Groundwater Availability Modeling

Contract Manager
Ted Angle

Texas Water Development Board
Purpose: to develop tools that can be used to help GCDs, RWPGs, and others assess groundwater availability.

Public process: you get to see how the model is put together.

Freely available: standardized, thoroughly documented, and available over the internet.

Living tools: periodically updated.
Location of completed GAMs for the major aquifers of Texas

- Ogallala (northern part) 12/2001
- Ogallala (southern part) 4/2003
- Cenozoic Pecos alluvium 9/2004
- Hueco Bolson 12/2001
- Mesilla Bolson 9/2004
- Edwards-Trinity (Plateau) 9/2004
- Trinity (Hill Country) 8/2000
- Edwards (San Antonio segment) 9/2004
- Carrizo-Wilcox (northern part) 4/2003
- Carrizo-Wilcox (central part) 5/2003
- Gulf Coast (northern part) 9/2004
- Edwards (northern segment) 12/2003
- Edwards (Barton Springs segment) 12/2001
- Gulf Coast (central part) 9/2004
- Gulf Coast (southern part) 12/2003

Note: The Edwards-Trinity (Plateau) and Cenozoic Pecos Alluvium aquifers are included in the same model.
Location of Completed and Ongoing Models for GAM: Minor Aquifers

Status as of April 2006
Managed available groundwater (MAG)…the amount of groundwater available for use.

The State does not directly decide how much groundwater is available for use: GCDs will through GMA process

A GAM is a tool that can be used to assess groundwater availability once GCDs and GMAs decide on the desired future condition of the aquifer.
Do we have to use GAM?

- Water Code & TWDB rules require that GCDs use GAM information, if available, for their management plans.
- TWDB rules require that RWPGs use managed available groundwater estimates, if developed in time for the planning cycle.
How do we use GAM?

- **The model**
  - predict water levels and flows in response to pumping and drought
  - effects of well fields

- **Data in the model**
  - water in storage
  - recharge estimates
  - hydraulic properties

- **GCDs and RWPGs can request runs**
GCDs, RWPGs, TWDB, and others collect new information on aquifer.

This information can enhance the current GAMs.

TWDB plans to update GAMs every five years with new information.

Please share information and ideas with TWDB on aquifers and GAMs.
Participating in the GAM process

- **SAF meetings**
  - hear about progress on the model
  - comment on model assumptions
  - offer information (timing is important!)

- **Report review**
  - at end of project

- **Contact TWDB**
  - Ted Angle
Comments:

Ted Angle
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www.twdb.state.tx.us/gam
Groundwater Availability Modeling (GAM) for the West Texas Bolson Aquifers

Presented to
Stakeholder Advisory Forum
Van Horn, Texas
July 13, 2006
Presentation Outline

1) the basics of groundwater flow in the aquifer;

2) the concept of numerical groundwater flow modeling;

3) experience from previous models of the aquifer, if applicable;

4) the planned approach for modeling the aquifer;

5) request for local scientific data and model input information; and

6) the proposed schedule for the project
West Texas Bolson GAM Team

- LBG-Guyton Associates
- John Shomaker & Associates, Inc.
- Daniel B. Stephens & Associates, Inc.
- Senior Technical Advisors
  - Eddie Collins, UT BEG
  - Barry Hibbs, Ph.D.
  - Kevin Urbanczyk, Ph.D.
Minor Aquifers

West Texas Bolson GAM
Why GAMs?

- A groundwater model provides a good way to integrate geologic information and measured data to predict groundwater flow.

- Best available technology.
What a GAM IS.

- Tool to meet the TWDB GAM objectives as specified by Texas Legislature.
- Tool to perform regional evaluation for long-term water supply.
- Tool developed from an assimilation and interpretation of significant research and different types of data.
What a GAM is NOT.

- Something that can tell you the water level in your backyard well to the nearest hundredth of a foot every minute of the day.

- Icon on a desktop computer that can be easily used and correctly interpreted by anyone.

- The definition of groundwater availability.
A numerical groundwater flow model is the mathematical representation of the physical aquifer.

A numerical model calculates the water level at specific locations based on aquifer characteristics, pumping, recharge, etc.

Calculated water levels can be compared to measured water levels in wells.
Modeling Basics
Groundwater Flow Modeling

Model “Cell” or “Gridblock”
Cells “Communicate”

Groundwater flow
What Goes on In A Gridblock?

- Groundwater flow
Gridblock Accounting

- Natural recharge
- Exchange of water with neighboring cells
- Irrigation return flow
- Water removed from storage by pumping
- Water remaining in storage
- Permeability
- Storage value
- Thickness
Previous Investigations of West Texas Bolson Aquifers

- **Bolson Studies**
  - Gates and Smith (1975)
  - Gates, et. al. (1980)
  - Darling (1994)
  - Darling, Hibbs, and Dutton (1994)
  - UT BEG (unpublished)
Bolson Aquifers

After George and others, 2005
Mountains and Bolsons

- N.W. Eagle Flat
- S.E. Eagle Flat
- Devil Ridge
- Quitman Mountains
- Carrizo Mtns
- S.E. Eagle Flat
- Red Light Draw
- Green River Valley
- Indio Mtns
- Van Horn Mtns
- Eagle Mtns
Hydrogeologic Cross-section

After George and others, 2005
Hydrogeologic Cross-sections

After George and others, 2005
Hydrogeologic Cross-section

After George and others, 2005
Regional Groundwater Flow

After Hibbs and Darling, 2005
Conceptual Approach

Recharge

Evapotranspiration

Pumping

Groundwater-Surface Water Interaction Rio Grande River

Cross-formational Flow

Bolsons

Cretaceous-Permian-Other?

Cretaceous-Permian-Other?

No Flow Boundary
Do you have new information?

- Well locations
- Pump test information
- Water quality data
- Water usage records
## Project Schedule

<p>| TASK                        | Jun-06 | Jul-06 | Aug-06 | Sep-06 | Oct-06 | Nov-06 | Dec-06 | Jan-07 | Feb-07 | Mar-07 | Apr-07 | May-07 | Jun-07 | Jul-07 | Aug-07 | Sep-07 | Oct-07 | Nov-07 | Dec-07 | Jan-08 | Feb-08 | Mar-08 | Apr-08 | May-08 | Jun-08 |
|-----------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| <strong>Task 1 – Stakeholder Input</strong> |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| Stakeholder Meetings and Training | S      | S      |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| <strong>Task 2 – Model Development</strong> |    |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| Physiography and Climate |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| Geology |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| Hydrostratigraphy |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| Structure |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| Water Levels &amp; Regional Flow |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| Recharge |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| Rivers, Streams, Lakes, and Springs |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| Hydraulic Properties |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| Discharge &amp; Pumpage |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| Water Quality |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| Steady-State Calibration |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| Transient Calibration |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| Sensitivity Analysis |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| <strong>Task 3 – Documentation</strong> |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| GIS / Data Deliverables |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| Report |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| C |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| D |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| F |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| <strong>Task 4 – Project Management</strong> |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| Contract Administration |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| Technical Review Meetings with TWDB |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| Monthly Status Reports |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |</p>
<table>
<thead>
<tr>
<th>Item</th>
<th>Date</th>
<th>Topics</th>
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<tbody>
<tr>
<td>1</td>
<td>Jul-2006</td>
<td>Introduction &amp; Modeling Approach</td>
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<tr>
<td>2</td>
<td>Apr-2007</td>
<td>Conceptual Model</td>
</tr>
<tr>
<td>3</td>
<td>Dec-2007</td>
<td>Model Architecture &amp; Calibration</td>
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<tr>
<td>4</td>
<td>Apr-2008</td>
<td>Final Report</td>
</tr>
<tr>
<td>Training</td>
<td>TBD</td>
<td>Stakeholder Training Seminar</td>
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<tr>
<td>Final Report</td>
<td>Jul-2008</td>
<td>Final Report Due to TWDB</td>
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Contractor Contact:

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jbeach@lbg-guyton.com
(512) 327-9640
# First Stakeholder Advisory Forum
## West Texas Bolsons GAM
### July 13, 2006

<table>
<thead>
<tr>
<th>Name</th>
<th>Affiliation</th>
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<tbody>
<tr>
<td>Hector Garza</td>
<td>USGS</td>
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<tr>
<td>Barbara Kauffman</td>
<td>Rio Grande Council of Governments</td>
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<tr>
<td>James Beach</td>
<td>LBG-Guyton Associates</td>
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<td>Ted Angle</td>
<td>TWDB</td>
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Q: Will the project collect any new field data?
A: The scope and resulting budget for the project did not anticipate collecting new field data. However, the TWDB is open to collecting water levels and other information in the model area willing landowners and appropriate wells can be located.

Comment: Hector Garza (with the UGGS) said that he would check to see if the USGS or any other agencies had any new data in the study area.