Water Availability Model Status

Introduction

The Water Availability Models (WAMs) are the backbone of the Texas Commission on Environmental Quality's (TCEQ) water rights permitting program. TCEQ uses WAMs to determine whether water is available for new permits or whether changing an existing permit would affect other water rights. Texas Water Code Chapter 11 requires TCEQ to administer water rights based on the prior appropriation doctrine, older water rights get water before newer water rights. TCEQ's WAMs implement the prior appropriation doctrine, which ensures protection of senior water rights and that TCEQ is only permitting water that is available.

TCEQ WAMs include a modeling engine, developed at Texas A&M University, which is used to process datasets for each river basin. WAMs also include naturalized streamflow, which is the estimated flow that would be in a river if there were no permitted water rights. The naturalized streamflow includes both floods and droughts. WAMs also include data about individual water rights such as their location on the river, priority dates, and the amounts of permitted diversion and storage.

The TCEQ WAM operates by deducting the fully authorized diversion and storage amounts of each water right from the naturalized streamflow in the order of the water right's priority date. If there is no water in the river when the model gets to a water right, the water right cannot divert in the model. After all existing water rights are fully considered, any remaining streamflow is available for new water rights.

TCEQ's Water Availability Models webpage provides information on how the model is used, the available input files for each river basin, and how to download the input files. Information on the modeling engine and the associated technical manuals are available on Texas A&M University's WRAP webpage.

Development of WAMs

During the 1970s and 1980s, TCEQ's predecessor agencies developed models for eight of the twenty-three river basins in Texas. These early models were outdated by the 1990s. The Texas Legislature passed 75(R) Senate Bill 1 in 1997. The bill required TCEQ to develop updated water availability models for twenty-two Texas river basins. The 76th Legislature subsequently required TCEQ to develop an updated model for the Rio Grande.

TCEQ developed the WAMs between 1998 and 2004 in response to the legislation, as shown in Figure 1. below. Texas A&M University developed the modeling engine and the datasets were developed by consulting firms. The legislature appropriated a total of $12,610,000 for WAM development in the Appropriation Acts for fiscal years (FY) 1998-1999, FY2000-2001, and FY2002-2003. The results of these efforts are

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documented in Water Availability Model Final Reports for each river basin. The current TCEQ WAMs provide updated and uniform modeling tools for water rights permitting and for other uses such as water planning.

Figure 1. Water Availability Model Development Timeline

Structure of WAMs

WAMs include both a modeling engine that processes data and basin datasets that include water rights and naturalized streamflow. Figure 2. shows the main components of WAMs. TCEQ recognized the need for flexibility during WAM development. The basin datasets are text files that can be edited by a model user.

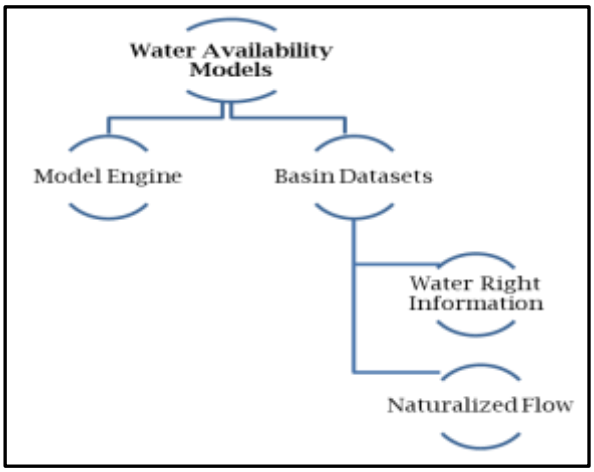

Figure 2. WAM Structure

Model Engine

The model engine is the Water Rights Analysis Package, or WRAP. The **WRAP modeling system** includes computer programs for processing WAM datasets and instructions on how to run the modeling program. TCEQ's Water Rights program contracts with Texas A&M University to provide technical support for WRAP. This work includes maintaining WRAP, developing instruction manuals, and developing an online training program for agency staff and new model users across the state. TCEQ collaborates with its modeling stakeholders to develop, improve, and expand the WRAP modeling system. An Additions and Revisions Report provides a history of WRAP updates.

Basin Datasets

The WAM for each river basin is a dataset that includes naturalized streamflow, evaporation data, and data about individual water rights. The evaporation data in the WAMs is based on information from the U.S. Army Corps of Engineers (USACE) and the Texas Water Development Board (TWDB). Data about individual water rights includes their location on the river, the amount of water authorized for storage and diversion, the associated priority dates, and any instream flow requirements or other special conditions that affect water availability. Information on individual water rights is available from the Texas Water Rights Viewer.

Naturalized Streamflow

The WAM hydrology is the naturalized streamflow. Naturalized streamflow is the flow that would be in the river without any permitted water rights. The naturalized streamflow values in the WAMs are calculated for each month over at least fifty years. The number of years of naturalized streamflow in each model is often referred to as the period of record. The period of record for all TCEQ WAMs includes the drought of the 1950s, recognized as an extremely severe drought throughout much of the state. The period of record also includes major floods and less severe droughts to ensure that the WAMs represent the variable weather conditions across Texas.

Naturalized streamflow is calculated by:

- Identifying all U.S. Geological Survey (USGS) gages in a river basin that have a long-term period of record;
- Adjusting the gage flows to add in historical diversions, subtract historical return flows, and account for water stored in large reservoirs and reservoir evaporation; and
- Accounting for channel losses and any measured spring flows.

Model Updates

The WAM datasets and the WRAP model engine have been updated since they were originally developed. Water right information, WRAP functionality, and naturalized streamflow have been updated. TCEQ continues to work with its stakeholders to develop and prioritize updates to both the WAM datasets and the WRAP model engine.

Water Right Information

TCEQ routinely updates the water right information in the WAMs as it grants new applications and in response to upgraded functionality.

TCEQ maintains a permitting WAM (Full Authorization or Run 3) for each river basin in the state. The permitting WAM uses the authorized amount of diversion and storage for all water rights and does not include return flows. The permitting WAM is used to look at whether water is available for new appropriations and whether existing water rights are affected by an application. The permitting WAM includes the TCEQ's adopted environmental flow standards where necessary to support the business needs of TCEQ's water rights permitting program.

TCEQ also maintains a current conditions WAM for some river basins. The current conditions WAM includes current reported water use and return flows and is used to evaluate whether appropriated but unused water is available for a shorter time, typically ten years. TCEQ does not maintain the current conditions WAM in basins where water rights use most or all of their authorized water.

WRAP Functionality

When the WAMs were first developed in the late 1990s, TCEQ met with state agencies and other interested stakeholders to develop the technical assumptions for the new models. In 2015, TCEQ met with its model stakeholders to look at the original model assumptions and determine if any changes should be made as the result of ongoing efforts to improve WRAP functionality. The result of these meetings was documented in the WAM Technical Issues 2015.

Over time, water right applications have become more complex. This has resulted in a need for more advanced modeling options to ensure that TCEQ's model can accommodate more complex applications.

Naturalized Streamflow Updates

Completed and Pending Updates

Over the past twenty years, TCEQ has modified some of the data in the original naturalized streamflow datasets in response to issues raised by Regional Planning groups and other stakeholders. Most recently, the 86th Legislature (2019) appropriated $2,162,000 to update and extend the naturalized streamflow in the WAMs for four river basins – the Brazos, Red, and Neches River Basins, and the Rio Grande. TCEQ used those funds to issue contracts for the work following an open, competitive process. TCEQ completed the work in August of 2021 and the four WAMs were updated through 2018.

TCEQ has also participated in updates to the naturalized streamflow in the Colorado River Basin (updated through 2016) and the Sulphur River Basin (updated through 2017). TCEQ is currently collaborating with stakeholders in the Cypress Creek Basin to

update the naturalized streamflow in that basin. Figure 3. shows the basins with completed and pending updates.

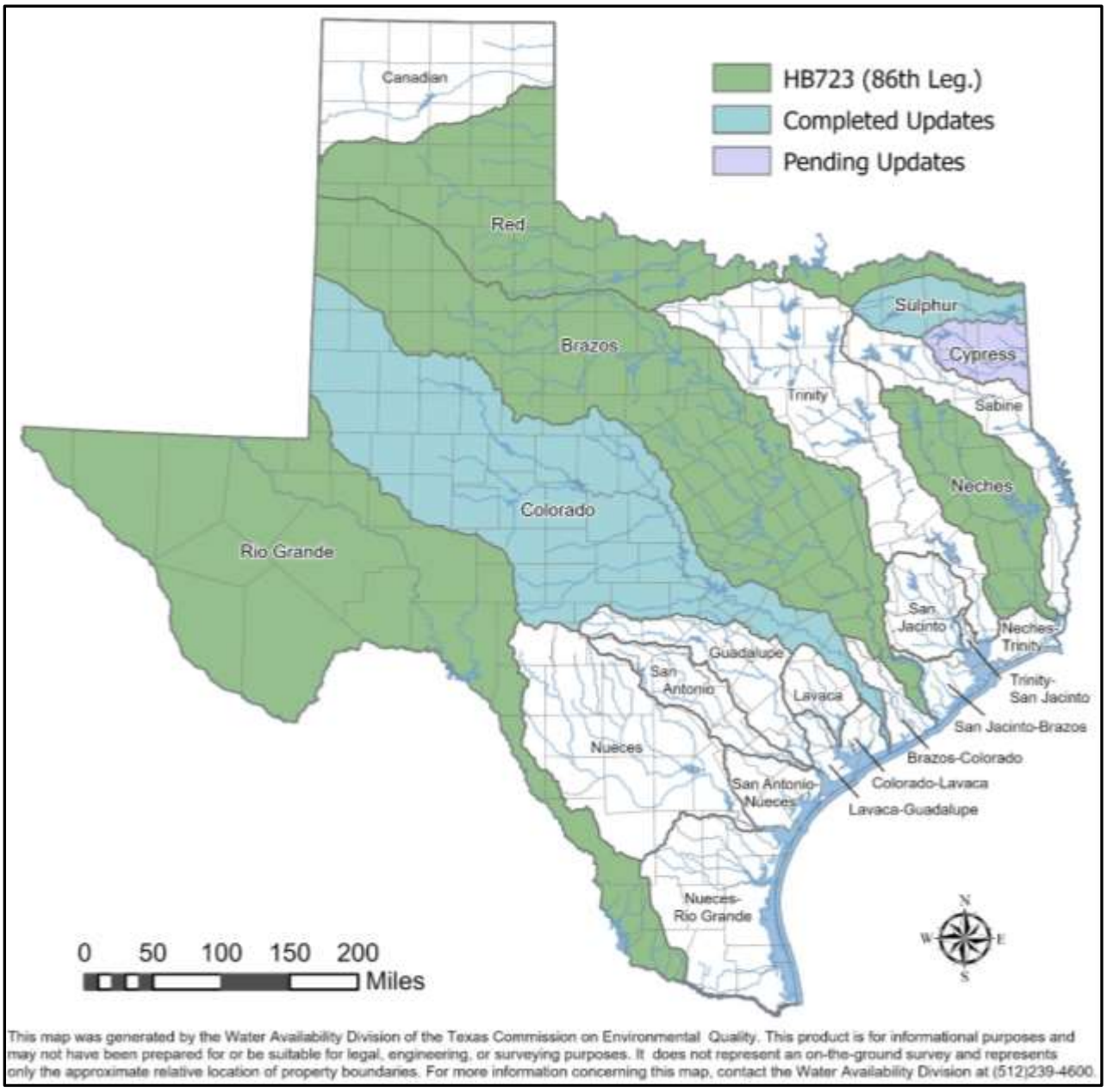

Figure 3. Texas River Basins with Updated Naturalized Streamflow

Future Updates

TCEQ worked with its stakeholders to develop estimated costs to extend the naturalized streamflow in additional river basins. Table 1. shows the prioritization and the 2023 estimated costs for these basins. The basins are separated into two groups to ensure that TCEQ has the resources to manage and review the contract deliverables.

Table 1. WAM Update Priorities

Priority	River Basin	Estimated Cost ($)		
		WAM Extension	Peer Review (10%)	Total Cost
1	Nueces	550,000	55,000	605,000
2	Guadalupe-San Antonio	1,100,000	110,000	1,210,000
3	Trinity	975,000	98,000	1,073,000
4	Lavaca	225,000	23,000	248,000
Total		2,850,000	286,000	3,136,000
5	San Jacinto	350,000	35,000	385,000
6	Sabine	440,000	44,000	484,000
7	Canadian	110,000	11,000	121,000
8	Coastal Basins	530,000	53,000	583,000
Total		1,430,000	143,000	1,573,000
Grand Total		4,280,000	429,000	4,709,000