Austin WATER | WATER FORWARD
INTEGRATED WATER RESOURCE PLAN

Austin Integrated Water Resource Planning Community Task Force

Packet Index

March 7, 2017

Austin Integrated Water Resource Planning Community Task Force
March 7, 2017 – 6:00 p.m.
Waller Creek Center, Room 104
625 East 10th Street
Austin, Texas 78701

For more information go to:
Austin Integrated Water Resource Planning Community Task Force

AGENDA

Voting Members:

Sharlene Leurig - Chair	Marianne Dwight	Sarah Richards
Jennifer Walker – Vice Chair	Diane Kennedy	Lauren Ross
Todd Bartee	Perry Lorenz	Robert Mace
Clint Dawson	Bill Moriarty	

Ex Officio Non-Voting Members:
Austin Water: Greg Meszaros
Austin Energy: Kathleen Garrett
Austin Resource Recovery: Sam Angoori
Neighborhood Housing and Community Development: Rebecca Giello
Office of Innovation: Kerry O'Connor
Office of Sustainability: Lucia Athens
Parks and Recreation: Sara Hensley
Watershed Protection: Mike Personett

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1. **CALL TO ORDER – March 7, 2017, 6:00 p.m.**

2. **CITIZEN COMMUNICATION**

   The first 10 speakers signed up prior to the meeting being called to order will each be allowed a three-minute allotment to address their concerns regarding items not posted on the agenda.

3. **APPROVAL OF MEETING MINUTES**
   a. Approval of the meeting minutes from the February 7, 2017 Task Force meeting (5 minutes)

4. STAFF BRIEFINGS, PRESENTATIONS, AND OR REPORTS

a. Presentation on Screened Demand Management Options, Screening Assumptions, and Resulting Ten Options For Characterization – Consultant, City Staff (50 minutes)
    i. Task Force Discussion and Input
b. Presentation on List of 22 Water Supply Options to be Screened– City Staff (50 minutes)
    i. Task Force Discussion and Input

5. SUBCOMMITTEE REPORTS

6. VOTING ITEMS FROM TASK FORCE

7. FUTURE AGENDA ITEMS

8. ADJOURN

Note: Agenda item sequence and time durations noted above are subject to change.

The City of Austin is committed to compliance with the American with Disabilities Act. Reasonable modifications and equal access to communications will be provided upon request. Meeting locations are planned with wheelchair access. If requiring Sign Language Interpreters or alternative formats, please give notice at least 2 days (48 hours) before the meeting date. Please call Austin Integrated Water Resource Planning Community Task Force, at 512-972-0194, for additional information; TTY users route through Relay Texas at 711.

For more information on the Austin Integrated Water Resource Planning Community Task Force, please contact Marisa Flores Gonzalez at 512-972-0194.

MINUTES

The *Austin Integrated Water Resource Planning Community Task Force* convened in a regular meeting on February 07, 2017 at Waller Creek Center, Conference Rm 104, 625 E 10th Street, in Austin, Texas.

Members in Attendance:

Sharlene Leurig - Chair	Marianne Dwight	Lauren Ross
Jennifer Walker – Vice Chair	Diane Kennedy	Clint Dawson
Todd Bartee	Bill Moriarty	

Ex-Officio Members in Attendance:
Mike Personett

Staff in Attendance:
Kevin Critendon, Daryl Slusher, Teresa Lutes, Joe Smith, Marisa Flores Gonzalez, Mark Jordan, Ginny Guerrero, Prachi Patel, Katherine Jashinski, Jadell Hines, Drema Gross, Jeff Fox

Additional Attendees:
John Burke, Ron Anderson, Richard Hoffpauir, Tina Peterson, Dan Rodrigo

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1. CALL TO ORDER
Sharlene Leurig, Chair, called the meeting to order at 6:10 p.m.

2. CITIZEN COMMUNICATION: GENERAL
None

3. APPROVAL OF MEETING MINUTES
The meeting minutes from the January 31, 2017 Austin Integrated Water Resource Planning Community Task Force regular meeting were approved on Member Walker's motion and Member Kennedy's second on a 7-0-1-2 vote with Members Lorenz and Richards absent.

4. STAFF BRIEFINGS, PRESENTATIONS, AND/OR REPORTS

a. Recap of near-term schedule and deadlines was provided by Marisa Flores Gonzalez, Senior Planner, Austin Water. This briefing was followed by a Task Force discussion including questions and answers.
b. Preliminary water needs identification presentation was made by consultant Richard Hoffpauir. This briefing was followed by a Task Force discussion including questions and answers.
c. Discussion on Demand Management and Supply Side Options was led by consultant Dan Rodrigo, CDM Smith and Marisa Flores Gonzalez, Senior Planner, Austin Water. This briefing was followed by a Task Force discussion including questions and answers.

5. SUBCOMMITTEE REPORTS
None

6. VOTING ITEMS FROM TASK FORCE
None

10. FUTURE AGENDA ITEMS
None

Chair Leurig adjourned the meeting at 8:32 pm.

PRESENTATION

Water Forward – Austin's Integrated Water Resource Plan

March 7, 2017

Outline

- Presentation on Screened Demand Management Options, Screening Assumptions, and Resulting Ten Options For Characterization
- Presentation on List of 22 Water Supply Options to be Screened
- Next steps

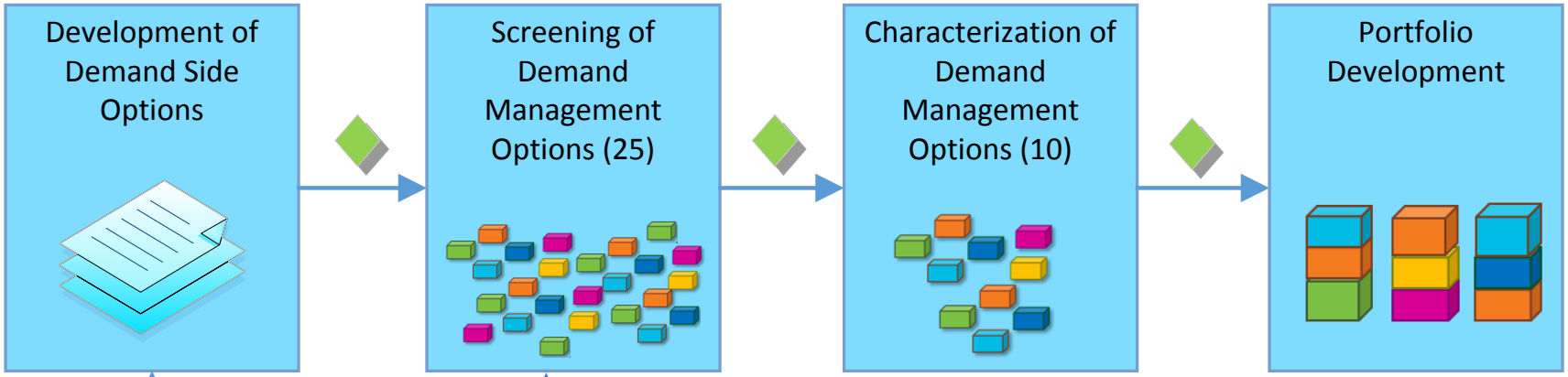
Screened Demand Management Options, Screening Assumptions, and Resulting Ten Options For Characterization

Peter Mayer, Water DM

Presentation Plan

- The IWRP Process
- Screening Criteria and Weights
- Demand Management Options
- Screening Results
- Discussion of Specific options
- Next Steps

Demand Management Options Process



Input:
- Austin Water
- Task Force
- Public and Stakeholders

Previous Studies/Task Force Efforts:
- Water Conservation Study
- Previous task force reports
- Other conservation studies

Task Force Presentation

POTENTIAL OPTIONS

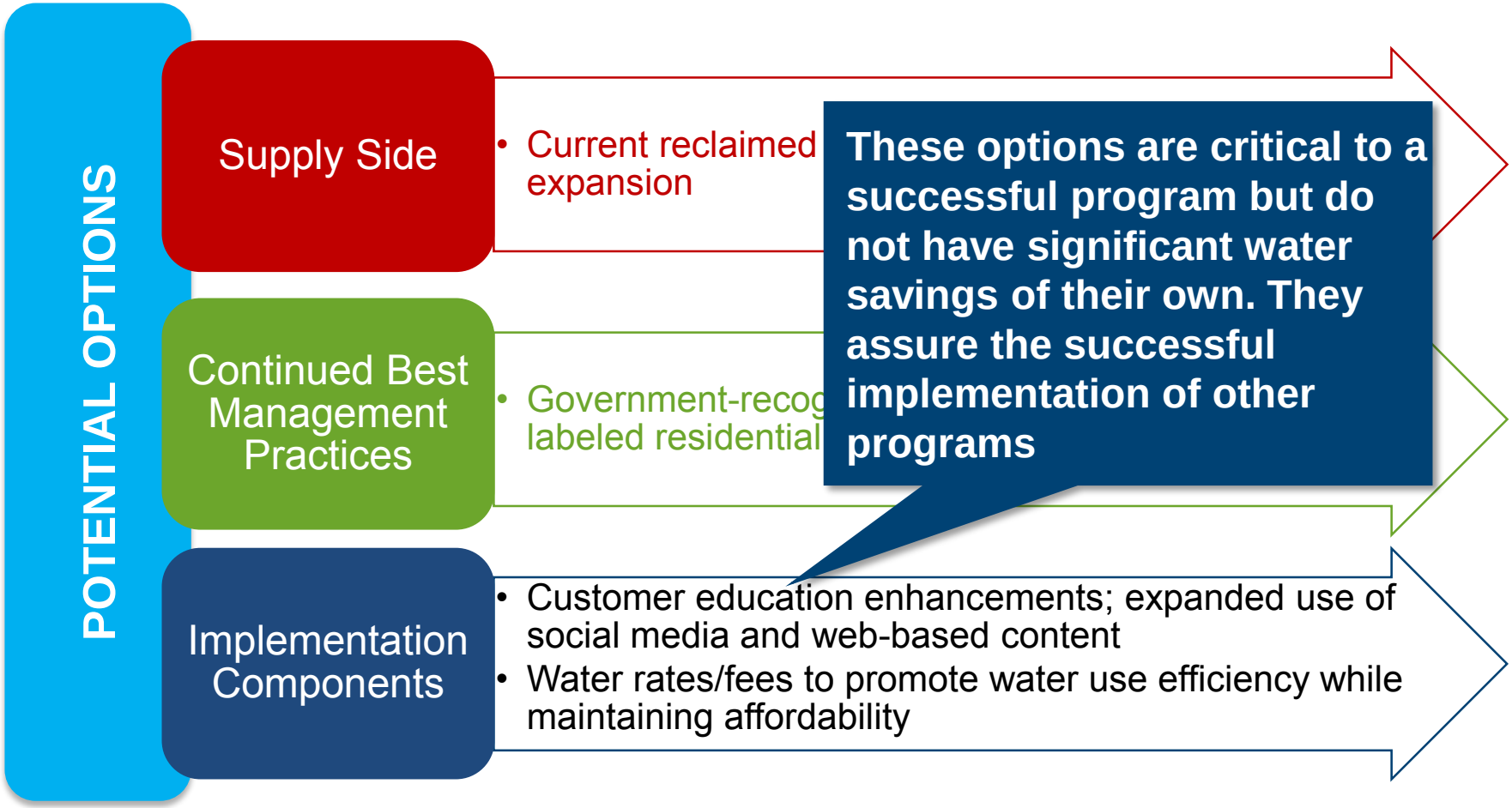
List of options from "a" to "y"

AW Refined List of 25 Demand Management Options for Screening

Options on this list have been identified as having potential for substantial water savings and were developed based on input from the Water Forward Task Force, other previous Task Force efforts, the Water Conservation Study (Maddaus 2015), other conservation studies, and Austin Water staff and the consulting team. The next step of the process is to conduct a qualitative-based screening process to identify the top 10 options for characterization. The characterization process for the top 10 options will include development of quantified water savings estimates.

			Changes Made
Water Loss Control – utility side			
a. Enhance current utility –side water loss control programs	Austin Water currently implements utility-side water loss control programs (including leak detection, main break response, and water main replacements) and anticipates that additional savings could be achieved with program enhancements.	Sector: System wide End Use: Nonrevenue Water	Changes Made: Clarified focus of option is on utility side in option name
Automated Metering Infrastructure (AMI)			
b. Implement customer-facing programs that provide real-time water use information, including identification of customer-side leaks and other water-saving opportunities (implemented through Automated Metering Infrastructure - AMI)	Austin Water is currently conducting an AMI pilot program to test "smart meters" that electronically transmit water usage data, rather than being visually read by a meter reader. The pilot testing includes an interface portal that provides water use information to customers. Smart meters offer more timely data to encourage conservation and allow customers and the utility to monitor water use, including the ability to quickly identify water loss sooner and reduce the risk of meter-read inaccuracies. Preliminary project planning is underway for full-scale implementation using a phased approach.	Sector: All End Use: All	Comments: This is an in progress option that's focused on better measuring and managing supply and customer engagement. There's currently a pilot study in progress in advance of wide-scale implementation. Added reference to AMI within the option name.
Landscape Transformation Ordinances and Incentives			
c. Implement ordinances or incentives to encourage water use efficiencies and reduce water needs for outdoor irrigation and other goals through Regionally Appropriate landscapes with an emphasis on landscape functionality (soil health, cooling/shade, carbon sequestration, erosion control, water quality, stormwater control)		For all sectors, end use: irrigation	Changes Made: Added new option that would be inclusive of what were previously options C (Implement turf grass area, irrigated area, and/or irrigation system limitations), D (Increase WaterWise landscape rebates for residential and multifamily), and E (Implement a new WaterWise landscape rebate for commercial)
Alternative Water ordinances and incentives			
d. Incentivize and/or require on-site (building-scale) alternative water use (for rainwater, stormwater, graywater, blackwater, sewer mining, and ac condensate) for new developments	This strategy aligns with Watershed Protection's beneficial reuse of stormwater efforts. Potential onsite non-potable water savings for new development may depend on implementation approach and external drivers. Implementation may be facilitated by a balanced range of incentives and requirements.	Sector: All (new development) End Use: Non-potable indoor, irrigation	Changes Made: Clarified source water applicability to include all alternative waters evaluated as part of Task 6.3 plus AC condensate at the building scale. Larger scale options will be evaluated on the supply side list. Option is considered to be inclusive of what were previously options G (Modify current rainwater harvesting rebate to encourage larger onsite systems while having favorable cost benefits for systems of all sizes) and H (Offer an incentive to encourage the installation and use of graywater systems).
e. Incentivize and/or require building and plumbing innovations (such as requiring dual plumbing for new development) to expand non-potable use of alternative water sources	Focus on dual plumbing could expand non-potable end uses (such as toilet flushing) that can be provided by alternative water sources.	Sector: Single family, Multifamily, Commercial,	Changes Made: Clarified language

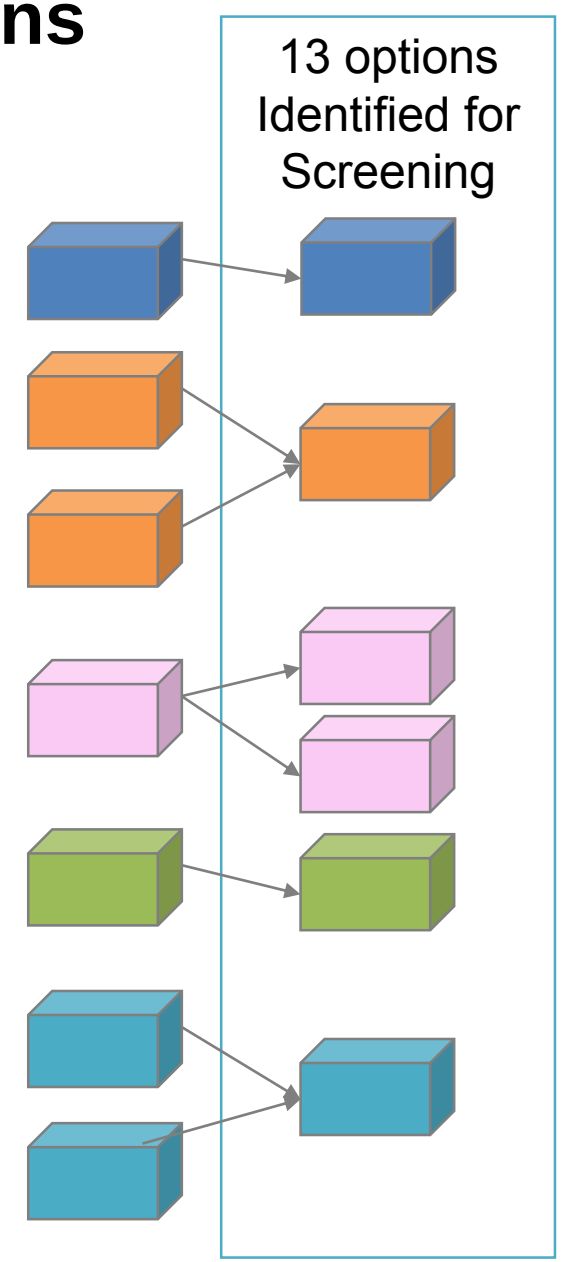
Options Screening – Options Moved



Options Screening – Options Combined or Split

REMAINING OPTIONS

Single Definable and Scalable Option

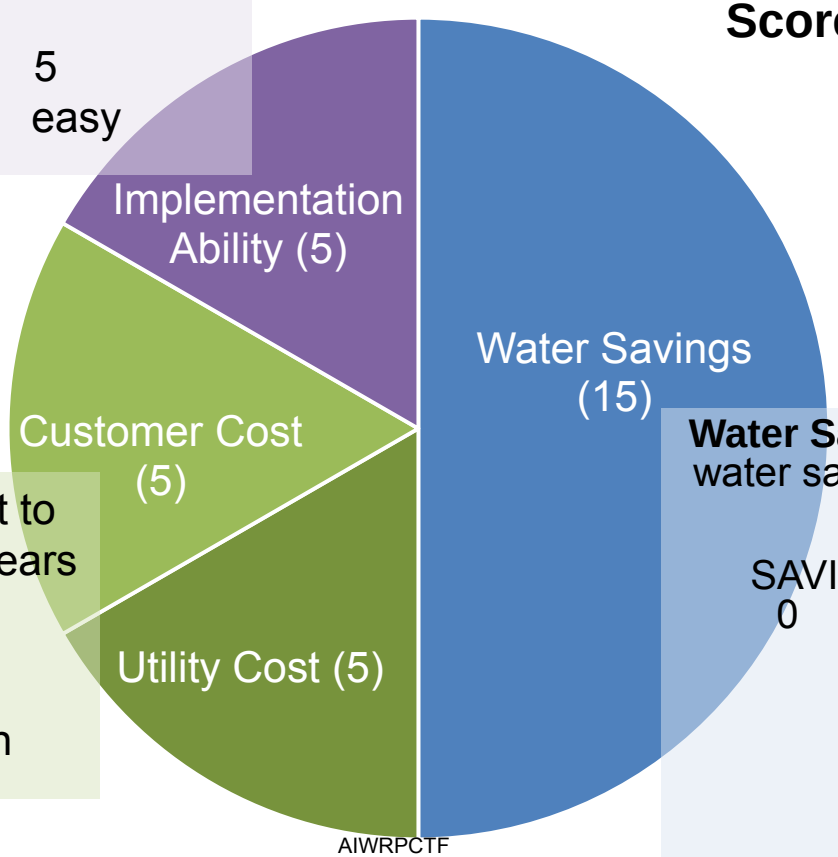


Screening Criteria - Utility & Customer Perspective

Ability= Relative ease to implement

ABILITY
1 2 3 4 5
difficult easy

Highest Potential Score = 30



Costs= Relative cost to implement over 100 years

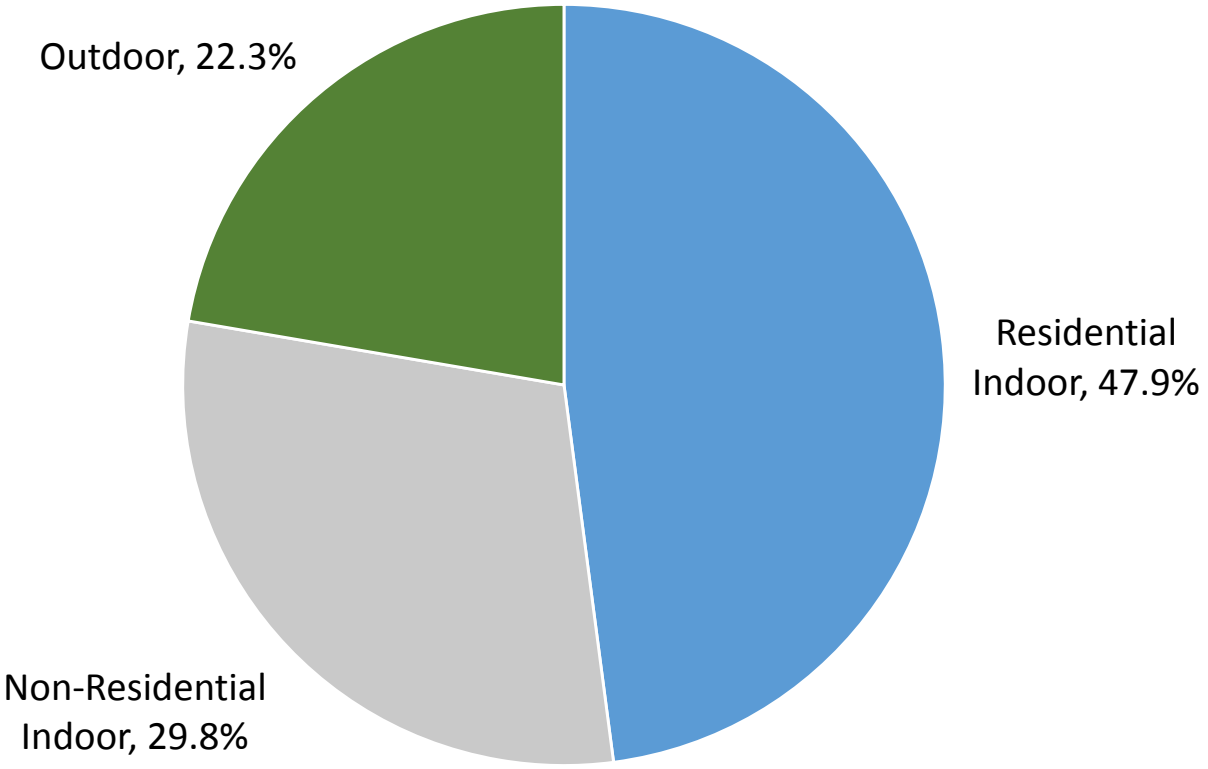
COST
1 2 3 4 5
low high

Water Savings = Incremental water savings over 100 years

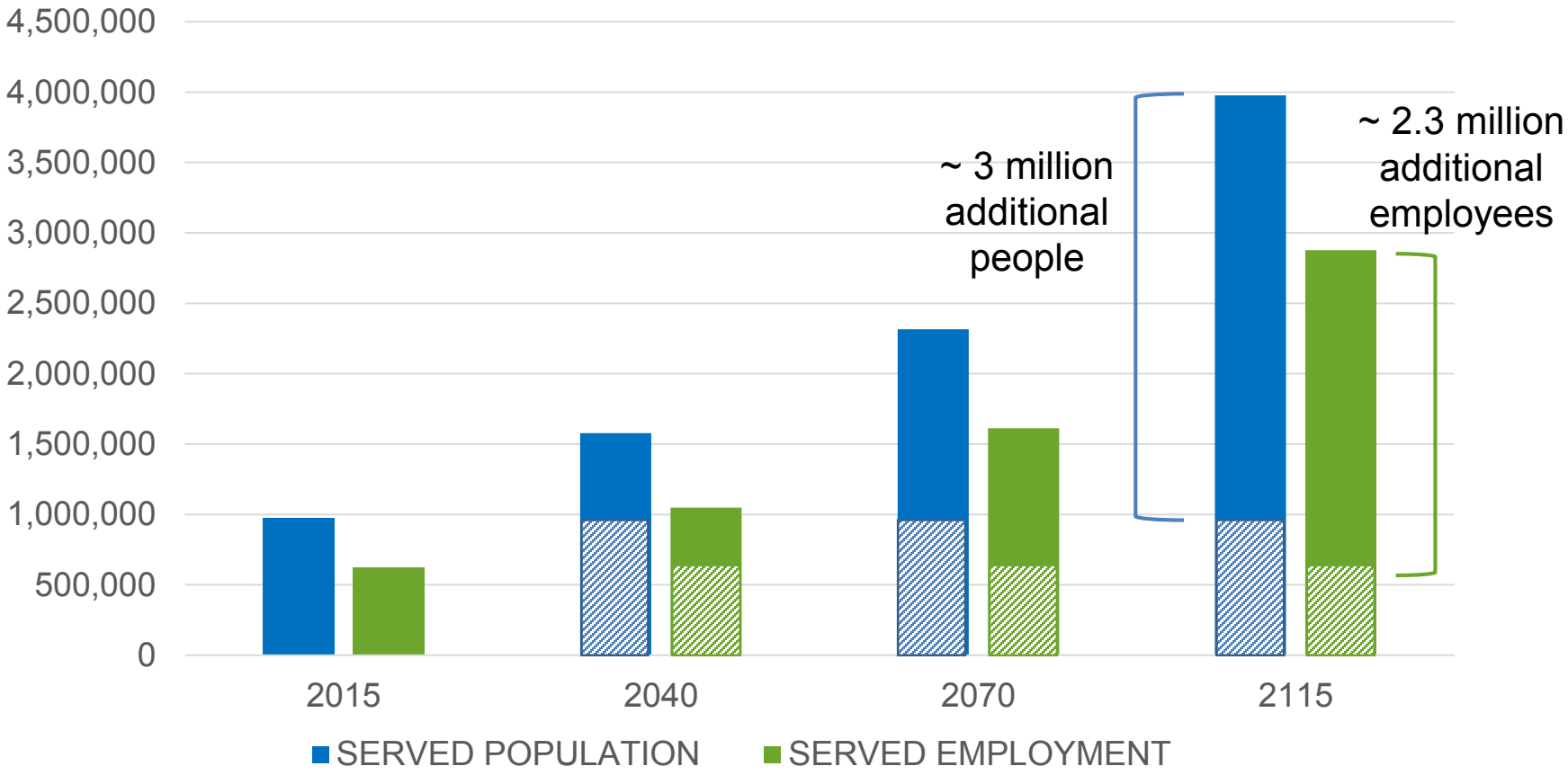
SAVINGS POTENTIAL
0 1 2 3 4 5
low high

Score x 3

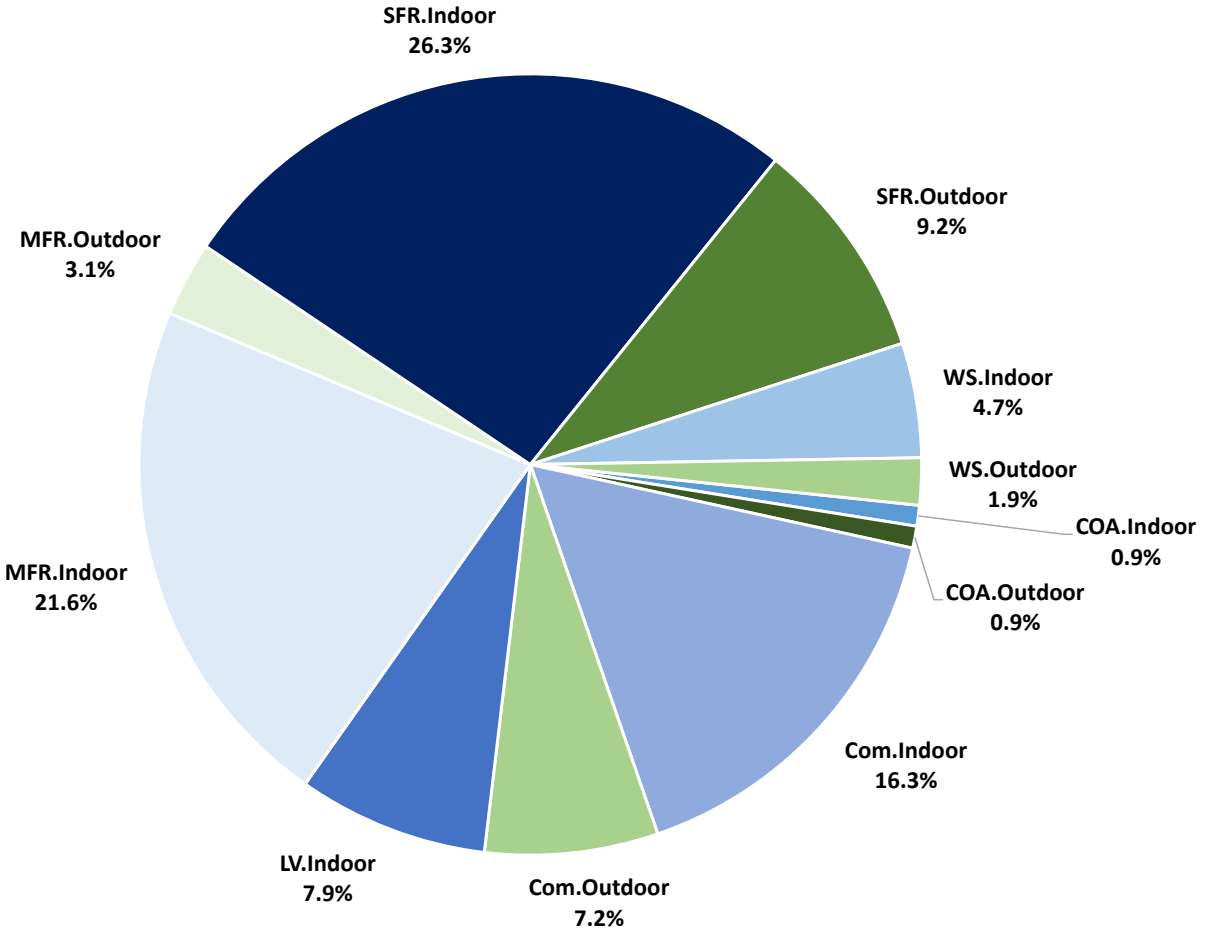
Summary of Water Use in Austin, 2013-15



Planning for 100 Years



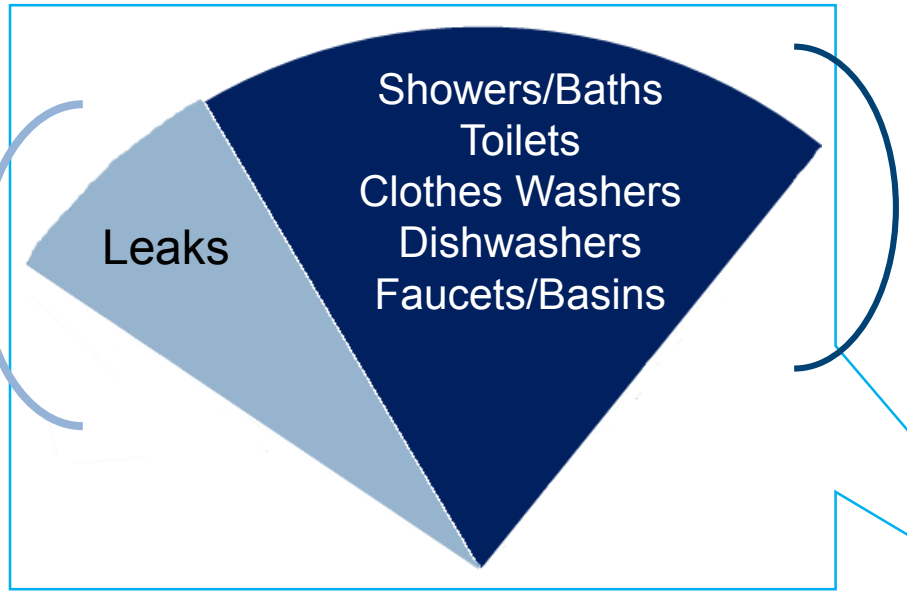
Summary of Austin Water Use, Average 2013-15



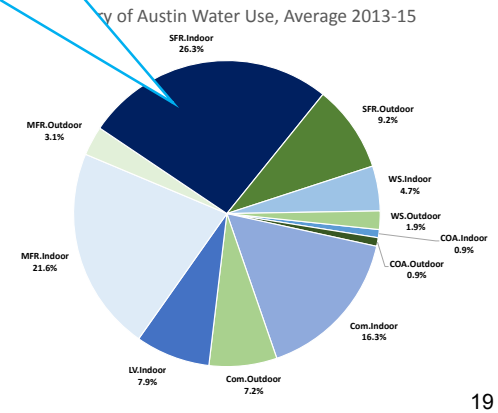
The water demand management options considered, impact across every sector in Austin, maximizing efficiency opportunities over the next 100 years.

Considering the Best Options
Single-Family Residential Example

AMI targets "Leaks"



Efficiency gains from fixtures will occur through Best Management Practices and gains through market



The best options will target the largest slices of the pie where there are efficiencies to be gained through active conservation programs

Measure Name	Measure Description	Sector; End Use	Target
Alternative Water Incentives (g, p)	Incentivize on-site (building-scale) alternative water use (for rainwater, stormwater, blackwater, and ac condensate)	All; Nonpotable with potential for potable RWH in Single Family	Existing
Alternative Water Incentives – Graywater (h)	Offer an Incentive to encourage the installation and use of graywater systems	All; Nonpotable indoor and irrigation	Existing and New
Alternative Water Ordinances (f, p)	Require on-site (building-scale) alternative water use (for rainwater, stormwater, blackwater, and ac condensate)	Multifamily, Commercial; Nonpotable	New
Automated Metering Infrastructure (AMI) (b, n)	Implement customer-facing programs that provide real-time water use information, including identification of customer-side leaks and other water-saving opportunities (implemented through Automated Metering Infrastructure - AMI); AMI + customer portal and engagement (including commercial customer benchmarking)	All; All	All
CII Ordinances - Cooling Towers and Steam Boilers (q, r)	Require older cooling towers and steam boilers to meet water efficiency standards and use efficient equipment	Commercial; Colling towers and steam boilers	Existing
CII Ordinances - Swimming Pools (t)	Require swimming pool efficiency (retrofit)	COA, Multifamily, Commercial; Pools	Existing
Development-focused Water Use Estimates/ Benchmarking Plan Submittal (o)	Require water use estimate submittal for new development concurrent with preliminary plan submittal, to be reviewed by City staff for comparison to benchmarks. As part of this review, City staff will provide potential water use efficiency recommendations and information on available incentive and rebate programs.	All; All	New/Re-development

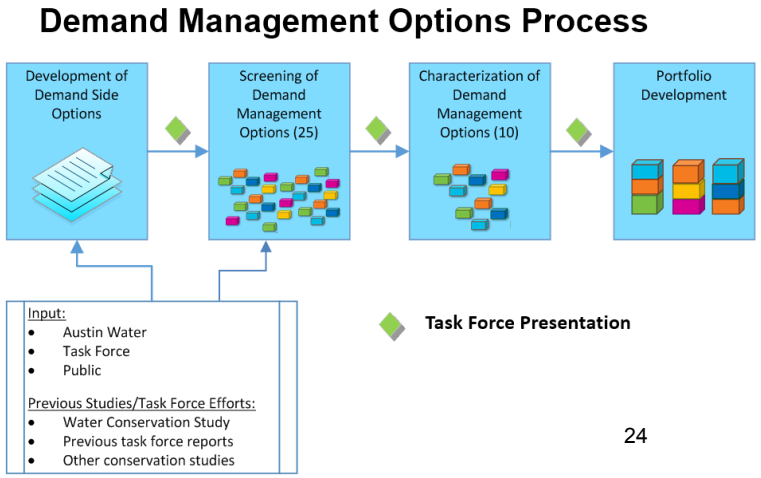
Measure Name	Measure Description	Sector; End Use	Target
Development-focused Water Use Estimates/ Benchmarking Seller Disclosure (s)	Require sellers of commercial property to provide written disclosure of older water using equipment not meeting current standards or fixtures at point of sale to buyers and City staff	Commercial; All	All
Irrigation Efficiency Incentives (j, k)	Expand current irrigation rebate programs to include irrigation system controllers that respond to leaks, high pressure, and soil moisture; Incentivize retrofit of grandfathered irrigation systems to encourage more efficient irrigation systems	All; Irrigation	Existing
Irrigation Efficiency Code Change (l)	Replace existing code that requires installation of a permanent irrigation system with a code that allows for installation of a temporary irrigation system to establish permanent landscaping	Multifamily, Commercial; Irrigation	New
Landscape Transformation Ordinances (c)	Implement ordinances to encourage water use efficiencies and reduce water needs for outdoor irrigation and other goals through regionally appropriate landscapes with an emphasis on landscape functionality (Implementation of this option could include implementing turf grass area, irrigated area, and/or irrigation area limitations)	All; Irrigation	New
Landscape Transformation Incentives (d, e)	Implement incentives to encourage water use efficiencies and reduce water needs for outdoor irrigation and other goals through regionally appropriate landscapes with an emphasis on landscape functionality (implementation of this option could include increasing WaterWise landscape rebates for residential and multifamily and implementing a new WaterWise landscape rebate for commercial)	All; Irrigation	Existing
Water Loss Control Utility Side (a)	Enhance current utility –side water loss control programs	System Wide; Nonrevenue Water	N/A

Rank	Option Name	Incremental Water Saving Potential	Incremental Cost Implementation Utility	Ease of Implementation	Incremental Cost Implementation Customer	Weighted Score
1	Landscape Transformation - Ordinances	5	2	2	2	**21**
2	Automated Metering Infrastructure (AMI)	4	1	1	5	**19**
3	Water Loss Control Utility Side	3	1	1	5	**16**
4	Landscape Transformation - Incentives	3	2	3	2	**16**
5	Irrigation Efficiency -Incentives	2	3	4	2	**15**
6	CII Ordinances - Cooling Towers and Steam Boilers	2	4	3	2	**15**
7	Alternative Water - Ordinances	3	3	1	1	**14**
8	Development-focused Water Use Estimates/ Benchmarking - Plan Submittal	2	2	2	4	**14**
9	Alternative Water -Incentives	2	2	3	2	**13**
10	Alternative Water Incentives - Graywater	1	2	2	3	**10**
11	Development-focused Water Use Estimates/ Benchmarking - Seller Disclosure	1	2	1	3	**9**
12	CII Ordinances - Swimming Pools	1	3	2	1	**9**
13	Irrigation Efficiency - Code Change	0.5	4	2	1	**8.5**

Discussion of Specific Options and Scores

Next Steps

- Task Force input on screening and resulting 10 options for full evaluation
- Final list from Austin Water on which 10 options to carry forward through IWRP process
- Technical work begins to characterize demand management options in terms of cost, savings, environmental impacts, advantages, disadvantages, etc.
- Development of IWRP portfolios that combines conservation options in a manner consistent with the portfolio theme



Thank you!

Peter Mayer, P.E.

WaterDM
DEMAND MANAGEMENT

1 - Landscape Transformation - Ordinances

option Name	Description	
Definition	Implement ordinances to encourage water use efficiencies and reduce water needs for outdoor irrigation and other goals through regionally appropriate landscapes with an emphasis on landscape functionality. Implementation of this option could include implementing turf grass area, irrigated area, and/or irrigation area limitations.	
Savings Score	5 - Future outdoor use represents the largest potential demand sector in Austin over 100 years. Regionally appropriate landscapes requiring minimal supplemental irrigation beyond establishment could reduce future outdoor use by a considerable amount. Savings from this option would need to be evaluated in light of current1x per week irrigation restrictions.	
Utility Cost Score	2 - Landscape ordinances will take time and effort to develop in the beginning and will require additional staff resources to implement and enforces. Costs could reduce in the long-term.	
Implementation Ease Score	2 - In the early phases of implementation, effort will be required to inform, educate and to inspect, and verify to ensure proper implementation. Will require coordination with other departments in Austin and the land development code.	
Customer Cost Score	2 - Customer costs for landscaping may be higher initially until the industry fully adapts to the ordinances. Over the long-term perspective, customer costs will decline as the incremental costs come down.	
Notes	A long-term effort yielding substantial water savings in a critical sector. Incremental customer costs are expected to decline over time.	
Examples	**California**	The State of California has a Model Water Efficient Landscape Ordinance (MWELO) which sets a maximum applied water allowance on landscape areas for all new construction. The formula used to calculate the estimated total water use has limits on the percent of landscape that is irrigated turf. This percentage has been changed over time.
	Colorado	Westminster Colorado has landscape ordinances requiring minimum soil amendments and mulch for all new landscapes, coupled with inspections and verification. A water use analysis approach to the connection fee calculations provides financial incentive for water efficiency across all new buildings and landscapes.

2 - Automated Metering Infrastructure - AMI

option Name	Description	
Definition	Implement customer-facing programs that provide real-time water use information, including identification of customer-side leaks and other water-saving opportunities (implemented through Automated Metering Infrastructure - AMI); AMI + customer portal and engagement with personal electronic technology (including commercial customer benchmarking).	
Savings Score	4 - The future efficiency potential from customer information and engagement brought about by AMI is significant. Preliminary studies suggest a 5% reduction in residential usage from engagement efforts. This technology is still in its infancy and implementation will help reduce customer side leaks and excessive use for years to come.	
Utility Cost Score	1 - AMI and customer engagement software represents a significant investment for AW. Over the next 100 years, the AMI system equipment is likely to be replaced multiple times as equipment ages.	
Implementation Ease Score	1 - Metering and meter replacement is standard utility function, but AMI implementation will require substantially more effort and maintenance over time. Implementation of this option may be more difficult as development of a new customer portal will be required.	
Customer Cost Score	5 - This option is not anticipated to have required significant customer-side incremental costs.	
Notes	This is an in-process option that is focused on better measuring and managing supply as well as increasing customer engagement. It is expected that all water utilities will eventually utilize these technologies.	
Examples	Austin, TX	Pilot scale AMI project underway
	Fort Collins, CO	AMI leak alert program started in 2015, notifying customers with continuous use. Leveraging AMI for Leak Detection www.watersmartinnovations.com/documents/sessions/2015/2015-W-1532.pdf
	East Bay MUD	Various AMI pilots and evaluation of engagement software platforms.
	Valencia, CA	Water budgets linked with AMI technology for advanced customer communication.
	Leesburg, VA	Reduced non-revenue water from 15% to 7% since installing AMI

3 - Water Loss Control

option Name	Description	
Definition	Enhance current utility–side water loss control programs	
Savings Score	3 - As Austin's system ages over the next 100 years, advanced water loss control will yield increased water savings. Water loss in systems 50 - 100 years older than AW is much higher. New water loss control technologies are expected too.	
Utility Cost Score	1 - A significant incremental expense for AW, particularly if the costs of leak repair and pipe replacement are included.	
Implementation Ease Score	1 - Water loss control is already a core AW utility function. The enhanced program will require more utility staff and effort and may face challenges associated with capital project implementation.	
Customer Cost Score	5 - This option is not anticipated to have required significant customer-side incremental costs.	
Notes	As Austin's system continues to age, reducing water loss will become increasingly important.	
Examples	Georgia	State mandated annual validated water loss audits. Funding tied to steady improvement.
	Texas	The City of Fort Worth submitted a SWIFT application for implementation of AMI with an automated leak detection system. Water loss for the City was estimated at 14%. The expected annual volume of water conserved was estimated at 9,450 AFY. http://texaslivingwaters.org/wp-content/uploads/2016/11/SWIFT-Guidance-Document_FINAL.pdf
	California	Major new state water loss control initiative focused on training, education, audit validation, and continuous improvement.

4 – Landscape Transformation Incentives

option Name	Description	
Definition	Implement incentives to encourage water use efficiencies and reduce water needs for outdoor irrigation and other goals through Regionally Appropriate landscapes with an emphasis on landscape functionality. Implementation of this option could include increasing WaterWise landscape rebates for residential and multifamily and implementing a new WaterWise landscape rebate for commercial.	
Savings Score	3 - Current outdoor use represents about 22% of total metered demand. Regionally appropriate landscapes requiring minimal supplemental irrigation beyond establishment would help adapt landscapes to require less water and could further reduce outdoor use by a considerable amount. Savings from this option would need to be evaluated in light of current1x per week irrigation restrictions.	
Utility Cost Score	2 - AW already offers landscape transformation incentives and has a program in place for implementation. The incremental cost of expanding the program is scalable and comparatively low.	
Implementation Ease Score	3 - A moderate level of effort is anticipated as the program expands. This option will require coordination with other departments (WPD) and the Land Development Code.	
Customer Cost Score	2 - Customer receives an incentive, but replacing landscaping can be expensive. Compared with other options, there will be some incremental customer costs.	
Notes	This option will accelerate water savings and landscape transformation in Austin.	
Examples	California	Metropolitan Water District and member agencies implemented a massive turf replacement program in 2014-16. Thousands of acres of turf were converted and more than $370 million in rebates were provided.
	Nevada	The Southern Nevada Water Authority developed and continues to implement a landscape incentive program focused on locally appropriate plantings. Significant impact and reduction in turf landscapes.
	Colorado	Water utilities and a local non-profit team annual to offer "Garden in a Box" plant packages, aimed a regionally appropriate landscaping.

5 - Development-focused Water Use Estimates/ Benchmarking Plan Submittal

option Name	Description	
Definition	Require water use estimate submittal for new development concurrent with preliminary plan submittal, to be reviewed by City staff for comparison to benchmarks. As part of this review, City staff will provide potential water use efficiency recommendations and information on available incentive and rebate programs.	
Savings Score	2 - Beginning with a development review process focused on sensible efficiency recommendations, the water savings may be relatively small. Over the 100 year timeframe, this effort will likely evolve into a process where new buildings in Austin are scored against efficiency benchmarks. Eventually this could lead to the creation of a reasonable water allocation (water budget) for every new (and eventually existing) property in Austin that could be used to benchmark efficiency. Phased implementation of this option could lead to more substantial water savings over time.	
Utility Cost Score	2 - This will require significant effort at the outset, but overtime as benchmarks are established and the process become more routine, effort will be reduced.	
Implementation Ease Score	2 - A challenging implementation for AW at the outset. This option could build off the Austin Energy Green Building program or AW Service Extension Request process. This option could be resource intensive in terms of staffing and process to establish benchmarks.	
Customer Cost Score	4 - Some additional time andresources may be expended by customer/contractor/engineer for this preliminary submittal. No incremental cost to current customers. Future customers benefit from built-in water efficiency.	
Notes	Could be an important step for AW in the direction of customer-specific water efficiency and ensuring new buildings join the system as highly water efficient from the start.	
Examples	Colorado	Westminster Colorado charges substantially higher connection fees based on increased tap size and anticipated water usage based on customer type and size. This brings new buildings to the table with water efficiency built-in to achieve a lower connection fee.
	California	A water budget approach to both new and existing customers has been used by a handful of utilities for years, and has recently been adopted widely across the state. The State has embraced this approach from the customer up through the utility itself.

6 – Irrigation Efficiency Incentives

option Name	Description	
Definition	Expand current irrigation rebate programs to include irrigation system controllers that respond to leaks, high pressure, and soil moisture. Incentivize retrofit of grandfathered irrigation systems to encourage more efficient irrigation systems.	
Savings Score	2 - Impacts to existing irrigation systems and savings are assumed to accrue in first 20 - 30 years only. Savings likely to be small with 1x per week irrigation restrictions.	
Utility Cost Score	3 - Moderate incremental cost. Scalable, based on rebate level.	
Implementation Ease Score	4 - AW already offers an irrigation incentive for residential and a smart controller incentive for multifamily and commercial with programs in place for implementation. AW also offers free evaluations for residential and mandatory irrigation audits for commercial and multifamily. The incremental effort of expanding the program is scalable and comparatively low.	
Customer Cost Score	2 - Customer's receive an incentive, but must bear the costs of system repair and replacement. Compared with other options, there will be some incremental customer costs.	
Notes	Incentives could be designed to assist in landscape transformation as well. Impacts existing customers. Savings likely to be small with 1x per week irrigation restrictions.	
Examples	Arizona	Tucson and other cities offer rebates for drip irrigation and climate based control
	Utah	Salt Lake City. WaterCheck irrigation audits and system upgrades. Rebates.
	Texas	San Antonio (SAWS) has offered a variety of irrigation efficiency programs. Dallas Water Utilities also offers free irrigation system check-ups.

7 – Alternative Water Ordinances

option Name	Description	
Definition	Require on-site (building-scale) alternative water use (for rainwater, stormwater, blackwater, and air conditioning (AC) condensate) for new developments in the multifamily and commercial sectors	
Savings Score	3 - Applies to future construction which represents a big portion of future demand. Scalable.	
Utility Cost Score	3 - These regulations will be complex to design, implement, and regulate, particularly in the early stages. Over time, the implementation effort could be reduced.	
Implementation Ease Score	1 - The challenges of design and early stage implementation are unknown and could be significant.	
Customer Cost Score	1 - Mandating these systems will increase the cost of land development. Installation of these systems would require dual plumbing. Long term maintenance of these systems adds to customer expense as well.	
Notes	While generally expensive and challenging to implement, this option could provide savings and other benefits. As with all options, savings must be proven for this to be considered a reliable source of future demand reduction for Austin.	
Examples	Australia	Gold Coast Water, south of Brisbane mandated dual plumbing and on-site capture systems during the millennial drought. Most systems were quickly abandoned once the drought ended. AWE published a "lessons learned" from the Australian drought report.
	San Antonio, Texas	San Antonio requires new commercial construction on or after January 1, 2006, to have a single independent condensate collection line to collect condensate for use as process water, cooling tower makeup, and landscape irrigation.

8 – CII Ordinances, Cooling Towers

option Name	Description	
Definition	Require older cooling towers to meet water efficiency benchmarks and use efficient equipment	
Savings Score	2 - Only impacts cooling towers for existing systems. New equipment is assumed efficient by code. All savings accrue in the first 30 - 40 years.	
Utility Cost Score	4 - Incremental utility cost is comparatively small.	
Implementation Ease Score	2 - Enforcement and verification will require substantial effort.	
Customer Cost Score	1 - Complying with the requirement will be expensive for customers, but will also yield benefits over time.	
Notes	This option is currently being considered as part of the plumbing code adoption cycle. Notes	
Examples	Colorado	Denver Water has had trouble maintaining long term water savings from cooling tower retrofits.
	California	MWD offers different cooling tower incentives, but has not established formal requirements.

9 – Alternative Water Incentives

option Name	Description	
Definition	Incentivize on-site (building-scale) alternative water use (for rainwater, stormwater, blackwater, and AC condensate) for existing developments	
Savings Score	2 - Applies to existing development as retrofit. Scalable.	
Utility Cost Score	2 - Program would add to complexity of existing programs. Over time, the implementation effort could be reduced.	
Implementation Ease Score	3 - Design and early stage implementation could be built off of existing incentive programs for rainwater harvesting and ac condensate.	
Customer Cost Score	2 - Even with an incentive, these systems are usually expensive to retrofit. Installation of these systems would require dual plumbing.	
Examples	Australia	Gold Coast Water, south of Brisbane mandated and incentivized dual plumbing and on-site capture systems during the millennial drought. Most systems were quickly abandoned once the drought ended. AWE published a "lessons learned" from the Australian drought report.

10 – Alternative Water Incentives, Graywater

option Name	Description	
Definition	Offer an Incentive to encourage the installation and use of graywater systems, which are defined as shower-to-toilet and landscape irrigation systems that collect shower, faucet, and laundry discharge, provide some element of filtration and treatment and then reuse the water.	
Savings Score	1 - Limited water savings potential as clothes washers, faucets, and showers become more efficient and use less and less water. Less and less graywater will be produced.	
Utility Cost Score	2 - Comparatively expensive to implement. Incentives would need to be substantial to achieve meaningful participation rates. 2017 AWE study found some potential long term benefits for water utilities, but also cautioned about the lack of cost effectiveness and demonstrable savings data.	
Implementation Ease Score	2 - Graywater systems are complex. Implementation from the utility perspective will be on a long-term time frame requiring staff effort.	
Customer Cost Score	3 - From the AWE report, "if the total life-cycle costs of the system exceed the total life-cycle savings from reduced potable water purchases, the system will have a net cost to the homeowner." This is the expected outcome from most systems.	
Notes	The 2017 research indicates that graywater systems have yet to be proven cost-effective from the customer or the utility perspective.	
Examples	Australia	Gold Coast Water began installing on-site systems during the millennial drought. These systems were quickly abandoned once the drought ended.

[1] Gauley, Bill (2017) *Water Savings and Financial Benefits Associated with Single-Family Package Graywater Systems.* Alliance for Water Efficiency. Chicago, IL.

11 - Development-focused Water Use Estimates/ Benchmarking - Seller Disclosure

option Name	Description	
Definition	Require sellers of commercial property to provide written disclosure of older water using equipment not meeting current standards or fixtures at point of sale to buyers and City staff	
Savings Score	1 – This is not a mandate for water efficient fixtures, only for disclosure. Water savings could be significant if turned into a "retrofit on resale" requirement as California has just done. Without a mandate or incentive, the potential for water savings should be assumed limited, until proven.	
Utility Cost Score	3 - Setting the "current standards" that must be met will be an on-going process for AW. Requires staff effort.	
Implementation Ease Score	1 - Expect significant pushback from the real estate industry and commercial property owners. Anything that complicates the transfer of real property is seen as an impediment.	
Customer Cost Score	3 - Customer cost would likely be low to moderate but could have cost and transaction time impacts.	
Notes	While savings are scored low, the effort could evolve into a major contributor to future water efficiency in Austin if retrofit on resale was included.	
Examples	California	State law mandates 1.28 gallons per flush (gpf) toilets and other fixtures in all single-family residences. Effectively a retrofit on re-sale ord. Expected to be enforced as part of the inspection and title transfer of real estate.
	California	City of Burbank has "retrofit upon resale" requirements for residential properties that went into effect in 2010. https://www.burbankwaterandpower.com/water/rules-and-regulations-water/retrofit-upon-resale-requirements
	California	City of San Diego has "retrofit upon resale" requirements for residential properties that went into effect in 2000. https://www.sandiego.gov/water/conservation/selling

12 – CII Ordinances, Swimming Pools

option Name	Description
Definition	Require swimming pool efficiency (retrofit)
Savings Score	1 - The sector impacted is comparatively small. 100-year savings are small.
Utility Cost Score	3 – Unclear what ordinances would be and how substantive water savings would be achieved. Could require a utility expert in swimming pool operation.
Implementation Ease Score	2 – High level of staff expertise and effort required for successful implementation.
Customer Cost Score	1 – Incremental cost of implementation for customers with pools could be substantial.
Notes	Require swimming pool efficiency (retrofit)

13 – Irrigation Efficiency Code Change

option Name	Description
Definition	Replace existing code that requires installation of a permanent irrigation system with a code that allows for installation of a temporary irrigation system to establish permanent landscaping
Savings Score	0.5 - Water savings would be most realized if combined with another option like landscape transformation.
Utility Cost Score	4 – Once implemented this requirement would not have a significant utility cost impact.
Implementation Ease Score	2 – Challenging to implement initially, but easier over time. Would require coordination with Watershed Protection Department and consistency with the Innovative Commercial Landscape Ordinance.
Customer Cost Score	1 – Could be "cost neutral" to customers depending on implementation approach.

Questions?

List of 21 Water Supply Options to be Screened

List of 21 Water Supply Options

1	Aquifer storage and recovery (FEA 5)
2	Direct non-potable reuse (centralized reclaimed purple-pipe system)
3	Lake Austin operations (lake level variation)
4	Stormwater and Rainwater Harvesting
5	Sewer mining (wastewater skimming)
6	Distributed wastewater systems
7	Capture Lady Bird Lake Inflows (FEA 4)
8	Indirect reuse – bed and banks
9	Indirect Potable Reuse through Lady Bird Lake (FEA 2)
10	Indirect Potable Reuse through Alluvial Aquifer (FEA 3)

List of 21 Water Supply Options

11	Direct potable reuse
12	Desalination – brackish groundwater
13	Desalination – seawater
14	Enhanced Off-Channel Storage at Walter E. Long Lake (Decker Lake) (FEA 1)
15	Lake Evaporation Suppression
16	Conventional Groundwater
17	Additional supply from LCRA
18	Aquifer Storage and Recovery (Carrizo Aquifer)
19	Explore partnership approaches on regional strategies with Corpus Christi or others
20	Inter-Basin Transfers from Available Surface Water Supplies
21	Off Channel Reservoir (Austin vicinity)

Discussion

Next Steps

Next Steps

- March 13th Deadline
  - Task Force feedback on screened 10 demand management options due
  - Task Force feedback on list of 21 supply options due
- April 4th Task Force Meeting (tentative agenda)
  - Update on FEA 5 – Aquifer Storage and Recovery
  - South Central Waterfront Presentation
  - Potentially other items
- May 2nd Task Force Meeting
  - Presentation on characterized 10 demand management options
- June 6th Task Force Meeting
  - Presentation on screening from 21 to 10 supply options

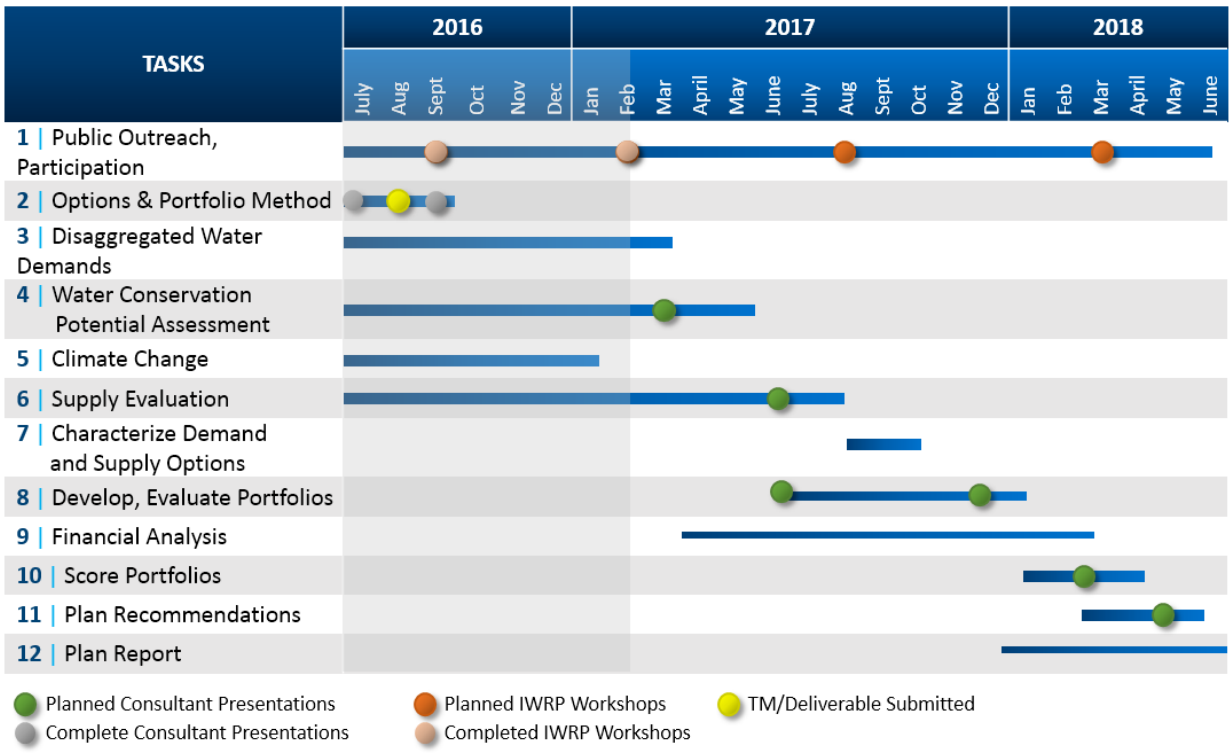
Questions?

BACKUP MATERIALS

Water Forward Updates

Project Update

	TASK	PROGRESS TO DATE	NEXT STEPS
1	Public Outreach	• Completed three targeted stakeholder meetings and public workshop #2	• Planning for upcoming stakeholder events and upcoming public workshop #3 in August
2	Methodology	• Draft completed	• Finalize draft edits
3	Disaggregated Water Demand	• Draft disaggregated demand model completed	• Finalize disaggregated demand model and incorporate climate change scenarios • Develop draft technical memorandum
4	Conservation Potential Evaluation	• List of 25 demand management measures developed	• Complete demand management screening
5	Climate Change	• Preliminary water needs analysis with climate change considerations was presented at February Task Force Meeting	• Finalize climate change projections and preliminary water needs analysis
6	Supply Analysis	• Initial data collection for supply options underway • Preliminary definitions of decentralized options developed	• Conduct preliminary decentralized options analysis • Data collection and initiate screening of supply options



Public Outreach Update

From mid-January 2017 to early February 2017, the Water Forward team conducted three targeted stakeholder meetings and Public Workshop #2. Reports from the stakeholder meetings have been compiled and are included as part of this packet. A final report from Public Workshop #2 is still pending. Upcoming events include the Zilker Garden Festival, held March 25th-26th and Earth Day ATX, held April 22nd at the Huston-Tillotson University campus. The team has also begun planning Public Workshop #3, to be held in August 2017 and lead up events in the spring and summer.

Subcommittee Updates

Public Outreach Subcommittee

The Public Outreach Subcommittee met on February 28th. The subcommittee discussed past outreach events, included targeted stakeholder meetings and the public workshop held in January 2017. The subcommittee also discussed upcoming events in the spring including Earth Day ATX (to be held at the Huston-Tillotson University campus) and the Zilker Garden Festival. The subcommittee provided feedback on draft public outreach materials and also provided input on possible community contacts and outreach methods.

Code Subcommittee

Austin Water staff attended a CodeNext Board & Commission Forum hosted by the Code Advisory Group (CAG) on Saturday, March 4th as Chair Leurig and Vice Chair Walker were unable to attend. The CAG has requested that Boards and Commissions with input that they would like to see included in the CAG report on the draft land development code (LDC) submit their comments by May 15th. The deadline for public comment on the first draft of the LDC is June 7th. There will also be other opportunities to provide input on future versions of the LDC. Austin Water Staff is currently drafting a letter to send to the CAG communicate that Water Forward plan recommendations may require revisions to the LDC post adoption. Preliminary feedback indicated that advancing revisions to the LDC in future implementation stages of the Water Forward plan would be possible. To the extent possible, the characterization of options will be informed by the CodeNext process.

Austin WATER | WATER FORWARD
INTEGRATED WATER RESOURCE PLAN

Memorandum

To: *Marisa Flores Gonzalez, Austin Water*
Teresa Lutes, Austin Water

From: *Peter Mayer, WaterDM*

Copied: *Dan Rodrigo, CDM Smith*
Bill Davis, CDM Smith

Date: *March 2, 2017*

Subject: *Austin Water Integrated Water Resources Plan*
Task 4 – Demand Management Options Screening
CDM P/N: 0590-114879

Water conservation programs (i.e., demand management) have been and will continue to be a critical element in Austin's management of water resources. Accordingly, Austin Water (AW) and the Water Forward Task Force have established water conservation as a major focal point for the Integrated Water Resource Plan (IWRP). Thus, an important task of the IWRP is to describe existing conservation measures implemented by AW, identify potential new options for future implementation, screen the potential new options to a list of those best analyzed as potential components of the IWRP, and characterize and quantify those measures (Task 4). This memorandum summarizes the demand management options screening effort and results. The outcome of this process will be a list of the ten demand management measures to be fully evaluated for cost and benefits and thereby carried forth into the subsequent task of portfolio development.

1.0 Screening Criteria and Weights

The screening process for assessing the potential demand management options under consideration for the IWRP focused on a total of four broad qualitative criteria:

- **Incremental Water Savings Potential:** This criterion provides a qualitative, comparative assessment of the incremental water savings potential for a given measure. Each measure is scored numerically from a 0 to 5, with 0 indicating very little water savings potential and 5 indicating significant water savings potential. The water savings potential for each measure is determined based on consideration of current or historical programs that have targeted the end-use targeted by the measure, additional savings that can be achieved by that measure given the extent of the sector/end use demand currently, new vs existing development, the 100-year planning horizon that projects an addition of roughly 3 million additional people to be serviced, and success that other utilities have had implementing a similar program.

- **Incremental Utility Cost of Implementation:** This criterion characterizes the incremental utility cost of implementing a measure. Each measure is scored numerically from 1 to 5, with 1 indicating significant expense and 5 indicating minimal costs. The utility cost of implementation scoring takes into consideration whether the measure requires rebate investments, staff time and resources, potential for requiring capital expenditures, and the complexity of designing an ordinance or code, for examples, and considers how these costs might change over time.

- **Ease of Implementation:** This criterion provides a qualitative assessment of how difficult or easy it will be to implement a given measure. Each measure is scored numerically from 1 to 5, with 1 indicating the measure is extremely difficult to implement with many hurdles and 5 indicating minimal implementation challenges and minimal additional staff/resources required. The ease of implementation scoring for each measure takes into consideration customer/stakeholder acceptance or resistance, programmatic design challenges, enforcement assumptions, and technological hurdles.

- **Incremental Customer Cost of Implementation:** This criterion characterizes the incremental customer cost of implementing a measure. Each measure is scored numerically from 1 to 5, with 1 indicating significant expense to the customer and 5 indicating minimal customer expense. The customer cost of implementation scoring takes into consideration the potential costs that would be absorbed by the customer for a given measure, such as cost of compliance, cost of equipment/materials, maintenance, and considers how these costs might change over time.

These four criteria are then combined (as follows) to develop a single weighted score:

- Incremental Water Savings Potential was assumed 50% of weighted score.

- The Incremental Utility Cost of Implementation, Ease of Implementation, and Incremental Customer Cost of Implementation are also assumed 50% of weighted score.

For the purposes of calculating the weighted score, the incremental water savings potential was multiplied by three and then added together with the remaining scores. The highest potential score is a 30, which would indicate a demand management measure that has high water savings with low overall costs that is easy to implement.

2.0 Demand Management Options

The demand management options list was developed through a collaborative process, with options developed based on previous task force recommendations, input from the Water Forward Task Force members, AW staff, the public, and the consulting team.

Of the initial 25 options, two were re-categorized as supply side options, two were determined to be continuing best management practices, and three were determined to be necessary implementation

components to other options. The remaining options were combined or split out into one or more options, thereby reducing the number of options for screening to thirteen.

To recap, given the list of potential measures that was ultimately developed and for which input was sought, through discussions with AW staff and the consulting team several options were determined to be best handled through separate processes, as follows:

- The options to require or incentivize expansion of the use of the current reclaimed water system along with option to require or incentivize building plumbing innovations such as dual plumbing were moved to the supply side list.

- The option to require or incentivize government-recognized energy and water efficiency-labeled residential and commercial fixtures and the option to incentivize or require toilet, urinal, and bathroom faucet aerator efficiencies were determined to be "*continued best management practices*" to be included in demand offsets separately (i.e., off-the-top reduction from the baseline forecast that does not require evaluation through the IWRP process) and reflects Austin Water's longstanding programs to incentive, require or freely distribute these fixtures.

- Three options were determined to be "*implementation components*" of a successful conservation program and were not further evaluated or screened. These measures include water rates and fees to promote water use efficiency while maintaining affordability, customer education enhancements, and use of social media programs and web-based content to promote conservation. These types of programs are indeed critical to a successful program but do not necessarily have significant water savings of their own, but rather they assure the successful implementation of other programs.

The remaining measures were then combined or split out into one or more options so that, if selected to be fully evaluated, the option would represent a single definable measure with scalable parameters. For example, ordinances and incentives for landscape transformation have different costs on a per unit basis at the utility-level, thus the implementation approach is assessed as two different options. This approach will allow further assessment of a range of potential implementation approaches within the options characterization process. As another example, graywater was identified as being an alternative water source that has characteristics that differ from other sources (such as rainwater or stormwater) because of the implementation complexity and thus was analyzed as a separate measure. In total, 13 demand management options for the screening were identified and delineated, as shown in **Table 2-1.** The goal of the screening process is to identify the ten demand management options for fuller characterization and use within the portfolio development process.

Table 2-1 List of Demand Management Measures for Screening (listed alphabetically)

Measure Name	Measure Description	Sector; End Use	Target[1]
Alternative Water Incentives	Incentivize on-site (building-scale) alternative water use (for rainwater, stormwater, blackwater, and ac condensate)	All; Nonpotable with potential for potable RWH in Single Family	Existing
Alternative Water Incentives - Graywater	Offer an Incentive to encourage the installation and use of graywater systems	All; Nonpotable indoor and irrigation	Existing and New
Alternative Water Ordinances	Require on-site (building-scale) alternative water use (for rainwater, stormwater, blackwater, and ac condensate)	Multifamily, Commercial; Nonpotable	New
Automated Metering Infrastructure (AMI)	Implement customer-facing programs that provide real-time water use information (including commercial customer benchmarking), including identification of customer-side leaks and other water-saving opportunities (implemented through Automated Metering Infrastructure - AMI)	All; All	All
CII Ordinances Cooling Towers and Steam Boilers	Require older cooling towers to meet water efficiency benchmarks and use efficient equipment and require efficiency standards for steam boilers in new development	Commercial; Cooling towers, Steam Boilers	Existing
CII Ordinances Swimming Pools	Require swimming pool efficiency (retrofit)	COA, Multifamily, Commercial; Pools	Existing
Development-focused Water Use Estimates/ Benchmarking Plan Submittal	Require water use estimate submittal for new development concurrent with preliminary plan submittal, to be reviewed by City staff for comparison to benchmarks. As part of this review, City staff will provide potential water use efficiency recommendations and information on available incentive and rebate programs.	All; All	New/Re-development
Development-focused Water Use Estimates/ Benchmarking Seller Disclosure	Require sellers of commercial property to provide written disclosure of older water using equipment not meeting current standards or fixtures at point of sale to buyers and City staff	Commercial; All	All
Irrigation Efficiency Incentives	Expand current irrigation rebate programs to include irrigation system controllers that respond to leaks, high pressure, and soil moisture; Incentivize retrofit of grandfathered irrigation systems to encourage more efficient irrigation systems	All; Irrigation	Existing
Irrigation Efficiency Code Change	Replace existing code that requires installation of a permanent irrigation system with a code that allows for installation of a temporary irrigation system to establish permanent landscaping	Multifamily, Commercial; Irrigation	New
Landscape Transformation Ordinances	Implement ordinances to encourage water use efficiencies and reduce water needs for outdoor irrigation and other goals through regionally appropriate landscapes with an emphasis on landscape functionality (Implementation of this option could	All; Irrigation	New

[1] For this analysis, the definitions for existing/new sectors are tied to the development permitting and review process. "Existing" is any development that has received a certificate of occupancy. "New" would include any new construction in the process of obtaining permitting approvals.

Measure Name	Measure Description	Sector; End Use	Target[1]
	include implementing turf grass area, irrigated area, and/or irrigation area limitations)		
Landscape Transformation Incentives	Implement incentives to encourage water use efficiencies and reduce water needs for outdoor irrigation and other goals through regionally appropriate landscapes with an emphasis on landscape functionality (implementation of this option could include increasing WaterWise landscape rebates for residential and multifamily and implementing a new WaterWise landscape rebate for commercial)	All; Irrigation	Existing
Water Loss Control Utility Side	Enhance current utility –side water loss control programs	System Wide; Nonrevenue Water	N/A

3.0 Screening Results

Based on the screening criterion described in Section 1.0, the list of measures identified for screening were scored based on professional judgment of the CDM Smith team in consultation with AW conservation staff, as detailed in the scope. Results of the screening are provided in **Table 3-1**. The tables that follow provide the general assumptions that went into scoring each measure. Where readily available, examples of similar programs are provided.

Table 3-1 Demand Management Measure Screening Results

Rank	Measure Name	Incremental Water Saving Potential	Incremental Cost Implementation Utility	Ease of Implemen-tation	Incremental Cost Implementation Customer	Weighted Score
1	Landscape Transformation - Ordinances	5	2	2	2	21
2	Automated Metering Infrastructure (AMI)	4	1	1	5	19
3	Water Loss Control Utility Side	3	1	1	5	16
4	Landscape Transformation - Incentives	3	2	3	2	16
5	Irrigation Efficiency - Incentives	2	3	4	2	15
6	CII Ordinances - Cooling Towers and Steam Boilers	2	4	3	2	15
7	Alternative Water - Ordinances	3	3	1	1	14
8	Development-focused Water Use Estimates/ Benchmarking - Plan Submittal	2	2	2	4	14
9	Alternative Water -Incentives	2	2	3	2	13
10	Alternative Water Incentives - Graywater	1	2	2	3	10

11	Development-focused Water Use Estimates/ Benchmarking - Seller Disclosure	1	2	1	3	9
12	CII Ordinances - Swimming Pools	1	3	2	1	9
13	Irrigation Efficiency - Code Change	0.5	4	2	1	8.5

1. Landscape Transformation – Ordinances		
Measure Name	**Description**	
Definition	Implement ordinances to encourage water use efficiencies and reduce water needs for outdoor irrigation and other goals through regionally appropriate landscapes with an emphasis on landscape functionality. Implementation of this option could include implementing turf grass area, irrigated area, and/or irrigation area limitations.	
Savings Score	5 - Future outdoor use represents the largest potential demand sector in Austin over 100 years. Regionally appropriate landscapes requiring minimal supplemental irrigation beyond establishment could reduce future outdoor use by a considerable amount. Savings from this measure would need to be evaluated in light of current1x per week irrigation restrictions.	
Utility Cost Score	2 - Landscape ordinances will take time and effort to develop in the beginning and will require additional staff resources to implement and enforces. Costs could reduce in the long-term.	
Implementation Ease Score	2 - In the early phases of implementation, effort will be required to inform, educate and to inspect, and verify to ensure proper implementation. Will require coordination with other departments in Austin and the land development code.	
Customer Cost Score	2 - Customer costs for landscaping may be higher initially until the industry fully adapts to the ordinances. Over the long-term perspective, customer costs will decline as the incremental costs come down.	
Notes	A long-term effort yielding substantial water savings in a critical sector. Incremental customer costs are expected to decline over time.	
Examples	*California*	The State of California has a Model Water Efficient Landscape Ordinance (MWELO) which sets a maximum applied water allowance on landscape areas for all new construction. The formula used to calculate the estimated total water use has limits on the percent of landscape that is irrigated turf. This percentage has been changed over time.
	Colorado	Westminster Colorado has landscape ordinances requiring minimum soil amendments and mulch for all new landscapes, coupled with inspections and verification. A water use analysis approach to the connection fee calculations provides financial incentive for water efficiency across all new buildings and landscapes.

2. Automated Metering Infrastructure (AMI)		
Measure Name	**Description**	
Definition	Implement customer-facing programs that provide real-time water use information, including identification of customer-side leaks and other water-saving opportunities (implemented through Automated Metering Infrastructure - AMI); AMI + customer portal and engagement with personal electronic technology (including commercial customer benchmarking).	
Savings Score	4 - The future efficiency potential from customer information and engagement brought about by AMI is significant. Preliminary studies suggest a 5% reduction in residential usage from engagement efforts. This technology is still in its infancy and implementation will help reduce customer side leaks and excessive use for years to come.	
Utility Cost Score	1 - AMI and customer engagement software represents a significant investment for AW. Over the next 100 years, the AMI system equipment is likely to be replaced multiple times as equipment ages.	
Implementation Ease Score	1 - Metering and meter replacement is standard utility function, but AMI implementation will require substantially more effort and maintenance over time. Implementation of this option may be more difficult as development of a new customer portal will be required.	
Customer Cost Score	5 - This measure is not anticipated to have required significant customer-side incremental costs.	
Notes	This is an in-process option that is focused on better measuring and managing supply as well as increasing customer engagement. It is expected that all water utilities will eventually utilize these technologies.	
Examples	*Austin, TX*	Pilot scale AMI project underway
	Fort Collins, CO	AMI leak alert program started in 2015, notifying customers with continuous use. Leveraging AMI for Leak Detection www.watersmartinnovations.com/documents/sessions/2015/2015-W-1532.pdf
	East Bay MUD	Various AMI pilots and evaluation of engagement software platforms.
	Valencia, CA	Water budgets linked with AMI technology for advanced customer communication.
	Leesburg, VA	Reduced non-revenue water from 15% to 7% since installing AMI

3. Water Loss Control – Utility Side		
Measure Name	**Description**	
Definition	Enhance current utility–side water loss control programs	
Savings Score	3 - As Austin's system ages over the next 100 years, advanced water loss control will yield increased water savings. Water loss in systems 50 - 100 years older than AW is much higher. New water loss control technologies are expected too.	
Utility Cost Score	1 - A significant incremental expense for AW, particularly if the costs of leak repair and pipe replacement are included.	
Implementation Ease Score	1 - Water loss control is already a core AW utility function. The enhanced program will require more utility staff and effort and may face challenges associated with capital project implementation.	
Customer Cost Score	5 - This measure is not anticipated to have required significant customer-side incremental costs.	
Notes	As Austin's system continues to age, reducing water loss will become increasingly important.	
Examples	*Georgia*	State mandated annual validated water loss audits. Funding tied to steady improvement.

3. Water Loss Control – Utility Side		
Measure Name	**Description**	
	Texas	The City of Fort Worth submitted a SWIFT application for implementation of AMI with an automated leak detection system. Water loss for the City was estimated at 14%. The expected annual volume of water conserved was estimated at 9,450 AFY. http://texaslivingwaters.org/wp-content/uploads/2016/11/SWIFT-Guidance-Document_FINAL.pdf
	California	Major new state water loss control initiative focused on training, education, audit validation, and continuous improvement.
	Texas	Water loss audits are required by State for all retail public water suppliers every five years. Retail water suppliers with greater than 3,300 connections are required to submit an audit annually.

4. Landscape Transformation Incentives		
Measure Name	**Description**	
Definition	Implement incentives to encourage water use efficiencies and reduce water needs for outdoor irrigation and other goals through Regionally Appropriate landscapes with an emphasis on landscape functionality. Implementation of this option could include increasing WaterWise landscape rebates for residential and multifamily and implementing a new WaterWise landscape rebate for commercial.	
Savings Score	3 - Current outdoor use represents about 22% of total metered demand. Regionally appropriate landscapes requiring minimal supplemental irrigation beyond establishment would help adapt landscapes to require less water and could further reduce outdoor use by a considerable amount. Savings from this measure would need to be evaluated in light of current1x per week irrigation restrictions.	
Utility Cost Score	2 - AW already offers landscape transformation incentives and has a program in place for implementation. The incremental cost of expanding the program is scalable and comparatively low.	
Implementation Ease Score	3 - A moderate level of effort is anticipated as the program expands. This option will require coordination with other departments (WPD) and the Land Development Code.	
Customer Cost Score	2 - Customer receives an incentive, but replacing landscaping can be expensive. Compared with other measures, there will be some incremental customer costs.	
Notes	This measure will accelerate water savings and landscape transformation in Austin.	
Examples	*California*	Metropolitan Water District and member agencies implemented a massive turf replacement program in 2014-16. Thousands of acres of turf were converted and more than $370 million in rebates were provided.
	Nevada	The Southern Nevada Water Authority developed and continues to implement a landscape incentive program focused on locally appropriate plantings. Significant impact and reduction in turf landscapes.
	Colorado	Water utilities and a local non-profit team annual to offer "Garden in a Box" plant packages, aimed a regionally appropriate landscaping.

5. Development-focused Water Use Estimates/ Benchmarking Plan Submittal	
Measure Name	**Description**
Definition	Require water use estimate submittal for new development concurrent with preliminary plan submittal, to be reviewed by City staff for comparison to benchmarks. As part of this review, City

5. Development-focused Water Use Estimates/ Benchmarking Plan Submittal		
Measure Name	**Description**	
	staff will provide potential water use efficiency recommendations and information on available incentive and rebate programs.	
Savings Score	2 - Beginning with a development review process focused on sensible efficiency recommendations, the water savings may be relatively small. Over the 100 year timeframe, this effort will likely evolve into a process where new buildings in Austin are scored against efficiency benchmarks. Eventually this could lead to the creation of a reasonable water allocation (water budget) for every new (and eventually existing) property in Austin that could be used to benchmark efficiency. Phased implementation of this option could lead to more substantial water savings over time.	
Utility Cost Score	2 - This will require significant effort at the outset, but overtime as benchmarks are established and the process become more routine, effort will be reduced.	
Implementation Ease Score	2 - A challenging implementation for AW at the outset. This option could build off the Austin Energy Green Building program or AW Service Extension Request process. This option could be resource intensive in terms of staffing and process to establish benchmarks.	
Customer Cost Score	4 - Some additional time andresources may be expended by customer/contractor/engineer for this preliminary submittal. No incremental cost to current customers. Future customers benefit from built-in water efficiency.	
Notes	Could be an important step for AW in the direction of customer-specific water efficiency and ensuring new buildings join the system as highly water efficient from the start.	
Examples	*Colorado*	Westminster Colorado charges substantially higher connection fees based on increased tap size and anticipated water usage based on customer type and size. This brings new buildings to the table with water efficiency built-in to achieve a lower connection fee.
	California	A water budget approach to both new and existing customers has been used by a handful of utilities for years, and has recently been adopted widely across the state. The State has embraced this approach from the customer up through the utility itself.

6. Irrigation Efficiency Incentives		
Measure Name	**Description**	
Definition	Expand current irrigation rebate programs to include irrigation system controllers that respond to leaks, high pressure, and soil moisture. Incentivize retrofit of grandfathered irrigation systems to encourage more efficient irrigation systems.	
Savings Score	2 - Impacts to existing irrigation systems and savings are assumed to accrue in first 20 - 30 years only. Savings likely to be small with 1x per week irrigation restrictions.	
Utility Cost Score	3 - Moderate incremental cost. Scalable, based on rebate level.	
Implementation Ease Score	4 - AW already offers an irrigation incentive for residential and a smart controller incentive for multifamily and commercial with programs in place for implementation. AW also offers free evaluations for residential and mandatory irrigation audits for commercial and multifamily. The incremental effort of expanding the program is scalable and comparatively low.	
Customer Cost Score	2 - Customer's receive an incentive, but must bear the costs of system repair and replacement. Compared with other measures, there will be some incremental customer costs.	
Notes	Incentives could be designed to assist in landscape transformation as well. Impacts existing customers. Savings likely to be small with 1x per week irrigation restrictions.	
	Arizona	Tucson and other cities offer rebates for drip irrigation and climate based control

6. Irrigation Efficiency Incentives		
Measure Name	**Description**	
Examples	*Utah*	Salt Lake City. WaterCheck irrigation audits and system upgrades. Rebates.
	Texas	San Antonio (SAWS) has offered a variety of irrigation efficiency programs. Dallas Water Utilities also offers free irrigation system check-ups.

7. Alternative Water Ordinances		
Measure Name	**Description**	
Definition	Require on-site (building-scale) alternative water use (for rainwater, stormwater, blackwater, and air conditioning (AC) condensate) for new developments in the multifamily and commercial sectors	
Savings Score	3 - Applies to future construction which represents a big portion of future demand. Scalable.	
Utility Cost Score	3 - These regulations will be complex to design, implement, and regulate, particularly in the early stages. Over time, the implementation effort could be reduced.	
Implementation Ease Score	1 - The challenges of design and early stage implementation are unknown and could be significant.	
Customer Cost Score	1 - Mandating these systems will increase the cost of land development. Installation of these systems would require dual plumbing. Long term maintenance of these systems adds to customer expense as well.	
Notes	While generally expensive and challenging to implement, this option could provide savings and other benefits. As with all measures, savings must be proven for this to be considered a reliable source of future demand reduction for Austin.	
Examples	*Australia*	Gold Coast Water, south of Brisbane mandated dual plumbing and on-site capture systems during the millennial drought. Most systems were quickly abandoned once the drought ended. AWE published a "lessons learned" from the Australian drought report.
	San Antonio, Texas	San Antonio requires new commercial construction on or after January 1, 2006, to have a single independent condensate collection line to collect condensate for use as process water, cooling tower makeup, and landscape irrigation.

8. CII Ordinances Cooling Towers and Steam Boilers		
Measure Name	**Description**	
Definition	Require older cooling towers to meet water efficiency benchmarks and use efficient equipment and require efficiency standards for steam boilers in new development	
Savings Score	2 - Impacts cooling towers installed prior to 2008. New equipment is assumed efficient by code. All savings accrue in the first 30 - 40 years.	
Utility Cost Score	4 - Incremental utility cost is comparatively small.	
Implementation Ease Score	3 - Enforcement and verification patterned after existing car wash program through registration, third-party inspection paid by customer, and self-reporting will help with ease of implementation.	
Customer Cost Score	2 - Complying with the cooling tower requirement portion of this option would have low to moderate costs for customers.	
Notes	This measure is currently being considered as part of the plumbing code adoption cycle.	
Examples	*Colorado*	Denver Water has had trouble maintaining long term water savings from cooling tower retrofits.

8. CII Ordinances Cooling Towers and Steam Boilers		
Measure Name	**Description**	
	California	MWD offers different cooling tower incentives, but has not established formal requirements.

9. Alternative Water Incentives		
Measure Name	**Description**	
Definition	Incentivize on-site (building-scale) alternative water use (for rainwater, stormwater, blackwater, and AC condensate) for existing developments	
Savings Score	2 - Applies to existing development as retrofit. Scalable.	
Utility Cost Score	2 - Program would add to complexity of existing programs. Over time, the implementation effort could be reduced.	
Implementation Ease Score	3 - Design and early stage implementation could be built off of existing incentive programs for rainwater harvesting and ac condensate.	
Customer Cost Score	2 - Even with an incentive, these systems are usually expensive to retrofit. Installation of these systems would require dual plumbing.	
Examples	*Australia*	Gold Coast Water, south of Brisbane mandated and incentivized dual plumbing and on-site capture systems during the millennial drought. Most systems were quickly abandoned once the drought ended. AWE published a "lessons learned" from the Australian drought report.

10. Alternative Water Incentives - Graywater		
Measure Name	**Description**	
Definition	Offer an Incentive to encourage the installation and use of graywater systems, which are defined as shower-to-toilet and landscape irrigation systems that collect shower, faucet, and laundry discharge, provide some element of filtration and treatment and then reuse the water.	
Savings Score	1 - Limited water savings potential as clothes washers, faucets, and showers become more efficient and use less and less water. Less and less graywater will be produced.	
Utility Cost Score	2 - Comparatively expensive to implement. Incentives would need to be substantial to achieve meaningful participation rates. 2017 AWE study found some potential long term benefits for water utilities, but also cautioned about the lack of cost effectiveness and demonstrable savings data.[2]	
Implementation Ease Score	2 - Graywater systems are complex. Implementation from the utility perspective will be on a long-term time frame requiring staff effort.	
Customer Cost Score	3 - From the AWE report, "if the total life-cycle costs of the system exceed the total life-cycle savings from reduced potable water purchases, the system will have a net cost to the homeowner." This is the expected outcome from most systems.	
Notes	The 2017 research indicates that graywater systems have yet to be proven cost-effective from the customer or the utility perspective.	
Examples	*Australia*	Gold Coast Water began installing on-site systems during the millennial drought. These systems were quickly abandoned once the drought ended.

[2] Gauley, Bill (2017) *Water Savings and Financial Benefits Associated with Single-Family Package Graywater Systems*. Alliance for Water Efficiency. Chicago, IL.

11. Development-focused Water Use Estimates/ Benchmarking - Seller Disclosure		
Measure Name	**Description**	
Definition	Require sellers of commercial property to provide written disclosure of older water using equipment not meeting current standards or fixtures at point of sale to buyers and City staff	
Savings Score	1 – This is not a mandate for water efficient fixtures, only for disclosure. Water savings could be significant if turned into a "retrofit on resale" requirement as California has just done. Without a mandate or incentive, the potential for water savings should be assumed limited, until proven.	
Utility Cost Score	2 - Setting the "current standards" and developing the process that must be met will be an on-going challenge for AW. Requires staff effort and will likely require new staff because of real estate transaction complexity and reporting.	
Implementation Ease Score	1 - Expect significant pushback from the real estate industry and commercial property owners. Anything that complicates the transfer of real property is generally seen as an impediment. Monitoring real estate transaction will be difficult, especially for the commercial sector.	
Customer Cost Score	3 - Customer cost would likely be low to moderate but could have cost and transaction time impacts.	
Notes	While savings are scored low, the effort could evolve into a major contributor to future water efficiency in Austin if retrofit on resale was included.	
Examples	*California*	State law mandates 1.28 gallons per flush (gpf) toilets and other fixtures in all single-family residences. Effectively a retrofit on re-sale ord. Expected to be enforced as part of the inspection and title transfer of real estate.
	California	City of Burbank has "retrofit upon resale" requirements for residential properties that went into effect in 2010. https://www.burbankwaterandpower.com/water/rules-and-regulations-water/retrofit-upon-resale-requirements
	California	City of San Diego has "retrofit upon resale" requirements for residential properties that went into effect in 2000. https://www.sandiego.gov/water/conservation/selling

12. CII Ordinances Swimming Pools	
Measure Name	**Description**
Definition	Require commercial and public swimming pool efficiency (retrofit)
Savings Score	1 - The sector impacted is comparatively small. 100-year savings are relatively small.
Utility Cost Score	3 – Varies; measures range from water efficient backwash filters to major leak repairs.
Implementation Ease Score	2 – High level of staff expertise and effort required for successful implementation.
Customer Cost Score	1 – Incremental cost of implementation for customers with pools could be substantial.
Notes	Require swimming pool efficiency (retrofit)

13. Irrigation Efficiency Code Change	
Measure Name	**Description**
Definition	Replace existing code that requires installation of a permanent irrigation system with a code that allows for installation of a temporary irrigation system to establish permanent landscaping
Savings Score	0.5 - Water savings would be most realized if combined with another option like landscape transformation.
Utility Cost Score	4 – Once implemented this requirement would not have a significant utility cost impact.
Implementation Ease Score	2 – Challenging to implement initially, but easier over time. Would require coordination with Watershed Protection Department and consistency with the Innovative Commercial Landscape Ordinance.
Customer Cost Score	1 – Could be “cost neutral” to customers depending on implementation approach.

Task Force Feedback on 25 Demand Management Options to Be Screened

Task Force Member Clint Dawson

On the demand side, I know we've seen the presentation on where the water is going, but we need to map that to the demand side options; i.e., irrigation systems currently use xx% of city water. It would be nice to have this in one document. There are so many documents floating around it is head spinning. Has anyone done that, did I miss it?

Task Force Member Jennifer Walker

a. I think that water loss control is a priority. We should not be losing water that we already have through leaky infrastructure. This will likely be an ongoing program but should have added emphasis.

b. AMI, Austin currently has a plan in place to install and AMI system and has a SWIFT loan approved to do so. Since this strategy is going to happen we should include it on the list because we need to capture that savings from it. However, it should not be evaluated as part of a portfolio where it can be turned on or off. It will be on because the city is committed to implementing it. I am not sure how to address that. Perhaps include it in all portfolios as a baseline savings?

There are several strategies related to outdoor watering/turf grass and other requirements. These should all be a focus and the team should look at whether it is possible to aggregate them in some way. Maybe we can have different levels of implementation? I am interested in measure l, eliminating the irrigation system requirement. This makes a lot of sense as irrigation systems are the culprit much of the water waste outdoors. This is something that we should really examine the savings potential of. Another thing to consider is that many of these outdoor strategies will have different savings based on how they are actually deployed (ordinance, voluntary implementation, retrofits required, year round enforcement, targeted education, incentives).

I like the use of AC Condensate, gray water and other non-potable water onsite. These are good strategies to consider. Again, if it is just allowed versus being required on new construction that will make a big difference in savings.

I am not sure the swimming pool efficiency strategy rises to the top. My first concern is that anything related to swimming pools will be difficult if not impossible to enforce as pools are often in the backyard behind a fence. We should have strong baseline standards for pool construction and maintenance (pool covers during drought for example) but I think that might be the best we can do and may already be standard operating procedure

I am not sure about the efficacy of Measure S with all of the other strategies in play.

New buildings should be constructed in a way that makes them as efficient as possible and allows them to take advantage of emerging technologies and demand reductions strategies (Building codes/standards?) (retrofits/new construction?) Meaure I & h.

As I mentioned at the meeting, I fully support education and outreach and expect it to be a big part of making each of the strategies that we end up recommending as successful as possible. I have heard that education & outreach can be difficult to quantify in terms of actual water conservation savings so I am

not sure how the consultants will approach that. Also, this strategy will happen no matter what. Perhaps it should be included as a baseline strategy in each portfolio or savings from this strategy should be included in the baseline demand projections. We do, however, want to make sure and list outreach and education as a important component of our future water supply success so it may not make sense to relegate it to the "background".

Task Force Member Lauren Ross

My major concern is the assumptions that will be used as a basis for screening. Of the screening factors, potential for water savings and cost are very dependent on the assumptions. I appreciate the chicken-egg challenge and hope we will think expansively, in terms of "next practices for a possible tomorrow" rather than limiting ourselves to "best practices" in today's world.

Task Force Member Sharlene Leurig

- **Outdoor use** is the most important category to crack and so I would elevate all outdoor options (with the exception of pool losses, based upon Brewster McCracken's presentation that showed that outdoor watering use is multiples of pool use). (3-5) I agree with Dan Rodrigo's idea of looking at 2 implementation options (regulatory v. incentive based) for each type of sector/outdoor demand suppression reduction. I would like us to implement both a limit on irrigable area and a requirement that water be provided from onsite capture FOR ALL SECTORS. To me, this is the incentive for encouraging AC condensate or any other type of capture; AWU doesn't need to be prescriptive about what is captured if there is a clear and substantive repercussion to not capturing the water (you don't get to grow stuff outside).
- **Water loss control** programs (1a) seem like an obvious fit with laterals the place to focus based on the Disaggregated Demand presentation.
- I have a hard time believing that indoor efficiencies won't happen passively anyway and would therefore focus my efforts on **10w** requiring dual plumbing for all non-potable commercial/multifamily indoor uses; this has the benefit of increasing demand for the purple pipe Supply Option as well.
- I would be opposed to modeling **Water Rates/Fees or Development benchmarking** if it knocked off the list anything more tangible (e.g. regulatory restrictions on outdoor use).
- **Education and outreach programs** are important but not sure how you model yield on that...I would focus on clear and measurable programs/requirements.

Task Force Member Todd Bartee

- In general, we should do all options which address the largest "uses" of water and do not negatively impact way of life.
    - This would include anything which addresses leaks (~10% of our water "use" if I remember correctly)
    - This would also include decentralized rainwater collection options
    - This would also include any decentralized reuse options
- I'm not a fan of regulating turf grass. Instead, I think we should either limit the water which can be used outside the home and/or charge more for water above a level necessary for internal

use. We need to incent folks to use other options if they want to water grass like rainwater collection or water reuse.

- Increasing rebates for waterwise landscaping is a great idea
- Requiring the most efficient irrigation systems is also a good options

I know this feedback isn't specific to each option, but I think we need to be thinking in terms of large goals impacting the largest buckets of "use" and a variety of strategies to positively impact those uses. The feedback above covers about ¾ of the options I believe.

List of 21 Water Supply Options To Be Screened

Relative magnitudes indicated for each option are planning level estimates and may be refined through the IWRP process.

Relative Magnitude of Annual Supply (Acre-Feet)	Resiliency	Supply Types
< 10,000 AF	Low	Drought
10-20,000 AF	Medium	Constant
>20,000 AF	High	Variable

	Option	Brief Description	Est. Annual Supply	Resiliency	Supply Type
1	Aquifer storage and recovery (FEA 5)	Aquifer storage and recovery is a strategy in which water (ex: potable drinking water) can be stored in an aquifer during wetter periods and recovered for use during drier periods. Storing water underground can improve drought preparedness and reduces the amount of water that evaporates compared to water storage in open above-ground reservoirs. This type of strategy is currently being used by cities in Texas including San Antonio, Kerrville and El Paso. Exploring aquifer storage and recovery as a potential option was a recommendation of the 2014 Task Force and has been analyzed by Austin Water as part of Feasibility and Engineering Analysis #5 (Northern Edwards and Trinity Aquifers).		Medium	Drought
2	Direct non-potable reuse (centralized reclaimed purple-pipe system)	Through its Water Reclamation Initiative (WRI) program, Austin Water provides highly treated wastewater effluent for non-potable uses such as irrigation, cooling, manufacturing, and toilet flushing. Austin's direct reuse (purple pipe) system currently supplies approximately 4,600 AF per year. The 25-year direct reuse system master plan includes a total of 130 miles of transmission mains to be constructed and an estimated annual use volume of 25,600 AF. Potential expansion beyond this amount may be explored as part of the IWRP process.		High	Constant
3	Lake Austin operations (lake level variation)	This option is an operational drought strategy to vary the Lake Austin operating level during non-peak months (October-May) and after combined storage in the Highland Lakes falls below 600,000 acre-feet. This strategy would allow local usage to draw the lake down a maximum of three feet to be able to catch runoff from local storm events should they occur. This approach would allow for use of this runoff as opposed to excess runoff spilling over Tom Miller Dam to flow downstream. This measure was included as a recommendation of the 2014 Task Force.		Low	Drought
4	Stormwater and Rainwater Harvesting	This option involves the collection and reuse of rainwater or stormwater to meet appropriate end use demands. The implementation of this strategy is dependent on a number of factors including the catchment area, storage capacity, rainfall frequency, and water demand of the end user. On average, the Austin area generally receives about 32 inches of rainfall per year. This rainfall is not distributed uniformly during the year and, as a result, implementation of this strategy should consider water demands and supplies over a multi-month period. This option is being analyzed as part of Task 6.3.		Low	Constant, subject to availability
5	Sewer mining (wastewater skimming)	This option involves the extraction (mining or scalping) of wastewater from the centralized sewer system, treatment at a small local facility, and reuse to meet non-potable demands. Implementation of this strategy is highly site-specific, dependent on factors including accessibility of wastewater flows and proximity to suitable non-potable demands, with drivers being to minimize potable water consumption and infrastructure upsizing. Wastes from the treatment process are typically discharged to the centralized sewer system for subsequent treatment at the downstream Wastewater Treatment Plants (WWTPs). This option is being analyzed as part of Task 6.3.		High	Constant
6	Distributed wastewater systems	This option involves the onsite capture and treatment of the wastewater stream generated in a building or development for reuse to meet non-potable demands onsite. To be feasible, this option requires that a building or development have sufficient non-potable demand to beneficially use all of the reuse water that is produced and that the building have enough wastewater available to reuse and meet non-potable demands. Types of treatment systems may include constructed wetlands (for example the "Living Machine" at SFPUC), membrane bioreactors, etc. This option is being analyzed as part of Task 6.3.		High	Constant
7	Capture Lady Bird Lake Inflows (FEA 4)	This option would Capture available spring and stormwater flow into Lady Bird Lake and convey the water to the Ullrich WTP through a potential new intake pump and piping system. Exploring capturing Lady Bird Lake inflows as a potential option was a recommendation of the 2014 Task Force and has been analyzed by Austin Water as part of Feasibility and Engineering Analysis #4.		Low	Variable

	Option	Brief Description	Est. Annual Supply	Resiliency	Supply Type
8	Indirect reuse – bed and banks	Recapture discharged treated effluent from Austin's Wastewater Treatment Plants downstream to be pumped back upstream for treatment. City of Austin and LCRA have applied jointly for the water right permit for indirect reuse in accordance with the terms of the 2007 settlement agreement between Austin and LCRA.	Variable, subject to permitting, availability, and terms of the 2007 agreement		
9	Indirect Potable Reuse through Lady Bird Lake (FEA 2)	This option would convey highly treated reclaimed water from one treatment train at South Austin Regional Wastewater Treatment Plant to Lady Bird Lake and subsequently divert water by a potential new intake pump and piping system downstream of Tom Miller Dam to the Ullrich Water Treatment Plant to help meet City demands. This approach could supplement water releases from lakes Buchanan and Travis to extend water supplies during severe drought. This option was a recommendation of the 2014 Task Force and has been analyzed by Austin Water as part of Feasibility and Engineering Analysis #2		High	Drought
10	Indirect Potable Reuse through Alluvial Aquifer (FEA 3)	This option would convey highly treated reclaimed water from one treatment train at South Austin Regional Wastewater Treatment Plant to an infiltration basin within the Colorado River alluvium. After a minimum six month retention time, recovery wells and pump station would capture and transport the water to Lady Bird Lake. A potential new intake pipe and pump station downstream of Tom Miller Dam would convey the water to the Ullrich Water Treatment Plant to help meet City demands. This approach could supplement water releases from lakes Buchanan and Travis to extend water supplies during severe drought. Exploring reclaimed water infiltration as a potential option was a recommendation of the 2014 Task Force and has been analyzed by Austin Water as part of Feasibility and Engineering Analysis #3.		High	Variable
11	Direct potable reuse	This option is relatively new to Texas and involves taking treated wastewater effluent, further treating it at an advanced water treatment plant, and then either introducing it upfront of the water treatment plant or directly into the potable water distribution system.		High	Constant
12	Desalination – brackish groundwater	Desalination is the process of removing dissolved solids from seawater or brackish groundwater, often by forcing the source water through membranes under high pressure. The specific process used to desalinate water varies depending upon the total dissolved solids, the temperature, and other physical characteristics of the source water but always requires disposal of concentrate that has a higher total dissolved content than the source water. Disposal may take the form of an injection well, evaporation beds, or an ocean outfall diffuser. Exploring desalination of brackish groundwater as a potential option was a recommendation of the 2014 Task Force		High	Constant
13	Desalination – seawater	Desalination is the process of removing dissolved solids from seawater or brackish groundwater, often by forcing the source water through membranes under high pressure. The specific process used to desalinate water varies depending upon the total dissolved solids, the temperature, and other physical characteristics of the source water but always requires disposal of concentrate that has a higher total dissolved content than the source water. Disposal may take the form of an injection well, evaporation beds, or an ocean outfall diffuser.		High	Constant
14	Enhanced Off-Channel Storage at Walter E. Long Lake (Decker Lake) (FEA 1)	If Decker Power Station were taken offline and Walter E. Long (Decker) Lake was no longer needed for electric generation purposes, this strategy would involve use of the lake as enhanced off-channel storage for water supply augmentation. Enhanced operations of Lake Long would allow more fluctuation in the lake level than current operations, up to approximately 25 feet. In concept, the strategy would allow water from Lake Long to be released to meet downstream needs, including environmental flows and other uses, which would otherwise need to be released from Lakes Travis and Buchanan. This strategy would require making improvements to increase the capacity to refill Lake Long through a combination of Colorado River water and reclaimed water. This option was a recommendation of the 2014 Task Force and has been analyzed by Austin Water as part of Feasibility and Engineering Analysis #1. Based on preliminary results from this analysis, potential for water quality issues and lower than expected yields have been indicated.		Low	Drought
15	Lake Evaporation Suppression	Under development		High	Variable
16	Conventional Groundwater	Under development	TBD	Medium	Variable
17	Additional supply from LCRA	Under development	TBD	Medium	Constant

	Option	Brief Description	Est. Annual Supply	Resiliency	Supply Type
18	Aquifer Storage and Recovery (Carrizo Aquifer)	Under development	TBD	Medium	Drought
19	Explore partnership approaches on regional strategies with Corpus Christi or others	Potential strategies could include aquifer storage and recovery, purchase of available water supply, or other partnerships.	TBD	TBD	TBD
20	Inter-Basin Transfers from Available Surface Water Supplies	Under development	TBD	TBD	TBD
21	Off Channel Reservoir (Austin vicinity)	Under development	TBD	TBD	TBD

Task Force Feedback on Blue Sky List of Supply Side Options

Task Force Member Clint Dawson

on the supply side, the consultant said that about 400,000 ac-ft per year was lost down the Colorado River. If we were going to better capture that, where is that reflected in the supply side options? It would seem that most of it would go into Lady Bird Lake, but in the document it does not indicate that Lady Bird Lake could be used to store much water. Where is this water coming into the system primarily? Would it be captured and put into an aquifer or at Decker Lake, or captured through extensive rainwater capturing systems? Can the consultant be more specific about how this water could be captured?

Also, I think option 14 is a non-starter in terms of using Decker Lake for storage of treated wastewater.

Task Force Member Jennifer Walker

1. I think that the Direct potable reuse makes sense but from what I understand a vast majority of the water is used for outdoor irrigation and not being used indoors. Using this water outdoors for parks and public spaces makes sense but it important that this water is not being treated as "free" water and that it is being used in a very efficient manner much as we expect of people using potable water (with higher expectations for efficiency in the future). This strategy should be carefully deployed. Water that we are putting into the purple pipe system is water that would provide downstream flows. Let's make sure that we are using it well and where it is actually needed.

2. There were a lot of concerns about this strategy during the 2014 Task Force and we agreed that this would only be used in case of a sever emergency. I still have concerns.

3. I am not sure if this is a great strategy. I am unclear on whether or not al alluvial aquifer is a good ASR candidate. The Colorado River along this stretch is a gaining steam.

4. My concern here is that we are removing water that would otherwise flow downstream and meet environmental and/or other downstream water users. Reuse/bed & banks strategies need to be thoughtfully deployed and be responsive to environmental conditions.

5. This strategy is worth looking in to. However, it is expensive and may fall to the lower end of the list for actual deployment.

6. I do not know a lot about this strategy. See concerns in #1 above though.

7. Distributed wastewater systems should be in areas of high growth or where there is considerable new construction.

8. Stormwater capture and rainwater harvesting should definitely be on the list of 10.

9. ASR is a good strategy for Central Texas. I do not know if we have an ideal formation keeps the operation local.

10. Lake level variability was not popular with some folks during the 2014 Task Force but I continue to think that it could be a good option for drought periods.

12. There is a lot of push back in the effected community on this strategy and possibly from Texas Parks and Wildlife Department. I tend to this that this strategy will not make the cut.

13. Brackish groundwater desal is a strategy that should be explored.

14 & 15. I do not think that imported groundwater or seawater desal make sense for Austin. The cost is too high and the sources are too far away. Perhaps seawater desal (if deployed in a environmentally benign way) could be done in exchange to the Garwood Water right that is currently held by Corpus Christi.

Fayette Power plant is supposed to shut down. We need to reallocate that water to help meet other municipal demands.

Task Force Member Lauren Ross

1. We do NOT want to store potable drinking water (meaning the product of a water treatment plant) in the aquifer. We definitely don't, under any circumstances, want to inject water with chlorine into an aquifer. Since a significant fraction is lost, we also don't want to inject process- and energy-expensive water into aquifers.
2. Lake Austin has functioned for the last several weeks with a drawdown of 10 feet. I recommend increasing the maximum drawdown considered to this level.
3. A comment was made during our last meeting that rainwater benefits would be limited during drought. When integrated with lake storage, this is less true. Integration of smaller-scale rain storage with lake storage benefits should be part of the analysis of this supply.
4. There is a racial justice issue in comparing use of Decker Lake and Lady Bird Lake for treated effluent storage. How will racial/environmental justice be integrated into both the screening matrix and option and portfolio analysis?
5. Please clarify that conventional groundwater is limited to available supplies within the Water Forward Planning Area.
6. LCRA has currently issued firm contracts for more than its firm yield. So there is no more firm supply unless we buy someone else out or LCRA builds additional reservoirs. I don't know how realistic that is; and I recommend that we don't make this option appear to be simpler than it actually is.
7. A supply side option should be added to consider available water supply from Austin Energy conversion from steam-electric generation to renewable sources of electricity.

Task Force Member Sharlene Leurig

- I would include on the list of 10 changing the beneficial use of Austin's **Fayette water rights** to municipal when the power plant is decommissioned or the city sells its stake. Depending upon what we think is more likely to happen first, I would also suggest that we consider making note of the use of their cooling water reservoir for off channel storage to meet environmental flow needs downstream.
- Generally speaking I'd like us to look at **ASR in the Carrizo**, and particularly am interested in seeing if there's a way to do this with LCRA. I have heard that their Boy Scout property may be a good location for ASR. Either way, it sounds like the Carrizo has more storage potential than the Edwards or Trinity options we've been looking at.
    - I would like to see us look at the potential to co-invest in ASR with LCRA/Corpus Christi to store some of our Highland Lake allocation and Corpus's Garwood right in dry years. Right now they are pushing Colorado water that they don't need in average or wet years through their Mary Rhodes pipeline and then storing it in Lake Corpus Christi where 60% evaporates off. It's ridiculous, and in conversations with some folks on their new City Council (for an unrelated project) it is clear that they are interested in opportunities to

make better use of that water; I also think that even if they weren't interested in co-investing in ASR they would be interested in selling that excess water in average/wet years and so it's an opportunity for someone to use it defray the cost of an ASR project.

- I would like to strongly discourage the city from looking at reuse water as a source for outdoor consumptive demands. I think we should be pushing people away from irrigation of any type other than what they can satisfy through local catchment. Tethering our unnecessary consumptive uses to reuse water runs the risk of reducing environmental flows downstream. With that qualification, I would say that it makes sense for us to expand our **direct non-potable system** for indoor uses and to supplement this reuse strategy with decentralized reuse opportunities, recognizing that the city will never (and probably should never) build a purple pipe system across the entire city. The **decentralized direct non-potable system** investments (whether sewer mining or distributed wastewater) should be focused in areas with high growth projections in the commercial, institutional, industrial and perhaps dense multi-family uses.
- I continue to think we are underestimating the potential for **stormwater and rainwater harvesting** but am excited to see where the analysis in 6.3 goes.
- I am very hesitant about any indirect reuse strategy that stores treated wastewater in our lake without major polishing; Town Lake gets enough pollution from roadways. The **alluvial storage option FEA3** is more interesting to me than FEA2 as I would hope there would be an environmental filter effect. If there is any way to look at this strategy as a significant **tertiary wetland system** like NTMWD's Trinity Wetlands, that could be a great project for habitat value and I will resist us costing out any option that envisions indirect reuse water being stored in our lakes without environmental filtration/polishing treatment.
- I have no qualms with exploring **DPR** but hope it could be obviated by demand suppression and direct nonpotable strategies.
- I do not think we should be assessing **conventional/imported groundwater** or **seawater desalination** but if others on the task force want to do it, I am confident that the risks and costs in these options will become apparent. Desal only makes sense to examine if we are considering it in exchange for the Garwood right or another senior right on the Colorado. I would not support this unless the city of Austin used this as leverage to secure significant environmental flows from LCRA in Matagorda and Corpus Christi in Nueces Bay.

Task Force Member Todd Bartee

- Aquifer storage and recovery is a must. This gives us additional supply from our contracted water source which is less susceptible to evaporation and can be used during a drought.
- The reuse options (non-potable direct, potable direct, potable reuse through aquifer, and potable reuse through town lake) should be maximized. I realized all four of these cannot be used and I'm not sure which ones we should do, but we should maximize the water we reuse. I'd be a little concerned about the two which divert water to town lake for a couple of reasons – first, they are subjected to evaporation and second, I wouldn't do anything to impact the recreation on town lake.
- I'm a big fan of decentralized rainwater catchment. I believe this should be in as many new building codes (residential and commercial) as possible and we should look at incentives to retrofit current construction. This water can be used for outside use and that is the single largest use of potable water currently. I don't believe its impact is low if we fully implement. However, this may be caught in the demand options. Still, I think we should include and evaluate.
- Option 14 should probably be included on the list. Not sure the impact to power production.

- I'm not a fan of things that negatively impact the Austin way of life or property/tax values. The Lake Austin operations option would seem to do that. While only 3 feet, that would likely make several canals granting recreational access to the lake less useful and it would devalue the property along the lake likely impacting tax values.
- Options 5 and 6 do not seem that attractive and would potentially not be as accepted by the population.
- Salt water desal seems expensive and overkill. We can get there with other measures. Let's leave that for the next plan when some new cool technology has been invented to make it more cost effective.
- 15-17 seem unnecessary. I think we can get there without them.

Ex Officio Member Mike Personett

- As I've noted, overall the big picture of supply and demand suggests to me that for the foreseeable future the investments that make the most sense are on the demand side. These would be relatively small incremental investments, as well as regulatory measures, with effects that accumulate over time and with near term objective of delaying/minimizing future contractual payments to LCRA and a long-term objective of delaying large capital investments in supply-side options as long as possible. And with the understanding that the timing of large capital investments should be such as to avoid rate shock, which could induce additional conservation in any case raising the prospect of "stranded" investments.

- Question…are the costs demand side measures borne by customers included in the cost analysis or only those costs borne directly by the utility?

- ASR. If I recall correctly from the results of the FEA, it's recognized that ASR in the Barton Springs segment is not technically feasible as any water placed in the formation won't stay there. In the southern Edwards, the modeled benefit of enhanced recharge and ASR is to reduce the time that Comal and San Marcos springflow is critical or ceased altogether. No additional supply is created. The formations immediately east of Austin do have potential but at a relatively high cost for treatment and with potential concerns about chemical compatibility, which wouldn't be insurmountable. I'm skeptical of ASR in the northern Edwards in that the costs of land and integration into the transmission/distribution system would likely be prohibitive due to land availability in an already urbanized area, acquisition costs, utility conflicts, etc.

- Non-potable reuse. I think the "sewer mining" option deserves particular attention, primarily because the great cost of extending reclaimed water transmission lines further to the west (Jollyville Plateau area for example). This strategy has been successfully implemented in other areas. Sewer mining or scalping was brought up when the reuse planning was done back around 2000 but was not given any significant attention I think perhaps due to a "centralization" bias. Of course this decentralized approach would mean the utility providing and operating/maintaining some number of small WWTPs, which has traditionally been seen as a negative. Self-contained and highly-automated MBR facilities are becoming the technology of

choice for this type of reuse strategy. I've seen MBR plants sited in very high-end residential areas that from the outside look like a resort hotel or a horse barn. Pretty cool.

- Distributed systems. Having once marketed onsite 'black water" wastewater treatment and recycling systems in the Austin area and elsewhere, I can attest that this is viable technology for new mostly non-residential development. The systems that were installed in Austin were all about reducing the amount of wastewater that had to be disposed of onsite, which would consume a lot of otherwise buildable land. Water conservation was a side benefit. In a commercial office setting, without onsite food preparation, potable demand would be preduced 95+ percent. About 70% in a typical shopping center or school. As with "sewer mining" one strategy would be for the utility to provide and operate the WWTP facility with cost recovery through rates.

- Direct potable reuse. While technically feasible today, it's hard to imagine this option being anything other than a very long term strategy.

- Lake evaporation suppression. This has obvious fatal flaws given the size of our water supply reservoirs and weather conditions (winds particularly). As I mentioned in the last meeting, the only applications I'm aware of that had some viability are relatively small and protected terminal storage reservoirs in Southern California.

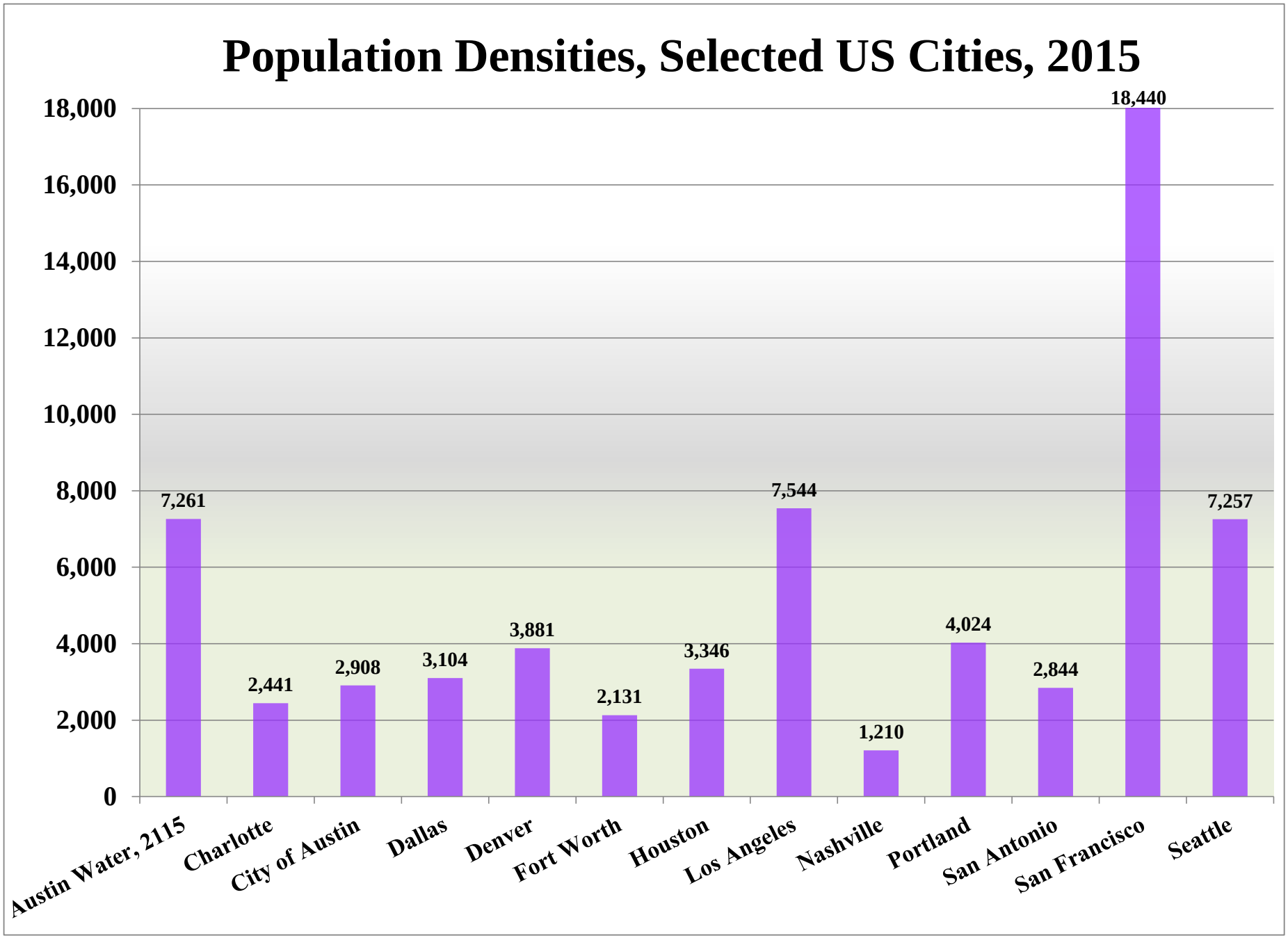
- Brackish ground water desalination. Potentially viable in conjunction With ASR in the formations to the east, or the brackish zone of the Edwards Aquifer.

- Seawater desalination. The only way I see this as being remotely feasible is if it's based on a strategy of swapping desal product water for additional water supply from the Colorado River. For example, it might be viable to pay for the cost of desal as a future supplemental water supply for Corpus Christi in exchange for a like amount of the super senior Garwood water rights (35,000 afy owned by Corpus), which could be provided from the Highland Lakes. Another possibility would be providing water for steam electric needs in the lower basin (e.g., South Texas Project). Otherwise the cost to both produce water and transport it 200 miles inland would be prohibitive.

- For the very long-term, I think inter-basin transfers from existing surface water sources in the eastern part of the state should be on the table. One way this was being conceived of (see Trans-Texas Water Program studies sponsored by TWDB in the 1990s, pre-SB1 regional planning) was to created a water wheeling system of interconnections between basins that would enable swapping of water supply. For example, Toledo Bend to Houston, which might allow other Houston supplies to meet demands in the Brazos Basin, and free up water in the Brazos to shift further west. Of course it was exactly this kind of thinking that led to the current restrictions on inter0basin transfer that were enacted in 1997 as part of SB1.

Demographic Follow-Up Information

- Population Densities, Selected US Cities
- Comparison to Texas Water Development Board (TWDB) Population Projections for Regional Water Planning
- Housing Type Mixes, Selected US Cities
- Undeveloped Area Within the Water Forward Planning Area


Population Densities, Selected US Cities, 2015
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
7,261
2,441
2,908
3,104
3,881
2,131
3,346
7,544
1,210
4,024
2,844
18,440
7,257
Austin Water, 2115
Charlotte
City of Austin
Dallas
Denver
Fort Worth
Houston
Los Angeles
Nashville
Portland
San Antonio
San Francisco
Seattle

Comparison to Texas Water Development Board (TWDB) Population Projections for Regional Water Planning

City of Austin Population History*		
	Total Population	Annualized Growth Rate
1900	22,258	
1905	25,299	2.6%
1910	29,860	3.4%
1915	32,870	1.9%
1920	34,876	1.2%
1925	47,647	6.4%
1930	53,120	2.2%
1935	63,563	3.7%
1940	87,930	6.7%
1945	105,742	3.8%
1950	132,459	4.6%
1955	154,093	3.1%
1960	186,545	3.9%
1965	214,117	2.8%
1970	251,808	3.3%
1975	302,500	3.7%
1980	345,890	2.7%
1985	417,033	3.8%
1990	465,622	2.2%
1995	526,128	2.5%
2000	656,562	4.5%
2005	700,407	1.3%
2010	790,390	2.4%
2015	900,701	2.6%

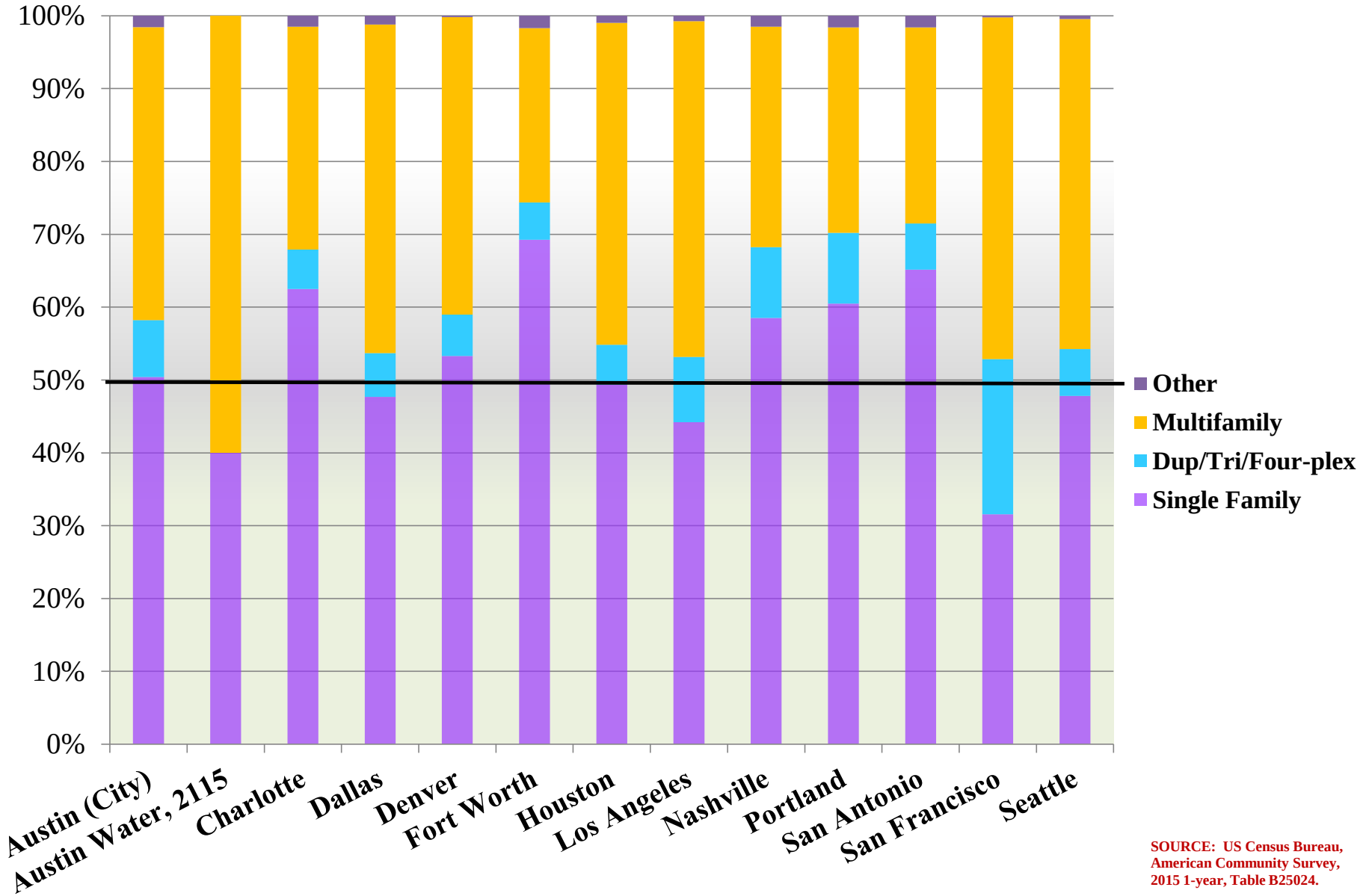
* City of Austin Population History in this table does not include additional areas served by Austin Water outside of the city limits.

Comparing Population Projections for Austin's Water Service Area				
	TWDB Projection - Region K Plan		City of Austin Projection	
Year	Austin Water Service Area	Annualized Growth Rate	Austin Water Service Area	Annualized Growth Rate
2010	875,936		875,936	
2020	1,092,586	2.2%	1,101,632	2.3%
2030	1,252,021	1.4%	1,342,884	2.0%
2040	1,427,484	1.3%	1,577,760	1.6%
2050	1,561,354	0.9%	1,808,586	1.4%
2060	1,679,087	0.7%	2,051,178	1.3%
2070	1,819,665	0.8%	2,314,769	1.2%
2080			2,610,656	1.2%
2090			2,944,366	1.2%
2100			3,320,732	1.2%
2110			3,745,208	1.2%
2115			3,977,380	1.2%

TWDB Projections

- TWDB annualized growth rates for Austin Water Service Area projections are less than 1% beyond 2040
- Over the past 100 years Austin's annualized population growth rates have generally not been below 1.2%

Housing Type Mixes, Selected US Cities, 2015

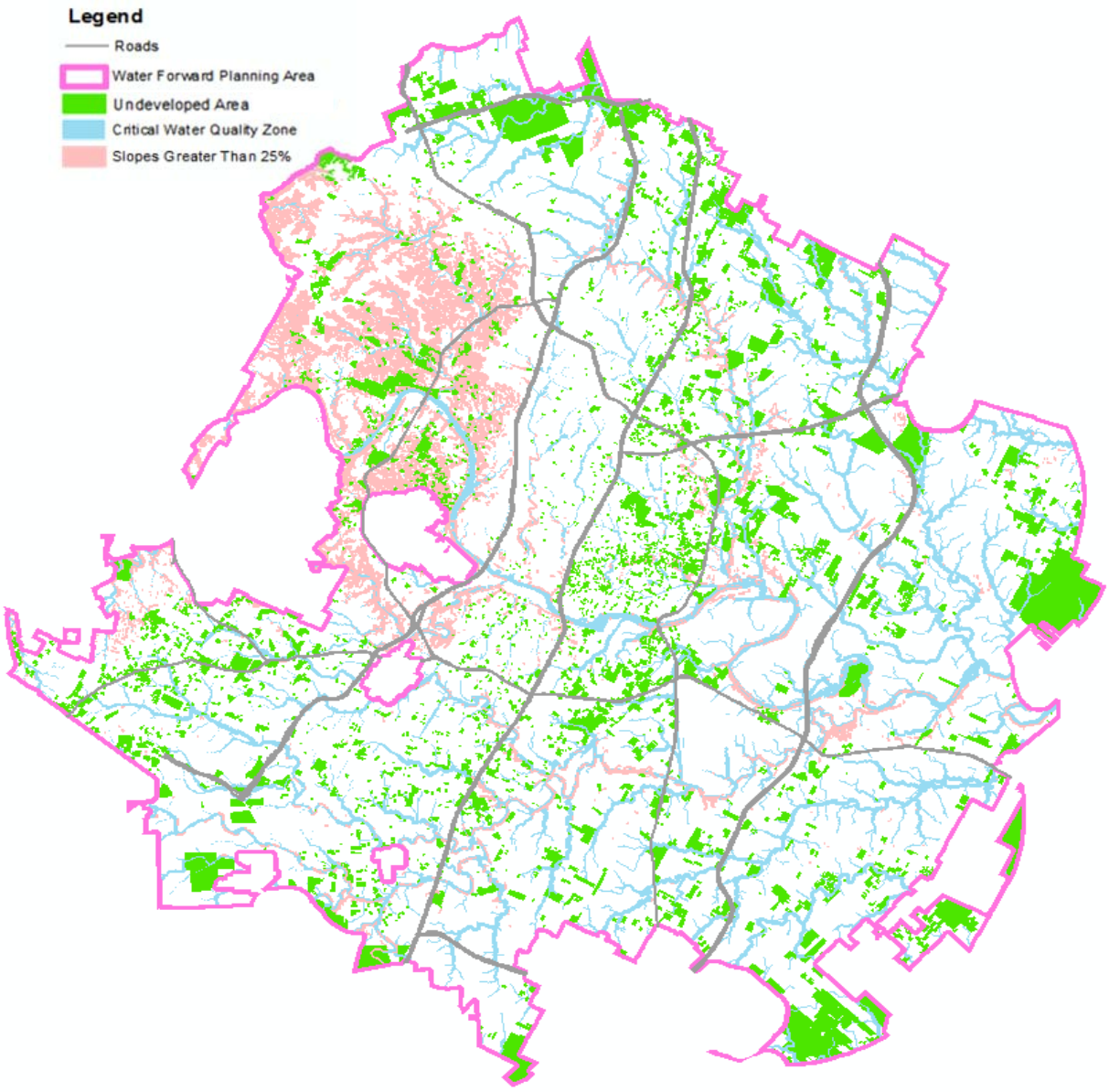


SOURCE: US Census Bureau, American Community Survey, 2015 1-year, Table B25024.

Undeveloped Area Within the Water Forward Planning Area

Summary: Area calculated by identifying undeveloped land use parcels in the City of Austin 2012 land use layer, with adjustments made to reflect updated Travis County Appraisal District and water billing data information.

	Current Zoning					
	Commercial	Industrial	Residential	Special Purpose	Unzoned	Total
Undeveloped Area outside of Critical Water Quality Zones and with slopes of less than 25%	2,544	1,001	5,332	4,672	13,788	27,336 acres
	9%	4%	20%	17%	50%	



Overview of Groundwater Contribution to the Highland Lakes and Colorado River

Excerpts from "Low Flow Gain-Loss Study of the Colorado River in Texas" (Saunders, 2012)

"Gain-loss estimates from major and minor aquifers to the Highland Lakes are summarized in Table 1. Total groundwater contribution from major and minor aquifers to the Highland Lakes cannot be estimated with confidence until groundwater availability models or analytical methods are completed by the Texas Water Development Board." (p 424)

Source Aquifer	Receiving Surface Water Body	Estimated Surface Water Gains	Method of Estimation	Reference(s)
Llano Uplift aquifers (Hickory, Ellenburger–San Saba, and Marble Falls)	Lakes Buchanan, Inks, LBJ, Marble Falls	To be determined	Modeled Available Groundwater estimates	TWDB (twdb.texas.gov)
Trinity Aquifer	Lake Travis, Lake Austin	15,500 acre-feet per year	Groundwater Availability Model water budget	TWDB (Jones and others, 2011)
Northern Segment, Edwards BFZ Aquifer	Lake Austin	19,000 acre-feet per year	Groundwater Availability Model water budget	TWDB (Jones, 2003)
	Highland Lakes	18,600–95,500 acre-feet per year	Highland Lakes water balance	LCRA (Saunders, 2011)

" Total groundwater contribution from major and minor aquifers to the lower Colorado River was estimated to be at least 200 cfs during low flow conditions. Gain-loss estimates from major and minor aquifers to the lower Colorado River are summarized in Table 2." (p. 428)

Source Aquifer	Receiving Surface Water Body	Estimated Surface Water Gains	Method of Estimation	Reference(s)
Barton Springs Segment, Edwards BFZ Aquifer	Lower Colorado River (Tom Miller Dam to Austin)	39,700 acre-feet per year	Groundwater Availability Model water budget	TWDB (Winterle et al., 2009)
Carrizo-Wilcox Aquifer	Lower Colorado River (Austin to Smithville)	26,100 acre-feet per year	Base flow separation analysis	TWDB (Dutton et al., 2003)
Carrizo-Wilcox Aquifer	Lower Colorado River (Austin to Smithville)	21,700 acre-feet per year	Low flow gain-loss study	LCRA (Saunders, 2009)
Queen City and Sparta aquifers	Lower Colorado River (Smithville to LaGrange)	2400 acre-feet per year	Water Availability Model-based stream-aquifer interaction study	TWDB (Kelley et al., 2004)
Yequa-Jackson Aquifer	Lower Colorado River (LaGrange to Columbus)	12,000 acre-feet per year	Groundwater Availability Model water budget	TWDB (Deeds et al., 2010)
Gulf Coast Aquifer (Evangeline, and Chicot Forma-	Lower Colorado River (Columbus to Bay City)	78,240 acre-feet per year	Low flow gain-loss study	TWDB (Deeds et al., 2006)

References Cited

Saunders, G. P., 2012, Gain-loss studies in the Colorado River Basin of Texas: Drought of 2011–2012 update: Gulf Coast Association of Geological Societies Transactions, v. 62, p. 423–431.

Additional Online Resources

George, P.G, Mace, R.E., Petrossian, R., 2011. Aquifers of Texas. Austin, Texas: Texas Water Development Board. 182 p. Available from: http://www.twdb.texas.gov/publications/reports/numbered_reports/doc/R380_AquifersofTexas.pdf

Parsons Engineering Science Inc. 1999. Surface water/ groundwater interaction evaluation for 22 Texas river basins. Austin (Texas): Texas Natural Resource Conservation Commission. Available from: http://www.twdb.texas.gov/publications/reports/contracted_reports/doc/Surface-Groundwater_Interaction.pdf

Scanlon BR, Tachovsky JA, Reedy R, Nicot J-P, Keese K, Slade RM, Merwade V, Howard MT, Wells GL, Mullins GJ, et al. 2005. Groundwater-surface water interactions in Texas. Austin (Texas): Bureau of Economic Geology. 240 p. Available from: http://www.beg.utexas.edu/staffinfo/pdf/scanlon_gwswr2005.pdf

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Austin Water - Demand Assumptions for Water Forward Modeling
DRAFT - SUBJECT TO CHANGE, 3/3/2017 - Corrected Version

	DEMAND CATEGORY / PARAMETER All Demands in units of acre-feet per year.	Year 2020	Year 2040	Year 2070	Year 2115	Climate Adjusted Demands Year 2040	Year 2070	Year 2115
[1]	**Firm Demands**					**2.0%**	**4.0%**	**6.0%**
[2]	City of Austin Municipal Baseline Demand (Avg Year)	153,649	212,712	322,025	548,224	216,966	334,906	581,117
[3]	City of Austin Municipal Direct Reuse (Avg Year)	3,816	3,816	3,816	3,816	3,816	3,816	3,816
[3a]	City of Austin Parks and LBL Evap	1,415	1,415	1,415	1,415	1,443	1,472	1,500
[4]	**City of Austin Baseline + Reclaimed + Parks + LBL Evap Demand Total**	**158,880**	**217,943**	**327,256**	**553,455**	**222,226**	**340,194**	**586,433**
[5]	Fayette County (Power generation downstream of lakes)	20,000	20,000	20,000	20,000	20,000	20,000	20,000
[6]	Sim Gideon / Lost Pines Demand	0	0	0	0	0	0	0
[7]	Llano County (Power generation near/upstream of lakes)	5,500	11,300	20,000	20,000	11,300	20,000	20,000
[8]	**LCRA - Power Plant Demand**	**25,500**	**31,300**	**40,000**	**40,000**	**31,300**	**40,000**	**40,000**
[9]	Fayette County	9,000	9,000	9,000	9,000	9,000	9,000	9,000
[10]	Travis County	9,000	9,500	9,500	9,500	9,500	9,500	9,500
[11]	**City of Austin - Power Plant Demand**	18,000	18,500	18,500	18,500	18,500	18,500	18,500
[12]	Municipal Firm Contract Demand	65,684	97,170	143,046	169,000	99,113	148,768	179,140
[13]	LCRA New Contracts (Region K Table 5-19)	2,877	19,154	33,654	45,000	19,537	35,000	47,700
[14]	Domestic lakeside use	5,000	5,000	5,000	5,000	5,000	5,000	5,000
[15]	LCRA Firm Irrigation	4,800	7,400	10,000	10,000	7,548	10,000	10,000
[16]	BRA - HB 1437 Demand	6,386	25,000	25,000	25,000	25,000	25,000	25,000
[17]	Manufacturing and Mining Demand	16,253	18,277	20,300	24,000	18,642	21,112	25,440
[18]	Other (Conveyance and Emergency Release)	5,000	5,000	5,000	5,000	5,000	5,000	5,000
[19]	**Other Municipal, Industrial, Misc Firm Demands**	**106,000**	**177,000**	**242,000**	**283,000**	**179,840**	**249,880**	**297,280**
[20]	**Total Firm Demand, Rows 4+8+11+19:**	**308,380**	**444,743**	**627,756**	**894,955**	**451,866**	**648,574**	**942,213**
[21]	STPNOC ROR + LCRA Backup	102,000	102,000	102,000	102,000	102,000	102,000	102,000
[22]	Corpus Christi Garwood Water Rights	35,000	35,000	35,000	35,000	35,000	35,000	35,000
	Interruptible Agricultural Demand							
[23]	Garwood Irrigation Demand (Dry - 90th Percentile)	89,700	85,300	79,200	69,300	90,369	86,546	77,258
[24]	Gulf Coast Irrigation Demand (Dry - 90th Percentile)	147,400	113,400	103,900	88,600	136,928	127,371	111,875
[25]	Lakeside Irrigation Demand (Dry - 90th Percentile)	135,500	128,100	119,300	106,700	137,464	131,580	121,074
[26]	Pierce Ranch Irrigation Demand (Dry - 90th Percentile)	27,000	25,600	24,100	22,300	26,091	25,608	24,390
[27]	**Total Interruptible Agricultural Demand, Rows 23+24+25+26:**	**399,600**	**352,400**	**326,500**	**286,900**	**390,852**	**371,106**	**334,597**

Note: All other surface water demands in the water availability model are represented at full water right authorization levels.