

Texas Water Development Board (TWDB) Groundwater Availability Modeling (GAM) Program

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Texas Water Development Board



Disclaimer

The following presentation is based upon professional research and analysis within the scope of the Texas Water Development Board's statutory responsibilities and priorities but, unless specifically noted, does not necessarily reflect official Board positions or decisions.

Agenda

- TWDB Introduction GAM
- Introduce Contract Team
- GSI Environmental Presentation
 - Background and History
 - Project Approach
 - Model Details
 - Schedules
 - Request for Data

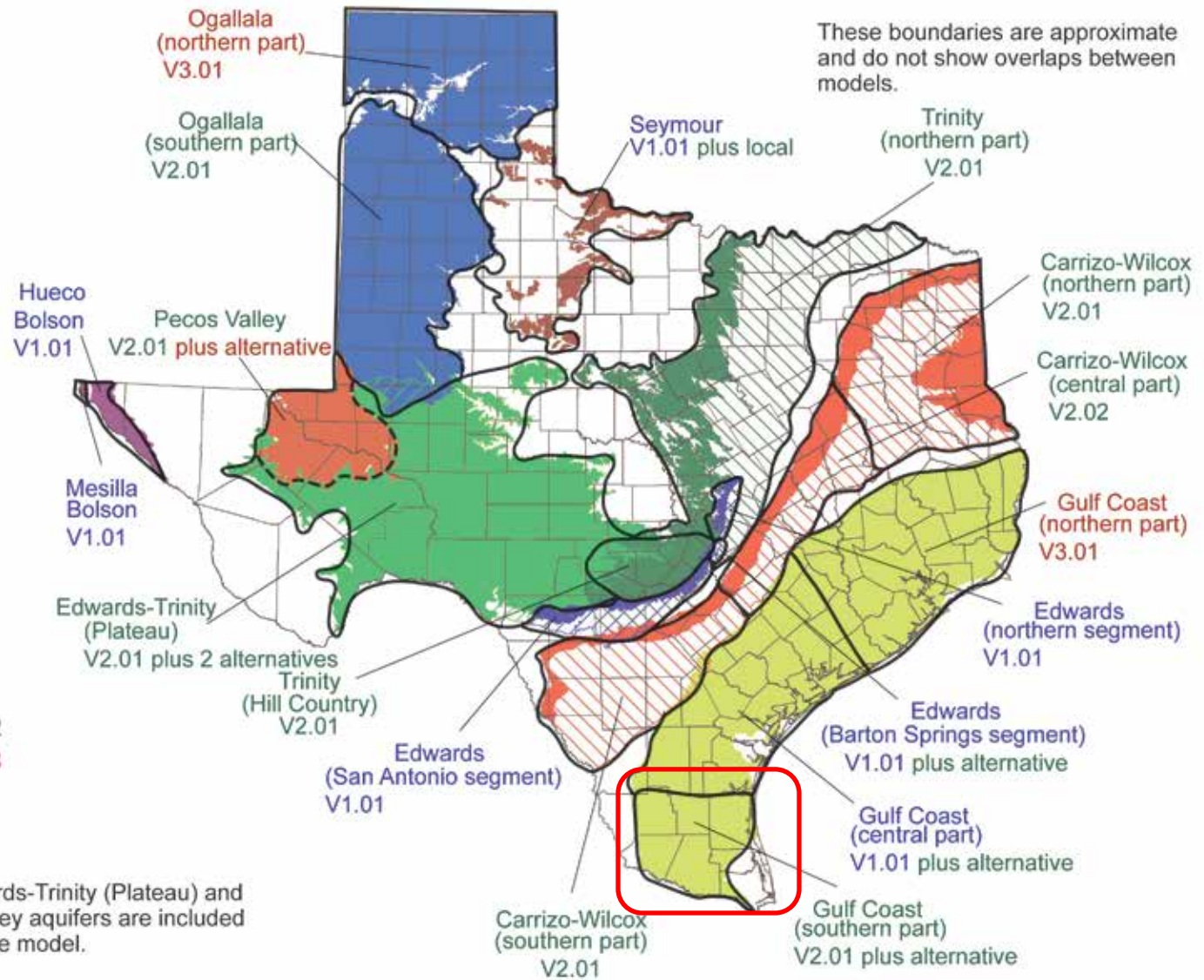
GAM Program

- **Aim:** Develop groundwater flow models for the major and minor aquifers of Texas.
- **Purpose:** Tools that can be used to aid in groundwater resources management by stakeholders.
- **Public process:** Stakeholder involvement during model development process.
- **Models:** Freely available, standardized, thoroughly documented. Reports available over the internet.
- **Living tools:** Periodically updated.

GAM Program

- So far the models developed for the program are groundwater flow only and do not include water quality or density flow
- This project is a new feasibility study into upgrading models and the data used to develop them for analyzing density flow/water quality
- Goal of this project to evaluate impacts of desalination in Region M

Major Aquifers



Updated December 2014

Why Stakeholder Advisory Forums?

- Keep stakeholders updated about progress of the model
- Inform how the groundwater model can, should, and should not be used
- Provide stakeholders with the opportunity to provide input and data to assist with model development

Contact Information

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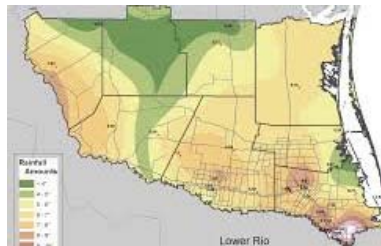
Web information:
http://www.twdb.texas.gov/groundwater/models/research/lrgv_t/lrgv_t.asp#saf

Introduce Contract Team

- Includes the leaders and pioneers of groundwater modeling
 - GSI Environmental: **Sorab Panday** wrote the code MODFLOW-USG that has been released by U.S. Geological Survey
 - Environmental Simulations: President **James Rumbaugh** recipient of 2014 National Ground Water Association Technology Award. Co-authored Groundwater Vistas (pre- and post- processor of MODFLOW)
 - **Bill Hutchison**: Worked at El Paso Utilities, location of the largest inland desalination plant in the world, Kay Bailey Hutchinson Desalination Plant

LRGV GROUNDWATER TRANSPORT MODEL

STAKEHOLDER ADVISORY FORUM



*Sorab Panday, Staffan Schorr,
Julie Spencer*

November 4, 2015

*William Hutchison, PhD, PE, PG,
Independent Groundwater Consultant*



TOPICS

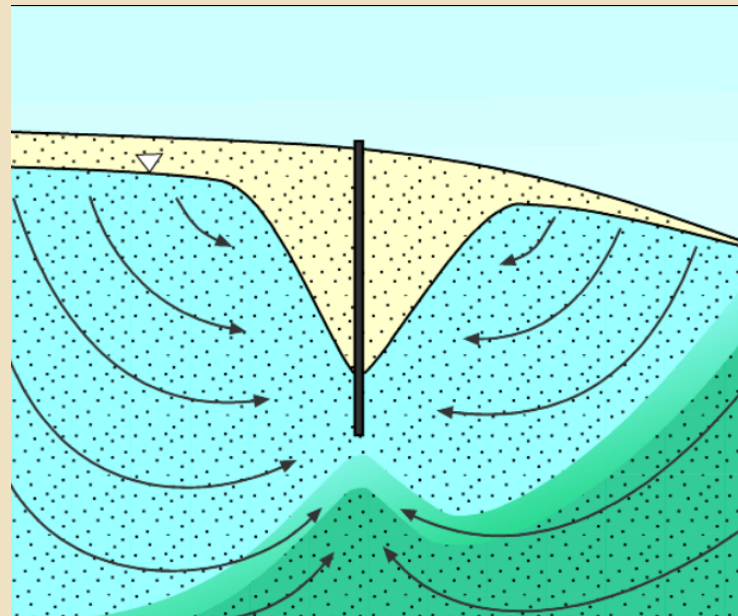
- **Background and History**
- **Project Approach**
 - **Model Details**
 - **Schedules**
- **Request for Data**

BACKGROUND

- **LRGV has seven brackish groundwater desalination plants**
- **Region M plan recommends an additional 23 brackish groundwater desalination plants**
 - **Supply an additional 92,000 AF/yr by 2060**
- **Model is needed to:**
 - **Evaluate groundwater level changes**
 - **Evaluate groundwater quality changes**
 - **Evaluate impacts to surface water**
 - **Evaluate potential for subsidence**

OBJECTIVE (FROM TWDB)

- The primary objective of this project is to develop a numerical groundwater model to simulate impacts of brackish water withdrawal by the current and recommended desalination plants in the Lower Rio Grande Valley



CURRENT GAM OF LRGV

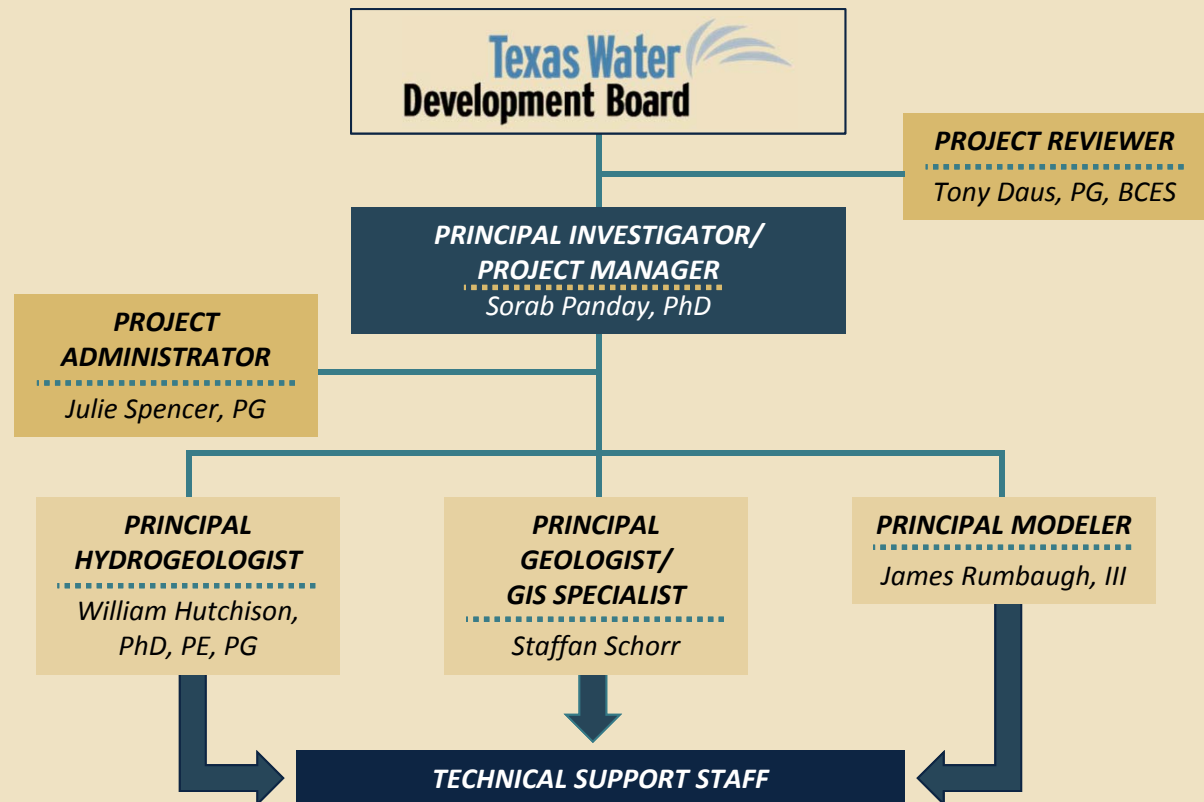
- **Does not provide the ability to simulate water quality changes that are likely with increased pumping**
- **Does not account for the density effects of brackish groundwater**
- **Uses a coarse grid (1 sq. mi.)**
 - **Insufficient resolution in critical locations**
 - **Limited ability to simulate groundwater-surface water interactions**

HISTORY

- **December 19, 2014**
 - TWDB Published Request for Statement of Qualifications
- **February 17, 2015**
 - Due date for Statement of Qualifications
- **April 15, 2015**
 - TWDB Awarded Project to GSI Environmental Team
- **August 18, 2015**
 - Contract signed by TWDB
- **September 10, 2015**
 - Kick-off Meeting with TWDB and GSI Environmental Team

GSI ENVIRONMENTAL TEAM

- Sorab Panday
- Julie Spencer
- Jim Rumbaugh
- Bill Hutchison
- Staffan Schorr



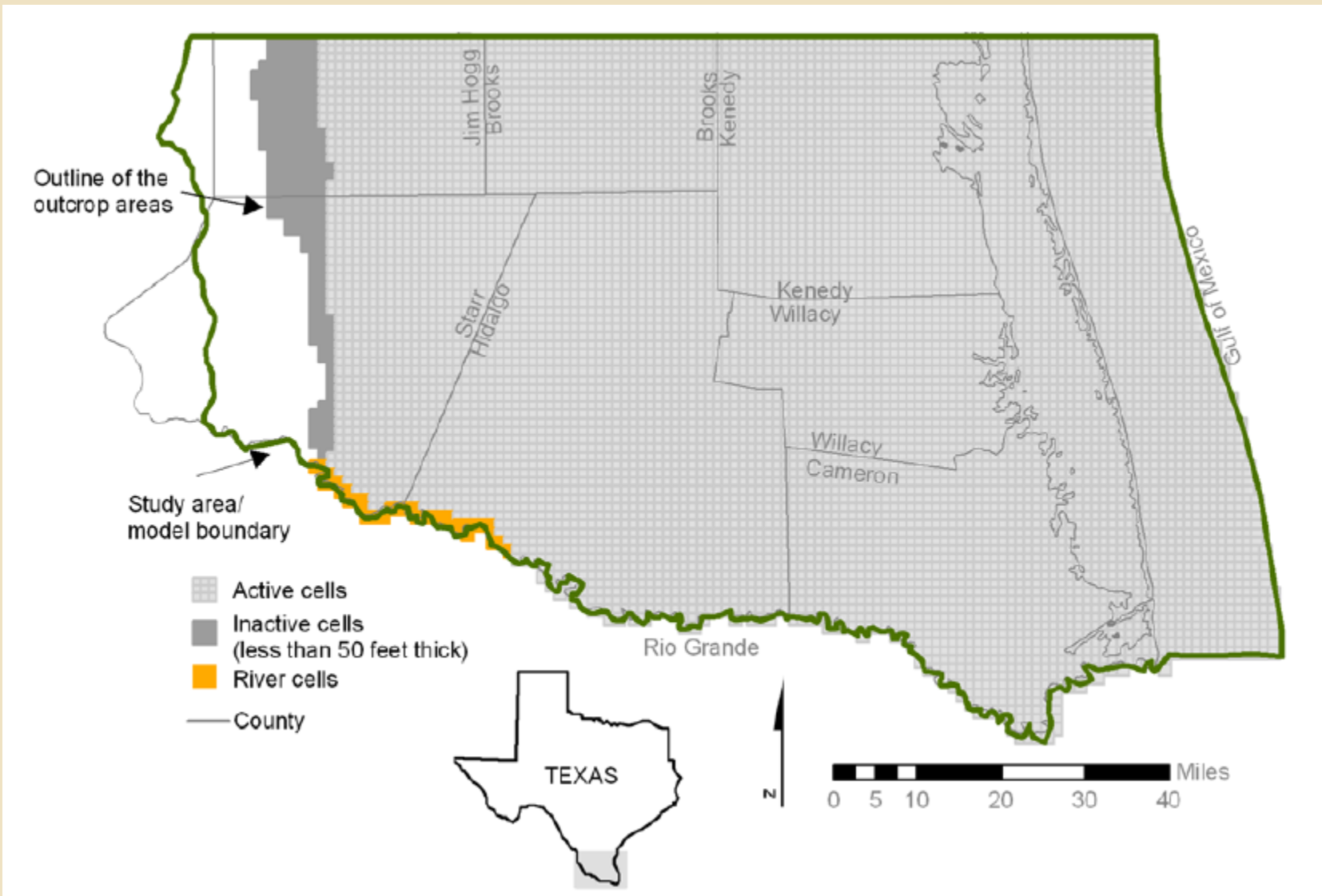
TEAM BACKGROUND

- **SORAB PANDAY**
 - Developed MODFLOW-USG
 - *Groundwater modeling code which will be used for this effort*
- **JIM RUMBAUGH**
 - Developed Groundwater Vistas
 - *Graphic User Interface to MODFLOW-USG model*
- **BILL HUTCHISON**
 - Former Water Resources Manager at El Paso Water Utilities
 - *Principal Hydrogeologist for Kay Baily Hutchison Desalination Plant*
- **STAFFAN SCHORR**
 - Expertise in developing 3-D geologic data for model
 - *ArcGIS and Leapfrog Geo software*

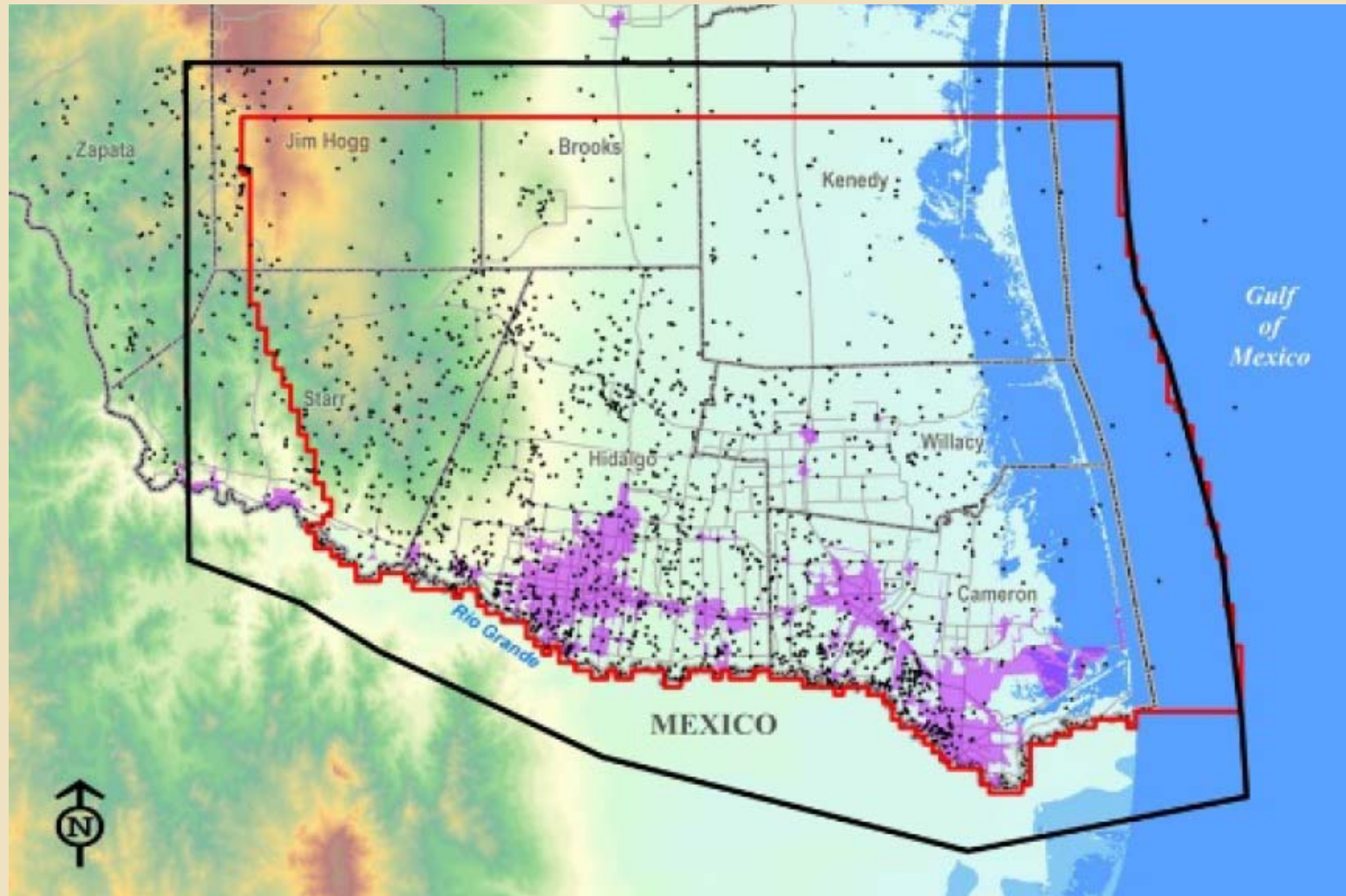
PROJECT APPROACH

- **Model will be developed from four primary sources of data and information:**
 - 1. The Groundwater Availability Model for the LRGV (Chowdhury and Mace, 2007)**
 - 2. The hydrogeologic framework developed by Young and others (2010)**
 - 3. Groundwater quality data from the Brackish Resource Aquifer Characterization System (BRACS) TWDB database (Meyer and others, 2014)**
 - 4. Data obtained from stakeholders**

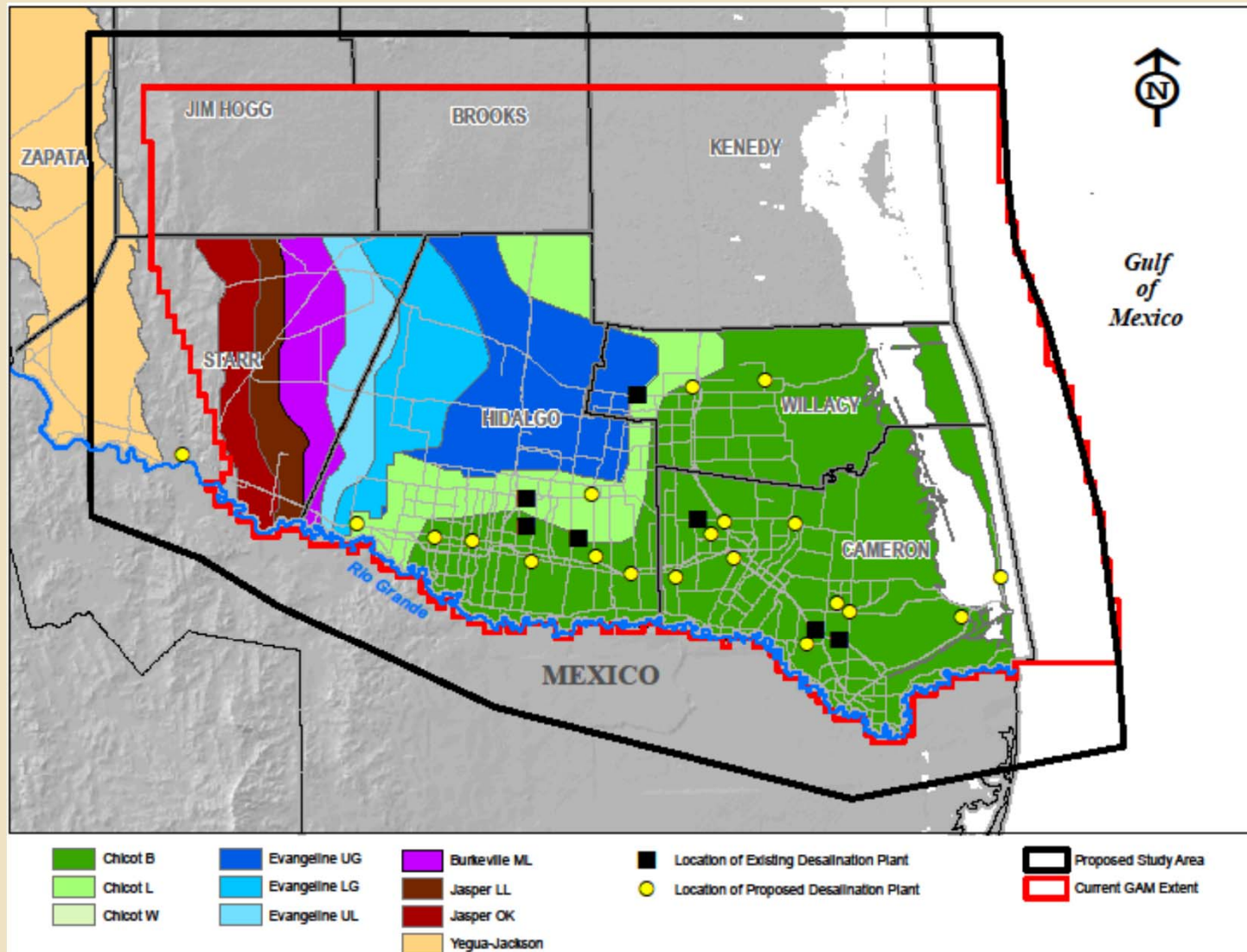
CURRENT GAM (MODFLOW)



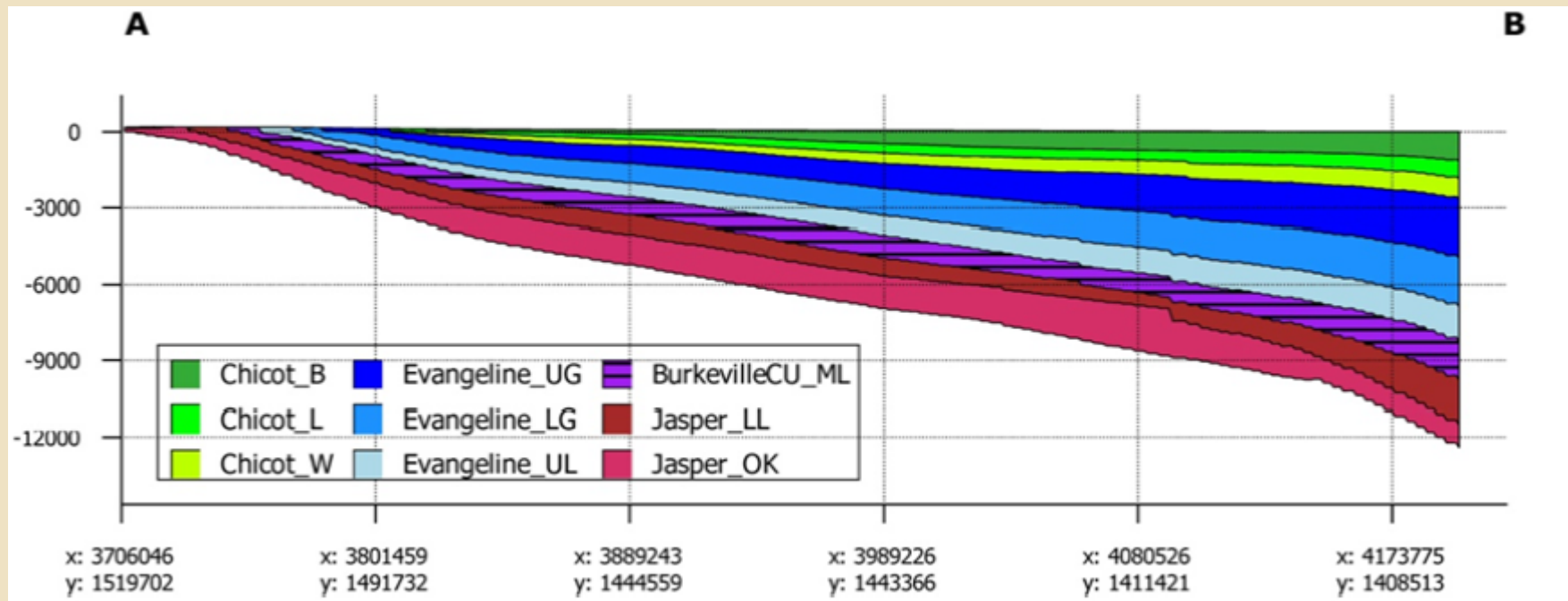
MODEL DOMAIN AND DATA POINTS IN MEYER AND OTHERS (2014)



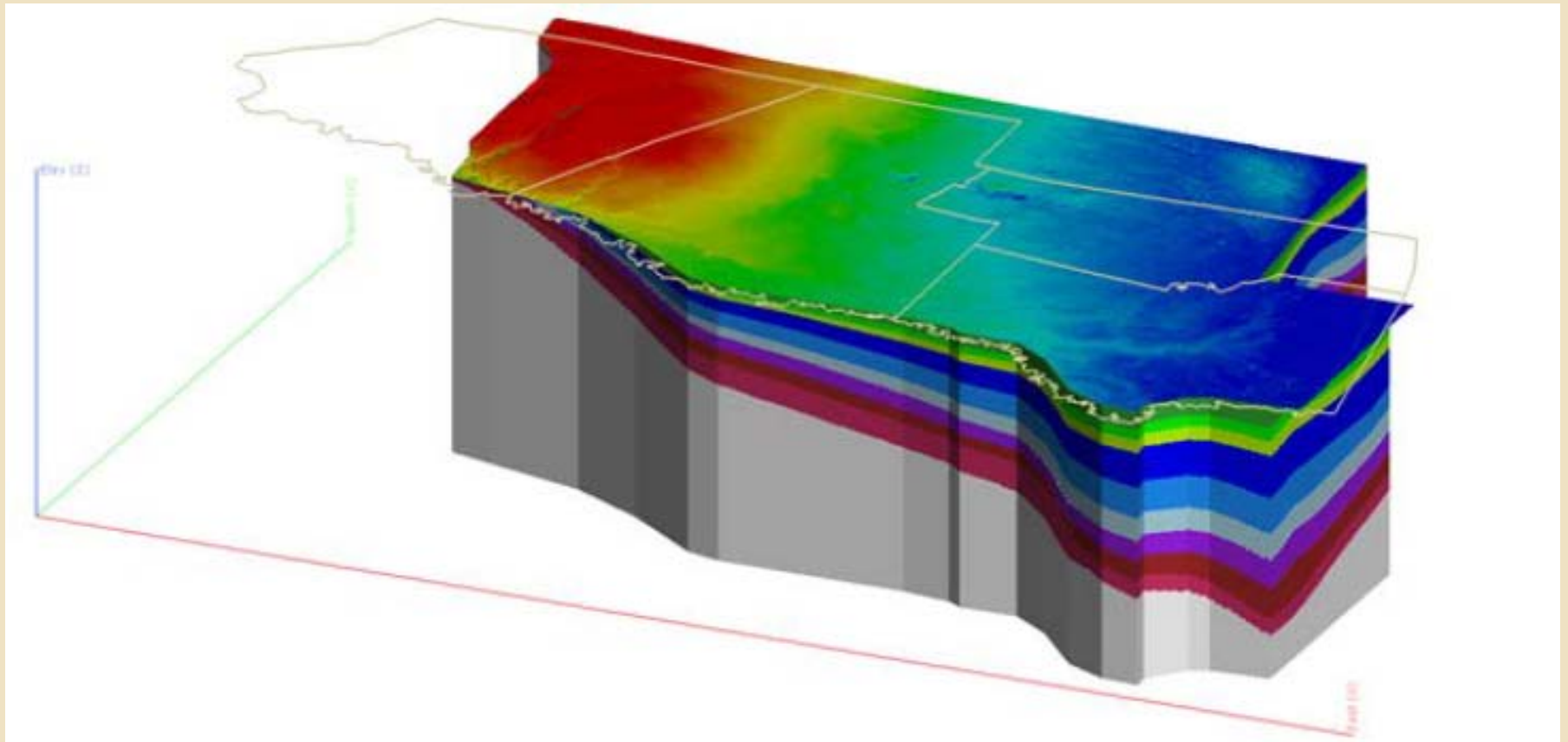
EXTENTS OF AQUIFER UNITS FROM MEYER AND OTHERS (2014)



EXAMPLE CROSS-SECTION FROM MEYER AND OTHERS (2014)



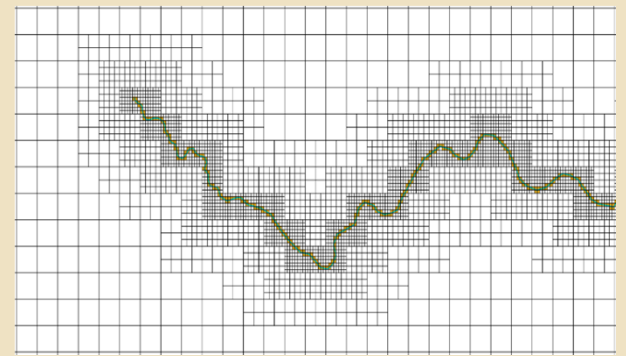
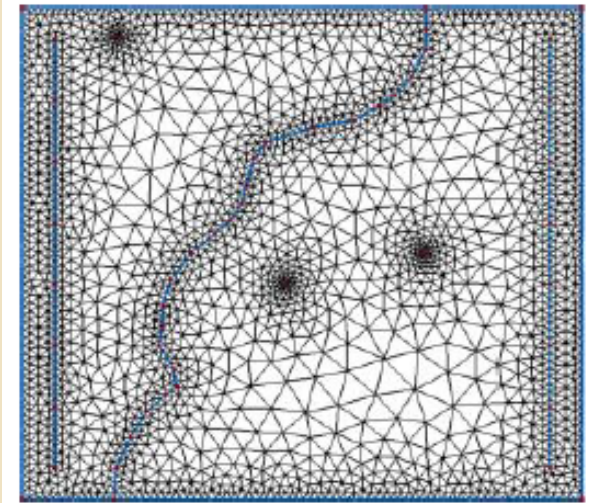
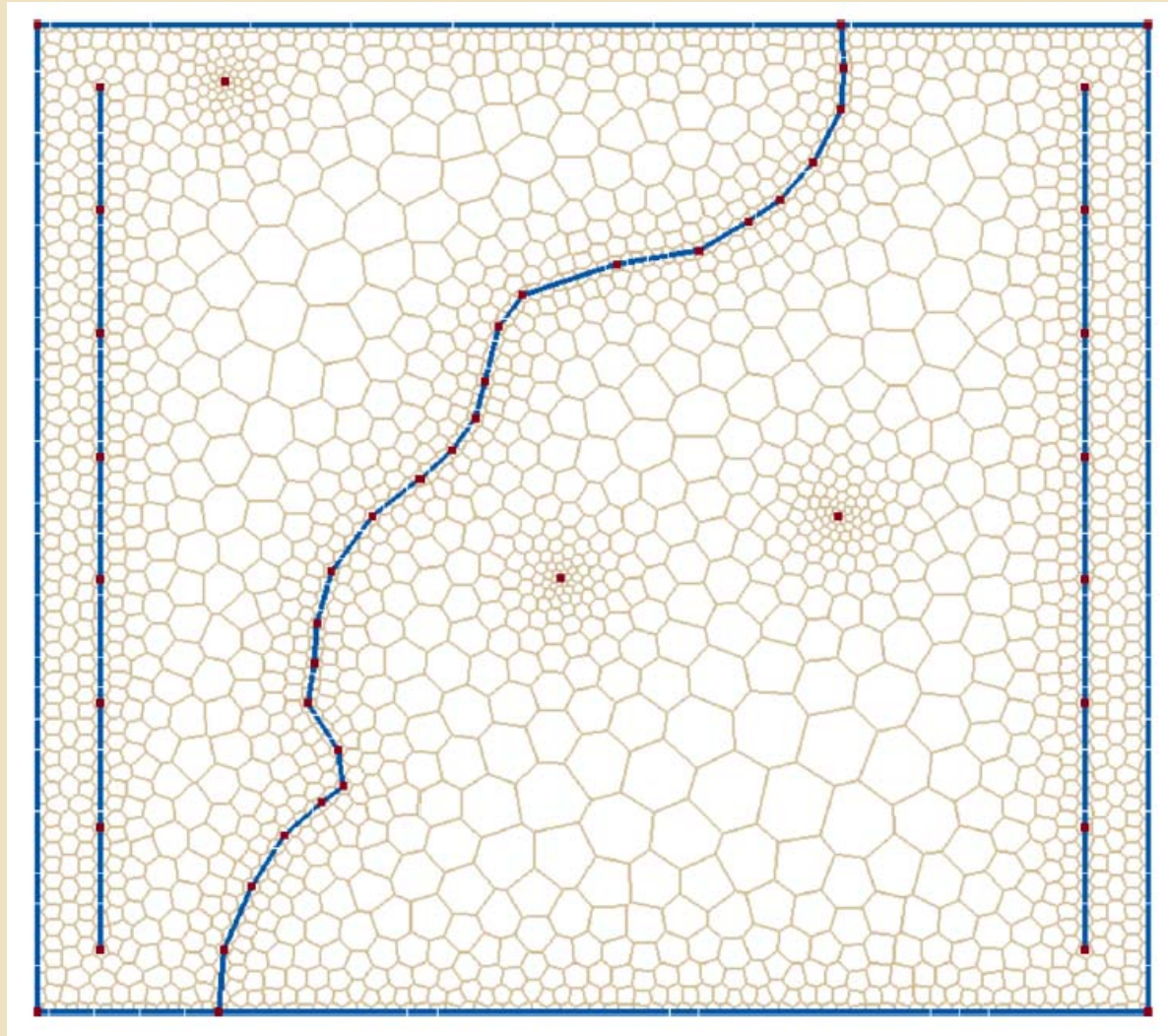
EXAMPLE 3-D FRAMEWORK BASED ON DATA FROM MEYER AND OTHERS (2014)



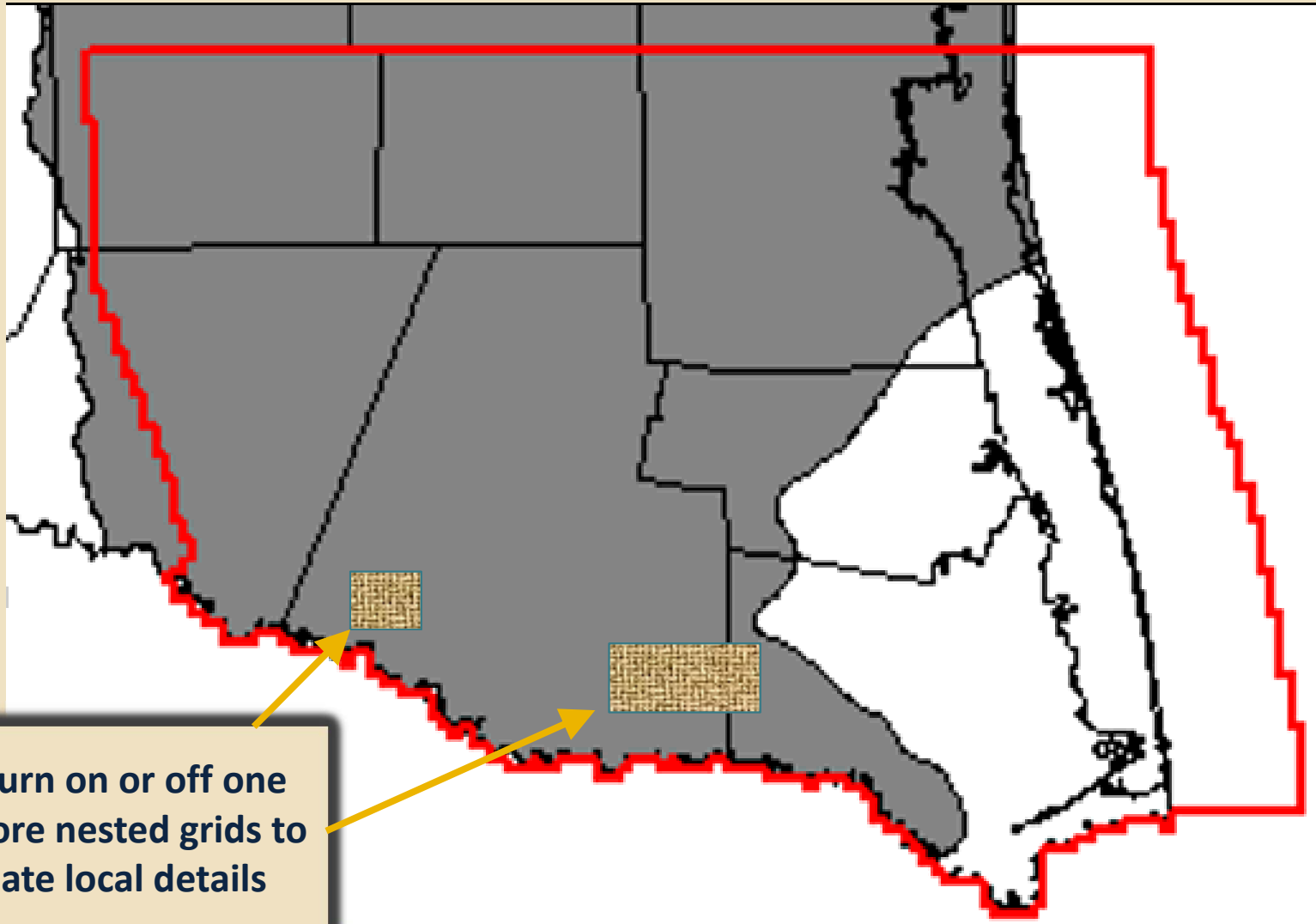
MODEL CODE SELECTION - MODFLOW-USG

- **Open-Source, Public Domain MODFLOW-based groundwater flow model using Unstructured Grids**
 - **Better representation of boundary features**
 - **Can refine for salinity gradients**
 - *Horizontal and vertical*
 - **Better representation for outcrops and pinch-outs**
 - **Can have multiple wells in a single cell**
 - *Well drawdown independent of cell size*
 - **Robust solution schemes**
 - *No “dry” cells*

EXAMPLES OF UNSTRUCTURED GRIDS



LOCAL SCALE EVALUATIONS



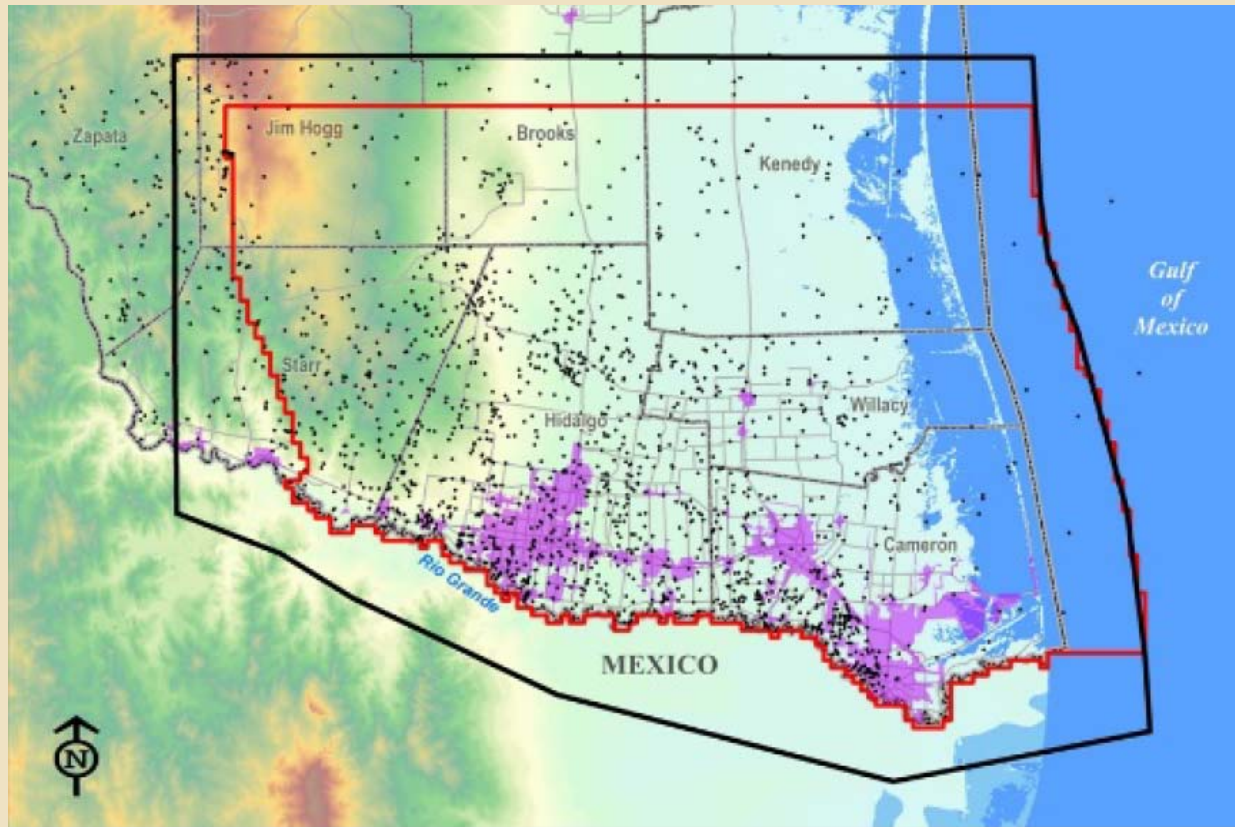
Can turn on or off one or more nested grids to evaluate local details

MODELING OUTCOMES

- **Expectations**
 - **Simulate impact of pumping**
 - *On water levels in aquifers and at wells*
 - *On chlorides in aquifers and at wells*
 - *On surface-water flows*
 - *On ground subsidence*
- **Ensure that the completed model addresses important questions of concern**
 - **Input on issues**
 - **Input on available information – data**

REQUEST FOR DATA

- **Information for wells**
 - Locations and construction
 - Lithologic logs, geophysical logs
 - Pumping, water levels, water quality
- **Information for surface water network**
 - River and stream flows
 - Locations and construction of main canals, drains
 - Diversions, water quality
- **Same information for Mexico**



QUESTIONS AND DISCUSSION

jaspencer@gsi-net.com

MEMORANDUM

TO: Rohit Goswami, TWDB
CC: Cindy Ridgeway, TWDB
Larry French, TWDB
FROM: Julie Spencer, GSI Environmental Inc.
RE: Notes from the kickoff Stakeholder Advisory Forum for the Lower Rio Grande Valley Groundwater Transport Model project

The kickoff Stakeholder Advisory Forum for the Lower Rio Grande Valley (LRGV) Groundwater Transport Model was held at the Lower Rio Grande Valley Development Council Transit Center located at 510 S. Pleasantview Drive, in Weslaco, Texas at 2:30 PM CST on November 4, 2015. A summary of the meeting, questions asked and answers provided, and a list of attendees is provided below.

The meeting began at 2:30 PM with an introduction to the project and TWDB team by Cindy Ridgeway. During the project introduction, Larry French, director of the TWDB Groundwater Resources group, discussed the TWDB recorder well program. The program currently consists of more than 184 water wells across the state equipped with satellite telemetry that transmit near-real-time water level data that is received and published by TWDB. However, there is a critical need for wells from the Lower Rio Grande Valley to be added to this network. Larry asked that if anyone knew of well owners in the area interested in joining this network to have them please contact Blake Neffendorff at the TWDB. Blake Neffendorff can be contacted at 512-463-7839 (work) or 512-971-7089 (cell). His email is blake.neffendorf@twdb.texas.gov

After TWDB's introduction, Dr. Sorab Panday, Technical Lead for the project, gave a presentation summarizing the project background, history, approach, and the types of additional data desired to develop the groundwater transport model. It was stressed that additional data would make the model more robust and allow for predictions that have less uncertainty. During the presentations by TWDB and GSI, the following data requests were made:

- Information on where future desalination plants would be located and any groundwater data available for that location.
- Information for wells within the study area. This would include well locations and construction; lithologic and geophysical logs; pumping, water level and water quality data; historical drawdowns; changes over time, etc. for both Texas and Mexico.
- Information on surface water within the study area. This would include river and stream flows; locations and construction of main canals and drains; diversions; and water quality for both Texas and Mexico.
- The project team would like to have this data collected by the end of the year, so it can be put into the correct format and incorporated into the conceptual model. Please contact us as soon as possible with any information that you might have. Please provide the information to either the TWDB or GSI at the contact information provided at the end of this presentation.

After the presentations were concluded, the floor was opened to questions from the audience. These questions and answers are summarized below:

Q1: Is a personal record of water levels OK or do you need something more official? I have rainfall data that shows differences of up to 6-inches over a two mile distance.

A1: This information is valuable to us. The only stipulation is that we would need to know exactly (lat/long) where it was collected.

Q2: Are you expanding the northern boundary of your model area to pick up the Yegua-Jackson aquifer? This aquifer is deep, approximately 1200 to 1500 feet bgs. There are a lot of producers there and I believe it would be beneficial.

A2: Currently, we do not anticipate including the Yegua-Jackson in our conceptual model. However, if we are provided information that indicates a desalination plant is proposed in this aquifer, we may decide to include it in our model. We will evaluate where to draw our model boundaries based on information provided. That is why we would like to make sure we have all the available data so we can make that determination.

The TWDB already has a regional scale model of the Yegua-Jackson that goes from the Rio Grande all the way to Louisiana that was developed within the past 5 years. Also have a study that was done to study the Yegua and Upper and Lower Jackson. It is just a numerical flow model, but it does give a rough idea of pumping effects. To do water quality we will need data on a smaller scale. We will need to evaluate where major pumping centers are located to ensure we do not run into a boundary effect within the model.

Q3: Have you seen contamination of bad water from shallow aquifers into the lower aquifer zones within older wells?

A3: If your well is open to multiple zones, the model will account for that. We will need water quality data to determine the effects of the water change due to this mixing.

Q4: What types of water quality data are you looking for? What about iron, arsenic, boron, other constituents of concern?

A4: TDS and salinity. We will need to focus on our objectives so we can demonstrate the density effects of brackish water for use at future desalination plants. Once the model is calibrated for this effect, it may be able to be applied to other properties. Meaning, that a constituent other than TDS could be put in to see how it flows.

There are other models that can be used to evaluate other constituents such as iron, but you would first need to know the properties of the aquifer, which is what this model will provide. It is important to note, however, that this model is not an alternative to a local study. This is a regional scale model, a stepping-stone. A specific local-scale model would still be required to assess conditions at a particular site.

Q5: Are you also approaching agriculture sector to get water data? There are some Water Supply Corporations that have wells along Military Highway used for agricultural purposes. Will those be included in the model?

A5: Not specifically, this is voluntary, but if you know of someone who has actual or anecdotal information it would be good to have. Site specific information is the best, but anecdotal information is also helpful if we have the associated location information. It

can give us a “soft” target for the model. The more data we can get the better. The TWDB does not have all the wells in the state in their database. Even if the data is not “solid” it is still helpful. The whole area will be modeled, so areas along Military Highway should be part of the effort and information on these wells would be valuable. The TWDB groundwater database currently has a handful of irrigation wells in it, but the main focus has been to know where public water supply wells are. Not all wells in the State are in the database. So, often we have to utilize alternative sources of information to fill in the blanks within the models. Having information on irrigation wells will be helpful to develop this model.

Q6: So, in essence you want drawdown, flow, TDS, screened intervals, location, etc.?

A6: Yes.

Q7: Do you want surface water flow data for rivers only? We have a lot of data that could be incorporated from the irrigation districts.

A7: No, we want data on everything. We’ll take all we can get, even irrigation ditches and canals. However, we would need to know which irrigation ditches are lined versus unlined, their exact locations, and when ditches were lined. This data may take a lot of filtering, but it will help us model our surface water/groundwater interactions. We will be looking at evapotranspiration and surface water interactions to input into the model. GIS coverages of the ditch layouts would also be helpful.

Q8: Are you guys going to contact the irrigation districts?

A8: I think that is an issue. When the irrigation districts hear this is a groundwater model, they don’t think that they can provide any valuable information. However, the history of their canals is important and has a direct impact. This model will also benefit them. It can help determine if the aquifer is helping to keep the irrigation ditches full or if they are losing surface water to groundwater. Knowing this interaction, which can change overnight, is very important.

Q9: There is irrigation water running through a canal. They are dumping water on the ground, so it is all going to become groundwater eventually, correct?

A9: The difference is if the canal is leaking it will recharge the aquifer, but it will also lose water to evapotranspiration. The losses are different. The point is that if the irrigation districts give us this information we can incorporate it into the model and provide feedback of the surface water/groundwater interactions. If that information is available it would be good to have.

Q10: I think you can contact the International Boundary and Water Commission (IBWC) for information on the Mexican side of the Rio Grande.

A10: We will do that, however, we know it is a challenge to get data from across the border. We have collected some recent data from the Mexican side of the Rio Grande, but it is at a much bigger scale than what we would like. Access to the data is different everywhere, and we would like to explore additional avenues of obtaining that data.

Q11: From how far back to want data? A year, two years?

A11: That would be helpful. Remember that movement of groundwater, especially brackish groundwater, is slow. So, the further back the data goes the better. In fact, some TWDB models have gone back 100 years.

I believe I can get you data from 7 years back.

That would be great data to have.

In closing, it was stated that as the project team moves forward, we will focus on our objectives of refining the model to assist with determining the effects of future proposed desalination plants. The audience was reminded that the presentations given today would be available for download from the TWDB website in about 1 week. The meeting was adjourned at approximately 3:30 PM. A list of attendees is provided below:

Name	Affiliation
Cindy Ridgeway	TWDB
Rohit R. Goswami	TWDB
Larry French	TWDB
Nathan van Ort	TWDB
Connie Townsend	TWDB
Sorab Panday	GSI Environmental Inc.
Julie Spencer	GSI Environmental Inc.
Staffan Schorr	Montgomery & Associates
Armando Vela	GMA 16 / Red Sands GCD
Scott Fry	Valley MUD #2
Felix Saenz	Brush Country GCD
Rinni Min	City of Laredo
Andy Garza	Kenedy County GCD
Omar Anzalclua, Jr.	Brownsville PUB
Kevin Spencer	R.W. Harden and Associates
Steven Sanchez	North Alamo WSC
Robert Rodriguez	North Alamo WSC
Tomas m. Rodriguez	Region M
Brian Macmanus	East Rio Hondo WSC
Juan Bujanos	Brownsville PUB
Arturo Martinez	City of Edinburgh
Antonio Leal	City of Edinburgh

Mark Vega	McAllen Public Utility
Sara Eatman	Black & Veatch
Nick Benavides	Rio Grande Regional Water Planning Group
Debby Morales	Lower Rio Grande Valley Development Council
Marcie Oviedo	Lower Rio Grande Valley Development Council

To provide information for use in developing the Lower Rio Grande Density Flow Model, please contact any of the following:

Sorab Panday
GSI Environmental Inc.
LRGV Model, Technical Lead
281-833-9194 (office)
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spanday@gsienv.com

Staffan Schorr
Hydrogeologist / Principal
Montgomery & Associates
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www.elmontgomery.com

Julie Spencer
GSI Environmental Inc.
LRGV Model, Administrative Lead
512-346-4474 (office)
jaspencer@gsi-net.com

Rohit R. Goswami, Ph.D.
Texas Water Development Board
Groundwater Availability Modeling
512-463-0495
Rohit.Goswami@twdb.texas.gov

To provide information related to the TWDB recorder well program, please contact:

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512-971-7089 (cell)
blake.neffendorff@twdb.texas.gov