# Socioeconomic Impacts of Projected Water Shortages

# for the Region G Regional Water Planning Area

**Prepared in Support of the 2016 Region G Regional Water Plan**

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## Executive Summary

Evaluating the social and economic impacts of not meeting identified water needs is a required part of the regional water planning process. The Texas Water Development Board (TWDB) estimates those impacts for regional water planning groups, and summarizes the impacts in the state water plan. The analysis presented is for the Region G Regional Water Planning Group.

Based on projected water demands and existing water supplies, the Region G planning group identified water needs (potential shortages) that would occur within its region under a repeat of the drought of record for six water use categories. The TWDB then estimated the socioeconomic impacts of those needs—if they are not met—for each water use category and as an aggregate for the region.

The analysis was performed using an economic modeling software package, IMPLAN (Impact for Planning Analysis), as well as other economic analysis techniques, and represents a snapshot of socioeconomic impacts that may occur during a single year during a drought of record within each of the planning decades. For each water use category, the evaluation focused on estimating income losses and job losses. The income losses represent an approximation of gross domestic product (GDP) that would be foregone if water needs are not met.

The analysis also provides estimates of financial transfer impacts, which include tax losses (state, local, and utility tax collections); water trucking costs; and utility revenue losses. In addition, social impacts were estimated, encompassing lost consumer surplus (a welfare economics measure of consumer wellbeing); as well as population and school enrollment losses.

It is estimated that not meeting the identified water needs in Region G would result in an annually combined lost income impact of approximately $7 billion in 2020, increasing to $16 billion in 2070 (Table ES-1). In 2020, the region would lose approximately 45,000 jobs, and by 2070 job losses would increase to approximately 146,000.

All impact estimates are in year 2013 dollars and were calculated using a variety of data sources and tools including the use of a region-specific IMPLAN model, data from the TWDB annual water use estimates, the U.S. Census Bureau, Texas Agricultural Statistics Service, and Texas Municipal League.

**Table ES-1: Region G Socioeconomic Impact Summary**

| Regional Economic Impacts | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| Income losses ($ millions)* | $7,095 | $8,366 | $8,556 | $9,571 | $12,397 | $16,054 |
| Job losses | 45,029 | 51,678 | 57,465 | 66,771 | 101,683 | 146,122 |
| **Financial Transfer Impacts** | **2020** | **2030** | **2040** | **2050** | **2060** | **2070** |
| Tax losses on production and imports ($ millions)* | $655 | $759 | $729 | $779 | $1,003 | $1,299 |
| Water trucking costs ($ millions)* | $1 | $1 | $1 | $3 | $2 | $27 |
| Utility revenue losses ($ millions)* | $91 | $180 | $293 | $423 | $515 | $725 |
| Utility tax revenue losses ($ millions)* | $1 | $3 | $5 | $7 | $9 | $12 |
| **Social Impacts** | **2020** | **2030** | **2040** | **2050** | **2060** | **2070** |
| Consumer surplus losses ($ millions)* | $41 | $79 | $195 | $378 | $302 | $1,100 |
| Population losses | 8,267 | 9,488 | 10,551 | 12,259 | 18,669 | 26,828 |
| School enrollment losses | 1,529 | 1,755 | 1,952 | 2,268 | 3,454 | 4,963 |

***Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000.***

# 1 Introduction

Water shortages during a repeat of the drought of record would likely curtail or eliminate certain economic activity in businesses and industries that rely heavily on water. Insufficient water supplies could not only have an immediate and real impact on existing businesses and industry, but they could also adversely and chronically affect economic development in Texas. From a social perspective, water supply reliability is critical as well. Shortages could disrupt activity in homes, schools and government and could adversely affect public health and safety. For these reasons, it is important to evaluate and understand how water supply shortages during drought could impact communities throughout the state.

Administrative rules (31 Texas Administrative Code §357.33 (c)) require that regional water planning groups evaluate the social and economic impacts of not meeting water needs as part of the regional water planning process, and rules direct the TWDB staff to provide technical assistance upon request. Staff of the TWDB's Water Use, Projections, & Planning Division designed and conducted this analysis in support of the Region G Regional Water Planning Group.

This document summarizes the results of the analysis and discusses the methodology used to generate the results. Section 1 summarizes the water needs calculation performed by the TWDB based on the regional water planning group's data. Section 2 describes the methodology for the impact assessment and discusses approaches and assumptions specific to each water use category (i.e., irrigation, livestock, mining, steam-electric, municipal and manufacturing). Section 3 presents the results for each water use category with results summarized for the region as a whole. Appendix A presents details on the socioeconomic impacts by county.

## 1.1 Identified Regional Water Needs (Potential Shortages)

As part of the regional water planning process, the TWDB adopted water demand projections for each water user group (WUG) with input from the planning groups. WUGs are composed of cities, utilities, combined rural areas (designated as county-other), and the county-wide water use of irrigation, livestock, manufacturing, mining and steam-electric power. The demands are then compared to the existing water supplies of each WUG to determine potential shortages, or needs, by decade. Existing water supplies are legally and physically accessible for immediate use in the event of drought. Projected water demands and existing supplies are compared to identify either a surplus or a need for each WUG.

Table 1-1 summarizes the region's identified water needs in the event of a repeat of drought of the record. Demand management, such as conservation, or the development of new infrastructure to increase supplies are water management strategies that may be recommended by the planning group to meet those needs. This analysis assumes that no strategies are implemented, and that the identified needs correspond to future water shortages. Note that projected water needs generally increase over time, primarily due to anticipated population and economic growth. To provide a general sense of proportion, total projected needs as an overall percentage of total demand by water use category are presented in aggregate in Table 1-1. Projected needs for individual water user groups within the aggregate vary greatly, and may reach 100% for a given WUG and water use category. Detailed water needs by WUG and county appear in Chapter 4 of the 2016 Region G Regional Water Plan.

**Table 1-1 Regional Water Needs Summary by Water Use Category**

| Water Use Category | | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|---|
| **Irrigation** | Water Needs (acre-feet per year) | 83,282 | 83,309 | 83,494 | 77,474 | 70,276 | 67,070 |
| | % of the category's total water demand | 29% | 29% | 30% | 29% | 27% | 26% |
| **Livestock** | Water Needs (acre-feet per year) | - | - | - | - | - | - |
| | % of the category's total water demand | - | - | - | - | - | - |
| **Manufacturing** | Water Needs (acre-feet per year) | 7,656 | 7,812 | 9,199 | 10,350 | 11,619 | 12,898 |
| | % of the category's total water demand | 35% | 32% | 34% | 35% | 36% | 37% |
| **Mining** | Water Needs (acre-feet per year) | 41,731 | 50,127 | 50,494 | 53,675 | 57,802 | 64,121 |
| | % of the category's total water demand | 68% | 71% | 73% | 76% | 77% | 79% |
| **Municipal** | Water Needs (acre-feet per year) | 32,144 | 65,816 | 106,036 | 153,098 | 205,731 | 262,429 |
| | % of the category's total water demand | 8% | 15% | 21% | 27% | 33% | 38% |
| **Steam-electric power** | Water Needs (acre-feet per year) | 70,834 | 88,264 | 99,300 | 128,694 | 144,204 | 162,658 |
| | % of the category's total water demand | 30% | 32% | 34% | 40% | 42% | 45% |
| **Total water needs (acre-feet per year)** | | **235,647** | **295,328** | **348,523** | **423,291** | **489,632** | **569,176** |

# 2 Economic Impact Assessment Methodology Summary

This portion of the report provides a summary of the methodology used to estimate the potential economic impacts of future water shortages. The general approach employed in the analysis was to obtain estimates for income and job losses on the smallest geographic level that the available data would support, tie those values to their accompanying historic water use estimate (volume), and thereby determine a maximum impact per acre-foot of shortage for each of the socioeconomic measures. The calculations of economic impacts were based on the overall composition of the economy using many underlying economic "sectors." Sectors in this analysis refer to one or more of the 440 specific production sectors of the economy designated within IMPLAN (Impact for Planning Analysis), the economic impact modeling software used for this assessment. Economic impacts within this report are estimated for approximately 310 of those sectors, with the focus on the more water intense production sectors. The economic impacts for a single water use category consist of an aggregation of impacts to multiple related economic sectors.

## 2.1 Impact Assessment Measures

A required component of the regional and state water plans is to estimate the potential economic impacts of shortages due to a drought of record. Consistent with previous water plans, several key variables were estimated and are described in Table 2-1.

**Table 2-1 Socioeconomic Impact Analysis Measures**

| Regional Economic Impacts | Description |
|---|---|
| **Income losses - value added** | The value of output less the value of intermediate consumption; it is a measure of the contribution to GDP made by an individual producer, industry, sector, or group of sectors within a year. For a shortage, value added is a measure of the income losses to the region, county, or WUG and includes the direct, indirect and induced monetary impacts on the region. |
| **Income losses - electrical power purchase costs** | Proxy for income loss in the form of additional costs of power as a result of impacts of water shortages. |
| **Job losses** | Number of part-time and full-time jobs lost due to the shortage. |
| **Financial Transfer Impacts** | **Description** |
| **Tax losses on production and imports** | Sales and excise taxes (not collected due to the shortage), customs duties, property taxes, motor vehicle licenses, severance taxes, other taxes, and special assessments less subsidies. |
| **Water trucking costs** | Estimate for shipping potable water. |
| **Utility revenue losses** | Foregone utility income due to not selling as much water. |
| **Utility tax revenue losses** | Foregone miscellaneous gross receipts tax collections. |
| **Social Impacts** | **Description** |
| **Consumer surplus losses** | A welfare measure of the lost value to consumers accompanying less water use. |
| **Population losses** | Population losses accompanying job losses. |
| **School enrollment losses** | School enrollment losses (K-12) accompanying job losses. |

### 2.1.1 Regional Economic Impacts

Two key measures were included within the regional economic impacts classification: income losses and job losses. Income losses presented consist of the sum of value added losses and additional purchase costs of electrical power. Job losses are also presented as a primary economic impact measure.

#### *Income Losses - Value Added Losses*

Value added is the value of total output less the value of the intermediate inputs also used in production of the final product. Value added is similar to Gross Domestic Product (GDP), a familiar measure of the productivity of an economy. The loss of value added due to water shortages was estimated by input-output analysis using the IMPLAN software package, and includes the direct, indirect, and induced monetary impacts on the region.

#### *Income Losses - Electric Power Purchase Costs*

The electrical power grid and market within the state is a complex interconnected system. The industry response to water shortages, and the resulting impact on the region, are not easily modeled using traditional input/output impact analysis and the IMPLAN model. Adverse impacts on the region will occur, and were represented in this analysis by the additional costs associated with power purchases from other generating plants within the region or state. Consequently, the analysis employed additional power purchase costs as a proxy for the value added impacts for that water use category, and these are included as a portion of the overall income impact for completeness.

For the purpose of this analysis, it was assumed that power companies with insufficient water will be forced to purchase power on the electrical market at a projected higher rate of 5.60 cents per kilowatt hour. This rate is based upon the average day-ahead market purchase price of electricity in Texas from the recent drought period in 2011.

#### *Job Losses*

The number of jobs lost due to the economic impact was estimated using IMPLAN output associated with the water use categories noted in Table 1-1. Because of the difficulty in predicting outcomes and a lack of relevant data, job loss estimates were not calculated for the steam-electric power production or for certain municipal water use categories.

### 2.1.2 Financial Transfer Impacts

Several of the impact measures estimated within the analysis are presented as supplemental information, providing additional detail concerning potential impacts on a sub-portion of the economy or government. Measures included in this category include lost tax collections (on production and imports), trucking costs for imported water, declines in utility revenues, and declines in utility tax revenue collected by the state. Many of these measures are not solely adverse, with some having both positive and negative impacts. For example, cities and residents would suffer if forced to pay large costs for trucking in potable water. Trucking firms, conversely, would benefit from the transaction. Additional detail for each of these measures follows.

### *Tax Losses on Production and Imports*

Reduced production of goods and services accompanying water shortages adversely impacts the collection of taxes by state and local government. The regional IMPLAN model was used to estimate reduced tax collections associated with the reduced output in the economy.

### *Water Trucking Costs*

In instances where water shortages for a municipal water user group were estimated to be 80 percent or more of water demands, it was assumed that water would be trucked in to support basic consumption and sanitation needs. For water shortages of 80 percent or greater, a fixed cost of $20,000 per acre-foot of water was calculated and presented as an economic cost. This water trucking cost was applied for both the residential and non-residential portions of municipal water needs and only impacted a small number of WUGs statewide.

### *Utility Revenue Losses*

Lost utility income was calculated as the price of water service multiplied by the quantity of water not sold during a drought shortage. Such estimates resulted from city-specific pricing data for both water and wastewater. These water rates were applied to the potential water shortage to determine estimates of lost utility revenue as water providers sold less water during the drought due to restricted supplies.

### *Utility Tax Losses*

Foregone utility tax losses included estimates of uncollected miscellaneous gross receipts taxes. Reduced water sales reduce the amount of utility tax that would be collected by the State of Texas for water and wastewater service sales.

## 2.1.3 Social Impacts

### *Consumer Surplus Losses of Municipal Water Users*

Consumer surplus loss is a measure of impact to the wellbeing of municipal water users when their water use is restricted. Consumer surplus is the difference between how much a consumer is willing and able to pay for the commodity (i.e., water) and how much they actually have to pay. The difference is a benefit to the consumer’s wellbeing since they do not have to pay as much for the commodity as they would be willing to pay. However, consumer’s access to that water may be limited, and the associated consumer surplus loss is an estimate of the equivalent monetary value of the negative impact to the consumer’s wellbeing, for example, associated with a diminished quality of their landscape (i.e., outdoor use). Lost consumer surplus estimates for reduced outdoor and indoor use, as well as residential and commercial/institutional demands, were included in this analysis. Consumer surplus is an attempt to measure effects on wellbeing by monetizing those effects; therefore, these values should not be added to the other monetary impacts estimated in the analysis.

Lost consumer surplus estimates varied widely by location and type. For a 50 percent shortage, the estimated statewide consumer surplus values ranged from $55 to $2,500 per household (residential use), and from $270 to $17,400 per firm (non-residential).

### *Population and School Enrollment Losses*

Population losses due to water shortages, as well as the related loss of school enrollment, were based upon the job loss estimates and upon a recent study of job layoffs and the resulting adjustment of the labor market, including the change in population.[1] The study utilized Bureau of Labor Statistics data regarding layoffs between 1996 and 2013, as well as Internal Revenue Service data regarding migration, to model an estimate of the change in the population as the result of a job layoff event. Layoffs impact both out-migration, as well as in-migration into an area, both of which can negatively affect the population of an area. In addition, the study found that a majority of those who did move following a layoff moved to another labor market rather than an adjacent county. Based on this study, a simplified ratio of job and net population losses was calculated for the state as a whole: for every 100 jobs lost, 18 people were assumed to move out of the area. School enrollment losses were estimated as a proportion of the population lost.

## 2.2 Analysis Context

The context of the economic impact analysis involves situations where there are physical shortages of surface or groundwater due to drought of record conditions. Anticipated shortages may be nonexistent in earlier decades of the planning horizon, yet population growth or greater industrial, agricultural or other sector demands in later decades may result in greater overall demand, exceeding the existing supplies. Estimated socioeconomic impacts measure what would happen if water user groups experience water shortages for a period of one year. Actual socioeconomic impacts would likely become larger as drought of record conditions persist for periods greater than a single year.

### 2.2.1 IMPLAN Model and Data

Input-Output analysis using the IMPLAN (Impact for Planning Analysis) software package was the primary means of estimating value added, jobs, and taxes. This analysis employed county and regional level models to determine key impacts. IMPLAN is an economic impact model, originally developed by the U.S. Forestry Service in the 1970's to model economic activity at varying geographic levels. The model is currently maintained by the Minnesota IMPLAN Group (MIG Inc.) which collects and sells county and state specific data and software. The year 2011 version of IMPLAN, employing data for all 254 Texas counties, was used to provide estimates of value added, jobs, and taxes on production for the economic sectors associated with the water user groups examined in the study. IMPLAN uses 440 sector-specific Industry Codes, and those that rely on water as a primary input were assigned to their relevant planning water user categories (manufacturing, mining, irrigation, etc.). Estimates of value added for a water use category were obtained by summing value added estimates across the relevant IMPLAN sectors

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[1] Foote, Andrew, Grosz, Michel, Stevens, Ann. "Locate Your Nearest Exit: Mass Layoffs and Local Labor Market Response." University of California, Davis. April 2015. http://paa2015.princeton.edu/uploads/150194

associated with that water use category. Similar calculations were performed for the job and tax losses on production and import impact estimates.

Note that the value added estimates, as well as the job and tax estimates from IMPLAN, include three components:

- *Direct effects* representing the initial change in the industry analyzed;
- *Indirect effects* that are changes in inter-industry transactions as supplying industries respond to reduced demands from the directly affected industries; and,
- *Induced effects* that reflect changes in local spending that result from reduced household income among employees in the directly and indirectly affected industry sectors.

### 2.2.2 Elasticity of Economic Impacts

The economic impact of a water need is based on the relative size of the water need to the water demand for each water user group (Figure 2-1). Smaller water shortages, for example, less than 5 percent, were anticipated to result in no initial negative economic impact because water users are assumed to have a certain amount of flexibility in dealing with small shortages. As a water shortage deepens, however, such flexibility lessens and results in actual and increasing economic losses, eventually reaching a representative maximum impact estimate per unit volume of water. To account for such ability to adjust, an elasticity adjustment function was used in estimating impacts for several of the measures. Figure 2-1 illustrates the general relationship for the adjustment functions. Negative impacts are assumed to begin accruing when the shortage percentage reaches the lower bound b1 (10 percent in Figure 2-1), with impacts then increasing linearly up to the 100 percent impact level (per unit volume) once the upper bound for adjustment reaches the b2 level shortage (50 percent in Figure 2-1 example).

Initially, the combined total value of the three value added components (direct, indirect, and induced) was calculated and then converted into a per acre-foot economic value based on historical TWDB water use estimates within each particular water use category. As an example, if the total, annual value added for livestock in the region was $2 million and the reported annual volume of water used in that industry was 10,000 acre-feet, the estimated economic value per acre-foot of water shortage would be $200 per acre-foot. Negative economic impacts of shortages were then estimated using this value as the maximum impact estimate ($200 per acre-foot in the example) applied to the anticipated shortage volume in acre-feet and adjusted by the economic impact elasticity function. This adjustment varied with the severity as percentage of water demand of the anticipated shortage. If one employed the sample elasticity function shown in Figure 2-1, a 30% shortage in the water use category would imply an economic impact estimate of 50% of the original $200 per acre-foot impact value (i.e., $100 per acre-foot).

Such adjustments were not required in estimating consumer surplus, nor for the estimates of utility revenue losses or utility tax losses. Estimates of lost consumer surplus relied on city-specific demand curves with the specific lost consumer surplus estimate calculated based on the relative percentage of the city's water shortage. Estimated changes in population as well as changes in school enrollment were indirectly related to the elasticity of job losses.

Assumed values for the bounds b1 and b2 varied with water use category under examination and are presented in Table 2-2.

**Figure 2-1 Example Economic Impact Elasticity Function (as applied to a single water user's shortage)**

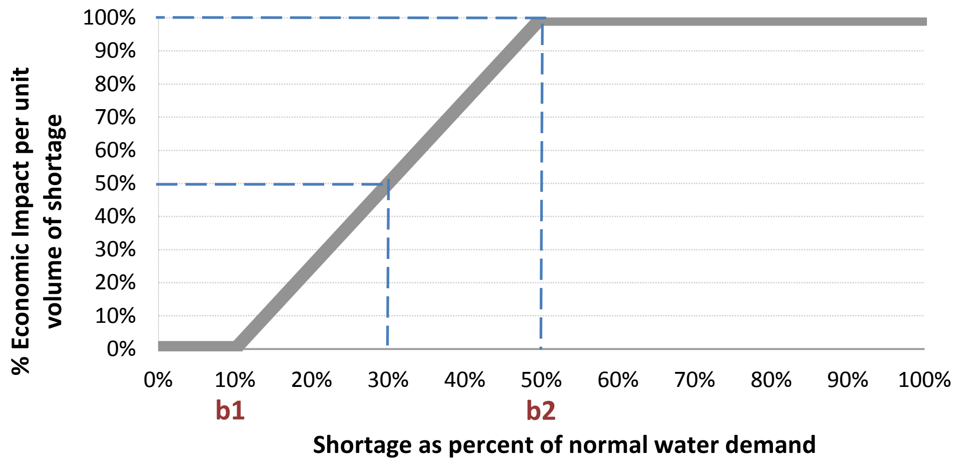


**Table 2-2 Economic Impact Elasticity Function Lower and Upper Bounds**

| Water Use Category | Lower Bound (b1) | Upper Bound (b2) |
|---|---|---|
| **Irrigation** | **5%** | **50%** |
| **Livestock** | **5%** | **10%** |
| **Manufacturing** | **10%** | **50%** |
| **Mining** | **10%** | **50%** |
| **Municipal (non-residential water intensive)** | **50%** | **80%** |
| **Steam-electric power** | **20%** | **70%** |

## 2.3 Analysis Assumptions and Limitations

Modeling of complex systems requires making assumptions and accepting limitations. This is particularly true when attempting to estimate a wide variety of economic impacts over a large geographic area and into future decades. Some of the key assumptions and limitations of the methodology include:

1. The foundation for estimating socioeconomic impacts of water shortages resulting from a drought are the water needs (potential shortages) that were identified as part of the regional water planning process. These needs have some uncertainty associated with them, but serve as a reasonable basis for evaluating potential economic impacts of a drought of record event.

2. All estimated socioeconomic impacts are snapshot estimates of impacts for years in which water needs were identified (i.e., 2020, 2030, 2040, 2050, 2060, and 2070). The estimates are independent and distinct "what if" scenarios for each particular year, and water shortages are assumed to be temporary events resulting from severe drought conditions. The evaluation assumed that no recommended water management strategies are implemented. In other words, growth occurs, future shocks are imposed on an economy at 10-year intervals, and the resulting impacts are estimated. Note that the estimates presented were not cumulative (i.e., summing up expected impacts from today up to the decade noted), but were simply an estimate of the magnitude of annual socioeconomic impacts should a drought of record occur in each particular decade based on anticipated supplies and demands for that same decade.

3. Input-output models such as IMPLAN rely on a static profile of the structure of the economy as it appears today. This presumes that the relative contributions of all sectors of the economy would remain the same, regardless of changes in technology, supplies of limited resources, and other structural changes to the economy that may occur into the future. This was a significant assumption and simplification considering the 50-year time period examined in this analysis. To presume an alternative future economic makeup, however, would entail positing many other major assumptions that would very likely generate as much or more error.

4. This analysis is not a cost-benefit analysis. That approach to evaluating the economic feasibility of a specific policy or project employs discounting future benefits and costs to their present value dollars using some assumed discount rate. The methodology employed in this effort to estimate the economic impacts of future water shortages did not use any discounting procedures to weigh future costs differently through time.

5. Monetary figures are reported in constant year 2013 dollars.

6. Impacts are annual estimates. The estimated economic model does not reflect the full extent of impacts that might occur as a result of persistent water shortages occurring over an extended duration. The drought of record in most regions of Texas lasted several years.

7. Value added estimates are the primary estimate of the economic impacts within this report. One may be tempted to add consumer surplus impacts to obtain an estimate of total adverse economic impacts to the region, but the consumer surplus measure represents the change to the wellbeing of households (and other water users), not an actual change in the flow of dollars through the economy. The two categories (value added and consumer surplus) are both valid impacts but should not be summed.

8. The value added, jobs, and taxes on production and import impacts include the direct, indirect and induced effects described in Section 2.2.1. Population and school enrollment losses also indirectly include such effects as they are based on the associated losses in employment. The remaining measures (consumer surplus, utility revenue, utility taxes, additional electrical power purchase costs, and potable water trucking costs), however, do not include any induced or indirect effects.

9. The majority of impacts estimated in this analysis may be considered smaller than those that might occur under drought of record conditions. Input-output models such as IMPLAN only capture "backward linkages" on suppliers (including households that supply labor to directly affected industries). While this is a common limitation in these types of economic impact modeling efforts, it is important to note that "forward linkages" on the industries that use the outputs of the directly affected industries can also be very important. A good example is impacts on livestock operators. Livestock producers tend to suffer substantially during droughts, not because there is not enough water for their stock, but because reductions in available pasture and higher prices for purchased hay have significant economic effects on their operations. Food processors could be in a similar situation if they cannot get the grains or other inputs that they need. These effects are not captured in IMPLAN, which is one reason why the impact estimates are likely conservative.

10. The methodology did not capture "spillover" effects between regions – or the secondary impacts that occur outside of the region where the water shortage is projected to occur.

11. The model did not reflect dynamic economic responses to water shortages as they might occur, nor does the model reflect economic impacts associated with a recovery from a drought of record including:
    a. The likely significant economic rebound to the landscaping industry immediately following a drought;
    b. The cost and years to rebuild liquidated livestock herds (a major capital item in that industry);
    c. Direct impacts on recreational sectors (i.e., stranded docks and reduced tourism); or,
    d. Impacts of negative publicity on Texas' ability to attract population and business in the event that it was not able to provide adequate water supplies for the existing economy.

12. Estimates for job losses and the associated population and school enrollment changes may exceed what would actually occur. In practice, firms may be hesitant to lay off employees, even in difficult economic times. Estimates of population and school enrollment changes are based on regional evaluations and therefore do not accurately reflect what might occur on a statewide basis.

13. The results must be interpreted carefully. It is the general and relative magnitudes of impacts as well as the changes of these impacts over time that should be the focus rather than the absolute numbers. Analyses of this type are much better at predicting relative percent differences brought about by a shock to a complex system (i.e., a water shortage) than the precise size of an impact. To illustrate, assuming that the estimated economic impacts of a drought of record on the manufacturing and mining water user categories are $2 and $1 million, respectively, one should be more confident that the economic impacts on manufacturing are twice as large as those on mining and that these impacts will likely be in the millions of dollars. But one should have less confidence that the actual total economic impact experienced would be $3 million.

# 3 Analysis Results

This section presents a breakdown of the results of the regional analysis for Region G. Projected economic impacts for six water use categories (irrigation, livestock. municipal, manufacturing, mining, and steam-electric power) are also reported by decade.

## 3.1 Overview of the Regional Economy

Table 3-1 presents the 2011 economic baseline as represented by the IMPLAN model and adjusted to 2013 dollars for Region G. In year 2011, Region G generated about $85 billion in gross state product associated with 1,045,000 jobs based on the 2011 IMPLAN data. These values represent an approximation of the current regional economy for a reference point.

**Table 3-1 Region G Economy**

| Income ($ millions)* | Jobs | Taxes on production and imports ($ millions)* |
|---|---|---|
| **$85,103** | **1,044,611** | **$6,473** |

[1]*Year 2013 dollars based on 2011 IMPLAN model value added estimates for the region.*

The remainder of Section 3 presents estimates of potential economic impacts for each water use category that could reasonably be expected in the event of water shortages associated with a drought of record and if no recommended water management strategies were implemented.

## 3.2 Impacts for Irrigation Water Shortages

Nineteen of the 37 counties in the region are projected to experience water shortages in the irrigated agriculture water use category for one or more decades within the planning horizon. Estimated impacts to this water use category appear in Table 3-2. Note that tax collection impacts were not estimated for this water use category. IMPLAN data indicates a negative tax impact (i.e., increased tax collections) for the associated production sectors, primarily due to past subsidies from the federal government. Two factors led to excluding any reported tax impacts: 1) Federal support (subsidies) has lessened greatly since the year 2011 IMPLAN data was collected, and 2) It was not considered realistic to report increasing tax revenue collections for a drought of record.

**Table 3-2 Impacts of Water Shortages on Irrigation in Region**

| Impact Measure | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Income losses ($ millions)*** | $17 | $16 | $16 | $15 | $14 | $13 |
| **Job losses** | 717 | 685 | 671 | 642 | 580 | 549 |

**** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000.***

## 3.3 Impacts for Livestock Water Shortages

None of the 37 counties in the region are projected to experience water shortages in the livestock water use category for one or more decades within the planning horizon. Estimated impacts to this water use category appear in Table 3-3. Note that tax impacts are not reported for this water use category for similar reasons that apply to the irrigation water use category described above.

**Table 3-3 Impacts of Water Shortages on Livestock in Region**

| Impact Measures | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Income losses ($ millions)*** | - | - | - | - | - | - |
| **Jobs losses** | - | - | - | - | - | - |

**** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000***

## 3.4 Impacts for Municipal Water Shortages

Thirty of the 37 counties in the region are projected to experience water shortages in the municipal water use category for one or more decades within the planning horizon. Impact estimates were made for the two subtypes of use within municipal use: residential, and non-residential. The latter includes commercial and institutional users. Consumer surplus measures were made for both residential and non-residential demands. In addition, available data for the non-residential, water-intensive portion of municipal demand allowed use of IMPLAN and TWDB Water Use Survey data to estimate income loss, jobs, and taxes. Trucking cost estimates, calculated for shortages exceeding 80 percent, assumed a fixed cost of $20,000 per acre-foot to transport water for municipal use. The estimated impacts to this water use category appear in Table 3-4.

**Table 3-4 Impacts of Water Shortages on Municipal Water Users in Region**

| Impact Measures | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Income losses[1] ($ millions)*** | $157 | $280 | $526 | $814 | $2,215 | $4,025 |
| **Job losses[1]** | 3,153 | 5,643 | 10,588 | 16,348 | 44,482 | 80,837 |
| **Tax losses on production and imports[1] ($ millions)*** | $14 | $25 | $48 | $73 | $200 | $363 |
| **Trucking costs ($ millions)*** | $1 | $1 | $1 | $3 | $2 | $27 |
| **Utility revenue losses ($ millions)*** | $91 | $180 | $293 | $423 | $515 | $725 |
| **Utility tax revenue losses ($ millions)*** | $1 | $3 | $5 | $7 | $9 | $12 |

***[1] Estimates apply to the water-intensive portion of non-residential municipal water use.***
**** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000.***

## 3.5 Impacts of Manufacturing Water Shortages

Manufacturing water shortages in the region are projected to occur in 10 of the 37 counties in the region for at least one decade of the planning horizon. Estimated impacts to this water use category appear in Table 3-5.

**Table 3-5 Impacts of Water Shortages on Manufacturing in Region**

| Impacts Measures | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Income losses ($ millions)*** | $1,110 | $1,130 | $1,344 | $1,527 | $1,750 | $1,960 |
| **Job losses** | 16,523 | 16,687 | 19,835 | 22,573 | 25,836 | 28,963 |
| **Tax losses on production and Imports ($ millions)*** | $60 | $61 | $72 | $82 | $94 | $106 |

**** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000.***

## 3.6 Impacts of Mining Water Shortages

Mining water shortages in the region are projected to occur in 34 of the 37 counties in the region for at least one decade of the planning horizon. Estimated impacts to this water use type appear in Table 3-6.

**Table 3-6 Impacts of Water Shortages on Mining in Region**

| Impact Measures | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Income losses ($ millions)*** | $4,213 | $4,886 | $4,456 | $4,577 | $5,195 | $6,061 |
| **Job losses** | 24,636 | 28,662 | 26,371 | 27,207 | 30,786 | 35,773 |
| **Tax losses on production and Imports ($ millions)*** | $580 | $673 | $609 | $623 | $709 | $830 |

**** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000.***

## 3.7 Impacts of Steam-Electric Water Shortages

Steam-electric water shortages in the region are projected to occur in 10 of the 37 counties in the region for at least one decade of the planning horizon. Estimated impacts to this water use category appear in Table 3-7.

Note that estimated economic impacts to steam-electric water users:

- Are reflected as an income loss proxy in the form of the estimated additional purchasing costs for power from the electrical grid that could not be generated due to a shortage;
- Do not include estimates of impacts on jobs. Because of the unique conditions of power generators during drought conditions and lack of relevant data, it was assumed that the industry would retain, perhaps relocating or repurposing, their existing staff in order to manage their ongoing operations through a severe drought.
- Does not presume a decline in tax collections. Associated tax collections, in fact, would likely increase under drought conditions since, historically, the demand for electricity increases during times of drought, thereby increasing taxes collected on the additional sales of power.

**Table 3-7 Impacts of Water Shortages on Steam-Electric Power in Region**

| Impact Measures | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Income Losses ($ millions)*** | $1,598 | $2,054 | $2,214 | $2,638 | $3,224 | $3,994 |

**** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000.***

## 3.8 Regional Social Impacts

Projected changes in population, based upon several factors (household size, population, and job loss estimates), as well as the accompanying change in school enrollment, were also estimated and are summarized in Table 3-8.

**Table 3-8 Region-wide Social Impacts of Water Shortages in Region**

| Impact Measures | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
|---|---|---|---|---|---|---|
| **Consumer surplus losses ($ millions)*** | $41 | $79 | $195 | $378 | $302 | $1,100 |
| **Population losses** | 8,267 | 9,488 | 10,551 | 12,259 | 18,669 | 26,828 |
| **School enrollment losses** | 1,529 | 1,755 | 1,952 | 2,268 | 3,454 | 4,963 |

**** Year 2013 dollars, rounded. Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000.***

# Appendix A - County Level Summary of Estimated Economic Impacts for Region G

County level summary of estimated economic impacts of not meeting identified water needs by water use category and decade (in 2013 dollars, rounded). Values presented only for counties with projected economic impacts for at least one decade.

**** Entries denoted by a dash (-) indicate no economic impact. Entries denoted by a zero ($0) indicate income losses less than $500,000***

| | | Income losses (Million $)* | | | | | | Job losses | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| County | Water Use Category | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| BELL | IRRIGATION | $ 0 | $ 0 | $ 0 | $ 0 | $ 0 | $ 0 | 15 | 14 | 14 | 14 | 14 | 13 |
| BELL | MANUFACTURING | $ 156 | $ 178 | $ 198 | $ 217 | $ 241 | $ 268 | 1,642 | 1,868 | 2,088 | 2,283 | 2,539 | 2,815 |
| BELL | MINING | $ 43 | $ 53 | $ 62 | $ 72 | $ 82 | $ 93 | 416 | 511 | 591 | 687 | 784 | 895 |
| BELL | MUNICIPAL | $ 5 | $ 6 | $ 7 | $ 9 | $ 35 | $ 67 | 100 | 120 | 141 | 187 | 705 | 1,354 |
| BELL | STEAM ELECTRIC POWER | $ 157 | $ 183 | $ 216 | $ 255 | $ 303 | $ 360 | - | - | - | - | - | - |
| **BELL Total** | | **$ 362** | **$ 420** | **$ 483** | **$ 553** | **$ 662** | **$ 789** | **2,173** | **2,513** | **2,833** | **3,171** | **4,042** | **5,078** |
| BOSQUE | IRRIGATION | $ 0 | $ 0 | $ 0 | $ 0 | $ 0 | $ 0 | 1 | 1 | 1 | 1 | 1 | - |
| BOSQUE | MANUFACTURING | $ 502 | $ 587 | $ 672 | $ 744 | $ 829 | $ 921 | 9,017 | 10,557 | 12,072 | 13,381 | 14,906 | 16,562 |
| BOSQUE | MINING | $ 71 | $ 74 | $ 68 | $ 67 | $ 65 | $ 65 | 479 | 505 | 459 | 453 | 443 | 440 |
| BOSQUE | STEAM ELECTRIC POWER | - | - | $ 11 | $ 56 | $ 132 | $ 240 | - | - | - | - | - | - |
| **BOSQUE Total** | | **$ 572** | **$ 662** | **$ 750** | **$ 867** | **$ 1,027** | **$ 1,226** | **9,497** | **11,063** | **12,532** | **13,835** | **15,350** | **17,002** |
| BRAZOS | IRRIGATION | $ 3 | $ 2 | $ 2 | $ 1 | $ 1 | $ 1 | 111 | 90 | 72 | 56 | 42 | 31 |
| BRAZOS | MANUFACTURING | $ 196 | $ 53 | $ 97 | $ 142 | $ 190 | $ 230 | 3,041 | 819 | 1,504 | 2,201 | 2,952 | 3,575 |
| BRAZOS | MINING | $ 172 | $ 254 | $ 226 | $ 181 | $ 146 | $ 129 | 971 | 1,438 | 1,279 | 1,021 | 824 | 727 |
| BRAZOS | MUNICIPAL | - | - | - | $ 12 | $ 683 | $ 1,464 | - | - | - | 241 | 13,742 | 29,474 |
| BRAZOS | STEAM ELECTRIC POWER | $ 7 | $ 2 | $ 3 | - | $ 2 | $ 1 | - | - | - | - | - | - |
| **BRAZOS Total** | | **$ 377** | **$ 311** | **$ 328** | **$ 336** | **$ 1,021** | **$ 1,825** | **4,123** | **2,347** | **2,855** | **3,519** | **17,559** | **33,807** |
| BURLESON | MANUFACTURING | - | $ 0 | $ 0 | $ 0 | $ 1 | $ 1 | - | - | 2 | 5 | 9 | 13 |
| BURLESON | MINING | $ 289 | $ 559 | $ 439 | $ 320 | $ 199 | $ 124 | 1,586 | 3,064 | 2,410 | 1,753 | 1,093 | 682 |
| **BURLESON Total** | | **$ 289** | **$ 559** | **$ 439** | **$ 320** | **$ 200** | **$ 125** | **1,586** | **3,065** | **2,412** | **1,758** | **1,102** | **695** |

| | | Income losses (Million $)* | | | | | | Job losses | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| County | Water Use Category | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| CALLAHAN | MINING | $ 22 | $ 22 | $ 21 | $ 19 | $ 18 | $ 17 | 130 | 129 | 122 | 114 | 108 | 103 |
| CALLAHAN | MUNICIPAL | $ 0 | $ 0 | $ 0 | $ 0 | $ 0 | $ 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| **CALLAHAN Total** | | **$ 22** | **$ 22** | **$ 21** | **$ 20** | **$ 18** | **$ 18** | **131** | **130** | **123** | **116** | **110** | **104** |
| COMANCHE | IRRIGATION | - | $ 0 | $ 0 | - | - | - | - | 1 | - | - | - | - |
| COMANCHE | MINING | $ 121 | $ 145 | $ 98 | $ 73 | $ 47 | $ 30 | 666 | 795 | 537 | 398 | 258 | 163 |
| **COMANCHE Total** | | **$ 121** | **$ 145** | **$ 98** | **$ 73** | **$ 47** | **$ 30** | **666** | **796** | **537** | **398** | **258** | **163** |
| CORYELL | MINING | $ 169 | $ 120 | $ 55 | $ 41 | $ 45 | $ 49 | 983 | 698 | 320 | 236 | 259 | 284 |
| CORYELL | MUNICIPAL | - | - | - | - | - | $ 16 | - | - | - | - | - | 325 |
| **CORYELL Total** | | **$ 169** | **$ 120** | **$ 55** | **$ 41** | **$ 45** | **$ 65** | **983** | **698** | **320** | **236** | **259** | **609** |
| EASTLAND | IRRIGATION | $ 0 | $ 0 | $ 0 | $ 0 | $ 0 | $ 0 | 9 | 9 | 9 | 9 | 9 | 9 |
| EASTLAND | MINING | $ 210 | $ 212 | $ 168 | $ 129 | $ 94 | $ 78 | 1,179 | 1,188 | 941 | 723 | 525 | 437 |
| **EASTLAND Total** | | **$ 211** | **$ 212** | **$ 168** | **$ 129** | **$ 94** | **$ 78** | **1,188** | **1,197** | **950** | **732** | **534** | **447** |
| FALLS | MINING | $ 3 | $ 3 | $ 3 | $ 4 | $ 4 | $ 4 | 29 | 32 | 33 | 37 | 39 | 43 |
| **FALLS Total** | | **$ 3** | **$ 3** | **$ 3** | **$ 4** | **$ 4** | **$ 4** | **29** | **32** | **33** | **37** | **39** | **43** |
| FISHER | MANUFACTURING | - | $ 1 | $ 3 | $ 6 | $ 9 | $ 13 | - | 11 | 33 | 59 | 89 | 125 |
| FISHER | MINING | $ 117 | $ 115 | $ 103 | $ 90 | $ 78 | $ 68 | 640 | 632 | 564 | 492 | 429 | 374 |
| FISHER | MUNICIPAL | $ 0 | - | - | - | - | $ 0 | 0 | - | - | - | - | 2 |
| **FISHER Total** | | **$ 117** | **$ 116** | **$ 106** | **$ 95** | **$ 87** | **$ 81** | **640** | **643** | **597** | **550** | **518** | **501** |
| GRIMES | MINING | $ 84 | $ 165 | $ 127 | $ 89 | $ 51 | $ 28 | 462 | 907 | 698 | 489 | 280 | 151 |
| GRIMES | STEAM ELECTRIC POWER | $ 145 | $ 192 | $ 247 | $ 324 | $ 447 | $ 590 | - | - | - | - | - | - |
| **GRIMES Total** | | **$ 229** | **$ 358** | **$ 374** | **$ 413** | **$ 498** | **$ 618** | **462** | **907** | **698** | **489** | **280** | **151** |
| HAMILTON | IRRIGATION | $ 0 | $ 0 | $ 0 | $ 0 | - | - | - | - | - | - | - | - |
| HAMILTON | MINING | $ 110 | $ 65 | $ 26 | - | - | - | 606 | 355 | 140 | - | - | - |
| HAMILTON | MUNICIPAL | - | - | - | - | - | $ 0 | - | - | - | - | - | - |
| **HAMILTON Total** | | **$ 110** | **$ 65** | **$ 26** | **$ 0** | **-** | **$ 0** | **606** | **355** | **140** | **-** | **-** | **-** |
| HASKELL | IRRIGATION | - | $ 0 | $ 0 | - | - | - | - | - | 1 | - | - | - |
| HASKELL | MINING | $ 27 | $ 27 | $ 24 | $ 21 | $ 19 | $ 17 | 148 | 147 | 132 | 118 | 105 | 94 |
| **HASKELL Total** | | **$ 27** | **$ 27** | **$ 24** | **$ 21** | **$ 19** | **$ 17** | **148** | **147** | **134** | **118** | **105** | **94** |

| | | Income losses (Million $)* | | | | | | Job losses | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| County | Water Use Category | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| HILL | MINING | $ 54 | $ 3 | - | - | - | - | 310 | 16 | - | - | - | - |
| **HILL Total** | | **$ 54** | **$ 3** | **-** | **-** | **-** | **-** | **310** | **16** | **-** | **-** | **-** | **-** |
| HOOD | MINING | $ 87 | $ 158 | $ 114 | $ 97 | $ 81 | $ 83 | 499 | 905 | 654 | 557 | 463 | 477 |
| **HOOD Total** | | **$ 87** | **$ 158** | **$ 114** | **$ 97** | **$ 81** | **$ 83** | **499** | **905** | **654** | **557** | **463** | **477** |
| JOHNSON | MINING | $ 173 | - | - | - | - | - | 953 | - | - | - | - | - |
| JOHNSON | MUNICIPAL | - | - | - | $ 11 | $ 53 | $ 110 | - | - | - | 184 | 968 | 2,024 |
| JOHNSON | STEAM ELECTRIC POWER | $ 210 | $ 210 | $ 210 | $ 210 | $ 210 | $ 210 | - | - | - | - | - | - |
| **JOHNSON Total** | | **$ 383** | **$ 210** | **$ 210** | **$ 221** | **$ 263** | **$ 320** | **953** | **-** | **-** | **184** | **968** | **2,024** |
| JONES | IRRIGATION | $ 0 | $ 0 | - | - | - | - | - | - | - | - | - | - |
| JONES | MINING | $ 30 | $ 29 | $ 27 | $ 25 | $ 23 | $ 21 | 172 | 168 | 156 | 143 | 131 | 121 |
| **JONES Total** | | **$ 30** | **$ 29** | **$ 27** | **$ 25** | **$ 23** | **$ 21** | **172** | **168** | **156** | **143** | **131** | **121** |
| KENT | MUNICIPAL | $ 2 | $ 2 | $ 2 | $ 2 | $ 2 | $ 2 | 37 | 37 | 36 | 36 | 35 | 35 |
| **KENT Total** | | **$ 2** | **$ 2** | **$ 2** | **$ 2** | **$ 2** | **$ 2** | **37** | **37** | **36** | **36** | **35** | **35** |
| KNOX | IRRIGATION | $ 0 | $ 0 | $ 1 | $ 1 | $ 0 | $ 0 | 2 | 12 | 37 | 46 | 17 | 12 |
| KNOX | MINING | $ 4 | $ 4 | $ 4 | $ 4 | $ 4 | $ 4 | 24 | 24 | 22 | 22 | 22 | 22 |
| KNOX | MUNICIPAL | - | - | - | $ 1 | $ 4 | $ 5 | - | - | - | 27 | 74 | 110 |
| **KNOX Total** | | **$ 4** | **$ 5** | **$ 5** | **$ 7** | **$ 8** | **$ 10** | **26** | **36** | **59** | **95** | **113** | **144** |
| LAMPASAS | IRRIGATION | $ 0 | $ 0 | $ 0 | $ 0 | $ 0 | $ 0 | 2 | 2 | 2 | 2 | 2 | 2 |
| LAMPASAS | MINING | $ 2 | $ 3 | $ 3 | $ 3 | $ 3 | $ 4 | 22 | 25 | 28 | 30 | 34 | 37 |
| **LAMPASAS Total** | | **$ 2** | **$ 3** | **$ 3** | **$ 3** | **$ 4** | **$ 4** | **25** | **28** | **30** | **33** | **36** | **39** |
| LEE | IRRIGATION | $ 0 | $ 0 | $ 0 | $ 0 | - | - | - | - | - | - | - | - |
| LEE | MINING | $ 175 | $ 400 | $ 426 | $ 456 | $ 489 | $ 528 | 1,121 | 2,569 | 2,738 | 2,927 | 3,139 | 3,395 |
| **LEE Total** | | **$ 175** | **$ 400** | **$ 426** | **$ 456** | **$ 489** | **$ 528** | **1,121** | **2,569** | **2,738** | **2,927** | **3,139** | **3,395** |
| LIMESTONE | MINING | $ 342 | $ 328 | $ 325 | $ 342 | $ 359 | $ 381 | 2,361 | 2,263 | 2,249 | 2,366 | 2,482 | 2,636 |
| LIMESTONE | MUNICIPAL | $ 13 | $ 13 | $ 13 | $ 13 | $ 13 | $ 14 | 271 | 267 | 263 | 262 | 263 | 277 |
| LIMESTONE | STEAM ELECTRIC POWER | - | - | $ 60 | $ 232 | $ 511 | $ 904 | - | - | - | - | - | - |
| **LIMESTONE Total** | | **$ 355** | **$ 341** | **$ 399** | **$ 588** | **$ 883** | **$ 1,299** | **2,632** | **2,530** | **2,512** | **2,628** | **2,745** | **2,913** |
| MCLENNAN | IRRIGATION | $ 1 | $ 1 | $ 1 | $ 1 | $ 1 | $ 1 | 24 | 24 | 24 | 25 | 25 | 25 |

| | | Income losses (Million $)* | | | | | | Job losses | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **County** | **Water Use Category** | **2020** | **2030** | **2040** | **2050** | **2060** | **2070** | **2020** | **2030** | **2040** | **2050** | **2060** | **2070** |
| MCLENNAN | MANUFACTURING | $ 149 | $ 177 | $ 214 | $ 236 | $ 267 | $ 277 | 1,752 | 2,085 | 2,512 | 2,773 | 3,133 | 3,251 |
| MCLENNAN | MINING | $ 51 | $ 62 | $ 63 | $ 73 | $ 80 | $ 89 | 400 | 482 | 493 | 572 | 629 | 697 |
| MCLENNAN | MUNICIPAL | - | - | - | - | $ 0 | $ 1 | - | - | - | - | 6 | 18 |
| **MCLENNAN Total** | | **$ 201** | **$ 239** | **$ 277** | **$ 310** | **$ 348** | **$ 367** | **2,176** | **2,591** | **3,029** | **3,370** | **3,794** | **3,991** |
| NOLAN | IRRIGATION | $ 0 | $ 0 | $ 0 | $ 0 | $ 0 | $ 0 | 19 | 16 | 14 | 12 | 10 | 8 |
| NOLAN | MANUFACTURING | $ 76 | $ 92 | $ 108 | $ 122 | $ 136 | $ 152 | 805 | 980 | 1,152 | 1,304 | 1,454 | 1,618 |
| NOLAN | MINING | $ 59 | $ 58 | $ 53 | $ 47 | $ 41 | $ 37 | 325 | 321 | 289 | 257 | 228 | 204 |
| NOLAN | MUNICIPAL | $ 38 | $ 40 | $ 41 | $ 45 | $ 47 | $ 50 | 764 | 807 | 829 | 897 | 955 | 1,009 |
| NOLAN | STEAM ELECTRIC POWER | $ 503 | $ 889 | $ 889 | $ 889 | $ 889 | $ 889 | - | - | - | - | - | - |
| **NOLAN Total** | | **$ 676** | **$1,080** | **$1,091** | **$ 1,103** | **$ 1,115** | **$ 1,128** | **1,913** | **2,124** | **2,283** | **2,470** | **2,647** | **2,838** |
| PALO PINTO | IRRIGATION | $ 0 | $ 0 | $ 0 | $ 0 | $ 0 | $ 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| **PALO PINTO Total** | | **$ 0** | **$ 0** | **$ 0** | **$ 0** | **$ 0** | **$ 0** | **1** | **1** | **1** | **1** | **1** | **1** |
| ROBERTSON | IRRIGATION | $ 12 | $ 12 | $ 11 | $ 11 | $ 11 | $ 10 | 518 | 499 | 481 | 464 | 448 | 435 |
| ROBERTSON | MINING | - | $ 32 | $ 367 | $ 1,056 | $ 2,155 | $ 3,301 | - | 175 | 2,020 | 5,820 | 11,872 | 18,187 |
| ROBERTSON | STEAM ELECTRIC POWER | - | - | - | $ 93 | $ 150 | $ 219 | - | - | - | - | - | - |
| **ROBERTSON Total** | | **$ 12** | **$ 44** | **$ 378** | **$ 1,160** | **$ 2,316** | **$ 3,531** | **518** | **675** | **2,501** | **6,284** | **12,319** | **18,622** |
| SHACKELFORD | MINING | $ 161 | $ 215 | $ 160 | $ 126 | $ 93 | $ 69 | 884 | 1,179 | 878 | 693 | 512 | 376 |
| **SHACKELFORD Total** | | **$ 161** | **$ 215** | **$ 160** | **$ 126** | **$ 93** | **$ 69** | **884** | **1,179** | **878** | **693** | **512** | **376** |
| SOMERVELL | MINING | $ 31 | $ 58 | $ 36 | $ 24 | $ 16 | $ 13 | 182 | 336 | 211 | 140 | 95 | 78 |
| SOMERVELL | STEAM ELECTRIC POWER | $ 577 | $ 577 | $ 578 | $ 578 | $ 579 | $ 580 | - | - | - | - | - | - |
| **SOMERVELL Total** | | **$ 608** | **$ 635** | **$ 614** | **$ 603** | **$ 595** | **$ 593** | **182** | **336** | **211** | **140** | **95** | **78** |
| STEPHENS | IRRIGATION | $ 0 | $ 0 | $ 0 | $ 0 | $ 0 | $ 0 | - | - | - | - | - | - |
| STEPHENS | MINING | $1,181 | $1,203 | $1,005 | $ 821 | $ 656 | $ 515 | 6,476 | 6,599 | 5,511 | 4,502 | 3,597 | 2,825 |
| **STEPHENS Total** | | **$1,181** | **$1,203** | **$1,005** | **$ 821** | **$ 656** | **$ 515** | **6,476** | **6,599** | **5,511** | **4,502** | **3,597** | **2,825** |
| STONEWALL | MINING | $ 117 | $ 115 | $ 97 | $ 78 | $ 61 | $ 45 | 643 | 631 | 530 | 426 | 335 | 245 |

| | | Income losses (Million $)* | | | | | | Job losses | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| County | Water Use Category | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 | 2020 | 2030 | 2040 | 2050 | 2060 | 2070 |
| **STONEWALL Total** | | **$ 117** | **$ 115** | **$ 97** | **$ 78** | **$ 61** | **$ 45** | **643** | **631** | **530** | **426** | **335** | **245** |
| TAYLOR | IRRIGATION | $ 0 | $ 0 | $ 0 | $ 0 | $ 0 | $ 0 | 15 | 14 | 14 | 13 | 13 | 12 |
| TAYLOR | MINING | $ 21 | $ 21 | $ 20 | $ 18 | $ 18 | $ 17 | 133 | 133 | 124 | 118 | 112 | 107 |
| TAYLOR | MUNICIPAL | $ 3 | $ 3 | $ 4 | $ 4 | $ 4 | $ 5 | 60 | 68 | 75 | 82 | 88 | 94 |
| **TAYLOR Total** | | **$ 24** | **$ 24** | **$ 23** | **$ 23** | **$ 22** | **$ 22** | **208** | **215** | **213** | **213** | **213** | **213** |
| THROCKMORTON | MINING | $ 56 | $ 55 | $ 50 | $ 44 | $ 38 | $ 34 | 309 | 304 | 273 | 239 | 210 | 185 |
| **THROCKMORTON Total** | | **$ 56** | **$ 55** | **$ 50** | **$ 44** | **$ 38** | **$ 34** | **309** | **304** | **273** | **239** | **210** | **185** |
| WASHINGTON | MANUFACTURING | - | $ 6 | $ 18 | $ 32 | $ 54 | $ 82 | - | 63 | 189 | 338 | 567 | 855 |
| WASHINGTON | MINING | $ 111 | $ 169 | $ 137 | $ 105 | $ 73 | $ 51 | 619 | 942 | 764 | 585 | 406 | 287 |
| **WASHINGTON Total** | | **$ 111** | **$ 175** | **$ 155** | **$ 137** | **$ 127** | **$ 133** | **619** | **1,004** | **954** | **923** | **972** | **1,142** |
| WILLIAMSON | IRRIGATION | $ 0 | $ 0 | $ 0 | $ 0 | $ 0 | $ 0 | - | - | - | - | - | - |
| WILLIAMSON | MANUFACTURING | $ 31 | $ 36 | $ 33 | $ 27 | $ 22 | $ 18 | 266 | 305 | 283 | 230 | 188 | 149 |
| WILLIAMSON | MINING | $ 64 | $ 78 | $ 93 | $ 109 | $ 126 | $ 144 | 610 | 749 | 893 | 1,046 | 1,203 | 1,384 |
| WILLIAMSON | MUNICIPAL | $ 95 | $ 216 | $ 459 | $ 717 | $ 1,373 | $ 2,291 | 1,921 | 4,343 | 9,244 | 14,431 | 27,644 | 46,114 |
| **WILLIAMSON Total** | | **$ 190** | **$ 330** | **$ 586** | **$ 853** | **$ 1,521** | **$ 2,453** | **2,796** | **5,398** | **10,420** | **15,707** | **29,035** | **47,647** |
| YOUNG | IRRIGATION | $ 0 | $ 0 | $ 0 | $ 0 | $ 0 | $ 0 | - | - | - | - | - | - |
| YOUNG | MINING | $ 54 | $ 80 | $ 57 | $ 44 | $ 31 | $ 21 | 298 | 440 | 312 | 241 | 167 | 116 |
| **YOUNG Total** | | **$ 54** | **$ 80** | **$ 57** | **$ 44** | **$ 31** | **$ 21** | **298** | **440** | **312** | **241** | **167** | **116** |
| **Regional Total** | | **$7,095** | **$8,366** | **$8,556** | **$ 9,571** | **$12,397** | **$16,054** | **45,029** | **51,678** | **57,465** | **66,771** | **101,683** | **146,122** |