APPENDIX 5A
RECOMMENDED AND ALTERNATE WATER MANAGEMENT STRATEGIES

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INTRODUCTION

"A water management strategy is a plan to meet an identified water need for additional water by an entity, which can mean increasing the total water supply or maximizing an existing supply, including through reducing demand. When a water management strategy project is implemented, it is intended to develop, deliver, and/or treat additional water supply volumes, or conserve water for an entity" (TWDB-Exhibit C General Guidelines-April 2018). The Far West Texas Regional Water Planning Group has identified and evaluated a total of 58 65 water management strategies. Of this total, seven 10 are "Alternate" strategies, which can be substituted for "Recommended" strategies that are later determined to be non-viable.

Water management strategies described in this appendix are proposed recommended and alternate projects to meet projected water supply shortages in future decades, and projects of specific interest by water-user entities participating in this planning process. Section 5.2 of this chapter provides an explanation of the strategy evaluation procedure and Tables 5-2, 5-3, and 5-4 provide a side-by-side comparison such that all strategies can be assessed based on the same quantifiable factors.

Table 5-2

- Quantity of new water produced
- Chemical quality
- Reliability of supply
- Impacts to water, agricultural, and natural resources, and to ecologically unique stream segments

Table 5-3

- Financial cost (total capital cost, annual cost, and cost per acre-foot)

Table 5-4

- Environmental impacts
  - Environmental water needs
  - Wildlife habitat
  - Cultural resources
  - Environmental water quality
  - Inflows to bays and estuaries

Water management strategies recommended for this *2021 Plan* include specific projects or programs related to conservation and reuse, water-loss audit and main-line repair for entities with more than a reported 10-percent water loss, and projects requiring infrastructure construction, upgrades or modifications.

5A-1 WATER MANAGEMENT STRATEGIES FOR BREWSTER COUNTY

5A-1.1 MANAGEMENT STRATEGIES FOR CITY OF ALPINE

The City of Alpine relies on groundwater from the Davis Mountains Igneous Aquifer, which is significantly impacted by local pumping during drought years. The following two strategies are intended to:

1. Utilize all available water (rainwater runoff and treated effluent) for restoration of Alpine Creek, which will improve wildlife habitat, and increase outdoor recreation in the area;
2. To develop a water source that is available to recharge the underlying aquifer system (ASR);
3. To diminish the amount of treated groundwater that is currently used for landscape irrigation;
4. To provide for more reuse-efficient landscape irrigation of the Country Club golf course, baseball fields, Kokernot Park (pool and picnic areas), and Poets Grove.

- (E-1) Modification to wastewater treatment facility & irrigation system
- (E-2) Irrigation and recharge application of captured rainwater runoff

E-1 Modification to Wastewater Treatment Facility & Irrigation System

The City of Alpine Wastewater Treatment Plant receives up to 400,000 gallons per day and discharges 75,000 gallons per day. Currently the WWTP treated effluent can irrigate the north section of the *project area* (Golf Course) from a 35,000-gallon surface storage tank. Modifications and additions to the infrastructure include installation of an additional 50,000-gallon storage tank (for a total of 85,000-gallon storage capacity) and extension of the irrigation system to supply the south side of the Golf Course. An additional irrigation system is proposed to use the additional treated effluent to irrigate around the baseball fields, Kokernot Park (pool, picnic areas), and Poets Grove, all located in the pilot project area. This would allow the City to efficiently reuse all the treated effluent available for irrigation, with any surplus supplied to Alpine Creek, enhancing bird habitat by establishing native trees and vegetation as well as providing a water feature for a nature trail along the creek between the golf course and the loop road. A hydrological analysis will explore the possibility of additionally using some of the treated effluent for Aquifer Storage Recovery (ASR). The City will submit an amendment to the TCEQ Wastewater permit (WQ0014349001) to include the proposed plan to reuse 100 percent of the treated effluent.

Quantity, Reliability and Cost - The project will allow the City to use 100 percent of treated wastewater discharge, an increase of 30 percent or 25 acre-feet per year to irrigate project properties. The project is planned for completion and delivery of water by the start of the 2030 ~~construction within the 2020~~ decade and the estimated capital cost of infrastructure modification and irrigation system is $2,318,000~~74,400~~.

E-2 Irrigation and Recharge Application of Captured Rainwater Runoff

In a good year, the City of Alpine receives approximately 17 inches of rain, much of which is lost to runoff. High-intensity thunderstorms contribute to greater runoff into nearby Alpine Creek, causing higher peak flooding. This prevents the creek from functioning properly as evidenced by the scoured, cut and straightened channel that exists today which must be armored with engineered banks. Additionally, runoff transports pollutants into the creek, which eventually flows into the Rio Grande. As with many towns in West Texas, the streets act as a storm water drainage system. These water catchments take that liability and turn it into an asset.

This strategy proposes constructing rainwater catchment basins at three locations around Kokernot Park, which will drain neighboring streets~~ to reduce down-stream flooding~~. Impounding a large volume of water from the roads will allow ~~it~~ the captured water time to infiltrate the soil, recharge the underlying aquifer, and remediate pollutants. These basins will also be landscaped with water-efficient plants without tapping into the city's aquifer water for irrigation. These catchments will also demonstrate how residents can reduce water use and cost by capturing rainwater and landscaping with water-efficient native plants. This project will also help reduce down-stream flooding.

~~The project also aims to address future water shortages. The tremendous drought of 2011 saw many water wells in the area go dry. A large percentage of municipal water supply currently goes to landscaping. With growing populations and a warming climate, this water supply will be subject to even more demand. This native landscaping is very resilient to natural drought and is extremely self-sustaining.~~

Quantity, Reliability and Cost - The three catchment basins (approximately 70 acres in combined size) are calculated to capture approximately 70 acre-feet during an average drought (12 inches or 75% of average annual rainfall) year. ~~The project supply is considered interruptible during severe drought conditions.~~ The project is planned for construction within the 203~~2~~0 decade and come online prior to 2030. T~~t~~he estimated capital cost to construct the thee catchment basins and retention dams is $1,296,000~~4,500~~.

5A-1.2 MANAGEMENT STRATEGIES FOR BREWSTER COUNTY - OTHER

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Although the supply-demand analysis (Chapter 4) does not project a future water supply deficit for Brewster County Other, the following water management strategies are recommended to enhance the reliability of the future water supply availability for rural and small-town residents within Brewster County:

- (E-3) Marathon Water Supply & Sewer Service Co. - Water loss audit and main-line repair
- (E-4) Lajitas Municipal Services - Water loss audit and main-line repair
- (E-5) Study Butte Terlingua WS - Water loss audit and main-line repair

E-3 Marathon Water Supply & Sewer Service Company - Water Loss Audit and Main-line Repair

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According to the 2016 TWDB Public Water System Water Loss Survey, the Marathon Water Supply & Sewer Service Company had real water losses (as opposed to apparent "paper" losses) of 19 acre-feet in 2016 (19.6%) due to leaking infrastructure. This amount of water loss is the sum of reported breaks and leaks, and unreported loss. The water supply system can reduce water losses and get a more accurate look at water consumption by taking the proper measures to identify and repair old infrastructure and inaccurate water meters. This strategy will provide a savings of only a portion of the total reported loss and assumes that a leak testing program would be implemented prior to possibly replacing portions of the existing leaking pipe.

Quantity, Reliability and Cost - The strategy assumes 1 mile of 6-inch diameter pipe will be replaced, at a total estimated project capital cost of $255,000. The strategy is estimated to generate a potential savings of 12 acre-feet of water per year throughout the planning period.

E-4 Lajitas Municipal Services - Water Loss Audit and Main-line Repair

According to the 2016 TWDB Public Water System Water Loss Survey, the Lajitas Municipal Services Company had real water losses (as opposed to apparent "paper" losses) of 98 acre-feet in 2016 (59.3%) due to leaking infrastructure. This amount of water loss is the sum of reported breaks and leaks, and unreported loss. The water supply system can reduce water losses and get a more accurate look at water consumption by taking the proper measures to identify and repair old infrastructure and inaccurate water meters. This strategy will provide a savings of only a portion of the total reported loss and assumes that a leak testing program would be implemented prior to possibly replacing portions of the existing leaking pipe.

Quantity, Reliability and Cost - The strategy assumes 10 miles of 6-inch diameter pipe will be replaced, at a total estimated project capital cost of $2,545,000. The strategy is estimated to generate a potential savings of 51 acre-feet of water per year throughout the planning period.

E-5 Study Butte Terlingua Water System - Water Loss Audit and Main-line Repair

According to the 2015 TWDB Public Water System Water Loss Survey, the Study Butte Water Supply Corporation, the Terlingua water utility, had real water losses (as opposed to apparent "paper" losses) of

31 acre-feet in 2015 (50.5%) due to leaking infrastructure. This amount of water loss is the sum of reported breaks and leaks, and unreported loss. The water supply system can reduce water losses and get a more accurate look at water consumption by taking the proper measures to identify and repair old infrastructure and inaccurate water meters. This strategy will provide a savings of only a portion of the total reported loss and assumes that a leak testing program would be implemented prior to possibly replacing portions of the existing leaking pipe.

Quantity, Reliability and Cost - The strategy assumes 12 miles of 6-inch diameter pipe will be replaced, at a total estimated project capital cost of $3,054,000. The strategy is estimated to generate a potential savings of 25 acre-feet of water per year throughout the planning period. The Study Butte Terlingua Water System is not an official Water User Group for regional water planning purposes, so demand projections were not developed specifically for them but are accounted for under Brewster County-Other by TWDB. The potential savings identified in this strategy are based the amount used in 2015.

5A-2 WATER MANAGEMENT STRATEGIES FOR CULBERSON COUNTY

5A-2.1 —WATER MANAGEMENT STRATEGIES FOR CULBERSON COUNTY IRRIGATION

Culberson County has a water supply deficit for irrigation use projected at 333 acre-feet per year in 2020 ~~through 2070~~ and in 2030. The following water management strategies are recommended to enhance the reliability of the future water supply availability for the irrigation water supply shortages within Culberson County:

- (E-6) Irrigation ~~Conservation:~~ Scheduling
- (E-7) Additional well in the West Texas Bolsons Aquifer (Upper Salt Basin)

E-6 Irrigation ~~Conservation:~~ Scheduling

This strategy is intended for producers with an adequate supply of water throughout the growing season. It involves scheduling the time and amount of water that is applied to a crop based on the amount of water present in the crop root zone, the amount of water consumed by the crop since the last irrigation, and other considerations. Water savings are difficult to quantify and vary from year to year based on cropping practices, water quality, and quantity. It is estimated that 0.3 to 0.5 acre-feet of water per acre may be saved. (Modified from TWDB BMPs at: http://www.twdb.texas.gov/conservation/BMPs/Ag/index.asp)

Quantity, Reliability and Cost - According to the 2017 U.S. Ag Census, Culberson County had sixteen farms with irrigated land in 2017 and 5,730 acres of irrigated land, which gives an average of 358 acres per farm using the process described below, and assuming that scheduling would conserve 0.3 acre-feet per acre, this results in a conservation savings of approximately 107 acre-feet per farm. The reliability of this supply is low due to uncertainty associated with estimated implementation of BMPs. There is no capital cost associated with implementing this strategy.

E-7 Additional Well in the West Texas Bolsons Aquifer (Upper Salt Basin)

This strategy assumes that one new well will need to be drilled to approximately 400 feet below the surface. Historical agriculture use indicates that the Upper Salt Basin aquifer is a viable source. The Upper Salt Basin Aquifer is the northern most aquifer of the West Texas Bolsons Aquifer System and is a potential source of water to meet irrigation supply shortages within Culberson County. Groundwater within the Upper Salt Basin varies from fresh to moderately saline ranging between 1,000 and 4,000 milligrams per liter of total dissolved solids.

Quantity, Reliability, and Cost - One new well is assumed to supply 333 acre-feet per year. The reliability of this supply is medium to high, based on competing demands. The total capital cost of this project is approximately $510,000.

5A-3 WATER MANAGEMENT STRATEGIES FOR EL PASO COUNTY

5A-3.1 WATER MANAGEMENT STRATEGIES FOR THE TOWN OF ANTHONY

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The Town of Anthony and many other residents of El Paso County rely on the Hueco-Mesilla Bolson Aquifer for municipal, domestic, livestock, and irrigation water supply needs. The Town's population is projected to increase from 4,206 in 2020 to 8,052 by 2070. As the population increases, water demands increase. This creates a significant amount of strain on the Hueco-Mesilla Bolson Aquifer. Continued withdrawals from the Aquifer may negatively impact the Aquifer's ability to meet the long-term water supply needs of the area.

The Town of Anthony does not have a projected water supply deficit this planning cycle. The following water management strategies are recommended to enhance the reliability of the City's future water supply availability:

- (E-8) Arsenic treatment facility
- (E-9) Additional groundwater well

The City of Anthony is currently being funded for a wholesale water treatment plant replacement and expansion through the TWDB's Clean Water State Revolving Fund (CWSRF).

E-8 Arsenic Treatment Facility

Naturally occurring arsenic is found in the groundwater relied upon by the residents of the Town of Anthony. The community's groundwater supply from the Mesilla Bolson Aquifer hovers around the maximum contaminant limit of 10 ppb. Aided by financial assistance from the TWDB, utilizing the Drinking Water State Revolving Fund, the Town has plans to install an arsenic treatment system to meet the State's water supply and public safety standards. ~~The community has been performing pilot studies on two arsenic removal technologies: absorption and oxidation/removal.~~

~~The funding received is also intended to construct a 250,000-gallon elevated storage tank, upgrade pumping stations, install re-chlorination facilities in the distribution system, and rehabilitate or replace water lines. Currently, the Town of Anthony has inadequate storage capacity. Wells and booster stations are in critical need of system upgrades and alternate power supplies, in addition to old and undersized distribution lines.~~

Capital cost is derived from taking the total project cost reported in the 2019 TWDB Drinking Water State Revolving Fund Intended Use Plan ($7,449,947) and incorporating it into the TWDB Costing Tool to add contingencies and develop annual costs.

Quantity, Reliability, and Cost - The new arsenic treatment facility is assumed to supply 2,800 acre-feet per year of potable water. Reliability of the project is high since the Mesilla Bolson Aquifer has historically been found as a reliable source. The total capital cost for this project is estimated to be $10,334,000.

E-9 Additional Groundwater Well

Due to ongoing drought resulting in lower aquifer water levels and condition of existing wells because of age, the Town of Anthony has experienced a decrease in water production from their three existing municipal water wells. Additionally, one of the three wells has been taken out of service. Preliminary inspection of the well shows that the casing is corroded and fractured allowing sand to enter and fill the well screen. The Town is pursuing rehabilitation of this well. However, based on existing and future water demands, in addition to the condition of the Town's existing wells, a new municipal water well is required to reliably supply additional water. Anticipated depth of the well is 800 feet and a capacity of 1,200 GPM.

Quantity, Reliability and Cost – The well is anticipated to reliably provide an additional supply of 960 acre-feet per year from the Mesilla Bolson Aquifer, even though some long-term water level decline can be expected. According to Parkhill Smith & Cooper (project engineers), the estimated budget cost of a new well for the Town of Anthony is $1,913,000.

5A-4 —EL PASO WATER INTEGRATED STRATEGIES

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El Paso Water (EPW) is the City's municipal water-supply utility as well as wholesale water-supply provider for several other municipal entities and industries. EPW supply sources include both surface water (Rio Grande) and groundwater (Hueco and Mesilla Bolson aquifers), which are managed in an "integrated" approach that balances each source's availability throughout the year. EPW further manages these primary sources with innovative approaches including advanced purification treatment, reuse of previously used water, and desalination of brackish groundwater. And of critical importance, the various management practices are all preceded by one of the state's most successful conservation programs.

The projected demand for water provided by EPW, including the City of El Paso and all wholesale clients, is projected to increase from 137,479 acre-feet per year in 2020 to 198,364 acre-feet per year in 2070. With current infrastructure and supply availability, EPW is projected to see a need for the development of additional supplies by the 2030 decade, which will increase to approximately 58,498 acre-feet per year by 2070.

To meet the future need for additional water supply, EPW continues to update its *Integrated Water Management Plan*. The Plan involves the design of new project strategies to be implemented at appropriate time periods to ensure that EPW maintains sufficient water supplies in advance of projected need. The *Integrated Water Management Plan* evolved from an analysis of integrated water-development strategies for the City and County of El Paso in the *2006 Far West Texas Water Plan*, which was subsequently updated in the *2011 and 2016 Plans*. The strategies considered are termed "integrated" because they represent combinations of individual sources due to the unique nature of water management in El Paso. Taken separately, each source can be evaluated and analyzed. However, combining all sources into an integrated strategy provides an opportunity to evaluate the interrelationship of the individual components and provides a regional context to the *Regional Plan*. For this *2021 Far West Texas Plan*, the recommended Integrated Water Management Strategy in the *2016 Plan* has again been updated and several new component strategies have been added. The recommended Integrated Strategy adopted to meet the needs for additional water supply for EPW is comprised of the following individual projects listed below. The first ~~eight~~ five strategies are "recommended" to meet EPW's future demand needs, while the remaining ~~six~~ nine are considered as "alternate" strategies available to be considered if any of the "recommended" strategies fail to fully meet future projected needs.

EPW Integrated Water Management Strategies

Strategy Number	Strategy Name
Recommended Strategies	
E-10	Municipal conservation programs
E-11	Advanced water purification at the Bustamante WWTP
~~E-12~~	~~Advanced water purification at the Haskell WWTP~~
~~E-13~~	~~Expansion of the Kay Bailey Hutchison Desal Plant~~
E-14	Hueco Bolson Artificial Recharge
~~E-15~~	~~Riverside regulating reservoir~~
E-16	Groundwater from Dell City area (Phase 1)
E-17	Groundwater from Dell City area (Phase 2)
Alternate Strategies	
E-12	Advanced water purification at the Haskell WWTP
E-13	Expansion of the Kay Bailey Hutchison Desal Plant
E-15	Riverside regulating reservoir
E-18	Treatment and reuse of agricultural drain water
E-19	Expansion of Canutillo Mesilla Bolson wellfield
E-20	Lower Valley wellhead RO
E-21	Expansion of Jonathan Rogers WTP
E-22	Conjunctive treatment of groundwater and surface water at the Upper Valley WWTP
E-23	Advanced water purification at the Fred Hervey WWTP

E-10 Municipal Conservation Programs

Reduction of municipal water consumption may be achieved with the implementation of conservation programs that reduce per capita usage and prevent water waste. El Paso Water (EPW) has been implementing an aggressive water conservation program for nearly 30 years with actions such as adoption of a rate structure that penalizes high consumption, restrictions on residential watering, rebate programs for replacing appliances and bathroom fixtures for low consumption units, plumbing fixtures to reduce leaks, native landscaping programs to reduce landscape irrigation, public education, control of water losses, and enforcement.

Since 1990, the City has had a water conservation department with at least seven full time staff members overseen by a Water Conservation Manager (for a total of eight full time staff members). The department develops and oversees the City's conservation program, collects data, provides enforcement, and develops public outreach programs.

Reuse is ~~considered a conservation strategy by the TWDB~~ an important component of EPW's water-supply management program. The City currently has a 'purple pipe' water reuse program that provides treated wastewater for irrigation of golf courses, city parks, school grounds, and apartment landscapes, construction and industrial use, as well as indirect reuse by using treated wastewater for artificial recharge. The City is also in the process of implementing a direct reuse strategy, which is evaluated separately.

EPW's water conservation efforts have reduced per capita municipal use in El Paso from about 225 gallons per capita per day (gpcd) in the late 1970s to a current level of 128 gpcd. Residential per capita consumption was 72 gpcd in 2018. The overall per capita potable water use for EPW and its wholesale customers, including steam electric and industrial use, was about 128 gpcd in 2018. This strategy assumes the continuation of EPW's aggressive water conservation efforts and estimates that demand can be reduced by conservation efforts to approximately 112 gpcd by 2070.

Quantity, Reliability, and Cost – The table below presents the additional supplies that would result from this strategy's projected level of conservation.

Projected Conservation Supply (Acre-Feet)

	2020	2030	2040	2050	2060	2070
Projected Population Served by El Paso Water WUG	734,031	822,625	904,900	986,455	1,063,672	1,136,275
TWDB Projected gpcd[1]	134	131	128	127	126	126
EPW Expected gpcd[2]	128	125	123	118	115	112
Savings above TWDB Projections (acre-feet/year)	**4,950**	**5,530**	**5,080**	**9,940**	**13,140**	**17,820**

1. TWDB Project gpcd includes savings from plumbing code
2. Expected gpcd goals are based on conversations with EPW and are equal to or lower than the 2019 Water Conservation Plan (WCP) goals

Projected Cost of El Paso Water Utilities Conservation Strategy

	2020	2030	2040	2050	2060	2070
Annual Cost	$1,071,000	$1,071,000	$1,071,000	$1,071,000	$1,071,000	$1,071,000
Cost per Acre-Foot	$216	$194	$211	$108	$82	$60
Cost per 1,000 gallons	$0.66	$0.59	$0.65	$0.33	$0.25	$0.18

EPW has successfully reduced per capita demands resulting in considerable water savings. Water demand projections prepared by TWDB already account for water efficiency savings through time due primarily to plumbing code savings. The savings reported in the Table above are the result of "active" water conservation strategies that conserve water above and beyond what would happen anyway as a result of "passive" water conservation measures that stem from federal and state legislation requiring more efficient plumbing fixtures in new building construction. The trend in expected gpcd is consistent with EPW's 2019 Water Conservation Plan (WCP) through the 2040 decade. Beginning in 2050, the gpcd goals are lower than the goals laid out in the 2019 WCP.

EPW budgeted $1,071,000 for water conservation programs in their annual budget for fiscal year 2019-2020. Because of the importance of conservation, it was assumed that EPW will invest a similar amount in conservation over the planning period. The projects annual costs for water conservation are shown in the table above.

E-11 Advanced Water Purification at the Bustamante WWTP

The Roberto R. Bustamante Wastewater Treatment Plant (Bustamante WWTP) is located in southern El Paso near the community of Socorro. The plant is adjacent to the Jonathan Rogers Water Treatment Plant and the Rio Bosque wetlands. The wastewater plant currently discharges approximately 27 million gallons per day (MGD) into the Riverside Irrigation canal and 1.5 MGD to reclaimed water "purple pipe" customers as part of the Mission Valley Reclaimed Water Project.

The Bustamante Advanced Water Purification strategy has been studied in detail by Arcadis and Carollo Engineers. Project components recommended by Arcadis include additional conventional wastewater treatment at the existing plant to remove nutrients, an advanced treatment facility (microfiltration/ultrafiltration, nanofiltration or reverse osmosis, ultraviolet/advanced oxidation process, activated carbon and chlorine disinfection) and storage. The purified water will be placed directly into the distribution system.

Carollo estimated that the amount treated by the advanced treatment facility would be 10.7 MGD initially and increase to 13.3 MGD at build-out. Approximately 70% of this influent would become finished drinking water. For this evaluation, disposal of the waste stream was assumed to be by deep well injection and to be approximately 30% of the amount treated. Construction costs and annual operation and maintenance costs for the Advanced Water Treatment Facility (AWTF) were based on a 2019 cost estimate by Carollo Engineers. Construction costs for the additional wastewater treatment plant improvements and for conveyance from the Bustamante WWTP to the AWTF were based on a 2014 cost estimate by Arcadis and indexed up to 2018 costs. For this evaluation, costs were added for the necessary connection piping to the distribution system and the disposal well system.

Currently, most of the wastewater from the Bustamante WWTP that is not being reused is discharged into a canal system. Much of that water is then used for downstream irrigation, although some of the flow may also serve to maintain environmental functions. Reuse of additional water may impact those functions, but the overall impact is expected to be small. The current conceptual design for this project uses deep well injection to dispose of the brine waste stream, which should have minimal environmental impact. If this was to change and the brine was released to a stream, impacts to the receiving water body would need to be evaluated.

The Advanced Water Purification strategy will treat only part of the effluent from the Bustamante WWTP. EPW will continue to meet its contractual obligations to purple pipe customers and to provide a portion of the wastewater that originates as surface water for downstream irrigators. There may be other impacts from reducing the amount of wastewater that is not covered by contractual obligations.

It is anticipated that this strategy will be implemented by 2030. After reviewing data from a pilot facility, the Texas Commission on Environmental Quality (TCEQ) gave EPW approval to proceed with design of the of the full-scale facility. EPW officials hope to break ground on the Advanced Water Treatment Facility in the next few years and supply their customers with reclaimed water within 10 years.

This project is part of EPW's Integrated Water Strategy and is inherently related to other EPW strategies and sources of supply. The availability of water from this strategy is affected by the portion of the treated effluent that originates as surface water, a portion of which is dedicated by contract to downstream irrigators. There may be some reduction in return flows that EPW is not obligated to discharge, but this impact is expected to be small.

Quantity, Reliability, and Cost – Based on estimates from Carollo, this strategy would initially provide approximately 8,500 acre-feet per year in 2020, stepping up by 2 MGD per decade, and expanding to approximately 10,600 acre-feet per year by 2070. Because of the quantity of wastewater treated at the plant, the supply should be very reliable, even after accounting for the portion of the supply committed to irrigators and purple pipe customers. The capital cost for this strategy is estimated at $100.4 ~~142.6~~ million.

E-12 Advanced Water Purification at the Haskell Street WRP (ALTERNATE)

The Haskell R. Street Wastewater Treatment Plant (WRP) is located in south central El Paso on the Rio Grande and has a capacity of 27.7 MGD. A portion of the treated wastewater effluent from this plant is the source for the Central Reclaimed Water Project (purple pipe reuse), which is used to irrigate several central El Paso schools and parks, including Ascarete Park and Golf Course. Currently most of the remaining effluent from the Haskell Plant is discharged into either the American Canal, which may then be used for irrigation downstream, or the Rio Grande.

This strategy is assumed to treat additional wastewater effluent to potable safe drinking water standards. The purified water would flow directly into the EPW distribution system, while the remaining brine will be disposed by deep-well injection. EPW will continue to meet its contractual obligations to provide a portion of the wastewater that originates as surface water for downstream irrigators. It is anticipated that this strategy will be implemented in the 2070 decade.

The conceptual design and cost for the strategy were based on the Bustamante Advanced Purified Water Plant. The Haskell R. Street WRP Advanced Water Purification strategy includes additional conventional wastewater treatment at the existing plant to remove nutrients, and advanced treatment facility (microfiltration/ultrafiltration, nanofiltration or reverse osmosis, ultraviolet/advanced oxidation process, activated carbon and chlorine disinfection). Disposal wells and pump stations, assumed to be 30% of the amount treated, were added to expansion phases as needed. The purified water will be placed directly into the public supply distribution system.

Quantity, Reliability, and Cost – For this strategy analysis, it is assumed that the initial capacity of the project would be approximately 12 MGD, with the project on-line in 2070. Assuming a peaking factor of 1.5, this would provide a supply of approximately 8,900 acre-feet per year. The capital cost to build the project is approximately $~~189,356,000~~ 279,464,000.

E-13 Expansion of the Kay Bailey Hutchison Desalination Plant (ALTERNATE)

The Kay Bailey Hutchison Desalination Plant is one of the world's largest inland desalination facilities. The facility is a joint project of El Paso Water (EPW) and Fort Bliss and currently has the capacity to treat 27.5 MGD of brackish groundwater. Disposal of brine reject from the facility is through deep well injection. The project not only provides a safe and reliable supply for the City of El Paso and Fort Bliss, but it also protects fresh groundwater supplies by intercepting the flow of brackish groundwater toward the freshwater wells.

This strategy would expand both the production of brackish groundwater and increase the capacity of the plant by 5.0 MGD for a total of 32.5 MGD. This will involve expanding the existing facility, adding four new source wells and associated piping. For planning purposes, it is assumed that this strategy will be implemented in a single phase. It is assumed that EPW's current disposal facilities are adequate for the project. It is anticipated that this strategy will be ~~implemented~~ producing new water in the 2060 decade.

Quantity, Reliability, and Cost – This project will provide additional water supply in EPW's conjunctive use portfolio. The combination of new wells and another 5.0 MGD of capacity will provide approximately 5,000 acre-feet of water per year. This supply is assumed to be very reliable. The project is expected to cost approximately $26,490,000.

E-14 Hueco Bolson Artificial Recharge

Water treatment plant capacity and the timing of demand for water currently limit the use of surface water by EPW. Early in the irrigation season, the water available from the Rio Grande exceeds the demand that can be supplied by surface water. Later in the irrigation season, the demand can exceed the treatment plant capacity. In order to make use of the available surface water early in the irrigation season, EPW plans to develop a facility to recharge the Hueco Bolson Aquifer with treated surface water.

The Hueco Bolson Aquifer is the primary source of water for the City of El Paso, Fort Bliss, Ciudad Juarez and private industries in the area. Since 1903 groundwater levels have declined by as much as 150 feet in some areas of the Aquifer, thus developing a cone-of-depression around a major pumping center serving the City of El Paso. This area is located over an ancient watercourse of the Rio Grande and is well suited for both short- and long-term groundwater storage due to the high porosity and permeability of the de-saturated vertical portion of the Aquifer formation. The substantial depression in the water table surface thus affords ample underground storage space and reasonably high assurances of long-term recovery of stored water. The recharge basin area described in this strategy is in the northern portion of the cone-of-depression and water percolating downward through the basins will naturally gravity drain in the subsurface toward the existing production wells located approximately two miles away.

Previous projects and studies have shown the practicality of aquifer recharge in the El Paso area. The Hueco Bolson Aquifer has been successfully recharged with tertiary treated wastewater from the Fred Hervey Water Reclamation Plant that is treated to drinking water quality standards. Injection rates of up to about 10,000 acre-feet per year through deep injection wells and spreading basins have occurred since the mid-1980s. Aquifer recharge using both treated wastewater effluent and available surface water provide an opportunity to mitigate aquifer overdraft and potentially restore groundwater supplies for continued use.

The treated water strategy will expand the artificial-recharge basins and supplement the recharge supply with excess treated water from the Jonathan Rogers WTP, and does not include expansion of the Fred Hervey Plant. This strategy will require approximately 10,000 feet of 20-inch pipe and six new spreader basins for the treated water. It is anticipated that this strategy will be ~~implemented~~producing water in the 2030 decade.

Quantity, Reliability, and Cost - This strategy is estimated to provide 5,000 acre-feet of additional supply per year from the Hueco Bolson aquifer; however, the supply is contingent on surface water supplies availability. Capital costs for this project is approximately $38,003,000.

E-15 Riverside Regulating Reservoir (ALTERNATE)

In order to make more efficient use of surface water supplies, EPCWCID#1 has ~~proposed~~ purchased~~ing~~ the City of El Paso former Socorro Pond Sewage Treatment Facility located in the city limits of El Paso near the Bustamante Wastewater Facility. The project will then be developed into the Riverside Regulating Reservoir with project water and cost shared equally between EPW and the EPCWCID#1

The regulating reservoir will allow more efficient use of stored water releases from the Rio Grande Project storage reservoirs, as well as flows that originate as stormwater runoff below Caballo Reservoir. The primary source of water stored in the reservoir would be from excess flows diverted at American Dam and conveyed to the heading of the Riverside Canal. These excess flows primarily consist of storm runoff and operation spills from upstream water users. The temporary stored water would be used either by~~from~~ downstream irrigators or be pumped to the nearby Jonathan Rogers Water Treatment Plant for municipal use. All Rio Grande water is authorized through existing state and federal contracts, agreements and water rights.

The primary benefits of the project are: (1) Improved farm delivery scheduling and flows; (2) Conservation of water stored in upstream storage reservoir through using water captured in regulating reservoirs to meet downstream demands; and (3) A five-day supply of raw water for use by City of El Paso in case of an emergency such as failure or contamination of the American Canal system.

Portions of the project have already been completed, including improvements to the Riverside Franklin Feeder Check Structure; a concreate bridge to the Jonathan Rogers WTP; canal lining; and a flood waste-way to the river.

EPCWID#1 is collaborating with municipalities in El Paso County to make capacity upgrades to existing irrigation drain infrastructure to mitigate flooding while facilitating the capture and reuse of stormwater from local storm events. Stormwater capture and reuse would lead to the development of a new water source for EPCWID#1. Additional studies are needed to determine the quantity and quality of the stormwater that can be captured and the upgrades that are necessary for reuse. EPCWID#1 intends to pursue a mixture of funding options to develop stormwater capture and reuse infrastructure, such as any programs resulting from flood-related legislation passed by the 86th Texas Legislature, including Senate Bill (SB)7, SB 8, SB 500, and House Joint Resolution 4. While the project through EPCWCID#1 (Strategy E-43) is scheduled to come online in the 2020 decade, EPW does not intend to draw water from the project until the 2040 decade.

Quantity, Reliability, and Cost - The primary benefit of this strategy is allowing for more efficient use of existing supplies of water. Previous studies of this project have estimated that the project could provide 6,500 acre-feet of water per year. However, there may be some years where the strategy could provide more or less water, depending on available river supplies and the amount of excess water in the canal. The total capital cost of approximately $13.5 million and supply of 6,500 acre-feet developed from this project is equally split between EPW and the EPCWID#1 ($6,750,000 and 3,250 acre-feet per year each). The strategy supply for EPW is anticipated to come online in 2040.

E-16 Groundwater from Dell City Area (Phase I)

Importation of groundwater from the Dell City area has been part of the Far West Texas Water Plan since 2006. This strategy includes obtaining water rights through the purchase of properties, drilling and completion of public supply permitted water wells, construction of a desalination water treatment facility, and installation of a pipeline to El Paso. Project water will be obtained from two wellfields, the first capturing Capitan Reef Aquifer underlying property referred to as Diablo Farms (Phase 1; E-16), and the second wellfield developed in the Bone Springs-Victorio Peak Aquifer underlying the local Dell Valley irrigated area (Phase 2; E-17).

In 2003 and 2004, EPW purchased about 28,000 acres of land (Diablo Farms) overlying the Capitan Reef Aquifer. The property straddles the Hudspeth and Culberson County lines adjacent to the Salt Basin southeast of Dell City. The property is currently leased out for irrigated agricultural use, and until the construction phase is started, the land will continue to be used for agricultural purposes. The proposed strategy calls for production of up to 10,000 acre-feet per year from six new wells beginning in 2040.

EPW has completed preliminary evaluations of groundwater availability in the area and estimates that recharge to this portion of the Capitan Reef Aquifer ranges from 10,000 to 20,000 acre-feet per year. TDS concentrations in the area range from 850 to 1,500 mg/L. All the currently operating irrigation wells on

Diablo Farms have TDS values below 1,000 mg/L. However, it is expected that significant increases in pumping amounts would result in movement of poorer quality groundwater into the area.

The evaluation concluded that pumping less than 10,000 acre-feet per year would not require desalination. Pumping between 10,000 and 25,000 acre-feet per year would not result in mining of the Aquifer, but the groundwater would likely have to be desalinated over time as the intrusion of poorer quality water into the wellfield area increases salinity.

It is assumed that the transmission facilities for this project would be shared with the Dell City groundwater project - Phase 2 (Strategy E-17), and that the pipeline will have sufficient capacity to carry the volume of water at full development of both projects (10,000 acre-feet per year from Diablo Farms and 10,000 acre-feet per year from Dell City). EPW already owns the property at Diablo Farms, so land acquisition is limited to pipeline right-of-way (100 foot).

Quantity, Reliability, and Cost – The volume of water generated from this strategy will be 10,000 acre-feet per year beginning in the 2040 decade. The capital cost of the project is approximately $569,357,000.

E-17 Groundwater from Dell City Area (Phase II)

Dell City is located approximately 75 miles east of El Paso, near the New Mexico-Texas border and is underlain by the Bone Spring-Victorio Peak Aquifer, which covers 130 square miles on the Texas side of the state border. Importation of 10,000 acre-feet per year from the Bone Spring-Victorio Peak Aquifer is proposed by 2050.

The Hudspeth County Underground Water Conservation District No.1 (HCUWCD #1) sustainably manages the aquifer for through regulatory rules as established in the District's groundwater management plan. The modeled available groundwater (MAG) established for the aquifer is 101,400 acre-feet per year assuming an irrigation return flow of 30 percent. Aquifer withdrawals from the Bone Spring-Victorio Peak Aquifer at the proposed pumping rates for this strategy are at a sustainable level based on the current rules of the HCUWCD #1.

Approximately 45 acre-feet per year is withdrawn from the aquifer for municipal use by the community of Dell City, with the remainder used for irrigated agriculture. Water from this aquifer has concentrations of iron, chloride, nitrate, sulfate, and aluminum that exceed water quality standards for municipal supply. With total dissolved solids ranging from 1,810 to 3,900 mg/l, desalination would be required before the source could be used for municipal purposes.

The first decade (2060) of the Dell City project includes rehabilitation of seven wells plus one contingency well with accompanying pumps, pipelines and other appurtenances, a pump station, 12 miles of 42-inch pipeline, expansion of the existing pump stations on the Diablo Farms (Phase 1) to El Paso pipeline, and an 18 MGD desalination facility with disposal wells. The water from the desalination facility will be blended with untreated water to produce the desired water quality.

The second decade (2070) of the project adds rehabilitation of eight more wells with the associated facilities, another expansion of the pump stations on the pipeline to El Paso, and an 18 MGD expansion of the desalination facility. Also included is $55 million for purchase of additional property, for a total of $110 million between the two decades of the project

Quantity, Reliability, and Cost - The volume of water generated from this strategy will be 10,000 acre-feet per year beginning in the 2050 decade. The capital cost for this strategy is estimated at $320,226,000.

E-18 Treatment and Reuse of Agricultural Drain Water (ALTERNATE)

The 2011 Far West Texas Water Plan included a strategy to develop two 5 MGD desalination plants at the Rogers and Canal Water Treatment Plants to treat agricultural drain water for municipal use. Hazen and Sawyer, P.C. since completed a study on the treatment of drain water near the Upper Valley Water Treatment Plant using conventional treatment and blending with other sources to meet water quality standards. This strategy in the 2016 Plan proposed using the same combination of conventional treatment and blending at the Rogers and Canal Plants for the facility at the Upper Valley WTP examined in the Hazen and Sawyer study. This current 2021 strategy now assumes that a 2.41 MGD (2,700 acre-feet per year) plant renovation (see strategy E-14) will be built at the Upper Valley WTP in the 2030 decade.

The use of conventional treatment eliminates the need for brine disposal. However, it does require the availability of lower TDS treated water source in sufficient quantity for blending. The Hazen and Sawyer study found that hardness was a controlling factor, along with TDS, in determining blending ratios with treated water from the Upper Valley WTP. Blend ratios varied from approximately 4 to 1 to more than 14 to 1, depending on target water quality. If additional treatment such as desalination becomes necessary, the strategy's cost estimate will be impacted. This strategy assumes that the treatment waste stream will most likely be discharged directly into the sewer system with solids going to a landfill.

Quantity, Reliability, and Cost - The volume of water generated from this strategy will be 2,700 acre-feet per year beginning in the 2040 decade. The total capital cost for the water treatment plant is estimated to be approximately $21,466,000.

E-19 Expansion of Canutillo Mesilla Bolson Wellfield (ALTERNATE)

A portion of EPW's groundwater supply is obtained from their Canutillo wellfield in the Mesilla Bolson Aquifer on the west side of the Franklin Mountains. Groundwater in this location of the aquifer occurs in three separate horizons with varying water quality, including elevated levels of arsenic which must be treated to drinking-water standards. Groundwater retrieved from the Canutillo wellfield is transported to the Upper Valley WTP for further treatment including arsenic remediation (see Strategy E-14).

The strategy includes the completion of 10 new wells at an average depth of 200 feet and pumping capacity of 500 GPM in the existing wellfield and a pipeline to transport the groundwater to the Upper Valley WTP. Wellhead RO filtration is also being considered for wells contending with high arsenic levels, but is not included in this current analysis. The cost of drilling and equipping 10 new wells includes an additional contingency of 35 percent has been added to the cost, as well as allowances for permitting and mitigation, land acquisition, and interest during construction. The strategy also includes a pipeline to the Upper Valley WTP.

Quantity, Reliability, and Cost - This strategy is scheduled to begin initial implementation by 2030 with the production of 7,760 acre-feet per year of new supply and increases each decade to a total of 23,280 by the 2070 decade. Total capital cost for this strategy is $6,444,000 million. Pumping from the Canutillo wellfield can impact flows in the Rio Grande and is monitored by the Bureau of Reclamation.

E-20 Lower Valley Wellhead RO Desalination (ALTERNATE)

This strategy assumes that five new water wells will be drilled and completed in the Rio Grande Alluvium Aquifer in the Lower Valley to provide an additional 5,000 acre-feet per year of municipal supply. As the raw groundwater from this aquifer is slightly brackish, each well will be equipped with a reverse osmosis desalination filtration system. The resulting supply that will meet safe drinking water standards will be connected directly to the nearest distribution pipeline. The brine concentrate generated from the wells will be discharged to the sewer system. The cost estimate includes the five new wells, associated pipelines, storage, pumps and power.

Quantity, Reliability, and Cost - The five new wells are assumed to be drilled to a depth of 500 feet to provide an additional supply of 5,000 acre-feet per year beginning in 2040. Historical municipal, agricultural and industrial use indicates that the Rio Grande Alluvium Aquifer is a viable source. The total capital cost of this project will be approximately $52,681,000.

E-21 Expansion of Jonathan Rogers WTP (ALTERNATE)

EPW currently obtains surface water from the Rio Grande in accordance with a series of contracts with EPCWID #1, the U.S. Bureau of Reclamation, and the Lower Valley Water District. These contracts allow the conversion of water allocated for irrigation of lands owned or leased by EPW into municipal supply. Over time, EPW may increase the annual diversion from surface water by converting additional water allocated to irrigated lands in El Paso County. The conversion of water for municipal supply will require amendments to contracts or agreements with the U.S. Bureau of Reclamation and EPCWID #1.

This strategy assumes that the increased surface water supply will require additional treatment capacity. Currently, the Jonathan Rogers Water Treatment Plant capacity is 60 MGD. The proposed strategy will increase the capacity to 80 MGD by replacing and enhancing existing treatment facilities. A preliminary design of the plant expansion by CH2M Hill Engineers, Inc. is the basis for the cost estimates for this strategy. Costs associated with the acquisition of irrigation rights are not included.

Quantity, Reliability, and Cost - This strategy to be implemented by 2040 will provide up to 6,500 acre-feet of treated water per year, based on a 7-month irrigation season and assuming a peaking factor of 2. The actual quantity of water is dependent on new irrigation properties acquired by EPW and the availability of surface water from the Rio Grande Project, which varies from year to year. The estimated total capital cost for this strategy is approximately $88,679,000.

E-22 Conjunctive Treatment of Groundwater and Surface Water at the Upper Valley WTP (ALTERNATE)

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The Upper Valley Water Treatment Plant located north of Vinton is one of the largest water-treatment facilities in the nation built as a direct result of the EPA revision to the federal regulation of arsenic levels in drinking water. The areas served by the plant include Upper Valley, West Side, Canutillo, Vinton and Westway. The existing plant removes arsenic occurring within groundwater pumped from wells in the Canutillo Wellfield (see strategy E-6), and treats up to 30 MGD of this groundwater for blending with up to 30 MGD of untreated groundwater to produce a finished product with an arsenic concentration of 8 ppm or less. For this strategy, the existing plant will be enlarged and renovated to treat proposed new water sources including additional groundwater from the Canutillo Wellfield and, raw Rio Grande surface water delivered from a proposed new La Union diversion point (see EPCWCID#1 strategy), and as well as other agricultural drain water sources (see strategy E-5).

The Upper Valley WTP Advanced Water Purification strategy includes additional conventional wastewater treatment at the existing plant to remove nutrients, an advanced treatment facility (microfiltration/ultrafiltration, nanofiltration or reverse osmosis, ultraviolet/advanced oxidation process, activated carbon and chlorine disinfection) and storage. The purified water will be placed directly into the distribution system. Costs associated with the acquisition of irrigation rights are not included

Quantity, Reliability, and Cost - The improvement to the plant will produce 10,000 acre-feet per year of additional water supply and is planned to go into operation in 2030. The estimated total capital cost for this strategy is approximately $72,873,000.

E-23 Advanced Water Purification at the Fred Hervey WRP (ALTERNATE)

The Fred Hervey Water Reclamation Plant treats 12 MGD of wastewater from nearby homes, businesses and industries. The reclaimed water is sent to irrigation and industrial customers including the Newman Power Plant, Painted Dunes Golf Course and the Northeast Regional Park. The plant further treats reclaimed water to drinking water standards and uses it to replenish the aquifer through injection wells and infiltration basins. It was among the first in the nation to create drinking-quality water by treating used water and demonstrate the feasibility of artificial aquifer recharge.

The Fred Hervey Advanced Water Purification strategy includes additional conventional wastewater treatment at the existing plant to remove nutrients, an advanced treatment facility (microfiltration/ultrafiltration, nanofiltration or reverse osmosis, ultraviolet/advanced oxidation process, activated carbon and chlorine disinfection) and storage. The conceptual design and cost for the strategy were based on the Bustamante Advanced Water Purification Plant. The additional purified water will be placed directly into the distribution system. Disposal of the waste stream was assumed to be by deep well injection and to be approximately 30% of the amount treated.

Quantity, Reliability, and Cost - The improvement to the plant will produce around 10,000 acre-feet per year of additional water supply and is planned to go into operation in 2040. The capital cost for this strategy is estimated at $140,394,000.

5A-5 WATER MANAGEMENT STRATEGIES FOR THE LOWER VALLEY WATER DISTRICT

The Lower Valley Water District (LVWD) is located in the southeastern portion of El Paso County and currently offers water, wastewater and solid waste services to residents within a distribution system of 210 square miles east of the City of El Paso city limits. The City of Socorro, the community of San Elizario, the Town of Clint, El Paso County Sparks Addition, Sand Hills and other El Paso County Colonias are located within the LVWD's boundaries. The LVWD's sole source of water is purchased from the combined (blended) EPW sources developed in the previously described EPW Integrated Strategy (5A-4). The LVWD transfers its Rio Grande water rights to EPW and, in exchange, receives treated water ready for distribution. The LVWD is proposing several new sources of water that will help limit the supplies delivered by EPW to roughly current levels, and obtain additional supply needed for growth independently. The LVWD has a projected water-supply deficit of 1,358 acre-feet per year in 2020 increasing to 5,689 by 2070.

~~The LVWD has a projected water-supply deficit of 1,358 in 2020 increasing to 5,689 by 2070.~~ The following water management strategies are recommended to enhance the reliability of the LVWD's future water supply availability:

- (E-24) Public conservation education
- ~~(E-25) Install loop lines inside existing connections~~
- (E-26) Purchase water from El Paso Water (EPW)
- (E-27) Surface water treatment plant and transmission line
- (E-28) Groundwater from proposed wellfield – Rio Grande Alluvium Aquifer
- (E-29) Groundwater from proposed wellfield – Hueco Bolson Aquifer
- (E-30) Wastewater treatment facility and ASR

The LVWD ~~has the following~~ active projects, which are currently being funded through other financial measures offered by the TWDB, include extension of its collection system and a water main replacement. The District is also very interested in addressing an issue of low pressure in its distribution system. Several lines dead end, which results in low pressure at the distal end of the lines. Low pressure is resulting in excessive use of water due to the need to flush toilets more than once to clear the sanitary lines. By looping the dead-end lines, adequate pressure can be maintained, thus conserving a significant volume of water.

E-24 Public Conservation Education

Public information programs, even though they may not be directly related to any equipment or operational change, can result in both short- and long-term water savings. Behavioral changes by customers will only occur if a reasonable yet compelling cause can be presented with sufficient frequency to be recognized and absorbed by the customers. There are many resources that can be consulted to provide insight into implanting effective information programs. Like any marketing or public information program, to be effective, water conservation public information should be planned out and implemented in a consistent and continual manner. A more detailed description of conservation BMPs that might be encouraged is available in ***TWDB Report 362, Water Conservation Best Management Practices Guide.*** These BMPs can also be found at: http://www.twdb.texas.gov/conservation/outreach/index.asp

The LVWD is encouraged to emphasize conservation through public information programs. A total of one percent reduction in demand is anticipated, which would result in a water savings of 57 acre-feet per year in 2020; increasing to 100 acre-feet per year in 2070. The annual cost for implementing a public information conservation program is estimated at $35,956 in 2020; increasing to $41,954 in 2030. The total capital cost for this strategy is assumed to be $237,461.

~~E-25 Loop Distribution Lines for Pressure Redundancy – Conservation~~

~~Several LVWD distribution lines dead end, which results in low pressure at the distal end of the lines. Low pressure is resulting in excessive use of water due to the need to flush toilets more than once to clear the sanitary lines. By looping the dead-end lines, adequate pressure can be maintained, thus conserving a significant volume of water.~~

~~**Quantity, Reliability, and Cost** - The LVWD distribution system can be looped (connected) with the addition of XXXX feet of XX-inch pipe at a cost of approximately $XXXX. Approximately XXX low-pressure impacted connection will benefit from this upgrade with an estimated water savings of approximately XXX acre-feet per year.~~

E-26 Purchase Water from El Paso Water (EPW)

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The LVWD has historically purchased its water supply from EPW and furnishes this supply to its wholesale and retail customers. This strategy provides for the purchase of additional water supplies from EPW to meet the projected future supply needs of its customers. The total volume of treated water available for purchase from EPW is contingent on the Rio Grande water-right volume transferred to EPW the LVWD. The purchased supply is also reliant on EPW maintaining its blended water supply and implementation of its Integrated Strategies (5A-4).

Quantity, Reliability and Cost -This strategy assumes that LVWD would purchase an additional 1,344 acre-feet per year of water in 2020 and increasing to 5,632 acre-feet per year by 2070 from EPW at a cost of $440 per acre-foot. The annual cost for the water purchase increases from $591,000 in 2020 to $2,478,000 in 2070. The estimated quantity of supply for this strategy is dependent on EPW maintaining its blended water supply and implementing its Integrated Strategies. The reliability of this supply is high, assuming EPW successfully implements their Integrated Strategies. In contrast to many other water management strategies, there are no capital costs associated with the purchase EPW water strategies.

E-27 Surface Water Treatment Plant and Transmission Lines

The canals that serve as the primary surface water source in the El Paso area divert water from the Rio Grande upstream of El Paso wastewater discharges. Currently, the flows in the Rio Grande in the vicinity of the Lower Valley Water District (LVWD) contains a large percentage of wastewater discharges, originating from both the City of El Paso and the Mexican City of Juarez. The most feasible surface water supply alternative available to the LVWD is to build an intake on the American Canal upstream of the intake for the Jonathan Rogers Water Treatment Plant (WTP), which is owned by El Paso Water (EPW). This strategy assumes that the LVWD and the El Paso County WID #1 come to an agreement to deliver the water to the proposed intake location. Furthermore, this strategy assumes that the LVWD will hold all necessary future Rio Grande Project (RGP) leased water rights. In addition, the LVWD will need to inform EPW that they will be providing their own supplemental water supplies in the future. The obligation of EPW to provide water via the Jonathan Rogers WTP would be limited to the pro rata share of the plant capital costs paid by the LVWD. From that point on, future RGP water rights obtained via lease from agricultural properties would not be traded to EPW, but rather the LVWD would utilize them directly. This source is currently used for agricultural purposes, and thus this strategy will reduce the amount of water currently available to agricultural users. It is assumed that the transfer of water rights will be between a willing buyer and a willing seller, and therefore minimal impact to agricultural users is anticipated.

This strategy assumes that the surface water supplies are only available seasonally, and therefore water will only be provided during the irrigation season (approximately March through October). The LVWD will need to either purchase water from EPW during the winter months, utilize a groundwater supply source, or construct an Aquifer Storage and Recovery (ASR) project to provide the balance of supplies needed to meet future system demands.

The Surface Water Treatment Plant and Transmission Lines Strategy has been studied in detail by the LVWD. Project components include the purchase of 24 acres, construction of a new intake and pump station on the American Canal, a 1.6 mile 24-inch pipeline to a new 10 MGD water treatment plant, a ground storage tank providing 4 hours of storage at peak flow and a pump station at the WTP, and finally a 0.4 mile 24-inch pipeline to transport water from the WTP to the existing distribution system. Exact locations for these facilities are presently undetermined. Engineering preliminary studies are recommended to determine the best location for these facilities. It is anticipated that the new treatment plant will be designed to treat approximately 10 MGD and be similar in design to the Jonathan Rogers WTP as it is important to produce water that is not significantly different in pH or corrosiveness in order to blend well with EPW water.

Quantity, Reliability, and Cost – This strategy will supply an additional 5,000 acre-feet per year of treated water. The proposed plant has a maximum operating capacity of 10 MGD. However, the plant will only provide water seasonally (approximately March through October). The new supply would go directly into customer distribution. The reliability of this project is medium to high depending on available river supplies. The total estimated capital cost for this strategy is $74,338,000.

E-28 Groundwater from Proposed Wellfield – Rio Grande Alluvium Aquifer

For the LVWD to provide a balance of supplies needed to meet future system demands, the Surface Water Treatment Plant (Strategy E-27) will operate in conjunction with a groundwater project. Groundwater supply sources from both the Rio Grande Alluvium (E-28) and Hueco Bolson Aquifers (E-29) are being considered to acquire water supply for the four months that surface water is not available.

This strategy assumes that the wellfield will produce a supply of 10 MGD. A desalination facility (8.3 MGD) utilizing deep-well injection (1.5 MGD) for concentrate disposal will be required. It is recommended that the location of the wellfield be close to the existing distribution system to reduce the costs of transmission line. A 3-mile pipeline will transport the new supply to the storage facilities. Since the Rio Grande Alluvium Aquifer is high in total dissolved solids (TDS), advanced treatment will be required for municipal purposes, which includes a 2 MGD ground-storage tank and the purchase of 80 acres of land for the plant and another 280 acres for the wellfield.

Seven new wells, with approximately 2,200 feet of well-spacing, will be drilled to produce water from 150 feet below the surface. Each water well will have a capacity of approximately 1,000 gpm. The design of the wellfield is to operate in conjunction with the Surface Water Treatment Plant (Strategy E-27) during the winter period when surface water is limited.

Quantity, Reliability, and Cost – The quantity of water produced from seven wells over a four-month period is approximately 6,800 acre-feet per year. Capital costs for public supply wells completed in the Rio Grande Alluvium Aquifer are based on 1,000 gpm wells with 16-inch production casing, drilled to an average total depth of 150 feet, pumping equipment and site improvement. The estimated cost for a single well completed in this Aquifer is $835,000. The total estimated capital cost for this project is $39,240,000, which includes the desalination facility.

The Rio Grande Alluvium Aquifer has shown that it can be considered reliable as a water supply if properly developed and is not compromised by additional water demands. This strategy could potentially compete for groundwater that at times is used for agricultural purposes; however, the aquifer is currently being used at less than sustainable capacity.

E-29 Groundwater from Proposed Wellfield – Hueco Bolson Aquifer

Production from a wellfield completed in the Hueco Bolson Aquifer is a second groundwater alternative being considered by the LVWD as a feasible strategy to help supplement the proposed Surface Water Treatment Plant (Strategy E-27). In winter, surface water supplies cannot provide the water supply needed to accommodate the growing water demands. To acquire water supply for the four months that surface water is not available, the LVWD has studied in detail the feasibility of developing a new wellfield in the Hueco Bolson Aquifer.

This strategy assumes six new wells with approximately 2,500 feet of well spacing will be drilled to produce water from 650 feet below the surface. Each water well will have a capacity of approximately 1,000 gpm. It is assumed that the wellfield will produce a supply of 10 MGD. A desalination facility (8.3 MGD) utilizing deep-well injection (1.5 MGD) for concentrate disposal will be required. It is recommended that the location of the wellfield be close to the existing distribution system to reduce the costs of transmission line. A 3-mile pipeline will transport the new supply to the storage facilities. This strategy also includes a 2 MGD ground storage tank and the purchase of 80 acres of land for the plant and another 360 acres for the proposed wellfield.

Quantity, Reliability, and Cost –The LVWD is proposing to use this strategy in conjunction with the Surface Water Treatment Plant (Strategy E-27), only during the winter period when the availability of surface water is limited. The supply yield during this designated period of production will provide an additional supply of approximately 6,800 acre-feet per year.

The capital costs associated with this strategy are based on six 1,000 gpm wells with 16-inch production casing drilled to an average total depth of 650 feet, pumping equipment and site improvement. The estimated capital cost for a single well completed in the Hueco Bolson is approximately $835,000. The total estimated capital cost for this project is approximately $36,110,000. Production from the Hueco Bolson is more expensive compared to the Rio Grande Alluvium due to the increased capital costs required for deeper wells, increased pumping costs, and the increased costs associated with pumping from a confined aquifer. The Hueco Bolson Aquifer has shown that it can be considered reliable as a water supply if properly developed and is not compromised by additional water demands.

E-30 Wastewater Treatment Facility and ASR

To provide the balance of supplies needed to meet future system demands, along with strategies E-27, E-28, and E-29), the LVWD is also considering the possibility of constructing a wastewater treatment facility and an aquifer storage and recovery (ASR) project similar to El Paso Water's Fred Hervey Water Reclamation Plant and aquifer recharge project. The concept of this strategy is to tertiary treat wastewater to near drinking-water standards, inject specified volumes into the distribution system, and store the surplus amount into the Hueco Bolson Aquifer for later recovery.

There are three potential sources of water that could be stored and recovered in the ASR project: (1) excess treated surface water (strategy E-27); (2) treated wastewater provided by EPW; or (3) excess LVWD treated wastewater. The first option would include pumping water from the American Canal at a rate equivalent to taking the full 6.8 MGD over eight months instead of the twelve and deposit the excess in the ASR for use in the winter. The second option would require that EPW modify its treatment train to produce water to a quality suitable for ASR. The third option requires the LVWD build its own wastewater treatment facility. It is recommended that additional studies be conducted to better determine the feasibility of each of these options.

The Hueco Bolson Aquifer is considered as the ASR repository as it has more potential storage volume and is less subject to outside pumping that might pirate a portion of the injected supply. However, the Rio Grande Alluvium may also be an option for the ASR if the Hueco Bolson is determined to be infeasible.

For this strategy, the third option is chosen for consideration in this strategy and thus considers the construction of a new 3 MGD tertiary wastewater treatment facility, an ASR facility consisting of two 650-foot wells capable of both injection and withdrawal, and 5,280 feet of 12-inch diameter wellfield piping.

Quantity, Reliability, and Cost – The strategy assumes that an estimated 5,589 acre-feet per year of treated water will be injected into the Hueco Bolson Aquifer. The total capital cost is approximately $23,509,000. Reuse of existing supplies makes this treated supply reliable.

5A-6 WATER MANAGEMENT STRATEGIES FOR HORIZON REGIONAL MUNICIPAL UTILITY DISTRICT (MUD)

The Horizon Regional MUD's mission is to provide affordable, high quality drinking water and environmentally sound wastewater treatment and disposal. The Utility District operates a state-of-the-art reverse osmosis water treatment plant servicing residents within an area of approximately 91,000 acres. The District relies on the Hueco Bolson Aquifer and the Rio Grande Alluvium Aquifer for its municipal water supply needs. Drawing from the Rio Grande Alluvium Aquifer, the District converts brackish groundwater into six million gallons of drinking water per day. The District has plans to expand production by an additional two million gallons per day.

Horizon Regional MUD has a projected water supply deficit of 2,709 in 2020; increasing to 17,008 by 2070. The following water management strategies are recommended to enhance the reliability of the Utility District's future water supply availability:

- (E-31) Water Loss Audit and Main-line Repair
- (E-32) Public conservation education
- (E-33) Drill additional wells and expansion of desalination plant

E-31 Water Loss Audit and Main-line Repair

According to the 2015 TWDB Public Water System Water Loss Survey, the Horizon Regional Municipal Utility District had real water losses (as opposed to apparent "paper" losses) of 688 acre-feet in 2015 (12.5 percent) due to leaking infrastructure. This amount of water loss is the sum of reported breaks and leaks, and unreported loss. The water supply system can reduce water losses and get a more accurate look at water consumption by taking the proper measures to identify and repair old infrastructure and inaccurate water meters. This strategy will provide a savings of only a portion of the total reported loss and assumes that a leak testing program would be implemented prior to possibly replacing portions of the existing leaking pipe.

Quantity, Reliability and Cost - The strategy assumes 1 mile of 6-inch diameter pipe will be replaced, at a total estimated project capital cost of $255,000. The strategy is estimated to generate a potential savings of 197 acre-feet of water per year in 2020 and up to 551 acre-feet per year by 2070. The increase in estimated savings is due to a corresponding increase in demand over the planning period.

E-32 Public Conservation Education

Public information programs, even though they may not be directly related to any equipment or operational change, can result in both short- and long-term water savings. Behavioral changes by customers will only occur if a reasonable yet compelling cause can be presented with sufficient frequency to be recognized and absorbed by the customers. There are many resources that can be consulted to provide insight into implanting effective information programs. Like any marketing or public information program, to be effective, water conservation public information should be planned and implemented in a consistent and continual manner. A more detailed description of conservation BMPs that might be encouraged is available in ***TWDB Report 362, Water Conservation Best Management Practices Guide.*** These BMPs can also be found at: http://www.twdb.texas.gov/conservation/outreach/index.asp

Horizon Regional MUD is encouraged to emphasize conservation through public information programs. A total of one percent reduction in demand is anticipated, which would result in a water savings of 79 acre-feet per year in 2020; increasing to 222 acre-feet per year in 2070. The annual cost for implementing a public information conservation program is estimated at $19,714 in 2020; increasing to $25,467 in 2030. This project assumes a total capital cost of approximately $137,000.

E-33 Additional Wells and Expansion of Desalination Plant

Brackish groundwater is supplied from wells in the Rio Grande Alluvium Aquifer and is desalinated through a 6.0 MGD plant. The MUD also has wells in the Hueco Bolsons Aquifer that do not require desalination. The Horizon Regional MUD will require additional infrastructure to produce the needed supply in the decade beginning in the year 2020. This strategy assumes that five additional wells will be drilled in the Rio Grande Alluvium and four in the Hueco Bolsons Aquifer. The five wells in the Rio Grande Alluvium will need to be drilled at approximately 150 feet below the surface. The four wells in the Hueco Bolsons Aquifer will be produced at a depth of 500 feet. These wells combined are anticipated to have an average capacity of 1,200 gpm. This strategy also includes expanding the desalination plant from the 6.0 MGD to 21.4 MGD.

Quantity, Reliability, and Cost – The nine proposed wells will have a total production capacity of 16,786 acre-feet per year. The groundwater source will continue to be brackish and will be converted to fresh quality through the desalination facility. The capital cost for this project is estimated at $71,809,000. There is a significant quantity of brackish quality water in the Rio Grande Alluvium Aquifer; therefore, the source is considered very reliable. Since this strategy relies on brackish supplies that are only occasionally used for agricultural irrigation users, competition for the water is expected to be minimal.

5A-7 WATER MANAGEMENT STRATEGIES FOR HACIENDAS DEL NORTE WID

E-34 Water Loss Audit and Main-line Repair

According to the 2015 TWDB Public Water System Water Loss Survey, the Haciendas Del Norte Water Improvement District had real water losses (as opposed to apparent "paper" losses) of 27 acre-feet in 2015 (16.1 percent) due to leaking infrastructure. This amount of water loss is the sum of reported breaks and leaks, and unreported loss. The water supply system can reduce water losses and get a more accurate look at water consumption by taking the proper measures to identify and repair old infrastructure and inaccurate water meters. This strategy will provide a savings of only a portion of the total reported loss and assumes that a leak testing program would be implemented prior to possibly replacing portions of the existing leaking pipe.

Quantity, Reliability and Cost - The strategy assumes 3 miles of 6-inch diameter pipe will be replaced, at a total estimated project capital cost of $764,000. The strategy is estimated to generate a potential savings of 12 acre-feet of water per year in 2020 and up to 19 acre-feet per year by 2070.

5A-8 WATER MANAGEMENT STRATEGY FOR EAST MONTANA WS

E-35 Water Loss Audit and Main-line Repair

According to the 2016 TWDB Public Water System Water Loss Survey, the East Montana Water System had real water losses (as opposed to apparent "paper" losses) of 155 acre-feet in 2016 (15.1 percent) due to leaking infrastructure. This amount of water loss is the sum of reported breaks and leaks, and unreported loss. The water supply system can reduce water losses and get a more accurate look at water consumption by taking the proper measures to identify and repair old infrastructure and inaccurate water meters. This strategy will provide a savings of only a portion of the total reported loss and assumes that a leak testing program would be implemented prior to possibly replacing portions of the existing leaking pipe.

Quantity, Reliability and Cost - The strategy assumes 4 miles of 6-inch diameter pipe will be replaced, at a total estimated project capital cost of $1,018,000. The strategy is estimated to generate a potential savings of 41 acre-feet of water per year in 2020 and up to 63 acre-feet per year by 2070.

5A-9 WATER MANAGEMENT STRATEGIES FOR EL PASO COUNTY TORNILLO WID

The township of Tornillo is an unincorporated community in El Paso County with a current population of 3,202 people and has been designated as a "Colonia". The El Paso County Tornillo Water Improvement District provides water services to approximately 985 connections, mostly residential, within the community. The District is self-supplied and relies on the Hueco Bolson Aquifer for municipal water supply needs. Although the supply-demand analysis does not project a future water supply deficit for El Paso County Tornillo WID, the following water management strategy is recommended to enhance the reliability of the District's future water supply availability:

E-36 Additional Groundwater Well and Transmission Line

The District with support from El Paso County received funding to construct a new well in the Hueco Bolson Aquifer, which was completed and online by the end of 2010. The District is expecting to need an additional well in the future to meet local population growth. Water produced from these wells will be included in the arsenic treatment process upon completion of the treatment facility.

This strategy assumes the development of one new well at a depth of 400 feet. The well is assumed to be operating at a capacity of 310 gpm. In addition, this strategy includes 0.25 miles of 6-diameter transmission line. Minimal treatment, such as chlorine disinfection, will be required for municipal purposes.

Quantity, Reliability, and Cost – This strategy will yield an additional water supply of 333 acre-feet per year. The estimated total capital cost for this project is $2,060,000. Reliability of this source is high due to the Hueco Bolson Aquifer being a prolific aquifer. Modeling indicates that the Aquifer can be sustainably developed beyond previous estimates. However, development of Hueco Bolson groundwater may have a minor impact on other wells used for agricultural and rural purposes.

5A-10 WATER MANAGEMENT STRATEGIES FOR EL PASO COUNTY-OTHER (VINTON HILLS)

El Paso County-Other Vinton Hills Estates and Vinton Hills Subdivision are combined in this Plan as Vinton Hills. Together, they have a projected population of 1,231 in 2020; increasing to 3,277 by 2070. Vinton Hills Estates and Subdivision have a combined projected water supply deficit of 14 acre-feet in 2050; increasing to 138 acre-feet by 2070. The following water management strategies for the two combined areas are recommended to enhance the reliability of the future water supply availability for El Paso County Other – Vinton Hills:

- (E-37) Public Conservation Education
- (E-38) Purchase water from El Paso Water (EPW)
- ~~(E-39) High Capacity Water Lines for Improved Distribution of Water from EPW~~

E-37 Public Conservation Education

Public information programs, even though they may not be directly related to any equipment or operational change, can result in both short- and long-term water savings. Behavioral changes by customers will only occur if a reasonable yet compelling cause can be presented with sufficient frequency to be recognized and absorbed by the customers. There are many resources that can be consulted to provide insight into implanting effective information programs. Like any marketing or public information program, to be effective, water conservation public information should be planned and implemented in a consistent and continual manner. A more detailed description of conservation BMPs that might be encouraged is available in *TWDB Report 362, Water Conservation Best Management Practices Guide.* These BMPs can also be found at: http://www.twdb.texas.gov/conservation/outreach/index.asp

County-Other entities are encouraged to emphasize conservation through public information programs. EPW will likely provide this service to many of the citizens in this category. This strategy has been developed for both Vinton Hills Estates and Vinton Hills Subdivision to meet their projected future supply water needs. A total of one percent reduction in demand is anticipated, which would result in a water savings of 2.8 acre-feet by year 2030. The 2030 annual cost for implementing a public information conservation program is estimated at $1,119. ~~The total capital cost for this strategy is assumed to be $6,072.~~

E-38 Purchase Water from El Paso Water

El Paso County-Other entities have historically purchased a portion of their water supply from EPW. This strategy provides for the purchase of additional supplies from EPW by Vinton Hills Estates and Vinton Hills Subdivision to meet their projected future supply needs.

Quantity, Reliability and Cost -This strategy assumes that Vinton Hills will purchase a combined amount of 10 acre-feet of water per year from EPW starting in 2050 and increasing to 133 acre-feet per year by 2070 at a cost of $1,041 per acre-foot. The total annual cost for the water purchase is approximately $15,000~~0,400~~ in 2050 and $143,000~~38,500~~ by 2070. The purchased supply is reliant on EPW maintaining its blended water supply and implementation of its Integrated Strategies.

El Paso County Other (Vinton Hills)	2020	2030	2040	2050	2060	2070
Supply Amount (ac-ft/yr)	0	0	0	10	73	133
Total Annual Cost ($/year)	$0	$0	$0	$15,000	$75,993	$138,453

The estimated quantity of supply for this strategy is dependent on EPW maintaining its blended water supply and implementing its Integrated Strategies. Supply amounts for individual WUGs range from 0 to 7,260 acre-feet. The reliability of this supply is high, assuming EPW successfully implements their Integrated Strategies. In contrast to many other water management strategies, there are no capital costs associated with the purchase EPW water strategies

~~E-39 High Capacity Water Lines for Improved Distribution of Water from EPW~~

~~The City of Vinton has applied for financial assistance from the TWDB Drinking Water State Revolving Fund (DWSRF) program. The project is for the installation of new high capacity water lines, able to maintain a minimum pressure, to be tied into EPW's water system. A service fee will be needed to allow EPW to provide adequate water storage. This project will provide the City of Vinton with the community's first public water system.~~

~~**Quantity, Reliability, and Cost** – This strategy will yield an additional 400 acre-feet per year of water starting in 2050. Reliability of this source is high as it is part of the EPW Integrated Strategy. The estimated total capital cost for this project is approximately $17,075,000. This amount is derived from taking the total project cost reported in the 2018 TWDB Drinking Water State Revolving Fund Intended Use Plan ($12,782,746) and incorporating it into the TWDB Costing Tool to add contingencies and develop annual costs.~~

5A-11 WATER MANAGEMENT STRATEGIES FOR EL PASO COUNTY IRRIGATION (EPCWID #1)

Irrigation shortages in El Paso County are the direct result of insufficient water in the Rio Grande during drought-of-record periods to meet anticipated needs. Thus, the quantity of water needed to meet the full demands cannot be realistically achieved during drought conditions and farmers in these areas have generally approached this situation by supplementing supplies with Rio Grande Alluvium Aquifer groundwater, reducing irrigated acreage, changing types of crops planted, or possibly not planting crops until water becomes available during the following season.

In some cases farmers may benefit from Best Management Practices (BMPs) for agricultural water users, which are a mixture of site-specific management, educational, and physical procedures that have proven to be effective and are cost-effective for conserving water. The Texas Water Development Board (TWDB), through the Water Conservation Implementation Task Force has published a report title *Water Conservation Best Management Practices* Guide (TWDB Report 362), which in part contains numerous BMPs for agricultural water users. These agricultural BMPs can also be found at: http://www.twdb.texas.gov/conservation/BMPs/Ag/index.asp

During previous planning periods, the FWTWPG sponsored and the TWDB funded an interim project to evaluate the effectiveness of previously recommended irrigation BMP strategies. The evaluation was conducted by the Texas AgriLife Research Center in El Paso. The entire report can be viewed at http://www.twdb.texas.gov/publications/reports/contracted_reports/doc/0704830690_RegionE/TxAgriLifeResearchIrrigationEfficiency-FinalReport.pdf.

The overall conclusion is that very limited opportunities exist for significant additional water conservation in Far West Texas irrigated agriculture. Those practices that suggest economic efficient additional water conservation include lining or pipelining district canals and the very small potential for additional irrigation scheduling and tail water recovery systems. In nearly all cases, these practices have been adopted to a large extent if applicable, further emphasizing the very limited opportunities for additional conservation. If all of these strategies were implemented, the water conserved would satisfy less than 25 percent of the projected unmet agricultural water demand in 2070 during drought-of-record conditions.

Based on this evaluation, the FWTWPG recommends the following conservation and reuse strategies: irrigation scheduling, tailwater reuse, and improvements to water district delivery systems. These strategies are intended for irrigation practices within the El Paso County Water Improvement District #1 (EPCWID#1). The potential water savings under both drought and full supply conditions is shown in the table below.

Potential Water Savings for EPCWID #1

BMP Strategy	Drought	Full
Scheduling (subtotal)	1,740	5,070
Pivot Sprinkler	-	-
Surface Irrigation	-	-
Pipeline / Lining District Canals	25,000	50,000
Tailwater Reuse	1,723	6,274
Total	**28,463**	**61,344**

El Paso County has approximately 16,570 acre-feet per year of an irrigation shortage in 2020, which decreases to 13,042 acre-feet per year by 2070. The following water management strategies are recommended to enhance the reliability of the future water supply availability for the irrigation needs within El Paso County:

- (E-40) Irrigation scheduling
- (E-41) Tailwater reuse
- (E-42) Improvements to water district delivery systems
- (E-43) Riverside Regulating Reservoir
- (E-44) New Rio Grande diversion point at La Union Canal

E-40 Irrigation Scheduling

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This strategy is intended for producers with an adequate supply of water throughout the growing season. It involves scheduling the time and amount of water that is applied to a crop based on the amount of water present in the crop root zone, the amount of water consumed by the crop since the last irrigation, and other considerations. Water savings are difficult to quantify and vary from year to year based on cropping practices, water quality, and quantity. It is estimated that 0.3 to 0.5 acre-feet of water per acre may be saved.

Due to recent droughts, EPCWID #1 has made several changes to aid the agricultural sector. Farmland is currently being irrigated with effluent (sewer treated) water. In 2015, 10,000 acres were irrigated in this manner. Also, modifications have been made to the local irrigation schedule. Farmers will now wet their lands for planting starting in February (irrigating as much as possible), up until the beginning of the irrigation season starting June 1st. This strategy assumes that upon the release of the Rio Grande project water, the project water will be mixed with well water and the effluent water in order to produce more supply to be allocated to other users including El Paso Water.

Quantity, Reliability, and Cost - Costs vary depending upon which scheduling method is used, number of fields scheduled, type of program and technical assistance. Based upon existing research conducted on surface water delivery through a series of canals, laterals, and on-farm distribution system, irrigation scheduling offers the potential to reduce water deliveries between 10 and 25 percent and more depending upon the capabilities of the individual district and producer. The project would have a benefit of 1,740 acre-feet per year. This strategy assumes an annual cost of approximately $102,595.

E-41 Tailwater Reuse

This strategy is applicable to any irrigated system in which significant water quantity runs off the end of the irrigated field. This strategy consists of ditches or pipelines to collect tailwater and deliver it to a storage reservoir or small field pump. The water is then pumped to the upper end of the field and applied with the irrigation water. Water savings from the installation of tailwater reuse systems are highly dependent upon the local water supply (groundwater or surface water) and the current on-farm water management practices of the grower. Water savings will typically vary between 5 and 25 percent of the water applied to the head (upper) end of the field. This may range from a few to several inches (0.5 to 1.5 acre-foot per acre per year).

Quantity, Reliability, and Cost – Reservoirs or pumps costs range between $35 and $70 per acre per year for pump systems and between $60 and $120 per acre per year for reservoir systems. This project will deliver approximately 1,723 acre-feet of water per year and has an estimated annual cost of $973,368.

E-42 Improvements to Water District Delivery Systems

EPCWID #1 continues to implement meaningful irrigation conservation measures. The District provides irrigation water for 69,010 acres, includes 350 miles of canals and 269 miles of drains, and supplies raw water to El Paso Water. Improvements to the water district delivery system include but are not limited to: lining of District irrigation canals, replacement of District canals and lateral canals with pipelines.

Lining of District irrigation canals involves the installation of a fixed lining impervious material in an existing or newly constructed canal. Concrete lining of canals and replacement of headgates has been a critical component of irrigation conservation for the District. EPCWID #1 has lined 15 miles of canals within the last seven years and strives to continue lining approximately 5 miles each upcoming year. This allows for water to be delivered more efficiently to the farms. In addition, in 2015 a joint project between EPCWID #1 and EPWU for $120,000 was implemented to repair and upgrade the canal infrastructure at the headgates.

In 2002, EPCWID #1 received state funding from the TWDB to perform a water and energy conservation feasibility study on lining three canal segments to reduce seepage, construction of check structures and storage, and equalization structures to increase the efficiency and flexibility of water delivery. Funds were available through oil overcharge fees collected by the State Energy Conservation Office and deposited in the Water Bank Account. Water savings involve reduced seepage from the installation of a lining material. Concrete liners are estimated to salvage 80 percent of the original seepage. Costs vary by lining method.

This strategy assumes that replacement of District canals and lateral canals with pipelines involves replacing open canals with buried pipeline that is generally 72 inches in diameter or less. PVC Plastic Irrigation Pipe (PIP) and Reinforced Concrete Pipe (RCP) are the two most commonly used pipelines. Two primary limitations involve cost and water capacity. Water savings stem from reduced seepage. Costs vary and depend on pipe diameter, transportation of pipes, trenching, and other site-specific considerations. Federal funds, state funds and local funds have contributed to the success of this strategy. With the purchase of the proper equipment, the goal is to eventually control the headgates of the system through both the dispatch office and the telemetry system.

Quantity, Reliability, and Cost – The estimated total capital cost for this project is approximately $157,777,783 and will deliver approximately 25,000 acre-feet per year.

E-43 Riverside Regulating Reservoir

To make more efficient use of surface water supplies, EPCWCID #1 has proposed purchasing the City of El Paso former Socorro Pond Sewage Treatment Facility located in the city limits of El Paso near the Bustamante Wastewater Facility.

The regulating reservoir will allow more efficient use of stored water releases from the Rio Grande Project storage reservoirs, as well as flows that originate as stormwater runoff below Caballo Reservoir. The primary source of water stored in the reservoir would be from excess flows diverted at American

Dam and conveyed to the heading of the Riverside Canal. These excess flows primarily consist of storm runoff and operation spills from upstream water users. The temporary stored water would be used either from downstream irrigators or be pumped to the nearby Jonathan Rogers Water Treatment Plant for municipal use. All of the water sources are already authorized through existing state and federal contracts, agreements and water rights. The supply volume is EPCWCID#1's estimate based on increased delivery efficiency in the canal delivery system after diversion from the river, and therefore, environmental flow consideration is not required for this evaluation.

The primary benefits of the project are: (1) Improved farm delivery scheduling and flows; (2) Conservation of water stored in upstream storage reservoir through using water captured in regulating reservoirs to meet downstream demands; and (3) A five-day supply of raw water for use by City of El Paso in case of an emergency such as failure or contamination of American Canal system.

Portions of the project have already been completed, including improvements to the Riverside Franklin Feeder Check Structure; a concreate bridge to the Jonathan Rogers WTP; canal lining; and a flood waste-way to the river.

EPCWID #1 is collaborating with municipalities in El Paso County to make capacity upgrades to existing irrigation drain infrastructure to mitigate flooding while facilitating the capture and reuse of stormwater from local storm events. Stormwater capture and reuse would lead to the development of a new water source for EPCWID #1. Additional studies are needed to determine the quantity and quality of the stormwater that can be captured and the upgrades that are necessary for reuse. EPCWID #1 intends to pursue a mixture of funding options to develop stormwater capture and reuse infrastructure, such as any programs resulting from flood-related legislation passed by the 86th Texas Legislature, including Senate Bill (SB)7, SB 8, SB 500, and House Joint Resolution 4.

Quantity, Reliability, and Cost - The primary benefit of this strategy is allowing for ~~more efficient use of existing supplies of water.~~ increased delivery efficiency in the canal delivery system after diversion from the river. Previous studies of this project have estimated that the project could provide 6,500 acre-feet of water per year. However, there may be some years where the strategy could provide more or less water, depending on available river supplies and the amount of excess water in the canal. The total capital cost of approximately $13.5 million and supply of 6,500 acre-feet per year developed from this project is equally split between EPW and the EPCWID#1 ($6,750,000 and 3,250 acre-feet per year each).

E-44 New Wasteway 32 River Diversion Pumping Plan

EPCWID #1 is planning to develop a new diversion point at the Rio Grande at the El Paso Upper Valley. The new diversion pint will make irrigation water deliveries to agricultural water users via the La Union East Canal more efficient. In collaboration with EPW, the new diversion pint will allow the delivery of surface water to the Upper Valley Water Treatment Plant. The details for collaboration between EPCWID #1 and EPW for this option have yet to be determined and are outside the scope of regional water planning.

Diversions for irrigation water deliveries in the El Paso Upper Valley are currently made in collaboration with Elephant butte Irrigation District at the Mesilla Dam near Las Cruces, New Mexico. Water for EPCWID #1 is diverted at Mesilla Dam into the Westside Canal and conveyed approximately 20 miles to the heading of the La Union East and West canals and near the Rio Grande Project Wasteway 32. This Wasteway canal conveys bypass water from the La Union East Canal to the Rio Grande.

The proposed conversion of Wasteway 32 into a diversion point on the Rio Grande will reduce the amount of water lost to seepage in the Westside Canal and provide EPCWID #1 and EPW access to surface water during times when no water is or can be diverted at Mesilla Dam.

Portions of the project are already in progress, including concrete lining sections of the La Union East Canal and making sediment control upgrades at Wasteway 32. Additional costs for the Wasteway 32 La Union East River Pumping Plant are included as part of this water management strategy. Further agreements and possible re-routing may be required for surface water deliveries to the Upper Valley Water Treatment Plant.

Quantity, Reliability, and Cost – The primary benefit of this strategy is to increase the resiliency of existing supplies of water, reduction to seepage losses, and increased flexibility in operating the Rio Grande Project. The estimated total capital cost of this project is approximately $4,055,887 and will deliver approximately 5,000 acre-feet per year additional water supply as a result of delivery efficiencies.

5A-12 WATER MANAGEMENT STRATEGIES FOR EL PASO COUNTY MANUFACTURING

El Paso County Manufacturing entities have historically purchased a portion of their water supply from EPW. This strategy provides for the purchase of additional water supplies from EPWU to meet their projected future supply needs. Manufacturing shortages in El Paso County is projected at 8,841 acre-feet per year in 2020; increasing to 15,050 acre-feet per year by 2070. The following water management ~~strategies are~~ strategy is recommended to enhance the Manufacturing sector's future water supply availability:

- Manufacturing Conservation
- (E-46) Purchase water from El Paso Water

Manufacturing Conservation

Most groundwater used for manufacturing in El Paso County is for petroleum refining. Upgrading from a wet cooling tower to a hybrid water/air cooling tower minimizes loss by evaporation and required make-up water. The change of the cooling water system minimizes the lost by evaporation, entrainment and purge and as consequence to minimize the fresh water (make-up water) consumption. To minimize waste, cooling tower blowdown can be treated. Thus, depending on the treated effluent quality, it can be recycled to the cooling tower or to another purpose such as fired fighting or service water.

Maximizing cooling tower cycles offers many benefits in the way it reduces water consumption, minimizes waste generation, decreases chemical treatment requirements, and diminishes overall operating costs. Cooling tower cycles can be maximized in a variety of ways. These include pH adjustment, chemical scale inhibitors, and pretreatment of the tower make-up water. Potential cost savings vary from plant to plant, depending on the cost of fresh water, waste disposal costs, chemical treatment dosages, and energy. Nevertheless, in addition to the environmental, health, and safety improvements, some studies show that the return on investment for improving cooling tower efficiency is typically less than one year.

~~E-45~~E-46 Purchase Water from El Paso Water (EPW)

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This strategy assumes that El Paso County Manufacturing entities would purchase an additional 860 acre-feet of water per year from EPW starting in 2030 at a cost of approximately $1,220 per acre-foot.

Quantity, Reliability and Cost -The total annual cost for the water purchase is approximately $1,049,000. In contrast to many other water management strategies, there are no capital costs associated with the purchase EPW water strategies. The purchased supply is reliant on EPW maintaining its blended water supply and implementation of its Integrated Strategies (5A.4).

5A-13 WATER MANAGEMENT STRATEGIES FOR EL PASO COUNTY MINING

El Paso County Mining entities purchase a portion of their water supply from EPWU; however, much of the water needs for mining operations are self-supplied from private/company water wells. Projected Mining water supply shortages in El Paso County begin in 2020 with a 1,926 acre-feet per year deficit; decreasing to 1,792 acre-feet per year by 2070. The following water management strategiesy is recommended to enhance the Mining industry's future water supply availability:

- Mining Conservation
- (E-48) Additional groundwater wells in the Hueco-Mesilla Bolson Aquifer

Mining Conservation

Mining groundwater use in Far West Texas is primarily associated with oil and gas production. Water is needed for well drilling activities, formation fracing, and sand (proppant) mining plants. The FWTWPG encourages the use of alternative water sources when and where it is economically feasible to do so. For conservation of freshwater resources associated with fracing, on-site treatment of produced and/or flowback water allows for reuse of the water stream. There are numerous third-party vendors who offer mobile produced water recycling systems.

In 2018, approximately ten percent of fracwater supply in the Permian Basin was recycled produced water. Conservation of 15 percent of El Paso County mining needs in 2020 would reduce mining needs by 278 acre-feet per year.

~~E-46~~E-48 Additional Groundwater Wells in the Hueco-Mesilla Bolson Aquifer

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The Hueco-Mesilla Bolson Aquifer has been identified as a potential source of water to meet the mining shortages within El Paso County. This Aquifer, a major source of groundwater for cities in El Paso County, extends southeastward from the New Mexico state line in El Paso County to the southern end of the Quitman Mountains in Hudspeth County.

Water from this source is typically good. Fresh to slightly saline water exists in the upper portions of the bolson. Brackish water exists at greater depths and is recommended for mining purposes. This strategy assumes that five new wells will need to be drilled to an average depth of 585 feet below the surface.

Quantity, Reliability, and Cost – The quantity of water from five new wells in this source is expected to be approximately 600 gpm or 4,251 acre-feet per year. The reliability of this supply is medium to high, based on competing demands and water quality issues. Total cost of this project will be approximately $1,208,000.

5A-14 WATER MANAGEMENT STRATEGIES FOR EL PASO COUNTY STEAM ELECTRIC POWER

Steam Electric Power water supply shortages in El Paso County is projected at 7,260 acre-feet per year through 2070. Water supply needs are met partly by EPW's blended source along with obtaining self-supplied groundwater from the Hueco-Mesilla Bolson Aquifer. The following water management strategies strategy is to enhance the reliability of the future water supply availability for steam electric power.

- Steam Electric Power Conservation
- (E-50) Purchase water from El Paso Water

Steam Electric Power Conservation

Upgrading from a wet cooling tower to a hybrid water/air cooling tower minimizes loss by evaporation and required make-up water. The change of the cooling water system minimizes the lost by evaporation, entrainment and purge and as consequence to minimize the fresh water (make-up water) consumption. Dry cooling processes use very little water. However, compared to traditional wet cooling, dry cooling systems have higher upfront and higher operating costs, are less efficient and reliable at warmer temperatures, and demand a larger footprint. Hybrid systems combine wet cooling with dry cooling systems to solve some of these drawbacks, allowing them to function reliably in higher temperatures and a smaller footprint. To minimize waste, cooling tower blowdown can be treated. Thus, depending on the treated effluent quality it can be recycled to the cooling tower or to another purpose such as fired fighting or service water.

Maximizing cooling tower cycles offers many benefits in the way it reduces water consumption, minimizes waste generation, decreases chemical treatment requirements, and diminishes overall operating costs. Cooling tower cycles can be maximized in a variety of ways. These include pH adjustment, chemical scale inhibitors, and pretreatment of the tower make-up water. Potential cost savings vary from plant to plant, depending on the cost of fresh water, waste disposal costs, chemical treatment dosages, and energy. https://www.samcotech.com/how-can-you-reduce-water-used-in-electrical-generation/

E-47E-50 Purchase Water from El Paso Water (EPW)

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Quantity, Reliability and Cost - This strategy assumes that El Paso County Steam Electric Power would purchase 7,260 acre-feet of additional water per year from EPW starting in 2020 at a cost of $131 per acre-foot. The total annual cost for the water purchase is approximately $951,000. The purchased supply is reliant on EPW maintaining its blended water supply and implementation of its Integrated Strategies (5A.4).

5A-15 WATER MANAGEMENT STRATEGIES FOR HUDSPETH COUNTY

5A-15.1 -WATER MANAGEMENT STRATEGIES FOR HUDSPETH COUNTY-OTHER (DELL CITY)

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Dell City relies on the Bone Spring-Victorio Peak Aquifer for its municipal supply. While the supply availability is adequate, water from the aquifer must be desalinated to make it potable for public drinking water use. Although the supply-demand analysis does not project a future water supply deficit for Dell City, the maintenance and upgrade of the City's desalination facility is recommended to enhance the reliability of its future water supply availability.

~~E-48~~E-51 Brackish Groundwater Desalination Facility

Aided by financial assistance from the TWDB, Dell City has plans to replace the City's water treatment facility with a reverse osmosis system. The existing ionic filtration system is outdated and replacement parts are difficult to obtain. In addition, the City's groundwater source exceeds water quality standards for total dissolved solids and fluoride. This strategy incorporates Dell City's funding application from the TWDB Drinking Water State Revolving Fund (DWSRF) for an amount of $244,450. It is assumed that all other necessary infrastructure (e.g., piping, concentrate disposal) is currently in place for the existing facility and will not need to be updated.

Quantity, Reliability, and Cost – This strategy assumes an additional supply of 111 acre-feet of water per year. The reliability of this strategy is high due to the sufficient amounts of brackish groundwater. It is estimated that the total capital cost for this project is $1,636,000.

5A-15.2 WATER MANAGEMENT STRATEGIES FOR HUDSPETH COUNTY-OTHER (SIERRA BLANCA-HUDSPETH COUNTY WCID#1)

The Hudspeth County WCID#1 provides water to the Community of Sierra Blanca and the surrounding area. The Utility is under contract with the Town of Van Horn for delivery of water obtained from wells in the Wild Horse Flat Aquifer north of Van Horn near the airport. Since 1970, Sierra Blanca has drilled several wells near the town in unsuccessful attempts to develop local sources of groundwater. Although the supply-demand analysis does not project a future water supply deficit for the Utility, the following water management strategies are recommended to enhance the reliability of the Utility's future water supply availability:

- (E-52) Public Conservation Education
- (E-53) Replace Water-supply Line from Van Horn
- (E-54) Local Groundwater Well
- (E-55) Groundwater Well NE of Van Horn
- (E-56) Groundwater Well West of Van Horn

~~E-49~~E-52 Public Conservation Education

Public information programs, even though they may not be directly related to any equipment or operational change, can result in both short- and long-term water savings. Behavioral changes by customers will only occur if a reasonable yet compelling cause can be presented with sufficient frequency to be recognized and absorbed by the customers. There are many resources that can be consulted to provide insight into implanting effective information programs. Like any marketing or public information program, to be effective, water conservation public information should be planned out and implemented in a consistent and continual manner. A more detailed description of conservation BMPs that might be encouraged is available in TWDB Report 362, Water Conservation Best Management Practices Guide. These BMPs can also be found at: http://www.twdb.texas.gov/conservation/outreach/index.asp

The Hudspeth County WCID#1 (Sierra Blanca) is encouraged to emphasize conservation through public information programs. A total of one percent reduction in demand is anticipated, which would result in a water savings of 1.5 acre-feet by year 2030. The 2030 annual cost for implementing a public information conservation program is estimated at $621.54. It is estimated that the total capital cost for this project is $3,513.

~~E-50~~E-53 Replace Water-Supply Line from Van Horn

Water supply generated by the Town of Van Horn is delivered to the Hudspeth County WCID#1 (Sierra Blanca) through an old pipeline that needs major repair or replacement. The Utility estimates a substantial loss along the pipeline resulting in frequent repairs. In 2015, a loss of 7.4 acre-feet or 3.8 percent of the annual flow through the pipeline was recorded. This strategy describes the replacement of the old pipeline with 40 miles of eight-inch transmission line along an existing right of way. Also included is one pumping station and one booster station to overcome elevation gains.

Quantity, Reliability, and Cost – This strategy assumes an additional supply of 39 acre-feet of water per year. The supply from the Van Horn wellfield is very reliable. It is estimated that the total capital cost for this project is $18,432,000.

~~E-51~~E-54 Local Groundwater Well

A new groundwater well located within or adjacent to the Sierra Blanca may provide a local option for additional water supply. The source from which this well would produce is ~~uncertain, but~~uncertain but is likely from the Diablo Plateau Aquifer. Historically, wells in this area have produced small amounts of brackish groundwater. A well-site assessment is likely necessary for this project. For this strategy, a single well drilled to an estimated depth of 500 feet and completed to public-supply specifications might produce a desired yield of 20 GPM and be operated 12 hours a day. One half mile of 6-inch pipe will connect the supply to the nearest distribution line. As the anticipated supply will likely be brackish in quality, a small wellhead reverse osmosis desalination filtration system.

Quantity, Reliability and Cost - This strategy assumes an additional supply of 16 acre-feet of water per year. The supply from the Diablo Plateau Aquifer well is uncertain. It is estimated that the total capital cost for this project is $940,000.

~~E-52~~E-55 Groundwater Well NE of Van Horn

The Hudspeth County WCID#1 is under contract with the Town of Van Horn for delivery of water obtained from wells in the Wild Horse Flat Aquifer north of Van Horn near the airport. One well in this area is currently specifically designated for the District's supply, and there is substantial room for expansion if an additional well is needed to meet increased demand. This strategy describes the construction and completion of one additional well to supply the increased future need for the District. The well is proposed to be 1,500 feet deep with an average pumping capability of 400 GPM. One mile of pipeline is proposed to connect the new well to the main Utility transmission line.

Quantity, Reliability, and Cost – This strategy assumes an additional supply of 39 acre-feet of water per year. The supply from the Van Horn wellfield is very reliable. It is estimated that the total capital cost for this project is $2,132,000.

~~E-53~~E-56 Groundwater Well West of Van Horn

One new well is proposed for the Hudspeth County WCID #1 near the Allamoore industrial site along IH10 west of Van Horn. Groundwater availability at this location is uncertain; however, likely host aquifer formations include shallow Eagle Flat alluvium, Permian and Pre-Cambrian limestones and breccia, which for this strategy will be referred to as the Diablo Plateau Aquifer. This strategy describes the construction and completion of one well to supply the increased future need for the District. The well is proposed to be 500 feet deep with an average pumping capability of 100 GPM. A half-mile pipeline is proposed to connect the new well to the main Utility transmission line.

Quantity, Reliability, and Cost – This strategy assumes an additional supply of 39 acre-feet of water per year. The reliability of this strategy is uncertain as few wells have been drilled in this vicinity. It is estimated that the total capital cost for this project is $636,000.

5A-15.3 WATER MANAGEMENT STRATEGIES FOR HUDSPETH COUNTY MINING

Mining water supply shortages in Hudspeth County are projected at 219 acre-feet per year in 2070. Mining water supply needs within the county obtain supplies from both surface and groundwater sources. Surface water such as local supply is commonly used but limited during drought conditions. Groundwater from the Rio Grande Alluvium Aquifer and West Texas Bolsons Aquifer are more reliable sources. The following water management strategy is recommended to enhance the reliability of the future water supply availability for the mining water-supply needs within Hudspeth County:

- Mining Conservation
- (E-58) Additional groundwater well in the West Texas Bolsons (Eagle Flat) Aquifer

Mining Conservation

Mining groundwater use in Far West Texas is primarily associated with oil and gas production. Water is needed for well drilling activities, formation fracing, and sand (proppant) mining plants. The FWTWPG encourages the use of alternative water sources when and where it is economically feasible to do so.

For conservation of freshwater resources associated with fracing, on-site treatment of produced and/or flowback water allows for reuse of the water stream. There are numerous third-party vendors who offer mobile produced water recycling systems.

In 2018, approximately 10 percent of fracwater supply in the Permian Basin was recycled produced water. Conservation of 15 percent of Hudspeth County mining needs in 2020 would reduce mining needs by 29 acre-feet per year.

E-58 Additional Groundwater Well in the West Texas Bolsons (Eagle Flat) Aquifer

The West Texas Bolsons Aquifer has been identified as a potential source of water to meet the mining shortages within Hudspeth County. The Eagle Flat Bolson is situated between the Eagle Mountains along the south-southwest, the Diablo Plateau along the north, and the Carrizo and Van Horn Mountains along the east. Groundwater underlying the Eagle Flat area is not a source of supply for municipalities in Hudspeth County due to water quality and quantity limitations. However, the Eagle Flat is a sufficient source for mining purposes. This strategy assumes that one new well will be drilled to a depth of 375 feet.

Quantity, Reliability, and Cost – The one new well is assumed to produce at a rate of 240 GPM or 219 acre-feet per year. Historical industrial and agricultural use indicates that the West Texas Bolsons Aquifer may be a viable source, with a reliability range medium to high, based on competing demands and water quality issues. Total cost of this project will be approximately $306,000.

5A-16 WATER MANAGEMENT STRATEGIES FOR JEFF DAVIS COUNTY

5A-16.1 WATER MANAGEMENT STRATEGIES FOR FORT DAVIS WSC

Fort Davis Water Supply Corporation (FDWSC) provides water to the Community of Fort Davis and the surrounding area from three wells completed in the Davis Mountains Igneous Aquifer and continues to consider the feasibility of future water well development in surrounding areas. Although the supply-demand analysis does not project a future water supply deficit for the FDWSC, the following water management strategies ae recommended to enhance the reliability of the future water supply availability.

- (E-59) Additional groundwater well in the Igneous Aquifer
- (E-60) Transmission line to connect Fort Davis WSC to Fort Davis Estates

E-59 Additional Groundwater Well – Igneous Aquifer

This strategy assumes that one new well would need to be drilled into the Igneous Aquifer to provide approximately 274 acre-feet per year. The Aquifer is not a single homogeneous aquifer but rather a system of complex water-bearing formations that are in varying degrees of hydrologic communication. Most wells developed are less than 1,000 feet in depth.

This well would be located on the opposite end of the existing storage facility and produce water from approximately 300 feet below the surface. In addition, 500 feet of eight-inch diameter connection pipeline will be necessary to connect to the storage facility. Minimal treatment will be required, such as chlorination disinfection for municipal use.

Quantity, Reliability, and Cost – The quantity and reliability of water from this source is expected to be approximately 274 gpm. Water quality of the aquifer is relatively good and generally meets safe drinking water standards. Minimal advanced treatment will be required for municipal purposes. The reliability of this supply is medium to high, based on competing demands. The total estimated project cost is approximately $584,000.

E-60 Transmission Line to Connect Fort Davis WSC to Fort Davis Estates

FDWSC provides water to the Community of Fort Davis and the surrounding area which includes Fort Davis Estates. FDWSC has plans to construct an additional transmission line to connect FDWSC to the Fort Davis Estates subdivision, which has its own well. This strategy assumes the connection of 20 houses, with a 2-mile, 6-inch diameter transmission pipeline. Conveyance of water would flow both directions depending on peak demand. This pipeline would only be used for emergency purposes to meet the peak demand during summer months. The evaluation does not include additional storage. Funding is expected to be provided solely by Fort Davis WSC.

Quantity, Reliability, and Cost – This strategy would supply 114 acre-feet per year and is considered reliable. The total estimated capital cost for this project is $1,671,000.

5A-17 WATER MANAGEMENT STRATEGIES FOR JEFF DAVIS COUNTY-OTHER (TOWN OF VALENTINE)

The Town of Valentine, a small community in western Jeff Davis County, currently derives its entire water supply from one groundwater well completed in the Ryan Flat portion of the Salt Basin Aquifer, a subdivision of the West Texas Bolson Aquifers. A second well is needed as a supplemental and backup supply for the community. Although the supply-demand analysis does not project a future water-supply deficit for the Town of Valentine, the following water management strategy is recommended to enhance the reliability and security of the community's future water supply availability.

E-61 Additional Groundwater Well in the Ryan Flat Aquifer

This strategy assumes that one new municipal well is needed to provide an additional water supply for the Town of Valentine. This new groundwater well, likewise completed in the Ryan Flat Aquifer, would be located near the existing well and drilled to a depth of approximately 870 feet below the surface. In addition, 500 feet of six-inch diameter connection pipeline will be necessary. Minimal treatment will be required, such as chlorination disinfection for municipal use.

Quantity, Reliability, and Cost – The well is expected to reliably yield approximately 80 gpm and produce 129 acre-feet per year. Water quality of the Aquifer is relatively good and generally meets safe drinking water standards. Minimal advanced treatment will be required for municipal purposes. The total estimated project capital cost is approximately $783,000.

5A-18 WATER MANAGEMENT STRATEGIES FOR PRESIDIO COUNTY

5A-18.1 WATER MANAGEMENT STRATEGIES FOR THE CITY OF PRESIDIO

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The City of Presidio is located on the Rio Grande adjacent from Ojinaga, Chihuahua on the U.S.-Mexico Border. The City and many other border residents of Presidio County rely on the West Texas Bolsons – Presidio-Redford Bolson Aquifer for municipal, domestic, livestock and irrigation water supply needs. Although the City's supply-demand analysis does not project a future water supply deficit for the City of Presidio, the following water management strategies are recommended to enhance the reliability of the City's future water supply availability:

- (E-62) Water loss audit and main-line repair
- (E-63) Additional groundwater well in the Presidio Bolson Aquifer

E-62 Water Loss Audit and Main-line Repair

According to the 2015 TWDB Public Water System Water Loss Survey, the City of Presidio had real water losses (as opposed to apparent "paper" losses) of 98 acre-feet in 2015 (14.8%) due to leaking infrastructure. This amount of water loss is the sum of reported breaks and leaks, and unreported loss. The water supply system can reduce water losses and get a more accurate look at water consumption by taking the proper measures to identify and repair old infrastructure and inaccurate water meters. This strategy will provide a savings of only a portion of the total reported loss and assumes that a leak testing program would be implemented prior to possibly replacing portions of the existing leaking pipe.

Quantity, Reliability, and Cost - The strategy assumes 2 miles of 6-inch diameter pipe will be replaced, at a total estimated project capital cost of $509,000. The strategy is estimated to generate a potential savings of 35 acre-feet of water per year in 2020 and up to 45 acre-feet per year by 2070.

E-63 Additional Groundwater Well in the Presidio Bolsons Aquifer

The City of Presidio has plans to develop new water supplies to meet growing water demands within the community. Currently, the Border Environment Cooperation Commission is working with the City of Presidio to develop several improvements to the City's existing water infrastructure. One such project is to extend water services along Highway 67 as far as the airport 5 miles north of town to provide services to Las Pampas Colonia. The new water line will benefit approximately 12 existing residences and an equal number of businesses. This strategy assumes that one new well will be drilled into the West Texas Bolsons Aquifer (Presidio-Redford Bolson) to a depth of 90 feet to generate approximately 150 gpm. The project includes 5 miles of 8-inch diameter transmission pipeline, one pump station, one 50,000-gallon storage tank and minimal treatment such as chlorine disinfection.

Quantity, Reliability, and Cost – The quantity and reliability of water from this source is expected to be approximately 120 acre-feet of water per year. The combined supplies from strategies using water from the Presidio Bolson Aquifer do not exceed the MAG value, indicating there are sufficient supplies for these strategies. Minimal advanced treatment will be required for municipal purposes. The reliability of this supply is low to medium based on finding a good location for a productive well. The total estimated project cost is approximately $5,509,000.

5A-19 WATER MANAGEMENT STRATEGIES FOR TERRELL COUNTY

5A-19.1 WATER MANAGEMENT STRATEGIES FOR TERRELL COUNTY MINING

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Mining interests in Terrell County obtains their water from local surface water supplies and from the Edwards-Trinity (Plateau) Aquifer. Local surface water sources are commonly used but limited during drought conditions. The Aquifer source is more reliable and is thus identified as a potential supply to meet the projected mining water supply deficits which are projected at 483 acre-feet per year in 2020; increasing to 586 acre-feet per year by 2030; and then decreasing to 195 acre-feet per year by 2070.

- Mining Conservation
- (E-65) Additional wells in the Edwards-Trinity (Plateau) Aquifer - ALTERNATE

Mining Conservation

Mining groundwater use in Far West Texas is primarily associated with oil and gas production. Water is needed for well drilling activities, formation fracing, and sand (proppant) mining plants. The FWTWPG encourages the use of alternative water sources when and where it is economically feasible to do so.

For conservation of freshwater resources associated with fracing, on-site treatment of produced and/or flowback water allows for reuse of the water stream. There are numerous third-party vendors who offer mobile produced water recycling systems. In 2018, approximately 10 percent of fracwater supply in the Permian Basin was recycled produced water.

~~E-64~~E-65 Additional Wells in the Edwards-Trinity (Plateau) Aquifer (ALTERNATE)

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The following water management strategy exceeds the current MAG groundwater availability for the Edwards-Trinity (Plateau) Aquifer in Terrell County and therefore cannot be recommended. However, this strategy is included as an "Alternate" strategy designed to be recommended upon a change in DFC and MAG availabilities in future planning cycles, or by a rule modification by the Terrell County Groundwater Conservation District. Should the MAG change in future planning cycles, this strategy will become a recommended strategy. This strategy assumes that six new wells will be drilled to approximately 630 feet below the surface in the general central part of the county.

Quantity, Reliability, and Cost –Six new wells are assumed to supply an additional 470 acre-feet per year. Historical use indicates that the Edwards-Trinity (Plateau) Aquifer may be a viable source and the reliability of this supply is medium to high, based on competing demands and water quality issues. Total cost of this project will be approximately $921,000.

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APPENDIX 5B
STRATEGY EVALUATION
QUANTIFICATION MATRIX

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STRATEGY EVALUATION QUANTIFICATION MATRIX

The practicality of an implemented water management strategy may be measured in terms of quantity, quality and reliability of water produced and the varying degree of impact (positive or negative) on pre-existing local conditions. The Far West Texas Water Planning Group has adopted a standard procedure for ranking potential water management strategies. Quantitative and qualitative measurements are tabulated in Chapter 5 Tables 5-2 and 5-4. This procedure classifies the strategies using the TWDB's following standard categories developed for regional water planning:

Table 5-2:

- Quantity
- Quality
- Reliability
- Impact of Water, Agricultural, and Natural Resources
- Impact on Ecologically Unique Stream Segments

Table 5-4:

- Environmental Impact
  - Environmental water needs
  - Wildlife habitat
  - Cultural resources
  - Environmental water quality
  - Bays and estuaries

Quantity, Quality and Reliability

Quantity, quality and reliability are quantitatively assessed and assigned a ranking from 1 to 3 as listed in the Table 5B-1below, which shows the correlation between the category and the ranking.

Table 5B-1. Quantity, Quality and Reliability Category Ranking Matrix

Rank	Quantity	Quality	Reliability
1	Meets 100% of shortage	Meets safe drinking water standards	Sustainable
2	Meets 50-99% of shortage	Must be treated or mixed to meet safe drinking water standards	Interruptible
3	Meets < 50% of shortage	Usable for intended non-drinking use only	Un-sustainable

Quantity adequacy is measured as a percent of the volume of water needed to meet the specified water user group's (WUG's) shortage as calculated in Table 4-1 of Chapter 4 that is produced by the water management strategy. Percent volumes are only analyzed for WUGs with projected supply shortages.

Quality adequacy is measured in terms of meeting TCEQ Safe Drinking Water Standards. However, not all strategies are intended for use requiring SDWSs.

Reliability is evaluated based on the expected or potential for the water to be available during drought. Strategies that use water from a source that would not exceed permits or MAGs even during droughts are rated as sustainable. Strategies that use water from a source that is available during normal meteorological conditions but may not be 100% available during drought are rated as interruptible. Strategies in which 100% of the supply cannot be maintained even during normal meteorological conditions are rated as un-sustainable.

Impact on Water, Agricultural and Natural Resources, and Ecologically Unique Stream Segments

Impacts are quantitatively assessed and assigned a ranking from 1 to 5 as listed in Table 5B-2 below, which shows the correlation between the category and the ranking.

Table 5B-2. Strategy Impact Category Ranking Matrix

Rank	Water Resources	Agricultural Resources	Natural Resources	Ecologically Unique Streams
1	Positive	Positive	Positive	Positive
2	None	None	None	None
3	Low	Low	Low	Low
4	Medium	Medium	Medium	Medium
5	High	High	High	High

Water Resources impacts refer to the potential for the implemented strategy to compete for water sources shared with adjacent properties. The matrix ranking depicts the potential range of water-level drawdown induced across property boundaries during the life of the strategy project.

1 Positive - No aquifer drawdown; increased surface water flow

2 None – No new aquifer drawdown; no change to surface water flow

3 Low – <10 feet of aquifer drawdown; < 10% reduction in average surface flows

4 Medium – 10 to 50 feet of aquifer drawdown; 10 to 30% reduction in average surface flows

5 High - > 50 feet of aquifer drawdown; > 30% reduction in surface flows

Agricultural Resources impacts refer to the agricultural economic impact resulting from the loss or gain of water supplies currently in use by the agricultural user as the result of the implementation of a strategy. See Section 1.2.8 in Chapter 1 for a detailed discussion on the Agricultural Resources of Far West Texas.

1 Positive – provides water to agricultural users

2 None – does not impact agricultural supplies

3 Low – reduces agricultural activity by less than 10%

4 Medium – reduces agricultural activity by more than 10%

5 High – water rights use changes from agricultural to some other use thus elimination agricultural activity

Natural Resources impacts are those that impact the terrestrial and aquatic habitat of native plant and animal wildlife, as well as the scenic beauty of the Region that is critical to the tourism industry. See Section 1.2.9 in Chapter 1 for a detailed discussion on the Natural Resources of Far West Texas.

1 Positive – provides water to natural resources

2 None – does not impact natural resources

3 Low – reduces natural resources water supply by less than 10%

4 Medium – reduces natural resources water supply by more than 10%

5 High – reduces natural resources water supply by more than 50%

Ecologically Unique Stream Segments impacts are those that impact the natural habitat of portions of streams that have been identified by the Far West Texas Water Planning Group as "ecologically unique stream segments". See Chapter 8 of both the 2011 and 2016 Far West Texas Water Plan for a location and description of designated stream segments.

1 Positive – provides water to designated stream segments

2 None – does not impact designated stream segments

3 Low – reduces designated stream segment water supply by less than 10%

4 Medium – reduces designated stream segment water supply by more than 10%

5 High – reduces designated stream segment water supply by more than 50%

Environmental Impacts

Environmental impacts are quantitatively assessed and assigned a ranking from 1 to 5 as listed in the Table 5B-3 below, which shows the correlation between the category and the ranking. The Environmental Matrix takes into consideration the following categories;

- Environmental Water Needs
- Wildlife Habitat
- Cultural Resources

- Environmental Water Quality
- Bays and Estuaries

Table 5B-3. Environmental Impact Category Ranting Matrix

<table>
<tr><th>Rank</th><th>Environmental Water Needs</th><th>Wildlife Habitat</th><th>Cultural Resources</th><th>Environmental Water Quality</th><th>Bays and Estuaries</th></tr>
<tr><td>1</td><td>Positive</td><td>Positive</td><td>Positive</td><td>Positive</td><td rowspan="5">Not applicable</td></tr>
<tr><td>2</td><td>No new</td><td>No new</td><td>No new</td><td>No new</td></tr>
<tr><td>3</td><td>Minimal negative</td><td>Minimal negative</td><td>Minimal negative</td><td>Minimal negative</td></tr>
<tr><td>4</td><td>Moderate negative</td><td>Moderate negative</td><td>Moderate negative</td><td>Moderate negative</td></tr>
<tr><td>5</td><td>Significant negative</td><td>Significant negative</td><td>Significant negative</td><td>Significant negative</td></tr>
</table>

Environmental Water Needs impacts refer to how the strategy will impact the area's overall environmental water needs. Water is vital to the environmental health of a region, and so it is important to take into account how strategies will impact the amount of water that will be available to the environment.

1 Positive – additional water will be introduced for environmental use

2 No new – no additional water will be introduced for environmental use

3 Minimal negative – environmental water needs will be reduced by <10%

4 Moderate negative – environmental water needs will be reduced by 10 to 30%

5 Significant negative - environmental water needs will be reduced by >30%

Wildlife Habitat impacts refer to how the strategy will impact the wildlife habitat of the local area. The more area that is impacted due to the implementation of the strategy, the more the area's habitat will be disrupted.

1 Positive – additional habitat area for wildlife use will be created

2 No new – no additional habitat area for wildlife use will be created or destroyed

3 Minimal negative – wildlife habit will be reduced by < 100 acres

4 Moderate negative – wildlife habit will be reduced by 100 to 1,000 acres

5 Significant negative - wildlife habit will be reduced by > 1,000 acres

Cultural Resources impacts refer to how the strategy will impact cultural resources located within the area. Cultural resources are defined as the collective evidence of the past activities and accomplishments of people. Locations, buildings and features with scientific, cultural or historic value are considered to be cultural resources.

1 Positive – cultural resources will be identified and protected

2 No new – no impact will occur to local cultural resources

3 Minimal negative – disturbance to cultural resources will be < 10%

4 Moderate negative – disturbance to cultural resources will be 10 to 20%

5 Significant negative - disturbance to cultural resources will be > 20%

Environmental Water Quality impacts refer to the impact that the implementation of the strategy will have on the local area's natural water quality. Negative impacts could include the introduction of poorer quality water, the reduction of the natural flow of water of native quality source water, or the introduction of detrimental chemical elements into the natural water ways.

1 Positive – water quality of area streams will be enhanced for existing environmental use

2 No new – water quality characteristics of existing environmental habitat will not be changed

3 Minimal negative – water quality characteristics of existing environmental habitat will be negatively altered by < 10%

4 Moderate negative – water quality characteristics of existing environmental habitat will be negatively altered by < 10 to 30%

5 Significant negative - water quality characteristics of existing environmental habitat will be negatively altered by > 30%

Bays and Estuaries - Far West Texas is located too far away from any bays and estuaries of the Texas coastline to have a quantifiable impact. Therefore, this category was assumed to be non-applicable for every strategy.

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