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Utah's Regional M&I Water Conservation Goals

August 2019



Prepared for:



Prepared by:



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UTAH'S REGIONAL M&I WATER CONSERVATION GOALS

Prepared for:
Utah Division of Water Resources

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August 2019

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PREFACE

The 2030 water conservation goals in this report will require significant effort, increased attention, participation and funding from the legislature, state agencies, municipal water retailers, local elected officials, wholesale public water suppliers and citizens of Utah.

Depending on the approaches taken and water user behavior, costs for achieving the targets associated with the recommendations in this report are estimated in the range of \$1.4 billion of capital cost. An important aspect of covering these costs will be who pays for the costs, what the relationship is between the cost and use of water, and how the capital costs of conservation net against not yet identified conservation savings and the price of increasing water scarcity.

The goals require the state and its municipalities to increase water pricing, establish and enforce water use ordinances, encourage broader adoption of existing water technology, as well as secure additional funding to reach the target water use levels.

These efforts fall on all those who have the authority to implement the measures recommended in this report, including but not limited to state and local elected officials in their key roles and businesses. These efforts include, but are not limited to:

1. Reducing new lot sizes, as determined by both market forces and state or local elected officials setting land use policy;
2. Adopting water efficient practices and landscaping changes, including reductions in grass, as determined by both market forces and state or local elected officials through landscaping and water restricting ordinances;
3. Installing secondary water meters and smart controllers on outdoor irrigation systems, as determined by water consumers through market forces and state or local elected officials; and
4. Increasing water pricing, as determined by municipal water retailers and state policies.

Recognizing these measures will require time to enact and implement, the state of Utah recommends a five-year flexibility period to achieve these 2030 goals.

Given the state's wholesale public water suppliers do not have the authority to regulate land use, mandate conservation practices or set end user water rates, they are tasked with providing support, recommendations, educational resources and leadership to the state as well as the municipalities and constituents in their respective service areas.

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)
gpm	gallons per minute
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 August 2019

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. The project does not recommend a comprehensive water strategy.

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 estimated for 2000. Thanks to the efforts of many Utahns and their water providers, 2015 M&I per capita water use declined by at least 18% since then. Annual reporting from many individual water suppliers confirms significant progress in water conservation. According to the state's most recent data, the 2015 statewide M&I water use estimate is about 240 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, the continued growth and demand for water is not stopping. Both water conservation and development of new supplies will be 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.

HIGHLIGHTS

- Regional M&I water conservation goals are recommended for 2030, and projections are given for 2040 and 2065.
- Utah's Municipal and industrial (M&I) per capita water use declined by at least 18% from 2000 to 2015.
- 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 and engagement from all Utahns.

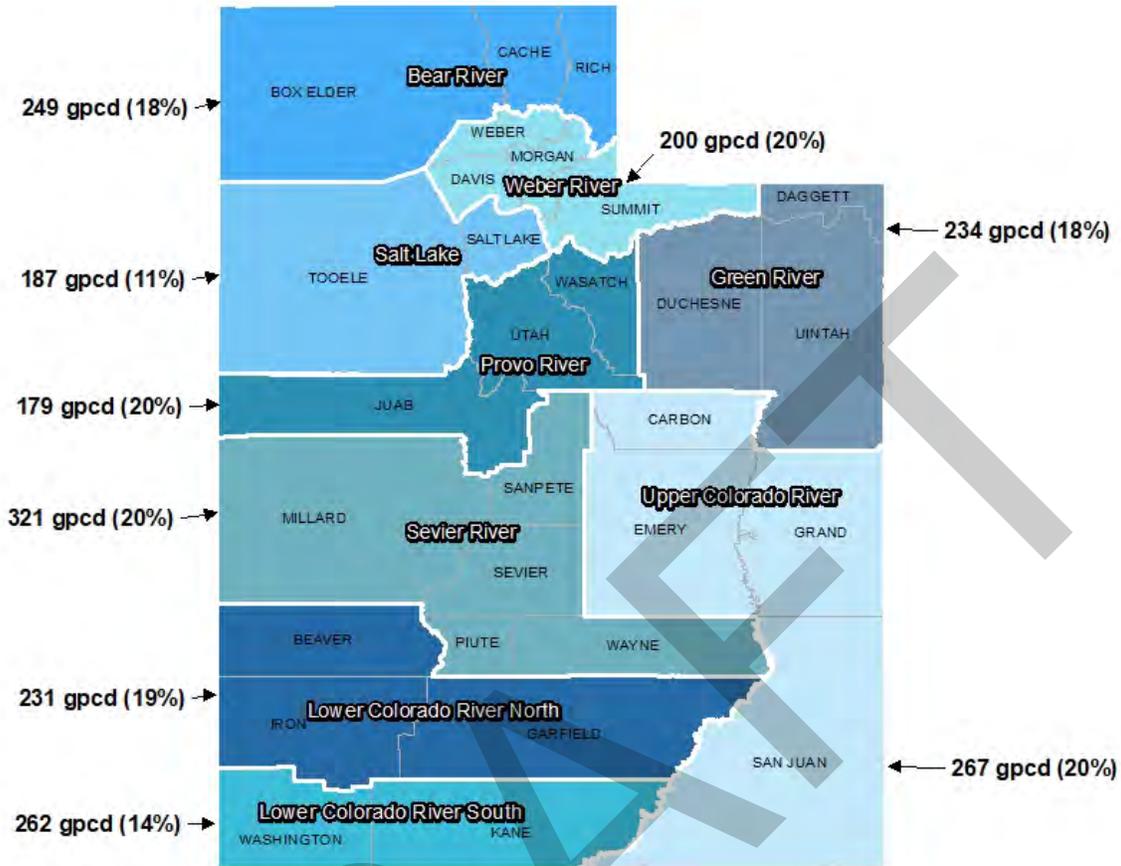
APPROACH

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 gross unit costs, potential for reducing water use, and public acceptance. Finally, combining all of these interdependent elements, the project team developed a timeline of regional water conservation goals and projections from the 2015 baseline year through 2065.

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 the next goals for the State to pursue, while the 2040 and 2065 values are projected water use levels to inform future planning. Actual goals for 2040 will not be established until 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	249	18%	232	24%	219	28%
Green River	284	234	18%	225	21%	225	21%
Lower Colorado River North	284	231	19%	216	24%	205	28%
Lower Colorado River South	305	262	14%	247	19%	237	22%
Provo River	222	179	20%	162	27%	152	32%
Salt Lake	210	187	11%	178	15%	169	19%
Sevier River	400	321	20%	301	25%	302	24%
Upper Colorado River	333	267	20%	251	25%	248	25%
Weber River	250	200	20%	184	26%	175	30%
Statewide	240	202	16%	188	22%	179	26%

Note M&I = municipal and industrial; gpcd = gallons per capita per day based on permanent population. Reported per-capita use includes all residential, commercial, institutional, and industrial uses averaged over the permanent population in each region.

In 2015, Utah's M&I water use was about 240 gpcd. When considering all regional results together, the resulting water use for the entire state is 202 gpcd by 2030 (16% reduction from 2015), 188 gpcd by 2040 (22% reduction from 2015), and 179 gpcd by 2065 (26% reduction from 2015). Meeting the initial 2030 goal will save nearly 175,000 acre-feet of water annually across the state.

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 lowering base rates, increasing tiers for usage, reviewing funding sources, and using customer feedback technology.



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

(Drawing at top by B. Banner from Salt Lake County)

COSTS

Achieving the goals identified in this report will require a major investment. As with past and current water conservation efforts, the costs are assumed to be borne by all Utahns; however, effective conservation strategies will closely connect water costs to water use.

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. Since changing water use behavior, policies, and technologies will become more difficult and expensive with time, prompt action on water conservation will bring the most benefit. A few starting actions are recommended here.

State and Local Policy Leaders

Policy plays a vital role in motivating and enabling water conservation. State, county, and local policy leaders should establish policies which require accountability for efficient water use. Policy leaders' support must consider universal metering, water loss control, education, and other water conservation activities, as well as the necessary funds for success. Policy leaders must also decide whether they are willing to support the necessary land use changes that will be required to reach the water conservation goals. This will include working with and being responsive to market forces to reduce 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 and reflect the cost of water scarcity. 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.

Water Users

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

DRAFT

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. 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.

This study does not recommend a comprehensive strategy for the funding, development, use, or management of Utah's water resources. This study will inform state water planning.

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.

M&I Water Use Disclaimer

Using “gallons per capita per day” (gpcd) is helpful in estimating future water demand as well as tracking water conservation achievements but has limitations as a metric to compare water use efficiencies. Utah has one of the most comprehensive water use accounting practices in the nation. Unlike other cities and states, Utah counts all potable (treated), secondary (untreated), and reuse (treated wastewater) water by all users.

M&I water use includes residential, commercial, institutional (e.g., schools and parks), and industrial water use. It excludes agriculture, mining, aquaculture, and power generation. It also includes secondary water used in municipal and industrial settings. M&I makes up about 15% of all withdrawals from Utah’s natural waters (Dieter et al. 2018).

Per-capita use is computed according to the permanent population (excluding tourist and commuter populations). Numbers used throughout this report represent total M&I water use within a region divided by the region’s permanent population. Other states and cities report water use differently.

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 at least 25% by 2050 (DWRe 2001). With substantial early progress, the goal was later modified to aim for at least 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 2019a, 2019b), Utah’s average M&I water use in 2015 was about 240 gallons per capita per day (gpcd). This represents a decrease of at least 18% from the value estimated for 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 water and the state as a whole.

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'Donoghue 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, former 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 recent 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 the importance of 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 State's previous goal of a 25% reduction in per capita water use 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.

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 agricultural and environmental (Figure 1-1).

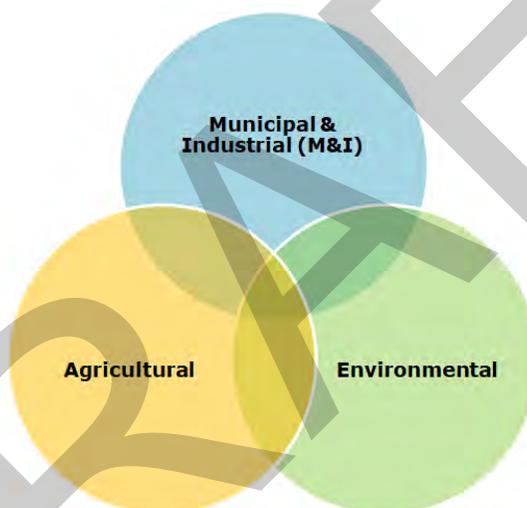


Figure 1-1: Major Uses of Water in Utah
(Graphic not proportional to actual use by category)

Agriculture supports a significant portion of the state's economy outside the Wasatch Front and those 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* (GWSAT 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* (GWSAT 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.

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 E also contributed.

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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.

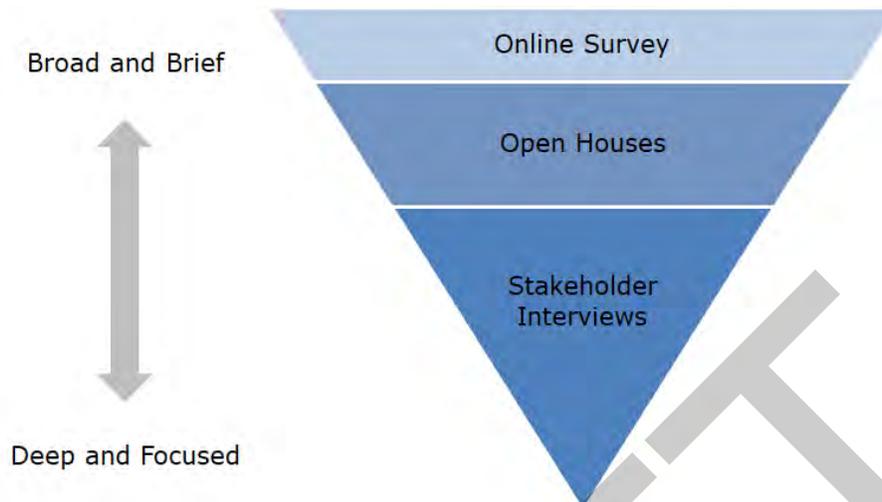


Figure 2-1: Public Involvement Activities

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 C. 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 D.



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 E. These interviews occurred in person or by phone in October and November 2018. Their comments are presented in Appendix D. 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 D.

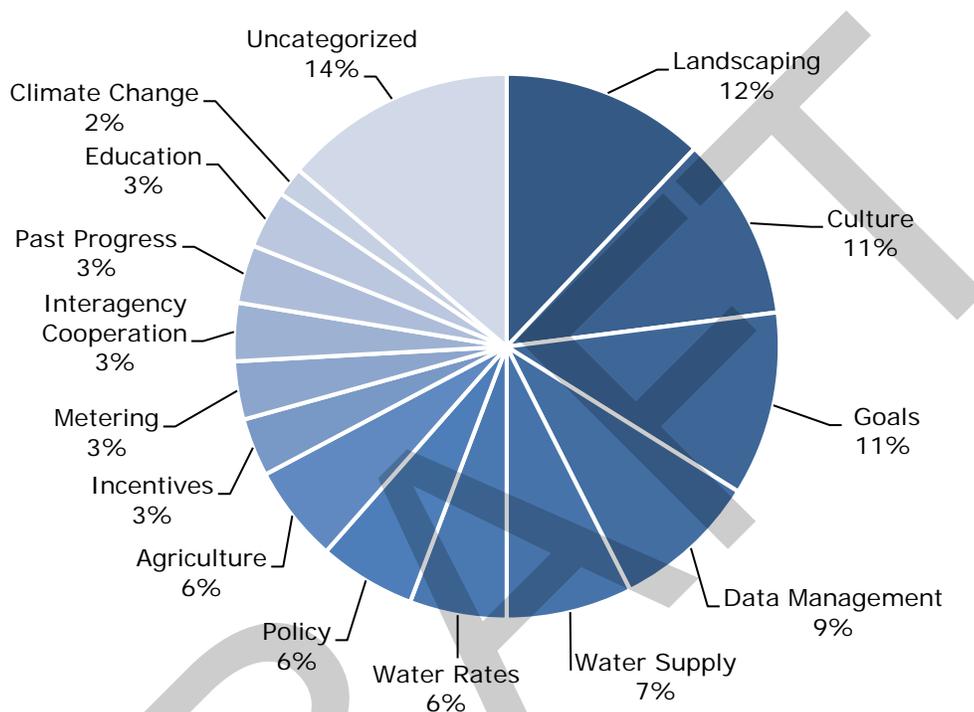


Figure 2-4: Comment Frequency

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 fund 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. There are also real costs associated with developing water supplies and infrastructure to provide "public good" benefits to Utahns, such as flood control, recreation, fire protection, environmental enhancements, and adding value to land through water supply entitlements. Water suppliers have water funding sources that include user charges, impact fees, and property taxes. While this report does not analyze or recommend the philosophy and means of funding these various water services, governments and water agencies can look for opportunities where a greater portion of water delivery system costs can be repaid through user charges, while not disturbing critical funding sources for other water services. With new water resources becoming more difficult and expensive to develop, increased price signals can motivate water conservation in Utah.

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?

Gross unit costs for various 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 in order to secure funding for implementation. The project team also recognizes that as water becomes scarcer, the costs of water will increase, which poses implications for the fiscal attractiveness and viability of various water conservation strategies. Thus, while the costs provided in this report are useful starting points for comparing

and prioritizing various conservation practices, a full analysis of the net costs and benefits of individual water conservation practices and how these practices should be implemented in each region is beyond the scope of this report. It is expected that water providers in each region will consider both the information contained in this report along with the unique circumstances of their systems to identify the most cost-effective approaches to conservation.

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.

DRAFT

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.

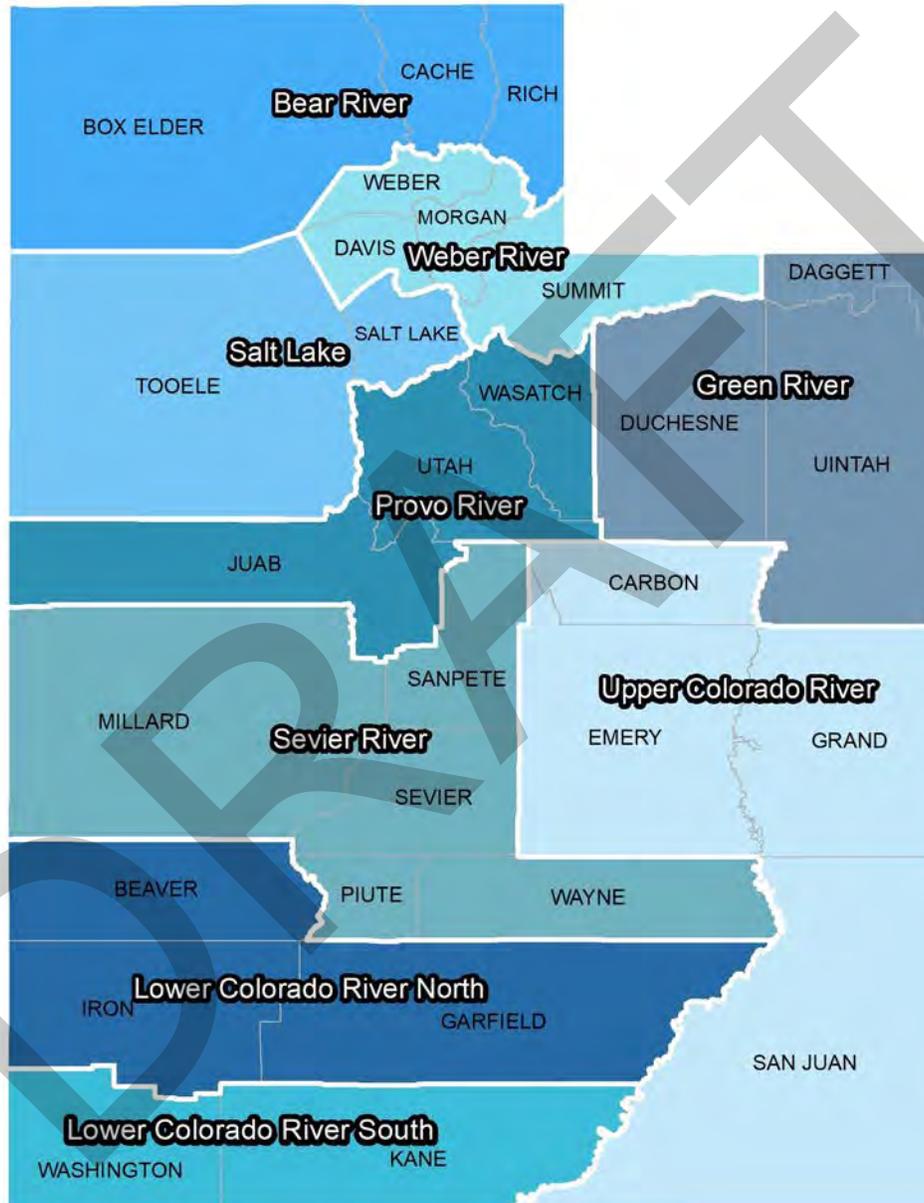


Figure 3-1: M&I Water Conservation Regions

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 variables that affect 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 determine water conservation potential and project future M&I water use, a thorough analysis of the current statewide use has been completed. Figure 4-1 summarizes the statewide M&I water use by type (DWR 2019a, 2019b).

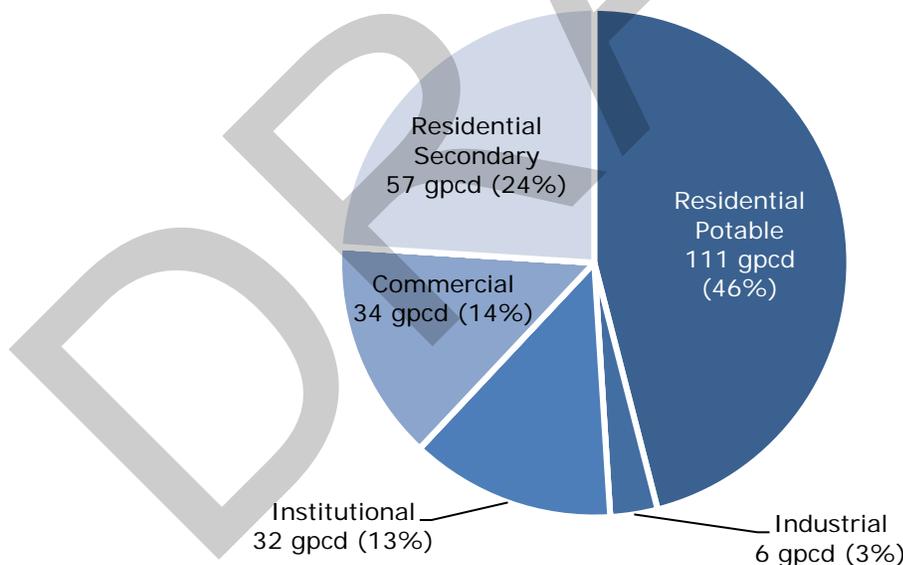


Figure 4-1: Statewide M&I Water Use by Type

As shown in the figure, M&I water use data assembled by DWR 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

When projecting future water use and conservation potential, it is important to understand that water users' choices regarding water use will be influenced by a complicated combination of factors. As represented in Figure 4-2, there are two broad types of factors that can instigate changes in how water is used:

- **Market and Social Trends** – Independent of any deliberate policy actions, there are market and social trends that affect how water is used in the state. An example of this is the observed shift in recent years toward smaller lot sizes (both as a result of increasing land prices and consumers desire for lower maintenance properties). As lot sizes decrease, outdoor water use will also naturally decrease (on a per lot basis), even without further intervention from policy leaders. Individual components within these market and social trends can result in either decreasing water use or increasing water use depending on the nature of the trend.
- **Policy Interventions** – Policy makers can also initiate strategic changes in policy to instigate changes in water use. Several examples of policy changes are shown in Figure 4-2, but these are not meant to be a comprehensive representation of potential policy interventions.

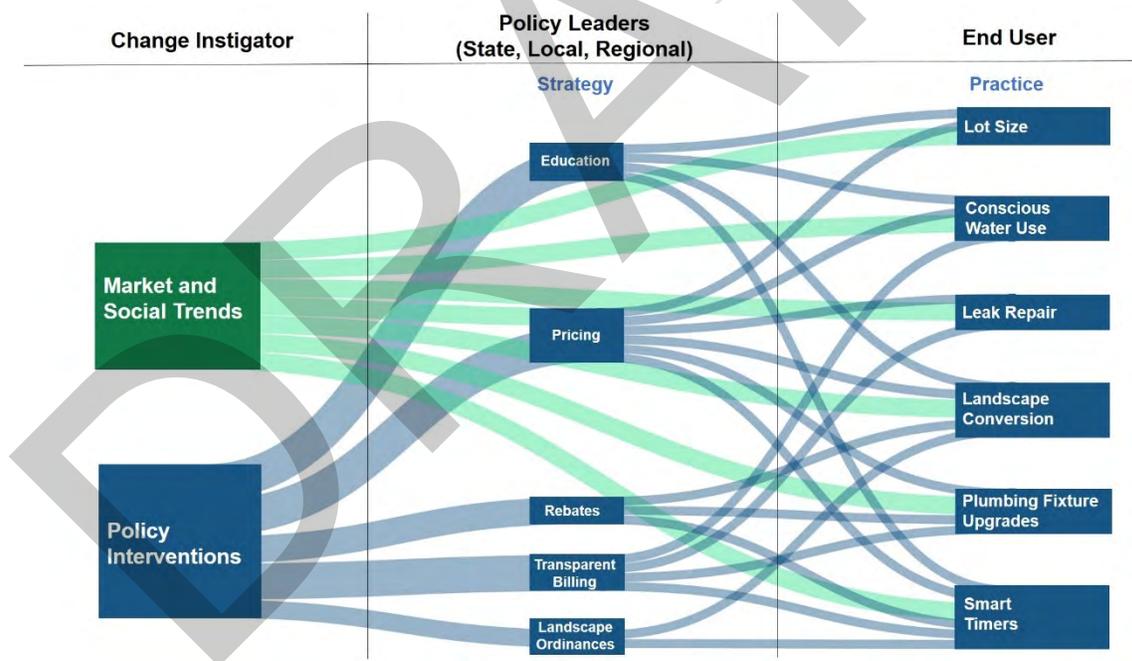


Figure 4-2: Change in Future M&I Water Use

Because of the interrelated nature of these several factors, it is difficult to isolate the conservation potential of any one single policy. Instead, conservation potential calculations must focus on the resulting conservation practices and how their implementation will affect water use. It then becomes the task of policy leaders to identify the best combination of policies to implement practices that achieve the desired change in water use.

With this understanding, the remaining sections of this chapter examine individual conservation practices in different categories of water use and how policy interventions might be used to change the water use in that category. For each category of water use, multiple policy options will be established. Included in each group of options will be a baseline scenario. Because of market and social trends, as well as past and ongoing conservation efforts, the State has seen a significant reduction in per capita water use. As long as current conservation efforts continue, further reductions are expected. The baseline option represents expected behavior if current conservation policies continue unchanged from the recent past¹. Beyond the baseline option, the other options included in each group represent additional policies that could be implemented to achieve additional conservation.

Policy Options for Conservation Scenarios

As part of the extensive process followed for this project, identification of policy options for analysis was achieved through a two-step process:

- **Example Conservation Scenarios for Public Outreach and Discussion Purposes –** Prior to gathering input from the community as part of the public outreach process, it was unknown what policies or practices the public and decision makers would like to see included as part of future conservation goals. This put the team in a bit of a “chicken or the egg” scenario. It was not possible to move forward on detailed conservation potential calculations without knowing which specific policies or practices to include, but it would be difficult to gather input on which policies and practices to include without understanding their potential to affect conservation.

To overcome this challenge, the project team prepared a series of three example conservation scenarios. These scenarios looked at what conservation could be achieved in each region given a sample set of assumed water use characteristics without worrying about the specifics of what policies and practices would be used to achieve those water use characteristics. For example, one scenario included an assumption that outdoor turf would be reduced to no more than 50% of landscaped areas without trying to identify how that reduction would occur.

While these example scenarios provided context and perspective to facilitate discussion during the public outreach and stakeholder coordination process, they have subsequently been replaced with specific policy-based scenarios (see next bullet) and will not be discussed further here. However, additional information regarding these scenarios can be found in Appendix B of this report.

¹ The baseline option should not be confused with a “Do Nothing” option. Doing nothing will not sustain the conservation momentum achieved to this point. The baseline option will still require significant time and investment in education, regulation, and financial incentives. It just does not represent a major change from what is already occurring.

- **Policy Based Conservation Scenarios for Goal Decision Making** – With input gathered as part the public outreach phase of the project, the project team was able to assemble a list of specific policies and practices for further consideration as part of the goal setting process. This allowed the conservation potential calculations to be refined from considering only assumed water use patterns to considering specific policies and practices. The remainder of this chapter explains the policies and practices considered as part of this evaluation of conservation potential and how they are predicted to affect water use in each region.

There are many different areas where conservation policies can affect water use. For discussion purposes, the conservation policies selected for analysis have been grouped by indoor water use policies, outdoor water use policies, and density policies. The following sections of this chapter discuss each of these policy groups and what policy options have been considered in each group. After identifying the specific policy options to be considered, this chapter calculates the conservation potential associated with the implementation of the various policies. The purpose of providing this information is to provide necessary insight into the impacts of each policy so that recommended policies and corresponding conservation goals can be selected in Chapter 5.

It should be noted that residential water use will be the primary focus of discussion for all policy options. This is both because it constitutes the majority of M&I water use (70%) and because the data available to estimate conservation potential is most complete for residential use. Following discussion of residential use will be a description of how conservation potential can correspondingly be applied to all municipal and industrial user types.

RESIDENTIAL—INDOORS

Conservation policy options associated with indoor water use can be organized into the following categories:

- Faucet and Shower Head Conversion
- Toilet Conversion
- Washing Machines
- Leak Report

Faucet and Shower Head Conversion

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.

One area where significant progress has already been made in fixture replacement is faucets and shower heads. It is estimate that 80% of existing fixtures nationwide currently meet high efficiency standards (2.5 gpm per fixture vs. 5 gpm historic, DeOreo et al. 2016). With this in mind, two policy options have been identified relative to faucet and shower head fixture replacement.

- **Baseline** – Under the baseline scenario, it is assumed that adoption of high efficiency fixtures in existing development will occur at roughly the natural replacement rate (i.e. the replacement rate of the fixture based on its expected life span). For new development, federal regulations (Energy Policy Act of 1992) require the use of high-efficiency fixtures in this category. Thus, the adoption rate of high efficiently fixtures in new development is expected to be 100%.
- **Policy Option F1, Aggressive Faucet and Shower Head Conversion Efforts** – Because of the relatively widespread adoption of high efficiency faucets and shower heads, there is limited potential for making major changes in this category. However, policy makers could pursue aggressive incentive programs or water rate increases that could accelerate conversion. This option assumes policies are adopted to accelerate fixture replacement to twice as fast as the rate of natural replacement.

Fixture conversion rates associated with each policy option are summarized in Table 4-1.

Table 4-1: Fixture Conversion Rates (Faucets and Shower Heads)

Baseline – Proportion of Households with High-Efficiency Faucets and Shower Heads				
	Current	2030	2040	2065
Existing Development	80% ¹	89%	94%	98%
New Construction	-	100%	100%	100%
Policy Option F1 – Proportion of Households with High-Efficiency Faucets and Shower Heads				
	Current	2030	2040	2065
Existing Development	80% ¹	94%	97%	99%
New Construction	-	100%	100%	100%

¹ DeOreo et al. 2016

Toilet Conversion

Another area of potential fixture replacement is toilets. Toilet replacement is complicated by the fact that there are two common levels of water use that are considered high efficiency. Federal regulations require all new toilets use no more than 1.6 gallons per flush. However, there are

also toilets on the market that use less than 1.28 gallons per flush (these are sometimes referred to as ultra-high efficiency). Use of 1.6 gallons per flush toilets is widespread in Utah. Use of the higher efficiency 1.28 gallons per flush is still relatively rare. With this in mind, three policy options have been identified relative to toilet replacement.

- **Baseline** – Under the baseline scenario, it is assumed that adoption of high efficiency fixtures in existing development will occur at roughly the natural replacement rate (i.e. the replacement rate of the fixture based on its expected life span). For new development, federal regulations now require the use of high-efficiency fixtures in this category. Thus, the adoption rate of high efficiency fixtures in new development is expected to be 100%. For both new and existing replacement, it has been assumed that use of the 1.28 gallon per flush toilets will continue to grow at the same rate as observed historically.
- **Policy Option T1, Aggressive Toilet Conversion Efforts** – Policy makers could pursue aggressive incentive programs or water rate increases that could accelerate conversion. This option assumes policies are adopted to accelerate fixture replacement to twice as fast as the rate of natural replacement and that the market share of 1.28 gallon per flush toilet also grows twice as fast.
- **Policy Option T2, New Toilet Standard (<1.28 gallon/flush)** – In the future, circumstances could change to require 1.28 gallons per flush instead of the current standard of 1.6 gallons per flush. This policy option assumes that 1.28 gallons per flush becomes the new standard either through federal policy, state policy, or other factors.

Fixture conversion rates associated with each policy option are summarized in Table 4-2.

Table 4-2: Fixture Conversion Rates (Toilets)

Baseline – Proportion of Households with High-Efficiency Toilets					
		Current	2030	2040	2065
1.6 gallon/flush	Existing Development	61% ¹	76%	86%	93%
	New Construction	-	94%	92%	87%
1.28 gallon/flush	Existing Development	2% ¹	3%	4%	5%
	New Construction	-	6%	8%	13%
Policy Option T1 – Proportion of Households with High-Efficiency Toilets					
		Current	2030	2040	2065
1.6 gallon/flush	Existing Development	61% ¹	86%	91%	94%
	New Construction	-	94%	92%	87%
1.28 gallon/flush	Existing Development	2% ¹	4%	4%	5%
	New Construction	-	6%	8%	13%
Policy Option T2 – Proportion of Households with High-Efficiency Toilets					
		Current	2030	2040	2065
1.6 gallon/flush	Existing Development	61% ¹	52%	47%	23%
	New Construction	-	0%	0%	0%
1.28 gallon/flush	Existing Development	2% ¹	37%	48%	76%
	New Construction	-	100%	100%	100%

¹ Utah DWRe estimate

Washing Machine Conversion

Another area of potential fixture replacement is washing machines. While replacement of washing machines is not currently a very cost-effective way of saving water², movement toward high-efficiency washing machines³ 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. With this in mind, two policy options have been identified relative to washing machine replacement.

² Cost of replacing washing machines is relatively high when compared to the amount of water saved. See Chapter 5.

³ Defined as machines using less than 25 gallons per load compared to 40 gallons or more historic

- **Baseline** – Under the baseline scenario, it is assumed that adoption of high efficiency washing machines in existing development will occur at roughly the natural replacement rate (i.e. the replacement rate of the fixture based on its expected life span). For new development, it is assumed that use of high-efficiency washing machines will be a little higher than existing. This is because many people moving into new homes will be buying new washing machines as well. Because of the advantages listed above, it is expected that the market share for higher efficiency machines will be relatively high.
- **Policy Option W1, Aggressive Washing Machine Conversion Efforts** – Policy makers could pursue aggressive incentive programs or water rate increases that could accelerate conversion. This option assumes policies are adopted to accelerate washing machine replacement to twice as fast as the rate of natural replacement. While this policy option has been included for discussion purposes, it does not appear to be a very logical option to implement because of the relatively low cost effectiveness of washing machine replacement as a way of saving water.

Washing machine conversion rates associated with each policy option are summarized in Table 4-3.

Table 4-3: Fixture Conversion Rates (Washing Machines)

Baseline – Proportion of Households with High-Efficiency Washing Machines				
	Current	2030	2040	2065
Existing Development	46% ¹	75%	85%	98%
New Construction	-	80%	90%	98%
Policy Option W1 – Proportion of Households with High-Efficiency Washing Machines				
	Current	2030	2040	2065
Existing Development	46% ¹	88%	93%	99%
New Construction	-	90%	95%	99%

¹ DeOreo et al. 2016

Leak Repair

The final areas of indoor water use considered as part of this analysis is indoor leaks and other water waste. On the surface, most water users will indicate that they strongly 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. With this in mind, two policy options have been identified relative to leak repair.

- **Baseline** – Under the baseline scenario, it is assumed that progress in leak repair and elimination of other indoor water waste will be limited. While separating out these types of water savings is difficult based on the available data, recent decreases in observed indoor water use appear to be primarily the result of fixture conversion as previously discussed. Thus, the baseline scenario for this area of water use assumes only moderate savings based on expected education and rate increase typical of historic trends.
- **Policy Option I1, Aggressive Leak Repair Efforts** – Policy makers could pursue aggressive water rate increases and education programs that could accelerate leak repair. This option assumes policies are adopted to accelerate leak repair to 2.5 times as fast as the baseline rate. Because leak repair and water waste can vary significantly from home to home, it is expected that these types of savings may be difficult to obtain and rate increases and other programs will need to be very aggressive to achieve this level of water savings.
- **Policy Option I2, Theoretical Maximum Leak Repair Efforts** – In all of the previous indoor water use areas, at least one policy option has been included that reaches full (or very nearly full) projected water savings by 2065. To provide a similar scenario in the area of leak repair, this policy option has been included. While a useful policy for comparison purposes, it should be emphasized that increasing leak repair to this level would be extremely difficult. It would likely require detailed and expensive leak location programs and crisis level water pricing to achieve.

Realization of water savings associated with each leak repair policy option are summarized in Table 4-4.

Table 4-4: Water Savings Associated with Leak Repair

Baseline – Percent Reduction in Wasted Water Associated with Leaks				
Current	2030	2040	2065	
-	6%	10%	20%	
Policy Option I1 – Percent Reduction in Wasted Water Associated with Leaks				
Current	2030	2040	2065	
-	15%	25%	50%	
Policy Option I2 – Percent Reduction in Wasted Water Associated with Leaks				
Current	2030	2040	2065	
-	30%	50%	100%	

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 2019a, 2019b). Based on the size of this category alone, it should not be a surprise 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.

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, irrigation efficiency for metered connections in individual counties ranges between 50% and 70% with the average overall efficiency for the state estimated to be just over 63% based on collected water use data (DWRe 2019a). While this represents notable improvement from past irrigation practices (estimated to be around 50% efficient statewide), there is obviously still room for improvement.

For the purposes of this analysis, increases in irrigation efficiency are expected to change through two primary mechanisms. First, one of the most effective ways shown to increase efficiency is through the metering of secondary connections (BC&A and HAL 2018). Second, irrigation efficiency can be considerably improved simply by adjusting irrigation systems to correlate with seasonal evapotranspiration (ET) rates (DWRe 2014).

Secondary Metering

Unmetered secondary irrigation connections have been shown to use about 50% more water than metered connections (BC&A 2018). This additional water use is excess water applied above and beyond the evapotranspiration needs of landscapes. Thus, adding secondary meters is an area that has shown great potential to reduce waste and increase irrigation efficiency. Unfortunately, progress in this area has been limited as a result of initial construction costs and customers' resistance to losing access to unlimited "free" water. With this in mind, two policy options have been identified relative to secondary metering.

- **Baseline** – In the 2019 legislative session, there was significant discussion of requiring all secondary connections to be metered by the year 2030. Although this requirement was not ultimately adopted, an alternative bill (Senate Bill 52) did adopt a requirement that all new secondary connections be metered and that each irrigation system prepare

a plan for eventually metering existing connections as well. Based on these requirements, this baseline scenario assumes that metering of existing connections will match the historic trend for metering but that the rate of metering in new development will be 100%.

- **Policy Option M1, Required Secondary Metering** – Policy makers could choose to return to the original concept of requiring all secondary connections to be metered. If this were done, it would still take some time to meter all existing connections, but implementation would likely be much faster than under the current requirement. This option assumes a fixed deadline for metering is established and that adequate assistance is provided to finance the required improvements.

Secondary metering rates associated with each policy option are summarized in Table 4-5.

Table 4-5: Secondary Metering Rates

Baseline – Proportion of Secondary Connections that are Metered				
	Current	2030	2040	2065
Existing Development	2%	4%	7%	18%
New Construction	-	100%	100%	100%
Policy Option M1 – Proportion of Secondary Connections that are Metered				
	Current	2030	2040	2065
Existing Development	2%	70%	100%	100%
New Construction	-	100%	100%	100%

Irrigation Efficiency

At an average irrigation efficiency rate of just over 63%, it is clear that even metered connections can do much better in effectively applying water to their landscape. 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 residential water user can get to 100% efficient. For the purposes of this analysis, it has been estimated that the maximum average efficiency that can be obtained using sprinkling systems is 70% and that the maximum average efficiency that can be obtained using drip irrigation systems is 80%. These numbers should be viewed with the understanding that additional efficiency will always be the goal, but significant additional savings based on average efficiency across a region is unlikely. With this in mind, two policy options have been identified relative to irrigation efficiency.

- **Baseline** – As noted previously, average irrigation efficiency has improved from around 50% in 2000 to 63% in 2015. This improvement has been achieved through current conservation efforts (education and outreach, tiered rates, etc.). It is assumed that a similar rate of improvement in efficiency can be obtained in the future as long as current conservation efforts continue.
- **Policy Option E1, Aggressive Irrigation Efficiency Improvements** – Policy makers could pursue aggressive water rate increases and education programs that could accelerate efficiency improvements. This would likely need to include improved incentives for water controller improvements, more aggressive tiered rates and significant increases in education and outreach funding. This option assumes policies are adopted to accelerate efficiency improvements to twice as fast as the baseline rate.

Because of the difference in efficiency between sprinkling systems and drip irrigation systems, the maximum efficiency that can be achieved by any given county or region will vary depending on its mix of turf (assumed to be sprinkled) and water wise plantings (assumed to be drip irrigation). For example, the best expected efficiency for the state as a whole based on its current landscape mix is 72%. However, this is expected to increase as changes to landscaping patterns increases the amount of water delivered through drip irrigation systems. Thus, instead of reporting irrigation efficiency for each policy option based on absolute irrigation efficiency, Table 4-6 reports the ratio of irrigation efficiency to the maximum expected based on the landscape mix. These ratios have been grouped into a few broad geographical categories for comparison purposes.

Table 4-6: Irrigation Efficiency

Baseline – Ratio of Efficiency to Best Expected				
	Current¹	2030	2040	2065
Wasatch Front/Population Centers	0.88	0.93	0.96	0.98
Wasatch Back/Rural Areas	0.82	0.90	0.94	0.98
Southern Utah	0.92	0.96	0.97	0.99
Policy Option E1 – Ratio of Efficiency to Best Expected				
	Current¹	2030	2040	2065
Wasatch Front/Population Centers	0.88	0.98	1.0	1.0
Wasatch Back/Rural Areas	0.82	0.97	1.0	1.0
Southern Utah	0.92	0.99	1.0	1.0

¹ DWRe records

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 Study* (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 4-7 shows the water applied to each landscape area after establishment.

**Table 4-7: JWCD 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
Demonstration Garden	Theoretical Evapotranspiration for Turf at Garden Location	21.9
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.

- *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 described below.

- **Baseline** – Through education efforts and market forces, some movement has been observed over the last 15 years away from cool season turf grasses. This baseline scenario assumes that this gradual trend away from turf grasses will continue at approximately the same rate as historic.
- **Policy Option L1, Aggressive Landscape Conversion Efforts** – During public open houses, many residents expressed a desire to move toward more efficient landscapes but had not done so yet because of various barriers including cost, local landscaping regulations, less familiar maintenance requirements, limited availability of water wise plants, etc. Policy makers could focus on implementing policies to reduce or remove these barriers. This would likely include increased conservation education budgeting, providing incentives for turf reduction, aggressive tiered rates for outdoor water use, and working with communities to implement conservation friendly landscaping ordinances. This option assumes policies are adopted to accelerate movement away from landscaping with cool season turf grasses to twice as fast as the baseline rate.
- **Policy Option L2, Aggressive Turf Restrictions in Landscape Ordinances for New Construction** – Despite policy makers best efforts, the comparatively high cost of landscape conversion (see Chapter 5) will limit how quickly conversion will happen in existing landscapes. It will be much more cost effective to focus on reducing turf for new construction. This option assumes that all policies associated with Option L1 and in place and that landscape conversion rates for existing properties are the same as Option L1. Additionally, it assumes that landscaping ordinances are implemented that include a firm restriction on the utilization of turf for new properties. Maximum turf rates would vary based on location – 20% for counties in southern Utah, 35% for the Wasatch Front and other population centers, and 50% for the Wasatch Back and rural areas.

Turf utilization rates associated with each policy option are summarized in Table 4-8. These values are reflected as a percentage of total irrigated area (not to be confused with percentage of total lot size).

Table 4-8: Cool-Season Turf Grass Utilization

Baseline – Percent of Irrigated Area Landscaped with Cool Season Turf Grasses					
		Current¹	2030	2040	2065
Existing Development	Wasatch Front/Population Centers	69.1%	67.6%	67.0%	65.7%
	Wasatch Back/Rural Areas	65.3%	64.0%	63.4%	62.2%
	Southern Utah	34.8%	34.4%	34.3%	33.9%
New Development	Wasatch Front/Population Centers	-	64.7%	62.8%	58.8%
	Wasatch Back/Rural Areas	-	61.4%	59.6%	55.9%
	Southern Utah	-	33.7%	33.2%	32.1%
Policy Option L1 – Percent of Irrigated Area Landscaped with Cool Season Turf Grasses					
		Current¹	2030	2040	2065
Existing Development	Wasatch Front/Population Centers	69.1%	65.8%	62.5%	57.5%
	Wasatch Back/Rural Areas	65.3%	62.3%	59.4%	54.7%
	Southern Utah	34.8%	34.0%	33.1%	31.8%
New Development	Wasatch Front/Population Centers	-	59.1%	49.3%	34.3%
	Wasatch Back/Rural Areas	-	56.4%	47.6%	33.5%
	Southern Utah	-	32.2%	29.7%	25.8%
Policy Option L2 – Percent of Irrigated Area Landscaped with Cool Season Turf Grasses					
		Current¹	2030	2040	2065
Existing Development	Wasatch Front/Population Centers	69.1%	65.8%	62.5%	57.5%
	Wasatch Back/Rural Areas	65.3%	62.3%	59.4%	54.7%
	Southern Utah	34.8%	34.0%	33.1%	31.8%
New Development	Wasatch Front/Population Centers	-	35.0%	35.0%	35.0%
	Wasatch Back/Rural Areas	-	50.0%	50.0%	50.0%
	Southern Utah	-	20.0%	20.0%	20.0%

¹ DWRe analysis

Changes in Development Density

Over the past few decades, Utah’s historically rural landscape has rapidly transformed and developed in some areas. As Utah continues to grow, development density continues to change

and can significantly affect outdoor water use. Not all water suppliers can explicitly 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 4-9 shows percent reduction in lot size used in the conservation potential calculations.

Table 4-9: Reduction in Average Lot Size by County

County	2015 Average Lot Size (ft²)	2015 Average Landscaped Area Per Lot (ft²)	2030 Reduction in Lot Size	2040 Reduction in Lot Size	2065 Reduction in Lot Size
Beaver	16,234	8,117	7%	10%	14%
Box Elder	15,264	8,759	8%	11%	15%
Cache	12,805	7,770	12%	17%	24%
Carbon	12,149	6,075	4%	6%	9%
Daggett	11,419	5,710	0%	0%	0%
Davis	10,652	6,156	9%	13%	18%
Duchesne	13,882	6,941	5%	7%	9%
Emery	17,725	9,330	7%	10%	16%
Garfield	21,763	10,881	1%	1%	1%
Grand	12,713	6,356	9%	12%	16%
Iron	11,577	5,789	10%	13%	18%
Juab	17,986	9,109	12%	16%	20%
Kane	19,014	9,507	3%	3%	4%
Millard	25,875	12,938	6%	9%	13%
Morgan	21,033	10,704	14%	18%	21%
Piute	24,523	12,262	2%	2%	3%
Rich	20,150	10,075	3%	5%	7%
Salt Lake	8,463	4,239	7%	10%	14%
San Juan	14,607	7,304	16%	22%	29%
Sanpete	19,913	9,957	9%	12%	17%
Sevier	18,020	9,010	8%	11%	15%
Summit	16,063	8,031	6%	8%	11%
Tooele	12,138	6,069	14%	18%	22%
Uintah	16,889	8,445	8%	12%	17%
Utah	13,154	6,577	17%	23%	31%
Wasatch	19,113	10,294	13%	16%	19%
Washington	11,852	5,926	17%	22%	28%
Wayne	28,648	14,324	2%	3%	5%
Weber	11,880	6,828	10%	13%	18%
Statewide Average	11,300	5,899	10%	14%	19%

Lot size reductions are based on the following assumptions:

- Salt Lake and Davis Counties do not have enough developable land to sustain growth at their current lot sizes. As a result, density changes in these two counties are simply based on the required reduction to limit development to available land. This results in lot size reductions of 14% in Salt Lake County and 18% 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 at current lot sizes by the end of the planning window (2065) but don't quite reach it.
- For other counties with population centers (Cache, Utah, Washington, and Weber), it has been assumed that all future development will average no more than 7,280 square feet, the projected average lot size in Salt Lake County at buildout. In other words, all new development in these counties will look like average densities in developed areas along the Wasatch Front.
- For all other counties, it has been assumed that the decrease in lot size will be exactly enough to 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.

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.

Dendrohydrology 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.

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; Gillies et al. 2012; Kunkel 2013; EPA 2015; JWCD 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 4-2.

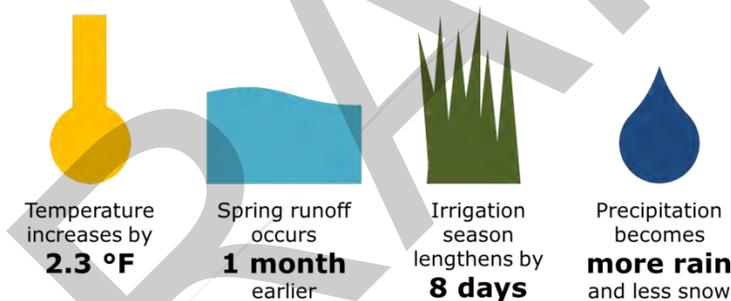


Figure 4-2: Climate Change Impacts in Utah by 2050

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% (JWCD 2017). For the purposes of this analysis, a 10% increase in ET rates as a result of climate change has been included in the water conservation potential calculations. It is assumed that this increase will occur linearly between 2015 and 2065.

Total Water Application

Based on the several issues discussed above, the expected average annual use of irrigation water on landscaped areas can be calculated. This calculation takes into account evapotranspiration, efficiency, lot size, changes in landscaping, and climate change.

OTHER WATER USE TYPES

Estimating water conservation potential for other types of water use is difficult because of the broad range of potential uses 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 use 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.

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) Institutional

One of the most important places to save water and a recommended area of focus is institutional water use. Even though institutional water use only accounted for 13% of total M&I water use in 2015, much of this water use occurs outdoors on parks, school ball fields, etc. where there is great potential for increases in efficiency. 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. Therefore, water conservation by institutional users must be a priority 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 and 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 institutional considers the same general areas of savings as identified for residential use with a few adjustments:
 - 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 residential savings.
 - Increases in Efficiency—While detailed data regarding institutional efficiency is not available, it is believed that there is potential for significant improvements in this area. Correspondingly, it has been assumed that increases in institutional efficiency are expected to exceed those achieved by residents. Water savings associated with efficiency have been calculated based on approximately 50% greater increases in efficiency than those expected for residential customers as summarized in Table 4-2.
 - Changes in 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 as described above, but there is no reduction in institutional outdoor area per person.

c) Industrial

It has been estimated that industrial water use will remain constant on a per capita basis in each region and each scenario. This does not mean that water conservation is not expected from industrial customers. It is expected that resources will continue to be invested in looking for ways industrial water use can be decreased. 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.

Mixture of Use Types

It should be noted that all conservation potential calculations assume that the proportional mixture of commercial, institutional, and industrial development in each region will remain approximately the same moving forward. While this is a 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

Conservation potential for M&I water use is summarized in Tables 4-10 and 4-11. Conservation potential will obviously vary depending on which policy options are implemented from the list above. With the number of policy options identified above, there are literally hundreds of different combinations that could be implemented. Since it is not practical to report results for all of these combinations, only the two extremes are shown here. Table 4-10 summarizes water use by region for the baseline scenario in each area of water use. Table 4-11 summarizes water use by region if the most aggressive policy was implemented in each area of water use.

Table 4-10: Total Potential M&I Water Use (gpcd) by Region – Baseline Scenario¹

Region	2015	2030	2040	2065
Bear River	304	274	261	250
Green River	284	259	250	240
Lower Colorado North	284	256	246	235
Lower Colorado South	305	278	267	258
Provo River	222	194	183	173
Salt Lake	210	197	193	187
Sevier River	400	366	349	332
Upper Colorado	333	301	288	274
Weber River	250	230	221	210
Statewide Average	240	220	211	202

¹ Baseline scenario assumes current conservation trends continue

Table 4-11: Total Potential M&I Water Use (gpcd) by Region – With All Aggressive Policy Options

Region	2015	2030	2040	2065
Bear River	304	236	221	212
Green River	284	226	215	213
Lower Colorado North	284	217	203	194
Lower Colorado South	305	246	232	222
Provo River	222	167	153	148
Salt Lake	210	177	169	161
Sevier River	400	307	284	281
Upper Colorado	333	254	236	228
Weber River	250	189	174	167
Statewide Average	240	190	178	171

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.

WATER CONSERVATION POTENTIAL AND ITS RELATIONSHIP TO GOAL SETTING

As discussed previously, the calculations contained here are included to provide perspective on what water use could be for a given set of policies. While it is hoped that this information will be useful in understanding regional water conservation potential, it is recognized that this is not the final step in goal setting.

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/policies 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 and prioritize water conservation practices for implementation.
- From the water conservation policy options developed in Chapter 4, select the water use policies that incorporate the identified practices for implementation.
- Using the water conservation potential model and selected policy options, calculate the regional goals.
- Develop a regression model of 2015 water use to explore important regional variations and inform the goals (Appendix G).

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

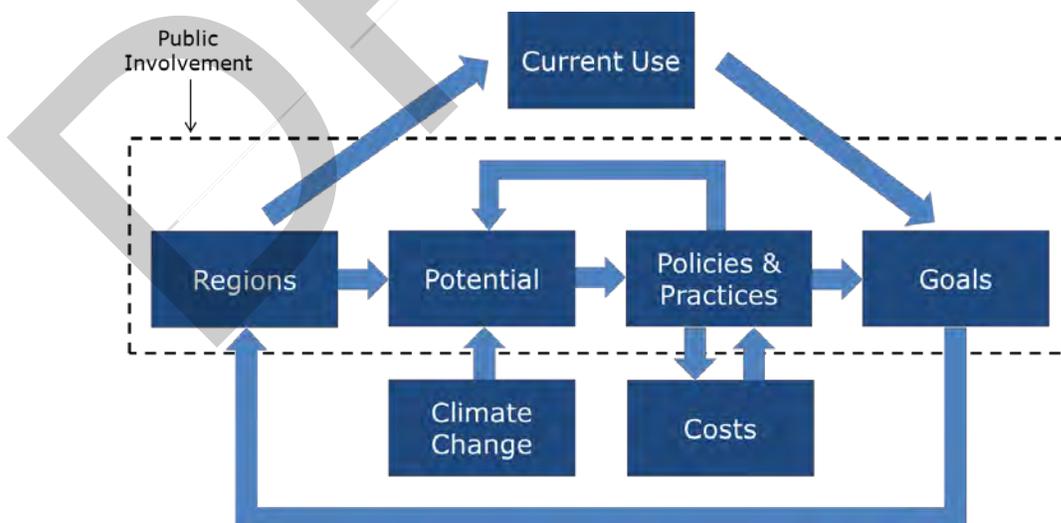


Figure 5-1: Goal Development Process

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 (DWR 2001, 2014; Sovocol 2005; EPA 2010; BWCD 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 Discussion

All of the aforementioned practices have merit in some applications. 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 Shower Heads)—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 (either in the form of positive incentives such as providing cash rebates on the purchase of high-efficiency machines, or negative incentives such as pricing water such that machine conversion is more likely), 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 the priority of implementation for a water conservation practice is cost. The project team recognizes that water conservation of the magnitude proposed here is not free and that the costs must be acknowledged in order to secure funding for implementation. While the complete costs and benefits of achieving the goals cannot be presented here, gross unit costs can inform a future statewide implementation plan as well as local water conservation actions.

Table 5-1 summarizes estimated gross unit costs for various water conservation practices. To facilitate comparison, annualized unit costs are presented in dollars per acre-foot per year based on the estimated implementation costs and estimated water savings.

Table 5-1: Water Conservation Practice Costs

Practice	Cost (\$)	Yield (ac-ft)	Unit Cost (\$/ac-ft)	Annualized Cost¹ (\$/ac-ft)
General				
Water Conservation Education				Varies
Conservation Pricing				Varies
Indoor				
Fixture Conversion—Toilets, Shower Heads, 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/ft² for turf and sprinklers and \$5/ft² 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. Landscaping costs can vary significantly depending on how the landscape is designed and whether a homeowner does the work themselves or hires it out to a contractor. Estimates here reflect a relatively basic landscape completed by a contractor. For simple landscapes completed by homeowners, expected costs would be 65% of the current estimate. For more ornate landscapes done by a contractor, expected costs could be 150% or more of the current estimate.

A few items should be noted regarding these cost calculations:

- Cost “varies”—There are four categories for which a gross 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 gross 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/ft² and a water supplier offers a rebate of \$1.50/ft², the customer must still cover the remaining \$3.50 /ft². 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	Cost¹ (\$)	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/ft², 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/ft², rebate costs would be half the value shown. If entities offered \$3.00/ft², 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.

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 gross direct cost does provide important insight into the selection and prioritization of viable practices, there are several reasons cost should not be used as the exclusive selection criterion:

- **Water is a limited resource**—When conservation costs are compared against water source costs, the water sources will usually be those that are 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 significant new sources. Consequently, conservation must occur in order to meet Utah’s growing population in the long term, regardless of any future water developed. With limited viable water sources available, it is prudent for the residents of the state to implement some practices now in order to stretch the available remaining water supply to meet future demands (and to recognize the costs of future water depletion today).
- **Long-term vs. short-term cost**—A quick review of the water conservation practices cost table will reveal that an investment now 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. While this may be above the cost of development of some sources currently identified to serve the Wasatch Front, at some point less expensive sources will be used up and 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**—Costs of both conservation and source development are most immediately limited to gross direct costs that can be readily calculated. During public outreach meetings throughout the state, many comments were received expressing the need to consider impacts that have either indirect costs or costs that are difficult to quantify. Some examples of non-cost issues mentioned during public outreach meetings include: reduced instream flows for wildlife habitat, reduced lake levels at the Great Salt Lake, increased treatment costs, negative impacts to urban forestry health, and reduced 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 comparison of direct costs only.
- **Cost uncertainty**—While the costs contained in Tables 5-1 represent the most up-to-date gross cost estimates for conservation practices, actual costs will not be known until the practices are fully implemented.
- **Consideration of Direct Cost Offsets and Benefits**—In addition to the direct and indirect costs noted above, there is a range of financial offsets and non-financial benefits that exists for different approaches to more efficiently use currently developed water. Policymakers should consider not only the costs but also the benefits and offsets of each approach and the associated tradeoffs.

For example, assume that installing smart meters encourages more efficient use of water by (a) giving consumers better real-time feedback to inform timely water use decisions, and (b) interacting directly with smart timers, automatic leak shutoff mechanisms, and other watering devices to directly impact water use. A comprehensive financial cost and benefit comparison can examine not only the capital cost of installing the meter, but also the direct on-ledger offsets related to that water meter installation, including savings in meter reader labor and transportation costs, and other benefits such as the impact on market price, and foregone or delayed capital costs, as well as non-financial benefits such as environmental improvements.

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. Included in each section is also a summary of how the recommended practices translate into policy options to be included in the conservation potential model as part of the final goals.

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

Conservation Policy Implications: Both of these practices are expected to be ongoing, fundamental components of overall water conservation efforts. They will form the backbone of efforts to encourage and support the other practices described in the following sections. Correspondingly, no specific policy implications are identified here. Instead, the identification of selected policy options in subsequent sections will inform the required level of conservation education and pricing.

Indoor Practices

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

- **Fixture conversion (Faucets, shower heads, and toilets)**—Assume continued 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. With this said, federal regulations now require the use of high-efficiency fixtures in these categories. As a result, natural replacement is already resulting relatively efficient replacement rates. Adding significant additional investment in this area could accelerate the process but would take resources away from other important areas of conservation. Correspondingly, it is recommended that programs in this area be sustained at current levels.

Conservation Policy Implications: The Baseline policy option will be used in all counties for these categories of water use.

- **Appliance conversion (washing machines)**—Assume continued 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.

Conservation Policy Implications: The Baseline policy option will be used in all counties for this category of water use.

- **Other indoor measures (leak repair and indoor water use habits)**— 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.

Conservation Policy Implications: Policy Option I1 – Aggressive Leak Repair Efforts will be used in Grand, Kane, and Washington counties for this category of water use. The Baseline policy option will be used in all other counties.

Outdoor Practices

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

- **Secondary meters**—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. While Senate Bill 52 provides a good start, it is recommended that required metering be extended to all secondary water users.

Conservation Policy Implications: Policy Option M1 – Required Secondary Metering will be used in all counties for this category of water use.

- **Increases in Irrigation Efficiency (Smart controllers, etc.)**—Increasing irrigation efficiency is one of the most cost-effective methods of saving water available. Thus, it is recommended that all counties emphasize increasing efficiency through smart controller rebates, water audits, conservation education, and aggressive pricing tiers.

Conservation Policy Implications: Policy Option E1 – Aggressive Irrigation Efficiency Improvements will be used in all counties for this category of water use.

- **Water-wise landscaping (construction of new properties and conversion of existing properties)**—Water-wise landscaping has the greatest potential for water conservation but is also the most dependent upon cost and regional attitudes toward landscaping. Two issues should be noted in estimating rates of water-wise landscaping adoption for goal setting purposes:
 - As shown in Table 5-1, the cost of water-wise landscaping in new construction is significantly less than the conversion of existing landscape. As a result, all areas of the State are encouraged to pursue water-wise landscaping for all new construction.
 - Water-wise landscaping is a practice where cost may not be the driving factor in adoption. More and more water customers have been willing 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 is 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 prices.

Based on this discussion, assumed progress in this area will vary depending on location and type of construction (new construction vs. existing landscape conversion).

Conservation Policy Implications: Policy Option L1 – Aggressive Landscape Conversion Efforts will be used in Wasatch Front counties, counties with population centers, and counties in Southern Utah for this category of water use. The Baseline policy option will be used in all other counties (Wasatch Back and rural counties).

A summary of policy options selected for inclusion in the regional goals are summarized by county in Table 5-3.

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Table 5-3: Conservation Policies by Category of Water Use and County

County	Faucet and Shower Head Conversion	Toilet Conversion	Washing Machine Conversion	Leak Repair	Secondary Metering	Irrigation Efficiency	Landscaping
Beaver	Baseline	Baseline	Baseline	Baseline	M1	E1	Baseline
Box Elder	Baseline	Baseline	Baseline	Baseline	M1	E1	L1
Cache	Baseline	Baseline	Baseline	Baseline	M1	E1	L1
Carbon	Baseline	Baseline	Baseline	Baseline	M1	E1	Baseline
Daggett	Baseline	Baseline	Baseline	Baseline	M1	E1	Baseline
Davis	Baseline	Baseline	Baseline	Baseline	M1	E1	L1
Duchesne	Baseline	Baseline	Baseline	Baseline	M1	E1	Baseline
Emery	Baseline	Baseline	Baseline	Baseline	M1	E1	Baseline
Garfield	Baseline	Baseline	Baseline	Baseline	M1	E1	Baseline
Grand	Baseline	Baseline	Baseline	I1	M1	E1	L1
Iron	Baseline	Baseline	Baseline	Baseline	M1	E1	L1
Juab	Baseline	Baseline	Baseline	Baseline	M1	E1	Baseline
Kane	Baseline	Baseline	Baseline	I1	M1	E1	L1
Millard	Baseline	Baseline	Baseline	Baseline	M1	E1	Baseline
Morgan	Baseline	Baseline	Baseline	Baseline	M1	E1	Baseline
Piute	Baseline	Baseline	Baseline	Baseline	M1	E1	Baseline
Rich	Baseline	Baseline	Baseline	Baseline	M1	E1	Baseline
Salt Lake	Baseline	Baseline	Baseline	Baseline	M1	E1	L1
San Juan	Baseline	Baseline	Baseline	Baseline	M1	E1	Baseline
Sanpete	Baseline	Baseline	Baseline	Baseline	M1	E1	Baseline
Sevier	Baseline	Baseline	Baseline	Baseline	M1	E1	Baseline
Summit	Baseline	Baseline	Baseline	Baseline	M1	E1	Baseline
Tooele	Baseline	Baseline	Baseline	Baseline	M1	E1	Baseline
Uintah	Baseline	Baseline	Baseline	Baseline	M1	E1	Baseline
Utah	Baseline	Baseline	Baseline	Baseline	M1	E1	L1
Wasatch	Baseline	Baseline	Baseline	Baseline	M1	E1	Baseline
Washington	Baseline	Baseline	Baseline	I1	M1	E1	L1
Wayne	Baseline	Baseline	Baseline	Baseline	M1	E1	Baseline
Weber	Baseline	Baseline	Baseline	Baseline	M1	E1	L1

RESULTS

Based on the selected policies, regional goals and future goal projections as calculated in the water conservation potential model are summarized in Table 5-4. Further details are presented in Chapter 7.

Table 5-4: Regional M&I 2030 Water Conservation Goals and Projections

Region	2015 Baseline (gpcd)	2030 Goal (gpcd)	2040 Projection (gpcd)	2065 Projection (gpcd)	Reduction from Baseline		
					2030	2040	2065
Bear River	304	249	232	219	18%	24%	28%
Green River	284	234	225	225	18%	21%	21%
Lower Colorado River North	284	231	216	205	19%	24%	28%
Lower Colorado River South	305	262	247	237	14%	19%	22%
Provo River	222	179	162	152	20%	27%	32%
Salt Lake	210	187	178	169	11%	15%	19%
Sevier River	400	321	301	302	20%	25%	24%
Upper Colorado River	333	267	251	248	20%	25%	25%
Weber River	250	200	184	175	20%	26%	30%
Statewide	240	202	188	179	16%	22%	26%

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

In reviewing the numbers produced by this process as summarized in Table 5-4, 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, a region with one of the higher overall goals (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, a region with one of the lower overall goals (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 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 much 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. It should also be reiterated that the 2040 and 2065 per capita use estimates serve as projections and not goals. Actual 2040 and 2065 per capita use goals will be revisited and revised as conditions change, including adjustments to reflect advances in current technology and emergence of new technologies.

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. Four specific recommendations regarding water rates include:
 - **Minimize base rates**—According to data provided by JWCD (Forsyth and Schultz 2017), a small base rate (with correspondingly higher volume rates) correlates with improved water conservation. The data on JWCD'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.
 - **Review water funding sources**— Water suppliers have water funding sources that include user charges, impact fees, and property taxes. The scope of this report does not include analyzing or recommending the balance of these funding sources. However, as part of its 2015 audit, the Office of the Legislative Auditor General recommended policymakers consider the way water is funded in Utah and look for opportunities where a greater portion of water delivery system costs can be repaid through user charges, while not disturbing critical funding sources for other water services.

- **Use technology to provide nearly real-time water use information to water users**—Changes in water pricing will be of limited effect unless water users understand how their personal water use practices are connected to how they are charged for water. Providing detailed water use data using advanced metering infrastructure, together with more graphical and useful water bill information, can transform water users into educated and motivated water consumers.

Indoor Practices

The following indoor water conservation practices are recommended.

- **Fixture conversion**—Conversion of toilets, faucets, and shower heads 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, shower heads, 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. While

the net cost of metering will vary from system to system, it is expected that many systems will actually save money in the long-term through installing meters. However, even in systems expected to see long-term net savings, metering will require a major initial capital investment from the water suppliers.

Correspondingly, it is recommended that the requirement to install secondary metering 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 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 cost of landscape conversion is still relatively expensive compared to typical turf rebates. Thus, experience suggests that offering turf rebates at historic 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**—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 and respond to market demand for smaller lot sizes.

WATER CONSERVATION COSTS

As discussed in Chapter 5, there are a host of financial and non-financial costs and benefits associated with water conservation practices. Evaluating each of these to calculate the net cost of conservation is beyond the scope of this study. However, independent of long-term benefits, it is clear that achieving the goals identified in this report will require a major initial investment from the citizens of the state. It is estimated that initial direct costs associated with statewide conservation activities may range from hundreds of millions to billions of dollars statewide depending on the approaches taken. For the set of conservation policies selected for inclusion in the current goals, estimated capital costs are approximately \$1.4 billion through the year 2030. This number is based on estimated capital costs only and does not reflect any potential cost savings or on-ledger offsets associated with conservation. It is reported in 2019 dollars and does not include any inflation or financing costs. While this cost is significant, making this investment will be an essential component of the state's plan to meet future water needs.

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, guide local water suppliers in their own water conservation efforts, and promote effective policies to support water conservation.

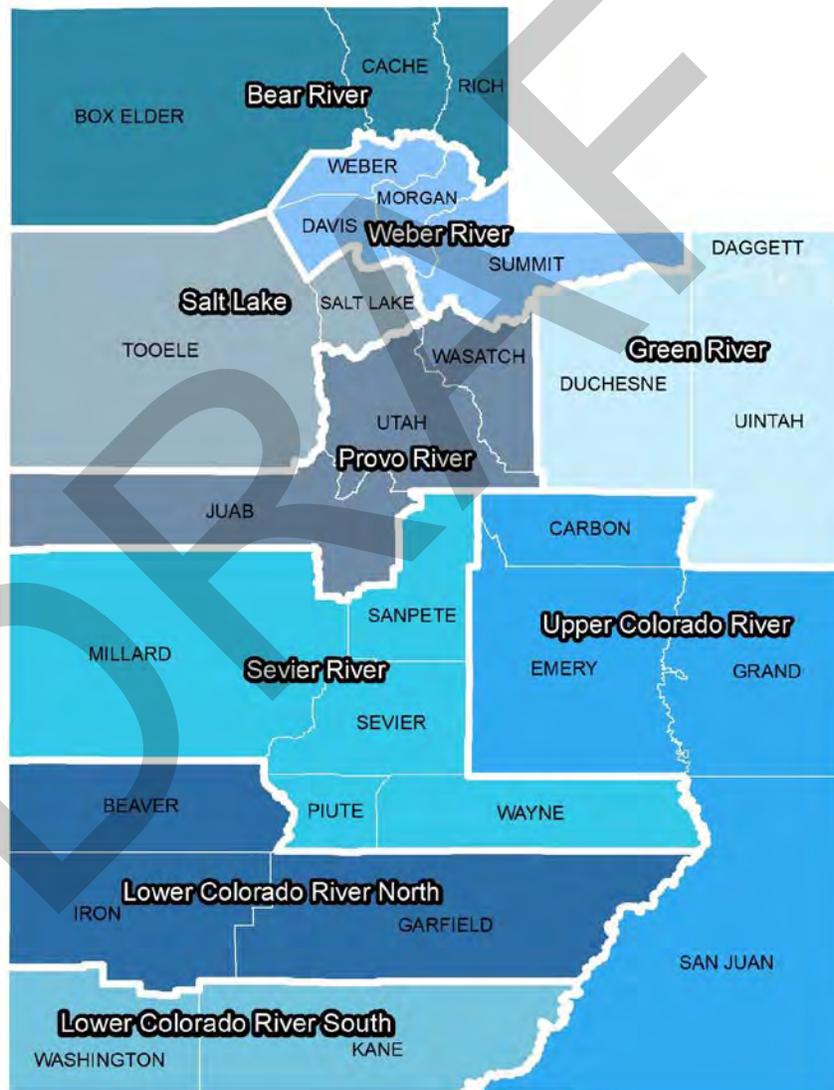


Figure 7-1: Regional M&I Water Conservation Boundaries

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	249	18%	232	24%	219	28%
Green River	284	234	18%	225	21%	225	21%
Lower Colorado River North	284	231	19%	216	24%	205	28%
Lower Colorado River South	305	262	14%	247	19%	237	22%
Provo River	222	179	20%	162	27%	152	32%
Salt Lake	210	187	11%	178	15%	169	19%
Sevier River	400	321	20%	301	25%	302	24%
Upper Colorado River	333	267	20%	251	25%	248	25%
Weber River	250	200	20%	184	26%	175	30%
Statewide	240	202	16%	188	22%	179	26%

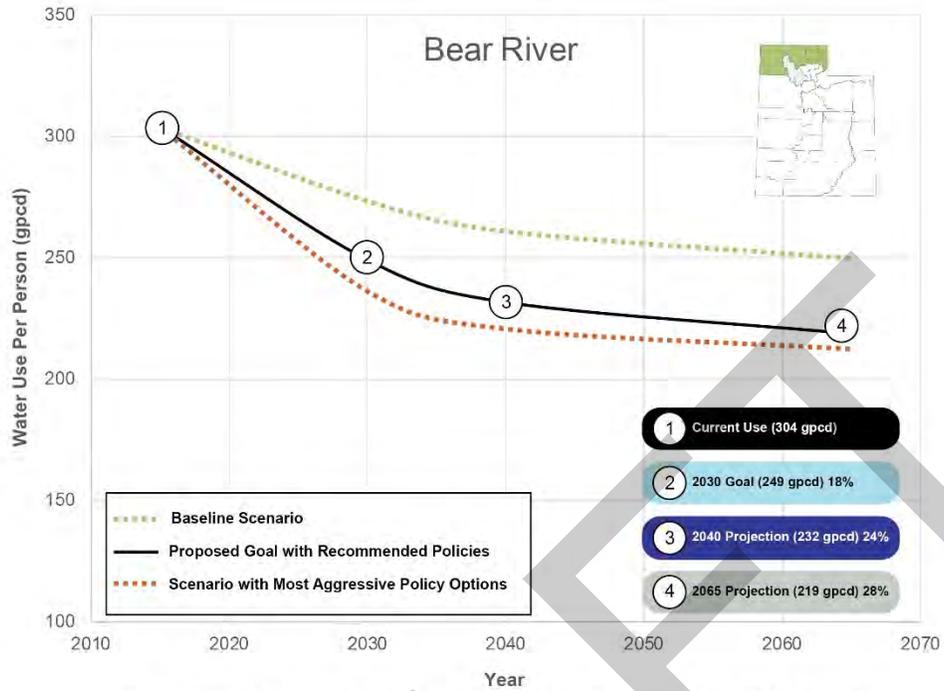
Note M&I = municipal and industrial; gpcd = gallons per capita per day based on permanent population. Reported per capita use includes all residential, commercial, institutional, and industrial uses averaged over the permanent population in each region.

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. The water conservation goals assume action above baseline improvements, with baseline representing more efficient water use that will likely occur without any new or more aggressive policy interventions. (Baseline activities include natural replacement of household fixtures, new homes constructed using existing water technology, market trends toward smaller lot sizes, and status quo price trajectories.) The lower limit of the water conservation potential is the scenario with the most aggressive policy options.

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.

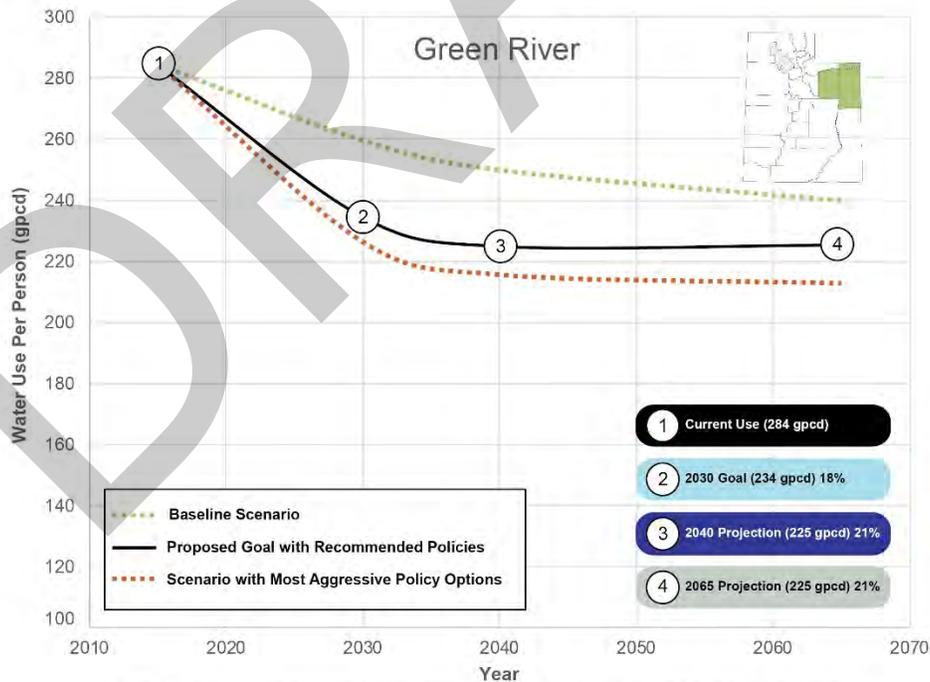
As 2030 approaches, the 2040 and 2065 projections will be revisited and modified as demographics, technology, conditions, and behaviors change. Once adopted, however, the goals should not be reset before the year for which they were intended in order to accurately assess progress during that time period.

In 2015 (the new baseline year), Utah's M&I water use was about 240 gpcd (DWR 2019a, 2019b). If considering all regional goals together, the outcome for the entire state is 202 gpcd by 2030 (16% reduction from 2015). Projections for all regions, considered together, are 188 gpcd by 2040 (22% reduction from 2015), and 179 gpcd by 2065 (26% reduction from 2015). Meeting the 2030 goals will save nearly 175,000 ac-ft annually across the state.



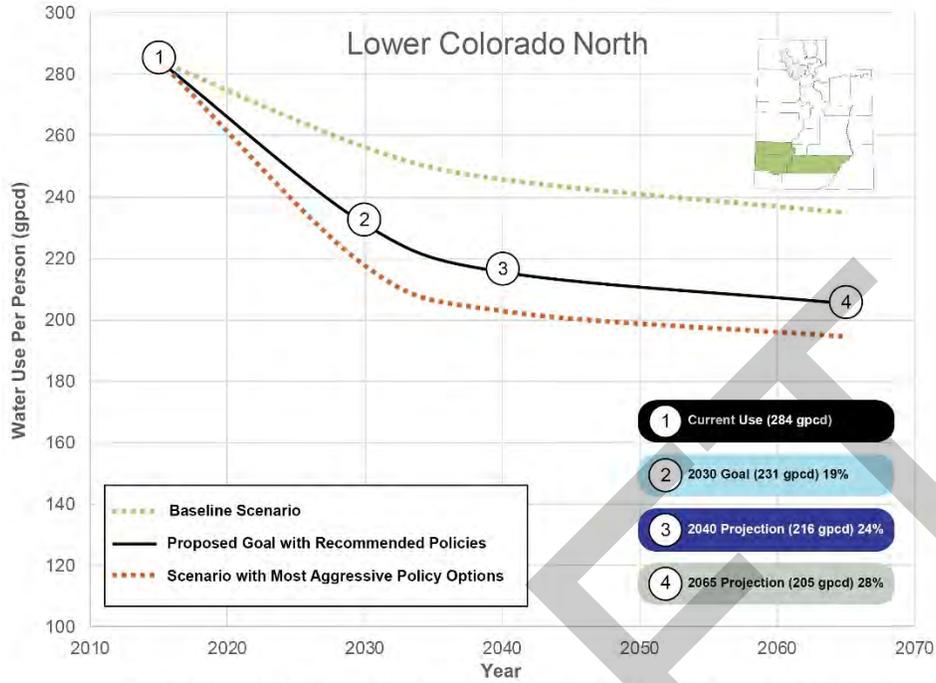
Note: The baseline and aggressive policy scenarios do not consider the cost or feasibility of achieving the assumed use patterns. They have been included solely to provide perspective relative to past and current water use and to help each region understand what must occur to achieve the final goals.

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



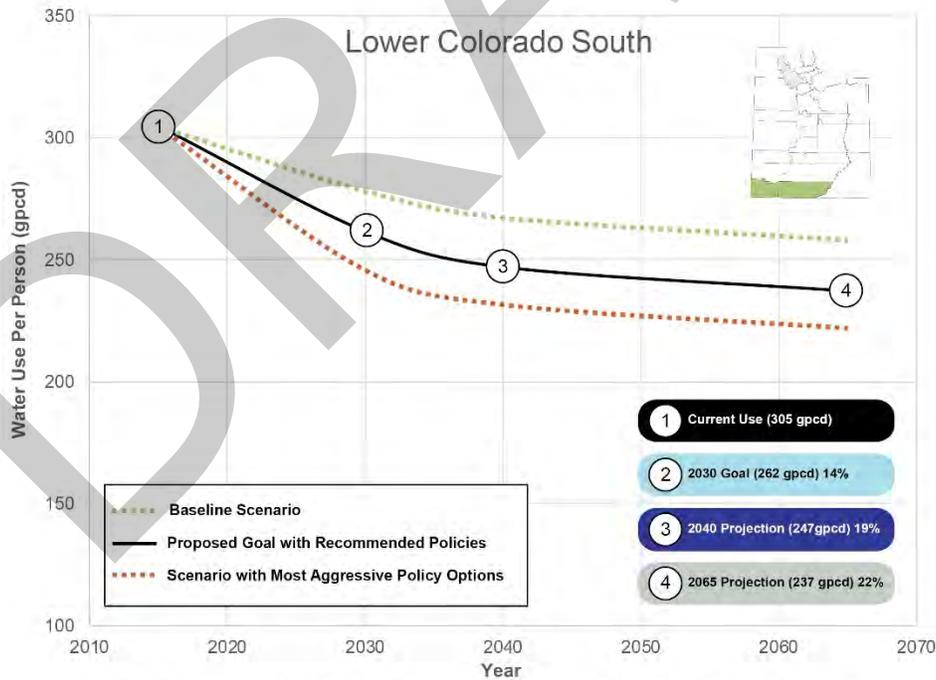
Note: The baseline and aggressive policy scenarios do not consider the cost or feasibility of achieving the assumed use patterns. They have been included solely to provide perspective relative to past and current water use and to help each region understand what must occur to achieve the final goals.

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



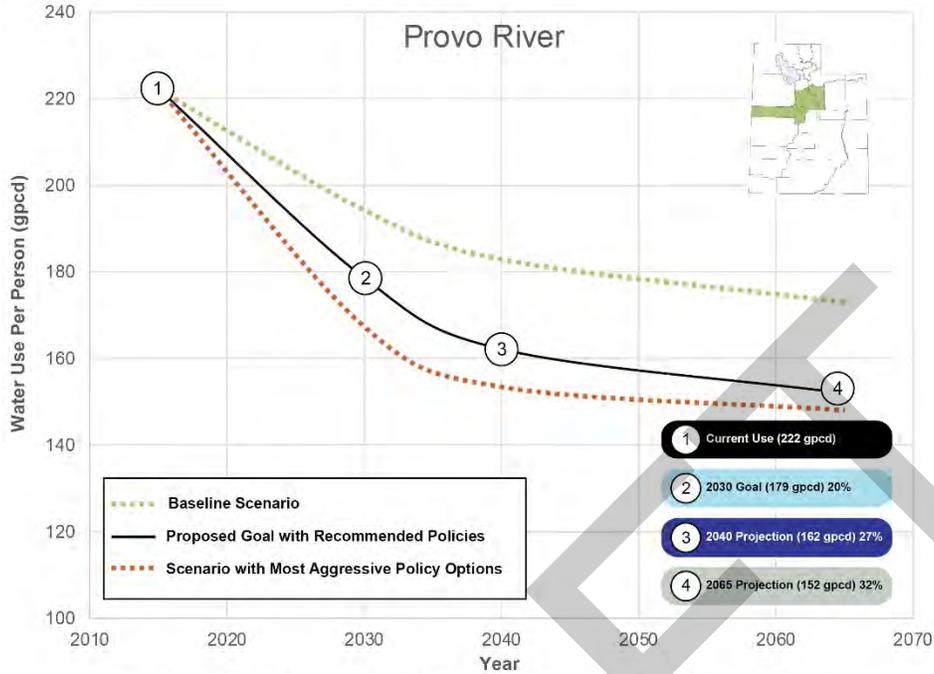
Note: The baseline and aggressive policy scenarios do not consider the cost or feasibility of achieving the assumed use patterns. They have been included solely to provide perspective relative to past and current water use and to help each region understand what must occur to achieve the final goals.

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



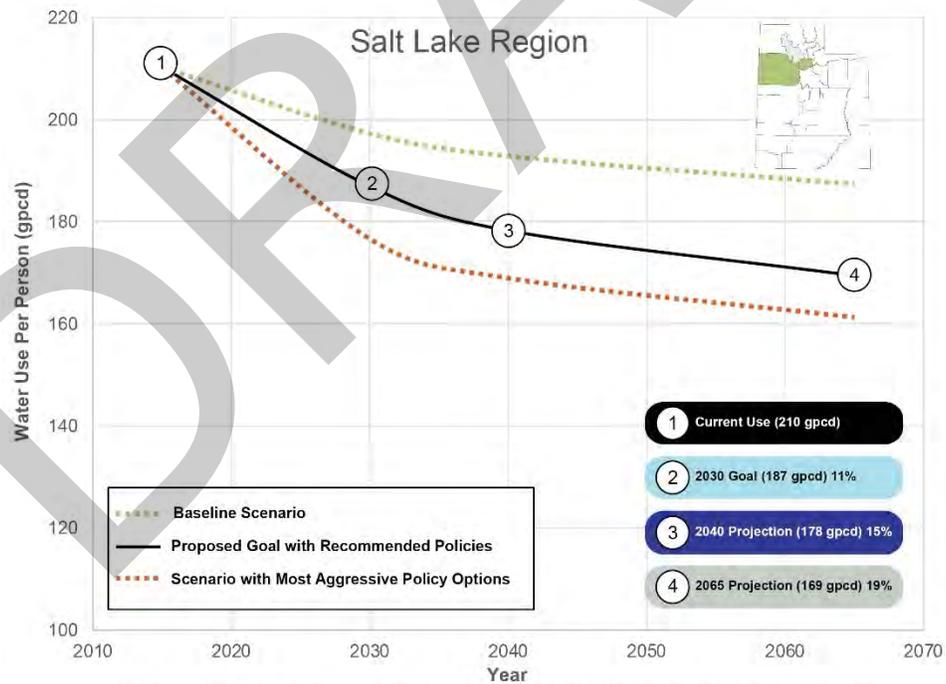
Note: The baseline and aggressive policy scenarios do not consider the cost or feasibility of achieving the assumed use patterns. They have been included solely to provide perspective relative to past and current water use and to help each region understand what must occur to achieve the final goals.

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



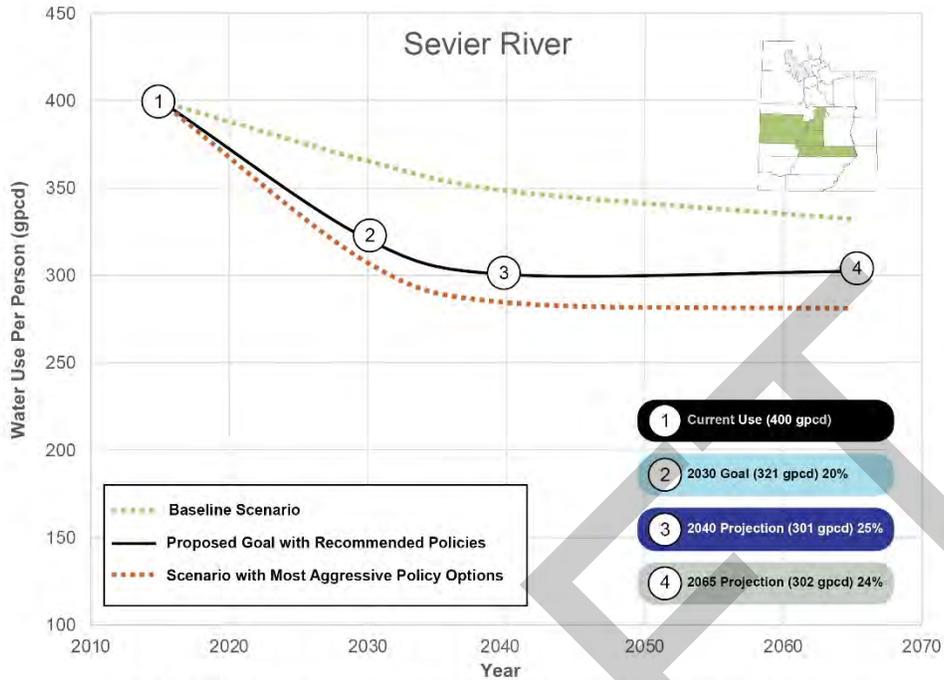
Note: The baseline and aggressive policy scenarios do not consider the cost or feasibility of achieving the assumed use patterns. They have been included solely to provide perspective relative to past and current water use and to help each region understand what must occur to achieve the final goals.

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



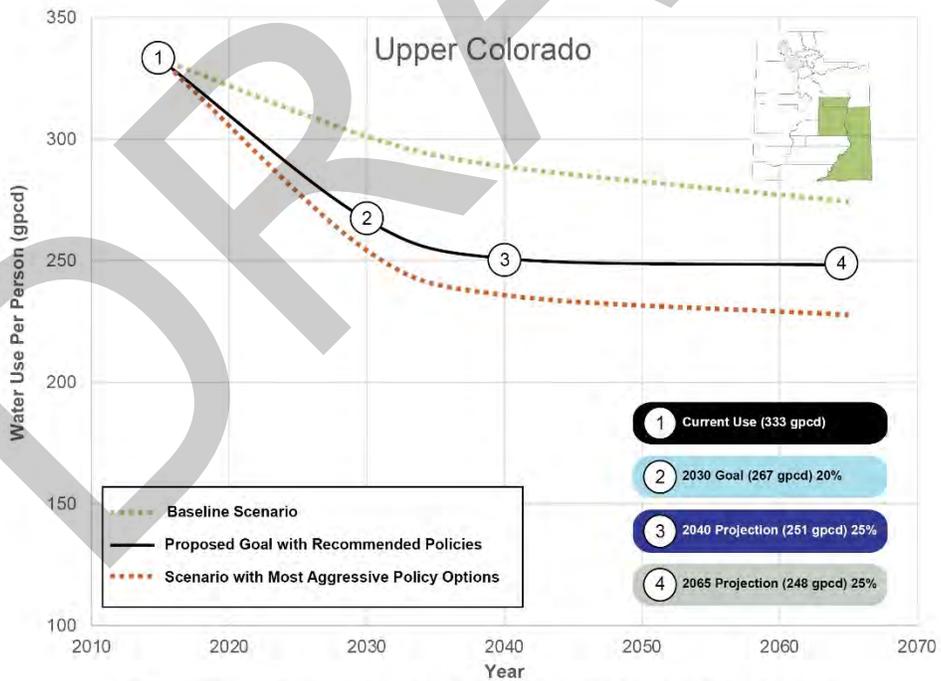
Note: The baseline and aggressive policy scenarios do not consider the cost or feasibility of achieving the assumed use patterns. They have been included solely to provide perspective relative to past and current water use and to help each region understand what must occur to achieve the final goals.

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



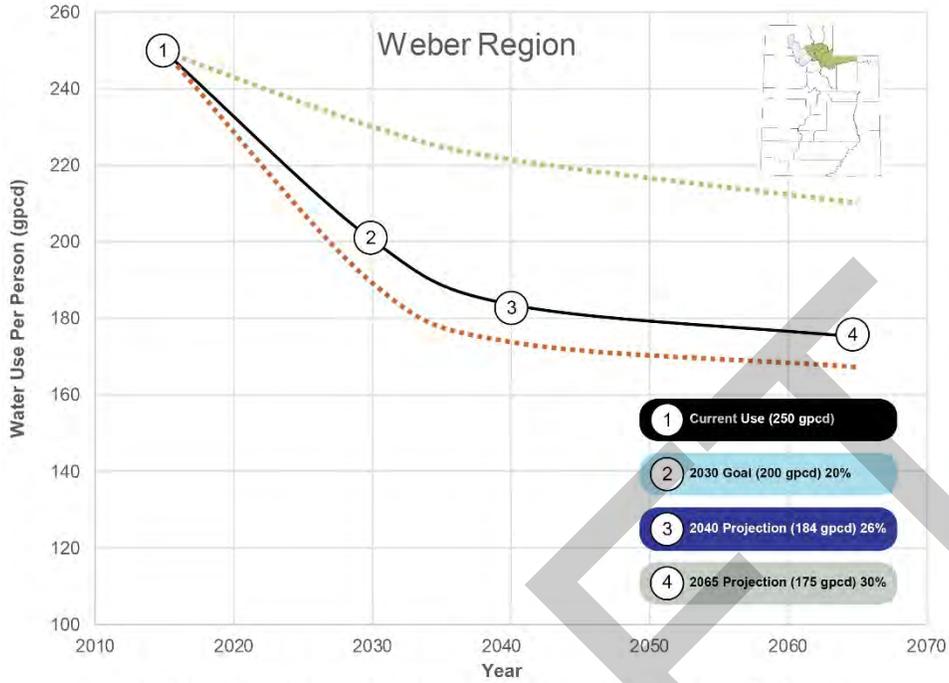
Note: The baseline and aggressive policy scenarios do not consider the cost or feasibility of achieving the assumed use patterns. They have been included solely to provide perspective relative to past and current water use and to help each region understand what must occur to achieve the final goals.

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



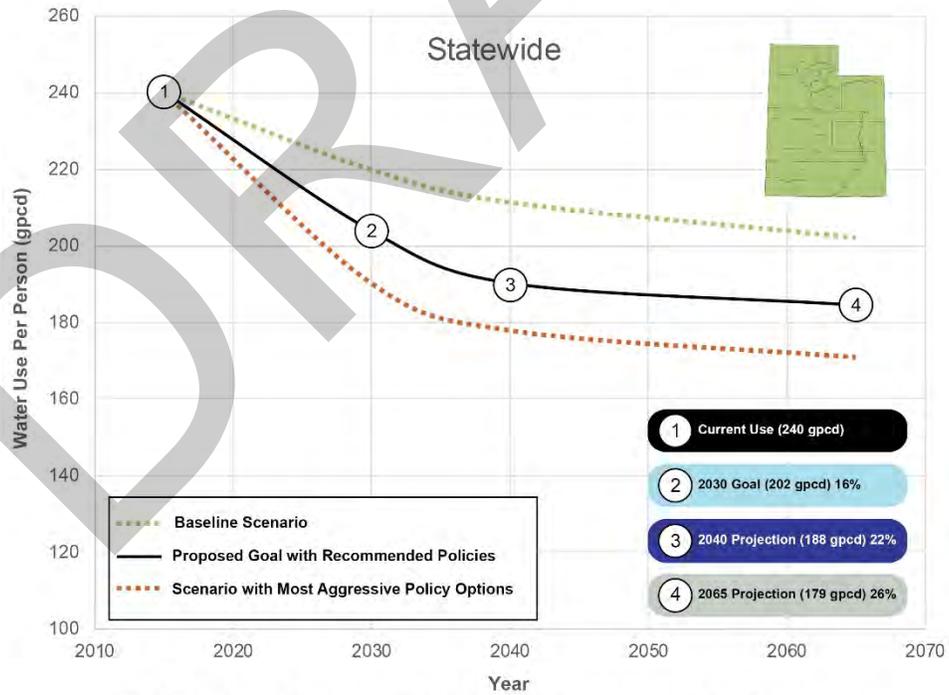
Note: The baseline and aggressive policy scenarios do not consider the cost or feasibility of achieving the assumed use patterns. They have been included solely to provide perspective relative to past and current water use and to help each region understand what must occur to achieve the final goals.

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



Note: The baseline and aggressive policy scenarios 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

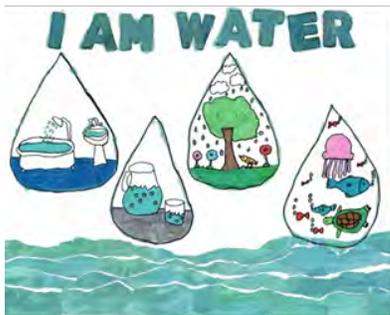


Note: The baseline and aggressive policy scenarios do not consider the cost or feasibility of achieving the assumed use patterns. They have been included solely to provide perspective relative to past and current water use and to help each region understand what must occur to achieve the final goals.

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 lowering base rates, increasing tiers for usage, reviewing funding sources, and using customer feedback technology.



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

(Drawing at top by B. Banner from Salt Lake County)

COMPARING COSTS AND BENEFITS

A range of financial and non-financial costs, offsets, and benefits exists for different approaches to more efficient use of currently developed water. In selecting conservation practices for implementation, policymakers should consider the full costs and benefits of each approach and the associated tradeoffs.

For example, assume that installing smart meters encourages more efficient use of water by (a) giving consumers better real-time feedback to inform timely water use decisions, and (b) interacting directly with smart timers, automatic leak shutoff mechanisms, and other watering devices to directly impact water use. A comprehensive financial cost and benefit comparison can examine not only the capital cost of installing the meter, but also the full benefits associated with that water meter installation, including savings in meter reader labor and transportation costs, the impact on the market price, and foregone or delayed capital costs, as well as non-financial benefits such as environmental improvements.

Because costs and benefits will vary depending on the unique circumstances of each water provider, this report does not attempt to quantify the all the costs and benefits associated with future conservation efforts here. Each provider will need to more fully explore the marginal financial costs of various approaches. Important features of this evaluation should be:

- Examining who pays for the costs and the relationships between cost of water and the use of that water
- Understanding marginal financial benefits from these same approaches, including financial savings to water users and taxpayers
- Exploring the non-financial costs and benefits of these different approaches.

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. Since changing water use behavior, policies, and technologies will become more difficult and expensive with time, prompt action on water conservation will bring the most benefit. A few starting actions are recommended here.

State and Local Policy Leaders

Policy plays a vital role in motivating and enabling water conservation. State, county, and local policy leaders should establish policies which require accountability for efficient water use. Policy leaders' support must consider universal metering, water loss control, education, and other water conservation activities, as well as the necessary funds for success. Policy leaders must also decide whether they are willing to support the necessary land use changes that will be required to reach the water conservation goals. This will include working with and being responsive to market forces to reduce 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 and reflect the cost of water scarcity. 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. To date, much of the focus of data collection and research has been on residential water use. State agencies can take the lead in making sure there is adequate focus on the other categories of water use: commercial, institutional, and industrial. 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.

Water Users

The water conservation mindset begins with individual water users. By recognizing water as a limited resource and changing their water use practices accordingly, water 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.

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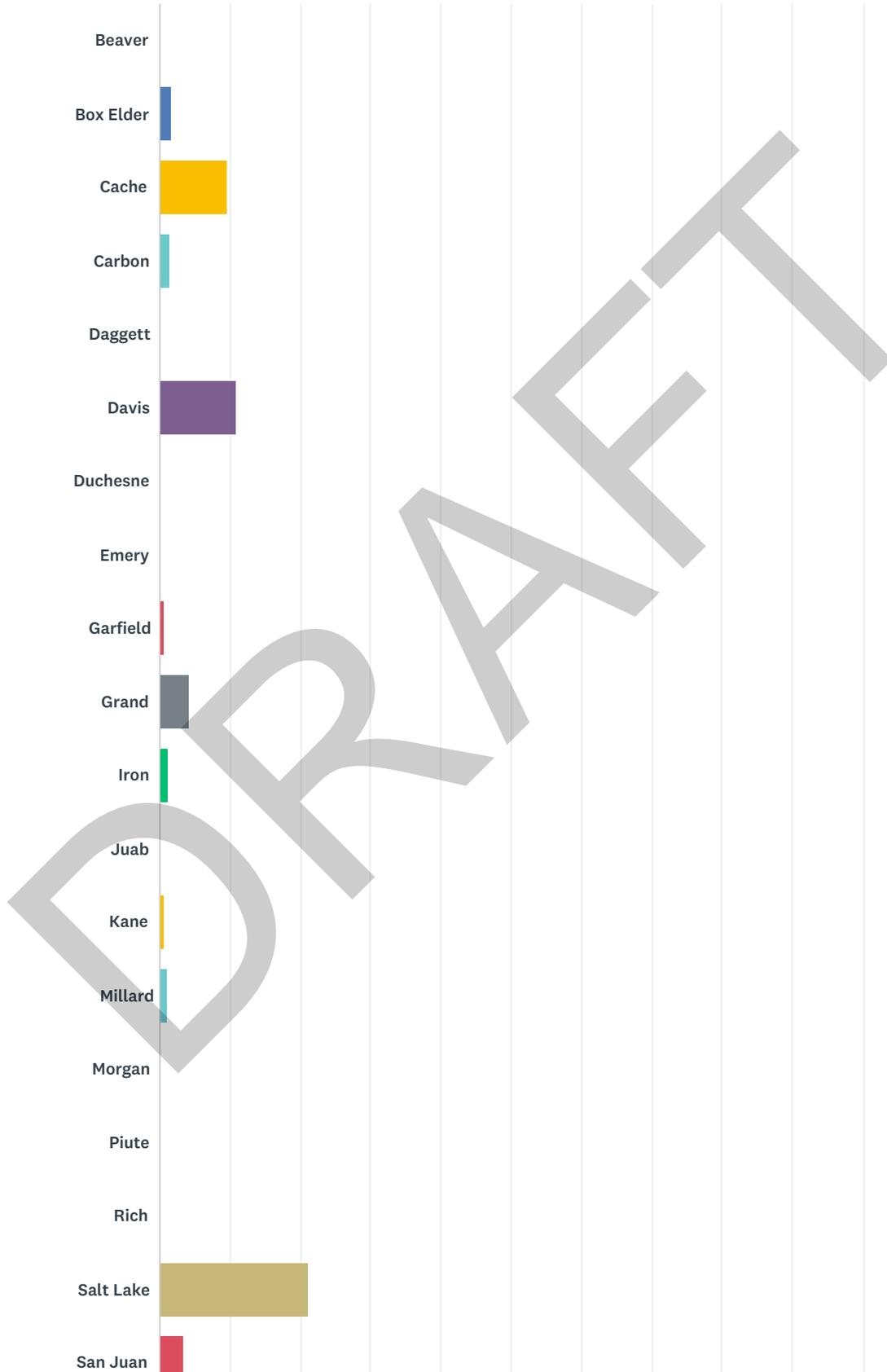
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Appendix A: Online Survey and Results

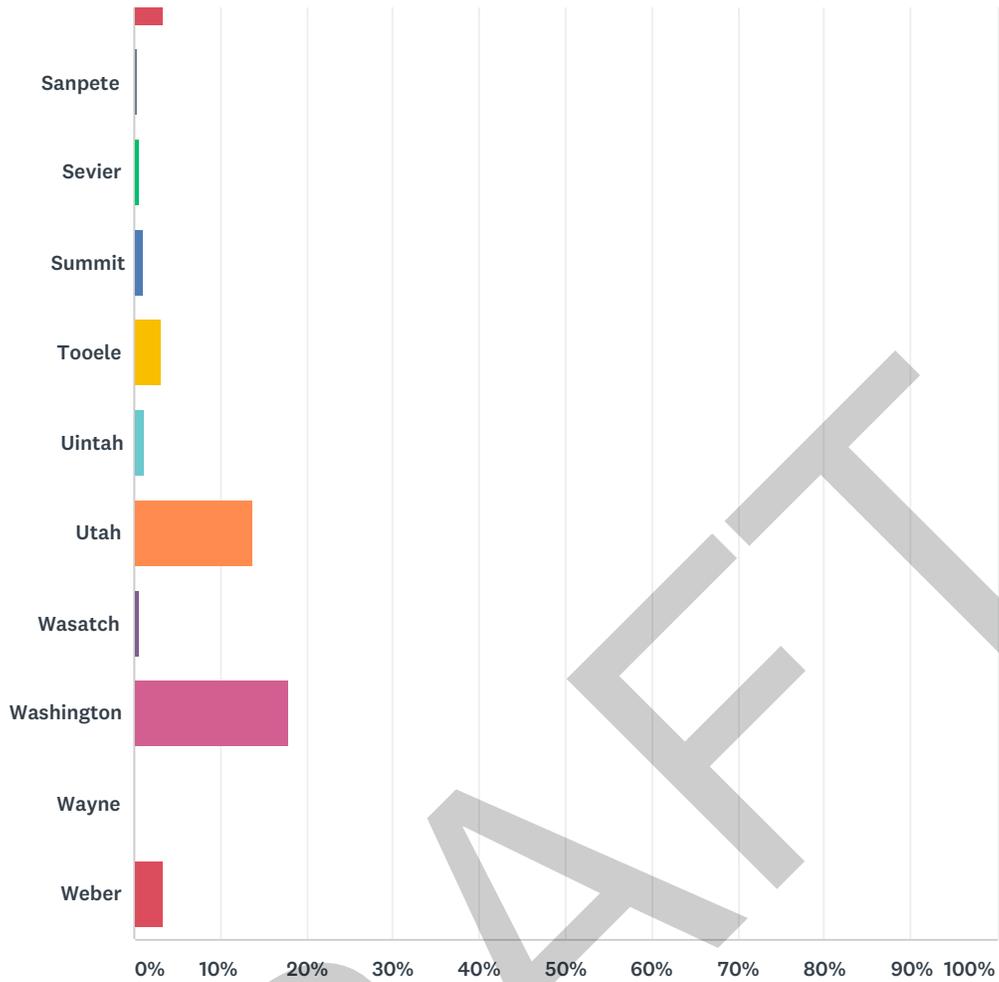
DRAFT

Q1 In which county do you live?

Answered: 1,655 Skipped: 0



Utah's Regional Water Conservation Survey



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

Utah's Regional Water Conservation Survey

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

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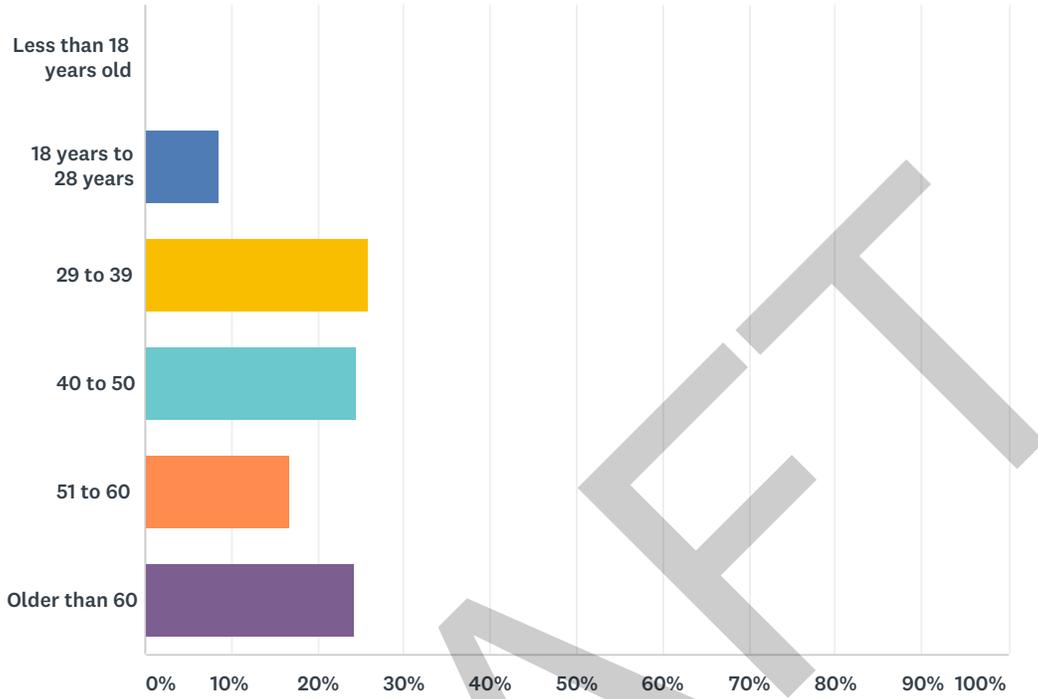
Q2 In which city do you live?

Answered: 1,647 Skipped: 8

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Q3 How old are you?

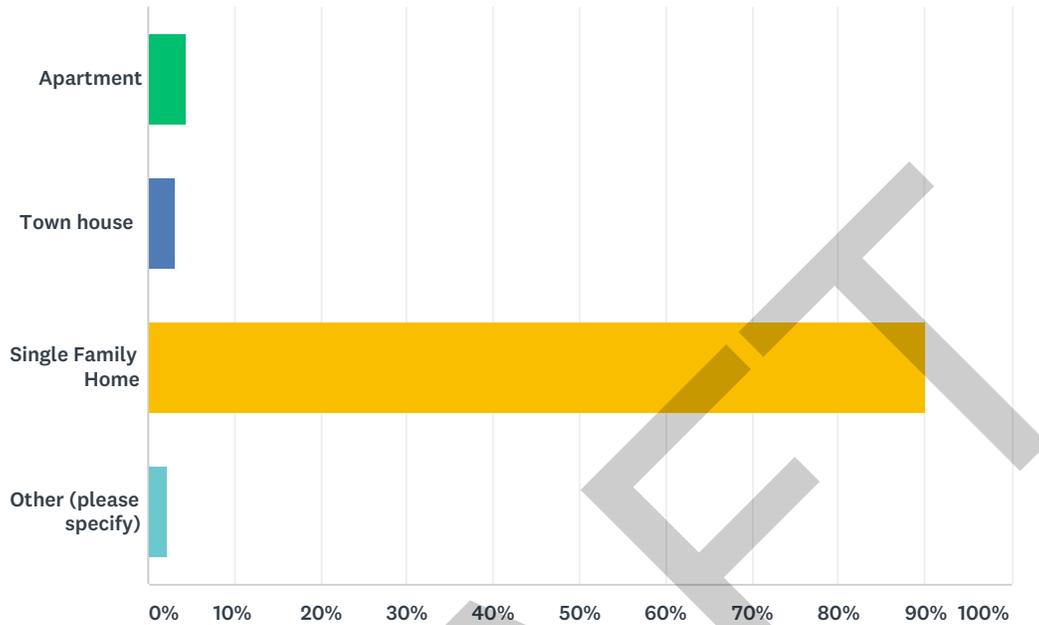
Answered: 1,655 Skipped: 0



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?

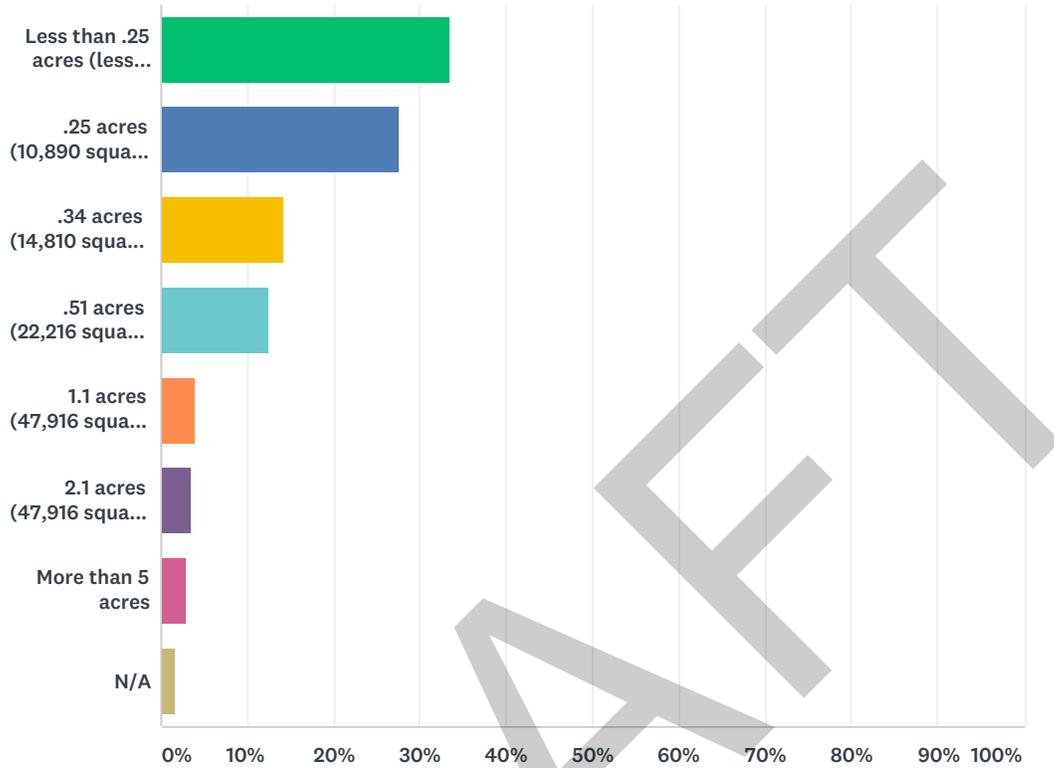
Answered: 1,655 Skipped: 0



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?

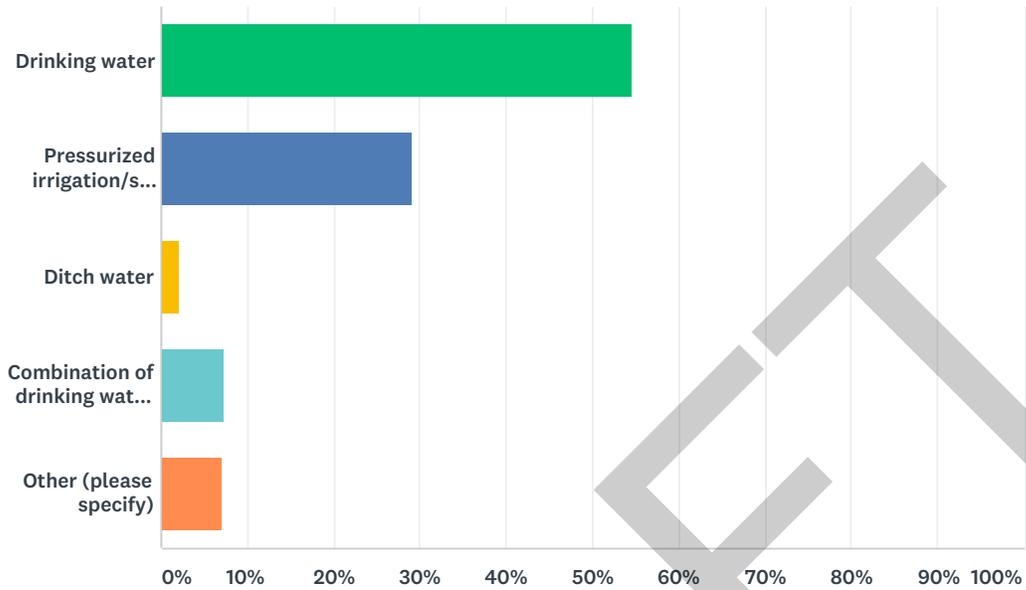
Answered: 1,644 Skipped: 11



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?

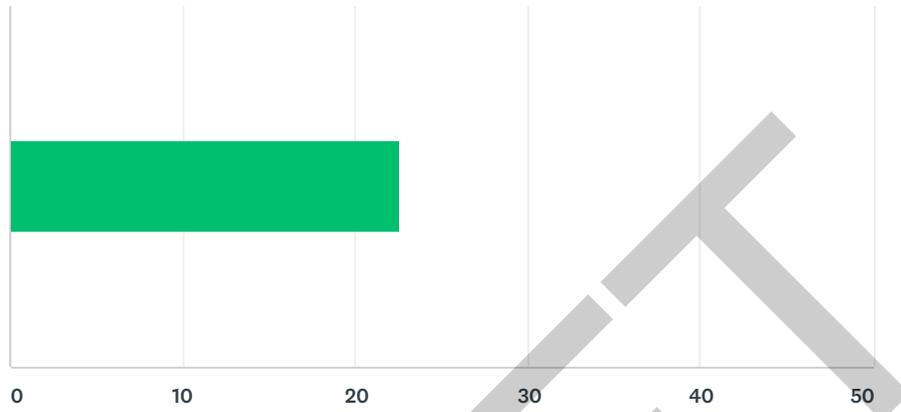
Answered: 1,646 Skipped: 9



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

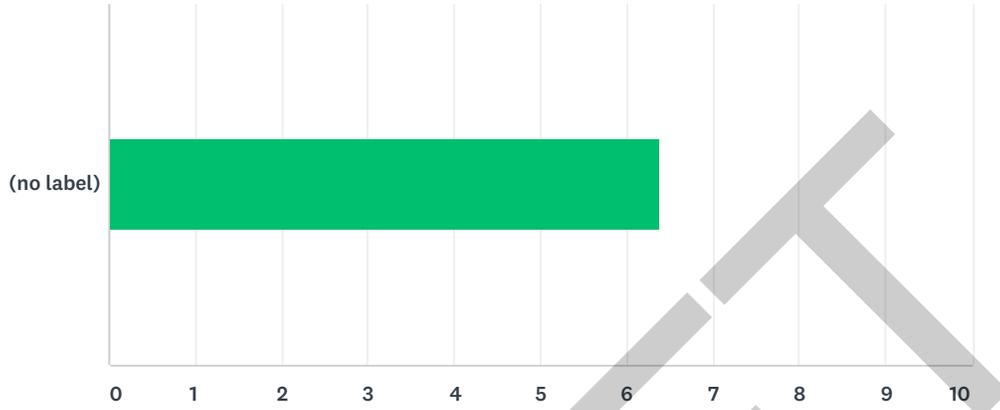


ANSWER CHOICES	AVERAGE NUMBER	TOTAL NUMBER	RESPONSES
	23	30,203	1,338
Total Respondents: 1,338			

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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?

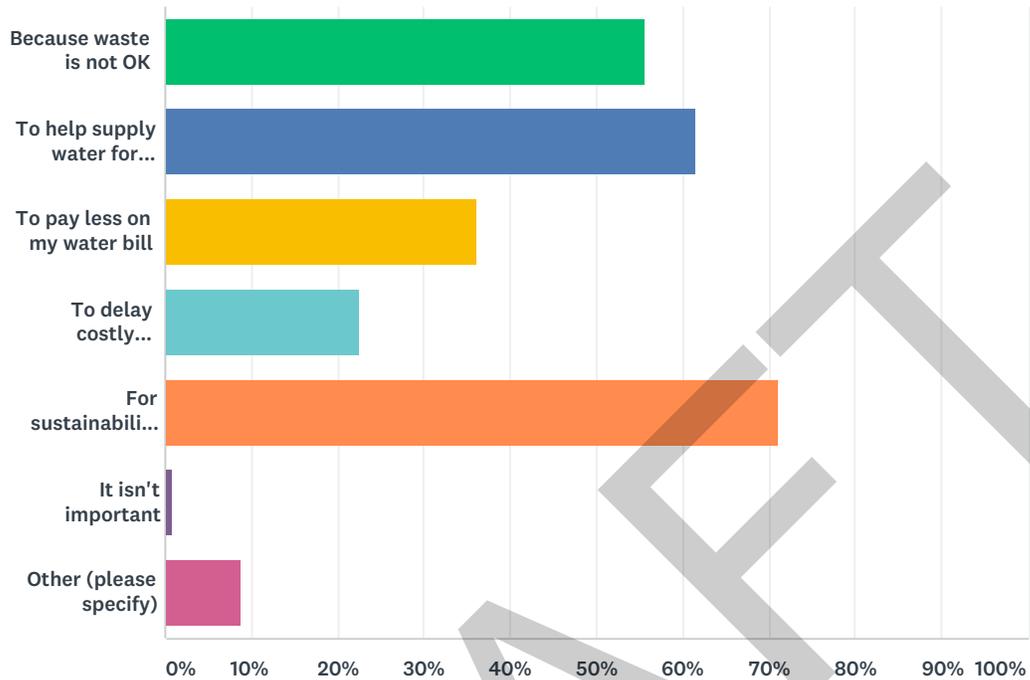
Answered: 1,407 Skipped: 248



	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?

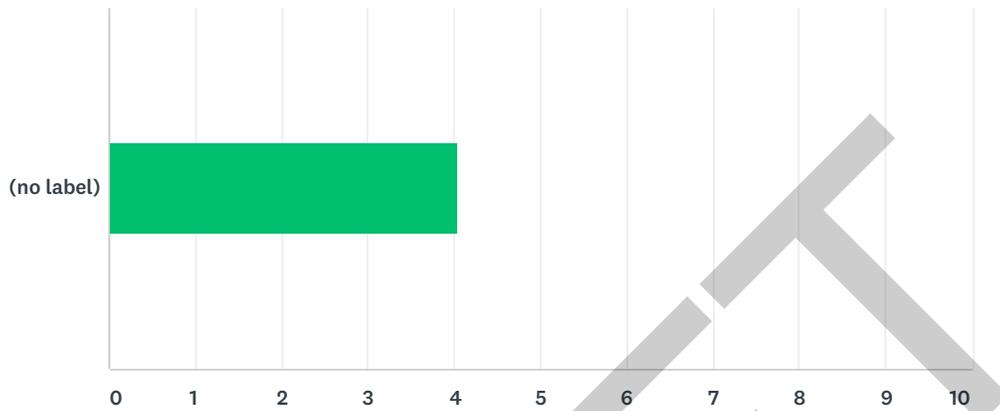
Answered: 1,402 Skipped: 253



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

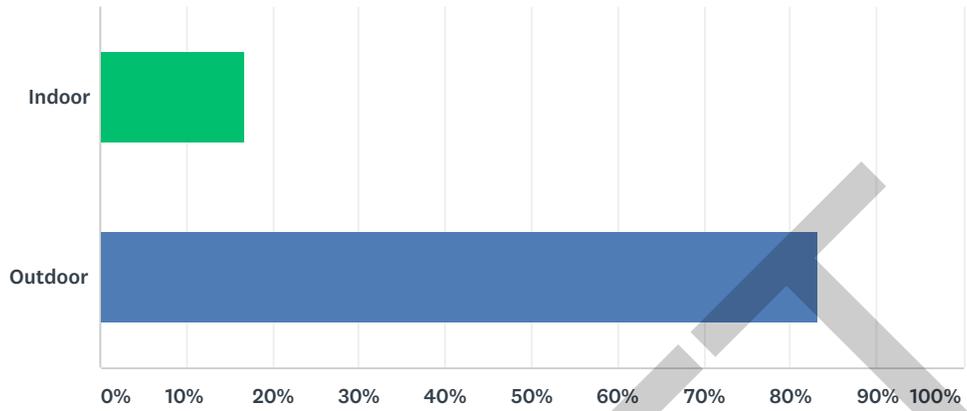


	1 (VERY UNWILLING)	2	3	4	5	6	7 (VERY WILLING)	TOTAL	WEIGHTED AVERAGE
(no label)	4.72% 66	14.58% 204	19.87% 278	28.09% 393	19.30% 270	7.58% 106	5.86% 82	1,399	4.03

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

Answered: 1,407 Skipped: 248

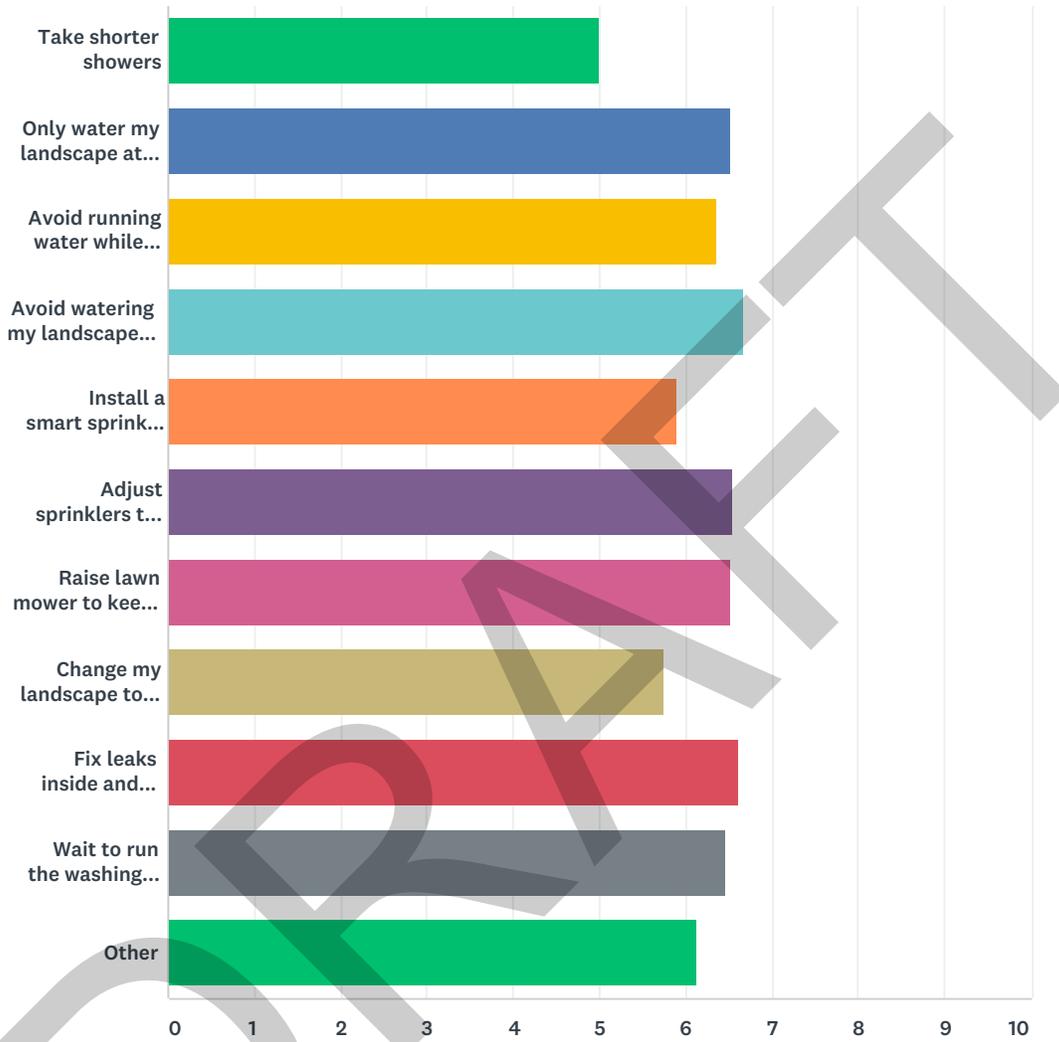


ANSWER CHOICES	RESPONSES	
Indoor	16.70%	235
Outdoor	83.30%	1,172
TOTAL		1,407

DRAFT

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

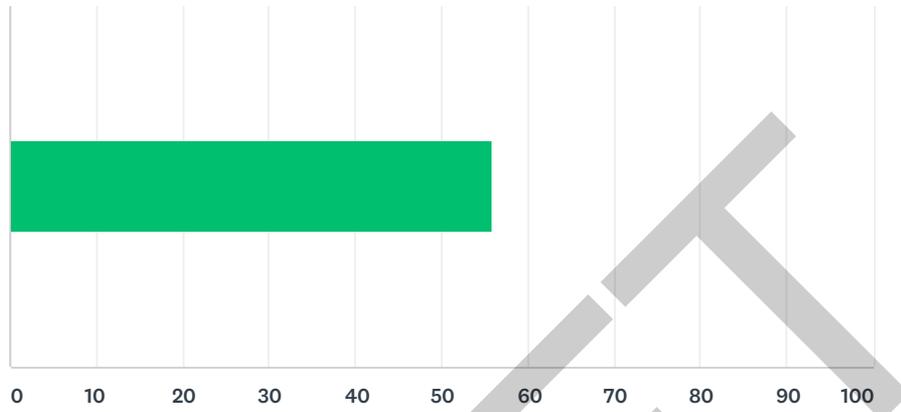
Utah's Regional Water Conservation Survey

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

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

Answered: 1,407 Skipped: 248

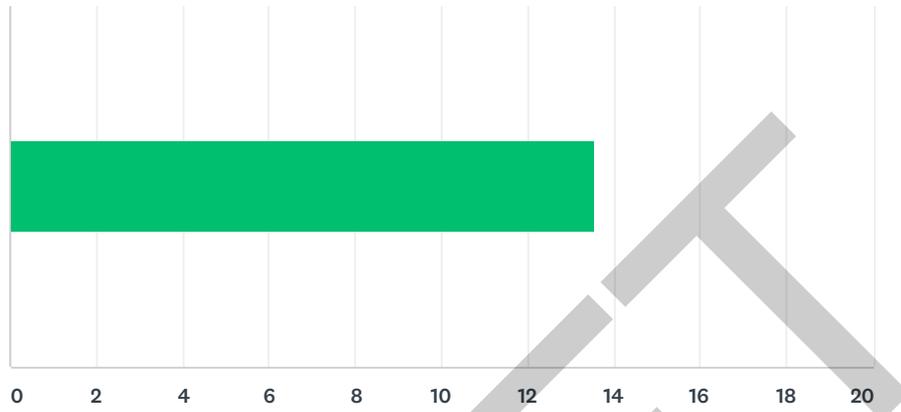


ANSWER CHOICES	AVERAGE NUMBER	TOTAL NUMBER	RESPONSES
	56	78,739	1,407
Total Respondents: 1,407			

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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

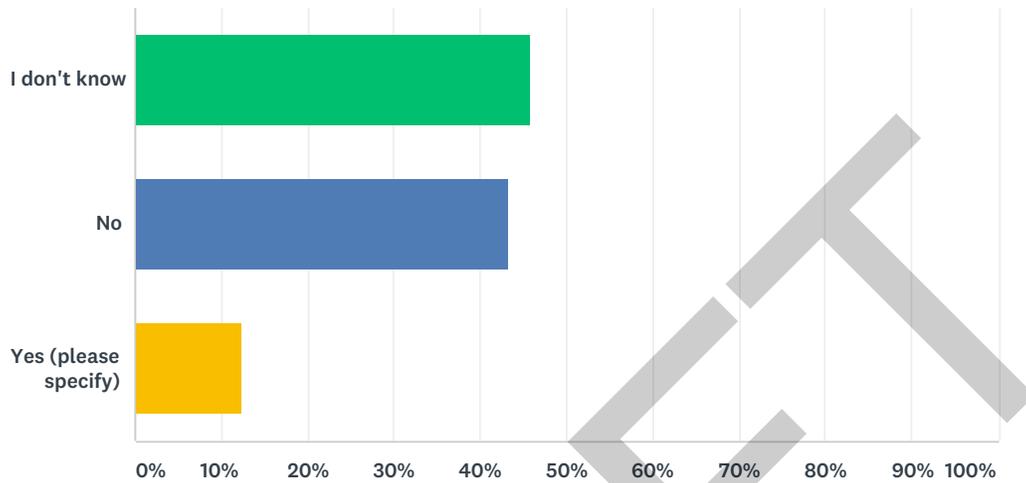


ANSWER CHOICES	AVERAGE NUMBER	TOTAL NUMBER	RESPONSES
	14	17,982	1,325
Total Respondents: 1,325			

DRAFT

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	

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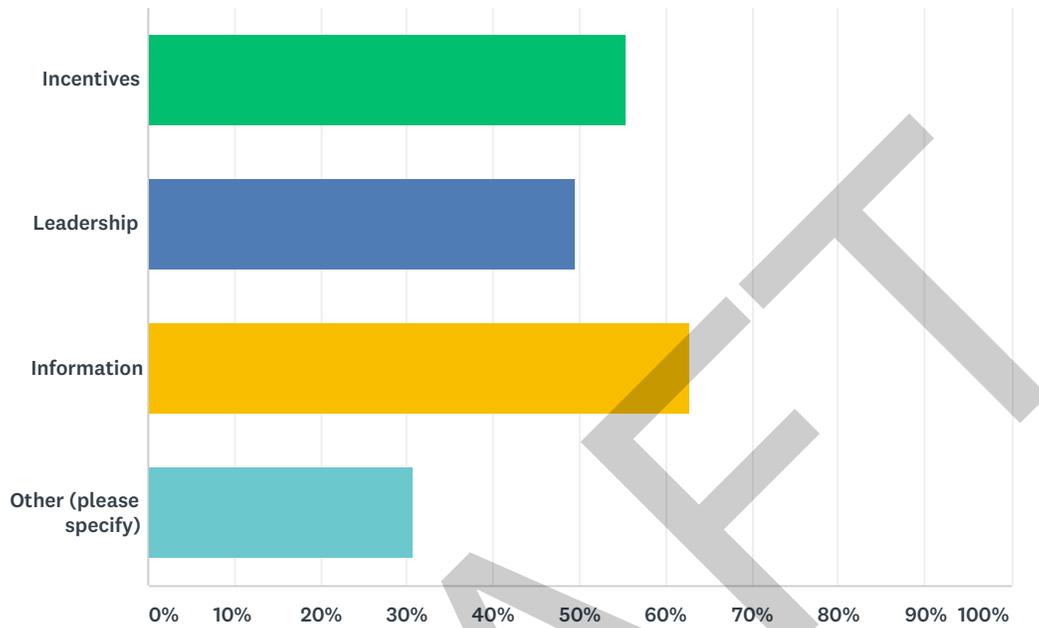
Q16 What is the organization and/or name and title of the person who takes the lead on water conservation programs in your community?

Answered: 1,118 Skipped: 537

DRAFT

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

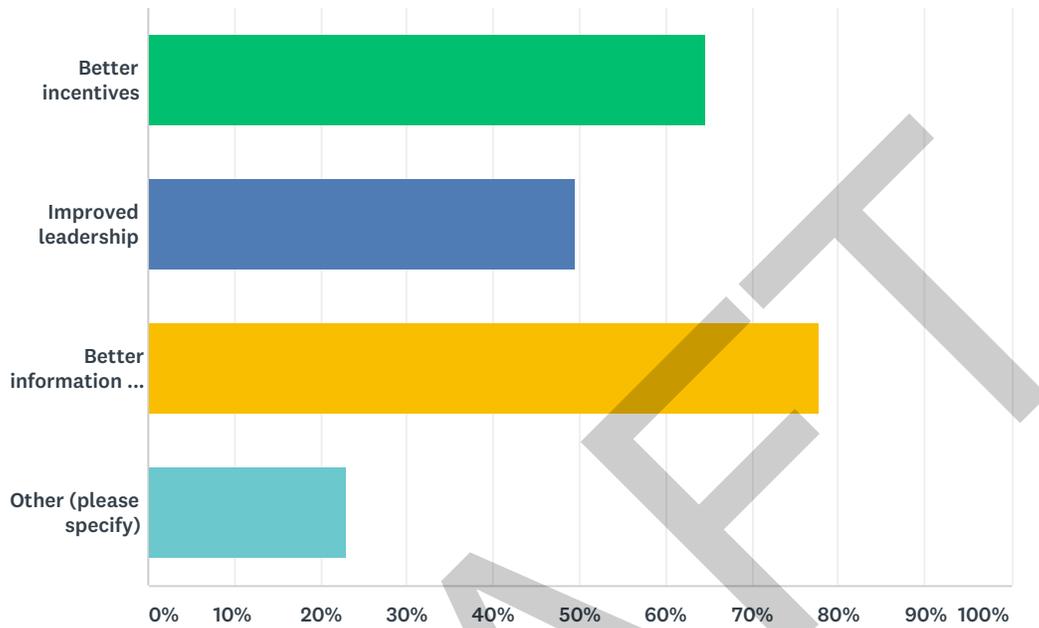
Answered: 1,407 Skipped: 248



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		

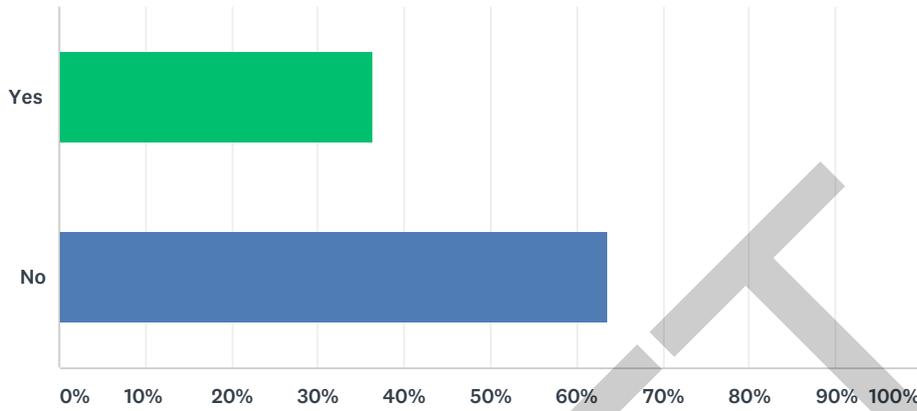
Q19 Please tell us about the regional factors or context that should be considered when setting conservation goals in your area?

Answered: 982 Skipped: 673

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Q20 Are you willing to be contacted for an interview?

Answered: 1,359 Skipped: 296

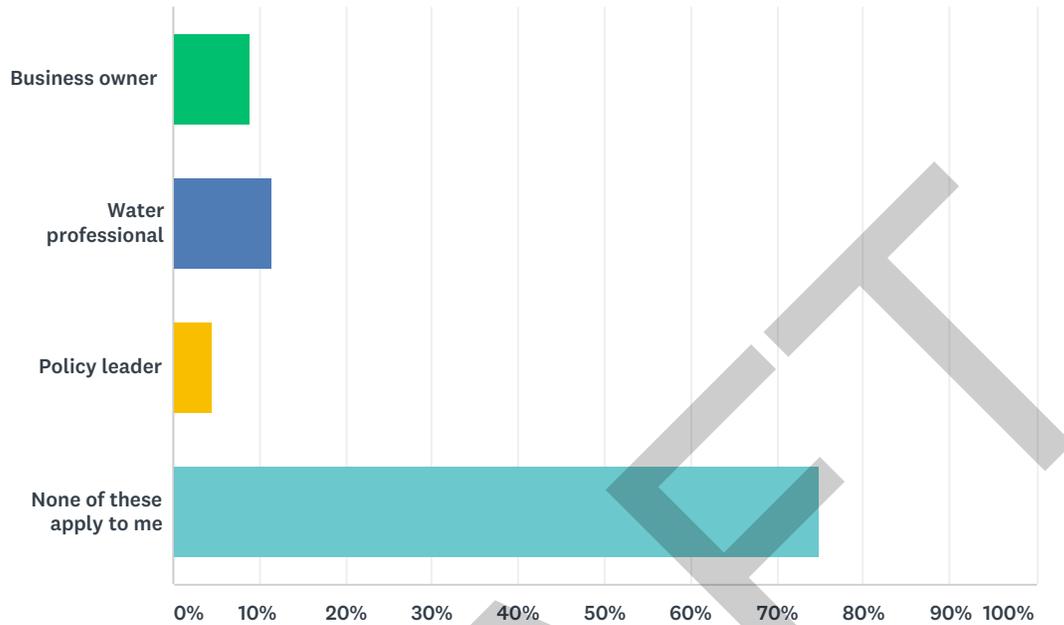


ANSWER CHOICES	RESPONSES	
Yes	36.50%	496
No	63.50%	863
TOTAL		1,359

DRAFT

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

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

Answered: 83 Skipped: 1,572

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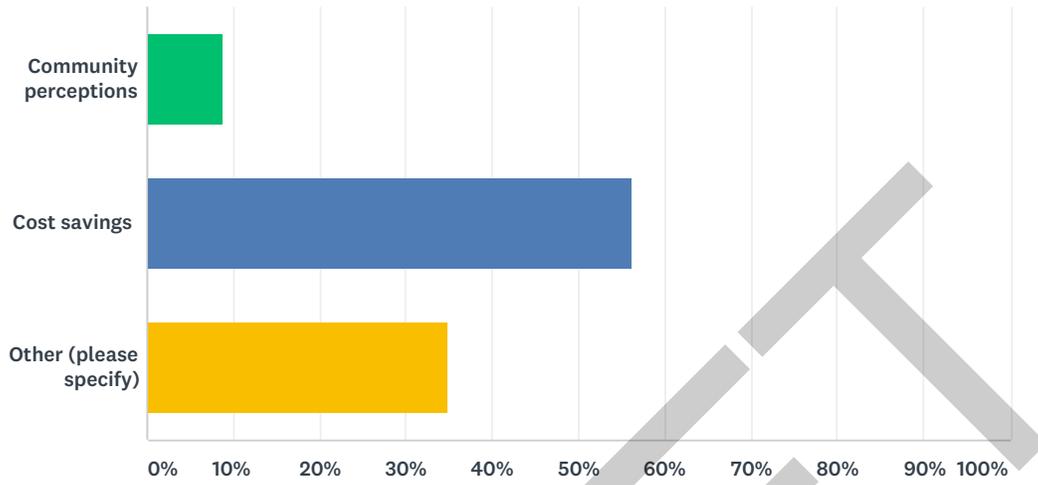
Q24 What water efficiency measures are being implemented at your business?

Answered: 82 Skipped: 1,573

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

Answered: 103 Skipped: 1,552

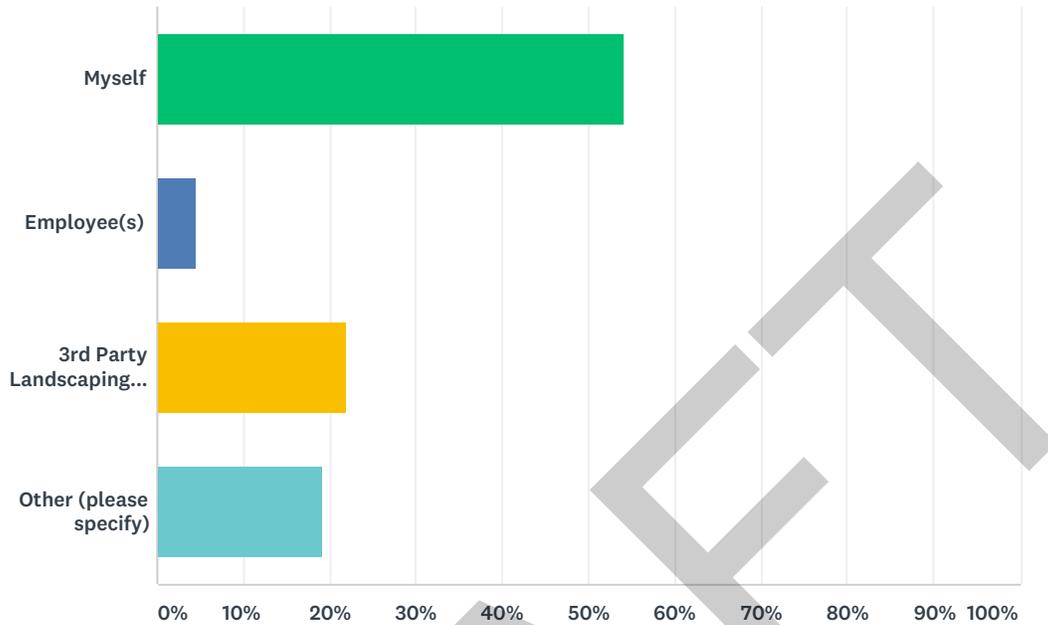


ANSWER CHOICES	RESPONSES	
Community perceptions	8.74%	9
Cost savings	56.31%	58
Other (please specify)	34.95%	36
TOTAL		103

DRAFT

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

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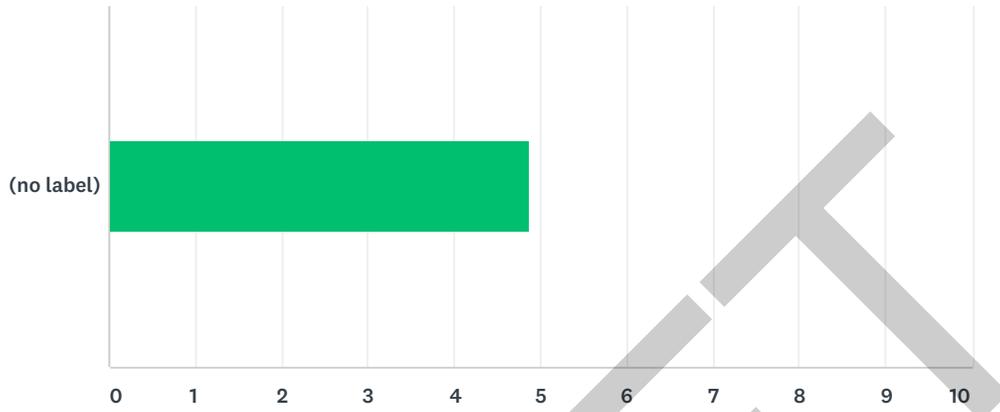
Q28 Which policies would help the State of Utah or your region become more water efficient (please specify whether the policy is a statewide or local policy)?

Answered: 43 Skipped: 1,612

DRAFT

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%	3.70%	9.26%	25.93%	24.07%	31.48%	5.56%	54	4.87
	0	2	5	14	13	17	3		

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

Answered: 143 Skipped: 1,512

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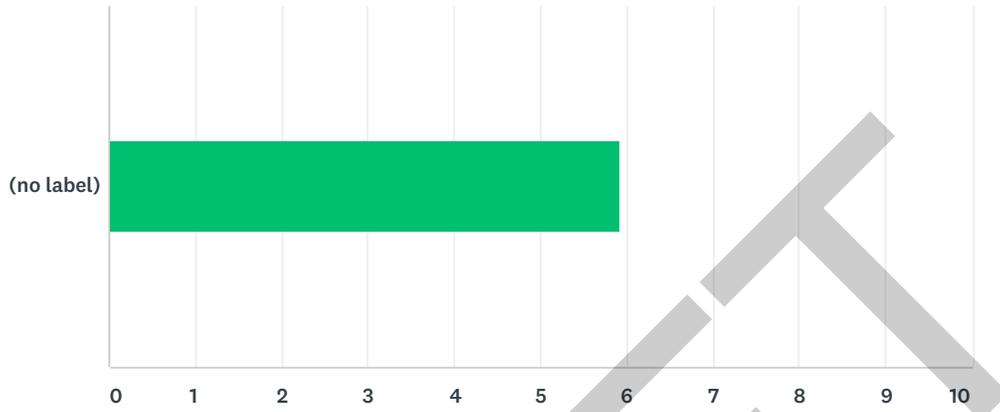
Q31 What, as a water professional, do you see as the greatest opportunities to improve efficiency in your area?

Answered: 140 Skipped: 1,515

DRAFT

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

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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

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Appendix B: Example Conservation Scenarios for
Public Outreach and Discussion Purposes

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Example Conservation Scenarios for Public Outreach and Discussion Purposes

INTRODUCTION

As discussed in Chapter 4, prior to gathering input from the community as part of the public outreach process, it was unknown what policies or practices the public and decision makers would like to see included as part of future conservation goals. This put the team in a bit of a “chicken or the egg” scenario. It was not possible to move forward on detailed conservation potential calculations without knowing which specific policies or practices to include, but it would be difficult to gather input on which policies and practices to include without understanding their potential to affect conservation.

To overcome this challenge, the project team prepared a series of three example conservation scenarios. These scenarios looked at what conservation could be achieved in each region given a sample set of assumed water use characteristics without worrying about the specifics of what policies and practices would be used to achieve those water use characteristics. The purpose of these example scenarios was to provide context and perspective to facilitate discussion during the public outreach and stakeholder coordination process. The purpose of this appendix is to explain the sample conservation scenarios developed and used during the public outreach process.

METHODS

To quantify water conservation potential by region and provide perspective for future discussions regarding goals, three example 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. 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 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 reflective of estimated water use practices 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 B-1 and as described below. For this and all factors to be discussed in this section, the assumed use in the scenario definitions would apply to both existing and future development.

Table B-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 assumptions 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 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 B-2 and as described below.

Table B-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 Study* (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 B-3 shows the water applied to each landscape area after establishment.

**Table B-3: JWCD 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	21.9
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 B-1 and as described below.

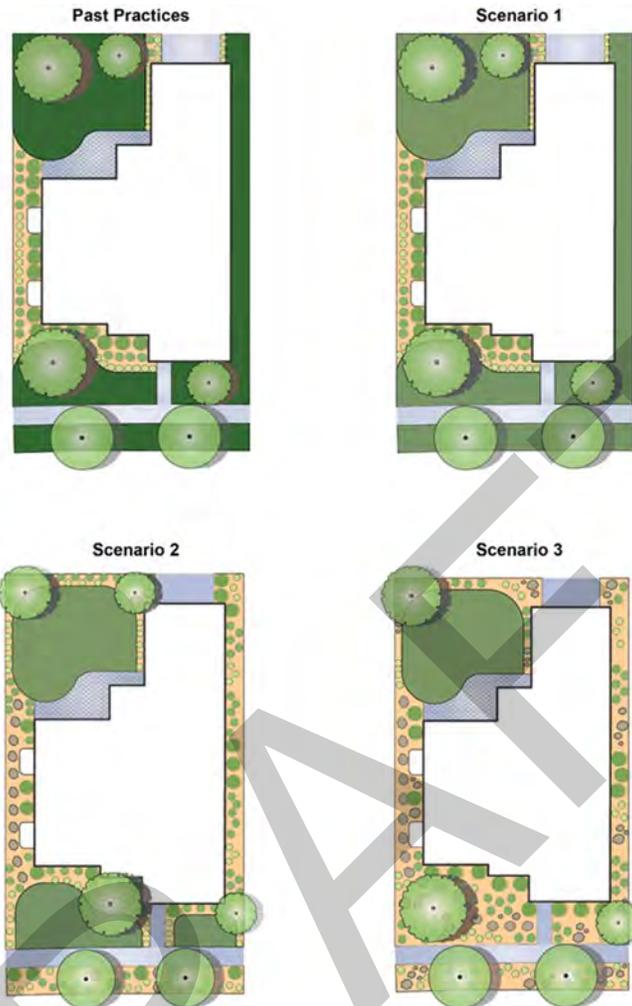


Figure B-1: Potential Scenarios for Residential Landscaping Practices

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.

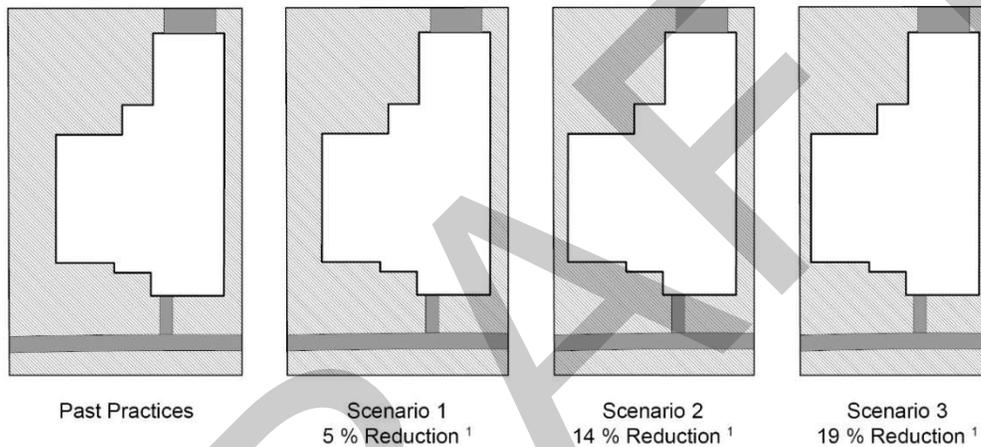
Household size is important because it affects the amount of residential landscape associated with each person. If residential lots continued to develop at the average lot size of the past but household size decreased, then the amount of irrigated acreage per person would increase over time. However, 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 B-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 B-2.



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

Figure B-2: Potential Scenarios for Decreases in Residential Lot Sizes

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

County	Average Single Family Lot Size (ft ²)	Average Landscaped Area Per Lot (ft ²)	Scenario 1	Scenario 2	Scenario 3
Beaver	16,234	8,117	7%	14%	24%
Box Elder	15,264	8,759	8%	15%	25%
Cache	12,805	7,770	6%	12%	24%
Carbon	12,149	6,075	4%	9%	17%
Daggett	11,419	5,710	0%	0%	10%
Davis	10,652	6,156	18%	18%	18%
Duchesne	13,882	6,941	5%	9%	21%
Emery	17,725	9,330	8%	16%	25%

Garfield	21,763	10,881	1%	1%	24%
Grand	12,713	6,356	8%	16%	20%
Iron	11,577	5,789	9%	18%	21%
Juab	17,986	9,109	10%	20%	43%
Kane	19,014	9,507	2%	4%	25%
Millard	25,875	12,938	6%	13%	31%
Morgan	21,033	10,704	11%	21%	45%
Piute	24,523	12,262	2%	3%	20%
Rich	20,150	10,075	4%	7%	28%
Salt Lake	8,463	4,239	14%	14%	14%
San Juan	14,607	7,304	14%	29%	33%
Sanpete	19,913	9,957	8%	17%	34%
Sevier	18,020	9,010	7%	15%	28%
Summit	16,063	8,031	5%	11%	28%
Tooele	12,138	6,069	11%	22%	25%
Uintah	16,889	8,445	9%	17%	28%
Utah	13,154	6,577	8%	16%	31%
Wasatch	19,113	10,294	10%	19%	45%
Washington	11,852	5,926	5%	11%	28%
Wayne	28,648	14,324	3%	5%	31%
Weber	11,880	6,828	7%	15%	18%
Statewide Average	11,300	5,899	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 7,280 square feet, the projected average lot size in Salt Lake County 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 (DWR 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.

Dendrohydrology 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; JWCD 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 B-3.



Figure B-3: 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 B-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 B-5: Potential Increase in Irrigation Needs Associated with Climate Change

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

OTHER WATER USE TYPES

Estimating water conservation potential for other types of water use was done following the same procedure defined in Chapter 4 of the main report.

RESULTS

M&I water use under these scenarios is summarized in Tables B-6 and B-7. Table B-6 summarizes water use by component and Table B-7 summarizes water use by region. See Appendix G for a summary of water use by county.

Table B-6: Potential M&I Water Use (gpcd) by Type

User Type	2015	Scenario 1	Scenario 2	Scenario 3
Res. Indoor	60	61	51	41
Res. Outdoor	108	95	70	48
Commercial	34	35	31	27
Institutional	33	32	28	26
Industrial	6	5	5	5
Total	240	228	186	148

Table B-7: Potential M&I Water Use (gpcd) by Region

Region	2015	Scenario 1	Scenario 2	Scenario 3
Bear River	304	275	230	180
Green River	284	261	216	169
Lower Colorado North	284	250	202	159
Lower Colorado South	305	335	267	214
Provo River	222	210	169	129
Salt Lake	210	204	168	139
Sevier River	400	339	276	208
Upper Colorado	333	292	231	186
Weber River	250	213	176	141
Statewide Average	240	228	186	148

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.

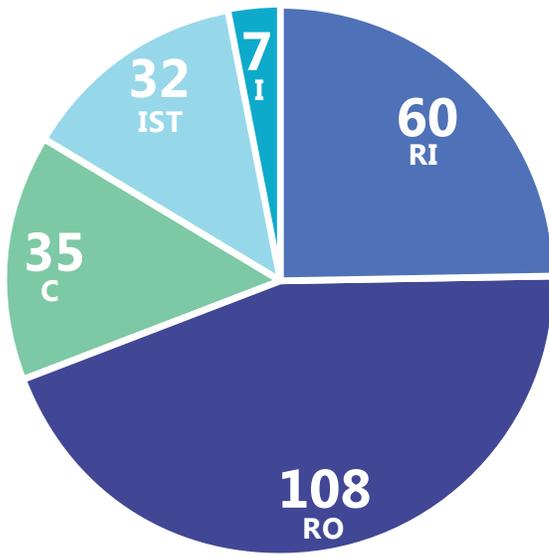
In reviewing Table B-7, it should be noted that, simply because a region has a 2015 use below the benchmark for a given scenario, it does not mean that the region has necessarily met all the assumptions associated with that scenario. Consider Lower Colorado South for example. Its 2015 use is below Scenario 1. 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 average residential turf grass use 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.

Appendix C: Open House Materials

DRAFT

WHERE ARE WE AT TODAY?

STATEWIDE WATER USE 2015

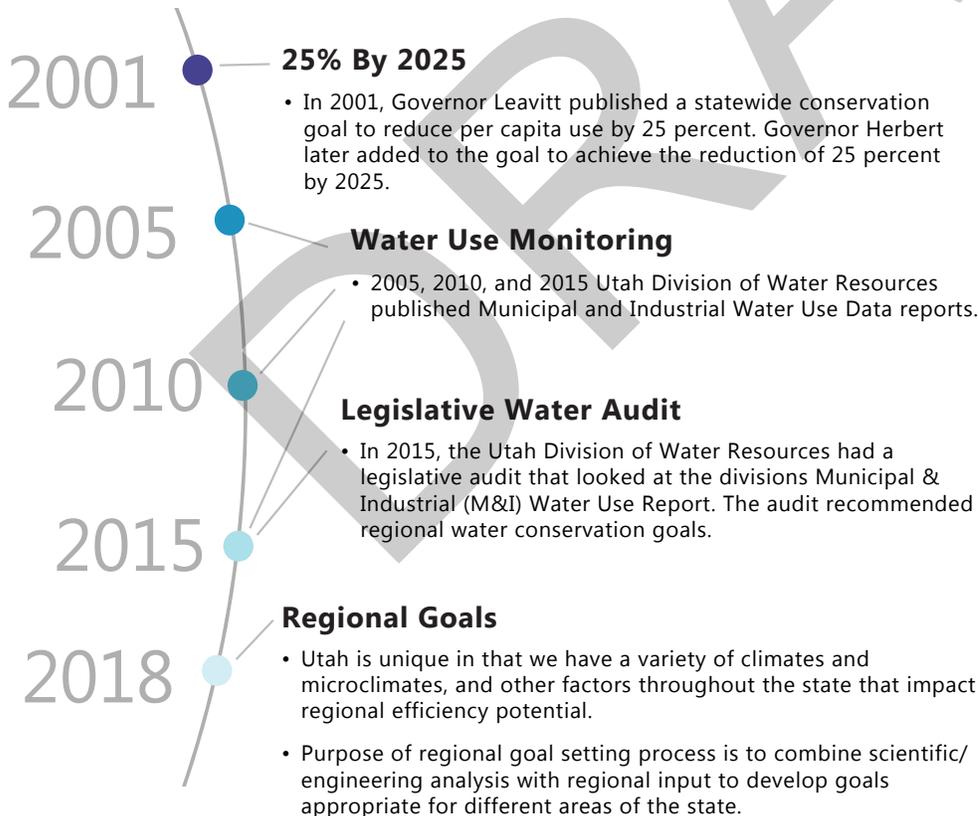


- I Industrial Water Use** - Manufacturing, plants, oil and gas producers, mining companies, dairies and stock watering.
- IST Institutional Water Use** - Various public agencies and institutions (i.e. schools, municipal buildings, churches)
- C Commercial Water Use** - Office spaces, retail businesses, 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?



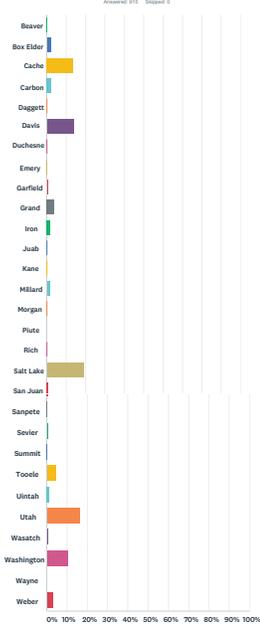
Major Recommendations Of The Legislative Water Audit

- 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?

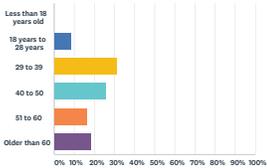


Q2 In which city do you live?

Answered: 813 Skipped: 2

Q3 How old are you?

Answered: 813 Skipped: 0



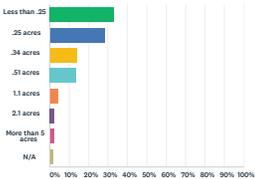
Q4 Which best describes your residence?

Answered: 918 Skipped: 0



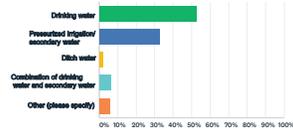
Q5 What is the approximate size of your property?

Answered: 814 Skipped: 1



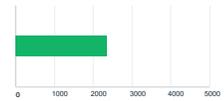
Q6 What source of water do you use to irrigate your landscape?

Answered: 214 Skipped: 1



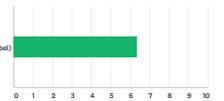
Q7 On average, how many gallons of water do you think your household uses daily, including indoor and outdoor use?

Answered: 770 Skipped: 16



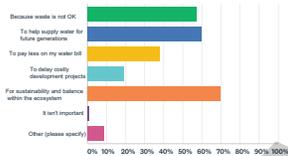
Q8 On a scale of 1 to 7, where 1 is not important and 7 is very important, how important is water conservation in the State of Utah?

Answered: 770 Skipped: 16



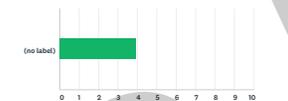
Q9 Why is it important to use water efficiently?

Answered: 770 Skipped: 16



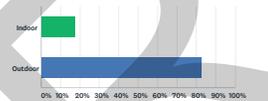
Q10 On a scale of 1 to 7, where 1 is very unwilling and 7 is very willing, how would you rate your community's willingness to conserve water?

Answered: 768 Skipped: 107



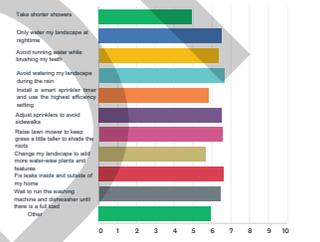
Q11 Where do you think you can save the most water?

Answered: 770 Skipped: 16



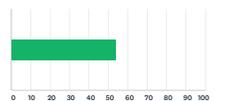
Q12 On a scale of 1 to 7, where 1 is very unwilling and 7 is very willing, how willing are you to do the following to become more efficient?

Answered: 770 Skipped: 16



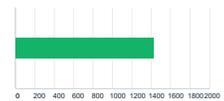
Q13 How much of your landscape are you willing to transition to water-wise plants and features?

Answered: 770 Skipped: 16



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: 161



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

Answered: 768 Skipped: 16



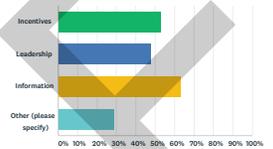
Q16 What is the organization and/or name and title of the person who takes the lead on water conservation programs in your community?

Answered: 610 Skipped: 300



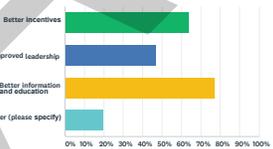
Q17 What are the barriers to water conservation in your community (select all that apply)?

Answered: 770 Skipped: 16



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

Answered: 770 Skipped: 16



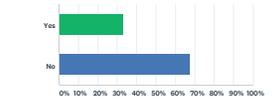
Q19 Please tell us about the regional factors or context that should be considered when setting conservation goals in your area?

Answered: 822 Skipped: 38



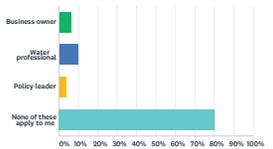
Q20 Are you willing to be contacted for an interview?

Answered: 770 Skipped: 16



Q21 Which of the following apply to you?

Answered: 770 Skipped: 16



BUSINESS OWNERS :

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

Answered: 31 Skipped: 168

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

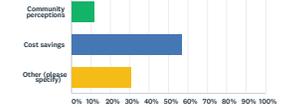
Answered: 31 Skipped: 168

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

Answered: 29 Skipped: 166

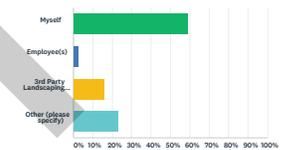
Q25 As a business person, what motivates you the most to conserve?

Answered: 102 Skipped: 673



Q26 Who manages the landscape at your business?

Answered: 44 Skipped: 671



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?

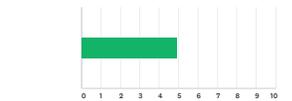
Answered: 24 Skipped: 191

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: 387

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: 160



WATER PROFESSIONALS :

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

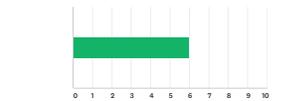
Answered: 61 Skipped: 169

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

Answered: 64 Skipped: 164

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: 165



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

Answered: 380 Skipped: 155

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: 377 Skipped: 128

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.



HOW MUCH WATER COULD WE SAVE ?

INDOOR WATER USE PROJECTIONS FOR DIFFERENT DEVELOPMENT PATTERNS



Inefficient Past Practices

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



Improved Efficiency

- 40% conversion to high efficiency fixtures and appliances.



Additional Efforts

- 80% conversion to high efficiency fixtures and appliances.



Maximum Conservation

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



Source: Water Research Foundation

OUTDOOR WATER USE PROJECTIONS FOR DIFFERENT DEVELOPMENT PATTERNS

Inefficient Past Practices



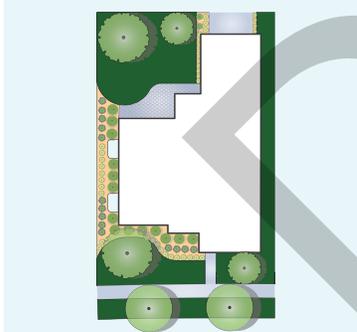
Improved Efficiency



Additional Efforts



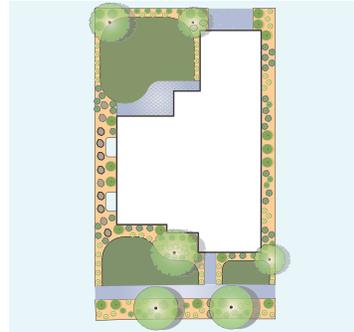
Maximum Conservation



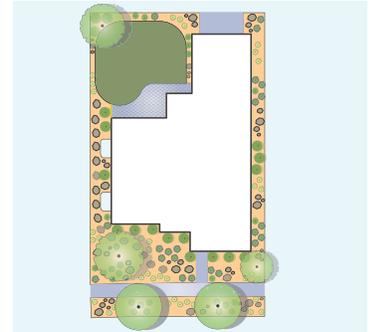
- Traditional Landscaping – 80% turf 20% planting beds and hardscaped areas.
- Historic irrigation efficiency = 50% (Double the amount needed)



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



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



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



GOAL SETTING METHOD



ADDITIONAL RESOURCES



Water.Utah.Gov/H2Oath



Water.Utah.gov/FameOrShame



ConserveWater.Utah.Gov/guide.html



UtahWaterSavers.com



Locascapes.com



EPA.gov or WaterSense.com



SlowTheFlow.org



WaterConservationCertification.com

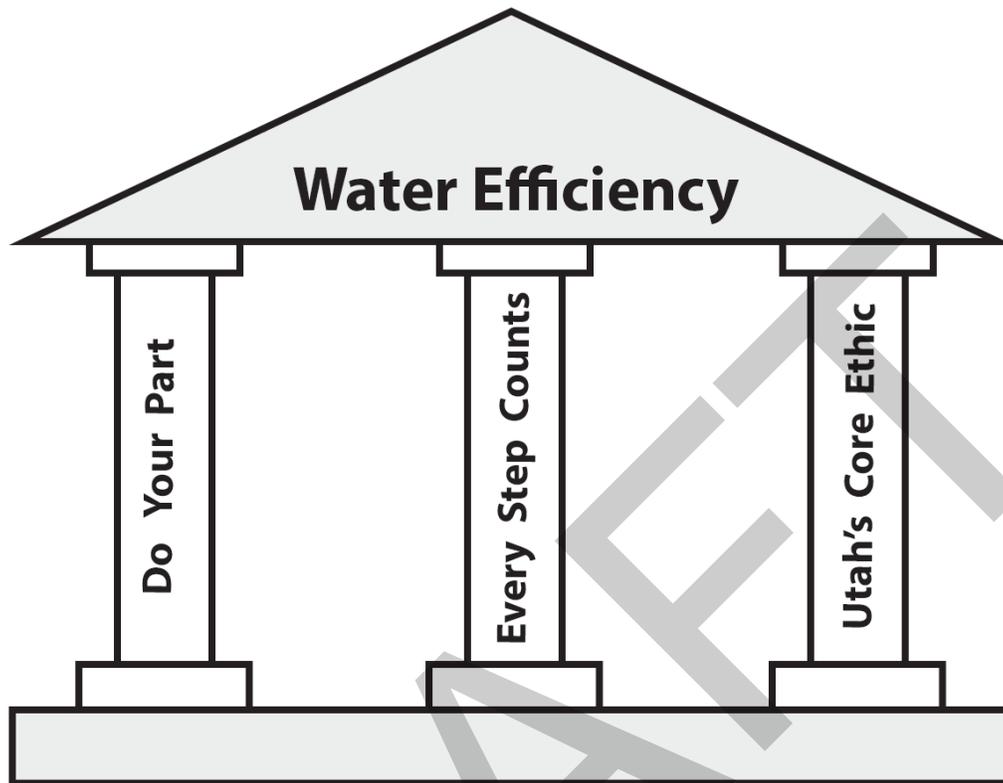


UtahWaterConservationForum.org



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 D: Stakeholder and Open House Comments

DRAFT

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 following 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. JWWCD 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 E: List of Interviewees and Reviewers

DRAFT

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
Kristin Cox, Governor's Office of Management and Budget
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
Stephanue Duer, Salt Lake City Department of Public Utilities
Michael Fazio, City of Bluffdale
Christine Finlinson, Central Utah Water Conservancy District
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
Todd Schultz, Jordan Valley Water Conservancy District
Gene Shawcroft, Central Utah Water Conservancy District
Marcelle Shoop, National Audubon Society
Brad Stewart, Salt Lake City Department of Public Utilities
Nate Talley, Governor's Office of Management and Budget
Brie Thompson, Washington County Water Conservancy District
Ron Thompson, Washington County Water Conservancy District
Gerard Yates, Central Utah Water Conservancy District

Appendix F: Meeting Notes

DRAFT

**Utah Division of Water Resources
Regional Water Conservation Goals
Kickoff Meeting Notes
July 12, 2018**

1. Introductions

Attending:

Rachel Shilton, DWRe, River Basin Planning Manager
Todd Adams, DWRe, Deputy Director
Candice Hasenyager, DWRe, Assistant Director of Planning
Josh Palmer, DWRe, Water Efficiency and Engagement Manager
Aaron Simon, DWRe, GIS Analyst
Russ Barrus, DWRe, State Water Plan
Steve Jones, HAL, Project Manager
Rob Sowby, HAL, Project Engineer
Keith Larsen, BC&A, Project Engineer

Excused (to attend in future):

Faye Rutishauser, DWRe, Water Conservation Manager
Adam Clark, DWRe, GIS Analyst
Mike Collins, BC&A

2. Project Overview

- a. Scope review
- b. Goals
 - i. Establish regional boundaries
 - ii. Recommend regional water conservation goals
- c. Schedule

3. Approach to Project

- a. "Blender"—Multivariable linear regression (or similar model) to identify important influencers of M&I water use, assist with region definitions, and inform goals and practices
 - i. Offers transparency—"We considered it"
 - ii. Scenario modeling
 - iii. Statistical rigor and defensibility
 - iv. Rob to provide list of suggested explanatory variables (precipitation, % indoor use, population, etc.)
 - v. Ask in outreach—what variables to consider
 - vi. Survey stakeholders—develop trust in the approach
- b. Range of conservation options
 - i. Avoid specific numbers; give ranges—low, mid, high
 - ii. Don't "demonize" water—OK to use it
 - iii. Purpose is to inform and make progress
- c. DWRe will trust consultant approach and recommendations; don't want to influence too much
 - i. Public outreach important—firsthand feedback
- d. Timing is good for public discussion
 - i. Legislative audits

- ii. Water use program improvements
- iii. Drought
- iv. 2015 water data release (data portal)
- e. What's most important?
 - i. "Define regions, set goals"
 - ii. Objective criteria by which to make recommendations; third party adds objectivity and credibility
 - iii. Regions must make sense to public (e.g., counties, not river basins)
 - 1. Know what efficiency potential is
 - 2. Act accordingly
 - iv. Empower water suppliers to make decisions
 - v. Cost
 - vi. "Goal must stretch us"—past goals maybe not aggressive enough
- f. "How do you use these numbers?"
 - i. Collaborating with communities to set goals and implement practices
 - ii. Inform local water conservation plans
 - iii. "Grading" water conservation plans
 - iv. Potential funding incentive for plans or goals
 - v. State Water Plan
 - vi. Water Demand Model (planning scenarios)
 - vii. Consistent messaging—"This is your goal"
- g. Deliberately limited planning window
 - i. Known practices and technologies
 - ii. Revise goal as new information arises

Outreach

- Step 1—Initial effort these (LEAP)—DWR to prioritize and help make contact
 - Legislative
 - Water Development Commission
 - Executive Water Task Force
 - Friends of Great Salt Lake
 - Auditors
 - NREA interim
 - Water Strategy Team
 - Tim Hawks
 - Warren Peterson
 - Executive
 - Evan Curtis
 - Phil Dean
 - Alan Matheson
 - Gov. Herbert, Lt. Gov. Cox
 - Administrative
 - Prep60 (WBWCD, JVWCD [Matt Olsen, Cynthia Bee], CUWCD, WCWCD)
 - City water conservation specialists, including rural
 - Water districts
 - Marie Owens
 - Kent Jones
 - Tage Flint
 - Clyde Watkins

- Gawain Snow
 - Vonnene Jorgensen
- Public
 - Nature Conservancy
 - Audubon Society
 - Utah Rivers Council
 - Trout Unlimited
 - Conserve Southwest
 - Academic
 - Kelly Kopp
 - Adrea Wheaton
 - Courtney Flint
 - Candice _____ (Cedar City)
 - Business
 - Landscaping
 - Manufacturing
 - Chambers of Commerce
- Step 2—Meetings with water suppliers
 - Share draft results before public meetings
- Step 3—Meetings with public
 - One meeting in each proposed region
 - Receive comments
 - Use DWRe staff
 - DWRe creates strategic communications plan (demographic analysis, social media, video, in-person meetings)

4. **Establish Geodatabase Specs**

- Geodatabase format as deliverable
- UTM Zone 12
- Attribute fields
- Metadata to describe fields, units, data sources, etc.
- Work with Adam Clark directly

5. **Next Meeting**

Thu. Aug. 2, 2018
 3:00–4:30 PM
 DWRe Room 314

Assignments

- Steve: Distribute meeting notes
- Rob: Suggest variables for survey
- DWRe: Prioritize outreach list
- Josh: Prepare survey

Utah Division of Water Resources
Regional Water Conservation Goals
Progress Meeting Notes

Aug. 2, 2018

Attendees

Steve Jones, Rob Sowby, Keith Larson, Rachel Shilton, Candice Hasenyager, Todd Adams, Arthur Guo, Ashley Nay, Russ Barrus

Assignment follow-up

Josh: Survey progress. Todd is following up with Josh to have a draft next week.

File sharing and data requests

Just received green space data. Everything else requested has been received.

Public outreach plan

- Meeting Fri. Aug. 10, 1:00–3:00 PM to discuss survey content
 - Josh to draft questions
- By Aug. 16: Send survey to large list
 - Get input on the thinking about water conservation
 - Like Envision Utah
 - What should be considered when developing goals
 - E.g., transient population in SLC and second homes in St. George
 - Community willingness to adopt certain practices
 - Include question about interest in having a more in-depth interview
 - DWRe has email addresses for most on the list
 - Josh consider posting on website (minus interview question)
- By Aug. 30: Receive responses
- Review responses and identify key people to meet with in person during early September based on interest indicated on survey and variety of background
- Share draft before public meetings in October or possibly earlier through website
- Public meetings
 - Purpose is to get input
 - Early October
 - Need to identify venues and times to notify
 - DWRe to draft list of locations
 - SLC/JVWCD
 - WBWCD/Layton
 - CUWCD/Provo/Orem
 - Logan/Cache Co.
 - Richfield
 - Price
 - Tooele/Delta

- Monticello
 - St. George
 - Uinta Basin/Roosevelt
 - DWRe to set up meetings
 - DWRe to make press release
- Start in SLC to generate buzz
 - Invite media
- Consulting team to lead/facilitate meetings
- Draft report by October—make available to public
 - Public summary, 1 page
 - Full version to satisfy certain groups
 - GSL Advisory Council
 - Utah Rivers Council
 - Nature Conservancy
 - Etc.
 - Maybe present during interim legislative meeting

Statistical model progress

Good approach; need to consider green space, secondary systems, and finer resolution (water system vs. county level)

Assignments

- Josh and team: Draft questions for survey and prepare for Aug. 10 meeting; work with Keith
- Rachel: Compile email addresses
- Todd: Draft list of public meeting locations (see above)
- Barbara: Set up meetings and post on website
- Rob: Continue statistical analysis
- Keith, Steve, Rob: Develop schedule, critical path

Next meeting

Survey Preparation Meeting

Fri. Aug. 10, 1:00–3:00 PM

DWRe room 314

**Utah Division of Water Resources
Regional Water Conservation Goals
Progress Meeting Notes
Sept. 13, 2018**

Attendees

- DWRe: Rachel Shilton, Aaron Austin, Josh Palmer, Brooke Olsen, Jamie Tsandes, Arthur Guo, Marcie Larsen, Candice Hasenyager, Adam Clark, Russ Barrus, Todd Adams
- Consultant: Steve Jones, Rob Sowby, Keith Larson, Mike Collins

1. Survey results (Josh)

- 722 responses as of this morning; average 70 per day
- Expect to double in 4 weeks
- Cache, Davis, Grand overrepresented
- Utah, Salt Lake, Weber underrepresented
- Josh to push for local responses in certain counties so each is represented
- Closing date Oct. 19, after open houses; may need to extract data sooner for analysis, but can still continue to gather feedback
- Largely positive response, perhaps due to drought
- Results
 - Q7 average guess 25,000 gal/day
 - Q8 average importance 6.3 out of 7
 - Q9 top reasons: sustainability, future generations, waste not OK; bottom reasons: cost savings, delay projects
 - Other: many mentioned desert, drought, and preserving GSL
 - Q10 community willingness 4.0 out of 7
 - Disconnect from 6.3 importance in Q8
 - Show gratitude for those already conserving
 - Q12 willingness toward specific practices: most around 5 out of 7
 - Which ones cost money? Trend lower?
 - Q13 willing to transition 52% of landscape to water-wise
 - Likely correlate with those willing to take survey
 - Q15 need to determine specific cities/counties for policy hotspots
 - Q17/18 better *information* is best opportunity, more than incentives and leadership
 - Must come from city government—users may not identify their water supplier or be willing to listen to state
 - 409 text responses to analyze
 - Q25 cost savings motivate businesspeople to conserve
 - Q26 most business landscapes are self-managed
 - Q29 average 4.9 out of 7 importance of water conservation to constituents—disconnect from 6.3 importance in Q8
- Rob has access and will start examining patterns

2. Conservation potential (Keith)

- In 2015, 242 gpcd statewide
- 3 scenarios on potential:
 - 192 gpcd (-21%) conservative
 - 165 gpcd (-32%) moderate
 - 137 gpcd (-44%) aggressive

- All assume 0% contribution from industry; consider 3% or 5% goal for industry to make message consistent
 - All assume commercial and institutional potential is half of residential potential
 - Industrial is only 3% of all M&I use in 2015
 - Potential separate from goal
 - Indoor
 - 60 gpcd conservative
 - 50 gpcd moderate
 - 40 gpcd aggressive
 - Outdoor varies by application rate
 - Conservative: about 30 inches
 - Moderate: about 24 inches
 - Aggressive: about 18 inches
 - Accomplish by transitioning to water-efficient landscapes and reducing waste
 - Assume increased density in certain counties (smaller new lots and high density redevelopment of old lots)
 - Conservative: same density, more irrigated area
 - Moderate: greater density, same irrigated area
 - Aggressive: greater still density, less irrigated area, assume average 2065 lot size in SLC
3. Approach to goal setting (Steve)
- Scale of goals based on conservation potential, survey results, and correlated factors
 - Example of Denver: setting goal based on percentage of users who are using water efficiently
 - Must consider costs
 - To user: e.g., per square foot of turf converted
 - To state/legislature: level of support needed
 - How to define goal—gpcd number, percentage reduction, or other? How to communicate
 - Gpcd number preferred
 - Scenario approach is preferred
4. Plan for public outreach (Rachel/Keith)
- a. Schedule
 - Dates are set
 - b. Venues
 - Venues TBD
 - c. Attendance assignments
 - 2 consultants
 - Josh or Marcie
 - 2 other DWRe
 - d. Materials and communication tools
 - Poster showing conservation scenarios and pictures, including in-between scenarios to show stepwise process
 - Careful on comparisons, especially secondary; potable OK
 - Don't show 2000 values—start from 2015 (“today”)
 - Note audits, reports, etc., improved data
 - Consider one-question survey on preferred scenario (after viewing posters)

- DWR_e will provide tablets and papers
 - Regional maps (2–3 counties each)
 - DWR_e to provide maps
 - Poster assignments by BC&A
5. Plan for report development (Rob/Steve)
- Rob to provide outline early next week
6. Next meeting
- Before first open house
 - Review materials and plans
 - **Thu. Sept. 20, 2018, 1:30–3:30 PM, DWR_e**

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**Utah Division of Water Resources
Regional Water Conservation Goals
Progress Meeting Notes
Sept. 20, 2018**

1. Discussion of draft goals
 - a. Major decisions
 - i. Approach—OK. Data and assumptions may change.
 - ii. Regions—8 board districts; public meeting in each. Also show county goals.
 - iii. Percent vs. GPCD—Use both. Each has its own purpose and communication value.
 - iv. Timeline—Need multiple goals. Can adjust goals according to timeline. Exact timeline to be determined by practices, cost, implementation. For planning:
 1. 2030—proportion of next scenario
 2. 2040—as planned
 3. 2065—don't go below floor
2. Open house preparation
 - a. Materials (Keith/Jamie)
 - b. Attendance (Keith)
 - c. Logistics (posters, equipment, travel, setup, access...)
3. Draft report outline (Rob)
 - a. Review and respond by Mon. Sept. 24
4. Update on survey results (Josh/Rob)
5. Next meeting
 - a. Wed., Oct. 24, 2018, 1:30 PM

**Utah Division of Water Resources
Regional Water Conservation Goals
Progress Meeting Notes
Oct. 30, 2018**

Attending: Rachel Shilton, Todd Adams, Candice Hasenyager, Marcie Larson, Joel Williams, Russ Barrus, Steve Jones, Rob Sowby, Keith Larson

1. Outcome of public involvement
 - a. Survey (complete—1,655 responses)
 - b. Open houses (complete)
 - i. Experience improved with each one
 - ii. Attendance improved with each one
 - iii. Good quality of interaction, personal attention
 - iv. Diverse attendance
 - c. Stakeholder interviews (in progress)
 - i. Show progress since 2000, but acknowledge limited data and different methods in the past. New baseline is 2015 for reasons of data quality and improved methods. Use this opportunity to explain why 2000 baseline is no longer valid.
 - ii. Use State Water Plan meeting to connect with others to be interviewed
 - iii. Regions:
 1. Split Lower Colorado into North and South (separate Washington Co. from Iron)
 2. Rich County its own region? Second homes make different GPCD and practices should focus on second homes—no, keep in region.
 3. Split into 29 counties? No, more reliable data when grouped into regions.
 4. 9 regions total.
 - d. Lessons learned
 - i. Advertise earlier
 - ii. Advertise with multiple methods—social media, newspaper, website, radio, TV news
 - iii. Consider presentation first, then follow-up interaction
 - iv. Venue: water district or community space? Advantages to both.
 1. District: show unity, recognize important “boots on the ground” role in water conservation
 2. Community: Neutral location, not “tool of the district,” more public
 3. Best: meet with districts first to get their support, then go to public meetings
 - e. Notes to be discussed Friday
2. Revised approach to goal setting
 - a. Conservation practices and costs
 - i. Persuade, bribe, force
 - b. Conservation potential
 - i. Still missing how to connect potential to practices; some judgment required.
 - c. Climate change
 - i. 18% increase in ET? Rob Gilles
 1. Differs by county, especially precipitation
 - ii. Water demand will increase as a result of climate change

- iii. Climate change will motivate water conservation
 - d. Regression model
 - i. Improved accuracy and significance
 - e. Others
 - i. 2065 goal to be communicated as “long-term goal”
 - ii. Remove floor from scales
 - iii. Show fuzziness
- 3. Schedule for completion
 - a. Report
 - i. Draft report to water districts, or summary figure?
 - 1. Key figure(s) plus sufficient explanation
 - ii. 4 reviews: DWRe, water districts, legislature, public
 - iii. Clarify expectations; what will we do with the comments
 - iv. HAL/BC&A to prepare timeline for completion
 - b. Presentations
 - c. Contract to be extended to March
- 4. Next meeting
 - a. State Water Plan advisory committee—Thu. Nov. 1
 - b. Compile notes—Fri. Nov. 2

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Regional Water Conservation Goals

Progress Meeting Notes

Dec. 21, 2018, 9:00 AM, DWRe

Attending: Rachel Shilton, Todd Adams, Faye Rutishauser, Josh Palmer, Joel Williams, Marcie Larson, Candice Hasenyager, Rob Sowby, Steve Jones, Keith Larson

Stakeholder Involvement

A report draft (v0) was shared with the following stakeholders during the week of Dec. 3 with comments requested by Dec. 10:

- JVVCD (comments received)
- WBWCD (comments received)
- CUWCD (comments received)
- WCWCD (declined comment on this draft)
- MWDSLS (responded no comment)
- BRWCD
- SLCDPU
- Bluffdale
- DDW
- Trout Unlimited
- Audubon Society
- Friends of GSL (comments pending)

Consultants met with DWRe last week to discuss comments and plan revisions. Keith met with JVVCD and adjusted density assumptions with better data (see below). A new draft of the report (v1) was shared with DWRe prior to today's meeting.

Stakeholders' involvement has significantly improved the quality of the work. Diversity of relationships with water districts, environmental groups, and local officials improves credibility of study. We hope they will promote these goals to their constituents and public media.

Rachel and Josh's report on meeting with WBWCD

- WBWCD wanted to show progress since 2000, but not to their benefit considering recent data issues and audits. Might lose legitimacy referring to questionable historic data.
- Give credit for efforts (e.g., leadership in secondary metering), but avoid use of 2000 baseline
- Draw the line: DWRe is not going back to 2000. Others may choose something else. Josh to reach out to CUWCD for similar conversation on these 3 points.
- For report, separate regions on summary figure—one per page—to avoid inadvertent comparisons. Scales are not the same.

- For presentations, adjust scales and show all on one figure. Also consider other alternatives for showing all goals in one place.
- Sufficiently introduce graphics.
- Scenario 3: Footnote to emphasize goals only go to 2065; conservation will change/continue.
- Clarify potential, not 2015 use, as starting point for goals.
- Add detail to language about goals being revisited at 2030, 2045, and 2060.
- Scientific document; avoid hyperbole.
- Water use in other locations—not comparable.

Keith's report on meeting with JWCD

- JWCD felt this project should be 2-year process. Lots of data, analysis, stakeholders, comments, reviews.
- JWCD felt the landscape transition is uncertain. Expensive, time-consuming, public preference. Will need to work with communities and change culture as well as density. Maybe more density/development issue than landscaping. Can't enforce land development ordinances, only recommend and influence.

One purpose of report is to recommend policy/actions to state leadership and justify doing the right thing.

Incidentally, development data show trends toward smaller lots, less water use, less irrigated area. Market forces are already working; policy can accelerate progress.

Process from here

Revise report (v2), share with stakeholders (including those who have not yet received v1) early next week. V2 will be more complete than v1. DWR will review simultaneously with other stakeholders.

Emphasize this is last opportunity for review and need to maintain schedule.

Few changes are expected in the goals.

Emphasize "regional" nature of goals: not just for water district, but communities.

Prepare comment matrix and share with stakeholders.

Todd to share with Gov's office

Distribute v2 by Dec. 24

Receive comments by Jan. 7; evaluate

Next meeting Jan. 10, morning

Appendix G: Regression Model

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Regression Model

To help determine what variables correlate with water use and to consider the unique features of each of Utah's counties, the project team developed an empirical regression model of county-level M&I 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, which 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 2019a, 2019b) 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 2019a)
 - Average elevation (USGS 2018)
- Demographic
 - 2015 population (DWRe 2019a, 2019b)
 - 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 2018; 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 2018; 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 2019a, 2019b)

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 2019a, 2019b).

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 G-1 compares the observed and predicted values.

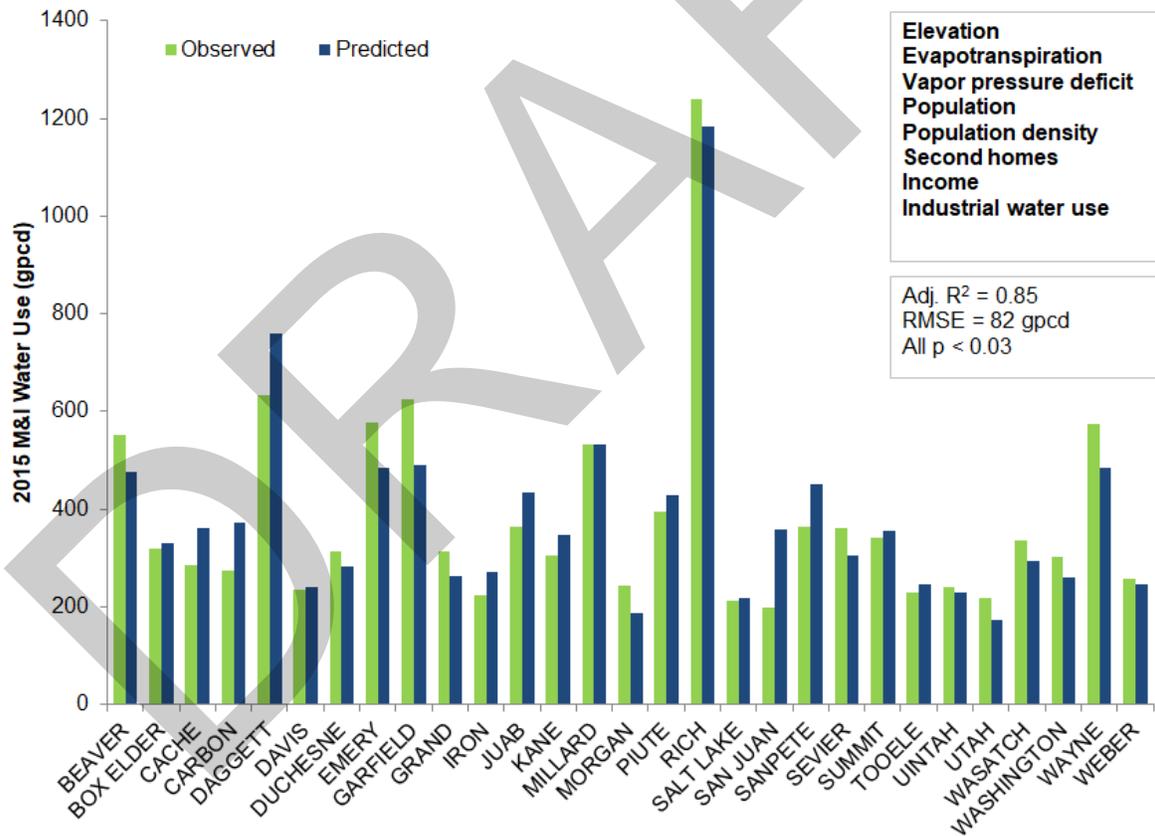


Figure G-1: Regression Model Comparison

Appendix H: Supplemental Data

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Data will be made available upon request to the Utah Division of Water Resources.

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Appendix I: County-Level M&I Water Conservation
Data

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County-Level M&I Water Conservation Data

Regions/ Counties	Baseline (gpcd)	2030	2040	2065	Reduction from Baseline		
	2015	Goal (gpcd)	Projection (gpcd)	Projection (gpcd)	2030	2040	2065
Bear River							
Box Elder	318	266	249	236	17%	22%	26%
Cache	284	233	217	204	18%	24%	28%
Rich	1,275	984	918	909	23%	28%	29%
Green River							
Daggett	423	343	314	307	19%	26%	27%
Duchesne	327	267	254	254	18%	22%	22%
Uintah	256	212	205	206	17%	20%	19%
Lower Colorado River North							
Beaver	553	390	360	356	30%	35%	36%
Garfield	582	463	432	429	20%	26%	26%
Iron	223	193	182	173	13%	19%	23%
Lower Colorado River South							
Kane	358	304	289	282	15%	19%	21%
Washington	302	260	246	236	14%	19%	22%
Provo River							
Juab	373	292	280	284	22%	25%	24%
Utah	214	172	155	145	20%	27%	32%
Wasatch	344	265	249	249	23%	28%	28%
Salt Lake							
Salt Lake	210	186	178	169	11%	15%	19%
Tooele	224	195	184	176	13%	18%	21%
Sevier River							
Millard	522	422	398	397	19%	24%	24%
Piute	391	341	322	325	13%	18%	17%
Sanpete	366	272	250	252	26%	32%	31%
Sevier	363	322	312	317	11%	14%	13%
Wayne	537	412	381	388	23%	29%	28%
Upper Colorado River							
Carbon	267	239	230	230	11%	14%	14%
Emery	569	376	337	333	34%	41%	41%
Grand	309	282	272	267	9%	12%	13%
San Juan	199	180	175	177	11%	14%	13%
Weber River							
Davis	235	188	170	161	20%	28%	32%
Morgan	238	187	179	186	22%	25%	22%
Summit	341	300	290	286	12%	15%	16%
Weber	256	202	184	175	21%	28%	32%
Statewide	240	202	188	179	16%	22%	26%

Note M&I = municipal and industrial; gpcd = gallons per capita per day based on permanent population. Reported per-capita use includes all residential, commercial, institutional, and industrial uses averaged over the permanent population in each region.