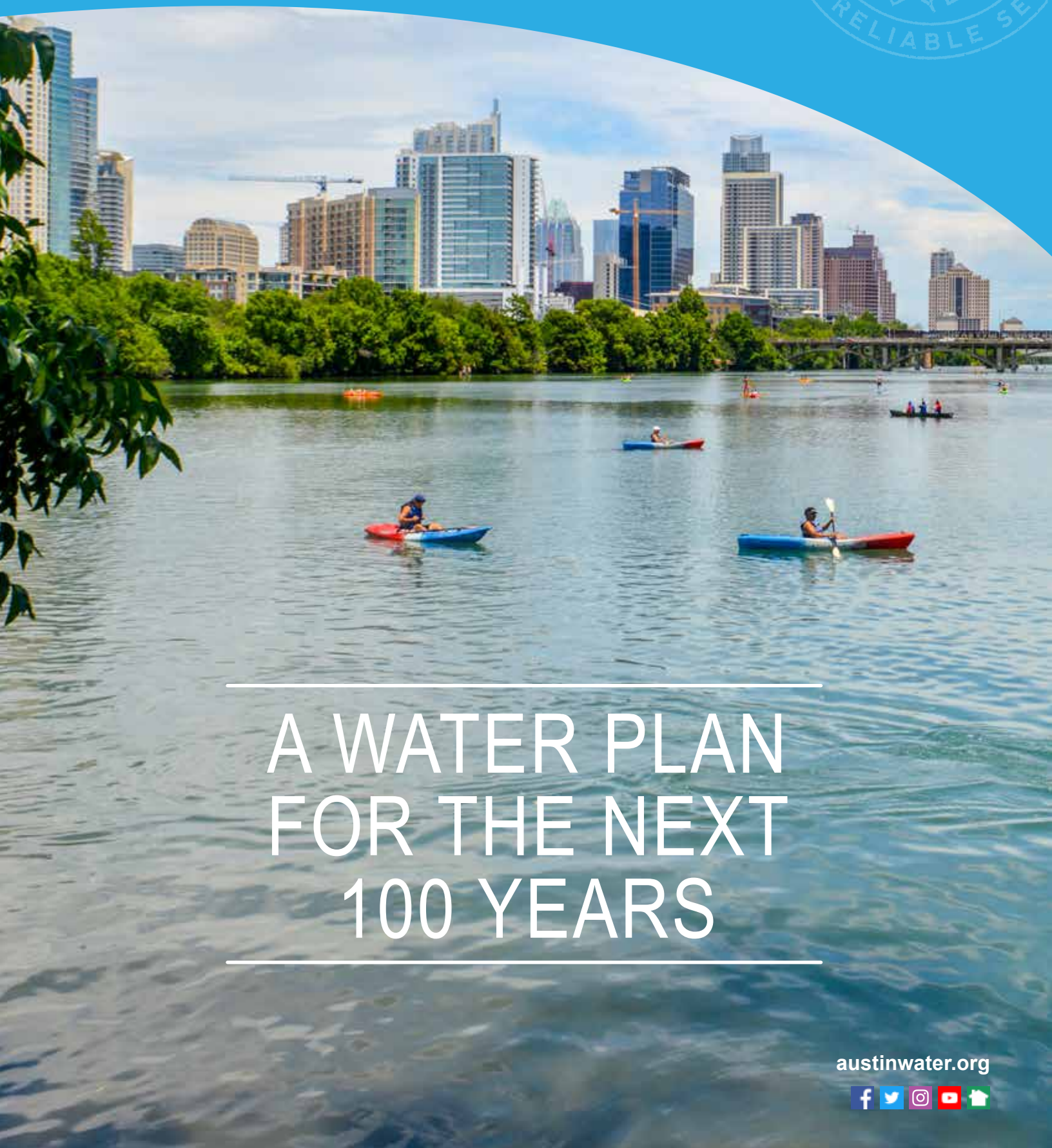
Austin WATER

WATER FORWARD
INTEGRATED WATER RESOURCE PLAN



A WATER PLAN FOR THE NEXT 100 YEARS

austinwater.org

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Executive Summary

For more than 100 years, Austin Water has been committed to providing clean, safe, reliable, high quality, sustainable, and affordable water services to our customers. Austin's Water Forward Integrated Water Resources Plan intends to support that enduring commitment for the next 100 years and beyond. The Water Forward Guiding Principles, shown in the box to the right, provide an overview of the key foundational aspects of the plan.

Creating an Integrated Water Resources Plan entails a sophisticated and holistic planning approach. For Water Forward, this holistic approach included looking at both new water supply options and methods to reduce water demand, including alternative water sources within the Austin cityscape that can help build supply diversity and meet future needs. Another aspect of Water Forward's integrated nature includes using an adaptive management approach which considers climate change and potential droughts worse than those experienced in the recent past. Considering these types of changes and uncertainties about the future supports a holistic framework for building resilience and sustainability. The Water Forward framework also has a strong focus on community input and support, significant public outreach, and balancing multiple objectives — including the combination of economic, environmental, and social benefits which comprise the triple bottom line of sustainability.

Austin Water led development of the Water Forward plan with support from the Water Forward Task Force, other City departments, and the Austin community. Upon Council plan adoption, Austin Water intends to work proactively to implement this plan to provide additional water supply reliability, more resiliency against droughts and climate change, and increased stewardship and sustainability for the Austin community.

Need for an Integrated Water Resources Plan

From 2008-2016, the City of Austin experienced an historic drought. The Austin Water Resource Planning Task Force, created (hereafter referred to as the 2014 Task Force) by the City Council in 2014 during that drought, made a key recommendation to develop an Integrated Water Resources Plan to holistically plan for Austin's water future.

All of Austin's drinking water supply comes from the lower Colorado River system, which includes Lakes Travis and Buchanan, the region's water supply reservoirs. This core Colorado River supply is available to the City through a combination of water rights and a water supply contract with the Lower Colorado River Authority. The entire lower Colorado River system is managed by the Lower Colorado River Authority, including Lakes Travis and Buchanan. The water available for use from Austin's core Colorado River supply is generally dependent on rainfall, inflows to the storage reservoirs, and the Lower Colorado River Authority's management of water stored in Lakes Travis and Buchanan. In addition to Austin's Colorado River supply, other core supplies include Austin's centralized reclaimed water program, known as the "Water Reclamation Initiative", and water conservation programs which were strengthened significantly over the past decade. Austin's centralized reclaimed water system and the Austin community's water conservation efforts have allowed the City, especially in recent years, to significantly reduce its demand Colorado River water.

WATER FORWARD GUIDING PRINCIPLES

Austin's Water Forward is a program to develop a long-term integrated water resources plan for the next 100 years. The following represents the plan's guiding principles:

- *Recognizing that Colorado River water is Austin's core supply, continue a strong partnership between the City and LCRA to assure its reliability*
- *Continue Austin's focus on water conservation and water use efficiency*
- *Strengthen long-term sustainability, reliability, and diversity of Austin's water supply through maximizing local water resources*
- *Avoid severe water shortages during times of drought*
- *Focus on projects that are technically, socially, and economically feasible*
- *Continue to protect Austin's natural environment, including source and receiving water quality*
- *Ensure Austin's water supply continues to meet/exceed all federal, state and local public health regulations*
- *Align with Imagine Austin's "Sustainably Manage Our Water Resources Priority Program"*
- *Maintain coordination and communication with regional partners*
- *Engage the public and stakeholders throughout the plan development process*

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Key drivers for the Water Forward plan are highlighted in **Figure 1**. These drivers include the recent historic drought, population and development within the Austin area and the region, climate change impacts on water supply reliability, and alignment with community values.

Planning for climate change and droughts that could be worse than historic droughts was a key driver of the plan, as research and analysis of climate change and hydrology in the Colorado River basin shows that the basin is likely to experience greater hydrologic variability in the future. This increased variability is projected to lead to more droughts like the recent historic drought and even more severe droughts as the effects of climate change increase. Projections for the future show that the region is likely to experience more intense drought periods punctuated by more intense periods of rain.

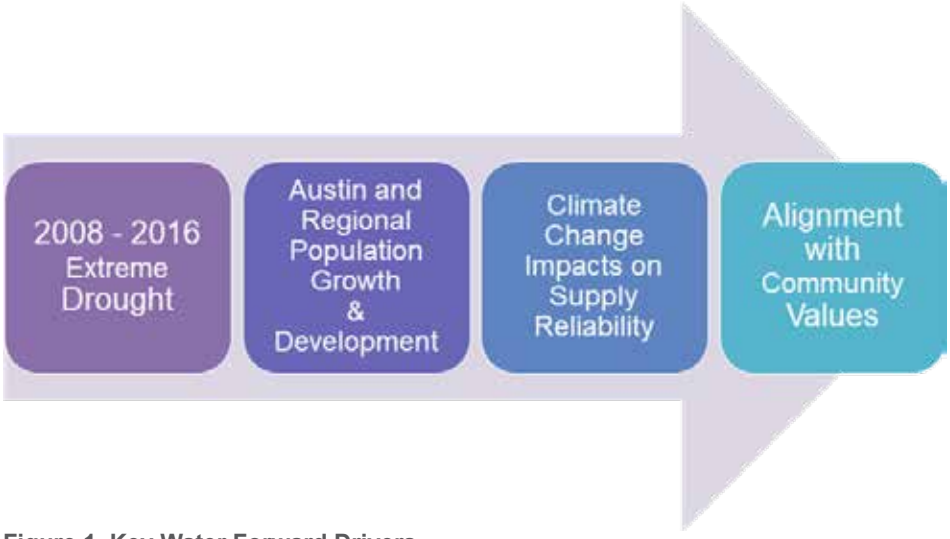

Figure 1. Key Water Forward Drivers

In addition to changing hydrologic conditions in the basin, another key driver is that the population Austin Water serves is projected to grow from one million people to 4 million people over the next 100 years. Uncertainties and changing conditions, coupled with continued growth and development in the Austin area and region, make future water planning more challenging than in the past. Water Forward provides the essential strategic framework for Austin to meet these challenges and the goal of ensuring a diversified, sustainable, and resilient water future, continuing our strong emphasis on water conservation.

The Water Forward framework addressed the unique water supply challenges of the City of Austin in a more robust way than traditional water planning processes. For example, development of Austin's integrated water resource plan considered multiple objectives and sub-objectives to balance the community's values, rather than simply comparing water supply and demand. The objectives and sub-objectives that form the basis of the Water Forward plan were built based upon the objectives provided by the 2014 Task Force.

Water Forward's robust planning process also included projections of future demands for Water Forward that were developed based on a detailed end-use demand model using geographically distributed demographic projections, rather than focusing on the bulk water use of the city as a whole. Other aspects of Water Forward that helped make it a holistic and integrated water resources plan include: when deciding which new water options to consider, focus was placed on developing a mix of demand management, water conservation, and water supply strategies needed to fulfill plan objectives; the Water Forward process included an extensive public outreach effort that collected feedback and input throughout the plan development process; water supply availability of options was analyzed under four different future hydrologic scenarios, which allowed evaluation of the effects of climate change and droughts worse than those experienced in the past. More discussion this robust planning process is presented in the following section.

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The Water Forward Planning Process

Austin Water gathered public input to inform the integrated water resource plan through over 80 outreach events, including five Water Forward public workshops held throughout the City and a Summer Series presentation and public input session held in every City Council district.

In early 2015, the City Council-appointed Water Forward Task Force was first convened. This task force is made up of members who represent the Mayor and each of the ten City Council districts. The Water Forward Task Force also includes ex-officio representatives from Austin Water, Austin Energy, Watershed Protection Department, Office of Sustainability, Neighborhood Housing and Community Development, and others. At the beginning of the Water Forward process, the Task Force provided input on the scope of work and selection of the consultant team to help develop the integrated water resource plan. As the process continued, the Task Force provided key guidance and review of technical work and plan recommendations through monthly meetings that continued for the duration of the plan development process. Prior to the consultant coming on board in June 2016, through monthly Water Forward Task Force meetings, among many other relevant topics, information from other cities involved in similar processes was presented and discussed.

Figure 2. Water Forward Task Force Meeting

Figure 3. Water Forward Public Workshop

To guide the development of the integrated water resource plan, a set of objectives were established early in the process. These objectives, shown in **Figure 4**, were developed to balance water supply reliability, economic, environmental, social, and implementation benefits. This wide-ranging set of objectives aligned with the holistic nature of the integrated water resource plan. The objectives also aligned with the principles of sustainability, which call for balancing economic, environmental, and social needs now and into the future.

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Once the objectives were developed, the planning process proceeded through identification, screening, and characterization of new water demand management options (sometimes referred to as water conservation options) and water supply options. Austin Water led the identification process with development of a "blue sky" list of options with input from the Water Forward Task Force, consulting team, previous studies and planning efforts, stakeholders, and the public. The "blue sky' list was pared down through the screening process, resulting in a shorter list of options for characterization. **Figure 6** shows all of the options that were characterized as part of the Water Forward process. Characterization included developing option information such as costs and option yields or water savings.

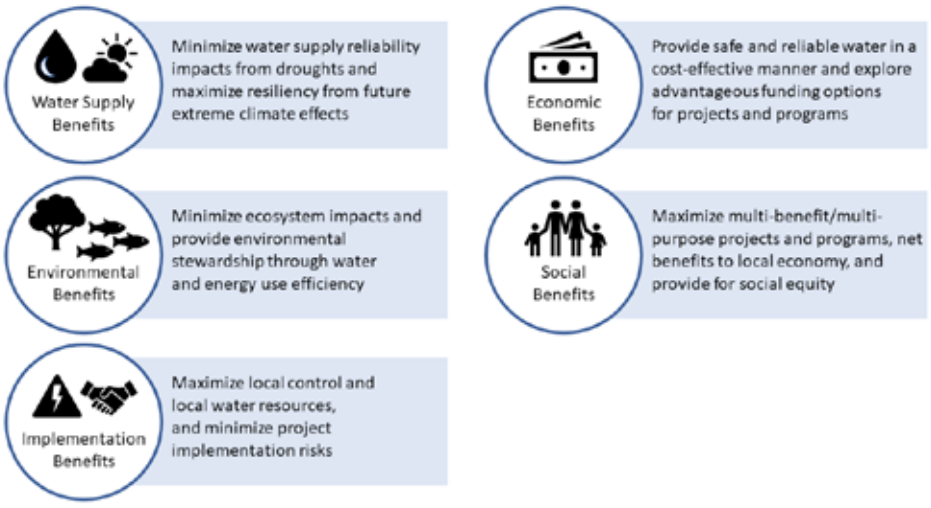

Figure 4. Water Forward Objectives

The options on the following page were combined into various groupings, referred to as portfolios of options. Five initial water portfolios were developed around objective-based themes: maximize reliability, maximize cost effectiveness, maximize implementation, maximize local control, and maximize conservation. The purpose of developing initial portfolios around themes was to allow a clearer assessment of trade-offs between maximizing one objective versus another. After evaluating the initial portfolios, two new groupings of options called hybrid portfolios were developed by balancing the trade-offs between objectives to increase the overall benefits. All portfolios were scored against the objectives and sub-objectives developed through the Water Forward process, including a planning-level comparison of unit cost estimates, and the highest-scoring portfolio became the basis for plan recommendations. **Figure 5** shows an overview of the major steps in the plan development process and their timeframe. Descriptions of the various integrated water resource plan portfolios created for evaluation and the results of the portfolio evaluation process are included in the Water Forward plan report.

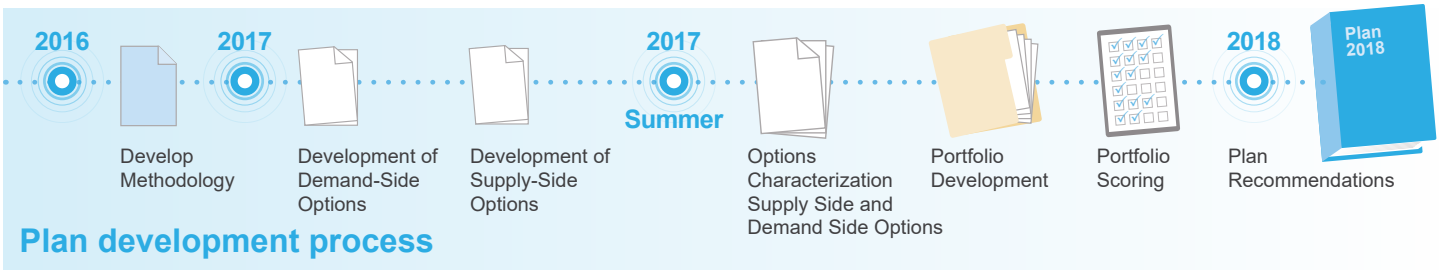

Figure 5. Plan Development Process Overview

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Water Forward Recommendations

The highest-scoring water portfolio was Hybrid 1, as it provided the best overall balance in meeting all objectives. Hybrid 1 combined the options from the initial portfolio aimed at maximizing conservation with additional options to increase the portfolio's reliability. The recommended Water Forward strategies include implementation of both demand management and supply options, as shown in **Table 1** on the following page in the figures at the end of this booklet. Water Forward recommendations aim to prepare the City for the future, to meet the goal of ensuring a diversified, sustainable, and resilient water future, with strong emphasis on water conservation.

Key plan recommendations also include:

- Core Colorado River Supplies: The Colorado River supply will continue to be Austin's core supply in the future. Planned actions to enhance supply include continued efforts with partners in the region and numerous complementary activities on a local and regional scale.

- Dual Plumbing Ordinance: In Phase 1, stakeholder process will explore requiring dual plumbing for new large Commercial and Multifamily development (with a potable backup). In Phase 2, stakeholder process will explore expanding ordinance's applicability to potentially include mid-size new Commercial and Multifamily development (with potable backup). These requirements would consider existing indoor reclaimed water use requirements. Evaluations to include refinement of ordinance scope, applicability, location in code, and enforcement considerations

- Expansion of Current Reclaimed Water Connection Requirements: Stakeholder process will explore expanding existing reclaimed water connection requirements. Evaluation to include refinement of ordinance scope, applicability, location in code, and enforcement considerations.

- Implementation of Best Management Practices: This includes requiring or incentivize government-recognized energy and water efficiency-labeled residential and commercial fixtures, incentivizing or requiring toilet, urinal, and bathroom faucet aerator efficiencies, and implementing Lake Austin Operations in defined drought conditions.

- Adaptive Management: Implement the Water Forward plan using a phased, adaptive management approach. Update Water Forward Integrated Water Resource Plan, plan recommendations, and adaptive management plan on a five-year cycle. Adaptive management is discussed further in the last section of this executive summary.

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Table 1. Water Forward Recommended Options with Planning Horizon Yields (From Hybrid 1 Portfolio)

Recommended Options	Average/ Drought	Yield Capacity (AFY)[1]			
		2020	2040	2070	2115
Demand Management Options					
Advanced Metering Infrastructure (AMI)	Both	596	3,882	5,766	9,371
Water Loss Control	Both	3,108	9,326	10,918	13,064
CII Ordinances	Both	1,063	1,063	1,063	1,063
Benchmarking	Both	-	5,953	11,670	25,228
Landscape Ordinance	Both	-	3,038	7,428	15,050
Landscape Transformation Incentive	Both	-	321	633	929
Irrigation Efficiency Incentive	Both	42	205	427	394
Lot Scale Stormwater Harvesting	Both	-	329	869	2,275
Lot Scale Rainwater Harvesting	Both	-	1,550	4,032	9,251
Greywater Harvesting	Both	-	2,126	5,617	12,667
Building Scale Wastewater Reuse	Both	-	1,323	3,672	7,875
AC Condensate Reuse	Both	100	1,084	2,711	5,150
Sub-Total	-	4,908	30,202	54,806	102, 317
Water Supply Options					
Aquifer Storage and Recovery	Drought	-	60,000	60,000	90,000
Brackish Groundwater Desal	Both	-	-	5,000	16,000
Direct Non-Potable Reuse	Both	500	12,000	25,000	54,600
Indirect Potable Reuse (IPR) through Lady Brid Lake	Drought	-	11,000	20,000	20,000
Capture Local Inflows to Lady Bird Lake (infrastructure also included as part of IPR, above)	Average	-	3,000	3,000	3,000
Off Channel Reservoir	Both	-	-	25,000	25,000
Distributed Wastewater Reuse	Both	-	3,154	14,467	30,049
Sewer Mining	Both	-	1,000	2,211	5,284
Community Stormwater Harvesting	Both	-	158	236	504
Sub-Total	-	500	90,312	154,914	244,437
OVERALL TOTAL	**-**	**5,408**	**120,512**	**209,720**	**346,754**

[1] *Yield capacity represents the maximum annual yield for the option in ideal conditions. Actual yield will vary based on hydrology and need*

Executive Summary

Water Forward Program Benefits

Implementation of the recommended Water Forward strategies will be transformative for the City of Austin. Plan implementation will result in multiple overarching benefits through various pathways, as shown in **Figure 7**. Some highlights of the plan implementation benefits include improved water supply reliability, greater water supply diversity, and sustainable support for the City's population growth and economic prosperity.

As shown in the figure, Water Forward's recommended demand management options will help Austin stretch existing supplies through more efficient water use, water reuse, and water conservation enhancements. Demand management options include use of regionally appropriate landscapes that can thrive using less water while providing ecosystem benefits. To help increase efficient water use, in addition to centralized and decentralized water reuse, the plan seeks to increase use of on-site alternative water sources, including rainwater harvesting, stormwater harvesting, and reuse of AC condensate, graywater, and blackwater. These options increase use of local water sources and provide demand management benefits.

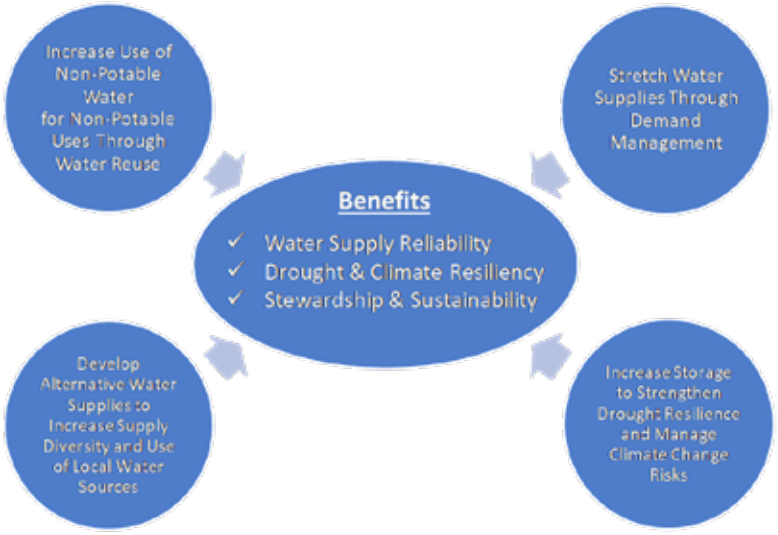


Figure 7. Benefits Associated with Water Forward Recommendations

Another major benefit of the plan is that over time it enables Austin to increasingly meet non-potable demands with non-potable supplies. As shown in **Figure 8**, in 2020 Austin will be meeting much of its non-potable demand with potable supplies (shown as purple in the figure). Water Forward plan recommendations would result in a reduction of potable supply meeting non-potable demand from 43% in 2020 to 6% in 2115. While potable water will still be needed as a back-up supply, this plan seeks to increase use of alternative water sources and reclaimed water to meet non-potable demands, which will increase the resiliency and sustainability of Austin's water supplies. Austin Water is committed to taking the necessary steps to ensure that these options are implemented in such a way that public health and safety is protected.

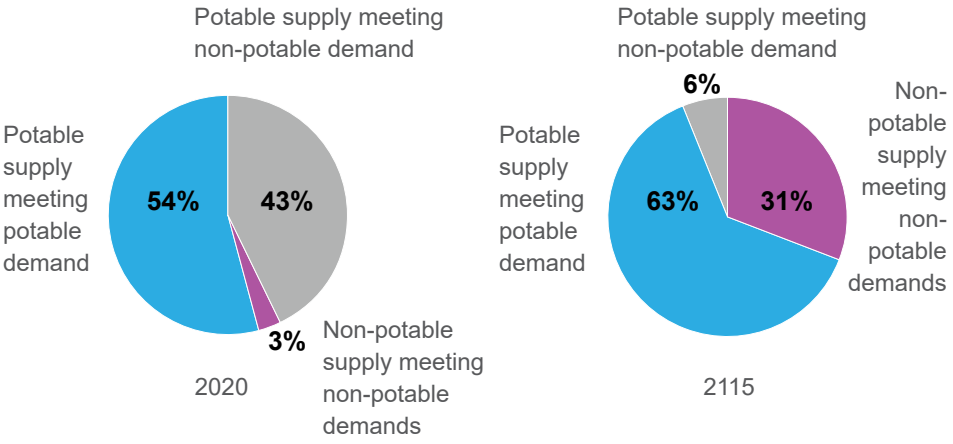


Figure 8. Comparison of Type of Supply Used to Meet Demand, 2020 to 2115

Executive Summary

In addition to helping match supply and demand types, Water Forward recommendations will use storage to help increase drought resiliency and manage climate change risks. With climate change projections indicating that the region will likely experience longer hot and dry periods punctuated by more intense wet periods, storage options such as aquifer storage and recovery will increase Austin's ability to store available water during wet periods. This stored water can then be drawn upon for use during dry periods. These storage options improve water supply reliability, strengthen Austin's drought resilience, and help prepare the Austin community for managing climate change effects on water supply effects.

Increased supply diversification and resilience is another important benefit of the Water Forward recommendations. Demand management options, reclaimed water (purple pipe), and water conservation program options will build on Austin's core supplies (including water from the Colorado River and Highland Lakes), increasing the diversity and resilience of Austin's water supply. Water supply resilience will also be increased through Water Forward's adaptive management approach, which includes planning for climate change, drought, and uncertainties, and will enable Austin to manage risk and respond to new information and changes as they arise.

Adaptive Management Plan, Implementation, and Next Steps

To achieve the benefits discussed in the previous section, the next phase of Water Forward focuses on implementation. Since one of the key features of an integrated water resource plan is its ability to deal with future uncertainty, this concept was carried through to preliminary implementation planning through the Implementation Outlook and Adaptive Management Plan companion document to the Water Forward Plan Report. This document lays out the high-level anticipated stages of implementation and potential decision points. Since the integrated water resource plan is using an adaptive management plan to guide implementation, these decision points can be used to inform the direction of implementation as the process progresses. Additionally, the adaptive management plan includes integrated water resource plan updates every five years, which allows the plan to be adapted to changing conditions in the future.

The estimated unit costs to implement the recommended options are presented in the options sheets included in this booklet. The costs of implementing the recommended strategies could be funded through, among other methods, Austin Water revenues, low-interest loans or other outside funding, development costs, or shared community investments. In some cases, Austin Water investments could be combined with investments from the community, as in rebates and other incentive programs. Austin Water is prepared to begin the plan implementation process immediately after City Council approval of the Water Forward Plan. The implementation process includes continued emphasis on public outreach and community involvement. Additionally, the Water Forward Plan includes a recommendation to convene the Water Forward Task Force on a quarterly basis to support plan implementation efforts. Austin Water is committed to working to implement the Water Forward plan as expeditiously as possible.

Glossary

Glossary

- **Potable water** – Water that is of drinking water quality
- **Non-potable water** – Water that is not drinking water quality and is used for non-drinking purposes such as toilet flushing and watering lawns.
- **Acre-Foot** – Acre-foot is a unit of volume commonly used in the U.S. in reference to large-scale water resources. One acre foot is roughly the volume of a football field covered in 1 foot of water, which about 326,000 gallons of water. An average household uses around a third of an acre foot of water per year.
- **Graywater** – Wastewater from showers, bathtubs, hand washing lavatories, sinks that are used for disposal of household or domestic products, sinks that are not used for food preparation or disposal, and clothes-washing machines. Graywater does not include wastewater from the washing of material, including diapers, soiled with human excreta or wastewater that has come into contact with toilet waste.
- **Blackwater** – Wastewater that originates as human, animal, or plant waste from certain activities, including use of toilet facilities, washing, bathing, and preparing food.
- **Indoor Potable use** – Types of indoor water uses that require water to be of drinking water quality are included in the indoor potable use type. This includes uses such as drinking, cooking, bathing and other such uses.
- **Indoor non-potable use** – Types of indoor water uses that do not require water to be of drinking water quality are included in indoor non-potable use type. These include, toilet flushing, clothes-washing machines, HVAC and other such uses.

Landscape Transformation
Incentives or Ordinances

Landscape transformation to regionally-appropriate landscapes can reduce water needs for outdoor irrigation and provide additional benefits.

The Water Forward recommendations are to implement incentives and ordinances to encourage water use efficiencies and reduce water needs for outdoor irrigation. Implementation of an ordinance option could include implementing limitations on turf grass area, and/or irrigation area.

Planning horizon when option is in effect

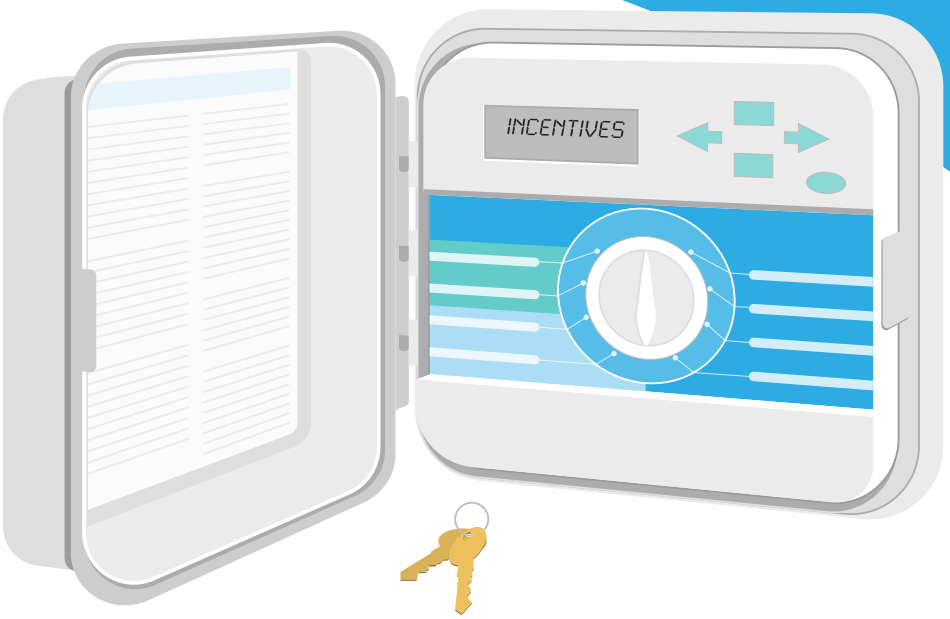
2020 — 2040 — 2070 — 2115

Option Category	Demand Management			
Target 2115 yield	16,000 acre-feet/year			
Applicable Customer Category and Types of Uses	**Sectors**	✓ Single-family residential	✓ Multi-family residential	✓ Commercial
	End Use	Indoor potable	Indoor non-potable	✓ Irrigation
	Type of development	✓ New	✓ Existing	
Climate resiliency indicator	Medium			
Unit cost ($/acre-foot/year)	$27			

Irrigation Efficiency
Incentives

Irrigation efficiency incentives involve incentivizing customers to improve the efficiency of their automatic irrigation systems, thereby decreasing water consumed for irrigation purposes.

The Water Forward recommendation focuses on expanding current irrigation rebate programs to include rebates for irrigation system controllers and other improvements. Improved irrigation system controllers make flow data such as the amount of water being used for irrigation accessible to the user and are capable of responding to leaks and high flow situations.



Planning horizon when option is in effect

2020 — 2040 — 2070 — 2115

Option Category	Demand Management			
Target 2115 yield	400 acre-feet/year			
Applicable Customer Category and End-Uses	**Sectors**	✓ Single-family residential	✓ Multi-family residential	✓ Commercial
	End Use	Indoor potable	Indoor non-potable	✓ Irrigation
	Type of development	✓ New	✓ Existing	
Climate resiliency indicator	Medium			
Unit cost ($/acre-foot/year)	$202			

Advanced Metering Infrastructure (AMI)

AMI, or smart meters, record near real-time water use and provide that information through an easy-to-use interface such as a web app or a smart phone app.

As recommended through the Water Forward plan, Austin Water plans to replace existing meters with AMI meters whose data will help reduce potable water loss primarily due to leaks and help customers better understand their water use.

Planning horizon when option is in effect

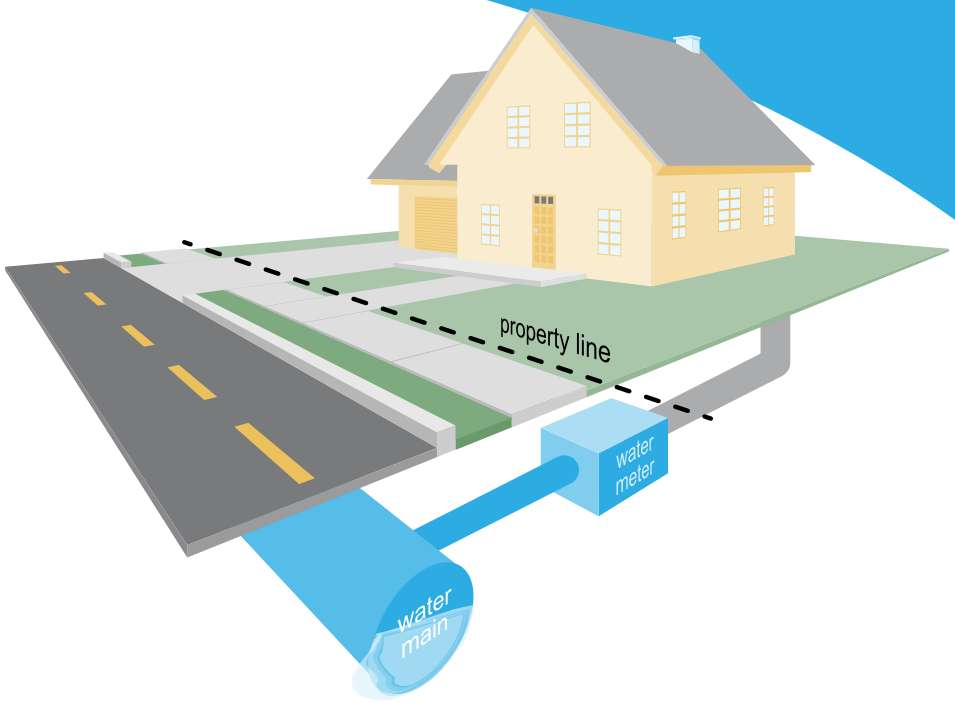
2020 | 2040 | 2070 | 2115

Option Category	Demand Management			
Target 2115 yield	9,380 acre-feet/year			
Applicable Customer Category and End-Uses	**Sectors**	✓ Single-family residential	✓ Multi-family residential	✓ Commercial
	End Use	✓ Indoor potable	✓ Indoor non-potable	✓ Irrigation
	Type of development	✓ New	✓ Existing	
Climate resiliency indicator	High			
Unit cost ($/acre-foot/year)	$2,800			

Utility-Side Water Loss Control

Water loss in the potable water distribution system has been reduced through utility-side programs that focus on preventing leaks, finding and fixing leaks, and improving response times to active leaks between the water treatment plant and the end user.

The Water Forward recommendation is for Austin Water to continue and enhance its ongoing efforts to reduce utility-side water loss



Planning horizon when option is in effect

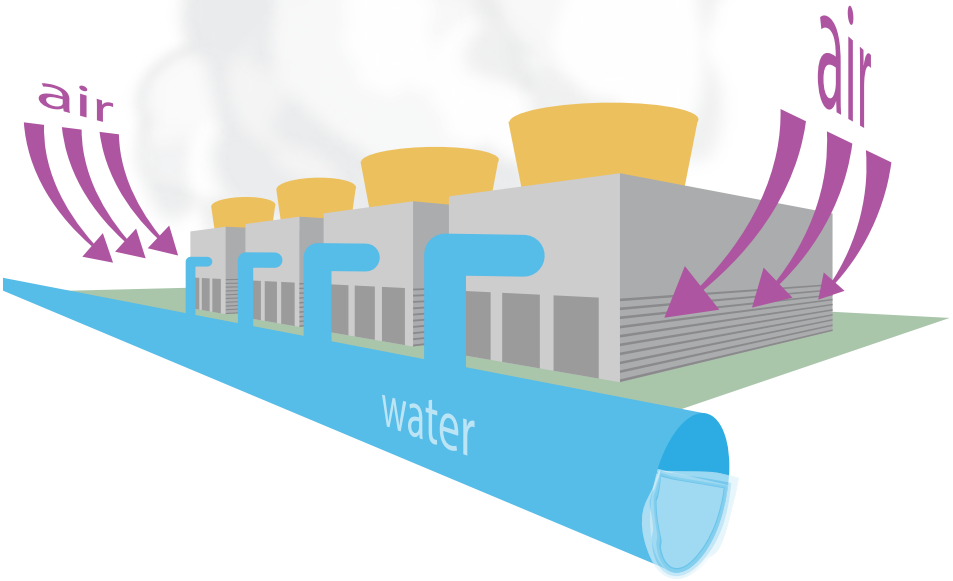
2020 2040 2070 2115

Option Category	Demand Management
Target 2115 yield	13,060 acre-feet/year
Applicable Customer Category and End-Uses	**System Wide**
Climate resiliency indicator	High
Unit cost ($/acre-foot/year)	$3,690

Commercial, Industrial and Institutional (CII) Ordinances – Cooling Towers and Steam Boilers

The Cooling Tower Efficiency Program requires customers to register their cooling towers with Austin Water and submit annual inspection forms. Austin Water developed this program to help customers save money on water and wastewater bills by identifying potential water efficient upgrades and available rebates while meeting cooling and tower equipment water efficiency standards.

This option is a current program and was included as a best management practice as part of the Water Forward plan.



Planning horizon when option is in effect

2020 — 2040 — 2070 — 2115

Option Category	Demand Management					
Target 2115 yield	1,060 acre-feet/year					
Applicable Customer Category and End-Uses	**Sectors**	Single-family residential	✓	Multi-family residential	✓	Commercial
	End Use	Indoor potable	✓	Indoor non-potable		Irrigation
	Type of development	New	✓	Existing		
Climate resiliency indicator	High					
Unit cost ($/acre-foot/year)	$71					

Water Use Benchmarking and Budgeting

Water use benchmarking and budgeting uses standards to “benchmark” how much water buildings of a certain size would be expected to use. Based on these benchmarks, a “water budget” can be created to track water use in a given building and help users meet their water benchmark.

Developers will provide information about all water-using equipment, fixtures (including counts), proposed water sources and building characteristics associated with the site. The utility will provide potential water use efficiency and alternative water recommendations and information on available incentive and rebate programs.

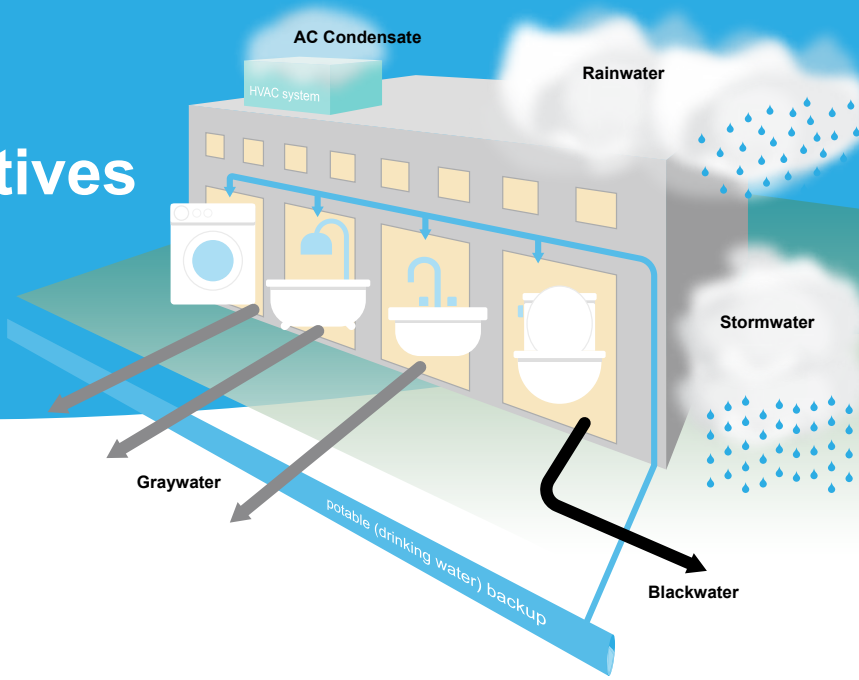
Based on the water use benchmarking data developed through these programs, this strategy will be expanded in the future to include a water use budget for new development constructed after 2025 (compliance mechanism to be determined).

Planning horizon when option is in effect

2020 — 2040 — 2070 — 2115

Option Category	Demand Management			
Target 2115 yield	25,200 acre-feet/year			
Applicable Customer Category and End-Uses	**Sectors**	✓ Single-family residential	✓ Multi-family residential	✓ Commercial
	End Use	✓ Indoor potable	✓ Indoor non-potable	✓ Irrigation
	Type of development	✓ New	Existing	
Climate resiliency indicator	High			
Unit cost ($/acre-foot/year)	$21			

Alternative Water Ordinances and Incentives



Require or incentivize, on-site (building-scale) alternative water use (for rainwater, stormwater, blackwater, graywater and AC condensate)

Planning horizon when option is in effect

2020 ● 2040 ● 2070 ● 2115

Rainwater Harvesting (lot-scale)

Lot-scale rainwater harvesting involves the capture and storage of runoff from roofs to supply a range of onsite non-potable demands at the single lot/building scale.

Option Category	Demand Management - Decentralized			
Target 2115 yield	10,600 acre-feet/year			
Applicable Customer Category and Endf Uses	**Sectors**	✓ Single-family residential	✓ Multi-family residential	✓ Commercial
	End Use	Indoor potable	✓ Indoor non-potable	✓ Irrigation
	Type of development	✓ New	✓ Existing	
Climate resiliency indicator	Medium			
Unit cost ($/acre-foot/year)	$2,864			

Planning horizon when option is in effect

2020 ● 2040 ● 2070 ● 2115

Stormwater Harvesting (lot-scale)

Lot-scale stormwater harvesting involves the capture and storage of runoff from impervious surfaces (including roof water) within a single lot boundary to supply a range of onsite non-potable demands at the lot/building scale.

Option Category	Demand Management - Decentralized			
Target 2115 yield	2,280 acre-feet/year			
Applicable Customer Category and Endf Uses	**Sectors**	Single-family residential	✓ Multi-family residential	✓ Commercial
	End Use	Indoor potable	Indoor non-potable	✓ Irrigation
	Type of development	✓ New	✓ Existing	
Climate resiliency indicator	Medium			
Unit cost ($/acre-foot/year)	$6,470			

Planning horizon when option is in effect

AC Condensate Reuse

Air conditioner (AC) condensate reuse involves the collection and reuse of condensate water from air handling units for multiple non-potable end uses.

Option Category	Demand Management - Decentralized			
Target 2115 yield	5,150 acre-feet/year			
Applicable Customer Category and Endf Uses	**Sectors**	✓ Single-family residential	✓ Multi-family residential	✓ Commercial
	End Use	Indoor potable	✓ Indoor non-potable	✓ Irrigation
	Type of development	✓ New	✓ Existing	
Climate resiliency indicator	High			
Unit cost ($/acre-foot/year)	$2,702			

Planning horizon when option is in effect

Graywater Reuse (lot-scale)

For the purposes of Water Forward, graywater harvesting is defined as the reuse of water from the laundry, shower, or sinks that are not used for food preparation at the lot/building scale to meet non-potable demands.

Option Category	Demand Management - Decentralized			
Target 2115 yield	12,700 acre-feet/year			
Applicable Customer Category and Endf Uses	**Sectors**	✓ Single-family residential	✓ Multi-family residential	✓ Commercial
	End Use	Indoor potable	✓ Indoor non-potable	✓ Irrigation
	Type of development	✓ New	✓ Existing	
Climate resiliency indicator	High			
Unit cost ($/acre-foot/year)	$9,797			

Planning horizon when option is in effect

Building-Scale Wastewater Reuse

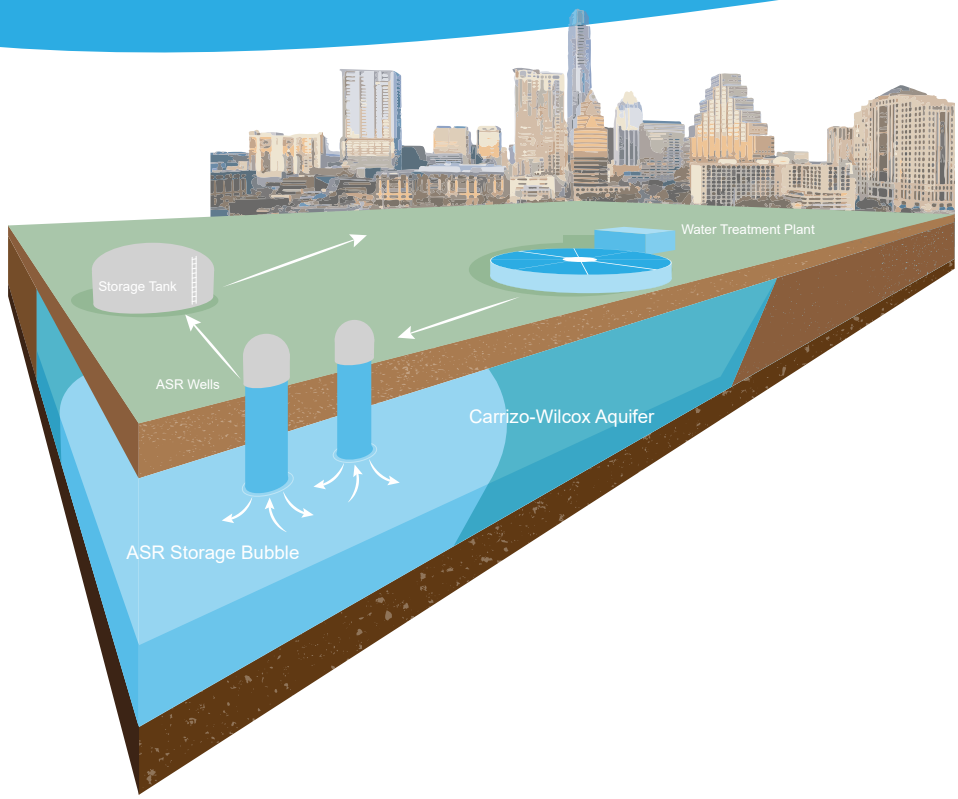
Building-scale wastewater (or blackwater) reuse involves the onsite capture and treatment of the wastewater stream generated from a building for onsite reuse for multiple non-potable end uses.

Option Category	Demand Management - Decentralized			
Target 2115 yield	7,880 acre-feet/year			
Applicable Customer Category and Endf Uses	**Sectors**	Single-family residential	✓ Multi-family residential	✓ Commercial
	End Use	Indoor potable	✓ Indoor non-potable	✓ Irrigation
	Type of development	✓ New	✓ Existing	
Climate resiliency indicator	High			
Unit cost ($/acre-foot/year)	$11,726			

Aquifer Storage and Recovery
Carrizo-Wilcox Aquifer

Aquifer storage and recovery is a strategy in which water (ex: potable or drinking water) is stored in an underground aquifer during wetter periods of rainfall and recovered for use during drier periods such as drought. Storing water underground avoids water loss due to evaporation that occurs in surface water storage.

The Water Forward plan includes a recommendation to pipe treated drinking water from the City of Austin's water distribution system to an aquifer storage and recovery well field for injection and storage in the Carrizo-Wilcox Aquifer. During drier periods stored water would be recovered and piped back into the City's water distribution system.



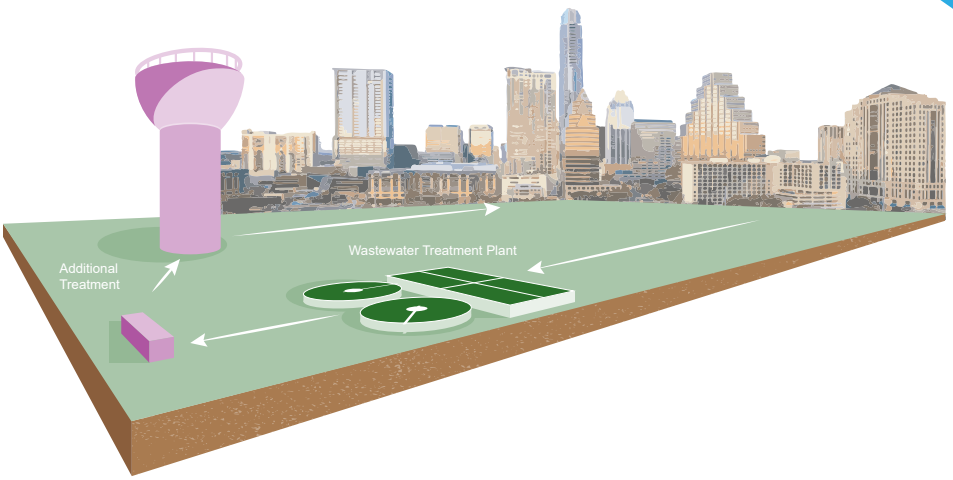
Planning horizon when option is in effect: 2020 ○ — 2040 ● — 2070 ● — 2115 ●

Option Category	Water Supply			
Target 2115 yield	90,000 acre-feet/year			
Applicable Customer Category and Types of Uses	**Sectors**	✓ Single-family residential	✓ Multi-family residential	✓ Commercial
	End Use	✓ Indoor potable	✓ Indoor non-potable	✓ Irrigation
	Type of Use	✓ New	✓ Existing	
Climate resiliency indicator	High			
Unit cost ($/acre-foot/year)	$1,174			

Direct Non-potable Reuse (Centralized Reclaimed or Purple Pipe System)

Austin Water provides highly treated wastewater (through a purple pipe reclaimed water system) for non-potable uses such as irrigation, cooling, manufacturing, and toilet flushing.

The Water Forward plan includes expansion of the existing reclaimed water system and reclaimed water use by 2040 to serve more than three times the amount currently used for meeting non-potable demands.



Planning horizon when option is in effect

2020 | 2040 | 2070 | 2115

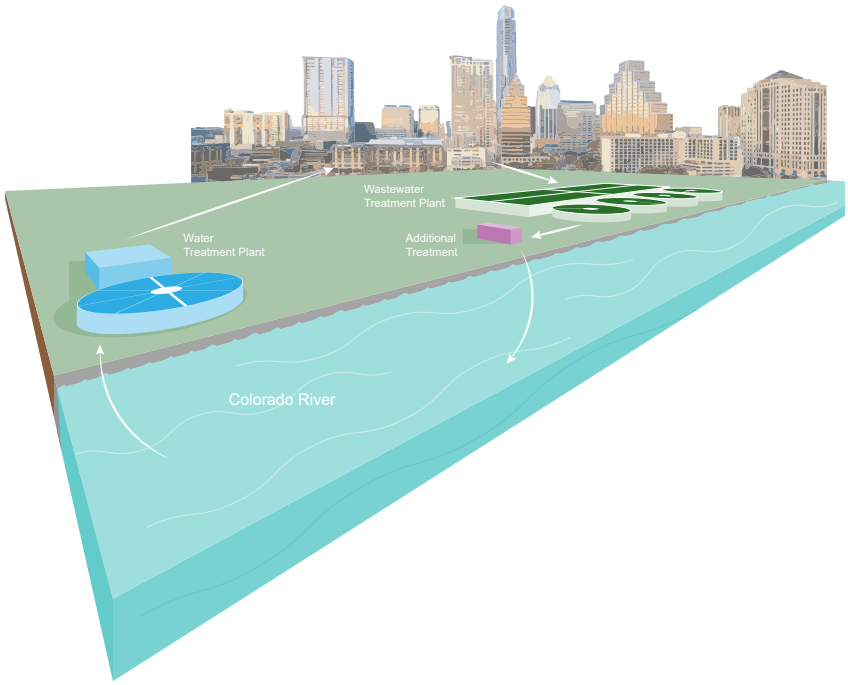
Option Category	Water Supply			
Target 2115 yield	54,600 acre-feet/year			
Applicable Customer Category and End-Uses	**Sectors**	✓ Single-family residential	✓ Multi-family residential	✓ Commercial
	End Use	Indoor potable	✓ Indoor non-potable	✓ Irrigation
	Type of development	✓ New	✓ Existing	
Climate resiliency indicator	High			
Unit cost ($/acre-foot/year)	$1,229			

Indirect Potable Reuse (IPR) and Capture Lady Bird Lake Inflows

Indirect potable reuse uses highly treated reclaimed water discharged into an environmental buffer such as a river before purification to drinking water quality at a water treatment plant.

As part of Water Forward's recommendations, indirect potable reuse would be used as a deep drought strategy. If the combined storage of lakes Travis and Buchanan reach levels less than 20%, highly treated reclaimed water would be conveyed from the South Austin Regional Wastewater Treatment Plant to Lady Bird Lake. The water would be pumped from Lady Bird Lake to be treated to drinking water quality at Ullrich Water Treatment Plant.

Elements of the infrastructure used in indirect potable reuse will serve multiple functions. Apart from being used for indirect potable reuse during deep drought, most of the infrastructure will be used for other purposes on a more regular basis. Some elements would be used to capture available water flowing into Lady Bird Lake from creeks and springs. This water would also be conveyed to Ullrich Water Treatment Plant. Other elements would be used to provide reclaimed water as part of the purple pipe reclaimed water system.



Planning horizon when option is in effect

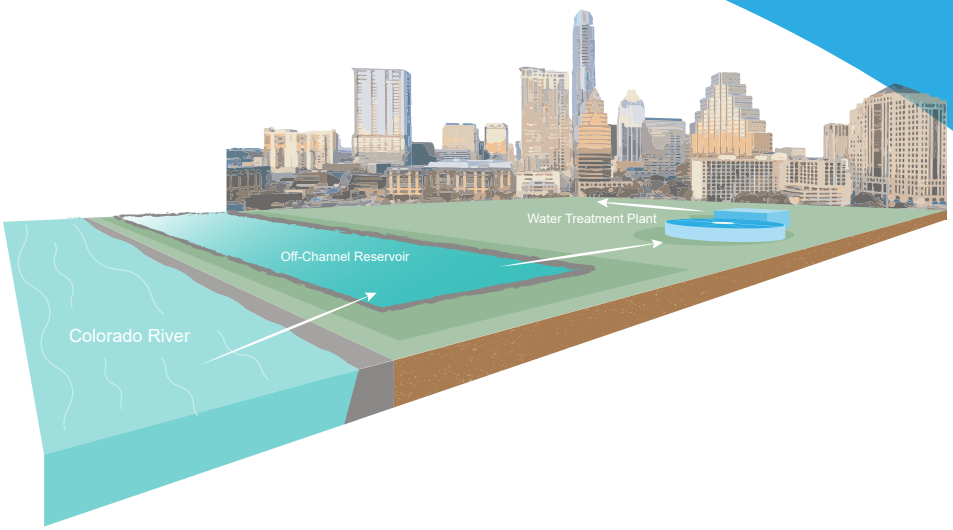
2020 ○ — 2040 ● — 2070 ● — 2115 ●

Option Category	Water Supply			
Target 2115 yield	20,000 acre-feet/year			
Applicable Customer Category and End-Uses	**Sectors**	✓ Single-family residential	✓ Multi-family residential	✓ Commercial
	End Use	✓ Indoor potable	✓ Indoor non-potable	✓ Irrigation
	Type of development	✓ New	✓ Existing	
Climate resiliency indicator	High			
Unit cost ($/acre-foot/year)	$605			

Off-Channel Reservoir (OCR) with Lake Evaporation Suppression

An off-channel reservoir is a water storage body constructed near a river. Water can be pumped from the river into the reservoir during wetter periods of rainfall and used as drinking water during drier periods such as drought.

This Water Forward recommendation would involve the construction of a new 25,000 acre-foot off-channel reservoir in the Austin area. A lake evaporation suppressant, such as a thin layer of food-safe material would be applied in the summer to reduce water loss due to evaporation.



Planning horizon when option is in effect

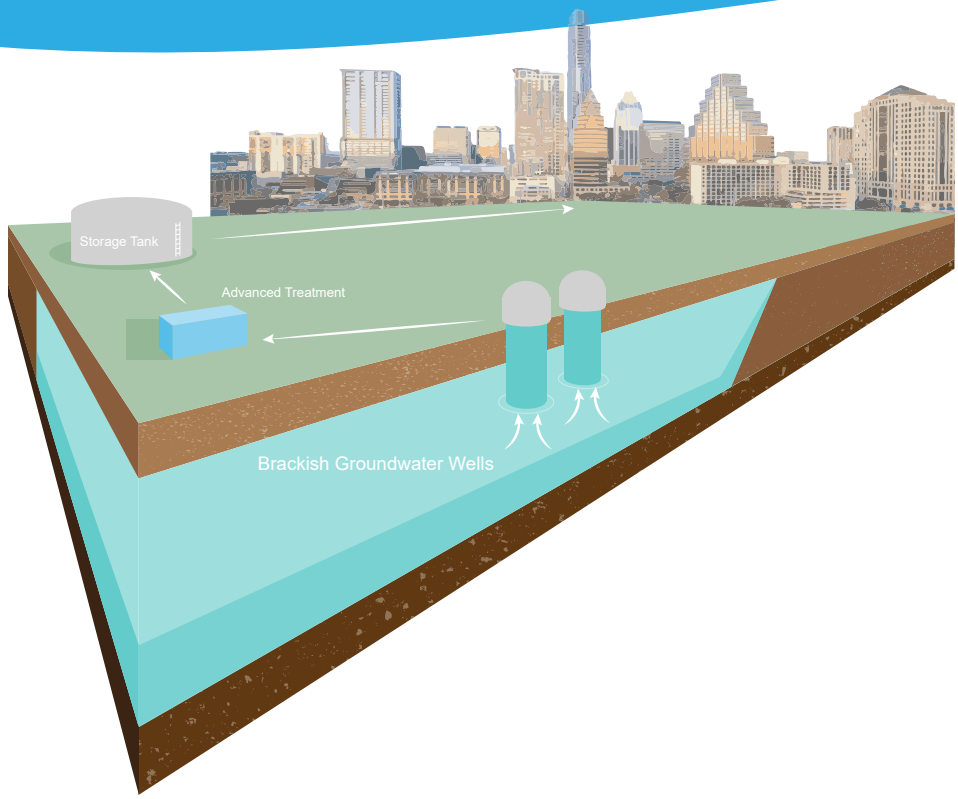
2020 ○ 2040 ○ 2070 ● 2115 ●

Option Category	Water Supply			
Target 2115 yield	25,000 acre-feet/year			
Applicable Customer Category and End-Uses	**Sectors**	✓ Single-family residential	✓ Multi-family residential	✓ Commercial
	End Use	✓ Indoor potable	✓ Indoor non-potable	✓ Irrigation
	Type of development	✓ New	✓ Existing	
Climate resiliency indicator	Medium			
Unit cost ($/acre-foot/year)	$846			

Brackish Groundwater Desalination

Brackish groundwater is essentially salty groundwater, which generally has lesser salt content than seawater. Desalination is the process of removing dissolved solids such as salts by forcing the water through fine membranes under high pressure.

Water Forward recommendations include brackish groundwater desalination as a potable water supply diversification strategy beyond the 2040 planning horizon.



Planning horizon when option is in effect

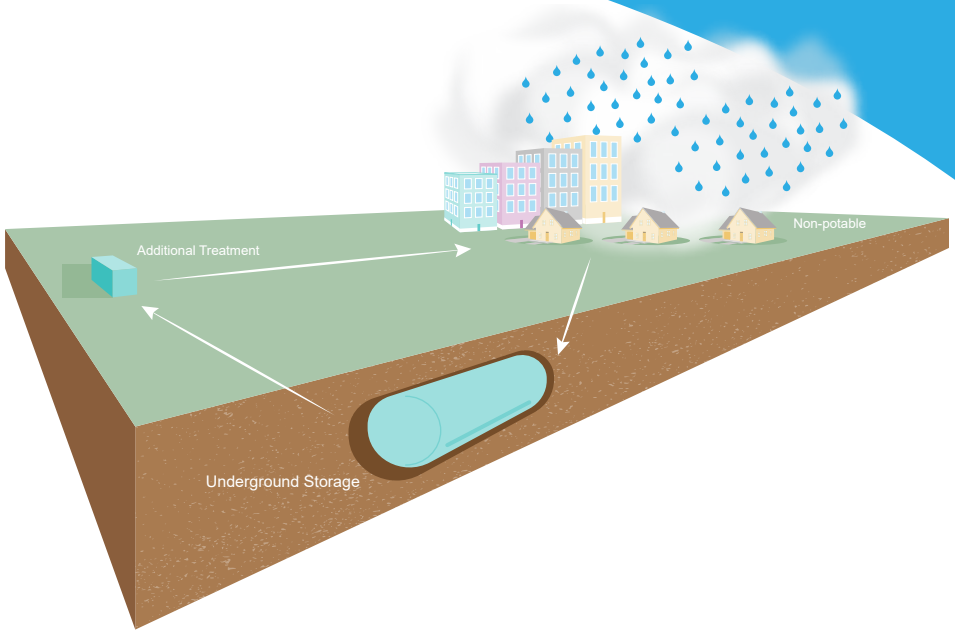
2020 ○ 2040 ○ 2070 ● 2115 ●

Option Category	Water Supply			
Target 2115 yield	16,000 acre-feet/year			
Applicable Customer Category and End-Uses	**Sectors**	✓ Single-family residential	✓ Multi-family residential	✓ Commercial
	End Use	✓ Indoor potable	✓ Indoor non-potable	✓ Irrigation
	Type of development	✓ New	✓ Existing	
Climate resiliency indicator	Medium			
Unit cost ($/acre-foot/year)	$2,690			

Community Stormwater Harvesting

In the Water Forward context, community stormwater harvesting means capturing runoff from impervious surfaces such as roofs or paved areas and storing it for non-potable uses like toilet flushing or irrigation.

In addition to on-site stormwater harvesting as a demand management option, Water Forward recommends community stormwater harvesting as a strategy to meet non-potable demands at the neighborhood scale.



Planning horizon when option is in effect

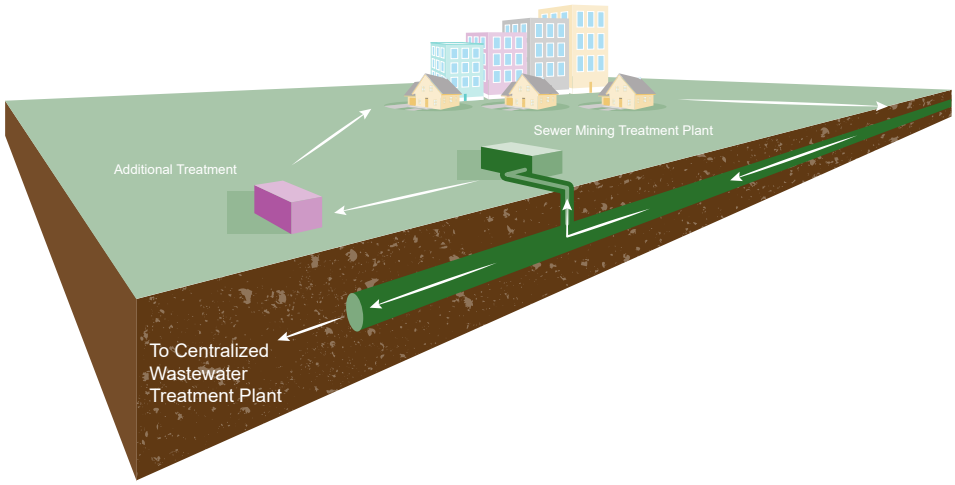
2020 ○ — 2040 ● — 2070 ● — 2115 ●

Option Category	Water Supply - Decentralized			
Target 2115 yield	500 acre-feet/year			
Applicable Customer Category and Types of Uses	**Sectors**	✓ Single-family residential	✓ Multi-family residential	✓ Commercial
	End Use	Indoor potable	Indoor non-potable	✓ Irrigation
	Type of development	✓ New	✓ Existing	
Climate resiliency indicator	Medium			
Unit cost ($/acre-foot/year)	$4,261			

Sewer Mining

Although it sounds unusual, sewer mining is a lot like wastewater treatment and reuse but carried out on a smaller scale. It involves extraction of wastewater from centralized wastewater collection pipes, treatment for non-potable uses, and discharge of waste back into the centralized collection system for treatment at a centralized wastewater treatment plant.

The Water Forward recommendation for sewer mining targets meeting non-potable end uses at the neighborhood scale, which could include irrigation, laundry, and water for use in cooling towers.



Planning horizon when option is in effect

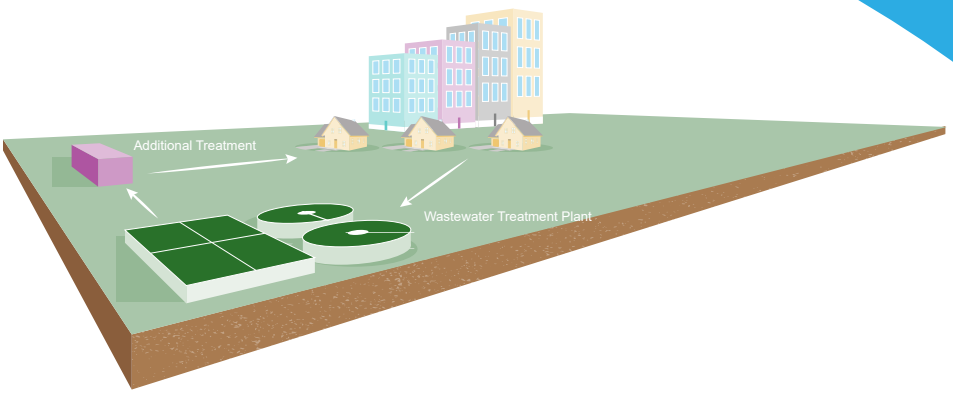
2020 ● 2040 ● 2070 ● 2115

Option Category	Water Supply - Decentralized			
Target 2115 yield	5,300 acre-feet/year			
Applicable Customer Category and End-Uses	**Sectors**	✓ Single-family residential	✓ Multi-family residential	✓ Commercial
	End Use	Indoor potable	✓ Indoor non-potable	✓ Irrigation
	Type of development	✓ New	Existing	
Climate resiliency indicator	High			
Unit cost ($/acre-foot/year)	$2,906			

Distributed Wastewater Systems

Distributed wastewater systems are typically small-scale wastewater treatment plants that operate separately from the centralized wastewater collection and treatment system. They collect water through a local system of wastewater collection pipes, transport it to the distributed wastewater plant, treat the water for non-potable use, and distribute it back out through a small purple pipe reclaimed water system for non-potable use, such as irrigation and cooling, in the surrounding community.

This recommendation targets areas of new development that may be far away from existing centralized wastewater treatment plants.



Planning horizon when option is in effect

2020 | 2040 | 2070 | 2115

Option Category	Water Supply - Decentralized			
Target 2115 yield	30,000 acre-feet/year			
Applicable Customer Category and End-Uses	**Sectors**	✓ Single-family residential	✓ Multi-family residential	✓ Commercial
	End Use	Indoor potable	✓ Indoor non-potable	✓ Irrigation
	Type of development	✓ New	Existing	
Climate resiliency indicator	High			
Unit cost ($/acre-foot/year)	$1,295			

Austin WATER

WATER FORWARD

INTEGRATED WATER RESOURCE PLAN

CITY OF AUSTIN
FOUNDED 1839

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