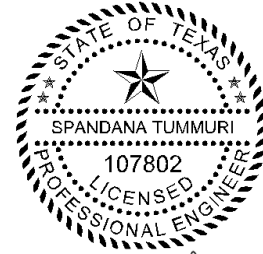


SAN JACINTO RIVER AUTHORITY RAW WATER SUPPLY MASTER PLAN DETAILED STRATEGY EVALUATION TECHNICAL MEMORANDUM

Project Name:	Municipal Water Conservation
Project Type:	Conservation
Potential Supply Quantity (Rounded):	2020: 8,576 ac-ft/year (7.7 MGD) 2070: 43,588 ac-ft/year (38.9 MGD)
Development Timeline:	Escalating throughout the planning horizon
Project Capital Cost:	NA
Unit Water Cost (Rounded):	2020: \$0-\$209 per ac-ft (\$0.00-\$0.64 per 1,000 gallons) 2070: \$0-\$92 per ac-ft (\$0.00-\$0.28 per 1,000 gallons)



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STRATEGY DESCRIPTION

Water Conservation involves the use of various methods to increase the efficiency of water use for a particular demand category. Conservation may include practices to reduce water consumption for industrial, irrigation, or municipal uses. However, this proposed strategy focuses on the application of efficient water use methods for municipal water demand which includes water used to serve residential, commercial, and light industrial demands as well as any landscape irrigation associated with these customers which may include golf courses supplied by public water systems or private wells.

Unlike other strategies which typically involve potential activities by the SJRA to either acquire new water supplies or relocate existing supplies to address future identified shortages, this detailed strategy evaluation instead addresses the potential for the SJRA to permanently reduce demands that would otherwise occur by promoting proven water conservation practices. Therefore, instead of creating a “project”, this strategy considers how SJRA might develop programs to promote specific water conservation activities within the various utilities in Montgomery County that would directly benefit those utilities and result in a permanent reduction of raw water demands for those entities and to lower-cost water supplies overall for the region.

The 2016 Region H Regional Water Plan (RWP) included up to a regional average 16.8 percent in conservation savings over baseline demands by the year 2070. This conservation savings came from a combination of baseline conservation applied by the Texas Water Development Board (TWDB) in the development of water demands, water loss reduction, and advanced conservation through methods applied by the Region H Water Planning Group (RHWPG).

The strategies proposed for the San Jacinto River Authority (SJRA) service area in Montgomery County consists of the following:

- Option 1: TWDB baseline conservation.
- Option 2: Recommendations adapted from the 2016 Region H RWP development process.
 - Advanced conservation adapted from the Goldwater Study by Averitt & Associates and the Texas Water Foundation.
 - Additional recommendations made by Averitt & Associates and the Texas Water Foundation but not incorporated into the RWP.
 - Water savings related to water loss reduction.

Previous Planning Activities

In each round of regional water planning, TWDB has prepared estimates of water demands that include projected reductions in per-capita municipal water use based on various trends. Historically, these projections have included the adoption of efficient plumbing codes as new development occurs with higher standards for water efficiency and the replacement of legacy plumbing fixtures over time. In the 2016 RWPs, projections also included provisions for high-efficiency appliances and other water savings that are expected to occur passively. Because of the passive nature of implementation, it can be assumed that these reductions in demand will occur over time without formal implementation by a project sponsor, such as SJRA.

The RHWPG also included certain recommendations from the Goldwater Project conducted by Averitt & Associates and the Texas Water Foundation. The project aimed to quantify and measure ongoing water conservation efforts in Region H and work with stakeholders to identify gaps in attaining the desired results and recommend projects for meeting the recommended conservation goals in the 2011 RWP. These additional practices include the use of:

- Efficient residential irrigation controllers,
- Efficient meter installations,
- Tank-type ultra-low-flow toilet rebates,
- Efficient commercial dishwashers,
- Efficient commercial spray-rinse valves,
- Efficient commercial steamers,
- Efficient commercial cooling towers,
- Large landscape surveys for single-family residences,
- Large landscape water budgets for single-family residences,
- Large landscape irrigation controllers for single-family residences.

The RHWPG also investigated the reduction of water loss within the region as a means of reducing overall water demand. Information from the 2010 Water Loss Audit Report was used to identify water loss experienced by various utilities and associated these with the Water User Groups (WUGs) throughout Region H. Any WUGs with water loss levels greater than 10 percent were assumed to reduce their water loss at a rate of one percent annually until losses were limited to a target of 10 percent. Although losses could be reduced below this level, 10 percent was identified as a reasonable

target that would provide the greatest benefit per unit cost. These loss reductions would be conducted through a process of system auditing and leak detection and repair.

Results from the study of current and required practices for meeting the goals in the 2011 RWP were adapted into potential projects for all Region H counties in the 2016 RWP with the exception of those that could conserve a considerable amount of water (approaching the level recommended for projects in the 2011 RWP) through water loss reduction alone. This list of practices and recommended strategies listed above is not intended to be exhaustive of all practices that may be employed to reduce municipal water use.

While the 2016 RWP was under development, the Goldwater Project continued gathering information from stakeholders and identifying opportunities for additional conservation savings. One such opportunity was identified from the report, *Water Conservation by the Yard* by the Texas Living Waters Project. The study investigated the potential for reducing water use through the implementation of mandatory restriction on outside landscape irrigation to no more than twice-per-week watering. The results of this study suggested that water savings of four percent could be achieved by water users within Region H as a result of these restrictions. This recommendation was made too late to be incorporated into the 2016 RWP but was contained in the final Goldwater Study report.

Basic Approach

This memorandum categorizes two primary mechanisms for incorporating conservation into the SJRA Raw Water Supply Master Plan (RWSMP). The first mechanism provides for the reduction in demand according to the passive measures identified by TWDB. These practices are expected to occur over time without an active conservation program. Including these measures into the RWSMP will help prevent over-planning that can occur when long-term trends in water demand reduction are not adequately identified during planning. The second mechanism is the use of the active measures prescribed in the Region H and Goldwater studies. These reductions will require an active conservation sponsor such as SJRA or one or more of its customers in order to implement further reductions in demand. A combination of these strategies (both passive and active measures) could be used to achieve the five- and ten-year goals set forth in the SJRA water conservation plans. The most recent plans for all SJRA divisions were adopted March 27, 2014 and contain a recommendation of a one percent annual reduction in water use over the five- and ten-year target periods.

STRATEGY ANALYSES

The strategy analyses for Water Conservation include evaluations of the potential supply to be created through demand reduction, environmental factors to be considered with this strategy, implementation considerations, and an analysis of potential cost.

Supply Development

Unlike other strategies, the potential amount of demand reductions in municipal use are typically evaluated as being achieved under a programmatic effort within each specific utility. Based on the previous planning efforts for this region, four categories of activities were identified as the most appropriate areas for focus by the SJRA.

- Option 1 – Passive Measures
 - TWDB Baseline Conservation - passive reduction expected to be achieved due to fundamental changes to plumbing codes and to improved appliance efficiencies.
- Option 2 – Active Measures
 - Advanced Conservation Programs - RHWPG estimates from Goldwater Study based on ongoing active water conservation programs throughout the region designed to encourage various best management practices for municipal utilities.
 - Water Loss Reduction - additional demand reductions for specific utilities due to savings in water loss through infrastructure improvements.
 - Outdoor Landscape Watering Programs - potential savings from implementing irrigation schedules that limit outdoor watering to two occurrences weekly.

Baseline per capita demand reductions identified by TWDB for the 2016 Region H Regional Water Plan were calculated for each demand unit identified during Task 1102 of the RWSMP, Demand Scenario Evaluation. For this analysis, each unit was assigned a representative WUG from the Region H RWP with a corresponding per capita demand as the demand units did not necessarily align with Region H-designated WUGs. The differences between the initial per capita used by TWDB to generate WUG demands and the per capita demand adjusted by TWDB for each decade represent the adjustment made for baseline conservation. Therefore, finding the difference between demands developed with each per capita basis represents the intended reduction in demand associated with the TWDB baseline savings. Finally, demand reduction for the SJRA service area was developed based on the same delineation of the SJRA GRP customers used for demand development. It should be noted that the Woodlands has already adopted a twice per week watering schedule and should already benefit from the associated savings. However, this adoption occurred after the development of the baseline per capita demand used in the demand and strategy analyses and, therefore, the identified savings may still be applied as a strategy within the master plan.

During the development of the 2016 RWP, the Goldwater Study was able to identify high level savings from the programs recommended for each county but applying these on a WUG level was recognized as a much less certain exercise. At the time, a methodology was adopted to distribute identified conservation savings across WUGs within a county based on the distribution of demand. Therefore, WUGs with higher levels of water use were assumed to have greater potential in reducing demand and, therefore, received a higher allocation of water demand reduction through conservation. A similar methodology was employed in this study and the county-wide advanced conservation goals in the Region H RWP were allocated across the demand units in Montgomery County based on their demand after the application of baseline conservation, as was calculated in the RWP. Again, demand reduction for the SJRA service area was developed based on the same delineation of the SJRA GRP customers used for demand development.

In the 2016 Region H RWP, water loss calculations were developed for each WUG based on data presented for the utilities in the *2010 Water Audit Loss Report* where possible. In cases where direct data was not available such as for County Other WUGs, data on real losses were derived from an aggregation of utilities representing portions of the WUG. As the demand units evaluated in the Demand Scenario Evaluation of the RWSMP were already associated with Region H WUGs, the water loss savings in the Region H RWP were distributed across the matching demand units in the RWSMP.

Once this distribution was made, water loss reductions associated with demand units within the SJRA GRP were summarized to determine the overall potential for use of this strategy.

The Texas Living Waters Project produced report, *Water Conservation by the Yard*, examined outdoor water use in both Region H and Region C. Specifically, the study examined the largely untapped potential of implementing irrigation schedules that limit outdoor watering to two occurrences weekly. The Region H results proposed as much as a four percent reduction in water demand with the implementation of ordinances restricting watering schedules. Water demands for all demand units, after application of baseline conservation, were reduced by four percent and the conservation potential summarized for the SJRA GRP service area. As mentioned previously, uncertainty is an element of all conservation studies and this is especially true for ongoing watering restrictions which will reduce demand more in dry years than wet years and which are also highly variable based on enforcement and compliance.

The combined, projected conservation savings for the SJRA GRP service area in Montgomery County by decade are shown below in *Figure 1*. The passive savings projected from Option 1 are shown in blue while all other approaches associated with Option 2 are shown in green. A considerable volume of savings can be anticipated through only passive measures captured in the TWDB baseline conservation. Further conservation requires the implementation of active measures in Option 2 including advanced conservation, water loss reduction, and twice per week watering. Adopting the Goldwater recommendations identified in the 2016 Region H RWP also provides a significant level of savings which only increase with the addition of the recommended twice per week watering schedule. The most limited savings can be obtained from water loss reduction. The reason for this is that the largest demand units within the SJRA GRP, The Woodlands, and the City of Conroe are already good performers in terms of water loss and report losses less than 10 percent, thus limiting water loss reduction to other smaller users with limited opportunity to provide benefit to the overall water supply.

The RWSMP has been conducted in a way which provides for water needs to be identified and addressed on a sub-annual basis. Because of this, it is important to consider the efficacy of various conservation programs throughout the year. Conservation practices such as the use of more efficient indoor fixtures will generally produce a fairly constant benefit throughout the year. In contrast, modified outdoor watering schedules will demonstrate their greatest benefits at peak watering periods throughout the year. For the purpose of this analysis, TWDB baseline and advanced conservation programs recommended in the Goldwater Study for the 2016 RWP were assumed to reduce demands evenly throughout the year. Benefits from water loss reduction and outdoor twice-per-week watering were assumed to provide benefits distributed throughout the year by the overall

demand curve. The resulting monthly benefits by month for each decade of Option 2 are shown below in *Figure 2*. It is assumed that Option 1 benefits will occur throughout the year at a constant rate.

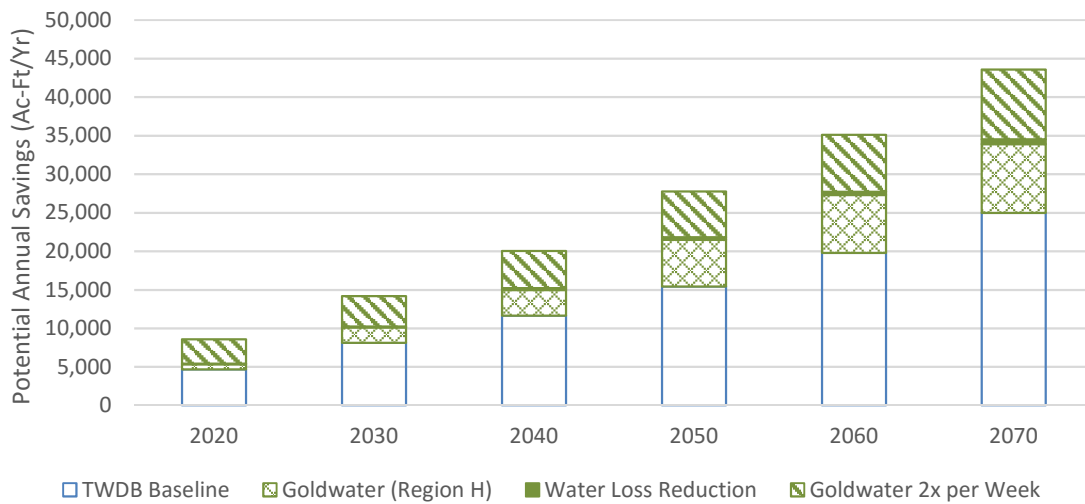


Figure 1 – Potential Water Savings for the SJRA GRP by Program (Options 1 and 2)

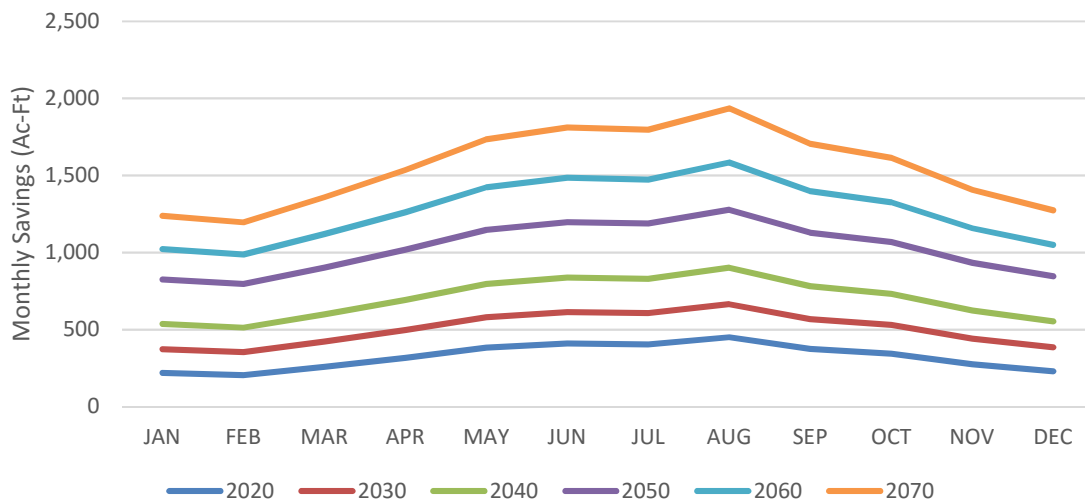


Figure 2 – Monthly Projected Active Conservation Savings for the SJRA GRP under Option 2

Environmental Considerations

Generally, there are no significant negative environmental impacts associated with the conservation programs outlined herein or that may result from implementation of any specific conservation management project. Large-scale structural modifications (constructing physical facilities) are not necessary to implement the water conservation management program. Improvements required for

most water loss programs often require water main replacement within existing streets or rights-of-way. Therefore, construction impacts are not anticipated as with other strategies. However, improved conservation may create various types of social impacts and will be subject to varying degrees of acceptance throughout the community. It is noteworthy that conservation measures do sometimes change the pattern of return flows introduced to streams. Municipal effluent is a critical and substantial component to baseflows in the San Jacinto River basin and conservation measures, particularly those associated with in-house methods, will reduce these flows below the level that would occur without conservation in place. However, the reduction in return flows in the demand basin due to conservation would, theoretically, be more than offset by the reduced diversions of water from the source basins or development of other, less environmentally friendly alternatives.

Permitting and Development

Accomplishing the water conservation demand reductions, as described herein, requires proactive implementation. Identification of an appropriate utility or political subdivision to manage or legislate implementation of the conservation measures to the municipal users is one of the critical issues facing the success of this strategy. Development of any conservation program for the SJRA GRP will inevitably require a high degree of coordination across the division's customer base. Individual systems will have varying attitudes toward conservation and efforts will have to be implemented to demonstrate the value of conservation to the GRP participants as well as their retail customers.

Option 1 will require no effort by SJRA since these savings rely on the natural adoption of water-efficient fixtures and appliances over time. Incorporation of these savings into the RWSMP will represent the acceptance of this assumption rather than the deliberate development of a conservation program by SJRA. Option 2, in contrast, will require an active initiative by SJRA or other parties in order to realize the potential savings estimated in this analysis. One fundamental requirement for SJRA will be the development of a staff position dedicated to the implementation of conservation programs or the shared purposing of a staff member who can focus on these responsibilities in addition to other tasks. Although this staff member or members may be employed at a number of levels, including the SJRA customer level, a dedicated staff member employed by SJRA will have the greatest range in promoting conservation initiatives throughout the organization and down to all SJRA customers as appropriate. While direct savings are not associated with this position, the assumed savings from Option 2 are dependent on active implementation through such a position. The primary costs for this position includes the salary and overhead expenses for the SJRA which can range from \$135,000 to \$165,000 depending on qualifications and level of experience. For the purpose of this analysis the high end of the salary range was added to the annual cost for Option 2.

Other requirements for the implementation of Option 2 will include the planning and funding of specific initiatives intended to promote the advanced conservation, water loss reduction, and twice per week watering approaches described here. These include the following for each approach:

- **Advanced Conservation**
 - Assess current conservation practices employed by SJRA divisions and major customers.
 - Adapt the Alliance for Water Efficiency (AWE) tool for representing water systems served by SJRA.

- Utilize the AWE tool to estimate the efficacy of current programs.
- Identify future conservation goals and use the AWE tool to select conservation strategies, including those identified in the Goldwater Study, that may be most appropriately implemented within the SJRA service area.
- Evaluate and select detailed actions desired to promote prescribed conservation practices through SJRA divisions and customers.
- Water Loss Reduction
 - Determine existing water loss estimates associated with and reduction efforts by SJRA divisions and customers.
 - Identify qualified contractors to provide services in locating sources of water loss through desktop and field analyses.
 - Work with customers experiencing high levels of water loss along with qualified contractor to select measures to increase accountability.
- Twice per Week Watering
 - Review current customer policies encouraging twice per week watering and identify those that can benefit from enacting more appropriate policies or enhancing existing water ordinances.
 - Develop model ordinances, public relations materials, and recommended enforcement approach to promote more efficient outdoor water use including restrictions on watering more frequently than twice per week.
 - Work with SJRA divisions and customers to promote adoption of efficient outdoor watering ordinances.

Cost Analysis

Costs for the conservation measures adapted from the 2016 Region H RWP were developed based on information in that document. Since TWDB baseline conservation relies on passive measures to achieve conservation, no cost has been associated with this practice.

Costs in the 2016 Region H RWP for advanced conservation programs were developed as part of the Goldwater Study and originated from information included in the AWE Water Conservation Tool. Due to the uncertainties in the actual implementation of these programs, costs developed on a WUG-level in the RWP were summarized and distributed across all WUGs after the initial estimates were developed in order to provide a uniform cost across the region. In a similar manner, the Region H conservation costs for Montgomery County were distributed across the various demand units in the RWSMP study, after which the portion associated with the SJRA GRP was identified separately. Water loss reduction was similarly calculated for the SJRA service area. Costs identified for Montgomery County in the 2016 RWP were allocated across demand units based on the projected savings for each with data for the SJRA service area being compiled separately. It was assumed that twice-per-week watering would cost each entity \$0.07 per thousand gallons (Fort Worth Water Conservation Plan,

April 2014). It is assumed that any coordination and enforcement of this policy would require part-time or full-time staff which would be funded within SJRA and the GRP customer systems.

Costs for all conservation practices derived from Region H are shown below in *Table 1*.

Table 1 – Estimated Annual Program Costs for Conservation in SJRA GRP by Approach

Approach	Estimated Annual Program Cost					
	2020	2030	2040	2050	2060	2070
Option 1: TWDB Baseline	\$0	\$0	\$0	\$0	\$0	\$0
Option 2: Active Measures	\$808,620	\$931,328	\$1,069,261	\$1,394,182	\$1,532,648	\$1,716,145
Total	\$808,620	\$931,328	\$1,069,261	\$1,394,182	\$1,532,648	\$1,716,145

Table 2 shows the unit costs for active measures based on the estimated annual cost for Option 2 compared against the estimated savings from the active measures. The cost per acre foot ranges from \$209 in 2020 to \$92 by 2070 with the cost per 1,000 gallons ranging from \$0.64 in 2020 to \$0.28 by 2070. It is often said that conservation is one of the most cost-effective strategies, which is shown in this cost analysis. It is notable that the effective benefit of conservation is the reduction of water demand at the point of use. Many other comparable strategies may produce water at a lower cost, but must be coupled with treatment and transmission projects in order to satisfy demands. These additional projects are not necessary with a conservation approach, making conservation programs extremely cost-competitive if the efficacy of the programs can be realized.

Table 2 – Estimated Units Costs by Decade for Conservation in SJRA GRP for Option 2 (Active Conservation)

Decade	Active Water Savings (Ac-Ft/Yr)	Annual Cost	Cost per Ac-Ft	Cost per 1,000 gallons
2020	3,872	\$808,620	\$209	\$0.64
2030	6,037	\$931,328	\$154	\$0.47
2040	8,394	\$1,069,261	\$127	\$0.39
2050	12,327	\$1,394,182	\$113	\$0.35
2060	15,287	\$1,532,648	\$100	\$0.31
2070	18,607	\$1,716,145	\$92	\$0.28

WATER MANAGEMENT STRATEGY EVALUATION

Based on the analysis provided above, the Water Conservation project was evaluated across the eleven different criteria for the purpose of a quick comparison against other alternative strategies that are under consideration within this Raw Water Supply Master Plan. The results of this evaluation are shown in *Table 3* below. Project criteria and scoring methodology are described in the technical memorandum, *Preliminary Strategy Identification and Evaluation (Task 1104)*. Higher scores relate to more preferable characteristics.

Baseline conservation or passive measures expected to occur over time ranked higher than active measures due to the cost of those active measures. Potential application of these conservation strategies assume that the baseline conservation goals will be achieved organically over time. SJRA may further choose to implement the effective, yet more costly, active measures in order to achieve 5- and 10-year conservation goals and further reduce identified water needs.

Table 3 – Screening Criteria and Scores of the Water Conservation Strategy

Criteria	Rating	
	Option 1	Option 2
	Passive Measures	Active Measures
Cooperation	3	3
Cost	4	4
Diversification	3	3
Environmental	4	4
Funding	4	4
Land Acquisition	4	4
Legal	3	3
Location	4	4
Magnitude	2	2
Other Supplies	2	2
Public	4	4
Scalability	4	4
Schedule	3	3
Yield Risk	3	3
Weighted Score¹	364	364

¹ Based on weighting methodology adopted in Preliminary Strategy Identification and Evaluation (Task 1104)

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Water Conservation Implementation Task Force Report to the 79th Legislature. November 2004. Published by the Texas Water Development Board.

Water Conservation Plan. City of Fort Worth, 2014.