A TOOL TO ASSESS HOW THE BLANCO RIVER INTERACTS WITH ITS AQUIFERS

CREATING THE NUMERICAL MODEL: PHASE II

WHAT?

Constructing an integrated surface water/groundwater numerical model that will simulate how the Blanco River interacts with its aquifers. The numerical model (Phase II) will be based on the conceptual model (Phase I). The model has been named the Blanco River-Aquifers Tool for Water and Understanding Resiliency and Sustainability Trends.

WHERE?

The Blanco River watershed from its headwaters to its confluence with the San Marcos River. The model domain extends to surrounding areas, including Onion Creek, to represent groundwater flow in the Trinity and Edwards aquifers as it pertains to interaction with Blanco River system.

WHY?

The Blanco River basin includes some of the nation's fastest-growing counties. With increased growth comes increased aquifer pumping, and with increased aquifer pumping comes decreased flows to the Blanco River and springs. A detailed numerical model currently does not exist for this area and will be a vital tool for landowners, communities, and groundwater conservation agencies to better understand and manage groundwater and surface resources in the Blanco River Basin.

WHO?

Dr. Robert E. Mace of The Meadows Center for Water and the Environment is the management and communication lead on the study while Dr. Ron Green of Southwest Research Institute is the technical lead. The project will be a collaborative effort involving numerous stakeholders and experts. These will include, but are not limited to, Southwest Research Institute, The Meadows Center for Water and the Environment, Barton Springs Edwards Aquifer Conservation District, Blanco-Pedernales Groundwater Conservation District, Hays Trinity Groundwater Conservation District, and Edwards Aquifer Authority.

HOW MUCH?

Phase I of the project (creating the conceptual model) cost $95,000, not including substantial in-kind services from the local groundwater conservation agencies. The estimate cost of the Phase II numerical model, including model development and calibration, is estimated to cost $500,000. The final model will be in the public domain and available for interested parties.

HOW CAN YOU HELP?

If you would like to make a gift to support this project, please visit donate.txstate.edu/meadows and note in the comments "Blanco Model." If you have any questions, contact Dr. Robert Mace at 512.245.6021 or robertmace@txstate.edu.

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A TOOL TO ASSESS HOW THE BLANCO RIVER INTERACTS WITH ITS AQUIFERS: CREATING THE NUMERICAL MODEL

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The Meadows Center for Water and the Environment
TEXAS STATE UNIVERSITY
MEMBER THE TEXAS STATE UNIVERSITY SYSTEM

STATEMENT OF PROBLEM

There is and continues to be a very high level of economic development and growth along the I-35 corridor between Austin and San Antonio as well as west of I-35 in ecologically sensitive areas of the Hill Country. A significant by-product of this growth is the stress and demand placed on natural resources, foremost of which are water resources in the Blanco River watershed .Increased demand for water leads to more wells and more pumping which in turn affect springs and baseflow to rivers and streams. For example, water levels in the Middle Trinity Aquifer declined between 3 and 54 feet between 1980 and 1997 (Jones and others 2011). A historical observational well near Wimberley shows a decrease in water levels of more than 100 feet since the mid-1980s (TWDB 2018a). Water wells near the river also show substantial water-level declines during drought when pumping is typically higher. For example, a well in Blanco near the river showed more than 80 feet of water-level decline during drought periods (TWDB 2018b). Water-level declines decrease spring and baseflow which in turn affect iconic springs; flows in the river for the environment, recreation, and water supplies; and recharge to the Edwards Aquifer (which affects other iconic springs).

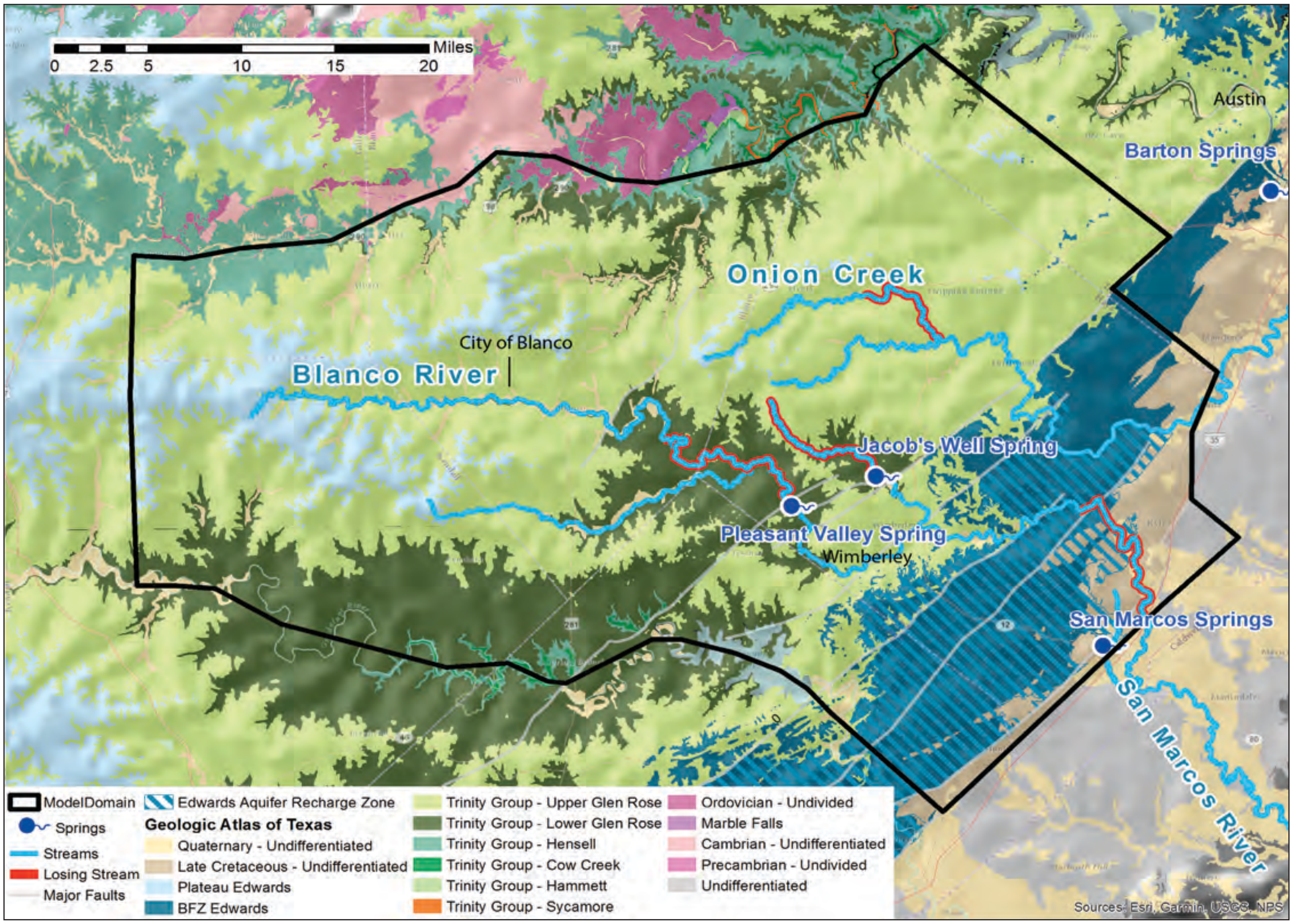
As a result, a new groundwater model—specific to the aquifers in the Blanco River watershed—will be developed to create the tool needed by local landowners, communities, and groundwater conservation agencies to better understand and manage groundwater resources in the Hill Country.

This new, more local model would not replace Texas Water Development Board's groundwater availability model; instead, it would supplement the Texas Water Development Board's model with more detailed data that local groundwater conservation agencies can use to not only inform local management decisions but to inform decisions on desired future conditions and to improve subsequent updates of the regional model.

The project will be a collaborative effort involving numerous stakeholders and experts. These will include, but are not limited to, Southwest Research Institute©, The Meadows Center for Water and the Environment, Barton Springs Edwards Aquifer Conservation District, Blanco-Pedernales Groundwater Conservation District, Cow Creek Groundwater Conservation District, Hays Trinity Groundwater Conservation District, and Edwards Aquifer Authority.

MODEL DOMAIN

The geographical extent of the model is shown on page 2. Defining the extent of the study domain of this project is of critical importance to ensure that the tools developed by this project are capable of and appropriate to address the technical and programmatic questions facing the Blanco River watershed. Of concern is how far beyond the Blanco River watershed should the model domain extend to appropriately represent groundwater flow in the Trinity and Edwards aquifers as it pertains to interaction with Blanco River system. Accordingly, the study area has been extended outside of the Blanco River watershed to include the Onion Creek watershed to the northeast and the headwaters of the San Marcos River and other areas to the south and east. This extension, which also includes a fault-bounded section of the Edwards Aquifer, enables the model to address periods of drought when the direction of groundwater flow within the Balcones Fault Zone can change with the result of a relocation of the groundwater divide that separates the contributing zone for San Marcos Springs from the contributing zone for Barton Springs.



PHASE II MODELING OVERVIEW

Phase I focused on developing the conceptual model, which, based on data and hydrologic principles, is our best idea of how the aquifer works. Associated with the conceptual model are the supporting data, including geology, depths, groundwater levels, pumping amounts, climatology, river and spring flows, and aquifer properties.

Based on this conceptual model, we are now ready for Phase II of the project: building the numerical groundwater flow model. The numerical model will include the relevant geologic and hydrologic parameters, the fault zones and interactions with the Blanco River, and the connection between the Trinity Aquifer where it is exposed at land surface and the Trinity Aquifer where it is located below the Edwards Aquifer and other younger formations.

With a geologic framework in place, we will assign hydraulic parameters and boundary conditions to calibrate the model. Calibration involves adjusting hydraulic parameters between accepted ranges identified during the development of the conceptual model to match water-levels, spring flows, and base flows over time. We will seek to match water levels, spring flows, and base flows as closely as possible without overcalibrating the model (overcalibrated models can be physically unreasonable and are less able to accurately project into the future).

While the tasks required to build a numerical model are easy to describe, they are complicated and multifaceted. Enormous amounts of data will go into the model, and enormous amounts of time, informed by expertise, go into calibrating the model. Integrating surface water and groundwater and Including the fault zone where the Trinity Aquifer transitions underneath the Edwards Aquifer adds complexity.

Once calibrated, the numerical model is then able to be used as a tool. One way the model can be used is to inspect how the model represents groundwater flow. The model could be used to investigate the effects of droughts and pumping on water levels, baseflows, and spring flows.

PROJECT OUTCOMES

The outcome of the Phase II will be a calibrated, integrated hydrologic model.

Questions that could be addressed by the model could include:

1. What are the impacts to surface water and groundwater from current and future development within the basin?
2. What is a sustainable yield from the aquifer that will maintain adequate environmental flows?
3. Is the Middle Trinity aquifer already oversubscribed by existing groundwater pumping permits?
4. What is the sensitivity of spring flow from groundwater withdrawals in certain areas of the basin?
5. What are the projected impacts of large pumping centers on water levels, baseflow, and springs in the area?
6. Will changes in weather patterns (i.e., precipitation and temperature) and water-management scenarios (i.e., groundwater extraction for local or external uses) affect surface water and groundwater in light of the complex relationship between the Blanco River and the underlying aquifers.
7. Will increased development impact or affect the environmental health of flow in the Blanco River and its tributaries and discharge of the major springs, including Pleasant Valley Springs, Jacobs Well Spring, San Marcos Springs, and Barton Springs.
8. How does water in the river (including treated wastewater) interact with underlying aquifers? Where does this water go?

PROJECT MANAGEMENT

Dr. Robert E. Mace of The Meadows Center for Water and the Environment has agreed to be the management and communication lead on the study. Dr. Ron Green of Southwest Research Institute will serve as the technical lead for the study.

SCHEDULE AND COST

The duration of Phase II of the project will be 18 – 24 months. Total costs for Phase II of the project will be $500,000.

REFERENCES

Jones, I.C., Anaya, R., and Wade, S.C., 2011, Groundwater availability model—Hill Country portion of the Trinity Aquifer of Texas: Texas Water Development Board Report 377, 165 p.

TWDB (Texas Water Development Board), accessed 2018a, Groundwater Data Viewer for Well 68-08-109): http://www2.twdb.texas.gov/apps/waterdatainteractive//GetReports.aspx?Num=6808109&Type=GWDB

TWDB (Texas Water Development Board), accessed 2018b, Groundwater Data Viewer for Well 57-61-223): http://www2.twdb.texas.gov/apps/waterdatainteractive//GetReports.aspx?Num=5761223&Type=GWDB