# 2 Water Conservation

## 2.1 Municipal Water Conservation

Water conservation is defined as those methods and practices that either reduce the demand for water supply or increase the efficiency of the supply. Water facilities are used so that supply is conserved and made available for future use. Water conservation is typically a non-capital intensive alternative that any water supply entity can pursue.

Water supply entities and major water right holders that meet the following criteria are required by Texas Water Code and Texas Administrative Code statute to submit a Water Conservation Plan to the TCEQ:

- Entities who are requesting Texas Water Development Board (TWDB) financial assistance greater than $500,000
- Entities with 3,300 connections or greater
- Surface water right holders of:
  - Greater than 1,000 acft/year (non-irrigation)
  - Greater than 10,000 acft/year (irrigation)

The purpose of a water conservation plan is to establish strategies for reducing the volume of water used from a water supply source, reduce loss or waste of water, and maintain and improve the efficiency in the use of water. Water conservation plans must identify 5 and 10 year targets and goals for water use and water loss, including methods used to track progress in meeting targets and goals. Water conservation plans for Brazos G municipal water user groups, including the most common water conservation best management practices (BMPs) identified in the water conservation plans, are summarized in Volume I, Chapter 5.40.

The TWDB guidance and Texas Administrative Code 357.34(f)2 requires Regional Water Planning Groups to consider water conservation practices, including potentially applicable BMPs, for each water user group with an identified water need (shortage) in the regional water plan. For the 2016 Regional Water Plans, the TWDB has new requirements for water conservation content to be included in the Plans including directives for regional water planning groups to assess the highest level of water conservation and efficiencies achievable, report the resulting projected water use savings in gallons per capita per day, and develop conservation strategies based on this information. This write-up addresses the TWDB directives related to water conservation.

There are several water conservation resources that have been developed for use in developing the Regional Water Plans. The Water Conservation Implementation Task Force, created by Senate Bill 1094, provided guidance on Water Conservation Best Management Practices (BMPs). Additionally a GDS Associates Report provides guidance on expected water savings and costs associated with implementing water conservation best management practices.

### 2.1.1 Description of Strategy

For regional water planning purposes, municipal water use is defined as residential and commercial water use. Municipal water is primarily for drinking, sanitation, cleaning, cooling, fire protection, and landscape watering for residential, commercial, and institutional establishments. A key parameter for assessing municipal water use within a typical city or water service area is the number of gallons used per person per day (per capita water use). The objective of water conservation is to decrease the amount of water – measured in gallons per capita per day (gpcd) – that a typical person uses.

The Task Force recommends that a standardized methodology be used for determining gpcd municipal water use so as to allow consistent evaluations of the effectiveness of water conservation measures among Texas cities that are located in the different climates of Texas. The following were recommendations provided in the Task Force Report, some of which have been incorporated as requirements by TCEQ for water conservation plans submitted to the state:

- All public water suppliers that are required to prepare and submit water conservation plans should establish targets for water conservation, including specific goals for per capita water use and for water loss programs using appropriate water conservation BMPs.
- Municipal Water Conservation Plans required by the State shall include per capita water-use goals, with targets and goals established by an entity giving consideration to a minimum annual reduction of 1 percent in total gpcd, based upon a 5-year moving average, until such time as the entity achieves a total gpcd of 140 gpcd or less, or
- Municipal water use (gpcd) goals approved by regional water planning groups.

The current TWDB municipal water demand projections account for expected water savings due to implementation of the 1991 State Water-Efficient Plumbing Act. However, any projected water savings due to conservation programs over and above the savings associated with the 1991 Plumbing Act must be listed as a separate water management strategy. The projections assume that 100 percent of new construction includes water-efficient plumbing fixtures. Consequently, any water management strategy intended to replace inefficient plumbing fixtures installed prior to 1995 would constitute an acceleration of the effects of the 1991 Plumbing Act, but provide no additional long-term savings. Including a retrofit program as a water management strategy without first discounting the TWDB per capita water use reductions would double-count water savings, since those savings due to retrofits are already included in the base water demand projections.

In 2009, the Texas Legislature enacted House Bill (HB) 2667 establishing new minimum standards for plumbing fixtures sold in Texas beginning in 2014. HB 2667 clarifies and sets out the national standards of the American Society of Mechanical Engineers and American National Standards Institute by which plumbing fixtures will be produced and tested. This bill establishes a phase-in of high efficiency plumbing fixtures brought into Texas, which will allow manufacturers the time to change their production, at the same time allowing retailers the opportunity to turn over their inventory. HB 2667 creates an exemption for those manufacturers that volunteer to register their products with the

United States Environmental Protection Agency's WaterSense Program, which should result in additional water savings. This bill also repeals the TCEQ certification process for plumbing fixtures since the plumbing fixtures must meet national certification and testing procedures.

The TCEQ has promulgated rules to reflect this new change in law. The 2009 law requires that by January 2014, all toilets use no more than 1.28 gallons per flush (20% savings from the 1991 1.6 gallons per flush standard). Based upon an average frequency of per-person toilet use in households of 5.1 and a per-use savings of 0.32 gallons per use the supplementary savings of adopting high-efficiency toilets is 1.63 gpcd. This change is also reflected in Table 2.1-1.

**Table 2.1-1. Standards for Plumbing Fixtures**

| Fixture | Standard |
|---|---|
| Toilets* | 1.28 gallons per flush |
| Shower Heads | 2.75 gallons per minute at 80 psi |
| Urinals | 0.5 gallon per flush |
| Faucet Aerators | 2.20 gallons per minute at 60 psi |
| Drinking Water Fountains | Shall be self-closing |

*Bill 2667 of the 81st Texas Legislature, 2009

The TWDB has estimated that the effect of the new plumbing fixtures in dwellings, offices, and public places will be a reduction in per capita water use of approximately 20 gpcd, in comparison to what would have occurred with previous generations of plumbing fixtures.[1] The estimated water conservation effect of 20 gpcd was obtained from TWDB data shown in Table 2.1-2. The low flow plumbing fixtures effects that are already included in the water demand projections are deducted from the 20 gpcd plumbing fixtures potentials for municipal water demand reduction before additional conservation measures are suggested.

**Table 2.1-2. Caption Water Conservation Potentials of Low Flow Plumbing Fixtures**

| Plumbing Fixture | Water Savings (gpcd) |
|---|---|
| Toilets and Showerheads | 16.0 |
| Additional Savings (High Efficiency Toilet)* | 1.63 |
| Faucet Aerators – 2.2 gallons per minute | 2.0 |
| Urinals – 1.0 gallon per minute | 0.3 |
| Drinking Fountains (self-closing) | 0.1 |
| Total | 20.03 (~20 gpcd) |

* TWDB, 2013

[1] "Water Conservation Impacts on Per Capita Water Use," Water Planning Information, Texas Water Development Board, Austin, Texas, 1992.

### 2.1.2 Brazos G Municipal Water Conservation Approach

The Brazos G Regional Water Planning Group (Brazos G RWPG) recommends additional water conservation beyond Plumbing Act savings for all municipal water user groups with per capita use above 140 gpcd in the TWDB base gpcd[2], regardless of whether or not the entity has needs. For these entities, the goal would be to reduce per capita use by 1% annually until the target is met, and then hold the 140 gpcd rate constant throughout the remainder of the planning period. This conservation can be achieved in a variety of ways, including using these BMPs identified by the Water Conservation Implementation Task Force:

1. System Water Audit and Water Loss,
2. Water Conservation Pricing,
3. Prohibition on Wasting Water,
4. Showerhead, Aerator, and Toilet Flapper Retrofit,
5. Residential Toilet Replacement Programs with Ultra-Low-Flow toilets,
6. Residential Clothes Washer Incentive Program,
7. School Education,
8. Water Survey for Single-Family and Multi-Family Customers,
9. Landscape Irrigation Conservation and Incentives,
10. Water-Wise Landscape Design and Conversion Programs,
11. Athletic Field Conservation,
12. Golf Course Conservation,
13. Metering of all New Connections and Retrofitting of Existing Connections,
14. Wholesale Agency Assistance Programs,
15. Conservation Coordinator,
16. Reuse of Reclaimed Water,
17. Public Information,
18. Rainwater Harvesting and Condensate Reuse,
19. New Construction Graywater,
20. Park Conservation, and
21. Conservation Programs for Industrial, Commercial, and Institutional Accounts.

The Brazos G RWPG does not recommend specific conservation BMPs for each municipal entity, as each entity should choose those conservation strategies that best fit their individual situation. However, based on a review of water conservation plans for Brazos G water user groups, the most common BMPs cited

[2] Typically based on 2011 water use, but may represent a different year based on revisions.

to assist in conserving water in the Brazos G region are shown bolded in the above list.

### 2.1.3 Available Supply

The available supply attributed to implementation of this strategy would be a 1% annual reduction in demand over and above that assumed in the TWDB water demand projections. All entities, in order to be in line with projections, will need to verify that their conservation planning measures are consistent with TCEQ standards and the TWDB projections. Beyond that, some communities with projected needs may be able to reduce or eliminate those needs with stronger conservation planning. Table 2.1-3 shows a comparison of TWDB baseline per capita rates for the 2016 Brazos G Plan to per capita rates with advanced conservation for Brazos G entities with per capita rates greater than 140 gpcd. Table 2.1-4 lists municipal WUGs with per capita use rates greater than 140 gpcd, and projected needs (shortages). The table also lists the additional water savings attributable to the Brazos G RWPG conservation recommendations[3].

[3] Additional savings represents savings beyond the 1991 Plumbing Act savings.

## Table 2.1-3. Comparison of TWDB Baseline Per Capita Rates for the 2016 Brazos G Plan and Per Capita Rates With Advanced Conservation

| | | GPCD Board Projections without Advanced Conservation | | | | | | | GPCD Goal with Advanced Conservation | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Base GPCD | Projected GPCD | | | | | | Projected GPCD | | | | | |
| County | WUG | 2011 | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| TAYLOR | ABILENE | 169 | 169 | 167 | 165 | 164 | 162 | 160 | 157 | 142 | 140 | 140 | 140 | 140 |
| SHACKELFORD | ALBANY | 258 | 253 | 250 | 248 | 245 | 243 | 240 | 236 | 213 | 193 | 174 | 158 | 143 |
| LEE | AQUA WSC | 156 | 153 | 151 | 150 | 148 | 147 | 145 | 143 | 140 | 140 | 140 | 140 | 140 |
| BELL | ARMSTRONG WSC | 168 | 165 | 163 | 161 | 160 | 158 | 157 | 153 | 140 | 140 | 140 | 140 | 140 |
| STONEWALL | ASPERMONT | 250 | 245 | 243 | 240 | 238 | 235 | 233 | 228 | 207 | 187 | 169 | 153 | 140 |
| CALLAHAN | BAIRD | 153 | 150 | 148 | 147 | 146 | 144 | 143 | 140 | 139 | 135 | 135 | 135 | 135 |
| WILLIAMSON | BARTLETT | 181 | 177 | 176 | 174 | 172 | 170 | 169 | 165 | 150 | 140 | 140 | 140 | 140 |
| BELL | BELL COUNTY-OTHER | 162 | 159 | 157 | 156 | 154 | 153 | 151 | 148 | 140 | 140 | 140 | 140 | 140 |
| BELL | BELL-MILAM FALLS WSC | 142 | 139 | 139 | 139 | 139 | 139 | 139 | 134 | 130 | 128 | 126 | 126 | 126 |
| BELL | BELTON | 165 | 162 | 160 | 158 | 157 | 155 | 154 | 151 | 140 | 140 | 140 | 140 | 140 |
| JOHNSON | BETHESDA WSC | 197 | 193 | 191 | 189 | 187 | 185 | 184 | 180 | 163 | 147 | 140 | 140 | 140 |
| BRAZOS | BRAZOS COUNTY-OTHER | 142 | 139 | 139 | 139 | 139 | 139 | 139 | 131 | 130 | 130 | 129 | 128 | 128 |
| STEPHENS | BRECKENRIDGE | 161 | 158 | 156 | 155 | 153 | 152 | 150 | 147 | 140 | 140 | 140 | 140 | 140 |
| ROBERTSON | BREMOND | 174 | 171 | 169 | 167 | 165 | 164 | 162 | 159 | 144 | 140 | 140 | 140 | 140 |
| WASHINGTON | BRENHAM | 219 | 215 | 212 | 210 | 208 | 206 | 204 | 200 | 181 | 164 | 148 | 140 | 140 |
| MCLENNAN | BRUCEVILLE-EDDY | 174 | 171 | 169 | 167 | 165 | 164 | 162 | 159 | 144 | 140 | 140 | 140 | 140 |
| WILLIAMSON | BRUSHY CREEK MUD | 231 | 226 | 224 | 222 | 220 | 217 | 215 | 211 | 191 | 173 | 156 | 141 | 140 |
| BRAZOS | BRYAN | 168 | 165 | 163 | 161 | 160 | 158 | 157 | 153 | 140 | 140 | 140 | 140 | 140 |
| JOHNSON | BURLESON | 143 | 140 | 139 | 139 | 139 | 139 | 139 | 135 | 132 | 130 | 129 | 129 | 129 |
| BURLESON | CALDWELL | 197 | 193 | 191 | 189 | 187 | 185 | 184 | 180 | 163 | 147 | 140 | 140 | 140 |
| ROBERTSON | CALVERT | 152 | 149 | 147 | 146 | 145 | 143 | 142 | 140 | 137 | 135 | 135 | 134 | 134 |
| MILAM | CAMERON | 216 | 212 | 210 | 207 | 205 | 203 | 201 | 197 | 178 | 161 | 146 | 140 | 140 |
| WILLIAMSON | CEDAR PARK | 235 | 230 | 228 | 226 | 223 | 221 | 219 | 190 | 172 | 155 | 140 | 140 | 140 |
| BOSQUE | CHILDRESS CREEK WSC | 147 | 144 | 143 | 141 | 140 | 140 | 140 | 138 | 134 | 132 | 130 | 130 | 130 |
| WILLIAMSON | CHISHOLM TRAIL SUD | 174 | 171 | 169 | 167 | 165 | 164 | 162 | 159 | 144 | 140 | 140 | 140 | 140 |
| EASTLAND | CISCO | 168 | 165 | 163 | 161 | 160 | 158 | 157 | 153 | 140 | 140 | 140 | 140 | 140 |
| JOHNSON | CLEBURNE | 172 | 169 | 167 | 165 | 164 | 162 | 160 | 157 | 142 | 140 | 140 | 140 | 140 |
| BOSQUE | CLIFTON | 173 | 170 | 168 | 166 | 165 | 163 | 161 | 158 | 143 | 140 | 140 | 140 | 140 |
| BRAZOS | COLLEGE STATION | 177 | 173 | 172 | 170 | 168 | 167 | 165 | 162 | 146 | 140 | 140 | 140 | 140 |
| LIMESTONE | COOLIDGE | 156 | 153 | 151 | 150 | 148 | 147 | 145 | 143 | 140 | 140 | 140 | 139 | 139 |
| CORYELL | CORYELL CITY WATER SUPPLY DISTRICT | 154 | 151 | 149 | 148 | 146 | 145 | 144 | 141 | 140 | 140 | 140 | 140 | 140 |
| MCLENNAN | CRAWFORD | 191 | 187 | 185 | 183 | 182 | 180 | 178 | 174 | 158 | 143 | 140 | 140 | 140 |
| HOOD | CRESSON | 143 | 140 | 139 | 139 | 139 | 139 | 139 | 136 | 133 | 131 | 129 | 129 | 129 |
| MCLENNAN | CROSS COUNTRY WSC | 158 | 155 | 153 | 152 | 150 | 149 | 147 | 144 | 140 | 140 | 140 | 140 | 140 |
| CALLAHAN | CROSS PLAINS | 162 | 159 | 157 | 156 | 154 | 153 | 151 | 148 | 140 | 140 | 140 | 140 | 140 |
| JOHNSON | CROWLEY | 141 | 140 | 140 | 140 | 140 | 140 | 140 | 140 | 130 | 129 | 129 | 129 | 128 |
| EASTLAND | EASTLAND | 150 | 147 | 146 | 144 | 143 | 141 | 140 | 140 | 137 | 134 | 132 | 131 | 131 |
| WILLIAMSON | FERN BLUFF MUD | 190 | 186 | 184 | 183 | 181 | 179 | 177 | 174 | 157 | 142 | 140 | 140 | 140 |
| HILL | FILES VALLEY WSC | 146 | 143 | 142 | 140 | 139 | 139 | 139 | 137 | 133 | 131 | 129 | 129 | 129 |
| BELL | FORT HOOD | 215 | 211 | 209 | 207 | 204 | 202 | 200 | 196 | 178 | 161 | 145 | 140 | 140 |
| JOHNSON | FORT WORTH | 185 | 181 | 180 | 178 | 176 | 174 | 172 | 169 | 153 | 140 | 140 | 140 | 140 |
| ROBERTSON | FRANKLIN | 142 | 139 | 139 | 139 | 139 | 139 | 139 | 132 | 128 | 125 | 124 | 124 | 123 |
| CORYELL | GATESVILLE | 229 | 224 | 222 | 220 | 218 | 216 | 213 | 209 | 189 | 171 | 155 | 140 | 140 |
| WILLIAMSON | GEORGETOWN | 205 | 201 | 199 | 197 | 195 | 193 | 191 | 187 | 169 | 153 | 140 | 140 | 140 |
| LEE | GIDDINGS | 188 | 184 | 182 | 181 | 179 | 177 | 175 | 172 | 155 | 140 | 140 | 140 | 140 |
| SOMERVELL | GLEN ROSE | 200 | 196 | 194 | 192 | 190 | 188 | 186 | 183 | 165 | 149 | 140 | 140 | 140 |
| YOUNG | GRAHAM | 266 | 261 | 258 | 256 | 253 | 250 | 248 | 243 | 220 | 199 | 180 | 163 | 147 |
| LIMESTONE | GROESBECK | 149 | 146 | 145 | 143 | 142 | 140 | 139 | 139 | 137 | 134 | 132 | 132 | 132 |
| MCLENNAN | HALLSBURG | 141 | 140 | 140 | 140 | 140 | 140 | 140 | 133 | 128 | 124 | 124 | 123 | 123 |
| HAMILTON | HAMILTON | 162 | 159 | 157 | 156 | 154 | 153 | 151 | 148 | 140 | 140 | 140 | 140 | 140 |
| JONES | HAMLIN | 178 | 174 | 173 | 171 | 169 | 168 | 166 | 163 | 147 | 140 | 140 | 140 | 140 |
| BELL | HARKER HEIGHTS | 182 | 178 | 177 | 175 | 173 | 171 | 170 | 166 | 150 | 140 | 140 | 140 | 140 |
| HASKELL | HASKELL | 148 | 145 | 144 | 142 | 141 | 139 | 139 | 139 | 135 | 131 | 130 | 129 | 129 |
| ROBERTSON | HEARNE | 161 | 158 | 156 | 155 | 153 | 152 | 150 | 147 | 140 | 140 | 140 | 140 | 140 |

## Table 2.1-3 (Concluded)

| | | GPCD Board Projections without Advanced Conservation | | | | | | | GPCD Goal with Advanced Conservation | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Base GPCD | Projected GPCD | | | | | | Projected GPCD | | | | | |
| County | WUG | 2011 | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| MCLENNAN | HEWITT | 165 | 162 | 160 | 158 | 157 | 155 | 154 | 151 | 140 | 140 | 140 | 140 | 140 |
| HILL | HILLSBORO | 200 | 196 | 194 | 192 | 190 | 188 | 186 | 183 | 165 | 149 | 140 | 140 | 140 |
| KENT | JAYTON | 164 | 161 | 159 | 158 | 156 | 154 | 153 | 150 | 140 | 140 | 140 | 140 | 140 |
| LAMPASAS | KEMPNER | 158 | 155 | 153 | 152 | 150 | 149 | 147 | 144 | 140 | 140 | 140 | 140 | 140 |
| CORYELL | KEMPNER WSC | 164 | 161 | 159 | 158 | 156 | 154 | 153 | 150 | 140 | 140 | 140 | 140 | 140 |
| KNOX | KNOX CITY | 195 | 191 | 189 | 187 | 185 | 184 | 182 | 178 | 161 | 146 | 140 | 140 | 140 |
| LAMPASAS | LAMPASAS | 154 | 151 | 149 | 148 | 146 | 145 | 144 | 141 | 139 | 136 | 135 | 135 | 135 |
| LEE | LEXINGTON | 169 | 166 | 164 | 162 | 161 | 159 | 158 | 154 | 140 | 140 | 140 | 140 | 140 |
| BELL | LITTLE RIVER-ACADEMY | 160 | 157 | 155 | 154 | 152 | 151 | 149 | 146 | 140 | 140 | 140 | 140 | 140 |
| LAMPASAS | LOMETA | 177 | 173 | 172 | 170 | 168 | 167 | 165 | 162 | 146 | 140 | 140 | 140 | 140 |
| MCLENNAN | LORENA | 154 | 151 | 149 | 148 | 146 | 145 | 144 | 141 | 140 | 139 | 138 | 138 | 137 |
| JOHNSON | MANSFIELD | 252 | 247 | 245 | 242 | 240 | 237 | 235 | 230 | 208 | 188 | 170 | 154 | 140 |
| WILLIAMSON | MANVILLE WSC | 148 | 145 | 144 | 142 | 141 | 139 | 139 | 139 | 136 | 135 | 134 | 134 | 134 |
| FALLS | MARLIN | 254 | 249 | 246 | 244 | 242 | 239 | 237 | 232 | 210 | 190 | 172 | 155 | 140 |
| MCLENNAN | MART | 142 | 139 | 139 | 139 | 139 | 139 | 139 | 133 | 129 | 126 | 124 | 124 | 124 |
| MCLENNAN | MCGREGOR | 146 | 143 | 142 | 140 | 139 | 139 | 139 | 137 | 133 | 129 | 128 | 127 | 127 |
| PALO PINTO | MINERAL WELLS | 155 | 152 | 150 | 149 | 147 | 146 | 144 | 142 | 140 | 139 | 137 | 137 | 137 |
| JOHNSON | MOUNTAIN PEAK SUD | 290 | 284 | 281 | 279 | 276 | 273 | 270 | 265 | 240 | 217 | 196 | 177 | 160 |
| KNOX | MUNDAY | 180 | 176 | 175 | 173 | 171 | 169 | 168 | 164 | 149 | 140 | 140 | 140 | 140 |
| GRIMES | NAVASOTA | 184 | 180 | 179 | 177 | 175 | 173 | 172 | 168 | 152 | 140 | 140 | 140 | 140 |
| BELL | NOLANVILLE | 212 | 208 | 206 | 204 | 202 | 200 | 198 | 194 | 175 | 158 | 143 | 140 | 140 |
| MCLENNAN | NORTH BOSQUE WSC | 235 | 230 | 228 | 226 | 223 | 221 | 219 | 215 | 194 | 176 | 159 | 144 | 140 |
| WILLIAMSON | PFLUGERVILLE | 155 | 152 | 150 | 149 | 147 | 146 | 144 | 142 | 140 | 140 | 140 | 140 | 140 |
| PALO PINTO | POSSUM KINGDOM WSC | 392 | 384 | 380 | 377 | 373 | 369 | 365 | 358 | 324 | 293 | 265 | 240 | 217 |
| TAYLOR | POTOSI WSC | 146 | 143 | 142 | 140 | 139 | 139 | 139 | 138 | 135 | 133 | 132 | 131 | 131 |
| EASTLAND | RANGER | 171 | 168 | 166 | 164 | 163 | 161 | 159 | 156 | 141 | 140 | 140 | 140 | 140 |
| MCLENNAN | ROBINSON | 181 | 177 | 176 | 174 | 172 | 170 | 169 | 165 | 150 | 140 | 140 | 140 | 140 |
| FISHER | ROBY | 175 | 172 | 170 | 168 | 166 | 165 | 163 | 160 | 145 | 140 | 140 | 140 | 140 |
| MILAM | ROCKDALE | 184 | 180 | 179 | 177 | 175 | 173 | 172 | 168 | 152 | 140 | 140 | 140 | 140 |
| WILLIAMSON | ROUND ROCK | 152 | 149 | 147 | 146 | 145 | 143 | 142 | 140 | 140 | 139 | 139 | 139 | 138 |
| BELL | SALADO WSC | 292 | 286 | 283 | 280 | 278 | 275 | 272 | 267 | 241 | 218 | 197 | 178 | 161 |
| BURLESON | SNOOK | 307 | 301 | 298 | 295 | 292 | 289 | 286 | 280 | 254 | 229 | 207 | 188 | 170 |
| BURLESON | SOMERVILLE | 170 | 167 | 165 | 163 | 162 | 160 | 158 | 155 | 140 | 140 | 140 | 140 | 140 |
| MILAM | SOUTHWEST MILAM WSC | 152 | 149 | 147 | 146 | 145 | 143 | 142 | 140 | 140 | 137 | 136 | 136 | 136 |
| JONES | STAMFORD | 237 | 232 | 230 | 228 | 225 | 223 | 221 | 217 | 196 | 177 | 160 | 145 | 140 |
| PALO PINTO | STRAWN | 182 | 178 | 177 | 175 | 173 | 171 | 170 | 166 | 150 | 140 | 140 | 140 | 140 |
| NOLAN | SWEETWATER | 153 | 150 | 148 | 147 | 146 | 144 | 143 | 140 | 138 | 135 | 134 | 134 | 134 |
| WILLIAMSON | TAYLOR | 157 | 154 | 152 | 151 | 149 | 148 | 146 | 143 | 140 | 140 | 139 | 139 | 139 |
| BELL | TEMPLE | 229 | 224 | 222 | 220 | 218 | 216 | 213 | 209 | 189 | 171 | 155 | 140 | 140 |
| BRAZOS | TEXAS A & M UNIVERSITY | 487 | 477 | 473 | 468 | 463 | 459 | 454 | 445 | 402 | 364 | 329 | 298 | 269 |
| THROCKMORTON | THROCKMORTON | 205 | 201 | 199 | 197 | 195 | 193 | 191 | 187 | 169 | 153 | 140 | 140 | 140 |
| BOSQUE | VALLEY MILLS | 184 | 180 | 179 | 177 | 175 | 173 | 172 | 168 | 152 | 140 | 140 | 140 | 140 |
| JOHNSON | VENUS | 174 | 171 | 169 | 167 | 165 | 164 | 162 | 159 | 144 | 140 | 140 | 140 | 140 |
| MCLENNAN | WACO | 220 | 216 | 213 | 211 | 209 | 207 | 205 | 201 | 182 | 164 | 149 | 140 | 140 |
| BRAZOS | WELLBORN SUD | 186 | 182 | 180 | 179 | 177 | 175 | 173 | 170 | 154 | 140 | 140 | 140 | 140 |
| MCLENNAN | WEST | 160 | 157 | 155 | 154 | 152 | 151 | 149 | 146 | 140 | 140 | 140 | 140 | 140 |
| BELL | WEST BELL COUNTY WSC | 149 | 146 | 145 | 143 | 142 | 140 | 139 | 138 | 134 | 131 | 131 | 130 | 130 |
| HILL | WHITE BLUFF COMMUNITY WS | 198 | 194 | 192 | 190 | 188 | 186 | 185 | 181 | 164 | 148 | 140 | 140 | 140 |
| HILL | WHITNEY | 180 | 176 | 175 | 173 | 171 | 169 | 168 | 164 | 149 | 140 | 140 | 140 | 140 |
| WILLIAMSON | WILLIAMSON COUNTY MUD #10 | 196 | 192 | 190 | 188 | 186 | 185 | 183 | 179 | 162 | 146 | 140 | 140 | 140 |
| WILLIAMSON | WILLIAMSON COUNTY MUD #11 | 185 | 181 | 180 | 178 | 176 | 174 | 172 | 169 | 153 | 140 | 140 | 140 | 140 |
| WILLIAMSON | WILLIAMSON COUNTY MUD #9 | 188 | 184 | 182 | 181 | 179 | 177 | 175 | 172 | 155 | 140 | 140 | 140 | 140 |
| WILLIAMSON | WILLIAMSON COUNTY-OTHER | 148 | 145 | 144 | 142 | 141 | 139 | 139 | 139 | 135 | 134 | 133 | 133 | 133 |
| MCLENNAN | WOODWAY | 352 | 345 | 342 | 338 | 335 | 331 | 328 | 322 | 291 | 263 | 238 | 215 | 195 |

### Table 2.1-4. Estimated Water Savings for WUGs with Recommended Conservation

| County Name | Water User Group | Projected Water Needs | | | | | | Additional Water Saved-W/Conservation (acft)* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| TAYLOR | ABILENE | - | (8,445) | (9,115) | (9,802) | (10,587) | (11,314) | 710 | 2,331 | 2,246 | 2,045 | 2,040 | 2,067 |
| SHACKELFORD | ALBANY | - | - | - | - | - | - | 32 | 85 | 133 | 181 | 225 | 267 |
| LEE | AQUA WSC | - | - | - | - | - | - | 14 | 12 | 5 | 1 | 1 | 0 |
| BELL | ARMSTRONG WSC | - | - | - | - | - | - | 14 | 39 | 32 | 29 | 30 | 32 |
| STONEWALL | ASPERMONT | - | - | - | - | - | - | 13 | 30 | 48 | 66 | 82 | 95 |
| CALLAHAN | BAIRD | - | - | - | - | - | - | 6 | - | - | - | - | - |
| WILLIAMSON | BARTLETT | (281) | (309) | (344) | (383) | (428) | (472) | 12 | 40 | 61 | 62 | 68 | 73 |
| BELL | BELL COUNTY-OTHER | - | - | (768) | (1,828) | (2,824) | (3,788) | 14 | 62 | 73 | 94 | 117 | 138 |
| BELL | BELTON | - | - | - | - | - | - | 119 | 340 | 318 | 321 | 347 | 379 |
| JOHNSON | BETHESDA WSC | (1,486) | (1,981) | (2,560) | (3,139) | (3,778) | (4,475) | 126 | 410 | 763 | 1,018 | 1,138 | 1,271 |
| STEPHENS | BRECKENRIDGE | - | - | - | - | - | - | 30 | 51 | 29 | 17 | 15 | 15 |
| ROBERTSON | BREMOND | - | - | - | - | - | - | 6 | 20 | 22 | 23 | 23 | 25 |
| WASHINGTON | BRENHAM | - | (217) | (400) | (605) | (780) | (928) | 190 | 531 | 889 | 1,272 | 1,508 | 1,553 |
| MCLENNAN | BRUCEVILLE-EDDY | - | - | - | - | - | - | 11 | 33 | 38 | 36 | 38 | 40 |
| WILLIAMSON | BRUSHY CREEK MUD | (877) | (1,204) | (1,170) | (1,150) | (1,146) | (1,145) | 197 | 589 | 947 | 1,282 | 1,599 | 1,623 |
| BRAZOS | BRYAN | (6,123) | (5,019) | (10,156) | (16,498) | (23,413) | (31,201) | 493 | 1,573 | 1,616 | 1,697 | 1,899 | 2,143 |
| BURLESON | CALDWELL | - | - | - | - | - | - | 40 | 121 | 203 | 240 | 242 | 246 |
| ROBERTSON | CALVERT | - | - | - | - | - | - | 3 | - | - | - | - | - |
| MILAM | CAMERON | - | - | - | - | - | - | 58 | 163 | 269 | 389 | 448 | 464 |
| WILLIAMSON | CEDAR PARK | (2,075) | (3,854) | (4,082) | (4,159) | (4,244) | (4,348) | 1,149 | 3,048 | 5,001 | 6,657 | 8,166 | 8,521 |
| WILLIAMSON | CHISHOLM TRAIL SUD | (2,392) | (3,577) | (5,070) | (6,685) | (8,512) | (10,401) | 209 | 747 | 1,055 | 1,248 | 1,477 | 1,720 |
| EASTLAND | CISCO | - | - | - | - | - | - | 23 | 67 | 52 | 44 | 42 | 42 |
| JOHNSON | CLEBURNE | - | - | - | - | (1,092) | (2,373) | 207 | 685 | 736 | 749 | 809 | 883 |
| BOSQUE | CLIFTON | - | - | - | - | - | - | 21 | 74 | 77 | 71 | 71 | 71 |
| BRAZOS | COLLEGE STATION | (4,973) | (8,024) | (7,372) | (7,673) | (8,085) | (8,401) | 679 | 2,585 | 3,465 | 3,823 | 4,332 | 4,926 |
| LIMESTONE | COOLIDGE | (72) | (12) | (38) | (70) | (105) | (140) | 5 | 4 | 1 | - | - | - |
| CORYELL | CORYELL CITY WATER SUPPLY DISTRICT | - | - | - | - | - | - | 34 | 21 | 9 | 1 | - | - |
| MCLENNAN | CRAWFORD | (5) | (3) | (3) | (3) | (5) | (7) | 7 | 16 | 27 | 28 | 28 | 29 |
| MCLENNAN | CROSS COUNTRY WSC | - | - | - | (138) | (139) | (141) | 20 | 24 | 14 | 10 | 8 | 8 |
| CALLAHAN | CROSS PLAINS | - | - | - | - | - | - | 5 | 10 | 5 | 5 | 5 | 4 |
| JOHNSON | CROWLEY | (9) | (12) | (17) | (23) | (29) | (35) | 1 | - | - | - | - | - |
| EASTLAND | EASTLAND | - | - | - | - | - | - | 4 | - | - | - | - | - |
| WILLIAMSON | FERN BLUFF MUD | (63) | (161) | (253) | (261) | (259) | (259) | 63 | 161 | 253 | 261 | 259 | 259 |
| BELL | FORT HOOD | - | - | - | - | - | - | 293 | 842 | 1,376 | 1,946 | 2,134 | 2,133 |
| JOHNSON | FORT WORTH | - | - | - | (759) | (1,238) | (1,573) | - | - | - | 167 | 265 | 331 |
| CORYELL | GATESVILLE | - | (629) | (1,406) | (2,356) | (3,152) | (3,995) | 208 | 610 | 1,097 | 1,644 | 2,261 | 2,462 |
| WILLIAMSON | GEORGETOWN | - | (2,194) | (6,695) | (11,781) | (17,840) | (24,121) | 734 | 2,507 | 5,068 | 8,141 | 9,756 | 11,442 |
| LEE | GIDDINGS | - | - | - | - | - | - | 39 | 131 | 231 | 230 | 232 | 233 |
| SOMERVELL | GLEN ROSE | - | - | - | - | (14) | (39) | 24 | 73 | 128 | 167 | 172 | 178 |
| YOUNG | GRAHAM | - | - | - | - | - | - | 140 | 354 | 568 | 795 | 1,029 | 1,260 |

## Table 2.1-4 (Continued)

| County Name | Water User Group | Projected Water Needs | | | | | | Additional Water Saved-W/Conservation (acft)* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| LIMESTONE | GROESBECK | (688) | (677) | (668) | (665) | (668) | (672) | 2 | - | - | - | - | - |
| HAMILTON | HAMILTON | - | - | - | - | - | - | 18 | 32 | 20 | 14 | 13 | 13 |
| JONES | HAMLIN | - | - | - | - | - | - | 14 | 43 | 57 | 57 | 58 | 58 |
| BELL | HARKER HEIGHTS | - | - | (938) | (1,496) | (1,974) | (3,170) | 262 | 836 | 1,367 | 1,499 | 1,656 | 1,819 |
| ROBERTSON | HEARNE | - | - | - | - | - | - | 22 | 35 | 16 | 14 | 12 | 12 |
| MCLENNAN | HEWITT | (87) | (237) | (211) | (204) | (216) | (231) | 87 | 237 | 211 | 204 | 216 | 231 |
| HILL | HILLSBORO | - | - | - | - | - | - | 79 | 230 | 385 | 495 | 506 | 517 |
| KENT | JAYTON | (92) | (91) | (89) | (89) | (88) | (88) | 3 | 6 | 4 | 4 | 3 | 3 |
| LAMPASAS | KEMPNER | (7) | (10) | (6) | (6) | (5) | (5) | 7 | 10 | 6 | 6 | 5 | 5 |
| CORYELL | KEMPNER WSC | (536) | (814) | (1,076) | (1,344) | (1,612) | (1,868) | 94 | 225 | 211 | 209 | 219 | 232 |
| KNOX | KNOX CITY | (48) | (83) | (118) | (154) | (190) | (226) | 9 | 25 | 45 | 54 | 54 | 55 |
| LAMPASAS | LAMPASAS | (49) | (148) | (227) | (318) | (414) | (505) | 27 | - | - | - | - | - |
| LEE | LEXINGTON | - | - | - | - | - | - | 8 | 26 | 23 | 21 | 21 | 21 |
| BELL | LITTLE RIVER-ACADEMY | - | (21) | (59) | (102) | (146) | (190) | 12 | 19 | 13 | 11 | 11 | 11 |
| LAMPASAS | LOMETA | - | - | - | - | - | - | 7 | 21 | 26 | 27 | 28 | 29 |
| MCLENNAN | LORENA | - | - | - | - | - | - | 10 | 3 | - | - | - | - |
| JOHNSON | MANSFIELD | (43) | (144) | (293) | (490) | (738) | (1,024) | 43 | 144 | 293 | 490 | 738 | 1,024 |
| FALLS | MARLIN | - | - | - | - | - | - | 86 | 226 | 357 | 480 | 619 | 756 |
| PALO PINTO | MINERAL WELLS | (1,931) | (1,884) | (1,816) | (1,803) | (1,735) | (1,616) | 70 | 31 | - | - | - | - |
| JOHNSON | MOUNTAIN PEAK SUD | - | - | - | - | - | - | 34 | 99 | 184 | 288 | 413 | 555 |
| KNOX | MUNDAY | (55) | (91) | (125) | (164) | (200) | (237) | 8 | 26 | 36 | 37 | 36 | 37 |
| GRIMES | NAVASOTA | - | - | - | - | - | - | 55 | 158 | 238 | 229 | 231 | 235 |
| BELL | NOLANVILLE | (72) | (444) | (858) | (1,330) | (1,758) | (2,188) | 67 | 224 | 444 | 720 | 884 | 1,003 |
| MCLENNAN | NORTH BOSQUE WSC | (14) | (146) | (265) | (385) | (507) | (628) | 33 | 99 | 183 | 280 | 390 | 452 |
| WILLIAMSON | PFLUGERVILLE | - | - | - | - | - | - | 3 | 5 | 5 | 6 | 7 | 8 |
| PALO PINTO | POSSUM KINGDOM WSC | (60) | (110) | (142) | (173) | (199) | (221) | 53 | 126 | 198 | 271 | 342 | 410 |
| EASTLAND | RANGER | - | - | - | - | - | - | 15 | 46 | 39 | 37 | 36 | 36 |
| MCLENNAN | ROBINSON | - | (346) | (720) | (1,109) | (1,511) | (1,909) | 91 | 316 | 507 | 549 | 605 | 663 |
| FISHER | ROBY | - | - | - | - | - | - | 5 | 13 | 14 | 13 | 12 | 12 |
| MILAM | ROCKDALE | - | - | - | - | - | - | 43 | 128 | 198 | 195 | 200 | 207 |
| WILLIAMSON | ROUND ROCK | (2,116) | (8,201) | (16,000) | (24,896) | (35,190) | (45,861) | 513 | 117 | - | - | - | - |
| BELL | SALADO WSC | - | - | - | - | (112) | (278) | 97 | 255 | 431 | 624 | 830 | 1,044 |
| BURLESON | SNOOK | - | - | - | - | - | - | 11 | 26 | 42 | 59 | 76 | 91 |
| BURLESON | SOMERVILLE | - | - | - | - | - | - | 8 | 26 | 23 | 23 | 23 | 24 |
| MILAM | SOUTHWEST MILAM WSC | - | - | - | - | - | - | 33 | - | - | - | - | - |
| JONES | STAMFORD | (1,834) | (1,865) | (1,885) | (1,910) | (1,932) | (1,951) | 40 | 105 | 172 | 246 | 316 | 344 |
| PALO PINTO | STRAWN | - | - | - | - | - | - | 5 | 16 | 22 | 22 | 22 | 22 |
| NOLAN | SWEETWATER | (1,349) | (1,390) | (1,410) | (1,474) | (1,527) | (1,576) | 39 | - | - | - | - | - |
| WILLIAMSON | TAYLOR | (13) | (14) | (16) | (18) | (20) | (21) | 75 | 73 | 17 | - | - | - |
| BELL | TEMPLE | - | - | (1,904) | (4,373) | (8,268) | (11,600) | 914 | 2,740 | 5,015 | 7,724 | 10,771 | 11,850 |
| BRAZOS | TEXAS A & M UNIVERSITY | - | - | - | - | - | - | 416 | 942 | 1,418 | 1,869 | 2,289 | 2,670 |

## Table 2.1-4 (Concluded)

| County Name | Water User Group | Projected Water Needs | | | | | | Additional Water Saved-W/Conservation (acft)* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| THROCKMORTON | THROCKMORTON | - | - | - | - | - | - | 8 | 20 | 32 | 45 | 44 | 44 |
| BOSQUE | VALLEY MILLS | - | - | - | - | - | (2) | 10 | 31 | 48 | 47 | 48 | 48 |
| JOHNSON | VENUS | (24) | (117) | (237) | (355) | (478) | (604) | 30 | 90 | 115 | 127 | 140 | 156 |
| MCLENNAN | WACO | - | - | - | - | - | (1,348) | 1,462 | 4,033 | 6,781 | 9,781 | 11,940 | 12,554 |
| BRAZOS | WELLBORN SUD | - | - | (202) | (625) | (1,216) | (1,867) | 78 | 279 | 508 | 563 | 633 | 713 |
| MCLENNAN | WEST | - | - | - | - | - | - | 15 | 23 | 13 | 7 | 6 | 6 |
| HILL | WHITE BLUFF COMMUNITY WS | - | - | - | - | - | - | 24 | 63 | 103 | 125 | 128 | 132 |
| HILL | WHITNEY | - | - | - | - | - | - | 17 | 50 | 70 | 68 | 69 | 71 |
| WILLIAMSON | WILLIAMSON COUNTY MUD #10 | (61) | (181) | (352) | (489) | (587) | (688) | 61 | 181 | 352 | 489 | 587 | 688 |
| WILLIAMSON | WILLIAMSON COUNTY MUD #11 | (35) | (103) | (193) | (233) | (278) | (326) | 35 | 103 | 193 | 233 | 278 | 326 |
| WILLIAMSON | WILLIAMSON COUNTY MUD #9 | (37) | (128) | (263) | (319) | (382) | (448) | 37 | 128 | 263 | 319 | 382 | 448 |
| MCLENNAN | WOODWAY | - | (7) | (20) | (57) | (74) | (103) | 208 | 512 | 832 | 1,180 | 1,541 | 1,906 |

* Note: This conservation is in addition to savings attributed to the 1991 Water Efficient Plumbing Fixtures Act.

## 2.1.4 Additional Advanced Conservation

While a goal of 140 gpcd or less was chosen as a standard for all WUGs in Region G, an additional advanced conservation goal of 120 gpcd was used for select WUGs in Williamson County. Rather than applying a 1% per year reduction until a gpcd of 140 or less was achieved, the annual reduction rate was calculated to bring the gpcd of each WUG to 120 by 2070 and that rate was applied over the planning period. The annual reduction rate and projected gpcd for each WUG are shown in Table 2.1-5. The additional water savings achieved above and beyond advanced conservation goals of 140 gpcd are shown in Table 2.1-6. A total savings of 17,909 acft/yr in 2070 is estimated for Williamson County.

**Table 2.1-5. Projected Reduction Rates and Decadal GPCDs for Additional Advanced Conservation for selected WUGs in Williamson County**

| Participating WUG | Base GPCD | Annual Reduction Rate | Projected with Additional Advanced Conservation (GPCD) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | *2020* | *2030* | *2040* | *2050* | *2060* | *2070* |
| BARTLETT | 181 | 0.694% | 170 | 159 | 148 | 138 | 129 | 120 |
| BRUSHY CREEK MUD | 231 | 1.104% | 209 | 187 | 167 | 150 | 134 | 120 |
| CHISHOLM TRAIL SUD | 174 | 0.628% | 164 | 154 | 145 | 136 | 128 | 120 |
| WILLIAMSON COUNTY-OTHER | 148 | 0.355% | 143 | 138 | 134 | 129 | 124 | 120 |
| GEORGETOWN | 205 | 0.904% | 189 | 173 | 158 | 144 | 131 | 120 |
| ROUND ROCK | 152 | 0.400% | 147 | 141 | 135 | 130 | 125 | 120 |

**Table 2.1-6. Estimated Water Savings for Reductions Identified for WUGs in Williamson County with Additional Advanced Conservation**

| Participating WUG | Estimated Water Savings (acft/yr) | | | | | |
|---|---|---|---|---|---|---|
| | *2020* | *2030* | *2040* | *2050* | *2060* | *2070* |
| BARTLETT | 0 | 0 | 0 | 6 | 35 | 68 |
| BRUSHY CREEK MUD | 39 | 81 | 111 | 135 | 152 | 430 |
| CHISHOLM TRAIL SUD | 0 | 0 | 6 | 503 | 1,159 | 1,967 |
| WILLIAMSON COUNTY-OTHER | 0 | 0 | 56 | 567 | 1,432 | 2,594 |
| GEORGETOWN | 0 | 0 | 0 | 0 | 1,612 | 4,404 |
| ROUND ROCK | 0 | 0 | 1,060 | 2,825 | 5,310 | 8,446 |
| **Total** | **39** | **81** | **1,234** | **4,036** | **9,700** | **17,909** |

## 2.1.5 Environmental Issues

No substantial environmental impacts are anticipated, as water conservation is typically a non-capital intensive alternative that is not associated with direct physical impacts to the natural environment. A summary of the few potential environmental issues that might arise for this alternative are presented in Table 2.1-7.

**Table 2.1-7. Environmental Issues: Municipal Water Conservation**

| Water Management Option | Municipal Water Conservation |
|---|---|
| Implementation Measures | Voluntary reduction, reduced diversions, changing water pricing, mandatory restrictions (landscaping ordinances, watering days), reducing unaccounted for water |
| Environmental Water Needs / Instream Flows | No substantial impact identified, assuming relatively low reduction in diversions and return flows; substantial reductions in municipal and industrial diversions from water conservation would potentially result in low to moderate positive impacts as more stream flow would be available for environmental water needs and instream flows |
| Bays and Estuaries | No substantial impact identified, assuming relatively low reduction in diversions and return flows |
| Fish and Wildlife Habitat | No substantial impact identified, assuming relatively low reductions in diversions and return flows; potential low to moderate positive impact to aquatic and riparian habitats with substantial reductions as more stream flow would be available to these habitats; potential moderate positive benefits from implementation of site-specific xeriscape landscaping |
| Cultural Resources | No substantial impacts anticipated. |
| Threatened and Endangered Species | No substantial impact identified, assuming relatively low reduction in diversions and return flows; potential low to moderate positive impact to aquatic and riparian threatened and endangered species (where they occur) with substantial diversion reductions |
| Comments | Assumes no substantial change in infrastructure with attendant landscape impacts; further assumes that infrastructure improvements which do occur will largely be in urbanized settings |

## 2.1.6 Engineering and Costing

The TWDB requires that costs and water supply estimates be developed for each recommended water management strategy. However, the Task Force Report does not present methods for computing water savings and costs for each of the above BMPs, reducing the list of specific BMPs that can be used to compute costs and savings. Eleven of the twenty-one BMPs suggested by the Task Force and listed above were averaged to calculate program costs. These eleven BMPs included indoor practices, such as toilet retrofits, showerhead replacements, and clothes washer rebates, as well as outdoor conservation measures such as landscape incentives, rainwater harvesting and rain barrels. The Brazos G RWPG also considered water loss data provided by the TWDB for Brazos G entities and prepared costs of a pipeline replacement program to reduce water losses. Due to the high cost, the Brazos G RWPG did not specifically recommend pipeline replacement programs but supports it as a BMP that may be selected by municipal water user groups to reduce water use, as discussed in more detail below.

Based upon the costs obtained for the selected BMPs from the GDS Associates report[4] the cost per acft of water saved by implementing water conservation practices would range between $53 and $1,022 depending on which of the eleven BMPs were selected. An average cost of $496 per acre-foot is assumed in rural areas for purposes of assigning a cost to the water conservation strategy. An average cost of $474 and $470 per acre-foot was estimated for urban and suburban areas respectively. This is the cost associated with water savings above those already included in the TWDB water demand projections. The total program costs for municipal entities having per capita use greater than 140 gpcd in 2011 are presented in Table 2.1-8 and are based on the water savings presented in Table 2.1-4.Total Brazos G costs for water conservation are estimated at $5,378,087 in 2020 and increasing to $40,904,532 by 2070, with unit costs ranging from $470 to $496 per acft of water saved.

**Table 2.1-8. Estimated Cost of Conservation to Achieve Water Savings Identified in Table 2.1-4**

| Water User Group | Costs of Water Savings* | | | | | |
|---|---|---|---|---|---|---|
| | *2020* | *2030* | *2040* | *2050* | *2060* | *2070* |
| ABILENE | $336,623 | $1,104,672 | $1,064,615 | $969,390 | $966,734 | $979,948 |
| ALBANY | $16,003 | $42,127 | $65,953 | $89,590 | $111,837 | $132,492 |
| AQUA WSC | $6,829 | $5,718 | $2,406 | $618 | $278 | $162 |
| ARMSTRONG WSC | $6,346 | $18,348 | $15,188 | $13,609 | $14,127 | $14,792 |
| ASPERMONT | $6,504 | $15,029 | $23,724 | $32,932 | $40,765 | $47,354 |
| BAIRD | $3,173 | - | - | - | - | - |
| BARTLETT | $5,830 | $18,658 | $28,452 | $29,092 | $31,883 | $34,058 |
| BELL COUNTY-OTHER | $6,762 | $30,916 | $36,038 | $46,618 | $57,932 | $68,629 |
| BELTON | $55,986 | $159,689 | $149,042 | $150,590 | $162,667 | $177,675 |
| BETHESDA WSC | $59,177 | $192,296 | $357,847 | $477,508 | $533,580 | $596,148 |
| BRECKENRIDGE | $15,016 | $25,378 | $14,283 | $8,313 | $7,633 | $7,624 |
| BREMOND | $2,881 | $9,157 | $10,241 | $10,685 | $10,953 | $11,838 |
| BRENHAM | $94,145 | $263,574 | $441,051 | $630,708 | $747,825 | $770,052 |
| BRUCEVILLE-EDDY | $5,145 | $15,388 | $17,628 | $16,969 | $17,716 | $18,610 |
| BRUSHY CREEK MUD | $92,525 | $276,227 | $444,326 | $601,392 | $750,047 | $761,359 |

[4] "Quantifying the Effectiveness of Various Water Conservation Techniques in Texas," Texas Water Development Board, prepared by GDS Associates, Austin, Texas, July 2003.

## Table 2.1-8 (Continued)

| Water User Group | Costs of Water Savings* | | | | | |
|---|---|---|---|---|---|---|
| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| BRYAN | $233,851 | $745,799 | $766,035 | $804,443 | $900,310 | $1,015,578 |
| CALDWELL | $18,780 | $56,522 | $95,335 | $112,547 | $113,634 | $115,282 |
| CALVERT | $1,440 | - | - | - | - | - |
| CAMERON | $29,006 | $80,883 | $133,608 | $192,894 | $222,241 | $230,338 |
| CEDAR PARK | - | $673,483 | $1,321,567 | $1,925,335 | $1,937,258 | $1,936,320 |
| CHISHOLM TRAIL SUD | $98,166 | $350,421 | $494,775 | $585,447 | $692,758 | $806,494 |
| CISCO | $11,463 | $33,426 | $25,675 | $21,629 | $20,637 | $20,637 |
| CLEBURNE | $96,961 | $321,130 | $345,303 | $351,235 | $379,401 | $414,341 |
| CLIFTON | $10,205 | $36,637 | $38,226 | $35,311 | $35,166 | $35,216 |
| COLLEGE STATION | $321,615 | $1,225,425 | $1,642,442 | $1,812,264 | $2,053,396 | $2,335,020 |
| COOLIDGE | $2,502 | $2,214 | $621 | - | - | $66 |
| CORYELL CITY WATER SUPPLY DISTRICT | $15,817 | $9,934 | $4,231 | $283 | - | - |
| CRAWFORD | $3,242 | $7,681 | $12,789 | $13,120 | $13,322 | $13,525 |
| CROSS COUNTRY WSC | $9,228 | $11,303 | $6,449 | $4,896 | $3,931 | $3,877 |
| CROSS PLAINS | $2,369 | $4,750 | $2,631 | $2,486 | $2,311 | $2,029 |
| CROWLEY | $469 | - | - | $181 | $160 | - |
| EASTLAND | $2,077 | - | - | - | - | - |
| FERN BLUFF MUD | $29,403 | $75,494 | $118,517 | $122,288 | $121,350 | $121,350 |
| FORT HOOD | $137,245 | $394,722 | $645,330 | $912,670 | $1,001,051 | $1,000,582 |
| FORT WORTH | - | - | - | $78,276 | $124,491 | $155,145 |
| GATESVILLE | $97,750 | $286,113 | $514,585 | $771,162 | $1,060,445 | $1,154,452 |
| GEORGETOWN | $344,326 | $1,175,793 | $2,376,874 | $3,817,976 | $4,575,506 | $5,366,079 |
| GIDDINGS | $19,176 | $65,196 | $114,817 | $114,060 | $114,869 | $115,707 |
| GLEN ROSE | $12,050 | $36,451 | $63,389 | $82,613 | $85,252 | $88,240 |
| GRAHAM | $69,343 | $175,368 | $281,897 | $394,160 | $510,323 | $624,943 |
| GROESBECK | $3,522 | - | - | - | - | $5 |
| HAMILTON | $8,825 | $15,657 | $9,705 | $6,729 | $6,233 | $6,233 |
| HAMLIN | $6,394 | $20,227 | $26,525 | $26,738 | $27,116 | $27,366 |
| HARKER HEIGHTS | $122,989 | $392,267 | $641,026 | $703,240 | $776,607 | $853,016 |
| HEARNE | $10,503 | $16,293 | $7,382 | $6,444 | $5,506 | $5,506 |

### Table 2.1-8 (Continued)

| Water User Group | Costs of Water Savings* | | | | | |
|---|---|---|---|---|---|---|
| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| HEWITT | $40,674 | $111,188 | $98,860 | $95,498 | $101,093 | $108,545 |
| HILLSBORO | $39,267 | $114,266 | $191,147 | $245,305 | $250,796 | $256,413 |
| JAYTON | $1,683 | $3,133 | $2,141 | $2,141 | $1,645 | $1,645 |
| KEMPNER | $3,216 | $4,597 | $3,017 | $2,624 | $2,175 | $2,388 |
| KEMPNER WSC | $44,241 | $105,579 | $99,117 | $97,896 | $102,790 | $108,831 |
| KNOX CITY | $4,335 | $12,590 | $22,470 | $26,626 | $26,743 | $27,172 |
| LAMPASAS | $12,459 | - | - | - | - | - |
| LEXINGTON | $3,807 | $12,899 | $11,384 | $10,568 | $10,267 | $10,248 |
| LITTLE RIVER-ACADEMY | $5,503 | $8,832 | $6,060 | $5,045 | $4,941 | $5,130 |
| LOMETA | $3,338 | $9,930 | $12,391 | $12,678 | $13,157 | $13,683 |
| LORENA | $4,498 | $1,450 | - | - | $18 | - |
| MANSFIELD | $20,081 | $67,696 | $137,417 | $229,991 | $346,010 | $480,043 |
| MARLIN | $40,333 | $105,891 | $167,336 | $225,048 | $290,278 | $354,582 |
| MINERAL WELLS | $34,739 | $15,260 | - | - | - | - |
| MOUNTAIN PEAK SUD | $15,966 | $46,340 | $86,199 | $135,163 | $193,731 | $260,510 |
| MUNDAY | $4,100 | $12,793 | $17,808 | $18,140 | $18,024 | $18,296 |
| NAVASOTA | $25,906 | $73,939 | $111,629 | $107,182 | $108,371 | $110,093 |
| NOLANVILLE | $31,501 | $104,969 | $208,031 | $337,913 | $414,432 | $470,584 |
| NORTH BOSQUE WSC | $15,579 | $46,435 | $85,732 | $131,201 | $182,773 | $212,152 |
| PFLUGERVILLE | $1,575 | $2,191 | $2,240 | $2,813 | $3,249 | $3,712 |
| POSSUM KINGDOM WSC | $26,130 | $62,376 | $98,262 | $134,332 | $169,773 | $203,321 |
| RANGER | $7,293 | $22,670 | $19,331 | $18,339 | $17,843 | $17,843 |
| ROBINSON | $42,815 | $148,282 | $237,744 | $257,348 | $283,564 | $310,920 |
| ROBY | $2,461 | $6,476 | $7,133 | $6,637 | $6,141 | $6,141 |
| ROCKDALE | $21,168 | $63,641 | $98,113 | $96,767 | $99,419 | $102,896 |
| ROUND ROCK | $240,748 | $55,060 | - | - | - | - |
| SALADO WSC | $45,338 | $119,671 | $201,992 | $292,881 | $389,490 | $489,869 |
| SNOOK | $5,254 | $13,015 | $20,682 | $29,093 | $37,506 | $45,042 |
| SOMERVILLE | $3,600 | $12,079 | $10,912 | $10,776 | $10,878 | $11,173 |

### Table 2.1-8 (Concluded)

| Water User Group | Costs of Water Savings* | | | | | |
|---|---|---|---|---|---|---|
| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| SOUTHWEST MILAM WSC | $16,195 | - | - | - | - | - |
| STAMFORD | $18,661 | $49,470 | $80,756 | $115,175 | $148,312 | $161,194 |
| STRAWN | $2,367 | $7,766 | $10,919 | $10,910 | $10,949 | $10,960 |
| SWEETWATER | $19,112 | - | - | - | - | - |
| TAYLOR | $35,322 | $34,307 | $7,795 | - | - | - |
| TEMPLE | $433,105 | $1,298,837 | $2,376,991 | $3,660,947 | $5,105,344 | $5,616,738 |
| TEXAS A & M | $197,306 | $446,413 | $672,095 | $885,715 | $1,084,774 | $1,265,612 |
| THROCKMORTON | $3,810 | $10,093 | $16,082 | $22,163 | $21,667 | $21,667 |
| VALLEY MILLS | $4,964 | $15,285 | $24,035 | $23,278 | $23,609 | $23,726 |
| VENUS | $14,167 | $42,387 | $53,747 | $59,395 | $65,882 | $73,353 |
| WACO | $692,979 | $1,911,441 | $3,214,161 | $4,636,431 | $5,659,560 | $5,950,518 |
| WELLBORN SUD | $36,916 | $132,294 | $240,674 | $266,767 | $299,871 | $338,053 |
| WEST | $7,053 | $10,847 | $6,131 | $3,292 | $2,797 | $2,919 |
| WHITE BLUFF COMMUNITY WS | $12,066 | $31,494 | $50,907 | $62,069 | $63,646 | $65,242 |
| WHITNEY | $8,221 | $24,741 | $34,588 | $33,676 | $34,135 | $35,186 |
| WILLIAMSON COUNTY MUD #10 | $28,790 | $84,888 | $164,908 | $229,529 | $275,123 | $322,722 |
| WILLIAMSON COUNTY MUD #11 | $16,424 | $48,391 | $90,396 | $109,405 | $130,578 | $153,104 |
| WILLIAMSON COUNTY MUD #9 | $17,349 | $60,235 | $123,352 | $149,669 | $179,092 | $210,097 |
| WOODWAY | $97,676 | $240,256 | $390,206 | $553,223 | $722,666 | $894,110 |
| **Total Brazos G:** | $4,841,756 | $14,202,763 | $21,875,416 | $29,330,089 | $35,150,363 | $38,844,520 |

* Note: This conservation is in addition to savings attributed to the 1991 Water Efficient Plumbing Fixtures Act.

### Table 2.1-9 Estimated Costs to Achieve Additional Advanced Conservation Costs for Select WUGs in Williamson County

| Participating WUG | Estimated Additional Advanced Conservation Costs | | | | | | |
|---|---|---|---|---|---|---|---|
| | Type | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| BARTLETT | Suburban | $0 | $0 | $0 | $2,927 | $16,431 | $32,036 |
| BRUSHY CREEK MUD | Suburban | $18,342 | $37,853 | $52,226 | $63,131 | $71,213 | $201,693 |
| CHISHOLM TRAIL SUD | Suburban | $0 | $0 | $3,037 | $236,106 | $543,669 | $922,431 |
| WILLIAMSON COUNTY-OTHER | Suburban | $0 | $0 | $26,294 | $266,037 | $671,598 | $1,216,511 |
| GEORGETOWN | Suburban | $0 | $0 | $0 | $0 | $756,076 | $2,065,489 |
| JONAH WATER SUD | Suburban | $0 | $0 | $0 | $0 | $0 | $0 |
| ROUND ROCK | Suburban | $0 | $0 | $497,240 | $1,324,850 | $2,490,465 | $3,961,318 |
| **Total Brazos G:** | Suburban | $18,342 | $37,853 | $578,797 | $1,893,051 | $4,549,452 | $8,399,478 |

## 2.1.7 Implementation Issues

This water supply option has been compared to the plan development criteria, as shown in Table 2.1-10, and the option meets each criterion.

**Table 2.1-10. Caption Comparison of Municipal Water Conservation Option to Plan Development Criteria**

| Impact Category | Comment(s) |
|---|---|
| A. Water Supply | |
| 1. Quantity | 1. Variable, dependent on current per capita rate |
| 2. Reliability | 2. Variable, dependent on public acceptance |
| 3. Cost | 3. Reasonable |
| B. Environmental factors | |
| 1. Environmental Water Needs | 1. None or low impact |
| 2. Habitat | 2. No apparent negative impact |
| 3. Cultural Resources | 3. None |
| 4. Bays and Estuaries | 4. None or low impact |
| 5. Threatened and Endangered Species | 5. None or low impact |
| 6. Wetlands | 6. None or low impact |
| C. Impact on Other State Water Resources | • No apparent negative impacts on state water resources; no effect on navigation |
| D. Threats to Agriculture and Natural Resources | • None |
| E. Equitable Comparison of Strategies Deemed Feasible | • Option is considered to meet municipal shortages |
| F. Requirements for Interbasin Transfers | • Not applicable |
| G. Third Party Social and Economic Impacts from Voluntary Redistribution | • Not applicable |

### 2.1.8 Water Loss Reduction

The TWDB provided results of their 2010 Water Loss Audit on December 5, 2011 for regional water planning groups to consider when developing the regional water plans (Texas Administrative Code §357.34 (f)(2)D). Furthermore, water management strategy evaluations for the 2016 Brazos G Plan are to take into account anticipated water losses associated with the each strategy when calculating the quantify of water delivered and treated, according to TWDB guidelines (Texas Administrative Code §357.34 (d)(3)A). The reported water losses include both real and apparent losses. Real Loss is water lost through distribution system leakage and line breaks; Apparent Loss includes water that was not read accurately by a meter, unauthorized consumption, including water taken by theft, and data analysis errors. The best opportunity for water savings for Brazos G entities is by implementing water management strategies to reduce Real Loss.

Municipal water entities seeking infrastructure replacement programs to reduce water loss may be eligible for state supported programs, including State Water Implementation Fund for Texas (SWIFT), which has been allocated $2 billion to make financing of water projects more affordable and provide consistent state financial assistance for development of water supply projects identified in the State Water Plan.

The Brazos G RWPG considered TWDB-provided water loss information for Brazos G entities and water conservation BMP for pipeline replacement for municipal entities that report real losses greater than 15% of water system input volume. Ninety-five (95) of the 234 reported entities, or 40%, report real losses exceeding 15%, as shown in Table 2.1-11. The real losses for these entities range from 15% to 99%[5]. For these entities, a water loss program as a water management strategy considered targeted annual replacement of 5% of a utility's existing water main lines. This would replace the entire existing distribution system (100%) in 20 years. Note that this does not deal with new distribution system infrastructure installed to accommodate growth and expansion of the system, but only with losses experienced from a utility's existing distribution system. Real loss information is also presented for Moffat WSC who had a reported real loss of 2% and requested inclusion of analysis of savings and costs associated with the infrastructure replacement program. The Brazos G RWPG supports Moffat WSC's interest in pipe replacement programs as a water conservation BMP.

Some water losses are still expected to occur from the replaced system due to aging, pipe joints, minor connection leaks, and other factors (estimated at 5% of existing system input). For this reason, the full 20-year pipe replacement program is assumed to provide a total water savings to achieve an ultimate real loss of 5% from a utility's existing distribution system after 20 years.

This total water savings is divided by 20 years to calculate the annual water savings expected with annual replacement of 5% of the existing water supply mains. This assumes that losses are distributed uniformly over the existing distribution system. In early years of a main replacement program, however, areas with higher loss rates would be identified and likely replaced first, depending upon coordination with other utilities (sewer, electric, gas, telecommunications) and the municipality's plans for pavement

[5] Ten entities report real losses exceeding 50%, which is likely erroneous data. Each entity should review the submitted data before utilizing this BMP.

replacement. Water savings, therefore, would actually be greater in the early years of the main replacement program because the larger loss areas of a system would be targeted and corrected earliest.

The cost of line replacement, at 5% of the utility's main lines annually, was estimated based on the Unified Costing Model Tool for Regional Water Planning with the following assumptions:

- Entities reporting < 32 connections per mile were assumed to be more rural in nature. The pipeline unit cost was assumed for 12" diameter replacement in soil in a rural environment at a cost of $35 per linear foot[6] (or $184,500 per mile).
- Entities reporting > 32 connections per mile were assumed to be more urban in nature. Pipeline unit cost was assumed for 16" diameter replacement in soil in an urban environment at a cost of $81 per linear foot[7] (or $427,680 per mile).

The total annual cost of pipe replacement varies from $18,480 to $128,019,936 depending on the utility and number of water main line miles reported. The annual unit costs for a 10-year program amortized over 20 years range from $12,710 per acft of water saved to more than $1.8 million per acft of water saved, based strictly upon the loss data and number of miles of pipe reported in data provided by the TWDB. Overall, as shown by this initial analysis, pipe replacement programs are generally more expensive than other water conservation BMPs. Note that the quality of much of these data, including System Input Volume (water supplied), is questionable and can lead to erroneous savings, annual replacement costs, and unit cost estimates. These data should be reviewed individually for each water user group for which this water management strategy is considered.

[6] The unit costs include installed cost of the pipeline and appurtenances, such as markers, valves, thrust restraint systems, corrosion monitoring and control equipment, air and vacuum valves, blow-off valves, erosion control, revegetation of rights-of-way, fencing and gates.

## Table 2.1-11. Summary of Brazos G Water Loss Audit and Estimated Savings and Costs with Pipe replacement Program for WUGs with Real Loss Greater than 15%

| UtilityName | Retail Pop Served 20,608,300 | Main Line Miles | Service Connection Density/ml m Av = 46.6 | Real Loss (gallons) | Real Loss/Input Volume | Total 20 Year Water Savings Needed to Achieve 5% Real Loss (gallons) | Annual Water Savings Needed to Achieve 5% Real Loss in 20 years (gallons) | Amount of Pipe (mi) to Be Replaced Annually to Achieve 100% Replacement in 20 years | Annual Cost ($) | Cost 10 Year Program ($) | Amortized Annual Cost of 10-Year Program ($) | Unit Cost ($ per acft saved) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 439 WSC | 6,459 | 60 | 36 | 55,305,900 | 17% | 39,098,800 | 1,954,940 | 3 | $1,283,040 | $12,830,400 | $1,073,639 | $178,955 |
| ARMSTRONG WSC | 2,526 | 90 | 9 | 18,882,960 | 18% | 13,617,010 | 680,851 | 4.5 | $831,600 | $8,316,000 | $695,877 | $333,043 |
| BELL MILAM FALLS WSC | 4,568 | 170 | 11 | 83,139,703 | 38% | 72,138,925 | 3,606,946 | 8.5 | $1,570,800 | $15,708,000 | $1,314,435 | $118,746 |
| BISTONE MUNICIPAL WATER SUPPLY | 546 | 80 | 3 | 42,455,663 | 77% | 39,707,248 | 1,985,362 | 4 | $739,200 | $7,392,000 | $618,558 | $101,522 |
| BLAIR WSC | 966 | 290 | 1 | 2,716,550 | 17% | 1,935,750 | 96,788 | 14.5 | $2,679,600 | $26,796,000 | $2,242,271 | $7,548,974 |
| BLOCK HOUSE MUD | 5,505 | 17 | 129 | 38,269,190 | 16% | 26,102,524 | 1,305,126 | 0.85 | $363,528 | $3,635,280 | $304,198 | $75,949 |
| BLUEBONNET WSC | 0 | 51 | 0 | 38,883,860 | 99% | 36,910,060 | 1,845,503 | 2.55 | $471,240 | $4,712,400 | $394,330 | $69,625 |
| BRANDON IRENE WSC | 2,069 | 54 | 13 | 109,586,583 | 63% | 100,955,833 | 5,047,792 | 2.7 | $498,960 | $4,989,600 | $417,526 | $26,953 |
| BRUSHY CREEK MUD | 19,630 | 63 | 100 | 266,990,000 | 25% | 212,640,000 | 10,632,000 | 3.15 | $1,347,192 | $13,471,920 | $1,127,321 | $34,550 |
| CADE LAKES WSC | 444 | 12 | 12 | 15,616,970 | 66% | 14,431,384 | 721,569 | 0.6 | $110,880 | $1,108,800 | $92,784 | $41,900 |
| CEDAR CREEK WATER SYSTEM | 4,086 | 83 | 16 | 25,234,185 | 23% | 19,627,907 | 981,395 | 4.15 | $766,920 | $7,669,200 | $641,754 | $213,080 |
| CEDAR SHORES WATER CORPORATION | 636 | 7 | 30 | 2,177,773 | 23% | 1,708,818 | 85,441 | 0.35 | $64,680 | $646,800 | $54,124 | $206,415 |
| CEDRON CREEK RANCH WATER SUPPLY | 283 | 9 | 11 | 2,584,632 | 33% | 2,198,824 | 109,941 | 0.45 | $83,160 | $831,600 | $69,588 | $206,249 |
| CEGO DURANGO WSC | 870 | 119 | 3 | 11,731,736 | 23% | 9,183,316 | 459,166 | 5.95 | $1,099,560 | $10,995,600 | $920,104 | $652,960 |
| CENTRAL BOSQUE WSC | 990 | 60 | 5 | 12,709,814 | 28% | 10,459,109 | 522,955 | 3 | $554,400 | $5,544,000 | $463,918 | $289,065 |
| CENTRAL WASHINGTON COUNTY WSC | 2,049 | 96 | 7 | 11,197,540 | 19% | 8,212,293 | 410,615 | 4.8 | $887,040 | $8,870,400 | $742,269 | $589,042 |
| CHALK BLUFF WSC | 3,438 | 47 | 24 | 26,438,133 | 22% | 20,439,042 | 1,021,952 | 2.35 | $434,280 | $4,342,800 | $363,403 | $115,871 |
| CHAPPELL HILL WSC | 657 | 9 | 24 | 10,790,526 | 39% | 9,390,526 | 469,526 | 0.45 | $83,160 | $831,600 | $69,588 | $48,294 |
| CHATT WSC | 864 | 83 | 3 | 33,215,779 | 98% | 31,529,684 | 1,576,484 | 4.15 | $766,920 | $7,669,200 | $641,754 | $132,647 |
| CITY OF ABBOTT | 356 | 5 | 44 | 3,518,100 | 17% | 2,500,774 | 125,039 | 0.25 | $106,920 | $1,069,200 | $89,470 | $233,159 |
| CITY OF ASPERMONT | 1,000 | 60 | 10 | 15,845,414 | 20% | 11,884,014 | 594,201 | 3 | $554,400 | $5,544,000 | $463,918 | $254,406 |
| CITY OF CALDWELL | 4,104 | 45 | 42 | 64,011,917 | 26% | 51,801,764 | 2,590,088 | 2.25 | $962,280 | $9,622,800 | $805,229 | $101,303 |
| CITY OF CARBON | 660 | 17 | 13 | 3,879,332 | 24% | 3,075,580 | 153,779 | 0.85 | $157,080 | $1,570,800 | $131,443 | $278,523 |
| CITY OF CEDAR PARK | 57,533 | 320 | 59 | 714,613,800 | 19% | 525,802,050 | 26,290,103 | 16 | $6,842,880 | $68,428,800 | $5,726,076 | $70,971 |
| CITY OF CISCO | 3,851 | 150 | 10 | 68,346,017 | 34% | 58,312,349 | 2,915,617 | 7.5 | $1,386,000 | $13,860,000 | $1,159,796 | $129,619 |
| CITY OF COMANCHE | 4,482 | 250 | 7 | 34,416,433 | 21% | 26,222,000 | 1,311,100 | 12.5 | $2,310,000 | $23,100,000 | $1,932,993 | $480,412 |
| CITY OF FLORENCE | 1,148 | 4 | 110 | 8,651,848 | 16% | 5,905,980 | 295,299 | 0.2 | $85,536 | $855,360 | $71,576 | $78,981 |
| CITY OF GEORGETOWN | 51,000 | 360 | 58 | 1,421,950,800 | 29% | 1,180,498,657 | 59,024,933 | 18 | $7,698,240 | $76,982,400 | $6,441,836 | $35,563 |
| CITY OF GOREE | 321 | 10 | 10 | 2,687,439 | 24% | 2,138,804 | 106,940 | 0.5 | $92,400 | $924,000 | $77,320 | $235,596 |
| CITY OF HARKER HEIGHTS | 26,700 | 171 | 55 | 1,718,740,000 | 57% | 1,568,923,500 | 78,446,175 | 8.55 | $3,656,664 | $36,566,640 | $3,059,872 | $12,710 |
| CITY OF HASKELL | 3,106 | 48 | 31 | 34,350,490 | 21% | 26,243,615 | 1,312,181 | 2.4 | $443,520 | $4,435,200 | $371,135 | $92,163 |

## Table 2.1-11 (Continued)

| UtilityName | Retail Pop Served 20,608,300 | Main Line Miles | Service Connection Density/mlm Av = 46.6 | Real Loss (gallons) | Real Loss/Input Volume | Total 20 Year Water Savings Needed to Achieve 5% Real Loss (gallons) | Annual Water Savings Needed to Achieve 5% Real Loss in 20 years (gallons) | Amount of Pipe (mi) to Be Replaced Annually to Achieve 100% Replacement in 20 years | Annual Cost ($) | Cost 10 Year Program ($) | Amortized Annual Cost of 10-Year Program ($) | Unit Cost ($ per acft saved) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CITY OF ITASCA | 1,875 | 9 | 69 | 13,057,987 | 21% | 10,005,366 | 500,268 | 0.45 | $192,456 | $1,924,560 | $161,046 | $104,898 |
| CITY OF JAYTON | 285 | 20 | 14 | 9,308,474 | 28% | 7,673,646 | 383,682 | 1 | $184,800 | $1,848,000 | $154,639 | $131,331 |
| CITY OF KOSSE | 487 | 19 | 13 | 4,380,090 | 26% | 3,526,505 | 176,325 | 0.95 | $175,560 | $1,755,600 | $146,907 | $271,487 |
| CITY OF LUEDERS | 300 | 12 | 15 | 11,438,028 | 50% | 10,301,120 | 515,056 | 0.6 | $110,880 | $1,108,800 | $92,784 | $58,700 |
| CITY OF MALONE | 264 | 2 | 63 | 1,787,971 | 18% | 1,289,277 | 64,464 | 0.1 | $42,768 | $427,680 | $35,788 | $180,901 |
| CITY OF MERKEL | 2,842 | 29 | 42 | 24,456,910 | 24% | 19,424,060 | 971,203 | 1.45 | $620,136 | $6,201,360 | $518,926 | $174,106 |
| CITY OF MEXIA | 10,080 | 85 | 32 | 89,787,530 | 21% | 67,896,830 | 3,394,842 | 4.25 | $785,400 | $7,854,000 | $657,217 | $63,082 |
| CITY OF MOUNT CALM | 310 | 10 | 10 | 1,793,740 | 17% | 1,250,305 | 62,515 | 0.5 | $92,400 | $924,000 | $77,320 | $403,017 |
| CITY OF MUNDAY | 1,300 | 16 | 23 | 28,210,530 | 34% | 24,000,004 | 1,200,000 | 0.8 | $147,840 | $1,478,400 | $123,712 | $33,593 |
| CITY OF OGLESBY | 828 | 30 | 9 | 11,180,567 | 32% | 9,425,497 | 471,275 | 1.5 | $277,200 | $2,772,000 | $231,959 | $160,382 |
| CITY OF ROCKDALE | 5,595 | 60 | 41 | 95,363,980 | 29% | 79,078,071 | 3,953,904 | 3 | $1,283,040 | $12,830,400 | $1,073,639 | $88,481 |
| CITY OF ROSCOE | 1,271 | 20 | 27 | 17,121,050 | 32% | 14,424,111 | 721,206 | 1 | $184,800 | $1,848,000 | $154,639 | $69,868 |
| CITY OF RULE | 636 | 11 | 30 | 9,138,950 | 35% | 7,834,200 | 391,710 | 0.55 | $101,640 | $1,016,400 | $85,052 | $70,752 |
| CITY OF TEHUACANA | 307 | 12 | 14 | 1,584,128 | 16% | 1,077,078 | 53,854 | 0.6 | $110,880 | $1,108,800 | $92,784 | $561,401 |
| CITY OF TOLAR | 954 | 10 | 32 | 6,730,624 | 24% | 5,324,747 | 266,237 | 0.5 | $92,400 | $924,000 | $77,320 | $94,632 |
| CITY OF WEINERT | 177 | 9 | 11 | 6,329,702 | 39% | 5,526,166 | 276,308 | 0.45 | $83,160 | $831,600 | $69,588 | $82,065 |
| CITY OF WOODWAY | 8,733 | 81 | 47 | 127,596,208 | 16% | 87,227,939 | 4,361,397 | 4.05 | $1,732,104 | $17,321,040 | $1,449,413 | $108,289 |
| COMANCHE COUNTY WSC BEATTIE | 948 | 189 | 2 | 7,309,300 | 34% | 6,239,200 | 311,960 | 9.45 | $1,746,360 | $17,463,600 | $1,461,342 | $1,526,413 |
| DOG RIDGE WSC | 4,428 | 6 | 246 | 36,809,990 | 20% | 27,468,559 | 1,373,428 | 0.3 | $128,304 | $1,283,040 | $107,364 | $25,472 |
| EAST BELL WSC | 3,500 | 475 | 2 | 26,326,741 | 24% | 20,880,234 | 1,044,012 | 23.75 | $4,389,000 | $43,890,000 | $3,672,686 | $1,146,298 |
| ELM CREEK WSC | 4,170 | 225 | 6 | 31,125,350 | 22% | 23,946,900 | 1,197,345 | 11.25 | $2,079,000 | $20,790,000 | $1,739,693 | $473,448 |
| FILES VALLEY WSC | 3,024 | 206 | 5 | 44,783,005 | 22% | 34,746,755 | 1,737,338 | 10.3 | $1,903,440 | $19,034,400 | $1,592,786 | $298,739 |
| FORT BELKNAP WSC | 6,156 | 750 | 3 | 42,284,630 | 23% | 32,983,380 | 1,649,169 | 37.5 | $6,930,000 | $69,300,000 | $5,798,978 | $1,145,791 |
| GAUSE WSC | 1,015 | 24 | 14 | 7,689,850 | 34% | 6,551,455 | 327,573 | 1.2 | $221,760 | $2,217,600 | $185,567 | $184,592 |
| H & H WSC | 1,593 | 48 | 11 | 7,294,789 | 16% | 5,068,477 | 253,424 | 2.4 | $443,520 | $4,435,200 | $371,135 | $477,203 |
| HILLTOP WSC | 855 | 35 | 8 | 5,926,441 | 23% | 4,613,311 | 230,666 | 1.75 | $323,400 | $3,234,000 | $270,619 | $382,291 |
| HOG CREEK WSC | 297 | 49 | 5 | 27,870,610 | 55% | 25,345,046 | 1,267,252 | 2.45 | $452,760 | $4,527,600 | $378,867 | $97,419 |
| JARRELL SCHWERTNER WSC | 4,350 | 210 | 7 | 77,351,401 | 37% | 66,878,673 | 3,343,934 | 10.5 | $1,940,400 | $19,404,000 | $1,623,714 | $158,223 |
| JONAH WATER SUD | 13,958 | 390 | 13 | 133,790,000 | 23% | 104,311,500 | 5,215,575 | 19.5 | $3,603,600 | $36,036,000 | $3,015,468 | $188,396 |
| KEMPNER WSC | 14,908 | 360 | 14 | 500,038,950 | 33% | 423,656,014 | 21,182,801 | 18 | $3,326,400 | $33,264,000 | $2,783,509 | $42,818 |
| LAKESHORE WATER SYSTEM | 1,428 | 27 | 18 | 12,103,585 | 42% | 10,663,125 | 533,156 | 1.35 | $249,480 | $2,494,800 | $208,763 | $127,591 |
| LCRA LOMETA REGIONAL WATER SYSTEM | 2,769 | 223 | 4 | 66,622,694 | 45% | 59,291,097 | 2,964,555 | 11.15 | $2,060,520 | $20,605,200 | $1,724,229 | $189,520 |

## Table 2.1-11 (Concluded)

| UtilityName | Retail Pop Served 20,608,300 | Main Line Miles | Service Connection Density/mlm Av = 46.6 | Real Loss (gallons) | Real Loss/Input Volume | Total 20 Year Water Savings Needed to Achieve 5% Real Loss (gallons) | Annual Water Savings Needed to Achieve 5% Real Loss in 20 years (gallons) | Amount of Pipe (mi) to Be Replaced Annually to Achieve 100% Replacement in 20 years | Annual Cost ($) | Cost 10 Year Program ($) | Amortized Annual Cost of 10-Year Program ($) | Unit Cost ($ per acft saved) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LEE COUNTY WSC | 10,000 | 700 | 5 | 44,235,160 | 15% | 29,723,653 | 1,486,183 | 35 | $6,468,000 | $64,680,000 | $5,412,379 | $1,186,684 |
| LEROY TOURS GERALD WSC | 1,557 | 35 | 14 | 8,580,250 | 18% | 6,179,815 | 308,991 | 1.75 | $323,400 | $3,234,000 | $270,619 | $285,385 |
| M & H WATER SUPPLY | 135 | 2 | 23 | 3,101,874 | 47% | 2,772,244 | 138,612 | 0.1 | $18,480 | $184,800 | $15,464 | $36,353 |
| MARLOW WSC | 480 | 29 | 7 | 9,988,863 | 39% | 8,711,389 | 435,569 | 1.45 | $267,960 | $2,679,600 | $224,227 | $167,745 |
| MOFFAT WSC | 4,890 | 80 | 17 | 2,822,389 | 2% | 14,767,143 | 738,357 | 4 | $739,200 | $7,392,000 | $618,558 | $272,981 |
| MORTON VALLEY WSC | 500 | 55 | 4 | 7,221,588 | 28% | 5,933,338 | 296,667 | 2.75 | $508,200 | $5,082,000 | $425,258 | $467,092 |
| MULTI-COUNTY WSC | 3,576 | 400 | 3 | 15,115,000 | 18% | 10,825,550 | 541,278 | 20 | $3,696,000 | $36,960,000 | $3,092,788 | $1,861,870 |
| MURRAY HILL WATER SYSTEM | 1,278 | 35 | 12 | 19,495,186 | 38% | 16,952,231 | 847,612 | 1.75 | $323,400 | $3,234,000 | $270,619 | $104,035 |
| MUSTANG VALLEY WSC | 3,000 | 150 | 4 | 77,058,440 | 54% | 69,887,690 | 3,494,385 | 7.5 | $1,386,000 | $13,860,000 | $1,159,796 | $108,151 |
| NORTH HAMILTON HILL WSC | 51 | 3 | 9 | 490,000 | 16% | 340,000 | 17,000 | 0.15 | $27,720 | $277,200 | $23,196 | $444,612 |
| NORTH MILAM WSC | 1,348 | 154 | 4 | 26,652,715 | 42% | 23,499,225 | 1,174,961 | 7.7 | $1,422,960 | $14,229,600 | $1,190,723 | $330,222 |
| PENELOPE WSC | 198 | 2 | 47 | 1,038,359 | 17% | 735,469 | 36,773 | 0.1 | $42,768 | $427,680 | $35,788 | $317,119 |
| POST OAK SUD | 2,500 | 350 | 2 | 24,589,327 | 22% | 18,936,577 | 946,829 | 17.5 | $3,234,000 | $32,340,000 | $2,706,190 | $931,335 |
| PRAIRIE HILL WSC | 2,004 | 523 | 1 | 22,346,605 | 35% | 19,168,437 | 958,422 | 26.15 | $4,832,520 | $48,325,200 | $4,043,820 | $1,374,847 |
| ROBERTSON COUNTY WSC | 2,670 | 270 | 4 | 19,660,166 | 18% | 14,238,293 | 711,915 | 13.5 | $2,494,800 | $24,948,000 | $2,087,632 | $955,532 |
| ROCKY CREEK WATER SYSTEM | 3,132 | 38 | 27 | 20,423,673 | 25% | 16,328,844 | 816,442 | 1.9 | $351,120 | $3,511,200 | $293,815 | $117,265 |
| ROSS WSC | 2,388 | 69 | 12 | 13,997,560 | 18% | 10,195,490 | 509,774 | 3.45 | $637,560 | $6,375,600 | $533,506 | $341,020 |
| RRA TRUSCOTT GILLILAND WATER SYSTEM | 202 | 90 | 1 | 5,713,936 | 48% | 5,115,156 | 255,758 | 4.5 | $831,600 | $8,316,000 | $695,877 | $886,590 |
| SANTO SUD | 2,550 | 103 | 8 | 14,470,465 | 19% | 10,599,760 | 529,988 | 5.15 | $951,720 | $9,517,200 | $796,393 | $489,644 |
| SHACKELFORD WSC | 2,616 | 220 | 4 | 24,387,320 | 34% | 20,805,432 | 1,040,272 | 11 | $2,032,800 | $20,328,000 | $1,701,033 | $532,826 |
| SHILOH WSC | 585 | 21 | 9 | 5,638,906 | 34% | 4,815,504 | 240,775 | 1.05 | $194,040 | $1,940,400 | $162,371 | $219,744 |
| SOUTHWEST MILAM WSC | 8,925 | 575 | 5 | 155,229,780 | 36% | 133,469,733 | 6,673,487 | 28.75 | $5,313,000 | $53,130,000 | $4,445,883 | $217,082 |
| STAFF WSC OLDEN AREA | 1,569 | 40 | 14 | 12,096,116 | 38% | 10,511,581 | 525,579 | 2 | $369,600 | $3,696,000 | $309,279 | $191,748 |
| STEELE CREEK HARBOR | 468 | 12 | 13 | 976,384 | 17% | 690,263 | 34,513 | 0.6 | $110,880 | $1,108,800 | $92,784 | $876,004 |
| STEPHENS REGIONAL SUD | 3,132 | 250 | 6 | 19,998,858 | 19% | 14,863,111 | 743,156 | 12.5 | $2,310,000 | $23,100,000 | $1,932,993 | $847,558 |
| TRI COUNTY SUD | 4,075 | 430 | 4 | 54,192,758 | 27% | 44,293,602 | 2,214,680 | 21.5 | $3,973,200 | $39,732,000 | $3,324,747 | $489,178 |
| TUSCOLA-TAYLOR COUNTY WCID 1 | 714 | 10 | 38 | 15,820,000 | 33% | 13,409,500 | 670,475 | 0.5 | $213,840 | $2,138,400 | $178,940 | $86,965 |
| WEST BELL COUNTY WSC | 3,800 | 67 | 19 | 40,539,873 | 20% | 30,276,261 | 1,513,813 | 3.35 | $619,080 | $6,190,800 | $518,042 | $111,509 |
| WESTBOUND WSC CISCO SOURCE | 2,400 | 850 | 1 | 24,120 | 98% | 22,896 | 1,145 | 42.5 | $7,854,000 | $78,540,000 | $6,572,175 | $1,870,716,656 |
| WHITE ROCK WSC 1 | 240 | 6 | 13 | 1,522,780 | 25% | 1,216,280 | 60,814 | 0.3 | $55,440 | $554,400 | $46,392 | $248,575 |
| WHITE ROCK WSC 2 FOREST GLADE | 1,632 | 39 | 14 | 11,066,000 | 24% | 8,751,200 | 437,560 | 1.95 | $360,360 | $3,603,600 | $301,547 | $224,562 |
| WOODROW OSCEOLA WSC BLANTON WELL PLAN | 2,046 | 100 | 7 | 9,586,471 | 16% | 6,634,951 | 331,748 | 5 | $924,000 | $9,240,000 | $773,197 | $759,454 |
| WOODROW OSCEOLA WSC PLEASANT VW | 1,278 | 100 | 4 | 7,326,604 | 20% | 5,516,585 | 275,829 | 5 | $924,000 | $9,240,000 | $773,197 | $913,417 |
| **Total (Region G Entities Evaluated for Water Loss Program)** | | | | **6,940,861,811** | | **5,811,590,711** | **290,579,536** | **534.9** | **$114,020,016** | **$1,138,352,160** | **$95,256,546** | |

# 2.2 Irrigation Water Conservation

## 2.2.1 Description of Strategy

Irrigation water use is the use of freshwater that is pumped from aquifers and/or diverted from streams and reservoirs of the planning area and applied directly to grow crops, orchards, and hay and pasture in the study area. Irrigation water is typically applied to land by: (1) flowing or flooding water down furrows; and (2) the use of sprinklers. When groundwater is used, irrigation wells are usually located within the fields to be irrigated. For surface water supplies, typically water is diverted from the source and conveyed by canals and pipelines to the fields. For both groundwater and surface water, the conservation objective is to reduce the quantity of water that is lost to deep percolation and evaporation between the originating points (wells in the case of groundwater, and stream diversion points in the case of surface water), and the irrigated crops in the fields. Thus, the focus is upon investments in irrigation application equipment, instruments, and conveyance facility improvements (canal lining and pipelines) to reduce seepage losses, deep percolation, and evaporation of water, and management of the irrigation processes to improve efficiencies of irrigation water use and reduce the quantities of water needed to accomplish irrigation.

## 2.2.2 Brazos G Irrigation Water Conservation Approach

The Brazos G RWPG recommends conservation for irrigation WUGs with projected irrigation water needs during the planning period from 2020 to 2070. A voluntary target is recommended for these irrigation entities with needs to reduce water demands by 3% by 2020, 5% by 2030, and 7% from 2040-2070. In the Brazos G Area, eighteen counties are projected to have irrigation needs (shortages) during the 2020 to 2070 planning period, as shown in Table 2.2-1. Irrigation shortages range from 3 acft/yr in Taylor County (2030) to almost 53,000 acft in Robertson County (2020). Generally, the shortages decrease over time except for Eastland and Knox County, where minimal increases in shortages are anticipated and Williamson County where the shortages remain constant. Most of the counties use both surface water and groundwater supplies to meet irrigation water demands. Palo Pinto solely receives surface water supplies for irrigation while Haskell and Stephenson rely on groundwater. Young County irrigation does not currently have surface or groundwater supplies.

## Table 2.2-1. Projected Irrigation Water Demands, Supplies, and Needs (Shortages) in Counties Having Projected Irrigation Shortages

| County | Projections (acft/yr) | | | | | |
|---|---|---|---|---|---|---|
| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| **Bell** | | | | | | |
| Irrigation Demand | 2,205 | 2,174 | 2,147 | 2,117 | 2,086 | 2,058 |
| Irrigation Existing Supply | | | | | | |
| Groundwater | 385 | 385 | 385 | 385 | 385 | 385 |
| Surface water | 540 | 541 | 541 | 542 | 542 | 543 |
| Total Irrigation Supply | 925 | 926 | 926 | 927 | 927 | 928 |
| (Shortage)/ Surplus | (1,280) | (1,248) | (1,221) | (1,190) | (1,159) | (1,130) |
| **Bosque** | | | | | | |
| Irrigation Demand | 2,128 | 2,094 | 2,060 | 2,029 | 1,998 | 1,968 |
| Irrigation Existing Supply | | | | | | |
| Groundwater | 1,460 | 1,460 | 1,460 | 1,460 | 1,460 | 1,460 |
| Surface water | 132 | 132 | 132 | 131 | 131 | 131 |
| Total Irrigation Supply | 1,592 | 1,592 | 1,592 | 1,591 | 1,591 | 1,591 |
| (Shortage)/ Surplus | (536) | (502) | (468) | (438) | (407) | (377) |
| **Brazos** | | | | | | |
| Irrigation Demand | 26,050 | 24,791 | 23,594 | 22,459 | 21,374 | 20,438 |
| Irrigation Existing Supply | | | | | | |
| Groundwater | 14,808 | 14,808 | 14,808 | 14,808 | 14,808 | 14,808 |
| Surface water | 350 | 310 | 270 | 230 | 190 | 151 |
| Total Irrigation Supply | 15,158 | 15,118 | 15,078 | 15,038 | 14,998 | 14,958 |
| (Shortage)/ Surplus | (10,892) | (9,673) | (8,516) | (7,421) | (6,376) | (5,480) |
| **Comanche** | | | | | | |
| Irrigation Demand | 27,458 | 27,175 | 26,894 | 26,617 | 26,342 | 26,076 |
| Irrigation Existing Supply | | | | | | |
| Groundwater | 21,597 | 21,597 | 21,597 | 21,597 | 21,597 | 21,597 |
| Surface water | 5,164 | 5,164 | 5,164 | 5,164 | 5,164 | 5,164 |
| Total Irrigation Supply | 26,761 | 26,761 | 26,761 | 26,761 | 26,761 | 26,761 |
| (Shortage)/ Surplus | (697) | (414) | (133) | 144 | 419 | 685 |

### Table 2.2-1 (Continued)

| County | Projections (acft/yr) | | | | | |
|---|---|---|---|---|---|---|
| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| **Eastland** | | | | | | |
| Irrigation Demand | 6,819 | 6,829 | 6,837 | 6,840 | 6,843 | 6,850 |
| Irrigation Existing Supply | | | | | | |
| Groundwater | 4,328 | 4,329 | 4,331 | 4,332 | 4,332 | 4,332 |
| Surface water | 77 | 76 | 76 | 76 | 75 | 75 |
| Total Irrigation Supply | 4,404 | 4,406 | 4,407 | 4,408 | 4,408 | 4,407 |
| (Shortage)/ Surplus | (2,415) | (2,423) | (2,430) | (2,432) | (2,435) | (2,443) |
| **Hamilton** | | | | | | |
| Irrigation Demand | 507 | 504 | 495 | 471 | 448 | 436 |
| Irrigation Existing Supply | | | | | | |
| Groundwater | 383 | 383 | 383 | 383 | 383 | 383 |
| Surface water | 54 | 53 | 51 | 50 | 49 | 47 |
| Total Irrigation Supply | 437 | 435 | 434 | 432 | 431 | 430 |
| (Shortage)/ Surplus | (71) | (69) | (61) | (39) | (17) | (6) |
| **Haskell** | | | | | | |
| Irrigation Demand | 47,844 | 46,422 | 45,040 | 43,072 | 42,405 | 41,207 |
| Irrigation Existing Supply | | | | | | |
| Groundwater | 45,619 | 44,034 | 41,843 | 42,007 | 43,087 | 43,087 |
| Surface water | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Irrigation Supply | 45,619 | 44,034 | 41,843 | 42,007 | 43,087 | 43,087 |
| (Shortage)/ Surplus | (2,225) | (2,388) | (3,197) | (1,065) | 682 | 1,880 |
| **Hill** | | | | | | |
| Irrigation Demand | 582 | 582 | 582 | 582 | 568 | 563 |
| Irrigation Existing Supply | | | | | | |
| Groundwater | 405 | 405 | 405 | 405 | 405 | 405 |
| Surface water | 9 | 9 | 9 | 9 | 9 | 9 |
| Total Irrigation Supply | 414 | 414 | 414 | 414 | 414 | 414 |
| (Shortage)/ Surplus | (168) | (168) | (168) | (168) | (154) | (149) |

### Table 2.2-1 (Continued)

| County | Projections (acft/yr) | | | | | |
|---|---|---|---|---|---|---|
| | ***2020*** | ***2030*** | ***2040*** | ***2050*** | ***2060*** | ***2070*** |
| **Knox** | | | | | | |
| Irrigation Demand | 41,033 | 40,025 | 39,041 | 38,082 | 37,147 | 36,278 |
| Irrigation Existing Supply | | | | | | |
| Groundwater | 37,752 | 34,368 | 30,412 | 28,693 | 31,103 | 31,103 |
| Surface water | 160 | 142 | 124 | 106 | 88 | 70 |
| Total Irrigation Supply | 37,912 | 34,510 | 30,536 | 28,799 | 31,191 | 31,173 |
| (Shortage)/ Surplus | (3,122) | (5,516) | (8,506) | (9,284) | (5,957) | (5,106) |
| **Lampasas County** | | | | | | |
| Irrigation Demand | 387 | 382 | 377 | 372 | 370 | 366 |
| Irrigation Existing Supply | | | | | | |
| Groundwater | 64 | 64 | 64 | 64 | 64 | 64 |
| Surface water | 103 | 103 | 103 | 103 | 103 | 103 |
| Total Irrigation Supply | 166 | 166 | 166 | 166 | 166 | 166 |
| (Shortage)/ Surplus | (221) | (216) | (211) | (206) | (204) | (200) |
| **McLennan** | | | | | | |
| Irrigation Demand | 4,880 | 4,877 | 4,872 | 4,867 | 4,862 | 4,858 |
| Irrigation Existing Supply | | | | | | |
| Groundwater | 1,158 | 1,158 | 1,158 | 1,158 | 1,158 | 1,158 |
| Surface water | 1,424 | 1,406 | 1,389 | 1,372 | 1,354 | 1,337 |
| Total Irrigation Supply | 2,581 | 2,564 | 2,547 | 2,529 | 2,512 | 2,495 |
| (Shortage)/ Surplus | (2,299) | (2,313) | (2,325) | (2,338) | (2,350) | (2,363) |
| **Nolan** | | | | | | |
| Irrigation Demand | 7,413 | 7,217 | 7,024 | 6,842 | 6,663 | 6,497 |
| Irrigation Existing Supply | | | | | | |
| Groundwater | 3,126 | 3,126 | 3,126 | 3,126 | 3,126 | 3,126 |
| Surface water | 40 | 40 | 40 | 40 | 40 | 40 |
| Total Irrigation Supply | 3,166 | 3,166 | 3,166 | 3,166 | 3,166 | 3,166 |
| (Shortage)/ Surplus | (4,247) | (4,051) | (3,858) | (3,676) | (3,497) | (3,331) |

## Table 2.2-1 (Continued)

| County | Projections (acft/yr) | | | | | |
|---|---|---|---|---|---|---|
| | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| **Palo Pinto** | | | | | | |
| Irrigation Demand | 3,138 | 3,097 | 3,063 | 3,022 | 2,981 | 2,944 |
| Irrigation Existing Supply | | | | | | |
| Groundwater | 0 | 0 | 0 | 0 | 0 | 0 |
| Surface water | 550 | 550 | 550 | 550 | 550 | 550 |
| Total Irrigation Supply | 550 | 550 | 550 | 550 | 550 | 550 |
| (Shortage)/ Surplus | (2,588) | (2,547) | (2,513) | (2,472) | (2,431) | (2,394) |
| **Robertson** | | | | | | |
| Irrigation Demand | 63,420 | 61,607 | 59,841 | 58,127 | 56,460 | 55,124 |
| Irrigation Existing Supply | | | | | | |
| Groundwater | 9,896 | 9,996 | 10,096 | 10,144 | 10,144 | 10,144 |
| Surface water | 535 | 535 | 535 | 535 | 535 | 535 |
| Total Irrigation Supply | 10,431 | 10,531 | 10,631 | 10,679 | 10,679 | 10,679 |
| (Shortage)/ Surplus | (52,989) | (51,076) | (49,210) | (47,448) | (45,781) | (44,445) |
| **Stephens** | | | | | | |
| Irrigation Demand | 116 | 115 | 113 | 112 | 111 | 110 |
| Irrigation Existing Supply | | | | | | |
| Groundwater | 86 | 86 | 86 | 86 | 86 | 86 |
| Surface water | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Irrigation Supply | 86 | 86 | 86 | 86 | 86 | 86 |
| (Shortage)/ Surplus | (30) | (29) | (27) | (26) | (25) | (24) |
| **Taylor** | | | | | | |
| Irrigation Demand | 1,557 | 1,519 | 1,481 | 1,444 | 1,406 | 1,373 |
| Irrigation Existing Supply | | | | | | |
| Groundwater | 500 | 500 | 500 | 500 | 500 | 500 |
| Surface water | 1,016 | 1,016 | 1,016 | 1,016 | 1,016 | 1,016 |
| Total Irrigation Supply | 1,516 | 1,516 | 1,516 | 1,516 | 1,516 | 1,516 |
| (Shortage)/ Surplus | (41) | (3) | 35 | 72 | 110 | 143 |

## Table 2.2-1 (Concluded)

| County | Projections (acft/yr) | | | | | |
|---|---|---|---|---|---|---|
| | *2020* | *2030* | *2040* | *2050* | *2060* | *2070* |
| **Williamson** | | | | | | |
| Irrigation Demand | 151 | 151 | 151 | 151 | 151 | 151 |
| Irrigation Existing Supply | | | | | | |
| Groundwater | 13 | 13 | 13 | 13 | 13 | 13 |
| Surface water | 65 | 65 | 65 | 65 | 65 | 65 |
| Total Irrigation Supply | 79 | 79 | 79 | 79 | 79 | 79 |
| (Shortage)/ Surplus | (72) | (72) | (72) | (72) | (72) | (72) |
| **Young** | | | | | | |
| Irrigation Demand | 51 | 50 | 48 | 47 | 45 | 44 |
| Irrigation Existing Supply | | | | | | |
| Groundwater | 0 | 0 | 0 | 0 | 0 | 0 |
| Surface water | 0 | 0 | 0 | 0 | 0 | 0 |
| Total Irrigation Supply | 0 | 0 | 0 | 0 | 0 | 0 |
| (Shortage)/ Surplus | (51) | (50) | (48) | (47) | (45) | (44) |

NOTE: Positive values = surplus. Negative values (in parenthesis) = shortages.

The Task Force report[7] lists the following irrigation BMPs that may be used to achieve the recommended water savings:

1. Irrigation Scheduling,
2. Volumetric Measurement of Irrigation Water Use,
3. Crop Residue Management and Conservation Tillage,
4. On-Farm Irrigation Audit,
5. Furrow Dikes,
6. Land Leveling,
7. Contour Farming,
8. Conservation of Supplemental Irrigated Farmland to Dry-Land Farmland,
9. Brush Control/Management,
10. Lining of On-Farm Irrigation Ditches,
11. Replacement of On-Farm Irrigation Ditches with Pipelines,
12. Low-Pressure Center Pivot Sprinkler Irrigation Systems,
13. Drip/Micro-Irrigation Systems,
14. Gated and Flexible Pipe for Field Water Distribution Systems,
15. Surge Flow Irrigation for Field Water Distribution Systems,
16. Linear Move Sprinkler Irrigation Systems,
17. Lining of District Irrigation Canals,
18. Replacement of District Irrigation Canals and Lateral Canals with Pipelines,
19. Tailwater Recovery and Use Systems, and
20. Nursery Production Systems.

The Task Force report describes the above BMP methods and how they reduce irrigation water use; however, information regarding specific water savings and costs to install irrigation water saving systems is generally unavailable. The Task Force report does include water savings and costs for three irrigation water conservation BMPs: (1) furrow dikes; (2) low-pressure sprinklers (LESA); and (3) low-energy precision application systems (LEPA). These major irrigation water conservation techniques are described briefly below.

Furrow dikes are small mounds of soil mechanically installed a few feet apart in the furrow. These mounds of soil create small reservoirs that capture precipitation and hold it until it soaks into the soil instead of running down the furrow and out the end of the field. This practice can conserve (capture) as much as 100 percent of rainfall runoff, and furrow dikes are used to prevent irrigation runoff under sprinkler systems. This maintains high irrigation uniformity and increases irrigation application efficiencies. Capturing and

7 Texas Water Development Board (TWDB) Report 362 Special Report, developed from work by the Water Conservation Implementation Task Force, Austin, Texas, November 2004.

holding precipitation that would have drained from the fields replaces required irrigation water. Furrow dikes have been demonstrated to be useful management tools on both irrigated and non-irrigated cropland. Use of furrow dikes can have water savings up to 12 percent of the gross quantity of water applied using sprinkler irrigation. Furrow dikes require special tillage equipment and cost $7 to $39 per acre to install.

Low-pressure sprinklers (LESA), with 90 percent application efficiency, improve irrigation application efficiency in comparison to conventional furrow irrigation by reducing water requirements per acre by between 10 and 25 percent. Low-pressure sprinklers spray water into the atmosphere above the crops as the sprinkler systems are moved across the fields. LEPA systems involve a sprinkler system that has been modified to discharge water directly into furrows at low pressure, thus reducing evaporation losses. When used in conjunction with furrow dikes, LEPA systems can accomplish the irrigation objective with less water than is required for the furrow irrigation and pressurized sprinkler methods. When used with furrow dike systems, the expected water savings from LEPA would range from 0.17 acft/acre to 0.30 acft/acre (a total reduction in water use of 16 to 37 percent). Use of LEPA and furrow dikes allows irrigation farmers to produce equivalent yields per acre at lower energy and labor costs. It has been demonstrated that LEPA systems improve production and profitability of irrigation farming. The barriers to installation are high capital costs; with no assurance (at the present time) that the water saved would be available to the irrigator who incurred the costs.

### 2.2.3 Available Yield

The Brazos G RWPG recommends that counties with projected irrigation needs (shortages) reduce their irrigation water demands by 3 percent by 2020, 5 percent by 2030, and 7 percent from 2040 to 2070 by using BMPs listed previously. A reduction in irrigation water demand subsequently reduces shortages for each decade, if water supplies remain constant. In 2070, with conservation reductions, the shortages are reduced between 7 percent for Young County to 50 percent for Knox County (Table 2.2-2). The maximum water savings expected by irrigation water conservation by implementing the schedule above amongst the eighteen counties is for Robertson County, with a recommended savings of 4,189 acft/yr in 2040.

**Table 2.2-2. Projected Water Demands and Needs (Shortages) for Irrigation Users after Recommended Irrigation Water Conservation**

| Counties | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Bell** | | | | | | |
| New Demand ( after conservation) | 2,139 | 2,065 | 1,997 | 1,969 | 1,940 | 1,914 |
| Expected Conservation Savings | *66* | *109* | *150* | *148* | *146* | *144* |
| New Surplus (Shortage) (acft/yr) | (1,214) | (1,140) | (1,071) | (1,042) | (1,013) | (986) |
| Shortage Reduction w/ Conservation | 5% | 9% | 12% | 12% | 13% | 13% |
| **Bosque** | | | | | | |
| New Demand ( after conservation) | 1,989 | 1,916 | 1,887 | 1,858 | 1,830 | (473) |
| Expected Conservation Savings | *64* | *105* | *144* | *142* | *140* | *138* |
| New Surplus (Shortage) (acft/yr) | (473) | (398) | (324) | (295) | (267) | (239) |
| Shortage Reduction w/ Conservation | 12% | 21% | 31% | 32% | 34% | 37% |
| **Brazos** | | | | | | |
| New Demand ( after conservation) | 25,269 | 23,551 | 21,942 | 20,887 | 19,878 | 19,007 |
| Expected Conservation Savings | *782* | *1,240* | *1,652* | *1,572* | *1,496* | *1,431* |
| New Surplus (Shortage) (acft/yr) | (10,111) | (8,434) | (6,864) | (5,849) | (4,880) | (4,049) |
| Shortage Reduction w/ Conservation | 7% | 13% | 19% | 21% | 23% | 26% |
| **Comanche** | | | | | | |
| New Demand ( after conservation) | 26,634 | 25,816 | 25,011 | 24,754 | 24,498 | 24,251 |
| Expected Conservation Savings | *824* | *1,359* | *1,883* | *1,863* | *1,844* | *1,825* |
| New Surplus (Shortage) (acft/yr) | 127 | 945 | 1,749 | 2,007 | 2,263 | 2,510 |
| Shortage Reduction w/ Conservation | 100% | 100% | 100% | 100% | 100% | 100% |
| **Eastland** | | | | | | |
| New Demand ( after conservation) | 6,614 | 6,488 | 6,358 | 6,361 | 6,364 | 6,371 |
| Expected Conservation Savings | *205* | *341* | *479* | *479* | *479* | *480* |
| New Surplus (Shortage) (acft/yr) | (2,210) | (2,082) | (1,951) | (1,953) | (1,956) | (1,963) |
| Shortage Reduction w/ Conservation | 8% | 14% | 20% | 20% | 20% | 20% |

## Table 2.2-2 (Continued)

| Counties | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Hamilton** | | | | | | |
| New Demand ( after conservation) | 492 | 479 | 460 | 438 | 417 | 405 |
| Expected Conservation Savings | *15* | *25* | *35* | *33* | *31* | *31* |
| New Surplus (Shortage) (acft/yr) | (55) | (44) | (27) | (6) | 15 | 24 |
| Shortage Reduction w/ Conservation | 22% | 37% | 57% | 86% | 100% | 100% |
| **Haskell** | | | | | | |
| New Demand ( after conservation) | 46,409 | 44,101 | 41,887 | 40,057 | 39,437 | 38,323 |
| Expected Conservation Savings | *1,435* | *2,321* | *3,153* | *3,015* | *2,968* | *2,884* |
| New Surplus (Shortage) (acft/yr) | (790) | (67) | (44) | 1,951 | 3,651 | 4,765 |
| Shortage Reduction w/ Conservation | 65% | 97% | 99% | 100% | 100% | 100% |
| **Hill** | | | | | | |
| New Demand ( after conservation) | 565 | 553 | 541 | 541 | 528 | 524 |
| Expected Conservation Savings | *17* | *29* | *41* | *41* | *40* | *39* |
| New Surplus (Shortage) (acft/yr) | (151) | (139) | (127) | (127) | (114) | (110) |
| Shortage Reduction w/ Conservation | 10% | 17% | 24% | 24% | 26% | 26% |
| **Knox** | | | | | | |
| New Demand ( after conservation) | 39,802 | 38,024 | 36,308 | 35,416 | 34,547 | 33,739 |
| Expected Conservation Savings | *1,231* | *2,001* | *2,733* | *2,666* | *2,600* | *2,539* |
| New Surplus (Shortage) (acft/yr) | (1,891) | (3,514) | (5,773) | (6,618) | (3,356) | (2,566) |
| Shortage Reduction w/ Conservation | 39% | 36% | 32% | 29% | 44% | 50% |
| **Lampasas** | | | | | | |
| New Demand ( after conservation) | 375 | 363 | 351 | 346 | 344 | 340 |
| Expected Conservation Savings | *12* | *19* | *26* | *26* | *26* | *26* |
| New Surplus (Shortage) (acft/yr) | (209) | (197) | (184) | (180) | (178) | (174) |
| Shortage Reduction w/ Conservation | 5% | 9% | 13% | 13% | 13% | 13% |

### Table 2.2-2 (Continued)

| Counties | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **McLennan** | | | | | | |
| New Demand (acft/yr) | 4,734 | 4,633 | 4,531 | 4,526 | 4,522 | 4,518 |
| *Expected Savings (acft/yr)* | *146* | *244* | *341* | *341* | *340* | *340* |
| New (shortage)/surplus (acft/yr) | (2,152) | (2,069) | (1,984) | (1,997) | (2,010) | (2,023) |
| Shortage Reduction (acft/yr) | 6% | 11% | 15% | 15% | 14% | 14% |
| **Nolan** | | | | | | |
| New Demand ( after conservation) | 7,191 | 6,856 | 6,532 | 6,363 | 6,197 | 6,042 |
| Expected Conservation Savings | *222* | *361* | *492* | *479* | *466* | *455* |
| New Surplus (Shortage) (acft/yr) | (4,025) | (3,690) | (3,366) | (3,197) | (3,031) | (2,876) |
| Shortage Reduction w/ Conservation | 5% | 9% | 13% | 13% | 13% | 14% |
| **Palo Pinto** | | | | | | |
| New Demand ( after conservation) | 3,044 | 2,942 | 2,849 | 2,810 | 2,772 | 2,738 |
| Expected Conservation Savings | *94* | *155* | *214* | *212* | *209* | *206* |
| New Surplus (Shortage) (acft/yr) | (2,494) | (2,392) | (2,299) | (2,260) | (2,222) | (2,188) |
| Shortage Reduction w/ Conservation | 4% | 6% | 9% | 9% | 9% | 9% |
| **Robertson** | | | | | | |
| New Demand ( after conservation) | 61,517 | 58,527 | 55,652 | 54,058 | 52,508 | 51,265 |
| Expected Conservation Savings | *1,903* | *3,080* | *4,189* | *4,069* | *3,952* | *3,859* |
| New Surplus (Shortage) (acft/yr) | (51,086) | (47,995) | (45,021) | (43,379) | (41,829) | (40,586) |
| Shortage Reduction w/ Conservation | 4% | 6% | 9% | 9% | 9% | 9% |
| **Stephens** | | | | | | |
| New Demand ( after conservation) | 113 | 109 | 105 | 104 | 103 | 102 |
| Expected Conservation Savings | *3* | *6* | *8* | *8* | *8* | *8* |
| New Surplus (Shortage) (acft/yr) | (26) | (23) | (19) | (18) | (17) | (16) |
| Shortage Reduction w/ Conservation | 12% | 20% | 30% | 30% | 31% | 32% |

## Table 2.2-2 (Concluded)

| Counties | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Taylor** | | | | | | |
| New Demand ( after conservation) | 1,510 | 1,443 | 1,377 | 1,343 | 1,308 | 1,277 |
| Expected Conservation Savings | *47* | *76* | *104* | *101* | *98* | *96* |
| New Surplus (Shortage) (acft/yr) | 6 | 73 | 139 | 174 | 209 | 240 |
| Shortage Reduction w/ Conservation | 100% | 100% | 100% | 100% | 100% | 100% |
| **Williamson** | | | | | | |
| New Demand ( after conservation) | 146 | 143 | 140 | 140 | 140 | 140 |
| Expected Conservation Savings | *5* | *8* | *11* | *11* | *11* | *11* |
| New Surplus (Shortage) (acft/yr) | (68) | (65) | (62) | (62) | (62) | (62) |
| Shortage Reduction w/ Conservation | 6% | 10% | 15% | 15% | 15% | 15% |
| **Young** | | | | | | |
| New Demand ( after conservation) | 49 | 48 | 45 | 44 | 42 | 41 |
| Expected Conservation Savings | *2* | *3* | *3* | *3* | *3* | *3* |
| New Surplus (Shortage) (acft/yr) | (49) | (48) | (45) | (44) | (42) | (41) |
| Shortage Reduction w/ Conservation | 3% | 5% | 7% | 7% | 7% | 7% |
| **Total Brazos G Savings:** | **7,072** | **11,481** | **15,656** | **15,208** | **14,858** | **14,514** |

### 2.2.4 Environmental Issues

The irrigation water conservation methods described above have been developed and tested through public and private sector research, and have been adopted and applied within the region. Hundreds of LEPA systems have been installed and are in operation today, and experience has revealed no significant environmental issues associated with this water management strategy. This method improves water use efficiency without making significant changes to wildlife habitat. This method of application, when coupled with furrow dikes, reduces runoff of both applied irrigation water and rainfall. These actions results in the reduced transport of sediment, fertilizers, pesticides and other chemicals that have been applied to the crops. Thus, the proposed conservation practices are not anticipated to have significant potential adverse environmental effects, and may have potentially beneficial environmental effects.

### 2.2.5 Engineering and Costing

The Brazos G RWPG recommended irrigation water conservation as a water management strategy for irrigation needs, resulting in a total water savings of 7,072 acft/yr beginning in 2020, 15,656 acft/yr in 2040 and 14,514 acft/yr in 2070 as shown in Table 2.2-3. Brazos G recommends the use of furrow, LESA, and LEPA systems described above but supports flexibility for each WUG to voluntarily decide which of these or other options might serve them best. An average cost of implementing furrow dikes, LESA, and LEPA programs of $230 per acft/yr was used for water saved since the exact technology utilized by each WUG is unknown[8]. The total estimated cost of implementing these three BMPs for Brazos G entities is estimated to cost $3,600,926 in 2040 when largest water savings are expected to occur to $3,338,190 in 2070 as shown in Table 2.2-3.

Each of the three irrigation water conservation strategies described (furrow dikes, LESA, and LEPA) have the potential to increase water savings beyond the minimum recommended by the Brazos G RWPG; however, none of the strategies can accomplish water savings sufficient to meet all of the projected needs. Further studies are needed to consider other irrigation water conservation BMPs that can be applied to surface applications to increase their application efficiencies.

It may not be economically feasible for agricultural producers to pay for additional water supplies to meet projected irrigation water needs (shortages), even if such supplies were available. For example, in 2004, the estimated income for irrigated cotton remaining after other production expenses had been paid was about $68 per acre, and the income for wheat with high input management was about $65 per acre. At an application rate of about 1 acft/acre, the cost of water from other sources far exceeds these values. For example, costs for water management strategies (new reservoirs) considered to meet projected municipal needs *could range* between $481 per acft and $1,760 per acft for water supply at the reservoirs. The costs greatly exceed the income that would be realized from land irrigated with these water supplies.

[8] Installing LESA or LEPA systems would incur a greater capital cost, and therefore higher annual costs, however both achieve a substantially higher water savings potential and therefore have more economical unit cost ($/acft) when compared to furrow dikes.

### Table 2.2-3. Brazos G Irrigation Water Savings and Estimated Costs

| Brazos G Irrigation WUG[1] | WATER SAVINGS WITH IRRIGATION WATER CONSERVATION (acft/yr) | | | | | | Estimated Cost of Water Savings ($230 per acft)[2] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2020 (3%) | 2030 (5%) | 2040 (7%) | 2050 (7%) | 2060 (7%) | 2070 (7%) | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| BELL COUNTY-IRRIGATION | 66 | 109 | 150 | 148 | 146 | 144 | $15,215 | $25,001 | $34,567 | $34,084 | $33,585 | $33,134 |
| BOSQUE COUNTY-IRRIGATION | 64 | 105 | 144 | 142 | 140 | 138 | $14,683 | $24,081 | $33,166 | $32,667 | $32,168 | $31,685 |
| BRAZOS COUNTY-IRRIGATION | 782 | 1,240 | 1,652 | 1,572 | 1,496 | 1,431 | $179,745 | $285,097 | $379,863 | $361,590 | $344,121 | $329,052 |
| COMANCHE COUNTY-IRRIGATION | 824 | 1,359 | 1,883 | 1,863 | 1,844 | 1,825 | $189,460 | $312,513 | $432,993 | $428,534 | $424,106 | $419,824 |
| EASTLAND COUNTY-IRRIGATION | 205 | 341 | 479 | 479 | 479 | 480 | $47,051 | $78,534 | $110,076 | $110,124 | $110,172 | $110,285 |
| HAMILTON COUNTY-IRRIGATION | 15 | 25 | 35 | 33 | 31 | 31 | $3,498 | $5,796 | $7,970 | $7,583 | $7,213 | $7,020 |
| HASKELL COUNTY-IRRIGATION | 1,435 | 2,321 | 3,153 | 3,015 | 2,968 | 2,884 | $330,124 | $533,853 | $725,144 | $693,459 | $682,721 | $663,433 |
| HILL COUNTY-IRRIGATION | 17 | 29 | 41 | 41 | 40 | 39 | $4,016 | $6,693 | $9,370 | $9,370 | $9,145 | $9,064 |
| KNOX COUNTY-IRRIGATION | 1,231 | 2,001 | 2,733 | 2,666 | 2,600 | 2,539 | $283,128 | $460,288 | $628,560 | $613,120 | $598,067 | $584,076 |
| LAMPASAS COUNTY-IRRIGATION | 12 | 19 | 26 | 26 | 26 | 26 | $2,670 | $4,393 | $6,070 | $5,989 | $5,957 | $5,893 |
| MCLENNAN COUNTY-IRRIGATION | 146 | 244 | 341 | 341 | 340 | 340 | $33,672 | $56,086 | $78,439 | $78,359 | $78,278 | $78,214 |
| NOLAN COUNTY-IRRIGATION | 222 | 361 | 492 | 479 | 466 | 455 | $51,150 | $82,996 | $113,086 | $110,156 | $107,274 | $104,602 |
| PALO PINTO COUNTY-IRRIGATION | 94 | 155 | 214 | 212 | 209 | 206 | $21,652 | $35,616 | $49,314 | $48,654 | $47,994 | $47,398 |
| ROBERTSON COUNTY-IRRIGATION | 1,903 | 3,080 | 4,189 | 4,069 | 3,952 | 3,859 | $437,598 | $708,481 | $963,440 | $935,845 | $909,006 | $887,496 |
| STEPHENS COUNTY-IRRIGATION | 3 | 6 | 8 | 8 | 8 | 8 | $800 | $1,323 | $1,819 | $1,803 | $1,787 | $1,771 |
| TAYLOR COUNTY-IRRIGATION | 47 | 76 | 104 | 101 | 98 | 96 | $10,743 | $17,469 | $23,844 | $23,248 | $22,637 | $22,105 |
| WILLIAMSON COUNTY-IRRIGATION | 5 | 8 | 11 | 11 | 11 | 11 | $1,042 | $1,737 | $2,431 | $2,431 | $2,431 | $2,431 |
| YOUNG COUNTY-IRRIGATION | 2 | 3 | 3 | 3 | 3 | 3 | $352 | $575 | $773 | $757 | $725 | $708 |
| Brazos G Total | 7,072 | 11,481 | 15,656 | 15,208 | 14,858 | 14,514 | $1,626,599 | $2,640,527 | $3,600,926 | $3,497,773 | $3,417,386 | $3,338,190 |

[1]Conservation values applied only to those WUGs with needs by decade. Values assume 3% of demand reduction in 2020, 5% demand reduction in 2030 and

[2]Cost of water savings based on averaging cost to convert sprinkler systems (from TWDB 2000 irrigation survey) to Furrow Dikes ($308 per acft), LESA ($212

## 2.2.6 Implementation Issues

Irrigation demand reduction through water conservation is being implemented throughout the Brazos G Area and the State of Texas. The rate of adoption of efficient water-use practices is dependent upon public knowledge of the benefits, information about how to implement water conservation measures, and financing.

There is widespread public support for irrigation water conservation and it is being implemented at a steady pace, and as water markets for conserved water expand, this practice will likely reach its maximum potential. A major barrier to implementation of water conservation is financing. The TWDB has irrigation conservation programs that may provide funding to irrigators to implement irrigation BMPs that increase water use efficiency. Future planning efforts should consider the use of detailed studies to fully determine the maximum potential benefits of additional irrigation conservation.

This option is compared to the plan development criteria in Table 2.2-4 and meets most criteria.

**Table 2.2-4. Comparison of Irrigation Conservation to Plan Development Criteria**

| Impact Category | Comment(s) |
|---|---|
| A. Water Supply | |
| 1. Quantity | 1. Firm Yield: Variable according to BMP selected. |
| 2. Reliability | 2. High reliability |
| 3. Cost | 3. High for internal use (based on BMP selected) |
| B. Environmental factors | |
| 1. Environmental Water Needs | 1. None or low impact |
| 2. Habitat | 2. None or low impact |
| 3. Cultural Resources | 3. No apparent negative impact |
| 4. Bays and Estuaries | 4. None |
| 5. Threatened and Endangered Species | 5. None |
| 6. Wetlands | 6. No cultural resources affected |
| C. Impact on Other State Water Resources | • No apparent negative impacts on state water resources; no effect on navigation |
| D. Threats to Agriculture and Natural Resources | • None |
| E. Equitable Comparison of Feasible Strategies | • Standard analyses and methods used |
| F. Requirements for Interbasin Transfers | • None |
| Third Party Social and Economic Impacts from Voluntary Redistribution | • None |

# 2.3 Industrial Water Conservation

## 2.3.1 Description of Strategy

Water uses for industrial purposes (manufacturing, steam-electric power generation, and mining) are primarily associated with manufacturing products, cleaning and waste removal, waste heat removal, dust control, landscaping, and mine dewatering. In the Brazos G Area, industrial water demands are assumed to be 322,733 acft/yr in 2020 and are projected to increase to 478,772 acft/yr in 2070 as shown in Table 2.3-1.

Manufacturing is a significant part of the Brazos G Area's economy, and industries use water as a component of the final product, for cooling, and cleaning/wash-down of parts and/or products. Regional industries that are major water users include food and kindred products, apparel, fabricated metal, machinery, and stone and concrete production. Manufacturing water demand is projected at 21,848 acft/yr in 2020 and expected to increase to 34,977 acft/yr by 2070. There are twelve (12) counties in the Brazos G Area with projected manufacturing needs: Bell, Bosque, Brazos, Burleson, Grimes, Fisher, Limestone, McLennan, Nolan, Washington, Williamson, and Young. In 2070, the estimated water needs are 12,135 acft/yr, which is 35% of the manufacturing water demand for the Brazos G Area.

In the Brazos G Area, the trends for steam-electric water demands are projected to increase each decade with a maximum demand of 362,386 acft/yr by 2070. Grimes, Limestone, Milam, Nolan, Robertson, and Somervell Counties comprise over 80 percent of the projected regional steam-electric water use in 2070. The increase in water demand is due to projected increases in population and manufacturing growth and estimated increases in fresh water use based on projected power generation capacities. The Brazos G Area steam-electric users are projected to receive around 90% of their water supplies from surface water sources in 2070. There are seven (7) counties in the Brazos G Area with projected steam-electric needs: Bell, Brazos, Grimes, Johnson, Limestone, Milam, and Robertson. In 2070, the estimated water needs are 139,187 acft/yr, which is 38% of the steam-electric water demand for the Brazos G Area.

Gross state product data released from the U.S. Department of Commerce shows mining economic outputs of $37.6 billion for 1999 and $29.9 billion for 2000.[9] The TWDB water demand projections for mining users is generally based on projected economic output, assuming that past and current water use trends remain constant over time. In the Brazos G Area, the mining water demands increase from 61,586 acft/yr in 2020 to 81,409 acft/yr by 2070. In 2070, the Brazos G Area mining users are projected to receive over 90% of their water supplies from groundwater sources. Thirty-five (35) of the thirty-seven counties in the Brazos G Area have projected mining needs over the planning period. In 2070, the estimated water needs are 64,577 acft, which is about 75% of the mining water demand for the Brazos G Area.

[9] TWDB, "Water Demand Methodology and Projections for Mining and Manufacturing," March 2003.

## Table 2.3-1. Projected Water Demands, Supplies, and Needs (Shortages) for Industrial Uses

| | Projections (acft/yr) | | | | | |
|---|---|---|---|---|---|---|
| | ***2020*** | ***2030*** | ***2040*** | ***2050*** | ***2060*** | ***2070*** |
| **Manufacturing** | | | | | | |
| Demand | 21,848 | 24,554 | 27,270 | 29,687 | 32,223 | 34,977 |
| Existing Supply | | | | | | |
| Groundwater | 7,380 | 9,080 | 9,414 | 9,720 | 10,043 | 10,414 |
| Surface water | 19,251 | 20,221 | 21,163 | 22,047 | 22,939 | 24,007 |
| Total Supply | 26,631 | 29,302 | 30,577 | 31,766 | 32,981 | 34,421 |
| Manufacturing Balance (All Brazos G) | 4,783 | 4,748 | 3,307 | 2,079 | 758 | (556) |
| Manufacturing Balance (Counties with Shortages) | (6,972) | (6,972) | (8,378) | (9,570) | (10,856) | (12,135) |
| **Steam-Electric** | | | | | | |
| Demand | 239,299 | 272,711 | 288,696 | 322,702 | 341,364 | 362,386 |
| Existing Supply | | | | | | |
| Groundwater | 23,211 | 20,452 | 20,386 | 21,885 | 22,526 | 22,516 |
| Surface water | 264,127 | 251,408 | 238,736 | 226,048 | 213,359 | 200,683 |
| Total Supply | 287,338 | 271,860 | 259,122 | 247,933 | 235,886 | 223,199 |
| Steam-Electric Balance (All Brazos G) | 48,039 | (851) | (29,574) | (74,769) | (105,478) | (139,187) |
| Steam-Electric Balance (Counties with Shortages) | (73,820) | (97,401) | (120,953) | (160,259) | (184,995) | (212,876) |
| **Mining** | | | | | | |
| Demand | 61,586 | 70,381 | 68,875 | 70,949 | 75,038 | 81,409 |
| Existing Supply | | | | | | |
| Groundwater | 17,686 | 17,686 | 17,686 | 17,686 | 17,686 | 17,686 |
| Surface water | 3,455 | 3,055 | 2,655 | 2,255 | 1,855 | 1,455 |
| Total Supply | 21,141 | 20,741 | 20,341 | 19,941 | 19,541 | 19,141 |
| Mining Balance (All Brazos G) | (40,445) | (49,640) | (48,534) | (51,008) | (55,497) | (62,268) |
| Mining Balance (Counties with Shortages) | (41,749) | (50,261) | (49,306) | (53,690) | (58,022) | (64,577) |

**Table 2.3-1 (Concluded)**

| | Projections (acft/yr) | | | | | |
|---|---|---|---|---|---|---|
| | ***2020*** | ***2030*** | ***2040*** | ***2050*** | ***2060*** | ***2070*** |
| **Total Industrial** | | | | | | |
| Demand | 322,733 | 367,646 | 384,841 | 423,338 | 448,625 | 478,772 |
| Existing Supply | | | | | | |
| Groundwater | 48,278 | 47,218 | 47,485 | 49,291 | 50,255 | 50,616 |
| Surface water | 286,832 | 274,685 | 262,554 | 250,350 | 238,153 | 226,145 |
| Total Supply | 335,110 | 321,903 | 310,040 | 299,641 | 288,408 | 276,761 |
| Total Industrial Balance (All Brazos G) | 12,377 | (45,743) | (74,801) | (123,697) | (160,217) | (202,011) |
| Total Industrial Balance (Counties with Shortages) | (122,541) | (154,634) | (178,638) | (223,520) | (253,872) | (289,588) |

## 2.3.2 Brazos G Industrial Water Conservation Approach

The Brazos G RWPG recommends that counties with projected needs (shortages) for industrial users (manufacturing, steam electric, or mining) reduce those water demands by 3 percent by 2020, 5 percent by 2030, and 7 percent from 2040 to 2070 by using BMPs identified by the Water Conservation Implementation Task Force.

The Task Force report lists the following industrial BMPs that may be used to achieve the recommended water savings:[10]

1. Industrial Water Audit,
2. Industrial Water Waste Reduction,
3. Industrial Submetering,
4. Cooling Towers,
5. Cooling Systems (other than Cooling Towers),
6. Industrial Alternative Sources and Reuse and Recirculation of Process Water,
7. Rinsing/Cleaning,
8. Water Treatment,
9. Boiler and Steam Systems,
10. Refrigeration (including Chilled Water),
11. Once-Through Cooling,
12. Management and Employee Programs,
13. Industrial Landscape, and
14. Industrial Site Specific Conservation.

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[10] Water Conservation Implementation Task Force, Report to the 79$^{th}$ Legislature, Texas Water Development Board,

The Task Force report describes the above BMP methods and how they reduce water use; however, information regarding specific water savings and costs to implement conservation programs is generally unavailable. Conservation savings and costs are by nature facility-specific. Since industrial entities are presented on a county basis and are not individually identified, identification of specific water management strategies is not a reasonable expectation.

### 2.3.3 Available Yield

The Brazos G RWPG recommends that counties with projected needs (shortages) for industrial users (manufacturing, steam electric, or mining) reduce those water demands by 3 percent by 2020, 5 percent by 2030, and 7 percent from 2040 to 2070 by using Best Management Practices identified by the Water Conservation Implementation Task Force.

For the 12 manufacturing users with projected needs, the total water savings after 7 percent water demand reduction in 2070 is 1,688 acft/yr (a 14% reduction in total regional manufacturing shortages) as shown in Table 2.3-2.

For the seven (7) steam-electric users with projected needs, the total water savings after 7 percent water demand reduction in 2070 is 14,307 acft/yr (a 7% reduction in total regional steam-electric shortages) as shown in Table 2.3-3. Nolan and Somervell Counties have significant increases in steam-electric demands during the planning period. It is assumed that with these new demands generating facilities will utilize the most water efficient means appropriate to produce power; therefore, no additional steam-electric conservation is recommended for Nolan and Somervell counties.

For the thirty five (35) mining users with projected needs, the total water savings after 7 percent water demand reduction in 2060 is 5,680 acft/yr (a 9% reduction in total regional mining shortages) as shown in Table 2.3-4.

**Table 2.3-2. Projected Water Demands and Needs (Shortages) for Manufacturing Users Considering up to a 7 Percent Demand Reduction by 2040**

| Manufacturing Projections (acft/yr) | | | | | | |
|---|---|---|---|---|---|---|
| | *2020 (3%)* | *2030 (5%)* | *2040 (7%)* | *2050 (7%)* | *2060 (7%)* | *2070 (7%)* |
| **Bell** | | | | | | |
| New Demand ( after conservation) | 1,329 | 1,416 | 1,495 | 1,591 | 1,718 | 1,854 |
| Expected Conservation Savings | 41 | 75 | 112 | 120 | 129 | 140 |
| New Surplus (Shortage) (acft/yr) | (832) | (919) | (998) | (1,094) | (1,221) | (1,357) |
| Shortage Reduction w/ Conservation | 5% | 8% | 10% | 10% | 10% | 9% |
| **Bosque** | | | | | | |
| New Demand ( after conservation) | 2,657 | 2,905 | 3,136 | 3,388 | 3,682 | 4,001 |
| Expected Conservation Savings | 82 | 153 | 236 | 255 | 277 | 301 |
| New Surplus (Shortage) (acft/yr) | (1,786) | (2,034) | (2,265) | (2,517) | (2,811) | (3,130) |
| Shortage Reduction w/ Conservation | 4% | 7% | 9% | 9% | 9% | 9% |

### Table 2.3.2 (Continued)

| Manufacturing Projections (acft/yr) | | | | | | |
|---|---|---|---|---|---|---|
| | *2020 (3%)* | *2030 (5%)* | *2040 (7%)* | *2050 (7%)* | *2060 (7%)* | *2070 (7%)* |
| **Brazos** | | | | | | |
| New Demand ( after conservation) | 2,382 | 2,640 | 2,891 | 3,167 | 3,435 | 3,727 |
| Expected Conservation Savings | 74 | 139 | 218 | 238 | 259 | 281 |
| New Surplus (Shortage) (acft/yr) | (1,646) | (537) | (791) | (1,065) | (1,334) | (1,626) |
| Shortage Reduction w/ Conservation | 4% | 21% | 22% | 18% | 16% | 15% |
| **Burleson** | | | | | | |
| New Demand ( after conservation) | 135 | 153 | 170 | 189 | 206 | 224 |
| Expected Conservation Savings | 4 | 8 | 13 | 14 | 15 | 17 |
| New Surplus (Shortage) (acft/yr) | 4 | (14) | (31) | (50) | (67) | (85) |
| Shortage Reduction w/ Conservation | 100% | 36% | 29% | 22% | 19% | 16% |
| **Grimes** | | | | | | |
| New Demand ( after conservation) | 350 | 388 | 423 | 462 | 501 | 544 |
| Expected Conservation Savings | 11 | 20 | 32 | 35 | 38 | 41 |
| New Surplus (Shortage) (acft/yr) | 164 | 127 | 91 | 52 | 38 | 41 |
| Shortage Reduction w/ Conservation | N/A | N/A | N/A | N/A | 100% | 100% |
| **Fisher** | | | | | | |
| New Demand ( after conservation) | 218 | 242 | 264 | 288 | 312 | 339 |
| Expected Conservation Savings | 7 | 13 | 20 | 22 | 24 | 25 |
| New Surplus (Shortage) (acft/yr) | (14) | (38) | (59) | (84) | (108) | (134) |
| Shortage Reduction w/ Conservation | 33% | 25% | 25% | 21% | 18% | 16% |
| **Limestone** | | | | | | |
| New Demand ( after conservation) | 90 | 97 | 103 | 110 | 118 | 127 |
| Expected Conservation Savings | 3 | 5 | 8 | 8 | 9 | 10 |
| New Surplus (Shortage) (acft/yr) | 3 | 6 | 7 | 8 | 9 | 10 |
| Shortage Reduction w/ Conservation | 100% | N/A | 100% | 100% | N/A | N/A |

**Table 2.3.2 (Concluded)**

| Manufacturing Projections (acft/yr) | | | | | | |
|---|---|---|---|---|---|---|
| | 2020 (3%) | 2030 (5%) | 2040 (7%) | 2050 (7%) | 2060 (7%) | 2070 (7%) |
| **McLennan** | | | | | | |
| New Demand ( after conservation) | 4,934 | 5,438 | 5,927 | 6,468 | 7,005 | 7,586 |
| Expected Conservation Savings | 153 | 286 | 446 | 487 | 527 | 571 |
| New Surplus (Shortage) (acft/yr) | (1,511) | (1,630) | (1,758) | (1,930) | (2,137) | (2,263) |
| Shortage Reduction w/ Conservation | 9% | 15% | 20% | 20% | 20% | 20% |
| **Nolan** | | | | | | |
| New Demand ( after conservation) | 1,377 | 1,530 | 1,673 | 1,827 | 1,981 | 2,147 |
| Expected Conservation Savings | 43 | 81 | 126 | 138 | 149 | 162 |
| New Surplus (Shortage) (acft/yr) | (838) | (991) | (1,134) | (1,288) | (1,442) | (1,608) |
| Shortage Reduction w/ Conservation | 5% | 8% | 10% | 10% | 9% | 9% |
| **Washington** | | | | | | |
| New Demand ( after conservation) | 671 | 719 | 764 | 817 | 884 | 957 |
| Expected Conservation Savings | 21 | 38 | 58 | 62 | 67 | 72 |
| New Surplus (Shortage) (acft/yr) | (41) | (89) | (134) | (187) | (254) | (326) |
| Shortage Reduction w/ Conservation | 34% | 30% | 30% | 25% | 21% | 18% |
| **Williamson** | | | | | | |
| New Demand ( after conservation) | 2,283 | 2,557 | 2,820 | 3,105 | 3,372 | 3,662 |
| Expected Conservation Savings | 71 | 135 | 212 | 234 | 254 | 276 |
| New Surplus (Shortage) (acft/yr) | 60 | 125 | 201 | 223 | 243 | 265 |
| Shortage Reduction w/ Conservation | 100% | 100% | 100% | 100% | 100% | 100% |
| **Young** | | | | | | |
| New Demand ( after conservation) | 57 | 61 | 64 | 67 | 73 | 81 |
| Expected Conservation Savings | 2 | 3 | 5 | 5 | 6 | 6 |
| New Surplus (Shortage) (acft/yr) | (23) | (22) | (20) | (20) | (19) | (19) |
| Shortage Reduction w/ Conservation | 7% | 13% | 19% | 20% | 22% | 24% |
| **Total Savings** | **454** | **849** | **1,320** | **1,436** | **1,557** | **1,688** |

### Table 2.3-3. Projected Water Demands and Needs (Shortages) for Steam-Electric Users Considering up to a 7% Percent Demand Reduction by 2040

| Steam-Electric Projections (acft/yr) | | | | | | |
|---|---|---|---|---|---|---|
| | *2020 (3%)* | *2030 (5%)* | *2040 (7%)* | *2050 (7%)* | *2060 (7%)* | *2070 (7%)* |
| **Bell** | | | | | | |
| New Demand ( after conservation) | 4,093 | 4,687 | 5,398 | 6,384 | 7,586 | 9,014 |
| Expected Conservation Savings | 127 | 247 | 406 | 481 | 571 | 679 |
| New Surplus (Shortage) (acft/yr) | (4,093) | (4,687) | (5,398) | (6,384) | (7,586) | (9,014) |
| Shortage Reduction w/ Conservation | 3% | 5% | 7% | 7% | 7% | 7% |
| **Brazos** | | | | | | |
| New Demand ( after conservation) | 488 | 386 | 428 | 290 | 377 | 357 |
| Expected Conservation Savings | 15 | 20 | 32 | 22 | 28 | 27 |
| New Surplus (Shortage) (acft/yr) | 3,358 | 2,757 | 1,995 | 1,413 | 606 | (94) |
| Shortage Reduction w/ Conservation | 4% | 21% | 22% | 18% | 16% | 15% |
| **Grimes** | | | | | | |
| New Demand ( after conservation) | 30,807 | 31,502 | 32,234 | 34,094 | 36,884 | 39,902 |
| Expected Conservation Savings | 953 | 1658 | 2426 | 2566 | 2776 | 3003 |
| New Surplus (Shortage) (acft/yr) | (13,970) | (14,665) | (15,396) | (17,256) | (20,046) | (23,064) |
| Shortage Reduction w/ Conservation | 6% | 10% | 14% | 13% | 12% | 12% |
| **Johnson** | | | | | | |
| New Demand ( after conservation) | 6,790 | 6,650 | 6,510 | 6,510 | 6,510 | 6,510 |
| Expected Conservation Savings | 210 | 350 | 490 | 490 | 490 | 490 |
| New Surplus (Shortage) (acft/yr) | (5,446) | (5,306) | (5,166) | (5,166) | (5,166) | (5,166) |
| Shortage Reduction w/ Conservation | 4% | 6% | 9% | 9% | 9% | 9% |
| **Limestone** | | | | | | |
| New Demand ( after conservation) | 21,920 | 25,099 | 28,903 | 34,185 | 40,623 | 48,391 |
| Expected Conservation Savings | 678 | 1321 | 2176 | 2573 | 3058 | 3642 |
| New Surplus (Shortage) (acft/yr) | 756 | (6,791) | (14,963) | (24,611) | (35,417) | (47,552) |
| Shortage Reduction w/ Conservation | N/A | 16% | 13% | 9% | 8% | 7% |

### Table 2.3-3 (Concluded)

| Steam-Electric Projections (acft/yr) | | | | | | |
|---|---|---|---|---|---|---|
| | ***2020 (3%)*** | ***2030 (5%)*** | ***2040 (7%)*** | ***2050 (7%)*** | ***2060 (7%)*** | ***2070 (7%)*** |
| **Milam** | | | | | | |
| New Demand ( after conservation) | 31,062 | 30,422 | 29,781 | 38,120 | 38,120 | 38,120 |
| Expected Conservation Savings | 961 | 1601 | 2242 | 2869 | 2869 | 2869 |
| New Surplus (Shortage) (acft/yr) | 3,848 | 1,711 | 2,285 | (4,553) | (3,913) | (3,923) |
| Shortage Reduction w/ Conservation | N/A | N/A | N/A | 39% | 42% | 42% |
| **Robertson** | | | | | | |
| New Demand ( after conservation) | 16,937 | 28,861 | 33,026 | 43,695 | 45,694 | 47,784 |
| Expected Conservation Savings | 524 | 1519 | 2486 | 3289 | 3439 | 3597 |
| New Surplus (Shortage) (acft/yr) | 16,961 | 601 | (8,000) | (23,105) | (29,540) | (36,067) |
| Shortage Reduction w/ Conservation | N/A | 100% | 24% | 12% | 10% | 9% |
| **Total Savings** | **3,467** | **6,716** | **10,258** | **12,290** | **13,232** | **14,307** |

### Table 2.3-4. Projected Water Demands and Needs (Shortages) for Mining Users Considering up to a 7% Percent Demand Reduction by 2040

| Mining Projections (acft/yr) | | | | | | |
|---|---|---|---|---|---|---|
| | ***2020 (3%)*** | ***2030 (5%)*** | ***2040 (7%)*** | ***2050 (7%)*** | ***2060 (7%)*** | ***2070 (7%)*** |
| **Bell** | | | | | | |
| New Demand ( after conservation) | 3,145 | 3,781 | 4,277 | 4,975 | 5,678 | 6,480 |
| Expected Conservation Savings | 97 | 199 | 322 | 374 | 427 | 488 |
| New Surplus (Shortage) (acft/yr) | (3,145) | (3,781) | (4,277) | (4,975) | (5,678) | (6,480) |
| Shortage Reduction w/ Conservation | 3% | 5% | 7% | 7% | 7% | 7% |
| **Bosque** | | | | | | |
| New Demand ( after conservation) | 1,913 | 1,967 | 1,760 | 1,741 | 1,705 | 1,694 |
| Expected Conservation Savings | 59 | 104 | 132 | 131 | 128 | 127 |
| New Surplus (Shortage) (acft/yr) | (1,784) | (1,839) | (1,631) | (1,612) | (1,576) | (1,565) |
| Shortage Reduction w/ Conservation | 3% | 5% | 8% | 8% | 8% | 8% |
| **Brazos** | | | | | | |
| New Demand ( after conservation) | 1,055 | 1,530 | 1,333 | 1,064 | 858 | 757 |
| Expected Conservation Savings | 33 | 81 | 100 | 80 | 65 | 57 |
| New Surplus (Shortage) (acft/yr) | (1,055) | (1,530) | (1,333) | (1,064) | (858) | (757) |
| Shortage Reduction w/ Conservation | 3% | 5% | 7% | 7% | 7% | 7% |
| **Burleson** | | | | | | |
| New Demand ( after conservation) | 965 | 1,827 | 1,406 | 1,023 | 638 | 398 |
| Expected Conservation Savings | 30 | 96 | 106 | 77 | 48 | 30 |
| New Surplus (Shortage) (acft/yr) | (965) | (1,827) | (1,406) | (1,023) | (638) | (398) |
| Shortage Reduction w/ Conservation | 3% | 5% | 7% | 7% | 7% | 7% |
| **Callahan** | | | | | | |
| New Demand ( after conservation) | 221 | 216 | 199 | 187 | 177 | 167 |
| Expected Conservation Savings | 7 | 11 | 15 | 14 | 13 | 13 |
| New Surplus (Shortage) (acft/yr) | (221) | (216) | (199) | (187) | (177) | (167) |
| Shortage Reduction w/ Conservation | 3% | 5% | 7% | 7% | 7% | 7% |

**Table 2.3.4 (Continued)**

| Mining Projections (acft/yr) | | | | | | |
|---|---|---|---|---|---|---|
| | *2020 (3%)* | *2030 (5%)* | *2040 (7%)* | *2050 (7%)* | *2060 (7%)* | *2070 (7%)* |
| **Comanche** | | | | | | |
| New Demand ( after conservation) | 431 | 499 | 338 | 257 | 175 | 119 |
| Expected Conservation Savings | 13 | 26 | 25 | 19 | 13 | 9 |
| New Surplus (Shortage) (acft/yr) | (404) | (473) | (311) | (230) | (149) | (93) |
| Shortage Reduction w/ Conservation | 3% | 5% | 8% | 8% | 8% | 9% |
| **Coryell** | | | | | | |
| New Demand ( after conservation) | 1,465 | 1,018 | 457 | 338 | 370 | 406 |
| Expected Conservation Savings | 45 | 54 | 34 | 25 | 28 | 31 |
| New Surplus (Shortage) (acft/yr) | (1,465) | (1,018) | (457) | (338) | (370) | (406) |
| Shortage Reduction w/ Conservation | 3% | 5% | 7% | 7% | 7% | 7% |
| **Eastland** | | | | | | |
| New Demand ( after conservation) | 1,129 | 1,114 | 864 | 664 | 482 | 402 |
| Expected Conservation Savings | 35 | 59 | 65 | 50 | 36 | 30 |
| New Surplus (Shortage) (acft/yr) | (1,129) | (1,114) | (864) | (664) | (482) | (402) |
| Shortage Reduction w/ Conservation | 3% | 5% | 7% | 7% | 7% | 7% |
| **Falls** | | | | | | |
| New Demand ( after conservation) | 218 | 234 | 241 | 266 | 286 | 308 |
| Expected Conservation Savings | 7 | 12 | 18 | 20 | 21 | 23 |
| New Surplus (Shortage) (acft/yr) | (218) | (234) | (241) | (266) | (286) | (308) |
| Shortage Reduction w/ Conservation | 3% | 5% | 7% | 7% | 7% | 7% |
| **Fisher** | | | | | | |
| New Demand ( after conservation) | 395 | 382 | 334 | 291 | 254 | 221 |
| Expected Conservation Savings | 12 | 20 | 25 | 22 | 19 | 17 |
| New Surplus (Shortage) (acft/yr) | (395) | (382) | (334) | (291) | (254) | (221) |
| Shortage Reduction w/ Conservation | 3% | 5% | 7% | 7% | 7% | 7% |

### Table 2.3.4 (Continued)

| Mining Projections (acft/yr) | | | | | | |
|---|---|---|---|---|---|---|
| | *2020 (3%)* | *2030 (5%)* | *2040 (7%)* | *2050 (7%)* | *2060 (7%)* | *2070 (7%)* |
| **Grimes** | | | | | | |
| New Demand ( after conservation) | 313 | 572 | 438 | 316 | 194 | 119 |
| Expected Conservation Savings | 10 | 30 | 33 | 24 | 15 | 9 |
| New Surplus (Shortage) (acft/yr) | (281) | (539) | (405) | (284) | (162) | (86) |
| Shortage Reduction w/ Conservation | 3% | 5% | 8% | 8% | 8% | 9% |
| **Hamilton** | | | | | | |
| New Demand ( after conservation) | 381 | 224 | 94 | 0 | 0 | 0 |
| Expected Conservation Savings | 12 | 12 | 7 | 0 | 0 | 0 |
| New Surplus (Shortage) (acft/yr) | (369) | (212) | (81) | 13 | 13 | 13 |
| Shortage Reduction w/ Conservation | 3% | 5% | 8% | N/A | N/A | N/A |
| **Haskell** | | | | | | |
| New Demand ( after conservation) | 90 | 87 | 77 | 69 | 61 | 55 |
| Expected Conservation Savings | 3 | 5 | 6 | 5 | 5 | 4 |
| New Surplus (Shortage) (acft/yr) | (90) | (87) | (77) | (69) | (61) | (55) |
| Shortage Reduction w/ Conservation | 3% | 5% | 7% | 7% | 7% | 7% |
| **Hill** | | | | | | |
| New Demand ( after conservation) | 1,585 | 1,131 | 721 | 375 | 405 | 358 |
| Expected Conservation Savings | 49 | 60 | 54 | 0 | 31 | 33 |
| New Surplus (Shortage) (acft/yr) | (554) | (299) | (90) | 0 | (174) | (326) |
| Shortage Reduction w/ Conservation | 8% | 17% | 38% | N/A | 15% | 26% |
| **Hood** | | | | | | |
| New Demand ( after conservation) | 2,016 | 2,314 | 2,066 | 1,984 | 1,900 | 1,913 |
| Expected Conservation Savings | 62 | 122 | 156 | 149 | 143 | 144 |
| New Surplus (Shortage) (acft/yr) | (792) | (1,090) | (843) | (760) | (676) | (689) |
| Shortage Reduction w/ Conservation | 7% | 10% | 16% | 16% | 17% | 17% |

**Table 2.3.4 (Continued)**

| Mining Projections (acft/yr) | | | | | | |
|---|---|---|---|---|---|---|
| | *2020 (3%)* | *2030 (5%)* | *2040 (7%)* | *2050 (7%)* | *2060 (7%)* | *2070 (7%)* |
| **Johnson** | | | | | | |
| New Demand ( after conservation) | 4,002 | 2,649 | 1,409 | 942 | 1,080 | 1,242 |
| Expected Conservation Savings | 124 | 139 | 106 | 71 | 81 | 94 |
| New Surplus (Shortage) (acft/yr) | (1,140) | 214 | 1,453 | 1,920 | 1,782 | 1,620 |
| Shortage Reduction w/ Conservation | 10% | N/A | N/A | N/A | N/A | N/A |
| **Jones** | | | | | | |
| New Demand ( after conservation) | 232 | 222 | 203 | 185 | 170 | 157 |
| Expected Conservation Savings | 7 | 12 | 15 | 14 | 13 | 12 |
| New Surplus (Shortage) (acft/yr) | (232) | (222) | (203) | (185) | (170) | (157) |
| Shortage Reduction w/ Conservation | 3% | 5% | 7% | 7% | 7% | 7% |
| **Knox** | | | | | | |
| New Demand ( after conservation) | 15 | 14 | 13 | 13 | 13 | 13 |
| Expected Conservation Savings | 0 | 1 | 1 | 1 | 1 | 1 |
| New Surplus (Shortage) (acft/yr) | (15) | (14) | (13) | (13) | (13) | (13) |
| Shortage Reduction w/ Conservation | 3% | 5% | 7% | 7% | 7% | 7% |
| **Lampasas** | | | | | | |
| New Demand ( after conservation) | 192 | 210 | 224 | 243 | 266 | 291 |
| Expected Conservation Savings | 6 | 11 | 17 | 18 | 20 | 22 |
| New Surplus (Shortage) (acft/yr) | (167) | (185) | (199) | (218) | (241) | (266) |
| Shortage Reduction w/ Conservation | 3% | 6% | 8% | 8% | 8% | 8% |
| **Lee** | | | | | | |
| New Demand ( after conservation) | 3,085 | 6,925 | 7,223 | 7,723 | 8,281 | 8,957 |
| Expected Conservation Savings | 95.4 | 364.45 | 543.69 | 581.28 | 623.28 | 674.17 |
| New Surplus (Shortage) (acft/yr) | (3,085) | (6,925) | (7,223) | (7,723) | (8,281) | (8,957) |
| Shortage Reduction w/ Conservation | 3% | 5% | 7% | 7% | 7% | 7% |

### Table 2.3.4 (Continued)

| Mining Projections (acft/yr) | | | | | | |
|---|---|---|---|---|---|---|
| | *2020 (3%)* | *2030 (5%)* | *2040 (7%)* | *2050 (7%)* | *2060 (7%)* | *2070 (7%)* |
| **Limestone** | | | | | | |
| New Demand ( after conservation) | 10,007 | 9,429 | 9,174 | 9,615 | 10,049 | 10,625 |
| Expected Conservation Savings | 310 | 496 | 691 | 724 | 756 | 800 |
| New Surplus (Shortage) (acft/yr) | (9,198) | (8,619) | (8,365) | (8,806) | (9,239) | (9,816) |
| Shortage Reduction w/ Conservation | 3% | 5% | 8% | 8% | 8% | 8% |
| **McLennan** | | | | | | |
| New Demand ( after conservation) | 2,462 | 2,850 | 2,846 | 3,262 | 3,564 | 3,921 |
| Expected Conservation Savings | 76 | 150 | 214 | 246 | 268 | 295 |
| New Surplus (Shortage) (acft/yr) | (2,188) | (2,576) | (2,572) | (2,989) | (3,290) | (3,647) |
| Shortage Reduction w/ Conservation | 3% | 6% | 8% | 8% | 8% | 7% |
| **Milam** | | | | | | |
| New Demand ( after conservation) | 14 | 13 | 13 | 13 | 13 | 13 |
| Expected Conservation Savings | 0 | 1 | 1 | 1 | 1 | 1 |
| New Surplus (Shortage) (acft/yr) | (14) | (13) | (13) | (13) | (13) | (13) |
| Shortage Reduction w/ Conservation | 3% | 5% | 7% | 7% | 7% | 7% |
| **Nolan** | | | | | | |
| New Demand ( after conservation) | 218 | 211 | 186 | 166 | 147 | 131 |
| Expected Conservation Savings | 7 | 11 | 14 | 12 | 11 | 10 |
| New Surplus (Shortage) (acft/yr) | (218) | (211) | (186) | (166) | (147) | (131) |
| Shortage Reduction w/ Conservation | 3% | 5% | 7% | 7% | 7% | 7% |
| **Robertson** | | | | | | |
| New Demand ( after conservation) | 9,616 | 11,165 | 12,804 | 15,086 | 17,872 | 21,334 |
| Expected Conservation Savings | 297 | 588 | 964 | 1136 | 1345 | 1606 |
| New Surplus (Shortage) (acft/yr) | 589 | (960) | (2,599) | (4,881) | (7,667) | (11,129) |
| Shortage Reduction w/ Conservation | N/A | 38% | 27% | 19% | 15% | 13% |

**Table 2.3.4 (Continued)**

| Mining Projections (acft/yr) | | | | | | |
|---|---|---|---|---|---|---|
| | *2020 (3%)* | *2030 (5%)* | *2040 (7%)* | *2050 (7%)* | *2060 (7%)* | *2070 (7%)* |
| **Shackelford** | | | | | | |
| New Demand ( after conservation) | 545 | 710 | 519 | 411 | 305 | 226 |
| Expected Conservation Savings | 17 | 37 | 39 | 31 | 23 | 17 |
| New Surplus (Shortage) (acft/yr) | (538) | (703) | (512) | (404) | (298) | (219) |
| Shortage Reduction w/ Conservation | 3% | 5% | 7% | 7% | 7% | 7% |
| **Somervell** | | | | | | |
| New Demand ( after conservation) | 1,079 | 1,215 | 1,066 | 986 | 928 | 903 |
| Expected Conservation Savings | 33 | 64 | 80 | 74 | 70 | 68 |
| New Surplus (Shortage) (acft/yr) | (374) | (510) | (361) | (281) | (223) | (198) |
| Shortage Reduction w/ Conservation | 8% | 11% | 18% | 21% | 24% | 26% |
| **Stephens** | | | | | | |
| New Demand ( after conservation) | 4,912 | 4,884 | 4,146 | 3,557 | 3,029 | 2,579 |
| Expected Conservation Savings | 152 | 257 | 312 | 268 | 228 | 194 |
| New Surplus (Shortage) (acft/yr) | (3,912) | (3,884) | (3,146) | (2,557) | (2,029) | (1,579) |
| Shortage Reduction w/ Conservation | 4% | 6% | 9% | 9% | 10% | 11% |
| **Stonewall** | | | | | | |
| New Demand ( after conservation) | 566 | 547 | 476 | 415 | 361 | 314 |
| Expected Conservation Savings | 18 | 29 | 36 | 31 | 27 | 24 |
| New Surplus (Shortage) (acft/yr) | (391) | (372) | (301) | (240) | (186) | (139) |
| Shortage Reduction w/ Conservation | 4% | 7% | 11% | 12% | 13% | 15% |
| **Taylor** | | | | | | |
| New Demand ( after conservation) | 379 | 371 | 340 | 322 | 306 | 293 |
| Expected Conservation Savings | 12 | 20 | 26 | 24 | 23 | 22 |
| New Surplus (Shortage) (acft/yr) | (379) | (371) | (340) | (322) | (306) | (293) |
| Shortage Reduction w/ Conservation | 3% | 5% | 7% | 7% | 7% | 7% |

**Table 2.3.4 (Concluded)**

| Mining Projections (acft/yr) | | | | | | |
|---|---|---|---|---|---|---|
| | 2020 (3%) | 2030 (5%) | 2040 (7%) | 2050 (7%) | 2060 (7%) | 2070 (7%) |
| **Throckmorton** | | | | | | |
| New Demand ( after conservation) | 188 | 181 | 159 | 140 | 123 | 108 |
| Expected Conservation Savings | 6 | 10 | 12 | 11 | 9 | 8 |
| New Surplus (Shortage) (acft/yr) | (188) | (181) | (159) | (140) | (123) | (108) |
| Shortage Reduction w/ Conservation | 3% | 5% | 7% | 7% | 7% | 7% |
| **Washington** | | | | | | |
| New Demand ( after conservation) | 552 | 823 | 654 | 500 | 347 | 246 |
| Expected Conservation Savings | 17 | 43 | 49 | 38 | 26 | 18 |
| New Surplus (Shortage) (acft/yr) | (552) | (823) | (654) | (500) | (347) | (246) |
| Shortage Reduction w/ Conservation | 3% | 5% | 7% | 7% | 7% | 7% |
| **Williamson** | | | | | | |
| New Demand ( after conservation) | 5,008 | 5,935 | 6,849 | 7,956 | 9,097 | 10,403 |
| Expected Conservation Savings | 155 | 312 | 515 | 599 | 685 | 783 |
| New Surplus (Shortage) (acft/yr) | (4,593) | (5,520) | (6,433) | (7,541) | (8,682) | (9,988) |
| Shortage Reduction w/ Conservation | 3% | 5% | 7% | 7% | 7% | 7% |
| **Young** | | | | | | |
| New Demand ( after conservation) | 181 | 262 | 182 | 140 | 98 | 68 |
| Expected Conservation Savings | 6 | 14 | 14 | 11 | 7 | 5 |
| New Surplus (Shortage) (acft/yr) | (181) | (262) | (182) | (140) | (98) | (68) |
| Shortage Reduction w/ Conservation | 3% | 5% | 7% | 7% | 7% | 7% |
| **Total Savings** | **1,827** | **3,475** | **4,775** | **4,902** | **5,227** | **5,680** |

## 2.3.4 Environmental Issues

The Task Force BMPs have been developed and tested through public and private sector research, and have been applied within the region. Such programs have been installed, and are in operation today, and are not expected to have significant environmental issues associated with implementation. For example, most BMPs improve water use efficiency without making significant changes to wildlife habitat. Thus, the proposed conservation practices are not anticipated to have significant potential adverse environmental effects, and may have potentially beneficial environmental effects.

## 2.3.5 Engineering and Costing

The Brazos G RWPG recommends implementing water conservation for industrial users (manufacturing, steam-electric, and mining) with projected needs amounting to a 3 percent water demand reduction by 2020, 5 percent by 2030, and 7 percent from 2040 to 2070. The 12 counties in the Brazos G Area with projected manufacturing shortages can save up to 1,688 acft/yr in 2070. The seven counties in the Brazos G Area with projected steam-electric shortages can save up to 14,307 acft in 2070. The 35 counties in the Brazos G Area with projected mining shortages can save up to 5,680 acft in 2070. Costs to implement BMPs vary from site to site and the Brazos G RWPG recognizes that industries will pursue conservation strategies that are economically feasible with water savings benefits. For this reason, it is impractical to evaluate the costs of implementing industrial water conservation strategies.

## 2.3.6 Implementation Issues

Demand reduction through water conservation is being implemented throughout the Brazos G Area. The rate of adoption of efficient water-using practices is dependent upon public knowledge of the benefits, information about how to implement water conservation measures, and financing.

There is public support for industrial water conservation; and, it is being implemented at a steady pace, and as water markets for conserved water expand, this practice will likely reach greater potentials. The TWDB has industrial water conservation programs including presentations and workshops for utilities who wish to train staff to develop local programs including water use site surveys, publications on industrial water reuse potential, and information on tax incentives for industries that conserve or reuse water. Future planning efforts should consider the use of detailed studies to fully determine the maximum potential benefits of mining conservation.

This option is compared to the plan development criteria in Table 2.3-5 and the option meets each criterion.

### Table 2.3-5. Comparison of Industrial Conservation to Plan Development Criteria

| Impact Category | Comment(s) |
|---|---|
| A. Water Supply | |
| 1 Quantity | 1. Manufacturing Firm Yield: up to 1,688 acft/yr (2070)<br>Steam-Electric Firm Yield: up to 14,307 acft/yr (2070)<br>Mining Firm Yield: up to 5,680 acft/yr (2070) |
| 2. Reliability and Cost | 2. Good reliability. |
| 3. Cost | 3. Cost: Highly variable based on BMP selected and facility specifics. |
| B. Environmental factors | |
| 1. Instream flows | 1. None or low impact. |
| 2. Bay and Estuary Inflows | 2. None or low impact. |
| 3. Wildlife Habitat | 3. None or low impact. |
| 4. Wetlands | 4. None or low impact. |
| 5. Threatened and Endangered Species | 5. None. |
| 6. Cultural Resources | 6. No cultural resources affected. |
| 7. Water Quality | 7. None or low impact. |
| C. Impacts to State water resources | • No apparent negative impacts on water resources |
| D. Threats to agriculture and natural resources in region | • None |
| E. Recreational impacts | • None |
| F. Equitable Comparison of Strategies | • Standard analyses and methods used |
| G. Interbasin transfers | • None |
| H. Third party social and economic impacts from voluntary redistribution of water | • None |
| I. Efficient use of existing water supplies and regional opportunities | • Improvement over current conditions by reducing the rate of decline of local groundwater levels. |
| J. Effect on navigation | • None |
| K. Consideration of water pipelines and other facilities used for water conveyance | • None |