

Northern Segment of the Edwards (Balcones Fault Zone) and Associated Trinity Aquifers: Conceptual Model

Stakeholder Advisory Forum #2

August 4, 2020

Ian C. Jones, Ph.D., P.G.



Outline

- Introduction
- Basics of groundwater flow
- Groundwater modeling
- Overview of Northern Segment of the Edwards (Balcones Fault Zone) Aquifer and associated Trinity Aquifer
- Project schedule

INTRODUCTION



Groundwater Availability Modeling Program

- **Aim:** Develop groundwater flow models for the major and minor aquifer 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.

How we use Groundwater Availability Models

- Uses required by statute
 - Provide groundwater conservation districts with water budget data for their management plans.
 - Calculating Modeled Available Groundwater.
 - Calculating Total Estimated Recoverable Storage
 - HB 1232 Texas aquifer study
 - HB 30 potential brackish groundwater production area determination
- Other uses
 - Assisting groundwater management areas in determining desired future conditions.

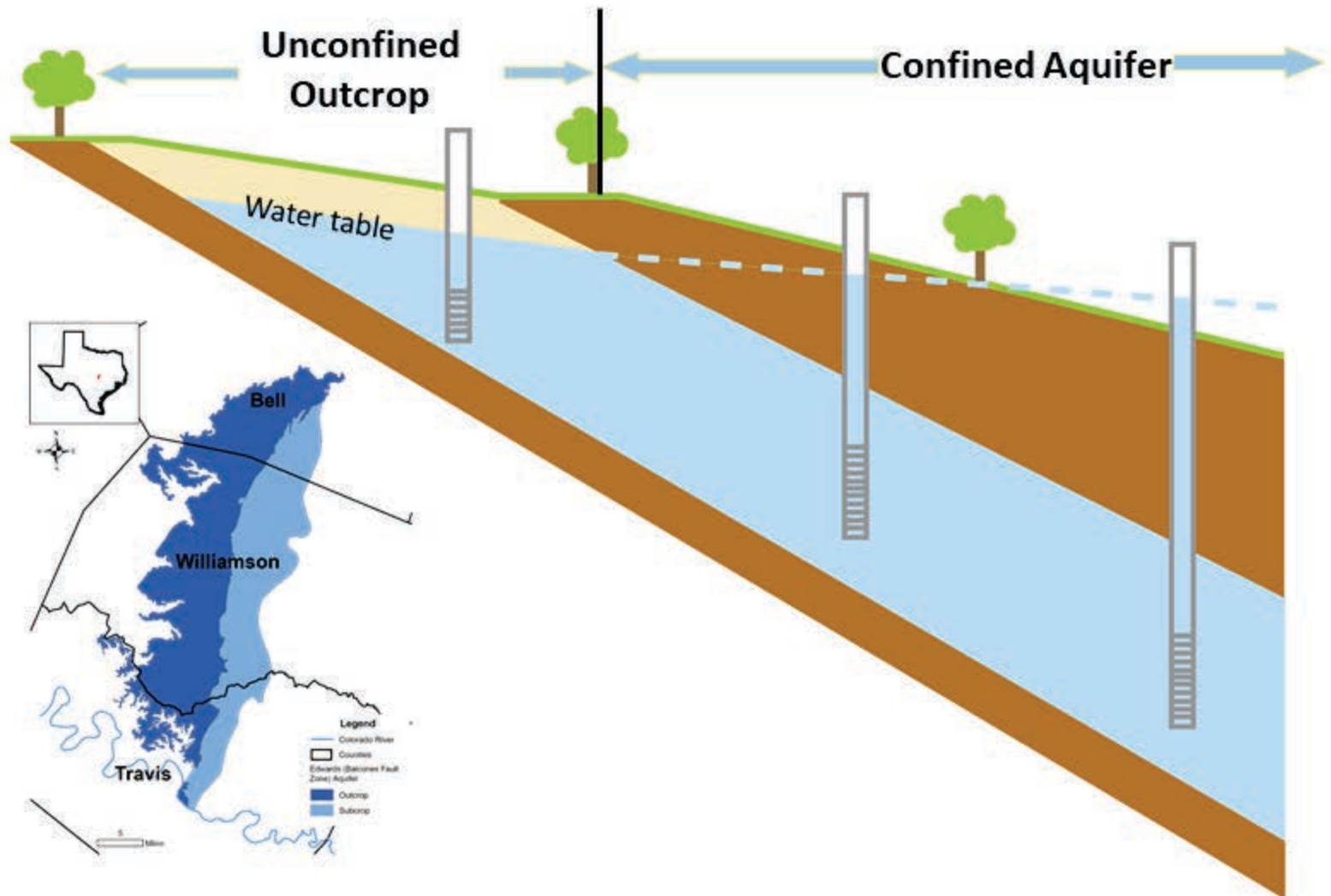
Stakeholder Advisory Forums

- 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

BASICS OF GROUNDWATER FLOW



Confined/Unconfined Aquifer



GROUNDWATER MODELING



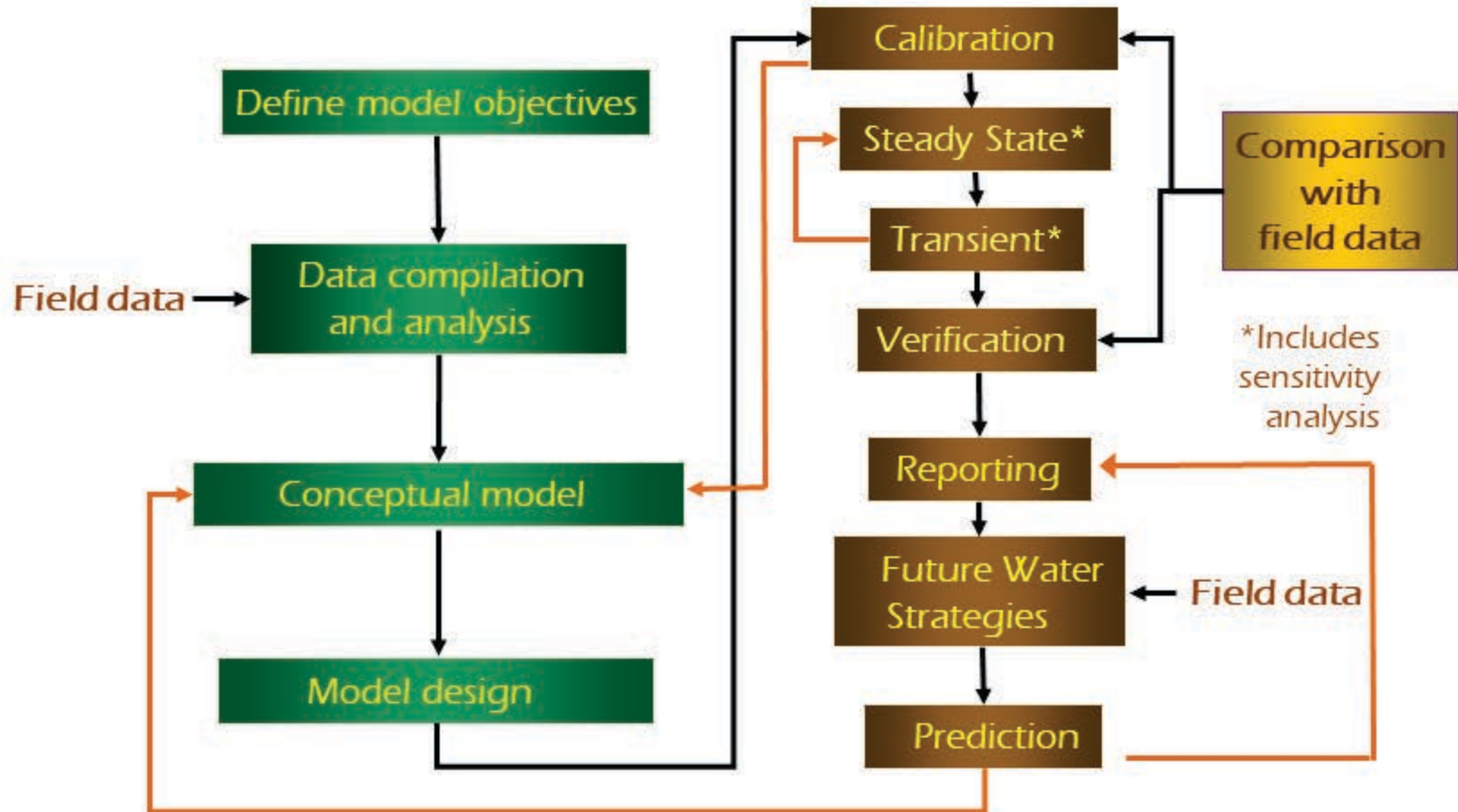
Definition

- A mathematical device that represents an approximation of an aquifer (*The Compendium of Hydrogeology*)
- Simulation of groundwater flow by means of a governing equation used to represent the physical processes that occur in the aquifer, together with equations that describe heads or flows along the boundaries of the model (*Anderson and Woessner, 2002*)

Why Groundwater Flow Models?

- In contrast to surface water, groundwater flow is difficult to observe
- Aquifers are typically complex in terms of spatial extent and hydrogeological characteristics
- A groundwater model provides the only means for integrating available data for the prediction of groundwater flow at the scale of interest

Modeling Process

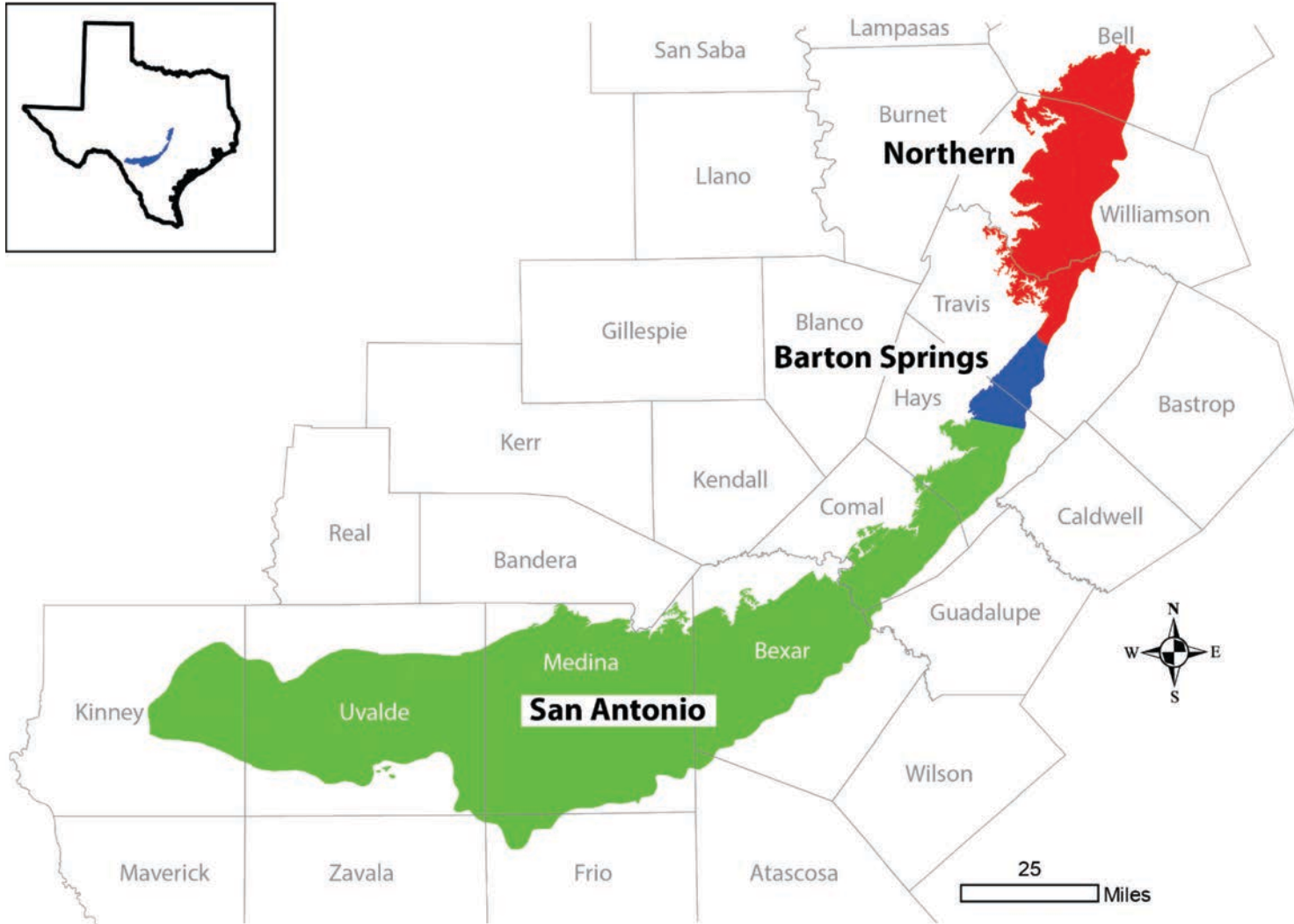


NORTHERN SEGMENT OF THE EDWARDS (BALCONES FAULT ZONE) AQUIFER

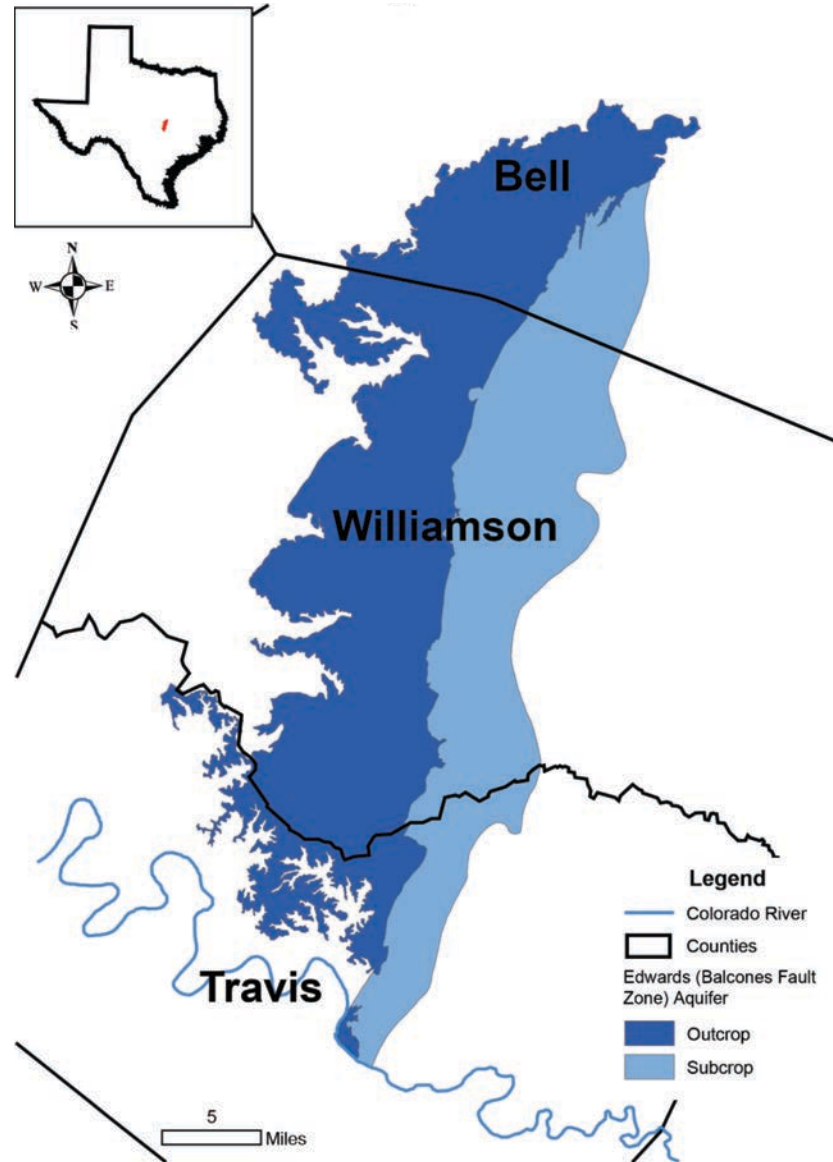


Study Area

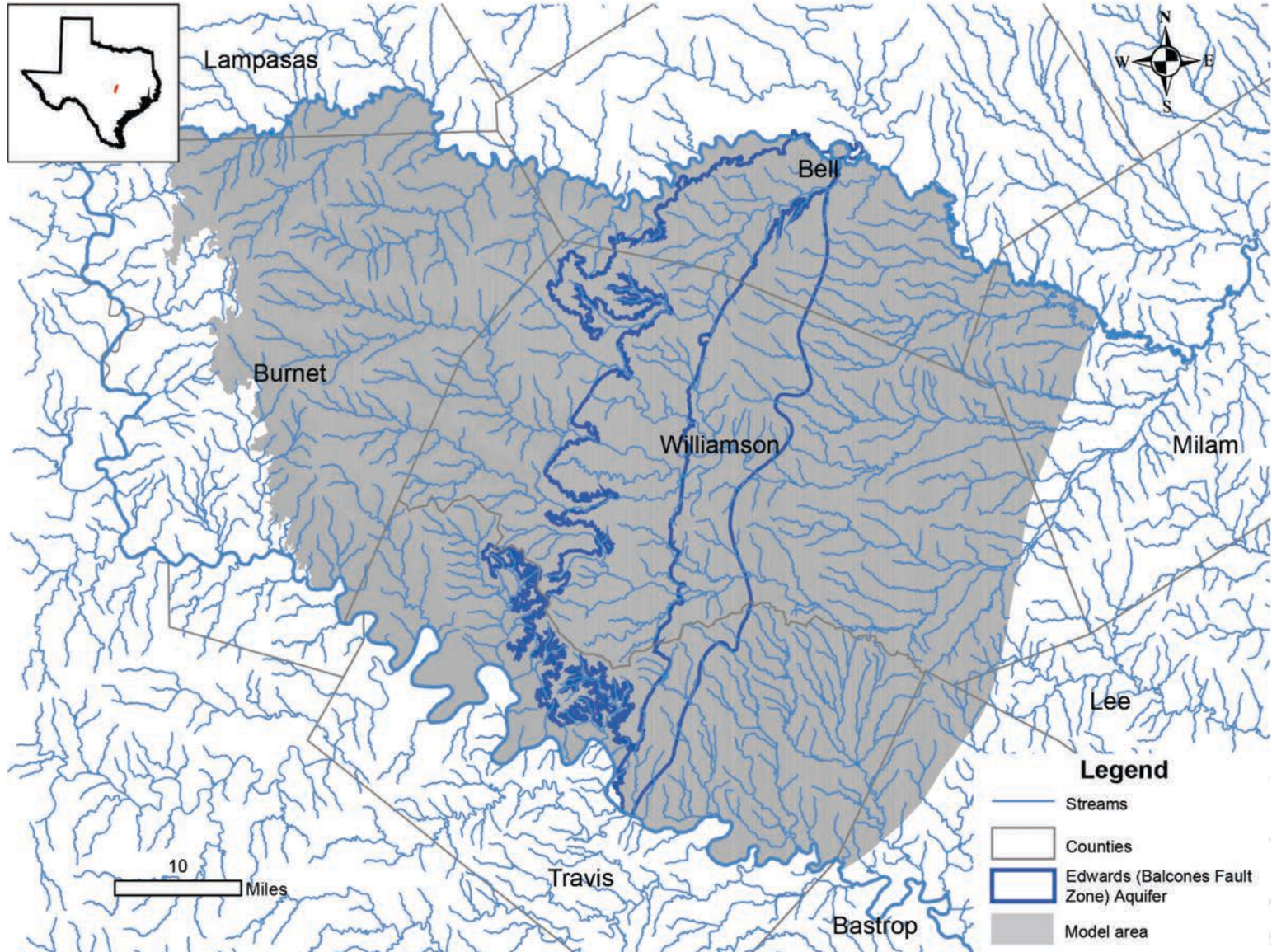
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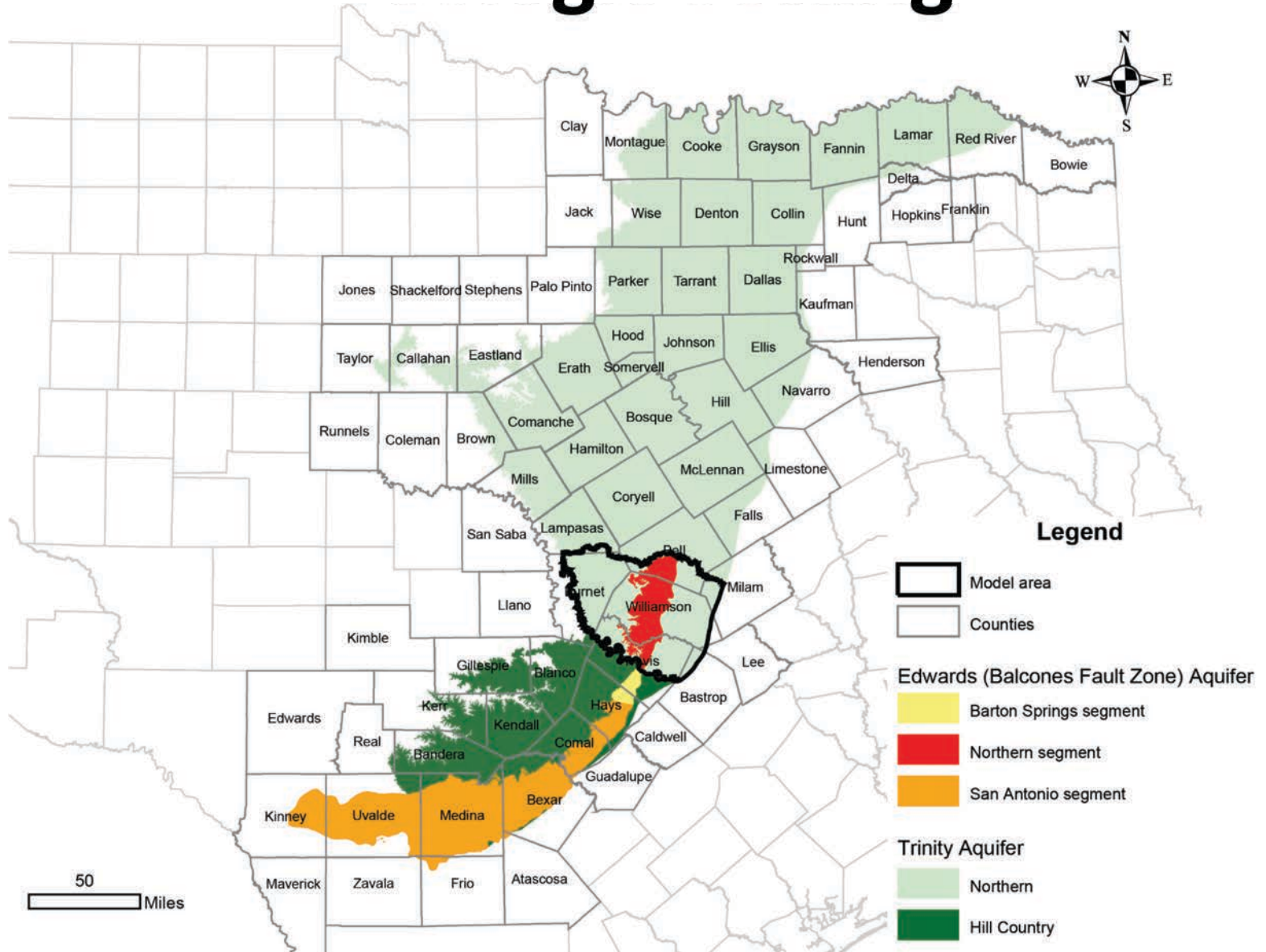
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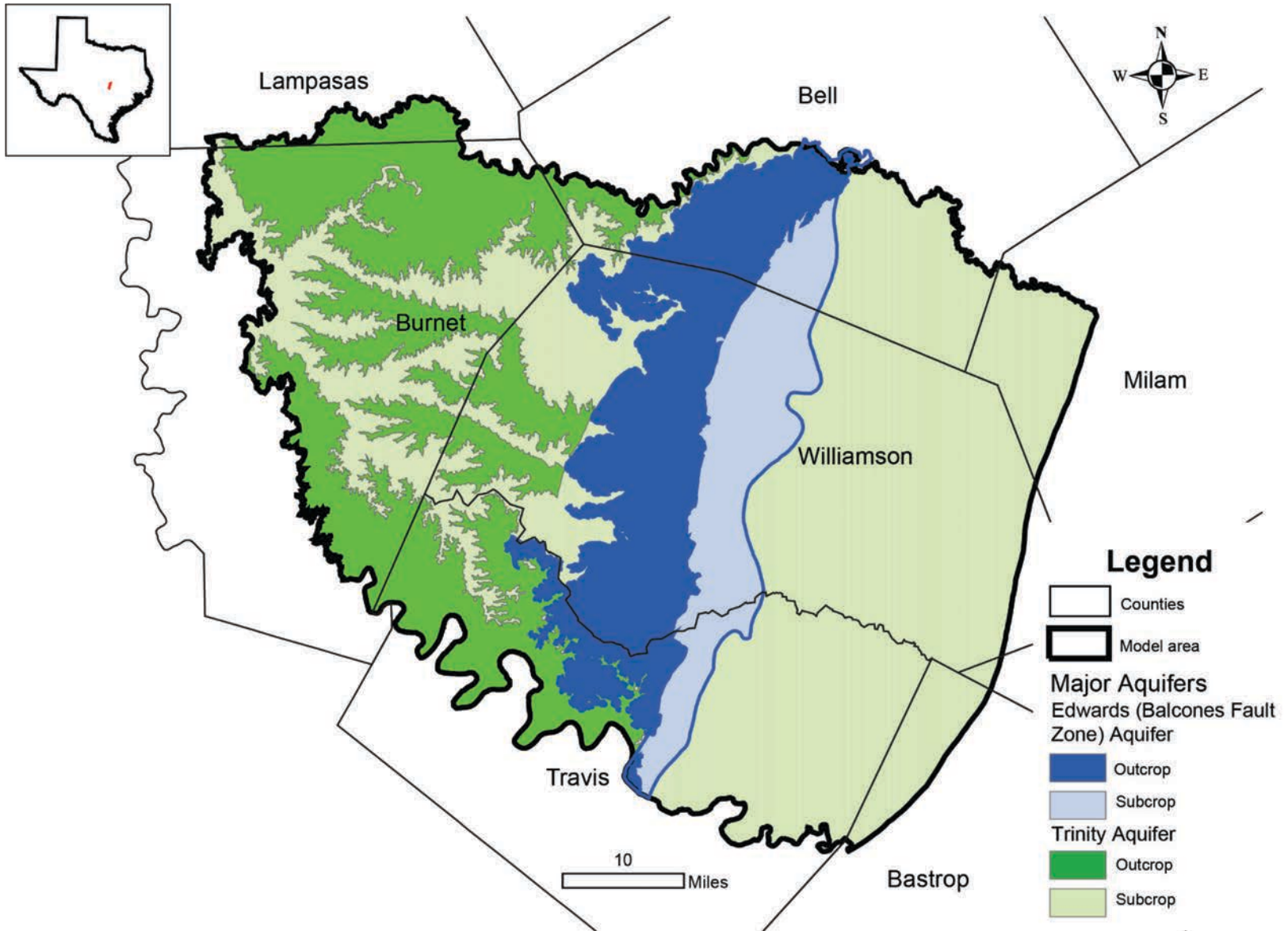
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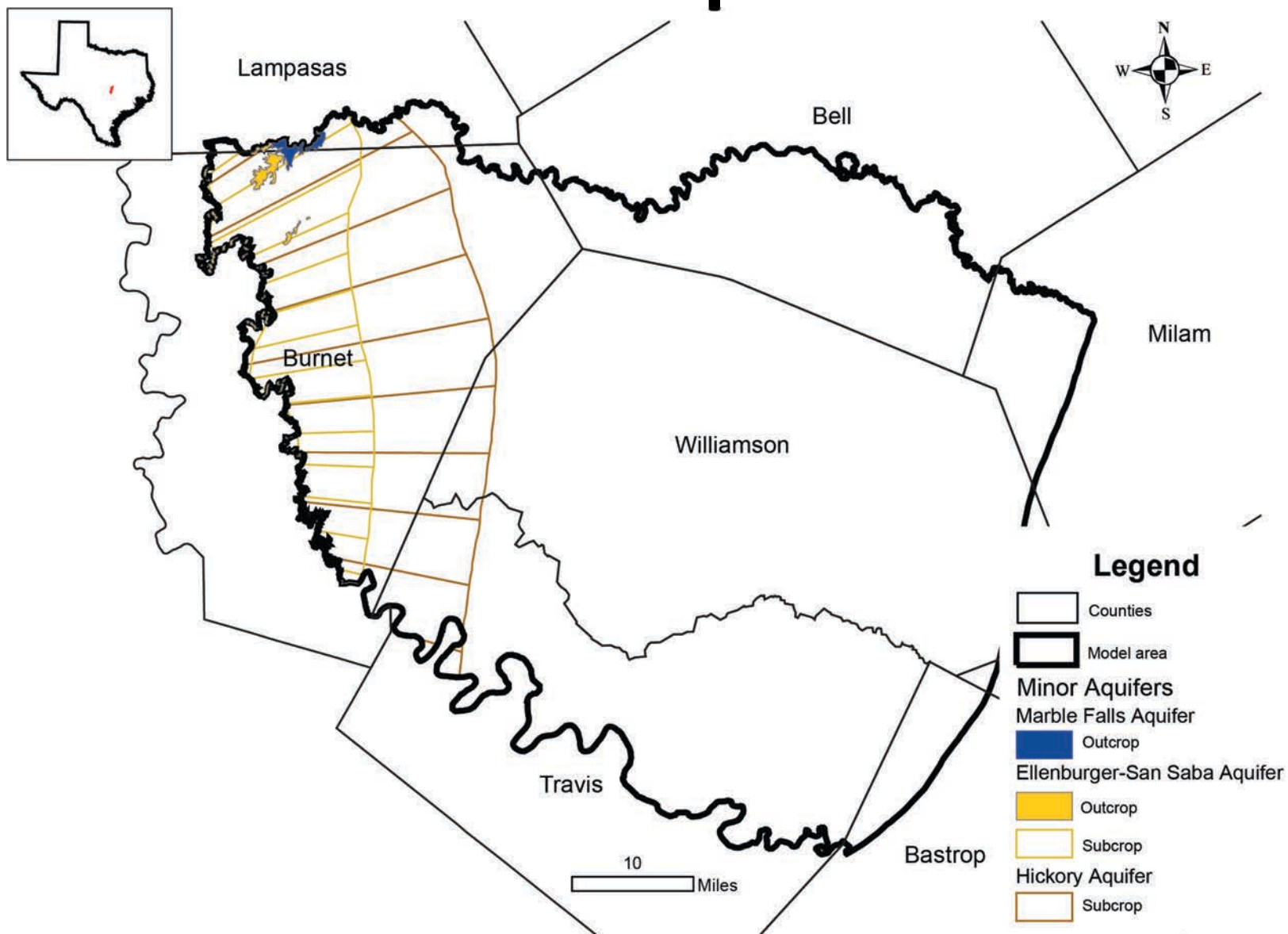
Geologic Setting



Major Aquifers

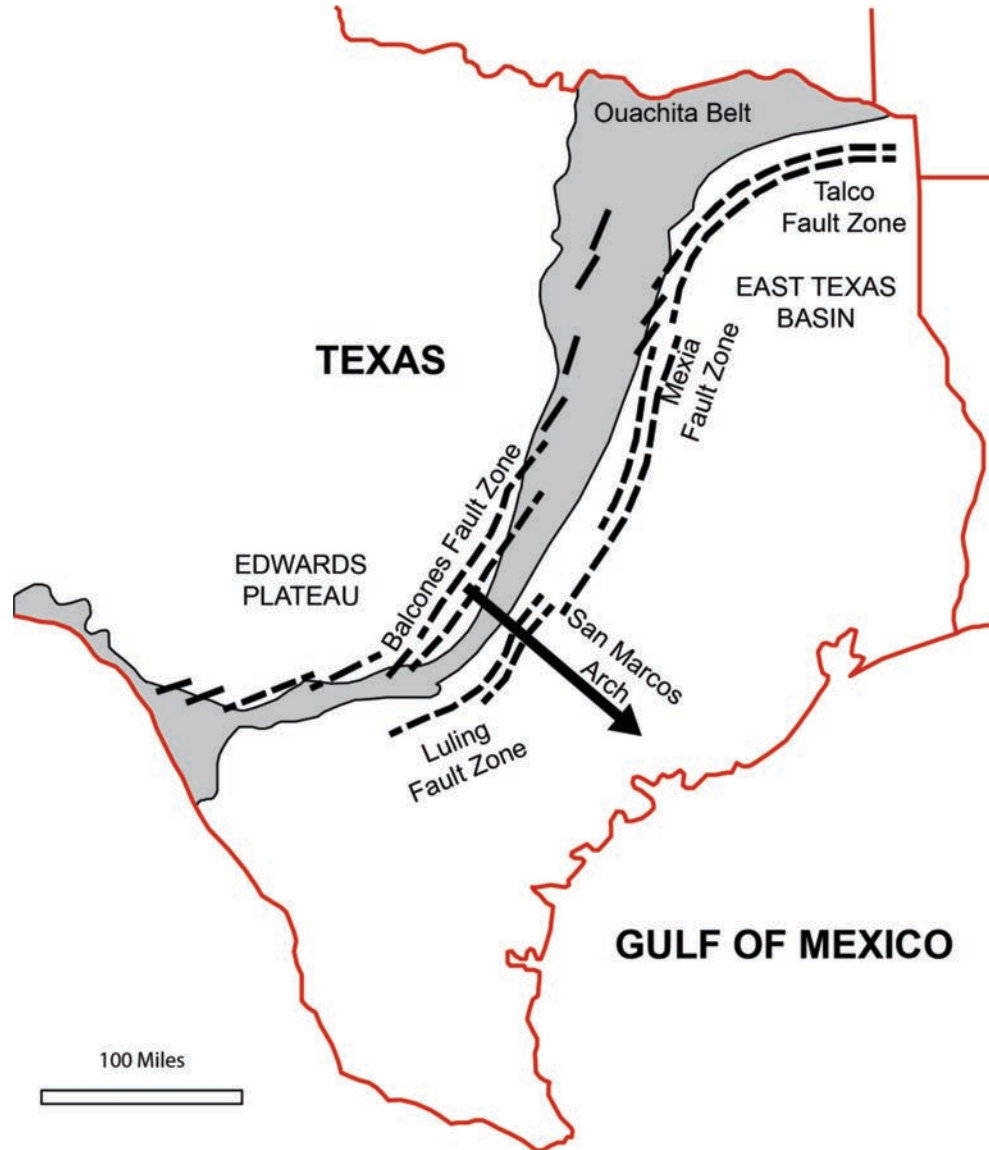


Minor Aquifers

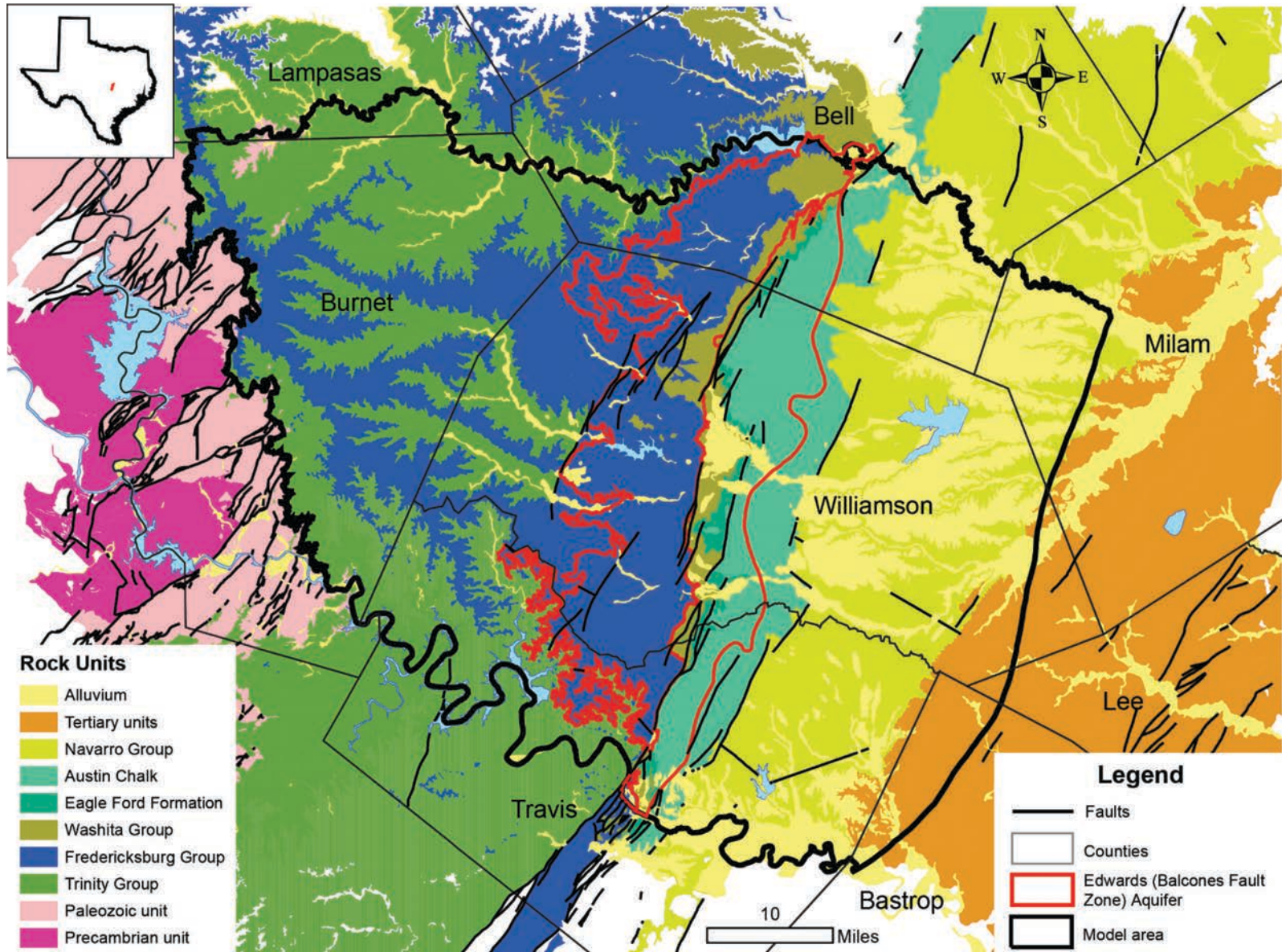


Geology

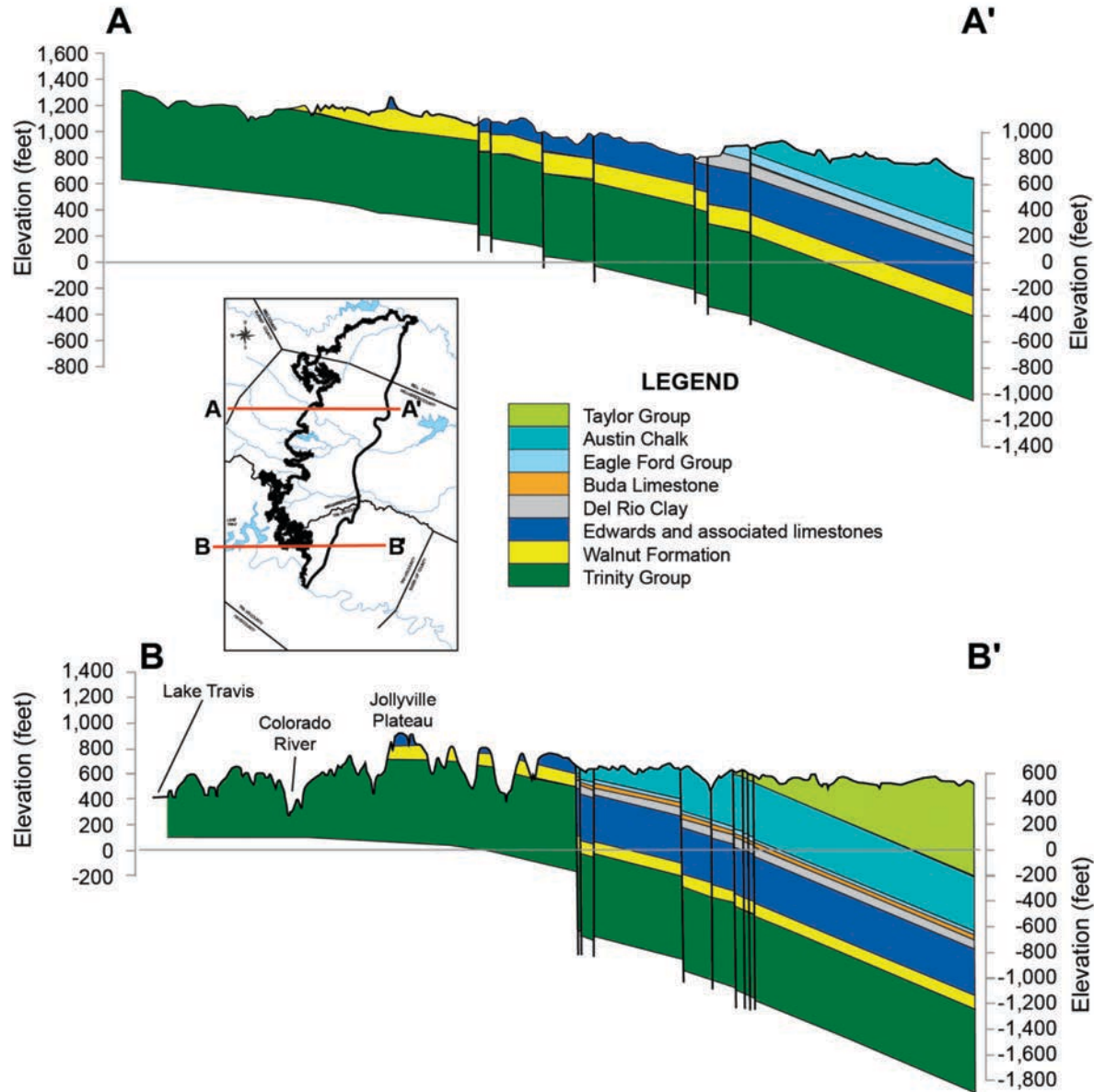
Geologic Setting



Surface Geology

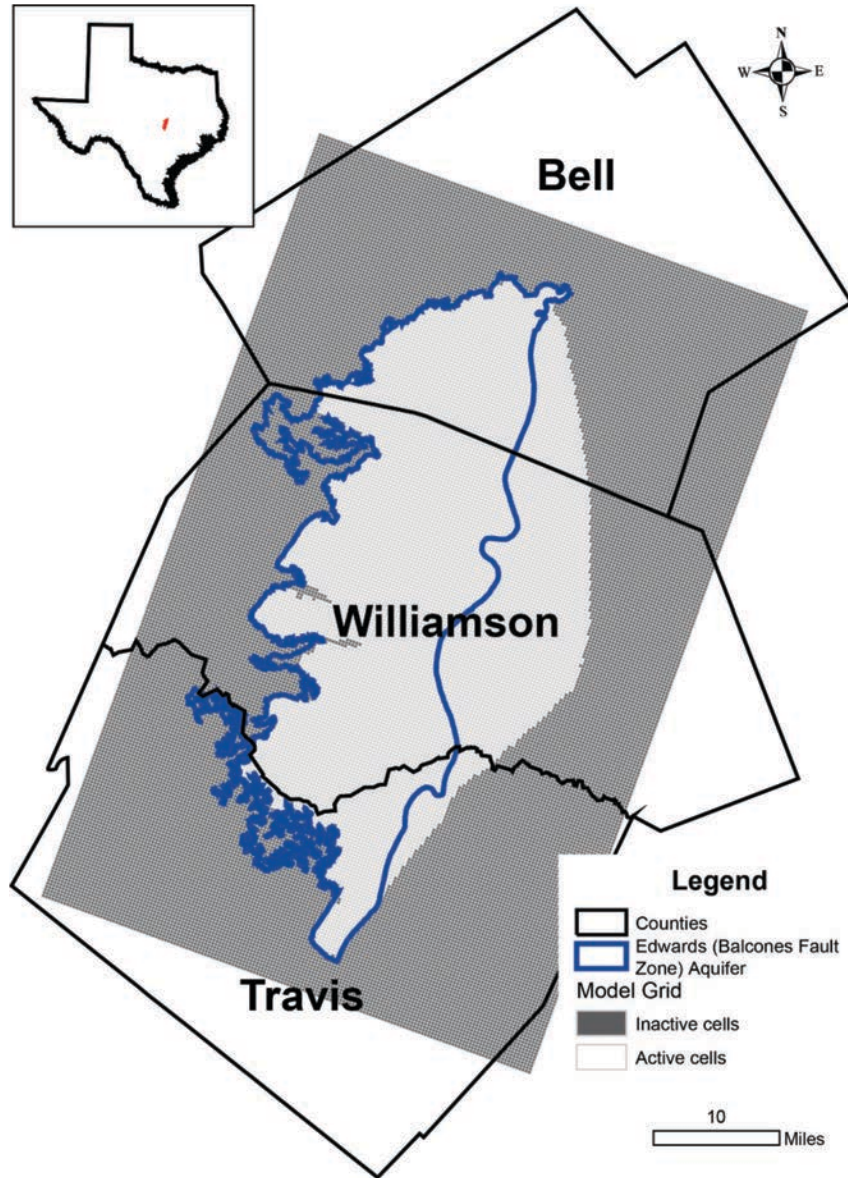


Cross Sections



Previous Work

Previous Model

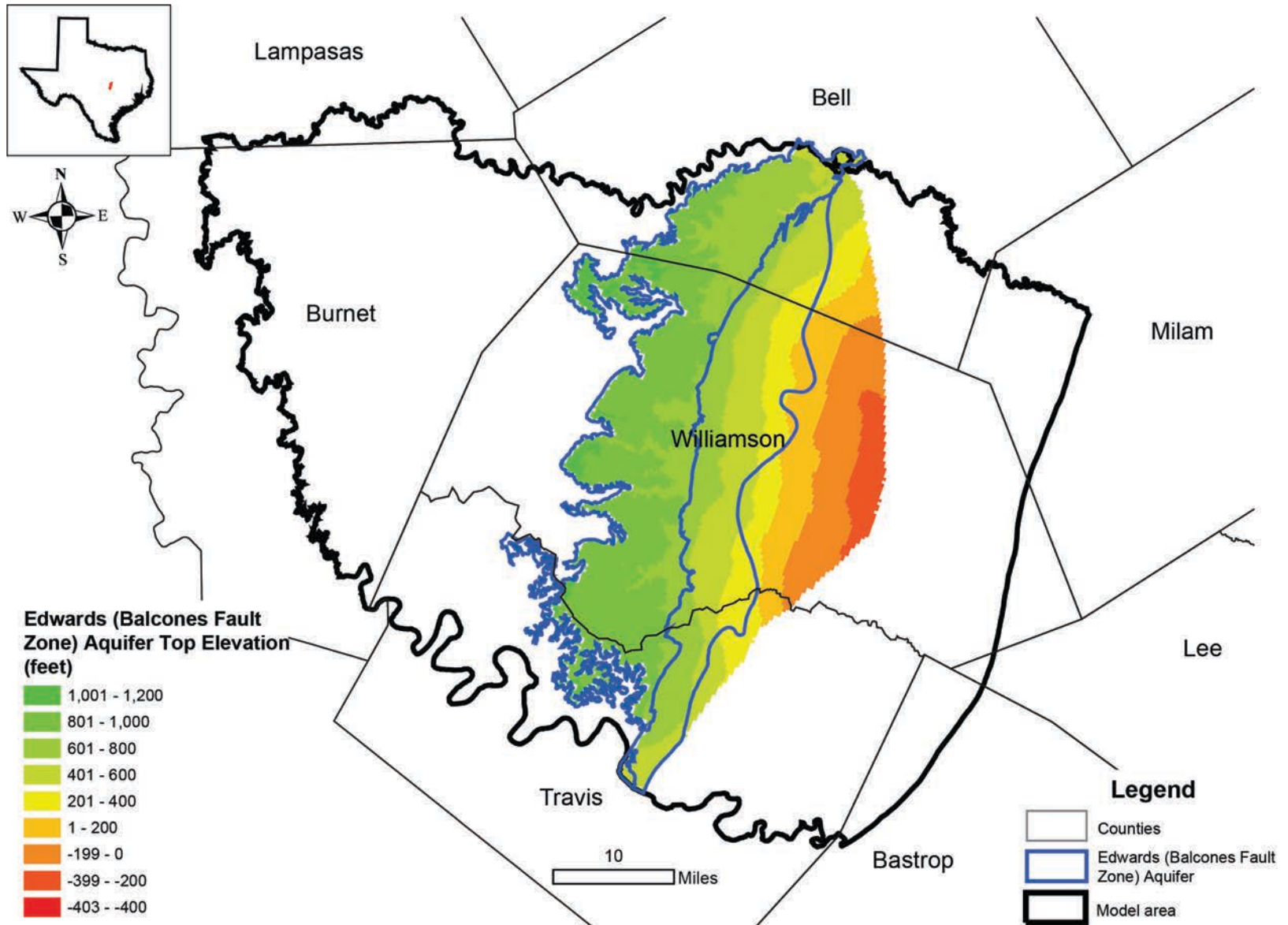


Hydrostratigraphy

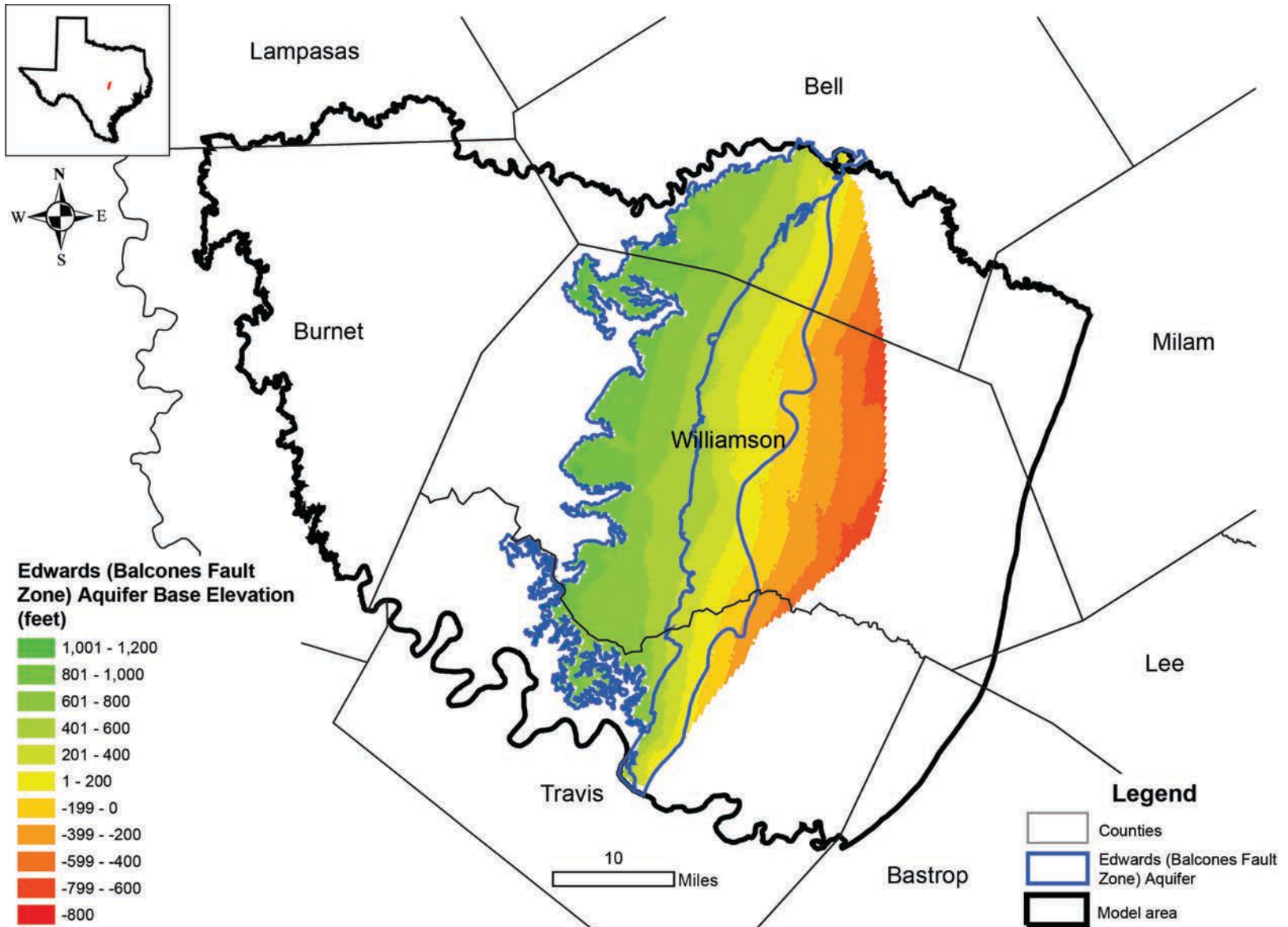
Hydrostratigraphic Column

Era	System	Age	Group	Stratigraphic Unit	Hydrologic Unit	Model Layer
Mesozoic	Cretaceous	Campanian	Navarro	Navarro and Taylor Group	Confining unit	
			Taylor			
		Coniacian	Austin	Austin Chalk		
		Turonian	Eagle Ford			
		Cenomanian	Washita	Buda Limestone		
				Del Rio Clay		
				Georgetown Formation	Edwards (Balcones Fault Zone) Aquifer	1
		Fredericksburg	Edwards Limestone			
		Albian	Fredericksburg	Comanche Peak Limestone		
				Walnut Formation	Confining unit	2
		Aptian	Trinity	Paluxy Formation	Upper Trinity Aquifer	3
				Glen Rose	Lower Member	
				Travis Peak	Hensell Sand Member	
					Cow Cr. Limestone Member	
					Hammett Shale Member	
Sligo Member	Lower Trinity Aquifer					
Hosston Member						
Pre-Aptian						

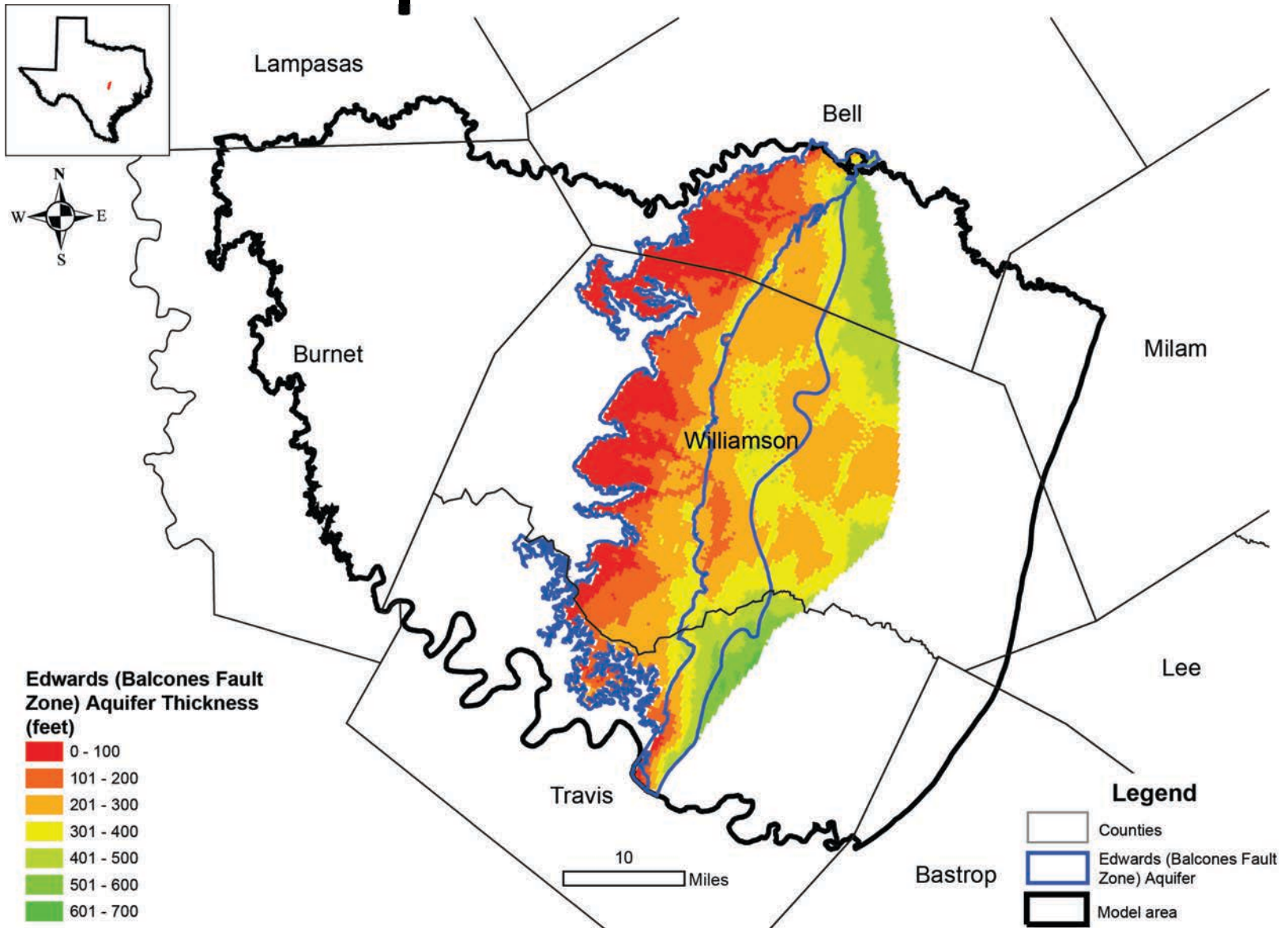
Aquifer Top



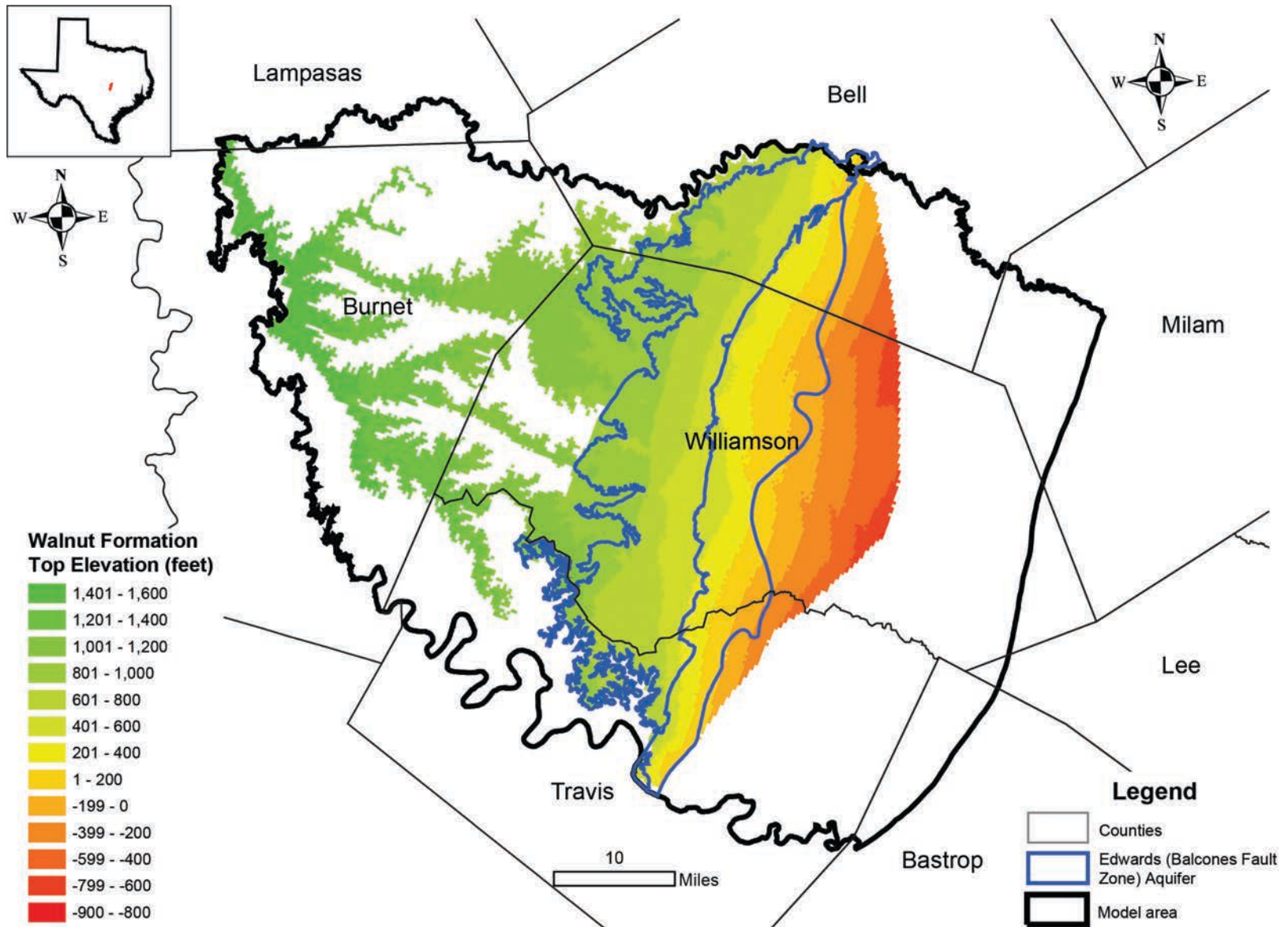
Aquifer Base



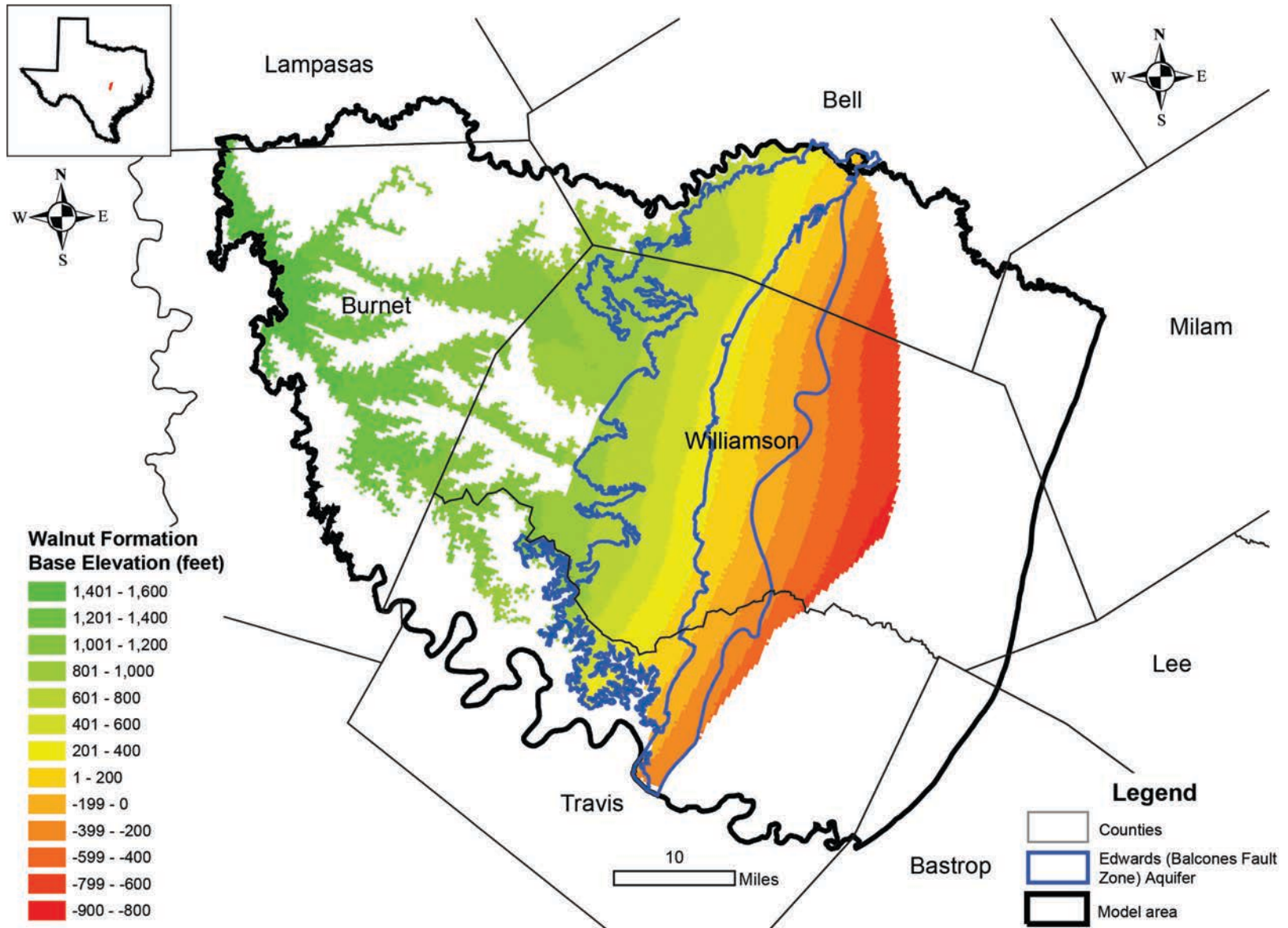
Aquifer Thickness



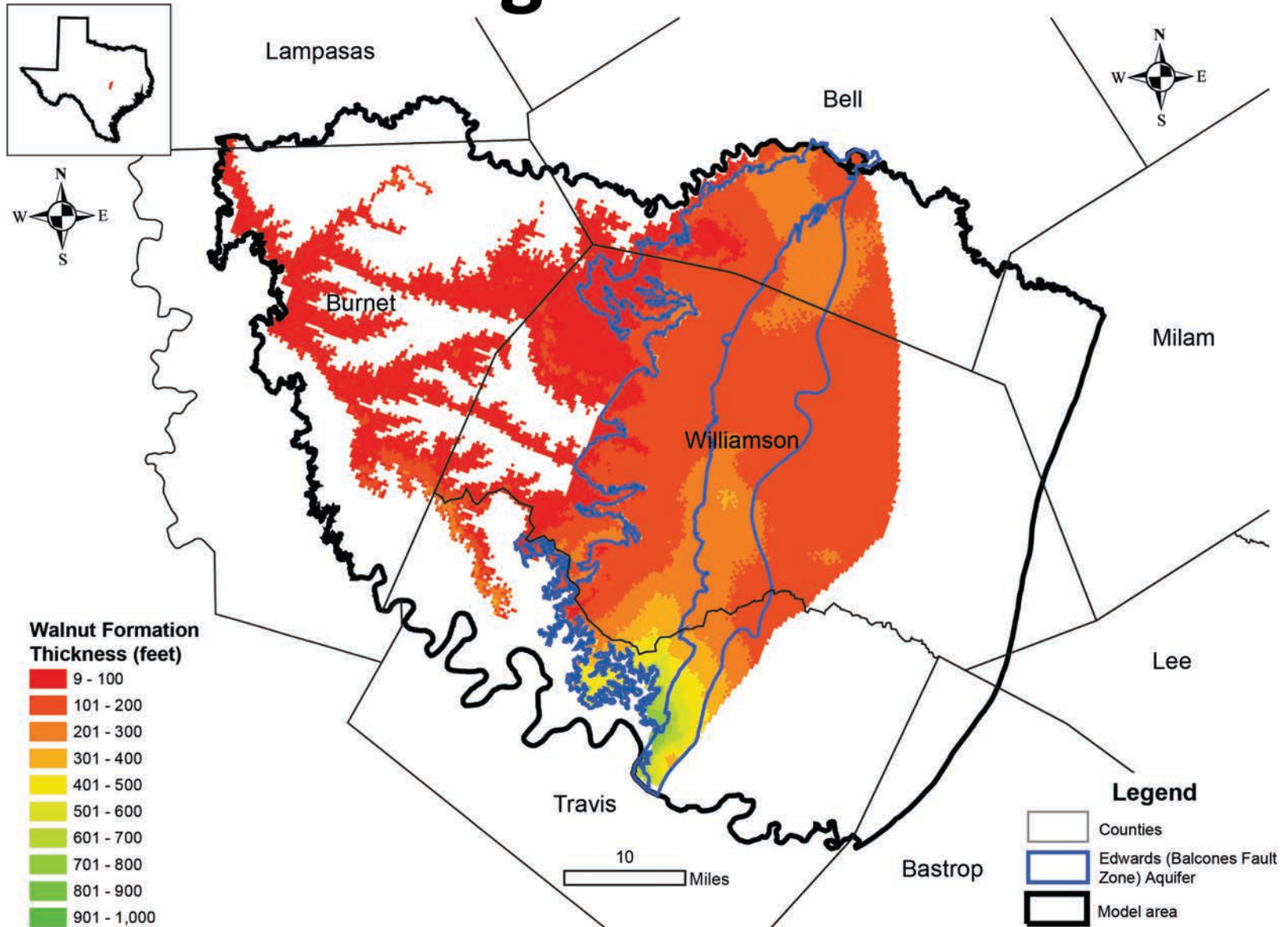
Confining Unit Top



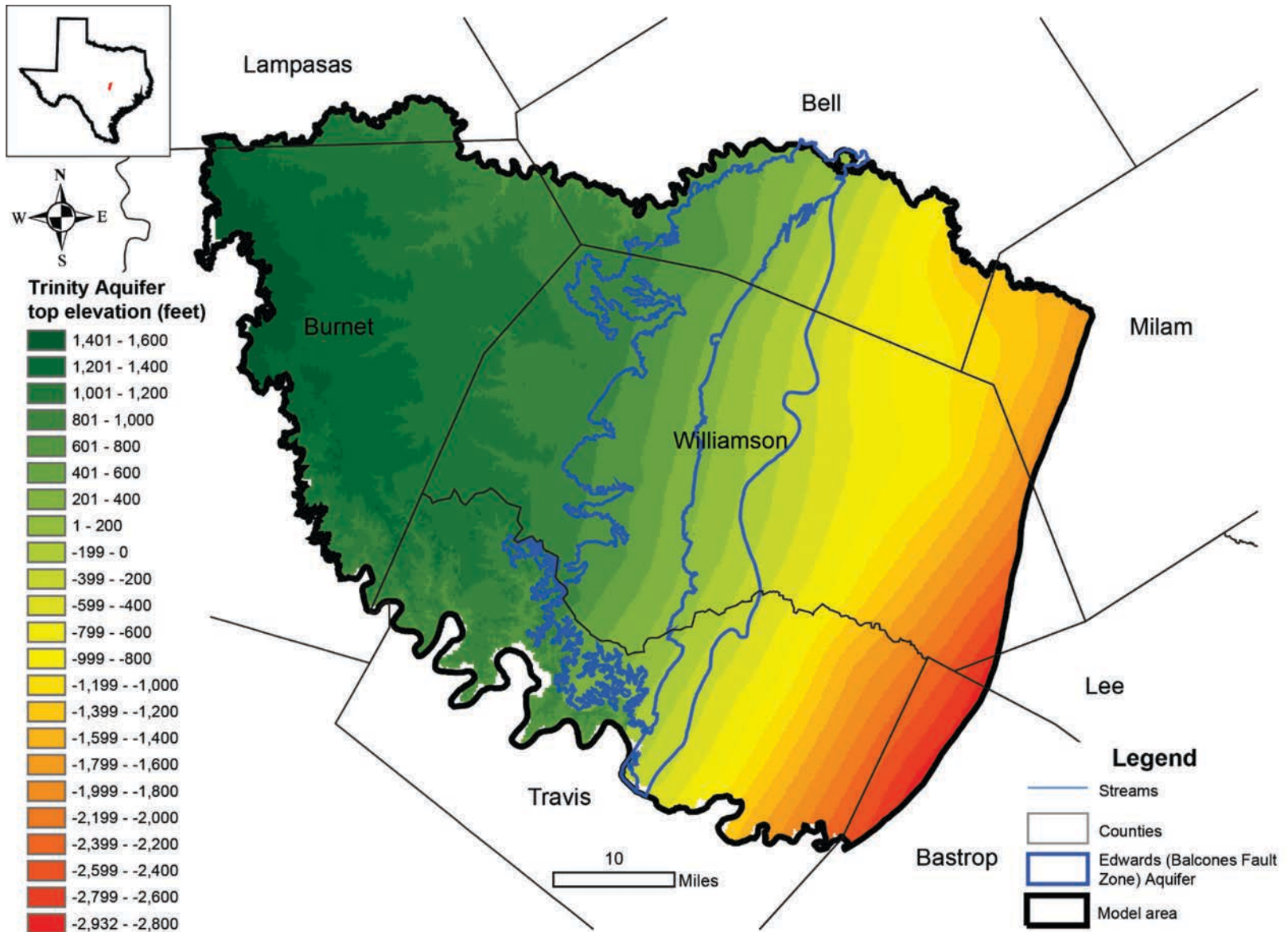
Confining Unit Base



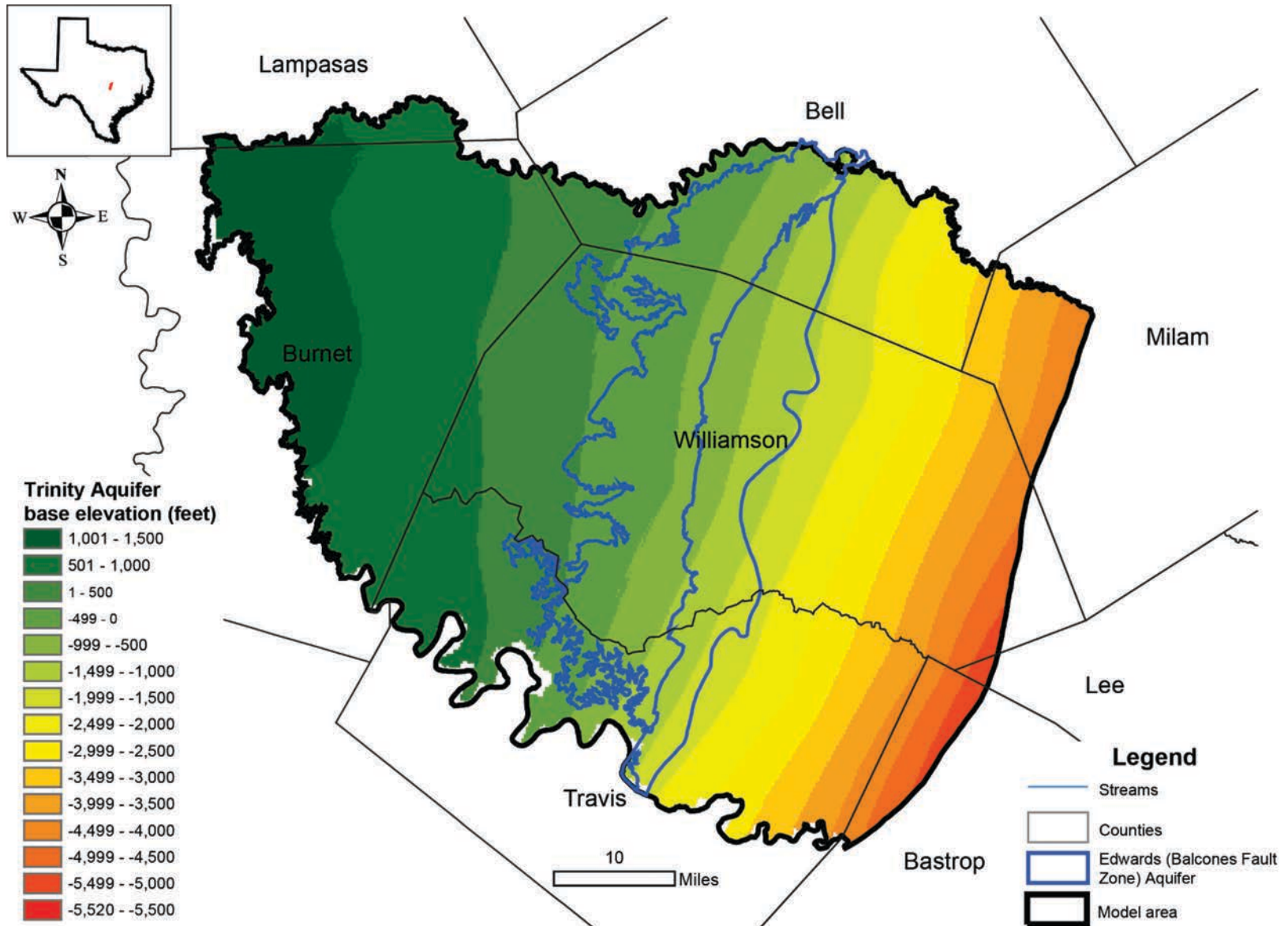
Confining Unit Thickness



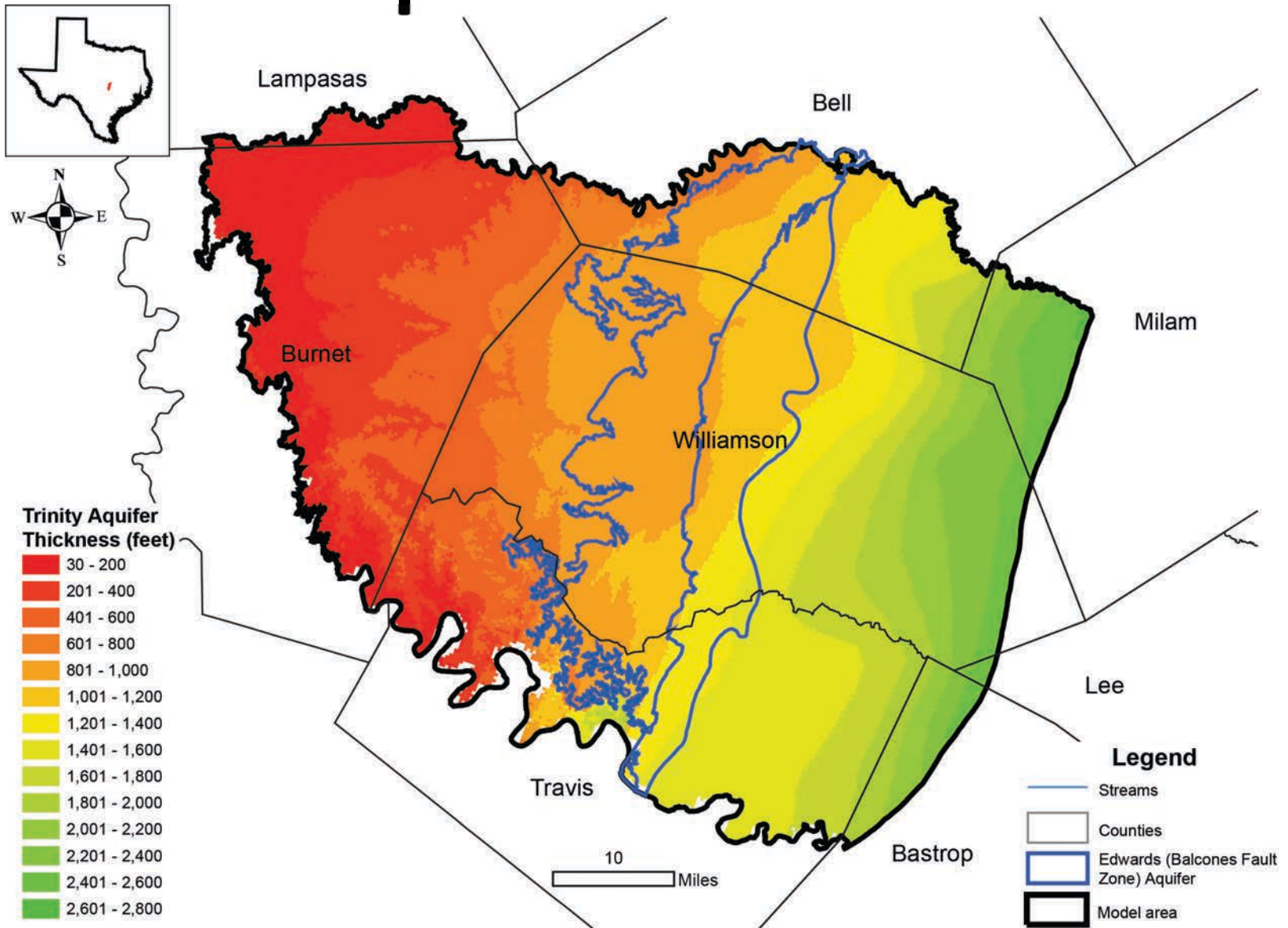
Aquifer Top



Aquifer Base

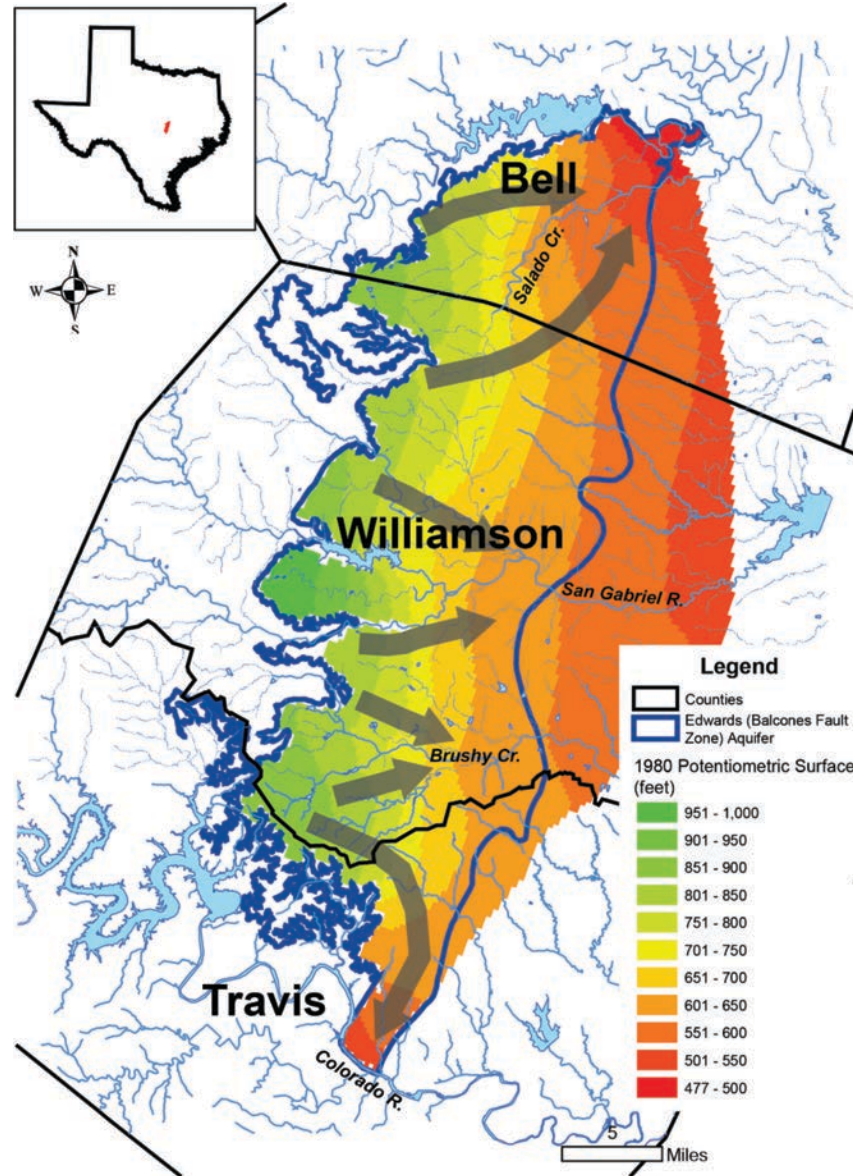


Aquifer Thickness

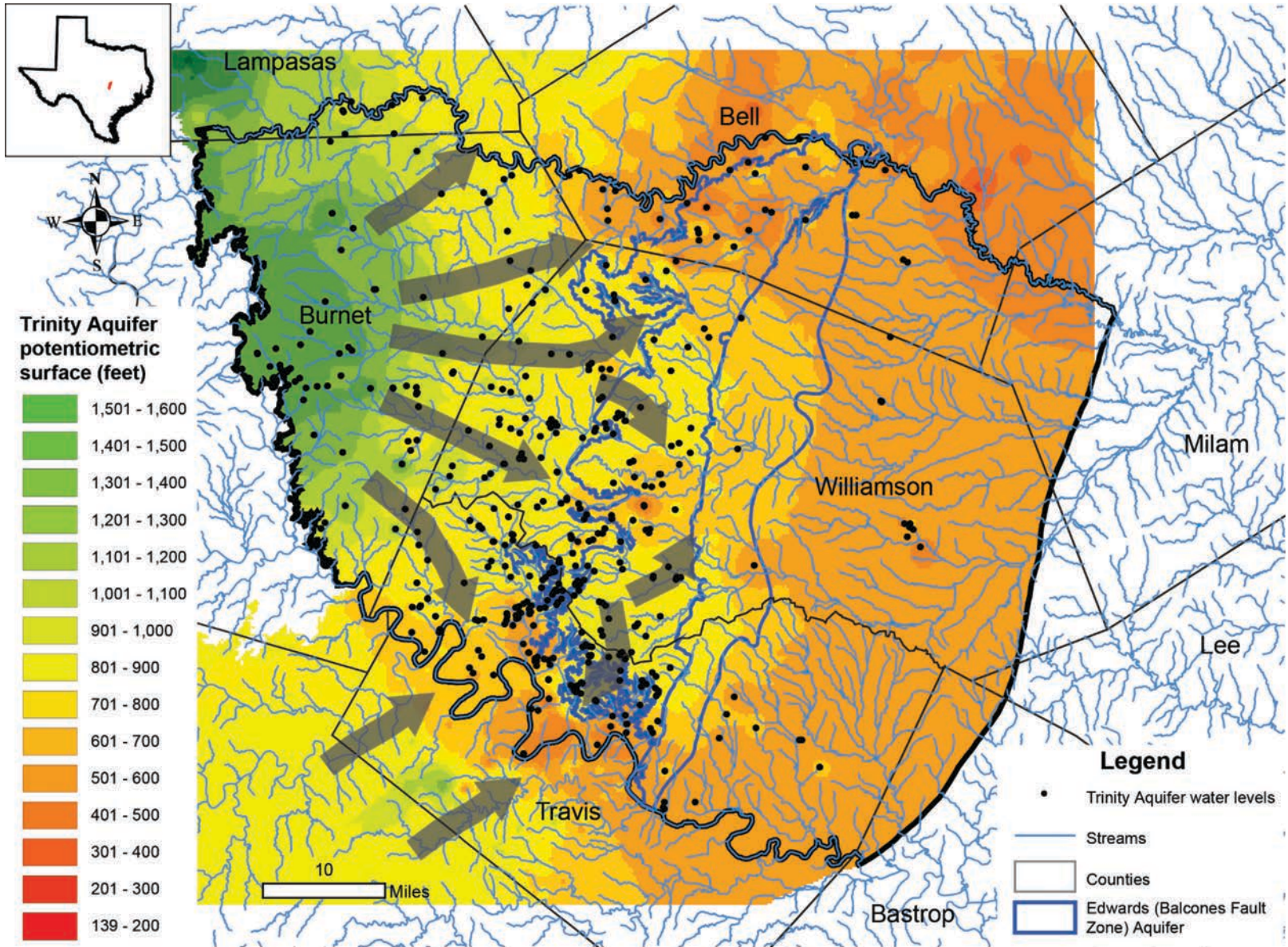


Water Levels

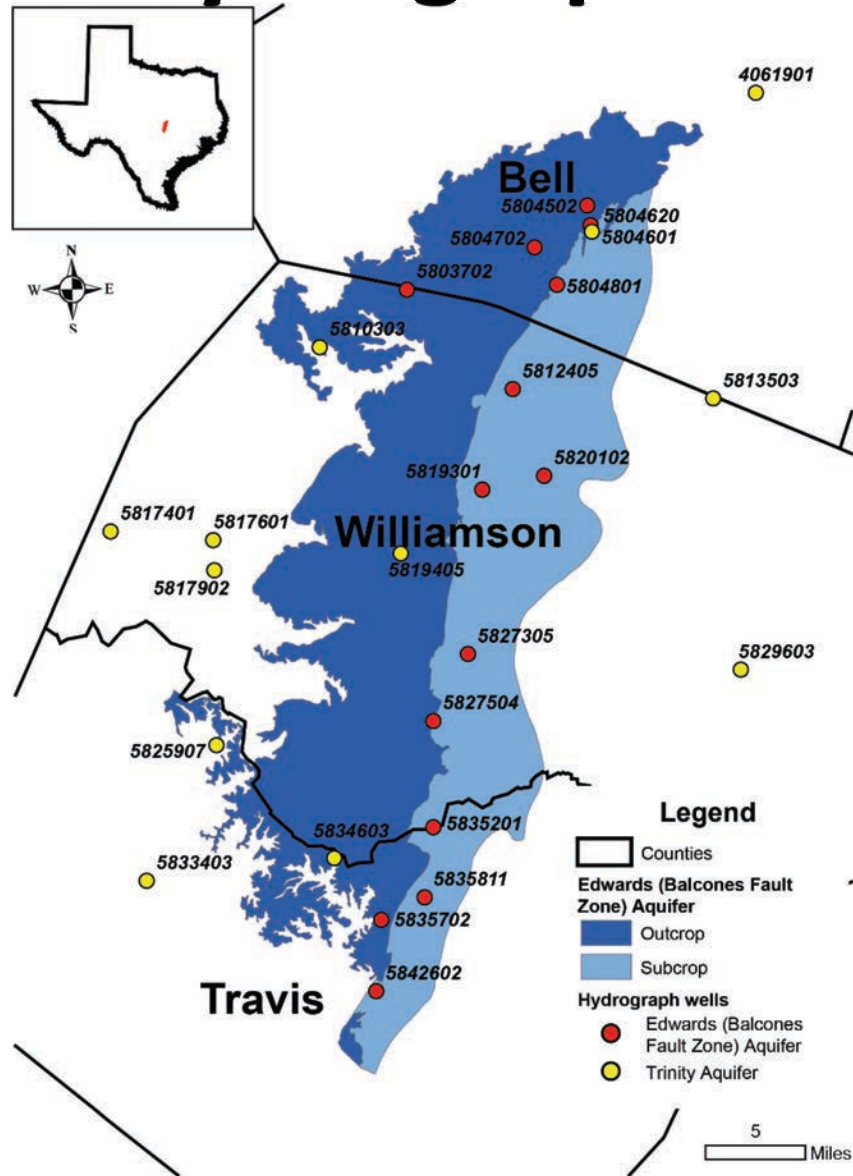
Water Level Elevations



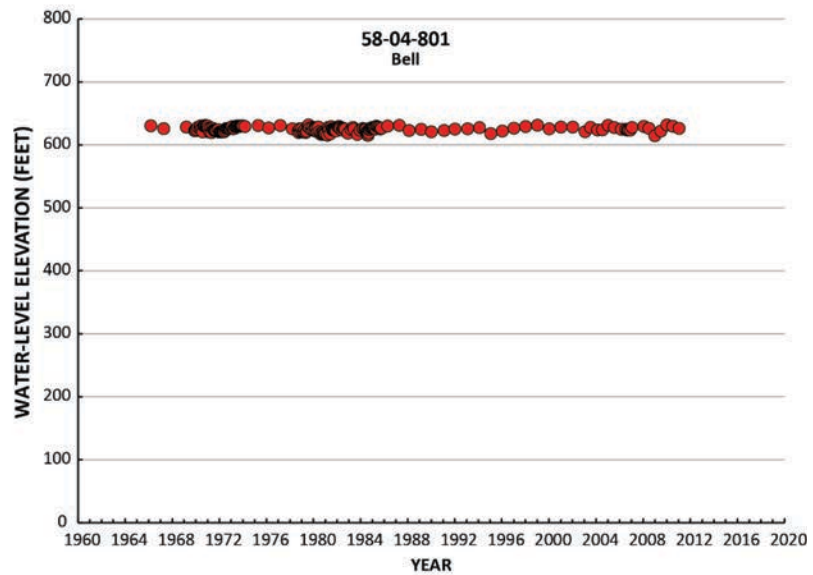
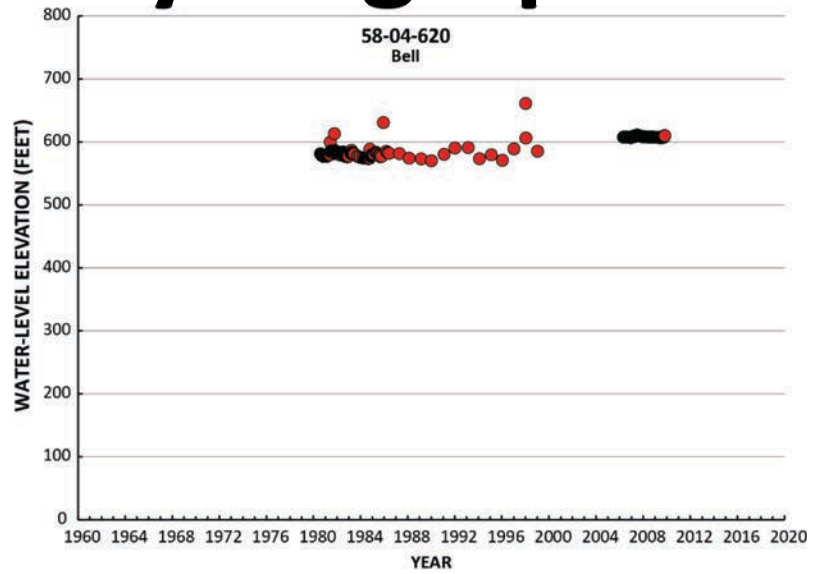
Water Level Elevations



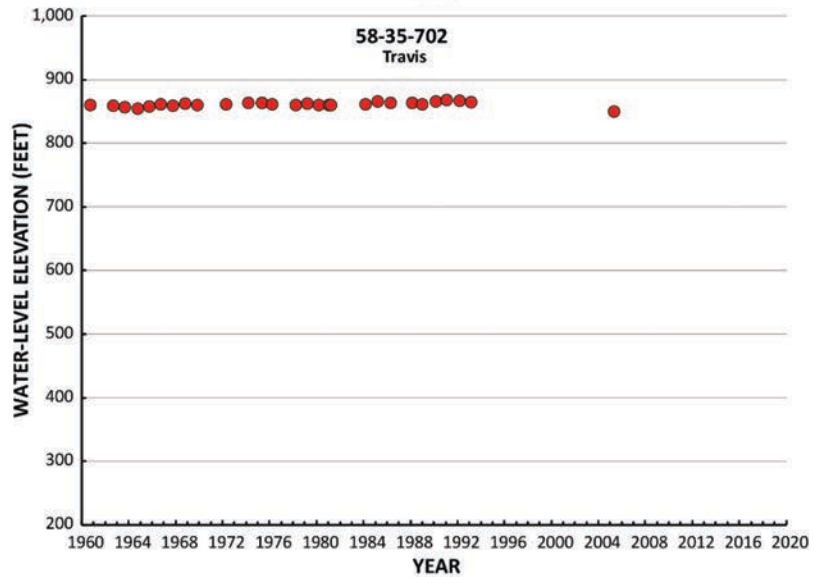
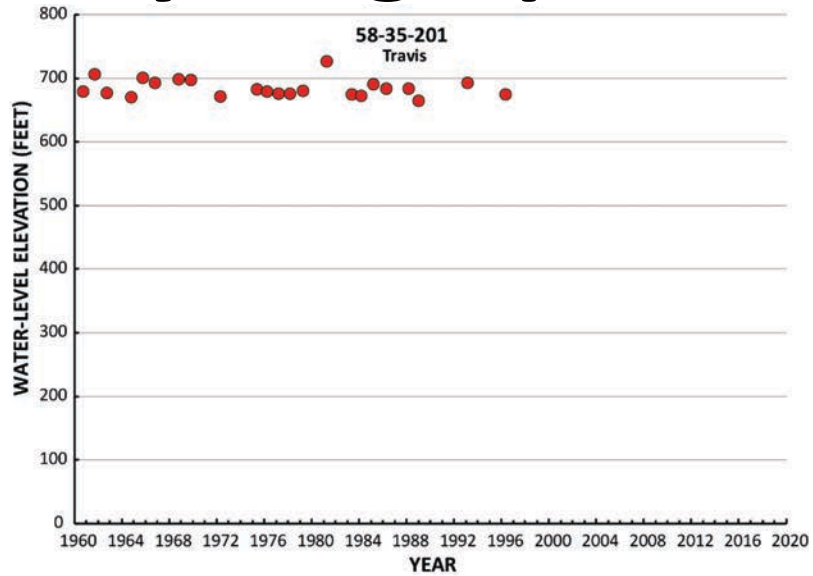
Hydrographs



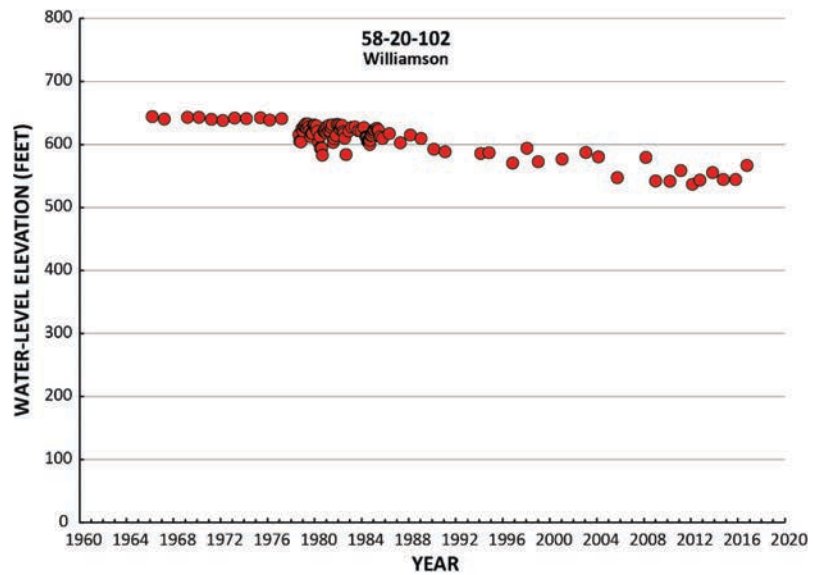
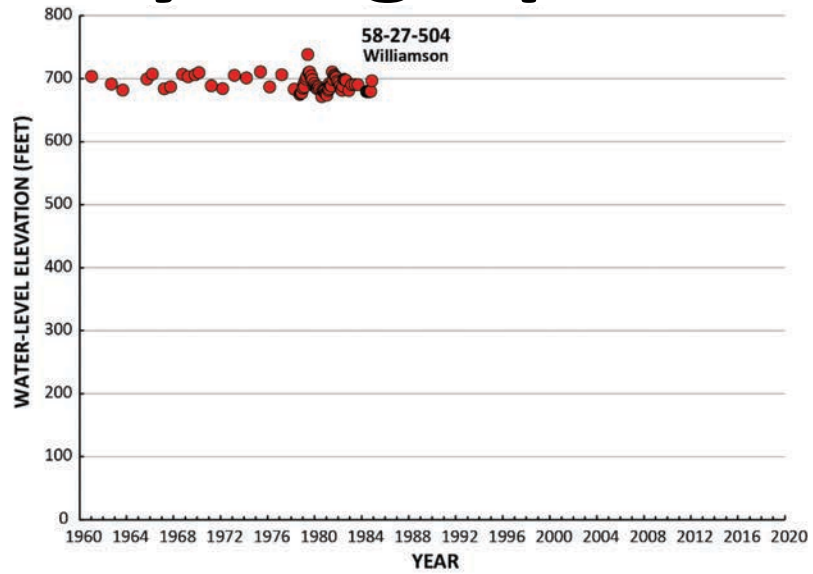
Hydrographs



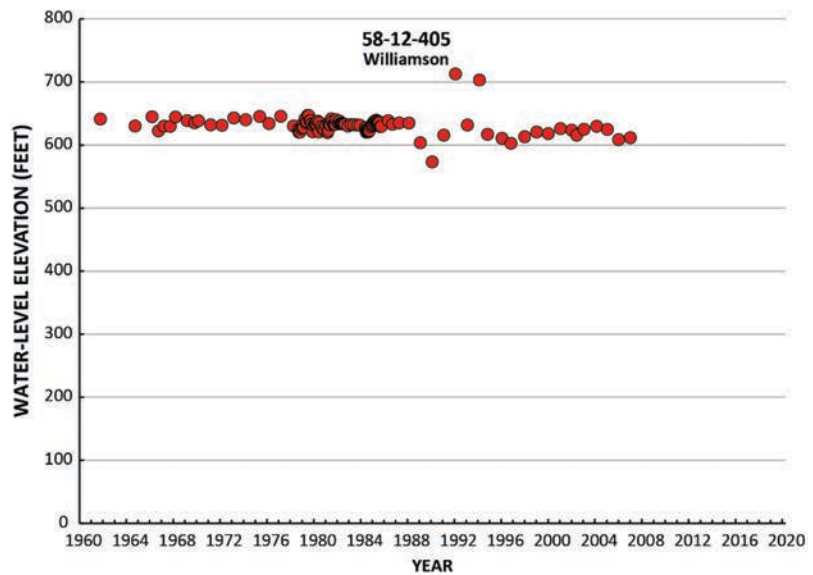
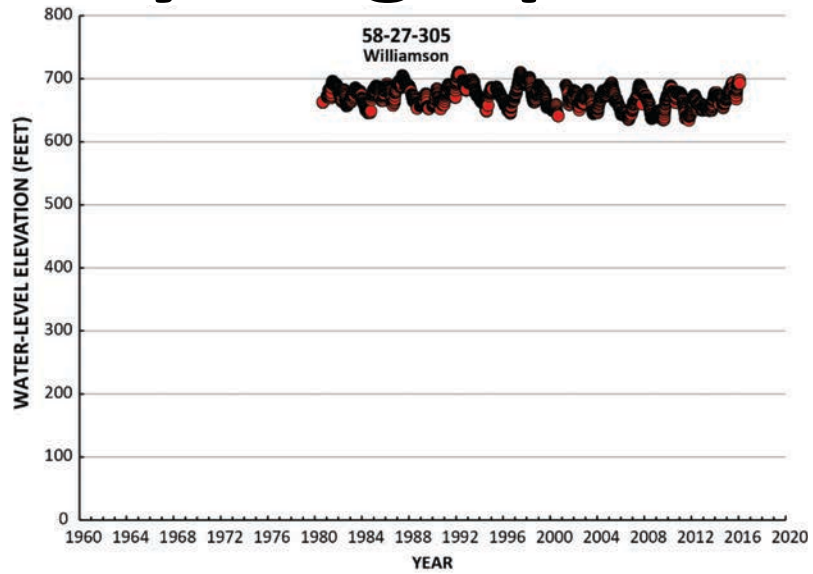
Hydrographs



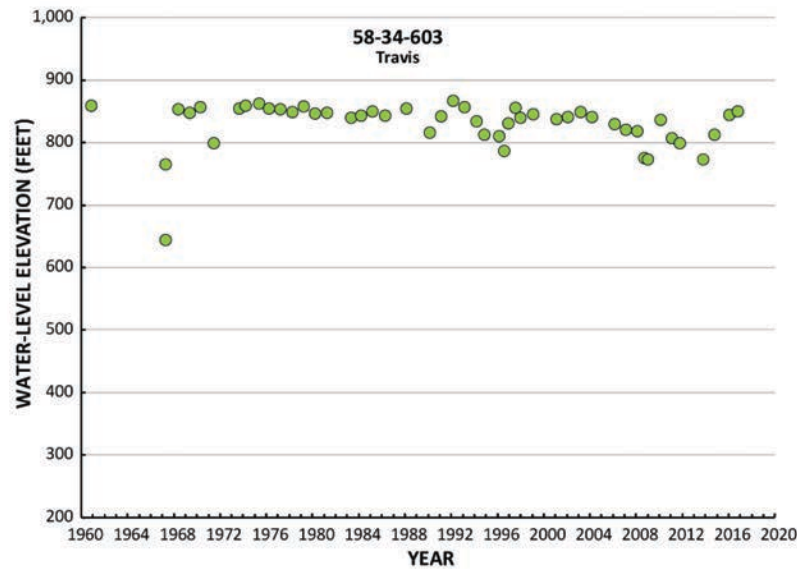
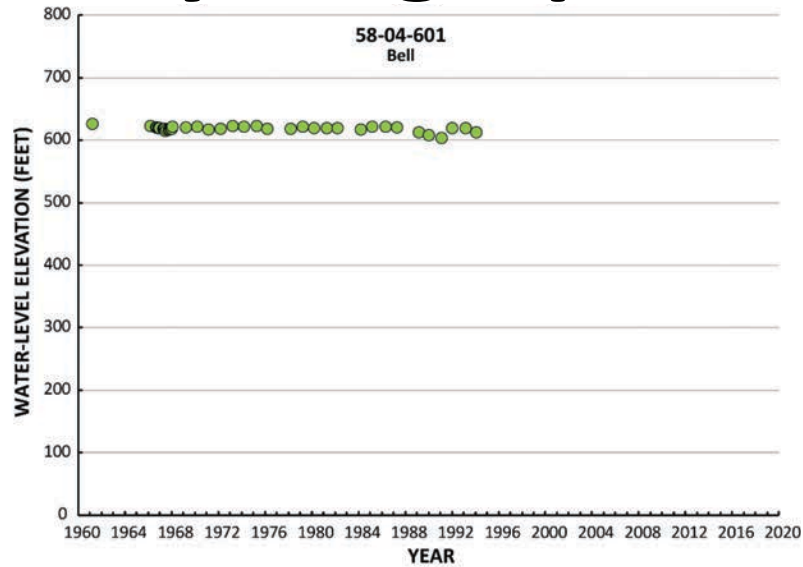
Hydrographs



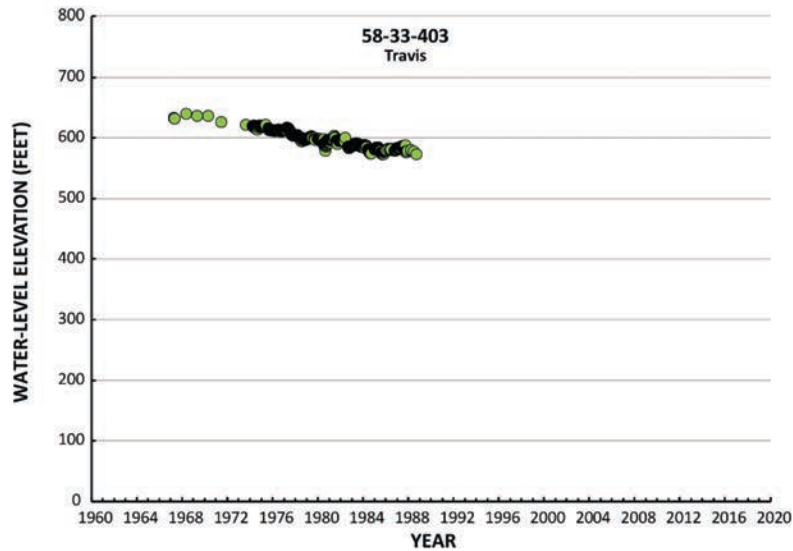
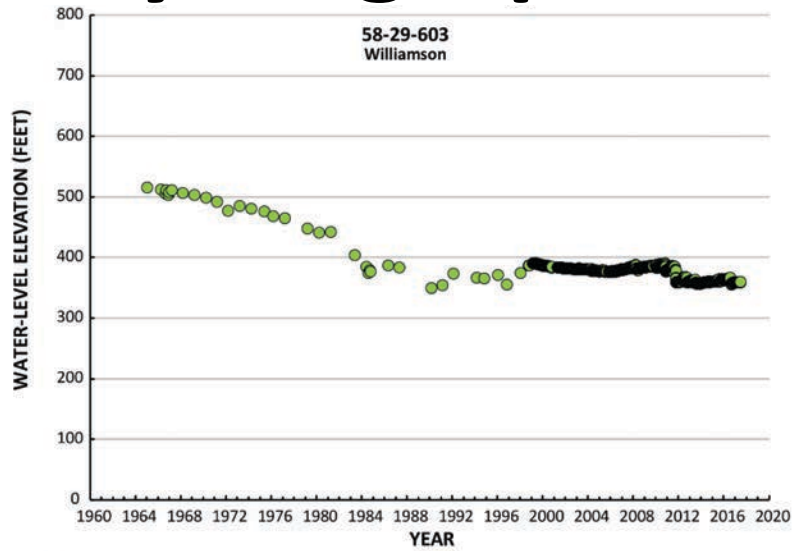
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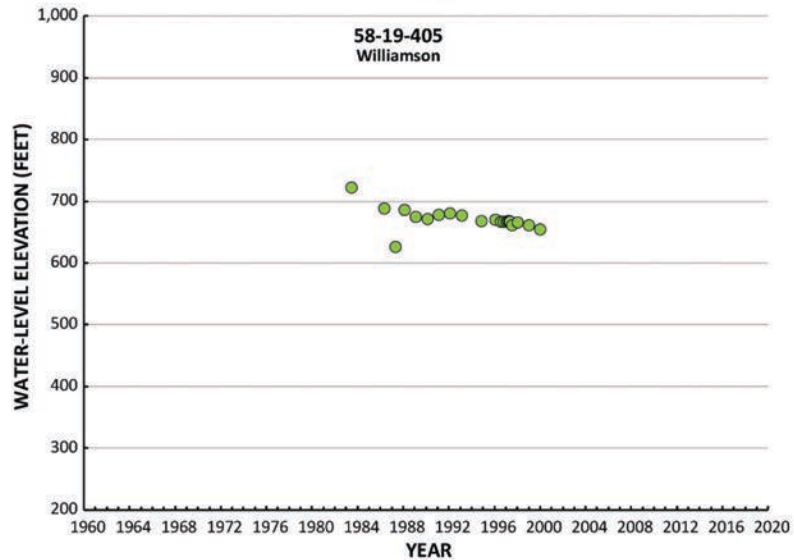
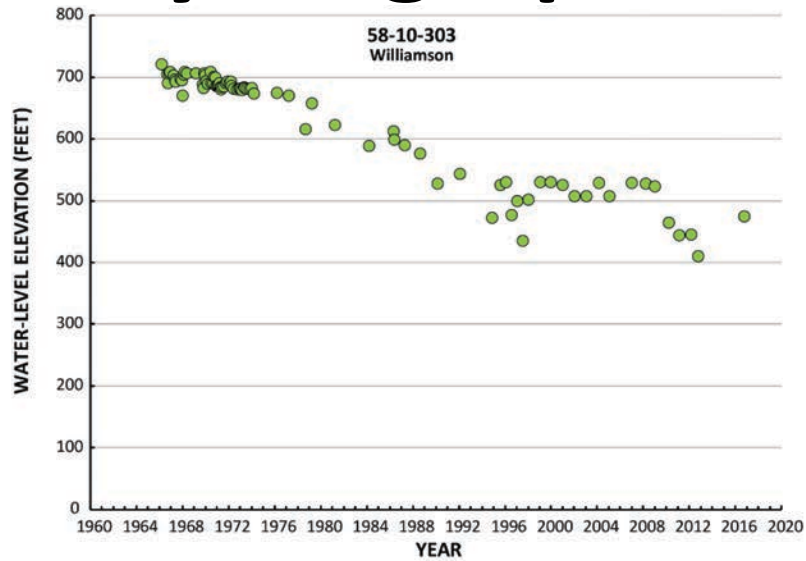
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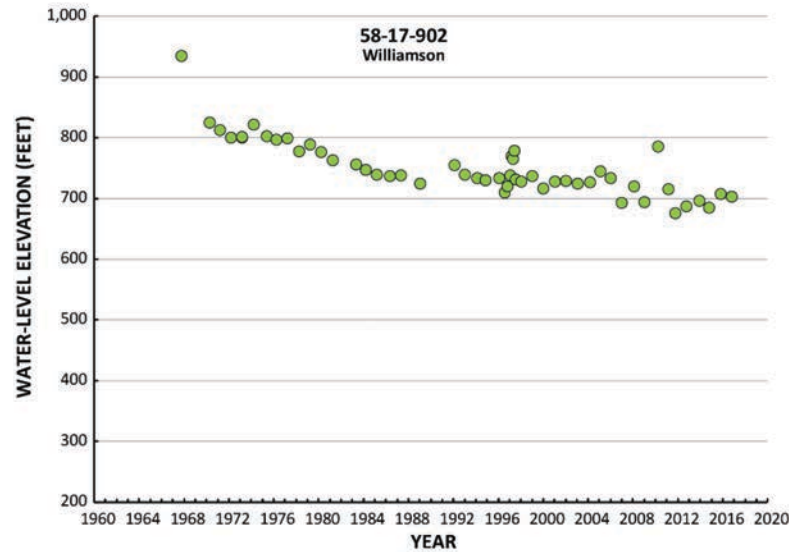
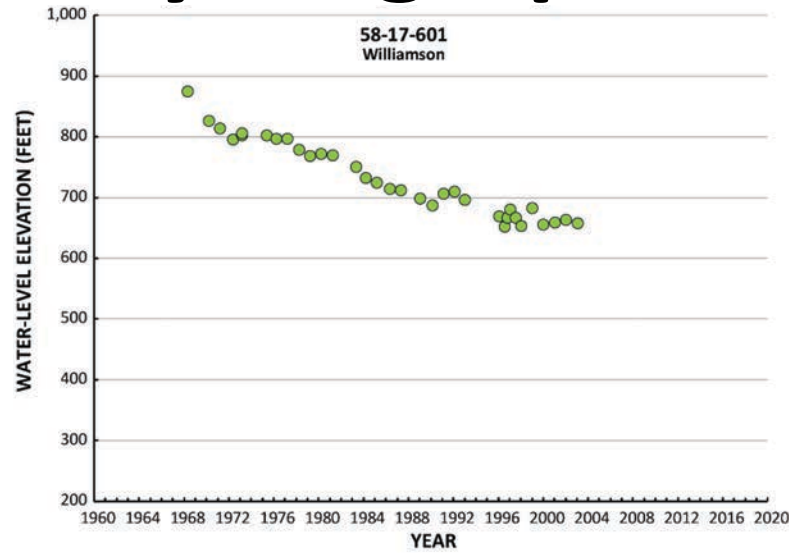
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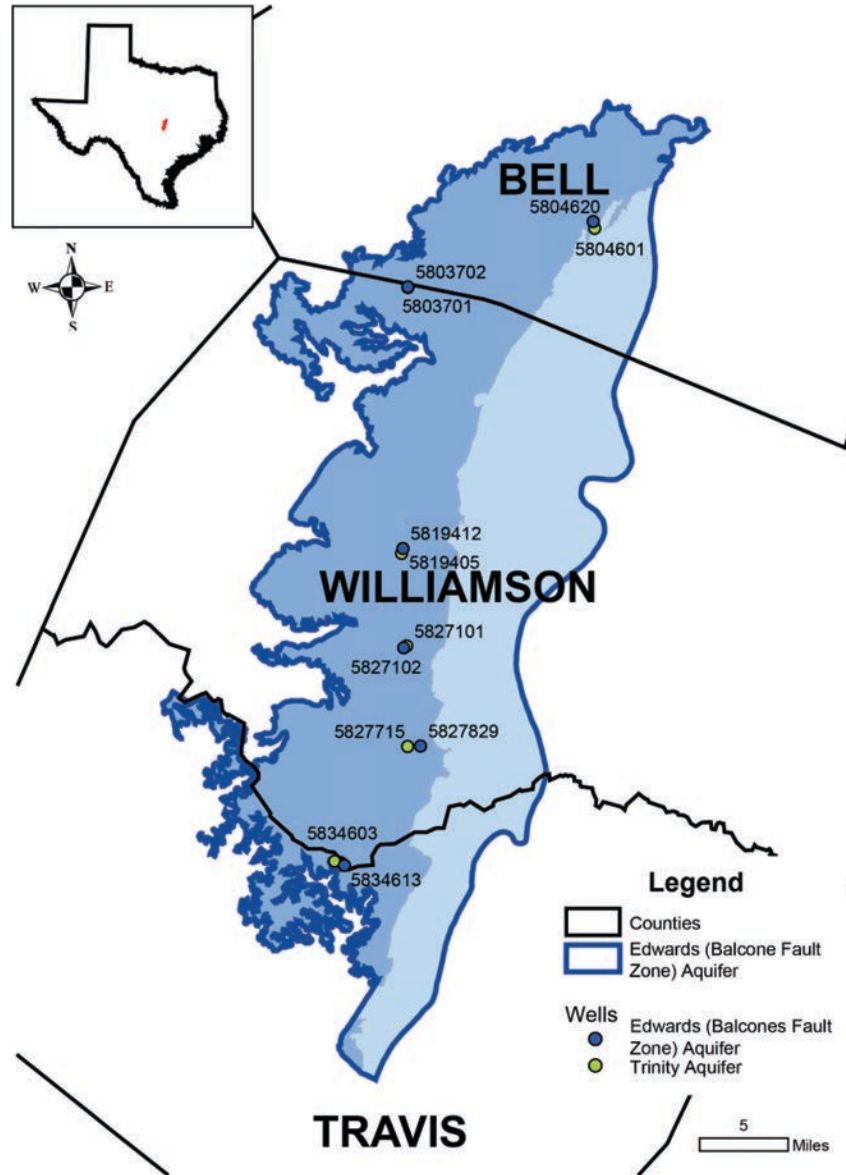
Hydrographs



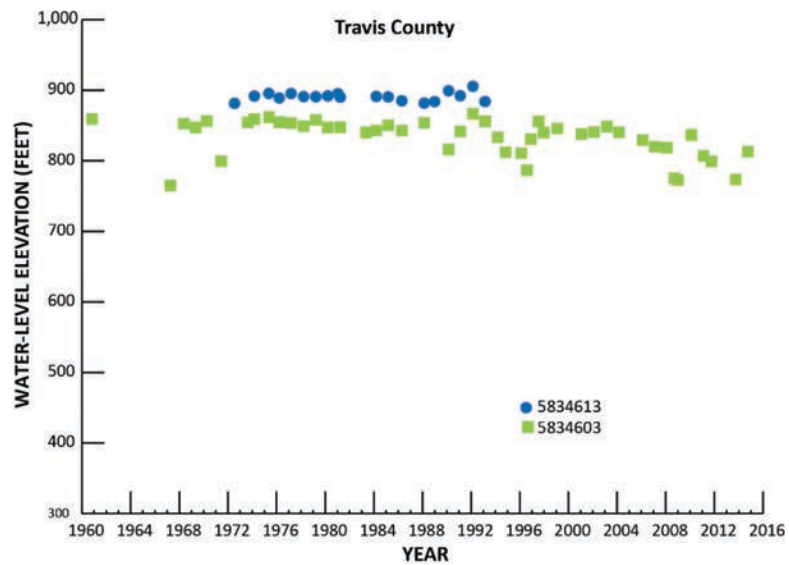
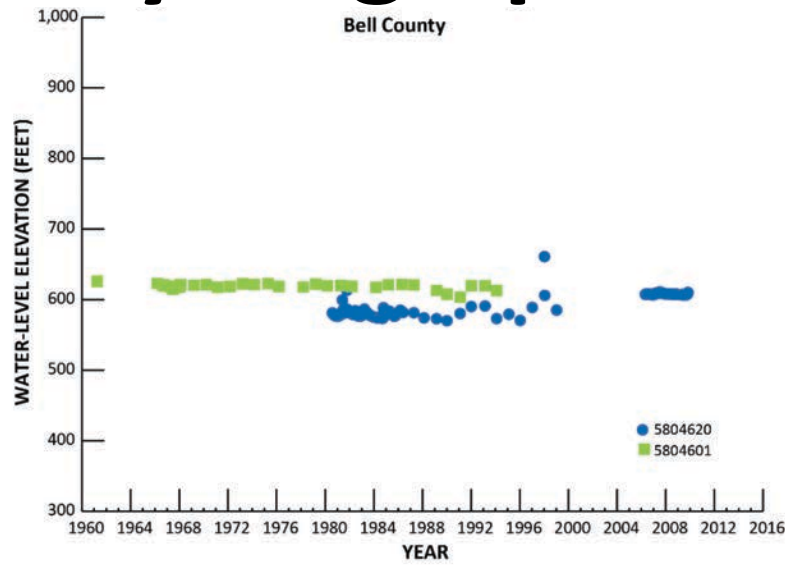
Hydrographs



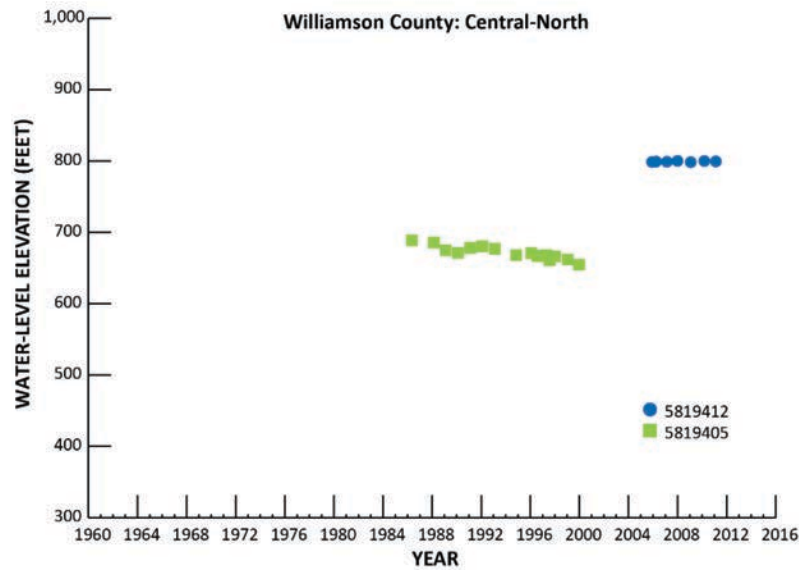
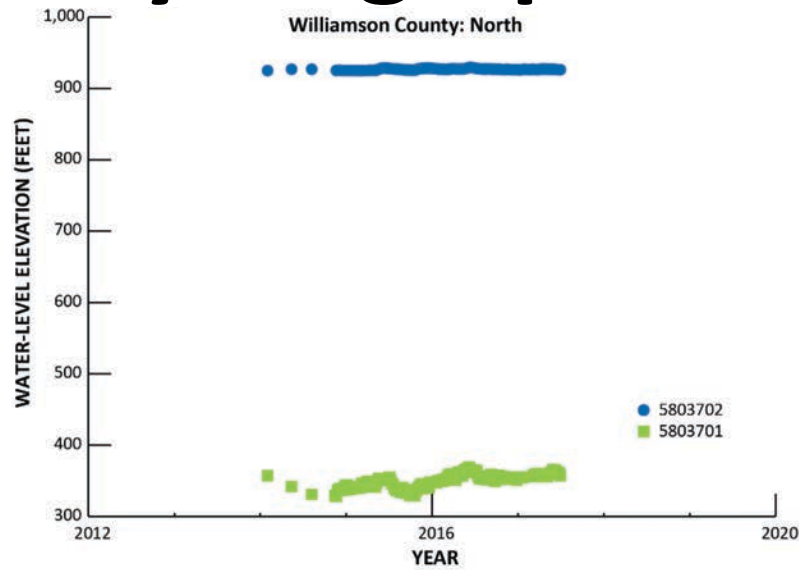
Hydrographs



Hydrographs

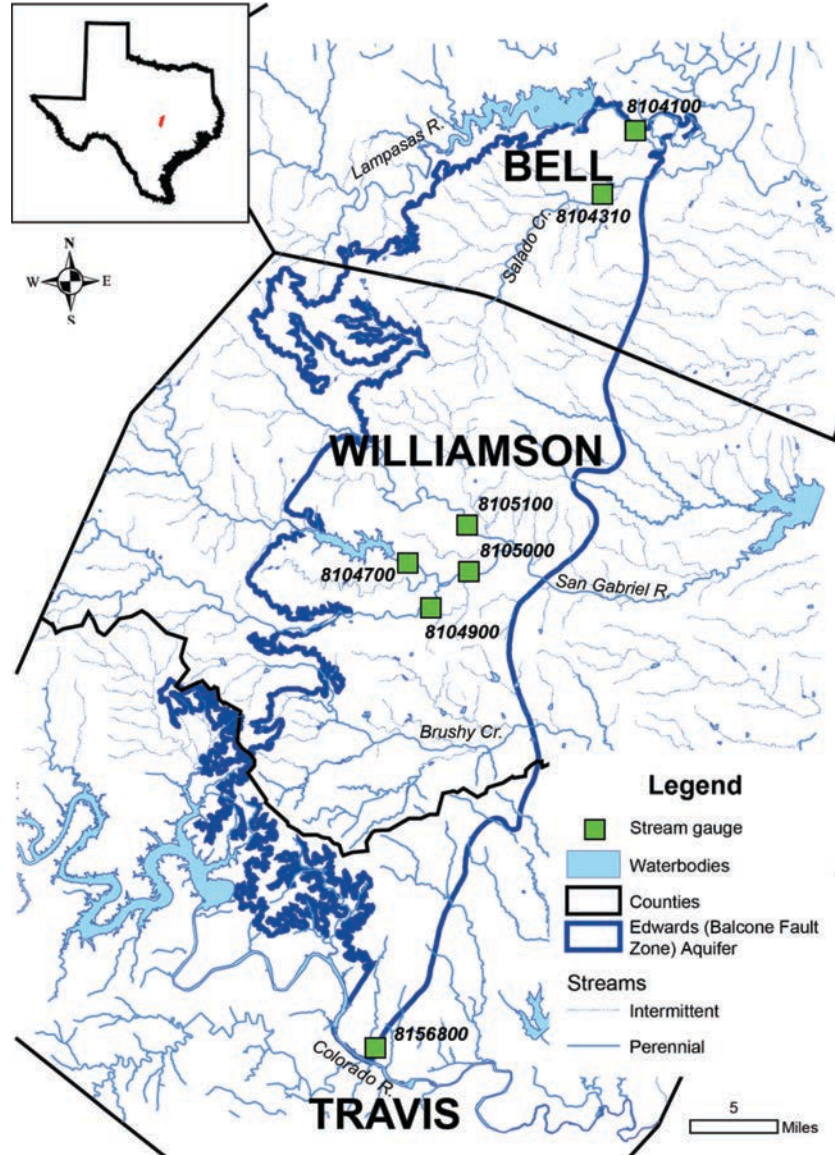


Hydrographs

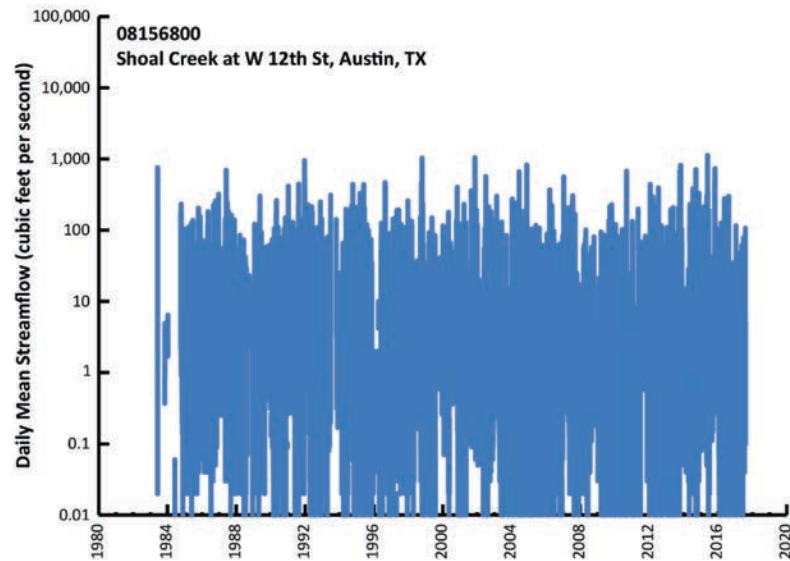
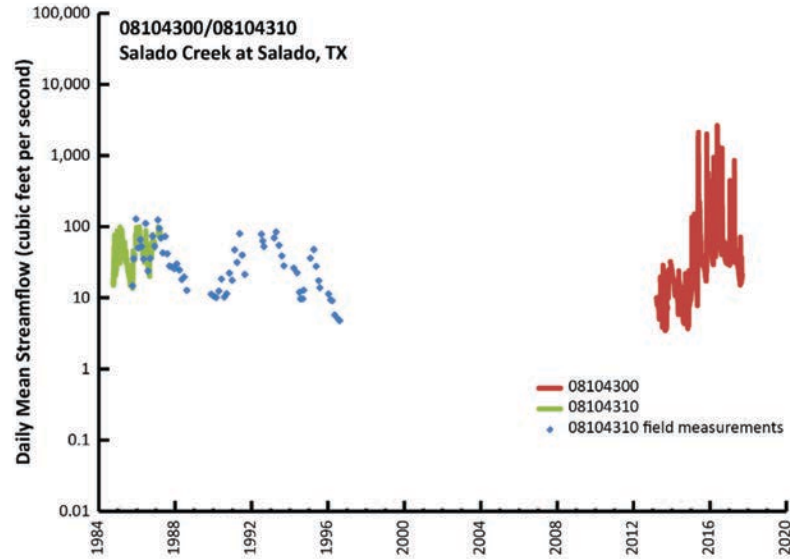


Surface Water

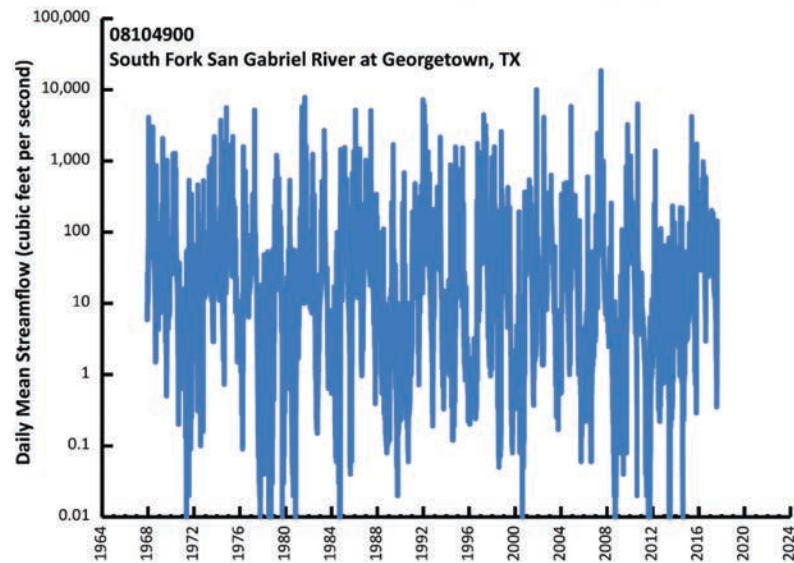
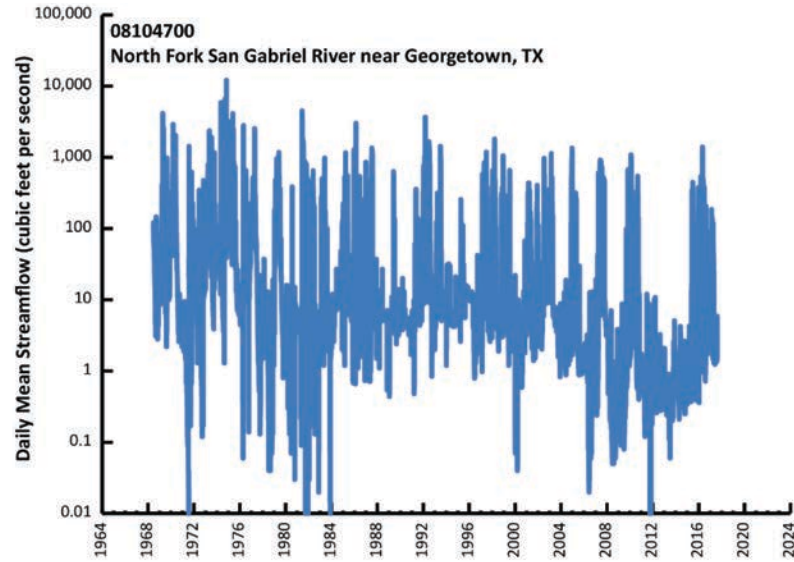
Stream Gauges



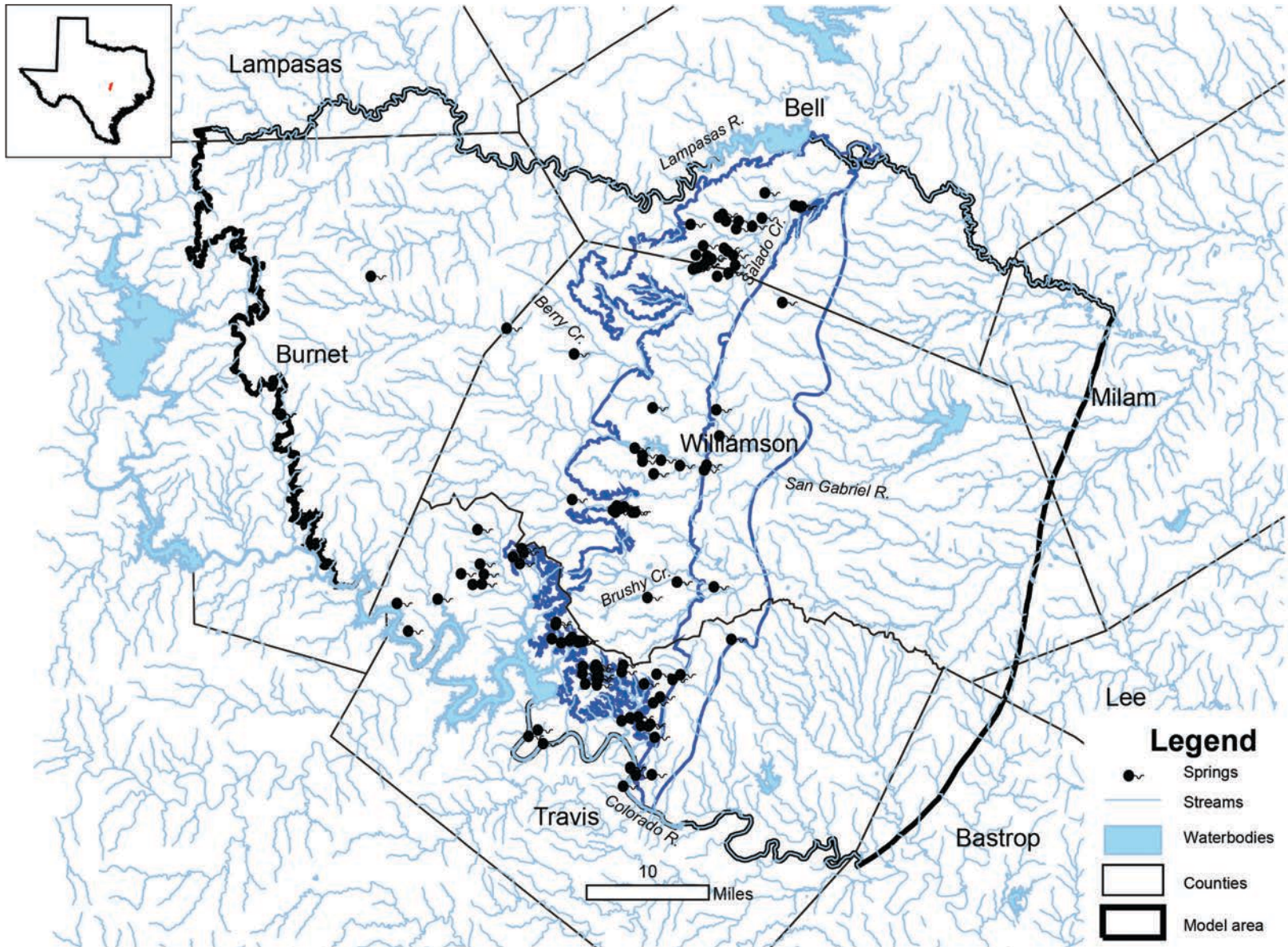
Streamflow Hydrographs



Streamflow Hydrographs

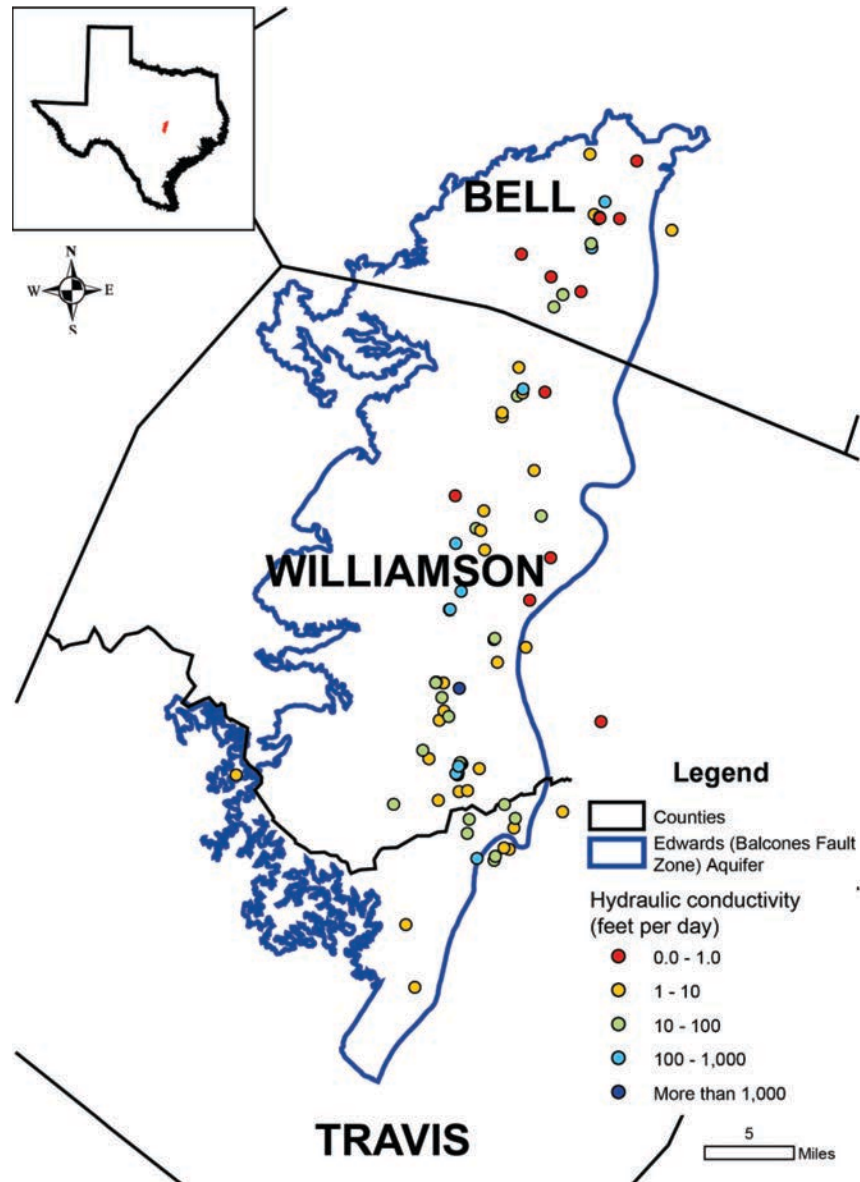


Springs

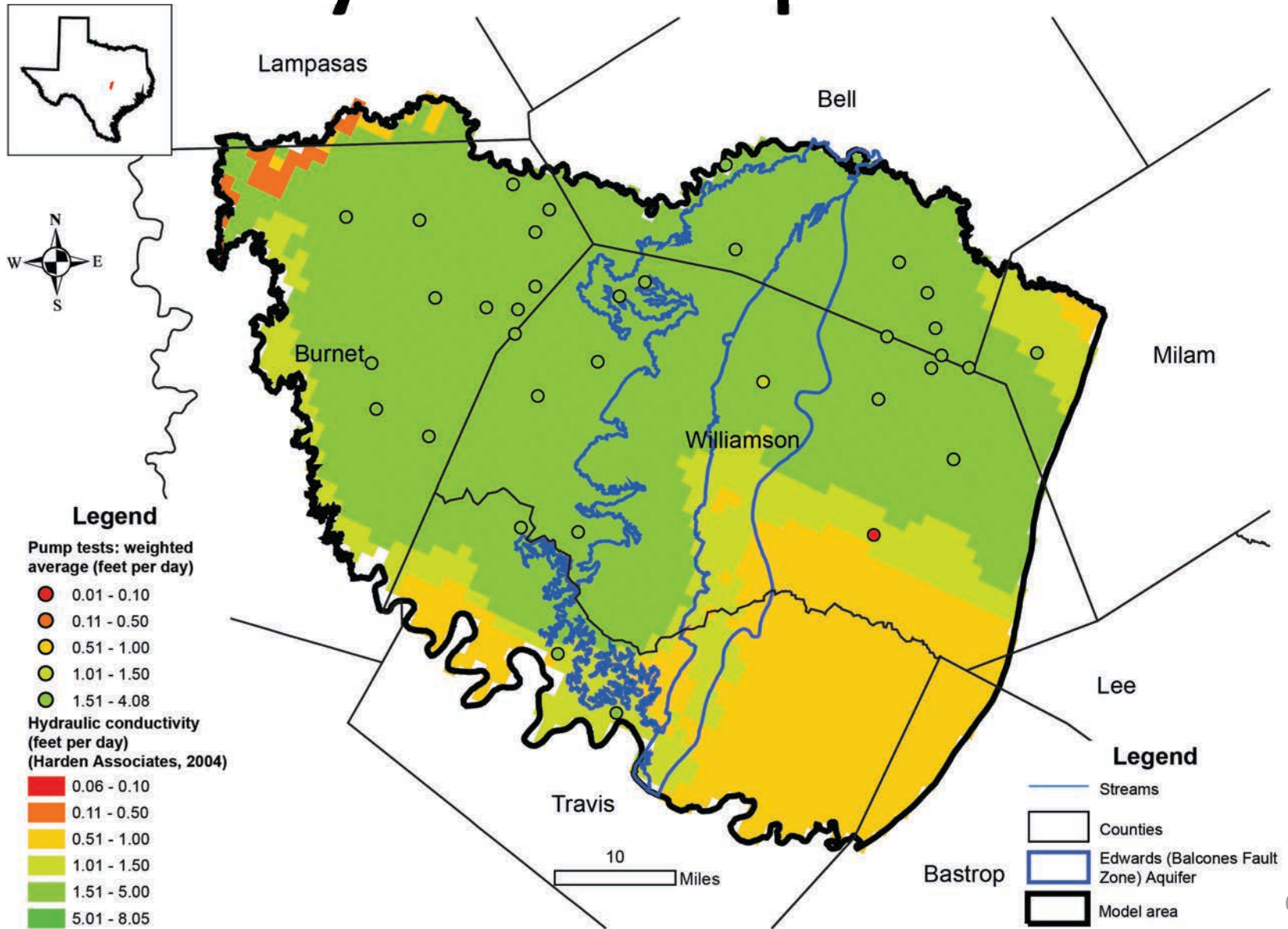


Hydraulic Properties

Hydraulic Properties

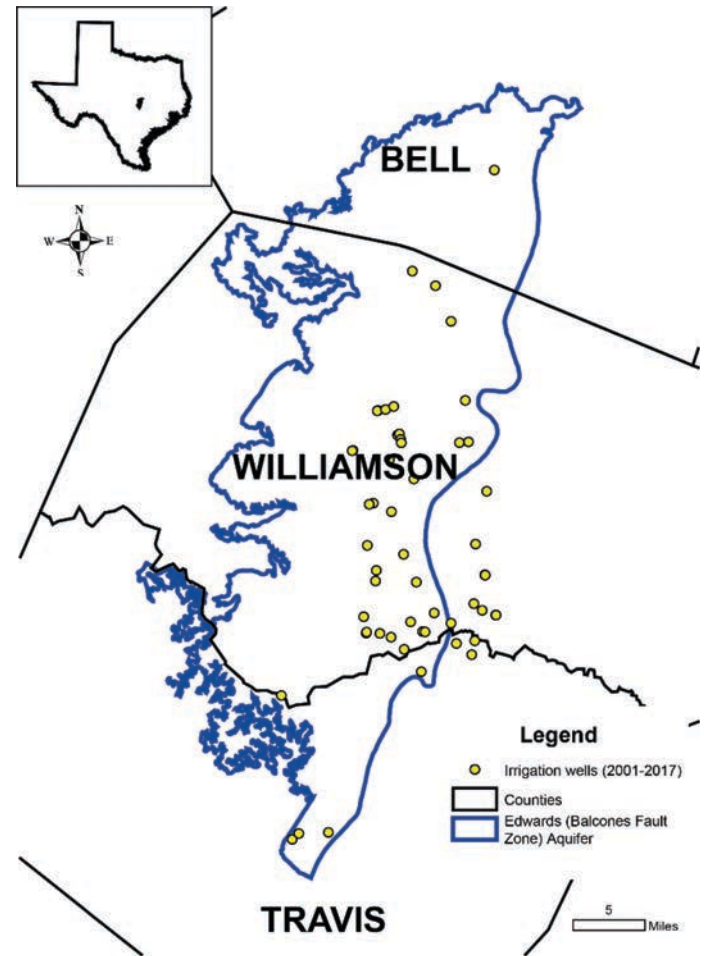
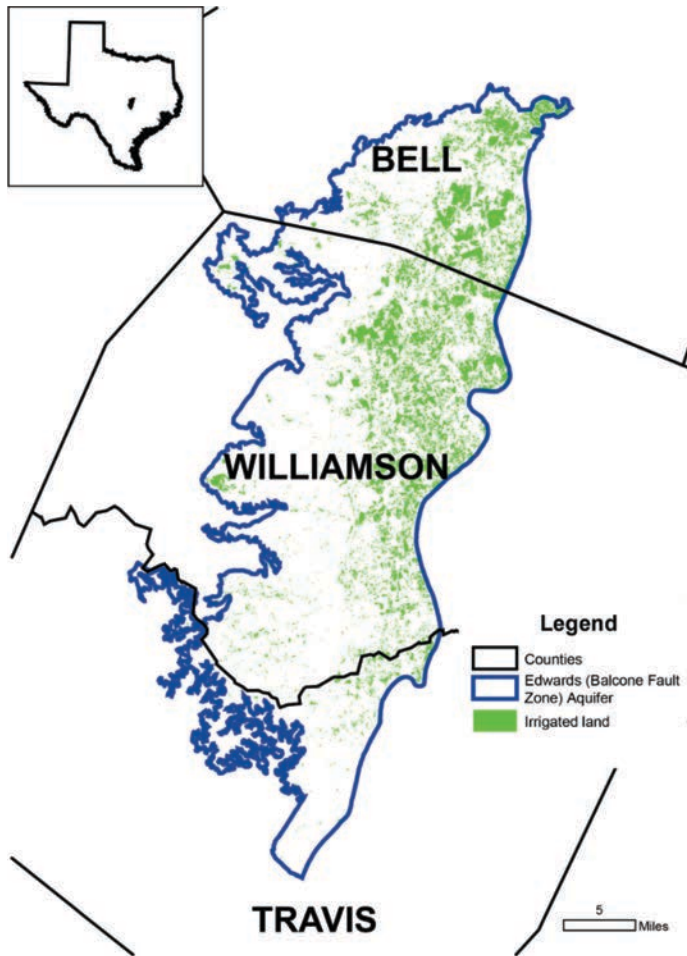


Hydraulic Properties

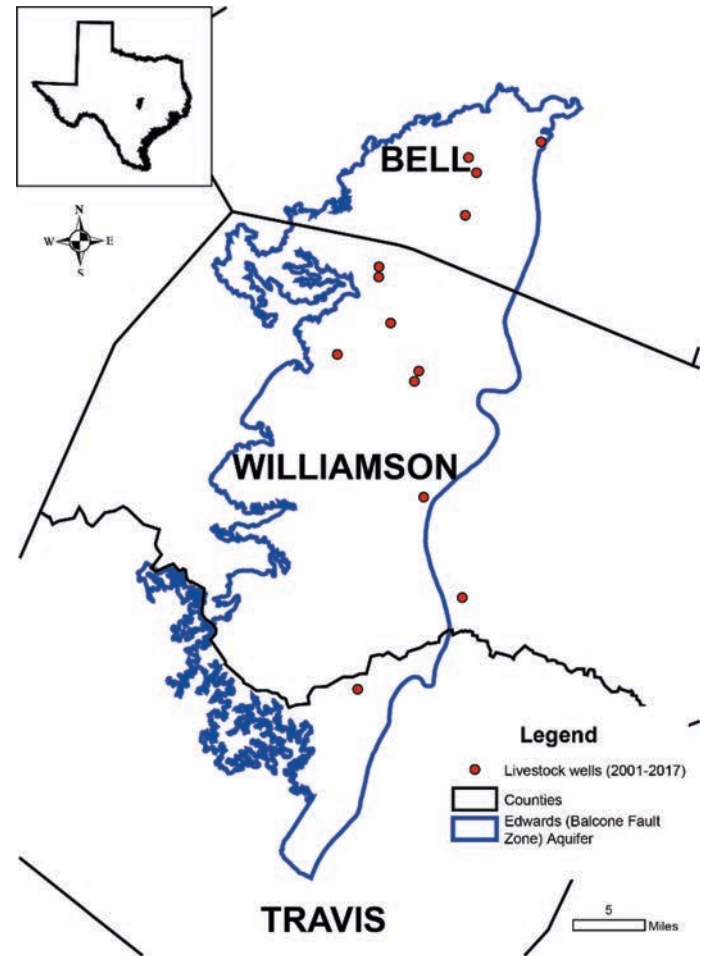
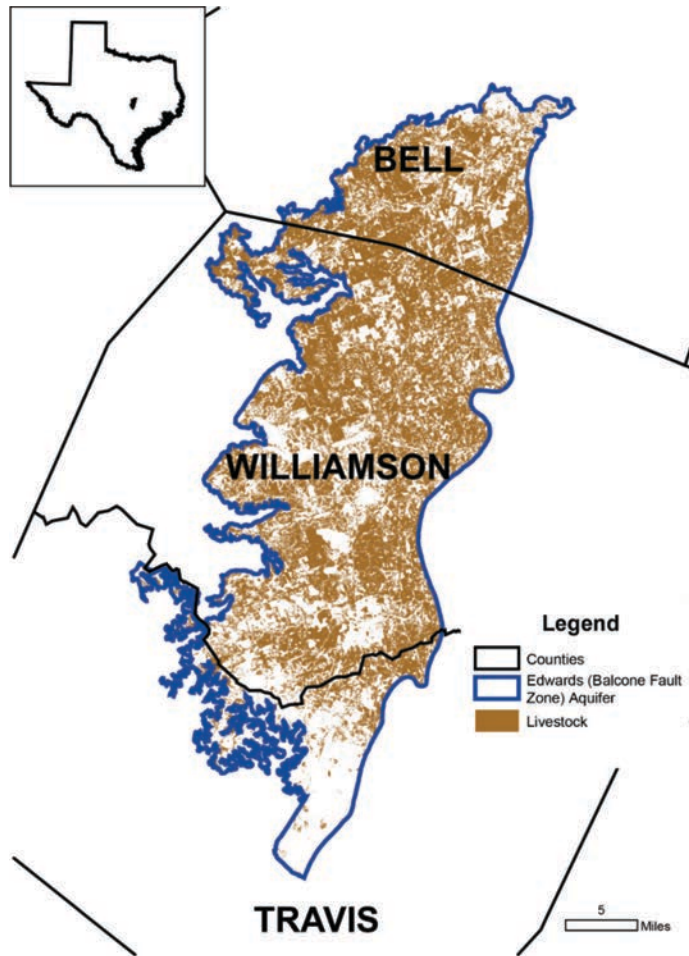


Pumping

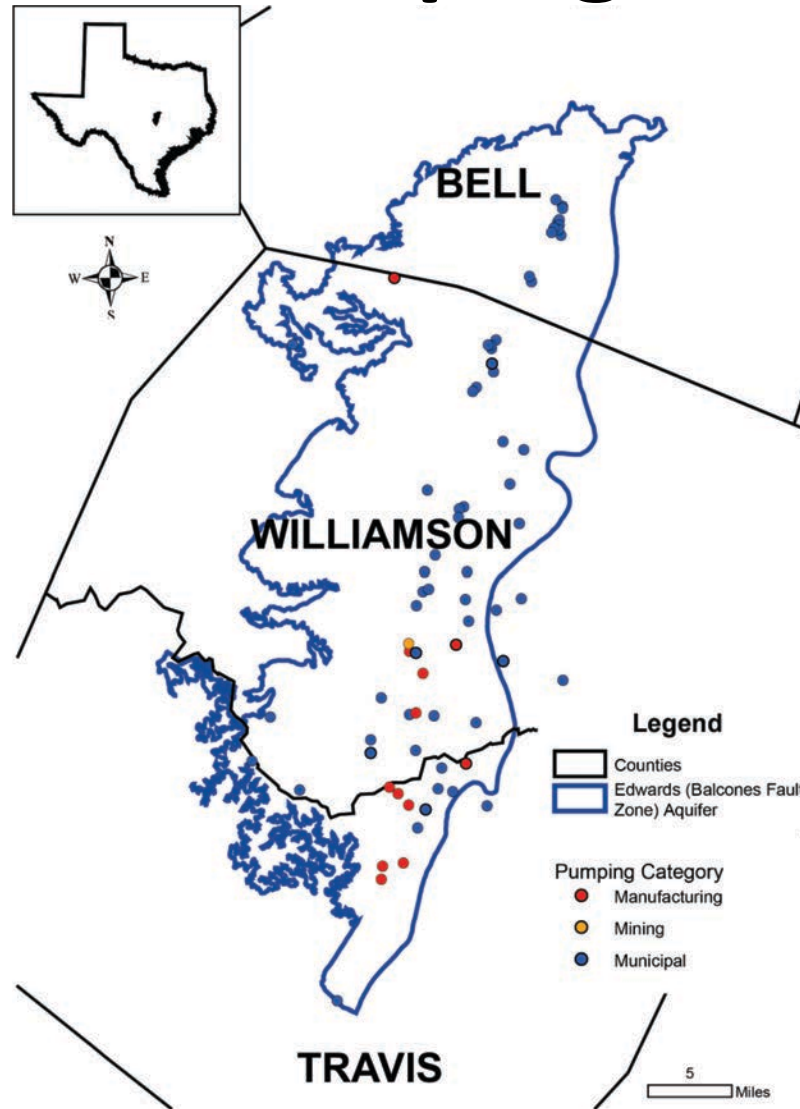
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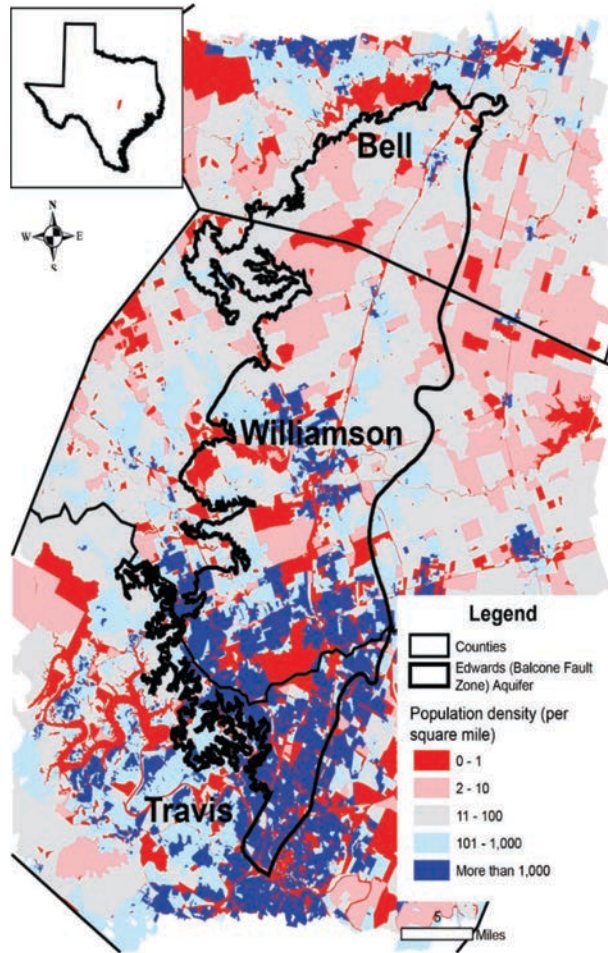
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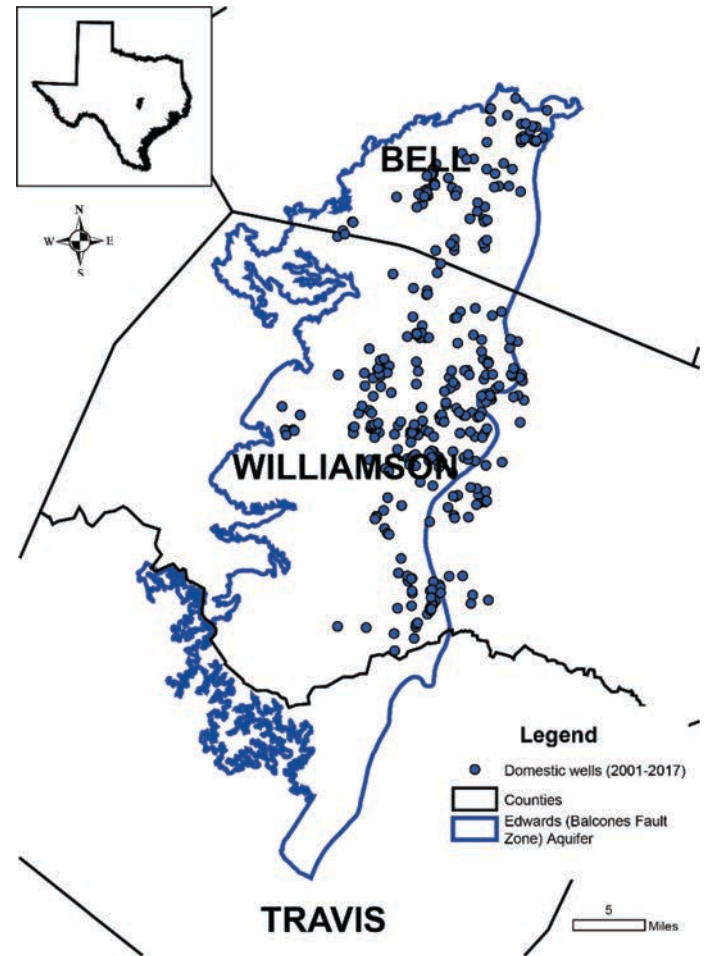
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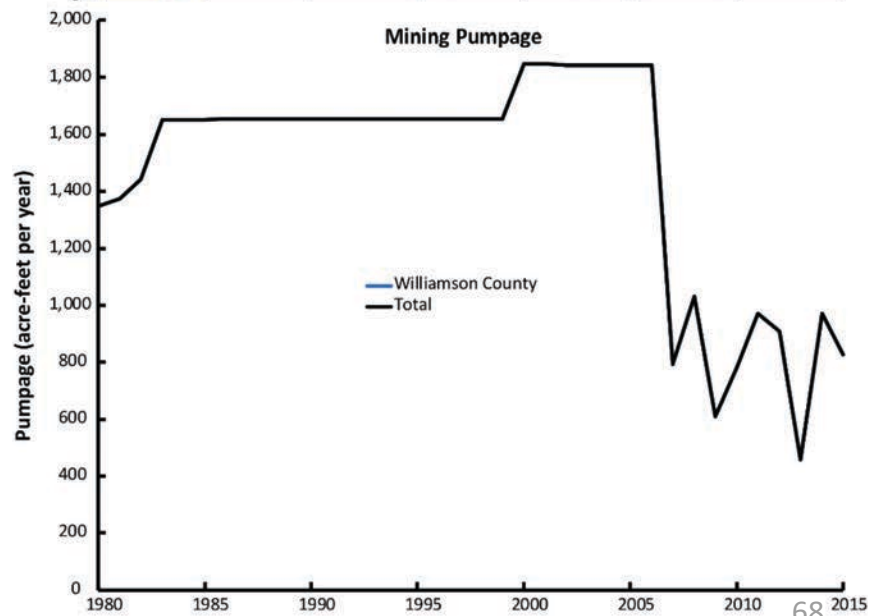
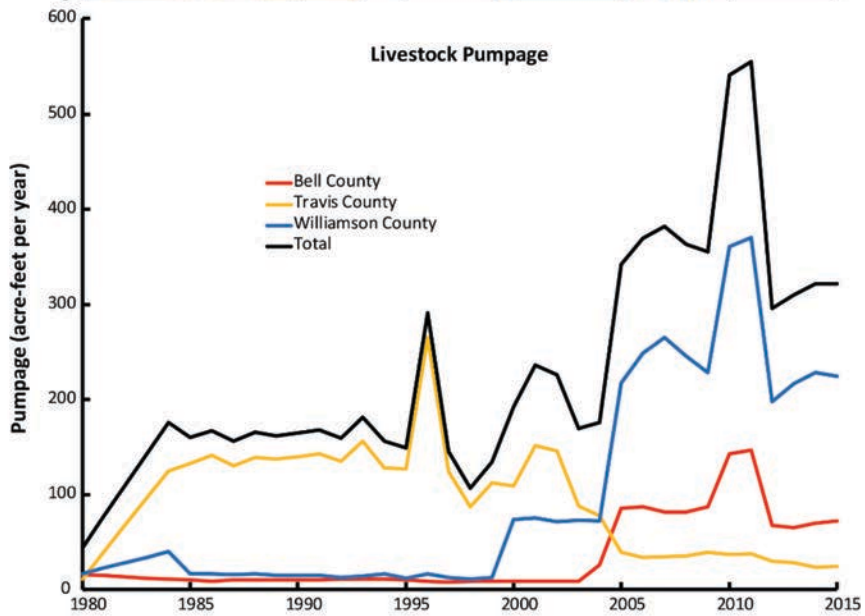
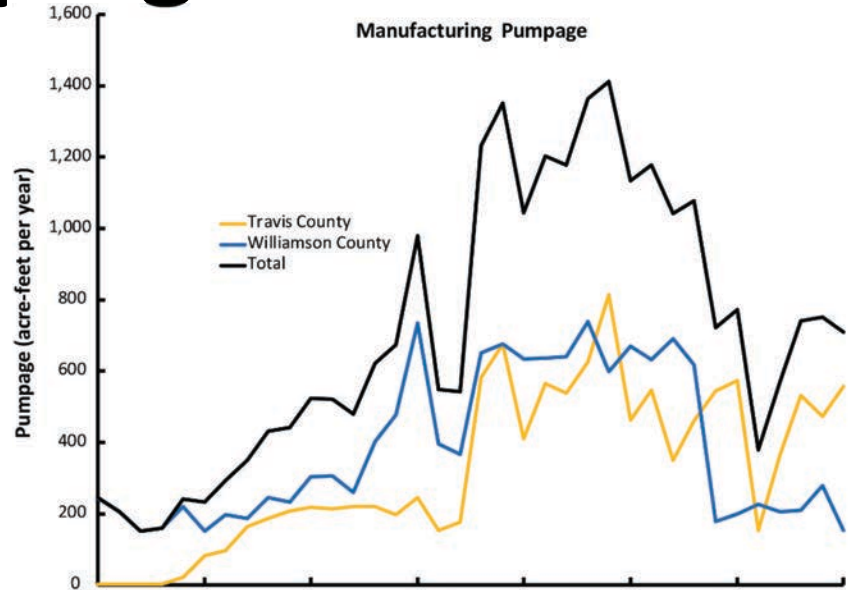
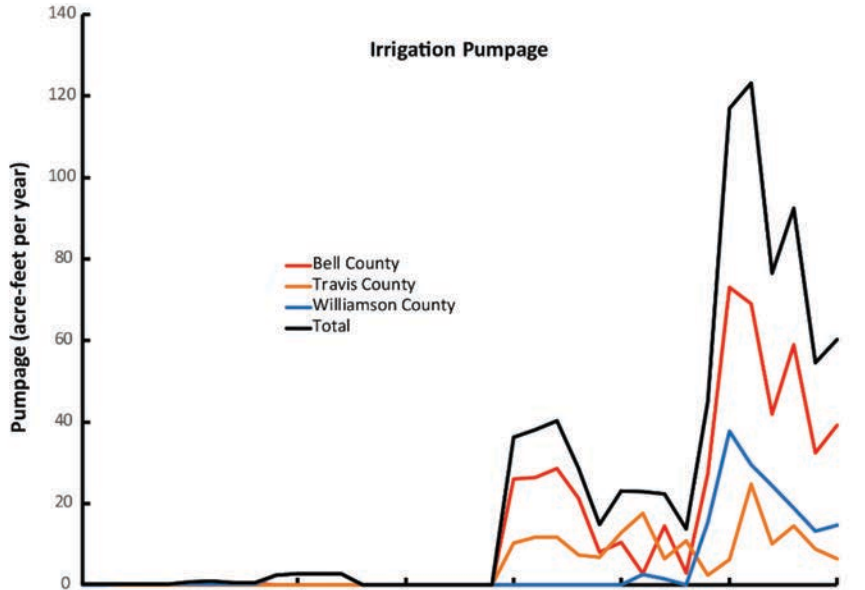
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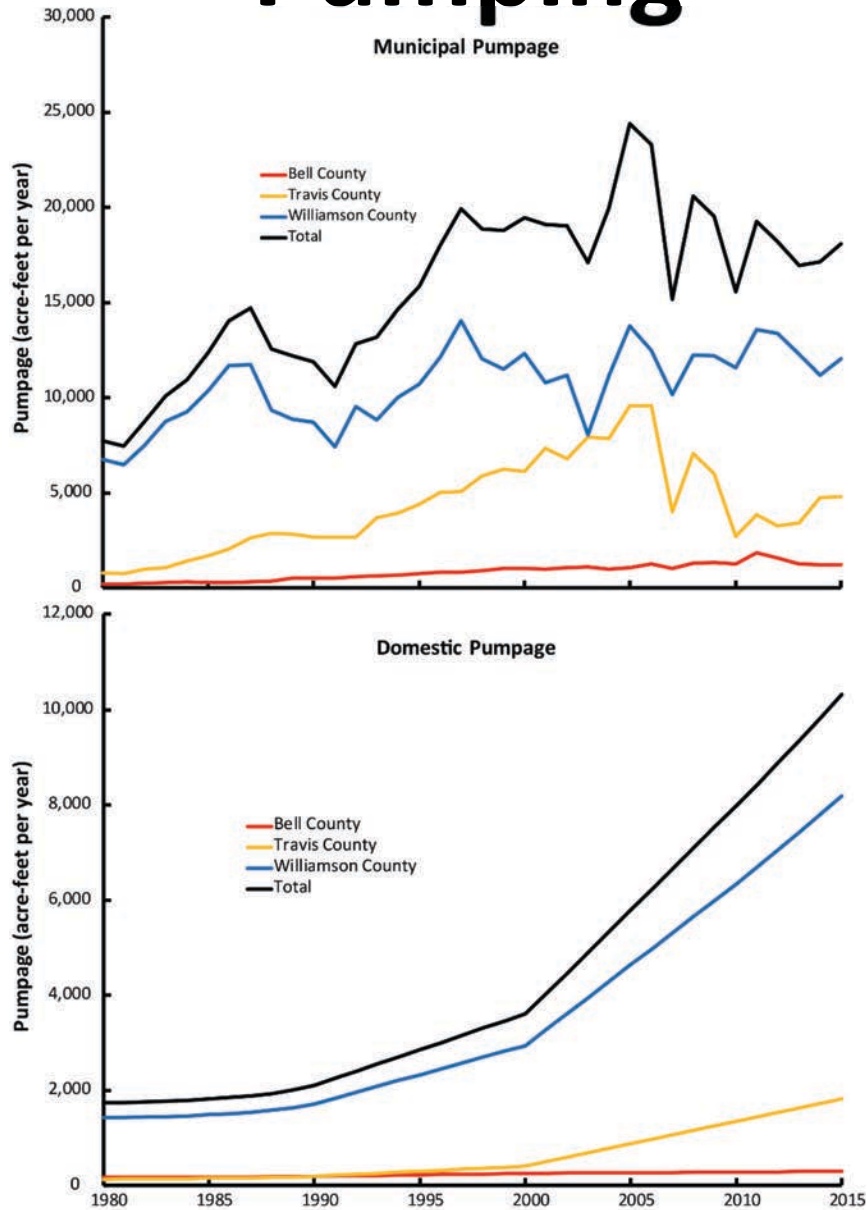
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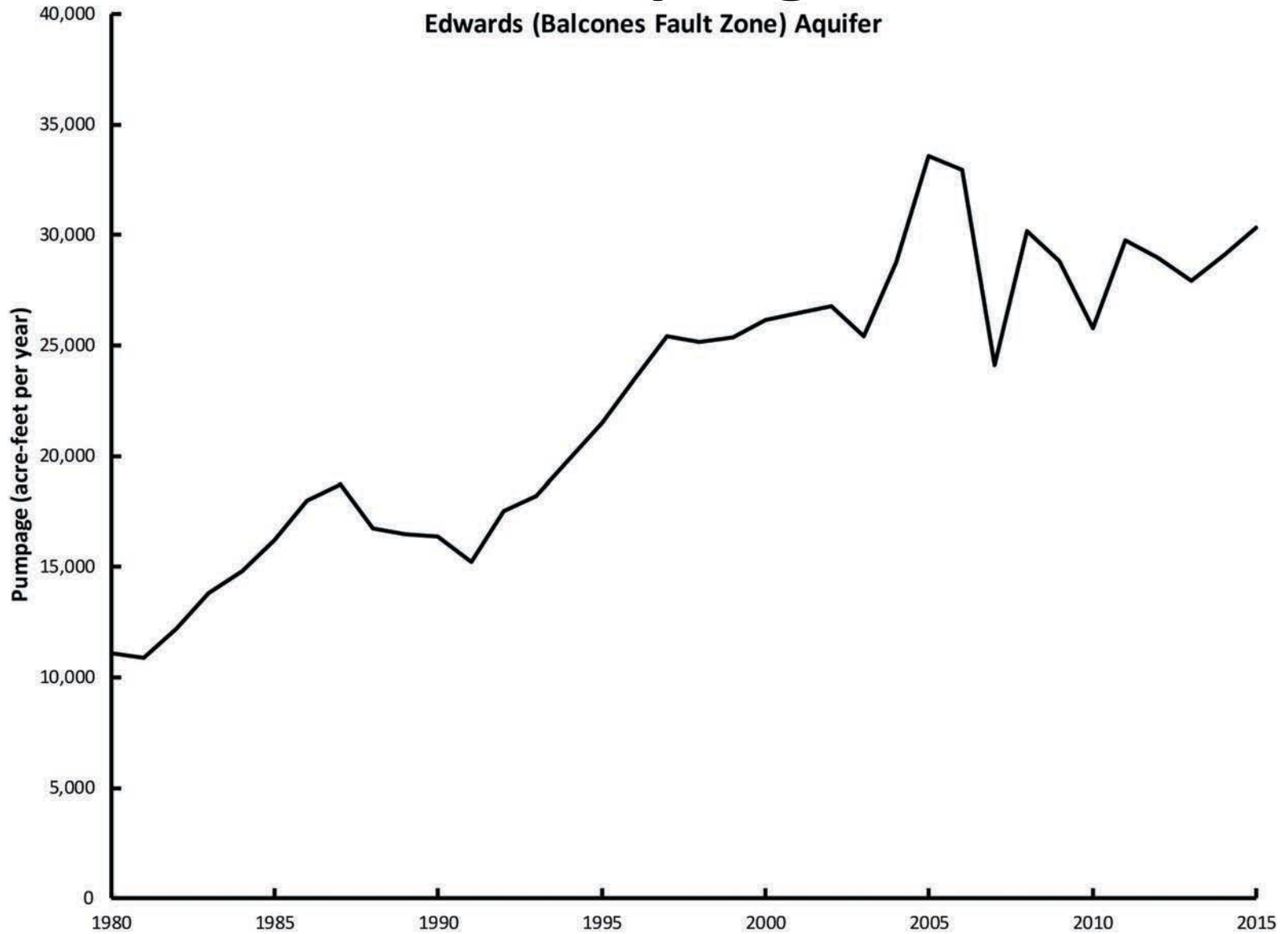


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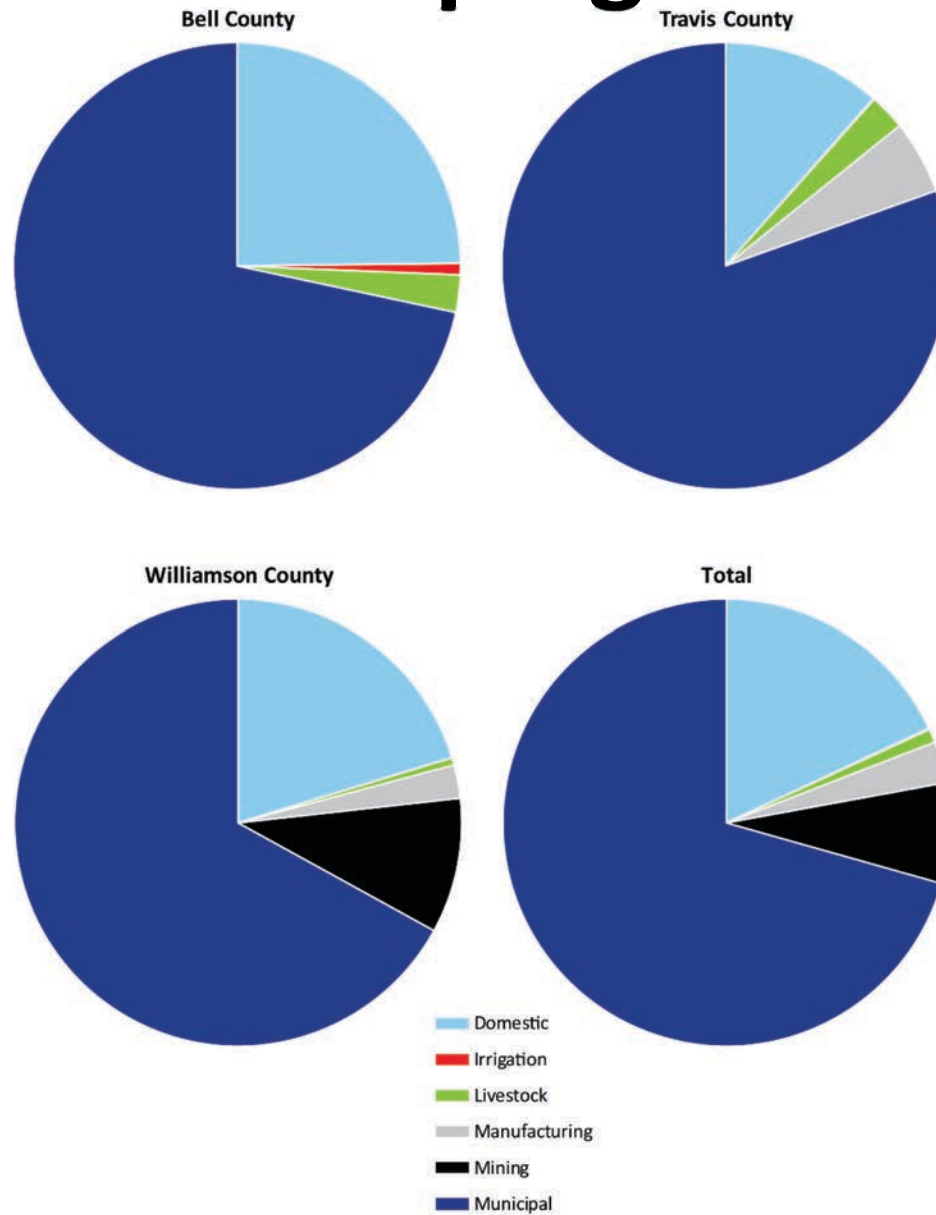


Pumping

Edwards (Balcones Fault Zone) Aquifer

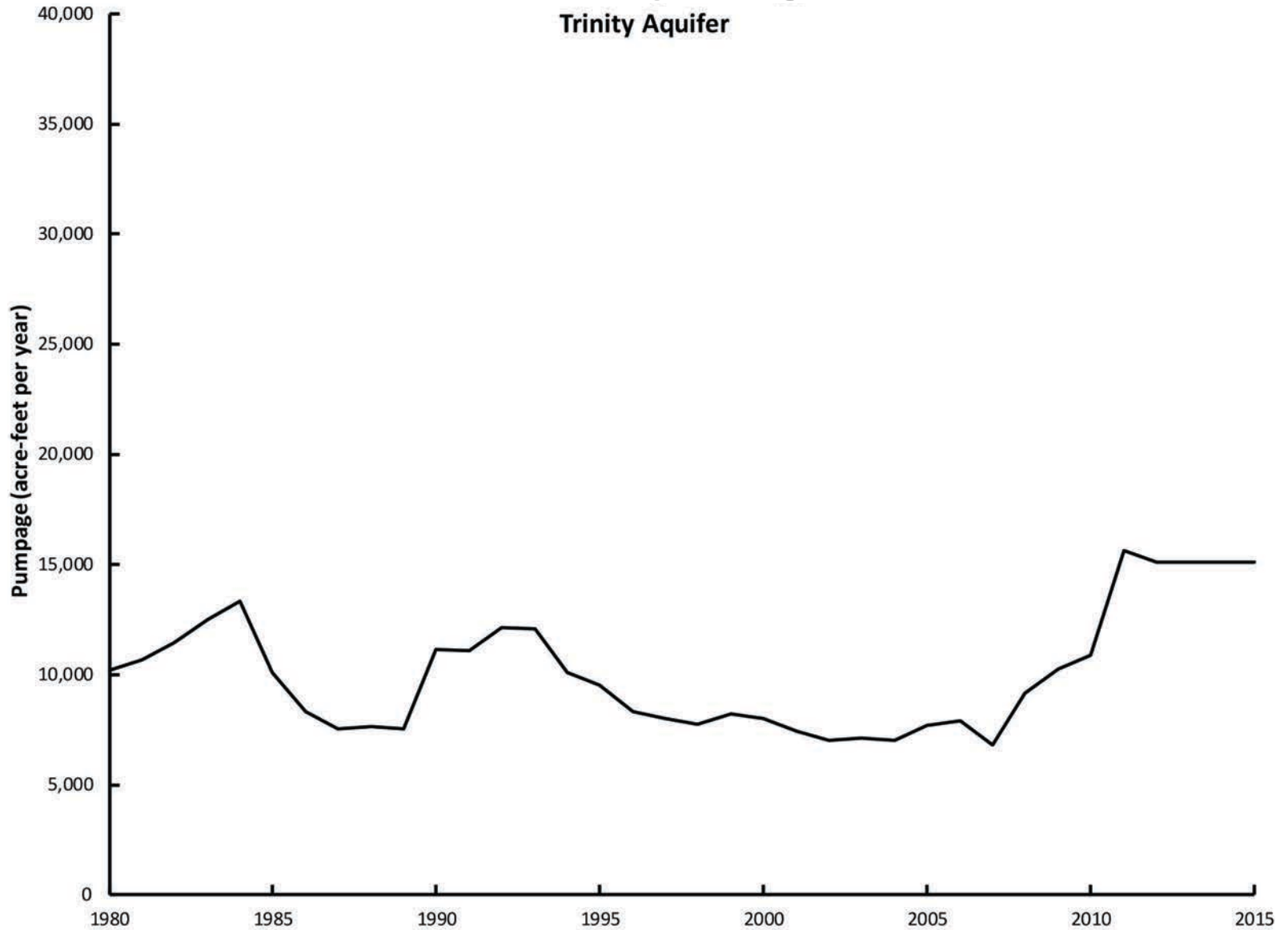


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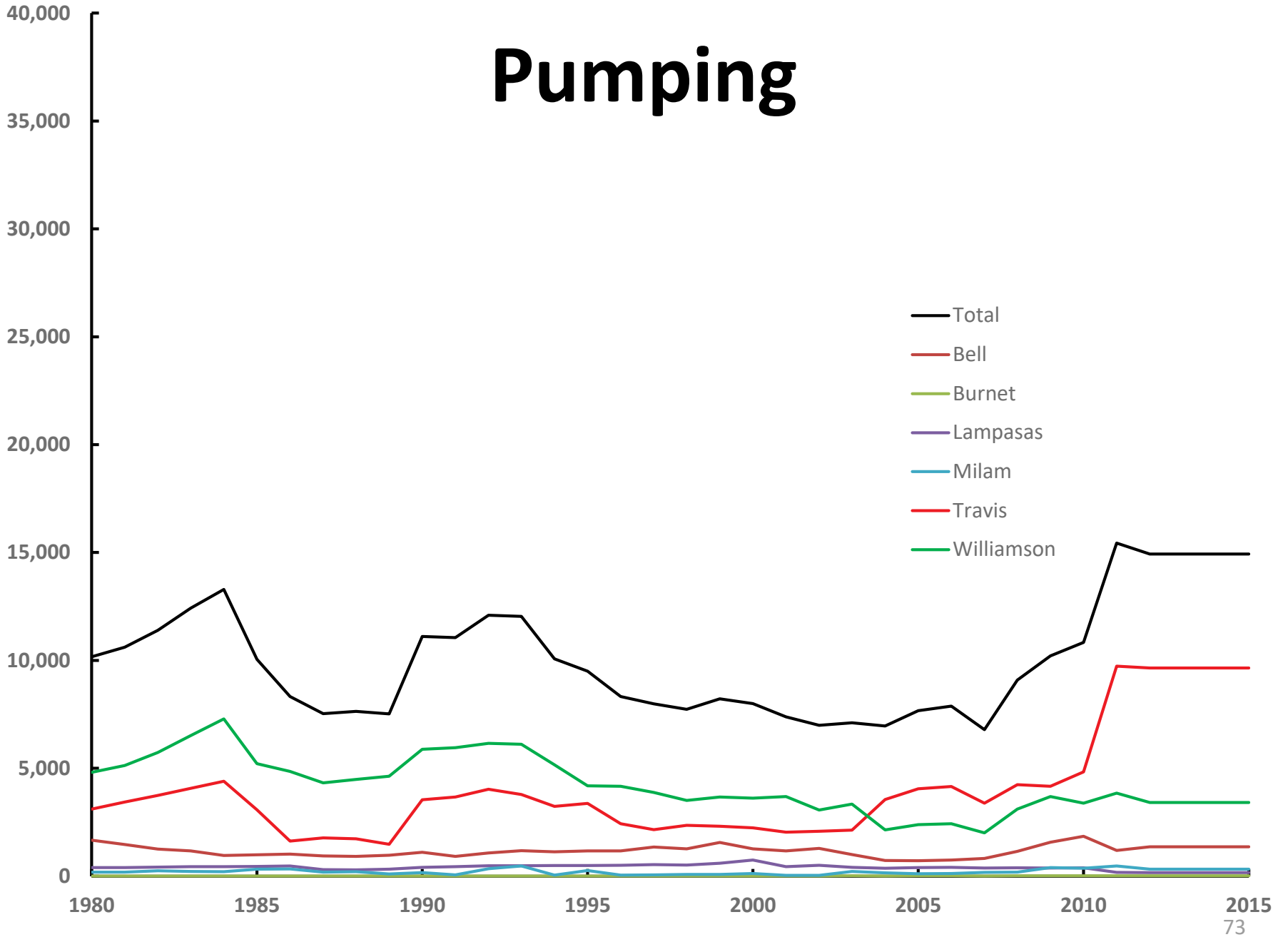


Pumping

Trinity Aquifer

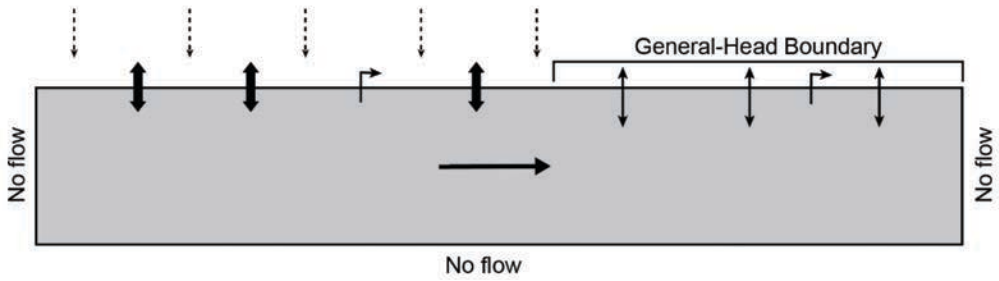
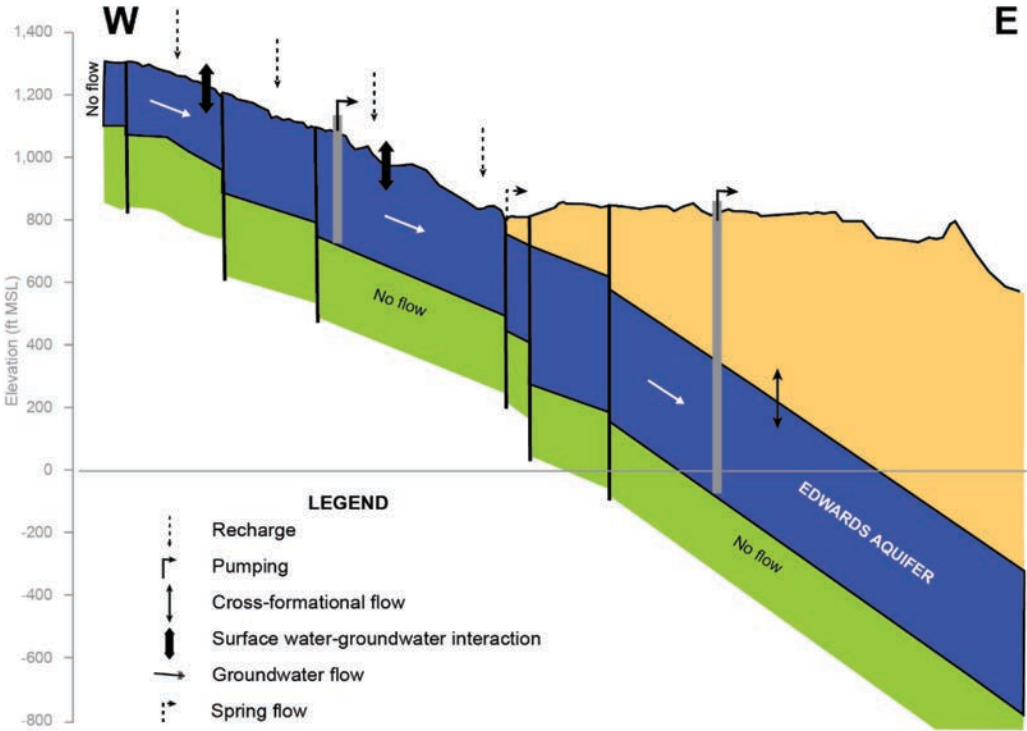


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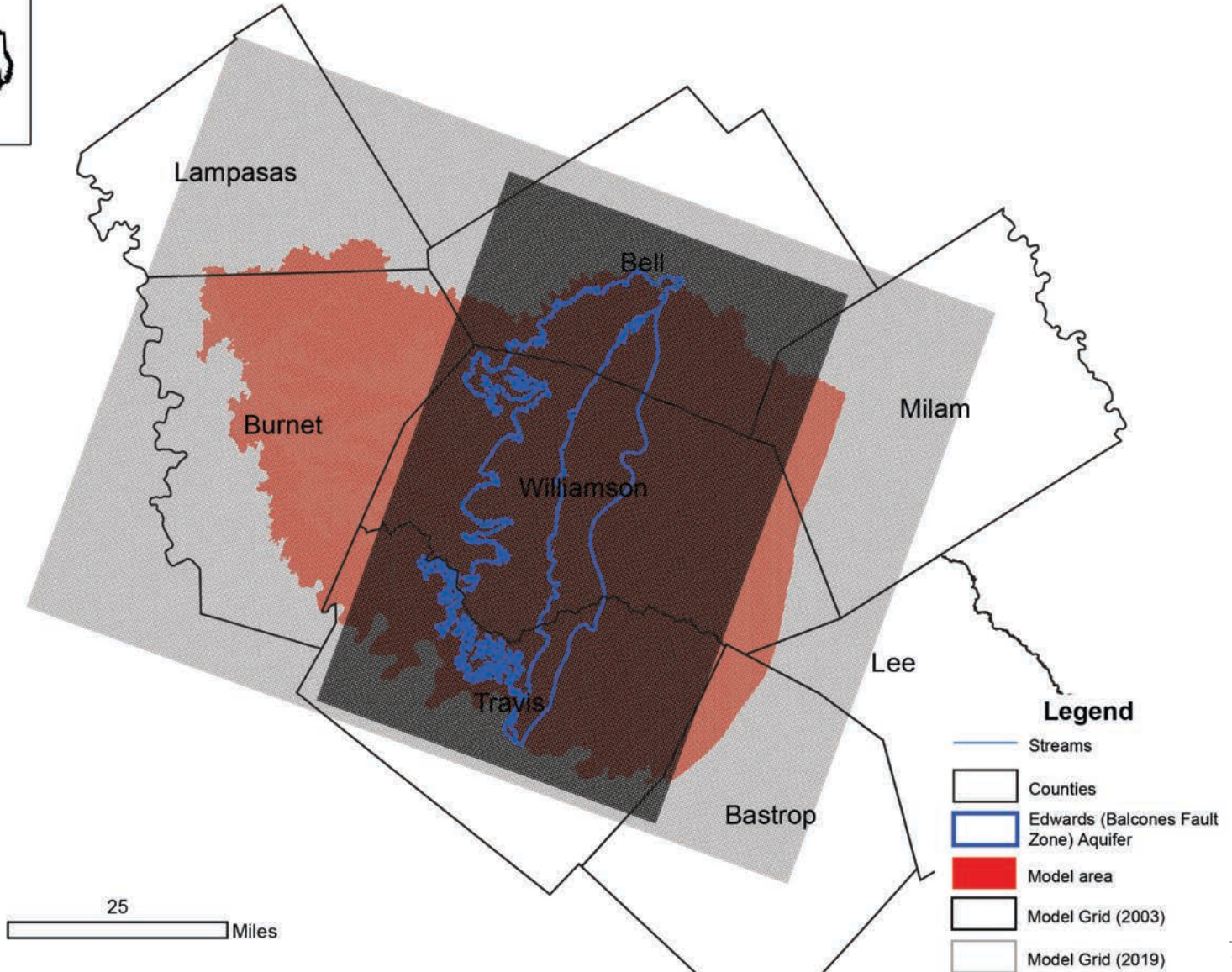


Conceptual Model

Conceptual Models



Model Grid



PROJECT SCHEDULE



Model Update Process

- Revise conceptual model
 - Interaction with the Trinity Aquifer
- Review input data
 - Review other aquifer-related studies
 - Fill data gaps, where possible
 - Pumping volumes per well, where feasible
- Extend calibration period
- Current version of MODFLOW

Project Tasks and Proposed Schedule

Project Task	2018												2019												2020												2021																						
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D											
1.0 Project Management																																																											
2.0 Stakeholder Communication																																																											
2.1 Stakeholder Advisory Forums		X																																																									
3.0 Model Development																																																											
3.1 Data Collection and Conceptual Model																																																											
3.2 Model Design																																																											
4.0 Model Calibration																																																											
4.1 Steady-State Calibration																																																											
4.2 Transient Calibration																																																											
4.3 Sensitivity Analysis																																																											
5.0 Documentation																																																											
5.1 Data Model Documentation																																																											
5.2 Reporting																																																											

Contact Information

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Austin, Texas 78711-3231

Web information:

www.twdb.texas.gov/groundwater/models/gam/ebfz_n/ebfz_n.asp

Deadline for comments is August 14, 2020



Questions/Answers

Q1: Define what a stakeholder is.

A1: A stakeholder is anyone interested in the aquifer. Usually, stakeholders are the local groundwater conservation district, but any entity, or even the general public who are interested in aquifers are stakeholders.

Q2: How much is known about the Walnut Formation?

A2: The Walnut Formation is not as well known as the Edwards or Trinity Aquifer units because the well yields are very low. The Walnut Formation is mostly a clay unit, however, in some places it is made up of shells and is transmissive. Those shelly parts of the Walnut Formation are usually included in the Edwards Aquifer.

Q3: Why are there no irrigation wells in northern Williamson County?

A3: The map (Slide 64) only shows the location irrigation over the period 2001 through 2017. Irrigation pumping will be distributed based on land use.

Q4: The domestic pumping in the west of the Northern Edwards Aquifer outcrop does not account for domestic wells used for lawn irrigation.

A4: The domestic pumping is an initial estimate that may be adjusted during model calibration.

Q5: Will Clearwater Underground Water Conservation District have a seat at the table to offer data that have different perspective?

A5: We will be happy to see all data relevant to the project.

Questions/Answers

Q6: Could you talk about the differentiation of Trinity Aquifer? Is there any information from the original northern Edwards Aquifer model that you can integrate? Undifferentiation of the Trinity Aquifer could be problematic.

A6: The Trinity Aquifer is merged into one layer because it is not the primary focus of the model. The Trinity Aquifer is more of a boundary condition. The multilayer groundwater availability model of the northern Trinity Aquifer is more appropriate for analyze of the Trinity Aquifer in the study area.

Q7: What evidence is there that there is groundwater flow between the Edwards and Trinity aquifer?

A7: Based on comparison of water levels in the respective aquifers. Large water level differences (Slide 53) indicate no communication between the aquifers in some areas, while in other areas, water levels are similar and move in lockstep with each other (Slide 54) suggesting communication between the aquifers in that area.

Q8: Do you plan to calibrate the Trinity Aquifer in the model?

A8: Yes.

Q9: The way the model is conceptualized, the Trinity Aquifer outflows through the Edwards Aquifer. Do you risk forcing groundwater flow from the Trinity to the Edwards, artificially increasing the availability in the Edwards Aquifer?

A9: One of the reasons we included the Walnut Formation in the model was as a tight confining unit restricting flow between the two aquifers.

Q10: Can you discuss the decision to include vertical communication between the Trinity and Edwards aquifers? In northwest Austin, water discharges from the Edwards Aquifer and there is little water in the Trinity Aquifer.

A10: That is the explanation for the large water-level difference observed (in Slide 53) where the groundwater in the Edwards Aquifer is probably perched and there is probably an unsaturated zone at the top of the Trinity Aquifer. I do not think the connection between the two aquifers occurs everywhere.

Questions/Answers

Q11: One Edwards Aquifer well has significant fluctuations. Is there any significance to that or is it an outlier well since the other wells trend consistently?

A11: The seasonal water-level fluctuations are observed in wells with daily water-level measurements (Slide 47) while other wells have less frequent water-level measurements.

Q12: The previous model indicated little or no communication except along known faults. How is this model different, is it location specific?

A12: The previous model assumed no communication between the Edwards and Trinity aquifers. In this model, we assume at least some communication, possibly along faults.

Q13: Who is involved in model development and how is the program paid for?

A13: I work for the Groundwater Availability Modeling Department at the Texas Water Development Board which is responsible for developing or overseeing the development of all the TWDB groundwater availability models. The program is paid for with tax dollars.

Q14: What are future water model projects? What aquifer segments will they cover and how chosen?

A14: The models have been paid for with legislative appropriations since the 1990's.

We work with our staff at the TWDB and contract with technical services firms around the state to construct models. Currently, we are working on updates to groundwater availability models for the Edwards-Trinity (Plateau), Trinity (Hill Country), and Pecos Valley aquifers, as well as, models for the northern and southern portions of the Carrizo-Wilcox Aquifer, and the combined southern and central parts of the Gulf Coast Aquifer. In the future, we will be upgrading about 23 of our models to use the most recent software codes.

We are finishing up some of the minor aquifers, wrapping up the model for the Blossom Aquifer and have contracted out development of a conceptual model for the Cross Timbers and Marathon aquifers.

List of Attendees

Name	Affiliation	Name	Affiliation	Name	Affiliation
Andrew Donnelly	D.B. Stephens & Associates	Evan Strickland	TWDB	John Ellis - USGS	U.S. Geological Survey
Andrew Weinberg	TWDB	Grayson Dowlearn	TWDB	John Mikels	GEOS Consulting
Brian Hunt	Barton Springs/Edwards Aquifer Conservation District	Grayson Dowlearn	TWDB	Joseph duMenil	Trinity Glen Rose GCD
Brian Smith	Trihydro Corporation	Ian Jones	TWDB	Ken Kramer	Sierra Club - Lone Star Chapter
Changbing Yang	Edwards Aquifer Authority	Intern- CUWCD	Clearwater UWCD	Kendall Bell-Enders	Barton Springs/Edwards Aquifer Conservation District
Cindy Ridgeway	TWDB	James Beach	WSP	Ki Cha	TWDB
Craig Bennett	Bullock, Bennett & Associates	Jamie Childers	Edwards Aquifer Authority	Kirk Holland	Holland Groundwater Management Consultants LLC
Daniel Meyer	Plum Creek Conservation District	Jim Briggs	Private citizen	Kodi Sawin	Southwest Travis County GCD
Daryn Hardwick	TWDB	Jim Winterle	Edwards Aquifer Authority	Larry French	TWDB
Dirk Aaron	Clearwater UWCD	John Dupnik	TWDB	Lola Fender- Sen. Schwertner	Texas Legislature

List of Attendees (cont.)

Name	Affiliation	Name	Affiliation	Name	Affiliation
Maggie Behnke	Blanton Associates	Ripendra Awal	Prairie View A&M University	Yelderman, Joe C.	Baylor University
Marcus Gary	Edwards Aquifer Authority	Robert Bradley	TWDB	Zach Dooley	Texas Legislature
Mark Robinson	TWDB	Roberto Anaya	TWDB		
Micaela Pedrazas, LREWater	LRE Water	Rohit Goswami	WSP		
Michael Redman		Ryland Howard	Headwaters Alliance		
Mike Gershon	Lloyd Gosselink Rochelle & Townsend, P.C.	Shirley Wade	TWDB		
Mike Keester (LRE Water)	LRE Water	Stephanie Moore	D.B. Stephens & Associates		
Natalie Ballew	TWDB	Stephanie Wong	Baylor University		
Peter George	Collier Consulting, Inc.	Thomas Hill	Guadalupe-Blanco River Authority		
Rep. Vikki Goodwin	Texas Legislature	Vince Clause	Allan R. Standen LLC		

