Weber River Basin
Planning for the Future

UTAH STATE WATER PLAN

September 2009

WEBER RIVER BASIN
PLANNING FOR THE FUTURE

September 2009

By:

Utah Division of Water Resources

With input from the State Water Plan Coordinating Committee
(see inside-back cover for participating agencies)

U T A H S T A T E W A T E R P L A N

This document and other state water plans are available online at: www.water.utah.gov

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PREFACE

One of the major responsibilities of the Utah Division of Water Resources is comprehensive water planning. Over the past two decades, the division has prepared a series of documents under the title "Utah State Water Plan." This includes two statewide water plans and an individual water plan for each of the state's eleven major hydrologic river basins. Preparing these plans involves several major data collection programs as well as extensive inter-agency and public outreach efforts. Much is learned through this process; state, local, and federal water planners and managers obtain valuable information for use in their programs and activities, and the public receives the opportunity to provide meaningful input in improving the state's water resources stewardship.

This document is the latest in the "Utah State Water Plan" series and is intended to guide and direct water-related planning and management in the Weber River Basin over the next several years. It summarizes key data obtained through the previous water planning documents, introduces new data where available, and addresses issues of importance to all future water planning efforts. It identifies water use trends and makes projections of water use. The document also explores various means of meeting future water demands and identifies important issues that need to be considered when making water-related decisions. It is hoped that water managers and planners within the basin will find the data, insights and direction provided by this document valuable in their efforts. The general public will discover many useful facts and information helpful in understanding the basin's water resources. Both audiences should appreciate the real-life, Weber River Basin examples highlighted in the text, sidebars and photographs. Although the use of technical words is avoided wherever possible, an extensive glossary illuminates exact usage of terminology that may be unfamiliar.

In addition to the printed form of this document, the Utah Division of Water Resources has made a "pdf" version available on the Internet. This can be accessed through the division's home page at: www.water.utah.gov. This web page allows this document and other water planning documents to be viewed by the largest audience possible, thus facilitating better planning and management at the state and local level. It also provides a convenient mode for readers to provide comment and feedback to the division regarding its water planning efforts.

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EXECUTIVE SUMMARY

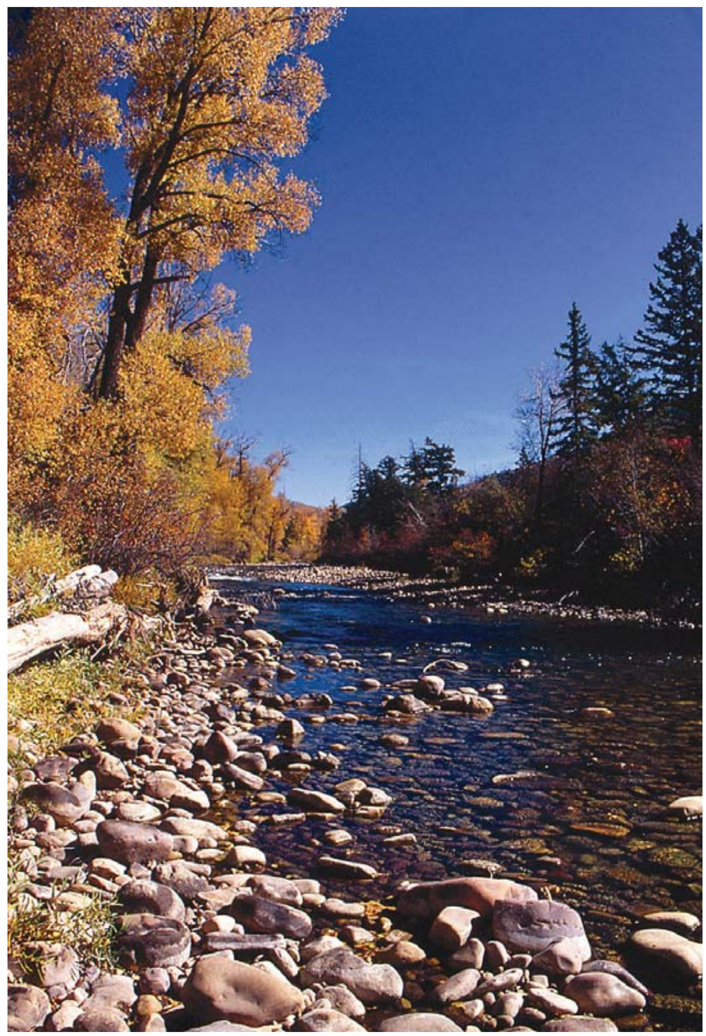
The water resources of the Weber River Basin play an integral role in the life of every basin resident. From a morning shower to a weekend trip on Pineview Reservoir, water is interwoven into nearly every activity. Use of the basin's water resources has allowed the land to be settled, has provided the basin's citizens with numerous employment and recreational opportunities, and has made possible a high quality of life. The far-reaching vision of the basin's leaders, coupled with modern engineering technology, has allowed the basin's water supply to be harnessed and used on a large scale. Water has been made so readily available, in fact, that its scarcity is often overlooked. This reality must be fully recognized and appropriate decisions made in order to provide sufficient water for the basin's future population.

Weber River Basin—Planning for the Future emphasizes the importance of careful planning and wise management in meeting future needs. It estimates the basin's available water supply, makes projections of water need, explores how needs will most likely be met, and discusses the importance of water quality and other environmental values. This document will be a useful guide and reference to local water planners and managers as they work diligently to meet the basin's many water needs. It will also be of help to those in the general public who are interested in making greater contributions to water-related decisions being made by local, state and federal government officials. The following paragraphs summarize the main points of each chapter:

CHAPTER 1
INTRODUCTION:
WATERS OF THE WEBER RIVER BASIN

The Weber River Basin's diverse and beautiful landscapes and its rich cultural history owe their existence, in large part, to the presence of water resources. Water is the medium that helped shape many of the basin's unique natural features and is the ingredient that allowed its communities to literally blossom in the semi-arid climate. The basin's natural beauty and its close proximity to Utah's main population and commerce core in the Salt Lake Valley have contributed to the basin's rapid growth in the past and will continue to do so in the future.

In order to meet future water needs, water planners and managers within the Weber River Basin must promote effective water conservation programs and measures. They must also put in place a process to ensure that agricultural water is converted to municipal and industrial use in order to meet both indoor and outdoor urban water needs, and implement innovative water management strategies. This, along with carefully planned water developments, will secure sufficient water for the future.



The waters of the Weber River play a central role in the basin's natural beauty and cultural history. (Photo of Weber River near Oakley.)

CHAPTER 2
WATER SUPPLY

On average, the Weber River Basin receives 26 inches of precipitation each year; this is more than any other major river basin in Utah and double the statewide average of 13 inches. This is in large part due to the fact that more than 80 percent of the basin's land area is located at an elevation of 5,000 feet or higher and the winter "lake effect" caused by the Great Salt Lake.

The basin's 26 inches of average annual precipitation translates into an average total water volume of 3,453,000 acre-feet. Approximately 66 percent of this amount, or 2,277,000 acre-feet, is consumed by vegetation and natural systems. This leaves an average annual amount of about 1,176,000 acre-feet that is yielded to the basin's rivers, streams and ground water aquifers. Of this amount, as much as 37,000 acre-feet per year is exported from the basin through the Weber-Provo and Ogden-Brigham canals, leaving an average of 1,139,000 acre-feet per year of available supply.

CHAPTER 3
POPULATION AND WATER USE TRENDS AND PROJECTIONS

According to the 2000 U.S. Census, the total population within the Weber River Basin was 472,000. The Governor's Office of Planning and Budget projects the basin's population to more than double to about 1,159,000 by 2060. This growth will place increased demands on municipal and industrial (M&I) water supplies. In 2005, total M&I water use was estimated to be approximately 206,000 acre-feet. By 2060, this demand is projected to increase to about 321,000 acre-feet (this estimate is based on a reduction in per capita use rates of 25 percent and future population from the Governor's Office of Planning and Budget).

While M&I water demands will increase, agricultural water demands will decline as urban growth consumes irrigated farms throughout the basin. In 2007, agricultural water diversions were estimated to be about 309,000 acre-feet. By 2060, these are projected to decrease to about 161,000 acre-feet as agricultural land is converted to urban uses. It is expected that much of the water currently used on this land will be transferred to meet M&I demands.

In addition to the changes in M&I and agricultural water demands, environmental and recreational uses of the basin's water will continue to play important roles in the future. Pressure to use water to sustain important environmental values and recreational purposes will increase.

CHAPTER 4
MUNICIPAL AND INDUSTRIAL WATER CONSERVATION: REDUCING FUTURE DEMANDS

Water conservation will play an important role in satisfying future water needs in the Weber River Basin by reducing future municipal and industrial water demands. Achieving the state's goal to reduce per capita water demand by at least 25 percent before 2050 translates into a future demand in the Weber River Basin of approximately 102,000 acre-feet per year less in 2060 than it would be without conservation.

Water providers within the basin can do several things to help ensure water conservation goals are achieved. These are listed below and discussed in depth in Chapter 4:

- Prepare water conservation plans
- Support the public information program of the Governor's Water Conservation Team
- Implement best management practices
- Set example at publicly owned facilities

The Division of Water Resources is monitoring progress toward achieving the state's water conservation goal and to date has measured approximately 5 percent reduction in per capita water use since 2001 in the Weber River Basin. This is less than the statewide reduction of 12 percent and could be partially the result of the rapid growth of unmetered secondary irrigation systems in the basin. Subsequently, Weber Basin Water Conservancy District has initiated a program to meter all new secondary systems that receive water from the district and to gradually install meters on existing secondary system connections within their retail system.

CHAPTER 5
WATER TRANSFERS AND EFFICIENT MANAGEMENT OF EXISTING SUPPLIES

Using existing developed water supplies as efficiently as possible is an important element in successfully addressing the future water needs of the Weber River Basin. The conversion of agricultural water to satisfy municipal and industrial uses has and will continue to meet a large portion of the basin's future water needs as irrigated farmland becomes urban. Other innovative water management strategies that will help meet future needs include:

- Conjunctive use of surface and ground water
- Efficient secondary water systems
- Cooperative agreements
- Water reuse

The Weber River Basin is a leader in Utah and the nation when it comes to irrigating urban landscapes through secondary water systems. Out of the basin's 83 public community water systems, 63 (or 76 percent) have secondary water available to at least some of their customers. The division estimates that 72 percent of the total municipal and industrial outdoor water demand in the basin is satisfied by secondary water systems. While secondary systems within the basin have allowed treated water to be preserved for potable (drinking water) purposes, they have led to a higher than average water use by the basin's residents. The division and Weber Basin Water Conservancy District are studying ways to conserve secondary water through the use of meters and climate-based sprinkler controllers.

CHAPTER 6
WATER DEVELOPMENT: MEETING SUPPLY AND INFRASTRUCTURE NEEDS

The importance of water development to the inhabitants of the Weber River Basin is evident from the pioneers' initial efforts to cultivate the land to the prosperity made possible by the large water projects of the 20th Century. In order to secure sufficient water for the future, additional water developments will eventually be necessary within the basin.

Several water development projects have been proposed within the basin to fully utilize existing water storage. Some of these projects are discussed in the document and include the Kanesville Secondary Irrigation Project and two projects for the Snyderville Basin and Park City area. Another project that has been investigated that would develop additional water for the Weber River Basin and other Wasatch Front areas includes the Bear River Project. The timing and size of this development will depend on the ability of water conservation and other water-management strategies to reduce water demand.

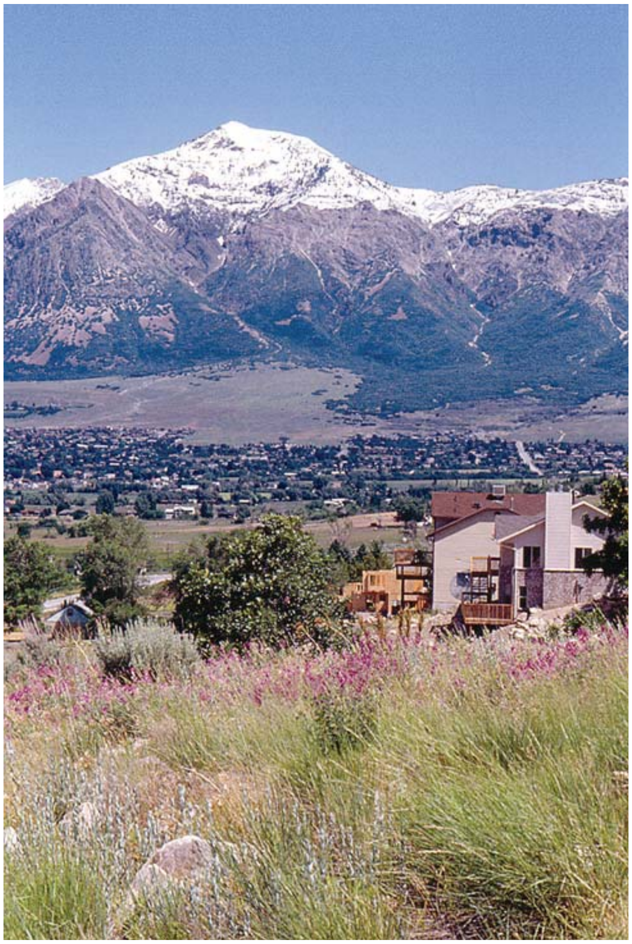
CHAPTER 7
WATER QUALITY AND THE ENVIRONMENT: CRITICAL COMPONENETS OF WATER MANAGEMENT

If water planners and managers in the Weber River Basin are to effectively meet future water needs, they will need to do more than simply provide adequate water supplies and delivery systems. The water supply decisions they make can greatly impact water quality, the environment and recreation. For the most part, water planners and managers are aware of these impacts and are working to develop plans and strategies that will protect these important values; however, there is still much that can be done.

This chapter discusses in detail the importance of water quality and the environment to the management of the Weber River Basin's water resources. It also elaborates on some of the things being done to safeguard these important values. Some of the important water quality and environmental topics discussed include:

- Total Maximum Daily Load Program
- Preservation and restoration of riparian and flood plain corridors
- Storm water discharge permitting
- Septic tank densities
- Threatended, endangered and sensitive species
- Wetlands and the Great Salt Lake ecosystem
- Instream flow maintenance

Water planners and managers, local leaders, and interested individuals within the Weber River Basin all play important roles in the management of water quality and environmental concerns within the basin. By working closely together, they can meet these future challenges. Following the spirit of the pioneers who first settled the basin, these leaders can help ensure a promising future for subsequent generations.



Wise management of water resources is necessary to ensure a bright future for the Weber River Basin. (Photo of Ben Lomond Peak above North Ogden.)

CHAPTER 8
CONCLUSIONS: MAKING IT HAPPEN

The Weber River Basin is at a critical juncture. The basin lies on the north end of the fast-growing Wasatch Front where much of the state's prime agricultural land is rapidly becoming urban. The basin is also located just south of the Bear River, which is a potential source of developable water for the Wasatch Front. As a result, water managers and planners within the basin will play an important role in meeting Utah's future water needs. The basin is also entering an important phase in the effort to improve and preserve water quality and the environment. With the population expected to increase rapidly in the coming decades, water quality and other environmental issues will challenge decision-makers and basin residents. Stakeholders need to continue to work together to ensure that current problems are resolved in a timely fashion and that future problems are avoided. Sufficient time and resources must be devoted to these efforts in order to sculpt the best and most efficient solutions.

1

INTRODUCTION: WATERS OF THE WEBER RIVER BASIN

The Weber River Basin contains a major portion of the Wasatch Range and receives runoff from these mountains as well as the northwest slopes of the Uinta Mountains (see Figure 1). The basin is Utah's wettest. It receives an average of 26 inches of precipitation annually, which is more than any of Utah's ten other major river basins, and twice that of the statewide average of 13 inches. The water resources of the Weber River Basin are also considered among Utah's most highly developed. The waters of the basin sustain one of the state's productive agricultural areas and a significant portion of the state's total population. The combination of relatively high precipitation and advanced development has placed the Weber River Basin in a good position to meet current and future needs. However, this does not mean that current conditions within the basin are without challenges or that accommodating future growth will come without difficulty.

Several streams and water bodies in the Weber River Basin do not meet Utah's water quality standards and are in danger of further degradation if current trends continue. In addition to these problems, environmental and recreational demands are increasing. This competition will continue and will require increased emphasis on wise management and efficient use of the basin's water resources.

Keys to assuring a productive future for the water resources of the Weber River Basin include the following:

- Strong cooperation between all water resources stakeholders;
- Concerted effort to implement water conservation measures and practices;
- Judicious transfers of agricultural water to meet municipal and industrial water supply needs as irrigated farm land becomes urban;
- Careful and thoughtful application of innovative water management strategies such as aquifer storage and recovery, water reuse, and cooperative agreements;
- Continued investment in new infrastructure and water developments, as well as maintenance of existing facilities;
- Continued investment in water quality programs; and
- Careful consideration of environmental, recreational and other needs.

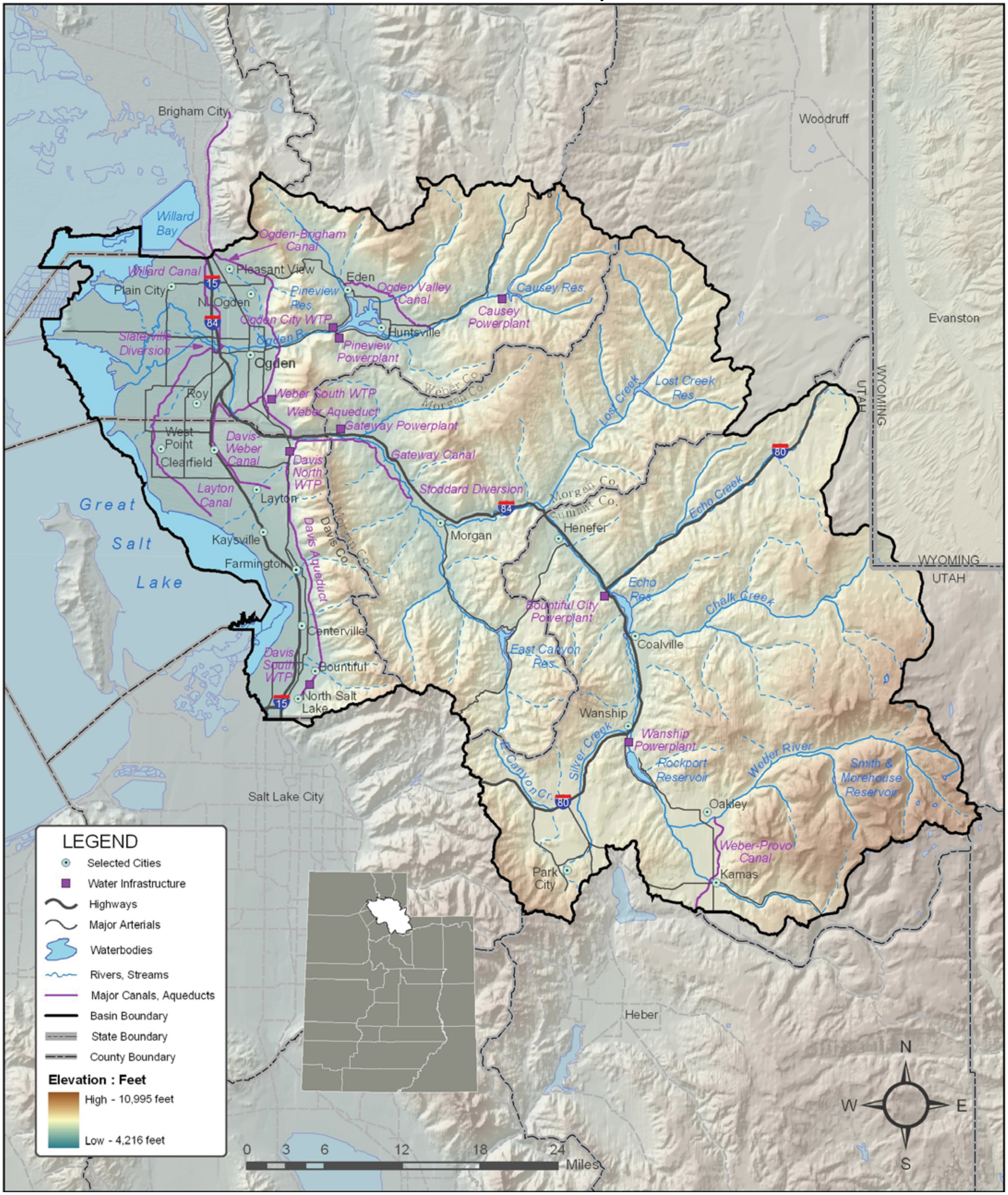
PURPOSE OF THIS DOCUMENT

The purpose of this document is to describe the current status of the water resources in the Weber River Basin and estimate the future demands that will be placed upon them. This involves quantifying the available water supply, measuring current uses, estimating future uses, and identifying ways to manage existing supplies and obtain new ones to satisfy future needs. A main goal of this document is to help water managers, planners and others formulate strategies and policies that will ensure a bright future. In addition to presenting basic water data, this document should also be a valuable resource for those who live in the Weber Basin or who are otherwise interested in contributing to water-related decisions.

THE SIGNIFICANCE OF WATER RESOURCES

Water is a central feature of the Weber River Basin's landscapes. Originating high in the Wasatch and

FIGURE 1
Weber River Basin Map



Uinta mountains from snowfields and lakes, the Weber River, Ogden River and other tributaries have carved out many beautiful canyons, depositing rich soil in numerous mountain valleys. The Weber and Ogden rivers eventually make their way through the Wasatch Range to the lowlands of the Great Basin and its terminus: the Great Salt Lake—North America's largest inland sea. Native inhabitants of the Weber River Basin depended upon water resources and associated habitat and wildlife to sustain their way of life. They often spent the summers in the upper valleys where wildlife was abundant and returned to the low-lying areas for winter. Later, with the arrival of the early pioneers, the waters of the basin were increasingly utilized.

In 1869 the railroad made its way though the heart of the basin, bringing with it increased commerce and population. As a result, Ogden—a main hub of the railroad—grew and expanded its role as one of Utah's major cities. Located at the foot of the Wasatch Mountains, near the spot where the Ogden and Weber Rivers meet, Ogden is currently the seventh largest city in Utah and near the northern extreme of the Wasatch Front—Utah's most densely populated region.

The close proximity of the Weber River Basin to the main population and commerce core of the Salt Lake Valley and diverse outdoor activities have contributed to the basin's rapid growth. For these and other reasons, the basin is expected to experience substantial population growth in the future. Wise use of water resources of the basin will play a key role in facilitating growth.

History of Water Planning and Development

The Pioneer Period (1847-1880)

The first irrigation by settlers in Utah occurred in 1845 at Fort Buenaventura, near present-day Ogden. Miles Goodyear—a trapper by trade—built the fort as an emigrant waystation. Settlers at the fort carried water from the nearby Weber River in buckets to water a small garden.[1] However, it was not until after the Mormon pioneers purchased the fort from Mr. Goodyear in 1847 that significant irrigation in the basin began.

Early Mormon settlement occurred near the mouths of streams flowing from the Wasatch Range toward the Great Salt Lake. By the early 1850s, small communities sprang up next to nearly every stream with sufficient flow to sustain irrigation. Later, as the pioneers became more familiar with the practice of irrigation (through trial-and-error), communities combined their resources to dig canals and ditches to water distant plots of land. During the mid-1850s, settlement and diversion of upper basin streams and tributaries began in earnest.

Following the ambitious vision of Brigham Young to engage cooperatively in water development projects,[2] early settlers developed a model of irrigation that changed the face of the West. Irrigation became such an integral part of the communities within the entire basin that by 1860 the flow in many streams was insufficient to meet demands. Disputes over who had the right to use the available water were

Fort Buenaventura, built by the trapper Miles Goodyear in 1845, was the first non-Indian settlement in Utah. The Mormon pioneers purchased the fort from Mr. Goodyear in 1847.

common as the fields of downstream settlements dried-up and crops failed.

The pioneers recognized early that there was water available to sustain all their crops; however, since most of the water ran down the canyons and past irrigated fields in the spring, many crops failed. In 1852, Elias Adams and his sons countered this problem for their farm by building a reservoir on Holmes Creek, near present-day Layton. Although only four feet high and 70 feet long, it is believed that this structure was the first irrigation storage reservoir constructed in western America. The community recognized Adams' wisdom and by 1863 gathered their resources together to raise the dam to 15 feet.[3]

Nearly every community within the basin shares a similar story to that of Elias Adams and his neighbors. Brought together by common beliefs and the need to make a living from the arid soil, settlers worked together and contributed whatever they could for the welfare of the entire community. More often than not, shares of irrigation water were allotted to individuals according to the amount of labor and materials they provided to a project.

An Era of Secularization (1880-1935)

Although the communal model of water development that the Mormon pioneers used worked well for many decades, the growing size and diversity of Utah's population created a movement away from this model to a more secular method. In 1880, the territorial government passed a new water law declaring that "it was no longer the duty of the territory to enforce a beneficial and economical use of the public waters but merely to supply a means of adjudicating the difficulties which may arise."[4] The law also removed the understanding that water rights had to remain with the land and allowed their owners to use and dispose of them as personal property.

The 1880 law initially led to a few water projects and transactions of a speculative nature that ended in failure. This included the Bear River Canal project that would have brought water from the Bear River as far south as Ogden. Originally surveyed in 1868, this project did not begin construction until it got a boost from investors in 1883. Although portions of the project were built, the project never completely materialized and only delivered water as far south as the Hammond Canal (south of Deweyville). As part of this project, the Bear River Irrigation and Ogden Water Works Company purchased the Ogden City Water Works with the intention of selling water rights. Although this speculation never progressed to a point where it harmed the citizens of Ogden, it was not until 1910 that a newly elected city government bonded for $100,000 to repurchase the water works, and restore public control.[5]

From 1897-1919, the Utah Legislature passed several laws that restored public control of the state's water. Highly influenced by the experiences of other western states and the federal National Reclamation Act of 1902, Utah's new water laws paved the way for the adjudication of water rights claims, a pre-requisite to the construction of large water development projects through the federal reclamation program.

While the Bureau of Reclamation's Weber Basin Project had to wait until after the adjudication of the Weber River was completed in 1937, several other locally led projects became a reality during this era. These included the Weber and Davis Canal, East Canyon Dam, Pioneer Electric Power Plant, Bonneville Canal, Echo Dam, and Pineview Dam. The completion of the Weber and Davis Canal, and the storage of water to keep it full (in East Canyon Reservoir), marked the partial fulfillment of the proposal Brigham Young made in 1856 to build a canal that would bring water from the Weber River all the way south to Bountiful.[6]

The Modern Age (1936-Present)

Prior to and during World War II, the Weber River Basin experienced rapid growth. Much of this growth occurred as the result of large investments in military infrastructure.[7] In 1936, the U.S. Army activated its arsenal at Sunset; in 1939, construction at Hill Air Field began; and in 1940, the Army established a supply depot near Ogden. Although water for these installations and the population they brought was easily obtained, this growth prompted local leaders to become more concerned about water development.

During the mid-1940s, local leaders began a concerted grassroots effort to promote water development. Strong support for such development came from the agricultural community. Weber and Davis counties had long been one of the state's most productive agricultural regions, and farmers there were enticed by the prospect of bringing more land under production as well as increasing the productivity of existing land. This effort, along with the earlier completion of the Weber River adjudication in 1937, prompted the U.S. Bureau of Reclamation to begin substantial investigations.

In 1951, the Bureau of Reclamation, with strong local backing, proposed an ambitious water development project—the Weber Basin Project. The project would capture much of the remaining surface water supply of the Weber River, mainly excess runoff, allowing the river to be more fully utilized. In order for this project to proceed, the Weber Basin Water Conservancy District was created to pay back the federal obligations and operate and maintain project facilities. Completed in the late 1960s, the Weber Basin Project was the last major water development project within the basin. The water supply provided by this project has allowed growth within the basin to continue to the present day and is near full utilization.

State Water Planning: Fulfilling a Stewardship

One of the main responsibilities of the Division of Water Resources is to conduct comprehensive water planning in Utah. Over the past several decades, the division has conducted numerous studies and prepared many reports for the Weber River Basin. A landmark document resulting from these studies was the *Weber River Basin Plan*, published in 1997.

1997 Weber River Basin Plan

Although this document, *Weber River Basin—Planning for the Future*, touches upon many of the same topics presented in the 1997 *Weber River Basin Plan*, there is a valuable collection of pertinent data and useful information contained in the original plan that will not be revisited here. Some of the topics that will not be repeated, but may be valuable to the reader, are listed below:

- *Section 3.3 – Basin Description:* A detailed description of the basin's drainage area, topography, climate, physiography and geology.
- *Section 7 – Regulation/Institutional Considerations:* A discussion of water-related laws and regulations and the responsibilities of various state and federal agencies with regard to carrying-out these laws.
- *Section 8 – Water Funding Programs*: A description of significant state and federal water funding programs.
- *Section 11.3 – Organizations and Regulations:* A discussion of local, state and federal agencies as well as the various laws that regulate drinking water.
- *Section 13 – Disaster and Emergency Response:* A description of the various types of disasters and emergencies that could disrupt the supply of water and the organizations and regulations that deal with them.
- *Section 16 – Federal Water Planning and Development:* A list of all the federal agencies involved directly or indirectly with water planning and development within the basin and description of their respective responsibilities.
- *Section 19.2 – Subsurface Geology and Aquifer Characteristics:* A geologic description of the major ground water areas within the basin.

A copy of the entire 1997 *Weber River Basin Plan* can be obtained by contacting the Division of Water

Causey Reservoir, a major feature of the Weber River Basin Project, was built by the U.S. Bureau of Reclamation in 1966.

Resources, or online at the division's web site: **www.water.utah.gov**.

The 2001 Utah State Water Plan

In May of 2001, the Division of Water Resources updated the Utah State Water Plan with the publication of *Utah's Water Resources—Planning for the Future*. This plan addressed a host of issues important to Utah's future (see sidebar). While the Utah State Water Plan is a valuable guide to water planners, managers and others interested in contributing to water-related decisions throughout the state, it does not address in detail the specific needs of the state's various river basins.

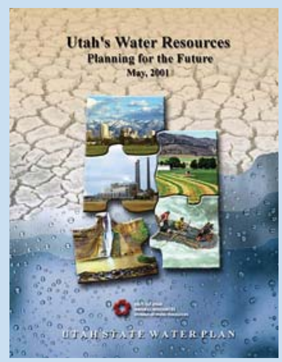
The Current Plan

This document, *Weber River Basin—Planning for the Future*, is modeled after the 2001 State Water Plan and provides the reader with more detail and perspective concerning issues of importance to the Weber River Basin. It takes a fresh new look at the water resources of the Weber River Basin. With increasing water demands caused by rapid population growth, water is becoming a more precious resource. The waters of the Weber River Basin will play an important role in meeting some of Utah's future needs, and protecting the quality of this water and its ability to sustain the increased population is of utmost concern. The Division of Water Resources hopes that this plan establishes a strong framework that will help guide and influence water-related decisions within the basin.

2001 Utah State Water Plan: Utah's Water Resources—Planning for the Future

Managing water resources in Utah is not an easy task. Supply is limited and competition between various uses continues to intensify. Add to that the cyclical nature of wet vs. dry periods, and one gets an inkling of the complex challenges facing Utah's water planners and managers.

Utah's Water Resources—Planning for the Future attempts to bring all the issues to light and to put the many pieces together that are required to obtain balanced and efficient water management. It discusses the major issues facing Utah's water resources and provides valuable data and guidance that will help in the important effort to efficiently manage one of the state's most precious resources.



NOTES

[1] Sadler, Richard W. and Richard C. Roberts, *The Weber River Basin: Grass Roots Democracy and Water Development* (Logan, Utah: Utah State University Press, 1994), 27. This 283-page book presents a comprehensive history of water development in the Weber River Basin.

[2] Pratt, Orson, ed., *Journal of Discourses*, vol. 3 (Liverpool: Orson Pratt, 1856), 339-40. Following an inspection of a canal being built in the Salt Lake Valley, Brigham Young made the following statements at the Bowery in Salt Lake City on June 8, 1856 (portions in bold type concern the Weber River):

> Shall we stop making canals, when the one now in progress is finished? No, for as soon as that is completed from Big Cottonwood to this city, we expect to make a canal on the west side of Jordan, and take its water along the east base of the west mountains, as there is more farming land on the west side of that river than on the east. When that work is accomplished we shall continue our exertions, until Provo River runs

> to this city. We intend to bring it around the point of the mountain to Little Cottonwood, from that to Big Cottonwood, and lead its waters upon all the land from Provo Canyon to this city, for there is more water runs in that stream alone than would be needed for that purpose.
>
> If we had time we should build several reservoirs to save the waters of City Creek, each one to contain enough for once irrigating one-third of the city. If we had such reservoirs the whole of this city might be irrigated with water that now runs to waste. Even then we do not intend to cease our improvements, for **we expect that part of the Weber will be brought to the Hot Springs [near Bountiful], there to meet the waters from the south and empty into Jordan.** Then we contemplate that Bear River will be taken out at the gates to irrigate a rich and extensive region on its left bank, and also upon the other side to meet the waters of the Malad. We know not the end of our public labors and enterprises in this Territory, and we design performing them as fast as we can.

[3] Sadler, 64. Elias Adams' history-making dam eventually reached a final height of 70 feet in 1930.

[4] Thomas, George, *The Development of Institutions under Irrigation with Special Reference to Early Utah Conditions* (New York: Macmillan Co., 1920), 138-139.

[5] Sadler, 107-109.

[6] See Note 2.

[7] Sadler, 139.

2

WATER SUPPLY

The Weber River Basin receives an average of 26 inches of precipitation annually. This precipitation is distributed as shown in Figure 2 and ranges from a low of about 13 inches near Ogden Bay to a high of over 60 inches on Ben Lomond Peak. The average amount of precipitation that the Weber River Basin receives is more than any of Utah's other major river basins. The Weber River Basin experiences higher than normal precipitation mainly because 80 plus percent of its land area is composed of mountain ranges and mountain valleys that are at an elevation of 5,000 feet or more. The basin is also fortunate in that its land area receives a substantial amount of precipitation due to the lake effect caused by the Great Salt Lake. As a result, the Weber River Basin has the second highest ratio of water yield to land area (0.75) of any basin within the state (see Table 1).

CLIMATE

The climate of the Weber River Basin is typical of the semiarid central and northern mountainous regions of Utah. Table 2 contains climate data from many of the National Weather Service stations within the basin. At these stations, average annual temperatures range from a low of 43.1° F at Park City to a high of

FIGURE 2
Average Annual Precipitation

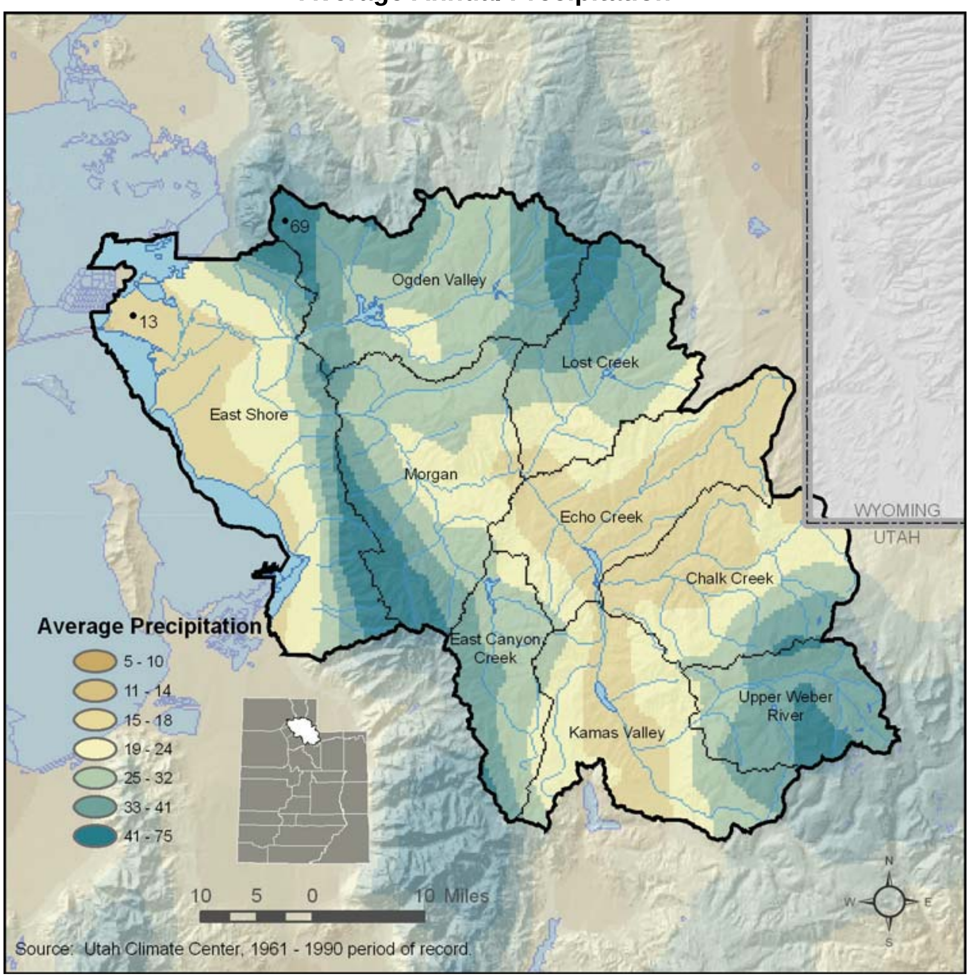


TABLE 1
Ratio of Water Yield to Land Area for Major Basins in Utah

Basin	Average Water Yield (acre-feet/yr.)	Land Area* (acres)	Ratio (acre-feet/acre)
Bear River	1,822,000	2,149,000	0.85
Weber River	1,176,000	1,561,000	0.75
Jordan River	296,000	497,000	0.60
Utah Lake	857,000	1,945,000	0.44
Uintah	1,472,000	6,970,000	0.21
Sevier River	823,000	6,768,000	0.12
Kanab Creek/Virgin River	235,000	2,237,000	0.11
West Colorado River	585,000	9,863,000	0.06
Cedar/Beaver	179,000	3,616,000	0.05
West Desert	400,000	11,737,000	0.03
Southeast Colorado River	131,000	6,961,000	0.02
STATEWIDE TOTAL	**7,891,000**	**54,304,000**	**0.14**

* These figures do not include basin land area that is not in Utah.

52.1° F at Ogden Pioneer Powerhouse, a variance of about 17 percent. The record high and low temperatures are 108° F (July-Ogden Sugar Factory) and -40° F (December-Coalville), respectively. Average annual precipitation at these stations varies more than 50 percent from a low of 13.1 inches at Bear River Bay near Plain City to a high of 32.4 inches at Pine View Dam.

Figure 3 contains a temperature chart and a precipitation/evapotranspiration chart for four of the weather stations listed in Table 2. As shown in the temperature charts on the top, the peak monthly and normal maximum temperatures observed at the Ogden Pioneer Powerhouse weather station are about 10 degrees greater than those at Park City. In the precipitation and evapotranspiration charts on the bottom, evapotranspiration (red line) exceeds normal precipitation (dark blue column) during all but the winter months. This is why the basin's climate is considered semiarid and articulates clearly why it is necessary to irrigate crops and landscapes in the basin. Even more interesting is the fact that evapotranspiration even exceeds the record precipitation at every station during the summer months of June, July and August. Thus, even during the wettest of summer months, it is still necessary to irrigate crops and landscapes.

Precipitation

Most of the precipitation that occurs in the Weber River Basin falls on the mountains and mountain valleys as snow (see Figure 2 shown previously). This snow is extremely important to the water supply of the basin because it functions as a storage reservoir, releasing the water into streams and aquifers as temperatures rise. Depending on surface conditions of the soil and the rate of melting, the precipitation that is not evaporated or used by vegetation flows directly into streams or seeps into the soil. While much of the precipitation makes its way to surface waterways, some percolates into the soil and becomes part of the basin's ground water. Topography, soil characteristics, geologic configurations and other factors affect the path and movement of ground water. At some lower elevation, it may come to the surface as a natural spring or seep, discharge into a lake or river, or become part of the ground water storage in the valleys.

Although precipitation varies significantly from one point within the basin to another, it averages about 26 inches or 3.45 million acre-feet[1] per year. Table 3 lists the average annual precipitation values for

TABLE 2
National Weather Service Stations Climatological Data (1971-2000)*

Station	Temperature (Normal Jan., July and Ann.)							Precipitation		ET†	Avg. Frost Free Days
	January		July			Record					
	Max (ºF)	Min (ºF)	Max (ºF)	Min (ºF)	Ann.	Max (ºF)	Min (ºF)	Snow (in.)	Ann. (in.)	Ann. (in.)	
Davis County											
Bountiful-Val Verda*	36.9	22.3	88.1	63.5	51.6	104	-30	62.5	23.5	42.0	189
Farmington 3 NW	38.2	20.5	91.9	60.0	51.9	105	-14	54.1	22.3	46.2	163
Weber County											
Bear River Bay*	32.3	18.7	88.9	66.4	51.3	105	-9	10.4	13.1	39.1	192
Ogden Pioneer Powerhouse‡	36.8	21.0	90.5	62.9	52.1	106	-23	41.7	23.8	44.0	164
Ogden Sugar Factory	36.1	18.2	91.9	59.6	51.2	108	-26	25.6	17.8	46.1	161
Pine View Dam‡	30.8	8.0	85.6	49.9	43.6	100	-39	123.4	32.4	42.7	124
Riverdale (inactive, 1914-1991)	36.0	18.1	90.5	59.8	50.3	104	-25	29.0	19.9	45.0	151
Morgan County											
Morgan Power and Light	35.6	12.9	88.9	50.9	46.7	105	-38	73	19.0	46.1	98
Summit County											
Coalville	36.9	12.5	86.4	46.2	45.2	102	-40	76.5	16.8	44.7	75
Echo Dam	34.0	11.4	86.9	49.6	45.1	100	-34	74.5	15.2	45.1	97
Kamas‡	35.6	12.3	84.4	47.5	44.0	101	-31	98.0	16.6	41.6	84
Park City‡	34.7	13.3	83.3	48.3	43.1	99	-19	116.0	19.9	38.9	92
Wanship Dam*	35.9	11.2	86.5	46.4	44.5	101	-37	69.7	16.5	44.9	77

Source: Utah Climate Center webpage (http://climate.usurf.usu.edu/products/data.php) and Utah Climate Center, *Utah Climate, 2nd Edition* (Logan: Utah State University, 2008).
* Period of record is 1971-2000 except for the following stations: Bountiful-Val Verda (1981-2005), Bear River Bay (1969-1992), Wanship Dam (1955-2005).
† Reference Evapotranspiration
‡ See Figure 3 for a visual representation of the data for this weather station.
§ Average of entire period of record, not just 1971-2000.

each of the basin's major watersheds. As shown, the Upper Weber River watershed receives the highest amount of precipitation, about 36 inches per year. Ogden Valley is not far behind, receiving 33 inches. The East Shore watershed, where the majority of the basin's population resides, receives about 23 inches of precipitation per year. Three of the watersheds located in the upper portion of the basin all receive less precipitation than the East Shore watershed—the watershed with the lowest average elevation.

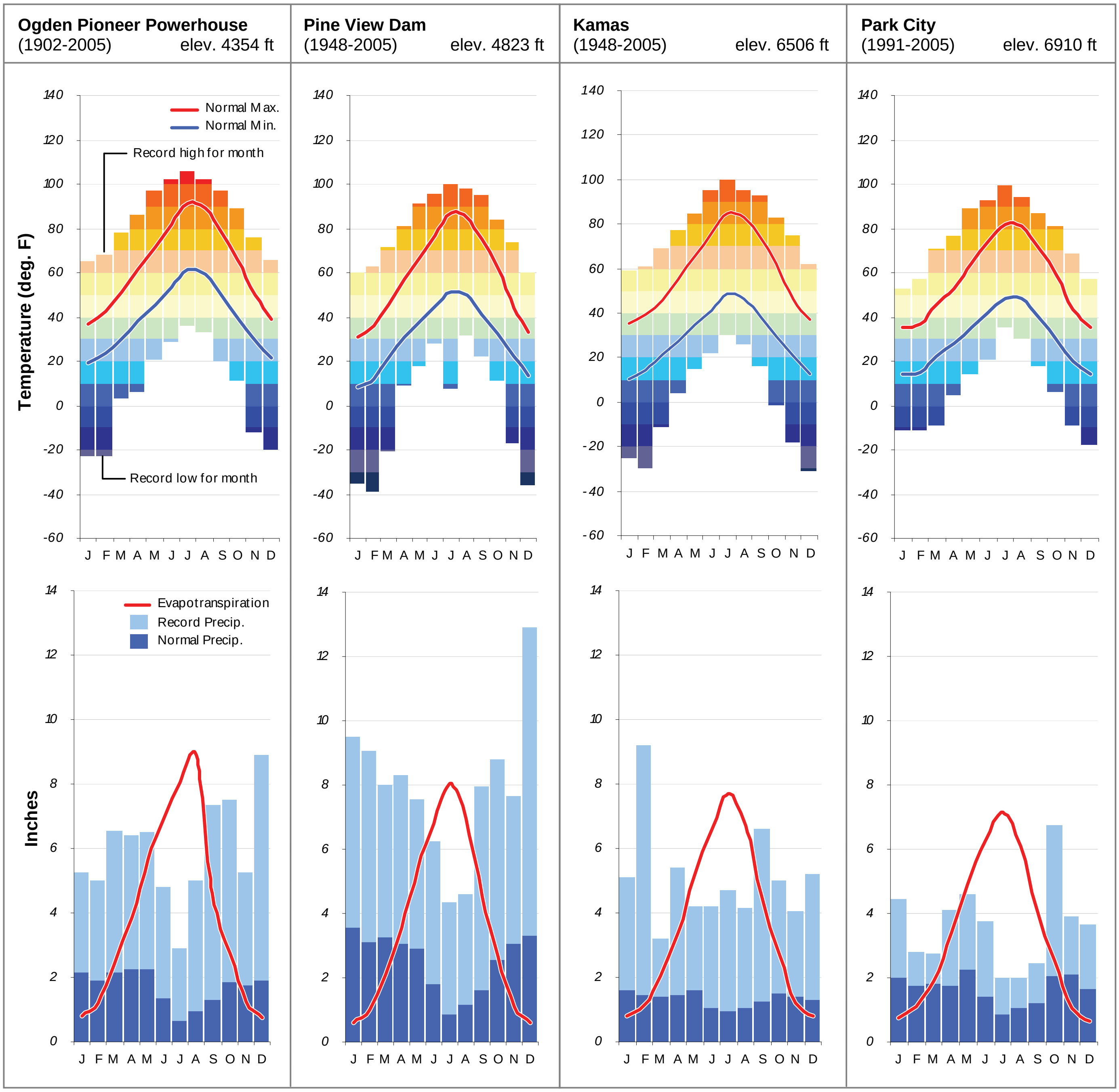
TABLE 3
Average Precipitation by Watershed

Watershed	Average Annual Precipitation (in.)
Upper Weber River	36
Ogden Valley	33
East Canyon Creek	31
Morgan	30
Lost Creek	30
East Shore	23
Kamas Valley	22
Chalk Creek	22
Echo Creek	18
WEBER BASIN AVERAGE	**26**

Evaporation and Transpiration

Precipitation is the process that moves water from the atmosphere to the surface of the earth. Evaporation returns some of this water to the

FIGURE 3
Temperature (left), Precipitation and Evapotranspiration (right) at Four Weather Stations



Source: Utah Climate Data Center webpage: http://climate.usurf.usu.edu/products/data.php.

atmosphere through vaporization directly from the surface of the Earth; transpiration returns water to the atmosphere through skin and plant tissue. These two terms are often combined into one "evapotranspiration" to represent their net effect. Evapotranspiration is highly dependent upon solar radiation, temperature, humidity and wind.

Approximately 68 percent, or 2.36 million acre-feet, of the precipitation falling on the Weber River Basin each year is removed by the natural environment through evapotranspiration before it reaches a stream or aquifer where it can be beneficially used by society. An additional 7 percent, or 230,000 acre-feet per year, is removed by the environment through evaporation from lakes and reservoirs or transpiration from riparian and wetland vegetation after it reaches areas where it can be used. About 20 percent of this, or 47,000 acre-feet per year, evaporates from Willard Bay and other reservoirs or open water bodies in the basin.[2]

AVERAGE ANNUAL WATER SUPPLY

Surface Water

The portion of precipitation not initially evaporated or transpired by vegetation eventually makes its way into streams and other surface water-bodies, or percolates into the ground water. Surface water can be quantified at gauging stations on stream segments. The U.S. Geological Survey, in cooperation with other federal and state entities, monitors an extensive network of gauging stations throughout Utah. Figure 4 shows the average annual stream flow and diversions for the entire Weber River Basin for the 1961-1990 period.

The Ogden River is the most significant tributary to the Weber River. Other major tributaries include East Canyon, Lost, Echo, Chalk, Silver, Beaver and Smith & Morehouse creeks. Although a large portion of the basin's population lives near Ogden, where the Ogden River joins the Weber River, a significant portion of the population lives south of this point along the much smaller streams emanating from the Wasatch Range. This fact, combined with the rapid growth of the Park City area at the headwaters of East Canyon Creek, highlights one of the main challenges facing the Weber River Basin today—delivering the water supply of the basin to those areas where it is in highest demand.

Ground Water

Detailed estimates of developed ground water supply exist for the areas of the state with significant ground water use. These are the East Shore area, Ogden Valley and Park City area. Table 4 lists the estimated withdrawal of ground water in each of these areas. The withdrawal estimates are based on available data for the year shown.

TABLE 4
Estimated Ground Water Withdrawals

Area	Year	Withdrawal (acre-feet/yr.)
East Shore area	2007	52,000
Ogden Valley	2007	11,700
Park City area	1999	4,800
	TOTAL	**60,300**

Sources: U.S. Geological Survey, *Ground-Water Conditions in Utah, Spring of 2005,* (Salt Lake City: Utah Dept. of Natural Resources, 2008), 5, 89. Utah Division of Water Rights, *Snyderville/Park City Basin Ground-Water Usage Report,* obtained online at: www.waterrights.utah.gov/ wrinfo/policy/ground.htm, November 12, 2003.

East Shore Area

The East Shore area is located between the Wasatch Range and Great Salt Lake and is bounded on the north by North Ogden and on the south by North Salt Lake. Ground water occurs in unconsolidated deposits under both water-table and artesian conditions. Most water is withdrawn from the deep, confined portion of the aquifer. Water enters the artesian aquifers along the east edge of the Weber River Delta and all along the Wasatch Fault zone where the aquifers are unconfined.[3]

Figure 5 shows hydrographs of two wells in the East Shore area and the other areas with significant ground water withdrawals in the basin. While water levels have generally declined throughout the East Shore area since the 1950s, a few wells, including the one shown near Woods Cross, have experienced a slight increase in water level. Water levels around Hill Air Force Base in northern Davis County have experienced some of the largest declines in all of Utah.[4] The State Engineer has closed the East Shore area to new ground water appropriations, except for one acre-foot applications and shallow wells less than 30 feet deep.

Ogden Valley

The Ogden Valley is located entirely in Weber County east of the Wasatch Range. Ground water occurs in unconsolidated deposits under both water table and artesian conditions. Water is withdrawn primarily from the artesian aquifers, which generally have recharge zones along the flanks of the valley.[5]

FIGURE 4
Average Annual Stream Flows and Diversions

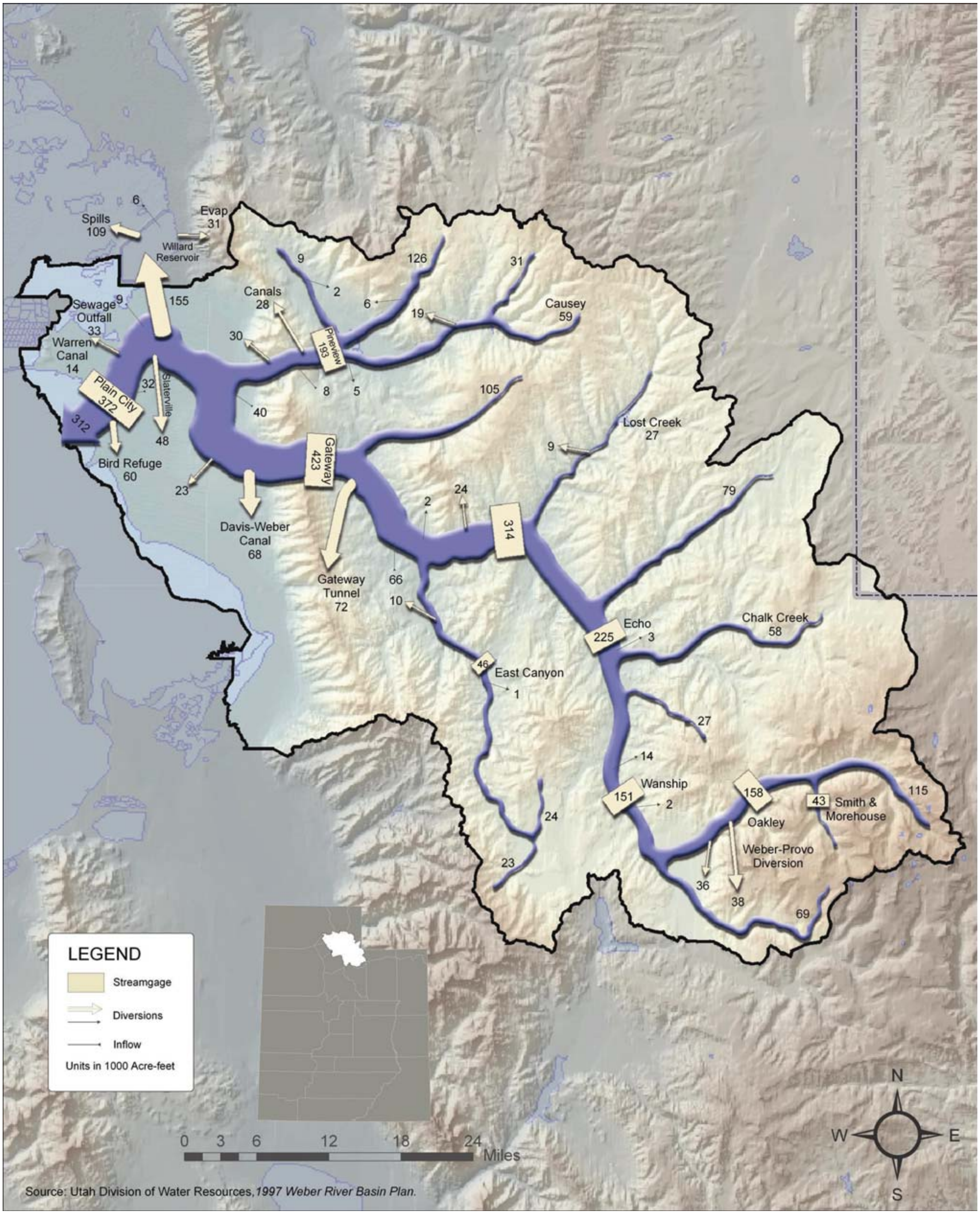
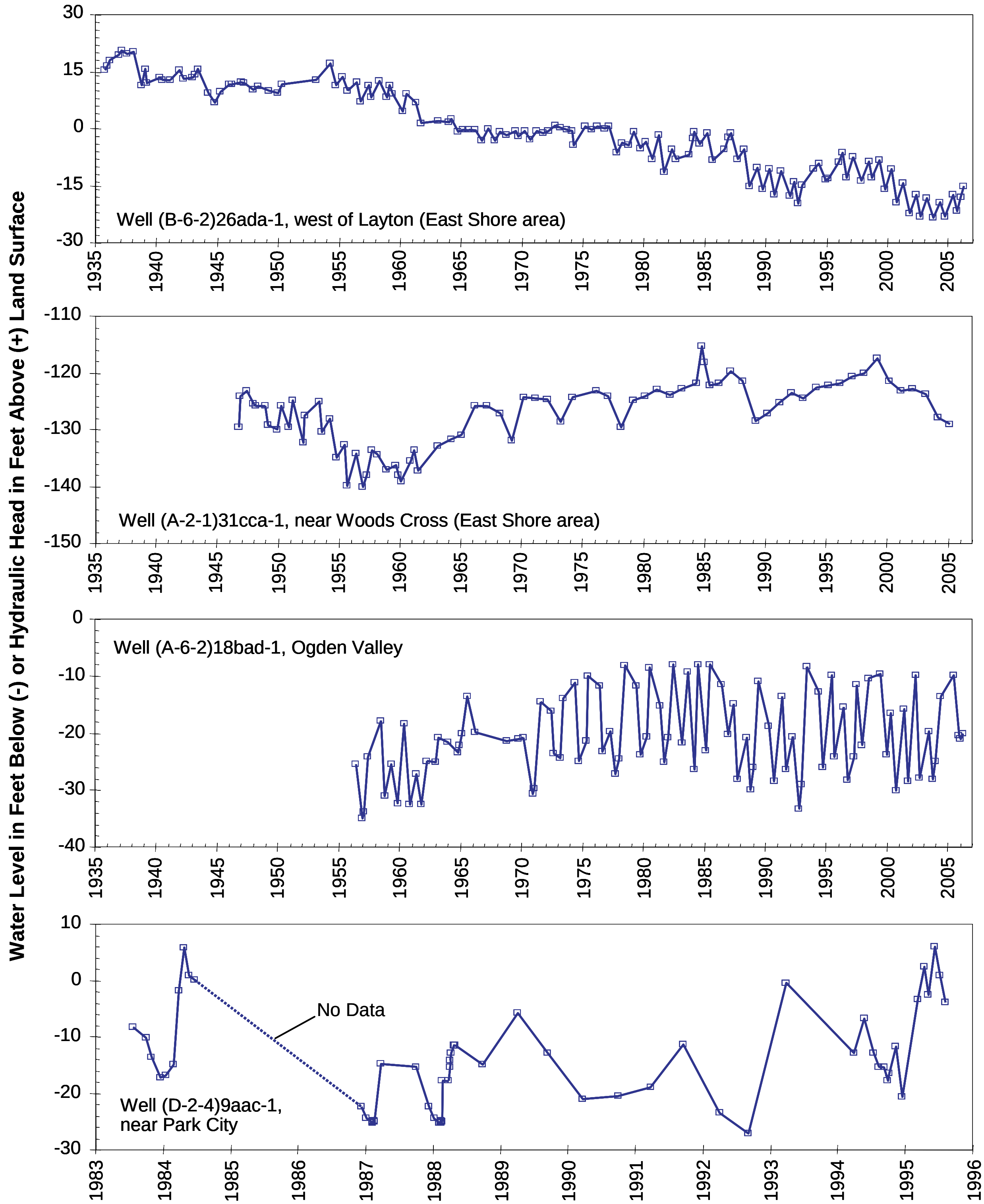


FIGURE 5
Hydrographs for Selected Wells in the East Shore Area, Ogden Valley and Park City



Source: U.S. Geological Survey, National Water Information System web page: nwis.waterdata.usgs.gov, Oct. 2006.

Figure 5 includes the hydrograph at one representative well location within Ogden Valley.

Park City Area[6]

The Park City Area is located in the southwestern corner of Summit County and includes all of the East Canyon Creek drainage within the county and most of the Silver Creek drainage. Ground water within the area is present in consolidated rocks and unconsolidated valley fill. The complex geology makes it difficult to determine the degree to which various water-bearing formations are connected.

Water levels within the area fluctuate seasonally, and generally mirror rates of precipitation, snow melt, etc. Figure 5 includes one hydrograph from a well near Park City. Despite a steady increase in pumping from 1983 to 1995, ground water levels in this well indicate no long-term decline. However, finding productive wells in the area is difficult and water providers have largely abandoned plans to develop additional ground water.

Available Water Supply

The combination of all the climatological data with the streamflow and ground water data presented to this point yields a snapshot of the water supply in the Weber River Basin. This is contained in Table 5, which shows the disposition of the average annual precipitation that falls within the basin (3.453 million acre-feet).

After the initial evaporation and transpiration from vegetation and natural systems (2.277 million acre-feet), approximately 34 percent (1.176 million acre-feet) enters the Weber River, its tributaries and the basin's ground water aquifers annually. This is called the "Basin Yield."

Approximately 37,000 acre-feet per year is exported out of the basin.[7] leaving a net available water supply of approximately 1.139 million acre-feet per year. Currently, annual agricultural depletions in the Weber River Basin amount to about 160,000 acre-feet and annual municipal and industrial (M&I) depletions amount to 87,000 acre-feet, or 14 and 7 percent of the available water supply, respectively. Reservoir evaporation and other natural depletions combine to deplete another 230,000 acre-feet per year, or 20 percent. This leaves an annual average of about 662,000 acre-feet of the available supply (or 58 percent) that enters the Great Salt Lake from the Weber River Basin.

Variability of Supply

For the sake of convenience, the discussion to this point has focused on the Weber River Basin's average annual water supply. Actual water supply conditions rarely match these averages. In fact, it is not unusual to experience conditions that are much wetter or much drier than average. Figure 6 illustrates the precipitation and streamflow for a dry, average and wet year at several locations in the basin. The blue bars show monthly precipitation in inches and the red lines show monthly streamflow in acre-feet.

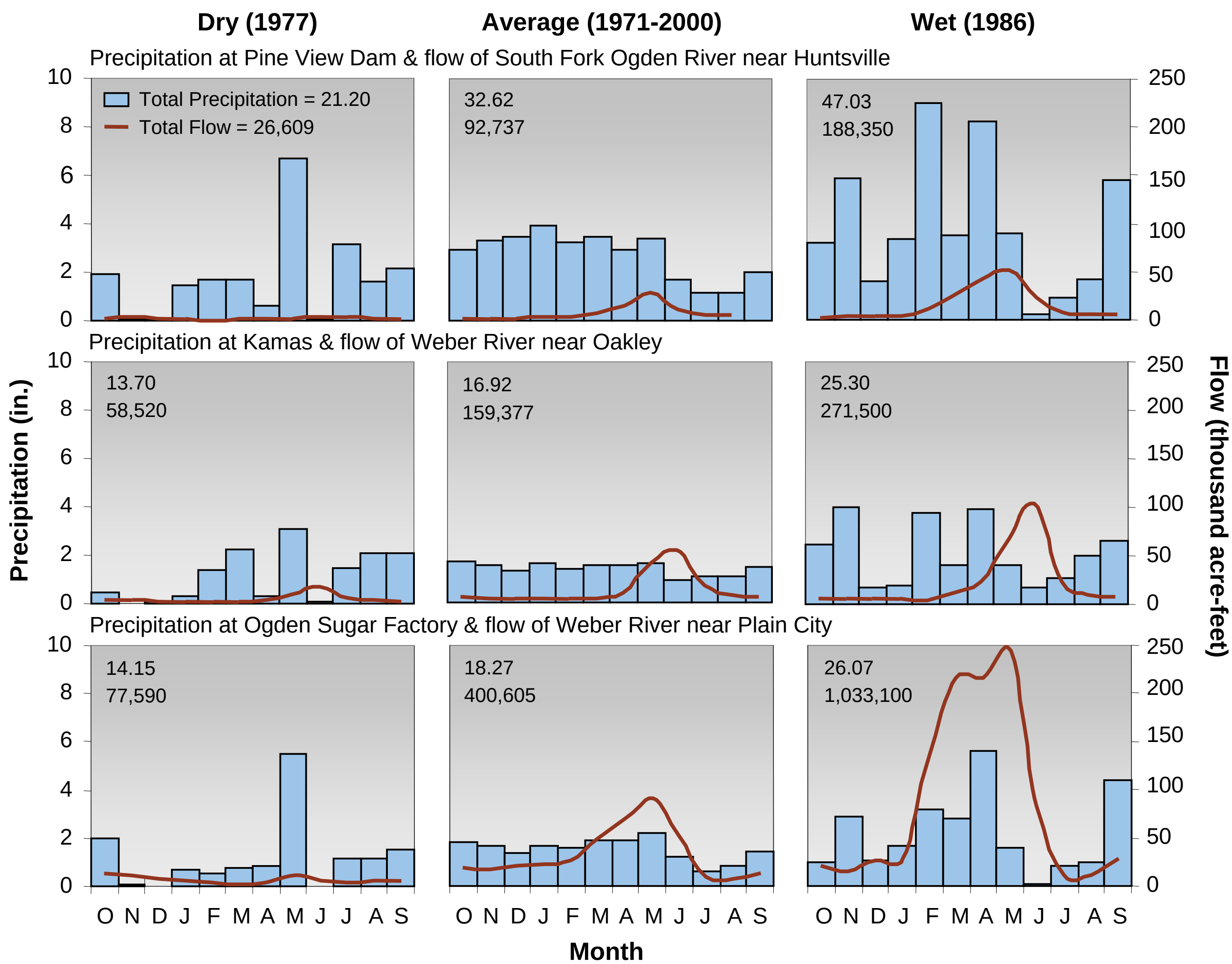
The extreme range of Weber River flow at the Plain City gage (77,590 acre-feet in 1977 to 1,033,100 acre-feet in 1986) exemplifies the fact that actual water supply can vary substantially from the average amounts. This variability also emphasizes the importance of water storage reservoirs to the basin. Without the benefits of storage, the effects of prolonged drought periods would be severely felt, as would the effects of flooding during wet periods. Instead, storage reservoirs allow much of the excess flows available during wet years to be captured and held in storage for use in subsequent years.

TABLE 5
Estimated Water Budget

Category	Water Supply (acre-feet/yr.)*
Total Precipitation	3,453,000
Used by vegetation and natural systems	2,277,000
Basin Yield	*1,176,000*
Exports out of basin	37,000
Available Supply	*1,139,000*
Agricultural Depletions†	160,000
M&I Depletions†	87,000
Other Depletions‡	230,000
Flows to Great Salt Lake	*662,000*

* Values based on 1961-1990 period of record, except as noted.
† Based on irrigated cropland observed in 2003 and M&I data collected in 2005 by the Division of Water Resources.
‡ Wetland and riparian depletion and reservoir evaporation.

FIGURE 6
Precipitation and Flow for a Dry, Average and Wet Year at Various Locations in the Basin



Water Rights Policy

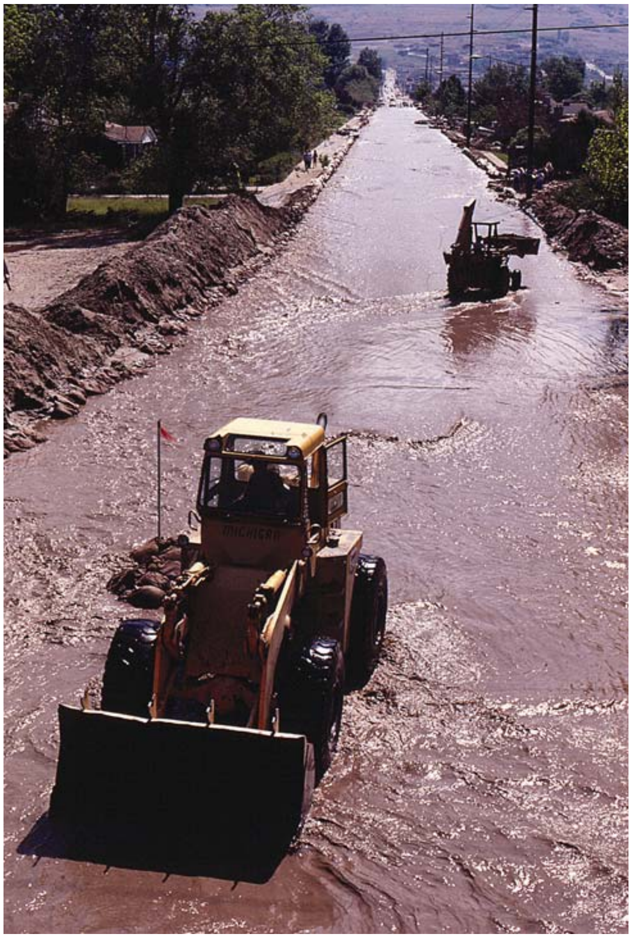
The Division of Water Rights has divided the Weber River Basin into two management areas: the Weber and Ogden rivers and Davis County. The division has established water rights policy for both of these areas, including three ground water management plans for subareas within the basin. Because these policies have a profound impact on the availability and management of water resources, summaries of these policies are provided below:

Weber and Ogden Rivers[8]

The 1937 Weber River Decree and the 1948 Ogden River Decree adjudicated the area's surface water rights prior to those dates. No adjudications have been ordered to update these decrees or include ground water rights. The State Engineer's Interim Policy for the Snyderville/Park City Basin[9] and the Weber Delta Subarea Ground-water Management Plan[10] are management policies affecting specific parts of this area.

Surface Water

Surface waters are considered to be fully appropriated. Per current rules, diligence claims may be filed on water uses not in the decrees and which were established prior to 1903 for surface water and 1935 for underground water. New diversions and consumptive uses in these sources must be accom-



In 1983, severe flooding forced water into the streets of Bountiful and other communities throughout Utah.

plished by change applications filed on owned or acquired rights. Non-consumptive use applications, such as hydroelectric power generation, will be considered on their individual merits. Fixed period or transient projects in canyon or foothill areas must be handled by temporary change applications. New water diversions, based on exchange applications, will be permitted for those projects where the point of release of the storage water is upstream of the proposed point of diversion and there are intervening water rights.

Ground Water

Ground water within the area is limited. No new appropriations are approved above the mouths of the canyons. Development of new or different consumptive use projects in these areas must be accomplished by change applications on existing water rights. New appropriations below the canyons are reviewed on an individual basis. Individual domestic filings for 1.0 acre-foot per year are generally approved in areas where a public water supply is not accessible. Larger projects are generally held pending development of approved rights and data from water users. Changes from surface to underground sources, and vice versa, are also considered on their individual merits, with emphasis on their potential to interfere with existing rights and to ensure that there is no enlargement of the underlying rights. Applicants are placed on notice that development should be pursued as soon as possible. Extension of time requests will be critically reviewed beyond the initial five-year period.

Approvals based on irrigation company stock or leases generally contain conditions requiring maintenance of shares or contracts for the underlying changed rights and/or installation of measuring devices. In some instances, further limitations are imposed as follows:

- Snyderville/Park City Sub-basin: Only change or exchange applications based on rights already approved within the boundaries of this sub-basin are approved.
- Samak Area: Changes on shares of stock in Beaver and Shingle Creek Irrigation Company are subject to evaluation of the shares at 0.3 acres of irrigation per share, maintenance of those shares, installation of measuring devices, and the restriction of irrigation at the new diversion to the same period in which water is available in the original canal system.
- Garff Ranch/Kamas Area: Exchanges based on contracts with the Weber Basin Water Conservancy District are limited to inside domestic uses with in the Indian Creek drainage. Applications for domestic use in locations not tributary to Indian Creek may include irrigation.

Davis County[11]

Five Proposed Determination of Water Rights books have been published. Four were published for the Southern Davis Division in 1966, and one for the Centerville Division on 1970. No final decrees have been issued. There are no state-administered distribution systems in this area. This area is covered by the Bountiful Subarea Ground-water Management Plan[12] and the Weber Delta Subarea Ground-water Management Plan.[13] There are approximately 5,200 water rights on file with the State Engineer in this area.

Surface Water

Surface waters within Davis County are generally considered to be fully appropriated. New diversions and consumptive uses in all surface water sources must be accomplished within the context of change applications filed on existing rights. Non-consumptive use applications, such as hydroelectric power generation, will be considered on their individual merits.

Ground Water

Ground water within the area is limited. New appropriations are limited to 1.0 acre-foot per year for fixed-time periods in areas not served by a public supply system. These filings are to connect to public supply systems when they become available. Large projects must be accomplished by change applications on existing rights. Changes from surface to underground sources, and vice versa, are also considered on their individual merits, with emphasis on their potential to interfere with existing rights and to ensure that there is no enlargement of the underlying rights. Applicants are placed on notice that development should be pursued as soon as possible. Extension of time requests will be critically reviewed beyond the initial five-year period.

NOTES

[1] An acre-foot is enough to cover an acre of land with one foot of water, or to satisfy the needs of a family of four or five for one year.

[2] Utah Division of Water Resources, *Water Budget Report of the Weber River Basin,* (Salt Lake City: Utah Dept. of Natural Resources, 1996), 87, 89. Of this amount, 31,000 acre-feet evaporates from Willard Bay and 16,000 acre-feet from other reservoirs.

[3] U.S. Geological Survey, *Ground-water Conditions in Utah: Spring of 2002*, Cooperative Investigations Report No. 42, (Salt Lake City: U.S. Geological Survey, 2008), 17.

[4] The Division of Water Resources has estimated that wells in this area have declined anywhere from 50-70 feet, since 1950.

[5] U.S. Geological Survey, 2008, 111-112.

[6] U.S. Geological Survey, *Hydrology and snowmelt simulation of Snyderville Basin, Park City, and adjacent areas, Summit County, Utah,* (Salt Lake City: Dept. of Natural Resources, 1998), 7.

[7] This includes an export 30,000 acre-feet per year to the Utah Lake Basin through the Weber-Provo Canal and an export of 7,000 acre-feet per year to the Bear River Basin through the Ogden-Brigham Canal.

[8] The text of this section was borrowed from the Utah Division of Water Rights, *Water Rights Policy: Weber and Ogden Rivers-Area 35*. Retrieved from the Division of Water Rights' Internet web page: http://www.waterrights.utah.gov/wrinfo/policy/wrareas/area35.html, October 26, 2004.

[9] For a complete copy of this interim policy and other ground water management plans, see the Division of Water Rights' Web Page: http://www.waterrights.utah.gov/wrinfo/policy/ground.htm.

[10] Ibid.

[11] The text of this section was borrowed from the Utah Division of Water Rights, *Water Rights Policy: Davis County-Area 31*. Retrieved from the Division of Water Rights' Internet web page: http://www.waterrights.utah.gov/wrinfo/policy/wrareas/area31.html, October 26, 2004.

[12] See note 9.

[13] See note 9.

3

POPULATION AND WATER USE TRENDS AND PROJECTIONS

THE 21ST CENTURY: A PROMISING ERA OF GROWTH AND PROSPERITY

The 21st century promises a continuation of rapid growth along the Wasatch Front and most other areas of the Weber River Basin. Desirable communities, education and employment opportunities, a pleasant climate, a beautiful environment, and a broad range of recreational opportunities will encourage current residents and their children to stay and others to move to the region. As a result, the Weber River Basin's population is expected to continue to grow well into the foreseeable future.

With such growth comes an abundance of issues and challenges for the leaders in the area. How to plan infrastructure and manage resources are some of the important issues that they will need to resolve effectively. One certainty is that additional water will be required for municipal and industrial (M&I) purposes. This chapter looks at some of these issues and attempts to quantify the amount of water that will be needed to meet future needs. Chapters 4, 5 and 6 address specific ways whereby these needs will likely be met.

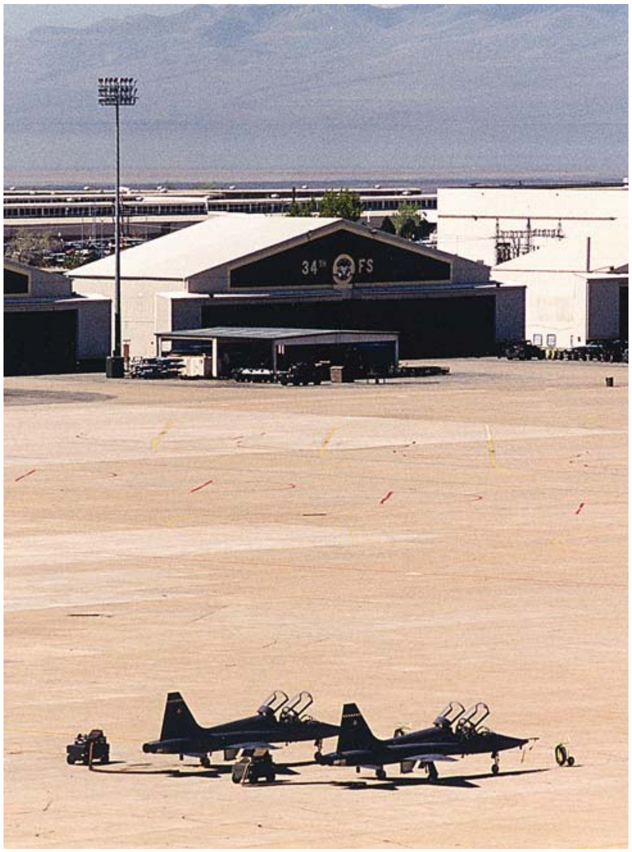
Economic/Employment Trends and Projections

Employment opportunities directly influence population growth. Utah's population and economic growth rates are projected to continue to out-pace most of the nation through the year 2020. The Weber River Basin will experience a large portion of this growth. In 1994, the total number of people employed in Utah reached 1 million. About 200,000 (20 percent) of these people were employed in the Weber River Basin. While total employment in Utah is expected to double to 2 million by the year 2015, employment in the basin is expected to grow at a slightly slower rate, not reaching 400,000 until 2018.[1]

Although agricultural employment in the basin has risen rather steadily since 1995, the long-term trend in all but Weber County shows agricultural employment slowly declining. Mining employment, which is a minor component of the basin total, is also expected to slowly decline. Other employment sectors are expected to remain constant or grow at varying rates.

Military employment is a major economic influence in the Weber River Basin. During the 1990s, the U.S. military scaled back much of its forces, closing bases and down-sizing operations. In 1997, the Ogden Defense Depot was closed as part of this consolidation. During this period, Hill Air Force Base (HAFB) was also included on lists for possible closure. Although the events of September 11, 2001 and subsequent military actions throughout the world have increased military and national security budgets, the military continues to consolidate its facilities to eliminate duplication and improve efficiency.

The ski industry also is a significant player in the economy of the Weber River Basin. The basin has six ski resorts, including world-renowned ski areas at Park City, Deer Valley and Snow Basin. While the year-to-year success of the ski industry is reliant to some extent on the weather, the industry is a steady and important contributor to the basin's economy.



Hill Air Force Base is the largest employer in the Weber River Basin and has a significant impact on the local economy and water use.

Population Trends and Projections

From the time Mormon pioneers first settled at Fort Buenaventura in 1847 until now, the basin's population has grown steadily. With exception of the Great Depression, this growth has occurred at a rate of at least 1 percent every year, with an annual average of nearly 3 percent. Shortly after the construction of Hill Air Force Base and other military depots in Weber County, the basin experienced very rapid growth. In 1942, the basin population grew 8 percent. In 1943, the basin population increased an astounding 23 percent. Since 1940, Davis County has experienced the most rapid rate of growth of any area in the basin, growing at an average annual rate of about 5 percent.[2]

According to the 2000 U.S. Census, the Weber River Basin's population was about 472,000. The Governor's Office of Planning and Budget projects this population to increase to over 815,000 by 2030, and more than double to about 1,159,000 by 2060. The highest rate of growth will occur in the portion of Summit County that lies within the basin, where the population is projected to increase from the 2000 level of about 29,000 to nearly 156,000 in 2060; this is greater than a 530 percent increase, or an annual rate of growth of nearly 9 percent. Davis County is expected to have the slowest rate of growth over the same period, increasing from 239,000 to 441,000, or about 84 percent (1.4 percent per year). For a breakdown of population projections by city and town within the basin, see Table 6.

The basin's 2000 population is distributed as shown in Figure 7. Approximately 95 percent of the basin's population currently lives in the area known as the Greater Wasatch Area. The Greater Wasatch Area extends roughly 50 miles north and 70 miles south of Salt Lake City (Brigham City to Nephi) and extends approximately 30 miles west and 30 miles east (Tooele to Park City).

Several of the state's most popular ski resorts are located in the Weber River Basin. (Photo courtesy of Patrick Cone.)

The 2007 population estimates by the U.S. Census Bureau provides some interesting insight into population growth in Utah and the Weber River Basin. According to the bureau, two of the four most highly populated counties in Utah are located in the basin. They are Davis County (3) and Weber County (4). The Weber River Basin is also Utah's second most populous basin, trailing only the Jordan River Basin (Salt Lake County). The Weber River Basin also contains four of the state's 20 largest cities: Ogden (7), Layton (9), Bountiful (14), and Roy (19). The basin also contains the two fastest growing cities larger than 5,000 in Utah from 2006 to 2007: West Haven (1) and Hooper (2).[3] Both of these communities were both predominately farming areas ten years ago.

Quality Growth

In 1999, the legislature passed the Quality Growth Act to help address the challenges associated with Utah's rapid growth and help ensure that growth takes place in an orderly and efficient manner. The act created the Quality Growth Commission and directed it to administer a land conservation fund, allocate local planning grants, and make recommendations to the legislature on growth issues. The commission has since defined quality growth as "creating a responsible balance between the protection of natural resources—land, air, and water—and the requisite development of residential, commercial, and industrial land to accommodate our expanding economy and population."[4]

The commission has developed the following six principles that it believes, if followed, will ensure quality growth in Utah.[5] The Division of Water Resources encourages communities within the Weber River Basin to follow these principles as they work to meet their future water resources needs (those directly related to water are shown in bold type):

1. <u>Local Responsibility</u> – Local governments are responsible for planning and land use decisions in their own jurisdictions in coordination and cooperation with other government entities.

TABLE 6
Weber River Basin 2000 Population and Projections

County / Community	2000	2030	2060
Davis County			
Bountiful	41,301	42,786	42,682
Centerville	14,585	17,378	18,471
Clearfield	25,974	34,034	36,325
Clinton	12,585	31,449	34,233
Farmington	12,081	22,012	26,232
Fruit Heights	4,701	6,807	8,173
Kaysville	20,351	32,731	39,214
Layton	58,474	86,543	94,341
North Salt Lake	8,749	15,558	15,892
South Weber	4,260	12,349	13,622
Sunset	5,204	4,904	4,756
Syracuse	9,398	34,034	44,540
West Bountiful	4,484	6,731	7,732
West Point	6,033	24,499	35,396
Woods Cross	6,419	11,103	11,834
Balance of County	4,395	7,241	7,954
COUNTY TOTAL	**238,994**	**390,159**	**441,398**
Morgan County			
Morgan	2,635	4,812	6,903
Balance of County	4,494	19,666	61,343
COUNTY TOTAL	**7,129**	**24,478**	**68,246**
Summit County			
Coalville	1,382	2,383	2,600
Henefer	684	2,729	4,100
Kamas	1,274	3,982	4,900
Oakley	948	4,993	7,600
Park City	7,371	15,838	19,400
Balance of County	17,310	50,146	117,127
COUNTY TOTAL	**28,969**	**80,070**	**155,727**
Weber County			
Farr West	3,094	7,374	13,348
Harrisville	3,645	9,520	16,721
Hooper	4,058	13,812	27,809
Huntsville	649	630	788
Marriott-Slaterville	1,425	2,854	5,590
North Ogden	15,026	27,256	46,019
Ogden	77,226	106,062	124,163
Plain City	3,489	8,115	14,827
Pleasant View	5,632	10,743	21,500
Riverdale	7,656	9,720	10,750
Roy	32,885	39,567	55,057
South Ogden	14,377	21,486	35,993
Uintah	1,127	2,019	3,615
Washington Terrace	8,551	12,466	20,449
West Haven	3,976	18,209	38,441
Balance of County	13,717	30,802	58,288
COUNTY TOTAL	**196,533**	**320,634**	**493,358**
WEBER BASIN TOTAL	**471,625**	**815,341**	**1,158,729**

Source: Governor's Office of Planning and Budget, "2008 Baseline City Population Projections," (Salt Lake City: May, 2008).

FIGURE 7
Population Distribution

2. State Leadership – The state's role is to provide planning assistance, technical assistance, information and incentives for local governments to coordinate and cooperate in the management of growth.
3. Economic Development – The state shall promote a healthy statewide economy and quality of life that supports a broad spectrum of opportunity.
4. **Efficient Infrastructure Development** – State and local governments and the private sector should cooperate to encourage development that promotes efficient use of infrastructure and **water** and energy resources.
5. Housing Opportunity – Housing choices and housing affordability are quality of life priorities and state and local governments should cooperate with the private sector to encourage both.
6. **Conservation Ethic** – The public sector, private sector and the individual should co-operate to protect and conserve **water**, air, critical lands, important agricultural lands and historical resources.

The Greater Wasatch Area

Approximately 80 percent of Utah's future growth is projected to occur in the Greater Wasatch Area (see Figure 7). Through extensive research and involvement of the public, the Quality Growth Efficiency Tools (QGET) Technical Committee and Envision Utah have gathered information about what residents of this area value and how they think growth should be accommodated. Based on this information, several issues were identified that are important to the Weber River Basin. These issues, which include improving air quality, increasing transportation options, and conserving and maintaining availability of water resources, need to be addressed in order to protect the environment and maintain economic vitality and quality of life.

To address these issues, Envision Utah developed specific quality growth strategies that seek to bring about change through means other than regulatory authority. Several of the strategies that either directly or indirectly influence water use include:[6]

- Preserving open spaces by including open areas in new development and providing incentives to reuse currently developed land; and

This before and after photo of the Ogden-Brigham Canal and Ben Lomond Peak shows how much the city of North Ogden has grown over the years. The photo on the left was taken in 1956 and shows mostly agricultural land with only a few homesteads. The photo on the right was taken in 2004 and shows how many homes have been built on the agricultural land.

- Restructuring water bills to encourage water conservation.

If future growth in the Weber River Basin follows these strategies, the potential for water savings will be significant. A trend away from dispersed development toward more concentrated population centers would result in reduced lot sizes (0.32 acres to 0.29 acres) and lower per capita water use.[7] This would translate into a decline in per capita water use in the basin of approximately 6 percent by the year 2020. Also, this pattern of future development would require fewer acres of agricultural land to accommodate urban development.

<u>Rural Areas</u>

Only a very small portion (about five percent) of the Weber River Basin's population is found in relatively small rural communities outside the Greater Wasatch Area (Henefer, Coalville, Wanship, Oakley, and Kamas for instance). While these communities share some of the same concerns that QGET and Envision Utah have identified for the Greater Wasatch Area, they have their own unique needs. Responding to these needs, the Governor's Rural Partnership Office has created a program specifically designed to assist rural communities with their growth-related challenges. The goal of this program, entitled "21st Century Communities," is to provide planners and leaders in rural communities with the training, guidance and tools that will help them succeed in their planning efforts.

Part of the 21st Century Communities program is an assessment of a community's environmental quality. Items related to water resources that are part of this assessment include what the community is doing to:

- Guarantee its citizens have access to safe, high quality drinking water;
- Protect its ground water from pollution; and
- Ensure its wastewater is handled in a safe manner.

The state of Utah hopes that this program will help rural communities identify problems that need attention and tailor solutions that fit their own unique circumstances. Rural community leaders should take advantage of these valuable planning tools, which will help them avoid water resources problems and other difficulties.[8]

Water and Limitations on Growth

Although challenges exist, water will not be a limiting factor on growth in the basin in the immediate future. However, in the Snyderville Basin, water has already become a critical component in the ability to sustain growth. As a result, the State Engineer closed the area to new appropriations and Summit County implemented a "concurrency requirement" to all non-municipal water providers, which requires them to demonstrate they have adequate water to meet current and approved growth needs within their boundaries. In 1999, the State Engineer established a ground water management plan which regulates water withdrawals by priority date. In 2003, the State Engineer restricted water uses in the area due to the lack of water supply caused by the drought. Since then, water has been imported to the area, but further imports will be necessary to curtail future restrictions.

PRESENT AND FUTURE USES OF THE WEBER RIVER BASIN'S WATER RESOURCES

While natural environment is the largest "user" of the Weber River Basin's water, agricultural irrigation is the primary use of the developed water supply in the Weber River Basin. Agriculture currently consumes about 69 percent of the developed supply. Municipal and industrial (M&I) uses consume the remaining 31 percent. Environmental and recreational uses, which are not quantified in consumptive terms, are also significant uses of the water. Increasing competition between each of these uses will continue to shape the way the Weber River Basin's water resources are utilized. While the importance of each will increase, M&I uses are the only ones expected to increase because of population growth. As M&I water uses increase, agricultural and environmental uses will decline.

Municipal and Industrial

The Division of Water Resources recently completed an intensive study of M&I water supply and use in the Weber River Basin for the year 2005. Table 7 shows a summary of the basin's total M&I water use as estimated by this study. As shown, potable (water treated to drinking water standards) uses amounted to over 98,000 acre-feet, or roughly 48 percent of total M&I use, in 2005. Non-potable uses (often referred to as secondary uses) amounted to nearly 108,000 acre-feet in 2005, or 52 percent of total M&I use.

Also evident in Table 7 is the majority of the basin's total M&I water is supplied by public community systems and secondary irrigation systems. In 2005, water supplied through these systems amounted to approximately 193,000 acre-feet (92,262 plus 101,121), or 94 percent of the basin's total M&I use. Only about 13,000 acre-feet, or 6 percent of the

TABLE 7
Total M&I Water Use by County (2005)

Use Category	Water Use (acre-feet) Davis County	Morgan County	Summit County	Weber County	TOTAL
Potable Suppliers:					
Public Community Systems*	41,320	1,302	10,685	38,955	**92,262**
Public Non-Community Systems†	1,778	55	60	185	**2,078**
Self-Supplied Industries‡	2,175	40	0	1,022	**3,237**
Private Domestic§	80	400	150	300	**930**
POTABLE TOTAL	**45,353**	**1,797**	**10,895**	**40,462**	**98,507**
Non-Potable Suppliers:					
Secondary Irrigation Companies	61,125	530	2,236	37,230	**101,121**
Non-Community Systems	468	380	150	205	**1,203**
Self-Supplied Industries	0	220	0	5,336	**5,556**
NON-POTABLE TOTAL	**61,593**	**1,130**	**2,386**	**42,771**	**107,880**
TOTAL	**106,946**	**2,927**	**13,281**	**83,233**	**206,387**

* A private or publicly owned system that provides water to at least 15 connections or 25 individuals year round.
† A private or publicly owned system that provides water to at least 25 temporary residents for at least 60 days per year.
‡ An industry that has its own water supply that is not part of a public system.
§ Private wells or springs that provide water to individual homes.

M&I water supply, is used by non-community systems, self-supplied industries or private domestic users. Table 8 presents water supply and use for public community systems as estimated for 2005. It also shows projected demands in 2030 and 2060 along with estimated deficits and surpluses based on the estimated water supply available in 2005.

As estimated in Table 8, many systems will need to increase their supplies before 2030, especially in Morgan, Summit and Weber counties. Only a few systems appear to have adequate surpluses to meet growth to 2060 and beyond, with almost all in Morgan, Summit and Weber counties experiencing deficits before 2060. If municipalities with surpluses could share them with neighboring systems, some of these deficits could be reduced. Weber Basin Water Conservancy District is helping communities do this and is in the best situation to make sure it continues.

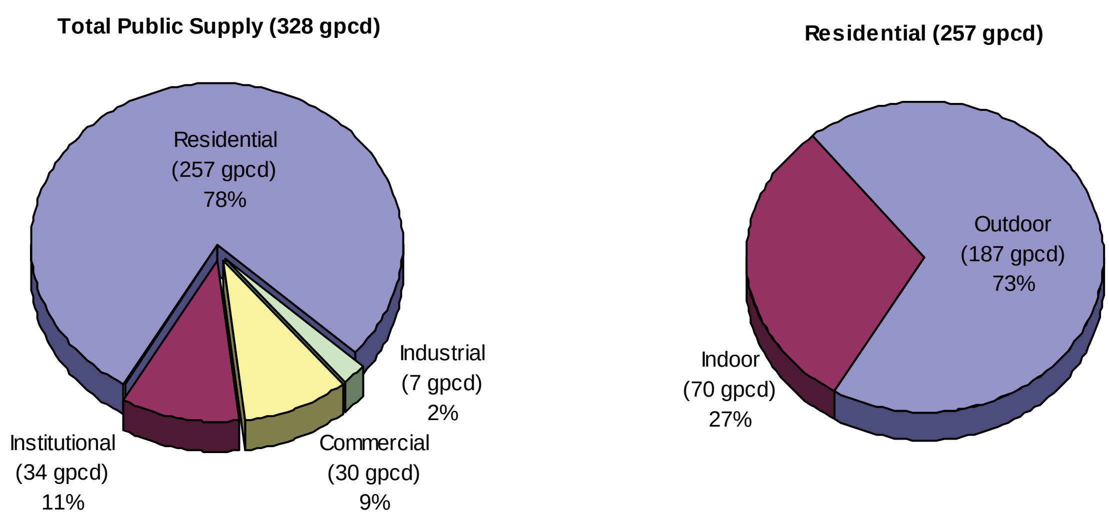
Figure 8 contains the average per capita use rate of all the public community and secondary water systems in the basin obtained by the division's 2005 study. Water used by self-supplied industries, private domestic and non-community systems is not shown. As indicated, residential water use amounts to 257 gallons per capita per day (gpcd), or 78 percent of the total (328 gpcd). Institutional water use represents 34 gpcd (11 percent), commercial 30 gpcd (9 percent), and industrial 7 gpcd (2 percent). The portion of residential water use that is applied to outdoor landscapes, estimated at 73 percent, is significantly higher than the 2005 statewide average of 62 percent. The higher than average outdoor water use is due primarily to the significant number of unmetered secondary irrigation systems in the basin.

Table 9 shows estimates of total M&I water use for 1992, 2001, 2003, 2005, 2030 and 2060. The Division of Water Resources derived the future projections using the Utah Water Demand/Supply Model. This model utilized the Governor's Office of Planning and Budget's population projections and M&I data collected by the division. Clearly the M&I water needs in Davis and Weber counties are the largest; however, water demands in Morgan and Summit counties are projected to increase significantly by 2060. As shown, the basin's total annual M&I water demand is expected to increase by about 115,000 acre-feet by the year 2060 with water conservation (from 206,300 acre-feet in 2005 to 320,100 acre-feet in 2060). Without water conservation the 2060 demand would increase by about 217,000 acre-feet (not shown in Table 9).

Agriculture

While other parts of the state have become less reliant on agriculture and more reliant on tourism, recreation, services and technology for their economic base, agriculture has maintained a relatively steady, although small, part of the economy of the Weber River Basin. Although declines in agricultural acreage are occurring across the basin, those acres

FIGURE 8
Breakdown of Public Community System Water Use Including Secondary Water (2005)



(Source: Division of Water Resources, Municipal and Industrial Water Supply Studies Program, November 2006.)

TABLE 8

Current Public Community System Water Supplies vs. Future Demands

Water System	2005 Demand (acre-feet)	2005 Supply* (acre-feet)	Water Use Projections w/ Water Conservation† (acre-feet)		Water Supply Deficits/Surpluses‡ (acre-feet)	
			2030	2060	2030	2060
Davis County						
Bountiful City	16,721	19,130	13,955	12,317	5,175	6,813
Centerville City	7,447	9,183	7,296	6,862	1,887	2,321
Clearfield City	5,718	9,703	6,072	5,734	3,631	3,969
Clinton City	6,757	7,745	9,602	9,248	(1,857)	(1,503)
Farmington City	9,666	10,104	11,637	12,270	(1,533)	(2,166)
Fruit Heights	1,565	2,803	1,844	1,959	959	844
Hill Air Force Base	5,228	6,762	4,444	3,932	2,318	2,830
Kaysville City	10,540	10,300	12,444	13,191	(2,144)	(2,891)
Layton City	16,008	19,439	18,777	18,110	662	1,329
Mutton Hollow Improvement Dist.	287	305	244	216	61	89
North Salt Lake	3,953	6,664	4,508	4,074	2,156	2,590
South Davis Water Imp. Dist.	3,279	5,480	6,401	6,121	(921)	(641)
South Weber City	2,483	2,642	4,489	4,381	(1,847)	(1,739)
Sunset Municipal Water System	1,060	1,400	900	772	500	628
Syracuse Water System	4,813	4,713	7,017	8,125	(2,304)	(3,412)
West Bountiful Water System	1,868	2,674	2,061	2,095	613	579
West Point Water System	1,997	2,906	4,604	5,885	(1,698)	(2,979)
Woods Cross Water System	3,055	4,520	3,530	3,329	990	1,191
DAVIS COUNTY TOTAL	**102,445**	**126,473**	**119,825**	**118,621**	**6,648**	**7,852**
Morgan County						
Central Enterprise Water Assoc.	100	55	85	75	(30)	(20)
Croydon Pipeline Company	22	20	108	323	(88)	(303)
Highlands Water Company	211	293	1032	3,105	(739)	(2,812)
Monte Verde Water Association	25	54	122	368	(68)	(314)
Morgan City Corporation	1,079	1,160	1,379	1,750	(219)	(590)
Mt. Green Subdiv. Water Assoc.	16	5	80	241	(75)	(236)
Peterson Pipeline Company	131	104	640	1,926	(536)	(1,822)
Richville Pipeline Company	58	68	281	845	(213)	(777)
S. Robinson Spring Water Users	12	15	10	9	5	6
West Enterprise Water Assoc.	12	7	10	9	(3)	(2)
Wilkinson Water Company	166	40	809	2,433	(769)	(2,393)
MORGAN COUNTY TOTAL	**1,832**	**1,821**	**4,556**	**11,084**	**(2,735)**	**(9,263)**
Summit County						
Bridge Hollow Water Association	8	37	7	6	30	31
Cluff Ward Pipeline Company	23	102	48	46	54	56
Coalville City Water System	375	889	535	516	354	373
Community Water Company	126	424	240	498	184	(74)
Echo Mutual Water System	22	46	42	87	4	(41)
Gorgoza Mutual Water Company	578	1,319	1100	2,286	219	(967)
Henefer Town	273	350	877	1,166	(527)	(816)
High Valley Water Company	131	285	251	521	34	(236)
Hoytsville Pipeline Company	145	260	276	573	(16)	(313)
Kamas City Water System	412	852	1117	1,216	(265)	(364)
Marion Waterworks Company	135	210	258	535	(48)	(325)
Mountain Regional SSD	2,955	1,967	5,620	11,677	(3,653)	(9,710)

TABLE 8 (continued)

Water System	2005 Demand (acre-feet)	2005 Supply* (acre-feet)	Water Use Projections w/ Water Conservation† (acre-feet) 2030	2060	Water Supply Deficits/Surpluses‡ (acre-feet) 2030	2060
Oakley Town Water System	480	888	1568	2,112	(680)	(1,224)
Park City Culinary Water	4,765	7,981	7,976	8,644	5	(663)
Peoa Pipeline Company	42	302	80	166	222	136
Summit County Service Area #3	68	161	129	267	32	(106)
Summit Water Distribution	2,282	3,098	4,339	9,015	(1,241)	(5,917)
Wanship Cottage Sites	4	7	3	3	4	4
Wanship Mutual Water Company	67	97	128	266	(31)	(169)
Wooden Shoe Water Company	21	40	18	16	22	24
SUMMIT COUNTY TOTAL	**12,912**	**19,315**	**24,612**	**39,616**	**(5,297)**	**(20,301)**
Weber County						
Abbey of the Holy Trinity	508	772	432	382	340	390
Bona Vista Water District	6,495	7,686	10,017	15,566	(2,331)	(7,880)
Casey Acres Water Company	23	33	34	64	(1)	(31)
Cole Canyon Water Company	51	88	75	142	13	(54)
Durfee Creek Subdivision	9	20	13	25	7	(5)
Eden Waterworks System	365	359	536	1,016	(177)	(657)
Green Hill Country Estates	86	93	126	238	(33)	(145)
Hooper Water Improvement Dist.	5,346	8,520	13,498	24,045	(4,978)	(15,525)
Huntsville Municipal Water Sys.	919	862	757	838	105	24
Lake View Corporation	58	50	85	161	(35)	(111)
Liberty Pipeline Company	283	363	415	787	(52)	(424)
Nordic Mountain Water Company	44	61	64	121	(3)	(60)
North Ogden Municipal Water	3,840	4,150	5,296	7,912	(1,146)	(3,762)
Ogden City	32,100	37,512	37,061	38,386	451	(874)
Pineview West Water Company	21	54	31	58	23	(4)
Pleasant View Culinary Water	1,410	1,902	1,985	3,515	(83)	(1,613)
Pole Patch Water System	29	0	25	22	(25)	(22)
Riverdale City	2,353	4,486	2,436	2,384	2,050	2,102
Roy Municipal Water System	7,261	10,739	6,957	8,564	3,782	2,175
South Ogden City	4,600	5,574	5,481	8,124	93	(2,550)
Taylor-West Weber Water ID	3,721	4,590	5,463	10,356	(873)	(5,766)
Uintah Highlands Imp. District	2,424	2,696	3,558	6,744	(862)	(4,048)
Uintah Municipal Water System	388	835	548	868	287	(33)
Washington Terrace Mun. Water	2,718	4,792	3,473	5,040	1,319	(248)
West Warren Improvement Dist.	455	560	668	1,266	(108)	(706)
Wolf Creek Water and Sewer Co.	680	550	998	1,893	(448)	(1,343)
WEBER COUNTY TOTAL	**76,187**	**97,347**	**100,032**	**138,517**	**(2,685)**	**(41,170)**
Weber Basin Water Conservancy Dist.*	-	25,551	-	-	25,551	25,551
WEBER BASIN TOTAL	**193,376**	**270,507**	**249,025**	**307,838**	**21,482**	**(37,331)**

* Weber Basin Water Conservancy District has a dry-year reliable supply of about 133,875 acre-feet for M&I purposes. Approximately 95,309 acre-feet of this is under contract or delivered to the individual systems listed and is shown as part of their supplies; 13,015 acre-feet is under contract to other entities not listed; the remaining 25,551 acre-feet (shown as the district's supply) is the estimated amount currently available from the district to meet future needs. Of the available amount, the district has contracted or reserved a total of 6,000 acre-feet for Summit Co. and 1,000 acre-feet for Morgan Co.

† All water use projections come from the Utah Water Demand/Supply Model (April 2009) and include incremental estimates of water conservation, with a total of 25% by 2050.

‡ Positive numbers indicate surpluses; numbers in parentheses (dark blue text) are deficits.

TABLE 9
Past, Present and Projected Total M&I Water Use by County (With Conservation)

County	Water Use (acre-feet/yr)					
	1992*	2001*	2003*	2005*	2030†	2060†
Davis	72,000	94,100	83,300	106,900	124,300	123,100
Morgan	3,000	2,800	2,600	2,900	5,700	12,200
Summit	8,000	12,100	12,500	13,300	25,000	40,000
Weber	86,000	91,900	78,600	83,200	107,100	145,600
BASIN TOTAL	**169,000**	**200,900**	**177,000**	**206,300**	**262,100**	**320,900**

* Data obtained by the Division of Water Resources through its intensive M&I Water Supply Studies program.
† Projections include 15% water conservation by 2030 and 25% by 2050 and are estimated by the Division of Water Resources' Utah Water Demand/Supply Model, April 2009.

remaining are becoming more productive. This is evident in the recent upward trend in agricultural employment. From 1980 to 2000, agricultural employment in the basin rose slowly, with the largest gains in Weber County.[9] Projections show agricultural employment declining through 2060.

Table 10 lists estimates of agricultural cropland in the basin for 2007. As shown, the basin has about 90,800 acres of irrigated land and an additional 33,400 acres of non-irrigated or dry-crop land. In 2007, roughly 77,700 acres, or 74 percent of the basin's irrigated acres, were used to raise feed such as alfalfa, grass hay and pasture for the livestock industry. The remaining irrigated acres within the basin were used to grow high-value vegetables, fruits and other specialty crops.

Table 11 shows past, present and future projections of irrigated cropland within the Weber River Basin. As shown, the trend all along the Wasatch Front has been a rapid decrease in agricultural land as the growing population has converted farms to residential and commercial areas. In the rural areas of the basin (Morgan and Summit counties), agricultural acres remained relatively constant since 1987, but have expressed a greater decline in the four year period from 2003 to 2007. The rate of decline is expected to increase in the future. These declines will likely continue well into the future with an estimated 43,400 acres of irrigated cropland converting to urban uses between the years 2007 and 2060. Table 12 shows estimates of past, present and future agricultural water use on the irrigated cropland shown in Table 11. Much of the water that was once used for agriculture is being and will eventually be converted to meet the water needs associated with the new urban land use. However, in order to convert agricultural water from the Weber Basin Project to meet M&I needs, contracts with the federal government will need to be renegotiated. This is a painstaking process that will take many years.

In recent years, there has been a strong interest in preserving open spaces and other values associated with agricultural lands. This is especially true along the shore of the Great Salt Lake, where numerous reserves have been created and development rights to other agricultural lands have been purchased. With growth pressures mounting all along the lakefront, this trend is expected to continue, preserving many more acres.

Environment

While agriculture uses most of the developed water supply within the basin, the environment is by far the greatest consumer of the precipitation that falls to the earth from the sky. In the Weber River Basin, the environment consumes about 93 percent of the annual average precipitation (see Table 5). While agricultural and M&I uses amount to only a very small part of the average precipitation, these uses can have a profound impact on the environment. These impacts have become more apparent over the years and have resulted in more concern being expressed about the environment and society's effects on ecosystems.

The Weber River, its tributaries and the Great Salt Lake are all important parts of the environment within the Weber River Basin. Instream flows in the

TABLE 10
Agricultural Cropland by County (2007)*

Crop	Acres				TOTAL
	Davis	Morgan	Summit	Weber	
Irrigated Cropland					
Pasture	5,637	1,787	10,855	11,975	**30,253**
Alfalfa	4,066	4,219	3,302	13,201	**24,787**
Grass Hay	573	1,643	6,211	3,258	**11,686**
Subirrigated Pasture and Hay†	3,470	576	4,420	2,566	**11,031**
Corn	1,939	577	0	3,674	**6,191**
Grain	1,140	946	494	2,214	**4,794**
Onions	395	0	0	206	**601**
Other Vegetables	199	0	0	153	**352**
Orchard	210	2	11	88	**311**
Other Horticulture	233	0	0	16	**249**
Grass/Turf	214	0	0	33	**248**
Beans	148	0	0	0	**148**
Sorghum	8	48	0	66	**122**
Berries	15	0	0	0	**15**
Potatoes	9	0	0	0	**9**
Tomatoes	0	0	0	8	**8**
IRRIGATED TOTAL	**18,256**	**9,798**	**25,293**	**37,458**	**90,805**
Non-Irrigated					
Idle/Dry Idle	5,301	3,542	2,677	6,657	**18,177**
Dry Pasture	501	1,972	3,815	4,506	**10,794**
Dry Alfalfa	396	1,010	347	830	**2,583**
Dry Grain/Beans/Seeds	21	878	651	82	**1,632**
Fallow	59	0	18	134	**211**
NON-IRRIGATED TOTAL	**6,278**	**7,402**	**7,508**	**12,209**	**33,397**
TOTAL CROPLAND	**24,534**	**17,200**	**32,801**	**49,667**	**124,202**

* Data was collected during the summer of 2007 as part of the Division of Water Resources' intensive water-related land use program. For further information and GIS data from this program, see: www.water.utah.gov/planning/landuse/.
† Croplands that are irrigated naturally by a high ground water table.

Weber River and its tributaries sustain valuable habitat for wildlife, as do the wetlands of the Great Salt Lake, which is considered by many to be one of the state's most precious, yet under-valued resources. Properly balancing these environmental needs with other important water management objectives will allow future M&I demands to be met without compromising the quality of life that comes with healthy ecosystems.

Recreation

Recreation is an important component of water use within the Weber River Basin. Some of the most popular recreation activities in the basin are associated with its many and varied waterways. Popular recreational activities at lakes and smaller reservoirs include fishing, swimming and canoeing. At the basin's larger reservoirs, such as Pineview, Rockport, Echo, East Canyon and Willard Bay, motor boating is also very popular. Although few people participate in water sports such as rafting and kayaking, the Weber River from Henefer to the mouth of Weber Canyon and portions of the Ogden River are some of the more popular spots in the state for kayaking enthusiasts.

Recreational water use in Utah continues to grow rapidly. While the state's population roughly increased 2.5 times from 1959 to 1998, the number of registered boats increased nine fold and the number of fishing licenses increased nearly three fold during the same period.[10] Many of these new recreationists visit the reservoirs and streams located in the Weber River Basin. Of the ten largest reservoirs located within the Greater Wasatch Area, seven of them are located in the Weber River Basin (Willard Bay, Pineview, Causey, Lost Creek, East Canyon, Echo

TABLE 11
Past, Present and Projected Irrigated Cropland

County	Irrigated Acres*					
	1987†	1999†	2003†	2007	2030‡	2060‡
Davis	36,481	28,268	26,282	18,256	9,100	5,700
Morgan	9,321	10,329	10,535	9,798	8,400	5,300
Summit	29,134	30,129	28,394	25,293	21,000	14,400
Weber	61,639	48,570	40,630	37,458	31,600	22,000
BASIN TOTAL	**136,576**	**117,296**	**105,843**	**90,805**	**70,100**	**47,400**

* The acres shown includes idle and fallow land that were likely not irrigated during the year shown, but could have been irrigated if adequate water were available.
† Data obtained by the Division of Water Resources through its intensive water-related land use program.
‡ Future projections are based on current population densities, future population, and estimates of what percentage of new growth will consume irrigate land.

TABLE 12
Estimated Past, Present and Future Agricultural Water Use/Diversions

County	Estimated Diversion (acre-feet)*					
	1987	1999	2003	2007	2030	2060
Davis	125,700	96,100	89,400	62,100	30,900	19,400
Morgan	41,600	35,100	35,800	33,300	28,600	18,000
Summit	90,500	102,400	96,500	86,000	71,400	49,000
Weber	214,900	165,100	138,100	127,400	107,400	74,800
BASIN TOTAL	**472,700**	**398,700**	**359,800**	**308,800**	**238,300**	**161,200**

* Estimates of water use are based on a detailed water budget that used the 1987 land use data and climatic data from 1951-1980. This water budget estimated that 3.4 acre-feet of water was diverted per acre of irrigated cropland.

and Rockport). All of these have facilities to serve the various needs of recreationists. Willard Bay, East Canyon, Echo and Rockport reservoirs also have State Parks.

The Division of Parks and Recreation has conducted numerous studies of recreation in Utah. These surveys estimate that 95 percent of those boating in Utah are from within the state. These boaters indicated that most reservoirs within the Weber River Basin were not overly crowded. However, most of them felt boater limits should be enforced at Pineview Reservoir and several felt that limits may also be appropriate for East Canyon and Echo reservoirs. Despite these concerns, those surveyed felt optimistic that if they could not get their boat into the reservoir of their choice, there were sufficient alternatives nearby.[11]

Although recreational water use is largely non-consumptive, its rapid growth in Utah will still create some challenges. As water is released from reservoirs to meet downstream demands, water levels in reservoirs decline, impacting recreational water uses.

In addition to open-water recreation on reservoir, rivers and streams, Utahans enjoy many winter recreational activities. As the population in the basin and along the Wasatch Front increases, so will the demand for these activities, especially winter skiing. This increased demand could impact commercial water use slightly within the basin, as ski resorts turn to artificial snowmaking to extend the ski season and enhance the skiing experience for their customers.

NOTES

[1] Governor's Office of Planning and Budget, "2008 Baseline Projections." Retrieved from the Governor's Office of Planning and Budget's Internet web page: www.governor.utah.gov/dea/projections.html, October 2008.

[2] Estimates of growth rates are derived from "2002 Baseline City Population Projections," provided to the Division of Water Resources by the Governor's Office of Planning and Budget in April of 2003.

[3] Utah State Data Center, "Utah Data Guide: A Newsletter for Data Users," (Salt Lake City: Governor's Office of Planning and Budget, 2008), Summer 2008. Data from U.S. Census Bureau: www.census.gov/popest/estimates.php.

[4] From a handout presented to the Board of Water Resources by the Utah Quality Growth Commission, September 19, 2003.

[5] Quality Growth Commission, "Utah's Guiding Principles for Quality Growth." Retrieved from the commission's Internet web page: http://governor.utah.gov/Quality/principles.pdf, October 2008.

[6] Governor's Office of Planning and Budget, *Strategy Analysis: QGET Quality Growth Efficiency Tools*, (Salt Lake City, 2000), 49, 50.

[7] Ibid.

[8] More information about 21st Century Communities can be obtained online at: http://planning.utah.gov/21stcenturycommunities.htm.

[9] Governor's Office of Planning and Budget, UPED Model. Retrieved from the GOPB's web page, July 2002: http://governor.utah.gov/dea/Projections/projections.html.

[10] Utah Division of Parks and Recreation, *State of Utah: Strategic Boating Plan*, (Salt Lake City: Utah Dept. of Natural Resources, 2000) and license sales records.

[11] Utah State University Institute for Outdoor Recreation and Tourism, *A Summary Report: 2001 Utah State Park Boater Intercept Survey*, (Logan: USU Press, 2002). Prepared in cooperation with the Utah Division of State Parks and Recreation.

4

MUNICIPAL AND INDUSTRIAL WATER CONSERVATION: REDUCING FUTURE DEMANDS

Water conservation will play an important role in satisfying future water needs in the Weber River Basin by reducing future water demands as well as the costs associated with additional water development. If water providers implement water conservation programs and measures now, not only will they be better able to meet immediate needs but they will also be better prepared to satisfy long-term demands. Since the bulk of new water demands will be in the municipal and industrial (M&I) sector, the focus of this chapter is M&I water conservation.

UTAH'S M&I WATER CONSERVATION GOAL

The state has developed a specific goal to conserve water use directly linked to M&I needs. This goal is to reduce the 2000 per capita water demand from public community systems[1] by at least 25 percent before 2050. Specifically, statewide per capita demand will need to decline from 295 gallons per capita per day (gpcd) to a sustained 220 gpcd or less. This goal is based on modeling and research that indicate indoor and outdoor water use can be reduced by 25 percent or more. Indoor reductions will be realized through the installation of more efficient fixtures and appliances and public education. Outdoor reductions will be realized primarily through public education and emphasizing more efficient application of water on landscapes.

Monitoring Progress

The Division of Water Resources has established a process to monitor the progress toward achievement of the state's water conservation goal. Currently, M&I water use is collected for several hydrologic river basins every year. This data is stored in a database and published in an M&I water use study for each basin. Periodically, the data from each of these studies is compiled and a new statewide summary of M&I water use is prepared.

The division surveyed M&I water users in the Weber River Basin in 1992, 2001, 2003 and 2005. The basin data for 2001 serves as the 2000 baseline and is also used for conservation monitoring and demand projections. This baseline shows that water use in public community systems within the basin was 347 gpcd, which is higher than the statewide average of 295 gpcd. The 25 percent water conservation goal for the Weber River Basin would reduce this use amount to 260 gpcd by the year 2050.

To monitor progress toward reaching the statewide conservation goal, the Utah Division of Water Resources surveyed M&I water users throughout the state in 2005. The statewide results of this survey, as well as data for the Weber River Basin, are discussed at the end of this chapter under the section titled, "Progress Made Thus Far."

WATER CONSERVATION'S ROLE IN MEETING FUTURE NEEDS

Achieving the goal of at least a 25 percent reduction in per capita demand of publicly supplied water will have significant impacts on Utah's future water needs. If Utah successfully achieves its M&I water conservation goal, the total statewide demand will decrease more than 500,000 acre-feet per year by 2060, which represents the most significant component in meeting Utah's future water needs. Approximately 102,000 acre-feet per year of this amount (the approximate capacity of Pineview Reservoir) will occur within the Weber River Basin. Without water conservation, it is estimated that by the year 2060 the Weber River Basin would experience an increase in water demand above the current demand of about 217,000 acre-feet per year. With conservation, this increase can be cut to approximately 115,000 acre-feet.

WHAT WATER PROVIDERS CAN DO TO ENSURE WATER CONSERVATION GOALS ARE MET

In July 2003, the Division of Water Resources published an M&I water conservation plan for the state of Utah.[2] This plan outlines the state's strategy to help ensure the water conservation goal is achieved and contains specific programs and other activities water providers can implement to ensure that their goals are met. This strategy incorporates various existing planning activities as well as some new programs implemented recently. The portions of this strategy with which local water providers can assist the state in achieving the water conservation goal are listed below:

1 - Prepare Water Conservation Plans
2 - Support the Public Information Program of the Governor's Water Conservation Team
3 - Implement Best Management Practices
4 - Set Example at Publicly Owned Facilities

The Water Conservation, Education and Use Section within the Division of Water Resources is responsible for administering these strategies. The section's Water Conservation and Education coordinators can work with water providers to develop a balanced strategy that will help them achieve their goals.

1 - Prepare Water Conservation Plans

In 1998 and 1999, the Utah Legislature passed and revised the Water Conservation Plan Act. This act requires each water retailer with more than 500 connections and water conservancy districts to prepare a water conservation plan and submit it to the Division of Water Resources. Water conservation plans are to be updated and resubmitted every five years from the date the original plan was submitted.

Reducing outdoor water waste will play an important role in meeting future water needs.

In 2004, the legislature revised the act to enhance the quality of water conservation plans and increase the rate of compliance. The changes made in the 2004 amendment are summarized below:[3]

- Water conservation plans shall include an overall water use reduction goal, implementation plan, and a timeline for action and measuring progress.
- Water conservancy districts and water providers shall devote a part of at least one regular governing body meeting every five years to discuss and formally adopt the water conservation plan and allow public comment.
- Water conservancy districts and water providers shall deliver a copy of the plan to the local media and the governing body of each municipality and county to whom they provide water.
- The Division of Water Resources shall publish an annual report in a newspaper of statewide distribution a list of water conservancy districts and water providers that have not submitted a plan or five-year update to the division.
- No entity shall be eligible for state water development funding without satisfying the water conservation plan requirements outlined in the act.

In addition to these legislative requirements, the Board of Water Resources also requires that petitioners for its funds implement a progressive water rate structure and a time-of-day watering ordinance (prohibiting watering during the hottest daytime hours between 10 am to 6 pm, for example).

TABLE 13
Status of Water Conservation Plans

Community System	Submitted Plan	Update Due*	Community System	Submitted Plan	Update Due*
Bona Vista WID	Yes	2009	Perry City	Yes	2009
Bountiful City	Yes	2012	Pleasant View	Yes	2009
Centerville	Yes	2009	Riverdale City	Yes	2009
Clearfield	Yes	2010	Roy	Yes	2009
Clinton City	Yes	2011	South Davis Co. WID	Yes	2009
Community Water Co.	Yes	2009	South Ogden City	Yes	2009
Farmington	Yes	2009	South Weber City	Yes	2011
Fruit Heights	Yes	2009	Summit Water Dist. Co.	Yes	2009
Gorgoza Mutual Water Co.	Yes	2009	Sunset City	Yes	2009
Hooper WID	Yes	2009	Syracuse	Yes	2009
Kamas City	Yes	2009	Taylor-West Weber WID	Yes	2008
Kaysville	Yes	2009	Uintah Highlands Improvement District	Yes	2009
Layton City	Yes	2011	Washington Terrace	Yes	2009
Morgan City	Yes	2009	Weber Basin WCD	Yes	2013
Mountain Regional SSD	Yes	2009	West Bountiful	Yes	2009
North Ogden	Yes	2009	West Corrine	Yes	2012
North Salt Lake	Yes	2011	West Point	Yes	2010
Ogden City	Yes	2009	Wolf Creek Water and Sewer Company	Yes	2009
Park City	Yes	2009	Woods Cross	Yes	2013

* Updates are due at the end of the every fifth year after the original plan is submitted.
† These entities have not submitted a five-year update and are no longer in compliance with the law.

Table 13 shows the status of conservation plans that are required within the basin and the dates that updates are due. As of the end of 2008, 100 percent of the water retailers and conservancy districts in the Weber River Basin who were supposed to submit a plan or update have done so.[4]

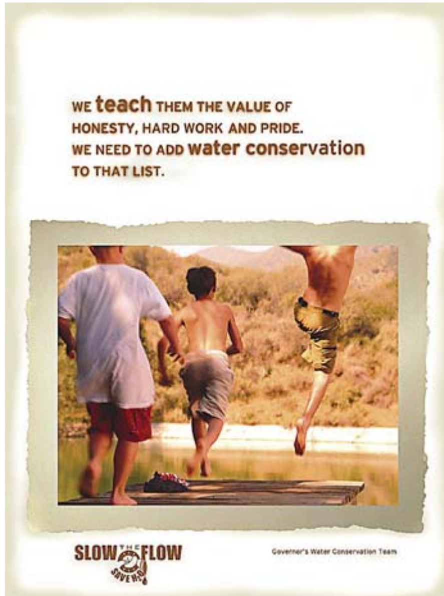
The Water Conservation Plan Act and the recent drought have given water conservation needed emphasis. Local water providers need to capitalize on the increased awareness by making water conservation an integral part of their policy and operations. Each community can take advantage of this opportunity by preparing an effective water conservation plan.

2 - Support the Public Information Program of the Governor's Water Conservation Team

All local water providers have the opportunity to provide valuable support for the public information program created by the Governor's Water Conservation Team. This program is designed to inform the public by providing water conservation information and education. The program's main component is to produce and manage a comprehensive water conservation media campaign. The Division of Water Resources supports this program by providing information through a water conservation web page, a water-wise plant tagging program and web page, and water conservation workshops.

Governor's Water Conservation Team

During the summer of 2001, Utah's Governor called an urgent meeting with Utah's water officials. After discussing the serious nature of the drought and the need for a long-term effort to conserve water, the Governor called for the creation of a committee to coordinate a statewide water conservation campaign. This committee was organized and eventually became the Governor's Water Conservation Team. The team is chaired by the Director of the Utah Division of Water Resources and made up of key water officials from the state's five largest water conservancy and metropolitan water districts (including the Weber Basin Water Conservancy District).



The Governor's Water Conservation Team has produced a variety of TV, radio and print ads.

The Team's Mission

The mission of the team is to develop a long-term statewide water conservation ethic that will result in a reduction in M&I water use of at least 25 percent. Building upon the successes and name recognition of Jordan Valley Water Conservancy District's "Slow the Flow" campaign, the team is working together to develop a statewide water conservation ethic. The team believes that through its efforts, state and local entities will be better able to communicate a consistent water conservation message to their constituents.

Media Campaign

Thus far, the top priority of the Governor's Water Conservation Team has been the joint funding and production of a statewide media campaign, which includes radio and TV ads, printed materials, and various presentations.

The team has also facilitated the production of various printed materials to support the media campaign. To date, several posters and brochures have been produced to help spread the water conservation message to Utah's citizens. Building upon Utah's heritage and the legacy of water resources management in the state, these printed materials reinforce and expand upon the conservation message of the radio and TV ads. Two of the brochures deal with water-wise landscaping and how to efficiently water a landscape and are available for distribution from the team or the Division of Water Resources or at: www.conservewater.utah.gov.

Water Conservation Web Page – www.conservewater.utah.gov

Over the past few years the public interest in water conservation has grown tremendously. With it has come a demand to disseminate a consistent and effective water conservation message. Recognizing this need, the Division of Water Resources has created a water conservation web page to promote effective water conservation habits in Utah and support the Governor's Water Conservation Team. This web page has been online since the spring of 2002 and contains materials of interest to all ages, as well as valuable resources for water agencies. Founded on the concept that water conservation is easy and can save everyone money, the web page is one of the best resources for those searching for ways to conserve.

Water-Wise Plant Tagging Program and Web Page – www.waterwiseplants.utah.gov

The Division of Water Resources, in cooperation with USU Extension, Bureau of Reclamation, and other water providers and interested agencies, has helped develop a water-wise plant tagging program to promote the use of native and other well-adapted plants in Utah landscapes. This program has distributed over 500,000 bright-yellow tags and promotional posters to participating nurseries and garden centers. The tags make it easy for customers to find water-wise plants to use in their landscapes.

The division has also created a web page to support the effort. This web page allows customers to identify and select plants for their landscapes; it includes over 300 plant species with pictures and descriptions of water needs, hardiness and other characteristics. The web site is hosted on the state's Internet domain.

3 - Implement Best Management Practices

The Division of Water Resources recommends that the basin's water providers consider using the following list of Best Management Practices (BMPs) in their water conservation programs. Water providers should implement a mixture of these practices that is tailored to fit their own unique needs. Broad implementation of these BMPs will help the state achieve its water conservation goal:

BMP 1 – Comprehensive Water Conservation Plans
BMP 2 – Universal Metering
BMP 3 – Incentive Water Conservation Pricing
BMP 4 – Water Conservation Ordinances
BMP 5 – Water Conservation Coordinator
BMP 6 – Public Information Programs
BMP 7 – System Water Audits, Leak Detection and Repair
BMP 8 – Large Landscape Conservation Programs and Incentives
BMP 9 – Water Survey Programs for Residential Customers
BMP 10 – Plumbing Standards
BMP 11 – School Education Programs
BMP 12 – Conservation Programs for Commercial, Industrial and Institutional Customers

The main components of each BMP are described below along with a detailed discussion of those for which the Utah Division of Water Resources has collected specific data or information.

BMP 1 – Comprehensive Water Conservation Plans

- Develop a water management and conservation plan as required by law. Plans are to be adopted by the water agency authority (city council, board of directors, etc.) and updated no less than every five years.

(For more information, see "1 - Prepare Water Conservation Plans" on page 36.)

BMP 2 - Universal Metering

- Install meters on all residential, commercial, institutional and industrial water connections. Meters should be read regularly.
- Establish a maintenance and replacement program for existing meters.
- Meter secondary water at the most specific level possible, somewhere below source water metering. Individual secondary connection metering should be done as soon as technology permits.

In order to effectively bill customers according to the amount of water they use, their connection must be metered, and these meters must be read frequently. Metering potable (drinking) water connections is a high priority for most community water systems within the Weber River Basin. As indicated in the water conservation plans submitted to the Division of Water Resources, not only do these systems meter their connections but most of them actively read and replace meters to assure they are functioning properly.

While potable water lines are metered, individual secondary water connections are rarely monitored. Because secondary water generally undergoes minimal, if any, treatment, and the water lines are typically drained each fall, meters on these lines easily clog and malfunction. These problems are not easy to overcome and may require expensive retrofits that are not currently feasible. Eventually, however, a better accounting of secondary water use by the end user will be required. This may make it necessary for secondary water providers to apply some degree of treatment to the water or use a meter that will operate satisfactorily with untreated water.

BMP 3 - Incentive Water Conservation Pricing

- Implement a water pricing policy that promotes water conservation.
- Charge for secondary water based on individual use levels as soon as technology permits.

Table 14 lists average water prices for potable water of several cities in the Weber River Basin. As shown, rates in the basin are slightly lower than the Utah average and are well below the national average. Some reasons that may help explain why rates are lower in the Weber River Basin include the following:

- Much of the basin's population is located near mountain watersheds which have been easily developed to gravity feed a significant portion of the water needs;
- Property taxes are used to pay a portion of the water costs;
- Many communities have secondary water systems which provide less-expensive, untreated water for outdoor irrigation; and
- The federally subsidized Weber Basin Project provides inexpensive water to a large portion of the population.

Whatever the reasons for the basin's lower rates, simply raising water rates is not the solution. Instead, water pricing strategies that provide an incentive to customers to eliminate waste and use less water should be implemented. Rate structures must also be designed to avoid capital shortfalls as customers succeed in conserving water and provide sufficient income to finance system maintenance and improvements. Some of these effective rate structures are discussed briefly below. See Figure 9, on page 42, for a visual representation and example bill summaries for each structure.

TABLE 14
Potable Water Prices of Various Weber River Basin Communities*

City	Estimated Cost per 1,000 gallons	Average Monthly Bill
Park City	$2.24	$54.45
North Ogden	$2.22	$16.91
Eden	$1.96	$25.92
Roy	$1.43	$13.81
Morgan	$1.20	$25.25
Layton	$1.16	$23.74
Kaysville	$1.11	$12.53
Bountiful	$1.05	$13.90
Sunset	$0.81	$17.11
Riverdale	$0.73	$24.00
WEBER BASIN AVG.†	**$1.15**	**$22.34**
Utah Average	$1.17	$28.77
National Average	$2.20	$32.48

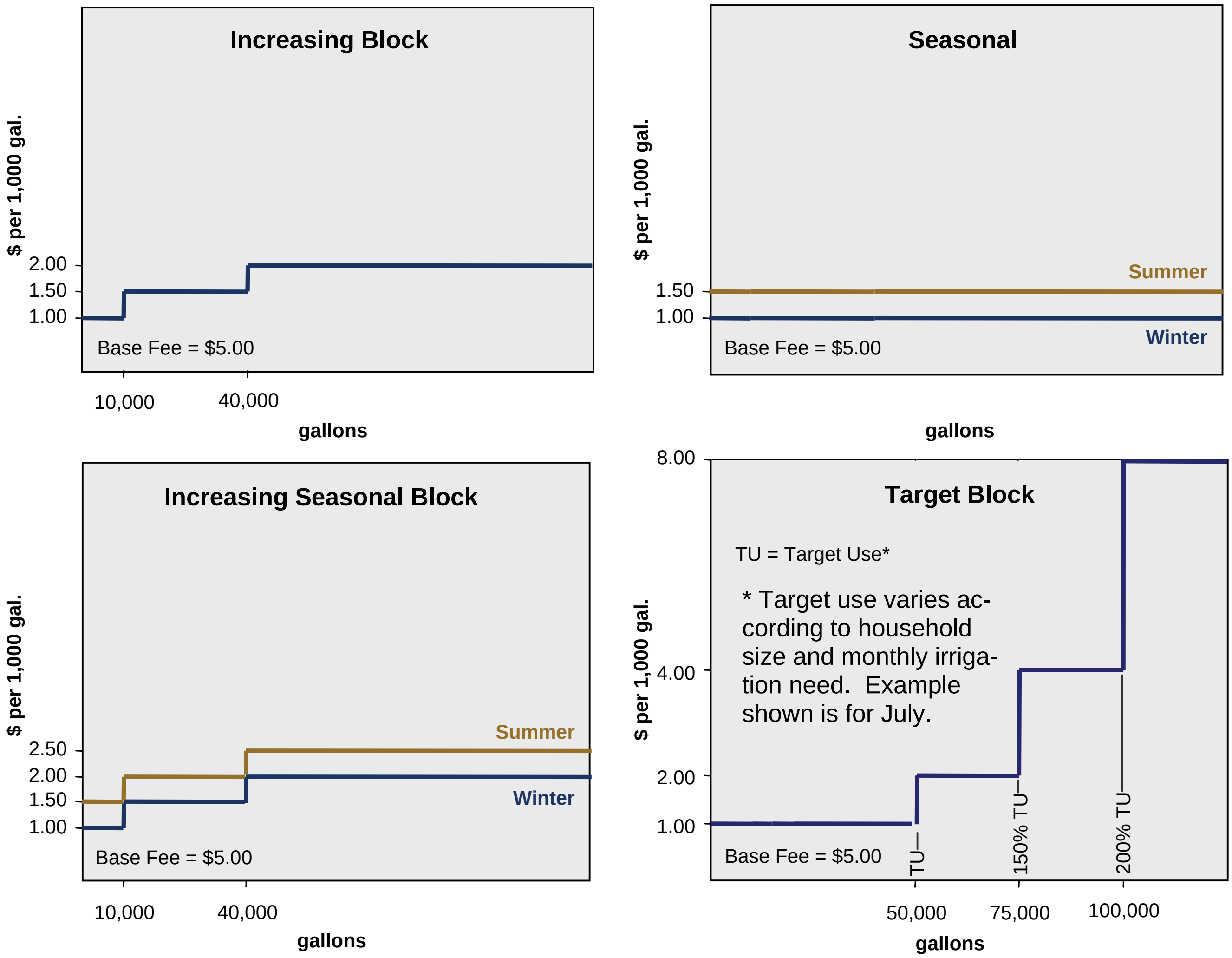
Sources: Utah Division of Drinking Water, *2001 Survey of Community Drinking Water Systems,* 2002. Raftelis Financial Consulting, PA, *2002 Water and Wastewater Rate Survey,* Charlotte, N.C., 2002, 6.
* Does not include the cost of nonpotable water (which is generally much cheaper) that may be delivered within the communities listed.
† Average based on only those communities that submitted data, including some not listed above.

Increasing Block Rates

Most pricing structures have a base fee, which must be paid whether or not any water is used. A fixed amount of water is usually made available at no additional cost as part of this fee. The price of subsequent increments of water supplied then increases in a step-wise fashion. This rate structure encourages efficiency only if the steps in the incremental price are sufficient to discourage excessive use. Separating the base fee from any water actually delivered allows the water supplier to better reflect the actual costs of providing water service. Ideally, the base fee would be set to cover the fixed costs of providing service while the overage rates would be set to cover the variable costs of delivery.

According to a recent survey, the increasing block rate is used by about 42 percent of Utah's drinking water systems. In the Weber River Basin, 56 percent of drinking water systems employ this type of rate structure.[5] Base charges in these systems range from a low of $4.55 in South Ogden to a high of $64 in some areas of Summit County, and average about $17.48. The amount of water made available at no additional cost ranges from a low of 0 gallons in many communities to 20,000 gallons in some areas of Summit County, with an average of about 9,000 gallons. The price of the first additional increment of water (not supplied as part of the base charge) ranges from a low of $0.25 per 1,000 gallons in Ogden to $2.50 per 1,000 gallons in Riverdale, with an average of about $1.22 per 1,000 gallons. The price of additional increments ranges from a low of $0.75 in Clearfield to $15 for the Gorgoza Mutual Water Co.[6]

FIGURE 9
Example Rate Structures and Bill Comparison



Billing Month & Use Scenario	Increasing Block	Seasonal	Increasing Seasonal Block	Target Block
January				
Low Use (7,500 gal.)	$12.50	$12.50	$12.50	$12.50
Average Use (10,000 gal.)*	$15.00	$15.00	$15.00	$15.00
High Use (15,000 gal.)	$22.50	$20.00	$22.50	$25.00
July				
Low Use (37,500 gal.)	$50.50	$60.50	$75.00	$42.00
Average Use (60,000 gal.)*	$85.00	$95.00	$130.00	$75.00
High Use (90,000 gal.)	$145.00	$140.00	$205.00	$165.00

* For January, the average use is based on a household of four which uses approximately 80 gallons per person per day. For July, the average use is based on an irrigation requirement of 7.6 inches and a lot size of about 0.29 acres.

Seasonal Rates

This rate structure has a base charge much the same as the increasing block rate. The main difference is that instead of rate increases depending on the volume of water used, rates are set according to seasons. The price for each unit of water delivered in winter is lower than for water delivered in the summer. The summer price is set strategically to cover peak delivery costs and to encourage consumers to be more conscious of irrigation habits during the months when peak demands often strain the delivery system. If desired, a spring and fall use rate can also be applied. This helps reflect the rising and falling costs associated with typical use patterns of a water supply system. It also provides water suppliers with an opportunity to remind consumers that irrigation needs are typically less during the spring and fall months and, therefore, sprinkler timers should be adjusted accordingly. There are no water systems in the Weber River Basin that currently use a seasonal block rate structure.

Increasing Seasonal Block Rates

This rate structure is a combination of the increasing block and seasonal rates. Like the seasonal rate, it has a price for each unit of water delivered in winter that is lower than for water delivered in the summer. However, instead of a flat rate for a given season, the increasing seasonal block rate has an increasing block rate for each season (see Figure 9). If desired, an increasing rate for the spring and fall seasons can also be applied. This type of rate structure is new to Utah. In 2003, Salt Lake City and Sandy adopted this type of rate structure. Kaysville is the only community in the Weber River Basin that currently uses an increasing seasonal block rate structure. Kaysville charges a base rate of $12.50 for the first 10,000 gallons. During the winter season, the city charges $1.25 per thousand gallons for all use in excess of the initial 10,000 gallons. During the summer, the city charges $1.85 per thousand gallons for all use between 10,000 and 20,000 gallons, with a rate that increases to $3.70 for each thousand gallon used in excess of 20,000 gallons.

Target Block Rates

This rate structure requires that a target use be established for each customer. This target is based on the water needs of the landscape and the number of people in the home or business. Landscape water need is determined by using evapotranspiration rates for turf grass from local weather stations and landscape size. Then, each unit of water is priced in such a way so as to reward the consumer for using less than the target use and penalize them for using amounts that exceed the target use (see Figure 9). Water providers can assess penalties by using a sequentially higher rate, which typically doubles with each volume increment in excess of the target. Because of the effort required to obtain and maintain accurate data on all customers, the target block rate requires more staff and capital resources than any of the other rate structures. Currently, there are no water systems in the Weber River Basin that use a target block rate structure.[7]

Keys to Successful Incentive Pricing

Implementing incentive pricing structures, such as those outlined above, must be done carefully to be successful. A successful rate structure has the following characteristics:

- encourages more efficient water use without causing a reduction in system revenue;
- rewards efficient use and penalizes excessive use;
- produces revenues that are used to fund water conservation programs;
- is supported by a water bill that clearly communicates the cost of wasted water to the responsible person;
- is supported by staff who can respond to customer calls for help in reducing use; and
- is accepted by the community.

BMP 4 - Water Conservation Ordinances

- Adopt an incentive water rate structure.
- Adopt a time-of-day watering ordinance.
- Adopt an ordinance requiring water-efficient landscaping in all new commercial development. This should include irrigation system efficiency standards and an acceptable plant materials lists.
- Adopt an ordinance prohibiting the general waste of water.

(For sample ordinances, go to www.conservewater.utah.gov and click on “Agency Resources.”)

Outdoor Watering Guidelines and Ordinances

If residential outdoor conservation were practiced, the potential water savings would be great since it makes up the biggest part of residential use (approx. 70 percent) in the Weber River Basin. The Division of Water Resources estimates the water needed to produce a healthy lawn on a typical residential landscape could be reduced at least 25 percent in the Weber River Basin by following two simple steps. These are: (1) Watering to meet the turf water requirement—the amount of water needed by a turf to produce full growth; and (2) Maintaining a sprinkler distribution uniformity (how evenly the sprinkler system spreads the water) of at least 60 percent.[8] Table 15 contains a recommended irrigation schedule for each of the counties within the Weber River Basin. Not only will watering to meet this turf water requirement conserve water, but it also produces a healthier and better-adapted turf. Average residential sprinkler uniformities in Utah have been found to be about 58 percent.[9] Increasing these to at least 60 percent can be easily achieved by designing sprinkler systems properly and by inspecting and maintaining their performance regularly.

Other conservation measures include setting watering durations to suit different soil types and microclimates, using several short durations (cycling) to water deeply while avoiding runoff, and watering flower and shrub areas less than turf areas. Another method that has proven effective in reducing water consumption is simply confining watering to times during the day that minimize evaporation, between 6 p.m. and 10 a.m., for example. These recommendations should be made to the public during both wet and dry climatic conditions.

The Bountiful Water Sub-Conservancy District was one of the first water suppliers along the Wasatch Front to implement a time-of-day watering restriction. After recommending a voluntary restriction in watering during the daytime hours in the mid-1980s, the district immediately realized a decrease in water consumption of about 17 percent.[10] In 1999, the Sub-Conservancy District adopted this restriction as a formal ordinance. Since that time, the Weber Basin Water Conservancy District and numerous communities across the state have adopted similar ordinances.

The potential savings resulting from irrigation guidelines and ordinances make such measures extremely attractive. The immediate reduction in peaking loads that is produced not only conserves water but also delays the need for system upgrades and expansion that are dictated by peak system demands. Any water conservation program should seriously consider such measures.

TABLE 15
Recommended Irrigation Schedule*

	Watering Interval† (days between watering sessions)			
Irrigation Period	**Davis County**	**Weber County**	**Morgan County**	**Summit County**
Startup until April 30	6	6	7	7
May	4	4	5	5
June	3	3	3	4
July	3	3	3	4
August	3	3	4	4
September	5	6	5	6
October 1 until shutdown	9	10	9	-

* This schedule assumes an application of ½ inch of water per watering session and is based on historical turf water requirements from Hill, Robert, *Consumptive Use of Irrigated Crops in Utah,* (Logan: Utah Agricultural Experiment Station, 1994).

† Based on annual average turf water requirements of approximately 24” (Davis), 25” (Weber), 20” (Morgan), 18.5” (Summit).

Landscape Guidelines and Ordinances

The types of plants that make up a landscape and the total area that requires landscaping can have a significant impact on overall water consumption. Replacing typical turf grass and other water-intensive vegetation with native or adapted low water-use plants significantly reduces outdoor water needs; hardscaping a portion of the landscape eliminates the need to water that area. Not only do water-wise landscapes conserve water, but they consume less amounts of chemicals, require less maintenance than typical turf, and add interest and color to the ordinary landscape.

Changing the way people landscape so that it more closely matches the stresses of Utah's semiarid climate is an important aspect of long-term water conservation. Demonstration gardens and public education programs that communicate efficient landscaping techniques, as well as ordinances that promote more "natural" landscaping practices, are important components of an outdoor water conservation program. Ordinances that require unnecessary green spaces and promote water waste should be eliminated.

The Utah Botanical Garden, located near I-15 in Kaysville, demonstrates water conservation principles in its landscapes. The Utah House, a model home that demonstrates energy and water conservation principles, is now open to the public at the garden. The garden provides residents of the Weber River Basin with a useful resource for landscaping ideas that are both attractive and water conscious.

Weber Basin Water Conservancy District has also contracted with Utah State University to include a demonstration garden at their headquarters in Layton. This garden will be an extension of the Utah Botanical Garden in Kaysville. Red Butte Garden and Jordan Valley Water Conservancy District's demonstration gardens in the Salt Lake Valley are also valuable resources for those interested in water-wise landscaping.

BMP 5 - Water Conservation Coordinator

- Designate a water conservation coordinator to facilitate water conservation programs. (This could be a new person or an existing staff member.)

The Division of Water Resources recommends that the individual appointed to the position of water conservation coordinator have knowledge and/or training in the following areas:

- principles and practices of water conservation;
- techniques and equipment used in landscape design and installation;
- Utah native and adapted plants, and turf grasses;
- laws and regulations applicable to water management;
- ability to conduct residential, light commercial and irrigation water audits;
- make presentations to community, technical or professional groups;
- maintain computer records and customer databases;
- research and implement State and local water conservation requirements;
- review architectural and landscape plans for water efficiency requirements;
- communicate effectively verbally and in writing;
- design simple informational publications; and
- Education equivalent to completion of college level course work in landscape architecture, horticulture, computer operations, public relations, architecture or a closely related field.

BMP 6 - Public Information Programs

- Implement a public information program consistent with the recommendations of the Governor's Water Conservation Team. Such programs can be adapted to meet the specific needs of the

The Utah House, located at the Utah Botanical Center in Kaysville Utah, showcases water-wise landscaping principles and indoor water use efficiency.

local area and may use the "Slow the Flow" logo with approval of the division. (For more information, see "Support the Public Information Program of the Governor's Water Conservation Team" on page 37.)

BMP 7 - System Water Audits, Leak Detection and Repair

- Set specific goals to reduce unaccounted for water to an acceptable level.
- Set standards for annual water system accounting that will quantify system losses and trigger repair and replacement programs, using methods consistent with American Water Works Association's Water Audit and Leak Detection Guidebook.

In some water systems, the best way to conserve water may be to discover and repair leaks in the distribution system. Leak detection and repair programs require substantial capital investment but are popular because the results are easily quantified. However, if a thorough investigation determines that leaks are not significant, such programs may not yield savings as significant as other measures.

Homeowners in Davis or Weber County may receive a free outdoor "Water Check" by calling 1-877-SAVE-H20.

Nearly all of the water providers within the Weber River Basin who submitted water conservation plans to the Division of Water Resources indicated the importance of leak detection and repair programs to their operations. Some indicated that leaks had been measured to be less than 10 percent. Water utilities should carefully weigh the costs of infrastructure repair and replacement against all possible conservation measures in order to determine which will most economically attain the desired objectives.

BMP 8 - Large Landscape Conservation Programs and Incentives

- Promote a specialized large landscape water conservation program for all schools, parks and businesses.
- Encourage all large landscape facility managers and workers to attend specialized training in water conservation.
- Provide outdoor water audits to customers with large amenity landscapes.

The Division of Water Resources currently sponsors a series of Water Use Workshops aimed at large landscape water users. These daylong workshops cover topics including Water Checks, Weather, Plants, Soils and Irrigation. Participants are given education and training by qualified USU Extension instructors, as well as a workbook, a set of catch-cups, and a soil probe.

BMP 9 - Water Survey Programs for Residential Customers

- Implement residential indoor and outdoor water audits to educate residents on how to save water.

A water audit is becoming a commonly used tool to help consumers reduce their water use. A complete water audit consists of an indoor and outdoor component. Indoors, a typical audit involves checking the flow rates of appliances and identifying leaks, and if necessary, replacing basic fixtures with low-flow devices and making other necessary adjustments or repairs. Outdoors, an audit measures the uniformity and application rate of an irrigation system, identifies problems, and suggests how to improve system efficiency and water according to actual plant requirements.

Beginning in 1999, the Jordan Valley Water Conservancy District, in cooperation with the Central Utah Water Conservancy District and Utah State University Extension Service initiated a free "water check" program in Salt Lake County. A water check is basically a simplified outdoor water audit for residents. The slogan for the program is "Slow-the-Flow, Save H_20."

BMP 10 - Plumbing Standards

- Review existing plumbing codes and revise them as necessary to ensure water-conserving measures in all new construction.
- Identify homes, office building and other structures built prior to 1992 and develop a strategy to distribute or install high-efficiency plumbing fixtures such as ultra low-flow toilets, showerheads, faucet aerators, hot water recirculators, etc.

Retrofit, Rebate and Incentive Programs

It has long been known that the largest indoor consumption of water occurs via the toilet. This fact prompted legislation to phase out the manufacture of toilets, which typically consumed 3.5 to 7.5 gallons per flush, and replace them with newer low-flow devices that consume 1.6 gallons or less. Since 1992, Utah law requires the installation of these toilets in new construction, and since 1994, federal law prohibits the manufacture of higher-flow toilets. This change reduces indoor residential water consumption in new construction by an estimated six gpcd,[11] but does not affect homes constructed prior to 1992 unless old toilets are replaced. Replacing old-style toilets with newer water efficient designs is recognized by many utilities across the country as an effective way to produce water savings. This is accomplished through retrofit programs or rebates which provide an incentive for residents to remove their old appliances. Because it is fairly easy to estimate the water savings that retrofit, rebate and incentive programs are likely to produce, these programs are a popular method used to help reach water conservation goals.

Although there are no communities within the Weber River Basin that currently sponsor a program to replace toilets or other appliances, Clearfield identified replacing toilets as an option that would be an effective way to reach its water conservation goal. According to its water conservation plan, if a homeowner were to replace all old-style toilets with newer models (average cost per unit of $75), they would save approximately $20 a year on their water bill and the city's water use would decline about 5 percent.[12]

BMP 11 - School Education Programs

- Support state and local water education programs for the elementary school system.

(For more information, go to www.watereducation.utah.gov.)

BMP 12 - Conservation Programs for Commercial, Industrial and Institutional Customers

- Change business license requirements to require water reuse and recycling in new commercial and industrial facilities where feasible.
- Provide comprehensive site water audits to those customers known to be large water users.
- Identify obstacles and benefits of installing separate meters for landscapes.

4 - Set Example at Publicly Owned Facilities

It is important that government entities within the basin be a good example of water conservation for the citizens they serve. To help accomplish this at state owned facilities, the state recently revised its building guidelines and policies to incorporate water-wise landscapes and more water-efficient appliances at new facilities. In addition, the Governor has mandated that all state facilities avoid watering between 10 a.m. and 6 p.m. Local governments should consider making similar adjustments to their building guidelines. This will help ensure that water use at public facilities does not deter citizens from conserving water on their own landscapes.
The Division of Water Resources has a vast collection of materials that can help local governments strengthen their water conservation program and

develop a strong long-term conservation ethic. Various guidelines and recommendations, including sample ordinances, Xeriscape manuals and other resources are all available through the division. Many of these materials are also available at the state's water conservation web page: www.conservewater.utah.gov.

PROGRESS MADE THUS FAR

Statewide Summary

According to the process described previously, the Division of Water Resources recently completed a statewide summary of M&I water use. This summary includes data that represents an approximate statewide value for the year 2005. According to the data, statewide per capita use of publicly supplied water has declined from the 2000 level of 295 gpcd to 260 gpcd, or nearly 12 percent.

Weber River Basin

The Division of Water Resources has conducted several M&I water use studies in the Weber River Basin. The per capita water use delivered by public community systems as determined by each of these studies is shown in Table 16.

TABLE 16
Per Capita Water Use of Public Community Water Systems (GPCD)

Water Use Category	Year			
	1992	2001	2003	2005
Potable	196	184	161	156
Secondary	134	163	126	172
TOTAL	**330**	**347**	**287**	**328**

As the data indicates, since 1992 the water conservation message has not yet had an appreciable impact on the water use habits of the basin's residents. However, since the baseline year of 2001, per capita water use within the basin has declined by about 5 percent. This is a reduction of nearly 1.25 percent per year—more than twice the rate of decline necessary to reach the 25 percent reduction goal by 2050.

One reason for the small overall reduction in use may be the significant impact that the rapid increase in secondary systems has had over this period. Because secondary systems are not metered at the customer level, there is little incentive to conserve. Weber Basin Water Conservancy District recognizes this and has therefore begun a process whereby all new subdivisions within their service area will be required to be metered at the customer level. Additionally, it is the goal of the district that over the next decade all of their retail secondary customers will be metered.

The division will continue to monitor water use closely and make additional recommendations in the future that will help the basin's residents achieve the state's water conservation goals.

NOTES

[1] A private or publicly owned community water system which provides service to at least 15 connection or 25 individuals year round.

[2] Utah Division of Water Resources, *Utah's M&I Water Conservation Plan,* (Salt Lake City: Department of Natural Resources, 2003). This plan is available through the division's web page at: www.conservewater.utah.gov.

[3] *Utah Administrative Code, Title 73-10-32,* (2004).

[4] For an updated list of systems that have submitted plans to the Division of Water Resources, visit the following web page: http://www.conservewater.utah.gov/agency/plans/WMCP.php. All plans are available to the public at the division's office in Salt Lake City.

[5] Utah Division of Drinking Water, *2001 Survey of Community Drinking Water Systems,* (Salt Lake City: Dept. of Environmental Quality, 2002). A total of 40 systems within the Weber River Basin responded with information about their water rate structures. 21 of these employed a uniform rate structure; 18 employed an increasing block rate structure; and one system (Morgan City) used a decreasing block rate structure. Conclusions cited in the text are based upon the data provided by these systems only and may not be representative of all systems within the basin.

[6] Ibid.

[7] West Jordan City is the only community in Utah to have experimented with this type of rate structure, which they have not yet successfully implemented.

[8] Utah Division of Water Resources, *Identifying Residential Water Use: Survey Results and Analysis of Residential Water Use for Thirteen Communities in Utah,* (Salt Lake City: Dept. of Natural Resources, 2000), 27. Weber River Basin communities that were included in the study are Clearfield, Kaysville and Roy. A copy of this document can be obtained online at the division's web site: www.water.utah.gov.

[9] Jackson, Earl, *Results and Impacts Report: Water Check 2001, Salt Lake County*, (Salt Lake City: USU Extension, 2002), Table 6.

[10] Utah Division of Water Resources, *An Analysis of Secondary Water Use in Bountiful, Utah.* This is a non-published report.

[11] Utah Division of Water Resources, 2000, 9.

[12] Gilson Engineering, *Water Conservation Plan—Clearfield City*, (2000), 9.

5

WATER TRANSFERS AND EFFICIENT MANAGEMENT OF EXISTING SUPPLIES

Using existing developed water supplies efficiently is an important element in successfully addressing the future water needs of the Weber River Basin. Increased competition for the basin's water supplies will boost the value of those supplies and encourage innovative water management strategies to be implemented. In some instances, the economic incentive created by increased competition may also lead to the outright transfer of water from one use to another. This chapter discusses the nature of some of these water transfers and highlights some of the other management strategies, which the Division of Water Resources believes will play an important role in the Weber River Basin. These include conjunctive use of surface and ground water, secondary water systems, cooperative water operating agreements and water reuse.

AGRICULTURAL WATER TRANSFERS

Agriculture uses about 67 percent of the presently developed water supply in the Weber River Basin. Municipal and industrial (M&I) demands account for the remaining use (33 percent) of the developed water supply.[1] Existing developed supplies for agriculture represent the most significant source of water to meet future M&I demands, especially along the Wasatch Front where urbanization is replacing irrigated farmland at a rapid pace. Agricultural water transfers—voluntary exchanges of water rights from one individual or entity to another—have and will continue to be a reasonable way to meet future water needs within the basin.

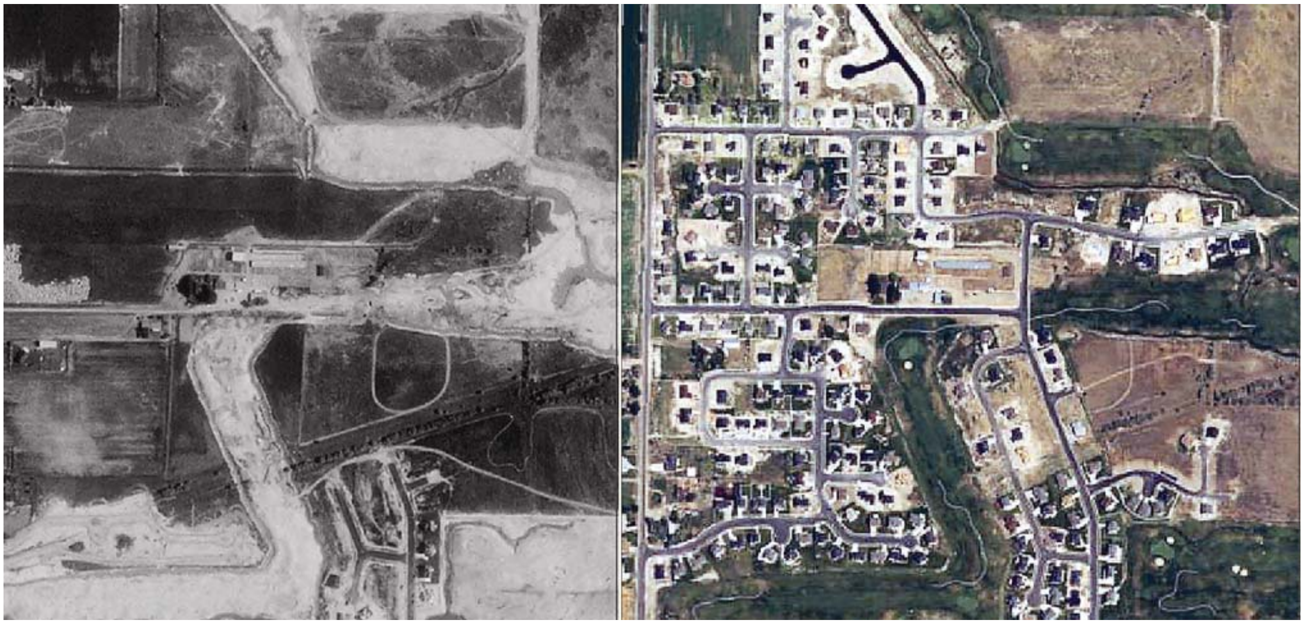
There are three main types of agricultural water transfers: land and water conversions, water rights sales, and water leases. Although land and water conversions have been, and likely will continue to be the most common type of transfer in the basin, it is possible for all three types of transfers to occur. A brief discussion of each is included below.

Land and Water Conversions

As the communities in the Weber River Basin grow, much of this growth will occur on irrigated agricultural land. This is especially true along the Wasatch Front where many cities are constrained on one or more sides by the Wasatch Mountains and the Great Salt Lake, which constrict the lands available for development. Under such conditions, urban development on irrigated agricultural lands will continue to occur at a rapid pace.

When a piece of irrigated farm land changes from agricultural to urban use, many communities in Utah require the agricultural water rights associated with the land to be transferred to the municipality as a condition of approving the development. In most cases, the same amount of water used to irrigate an acre of agricultural land is sufficient to meet the indoor and outdoor water needs of an acre of urban development. Water transferred in this manner typically becomes part of the municipality's water supply, which can then be treated and delivered to meet growing water demands. In the Weber River Basin, however, many communities do not necessarily acquire the water rights; instead, they require the water to be added to the supply of the local secondary water supplier.

Although the amount of water required per acre of land for irrigated agriculture is about the same as the water required for urban development on the same



In many areas of the basin, agricultural lands are quickly becoming urban. The agricultural water rights associated with these lands need to be converted to urban uses. These photos, taken around 1993 (left) and 1999 (right), show the rapid development of the Glen Eagle Golf Course Community in Syracuse.

acre, the water is not always transferred in such a way that fully meets both indoor and outdoor water needs. This forces the city to utilize its own drinking water sources to satisfy indoor uses or to apply for additional drinking water from the Weber Basin Water Conservancy District (WBWCD). This places a higher strain on the city's or district's existing water supplies, and will eventually lead to the city or district searching for additional supplies to meet growing drinking water demands. Ideally, a portion of each agricultural water conversion should be transferred to the entity supplying drinking water.

To help address this issue, the WBWCD recently negotiated agreements with several Davis County communities and Davis and Weber Counties Canal Company (D&W), requiring that developers acquire water rights and turn these rights into the cities before new subdivisions are approved. The Cities will retain the water rights and lease the water to secondary water providers to deliver to their customers, at no cost. The effected communities and WBWCD will use these water rights to meet all new outdoor and indoor demands for these subdivisions. If the land to be developed does not have sufficient water on it or has never had irrigation water on it, the developer would be required to pay a water fee that would allow WBWCD to contract with D&W to supply water to the development.[2]

Water Rights Sales

Another form of water transfer is a simple water right sale, which involves the transfer of a water right from one user to another, separate from any land use considerations. In agriculture, such a transfer requires retiring (taking out of production) agricultural lands and changing the place and purpose of use of the associated water rights. Those seeking to buy water rights in this manner should be cautious to only purchase certified water rights with an adequate priority date.

Water rights sales take advantage of available mechanisms to legally move water from one area to another. Such transfers generally result in a shift of available water supplies from lower-valued to higher-valued uses, thus producing an increase in the economic value of the water. However, such transfers can also have negative impacts on localized land values and will reduce the amount of agricultural production available to local communities.

Water Leases

Another type of transfer is a conditional or "dry year" transfer. Conditional transfers are temporary water leases that are contingent upon certain conditions. Such transfers often have arrangements that define an "interruptible supply" that may periodically be used, under certain conditions such as a drought or other emergency. Although the Division of Drinking Water does not recognize such leases toward meeting minimum fire flow and long-term water requirements, they are useful for obtaining adequate supply under extenuating circumstances.

WBWCD is currently pursuing a water lease with several cities. These cities have developed water rights, which they have no immediate plans to use. Since current Utah law does not allow municipalities to divest themselves of water rights, WBWCD is negotiating a long-term lease with these cities that will allow them to put the water to beneficial use.

Quantifying Land Conversions and Associated Water Transfers

The extent to which agricultural water will be converted to meet municipal and industrial (M&I) needs depends on state agricultural policy, the proximity of growth to irrigated lands, and the relative value of the land and water to be exchanged. Another factor is the amount of water that can actually be converted. Because there are return flow obligations associated with agricultural water rights, when they are converted to M&I uses a portion of the water right must remain in the hydrologic system. For instance, while a farmer in Morgan County may be allowed by his water right to divert 4.0 acre-feet per acre, the depletion limit of the water right is closer to 2.2 acre-feet per acre. Thus, when his water right is sold to a neighboring community, the State Engineer limits the amount of water that the community can divert under the new water right to 2.2 acre-feet per acre of the original acreage. The rest of the water remains in the hydrologic system to make sure downstream users that rely on the return flows associated with the water right are not adversely impacted.

Agricultural to urban water transfers will play an important role in meeting the future water needs of the Weber River Basin. Table 17 contains estimates of the reduction in agricultural water diversions (projected to occur in the future due to urban growth) and Table 18 estimates the portion of these diversions that can be converted to M&I uses. The following paragraph describes the methodology used by the Utah Division of Water Resources to make these estimates.

The division conducted a land use survey of the Weber River Basin in the summer of 2007. Using the data collected from this survey, 2007 population densities, and future population estimates, the division estimated how much irrigated agricultural land would be converted to urban use and, subsequently, how much water would no longer be used to irrigate these lands (see Table 11 and Table 12 in chapter 3). The division then approximated how much of this water may be able to be transferred from agricultural to M&I uses as a result of these land changes. If these estimates prove accurate, a significant volume of water will become available over the next several decades to meet M&I needs. However, in order to convert all of this agricultural water (some of which is provided by the Weber Basin Project), contracts with the federal government will need to be renegotiated.

TABLE 17
Reduced Agricultural Diversions

	Reduced Agricultural Diversions (acre-feet/yr)*	
County	**2030**	**2060**
Davis	31,200	42,700
Morgan	4,700	15,300
Summit	14,600	37,000
Weber	20,000	52,600
BASIN TOTAL	**70,500**	**147,600**

* See Table 12 for estimates of water diversion changes.

TABLE 18
Estimated Agricultural Water Available to Convert to M&I Uses

	Estimated Conversions (acre-feet/yr)*	
County	**2030**	**2060**
Davis	20,143	27,623
Morgan	3,076	9,896
Summit	9,445	23,965
Weber	12,888	34,008
BASIN TOTAL	**45,551**	**95,491**

* Based on a depletion limit of 2.2 acre-feet per acre of agricultural land lost to development (see Table 11 for estimates of irrigated cropland changes).

CONJUNCTIVE USE OF SURFACE AND GROUND WATER SUPPLIES

In areas where the available water resources have been nearly fully developed, optimal beneficial use can be obtained by conjunctive use of surface water and ground water supplies. This involves carefully coordinating the storage, timing and delivery of both resources. Surface water is used to the fullest extent possible year round, while ground water is retained to meet demands when stream flows are low. Generally, the total benefit from a conjunctively managed basin will exceed that of a basin wherein the resources are managed separately. Additional benefits of conjunctive use may include:

- better management capabilities with less waste;
- greater flood control capabilities;
- greater control over surface reservoir releases; and
- more efficient operation of pump plants and other facilities.

Aquifer storage and recovery (ASR) is a form of conjunctive use where excess water is stored underground in a suitable aquifer and recovered later as needed. Water can recharge the aquifer through surface infiltration basins or injection wells. Some water utilities in the U.S. use ASR to store treated surface water during periods of low water demand and provide the recovered water later to meet peak daily, short-term, or emergency demands. Others store it for use during periods of drought.

Unlike surface water storage, aquifer storage requires minimal structural elements. This is an attractive benefit considering the difficult political and environmental challenges facing most modern surface water storage projects. Aquifers also do not lose water to evaporation and provide a water quality benefit since they have a natural ability to filter sediment and remove some biological contaminants.

In Utah, there are several existing ASR projects. Brigham City, Jordan Valley Water Conservancy District (JVWCD), Metropolitan Water District of Salt Lake and Sandy (MWDSLS), Washington County Water Conservancy District (WCWCD), and Weber Basin Water Conservancy District (WBWCD) operate these projects. Brigham City and JVWCD both utilize injection wells to recharge aquifers and supplement their existing water supplies. The other three entities utilize various types of surface infiltration to recharge local aquifers and enhance available ground water supplies.

Weber Basin Water Conservancy District's Aquifer Storage and Recovery Pilot Project

Background

In 1952, the U.S. Bureau of Reclamation (BOR) conducted a series of ground water recharge experiments near the mouth of Weber Canyon. The purpose was to determine whether surface infiltration at this location would recharge the Weber Delta Aquifer. These experiments were very successful. Using the gravel pit nearest the mouth of the canyon, BOR realized an infiltration rate of approximately 7 cfs per acre and measured a significant hydraulic response to this recharge in several monitoring wells located near the site and several miles away. The experiments lasted seven weeks and added approximately 2,200 acre-feet of water to the ground water aquifer.

Since then, there have been flooding events and ground water studies conducted that have increased the knowledge of recharge at the mouth of the canyon. During the flood of 1983, part of the Weber River flooded into one of the gravel pits near the mouth of the canyon. Within two weeks this water (estimated to be several thousand acre-feet) had disappeared into the ground. In 1986, a study of the aquifer was completed, which culminated in a proposal to recharge ground water at the mouth of the canyon on a permanent basis.[3] Due to liability concerns and lack of funding, however, this proposal was eventually abandoned.

In the summer of 2002, BOR approached the Utah Division of Water Resources and the Weber Basin Water Conservancy District (WBWCD) seeking water supply topics that needed further study within the basin. The three agencies decided to initiate an aquifer storage and recovery pilot project at the mouth of Weber Canyon. Later, the Utah Geological Survey and Weber State University joined the project team.

The Weber River Aquifer Storage and Recovery Pilot Project is located in a retired gravel pit near the mouth of Weber Canyon. Shown here are two of the project's four recharge basins filled with water in the spring of 2004.

Purpose of Pilot Project

The main purpose of the pilot project was to enhance the understanding of the aquifer recharge potential at the mouth of Weber Canyon. Using the knowledge gained, WBWCD hopes to expand the pilot project into a large-scale, permanent recharge facility. A permanent project would have many benefits, including the following:

- Increase the total available water supply within the Weber River drainage and improve its reliability.
- Allow WBWCD and its contracting entities greater flexibility to meet peak demands during the summer and shortages during drought.
- Slow and possibly reverse ground water level declines in the Weber Delta aquifer.
- Reduce and possibly eliminate the threat of ground subsidence.
- Reduce the risk of saltwater intrusion from the Great Salt Lake.
- Develop a new ground water model for the Weber Delta aquifer.

In addition to the benefits that the Weber River Basin will realize, a successful project could greatly impact the use of this technology throughout the rest of the state. Much has been learned already, and this knowledge is forming a solid foundation for future projects.

SECONDARY WATER SYSTEMS

A secondary (or dual) water system supplies non-potable water for uses that do not have high water treatment requirements, such as residential landscape irrigation. A secondary system's major purpose is to reduce the overall cost of providing water by using cheaper, untreated water for irrigation and preserv-

WBWCD's Aquifer Storage and Recovery Pilot Project Summary

Cost	
Federal Share	$275,000
Local Share	$550,000
Total Cost	$825,000
Site Data (approximations)	
Sedimentation Basin	0.3 acre
Four Recharge Basins	3.7 acres
Total Site Area (bottom of pit)	6.0 acres
Water Supply	8.1 cfs
Infiltration Rate	1.3-2.5 cfs/acre
Total Infiltration Vol.	3,000 acre-feet

Participating Agencies
U.S. Bureau of Reclamation (funding agency)
Weber Basin Water Conservancy District (sponsor)
Weber State University
Utah Geological Survey
Utah Division of Water Resources

Regulatory Oversight
Utah Division of Water Quality
Utah Division of Water Rights

ing higher-quality, treated water for drinking water uses. Secondary systems are also an efficient way to transfer agricultural water to M&I uses as farm lands are sold and become urban, as many of the same facilities and right-of-ways that were used to deliver water to farms can be used to deliver secondary water to homes.

The Weber River Basin—
A Leader in Providing Secondary Water

Water suppliers in the Weber River Basin have long recognized the value of secondary systems. The first secondary irrigation system that the U.S. Bureau of Reclamation ever built was in South Ogden in 1934. Table 19 shows estimates of secondary system water deliveries by county for 1992 and 2005. Water suppliers in the Weber River Basin deliver more secondary water for outdoor irrigation than the rest of the state combined. In 1992, approximately 58,000 acre-feet, or 54 percent of the state's total secondary water use of 92,000 acre-feet per year, occurred within the Weber River Basin.[4] This percentage is likely much higher today, as secondary systems within the basin grew about 75 percent between 1992 and 2005, with a total use within the basin of 101,000 acre-feet estimated in 2005.

While water professionals around the country are clamoring for the day that dual systems will exist on a large scale in their respective areas, that day has already arrived for the Weber River Basin. Out of the basin's 83 community water systems, 63 (or 76 percent) provide secondary water to at least some of their customers. In Davis and Weber counties, 44 out of the 52 community systems (or 85 percent)

Secondary water reservoirs like this one in Davis County are an important component of the extensive secondary irrigation systems within the Weber River Basin.

provide secondary water. When estimating how much of the total water demand in the basin is satisfied by secondary water systems, the percentages are unusually high. In 2005, approximately 49 percent of the total M&I water demand and 72 percent of the total outdoor water demand was provided by secondary systems—up from the 34 and 52 percent estimated in 1992. While water managers and planners deserve praise for promoting and building the basin's secondary water systems, local governments are largely responsible for making it happen. Many local ordinances require secondary irrigation of landscapes, making secondary systems the norm—not the exception—within the basin.

High Water Use in Secondary Systems

Although secondary systems do free up treated water supplies for drinking water purposes, it is important to recognize that they typically result in higher overall water use than a typical potable (culinary) water system that provides water for both indoor and outdoor uses. This is because most secondary connections are not metered and users pay a flat rate for all the water they use. The Division of

TABLE 19
Estimated Secondary System Water Use by County

County	1992 No. of Systems	1992 Water Use (acre-feet)	2005 No. of Systems	2005 Water Use (acre-feet)
Davis	12	28,500	34	61,125
Morgan	7	200	16	530
Summit	15	1,800	30	2,236
Weber	17	27,400	44	37,230
BASIN TOTAL	**51**	**57,900**	**124**	**101,121**

Sources: Utah Division of Water Resources, *Municipal and Industrial Water Supply Studies—Weber River Basin*, (Salt Lake City: Dept. of Natural Resources, 1996, rev. 2000), and data collected in 2005 that has not yet been published.

Water Resources and WBWCD are currently studying the water use in several secondary systems located in Davis, Weber and Tooele counties. Preliminary results from this study indicate that secondary water users over-water their landscapes by 25 to 150 percent with an average of nearly 50 percent more water applied than necessary. In a separate study of outdoor water use in potable water systems, the division found that homeowners over-water their landscapes by an average of 20 percent.[5]

Because secondary systems have a higher water use than typical drinking water systems and the number of secondary systems within the basin is rapidly increasing, the Utah Division of Water Resources is working with WBWCD to find ways to reduce water use in secondary systems.

One way to deal with over-watering in secondary systems is to meter the water and charge according to an incentive pricing rate structure. However, because conventional meters plug up and wear out quickly on secondary systems, filtering the water to a level where conventional meters will function properly or using a meter that can function in such conditions is usually required and is almost always an economic impediment to metering. Another option that would help reduce the amount of water used by secondary water customers would be to install some type of "smart" timer or irrigation controller that automatically applies water according to the needs identified by a local weather station. The division has been studying the use of two such timers in recent years. Preliminary results from these studies[6] show that water use can easily be decreased anywhere from 10 to 50 percent. These studies also demonstrate that targeting the highest water users with a "smart" timer is extremely effective, with an average savings of 35 percent. Whatever the solution, making water use in secondary systems more efficient is an important component of future water management within the basin.

Health Issues

Because secondary water is untreated, care must be taken to protect the public from inadvertently drinking from a secondary system and possibly becoming ill. Codes preventing cross-connections and providing adequate backflow prevention devices need to be enforced and secondary lines and connections need to be clearly labeled. In public areas, signs need to be installed to warn individuals against drinking from the irrigation system.

COOPERATIVE WATER OPERATING AGREEMENTS

Temporary localized water shortages may occur as the result of system failures or as a result of growth that approaches the limits of the water system or supply. A cooperative approach to water resource and system management at the local and regional level can help water managers prevent these type of shortages and better cope with them if they do occur. This is often accomplished without committing large sums of money to capital expenditures for new supplies that would otherwise be required. In its simplest form, connections are installed between adjoining water systems and an agreement is made regarding the transfer of water between them.

At an institutional level, the managers of the cooperating systems must agree on such things as water transfer strategies, plans for interconnections, water conservation enforcement policies and emergency management plans. Perhaps the most significant institutional challenge is to remove the psychological hurdle of taking water from one system and sharing it with another. To do this, education of the public on the benefits of a regional, cooperative approach to system management will often be necessary. The Utah Division of Drinking Water is working towards this goal by helping small local water systems consolidate their water treatment operations. The Division of Water Resources also encourages water suppliers to explore these opportunities.

In the spring of 2000, the City of Bountiful entered into a 25-year cooperative agreement with the South Davis County Water Improvement District. This agreement allows Bountiful to utilize the unused capacity of three district wells and associated piping to meet the needs in the south part of the city. By sharing these facilities, the city will not have to invest large amounts of capital to drill their own wells and construct related infrastructure. The district benefits from the agreement by being able to share the associated treatment, operation and maintenance costs with Bountiful. The district also receives a fee for each acre-foot of water that Bountiful withdraws—turning what for them was an unused water source into a revenue-producing asset. Under full operation, Bountiful will be able to supplement their supplies by approximately 1,355 acre-feet per year until such a time that the district needs the additional capacity to provide water to their own customers.

WATER REUSE

Only about 20 percent of a community's indoor water use is consumed and made unavailable for further use. The remaining 80 percent, returns to the hydrologic system as municipal wastewater. In the past, this wastewater was often viewed as a nuisance to be disposed of and forgotten. However, due largely to a rapidly increasing population that is stretching current water supplies, views towards treated effluent (reclaimed water) are changing. Pristine drinking water sources are diminishing, and reclaimed water is becoming appealing as a substitution for drinking water in nonpotable applications, such as the irrigation of landscapes. Today treated municipal wastewater is being increasingly tapped as a valuable source of supply.

Water has always been used and reused (or recycled) by humans as a natural part of the hydrologic cycle. The return of wastewater to streams and rivers, and the reuse of these waters by downstream users, is not new. However, in this document, "water reuse" refers to the deliberate reuse of treated wastewater, which involves varying degrees of additional treatment and disinfection, and the planned use of the resulting effluent for another purpose.

Reuse Options

Utah Administrative Code, Title R317-1-4, provides regulations that must be followed for reuse of treated wastewater. These regulations describe the water quality standards that must be met for two distinct categories of reuse—Type II reuse, where human contact is unlikely, and Type I reuse, where human contact is likely. Type II water quality standards require secondary level treatment plus disinfection. Type I water quality standards require tertiary level treatment (advanced filtration), as well as a higher level of disinfection. The allowable applications for Type II and Type I reuse categories are listed in Table 20.

In Utah, the number of reuse projects is growing. Most projects to date have used the reclaimed water for agricultural irrigation of animal feed crops and have done so primarily to avoid discharging to a water body. However, recent projects in Salt Lake and Tooele counties have used reclaimed water to irrigate golf courses. Although not yet in operation, several water reuse projects throughout the state will also use reclaimed water to irrigate commercial and residential landscapes.[7]

TABLE 20
Acceptable Uses for Reclaimed Water in Utah

Type II – Human Contact Unlikely
1. Irrigation of sod farms, silviculture (tree farming), limited access highway rights-of-way, and other areas where human access is restricted or unlikely to occur.
2. Irrigation of food crops where the applied reclaimed water is not likely to have direct contact with the edible part, whether the food will be processed or not (spray irrigation not allowed).
3. Irrigation of animal feed crops other than pasture used for milking animals.
4. Impoundments of wastewater where direct human contact is not allowed or is unlikely to occur.
5. Cooling water. Use for cooling towers that produce aerosols in populated areas may have special restrictions imposed.
6. Soil compaction or dust control in construction areas.
Type I – Human Contact Likely
1. All Type II uses listed above.
2. Residential irrigation, including landscape irrigation at individual houses.
3. Urban uses, which includes non-residential landscape irrigation, golf course irrigation, toilet flushing, fire protection, and other uses with similar potential for human exposure.
4. Irrigation of food crops where the applied reclaimed water is likely to have direct contact with the edible part. Type I water is required for all spray irrigation of food crops.
5. Irrigation of pasture for milking cows.
6. Impoundments of treated effluent where direct human contact is likely to occur.

Source: *Utah Administrative Code, R317-1-4.*

Existing and Proposed Water Reuse in the Weber River Basin

Currently, there are no deliberate instances of water reuse in the Weber River Basin. However, there are numerous examples of incidental reuse. The most significant of these occurs below the Central Weber Wastewater Treatment Plant, which discharges its effluent into the Warren Canal. Once discharged to the canal, the effluent mixes with Weber River water and is used to irrigate crops during the irrigation season. All other instances occur after the wastewater effluent has been discharged to a natural water body, such as the effluent discharged from the Snyderville Basin Water Reclamation facilities located on East Canyon and Silver creeks. This effluent is collected in East Canyon and Echo reservoirs, where it is stored along with other natural runoff for various uses.

Currently, there are two proposed water reuse projects in the Weber Basin that are being studied. Both of these projects are for secondary irrigation purposes and are described below.

Central Weber Sewer Improvement District[8]

Central Weber Sewer Improvement District is also proposing a water reuse project in Weber County, northwest of Ogden. In conjunction with the District, Pine View Water Systems proposes to use approximately 10 million gallons per day (5,554 acre-feet per year) of treated effluent to help meet the growing demand for secondary water within its service boundaries. This is approximately 30 percent of the effluent that is currently treated and discharged into the Weber River and the Warren Canal. In order to meet water quality standards required for use in secondary systems, the treatment plant will install bio-enhanced membrane filters. This filtering technology was recommended because it will provide a level of treatment that is more reliable than other filtering technology, and although it is more expensive, will likely be more acceptable to water users. After treatment, the water will be pumped approximately four miles into an existing secondary water storage reservoir where it will mix with untreated Ogden River water before it enters the existing secondary irrigation pipelines. The total estimated cost of the project is approximately $22.5 million.

Snyderville Basin Water Reclamation District

In February 2006, the U.S. Bureau of Reclamation (BOR), in conjunction with the Utah Division of Water Resources, completed a study of water needs within the Snyderville Basin and proposed several alternatives to meet these needs.[9] The most cost-effective option identified by this study was water reuse. As a result of this favorable economic assessment, the study subsequently assumed that local entities would develop approximately 3,600 acre-feet of reuse water by 2050 to help satisfy future irrigation demands within the basin.[10]

Following the recommendations of the BOR study, the Snyderville Basin Water Reclamation District (SBWRD) commissioned a study to lay out a master plan that incorporated all the major water development components recommended in the plan, including water reuse.[11] This study proposed the development of a combined water reuse/raw water delivery line that would have the capacity to deliver an annual volume of 8,700 acre-feet to all golf courses and other large landscapes within the basin. 4,600 acre-feet of this capacity would be for the maximum volume of water reuse water believed available by the year 2050.[12] The SBWRD study estimated the total cost of the proposed reuse/raw water delivery system would be approximately $37.5 million, of which the water reuse component would be approximately half (based on water reuse's proportion of the total capacity).[13]

Potential for Reuse

The potential for further water reuse in the Weber River Basin is great. Table 20 shows the estimated volume of wastewater effluent from all of the Weber River Basin's sewage treatment plants. Two of the fourteen treatment facilities in the basin (listed as advanced tertiary processes) already treat their water to "Type I" standards for purposes where human contact is likely. The other twelve plants would only be able to apply reclaimed water for purposes listed as "Type II," where human contact is unlikely, without upgrading their current treatment process.

In addition to these important water quality standards, the appropriateness of any individual reuse project depends upon how it will affect existing water rights and the environment. Often, downstream users and the environment depend upon the wastewater effluent. These needs must be addressed as part of the feasibility of any reuse project.[14]

As shown in Table 21, the total volume of estimated effluent was approximately 83,243 acre-feet per year. Most of this volume is located in the lower portion of the basin near the Great Salt Lake. While it may be possible to immediately use more of this water to irrigate agriculture on nearby farms, much of the potential for reuse will likely come in the future as urban growth continues westward from the Wasatch Range toward the Great Salt Lake. However, even then, reuse within the basin may not be competitive with other water supply options because of the high cost of treating effluent to standards acceptable for municipal and industrial use and the expected decline in demand for agricultural irrigation water as farmland is replaced by urban developments.

Gray Water Recycling and Rainwater Harvesting

Gray water recycling is a form of water reuse that is often spoken of as a potential conservation measure. Gray water is typically what goes down the bathtub drain, bathroom sink or out of the washing machine. The effluent from the toilet, kitchen sink and dishwasher is typically not suitable for home recycling. Gray water systems are usually installed on individual homes; however, large hotels have been known to install gray water systems as the water supply for flushing toilets. A well-designed gray water system has the potential to reduce indoor household water use by up to 30 percent.

Gray water is not without its problems. It contains organic matter, pathogens, detergents, and salts, and without disinfection, is only suitable for certain uses, such as subsurface irrigation. Some gray water systems provide disinfection and short-term storage; these systems are more expensive, but in some states

TABLE 21
Annual Discharges by Wastewater Treatment Plants in the Weber River Basin

Facility	Treatment Process	Receiving Water Body	Design Capacity (MGD)	Average Daily Flow (MGD)	Est. Annual Discharge (ac-ft/yr.)
Upper Basin					
Kamas City	Secondary	Weber River	2.00	0.30	336
Oakley City	Advanced Tertiary	Weber River	0.25	0.20	224
East Canyon	Advanced Tertiary	East Canyon Creek	4.00	2.48	2,800
Silver Creek	Secondary	Silver Creek	2.00	0.97	1,100
Coalville City	Secondary	Chalk Creek	0.35	0.25	280
Henefer Town	Secondary	Weber River	0.50	0.09	100
Morgan City	Secondary	Weber River	0.46	0.25	280
Mountain Green	Secondary	Weber River	0.25	0.09	100
Lower Basin					
Plain City	Secondary	Dix Creek	0.42	0.36	403
Central Weber	Secondary	Warren Canal*	80.00	35.00	39,200
North Davis	Secondary	Great Salt Lake	25.00	22.00	24,640
Central Davis	Secondary	Great Salt Lake	9.99	5.00	5,600
South Davis North	Secondary	Great Salt Lake	12.00	5.00	5,600
South Davis South	Secondary	Great Salt Lake	4.00	2.30	2,580
		TOTAL	**141.22**	**74.29**	**83,243**

Source: Individual wastewater treatment plant operators, October 2004.
* During the irrigation season, this effluent mixes with Weber River water and is used to irrigate crops. During the winter, the canal acts as an oxidation ditch, providing further treatment.

can be set up to run recycled water to surface irrigation and toilets. In Utah, however, the law only permits subsurface irrigation and reuse for toilets in large commercial applications.[15] Because of health concerns, the cost of installing a recycling system, difficulties in retrofitting existing homes to separate gray water, regulatory constraints, and climate limitations, gray water reuse will likely not see much application in Utah within the foreseeable future.

Rainwater harvesting for nonpotable outdoor use is generally easier and less problematic than using gray water, and therefore, could see more widespread application. However, recent decisions by the Utah Division of Water Rights requiring a water right for rainwater harvesting systems makes even these simple systems difficult. If these legal challenges are not insurmountable, all that is needed are rain gutters and storage tanks large enough to capture the volume of precipitation that could be expected to be collected at the bottom of each down-spout. A simple screen placed at the inlet filters off shingle grit, leaves and other matter. The water "harvested" in this manner can then be used to water flower-beds, shrubs, gardens and even indoor plants. However, due to the low annual precipitation rates experienced throughout much of the basin and the cost of such systems, rainwater harvesting is unlikely to become common in new or existing homes.

The Utah Botanical Center in Kaysville contains buildings that demonstrate rainwater harvesting and study its potential in Utah's northern region. The Utah House, a demonstration home dedicated to implementing cost-efficient, conservation principles at a typical Utah residence, has a 7,000 gallon tank buried next to the garage that captures rainwater. This water is used to flush the public toilet inside the home and to irrigate a raised vegetable garden. If possible, it may also be used to irrigate an additional portion of the permanent landscape. Although the center has no definite plans to install a gray water system in any of its other facilities, it hopes to also explore the viability of such systems if sufficient funding can be secured.[16]

NOTES

[1] When environmental depletions are included (natural depletions not caused by human activities), agricultural and M&I depletions amount to less than one-third of the available water supply, or 16 and 8 percent, respectively.

[2] Personal communication with Scott Paxman, Assistant General Manager for the Weber Basin Water Conservancy District, January 13, 2004.

[3] U.S. Bureau of Reclamation and State of Utah, *Groundwater Recharge at the Mouth of Weber Canyon,* a proposal for a demonstration project sponsored by the Davis County Council of Governments, (Davis Co., Utah: 1986).

[4] Utah Division of Water Resources, *1995 Statewide Summary of M&I Use,* (Salt Lake City: Dept. of Natural Resources, 2003).

[5] Utah Division of Water Resources, *Identifying Residential Water Use: Survey Results and Analysis of Residential Water Use for Thirteen Communities in Utah*, (Salt Lake City: Dept. of Natural Resources, 2000), 2.

[6] This note refers to two unpublished reports by the Utah Division of Water Resources: (1) *WeatherTRAK Automatic Timer Study: North Salt Lake City, West Valley City, West Jordan City* and (2) *Secondary Water Use Study in Weber, Davis and Tooele Counties: Water Years 2000-2004.*

[7] Some of the existing reuse projects include the Overlake development near Tooele, which utilizes the effluent from the city's new wastewater treatment plant to irrigate its golf course and eventually residential landscapes; and, the Central Valley Golf Course, which uses wastewater effluent to fill its water features and irrigate its grounds.

[8] Pine View Water Systems, *Wastewater Recycling Project Appraisal Report*, (April 2004), 2, 6 and 8.

[9] U.S. Bureau of Reclamation, *Park City and Snyderville Basin Water Supply Study Special Report*, (Provo, Utah: 2006).

[10] Ibid, page 6-7.

[11] Bowen Collins & Associates, Inc., *Snyderville Basin Water Transport Study*, (Draper, Utah: 2006), pages 2-7, 2-8, 3-22. This report was prepared for the Snyderville Basin Water Reclamation District with the assistance of all public and private water suppliers within the basin.

[12] Ibid, page 2-9.

[13] Ibid, page ES-7.

[14] For more information on water reuse and water rights, see the Utah Code, Title 73, Chapter 3c. The entire code is available online at: www.le.state.ut.us/%7Ecode/code.htm.

[15] For more information on Utah law regarding gray water reuse, see the Utah Administrative Code, Title R317-401. The entire code is available online at: www.rules.utah.gov.

[16] From a personal communication with Dave Anderson, Project Director for the Utah Botanical Center, May 28, 2002.

6

WATER DEVELOPMENT: MEETING SUPPLY AND INFRASTRUCTURE NEEDS

Since Elias Adams built the first storage reservoir on Holmes Creek in 1852 (Adams Reservoir), harnessing the available water supply has played an indispensable role in the Weber River Basin. Figure 10 chronicles the legacy of water storage development within the basin. The importance of water development to the inhabitants of the basin is evident from the pioneers' initial efforts to the prosperity made possible by the larger endeavors of the 20th century. Although current residents within the basin often take these developments for granted, they are the beneficiaries of the visionary water developments of the past.

In order to secure sufficient water for the future, further innovative water developments will eventually be necessary in the Weber River Basin. The timing and size of these developments will depend on the ability of water conservation and other water-saving strategies to reduce water demand. To ensure the greatest benefit to the basin's citizens, all needed water developments will be based on sound engineering, economic and environmental principles.

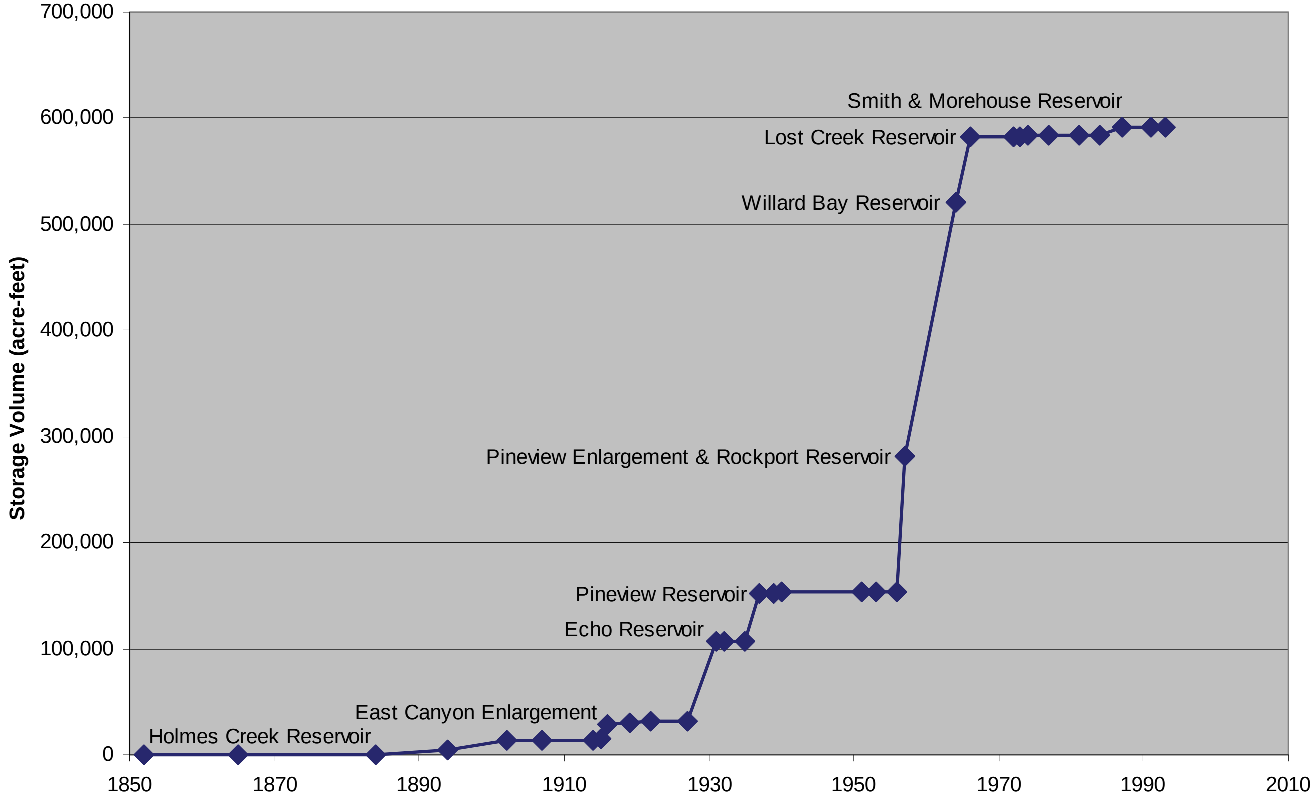
This chapter outlines some of the water projects currently under construction or being investigated in the Weber River Basin. While most of these projects provide the infrastructure to deliver water storage that has already been developed, other projects, such as the Bear River Project, will develop additional water for use within the basin. This chapter also discusses the significance of water development through weather modification and urges local entities to fully participate in this program to enhance the water supply.

WATER DEVELOPMENT PROJECTS

Currently, there are only a few large water projects under consideration in the basin. These projects include the Kanesville Secondary Irrigation Project, two projects proposed for the Snyderville Basin and Park City areas, and the Bear River Project. The Kanesville and Snyderville Basin/Park City projects propose to develop in-frastructure to utilize existing water storage; the Bear River Project would develop additional water for use within the Weber River basin.

Adams Reservoir, now surrounded by many homes in the growing community of Layton, is a reminder of the hard work required of those who first settled the Weber River Basin.

FIGURE 10
Development of Surface Water Storage in the Weber River Basin



Kanesville Secondary Irrigation Project

Recently, the Kanesville Irrigation Company approached WBWCD with a proposal to sell its operation to the district. The lands serviced by the irrigation company are quickly becoming urban, and the company felt that the district was better equipped to provide the necessary conversions from agricultural to municipal and industrial use. Subsequently, WBWCD purchased the irrigation company and completed plans to service the area with a secondary water system. Acquisition of all the Kanesville Irrigation Company's water rights will also enable the district to supply the area with sufficient potable (drinking) water, without having to deplete any of its existing sources.

The existing secondary irrigation system acquired by the district services 561 acres. Upon build-out, a total of about 11,700 acres will be irrigated by the secondary system. The district estimates the total cost of developing the infrastructure for this area to be $29 million, which includes a main aqueduct, lateral lines, a new storage reservoir and an enlarged Layton Canal.

Snyderville Basin and Park City Area Projects

Increasing the water supply in the Snyderville Basin and Park City area is a top priority of Summit County officials, local water providers and WBWCD. During parts of the year, several water systems are operating at or near capacity with little or no room to endure emergencies, let alone accommodate new growth. As a result, several independent proposals to import water into the Snyderville Basin and Park City area have been investigated in recent years. Summit Water Distribution Company, a privately-owned company, has proposed to import water from East Canyon Reservoir. Weber Basin Water Conservancy District, Park City and Mountain Regional Water Special Service District, a Summit County public entity, propose to expand and enlarge the project that they have already constructed which imports water into the basin from the main stem of the Weber River near Rockport Reservoir.

Over the past few years, Congress has directed the U.S. Army Corps of Engineers (Corps) and the U.S. Bureau of Reclamation (BOR) to investigate water supply options for Park City and the surrounding area. The Corps study was completed in 2003 and looked at various alignments available to import water from the Weber River near Rockport Reservoir. The BOR study[1] was completed in 2006 and looked at additional water supply options, including importing water from East Canyon Reservoir. The BOR worked closely with WBWCD and the Utah Division of Water Resources to identify future water demands and investigate all practical options.

The BOR study determined that the long-term needs (2050) within the Snyderville Basin and Park City area would require the importation of approximately 17,100 acre-feet. In addition to this need, the study assumed that 3,600 acre-feet of water would be developed within the basin in the form of a water reuse project. The projected future demand also includes 1,600 acre-feet of water for instream flow augmentation on East Canyon Creek.[2] This instream flow will help ensure water quality standards in the creek will be maintained during critical periods of low-flow.

In order to meet the projected deficit, the BOR study recommended that both the Rockport Reservoir and East Canyon Reservoir importation projects (5,000 acre-feet and 12,100 acre-feet, respectively) be constructed. The BOR estimated the cost of the Rockport Reservoir project (which it called the Lost Creek Canyon Pipeline) to be approximately $25.5 million and the East Canyon Reservoir project (which it called the East Canyon Pipeline) to be approximately $67 million.[3] In order to develop both these projects in a cooperative manner and best serve the needs of the basin's citizens, the BOR report also strongly stressed the need for all local stakeholders to work together.

Subsequent to the BOR study, the Snyderville Basin Water Reclamation District commissioned a report to further define the necessary infrastructure and estimate construction costs. This report[4] was completed in October 2006, with the assistance of all the major water providers within the basin, and lays out

In order to sustain the projected growth in the Snyderville Basin and Park City, more water will soon need to be imported into the area.

a master plan for how to deliver the imported water throughout the basin. The plan contains three main components: (1) potable (culinary) water system improvements and interconnections, (2) Lost Creek Canyon raw water system, and (3) raw water/reuse system. The total estimated cost of all of these components is estimated to be about $63 million ($23 million for the potable water system, $3 million for the Lost Creek Canyon system, and $37 million for the raw water/reuse system).[5]

Although significant operation, maintenance, legal and institutional agreements still need to be negotiated and permits obtained, it is hoped that all major stakeholders will endorse the concepts presented in the SBWRD's study. Universal support of the master plan is an important step forward for the future of the Snyderville Basin and Park City area.

Bear River Project

The Bear River represents one of only a few significant remaining water sources that are available to meet future growth along the Wasatch Front. In the Bear River Development Act passed by the Legislature in 1991, the Division of Water Resources is directed to develop the surface waters of the Bear River and its tributaries.[6] The act also allocates water among various entities and provides for the protection of existing water rights. The act allocates a total of 220,000 acre-feet of water annually as follows: the Jordan Valley Water Conservancy District (JVWCD) and WBWCD are entitled to 50,000 acre-feet each; and the Bear River Water Conservancy

District and Cache County water users 60,000 acre-feet each.[7] The total cost of the project is estimated to be $1.3 billion, with the first phase of diverting water from the river to north Weber County at about $290 million. If the project is constructed, the state of Utah will be obligated to construct diversion and, if necessary, storage and delivery facilities to move the water as far south as the Willard Bay area. All other required conveyance and treatment systems will be the responsibility of the contracting entities. In the Weber River Basin, this entity will be WBWCD.

Based on revised water need estimates, public response and cost analysis, the division's current plan for the Bear River Project is: (1) identify and develop facilities to allow storage of Bear River water, including—discussions with WBWCD and U.S. Bureau of Reclamation (USBR) on the opportunity of using Willard Bay as the initial point of storage even perhaps on a interim basis; (2) connect the Bear River to the Slaterville Diversion Facility via canal or pipeline from a point near the I-15 crossing near Elwood in Box Elder County; (3) construct conveyance and treatment facilities to deliver water to the Wasatch Front; and (4) develop additional storage facilities in the Bear River Basin. The Washakie reservoir site is the principal site currently being considered. Current costs for developing this reservoir are about $1 billion. While parts one through three would be timed to deliver water to the Wasatch Front by about 2035, part four would be carried out when the water users need additional water. If the use of Willard Bay turns out to not be viable, part four could occur sooner.

WEATHER MODIFICATION

As noted in the Utah State Water Plan, weather modification (or cloud seeding) has long been recognized as a means to enhance existing water supplies in Utah.[8] Cloud seeding assists nature in the formation of precipitation by providing droplet-forming nuclei at the proper times and places.

Cloud Seeding Projects

Currently, there is only one project area that seeds clouds to enhance the water supply of the Weber River Basin and surrounding basins; this area is the West Uintas area. Two other areas, the Ogden River and Wasatch Front areas have seeded clouds in the past but are currently inactive.

Cloud seeding has been shown to increase mountain snowpack and subsequent runoff in many Utah watersheds. (Photo courtesy of Patrick Cone.)

A study conducted by the Division of Water Resources estimates that other active project areas within the state have realized a 2.3-18 percent increase in April 1 snow water content.[9] This translates into an increase in estimated average annual runoff of about 223,000 acre-feet statewide, or 7 percent above historical runoff in the seeded areas. The division estimates the cost of water developed from cloud seeding these areas to be about $1.69 per acre-foot.[10] With typical water costs ranging anywhere from $100–350 per acre-foot, this represents by far the most economical alternative available to water entities within the basin to supplement their water supplies.

During the water years 2001 through 2006 the cost of operating the West Uintas project ranged from $46,811 to $69,100. The state and local shares of these costs are illustrated in Table 22. WBWCD is the only entity within the basin which lends financial support to this cloud seeding project. Cloud seeding is most effective when it is continued over several years because consistent cloud seeding increases soil moisture and provides greater ground water and spring flows, which help sustain base flows in streams and rivers. Seeding only in dry periods will not be as effective due to the lack of seedable storm systems.

TABLE 22
West Uintas Area Cloud Seeding Costs

Cost Share Participant	Water Year*					
	2001	2002	2003	2004	2005	2006
Weber Basin Water Conservancy District	$18,450	$16,900	$20,218	$20,460	$20,980	$22,049
Provo River Water Users Association	$18,450	$16,900	$20,218	$20,460	$20,980	$0
Board of Water Resources	$32,200	$33,900	$28,604	$24,762	$24,762	$24,762
TOTAL	**$69,100**	**$67,800**	**$69,100**	**$65,670**	**$66,710**	**$46,811**

* A water year begins on October 1 of the previous year and ends on September 30 of the given year. Water year 2001: Oct. 1, 2000 to Sept. 30, 2001.

Upgrading and Enhancing Existing Infrastructure

Many water systems in the basin have sufficient water to meet needs through 2030 and beyond. Although they have sufficient water rights, many do not have the capacity or facilities to actually divert and deliver this water. Thus, simply upgrading and enhancing existing infrastructure will play an important role in meeting the water demands of the future. Other systems are very old and need upgrades and expansion to meet future needs and supply water efficiently as possible.

In a 2001 survey of drinking water systems conducted by the Utah Division of Drinking Water, 92 percent of the respondents within the Weber River Basin indicated that the overall physical condition of their system would need to be upgraded within the next 15 years, and 29 percent of the respondents indicated their present system was deficient, particularly with respect to its ability to maintain minimum fire flows.[11] Solutions to these problems include additional sources, new and enlarged piping, more storage capacity, and additional or larger water treatment facilities. The survey also revealed that 28 percent of systems do not collect enough revenue from water bills to meet the usual operation and maintenance expenses of their system, and only 24 percent of the systems collect sufficient funds to cover the costs of future improvements.[12]

Funding

Water projects have become increasingly complex and expensive. The developable water is now farther away and deeper in the ground, and the available dam sites need more work to make them suitable. Projects in or near urban areas must work around existing features and pay a higher price for land purchases, easements and rights-of-way. Environmental considerations also add to project costs, as habitat and species protection must be considered in project planning, construction and operation.

The water funding programs administered by state and federal governments have been important in developing water projects and infrastructure.[13] State funding programs are generally low-interest loans that, when repaid, fund other water projects through a revolving fund.

Over the years, the people of Utah have benefited substantially from the various funding programs. The federal share of constructing the basin's largest projects, including the Ogden River Project, the Weber River Project and the Weber Basin Project, have directly benefited those living in the Weber River Basin. In addition to this funding, state funding programs have played an important role in the basin's water development. During the period 1947-2006, entities in the basin have received a total of $193 million in financial assistance (primarily low interest loans) from the Utah Board of Water Resources to develop approximately 70,000 acre-feet of water.

Ultimately, water users within the basin will need to bear more of the costs associated with water development. As an absolute minimum, water suppliers within the basin should set their rates such that all operation and maintenance costs are satisfied. Funding trends and sound financial planning would dictate that sufficient money also be set aside for capital improvements.

NOTES

[1] U.S. Bureau of Reclamation, *Park City and Snyderville Basin Water Supply Study Special Report*, (Provo, Utah: 2006).

[2] Ibid, page ES-3 & ES-4.

[3] Ibid, page ES-7 & ES-5.

[4] Bowen Collins & Associates, Inc., *Snyderville Basin Water Transport Study*, (Draper, Utah: 2006).

[5] U.S. Bureau of Reclamation (2006), page ES-4 to ES-7.

[6] *Utah Administrative Code, Title 73-26-102(2)(a)*.

[7] Ibid, *Title 73-26-202.*

[8] Utah Division of Water Resources, *Utah's Water Resources—Planning for the Future*, (Salt Lake City: Utah Dept. of Natural Resources, 2001), 48-49.

[9] Ann Merrill, Todd Adams and Dave Cole, *Utah Cloud Seeding Program: Increased Runoff/Cost Analyses* (Salt Lake City: Utah Division of Water Resources, 2005), 6 (Table 2).

[10] Ibid, 7.

[11] Utah Division of Drinking Water, *2001 Survey of Community Drinking Water Systems*, (Salt Lake City: Department of Environmental Quality, 2002). An annual survey prepared in cooperation with the Division of Water Rights and the Division of Water Resources. While this document shows only statewide results, the source data was used to obtain values specific to the Weber River Basin.

[12] Ibid.

[13] For a thorough listing of funding programs administered by the state and federal governments, see Division of Water Resources, *Weber River Basin Plan*, (Salt Lake City: Department of Natural Resources, 1997), sec. 8.

7

WATER QUALITY AND THE ENVIRONMENT: CRITICAL COMPONENTS OF WATER MANAGEMENT

If water planners and managers in the Weber River Basin are to effectively meet future water needs, they will need to do more than provide adequate water supplies and delivery systems. The water supply decisions they make can greatly impact water quality, the environment and recreation. For the most part, water planners and managers are aware of these impacts and are working to develop plans and strategies that will protect these important values; however, there is still much that could be done. This chapter discusses in detail the importance of water quality and the environment to the management of the Weber River Basin's water resources, and it also elaborates on some of the things being done to safeguard these important values.

WATER QUALITY

Regulation of water quality in Utah began in 1953 when the state legislature established the Water Pollution Control Committee and the Bureau of Water Pollution Control. Later, with the passage of the federal Clean Water Act in 1972 and the federal Safe Drinking Water Act in 1974, strong federal emphasis was given to preserving and improving water quality. Today, the Utah Water Quality Board and Division of Water Quality, and the Utah Drinking Water Board and Division of Drinking Water are responsible for the regulation and management of water quality in the state of Utah.

As a result of these agencies and regulations, residents of the Weber River Basin enjoy safer water systems than the basin's early settlers. However, due to the magnitude of growth and development that is projected to occur and the increased pollution loads that this growth will bring, the Weber River Basin will continue to face some serious water quality challenges. Water resource planners and managers within the basin need to be increasingly aware of these issues and work closely together to satisfy future water quality needs.

The State Water Plan identified six water quality programs or concerns that are of particular importance to the future of the state's water resources.[1] These are also of concern to the Weber River Basin and are as follows:

- Total Maximum Daily Load program
- Preservation and restoration of riparian and flood plain corridors
- Storm water discharge permitting
- Nutrient loading
- Concentrated animal feedlot operations
- Septic tank densities

Each of these topics is discussed below with emphasis given to how they affect the water resources of the Weber River Basin. A brief discussion of ground water contamination at Hill Air Force Base is also included.

Total Maximum Daily Load Program

Section 303 of the Clean Water Act directs each state to establish water quality standards to protect beneficial uses of surface and ground water resources. The Act also requires states to identify impaired water bodies every two years and develop a total maximum daily load (TMDL)[2] for each pollutant causing impairments in the various water bodies.

The Division of Water Quality (DWQ) has identified stream segments that are fully supporting, partially supporting or not supporting their beneficial uses in the Weber River Basin (see Figure 11). Table 23 lists all the impaired water bodies for which TMDLs are required, the pollutant or nature of impairment, and the status of the TMDL. In cooperation with state, federal and local stakeholders, DWQ has organized and facilitated locally led watershed groups to establish TMDLs for each of the impaired water bodies. Below is a brief description of a few of the TMDLs and some of the progress that has been realized as remediation projects have been implemented.

TABLE 23
TMDLs in the Weber River Basin

Water Body	Pollutant(s) or Stressor(s)	TMDL Status
Chalk Creek	Sediment Total phosphorus Stream habitat loss Riparian habitat loss	Approved 1997
East Canyon Creek	Dissolved oxygen	Approved 2000 Being Revised
East Canyon Reservoir	Total phosphorus Dissolved oxygen	Approved 2000 Being Revised
Echo Creek	Sediment	Approved 2006
Echo Reservoir	Total phosphorus Dissolved oxygen	Approved 2006 Being Revised
Pineview Reservoir	Total phosphorus Dissolved oxygen	Approved 2002
Silver Creek	Zinc Cadmium	Approved 2004

Sources: Utah Division of Water Quality web page: http://www.waterquality.utah.gov/TMDL, October 16, 2008.

Chalk Creek TMDL

The Chalk Creek Watershed has an established group of stakeholders that has worked together for several years to improve water quality. This watershed group produced a Coordinated Resource Management Plan that was submitted to EPA as a TMDL. This plan was approved by EPA and has served as the foundation for countless watershed projects that have been completed on Chalk Creek and its tributaries. These programs have been well received by local residents and have already had a positive impact on water quality and the total stream environment. Over $3.5 million dollars has been spent on various projects, with 40 percent of that amount coming from many of the 90 private land owners involved. These efforts have stabilized stream banks and improved the riparian habitat along at least 15 stream miles, and reduced sediment entering Echo Reservoir from Chalk Creek at least 70,000 tons per year.[3]

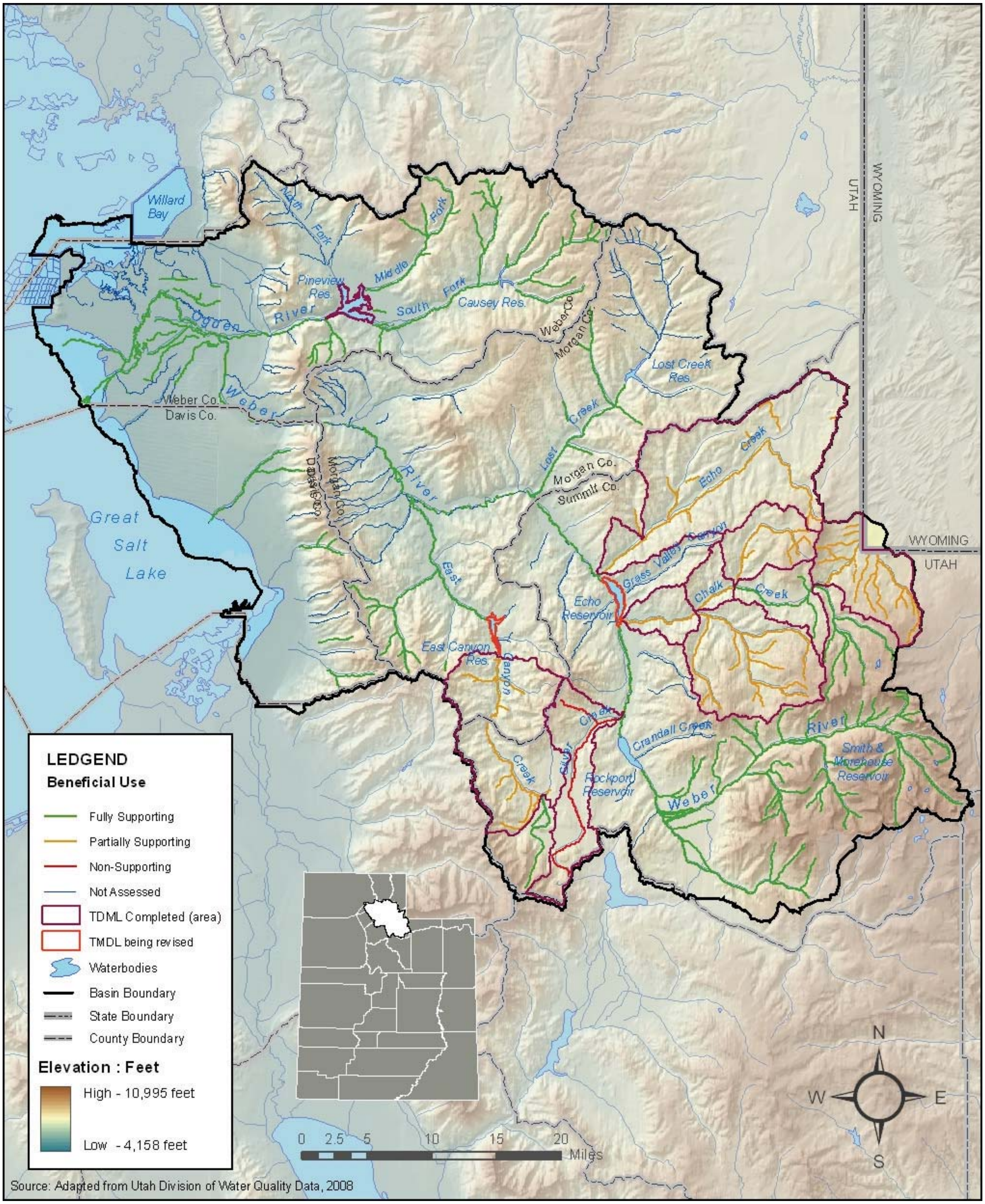
East Canyon Creek and East Canyon Reservoir TMDLs

East Canyon Creek and East Canyon Reservoir have TMDL plans that have been completed. The East Canyon Creek TMDL has the goal to reduce total phosphorus above and below the wastewater treatment plant, maintain a healthy level of dissolved oxygen in the water and reduce macrophyte growth by 50 percent or more. The East Canyon Reservoir TMDL has similar goals that will preserve the quality of the water in the reservoir to meet all of its beneficial uses. To accomplish these goals, sediment and phosphorus loads will be reduced from the following sources: Snyderville Basin Water Reclamation District's East Canyon Wastewater Treatment Plant, urban runoff, construction activities, agricultural activities and the riparian corridor.[4]

At the end of 2002, the Snyderville Basin Water Reclamation District completed a $9 million facility upgrade of their East Canyon wastewater treatment plant to increase capacity and reduce the amount of phosphorus in their effluent. With this new facility online, the District has successfully reduced phosphorus levels in East Canyon Creek below the levels articulated in the East Canyon Creek TMDL. These reductions have in turn had a positive impact on the water quality of East Canyon Reservoir, which is also impaired for phosphorus. Since 2002, water quality in the reservoir has shown significant signs of improvement, especially in the reduction of toxic algae growth.[5] Both TMDLs are being revised to reflect these and other changes.

Despite the successful reduction in phosphorus loads in East Canyon Creek, the Snyderville Basin Water Reclamation District and other local entities and individuals are concerned that low flows in East Can-

FIGURE 11
Water Quality Impairments and Beneficial Use Support Assessment



yon Creek could undermine the investments that have been made to upgrade the wastewater treatment plant. During the summer of 2003, portions of East Canyon Creek above the plant dried up, killing off many fish. Although flows in the creek were sufficient below the plant to satisfy water quality requirements, there is no guarantee that the standards could be met in the future if such a situation were to occur again. To combat this problem, the District has teamed up with the DWQ and others to study options to augment flows in East Canyon Creek. The details of this study will be discussed in the "Instream Flow Maintenance" section found later in this chapter.

The East Canyon Watershed Committee is also helping DWQ coordinate several efforts within the watershed that will further reduce nutrient and sediment loads, these include:

- Helping various landowners along the creek control streambank erosion.
- Educating ski resort and golf course owners and operators on the use of best management practices to minimize erosion.
- Assisting ranchers and animal feedlot operators to implement protective measures.
- Helping Park City and Summit County develop storm water management programs to control urban runoff and minimize erosion from construction sites.

Preservation and Restoration of Riparian and Flood Plain Corridors

Many riparian zones adjacent to the Weber River and its tributaries have been severely impacted by development that has occurred in their corresponding flood plains. As the basin's human population increases, additional riparian and flood plain corridors are in jeopardy. Improper stream bank modification and channelization (often referred to as habitat alteration and hydrologic modification) are the cause of many water quality impairments in the Weber River Basin's streams. DWQ estimates that these stream modifications affected about 19 percent of the basin's stream miles and were a source of nearly 32 percent of the basin's stream water quality impairments.[6]

County and city planners and commissions need to work together to preserve riparian zones and flood plains from unwise development. Zoning laws and master plans need to consider the ability of these lands to improve water quality and buffer the population from the impacts of flooding. If necessary, these lands can be acquired or easements obtained and these areas turned into parkways. Such lands will provide nearby communities with a valuable recreational and aesthetic resource and permit natural flooding with minimal impacts to the land or structures within this area.

These before and after photos show the successful restoration of riparian habitat along a segment of Echo Creek in Summit County. The photo on the left was taken in 1989, just after the v-log weir was installed. The photo on the right was taken in 2002. (Photos courtesy of the Utah Division of Water Quality.)

In order to manage flood plains effectively, they need to be clearly delineated. This can be a challenge in communities where existing flood plain maps are out of date. For instance, the flood plain maps available in Weber County were produced over 25 to 30 years ago. Since that time, stream banks have been modified and extensive development has occurred. These maps should be updated.

While most stream bank modifications impair water quality, carefully designed and implemented modifications can help preserve and enhance water quality. The U.S. Army Corp of Engineers, in cooperation with the Utah Division of Wildlife Resources, is in the process of modifying the stream banks of the Weber River near Henefer, Uintah and Peterson. The objective of these modifications is to restore the natural flood plain, which will enhance water quality and wildlife habitat along these degraded segments of the river. These enhancements will also restore some of the natural ground water recharge that was diminished due to past modifications.

Storm Water Discharge Permitting

Storm water runoff from industrial and urban landscapes that makes its way into the Weber River Basin's streams and rivers often contains high concentrations of various pollutants and is a significant point source of pollution. Common pollutants found in storm water runoff include pesticides, fertilizers, oils, salt, sediment and other debris.[7]

Engineered Wetlands Treat Storm Water Runoff in Riverdale

Riverdale recently became Utah's latest beneficiary of an engineered wetland. The wetlands are located on the grounds of the new Wal Mart and Sam's Club. Diversified Development Realty Corp. built the wetlands to treat storm water runoff from its commercial development as well as an adjacent residential area.

The wetlands consist of three ponds: a settling pond, a planted pond and a polishing pond. Each serves a specific purpose and cleanses the water before it is released to the Weber River.

The settling pond removes sediments from the storm water. When sediment enters a stream, it covers up stream habitat that is essential for fish spawning.

The planted pond includes over 3,700 wetland plants. These plants help remove heavy metals such as lead, chromium, arsenic, copper and zinc that are generated by cars on parking lots and roads. The planted pond also removes coliform, E.coli, and streptococci bacteria introduced to the runoff from bird and animal feces.

The polishing pond acts as a purifying basin. This pond, along with the planted area, removes most of the nitrogen and phosphate compounds entering the storm water runoff from fertilized lawns.

(From a personal communication with Weber County's former River Keeper, Stan Hadden, June 2003)

To minimize the amount of pollutants that enter the nation's water bodies through storm water runoff, the U.S. Environmental Protection Agency (EPA) initiated a two-phase process for implementation of storm water regulations. Implementation of Phase I began in 1990, and affected certain types of industry, construction sites larger than five acres, and cities with a population larger than 100,000. No communities in the Weber River Basin were impacted by Phase I.

Phase II of EPA's storm water regulations, which began implementation in 2003, will affect smaller construction sites and any area designated as "Urbanized Areas" by the U.S. Census Bureau.[8] Phase II rules will also apply to any community outside an Urbanized Area that has a population greater than 10,000 and a population density higher than 1,000 people per square mile. In Utah, this includes nearly all the communities along the Wasatch Front, Cedar City, and the Logan and St. George areas. Effected communities were required to apply for a storm water discharge permit with DWQ by March 10, 2003, and fully implement a storm water management program in compliance with the permit within five years.

Table 24 lists the communities within the Weber River Basin that are required to comply with the Phase II rules. DWQ is working closely with these communities to help them comply. In Weber County, all the communities are pooling their resources to develop a strategy to help them satisfy the new rules. By doing so, they will be able to coordinate their storm water management activities and will be allowed by

TABLE 24
Communities Affected by EPA's Phase II Storm Water Rules

Community	Population	Population Density (people/mi^2)	In Designated Urbanized Area?
Davis County			
Bountiful	40,889	3,065	Yes
Centerville	14,509	2,416	Yes
Clearfield	25,974	3,352	Yes
Clinton	12,585	2,286	Yes
Farmington	11,662	1,558	Yes
Fruit Heights	4,701	2,134	Yes
Kaysville	19,915	2,016	Yes
Layton	58,472	2,824	Yes
North Salt Lake	8,123	1,061	Yes
South Weber	3,695	921	Yes
Sunset	5,195	3,532	Yes
Syracuse	8,947	1,079	Yes
West Bountiful	4,418	1,511	Yes
West Point	5,296	840	Yes
Woods Cross	6,405	1,783	Yes
AVERAGE	**15,386**	**2,025**	**-**
Weber County			
Farr West	2,853	530	Yes
Harrisville	3,645	1,348	Yes
Hooper	2,900	340	Yes
Marriott-Slaterville	966	196	Yes
North Ogden	15,020	2,310	Yes
Ogden	77,179	2,899	Yes
Plain City	3,264	935	Yes
Pleasant View	5,126	837	Yes
Riverdale	7,656	1,726	Yes
Roy	32,885	4,330	Yes
South Ogden	14,377	3,917	Yes
Uintah	1,123	1,120	Yes
Washington Terrace	8,551	4,477	Yes
West Haven	3,299	391	Yes
AVERAGE	**12,775**	**1,811**	**-**
Summit County			
Park City*	7,371	781	No

Sources: Utah Division of Water Quality and the U.S. Census Bureau's web page: www.census.gov/main/www/cen2000.html.
* Park City is not required to comply with the new Phase II rules; however, the Division of Water Quality has asked that they voluntarily comply.

EPA to apply for a group storm water discharge permit. While Park City and Summit County are not yet required by EPA to comply with the Phase II rules, DWQ has asked them to voluntarily comply. Both have agreed to do so and are currently implementing programs to manage storm water.

Nutrient Loading

Nutrient over-enrichment continues to be one of the leading causes of water quality impairment in the Weber River Basin. Although these nutrients (nitrogen and phosphorus) are essential to the health of aquatic ecosystems, excessive loads have resulted in the undesirable growth of aquatic vegetation and algae and oxygen depletion in several water bodies. DWQ estimates nutrients are the cause of over 27 percent of the basin's water quality impairments.[9]

Nutrients enter the basin's waterways primarily through wastewater treatment plant effluent. Nutrients also enter the water through septic tank systems, agricultural return flows, and runoff from heavily fertilized urban lawns and landscapes. Although it is a relatively easy process to remove nutrients from wastewater (a point source), it is not inexpensive, and controlling nutrient loads from the other non-point sources is even a bigger challenge. In areas of high septic tank densities, sewer systems need to be installed and nutrients removed at a wastewater treatment plant. On agricultural and urban landscapes, the proper application of fertilizer and efficient irrigation helps reduce the amount of these nutrients entering waterways. With a concerted effort by all those living within the basin, nutrient loads can be reduced and the quality of basin's waterways improved.

Concentrated Animal Feeding Operations

Another water quality concern within the Weber River Basin is the impact animal feeding operations (AFO) and concentrated animal feeding operations (CAFO) have on water quality. These operations, where large numbers of animals are grown for meat, milk or egg production, can increase the biological waste loads introduced into rivers, lakes, and surface or ground water reservoirs. Animal manure contains nutrients, pathogens and salts.

The Utah Division of Water Quality has prepared a Utah AFO and CAFO strategy.[10] This strategy has three primary goals: (1) to restore and protect the quality of water for beneficial uses, (2) to maintain a viable and sustainable agricultural industry, and (3) to keep the decision-making process on these issues at the state and local level. The strategy provides a five-year window for facilities of particular concern to make voluntary improvements. After this "grace" period, the initial focus of more stringent regulatory action will be directed toward those facilities located within priority watersheds with identified water quality problems, such as Chalk Creek, East Canyon Creek, Echo Creek and Silver Creek.

If managed improperly, animal feedlot operations can adversely impact water quality.

The first step in implementing this strategy—completing a statewide inventory of AFO and CAFO—is complete. As of January 2006, the inventory has identified 2,803 AFOs, 58 CAFOs and 391 potential CAFOs.[11] Approximately 7 percent of the state's AFOs (209), 3 percent of the state's CAFOs (2), and 16 percent of the state's potential CAFOs (64) are located in the Weber River Basin.[12] Of the 209 AFOs, 58 are located in the Upper Weber watershed (above Devil's Slide, primarily Summit County) and 151 are located in the Lower Weber watershed (primarily Davis, Morgan and Weber counties). While both the CAFOs are located in the Lower Weber watershed, 15 of the potential CAFOs are located in the Upper Weber watershed and 49 are located in the Lower Weber watershed.[13]

Septic Tank Densities

In some of the rural areas of the basin, advanced wastewater treatment systems have not yet been constructed and individual septic tank systems are used to dispose of domestic wastes. While septic tanks are designed to partially treat domestic waste and disperse the remaining pollutants into the natural environment in quantities that are not particularly harmful, when densities become too high, concentrations of certain pollutants (nitrogen, for example) can begin to cause problems.

Septic tanks are used extensively in certain portions of the basin. This is the case in Ogden Valley, Morgan County, andd other sparsely populated areas of the basin. As the population in these areas grows, the density of septic tanks will increase and eventually threaten water quality.

In Ogden Valley, the high concentration of septic tanks and the lack of a sewer collection and treatment system above Pineview Reservoir has been a concern for many years. Division of Water Quality has developed a TMDL for Pineview Reservoir that proposes a maintenance and education program for septic tank users. In addition, Weber County has completed a wastewater master plan for the valley, which includes recommendations for wastewater collection and treatment facilities in the more developed areas of the valley.

In Morgan County, a study is underway that will analyze the impacts of septic systems. If problems are found to be serious enough, limits on septic tank densities will be implemented. Eventually, a wastewater collection and treatment system may also be required.

While existing state septic system regulations provide important guidelines for use of such systems, some within the basin feel that the regulations are inadequate to meet the needs of growing rural areas. For instance, the requirement for a new development to hook up to the sewer system only if it is located within 300 feet of an existing sewer line has little effect in Summit County where much of the new development is spread-out. Septic system guidelines that acknowledge these unique growth-related challenges should be considered.

Ground Water Contamination at Hill Air Force Base[14]

As early as 1941, the U.S. Air Force began using various chemicals to operate, repair and maintain its fleet at the Ogden Air Depot (renamed Hill Air Force Base in 1948). These chemicals included cleaners, such as the degreasing solvent Trichloroethene (TCE), and other petroleum fuel products. Prior to laws governing the disposal of such chemicals in the early 1980s, TCE was routinely dumped on the ground. Because TCE evaporates very quickly, it was believed by many that it would simply "go away." However, while much of the TCE did evaporate, some did not and it seeped into the soil where precipitation eventually forced it deeper into the ground and the shallow ground water.

Hill Air Force Base first became aware of contaminated ground water when a plume of contaminants was discovered on its northeast boundary in 1976. While this plume did not contain TCE, it did contain cis-1,2 dichloroethene (1,2-DCE) and various other contaminants associated with fuel products (1,2-DCE is a byproduct of TCE formed when it breaks down in the environment). By 1987, more contamination was discovered on the base, including four more plumes of ground water contamination, and the entire base was declared a Super Fund site. Since that time, HAFB has identified 6 additional plumes of ground water contamination, one of which contain MTBE (a relatively modern fuel additive).

Several of the contaminated plumes extend off the base into the shallow ground water beneath Clearfield, Clinton, Layton, Riverdale, Roy, South Weber and Sunset. To date, no contamination has been discovered in the drinking water systems of these communities.[15] HAFB has made efforts to inform the citizens within these areas about the contamination and identify people who might be using contaminated ground water. Where individuals using contaminated water have been found, usually for irrigation of gardens or lawns, HAFB has offered to provide them with an alternative source of water, at the expense of the Air Force.

The Air Force has spent approximately $175 million to clean up contaminated sites that have been identified. The total cost of cleanup is estimated to be approximately $350 million. HAFB anticipates cleanup to be completed for some sites within the next 30 years, others are estimated to take longer.

Water Quality Protection and Improvement Efforts

Many state and federal programs exist to improve Utah's water quality. The Utah Pollutant Discharge Elimination System closely regulates point sources of pollution. DWQ is also working hard to eliminate nonpoint source pollution and does so through its TMDL planning process, which is coordinated by local watershed groups. By organizing and fostering local watershed groups, DWQ seeks the critical participation and involvement of local stakeholders.

Weber River Watershed Coalition

The Weber River Watershed Coalition was established in the spring of 2002. This group consists of approximately 50 members, representing federal, state and local agencies, as well as some local landowners. The Technical Advisory Committee meets at least quarterly to discuss activities within the watershed, progress on TMDLs, and the progress on other projects that are to improve water quality. The Coalition oversees and coordinates the efforts of six smaller watershed groups:[16] East Canyon Water Quality Advisory Committee, Lower East Canyon Watershed Committee, Chalk Creek Watershed Committee, Echo Creek Watershed Committee, Upper Silver Creek Watershed Stakeholder Group, and Ogden Valley Watershed Committee.

Recently, members of the Coalition participated with DWQ in writing and distributing the *Weber River Watershed Restoration Action Strategy*. This document describes the watershed, identifies water quality issues, and describes the goals and objectives that the group would like to implement. Key goals are listed below:

- Restore water quality to meet or exceed Utah water quality standards in all impaired waterbodies.
- Protect and maintain the water quality in all waterbodies that presently meet state standards.
- Enhance and improve water quality through local riparian and stream bank restoration projects.
- Assure ongoing monitoring and assessment of water quality.
- Develop and support public outreach and education efforts.
- Develop funds to support all needed water quality programs and projects within the watershed.
- Develop watershed plans for each sub-basin.

The Coalition has also facilitated the hiring of two Watershed Coordinators for active areas of the watershed, one for the East Canyon Creek and everything above the confluence of the Weber River and Echo Creek and the other for everything else in the Weber River drainage. These coordinators will assist DWQ and the Coalition in writing and coordinating grant applications for needed funding, coordinating and implementing projects, and helping to educate land owners on various water quality issues.

Weber Basin Water Quality Lab

The Weber Basin Water Conservancy District (WBWCD) has long recognized the importance of water quality within the Weber River Basin. The district employs a staff of water quality professionals at the Weber Basin Water Quality Lab. This lab has established an extensive network of monitoring sites and takes water quality samples throughout the basin on a regular basis. Over the years, the lab has developed an extensive database of water quality data that it is able to correlate closely with the water quantity data available from WBWCD. This data helps the Weber River Watershed Coalition and DWQ to improve water quality within the basin.

THE ENVIRONMENT

For much of the 20th century, water management activities in the Weber River Basin focused mainly on the development and control of available water resources. In addition to numerous small, locally owned projects, three federally funded water projects were constructed in the basin: the Weber River Project, the Ogden River Project and the Weber Basin Project. At the time these projects were constructed, environmental values associated with water resources were not well understood. Since then, however, the arena in which water managers and planners operate has undergone enormous change. Environmental values are now better understood and there is an effort throughout the country and within the Weber River Basin to protect the environment from unnecessary degradation and mitigate or restore areas impacted from past actions. Water planners and managers within the basin are and will continue to integrate environmental policies and strategies into their operations to provide balanced and comprehensive solutions to water supply problems. This will be important to the success of any future water development project or management measure.

Some of the environmental values that affect the water resources of the Weber River Basin, or have the potential to do so, include: threatened, endangered and sensitive species, wetlands and the Great Salt Lake ecosystem, instream flow maintenance, and Wild and Scenic River designation. Each is discussed briefly below.

Threatened, Endangered and Sensitive Species

In 1973, the federal Endangered Species Act (ESA) was passed by Congress to prevent plant and animal species from becoming extinct. Although the ESA has had some success, it has been widely criticized because of its negative impacts on the communities located near threatened and endangered species. Once a species is federally listed as either threatened or endangered, the ESA restricts development, land management and other activities that may impair recovery of the species.[17]

As of the year 2008, one plant species and two animal species in the Weber River Basin were listed as threatened or endangered.[18] The only endangered species located in the basin is the June Sucker, a fish that is not native to the basin and exists only in a local pond as part of a recovery effort. Its presence will not affect basin water development or management. The other two species found within the basin are the Ute Ladies-tresses (a plant species associated with wetland vegetation along the Weber River) and the Canada Lynx. In addition to these species, the Yellow-billed Cuckoo and the Ogden Rocky Mountainsnail are listed as candidates for potential listing as threatened or endangered. The Bald Eagle was recently delisted. As many as 200 bald eagles use the shore of the Great Salt Lake, in Davis County, and riparian areas of the Weber River and East Canyon Creek as wintering range.

To avoid the difficulties encountered when a species becomes federally listed as threatened or endangered, and to better protect Utah's plant and wildlife resources, the Utah Division of Wildlife Resources (DWR) has developed the Utah Sensitive Species List, which identifies species most vulnerable to population or habitat loss. In addition to the five species previously mentioned, 31 species that reside within the Weber River Basin are listed on Utah's Sensitive Species List. Of these, 14 are bird species, many of which have critical habitat along the east shore of the Great Salt Lake (including the American White Pelican, bald eagle, and Long-billed Curlew); 5 are mammals; 2 are amphibians (Columbia Spotted Frog and Western Toad); 5 are fish species (including the Bonneville Cutthroat Trout, Least Chub and Bluehead Sucker); 4 are snail or mussel species; and 1 is a reptile.[19] DWR's goal is to develop and implement appropriate conservation strategies for these species that will preclude their being listed as threatened or endangered.[20]

In 1998, the Utah Legislature created the Endangered Species Mitigation Fund (ESMF) to help protect essential habitat for Utah's threatened, endangered and sensitive species. The fund helps Utah land and water developers to continue responsible economic growth and development throughout the state while providing for the needs of various wildlife species. Through innovative, cooperative partnerships funded by the ESMF, state wildlife managers are working hard to create conservation and habitat agreements aimed at down-listing existing threatened and endangered species and avoiding the listing of other sensitive species. The ESMF provides a

The Weber River Basin does not have any endangered species. However, the Bald Eagle was previously listed as threatened and the American White Pelican and Bonneville Cutthroat Trout are listed as sensitive species. The Northern River Otter and Blue Grosbeak were recently taken off of the sensitive species list. (Photos courtesy of the Utah Division of Wildlife Resources.)

stable, non-lapsing revenue base which addresses the needs of Utah communities, local government and citizens who have struggled financially to comply with the requirements of federal law.[21]

Wetlands and the Great Salt Lake Ecosystem

The Great Salt Lake and surrounding wetlands make up one of the West's most biologically productive ecosystems. This ecosystem is also internationally known for its significance—not only is it a critical stop on the Intermountain migratory bird route, and North America's largest water body with no outlet to the ocean, but the lake is also a significant economic resource. It supports a host of mineral extraction operations and is a major source of brine shrimp, which are used worldwide in aquaculture operations.

The water resources of the Weber River Basin are an important part of the Great Salt Lake ecosystem. Not only do the Weber River and other frontal streams flow into the lake, but ground water along the Wasatch Range also gravitates toward the lake. While most of the water flows to the lake directly, some of it is filtered through the wetlands located along the lake's shore. These wetlands provide many benefits; among other things, they provide natural flood protection, improve water quality, assist in storm water management, and afford unique opportunities for recreation, education and research.

While some of the wetlands located within the Weber River Basin are protected from development within waterfowl and wildlife management areas or refuges (see Figure 12), others are still vulnerable to disturbance by urban growth. To address this situation, Davis County recently completed a master plan for the Great Salt Lake shore lands within the county. This plan provides communities with tools that help manage land use at the local level while preserving the regionally important resources of the Great Salt Lake. The plan includes maps of all the shore lands and the uses of those lands that were identified by the public as most desirable. These include areas where development will be prohibited (land below the floodline), an agricultural buffer zone between shore lands and developable lands, and a transition zone of low- to high-density development.[22] In addition to Davis County's master plan, Weber County is preparing a similar plan to protect the shore lands within its boundaries. If adopted by the affected communities, these plans will go a long way in protecting these sensitive lands as sanctuaries for wildlife and the enjoyment of future generations.

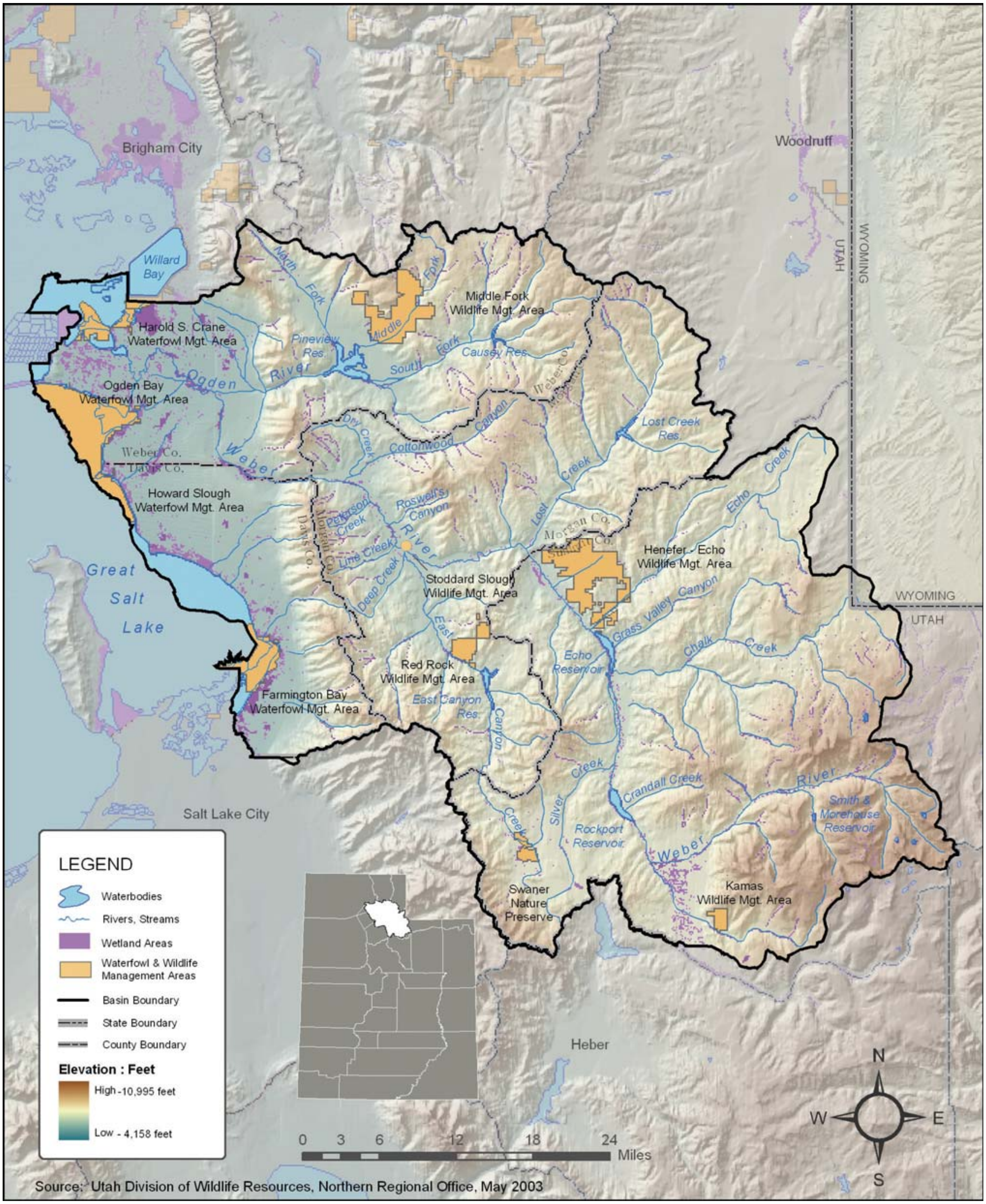
Instream Flow Maintenance

An instream flow is often defined as "free flowing water left in a stream in quantity and quality appropriate to provide for a specific purpose."[23] In general, the purpose of an instream flow is to provide habitat for fish and other aquatic wildlife; however, an instream flow may also provide water for terrestrial wildlife and livestock watering, maintain critical riparian vegetation, accommodate certain recreational purposes, or simply enhance the esthetics of the natural environment. The quantity and timing of instream flows vary with each purpose and are not necessarily the same as a minimum flow.

In Utah, there are several ways to obtain instream flows; these are listed below:

- Instream Flow Agreements – When water storage and diversion facilities are constructed, minimum instream flows are often negotiated among the various water users as a means of mitigating negative impacts of the project to fish and wildlife values. These agreements often describe conditions where the minimum flows may be compromised and have no legal mechanism of enforcement. Instream flow agreements are the most common form of stream flow maintenance in Utah.
- Conditions on New Water Rights Appropriations – Since 1971, the State Engineer has had the authority to place a condition on the approval of a water right application if, in his judgment, approval of the full requested right would "unreasonably affect public recreation or the natural stream environment." In other words, the State Engineer can reject (or reduce the amount of) a new appropriation or reject a change application in order to reserve sufficient flow for recreation or the environment.

FIGURE 12
Wetlands, Wildlife Management Areas and Wildlife Preserves



There are no instances in the Weber River Basin where the State Engineer was required to exercise this authority.

- Conditions of Permits or Licenses – Hydroelectric facilities must receive a license from the Federal Energy Regulatory Commission to operate. Alterations to streams must receive a permit from the Utah Division of Water Rights. Before a license or permit is issued or renewed, the public is given the opportunity to comment. If this process identifies instream flows as critical to other uses of the water, such as wildlife habitat, these flows may become part of the permit or license conditions.
- Instream Flow Water Rights – In 1986 the Utah Legislature amended the water rights law of the state to allow the Utah Division of Wildlife Resources to file for changes of a perfected water right that would provide sufficient instream flow for fish propagation. These water rights may be obtained through purchase, lease, agreement, gift, exchange or contribution. Acquisition of such flows must be approved by the legislature before the State Engineer can make a determination. Later, the Utah Division of State Parks and Recreation was given the same authority.

Instream Flow Agreements in the Weber River Basin

Table 25 lists the only known minimum instream flow agreements within the Weber River Basin. These flows are all agreements that are part of the federally funded Weber Basin Project, and, therefore, deal with stream segments below Weber Basin Project facilities. Although these agreements exist, wildlife managers have expressed concern that in some locations these flows are not always maintained.

In addition to the importance of maintaining instream flows, wildlife managers, water quality officials and recreationists have expressed concern that rapid fluctuations in stream flow occasionally occur on the Weber River system. These are most likely the result of operational procedures at various reservoirs and are believed to be detrimental to aquatic life and water quality in the effected streams. When significant changes in reservoir releases are required, they should be coordinated with other affected stakeholders to assure that they occur in a way that is not damaging to the river corridor.

East Canyon Creek Flow Augmentation Feasibility Study

Although the minimum instream flow agreements listed in Table 25 cover many of the stream miles within the Weber River Basin, other stream segments not protected by such agreements are susceptible to inadequate instream flows. One such segment is East Canyon Creek above the wastewater treatment plant located in the Snyderville Basin near Jeremy Ranch. In August 2003, the stream dried up about one mile above the plant, killing off many fish and adversely impacting other wildlife and water quality. Although the cause of

TABLE 25
Minimum Instream Flow Agreements in the Weber River Basin

Reservoir or Diversion Dam	River	Min. Instream Flow (cfs)
Pineview*	Ogden	10
Rockport Lake	Weber	25
East Canyon*	East Canyon Creek	5
Echo	Weber	0
Lost Creek*	Lost Creek	8
Causey*	South Fork Ogden	25
Smith and Morehouse	Morehouse Creek	5
Stoddard Diversion†	Weber	15-30
Slaterville Diversion‡	Weber	20-150

Source: “Operating Criteria for Fish and Wildlife Purposes” provided to the Utah Division of Wildlife Resources by Weber Basin Water Cons. Dist., May 1995.
* Minimum flows can be less than shown if total inflows into the reservoir are less.
† Minimum flow applies at a point approximately 200 feet below the diversion dam where a canal bypass returns water to the river. The minimum flow is normally 30 cfs, but may be reduced to 15 cfs when more flow is necessary to operate the Gateway Powerplant at minimum capacity.
‡ Varies according to season: 20 cfs (Dec. 11-Feb. 28); 50 cfs (Mar. 1-April 10); 135 cfs (Apr. 11-June 15); 80 cfs (June 16-Oct. 15); and 150 cfs (Oct. 16-Dec. 10).


On August 13, 2003, East Canyon Creek dried up near Kimball Junction. The lack of water greatly impacted water quality and killed many downstream fish. (Photos courtesy of the Snyderville Basin Water Reclamation District.)

this event was eventually traced to several illegal diversions upstream, the possibility that this could happen again during extreme dry conditions has triggered an intense interest in maintaining minimum flows in the creek.

To address this problem, the Snyderville Basin Water Reclamation District (SBWRD), Utah Division of Water Quality and the U.S. Environmental Protection Agency commissioned the East Canyon Flow Augmentation Feasibility Study, which was completed in 2005. The purpose of this study was to complete a detailed analysis of the feasibility of flow augmentation for East Canyon Creek and to identify options to maintain minimum instream flows that will allow the beneficial uses designated for the creek to be preserved. The report identified several alternatives to augment flows and followed the recommendations of the Utah Division of Wildlife Resources by setting a minimum instream flow goal of 3.5 cfs under extreme conditions and up to 6.0 cfs for various stretches of the creek under normal conditions. Below is a list of all the alternatives identified in the report to augment flows:[24]

1. Improve Management of Water Rights and Diversions – Increase stream flow through improved enforcement of water right laws, better management of diversions and return flows, coordinating the timing of direct stream withdrawals, and conservation.
2. Purchase or Lease Irrigation Water Rights – Acquire irrigation water rights by purchase, lease, donation or loan for dedication to instream flow.
3. Store Springtime Runoff in Surface Impoundments – Capture and store winter and springtime flows in the upper East Canyon Creek watershed for later release during the low-flow summer months of July, August and September.
4. Supplement Stream Flow with Ground Water – Pump wells to augment stream flow.
5. Utilize Aquifer Storage and Retrieval Methods – Inject water into an aquifer by wells or spreading basins, store it there on a short-term basis, and retrieve it when needed by pumping wells.
6. Utilize Mine Storage and Retrieval Methods – Storage a portion of the flow from the Spiro Tunnel into the workings of the deeper Silver King Mine and retrieve the stored water by pumping on a seasonal basis.
7. Substitute Snyderville Basin Water Reclamation District Reclaimed Water for Stream Diversions – Provide treated effluent from the East Canyon Water Reclamation Facility for irrigation in trade for surface water diversion rights that could be dedicated to instream flow.
8. Discharge Reclaimed Water Higher in Watershed – Construct a new wastewater treatment plant in the upper reaches of the watershed.
9. Import from East Canyon Reservoir – Pump water from East Canyon Reservoir to the location of the Summit Water culinary treat-

ment plant, and discharge it into East Canyon Creek to augment flow downstream to the reservoir.

10. Import from Weber River/Rockport Reservoir - Augment flow in East Canyon Creek with water imported from the Weber River or Rockport Reservoir. Importation would require a use agreement, lease or purchase of water from Weber Basin, Mountain Regional or Park City.
11. Import from Ontario #2 Drain Tunnel – import and lease water from the Ontario #2 Drain Tunnel, which is located about 3 miles east of Park City.
12. Reduce Diversions to the Silver Creek Watershed – reduce the amount of water that is diverted into the Silver Creek watershed from McLeod Creek at the Mount Aire splitter.

The study contains a detailed discussion of each alternative, including the important issues of water rights, water quality, cost and environmental impacts. The report concluded that a combination of the alternatives would need to be pursued in order to ensure adequate instream flows over the long-term. Specifically, the report recommended the following:[25]

- Pursue alternative 1 (Improve Management of Water Rights and Diversions), alternative 2 (Purchase or Lease of Irrigation Water Rights for Instream Flow) and alternative 12 (Reduce Diversion to Silver Creek Watershed) immediately.
- Encourage water suppliers in the Snyderville Basin to adopt the goal of stream flow augmentation and promote inclusion of the goals in water resource projects. (As discussed in Chapter 6, the need to maintain a minimum instream flow has already been included as a component of the future water needs in the *Snyderville Basin Water Supply Study* by the U.S. Bureau of Reclamation and in the subsequent *Snyderville Basin Water Transport Study* prepared for SBWRD.)
- Identify mechanisms for funding stream flow augmentation.
- Work with the public to garner their support.

The water quality and environmental benefits of stream augmentation should provide strong enough incentives for the public to support augmentation, so long as the incremental costs are not excessive and are distributed equitably among all the residents.

Wild and Scenic River Designation

The Wild and Scenic Rivers Act (WSRA) of 1968 states that, “certain selected rivers of the nation which, with their immediate environments, possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or similar values, shall be preserved in free-flowing condition, and that they and their immediate environments shall be protected for the benefit and enjoyment of present and future generations."[26] Only Congress has the authority to designate a stream or river segment as “Wild and Scenic.” In most cases, such designation would prevent construction of flow modifying structures or other facilities on designated river segments. The area for which development is limited along a wild and scenic river varies, but includes at least the area within one-quarter mile of the ordinary high water mark on either side of the river.

Currently there are no rivers in the Weber River Basin with the Wild and Scenic River designation. In recent years, however, national forests and other federal agencies have made inventories of streams for consideration as wild and scenic rivers and found numerous stretches to be eligible. Table 26 shows the stream segments in the Weber River Basin that the Wasatch-Cache National Forest recently deemed eligible for Wild & Scenic River designation. The Forest will now undertake further study to determine whether these segments are suitable for designation.

Obtaining Balance Between Competing Values

In recent decades, water quality and environmental values have emerged as important players in the water resources arena. Taking their place alongside the traditional role of supplying the public with adequate water supply, these important values have changed the landscape within which water planners and managers operate. Water resources are now subject to numerous federal and state laws which are intended to help keep water clean and protect the environment.

Water quality and environmental laws help sustain the beneficial use of water and bring valuable balance to the water resources arena, where growing needs are causing increased competition and are often conflicting in nature. While this balancing act is not easy, if properly orchestrated, it will lead to better water planning and management, higher quality water, and a healthier and more pristine environment.

TABLE 26
Wasatch-Cache National Forest Eligible Wild & Scenic Rivers

River Name	Eligible Segment	Classification
Beaver Creek	Source to Forest boundary	Recreational
Left Fork South Fork Ogden River	Frost Canyon/Bear Canyon Confluence to Causey Reservoir	Wild
Middle Fork Weber River	Source to Forest boundary	Wild
Main Fork Weber River	Source to Forest boundary	Scenic

Source: Wasatch-Cache National Forest, *Final Environmental Impact Statement,* (U.S. Forest Service: Salt Lake City, 2003), 3-375.

Water planners and managers, local leaders, and interested individuals within the Weber River Basin all play important roles in the management of the basin's water resources. By working closely together, they can help meet future water resources challenges. Following the spirit of the pioneers who first settled the basin, they too can assure a promising future for subsequent generations.

NOTES

[1] Utah Division of Water Resources, *Utah's Water Resources—Planning for the Future,* (Salt Lake City: Utah Dept. of Natural Resources, 2001), 51-54.

[2] A TMDL sets limits on pollution sources and outlines how these limits will be met through implementation of best available technologies for point sources and best management practices for nonpoint sources. For more information, see U.S. Environmental Protection Agency, "Total Maximum Daily Load (TMDL) Program." Retrieved from EPA's Internet web page: www.epa.gov/owow/Total Maximum Daily Load/intro.html, March, 2000.

[3] Green, Shane, "Watershed Progress Report: Chalk Creek Watershed," (Coalville: NRCS, 2001).

[4] Weber River Watershed Coalition, *Weber River Watershed Restoration Action Strategy,* (Salt Lake City: Division of Water Quality, 2003).

[5] Personal communication with Jerry Miller, U.S. Bureau of Reclamation, May 2004.

[6] Utah Division of Water Quality, *Weber River Watershed Management Water Quality Assessment Report,* (Salt Lake City: Dept. of Environmental Quality, 2000), 21. This report is also available online at the Division of Water Quality's web page: www.waterquality.utah.gov.

[7] U.S. Environmental Protection Agency, "Storm Water Phase II Final Rule," Fact Sheet 1.0, (Roanoke, Virginia: EPA, 2000), 1. This fact sheet is a concise, four-page description of the Phase II rules, their intent and who is required to comply. A copy of this and other fact sheets can be obtained from EPA's web page at: www.epa.gov/owm/sw/phase2.

[8] U.S. Census Bureau, "United States Census 2000." Retrieved from the U.S. Census Bureau's Internet web page: http://www.census.gov/main/www/cen2000.html, January 2003. As defined by the Bureau, an urbanized area is "an area consisting of a central place(s) and adjacent territory with a general population density of at least 1,000 people per square mile of land area that together have a minimum residential population of at least 50,000 people."

[9] Utah Division of Water Quality, 2000, 19.

[10] Utah Department of Agriculture and Food, "Animal Feeding operations... A Utah Strategy: How Will it Affect You?," (Salt Lake City: 1999). A brochure prepared in cooperation with EPA, USDA, NRCS, Utah Department of Environmental Quality, Utah Association of Conservation Districts, and USU Extension.

[11] Mark M. Peterson, *2006 Annual Progress Report: Utah AFO/CAFO Inventory and Assessment Project,* (Utah Farm Bureau Federation, 2006), Tab 4. This document summarizes project progress as of December 31, 2005.

[12] Ibid, Tab 3, pages 29-32.

[13] Ibid.

[14] Personal communications with Steve Hicken, Remedial Investigations Program Manager, Restoration Division, HAFB. Some of the information in this section was derived from an "Information Packet" which was distributed at an InfoFair hosted by the Air Force in Clearfield on November 7, 2002.

[15] Drinking water in these communities is obtained from a deep confined aquifer and from surface water sources through the WBWCD. The deep aquifer is separated from the shallow aquifer by a thick clay layer, which serves as a barrier, which has thus far prevented the contamination from mingling with the drinking water.

[16] Utah Division of Water Quality, *Utah's 2006 Integrated Report, Volume II – 303(d) List of Impaired Waters,* (Salt Lake City: Dept. of Environmental Quality, 2006), II-21.

[17] Utah Division of Wildlife Resources, *Species on the Edge Benefits to Local Communities,* (Salt Lake City: Dept. of Natural Resources, 2002), 7.

[18] Utah Division of Wildlife Resources, "Federal Threatened and Endangered List by County," (Salt Lake City: Dept. of Natural Resources, July 1, 2008). This and other lists are updated frequently and can be obtained online at the division's Conservation Data Center: http://dwrcdc.nr.utah.gov/ucdc.

[19] Utah Division of Wildlife Resources, "Utah's Sensitive Species List," (Salt Lake City: Dept. of Natural Resources, July 1, 2008).

[20] Utah Division of Wildlife Resources, 2002.

[21] Ibid, 3 & 4.

[22] Davis County Council of Governments, *Davis County Shorelands Comprehensive Land Use Master Plan,* (Farmington: 2001), 2, 12. This plan seeks to conserve and preserve the unique values associated with the lands along the east shore of the Great Salt Lake, and was prepared in partnership with The Nature Conservancy and Envision Utah.

[23] Holden, Mark A., "The Importance of Instream Flow and Recreational Needs in State Water Planning," transcript of a talk given at the Sixteenth Annual Conference, Utah Section, American Water Resources Association, April 21, 1988.

[24] Kleinfelder, Inc., Barnett Intermountain Water Consulting, and CRS Consulting Engineers, Inc., *East Canyon Creek Flow Augmentation Feasibility Study, Summit and Morgan Counties, Utah,* (Park City: 2005), 45-85.

[25] Ibid, 95.

[26] U.S. Congress, *Wild and Scenic Rivers Act, P.L. 90-542,* as amended, 16 U.S.C. 1271-1287, (Washington D.C.: Government Printing Office, 1986).

8

CONCLUSION: MAKING IT HAPPEN

The Weber River Basin is at a critical juncture. The basin lies on the north end of the fast-growing Wasatch Front where much of the state's prime agricultural land is rapidly becoming urban and is located just south of the Bear River, which is a potential source of developable water for the Wasatch Front. The basin is also entering an important phase in the effort to improve and preserve water quality and the environment. With the population expected to increase rapidly in the coming decades adequately addressing water quality problems will continue to be a priority. All stakeholders need to work together to ensure that current problems are resolved in a timely fashion and that future problems are avoided. Sufficient time and resources must be devoted to these efforts in order to sculpt the best and most efficient solutions.

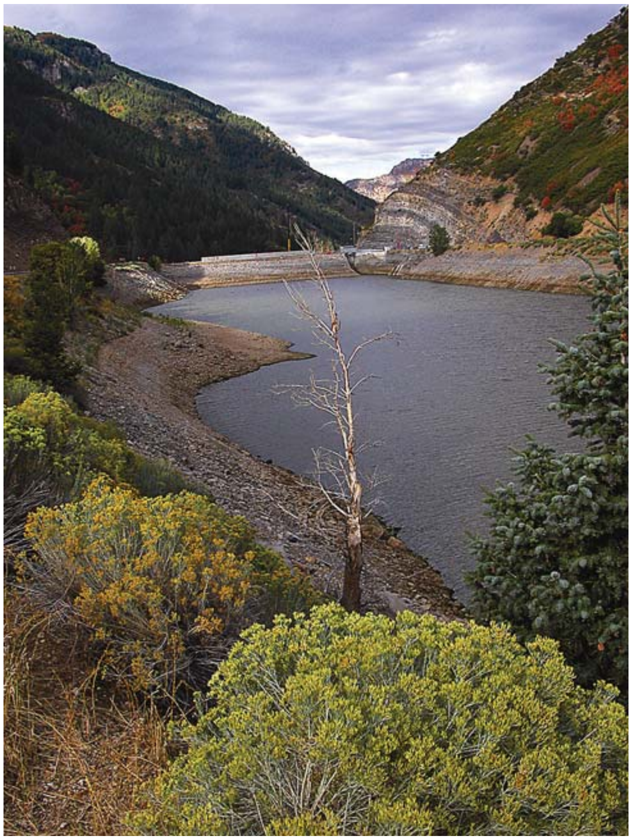
The challenges facing the Weber River Basin are complex—solutions will involve many stakeholders and may stir emotional public debate and scrutiny. Water planners and managers within the basin must rise to the occasion and resolve these problems with care and deliberation. The timing and size of new water developments must be carefully balanced against the ability of water conservation and efficient management of existing water supplies to meet future needs. Water quality needs, environmental values and other issues must be understood and properly considered. Doing this, and cooperating with federal, state and local interests in the planning and decision-making process, will enable leaders within the Weber River Basin to meet their future water needs while preserving the aesthetic and ecological integrity of the environment.

LOCAL AND GOVERNMENT ROLES IN MEETING FUTURE NEEDS

One of the guiding principles listed in the state water plan, *Utah's Water Resources—Planning for the Future,* is that the responsibility for making many water-related decisions resides with local leaders. Local leaders are best able to make wise decisions when they fully educate the public on current water resources issues and seek their input in the decision-making process. The state of Utah and federal government assist in this process by setting policy (as necessary), providing valuable guidance on issues of statewide and national concern, and giving financial and technical assistance when possible. Working together with the public and government agencies with water-related responsibilities will empower local leaders with the tools and support needed to meet the future needs of the Weber River Basin. These roles are discussed in more detail below.

The Role of Local Stakeholders: Stewards of the Weber River Basin

Water resources stakeholders in the Weber River Basin include any individual or organization that has an interest or role in water management activities. This includes people who live, work or recreate within the area. These local stakeholders need to be included in the planning and decision-making process within their individual communities and the basin. They are the ones who depend upon the water and other resources the most and without whose support water management activities are largely unsuccessful. These individuals are also the ones most likely to be direct and active stewards over their re-



Pineview Reservoir was enlarged by the U.S. Bureau of Reclamation as part of the Weber Basin Project and is a good example of the value of strong local, state and federal cooperation.

sources, because not doing so may impair their quality of life and that of future generations.

The Role of Government: Guiding and Assisting Local Efforts

State and federal agencies are important contributors to effective water resources planning and management in the Weber River Basin. These agencies have and will continue to offer valuable technical and financial resources that assist local decision-makers with their planning and management efforts. State and federal agencies possess a wealth of technical data and knowledge regarding the water resources of the basin and important issues associated with their development and use. These agencies need to continue to make this information readily available to local stakeholders who typically have neither the time nor the resources to collect and research this information. This information allows local stakeholders to make educated decisions based on sound scientific facts. State and federal agencies can foster a spirit of cooperation by attending local planning activities and meetings. Active participation by these agencies will also help ensure that local plans comply with all state and federal laws and regulations.

The Weber Basin Water Conservancy District's aquifer storage and recovery demonstration project is one of many examples of the role government can play in assisting local water management officials. Funded by the U.S. Bureau of Reclamation, this project has enjoyed strong technical support from various state agencies as well as Weber State University; and, if successful, will have a positive impact on the ability of surface and ground water resources within the basin to meet future demands.

Resolving Conflicts and Looking Toward the Future

Although water managers and planners throughout the basin share a common goal—to meet the future water needs of the Weber River Basin's citizens in a timely and efficient manner—they do not always agree on the best way to go about it. In the Snyderville Basin and Park City areas, these differences have risen to a level that many believe is counter-productive and damaging to the long-term relationships and cooperation that is required to meet the needs of the area's citizens. This and other conflicts within the basin need to be resolved. The state can help with these sensitive matters by providing fair and impartial policy and guidance, as well as strong leadership. Local stakeholders can also help by working together to craft win-win solutions that build relationships and forge public support.

As the basin's population grows, so will the demands on the available water supplies. The challenges associated with these growing demands will not go away, they will only intensify. Local stakeholders need to prepare now to be in a favorable position to satisfy future needs.

GLOSSARY

Acre-Foot (ac-ft) - The volume of water it takes to cover one acre of land (a football field is about 1.3 acres) with one foot of water; 43,560 cubic feet or 325,850 gallons. One acre-foot is approximately the amount of water needed to supply a family of four with enough water for one year (assuming a residential use rate of 225 gpcd).

Adjudication - A judicial process whereby water rights are determined or decreed by a court of law.

Animal Feedlot Operations (AFO) - A lot or facility where animals have been, are, or will be stabled or confined and fed or maintained for a total of 45 days or more in any 12-month period; and where crops, vegetation, forage growth, or post-harvest residues are not sustained over any portion of the lot or facility in the normal growing season.

Appropriate - The action by the State Engineer to authorize the use of a quantity of water.

Aquifer - A geologic formation that stores and/or transmits water. A confined aquifer is bounded above and below by formations of impermeable or relatively impermeable material. An unconfined aquifer is made up of loose material, such as sand or gravel, that has not undergone settling, and is not confined on top by an impermeable layer.

Aquifer Storage and Recovery - The deliberate recharge of ground water through surface spreading or well injection and subsequent recovery for a beneficial purpose.

Artesian Well - A well from which water flows freely without pumping because the static water level stands above the ground surface.

Beneficial Use - Use of water for one or more of the following purposes including but not limited to, domestic, municipal, irrigation, hydro power generation, industrial, commercial, recreation, fish propagation, and stock watering; the basis, measure and limit of a water right.

Commercial Use - Water uses normally associated with small business operations which may include drinking water, food preparation, personal sanitation, facility cleaning and maintenance, and irrigation of landscapes.

Concentrated Animal Feedlot Operations (CAFO) - An animal feedlot operation (see above) where more than 1,000 animal units are confined, or 301 - 1,000 animal units are confined and waters of the United States pass through the facility or the operation discharges via a man-made device into waters of the United States. Also, AFOs can be designated as CAFOs on a case-by-case basis if the NPDES permitting authority determines that it is a significant contributor of pollution to waters of the U.S.

Cone of Depression - A cone-like depression of the water table formed in the vicinity of a well by withdrawal of water.

Conjunctive Management - The coordinated and combined management of surface water and ground water resources to increase the availability and reliability of existing supplies.

Conjunctive Use - The combined use of surface water and ground water for a beneficial purpose. This often includes aquifer storage and recovery, but may also simply be the coordinated use of both resources.

Conservation - According to Webster's Dictionary, conservation is the act or process of conserving, where conserve is defined as follows: (1) To protect from loss or depletion, or (2) to use carefully, avoiding waste. In this document, the second definition is used exclusively. However, in the water resources field the first definition is also used. Using the first definition, constructing a reservoir to capture excess runoff in order to more fully utilize the water is also considered conservation.

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.

Culinary Water - See "Potable Water."

Depletion - The net loss of water through consumption, export and other uses from a given area, river system or basin. The terms consumptive use and depletion, often used interchangeably, are not the same.

Developable - That portion of the available water supply that has not yet been developed but has the potential to be developed. In this document, developable refers to the amount of water that the Division of Water Resources estimates can be developed based on *current* legal, political, economic and environmental constraints.

Diversion - 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. This is often referred to as withdrawal.

Drinking Water - See "Potable Water."

Dual Water System - See "Secondary Water System."

Efficiency - The ratio of the effective or useful output to the total input in a system. In agriculture, the overall water-use efficiency can be defined as the ratio of crop water need (minus natural precipitation) to the amount of water diverted to satisfy that need.

Eutrophication - The process of increasing the mineral and organic nutrients which reduces the dissolved oxygen available within a water body. This condition is not desirable because it encourages the growth of aquatic plants and weeds, is detrimental to animal life, and requires further treatment to meet drinking water standards.

Evapotranspiration - The scientific term which collectively describes the natural processes of evaporation and transpiration. Evaporation is the process of releasing vapor into the atmosphere through the soil or from an open water body. Transpiration is the process of releasing vapor into the atmosphere through the pores of the skin of the stomata of plant tissue.

Export - Water diverted from a river system or basin other than by the natural outflow of streams, rivers and ground water, into another hydrologic basin. The means by which it is exported is sometimes called a transbasin diversion.

Flood Plain - A relatively flat area bordering a stream or adjoining a body of standing water that may be inundated during periods of high stream flow.

Forfeiture - The loss of a water right or part of a water right because of five or more years of non use.

Gallons per Capita per Day (gpcd) - The average number of gallons used per person each day of the year for a given purpose within a given population.

Ground Water - Water which is contained in the saturated portions of soil or rock beneath the land surface. It excludes soil moisture which refers to water held by capillary action in the upper unsaturated zones of soil or rock.

Ground Water Mining (Overdraft) - Withdrawal of water from an aquifer in excess of recharge which, if continued over time, would eventually cause the underground supply to be exhausted or drop too low to be feasibly pumped.

Hydrology - The study of the properties, distribution, and effects of water in the atmosphere, on the earth's surface and in soil and rocks.

Incentive Pricing - Pricing water in a way that provides an incentive to use water more efficiently. Incentive pricing rate structures include a base fee covering the system's fixed costs and a commodity charge set to cover the variable costs of operating the water system.

Industrial Use - Use associated with the manufacturing or assembly of products which may include the same basic uses as a 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 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.

Instream Flow - Water maintained in a stream for the preservation and propagation of wildlife or aquatic habitat and for aesthetic values.

Mining - Long-term ground water withdrawal in excess of natural recharge. (See "Recharge," below.) Mining is usually characterized by sustained (consistent, not fluctuating) decline in the water table.

Municipal Use - This term is commonly used to include residential, commercial and institutional water use. It is sometimes used interchangeably with the term "public water use," and excludes uses by large industrial operations.

Municipal and Industrial (M&I) Use - This term is used to include residential, commercial, institutional and industrial uses.

Nonpoint Source Pollution (NPS) - 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.

Nonpotable Water - Raw water that is not suitable for drinking because of pollutants, contaminants, minerals or ineffective agents.

Nutrient Loading - The amount of nutrients (nitrogen and phosphorus) entering a waterway from either point or nonpoint sources of pollution. Nutrients are a byproduct of domestic and animal waste, and are present in runoff from fertilized agricultural and urban lands. Nutrients are not typically removed from wastewater effluent, and if present in excessive amounts result in growth of aquatic weeds and algae.

Phreatophyte - A plant species which extends its roots to the saturated zone under shallow water table conditions and transpires ground water. These plants are high water users and include such species as tamarisk, greasewood, willows and cattails.

Point Source Pollution - Pollutants discharged from any identifiable point, including pipes, ditches, channels and containers.

Porosity - The measure of the water-bearing capacity of a soil or rock formation.

Potable Water - Water meeting all applicable safe drinking water requirements for residential, commercial and institutional uses. This is also known as culinary or drinking water.

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.

Public Water Supply - Water supplied to a group through a public or private water system. This includes residential, commercial, institutional, and industrial purposes, including irrigation of publicly and privately owned open areas. As defined by the State of Utah, this supply includes potable water supplied by either privately or publicly owned community systems which serve at least 15 connections or 25 individuals at least 60 days per year.

Recycling - Reuse of wastewater in the same process or for the same purpose that created the wastewater. Although recycling often requires treatment of the wastewater, recycling can occur without treatment.

Recharge - Water added to an aquifer or the process of adding water to an aquifer. Ground water recharge occurs either naturally as the net gain from precipitation, or artificially as the result of human nfluence. Artificial recharge can occur by diverting water into percolation basins or by direct injection into the aquifer with the use of a pump.

Residential Use - Water used for residential cooking; drinking; washing clothes; miscellaneous cleaning; personal grooming and sanitation; irrigation of residential lawns, gardens, and landscapes; and washing automobiles, driveways, etc.

Reuse - The direct or indirect use of wastewater effluent for a beneficial purpose.

Return Flow - That portion of a diverted flow that is not depleted and returns to the local hydrologic 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.

Runoff - Precipitation, snow melt or irrigation water that appears in uncontrolled surface streams or rivers.

Safe Yield - The amount of water that can be withdrawn from an aquifer on a long-term basis without serious water quality, net storage, environmental or social consequences.

Secondary Water System - Pressurized or open ditch water delivery system 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.

Self-supplied Industry - A privately owned industry that provides its own water supply.

Sewage - Waste matter and refuse liquids produced by residential, commercial and industrial sources and discharged into sewers.

Stakeholders - Any individual or organization that has an interest in water management activities. In the broadest sense, everyone is a stakeholder, because water sustains life. Water resources stakeholders are typically those involved in protecting, supplying, or using water for any purpose, including environmental uses, who have a vested interest in a water-related decision.

Total Maximum Daily Load (TMDL) - As defined by the EPA, a TMDL "is the sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources. [Its] calculation must include a margin of safety to ensure that the water body can be used for the purposes the State has designated. The calculation must also account for seasonal variation in water quality." The TMDL must also provide some "reasonable assurance" that the water quality problem will be resolved. The states are responsible to implement TMDLs on impaired water bodies. Failure to do so will require the EPA to intervene.

Transmissivity - The rate at which ground water can travel through an aquifer.

Vadose Zone - The portion of the subsurface that contains water under less than atmospheric pressure. It extends from the land surface to the zone of saturation or water table.

Wastewater - Sewage, industrial waste or other liquid substances that if untreated might cause pollution of a natural or man-made water body.

Wastewater Reclamation - The act or process of recovering, restoring and making wastewater available for another use. The product resulting from this process is often called "reclaimed water."

Water Audit - A detailed analysis and accounting of water use at a given site. A complete audit consists of an indoor and outdoor component and emphasizes areas where water could be used more efficiently and waste reduced.

Water Duty - The volume of water that can be diverted from a stream or aquifer in order to mature a particular type of crop. This typically includes sufficient water to cover transmission losses.

Water Right - The right to use a specified volume of water during a certain period of time for a beneficial purpose.

Water Table - The upper surface of a saturated ground water zone, where the body of ground water is not confined by an overlying impermeable formation.

Water Year - The year-long period between October 1 through September 30, designated by the calendar year in which it ends. Water resources professionals often use the water year because it allows the water supply to correspond to the same time period for which the water fell to the earth, was collected and subsequently used. (The water year begins in October because some of the water that is used during the subsequent year falls as snow in the mountains during the winter months of October through December the previous year.)

Water Yield - The runoff from precipitation that reaches water courses and therefore may be available for human use.

Watershed - The land above a given point on a waterway that contributes runoff water to the flow at that point; a drainage basin or a major subdivision of a drainage basin.

Wetlands - Areas where vegetation is associated with open water and wet and/or high water table conditions.

Withdrawal - See "Diversion."

UTAH STATE WATER PLAN
Weber River Basin—Planning for the Future

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