2026 Regional Water Plans/2027 State Water Plan Socioeconomic Impact Analysis Frequently Asked Questions (FAQs)

Note: References to Impact Analysis within this set of FAQ questions and responses refer to the Texas Water Development Board (TWDB) Socioeconomic Impact Analysis.

Users are encouraged to use the search tool (ctrl F) associated with their web browser or pdf reader to locate the questions related to their topic of interest requiring additional explanation.

Questions may be submitted to the Economic and Demographic Analysis (EDA) staff at the email address: EDA@twdb.texas.gov. Interested readers are also encouraged to consult the resources listed below for additional details concerning the data, assumptions, and methodologies used in developing the impact estimates described here.

Additional Resources:

Projections Methodology
Regional Impact Reports
Planning Data Dashboard
State Water Plan

ACRONYMS

- CPI: Consumer Price Index
- DFC: Desired Future Condition
- EIA: U.S. Energy Information Administration
- ERCOT: Electrical Reliability Council of Texas
- GAM: Groundwater Availability Model
- IMPLAN: Impact Planning Model
- MAG: Modeled Available Groundwater
- NAICS: North American Industry Classification System
- PSA: TWDB Projections and Socio-Economic department
- RWP: Regional Water Plan
- RWPA: Regional Water Planning Area
- RWPG: Regional Water Planning Group
- SWP: State Water Plan
- TCEQ: Texas Commission on Environmental Quality
- TML: Texas Municipal League
- TWDB: Texas Water Development Board
- USDA: United States Department of Agriculture
- WAM: Water Availability Model
- WSC: TWDB Water Science & Conservation
- WUG: Water User Group
- WUS: Water Use Survey

FAQs

1. What is the purpose and scope of the Socioeconomic Impact Analysis?

The analysis estimates the social and economic costs of not meeting water needs identified in the regional water plans. Ten impact estimates are developed to provide a measure of the impacts of a single year repeat of the drought of record if no water management strategies are implemented to offset the projected needs.

2. What impact measures are included in the Impact Analysis?

Ten measures, within three major categories, are estimated for the Regional Water Plan (RWP) Impact Analysis.

Type	Impact Measure
Economic	1. Income losses* (analogous to Gross Domestic Product, also known as Value-Added)
	2. Electrical power purchases
	3. At risk job losses*
Financial Transfer	4. Taxes*
	5. Water hauling costs
	6. Utility revenue losses
	7. Utility tax losses
Social	8. Consumer surplus losses (residential)
	9. Population at risk of out-migration
	10. At risk school enrollment losses

The primary measures of interest are the income and job estimates (measures 1 and 3). Three of the measures, marked with an asterisk (*), rely heavily on output from a Regional Water Planning Area (RWPA) specific IMPLAN model.

IMPLAN reports jobs associated with a given sector of the economy and those estimates, adjusted for the degree of water shortage, are termed as at risk job losses (vulnerable to loss) within the analysis. There is no reasonable means of determining what proportion of jobs associated within a given sector and locale would actually be lost during a single-year repeat of the drought of record. Similar at risk descriptors were added to the estimates of potential population out-migration and school enrollment losses.

3. What is IMPLAN, and what role did it play in the Impact Analysis?

IMPLAN, or the Impact Planning Model, is an economic impact assessment software system, originally developed by the U.S. Forest Service, and now maintained by the IMPLAN Group (IMPLAN.com). IMPLAN reflects economic activity by sector, and detailed economic data for all 254 counties within the state was used to develop 16 different regional planning area-based impact assessment models. IMPLAN output related to value-added, jobs, and taxes on production and imports was used as baseline data within the

Impact Analysis. Value-added is the dollar value of total production within an economic sector minus all costs of producing that output. For the 2026 Regional Water Plans analysis, year 2021 IMPLAN data was used as the baseline.

In addition, IMPLAN output allows converting initial estimates of impacts (value-added, jobs, taxes) to regional level impact estimates reflecting additional impacts within the economy. Note that value-added estimates from IMPLAN serve as the basis for the income estimates. Three types of effects may be incorporated into the final regional level impact estimates:

- ***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.

Traditional use of input-output analysis via IMPLAN only captures impacts on backwardly linked sectors (i.e., wheat sales as an input to pasta production). Potential adverse impacts in the forward linked sectors, such as the reduced retail beef sales accompanying fewer marketable cattle following a drought, are <u>not</u> accounted for in the Impact Analysis. This is a shortcoming of the current approach, and is a facet which the IMPLAN model is not readily suited for, especially when dealing with numerous impacted sectors and 254 counties.

Total estimates are calculated using IMPLAN based multipliers to adjust the baseline estimates of value-added, jobs, and taxes to their regional level impact estimates. Water use categories for which IMPLAN data was employed include livestock, mining, manufacturing, irrigated agriculture, and commercial: water-intensive.

4. What were the primary datasets incorporated into the Impact Assessment?

a. IMPLAN data and models (IMPLAN),
b. Historical water use estimates,
c. RWP projected water demands and needs,
d. Residential / commercial water use and prices, demand function and lost consumer surplus and lost utility revenue estimates,
e. Historical agriculture product prices, yields, water use and acreages (USDA, TWDB-WSC),
f. kWh/acre-foot estimates by county for steam electric power generation (EIA),
g. Miscellaneous gross receipts tax rate (Office of the Texas Comptroller of Public Accounts),
h. Kindergarten through high school proportion of total population.

5. What historical water use data sources provided the water use values used in the Impact Analysis?

Three key data sources were utilized for the baseline water use data:

a) The TWDB annual Water Use Survey (WUS) estimates,
b) The TWDB Water Science and Conservation (WSC) annual irrigation water use estimates, plus
c) The TWDB Projections & Socioeconomic Analysis staff annual population estimates and livestock and mining water use.

Combining the three sources resulted in estimates for 6 major water use categories:

i. Livestock,
ii. Irrigated Agriculture,
iii. Steam Electric Power,
iv. Mining,
v. Manufacturing, and
vi. Municipal

Summary results for the three combined efforts by year are available at the website: https://www.twdb.texas.gov/waterplanning/waterusesurvey/estimates/index.asp

6. What area of geographic influence is accounted for in the Impact Analysis, and are spillover impacts to other planning regions considered?

Water needs are estimated at the WUG-level, by region, for municipal water uses and at the county-level for the remaining water use categories. Regional level multipliers from IMPLAN were used to adjust the initial estimates of income, jobs, and taxes to reflect impacts on other sectors in the planning region only. Potential spillover effects to other planning regions do exist, but are not accounted for in the Impact Analysis. The Impact Analysis assumes that the drought occurs in Region X only. Backward linkages to input sectors in other regions are not accounted for. Similarly, forward linkages to relevant sectors which use Region X outputs are also not accounted for.

7. Are impacts in the forward linked sectors for a drought impacted production sector also considered in the Impact Analysis?

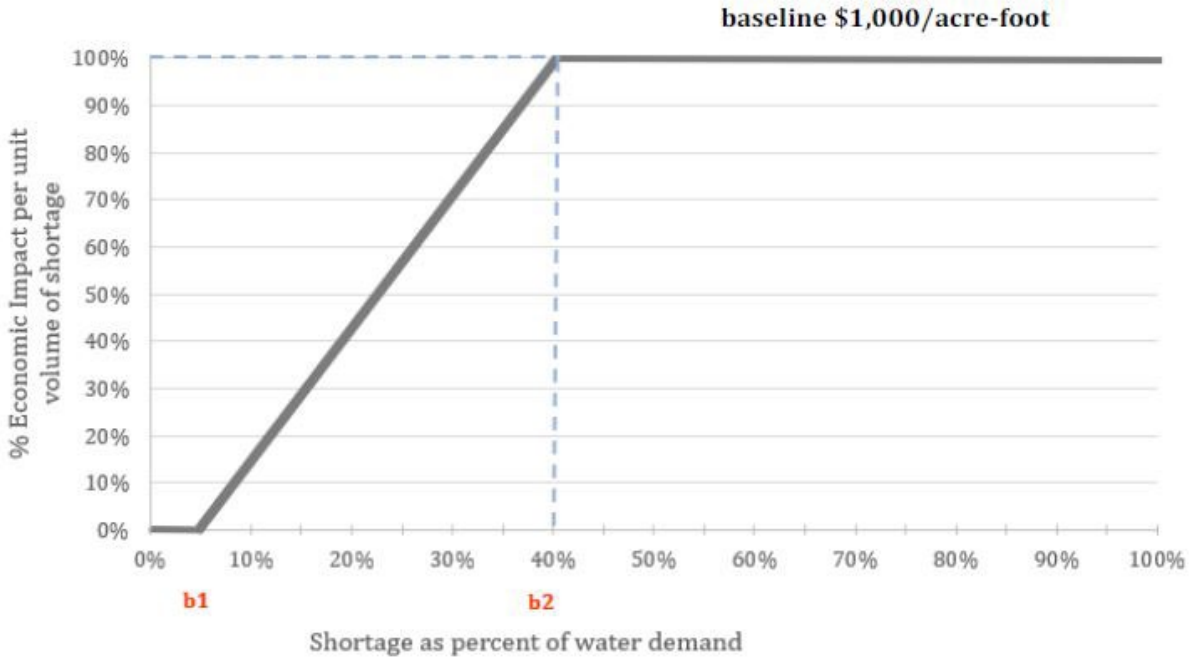
Traditional use of input-output analysis via IMPLAN only captures impacts on backwardly linked sectors (i.e., wheat sales as an input to pasta production). Potential adverse impacts in the forward linked sectors, such as the reduced retail beef sales accompanying fewer marketable cattle following a drought, are not accounted for in the Impact Analysis. This is a shortcoming of the current approach, and is a facet which the IMPLAN model is not readily suited for, especially when dealing with numerous impacted sectors and 254 counties.

8. How were water needs calculated in each regional water plan, and how were they employed in the Socioeconomic Impact Analysis?

The RWPGs assembled the available data for supplies including groundwater, surface water, and reuse for each county/WUG/water use category and planning decade. Projected demands for each county/WUG/water use type (developed by the TWDB and adopted by the Board) were then subtracted from the projected supplies to determine the county/WUG/water use type specific needs (acre-ft) for each planning decade. The county/WUG/water use type combinations where demands exceeded supply resulted in a schedule of needs by planning decade. A detailed impact assessment model combined the schedule of needs and numerous other factors to generate the ten impact measures described above. Several of those measures (electrical power purchases, water hauling costs, utility revenue losses, utility tax losses, and lost consumer surplus estimates) relied upon the acre-feet of needs within a given WUG/planning decade. Impact estimates for each of the five remaining impact measures relied upon both the percentage of needs (i.e., needs vs demands) and the acre-feet of needs by WUG and planning decade.

9. How were adverse economic impacts phased in for varying degrees of water shortages?

Additional adjustments, varying with the intensity of the drought, were applied to the lost income/ac-foot estimates, as well as the jobs at risk and lost tax impact measures. An impact elasticity function was used to phase in the degree of damage based upon the initial impact/ac-foot and the degree of water shortage. Water users were assumed to have a degree of flexibility in managing water use for small shortages. The figure below depicts a sample impact elasticity function where no damages are assumed to accrue for all shortages below a lower threshold (say a 5% shortage), and subsequent damage estimates/acre-foot increase linearly up to the initial estimate of lost income/acre-foot ($1,000/acre-foot in the figure). A second threshold (40% in the figure) serves as the level of shortage for which all damages are assigned the baseline lost income/acre-foot value. Lost income values for percent needs between the two thresholds were obtained by linear interpolation between zero and the baseline income/acre-foot estimate (i.e., $1,000/acre-foot in the figure).



Lower and upper thresholds (b1 and b2, respectively) were specified for each water use category as shown below, and this methodology was used for the final impact estimates for lost income, jobs, and taxes. Note that the impact elasticity methodology was not used for the steam electric power water use category. Supplemental power purchases from the electric power grid would have to be made at the full expected price of electricity, with no phase-in of adverse impacts.

Water Use Category	Impact Elasticity Parameters (b1, b2)
Irrigated Agriculture	5%, 40%
Mining	5%, 40%
Manufacturing	5%, 40%
Livestock	5%, 10%
Municipal:Commercial-water-intensive	5%, 40%
Steam Electric Power	NA

10. What were the major changes in water demand projection methodologies for the 2026 Regional Water Plans?

Major changes related to population or demand projections as well as data updates for this planning cycle include the following:

a) Allowance of possible declines in county-level population projections over time within the planning horizon (previous SWPs held such populations constant),

b) Incorporation of the year 2022 Bureau of Economic Geology Study results into the 2026 RWP mining water demands,
c) An updated manufacturing projection methodology to increase over the planning horizon,
d) Inclusion of year 2020 U.S. Census data results within baseline WUG-level population estimates as well as the accompanying population projections.

11. What were the key data sources used in the Socioeconomic Impact Analysis?

Over twenty different sources of data were employed in developing the impact estimates for each of the 16 different planning region assessments and ten impact measures. Key sources, grouped by data type or water use category, appear in the table below.

Key Data Sources	
Data Type	**Sources**
Irrigated Agriculture	IMPLAN; WSC; WUS, USDA Farm Service Agency; USDA: National Agricultural Statistics Service; Texas Commission on Environmental Quality (TCEQ)
Manufacturing	IMPLAN; WUS; U.S. Census Bureau: County Business Patterns
Mining	IMPLAN; WUS; University of Texas: Bureau of Economic Geology; Frac-Focus Oil & Gas Water Use Estimates
Livestock	IMPLAN; WUS; USDA: National Agricultural Statistics Service; Texas State Soil and Water Conservation Board; TCEQ
Municipal: Commercial, Water-Intensive	IMPLAN; WUS; Census Bureau: County Business Patterns; U.S. Census Bureau; Texas Municipal League; Texas Demographic Center; U.S. EPA Watersense
Steam Electric Power Generation	WUS; Electrical Reliability Council of Texas (ERCOT); U.S. Energy Information Administration (EIA); TCEQ; Texas Public Utilities Commission (PUC); University of Texas: Bureau of Economic Geology: Steam Electric Report
Municipal: Residential and Commercial	WUS; Texas Demographic Center; U.S. Census Bureau; Texas Municipal League; Office of the Texas Comptroller of Public Accounts
Miscellaneous Reports and Data	Texas Water Resources Institute; Pacific Institute; University of California at Davis; BBC Consulting Firm Peer Review; Lawrence Berkeley National Laboratory
Additional TWDB Sources	Texas Water Service Boundary Viewer; Texas Geographic Information Office (TxGIO); Various TWDB Technical Reports

12. What key data updates occurred when developing the 2026 RWP socioeconomic impact analysis?

Major updates include the following key datasets:

a) purchase of IMPLAN data for use in developing the RWP impact estimates, update the analysis snapshot picture of the structure of the economy as well as key IMPLAN multipliers.
b) water hauling costs,
c) consumer price index (CPI) values,
d) population and school enrollment multipliers,
e) irrigated agriculture prices, yields, acreages and water use (5-year averages)

13. How were the final impact estimates for income, job, and tax losses determined?

The initial regional level impact estimates for lost income, jobs, and taxes were possibly adjusted for the number of firms (i.e., within the mining and manufacturing water use categories), and were also adjusted for the degree of water shortage within the water use category. These calculations were made for each IMPLAN sector in the water use category within each county. Values/acre-foot were multiplied by the number of acre-feet short and summed across all IMPLAN sectors in the water use category for each county or WUG. This process implicitly takes into account the proportion of water used in each IMPLAN sector. The resulting impact estimates therefore reflected the variability of economic activity within each WUG. For example, a county with large mining water use for oil and gas exploration would have a higher impact estimate than one which focused on the less profitable sand and gravel quarrying, even if the two counties had the same degree of water shortage.

14. Why are the final impact estimates considered to be conservative?

Impact estimates within the analysis are likely conservative (too small) for several reasons, with a partial list appearing below:

a. The analysis focuses on those sectors with adequate water use data;
b. consideration of only 1 year of drought;
c. no consideration of impacts on the forwardly linked sectors (both within the region of interest as well as impacts on adjoining regions);
d. no consideration of backward linked impacts on other planning regions;
e. does not consider the possible impacts of building moratoriums for those WUGs with significant long term water shortages; and
f. a lack of considering the increasing scarcity of water throughout the region, and the resulting impact on the use of technology, on the true value of water.

15. What factors affect the magnitude and possible interpretation of the final impact estimates?

Two major types of impact measures are included in the SEIA impact analysis, one set which relies heavily on IMPLAN output and a second which relies on other types of input data. Factors affecting the magnitude of each type appear below.

Major factors affecting IMPLAN based impact estimates

Type: measure	Factor	Comment
IMPLAN based: income, taxes, at risk jobs, population(at risk out migration), at risk school enrollment losses	1. Percent degree of needs	The higher the degree of needs, the greater the proportion of the baseline value of water which is multiplied by the acre-feet of needs to determine the damage estimate. Please examine the degree of drought adjustment discussion as seen in FAQ question 10.
	2. acre-ft of needs	Total impact estimates vary directly with how many acre-ft of needs exist for a given 4-digit NAICS code classification.
	3. baseline estimate for the value of water	Some 4-digit NAICS level sectors have higher baseline values per acre-ft of water use (i.e., the dollar value of water in manufacturing is generally higher than using that same water in the irrigated agriculture sector). Such variability in magnitude applies for each of the three IMPLAN based impact measures (income, jobs at risk, and taxes). Additional examples include the fact that some NAICS sectors might have lower rates for the jobs at risk per acre-ft baseline values, while some NAICS sectors may have higher rates for the taxes collected per acre-ft of water.
	4. Relative proportion of high valued water use within the WUG level composite value of water estimate	A given WUG or county may have a high proportion of a high value product within the variety of outputs produced. As an example, water use for oil and gas within the county may be the clear leader in water use as well as have a high baseline value of that water. This results in a relatively higher water use weighted value for water in the mining sector for the county.
Non-IMPLAN based: Electrical power purchases, water hauling costs, utility revenue losses,	1. acre-feet of needs	Impact estimates of this type are generally determined by combining acre-feet of needs directly with measure-specific parameters such as electrical power costs per kWh, tax rates associated with water purchases, or transportation rates for hauling water. Lost consumer surplus estimates are also determined based upon the reduction in water use (acre-ft of needs).

utility tax losses, consumer surplus losses		

16. What are major facets of economic impacts not addressed by the Impact Assessment?

The Impact Assessment attempts to determine estimates of lost income and at risk jobs (among other measures) to the planning region accompanying a one-year repeat of the drought of record. The analysis does not attempt to address the more specific tasks below:

a. Perform a benefit-cost analysis of potential mitigation strategies,
b. Explore the impacts of building moratoriums for cities with limited water supplies, nor
c. Reflect impacts in the forward-linked sectors.

Benefit-cost analyses require extensive cost and benefit estimation efforts (across numerous time periods). Similar efforts to estimate the impact of a building moratorium, coupled with the possible lifting of the moratorium, also require a complex effort with multiple assumptions concerning both the timing and magnitude of positive and negative impacts. The Impact Analysis does provide baseline data which might be used in such efforts, but the listed tasks would require a great deal more effort and a large array of key assumptions, especially when considering the fifty-year time horizon, complexity of the various regional economies, continuing growth of regional populations, and approximately 2,800 individual WUGs within the 16 RWPAs. Building moratorium impacts as well as consideration of impacts in forwardly linked sectors (downstream in the production process) were also deemed too complex for the analysis context of the Impact Analysis.

17. Impact estimates for the irrigated agriculture sector relied upon IMPLAN data, yet employed a slightly different portion of that data to obtain the final impacts. What was the difference in approach, and what prompted that alteration in methodology?

IMPLAN value-added data for the agriculture sectors included the value of both irrigated and dryland production within each county. Direct use of the IMPLAN estimates of value-added would therefore have overstated the value of water in the sector, especially in counties with a mixture of both dryland and irrigated croplands. An alternative approach was used where estimates of the total output in dollars (crop yield*price*acres) were calculated for the appropriate irrigated crops using data from non-IMPLAN sources. A second type of multiplier, the Social Accounting Matrix Value-Added Effects per million dollars of output multiplier, is also available as output from each Planning Region's IMPLAN model. These crop type specific multipliers were used to convert the externally generated total output ($) estimates by crop type and county to the regional level estimates of value-added (income). Similar multipliers were also available to convert total output to the regional level estimates of the number of jobs related to regional total output. Taxes were not considered in this water use category due to the presence of government subsidies. The resulting estimates of lost income and jobs per acre-foot were then used in the analysis. Variability in water use, weather, and economics in the irrigated

agriculture category prompted use of the five-year average total output per acre-foot of use to determine the initial value of water per acre-foot. Total output data for the years 2017-2021 was used in developing these values, and adjustments for the degree of water shortage and the aggregation techniques described in earlier FAQ responses were used in determining the final impact estimates for the irrigated agriculture water use category.

18. An alternative income measure (non-IMPLAN based) was employed for the steam-electric power generation water use category. Why was the different methodology necessary, and how was the measure calculated?

The steam-electric power generation category is very dissimilar to the other categories considered. In general, without enough cooling water, utilities would have to throttle back plant operations, possibly forcing them to buy costly power from other providers or to generate higher cost power at other plants under their control in order to meet customer demands and previous contractual agreements. Direct use of the value-added estimates from IMPLAN was deemed less indicative of the damages incurred due to a drought, so instead, the income measure used was the expected cost of power purchased using the day-ahead market price within Texas. Average day-ahead prices for the heavy drought year 2011 were used as proxy values for the cost of the purchases, and year 2021 average megawatt per hour (mWh) per acre-foot of water estimates by facility, U.S. Energy Information Administration (EIA)) were used to determine the amount of electricity needed to be purchased for the acre-feet of needs. Average generation and water use was summarized by region. The final cost for each need was determined as the product of the electrical price per mWh and the estimated mWh associated with the acre-feet of needs. No impact elasticity functions (discussion within FAQ #10) were employed for this water use category.

19. How were utility revenue losses calculated?

Data from the Texas Municipal League (TML) annual survey concerning average monthly water prices paid and quantity used was employed to estimate lost utility revenue for both residential and commercial use. Price data is available for both residential and commercial use, and average prices from the TML data were multiplied by the acre-feet of needs to estimate the value of lost utility sales. The TML data for various years is available at the TML Survey Results Website

20. What water uses were considered to be water-intensive within the municipal-commercial water use category?

Eight general categories were considered to be water-intensive as shown in the table below. These sectors were included in the water-intensive classification based on the value of water and their susceptibility to larger drought induced adverse impacts. Estimates of the lost income, jobs, and taxes were made for each of the eight sectors listed and appear as an aggregated total within the impact estimates.

a) Car washes,
b) Education,
c) Health care,

d) Hospitality,
e) Laundries,
f) Meetings and recreation,
g) Food stores, and
h) Warehousing

21. What are water trucking (water hauling) costs?

Water hauling, or trucking costs, are the estimated cost to bring potable water into a municipal water system. These costs could vary significantly depending on the length of trip and the source of the trucked-in water. All municipal water needs (shortages) exceeding the 80% level of the projected demand were assumed to be trucked to the WUG to meet minimum sanitary and consumptive needs.

22. What is consumer surplus, and how is it used in the Impact Analysis?

Consumer surplus is a welfare economics measure of well-being, and is a useful tool to assess the damages or benefits accruing to consumers when economic or resource availability conditions change. In the context of a drought, reduced water supplies adversely affect consumers as they cannot consume as much water as they desire, and lost consumer surplus is a measure of how much homeowners would be willing to spend to be able to consume water at those normal levels of use.

Impact analysis estimates of lost consumer surplus were made using household level, municipal WUG specific, water demand functions (both outdoor and indoor water use) based on average price and quantity of water used data from the Texas Municipal League annual survey data effort. The analysis estimates of lost consumer surplus varied with the degree of shortage, up to shortages of 80%. Consumer surplus estimates for shortages greater than that value were not estimated, primarily due to estimation issues associated with the demand functions for very small quantities of water.

Lost consumer surplus is not an out-of-pocket cost or foregone income measure similar to the lost income estimated for the remaining water use categories. Although lost consumer surplus values are estimated monetary losses, they are a different type of monetary impact, and ideally should not be added to other monetary estimates of loss.

23. Should lost consumer surplus estimates from the residential water use impact measures be added to other monetary impact measures to obtain a total monetary impact?

Lost consumer surplus is not an out-of-pocket cost or foregone income measure similar to the lost income estimated for the remaining water use categories. Although lost consumer surplus values are estimated monetary losses, they are a different type of monetary impact, and ideally should not be added to other monetary estimates of loss.

24. How do regional demands, needs, and lost income estimates vary over time?

The relationships among these variables greatly depend on which water use sector, planning region, and time period one is interested in. As an example, irrigation results are portrayed for Region A irrigation demands and needs (Figure 6a) and for the corresponding lost income versus percent needs over time (Figure 6b). Declining groundwater supplies result in declining demand while needs decline at a slower rate. Assumptions within the relevant groundwater availability model (GAM) impact the supplies, which when balanced against the demand projections, result in the needs utilized in the socioeconomic modeling. The percent needs increase over time, resulting in higher values per acre-foot of water needs (FAQ # 8, above). Those higher values per acre-foot are applied to smaller volumes of water in each decade as seen in Figure 6a, resulting in the declining estimates of lost income shown Figure 6b.

Similar circumstances apply to each water use sector in each of the 16 planning regions. One must be very familiar with the ebb and flow of the relationships among demands, needs, how those variables were estimated originally and possibly adjusted by the RWPGs, in order to interpret the results.

Note: data for generating graphs similar to those shown below may be downloaded from the SEIA interactive data website.

Figure 6a.

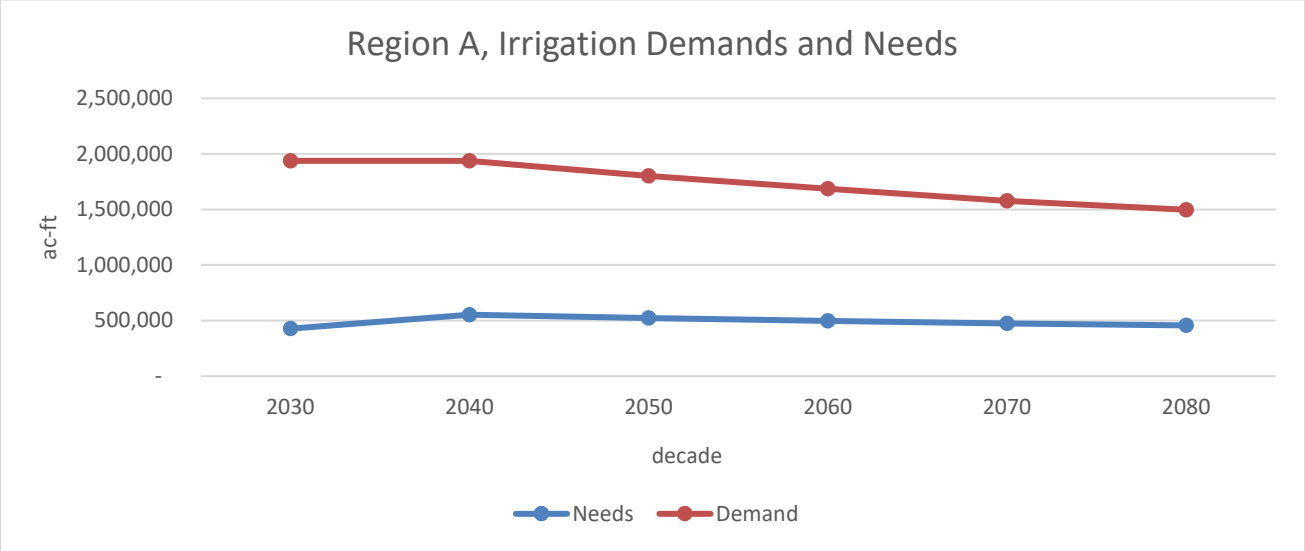
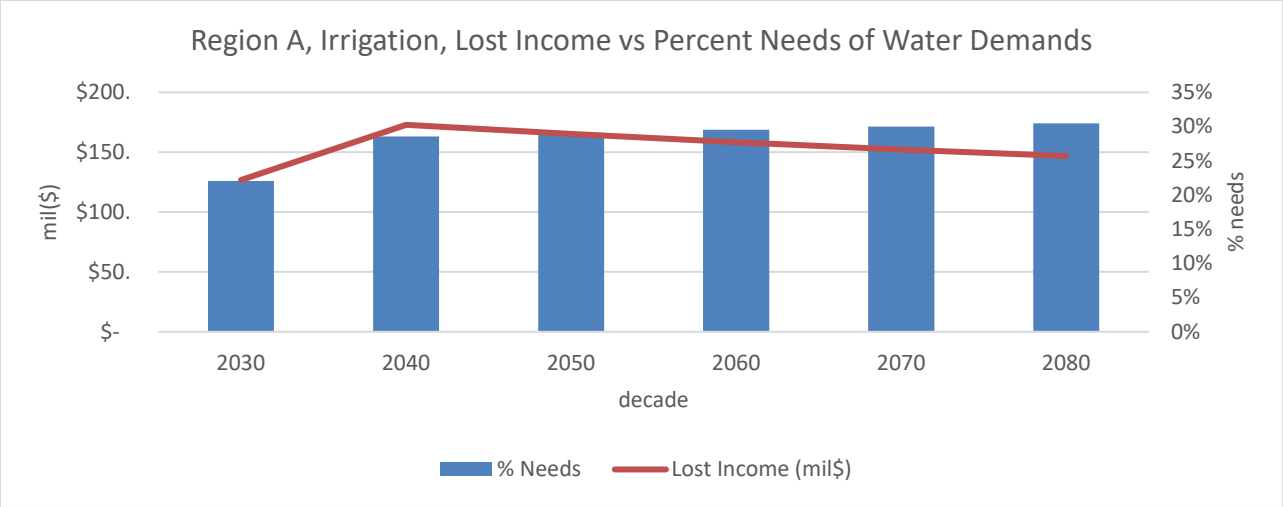


Figure 6b.



25. Why do some counties and water use categories have a water supply need, yet no economic impact?

Positive needs may exist for a given decade, yet use of the impact elasticity functions may result in no estimated economic damages. For example, if water shortages are less than 5%, the Impact Analysis assumes there is enough flexibility in the water supply system or production unit to result in no damage assessment.

26. What outside and internal peer reviews aided in alterations for the methodologies and data employed in the 2026 RWPs?

Following completion of the 2017 State Water Plan, three major entities were consulted concerning potential improvement in the methodology and reports associated with the Impact Analysis. In addition, details of the draft methodology for the 2021 RWPs were sent to the RWPGs in 2018 for review. Results of those efforts, coupled with an internal review by TWDB personnel for both of the two most recent RWPs, appear below.

Peer Review (External and Internal) Summary for Methodology		
Entity	**Survey Response**	**TWDB review and/or action**
BBC Consulting	Update of impact elasticity parameters, better explanation of interpretation of results	Incorporated into 2021 RWP
Office of the Texas Comptroller of Public Accounts: Data Analysis & Transparency Division	Reviewers noted TWDB effort did a good job given the available time, resources, and data. Minor alterations in report output suggested.	Incorporated into 2021 RWP
16 RWPGs	Suggestions provided by the RWPGs following the 2017 RWP included the desire	Alterations for the report contents and better explanation

	for better explanation of results, consideration of the impact of building moratoriums, and more detail on the impact estimation methodology. Requests from the TWDB for comments on the draft methodology for the Impact Assessment for the 2021 RWPs, forwarded to the RWPGs in 2018, resulted in no comments from the RWPGs.	of methodology were incorporated into 2021 RWP. Moratorium impacts were not incorporated due to the complexity and required assumptions.
TWDB		Refinement of firm adjustment procedures for the value of water estimates for the mining and manufacturing sectors. Updated process documentation for use in future planning efforts.

27. Why was the degree of shortage of 80% selected as the tipping point for impact measurement to switch from lost consumer surplus to trucking costs?

This threshold was chosen since it approximates general minimum daily use values required to meet daily human consumption and sanitary needs. Water for shortages exceeding the 80% threshold is assumed to have to be trucked in at significant cost. The specific minimum use percentage for human basic needs will vary by city, depending on how efficient the populace is at conserving water (i.e., how low the baseline average GPCD (gallons/person/day) values are for the city). A second factor prompting the switch was the reduced reliability of the underlying indoor demand functions when estimating lost consumer surplus for large degrees of shortage. The demand functions employed become very steep (primarily due to the underlying mathematical functional form used) as one approaches small levels of water use, and experience has shown that estimates of lost consumer surplus are not reliable in such instances.

28. Should regional level monetary impacts be summed across all regions to determine a state level impact estimate?

Aggregation of the results across some or all planning regions will result in an underestimate of the impacts, primarily due to regional level IMPLAN models not taking into account spillover impacts to counties and regions not included in the parent impact model for the region. In practice the TWDB does provide a state-level summation of the regional results within its published State Water Plan. Users of the results should take note of the potential underestimation concern, and inform their intended audience of that point. The degree of underestimation is not easily quantified due to the many complex points of interaction among the multiple flows of inputs and outputs across planning regions.

29. Why do impact estimates possibly differ for counties with similar volume of needs?

The variety of goods and services produced varies from one county to another, and the procedures used for determining the impact estimates reflect that variability as well as the

differing value of water in various economic sectors and water use categories. For example, counties with large irrigated agricultural production will have smaller adverse impact estimates when compared to counties with a similar degree of need in manufacturing due to the higher value of water within manufacturing.

30. Should impact estimates for regional total lost income for all WUGs be used as an estimate of the potential benefits of a water management strategy which mitigates all or a portion of an anticipated need?

The temptation in this setting is to divide the estimate of regional total lost income by the acre-feet of needs used to derive that lost income estimate, and then multiply by the acre-feet of needs mitigated by the proposed water management strategy. Regional total lost income estimates should not be used in this context as a means of determining the possible benefits of implementing a particular water management strategy. Several major reasons apply:

a) The regional total lost income estimates will include a composite impact, combining the various degrees of shortages and values of water for each of the WUGS and water use categories used to determine the regional total lost income estimate,
b) The underlying needs (percent shortage) used in estimating the RWP impact estimate will likely not correspond to the degree of shortage mitigated by the proposed water management strategy. The impact estimates vary with the degree of shortage of individual WUG and with water use category,
c) The proposed water management strategy may not address the needs in a single water use category, complicating assignment of the possible benefits to each category.

Individual water management strategies would likely offset needs in several WUGS and within several water use categories. Matching the specific needs of mitigation to the appropriate WUG and type of need, and then to the appropriate impact values, would likely be a daunting task.