Recommended State Water Strategy

July 2017

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Compiled by the Governor's Water Strategy Advisory Team

Invited by

The Honorable Gary R. Herbert

Governor, State of Utah

Facilitated by Envision Utah

Executive Summary

Utah faces a daunting challenge. We have the distinction of being both one of the driest states in the nation and one of the fastest growing. At the convergence of those two realities is the challenge of providing water for a population that is projected to nearly double by 2060 while maintaining strong farms and industries and healthy rivers, lakes, wetlands, and aquifers. This challenge is magnified by climate projections from the State Climatologist that show a significant decrease in Utah's snowpack, which presently provides more annual water storage capacity than all of Utah's human-made reservoirs combined.

In 2013, Governor Gary R. Herbert invited a group of stakeholders with extensive backgrounds in various aspects of water and with a diverse set of perspectives to form the State Water Strategy Advisory Team.[1] He tasked them to (1) solicit and evaluate potential water management strategies; (2) frame various water management options and the implications of those options for public feedback; and, (3) based on broad input, develop a set of recommended strategies and ideas to be considered as part of a 5O-year water plan.

Despite the often-contentious nature of water policy debate, the Team engaged in earnest discussion and reached agreement on the set of critical issues and strategy recommendations contained in this document, that if studied and advanced will help ensure a vibrant and sustainable water future. This document represents the culmination of a collaborative four-year effort that solicited input from thousands of Utahns through public meetings, written comments, an online survey, and a random-sample poll. The result of these efforts, as published here, lays the foundation for much needed water policy dialogue and collaborative decision-making.

[1] The Team members are listed in Appendix A.

The recommendations that follow do not constitute a prescriptive plan for providing water supplies over the next 50 years; the information and data to definitively create such a plan do not currently exist. Instead, these recommendations provide strategic direction and represent common ground upon which the needed information can be gathered and future decisions can be made. In the Utah tradition of working together to solve difficult problems, the Team has volunteered countless hours to define, plan for, and ultimately achieve a shared, long-term vision. Though additional planning and implementation will be required of stakeholders and the public in years to come, the team has elevated water analysis and discourse to a new level and produced this water strategy with what is likely the broadest and most inclusive body of water expertise that has come together in the history of our state.

VISION

Our vision sees Utahns working together to solve what may be one of the most daunting problems we have ever faced: how to stretch limited water supplies to meet the needs of the estimated 6 million people expected to call Utah home by the year 2060[2] and to do so in a way that provides enough clean and affordable water to sustain thriving communities and businesses, robust agriculture, ample recreation, and a healthy and resilient natural environment—all in the face of wide variations in precipitation and uncertain climatic patterns. To do so, we envision using science, technology, education, public deliberation, innovative policies, and well-designed incentives to find the best ways to use water in our homes, businesses, and farms, while also protecting our natural environment. We foresee working within the prior appropriation system to refine transparent, cost-effective, and fair processes to resolve conflicts and allocate water. We anticipate new levels of cooperative effort to collect data and conduct research necessary to ensure balanced and informed decisions consistent with this vision.

SUMMARY OF RECOMMENDATIONS

A summary of key strategies follows—organized by eleven key policy questions and recommended strategies to address each question. The Advisory Team offers these recommendations with the hope that elected officials and other policymakers, water planners, state and federal agencies, nongovernmental organizations, water user groups, and the public at large will seriously study these recommendations and take concrete steps to implement them. Actively engaging the broad range of water issues and taking proactive steps based on sound science and constructive policy deliberations will secure a promising water future for ourselves and those who come after us—our children, grandchildren, and future generations.

1. **What is the role of water conservation and efficiency in Utah?**
   - 1.1. Prioritize the efficient and sustainable use of water as a critical strategy for meeting Utah's water needs.
   - 1.2. Establish and utilize clear standards for water use measurement, tracking, and reporting.

[2]Of course, Utah's population will not cease to grow after 2060. Nevertheless, the Advisory Team had to select a timeframe in which to analyze these issues. Based on current estimates, 2060 represents the year in which the current population will approximately double.

1.3. Establish water efficiency standards to benchmark water use and identify conservation potential.
1.4. Support research on water conservation constraints and ways to overcome them.
1.5. Identify intended and unintended consequences of water efficiency and conservation to ensure appropriate choice and implementation of particular strategies.
1.6. Provide leadership and commitment for ongoing implementation of water conservation and efficiency strategies.
1.7. Provide adequate funding and investments for effective water efficiency and conservation.
1.8. Promote local, regional, and statewide water conservation planning, implementation, and evaluation.
1.9. Integrate water planning and land use planning to achieve long-term water use efficiencies in urban areas.
1.10. Determine and quantify the contributions that increasing water use efficiencies and conservation can make to future water supplies.

2. How will diverted water supplies be developed to meet competing and ever increasing demands?

2.1. Utilize water conservation and improved efficiencies to optimize water supplies.
2.2. Manage and restore watersheds to decrease transpiration, increase runoff, and protect water quality.
2.3. Develop and beneficially use Utah's allocated share of interstate rivers.
2.4. Develop other regional water supply projects for beneficial use.
2.5. Increase aquifer storage and recovery.
2.6. Implement water reuse.
2.7. Increase capacity of existing reservoirs.
2.8. Consider costs and benefits of water development.

3. How does Utah provide water for agricultural lands and food production in the face of competing water demands?

3.1. Mandate and fund a broad stakeholder engagement process to identify, sustain, and advance the multiple values associated with agricultural water use.
3.2. Combine the knowledge and cooperative foundation of mutual water companies with state agency planning to assure ongoing agricultural water management.
3.3. Continue and expand efforts to preserve the productive capacity of Utah agricultural lands and water through the Legislative Water Development Commission or Executive Water Task Force.
3.4. Establish basin-level councils to create benefits for farmers who help optimize regional water supplies, conserve in-stream flows, or enhance water quality.
3.5. Create mechanisms that help agricultural water users contribute to improving water quantity and quality management.
3.6. Enact or amend local land use regulations to enable costs to irrigation systems created by urbanization to be carried by those benefiting from the new development.
3.7. Support agriculture's infrastructure, water use measurement, data, and reporting needs.
3.8. Monitor the USU Extension Water Initiative and evaluate whether to modify or expand the program.
3.9. Create a clearinghouse to collect, compile, and publish real-time stream gauging, snowpack, soil moisture, and reservoir monitoring and to preserve a historical database.

3.10. Establish an education center dedicated to providing information on agriculture, water, and food production.

4. What should we do to preserve natural systems in the face of increasing water demands?

4.1. Improve science and conservation planning and funding.
4.2. Expand tools to protect instream flows.
4.3. Facilitate creation of a state water trust to acquire rights for instream flows.
4.4. Study opportunities and risks of more efficient water delivery.
4.5. Facilitate development of environmental water markets.

5. How do we protect and sustain the quality of Utah's water?

5.1. Implement nutrient controls where excess nutrients pose a problem.
5.2. Maintain sufficient stream flows and lake levels to sustain water quality and healthy ecosystems.
5.3. Incentivize agricultural practices that improve water quality.
5.4. Collaborate on salinity controls.
5.5. Recognize the connectivity between surface water and groundwater and manage those resources accordingly.
5.6. Control invasive species.
5.7. Adequately fund needed drinking water and water quality infrastructure.
5.8. Upgrade wastewater treatment plants and improve stormwater systems.
5.9. Regulate water quality in ways that protect the Great Salt Lake and its ecosystem.
5.10. Improve monitoring and mitigation strategies for nonpoint sources associated with mining, oil, and gas industries.
5.11. Improve drinking water source protection plans.
5.12. Embrace a holistic watershed planning approach.

6. How will Utah plan for, adequately fund, and use innovative solutions to maintain, replace, and redesign existing water infrastructure and build new water infrastructure over the next 40-50 years?

6.1. Plan for infrastructure to support a growing population and economy and make investments consistent with best scientific, engineering, management, and accounting practices.
6.2. Increase returns on investments for water infrastructure through designing and funding optimization strategies that integrate across the different domains of water infrastructure.
6.3. Ensure that water users and uses with less financial capacity, such as rural areas, less wealthy communities, and the environment, also receive necessary infrastructure investments to secure their water futures.
6.4. Ensure safety, reliability, and continuing service of existing water infrastructure by financing timely rehabilitation, expansion, and redesign.
6.5. Utilize judicious prioritization and sequencing in approving and funding new infrastructure.
6.6. Implement cybersecurity and physical security measures for water infrastructure.
6.7. Develop a state water infrastructure financing plan to account for changing levels of federal financing and competing water needs.
6.8. Water providers should pursue grants, loans, bonds, public-private partnerships, and other creative funding opportunities when and where appropriate to fund new infrastructure and appropriately allocate costs to beneficiaries.

6.9. Implement ongoing assessments of infrastructure investment portfolios to ensure financial accountability, adaptability, and minimization of long-term financial risks.
6.10. Incorporate energy consumption and provision considerations into planning and financing to achieve energy efficiency in water infrastructure.

7. In what ways will weather and a changing climate impact future water supply and demand?
7.1. Increase coordination among the state, water districts, local governments, and climate researchers.
7.2. Assess vulnerabilities and develop risk management strategies developed through studies to plan for climate change impacts.
7.3. Identify and develop adaptation strategies.
7.4. Identify and plan mitigation strategies.
7.5. Build on scientific knowledge base of climate research through increased resources and funding to enhance planning processes.

8. How do we optimize our water resources to sustain the economy and quality of life for Utah residents?
8.1. Maintain and provide sustainable water supplies for existing and future economic activity.
8.2. Structure water-related revenues to balance social, economic, and environmental values.
8.3. Promote stewardship of water to support our quality of life, recreation, and preservation of the natural environment.
8.4. Recognize and support agriculture's role in Utah's economy.

9. What is the framework for Utah water law and policy, and how will stakeholders modernize it?
9.1. Give the State Engineer more direction on "public welfare."
9.2. Expedite and fund water rights adjudications of water basins.
9.3. Clarify and strengthen the State Engineer's authority in administering change applications to avoid depletion enlargement.
9.4. Allow the State Engineer to define water duties.
9.5. Facilitate temporary transfers of water.
9.6. Allow water right holders to subordinate water rights.
9.7. Review constitutional requirements that preclude cities from selling surplus water.
9.8. Provide regular and robust forums for stakeholder involvement in modernizing Utah water law and policy.
9.9. Provide increased ongoing funding and resources for Division of Water Rights activities.

10. What is the role of policymakers, both elected and appointed, at all levels of government?
10.1. Create ongoing learning opportunities for policymakers and residents, relying on input from a broad range of water experts and professionals, to help them design and implement effective water policies.
10.2. Establish mechanisms to engage the public in decision-making processes with policymakers before decisions are made.
10.3. Support and fund research, science, and technology to enhance understanding of and education about water issues to facilitate decision-making on the various elements of this water strategy.

10.4. Encourage cooperative interagency water decision making within and between Utah's Departments of Natural Resources, Environmental Quality, and Agriculture and Food, and with states that share watersheds with Utah.
10.5. Accelerate funding for adjudication of water rights in order to provide greater certainty and marketability of rights.
10.6. Provide adequate ongoing funding and staff for technical work and intergovernmental cooperation needed to quantify and settle Federal Reserved Water Rights claims.
10.7. Enhance legislative and public support for ongoing funding to meet Utah's water-related needs.

11. What roles will science, technology, and innovation play in addressing Utah's future water needs?

11.1. Conduct and assess new water conservation programs and initiatives.
11.2. Pilot test and demonstrate water treatment technologies and processes.
11.3. Explore technology's effect on agricultural water usage.
11.4. Improve working relationships between regulatory agencies and water providers.
11.5. Explore green infrastructure and greywater projects.
11.6. Innovate wastewater treatment and reuse projects.
11.7. Increase integrated water management across all sectors.
11.8. Improve the quality of water data collected and reported.
11.9. Make water data more accessible to the public.
11.10. Optimize water operations with automation.
11.11. Minimize water distribution system losses.
11.12. Invest financial resources in science, technology, and education.
11.13. lmprove understanding of the geology and quantity of water in Utah.

We understand that all these recommendations cannot be implemented overnight, and we recognize that some water-related problems lie beyond the scope of this document. Even so, we believe that with focused resolve, collaboration, and careful planning, Utahns can come together to ensure we wisely manage our water resources to support thriving communities and businesses, robust local agriculture, a healthy environment, and world-class outdoor recreation.

Background

INTRODUCTION

Water sustains life and underpins nearly everything we value: our homes and families, jobs and a vibrant economy, food and safe drinking water, a healthy and resilient natural environment to live in, and recreational opportunities. As John Muir famously observed, "Everybody needs beauty as well as bread, places to play in and pray in, where nature may heal and give strength to body and soul alike." Water sustains both the beauty and the bread.

Consider the complexity of Utah water resources now and into the future. Utah's beautiful and diverse landscapes attract worldwide attention, with seven climatic zones soaring from sagebrush and greasewood desert floors to alpine forests and high altitude tundra; diverse aquatic life in its streams, lakes, and rivers; wetlands supporting international migratory bird habitat; and the climactic red rock river gorges that attract river runners and presidential pens. Active and growing cities, productive farm and grazing lands, and abundant outdoor recreation spaces are interlaced among both natural and constructed features of a robust and attractive environment. These dimensions all create an amazingly complex environment with water as an essential resource to all.

We, the residents of Utah, face increasingly difficult and urgent choices as we seek to optimize the water nature perennially recycles to this desert place. Before the coming of fur trappers and pioneers, tribal nations had largely adapted to the varying climate. Still, their experiences spanned times of abundance and times of devastating droughts. As other humans followed with successive waves of population growth, fluctuating water supplies have been continuously redistributed, reallocated, and rebalanced. Utah's leadership and communities have established a legacy of willingness to learn from our past while looking forward and preparing for potential challenges to future generations. We have built infrastructure on which we depend and institutions through which we make resource allocation decisions, and we continue to adapt to changes in our economy, technology, and environment. Looking ahead, we see ever greater needs as our population is projected to nearly double by 2060 and continue to grow thereafter, we deal with the consequences of past choices that threaten our rivers and lakes, and we prepare to face unfamiliar and foreboding weather patterns. We also see opportunity to use the collaborative genius and community resourcefulness of Utah's residents to build safe water supply systems, provide water needed to secure our food supplies and related benefits, and ensure the sustainability of our cherished natural environments.

BRIEF HISTORY OF WATER USE

From about 400 to about 1400 A.D. irrigated farms fed early residents of present day Utah as the Fremont people raised corn irrigated from Clear Creek and the Ancestral Puebloans (sometimes referred to as "Anasazi") raised and stored corn and other irrigated crops. Later tribes also relied on water to sustain the plants and animals on which they depended, whether through hunting and gathering, fishing, or irrigating crops. As 19th century Mormon and similar Anglo-American settlements and Native American reservations were established in the state, pasturing of livestock and irrigated agriculture provided the food required for survival. Utah farm enterprises were then founded, and still generally exist, on small areas of cultivated land scattered among various watersheds and on narrow financial margins. Agriculture was Utah's predominant industry for many decades. It was and remains the predominant user of diverted water—agriculture draws approximately 82% of water diverted for human

use in Utah.[3] Agricultural water systems are spread across Utah in both urban areas, where many uses compete for available water supplies, and rural areas, where agriculture is and will likely continue to be the predominant use.

Agriculture bore most of the water infrastructure development costs until the early 20th century. At that time, water engineering merged with social engineering to support U.S. regional economies through the building of large, multi-purpose federal water projects that provided agricultural irrigation and other water supplies at "subsidized" rates. These projects carried repayment obligations. Significant federal funding is less likely to be available to repair, upgrade, or replace federally-built infrastructure. Utah has and continues to provide significant capital for agricultural and other water infrastructure through Board of Water Resources loan programs.

Many stories can be told of human interaction with water in Utah and across the West. The first main narrative, to the extent that we know the history, involves the native tribes, whose societies rose and fell with changes water availability and survived for thousands of years by adapting to the region's aridity through migratory lifestyles. The second main narrative recounts a triumph of human ingenuity and engineering, creating systems of dams, ditches, pipes, pumps, and other infrastructure that makes it possible to establish permanent settlements, irrigate farms, and have clean, cheap, and plentiful water flow from a tap. However, from an ecological perspective those same years tell a tale of habitat loss and water quality degradation. Variations of these narratives in the stories of particular peoples and places provide different perspectives on the immense challenges of living in an arid region.

The time has come to tell a new story. That new story involves harnessing human ingenuity to find better ways to balance competing water demands; preserve our communities, farms, and natural habitats; and enhance future water supplies. It involves harnessing the same cooperative spirit that animated our forebears to meet the challenges of today. While this is no small undertaking, we are confident that the people of Utah are equal to the task.

WHERE WE ARE TODAY

We are at the convergence of several important water-related changes and trends. Utah's population is growing rapidly, with population projected to nearly double by 2060 with much of that growth coming from Utahns' own children and grandchildren. Undoubtedly, our population will continue to grow thereafter. Such changes and trends can also be seen in the State Climatologist's projections for our climate, pressures on intrastate and interstate rivers and aquifers, and aging infrastructure.

Much has already been accomplished in recent years to prepare for future water needs, and this document builds on those prior successes. In 2000, Governor Leavitt set a statewide goal for Utahns to reduce their per capita use for municipal and industrial (M&I) purposes by 25% by 2050. With a good public response to public education and water reduction becoming more urgent, Governor Herbert reset the goal to 25% by 2025. Consequently, residents and water districts throughout the state are working to achieve this level of conservation by 2025. Per capita use for municipal and industrial

[3] Current calculations indicate 6% of Utah's precipitation is diverted to human use. See introduction of Key Policy Question 2 for further discussion.

purposes continues to decrease. [4] We believe there has been a cultural shift in how Utahns view water use, which will further help reduce per capita use. The changing urban form, reflected most notably in the growth of higher density housing and a corresponding decrease in average lot size, will further alter future water needs. Accommodating the state's projected growth, however, will require additional reductions in per capita use, as well as additional water projects to optimize use of limited supplies, particularly if climate models showing a declining snowpack are accurate. Despite past accomplishments, much more needs to be done to address the various water challenges that lie ahead.

THE PROCESS

In view of these critical water needs, Governor Herbert established a process to address Utah's water future through 2060 and beyond. He said:

> "In Utah, we don't believe in sitting back and seeing where growth will take us. We seek to be visionary and to actively secure our future. Together, we will develop a voluntary, locally-implemented, market-driven vision to help keep Utah beautiful, prosperous, healthy and neighborly for current residents and future generations."

Gov. Herbert's process included three phases. Each has produced both tangible and intangible benefits.

Phase I

In March 2013, Gov. Herbert appointed a Water Task Force of six Utah residents with extensive water policy and management experience. He asked these six volunteers to gather public comment and ideas to address the state's water challenges. During the summer of 2013, this task force conducted open-microphone town hall meetings at eight locations throughout Utah. At each meeting site, each Task Force member also facilitated public discussions on the topics listed below. Throughout the process, the Task Force, supported by the Division of Water Resources staff, solicited comments by mail and Internet, which generated approximately 800 written comments representing diverse viewpoints.

Tangible Benefits

- This process produced a good baseline of Utahns' perceptions of water needs through the written comments and the summaries of the town meeting proceedings.
- In October 2013, the Task Force, informed by the public comments and through their own expertise, prepared white papers on:
  - Water Delivery and Efficiency
  - Recreation and the Environment
  - Competition for Water
  - Water Law
  - Water for Agriculture
  - Funding Water Infrastructure

  These white papers can be found in Appendix B of this document.

[4] While critics frequently cite Utah's per capita use as compared to other cities around the West, such comparisons can be problematic, reflecting variable inputs in terms of physical geography, climate, data used and omitted, etc. As a result, measuring Utahns' per capita use as compared to their past represents a more productive investment of time and resources and a better metric for conservation progress.

Intangible Benefits

- Direct participation and news coverage provided significant public awareness that the State of Utah had recognized water planning as a critical need.
- The process served as a focal point for a growing public interest in water issues.

Phase II

After the Water Task Force completed its work, in October 2103 Gov. Herbert established a State Water Strategy Advisory Team comprised of 41 volunteers representing a broad range of Utah water interests to build on the work of the Water Task Force. He tasked them to (1) solicit and evaluate potential water management strategies; (2) frame various water management options and the implications of those options for public feedback; and (3) based on broad input, develop a set of recommended strategies and ideas to be considered as part of a 5O-year water plan. He asked the Team to work with Envision Utah to facilitate further public input and provide expertise from the Team members as part of what became known as the *Your Utah, Your Future* statewide visioning project. In addition to water, the *Your Utah, Your Future* project tackled ten other topics.

In 2014, Envision Utah conducted a statewide values study to identify (1) what factors Utahns view as most affecting their quality of life and (2) the underlying emotions and values tied to those factors. The study determined that Utahns view water as a top priority in the state because it is linked to many of the quality-of-life factors and that Utahns value having plentiful, readily available, and affordable water for a variety of economic uses, with strong emphasis on local food production and community growth. Participant responses indicated belief that these features will lead to sustained economic growth, better communities, and financial and food security. They also value having clean water to sustain Utah's natural beauty and the environment for plants and wildlife. These values create a feeling of responsible stewardship of natural resources and the planet.

After the values study was completed, Envision Utah with input from the Team constructed five scenarios representing different ways to supply water for the projected increase in Utah's population. These scenarios were taken to the public as one of eleven topics included in the *Your Utah, Your Future* online survey in April and May 2015, and 52,845 people participated. A random-sample survey conducted simultaneously confirmed that the online survey accurately described the desires and opinions of Utah residents.

The survey respondents:

- rate water as one of the state's top priorities;
- would like to see significant reductions in per capita use, but still want some grass in their yards and open spaces;
- are willing to build regional water development projects to provide sufficient water for Utah's needs, after first implementing significant conservation measures;
- desire greater food availability, security, and locally grown food;
- are not willing to shift significant amounts of water from agriculture to urban uses; and
- place a high value on Utah's natural environment.

Tangible Benefits

- The *Your Utah, Your Future* project identified the values and relative priorities that drive water-related decisions among Utah residents.
- Surveys conducted as part of *Your Utah, Your Future* revealed a high level of concern about water and food issues among Utah residents, identifying water as the most significant priority for Utah's future, and food production as the top priority for water use.
- The results from these two survey were used to form a vision for future water policy that can be found, along with the full survey results, at www.envisionutah.org. A summary is included in Appendix C of this document.

Intangible Benefits

- The *Your Utah, Your Future* survey results provide an overwhelming mandate for wise water planning and policy development in Utah. The mandate is not specific to any particular project but shows a clear expectation that effective water strategies will be implemented to assure clean water to sustain life, support a strong economy, provide sufficient water for food production, and preserve the natural environment.
- The Advisory Team gleaned significant information from the public surveys and public comment from the *Your Utah, Your Future* process to carry into Phase III.

Phase III

The Team utilized the information gathered during Phases I and II and relied upon the Team members' extensive knowledge and experience to craft this 50-year water strategy. The Advisory Team co-chairs prepared and published a strawman draft of this document on September 25, 2016. The Team then solicited and received substantial public comment and conducted a poll of Team members on each key issue. Next, the Team members formed drafting committees for each key policy question that produced proposed drafts that were vetted by the entire Team. The final result is this document presented as a common ground upon which to base future discussions and decisions. While not all Advisory Team Members agree with all of the recommendations in this document, they generally agree that the document as a whole characterizes the issues that need to be addressed.

Tangible Benefits

- The record of the Advisory Team proceedings compiled by Envision Utah provides significant information on which to draw, including meeting summaries and public comments.
- This report, compiled through the process described above, and the thousands of hours contributed by the Advisory Team members and many other individuals and organizations provides a strong roadmap toward achieving the vision articulated above.

Intangible Benefits

- Though the Team members worked collaboratively and respectfully, they vigorously debated many hard questions and shared many drafts in their efforts to provide fair and balanced recommendations. The Team members' experience and their understanding of diverse viewpoints should serve our state and its communities well in future policy discussions.
- The Advisory Team demonstrated the ability of diverse stakeholders to develop recommendation to address very difficult issues, thereby providing a working model for effective water planning and policy development.

Key Policy Questions

As part of the process, the Advisory Team spent several meetings establishing key policy questions that should be addressed when looking at the future of Utah's water supplies. Each of the following key policy questions was carefully considered as part of a comprehensive list of matters that will need to be addressed now and in the future. This section of the document identifies policy questions and related issues identified by the Advisory Team members, followed by their recommendations.

1. What is the role of water conservation and efficiency in Utah?

Issues

1. Conservation and efficiency goal-setting and implementation
2. Lack of clear standards for water use measurement, tracking, and reporting
3. Standards for appropriate and efficient water use
4. Constraints to conservation and efficiency
5. Consequences of water efficiency and conservation
6. The necessity of improved conservation and water use efficiency
7. Inadequate funding and resources for water efficiency and conservation efforts
8. The need for effective water conservation planning, implementation, and evaluation
9. Integration of water planning and land use planning
10. How far water efficiency and conservation can take Utah to meet water demands

Recommendations

1. Prioritize the efficient and sustainable use of water as a critical strategy for meeting Utah's water needs.
2. Establish and utilize clear standards for water use measurement, tracking, and reporting.
3. Establish water efficiency standards to benchmark water use and identify conservation potential.
4. Support research on water conservation constraints and ways to overcome them.
5. Identify intended and unintended consequences of water efficiency and conservation to ensure appropriate choice and implementation of particular strategies.
6. Provide leadership and commitment for ongoing implementation of water conservation and efficiency strategies.
7. Provide adequate funding and investments for effective water efficiency and conservation.
8. Promote local, regional, and statewide water conservation planning, implementation, and evaluation.
9. Integrate water planning and land use planning to achieve long-term water use efficiencies in urban areas.
10. Determine and quantify the contributions that increasing water use efficiencies and conservation can make to future water supplies.

Issues

1.1. Conservation and efficiency goal-setting and implementation

Despite conservation progress, Utahns have room for improvement in their per capita water use.[5] Varying climatic zones, land use patterns, local economies, lack of accurate data, and limited experience and knowledge often complicate efforts to establish, strive for, and reach a statewide per capita use

[5] See Appendix D for resource and reference list associated with Key Policy Question 1.

goal. As a result, some Utah communities have had greater success in documenting and reducing their per capita water use than others. However, many western U.S. cities have reduced total water use even in the face of significant growth and other challenges similar to those Utah faces. Such conservation successes elsewhere and progress within Utah are encouraging and suggest there is additional capacity to conserve. Strong support for conservation as the primary strategy for addressing future water needs has been expressed in all public forums and comment opportunities associated with development of this document. To meet the water needs of the state's growth, Utah needs to strengthen conservation and efficiency goals by refining them regionally and revising them on a more frequent and continual basis. Implementation by all communities and throughout all sectors of water use—including agricultural, residential, commercial, industrial, institutional, and secondary municipal uses[6]—is needed to reach and achieve these goals.

1.2. Lack of clear standards for water use measurement, tracking, and reporting

Not all water use or water supplies in Utah are accurately and consistently measured, tracked, or reported by local and regional water providers. This situation makes analyses of current water use, gpcd (gallons per capita per day), future conservation potential, and progress toward water conservation goals very difficult. As a result, there is a need for better data and more consistent methodologies across geographies.

There is also a need to account for all water supplies using statewide standards across watersheds, including potential alternative sources. Some areas of Utah have secondary (untreated or non-potable) water systems for outdoor water use. Much of this secondary water remains unmetered and is reported only as an estimation of use. Water resources planning and management depend upon accurate accounting of all water use and supply through data that meets acceptable standards. Such data is vital for Utah to determine the role of water efficiency and conservation within the larger state water management context.

1.3. Standards for appropriate and efficient water use

It is important to identify, communicate, and enact clear standards for appropriate and efficient water use. Efficiency standards and benchmarks are needed to define appropriate consumer behavior, specify relevant irrigation and plumbing requirements, and identify and quantify Utah's water savings potential. Water waste is not permitted as a matter of Utah water law and, in times of shortage, certain uses may be designated as inappropriate through various water use restrictions. Understanding the role of such restrictions for both short- and long-term demand reduction would improve the ability of water providers to communicate the value of those restrictions to the communities they serve.

1.4. Constraints to conservation and efficiency

In Utah, there are often legal, economic, knowledge, and other constraints to organizations' and residents' abilities to conserve water and use it more efficiently. Some examples follow.

i. Some elements of Utah's prior appropriation water law (*e.g.*, the "first in time, first in right," "use it or lose it," and beneficial use principles) inhibit or discourage water conservation

[6] Municipal & Industrial (M&I) water use is comprised of residential, commercial, industrial, and institutional uses, including secondary water within each of those municipal sectors. Future references to M&I use in this section are inclusive of all these uses.

instead of incentivizing it. In addition, some municipal or Homeowners Association (HOA) codes and ordinances are counter to water efficiency objectives.

ii. Current financial structures and business operations of most water providers depend on selling water to repay capital debt financing and operate water systems. Under certain rate structures, a substantial reduction in use may undermine the income needed to properly maintain and operate water systems. These constraints may create internal disincentives for water providers' full support and pursuit of water conservation.

iii. Water rates in Utah are determined by the cost of service and, in some cases, may be perceived as low compared to those in other western cities. Implementation of effective pricing signals to promote water conservation is needed. This need includes implementation of tiered culinary pricing structures now required by Utah Code 73-10-32.5 or adoption of other rate structures proven effective at promoting conservation by organizations such as Alliance for Water Efficiency, CERES, or American Water Works Association.

iv. Financial capability, time, or knowledge may limit the ability of some people to engage in water conservation actions. For instance, people with limited understanding of landscape water needs and the impacts of microclimates often over-irrigate and may have unrealistic landscape-aesthetic expectations.

Due to these and other impediments to conservation, more policy, social, economic and other research is needed to better understand the full range of these obstacles and ways to effectively address them.

1.5. Consequences of water efficiency and conservation

Water efficiency and conservation savings can have beneficial effects of mitigating and reducing negative impacts to natural systems from stream and aquifer diversions and lowering costs of water provisions and stormwater management. However, there may also be detrimental effects to the environment where water bodies that are being depleted have come to depend on return flows from "wasted" water from human uses and effluent from wastewater treatment plants. There is a need to assess the environmental consequences of water efficiency and conservation and to address these consequences in ways that protect source waters, water supplies, and the natural environment. See Issue 3.5 for further discussion.

1.6. The necessity of improved conservation and water use efficiency

Increased water demand management is needed to enable Utah to ensure the most cost-effective measures to sustain its water resources for future generations. Water demand management has not received an appropriate amount of funding and policy emphasis to help meet Utah's future water needs, with far less emphasis than new supply development. Particular attention needs to be focused on areas with high water savings capacity, such as urban landscape irrigation, retrofitting older building structures with modern plumbing upgrades, and commercial and industrial practices.

Currently, there is poor implementation of water conservation best management practices (BMPs) for many M&I sectors. For example, greater conservation opportunities exist in commercial, industrial, and institutional (CII) sectors. Planning needs to consider water needs of new M&I growth and how growth can be made more water efficient through construction and landscaping standards.

Water use improvements in the agricultural sector are also important since agriculture uses approximately 80% of the diverted water supply. Technological and cooperative opportunities exist to reduce loss in agricultural water delivery and irrigation systems.

1.7. Inadequate funding and resources for water efficiency and conservation efforts

Water efficiency and conservation have not received adequate funding, staffing, and other resources in comparison to planning and management activities focused on pursuing new supply options. Adequate resources are needed to fully determine the potential contributions and return on investment that efficiency and conservation efforts can make to providing for Utah's water future.

1.8. The need for effective water conservation planning, implementation, and evaluation

Water providers have obligations to plan and encourage use of water resources in a manner that will best serve the physical, social, economic, and environmental needs of Utah residents. However, many cities and towns have not adopted adequate water conservation plans and fully complied with Utah Code 73-10-32. Retail water providers with over 500 service connections must have a water conservation plan that is adopted by the governing body of that community, submitted to the Division of Water Resources, and updated no less than every 5 years. This law requires water conservation plans to include benchmarks for improvement in conservation programs, conservation targets, a timeline for action, and an evaluation process to measure progress. Effective conservation plans that result in implemented, tracked, and completed programming are imperative to improving water supply and demand planning and management.

1.9. Integration of water planning and land use planning

Ongoing urbanization and associated land use transformations have significant implications for long-term water use patterns in Utah. Lack of coordination between local and regional water and land use planning often results in missed opportunities, such as abilities to pool financial resources, consider various water infrastructure alternatives, and realize financial and water use efficiencies. Without integration of water and land use perspectives, water footprints of new developments at city, neighborhood, and parcel scales can occur in ways that establish intensive and long-term water consumption patterns. These patterns may also impair water quality. Decisions concerning the amount of water required, urban design, site preparation for development, indoor and outdoor water delivery, and capture and runoff systems highly influence M&I water use patterns. These factors need to be thoroughly assessed and considered before projects are approved.

The effects of urban development on drinking water source areas and in sensitive watersheds should be studied in order to avoid or mitigate potential negative impacts. Additionally, drinking water source protection plans should be integrated into water and land-use planning processes.

1.10. How far water efficiency and conservation can take Utah to meet water demands

Many Utah residents have expressed strong support for water savings efforts across all sectors of water use. However, the contributions that water efficiency and conservation can make to addressing Utah's water challenges have not been adequately assessed and quantified. Determining the role of strong support and effective implementation of water demand management strategies is a very important issue for securing Utah's water future.

Recommendations

1.1. Prioritize the efficient and sustainable use of water as a critical strategy for meeting Utah's water needs.

Water efficiency and conservation are essential components in providing a sustainable water supply for Utah's future.[7] Utah should engage in determined and ongoing efforts to improve water use efficiency and conservation. Assessing and incorporating best policy and management practices successfully used in this and other states will help Utah strive to be a national leader in water conservation.[8]

Water efficiency and conservation strategies can be implemented at a supply system, organizational, or individual end user level. These strategies include but are not limited to repairing, replacing, and redesigning aging water infrastructure; pursuing water optimization strategies; educating and informing the public; replacing water-using appliances and technologies with more efficient models; irrigating to meet crop or landscape water needs; and transitioning to low-water urban landscapes. Water-saving efforts can reduce stress on natural ecosystems, reduce competition for limited water supplies, offer cost-effective options for stretching limited water supplies, and help avoid or delay the need to develop new supplies of water.

Water efficiency and conservation should be prioritized across all water use sectors (*e.g.*, agricultural, residential, commercial, industrial, and institutional) through setting targets and tracking progress toward local, regional, and state water conservation goals. At the writing of this document in 2017, the Governor's conservation goal of 25% reduction by 2025 has been nearly achieved for Utah. New and meaningful long-term water conservation goals should be set and realized to help assure a sustainable supply of water into the future. See Issue 3.5 for further discussion.

1.2. Establish and utilize clear standards for water use measurement, tracking, and reporting.

Utah needs to establish the foundation for a more accurate and reliable water use and supply data gathering and reporting system. Clear standards and targets for measuring, tracking, and reporting water use should be set so they can be used consistently by water providers, communities, and the State. These standards and targets should describe how different water uses are to be metered and measured, identify best technologies and practices for measuring devices, and specify reporting requirements in units and time periods of measurement. The standards should also specify the level of verification needed for data reporting and the responsibilities and procedures for water providers to meet the standards. Funding should be appropriated by the Llegislature to train water personnel in the standards and to assist water providers that currently do not have the capacity to meet them. An important component of implementing these standards is requiring water providers to meter and measure all water use within their service areas, including secondary water. A variety of funding mechanisms should be tapped to enable establishment and implementation of clear water data standards.

[7] Water savings can be gained by fulfilling the same purposes with less water (efficiencies), or by reducing water uses (conservation); in practice, the two strategies are very closely related.

[8] See list of conservation literature in Appendix D: Resource and Reference Lists

1.3. Establish water efficiency standards to benchmark water use and identify conservation potential.

Water use efficiency standards should be based on scientific methodologies to ensure appropriateness for different water sectors, implementation feasibility and effectiveness, and fairness for different water users. Significant advancements have been made in recent years in approaches and technologies for promoting and achieving water use efficiency, and Utah should commit to more fully implementing them. Examples follow.

i. Water districts, cities and towns, and other water suppliers should implement measures to reduce water supply system losses and to engage in more effective water demand management.

ii. Within the M&I sector, standards for indoor and outdoor water use efficiencies should be tied to industry and technology standards, such as those developed by the American Water Works Association (AWWA) M36 Audits and Loss Control Program (4th Edition), the Irrigation Association, the US-EPA WaterSense Program, the Alliance for Water Efficiency, and the Water Research Foundation Residential End Uses of Water Study (Version 2).

iii. Water budgeting approaches for assessing landscape water use efficiency should be refined and utilized. These approaches take local plant, weather, soil, and topographical characteristics into account, allowing efficiency metrics to be standardized for meaningful comparisons across geographic locations. Landscape water budgets can save water and still allow for healthy landscapes.

iv. Utah should continue current efforts to assess water use efficiencies in agriculture through implementing standards related to conveyance systems, updating duty of water (which determines allowable use in each sector), and determining depletion amounts (water lost to the system and distinguished from return flow that can meet requirements of other water rights holders).

1.4. Support research on water conservation constraints and ways to overcome them.

More comprehensive research and analysis of the many components of water conservation strategies is needed to support innovation, implementation, monitoring, and assessment. One research priority is analysis of the relative effectiveness of various system-wide and end user strategies for achieving water savings. Diverse strategies designed to motivate and enable customers to save water also need to be implemented and studied. These diverse strategies can be divided into categories such as outreach (*e.g.*, educational programming, information provision, and community engagement), financial incentives (*e.g.*, rate structures, rebates, grants, and loans), and policies and rules (*e.g.*, statutory changes to prior appropriation law to promote conservation and use restrictions under various circumstances).

Other strategies aim to improve technological efficiencies, change behaviors, and enable adoption of less water-intensive crops, landscapes, or industrial processes. Different approaches often work for different types of individuals or situations, thus requiring experimentation and applied research. Basic research is needed to increase our knowledge of plant and landscape water demands, appropriate application of evapotranspiration (ET), and improved turf varieties.

Another research priority is on answering the question, “How can financial management by water providers incentivize conservation while still maintaining fiscal stability for their organizations?” Answers will require focusing on structural constraints to efficiency in water provision systems like laws and regulations, aging infrastructure, water budget rate structures, take-or-pay contracts, and infrastructure reinvestment strategies.

Related areas of research also include the potential impacts as well as opportunities involved in seeking to utilize alternative water supplies such as reuse water, greywater, and stormwater on landscapes and in other applications. This will help to inform how best to utilize these and other potential alternative sources to optimize opportunities and minimize potential hazards to public health and safety and to the natural and constructed environments.

1.5. Identify intended and unintended consequences of water efficiency and conservation to ensure appropriate choice and implementation of particular strategies.

Implementation of water efficiency and conservation measures should identify and quantify the intended and unintended consequences within a water basin or stream context. This analysis of the potential impacts to natural and urban environments as a result of water efficiencies or water use reductions needs to extend to drinking water, waste water, and stormwater sources. This information is needed to promote environmental enhancements and mitigate any environmental detriments of such measures.

Water efficiency and conservation generally help promote a water ethic and help Utah to stretch limited water supplies by reducing unnecessary or wasteful water use. Upstream efficiencies and conservation can mean less water is diverted and more water remains in natural stream channels. Measures should be implemented to help ensure that conserved water enhances water bodies and improves water quality. However, as water supplies tighten, water conservation and efficiency measures could mean less water for the environment. Environmental water needs should be seen as equal with and connected to human water needs as consequences are identified and balanced.

For example, water that may be considered “wasted” sometimes ends up in streams or lakes and is calculated as a return flow, providing for use further downstream or maintaining environmental flows and levels. Wastewater effluent from treatment plants also returns back to the natural system after being treated. Increased interest in water reuse as a new supply source could have negative impacts by decreasing these flows, with unintended consequences to water bodies. Balance needs to be achieved between this potential new water source and environmental impacts through identifying appropriate contexts in which water reuse would be beneficial and avoiding or mitigating negative impacts.

1.6. Provide leadership and commitment for ongoing implementation of water conservation and efficiency strategies.

Increased support of water conservation programming on local, regional, and state levels is imperative to success. Existing water conservation programs being implemented by cities and water agencies should be evaluated and, where appropriate, improved. Multiple approaches to improving water efficiency and conservation should be supported when and where they prove to be effective. Examples of specific recommendations follow, recognizing that innovation and adaptation will continue to enhance these options in the future.

Set an Example with Good Government and Institutional Water Practices

Government entities and institutions at every level must provide an example of good water conservation practices since they are often large water users. They can set examples by implementing water efficiency best practices and standards for indoor uses in new construction and upgrades of existing buildings. Landscape water use efficiency is particularly visible and influential. Low water landscaping, efficient irrigation systems, and maintenance need to be budgeted and implemented at institutional facilities. Landscape transitions at state universities and other government properties should be expanded. Operation and expansion of public conservation demonstration gardens at Utah Botanical Center, by water districts, and within communities should continue.

Continue to Implement and Enlarge Education Programs

Public education programs are vital for social change and represent an important component of any conservation program. State universities and water agencies along with water providers should lead educational efforts. Public education includes university and Extension materials, demonstration gardens, water bills that better interpret and communicate water use information, materials distributed through traditional means and social media, and school curricula. These educational efforts are the backbone that connects other programs together to meet conservation goals on a long-term basis. Greater coordination on conservation messaging across these various efforts should be encouraged.

Expand Adoption of Financial Incentives for Water Conservation

i. Rate structures: Conservation-oriented rate structures should continue to be endorsed and adopted, such as ascending block rates which charge more per unit as usage increases, lower base or fixed charges and higher usage rates, water budget rate structures, seasonal rates, and time-of-use pricing. Take-or-pay water contracts should be evaluated for their impact on water conservation outcomes. A critical component for successful water pricing and funding is clear messaging on water bills and property tax bills so customers and residents are informed of actual costs and avoided costs of water use.

ii. Rebates and other incentives: Rebates and other incentives can provide assistance and encouragement for individuals and companies to conserve water. These efforts resonate well with the public and can be tied to educational elements that help get appropriate messages to targeted audiences. Incentives and rebates have generally been used for the purchase of indoor appliances and fixtures and outdoor irrigation equipment. Their use should be expanded to include other measures.

License Landscaping and Irrigation System Contractors

Having certified or licensed professionals design, install, and maintain sprinkler systems will help to ensure that those systems meet efficiency standards. Utah should expand training, licensing, and certification programs for landscape design and maintenance professionals focused on how to reduce water waste in urban landscapes. Certification or licensing programs will be more effective if they are enforced by local entities in charge of land use and building codes.

Improve Metering and Customer Feedback

Individuals can make informed decisions about how to reduce water use only when they know how much water they are using and can track their own water conservation progress. Research and practice have demonstrated that providing customers with more easily interpreted water bills and usage

comparisons can help reduce water use. Usage comparisons can be made to landscape water need and to demographically similar customers. This is particularly true with metering of secondary water connections, where information provisions on use compared to landscape water need, even absent a pricing incentive, have reduced water consumption. With Automatic Metering Infrastructure (AMI) systems becoming more widespread, more detailed and frequent water use reporting is becoming a reality. As they can afford it, water retailers should install systems that provide real-time and comparative data to their customers.

Improve Conservation Collaboration

Greater collaboration among water conservation interest groups and with the public should be promoted and supported. Multiple entities—including Master Gardeners, non-profit organizations, and the green industry in addition to state agencies, universities, and water providers—have a role to play. One example of a successful collaboration is the Qualified Water Efficient Landscaper (QWEL) Program, developed and delivered cooperatively by Utah State University Extension, the Utah Nursery and Landscape Association (UNLA), the Utah Division of Water Resources (UDWR), the Iron County Water Conservancy District, and the Jordan Valley Water Conservancy District (https://www.qwelutah.com/). Another example is the work of articulating this conservation strategy by the diverse membership of the Advisory Team.

Prioritize Conservation in State Policy

Legislative and Executive prioritization of ongoing implementation for water conservation and efficiency strategies is critical. The Utah Legislature should prioritize conservation in legislative actions, funding decisions, and interactions with residents and the public. Executive departments and divisions should prioritize conservation strategies in their water budgeting, staffing, and operations. Utah has a long history of leading the West in water development efforts; it should now be a leader in water conservation innovations.

1.7. Provide adequate funding and investments for effective water efficiency and conservation.

Funding and investments are needed to fully realize the potential contributions and return on investment that water efficiency and conservation efforts can make to providing for Utah's water future. Water agencies should budget for water conservation programs in a manner similar to the way they budget to develop new water supplies. Funding for conservation measures also should be made available on an ongoing basis.

Investments should be made in water demand management infrastructure to measure, track, report, and implement efficiency standards. Needed resources also include agency staffing and budgeting to better integrate conservation into water systems, enhance ongoing interactions with the public, deliver conservation programs, and conduct research and evaluation. Many different state, regional, and local entities can help promote water conservation, so funding and resources from multiple sources need to be allocated to these efforts. Ongoing and sufficient support for water efficiency and conservation should be prioritized and forthcoming to make these efforts effective at contributing to Utah's water future.

1.8. Promote local, regional, and statewide water conservation planning, implementation, and evaluation.

All water providers should adopt water conservation plans in compliance with Utah's Water Conservation Plan Act (Utah Code 73-10-32). As part of their planning, water providers should educate residents and stakeholders on the importance and scarcity of water and the need to conserve, manage and plan so future generations have enough water. They should explore obstacles related to various conservation programs and technologies and the legal and institutional means to augment existing water supplies, including water conservation and water use efficiency through more effective overall demand management. Based on their findings, they should optimize appropriate opportunities to ensure water is available to sustain growth and prosperity and to ensure water quality is protected.

Local governments' and water providers' conservation plans are needed to appropriately integrate water use and land use planning. More cities and towns should employ water conservation professionals to plan and coordinate their water conservation programs and to conduct program evaluations. These professionals should interact and network with other water conservation professionals across the state and nationwide to ensure that Utah's cities and towns are implementing water conservation best management practices. Staffing for water conservation is imperative to effective water systems operation and management.

To augment water efficiency and conservation options, water planning should consider these additional strategies:

i. utilization of integrated water resource management (IWRM) as an effective method for assessing adaptation options and their implications in the context of an evolving regulatory environment with its competing demands;

ii. enhancement of ways to manage all available water supplies, including groundwater, brackish water, surface water, and effluent, in a sustainable manner;

iii. increased ability to shift water within and between sectors (including agriculture to M&I) while mitigating any associated impacts in basins of origin;

iv. identification and evaluation of alternative water supply sources such as effluent reuse, rain catchment, stormwater runoff, and greywater;

v. strengthening communities through drought resilience and contingency planning; and

vi. adequate and ongoing funding for water efficiency measures across all sectors.

1.9. Integrate water planning and land use planning to achieve long-term water use efficiencies in urban areas.

Utah should plan that new growth is water-efficient by design. Water-efficient design and development standards must be established and implemented as land use changes and urbanization occurs. Coordination between land use planners and water managers should occur early in planning processes so water-efficient alternatives and trade-offs can be assessed in light of projected water use patterns. It

is important to balance the desire to conserve water with the need to protect public health and safety and the environment to ensure multiple goals are met. Examples of specific recommendations follow.

Include Water Conservation and Water Source Protection Elements in City and County General Plans
Including water conservation in local governments' general plans will encourage municipalities and counties to consider water conservation when making decisions about land development and related policies. It might be advisable to modify state law to require such an element. Creating local plans with watershed protections and sensitivities included helps to ensure that drinking water sources remain intact.

Enact Zoning Ordinances That Allow the Housing Market to Move to Higher Densities
Higher density developments can result in less irrigated landscape area per person and reduce per capita water demands. Land use mixtures will be decided by municipalities with public input, but water demand considerations should be part of that discussion. See Recommendation 6.8 for further discussion.

Enact Landscaping and Other Ordinances
Ordinances can play a significant role in achieving Utah's conservation goals. Local ordinances, including requirements of private and quasi-private planned communities such as HOA rules, should be modified to allow, incentivize, or require water-efficient landscapes in new and existing developments to achieve long-term savings. Policies and programs to water landscapes through rainwater capture and reuse could also be developed where appropriate.

Utilize Dual Water Source Delivery Systems Where Feasible
Dual water systems can represent an alternative source of water supply. Dual water delivery systems should be encouraged where environmentally and economically feasible. These alternative water sources should be metered and billed using conservation rate structures. Reuse and secondary water can have residential, industrial, and commercial applications which should be evaluated and implemented.

When implementing reuse, greywater, or other non-potable water sources, care should be taken to avoid the possibility of cross connection between non-potable and potable supplies. Codes should be reviewed and amended to address public health and safety issues, including the consideration of regulation and certification. Ongoing and continuing education of developers, installation contractors, designers, and the public should be a component of regulation and certification to ensure proper design, installation, and maintenance of cross connection prevention devices and systems.

1.10. Determine and quantify the contributions that increasing water use efficiencies and conservation can make to future water supplies.

Implementation of previous recommendations in this section should be accompanied by ongoing documentation, monitoring, and assessment. This will enable the State of Utah, local water providers, and water agencies to determine and quantify the contributions that increasing water use efficiencies and conservation can make to future water supplies. Determining these contributions should be based upon experiences gained in prioritizing these approaches, exercising leadership, committing resources for ongoing implementation, drought planning, and integrating water and land use planning. Quantifying these contributions should be based upon accurate water use and supply measurements and reporting, water efficiency standards to benchmark and quantify potential water savings, and water conservation

research and analysis. A more comprehensive statewide approach to funding, pursuing, and assessing water efficiency and conservation must be used in deliberations of tradeoffs between different approaches for meeting Utah's long-term future water needs.

2. How will diverted water supplies be developed to meet competing and ever increasing demands?

Utah is an arid state. Based on data from 1961-1990, the State estimates 61.5 million acre-feet per year, on average, falls in the form of precipitation annually. The State estimates the annual water supply is approximately 61 million acre-feet. This is calculated by using 13.5 inches of precipitation spread over 54,300,000 Acres of Utah's land. This data is dated and recent experience demonstrates that annual precipitation is declining as the climate appears to be getting warmer with more precipitation falling in the form of rain rather than snow. Of this annual precipitation, only a portion of that water ends up as water in our rivers and streams that can be diverted for various human uses. Traditionally, this diverted water has been allocated to human economic uses (e.g., municipal, industrial, agriculture), which has lead in some instances to our rivers, riparian areas, wetlands, lakes, and watersheds being negatively affected. The challenge for the future is how to assure that reasonable human needs are met, while—through improved science, water efficiency, and thoughtful policy and legal changes—adequate water is also available for the environment.

Issues

1. The variability of water supply yield
2. Water quantity and quality of healthy watersheds
3. Balancing competing uses and increasing demands
4. The role of regional and interstate river water supplies
5. The role of local water supply projects
6. Potential for additional groundwater development

Recommendations

1. Utilize water conservation and improved efficiencies to optimize water supplies.
2. Manage and restore watersheds to decrease transpiration, increase runoff, and protect water quality.
3. Develop and beneficially use Utah's allocated share of interstate rivers.
4. Develop other regional water supply projects for beneficial use.
5. Increase aquifer storage and recovery.
6. Implement water reuse.
7. Increase capacity of existing reservoirs.
8. Consider costs and benefits of water development.

Issues

2.1. The variability of water supply yield

The arid nature of Utah's climate, coupled with its fluctuating weather and long-term climate trends, creates uncertainty regarding the quantities of physical water supplies that may be reliably and economically available to meet the needs of a growing population. Limited surface storage is available for some surface supplies, and small quantities of water have been stored in aquifers for later recovery. However, many surface diversions and essentially all groundwater diversions lack storage and, thus, lack

the ability to hold this water in storage for use later in the season or even in another water year. Future water reliability and sustainability must factor into all future water supply development plans.

2.2. Water quantity and quality

The health and function of watersheds are critical to the State's water supplies. A healthy watershed is able to maintain and enhance water quality to support native plant, animal, and aquatic species. Streams and floodplains in a healthy watershed are more able to accommodate flood flows without regular destructive flooding and erosion. Healthy watersheds enable drought resilience at the basin scale, as improved flows not only allow fish and wildlife a better chance of surviving drought, but also provide more reliable water delivery for municipal, agricultural, and other uses. See Recommendation 4.1 for further discussion on this issue.

2.3. Balancing competing uses and increasing demands

From the earliest diversion of water by Native Americans to diversions by Mormon pioneers in the 1800s, agriculture and the water needed to support it in the arid Utah climate have always been major components of the Utah economy and social fabric. Agriculture will continue to be so into the future. A number of recent public opinion polls, surveys, and studies show that Utahns place the importance of agriculture very high. Water will continue to be converted from agricultural use to urban M&I use primarily through market-based transfers between willing sellers and buyers. Yet the strong value placed on agriculture and food security calls into question the long-time practice of shifting water and land from agriculture to other uses. Current laws do not fully enable shared use of water resources, and technological advances are needed to create more on-farm efficiencies that may free water formerly used for agricultural irrigation for other uses without drying up our farms. See Key Policy Question 3 for further discussion.

Public water supply agencies, together with some private water corporations, are developing additional water for municipal and industrial uses. These uses are driven largely by population growth and economic expansion. Growing municipal and industrial water supplies are critical to support strong population growth and a growing, vibrant economy in Utah.

Water for agriculture, municipal, and industrial uses often is diverted from natural streams. These surface diversions and depletions create challenges for natural streams and the ecosystems they support in some areas of the state. Due to the arid nature of Utah's climate, the diversions of water, together with the needs of natural systems and the environment, at times conflict, because there is an insufficient water supply to meet all of these competing needs. This creates a challenge for Utah policymakers, water interests, and conservation groups.

2.4. The role of regional and interstate river water supplies

Assuming that conservation occurs above the current state goal of a 25% reduction by 2025 and that all local projects are developed, there remains a potential gap between projected demand and supply, particularly in light of Utah's projected doubling of population by 2060 and continued growth thereafter. Regional water supply projects meet an important part of satisfying the gap between demand and supply. Regional water projects can provide service beyond municipal and jurisdictional boundaries. Sometimes these regional water supply projects provide water service throughout substantial portions of a county. In other cases, regional projects span multiple river basins and counties, such as the Central

Utah Project that provides water through the Central Utah Water Conservancy District to Uintah, Duchesne, Summit, Wasatch, Utah, Salt Lake, and Juab counties.

The 1948 Upper Basin Compact apportioned 23% of the Colorado River Upper Basin's water to Utah, which is calculated to be 1.4 million acre-feet per year. Of that amount, Utah currently uses approximately 1 million acre-feet. Of that 1 million, about 800,000 acre-feet are diverted within the Uinta Basin on the eastern side of the state. To collect more of its apportionment, Utah relies in part on the federally sponsored Central Utah Project (CUP). The CUP, among other things, transfers water from the Colorado River Basin in eastern Utah to the main population areas along the Wasatch Front.

Presently, there are two legislatively-approved interstate-river water development projects that are projected to be needed in the future after certain benchmarks are met. These projects include significant infrastructure and also further develop the State's allocated share of water under interstate compacts.

First, the 1958 Bear River Compact allocated water in the Bear River between Utah, Idaho, and Wyoming. In 1991, the Legislature passed the Bear River Development Act which states that "the Division [of Water Resources] shall develop the surface waters of the Bear River and its tributaries through the planning and construction of reservoirs and associated facilities as authorized and funded by the Legislature; own and operate the facilities constructed; and market the developed waters." The project waters were allocated between Bear River Water Conservancy District (60,000 AF/yr), Cache County or a local water conservancy district (60,000 AF/yr), Jordan Valley Water Conservancy District (50,000 AF/yr), and Weber Basin Water Conservancy District (50,000 AF/yr). The Bear River Project will benefit many communities in Northern Utah.

Second, the Lake Powell Pipeline Development Act, enacted by the Legislature in 2006, defines a project that will develop additional portions of Utah's allocation of Colorado River water to benefit Utah's growing population and economy. Water would be diverted from the Colorado River at Lake Powell and delivered to Sand Hollow Reservoir through a 139-mile buried pipeline. The legislatively-approved project also includes pumping facilities and hydroelectric generation facilities that will generate power to offset pumping costs. The pipeline will deliver approximately 86,000 acre-feet per year of water at full capacity to southwest Utah. The water diverted into the pipeline will be a small portion (approximately 6 percent) of Utah's current projected Upper Colorado River Compact allocation that currently flows on to other states.

In response to recent legislation (Senate Bill 251 from the 2016 legislative session), Utah is refining its assessment of its future water demands and supplies and is reviewing its estimate of the quantity of water that might be made available for reallocation through effective conservation programs, reuse projects, and a reasonable estimate of conversion of agricultural water to M&I uses to meet the projected M&I demands. A significant amount of water may be made available through these efforts that would defer the need for these projects well into the future. Some believe these efforts will be adequate to address Utah's growing demand for water and avoid the need to develop new regional water projects. For further discussion, see Recommendation 1.10, 2.8, 6.5, 6.9, and 7.2.

2.5. The role of local water supply projects

As water supplies are allocated among ever increasing demands it may be possible to implement local projects that benefit discrete jurisdictions to help with this need and delay some larger projects. Local

projects may be implemented while larger regional development and water importation projects are being planned and developed. Local projects that could and are being developed include completing approved groundwater development, metering secondary water systems, aquifer storage and recovery projects, the development of water reuse/recycling projects or systems, raising existing dams to increase reservoir capacity, and the repair of existing infrastructure to prevent losses in existing systems. The important role of water conservation programs as water supply projects is discussed further in Key Policy Question 1.

2.6. Potential for additional groundwater development

The State Engineer and Utah hydrology specialists have long known that surface water and underground water systems are hydrologically interconnected. Both systems rely on natural recharge from annual precipitation on Utah lands. In many cases, changes in natural recharge rates to underground aquifers and groundwater basins are manifested with lag times in the recharge changes. This makes measurement and monitoring of the underground water (groundwater) and surface water interactions difficult.

Utah water code does not allow for extracting groundwater from a basin at rates faster than a safe approximation of natural recharge rates ("safe yield"), taking into account water quality effects. This restriction has come to be measured in multi-year running averages, rather than every single year. The State Engineer has commissioned groundwater studies to document the groundwater budget, natural recharge rates, and water quality issues in many groundwater basins of Utah. As a result of these studies, the State Engineer has established a safe yield for these studied groundwater basins and has established a groundwater management plan for each studied basin.

Because of the difficulties in directly measuring groundwater basin recharge sources and rates, as well as groundwater discharge rates, significant estimations are needed in identifying the safe yield in each groundwater basin. This presents the opportunity for additional groundwater studies to "fine tune" safe yield calculations. These additional studies could identify additional groundwater that could be developable without "mining" of groundwater at rates beyond natural recharge rates.

Recommendations

2.1. Utilize water conservation and improved efficiencies to optimize water supplies.

Growing municipal populations will face water-demand pressures in the future. Municipal conservation efforts represent an important and usually cost-effective source of water to meet these new demands and may defer implementation of regional projects for a period of years. See Key Policy Question 1 for more information on this topic.

2.2. Manage and restore watersheds to decrease transpiration, increase runoff, and protect water quality.

Integrating natural storage into Utah's water management, as well as protecting and restoring natural watershed systems, will increase Utah's water supplies, drought resilience, and water quality and mitigate the destructive effects of floods. Multi-faceted watershed management plans that create real results within the state's river basins should be pursued by all affected stakeholders, including agriculture. Watershed management plans should include, at a minimum, active forestry management

to reduce transpiration rates of trees and to provide more water as surface runoff or underground percolation. Increased public and private funding for watershed projects should be sought. The Utah legislature should provide incentives and/or funding to encourage the development of these projects.

2.3. Develop and beneficially use Utah's allocated share of interstate rivers.

Utah should move forward now with planning and preliminary permitting efforts to keep options open to claim Utah's share of interstate river allocations. Development of the two State authorized projects, the Bear River and the Lake Powell projects, on interstate rivers should be coordinated with the development of regional and local water projects. They should also be based upon, and coordinate with, reasonable actions to stretch our current water supplies and develop reasonable alternative water supplies. Recommendation 2.8 more thoroughly outlines the need to consider costs and benefits before development occurs.

Due to the complexity of the interstate-river water development projects, planning should be underway now to complete initial planning so that actual project implementation can occur when demand dictates. Interstate-river water development projects will take many years to plan, permit, and construct, so it is not prudent to postpone these preliminary planning activities until the day water is needed.

With respect to the Lake Powell Pipeline Project, it is important for Utah to move forward to claim more of its share of the Colorado River. While the terms of the Upper Basin Compact protect Utah's allocation, increased development by other Upper Basin states, declining water supplies, and the political and economic realities may create obstacles to taking the water back from the Lower Basin states that are currently using the water and becoming reliant on its continued availability.[9]

2.4. Develop other regional water supply projects for beneficial use.

Development of new local and small regional water supply projects should be coordinated with Utah's two interstate-river water development projects (Lake Powell Pipeline and Bear River Development). The pursuit of local and regional projects may help stretch our current water supplies and possibly delay development of the interstate river water projects.

Utah water agencies should also pursue more localized regional projects such as the Central Water Project of the Central Utah Water Conservancy District. This district-funded project included the purchase of former industrial water rights used in Utah County and the construction of new water system infrastructure to deliver this water to northern Utah County municipalities and to a regional wholesale agency, Jordan Valley Water Conservancy District, in Salt Lake County. Similar opportunities may exist in other areas of the state that should be pursued where feasible.

2.5. Increase aquifer storage and recovery.

Aquifer storage and recovery (ASR) is the use of artificial groundwater recharge to store surface water in underground aquifer systems. The placement of surface water into underground storage can be done by infiltration basins or by injection wells. Storing surface water in underground aquifers via ASR during periods of high snowmelt runoff and lower water demands is an extremely beneficial use of an underground aquifer system. As water demands increase later in the year during the summer season, or in later years when surface runoff is low, water stored underground may be recovered using recovery

[9] See Appendix D for a reference and resource list on Lake Powell Pipeline Project.

wells to meet water demands. As a result, ASR becomes an unconventional and environmentally sensitive means of intra- and inter-season water storage. Technical, administrative and permitting challenges exist, and additional research and demonstration scale operations of water infrastructure will be required before there is wider use of ASR.

2.6. Implement water reuse.

Water reuse and water recycling may offer climate-independent water sources that are dependable and locally controlled. Water reuse practices allow communities to become less dependent on groundwater and surface water sources and can decrease the diversion of water from sensitive ecosystems. Recycled water can be used for beneficial purposes such as agriculture, landscape irrigation via municipal secondary water infrastructure, industrial processes, and possibly replenishing underground aquifer systems, depending on the water quality of the receiving aquifer and of the recycled water.

Water entities in Utah should pursue and continue working with municipal wastewater districts to identify financially and technically feasible water reuse projects. Certain water right issues will need to be resolved, and water reuse agreements will need to be negotiated. Downstream impacts to flows in natural systems and water quality need to be carefully analyzed to ensure downstream ecosystems and water users are not unreasonably impacted. Water reuse projects will likely need to be phased in gradually to avoid unforeseen negative downstream impacts.

2.7. Increase capacity of existing reservoirs.

In some cases, increasing existing reservoir capacity would increase annual yield. This is only possible if water rights allow and the hydrology of the watershed will deliver enough water to fill the increased capacity of the reservoir. Another important aspect is whether it is possible to add to the existing dam height from an engineering standpoint. Existing reservoirs will require some occasional dredging of deposited sediments to maintain their original capacities. Utah water entities should study the economic, technical, and hydrological feasibility of opportunities and implement those projects that appear feasible.

2.8. Consider costs and benefits of water development.

The demands for access to water are increasing, not only for drinking water, but also for environmental, recreational, and other purposes. There are trade-offs any time water is developed for one use. The new use may preclude the use of water for some other purpose or purposes that may meet the needs of a broader section of society. In making a cost-benefit analysis of water development projects, the potential project developer should consider:

i. the relative benefit and the relative detriment to the public resulting from the proposed use;

ii. the economic effect (both benefits and detriments) of the activity resulting from the proposed use;

iii. the potential loss of alternate uses of water that might be made within a reasonable time, if such alternative uses are not precluded or hindered by the proposed use;

iv. the economic, environmental, and other benefits or detriments of leaving the water in the area of origin for current or future beneficial uses, against the economic, environmental, and other benefits or detriments that may accrue in the area of where the proposed use will occur;

v. whether alternative sources of water supply are available to the applicant in the area of use;

vi. whether alternative sources of water are available to the area of origin to meet projected future demands within the area of origin; and

vii. the costs and benefits of future water development to the environment, fish and wildlife, and down-stream users (who are dependent upon receiving return flows to help satisfy their water rights) and possible disruption of the agricultural economic sector.

3. How does Utah provide water for agricultural lands and food production in the face of competing water demands?

Issues

1. Providing water in the face of competing water demands to sustain agriculture and the multiple benefits it provides
2. Lack of awareness of the history and current role that irrigation companies play in water development and management of water
3. Permanent conversion of water and land from agriculture to other uses
4. Inadequate integration of agricultural needs and innovations into regional water planning
5. Benefits to agriculture for efforts to optimize water resources and enhance water quality
6. Externalization of land development costs to agricultural water users
7. Capital for agricultural water infrastructure maintenance, replacement, and improvement
8. Need for more Utah-specific research on agricultural water use
9. Need to improve and apply both real-time and historical data to improve water management
10. Agriculture involvement, leadership, and education on water issues

Recommendations

1. Mandate and fund a broad stakeholder engagement process to identify, sustain, and advance the multiple values associated with agricultural water use.
2. Combine the knowledge and cooperative foundation of mutual water companies with state agency planning to assure ongoing agricultural water management.
3. Continue and expand efforts to preserve the productive capacity of Utah agricultural lands and water through the Legislative Water Development Commission or Executive Water Task Force.
4. Establish basin-level councils to create benefits for farmers who help optimize regional water supplies, conserve in-stream flows, or enhance water quality.
5. Create mechanisms that help agricultural water users contribute to improving water quantity and quality management.
6. Enact or amend local land use regulations to enable costs to irrigation systems created by urbanization to be carried by those benefiting from the new development.
7. Support agriculture's infrastructure, water use measurement, data, and reporting needs.
8. Monitor the USU Extension Water Initiative and evaluate whether to modify or expand the program.
9. Create a clearinghouse to collect, compile, and publish real-time stream gauging, snowpack, soil moisture, and reservoir monitoring and to preserve a historical database.
10. Establish an education center dedicated to providing information on agriculture, water, and food production.

Issues

3.1. Providing water in the face of competing water demands to sustain agriculture and the multiple benefits it provides

Agriculture plays and has played many key roles in Utah's history, culture, economy, and landscapes. Consequently, significant water resources have historically been devoted to agricultural production. However, in the face of competing demands for water from Utah's current urbanization trends and land use transitions, the multiple social values supported by water allocated to agriculture are too often overlooked. These values include security of local food production, sustaining rural Utah economies and communities, open space in increasingly urbanized areas, improved capacity for both drought management and flood control, and other ecosystem services such as providing wildlife habitat and buffering wetlands and other critical lands from impacts of urban development. In several recent Utah surveys, respondents expressed strong support for agriculture and Utah's food security and self-sufficiency, affirming that agriculture is a legitimate and viable use of water now and in the future.

Finding the best balance between water used for agriculture and related ecosystem services on one hand and water demands for other uses on the other is one of Utah's key water policy issues. Suitable water, land, and climate are essential natural resources for production agriculture, raising the important question of how much agricultural production can and should be sustained in Utah. In arid regions like Utah, agricultural viability requires that land and water be bound together, with food production as the most direct and primary beneficial use of agricultural water. The strong public interest in allocating sufficient water to agriculture and local food production recommends careful development of related water policy.

Yet, questions regarding the uses of water allocated to agriculture have increased, given that approximately 82% of water diverted from natural sources goes to agriculture.[10] The questions raised illustrate the complexity of water allocation in an arid region. One question often raised is why agriculture, an economic sector that represents $21.2 billion (15.1%) of the state economy, after adjusting for multipliers, requires so much water. A common response is that society should give priority to an industry devoted to meeting such basic human needs. Another question is whether production of Utah hay products sold into international trade[11] essentially constitutes an export of water that would be better redirected through local water markets to satisfy future water demands and at more reasonable infrastructure costs than regional water projects. Farmers note that this water export analysis has not been applied to computer chips and other export products, that Utah hay products enjoy a significant comparative advantage because of world-class quality, and that most of the water so used has such low quality and is in such remote places that it would require expensive regional water systems to transport it to urban areas and at great environmental cost. Transporting the agricultural products to cities is simply more efficient, especially in an economically efficient and competitive global market economy. Another question relates to the amount of water consumed in raising animal feed rather than food for direct human consumption. In direct production numbers, Utah produces adequate

[10] See introduction to Key Policy Question 2.

[11] Hay and forage exports account for less than 15% of Utah irrigated direct production agriculture during the 2012 to 2015 period.

livestock and grain to provide for present consumption by the human population, but much of the livestock production relies on grain shipped from the Midwest and elsewhere.[12] Only 26% of the state's dairy foods, 3% of its fruit supply, and 2% of its vegetable needs are produced in Utah. If Utah agriculture simply maintains current levels of food production while Utah's population increases, by 2050 the state will not be self-sufficient in any food production sector.

The biggest challenge faced by producers and critics alike is how to profitably produce more locally-grown food in a sustainable way with less water. A related question is how to compensate for the multiple social and environmental values that agricultural lands provide to the Utah landscape, economy, and culture. In the face of challenges posed by increasing operating costs, international competition, and fluctuating market prices for agricultural products, finding ways to protect and control costs related to delivery and utilization of water in agriculture is critical. Despite Utah residents' desire to see farms preserved and more local food production, thousands of acres of agricultural land and the related water supplies have been converted to urban uses in recent decades through voluntary sales and other transfers. Such conversion will likely continue unless Utah's agricultural practices and related markets—including consumer spending patterns—change dramatically. Assuring adequate capital and economic viability of farm enterprises as they adapt to changing conditions will be both essential and difficult. Will Utah stakeholders be able to adequately assess the water use trade-offs and policy changes needed to preserve a sustainable agricultural industry? This is an important topic for continuing analysis and policy deliberation.

3.2. Lack of awareness of the history and current role that irrigation companies play in water development and management of water

Irrigated crops fed early residents of the land in Utah some 1,400 years before the 1847 arrival of settlers, as noted in the Brief History above. Mormon settlers who entered the Great Salt Lake Valley in July 1847 immediately dammed City Creek to irrigate the desert soil. As Anglo-American settlements spread across the Utah landscape, irrigation systems were typically the first community infrastructure. Many of these systems were communal projects which were then or later managed under mutual water companies, largely because local governments were not sufficiently mature to provide management. Later commercial-based settlements such as Carey Act land developments also adopted the mutual water company model out of convenience similar to use of homeowners' associations in modern developments. Most of the more than 1,000 irrigation companies in Utah are at least a century old, yet today continue their original purposes of inexpensively and effectively delivering needed irrigation water to both urban and rural settings. These companies, operated as cooperatives on small budgets and minimal staff, manage by some estimates more than 70% of Utah's water supply at some point along the water supply chain. Indeed, so little attention has been focused on these companies that we do not have data on how much of our water supply is managed by them. Even more worrisome, we have not crafted suitable management alternatives should they not prove viable as rural-to-urban land use transitions occur.

Though these companies, along with the canals and ditches they manage, are essential, ubiquitous, and longstanding, they face frequent challenges both on the ground and in the policy arena. Over the past

[12] Grazing supports part of the livestock production. Currently, there are in Utah nearly 45 million acres of grazing lands that do not receive irrigation water, of which 73 percent are federally owned, 9 percent state-owned, and 18 percent privately owned (GOPB, 2011).

several decades, the percentage of Utah's population that works in or has direct involvement in agriculture has declined substantially. This decline is reflected in the Utah Legislature as well. Many once-rural seats held by farmers and other people from agrarian communities are now apportioned to urban areas and held by people from other professions and backgrounds. Even as these legislative seats have shifted from rural to urban areas and subdivisions have sprouted where stands of alfalfa once took root, the major irrigation canals and the mutual water companies that operate and maintain them have struggled to remain intact. While many, if not all, of these canals still serve multiple farms, canals in urban settings also serve municipal and industrial interests. They supply water for industrial processes; deliver secondary water to suburban lawns; move stormwater away from threatened homes, businesses, and institutions; and support wetlands and other riparian environments that would otherwise be lost. In spite of these critical services, the companies repeatedly face challenges rooted in a fundamental misunderstanding of and lack of appreciation for these benefits. While many water managers and rural and urban legislators have worked hard on behalf of such companies, they face and will continue to face serious challenges until a much greater share of Utahns understand why they should support, respect, and protect the purposes, value, and integrity of these companies.

3.3. Permanent conversion of water and land from agriculture to other uses

Because agriculture dominated Utah's early regional economies, many agricultural water rights were allocated early in Utah and are therefore senior rights, meaning they are the first to be satisfied in times of shortage. These rights are highly desired by municipalities and others who want reliable water supplies, whether for present or new water demands. Some water rights previously used on farmlands are converted for urban use in the same geographic area. Other water rights are taken, however, from more remote farms in a "buy and dry" scenario for transport to thirsty, distant cities. Besides taking water needed for food production, permanent fallowing of farmland creates other problems such as fugitive dust, weeds, and habitat for exotic species that become pests. "Buy and dry" also deprives rural areas of the short-term and long-term, direct and indirect economic benefits provided by agriculture; limits future development opportunities; and disrupts water delivery to remaining agricultural users. Whether in rural or urban settings, when water is taken and lands shift out of production, the remaining agricultural enterprises lose individual and community economies of scale, making them unprofitable and unsustainable. This situation often leaves farmers no choice but to sell both land and water. Farms and ranches simply do not enjoy the financial resources and extensive infrastructure typical of urban water systems, so they have a hard time working through droughts, economic cycles, urban conflicts, and fiercely competitive markets unless they can work at a scale supported by available markets. Society then loses these farms and the ecosystems they support, along with the important historical and community values that depend on them.

3.4. Inadequate integration of agricultural needs and innovations into regional water planning

Utah's lack of basin-wide, stakeholder-engaged water planning negatively impacts agriculture. These impacts will increase as a growing population bids more water resources away from agriculture. Instituting river or basin councils within each unique river basin can help overcome these challenges.

The Legislature has divided Utah into eight "river basins" to define representation on the Board of Water Resources, but these divisions more closely conform to county boundaries than to river basins. Meanwhile, the Division of Water Rights divides state water rights administration among seven regional offices. While the divisions of Water Rights and Water Resources usually communicate well with each other, they were created for different purposes. In addition, neither division has a mechanism for

ongoing stakeholder involvement in basin-level water planning. Yet another state agency, the Division of Water Quality, successfully used local watershed groups in its past planning efforts, but that program was transferred to another department and has become dormant. Thus, there are no existing forums in which stakeholders can engage to address the full range of water issues at the river basin or watershed level. Such forums are needed to facilitate discussions, collaboration, and problem-solving concerning how to more effectively integrate different aspects of water management and address regional water challenges.

3.5. Benefits to agriculture for efforts to optimize water resources and enhance water quality

Since about 80% of the water taken from natural sources is used by agriculture, much public comment received during preparation of this document was directed toward possible savings from water used in agricultural irrigation. Agricultural water users similarly recognize that there are opportunities to optimize water use, maintain or improve instream flows, and protect or improve water quality, but know from experience that these objectives are more simple to state than to accomplish. One significant problem is that accomplishment of these goals can best be implemented at the basin level rather than on individual farms, yet there are no existing forums in which to develop and implement effective strategies. Even defining "conservation" in an agricultural setting can be complex. As a starting point, characterizing wise water use as "conservation" or "efficient" means little unless defined and measured at the river basin level. "Efficiency" measures taken on an individual farm may negatively impact the quantity, distribution, and quality of water downstream. Flood irrigation, for example, is often criticized as inefficient when compared to sprinkler irrigation, yet it is often the most efficient irrigation method when analyzed on a basin-wide view, and sometimes even at the farm level. Flood irrigation also augments streams in certain areas through return flows and sustains ecosystems that would otherwise lack sufficient flows or water levels. In other river systems, however, sprinkler irrigation helps control downstream salinity problems better than flood irrigation with its inherent return flows. Water "conservation" in the agricultural sector may be inhibited by legal protections of downstream water users. Utah's existing water management policies, whether expressed in law or practice, presently provide very few tools to optimize water use while still protecting the historic return flow rights of downstream users and ecosystems that have grown up around irrigation water systems. See Issue 1.5 for further discussion.

3.6. Externalization of land development costs to agricultural water users

Urban development frequently impacts agricultural water systems through physical damage to irrigation systems and other externalized costs. For instance, many canals have been physically damaged during excavation and other work on new developments and by encroachments, with no reimbursement to the canal owners. Many times, stormwater outlets are constructed to dump water into canals without permission or engineered modifications to the canals needed to handle storm flows. This is especially true when such systems are located within or near urban development footprints. Policymakers and most developers recognize and attempt to deal with such impacts, but too often insolvent or simply intransigent developers externalize costs to irrigation interests. Cities and counties have tools available to appropriately allocate these costs to the developers and others who benefit from land use changes. Still, available tools, such as litigation, are often not fully utilized because of cost. Even when used the available tools do not sufficiently level the playing field, leaving irrigators burdened with costs for which others realize the benefits.

3.7. Capital for agricultural water infrastructure maintenance, replacement, and improvement

Agriculture infrastructure is generally the oldest water infrastructure in the state and has limited sources of funding. Agriculture bore most of its own water infrastructure development costs until the early 20th century as water users built local and regional water systems. Beginning in the early 1900s, large federal Bureau of Reclamation projects such as the Strawberry Valley Project, Hyrum Dam, and others were built, in most part to improve irrigation water supplies. State programs, such as Board of Water Resources revolving loan programs, also provided irrigation infrastructure funding. Both the Reclamation and state programs required that water users repay the construction costs, though often at below-market interest rates. All Utah agricultural water systems, whether built with public or private funds, are aging and will require maintenance and replacement. As noted above, canal systems previously dedicated solely to agriculture are being adapted to supply secondary (landscape irrigation) water and to serve as stormwater drainage channels for the municipalities that have grown up around them. These additional uses often accelerate the need for maintenance and replacement. There are no comprehensive inventories or cost estimates of all these maintenance, repair, and replacement needs.

3.8. Need for more Utah-specific research on agricultural water use

In agriculture, improved production through research, experimentation, and innovation is a way of life. Agricultural technologies change as rapidly as in any other field, yet university programs devoted to agricultural research are shrinking at the very time that we are losing significant portions of our agricultural lands and water and our food production needs are expanding. Farmers and ranchers have long enjoyed a beneficial relationship with research universities and recognize that applying science-based practices, founded in both basic and applied research, is the only way to optimize agricultural water use. Researchers also need knowledge and input from stakeholders (*e.g.*, farmers, water managers, and basin councils) to help guide their research agendas. Expanded and more focused research on the water use dimensions of agriculture is identified as a critical need in light of the state's overall water challenges and water strategy initiative.

3.9. Need to improve and apply both real-time and historical data to improve water management

In every river basin or water supply system where real-time data and historical information is available, the quality of water management decisions improves dramatically and the speed of decisions increases. Water user conflicts decrease. As water supplies tighten and water quality issues arise through climate variation and increased demand, the need for such information increases. A recent legislative audit strongly criticized the quality of available data, leading to some improvements in data gathering and analysis. However, there are still gaps in our ability to measure and calculate water use, especially agricultural water use. Greater water data management system changes are needed, and the data need to be made available to and evaluated and utilized by stakeholders in both basin-wide and statewide contexts. Finally, securing better water data requires better funding. As a state, we cannot criticize inadequate data collection while withholding the resources required to obtain it.

3.10. Agriculture involvement, leadership, and education on water issues

While the public has made clear its support for sustainable agriculture and local food production, the voice of agriculture is increasingly small in policy discussions. The public discourse often reflects a considerable lack of familiarity with both agriculture and water issues. In Utah and nationally, farmers make up a very small percentage of the population (approximately 0.8% of the national population is engaged in full-time agriculture), giving farmers and ranchers limited political representation. This

situation is further complicated on issues where the agricultural community is highly diversified (*e.g.*, large and small farms, conventional and organic farms, farms growing different kinds of agricultural products) and operates in different watershed settings (*e.g.*, different river systems, upstream and downstream water locations, dependence on surface versus groundwater, etc.). On a broader scale, agricultural water users, water attorneys, water planners, policymakers, and the public in general often cannot understand one another because they do not share a common water vocabulary. Agriculture may not have the resources to address all of these issues, yet farmers and ranchers cannot allow "their story to be told by others" and expect their needs or the needs of those who rely on the food and other goods produced by agriculture to be understood. Agricultural producers must shape and share their story. They have much historical and practical water knowledge, as well as valuable perspectives and innovative ideas to share with each other, other water professionals, consumers, policymakers, and the public.

Recommendations

3.1. Mandate and fund a broad stakeholder engagement process to identify, sustain, and advance the multiple values associated with agricultural water use.

Water applied to land for agricultural production is essential to society. Utah's water use planning and management should consider agriculture's role within the entire social, economic, and natural systems landscape. Evaluating agricultural profitability and advocating the preservation of agriculture for food production and food security has been a focus of Utah Department of Agriculture and Food (UDAF) efforts for many years. However, more specific analysis of the role of agricultural land and associated water use and the economic and social values provided in the social, economic, and physical landscapes of the state is needed. Such assessment would require collaboration among many state agencies and other stakeholders since remaining agricultural land and water use is often adjacent to public resources such as streams and other water bodies, wetlands, recreational lands, and other open spaces. Broad stakeholder engagement would need to include representatives from these categories: agricultural producers; other relevant agencies of state and local government; Utah State University (as Utah's land-grant university) and other research institutions; agriculture-related industry and marketing groups; nongovernmental organizations focused on land and water; and, especially, residents and consumers.

The mandate for this recommended assessment would be to:

i. understand changes in agriculture's presence and location in Utah landscapes;

ii. identify connections and compatibilities between agriculture and adjoining land uses;

iii. assess the water allocation and distribution systems needed to ensure productive systems of land uses for agriculture in relation to neighboring lands;

iv. support an appropriate level and variety of local, sustainable, secure, water-efficient food production for Utah, with a focus on "local farming" that helps ensure food security;

v. evaluate water-related incentives farmers need to ensure that food production remains part of Utah's future;

vi. inventory agricultural areas that have the highest value for food production and the degree to which the state can work to protect both the lands and waters that sustain them;

vii. balance the social and economic benefits of rural agricultural water use by facilitating industry clusters or other means of focusing on the comparative advantages of rural food production while leaving urban water supplies available to meet municipal and industrial demands;

viii. understand the best, most sustainable markets for agricultural production suited to Utah's people, climate, conditions, and comparative advantages; and

ix. recommend water-related policies that support and retain a sustainable, economically viable agricultural industry.

Promoting and retaining agricultural land and water for local food production, self-sufficiency, and food security are important goals. Local farming gives Utah the ability to feed people in its communities independent of outside influences and keeps dollars spent on agricultural products in the local economy. Once prime or important agricultural lands are converted to urban development and most or all associated water rights transferred to other uses, the ability to produce food is lost and our ability to be self-sufficient decreases. Additionally, loss and conversion of agricultural land and water rights has a variety of implications for Utah's natural landscapes and social systems. An important part of Utah's future water strategy needs to include deliberate, collaborative, and science-based assessment of the various changes and consequences of converting agricultural land and water uses. Utah needs a mandate to the state agencies with policy and management roles in food, land, and water to actively and prospectively prepare for our future instead of leaving it to chance.

3.2. Combine the knowledge and cooperative foundation of mutual water companies with state agency planning to assure ongoing agricultural water management.

Every mutual irrigation company in existence today has weathered parades of colorful directors (who are almost always part-time, uncompensated volunteers) and shareholders, yet have largely adapted to the multitude of challenges imposed by urbanization. The longevity of these companies suggests that mutual irrigation companies can continue to adapt to serve the needs of all their shareholders, whether the shareholders want to grow crops, water lawns, put the water to industrial use, or use the companies' canals to transport stormwater. However, the companies must become more proactively and consistently engaged in water policy forums, such as the Legislative State Water Development Commission and the Executive Water Task Force, and must also take advantage of opportunities to educate and interact with legislators and the public. This engagement may require some collaboration and coordination amongst the companies or the devotion of a part of shareholder assessments to such efforts. The companies possess the experience and knowledge necessary to make valuable contributions and even take leadership roles in their interactions with water professionals and legislators. There is need, however, for these companies' efforts to be augmented by training policymakers at the local and state level. Further, it is recommended that a task force organized under the Department of Natural Resources (DNR) (perhaps under the Board of Water Resources), in cooperation with UDAF and such other agency support as needed, further report to the Governor and the Legislature on these key issues:

i. identify the portion of Utah's total water supply managed by mutual water companies;

ii. establish ongoing evaluation and reporting to the Governor's office, DNR, UDAF, and the Water Development Commission on the value to the Utah economy, Utah culture, and the natural environment sustained by irrigation companies;

iii. recommend future management of mutual irrigation companies and their water assets in areas where mutual irrigation systems are or will be significantly affected by urban development;

iv. evaluate the best means to balance the equities, including costs, when urban development creates additional costs to irrigation systems users; and

v. educate the public and policymakers on the purposes, value, and integrity of these companies.

3.3. Continue and expand efforts to preserve the productive capacity of Utah agricultural lands and water through the Legislative Water Development Commission or Executive Water Task Force.

The Water Development Commission or Executive Water Task Force could recommend legislation to facilitate municipalities and other interested parties working with agricultural water users to identify demand management practices, split-season water uses, sharing benefits from improved water management, and other methods to allow better water sharing while assuring protection for vested water rights. Fallowing programs may have limited benefit in Utah because much of the prime farmland located within reach of urban water systems has already been converted to urban use, so research and planning should focus on other demand management and resource sharing programs. The evaluation could include:

i. amendments to change application statutes to allow leases of agricultural water rights so that a farmer can fallow land and temporarily transfer the right to unused water to a municipality or other interest, including split-season transfers;

ii. purchases of agricultural water rights sufficient to cover needs in extreme drought years, with long-term leases of extra water back to the farmer (a system that has been used successfully in Utah); and

iii. payments to farmers who curtail irrigation at critical points in the growing season, with compensation for lost crops, through structured water agreements.

Utah's water conservancy districts have the expertise to facilitate such arrangements and should be encouraged to develop such practices. The Legislative Water Development Commission and Executive Water Task Force are two forums in which such practices could be studied and necessary legislation prepared.

3.4. Establish basin-level councils to create benefits for farmers who help optimize regional water supplies, conserve in-stream flows, or enhance water quality.

There are many examples of projects that have restored natural species and habitats on Utah's rivers through collaboration with farmers. To help weigh the trade-offs between possible mixes of water management strategies (*e.g.*, water use optimization, agricultural transfers, water for the environment and new supply development), stakeholder groups could form basin-level advisory councils to create

such benefits. Solutions or cooperative agreements fostered by deliberative discussions among stakeholder groups and the public could help guide long-term sustainable water management decisions within water basins. Groups could recommend water management approaches that meet the needs of all stakeholders without causing injury to any particular stakeholder. In times of water shortages, such collaborative efforts with affected interests at the table could help achieve mutually agreeable solutions essential to good policymaking.

These stakeholder-led basin councils can coordinate and optimize basin-wide water use and water quality almost entirely within the present legal framework, but statutory authorization will be needed to create and provide administration of them. A primary goal of these councils would be to create systems from which farmers can benefit when they reduce diversion and consumption of water or protect water quality. These principles should guide such councils: a) apply sound science; b) measure gains at the basin level; c) address farm economics at the enterprise (individual farm) and community level; d) either work within existing agricultural markets or encourage market behavior that financially rewards improved practices; e) recognize established water rights; and f) create meaningful benefits for farmers to optimize water use and protect water quality. Though the means for doing so may vary from basin to basin, careful basin-wide management can create benefits to be shared among all involved. Such benefits might include improved storage patterns, lower nutrient and salinity concentrations, and greater water availability. Municipal water suppliers that receive the benefits of improved water supplies can, in turn, help finance system improvements which benefit all stakeholders. The Advisory Team recommends that these basin councils would be advisory to local water users, local governments, and state agencies, but have no separate regulatory authority.

3.5. Create mechanisms that help agricultural water users contribute to improving water quantity and quality management.

Actions should be taken to overcome legal, political or economic constraints that limit agricultural opportunities to optimize water use, maintain or improve instream flows, and protect or improve water quality. Incentive-based or win-win strategies must be prioritized to assure continued vitality of agricultural enterprises while simultaneously improving water quantity and quality management. These strategies will require careful balancing and integration of political and economic perspectives and state-level and basin-level decision-making. The basin councils in Recommendation 3.4 would be advisory to other entities with legal rights and administrative responsibilities for water resources and could potentially play a mediator role in seeking such balance and integration. Their ability to function effectively would require state law to set boundaries on the decisions and actions that can be taken locally but enable enough flexibility that unique solutions can be found to fit particular watershed contexts.

One example of a mechanism that could potentially provide desired flexibility in water management within the structure of state water law is water banks. A water bank is an institutional mechanism to facilitate the temporary transfer of water. Water banks have been created for different purposes and have carefully designed sets of rules to fulfill the particular purposes for which they are established. They are generally operated within a defined geographic context. For a more complete discussion, please see Recommendation 9.6.

Other examples come from growing experiences of successful collaborations, partnerships, stakeholder engagement processes, and water governance institutions occurring throughout the West and other

water-stressed regions. This is an area where Utah is well positioned to innovate and lead, particularly given its own history of cooperative water institutions.

3.6. Enact or amend local land use regulations to enable costs to irrigation systems created by urbanization to be carried by those benefiting from the new development.

Many Utah cities and counties have demonstrated that urban development can co-exist with farms and irrigation infrastructure through proper land use planning, consultation between developers and canal owners, and visionary use of cooperative funding tools and management agreements. In short, cities and counties can substantially assist with preventing the externalization of land development costs to irrigators while still achieving the benefits sought by land developers. Counties and cities should examine their existing land use regulations to determine if changes are required to mitigate impacts to irrigators from land development. They should also review local policies and procedures to facilitate cooperative uses of irrigation infrastructure for secondary irrigation systems and channeling urban runoff and to establish related funding mechanisms.

3.7. Support agriculture's infrastructure, water use measurement, data, and reporting needs.

There is currently no systematic reporting on the viability, condition, or need for maintaining or replacing existing or building new irrigation infrastructure. The Division of Water Resources and the Utah Department of Agriculture and Food each publish annual reports addressing a range of topics. One of the two reports should be expanded, with appropriate funding provided, to report on the condition of Utah agricultural water infrastructure and its ability to meet present and future agricultural and food production needs. The Division of Water Resources, in coordination and cooperation with UDAF, should be authorized and adequate funding provided to identify improved processes for measurement and calculation of agricultural water use in its water budgets.

The State of Utah Water Resources Construction Fund, Conservation and Development Fund, and other revolving loan funds administered through the Board of Water Resources provide important financing for key water conservation projects and water use optimization strategies. These loan programs enjoy an excellent repayment record. These funding programs have very successfully leveraged state funding for water conservation and local water projects by facilitating local government participation and private investment through mutual irrigation companies. The Department of Natural Resources, the Governor's Office of Management and Budget, and the Water Development Commission should each evaluate the potential economic returns (including tax revenues) and social benefits that could be realized by expanding the scope and budgets of these programs.

3.8. Monitor the USU Extension Water Initiative and evaluate whether to modify or expand the program.

Agriculture has proven its ability to produce more food with less water. Progress usually comes from basic research in plant and livestock genetics and from improvements to growing conditions. Progress can also come from advances in water application technology. Agricultural research has significantly improved production water use efficiency: compared to production in the 1950s, agriculture produces up to five times more product per acre and many times greater output per person.[13] Utah will not meet public expectations for food and fiber production without developing and implementing substantial changes in production and irrigation technologies. Funding, both public and private, must be focused on

[13] Productivity Growth in U.S. Agriculture, USDA, September 2007

Utah-specific research. Dedicated funding for water efficiency and conservation research, such as through the USU Extension Water Initiative, helps support research of specific relevance to this Utah Water Strategy. Such research might be advised by basin councils and other organized water stakeholder groups.

3.9. Create a clearinghouse to collect, compile, and publish real-time stream gauging, snowpack, soil moisture, and reservoir monitoring and to preserve a historical database.

Web-based information systems that publish stream flow gaging in real time abound in Utah. Experience has proven these systems to be cost effective in managing water resources, even if measured only by reduction of conflict and conflict-related costs and inefficiencies. The Advisory Team is not aware of a gathering point for all this information. It is instead scattered among various water agencies, districts, managers, and consultants. Various institutions maintain substantial parts of this information and willingly share it, such as the Utah State Water Laboratory; the State Climatologist; the divisions of Water Rights, Water Resources, Drinking Water, and Water Quality; the federal Natural Resource Conservation Services; and others. Nevertheless, only adept water professionals can navigate among these databases; comprehensive access to this information is not generally available to others. The Utah Division of Water Resources should be mandated and provided with sufficient funding to compile, publish, analyze, and preserve such information.

3.10. Establish an education center dedicated to providing information on agriculture, water, and food production.

In the *Your Utah, Your Future* process, Utah residents expressed strong interest in agricultural land, food security, and sufficient water resources for production agriculture. They expressed strong willingness to commit resources for protecting agricultural lands and water for future generations. The *Your Utah, Your Future* surveys and the public comment from Governor Herbert's 2013 Public Listening Sessions also revealed strong support for improved public education on these topics.

This high level of public interest in water issues suggests that voluntary funding through income tax return checkoffs or other voluntary contributions might support a center for public education on water and food topics. Given the expertise now available at Utah State University Extension, Utah Department of Agriculture and Food, and the Division of Water Resources, a cooperative team of these organizations could provide the institutional base for an ongoing, sustainable center. Synergies could be found in coordinating with visionary, forward-thinking programs such as Agriculture in the Classroom, Water Education, water conservancy district demonstration gardens, and other similar efforts.

The agricultural community must provide leadership for ongoing, effective programs that engage the broader community in water management and food production, but establishment of an education center should not excuse farmers and ranchers from providing public education through other channels. Only the farmers and ranchers—those 0.8% of the Utah population directly engaged in production agriculture, those who labor daily and risk their all to bridge the gap between Mother Nature's most extreme challenges and humanity's constant and ever-increasing need for water, food, and fiber—can adequately express the challenges producers face. The other 99.2% of the population, whose very existence depends on farmers and ranchers, need to know the challenges ahead. If farmers and ranchers and others in the food chain want to preserve their place at the water policy table, they must provide strong, meaningful public education on food production water issues, whether through an education center or by other means. The ample comment received in this planning process suggests

strong public interest in learning more and wide support for wise stewardship of water and land resources.

4. What should we do to preserve natural systems in the face of increasing water demands?

Issues

1. Threats to natural systems
2. The Great Salt Lake
3. Limited legal protections for in-stream flows
4. Opportunities and risks from more efficient water delivery
5. The role of water markets

Recommendations

1. Improve science and conservation planning and funding.
2. Expand tools to protect instream flows.
3. Facilitate creation of a state water trust to acquire rights for instream flows.
4. Study opportunities and risks of more efficient water delivery.
5. Facilitate development of environmental water markets.

Issues

4.1. Threats to natural systems

In Utah, many species of plants and wildlife depend on rivers and riparian, wetland, and lake systems for at least a portion of their life cycles. These areas also contribute significantly to recreational opportunities and our overall quality of life. They also reduce water temperatures, improve water quality for all users and build resilience to extremes like drought. Healthy water ecosystems adjacent to and within urban areas bring economic value in the form of increased property values, business and tourism dollars, and as components of water infrastructure systems. However, increasing demands on these scarce resources, with the added uncertainty of climate change, threaten these values. Impaired systems provide fewer ecosystem services (benefits humans derive from the proper functioning of the natural system) and also put water users at risk through federal control associated with endangered species listings.

While there are numerous isolated efforts to address these issues, basin-wide planning approaches remain limited. As a result, the State may miss opportunities to leverage programs and solve challenges at the watershed scale.

4.2. The Great Salt Lake

While all lakes in Utah provide important ecosystem services, the Great Salt Lake is unique. Estimated direct and indirect economic benefits total more than $1.3 billion annually, reflecting jobs and revenues associated with the mineral extraction and brine shrimp industries as well as recreation on the lake and surrounding wetlands. Higher lake levels decrease dust storms and contribute significantly to snow accumulations along the Wasatch Front in the form of lake-effect snow. Additionally, important ecologic benefits include providing critical habitat for many native birds as well as a major stopover for migratory

birds—one of the most important in North America and, for some species, in the world. Declining water levels jeopardize all these benefits. While there are consistent sources of water from Colorado River importations, the lake is also subject to depletions due to agricultural, mineral, and other human uses. Invasive species and lack of sufficient coordinated management are additional concerns that impact lake health. See Issue 5.3 for further discussion.

4.3. Limited legal protections for in-stream flows

Instream flows sustain fish and wildlife, provide recreational opportunities, and supply critical components of healthy river ecosystems. It is possible to legally secure instream flows in Utah, but the law is complicated. The existing legal tools fall into two categories: first, the instream flow statute (Utah Code 73-3-30); and, second, other legal tools such as water leasing, non-diversion agreements, and changes to the point of diversion. The existing instream flow statute is restricted to two state agencies (the Department of Parks and Recreation and the Division of Wildlife Resources) and non-profit fishing groups. While the provisions for each organization differ, they are all complex and limited. For example, state agencies must get the approval of the Legislature to fund purchase of water for in-stream flows, and non-profit fishing groups are limited to 10-year leases for three native trout species. These and other restrictions have resulted in limited use of the statute and few stream segments protected. As noted above, other legal tools are available but remain rarely used, limited, poorly understood, and subject to high transaction costs.

While shifting public values support managing water to protect and enhance the environment, change applications to shift water instream are often viewed as competing with other, consumptive uses. Around the West, innovative flow restoration strategies demonstrate that such conflicts are often more perceived than real. Given scarce resources and ever-increasing demands, Utah must continue to explore these and other strategies and adapt them as necessary to meet our particular needs.

4.4. Opportunities and risks from more efficient water delivery

In some areas, agricultural water users divert large volumes of water to provide a relatively small delivery at the end of the ditch or canal. New and improved technologies make it possible to divert far less water and still provide for the same consumptive uses. However, the financial investment in these new and improved technologies sometimes creates an expectation by water right holders that they should be able to benefit from the “conserved” part of their water rights to expand acreage or to lease or sell the surplus water that results. However, the original consumptive use cannot be enlarged, so investors in new and improved technology may not see the anticipated benefit from their investment. In addition, changes in conveyance systems can alter water tables, return flows, and even artificial wetlands that have grown up around leaky ditches and canals. Effective diversion strategies must consider these realities.

4.5. The role of water markets

Water markets—mechanisms used for trading water that provide incentives for wise use and efficient allocation of water—have not been harnessed to recognize or promote the value of water for the environment. As society places greater value on those uses, the power of the market should be harnessed to promote environmental water transactions.

Recommendations

4.1. Improve science and conservation planning and funding.

While few dispute the need to "provide water for the environment," information is lacking to both quantify and meet that need. Each of the areas mentioned below requires different solutions.

Rivers, Riparian, Wetland and Lake Systems

State, federal, and local natural resource agencies, along with other interested parties, should develop criteria (*e.g.*, the importance to at-risk species and opportunities for protection) to rank river, riparian, wetland and lake systems in the state. These criteria should then be used to identify a suite of mapped high priority sites. For these sites, agreed upon methodologies should be applied to quantify the amount of water needed to sustain them. Consideration of water quality standards should be included in the flow recommendation.

Based on this information, a further study would identify where existing water resources are adequate to sustain the systems both physically and legally. This quantification could then be used to (a) balance information already available on the water needs of people in water resource development planning; and (b) provide the State Engineer with studies and reports regarding potential negative effects of proposed change applications on the public welfare or natural stream environment, consistent with his statutory authority to manage water based on those public values.

Where possible, adaptive environmental flow targets (targets that could rise or fall depending on precipitation or other climatic patterns) could be developed to reflect those needs. If acted upon, these flows could meet the requirement of federal regulations under the Endangered Species and Clean Water Act. The June Sucker Recovery Implementation Program within the Provo River watershed provides an excellent example of water users working with conservation agencies to identify and provide adequate flows to sustain the endangered June sucker without posing a threat to existing consumptive uses.

Great Salt Lake

Better science and conservation planning could benefit the Great Salt Lake in several ways. For example, funding could be increased to eradicate invasive phragmites that choke out thousands of acres of important habitat for wildlife and consumes a significant amount of water that would ordinarily flow into lake wetlands. New tools such as the integrated water resource management (IWRM) model could be used to better understand how critical factors—such as upstream water diversions, in-lake water depletions, wastewater reuse, population growth, changes in land use, water conservation, etc.—in the Great Salt Lake watershed influence the lake's water levels and salinity and the ecosystem services the lake supports. Better data could inform target lake levels and trigger conservation initiatives in times of shortage.

More effective planning may also include expanding or modifying the role and responsibilities of the Great Salt Lake Advisory Council, establishing a full-time Great Salt Lake sovereign lands coordinator position in the Division of Forestry Fire and State Lands, and limiting development in the Great Salt Lake's floodplain that could put pressure on the State to restrict natural cycles of rising and falling lake levels.

Watershed Health

Because water moves both vertically—between the atmosphere, the surface, and subsurface aquifers—and laterally, it must be managed in a holistic way. As a result, stakeholders must develop collaborative and multi-faceted watershed management plans that maintain or improve natural watershed systems. Such plans should balance the needs to sustain or increase watershed supply yields that are essential for human needs, water quality, and maintaining and enhancing natural systems. Examples of plan components include protective riparian corridor and floodplain ordinances. See Recommendation 3.4 for further discussion.

4.2. Expand tools to protect instream flows.

To more effectively protect stream flows, Utah should further refine the legal and regulatory structure around existing tools such as water leasing, non-diversion agreements, and point of diversion changes. The State should also develop new tools and improve existing tools like water banking and consider expanding both the entities which can participate and the purposes for which instream flows can be protected.

4.3. Facilitate creation of a state water trust to acquire rights for instream flows.

While Utah allows the Division of Wildlife Resources and the Division of Parks and Recreation to acquire water rights for instream flows by donation or using money directly appropriated by the State Legislature, several other western states have much more robust (and less restrictive) programs. While not all those programs may be suitable for Utah, Utah should explore how best to enable state agencies like the Division of Wildlife resources to acquire and maintain instream flows.

4.4. Study opportunities and risks of more efficient water delivery.

While more efficient delivery of water represents a laudable goal, it can have unintended negative effects on natural ecosystems, systems that it some cases have been augmented by "inefficiencies" (*e.g.*, flood irrigation recharges an aquifer or a leaky canal creates a permanent wetland). For that reason, the state must foster a constructive dialogue among agricultural users, municipal water providers, conservation organizations, the Office of the State Engineer, and others to identify opportunities (interested water users, funding sources, etc.) to improve delivery efficiencies in ways that benefit natural systems and do not inadvertently harm those systems. To that end, the State should move forward with a pilot basin project to demonstrate the potential of this strategy, consistent with Recommendation 3.4. See also Recommendation 5.4 for further discussion.

4.5. Facilitate development of environmental water markets.

Because economic incentives (market forces) represent one of the most effective and lasting ways to promote a desirable goal, the State should develop legal, financial, and governance structures to enable water transactions and water markets that benefit the environment and traditional consumptive users alike. Examples of such innovations (many of which have been successfully tested in this and other states) include non-diversion agreements, dry-year options, deficit irrigation, crop substitution, split-season leases, infrastructure improvements or re-operation, groundwater recharge and storage, alternative water sources, and water right sales and leases. Beyond having the tools available, the State must find ways to keep transaction costs low so as to facilitate such innovations and keep markets operating smoothly and efficiently.

Consistent with that goal, the State should consider funding the Division of Water Resources to develop a database that tracks environmental water transactions. The database would include a summary of completed projects, cost, agreements, etc. in order to facilitate more participation in environmental water transactions.

5. How do we protect and sustain the quality of Utah's water?

As Utah's economy and population grow and land uses change, water-quantity demands will increase and additional stressors on water quality will come into play. For waters that currently attain water quality standards, the challenge is to protect existing good water quality in order to sustain designated uses for drinking water, agriculture, fisheries, recreation, and healthy ecosystems. For waters that currently do not meet water quality standards, the challenge is to mitigate risks and restore those waters to acceptable standards. Future land use decisions are a substantial factor affecting water quality, since it can be negatively affected by increased urbanization and associated stormwater runoff, higher volumes of discharged municipal wastewater, and industrial discharges, including those from the energy sector. If additional diversions deplete streams, existing concentrations of pollutants will increase, and water and wastewater treatment processes, whose operations rely upon the quality and quantity of the flows in those streams, will become more difficult and expensive. New challenges may also arise from emerging contaminants or from interactions among different constituents in water. Climate change further compounds the potential for positive or negative effects on water quality in the future.

These issues reinforce the critical need for informed and integrated water resource management decisions in order to address water quality issues. The appropriate water quality of Utah's rivers, streams, lakes, and wetlands needs to be protected in order to sustain human uses and aquatic ecosystems that depend on that water for survival in this arid state. Future strategies need to address the potential for negative effects while seeking opportunities for positive changes that protect and sustain the quality of Utah's waters for multiple uses and future generations.

Issues

1. Need for holistic water quality management
2. Multiple impacts to water quality
3. Unique challenges posed by the Great Salt Lake
4. Lack of coordinated administration between water quality and water quantity
5. Inadequate investment in water quality infrastructure

Recommendations

1. Implement nutrient controls where excess nutrients pose a problem.
2. Maintain sufficient stream flows and lake levels to sustain water quality and healthy ecosystems.
3. Incentivize agricultural practices that improve water quality.
4. Collaborate on salinity controls.
5. Recognize the connectivity between surface water and groundwater and manage those resources accordingly.
6. Control invasive species.
7. Adequately fund needed drinking water and water quality infrastructure.
8. Upgrade wastewater treatment plants and improve stormwater systems.
9. Regulate water quality in ways that protect the Great Salt Lake and its ecosystem.
10. Improve monitoring and mitigation strategies for nonpoint sources associated with mining, oil, and gas industries.
11. Improve drinking water source protection plans.
12. Embrace a holistic watershed planning approach.

Issues

5.1. Need for holistic water quality management

Soil conditions, precipitation patterns, vegetation, animals, and human activities all affect water quality and quantity. While achieving water quality standards requires a cooperative and proactive approach by all stakeholders, the current regulatory framework is not sufficient to adequately protect water quality. Because of the U.S. Forest Service, U.S. Bureau of Land Management, and other public lands within Utah's borders, the State must actively and persistently collaborate with the agencies managing these lands to the extent practicable to promote water quality. Holistic management of Utah waters must also include the integration of water diversions, water storage, groundwater and surface water. See Recommendation 3.4 and 7.3 for further discussion.

5.2. Multiple impacts to water quality

One of the key challenges to water quality management is the multiple and cumulative impacts of pollutants to Utah water bodies. Some impacts are runoff related, and others are from sources that directly or indirectly contribute to degradation of water quality.

Stormwater

Runoff pollutants include sediments, nutrients, and bacteria and also oils, metals, industrial materials, and other chemicals. Urban areas have more impervious surfaces where rain and snowmelt wash pollutants off streets, parking lots, construction sites, industrial storage facilities, vacant lots, parks, and

lawns. Runoff systems such as gutters, ditches, and storm sewers carry polluted runoff to nearby streams and lakes, often bypassing wastewater treatment.

Water Depletion

There is a significant connection between the quantity of water in a stream or lake and water quality. When water is removed from natural systems, the capacity of water bodies to assimilate pollutants is reduced. Regardless of the beneficial use the water depletion supports, the natural system may have reduced water quality due to insufficient flows. As an example, when flows are significantly reduced in water bodies due to consumptive use, the temperatures of the water may increase such that it will no longer support the resident cold water fish populations. In order to provide healthy water bodies, there may be a need for significant conservation across all uses of water. See Key Policy Question 1 for further discussion.

Agriculture

As the dominant land use in Utah (1.365 million acres for crops and 45 million acres for grazing), agricultural practices have important linkages to water quality. Return flow from irrigated agricultural lands carries fertilizer, pesticides, and sediment to Utah's waters. Grazing on public and private lands, especially in riparian areas, is an important source of pathogens, sediment, and nutrients to many of Utah's streams. In some areas, agricultural effects on water quality also relate to erosion of overgrazed lands and water depletion. Pollutants from animal feeding production operations are not permitted to discharge to waters of the State but sometimes find their way to waterways during extreme runoff events. Flood irrigation practices have been identified as an important contributor to salinity issues, especially in the Colorado River system.

Erosion

Waterways move tons of sediment annually in a continual cycle of erosion, transportation, and deposition. Sediments eroded from the land are transported by wind and water movement to streams and river systems and eventually are deposited in lakes and reservoirs. Natural or geological erosion takes place slowly. Erosion that occurs as a result of human activity may take place much faster. Eroded sediments can transport pollutants and further degrade water quality. Fires on both public and private lands can result in significant erosion events, requiring mitigation through cooperative efforts to evaluate and install appropriate control measures (*e.g.*, silt fences) and then re-seed to aid land re-vegetation.

Nutrients

Nutrients occur naturally, but high concentrations of nutrients also come from inorganic fertilizers applied to both agricultural lands and urban developments, as well as from organic sources such as manure and human waste. Excessive nutrients can contaminate groundwater and increase algae and cyanobacteria production in surface waters. Increased algae production may reduce oxygen levels necessary for aquatic organism survival and can negatively impact the natural aesthetics by making water less visually appealing. Algae also create taste and odor problems in drinking water. These impacts lead to reduced property values and recreational activities and increased costs for drinking water treatment. Some cyanobacteria blooms can produce toxins that are hazardous to human and wildlife health. Conversely, more research is needed to better understand the role of nutrients and cyanobacteria in non-freshwater systems like the Great Salt Lake, a nitrogen-limited system where blooms may play a role in nutrient cycling and fixing atmospheric nitrogen in ways that benefit the

productivity of the ecosystem. In such systems, nutrient reduction strategies designed for freshwater systems may cause unintended harm.

Wastewater Effluent

Municipal wastewater facilities are required to discharge wastewater effluent in compliance with Utah Pollutant Discharge Elimination System (UPDES) limits. They are finding it difficult to meet increasingly stringent water quality requirements, some of which are imposed by the process of identifying and implementing Total Daily Maximum Loads (TMDLs) to address water body impairment. Wastewater treatment effluents are also a source of pollutants of emerging concern, such as pharmaceuticals, microplastics, detergent metabolites, and nano-pollutants, that could represent new water quality issues to the State, especially in effluent-dominated waters. Unregulated wastewater effluent from septic systems and agricultural waste is an increasing concern.

Water Quantity Management

The magnitude and diversity of users in a watershed, along with ways water quantity is managed to meet their various needs, can create complex situations from a water quality perspective. Design and development of water transfer, storage, and discharge structures can have both positive and negative impacts on wildlife and water quality. Stream flow and lake level management can be challenging to regulate due to the physical, hydrological, biological, ecological, social, economic, water rights and political considerations and characteristics of a watershed. Water flow and level management need to mitigate negative impacts, yet balance potential benefits to, not only fish and wildlife, but also to recreation, agriculture, flood control, and population growth. To do so effectively, water rights must be considered and better data must be available to define “appropriate flows” and “minimum levels” of water bodies in a given watershed, along with better science, tools, and additional resources to establish and maintain those flows and levels. Insufficient water supply in natural systems creates water quality problems such as increased temperature and concentration of pollutants. In addition, if natural flows are reduced in urbanized areas, wastewater and stormwater discharges will be a greater proportion of the natural system flows, and this will degrade the entire watershed. There is a need for institutional and legal processes to address combined impacts and conflicts between water quality and water quantity and to assess how future climatic and land use changes may impact both.

Harmful Algal Blooms

Harmful algal blooms occur when cyanobacteria multiply quickly to form visible colonies or blooms. These blooms sometimes produce potent cyanotoxins that pose serious health risks to humans and animals. Conditions during the summer of 2016, including low water levels, abundant sunlight, high nutrient levels, warm water temperatures, and calm waters, led to numerous algal blooms in Utah waterbodies. These recent blooms were unprecedented in their size, scope, and severity. Conditions for such blooms may be exacerbated in the future, and management responses to help prevent or mitigate these conditions are needed.

Oil and Gas Production

Drilling and production of oil and natural gas can have numerous negative consequences to water quality. Utah’s energy industry has grown rapidly in recent years, providing economic growth and also creating greater potential for pollution of surface and ground waters caused by spills and discharges of oil, drilling mud, and production and injection waters.

Mining and Other Mineral Extraction Industries

There are numerous mines and mineral extraction industries in Utah. Many mines and mineral production facilities directly impact the quality of local water bodies due to their location or the nature of their operations. In addition to mines currently in operation, there are thousands of abandoned mines scattered throughout Utah, many of which discharge toxic or hazardous materials into streams, rivers, lakes, and groundwater.

Invasive Species

Water quality can be negatively impacted through the spread of various invasive species. Invasive plants, fish, and mussels all continue to cause water quality concerns in Utah. Invasive carp in Utah Lake destroy submerged aquatic vegetation that anchors sediments, thus re-suspending pollutants. Invasive cheatgrass burns easily and increases the risk of fires. Fires, in turn, increase erosion, which negatively impacts Utah's waters. The invasive tamarisk contributes to the salinity of Utah's waters and uptakes considerable water from river systems, thus allowing pollutants to concentrate. Of particular immediate concern is the spread of Quagga mussels, which pose significant threats to native wildlife, fisheries, and local ecosystems, and which threaten significant portions of Utah's economy related to recreation and tourism.

Other Water Pollution Sources

Toxic spill events continue to threaten water quality, often as a result of unintentional discharges from leaking storage tanks and pipelines, ruptured holding ponds, and highway and rail accidents. Lack of proper facility location or placement, maintenance, and monitoring can contribute to these risks. There is a need for increased collaboration and the dedication of adequate ongoing administrative and emergency resources to respond to and assist in the prevention, remediation, and recovery from these incidents.

5.3. Unique challenges posed by the Great Salt Lake

The Great Salt Lake is unique from other water bodies in the State of Utah and even unique among saline lakes globally by virtue of its system of interconnected bays, depth, and other features. That uniqueness poses several challenges from a water quality standpoint. An example of the consequences of this is that only a single water quality standard, selenium, has thus far been developed to protect the lake. This is because Utah generally relies on the EPA to perform the necessary science and to develop standards, but the EPA generally only does so for freshwater systems, thus leaving the State to develop specific water quality standards for the brackish to hypersaline waters of the Great Salt Lake.

The Great Salt Lake is important economically to the State and provides a vital and vibrant ecosystem that sustains millions of perennial, wintering, and migratory birds and their food web. Additionally, the Great Salt Lake adds to our quality of life and represents an important part of our heritage. Protecting its waters and wetlands must be a priority.

Considerable research on the Lake is necessary if water quality standards are to be developed. That research cannot be conducted without an ongoing commitment to funding and the active involvement of industrial, environmental, federal and state government, and municipal and special service district stakeholders as well as the general public. See Issue 4.2 and Recommendation 4.1 for further discussion.

5.4. Lack of coordinated administration between water quality and water quantity

Utah's water quantity and quality can no longer be thought of separately. Each facet impacts the other, and there is a growing and urgent need for our state water policy to address them conjunctively. As Utah plans for its water future, it is critical to better integrate water quality and quantity into planning and management.

The State of Utah manages water quality and quantity separately based on different constitutional, statutory and regulatory provisions. Nonetheless, state and federal statutes that protect instream, lake, aquifer and wetland water quality recognize the importance of protecting water rights while providing the authority to impose water pollution controls. For example, the federal statute that protects drinking water quality also recognizes integration with water quantity by including source water protections that reduce treatment costs.

Insufficient Water Flow and Water Level Protections

Insufficient water levels in lakes or streams create water quality problems such as increased water temperature and concentration of pollutants. In addition, if natural stream flows are reduced in urbanized areas, effluent discharges are a greater proportion of those flows and additional treatment levels may be required to attain or maintain water quality standards. Existing Utah water law does not adequately address these complexities or issues of how instream flows and conservation may affect water quality. For example, salinity levels in the Great Salt Lake—which rise and fall depending on the supply of water to the lake—strongly affect the production of brine shrimp, which in turn support an important local industry and tens of millions of migratory birds. Even so, Utah's system of water rights treats any water that enters the lake as wasted and affords no real legal tools to protect or manage that natural resource.

Wastewater Reuse

As wastewater treatment improves based on changes in water quality requirements, the discharged water often qualifies for beneficial reuse. Having reuse water available provides a margin of drought proofing, but reuse also removes water from the environment and natural systems, further reducing stream flows and lake levels. As flows and levels decrease, water bodies will be less able to meet their designated or beneficial uses from both quantity and quality perspectives. Consequently, the effects of water reuse, both potential beneficial and detrimental impacts, must be defined and assessed in the context of a particular reuse project (localized impacts) as well as the potential cumulative impacts of reuse projects in a watershed (broad-scale impacts). For further discussion, see Recommendation 3.4 and 4.4.

5.5. Inadequate investment in water quality infrastructure

Ensuring that water from storm and sanitary sewer systems is properly contained and treated requires significant investment in both construction and maintenance of raw water treatment and delivery infrastructure as well as wastewater collection, treatment, and disposal infrastructure. Adequate investment in water quality infrastructure is critical for protecting and sustaining existing water supplies upon which Utah's population and economy depend, and to date, we have not seen the requisite level of investment. While user rate and production cost increases can occur to improve infrastructure for point source discharges, other revenue sources will be needed for non-point source control.

Inadequate capacity of storm sewer systems can result in flooding, while inadequate capacity of sanitary sewer systems (including onsite wastewater systems) can result in discharges of levels of pollutants

higher than those allowed by state or federal law. Catch basins and irrigation reservoirs help improve water quality by removing pollutants and provide for the recharge of groundwater. Maintenance of all these systems is critical for them to properly function. Adequate investment in critical water quality infrastructure also needs to be reflected in the true cost of water and taken into account in investment and ongoing financing decisions for operations and maintenance

Recommendations

5.1. Implement nutrient controls where excess nutrients pose a problem.

Effective approaches to controlling excess nutrients need to be implemented. Negative impacts of excessive nutrients, especially nitrogen and phosphorus, must be addressed in order to protect surface and groundwater quality. These control strategies should reflect the best available science, be cost-effective, and take into consideration the potential environmental impacts associated with nutrient reductions, including reductions in biological productivity downstream.

Nutrient control strategies that may be considered include optimizing existing wastewater treatment plant processes for nutrient removal; upgrading wastewater treatment plants to remove excess nutrients and, where possible, pharmaceuticals and other pollutants; reducing stormwater runoff by encouraging the use of rain gardens, permeable pavements, vegetated filter strips, and the like; reducing soil erosion and agricultural runoff by encouraging the best available soil and water conservation practices; and, for non-sewered communities, assessing the density of on-site wastewater disposal systems to assure that groundwater is protected from excessive nitrates.

5.2. Maintain sufficient stream flows and lake levels to sustain water quality and healthy ecosystems.

As detailed in Key Policy Question 4, policymakers and water suppliers must recognize the connection between water quantity and water quality and explore new mechanisms to ensure that Utah can maintain sufficient stream flows and lake levels to meet water quality parameters and to protect drinking water supplies, recreational activities, and natural systems. Water purification is an important ecosystem service that healthy water bodies and aquatic ecosystems provide for humans. Statutory and regulatory provisions to protect water quantities needed to sustain water quality should be strengthened and implemented. Policymakers should also increase ongoing funding for monitoring water quality compliance and evaluating watershed health, including better information on how much water is being diverted and how much water remains in rivers, streams, and lakes. Such information will facilitate decision making to accurately determine appropriate water amounts needed to sustain water quality.

5.3. Incentivize agricultural practices that improve water quality.

Many agricultural soil and water conservation measures—like those detailed in Key Policy Question 3—have important implications for water quality. In consequence, identifying and implementing such measures is essential to protect Utah's water quality now and in the future. In terms of prioritizing those efforts, impaired watersheds that have more stringent Total Maximum Daily Loads (TMDLs) should be given the highest priority, particularly where agricultural water efficiency projects coupled with other best management practices can most positively affect water quality.

Producers should also be incentivized to implement best management practices that protect waters from fertilizer, pesticide, sediment, pathogen, and nutrient runoff. Existing state and federal incentive-based programs are inadequate to meet the voluntary demand by producers to improve management of agricultural lands to improve water quality. See Key Policy Question 3 for more discussion on opportunities for agricultural producers to collaborate and contribute to watershed improvement practices.

5.4. Collaborate on salinity controls.

Salinity is a measure of dissolved salt in the water, and high concentrations are an indicator of urban and rural pollution from point and non-point sources. Both natural and human actions can increase salts in underground and surface waters from erosion or stormwater run-off. Sources of salt include road salts, septic tanks, animal wastes, fertilizers, and poor irrigation practices in areas where soils have naturally higher salt concentrations. The wide array of potential sources of excessive salinity means that a variety of interests must work together to address these cumulative effects and effectively manage the salinity of Utah's water resources. Stakeholders, including farmers, wildlife agencies, drinking water purveyors, and wastewater agencies, need to produce collaborative plans on major streams and rivers in order to control salinity.

5.5. Recognize the connectivity between surface water and groundwater and manage those resources accordingly.

Nearly all surface-water features (streams, lakes, reservoirs, and wetlands) interact with groundwater. These interactions take many forms. In many situations, surface-water bodies gain water and solutes from groundwater systems, while in other circumstances the surface-water body is a source of groundwater recharge and causes changes in groundwater quality. As a result, withdrawal of water from streams can deplete groundwater or, conversely, pumpage of groundwater can deplete water in streams, lakes, or wetlands. Pollution of surface water can cause degradation of groundwater quality and, conversely, pollution of groundwater can degrade surface water. Thus, safeguarding water quality through effective land and water management requires a clear understanding of the linkages between groundwater and surface water as they apply to any given hydrologic setting. Water quality issues should be specifically considered and addressed in developing integrated groundwater and surface water management plans, taking actions to prevent the overdraft of ground water, and prioritizing areas where the threat of groundwater over-drafting is of greatest concern.

5.6. Control invasive species.

Coordinated efforts with all stakeholders are essential to evaluate, educate, and monitor, as well as to implement appropriate invasive species control measures. Dedicated resources are needed to provide adequate control measures to stop the spread of invasive species that directly or indirectly impact water bodies in Utah.

5.7. Adequately fund needed drinking water and water quality infrastructure.

Over time, State funding has declined for drinking water and water quality infrastructure relative to funding for water development and infrastructure repair and replacement costs. A cap remains in place for sales tax revenues dedicated to water quality and drinking water projects that limits the State's ability to fund these projects. Consideration should be given to eliminating this cap or otherwise finding ways to increase funding for water quality and drinking water projects.

5.8. Upgrade wastewater treatment plants and improve stormwater systems.

Owners of wastewater treatment plants should be encouraged to employ the latest equipment and technology to reduce discharges of pollutants, including excess nutrients in systems where excess nutrients pose a problem, with consideration to treatment costs and the best available science. This is especially relevant in light of persistent and massive algal blooms on Utah Lake and other water bodies during the summer of 2016. As the state grows, treatment facility upgrades will help maintain the ability to treat to higher levels as dilution flows diminish as well as address emerging pollutants of concern. Wastewater treatment plant upgrades are large capital investments that should anticipate future growth and regulations by selecting technologies that maximize the ability of facilities to adapt to new regulations, a changing climate, and future growth. Water quality trading should be encouraged where it is feasible and provides a cost-effective approach to water quality improvement. New regulations that drive wastewater treatment upgrades should be based on the needs of receiving waters determined through sound scientific study. Wastewater entities should develop and execute asset management plans that make provisions for funding and replacing outdated equipment and under-performing treatment processes. In addition, they should optimize processes at wastewater treatment plants by gathering and evaluating key performance indicators and prioritizing areas for improvement, including energy efficiency.

Communities reliant on septic systems for wastewater treatment should evaluate the cumulative effects of septic systems on surface and groundwater quality and consider sewering areas with high septic densities.

Stormwater system improvements are necessary especially in the highly urbanized Wasatch Front corridor. The most cost effective and efficient way to reduce stormwater pollution is by integrating stormwater management into municipal master planning and zoning ordinances. Stormwater runoff can be most easily managed when contemplated at the time of development planning. Embracing green infrastructure development practices reduces the quantity of stormwater generated at the source and avoids pollutant load increases from stormwater as Utah's communities grow. Retrofitting stormwater infrastructure is more costly but may be necessary in our built-out environments to restore urban waters which are increasingly valued for recreation and habitat.

5.9. Regulate water quality in ways that protect the Great Salt Lake and its ecosystem.

The Great Salt Lake represents a critically important ecological and economic resource for the State of Utah. In consequence, water quality standards developed and applied to the Lake and to freshwater systems tied to the Lake must reflect sound science and a careful weighing of costs and benefits, along with a recognition that standards applied to freshwater systems do not apply in the context of a hypersaline system like the Great Salt Lake and could cause unintended harms. Adequate funding must be secured to answer the critical research questions necessary to weigh those costs and benefits, to develop appropriate standards, and to pursue and implement adaptive management strategies. See Recommendation 4.1 for further discussion.

5.10. Improve monitoring and mitigation strategies for nonpoint sources associated with mining, oil, and gas industries.

The State must ensure sufficient resources are available to monitor water quality impacts associated with oil, gas, and mining operations. Further, cleanup of abandoned mines and production sites can be expensive and time-consuming but must be prioritized to serve the public's welfare. Sufficient

resources, as well as cooperation between various stakeholders, is essential to prevent future contamination, remediate existing sources of pollution, and reduce public responsibility for future impacts from these industries.

5.11. Improve drinking water source protection plans.

Improved water quality lowers the necessity for and cost of increased drinking water treatment. Drinking water source protection plans should address and mitigate water quality concerns. Maintaining and improving primary and secondary sources of drinking water should be a state legislative, administrative, and funding priority.

5.12. Embrace a holistic watershed planning approach.

Healthy watersheds maintain ecological processes, contribute to local and state economies, and improve the quality of life for Utah residents. Elements of an effective strategy to protect Utah watersheds include flow regulation, flood attenuation, water purification, erosion control, dilution and flushing of contaminants, and habitat protection. A holistic management approach should include riparian buffer creation, wetlands construction, and habitat restoration.

Water quality management requires coordinated efforts to balance agricultural, environmental, municipal, recreational, and industrial needs. Consequently, to protect Utah's water resources, encouragement of inclusive and proactive discussions and decisions, implementation of institutional changes, support and coordination of scientific efforts to assess and monitor water quality, and development of advanced water management practices must be cultivated.

To better understand and promote watershed health, it is important to support the development of watershed coalitions that bring together a diverse set of local stakeholders to develop watershed master plans that identify specific needs, including water quality needs, in different parts of the watershed. Those same coalitions should take the lead in implementing those plans. Utah already has developed these types of groups in certain areas, and they should be promoted statewide, especially in watersheds most at risk. See Recommendation 3.4 for further discussion.

6. How will Utah plan for, adequately fund, and use innovative solutions to maintain, replace, and redesign existing water infrastructure and build new water infrastructure over the next 40-50 years?

Issues

1. Integrated and innovative water infrastructure planning that supports Utah's increasing population, growing economy, and desired quality of life
2. Realizing both water and financial efficiencies in infrastructure investments
3. Incorporating fairness considerations into infrastructure financing
4. Need for repair, replacement, and redesign of existing infrastructure, recognizing costs will increase over time
5. Need for strategic investments in new water infrastructure to support multiple goals
6. Need to ensure the security of all of Utah's water infrastructure
7. Reduced federal participation in the financing of water infrastructure
8. Finding creative and diverse means to fund and finance infrastructure
9. Making infrastructure investment strategies adaptive and responsive over time to changes in water supply and demand forecasts
10. Consideration of the water-energy nexus in infrastructure design and operations

Recommendations

1. Plan for infrastructure to support a growing population and economy and make investments consistent with best scientific, engineering, management, and accounting practices.
2. Increase returns on investments for water infrastructure through designing and funding optimization strategies that integrate across the different domains of water infrastructure.
3. Ensure that water users and uses with less financial capacity, such as rural areas, less wealthy communities, and the environment, also receive necessary infrastructure investments to secure their water futures.
4. Ensure safety, reliability, and continuing service of existing water infrastructure by financing timely rehabilitation, expansion, and redesign.
5. Utilize judicious prioritization and sequencing in approving and funding new infrastructure.
6. Implement cybersecurity and physical security measures for water infrastructure.
7. Develop a state water infrastructure financing plan to account for changing levels of federal financing and competing water needs.
8. Water providers should pursue grants, loans, bonds, public-private partnerships, and other creative funding opportunities when and where appropriate to fund new infrastructure and appropriately allocate costs to beneficiaries.
9. Implement ongoing assessments of infrastructure investment portfolios to ensure financial accountability, adaptability, and minimization of long-term financial risks.
10. Incorporate energy consumption and provision considerations into planning and financing to achieve energy efficiency in water infrastructure.

Issues

6.1. Integrated and innovative water infrastructure planning that supports Utah's increasing population, growing economy, and desired quality of life

Utah's population is expected to double by the year 2060.[14] Repair, replacement, and redesign of existing water and wastewater infrastructure and development of new infrastructure will be required to accommodate this growth and maintain a vibrant economy and desirable quality of life. Integrated water infrastructure planning that carefully considers all the societal and environmental benefits of clean water is necessary to facilitate wise decision-making and ensure water sustainability. New and innovative strategies will also need to be developed and employed where appropriate in order to meet the difficult financial and adaptability challenges of the future.

6.2. Realizing both water and financial efficiencies in infrastructure investments

A central water challenge in Utah is the interconnection between two resource constraints: (1) having enough water in an arid and drought-prone environment to accommodate population and economic growth and (2) having adequate financing to meet the many different needs related to that growth. Growth-related needs include expansions to education, transportation, energy, and communication and emergency response systems, as well as broad needs for more comprehensive land use, economic, and environmental planning to protect desired air, water, and lifestyle qualities. Water infrastructure needs often compete directly with these other infrastructure and growth-related needs. In addition, drought and climate change, increasing water shortages, potential declining per capita demand, aging infrastructure, and tightened access to capital increase the financial challenges within the water sector as it is currently structured. Within this context, there is a need to ensure that infrastructure investments simultaneously realize both water and financial efficiencies and utilize the most cost-effective approaches for the benefits produced.

6.3. Incorporating fairness considerations into infrastructure financing

Decisions involving public funds should always consider fairness and equity issues and concerns. It is important that decisions take into consideration community needs and avoid disproportionate impacts or lost opportunity costs—or the perception of such impacts—upon communities with fewer resources. Moreover, water itself is a public resource. Water is declared the property of the public under Utah law and is held in trust for the benefit of the public (Utah Code 73-1-1). Water infrastructure needs to provide equitable access to clean water for the state's residents at affordable and justifiable costs. There is a need for transparency and oversight that is protective of taxpayers, the environment, water quality, and other public interest considerations prior to expenditures of public funds for water infrastructure.

6.4. Need for repair, replacement, and redesign of existing infrastructure, recognizing costs will increase over time

Most of Utah's water infrastructure was constructed in the late-nineteenth to mid-twentieth centuries, and much of it is already at the end of its engineered life or will be in the next several decades. This will generally be the first major replacement of large infrastructure networks in the State's history (in some cases, replacement may not take the identical form as the original infrastructure). The associated costs are of a magnitude not previously experienced. Even after adjusting for inflation, replacement costs will

[14] See Appendix D for resource and reference list associated with Key Policy Question 6.

likely be more expensive than the original construction. Generally, original construction occurred in areas with little obstruction, but replacement will largely occur in well-established urban areas.

In 2015, the American Society of Civil Engineers (ASCE) undertook an independent review of infrastructure needs in the State of Utah. Overall, the State's infrastructure earned a grade of C+, with water infrastructure generally faring worse than transportation, solid waste, and hazardous waste infrastructure. Utah's dams were given a passing grade of B-, drinking water and water supply were given grades of C-, and wastewater and stormwater earned C+ grades. Canals and levees scored the lowest of Utah's infrastructure, coming in with grades of D+ and D-, respectively. ASCE estimated that nearly $13 billion worth of improvements to existing water-related infrastructure and investment in new water-related infrastructure is required in Utah within the next 20 years. Utah's four largest water conservancy districts have estimated that over $33 billion of total water infrastructure funding may be needed statewide by 2060. While disagreements exist over needed projects and projected costs in these infrastructure inventories, the need to upgrade and expand water infrastructure and the fact that infrastructure needs exceed currently available funding is recognized and acknowledged.

6.5. Need for strategic investments in new water infrastructure to support multiple goals

Strategic investments are ones that identify long-term or overall aims and interests and the means of achieving them within an integrated whole and toward a planned effect. Strategic investments in the context of this state water strategy include financing various types of infrastructure to help integrate and meet the multiple goals articulated herein. This state water strategy has identified many different infrastructure needs, and meeting particular needs can often involve many different alternatives. Difficult decisions concerning infrastructure trade-offs lie ahead. Evaluation criteria and decision processes are necessary for ensuring that infrastructure investments are indeed judicious and cost-effective and support multiple goals.

6.6. Need to ensure the security of all of Utah's water infrastructure

Utah's water and wastewater infrastructure is vulnerable to natural disasters, as well as malevolent acts from individuals wishing to do harm to the infrastructure or to society. Vulnerabilities include not only the "nuts and bolts" of infrastructure structures but also those electronic and computerized systems that operate the infrastructure. Although water and wastewater managers have made great strides towards protecting their systems from vulnerabilities, new threats constantly arise, creating the continuing need to retrofit older systems and design protections for new systems.

6.7. Reduced federal participation in the financing of water infrastructure

The federal government has financed extensive water infrastructure in Utah over the last 110 years. Much of this infrastructure is in the form of dams, reservoirs, aqueducts, and canal systems. This federal involvement was brought about by conscious strategic decisions of Utah leaders in the first decade of the 1900s when the U.S. Bureau of Reclamation was formed (1902), Utah adopted its water laws (1903), and the Strawberry Valley Project commenced construction (1906). Some estimates identify the extent of federal participation as constituting about one-third of all municipal water infrastructure financed and constructed in Utah after 1903.

However, the priority of the federal government to finance water infrastructure in Utah has dramatically changed in the last ten years. Financing new water projects is no longer a priority for the federal government. In fact, the priorities have changed so dramatically that there is also little funding for

replacement of federally-owned water infrastructure as it ages. This dramatic shift in financing creates a requirement for Utah to determine a new strategy for "filling that gap."

Some federal funding still exists for water projects in Utah. These funds are in the form of revolving loan funds for drinking water and water quality projects and grant programs for watershed protection and water conservation. The U.S. Bureau of Reclamation also still funds selected dam safety improvements and rehabilitation projects. These funding sources continue to be important to Utah, particularly in rural areas.

6.8. Finding creative and diverse means to fund and finance infrastructure

Without reliable sources of state and other funding, water and wastewater rehabilitation and development is in jeopardy. Water projects require as much as 30-year lead times from identification of need to delivery of water. Factors such as environmental assessment and mitigation, changes in federal and state standards, design and administrative requirements, legal constraints, and financing all affect water development. Stable funding sources reduce uncertainty and allow efficiencies in contracting for services and construction and operation of water facilities. Most water entities will be hard-pressed to sufficiently raise their own rates, fees, and assessments to adequately deal with financing and funding for water development; new water and wastewater facilities; replacement of aging infrastructure; additional infrastructure; and operating costs required to meet existing and future federal and state requirements, watershed source protection, stormwater run-off regulations, environmental mitigation, and water conservation. Creative ways and diverse sources to finance and fund the many water infrastructure needs must be found. See Recommendation 1.9 for further discussion.

6.9. Making infrastructure investment strategies adaptive and responsive over time to changes in water supply and demand forecasts

Planning and developing water infrastructure projects can take decades, particularly with larger state inter-basin projects. They are designed, financed, and built based on estimates of water supply availability and water demands projected decades into the future. Future impacts of droughts and climate change, constraints on regional population growth, economic cycles, and the politics of water allocation in the West can introduce large uncertainties into those projections. Infrastructure investment strategies need to be adaptive and responsive over time to avoid water security and financial risks associated with these uncertainties and to remain efficient and prudent over time.

6.10. Consideration of the water-energy nexus in infrastructure design and operations

Utah's water sector has historically consumed approximately 7 percent of the state's total energy budget (excluding energy needed for transportation). Conversely, water use in Utah's energy sector amounts to roughly 1.4 percent of the state's total water use (or 8% of municipal and industrial water use). Future water infrastructure will undoubtedly make up a larger share of Utah's total energy consumption if water will need to be treated to higher standards, and pumped and distributed longer distances. Likewise, future energy developments will require additional water for cooling and other purposes. For example, if the proposed nuclear power plant in Green River is constructed, this project alone would nearly double the amount of water used by Utah's energy sector. Decisions about infrastructure design and operations and the financing and funding needed to build and operate water systems need to fully consider and address various implications of the water-energy nexus.

Recommendations

6.1. Plan for infrastructure to support a growing population and economy and make investments consistent with best scientific, engineering, management, and accounting practices.

To meet the water needs of different segments of Utah's growing population and economy, many types of infrastructure will be needed to supply and deliver water, ensure its quality and safety, treat wastewater and stormwater, and enhance natural ecosystems. Prudent planning that addresses these needs and the issues outlined above must occur. Consideration should be given to alternative approaches for meeting these needs, and water entities should pursue solutions with the goal of keeping taxes as low as possible by prioritizing the most cost-effective solutions. Benefits and costs as well as more broadly defined opportunities and risks involved in pursuing different alternatives need to be weighed. Difficult trade-offs that will likely be involved in infrastructure investment decisions need to be evaluated. Innovation and integration in Utah's larger water infrastructure system should be promoted as a way to address financing constraints. Planning should include public education and stakeholder involvement so Utah's residents can understand the value of water infrastructure and be involved in the decision-making.

Decision-making processes concerning infrastructure policies, plans, and projects need to ensure that infrastructure investments are consistent with best scientific, engineering, management, and accounting practices. Many of these practices are standard requirements of existing funding agencies, but Utah should seek opportunities to improve existing practices by researching and incorporating the latest tools, technologies, and approaches. Funding agencies should adopt requirements for new standards and practices as they become available. Funding agencies should also encourage infrastructure investments that integrate best management practices from across the various water resource disciplines and professional societies (*e.g.*, water supply, water quality, wastewater, etc.). Infrastructure projects should optimize the benefits of investments by addressing the needs of multiple users in order to achieve an equitable outcome in meeting Utah's many growth-related water needs.

6.2. Increase returns on investments for water infrastructure through designing and funding optimization strategies that integrate across the different domains of water infrastructure.

Water agencies must design infrastructure replacement programs and new infrastructure projects that benefit multiple users and interests. Stakeholder involvement and interagency cooperation are needed to achieve this outcome. These activities need to include people representing different areas of water infrastructure (*e.g.*, water supply, water quality, wastewater, stormwater, M&I water, agricultural water, etc.). Infrastructure planning should identify the beneficiaries of existing and proposed infrastructure and seek opportunities to expand the range of interests served by building coalitions to support necessary funding. Water agencies and stakeholders should also evaluate any opportunities to consolidate delivery of water-related services or projects. Such collaborative activities should be pursued to optimize water efficiencies, leverage financial resources, and increase returns on investments. Detailed economic analyses must accompany detailed engineering analyses to determine a project's benefits and costs, which portions of costs will be allocated to which users, and how construction as well as long-term operations and maintenance (O&M) costs will be financed and funded. It is necessary to find synergies wherever possible between different parts of the larger statewide water infrastructure system that serves Utah's growing and urbanizing population.

6.3. Ensure that water users and uses with less financial capacity, such as rural areas, less wealthy communities, and the environment, also receive necessary infrastructure investments to secure their water futures.

Fairness and equity considerations should be incorporated into evaluating proposals for financing water infrastructure. Ways this can be implemented include but are not limited to the following recommendations:

i. Evaluation criteria should be devised so as to not disadvantage smaller, rural water suppliers in a competitive process. The capacity of a community to finance major repair and replacement of existing infrastructure or construction of new infrastructure should be taken into account in funding and financing decisions.

ii. Decision-making processes should be as open and transparent as possible, with affirmative public outreach efforts and sufficient opportunities for public comment and participation.

iii. Social and environmental equity issues should be considered when utilizing tax revenues for financing water infrastructure.

6.4. Ensure safety, reliability, and continuing service of existing water infrastructure by financing timely rehabilitation, expansion, and redesign.

Planning for infrastructure rehabilitation and replacement must be initiated many years before facilities reach the end of their design life. Large infrastructure projects require long lead times to arrange for financing, obtain necessary authorizations and licenses, and work through environmental permitting. Large water districts in Utah are required to create asset management plans that track the condition and replacement value of district-owned as well as district-operated assets and dedicate funds and reserves to the replacement of those assets. Water user organizations that sponsor federally built and owned projects do not generally have the bonding capacity to finance the rehabilitation and replacement of these federal facilities, and the past model of relying on the federal government for a major component of water development funding is no longer an option. Future improvements and new infrastructure will be largely funded by cities and local districts and by various sources of financing provided by the State of Utah. Funding for State revolving loan programs should be prioritized to facilitate these critical rehabilitation and replacement projects. State agencies and water suppliers should create replacement and funding plans which adequately account for these costly future expenditures.

6.5. Utilize judicious prioritization and sequencing in approving and funding new infrastructure.

Utah should prepare a state water infrastructure financing plan that uses judicious evaluation criteria and decision-making processes for prioritizing and sequencing water infrastructure projects.

Criteria for prioritizing various infrastructure projects for funding should include:

i. public health and safety;

ii. consistency with the best scientific, engineering, management, and accounting principles;

iii. meaningful public involvement and transparent assessment of alternatives in project planning;

iv. verification of true need for water based on population projections and accurate water data;

v. consideration of potential environmental impacts (see Key Policy Question 4);

vi. thorough assessment of the projected reliability of a water source for a project's lifespan;

vii. incorporation of best management practices having the least environmental and social impacts;

viii. appropriate financing and repayment terms;

ix. independent review of the proposed construction plan for a large state water project funded through the Water Infrastructure Restricted Account and the applicant's plan to repay the loan;

x. assistance to those water users who cannot bear the cost of water infrastructure expansion, repair, or replacement;

xi. demonstration of economic returns to an area and suitable benefit/cost ratios;

xii. establishment of conservation and efficiency targets and documentation of water savings; and

xiii. ability to increase or meet acceptable water and energy efficiencies.

Criteria for sequencing or scheduling water infrastructure projects should include:

i. implementation of effective demand management before new supply projects are approved;

ii. repair, replacement, rehabilitation, and redesign of existing infrastructure before construction of new infrastructure where potential water savings from changes to existing infrastructure would alter the need for new infrastructure; and

iii. consideration of potential negative impacts on basins-of-origin when developing trans-basin diversion projects.

6.6. Implement cybersecurity and physical security measures for water infrastructure.

Utah's water and wastewater infrastructure is a vital component of the state's physical and economic health. This infrastructure was designated "Critical" in the Patriot Act of 2001. As such, it requires protection against both malicious acts and damage from natural disasters. Every project funded, whether new infrastructure or the repair and replacement of existing infrastructure, should consider and implement protective measures. Protective measures should take an "all hazards" approach to secure infrastructure against all types of threats. Infrastructure that should be protected includes not only the physical "nuts and bolts" aspect of the systems but also those electronic and computerized control systems (SCADA) which are at risk from cyber attacks. It should also be acknowledged that a valid project may be one which only upgrades protective measures.

6.7. Develop a state water infrastructure financing plan to account for changing levels of federal financing and competing water needs.

Issue 6.7 identified the dramatic shift from extensive federal financing involvement in Utah over the previous 110 years to a relatively sudden withdrawal from water project financing in Utah by the federal government in recent years. Utah leaders should develop and define a state water infrastructure

financing plan that accounts for these changing levels of federal financing. This should be done taking into account competing water needs. The decision processes and evaluation criteria should identify and justify the financing needed for funding public infrastructure investments. This water investment financing should be based upon the public interests served, "user-pay" principles, affordability of rates to customers, cost-effectiveness, and clear identification of which segments of society pay for which infrastructure improvements. Particular attention should be given to financing replacement of federal water infrastructure that is critical in supporting the Utah economy. Support should be given to Congressional delegation efforts to secure federal funding when possible.

6.8. Water providers should pursue grants, loans, bonds, public-private partnerships, and other creative funding opportunities when and where appropriate to fund new infrastructure and appropriately allocate costs to beneficiaries.

Given the significant population growth projected for Utah and the increasing complexity and lead time in water development, Utah cannot afford to neglect water development. Such development must be conducted in a consistent, planned, efficient manner to get the most benefit from water development funds. Significant synergies can be achieved by better land development codes adopted at the local levels that also consider water planning. Allowing higher density residential and commercial development, minimizing sprawl, and encouraging transit-oriented development all contribute to greater water use efficiencies and reduced need for new water infrastructure. Local government codes can be used to protect water sources and water infrastructure, and to enhance the capital contributions of land developers, who can in turn pass much of the new infrastructure costs on to the people and businesses creating the need for expansion of water distribution, collection, and treatment systems and water sources. Water managers should become more engaged and influential in municipal planning processes.

Sales tax toward water system repair and maintenance is one element for meeting the demands of water rehabilitation and replacement. As another example, state funding could also come from expiring transportation bonds. Revolving loan funds provide possibilities for financing the future of Utah's water. Unlike grants, a revolving loan fund would accumulate interest from the users, grow over time, and become self-sustaining. Bringing businesses to the water rather than bringing water to the businesses would result in a domino effect of good things, from reducing the cost and scarcity of water to further expanding the economy of Utah. Economic development policy should discourage locating new job-intensive developments far from existing infrastructure and population centers.

6.9. Implement ongoing assessments of infrastructure investment portfolios to ensure financial accountability, adaptability, and minimization of long-term financial risks.

Water projects have long lifespans. Waiting to build water projects until the demand occurs is not a feasible solution. Neither is building projects too far in advance of the expected demand based on projections of dynamic and uncertain conditions and requiring payment schemes burdening the current generation of taxpayers. Infrastructure projects should go through reassessments over their full life cycle, including planning, development, and operation of the project. As climate, society, and technology change over time, projects need to be re-evaluated to ensure their continuing suitability to meet the evaluation criteria used to prioritize and sequence them. New alternatives and innovations should be considered if, at some point in a project's development, conditions have changed significantly enough that another alternative offers verified prospects for outperforming the planned alternative over the

long term. Infrastructure innovations in areas such as Aquifer Storage and Recovery (ASR), water reuse, desalinization, and green infrastructure systems hold promise for providing alternatives that may prove to be even more feasible and desirable in the future. Funding of water infrastructure needs to remain adaptable and responsive to new information, technological innovations, and changing contexts.

6.10. Incorporate energy consumption and provision considerations into planning and financing to achieve energy efficiency in water infrastructure.

The water sector's impact on energy consumption and the energy sector's impact on water consumption should be carefully evaluated for future infrastructure projects. Efficient use of water and energy should be essential elements of future infrastructure developments, including encouragement to develop cost-effective on-site alternative energy sources (such as solar) for water infrastructure whenever possible.

Energy efficiency should be considered, when applicable, as a part of all water infrastructure repair and replacement projects and all new water infrastructure projects. Creative and innovative methods of achieving water and energy efficiencies should be encouraged. A project which only develops new energy efficiencies for a water or wastewater system should be given equal consideration by funding agencies.

Water and energy professionals should work together to achieve these goals. If necessary, policymakers could work with industry experts to set reasonable standards for both water and energy efficiency that would help ensure objectives are achieved.

7. In what ways will weather and a changing climate impact future water supply and demand?

A warming climate poses serious challenges for Utah's water future and our ability to plan and prepare for that future. This section attempts to grapple with those challenges and encourages Utahns to find common ground in our efforts to adapt to changes in climate so as to ensure a sufficient water supply to meet all of the State's needs.

Issues

1. Potential climate impacts on Utah's water resources
2. Changes in snowpack hydrology
3. Need for coordination and planning
4. Absence of risk management strategies
5. Need for flexible water adaptation policies
6. Complex climate change projections complicate planning scenarios
7. Water demand changes due to rising temperatures

Recommendations

1. Increase coordination among the state, water districts, local governments, and climate researchers.
2. Assess vulnerabilities and develop risk management strategies developed through studies to plan for climate change impacts.
3. Identify and develop adaptation strategies.
4. Identify and plan mitigation strategies.
5. Build on scientific knowledge base of climate research through increased resources and funding to enhance planning processes.

Issues

7.1. Potential climate impacts on Utah's water resources

Our climate is changing because the Earth is warming and Utah is transitioning to a very different hydrological regime.[15] As a result, our water supply will be impacted. Utah's climate has already changed and has warmed by about two degrees Fahrenheit—and in many parts of Utah by much more—in the last century.[16] In general, Utah's climate has warmed at a rate of two to four times that of the global climate as evidenced by the long-term trend of observational temperature records throughout Utah.[17]

[15] See Appendix D for additional resources and reference list associated with Key Policy Question 7.
[16] EPA What Climate change means for Utah. https://www.epa.gov/sites/production/files/2016-09/documents/climate-change-ut.pdf
[17] Robert R. Gillies 2017, Director of Utah Climate Center, and state Climatologist for the state of Utah; National Climate Assessment (Southwest climate assessment) 2013 (http://www.globalchange.gov/what-we-do/assessment)

Increasing temperatures and associated changes in precipitation patterns will likely have an adverse effect on watershed health. Increased temperatures will drive more evaporation and evapotranspiration (ET), which is the coupled process by which water is transferred from the land to the atmosphere by evaporation from the soil and other surfaces and by transpiration from plants. Increasing air temperatures result in increasing stream temperatures, which often exacerbate water pollutant concentrations and reduce water quality. Increased temperatures may also reduce the wetlands that purify our water. In addition, higher temperatures increase evaporation from streams and reservoirs with resultant water quality issues, depletion of soil moisture, and increased irrigation requirements for crops and plants. Impacts due to climate warming include:

Fluctuating Weather Patterns

Utah experiences significant shifts in the amount of precipitation from year to year. Precipitation and the resulting water supply in one particular year rarely match the average but rather can fluctuate in the extreme from wet periods to dry periods. These weather fluctuations could increase, become more extreme, and continue to impact short- and long-term trends of water supply and demand patterns.

Projections of climate change are complex in the Intermountain West, making it difficult to develop viable planning scenarios for specific regions of the state. Climate change will alter the amount of precipitation and likely the timing of that precipitation. Earth System Models predict that some regions will experience an increase in precipitation while in others a decrease. Nonetheless, both observational[18] and modeling studies[19] predict that less snow will fall on the land with greater variability in terms of intensity, timing, and length. Moreover, the hydrology and water supply will be driven more by precipitation in the form of rain.

Any such shift will create ongoing and substantial challenges for water providers to plan for the operation, maintenance, and management of Utah's public water supply and associated infrastructure. Early planning now could mitigate some of these problems.

Water Availability

The changing climate is likely to not only increase the need for water but also reduce the supply. For example, drier soils require more water for agriculture, but less water is likely to be available—even in areas that see a modest increase in precipitation—on account of increased evaporative loss and greater evapotranspiration (ET) rates. This evaporative demand change will reduce Utah's water supply in the absence of significant increases in annual precipitation.

Declining Groundwater Supplies

Water providers are already concerned about declining trends in groundwater levels due, in part, to increasing withdrawals for a growing population. It is stressing groundwater supplies because of its hydrological connection with a water supply that is generated overwhelmingly through snowpack accumulation and melt-off. Moreover, declining groundwater supplies are complicated by Utah's natural climate variability, which affects both the amount and form of precipitation. In areas experiencing a loss

[18] Observational and synoptic analyses of the winter precipitation regime change over Utah. Journal of Climate, Gillies, R. R., S.-Y. Wang, and M. R. Booth, 2012: 25, 4670-4698

[19] Climate change impact on the roles of temperature and precipitation in western U.S. snowpack variability. Geophysical Research, Scalzitti, Jason, Strong, Courtenay, Kochanski, Adam, 2016: 43, 10

of snowpack or declining precipitation, water demand may shift further to already diminishing groundwater supplies.

7.2. Changes in snowpack hydrology

Utah relies heavily on mountain snowpack for its water supply. Traditionally, snowpack accumulates in mountainous regions during the winter months. Water stored in the snowpack is then released to aquifers, streams, lakes, and reservoirs as it melts primarily during spring; this fundamental snowpack hydrology will be impacted by climate change.

As the climate warms, Utah's precipitation will fall more as rain than snow especially in low- and mid-elevation mountain regions.[20] Run-off due to snowmelt will occur earlier in the year with higher intensities and shorter durations. As a result, late summer river flows are projected to diminish, impacting water users who rely on natural river flows during this time of year. Furthermore, water rights providing diversions from Utah's waterways may be diminished or may need to be altered due to these changes in snowpack, timing of runoff, and streamflow hydrology.

7.3. Need for coordination and planning

Currently, there is very little planning for the impact of climate change on water resources in state or local water planning reports. The capricious nature of climate change will make planning complex. Coping with increasing complexity will require a new approach to planning. Every new option for addressing climate change will be subject to considerable study and analysis. The limited coordination that has taken place between water planners on the state and local level and the scientific community is not sufficient to address the uncertainty that climate change brings to the future.

Finally, both funding and personnel remain limited for state and local agencies to plan for climate change and the collection of data and climate science research.

7.4. Absence of risk management strategies

The seriousness of the risks posed by a warming climate necessitates effective strategies for responding to worst-case scenarios. For example, researchers fear that, if greenhouse gases continue to rise, atmospheric carbon concentrations could get so high that they present essentially unadaptable climate conditions, including megadroughts towards the end of the century. [21] Mitigation measures provide meaningful strategies to help address those risks. Presently, however, Utah does not have statewide risk management strategies that address the potential impacts of climate change.

7.5. Need for flexible water adaptation policies

The potential implications of climate change could severely impact water providers' ability to provide long-term confidence to their customers. Efficient water supply and infrastructure decision-making requires reliable and understandable information. To this end, water providers need flexible adaptive

[20] National Climate Assessment (Southwest climate assessment) 2013 (http://www.globalchange.gov/what-we-do/assessment); Observational and synoptic analyses of the winter precipitation regime change over Utah. Journal of Climate, Gillies, R. R., S.-Y. Wang, And M. R. Booth, 2012: 25, 4670-4698

[21]Relative impacts of mitigation, temperature, and precipitation on 21st-century megadrought risk in the American southwest. Science Advances, Toby R. Ault, Justin S. Mankin, Benjamin I. Cook, Jason E. Smerdon, 05 OCT 2016 : E1500873; Unprecedented 2lst century drought risk in the American Southwest and Central Plains, Science Advances, Benjamin I. Cook, Toby R. Ault, Jason E. Smerdon, 12 FEB 2015 : E1400082

strategies to guide the incorporation of uncertainty in precipitation projections (and the associated risks) into water planning.

7.6. Complex climate change projections complicate planning scenarios

The fundamental tension between climate variations and the need for long-term water supply planning is further complicated by at least two factors. First, there is a need for much finer resolution in climate projections (*e.g.*, at the watershed and sub-watershed levels), particularly given the complex climatology of the Intermountain West.

Second, there is a current and future need to produce more reliable sub-seasonal to seasonal forecasts of temperature and precipitation. Currently, National Weather Service (NWS) meteorological forecasting ability is limited to 7-10 days at most. While the Climate Prediction Center of the National Oceanic and Atmospheric Administration (NOAA) provides 3-month outlooks,[22] the guidance remains somewhat arbitrary.

7.7. Water demand changes due to rising temperatures

Outdoor irrigation accounts for the majority of Utah's municipal water use. As temperature increases in Utah's changing climate regime, there will be an increase in evapotranspiration along with an extended growing season. These factors will increase water demand unless there are significant changes to landscaping practices and how water is used in Utah. In addition, warming temperatures will increase indoor water demand, as more water will be required to cool homes and other structures.

Recommendations

7.1. Increase coordination among the state, water districts, local governments, and climate researchers.

State and local water providers should increase coordination in their climate change planning efforts and strategies. It is important to increase information sharing and partnerships with policymakers, existing institutions, universities, state climatologists, regional climate centers and hubs, water users, agricultural extension services, and resource management agencies. Bringing together resources can help policymakers and stakeholders appreciate and comprehend the latest climate science projections as well as learn about new tools that are in development. This would enable state agencies and others to anticipate and mitigate the impacts of climate change.

Possible approaches to increase coordination include the following: a) encourage water providers to do comprehensive water resource planning, taking into consideration climate change impacts; b) encourage more public participation in water planning activities; c) support water sharing agreements where feasible and cost-effective; d) explore options to reuse municipal water consistent with data-driven cost benefit analysis including potential adverse impacts to other water users and natural systems such as the Great Salt Lake; e) encourage opportunities for reservoir enlargement (where feasible and cost-effective and where benefits would outweigh potential downstream impacts) that could be used for municipal, agricultural, recreational and environmental purposes (see Recommendation 2.7 for further discussion); f) encourage partnerships and resource-sharing with

[22] http://www.cpc.ncep.noaa.gov/products/predictions/long_range/seasonal.php?lead=2

federal agencies; and g) work with the legislature, utilities, and federal agencies to identify and address regulatory barriers to climate preparedness and adaptation.

7.2. Assess vulnerabilities and develop risk management strategies developed through studies to plan for climate change impacts.

As water providers grapple with preparing for the large range of possible climate change impacts, many are searching for new planning techniques to help better prepare for a different, more uncertain water future. The first steps for water providers could be to a) better understand the climate science and climate predictions; b) conduct a vulnerability assessment; c) develop a plan that includes prioritized risk management strategies to address the impacts of climate change; and d) implement strategies as deemed appropriate.

Each water system has a unique combination of surface and groundwater sources. Water providers are encouraged to study and assess the vulnerabilities of their water sources that may be impacted by a changing climate. Water providers should then develop a risk management plan that identifies specific priority actions they could take to begin addressing its vulnerabilities and mainstreaming climate change strategies into their activities. In order to develop these, water providers may choose to include scenarios-based planning approach by studying the impacts of climate change on water supply and demand based upon predictions of global climate and down-scaled model projections. A risk management plan could include the following:

i. Reduce the demand for water through improved water use efficiency to help offset the potential risks and impacts associated with climate change. Water conservation and upgrading efficiency programs continue to be critical elements in providing a sustainable water supply as Utah's population continues to grow. See Key Policy Question 1 for a detailed discussion of demand reduction strategies.

ii. Fortify and improve management of existing water supplies.

iii. Consider climate change and projected sustainable water resources in land use planning decisions and land development entitlements.

iv. Adapt infrastructure for extreme weather events, plan for changes in rainfall patterns beyond design capacity, and consider upgrades in storm sewer and culvert capacity.

v. Take steps to prevent damage from flooding due to increased intensity of storms and early exaggerated melt/run-off that could overwhelm infrastructure.

vi. Adopt an "all hazards" approach to planning for emergencies and extreme weather events, including consideration of impacts predicted by climate change.

vii. Consider changes to reservoir operations which may involve flood-control releases due to more extreme flood events.

viii. Encourage, where appropriate, community support and expansion of drought and flood preparedness and response.

ix. Consider the advice of experts. For example, Federal Emergency Management Area (FEMA) Region VIII Preparedness and Mitigation[23] experts have several recommendations to help cities plan for extreme weather events.

7.3. Identify and develop adaptation strategies.

Adaptation to climate change means anticipating the adverse effects and taking appropriate action to prevent or minimize the potential damage associated with those impacts. It also means changing how the public uses water resources. It has been shown that well-planned, early adaptation action both increases resiliency and saves money.

Water policymakers and water management agencies could evaluate and revise the legal framework for water management policies to the extent allowable to ensure that sufficient flexibility exists to anticipate and respond to climate change. For example, the Division of Water Resources is currently updating its 2001 State Water Plan. This update should help cities and water systems develop water adaptive management to responding to a changing climate. Examples of adaptation measures include:

Water Conservation for Outdoor Water Use

Warming temperatures resulting from climate change may increase demand for water while reducing available supply. As a result, water conservation and improved water use efficiency will be key adaptation and risk management strategies to address the impacts of climate change. While the greatest reduction in Utah's municipal water use can be achieved by changes in landscaping and outdoor watering practices, indoor water use efficiency will remain important as water managers strive to provide a sustainable water supply.

However, as water conservation goals are met across the state, water conservation as an adaptive strategy to combat the impacts of climate change may become increasingly challenging and introduce other issues, such as increases in heat island effect and increased energy demands associated with increases in demand for cooling. As use is reduced, in times of drought, further reductions may reflect curtailment of what may be essential water use. Water systems, as part of the planning for climate change impacts and drought contingency plans need to determine thresholds and implementation strategies for curtailment under this scenario.

Improve Watershed Health and Function

Healthy watersheds, with their ability to capture and retain more water, play a vital role in buffering the effects of climate change. Our forests are in very poor health. Overgrowth and beetle kill, at a minimum, have put our watersheds and water supply in jeopardy. The risk of large fires is high, which would decimate the watershed. The overgrowth has caused increase water consumption and therefore decreased runoff. By far the majority of the water supply for the state originates on these poorly managed forests. If managed properly, a healthy forest and meadow system can reduce evapotranspiration losses, improving both water supply and water quality. Natural systems, such as meadows, riparian areas, floodplains, and wetlands, effectively store water during times of high flows and slowly release it back to surface water. Streams and floodplains in a healthy watershed are able to accommodate flood flows without destructive flooding and erosion. Healthy watersheds provide resilience to climate change at the basin scale, as improved flows not only allow fish and wildlife a better chance of surviving dry hydrologic conditions but also provide more reliable water delivery and

[23] State Hazard Mitigation Plan Climate Change Committee 2019 Update, March 1, 2017

improved water quality for municipal and agricultural use. Integrating natural storage into Utah's water management, as well as promoting the protection and restoration of natural systems, including control of non-native plant species, will increase Utah's preparedness for climate change and mitigate the destructive effects of floods.

Protect and Improve Water Quality in Source Water

Surface water and groundwater supplies will continue to play a vital role in providing for Utah's water needs. We must continue efforts to protect, maintain, and in many cases improve the quality of our surface water and groundwater sources by identifying protection zones. As discussed in Key Policy Question 5, water quality issues threaten Utah's surface water and groundwater supplies. In many cases, warming temperatures will only exacerbate this issue, especially during times of drought when nutrient concentrations are generally higher in our surface water sources.

Develop opportunities to store surface water underground

Aquifer Storage and Recovery (ASR) systems offer another way to diversify supply so as to adapt to a changing climate, albeit one limited by existing water tables, the porousness of the bedrock, and other factors. Even so, ASR offers another potential way to hedge against the risk of reduced supply due to climate change, particularly as such storage avoids loss from evaporation and evapotranspiration.

7.4. Identify and plan mitigation strategies.

The development of a risk management plan by a water provider should also include a range of prioritized mitigation strategies and actions. Water providers can use a scenarios planning approach to develop mitigation actions based on predictions from Earth System Models for the most likely carbon emissions pathways moving forward. Examples of some key mitigation strategies include:

Diversify Water Supply

One of the best strategies to mitigate the risks and impacts of climate change is to develop a diverse portfolio of water supply resources. This can be done by increasing local supplies through several methods, such as (a) developing water supplies from a variety of hydrologically separated river basins within Utah, (b) where feasible developing groundwater, (c) wastewater recycling, (d) modifying infrastructure to maintain efficient capture of supply, and (e) improving the efficiency of existing water supplies. Smart diversification employs a full range of water supply sources collectively to serve as a buffer against the deficiency of any one source.

Explore the Need for More Storage

Warming temperatures and reduced water supply predicted by Earth System Models may require additional storage to continue providing a reliable supply. This may involve construction of additional surface water storage and further practice of underground storage by construction of aquifer storage and recovery (ASR) systems. ASR additional storage may be needed to store more water during wet years or cycles as a carryover supply for future years during dry cycles.

Reduce Emissions

Consider taking steps to reduce emissions that contribute to climate change through planning and operations and as a part of needed new capital infrastructure.

7.5. Build on scientific knowledge base of climate research through increased resources and funding to enhance planning processes.

Utah should increase ongoing funding to improve state and local planning for climate change and fund climate science research. The State should fund climate science research towards improving the predictive capabilities for climate change and assessing and mitigating its impacts. Supplemental funding would allow for activities necessary for monitoring, assessing, and predicting future water supplies necessary to keep Utah's economy strong.

8. How do we optimize our water resources to sustain the economy and quality of life for Utah residents?

Issues

1. Assurance of a sustainable water supply is critical for existing and new businesses
2. Strategies to pay for water
3. Maintaining a healthy and attractive quality of life
4. Enhancing outdoor recreation and tourism
5. Economics of natural environment preservation (ecosystems services)
6. Economics of agriculture

Recommendations

1. Maintain and provide sustainable water supplies for existing and future economic activity.
2. Structure water-related revenues to balance social, economic, and environmental values.
3. Promote stewardship of water to support our quality of life, recreation, and preservation of the natural environment.
4. Recognize and support agriculture's role in Utah's economy.

Issues

8.1. Assurance of a sustainable water supply is critical for existing and new businesses

According to a 2014 study, 63% of businesses consider water availability and sustainability of water resources when determining where to locate new facilities.[24] The same study found that 86 percent believe that, by 2018, the sustainability of water resources will be an important factor in considering expansion of existing facilities, and the location of new facilities in the state. Therefore, offering concrete assurances of the sustainability of resources encourages businesses to expand or locate new facilities in Utah. The converse is also true: uncertainty in this area may deter businesses from expansion and location of new facilities in Utah. With population growth will come the need to retain, expand, and recruit businesses, all of which will want answers to the sustainability of resources question.

8.2. Strategies to pay for water

Water pricing strategies are very complex due to many factors, including:

i. Water's essentiality to human life

ii. Reflecting the dual nature of public water supply as a commodity and as a public good

iii. Social justice

iv. Affordability

v. Varying cost impacts between customer classes

[24] Vox Global and Pacific Institute

vi. Generational equity

vii. Infrastructure cost recovery

viii. Management of aging infrastructure

ix. Operation and maintenance cost recovery

x. Legal authorities and constraints

xi. Effects on economic development

xii. Legislative mandates

xiii. Messaging effects on use of water

These factors and others must all be weighed by public water providers in identifying their pricing strategies to pay for the various cost components of water service.

8.3. Maintaining a healthy and attractive quality of life

Utah's water resources play an integral role in the life of every person. Today, 3 million Utahns depend every day on clean, reliable water supplies for many uses. From a morning shower to a weekend trip down the Colorado River, water is interwoven into nearly every activity. A place known to have a desirable quality of life may attract local and regional businesses and stimulate economic growth. Businesses recognize recreational opportunities and community character when considering location or relocation, and this depends on Sustainability of Resources.

8.4. Enhancing outdoor recreation and tourism

Utah's economy and quality of life are integrally connected to the abundant year-round opportunities for outdoor recreation and tourism. Outdoor recreation and tourism depend on a healthy, clean, natural supply of water for parks, wildlife, national forests and other public lands, in-stream flows, and healthy lakes. In 2012, the in-state outdoor recreation economy generated a record $12 billion in consumer spending, $3.6 billion in wages and salaries, $856 million in state and local tax revenue, and 122,000 direct employment jobs.[25]

Utah has a diverse travel and tourism industry, which generates jobs and income for Utah businesses and produces tax revenue for the State. Utah is home to 14 ski areas and has the greatest concentration of national parks in the U.S. The state's five national parks—Arches, Bryce Canyon, Canyonlands, Capitol Reef, and Zion— are famous around the world for their spectacular and diverse natural beauty. In addition, Utah has eight national monuments, two national conservation areas, two national recreation areas, and 43 state parks that attract millions of visitors every year.

In the summer, Utah's outdoors provide world-class recreational opportunities on public lands with activities such as camping, hiking, mountain biking, ATV riding, rock climbing, fishing, and hunting in some of the most varied and spectacular scenery on earth. The state is a global destination for water

[25] Outdoor Industry Association website: outdoor industry.org/images/orereports/UT-utah-outdoorrecreationeconomy-oia.pdf

sports enthusiasts seeking adventure of whitewater rafting, swimming, kayaking, boating, jet skiing, and scuba diving.

Utah's economy and population have become highly diversified, with greater dependence on tourism and recreation that in turn rely on water of sufficient quantity and appropriate quality to sustain human activity and the rivers and lakes that form such an essential part of the state's natural environment. Due to increase in demand for recreational areas and water-dependent outdoor recreation in general, many water challenges lie ahead. To protect these robust and diverse outdoor experiences and the local, regional, and state economies that have developed around them, Utah must also protect the water resources on which they depend. Meeting this complex and difficult challenge cannot be left to chance.

8.5. Economics of natural environment preservation (ecosystems services)

In the past, the value of nature and open space was too often ignored or underestimated and therefore overlooked when land and water use decisions were made. More recently, there have been attempts to place monetary values on these resources in an effort to recognize their contribution to our way of life.

Ecosystem services, which are the benefits humans derive from the proper functioning of the natural systems, are perhaps the most difficult—and most important—of natural resources to quantify in terms of economic value. They are the natural systems that give us clean air and drinkable water, allowing us to survive. The cost to replicate these systems if they are lost is unimaginable (*e.g.*, to clean our water supplies and create the flood control provided by natural wetlands would cost many times what it would cost to protect the naturally occurring resource). The preservation of open space lands and natural water resources ensures that economic benefit of ecosystem services will continue in the future.

Quality of life is significantly impacted by the attributes of our natural world that help support water quality and the natural systems that sustain our positive sense of well-being. The challenge is how to retain our high-quality water supply for the future. To assess Utah's water quality, the Utah Department of Environmental Quality surveyed 750 rivers and stream segments. While 21% of the rivers and streams assessed met water quality standards, about 47 % did not, and 32% had insufficient data. The report found half of Utah's 142 lakes and reservoirs do not meet water quality standards. There were a dozen harmful algal blooms at public water bodies in 2016. Over time, deteriorating water quality will deter residents and visitors from enjoying our open spaces, lakes and rivers, and other natural settings, thus impairing their ecosystem service value.

8.6. Economics of agriculture

As noted above in Key Policy Question 3, Utah farming and ranching has a great impact on the State's economy, and most Utahns believe farming and ranching are critical to Utah's future.

In addition, food growers, processors, and other agriculture-related businesses employ more than 66,000 people and contribute approximately 14 percent of the state's economy, not including grocers. Decisions regarding future use of water will have a direct and significant impact on the State's agricultural economy.

Recommendations

8.1. Maintain and provide sustainable water supplies for existing and future economic activity.

Businesses require many levels of certainty when deciding to relocate or otherwise invest in Utah. To satisfy this certainty, water supply agencies must have adequate supplies of water in place today as well as sound plans to enhance water efficiency, employ effective water conservation measures, and expand water supplies and water system infrastructure to meet growing needs for the coming years. Recognizing that it often takes years to plan, obtain environmental review for, engineer, design, fund, and ultimately construct water supply projects, water agencies must engage in long-term planning and ongoing development so that essential water supplies and corresponding infrastructure are in place in advance of actual demand. Otherwise, business expansion will migrate to locales that have developed sustainable water supplies.

8.2. Structure water-related revenues to balance social, economic, and environmental values.

Water agencies should strategically create water rate structures and water-related revenues to balance social, economic, and environmental factors. This requires consideration of the following factors:

Reflecting the Dual Nature of Public Water Supply as a Commodity and as a Public Good
Provide for payment of public good services of water in revenue streams that reflect the benefits of that public good, such as to property owners in a community. Examples of public good benefits are recreation, flood control, environmental protection and enhancement, endangered species protection and recovery, fire protection, and increased value of vacant lands through land development approvals in which water is committed to support new developments (water entitlements).

Water districts in Utah have a water funding model that includes three components: user charges, property taxes, and impact fees. Each component is authorized, with defined limits, by the Utah Legislature. Each component has its specific purpose in creating a balanced and appropriate funding model for the cost of water services. Municipal and non-district water providers generally do not generate revenue from property tax, relying more on impact and user fees.

Property tax as a funding mechanism is an issue that has drawn considerable attention and generated debate. Some argue that property tax is not an appropriate component of the Utah water districts' funding model and that property tax revenue hides the full cost of water by fragmenting the sources of costs that water users pay. Water users may receive regular bills from water providers with use and cost information; however, tax notices list levying authorities and pro rata rates, and no other information is provided the rate payer. Opponents of property taxes as a funding mechanism also believe taxes are a subsidy and cause some rate payers to pay more than their share or to pay for water supplies to which they do not have access.

Conversely, others believe property taxes do not constitute a subsidy, because Utah water users pay both user charges and property taxes in a split payment system. Supporters of property tax revenues believe that taxes pay for the broad range of public services listed above. These values are not proportional to the cost of water measured through a water meter but, instead, are values provided to all members of the public living in a community.

Property tax revenue also supports efficient and cost-effective capital improvement bond financing for new water source and infrastructure capacity needed for the rapidly growing Utah population. New

water development projects may take decades to develop and additional decades for the public to "grow into" the full capacity of the projects. Thus, property tax revenue supports borrowed funds (commonly secured through issuance of bonds) that spread the costs from current ratepayers to future users who will benefit from the projects, thus achieving more generational equity.

Some of the concerns relating to the full expression of the cost of water could be alleviated through stronger, more transparent reporting and messaging regarding how tax-generated funds are used. Just as municipalities are striving to enhance the pricing and education signals attached to water bills, so too could the water districts look to alternative messaging mechanisms to convey water value and pricing.

Social Justice
Ensure access to a sufficient quantity of water to sustain life for every citizen.

Affordability
Provide for basic water needs to be affordable to each income sector of the public.

Impacts on Various Customer Classes
Avoid excessive charges to residential customers, especially those of lower income. Avoid excessive transfers of water costs to institutional water users, because of their wide-ranging services provided to the public.

Generational Equity
To the extent possible or reasonable, transfer the burden of repaying the initial capital cost financing of water projects to those generations of users who will benefit from them, rather than placing the entire capital cost on the backs of current water rate payers.

Infrastructure Cost Recovery
Ensure the ability of the water agency to recover and pay the financed capital cost of new water supply and related infrastructure.

Management of Aging Water Infrastructure
Provide for accumulation of replacement reserve funds sufficient for scheduled replacement of aging infrastructure. Provide sufficient financial resources to avoid "falling behind" in the critical work of asset management plans.

Operation and Maintenance Cost Recovery
Provide a water-related revenue structure that will annually repay the full cost of operating and maintaining each water system.

Legal Authorities and Constraints
Monitor legal authority and observe statutory constraints of each water agency to draw upon various sources of revenue, including user charges, property taxes, and impact fees. For example, property taxes can only be levied within statutory ceilings defined by the Utah Legislature.

Effects on Economic Development
Consider the cost placed upon commercial and industrial customers, with an eye toward being balanced between being low enough to stimulate economic development and high enough to allow commercial and industrial customers to bear equitable portions of water infrastructure costs.

Legislative Mandates
Identify statutory mandates regarding water rate structures, and establish structures that honor those mandates. For example, the 2016 Legislature mandated tiered water rate structures for all retail water providers in Utah.

Messaging Effects on Use of Water
Establish water rate structures and other water-related revenues that provide an effective price signal to water users to encourage conservation. Attempt to transform water users and rate payers into informed water consumers. Use technology to provide more real-time price signal and social norming feedback to water users. For example, water bills can show a customer how his/her water use compares to that of peers and neighbors.

8.3. Promote stewardship of water to support our quality of life, recreation, and preservation of the natural environment.

Maintaining open space resources such as conserved and protected lands, riparian areas, croplands, parks and trails, and recreational playing fields sustains ecosystem services and contributes to quality of life and community character. There is increasing need to expand urban parks. Buyers of second homes and retirement homes, in particular, search for areas considered to have a high quality of life. Land preservation can further protect resources such as drinking water supplies, local agriculture, and wildlife habitat for future generations to enjoy. Conserved land used to protect water quality is a public investment in one's community that will appreciate over time.

Outdoor recreation and tourism could be strengthened through greater integration of outdoor recreational interests such as community groups, non-profit groups, and federal agencies working together on common goals. Advocates could work with broader stakeholder groups to provide stewardship that will be vital to preserving the outdoor experience for the future. This coalition could build awareness that preservation of outdoor recreation is an economic value for the State. Increased ongoing funding is critical to maintain the quality of the outdoor experience and retain financial viability of the outdoor industry. With limited state budgets, opportunities to engage active volunteer stewardship partners should be encouraged. See basin council discussions in Key Policy Question 3 of this water strategy document.

Healthy watersheds, rivers, and streams are vital to maintaining quality of life. A healthy environment depends upon good water quality, connectivity of streams, and robust instream and riparian habitats. Careful water management of these resources will be required to retain them for long-term sustainability.

Unplanned or poorly planned development in watershed areas could threaten Utah's water quality. Communities could invest in buying acreage in critical watershed areas and engage in stream corridor restoration to provide a natural filtration system to reduce pollution loads. The Legislature could provide ongoing funding to provide for monitoring and enforcement measures to stabilize and reduce watershed pollution in our rivers and lakes so they are safe for public use. These assets are important to protecting Utah's economic future.

8.4. Recognize and support agriculture's role in Utah's economy.

In the *Your Utah, Your Future* survey to which over 50,000 Utahns responded, 98% chose scenarios in which Utah substantially increases its production of agricultural products, and three-quarters of Utahns agreed that farming and ranching are critical to Utah's future.[26] Even though agriculture accounts for only 15.1% of the State economy, it is important and significant to the residents for food production as well as to preserve open space among many other values.

As the state's population increases, decisions about how and where development occurs and changes to water use will have a direct impact on agriculture. It is recommended that stakeholders and decision-makers plan to keep agriculture economically viable and encourage development patterns that support agriculture.

[26] Utah County Agriculture Toolbox, Envision Utah

9. What is the framework for Utah water law and policy, and how will stakeholders modernize it?

Issues

1. The Prior Appropriation Doctrine as the fundamental basis for Utah water law
2. Over-appropriation of water sources
3. Challenges in meeting new demands in an over-appropriated system
4. Inadequate stakeholder involvement in the reallocation process
5. Insufficient resources for administration, adjudication, data collection and analysis in the State Engineer's office

Recommendations

1. Give the State Engineer more direction on "public welfare."
2. Expedite and fund water rights adjudications of water basins.
3. Clarify and strengthen the State Engineer's authority in administering change applications to avoid depletion enlargement.
4. Allow the State Engineer to define water duties.
5. Facilitate temporary transfers of water.
6. Allow water right holders to subordinate water rights.
7. Review constitutional requirements that preclude cities from selling surplus water.
8. Provide regular and robust forums for stakeholder involvement in modernizing Utah water law and policy.
9. Provide increased ongoing funding and resources for Division of Water Rights activities.

Issues

9.1. The Prior Appropriation Doctrine as the fundamental basis for Utah water law

Utah, from the first settlement by non-native Americans, has allocated water based on the common-law doctrine of prior appropriation. The doctrine developed out of custom and usage in the mining camps of Colorado and California and was adopted by almost all Western states. The basic tenets of the Prior Appropriation Doctrine are first in time, first in right (Priority of Appropriation); beneficial use is the measure and limit of the water right; non-interference with other water rights; and forfeiture (Use it or Lose it), which is a statutory penalty imposed if the appropriator ceases to beneficially use water without a defense to that non-use. The doctrine was codified in Utah in 1903, but the early statutes were mostly procedural. The body of law remained case law, and, as a common-law doctrine, it continued to evolve as societal values and practical experience dictated.

The water resources are the property of the State, and it holds title in trust for the benefit of its people. An appropriated water right is a conditional property right, protected by priority and the non-interference doctrine, but only so long as the appropriator keeps her end of the bargain by continuous beneficial use. If the appropriator ceases to use the water for beneficial purposes, the water right will forfeit by statute and the water will go back in the common pool to satisfy other vested rights, and any excess thereafter is open to new appropriation. Water is simply too precious in the West to allow it to

be hoarded or to go to waste. There can be no appropriated water right in the absence of continuous beneficial use.

The doctrine served the West well in the 19th Century. It afforded the appropriators the protection of priority so that they could take reasonable time to dig their ditches and canals, clear their land and make it possible to use the water, knowing that because of their priority, the water would be protected and available for them when the development work was completed. Intervening appropriators took their water subject to prior rights, and that basic tenet, coupled with the non-interference rule, protected the appropriators against new appropriations and changes of use by either senior or junior appropriators. Upon completion of an appropriation process, a conditional property right was vested in the appropriator known as a certificated or perfected water right in Utah.

Today, the doctrine is struggling to keep pace with the changing social and environmental values of the 21st Century. The law needs to be modernized but through legislative changes, as we no longer have time to wait for the courts to mold the law on a case-by-case basis. The world is simply moving too fast, and the law must keep pace as best it can to meet the needs of a modern and evolving society. There are now new stakeholders who were not at the appropriation table when most of the water was appropriated. These new interests represent environmental concerns, conservation, wildlife concerns, recreation, and those who find value in a flowing stream rather than diverting every drop of available water for some depletive beneficial use. These new stakeholders are demanding a share of the water, and in the absence of state water law reform, are using tools such as the Clean Water Act, the Endangered Species Act, the Federal Power Act, and the *Winters* Doctrine to force the reallocation of water from existing beneficial uses to these new public oriented uses that are outside the appropriation hierarchy. Some new stakeholders feel their interests are not adequately represented as changes to water law occur.

The prior appropriation doctrine will remain the bedrock principle of Utah's water law, as titles have vested—and too many economic decisions have been made on the strength and security of priorities—to abandon the doctrine. The alternative allocation doctrine of riparian rights simply does not fit our western landscape. The doctrine must evolve to meet the needs of the modern world, but that is the beauty of the appropriation doctrine—it is inherently flexible and has changed in the past and will continue to change in the future to meet changing needs.

9.2. Over-appropriation of water sources

Most of Utah's water sources are over-appropriated, meaning there are more approved water rights than a water source can fulfill under average conditions. This is understandable because the State has attempted to efficiently use its water resources and has approved rights for water that may only be available under high flow conditions. Water availability is not consistent from year to year, and delivery is based on who established water use first (first in time, first in right). Therefore, as the flow begins to taper off, deliveries to junior water rights are cut based on priority.

Some refer to water rights that can't be filled in an average year as "paper rights" as opposed to "wet rights". Those seeking to obtain water need to complete due diligence to understand the validity of the water right in question. However, transfers of existing water rights to public water suppliers, industries, and other new development will generally continue to be made through "willing seller-willing buyer" transactions and, unfortunately, some without adequate due diligence. In some areas, there is not

sufficient data comparing the sustainable water supply to existing water rights so that proper due diligence can be performed. This leaves all affected parties at risk.

9.3. Challenges in meeting new demands in an over-appropriated system

As Utah's economy and population continue to grow, sustainable water planning for the future must reflect careful deliberation and a balance of the many competing interests. Balancing competing uses and demands for water is not new, but the pressure to address them simultaneously is new. The challenge is how to handle future shortages in water supply and determine which water use takes priority over another. In addition, there are a rising number of uses with recognized social values such as environmental flows and recreation that have not been afforded legal protections given to other uses already recognized. Also, there are changes in societal values that could transform future management of water and times when water management decisions involve new types of conflicts. Challenges include demands in excess of supplies, water quality degradation, and recreational and environmental concerns. Balancing these uses in an already over-appropriated system will be challenging in part because present institutions are not well equipped to provide timely and cost-effective dispute resolution at the complex intersection between hydrology and human activity.

9.4. Inadequate stakeholder involvement in the reallocation process

The policy of most Western states (including Utah) has been to maximize the economic development of water resources without waste. Utah policymakers are discussing ways to reallocate water to stretch our water supply, which includes implementation of conservation practices. These discussions include opportunities to leave more water in streams. Due to the influence of an expanding range of stakeholders, these discussions now include notions such as instream flows, stream environment protection, recreation, public welfare, recycling or reuse of water, and other non-economic uses that have been determined to have social value. Many stakeholders have expressed the desire for more transparency and better stakeholder involvement in the reallocation process.

9.5. Insufficient resources for administration, adjudication, data collection and analysis in the State Engineer's office

An area where more water rights have been granted than there is actual water supply is often described as "over-appropriated." Utah has a well-established legal process called "general adjudication" that is often useful in bringing balance between water rights and water supplies in a water basin. The adjudication process is a long, tedious process of verifying water rights and making a formal determination about the volume of water available and whether it is being put to "beneficial" use. Time and resources are necessary to involve all claimants and collect sufficient data to complete the adjudication process. With growing demands for water, it is imperative the adjudication process be expedited to determine current use and what water might yet be available. As the value of water continues to increase, water right files need to be up-to-date and accurate through use of the adjudication process. Current funding for the State Engineer's office and the courts is insufficient to complete the adjudication process in a timely manner.

Recommendations

9.1. Give the State Engineer more direction on "public welfare."

Utah water code requires that the State Engineer consider whether an appropriation application or a change application is detrimental to the public welfare. However, the statute has no standard defined for public welfare. The water code should be updated to provide this defined standard.

9.2. Expedite and fund water rights adjudications of water basins.

Utah's Prior Appropriation Doctrine is based on the concepts of "first-in-time, first-in-right" and beneficial use. One of the important methods in moving water from lack of beneficial use by senior water right holders to needed beneficial use by junior appropriators is the adjudication process. Experience has shown that adjudications progress very slowly because of process difficulties and lack of funding. The water code has recently been modernized to provide a more streamlined adjudication process. Additional process improvements can be identified and defined. Accelerated funding for adjudications is needed from the Legislature. See Issue 10.5 and Recommendation 10.5 for further discussion of this issue.

9.3. Clarify and strengthen the State Engineer's authority in administering change applications to avoid depletion enlargement.

As uses for Utah's limited water evolve and increase, it is becoming increasingly important that the State Engineer maintain balance in hydrologic systems. This can best be done by avoiding "depletion creep." The Utah water code has recently been amended to describe State Engineer authority in administering change applications and providing his authority to prevent "quantity impairment." Additional clarifications in the water code can be made to provide the State Engineer with more tools to avoid depletion enlargement and to keep hydrologic systems in balance.

9.4. Allow the State Engineer to define water duties.

Work with the Sate Engineer through rulemaking and statutory opportunities to define water duties.

9.5. Facilitate temporary transfers of water.

Facilitating temporary transfers of all or portions of water rights through lease, contract or other easily administered arrangements would enable water to be used for various competing uses on a sequential basis during the same year to meet not only current authorized uses, but also to meet short-term needs for instream flows or other similar public uses of water. Laws and administrative rules may need adjusting to accommodate split season leases or other sharing arrangements. These shared use arrangements could be accomplished by individual voluntary transactions or through more institutionalized water banking programs administered under the direction of the Division of Water Rights. To be useful, such temporary transfers would need to be accomplished quickly, with minimal administrative processes and low transaction costs, but with sufficient transparency to assure no injury to other water users. Interested water groups should be encouraged to make recommendations for legislative adjustments that would facilitate water transfers to meet the needs of the public.

9.6. Allow water right holders to subordinate water rights.

The Utah water code allows for water right holders to develop "voluntary arrangements" for reversing over-drafted groundwater basins in critical groundwater management areas. These voluntary

arrangements, which must be approved by the State Engineer, supersede the strict enforcement of water rights priority schedules and may include a subordination of water rights where it may be accomplished without injuring interests of the public or parties who are not part of the arrangement. Subordination may allow a junior appropriator to share the water resource with a senior appropriator or even use the water under the junior water right before the senior water right uses it. There may be opportunity for similar voluntary arrangements and subordination of water rights, with State Engineer acceptance, in surface water system administration. These voluntary arrangements could be identified and guided by watershed councils. This process could also be facilitated by establishing water banking procedures through legislative action that could allow flexibility in the availability of water for various uses in a particular drainage system depending on the needs and water availability. A water bank is an institution that exists to facilitate the temporary transfer of water. If a bank were in place, rights to the water could be banked for another water user in the region to buy or lease. A benefit of a water bank includes more transparency in terms of both transactions and costs. Banked water could be available for agricultural, environmental, M&I, or other purposes. These banks allow water users to put unused water into the bank in years when they do not need it (without it counting against them for purposes of forfeiture "use it or lose it") and, conversely, to go to the bank to lease additional water when they need it for any lawful purpose.

9.7. Review constitutional requirements that preclude cities from selling surplus water.

Article XI, Section 6 of the Utah Constitution was adopted to protect cities from shortsighted decisions and to preserve their limited water resources for future growth within their expanding communities. While projected population growth underscores the wisdom of this approach, it may be reasonable to allow cities greater flexibility to market water (but not water rights) when there is a clear surplus.

9.8. Provide regular and robust forums for stakeholder involvement in modernizing Utah water law and policy.

The Utah Executive Water Task Force has been a good forum for developing modernization of Utah water law. This forum, or a similar one, should continue to meet regularly and to advertise its meetings widely. The Utah Water Development Commission membership was changed during the 2017 legislative session. The Commission is also a valuable forum for developing and modernizing Utah water law and policy. Its meetings should also continue to be widely advertised. Additional forums such as watershed councils or advisory councils are encouraged to help guide long-term sustainable water management decisions.

Utah's water laws can be modernized within the framework of the appropriation doctrine while protecting vested rights. This should be accomplished through a process that is open and inclusive so that those individuals and entities affected by legislative changes are engaged in the decision-making process. See Recommendation 4.2 and 4.5 for examples of this type of modernization.

9.9. Provide increased ongoing funding and resources for Division of Water Rights activities.

This document identifies the critical nature of limited water resources in arid Utah to provide for a rapidly growing population and economy. The Executive Branch and Legislative Branch of Utah government should seek consensus on accelerated funding levels for the Utah Division of Water Rights. These additional funds can accelerate river basin adjudications and more expedited administrative actions by the State.

10. What is the role of policymakers, both elected and appointed, at all levels of government?

Issues

1. Complexities of Utah water law
2. Public engagement
3. The need for better information for decision-makers
4. The challenge of working across government jurisdictions
5. General adjudications and the need for certainty
6. Federal reserved water rights
7. Lack of adequate resources to fully implement this strategy

Recommendations

1. Create ongoing learning opportunities for policymakers and residents, relying on input from a broad range of water experts and professionals, to help them design and implement effective water policies.
2. Establish mechanisms to engage the public in decision-making processes with policymakers before decisions are made.
3. Support and fund research, science, and technology to enhance understanding of and education about water issues to facilitate decision-making on the various elements of this water strategy.
4. Encourage cooperative interagency water decision making within and between Utah's Departments of Natural Resources, Environmental Quality, and Agriculture and Food, and with states that share watersheds with Utah.
5. Accelerate funding for adjudication of water rights in order to provide greater certainty and marketability of rights.
6. Provide adequate ongoing funding and staff for technical work and intergovernmental cooperation needed to quantify and settle Federal Reserved Water Rights claims.
7. Enhance legislative and public support for ongoing funding to meet Utah's water-related needs.

Issues

10.1. Complexities of Utah water law

The Prior Appropriation Doctrine has served the state well and provided a strong basis upon which water law in Utah has been established. For much of Utah's history, a significant number of legislators, administrators, and decision-makers had hands-on experience with water rights, water policy, and water use. This experience was generally related to water for agricultural use. As Utah has increased in population and become more urbanized, a smaller percentage of the population has direct involvement with water rights, policy, and management. Much knowledge and experience has been lost, leaving institutions that play an important role in shaping water law and policy with less practical knowledge, particularly from an agricultural perspective. In that void, people can be tempted to push competing interests in the legislature or to pursue changes to water law that lack reasonable consensus among water users or that have not been adequately vetted by the water community. This situation invites what water users fear the most: uncertainty.

10.2. Public engagement

Water agencies have found that educating and involving the public on water issues can be difficult and expensive. To date, much of the public is not overly concerned about water availability largely due to the fact that there have been few shortages because water development has been ahead of growth. However, members of the public have been concerned about water quality, sufficient water to maintain healthy natural systems, and growing conflicts over water in the face of increasing and competing demands. As articulated in this report, Utah faces critical decisions related to the state's water future and needs to call upon all residents to help address these challenges. Residents are being asked to use water more efficiently, keep Utah's waters clean, be informed and involved residents, fund water infrastructure, and adapt to changes that affect water resources and allocation. Reaching the public through information campaigns and involving them in water policy dialogues is necessary and critical to reaching consensus about Utah's future water use and garnering support for policy actions that will be needed.

10.3. The need for better information for decision-makers

The goal of state water policy and planning is to provide water to meet the changing needs of present and future generations. Policymakers need accurate, balanced, and comprehensive information to effectively make water decisions. They need management-related information from the many different federal, state, local, and private entities involved in developing, testing and delivering water. Scientific research from a variety of disciplines, including the policy, social, economic, hydrologic, engineering, physical, and biological sciences, is needed. Policymakers also need to understand values and perspectives of key stakeholder groups and the larger public. Since high-quality water is becoming scarce and more expensive, leadership will be key to obtaining the best information possible to inform decisions about this vital resource.

10.4. The challenge of working across government jurisdictions

Frequently, water source authorities—whether at the national, state, tribal or local level—are spread across numerous agencies with varying degrees of communication and interaction. These groups are difficult to gather at one table, yet, once together, they can often identify important common goals. Our current management of different water sources can be improved to facilitate more efficient comprehensive planning. Groundwater, surface water, stormwater, recycled water, and reused water all need to be integrated and thought of as a single water system, requiring many agencies at different levels of government within the state to work together.

In addition, Utah needs to work across state boundaries to manage and protect its water resources. Utah's water supply does not depend entirely on water sources within its borders. For example, Utah shares and manages the Bear River with the states of Idaho and Wyoming through the Amended Bear River Compact of 1980; Utah also shares the Colorado River with six other states through the Colorado River Compact of 1922 and the Upper Colorado River Compact of 1948. Managing shared rivers and water bodies requires ongoing, time-consuming, and often difficult interactions in order to adapt to regional hydrologic and climate variability and to demographic and economic changes.

10.5. General adjudications and the need for certainty

Inadequate funding is delaying the critical need to adjudicate water rights in Utah. General stream adjudications help to bring order and certainty to Utah's water rights record by defining existing rights,

quantifying unknown rights, removing forfeited and abandoned rights from the record, and submitting the rights to the court to be confirmed by judicial decree. Utah's legislative code and administrative rules prescribe detailed adjudication procedures that are time and resource intensive but that protect water as a public resource and people who have rights to use that water. Water rights adjudications are legal proceedings; they require detailed research, administrative work, and public outreach by the State Engineer and staff in the Division of Water Rights, and official hearings before any decisions by the District Courts.

Aside from the statutory mandate in Section 73-4 of the Utah Code, the State of Utah has a vested interest in adjudication of water rights for several reasons. First and foremost, Utah's population is expected to nearly double in the next 40 years and demands for water within the state are expected to grow in commensurate fashion. Better defining existing rights and identifying unknown rights is paramount to effective management of Utah's water resources. Among the water rights defined in general adjudications are federal reserved water rights, which may be previously unknown or unquantified; sovereign immunity prevents litigation against the federal government over reserved water rights, with the only exception being when states undertake general adjudication processes. Second, the general adjudication process was created by the Utah Legislature to avoid a "multiplicity of suits" by private parties in the quest to define respective water rights. Early in the 20th century, it was determined that conducting one comprehensive adjudication of water rights within a drainage provided more clarity, due process, and cost-savings to the public as opposed to relying on an unending string of private suits that failed to join all affected parties and definitively settle water rights issues. Lastly, the State Engineer has the legal mandate and institutional, technical, and professional means to conduct general adjudications efficiently without the cloud of conflicting interests or biases.

10.6. Federal reserved water rights

This issue is a specific case at the intersection of the two preceding issues: (1) it involves challenges regarding Utah and the many different federal land management agencies working across their jurisdictional authorities related to water (Issue 10.4) and (2) it relates to the legal and practical need to integrate federal reserved water rights and state appropriative water rights in general stream adjudications (Issue 10.5). This is a major water policy issue with implications for both water efficiency and water equity. Only coordinated action among water policymakers representing state, federal, and tribal governments can resolve this issue.

When the United States reserved public land for uses such as Indian reservations; military reservations; national parks, forests, or monuments; and other public lands, it also implicitly reserved sufficient water to satisfy the primary purposes for which those reservations were created. Reservations made by presidential executive order or those made by an act of Congress have implied federal reserved water rights. The date of priority of a federal reserved water right is the date the reservation was established. The United States Supreme Court has determined that the measure of a federal reserved water right is not dependent on beneficial uses to which the water has been historically applied but should be quantified based on the water needed to accomplish the primary purpose for which the reservation was established. While all federal reservations are created for specific purposes, and lands within any particular reservation are clearly defined in acts creating that reservation, the water rights for those reservations have rarely been quantified.

While some federal reserved water rights in Utah have been settled, many have not. This situation creates the potential for unknown and unquantified federal reserved water rights to disrupt long established appropriative state water rights if or when reservation uses are developed, even though the rights may have been unquantified, undeveloped, and unrecorded under state water rights laws for decades. Although federal reserved water right claims can be litigated and quantified during water right general adjudications under provisions of the McCarran Amendment, litigated outcomes are not predictable and often very expensive. Quantifying and bringing federal reserved water rights into the state water right records is an important component of Utah's strategy of providing order and certainty through an accurate and complete written record of water rights. Negotiated quantification of federal reserved water rights represents an opportunity to quantify these water rights while considering their impact to other existing and planned water uses. Utah's position is one of negotiation rather than litigation using a spirit of inter-governmental cooperation wherever possible. Utah has completed settlement agreements on 10 of the 17 national parks and monuments in Utah and a settlement agreement with the Shivwitts Band of Paiute Indians.

10.7. Lack of adequate resources to fully implement this strategy

Utah's water future depends on securing resources to address the many water issues identified throughout this document. Many elements of the strategy have accompanying funding needs, from providing water for a growing population and economy to ensuring that new municipal and industrial water demands do not impair existing water uses, agricultural production, rural areas, water quality, and natural systems. Of particular concern are the funding needs associated with our aging water-related infrastructure, much of which is being used beyond its engineered design life. In addition, the federal role in financing water resources programs is rapidly decreasing while its regulatory role is increasing. As a result, the State must find new means to maintain and replace large water projects built by the federal government. Currently, there is inadequate funding to take care of the need for federal as well as nonfederal infrastructure replacement. Policymakers and Utah residents are not fully aware of these funding needs or of the challenges ahead in securing resources to address them.

Recommendations

10.1. Create ongoing learning opportunities for policymakers and residents, relying on input from a broad range of water experts and professionals, to help them design and implement effective water policies.

Policymaking bodies, such as the State Legislature, county commissions, and city councils, must have a sufficient grasp of water law to make informed decisions about water policy, particularly as it relates to changing demands from more agricultural use to urban uses. With a decreasing number of those policymakers having a background in water law, water policy, and water use, water experts and professionals should increase their efforts to provide necessary data, information, analysis, and perspectives on the complexity of water issues confronting Utah. In turn, policymakers should make greater efforts to engage with water professionals and residents to gain more knowledge about water issues on which they make decisions.

A basic understanding of water and water law should be a prerequisite for city planners, council members, county leaders, and legislators called on to make critical policy decisions that affect Utah's

water future. Key water agencies and other members of the water community should provide basic and objective training on water rights and water issues for newly elected officials. The Land Use Academy of Utah should also be encouraged to develop and include water law education in its offering of on-line training materials. Doing so will help policymakers make better-informed decisions with the potential to provide Utah's residents with greater fairness, certainty, and guidance for sound long-term water planning.

10.2. Establish mechanisms to engage the public in decision-making processes with policymakers before decisions are made.

Currently, the Utah Water Development Commission and Executive Water Task Force established by the legislative and executive branches of state government attempt to facilitate and to a degree guide discussions on broad water policy. While these two groups play an important role, efforts should be made to ensure that these groups work together to solve problems and not in opposition to each other. Water policy discussions occur in many other local and state venues as well. Some of these discussions are conducted by formal government entities, but many of them occur within informal groups or coalitions. Generally, people in these discussions and the discussion topics about issues of concern are limited to that particular group. It is likely future groups, formal and informal, will be used to facilitate water policy discussions. Efforts need to be made to better inform and involve interested parties and residents in these groups and discussions at the formative and subsequent stages of water policy development. Providing more advance notice and greater facilitation of these discussions is needed to ensure they include and respond to diverse perspectives.

10.3. Support and fund research, science, and technology to enhance understanding of and education about water issues to facilitate decision-making on the various elements of this water strategy.

Future water management decision-making could be more informed by funding more research. Research on topics such as water conservation, new technologies for reducing water demand, ecosystem science, and innovations in water infrastructure designs will be necessary. Interdisciplinary water sciences, including policy and socio-economic analyses, as well as assessments of community views with appropriate attention to trade-offs between competing uses, will shape the future use of water. Utah's academic institutions are an important source of scientific information, particularly its land grant institution (Utah State University) with a mission and access to federal funding sources to focus on natural resources. Utah is fortunate to have water-related research occurring across different colleges, departments, centers, and laboratories in many of its universities. In order for policymakers and the public to make sound decisions regarding water policy, adequate and consistent funding for ongoing research on water issues should be provided, and opportunities for water policymakers and the public to interact with scientists should be pursued.

10.4. Encourage cooperative interagency water decision making within and between Utah's Departments of Natural Resources, Environmental Quality, and Agriculture and Food, and with states that share watersheds with Utah.

Productive interagency collaboration must be encouraged in order to facilitate more integrated and comprehensive water management. Utah policymakers must continue support for efforts to analyze potential water shortage scenarios over the long term with states in shared watersheds and determine what agreements could be negotiated. Interagency decision-making between divisions of the

Departments of Natural Resources, Environmental Quality, and Agriculture and Food must be encouraged in order to deal with water challenges within Utah. In addition, watershed-based planning groups should be established, where applicable. They should work to integrate components of land and water management and to gain the benefits of integrated watershed, river basin, regional, and interstate planning and management. Their aim should be to improve water use efficiencies and address water equity issues. Interagency and watershed collaboration must be financially supported. Utah policymakers should provide resources for within-state coordination and collaboration and help secure federal funding to support the interstate efforts in which Utah agencies engage. See Recommendation 3.4 for further discussion.

10.5. Accelerate funding for adjudication of water rights in order to provide greater certainty and marketability of rights.

Policymakers and the public need to be better informed with respect to the nature of water right adjudications and their critical function in identifying the amounts of water we have available for use in the state, thereby providing enhanced order and certainty to the State's overall water strategy. Currently, there are 13 general adjudications being conducted statewide, some of which have been underway for over 60 years. Recently, the Governor's Office and the Utah Legislature have moved to expedite the adjudication efforts utilizing a three-pronged strategy. First, the statute governing the adjudication process was modernized and streamlined to enhance due process and allow the State Engineer to focus efforts more systematically. Second, the Legislature provided funding for a court-appointed Special Master to preside over and resolve the backlog of outstanding objections to previously proposed determinations. Third, additional funding was authorized by the Legislature that increased the resources and manpower available to the State Engineer to apply towards adjudicative efforts.

Notwithstanding the recent legislative and funding advances, the water rights adjudication process remains a complex, resource-intensive, and time-consuming effort. These factors often inhibit a meaningful understanding of the role that the adjudication process plays in the determination and distribution of the State's water resources. Continued emphasis and funding of these efforts is crucial in order to move forward in a timely manner and continue progress towards comprehensive decrees on Utah's major hydrologic basins.

10.6. Provide adequate ongoing funding and staff for technical work and intergovernmental cooperation needed to quantify and settle Federal Reserved Water Rights claims.

Utah policymakers must allocate adequate funding and staff resources to conduct technical work, engage in intergovernmental negotiations and cooperative efforts, and implement additional settlements involving Federal Reserved Water Rights. Dedicated effort and ongoing state resources over many years will be needed to identify and quantify these rights and to integrate them with state appropriative rights in ways that minimize conflicts and achieve long-term certainty and stability in water rights administration. Settlements with several tribes are in various stages of negotiation and approval and need policymakers' support to be completed. Utah policymakers should provide their full support for fair and equitable settlements. They should encourage Congress to approve and fund federal reserved water rights settlements when they come before that legislative body for approval. Resolving Indian water rights and the other federal reserved water rights would remove significant uncertainty.

Federal reserved water rights in the Colorado River Drainage within Utah have to come out of Utah's remaining share of its Colorado River Compact rights, which is about 361,000 acre-feet.

Utah's policymakers should encourage the U. S. Congress to approve and fund the settlement agreements between the Navajo Nation, the Ute tribe of the Uintah and Ouray Reservation, and the State of Utah. Legislators should prioritize approval and state funding of the Navajo and Ute settlements. Legislators should also prioritize funding and direction regarding federal reserve water right claims for remaining national parks and the Goshute reservation.

10.7. Enhance legislative and public support for ongoing funding to meet Utah's water-related needs.

Policymakers will need to exercise bold leadership in garnering public support to meet Utah's water-related funding needs. They will also need to engage the public and each other in deliberating over trade-offs in allocating limited resources to make sure that public resources are wisely spent. Policymakers must lead efforts to find creative and effective funding strategies in order to ensure the health and sustainability of our water bodies, provide adequate supplies of high-quality water for the population, encourage water use efficiencies in all sectors, address the chronic underfunding of needed capital improvements and maintenance of existing water infrastructure, promote scientific and technological water innovations, and adapt to hydrologic and climatic variations over time. A wide range of federal agencies and programs provide water-related grants, loans, and cost-sharing arrangements that can help meet these needs. State leaders should support Utah's Congressional delegation in pursuing federal funding for Utah's water needs. Collaborating and forming intergovernmental and public-private partnerships whenever possible will help to stretch limited resources and should be pursued whenever appropriate and productive.

11. What roles will science, technology, and innovation play in addressing Utah's future water needs?

Issues

1. Effectiveness and appropriateness of water conservation methodologies
2. M&I water quality enhancements
3. Agricultural and environmental water quality enhancements
4. Additional water regulations
5. Green infrastructure and greywater
6. Water recycling, reuse, and brackish water demineralization
7. Fragmentation of water resources science, administration, and management
8. Water measurement improvements and communication
9. Availability, transparency, and integration of water data
10. Optimization of water operations
11. Water distribution system losses
12. Funding for development, implementation, and education in water science
13. Quantifying water supply and sustainability

Recommendations

1. Conduct and assess new water conservation programs and initiatives.
2. Pilot test and demonstrate water treatment technologies and processes.
3. Explore technology's effect on agricultural water usage.
4. Improve working relationships between regulatory agencies and water providers.
5. Explore green infrastructure and greywater projects.
6. Innovate wastewater treatment and reuse projects.
7. Increase integrated water management across all sectors.
8. Improve the quality of water data collected and reported.
9. Make water data more accessible to the public.
10. Optimize water operations with automation.
11. Minimize water distribution system losses.
12. Invest financial resources in science, technology, and education.
13. Improve understanding of the geology and quantity of water in Utah.

Issues

11.1. Effectiveness and appropriateness of water conservation methodologies

Science, technology, and innovation focused on promoting water efficiencies and conservation are needed in all water sectors to enhance the State's ability to effectively use limited water resources. Scientific contributions are needed from many disciplines (*e.g.*, climatology, hydrology, physical sciences, biological sciences, social sciences, engineering, and planning) through both basic and applied research. Technological advancements that can promote water savings need to be implemented, especially ones related to detecting water system losses, optimizing water system operations, metering M&I and secondary water, analyzing water use data, operating agricultural and urban irrigation systems,

and improving indoor water use. Innovations in water sciences and technology need to be supported, assessed, and adopted by water system providers and end users. Since most of the appropriated and developed water in Utah is used to irrigate plants in agriculture and the urban environment, the greatest needs are at the intersection of human behavior, plant sciences, and irrigation technologies. More attention to enhancing water efficiencies in the specific contexts of the commercial, industrial, and institutional sectors (CII) is also needed.

11.2. M&I water quality enhancements

Historically, the water industry has adapted to new technologies at a slow, incremental pace. As alternative water resources become increasingly less available, it will be necessary to integrate innovative and cost-effective treatment technologies to meet the demand for drinking water that meets higher standards.

Models can replicate the generation of pollutants and their movement through rivers, lakes, and streams. Models also show the impact of various water strategies on the flows in rivers and on downstream users. Characterizing a river system by modeling prior to physically measuring contaminant levels before diverting water minimizes the necessary treatment for culinary use. Mass balancing is an application of conservation of mass to the analysis of physical systems. This type of modeling may be effective on some river systems when looking at total maximum daily loads (TMDLs) in a system to determine nutrients in a water body.

11.3. Agricultural and environmental water quality enhancements

Increased water quality results are best achieved through a voluntary, incentive-based approach. Important to the success of this approach is a high level of trust between private landowners and government agencies. Landowners often fear that a cooperative effort with government-sponsored technical assistance programs will jeopardize property rights or the economic viability of their operations. A government-directed, penalty-oriented program to require major modifications of farming operations might not be nearly as successful as an education and incentive-based voluntary program. See Recommendation 3.5 for further discussion.

11.4. Additional water regulations

As water technology continues to improve the ability of water agencies to treat and analyze drinking water, the Environmental Protection Agency (EPA) continues to increase water quality standards. There are generally high costs associated with implementing new EPA regulations with the latest technology. The public will see water rates increase based on this trend.

11.5. Green infrastructure and greywater

Green infrastructure is an innovative approach to water management that protects, restores, or mimics the natural water cycle. This approach seeks to sustain healthy natural system functions and provide services to humans through design of corridors and open spaces in urban and suburban environments. Green infrastructure consists of planting trees, restoring wetlands and floodplains, recharging aquifers, constructing elements like bioswales and green roofs, and other design features. The services provided include flood prevention, drought resilience, water quality improvements, stormwater management, nutrient cycling, wildlife habitat, and recreation and aesthetic benefits. Green infrastructure is proving to be effective, economical, and valuable for enhancing community safety and quality of life. As an example of green infrastructure, Napa, CA mitigated flooding problems by restoring the Napa River's

natural channel and wetlands, rather than undertaking river stabilization projects. The effort has protected homes and prevented flood damage each year and has created new parks and open space.

Greywater is gently used water from indoor use such as bathroom sinks, showers, tubs, and washing machines that has not come in contact with human waste. Greywater may contain traces of dirt, food, grease, hair, and certain household cleaning products. Aside from the benefit of saving water, reusing greywater keeps it out of sewer or septic systems, thereby reducing the chance that it will pollute local water bodies. Reusing greywater for irrigation reconnects urban residents and their gardens and landscapes to the natural water cycle.

11.6. Water recycling, reuse, and brackish water demineralization

Water reuse, also called reclaimed or recycled water, refers to the process of treating and reusing wastewater for beneficial purposes. Potential uses include agriculture and landscape irrigation, industrial processing and cooling, dust control, watering golf courses and parks, and replenishing groundwater basins. Utah has limited reuse projects, but they could save higher quality existing supplies. Also, Utah has brackish water that is not being considered as water supply. Improved technology and declining costs of treating brackish water make it a possible solution. With supplies of clean water becoming scarce in certain areas, reusing or treating brackish water may be considered as a new supply.

The foregoing water reuse projects provide secondary water for outdoor irrigation uses. However, some limited reuse projects in the United States, and worldwide, provide re-purified water for potable uses. When treatment technologies are the only barrier between wastewater and the re-purified reused water for potable purposes, the approach is known as “direct potable water reuse.” When an additional barrier beyond treatment technology is used, such as first releasing treated wastewater into in a surface water or groundwater source, the concept is termed “indirect potable water reuse.”

11.7. Fragmentation of water resources science, administration, and management

Water resources are an important but singular domain within natural resources as a whole, which include land, air, plants, animals, and other resources. The field of water resources itself involves many scientific disciplines, administrative agencies, and management entities. Water sciences are spread across different disciplines, subspecialties, professional societies, and university campuses and units. Water administration and management involve agencies at local, regional, state, tribal, and federal levels. In addition, various agencies have different administrative tasks, such as researching and overseeing climate and weather, water quality, water supply, water rights, water delivery, or wastewater and stormwater removal. They often have responsibilities over different parts of the hydrologic cycle, such as climate, surface water, groundwater, lakes, and wetlands. While fragmentation related to specialization is needed to addresses various aspects of water and other natural resources, it can be problematic in meeting the need to address today’s integrated water challenges. Decisions and actions require better integration within water resources and with other domains of natural resources in order to take into account whole watershed or wider regional perspectives.

11.8. Water measurement improvements and communication

Most secondary water systems in Utah do not have water meters for end users. This is because the technology for meters until recent years has not allowed for untreated secondary water due in part to particles that can clog rotating meter elements. Technology advances provide an opportunity for

important metering of secondary water systems, with the potential of diminishing use per person or per acre.

New technology provides additional opportunities for potable water measuring. For example, Advanced Metering Infrastructure (AMI) allows for near real-time communication of meter measurements. This provides for better price signaling to water consumers. It also provides a tool that can be used by water consumers to decide, on an ongoing basis, how much water to use at their homes or businesses, especially on their outdoor landscapes.

AMI data also allow for improved communication with water users regarding water measurement. Water measurements can be shown for finer time scales, such as daily, thus informing water users on how they can improve or optimize outdoor irrigation. It also allows for social norming by sharing peer water usage data with water users.

11.9. Availability, transparency, and integration of water data

Most Utahns are aware of the need to conserve and are motivated to do so, but they want and need better water use information to track their own water use over time. Regional data, generated at the local level and compiled from systems files, has been tracked for decades. Timely publication of high-quality data is necessary to help Utahns assess use and track changes in their water habits and progress toward conservation goals. Additionally, high-quality, timely data is necessary for planning, decision-making, and funding processes. Unfortunately, water data variability has historically been an obstacle in public education and community planning processes.

Increasingly, the world is driven by data. Because data is readily available, it is glaringly obvious when reliable data is difficult to find or obtain. Data from water systems is used by four levels of the public: individual users regarding their own use (local); water systems regarding ability of the system to meet the needs within its service area (regional); state agencies and legislators regarding legal compliance and planning (state); and water associations, agencies, and legislators regarding state-to-state comparisons, innovations, and implementing lessons learned (national). Presently, data varies from year to year and system to system in quality and availability.

11.10. Optimization of water operations

Automation of diversion structures, real-time water measurement, and data collection are examples of water operations optimization currently being implemented in Utah. An example of the benefit that automation provides to a water user is a diversion gate opening tied to a forebay elevation through computerized logic software. As the forebay elevation rises due to diurnal fluctuations in the river flow, the diversion gate opens or closes accordingly, consistent with the water right of the water user, thus conserving water.

Data and analytics software allows water managers to make decisions with better information than in the past. A decision support system (DSS) is a computer-based information system that assists a user in optimizing the decision-making process. A dynamic DSS incorporates a variable, real-time component into the process. Computers can now process vast amounts of information and create organized datasets that make the information much easier to understand. The water and wastewater industries have for many years used DSSs in the planning, design, and operation of treatment processes. DSS technology is also used for agriculture and irrigation water management. As technology continues to

improve and large amounts of data can be processed and refined, better decisions can be made using this information. A challenge may be the cost of such systems and the water users' ability to afford it.

11.11. Water distribution system losses

Water losses are one component of "non-revenue water" and an issue in need of greater attention. Non-revenue water includes elements that do not involve physical loss of water from pipeline systems, such as meter inaccuracies. Water losses can also be actual water placed in a water distribution system that is lost through leakage from pipes and valves. This water returns to underground or surface water systems and may form return flow to natural systems. Many water distribution systems experience water losses greater than ten percent.

A water loss control program can help any water system with minimizing water losses. Water audits help identify locations and volumes of water losses in public water systems. Water audits often can be the first step in a series of steps for controlling water loss. After identifying locations of losses, the next step involves physical replacement of pipeline segments or lining of pipelines and valves.

11.12. Funding for development, implementation, and education in water science

In order to help Utah address the water challenges that lie ahead, funding is needed for development, implementation, and education in interdisciplinary water sciences and engineering. As in the past, people count on discoveries and innovations in science and technology to provide answers and alternatives to address the dilemmas Utah faces, but financial support for these efforts is needed. Applied science and experimentation is where effective assessment and implementation of new approaches occurs. Support is needed for scientists, managers, and users to collaborate on seeing what works and doesn't work and how to make things work better and in different contexts. Since this state water strategy seeks to look 50 years into the future, Utah needs to be educating and training the next generation of water scientists, engineers, and managers. State officials and water professionals also need to be educating the general population about water and the role everyone can play in helping to sustain clean, sufficient supplies to meet future needs.

11.13. Quantifying water supply and sustainability

Quantifying water supply is complicated and variable depending on climate and geology. Utah's underground geology complicates water management decisions, particularly the interaction between ground and surface water. This translates into uncertainty of groundwater availability and aquifer behavior. The Division of Water Rights regulates the use of surface water and groundwater in Utah but cannot do its job effectively in the absence of good information about the resources and how withdrawals and natural processes affect it.

Recommendations

11.1. Conduct and assess new water conservation programs and initiatives.

Innovations in water demand management science and technologies are improving monitoring and data management, efficiency, treatment, and infrastructure of water systems. Of all the developments in water sustainability, these demand management innovations may have the greatest potential in moving toward a sustainable and resilient water future. Larger water utilities are already developing water accounting systems, aided by cloud computing and wireless technologies that ease data input. Smart

water grid systems can track, monitor, and manage systems in near-real time, identifying leaks and encouraging people to use water more efficiently. New data gathering and management capabilities provide the foundation for sophisticated water budget rate structures that establish and track water usage budgets for individual properties (homes, businesses, agriculture, and institutions). These budgets are based on separate criteria for indoor and outdoor water need. For example, in residential use, a single-family home's indoor water budget is based on the number of residents and a target allocation of gallons per person per day; its outdoor budget is based on irrigable area and the local weather (evapotranspiration rate of irrigated plants in the microclimate). Obtaining this data requires an initial investment in customer and land surveys, metering of indoor and outdoor water use, billing system software upgrades, and public education. Agencies have found that the investment to measure water use efficiency is quickly returned, and the system generates new funding for additional conservation programs paid only by those who wastewater. Research shows people use less water if they know what they need and how much they are using. Utah needs to expand, implement and assess the effectiveness of new approaches such as these in water demand science and management. Water conservation programs and initiatives need to be implemented and expanded based upon these water demand science innovations.

11.2. Pilot test and demonstrate water treatment technologies and processes.

In the past 20 years, there has been a rapid entry of new technologies that continue to be developed, tested, and demonstrated. A standard protocol and proof standards need to be developed in order to shorten the period between technology development and introduction into the municipal water treatment market. Three examples of emerging technologies are membrane filtration, reverse osmosis (RO), and ultraviolet (UV) irradiation.

Stakeholders need to collaborate with research and regulatory communities to investigate new treatment applications, including advanced oxidation processes (AOP), ion exchange, and biological filtration. Combining technologies in series to address different contaminant issues needs to be included in the research, pilot test, and demonstration stages. As new technologies emerge, applications to water treatment and system optimization should be investigated.

Models can replicate the generation of pollutants and their movement across land and through rivers, lakes, and streams. Models also show the impact of various water strategies on the flows in rivers and on downstream users. Models need to be developed or adapted to predict contaminate loading and transport in river systems and hydrologic basins. Typical conditions need to be determined as screening criteria to identify areas where modeling may be effective when looking at total maximum daily loads (TMDLs) in a system. Utah should identify test river systems or hydrologic basins to evaluate using conservation of mass analysis to demonstrate benefits that may be derived from modeling.

11.3. Explore technology's effect on agricultural water usage.

Efficient application of agricultural water is an important way to optimize the use of water in the future. Several technologies have been developed recently that improve irrigation efficiency regardless of crop type. For example, subsurface drip irrigation systems minimize the amount of water lost due to evaporation and runoff by being buried directly beneath the soil surface and applying water directly to the root zone. Real-time weather monitoring and soil moisture sensors are emerging technologies that can potentially help improve the scheduling of irrigation. Efficient irrigation water transport and use of reclaimed water can also lead to more efficient agricultural water use. Finding ways to adopt these new

technologies broadly should help stretch existing water supplies, enhance efficiency on working agricultural lands, and increase agricultural production.

In order to enhance agriculture's ability to achieve increased water quality, program activities must include 1) educating landowners about laws and regulations concerning clean water and their impacts on downstream users, 2) working with individual landowners to identify existing and potential point and non-point source problems, 3) coordinating technical expertise to solve problems, 4) coordinating funding sources for projects, and 5) establishing demonstration projects.

11.4. Improve working relationships between regulatory agencies and water providers.

As drinking water regulations expand, compliance is often required without opportunities for minimizing expense or technology. However, technology can streamline the collection and analysis of water samples. Some discretion exists at the State Division of Drinking Water level for compliance with federal unregulated contaminate monitoring rules. Additional discretion can be applied in timing and grouping of water samples collected. Some laboratory services are available or can be made available through new technology at state laboratories. These benefits should be sought through relationships with the Division of Drinking Water and with county health departments.

11.5. Explore green infrastructure and greywater projects.

Where appropriate and cost effective, opportunities to design, test, and implement various design features of green infrastructure should be sought. Green infrastructure incorporates both the natural environment and engineered systems to provide clean water, conserve ecosystem values and functions, and provide a wide array of benefits to people and wildlife.

Green infrastructure solutions can be applied on different scales, from the house or building level to the broader landscape level. On the local level, green infrastructure practices include rain gardens, permeable pavements, green roofs, infiltration planters, trees and tree boxes, and rainwater harvesting systems. At the largest scale, the preservation and restoration of natural landscapes (such as forests, floodplains, and wetlands) are critical components of green infrastructure.

The easiest way to use greywater is to pipe it directly from indoors to outside and use it to water ornamental plants or fruit trees. Greywater can also be used to irrigate vegetable plants as long as it doesn't touch edible parts of the plants. In any greywater system, it is essential to use "plant friendly" products, those without salts, boron, or chlorine bleach. The build-up of salts and boron in the soil can damage plants. Greywater should be assessed and designed for feasibility and compatibility with the health and safety objectives and requirements of local water provision.

11.6. Innovate wastewater treatment and reuse projects.

On most water systems in Utah, the water is reused many times as it travels down the river. Water that is not consumed by one user is returned to the natural system and is diverted by another user downstream. There are additional opportunities statewide to implement reuse projects on water that would otherwise not be used. Reuse projects are limited currently because of the following factors:

i. Available water supply that is not already allocated is limited.

ii. The cost of sources of water, other than treated wastewater effluent, has been cheaper than treating water to reuse standards and delivering it to where it can be used.

iii. Utah laws require agreement from the water right holders of the treated water before reuse is authorized, which may be difficult to accomplish.

To support reuse, Utah should establish goals and explore modifications to state statues that will facilitate the permitting process.

11.7. Increase integrated water management across all sectors.

Increased integration across water sectors, agencies, and areas of expertise must occur to deal with administrative and scientific fragmentation of water resource management. One avenue for this integration is through implementation of the concept and approach of integrated water resources management (IWRM), which has been promoted by various professional associations within the water community. IWRM promotes integration across academic disciplines and across agency boundaries, and collaboration among water professionals, stakeholder groups, and the general public. Management contexts are where the sciences and policy dimensions of water meet, and facilitating the integration of information, knowledge, models, and perspectives in these contexts needs to occur. Integration across the scientific and management domains related to water quantity and water quality is particularly important. Another important realm needing integration is between climate and hydrological sciences. Integration is important for meeting multiple objectives that provide local and statewide benefits from water resource management and protection. Promoting integration requires dedicated resources, particularly financial support, facilitation expertise, and time commitment by participants.

11.8. Improve the quality of water data collected and reported.

Potable water meter and communication systems will be an important technological advancement for water systems. It is recommended that each water system work toward installation of an AMI system for metering water to their end users. The near real-time meter signals should be made available to the end users, through web applications or other means. It is recommended that each water system provide periodic water bills that are filled with useful information on daily water use and comparisons with efficient water use.

New technology will allow for better measurement and reporting of water use in cities and water systems. Utah requires reporting from these systems on water use annually to the Division of Water Rights. This information is then used by the Divisions of Drinking Water and Water Resources. Cities and water systems should provide increased expert staffing time, together with technology, to provide compiled end user water use data. This “net metering” will provide improved and more accurate water use information to Utah’s administrative water divisions.

Water systems that provide secondary water should each perform pilot testing and demonstration project efforts for new technology secondary water meters. When successful, these meters should be installed for each end user. This metering will allow for reporting of actual use compared with efficient use or even volumetric billing through user charges. Experience has shown that either of these actions will substantially reduce per capita water use.

11.9. Make water data more accessible to the public.

Specific, interpreted individual user information is necessary to allow the end users to make informed decisions about their water use. Establish policies that encourage water agencies to update metering and reporting systems to make specific, real-time information available to the end user. As Automatic Meter Reading (AMR) devices become more sophisticated, Advanced Metering Infrastructure (AMI) and

Advanced Metering Analytics (AMA) systems will be able to provide real-time water use at all types of individual connections (residential, commercial, industrial and institutional).

Financing assistance should be made available to build and start-up new system infrastructure necessary to operate AMA and AMI systems. Common communication devices (smartphones, tablet devices, as well as computers) should be integrated for account access, allowing users convenient access to user data. The investigation of new communication and reporting technologies for application in the water system operations should be encouraged.

Water systems should be encouraged to use real-time notification features of AMA systems to set effective signals and social norming with water bills and websites. A template that can be used by water systems to develop the notification system should be developed. Cooperative efforts between water systems to shorten the development and implementation phases of reporting activities should be encouraged.

State water agencies should coordinate to provide a comprehensive depository for regional and statewide data that is accessible to the public. The depository should be validated for official planning and reporting use and be available to the public. The standard for acceptable data submission by water systems to improve quality of data reported in the depository should also be raised, and further encouragement of quality data through training, assistance, and penalties is needed.

11.10. Optimize water operations with automation.

Water operations have become increasingly more efficient through the automation of water measurement and data collection. However, greater efficiencies can be obtained by expanding the number of systems and processes that are automated. Many of Utah's larger water districts and irrigation companies have automated their water measurement and data collection, and some have the ability to remotely monitor and control their facilities on a real-time basis. The Division of Water Resources and the U.S. Bureau of Reclamation have assisted some smaller water organizations in funding automation projects, but it is likely the majority of Utah irrigation systems do not have automation. Reliable data is essential for better water management to meet Utah's future water needs and to understand where the water is currently being used. All water systems can be optimized through better water measurement, data collection, and reporting. It is recommended that real-time measurement and data collection be obtained on all systems large and small throughout Utah.

Optimization of water operations includes energy conservation. Water utilities should seek to optimize energy savings for treatment or pumping through analysis of peak energy usage and modify operations accordingly. Agricultural water users should seek to improve their operations through optimizing water delivery systems for the specific crop type and local soil type.

Dynamic decision support systems can be valuable tools in water management, and research in this area should be pursued to improve water management decision-making and further optimize water system operations. Water use information should be obtained from all water systems and this data should be analyzed to inform policymakers as they make decisions regarding Utah's water.

11.11. Minimize water distribution system losses.

Physical losses of water from pipe systems constitute an inefficiency that requires development, treatment, and delivery of increased water supplies to meet end user requirements. For example, a

system that loses 20 percent of the water conveyed in its pipe distribution system must develop, treat, and convey at least 20 percent more water supply into its system.

Many physical losses occur because of aging pipe infrastructure that develops leaks. Each water system should develop an asset management plan for dealing with its aging infrastructure. Each system should actively monitor for leaks, perform water audits, conduct leak detection with new technology, and replace or line sections of pipe that are found to be leaking.

11.12. Invest financial resources in science, technology, and education.

Utah has long been an international leader in irrigation and arid land science/engineering, and currently has highly qualified, very diversified, and widely renowned expertise in a broad range of water sciences among its academic institutions, private industry, and management agencies. These experts are often hired to work on water projects throughout the western United States and all over the world. Utah must increase its financial investments in water-related sciences, technology, and education to not only use this expertise to address its own water challenges but also to maintain its leading edge internationally and expand economic opportunities for the State. These investments should include support for basic and applied research, technological advances, university Extension activities, and water education in K-12 as well as university and continuing education settings. Public sector funding must be encouraged, but private investments and partnerships can also be used to leverage limited financial resources and propel new discovery, innovation, and learning in water.

11.13. Improve understanding of the geology and quantity of water in Utah.

State and local water agencies should continue to collect and analyze data to improve the understanding of available water supply, quantify the safe yield of underground water basins, and better understand the interactions between ground and surface water. Funding for data collection is recommended to be continued and improved. Data needed to be collected includes surface stream flow records, diversion records, groundwater levels, well withdrawal estimates, geologic well logs, evapotranspiration estimates, and groundwater recharge estimates. In cooperation, both state and local water agencies should collect, analyze and study water data and compile the data into surface water and groundwater models to better understand our complex water systems.

Appendices

APPENDIX A: WATER STRATEGY ADVISORY TEAM

Co-chairs

TAGE FLINT
Weber Basin Water Conservancy District

TIM HAWKES
Great Salt Lake Brine Shrimp Cooperative, Inc. & Utah House of Representatives

WARREN PETERSON
Farmland Reserve Inc.

Members

Tom Adams
Utah Governor's Office of Outdoor Recreation

Walt Baker
Utah Division of Water Quality

Richard Bay
Jordan Valley Water Conservancy District

Todd Bingham
Utah Manufacturers Association

Joel Briscoe
Utah House of Representatives

Sterling Brown
Utah Farm Bureau

Charley Bulletts
Paiute Indian Tribe of Utah

Steve Clyde
Clyde Snow Attorneys at Law

Lynn de Freitas
Friends of Great Salt Lake

Joan DeGiorgio
The Nature Conservancy, Utah Chapter

Keith Denos
Provo River Water Users Association

Stephanie Duer
Salt Lake City Public Utilities

Joanna Endter-Wada
Utah State University

Steve Erickson
Great Basin Water Network

Bob Fotheringham
Cache County Water Manager

Robert Gillies
State Climatologist

Keith Grover
State Representative

Scott Jenkins
Utah Senate

Kent Jones
State Engineer

Voneene Jorgensen
Bear River Water Conservancy District

JT Martin
IWM Integrated

Dan McCool
University of Utah

Eric Millis
Division of Water Resources

Leland Myers
Central Davis Sewer District

Ralph Okerlund
Utah Senate

Shane Pace
Sandy City Public Utilities

Dale Pierson
Rural Water Association of Utah

Wayne Pullan
Bureau of Reclamation

Gene Shawcroft
Central Utah Water Conservancy District

Gawain Snow
Uintah Water Conservancy District

Mark Sovine
Grand County Water and Sewer District

Mark Stratford
Utah League of Cities and Towns

Ron Thompson
Washington County Water Conservancy District

Jane Whalen
Conserve Southwest Utah

Jody Williams
Holland and Hart

APPENDIX B: SUMMARY OF PUBLIC LISTENING SESSIONS

Utah's Water Future

Developing a 50-Year Water Strategy for Utah

Summary of Public Listening Sessions

October 2013

Introduction

Water is a precious resource, especially in an arid and fast-growing state like Utah. It is a key driver of our economy. It grows our food. It serves our quality of life. It sustains the beauty and health of our natural world. It is essential to life itself.

Utah's future depends on sound water management. Recognizing this, Governor Gary R. Herbert has directed the State to develop a 50-Year Water Strategy for Utah. This strategy will define priorities, inform water policy, and chart a path to maintaining and constructing needed infrastructure. In short, it will help us meet our long-term water needs without breaking the bank or drying up our streams.

Because we all use and value water, we all have a stake in this strategy. Extensive public input will guide the process. As a first step, the State held eight listening sessions around Utah this summer and gathered nearly 800 comments in person and online. Hundreds of Utahns shared their vision for Utah's water future and ideas for addressing our water challenges, laying a solid foundation for next steps in the strategy-development process. As we continue the process, there will be further opportunities for meaningful public involvement.

An independent working group of six Utahns with extensive background in water issues generously volunteered significant time to assist with the listening sessions:

Tage Flint, Weber Basin Water Conservancy District
Timothy Hawkes, Trout Unlimited
Voneene Jorgensen, Bear River Water Conservancy District
Bob Morgan, former State Engineer Warren Peterson,
Farmland Reserve, Inc.
Dennis Strong, Division of Water Resources

These individuals attended the listening sessions and met with key stakeholders and interested residents to answer questions and capture their comments and ideas. In addition, they reviewed all of the comments submitted online.

The papers that follow are summaries, prepared by the working group, of the listening sessions and online comments. The papers are intended to provide a convenient way for interested parties to get a good sense of the initial public input. They are neither a complete compilation of all ideas nor a reflection of state priorities. Instead, they attempt to capture the primary themes presented by the public this summer. Those interested can review all comments and listen to recordings of the listening sessions at www.utahswater.org. By listing ideas and recommendations in these papers, the working group does not necessarily endorse these recommendations or attempt to weigh their relative merits. Importantly, the ideas listed are not the only ideas that will advance through this process. All ideas—those shared this summer and through subsequent phases of this process—will be considered as the strategydevelopment process continues.

A diverse and experienced State Water Strategy Advisory Team has been formed to oversee next steps, including gathering sound data and ideas, framing proposed approaches for additional public feedback, and developing recommendations for the 50-Year Water Strategy.

Securing Utah's Water Future: Delivery and Water Efficiency

By Tage Flint

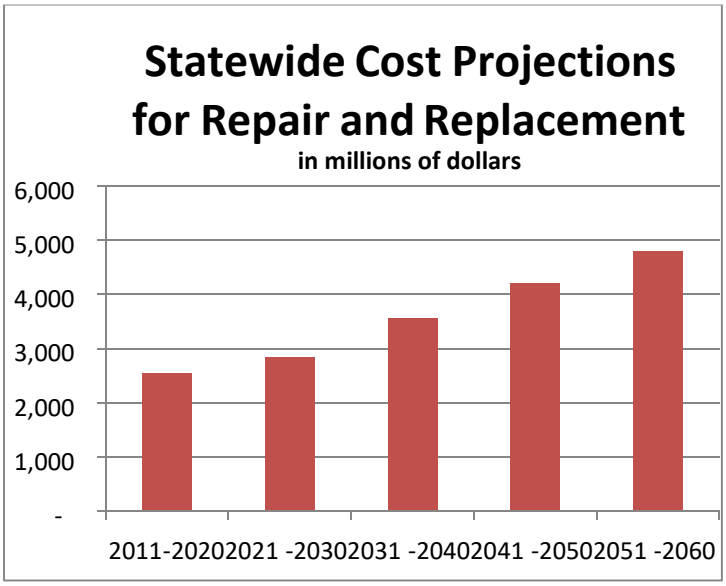
Delivery

A reliable water supply for any use is dependent upon two key factors: 1) a sufficient volume of water, and 2) a dependable infrastructure through which that water is conveyed. The two factors are mutually dependent. In Utah, delivery of water to the end user depends greatly upon the proper design, construction, maintenance, and replacement of infrastructure. With an inevitable surge in the state's population looming, significant additional conveyance facilities will be needed. Further, facilities that have already been built and are operating will need to be cared for and ultimately replaced. Recent projections for Utah infrastructure costs, calculated for each river basin, show that the repair and replacement costs for the next 50 years will equal those of constructing new infrastructure.

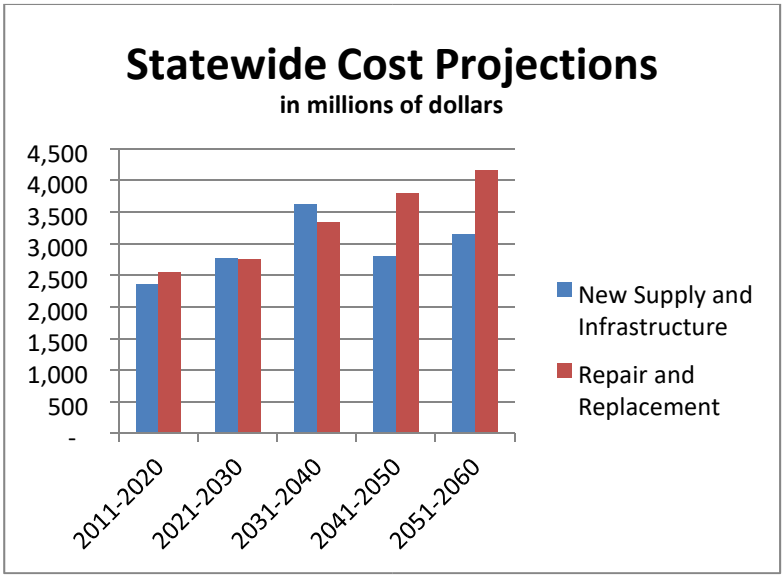
Agriculture - Some of the oldest water delivery systems in the state are those built for agricultural water supplies. They consist largely of diversion structures, canals, laterals, and pumps. Because they were built first, they are likely to need major overhaul the soonest. Undesirable effects of aging agriculture conveyance systems include loss of efficiency, higher operation costs, loss of crops, and higher liability in growing urban settings. Repair and replacement costs are high and very difficult to cover by mutual irrigation companies, irrigation districts and the like, all of which derive their funds from the users of the system. Generally, farmers find it difficult to generate infrastructure replacement funds because they operate on relatively small profit margins. Federal assistant programs are waning, and loan assistance from the Utah Division of Water Resources may not be enough in every case to make replacement affordable. As will be discussed later, most projects to restore agriculture infrastructure will require funding aid that may be generated from the restored facilities being more efficient than the preceding system.

Municipal - Because the vast majority of Utah's residents live in urban or semi-urban settings, dependence on reliable municipal transmission and distribution systems is growing rapidly. These are complex and expensive systems that are largely underground or otherwise invisible to the general public. Assuming sufficient water supplies are available, the amount of infrastructure needed to supply an urban population that is projected to double in 45 years is staggering. A typical urban water supply system consists of many components, including pipelines, treatment plants, wells, reservoirs, pump stations, meters, valves, pressure control stations, chemical feed stations, and much more. The engineered lives of these components vary; however, the generally accepted average for urban infrastructure is 50 years. Much of the Wasatch Front urban water infrastructure was built starting in the1940s until the present. Consequently, it is now experiencing the first period of large-scale replacement needs. In fact, water purveyors are now dealing with the reality that over the next 50 years, replacement costs will rival new capacity

construction costs. The aforementioned compilations of costs and demands indicate that the statewide costs for repair and replacement of existing infrastructure will exceed $16 billion between now and 2060. The chart below shows the anticipated municipal water expenses per each decade.



The chart below further illustrates the point that repair and replacement costs for existing municipal water delivery systems will equal or exceed the costs of new facilities, which are projected to be nearly $15 billion.



Water Efficiency

Because water is scarcer in some areas of Utah than formerly, and additional water needs are projected throughout the State, the efficiency of the water conveyance system in Utah is under scrutiny. Discussion topics include water conservation programs, canal and other pipeline enhancement projects, and use conversions. Water agencies and companies are aware of the need for additional efficiencies in delivering their product, and most of them have already implemented methods and systems to increase them. Nonetheless, these projects must be implemented before and concurrently with developing new water sources. In fact, a high level of efficiency should be obtained in each river basin before these projects are completed in order to transfer new water sources to high-demand areas.

Agriculture – In Utah, the vast majority of water is used for agricultural production. Agricultural efficiency projects tend to be relatively expensive to the user and involve complications and implications related to water rights. A typical agricultural efficiency project may be, for instance, converting flood to pressurized sprinkler irrigation. This has been accomplished statewide in areas where subsidized government funding was available, or where it otherwise made financial sense. In some cases, farmers can, in fact, benefit greatly by converting to a more efficient irrigation system.

Water efficiency projects in an agricultural setting are not always allowed−nor should they be− due to water rights restrictions. Most streams in Utah have appropriators who rely heavily upon the return flow from irrigated crops upstream to make up part or all of their water right. For this reason, some efficiency projects that allow for more efficient application of water to the same acreage, or otherwise expand irrigated acreage, will likely affect downstream appropriators negatively. Other types of efficiency projects, such as repairing leaking canals and pipelines, should be pursued, however.

Likewise, because of high expenses and water rights issues, large canal lining projects that would help save water may also be difficult. As mentioned above, such projects are typically prohibitively expensive for small farmers who commonly are the stockholders in water companies. Due to the high costs, the owner company will frequently seek a market for the saved water as a means to supplement the expense of such a project. Since all water savings will not be directly marketable−as the original rights are often tied to a duty acreage and return flow obligation−a careful water rights analysis is required. *Municipal* – At least two-thirds of urban water in Utah is used to water lawns and gardens.

Therefore, efficiency in the municipal settings is commonly equated with conserving water. Highlights of the State's water conservation efforts include constructing demonstration gardens, establishing irrigation system evaluation programs, amending city ordinances on water use and pricing, developing the first secondary system metering program, and modifying many retailers' pricing structures to discourage over-use. Indeed, since new indoor plumbing codes were

implemented, future municipal water savings will be achieved primarily through more efficient outdoor applications.
Additionally, Utah water and governmental agencies developed a statewide public education program and school-age education curricula. Happily, Utah residents have responded well to the increased education and conservation efforts. The per capita water use in urban areas has been reduced at least 15% during the past two decades. Moreover, the governor has modified the state's goal of 25% per capita reduction by the year 2050, to 25% reduction by 2025.

Noting our progress, existing and future urban residents still need to save more outdoor water. Areas of urban water efficiency that may be improved include installing more efficient residential and commercial irrigation systems, consumers being more accountable for secondary service, increasing further public exposure to and acceptance of education concepts, and gaining wider public acceptance and approval of water-efficient landscapes. Currently, most Utahns oppose adopting extreme arid landscape practices. Accordingly, the general approach by agencies has been a more acceptable form of green space landscape that is still significantly more water efficient than traditional landscaping.

Summary of Public Input

The following catalogs list general themes of the comments received from the public on the topic of "Delivery and Water Efficiency." The comments seemed to differ markedly in tenor and subject matter based on the geographical locations of the panel meetings.

Comments from Rural Locations

- The state needs better ideas on how to afford canal lining and piping projects. Most areas have canals that are seeping substantial amounts of water through their banks. Water companies are struggling to generate enough funds to pay for such improvements. Companies should be able to sell the water that is saved through these projects to help fund the efficiency improvement projects.

- The federal government showed foresight in financing and developing water storage projects in the past. In the absence of future federal funds, the state needs to take up this responsibility.

- The agricultural community needs to be more efficient in applying water and cultivate the correct crops for the geographical area.

- Water law should be altered in order to allow the saved water to benefit those who are paying for the efficiency projects.

- The state should match federal funds that pay for water quality enhancement programs, such as animal feeding operation cleanup.

- If agricultural water is to be converted to municipal water, a fair market price ought to be paid to the original owner of the water right.

- We must be cautious when lining canals, so the river system does not suffer from lack of return flows.

- SCADA systems make irrigation systems much more efficient. The cost can be recovered within a few years.

- If the climate does change, more water storage will be needed, not less. Accordingly, we need to plan and build new storage reservoirs throughout the state.

- Agricultural water supplies should continue to be subsidized in order to keep the cost of food down.

- There needs to be more resolution with the Native American tribes in Utah, so water that runs across their land is more efficiently used.

- A survival mode for cities is not enough; they need to grow.

Comments from Urban Locations

- The governor's goal of 25% savings from water conservation by 2025 should be mandatory.

- Secondary systems should be metered. Even though the cost will be high, the amount of water saved by metering will justify the expense.

- There should be alternatives to sod covering most of the area in yards. A water budget ought to be applied to each yard.

- Climate control irrigation systems should be mandatory in all outdoor application systems.

- The shallow groundwater table is not being used in urban settings.

- Transporting snow and piping water from remote river basins that experience frequent flooding should be considered.

- Water systems operations should take full advantage of thermo heat, solar energy, and wind energy.

- Water-saving landscape concepts, such as Xeriscaping, should be implemented in all the yards throughout the State.

- Residents should be fined for overwatering their yards.

- If the population is going to grow as projected, the State should set aside significant funds to finance large water projects.

- Education programs should be enhanced to teach residents how to use less water.

- Water systems should include small hydroelectric generation stations in places where the elevation changes significantly.

- Established cities should be able to turn back some contracted wholesale water once it has shown that it will never be needed.

- Efficient conversion of agricultural water to urban water should be promoted as development occurs.

- Re-use projects from waste water plants should be built for the irrigation of large landscapes.

- Homes should use gray water collection systems for watering yards.

- Many more aquifer storage projects should be built in order to help store new water supplies. The permitting process for these projects should be streamlined; however, water quality should be protected.

- Residents should be able to use as much water on their landscapes as they choose, as long as they are willing to pay for it. Utahns should be able to have the size of yard they wish without someone telling them how to do it.

- Water rates should be structured with steps that are increasing in cost.

- Good water infrastructure and sufficient water supplies are paramount to maintaining the economic viability of our communities.

- Water project funding should be on par with funding of roads in the State of Utah.

- Most attention should be focused on outdoor water conservation. The majority of water is consumed outdoors on lawns and gardens.

- State and other governmental agencies should be a better example of water conservation.

- Stressing a landscape too much requires more water to recover it.

- Tiered retail water rates do not seem to impact water use much. The high water users do not seem to care; they will just pay for it.

- The governor should make water delivery systems one of his top priorities.

- Conservation will not happen on a large scale as long as it is voluntary.

- Instantaneous hot water heaters should be mandatory so that water is not wasted waiting for hot water to arrive at the tap.

- Landscape irrigation systems need to be much more efficient. Currently, most systems are less than 50% efficient.

- Cities need to do much better zoning residential areas, so that large lots are not using high amounts of water.

- The use of our rivers would be more efficient, if there were more storage facilities.

Project Specific Comments

- Large water projects need to be built if the state is going to stay healthy economically.

- Negotiations with Southern Nevada Water Authority should be held to allow Snake Valley water to go to Washington County and the Lake Powell portion to Las Vegas.

- More water conservation should occur before the Lake Powell Pipeline is built. We are willing to pay more for water than more for the Lake Powell Pipeline.

- The Lake Powell Pipeline will encourage more growth with its related problems. Would prefer to limit the growth.

- Water efficiency will only go so far in Washington County, and if we expect to be prosperous, the Lake Powell Pipeline must be built.

- The residents of the entire Wasatch front should be much more water-conservation minded. If they were, Bear River project could be delayed significantly.

- If we do not start to fund and construct the Bear River Project now, we will experience a water crisis in northern Utah in the future.

- The CUP should complete the projects that were originally intended and not leave small communities out.

- The CUP should be funded by the federal government as programmed.

Recommendations Based on Public Input

The public meetings held throughout Utah during the summer 2013 by a panel appointed by Governor Herbert were significant because they provided an opportunity for Utah residents to voice their views on water issues affecting the State. The following is a summary of issues regarding “Delivery and Water Efficiency” that are worthy of further consideration as the 50Year Water Strategy proceeds:

- Water delivery infrastructure repair and replacement costs will be extremely high over the next 50 years and careful consideration is needed as to how they will be funded. In the anticipated absence of federal commitment and funding for water infrastructure and efficiency projects, the state and local agencies will largely shoulder the financial burden going forward. A comprehensive funding plan will need to be developed and adopted presently.

- Even though we have made considerable progress in conserving water, Utah residents should be encouraged through various methods and programs to use water even more efficiently. The emphasis should be on urban outdoor use and agricultural applications.

- Better planning is required for the interface zones between urban development and agricultural lands, so that water delivery systems for both uses coexist. Once an agricultural landowner decides to develop the land, policies should be in place for a smoother transition from the historical water use to the next use on the same land.

- Technology and other innovations, including better irrigation equipment and applications in both the urban outdoor and agricultural settings, should be explored and implemented to enhance water efficiency.

Securing Utah's Water Future: Recreation & the Environment

By Timothy Hawkes

Issue Overview

Since the Mormon Pioneers first arrived in the Salt Lake Valley, Utah residents have recognized the value of water for recreation and the environment. An avid outdoorsman, early apostle and eventual Church President Wilford Woodruff brought a split cane fly rod across the Plains and used it to fish for trout in Utah's mountain streams. Not above fishing on Sundays, Brother Woodruff often dreamed of catching fish, even when he wasn't actively pursuing them.[27] Beyond its value for recreation, however, many recognized an obligation to preserve the natural environment grounded in the principle of stewardship and described in decidedly spiritual terms: "You are here commencing anew," taught Brigham Young. "The soil, the air, the water are all pure and healthy. Do not suffer them to become polluted with wickedness."[28] Likewise, he said, "Let me love the world as He loves it, to make it beautiful, and glorify the name of my Father in Heaven. It does not matter whether I or anybody else owns it, if we only work to beautify it and make it glorious, it is all right."[29]

Some of the first territorial laws involved restricting the harvest of native Bonneville cutthroat trout and June sucker from Utah Lake, actions grounded not only in stewardship, but an instinct for self-preservation, as the settlers realized that eliminating an entire spawning run of fish would leave no fish to harvest in subsequent years. Those values and traditions continue today, and inform Utah's efforts to promote environmental and recreational uses for water under a water allocation system not designed with such uses in mind.

Like many Western States, Utah ultimately adopted the Prior Appropriation Doctrine as a way to allocate scarce water resources in an efficient and predictable way. To perfect a water right under that doctrine, a water user must, first, physically divert water out of the natural stream channel, and, second, put it to "beneficial use," a term historically understood to include water for human or livestock consumption, crop irrigation, mining, and industry (including power generation), but not uses such as "recreation" or "preserving the environment." Tension between those uses and the Prior Appropriation Doctrine are inevitable, as environmental and recreational uses typically involve leaving water instream (failing the first requirement), and putting it to a use that may not be recognized as "beneficial" (failing the second requirement).

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[27] Phil Murdock and Fred E. Woods, *I Dreamed of Ketching Fish: The Outdoor Life of Wilford Woodruff*, BYU Studies 37, no. 4 (1997-1998).

[28] Hugh Nibley and Shirley S. Ricks, *Brigham Young Challenges the Saints,* in The Collected Works of Hugh Nibley, Vol. 13 (1994).

[29] *Id.*

As long as Utah's population remained relatively small and its water resources relatively abundant, those tensions, by and large, remained hidden. This situation began to change, however, as Utah's population and economy grew to the point that many Utah streams became over-appropriated. In other words, claims to the water exceeded the total amount of water available. From an angler's perspective, a reduced stream flow and fewer fish is one thing, a dry stream bed with no fish is something else entirely. That kind of conflict—where the recreational and environmental value of a stream is reduced to zero—eventually spurred changes to the law. In 1986, the Utah Legislature passed a bill that allowed the Utah Division of Wildlife Resources and the Utah Department of Parks & Recreation to acquire and hold instream flow rights under certain circumstances.[30] While the statutory definition of "beneficial use" remained unchanged, as a practical matter, the State of Utah began recognizing "instream flows," water left instream for a specific environmental or recreational purpose, as a beneficial use from that point on. That law was amended in 2008 and again in 2013 to allow private, non-profit fishing groups to lease water to protect or restore stream flows for fish.

While few Utah residents understand the complexities or limitations of water law, observations submitted as part of the public commenting process confirm that Utahns continue to place a high value on environmental and recreational uses of water, and, further, that they want to see those uses valued, recognized, and protected, at least in some form. After all, water left instream or in a natural lake or impoundment provide recreational opportunities—fishing, boating, skiing, swimming, hunting, wildlife viewing—enjoyed by nearly all Utah residents. Instream water is vital, not only to our quality of life, but to an economy in which tourism and outdoor recreation play an increasingly important role. Water also enhances other outdoor experiences, like hiking and camping. Moreover, it increases property values to the point where a river-front property (or a property with a natural stream) can easily sell for double or even triple the price of a neighboring parcel without access to a similar water resource.

Holders of traditional, consumptive water rights have often viewed environmental or recreational uses of water as competition at best, a dire threat at worst. These fears have been validated in some instances by heavy-handed application of federal laws, such as the Endangered Species Act. Increasingly, however, more collaborative examples are emerging. In Montana, for instance, angling groups recently partnered with agricultural users to push for legislation that would better regulate exempt groundwater wells, which threaten both senior agricultural water rights and late season stream flows for trout.[31] Closer to home, environmental and recreational users have

[30] *See* Utah Code Ann. § 73-3-30.

[31] *See, e.g.*, Terri Adams, "Ground and Surface Water Rights Involved in Legislation," *The Prairie Star*, 5 Feb. 2010 (retrieved on October 4, 2013 at http://m.theprairiestar.com/news/local/ground-and-surface-water-rights-involvedin-legislation/article_ace8b790-380a-5b76-b119-508ca0aaf350.html).

helped fund much needed upgrades to irrigation infrastructure, particularly where such upgrades benefit both the water rights holder and fish and wildlife at the same time.[32]

These examples and others show that recreational and environmental uses hold a unique potential for collaborative and mutually beneficial solutions because they are generally *nonconsumptive*, meaning that they do not use water in a way that makes it useless (or unavailable) for other purposes. So, for example, the same reservoir that holds water for cities or farms can provide a great place to take one's family to boat or fish. Similarly, water that must carry downstream to a senior water rights holder can provide vital habitat for fish and wildlife and associated opportunities for recreation. That synergy opens up plenty of opportunities for winwin solutions, solutions that necessarily reflect compromises, but do not dictate that one use prevails entirely at the expense of another.

Summary of Public Comments

Most of the public comments related to water came in the form of written comments submitted through the website and comments made during the breakout session. Relatively few comments were made at the microphone in the open forum. Although public comments relating to this subject varied considerably, they can be grouped into three broad categories:

1. Value-based, those explaining why these uses matter to people;

2. Project-specific, those expressing support for or opposition to a proposed water development project; and

3. "Other," those not-value based or project-specific.[33]

Comments advocating a specific policy change or other action will be summarized and described in the final section, which lists "Recommendations Based on Public Input."

Value-Based Comments

Many comments cite Utah's traditions and heritage. "Our Supreme Creator endowed us with these resources to be used and enjoyed," says one, "as the founder of our great state declared from the beginning." "Utah's much-admired pioneers had a water ethic for their time," says another. "We need a new water ethic for our time that acknowledges new challenges and risks." Other comments invoke the public or shared nature of the resource: "I believe everyone should have the right to lawfully use and enjoy Utah's water. I also believe it is our responsibility to not

[32] *See, e.g.*, Brett Prettyman, "Fishing: Sharing H2O to 'Grow the Flows,'" *The Salt Lake Tribune*, 27 April 2011 (retrieved on October 4, 2013 at http://www.sltrib.com/sltrib/outdoors/51657325-117/bess-bill-dahle-dave.html.csp).
[33] Of course, many comments blur the distinctions between these categories or contain elements of more than one. Even so, these broad categories provide at least a rough way to organize and group a wide range of comments.

destroy nor misuse nor excessively use these water resources. These resources will become even more precious as our population increases. To squander them would be a shame."

Still others focus on the importance of environmental and recreational uses to support a quality of life: "One of the things I love most about living in Utah is recreating in our water, whether that's fishing, rafting, swimming, or hiking. This must be preserved. It's one of the major things that makes our state great." "Not only is fishing important economically, but it is also important to our quality of life. It is one of the reasons why I (personally) and many others choose to live here." "I am a river runner. Desolation canyon on the Green is just one of the great river trips available in Utah. There is no better place on the planet." "Utah is the West's top recreational state with more diverse opportunities than any other state. Heck, our state mantra is 'Life Elevated' with a heavy emphasis on recreational activities … including fishing, rafting, and kayaking on Utah's streams and rivers."

Water clearly touches almost a spiritual chord in people and helps define a sense of place and one's attachment to that place, as illustrated by the following comments: "The first fish I caught was on the Big Cottonwood Creek near Brighton, a brook trout on a salmon egg. I was fortunate enough to fish the Provo, Weber, Green, Strawberry, and even the Jordan River to name a few. Each [is a] very special place[ ] in my heart and ha[s] allowed me to recognize the beauty and importance of protecting these rivers." "The Great Salt Lake is an international, national, and backyard treasure for waterbirds and other wildlife." "I have lived in Utah most of my life and have enjoyed the lakes and rivers as I was growing up and also enjoyed them with my children as they grew up."

Project-Specific Comments

Not surprisingly, several proposed water development projects, or commercial activities that might impair a body of water, triggered a large number of comments. Those projects include the following (listed in rough order from "most comments" to least): the Lake Powell Pipeline, the Southern Nevada Water Authority's groundwater development project in the West Desert, Blue Castle Holding's nuclear power plant near Green River, the Gooseberry Narrows Dam, the Aaron Million Pipeline that would take water from Flaming Gorge to Colorado's Front Range, and phosphate mining activities that could conceivably impair Ashley Springs, a source of culinary water for the town of Vernal. Brief descriptions of each project and a general summary of the kind of comments received follow.

The Lake Powell Pipeline proposes to pump water—part of Utah's allocation of Colorado River water—from Lake Powell and deliver it via a pipeline to St. George and other rapidly growing areas of southern Utah. Proponents contend that the project is the only feasible way to provide essential water supplies to support anticipated growth in one of the hottest and driest parts of the State. Opponents generally view the pipeline as an unaffordable, unreliable, unnecessary, and environmentally harmful boondoggle. The issue came up in almost all public comments made

during the St. George meeting and mobilized proponents and opponents alike. Although a clear majority of written comments oppose the pipeline, many of these are form letters that use identical, or nearly identical, language. Regardless of the exact number of comments for or against, public opinion in the St. George area clearly remains sharply divided on this issue.

Public comments overwhelmingly oppose a proposal by the **Southern Nevada Water Authority** to extract groundwater from deep carbonate aquifers in basins near the Utah-Nevada border. Many applaud Governor Herbert's decision to refuse to sign an agreement with Nevada that would have helped pave the way for that project to move forward.

The proposed **Nuclear Power Plant** on the Green River has a significant water rights component on account of the water needed to cool the reactors. This project drew overwhelmingly negative comments. Opposition to that project appears to have been linked to opposition to the Lake Powell Pipeline, as many of the written comments, particularly the form letter comments, oppose both.

The proposed **Gooseberry Narrows Dam** on Gooseberry Creek in the headwaters of the Price River would deliver water to northern Sanpete County via transbasin diversion. This proposed reservoir, located in Sanpete County, has long been a source of controversy between Sanpete and Carbon counties. Sanpete County residents believe the project will provide essential late season irrigation water and support future municipal growth; moreover, they contend that they have both a legal and a moral right to build the dam. Carbon County residents, on the other hand, fear that putting a new reservoir in the headwaters of the Price River will cause significant harm to downstream water resources, particularly Scofield Reservoir, which many Carbon County residents rely on for a variety of uses. Predictably, comments on this project split along county lines. Many Sanpete County residents attended the Richfield meeting and expressed support for the project, while many Carbon County residents attended the Price meeting and expressed opposition to the project.

Several comments expressed opposition to the **Aaron Million Pipeline** proposal, which would divert water from the Upper Green or Flaming Gorge dam and send it to Colorado's Front Range. Several more expressed concerns over a phosphate mining operation that residents of Vernal believe could contaminate **Ashley Springs**, an important source of high quality culinary water.

Other Comments

A number of comments list various threats to environmental and/or recreational uses and the way those threats affect residents personally. "I hunt ducks on the Great Salt Lake. We are not even sure, if we will be able to float an airboat on the lake this hunting season." Other comments discuss the threat of catastrophic wildfire, citing examples like the Seeley fire, which wiped out a

Blue Ribbon fishery in Huntington Creek and continues to harm communities in that watershed as storm events push ash, sediment, and other debris downstream. “[R]iparian and wetland habitats represent less than 1% of the state’s land cover, but sustain a large majority of its wildlife,” says one comment. “These rare, critical and at-risk systems are often in degraded condition, many due to lack of water quality and quantity. There is an increasing appreciation of the value of these systems for both nature and people.” Several others cite climate change and its potential to worsen the effects of drought, fire, and other threats to water resources: “We’re squandering this precious resource, a problem that will only get worse as the effects of climate change deepen.” “It is time for Utah's government to recognize the impending threats of climate change and start talking about ways to mitigate and prepare for it.” “Climate change is happening and has begun to affect water in Utah and needs to be considered in any plan for water in the future.”

The topic of **stream access** drew more comments than any other topic by a wide margin, and, while the comments clearly reflect an organized campaign, all of the comments, which number in the hundreds, appear original and range from a couple of sentences to several pages in length. “I would like to see a Utah where the public is not shut out of public resources in favor of big business and big money,” says one, echoing a common class-based theme. Other illustrative comments follow: “My family and my livelihood depend on the public access set forth by the constitution of this great state.” “Myself and my sons buy fishing licenses every year, which helps pay for these rivers to be stocked; then the fish end up on private land, why should I not have access to these fish?” “Obviously, conserving water and water usage both impact what we end up with in the rivers and streams (and lakes for that matter) and that's important, but access to those rivers and streams is vital for outdoorsmen whether it be for fishing, hunting, bird watching, et cetera.” “[T]he local economy suffers some when I take my money out of State so that I can enjoy fly fishing without the fear of being ticketed for standing in what should be "MY WATER" because a land owner wants to keep it to his or her self. … There should be severe penalties for those who abuse any land, public or private, but the public should not be locked out of something they own because of the actions or wishes of a few.” “Really the only thing that matters is open water for the next generation to enjoy. WE ARE A FAMILY FRIENDLY STATE so we say and now it’s time to prove it.”

Many of the comments point out that both the streams themselves and the fish that swim in them are public resources and question whether a private property holder should be able to exclude public access to those resources. “I don't believe the land owners own the water or the fish!!!” “Waterways are community resources they cannot be privatized simply because they flow through a parcel with limited rights granted by the citizens to the landowners. Landowners neither have nor deserve unlimited rights to destroy wetlands, pollute the rivers that pass through, polite [sic] the air that flows over, destroy the wildlife habitat, destroy wildlife crossing the land, or develop without consideration of the surrounding community.” Others seem less concerned about the specifics of who owns what and more concerned about potential lost opportunities for future generations: “I fished Beaver Creek and the Weber rivers with my

Grandfather and father, we fished many of the lakes and streams in our beautiful state. Sadly, I no longer have the access to the waters I learned to fly fish on. I worry that I will not have access to the resources to teach my kids the same love and respect I have for fishing in Utah." One commenter, recognizing public interest in rivers and streams, expressed a practical concern about liability: "I must have fences to keep my cows in. My fences must cross the streams. The stream flow can vary in height 2-5 feet depending on the runoff and current conditions. How do I keep my cows in and not snag a fisherman/kayaker? I have scoured the internet looking for "floater friendly" fences that can take rising water levels and yet keep my cows inside when the waters are low in the fall. Help me - or don't make me liable."

Despite some disagreement about the relative value of various uses for water—public and private—many commenters recognize the potential for collaborative projects that benefit multiple interests: "[W]e see many opportunities to create win-win situations that benefit landowners, municipalities, and the environment." For example, "If the State or Federal Government could help the canal company with loans/grants/any kind of funding to place [a canal] in a pipeline, the farmers would not need near as much water to be removed from Scofield Reservoir as they do now." In other words, piping the canal could free up more water for other uses, including recreational users who like to boat and fish on Scofield Reservoir. Another sees the same potential for rivers and streams: "Wise and frugal use of water in our irrigation [systems] ought to be a priority and ought to be incentivized. This could leave more water available for recreation." These and other comments underscore that the interests of consumptive and non-consumptive can—and frequently do—align: "[R]eservoir storage for agriculture provides recreational and tourism benefits in addition to agricultural benefits. … [It can] reduce[ ] sediment loading on river systems … and [help] stabiliz[e] downstream water flows." "With modern delivery systems and better monitoring of irrigation shares there should be enough water to flow year-round to improve fish habitat (including that of the threatened Bonneville Cutthroat trout), and improve the quality of life for the public, and property values along the river corridor."

To identify those collaborative opportunities, however, many recognize the need for innovation and a greater spirit of cooperation both locally and regionally: "[W]estern states need to work together to save and conserve all water resources, instead of squabbling among themselves. Most important, protecting water resources helps people and wildlife and the environment to thrive." "Growing up in the ranching and farming areas of southern NM and west Texas I understand, respect and support agricultural water use. I enjoy the beauty and benefits of a green lawn. I'm also a fisherman and outdoorsman. All can and should coexist but all had better get real serious about responsible use and conservation of water." "We need to develop innovative approaches to support water being left in the streams and rivers to serve these purposes."

Recommendations Based on Public Input

Through extensive outreach, key stakeholders and interested members of the public provided a range of strategies for addressing Utah's water challenges. Several of these ideas relating to the topic, "Water for Recreation and the Environment," are listed below and merit consideration as the process of developing Utah's 50-Year Water Strategy proceeds.

- Create legal or financial incentives for agricultural users to conserve water.
- Explore water banking at the local and regional levels.
- Expand or modify the definition of "beneficial use."
- Provide legal recognition for recreational or environmental uses.
- Promote stream access generally (by whatever means).
- Repeal the 2010 Public Waters Access Act and replace it with compromise legislation like Idaho's stream access law.
- Better incorporate the needs of the environment into state water planning.
- Establish minimum flow requirements for rivers and streams to protect aquatic and riparian habitats generally and native species particularly. Create new or expanded conservation pools for reservoirs.
- Amend Utah Code 73-5-15 to give the State Engineer greater authority to create and enforce groundwater management plans and to manage groundwater in conjunction with surface water.
- Leave more water at the source (river or lake) by using recycled or gray water for agricultural or other non-culinary uses further away from the source.
- Restore beavers to more watersheds and educate the public on the value beavers provide to properly functioning aquifers and riparian zones.
- Create a conservation stamp to fund Utah's existing stream access program.
- Allow water rights holders to voluntarily convert water rights to an instream flow (i.e., without leasing them to a third party or donating them to the State).
- Allow for permanent transfers of water rights to private parties for instream flows.
- Allow instream flow laws to protect a broader range of species.
- Create a state water trust to purchase water rights to help preserve instream flows.
- Pursue a range of strategies to improve overall watershed health, including better management of grazing and off-highway vehicle impacts, as well as greater fuel reduction and more proactive management of forest and range resources to reduce threats from catastrophic wildfires.

- Better regulate Concentrated Animal Feeding Operations (CAFOs) to protect water quality.
- Identify additional sources of funding for river and stream restoration projects, including expanded partnerships with the Natural Resources Conservation Service (NRCS).
- Better incorporate climate change in water development analyses and environmental studies.
- Ensure sufficient water quality and quantity in order to protect the economic and ecological values of the Great Salt Lake.
- Explore dredging Utah Lake.
- Explore additional freshwater storage facilities in or around the Great Salt Lake.
- Develop a joint operating agreement for reservoirs located in the Weber River watershed.
- Ensure minimum stream flows in the Weber River below Echo Reservoir.
- Provide instream flows to the Blacksmith Fork River below the mouth of the canyon.
- Initiate a state water planning effort modeled on the one being pursued by Colorado and, in particular, guiding principles based on (1) vibrant and sustainable cities, (2) viable and productive agriculture, (3) robust skiing, recreation, and tourism industries, (4) efficient water infrastructure and land use, and (5) healthy and resilient watersheds.
- Explore alternative agriculture to municipal water transfer methods that avoid "buy and dry," such as interruptible supply agreements, long-term rotational fallowing, deficit/partial irrigation practices, and alternate cropping types, particularly in times of drought.
- Better urban and suburban planning to protect groundwater recharge areas.

Securing Utah's Water Future: Competition for Water

By Voneene Jorgensen

Issue Overview

According to the Governor's Office of Management and Budget, Utah's population is projected to increase over 1 million by 2030, an additional 1.3 million by 2050 and six million by the year 2060. As our population increases, the demand on our water supply increases as well. Conservation will play a significant role in Utah's future water supply that will serve the increasing population. The Governor's Water Conservation Team working with the Division of Water Resources set a goal to reduce the 1995 per capita water demand from public community water systems by 25% before 2050. Recently, Governor Herbert issued the challenge to reduce water demand by 25% by 2025.

The Division of Water Resources reports that 5.15 million acre feet of water is diverted for agriculture, municipal and industrial use annually. Agriculture diverts 82% and commercial, industrial and institutional 8%. The remaining 10% goes to residential for indoor and outdoor water use. As the population increases, changes to the uses of water will naturally take place, most likely through the market place, with a willing buyer and willing seller.

Utah is the second driest state in the nation. We depend heavily on annual precipitation and snow fall to replenish our water supply year to year. Our weather is unpredictable. We hope for above normal precipitation and snow fall but plan for drier years, even years of drought, through the management of storage reservoirs. Competition for water will intensify as water users vigorously vie for their share of the water supply.

The people of this state are very sincere, very concerned and very passionate about the use and preservation of water as our most precious natural resource. As I listened to the people in attendance at the general meetings and the breakout sessions, it became very clear that people's experiences and interests guide their priorities to the uses and management of water. Those interests are very special and unique to them and others who share those same interests. We appreciate the shared and written comments from those people who attended the public meetings and also the written comments submitted online. This paper will address the identified uses competing for water resources and summarize those shared comments relating to those competitive uses.

Conservation

The resounding message was for the public to become more aware of the value of water and more engaged in using water more efficiently. People were very concerned about the amount of outdoor water being wasted and overused by people watering parking strips, curbs, sidewalks, driveways, parking lots, sprinklers running during rainstorms or during the heat of the day, and over watering landscapes letting water run down the gutters. A considerable amount of water can

be lost through leaking pipes, valves, taps and toilets, sprinkling systems and other like facilities. Water wasting could effectively be remedied if people would realize the value of water and become vigilant in practicing efficient water use. Water waste is a huge competitor for the water supply.

Shared Comments Summarized:

- We live in a desert and need to be more conservative;
- Using research and technology, we can use water efficiently without compromising a beautiful landscape;
- Sprinklers running during a rainstorm is wasteful;
- Neighbors water their lawns excessively and let the water run down the gutter;
- Water saved from xeriscaping should go into the Great Salt Lake to promote duck hunting;
- Change outside watering practices and schedules, restrict midday watering;
- Install low flow facilities inside and outside;
- Implement heavy fines and penalties for those wasting water by watering curbs, parking strips, driveways, sidewalks, parking lots, watering during rainstorms etc.;
- Implement financial incentives for changing existing lawns and landscapes to water-wise xeriscapes;
- Maintain and repair sprinkling systems, operate systems manually;
- Implement incentives for putting in water saving appliances inside homes including hot water preheaters;

- Initiate tiered water rate schedules wherein the more water used the more expensive the water;

- Use science and technology to educate the public on efficient inside and outside wise water use;

- Maintain water and sewer lines, readily repairing leaks, conduct water audits, and account for water loss;

- Change city ordinances and HOA bylaws to be more conservation friendly;

- Incorporate new technology such as filtration/reverse osmosis to allow water reuse for outdoor watering of landscapes, gardens, and golf courses etc.;

- Harvest rainwater to irrigate small gardens, lawns, and landscape;

- Educate the public with a special emphasis on children in the efficient use of water;

- Educate through social media, websites, radio, TV, billboards and special apps to provide a forum for sharing information and promoting the efficient use of water;

- Construct and meter secondary water systems, update old water rate structures and increase the cost of secondary water;

- Construct wider streets and sidewalks to eliminate parking strips;

- Implement a restriction system similar to red, yellow, and green burn days;

- Landscape professionals and businesses provide jobs and add to Utah's economy. They believe in using water efficiently in their profession. They use

best management practices and incorporate research based methods that use water efficiently and enhance the beauty of landscapes.

- Green landscapes promote healthier, cooler environments;

The Division of Water Resources has an excellent website with valuable and varied information readily available for the public use. Public awareness of this valuable asset needs to be promoted. Programs like “Slow the Flow” sponsored by the large water conservancy districts and the state’s 4th grade water conservation program taught in the schools are valuable teaching tools. Many municipalities, water districts, and other water utilities have implemented tiered rate schedules and completed conservation plans. Irrigation companies are making an effort to conserve water by lining and piping canals as they can afford to do so. Weber Basin Water Conservancy District is currently piloting a program metering secondary water connections. Conservation is a critical component to Utah’s water future but will only be able to supply a portion of the future demand.

Recreation and Environment

Utah is a beautiful state with a wide variety of recreational opportunities. Being able to access the publically owned lakes, rivers and streams for recreational purposes is a real concern to many people. They enjoy boating, water skiing, hunting and fishing, swimming, floating, rafting, and canoeing down the rivers and streams of Utah. Recreation is a very important use of the water for those water sport enthusiasts. Protecting the water quality and quantity to maintain healthy environments for the fish and wildlife is critical.

Federal and State mandates are competing uses for the water supply and will have to be satisfied to protect the endangered species, fisheries, riparian habitats and sustainability of wetlands. Special interests such as privately owned duck clubs are purchasing water rights and will continue to compete for those available resources.

Shared Comments Summarized:

- Protect the water quality and quantity of the rivers and streams;

- Protect in-stream flows for sport fishing and duck hunting;

- Restore stream access, returning it back to the broader public use many feel has been restricted by the new stream access legislation;

- Manage the forests and watersheds using best management practices;

- Watersheds are the sources of our water supply and need to be protected from encroaching development and contamination;

- Preserving the water flow into the Bear River Bird Refuge is critical to its existence. The water fowl need nesting areas and places to rest and feed during the different migrating seasons of the year. It's critical they receive enough water to keep the water flowing through the Refuge to guard against botulism which is deadly to the birds.

- Manage the water efficiently so as to protect the flow into the natural wildlife habitats and wetland areas enhancing the beauty and health of those areas;

- Keep healthy stream flows in the rivers for sport fishing;

- Manage water quality in our watersheds and drainage basins through implementing water source protection plans on a watershed basis throughout the state;

- Repeal the stream access law and implement a law similar to Idaho's;

- Use best management practices in managing the forests by harvesting dead trees to avoid devastating impacts of fire and subsequent flooding.

The Great Salt Lake

There is a great love and respect for the Great Salt Lake that was expressed through the shared comments received calling it an "international, national and backyard treasure for water birds and other wildlife". Comments to protect the sustainability of the Great Salt Lake were heard.

Shared Comments Summarized:

The Great Salt Lake is a great asset and adds $1.3 billion to the state annually through commercial businesses and tourism.

- As the State plans for the future of water in Utah, it is critical that the water quality and inflow to the lake is protected;

- The Great Salt Lake is an important ecological asset to the state;

- Natural waters, like the Great Salt Lake, need first priority;

- Fund and complete the “Integrated Water Resources Model for the Great Salt Lake”;

- Involve all the stakeholders in planning efforts;

- Dike eastern half, move pumps, and create fresh water lake;

- Use the water before it gets to the Great Salt Lake;

Climate Change

Climate change needs to be evaluated in relation to the impact on our water supply and counted as a competitive use. Water is a renewable resource, replenished annually through precipitation and snowfall. It may be plentiful in some years and in short supply in others depending on the weather patterns. The weather in Utah is always changing and Mother Nature is very unpredictable. In times of drought and below-normal water years, we depend on the water supply that has been wisely managed and stored in reservoirs. Throughout the state there are large and small storage projects that have supplied demand through the years of drought. Saving in times of plenty and planning for times of shortage is critical in preparing for the impacts of climate change.

Shared Comments Summarized:

- Study climate change and the impact thereof on a more localized level. Studies are helpful in identifying impacts and providing planning tools to prepare for those impacts.

- Development of storage reservoirs and implementation of water banks may be viable solutions to the impacts of climate change and are worthy of discussion.

Agriculture

Agriculture is a large part of the economy of Utah. Throughout the state, there was overwhelming support for protecting agriculture. The people who derive their livelihood from agriculture are very sincere and love their way of life. They expressed that they are great stewards of the land and water and are dedicated to developing and implementing best management practices in their industry. Many have changed from flood irrigation to irrigating with sprinklers as a form of conservation. They expressed a desire to be able to pipe and line canals to conserve water and promote safety. Some are asking for changes so that irrigators can benefit from their conservation efforts. With 82% of the water in the state being used in agriculture, as the population grows and new homes are built on the land that has been historically used for agriculture, changes of beneficial use will naturally take place by willing buyers and willing sellers.

The idea of adopting management practices such as brokering, long term leases or water banking, that encourages beneficial use of water through efficient transfers and economic incentives, offer simple tools for developing water resources without searching for new water.

There is a concern regarding the practice of the Federal Government requiring water right conveyance to the federal government in exchange for the renewal or issuance of certain use permits. As a state we need to preserve our right to use and regulate our water rights without federal control or assertion.

Shared Comments Summarized:

- Preserve agriculture;
- Agricultural users are the best environmentalists;
- Communities can bank water for later use, they have advantage over agricultural users who have to use it or lose it;
- Protect agriculture from water transfers;
- Benefit those who actually conserve irrigation water;
- Simplify the water right transfer process;
- Create incentives for improved efficiency in water use;

- Simplify the transfer process from Ag to M&I;

- Respect our choice to sustain our families through agriculture;

- Water banking is one method that can be implemented to help agriculture retain its fair share of the water;

- Utah agriculture should not take second place to another state's municipal and industrial demands;

- Protect the Office of the State Engineer and existing water law; beneficial use and prior appropriation;

- Food is essential to life, protect agriculture;

- Open ditch and canal systems are very inefficient and need to be lined or piped; but need funding;

- Allow the market to work when agricultural lands are sold for development;

- We are being pushed around by the Federal Government;

- Let the State Engineer manage the water, not the Legislature;

- People need to realize where their food comes from;

- Keep the water with the land, you can't have land use without ensuring that the water is there.

Municipal, Industrial and Commercial

Water is life. We all need it to live; for drinking, sanitation, safety, and economic well-being. Many participants gave municipal use the highest priority. As Utah's population grows, conservation will play an important part, but will not be enough to supply future demand. As we plan for future growth, industrial and commercial uses will be competitors for water.

Shared Comments Summarized:

- As urban areas grow, the rural areas are concerned with trans-basin transfers;

- Industry, mining, and power were identified as large consumers of water that deplete the majority of the water that is needed for the future growth of the community;

- The State needs to stop encouraging more industry, businesses, and people to come to the state that will strain or deplete our water supply;

- Opposition was expressed to using large amounts of water in fracking in the oil and gas industry, and using water for tar sands development;

- Opposition to selling a large amount of water for nuclear power was heard;

- Power generation is a competitive use of the water supply and power is an integral factor in the development of water projects;

- Stop industrializing Utah and preserve the beautiful places;

- Many oil/mineral companies are boosting the economy of the eastern part of the State;

- Direct economic growth to rural areas where the water supply is available and to protect the economic viability of the rural communities;

- Encourage development in areas where water infrastructure and supplies are in place;

- The State needs to be more selective in the type of industries and businesses we encourage to come to Utah;

- Select industries and businesses that are most compatible with our climate and available natural resources;

- Review new technology and methods developed by professionals;

- Population growth is a problem, slow population growth;

Water Development

Conservation is a critical component to Utah's water future, but will not be sufficient. Thus more water will need to be developed to supply the demand needed for future growth. Power generation will be an integral part of these projects. These water projects will provide the needed water and storage for the future. There were many comments related to the development of future water storage projects throughout the state, some in opposition and others in support. The cost of water development is a concern, but support was expressed for the State to be involved in funding those projects.

Shared Comments Summarized:

- The message "Our water should stay in our State", referring to Snake Valley;

- The development and use of Utah's water rights in the Colorado River and the Bear River should be developed to supply future demand;

- Develop water where it originates;

- Consider water banking and water lease agreements;

- Reservoir construction is critical to growth;

- Encourage water development in areas where the water infrastructure and rights are in place;

- CUP was a great project, now is our time to be visionary for the future;
- Support and build Lake Powell Pipeline;
- Support the Office of the State Engineer, existing water law, and protect beneficial use;
- Water development should consider impact upon the wildlife and environment;
- More water storage is needed;
- Keep water in the drainage it originates in, no trans-basin transfers;
- Development needs to move to the water and not the other way around;
- Study water banking and water leases to protect water rights;
- Coordinate conjunctive use of surface water and groundwater including aquifer storage and recovery projects (ASR);
- Water reuse is an important tool to curb the increasing need for water;
- Use reclaimed wastewater;
- Implement best management and maintenance practices to reduce silt accumulation in the state's existing reservoirs to preserve capacity and water quality;
- Study the geology of ground water more extensively;
- Protect the quality of the water;
- Construct more reservoirs;

- Reservoir construction is critical to growth requirements, a reservoir is needed in Logan canyon;
- Water development needs to consider the impact upon wildlife and environmental systems;
- Continue cloud seeding;

Aging Infrastructure

Aging infrastructure plagues water utilities throughout the United States, and Utah is no exception. It is a safety concern, an extensive economic burden and the source of water loss. Our state, civic leaders, and water managers are studying and developing budgets and plans for rehabilitating and replacing aging infrastructure as well as developing and implementing master plans to meet the demand of the future population growth projections. Funding those projects is a major component of those master plans. The water loss associated with aging infrastructure is also a competing use.

***Shared Comments Summarized*:**

- Old infrastructure is responsible for huge losses of M&I water;
- Improve infrastructure;
- Need to provide more funding for water projects;
- Maintenance and repair of existing infrastructure is crucial and cost effective;

<u>Recommendations Based on Public Input</u>

Each of the competitive uses of water listed above have a special and unique place within our society. The challenge is how we will balance them in an effective and equitable manner. Considering the total population of Utah, a small portion has communicated those uses that are important to them in their lives. What is important to one may not necessarily be important to another. Working co-operatively with mutual respect to create win-win opportunities through efficient management practices that are mutually beneficial will be very important.

The challenge will be to effectively manage the many competing interests and uses on a fair playing field within the established framework of the prior appropriation doctrine, beneficial use, existing water rights and the change application process.

Based on public comment on varied issues, it seems that people lack understanding on the laws that govern the development, management and uses of water. Education on water management and basic water law is needed.

Continue strong conservation efforts and educate the public, with an emphasis on young schoolage children, using social media, TV commercials, newspaper and magazine ads, billboards, school projects and presentations, public open houses and other creative methods that will instill the importance of using water wisely and efficiently is of the upmost importance.

Study and develop future water projects including the Bear River Development Project, Lake Powell Pipeline and additional storage reservoirs to supply future water demands.

Agriculture plays an important role in Utah's economy. Long-term water leases, water banking and brokering were suggested as management tools that encourage beneficial use of water through efficient transfers and economic incentives and are worthy of discussion and study. The conversion of agricultural water to municipal and industrial use will to be another significant component in supplying water for the future.

Efficient management effort to protect in-stream flow to the wetlands, wildlife habitats, lakes, streams and rivers will be critical to our environment going into the future.

Utah is naturally a beautiful state and a great place to live, raise families, recreate, and conduct business. We are all part of this great state and have an obligation to work together to protect and preserve our quality of life and to make it a better place for us and future generations.

Securing Utah's Water Future: Water Law

By Robert Morgan

Historical Background on Utah Water Law

The history of the development of Utah water law is varied and colorful. When the first white settlers entered the Salt Lake Valley in July 1847, they immediately diverted water from City creek to irrigate the parched soil. Their purpose was not only to sow crops to ensure survival through the approaching winter but also plan for the future sustenance of the growing population in the area. Irrigation was probably a new concept to many of the newcomers because they had come from places in the East and Midwest where precipitation was abundant and crops grew without irrigation.

Throughout the ensuing years, pioneers settled various parts of the Utah Territory. The selection of suitable locations always depended on the availability of a reliable source of water and fertile land in order to ensure adequate crops to maintain livelihood. The problem was not finding the land but the water. The water sources, whether rivers or streams, were inherently finite and water level varied according to the seasons. Settlements were usually established where yearround streams or rivers entered a valley. Moreover, because communities had the common thread of the availability of water, they were often built close to each other.

As settlements grew, so did the demand for water. Arguments over water rights were commonly handled by the local ecclesiastical lenders, usually the bishop, and Bishop's courts became the standard forum for solving water disputes and other similar differences between residents. Indeed, the maxim, "Whiskey is for drinking, water is for fighting over," expressed a common sentiment throughout the early history of Utah water law.

Utah became a state in 1896, and the Office of the State Engineer was established a year later. The State Engineer's Office was renamed the Division of Water rights in the 1960s when the Department of Natural Resources was created. The Division is administered by the State Engineer who is appointed by the governor and confirmed by the State Senate.

Utah's first basic water law was enacted in 1903 and modeled initially after Wyoming's laws. Accordingly, Utah was to be a prior appropriation state, which essentially meant first in time, first in right. Residents were required to file for their water rights, and they had to claim prior uses, so that could be included as part of the public record. All county recorders in the State had a "Water Book" in which they kept records of water transactions and ownership. Individual water users had the responsibility to update titles in the State Engineer's Office.

It is perhaps not surprising that many water disputes in the 1910s and 1920s resulted in litigation. Often, a judge ordered initiating a statutory adjudication to adjudicate the water rights in a specific drainage. The State engineer prepared a Proposed Determination, describing all existing rights. After the Proposed determination was served on all water users and any protests resolved, the court entered a decree and confirmed all valid water rights. Many of the decrees, in fact, carry the name of the judge, for instance Cox Decree for the Sevier River. In 1935, litigation in Sanpete County over a ground water resource caused the laws concerning the water of the State of Utah to include ground water as well. Prior to that, it was widely assumed that surface water and ground water were two separate resources.

Current Legal Issues

Currently, Utah water law is contained in the Utah Code Title 73-1, 2, 3, 3a, 3b, 3c, 4, 5, 5a, 6, and 22 and governs the administration, use, and ownership of water. Water is specified by statute to be the property of the public, subject to existing rights to the use thereof. According to Utah Code 73-2-3a, the State Engineer is responsible for the general administrative supervision of the

waters of the state and the measurement, appropriation, apportionment, and distribution of those waters.

One of the current major issues in water law is filing change applications on water rights that have not been used for at least seven years. In the past, the State Engineer has rejected change applications that involve water rights that have not been used within the statutory 7-year period or that may be subject to a challenge for forfeiture in a court of law. However, this issue was recently brought before the Utah Supreme Court, which ruled that the State Engineer lacks the statutory authority to reject the application on the grounds of nonuse. Until this ruling, the State Engineer has issued decisions on a change application based on whether there was a valid water right to support the change.

Another important legal issue is the conversion by a change application of irrigation company shares of stock to municipal uses. Until the 1990s, shares of stock in an irrigation company were treated by the State Engineer as evidence of a water right and change applications were approved. A law suit between the State Engineer and East Jordan Irrigation (Morgan vs. East Jordan Irrigation Company) went to the Utah Supreme court, which decided that the basic water right resided with the irrigation company, and therefore any change applications had to be filed by the company or with the approval of the company. Specific laws were enacted and last amended in the 2008 General Session of the Utah State Legislature. Attempts are now being made to give shareholders more authority and responsibility in the change application process.

Additional issues that currently being discussed within the water community include the following:

- Stream access for recreation;
- Water Reuse;
- “Gray” water use;
- Rainwater capture and use;
- Water conservation and incentive to conserve; and The efficient use of water.

Public Comments

Comments were received from the public in the open forums and breakout sessions held during meetings at various locations throughout the State. Additional comments were collected through the Utah Water Ways website, www.utahswater.org.

Richfield

- The need for more dams;
- Not allowing Utah’s water to be exported;
- The relationship of depletion to return flow;

- Allowing utilities to bank water;
- Willing sellers should be able to market their water;
- Watersheds should be protected;
- Water rights should be made personal property;
- Developers hinder irrigation companies when shares are converted to domestic uses;
- Diligence or underground water claims should not be allowed; and
- The State engineer's traditional role ad "gate Keeper" should be restored. The State engineer is an essential part of the administration, allocation, and distribution of the State's water.

Layton

Discussions at this meeting focused on the conservation and efficient use of water. Several comments were made about the fact that secondary water should be metered rather than a flat fee being charged. Additional comments included the following suggestions:

- More storage reservoirs are needed:
- Rainwater ought to be allowed to be collected for personal use;
- Legality of using "gray" water;
- More public education on water use and conservation is needed;
- Conservation and expanding acreage;
- Use of effluent water;
- Need to create water banks;
- The difficulty of understanding the "use or lose" concept; and Support was expressed for the role of the State engineer in performing his duties.

Price

Residents of southeastern Utah seemed more concerned about funding for infrastructure, conservation, and new projects. Similar to the comments received in Layton, people expressed the following ideas:

- The desire for more dams; Additional water for urbanization; More effective watershed protection:
- Banking water;
- Educating the public about water;
- Not allowing Utah's water to be exported;

- Promoting secondary systems;
- Support for the State Engineer as the “gate keeper” for water rights; and
- Agriculture users questioned why acreage could not be expanded when they became more efficient.

Several comments were made that more meetings should have been held throughout the southeastern region because many participants had to travel long distances.

Provo

This was the first meeting where instream flows were mentioned. Attendees expressed interest in preserving habitat and providing water for wildlife as well as riparian areas. Additional comments involved the following issues:

- Funding for infrastructure;
- Not exporting Utah’s water;
- “Paper” water being a problem;
- Protecting irrigation company water;
- Canal Safety;
- Construction of illegal ponds;
- Tiered water prices;
- Concern that current water law does not promote conservation;
- Monitoring uses and diversions more closely; and
- Preserving the role of the State Engineer, and providing more money to the division of Water Rights to accomplish more monitoring and adjudication efforts.

The infiltration of ground water into sewer collection systems was also mentioned. Efforts should be made to prevent this infiltration, so that this water will remain in the watershed.

St. George

This meeting was dominated by those supporting the Lake Powell Pipeline and those opposed to it. Other comments included:

- Support for Utah’s water law foundation;
- Slowing growth and limiting population;
- Not exporting water out of state of from one watershed to another;
- Need for further study of ground water basins’
- Tiered water costs;

- Conserving water and promoting xeriscaping;
- Concerns about aging infrastructure; and
- Need to get all interests together to discuss problems and possible solutions.

The Paiute Tribe expressed concerns over how water projects are constructed, and the Jackson Flat storage project was specifically mentioned.

Vernal

Most concerns at this meeting were centered on funding for old and new water projects as well as resolving conflicts with the Ute Tribe and the Department of Justice. Other topics included:

- Protecting watersheds;
- Conflict with state agencies over future fertilizer mining;
- Old water rights should be developed or taken from the record; Moving high mountain storage to valley locations; and Improving current delivery systems.

Salt Lake City

The majority of this meeting involved discussions on water for the environment. Stream access, instream flows, and preservation of the Great Salt Lake were expressed. Additional comments included:

- Revising current water law;
- Making water a private resource rather than a public resource;
- Property taxes support water projects;
- The need for comprehensive ground water studies;
- Beneficial use and duties for water need to change;
- Creating a water bank; and
- Protecting the small ditches and delivery systems.

Logan

There was no dominant topic in this meeting. However, the following concerns were expressed:

- Instream flows and stream access;
- Watershed health;
- Water is too cheap;
- Canal safety;
- Rewarding efficiency and conservation;

- More water storage is needed; and
- What are the priorities of ground water filings?

In addition, water billings should be stepped to help conservation and make users aware of what they are using.

Strategies for Future

Analysis of the public comments shows that the following issues are common concerns throughout the State:

1. The State needs a "gate keeper," and this person is the State Engineer. The Division of Water Rights should get more money in order to administer the law and to gather data concerning water use and availability.

2. In evaluating change applications, the State Engineer should be able to evaluate whether there is a valid right to support a proposed change application.

3. The current change application statute regarding shares of stock in irrigation companies should be maintained. The functionality of the company needs to be maintained.

4. Conservation and efficiency were mentioned at all meetings.

5. Instream flows should be provided and protected to enhance water recreation and habitat.

6. The public should be allowed access to streams and rivers throughout the State.

7. All water deliveries should be metered or measured.

8. Water rates should be "tiered," so that the more you use the more you pay.

9. Basins of origin should be protected.

10. Some users assert that since a water right is a "property right," it should not be lost because of nonuse. However a water right is a conditional property under Utah law.

11. Should undefined and unrecorded Diligence Claims and Underground Water Claims be eliminated?

12. Water reuse is very important. It should be easier to get permitted to use this water.

13. Our watersheds are the origin of most of our water. They should be protected and their ability to produce water at the right time enhanced.

14. Considerable effort should be made to educate the public concerning water and water rights. The public needs to understand that a water right defines its use, and its use defines the depletion that is allowed. Increasing the depletion has consequences to other users and the water environment.

Water for Utah Agriculture

Governor's Water Initiative

October 2013

Prepared by Warren H. Peterson

Water for Utah Agriculture

Eight regional meetings conducted by Governor Gary Herbert's water team during July and August 2013, and the related publicity, produced hundreds of verbal and written comments from concerned Utah residents. A generous sampling of these comments supports two striking conclusions regarding Utah agriculture and water:

- Utah's people recognize that there is an inseparable connection between food production and water, and
- Utah's people would benefit from a greater understanding of this connection.

Similarly, the comments produced two clear themes regarding water and agriculture:

- With the many demands for this life-giving resource, it will be increasingly important to engage all willing stakeholders in serious, collaborative planning for Utah's water future.
- Agricultural water users, who account for 80% of Utah's water use, must have a key role in this effort.

Utah needs agriculture and Utah agriculture needs water. Water, food, and protection from the elements stand atop the hierarchy of human needs. Utah agriculture produces not only food, but also fiber and materials that protect us from the elements. Agriculture also manages reservoirs, waterways, riparian habitats, and large portions of Utah watersheds.

Are these facts important to our state and its people? A farmer who attended one of the meetings framed this question very well: "A person who has no water has only one problem – 'where will I get my next drink of water?' A person who has water but no food has only one problem – 'where will I get my next meal?' A person who has enough water and food can afford to have many problems."

Agriculture can produce the food, fiber, wood products, and the other varied products we need to survive only by interacting effectively with Nature's water cycle, especially in this second most arid state of the United States. Students of Utah history learn that the Mormon settlers who entered the Great Salt Lake Valley in July 1847 immediately dammed City Creek to irrigate the desert soil.

Careful students of Utah history also know that irrigated farms fed early residents of this land some 1,400 years before the settlers of 1847. From 400 to about 1400 A.D., the Fremont people raised corn sustained by the waters of Clear Creek in central

Utah and built rock granaries to store and preserve this essential food supply. One theory holds that the dramatic "Zipper Glyph" at Parowan Gap is a solar calendar brilliantly constructed by the Fremont people to mark corn planting dates for their future generations. During the same era, the Anasazi raised and stored corn and other crops irrigated by the Colorado and its tributaries.

These past dwellers in the varied land we now know as Utah built their societies, their cultures, and their economies around water. We "modern" dwellers have done the same. We do not know for a certainty why these earlier societies did not survive, but credible evidence points to prolonged drought as the prime suspect in their disappearance. Unfortunately, the Anasazi and Fremont are no longer here to share the knowledge which allowed them to survive for hundreds of years or the challenges that ultimately overcame them.

These rich histories demonstrate the need for carefully planned institutions and social compacts to allocate this life-sustaining resource. Our water management institutions–our individual business enterprises, state agencies, mutual water companies, cities and towns, water conservancy districts, trade associations, conservancy groups, tribal councils, cooperating federal agencies, and various other water stakeholders–must work cooperatively with agriculture for our society to survive. We must rise to meet challenges, old and new, as we attempt to match growing societal and environmental needs to the water resources which are providently, but unevenly, renewed by Nature.

Though water is a renewable resource, it is certainly a limited resource in a state with annual average precipitation of about 12 inches. Further, precipitation comes as it comes, not necessarily in predictable quantities and certainly not when and where we might prefer. Through experience we have learned of wet and dry cycles that last for a decade or two; we are only now learning of longer term cycles. Very recent experience suggests we may be encountering unprecedented weather patterns that will fundamentally disrupt our water use patterns. We don't know if we are on the leading edge of an extended period of drought, or a period of higher temperatures which will affect our essential snow-pack water storage. We do know that even as water supplies become less predictable, Utah faces significant growth and that this growth and other needs bring increased water demand. We also know water challenges have extinguished previous desert settlements and even entire societies. It is a fair question to ask whether we will suffer the same fate.

Utah Agriculture and Water – Current Conditions

Key Points

The public comments and other information received on Utah agriculture and water as part of Utah's Water Future raised these key points:

- ***Agriculture uses about 80% of Utah's developed water supply, mostly for irrigation.***

- *Farming and ranching play a major role in Utah's economy, providing the economic basis for:* o *79,000 jobs* o *$17.5 billion in economic activity* o *14% of the Gross State Product*
o *$2.9 billion in annual payroll*

- *In most of Utah's river basins, agricultural water use came first. Consequently, agricultural interests own the senior water rights.*

- *Utah's water laws provide order and certainty essential to our water and market economies and public water supplies.*

- *In Utah's populated river basins all physically available water has been allocated; new uses usually require transfer of the senior agriculture or other water rights to supply new uses.*

- *Agricultural enterprises tend to have narrow returns on capital assets, including water rights. Uses with higher returns often bid water away from ag uses – "water follows money."*

- *Perhaps 80% of Utah's water supply, and the majority of irrigation water, is managed by nonprofit, privately-owned cooperatives often referred to as "mutual water companies."*

- *Mutual water companies typically operate on assessments paid by member water users and notably tight budgets.*

- *An estimated 6,000 miles of canals deliver Utah irrigation water to both urban and rural areas; most of these are operated by mutual water companies.*

- *Two obvious but important facts:* o *Utah farms and ranches use water found in both rural and urban areas, and* o *it is very expensive to transport water from the rural areas to urban uses.*

- *Much of the water arising in urban areas has already been converted from agriculture to municipal and industrial use, almost exclusively through marketplace transactions.*

- *Agricultural irrigation often comes from low quality sources (e.g., Utah Lake) that are not suitable for culinary and other uses without very expensive treatment.*

- *True water conservation in agriculture is complex. It requires wise application of agronomy, hydrology, and sound technologies in a basin-wide context.*

- *Weather and commodity market patterns have both been more complex in recent years, greatly increasing uncertainty for farmers and ranchers.*

- ***Watershed management increases water supplies, prevents catastrophic fires, and contributes to cooperative water planning.***

- ***Agriculturists have proven to be innovative, creative problem solvers who can lend valuable training, hands-on experience, and integrity to meeting water challenges.***

- ***Recent years have seen increased attacks on water rights protections, some by policy makers who lack experience in water issues and some by individuals who act in their own selfinterest to the detriment of sound policy.***

- ***The public comments strongly support Utah agriculture.***

Discussion

What do the Utah public and their policy makers need to know about agricultural water to craft wise water management plans? What basic elements of our "water economy" must be considered?[34] To answer these questions we must first understand today's context and the experience and history that have brought us to this point.

- ***Agriculture uses about 80% of Utah's developed water supply, mostly for irrigation.***

- ***In most of Utah's river basins, agricultural water use came first; agricultural interests own the senior water rights.***

Just as the market economy allocates resources using money as a medium of exchange, we might measure resource allocation by examining the distribution and use of water. Indeed, the Utah Supreme Court has opined that "a drop of water is more precious than a drop of gold" in our arid state where all investments in land, improvements to land, and even public infrastructure become stranded assets without the value created by access to water. An experienced rancher said, "I'd rather have a bottle of water than a suitcase of gold if stranded in the desert."

In Utah we are "stranded in the desert." At the time our present communities developed, water, food, and shelter had much greater utility than anything else. To cope with this reality, the founders of Utah's communities first and foremost built water systems to deliver available water into places where it could be beneficially used. With very few exceptions these community dams, ditches, and canals supplied irrigation water, providing the first foothold for settlements in a harsh land. Only after this first foothold was secure did other community features follow, such as roads, stores, schools, and other infrastructure. The dominance of this historical use explains how 80% of Utah's developed water became directed to agricultural production.

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[34] One definition of "economy" is "careful management of wealth, resources, etc." and alternatively "an orderly management or arrangement of parts, organization or system." *Webster's New College Dictionary*, Fourth Edition. In this paper the term "water economy" is sometimes used to distinguish systems for managing water sources from the market economy.

Other community features and activities have grown, however, to the point they often overshadow the original agricultural land uses. Though these early canals still exist in most Utah communities, they quietly weave unnoticed through many neighborhoods–rising to public notice only when they fail to properly channel or transport water and thereby inconvenience the very children they raised up. Because Utah has largely become an urban society, with little direct experience or education in agricultural water and water rights, these critical arteries are often seen as a nuisance or danger by a public removed by multiple generations from the farm.

Utah's water laws provide order and certainty essential to our water and market economies and public water supplies.

Many public comments offered at the public meetings and in written submissions suggest that Utah laws which regulate the right to divert, store, and use water suffer even greater obscurity and lack of understanding than the forgotten canals. Like the canals, these legal structures were built with wisdom gained through long experience in managing critical water resources. The local and regional water systems that support agriculture, and in turn the more complex urban water economies, were built upon the order and certainty provided by these key legal principles:

 Utah law defines water as a social resource, declared by the Legislature "*to be the property of the public, subject to all existing rights to the use thereof."*

- Second, while the water is owned by the state, the right to use water is a constitutionally protected property that can be privately owned, subject to certain important conditions.
- Third, water can only be taken from a natural source for "beneficial use." In other words, the right to take and use water is legally protected only if taken for a use recognized by the law as beneficial to society. A key Utah statute (Section 73-3-3) declares the principle in these simple terms: "*Beneficial use shall be the basis, the measure and the limit of all rights to the use of water in this state."* Naturally, agriculture was one of the first such beneficial uses recognized by law.
- Fourth, water is allocated based on prior appropriation, often expressed as "first in time, first in right." The first or "senior" water right holder is typically entitled to full satisfaction of its water right before later water rights are satisfied and thus has priority access to available water supplies. This rule has been modified in certain locales.
- A fifth principle is that water rights not beneficially used can be forfeited, thereby allowing re-allocation of available water to other water right holders who can make beneficial use.

These protections have provided the foundation for agriculture and the tools for transitioning water to other uses. Prior to development of these legal protections, users with more money, greater power or audacity, or simply an upstream location, took water supplies away from prior users leaving dams, canals, and fields dry. Utah, like other western states, suffered a history of bloodshed in some instances, as well as destroyed dams, and much litigation over water issues.

Fortunately, our state has developed an effective and proven water rights system to such a degree that other states follow Utah's lead in many aspects of water policy and legislation.
These legal protections allowed agricultural water users, both individually and jointly with others, to build extensive water facilities, water-dependent improvements, and communities as described above. The intrinsic value of water and water facilities are only part of the equation. Much additional and dependent value lies in the farms, markets, secondary industries, community facilities, and all the broad scope of human and economic activities that rely on water and food. There must be order and stability for these secondary investments to occur.

The Office of the Utah State Engineer, also known as the Utah Division of Water Rights, has been and continues to be a very important force in maintaining the order and stability of water rights. The state engineer's office, by directive from the Utah Legislature, is responsible for the general administration of water rights, including distribution of water from rivers and groundwater to water rights owners, enforcement of water allocations, transfers to new locations and new uses, dam safety, well drilling, and many other important functions. Comments received demonstrate that the state engineer's office interacts effectively with agricultural water users in such ways as effective and timely water rights administration, annual informational meetings, monitoring dam safety, and a tradition of service. Water rights decisions from the state engineer's office are timely, inexpensive to obtain, and reflect a strong knowledge of agriculture. The office issues an average of 6,500 decisions each year, along with other services. The decisions are always subject to court review, but on average only 10 requests for judicial review (0.15%) are filed each year. This office has proven to be a cost-effective way to manage water issues and disputes, but it is increasing coming under attack as new players, especially speculators, enter the water market.

Agricultural enterprises tend to have narrow returns on capital assets, including water rights. Uses with higher returns often bid water away from ag uses – "water follows money."

Although agriculture is a major player in the Utah market economy, the competitive global commodities markets shave Utah farm profits very thin. This profoundly affects agricultural water. With low margins, farmers long ago learned to manage the mutual water companies that operate most of the major canals and ditches by using a great amount of volunteer labor and very small budgets. Consequently, dams, canals, and ditches often show need for upgrading and replacement of key structures.

Another effect of these low agricultural returns: many other economic water uses produce a higher market economy return on water. Consequently, agricultural water has become the pool from which water is taken for such uses. As commented in more than one meeting, society is somehow willing to buy water away from farming to grow Kentucky Blue Grass, which has no food value, even for water buffaloes. Fortunately, these transactions are usually willing seller/willing buyer market transactions. Unfortunately, these transfers tend to be permanent transfers away from agriculture, especially after the new water right owners build expensive

infrastructure to move the water from the farm to the new place of use, which will often be in distant urban settings.
In a tight agricultural economy, it doesn't help that Utah agriculture faces a major need for both new water infrastructure and replacement of old, especially where urban development and farm water systems coexist. Many communities, as echoed in many of the public comments, call for canals to be piped as houses encroach, but offer no monetary contribution toward these demands. Canals located in neighborhoods that used to grow crops have now grown houses, creating much greater risk of injury and property damage if the canal floods or fails. Canal flooding often occurs because the canal has received an influx of water from a city storm water system or other artificial conditions such as parking lots. Canal failures also occur because activities on adjoining land have compromised the structural integrity of the canal, such as landscaping with trees that send roots through the canal bank. Land use planners have often allowed changes around canals without understanding the impacts on canals and without providing funding sources to alleviate those impacts. Farmers and water companies are then left to deal with encroachments on the canals at their own cost, often with money borrowed from the Utah Board of Water Resources and repaid solely by the water users. As a result, these costs of land development are borne by, or externalized to farmers who did not benefit from new development.

As noted above, most of Utah's dams and major canals were built decades ago. Many dams have grown old and need repairs and rehabilitation. Much dam rehabilitation work has been done with Utah Dam Safety Act funding, but much work remains. Other critical dams and related water systems were built with federal funding and are growing old, but federal funding is not available and local funding has not been developed for their replacement. The person who commented, "*It is all going to be more expensive"* spoke the truth.

As a final thought on this topic, it should be obvious that as Utah's population expands we need food supply for new residents. We have the choice of either importing food, if it can be obtained, or of increasing our food production. If we are to increase food production in Utah, existing water supplies will need to be protected and new supplies developed. Public comments noted that the "cheap" water has already been developed, so new water and the food produced using it will cost more. Since agriculture works within very narrow margins, innovative thinking will be needed to develop additional water supplies, and to perhaps improve profit margins for agricultural enterprises so that they can bear greater water costs.

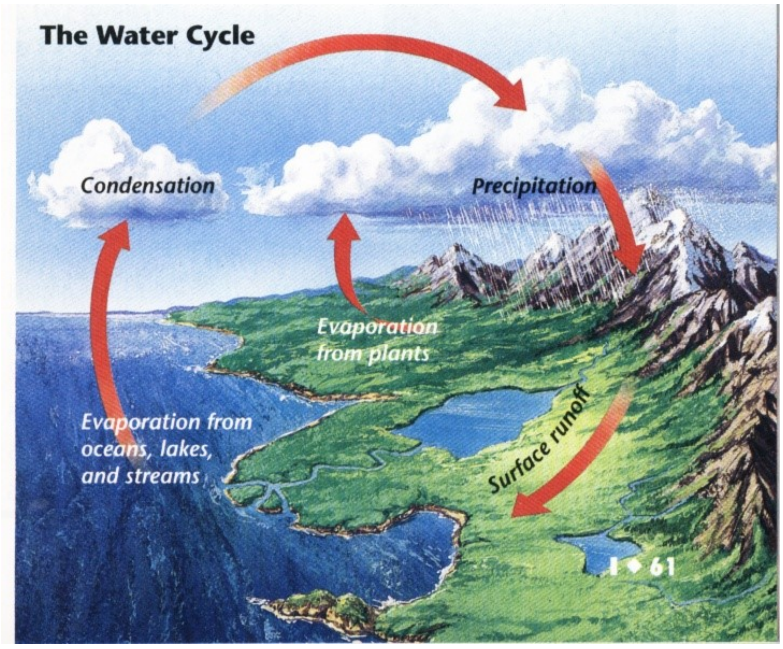
Water conservation in agriculture is complex. It requires wise application of agronomy, hydrology, and sound technologies in a basin-wide context.

As user of 80% of Utah's developed water, agriculture must practice wisdom by implementing water conservation efforts. Public comment seemed justifiably ambivalent on agriculture's role in water conservation and for good reason. Water conservation in agriculture is complex, and failure to apply good science often causes well-intended efforts to be ineffective. Methods such

as sprinkler systems which appear to create conservation at the farm level actually reduce water use efficiency when evaluated from a river basin-wide perspective.
There are many misconceptions. One is that agriculture should simply cut back on water use, forgetting that plants and livestock do not consume more water than is necessary to sustain life. Another misconception, as noted above, is that irrigation sprinklers save water. They do not. Sprinklers increase evaporation and thus return water to the water cycle before optimal use is attained. Sprinklers divert less water than traditional flood irrigation, creating the illusion of efficiency. As one commentator noted, the Sevier River system reaches 99% efficiency when measured at the river basin level by using mostly flood irrigation and reuse of return flows. On the other hand, sprinklers provide benefits such as decreased salt loading, as discussed below. Wise water management requires good science-based planning and selection of the best methods for a given location.

Mutual water companies have been heavily involved in "water conservation" projects, with a variety of private, local, state, and federal funding. The Utah Board of Water Resources has made numerous loans to water companies for canal lining, control automation, canal enclosures, and other agricultural water projects that help retain water for greater beneficial use. Water conservancy districts have been especially creative in funding improvements designed to reduce conveyance losses in return for use of the retained water.[35]

Weather and commodity market patterns have both been more complex in recent years, greatly increasing uncertainty for farmers and ranchers.



Discussion of water issues requires understanding that human water use occurs in the larger context of the water cycle and related natural systems. In simplest terms, as depicted in this diagram, the water cycle begins as water evaporates from oceans and other surface sources (and sublimation for snow and ice). Human water use largely occurs after the evaporated water moves across land masses, condenses, and then falls to the land surface as precipitation. Utah's mountains present barriers to water transported from the oceans by the

[35] The commonly used term of "saved" water is a misnomer. The objective of "conservation" is to retain water for further beneficial use before the water returns to the water cycle. The water kept in a system by such improvements is "saved" only in that it is retained for use at a given location, rather than being immediately returned to the hydrologic basin for use by downstream users or returned to the larger water cycle.

prevailing westerly winds, forcing air that bears water vapor to rise. As the water vapor rises, it cools and condenses to fall as either rain or snow. Some water falling as rain and snow collects into streams and rivers, some sinks into the soil and moves down-gradient as groundwater, and some returns to the atmosphere though evaporation, sublimation, and plant transpiration. Snowpack provides Utah's largest storage reservoir, holding water until snow melt moves down gradient into streams or as groundwater recharge. Water molecules involved in this process have been part of the Earth's water inventory for millions of years, going through this process time after time. We call it a renewable resource, and so it is to us, but it might also be called "welltraveled."

Many public comments addressed, with varied terminology, the prospects of changing weather patterns. Setting political rhetoric aside, we know from history, research, and present-day experience that Nature ultimately retains power over our water supply and her weather patterns always change. In a sense it is amusing that we deem water molecules falling upon Utah's watersheds to be the "property" of the people of the state, but in so doing we refer to the social compact by which we allocate the resource during the brief segment of the water cycle during which humans have ability to intercept and use water. Our Utah reservoirs, canals, legal systems, etc., are designed and built based on our experience with past weather patterns.

Like the Anasazi and Fremont, we may be entering an era beyond our experience and the capability of our systems. If so, we may need to adapt in order to survive by making changes to our infrastructure and improving watershed management. Since the water stored in snowpack dwarfs all water stored in Utah's storage reservoirs, an extended period of abnormally warm weather that prematurely melts the snow away or causes more rain and less snow will leave farmers with water shortages, especially in the late summer months when crops typically need more water. Farmers and other water managers who have by necessity committed their budgets to our existing diversion structures, dams, and canals must then either adapt or perish.

Watershed management increases water supplies, prevents catastrophic fires and contributes to cooperative water planning.

Watershed management offers exciting opportunities as was noted in a number of public comments, especially the comments made on behalf of soil conservation districts and at the Price meeting. First, we need to learn from and correct some past mistakes. The "no burn" policy of the past 100 years created massive changes to our watersheds. When left to her own devices, Nature will use fire to periodically set back climax vegetation, cleanse away pinion and juniper trees, and thin stands of spruce, fir, and other taller species. In the near past, governmental agencies and others have too rapidly extinguished fires rather than letting them do their work, leading to overpopulation of various tree species. In our dry climate, there is not enough water for the additional trees. Now, overpopulated timber stands burn hotter due to fuel loads, dryness, and proximity. These catastrophic fires denude mountainsides of the vegetation that would

otherwise slow water and increase infiltration. Subsequent storms on these exposed soils increase erosion, produce debris flows, and cause damaging floods.

Public comment at two of the rural locations criticized federal land managers for the devastating combination brought by decades of "no-burn," followed by the current "let-it-burn" policy, and then refusing to allow local agencies to enter burn-scarred areas to conduct watershed rehabilitation. Unfortunately, heavy rainfalls events followed, causing loss of locally-funded infrastructure.

Watershed management, whether fire damage is involved or not, has produced good results. The Vernon Watershed Project and similar efforts have shown that selective re-vegetation, combined with other rehabilitative work, restores stream flows, improves water quality, increases the land's bearing capacity, and fosters diversification of plant and animal populations. Such projects produce the additional benefit of bringing stakeholders together to accomplish mutual goals and build trust among participants.[36]

- ***Agriculturists have proven to be innovative, creative problem solvers who can lend valuable training, hands-on experience, and integrity to meeting water challenges.***

- ***Recent years have seen increased attacks on water rights protections, some by policy makers who lack experience in water issues and some by individuals who act in their own selfinterest to the detriment of sound policy.***

Many comments offered assurance of public support for agriculture and its water needs. Many other comments illustrated the need for better understanding of agricultural water. Discussion during the breakout sessions of the various public meetings reflected concern about repeated attacks in the Legislature on certain aspects of water management, particularly mutual water companies. These efforts, seen as attacks on water company viability, have come from land development interests and not from agriculture.

Today's farmers and ranchers build on a long tradition of creative adaptation to change. Fortunately, today's farm managers possess the education, experience, and practical knowledge to lead efforts to meet future water challenges. Water is such a major input to the business of agriculture that most farmers have good, hands-on, working knowledge of water issues. The diminishing number of farmers caused both by farm consolidation and by farmland conversion to other uses suggests that those who remain in agriculture can benefit their own posterity and the larger public by lending their recognized creativity to water planning. Otherwise, it might be expected that policy will be driven by others and to the detriment of agriculture. As one producer stated, "Either you're at the table, or you're on the menu."

- ***The public comments strongly support Utah agriculture.***

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[36] For a more complete discussion, see *Conservation Partnerships: Indicators of Success,* Toupal, Rebecca S.; Johnson, Michael D., Social Sciences Institute Technical Report, February, 1998.

Multiple comments addressed the importance of agriculture to our culture as well as to the Utah economy. One topic raised in public comments should cause concern to all Utah residents: the connection between our security and our food supply. The comments generally acknowledged the absolute necessity that our country be self-sufficient in food production. While Utah currently imports most of its food supply, its status as part of the United States provides access to the most reliable supply of high-quality, low-cost food in world history. In 2012 U.S. agriculture was an economic powerhouse, generating net agricultural exports of $33.95 billion. Other comments expressed desire to maintain local food production because of food quality, food security, quality of life, and reliability in the event of transportation problems or other supply chain disruptions. A few comments addressed the energy savings and lower "carbon footprint" aspects of local food sourcing. Overall, the public comments strongly support Utah agriculture.

Public Comment

In addition to the public comments referenced above, here is a cross-sampling of comments, written and verbal, some quoted directly and others paraphrased, from the eight public meetings and online submissions.

- "Preserve farms."
- Water planning needs to be done on a watershed basis.
- Water conservation is vital and development must be based on sound science.
- Future water development must factor in water depletion and loss of return flow. For instance, the Sevier River system is 99% efficient already.
- "Our paradigms regarding the cost of food and water must change. It's all going to be more expensive."
- There should be more agricultural representation in the water community.
- "The Utah Division of Water Rights is underfunded; we [farmers] have to spend too much money to protect our [water] rights."
- "If we conserve water it just goes down the stream."

- Water banking is one method that can help agriculture retain its fair share of water [rights].

- “A higher percentage of people use water for drinking than for agriculture.”

- “We need to distribute water around the State so that population will spread out.”

- “Develop water where it’s at.” Small areas cannot protect “their water rights” against big cities and big money.

- We need comprehensive planning on a river basin approach to meet the challenges of the future.

- Open canal and ditch systems are very inefficient – we need to line or pipe these systems.

- “We are starving for funding just to maintain the systems that we already have.”

- Better water control systems “are pretty darn cheap” and save a significant amount of water.

- “It all comes down to funding.”

- Water education should be provided to those who do land use planning.

- “We need to educate people about water rights.”

- “This community was built on the backs of farmers and ranchers.”

- Water should be transferred from agriculture to other uses only by market transactions with a willing buyer and a willing seller.

- “We need to watch what happens on our watersheds.”

- We need to harvest dead trees to prevent catastrophic fires that destroy watersheds.

- "Individual shareholders [in a mutual water company] should not be able to separate their holdings in the company at the expense of the remaining shareholders."

- "[W]e need central, state planning of all future water uses."

- "Food is a vital part of any community."

- "Education, coordination, cooperation and involvement by bringing all interested parties that use and/or make water available need to come together to develop a unified plan for future demands on water resources."

- "Vigorously pursue … aquifer storage and recovery projects."

- "We need more reservoirs."

- "Converting ag water to support municipal and industrial [uses] is counterproductive, will take all ag water and still not be enough."

- "Since so much water goes to ag we should have less ag."

- "Agriculture and urban development can both participate as partners in solving water for the future."

- "[W]e urge you to actively call on … experienced agricultural producers and leaders to assist … in the planning process."

- Replace existing water duties with a duty based on buffalo grass and drip irrigation.

Recommendations

Key points

These key points summarize recommendations from public comments and additional materials provided by participants. Some points are discussed in more detail below.

Agriculture and ag water are essential to Utah's future economy and culture: Utah needs agriculture and agriculture needs water.

- *The vision for Utah's water future must include focused advocacy, good science, farreaching education, informed policy development, sound planning, and effective implementation in a cooperative setting.*

- *Agricultural water users and other key stakeholders must be responsible advocates for our future water needs.*

- *Our universities, public agencies, and private interests need to continue and even accelerate applied research.*

- *The Utah public and their policy makers need at least basic water resource knowledge before creating water policy, especially as related to agriculture. Water education should be a prerequisite for city planners, council members, county leaders, and legislators called on to make such policy decisions.*

- *Sound water policy must be science based and include a balanced understanding of all stakeholder needs.*

- *Proper watershed management requires cooperative, basin wide planning with all stakeholders.*

- *Invite the agricultural community to contribute its unique perspective and training to water resource planning.*

- *Adaptive methods can be used for sharing water from agriculture with municipal and industrial users, with more emphasis on resource sharing and less on permanent transfers.*

- *Programs which compensate land owners for private conservation activities, wetlands enhancements, development of water powered energy sources, and public water supply improvements can be less expensive and more effective than purely governmental activities.*

- *Significant water savings can be realized through programs where special interest organizations, cities, or other users invest in programs or facilities that help agricultural users reduce water use in return for lease or transfer of the retained water.*

- *Reliable funding is needed from public and private sources to replace aging infrastructure and to build new facilities, especially for conservation oriented improvements. Long lead times are needed to build good projects.*

- *Watershed management, especially improved vegetation management, will:*

o *increase water supplies and improve water quality,* o *avoid catastrophic fires, and* o *set back plant succession by safer and more cost-effective means than wildfires.*

- ***Cluster zoning can preserve ag spaces, thereby reducing the call for landscaping water while keeping that water in agricultural production.***

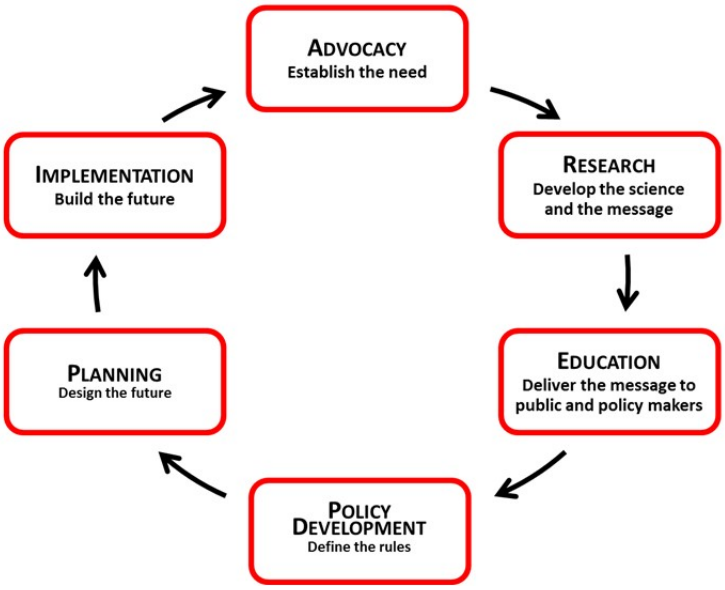
- ***Long-term protection of water rights is critical to encourage investment in technology, infrastructure and innovation, whether the water is used for agriculture or other uses.***

- ***Everyone benefits if agricultural users join with others in educating the public that agriculture provides stewardship of flora and fauna, critical open space, and other natural resources, including our aquifers, lakes, and streams***

Discussion

- ***Agriculture and ag water are essential to Utah's future economy and culture: Utah needs agriculture and agriculture needs water.***

Agriculture, the production of food and other essentials of life, must be a vital part of Utah's future. To accomplish this, we must have a balanced and wise water allocation that includes sufficient supply for agriculture now and in the future. Written submissions and comments at all meetings and from people of diverse interests asked that Utah protect water that will be needed for agriculture. In contrast, many others commented that transfers from agriculture would supply future urban water demands. Maintaining or increasing Utah agricultural production requires that we minimize or reverse the movement of water away from agriculture. A decrease in food production at a time of rapid population growth seems imprudent.



- ***The vision for Utah's water future must include focused advocacy, good science, farreaching education, informed policy development, sound planning, and effective implementation in a cooperative setting.***

Governor Herbert called for innovation as one of the four keys to Utah's water future. Need drives creativity in water management as in other human endeavors. During breakout sessions, discussions yielded good examples of creative water management methods used in other places to coordinate urban needs with agricultural production. In line with Governor Herbert's call for innovation, many expressed hope that new solutions could be discovered by Utah's water stakeholders.

Analysis of the written comments and public meeting discussions reveals a model that can drive the search for creative solutions. The model involves six steps or phases as depicted below. To accomplish the water innovations needed within our lifetimes, some of these steps will need to run concurrently. Also, the sequence might be modified to fit specific circumstances. It is imperative to view each step and the entire model as an iterative process in which lessons learned are then applied to create continous improvement. Experience may also suggest recruitment of additional stakeholders in later iterations. Finally, many comments, especially from experienced water managers, made clear that the entire process works best in a cooperative atmosphere. A few comments which reflected hard positions underscored the need for cooperative solutions and informed stakeholder engagement.

Agricultural water users and other key stakeholders must be responsible advocates for our future water needs.

It seems clear from the public comment that greater advocacy will be needed for even modest progress in water planning during the next 50 years. Gov. Herbert's water initiative is a good start, but the first challenge facing the water community is to demonstrate the need for the huge effort ahead, with all of its attendant costs**.** The urban dweller, whose focus will likely be on his or her own distinct contributions to society, might well be excused from realizing that their very existence depends on the ability of the agricultural producer and the water manager to manage in the face of Mother Nature's most severe challenges. The urban dweller cannot be held to understand how severe these challenges have become unless the story is told and told well.

Our universities, public agencies, and private interests need to continue and accelerate applied research.

Advocacy might well be directed toward new and additional research in these key areas:

- Improved technologies to obtain optimal water use within the portion of the water cycle accessible for human use, perhaps enlarging the segment in which water is available.
- Good data collection and understanding water mass balances to improve policy development, project planning and implementation, and water management effectiveness.
- Better understanding key water messages and how these may be best delivered to the public and policy makers.

- Improved decision making in water policy development and water management planning.
- Adapting agriculture and water infrastructure to changing weather patterns.

Research budgets, especially at our universtities, seem to be shrinking even as our need for greater water knowledge increases.

Utah public and their policy makers need at least basic water resource knowledge before creating water policy, especially as related to agriculture. Water education should be a prerequisite for city planners, council members, county leaders, and legislators called on to make such policy decisions.

The third element, education, has been actively and capably pursued by many farm groups, water agencies, a full range of media outlets, and others, yet the public both asked for more and demontrated a need for more. One idea advanced was for establishment of neighborhood experts through CERT or similar programs. Among the messages should be the current nature of agriculture and its water needs. Public perceptions of agriculture often seem to be 50 to 100 years out of date.

Sound water policy must be science based and include a balanced understanding of all stakeholder needs.

The fourth step is policy development. Like the other steps, success improves with cooperation, a strong knowledge base, and involvement of all affected stakeholders. Public comments, especially at the rural area meetings, were sometimes pointed about the lack of water expertise demonstrated by various levels of government where water policy is established. One offered solution, from a quite serious commentator, was to require water knowledge certification for any public official wanting to set rules that affect agriculture and its water supply. A better solution offered was for key water agencies to provide objective, basic training on water rights and water issues to newly elected officials. One person commented during a breakout in a rural area, with consent of others in the group, “They [making reference to a policy-making body] don’t have anyone who knows water and they’re not listening to us.”

Proper watershed management requires cooperative, basin wide planning with all stakeholders.

The fifth step, planning, requires a foundation of good science, good policy, and broad participation. Comments from the Utah Department of Agriculture and Food and various Soil Conservation Districts pointed to research findings that the most effective projects are planned and implemented through broad based participation. A welcome number of comments addressed the need for basin-wide planning involving all stakeholders. In the past, stewardship decisions such as the location, scope, design, and funding of infrastructure or allocation of water supplies

sometimes involved only a narrow range of interests. There is now a healthy trend of recruiting all relevant stakeholders when planning and implementing projects. This improved cooperation lends strength to shared values such as protecting water rights, conservation, wise responses to growth, environmental protections, and aquatic and riparian habitat enhancement. Experience suggest that this cooperative approach creates greater decision costs, but reduces litigation and other costs of conflict and provides more comprehensive solutions. This in turn increases water use efficiency and gives opportunities to distribute project costs over a larger user base. These larger constituencies can also generate greater political energy and effectiveness at the local, state, and regional level. Research on the Vernon Watershed Project cited involvement of 29 cooperating stakeholders as a critical key to its success. The inclusive approach has repeatedly proven to be effective in Washington County Water Conservancy District projects, the Provo Reservoir Canal Enclosure Project, the Wasatch County Water Efficiency Project, and in numerous other settings.

- ***Invite the agricultural community to contribute its unique perspective and training in planning and implementing water management programs and projects.***

All the previous steps have little value without implementation. Implementation produces the final product; it is the test of whether the other steps have been effective. In this light, two comments deserve special mention. First, various people commented that agricultural producers, both farmers and ranchers, deal with water issues on a daily basis and that they receive water management training from serving on water company and irrigation district boards, soil conservation district boards, formal university study, etc. They can contribute this knowledge and their hands-on, common sense experience at all stages of this model. Second, other comments also highlighted the need to train future water leaders and to pass on knowledge to future generations.

Additional ideas from public comments and materials submitted:

- ***Adaptive methods can be used for sharing water from agriculture with municipal and industrial uses, with more emphasis on resource sharing and less on permanent transfers.***

Past transfers of Utah water from ag to urban or industrial use have mostly been permanent transfers, largely through water rights purchases, but other, less permanent transfers can also be accomplished in the marketplace. These may be as simple as a municipal user leasing water in years of high demand, while leaving the water available for agricultural use in other years. Such “fallowing agreements” are in common use.

- ***Experience has proven that programs which compensate land owners for private conservation activities, wetlands enhancements, development of water powered energy***

sources, and public water supply improvements can be less expensive and more effective than purely governmental activities.

The Colorado River Basin Salinity Program projects in Emery County provide excellent examples of private and public partnership. To reduce salt loading in the Colorado River, the Bureau of Reclamation entered agreements with stockholder-owned water companies in Emery County under which the companies replaced open ditch and flood irrigation systems with pipelines and sprinkler systems. This significantly reduced salt-laden return flows to the Colorado River and at lower costs per ton of salt removed than other methods such as the Yuma desalinization plant.

- ***Significant water savings can be realized through programs where special interest organizations, cities, or other users invest in programs or facilities that help agricultural users reduce water use in return for lease or transfer of the retained water.***

There were well-informed public comments describing arrangements under which municipalities and others agencies provided funds to improve farm water conveyance systems and the water previously lost from these systems is then made available for urban uses. The projects mentioned are in other states and in the Central Utah Water Conservancy District. Such arrangements require care to avoid consuming more water than the affected agricultural rights allow, but when done properly benefits all participants.

- ***Reliable funding is needed from public and private sources to replace aging infrastructure and to build new facilities, especially for conservation oriented improvements.***

In nearly every meeting people described proposed projects to build new dams or other structures and systems or to replace old ones, but funding restraints hinder progress. Many of the proposed systems focused on water conservation. Water users commonly said the biggest obstacle to such systems is funding, especially in an era where federal funding has been greatly diminished. The proposed systems described are mostly single or limited purpose systems. Broadening participation may provide an answer, as well as dedicated funding sources which allow water projects to bid for available funds by demonstrating economic returns to an area and suitable benefit/cost ratios. Utah might also create greater opportunities for more private construction and funding of water infrastructure.

- ***Cluster zoning can preserve ag spaces, thereby reducing the call for landscaping water while keeping that water in agricultural production.***

Cluster zoning, sometimes referred to as "density-transfer," allows grouping of houses or other dwelling units while preserving open spaces. For example, a county may require overall density of five acres per lot or per dwelling unit, but allow grouping of eight dwelling units in a small portion of a 40 acre parcel while requiring the balance of the property to remain as open space.

This is hardly a new idea, but has interesting implications for water management. First, the designated open space can remain in farming. Second, more water remains in agriculture under this arrangement. Third, clustering houses allows for more compact and less costly infrastructure.

- ***Watershed management, especially improved vegetation management, will:*** o ***increase water supplies and improve water quality,*** o ***avoid catastrophic fires, and*** o ***set back plant succession by safer and more cost-effective means than wildfires.***

As noted above, the Utah Department of Agriculture and Food, the Utah Department of Natural Resources, and others provided insightful comments on the related topics of watershed management and preventing catastrophic fires. Utah has been plagued in recent years by many catastrophic fires. The frequency of such fires has been increased by proliferation of exotic plant species, especially cheat grass, and by a century of fire suppression that has disrupted natural set back of climax species. One comment read, "Watershed health and improved stream flow are the same thing."

Funding for watershed management is available through Cooperative Resource Management plans, under which state funds and USDA Natural Resources Conservation Service matching funds are available. Local staff at conservation districts can be the "foot soldiers" for the local leadership in the basin-wide planning efforts that will be necessary to plan and implement successful watershed management and enhancement projects. The value of these projects cannot be overstated. They are the most effective means, as noted above, to reverse the man-made conditions that have brought on catastrophic fires, enhance the ability of our watersheds to capture water into surface and groundwater supplies, enhance water quality, improve riparian and aquatic habitat, and provide cooperative undertakings that increase trust and experience among water stakeholders with varied interests. Enlarging on this last point, they also provide practical training for future water managers and policy makers. These projects are perhaps the only generally accepted method of increasing human interaction with the overall water cycle.

- ***Long-term protection of water rights is critical to encourage investment in technology, infrastructure and innovation, whether the water is used for agriculture or other uses.***

The need to protect ownership of water rights was raised many times during the breakout sessions and in written comments. It is probably the most critical policy issue and has many faces. Quite simply, our state will not see the needed level of investment, public or private, whether in water infrastructure or the wide range of human activity that depends on water, unless we protect the certainty of underlying water rights. Some commented rather forcefully that water is a social resource and the right to use it should not be the subject of private ownership. These comments not only ignore the cumulative wisdom of 165 years of water management in Utah and the fact that water rights are constitutionally protected, but also the fact that the market place will not interact with a water allocation system that is slow, uncertain, or too costly. It must be

stated that our water rights system has performed well, that the water community has worked diligently to bring water policy into line with current needs, and we have neither the political will nor the time to reinvent that system given the rapid growth facing our state.

The water economy creates value in ways not always easily measured by the market economy. The market economy provides its measure of water rights value, the cost of infrastructure, etc., but it does not measure well the value of society's absolute reliance on water. We measure the cost of building and maintaining irrigation reservoirs and water delivery systems, but we struggle to apply market economy measures to water allocations among sub-basins in a river system or the impact of proposals such as the Southern Nevada Water Authority's Eastern Nevada Pipeline project where proponents argue that water in Las Vegas creates more jobs per acre foot, but does not support basic food production. We can be caught in the trap of assigning high value to water removed from a mutual water company's system to a use for which the market economy pays more, but not the impact to the other water users in that system. In short, we have much to learn before we can model the optimal utilization of water for human need and the environment.

We know, however, that the billions invested in water infrastructure throughout the state form an essential foundation to our state's economy, whether measured by water use or by the market. When we move foundation stones, we must anticipate that we will shake the entire structure. We should not take water away from a farmer's field, intentionally or unintentionally, whether by regulatory activity or by other means, without first understanding the ripple effect through our culture, our economies, and the ecosystem that has grown up around the existing water use. This same restraint should be applied whether the water is used to produce turkeys in Sanpete County, milk in Cache and Millard counties, or cherries in Utah County. Weakening water rights for agriculture weakens water rights for all other users.

We will be wise to open careful, balanced discussions on many ideas raised so far in this process. Utah might benefit from concepts such as allowing agriculture to "bank" water rights needed for future expansion of agriculture, allowing additional private-public sharing of water resources and water development costs, developing better decisions-making algorithms for water basin planning with all stakeholders, etc. We have much work to do and many hard questions to answer. We must ultimately ask: if our population continues to grow, will we protect the water rights needed for agriculture to not only sustain, but also to expand the production of food and other commodities needed by our these new residents, whether they are our children or those who relocate here to enjoy the Utah lifestyle?

Conclusion

Utah needs agriculture, Utah agriculture needs water, and Utah's water future needs the creative engagement of Utah's agricultural community with all other committed participants. The process begun here will greatly benefit Utah agriculture during the next 50 years and longer. We want to learn from the Anasazi, the Fremont, and the others who lived before us by wise management of

Utah water. The Utah public has spoken and the answer is clear: We want our story to be one of sustainability and success.

Securing Utah's Water Future:

Funding Water Infrastructure Growth and Development

By Dennis Strong

Issue Overview

One of the most pressing questions regarding water infrastructure development projects is how to fund them. In recent years, funding has been secured through both commercial and state and federal government loans, state and federal grants, as well as cash received from water rates, taxes, and fees. These funding sources are likely to remain the same in the future. Nevertheless, available money for federal loans and grants will probably decline because federal funding is generally decreasing, and for water projects, in particular, the reduction has already begun. In fact, federal participation in the state revolving funding programs administered by the Utah Department of Environmental Quality is down from last year. Likewise, although state funding for water projects is expected to continue at its current level, pressure on the state budget and calls to increase water rates cause uncertainty even regarding state funding.

Typically, municipalities build into their revenue streams sufficient funding for water works operation and maintenance, but often not for capital projects. Most water purveyors are inclined to borrow money to build the majority of their water infrastructure and water development projects. There are a few cities, which routinely set aside funds, or develop reserve funds for future water development projects, but they are the exception. For example, when a city needs to replace a water tank, it usually issues a bond or takes a loan to cover the replacement costs. This philosophy of borrowing is often attributed to the public's reluctance to see cities or water providers with hefty surplus funds in reserve accounts, even for anticipated projects.

Another area of concern is the fact that water rates often do not have a set minimum charge to cover debt and fixed operating costs. When this is the case, some expenses must be covered by other revenue sources, such as property taxes, impact fees, and water sales. In order to avoid this predicament, it would be a good practice to enact a base water rate that covers not only debt and all fixed costs but also additional expenditures associated with providing water, including power, chemicals, operation, and maintenance, as well as replacement of existing systems.

In an effort to reduce costs, some water and wastewater providers across the United States have contracted with private companies to maintain and operate their water and wastewater systems, attempting to replicate the successful public-private partnership model for operating toll roads. States that have experimented with this approach, however, have used it in a narrow capacity with limited success. To date, this option has not been tried in Utah. Nevertheless, the concept of

public-private collaboration may have promise in some areas in our state. Studying further this strategy's potential for maintaining water management facilities adequately and meeting public needs successfully in the long term will be a worthwhile undertaking.
Planning and building for growth are serious challenges for municipalities. For example, when a city's water system reaches its maximum capacity and new connections cannot be added until the system is expanded, the city is faced with the necessity of planning and constructing water projects to ensure adequate water and infrastructure. Then, the question of how to pay for the expansion arises. Usually, cities try to find the cheapest option for providing more water. One possibility may be to construct a new well as an additional water supply that may provide water for several years of growth and require a loan that is repaid over 10 to 20 years. Another option may be to purchase water, with little or no concern over funding.

In the past, water users have been willing to accept small increases to their rates to pay for the cost of providing small-scale system capacity for growth. The idea is that "We all drink from wells we did not dig." In fact, new connections to an existing water system are frequently paid for by funds past and current water users provided in fees. However, we must consider what is fair to existing customers and residences: should they be charged for the cost of providing water for growth? Whether or not it is time to change this method of funding and providing water system capacity is at the forefront of the public dialogue among various stakeholders.

When cities are faced with constructing a dam or moving water over long distances, the costs are too high to consider using traditional funding methods, such as current water user fees. To deal with large water development projects that can provide a water supply to multiple users for up to 50 years, the State of Utah passed legislation, creating water conservancy districts. In the past, water conservancy districts have partnered with the federal government to take advantage of federal water funding programs that were developed for the purpose of helping finance large scale water projects for growth. In the West, the United States Bureau of Reclamation has worked with water conservancy districts to provide long term, low interest rate funding for water development. Projects, such as the Central Utah Project, the Colorado River Storage Project, and the Weber Basin Project are notable accomplishments that resulted from this partnership. More recently, water projects like the Quail Creek and Sand Hollow dams in Washington County, and the Provo River Enclosure Project in Utah and Salt Lake counties have been financed using state funding programs. Funds for these projects are repaid over extended periods of time at subsidized interest rates. Repayment of both the state and federal assistance is made not only using water user rates and fees but also with property taxes, authorized by legislation. In fact, the use of property taxes is inherent in the current funding philosophy for large water projects and has become the preferred method of reducing the burden on current water users to pay all the cost of future growth. Using property tax to repay part of the cost of funding large water projects is currently being questioned by some members of the public and some legislators. If the property tax is eliminated as a funding source, it may have a negative effect on municipalities' capacity of providing water for growth.

How to adapt to the future begins with evaluating growth. Utah has promoted and encouraged growth in the past. If that trend continues, the demand for building infrastructure to provide and deliver water and to treat wastewater will persist. Water use will, in fact, depend on both domestic customers' needs, as well as the type of businesses and industries that will be developed. In many cases, decisions must be made on water use rates before it is determined how much water and what facilities are needed.

A basic beginning for determining how much water will be used is to identify who will decide what Utah communities will look like and what industry will be allowed. Those decisions are currently made at the local or county level of government. However, when the cost of water becomes so expensive that state resources are needed to finance large water projects, should the state dictate precedent conditions? If the state does extend its current funding for water and wastewater, should it also set policy on how water is used, where it is used, and under what conditions the state will provide funds? Is it in the best interest of the state to assist in funding water projects that are beyond the financial ability of the local provider of water?

Because current funding methods have functioned well for many years, any changes must be considered thoughtfully and carefully. The likelihood of federal and state funding sources staying at the current levels in the future must be considered. The use of property tax is being questioned by some, and its role in funding needs to be analyzed. The federal government's role in financing large water projects where the water may not be fully used for many years seems to be ending; how will that loss of funding be addressed?

Summary of Public Input

During the public comment period, a total of 577 comments were received regarding the maintenance and future infrastructure of water projects in Utah. The comments were made either during the public meetings held across the state, or they were submitted in writing by email, online on the Governor's website, or by mail. These comments, which addressed a wide array of issues related to water, were categorized to ensure that each comment was delivered to the correct expert(s). In fact, nearly all of the comments addressed multiple issues facing Utah's water future, with 420 comments relating to funding.

Across the board, the submitted comments agreed that more needs to be done to conserve water. Water conservation was mentioned in 65% of the submitted comments. The most common conservation measure suggested by 19 percent of people was changing from a lawn to a xeriscaped (water wise) landscape. Another popular suggestion (9%) was to provide incentives or tax breaks to people who implement water conservation measures, such as changing landscaping, adopting more efficient irrigation measures, or using water-saving appliances. The next three most commented subjects were increasing the cost of water/rate structure, educating

public on conserving water, and changing regulation/city ordinances to encourage conservation. The submitted comments for conservation ideas are displayed in Table 1.

Table 1. Conservation measures suggested by the public

Conservation Measures	Number of comments	
Landscaping change	80	19.0%
Incentives/tax break	36	8.6%
Water cost/ rate structure	32	7.6%
Education	26	6.2%
Regulations/city ordinances	26	6.2%
Fines/enforcement	18	4.3%
Fix government/parks/churches/business landscaping/irrigation	17	4.0%
Secondary water (billing/metering)	12	2.9%
No water in property taxes	10	2.4%
Slow the Flow/water conservation message	10	2.4%
Water Use Bills - conservation based	3	0.7%
Implement water abuse hotline	2	0.5%
Conservation sprinkler certified installers	1	0.2%
	273	65.0%

The need to develop more water supplies was stressed in 42% of the comments. The ways to develop these supplies included creating new reservoirs/pipelines (10%) and water reuse systems (28%), harvesting rainwater (2%), developing ASR and other well projects (1%), and seeding clouds (1%). Aging infrastructure was a concern in 11% of the comments while the funding needed to replace/repair this infrastructure was stated in 4% of the comments.

The concern with or complete rejection of developing water supplies through the Lake Powell Pipeline and Bear River projects were expressed in 30 % of the comments. It was also suggested in 6% of the comments that there ought to be no growth or only limited growth beyond what the current water supply can support. According to 26% of the comments, no water or a limited amount of water ought to be used for energy projects, such as a nuclear power plant, hydraulic fracturing, or tar sands.

Table 2 displays a number of additional ideas that received five or fewer comments.

Table 2. Additional submitted comments

Main idea	Number of comments	
No Snake Valley pipeline	5	1.2%
Need more data (water use, supply)	5	1.2%
Increase beaver population	4	1.0%
Growth where water is/ no transfer water	4	1.0%
Private water market	2	0.5%
No water intensive agriculture	2	0.5%
Don't do anything	1	0.2%
Revise Colorado River Compact	1	0.2%
Utah Indian water compact	1	0.2%
Products		
Hot water circulation systems	3	0.7%
ET Controllers	2	0.5%
Bio Char	1	0.2%
Hydrophonic Gardening	1	0.2%
NO DES	1	0.2%
Moisture Sensors	1	0.2%
Water saving toilets (no auto flush)	1	0.2%
Operation Change		
Maximize our water resource/ work together	3	0.7%
Fill Lake Mead first	1	0.2%
Change municipal utilities/irrigation co. to revenue neutral state program	1	0.2%

Recommendations Based on Public Input

The following outline is provided as a guide to help move forward in determining how to fund water and wastewater facilities:

1) Local water users and government should decide what their communities look like.

2) Water and wastewater use rates should pay the majority of the costs to provide service. In addition, the following issues ought to be considered as part of the user rates/fees:

a) Having a minimum charge to cover the cost of operation, maintenance, and debt.

b) Including replacement costs and a part of the cost for growth.

c) An over-use fee to encourage wise water use; this part of the rate should be based on a reasonable amount of water to meet both inside and outside (landscape watering) needs.

3) Local government leaders and water providers need to be educated about the importance of having reserve, replacement and growth funds. A state law must allow for the accumulation of those funds.

4) Impact fees should be charged to offset some of the cost of growth.

5) Water and wastewater providers should share facilities and resources.

6) Water and wastewater projects should be phased when possible to reduce the cost to current users.

7) Public/private partnerships should be considered for funding projects and operating facilities.

8) The state and local water providers should look at current funding sources and determine what works and what does not work and make improvements when needed.

9) The state, with input from the public, should consider its responsibility and role in providing long-term (50 years) low-rate water financing resources for water and wastewater projects that provide service over a long period of time and must be constructed at full capacity to meet demands of future growth.

APPENDIX C: YOUR UTAH YOUR FUTURE SUMMARY

B A C K G R O U N D :

PROCESS FOR CREATING THE VISION

To create a vision for the future of water in Utah, a team of experts gathered over a two-year period to share knowledge and extensively research and discuss options for Utah's water future. Members of the State Water Strategy Advisory Team were selected by Governor Gary Herbert and Envision Utah to represent a spectrum of professional experience and political affiliations. Team members included water supply managers, legislators, administrators, farmers, professors, attorneys, advocates, and others from across the state. From 2013 to 2015, the team met to identify Utahns' choices related to water, create scenarios for public input, and synthesize a vision for the future. The State Water Strategy Advisory Team was also tasked with developing a proposed 2060 State Water Strategy, which may contain more detailed strategies than are included in this 2050 vision. The process of creating this vision also consisted of the following components:

1. *A 2014 Values Study*

   This study was conducted by Heart+Mind Strategies to identify **(1)** what factors Utahns view as affecting their quality of life the most and **(2)** the underlying emotions and values tied to those factors. The study determined that Utahns view water as a top priority in the state because it is linked to many of the quality-of-life factors that are most important to Utahns. The study also found that Utahns want to ensure there is an adequate supply of clean, affordable water for a variety of needs (agriculture, population growth, jobs, environment, etc.).

2. *The "Build Your 2050 Utah" Web App*

   This app allowed Utahns to identify behaviors and activities that affect water consumption and supply and interactively learn about the outcomes of making changes to those behaviors. More than 3,000 people across the state gave input through the app. Most expressed that water conservation should be a top priority in order to save water for other uses. Most participants also voiced that climate change should be considered when making decisions concerning the future of

the state.

WHY WATER MATTERS:

UTAHNS' VALUES

The 2014 Values Study, conducted by Envision Utah and Heart+Mind Strategies, found that Utahns not only care deeply about water, but that they attach a number of key emotions to its availability. Utahns want clean water to sustain human life and protect the environment; they also want sufficient water to grow food, communities, and the economy.

Utahns primarily value having safe and secure communities, a strong economy with an affordable cost of living, and beautiful surroundings in which to enjoy time with family and friends. Water—and how we manage it—affects all of these three overarching values. Safe, clean water improves Utahns' sense of security. Affordable water that is available for a variety of uses promotes economic growth. And plentiful, clean water in lakes and streams supports habitats and recreation.

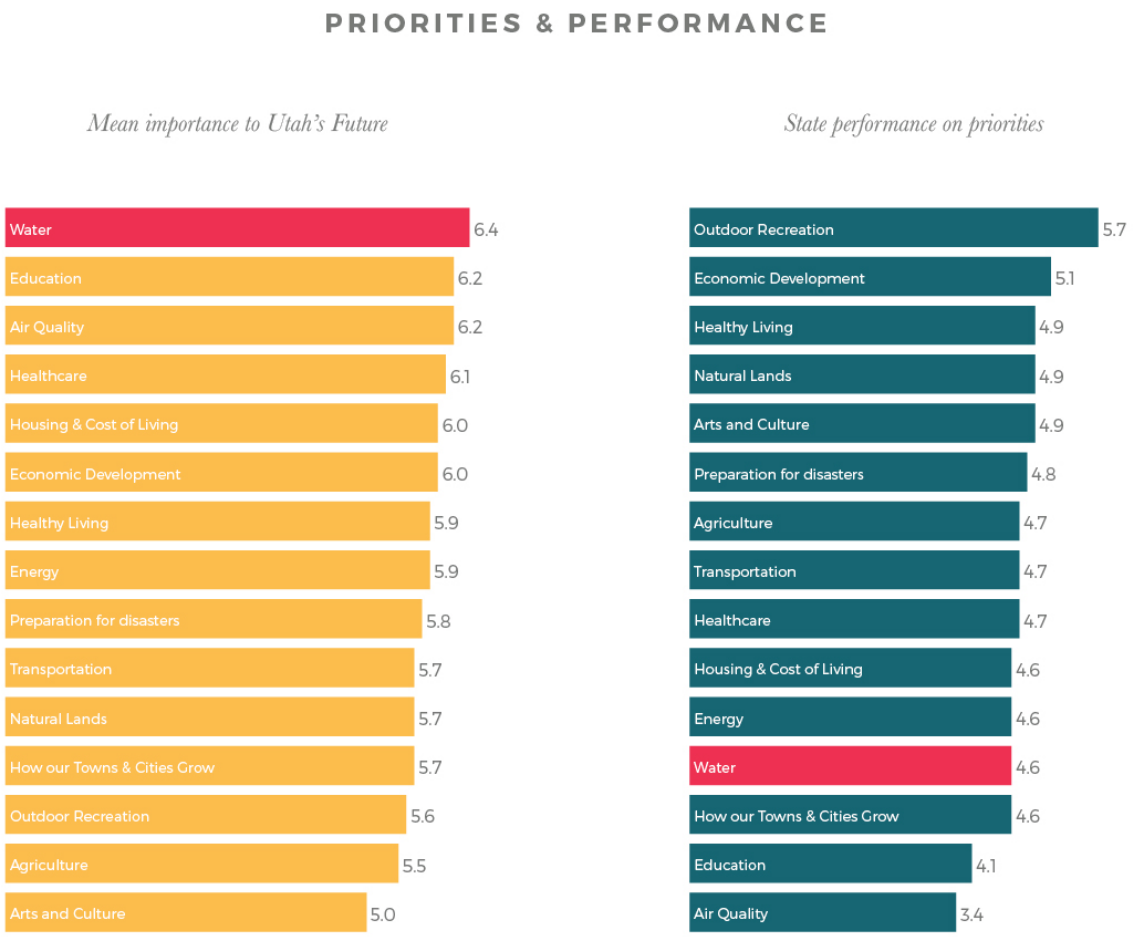
Specifically concerning water, Utahns value having plentiful, readily available, and affordable water for a variety of economic uses, with strong emphasis on local food production and community growth. They believe this will lead to economic growth, better communities, and financial security. They also value having clean water to sustain Utah's natural beauty and improve the environment for plants and wildlife. This creates a feeling of responsible stewardship of natural resources and the planet.

WATER & FINANCIAL SECURITY

"I want water strategies that ensure plentiful water for food production, community growth, and economic development. Readily available water leads to a lower cost of living, better communities, and a sense of financial security."

WATER & STEWARDSHIP

"I want clean water for nature and the environment because it sustains life and contributes to healthy living. This makes me feel like a better steward of my state and leads to less stress and a sense of enjoyment."



SURVEY RESULTS

In April and May 2015, 52,845 Utahns shared their voice through the *Your Utah, Your Future* survey. This survey presented a variety of outcomes for the future of water in our state organized into scenarios, and backed by the research of the State Water Strategy Advisory Team and the Envision Utah Values Study. Participants chose their favorite scenarios for water and other topics. After choosing their favorite scenarios, survey participants had the option to answer a series of questions to prioritize water among other issues, determine the most important outcomes related to water, and identify how willing they would be to take specific actions to ensure those outcomes. The survey results were cross-checked against a random-sample survey to ensure they represented the desires and opinions of Utahns.

WHAT UTAHNS WANT

Utahns consistently rate water as one of the state's top three priorities for 2050. On average, Utahns prefer to reduce overall consumption by 23% per capita between now and 2050. Because we have already

conserved significantly over the past several years, this additional conservation effort would result in over 35% less water use per person between 2000 and 2050. Utahns want to build regional water development projects, but after taking significant measures to delay them through conservation. Utahns are not willing to shift significant amounts of water from agriculture to urban uses or remove all grass from their yards or open spaces.

WHY THEY WANT IT

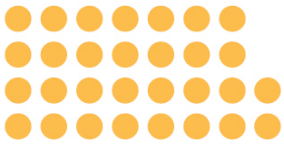
Utahns want to balance water demands so that future generations (their own children and grandchildren) have sufficient water for their families, the economy, food production, wildlife, and recreation.

WHAT THEY ARE WILLING TO DO

Utahns are very willing to take significant steps to reduce how much water they use, even at some personal expense, including changing their landscaping and irrigation systems, having smaller yards, and having less grass in yards, public parks, and other open spaces. They are also willing to fund the development of local and large-scale water projects after making significant conservation efforts.

WHY UTAHNS WANT IT
(OR WHAT OUTCOME UTAHNS EXPECT FROM WATER)

Survey participants were asked to allocate 100 points across these outcomes based on which they considered most important.



30%

Ensuring there is plenty of water for farms and food production

24%

Ensuring there's plenty of water in our streams and lakes for wildlife

13%

Ensuring there's plenty of water in our streams and lakes for recreation

12%

Limiting how much we need to spend maintaining our yards

10%

Minimizing how much we need to spend on water infrastructure (pipes, reservoirs, etc.)

8%

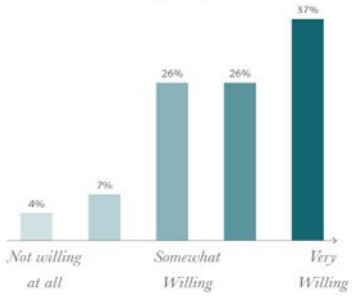
Ensuring we have sufficient grass and other greenery in our yards, parks, and other landscaping

3%

Ensuring we have large yards

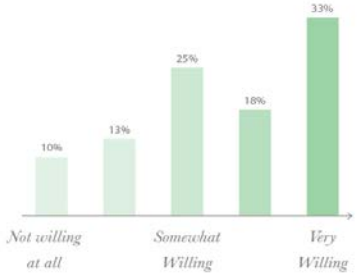
WHAT UTAHNS ARE WILLING TO DO TO CONSERVE WATER

We will have to spend money on changing and maintaining our landscaping and irrigation systems (e.g., installing and maintaining drip irrigation systems).



In our yards, parks, and other landscaping, we will have less grass and other vegetation that uses a lot of water.

Our homes will need to have smaller yards.



APPENDIX D: RESOURCE AND REFERENCE LISTS

Resource and Reference List for Key Policy Question 1

National Organizations for Water Efficiency Resources:

Alliance for Water Efficiency:
http://www.allianceforwaterefficiency.org/

American Water Works Association:
https://www.awwa.org/

Irrigation Association:
https://www.irrigation.org/

Pacific Institute:
http://pacinst.org/

US EPA WaterSense:
https://www.epa.gov/watersense

Water Research Foundation:
http://www.waterrf.org/Pages/Index3.aspx

Western Resource Advocates:
http://westernresourceadvocates.org/

Water Smart Innovations:
https://watersmartinnovations.com/about-us.php

Western States Water Council:
http://www.westernstateswater.org/

Selected Literature:

Alley, W. M., Evenson, E. J., Barber, N. L., Bruce, B. W., Dennehy, K. F., Freeman, M. C., . . . Verdin, J. P. (2013). *Progress Toward Establishing A National Assessment of Water Availability And Use* (1384). Retrieved from: http://pubs.er.usgs.gov/publication/cir1384

Alliance for Water Efficiency. (2015). *An Assessment of Increasing Water-Use Efficiency on Demand Hardening*. Allicance for Water Efficiency, Chicago, IL. Available at:
http://www.allianceforwaterefficiency.org/dhreport.aspx

Alliance for Water Efficiency, American Rivers, Environmental Law Institute. (2011). *Water Efficiency for Instream Flow: Making the Link in Practice.* Available at:
http://www.allianceforwaterefficiency.org/watereffc-instream-flow-proj.aspx

American Council for an Energy-Efficient Economy, Alliance for Water Efficiency. (2011). *Addressing the Energy-Water Nexus: A Blueprint for Action and Policy Agenda.*
Available at: http://aceee.org/white-paper/addressing-the-energy-water-nexus

Bateman, M., Teigen, S., & Kroes, S. H. (2014). *Flowing Toward 2050: Utah's Water Outlook* (723). Retrieved from: http://www.utahfoundation.org/uploads/rr723.pdf

Beckwith, D. (2009). *New House New Paradigm: A Model for How to Plan, Build, and Live Water-Smart*. Retrieved from: http://westernresourceadvocates.org/publications/new-house-new-paradigm/

Beecher, J., & Chesnutt, T. (2012). *Declining Water Sales and Utility Revenues: A Framework for Understanding and Adapting.* A White Paper for the National Water Rates Summit, August 29-30, 2012, Racine, WI. Sponsored by the Alliance for Water Efficiency and the Johnson Johnson Foundation. Available at: http://www.allianceforwaterefficiency.org/declining-sales-and-revenues.aspx

Bruce, B. W., Hardin, D., Young, D., Pring, J., Paeglis, L., Clay, L., & Maupin, M. (2014). *Western State Water Program Capabilities Assessment Survey & Report*.
Available at: http://www.westernstateswater.org/state-capabilities-assessment-workgroup/

Christiansen, W. (2015). *Water Offset Policies for Water-Neutral Community Growth: A Literature Review & Case Study Compilation*. Alliance for Water Efficiency, Chicago, IL.
Retrieved from: www.allianceforwaterefficiency.org/water-offset-report-Jan-2015.aspx

Cooley, H. and R. Phurisamban. (2016) *The Cost of Alternative Water Supply and Efficiency Options in California*. Pacific Institute, Oakland, CA.
Available at: http://pacinst.org/publication/cost-alternative-water-supply-efficiency-options-california/

Cooley, H., Cohen, M., Heberger, M., & Rippman, H. (2015). *Incentive-Based Instruments for Water Management*. A joint report by the Pacific Institute and the Rockefeller Foundation. Retrieved from: https://assets.rockefellerfoundation.org/app/uploads/20160208145427/issuelab_23697.pdf

DeOreo, W. B., Mayer, P. W., Dziegielewski, B., & Kiefer, J. C. (2016). *Residential End Uses of Water, Version 2* (4309b). A report by the Water Research Foundation.
Retrieved from: http://www.waterrf.org/PublicReportLibrary/4309A.pdf

Dziegielewski, B., & Kiefer, J. (2010). *Water Conservation Measurement Metrics, Guidance Report*. Report by the Water Conservation Division Subcommittee of the American Water Works Association. Retrieved from:
http://www.awwa.org/Portals/0/files/resources/resource%20dev%20groups/tech%20and%20educ%20program/documents/WaterConservationMeasurementMetricsGuidanceReport.pdf

Heberger, M., Donnelly, K., & Cooley, H. (2016). *A Community Guide for Evaluating Future Urban WaterDemand*. Pacific Institute, Oakland, CA. Retrieved from:
http://pacinst.org/app/uploads/2016/08/ACommunity-Guide-for-Evaluating-Future-Urban-Water-Demand-1.pdf

Maupin, M. A., Kenny, J. F., Hutson, S. S., Lovelace, J. K., Barber, N. L., & Linsey, K. S. (2014). *Estimated Use of Water in the United States in 2010.* US Geological Survey, US Department of the Interior. Circular1405. Available at: http://pubs.er.usgs.gov/publication/cir1405

Mount, J., Gray, B., Chappelle, C., Doolan, J., Grantham, T., & Seavy, N. (2016). *Managing Water for the Environment During Drought: Lessons from Victoria, Australia*. Public Policy Institute of California, Water Policy Center. Retrieved from: http://www.ppic.org/content/pubs/report/R_616JMR.pdf

Scarlett, P. L., Boyd, J. W., Brittain, A., Shabman, L. A., & Brennan, T. J. (2013). *Catalysts for Conservation: Exploring Behavioral Science Insights for Natural Resource Investments*. Report by Resources for the Future, Washington, D.C. Available at: http://www.rff.org/research/publications/catalystsconservation-

exploring-behavioral-science-insights-natural-resource

U.S. Bureau of Reclamation. (2012). *Colorado River Basin Water Supply and Demand Study. TechnicalReport C – Water Demand Assessment*. Available at: https://www.usbr.gov/lc/region/programs/crbstudy/finalreport/

U.S. Bureau of Reclamation. (2015). *Colorado River Basin Stakeholders Moving Forward to Address Challenges Identified in the Colorado River Basin Water Supply and Demand Study – Phase 1 Report*. Available at: https://www.usbr.gov/lc/region/programs/crbstudy/MovingForward/Phase1Report.html

U.S. Environmental Protection Agency (EPA). (2016a). *Best Practices to Consider When Evaluating Water Conservation and Efficiency as an Alternative for Water Supply Expansion*. (EPA-810-B-16-005). Retrieved from: https://www.epa.gov/sites/production/files/2016-12/documents/wc_best_practices_to_avoid_supply_expansion_2016_508.pdf

Young, R. (2013). *Saving Water and Energy Together: Helping Utilities Build Better Programs*. Report by the American Council for an Energy-Efficient Economy and the Alliance for Water Efficiency. Available at: http://aceee.org/research-report/e13h

Young, R. (2014). *Watts in a Drop of Water: Savings at the Water-Energy Nexus*. An American Council for an Energy-Efficient Economy White Paper. ACEEE, Washington, DC. Retrieved from: http://www.ourenergypolicy.org/wp-content/uploads/2015/07/watts-in-drops.pdf

Young, R. (2015). *A Survey of Energy Use in Water Companies*. An American Council for an Energy-Efficient Economy White Paper. ACEEE, Washington, DC. Retrieved from: http://www.nawc.org/uploads/documents-and-publications/documents/2015%20Water-Company-Energy-Use.pdf

Young, R., & Mackres, E. (2013). *Tackling the nexus: Exemplary programs that save both energy and water*. Report by the American Council for an Energy-Efficient Economy and the Alliance for Water Efficiency. Retrieved from: http://www.allianceforwaterefficiency.org/uploadedfiles/news/newsarticles/aceeeawe-report-e131.pdf

Resource and Reference List for Key Policy Question 4

Barnett, T.P. and D.W. Pierce, 2008, When will Lake Mead go dry?, *Water Resources Research* 44(3):W03201, DOI: 10.1029/ 2007WR006704.

Castle, S.L. et al., 2014, Groundwater depletion during drought threatens future water security of the Colorado River Basin, Geophysical Research Letters 41(16):5904-5911, DOI: 10.1002/2014GL061055.

Colorado River Basin Water Supply and Demand Study. Study Report. December 2014.

Powell, J.L., *Dead Pool: Lake Powell, Global Warming, and the Future of Water in the West* (University of California Press, 2009).

Technical Memorandum 86-68210-091. *Literature Synthesis on Climate Change Implications for Reclamation's Water Resources.* Prepared by Technical Service Center, Water Resources Planning and Operations Support Group, Water and Environmental Resources Division.

Technical Memorandum: Lake Powell Pipeline Hydrologic Modeling - Draft. Upper Colorado Region, Salt Lake City, UT. September 2015.

Udall, B. and J. Overpeck, 2017, The twenty-first century Colorado River hot drought and implications for the future, Water Resources Research 53:2404-2418, DOI: doi:10.1002/2016WR019638

U.S. Bureau of Reclamation (Reclamation). 2007. Final Environmental Impact Statement, Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead. Available online at: www.usbr.gov/lc/region/programs/strategies/FEIS/index.html

Virgin River Climate Change Analysis. Statistical Analysis of Streamflow Projections. Prepared by Katrina Grantz. March 2014.

West Wide Climate Risk Assessments: Bias Corrected and Spatially Downscaled Surface Water Projections. Technical Memorandum No. 86 68210 2011 01. Prepared by the U.S. Department of the Interior, Bureau of Reclamation, Technical Services Center, Denver, Colorado.

Wildman, W. and N. Forde, 2012, Management of Water Shortage in the Colorado River Basin: Evaluating Current Policy and the Viability of Water Trading, Journal of the American Water Resources Association 48(3):411-422, DOI: 10.1111/j.1752-1688.2012.00665.x.

Resource and Reference List for Key Policy Question 6

Websites

Alliance for Water Efficiency:
http://www.allianceforwaterefficiency.org/

Especially the section, Financing Sustainable Water: Rates, Revenue, Resources.
At: http://www.financingsustainablewater.org/

American Water Works Association - Infrastructure Financing:
https://www.awwa.org/legislation-regulation/issues/infrastructure-financing.aspx

American Society of Civil Engineers: Infrastructure Report Card
http://www.infrastructurereportcard.org/

Bipartisan Policy Center: Infrastructure Topic
https://bipartisanpolicy.org/topics/infrastructure/

Ceres – Water Infrastructure:
https://www.ceres.org/issues/water/water-infrastructure-and-financing

US EPA:
Sustainable Water Infrastructure:
https://www.epa.gov/sustainable-water-infrastructure

US Water Alliance:
http://uswateralliance.org/
See Resources Page that has a publications link: http://uswateralliance.org/resources

Value of Water Campaign:
http://thevalueofwater.org/
See list of Reports & Fact Sheets: http://thevalueofwater.org/resources

WaterWorld – Creative Financing Tools to Fund Water Infrastructure:
http://www.waterworld.com/articles/print/volume-28/issue-6/water-utility-management/creativefinancing-tools-to-fund-water-infrastructure.html

Literature

Alliance for Water Efficiency. 2014. *Building Better Rates in an Uncertain World: Balancing Revenue Management, Resource Efficiency and Fiscal Sustainability*. AWE Handbook. 266 pp.
File name: AWE Building Better Water Rates for an Uncertain World Nov 10 2014 (w appendices)

American Water Works Association. n.d. *Buried No Longer: Confronting American's Water Infrastructure Challenge.* 37 pp. File name: BuriedNoLonger

Anderson, R.F. 2010. *Trends in Local Government Expenditures on Public Water and Wastewater Services and Infrastructure: Past, Present and Future.* Report prepared for the U.S. Conference of Mayors – Mayors Water Council. Washington, D.C. 56 pp. File name: 201002-mwc-trends (Anderson 2010)
Colorado Water Plan. 2016. 567 pp. File name: CWP2016 (Colorado Water Plan)
Note: there is a lot of "strategy" in this "plan"

Cooley, Heather and Rapichan Phurisamban. 2016. *The Cost of Alternative Water Supply and Efficiency Options in California*. Pacific Institute, Oakland, CA. 30 pp. File name (full report): PI_TheCostofAlternativeWaterSupplyEfficiencyOptionsinCA File name (exec. summary): PI_TheCostofAlternativeWaterSupplyEfficiencyOptionsinCA_ExecutiveSummary

Copeland, C., S. Maguire, and W.J. Mallett. 2016. *Legislative Options in the 114th Congress for Financing Water Infrastructure*. Congressional Research Service Report R42467. Dec. 30, 2016. 25 pp. File name: R42467 (CRS – Copeland et al)

Emerton, L. and E. Bos. 2004. *Value: Counting ecosystems as water infrastructure*. IUCN, Gland, Switzerland and Cambridge, UK. 90 pp. File name: 2004-046 (Emerton and Bos)

Eskaf, S., J. Hughes, M. Tiger, K. Bradshaw, S. Leurig. 2014. *Measuring & Mitigating Water Revenue Variability: Understanding How Pricing Can Advance Conservation without Undermining Utilities' Revenue Goals*. A Ceres and UNC Environmental Finance Center Report, July 2014. 28 pp. File name: Ceres_WaterRevenueVariability_web_071114

Herberger, Matthew, Kristina Donnelly, Heather Cooley. 2016. *A Community Guide for Evaluating Future Urban Water Demand*. Pacific Institute, Oakland, CA. 48 pp. File name: A-Community-Guide-for-Evaluating-Future-Urban-Water-Demand

Johnson Foundation. 2012. *Charting New Waters - Convening Report: Financing Sustainable Water Infrastructure*. Meeting convened by American Rivers, Ceres. The Johnson Foundation at Wingspread. July –August 2011. Report published January 2012. 44 pp. File name: WaterInfrastructure (Johnson Foundation)

Leurig, S. and J. Brown. 2014. *Bond Financing Distributed Water Systems: How to Make Better Use of Our Most Liquid Market for Financing Water Infrastructure*. A Ceres Report, Sept. 2014. 50 pp.
File name: Ceres_WaterBondFinancing_082814

Leurig, S. 2010. *The Ripple Effect: Water Risk in the Municipal Bond Market.* A Ceres Report, October 2010. 95 pp. File name: Ceres_Ripple_Effect_102010

Nuding, Amelia. 2013. Local Waters Alternative to the Lake Powell Pipeline. Western Resource Advocates. March 13, 2013. 51 pp. File Name: Water Conservation Alternative to Lake Powell Pipeline

Nuding, A., S. Leurig, and J. Hughes. 2015. *Water Connection Charges: A Tool for Encouraging Water-Efficient Growth*. A Ceres and UNC Environmental Finance Center Report, August 2015. 44 pp.
File name: Water_Connection_Charges_FullReport

Utah Office of Legislative Research and General Counsel (OLRGC). 2012. *How Utah Water Works: An Overview of Sources, Uses, Funding, and Pricing.* 16 pp. File name: How Utah Water Works (00002706)

US Environmental Protection Agency, Office of Water. 2016. *Best Practices to Consider when Evaluating WaterConservation and Efficiency as an Alternative for Water Supply Expansion*. Report EPA-810-B-16-005, Dec. 2016, Washington, D.C. 63 pp.
File name: wc_best_practices_to_avoid_supply_expansion_2016_508

US Environmental Protection Agency. 2007. Tools for Financing Water Infrastructure. Office of the Chief Financial Officer, Office of Enterprise Technology and Innovation, Environmental Finance Staff. March 2007. 55pp.File name: waterinfra2007 (EPA-Tools for Financing Water Infrastructure)

Value of Water Campaign. *The Economic Benefits of Investing in Water Infrastructure*. 20 pp.
File name: Economic Impact of Investing in Water Infrastructure_VOW_FINAL_pages
Value of Water National Poll 2016. 16 pp. File Name: Value of Water Nation Poll 2016 Presentation.

World Water Council, 3rd World Water Forum and Global Water Partnership. 2003. *Financing Water for All:Report of the World Panel on Financing Water Infrastructure*. Panel chaired by Michel Camdessus, Reportwritten by James Winpenny. ISBN 92-95017-01-3 File name: CamdessusReport

World Water Council and Organization for Economic Co-operation and Development (OECD). 2015. Water: *Fitto Finance? Catalyzing National Growth through Investment in Water Security.* Report of the High Level Panel on Financing Infrastructure for a Water-Secure World. April 2015. 127 pp.
File name: WWC_OECD_Water-fit-to-finance_Report

Resource and Reference List for Key Policy Question 7

Blue Ribbon Advisory Council on Climate Change. Report to Governor Jon M. Huntsman, Jr. Oct. 3, 2007.

DeRose, J. R., M. Bekker, S.-Y. Wang, R. Kjelgren, E. B. Allen, T. Bardsley, and B. M. Buckley, 2014: A millennium-length reconstruction of Bear River stream flow, Utah. Journal of Hydrology, 529(2), 524-634.

DeRose, J. R., S.-Y. Wang, B. M. Buckley, and M. Bekker, 2014: c. The Holocene. 24(7), 805-813. DOI: 10.1177/0959683614530441

Garfin, G., A. Jardine, R. Merideth, M. Black, and S. LeRoy, eds. 2013. Assessment of Climate Change in the Southwest United States: A Report Prepared for the National Climate Assessment. A report by the Southwest Climate Alliance. Washington, DC: Island Press.

Gillies, R. R., S.-Y. Wang, and M. R. Booth, 2012: Observational and synoptic analyses of the winter precipitation regime change over Utah. Journal of Climate, 25, 4679-4698.

Goharian E, Burian S, Bardsley T, Strong C. 2016 Incorporating potential severity into vulnerability assessment of water supply systems under climate change conditions, *Journal of Water Resources Planning and Management*, 10.1061/(ASCE)WR.1943-5452.0000579, 04015051.

Liverman, D., S. Moser, P. Weiland, L. Dilling, M. Boykoff, H. E. Brown, D. E. Busch, E. Gordon, C. Greene, E. Hothaus, D. Niemeier, S. Pincetl, W. J. Steenburgh, and V. Tidwell, 2013: Climate choices for a sustainable Southwest. *Assessment of Climate Change in the Southwest United States: A Report Prepared for the National Climate Assessment*. G. Garfin, A. Jardine, R. Merideth, M. Black, and S. LeRoy, Eds., Island Press, 405-435.

Scalzitti J, Strong C, Kochanski A, 2016. A 26 year high-resolution dynamical downscaling over the Wasatch Mountains: Synoptic effects on winter precipitation performance, *Journal of Geophysical Research Atmos.*, 121, 3224-3240. doi: 10.1002/2015JD024497

Scalzitti J, Strong C, Kochanski A, 2016. Climate change impact on the roles of temperature and precipitation in western U.S. snowpack variability, *Geophysical Research Letters*, 43, 5361-5369. doi:10.1002/2016GL068798

Steenburgh, Jim, Secrets of the Greatest Snow on Earth: Weather, Climate Change, and Finding Deep Powder in Utah's Wasatch Mountains and around the World. Utah State University Press. 2014.

Steenburgh, W. J., K. Redmond, K. E. Kunkel, N. Doesken, R. Gillies, J. Horel, M. P. Hoerling, and T. H. Painter, 2013: Present weather and climate: Average conditions. *Assessment of Climate Change in the Southwest United States: A Report Prepared for the National Climate Assessment.* G. Garfin, A. Jardine, R. Merideth, M. Black, and S. LeRoy, Eds., Island Press, 56-73.

Wang, S.-Y., R. R. Gillies, and T. Reichler, 2012: Multi-decadal drought cycles in the Great Basin recorded by the Great Salt Lake: Modulation from a transition-phase teleconnection. Journal of Climate, 25, 1711-1721.