PLAN, CONSERVE, DEVELOP, AND PROTECT UTAH'S WATER RESOURCES

DRAFT

Utah's Regional M&I Water Conservation Goals

February 2019

Prepared for:

Utah DNR Water Resources

Prepared by:

Hansen Allen & Luce Inc Engineers

Bowen Collins & Associates

DRAFT—Feb. 6, 2019 (v4)

UTAH'S REGIONAL M&I WATER CONSERVATION GOALS

Prepared for:
Utah Division of Water Resources

Prepared by:
Hansen, Allen & Luce, Inc.
Bowen Collins & Associates, Inc.

Steven C. Jones, P.E.
Project Manager

February 2019

Hansen, Allen & Luce, Inc.
859 W. South Jordan Pkwy. Ste. 200
South Jordan, UT 84095
801-566-5599

TABLE OF CONTENTS

ABBREVIATIONS AND UNITS

ac	acre
ac-ft	acre-foot (325,851 gal)
AGRC	Utah Automated Geographic Reference Center
BC&A	Bowen Collins & Associates, Inc.
DNR	Utah Department of Natural Resources
DWRe	Utah Division of Water Resources
ET	evapotranspiration
ft	foot
ft^2	square foot
gal	gallon
gpcd	gallons per capita per day (based on permanent population)
GSLAC	Great Salt Lake Advisory Council
GWSAT	Governor’s Water Strategy Advisory Team
HAL	Hansen, Allen & Luce, Inc.
OLAG	Utah Office of the Legislative Auditor General
M&I	municipal and industrial [water use]
USGS	U.S. Geological Survey
yr	year

EXECUTIVE SUMMARY

Utah's Regional M&I Water Conservation Goals

DRAFT February 2019

HIGHLIGHTS

- Municipal and industrial (M&I) per capita water use in Utah has declined by at least 18% since 2000.
- Regional M&I water conservation goals are recommended for 2030, and projections are given for 2040 and 2065.
- Considered together, the 2030 regional goals constitute a 16% reduction in per capita use from the new 2015 baseline.
- Several water conservation practices are recommended to help achieve the goals.
- Implementation will be an immense effort requiring funding (est. $3.26 billion by 2030) and engagement from all Utahns.
- This project responds to a legislative audit and other water planning recommendations.

PURPOSE

This project recommends regional goals and practices for municipal and industrial (M&I) water conservation. M&I includes residential, commercial, institutional (e.g., schools and parks), and industrial water use, and excludes agriculture, mining, aquaculture, and power generation.

PROGRESS TOWARD STATEWIDE GOAL

Utah's statewide water conservation goal has been "25% by 2025," that is, to reduce per-capita M&I water use by 25% when starting at the value reported in 2000. Thanks to the efforts of many Utahns, M&I per capita water use has declined by at least 18% since then. Results from many individual water suppliers confirm significant progress in water conservation. According to the state's most recent data, the 2015 statewide M&I water use estimate is 242 gallons per capita per day (gpcd). Water suppliers and users alike are commended for their efforts to reduce water use.

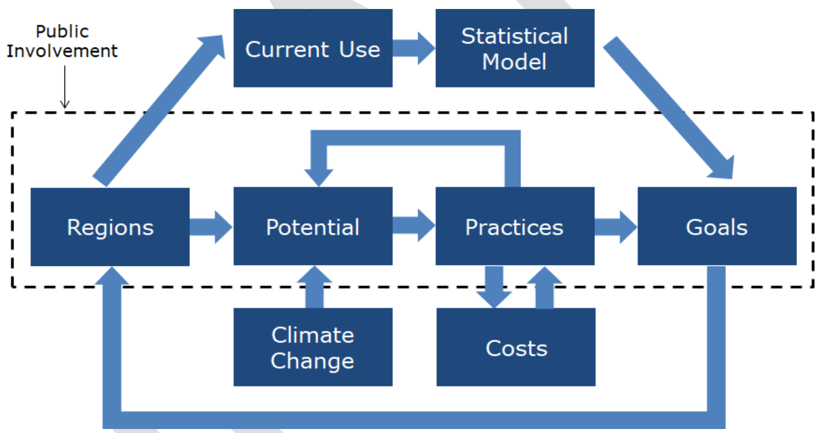
NEED FOR REGIONAL GOALS

While this progress is excellent, balanced efforts in both water development and water conservation are still necessary to meet Utah's long-term water needs. The next step—and one recommended by a legislative audit (no. 2015-01) and the *Recommended State Water Strategy*—is a suite of regional M&I water conservation goals that consider the various climates, populations, and water use practices in different parts of the state. These goals will guide the state's water industry in planning future infrastructure, policies, and programs consistent with Utah's semiarid climate and growing demand for water.

APPROACH

Recognizing its potential impact on Utahns, the project began with a large public involvement effort. An online survey collected information about water use awareness, attitudes, and opportunities from a broad audience, while a series of public open houses and interviews with key stakeholders provided more in-depth insight into the important issues. Early draft reports were circulated to several parties for review. The public process strongly affirmed the need for regional goals and guided the project team to data, perspective, and questions that improved the quality of the work.

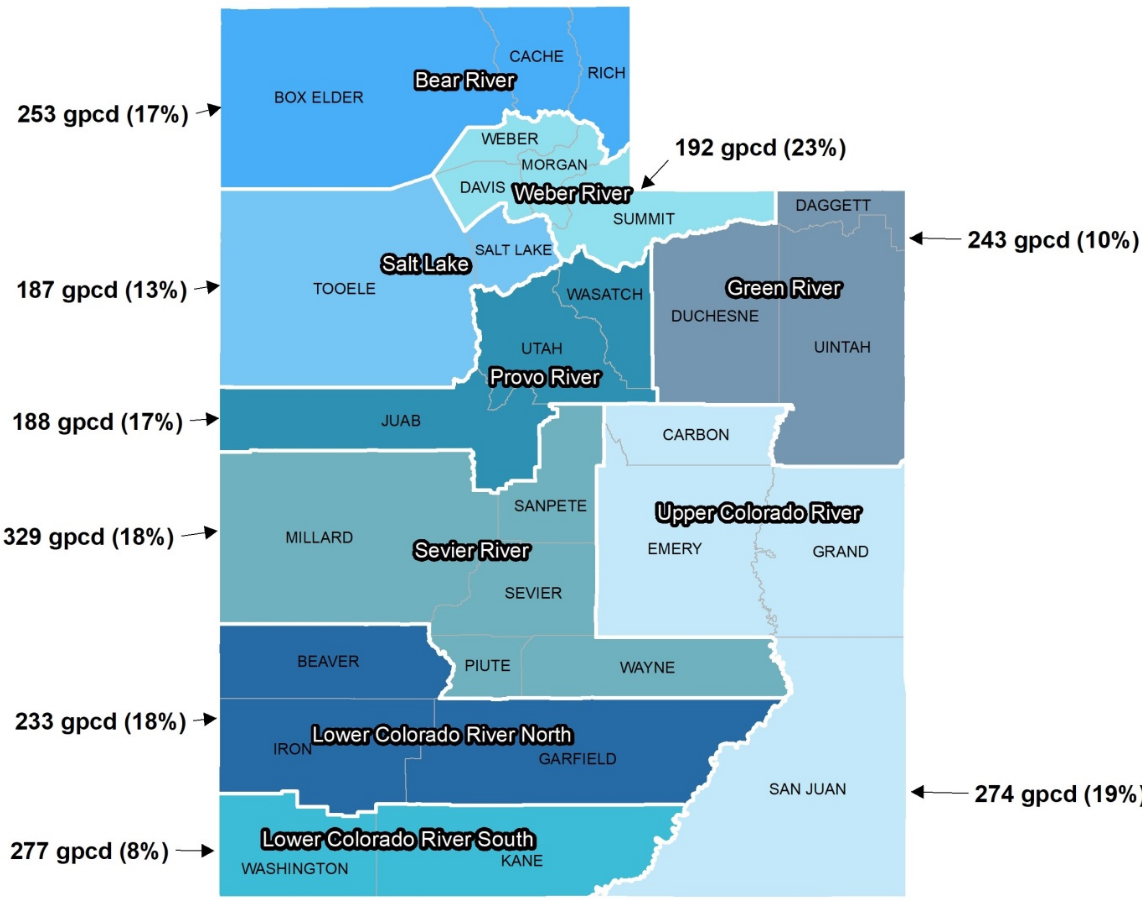
Multiple factors were considered when determining regions, including data availability, number of regions, water use practices, similarity of climates, and the ability of the public to recognize the regions. Next, water conservation potential was developed for each region. Many variables were examined; the most influential were secondary metering, climate change, amount of turf on new properties, conversion of turf on existing properties, and conversion to high-efficiency fixtures and appliances. Scenarios were developed to characterize three levels of water conservation within each region. Water conservation practices were then evaluated on costs, benefits, and public acceptance. A statistical model of past water use helped characterize each region's performance. Finally, combining all of these interdependent elements, the project team developed a timeline of regional water conservation goals and practices through 2065.



Goal Development Process

GOALS

Nine water conservation regions are proposed, along with a timeline of M&I water conservation goals and projections for each one. The 2030 values are recommended as goals, while the 2040 and 2065 values are projected future goals to inform future planning. Goals for 2040 will be recommended after evaluating progress toward the 2030 goal, and so on for future goals.



Proposed M&I Water Conservation Regions and 2030 Goals

Proposed Regional M&I 2030 Water Conservation Goals and Future Goal Projections

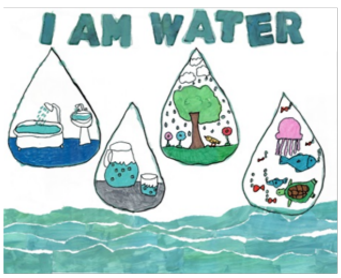
Region	2015 Baseline (gpcd)	2030 Goal		2040 Projection		2065 Projection	
		Goal (gpcd)	Reduction from 2015	Projection (gpcd)	Reduction from 2015	Projection (gpcd)	Reduction from 2015
Bear River	304	253	17%	232	24%	219	28%
Green River	270	243	10%	234	13%	232	14%
Lower Colorado River North	286	233	18%	214	25%	201	30%
Lower Colorado River South	303	277	8%	267	12%	259	15%
Provo River	226	188	17%	174	23%	170	25%
Salt Lake	214	187	13%	176	18%	167	22%
Sevier River	401	329	18%	306	24%	302	25%
Upper Colorado River	337	274	19%	257	24%	253	25%
Weber River	250	192	23%	176	30%	171	32%

Note M&I = municipal and industrial; gpcd = gallons per capita per day based on permanent population

In 2015, Utah's M&I water use was 242 gpcd. If considering all regional results together, the resulting water use for the entire state is 204 gpcd by 2030 (16% reduction from 2015), 190 gpcd by 2040 (22% reduction from 2015), and 185 gpcd by 2065 (24% reduction from 2015).

PRACTICES

The following practices, selected from analysis of many possible ones, are recommended to help achieve the proposed regional M&I water conservation goals. Of necessity, these practices are limited to broad categories that may have different application in different areas of the state. Local water suppliers, communities, and businesses are encouraged to adapt and refine these recommendations, as well as implement others, in their own water conservation efforts and in pursuit of the regional goals.



GENERAL

- **Water conservation education.** Continued emphasis and funding of education and outreach must be fundamental components of any water conservation plan.
- **Conservation pricing.** Financial impacts will help motivate water conservation. Important features are lower base rates, increased tiers for usage, and reduced or eliminated use of property taxes to cover water system costs.

INDOOR

- **Fixture conversion.** This will happen naturally with new construction and as old fixtures are replaced, but may be accelerated through incentives and policies.
- **Other measures.** Fixing indoor leaks and inspiring a change in indoor water use habits will reduce consumption.

OUTDOOR

- **Improved irrigation efficiency.** Secondary metering, smart irrigation controls, and drip irrigation systems will improve irrigation efficiency for any landscape.
- **Water-wise landscaping.** New construction can be water-wise from the beginning, while existing landscapes can be converted.
- **Lot size and density guidelines.** Smaller lot sizes and less irrigated area will reduce the amount of water needed outdoors in new developments.

Recommended M&I Water Conservation Practices

COSTS

Achieving the goals identified in this report will require a major investment. To help citizens and policy makers understand the level of investment required, the cost of implementing M&I water conservation actions through 2030 has been estimated by region as summarized below. The total is $3.26 billion.

Region	Required Investment in M&I Water Conservation by 2030
Bear River	$199,700,000
Green River	$37,500,000
Lower Colorado River North	$61,900,000
Lower Colorado River South	$358,300,000
Provo River	$791,800,000
Salt Lake	$901,300,000
Sevier River	$77,500,000
Upper Colorado	$46,800,000
Weber River	$786,400,000
Total	**$3.26 billion**

IMPLEMENTATION

The pursuit of the regional M&I water conservation goals will be an endeavor of immense magnitude. All levels of society—not just water suppliers—must engage over extended time periods. While implementation will be more fully addressed in the forthcoming State Water Plan and State Water Infrastructure Plan, a few starting actions are recommended here.

State and Local Policy Leaders

Policy plays a vital role in motivating and enabling water conservation. State and local policy leaders should establish policies—and funding—for universal metering, water loss control, education, and other water conservation activities and require accountability for efficient water use. Policy leaders must also decide whether they are willing to support the necessary land use restrictions that will be required to reach the water conservation goals. This will include limiting both overall lot sizes for residential development and the amount of turf grass allowed. Water suppliers should be consulted in land-use decisions to ensure alignment with water conservation efforts. Policy leaders can set or influence the pricing of water to promote conservation. State and local governments should consider the water use impacts of proposed businesses and their plans for water-efficient fixtures, landscaping, and operations before approval.

State Agencies

The Division of Water Resources and other state agencies should continue to support water suppliers' and end users' efforts by analyzing M&I water use data, administering funding programs, reviewing water conservation plans, and promoting education and outreach. It is recommended that the Division evaluate achievement of the 2030 goals and refine the 2040 and 2065 projections accordingly as new data, practices, and technologies develop.

Water Suppliers

Water suppliers have a public responsibility to provide sufficient, safe water to their customers and to carefully manage this invaluable resource. In fulfilling this responsibility, water suppliers are responsible for developing and implementing their own Water Conservation Plans that define local goals, practices, pricing, and accountability. This report recommends several practices which water suppliers may consider, supported by the other parties described here.

End Users

The water conservation mindset begins with individual end users. By recognizing water as a limited resource and changing their water use practices accordingly, end users will directly impact the overall water situation and the achievement of the regional goals. Utahns are encouraged to do their part in conserving water for Utah's future.

Chapter 1: Introduction

PURPOSE

The purpose of this project is to recommend regional boundaries, goals and practices for municipal and industrial (M&I) water conservation in Utah. M&I water use includes residential, commercial, institutional [e.g., schools and parks], and industrial water use, and excludes agriculture, mining, aquaculture, and power generation. M&I makes up about 15% of all withdrawals from Utah's natural waters (Dieter et al. 2018).

The new regional goals build on the previous statewide goal. While statewide water conservation remains important, this project considers water conservation challenges and opportunities relevant to particular regions of the state.

BACKGROUND

Mission of the Division of Water Resources

The mission of the Utah Division of Water Resources (DWRe or Division) is to "plan, conserve, develop and protect Utah's water resources." Per Utah Code (Title 73, Chapter 10), the Division is the water resources authority for the state. Under the Department of Natural Resources, the Division implements several programs to fulfill its mission including M&I water use data reporting, funding assistance, the State Water Plan, and water conservation planning.

Past Water Conservation Efforts

Water conservation planning has taken many forms since the Division's creation in 1967. The 1990 State Water Plan established a foundation for the state's policy on water management. The Division began discussing water conservation goals in 1994 and published its first M&I goal in 2001, which was to reduce the statewide per-capita water use in public community water systems by 25% (DWRe 2001). With substantial early progress, the goal was later modified to aim for a 25% reduction by 2025 (DWRe 2014). The Division's 2014 plan outlined numerous strategies to achieve the goal which have since been implemented.

Progress from 2000 to 2015

According to the Division's most recent data (DWRe 2018a, 2018b), Utah's average M&I water use in 2015 was 242 gallons per capita per day (gpcd). This represents a decrease of at least 18% from the value reported in 2000. The Division's methods of evaluating water use have improved over the years, especially after implementing recommendations from recent legislative audits and a third-party validation, beginning with the 2015 dataset (OLAG 2015, 2017; BC&A

and HAL 2018). Because of these improvements the Division has decided that going forward, 2015 will be the baseline against which M&I water conservation is measured.

Utahns have demonstrated great willingness to accept the statewide goal and conserve water. Beyond the statewide numbers, results from many water suppliers, reported in individual water conservation plans and other documents, confirm that per-capita M&I water use has trended downward. Notable efforts by water suppliers include implementing tiered rates, metering secondary water, repairing leaks, offering incentives for water-efficient appliances and landscapes, and educating the public through water conservation gardens and classes. Individual water users have improved sprinkler controls, converted turf to water-wise landscapes, and reduced irrigation frequency, while improved appliance and plumbing technology has made indoor water use more efficient. The Division sincerely appreciates the efforts of water suppliers, engineers, legislators, advocacy groups, researchers, government officials, and other Utahns who care about the state and its water.

The Current Situation

Today, Utah is among the fastest-growing states in the country. In 2016 it occupied the top position at 2.0% growth over one year, and now falls just behind Idaho and Nevada at 1.9% (U.S. Census Bureau 2016, 2017, 2018). Utah also happens to be among the driest states in the country in terms of its annual precipitation. Its water resources are finite and, as in many parts of the world, their future is uncertain. As Utah's population continues to grow, so will its demand for water. As such, water development and water conservation should be considered in parallel.

A 2015 legislative audit recommended, among other actions, a regional approach to water conservation goals (OLAG 2015). In 2017, after a multi-year effort, the Governor's Water Strategy Advisory Team (GWSAT) released its *Recommended State Water Strategy*. The first strategy concerns water conservation and recommends numerous actions.

In October 2018, as this project was underway, Gov. Gary Herbert declared a state of emergency due to drought (O'Donoughue 2018). Persistently dry conditions and low reservoir levels have affected Utahns across all industries from agriculture to urban water supply. "The drought is at a level unseen for many years and will not be solved with a small series of storms. In some areas, the drought is at, or near historic levels," Herbert said. Mike Styler, executive director of the Utah Department of Natural Resources, suggested that the situation prompts a new focus on water conservation. "We can't control precipitation, but we can find opportunities to decrease our water use all year long," he said.

Even with significant progress in water conservation and planning, Utah still has much to learn and much to do. As reaffirmed by the current drought, water conservation must still be part of the state's overall water strategy, in wet years as well as dry years. While water conservation will not solve all the problems of water supply and demand, it will help bridge the gap and establish sustainable practices consistent with our semiarid climate and fast-growing population.

The Need for Regional Goals

One of the limitations of a statewide water conservation goal is that it blurs important local differences. Utah is a large state with diverse terrain, climates, populations, development patterns, and attitudes that affect what water is available and how it is used. In fact, by 2010, two river basins had already achieved the goal and two others were very close, indicating that some regions have more potential to conserve water than others (OLAG 2015). The *Recommended State Water Strategy* (GWSAT 2017) acknowledged these complications.

The next step (and one recommended by legislative audits and the *Recommended State Water Strategy*) is to take a finer view of water conservation that considers each region's characteristics, challenges, and opportunities as they relate to water. Given the improved accuracy of the 2015 dataset mentioned above, the Division has selected 2015 as the new baseline for these goals.

This project recommends M&I water conservation boundaries, goals, and practices relevant to nine regions of Utah. It is not meant to diminish past efforts or discourage additional efforts by local water suppliers and city governments, whose role in water conservation is more immediate. It will, however, offer a more balanced view of M&I water conservation with regional specificity and inform future actions to fulfill the Division's ongoing mission.

OTHER USES OF WATER

While focusing on M&I water use, the project team acknowledges other major uses of Utah's water, particularly agriculture and environment (Figure 1-1).

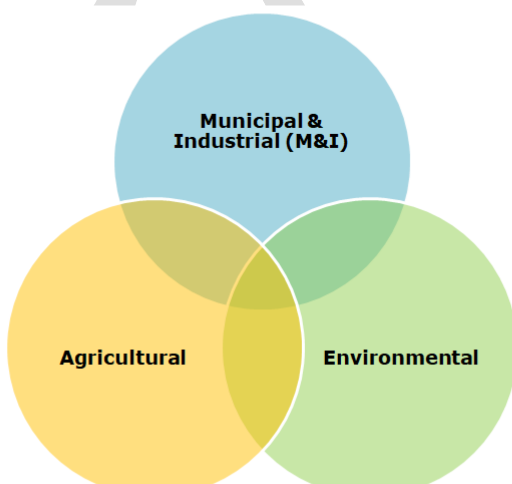


Figure 1-1: Major Uses of Water in Utah

Agriculture supports a significant portion of the state's economy and its residents' livelihoods. It constitutes about 70% of Utah's water diversions (Dieter et al. 2018). Those in the agriculture industry face trade-offs involving irrigation efficiency, local food production, and land development, just to name a few. Continued support for agriculture is a key component of the *Recommended State Water Strategy* (GSWAT 2017).

The need for water in natural systems is likewise important. The Great Salt Lake, for example, controls dust, increases snowfall, supports wildlife, and provides substantial economic value through recreation, mineral extraction, and brine shrimp harvesting (Bioeconomics 2012). Declining lake levels are adversely affecting these functions. As Utah's demand for M&I water continues grow, water for environmental needs must be evaluated. Dealing with water for natural systems is a key policy question in the *Recommended State Water Strategy* (GSWAT 2017).

While conservation is obviously an important part of the state's overall water strategy, determining the balance between these several water uses is beyond the scope of this project. This study does not suggest how Utah's water resources should be used; such issues are left to the State Water Plan and other efforts.

AUTHORIZATION

This project was recommended by the Legislative Auditor General (report no. 2015-01, "A Performance Audit of Projections of Utah's Water Needs," Chapter 3) and procured through the State of Utah Division of Purchasing (Solicitation #AS18135, conducted by the Division of Water Resources). The consultant team of Hansen, Allen & Luce and Bowen Collins & Associates was selected and began work under contract with the State of Utah in July 2018.

TEAM

The project team consisted of the following individuals. External stakeholders listed in Appendix D also contributed.

Hansen, Allen & Luce (HAL)
Steven C. Jones, P.E., *Project Manager*
Robert B. Sowby, Ph.D., P.E., ENV SP
Richard M. Noble, P.E.
Kayson M. Shurtz, P.E.
Kai M. Krieger
Kirk D. Kauer
Daniel R. Jones, CFM

Bowen Collins & Associates (BC&A)
Keith J. Larson, P.E., *Project Co-Manager*
Michael W. Collins, P.E.
Jamie Tsandes, PLA, ASLA
Brooke Olson

Utah Division of Water Resources (DWRe)
Rachel Shilton, P.E., *Project Sponsor*
Todd Adams, P.E.
Aaron Austin
Anny Baynard
Russ Barrus
Arthur Guo
Candice Hasenyager, P.E.
Laura Haskell, P.E.
Marcie Larson
Ashley Nay, P.E.
Josh Palmer
Faye Rutishauser
Joel Williams, P.E.

Chapter 2: Public Involvement

PURPOSE

Water conservation is an issue that touches everyone. From policymakers to water suppliers to individual customers, everyone has some stake. For the regional water conservation goals to succeed, the public must be able to inform the process. To this end, the project team devised a series of outreach activities to support the project.

METHODS

The American Society of Civil Engineers' Policy Statement 139, "Public Involvement in the Decision Making Process," states:

> In a period of enhanced awareness about the long-term effects that technical aspects of all types of engineered projects have on the lives of individuals, there is public concern for the environment, there is recognition that capital is limited and must satisfy competing demands, that technology is changing at a rapid rate, and that natural resources have finite limits. Effective public decision-making requires that a wide variety of viewpoints be assessed.

The statement also encourages public involvement through public and social media information, public meetings, presentations, discussions of alternatives, and explanations of the impact of potential decisions.

Considering the need to assess various viewpoints on water conservation, the project team planned and executed three stages of outreach activities: an online survey, open houses, and stakeholder interviews. Each successive stage moved from broad and brief to deep and focused as depicted in Figure 2-1. These activities allowed the project team to receive comments on the challenges, opportunities, and other considerations for regional water conservation goals.

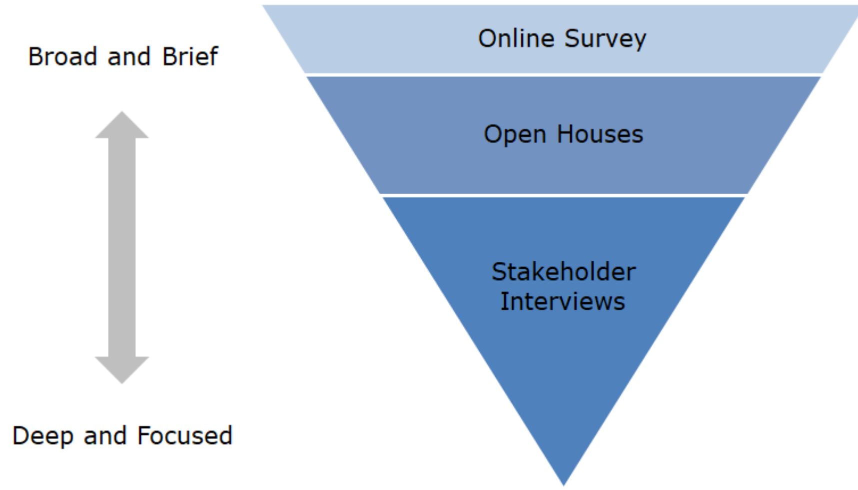


Figure 2-1: Public Involvement Activities

Online Survey

In order to provide an opportunity for the broader public to provide input on the regional water conservation goals, the project team developed an online survey. The survey sought information on respondents' regions, age ranges, lot sizes, water use awareness, water use practices, and attitudes and ideas concerning water conservation. The complete survey questions are presented in Appendix A. The survey ran during September and October 2018 and collected 1,655 responses. Figure 2-2 shows the beginning of the survey.

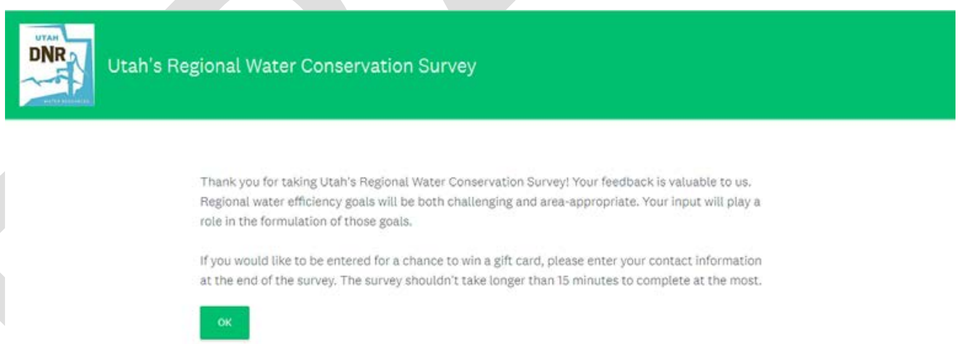


Figure 2-2: Portion of Online Survey

Open Houses

Eight open houses were held during September and October 2018 in Vernal, Provo, St. George, Richfield, Moab, Clearfield, Murray, and Logan. In these informal public meetings, members of the project team guided visitors through a series of posters explaining the history, purpose, and approach of developing the regional water conservation goals. Copies of materials used for the open houses are contained in Appendix B. These events, held in public spaces like libraries and schools, provided an opportunity for visitors to weigh in on the issues and ask questions while project team members listened and took notes. Figure 2-3 shows one such open house.

Over 100 people attended the open houses. About 30 water professionals also participated in a similar session held during the annual conference of the Intermountain Section of the American Water Works Association in Midway, Utah. While the number of people attending open houses was not nearly as great as those completing the online survey, the depth and quality of interaction was excellent. Most participants stayed for 30 to 60 minutes to discuss water issues and provided valuable comments. Their comments are presented in Appendix C.

Figure 2-3: Open House in Murray

Stakeholder Interviews

The project team interviewed dozens of key stakeholders in the water profession to obtain more in-depth insight about their experiences, concerns, and recommendations relating to water conservation. These included managers of water conservancy districts; officials from state agencies; state legislators; leaders of advocacy groups; and a selection of survey respondents representing water systems, city councils, and other associations throughout Utah. A list of interviewees is found in Appendix D. These interviews occurred in person or by phone in October and November 2018. Their comments are presented in Appendix C. The same stakeholders also had an opportunity to review multiple drafts of this report prior to public comment.

RESULTS

Online Survey

Insights from the online survey are summarized here. Full results are included in Appendix A.

- Residential irrigation—About 55% of respondents said they use drinking water, 29% pressurized irrigation/secondary water, and less than 2% use ditch water to irrigate their home landscapes. Some use a combination of the above.
- When asked how important water conservation in Utah is on a scale of 1 to 7 (7 being very important), respondents answered 6.4 on average. However, the average rank of their community's willingness to conserve water was only 4.1, indicating a perceived gap between recognition and action.
- "Sustainability" was the top reason people indicated why water conservation is important. Other prominent answers included "Helping supply future generations with water" and "Because waste is not OK." Saving money and delaying future water projects were deemed less important. Text responses to this question frequently mentioned Utah's desert climate or limited water resources.
- About 83% of respondents believed most water savings are possible outdoors.
- On average, respondents were willing to transition 56% of their landscapes to water-wise plants or features.
- About 12% of respondents indicated that a local policy restricts the kind of landscapes they can have. Text responses to this question indicated that these policies usually involve homeowners associations requiring turf and limiting other options.
- Participants believed that education and information are the barriers for water conservation in Utah, rather than incentives or leadership.
- Of the surveyed group, 9% were business owners, 11% were water professionals, and 5% were policy leaders.
- Business owners indicated that the main reason for them to conserve water was to save money. The same business owners reported that 54% of them maintain their own landscapes, while 23% use a third party. The rest do not have a landscape to manage.
- Policy leaders, on average, ranked the importance of water conservation to their constituents at 4.9 out of 7, which contrasts with the previous result of 6.4 out of 7 when respondents gauged themselves.

To summarize, most participants are over 30 and live in single-family homes on lots less than one-third of an acre. They mainly irrigate using drinking water or secondary water. They are largely unaware of the amount of water they are using, but still believe that water conservation is very important. Participants believe that sustainability is the most important reason to conserve, rather than saving money. Respondents said they are willing to change half of their landscapes (on average) to water-wise plants, and almost all believe that outdoor water use is the best water conservation opportunity. Business owners are motivated by cost savings of water conservation. Participants believe that a lack of education and information is the greatest barrier to water conservation in Utah.

The findings from the survey were used to inform the goals, practices, and recommendations described later.

Open Houses and Stakeholder Interviews

Several common themes emerged during open houses and interviews with key stakeholders. The most frequent comments concerned landscaping practices, water use culture, feedback on draft goals, data management, water supply limitations, and water rates. Complete comments are provided in Appendix C.

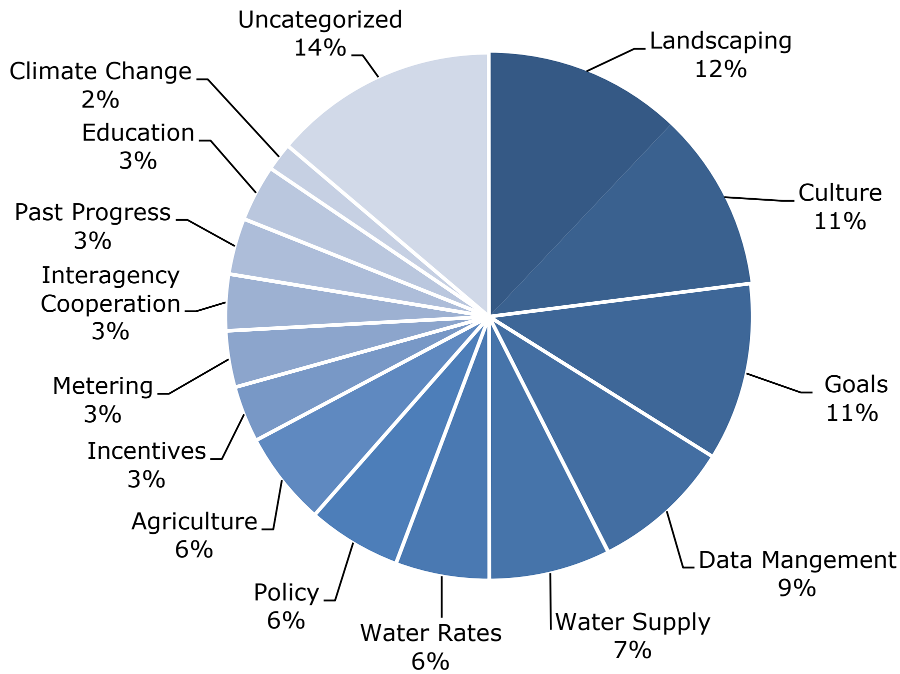


Figure 2-4: Comment Frequency

After synthesizing the various comments and considering their impact on this project, the project team identified the following key concerns. They are addressed briefly here and more fully elsewhere in the report where possible.

1. How do we get credit for water conservation from 2000 to 2015?

Most Utahns have embraced the state's past water conservation goal, contributing to a reduction of at least 18% in per-capita M&I water use since 2000. The results of individual water suppliers confirm that M&I water use has indeed trended downward since that time. Still, there is much to accomplish with new and continued efforts. Water suppliers should continue to monitor their progress and report their results through their water conservation plans (required for many water systems) and other means.

2. How do we move from cool-season turf grasses to more locally appropriate landscapes?

Utahns are accustomed to cool-season turf landscapes for reasons of convenience, familiarity, expense, and ease of maintenance. This type of landscape, however, is not the only option. While other locally appropriate landscapes may initially cost more and require maintenance activities different than those the public is most familiar with, cities and water suppliers can promote them through development policies, incentives, metered pricing, and education. It will require a cultural shift but will come with time.

3. How do we justify charging more for water?

There are real costs associated with developing, conveying, treating, and using water, and much of Utah's existing water infrastructure is aging, requiring significant investments to replace it. While property taxes and municipal funds have historically been used to supplement the income required to operate a viable water system, a recent legislative audit (no. 2015-01) has recommended "reducing water provider reliance on property taxes currently used to subsidize water system costs". Responsible governments and water agencies can look for opportunities where a greater portion of water system cost can be collected through usage fees assessed to their customers. With new water resources becoming more difficult and expensive to develop, increased prices will motivate water conservation and help fund the replacement, construction, and operation of the water infrastructure Utah needs. The legislature may also consider updating statutes governing water systems to require that reserve funds for repair and replacement be included in their operating budgets.

4. Why set goals by region?

The recent legislative audits (mentioned in Chapter 1) recommended that the Division develop regionally relevant water conservation goals to replace the single statewide goal. This will improve the state's ability to plan and will offer better guidance at a local level. Too many or too few regions, however, would complicate the process. Several other considerations for defining the regions are presented in Chapter 3.

5. The goals are too aggressive or not aggressive enough.

The method of developing the goals, described throughout this report and particularly in Chapters 4 and 5, involved many stakeholders and considerable research. The process was scientific wherever possible, even while acknowledging uncertainty. As demographics, technology, conditions, and behaviors change, the goals will be reevaluated. Recognizing that uncertainty increases with time, the results have been presented for three time periods—2030, 2040, and 2065. The 2030 result will be the goal for each region and will be the primary focus for action over the next decade. The 2040 and 2065 projections will provide guidance for planning and future expectations. As 2030 approaches, it is expected that the 2040 and 2065 projections will be revisited and modified as dictated by future conditions.

6. How is cost being considered?
Costs for various water sources and water conservation practices are considered in Chapter 5. The project team recognizes that water conservation of the magnitude proposed here is not free and that the costs must be acknowledged, even emphasized, in order to secure funding for implementation.

7. How is water supply being considered?
Some regions of the state have abundant water supplies and may perceive little or no reason to conserve M&I water when compared to others. Still, water resources are finite and have many other uses for agriculture and the environment. Further, an attitude of “doing your part to conserve” benefits local communities and the state in many ways.

Chapter 3: Regional Water Conservation Boundaries

PURPOSE

The previous statewide M&I water conservation goal was a necessary step. The next step is a finer, regional approach that considers the unique characteristics of certain parts of the state and their potential and ability to conserve water. This chapter describes the selection of water conservation regions for this purpose.

METHODS

The approach to defining the water conservation regions was multifaceted and iterative. As the analysis, potential, goals, and public outreach progressed, potential regions were reviewed according to the following qualitative and quantitative criteria:

- **Ease of communication.** Since the regional goals concern the public, the regions must be easy to communicate and the public must be able to easily recognize the regions. This suggested counties as a starting point, rather than hydrologic basins or some other less familiar designation.
- **Number.** Too many regions would complicate the project, increase the effort required, and, if the regions approached the size of counties or cities, overlap with the plans and goals of local water suppliers. Too few regions would obscure important local differences and offer only minimal improvement over a statewide goal.
- **Similar characteristics.** Counties were characterized in terms of water use, water needs, population, climate, demographics, topography, and numerous other variables described in Chapter 5. Counties with similar characteristics were considered as potential regions.
- **Geographic contiguity.** Neighboring counties were considered as potential regions.
- **Data adequacy.** In counties with few or very small public community water systems, water use and related data may not be sufficient to justify a county-specific goal. This necessitated grouping some counties to improve the adequacy of data.
- **Similar goals.** As the water conservation goals developed throughout the project, counties with similar goals were considered as potential regions.
- **Open house locations.** The project team desired to hold an open house (described in Chapter 2) in each proposed region. The planning and scheduling of these events informed the regional definitions.

All of these criteria were reviewed multiple times as the project progressed, considering the various results and how to balance the criteria, until the ultimate regions below were selected.

RESULTS

The nine groups of counties shown in Figure 3-1 constitute the M&I water conservation regions. Water conservation potential, goals, and practices presented in the following chapters are considered for each region individually.

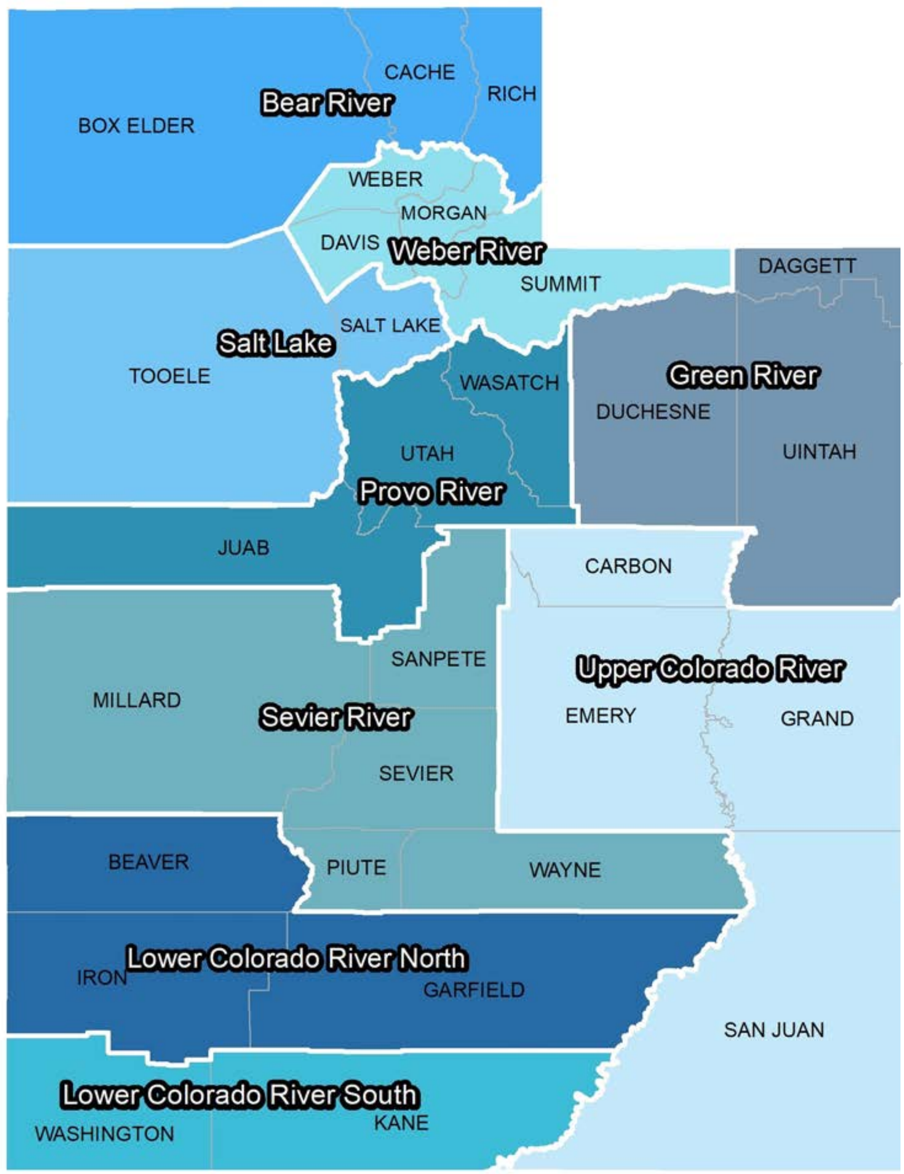


Figure 3-1: M&I Water Conservation Regions

Chapter 4: Regional Water Conservation Potential

PURPOSE

Before regional water conservation goals can be defined, water conservation potential must first be evaluated to estimate the amount of water that could realistically be conserved throughout Utah. The purpose of this chapter is to identify projected M&I water use by region for various irrigation and indoor water use scenarios. Water conservation potential should not be confused with goals. *Potential* seeks to understand what water use *could be* given an assumed set of water use patterns. *Goals* seek to decide what water use *should be* by examining potential and additional considerations relative to community values, economics, feasibility, etc.

METHODS

Current M&I Water Use

To project future M&I water use and water conservation potential, a thorough analysis of the current statewide use has been completed. Figure 4-1 summarizes the statewide M&I water use by type (DWRe 2018a, 2018b).

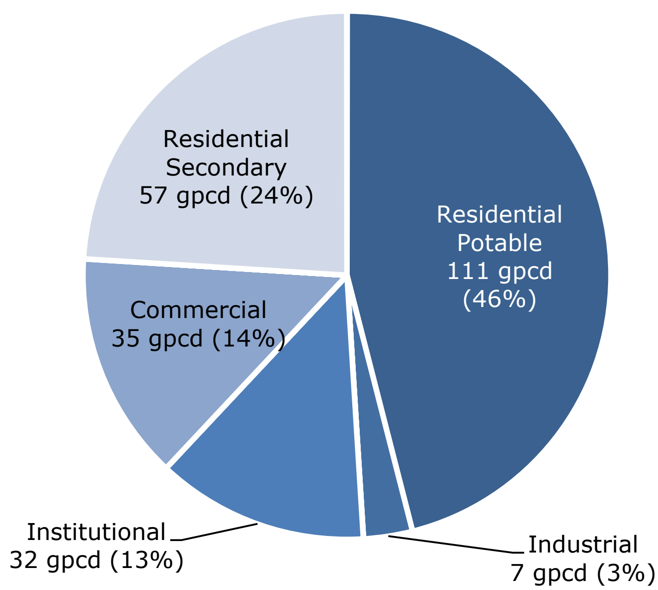


Figure 4-1: Statewide M&I Water Use by Type

As shown in the figure, M&I water use data assembled by DWRe includes a breakdown between several different types. This information is also available for individual counties throughout the state. Considering the amount of each type of use will be important when evaluating potential throughout the State.

Future M&I Water Use and Conservation Potential

To quantify water conservation potential by region and provide perspective for future discussions regarding goals, three future M&I water use scenarios have been developed. **It should be strongly emphasized that these scenarios are not goals.** They have been prepared to provide context and perspective to assist in the goal setting process as will be discussed in Chapter 5. These scenarios can be generally described as follows:

- **Scenario 1—**Scenario 1 is based on potential savings associated primarily with reducing M&I water use through higher-efficiency methods. While this scenario includes some minor changes to the way water is used, it does not include any significant changes in lifestyle or development patterns.
- **Scenario 2**—Scenario 2 is based on reducing M&I water use through partial conversion to higher-efficiency household fixtures and landscaping methods.
- **Scenario 3—**Scenario 3 is based on reducing M&I water use through full conversion to higher-efficiency household fixtures and low water use landscaping methods. This scenario represents the maximum theoretical reduction in water use if there were 100% adoption of all the water conservation activities identified herein.

The following sections of this chapter evaluate each of the M&I water use scenarios on a regional basis across all municipal and industrial user types. As a baseline for comparison, descriptions of the scenarios include a comparison to past water use practices. Values reported for "Past Practices" in the following sections are based on estimated water use practices reflective of average per capita use prior to 2000.

RESIDENTIAL—INDOORS

In 2016, the Water Research Foundation (WRF) published a study which analyzed residential end uses of water (DeOreo et al. 2016).This study found that the most significant reduction in indoor water use in recent years has been accomplished through conversion to higher-efficiency fixtures and appliances. Over the past few years, higher-efficiency fixtures and appliances have become progressively standardized. Indoor residential water use is expected to continue to be reduced over time as older fixtures and appliances wear out and are replaced.

Based on these findings, the WRF study concluded that indoor residential use could be reduced to approximately 40 gpcd if all fixtures were converted and best practices were exercised relative to leak repair and personal water use habits (e.g., shorter showers). Using the WRF study as a guideline, a range of water conservation potential scenarios for indoor residential water were developed as summarized in Table 4-1 and as described below. For this and all factors to be discussed in this chapter, the assumed use in the scenario definitions would apply to both existing and future development.

Table 4-1: Statewide Residential Indoor Water Conservation Potential

Scenario	Indoor Residential Water Use (gpcd)
Past Practices	70
1	60
2	50
3	40

Indoor Residential Water Use Scenarios

- Past Practices—70 gpcd
  - Average per capita residential indoor water use prior to 2000 (i.e. before the state established water conservation goals, DWRe 2010).
- Scenario 1—60 gpcd
  - This is approximately equal the current statewide average per capita residential indoor water use.
  - It represents about 80% conversion of shower heads and faucets to higher-efficiency fixtures and about 40% conversion of toilets and washing machines to higher-efficiency fixtures.
- Scenario 2—50 gpcd
  - This represents significant additional conversion of fixtures but limited additional water conservation associated with fixing leaks or changing personal habits.
  - It represents about 95% conversion of shower heads and faucets to higher-efficiency fixtures and about 80% conversion of toilets and washing machines to higher-efficiency fixtures.
- Scenario 3—40 gpcd
  - This represents 100% conversion to high-efficiency fixtures and appliances, a 60% reduction in residential indoor water leaks, and increased awareness and focus on water conservation.

It will be re-emphasized that these scenarios are not attempting to predict or dictate what future use will be. They are simply a sample of potential water use assumption that can then be used to provide perspective during the goal setting process.

RESIDENTIAL—OUTDOORS

Outdoor residential water use is the largest single category of municipal water use, averaging 108 gpcd or approximately 45% of statewide municipal use (DWRe 2018a, 2018b). Based on the size of this category alone, it should not be a surprise that that there is substantial potential for further water conservation outdoors by the state's residents. It is expected that outdoor water conservation will be affected by at least three different factors: 1) increases in water application efficiency through changes in water users' behavior and equipment, 2) changes in landscaping, and 3) changes in the sizes of our properties (i.e. development density). The following sections discuss each of these factors.

a) Increases in Efficiency

Irrigation efficiency is the ratio of water needed by vegetation to the amount of water actually applied through irrigation. For the purposes of this study, irrigation efficiency is defined as the evapotranspiration rate for a given area (as defined by Lewis and Allen [2017]) divided by metered outdoor water use. Inefficient irrigation practices result in a significant waste of water due to leaks, overwatering, watering outside of planting beds, and irrigating in the rain. Currently, average irrigation efficiency in the state for metered connections is estimated to be from approximately 60% to 65% efficient based on collected water use data (DWRe 2018a). While this represents notable improvement from past irrigation practices (estimated to be around 50% efficient), there is obviously still room for improvement.

Irrigation efficiency can be considerably improved without a large effort on the water users' part simply by adjusting irrigation systems to correlate with seasonal evapotranspiration (ET) rates (DWRe 2014). Irrigation efficiency also tends to improve when meters are added to secondary water connections and customers are required to pay based on the quantity of water they use. Based on perceived opportunity for improvement in this area, water conservation potential scenarios for outdoor residential efficiency were developed as summarized in Table 4-2 and as described below.

Table 4-2: Irrigation Efficiency Scenarios

Scenario	Irrigation Efficiency[1]
Past Practices	50%
1	70%
2	80%
3	>80%

1. Ratio of water needed by vegetation to the amount of water actually applied through irrigation

Irrigation Efficiency Scenarios

- Past Practices—50%
  - Historically, water use data has suggested that the average irrigation application rate along the Wasatch Front was 50% efficient, double the amount what was actually needed (Jackson et al. 2003).
- Scenario 1—70%
  - This scenario considers an increase in the average irrigation efficiency to 70% efficient, meaning almost one and a half times the needed water is applied.
- Scenario 2—80%
  - This scenario considers an increase in the average irrigation efficiency to 80% efficient, meaning about one and a quarter times the needed water is applied.

- Scenario 3—>80%
  - Studies have concluded that it is possible to reach 100% irrigation efficiency in demonstration gardens and other controlled settings (Sun et al. 2012). However, due to limitations of time, training, and interest, there is likely a practical limitation on how close the average water user can get to 100% efficient. For this scenario, water use has been calculated based on 80% efficiency (same as Scenario 2) with the understanding that additional efficiency will always be the goal, but significant additional savings is unlikely.

b) Change in Landscaping

In addition to changing how much water is applied to landscapes, the landscape appearance can also change. Historically, most Utah residential landscapes have consisted of cool-season turf grasses irrigated with sprinkler systems. While turf has some benefits (provides excellent play areas, requires maintenance activities that homeowners are familiar with, etc.), it generally requires more water than other landscaping options. This has been documented in a number of different studies. A couple of local examples include:

- *Jordan Valley Water Conservancy District Stud*y (Jackson et al. 2003)—The Jordan Valley Water Conservancy District Demonstration Gardens located in West Jordan feature a variety of residential demonstration gardens. Each garden has a water meter to monitor water use. Table 4-3 shows the water applied to each landscape area after establishment.

Table 4-3: JVWCD Demonstration Garden, Total Water Applied to Each Landscape Area 2001–2002

Landscape Type	Landscape Description	Total Seasonal Water Applied (Inches)
Homeowner Average	2000–2002	50
-	Theoretical Evapotranspiration for Turf at Garden Location	24
Traditional Landscape	Primarily Bluegrass	21.2
Harvest	Combination of turf, planting beds and hardscape with a focus on garden areas.	16.55
Perennial Garden	Combination of turf, planting beds and hardscape with a focus on flowering perennials.	15.85

The results of this study conclude that the amount of water used in the perennial and harvest gardens is significantly lower than the amount of water used in a traditional landscape primarily composed of traditional cool-season turf. ET rates for various water efficient plantings were used to estimate outdoor water conservation potential.

- *Water- Efficient Urban Landscapes: Integrating Different Water Use Categorizations and Plant Types. (Sun et al. 2012)*—This study analyzed the water use of various landscape types at the Utah State University Botanical Center located in Kaysville, Utah. The study found that the water use in landscapes composed of predominantly native and climate adapted landscape plants irrigated by drip irrigation systems was approximately 40% of the required irrigation for cool season turf grasses irrigated with sprinkling systems. Even within the turf grass category, there are options for lower-water-use turf than have been traditionally used in the state.

Based on these findings, it is clear that the types of plants we grow, the density at which they are planted, and the type of system used to irrigate them can all have a major effect on the amount of water needed outdoors. A switch from traditional cool-season turf grasses and sprinkling systems to perennials, shrubs, and trees with drip irrigation systems can save significant water. Choosing native and climate adapted landscape plants can save even more. Based on these general conclusions, water conservation potential scenarios for residential landscaping practices were developed as shown in Figure 4-2 and as described below.

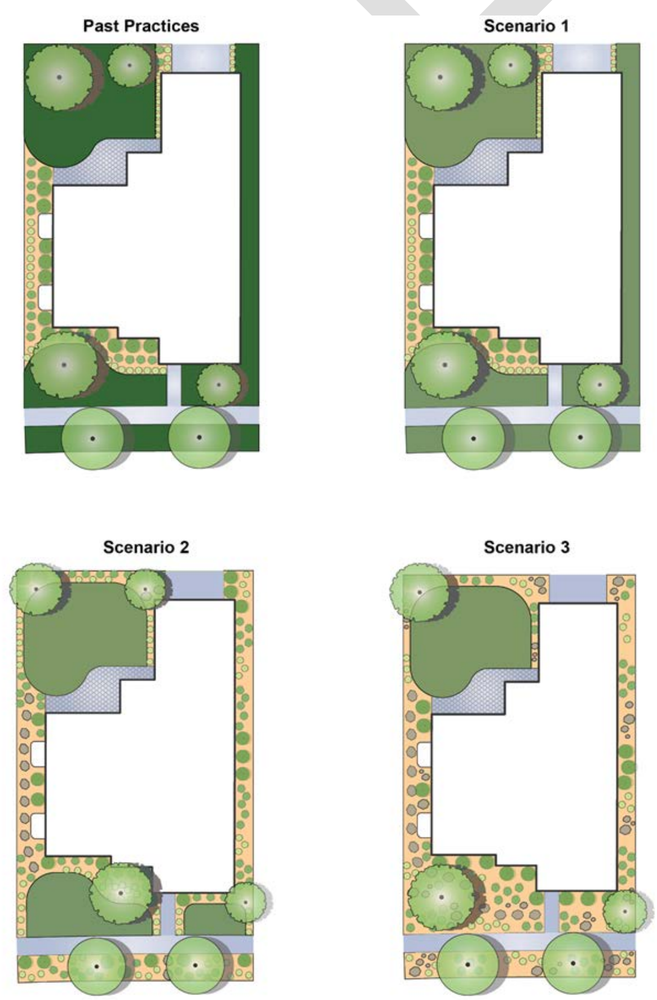


Figure 4-2: Potential Scenarios for Residential Landscaping Practices

Landscaping Type Scenarios

- Past Practices—Traditional Landscaping
  - Representative of a traditional residential landscape.
  - Composed of 80% cool -season turf and 20% planting beds/hardscaped areas.
- Scenario 1—Minimal Landscape Adjustments
  - Since Scenario 1 is designed to represent primarily increase in efficiency (by reducing overwatering), no major changes are included in this scenario for landscaping type.
  - Representative of a traditional residential landscape.
  - Composed of 80% cool-season turf and 20% planting beds/hardscaped areas.
- Scenario 2—Moderate Landscape Adjustments
  - Representative of a partial traditional/partial climate adapted landscape.
  - Composed of 50% cool -season turf and 50% planting beds and hardscaped areas.
  - Assumes that planting beds will include predominantly low water use plants and will be irrigated with drip irrigation systems.
- Scenario 3—Aggressive Landscape Adjustments
  - Representative of a climate adapted landscape.
  - Composed of 20% cool season turf and 80% planting beds and hardscaped areas.
  - Low-water-use plant selection and drip irrigation.

c) Changes In Development Density

Over the past few decades, Utah's historically rural landscape has rapidly transformed and developed in some areas. As Utah's continues to grow, development density continues to change and can significantly affect outdoor water use. Not all water suppliers can control density decisions that would allow density to be used as a conservation tool (e.g., water districts and private water companies do not generally have direct input in land use decisions). However, some water suppliers do regulate land use (e.g., cities that provide their own water) and changes in density are a reality that must be reflected in the water conservation potential calculations and corresponding goals.

Changes in development density can be broken down into two categories: 1) decreasing household size and 2) decreasing lot size.

1. **Decreasing household size—**Population data from the Kem C. Gardner Policy Institute at the University of Utah projects that Utah's household size has been decreasing steadily over the last couple of decades and will continue to decrease with time (Kem C. Gardner Policy Institute 2017). The statewide average household size is currently 2.94 persons per household, a decrease from the 2010 average of 3.09 persons per household. It is estimated that by the year 2065, average household size will decrease

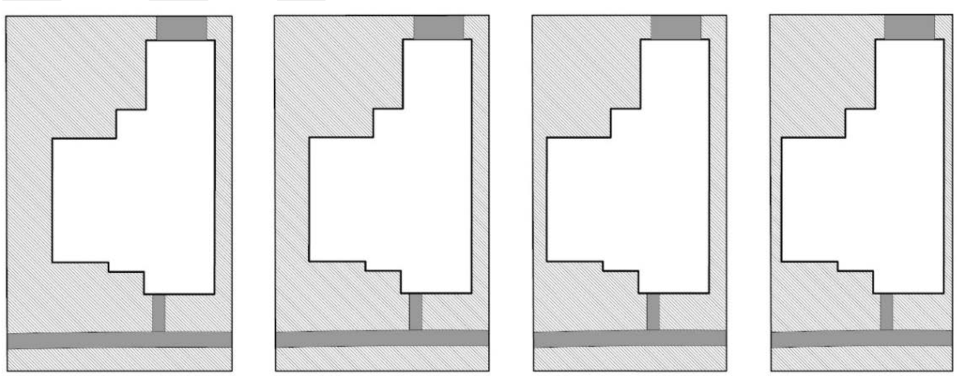
to 2.57 persons. For the purposes of this study, it has been assumed that future household sizes will be as projected by the Kem C. Gardner Policy Institute.

Household size is important because it affects the amount of residential landscape associated with each person. If residential lots continued to develop at the average lot size of the past but household size decreased, then the amount of irrigated acreage per person would increase over time. However, lot size is not expected to stay the same as discussed in the next section.

2. **Decreasing lot size—**Along with household sizes, lot sizes throughout Utah have also been decreasing over the last several decades. There are likely many factors contributing to smaller lots sizes, but two of the most influential appear to be land availability and smaller lot preferences:

    - **Land availability—**As counties continue to urbanize and expand, the amount of developable land continues to decrease. As a result, there is not enough land available to accommodate for future growth using historic average residential lot sizes. Counties like Salt Lake and Davis are necessarily seeing reductions in lot size simply based on availability of developable land.
    - **Smaller lot preferences—**Recent development trends have confirmed that Utah's residents have generally been moving away from larger lot sizes toward smaller lots sizes that are more affordable and take less time to maintain. There is no reason to believe this trend will change in the foreseeable future.

Based on these factors, decreases in lot size are expected in all areas of the state, but especially in urbanized areas along the Wasatch Front. Table 4-4 shows percent reduction in lot size included in each of the M&I water use scenarios. The impact of reduced lot size (based on the statewide average) is shown graphically in Figure 4-3.



[1] Based on state average. Actual reduction varies by county, see Table 4-4.

Figure 4-3: Potential Scenarios for Decreases in Residential Lot Sizes

Table 4-4: Reduction in Average Lot Size by County

County	Average Lot Size (ft^2)	Average Landscaped Area Per Lot (ft^2)	Scenario 1	Scenario 2	Scenario 3
Beaver	19,039	7,454	7%	14%	22%
Box Elder	17,881	7,033	7%	15%	25%
Cache	13,564	4,880	6%	13%	20%
Carbon	13,863	4,973	4%	9%	16%
Daggett	9,399	3,372	0%	0%	2%
Davis	9,485	4,620	13%	13%	13%
Duchesne	9,707	3,592	4%	9%	9%
Emery	28,086	10,107	8%	15%	28%
Garfield	25,548	9,164	1%	2%	21%
Grand	7,569	2,715	8%	16%	16%
Iron	9,185	3,295	9%	18%	18%
Juab	21,145	7,816	6%	13%	40%
Kane	11,125	3,991	2%	4%	9%
Millard	29,507	10,859	6%	12%	27%
Morgan	14,611	7,020	11%	21%	26%
Piute	21,008	7,536	2%	4%	16%
Rich	56,792	20,373	4%	7%	30%
Salt Lake	10,600	3,802	19%	19%	19%
San Juan	12,533	4,496	14%	28%	28%
Sanpete	16,194	6,097	9%	18%	24%
Sevier	15,783	5,662	7%	14%	20%
Summit	6,153	2,824	5%	11%	11%
Tooele	11,292	4,051	10%	21%	21%
Uintah	17,736	6,362	7%	13%	22%
Utah	10,189	4,387	7%	13%	13%
Wasatch	22,353	9,296	6%	13%	43%
Washington	14,994	5,379	6%	11%	31%
Wayne	27,195	9,755	3%	5%	26%
Weber	9,450	4,202	7%	15%	15%
Statewide Average	11,364	4,441	5%	14%	19%

- Scenario 1—5% reduction in lot size statewide
  - This scenario assumes that decreases in lot size will be relatively modest. The values included here are based on half of the change calculated in Scenario 2 (see next section).
  - There are two exceptions to the statement above. Salt Lake and Davis Counties do not have enough developable land to sustain growth at the size of lots that would result from the calculation described for this scenario. As a result, density changes in these two counties for all three scenarios (including this one) are simply based on the required reduction to limit development to available land. This results in lot size reduction of 19% in Salt Lake County and 13% in Davis County. These values are based on 80,000 developable acres left in Salt Lake County and 30,000 developable acres left in Davis County. Utah and Weber Counties would also approach full development of available property by the end of the planning window but don't quite reach it.

- Scenario 2—14% reduction in lot size statewide
  - This scenario assumes that the decrease in lot size is enough to exactly offset the projected decrease in household size. In other words, lot sizes will decrease such that the amount of landscaped space per person stays the same.

- Scenario 3—19% reduction in lot size statewide
  - In this scenario, all future development in each county would average no more than 8,600 square feet, the projected average lot size in the state's urban counties along the Wasatch Front at buildout.
  - Under this scenario, all new development in the state would look like average densities in developed areas along the Wasatch Front. While it is unlikely that most rural counties will densify at this rate, this scenario is intended to cover the full range of potential densification.

Resulting Residential Outdoor Water Conservation Potential

Based on the several factors above, residential outdoor water conservation potential can be calculated. Internal to this calculation are several components worth discussion in some detail:

Evapotranspiration Rate

Evapotranspiration (ET) rates are used to measure the amount of water needed in a landscape. Evapotranspiration occurs when water is moved from soil to the atmosphere by evaporation and from plants to the atmosphere by transpiration. Put simply, ET is essentially the minimum amount of water needed to grow plants. ET is generally measured in units of inches of water per year. To identify the amount of water saved associated with increasing efficiency and as a result of changing residential landscapes, a baseline for ET rates across the state needed to be established.

ET rates for each county have been calculated based on data developed by Lewis and Allen (Lewis et al. 2017). This study looked at vegetation water use variability throughout the state as a result of seasonal weather conditions and air temperature variations. From this raster data, zonal statistics were computed over the water systems' service areas in each county (DWRe 2015) and weighted by area to obtain the representative value for the county. In other words, the variable used for each county represents the area-weighted average of the water systems in that county.

Potential Climate Change Impact on Evapotranspiration

One issue of concern for many water suppliers is climate change and its potential impact on the irrigation needs of landscapes. Water resources planning, including conservation, must acknowledge a changing climate both past and future.

Dendrohydrolgy analysis (reconstructing past hydrologic conditions by examining tree rings) indicates that streamflow in the Weber River was most stable in the 20th century, while the centuries before showed much greater variability of extended wet and dry periods (Bekker et al. 2014). A similar analysis of the Bear River indicates that the latter half of the 20th century was the second-wettest period of the past 1200 years (DeRose et al. 2015). Both findings imply that future water conditions could be more uncertain than the recent past.

The climate continues to change. In Utah, the projected effects by 2050 relative to present conditions include a temperature increase of 2.3 °F, an 8-day lengthening of the irrigation season, reductions in mountain snowpack (shift from snow-dominated to rain-dominated hydrology), and peak runoff occurring one month earlier (Kunkel et al. 2004; Barnett et al. 2005; Gilles et al. 2012; Kunkel 2013; EPA 2015; JVWCD 2017; Khatri et al. 2018; USGCRP 2018). There is of course considerable uncertainty, but these values constitute representative projections for a variety of likely climate scenarios. See Figure 4-4.

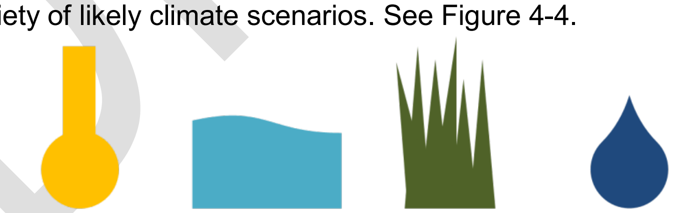


Figure 4-4: Climate Change Impacts in Utah by 2050

All of these effects have implications for water conservation. First, the increasing temperatures and longer irrigation seasons will demand more water for the same uses (especially outdoor) relative to today. Second, less snowpack and earlier runoff will limit available water supplies.

While not directly affecting water demand, a limited supply will motivate further water conservation.

Because of the significant uncertainty associated with climate change projections, the impact of these changes on ET are equally uncertain. Ranges of expected increases in ET from one recent study vary from 2% to 17% (JVWCD 2017). For the purposes of this analysis, an increase in ET rates as a result of climate change has been included in each water conservation scenario as summarized in Table 4-5. It will be noted that, in most cases, water conservation potential increases from Scenario 1 to Scenario 3. In this case, however, water conservation potential will decrease as the impact of climate change increases. (Additional impacts from climate change would result in more pressure to conserve and is correspondingly more likely to be associated with the higher scenarios.)

Table 4-5: Potential Increase in Irrigation Needs Associated with Climate Change

Scenario	Increase in Irrigation Needs
Past Practices	0%
1	5%
2	10%
3	15%

Total Water Application Scenarios

Based on the several issues discussed above, the expected average application rate for irrigation water on landscaped areas by county is summarized in Table 4-6 for each M&I water use scenario. This takes into account evapotranspiration, efficiency, changes in landscaping, and climate change. It should be emphasized that these are average application values for the entire landscaped area, not the actual irrigation rate for any specific type of landscaping. For example, if half the area were turf irrigated at 30 inches and the other half were low-water-use perennials irrigated at 18 inches, the reported average outdoor application rate would be 24 inches.

Table 4-6: Average[1] Irrigation Application Rate (Inches) by County

County	Past Practices	Scenario 1	Scenario 2	Scenario 3
Beaver	50.7	38.0	27.9	21.8
Box Elder	45.9	34.4	25.3	19.8
Cache	43.0	32.3	23.7	18.5
Carbon	46.1	34.5	25.3	19.9
Daggett	40.6	30.5	22.4	17.5
Davis	44.3	33.2	24.3	19.1
Duchesne	45.1	33.9	24.8	19.5
Emery	53.9	40.5	29.7	23.3
Garfield	46.5	34.9	25.6	20.0
Grand	57.9	43.4	31.8	25.0
Iron	48.9	36.7	26.9	21.1
Juab	46.9	35.2	25.8	20.2
Kane	57.9	43.4	31.8	25.0
Millard	52.1	39.1	28.6	22.5
Morgan	36.4	27.3	20.0	15.7
Piute	42.8	32.1	23.5	18.4
Rich	35.7	26.7	19.6	15.4
Salt Lake	43.3	32.5	23.8	18.7
San Juan	58.7	44.0	32.3	25.3
Sanpete	45.7	34.3	25.1	19.7
Sevier	48.1	36.1	26.4	20.7
Summit	32.2	24.2	17.7	13.9
Tooele	48.4	36.3	26.6	20.9
Uintah	50.4	37.8	27.7	21.8
Utah	42.9	32.2	23.6	18.5
Wasatch	33.9	25.4	18.7	14.6
Washington	72.6	54.5	39.9	31.3
Wayne	41.7	31.3	22.9	18.0
Weber	43.6	32.7	24.0	18.8
Statewide Average	48.0	36.0	26.4	20.3

[1] Based on overall inches applied to the landscaped portion of the lot. Incorporates the applicable mix of turf, low-water-need plants, and hardscape for each scenario. For “Past Practices”, this is based on 80% cool-season turf grass and 20% plant beds or hardscape.

OTHER WATER USE TYPES

Estimating water conservation potential for other types of water use is difficult because of the broad range of potential use within each category. However, many of the principles described above will also apply to other types of use. Using this approach, water conservation potential was calculated for other types of water use as follows.

a) Commercial

Statewide, commercial water use accounted for 14% of total M&I water user in 2015 (Figure 4-1). As a result, water conservation by commercial users must be an important part of overall goals. Unfortunately, evaluating water conservation potential for commercial use is complicated by the significant variation that can be observed between different types of commercial users. Whereas most residential users have relatively similar water use needs and patterns, commercial users can be very different. For example, the water use patterns of a restaurant are very different from the water needs of an office complex.

As result of this variability, available research on water conservation for commercial use is less available than for residential uses. Where good research does exist on certain types of commercial uses, current water use data collected throughout the state does not include enough detail to break down and analyze how this can be applied regionally. As part of future goal setting efforts, it is recommended that additional research and data collection be dedicated to this issue. Until then, it is necessary to make some simplified assumptions regarding water conservation in the commercial sector. For the purposes of this study, It has been assumed that commercial water conservation potential will be half the potential calculated for residential water use. For example, if residential water use is reduced by 10%, commercial water use is projected to be reduced by 5%. While all customer types have opportunities available to reduce water use, the commercial sector is generally more likely to already have taken some of the actions necessary to do so for various reasons. Municipal development standards throughout the state are typically more restrictive for commercial development and require water efficient fixtures and water-wise landscaping. The commercial sector also generally has more available resources to invest in water efficiency.

b) Industrial

The state's average per capita industrial use is currently 7 gpcd (DWRe 2018a, 2018b). It has been estimated that industrial water use will remain constant at 7 gpcd in each scenario. This does not mean that water conservation is not expected from industrial customers. However, this approach assumes that any reduction in water use achieved through water conservation will be made available to reinvest in industry coming into the state. This will help make water available to allow for future industrial growth to drive and sustain the economy.

c) Institutional

Statewide, institutional water use accounted for 13% of total M&I water user in 2015 (Figure 4-1). Much of this water use occurs outdoors on parks, school ball fields, etc. Institutional water use is also symbolic as most government properties are included in this category and looked at as an example of how state and local governments are conserving water. As a result, it is recognized that water conservation by institutional users must be an area of focus and an important part of overall goals moving forward.

With this in mind, institutional water conservation potential has been calculated as follows:

- Indoor conservation—Indoor water use at institutions will be similar to commercial water use. Thus, indoor water conservation for institutional use has been calculated under the same assumptions as commercial. This equates to half the potential calculated for residential indoor water use
- Outdoor conservation—This is the area of greatest potential savings for institutional use. Outdoor conservation potential for industrial considers the same general areas of savings as identified for residential use with a few adjustments:
    - Increases in Efficiency—Water savings associated with efficiency have been calculated based on the same increases in efficiency as expected for residential customers as summarized in Table 4-2.
    - Changes in Landscaping—Water savings associated with changes in landscaping assume that institutional landscaping will be modified to reduce cool-season turf grass areas to match the reductions for residential landscapes. The exception to this will be active play areas such as ball fields. It is expected that these areas will remain turf grass (although implementation of more water efficient species of grasses will still be encouraged). Outside of active play areas, movement to water-wise plantings or naturalized areas will match the residential scenarios.

      Changes in Density—The primary area where the calculation of outdoor water savings differs from savings calculated for residential use is density. For institutional use no decrease in lot size per person has been assumed. This approach has been used under the assumption that, as residential lot sizes reduce and densify, the availability of public open spaces will become increasingly important to the well-being and life quality of the residents surrounding them. Thus, increases in efficiency and changes in landscape type are included in the institutional outdoor water use estimate, but there is no reduction in institutional outdoor area per person.

Mixture of Use Types

It should be noted that all calculations assume that the proportional mixture of water use types remains the same in each region moving forward. In other words, the amount of commercial, institutional, and industrial development in each region will remain approximately the same moving forward. While this is reasonable assumption for planning purposes, it is recognized that the relocation of a major industry to a region or some significant shift in the economy could change the balance of development. Since the numbers in this report are calculated on a per capita basis, this type of shift would correspondingly affect water use numbers without actual change in water use behavior. While major shifts of this nature are not expected in the short term, the mixture of use types and their effect on water conservation goals should be reexamined as part of future goal setting efforts.

RESULTS

M&I water use under these scenarios is summarized in Tables 4-7 and 4-8. Table 4-7 summarizes water use by component and Table 4-8 summarizes water use by region. See Appendix F for a summary of water use by county.

Table 4-7: Potential M&I Water Use (gpcd) by Type

User Type	2015	Past Practices	Scenario 1	Scenario 2	Scenario 3
Res. Indoor	60	72	61	51	41
Res. Outdoor	108	140	91	63	47
Commercial	35	39	35	31	28
Institutional	33	38	34	31	28
Industrial	7	7	7	7	7
Total	**242**	**296**	**228**	**183**	**151**

Table 4-8: Potential M&I Water Use (gpcd) by Region

Region	2015	Past Practices	Scenario 1	Scenario 2	Scenario 3
Bear River	304	351	282	225	184
Green River	270	340	268	213	174
Lower Colorado North	285	343	264	207	170
Lower Colorado South	303	528	423	322	238
Provo River	226	267	201	160	132
Salt Lake	214	257	204	169	143
Sevier River	401	481	357	278	225
Upper Colorado	337	425	319	247	200
Weber River	250	290	208	167	140
Statewide Average	242	296	228	183	151

These results suggest that there is significant potential to conserve water throughout the state. Though the results vary on a regional basis, the state's residents and institutional properties in particular have substantial opportunity to reduce water use both indoors and outdoors. The other municipal and industrial user types have significant potential to conserve as well and should not be overlooked as potential contributors to water conservation.

In reviewing Table 4-8, it should be noted that, simply because a region has a 2015 use below the benchmark for a given scenario, it does not mean that the region has necessarily met all the assumptions associated with that scenario. Consider Lower Colorado South for example. Its 2015 use is below both Scenario 1 and Scenario 2. This does not necessarily mean that it has already met its goals relative to indoor fixture conversion and efficiency. In this case, its progress toward water conservation can primarily be explained by landscaping practices where turf grass for many residents is already less than 50% (the target for Scenario 2). Thus, savings through turf grass reduction offsets remaining water conservation that can be achieved in other areas. Even where 2015 water use falls below one or more of the scenarios, it is still expected that water conservation associated with items such as indoor fixture conversion and improved efficiency will be considered in these areas as goals are established in the next chapter.

WATER CONSERVATION POTENTIAL AND ITS RELATIONSHIP TO GOAL SETTING

As discussed previously, the three scenarios considered here were selected simply to provide perspective on what water use could be for a given set of assumptions. While it is hoped that these scenarios will be useful in understanding regional water conservation potential, it is recognized that there are infinite combinations of assumptions that could be selected to identify projected water use and conservation potential throughout the state.

With that in mind, the water conservation potential model developed here provides an important tool to begin the goal setting process. In essence, setting goals can be described as selecting which set of assumptions is appropriate for each region and then calculating the corresponding water use using the potential model. The following chapter describes the process used to develop assumptions for future water use patterns and correspondingly establish regional goals.

Chapter 5: Regional Water Conservation Goals

PURPOSE

This chapter describes the approach for developing regional M&I water conservation goals and documents the results.

METHODS

The project team's approach to developing the regional water conservation goals synthesizes many of the components already presented: current water use (Chapter 1), public involvement (Chapter 2), regional definitions (Chapter 3), and water conservation potential (Chapter 4). In this chapter, the project team uses these results to develop regional goals. The steps to developing the goals are as follows:

- Identify water conservation practices (in Utah and beyond) and their associated costs.
- Based on costs and input gathered during the public involvement process, identify water conservation practices for implementation.
- Using the water conservation potential model developed in Chapter 4, estimate the impact of the practices on water use and conservation potential. The resulting water use calculations serve as starting points for the regional goals.
- Develop a statistical model of 2015 water use to account for differences between observed and predicted water use that can then be used to adjust the final goals. (While the water conservation potential model attempts to account for all the anticipated contributions to water use, it is a necessarily simplified representation of actual conditions. The statistical model is intended to account for issues that cannot be captured in the water conservation potential model.)

Each of these steps are described below. Figure 5-1 summarizes the process.

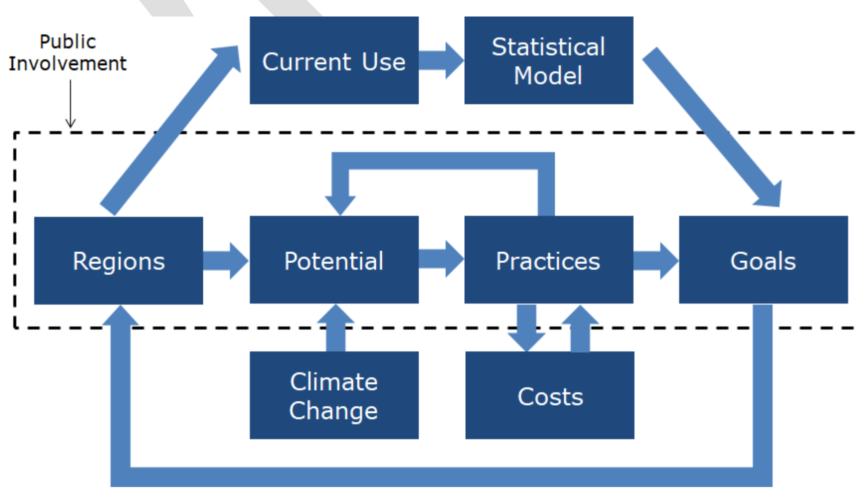


Figure 5-1: Goal Development Process

Water Conservation Practices

Possible Practices

There are hundreds of different practices that could be implemented to conserve water in Utah. This includes conservation both indoors and outdoors as well as among all different water user types. A sample of possible practices follows, obtained from a review of water conservation successes in Utah and other water-scarce places such as the southwestern U.S., Australia, and Israel (DWRe 2001, 2014; Sovocol 2005; EPA 2010; WBWCD 2013; SNWA 2014; Maddaus Water Management 2015, 2018; Siegel 2015; Edwards et al. 2016; Turner et al. 2016; LVVWD 2018).

General

- Educate through demonstration gardens
- Provide landscaping classes
- Distribute educational booklets
- Distribute information mailers
- Create website resources
- Promote mass media messaging
- Target high residential and commercial water users
- Implement business water efficiency management plans
- Increase stakeholder coordination
- Create data management programs
- Provide rebates (indoor and outdoor)
- AWWA M36 water audits to identify and eliminate sources of water loss
- Enhance leak detection and repair
- Water pricing policies
- Ordinances and policies

Indoor

- Provide do-it-yourself water saving kits
- Incentivize shower head replacement
- Incentivize toilet replacement
- Incentivize faucet replacement
- Incentivize washing machine replacement

Outdoor

- Increase landscape watering at night
- Incentivize and educate on landscape conversion
- Implement landscape watering regulations
- Implement lawn installation regulations
- Encourage rainwater harvesting
- Improve wastewater reuse
- Implement water waste fees
- Incentivize smart controllers
- Increase secondary water metering
- Implement irrigation schedules

Practices Selected for Analysis

While all of the aforementioned practices may have merit in some applications, detailed analysis is not possible in this report. Consequently, this analysis groups the selected practices into the following major categories. These categories have been developed because they are specific enough to provide detail regarding potential water savings but broad enough to be analyzed using the limited data available for all regions of the state.

General

- Water conservation education—Conservation gardens, landscaping classes, information mailers, websites, etc.
- Conservation pricing—Reducing or eliminating use of property tax to pay for water system costs, increasing block rates, collecting greater percentage of costs through volume rates, etc.

Indoor

- Fixture conversion or new installation (Toilets, Faucets, and Showers)—These fixtures are generally lower cost/more cost effective and have correspondingly been grouped together.
- Appliance conversion or new installation (Washing Machines)—The indoor appliance with the greatest water use that can be converted to higher-efficiency.
- Leak repair—Refers to indoor leaks only. Does not include water distribution system leaks (outside the scope of this study)
- Changing Indoor Water Use Habits—Shorter showers, etc.

Outdoor

- Smart irrigation controllers—Controllers that increase efficiency by adjusting irrigation schedules based on weather and landscaping needs.
- Secondary meters—Adding meters for all M&I secondary water customers.
- Existing landscape conversion—Changing existing residential turf landscapes to water-wise plants and drip irrigation.
- Initial landscape construction—Using water-wise plantings and drip irrigation on new construction.
- Turf rebates—While this is actually just a subcategory of “existing landscape conversion,” it has been separated to provide additional cost information.

It is recognized that these practices are not mutually exclusive (e.g., education will likely be necessary to implement the other practices). It is also recognized that, within these major categories, further discussions and decisions will be needed to effectively implement the overall strategies. For example, if fixture conversion of washing machines is selected as a practice for implementation, policy makers will need to decide whether this is accomplished through water conservation education (providing information on the benefits of high-efficiency washing machines and where to get them), incentives (providing cash rebates on the purchase of high-efficiency machines), and/or regulation (passing ordinances requiring the purchase of high-efficiency machines). Determining the most effective approach to implement each practice will vary by entity and is beyond the scope of this report.

Implementation Costs

One factor in determining whether or not a water conservation practice should be implemented is cost. Estimated implementation costs for each practice category identified above are summarized in Table 5-1. To provide a common basis of comparison between these costs and other options available to the water system, costs have been calculated in dollars per acre-foot per year based on the estimated implementation costs and estimated water savings associated with each practice.

Table 5-1: Water Conservation Practice Costs

Practice	Cost ($)	Yield (ac-ft)	Unit Cost ($/ac-ft)	Annualized Cost[1] ($/ac-ft)
General				
Water Conservation Education				Varies
Conservation Pricing				Varies
Indoor				
Fixture Conversion—Toilets, Showers, and Faucets				$485[2,3]
Appliance Conversion—Washing Machines				$1,830[2]
Leak Repair				Varies
Changing Indoor Water Use Habits				Varies
Outdoor				
Secondary Meters	$1,300	0.285	$4,567	$525[4]
Smart Irrigation Controllers				$198[2]
Landscape Conversion[5]—Wasatch Back	$26,136	0.259	$101,009	$6,571
Landscape Conversion—Wasatch Front	$26,136	0.345	$75,757	$4,928
Landscape Conversion—Southern Utah	$26,136	0.431	$60,605	$3,942
Initial Landscape[5]—Wasatch Back	$10,454	0.259	$40,403	$2,628
Initial Landscape—Wasatch Front	$10,454	0.345	$30,303	$1,971
Initial Landscape—Southern Utah	$10,454	0.431	$24,242	$1,577

[1] Annualized over 30 years at 5%.
[2] Sample of costs from Edwards et al. 2016 and Maddaus 2015.
[3] Based on average per acre-foot costs for all fixture types in this category.
[4] Because of the short lifespan of meters, annualized over 20 years. Includes $45/year/meter for meter reading and maintenance.
[5] Landscaping costs and water savings shown for ¼ acre residential lot. Costs assume $3/ft^2 for turf and sprinklers and $5/ft^2 for water-wise plantings with drip irrigation. In the case of new construction, costs only include the differential between water-wise plantings with drip irrigation and turf with sprinklers.

A few items should be noted regarding these cost calculations:

- Cost "varies"—There are four categories for which a cost number cannot be accurately reported. This includes water conservation education, conservation pricing, leak repair, and changing indoor habits. While cost estimates have been prepared by other entities for some of these activities, the reported values vary greatly depending on the specific application and are largely based on water savings assumptions that are difficult to verify.
- Location of landscape conversion—While the costs of landscape conversion will be approximately the same regardless of location, the water saved through this action can be significantly different depending on evapotranspiration needs. To represent the range of water savings available, calculations have been provided for three representative areas: Wasatch Back representing low ET requirements (e.g., Summit County, Wasatch County), Wasatch Front representing average ET requirements (e.g., Salt Lake County, Utah County) and Southern Utah representing high ET requirements (e.g., Washington County, Kane County).
- Turf Rebates—Turf rebates have not been included in Table 5-1. This is because the calculation of costs associated with turf rebates generally refer only to the costs incurred by the water supplier in offering the rebate. They do not include the remaining costs of converting turf that the customer must pay. For example, if turf conversion to more water-wise landscape costs $\$5/ft^2$ and a water supplier offers a rebate of $\$1.50/ft^2$, the customer must still cover the remaining $\$3.50\ /ft^2$. Thus, the full cost of a turf rebate program is identical to the landscape conversion costs already included in the table.

  With that said, it may be useful for water suppliers to have a calculation of cost for their portion of turf rebates only to use in comparison with other alternatives they are considering. Following the same approach used for other water conservation practices, the estimated costs of turf rebates (to the water supplier only) are shown in Table 5-2.

Table 5-2: Turf Rebate Costs to Water Supplier

Turf Rebate	Cost[1] ($)	Yield (ac-ft)	Unit Cost ($/ac-ft)	Annualized Cost ($/ac-ft)
Per dollar per ft^2, Wasatch Back	$43,560	1.725	$25,252	$1,643
Per dollar per ft^2, Wasatch Front	$43,560	2.300	$18,939	$1,232
Per dollar per ft^2, Southern Utah	$43,560	2.875	$15,151	$986

[1] Turf rebate costs are unit costs per dollar offered per square foot. For example, if an entity offered $\$3/ft^2$, the cost would be triple the value reported in the table. The total cost and water yield reported are based on 1 ac of turf conversion. Costs shown do not include program administration costs.

The costs reported in the table are per dollar per square foot. It is understood that water suppliers who choose to pursue turf rebates as a conservation strategy will opt for varying levels of rebate. If an entity offered $\$0.50/ft^2$, rebate costs would be half the value shown. If entities offered $\$3.00/ft^2$, rebate costs would be triple the value shown. With this said, it should be emphasized that the number of customers interested in pursuing turf rebates will directly relate to the size of the rebate. Thus, while a lower rebate may be less expensive, it will also have a much smaller impact on water savings than a larger rebate.

Finally, the costs reported in the table do not include program administration costs. These have been excluded because they will vary by entity and the amount of rebate being offered. However, they can be significant and should not be ignored when water suppliers are deciding if they want to implement a turf rebate program as part of their water conservation plans.

Water Source Costs

To understand whether or not a water conservation practice is cost effective, its cost must be compared against an alternative. In most cases, the alternative will be development of additional water sources. To provide a basis for comparison, Table 5-3 summarizes the cost of development for several different sources throughout the state.

Table 5-3: Water Source Costs

Source	Capital Cost	Yield (ac-ft)	Unit Capital Cost ($/ac-ft)	Annualized Capital Cost[1] ($/ac-ft)	O&M Cost ($/ac-ft)	Total Cost ($/ac-ft)
Lake Powell Pipeline	$1,383,430,000[2]	86,249	$16,040	$1,043	$208[3]	$1,252
Bear River Pipeline—to JVWCD	$723,260,182[9]	50,000	$14,465	$941	$188[3]	$1,129
Central Water Project[4]	$16,736	1	$16,736	$1,089	$156	$1,245
Reuse—High[5,7]	$56,957,000	4,200	$13,561	$882	$528	$1,411
Reuse—Low[5,7]	$11,546,000	1,341	$8,610	$560	$258	$818
Average Sized Municipal Well[7]	$8,073,000[8]	807	$10,009	$651	$186	$837
Mixed Portfolio of Local Water Sources[6,7]	$9,900[8]	1	$9,900	$644	$117	$761

[1] Annualized over 30 years at 5%.
[2] DWRe construction estimates including environmental mitigation based on current preferred alternative.
[3] Based on 20% of capital costs. Includes operations, maintenance, and power.
[4] From CUWCD rate schedule. Unit cost already given.
[5] Sample of reuse feasibility studies for Utah communities.
[6] Evaluation of historic culinary sources in SLC Secondary Master Plan, BC&A, 2018. Unit cost already given.
[7] For sources without known environmental mitigation costs, assumes 10% of construction costs.
[8] Includes capital costs and cost of purchasing water rights. Cost of water right assumed to be $6,000/ac-ft.
[9] Based on JVWCD portion of DWRe construction cost estimate for Bear River Project ($1,724,000,000 for total project), the JVWCD portion of project yield (220,000 ac-ft for the total project) and JVWCD finished water treatment and delivery costs. Unit costs are not shown for the project as a whole because the treatment and O&M portion of costs will vary depending on location and entity. The JVWCD portion of the project was chosen to be representative of the project here because it is located at the far southern end and has one of the highest unit costs for entities that would potentially participate in the project.

Based on the table, the expected cost to develop a new source can range from around $800/ac-ft/yr to more than $1,400/ac-ft/yr. Thus, the cost effectiveness of water conservation activities will vary by provider depending on the availability of alternative sources.

It should be noted that the costs reported in Table 5-3 represent costs from the perspective of the water supplier. These numbers will be most useful when water suppliers are considering the amount of money to invest into water conservation programs. For individual customers the math may change. In addition to the water source costs above, they will also pay for the ongoing use of the water through water rates. While water rates vary dramatically across the State, a resident paying $2.00 per thousand gallons in water rates (a typical value for culinary outdoor water use) would end up paying an extra $650/ac-ft/yr beyond what is shown in the table.

Considerations outside Direct Costs

One approach to deciding what water conservation practices should be selected for implementation into the regional goals would be to consider the practices from strictly a cost perspective. In this case, only those practices with costs lower than the next available source of water for a community would be implemented. While cost does provide important insight into the selection of viable practices, there are several reasons cost should not be used as the exclusive selection criterion:

- **Water is a limited resource—**The water sources included in this report primarily represent those that are currently being considered as viable for development. Correspondingly, these represent the most cost-effective and viable water sources currently known. This means that, after these sources are developed, costs for subsequent sources will be higher, and in many cases, significantly higher. In some areas, there may not be any other new sources of significance. With limited viable water sources available, it is prudent for the residents of the state to implement some practices now (even if they are more expensive than water development) in order to stretch the available remaining water supply to meet future demands.

- **Long-term vs. short-term cost—**A quick review of the water conservation practices cost table will reveal that an investment now (even if more expensive in the short term) can result in significant long-term savings. This is especially true of landscaping new properties.

  As an example, consider full water-wise landscaping for a property on the Wasatch front. The estimated cost of this practice is almost $2,000/ac-ft/yr. This is above the cost of development for any of the sources currently identified to serve the Wasatch Front. However, once the currently identified sources are used up, it is very likely that the next block of sources (if any can be located) will cost more than $2,000/ac-ft/yr. At that point, water suppliers will be looking for existing customers to convert to water-wise landscapes at a cost of $5,000/ac-ft/yr. In short, any turf that is avoided now may mean less turf that needs to be converted later at a greater overall cost to the community.

- **Indirect costs—**The costs listed above are necessarily limited to direct costs that can be readily calculated. During public outreach meetings throughout the state, a number of comments were received expressing the need to consider impacts that have either indirect costs or costs that are difficult to quantify. This includes impacts associated with water development (e.g., reduced instream flows for wildlife habitat, reduced lake levels at the Great Salt Lake, increased treatment costs, etc.) as well as impacts of water conservation (e.g., negative impacts to urban forestry health and useable recreational space at homes). While it is beyond the scope of this study to provide a detailed analysis of these issues, it is recognized that their consideration may result in selection of practices that may not appear viable from a strict economic perspective.

- **Cost uncertainty—**While the costs contained in Tables 5-1 and 5-2 represent the most up-to-date cost estimates for both water development and conservation practices, actual costs will not be known until either the development projects are completed or the practices are fully implemented.

Practices Selected for Implementation into Goals

Based on the analysis above, survey data, and input received at regional open houses and in stakeholder interviews, the major categories of practices have been implemented into the regional goals as described in the following sections.

General Practices

Water conservation practices identified under this heading have been included in regional goals as follows:

- **Water conservation education—**Continued aggressive emphasis throughout the state
- **Conservation pricing—**Continued aggressive emphasis throughout the state

Expected impact on water use: While both of these practices are expected to be ongoing, fundamental components of overall water conservation efforts, no specific impact on water use has been included in the water conservation potential model associated with these activities. It is expected that they will form the backbone of efforts to encourage and support the other practices described in the following sections.

Indoor Practices

Water conservation practices identified under this heading have been included in regional goals as follows:

- **Fixture conversion (toilets, faucets, and showers)—**Assume rapid progress toward full implementation throughout the state. This practice is more cost effective than any of the water development options identified and should be encouraged in all regions. Federal regulations also now require the use of high-efficiency fixtures in this category. Table 5-4 summarizes the assumed statewide progress.

Table 5-4: Fixture Conversion Rates (Toilets, Faucets, and Showers)

	Proportion of Households with High-Efficiency Faucets and Showers			
	Current	**2030**	**2040**	**2065**
Existing Development	80%[1]	88%	93%	98%
New Construction	-	100%	100%	100%
	Proportion of Households with High -Efficiency Toilets			
	Current	**2030**	**2040**	**2065**
Existing Development	37%[1]	61%	77%	98%
New Construction	-	100%	100%	100%

[1] DeOreo et al. 2016

- **Appliance conversion (washing machines)—**Assume gradual progress toward full implementation throughout the state. While this practice is currently more expensive than most water development options, movement toward high-efficiency washing machines has been observed over the last decade due to many advantages (water savings, power savings, improved cleaning performance, etc.). Federal energy efficiency requirements have also made it more difficult to get good performance from top-loading machines that use more water. As a result, many manufacturers and consumers are moving toward lower-water-use, front-loading machines. Table 5-5 summarizes the assumed statewide progress.

Table 5-5: Appliance Conversion Rates (Washing Machines)

	Proportion of Households with High-Efficiency Washing Machines			
Category	**Current**	**2030**	**2040**	**2065**
Existing Development	46%[1]	75%	85%	98%
New Construction	-	80%	90%	98%

[1] DeOreo et al. 2016

- **Other indoor measures (leak repair and indoor water use habits)—**Assume gradual progress toward partial implementation. While the cost effectiveness of these practices is difficult to quantify, most water users will support the elimination of leaks and indoor water waste. However, how diligently water users move toward making progress in these areas will likely depend on issues such as the cost of water and community perception toward water scarcity. Since these issues will vary by region, assumed progress varies by county depending on supply availability as summarized in Table 5-6.

Table 5-6: Other Indoor Water Conservation Measures

Category	**Proportion of Potential Savings Realized from Leak Repair and Changing Indoor Water Use Habits**			
	Current	**2030**	**2040**	**2065**
Counties with No Pending Water Shortage	0%	12%	15%	20%
Counties with Long-term Projected Water Shortages	0%	20%	30%	35%
Counties with Near-term Projected Water Shortages	0%	25%	40%	50%

Expected impact on water use: As described in Chapter 4, Scenario 3 includes 100% of the savings identified for indoor practices as identified above. Thus, potential savings associated with these several measures will be as summarized in Table 5-7. Within a given county or region, expected impact on water use will then be a function of the level of implementation of each practice. This includes consideration of the ratio of new growth to existing development since the rate of fixture conversion varies between the two.

Table 5-7: Potential Indoor Savings

Type of Water Use	2015 Water Use[1] (gpcd)	Scenario 3 Water Use (gpcd)
Toilet	14.2	6.3
Shower	11.1	9.3
Faucet	11.1	9.3
Washing Machine	9.6	7.6
Leaks/Other Indoor Uses	14.0	7.7
Total	60.0	40.0

[1] Adapted from DeOreo et al. 2016

Outdoor Practices

Water conservation practices identified under this heading have been included in regional goals as follows:

- **Smart irrigation controllers—**Smart irrigation controllers are one tool to improve irrigation efficiency. Thus, for goal setting, this section considers target improvements in overall irrigation efficiency, not just adoption of smart irrigation controllers. This is another area where most water users will support the efficient use of water outdoors. However, how diligently water users move toward making progress in this area will likely depend on issues such as the cost of water, community perception toward water scarcity, and overall irrigation requirements. Since these issues vary by region, it is assumed that progress will vary by county. To facilitate calculations between the various outdoor water conservation measures, adoption rates for all outdoor measures have been grouped into three categories based on irrigation requirements and water availability. Table 5-8 summarizes assumed progress for each category.

Table 5-8: Irrigation Efficiency

	Irrigation efficiency (required ET divided by actual water applied)			
Area	**Current**	**2030**	**2040**	**2065**
Wasatch Front/Population Centers	60%	72%	78%	79%
Wasatch Back/Rural Areas	60%	71%	75%	76%
Southern Utah	60%	80%	80%	80%

- **Secondary meters—**Assume rapid progress toward full implementation throughout the state. This practice of metering (and charging for) end-use irrigation water is more cost effective than any of the water development options identified and should be encouraged in all regions. There is also considerable discussion of making universal metering a regulatory requirement at the state level. Table 5-9 summarizes assumed progress statewide.

Table 5-9: Secondary Meter Adoption

	Proportion of M&I secondary water connections with meters			
	Current	**2030**	**2040**	**2065**
Statewide	Minimal	90%	100%	100%

- **Water-wise landscaping (construction of new properties and conversion of existing properties)—**This is an important area for discussion because it is the practice with both the greatest potential for water conservation and the most uncertainty. From the cost analysis presented previously, there are only a few instances where water-wise landscaping makes sense from strictly a cost perspective:
    - In high ET areas (Southern Utah), new construction using water-wise landscaping is within 25% of the projected cost of the Lake Powell Pipeline. When coupled with some of the non-cost considerations identified above, it seems prudent to pursue water-wise landscaping for all new construction in this area.
    - In medium ET areas (Wasatch Front), new construction using water-wise landscaping is about 75% more expensive than water development projects such as the Bear River Pipeline. However, with greater contractor experience and increasing popularity of water-wise landscaping, this cost difference is expected to decrease. When coupled with some of the non-cost considerations identified above, it seems prudent to encourage water-wise landscaping for new construction in this area.

  In all other circumstances (new construction in low ET areas and conversion of existing landscaping in all areas), use of water-wise landscaping appears to be more expensive than corresponding water source costs.

  With this said, outdoor landscaping appears to be an area where considerations outside of direct cost will have a major impact. In recent years, more and more water customers have shown a willingness to incur the higher costs of construction for water-wise landscaping in order to reduce maintenance, improve the aesthetics of their property, and/or out of a desire to save water, regardless of cost. Many water suppliers are also seeing the benefit of encouraging water-wise landscaping through regulations or incentives in order to stretch limited resources. For these reasons, it seems prudent to keep landscaping changes as a fundamental component of future water conservation goals, even in areas where it may not be justified by current water costs.

  Based on this discussion, assumed progress in this area will vary depending on location and type of construction (new construction vs. existing landscape conversion). Assumed progress to be included in the goals is as summarized in Tables 5-10 and 5-11[1].

[1] It should be noted that limitations in the dataset and conservation potential model necessarily require this analysis be limited to percentages and averages only, not consideration of individual properties. For example, if there were two properties and one had 60% water-wise landscaping and the other had 40% water-wise landscaping, the model could not distinguish between the individual properties and would report this as 100% of the properties meeting the 50% standard based on the average of the two properties. This is the reason the Southern Utah categories show 100% compliance in some cases even though it is understood that full compliance with any conservation practice is unlikely.

Table 5-10: Water-Wise Landscaping—New Construction

Area	Proportion of new properties with at least 50% of irrigated area with water-wise landscaping		
	2030	2040	2065
Wasatch Front/Population Centers	45%	75%	90%
Wasatch Back/Rural Areas	30%	48%	60%
Southern Utah	100%	100%	100%
	Proportion of new properties with 80% of irrigated area with water-wise landscaping		
Area	**2030**	**2040**	**2065**
Wasatch Front/Population Centers	10%	15%	20%
Wasatch Back/Rural Areas	5%	10%	15%
Southern Utah	90%	90%	90%

Table 5-11: Water-Wise Landscaping—Conversion of Existing

Area	Proportion of existing properties converting at least 50% of irrigated area to water-wise landscaping		
	2030	2040	2065
Wasatch Front/Population Centers	33%	50%	60%
Wasatch Back/Rural Areas	20%	33%	40%
Southern Utah	100%	100%	100%
	Proportion of existing properties converting 80% of irrigated area to water-wise landscaping		
Area	**2030**	**2040**	**2065**
Wasatch Front/Population Centers	7%	12%	15%
Wasatch Back/Rural Areas	4%	6%	8%
Southern Utah	25%	35%	40%

- **Other factors affecting outdoor water use (climate change and increased density) —**Although not necessarily conservation measures, climate change and increases in development density may have a significant effect on outdoor water use and must be accounted for:
    - To account for climate change, all areas of the state include an increase in evapotranspiration starting at 0% in 2015 and linearly increasing to 15% by 2065.
    - Assumed increases in density vary by county and are incorporated into the goals as summarized in Table 5-12. Major population centers (Davis, Salt Lake, Utah, Washington, and Weber Counties) are expected to have increases in density equal to Scenario 3. Other counties have been assigned density increases equal to Scenario 1 or 2 depending on projected population growth.

Table 5-12: Increases in Density

County	Reduction in Average Lot Size (2015–2065)
Beaver	7%
Box Elder	15%
Cache	13%
Carbon	4%
Daggett	0%
Davis	13%
Duchesne	4%
Emery	8%
Garfield	1%
Grand	16%
Iron	18%
Juab	13%
Kane	4%
Millard	6%
Morgan	21%
Piute	4%
Rich	7%
Salt Lake	19%
San Juan	28%
Sanpete	9%
Sevier	7%
Summit	11%
Tooele	21%
Uintah	13%
Utah	13%
Wasatch	28%
Washington	31%
Wayne	3%
Weber	15%
Statewide Weighted Average	**17%**

Expected impact on water use: With so many different conservation practices affecting outdoor water use and with impact of those practices varying based on location, it is not possible to isolate and summarize the impact of the selected measures on outdoor water use in a useful table as was done for indoor water use. However, total impact of all water conservation measures will be summarized in the following section.

Water Conservation Potential Results Based on Selected Practices

Based on implementation of water conservation practices and other factors as described above, Table 5-13 summarizes the projected water use for each region as identified in the water conservation potential model. This will serve as a baseline for setting goals.

Table 5-13: M&I Water Conservation Potential for Selected Practices

	Current (gpcd)	Potential Use With Selected Practices (gpcd)		
Region	**2015**	**2030**	**2040**	**2065**
Bear River	304	257	239	233
Green River	270	242	232	228
Lower Colorado River North	286	235	217	208
Lower Colorado River South	303	274	262	249
Provo River	226	184	168	159
Salt Lake	214	188	176	168
Sevier River	401	330	308	307
Upper Colorado River	337	277	262	262
Weber River	250	192	176	171

Statistical Model

To help determine what variables predict water use and how each county is performing relative to the prediction, the project team developed an empirical regression model of annual water use.

Following the approaches of similar work by the Committee on USGS Water Resources Research (2002) and others (Huang et al. 2017; Eslamian et al. 2016; Li 2013; Wong et al. 2010), the project team selected an ordinary least squares (OLS) multiple regression model. This is a common choice in the physical sciences and relatively easy to explain, use, and share. Details of the modeling theory are described elsewhere. Each county's 2015 per-capita M&I

water use in gallons per capita per day (DWRe 2018 a, 2018b) was the dependent variable (left-hand side) and all others were potential explanatory variables (right-hand side).

The following explanatory variables were considered, as suggested by public involvement, engineering experience, and review of the above-cited literature:

- Geographic
    - County (AGRC 2014)
    - Area (AGRC 2014)
    - Water right duty (DWRi 2018)
    - Ratio of developed area as green space (DWRe 2018a)
    - Average elevation (USGS 2018)
- Demographic
    - 2015 population (DWRe 2018a, 2018b)
    - Population density (computed)
    - Population change, 2010–2015 (Kem C. Garner Policy Institute 2016)
    - Average age (U.S. Census Bureau 2015a)
    - Ratio of second homes (vacation, recreational, or occasional) to total homes (U.S. Census Bureau 2015c)
    - Median household income (U.S. Census Bureau 2015b)
    - Persons per household (U.S. Census Bureau 2015b)
- Climatic
    - Climate zone (Gillies and Ramsey 2009)
    - Average annual precipitation, 1981–2010, raster (PRISM 2018a)
    - Average annual evapotranspiration, 1980–2017, raster (DWRe 2018c; Lewis and Allen 2017)
    - Average minimum vapor pressure deficit, 1981–2010, raster (PRISM 2018a)
    - Average maximum annual air temperature, 1981–2010, raster (PRISM 2018a)
    - 2015 total precipitation, raster (PRISM 2018b)
    - 2015 total evapotranspiration, raster (DWRe 2018d; Lewis and Allen 2017)
    - 2015 growing season (May–Sept.) average temperature, raster (PRISM 2018b)
    - 2015 growing season (May–Sept.) total precipitation, raster (PRISM 2018b)
    - 2015 growing season (May–Sept.) total evapotranspiration, raster (PRISM 2018b)
- Hydraulic and system-specific
    - Ratio of public water systems with tiered water rates (individual responses)
    - Ratio of public water systems with documented water conservation programs or policies (individual responses)
    - Ratio of public water systems with clearly defined water conservation goal (individual responses)
    - Ratio of public water systems also covered by secondary water service (individual responses)
    - Ratio of total water use as industrial water use (DWRe 2018a, 2018b)

For raster data, zonal statistics were computed over the water systems' service areas (DWRe 2015) and weighted by area to obtain the representative value for the county. In other words, the variable used for each county represents the area-weighted average (rather than population-weighted average, due to spatial coarseness of population data associated with the water supplier service areas) of the water systems in that county.

To improve the overall fit of the regression, several transformations were necessary, particularly on variables that showed a wide range of values or nonlinear relationships when plotted against water use. In these cases, the natural logarithm of the variable was substituted for the original variable. This is a common practice to linearize the data (Sowby and Burian 2018; Carlson and Wallburger 2007).

Three criteria were set for the specification. First, the adjusted R^2 value must exceed 0.75 (the model must explain more than 75% of the observed variation in water use). Second, the *p*-value for each variable must be less than 0.05 (the model may only accept less than a 5% chance that the correlation is random). Finally, the root mean square error (RMSE) must be less than 121 gpcd, or 50% of the observed 2015 water use of 242 gpcd (DWRe 2018a, 2018b).

The specification of such a model is an artful balance of plausibility and significance. While many variables may correlate significantly with water use, the cause-and-effect relationship must be plausible. This eliminates variables whose influence on water use is far-fetched even if they improve the fit. The inclusion of each variable in the final model was evaluated qualitatively for plausible influence.

Ultimately, a regression model with the following significant variables (and an intercept) was produced:

- Climatic
  - EL: Average elevation (feet)
  - ET: 2015 growing season evapotranspiration (inches)
  - VPD: Average minimum vapor pressure deficit, 1981–2010 (millibars)
- Demographic
  - POP: Population (persons)
  - PD: Population density (persons per square mile)
  - RSH: Ratio of second homes (vacation, recreational, or occasional) to total homes (unitless)
  - INC: Median household income, dollars
- Hydraulic
  - RIND: Ratio of industrial water use to total water use (unitless)

The mathematical expression for this model is:

$$\text{County's 2015 Water Use (gpcd)} = 11{,}416 - 722.9\ln(\text{EL}) + 74.46(\text{ET}) - 1{,}932\ln(\text{VPD}) \\ - 59.25\ln(\text{POP}) + 0.1345(\text{PD}) + 675.4(\text{RSH}) - 0.00378(\text{INC}) - 1{,}155(\text{RIND})$$

The model yields an adjusted R^2 of 0.85 and RMSE of 82 gpcd, with all variables' *p*-values less than 0.03. These satisfy the aforementioned criteria. Figure 5-2 compares the observed and predicted values.

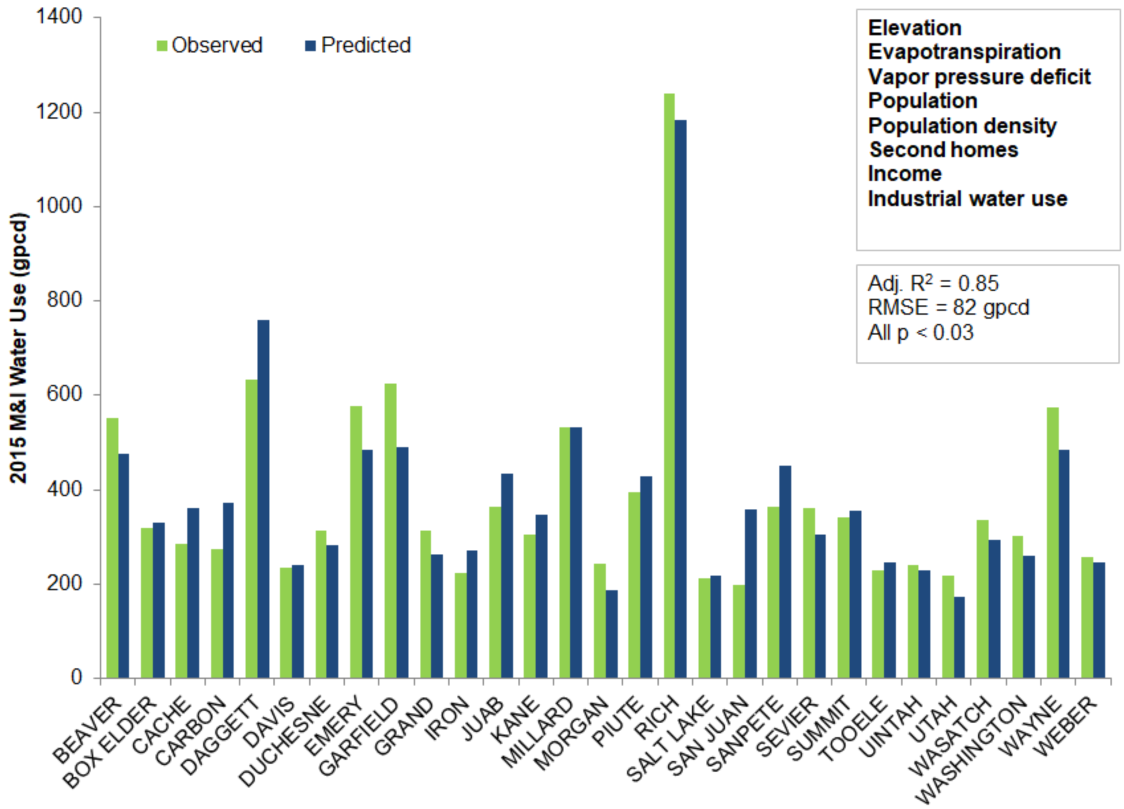


Figure 5-2: Regression Model Comparison

A portion of the difference between the observed and predicted 2015 water use for each county was used to adjust the final water conservation goals. If the county used more water than predicted, it was assumed that water conservation in that county was, for reasons not explained by the model, more difficult, and the goal was made less stringent. The opposite applied to counties that used less water than predicted.

Goal Definition

Historically, Utah's water conservation goal has been defined as a percentage reduction from a past baseline (e.g., "25% reduction from 2000 baseline by 2025"). This definition has been easy to understand and communicate but lacks specificity as to usage, local conditions, and the effects of water conservation practices. For example, if water use decreases in one year compared to the previous year, it may be attributed to conservation, or it may be a wet year in which outdoor water demand was lower. In developing the new goals, alternative definitions were considered.

One alternative is to specify a per-capita usage target, such as “200 gpcd,” instead of just a percentage. It is measurable, meaningful to water professionals, and suggests certain practices that may have not been apparent with just a percentage. However, it is difficult to define the target for non-residential uses that have custom needs, and even for residential uses where the use is not uniform.

Denver Water (2017) is specifying its goal as “the number of customers that are using water efficiently.” With this approach, Denver Water is evolving “from just focusing on water savings and toward helping our customers to meet their water needs in the most efficient ways.” Like a volume target, however, it is difficult to define and track for different types of users.

The Massachusetts Water Resources Authority (2018) specifies its goal as “below the safe yield” of its water sources. With abundant water supplies admittedly unlike Utah or Denver, Massachusetts still promotes water conservation but does not focus on per-capita usage.

Ultimately, based on the outcome of the public involvement and discussions with the Division, the project team decided on a combination of the usage target and the percentage relative to the new 2015 baseline, though still averaged within each region. Such a definition is consistent with the Division’s previous and forthcoming planning efforts, allows comparison with the 2015 baseline, satisfies federal reporting requirements, and offers both numbers to inform water conservation actions by water suppliers and individual users.

RESULTS

The approach described here produced the county-level data in Appendix F, which were aggregated (and weighted by population) to form the regional goals and future goal projections in Table 5-14. Further details are presented in Chapter 7.

Table 5-14: Regional M&I 2030 Water Conservation Goals and Projections

Region	Baseline (gpcd) 2015	2030 Goal (gpcd)	2040 Projection (gpcd)	2065 Projection (gpcd)	Reduction from Baseline 2030	Reduction from Baseline 2040	Reduction from Baseline 2065
Bear River	304	253	232	219	17%	24%	28%
Green River	270	243	234	232	10%	13%	14%
Lower Colorado River North	286	233	214	201	18%	25%	30%
Lower Colorado River South	303	277	267	259	8%	12%	15%
Provo River	226	188	174	170	17%	23%	25%
Salt Lake	214	187	176	167	13%	18%	22%
Sevier River	401	329	306	302	18%	24%	25%
Upper Colorado River	337	274	257	253	19%	24%	25%
Weber River	250	192	176	171	23%	30%	32%

Note: gpcd = gallons per capita per day based on permanent population

In reviewing the numbers produced by this process as summarized in Table 5-14, a few questions have arisen regarding the results that may be useful to address here:

- **Why do some areas have higher goals than others?** As described above, the goal setting process considered applicable water conservation practices and available water conservation potential. In the case of areas with above-average goals (by percentage), the higher goals are usually the result of above-average conservation potential. For example, consider the Weber River Region, the region with the highest overall goal (by percentage). This region has the highest overall percentage of unmetered secondary use. Thus, implementing secondary meters (one of the first conservation practices recommended for implementation) results in more conservation in this region than any other.
- **Why do some areas have lower goals than others?** Similar to the explanation above, lower goals can generally be explained by below-average water conservation potential. For example, consider the Lower Colorado River South Region, the region with the lowest overall goal (by percentage). This region actually has practices that are either equal to or more aggressive than all other regions. However, because this region has already made significant progress in some areas of water conservation (most specifically reduction in cool-season turf coverage), the implemented practices still result in a slightly lower amount of overall water conservation.

- **Why is the difference in projections between 2040 and 2065 relatively small in most regions?** In all regions, the decrease from 2040 to 2065 is smaller than the decrease from 2015 to 2040, even though the length of the period is the same. This can be explained by two factors. First, it is expected that water conservation will gradually slow over time as the easiest and most cost-effective practices are implemented first and only more difficult/expensive practices are reserved for later. However, this is only part of the explanation. A second factor that limits decreases in projected use during the later period is climate change. During this period, ongoing water conservation activities will be offset to some extent by increased need for water as the climate warms. This does not mean that conservation efforts can be reduced after 2040. Such activities will need to continue just to keep up with the increased need for water associated with climate change.

Chapter 6: Regional Water Conservation Practices

PURPOSE

This chapter identifies the water conservation practices that should be considered to achieve the regional M&I water conservation goals identified in this report. Local water suppliers, communities, and businesses are encouraged to adapt and refine these practices, as well as implement others, in their own water conservation efforts and in pursuit of the regional goal.

METHODS AND ANALYSIS

It is not the purpose of this report to develop a detailed water conservation plan for all the different regions in the state. Local water suppliers will have the best information regarding their own systems and will understand the unique opportunities and challenges associated with implementing water conservation practices in their service area.

With that in mind, this section will outline the areas where water conservation will be necessary and identify major water conservation categories that should be included in future efforts. It is expected that water suppliers in each region will then work together to identify the best approach to implementing the overall water conservation plan and reaching their goals.

The effectiveness of water conservation practices was analyzed as part of the goal setting process documented in Chapter 5. This section will summarize the major findings of that process and discuss implementation of water conservation practices. As in Chapter 5, practices will be grouped into simplified categories for discussion.

RECOMMENDED PRACTICES

Recommended implementation of water conservation practices over the next several decades are as follows.

General Practices

The following practices are expected to be ongoing, important parts of overall water conservation efforts in all regions of the state. While it is difficult to quantify the exact savings associated with these efforts, it is expected that they will form the backbone of efforts to encourage and support the other practices described in following sections. This includes:

- **Water conservation education—**Education is the foundation of any effective water conservation program. No action will occur until customers and water users understand what is needed and how to make it happen. Continued emphasis and funding of education and outreach must be fundamental components of any water conservation plan, and these efforts must evolve and innovate to be more effective than in the past. Customer feedback tools in bills and web applications, such as social norming comparisons and leak notifications, are also valuable, especially when enabled by advanced metering infrastructure (AMI) and supported by tiered rates.

- **Conservation pricing—**While most Utahns have a desire to save water, experience suggests that efforts to do so will be limited unless financial incentives exist to help motivate action. This is especially true where significant investment is required to implement water savings. With this in mind, it is recommended that water suppliers examine and update their existing water rate structures to identify ways of encouraging continued conservation. Three specific recommendations regarding water rates include:
    - **Reduce or eliminate use of property taxes to cover water system costs**—As part of its 2015 audit, the Office of the Legislative Auditor General recommended reconsidering the current use of property taxes to subsidize the cost of water. As noted in the audit, "Property taxes provide a stable source of revenue to some water districts. However, if water rates do not represent the full cost of water service, users may overuse the resource. By reducing property taxes for water and increasing prices on water use to be revenue neutral, consumers would be empowered to make market-based decisions. Policymakers will need to weigh the benefits of market-based pricing against the risk of subjecting water districts to less stable revenue."
    - **Minimize base rates—**According to data provided by JVWCD (Forsyth and Schultz 2017), a small base rate (with correspondingly higher volume rates) correlates with improved water conservation. The data on JVWCD's retail service area and a few member agencies show that base rates constituting less than 30% of the total revenue corresponded to greater reductions in per-capita water consumption from 2000 to 2015 than did base rates making up a larger share of the revenue. The smaller the base rate, the more customers pay for their actual consumption. This finding could inform future rate changes aimed at water conservation, where a relatively low base rate is one of the most important components.
    - **Improve increasing tier volume rates—**State regulations require that all water suppliers use an increasing block rate for volume charges in their system. However, no additional detail is provided regarding how the increasing block rates should be structured. To be effective, block break points should be selected at meaningful levels that provide clear price signals to customers. The difference in cost between blocks should also be large enough to provide a significant incentive to conserve. The tiers should be based on the cost of service in order to be defensible and effective. Many other western states have already adopted aggressive tiered rates to help in their water conservation efforts. For example, Boulder, Colorado, has a tiered structure that in the highest tier charges five times the base rate (Equinox Center 2009). Cities like Las Vegas and San Diego have also implemented this measure (SNWA 2014). While rates must be cost based and treat all customer classes equitably, it appears that there is still some

opportunity for each region to identify ways in which tiered volume rates could be improved to encourage conservation.

Indoor Practices

The following indoor water conservation practices are recommended.

- **Fixture conversion—**Conversion of toilets, faucets, and showers to high -efficiency options has been shown to be one of the most cost-effective conservation practices available. In addition to reducing water volume with each use, new fixtures also reduce leakage. Thus, it is expected that this practice will be included as a part of conservation plans in all regions. Conversion of washing machines is less cost effective, but still expected to contribute to conservation plans. For new construction, use of high-efficiency fixtures has already largely been implemented as a result of federal regulations that prohibit the sale of anything other than high-efficiency toilets, showers, and faucets. Market trends are also driving new consumers toward high-efficiency washing machines. For existing development, regions could decide to wait for natural replacement of the fixtures as they age (at essentially no cost to water suppliers) or offer cash incentives to accelerate the process.

- **Other indoor measures (leak repair and changing indoor water use habits)—**To achieve long-term water conservation, all regions will need to make at least some progress in reducing indoor leaks and changing indoor water use habits. The most effective methods of accomplishing this will vary but will rely heavily on water conservation education and conservation pricing to encourage improvement in these areas.

Outdoor Practices

Recommended outdoor conservation practices are as follows:

- **Improved irrigation efficiency—**While significant improvement has been made in irrigation efficiency over the last few decades, additional potential still exists. To make additional progress in efficiency, areas of focus should include:

    - **Secondary meters—**One of the most effective ways demonstrated to improve irrigation efficiency is to meter secondary water use. Since the amount of secondary use varies by region, the impact of this action will also vary. However, in regions with significant secondary water, full secondary metering is expected to reduce total water use by up to 15%. It is recommended that universal metering be implemented as a regulatory requirement at the state level. However, since this will require a major capital investment from the water suppliers, it is also recommended that this requirement be coupled with assistance in financing the required improvements.
    - **Smart irrigation controllers—**Smart irrigation controllers are a low-cost tool to improve irrigation efficiency. There are already a number of water suppliers

offering rebates for smart irrigation controllers. This practice should be continued and expanded.

    - **Drip irrigation systems—**There will always be a practical limit on how much efficiency can be improved in sprinkling systems. While sprinkling systems can be fine-tuned to minimize overspray and optimize coverage, issues such as wind will always result in some inefficiencies. Drip irrigation systems (including bubblers and micro-sprinklers) allow for more targeted delivery of water and greater efficiency. The challenge with drip irrigation is that it cannot be used for turf areas and correspondingly require changes in landscaping (as will be discussed below). However, where possible, use of drip irrigation systems must be encouraged in order to reach desired efficiency goals.

- **Water-wise landscaping—**As noted previously, this is an important area for discussion because it is the water conservation practice with the greatest potential for conservation but also the greatest cost. Based on the several considerations discussed previously, the following actions are recommended to reach the established water conservation goals in support of long-term water supply plans.

    - **Landscaping ordinances for new construction—**The most cost-effective time to install water-wise landscaping is during new construction. It is recommended that water suppliers work with entities regulating development to implement the following guidelines.
        - In high ET areas (Southern Utah), installation of turf during new construction should be limited to no more than 20% of the landscaped area in residential areas.
        - In medium ET areas (Wasatch Front), installation of turf during new construction should be limited to no more than 50% of the landscaped area in residential areas. It should be noted, however, that this is an absolute maximum that will only result in reaching projected long-term water conservation if it is also accompanied by existing residential areas converting landscaping such that turf is limited to 50%. To compensate for existing properties where conversion is more difficult to obtain, regions may consider limiting turf during new construction to 35%.
        - In low ET areas (Wasatch Back), installation of turf during new construction should be limited to no more than 60% of the landscaped area in residential areas.
        - In all areas, installation of turf should be minimal in commercial, industrial, and institutional areas except for designated activity areas such as ball fields.

    - **Conversion of existing landscaping—**Changes in the landscaping of future construction only will not save enough water to reach water conservation goals in most regions. It will also be necessary to encourage and incentivize conversion of landscapes on existing properties. While this is expected to be more difficult given the expense of conversion, the following actions are recommended as part of regional plans to achieve existing landscape conversion.

- **Water conservation education—**In recent years, more and more water customers have shown a willingness to incur the higher costs of construction for water-wise landscaping in order to reduce maintenance, improve the aesthetics of their property, and/or save water, regardless of cost. Continued education through demonstration gardens, landscaping classes, etc., will be important to support existing property owners who already desire to improve their current landscapes. An important aspect of this effort will be working with home improvement businesses and nurseries to ensure water-wise options are available to support existing property owners' efforts.
- **Financial incentives—**Recommended financial incentives to convert existing landscaping will likely come in one of two forms. First, conservation pricing structures that encourages the wise use of outdoor water can help make the decision to convert landscape more attractive. Second, regions may consider direct rebates for the removal of turf and sprinklers to be replaced with water-wise plants and drip irrigation. One challenge with this second approach is that the direct cost of water development is still relatively inexpensive compared to turf rebates. Information provided in Chapter 5 can be used to calculate the size of turf rebates that can be offered as a less expensive alternative to source development options. However, experience suggests that offering turf rebates at these levels will have limited success in motivating customers to change their landscapes. While offering turf rebates may be a prudent first step, turf rebates should be viewed as just one potential tool that can be considered and combined with other measures by water suppliers to achieve their goals.

- **Lot size and density ordinances—**While regulating density is outside the control of many water suppliers, future lot size will substantially impact the amount of water needed to serve the future population of Utah and must be considered when developing plans for water conservation. It is recommended that water suppliers work with entities regulating development to implement guidelines that encourage smaller lot sizes.

WATER CONSERVATION COSTS

Achieving the goals identified in this report will require a major investment from the citizens of the state. To help both citizens and policy makers understand the level of investment required, the cost of implementing water conservation actions through 2030 have been estimated by region. Estimated costs include the following major categories:

- **Water Conservation Education Costs—**Continuing education will form the foundation for future conservation activities and must be adequately funded. While determination of the right level of funding will vary by region, a survey of conservation investment by agencies throughout the west identified conservation expenditures ranging from about $0.50/person/year to $7.00/person/year (Maddaus 2018). While many of these programs include the costs of rebate programs and other measures, a larger portion of the costs are associated with education. Since a robust investment will be required to encourage the ongoing conservation identified in this report, water conservation education costs have been estimated based on a budget of $2.00/person/year.
- **Indoor Conservation Upgrades—**Much of the indoor conservation identified in this report will be achieved at essentially no cost as a result of federally mandated technology improvements as new fixtures and appliances are installed and/or replaced. However, there will various costs associated with providing incentives to accelerate these upgrades, repairing leaks, etc. For the purpose of this calculation, an annualized cost of $500/ac-ft has been included for all indoor conservation.
- **Secondary Metering—**Replacement of secondary meters has been based on $1,300 per typical residential meter, consistent with previously documented costs.
- **New Landscaping—**Installation of new landscaping is based on a differential of $2.00 per square foot of additional cost associated with well-designed water-wise landscaping and drip irrigation versus traditional cool-season turf grass and sprinkling system. It should be noted that no attempt has been made to determine who will be paying this cost. In most cases, it seems likely that the new property owner will bear most of this cost, not the water supplier. However, in order to give the most accurate picture of cost possible, the full cost is shown here. The implementation rate of water-wise landscaping for new development is as documented for the recommended goals.
- **Landscape Conversion**—Conversion of existing landscaping is based on a cost of $5.00 per square foot of cost associated with removal of existing turf and installation of a well-designed water-wise landscaping and drip irrigation system. Again, no attempt has been made to determine who will be paying this cost. The conversion rate of existing properties to water-wise landscaping is as documented for the recommended goals.

Based on these costs, the investment in water conservation required to meet the recommended 2030 regional goals is summarized in Table 7-2 and totals $3.26 billion. All costs are in 2019 dollars.

Table 7-2: Estimated Conservation Investment Required to Meet 2030 Regional Goals

Region	Water Conservation Education	Indoor Conservation Upgrades	Secondary Metering	New Landscaping Differential	Existing Landscape Conversion	Total
Bear River	$4,200,000	$3,000,000	$23,300,000	$25,000,000	$144,300,000	$199,700,000
Green River	$1,300,000	$500,000	$6,100,000	$5,300,000	$24,300,000	$37,500,000
Lower Colorado River North	$1,400,000	$600,000	$8,500,000	$8,500,000	$42,900,000	$61,900,000
Lower Colorado River South	$4,600,000	$4,500,000	$11,600,000	$237,800,000	$99,700,000	$358,300,000
Provo River	$16,500,000	$11,600,000	$124,100,000	$178,100,000	$461,500,000	$791,800,000
Salt Lake	$28,400,000	$18,400,000	$49,000,000	$111,500,000	$693,900,000	$901,300,000
Sevier River	$1,400,000	$600,000	$17,800,000	$9,400,000	$48,300,000	$77,500,000
Upper Colorado	$1,100,000	$500,000	$9,600,000	$7,300,000	$28,300,000	$46,800,000
Weber River	$15,300,000	$8,700,000	$148,600,000	$89,700,000	$524,200,000	$786,400,000
Statewide Total	$74,200,000	$48,400,000	$398,600,000	$672,600,000	$2.08 Billion	$3.26 Billion

Chapter 7: Conclusions and Recommendations

SUMMARY OF FINDINGS

This project developed M&I water conservation goals for nine regions of Utah (Figure 7-1). These goals, which build on the previous statewide goal, will complement water development, help the Division fulfill its mission of planning and conserving Utah's water resources, and guide local water suppliers in their own water conservation efforts.

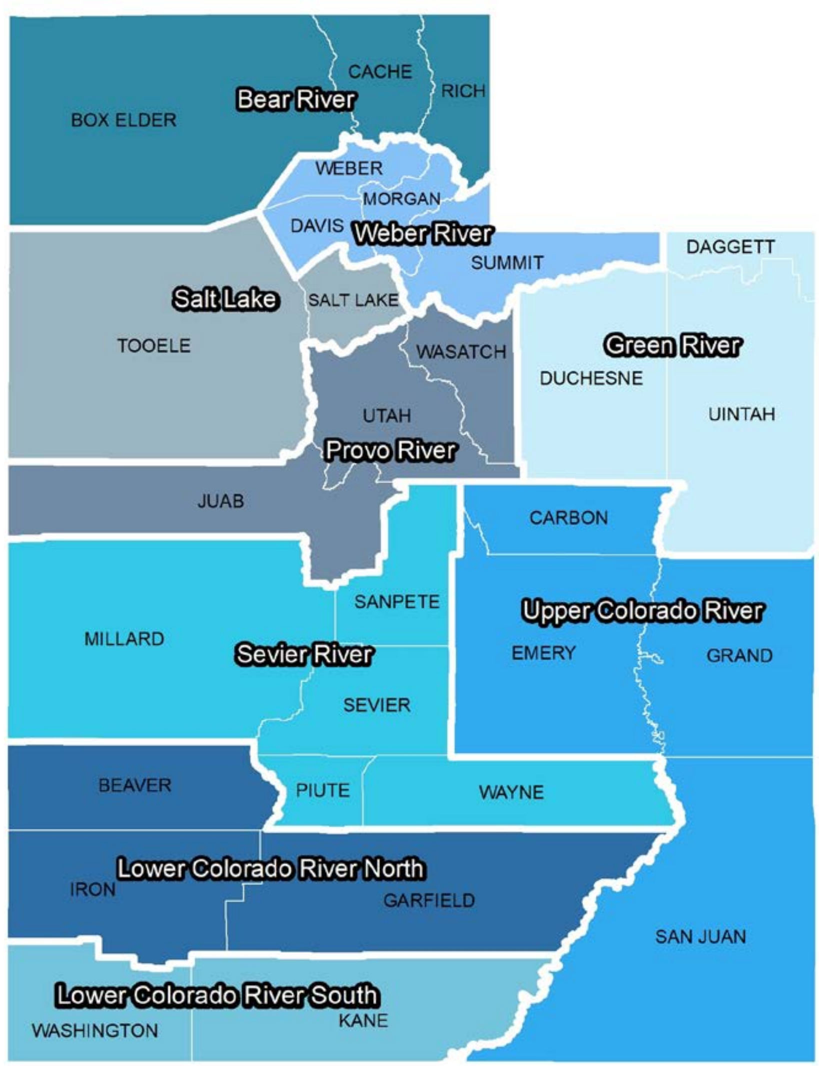


Figure 7-1: Regional M&I Water Conservation Boundaries

The approach relied heavily on public involvement from an online survey, informational open houses, and in-depth interviews with key stakeholders in Utah's water industry. The public process strongly affirmed the need for regional goals and guided the project team to data, insights, and questions that improved the quality of the work.

Rigorous analysis of M&I water conservation potential indicates that there is significant potential to conserve water throughout the state. Though the results vary by region, the state's residents have substantial opportunity to reduce water use both indoors and outdoors. The other M&I user types—commercial, institutional, and industrial—have significant potential to conserve as well and should not be overlooked.

While water conservation potential is high, it will not solve all of the problems of water supply and demand. A balance of water development and water conservation, pursued in parallel, will be necessary to meet the water needs of a rapidly growing state.

RECOMMENDED GOALS

Table 7-1 presents M&I water conservation goals and projections for each of the regions shown in Figure 7-1.

Table 7-1: Regional M&I 2030 Water Conservation Goals and Future Goal Projections

Region	2015 Baseline (gpcd)	2030 Goal		2040 Projection		2065 Projection	
		Goal (gpcd)	Reduction from 2015	Projection (gpcd)	Reduction from 2015	Projection (gpcd)	Reduction from 2015
Bear River	304	253	17%	232	24%	219	28%
Green River	270	243	10%	234	13%	232	14%
Lower Colorado River North	286	233	18%	214	25%	201	30%
Lower Colorado River South	303	277	8%	267	12%	259	15%
Provo River	226	188	17%	174	23%	170	25%
Salt Lake	214	187	13%	176	18%	167	22%
Sevier River	401	329	18%	306	24%	302	25%
Upper Colorado River	337	274	19%	257	24%	253	25%
Weber River	250	192	23%	176	30%	171	32%

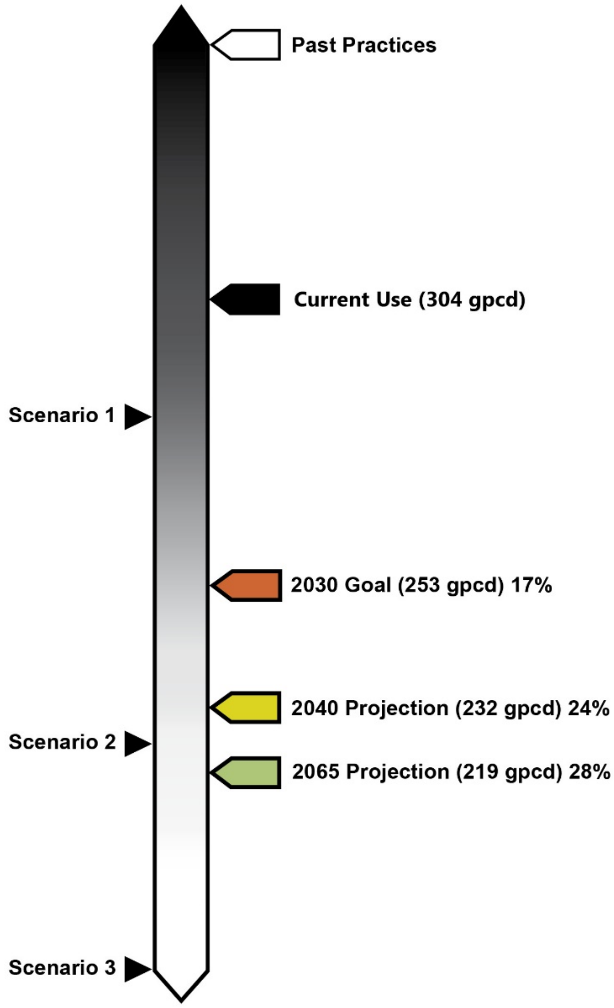
Note M&I = municipal and industrial; gpcd = gallons per capita per day based on permanent population

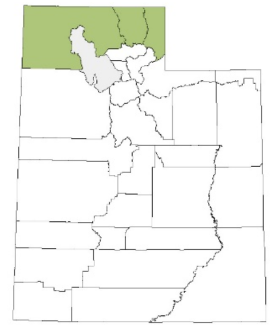
Recognizing that uncertainty increases with time, the goals and future goal projections have been presented for three time periods: 2030 (goal), 2040 (projection), and 2065 (projection). The 2030 goal will be the primary focus for action over the next decade with the 2040 and 2065 projections providing guidance for planning and future expectations. While 2065 is the planning horizon for this study, it is clear that M&I water conservation will need to continue thereafter. For planning purposes, it is recommended that the annual conservation rate in each region used for future planning beyond 2065 be half of the annual conservation rates projected for the 2040–2065 period.

As 2030 approaches, the 2040 and 2065 projections will be revisited and modified as demographics, technology, conditions, and behaviors change. Once adopted, however, the goals should not be reset before the year for which they were intended in order to accurately assess progress during that time period.

In 2015 (the new baseline year), Utah's M&I water use was 242 gpcd (DWRe 2018a, 2018b). If considering all regional goals together, the outcome for the entire state is 204 gpcd by 2030 (16% reduction from 2015). Projections for all regions, considered together, are 190 gpcd by 2040 (22% reduction from 2015), and 185 gpcd by 2065 (24% reduction from 2015).

Regional goals and their relationship to the water conservation scenarios (described in Chapter 4) and historic use are shown in Figures 7-2 through 7-10. Figure 7-11 shows the outcome for the state as a whole as a result of the regional goals and projections.



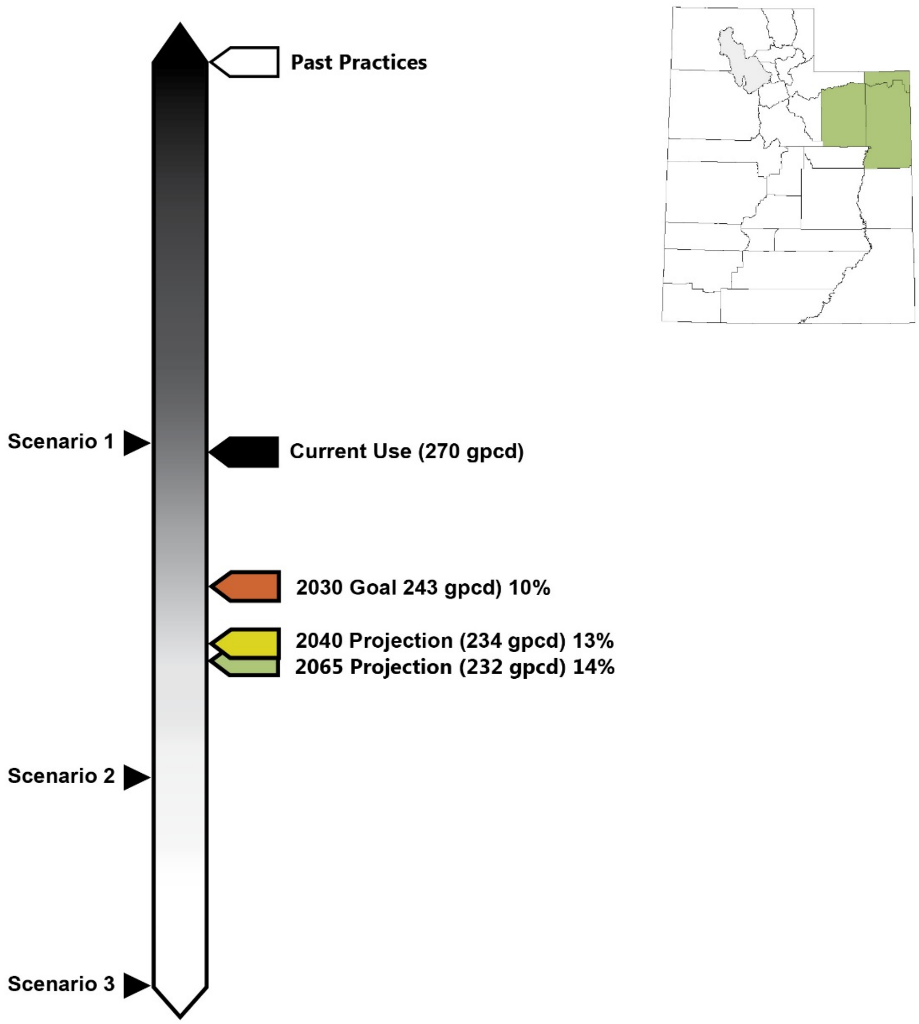


Notes: Scenarios shown are based on projected use for specific use patterns as described in Chapter 4 and summarized here:

Water Use Scenario	Indoor Use (gpcd)	Irrigation Efficiency	Residential Landscaping % Turf	Reduction in Residential Lot Size
Past Practices	70	50%	80%	None
Scenario 1	60	70%	80%	Conservative
Scenario 2	50	80%	50%	Moderate
Scenario 3	40	>80%	20%	Aggressive

The scenario markers do not consider the cost or feasibility of achieving the assumed use patterns. They have been included solely to provide perspective relative to past and current water use and to help each region understand what must occur to achieve the final goals.

Figure 7-2: M&I Water Conservation Goals—Bear River Region

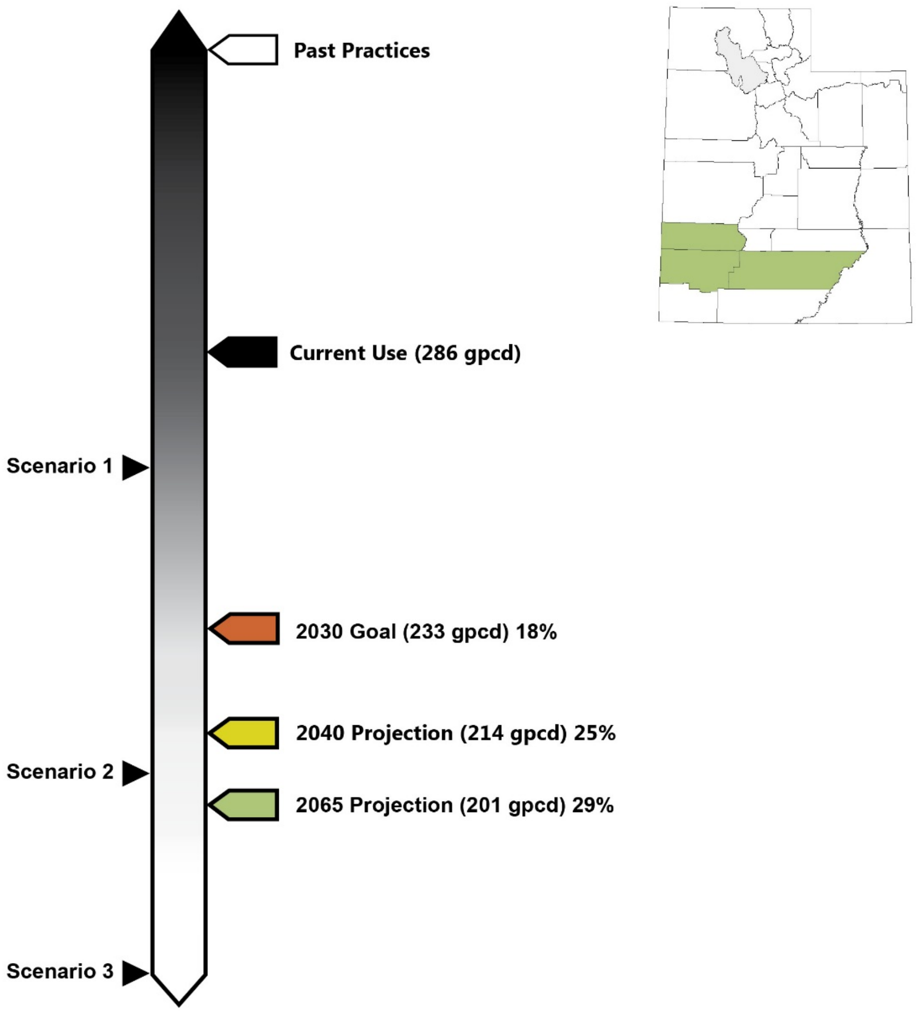


Notes: Scenarios shown are based on projected use for specific use patterns as described in Chapter 4 and summarized here:

Water Use Scenario	Indoor Use (gpcd)	Irrigation Efficiency	Residential Landscaping % Turf	Reduction in Residential Lot Size
Past Practices	70	50%	80%	None
Scenario 1	60	70%	80%	Conservative
Scenario 2	50	80%	50%	Moderate
Scenario 3	40	>80%	20%	Aggressive

The scenario markers do not consider the cost or feasibility of achieving the assumed use patterns. They have been included solely to provide perspective relative to past and current water use and to help each region understand what must occur to achieve the final goals.

Figure 7-3: M&I Water Conservation Goals—Green River Region

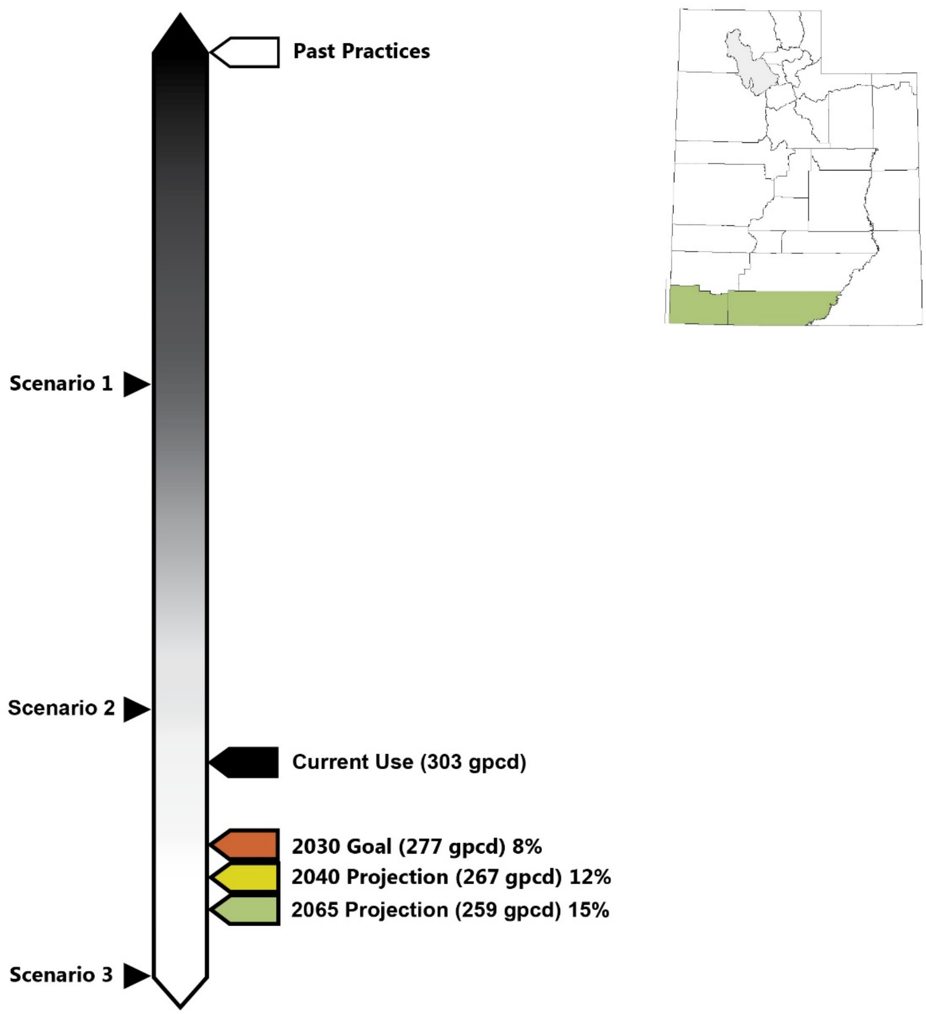


Notes: Scenarios shown are based on projected use for specific use patterns as described in Chapter 4 and summarized here:

Water Use Scenario	Indoor Use (gpcd)	Irrigation Efficiency	Residential Landscaping % Turf	Reduction in Residential Lot Size
Past Practices	70	50%	80%	None
Scenario 1	60	70%	80%	Conservative
Scenario 2	50	80%	50%	Moderate
Scenario 3	40	>80%	20%	Aggressive

The scenario markers do not consider the cost or feasibility of achieving the assumed use patterns. They have been included solely to provide perspective relative to past and current water use and to help each region understand what must occur to achieve the final goals.

Figure 7-4: M&I Water Conservation Goals—Lower Colorado North Region

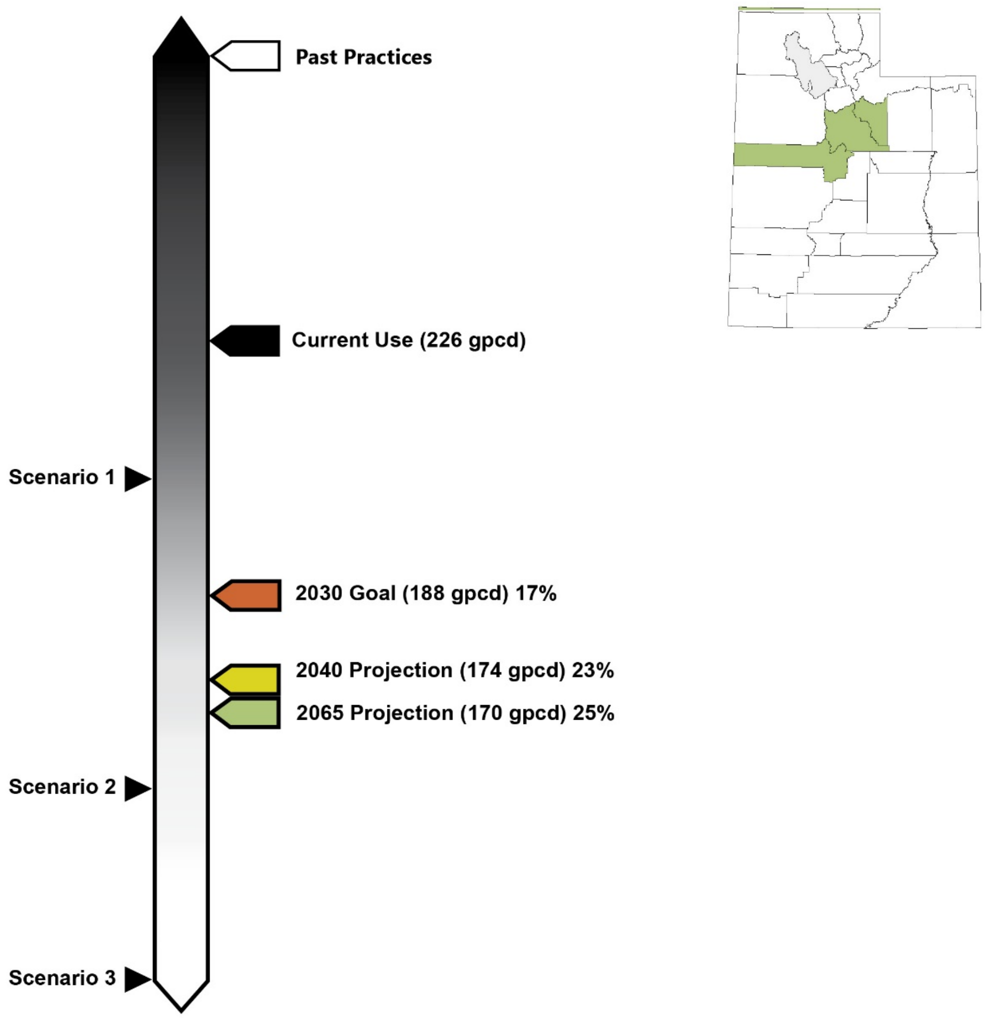


Notes: Scenarios shown are based on projected use for specific use patterns as described in Chapter 4 and summarized here:

Water Use Scenario	Indoor Use (gpcd)	Irrigation Efficiency	Residential Landscaping % Turf	Reduction in Residential Lot Size
Past Practices	70	50%	80%	None
Scenario 1	60	70%	80%	Conservative
Scenario 2	50	80%	50%	Moderate
Scenario 3	40	>80%	20%	Aggressive

The scenario markers do not consider the cost or feasibility of achieving the assumed use patterns. They have been included solely to provide perspective relative to past and current water use and to help each region understand what must occur to achieve the final goals.

Figure 7-5: M&I Water Conservation Goals—Lower Colorado South Region

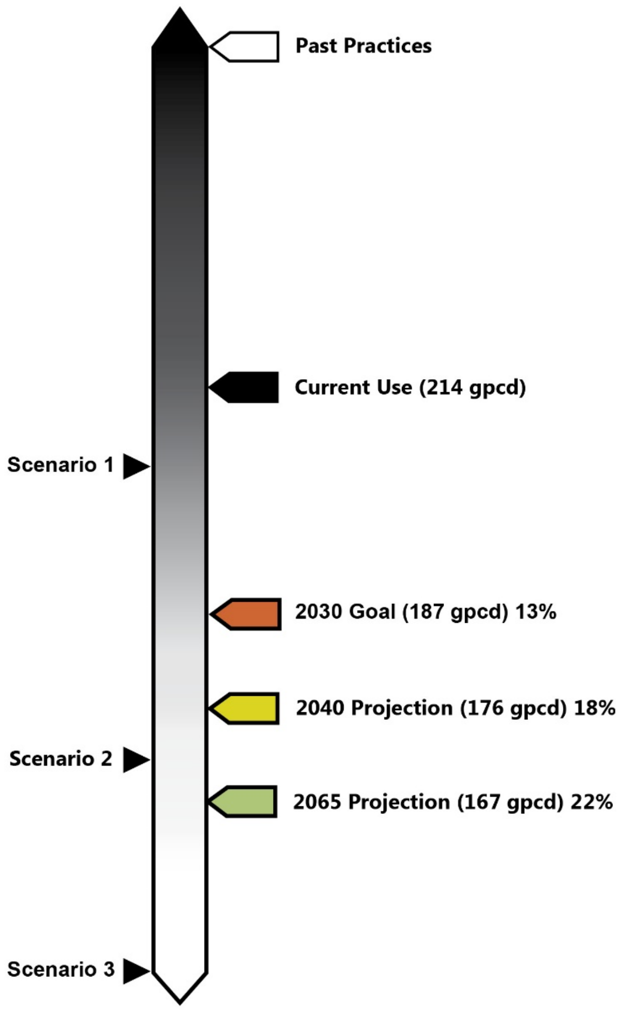


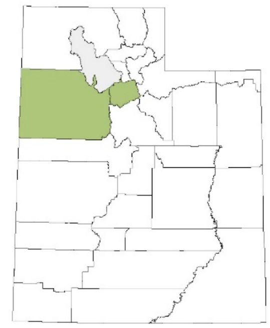
Notes: Scenarios shown are based on projected use for specific use patterns as described in Chapter 4 and summarized here:

Water Use Scenario	Indoor Use (gpcd)	Irrigation Efficiency	Residential Landscaping % Turf	Reduction in Residential Lot Size
Past Practices	70	50%	80%	None
Scenario 1	60	70%	80%	Conservative
Scenario 2	50	80%	50%	Moderate
Scenario 3	40	>80%	20%	Aggressive

The scenario markers do not consider the cost or feasibility of achieving the assumed use patterns. They have been included solely to provide perspective relative to past and current water use and to help each region understand what must occur to achieve the final goals.

Figure 7-6: M&I Water Conservation Goals—Provo River Region



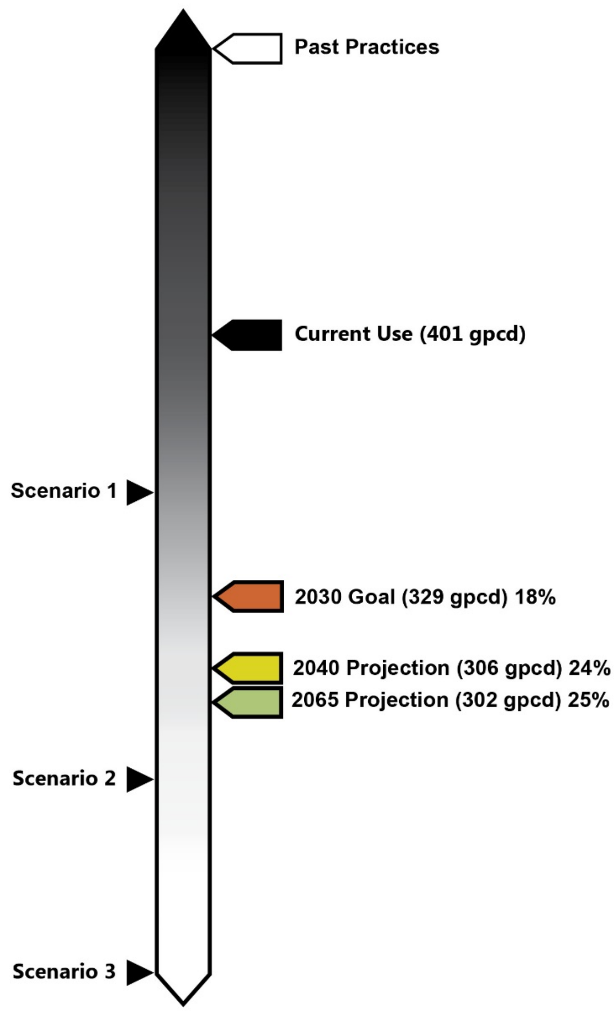


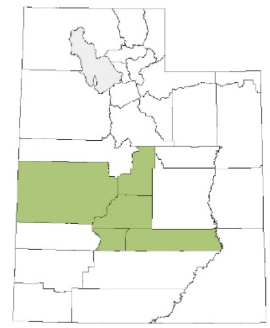
Notes: Scenarios shown are based on projected use for specific use patterns as described in Chapter 4 and summarized here:

Water Use Scenario	Indoor Use (gpcd)	Irrigation Efficiency	Residential Landscaping % Turf	Reduction in Residential Lot Size
Past Practices	70	50%	80%	None
Scenario 1	60	70%	80%	Conservative
Scenario 2	50	80%	50%	Moderate
Scenario 3	40	>80%	20%	Aggressive

The scenario markers do not consider the cost or feasibility of achieving the assumed use patterns. They have been included solely to provide perspective relative to past and current water use and to help each region understand what must occur to achieve the final goals.

Figure 7-7: M&I Water Conservation Goals—Salt Lake Region



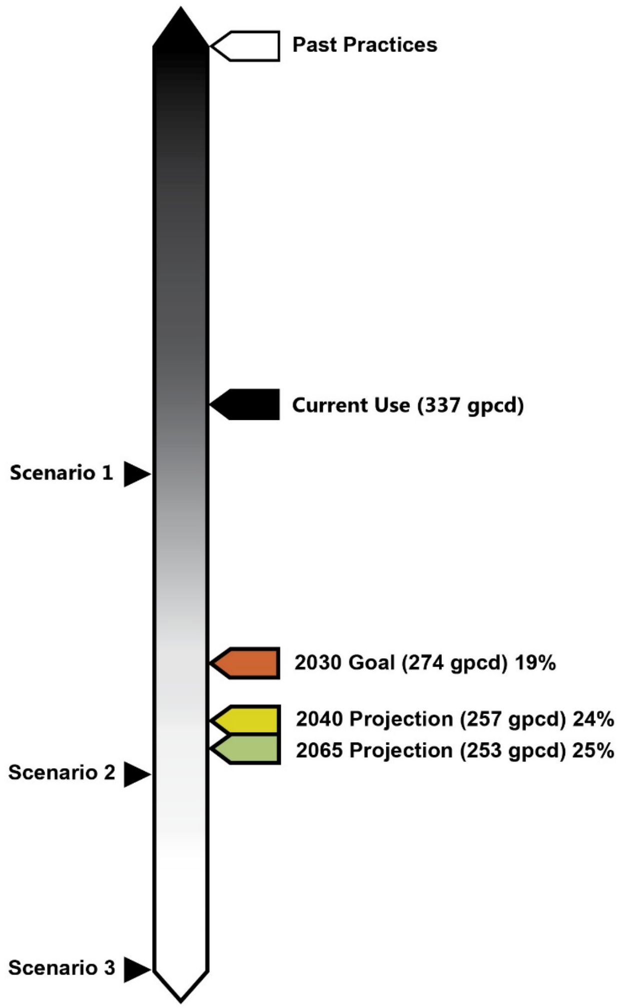


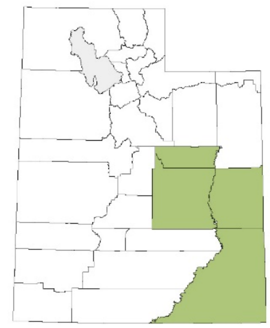
Notes: Scenarios shown are based on projected use for specific use patterns as described in Chapter 4 and summarized here:

Water Use Scenario	Indoor Use (gpcd)	Irrigation Efficiency	Residential Landscaping % Turf	Reduction in Residential Lot Size
Past Practices	70	50%	80%	None
Scenario 1	60	70%	80%	Conservative
Scenario 2	50	80%	50%	Moderate
Scenario 3	40	>80%	20%	Aggressive

The scenario markers do not consider the cost or feasibility of achieving the assumed use patterns. They have been included solely to provide perspective relative to past and current water use and to help each region understand what must occur to achieve the final goals.

Figure 7-8: M&I Water Conservation Goals—Sevier River Region



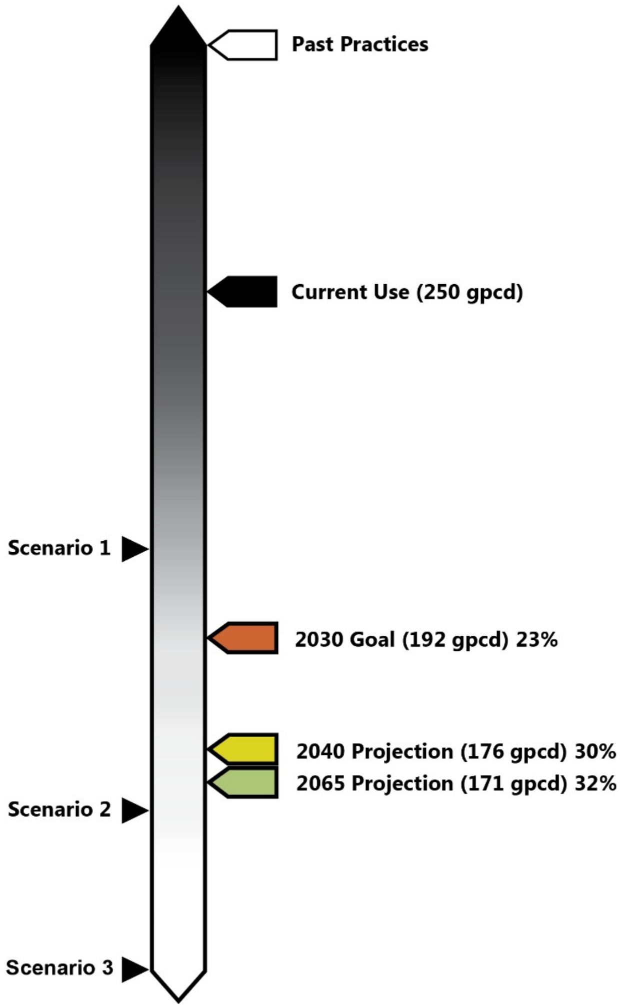


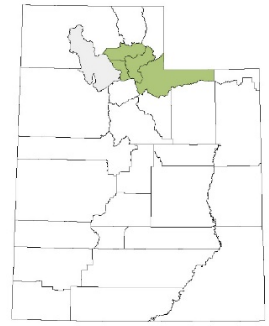
Notes: Scenarios shown are based on projected use for specific use patterns as described in Chapter 4 and summarized here:

Water Use Scenario	Indoor Use (gpcd)	Irrigation Efficiency	Residential Landscaping % Turf	Reduction in Residential Lot Size
Past Practices	70	50%	80%	None
Scenario 1	60	70%	80%	Conservative
Scenario 2	50	80%	50%	Moderate
Scenario 3	40	>80%	20%	Aggressive

The scenario markers do not consider the cost or feasibility of achieving the assumed use patterns. They have been included solely to provide perspective relative to past and current water use and to help each region understand what must occur to achieve the final goals.

Figure 7-9: M&I Water Conservation Goals—Upper Colorado Region



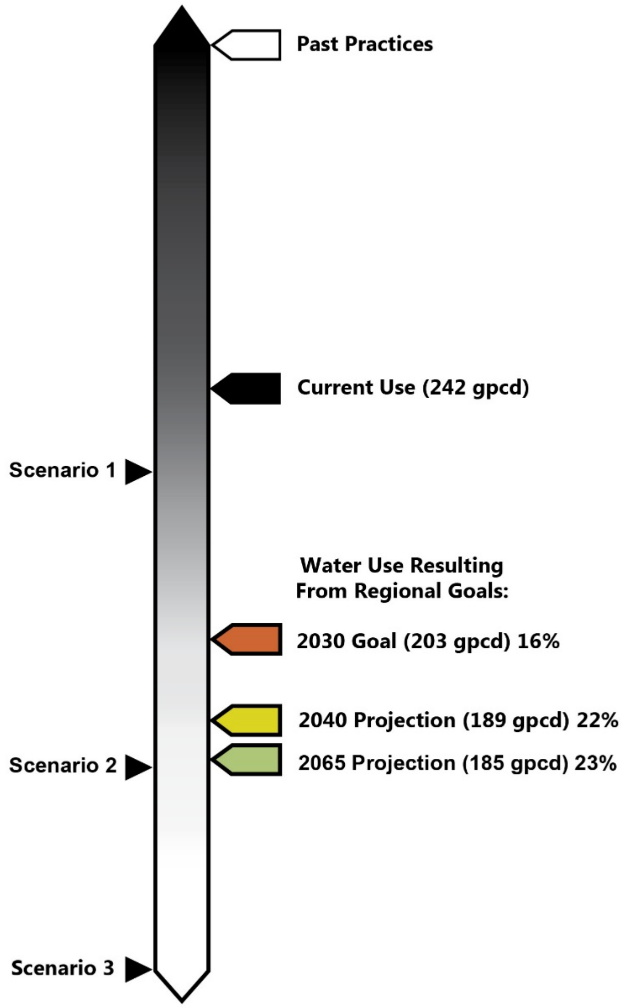


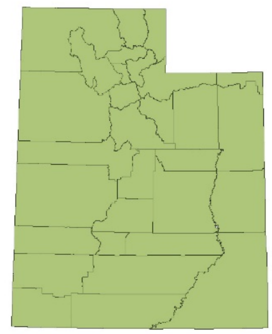
Notes: Scenarios shown are based on projected use for specific use patterns as described in Chapter 4 and summarized here:

Water Use Scenario	Indoor Use (gpcd)	Irrigation Efficiency	Residential Landscaping % Turf	Reduction in Residential Lot Size
Past Practices	70	50%	80%	None
Scenario 1	60	70%	80%	Conservative
Scenario 2	50	80%	50%	Moderate
Scenario 3	40	>80%	20%	Aggressive

The scenario markers do not consider the cost or feasibility of achieving the assumed use patterns. They have been included solely to provide perspective relative to past and current water use and to help each region understand what must occur to achieve the final goals.

Figure 7-10: M&I Water Conservation Goals—Weber River Region





Notes: Scenarios shown are based on projected use for specific use patterns as described in Chapter 4 and summarized here:

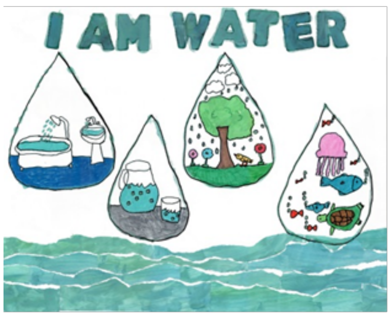
Water Use Scenario	Indoor Use (gpcd)	Irrigation Efficiency	Residential Landscaping % Turf	Reduction in Residential Lot Size
Past Practices	70	50%	80%	None
Scenario 1	60	70%	80%	Conservative
Scenario 2	50	80%	50%	Moderate
Scenario 3	40	>80%	20%	Aggressive

The scenario markers do not consider the cost or feasibility of achieving the assumed use patterns. They have been included solely to provide perspective relative to past and current water use and to help each region understand what must occur to achieve the final goals.

Figure 7-11 Impact of Regional Goals on Statewide M&I Water Use

RECOMMENDED PRACTICES

The following practices, selected from analysis of many possible ones, are recommended to help achieve the proposed regional M&I water conservation goals (Figure 7-12). Of necessity, these practices are limited to broad categories that may have different application in different areas of the state. Local water suppliers, communities, and businesses are encouraged to adapt and refine these recommendations, as well as implement others, in their own water conservation efforts and in pursuit of the regional goals.



GENERAL

- **Water conservation education.** Continued emphasis and funding of education and outreach must be fundamental components of any water conservation plan.
- **Conservation pricing.** Financial impacts will help motivate water conservation. Important features are lower base rates, increased tiers for usage, and reduced or eliminated use of property taxes to cover water system costs.

INDOOR

- **Fixture conversion.** This will happen naturally with new construction and as old fixtures are replaced, but may be accelerated through incentives and policies.
- **Other measures.** Fixing indoor leaks and inspiring a change in indoor water use habits will reduce consumption.

OUTDOOR

- **Improved irrigation efficiency.** Secondary metering, smart irrigation controls, and drip irrigation systems will improve irrigation efficiency for any landscape.
- **Water-wise landscaping.** New construction can be water-wise from the beginning, while existing landscapes can be converted.
- **Lot size and density guidelines.** Smaller lot sizes and less irrigated area will reduce the amount of water needed outdoors in new developments.

Figure 7-12: Recommended M&I Water Conservation Practices

ESTIMATED COSTS

Achieving the goals identified in this report will require a major investment. To help citizens and policy makers understand the level of investment required, the cost of implementing M&I water conservation actions through 2030 has been estimated by region as summarized below. The total is $3.26 billion.

Region	Required Investment in M&I Water Conservation by 2030
Bear River	$199,700,000
Green River	$37,500,000
Lower Colorado North	$61,900,000
Lower Colorado South	$358,300,000
Provo River	$791,800,000
Salt Lake	$901,300,000
Sevier River	$77,500,000
Upper Colorado	$46,800,000
Weber River	$786,400,000
Total	**$3.26 billion**

RECOMMENDATIONS FOR IMPLEMENTATION

The pursuit of the regional M&I water conservation goals will be an endeavor of immense magnitude. All levels of society—not just water suppliers—must engage over extended time periods. While implementation will be more fully addressed in the forthcoming State Water Plan and State Water Infrastructure Plan, a few starting actions are recommended here.

State and Local Policy Leaders

Policy plays a vital role in motivating and enabling water conservation. State and local policy leaders should establish policies—and funding—for universal metering, water loss control, education, and other water conservation activities and require accountability for efficient water use. Policy leaders must also decide whether they are willing to support the necessary land use restrictions that will be required to reach the water conservation goals. This will include limiting both overall lot sizes for residential development and the amount of turf grass allowed. Water suppliers should be consulted in land-use decisions to ensure alignment with water conservation efforts. Policy leaders can set or influence the pricing of water to promote conservation. State and local governments should consider the water use impacts of proposed businesses and their plans for water-efficient fixtures, landscaping, and operations before approval.

State Agencies

The Division of Water Resources and other state agencies should continue to support water suppliers' and end users' efforts by analyzing M&I water use data, administering funding programs, reviewing water conservation plans, and promoting education and outreach. It is recommended that the Division evaluate achievement of the 2030 goals and refine the 2040 and 2065 projections accordingly as new data, practices, and technologies develop.

Water Suppliers

Water suppliers have a public responsibility to provide sufficient, safe water to their customers and to carefully manage this invaluable resource. In fulfilling this responsibility, water suppliers are responsible for developing and implementing their own Water Conservation Plans that define local goals, practices, pricing, and accountability. This report recommends several practices which water suppliers may consider, supported by the other parties described here.

End Users

The water conservation mindset begins with individual end users. By recognizing water as a limited resource and changing their water use practices accordingly, end users will directly impact the overall water situation and the achievement of the regional goals. Utahns are encouraged to do their part in conserving water for Utah's future.

CONCLUSION

Population in Utah is expected to nearly double over the next 50 years. Meeting the water needs of this growing population will require conscientious planning and investment. Even as the state and its water suppliers explore options to more efficiently deliver existing sources and develop new sources, it is increasingly clear that conservation must be a foundational component of the state's plan to meet future water needs.

To assist citizens in reducing their water use, this report has developed customized M&I water conservation goals for nine regions of Utah. It is expected that policy leaders, state agencies, water suppliers, and all water users will work together to identify water conservation solutions to meet these goals. As we each do our part, our united efforts will help us prepare for the future.

References

AGRC (Utah Automated Geographic Reference Center). 2014. "State, County, and Municipal Boundaries." GIS data layer. Last updated July. https://gis.utah.gov/data/boundaries/citycountystate/.

Barnett, T. P., Adam, J. C., and Lettenmaier, D. P. 2005. "Potential Impacts of a Warming Climate on Water Availability in Snow-Dominated Regions." *Nature* 438 (November): 303–309. http://dx.doi.org/10.1038/nature04141.

BC&A and HAL (Bowen Collins & Associates and Hansen, Allen & Luce). 2018. *State of Utah Water Use Data Collection Program*. https://water.utah.gov/WaterUseCollectionReportFINAL1_29.pdf.

Bekker, M. F., DeRose, R. J., Buckley, B. M., Kjelgren, R. K., and Gill, N. S. 2014. "A 576-Year Weber River Streamflow Reconstruction from Tree Rings for Water Resource Risk Assessment in the Wasatch Front, Utah." *Journal of the American Water Resources Association* 50 (5): 1338–1348. https://doi.org/10.1111/jawr.12191.

Bioeconomics. 2012. *Economic Significance of the Great Salt Lake to the State of Utah.* Prepared for State of Utah and Great Salt Lake Advisory Council. .

Committee on USGS Water Resources Research. 2002. "Regression Models of Water Use." Chapter 6 in *Estimating Water Use in the United States: A New Paradigm for the National Water-Use Information Program*. Washington, D.C.: National Academy Press. https://www.nap.edu/catalog/10484/estimating-water-use-in-the-united-states-a-new-paradigm.

Denver Water. 2017. "Water Efficiency Plan (Draft)." https://www.denverwater.org/sites/default/files/water-efficiency-plan-draft.pdf.

DeOreo, W. B., Mayer, P. W., Dziegielwski, B., and Kiefer, J. C. 2016. "Residential Uses of Water, Version 2." Denver: Water Research Foundation. .

DeRose, R. J., Bekker, M. F., Wang, S. Y., Buckley, B. M., Kjelgren, R. K., Rittenour, T. M., and Allen, E. B. 2015. "A Millennium-Length Reconstruction of Bear River Stream Flow, Utah." *Journal of Hydrology* 529 (2): 524–534. https://doi.org/10.1016/j.jhydrol.2015.01.014.

Dieter, C. A., Maupin, M. A., Caldwell, R. R., Harris, M. A., Ivahnenko, T. I., Lovelace, J. K., Barber, N. L., and Linsey, K. S. 2018. *Estimated Use of Water in the United States in 2015*. U.S. Geological Survey Circular 1441. https://water.utah.gov/2015WaterData.pdf.

DWRe (Utah Division of Water Resources). 2001. *Utah's Water Resources: Planning for the Future.* Salt Lake City: DWRe. https://water.utah.gov/Planning/SWP/StatePlans/SWP2001/SWP_pff.pdf.

DWRe (Utah Division of Water Resources). 2005. *Water Reuse in Utah.* State Water Plan. Salt Lake City: DWRe. .

DWRe (Utah Division of Water Resources). 2010. 2009 *Residential Water Use: Survey Results And Analysis Of Residential Water Use For Seventeen Communities In Utah.* Salt Lake City: DWRe. https://water.utah.gov/OtherReports/RWU_Study.pdf

DWRe (Utah Division of Water Resources). 2014. *Utah's M&I Water Conservation Plan: Investing in the Future.* Salt Lake City: DWRe. https://water.utah.gov/OtherReports/M&IConservation_Revision_2012.pdf.

DWRe (Utah Division of Water Resources). 2015. "Retail Culinary Water Suppliers." GIS data layer. AGRC. https://gis.utah.gov/data/utilities/retail-culinary-water-suppliers/.

DWRe (Utah Division of Water Resources). 2018a. *2015 Municipal and Industrial Water Use Data*. Salt Lake City: DWRe. https://water.utah.gov/2015WaterData.pdf.

DWRe (Utah Division of Water Resources). 2018b. Utah's Open Water Data. http://dwre-utahdnr.opendata.arcgis.com/.

DWRe (Utah Division of Water Resources). 2018c. Net Potential Evapotranspiration Values for Turfgrass for 2015. GIS data layer. Emails from Craig Miller, July 25, and Tony Melcher, Oct. 16.

DWRi (Utah Division of Water Rights). 2018. "State of Utah Duty Values." Maps from Utah Division of Water Rights. Last updated March 17. https://www.waterrights.utah.gov/gisinfo/maps/aduty.pdf.

Edwards, E. C., Bosworth, R. C., Adams, P., Viviane, B., Burrows, A., Gerbes, C., and Jones, M. 2016. "Economic Insight from Utah's Water Efficiency Supply Curve." Logan, Utah: Utah State University Department of Applied Economics. https://www.mdpi.com/2073-4441/9/3/214.

EPA (U.S. Environmental Protection Agency). 2010. *Control and Mitigation of Drinking Water Losses in Distribution Systems.* EPA 816-R-10-019. Washington, D.C.: EPA. https://nepis.epa.gov/Exe/ZyPDF.cgi/P1009VCZ.PDF?Dockey=P1009VCZ.PDF

EPA (U.S. Environmental Protection Agency). 2015. *Adaptation Strategies Guide for Water Utilities*. Climate Ready Water Utilities. EPA 817-K-15-001. Washington, D.C.: EPA.

https://www.epa.gov/sites/production/files/2015-04/documents/updated_adaptation_strategies_guide_for_water_utilities.pdf.

Equinox Center. 2009. "A Primer on water Pricing in the San Diego Region." https://energycenter.org/sites/default/files/Equinox%20Water_Pricing_Brief%20102609.pdf.

Eslamian, S. A., Li, S. S., and Haghighat, F. 2016. "A New Multiple Regression Model for Predictions of Urban Water Use." *Sustainable Cities and Society* 27 (November): 419–429. https://doi.org/10.1016/j.scs.2016.08.003.

Forsyth, B., and Schultz, T. 2017. *Preparing for Climate Change—A Management Plan*. West Jordan, Utah: Jordan Valley Water Conservancy District.

Gilles, R. R., and Ramsey, R. D. 2009. "Climate of Utah." Chapter 5 in *Rangeland Resources of Utah* (ed. Ellie I. Leydsman McGinty). Logan, Utah: Utah State University Cooperative Extension Service and Utah Public Lands Policy Coordination Office. https://extension.usu.edu/rangelands/ou-files/RRU_Section_Five.pdf.

Gillies, R. R., Wang, S.-Y., and Booth, M. R. 2012. "Observational and Synoptic Analyses of the Winter Precipitation Regime Change over Utah." *Journal of Climate* 25: 4670–4698. https://doi.org/10.1175/JCLI-D-11-00084.1.

GOMB (Governor's Office of Management and Budget). 2018. *Governor Gary R. Herbert Budget Recommendations Fiscal Year 2019* (Governor's Budget Recommendations Book). Salt Lake City: GOMB. https://gomb.utah.gov/wp-content/uploads/2018/07/FY-2019-Governors-Budget-Recommendations.pdf.

GWSAT (Governor's Water Strategy Advisory Team). 2017. *Recommended State Water Strategy*. https://www.envisionutah.org/images/FINAL_Recommended_State_Water_Strategy_7.14.17_5b15d.pdf.

Hargreaves, G. H., Riley, P., and Sikka, A. 1993. "Influence of Climate on Irrigation." *Canadian Water Resources Journal* 18 (1): 53–59. https://doi.org/10.4296/cwrj1801053.

Hill R. W., and Kopp, K. L. 2002. "Turfgrass Water Use in Utah." *All Current Publications*. Paper 1408. https://digitalcommons.usu.edu/extension_curall/1408.

Huang, A.-C., Lee, T.-Y., Lin, Y.-C., Huang, C.-F., and Shu, C.-M. 2017. "Factor Analysis and Estimation Model of Water Consumption of Government Institutions in Taiwan." *Water* 9 (7): 492. https://doi.org/10.3390/w9070492.

Jackson, E. K., and Mohadjer, P. 2003. "Saving Water in Utah in the Fifth Year of Drought." *Slow The Flow Save H2O*. Accessed Nov. 11, 2018. https://www.irrigation.org/IA/FileUploads/IA/Resources/TechnicalPapers/2003/SavingUtahWaterInTheFifthYearOfDrought.pdf.

Kem C. Garner Policy Institute. 2016. "U.S. Census Bureau 2015 Population Estimates: Utah." http://gardner.utah.edu/wp-content/uploads/May-Census-Estimates-Fact-Sheet-V21.pdf.

Kem C. Gardner Policy Institute 2017. "2015–2065 State and County Projections Data." https://water.utah.gov/2015WaterData.pdf.

Khatri, K. B., Strong, C., Kochanski, A. K., Burian, S., Miller, C., and Hasenyager, C. 2018. "Water Resources Criticality Due to Future Climate Change and Population Growth: Case of River Basins in Utah, USA." *Journal of Water Resources Planning and Management* 144 (8): https://doi.org/10.1061/(ASCE)WR.1943-5452.0000959.

Kunkel, K. E., Easterling, D. R., Hubbard, K., and Redmond, K. 2004. "Temporal Variations in Frost-Free Season in the United States: 1895 –2000." *Geophysical Research Letters* 31: L03201. https://doi.org/10.1029/2003GL018624.

Kunkel, K. E. 2013. "Projected Changes in Frost-Free Season Length." NOAA NCDC / CICS-NC. https://data.globalchange.gov/report/nca3/chapter/our-changing-climate/figure/projected-changes-in-frostfree-season-length.

Li, Y. 2013. "Analysis of Urban Water Use and Urban Consumptive Water Use in Nebraska—Case Study in the City of Lincoln, Grand Island and Sidney." Master's thesis, University of Nebraska–Lincoln. http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1021&context=arch_crp_theses.

Lewis, C. S., and Allen, L. N. 2017. "Potential Crop Evapotranspiration and Surface Evaporation Estimates via a Gridded Weather Forcing Dataset." *Journal of Hydrology* 546 (March): 450–463. https://doi.org/10.1016/j.jhydrol.2016.11.055.

LVVWD (Las Vegas Valley Water District). 2018. "Drought and Conservation Measures."

Maddaus Water Management Inc. 2015. Technical Memorandum No. 2, Conservation Technical Analysis. Prepared for Utah Division of Water Resources and Washington County Water Conservancy District, Aug. 28.

Maddaus Water Management Inc. 2018. "Water Conservation Programs: A Comparative Evaluation." Prepared for Washington County Water Conservancy District, Dec. 17.

Massachusetts Water Resources Authority. 2018. "Summary Report of MWRA Demand Management Program, Fiscal Year 2018." http://www.mwra.state.ma.us/harbor/pdf/demandreport.pdf.

O'Donoughue, A. J. 2018. "Utah Governor Declares State of Emergency Due to Drought." *Deseret News*, Oct. 16. https://www.deseretnews.com/article/900037151/utah-governor-declares-state-of-emergency-due-to-drought.html

OLAG (Office of the Legislative Auditor General). 2015. "A Performance Audit of Projections of Utah's Water Needs." Report No. 2015-01. https://le.utah.gov/audit/15_01rpt.pdf.

OLAG (Office of the Legislative Auditor General). 2017. "An In-depth Follow-up of Projections of Utah's Water Needs." Report No. 2017-17. https://le.utah.gov/audit/17_17rpt.pdf

PRISM (PRISM Climate Group). 2018a. "30-Year Normals." Oregon State University. http://www.prism.oregonstate.edu/normals/.

PRISM (PRISM Climate Group). 2018b. "Recent Years." Oregon State University. http://www.prism.oregonstate.edu/recent/.

Siegel, S. M. 2015. *Let There Be Water: Israel's Solution for a Water-Starved World.* New York: St. Martin's Press.

SNWA (Southern Nevada Water Authority). 2014. "Water Conservation Plan." https://www.snwa.com/assets/pdf/reports-conservation-plan.pdf.

Sovocool, K. A. 2005. *Xeriscape Conversion Study Final Report*. Southern Nevada Water Authority. https://www.snwa.com/assets/pdf/reports-xeriscape.pdf.

Sun, H., Kopp, K., and Kjelgren, R. 2012. "Water-efficient Urban Landscapes: Integrating Different Water Use Categorizations and Plant Types." *HortScience* 47 (2): 254–263. http://hortsci.ashspublications.org/content/47/2/254.full. http://www.slcdocs.com/utilities/PDF%20Files/UtilityRates/WaterrateswebCurrent.pdf

Turner, A., White, S., Chong, J., Dickinson, M. A., Cooley, H., and Donnelly, K. 2016. *Managing Drought: Learning from Australia*. Alliance for Water Efficiency. http://pacinst.org/wp-content/uploads/2016/07/Managing-Drought-Report-2016-02-23-FINAL-US-Letter.pdf.

USGCRP (U.S. Global Change Research Program). 2018. *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* [Reidmiller, D. R., C. W. Avery, D. R. Easterling, K. E. Kunkel, K. L. M. Lewis, T. K. Maycock, and B. C. Stewart (eds.)]. Washington, D.C.: USGCRP. https://nca2018.globalchange.gov/.

USGS (U.S. Geological Survey). 2018. 10-Meter Digital Elevation Model. Dataset. Utah Automated Geographic Reference Center. https://gis.utah.gov/data/elevation-and-terrain/.

U.S. Census Bureau. 2015a. Age and Sex. Dataset. 2011–2015 American Community Survey 5-Year Estimates. https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_15_5YR_S0101&prodType=table.

U.S. Census Bureau. 2015b. Income in the Past 12 Months (in 2015 Inflation-Adjusted Dollars). Dataset. 2011–2015 American Community Survey 5-Year Estimates. https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_15_5YR_S1901&prodType=table.

U.S. Census Bureau. 2015c. Vacancy Status. Dataset. 2011–2015 American Community Survey 5-Year Estimates. https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_15_5YR_B25004&prodType=table.

U.S. Census Bureau. 2016. "Utah is Nation's Fastest-Growing State, Census Bureau Reports." Release No. CB16-214, Dec. 20. https://www.census.gov/newsroom/press-releases/2016/cb16-214.html.

U.S. Census Bureau. 2017. "Idaho is Nation's Fastest-Growing State, Census Bureau Reports." Release No. CB17-210, Dec. 20. https://www.census.gov/newsroom/press-releases/2017/estimates-idaho.html

U.S. Census Bureau. 2018. "Nevada and Idaho Are the Nation's Fastest-Growing States." Release No. CB18-193, Dec. 19. .

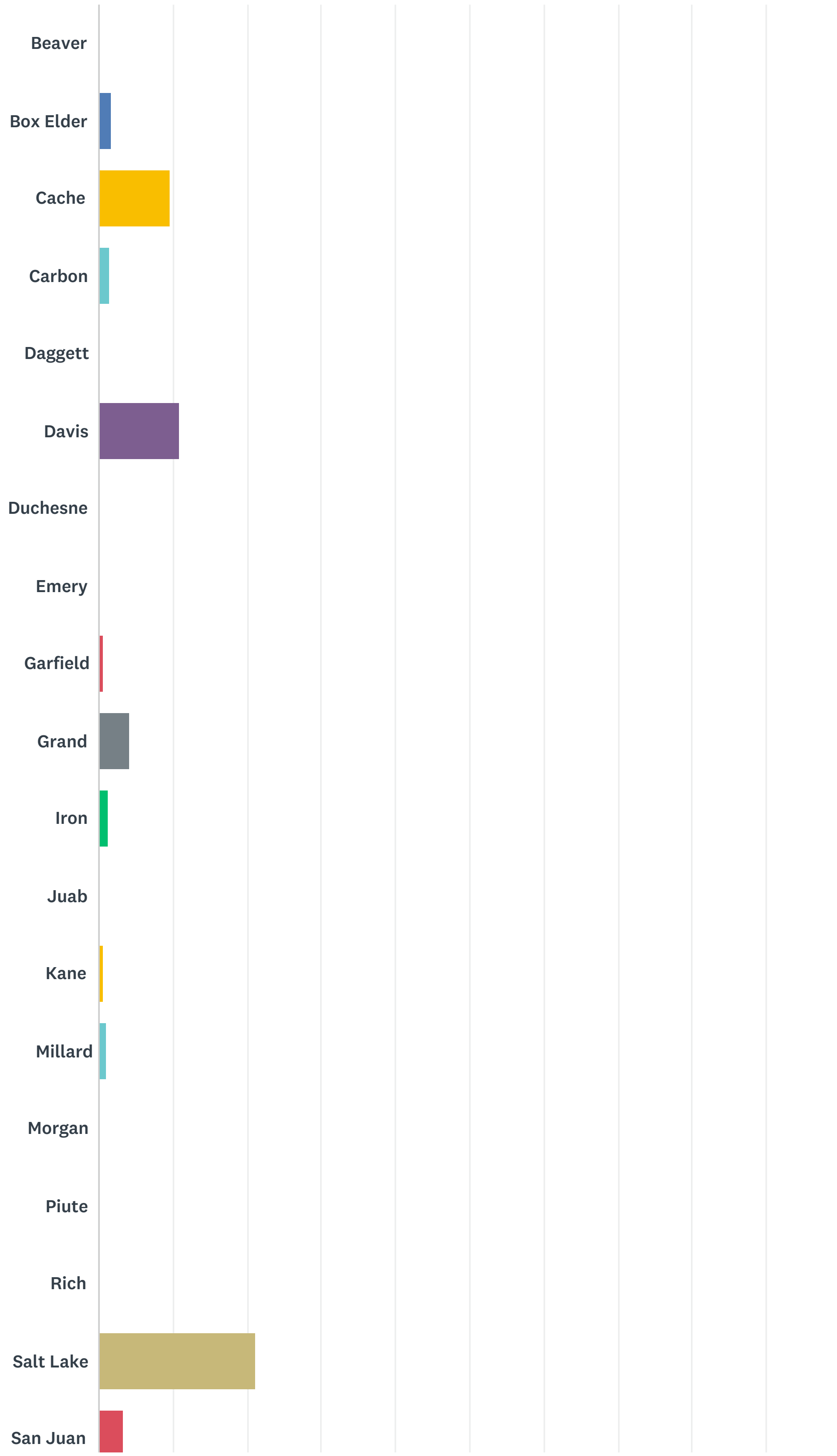
WBWCD (Weber Basin Water Conservancy District). 2013. "Water Conservation Plan Update 2013." https://conservewater.utah.gov/pdf/SamplePlans/WBWCD2013.pdf.

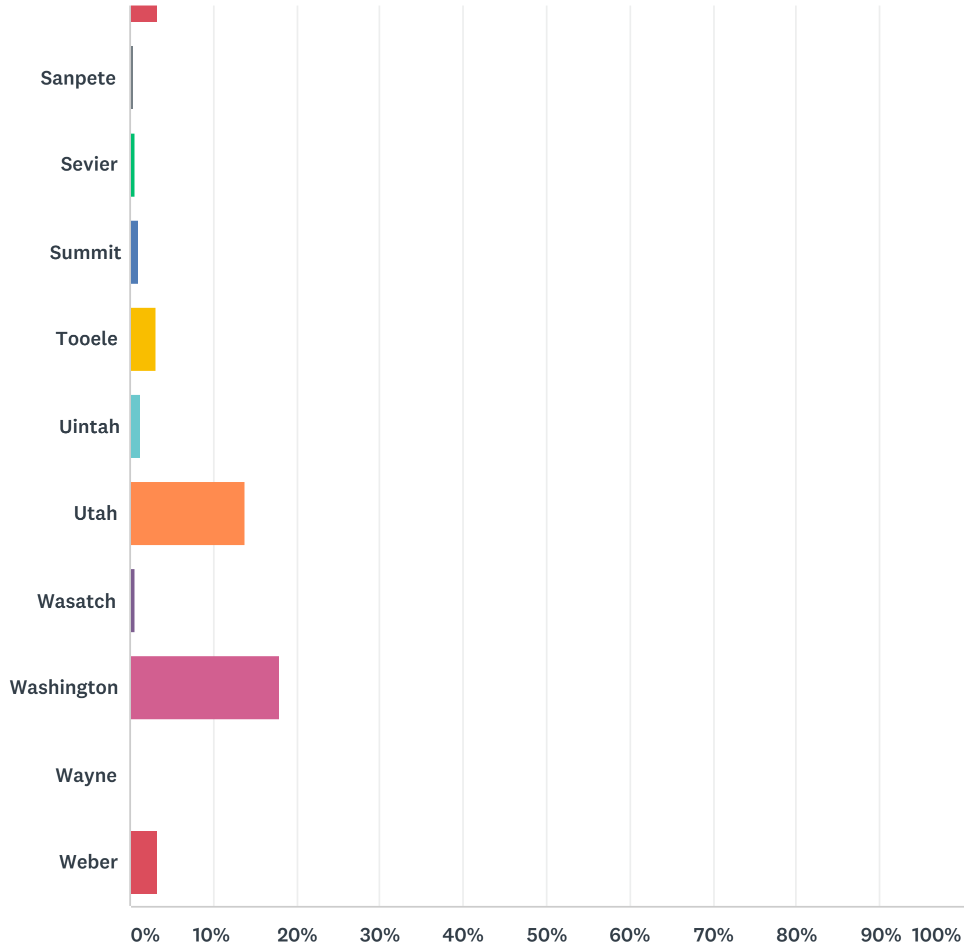
Wong, J. S., Zhang, Q., and Chen, Y. D. 2010. "Statistical Modeling of Daily Urban Water Consumption in Hong Kong: Trend, Changing Patterns, and Forecast." *Water Resources Research* 46 (3): W03506. https://doi.org/10.1029/2009WR008147.

Appendix A: Online Survey and Results

Q1 In which county do you live?

Answered: 1,655 Skipped: 0





ANSWER CHOICES	RESPONSES	
Beaver	0.24%	4
Box Elder	1.75%	29
Cache	9.61%	159
Carbon	1.39%	23
Daggett	0.12%	2
Davis	10.94%	181
Duchesne	0.30%	5
Emery	0.24%	4
Garfield	0.54%	9
Grand	4.11%	68
Iron	1.33%	22
Juab	0.12%	2
Kane	0.73%	12
Millard	0.97%	16

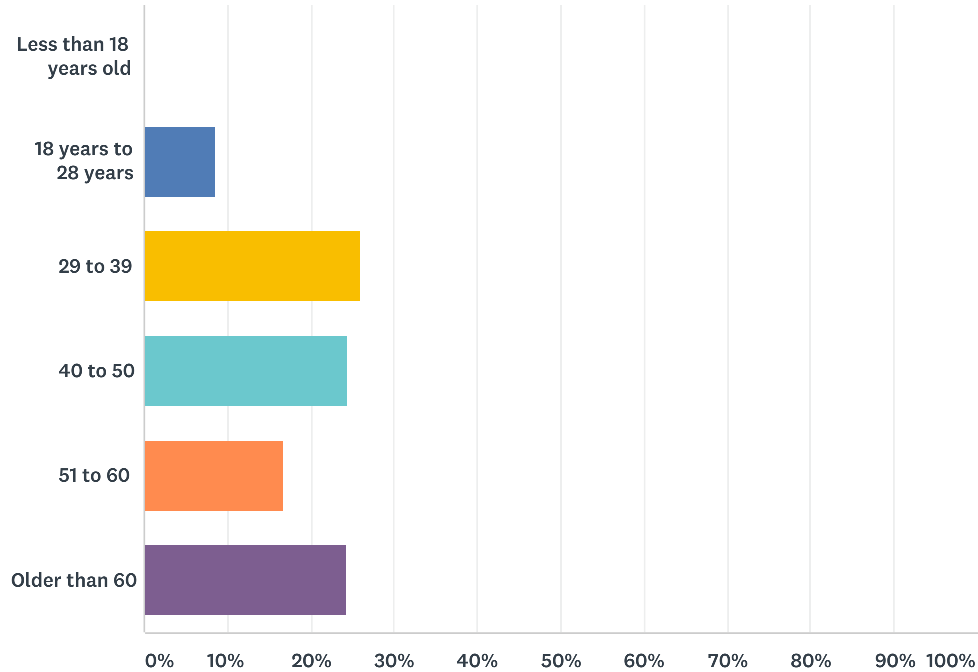
Morgan	0.24%	4
Piute	0.12%	2
Rich	0.30%	5
Salt Lake	21.09%	349
San Juan	3.26%	54
Sanpete	0.48%	8
Sevier	0.73%	12
Summit	1.03%	17
Tooele	3.14%	52
Uintah	1.33%	22
Utah	13.90%	230
Wasatch	0.54%	9
Washington	18.01%	298
Wayne	0.00%	0
Weber	3.44%	57
TOTAL		1,655

Q2 In which city do you live?

Answered: 1,647 Skipped: 8

Q3 How old are you?

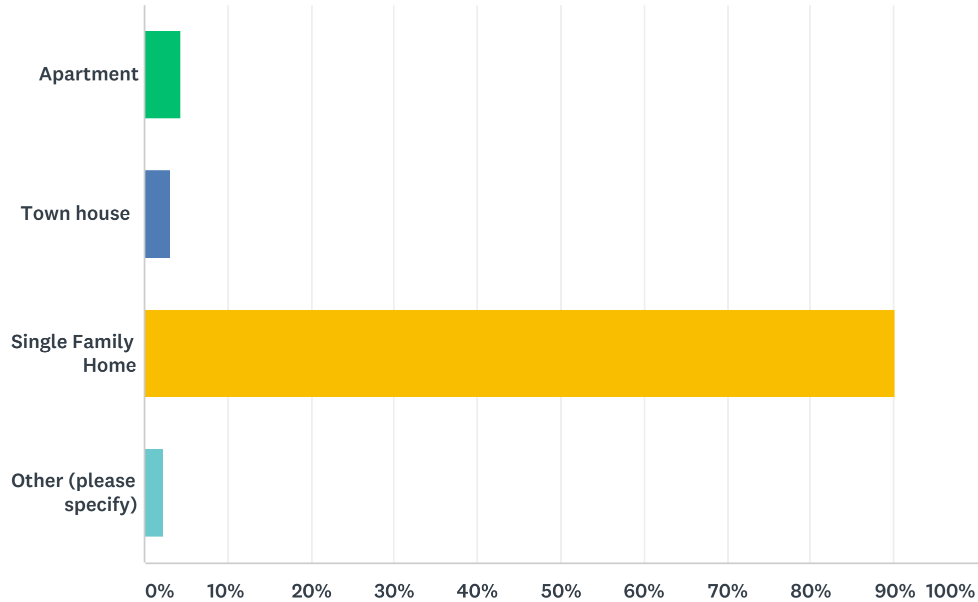
Answered: 1,655 Skipped: 0



ANSWER CHOICES	RESPONSES	
Less than 18 years old	0.12%	2
18 years to 28 years	8.64%	143
29 to 39	25.86%	428
40 to 50	24.41%	404
51 to 60	16.74%	277
Older than 60	24.23%	401
TOTAL		1,655

Q4 Which best describes your residence?

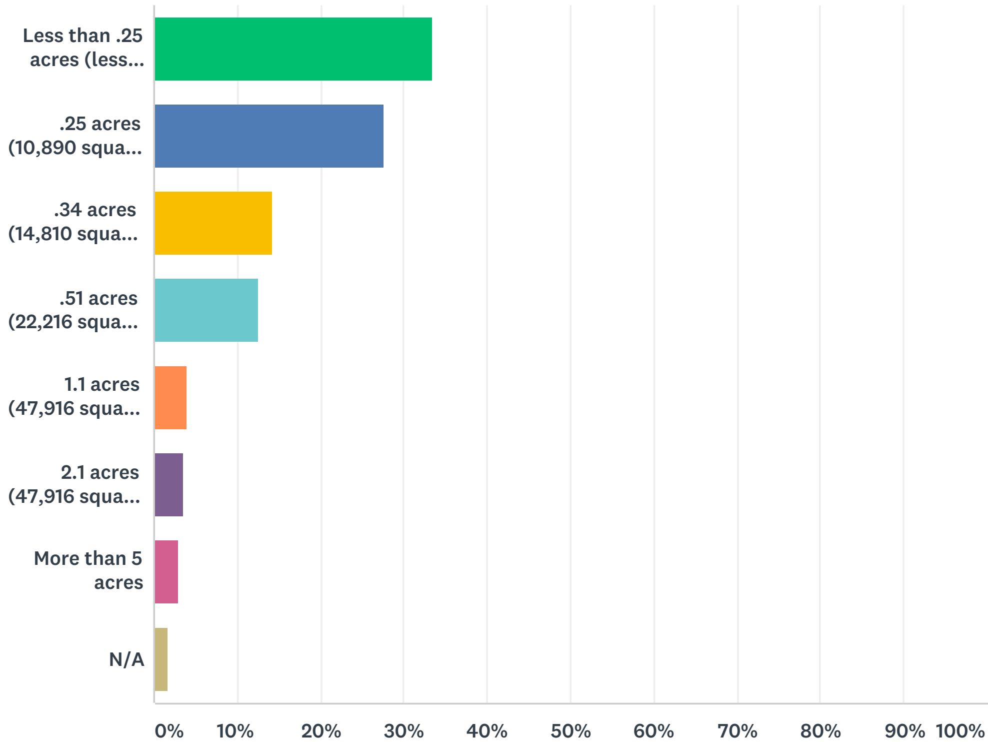
Answered: 1,655 Skipped: 0



ANSWER CHOICES	RESPONSES	
Apartment	4.35%	72
Town house	3.08%	51
Single Family Home	90.21%	1,493
Other (please specify)	2.36%	39
TOTAL		1,655

Q5 What is the approximate size of your property?

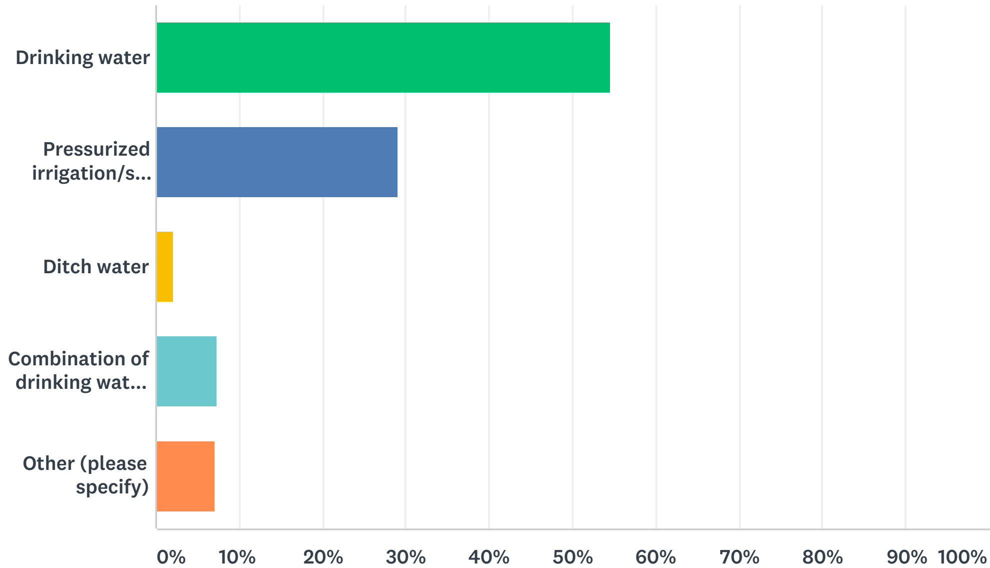
Answered: 1,644   Skipped: 11



ANSWER CHOICES	RESPONSES	
Less than .25 acres (less than 10,890 Square Feet)	33.39%	549
.25 acres (10,890 square feet) to .33 acres (14,374 square feet)	27.62%	454
.34 acres (14,810 square feet) to .50 acres (21,780 square feet)	14.29%	235
.51 acres (22,216 square feet) to 1 acres (43,560 square feet)	12.65%	208
1.1 acres (47,916 square feet) to 2 acres (87,120 square feet)	4.01%	66
2.1 acres (47,916 square feet) to 5 acres (217,800 square feet)	3.53%	58
More than 5 acres	2.92%	48
N/A	1.58%	26
TOTAL		1,644

Q6 What source of water do you use to irrigate your landscape?

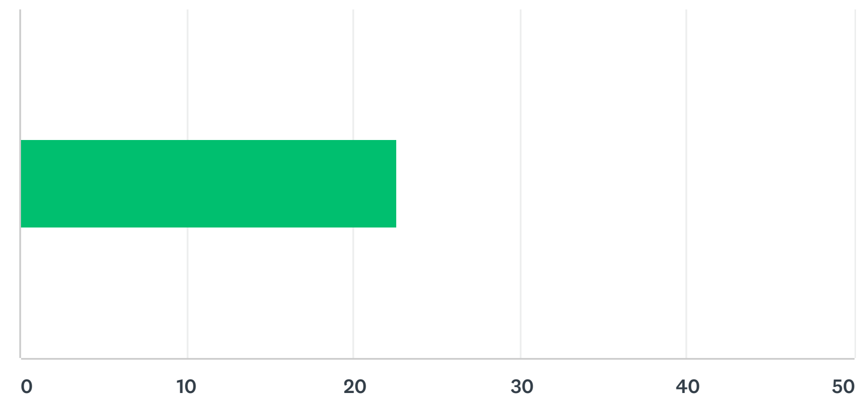
Answered: 1,646 Skipped: 9



ANSWER CHOICES	RESPONSES	
Drinking water	54.56%	898
Pressurized irrigation/secondary water	28.98%	477
Ditch water	2.00%	33
Combination of drinking water and secondary water	7.29%	120
Other (please specify)	7.17%	118
TOTAL		1,646

Q7 On average, how many gallons of water do you think your household uses daily, including indoor and outdoor use?

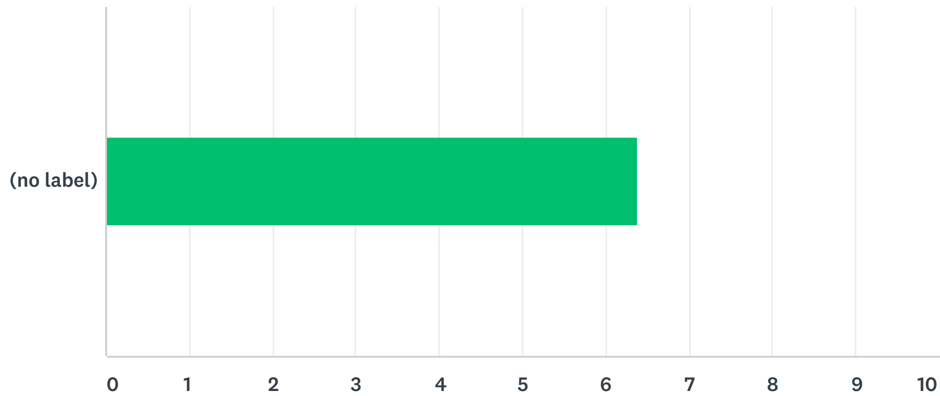
Answered: 1,338 Skipped: 317



ANSWER CHOICES	AVERAGE NUMBER	TOTAL NUMBER	RESPONSES
	23	30,203	1,338
Total Respondents: 1,338			

Q8 On a scale of 1 to 7, where 1 is not important and 7 is very important, how important is water conservation in the State of Utah?

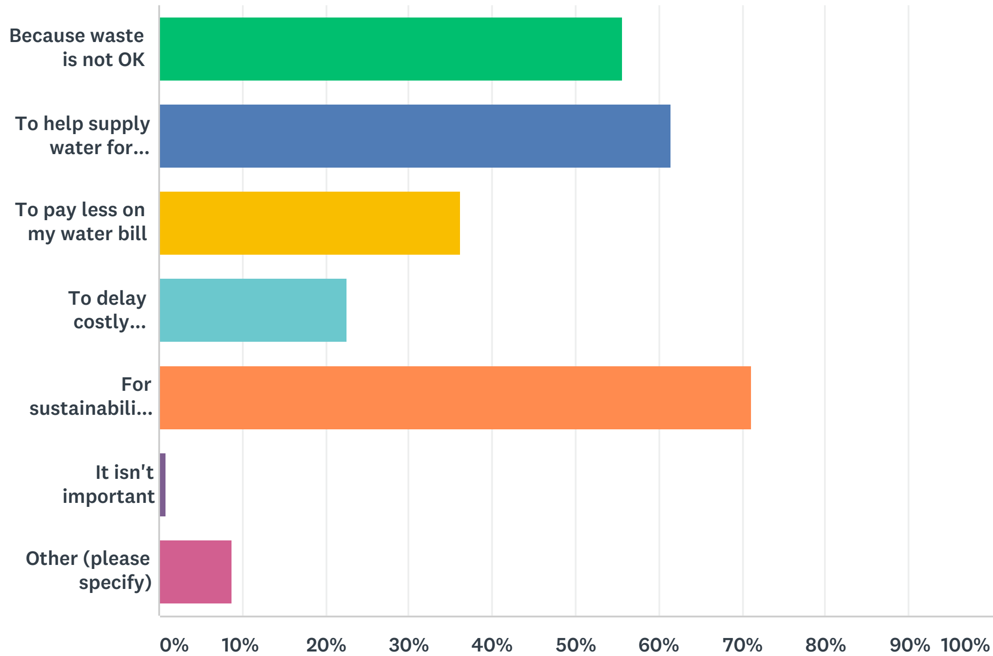
Answered: 1,407 Skipped: 248



	1 (NOT IMPORTANT)	2	3	4	5	6	7 (VERY IMPORTANT)	TOTAL	WEIGHTED AVERAGE
(no label)	0.92% 13	1.14% 16	1.49% 21	3.77% 53	8.46% 119	15.92% 224	68.30% 961	1,407	6.39

Q9 Why is it important to use water efficiently?

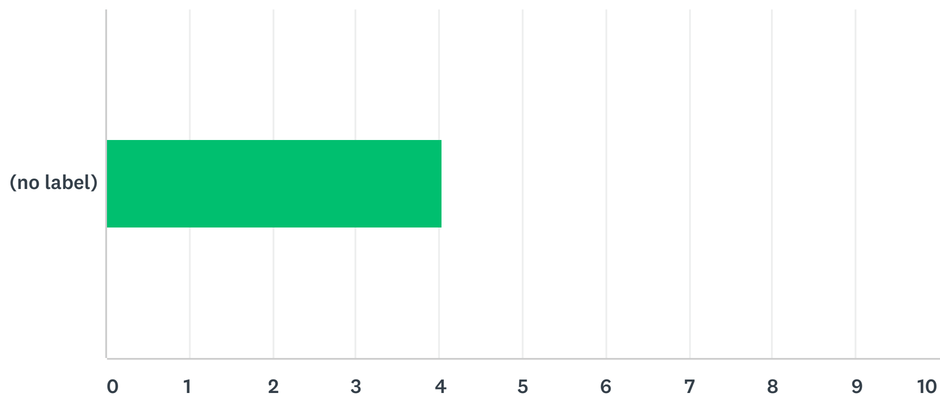
Answered: 1,402 Skipped: 253



ANSWER CHOICES	RESPONSES	
Because waste is not OK	55.56%	779
To help supply water for future generations	61.48%	862
To pay less on my water bill	36.23%	508
To delay costly development projects	22.61%	317
For sustainability and balance within the ecosystem	71.11%	997
It isn't important	0.93%	13
Other (please specify)	8.84%	124
Total Respondents: 1,402		

Q10 On a scale of 1 to 7, where 1 is very unwilling and 7 is very willing, how would you rate your community's willingness to conserve water?

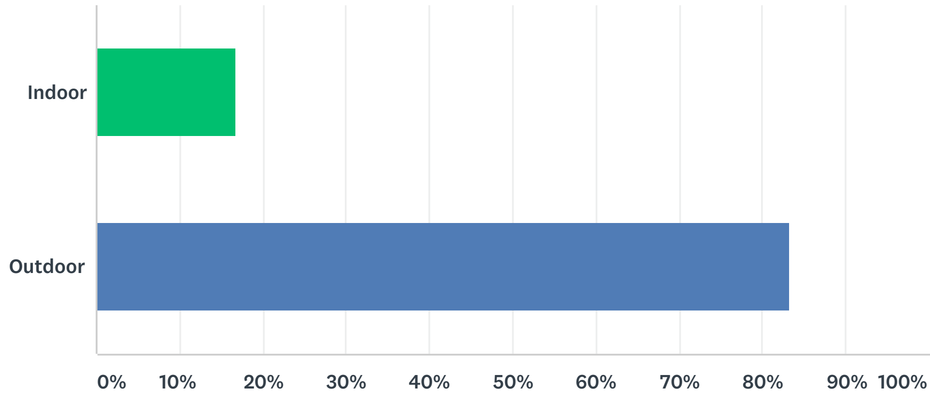
Answered: 1,399 Skipped: 256



	1 (VERY UNWILLING)	2	3	4	5	6	7 (VERY WILLING)	TOTAL	WEIGHTED AVERAGE
(no label)	4.72% 66	14.58% 204	19.87% 278	28.09% 393	19.30% 270	7.58% 106	5.86% 82	1,399	4.03

Q11 Where do you think you can save the most water?

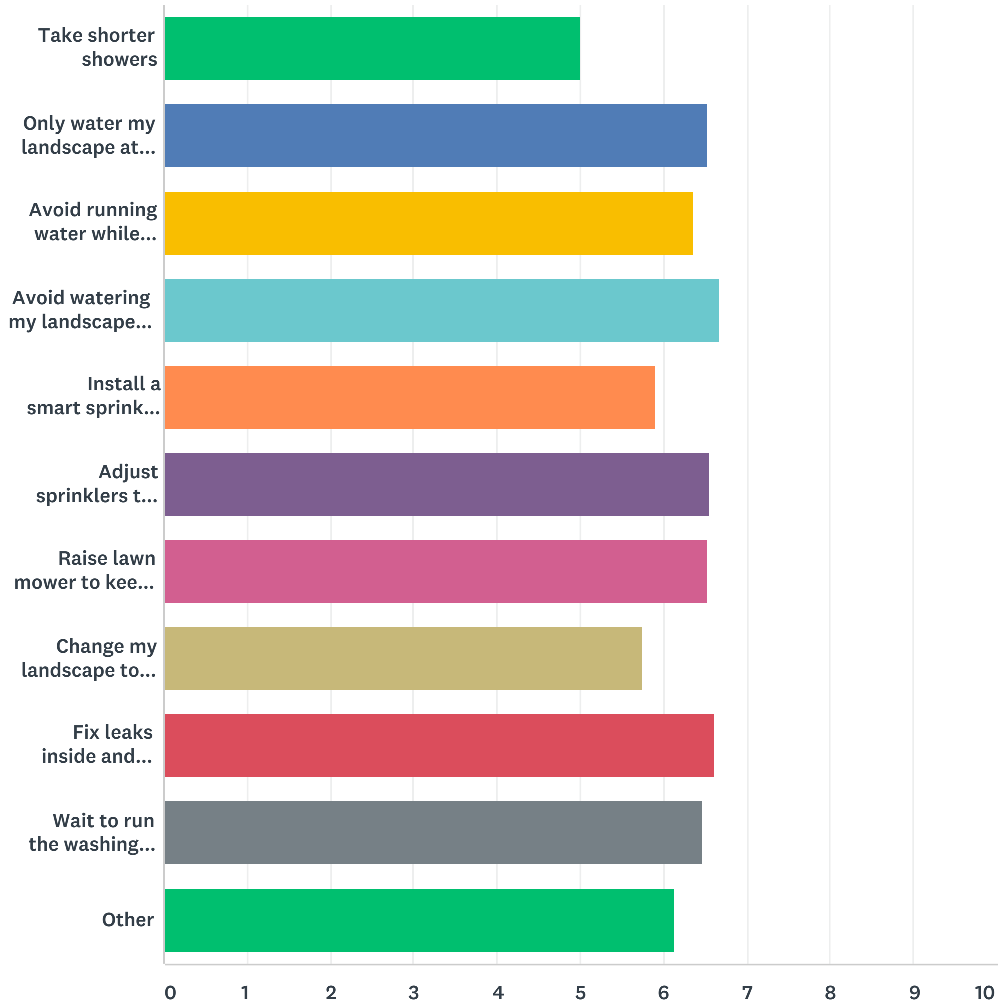
Answered: 1,407 Skipped: 248



ANSWER CHOICES	RESPONSES	
Indoor	16.70%	235
Outdoor	83.30%	1,172
TOTAL		1,407

Q12 On a scale of 1 to 7, where 1 is very unwilling and 7 is very willing, how willing are you to do the following to become more efficient?

Answered: 1,407   Skipped: 248

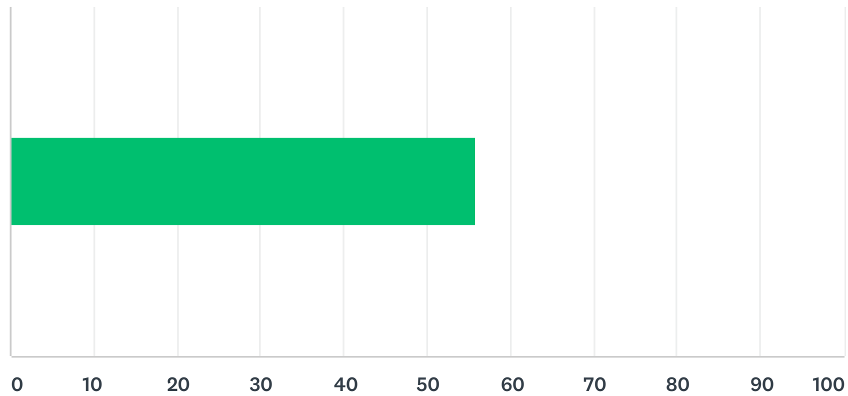


	1: VERY UNWILLING	2	3	4	5	6	7: VERY WILLING	TOTAL	WEIGHTED AVERAGE
Take shorter showers	4.39% 61	6.26% 87	9.57% 133	16.33% 227	19.42% 270	16.76% 233	27.27% 379	1,390	4.99
Only water my landscape at nighttime	1.36% 19	0.86% 12	1.22% 17	3.30% 46	5.02% 70	10.19% 142	78.05% 1,088	1,394	6.53
Avoid running water while brushing my teeth	1.93% 27	1.29% 18	2.00% 28	5.36% 75	5.08% 71	10.44% 146	73.91% 1,034	1,399	6.37
Avoid watering my landscape during the rain	1.65% 23	0.43% 6	0.72% 10	2.01% 28	2.44% 34	7.10% 99	85.66% 1,195	1,395	6.67
Install a smart sprinkler timer and use the highest efficiency setting	2.72% 38	2.79% 39	4.94% 69	7.31% 102	12.32% 172	12.97% 181	56.95% 795	1,396	5.90

Adjust sprinklers to avoid sidewalks	1.29% 18	0.22% 3	1.00% 14	3.01% 42	5.09% 71	12.62% 176	76.77% 1,071	1,395	6.55
Raise lawn mower to keep grass a little taller to shade the roots	1.37% 19	0.36% 5	1.15% 16	3.38% 47	4.67% 65	12.44% 173	76.64% 1,066	1,391	6.53
Change my landscape to add more water-wise plants and features	2.86% 40	3.00% 42	5.72% 80	9.01% 126	15.09% 211	12.59% 176	51.72% 723	1,398	5.75
Fix leaks inside and outside of my home	0.86% 12	0.07% 1	0.72% 10	1.72% 24	5.87% 82	13.18% 184	77.58% 1,083	1,396	6.62
Wait to run the washing machine and dishwasher until there is a full load	1.36% 19	0.57% 8	1.00% 14	3.22% 45	7.16% 100	14.33% 200	72.35% 1,010	1,396	6.47
Other	3.50% 14	0.75% 3	1.25% 5	12.25% 49	5.75% 23	9.50% 38	67.00% 268	400	6.13

Q13 How much of your landscape are you willing to transition to water-wise plants and features?

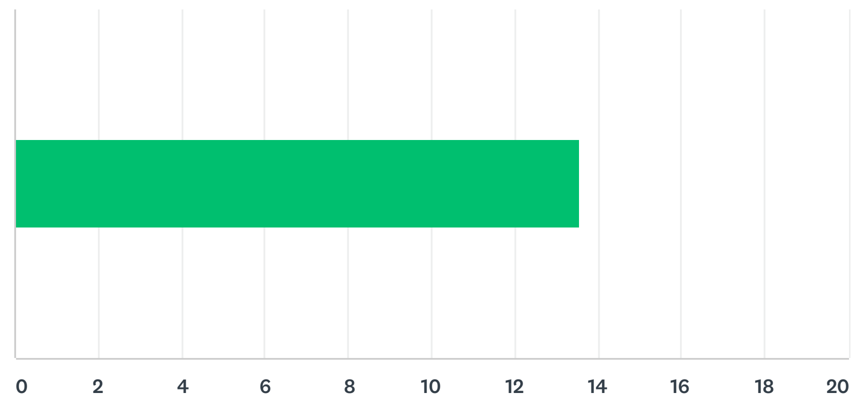
Answered: 1,407 Skipped: 248



ANSWER CHOICES	AVERAGE NUMBER	TOTAL NUMBER	RESPONSES
	56	78,739	1,407
Total Respondents: 1,407			

Q14 On average, how many less gallons of water daily, including indoor and outdoor use, do you think your household could use daily?

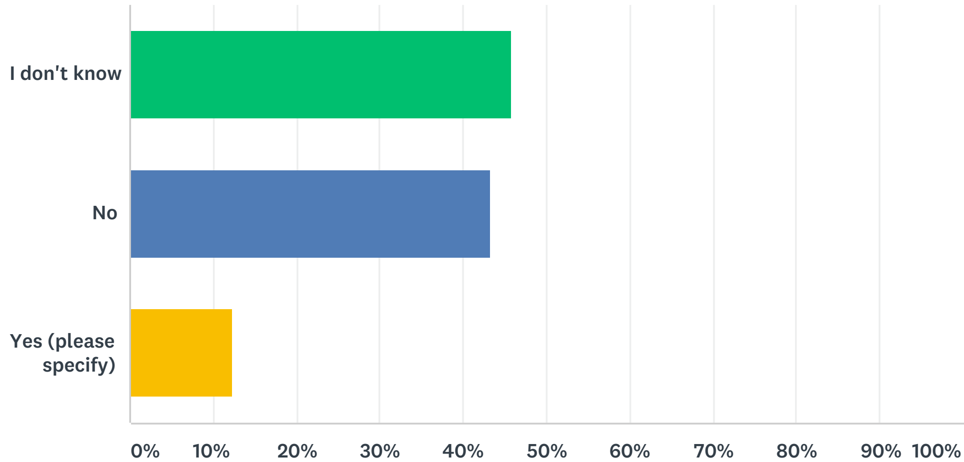
Answered: 1,325 Skipped: 330



ANSWER CHOICES	AVERAGE NUMBER	TOTAL NUMBER	RESPONSES
	14	17,982	1,325
Total Respondents: 1,325			

Q15 Are there policies in your community that restrict landscaping choices (for example, requiring turf in the park strip)?

Answered: 1,400   Skipped: 255



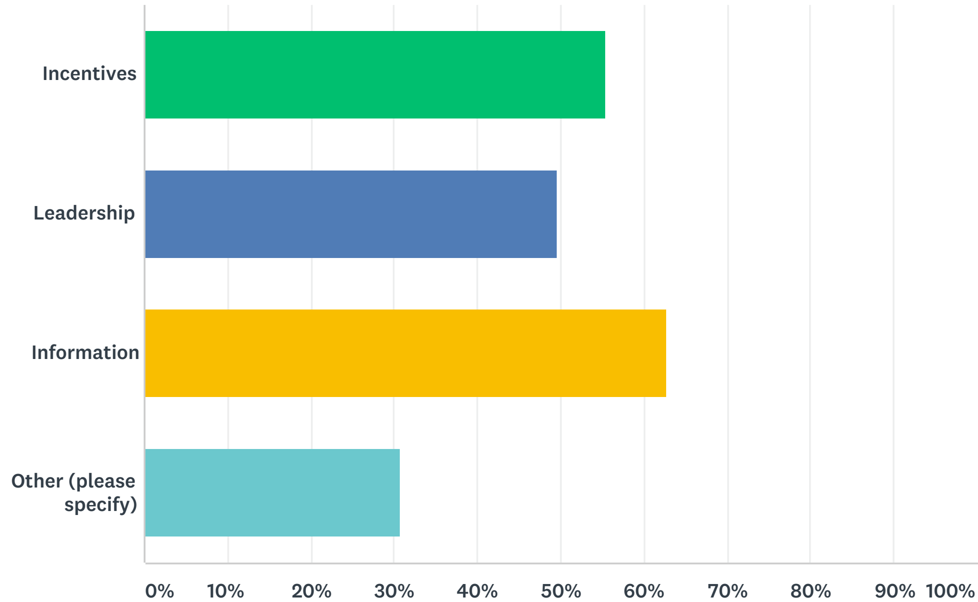
ANSWER CHOICES	RESPONSES	
I don't know	45.71%	640
No	43.29%	606
Yes (please specify)	12.43%	174
Total Respondents: 1,400		

Q16 What is the organization and/or name and title of the person who takes the lead on water conservation programs in your community?

Answered: 1,118 Skipped: 537

Q17 What are the barriers to water conservation in your community (select all that apply)?

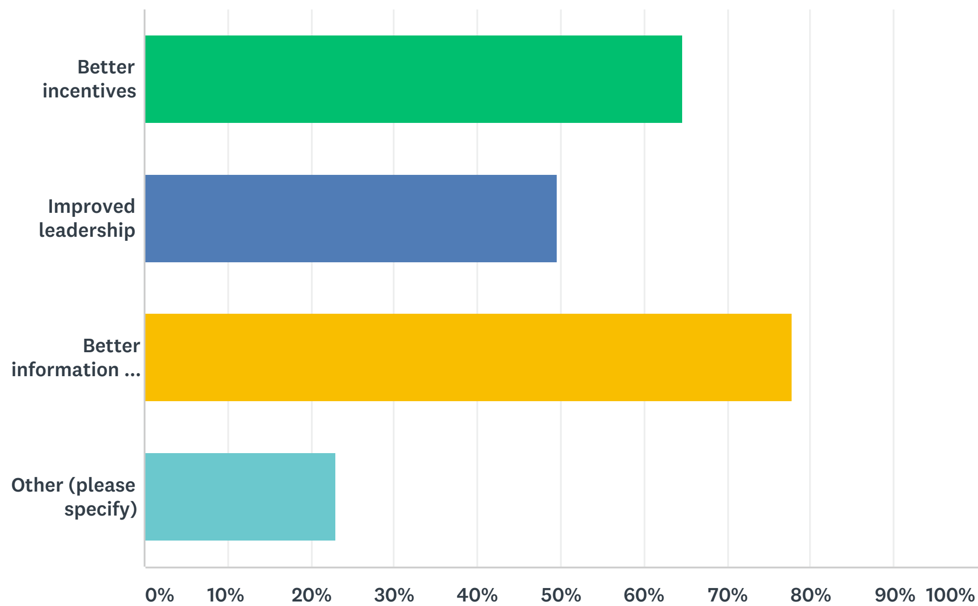
Answered: 1,407 Skipped: 248



ANSWER CHOICES	RESPONSES	
Incentives	55.51%	781
Leadership	49.61%	698
Information	62.76%	883
Other (please specify)	30.85%	434
Total Respondents: 1,407		

Q18 What do you think are Utah's best opportunities for water conservation (select all that apply)?

Answered: 1,407   Skipped: 248



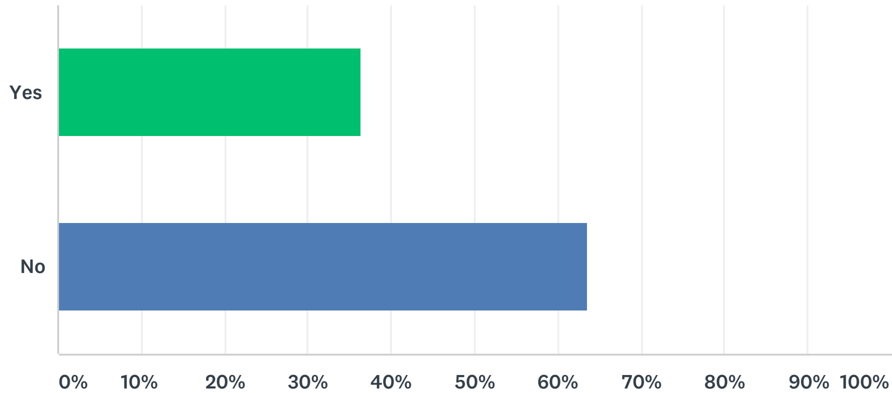
ANSWER CHOICES	RESPONSES	
Better incentives	64.75%	911
Improved leadership	49.54%	697
Better information and education	77.75%	1,094
Other (please specify)	22.96%	323
Total Respondents: 1,407		

Q19 Please tell us about the regional factors or context that should be considered when setting conservation goals in your area?

Answered: 982 Skipped: 673

Q20 Are you willing to be contacted for an interview?

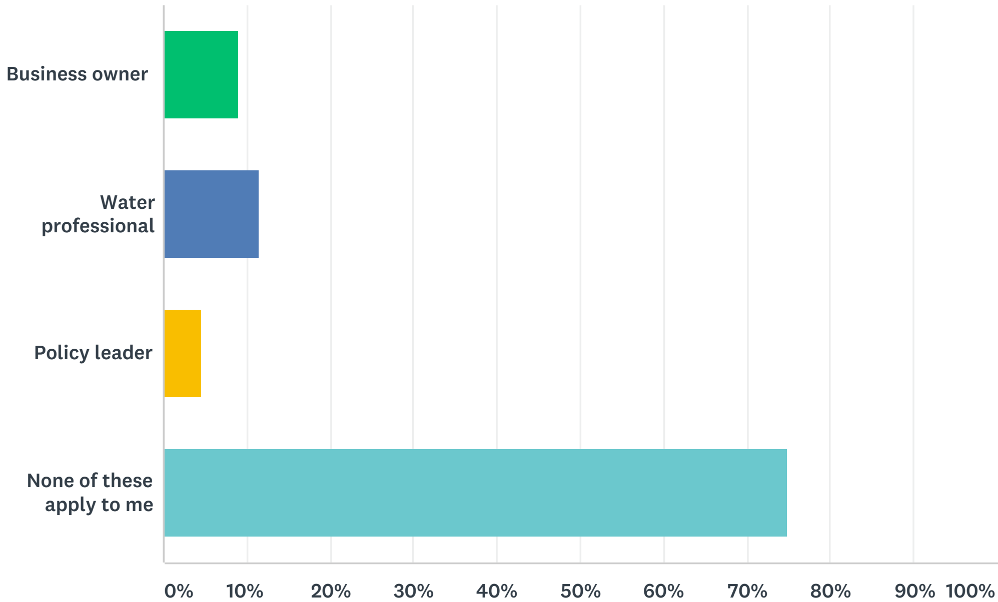
Answered: 1,359 Skipped: 296



ANSWER CHOICES	RESPONSES	
Yes	36.50%	496
No	63.50%	863
TOTAL		1,359

Q21 Which of the following apply to you?

Answered: 1,407 Skipped: 248



ANSWER CHOICES	RESPONSES	
Business owner	9.03%	127
Water professional	11.44%	161
Policy leader	4.69%	66
None of these apply to me	74.84%	1,053
TOTAL		1,407

Q22 What are some of the water efficiency challenges at your business?

Answered: 92 Skipped: 1,563

Q23 What are some of the water efficiency opportunities at your business?

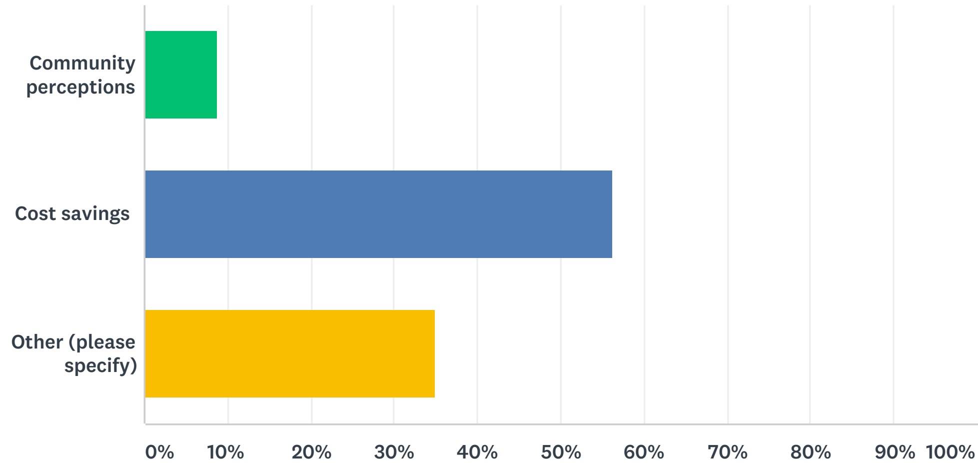
Answered: 83 Skipped: 1,572

Q24 What water efficiency measures are being implemented at your business?

Answered: 82 Skipped: 1,573

Q25 As a business person, what motivates you the most to conserve?

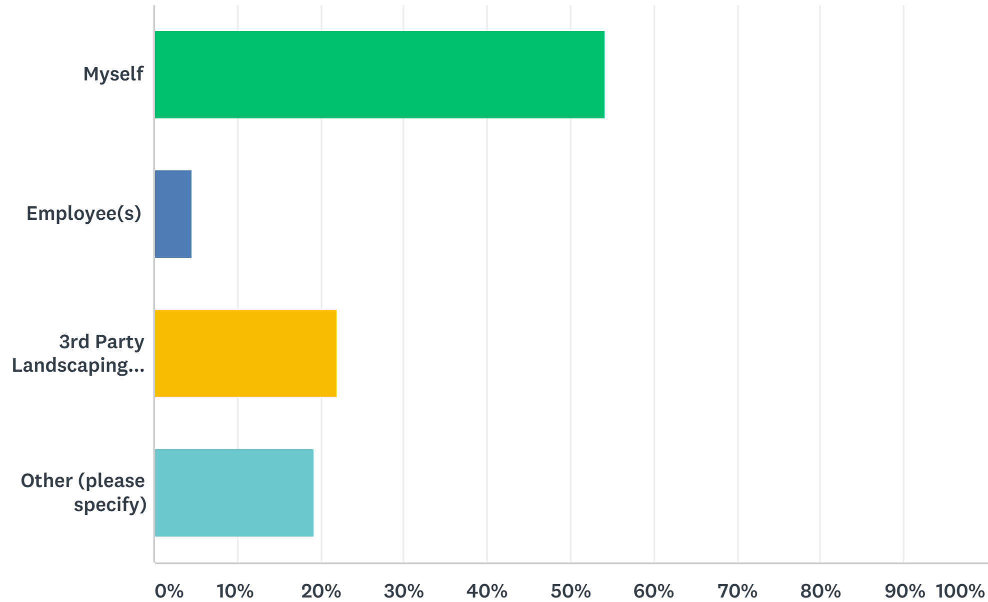
Answered: 103   Skipped: 1,552



ANSWER CHOICES	RESPONSES	
Community perceptions	8.74%	9
Cost savings	56.31%	58
Other (please specify)	34.95%	36
TOTAL		103

Q26 Who manages the landscape at your business?

Answered: 109 Skipped: 1,546



ANSWER CHOICES	RESPONSES	
Myself	54.13%	59
Employee(s)	4.59%	5
3rd Party Landscaping Company	22.02%	24
Other (please specify)	19.27%	21
TOTAL		109

Q27 As a policy leader, what are your greatest challenges related to encouraging water efficiency through statutes, rules and/or legislation in your constituency?

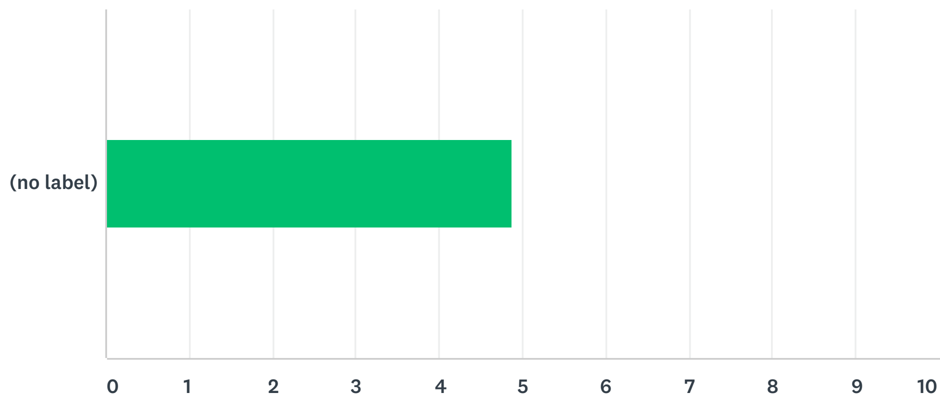
Answered: 50 Skipped: 1,605

Q28 Which policies would help the State of Utah or your region become more water efficient (please specify whether the policy is a statewide or local policy)?

Answered: 43 Skipped: 1,612

Q29 On a scale of 1 to 7, where 1 is not important and 7 is very important, how important is water efficiency to your constituents?

Answered: 54   Skipped: 1,601



	1 (NOT IMPORTANT)	2	3	4	5	6	7 (VERY IMPORTANT)	TOTAL	WEIGHTED AVERAGE
(no label)	0.00% 0	3.70% 2	9.26% 5	25.93% 14	24.07% 13	31.48% 17	5.56% 3	54	4.87

Q30 What, as a water professional, do you see as the greatest barriers to improved water efficiency?

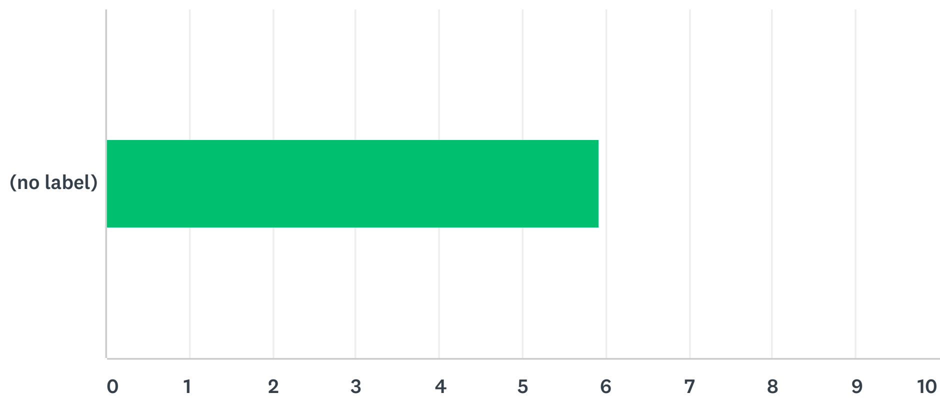
Answered: 143 Skipped: 1,512

Q31 What, as a water professional, do you see as the greatest opportunities to improve efficiency in your area?

Answered: 140 Skipped: 1,515

Q32 On a scale of 1 to 7, where 1 is not important and 7 is very important, how important is water conservation to your employer?

Answered: 151 Skipped: 1,504



	1 (NOT IMPORTANT)	2	3	4	5	6	7 (VERY IMPORTANT)	TOTAL	WEIGHTED AVERAGE
(no label)	2.65% 4	1.99% 3	2.65% 4	9.27% 14	13.25% 20	17.22% 26	52.98% 80	151	5.92

Q33 Is there any other feedback you feel is important to share?

Answered: 674   Skipped: 981

Q34 If you would like to be in the running to win a gift card for taking this survey, please enter your contact information below. Winners will be randomly selected.

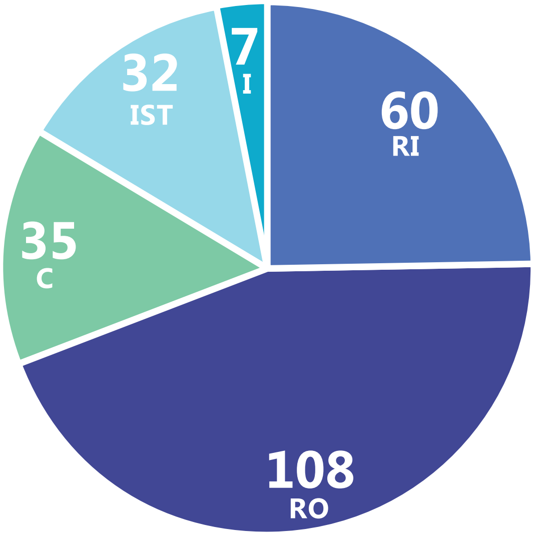
Answered: 668 Skipped: 987

ANSWER CHOICES	RESPONSES	
Name	100.00%	668
Company	0.00%	0
Address	98.20%	656
Address 2	5.69%	38
City/Town	98.65%	659
State/Province	98.65%	659
ZIP/Postal Code	98.65%	659
Country	0.00%	0
Email Address	97.01%	648
Phone Number	91.17%	609

Appendix B: Open House Materials

WHERE ARE WE AT TODAY?

STATEWIDE WATER USE 2015



- **I** — **Industrial Water Use** - Manufacturing, plants, oil and gas producers, mining companies, dairies and stock watering.
- **IST** — **Institutional Water Use** - Various public agencies and institutions (i.e. schools, municipal buildings, churches)
- **C** — **Commercial Water Use** - Office spaces, retail businesses, restaurants and hotels.
- **RI** — **Residential Indoor Water Use** - Residential drinking water, cooking, washing clothes, miscellaneous cleaning, personal grooming and sanitation.
- **RO** — **Residential Outdoor Water Use** - Irrigation of lawns, gardens and landscapes, and other residential activities.

Total - 242 gallons per capita per day(gpcd)

Source: Utah Division of Water Resources

HOW DID WE GET HERE?

2001

25% By 2025

- In 2001, Governor Leavitt published a statewide conservation goal to reduce per capita use by 25 percent. Governor Herbert later added to the goal to achieve the reduction of 25 percent by 2025.

2005

Water Use Monitoring

- 2005, 2010, and 2015 Utah Division of Water Resources published Municipal and Industrial Water Use Data reports.

2010

2015

Legislative Water Audit

- In 2015, the Utah Division of Water Resources had a legislative audit that looked at the divisions Municipal & Industrial (M&I) Water Use Report. The audit recommended regional water conservation goals.

2018

Regional Goals

- Utah is unique in that we have a variety of climates and microclimates, and other factors throughout the state that impact regional efficiency potential.
- Purpose of regional goal setting process is to combine scientific/ engineering analysis with regional input to develop goals appropriate for different areas of the state.

Major Recommendations Of The Legislative Water Audit

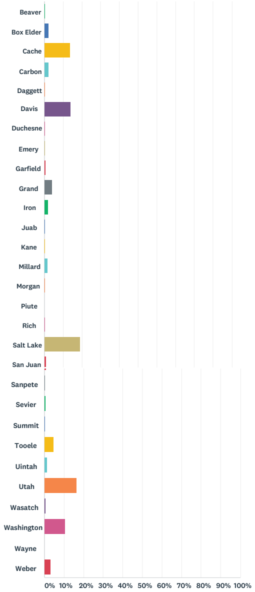
- Establish regional water conservation goals.
- Recommend that the Legislature consider adopting policies that will require the phasing in of universal (secondary [non-drinking] water) metering.
- Adopt pricing policies that encourage efficient water use.
- The Division should work with the legislature to encourage large water systems to conduct periodic AWWA M36 system water audits
- Use the 2015 M&I Report used as the baseline for future analysis and conservation goals.

SURVEY RESULTS

SURVEY RESULTS AS OF SEPT. 20, 2018:

Q1 In which county do you live?

Answered: 915 Skipped: 0

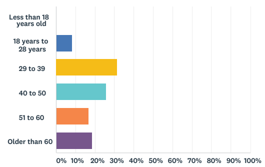


Q2 In which city do you live?

Answered: 913 Skipped: 2

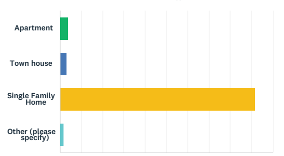
Q3 How old are you?

Answered: 915 Skipped: 0



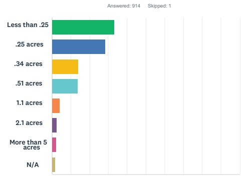
Q4 Which best describes your residence?

Answered: 915 Skipped: 0



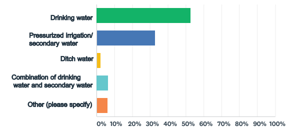
Q5 What is the approximate size of your property?

Answered: 914 Skipped: 1



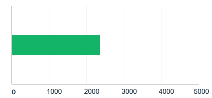
Q6 What source of water do you use to irrigate your landscape?

Answered: 914 Skipped: 1



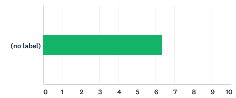
Q7 On average, how many gallons of water do you think your household uses daily, including indoor and outdoor use?

Answered: 735 Skipped: 180



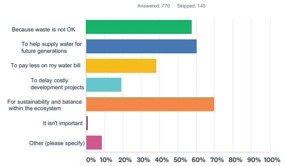
Q8 On a scale of 1 to 7, where 1 is not important and 7 is very important, how important is water conservation in the State of Utah?

Answered: 770 Skipped: 145



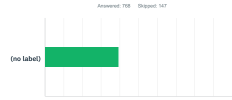
Q9 Why is it important to use water efficiently?

Answered: 770 Skipped: 145



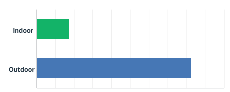
Q10 On a scale of 1 to 7, where 1 is very unwilling and 7 is very willing, how would you rate your community's willingness to conserve water?

Answered: 768 Skipped: 147



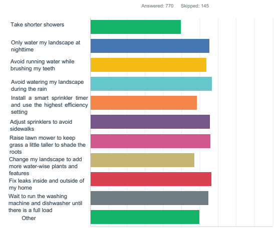
Q11 Where do you think you can save the most water?

Answered: 770 Skipped: 145



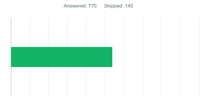
Q12 On a scale of 1 to 7, where 1 is very unwilling and 7 is very willing, how willing are you to do the following to become more efficient?

Answered: 770 Skipped: 145



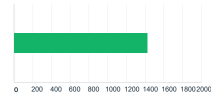
Q13 How much of your landscape are you willing to transition to water-wise plants and features?

Answered: 770 Skipped: 145



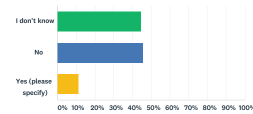
Q14 On average, how many less gallons of water daily, including indoor and outdoor use, do you think your household could use daily?

Answered: 724 Skipped: 191



Q15 Are there policies in your community that restrict landscaping choices (for example, requiring turf in the park strip)?

Answered: 769 Skipped: 146

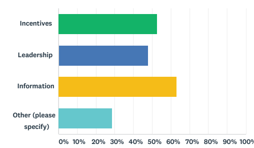


Q16 What is the organization and/or name and title of the person who takes the lead on water conservation programs in your community?

Answered: 615 Skipped: 300

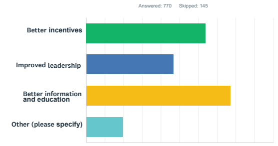
Q17 What are the barriers to water conservation in your community (select all that apply)?

Answered: 770 Skipped: 145



Q18 What do you think are Utah's best opportunities for water conservation (select all that apply)?

Answered: 770 Skipped: 145

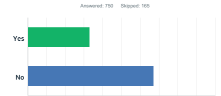


Q19 Please tell us about the regional factors or context that should be considered when setting conservation goals in your area?

Answered: 522 Skipped: 393

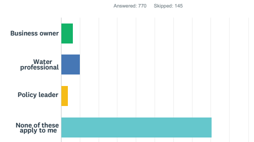
Q20 Are you willing to be contacted for an interview?

Answered: 750 Skipped: 165



Q21 Which of the following apply to you?

Answered: 770 Skipped: 145



BUSINESS OWNERS :

Q22 What are some of the water efficiency challenges at your business?

Answered: 33 Skipped: 882

Q23 What are some of the water efficiency opportunities at your business?

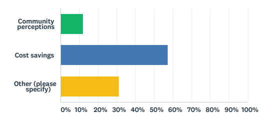
Answered: 31 Skipped: 884

Q24 What water efficiency measures are being implemented at your business?

Answered: 29 Skipped: 886

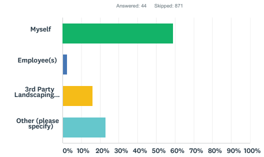
Q25 As a business person, what motivates you the most to conserve?

Answered: 42 Skipped: 873



Q26 Who manages the landscape at your business?

Answered: 44 Skipped: 871



POLICY LEADERS :

Q27 As a policy leader, what are your greatest challenges related to encouraging water efficiency through statutes, rules and/or legislation in your constituency?

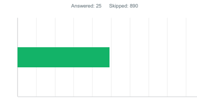
Answered: 24 Skipped: 891

Q28 Which policies would help the State of Utah or your region become more water efficient (please specify whether the policy is a statewide or local policy)?

Answered: 18 Skipped: 897

Q29 On a scale of 1 to 7, where 1 is not important and 7 is very important, how important is water efficiency to your constituents?

Answered: 25 Skipped: 890



WATER PROFESSIONALS :

Q30 What, as a water professional, do you see as the greatest barriers to improved water efficiency?

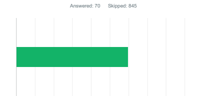
Answered: 65 Skipped: 850

Q31 What, as a water professional, do you see as the greatest opportunities to improve efficiency in your area?

Answered: 64 Skipped: 851

Q32 On a scale of 1 to 7, where 1 is not important and 7 is very important, how important is water conservation to your employer?

Answered: 70 Skipped: 845



Q33 Is there any other feedback you feel is important to share?

Answered: 360 Skipped: 555

Q34 If you would like to be in the running to win a gift card for taking this survey, please enter your contact information below. Winners will be randomly selected.

Answered: 387 Skipped: 528

Complete the Regional Water Conservation Survey:

The survey will be available through October 19, 2018

At One Of The Laptop Stations

Fill Out A Paper Survey

SurveyMonkey.com/r/LocalGoals

Our commitment to you, the public, is to actively listen to your ideas, feedback and concerns, and to communicate how public input informed these goals.

UTAH DNR WATER RESOURCES
HANSEN ALLEN & LUCE INC ENGINEERS
BOWEN COLLINS & ASSOCIATES

HOW MUCH WATER COULD WE SAVE ?

INDOOR WATER USE PROJECTIONS FOR DIFFERENT DEVELOPMENT PATTERNS

70 gpcd

Inefficient Past Practices

- Water use averages prior to 2000.
- Limited use of high efficiency fixtures and appliances.

60 gpcd

Improved Efficiency

- 40% conversion to high efficiency fixtures and appliances.

Clothes Washer | Shower | Faucet

50 gpcd

Additional Efforts

- 80% conversion to high efficiency fixtures and appliances.

Clothes Washer | Shower | Faucet | Toilet | Dish Washer

40 gpcd

Maximum Conservation

- 100% conversion to high efficiency fixtures and appliances.
- Elimination of leaks.
- Improved awareness and focus on water conservation.

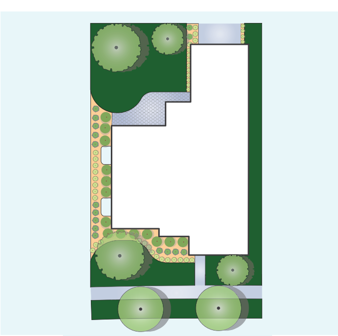
Clothes Washer | Shower | Faucet | Toilet | Dish Washer | Leak | Other

Source: Water Research Foundation

OUTDOOR WATER USE PROJECTIONS FOR DIFFERENT DEVELOPMENT PATTERNS

Inefficient Past Practices


Source: Utah Rivers Council

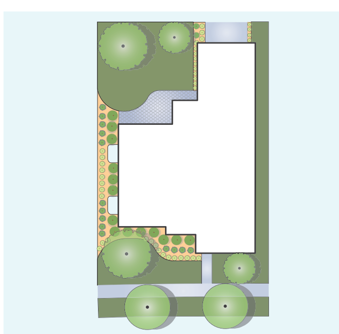


- Traditional Landscaping – 80% turf 20% planting beds and hardscaped areas.
- Historic irrigation efficiency = 50% (Double the amount needed)

0% Reduction

Improved Efficiency


Source: Localscapes

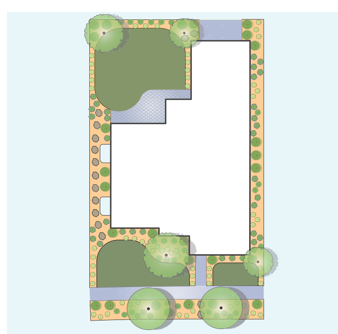


- Traditional Landscaping – 80% turf 20% planting beds and hardscaped areas.
- Increased irrigation efficiency to 70%

29% Reduction

Additional Efforts


Source: Localscapes

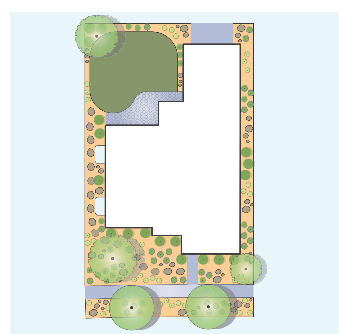


- 50% turf 50% planting beds and hardscaped areas.
- Increased irrigation efficiency to 80%.

50% Reduction

Maximum Conservation

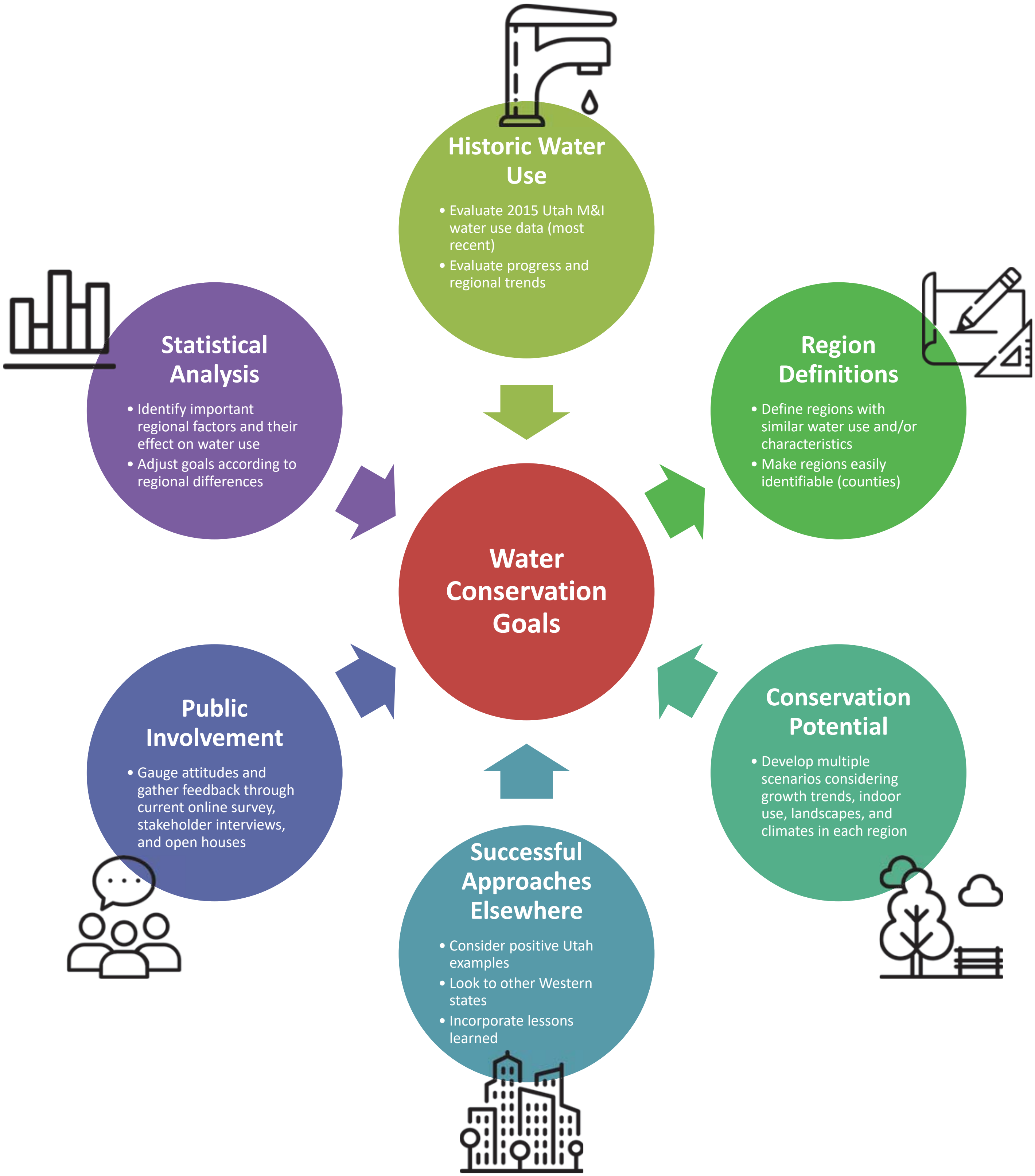

Source: Utah State University Botanical Center



- 20% turf 80% planting beds and hardscaped areas.
- Increased irrigation efficiency to >80%.

63% Reduction

GOAL SETTING METHOD



UTAH DNR WATER RESOURCES HANSEN ALLEN & LUCE INC ENGINEERS BOWEN COLLINS & ASSOCIATES

ADDITIONAL RESOURCES

Water.Utah.Gov/H2Oath

Water.Utah.gov/FameOrShame

ConserveWater.Utah.Gov/guide.html

UtahWaterSavers.com

Localscapes.com

EPA.gov or WaterSense.com

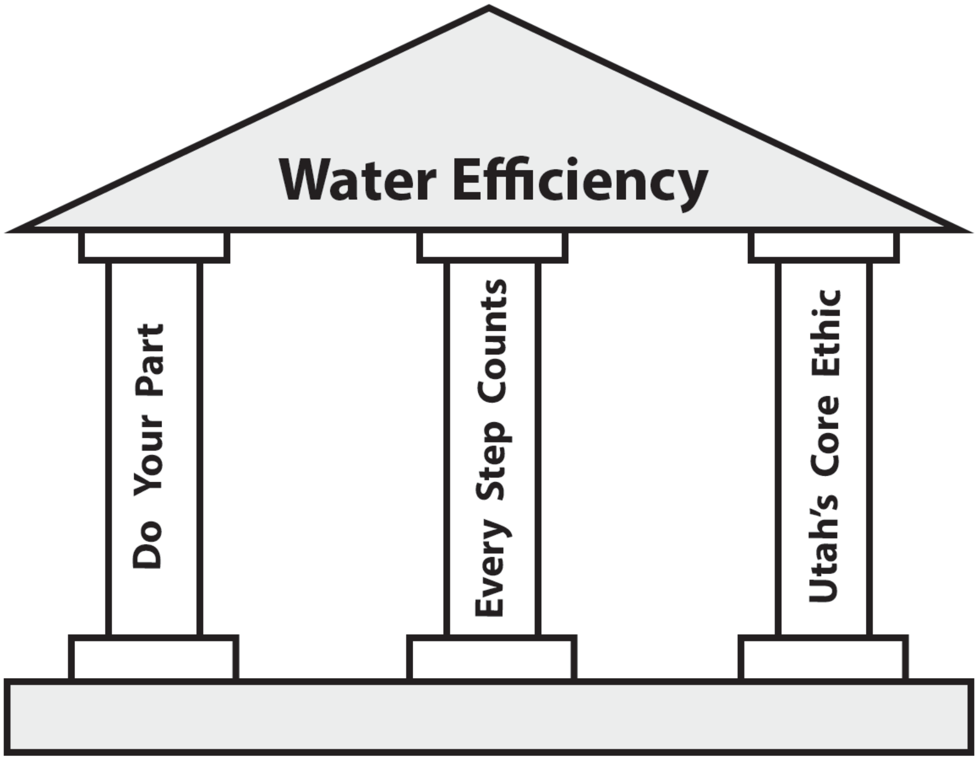
SlowTheFlow.org

WaterConservationCertification.com

UtahWaterConservationForum.org

Water.Utah.gov/

THREE PILLARS OF CONSERVATION



DO YOUR PART

There is not an entity or individual that is entirely responsible for, or is the exception to, water efficiency. We all need to do what we can to use water wisely.

EVERY STEP COUNTS

Whether that step is taking a shorter shower, updating infrastructures and appliances, fixing a leak, adjusting sprinkler timers, installing secondary water meters, using a tiered rate, running or following an education campaign, or installing water-wise landscaping. Each step helps us to create changes that will assist in reaching our goals in being water-wise.

EFFICIENCY IS UTAH'S ETHIC

We do not conserve water because we have a wet or dry year, we conserve because, as Utahns, we are not wasteful.

Appendix C: Open House and Stakeholder Comments

PUBLIC COMMENTS

The following comments were collected during open houses and stakeholder interviews from September to November 2018. They are organized here by topic.

Water Rates

1. Several highlighted local political barriers. “We should install secondary meters because it’s the responsible thing to do,” one said. “But it’s an unpopular move. My city council isn’t willing to do it because they wouldn’t get reelected.”
2. Resident said that Logan City doesn’t have tiered rates.
3. Need a tiered structure.
4. Many participants acknowledged that even though most water suppliers now have tiered rates, “the tiers are too flat to encourage conservation” but that most local governments aren’t willing to increase them for political reasons.
5. In one rural community that is very “pro-land use and pro-property rights,” according to a city council member, “rates are probably only way to change behavior.”
6. “Our pricing isn’t done right,” said a state planning official. “Water users don’t see the full cost when they decide to use or not user water.”
7. Abolish equal pay on water bills.
8. What is the cost—cheap water vs. expensive water.
9. Look at next most expensive block of water.
10. Metering, said one state official, must be combined with “effective rates and smart billing processes” to succeed as a conservation practice.

Incentives

1. “To inspire people to conserve water, there needs to be financial incentives.” Buy-back programs, buy homeowner’s ripped out turf, give $1,000 per household to flip your strip.
2. Incentivize changing landscaping; rebate for controllers is good; rebate on landscaping materials, like landscape rock and water-wise plants
3. A state water official spoke of a “tipping point” where financial incentives are enough to prompt individuals to act. Currently, she said, almost everyone recognizes that changing landscapes will save water, but frugal Utahns can’t afford to do it “on their own dimes” just for the social good. Incentives will help tip the scales, she said.
4. Want to know what incentives are available that will encourage a change in behavior.
5. One individual suggested incentives that allowed homeowners to sell their removed turf to conservancy districts to help fund a more water conservative landscape.
6. Promote specific actions to decrease water use; earn rewards by demonstrating less water use; publish the target rate within a water supplier boundary on the water bill; show the actual use on the water bill compared to the target use;

Universal Metering

1. “There seem to be no consequences to unmetered use.”

2. “There’s a world of waste caused by an apparent abundance of water, low costs, unmetered ditches, leaks, and no automation. Some people still flood irrigate their lawns and let the water run down the street. There’s a lot we could do.”
3. Many stakeholders emphasized the need for better data provided to water users, including metering all water.
4. A state planning official said, “If secondary water users want to conserve but aren’t metered, they can’t tell how they are doing. There’s no measurement and no financial benefit.”
5. Another state planning official said, “From the consumer’s perspective, it’s unlimited water use.” He recognized that retrofitting existing systems is difficult, but “we should get in the habit of installing secondary water meters in new developments.”
6. Water two times each day; using secondary water that is not metered.

Landscaping
1. Minimize lawn, keep our trees.
2. Work with local nurseries to retail water-wise plants (e.g., podless sunburst locust tree); identify nurseries that will special order appropriate plants.
3. Need trees for cooling.
4. Study measuring outdoor irrigation at night; does it save water?
5. Need to get rid of ordinances that require specific types of landscapes.
6. No availability of water-wise plants in the basin.
7. A city engineer said, “People don’t seem to notice that we’re in a desert,” especially when they live along the Wasatch Front. Further water conservation must be “a grassroots effort” where individuals recognize its importance, rather than merely responding to government. “The culture must change,” he said. “Grass is not the only option for landscapes,” he said, suggesting education on alternative localscapes.
8. A water conservation manager observed, “As long as people have turf, people will overwater.”
9. Stormwater professionals: “We don’t see a big deal with changing landscaping and stormwater runoff.”
10. By removing our front yards, do we lose community feel because people don’t spend time in their yards.
11. County requires more water use landscape.
12. “Maintaining instream flows and wildlife is more important than our lawns.”
13. “Utahns are very independent and like to do things themselves,” said a state water regulator. “They know how to install grass and sprinklers, but a water-wise landscape is harder and requires particular skills and money.”
14. Residents might be wary of localscapes, said several water professionals, “because they imagine the most extreme case” of bare rocks and dry plants. There’s the erroneous perception of a binary choice, many said, between lush turf and bare dirt. Poorly constructed localscapes only reinforce this perception.
15. Turf conversion, said one experienced water conservation manager, is only effective if the home does not change hands frequently. “The next owner might want grass and put it back in,” she said.

16. Several were concerned about the undesirable effects of landscape conversion. “In converting to water-wise landscapes, we can’t destroy our urban forests,” said a senior water conservation manager.
17. Several commented on a potential to increase heat islands and dust if landscapes were not properly managed.
18. Still, some people will want to plant grass for aesthetic reasons. “If you want grass, use a different kind that’s better for our climate,” said a senior water conservation manager.
19. Aesthetic standards of community need to support conservation.
20. A suggestion to help limit the residential outdoor use would be to have more community developments, like Daybreak or townhomes, where they residents share a park-like backyard. This scenario reduces the amount of unused space typically seen in a traditional landscaped backyard of a single family. Also, vertical growth, as in more multi-family structures, will be the quickest and easiest solution to handling the growing population and the limited water resources.
21. Need more emphasis on water-wise trees.

Supply Limitations
1. A rural city council member noted, “Water here is a regional problem. Conservation will help, but the bigger question is growth.”
2. Water supply must be considered.
3. A city water supervisor said, “There’s only so much water. We should learn to manage it better.”
4. Many stakeholders agreed that “the cheap water has already been developed” and that future water supplies will take more time and money, prompting further conservation as a way to get by in the meantime.
5. “We’re seeing water sources dry up that were once consistent and reliable,” said a state water regulator, referring to many springs and wells that supply drinking water. Water conservation will be driven not just by growth, she said, but also by a diminishing water supply.
6. Even with conservation, there is still a need to plan for water development. “We can’t conserve our way out of a demand problem,” said one senior water manager. “We have a responsibility to provide water, and those projects take time, often decades. They might be delayed, but we still need to plan so we’re ready when we need them.”
7. Other water managers acknowledged that “even with water development, the future supply is finite and uncertain.”
8. “We have a history of good conservation, but we’re always concerned about supply,” said a rural city council member. “We just don’t have access to water from other sources. When there’s no water, there’s no water.”
9. Gov. Herbert has repeatedly acknowledged that water is what constrains Utah’s growth, a sentiment reaffirmed by his staff and others during the outreach process.
10. Many interviewees supported the development of “water markets” or “water banks” to arrange exchanges of water, such as fallowing late-season crops and diverting the water to municipal uses.

11. “We’re all in the midst of some kind of project,” said a water conservancy district manager. His district has already spent $10–$12 million on its water conservation program since 2000, and expects another $10 million in next three years.
12. Take better care of the water we have. Be accountable for the water supply we do have.
13. Sending water; stop pirating water by California for California use.

Policy
1. “Hoping the State forces us to meter, so we have someone to blame. Local leaders know we have to do it, but are reluctant.”
2. Water conservation is political.
3. Decrease subsidizing of water.
4. Impose penalties for non-compliance.
5. Why don’t we have more reuse? Several conversations mentioned this question. Water Rights would need to evolve to include water reuse programs.
6. Require feasibility study for new development showing there is water available to support the development.
7. There should be state policies about how to implement a tiered rate system.
8. “Lots of older infrastructure, even in commercial areas, that needs replacement.”
9. Have we considered water efficiency in public facilities like schools? Low flow toilets would make a much bigger difference there than in individuals’ homes.
10. A homeowner understands that water-efficient appliances in the home don’t make the necessary impacts that we as a state need to conserve more water, although every bit does help. However, implementing low-flow toilets and other water efficient appliances in institutional facilities would greatly impact the water use and would be a much more effective use of time promoting water conservation.

Culture
1. Addition of LDS temple has brought in many retirees that like smaller yards.
2. Money available through oil/gas has resulted in more investment in piping canals and other water saving issues.
3. “General public doesn’t understand water is a finite resource.”
4. Even while encouraging less water use, several stakeholders acknowledged the need to maintain or improve environmental flows and quality of life. “We need places to recreate and to beautify the community,” one said.
5. “We all need reminders” on water conservation, said a water manager. “Like not irrigating during the day and taking shorter showers.”
6. “We need to be ahead of the curve.”
7. Cost of conservation and willingness to implement changes to reach the proposed goal.
8. “In our area, I feel like people are already good stewards of water,” said one water manager. “We’re pretty conservative.”
9. A state water official said, “We Utahns have not fundamentally changed our views on water conservation. We agree, collectively, that we should conserve water, but we lack individual implementation.”

10. Most participants agreed that waiting for a crisis before changing water use habits is unacceptable. “We can’t hit a wall and change drastically,” one water conservancy district manager said. “We need to anticipate the problems and plan our course of action.”
11. Water conservation requires a multiyear outlook. “We’ve had this attitude of ‘we’ll deal with next year next year,’” said a rural city council member. “We’re changing that mentality to smooth out usage over several years. We’d like everyone to be more conscious about water all the time, not just during droughts.”
12. “We need an ‘all of the above’ approach,” said a state planning official, “with water conservation first and foremost.”
13. A water conservancy district manager explained how water conservation takes time. “We can’t reach our maximum conservation potential right away, or even in our lifetime,” he said, “but what we can do is achieve a double-digit reduction in per-capita usage in the next few years.” Another manager in a similar position highlighted the difficulty of getting even new developments to go that far.
14. “In New Mexico, nothing changed until we started charging.”
15. To help lower outdoor water use, new homes should be built like the Daybreak community, townhomes with community, park-like backyards. That way, people can share their land and thus lower water use.
16. New development should be mandated to use water-wise landscaping and low flow fixtures. Plumbing codes address the low flow fixtures. There should be laws that require better water use choices and require HOAs and apartment complexes to be water wise.
17. Create “sound bites” to influence desired behaviors.
18. No more golf courses. Too much water spent on these amenities that benefit only a few people.
19. Take maximum advantage of the current drought conditions; strongly encourage behavior changes while water conditions are on people’s minds; begin early in the spring to remind people what the water supply is like.

Climate Change

1. “We are already in a water crisis,” said an experienced water conservation manager. “And climate change will only enhance our droughts and lengthen our irrigation seasons.”
2. Climate change is a real threat. Recent trends, as well as climate models, suggest higher temperatures, longer growing seasons, and less snowfall in the future.
3. “Future water will be harder to get, and we need a margin in drought years,” said a rural city council member. “The whole place is slowly drying up.”

Data Management

1. Improved water metering and data reporting are helping, said a state water regulator, referring to recent legislation and other efforts to better quantify water use.
2. GPCD metric has limits (permanent vs. daytime, tourist, or second home population; high-density development; water loss)
3. JVWCD board uses different measure for water reduction evaluation.
4. Normalization to account for wet years and dry years?
5. 2015 was a wet year; may skew acceptable water use.

6. AWWA— target operators—help small systems track their data.
7. Site that shows daily ET?
8. Meter readings from Sand Hollow—Entrada development
9. Find out what the use is.
10. Assume new growth will be like Entrada.
11. Compare historic data to current.
12. “In our future planning, we can’t just look at per-capita water use”—must consider density, etc., be wise about how we use the number.
13. Research should come through universities.
14. 2015 water year was wet year; shouldn’t use as baseline.
15. Hire consultant to compare water use to other like-states.

Cooperation Among Agencies

1. One water conservancy district manager said, “As a water conservancy district, we don’t need city approval to change water rates, install meters, or implement water conservation programs. However, we don’t want to irritate residents or oppose local governments. We have to cooperate with the cities and align our programs with theirs.” Another such manager said that “we don’t have the ‘policy whip’ that cities do, and we certainly need their support to complement our own efforts.”
2. Likewise, many water professionals expressed an interest to support, rather than oppose, the Division’s water conservation efforts.
3. A state planning official encouraged “working with municipal planning departments to ensure that water efficiency is built-in from the get-go” and that “local landscape ordinances don’t discourage conservation.”
4. “As a city, we need to send the right signal,” said a rural city council member.
5. A state planning official recommended “getting a better handle on institutional water use”—such as watering city parks—“and setting a positive example” for the community by not watering during rainstorms or during the hottest part of the day. ‘A summit of institutional water users might be convened to develop best practices,” he suggested. Another state planning official agreed that Institutional water use has “a very, very big potential for efficiency.”
6. Need to coordinate with: County Commissioners, Mayor, USU extension (Good resource), Farm Bureau.

Recognition of Past Achievements

1. “How do we get credit for past efforts?” several water officials asked. “We’ve invested millions of dollars to conserve water and worry that these new goals will reset our numbers and erase all of our progress.”
2. Concern about the conservation already achieved would be forgotten and the citizens wouldn’t get credit for what they have already done.
3. “Can we get any credit for what we’ve already accomplished?”
4. Previous reductions need to be accounted for.
5. Need a LOT of acknowledgment for progress since 2000. “Everybody is nervous about resetting the clock.” Consistent message from all WCDs.

6. Because [you] have worked so hard, it is time to take it to the next level; communities need to get credit for what has already been accomplished.

Agriculture

1. Several residents felt that any changes to behavior or use for municipal and industrial water are inconsequential since agricultural uses 80% of water.
2. It is not only vital, nor an option—we have to incorporate agriculture.
3. Zoning for agriculture?
4. Identify prime agricultural land; preserve for agricultural uses.
5. Need to put agriculture in the equation.
6. Ag water needs to be included in the discussion.
7. Verify percentage of water going to agricultural use. Is it still 80/20?
8. Lots of ag improvements recently.
9. Agriculture is the first one to have water restrictions. Restrictions should be for both residential and agriculture. Crops should be watered before grass.
10. The homeowner suggests that the agriculture community be educated on the different forms of irrigating their fields and livestock; and to be taught in a way that shows them the profits and benefits of switching over to more water conservative methods. The suggestion was not directed toward drip irrigation, as the homeowner understood that using drip irrigation uses more water over a longer period of time, and believes that other methods could be better implemented.

Thoughts on Goals

1. Overall state goal seems reasonable to me.
2. Setting goals is a waste of time. People will conserve when they have to.
3. Overall county numbers are too high.
4. Regional goals will be difficult to administer.
5. What happens when we don't meet the goals?
6. New growth is already achieving the minimum conservation goal.
7. Maximum conservation number is unrealistic.
8. Regional goal seems too aggressive, with our rural areas we want to have more open space and lawns than dense urban.
9. Needs to take into account available supply.
10. We've already done our share.
11. Goal is not aggressive enough. We need to accept that we live in the desert.
12. What is the basis of your goals?
13. Timeline must not be arbitrary.
14. Reasons to group by region? May confuse public.
15. Very different goals in the different communities even within the same county. (i.e. running out of water in Aurora vs. no problems in Richfield).
16. Another asked, "What does this regional goal mean for my water system? How does it help me?"
17. Cost of water needs to be factored into goal.
18. Factor in cost into goal setting.

19. Need to separate out Washington and Kane Counties?

Education

1. People want to do their part, but they don't know what to do.
2. Need education of retirement community.
3. Education of youth is important moving forward.
4. Ask Rural Water to post to their Water Conservation website and advertise with the Rural Water Water Conservation Certification class.
5. More commercials like the grass whisper: resonated with his community; established authority; likeable character; associated with a local, successful team, current.
6. Many visitors noted that people would use less water on their lawns if they knew what amount was sufficient, but it varies with lot size, type of plants, and weather. The information is available but not widely known.

Uncategorized comments

1. Macon shale formation results in selenium reduction and investment in sprinklers.
2. Need to consider both water use and electricity.
3. Messaging stinks.
4. Are we considering salt loads?
5. State watering schedule is bogus for St. George.
6. Vertical growth is the answer to water conservation.
7. There was some talk about gray water and wondered why we don't promote this.
8. Distribution system problems should not be used to push watering to less optimal times.
9. Demand hardening—if water use becomes very efficient, there will be no more wiggle room. (Conservation seen as immediate extra supply.)
10. Focus on in-filling.
11. Conservation ethic is expensive.
12. People are concerned with population growth and projected growth throughout the state.
13. Causes stress on system; if winds are strong at night what is the difference between ET rate.
14. They were concerned about tourism, development, and indoor hotel use.
15. A lot of drought in this year. Good window for promoting.
16. Don't use potable water for irrigation.
17. Oil prices dropping, resulting in slowing of economy in the Green River District; use the slower economy to encourage water conservation.
18. Must adequately and responsibly water that we have; that means secondary to work on water reuse.
19. Recommend specific actions (start M&I irrigation water later in the season—after May 1 or May 15—instead of April 15.

Appendix D: List of Interviewees and Reviewers

List of Interviewees and Reviewers

The following individuals provided input to this project during in-person and phone interviews and/or through comments on draft reports:

Richard Bay, Jordan Valley Water Conservancy District
Paul Burnett, Trout Unlimited
Evan Curtis, Governor's Office of Management and Budget
Lynn de Freitas, Friends of Great Salt Lake
Mike Duncan, Moab City Council
Phil Dean, Governor's Office of Management and Budget
Stephanie Duer, Salt Lake City Department of Public Utilities
Michael Fazio, City of Bluffdale
Tage Flint, Weber Basin Water Conservancy District
Bart Forsyth, Jordan Valley Water Conservancy District
Chris Hansen, Central Utah Water Conservancy District
Jared Hansen, Central Utah Water Conservancy District
Darren Hess, Weber Basin Water Conservancy District
Derek Johnson, Weber Basin Water Conservancy District
Julie Jones, Washington County Water Conservancy District
Voneene Jorgensen, Bear River Water Conservancy District
Rick Maloy, Central Utah Water Conservancy District
Alan Matheson, Utah Department of Environmental Quality
Devin McKrola, Central Utah Water Conservancy District
Annalee Munsey, Metropolitan Water District of Salt Lake and Sandy
Matt Olsen, Jordan Valley Water Conservancy District
Marie Owens, Utah Division of Drinking Water
Alan Packard, Jordan Valley Water Conservancy District
Jon Parry, Weber Basin Water Conservancy District
Scott Paxman, Weber Basin Water Conservancy District
Warren Peterson, Farmland Reserve
Karry Rathje, Washington County Water Conservancy District
Jeremy Redd, Blanding City Council
Zachary Renstrom, Washington County Water Conservancy District
Nick Schou, Utah Rivers Council
Todd Schultz, Jordan Valley Water Conservancy District
Gene Shawcroft, Central Utah Water Conservancy District Marcelle
Shoop, National Audubon Society
Brie Thompson, Washington County Water Conservancy District
Ron Thompson, Washington County Water Conservancy District
Gerard Yates, Central Utah Water Conservancy District

Appendix E: Meeting Notes

Appendix F: Supplemental Data

Indoor Parameters

	Fixture Conversion - New Construction			Fixture Conversion - Existing Construction			Other Indoor Measures		
County	**2030**	**2040**	**2065**	**2030**	**2040**	**2065**	**2030**	**2040**	**2065**
BEAVER	97.0%	98.5%	99.7%	40.9%	65.2%	94.9%	12.0%	15.0%	20.0%
BOX ELDER	97.0%	98.5%	99.7%	40.9%	65.2%	94.9%	20.0%	30.0%	35.0%
CACHE	97.0%	98.5%	99.7%	40.9%	65.2%	94.9%	20.0%	30.0%	35.0%
CARBON	97.0%	98.5%	99.7%	40.9%	65.2%	94.9%	12.0%	15.0%	20.0%
DAGGETT	97.0%	98.5%	99.7%	40.9%	65.2%	94.9%	12.0%	15.0%	20.0%
DAVIS	97.0%	98.5%	99.7%	40.9%	65.2%	94.9%	20.0%	30.0%	35.0%
DUCHESNE	97.0%	98.5%	99.7%	40.9%	65.2%	94.9%	12.0%	15.0%	20.0%
EMERY	97.0%	98.5%	99.7%	40.9%	65.2%	94.9%	12.0%	15.0%	20.0%
GARFIELD	97.0%	98.5%	99.7%	40.9%	65.2%	94.9%	12.0%	15.0%	20.0%
GRAND	97.0%	98.5%	99.7%	40.9%	65.2%	94.9%	25.0%	40.0%	50.0%
IRON	97.0%	98.5%	99.7%	40.9%	65.2%	94.9%	12.0%	15.0%	20.0%
JUAB	97.0%	98.5%	99.7%	40.9%	65.2%	94.9%	12.0%	15.0%	20.0%
KANE	97.0%	98.5%	99.7%	40.9%	65.2%	94.9%	25.0%	40.0%	50.0%
MILLARD	97.0%	98.5%	99.7%	40.9%	65.2%	94.9%	12.0%	15.0%	20.0%
MORGAN	97.0%	98.5%	99.7%	40.9%	65.2%	94.9%	12.0%	15.0%	20.0%
PIUTE	97.0%	98.5%	99.7%	40.9%	65.2%	94.9%	12.0%	15.0%	20.0%
RICH	97.0%	98.5%	99.7%	40.9%	65.2%	94.9%	12.0%	15.0%	20.0%
SALT LAKE	97.0%	98.5%	99.7%	40.9%	65.2%	94.9%	20.0%	30.0%	35.0%
SAN JUAN	97.0%	98.5%	99.7%	40.9%	65.2%	94.9%	12.0%	15.0%	20.0%
SANPETE	97.0%	98.5%	99.7%	40.9%	65.2%	94.9%	12.0%	15.0%	20.0%
SEVIER	97.0%	98.5%	99.7%	40.9%	65.2%	94.9%	12.0%	15.0%	20.0%
SUMMIT	97.0%	98.5%	99.7%	40.9%	65.2%	94.9%	20.0%	30.0%	35.0%
TOOELE	97.0%	98.5%	99.7%	40.9%	65.2%	94.9%	12.0%	15.0%	20.0%
UINTAH	97.0%	98.5%	99.7%	40.9%	65.2%	94.9%	12.0%	15.0%	20.0%
UTAH	97.0%	98.5%	99.7%	40.9%	65.2%	94.9%	20.0%	30.0%	35.0%
WASATCH	97.0%	98.5%	99.7%	40.9%	65.2%	94.9%	12.0%	15.0%	20.0%
WASHINGTON	97.0%	98.5%	99.7%	40.9%	65.2%	94.9%	25.0%	40.0%	50.0%
WAYNE	97.0%	98.5%	99.7%	40.9%	65.2%	94.9%	12.0%	15.0%	20.0%
WEBER	97.0%	98.5%	99.7%	40.9%	65.2%	94.9%	12.0%	15.0%	20.0%

Outdoor Parameters

	Adoption of Secondary Meters			Scenario 1 - Adoption of Increased Efficiency to 70%		
County	**2030**	**2040**	**2065**	**2030**	**2040**	**2065**
BEAVER	90.0%	100.0%	100.0%	75.0%	100.0%	100.0%
BOX ELDER	90.0%	100.0%	100.0%	75.0%	100.0%	100.0%
CACHE	90.0%	100.0%	100.0%	75.0%	100.0%	100.0%
CARBON	90.0%	100.0%	100.0%	75.0%	100.0%	100.0%
DAGGETT	90.0%	100.0%	100.0%	75.0%	100.0%	100.0%
DAVIS	90.0%	100.0%	100.0%	75.0%	100.0%	100.0%
DUCHESNE	90.0%	100.0%	100.0%	75.0%	100.0%	100.0%
EMERY	90.0%	100.0%	100.0%	75.0%	100.0%	100.0%
GARFIELD	90.0%	100.0%	100.0%	75.0%	100.0%	100.0%
GRAND	90.0%	100.0%	100.0%	75.0%	100.0%	100.0%
IRON	90.0%	100.0%	100.0%	75.0%	100.0%	100.0%
JUAB	90.0%	100.0%	100.0%	75.0%	100.0%	100.0%
KANE	90.0%	100.0%	100.0%	75.0%	100.0%	100.0%
MILLARD	90.0%	100.0%	100.0%	75.0%	100.0%	100.0%
MORGAN	90.0%	100.0%	100.0%	75.0%	100.0%	100.0%
PIUTE	90.0%	100.0%	100.0%	75.0%	100.0%	100.0%
RICH	90.0%	100.0%	100.0%	75.0%	100.0%	100.0%
SALT LAKE	90.0%	100.0%	100.0%	75.0%	100.0%	100.0%
SAN JUAN	90.0%	100.0%	100.0%	75.0%	100.0%	100.0%
SANPETE	90.0%	100.0%	100.0%	75.0%	100.0%	100.0%
SEVIER	90.0%	100.0%	100.0%	75.0%	100.0%	100.0%
SUMMIT	90.0%	100.0%	100.0%	75.0%	100.0%	100.0%
TOOELE	90.0%	100.0%	100.0%	75.0%	100.0%	100.0%
UINTAH	90.0%	100.0%	100.0%	75.0%	100.0%	100.0%
UTAH	90.0%	100.0%	100.0%	75.0%	100.0%	100.0%
WASATCH	90.0%	100.0%	100.0%	75.0%	100.0%	100.0%
WASHINGTON	90.0%	100.0%	100.0%	75.0%	100.0%	100.0%
WAYNE	90.0%	100.0%	100.0%	75.0%	100.0%	100.0%
WEBER	90.0%	100.0%	100.0%	75.0%	100.0%	100.0%

Outdoor Parameters (cont'd)

	Scenario 2 - % New Properties Meeting Scenario Standards (80% Efficient and 50% Turf)			Scenario 2 - % Existing Properties Meeting Scenario Standards (80% Efficient and 50% Turf)		
County	**2030**	**2040**	**2065**	**2030**	**2040**	**2065**
BEAVER	30.0%	48.0%	60.0%	20.0%	33.0%	40.0%
BOX ELDER	45.0%	75.0%	90.0%	33.0%	50.0%	60.0%
CACHE	30.0%	48.0%	60.0%	20.0%	33.0%	40.0%
CARBON	30.0%	48.0%	60.0%	20.0%	33.0%	40.0%
DAGGETT	30.0%	48.0%	60.0%	20.0%	33.0%	40.0%
DAVIS	45.0%	75.0%	90.0%	33.0%	50.0%	60.0%
DUCHESNE	30.0%	48.0%	60.0%	20.0%	33.0%	40.0%
EMERY	30.0%	48.0%	60.0%	20.0%	33.0%	40.0%
GARFIELD	30.0%	48.0%	60.0%	20.0%	33.0%	40.0%
GRAND	100.0%	100.0%	100.0%	33.0%	50.0%	60.0%
IRON	45.0%	75.0%	90.0%	33.0%	50.0%	60.0%
JUAB	30.0%	48.0%	60.0%	20.0%	33.0%	40.0%
KANE	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
MILLARD	30.0%	48.0%	60.0%	20.0%	33.0%	40.0%
MORGAN	30.0%	48.0%	60.0%	20.0%	33.0%	40.0%
PIUTE	30.0%	48.0%	60.0%	20.0%	33.0%	40.0%
RICH	30.0%	48.0%	60.0%	20.0%	33.0%	40.0%
SALT LAKE	45.0%	75.0%	90.0%	33.0%	50.0%	60.0%
SAN JUAN	30.0%	48.0%	60.0%	20.0%	33.0%	40.0%
SANPETE	30.0%	48.0%	60.0%	20.0%	33.0%	40.0%
SEVIER	30.0%	48.0%	60.0%	20.0%	33.0%	40.0%
SUMMIT	30.0%	48.0%	60.0%	20.0%	33.0%	40.0%
TOOELE	45.0%	75.0%	90.0%	33.0%	50.0%	60.0%
UINTAH	30.0%	48.0%	60.0%	20.0%	33.0%	40.0%
UTAH	45.0%	75.0%	90.0%	33.0%	50.0%	60.0%
WASATCH	30.0%	48.0%	60.0%	20.0%	33.0%	40.0%
WASHINGTON	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
WAYNE	30.0%	48.0%	60.0%	20.0%	33.0%	40.0%
WEBER	45.0%	75.0%	90.0%	33.0%	50.0%	60.0%

Outdoor Parameters (cont'd)

	Scenario 3 - % New Properties Meeting Scenario Standards (80% Efficient and 20% Turf)			Scenario 3 - % Existing Properties Meeting Scenario Standards (80% Efficient and 20% Turf)		
County	**2030**	**2040**	**2065**	**2030**	**2040**	**2065**
BEAVER	5.0%	10.0%	15.0%	3.5%	6.0%	7.5%
BOX ELDER	10.0%	15.0%	20.0%	7.0%	12.0%	15.0%
CACHE	5.0%	10.0%	15.0%	3.5%	6.0%	7.5%
CARBON	5.0%	10.0%	15.0%	3.5%	6.0%	7.5%
DAGGETT	5.0%	10.0%	15.0%	3.5%	6.0%	7.5%
DAVIS	10.0%	15.0%	20.0%	7.0%	12.0%	15.0%
DUCHESNE	5.0%	10.0%	15.0%	3.5%	6.0%	7.5%
EMERY	5.0%	10.0%	15.0%	3.5%	6.0%	7.5%
GARFIELD	5.0%	10.0%	15.0%	3.5%	6.0%	7.5%
GRAND	90.0%	90.0%	90.0%	25.0%	35.0%	40.0%
IRON	10.0%	15.0%	20.0%	7.0%	12.0%	15.0%
JUAB	5.0%	10.0%	15.0%	3.5%	6.0%	7.5%
KANE	90.0%	90.0%	90.0%	25.0%	35.0%	40.0%
MILLARD	5.0%	10.0%	15.0%	3.5%	6.0%	7.5%
MORGAN	5.0%	10.0%	15.0%	3.5%	6.0%	7.5%
PIUTE	5.0%	10.0%	15.0%	3.5%	6.0%	7.5%
RICH	5.0%	10.0%	15.0%	3.5%	6.0%	7.5%
SALT LAKE	10.0%	15.0%	20.0%	7.0%	12.0%	15.0%
SAN JUAN	5.0%	10.0%	15.0%	3.5%	6.0%	7.5%
SANPETE	5.0%	10.0%	15.0%	3.5%	6.0%	7.5%
SEVIER	5.0%	10.0%	15.0%	3.5%	6.0%	7.5%
SUMMIT	5.0%	10.0%	15.0%	3.5%	6.0%	7.5%
TOOELE	10.0%	15.0%	20.0%	7.0%	12.0%	15.0%
UINTAH	5.0%	10.0%	15.0%	3.5%	6.0%	7.5%
UTAH	10.0%	15.0%	20.0%	7.0%	12.0%	15.0%
WASATCH	5.0%	10.0%	15.0%	3.5%	6.0%	7.5%
WASHINGTON	90.0%	90.0%	90.0%	25.0%	35.0%	40.0%
WAYNE	5.0%	10.0%	15.0%	3.5%	6.0%	7.5%
WEBER	10.0%	15.0%	20.0%	7.0%	12.0%	15.0%

Reduction in Average Lot Size by 2065

County	% Reduction in Average Lot Size (2065)
BEAVER	6.8%
BOX ELDER	14.8%
CACHE	12.8%
CARBON	4.4%
DAGGETT	0.0%
DAVIS	13.0%
DUCHESNE	4.3%
EMERY	7.5%
GARFIELD	0.8%
GRAND	15.7%
IRON	17.7%
JUAB	13.0%
KANE	4.0%
MILLARD	6.2%
MORGAN	21.1%
PIUTE	3.9%
RICH	7.5%
SALT LAKE	18.8%
SAN JUAN	28.4%
SANPETE	9.1%
SEVIER	7.2%
SUMMIT	10.7%
TOOELE	20.9%
UINTAH	13.0%
UTAH	13.1%
WASATCH	27.9%
WASHINGTON	31.1%
WAYNE	2.6%
WEBER	14.5%

Other Data

County	County ID	Total M&I[1] (gpcd)	Potable[1] (gpcd)	Secondary[1] (gpcd)	Residential[1] (%)	Residential[1] (gpcd)	Indoor[1] (gpcd)	Indoor[1] (%)
BEAVER	1	552	232	320	67%	368.0	63.6	17%
BOX ELDER	2	320	238	82	73%	233.0	60.9	26%
CACHE	3	284	207	77	61%	174.0	59.6	34%
CARBON	4	273	180	92	68%	185.0	6.0	36%
DAGGETT	5	634	390	244	55%	346.0	63.2	18%
DAVIS	6	235	107	129	78%	183.0	59.0	32%
DUCHESNE	7	314	205	109	62%	196.0	61.6	31%
EMERY	8	577	136	441	80%	460.0	61.8	13%
GARFIELD	9	626	292	334	76%	477.0	62.8	13%
GRAND	10	313	251	62	56%	176.0	68.3	39%
IRON	11	223	175	47	73%	162.0	60.7	37%
JUAB	12	364	237	128	71%	260.0	59.1	23%
KANE	13	304	239	65	64%	194.0	64.2	33%
MILLARD	14	532	342	190	77%	412.0	61.8	15%
MORGAN	15	242	111	130	83%	202.0	57.2	29%
PIUTE	16	395	308	87	65%	256.0	58.6	23%
RICH	17	1240	1028	211	78%	962.0	56.3	6%
SALT LAKE	18	213	188	25	64%	137.0	61.3	45%
SAN JUAN	19	199	143	56	74%	147.0	55.2	38%
SANPETE	20	365	140	224	77%	282.0	60.3	21%
SEVIER	21	360	247	114	60%	216.0	62.8	29%
SUMMIT	22	342	253	89	54%	186.0	65.2	35%
TOOELE	23	228	167	60	68%	154.0	59.5	39%
UINTAH	24	239	187	52	76%	181.0	58.5	32%
UTAH	25	218	132	86	71%	155.0	56.5	36%
WASATCH	26	335	190	145	89%	297.0	59.8	20%
WASHINGTON	27	303	231	72	64%	195.0	61.8	32%
WAYNE	28	575	253	322	77%	445.0	64.6	15%
WEBER	29	256	112	145	76%	195.0	61.9	32%

1. DWRe 2018a, 2018b

Other Data (cont'd)

County	Industrial[1] (%)	Secondary[1] (%)	Secondary Indicator[2] (%)	Water Right Duty[3] (ac-ft/ac)	Climate Region[4]	2015 Population[5]
BEAVER	6%	58%	100%	4	South Central	5780
BOX ELDER	11%	26%	67%	3.8	North Central	51000
CACHE	2%	27%	91%	3.8	North Central	115850
CARBON	3%	34%	60%	4.4	Southeast	20670
DAGGETT	0%	38%	0%	3	Northern Mountains	650
DAVIS	1%	55%	86%	4	Northern Mountains	336100
DUCHESNE	15%	35%	75%	3.5	Uintah Basin	19500
EMERY	1%	76%	100%	4.7	Southeast	10050
GARFIELD	0%	53%	100%	3.7	South Central	4100
GRAND	1%	20%	0%	6	Southeast	9050
IRON	1%	21%	100%	4	South Central	46790
JUAB	4%	35%	100%	3.9	South Central	9950
KANE	1%	21%	100%	4.6	South Central	8290
MILLARD	4%	36%	100%	3.6	South Central	10160
MORGAN	2%	54%	100%	3	Northern Mountains	8500
PIUTE	14%	22%	no data	3	South Central	1410
RICH	0%	17%	0%	3	Northern Mountains	1640
SALT LAKE	4%	12%	63%	5	North Central	1111080
SAN JUAN	0%	28%	50%	4.3	Southeast	6330
SANPETE	1%	61%	80%	3	South Central	25580
SEVIER	4%	32%	100%	3	South Central	19120
SUMMIT	0%	26%	17%	3	Northern Mountains	36480
TOOELE	3%	26%	100%	4	North Central	59290
UINTAH	4%	22%	50%	3.8	Uintah Basin	35690
UTAH	1%	39%	89%	4	North Central	567370
WASATCH	0%	43%	50%	3	Northern Mountains	28310
WASHINGTON	0%	24%	71%	5.8	Dixie	153300
WAYNE	1%	56%	no data	3.2	South Central	2110
WEBER	5%	57%	92%	4.7	North Central	241090

2. DWRi 2018

3. Proportion of public water systems also served by secondary water

4. Gilles and Ramsey 2009

5. DWRe 2018a, 2018b

Other Data (cont'd)

County	Area[6] (mi^2)	Population Density[7] ($persons/mi^2$)	Household Size[8] (persons)	Income[8] (annual)	Population Growth 2010–2015[9]	Average Age[10]
BEAVER	2589.9	2.2	2.81	$48,083	-3.02%	33.1
BOX ELDER	5745.6	8.9	3.07	$55,514	5.60%	32.1
CACHE	1164.8	99.5	3.21	$51,935	7.91%	25
CARBON	2048.8	10.1	2.61	$47,793	-4.83%	35.6
DAGGETT	699.0	0.9	2.84	$75,938	0.37%	48.7
DAVIS	298.8	1124.9	3.29	$72,661	10.86%	30.9
DUCHESNE	3241.0	6.0	3.00	$61,244	8.95%	30.2
EMERY	4462.3	2.3	2.98	$51,276	-7.11%	34.3
GARFIELD	5175.1	0.8	2.88	$45,221	-3.79%	39.6
GRAND	3671.5	2.5	2.44	$43,529	3.69%	39.7
IRON	3296.7	14.2	3.09	$43,799	7.64%	28.5
JUAB	3392.3	2.9	3.28	$54,861	7.21%	30.3
KANE	3990.2	2.1	2.75	$50,517	1.57%	43.4
MILLARD	6572.4	1.5	2.98	$53,902	1.21%	34.9
MORGAN	609.2	14.0	3.46	$80,865	19.45%	32.3
PIUTE	757.8	1.9	3.34	$37,112	-6.52%	42.5
RICH	1028.8	1.6	3.65	$52,569	2.26%	34.3
SALT LAKE	742.3	1496.8	3.03	$64,601	8.56%	32.7
SAN JUAN	7820.0	0.8	3.83	$41,108	3.40%	30.6
SANPETE	1590.2	16.1	3.13	$48,866	4.88%	31.2
SEVIER	1910.6	10.0	2.88	$48,872	1.67%	34.9
SUMMIT	1871.7	19.5	2.67	$91,470	10.66%	38.2
TOOELE	6941.4	8.5	3.23	$64,149	10.42%	30.9
UINTAH	4479.7	8.0	3.35	$67,943	11.47%	29.8
UTAH	2003.5	283.2	3.63	$64,321	13.56%	24.6
WASATCH	1175.5	24.1	3.19	$71,337	29.30%	33.2
WASHINGTON	2426.4	63.2	2.98	$52,865	15.06%	35.4
WAYNE	2460.7	0.9	2.72	$41,684	-3.14%	40.1
WEBER	576.1	418.5	2.97	$59,660	6.54%	32.1

6. AGRC 2014

7. Computed

8. U.S. Census Bureau 2015b

9. Kem C. Garner Policy Institute 2016

10. U.S. Census Bureau 2015a

Other Data (cont'd)

County	Second-home Use[11]	Tiered rate Indicator[12]	Goal Indicator[13]
BEAVER	14%	50%	100%
BOX ELDER	2%	33%	100%
CACHE	2%	73%	45%
CARBON	7%	60%	60%
DAGGETT	69%	0%	0%
DAVIS	0%	64%	85%
DUCHESNE	24%	75%	50%
EMERY	7%	0%	67%
GARFIELD	41%	50%	50%
GRAND	11%	100%	100%
IRON	15%	100%	100%
JUAB	4%	0%	50%
KANE	42%	0%	100%
MILLARD	6%	100%	100%
MORGAN	2%	0%	0%
PIUTE	25%	no data	no data
RICH	66%	100%	100%
SALT LAKE	1%	68%	95%
SAN JUAN	13%	100%	100%
SANPETE	17%	80%	80%
SEVIER	10%	50%	50%
SUMMIT	43%	100%	67%
TOOELE	1%	33%	67%
UINTAH	2%	25%	25%
UTAH	1%	72%	72%
WASATCH	22%	100%	100%
WASHINGTON	18%	86%	86%
WAYNE	30%	no data	no data
WEBER	3%	85%	54%

11. Ratio of second homes to total homes, U.S. Census Bureau 2015c

12. Proportion of public water systems with tiered water rates, according to individual Water Conservation Plans and water supplier websites

13. Proportion of public water systems clearly defined water conservation goal, according to individual Water Conservation Plans and water supplier websites

Other Data (cont'd)

County	Precipitation[14] (in.)	Air Temperature[14] (˚F)	Evapotranspiration[15] (in.)	Green Space[16] (%)	Average Elevation[17] (ft)	Vapor Pressure Deficit[18] (mbar)	July Air Temperture[19] (˚F)
BEAVER	11.93	49.15	25.33	39%	5562	18.84	72.5
BOX ELDER	17.97	48.75	22.96	39%	4423	16.44	73.7
CACHE	18.89	46.96	21.5	36%	4593	15.48	71.5
CARBON	11.4	47.1	23.03	26%	6099	16.56	71.6
DAGGETT	11.73	44.64	20.32	29%	6460	15.68	68.8
DAVIS	20.38	51.35	22.13	49%	4477	16.74	76.3
DUCHESNE	10.15	45.05	22.57	37%	6028	15.98	69.6
EMERY	8.62	48.77	26.97	36%	5564	18.16	73.2
GARFIELD	11.7	46.62	23.24	29%	6723	16.89	68.6
GRAND	10.1	55.31	28.94	34%	4444	22.62	80
IRON	13.27	49.99	24.44	34%	5814	18.61	72.6
JUAB	17.15	49.53	23.47	37%	5313	17.87	73.4
KANE	14.47	52.31	28.94	16%	5436	21.33	74.4
MILLARD	12.64	49.85	26.04	37%	5074	19.49	74.5
MORGAN	25.92	46.66	18.2	48%	5252	14.83	70.6
PIUTE	10.73	47.5	21.39	32%	6275	17.05	69.6
RICH	17.18	41.05	17.83	36%	6304	12.88	64.3
SALT LAKE	19.1	51.19	21.64	32%	4821	16.87	75.8
SAN JUAN	12.72	52.67	29.36	24%	5737	19.12	75.9
SANPETE	13.79	47.25	22.85	38%	5731	17.26	70.6
SEVIER	9.85	48.84	24.04	30%	5407	18.65	72.1
SUMMIT	23.71	43.06	16.11	46%	6896	13.47	65.6
TOOELE	14.43	51.13	24.22	34%	4702	17.98	76.4
UINTAH	8.1	47.32	25.22	28%	5206	18.24	73.2
UTAH	18.83	49.8	21.46	43%	5109	16.87	73.5
WASATCH	21.79	44.09	16.96	42%	6807	14.09	66.6
WASHINGTON	10.91	60.77	36.31	19%	3521	27.78	83.1
WAYNE	9.42	45.79	20.86	33%	6783	16.02	68.1
WEBER	20.99	49.94	21.8	44%	4506	16.42	74.9

14. Average 1981–2010, PRISM 2018a
15. Average 1980–2017; DWRe 2018c; Lewis and Allen 2017
16. DWRe 2018a
17. USGS 2018
18. Maximum; PRISM 2018a
19. Average 1981–2010; PRISM 2018a

Other Data (cont'd)

County	Second Home Adjustment[20] (persons)	2015 Adjusted Population	2015 Adjusted Households	Potable Irrigation Per Household (ac-ft)	Secondary Irrigation Per Household (ac-ft)	Total Irrigation Per Household (ac-ft)
BEAVER	470	6,250	2,392	0.19	0.62	0.81
BOX ELDER	520	51,520	16,951	0.39	0.18	0.58
CACHE	1,182	117,032	36,827	0.20	0.20	0.40
CARBON	778	21,448	8,516	0.16	0.16	0.32
DAGGETT	723	1,373	738	0.10	0.11	0.21
DAVIS	0	336,100	102,158	0.06	0.40	0.46
DUCHESNE	3,079	22,579	8,553	0.14	0.18	0.32
EMERY	378	10,428	3,626	0.15	1.08	1.23
GARFIELD	1,425	5,525	2,413	0.16	0.59	0.75
GRAND	559	9,609	4,167	0.20	0.05	0.25
IRON	4,129	50,919	17,815	0.18	0.11	0.28
JUAB	207	10,157	3,160	0.35	0.36	0.70
KANE	3,002	11,292	5,197	0.10	0.09	0.19
MILLARD	324	10,484	3,627	0.52	0.57	1.09
MORGAN	87	8,587	2,507	0.14	0.41	0.54
PIUTE	235	1,645	563	0.33	0.20	0.53
RICH	1,592	3,232	1,322	1.09	0.09	1.18
SALT LAKE	5,612	,116,692	370,397	0.19	0.06	0.26
SAN JUAN	473	6,803	1,900	0.20	0.13	0.33
SANPETE	2,620	28,200	9,846	0.08	0.55	0.63
SEVIER	1,062	20,182	7,377	0.22	0.22	0.43
SUMMIT	13,760	50,240	23,970	0.11	0.06	0.16
TOOELE	299	59,589	18,541	0.20	0.14	0.34
UINTAH	364	36,054	10,871	0.32	0.13	0.45
UTAH	2,866	570,236	157,879	0.13	0.26	0.40
WASATCH	3,992	32,302	11,378	0.23	0.40	0.64
WASHINGTON	16,826	170,126	62,735	0.30	0.04	0.35
WAYNE	452	2,562	1,108	0.22	0.57	0.78
WEBER	3,728	244,818	83,686	0.02	0.41	0.43

20. Population associated with second homes

Other Data (cont'd)

County	Irrigated Area per Lot (ft²)	Adjusted Landscape Area (ft²)	Average Lot Size (ft²)	Total Irrigated (ac)	Total Adjusted Landscaped (ac)
BEAVER	7,454	7,454	19,039	409	409
BOX ELDER	7,033	7,033	17,881	2,737	2,737
CACHE	4,880	4,880	13,564	4,125	4,125
CARBON	3,615	4,973	13,863	707	972
DAGGETT	2,686	3,372	9,399	46	57
DAVIS	4,620	4,620	9,485	10,835	10,835
DUCHESNE	3,592	3,592	9,707	705	705
EMERY	10,107	10,107	28,086	841	841
GARFIELD	7,422	9,164	25,548	411	508
GRAND	2,537	2,715	7,569	243	260
IRON	3,164	3,295	9,185	1,294	1,347
JUAB	7,816	7,816	21,145	567	567
KANE	1,727	3,991	11,125	206	476
MILLARD	10,859	10,859	29,507	904	904
MORGAN	7,020	7,020	14,611	404	404
PIUTE	6,761	7,536	21,008	87	97
RICH	20,277	20,373	56,792	615	618
SALT LAKE	3,412	3,802	10,600	29,014	32,333
SAN JUAN	3,029	4,496	12,533	132	196
SANPETE	6,097	6,097	16,194	1,378	1,378
SEVIER	4,696	5,662	15,783	795	959
SUMMIT	2,824	2,824	6,153	1,554	1,554
TOOELE	3,793	4,051	11,292	1,614	1,724
UINTAH	5,049	6,362	17,736	1,260	1,588
UTAH	4,522	4,522	10,504	16,390	16,390
WASATCH	9,296	9,296	22,353	2,428	2,428
WASHINGTON	2,872	5,379	14,994	4,137	7,746
WAYNE	8,917	9,755	27,195	227	248
WEBER	4,202	4,202	9,450	8,072	8,072

Other Data (cont'd)

County	Adjusted Landscaped - Potable (ac)	Adjusted Landscaped - Secondary (ac)	Total Residential Developed (ac)
BEAVER	127	282	1,045
BOX ELDER	2,085	651	6,959
CACHE	2,505	1,620	11,467
CARBON	588	384	2,710
DAGGETT	34	23	159
DAVIS	2,062	8,774	22,243
DUCHESNE	370	336	1,906
EMERY	145	697	2,338
GARFIELD	144	363	1,415
GRAND	220	39	724
IRON	959	389	3,756
JUAB	336	231	1,534
KANE	292	184	1,327
MILLARD	525	379	2,457
MORGAN	134	270	841
PIUTE	69	28	271
RICH	585	33	1,723
SALT LAKE	26,645	5,687	90,134
SAN JUAN	137	59	547
SANPETE	247	1,131	3,661
SEVIER	574	384	2,673
SUMMIT	1,143	411	3,386
TOOELE	1,190	534	4,806
UINTAH	1,250	338	4,426
UTAH	7,091	9,299	38,070
WASATCH	1,129	1,299	5,839
WASHINGTON	7,065	681	21,594
WAYNE	90	158	692
WEBER	554	7,519	18,154

Potential M&I Water Use (gpcd) by County

Regions/ Counties	2015	Past Practices	Scenario 1	Scenario 2	Scenario 3
Bear River					
Box Elder	320	368	298	233	189
Cache	284	327	262	211	176
Rich	1,239	1,471	1,166	881	605
Green River					
Daggett	634	817	564	471	402
Duchesne	314	356	279	233	202
Uintah	239	323	261	197	157
Lower Colorado River North					
Beaver	552	632	462	367	306
Garfield	626	849	555	437	324
Iron	223	263	214	167	139
Lower Colorado River South					
Kane	304	549	404	319	258
Washington	303	527	424	322	237
Provo River					
Juab	364	424	336	257	195
Utah	218	258	200	158	133
Wasatch	335	396	288	210	140
Salt Lake					
Salt Lake	213	256	203	168	142
Tooele	227	273	226	177	149
Sevier River					
Millard	532	620	460	350	268
Piute	395	485	378	309	254
Sanpete	364	426	301	231	189
Sevier	360	457	362	288	242
Wayne	575	712	481	375	281
Upper Colorado River					
Carbon	273	372	283	224	183
Emery	577	676	453	340	261
Grand	313	358	302	243	208
San Juan	199	299	249	181	150
Weber					
Davis	235	276	196	159	132
Morgan	241	286	212	159	128
Summit	342	380	310	257	221
Weber	256	295	209	166	139
Statewide Average	**242**	**296**	**229**	**184**	**152**

Note: gpcd = gallons per capita per day based on permanent population

County-Level M&I Water Conservation Data

Regions/ Counties	Baseline (gpcd) 2015	2030 Goal (gpcd)	2040 Projection (gpcd)	2065 Projection (gpcd)	Reduction from Baseline 2030	Reduction from Baseline 2040	Reduction from Baseline 2065
Bear River							
Box Elder	320	267	245	237	17%	23%	26%
Cache	284	237	217	203	17%	23%	28%
Rich	1,240	1,097	1,009	1,024	12%	19%	17%
Green River							
Daggett	634	539	494	450	15%	22%	29%
Duchesne	314	268	255	256	15%	19%	19%
Uintah	239	223	217	216	7%	9%	10%
Lower Colorado River North							
Beaver	552	444	419	431	20%	24%	22%
Garfield	626	518	498	507	17%	20%	19%
Iron	223	187	171	157	16%	24%	29%
Lower Colorado River South							
Kane	304	278	265	255	9%	13%	16%
Washington	303	277	267	259	8%	12%	15%
Provo River							
Juab	364	294	270	259	19%	26%	29%
Utah	218	181	168	169	17%	23%	22%
Wasatch	335	263	241	240	21%	28%	28%
Salt Lake							
Salt Lake	213	185	174	165	13%	18%	23%
Tooele	228	196	182	177	14%	20%	22%
Sevier River							
Millard	532	437	405	405	18%	24%	24%
Piute	395	355	332	325	10%	16%	18%
Sanpete	365	276	249	239	24%	32%	34%
Sevier	360	330	321	328	8%	11%	9%
Wayne	575	464	434	441	19%	25%	23%
Upper Colorado River							
Carbon	273	235	222	209	14%	19%	24%
Emery	577	436	404	423	24%	30%	27%
Grand	313	265	248	247	15%	21%	21%
San Juan	199	176	166	150	12%	17%	25%
Weber							
Davis	235	178	162	157	24%	31%	33%
Morgan	242	192	181	189	20%	25%	22%
Summit	342	296	276	265	13%	19%	22%
Weber	256	193	177	172	24%	31%	33%

Note: gpcd = gallons per capita per day based on permanent population