.

13.3.2 State

In the event property damage and personal injuries exceed the capability of local agencies, the governor may declare a "state of emergency." A state of emergency provides state assistance and allows the state to request federal assistance. Each department and division of state government is prepared with plans that are consistent with their missions and responsibilities.

When a state of emergency is declared, the Governor's State Disaster Coordinating Officer (SDCO) assumes responsibility for distributing state and federal assistance to local disaster victims. The SDCO works with local coordinators to distribute aid in an efficient and effective way. The SDCO also serves as the governor's primary point of contact for all disaster-related correspondence between federal, state and local disaster management officials.

One responsibility of the Division of Comprehensive Emergency Management (SEM.) is to generate an interest in developing emergency response and management plans. With their help, towns, cities and counties are to prepare their own comprehensive emergency response and management plans. These plans should allow for close cooperation with state and federal agencies in case a major disaster goes beyond local capabilities. The SEM. also works closely with other state and federal agencies to assure needed resources reach areas seriously affected by a major disaster.

13.3.3 Federal

Federal assistance in a local disaster begins with a request from the governor. If the President of the United States declares the event a "federal emergency" or major disaster, the state is eligible for federal assistance. Many assistance programs are available through FEM.. A federal emergency is limited to funding required to save lives, protect property and restore essential public services. A "major disaster" declaration allows funding to restore public and private property and to change natural or man-made conditions that may contribute to future damage or additional disasters. Aid from federal disaster programs must be distributed under direction of the Federal Coordinating Officer, designated by FEM. and the State Disaster Coordinating Officer, designated by the governor.

The Corps of Engineers frequently becomes involved in flooding problems at the request of the SEM., to provide technical assistance, advance measures, flood fight assistance and post-flood mitigation recommendations. Other emergency assistance is provided in times of drought, earthquakes or other natural disasters.

Thistle slide in June 1983

13.4 Flooding Problems

Three types of flooding are common: spring snowmelt, summer thunderstorms and general rainstorms. Occasionally, a combination of snowmelt and rain will create flooding, as will rain on frozen ground. Snowmelt flooding occurs over large areas and may be sustained over long periods. These floods usually occur from April through June and affect most streams in the basin. Runoff produced by thunderstorms is much less, but peak flows may be higher.

Damages from the major snowmelt flood in 1983 totaled about $369 million in the Utah Lake drainage. The Thistle landslide and flood cost more than $200 million due to extensive damage to railroads and highways. Indirect costs have also been high. Revenue losses to the railroad and mining companies were a significant part of the damage. Approximately $4.7 million in damages were sustained around Utah Lake. Flooding on Salt Creek created damages of $2.4 million in the Nephi area.

Flood Insurance Rate Maps in Figures 13-1, 13-2 and 13-3 are shown for the American Fork, Provo and Spanish Fork rivers. These maps are provided by the Federal Emergency Management Agency. Table 13-1 shows historical damages from flooding on major basin streams.

13.5 Other Water-Related Emergency Problems

Water-related emergencies may arise from different types of events. Included are droughts, earthquakes, land slides and structural failure of water storage facilities.

13.5.1 Drought

The Utah Lake Basin has experienced extended droughts in the 1930s, 50s, 70s and 90s that threatened water supplies to all users. Effects of these drought events have been reduced by significant water storage that is available in Deer Creek, Mona, and Strawberry reservoirs. Jordanelle Reservoir provides additional carry-over storage to further reduce the impact of droughts.

13.5.2 Earthquakes

One of the most threatening natural disasters that may occur in this basin would be a major earthquake. Not only would this create substantial losses of lifeline and transportation services but could damage the structural integrity of major dams. Jordanelle Dam was designed and constructed according to modern standards. Two major faults are on the west side of Deer Creek Reservoir. There is no evidence of movement on either of these faults. The Wasatch Fault extends the full length of the basin from Nephi to Alpine and is the major seismic threat. Earthquake insurance is available.

The Bureau of Reclamation is currently re-evaluating all federally-constructed dams to assess structural integrity against various levels of seismic intensity. The bureau has completed extensive tests at Deer Creek and Mona reservoirs. Both structures are considered safe.

13.5.3 Landslides

The Thistle landslide is the most recent and largest of the major slides in Utah and the most expensive slide in U.S. history. It cost more than $69 million in direct costs to repair the severed highway, railroad and Spanish Fork River. Since it covered the river, it was also necessary to stabilize, bypass, then breach, the resulting dam. The extremely wet weather in 1982-1984 and specific geological factors caused the Thistle landslide.

13.5.4 Toxic Spills

The potential exists for spills of toxic substances into the Provo and Jordan Rivers and the Provo Reservoir Canal. Since those are present and potential sources of municipal water, extensive damage is possible.

13.6 Flood Damage Prevention Alternatives

Preparation through planning and ongoing activities help to minimize future damages. Government agencies, private organizations and families all have an important role in flood damage prevention.

13.6.1 Flood Plain Zoning and Insurance

Congress established the National Flood Insurance Program (NIP) with the passage of the National Flood Insurance Act of 1968. The NIP is a federal program enabling property owners to purchase insurance protection against losses from flooding and discourage unwise development in the floodplain. Insurance is designed to provide an alternative to disaster assistance to meet the escalating costs of repairing damage to buildings and their contents caused by floods.

Participation in the NIP is voluntary and based on an agreement between local communities and the federal

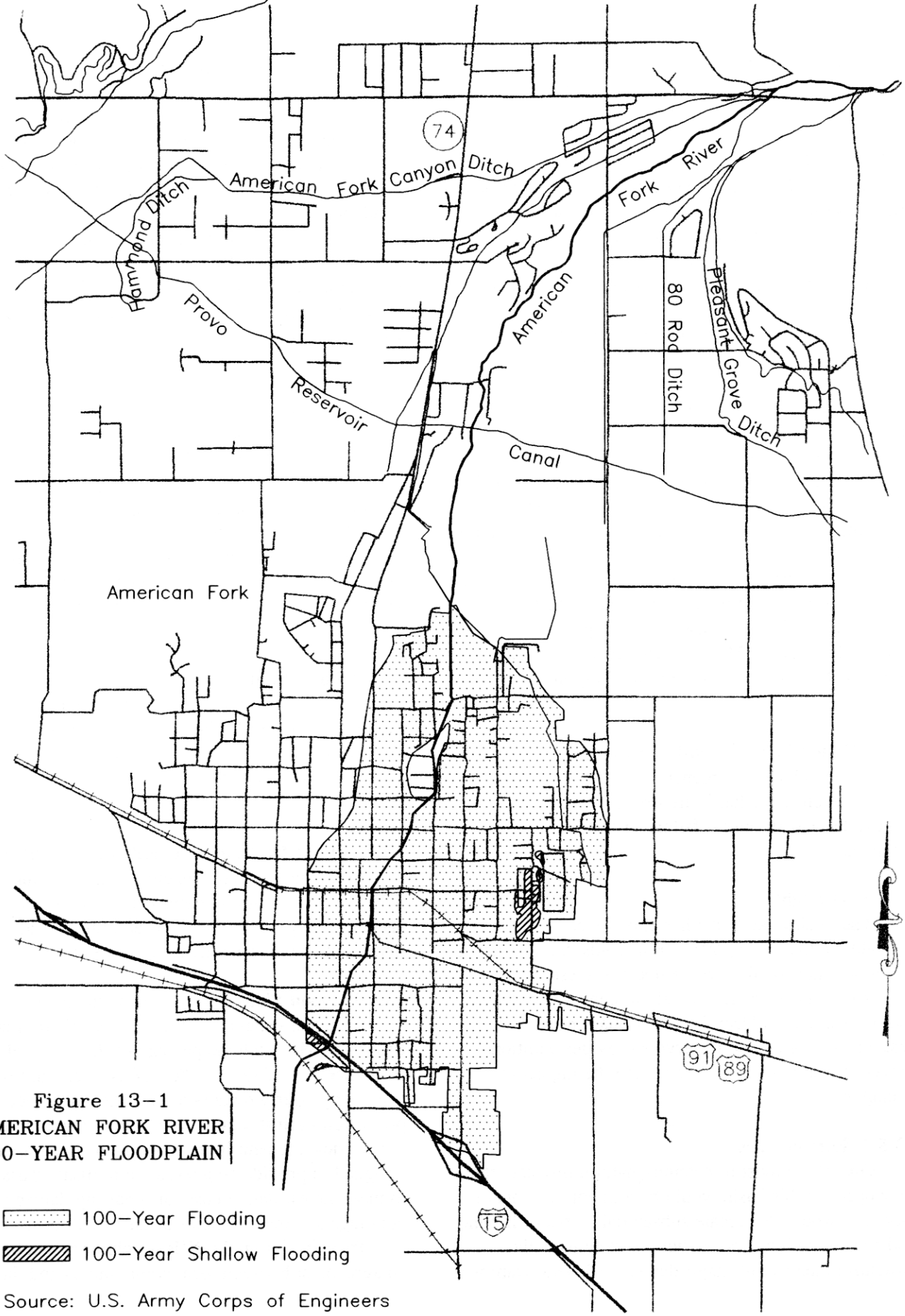

Figure 13-1
AMERICAN FORK RIVER
100-YEAR FLOODPLAIN

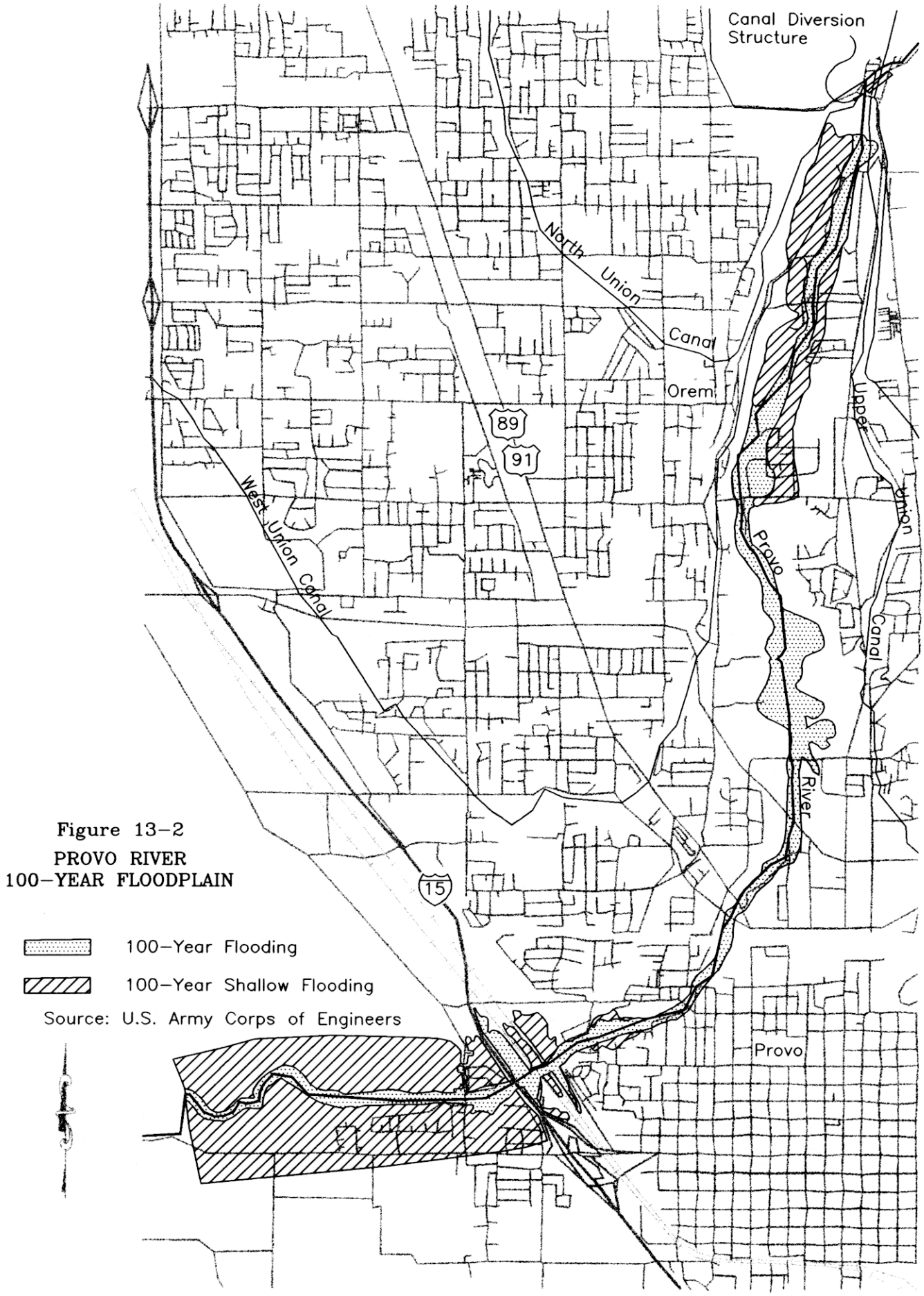

Figure 13-2
PROVO RIVER
100-YEAR FLOODPLAIN

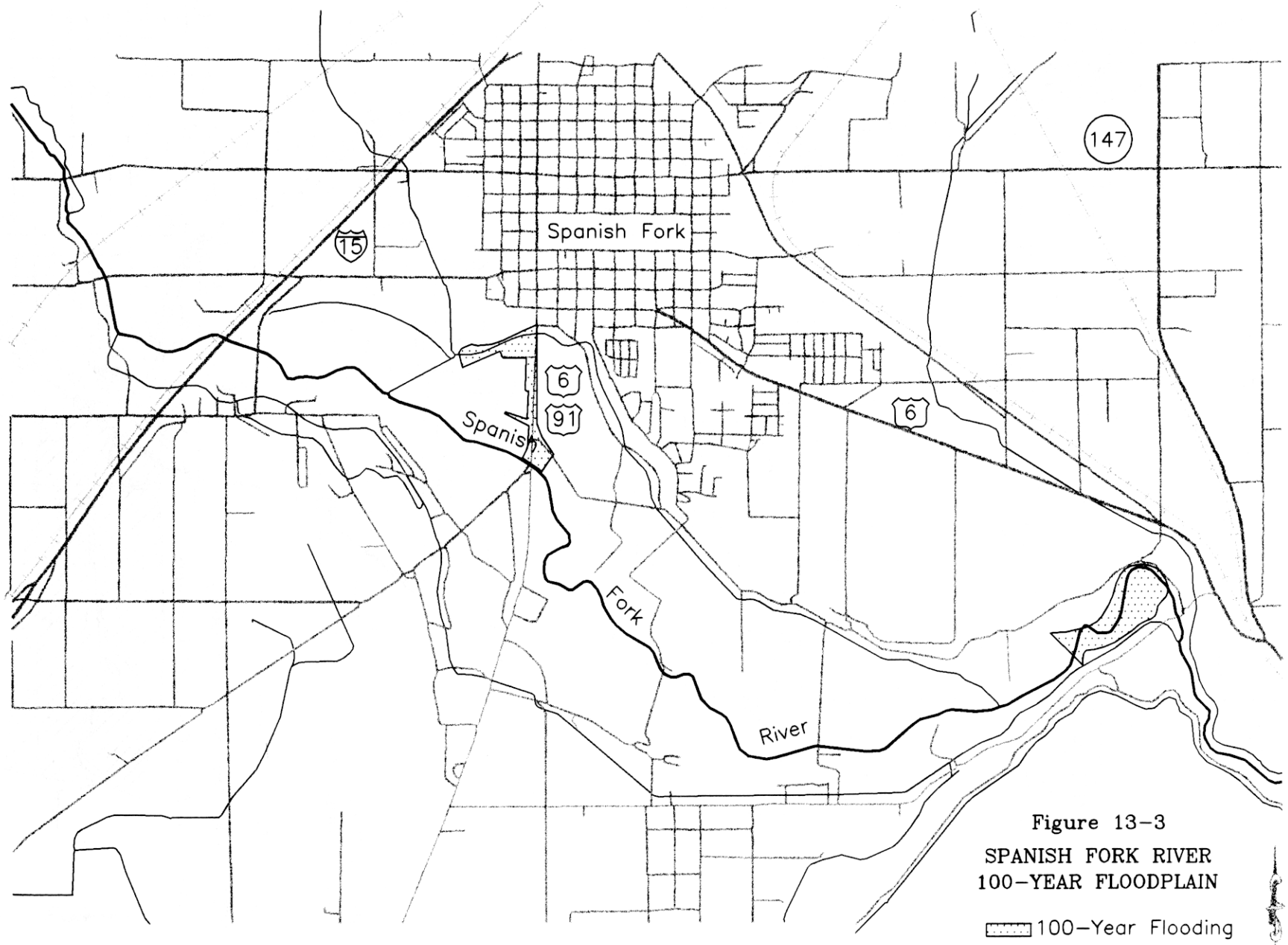

Figure 13-3
SPANISH FORK RIVER
100-YEAR FLOODPLAIN

Source: U.S. Army Corps of Engineers

Table 13-1 FLOOD DAMAGES IN 1983-84 FLOODS		
Stream	Location	Damages ($)
Salt Creek	Nephi	2,400,000
Summit Creek	Santaquin	No damage estimate
Peteetneet Creek	Payson	800,000
Spanish Fork River	Spanish Fork	337,000,000[a]
Hobble Creek	Springville	824,000
Provo River	Provo	1,309,000
Slate & Rock Canyons	Provo	No damage estimate
Battle & Grove Creeks	Pleasant Grove	No damage estimate
American Fork River	American Fork	No damage estimate
Dry Creek	Lehi	392,000

[a]Includes Thistle landslide $69 million direct, and $268 million revenue loss to railroad and utilities.

government which states that if a community will implement and enforce measures to reduce future flood risk to new construction in special flood hazard areas, the federal government will make flood insurance available within the community as a financial protection against flood losses which occur.

Flood insurance will not be available in communities having designated special flood hazard areas that choose not to participate or have been sanctioned by FEM.. No disaster assistance will be available for repair or replacement of real or personal property in special flood hazard areas within non-participating or sanctioned communities. Sanctioned communities are communities that have an identified special flood hazard area and have either failed to adopt or failed to enforce the required floodplain management ordinances. Individuals living in such communities should express their concerns to public officials regarding participation in the NIP. Communities currently participating in the NIP in the basin are shown in Table 13-2.

Utah County, the portion of Wasatch County within the boundaries of the Utah Lake Basin, and Nephi in Juab County participate in the NIP. Fifteen separate participating communities are found within the area of Utah County. Utah County government and these communities have approximately 89 policies in force and a total dollar coverage of approximately $7,183,000. A community agrees to enact and enforce minimum floodplain management requirements as stated in the Code of Federal Regulations (44 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 NIP. This office can help local participating communities in the achievement of floodplain management objectives defined by the NIP. Also, the Corps of Engineers, through its Floodplain Management Services Program, can develop or upgrade floodplain boundary maps at no cost for communities in need. Requests are made through the state floodplain administrator. Local jurisdictions and counties have adopted zoning and flood hazard regulations to reduce flood damage effects of future construction.

13.6.2 Watershed Protection

Three watershed projects are being considered. See Section 10 (Subsection 10.5.3) for more information.

13.6.3 Flood Control Structures

Prevention of flood damage depends more on families, cities and counties being prepared than on the weather. Local ordinances governing subdivision development and transportation planning should provide for safe disposal of all surface flows. Managing the stream channel where surface flows accumulate is also important. Table 13-3 shows actions that should be considered by local and state agencies to prevent flood damages along major basin streams.

13.7 Drought Damage Reduction Alternatives

Drought damages can be reduced by precipitation augmentation, water conservation, increasing carryover storage in reservoirs during non-drought years and drought planning.

Drought planning is a useful process to help those responsible for providing water supplies think ahead to the next drought and prepare long-range plans. Utah's drought response plan is available to provide guidance.

Of immediate concern to water managers who engage in drought planning are tourism, wildlife, agricultural enterprises and cities. Hydroelectric power generation and water quality can also be adversely affected. As cities grow and tourism activities expand, wildlife and agriculture become more vulnerable. Drought plans can establish priorities of water use.

Local governments and water right owners should work out understandings and agreements so water is more readily available when droughts occur. These can provide for water sharing so that the most valued activities continue and those who give up water temporarily are compensated. Several examples of water sharing are available in other states. In a typical case, farmers agree not to irrigate a specific acreage during future drought periods so that more water can be diverted to a municipality for its use. Each county in the basin should prepare and occasionally update a drought response plan.

13.8 Other Emergency Alternatives

Actions that ensure basic security in the face of nearly all disasters include:

- Disaster response plans by individual communities and counties.
- Investigation and construction of water storage and flood damage prevention projects.
- Continuation of cloud seeding
- Family emergency response plans and 72-hour kits.

The Division of Comprehensive Emergency Management suggests all residents prepare a 72-hour emergency survival kit. According to experts in the field, this will allow adequate time for relief efforts to reach most residents. Along with preparing this kit, families should develop their own emergency plan outlining each member's responsibility during a disaster. Emergency preparedness drills are a good way to familiarize family members with their duties and help ensure their safety. Knowing when and how to turn off natural gas, water and electric power utilities can reduce damage and save lives. Utility companies and water providers should provide guidelines.

Flood damage may be reduced by structural and/or non-structural methods. Establishment of a storm drainage utility is an example. Plans should provide adequate floodplain management objectives to reduce flood loses. Hazard mitigation plans can be carried out by communities to deal with specific identified potential disasters such as flooding and alluvial fan development.

13.9 Issues and Recommendations

Three policy issues are discussed. They are: flood plain management, hazard mitigation planning and disaster response plans.

13.9.1 Flood Plain Management

Issue - Not all local governments have plans for managing flood plains to prevent flood damages, and some plans need to be updated.

Discussion - Record precipitation in late 1982 and 1983 created mammoth flooding in this basin. Utah Lake peaked at 4.93 feet above compromise in 1986. Though costly and disruptive, this flooding exposed the vulnerabilities in local flood protection planning. Since then, Jordanelle Reservoir has been constructed and stretches of the Jordan, Spanish Fork and Provo rivers have been dredged. Storm drainage systems have been expanded, and awareness of flooding potential has been heightened. Flood damage prevention studies have been prepared for proposed improvements to decide feasibility and effectiveness. Where undeveloped floodplains exist, periodic flooding of wetlands and riparian areas can serve to perpetuate critical habitat for a variety of wildlife species.

Recommendation - Participating NIP communities should actively review their local flood damage prevention ordinance to ensure they are meeting the

Table 13-2 NATIONAL FLOOD INSURANCE PROGRAM PARTICIPANTS			
Community Name	County	Date of Entry	Date of Current Map
Alpine	Utah	2/11/76	4/4/83
American Fork	Utah	11/25/80	11/25/80
Cedar Fort	Utah	1/30/84	NSFHA
Charleston	Wasatch	8/5/80	8/5/80
Genola	Utah	1/30/84	NSFHA
Heber City	Wasatch	3/18/87	3/18/87
Lehi	Utah	9/14/79	3/1/83
Lindon	Utah	2/19/86	2/19/86
Mapleton	Utah	12/16/80	12/16/80
Midway	Wasatch	8/19/80	8/19/80
Nephi	Juab	8/5/86	8/5/86
Orem	Utah	9/24/84	9/24/84
Payson	Utah	11/15/78	1/6/81
Pleasant Grove	Utah	11/30/83	11/30/83
Provo	Utah	2/1/79	9/30/88
Salem	Utah	7/6/79	7/6/79
Santaquin	Utah	12/11/85	NSFHA
Spanish Fork	Utah	2/19/86	1/19/86
Springville	Utah	9/29/78	2/15/85
Utah County	Utah	10/15/82	12/15/94
Wasatch County	Wasatch	10/1/86	10/1/86
NSFHA means no significant flood hazard area			

minimum requirements for participation in the National Flood Insurance Program. The Division of Comprehensive Emergency Management can assist communities in the implementation of the NIP regulations for development in the 100-year floodplain.

13.9.2 Hazard Mitigation Plans

Issue - Not all communities have hazard mitigation plans.

Discussion - Community leaders are encouraged to develop mitigation strategies to eliminate or lessen impacts of a disaster. In the hazard mitigation planning process, agencies set priorities for these strategies and estimate costs and time frames to address proposed mitigation. Hazard mitigation may include structural and non-structural activities as they relate to flood protection. Communities can carry out hazard mitigation plans to deal with all other identified hazards in the region such as earthquakes and hazardous material spills. The Division of Comprehensive Emergency Management is responsible for disaster and emergency response at the state level. They prepare, carry out and maintain state mitigation programs.

Recommendation - Local governments should prepare hazard mitigation plans with assistance from the Division of Comprehensive Emergency Management.

Table 13-3 FLOOD DAMAGE PREVENTION ALTERNATIVES		
Stream	Location	Action
Salt Creek	Nephi	Additional debris basins and channel clearing
Summit Creek	Santaquin	Flood channel
Peteetneet Creek	Payson	Repair & enlarge existing facilities
Spanish Fork River	Spanish Fork	Intermittent channel improvements
Hobble Creek	Springville	Channel improvements & debris basins
Provo River	Provo	Channel improvements & flood storage
Slate & Rock Canyons	Provo	Improve existing system
Grove & Battle Creeks	Pleasant Grove	Outlet for present system
American Fork River	American Fork	Channel improvements
Dry Creek	Lehi	Enlarge Dry Creek and waste ditch, debris basin, channel improvements

13.9.3 Disaster Response Plans

Issue - All communities do not have a disaster response plan.

Discussion - Local governments need to increase their ability to respond to natural disasters and emergencies. Emergency Operations Plans (EOP), also called 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. Elected officials and agency managers should decide leadership positions and timing of response activities. Utah County has an Emergency Operation Plan (EOP) in place. This plan identifies hazards in the county. It also can address disruption, contamination or exceptional shortfall in water supplies that can occur during emergencies and may result in a temporary limitation of available water. When this happens, water managers should set priorities on deliveries to meet critical needs first. Emergency Actions Plans (EAPs) have also been developed, or are being developed, for all dams in the state. The Division of Comprehensive Emergency Management reviews the private dam EAPs to ensure an adequate call down list is incorporated in the plan. This review is done in cooperation with the State Engineer's Dam Safety Section.

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

Recommendation - Local communities should develop emergency operation plans with the assistance of the Division of Comprehensive Emergency Management. ✣ ✣

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Fisheries and Water-Related Wildlife

Wildlife habitats vary from the alpine environments of the Wasatch Range to the desert settings of eastern Juab County and Cedar Valley. These habitats support an equally diverse population of fish and wildlife species whose needs must be balanced with those of humans who share the resources.

14.1 Introduction

This section describes the fisheries and other water-related wildlife currently found in the basin. It also identifies associated problems and presents alternatives to improve this resource. The Division of Wildlife Resources has responsibility for managing, protecting, propagating and conserving the state's wildlife. Some federal agencies have limited authority for wildlife management on lands they administer. The Fish and Wildlife Service has authority to conserve and protect endangered and threatened species on private and federal lands.

14.2 Setting

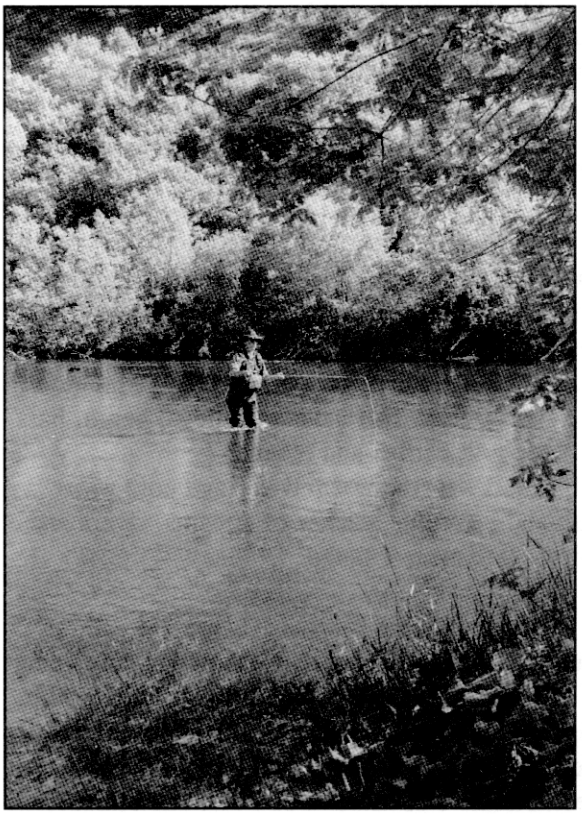
This basin has unique ecosystems supporting a diversity of species. Most of the wildlife habitat is on and around Utah Lake. Powell Slough and Goshen Warm Springs Wildlife Management Areas are nearby. Benjamin Slough and Goshen Bay are proposed wetland preserves under the Central Utah Project Completion Act (CUPCA). A 2,000-foot protection zone along the shoreline of the southern portion of Provo Bay has been identified in CUPCA where wetland habitat should be protected.

Major streams that end in Utah Lake are Currant Creek, Spanish Fork River, Hobble Creek, Provo River, American Fork River, Dry Creek, and West Canyon Creek in Cedar Valley. Most of the major drainages support good quality riparian habitats. They are also affected by highways and irrigation diversions. Irrigation and power demands reduce these streams' value as fisheries.

14.2.1 Fish and Wildlife Species

An estimated 90 species of mammals, 24 species of reptiles, 8 species of amphibians, 308 species of birds, and 33 species of fish are found in the basin. Nearly all require constant access to water. Species of fish are categorized as warm water or cold water and game or non-game.

Bird species can be categorized into three groups: upland game birds, waterfowl and non-game birds. Several naturally occurring species of hunted game animals are also found. Of special interest are those species designated as threatened and endangered. Each of these species has been judged to be in danger of



Fly fishing on the Provo River

extinction throughout all or a significant part of its range. Threatened and endangered species are protected by federal and state laws and regulations. The Endangered Species Act (ESA) strictly prohibits any person to take any federally listed member of a threatened or endangered species. To take also means to destroy or sufficiently change the habitat of a listed species.

The ESA does not apply directly to non-federal water-related activities that do not require federal permits. Owners and operators of non-federal projects are not affected as long as the normal and ongoing operations do not result in the taking of one of these species.

The criteria for threatened and endangered status and category designations are explained in Subsection 16.3.8. Fish and wildlife species classified as candidates for official listing, and those categorized as threatened or endangered, are shown in Table 16-1.

In the event federal permits are required to develop a water source or make revisions to existing ones, the Fish and Wildlife Service (FWS) will review the project. The scope and overall intent of the proposed project or change will be assessed to decide the effect on fish and wildlife in the immediate area. Endangered plants are treated differently than endangered animal species on private property. Threats to these plant species will not stop development activities in an area where federal permits are not required.

14.2.2 Fisheries

The Utah Lake Basin supports two state fish hatcheries (Midway and Springville) and several Class I fisheries for cold water and warm water sport fishes. Cold water fish include most species of trout and a few salmon. Warm water fish include walleye, perch, bass, crappie, blue gill, catfish and others.

Table 14-1 lists the warm water and cold water sport fish and identifies reaches of streams, rivers and reservoirs where each is found.

14.2.3 Wildlife Habitat

Habitat is the most important factor in maintaining healthy and substantial populations of fish and wildlife. Overall, habitat is influenced by the condition of the ecological system and the level and type of human activities. Nature's abundance of water and climate, along with construction of water storage facilities, have created exceptional habitat for a wide variety of fish and wildlife. However, the continued growth and demand for water and land is in direct conflict with the needs of some species.

Title 73-3-3 of the *Utah Code Annotated* allows the Division of Wildlife Resources to file for minimum instream flow water rights for the preservation of fish species. The division may file requests for permanent changes in the operation of certain streams to preserve critical fish habitats and provide permanent enhancement of fisheries. Section 5 discusses instream flows and shows pre-and post-Central Utah Project requirements for this basin (see Figure 5-3). Law protects most of the state's fish and wildlife. This is part of the purpose for controls on how water storage and conveyance facilities are operated.

14.3 Organizations and Regulations

Local, county, state and federal agencies have a part in passing and enforcing laws to regulate management of water facilities that affect wildlife. Private organizations work with these public groups to protect fish and wildlife habitat.

14.3.1 Local

Cities, counties, irrigation companies and water districts control water facilities that affect fish and wildlife. The impact may be either direct or indirect. Early irrigation rights holders are not required to leave water in the streams during time of low flow. Fish and wildlife management agencies may purchase water from these irrigators to prevent diversions and allow instream flows that protect various fishes.

Under the Central Utah Project Completion Act, the district is provided incentives to conserve water for instream flows. One purpose of the Water Conservation Credit Program of CUPCA is to "prevent or eliminate unnecessary depletion of waters in order to assist in the improvement and maintenance of water quantity, quality, and streamflow conditions necessary to augment water supplies and support fish, wildlife, recreation and other public benefits."

14.3.2 State

The Division of Wildlife Resources has responsibility for the management, protection, propagation and conservation of the state's wildlife resources. Much of the project planning currently being carried out by the Central Utah Water Conservancy District must be coordinated with the mission of this agency.

Table 14-1
SPORTS FISHERIES

Species	SC	CC	SF	HO	PR	AF	DR	DF	MR	UL	DC	JR
Rainbow Trout	X	X		X	X	X	X	X			X	X
Cutthroat Trout			X	X	X	X	X	X			X	
Brown Trout	X	X	X	X	X	X	X	X			X	X
Brook Trout				X	X	X		X				
Kokanee Salmon												
Mountain Whitefish					X							
Channel Catfish			X		X					X		
Black Bullhead		X	X		X				X	X		
White Bass			X		X					X		
Largemouth Bass		X			X					X	X	
Smallmouth Bass					X						X	X
Bluegill					X					X		
Black Crappie										X		
Yellow Perch					X				X	X	X	
Walleye			X		X					X	X	
Wipers (White Bass X Striped Bass)									X			

SC - Salt Creek
CC - Currant Creek
SF - Spanish Fork
HO - Hobble Creek
PR - Provo River
AF - American Fork
DR - Dry Creek
DF - Diamond Fork
MR - Mona Res.
UL - Utah Lake
DC - Deer Creek Reservoir
JR - Jordanelle Reservoir

The division has responsibility to play a lead role in identifying impacts to fish and wildlife from water development projects. Several agreements and plans have been developed for the management and conservation of aquatic species within the Utah Lake Basin. These include: Utah *Lake Fish Management Plan* which is consistent with recovery actions identified in the June *Sucker Recovery Plan*, the Bonneville *Cutthroat Trout Conservation Agreement and Strategy*, the Least *Chub Conservation Agreement and Strategy, and the Spotted Frog Conservation Agreement and Strategy*. Similar documents will be developed in the future for the leatherside chub and the boreal toad. These documents are being developed to expedite implementation of conservation and recovery measures as a collaborative and cooperative effort among resource agencies. The threats that warrant federal listing of these species should be eliminated through implementation of the actions identified in these documents.

14.3.3 Federal

The federal government influences fish and wildlife management through Department of the Interior agencies, and by passing legislation. The Fish and Wildlife Service (FWS) is charged with carrying out the Fish and Wildlife Coordination Act which requires consultation between FWS and state agencies on specific activities. The FWS is also charged with administering and regulating the Endangered Species Act. All federal agencies are charged with using their authorities to further the purposes of this act by carrying out programs for the conservation of threatened and endangered species.

The Bureau of Reclamation is currently required, pursuant to the biological opinion for the operation of the Provo River Project, to provide minimum instream flows for the endangered June sucker, and to fund several studies for June sucker research. June sucker flows are required pursuant to the Endangered Species Act.

The biological opinion provides a reasonable and prudent alternative which avoids the likelihood of jeopardy to the June sucker. It avoids destruction or adverse modification to its designated critical habitat (defined as the lower 7.8 km (4.9mi) of the Provo River from Utah Lake upstream to the Tanner Race Diversion Dam). There are four elements to the reasonable and prudent alternative. First, identify, store, deliver, and protect water necessary for minimum annual flushing, spawning, and nursery flows in the Provo River. Studies will be conducted for a three-year period (begun in 1995) to refine these flow recommendations. Second, ensure that storage flexibility in Deer Creek Reservoir occurs to assist with flow requests during June sucker spawning. Third, install a water quality monitoring system to maintain adequate water quality during June sucker residence in the Provo River. And fourth, ensure full discussion and action for June sucker flow and habitat needs through the interagency/ interdisciplinary Provo River Resource Team. All four of these elements should be implemented to preclude jeopardy to the June sucker.

The Bureau of Reclamation also works with state and local agencies to promote fish and wildlife activities at reservoirs constructed under reclamation law. The bureau develops facilities management plans for each project to promote sport fishing and optimize recreational opportunities. Potentially, the most important impact the federal government may have on fish and wildlife will be to fund environmental enhancement and mitigation projects of the Central Utah Project Completion Act.

14.4 Problems and Needs

Four problems are apparent which affect fish and wildlife in this basin. They are minimum instream flows, watershed protection, stream channel erosion, and wetlands protection and enhancement.

14.4.1 Minimum Instream Flows

Another environmental need on the Provo River is to insure that instream flows are provided to meet year round needs for the endangered June sucker. Appropriate flow levels, timing and duration that resemble the historic hydrograph of the Provo River should be attained. Studies have been conducted and several minimum instream flows have been recommended. But flows sufficient to maintain June sucker habitat in the Provo River have yet to be determined. One study recommended pre-spawning flows (May 1 to spawn) be at least 50 cfs and a minimum of 80 to 250 cfs below the Tanner Race Diversion. This will maintain at least 75 percent of the habitat. One hundred to 170 cfs will maintain 95 percent of habitat in this reach during spawning (June 1-July 1).

It is unknown what year-round instream flows are required to meet June sucker needs. Therefore, the biological opinion for the Provo River Project (USFWS 1994) required that several studies be conducted to determine these flows. Once flow studies have been completed and analyzed, a determination will be made on what instream flows are necessary to meet the needs of the June sucker.

Several major streams dry up during drought years, making it very difficult to maintain the excellent fisheries. Section 303 of the Central Utah Project Completion Act calls for instream flows in the Provo River from Jordanelle Reservoir to Utah Lake.

14.4.2 Watershed Protection

Canyons on the east side of the basin are heavily used during the summer for recreation and grazing. Summer homes, along with year-round homes, ATV travel and livestock grazing along riparian corridors contribute to stream bank instability, reduce vegetation, and increase the silt loading of streams.

14.4.3 Stream Channel Erosion

The Diamond Fork and Spanish Fork rivers

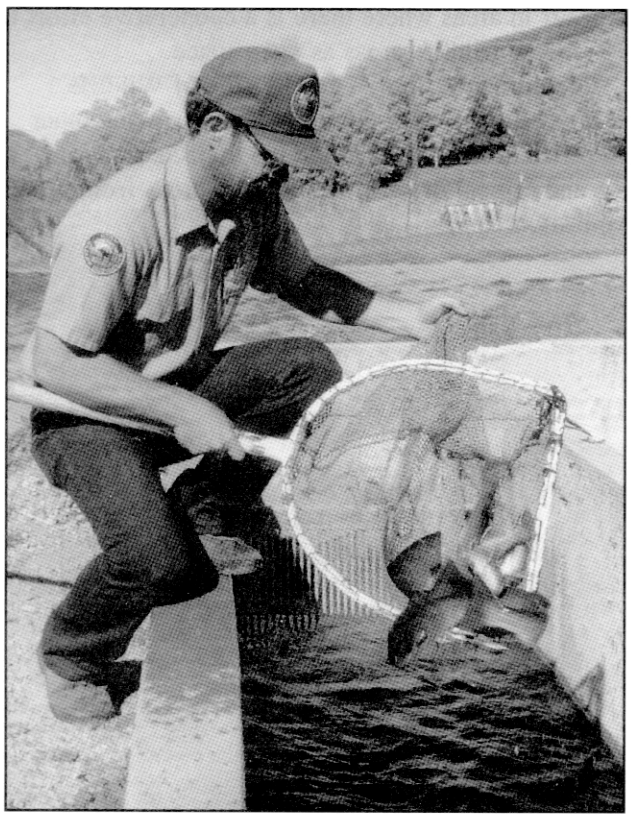
experience unusually high flows during the irrigation season, thus causing erosion of the stream banks. Under CUP, the high flows will be taken out of Diamond Fork River and placed in the Diamond Fork pipeline, reducing erosion in the stream.

14.4.4 Wetlands Protection

Utah Lake and surrounding wetlands are threatened by urban growth and farming practices. Drainage from urban surfaces and increased pumping of groundwater threatens the quality and quantity of the water supplied to wetland resources.

14.5 Alternative Solutions

Title III of the Central Utah Project Completion Act (CUPCA) calls for creation of the Utah Reclamation Mitigation and Conservation Commission. The Commission's purpose is: "to coordinate the implementation of the mitigation and conservation provisions of CUPCA among the federal and state fish, wildlife and recreation agencies." This commission is now organized and operating. Its duties are provided in Section 301 of CUPCA. The commission's *Mitigation and Conservation Plan* was published in May 1996. It provides an overview of the planning process and explanations of its programs, a budget and schedule for implementing projects, and a monitoring program.



Hatcheries benefit basin fisheries

Section 303 of the act provides instream flows in Diamond Fork River and the Provo River. Lower Spanish Fork River is also benefitted by instream flows in Diamond Fork. Sections 304 and 305 authorized completion of several fish and wildlife projects outlined in the *1988 Definite Plan Report*. The Mitigation and Conservation Commission is also directed to purchase big game winter rangelands to compensate for the impacts of federal reclamation projects in Utah. Big game crossings and wildlife escape ramps in large canals are also to be provided.

A Utah Lake Wetlands Preserve is to be established. Acquisition of land, water rights and other interests will be accomplished with an appropriation of $16,690,000. The preserve will be managed for the protection of migratory birds, wildlife habitat and wetland values in a manner compatible with the surrounding farmlands and orchards. Lands and water rights must be acquired from willing sellers.

Representatives from several agencies and organizations have developed a plan for the protection and enhancement of Utah Lake wetlands. Under the auspices of the *North American Waterfowl Management Plan*, and its regional Intermountain West Joint Venture, a conceptual plan for the Utah Lake Focus Area was completed in 1995.

Water quality and fish and wildlife benefits could be realized if local sponsors (cities, special service districts, corporations, conservation organizations, Utah County, state and federal agencies) could participate in joint ventures to enhance key wetlands adjacent to Utah Lake. Two project areas are proposed for wetland protection and enhancement using the discharge from wastewater treatment plants (Timpanogos WWTP and Orem WWTP). Allowing wetlands to improve the quality of treated effluent prior to discharged is a viable management strategy around Utah Lake and along the Jordan River.

A concept plan for the Utah Lake Focus Area was completed in 1995. This was a separate activity under the auspices of the multi-agency North American Waterfowl Management Plan. Its purpose is to protect and enhance Utah Lake wetlands.

The Governor's Office of Planning and Budget and natural resource agencies are preparing a state wetland protection plan. They are working through the

Resource Development Coordinating Committee and the Division of Wildlife Resources. High priority wetland areas throughout the state will be identified, and opportunities for protection and enhancement will be addressed. Ultimately, cities and counties should give wetlands and riparian land greater consideration as discharge areas for flood events. Salt Lake County's Jordan River Meander Corridor Ordinance offers an alternative to expensive flood control activities, and could be a model for other counties.

Several agreements and plans have been developed for the management and conservation of aquatic species within the Utah Lake Basin (see Section 14.3.2). Resource agencies developed these documents to expedite implementation of conservation and recovery measures as a collaborative and cooperative effort. Actions identified therein include population and habitat enhancement and protective actions. Opportunities for mitigation where impacts to these species and their habitat may occur have also been identified. Through the actions identified in these documents, the threats that warrant federal listing of these species should be eliminated.

14.6 Issues and Recommendations

One key issue, conversion of water from irrigation to municipal uses, is discussed.

Issue - Conversion of land and water from irrigation to municipal and industrial use impacts fish and wildlife.

Discussion - The availability of culinary water may limit growth in some rural and urbanizing areas. As the demand for housing increases, conversions from irrigation to municipal water uses take place. This conversion dewaters portions of streams, resulting in a significant impact on fisheries. In addition, critical wildlife habitat may be eliminated through urbanization. Counties need to address their open space and agricultural land needs as they revise their general plans. Sensitive wildlife areas could be identified and protected in this planning process. Habitat protection will occur in areas where there is a cooperative effort to set aside key wildlife areas as open space.

Recommendation - The Division of Wildlife Resources should work closely with county and other local officials to provide programs to protect stream flows and critical or sensitive wildlife areas from urbanization. ✤ ✤

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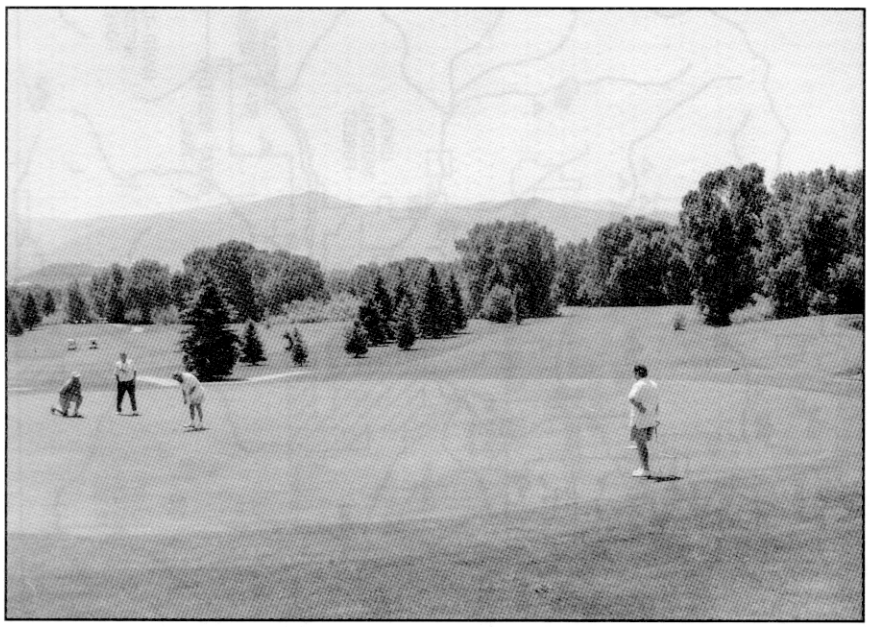
Water-Related Recreation

The Utah Lake Basin provides some of the best water-based recreation in the state. People along the Wasatch Front use basin parks and reservoirs as their playground. Three state parks in the basin received more than one million visits in 1995, up over 19 percent with the opening of Jordanelle State Park in July of that year.

15.1 Introduction

This section describes how water relates to recreation. Water is part of most recreation provided by the state, from skiing to golfing, to pools in municipal recreation centers, to flat water boating on major reservoirs. Design of water access and recreation features associated with water development projects are important components of water planning and development.



Golf at Wasatch Mountain State Park

15.2 Setting

Traversing the basin on the newly established Great Western Trail that connects north into Canada and south into Mexico is possible. It is on Forest Service lands along the front face and back ridges east of Utah Valley. Visitors to the area might visit Camp Floyd, Timpanogos Cave National Monument, Lone Peak and Mt. Timpanogos Wilderness areas. Many camp grounds are provided in the Uinta National Forest. Fishing is available at Deer Creek Reservoir, golf at Wasatch Mountains State Park and a Nature Center at Jordanelle State Park. The Provo River offers fly fishing, kayaking, and other enjoyable experiences. The Provo River Parkway Trail provides opportunities for walking, jogging, and biking. Off-highway vehicle (OHV) tours can be taken on BLM land and windsurfing on Mona Reservoir in Juab County is always fun. Boating, sunbathing or ice skating is common at Utah Lake depending on the season. Privately owned water parks and city and county parks round out the water-based recreation activities. The Utah Lake Basin provides some of the most diverse and highest quality recreation opportunities in the state. Figure 15-1 shows most of the recreation facilities in Utah County.

15.3 Organizations and Regulations

Federal, state and local governments are active in managing recreation of all types. Water directly impacts boating, fishing, swimming, golfing, skiing and many other recreation activities. Public lands managed by the Bureau of Land Management, Forest Service, National Park Service, Utah Division of Parks and Recreation and others create many opportunities.

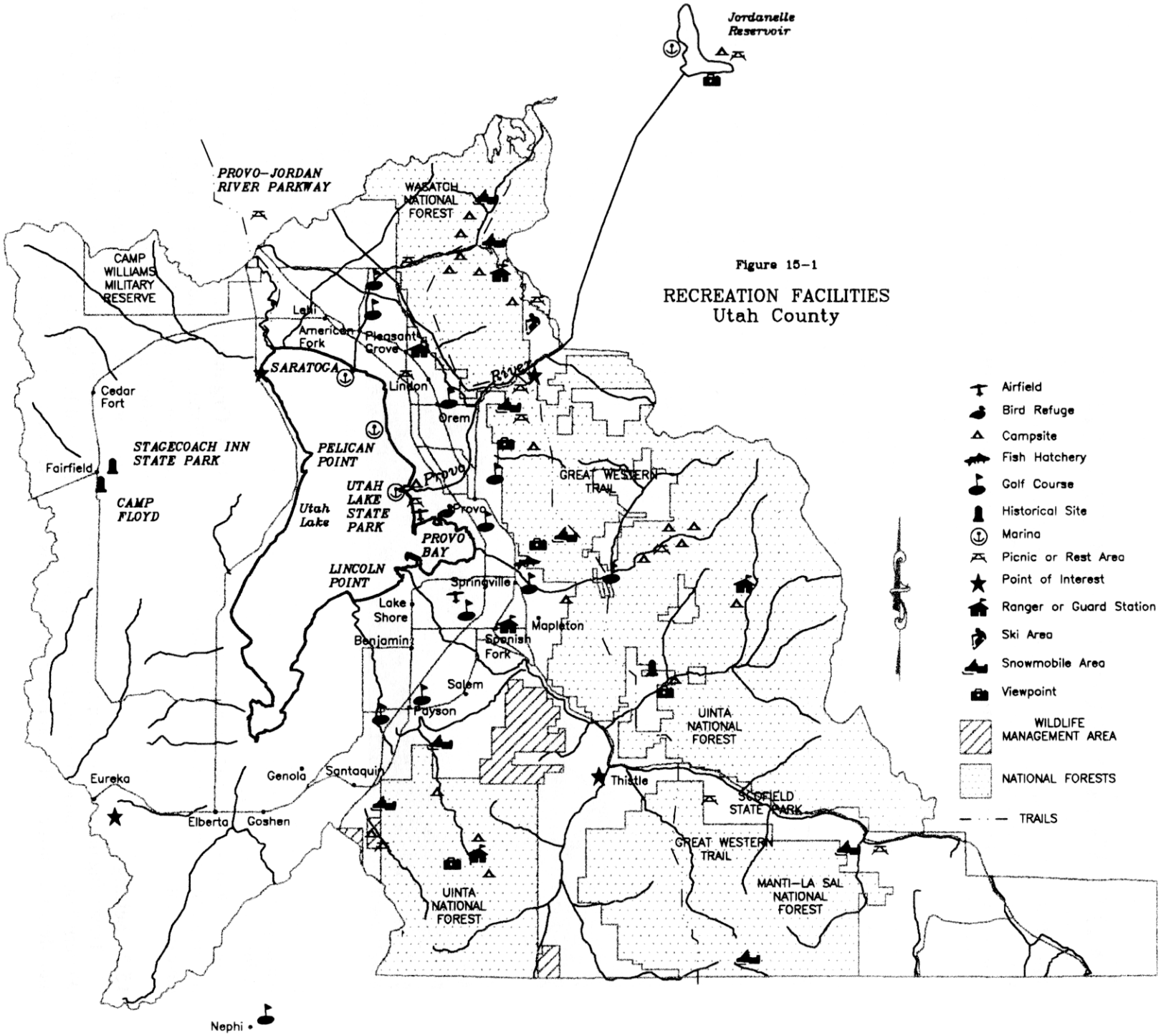


Figure 15-1

RECREATION FACILITIES
Utah County

15.3.1 Local

The Utah Lake Basin covers portions of two multi-county planning districts: Mountainlands (MCD 3) and Central (MCD 4). Only a small portion of the Central CD (Juab and Sanpete County) lies within the Utah Lake Basin and less than 10 percent of the population in the Central MCD lives in the basin. The Mountainlands MCD represents Summit, Wasatch and Utah counties

15.3.2 State

The Utah Division of Parks and Recreation has responsibility for conserving Utah's rich natural resource heritage while making its recreational opportunities available to the resident and non-resident user. Their mission is to "enhance the quality of life in Utah through parks, people and programs." The division also manages five state parks, coordinates four grant funding programs, manages OHV, boating and trails programs and prepares the *Statewide Comprehensive Outdoor Recreation Plan* (SCORP). The Division of Wildlife Resources plants millions of fish in streams and reservoirs, and it is heavily involved in hatchery and research efforts on Utah Lake, Jordanelle and Deer Creek reservoirs. They perform law enforcement and big game management functions in the entire basin.

15.3.3 Federal

Through local sponsors, the Bureau of Reclamation impounded the Provo River twice, creating Deer Creek and Jordanelle reservoirs. These impoundments, built primarily for agricultural and culinary use, have become an integral part of the recreation picture for Utahns.

15.4 Outdoor Recreation Facilities and Use

Local, state and federal agencies all play a role in filling the demand for recreation facilities and managing their use. Water may be incidental or crucial to public and private recreation facilities.

15.4.1 Local Parks

City and county recreation facilities range from golf courses to picnic tables. Every golf course uses millions of gallons of water annually for maintenance. Local recreation providers commonly use water in aquatic or ice skating programs, beyond landscaping needs. Ski areas, while being primarily reliant on natural snowfall, use water in snow making activities. The Utah Lake Basin has 12 golf courses and one ski area, Sundance Resort. The basins has 15 commercial campgrounds. Provo City and Utah County manage 14 miles of Provo River Parkway from Utah Lake to Vivian Park. The county is planning an access trail around Utah Lake, with several staging areas. It has developed 12 miles of trail from Utah Lake north to the Salt Lake County line. Under the Central Utah Project, public access will be developed at specific sites along the 10 miles from Jordanelle State Park to Deer Creek Reservoir.

15.4.2 State Parks

The Utah Division of Parks and Recreation manages Utah Lake State Park, Deer Creek State Park, Jordanelle State Park, Camp Floyd and Wasatch Mountain State Park. Table 15-1 illustrates the natural resource base and use of state parks managed by the division. Two major boat launching ramps are available for the public: one at Deer Creek and one at Jordanelle State Park. At Jordanelle, they provide special launching areas for fast, maneuverable personal water craft. Boating capacities at Jordanelle and Deer Creek reservoirs are 300 boats on the water at the same time. Heavy demand and public safety have dictated this decision. Water levels on Jordanelle will fluctuate, leaving mud flats exposed during periods of heavy demand on its water supply.

15.4.3 Federal Parks

Sixty campgrounds are within the national forests in and near the basin. Many are full service campgrounds with approved water systems. Some have lakes and streams nearby for fishing and other recreation activities. Timpanogos Cave National Monument provides hiking and picnicking facilities. Major parks are located on Bureau of Reclamation lands at Deer Creek and Jordanelle state parks. The Division of Parks and Recreation is under contract with the federal government to manage these sites for recreation uses.

15.5 Recreation Activity Problems and Needs

Many opportunities exist for recreation enjoyment. Two major public opinion surveys were conducted in 1994 and completed in early 1995. They are the *Community Assessment Survey On Tourism and Recreation, Wasatch County, 1994*; and *Final Report: Utah Division of Parks and Recreation Telephone Survey, January 6, 1995*. Among the many findings

Table 15-1 STATE PARKS VISITATION AND AREA				
Park Name	1995 Visitation	Water Area (acres)	Land Area (acres)	Camping Units
Deer Creek	299,534	2,965	2,626	32
Utah Lake	599,723	96,000	296	125
Jordanelle	135,965[a]	3,000	4,000	286
Camp Floyd/ Stagecoach	10,125	1	42	0
Wasatch Mountain	854,538	33	22,000	136
Total	1,899,885	101,999	28,964	579

[a] Opened in 1995

are: (1) 90 percent of the state population has visited Utah State Parks--a mean of eight visited; (2) most respondents had visited three to four parks in the last year; (3) 87 percent felt it inappropriate to sell all or portions of state parks; (4) over 75 percent felt additional lands should be acquired for new state parks; (5) condemnation of private lands for parks was disfavored by 75 percent of the public; (6) 65 percent agreed that fees for campgrounds and picnicking areas should be increased; and (7) over two-thirds felt parks should limit entry when the capacity of the park is reached.

The "community assessment" found: (1) Tourism encourages investment in the local economy and environmental impacts are relatively minor, (2) there was strong sentiment that the residents should be heavily involved in all planning processes in their county, and the county should develop plans to manage the growth of tourism and recreation.

Recreation agencies in local and state government keep up with recreation planning by participating in the *Statewide Comprehensive Outdoor Recreation Plan* (SCORP). On a five-year cycle, it analyzes the supply and demand issues associated with outdoor recreation. Public meetings were held in Provo (MCD 3) as part of the 1992 SCORP survey.

Surveys conducted in support of the SCORP process help to identify the most popular individual and family recreation activities. Figures 15-2 and 15-3 show these relationships.

15.6 Issues and Recommendations

This subsection discusses three major issues: Funding, outdoor ethics and comprehensive planning.

15.6.1 Funding

Issue - Increased recreation demands on existing facilities underscore the need for additional funding.

Discussion - Fees are charged at many recreation areas to offset costs. In fiscal year 1994-95, the Division of Parks and Recreation received 38 percent of its budget from user fees. Facility construction and property acquisition are extremely costly. In the past, a federal program known as the Land and Water Conservation Fund provided grant funds to state and local entities for the development of recreation facilities. Administered by the National Park Service, the program accrues funds from offshore continental oil and gas lease revenues. Appropriations to the states have dropped dramatically, and federal agencies receive the bulk of available funds. The Division of Parks and Recreation administers various grant programs to help address the funding concerns. Table 15-2 shows the number of projects and the funding amounts.

The issues raised during the SCORP process are important in that they help focus agency budget efforts. A typical weekend at Deer Creek State Park shows vehicles parked along the roadside due to overflowing parking lots. The campground is full and there are many complaints regarding conflicts between users. In winter, deer or elk are found eating shrubs as land

Figure 15-2
UTAH OUTDOOR RECREATION PARTICIPATION
BY FAMILY

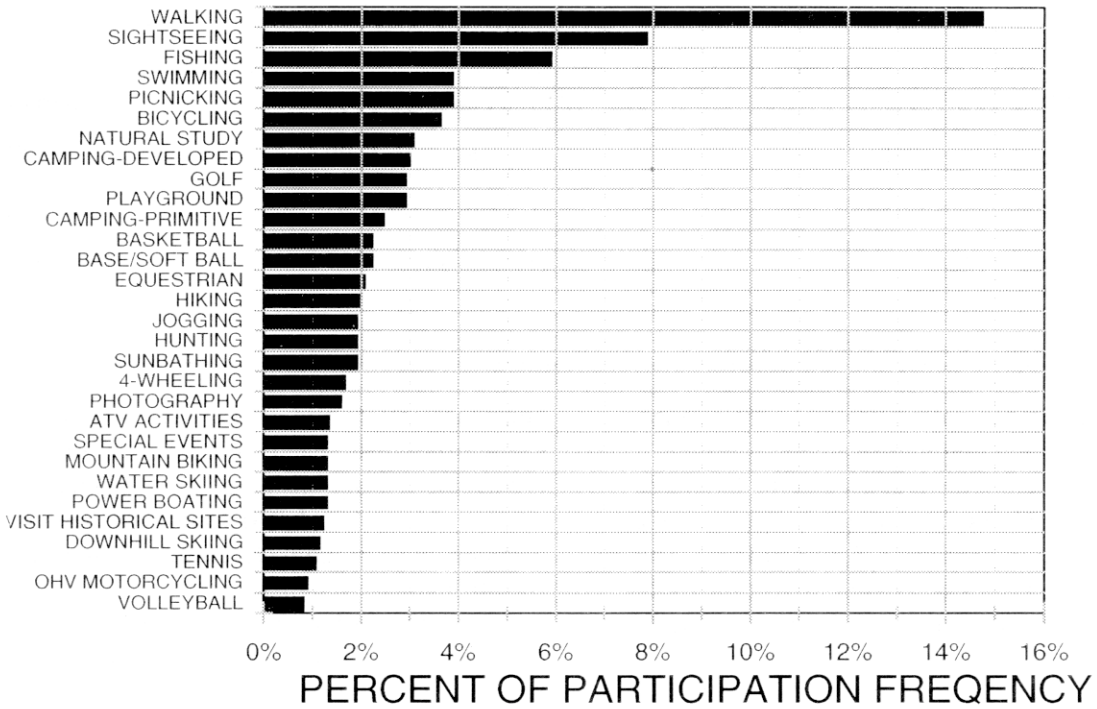


Figure 15-3
UTAH OUTDOOR RECREATION PARTICIPATION
BY INDIVIDUAL

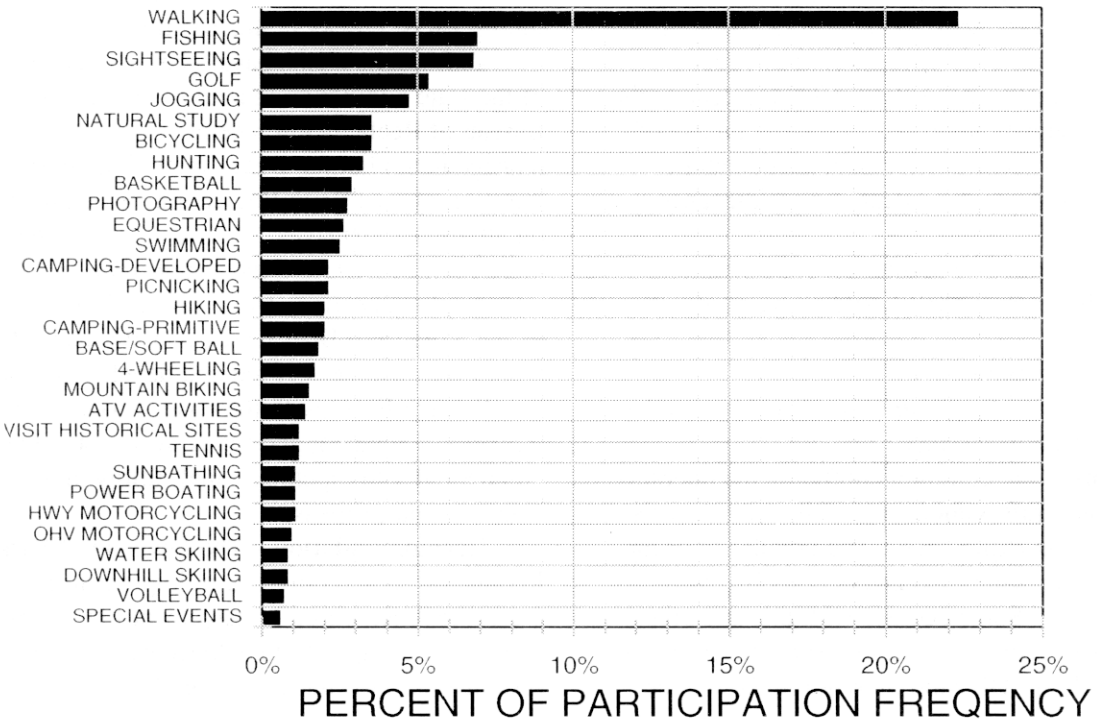


Table 15-2 GRANT PROGRAM OVERVIEW-1995		
Program	Number of Projects	Amount Granted [a] ($)
Non-Motorized Trails	12 projects since 1991	335,000
Motorized Trails (OHV)	6 projects since 1988	71,500
Riverway Enhancement	5 projects since 1991	327,000
Land and Water Conservation Fund	58 projects since 1967	6,100,000

[a] Does not include sponsors match

development encroaches upon historical winter range. Alternate means of funding improvements, such as container deposits, equipment taxes and the like have been proposed to address recreation's budget concerns. The most palatable alternative is increased fees. This is consistent with the 1995 study noted in Section 15.5. Park users stress the need to see their fees used in the park where they are paid. A formal program is suggested in *Frontiers 2000: A System Plan to Guide State Parks and Recreation into the Twenty-first Century*. Fifteen major challenges are cited by a statewide steering committee related to recreation associated with water developments. Park operation and maintenance remain under-funded, compromising safety and quality experiences of park visitors. In keeping with the spirit of "Frontiers 2000," the Division of Parks and Recreation may increase fees to cover operation and maintenance costs, establish a renovation sinking fund through a dedicated surcharge on use of park facilities, and prepare an annual accountability report showing park improvement and maintenance projects.

Recommendation - Funding recommendations provided in "Frontiers 2000" should be pursued.

15.6.2 Outdoor Ethics

Issue - Many conflicts are exacerbated by unethical behavior in recreation settings.

Discussion - One common conflict is the operation of personal watercraft without regard for other user's safety or recreation experience. The popularity of the activity has boating safety managers grappling with different solutions. Some success with this and other problems has been achieved through such programs as TREAD LIGHTLY, Division of Wildlife Resources hunter education, and off-highway vehicle and boating safety programs. The continuation of education and enforcement programs based on principled behavior is crucial. More than 1,000 youth have been trained and certified on personal watercraft, and more than 10,000 for off-highway vehicles.

Recommendation - The Division of Parks and Recreation, in cooperation with other recreation agencies, should organize focus groups with recreators and managers from throughout the state to obtain ideas and support from all members of the recreation community.

15.6.3 Comprehensive Planning

Issue - Comprehensive planning for allocation of recreation resources in this basin is vital.

Discussion - This basin plan represents a sampling of the state's initiative in addressing the challenge. The Bureau of Reclamation recently completed a resource management plan for Deer Creek State Park. The Division of Parks and Recreation, which does planning on all areas it manages, completed a *Wasatch Mountain State Park Resource Management Plan* in 1995.

Trail connections from Vivian Park along the Provo River into Deer Creek and Wasatch Mountain State Parks can be secured and developed, connecting the Wasatch Front with the basin's back valleys. Recreation planning and water access should continue to be factored into pipeline, canal, utility and Provo River enhancement projects.

Recommendation - The Division of Parks and Recreation should continue to implement findings of the Deer Creek Resource Management Plan to balance use and resource capacity to achieve sustainability of water resource uses for recreation. ✤ ✤

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Federal Water Planning and Development

The role of the federal government is changing from one of construction and development to preservation, conservation and maintenance. Federal funding is decreasing while regulatory programs are increasing.

16.1 Introduction

Although the activities of federal agencies are changing, many programs are still available. To use them, local people must be informed on program functions and how to gain access. With this information, better interagency and local working relationships are possible. To this end, a brief description of the agencies' programs is given.

16.2 Background

With an increase in regulatory requirements and congressional attempts to balance the budget, gaps in both technical assistance and funding may occur. Frequently, federal requirements of higher standards for resource uses, without additional funds, add costs to state and local budgets. This reduces the state and local funds to implement water resource conservation and development programs.

16.3 Federal Programs

Various federal agencies and their programs are briefly described below.

16.3.1 Bureau of Land Management

The Federal Land Policy and Management Act gives the Bureau of Land Management (BLM) authority to inventory and comprehensively plan for all public lands and resources under its jurisdiction, including water. They are also responsible for managing the wilderness areas and wild and scenic and recreational rivers. None of these, however, are on BLM land in the Utah Lake Basin.

Water resources are rapidly becoming a major determinant of resource management alternatives. Quality and quantity of water are now major elements of resource management plans (RMP) as BLM manages riparian habitats of streams, lakes, reservoirs and ponds. After public participation, RMPs become management plans for resources on BLM land. The published Record of Decision for the Pony Express and Rangeland Program Summary for Utah County is an example of methods used by BLM to dispose of lands for public purposes, i.e., landfills. Public lands in Tooele, Utah and Salt Lake counties are within the BLM's Salt Lake District and are administered by the Pony Express Resource Area.

16.3.2 Bureau of Reclamation

Four broad categories of water resources programs are administered by the Bureau of Reclamation. They are investigation, research, loans and service, all requiring close cooperation with the concerned citizens.

Investigation Programs - General investigations are conducted for single and multi-purpose water projects. Environmental assessments are usually included.

Research Programs - Reclamation conducts research on water project design, construction and materials. Research is also carried out on atmospheric management, as well as geothermal and solar power. Most programs are conducted in cooperation with other entities. In 1981-82 the bureau studied the feasibility of hydroelectric generation of peaking power with a pumped storage facility at Utah Lake. Feasibility of this site was less than at six other sites eventually selected for further study.

Loan Programs - These programs have provided federal loans to qualified organizations wishing to construct or improve smaller and generally less complex water resources development. Reclamation has recently

reassessed its loan programs and concluded that they need major re-direction. As a result, Reclamation is no longer accepting applications for loans.

Service Programs - These programs are designed to provide data, technical knowledge, and expertise to state and local government agencies. They aim to avoid duplication of special service functions. Local governments pay for these services.

Project Construction - The Bureau of Reclamation is phasing out its project construction programs. Construction of Jordanelle Dam and Sixth Water Aqueduct are the final major projects for the bureau in Utah. The Central Utah Project Completion Act transferred authority for constructing remaining elements of the project to the Central Utah Water Conservancy District.

16.3.3 Cooperative State Research, Education, and Extension Service

This new agency is assigned responsibility for all cooperative research programs presently performed by the Cooperative State Research Service. It is also assigned all cooperative education and extension programs presently under the Extension Service.

16.3.4 Corps of Engineers

If local entities are unable to deal with a large water resources problem, they may petition their congressional representatives for Corps of Engineers (COE) assistance under the Civil Works-General Investigation Authority. They may request assistance with smaller problems directly from the local COE office under the Continuing Authority Program. This allows the COE to investigate the economic, technical, social and environmental acceptability of remedial measures. When the directive covers an entire river basin, the COE studies it as a unit and prepares a comprehensive plan. Close coordination is maintained with local interests, the state and other federal agencies.

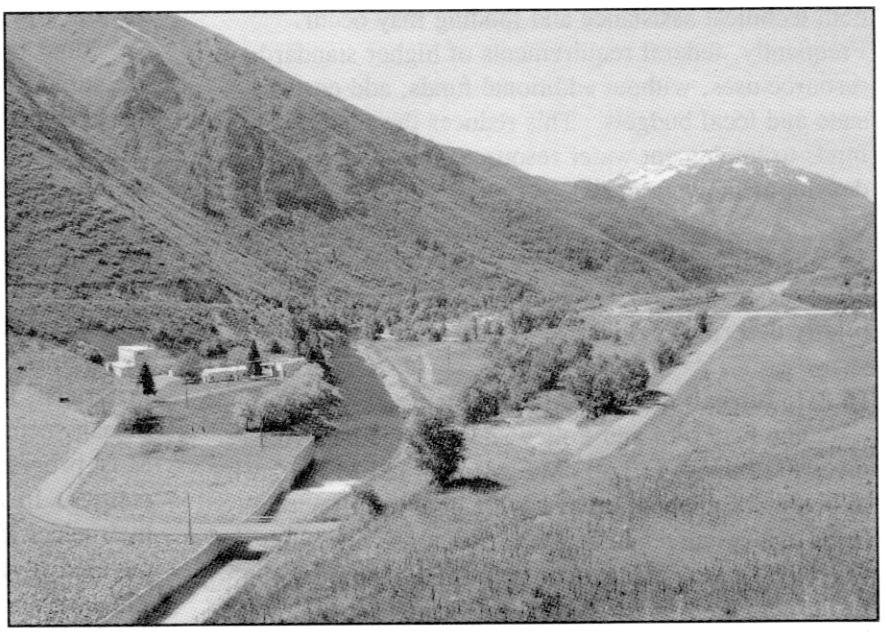
Numerous water resource studies have been conducted and several projects built within the basin. Recent studies include the Wasatch Front and Central Utah Investigation, authorized by Congress and completed in 1984. Smaller studies include Rock Canyon in 1986, and the Provo River in 1988. A reconnaissance investigation of the Provo River and east side drainages within Provo City is currently ongoing to decide if the COE can assist in reducing the threat of flooding.

The Corps of Engineers, in cooperation with the Bureau of Reclamation and the Central Utah Water Conservancy District, has established specific operating criteria for Jordanelle Dam during periods of high runoff and flooding. Under this authority, known as Section 7, the COE also monitors the operation on a real-time basis.

The COE also has emergency assistance authorities. It has had several emergency projects within the basin, primarily on Utah Lake/Provo River and at Thistle. Requests for emergency assistance should be made through the state's Division of Comprehensive Emergency Management.

16.3.5 Environmental Protection Agency

Environmental Protection Agency programs include safe drinking water under the Safe Drinking Water Act and water pollution control under the Clean Water Act. The Safe Drinking Water Act increased the number of regulated drinking water contaminants, added new required treatment methods and made other revisions. Congress re-authorized the act with amendments that created several new programs. Important aspects of the Clean Water Act include: National Pollutant Discharge Elimination System (NPDES) and Section 402,



Provo River below Deer Creek Reservoir

regulating the discharge of point sources of pollutants to waters of the United States.

Construction grants originally provided 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 states.

Water quality management planning and non-point source pollution control, Section 604(b), 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

The 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 designed to reduce soil erosion, mitigate water pollution, protect and improve the condition of cropland and pastures, conserve water, and preserve and enhance wildlife habitat. Where possible, it encourages 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. State and county committees, made up of local farmers and ranchers administered the ACP program.

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's Natural Resources Conservation Service and Forest Service, along with the Utah Division of Forestry, Fire and State Lands provide technical program guidance. The Utah State University-Cooperative Extension Service provides educational support.

16.3.7 Federal Emergency Management Agency

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

Presidential Declared Disaster - After the president declares a major disaster, usually following a governor's request, grants are available to state and local governments for mitigation.

Assistance Grants - The FEMA can provide matching grants to help the state develop and improve disaster preparedness plans, and develop effective state and local emergency management organizations. Grants are also 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 FEM. can also help 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) carries out the mandates of the Endangered Species Act, Fish and Wildlife Coordination Act, Clean Water Act, Eagle Protection Act and Migratory Bird Treaty Act. No land or water areas in the basin are directly managed by the FWS.

The FWS compiles lists of animal and plant species native to the United States that are being reviewed for possible addition to the List of Endangered and Threatened Species. Such species are generally called "candidate species." Candidate species are those for which the FWS has sufficient information on biological vulnerability and threats to support addition to the list. Species considered threatened or endangered that occur in the Utah Lake and Jordan River basins are given in Table 16-1. These lists change over time as other species are added when they become threatened or are removed when they recover. When any activity is planned which may affect a threatened or endangered species, it is the responsibility of the sponsor to take actions to protect them.

When right-of-way permits are required on federal lands, the consultation requirement under the Fish and Wildlife Coordination Act is actuated.

Table 16-1
CANDIDATE AND LISTED SPECIES

Candidate Species	Listed Species	Category
Deseret milkvetch	June sucker	Endangered
Mountain plover	Peregrine falcon	Endangered
Spotted frog	Least chub	Endangered
	Whooping crane	Endangered
	Bald eagle	Threatened
	Clay phacelia	Endangered
	Ute ladies-tresses orchid	Threatened
	Utah valvata snail	Endangered

If federal funds are involved, Section 7 consultation with the FWS is required by the Federal Endangered Species Act (also see Section 14 of this basin plan). Any action that is authorized, funded or carried out by a federal agency is also subject to Section 7 Consultation. Section 404 permitting under the Clean Water Act, as administered by the Corps of Engineers, calls for the FWS to respond on impacts to wetlands and on threatened or endangered species. Under the Migratory Bird Treaty Act, all birds are protected except 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 a violation of Section 9 of the Endangered Species Act. "Take" means harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect or attempting to engage in any such conduct. This can include significant habitat modification or degradation where it kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering.

16.3.9 Forest Service

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 56,750 acres of wilderness areas on national forest lands.

Watershed Management - Watershed protection insures that activities do not cause undue soil erosion and stream sedimentation, reduce soil productivity or otherwise degrade water quality. Water yields may be affected primarily through snowpack management because of timber harvest using well-planned layout and design. Potential increases may approach one-half acre-foot per acre for some treated areas, but multiple-use considerations and specific onsite conditions may limit actual increases.

Special Use Authorization - Construction and operation of reservoirs, conveyance ditches, hydropower facilities and other water developments require special use authorization and an annual fee. Authorization contains conditions necessary to protect all other resource use. Coordination of water developments by others requires communication early in the planning process to guarantee environmental concerns are addressed. The Forest Service has prepared a *Resource Management Plan* along with a Monitoring and Evaluation Program for the Uinta National Forest.

16.3.10 Geological Survey

The U.S. Geological Survey (USGS), through its Water Resources Division, investigates the occurrence, quantity, distribution, and movement of surface and groundwater. It also coordinates federal water data acquisition activities. This is accomplished through programs supported by the USGS independent of, or in cooperation with, other federal and non-federal agencies. The USGS is responsible for the National

Water Quality Assessment (NAWQA). The goal of the assessment is to describe the status of the nation's waters and trends in quality parameters. The Great Salt Lake Basin NAWQA was started in October 1996.

The USGS cooperates with various state and local agencies in cost sharing for collecting hydrologic data. Programs include water quality and water level changes in the Utah Lake Basin aquifers. They also read and evaluate surface water stream gages.

16.3.11 Natural Resources Conservation Service

The Natural Resources Conservation Service (NRCS) provides technical and financial assistance to conserve soil, water, and related resources on non-federal land through local soil conservation districts. In addition to working with individual landowners and units of government, the NRCS administers the following programs.

Published soil surveys - These contain descriptions of an area's soils, their uses and management, and maps depicting the extent of these soils. The surveys give information about non-federal lands.

Snow survey program - The NRCS measures snow water equivalent and precipitation at four locations ranging in elevation from 7,160 feet to 9,960 feet. These data are available to the public electronically. Basin outlook reports that compare current snowpack, precipitation and reservoir storage to monthly and annual averages are published monthly, along with stream flow forecasts.

River basin studies - Technical and financial assistance for watershed protection and flood prevention and the emergency watershed protection program were all authorized by the Small Watershed Protection and Flood Prevention Program (PL 83-566). The emergency watershed protection program provides immediate technical and financial assistance to relieve hazards to life and property resulting from conditions created by natural disasters.

Watershed protection and flood prevention projects (PL-566) - Two have been completed for the American Fork-Dry Creek Watershed in Utah County and the Miller-Biglow watershed near Nephi. The Santaquin Pilot Watershed Project has also been completed in Summit Creek near Santaquin. A watershed work plan has been prepared for Heber Valley in Wasatch County as part of the Tri-Valley Watershed Project. Applications for PL-566 projects for southern Utah County and Salt Creek in Juab County are being prepared.

Resource Conservation and Development project(RC&D)- An application for an RC&C project has been pending since 1978 for the Mountain Lands planning area. The application was updated in 1992, and interest has been expressed in several projects. East Juab County is part of the Panorama Land RC&D which is based in Richfield, Utah. The following projects are being assisted in the Nephi area: Landscape Development Plan, Juab Fairgrounds Study, Agriculture Diversification Study, and a Target Industry Study.

Significant changes in program titles and agency missions have occurred as a result of the 1996 Farm Bill. Anyone needing assistance from U.S.D.A. Programs should contact the NRCS for current information.

16.3.12 Rural Development

Rural Development is authorized to provide financial assistance for water and waste disposal facilities in rural areas and towns of up to 10,000 people. Priority will be given to public entities in areas smaller than 5,500 people to restore, improve or enlarge a water facility through the Rural Utilities Service. To be eligible for loan and grant funds, water or waste disposal systems must be consistent with state or political subdivision's development plans and regulations. Rural Development also makes loans for resource conservation and development projects.

16.3.13 Utah Reclamation Mitigation and Conservation Commission

A major impetus for the CUPCA was the awareness that prior mitigation efforts had lagged behind project construction or were inadequate when measured against modern environmental standards. It was the intent of Congress to balance the mitigation debt within Utah resulting from such development by establishing the Utah Reclamation Mitigation and Conservation Commission (URMCC) and its program. The URMCC was created in part to provide the opportunity to design and implement a comprehensive and integrated program for mitigation of impacts and for protection of resources rather than having mitigation responsibilities spread among different agencies.

16.4 Federal Concerns

Federal agencies identified four concerns in the *1990 State Water Plan*. All apply to the Utah Lake

Basin. These concerns were: (1) Reserved water rights, (2) interrelated planning, (3) stream and riparian habitat loss, and (4) water right filings. The agencies have made progress on all these concerns.

One other concern has been raised since the *State Water Plan* was published. This is the lack of coordination between federal, state, and local officials during planning and implementation of various programs. Improving the management of Utah Lake is an example. The inability of agencies at all levels to agree on a process for pursuing the common goal resulted in no action being taken. More can be done to promote better working relationships between local, state and federal jurisdictions. ✤ ✤

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Water Conservation/Education

When our grandparents had to draw water from the well or carry it from the creek, conservation and respect for the scarcity of water was a way of life. For two generations however, water has run from our taps as if by magic. Once again, shortages in some systems, environmental issues, social values and competing uses have brought conservation into vogue as the key to stretching local and imported supplies.

17.1 Introduction

This section discusses conservation ideas and their significance to water planning. The need for education is also addressed as an important part of any conservation program.

As this generation looks to the future from the perspectives of cultural traditions and strong economic growth, we are becoming aware of the limits water supply will impose. Water sources presently being developed are expensive. New sources will be even more costly. The time to think about and teach conservation has come.

Fortunately, water development has kept ahead of the need in modern times. For many years conservation has not been a priority of either suppliers or consumers, except during droughts. During the next generation, 25-30 years, developed supplies in some systems will become fully used and scarcity will return to some parts of the basin unless new supplies are developed.

Conversion of irrigation water to municipal and industrial uses will continue. When this conversion has reached its limits, communities will need to make a choice: Limit growth, look for additional water to import or find ways to live with less.

People can achieve significant water use reductions when they understand the reasons to conserve. Communities have shown a willingness to temporarily reduce water use during times of drought. Public education to teach the benefits of carrying out long-term water conservation programs will prepare us to support them as the need arises. A well-managed water conservation program may postpone the need for building new facilities and finding additional supplies.

In some cases, Utah water law may discourage water conservation by irrigators. Farmers who have sufficient supplies to meet crop requirements have no incentive to increase efficiency in order to use less water. Under current law, saved water cannot be used to irrigate new land, nor can it be sold to other users if downstream water right holders are adversely affected.

Water fairs in public schools teach conservation

Effective conservation programs combine measures designed to reduce the demand for water with measures to improve efficiency of delivery systems. Demand reduction measures include devices and practices employed by water users. It also includes pricing

policies that discourage overuse and provides incentives for users to save water.

A key to designing effective conservation programs is understanding the distinction between water diversion and depletion. Diversion is the amount of water diverted, or taken from a well or stream. The amount diverted must be sufficient to provide adequate water to the user after losses due to leaks, seepage and evaporation are accounted for. Depletion is water consumed and lost from the system, therefore unavailable for reuse. If a system were 100 percent efficient, diversions would equal depletions. This is almost never the case.

The goal of a conservation measure may be aimed at either diversions or depletions, or both. Exchanging a low efficiency flood irrigation system for high efficiency flood or sprinkler irrigation may reduce (conserve) water diverted while maintaining or increasing the amount of water depleted. Knowing the goal of the conservation program is necessary. If leaving more water in the river for instream flow is the objective, raising irrigation efficiency may work. This most likely will create a problem downstream, however, because total water going to some downstream users may be less. If the goal is to reduce depletions, improvements to the farmer's irrigation system may be counter productive.

Water quality is important in setting up a conservation program. If the goal is to conserve high quality water for meeting culinary growth demand, then providing a separate irrigation pipe network to substitute low quality water for lawn and garden irrigation may be a logical solution. That is if low quality water is available and costs less. The goal of conserving high quality water is met, but total water diversions and depletions may be the same or increase.

17.2 Background

Farmers and ranchers have voluntarily increased the percent of land under sprinkler irrigation to become more efficient and to increase profits. With passage of the Central Utah Project Completion Act, new conservation incentives have been added.

17.3 Water Conservation Opportunities

While much has been done to increase efficiency of water use, there are opportunities to do more. Inefficiencies can be found in several areas of water use.

17.3.1 Agricultural

Opportunities still exist to improve the conservation of water used in irrigation. Several canals in the Strawberry Water Users Association are in need of major repair. Some have been lined with concrete, but they have buckled and cracked in recent years. Some farms in this area are still flood irrigated at low efficiency in on-farm and conveyance systems. Others have fields that are laser leveled and highly efficient in on-farm water application.

17.3.2 Residential

Opportunities abound for residential water conservation. Appliances that use water efficiently are not in general use. Some private water systems charge users a flat fee for water, resulting in no incentive to use less. Water is inexpensive in most public municipal systems, and large blocks of water are provided for the initial base charges, again lessening the incentive to conserve.

17.3.3 Institutional

Institutional water could be conserved by auditing water delivery systems at parks, schools, golf courses and cemeteries. Computer monitoring and control systems are also available which can shut down a part of a system where malfunctions occur and send a warning to a central monitor. Several of these systems are now in operation. Leak detection programs may enable municipalities to reduce the water lost. Many opportunities exist to conserve treated culinary water by substituting low quality water for irrigating lawns and gardens.

Low water using plants are available to beautify landscapes in a municipal setting. When combined with state-of-the-art irrigation management systems, significant water savings can result.

17.3.4 Commercial

Opportunities for conserving water at commercial facilities are also available, but economic feasibility is questionable in some cases. Commercial laundries are moving to water conservation technologies because it also conserves energy used to heat the water. The technology is available for recycling water at commercial car washes. But public acceptance of using recycled water in commercial car wash facilities is questionable.

17.3.5 Industrial

Water is metered to all industries that are on public municipal systems. Opportunities exist for conserving water through the price structure for those on metered public systems. Water conservation will not likely be an issue for those industries on self-supplied systems until they need additional sources. Recycling and process modifications can be good water conservation alternatives.

17.3.6 Wastewater Reuse

Effluent may be used for many applications if the public accepts it. Lawn and garden irrigation, golf course watering and agricultural uses are examples. Additional treatment (tertiary) is required.

17.3.7 Methods and Strategies

Regulation may achieve water conservation objectives or incentives may be used. State law requiring cities to revise their plumbing codes and mandating all new construction will have low water using appliances and fixtures installed is an example of regulation.

Incentive programs include water pricing schedules that increase the unit costs as water use goes up. Public and private water providers should compare the cost of developing new sources with the cost of purchasing and installing low water using fixtures for their customers. The Water Conservation Credit Program contained in the Central Utah Project Completion Act is a combination of regulation and incentive programs.

Conjunctive use of water supplies, also called "joint use," is a strategy where use of surface water is coordinated with use of groundwater. Where both are available as water sources, 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.

17.3.8 Conservation Impacts

The Wasatch Front Water Demand/Supply Computer Model (WFCM) was used to project future water demands using current conservation trends in Utah County. Table 17-1 shows the base case for major suppliers in Utah County where M&I water demands will increase from 107,500 acre-feet/year now to about 183,000 in the year 2020. Installing plumbing fixtures that use less water will reduce total use by almost 9 percent during the 25-year period. Adding to this, a wide acceptance of water conserving landscapes will reduce use another 2.13 percent. Increasing the price of water by 10 percent, in a way that allows consumers to save money by reducing use, conserves another 2.63 percent. Using all of the above conservation measures in combination reduces total use by about 13 percent in 2020. Some studies suggest they could reduce lawn irrigation by 50 percent with no harmful effects to the lawns or the aesthetics.

Water conservation may have negative environmental consequences. When canals are piped or lined with concrete, wetlands caused by the prior seepage will dry up.

17.4 Central Utah Project Water Conservation Credit Program

The Central Utah Project Completion Act provides strong incentives for water conservation. The objective of the conservation incentive is to increase efficiency in water use to prevent or forestall additional importation of water to the Wasatch Front metropolitan area, and to provide permanent in stream flows for fish and wildlife. Subsection 9.4.5 discusses environmental aspects of conservation.

Water management improvement studies discussed in Section 9 include a Water Conservation Credit Program as part of the Central Utah Project. The purpose of the credit program is to identify, evaluate and prioritize water conservation projects included in the *Water Management Improvement Plan*. The goal of the program is to conserve 48.389 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. Congress authorized $50 million in federal funds for this program. The Wasatch County Water Efficiency Project will use $10 million, leaving $40 million for other projects. The Central Utah Water Conservancy District will evaluate the effectiveness of the credit program annually, and may adjust any section as necessary. Project requirements and evaluations will not differ between proposed projects in any given period when two or more projects are being compared.

The district or a petitioner may retain any water they conserve, if they do not violate rules on expanding the water right. Each petitioner may make saved water available to the district. The district may make this 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

Table 17-1
IMPACTS OF CONSERVATION ON M&I WATER DEMANDS FOR MAJOR SUPPLIERS IN UTAH COUNTY

Conservation Scenarios	Demand 1995	2000	2010 (ac-ft/yr)	2020	Change 2000	2010 (percent)	2020
Without Dual							
1.Base case	107,542	120,082	151,849	182,952	11.66	41.20	70.12
2.Plumbing		116,009	141,588	166,579	-3.39	-6.76	-8.95
3.Water efficient landscapes		119,805	150,226	179,023	-0.23	-1.07	-2.13
4.Price +10%		117,079	147,893	178,135	-2.50	-2.61	-2.63
5.Combination(2-4)		112,874	136,446	158,589	-6.00	-10.14	-13.32

Source: Wasatch Front Water Demand/Supply Model, April 1997

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 its goal.

Any person, group or organization with an idea for a project that conserves water is eligible to participate in the Water Conservation 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.

17.4.1 Public Education

Public education is authorized as an integral part of the conservation program. The purpose is to reduce the demand for water through education. People educated about water and its many values 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 CUPCA credit program are also eligible for 65 percent funding with federal grant monies.

17.4.2 Water Conservation Pricing

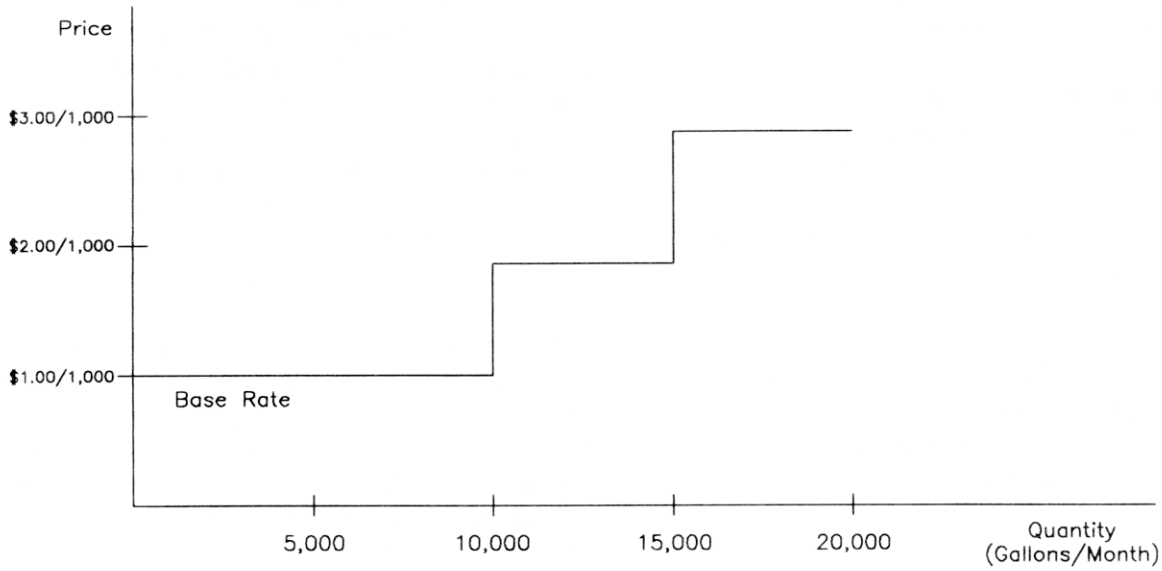
Under the Central Utah Project Completion Act, the Central Utah Water Conservancy District completed a study of wholesale and retail pricing to encourage water conservation. This study is contained in the *Report on Water Pricing Policy Study 1995*. It focused on ways to conserve water by reducing demand via various pricing mechanisms.

This study examined policies for irrigation water pricing, wastewater pricing, wholesale and retail pricing, and conservation pricing. 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. Figure 17-1 shows an increasing block rate schedule. It shows an initial price or base rate of $1/1000 gallons for the first 10,000 gallons used each month. The next 5,000 gallons per month cost $2/1000 gallons, increasing to $3/1000 gallons for all water use exceeding 15,000 gallons per month. This water pricing policy study pointed out that changes in pricing policies are likely to gain greater public acceptance if they are phased in over time.

17.4.3 Utah Water Conservation Advisory Board

The Central Utah Project Completion Act allowed the governor to establish a nine-member board known as the Utah Water Conservation Advisory Board. The Utah Board of Water Resources was designated to be this new board, adding one board member from the environmental community. This board was staffed by the Division of Water Resources. The duty of the board was to recommend water conservation standards and

Figure 17–1
INCREASING BLOCK RATES



regulations, most of which aimed to reduce water demand. These were then recommended for promulgation by state or local authorities in the service area of each petitioner of project water. They include the following:

- All water suppliers should develop a water management and conservation plan. The Utah Board of Water Resources, Drinking Water Board and Community Impact Board should require a water management and conservation plan from all recipients of state funding for water projects.

- The Central Utah Water Conservancy District should require a water management and conservation plan as a condition for receiving funds under Section 207(b) & (e)(2) of the Central Utah Project Completion Act (PL 102-575).

- Water management and conservation plans of municipal and industrial water providers should encourage the use of water conserving landscapes for residential and commercial buildings.

- All new state facilities should have water efficient landscape designs. State landscape watering should be restricted between 10:00 a.m. and 6:00 p.m. during the summer.

- Water providers should restrict outside watering for landscapes during the hottest time of the day (e.g., 10:00 a.m. to 6:00 p.m.) during the summer.

- County and city landscape ordinances should be reviewed and revised if appropriate by local governments to promote appropriate water conserving landscapes.

- Utah's strong and growing water education program for the state's elementary school system should be continued with additional funding to assure adequate teacher training adapted to a growing student population, and develop water education materials for secondary schools and the public.

- Metering and periodic reading of meters (monthly during peak summer seasons) of municipal and industrial systems should be started by all water suppliers.

- All federal facilities in Utah should install meters on municipal and industrial connections.

- Continue using the state engineer's existing methods of measuring and reporting agricultural water at points of diversion.

- Metering of individual secondary system connections is not recommended until an economical and reliable meter is developed.

- Each municipal water provider should adopt a water pricing policy that promotes water conservation.

- Water utilities and federal funding agencies, (Bureau of Reclamation) should investigate the feasibility of mutually revising "take or pay" contracts to minimize disincentives to conservation pricing.

- City and county governments should change business license requirements for commercial laundries and other commercial facilities that use tunnel wash or large tub washer systems to require water reuse and recycling in new facilities.

- The State Department of Commerce, Division of Business Regulation and Licensing, should amend the Uniform Mechanical Code to require recycling and/or reuse in newly installed commercial and industrial water operative air conditioning and refrigeration systems.

- Amend the Uniform Plumbing Code in Utah to require new ion exchange water softeners be of the high efficiency salt demand type.

- The Department of Environmental Quality should evaluate the feasibility of using lime softening as part of the surface water treatment process as a water quality enhancement.

- The Bureau of Reclamation should investigate the cost effectiveness of lime softening at surface water treatment plants in the Colorado River drainage for water conservation, water reuse and reduction of salinity in the Colorado River Basin. They should report results of this investigation to the Colorado River Basin Salinity Control Forum.

17.5 Policy Issues and Recommendations

Two issues are discussed. These are cash flow problems and conservation strategies.

17.5.1 Maintaining Cash Flows With Conservation

Issue - Efforts to conserve water may reduce the water provider's ability to maintain adequate cash flows if they do not take precautions.

Discussion - Many water providers resist implementing effective conservation measures for fear this will reduce revenue from water sales, and jeopardize their ability to meet debt service and new capital requirements. Consequently, financial pressures cause water providers not to conserve, but seek ways to increase water sales. Effective conservation pricing of water may require revenue flows be separated from the amount of water sold. Under present pricing practices, the incentive to conserve water will only exist when population growth forces a choice between conservation and new supply development. If it costs more to develop a new supply, the provider will have an incentive to promote conservation. Ideas for alternate pricing policies can be found in Water Conservation Recommendations" from the Division of Water Resources (1995) and in *Report of the Water Pricing Policy Study* from the Central Utah Water Conservancy District (1995).

Recommendation - Agencies responsible for providing water should implement pricing practices that provide an incentive to conserve water and are revenue neutral.

17.5.2 Choosing Effective Conservation Strategies

Issue - Conservation strategies are only effective when water providers understand users' habits and practices.

Discussion - Conservation is a response to inefficient use, or a proactive effort to shape water using habits in anticipation of future shortages. To choose which conservation strategy will be successful, the water supply manager must understand human behavior. Managers need to know how customers in their specific service area respond to different climatic and social events or conditions. Otherwise, specific conservation measures may be counter productive and wasteful of scarce resources.

Cost-effective technology currently exists to accurately measure such behavior. This involves the attachment of a data logger to a home or business water meter. The logger records gallons per minute vs. time

at very short intervals (as short as every 10 seconds). The intervals are short enough to permit identification of toilet flush, shower use, dishwasher cycles and outside use. This work can be done throughout the year both in winter and summer.

Given the ability of computers to handle massive amounts of data, and new techniques for identifying patterns, municipal water providers can greatly improve their understanding of how customers use water. These techniques can also measure how innovations in water conservation might change demand patterns. This can measurably increase accuracy, improve confidence in conservation strategies, and permit better decisions on where to spend water conservation dollars.

Recommendation - Before choosing water conservation measures, water providers should conduct sufficient studies to discern and understand water users' responses to climatic and social events and conditions. ✤ ✤

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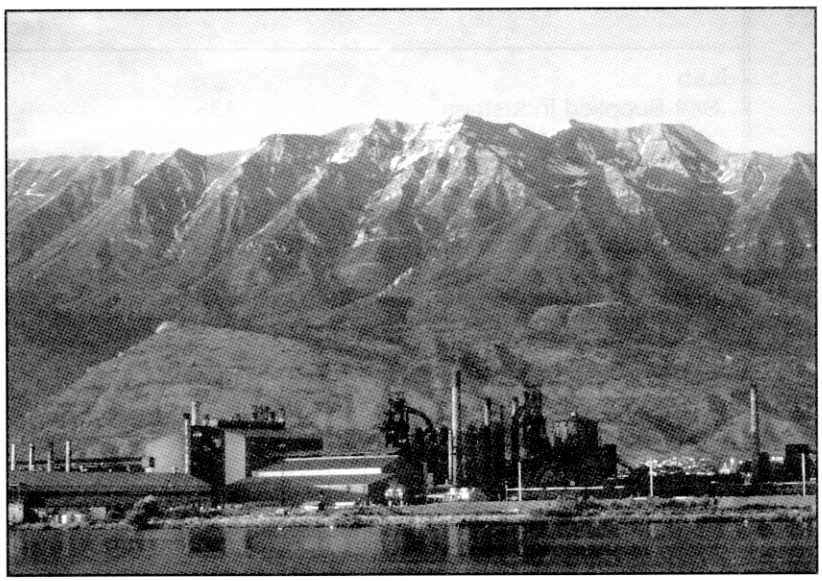
Industrial Water

The Utah Lake Basin has a growing industrial base. Most of the communities in this basin are actively recruiting clean industries.

18.1 Introduction

This section discusses the present and future uses of water for industrial purposes. In industry as elsewhere, water is the universal solvent, has special thermodynamic properties for temperature control, and plays a biological role as the working fluid for life support. Industry puts water into products, evaporates it for temperature control, and uses it to carry away wastes. Water makes green landscaping possible, adding aesthetic appeal to the working environment in fountains, streams and ponds.



Geneva Steel Company

18.2 Background

Usually, industrial water is distributed through cities' municipal systems. Some large industrial users have developed their own wells and other sources. Micron Technologies is the most recent industrial firm to purchase farmland to get its water supply.

18.3 Current and Projected Industrial Water Use

Steel production, hydroelectric power generation and processing of agricultural, computer and other manufactured products are the major industrial water uses. Much of this water is not consumed, but is returned to the hydrologic system.

18.3.1 Major Water Using Industries

Total industrial use is about 31,940 acre-feet, mostly for steel production at Geneva Steel. Plans for future expansion call for increased amounts, some of which will be provided by recycling. Micron Technologies expects to use 2,000 acre-feet, mostly from its own sources. It will upgrade the quality of this water in its own treatment facility. Current water use by all industries by county is shown in Table 18-1. Table 18-2 shows the amount of industrial water expected to be needed in the year 2020. Projection of industrial water use is based on population growth expected from 1995 to 2020.

18.3.2 Hydroelectric Power Generation

Hydroelectric power generation uses a significant amount of water also. This use does not deplete any water. The Federal Energy Regulatory Commission (FERC) issues licences for hydroelectric projects. Figure 18-1 shows the locations of power plants in the basin. Table 18-3 shows the stream, installed capacity, annual generation, owner and average flow at each plant.

The Deer Creek and Olmsted plants are the major producers with nearly 27 gigawatt hours and 60 gigawatt hours of annual power output respectively. The U.S. Bureau of Reclamation owns the major power

production facilities. Provo River Water Users Association operates the Deer Creek plant. Olmsted plant is operated by Utah Power under contract with the USBR. Strawberry Water Users Association, Utah Power and smaller cities own the rest.

18.3.3 Agricultural Industry

Significant amounts of water have historically been used in agriculture to wash and process orchard crops such as apples and tart cherries. While this continues, some orchards are giving way to residential, commercial and industrial land uses, reducing the demand for industrial water in agriculture. ✤ ✤

Table 18-1
INDUSTRIAL WATER USE

County	Potable	Non-Potable (acre-feet)	Total Industrial
Juab			
Self-Supplied Industries[a]	435	0	435
Public Community Systems	205	0	205
Summit			
Self-Supplied Industries	0	0	0
Public community Systems	0	0	0
Utah			
Self-supplied Industries[b]	6,080	4,240	10,320
Public Community Systems	20,920	0	20,920
Wasatch			
Self-Supplied Industries	0	0	0
Public Community Systems	60	0	60
Total	27,700	4,240	31,940

a Ash Grove Cement West, Inc., North Lily Mining Co.
b Big Three Industrial Gas, General Refractories Co., Geneva Rock Products, Geneva Steel, Ireco, Inc., Lehi Roller Mills, Inc., Pacific States Cast Iron Pipe Co., Trojan Corporation, Deseret Feed Lot, Valley Asphalt Co.

Table 18-2
PROJECTED INDUSTRIAL WATER USE[a]

County	1995 (acre-feet)	2020 (acre-feet)
Juab	640	900
Summit	0	0
Utah	31,240	46,740
Wasatch	60	90
Total	31,940	47,730

a Includes potable and non-potable water use.

Figure 18-1

LOCATION MAP FOR HYDROELECTRIC POWER PLANTS
Utah Lake Basin

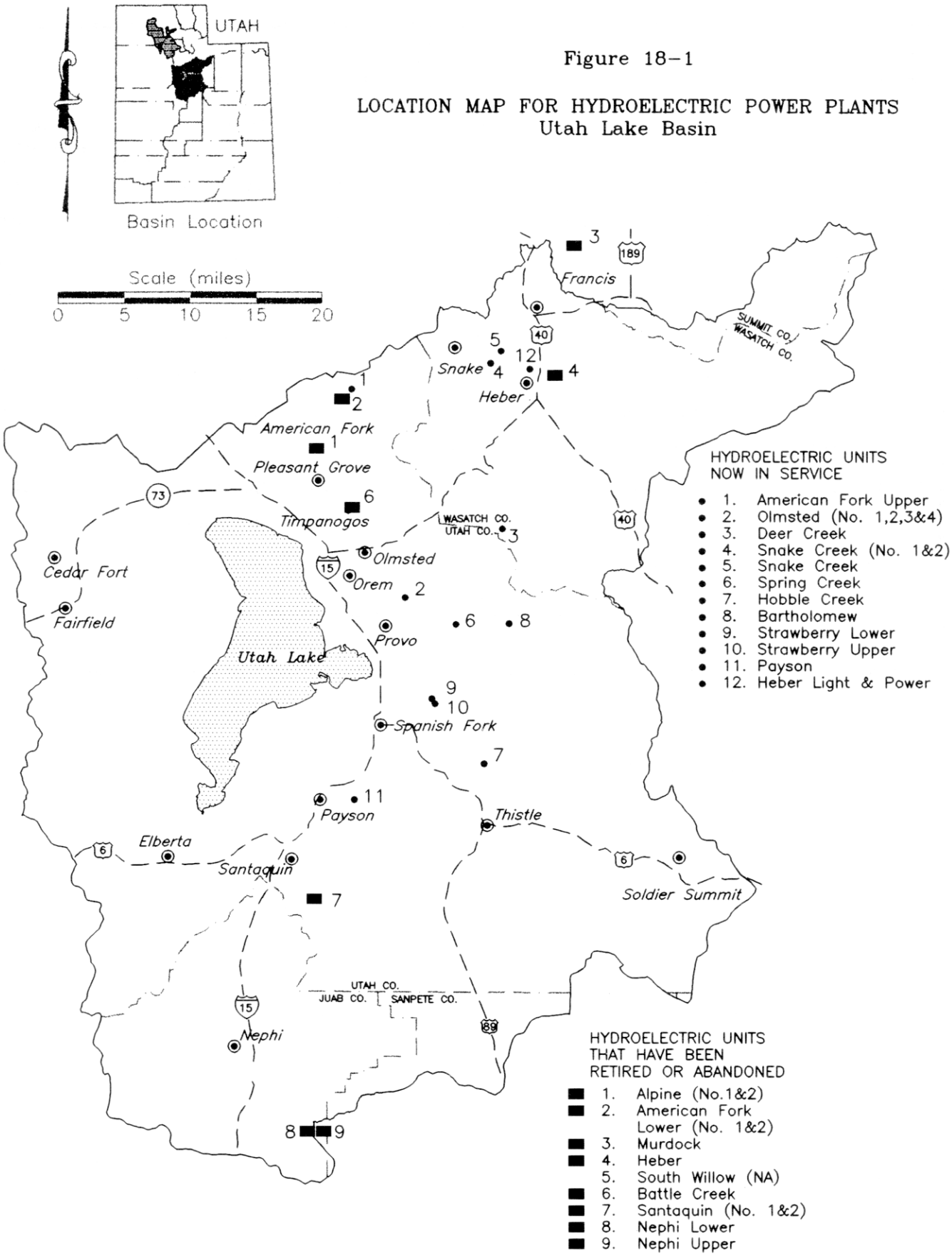


Table 18-3
HYDROELECTRIC POWER PLANTS

Name	Stream	Installed Capacity (MW)	Annual Generation (GWH)	Owner	Average Flow (acre-feet)
American Fork Upper	American Fork	.95	6.50	Utah Power	12,925
Bartholomew	Bartholomew Creek	.05	2.00	Springville	4,000
Deer Creek	Provo	4.95	26.80	USBR[1]	211,700
Hobble Creek	Hobble Creek	.30	1.60	Springville	4,000
Olmsted (1-4)	Provo	12.70	59.30	USBR[1]	NA
Payson	Petentneet Creek	.40	1.90	Strawberry WUA	4,300
Snake Creek	Snake Creek	.08	4.35	Heber L&P	2,210
Snake Creek 1&2	Snake Creek	1.18	3.20	Utah Power	2,540
Spring Creek	Spring Creek	.12	.70	Springville	NA
Strawberry Lower	Spanish Fork	.25	1.10	Strawberry WUA	4,260
Strawberry Upper	Spanish Fork	.90	5.20	Strawberry WUA	118,140
Total		21.88	112.65		364,075

[1] Power marketed by Utah power, Utah Municipal Power Agency and Utah Association of Municipal Power Systems

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Groundwater

Groundwater is an important element of the overall hydrologic system in the Utah Lake Basin. It provides substantial amounts of water for agricultural, municipal and industrial uses.

19.1 Introduction

This section discusses groundwater basins and their contribution to the water resources. Groundwater aquifers transfer water from areas of recharge, i.e., mountains and foothills rimming the basin down gradient to areas of discharge (springs, streams, lakes and reservoirs). Groundwater aquifers also serve as large underground reservoirs. Groundwater well owners and operators range from home owners with domestic wells to ranchers and farmers, municipalities, water districts and companies, and corporations with high production wells. As the third leading producer of groundwater, the Utah Lake Basin produces approximately 15 percent of the state's total groundwater. All major groundwater producing areas in the Utah Lake Basin were closed to new appropriation by the State Engineer in November 1995 (See Section 7 for water rights regulation).

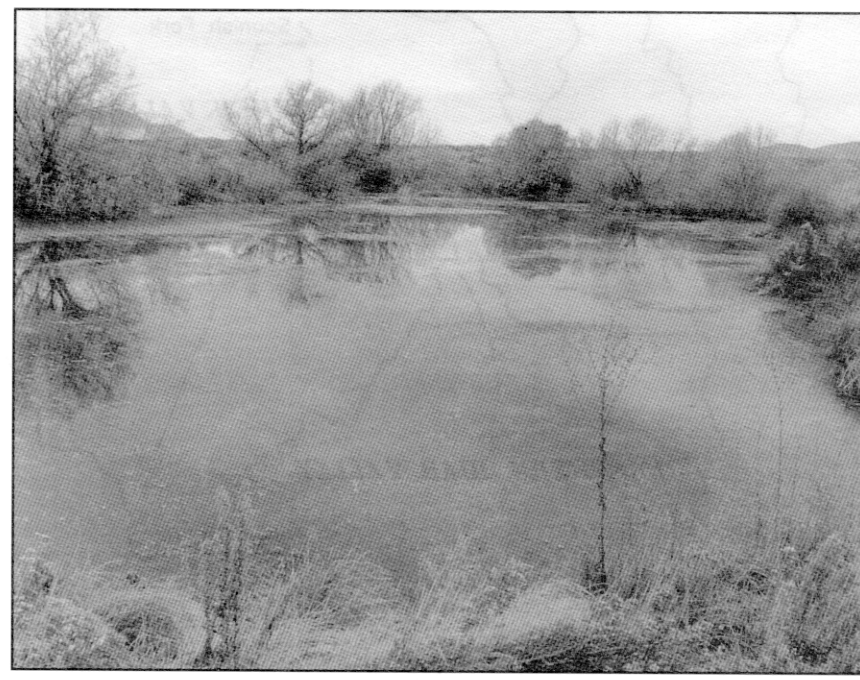
19.2 Subsurface Geology and Aquifer Characteristics

As shown on Figure 19-1, the Utah Lake Basin consists of five groundwater basins. These are Heber Valley and Round Valley in Wasatch County, Cedar Valley and Utah-Goshen Valley in Utah County, and northern Juab Valley in Juab County. Most of the groundwater developed in the Utah Lake hydrologic basin comes from unconsolidated valley fill. The valley fill, consisting of alternating granular alluvial fan deposits and finer grained lake bottom deposits, creates a number of confined, unconfined and perched aquifers as shown in Figure 19-2. Data from the five groundwater basins are summarized in Table 19-1.

19.2.1 Cedar Valley Groundwater Basin

Geologically the Cedar Valley groundwater basin is a down dropped graben (a depressed segment of the earth's crust bounded on at least two sides by faults) filled with alluvium eroded from the surrounding mountains and deposited as coalescing alluvial fans. Associated with the fan deposits are sediments laid down as ancient lake beds. These valley fill materials are coarse grained nearer the mountains along the valley margins, then become finer grained toward the center of the valley.

Discharge - Total groundwater discharge from the basin is estimated at 22,000 acre-feet with the majority (estimated at 15,000 acre-feet) leaving the basin as subsurface outflow to Utah Valley. Groundwater production is from springs and wells. Three springs west of Cedar Fort produce a combined flow of approximately 800 acre-feet annually. Fairfield Spring



Spring at Fairfield

Figure 19-1

GROUNDWATER BASIN BOUNDARIES
Utah Lake Basin

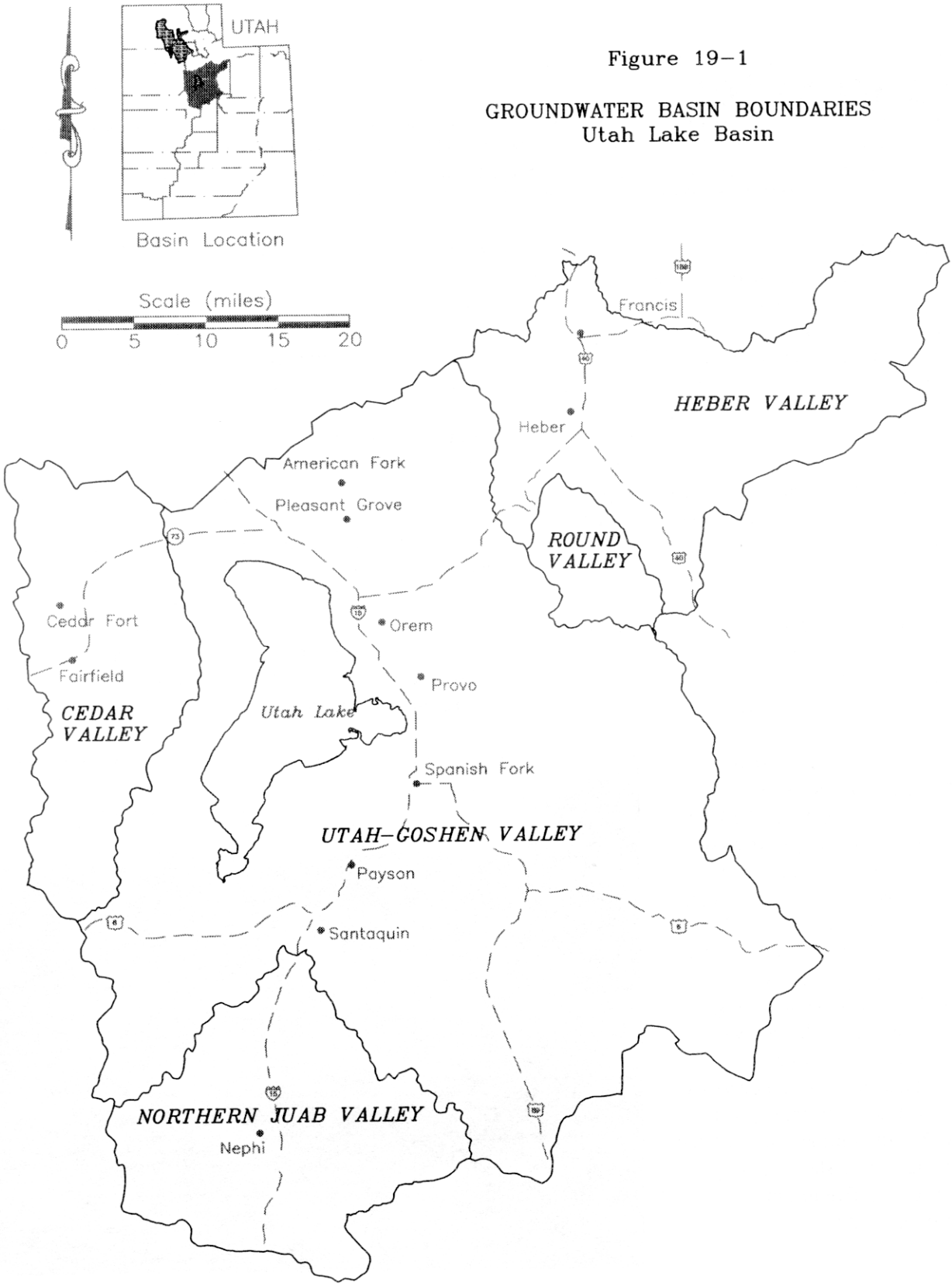
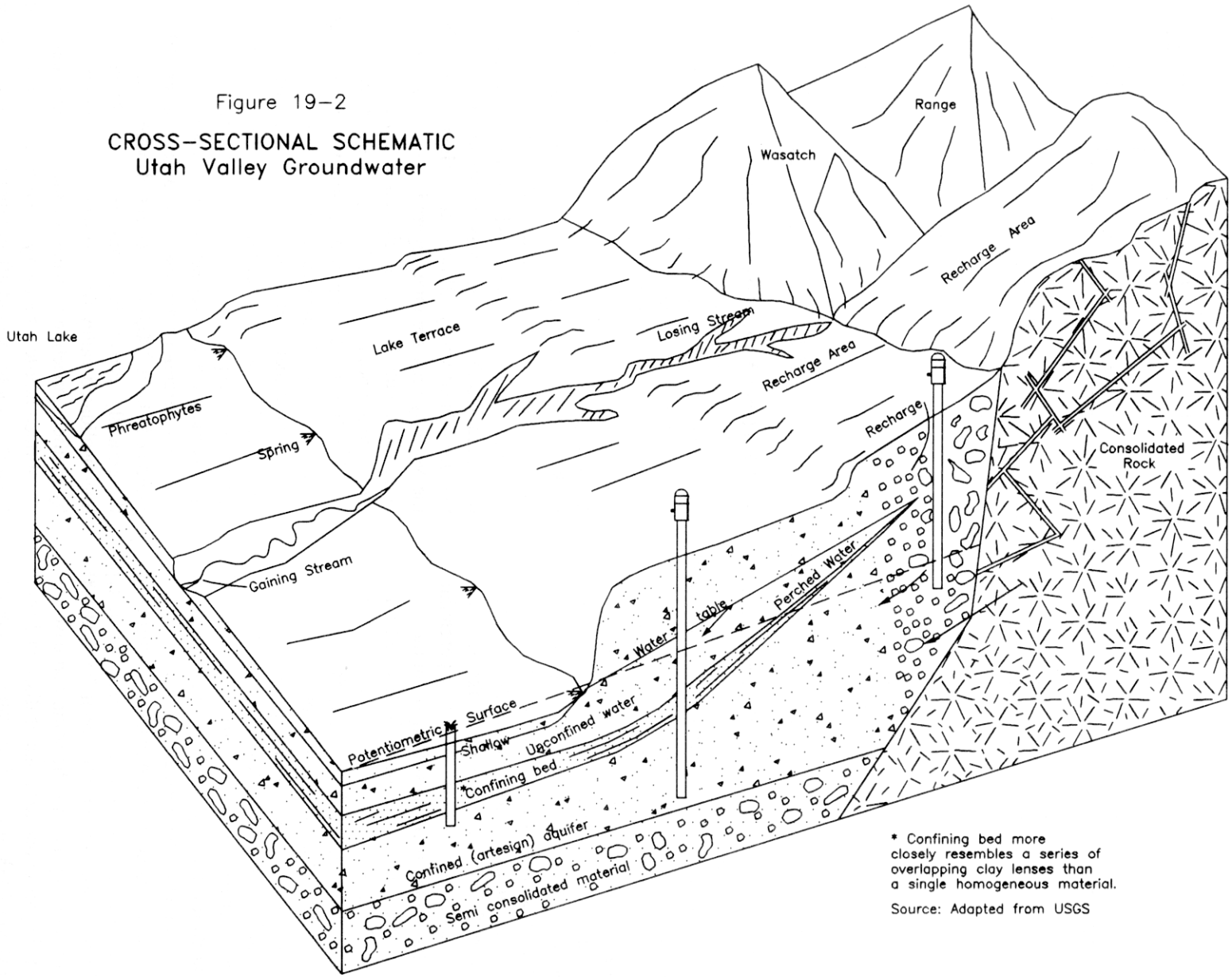


Figure 19–2

CROSS–SECTIONAL SCHEMATIC
Utah Valley Groundwater



* Confining bed more closely resembles a series of overlapping clay lenses than a single homogeneous material.

Source: Adapted from USGS

Table 19-1
AQUIFER CHARACTERISTICS OF GROUNDWATER BASINS

Name	Aquifer	Groundwater Model	Total Discharge (acre-feet)	Withdrawals From Wells (acre-feet)	Chemical Quality	Water Right Status	Reference
Cedar Valley	Valley Fill	No	22,000	2,950	Good to Marginal	Closed	Feltis, 1967
Heber Valley	Valley Fill	Yes	111,300	870	Good to Marginal	Closed	Roark & others, 1991
Round Valley	Valley Fill	No	7,950	140	Good	Closed	Roark & others, 1991
Utah & Goshen Valleys	Valley Fill	Yes	450,000	91,260	Good to Marginal	Closed	Price, 1985
Northern Juab Valley	Valley Fill	Yes	40,000	20,500	Good to Marginal	Closed	Price, 1985

generally discharges between 3 and 5 cfs, resulting in an annual average of approximately 3,000 acre-feet. Average annual discharge from wells accounts for 3,800 acre-feet, which is less than one-fifth of the average annual discharge for the entire basin. See Figure 19-3.

Recharge - Recharge to the Cedar Valley groundwater aquifers is estimated to average 22,000 acre-feet per year. Most of this water enters the basin from precipitation and snowmelt in the Oquirrh Mountains. Other areas of recharge are the East Tintic Mountains, Topliff Hill, Thorpe Hills, Lake Mountains and their associated alluvial fans. The only perennial stream in Cedar Valley is in West Canyon in the Oquirrh Mountains, and all the water is diverted for irrigation near Cedar Fort. Between the stream bed, diversion canal, and irrigated fields, fully 50 percent of the surface flow from West Canyon (approximately 1,000 acre-feet a year) is recharged to groundwater.

Water Quality - Water quality within the Cedar Valley groundwater basin generally meets all state and federal standards for culinary use. The highest quality groundwater is found in the northern and west central part of the basin, areas nearest the principal sources of recharge. Here the water is of calcium bicarbonate type with total dissolved solids (TDS) between 200 and 400 milligrams per liter (mg/l). To the south and east, the water contains higher concentrations of dissolved solids, between 1,000 and 2,000 mg/l. The water becomes a sodium sulfate type suggesting a longer flow path and increased resident time underground.

19.2.2 Heber Valley Groundwater Basin

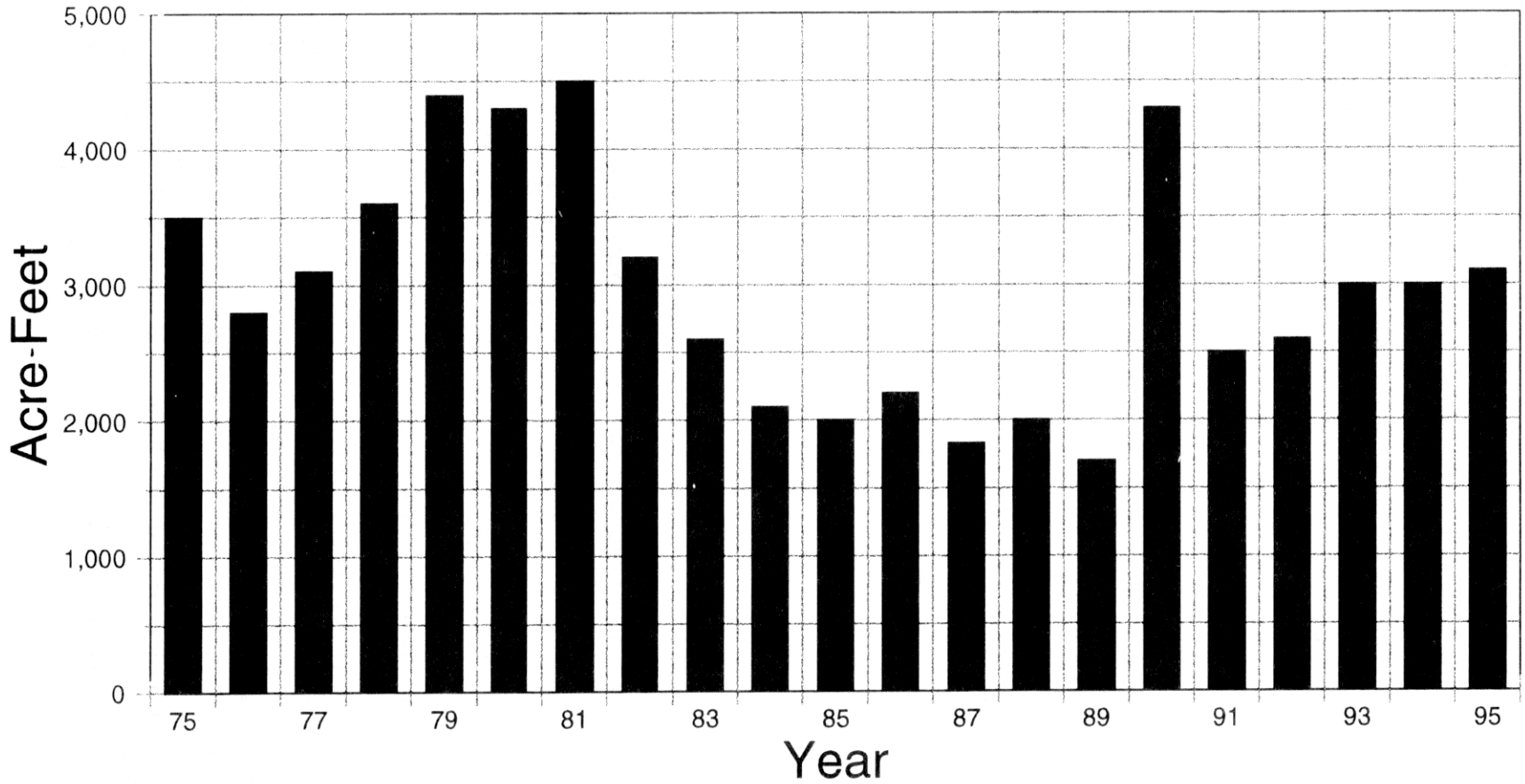
Heber Valley is an intermontane back valley. Surrounded by mountains, the valley fill is characterized as alluvial fan materials that are coarsest around the valley margins and become finer toward the valley bottom. The other component of valley fill comes from the through flowing Provo River, which in meandering back and forth across the valley has deposited fluvial sands and gravels. According to drillers' logs, discontinuous layers of clay, which have not been found to exceed 375 feet in thickness, occur in most of the unconsolidated valley fill deposits. The tufa deposits in the Midway area are interfingered and in hydraulic connection with the unconsolidated valley fill and therefore are not considered a separate hydrologic unit.

Discharge - Total annual groundwater discharge from the unconsolidated valley fill is estimated to be 111,300 acre-feet from evapotranspiration, leakage to Deer Creek Reservoir, seepage to the Provo River, springs and seeps, and wells. Well production of approximately 870 acre-feet accounts for only 7/10 of 1 percent of the total discharge. Baker (1970) estimated about 280,000 acre-feet of water was theoretically recoverable from the upper 100 feet of unconsolidated valley fill. However, due to the hydraulic connection between surface streams and the unconfined aquifer, recovery of large amounts of water from this storage would affect streamflow and existing water rights.

Figure 19 - 3

CEDAR VALLEY

ESTIMATED WITHDRAWAL FROM WELLS



Hot Pots - Thermal groundwater in and around the town of Midway is manifest at the surface as hot pots, which have no surface discharge, and hot springs that flow up to 3 cfs (Baker, 1970). The source for the heat, which is transferred to the circulating groundwater, is believed to be young intrusives that are still hot and are slowly cooling. These intrusives could underlie the Midway area, but are known to exist to the north. For example, in the Mayflower mine near Park City, temperatures as high as 65°C have been recorded on the 3,000 foot level (Kohler, 1979). The only current use for this thermal water is space heating. It is too saline to be used for culinary or most agricultural applications.

Recharge - Recharge to the Heber Valley groundwater aquifers is estimated to average 111,300 acre-feet per year. Recharge is from precipitation, stream infiltration, unconsumed irrigation water and subsurface inflow from consolidated rocks.

Water Quality - Water quality generally meets all state and federal standards for culinary use. Near Midway, however, the groundwater fails to meet state standards in either total dissolved solids or sulfate.

19.2.3 Round Valley Groundwater Basin

Mountains also surround Round Valley. Valley fill is alluvial fan deposits consisting of poorly sorted gravel, sand, silt and clay. The thickest section of unconsolidated valley fill drilled thus far is about 100 feet.

Discharge - Total annual groundwater discharge from the unconsolidated valley fill is estimated to be 7,950 acre-feet from evapotranspiration, springs, seeps and wells. Production from more than 115 small-diameter domestic and stock wells amount to about 140 acre-feet per year or about 2 percent of the average annual discharge.

Recharge - Recharge to the Round Valley groundwater aquifers is estimated to average 7,950 acre-feet per year. Recharge is from precipitation, stream infiltration, unconsumed irrigation water and subsurface inflow from consolidated rocks.

Water quality - Water quality within the Round Valley groundwater basin generally meets all state and federal standards for culinary use.

19.2.4 Utah and Goshen Valleys Groundwater Basin

Geologically, the Utah and Goshen Valley area is a string of aoalescing alluvial fans and river deltas on the hanging wall of the Wasatch Fault. The alluvium is composed of multiple layers of sand and gravel deposited at the mouths of canyons, becoming finer westward toward Utah Lake. This is interlayered with clay layers deposited on the beds of ancient lakes. Gravity and drill hole data show 1,000 feet for the depth of unconsolidated alluvium.

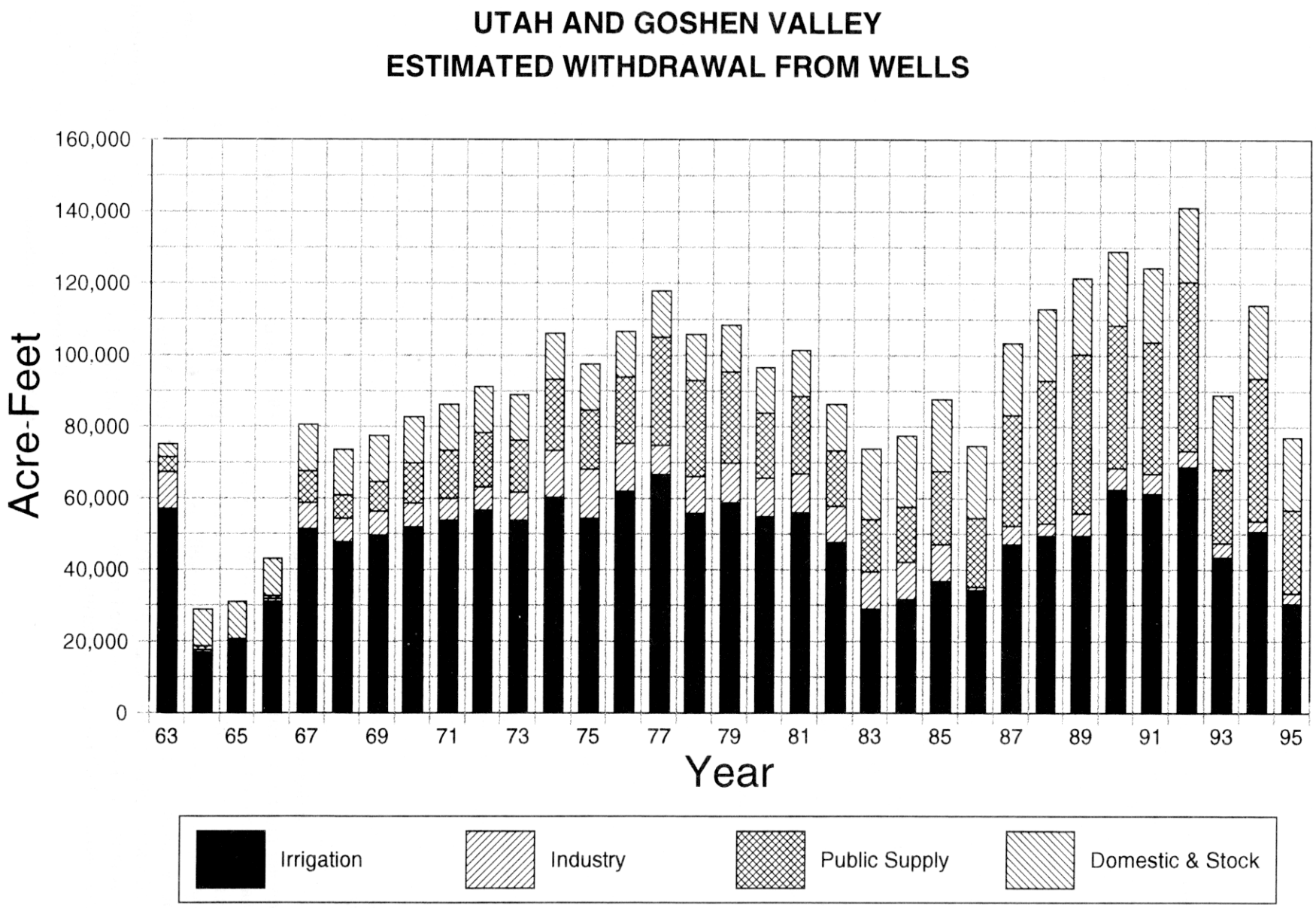
The State Engineer has determined the majority of groundwater discharge is tributary to Utah Lake. Groundwater development in northern Utah County is at a point of balance with tributary inflow to Utah Lake. Each additional acre-foot withdrawn via new wells will decrease one acre-foot of tributary inflow. This balance is an important element in the State Engineer's decision to close Utah and Goshen Valleys to further groundwater appropriations.

Discharge - The average annual discharge from the basin is estimated to be in balance with the recharge and amounts to 450,000 acre-feet. Discharge is to waterways and springs, wells, evapotranspiration, subsurface outflow, and diffuse seepage to Utah Lake. Groundwater production from wells for the period 1963-1995 averaged 121,000 acre-feet per year. See Figure 19-4.

Recharge - Recharge to the groundwater basin is estimated to average 450,000 acre-feet per year. Recharge is from precipitation, infiltration from stream channels and irrigation canals, seepage from irrigated fields, lawns and gardens, and from subsurface inflow through consolidated rocks.

Water Quality - Water quality within the Utah and Goshen Valley groundwater basin generally meets all state and federal standards for culinary use. The highest quality groundwater is found nearest the major sources of recharge along the east side of the basin. Here the groundwater is calcium bicarbonate type and TDS is generally less than 500 milligrams per liter (mg/l)and locally less than 250 mg/l. Two areas in the basin have degraded water quality. One is along the northwest shore of Utah Lake then north along the Jordan River to the Jordan Narrows. The second area is along the shore of Goshen Bay south to the area surrounding the town of Goshen and along Current Creek. In these areas, the groundwater is classified as slightly to moderately saline with dissolved solids concentrations ranging from 1,000 to 10,000 mg/l. The higher concentrations in these areas may be due to movement into the fill of saline water that rises along the major inferred north-south trending fault (called the Utah Lake fault, Hunt, et.al., 1953).

Figure 19 - 4


UTAH AND GOSHEN VALLEY
ESTIMATED WITHDRAWAL FROM WELLS
Acre-Feet
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
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

19.2.5 Northern Juab Valley Groundwater Basin

Geologically, the northern Juab Valley is a down dropped valley against the Wasatch Fault. Valley fill consists of a series of alluvial fans and interbedded lake bottom deposits. The alluvium is coarsest against the mountain front and becomes fine toward Mona Reservoir and the middle of the valley.

Recharge - In the long-term, recharge to the groundwater basin is estimated to average 40,000 acre-feet per year. Recharge is infiltration from streams, irrigation and water conveyance systems, subsurface inflow from adjacent areas and consolidated rock, and from precipitation.

Discharge - The average annual discharge is estimated to be 40,000 acre-feet. Groundwater is discharged by pumped and flowing wells, springs and seeps, evapotranspiration and subsurface outflow. Approximately 20,500 acre-feet of the total discharge is from wells. See Figure 19-5.

Water Quality - Water quality within the northern Juab Valley groundwater basin generally meets all state and federal standards for culinary use. However, a large part of the southeastern area of the basin (centered on Nephi) has groundwater with dissolved solids concentrations in excess of 500 mg/l and two areas of concentrations which generally exceed 1,000 mg/l. These higher concentrations are apparently associated with the erosion and deposition in the valley fill of the salt-bearing Arapien shale formation exposed in the watershed east of Nephi.

19.3 Problems and Needs

Groundwater levels generally showed a significant rise through the period of 1982-1984. This was in response to greater-than-average precipitation and stream flow coupled with a decrease in the amount of groundwater pumped. Groundwater levels have generally declined since 1985. This has been in response to the less-than-average precipitation and stream flows coupled with an increase in the amount of groundwater pumped to make up the shortfall. Each basin has been closed to new appropriations by the state engineer. This should result in a close to static situation where groundwater withdrawals, including wells, is essentially matched over time by the recharge. Under approved water rights, approximately 300,000 acre-feet may be withdrawn. Presently developed rights withdraw about 152,000 acre-feet annually.

19.4 Groundwater Management Plans

The State Engineer has completed a groundwater management plan for Utah and Goshen Valleys. This plan sets conditions under which groundwater can be developed while protecting existing rights. This plan, along with the existing distribution plan (see Section 7) and coordinated operation agreements will provide a more unified water management system.

All surface waters in the Utah Lake/Jordan River system are considered to be fully appropriated. From recent studies and computer ground-water models that have been developed, the data suggest a strong relationship between groundwater and surface water sources, particularly Utah Lake. The State Engineer wants to encourage the transfer of irrigation water to municipal purposes as farmland converts to subdivisions. To accomplish this will require that change applications be filed to transfer surface water rights to groundwater sources. Utah/Goshen Valley is closed to new appropriations of groundwater.

Present groundwater withdrawals (1989-1995) for Utah/Goshen Valley average about 109,000 acre-feet. The plan provides for average annual withdrawals from wells of 160,000 acre-feet in northern Utah Valley, 100,000 acre-feet in southern Utah Valley, and 18,000 acre-feet in Goshen Valley. This amounts to 278,000 acre-feet. Subtracting the 109,000 acre-feet present use results in an average potential withdrawal of 169,000 acre-feet. These amounts are conditioned upon the assumption the effect on surface water rights can be mitigated.

To develop this amount of water for municipal use would require well capacities of 2 to 2.5 times the amount of water now developed to meet seasonal peaking demands. Holders of Utah Lake water rights in Salt Lake County have objected to transferring their rights for use in Utah County. Those factors may limit the amount of groundwater developed in the Utah/Goshen Valley for use in Utah County.

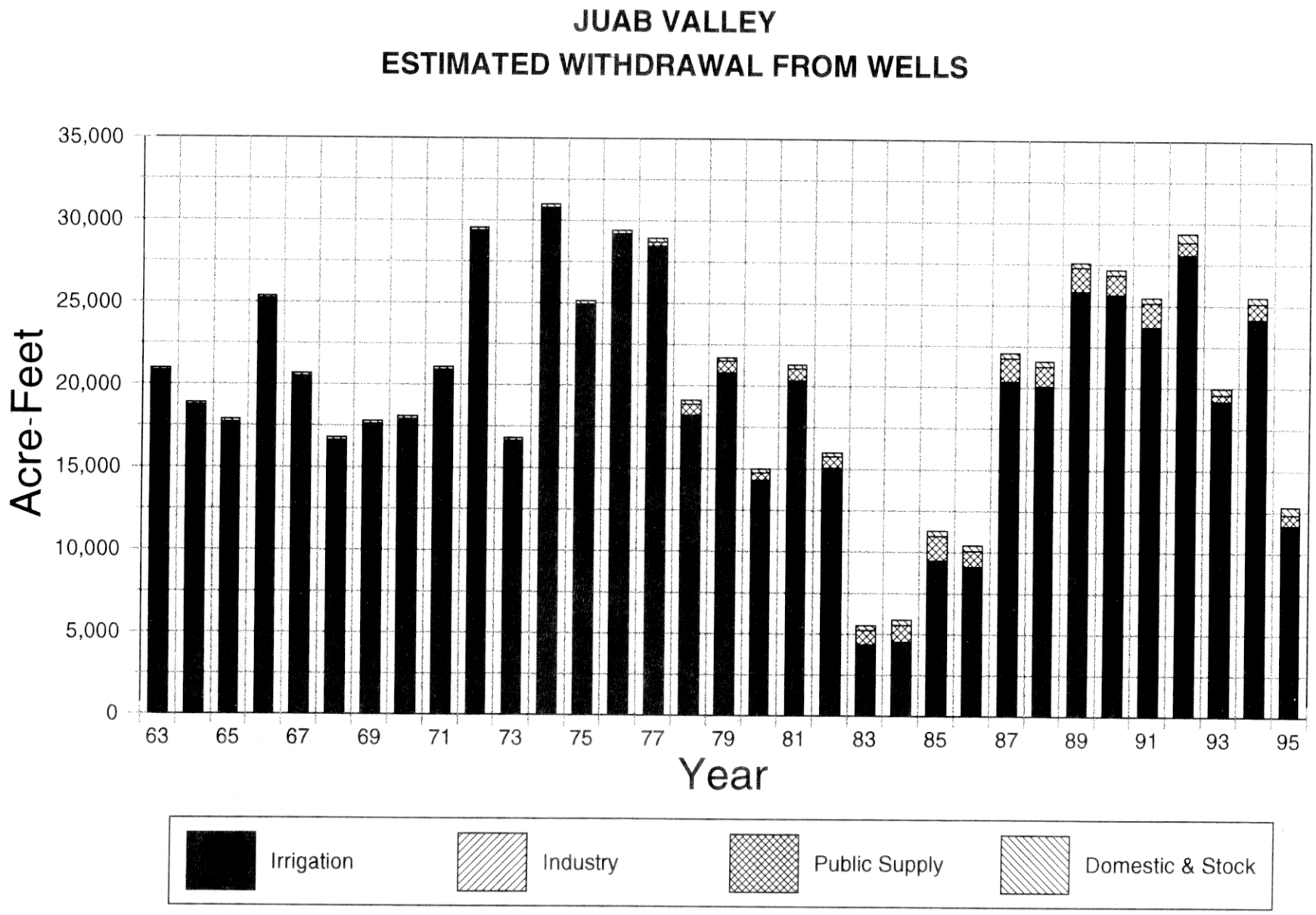
19.5 Issues and Recommendations

19.5.1 Increased Groundwater Use

Issue - Demand for groundwater development in Utah Valley is increasing as population expands. Because of the relationship between the groundwater and Utah Lake, this development could affect inflow to Utah Lake.

Discussion - As Utah Valley and the other basins experience a continuation of moderate to rapid growth,

Figure 19 - 5


JUAB VALLEY
ESTIMATED WITHDRAWAL FROM WELLS
Acre-Feet
35,000
30,000
25,000
20,000
15,000
10,000
5,000
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

a shift from predominately agricultural usage toward more municipal and industrial use will result. Local water providers will eventually be faced with the necessity of either expanding existing surface water treatment and distribution facilities or increasing current groundwater pumping rates to supplement M&I water supplies. The former option would require significant costs associated with the planning, design and construction of new and/or expanded treatment and distribution facilities.

However, the construction of injection wells or infiltration beds strategically near Provo and Spanish Fork canyons would potentially recharge a relatively large area of the existing groundwater aquifer near the most populated portions of the Utah Lake basin. The recharged aquifer would then allow for increased pumping rates at existing well sites and to a significant degree, eliminate the need for the construction of large surface water treatment and distribution facilities. At the same time, monitoring of groundwater aquifers to assure that Utah Lake water rights are not impaired is required. Exchanges of surface water with wells is also an option.

Recommendation - Major water suppliers, with funding and guidance from the Central Utah Water Conservancy District and permits from the State Engineer, should aggressively pursue the possibility of large groundwater recharge projects and exchanges, particularly in the most urbanized areas of Utah Valley.

19.5.2 Protecting Water Rights in the Provo River

Issue - When the Wasatch County Water Efficiency Project is constructed, changes in the historic pattern of irrigation return flows to the groundwater and Provo River water right holders will occur.

Discussion - In the spring, large amounts of water are diverted by irrigators to raise soil moisture; this water returns to the river later in the year and serves to augment late season flows to the lower users. Under the pressure irrigation proposal, water would be delivered as it is needed by the crop. This will alter the regime of the river, particularly in the late season, by decreasing the return flows to the river. When this project goes forward, a way needs to be found to minimize the impact on lower users in the late season.

Recommendation - The State Engineer, in consultation with local water users, the Bureau of Reclamation, and the Central Utah Water Conservancy District, should continue to insure that prior water rights on the Provo River are protected and factored into project plans. ✤ ✤

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 Utah Lake 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(gpm)	Gallons Per Minute
MCL	Maximum Contaminant Level
MGD(mgd)	Million Gallons Per Day
MG/L(mg/l	Milligrams Per Liter
MW(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 - Net loss of water through consumption, export and other uses to a given area, river system or basin. The terms consumptive use and depletion, often used interchangeably, are not the same.

Diversion/Withdrawal - Water diverted 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. The volume of water used by industrial businesses, however, 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, playgrounds, 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 residential, commercial, institutional and industrial uses.

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 and Industrial (M&I) Water Supply - A supply that provides culinary/secondary water for residential, commercial, institutional and industrial uses.

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/Non-Potable 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.

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 which refers to water held by capillary action in the upper unsaturated zones of soil or rock.

Mining - Long-term groundwater withdrawal in excess of recharge.

Phreatophyte - A plant species which extends its roots to the saturated zone under shallow water table conditions and transpires groundwater. 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.

Recoverable Reserves - The amount of water which could be reasonably recovered from the groundwater reservoir with existing technology.

Safe Yield - 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.

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 as a potable/culinary supply.

Export Water - A water diverted from a river system or basin other than by the natural outflow of streams, rivers and groundwater. The means by which it is exported is sometimes called a transbasin diversion.

Instream Flow - Water flow maintained in a stream for the preservation and propagation of wildlife or aquatic 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.

Point Source Pollution - Pollutants discharged from any identifiable point, including pipes, ditches, channels and containers.

Potable/Culinary - Water suitable for drinking or cooking purposes. The terms culinary and potable are often used interchangeably.

Reuse - The reclamation of water diverted from a municipal or industrial wastewater conveyance system.

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.

Water Yield - The runoff from precipitation that reaches water courses and therefore may be available for human use.

Wetlands - Areas where vegetation is associated with open water and wet and/or high water table conditions.

Wet/Open Water Areas - Includes lakes, ponds, reservoirs, streams, mud flats and other wet areas.

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