Texas Water Development Board

Uncertainty in Regional Water Planning

Uncertainty is the unavoidable fact of not knowing what the future will bring, such as when the next drought may occur or how severe it will be. The number of people that will live in Texas in the next 50 years, the amount of water they will require, and the amount of water that will be available all have associated uncertainty.

Regional water planning groups (RWPGs) develop plans to meet potential water shortages (needs) during drought. Planning factors, such as population, water demand, water supply, water needs, and water management strategies (strategies), all have associated uncertainty that can be difficult to quantify.

This document highlights sources of uncertainty in regional water planning, the challenges presented by uncertainty, and how RWPGs already attempt to address planning uncertainties within the existing regional water planning framework.

Uncertainty of Population and Water Demand

A wide range of factors influence the long-range outlook of municipal and non-municipal water demand.

Municipal water demand depends on population growth and its distribution and how much water each resident uses. Population growth and its geographic distribution depends on economic and social factors. Per capita water use depends on individual preferences, culture and habits, the weather, local conservation ordinances, and the adoption of more water-efficient appliances.

Irrigation and livestock demands are strongly influenced by the economy, crop types, government policies, and the weather.

Manufacturing, mining, and steam-electric power generation demands are influenced by numerous economic factors, such as price levels of their inputs and outputs, private facility siting decisions, other resources needed for production, technology, markets, and government regulation.

These underlying factors that influence water use are difficult to predict, especially at the local level and over the long term, resulting in inherent uncertainty in water demand projections.

Rather than attempting to predict a complex array of future economic, government, and other influences and trying to translate those often-contradictory factors into water demand projections, the Texas Water Development Board (TWDB) grounds the water demand projections utilized in regional water planning in the reported data of its historic annual water use estimates. Data limitations introduce their own uncertainty in the water use estimations, but demand projections are reexamined each five-year cycle. This allows regional water plans to be adaptive to changes, adjust for corrections, and incorporate the most recent and best available information.

Uncertainty of Water Supply

Many factors, such as precipitation, temperature, evaporation, and soil moisture conditions play a role in determining how much water moves in and through Texas' streams, reservoirs, and aquifers. The complex and interrelated nature of these variables makes it difficult to anticipate future water supply.

Quantifying surface water availability for regional water planning relies largely on deriving a single firm yield or safe yield value that is generated based on the historical record that includes the drought of record (the benchmark condition for Texas' long-term water planning). The assumption that any firm yield is 100 percent reliable is a weak assumption with inherent uncertainty.

Similarly, quantifying groundwater availability involves inherent uncertainty related to the complexity of aquifer systems, evolving state laws, and the dynamic nature of legal cases that may affect groundwater policy and management.

Uncertainty of Future Water Needs

Water needs (potential shortages) are also difficult to predict due to the multiple uncertainties that affect both factors on which is it based: water

demand and supply. Higher-than-projected per-capita water demand combined with lower-than-anticipated water supply results in a greater water need than either factor would cause individually. Fortunately, projected water needs are updated every five years to consider the most recent water demand and supply information.

Uncertainty of Strategy Implementation

RWPGs recommend strategies to increase future water supplies to meet needs during a severe drought. Strategy implementation may involve various technical and political uncertainties, including those related to the actual water volume a strategy will provide, permitting, financing, and when implementation will occur.

Eventually, some recommended strategies may become infeasible and may be shelved or abandoned. The further into the 50-year planning horizon, the greater the uncertainty of implementing a given strategy.

To account for the possibility of strategies being downsized, modified, or abandoned, some RWPGs recommend a combination of strategies that, if implemented, would provide more water supplies than are required to only meet needs. Some RWPGs also include 'alternative' strategies that can be easily substituted for a recommended strategy that becomes infeasible.

Uncertainty of Future Drought Conditions

Uncertainty of future drought conditions, including those related to potential impacts from climate variability and risks of drought conditions worse than the drought of record, poses significant challenges.

The natural variability of hydrologic factors that impact water supply can produce new droughts of record at any time, as occurred recently in the Colorado and Sulphur River basins. Warmer temperatures, increased evaporation, and increasingly variable precipitation, as experienced in recent years, enhance the risk of extreme drought in Texas (Nielsen-Gammon et al, 2019).

The 2010–2014 drought, which became the new drought of record for several areas of the state, highlighted the need to better quantify the potential magnitude and likelihood of new future droughts that will be more severe than the current droughts of record. That information will better inform decision makers of actual risks when making planning and investment decisions.

Projections of future rainfall, temperature, and streamflow can be utilized to quantify the uncertainty associated with future available water resources and drought conditions. Efforts to improve technical capabilities and address uncertainty are in progress. The TWDB is consulting with the state climatologist to receive information and projections that could be used to identify regions of the state more likely to experience severe drought.

Addressing Uncertainty

Within the existing regional water planning framework, RWPGs attempt to address planning uncertainties in a variety of ways, including by

- using conservative water supply yields;
- utilizing a management supply factor, which involves recommending additional strategy supplies that would provide water volumes in excess of the identified needs;
- incorporating information obtained from local and/or regional water providers that have developed their own long-range plans to assess their system's capacity under conditions worse than the drought of record; and
- quantifying potential water demand reductions associated with implementing drought contingency plans and accounting for these measures as a safety factor, in addition to all the water supply development strategies, to be available in the event of a drought worse than the drought of record.

The 2026 regional water plans will be the first to include summaries of 1) how each region incorporated planning for uncertainty; 2) any key assumptions, analyses, and strategies that go beyond meeting water needs in a drought of record; and 3) additional measures not recommended in the plan that could be available to offset a drought worse than the drought of record.

References

Nielsen-Gammon, J.W., Escobedo, J., Ott, C., Dedrick, J., and Van Fleet, A., 2019, Assessment of historic and future trends of extreme weather in Texas, 1900–2036: Texas A&M University, 39 p.

Additional Resources

www.twdb.texas.gov/waterplanning/rwp/index.asp.