



# Groundwater Availability Modeling (GAM) for the Central Gulf Coast (CGC) Aquifer

**A Presentation to:** Stakeholder Advisory Forum #3  
Bay City, Texas  
November 8, 2001



# Presentation Outline



- **GAM Objectives & Expectations**
- **GAM Schedule**
- **Status of Development of Data for the Conceptual Model Elements for Groundwater Flow in the CGC Aquifer**
- **Topics Planned for Next SAF**



# GAM Objectives & Expectations



- Include substantial Stakeholder input
- Result in standardized, publicly available groundwater flow models and supporting data (will be posted to the TWDB website)
- Provide water-management tools for regional water planning
- Provide information on groundwater availability through 2050



# GAM Schedule

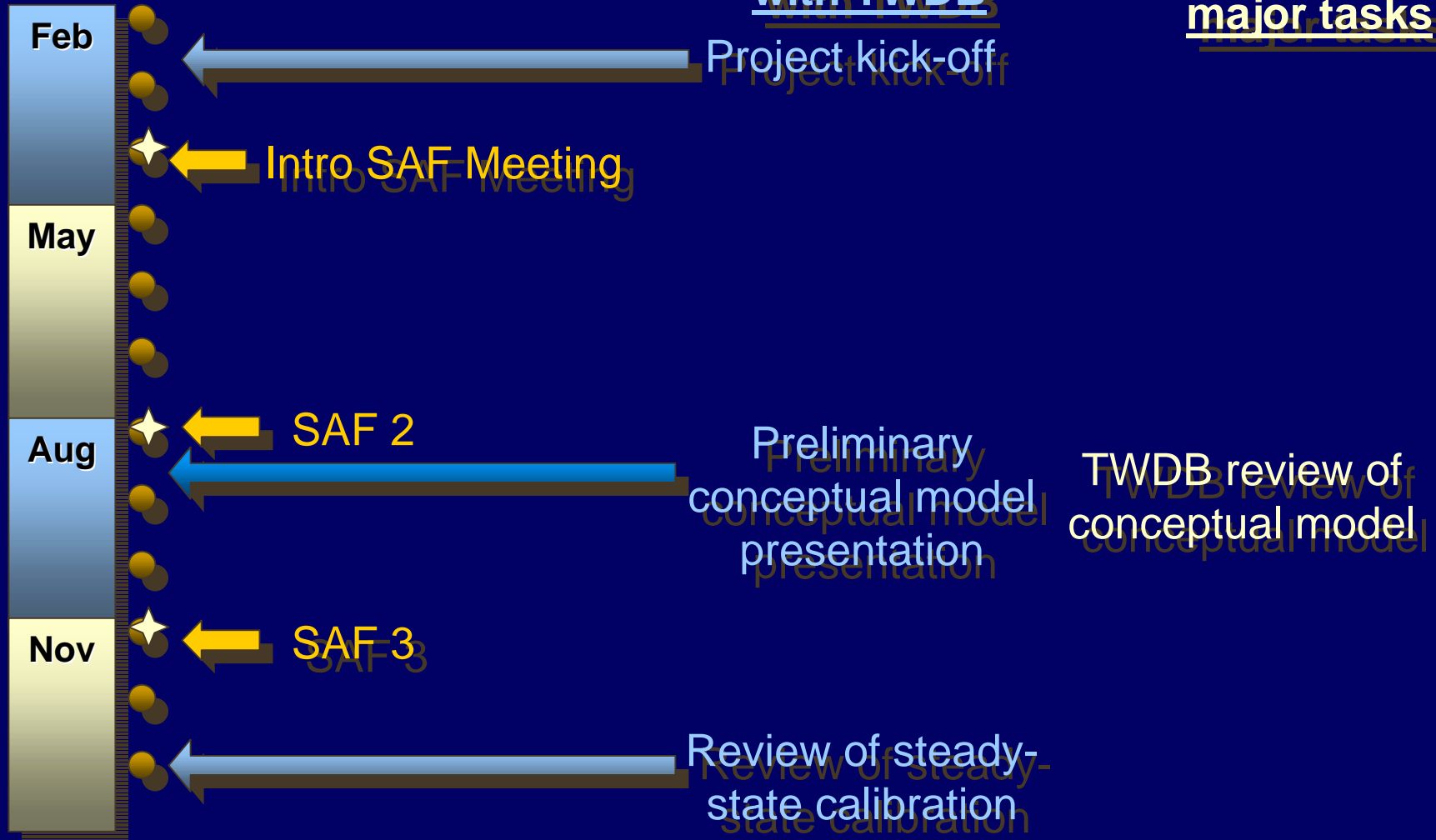


**Project quarter**

**Technical meetings with TWDB**

**TWDB major tasks**

2001





# GAM Schedule

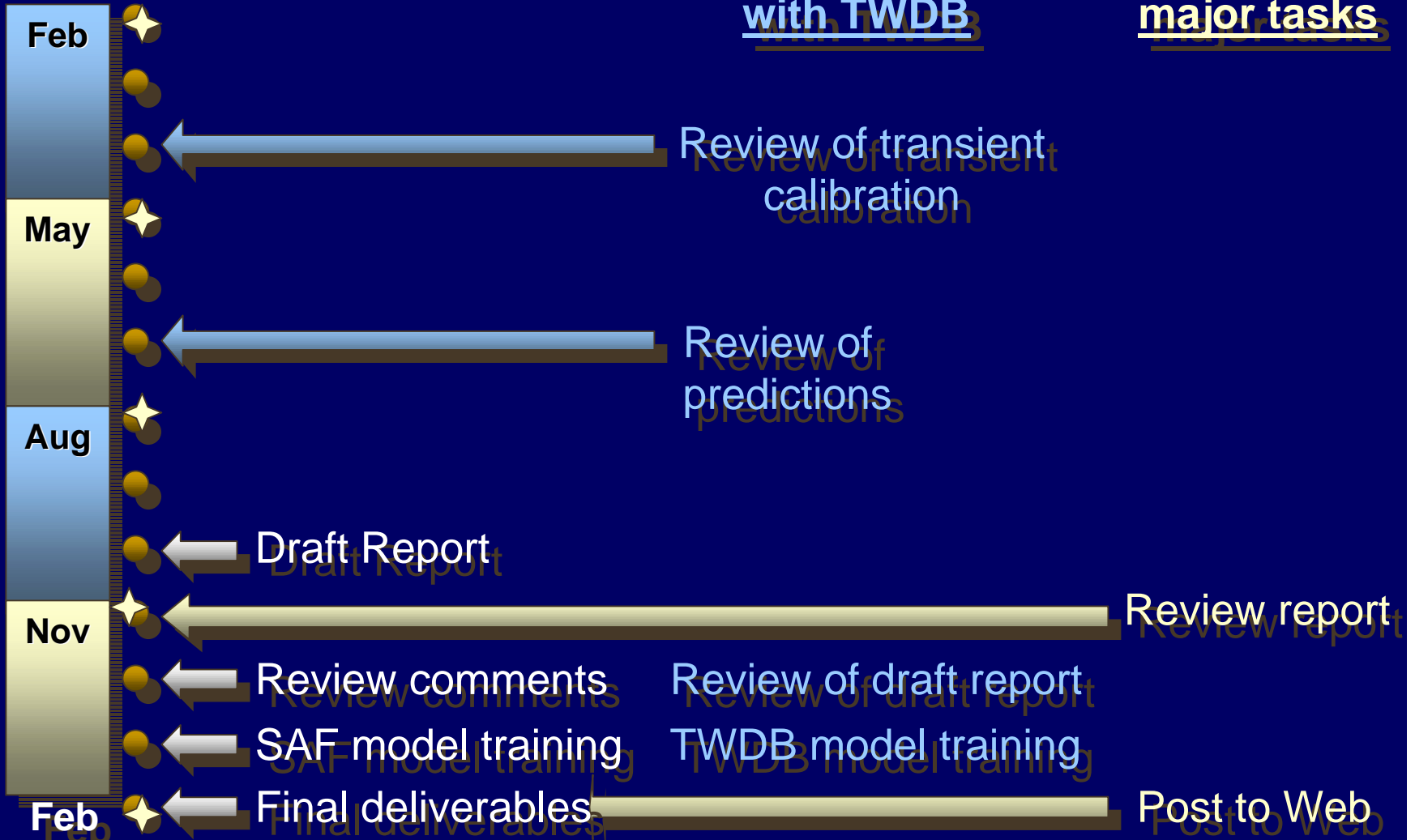


**Project quarter**

**Technical meetings with TWDB**

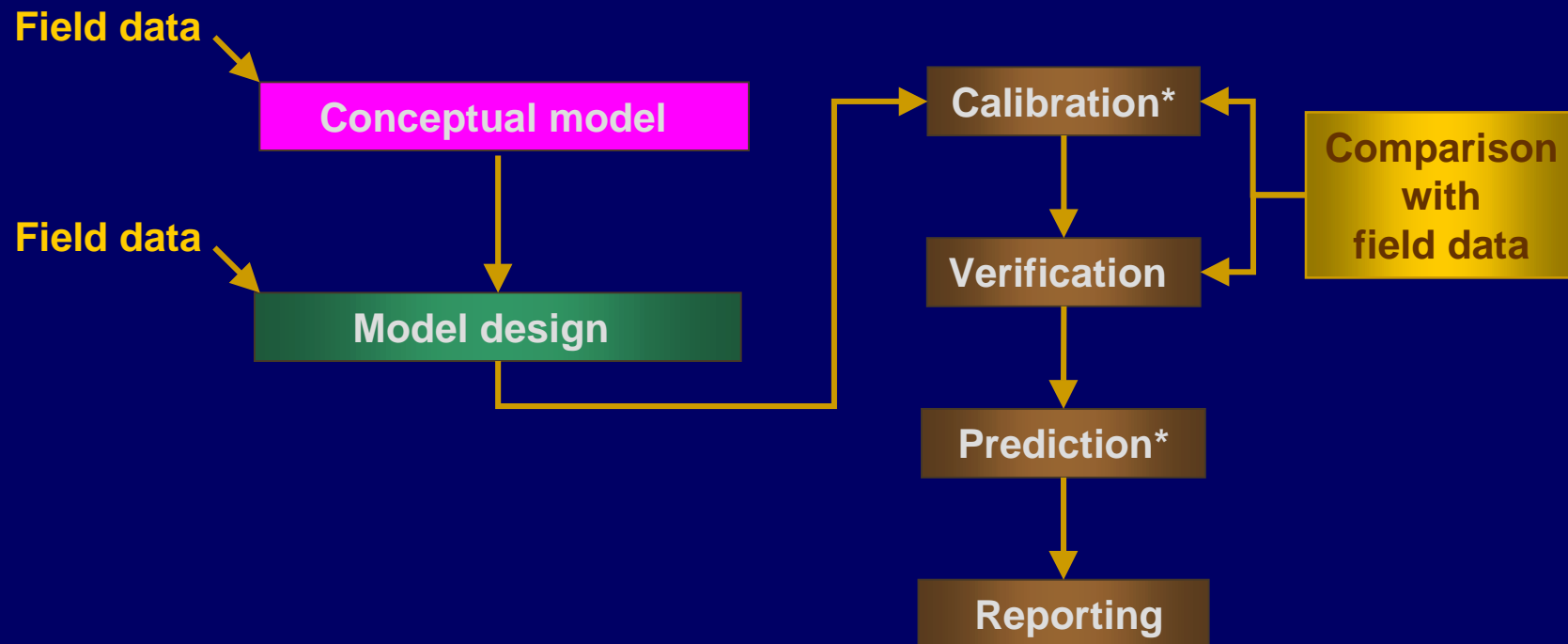
**TWDB major tasks**

2002





# Groundwater Modeling Steps



\*Includes sensitivity analysis



# Conceptual Model Topics



- Aquifer-system geometry (geology, hydrostratigraphy, outcrops, river basins, GAM region, model boundaries)
- Hydraulic properties
- Water levels
- Recharge
- Discharge (pumping, GW/SW interaction,)



# Aquifer-System Geometry



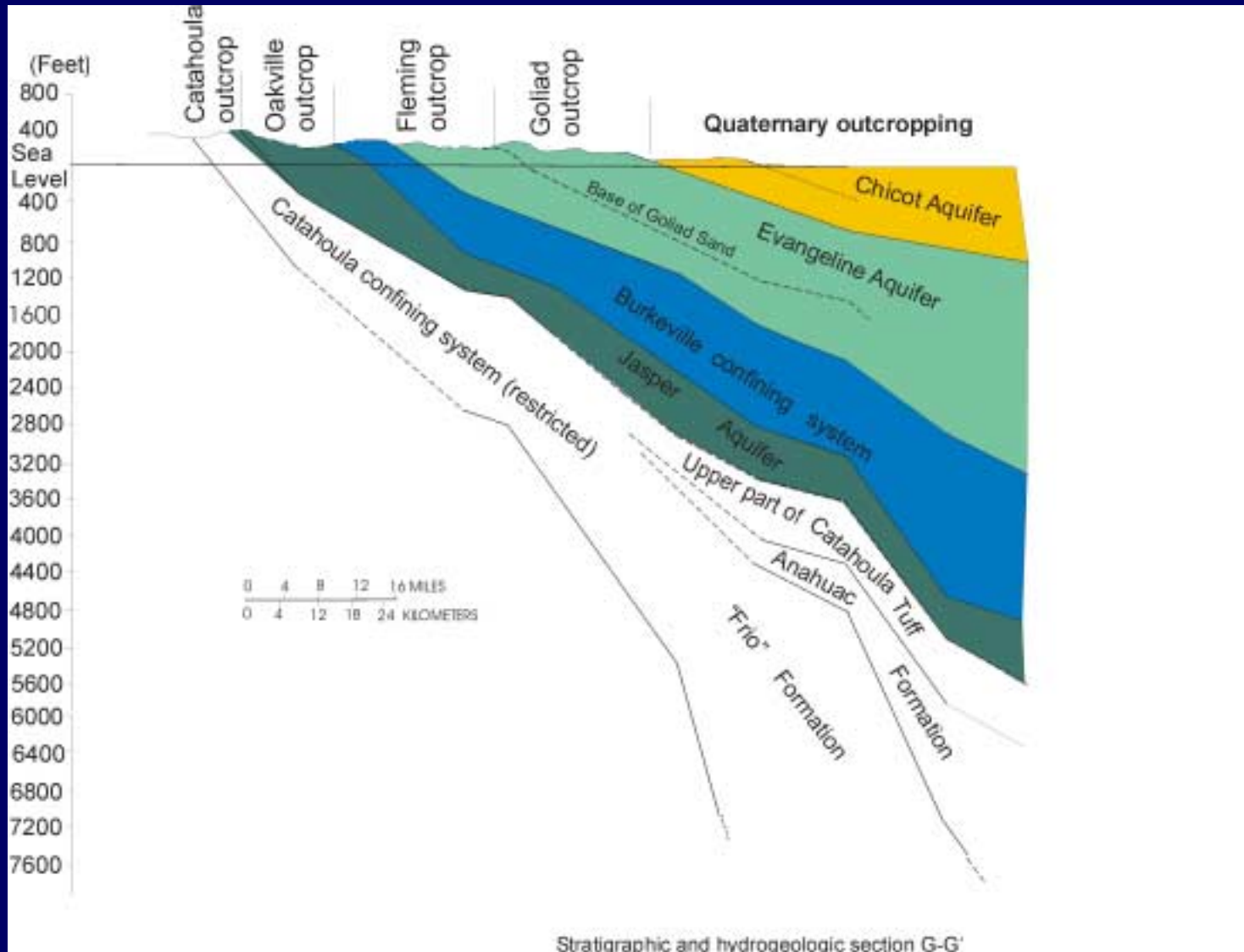
## STATUS: Completed

- Geology / Hydrostratigraphy
- Outcrops
- River basins
- GAM & model grid boundaries





# Cross Section



# Hydrostratigraphic Structure - Data Sources



- Baker (1979)—TWDB Report 236
  - 7 cross sections defining all 4 hydrostratigraphic units
- Carr et al. (1985)—TWDB Report 289
  - Detailed contour maps define base of Chicot and Evangeline
  - About 400 electric logs used to define contours
- Water-level & TDS databases
  - use Jasper well locations to adjust updip outcrop limit (Catahoula)



# Hydrostratigraphic Structure - Data Sources (cont.)



- **Northern Gulf Coast GAM (USGS)**
  - HSUs based on Baker (1979), Carr et al. (1985), and more recent review & modifications by Dr. Ernie Baker
  - Meetings to develop consistency with NGC GAM
- **Southern Gulf Coast GAM (TWDB)**
  - Meetings to develop consistency with SGC GAM



# Baker (1979) Cross Sections





# Chicot Aquifer



- Carr et al. (1985)
  - States subdivision in Houston area based on differences in water levels
  - Generally described as Chicot aquifer “undifferentiated”
  - Detailed elevation contours for lower surface only
- Ryder (1988) & TAMU-CC
  - Subdivision based on geology



## Chicot Aquifer (cont.)



- Southern Gulf Coast GAM (TWDB)
  - do not believe data supports 2 layers for modeling
  - no Chicot subdivision
- Northern Gulf Coast GAM (USGS)
  - Many years modeling in this region and do not believe data supports 2 layers for modeling
  - no Chicot subdivision
- Conclusion: Model Chicot as a single layer.



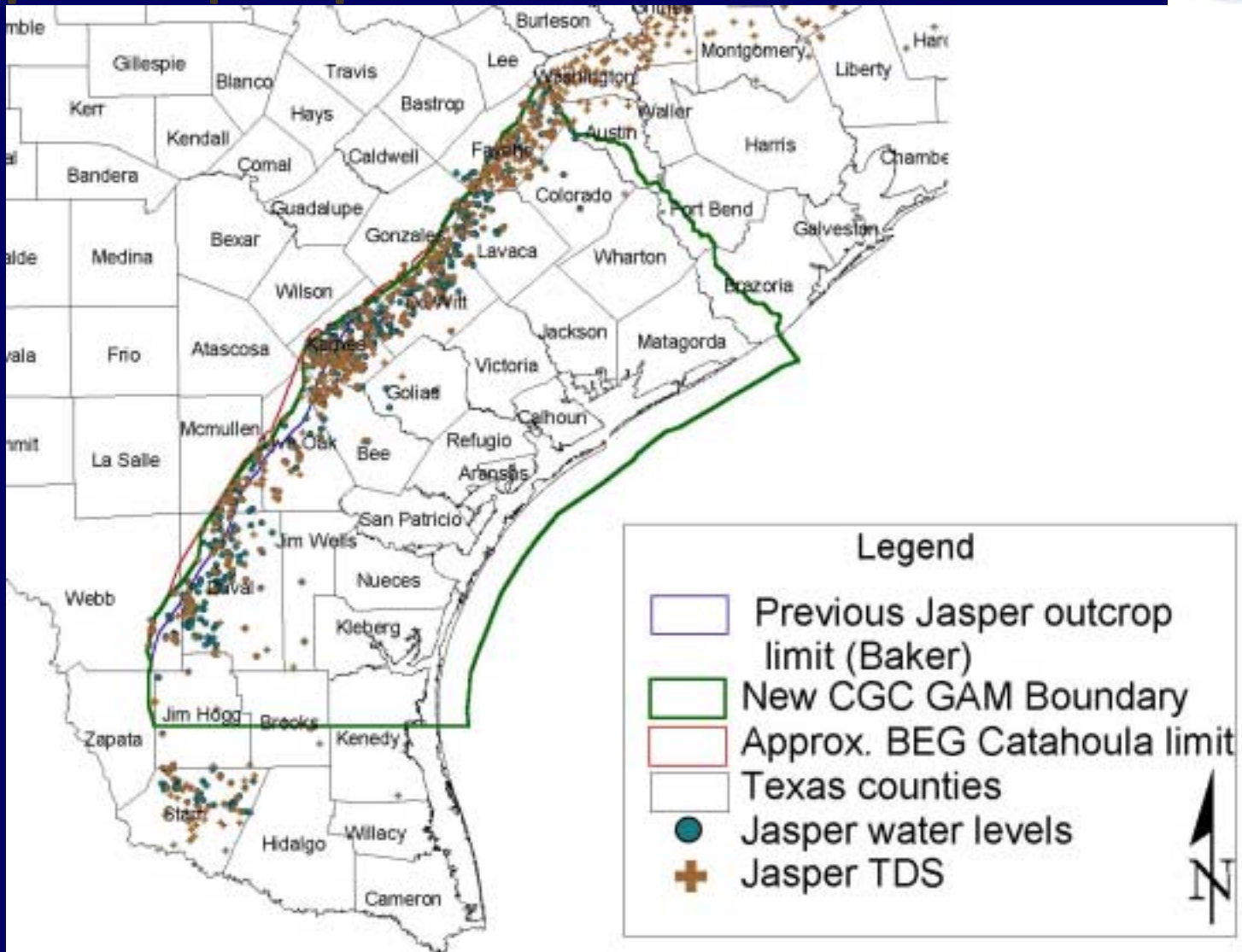
# Jasper Updip Limit Reconciliation



- Structure/hydrostratigraphy from Baker (1979)
- Catahoula outcrop limit on west (BEG)
- Jasper water-level database well locations
- Jasper TDS database well locations



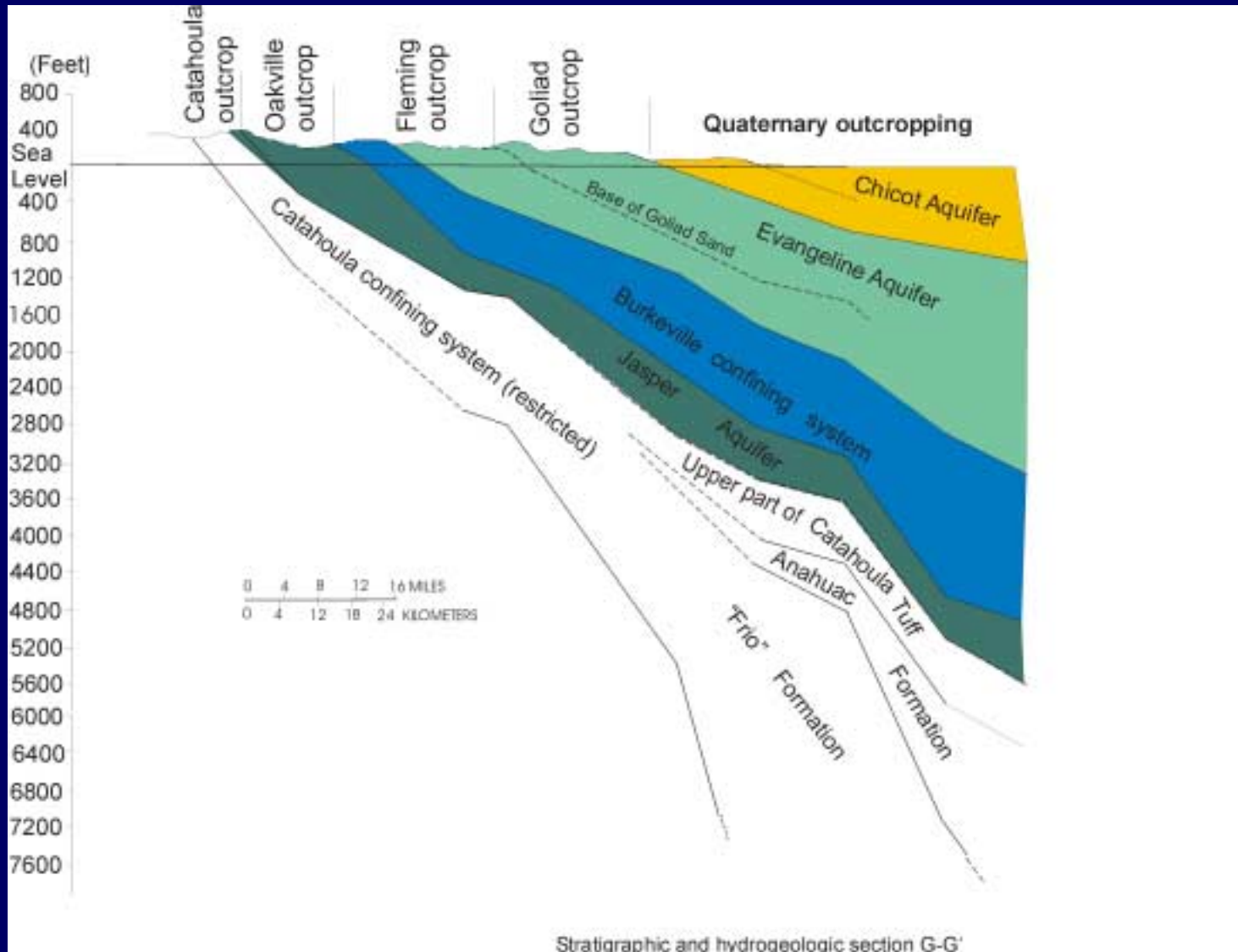
# Jasper Updip Limit Reconciliation





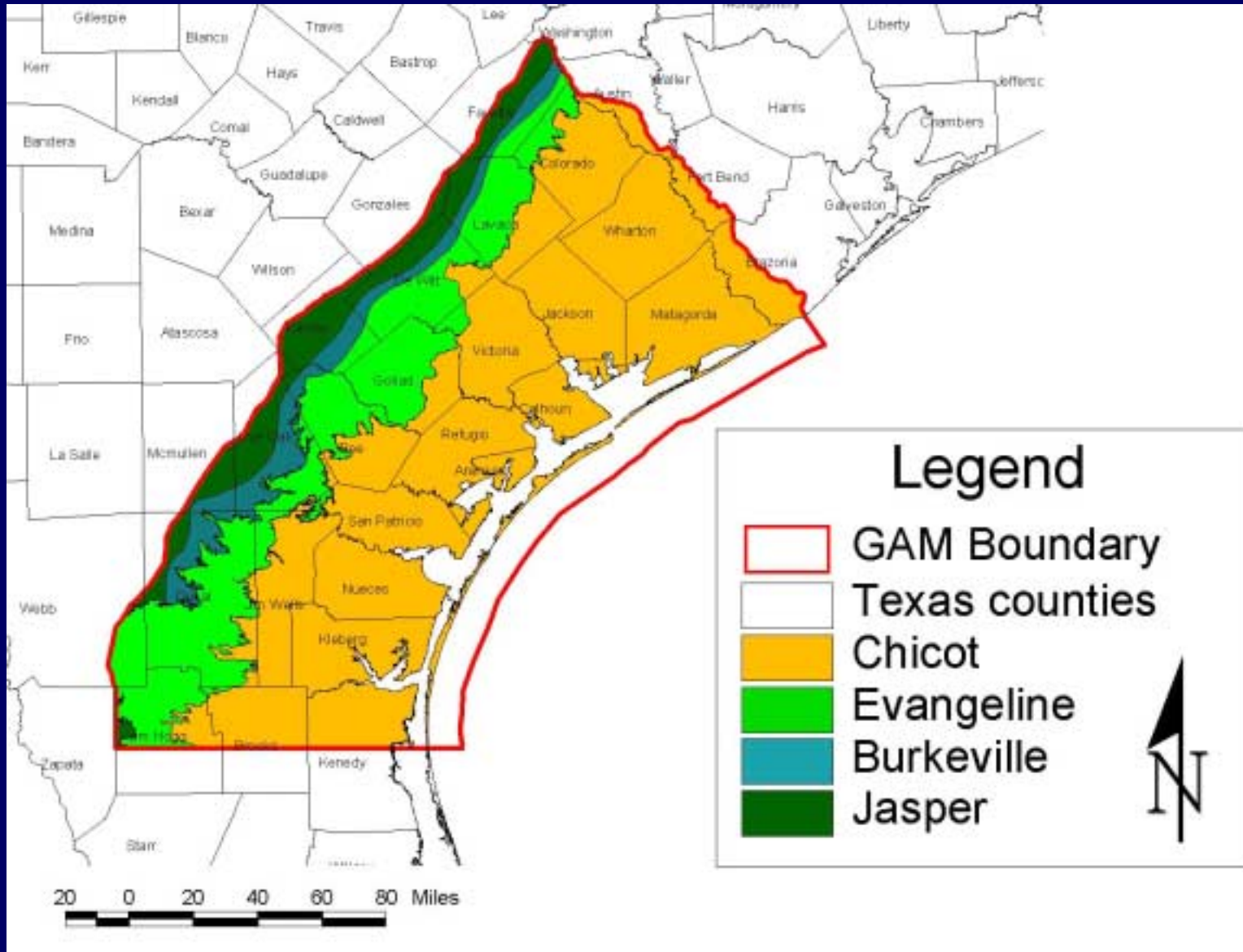


# Cross Section



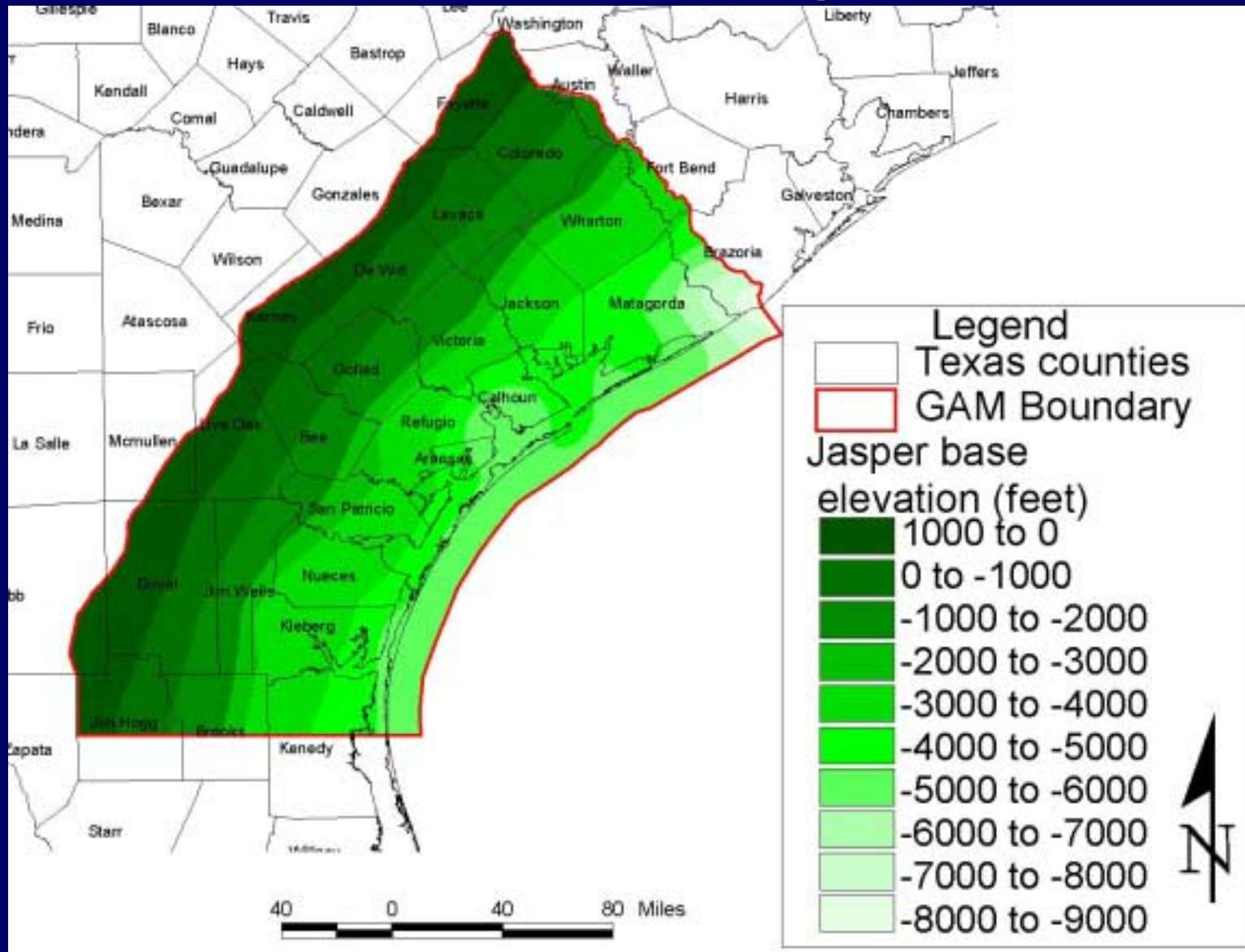


# HSU Geologic Outcrops



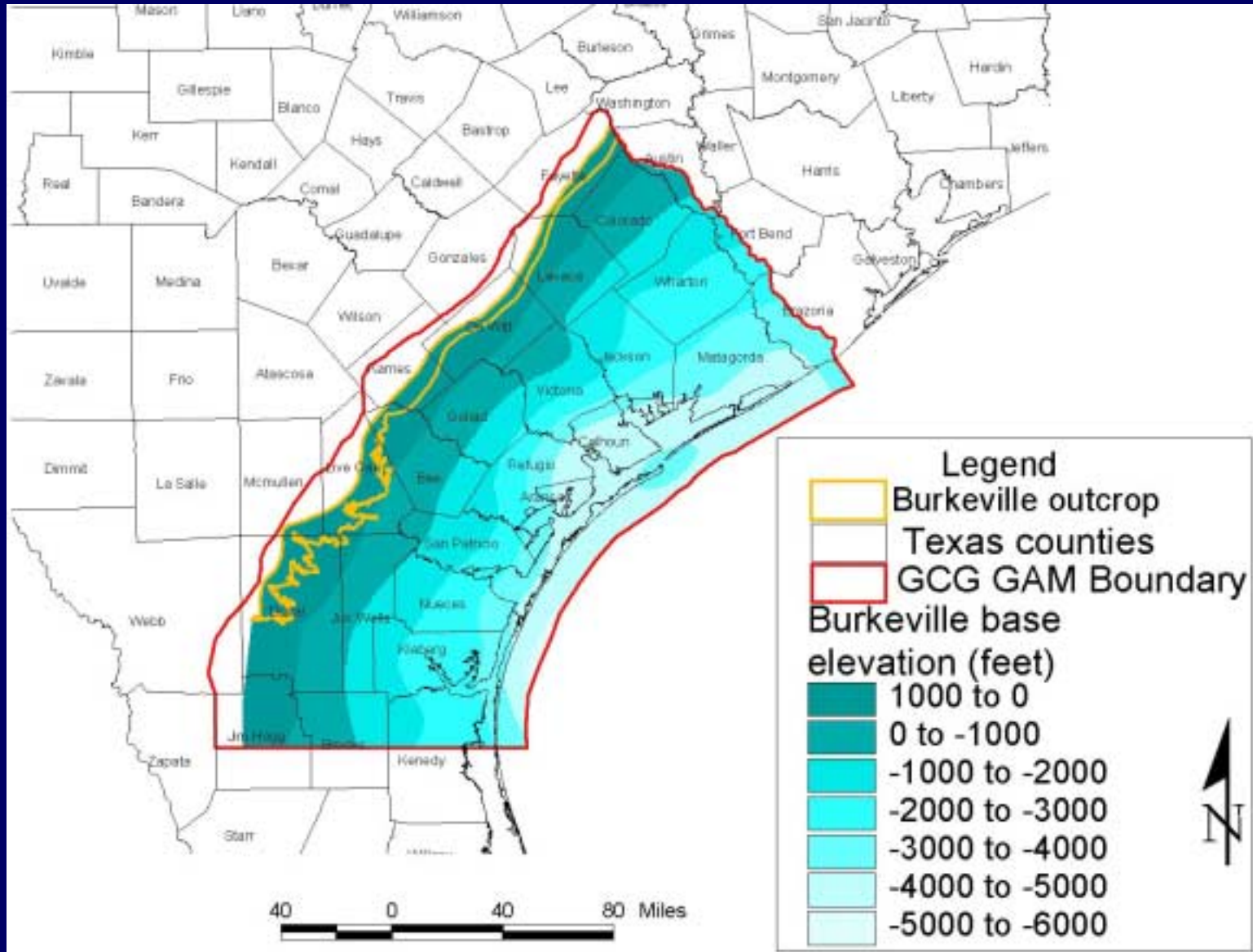


# HSU Structure – Jasper



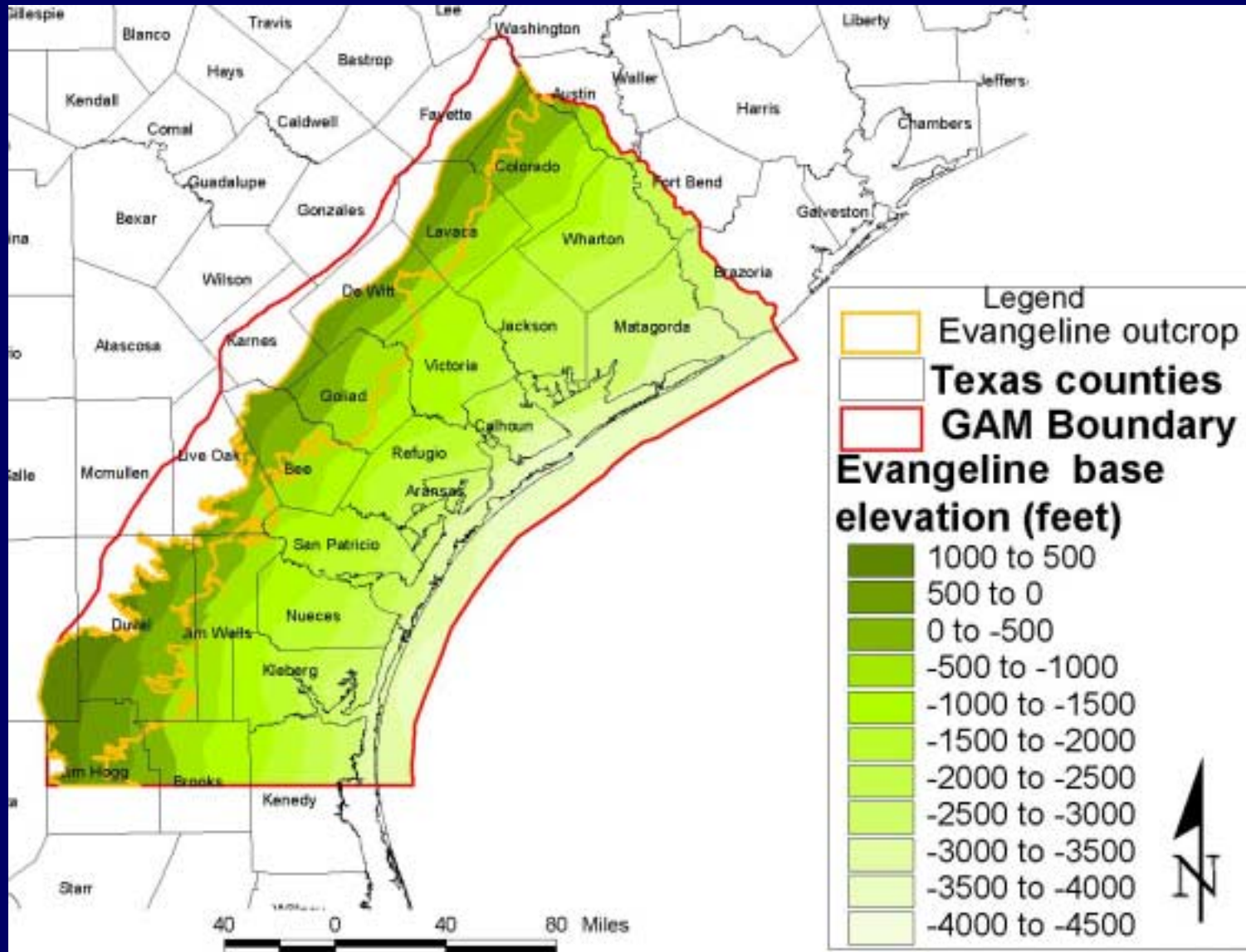


# HSU Structure – Burkeville



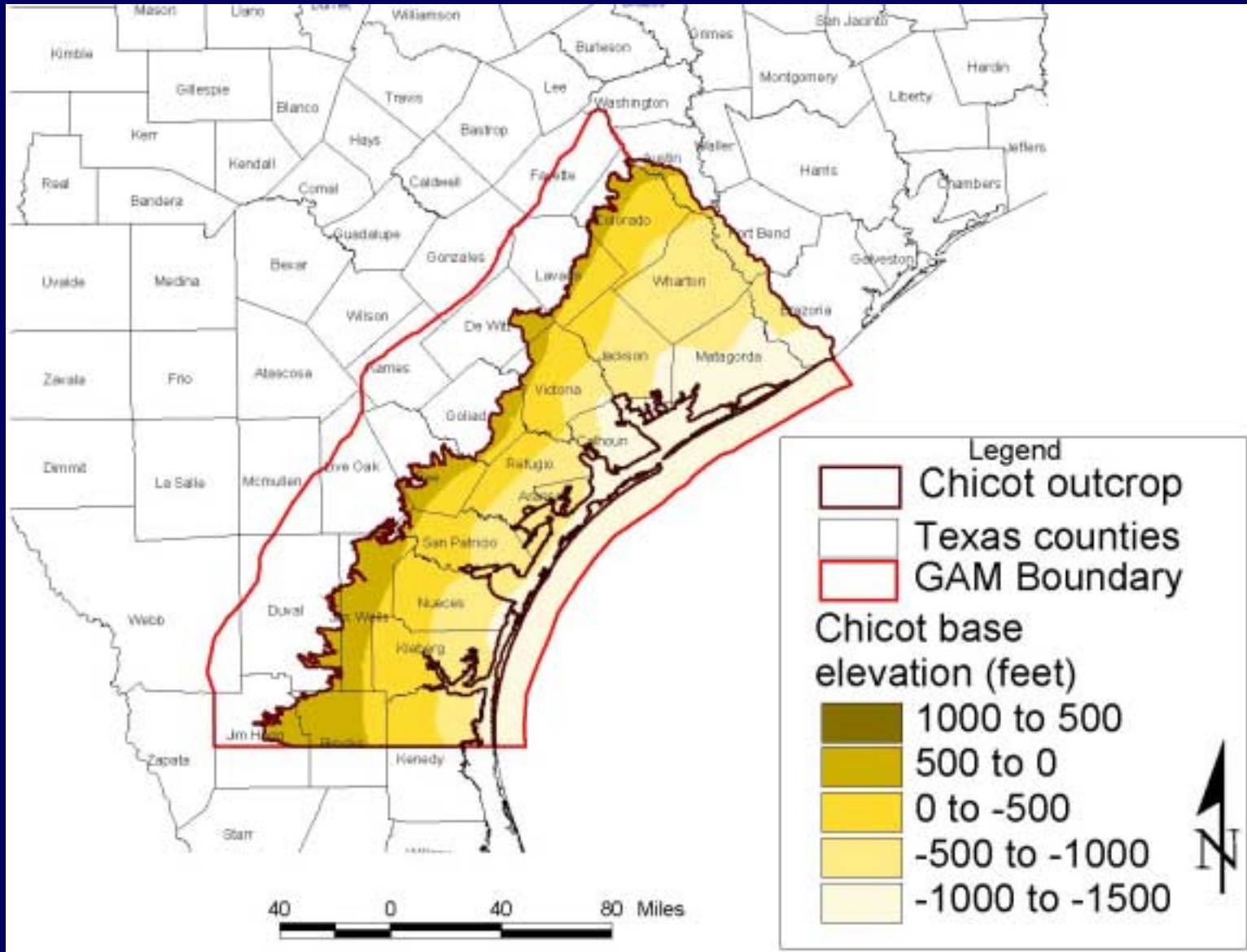


# HSU Structure – Evangeline

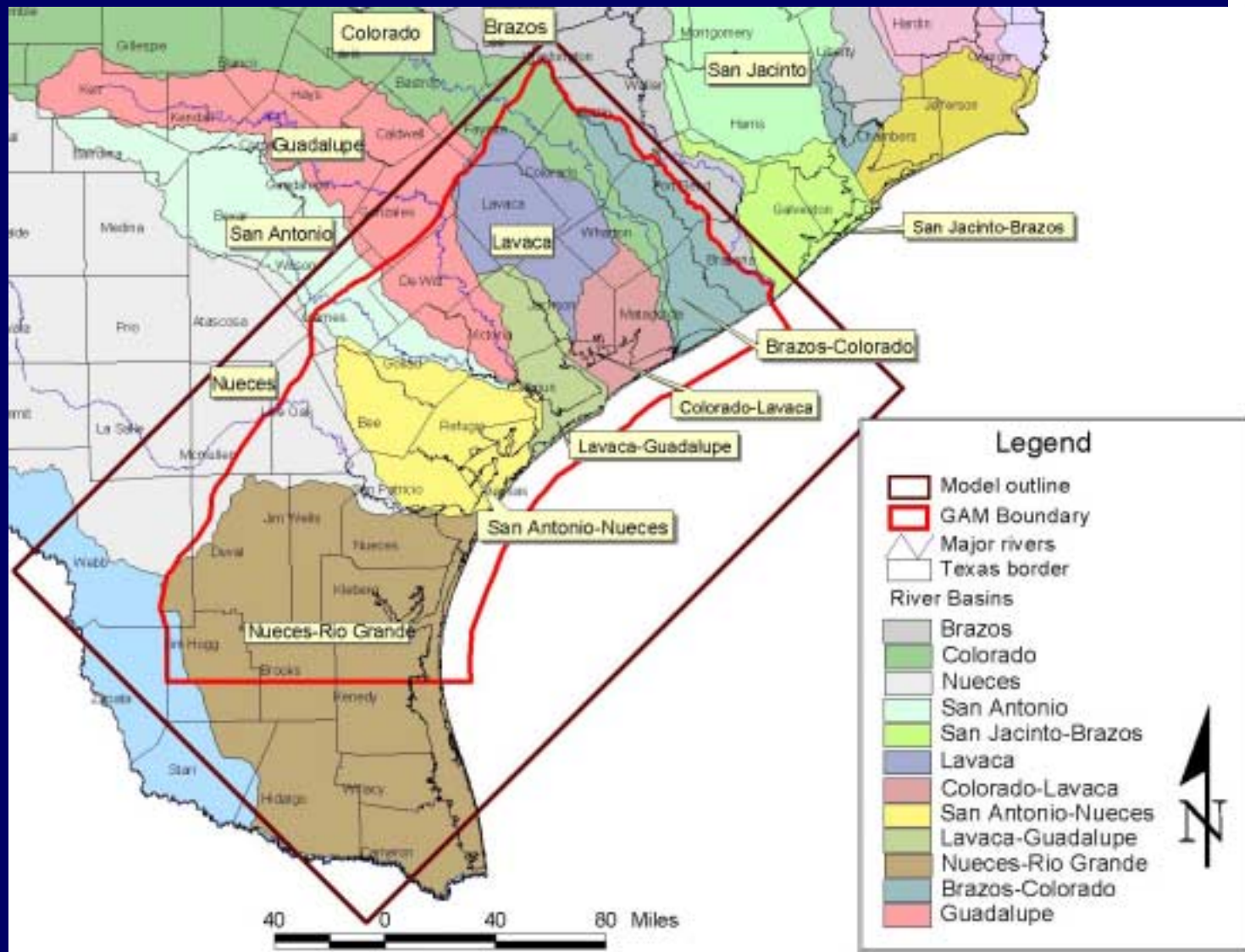




# HSU Structure – Chicot



# Model Grid, GAM Region, and River Basins





# Pumpage by Historical Usage for the period 1980 – 2000



- Conversion of Pumping Distribution into GIS format.
  - Spatial or well location analyses – 80% complete
    - Update point location data with recent TWDB user survey and other information sources.
    - Finalize SOP for irrigation uses: distribution by cell.
  - Vertical analyses – 70 % complete
    - Assign pumpage using flow layer and total depth data.
    - Assign pumpage using well screen and total depth data.





# Pumpage by Historical Usage for the period 1980 – 2000 (cont.)



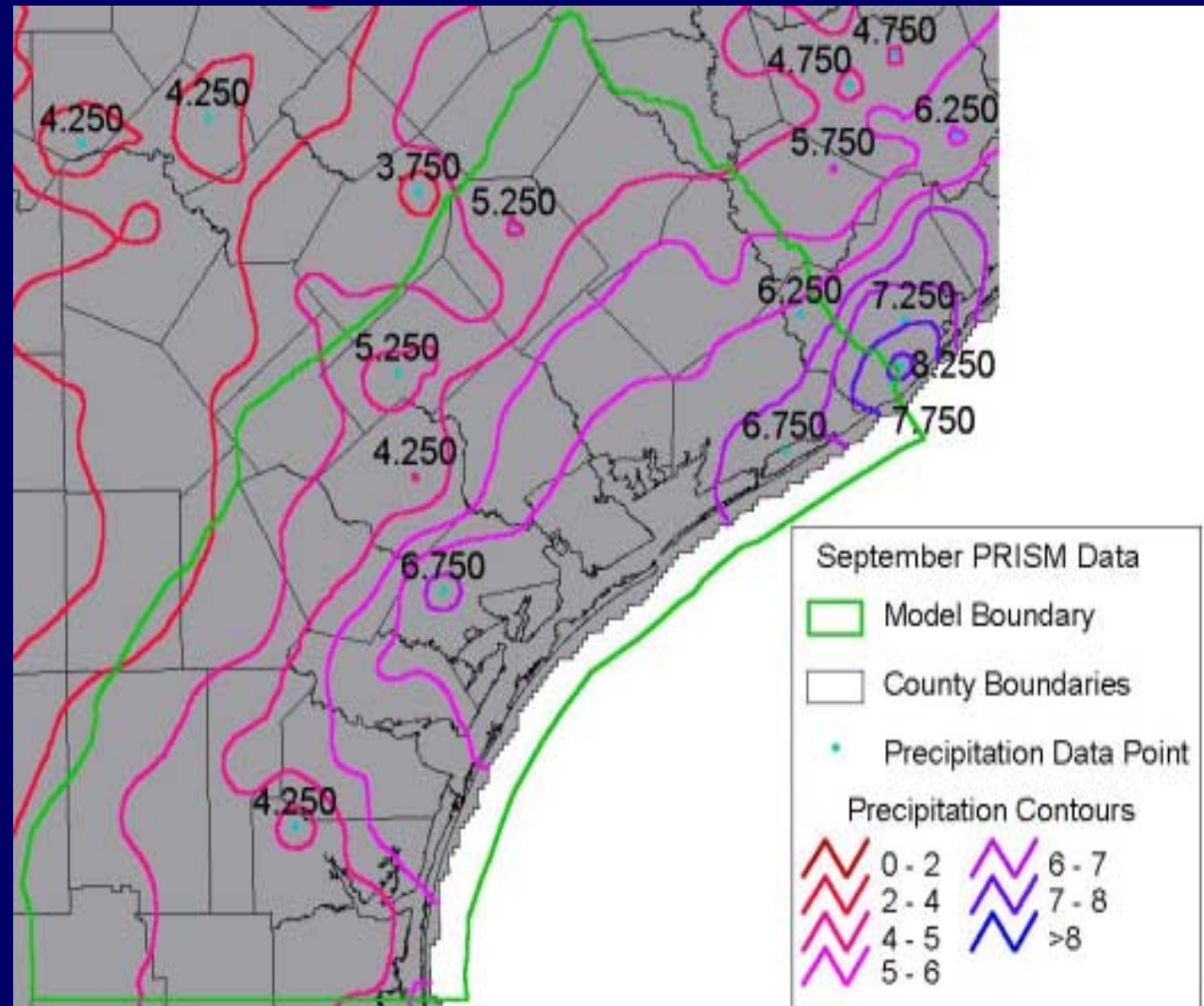
- Temporal analyses - 90% complete
  - Finalize SOP for Texas irrigation uses: use monthly coefficients to distribute annual data.



# Precipitation



- PRISM = Parameter-elevation Regressions on Independent Slopes Model
- Currently have monthly PRISM data for entire year
- Data will be correlated to model grid to provide recharge estimates





# Recharge



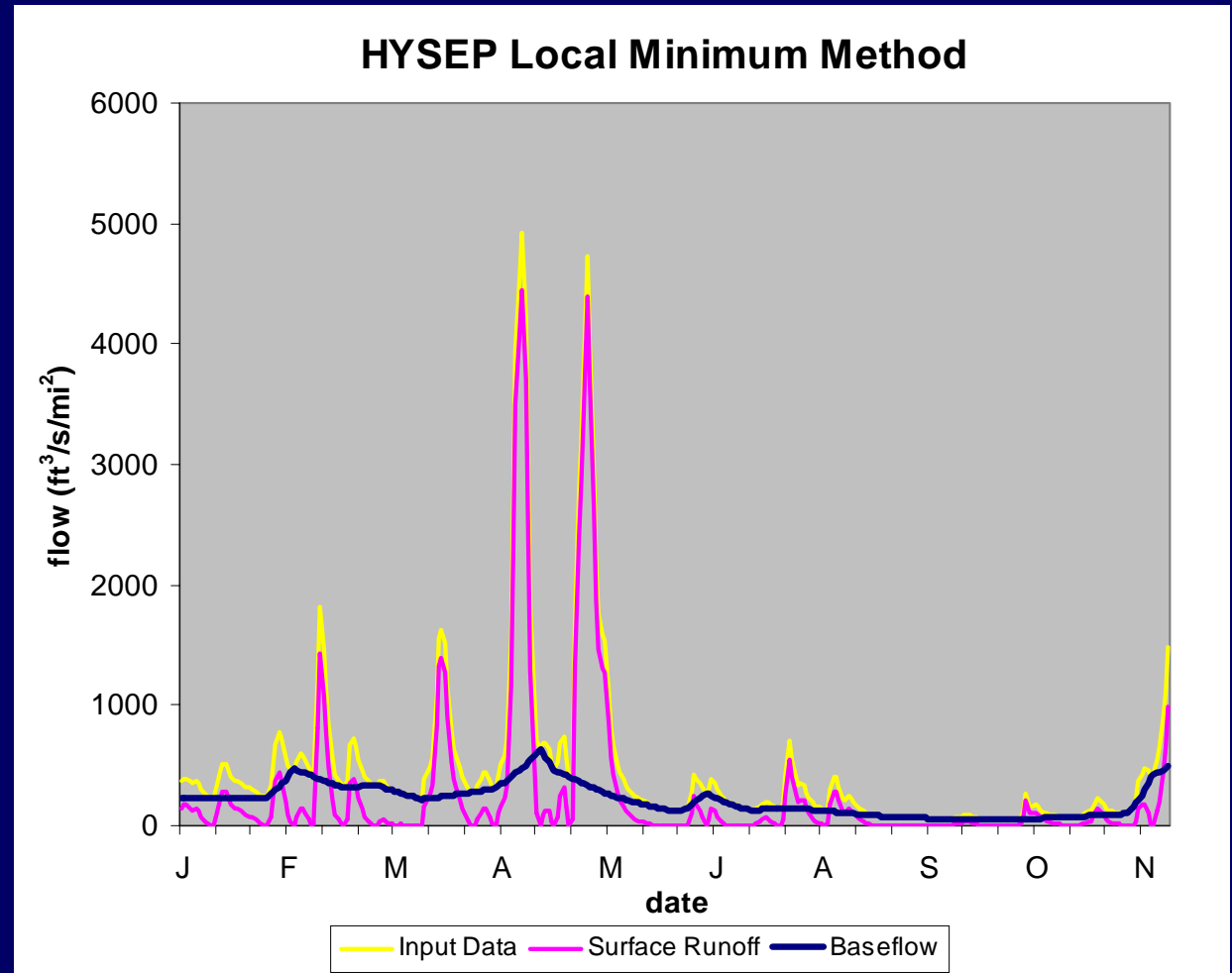
- **SWAT: Soil and Water Assessment**
  - Watershed model developed by Dr. Jeff Arnold of USDA
  - Approach has been tested on watershed for Southern Carrizo-Wilcox GAM
  - Uses land use, soil type, precipitation, and temperature as inputs.
  - Develops spatially distributed recharge values.



# Groundwater / Surface Water Interaction



- HYSEP baseflow separation
- 40 gages within model boundary
- Of these, 17 were usable, unregulated gages
- Flow at many gauges not valid because of large diversion structure.



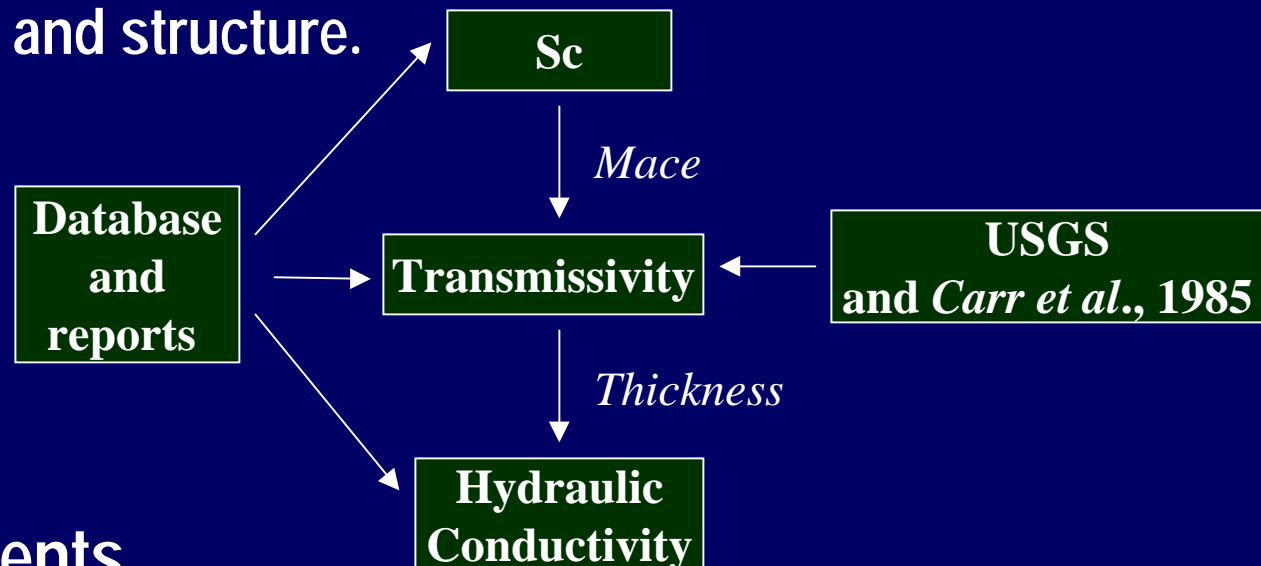


# Hydraulic Properties



- **Transmissivity and Specific Capacity**

- Manual extraction as well as automated database and spatial queries: 90 % complete.
- Transmissivity to Hydraulic Conductivity: synthesis of well-screen intervals, and structure.



- **Storage Coefficients**

- Manual extraction, automated database and spatial queries, cross checked with structure : 20 % complete.



# Water Levels



- Evaluate water-level observation quality and frequency to identify “good” values, potential for capturing seasonal fluctuations and trends.
  - Quality: identifying “good” values.
    - Nearest neighbor analysis to rank wells according to
      - ◆ Water levels (completed).
      - ◆ Well depth.
    - Multi-aquifer observations? Cross checking screen interval with structure.
  - Frequency: do observations provide good seasonal fluctuation and trend targets?
    - Temporal frequency of acceptable observations.



## Planned for Next SAF



- Preparation of initial input data sets for MODFLOW
- Initial model calibration to pre-development water levels

**CENTRAL GULF COAST GAM STAKEHOLDERS ATTENDENCE LIST**  
**Stakeholders Advisory Forum #3**  
**Held**  
**November 8, 2001 in Bay City, Texas**

Name	Affiliation
Larry H. Akers	Evergreen U.W.C.D.
Gil Barth	Waterstone
Jerry Boettcher	Private
Karen Dodson	Consultant (A&M Corpus Christi)
L.P. Gwin	Private
Ronald Gertson	Region K member
Kay Harold	Private
Jeff Irvin	URS
Billy Mann	Matagorda Co. Groundwater District
Charles Martinez	Bay City Mayor (Region K member)
Dan McClanahan	Private
David Meesey	TWDB
Steve Musick	TNRCC
Joy Mygrants	Matagorda Advocate
Ben Parnes	X Private
Bob Pickens	Post Oak G.C.D.
John Pickens	Waterstone Project Team
L.G. Raun	Region P member (Wharton Co. GCD)
Cindy Ridgeway	TWDB
A.A. Rodgers (RED)	Jackson Co. G.C.D.
Haskell Simon	Matagorda G.C.D.
Helen Sneary	Former Matagorda Co. Judge's wife
Harrison Stafford II	Jackson County Judge (Region P member)
Lonnie Stewart	Live Oak U.W.C.D.
Mike Thuss	Parsons Engr.
Greg Westmoreland	Matagorda Co. Judge
	X = Unable to confidently decipher name



**Questions/Responses/Discussion from  
Third Stakeholder Advisory Forum  
Central Gulf Coast GAM  
held  
November 8, 2001  
Bay City Civic Center**

1. Can you show the location of the Catahoula wells?

Response: The Catahoula well locations are shown on a later slide regarding Jasper Updip Limit Reconciliation.

2. Discussion (Haskell Simon): The Gulf Coast region is being analyzed in three models with overlap. Many stakeholders were initially concerned about boundary conditions, therefore the TWDB extended the overlap for the Northern and Central models (now the Central model's northern boundary extends to Brazoria County for a better coverage of Matagorda County).

3. What is the depth of the Jasper in Matagorda County?

Response: The base of the Jasper is at about 5,000 ft depth. The elevation of the base of the Jasper is shown in one of the presentation slides.

4. Isn't the Jasper too deep in Jackson County to use?

Response: Most of the Jasper wells are located in the outcrop area. Due to the depth and principally the water quality, the Jasper is not likely a useful water source in Jackson County and the immediate area. Later audience discussion: (Haskell: Chicot and Evangeline are more shallow and therefore more feasible to use).

5. By outcrop you mean recharge area?

Response: Yes.

6. Isn't the Gulf Coast aquifer mainly sands and not "honey-combed" limestone?

Response: Yes, the Gulf Coast is mainly fluvial-type deposits. Audience discussion: the "layers" are not like a blanket and are not necessarily continuous.

7. Open discussion on irrigation demands and how irrigation will be portrayed in the model. Discussion included:

- Be careful, driller logs for irrigation wells are screened differently. Wharton County is 95% rice farming and wells are slotted at 900 ft in both the Chicot and Evangeline.

- Discuss using wells versus irrigation surveys. Both methods have been considered, however since the well inventory for irrigation is not complete, using the survey was considered a viable alternative. Land use will be used to assign the irrigation pumpage.

8. Will poor irrigation data be important?

Response: Yes, but we are attempting to use the best information and scientific approach available to estimate the irrigation pumpage quantities and distribute it both areally and vertically.

9. Define aquifer. Can there be multiple sands? Are you considering wells below 600 feet?

Response: An aquifer is a saturated permeable geologic unit that can produce adequate quantities of water when pumped. It is usually delineated using geologic interpretations and other scientific observations and tests. Multiple sands exist. Layers may consist of both sands and clays. Some wells are shallower than 600 feet. The model will use a lumped average to represent the layer (one layer for each of the Chicot, Evangeline, Burkeville, and Jasper aquifers). The model will allow water withdrawals from the "layer"- not at specified and/or various depths within the aquifer layer.

10. If the database has more wells in Wharton County, does that make the model more accurate in this area?

Response: It depends on the distribution and quality of the data. The model is based on 1 square mile grid blocks to represent properties.

11. Is all the data from the Texas Water Development Board or is TNRCC data being considered?

Response: Per Steve Musick (TNRCC) - the TNRCC data has not had location/depth verified. TWDB data is still a preferred source. Both TWDB data and data added from other literature sources is being used.

12. By using "survey plots" [to distribute irrigation], do you risk a conservative estimate of domestic use?

Response: All uses will be compiled for the grid. Therefore if the grid contains multiple uses [county-other, irrigation, etc] they will be developed individually and then combined into one withdrawal value for that 1 square mile grid.

13. Are we using data from the Texas A&M weather station in Jackson County?

Response: Collection and evaluation of this type of data is still underway. We will check whether data from this station is included.

14. What is a "good" water level in database?

Response: One that is not suspicious, i.e., depth, screen interval, elevation are consistent.

15. Are you concentrating on a particular size of well? 98% of Jackson County wells are irrigation and only 2% are municipal.

Response: No, wells include observation and municipal pumping. There is no restriction to size. Since assignment of irrigation is based on a landuse survey, well size does not matter. We are attempting to capture all pumping stresses.

16. What about the problem with water pollution and industrial waste?

Response: Steve Musick responded: Disposal not allowed unless the water in the formation is greater than 10,000 ppm TDS and access to the sensitive portions of the aquifer is cased. Oil and gas wells have their own rules and restrictions.

17. If heavy pumping begins to occur in the recharge area up dip in Colorado County will the model predict any impacts in Wharton County?

Response: Yes.

18. Who will be the "keeper" of the model? What is the hierarchy?

Response: TWDB is the "keeper". Districts should cooperate and share data [both with TWDB, other GCDs, and the RWPGs]. TWDB will maintain the regional models as better data becomes available.

19. How will TWDB avoid duplicate requests/work [as it relates to model runs]?

Response: This is still under development. Initial discussions suggest creating a TWDB website page for each of the models that lists the model run requests, when they were requested, by whom, and when they were completed.

20. How will you address recharge? Is soil type the main parameter in the SWAT model? Does it consider soil horizons?

Response: Precipitation and streams are potential recharge sources. We will use the Soil and Water Assessment (SWAT) model to develop physically based estimates of recharge based on precipitation, land use, soil type, and antecedent moisture conditions.

21. Newly formed Groundwater Conservation Districts (GCD) are required to develop a groundwater management plan. When will the GAM model be available?

Response: The GAM will be completed in January 2003. Additional questions relating to groundwater management plans should be referred to Randy Williams (512-936-0879) or Rima Petrossian (512- 936-2420) at the TWDB.

22. The GCD in Wharton County feels comfortable with understanding groundwater use, but not with estimating the supply. What should they do prior to the release of the model?

Response: Suggest meeting with the appropriate RPWG(s).

23. Will the model be able to show overdrafts, subsidence, and salt water intrusions?

Response: This version will not show subsidence or water quality movements.

24. How soon does pumpage or precipitation events in the recharge zone appear in Matagorda County?

Response: The model will not track particle movements but will be able to show temporal water level changes. The model will use time stepping of 1 month to 1 year and therefore individual events may not be discernible. Audience discussion: We already know part of the answer. Our wells recover before the next growing season.

25. Does large pumpage in the lower part of the aquifer impact water levels in the recharge zone? If you overproduce the Chicot, can it impact the Evangeline in the outcrop area?

Response: Yes it could.

26. Is the confining unit between the Jasper and Evangeline [Burkeville] a good confining unit?

Response: It depends where you are. There are producing wells in the Burkeville in and near the outcrop. Further downdip where it is deeper, the Burkeville likely acts more like a confining unit.