



Bandera County Water Talk

Managing our groundwater resources

Natalie Ballew, P.G.

Groundwater Division Director, TWDB

February 29, 2024

Texas Water Development Board



DATA & SCIENCE



PLANNING



FINANCE

What we'll talk about



Groundwater: The Basics



Bandera County Aquifers



Joint Groundwater Planning



Groundwater Management: Who does what?

Groundwater: The Basics

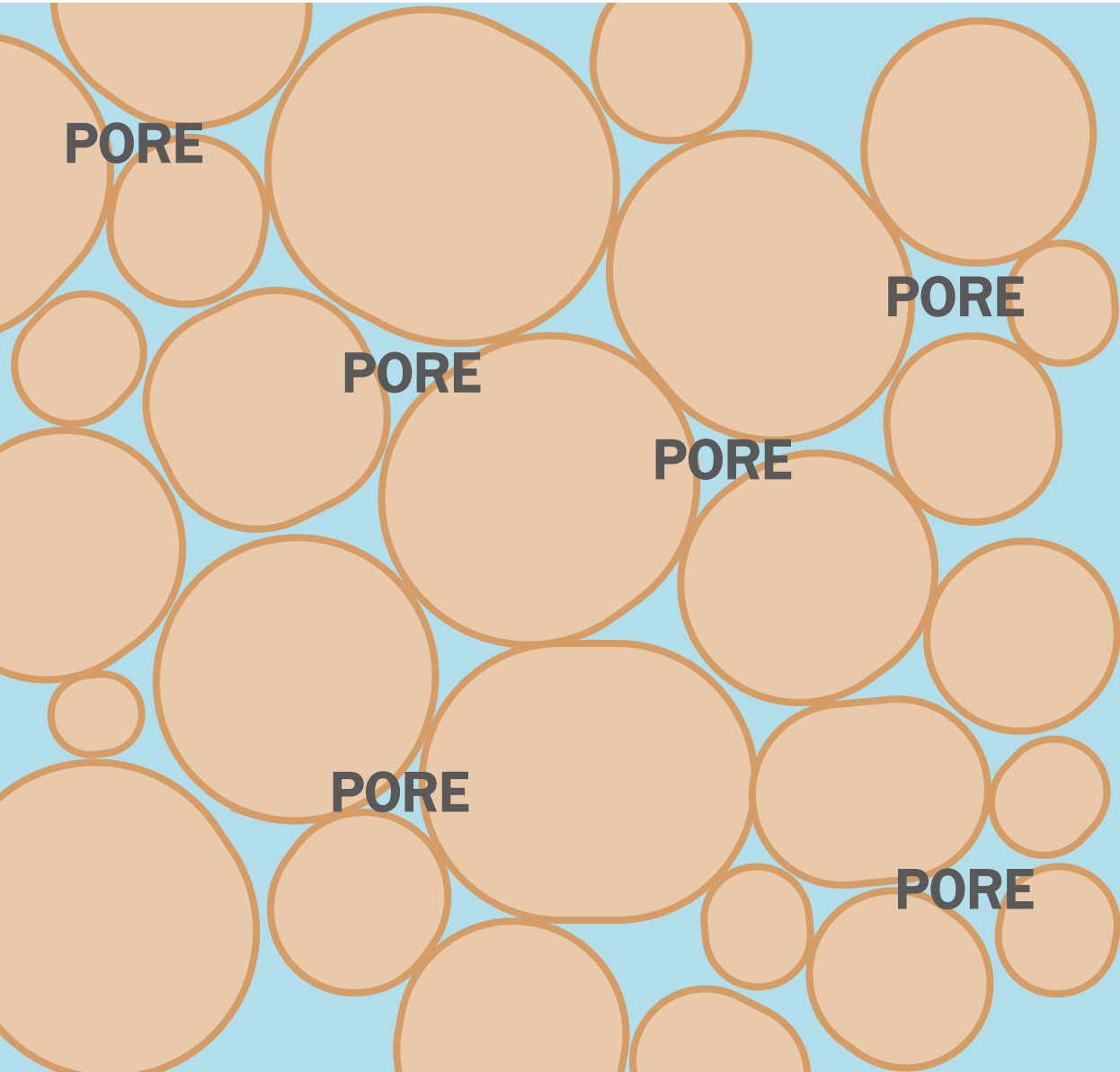


DIRT & ROCKS

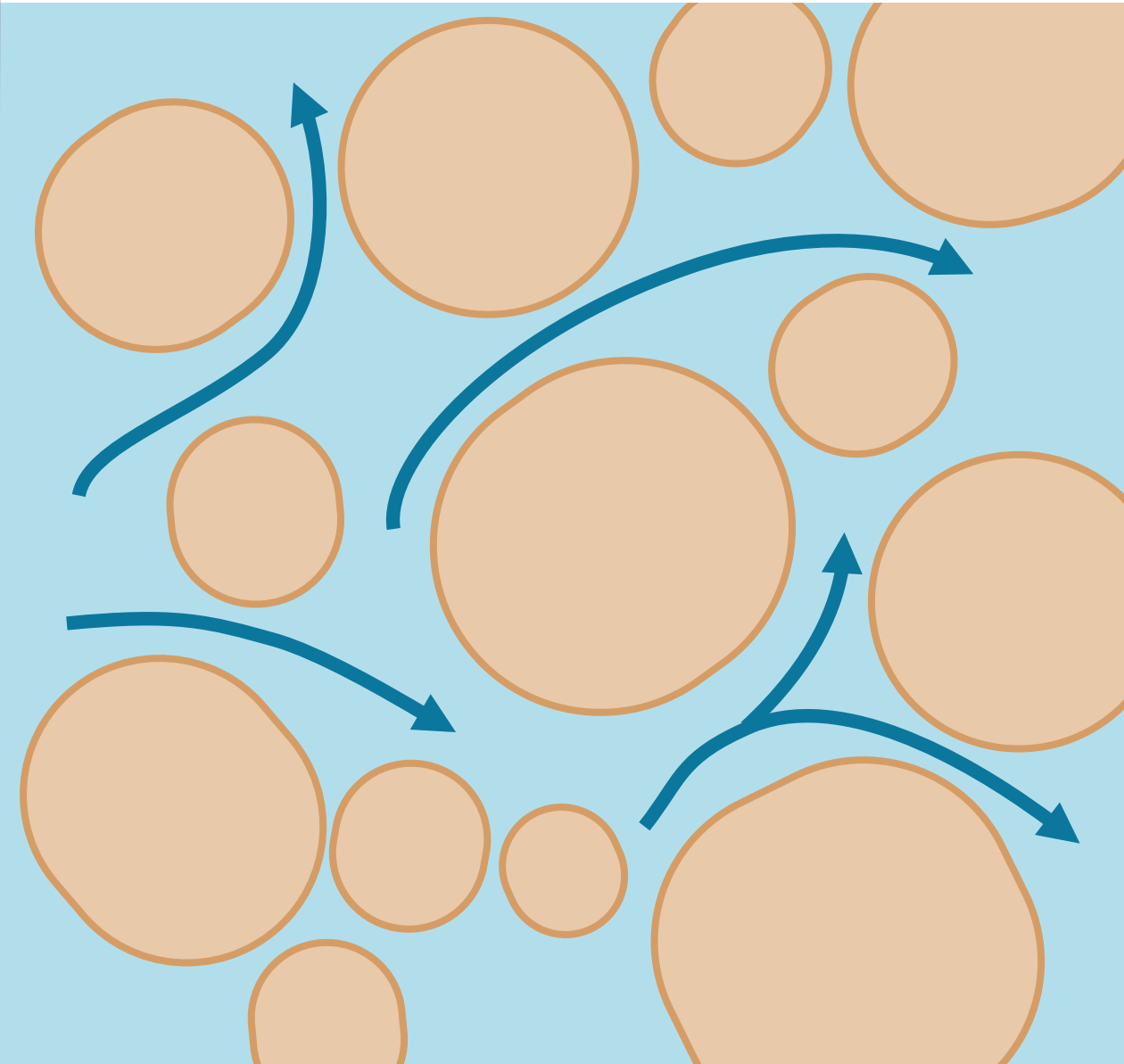


An aquifer is a **geologic media** that can yield **economically usable** amounts of water

porosity



permeability

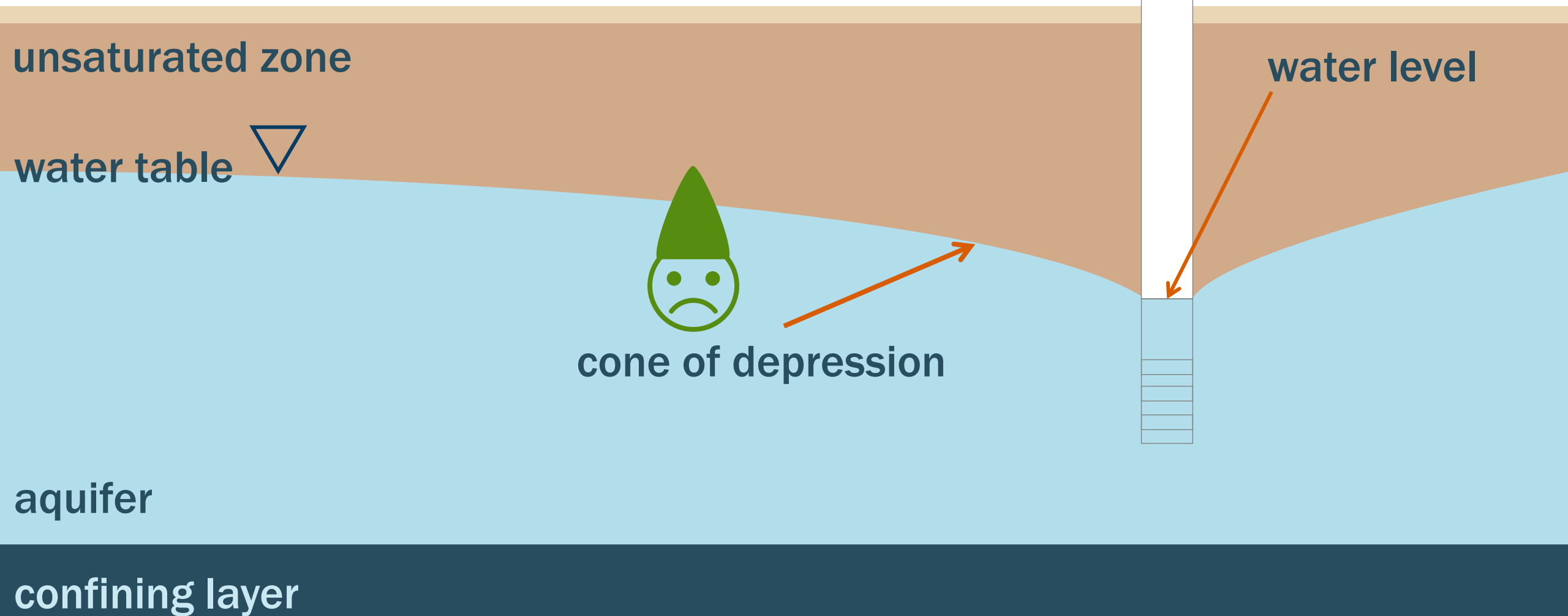


Two general types of aquifers

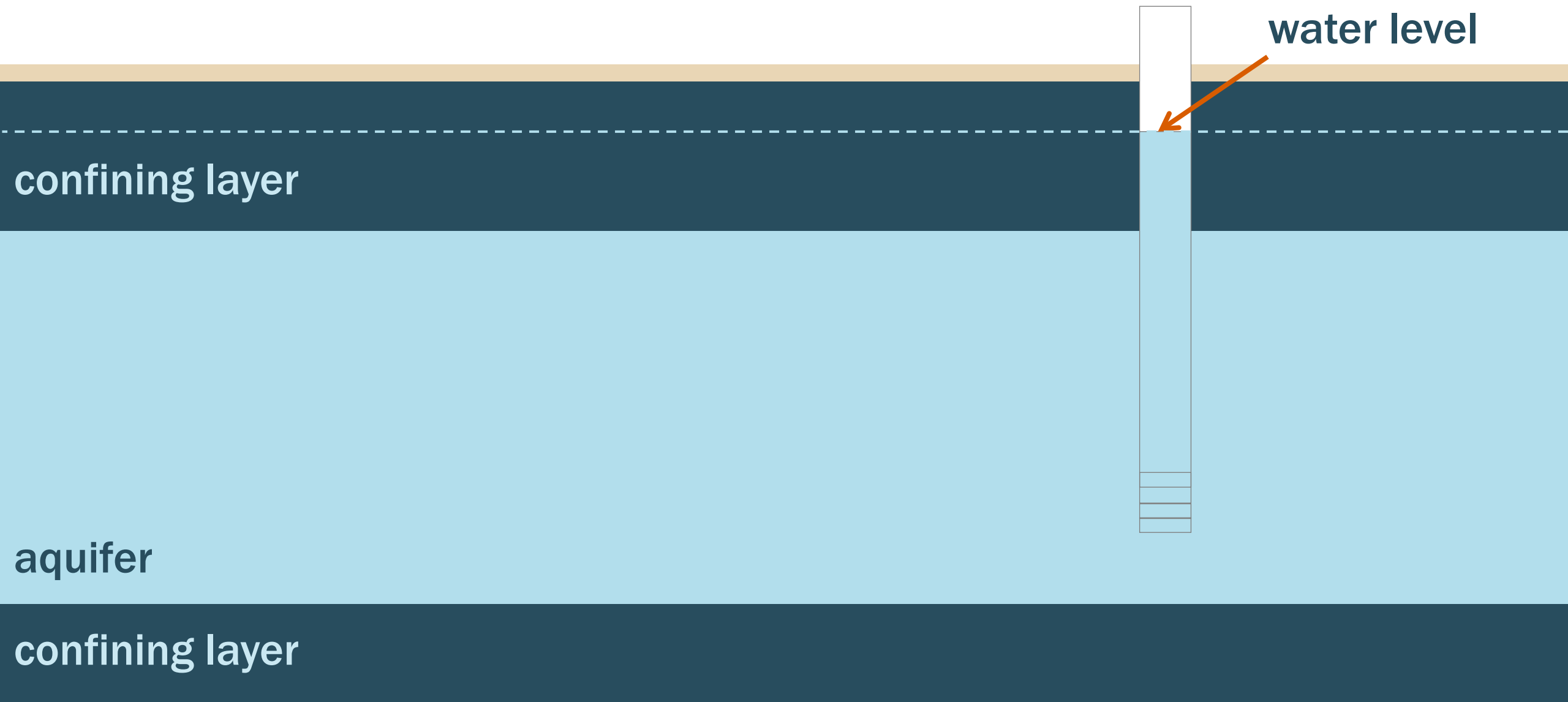
Unconfined aquifer



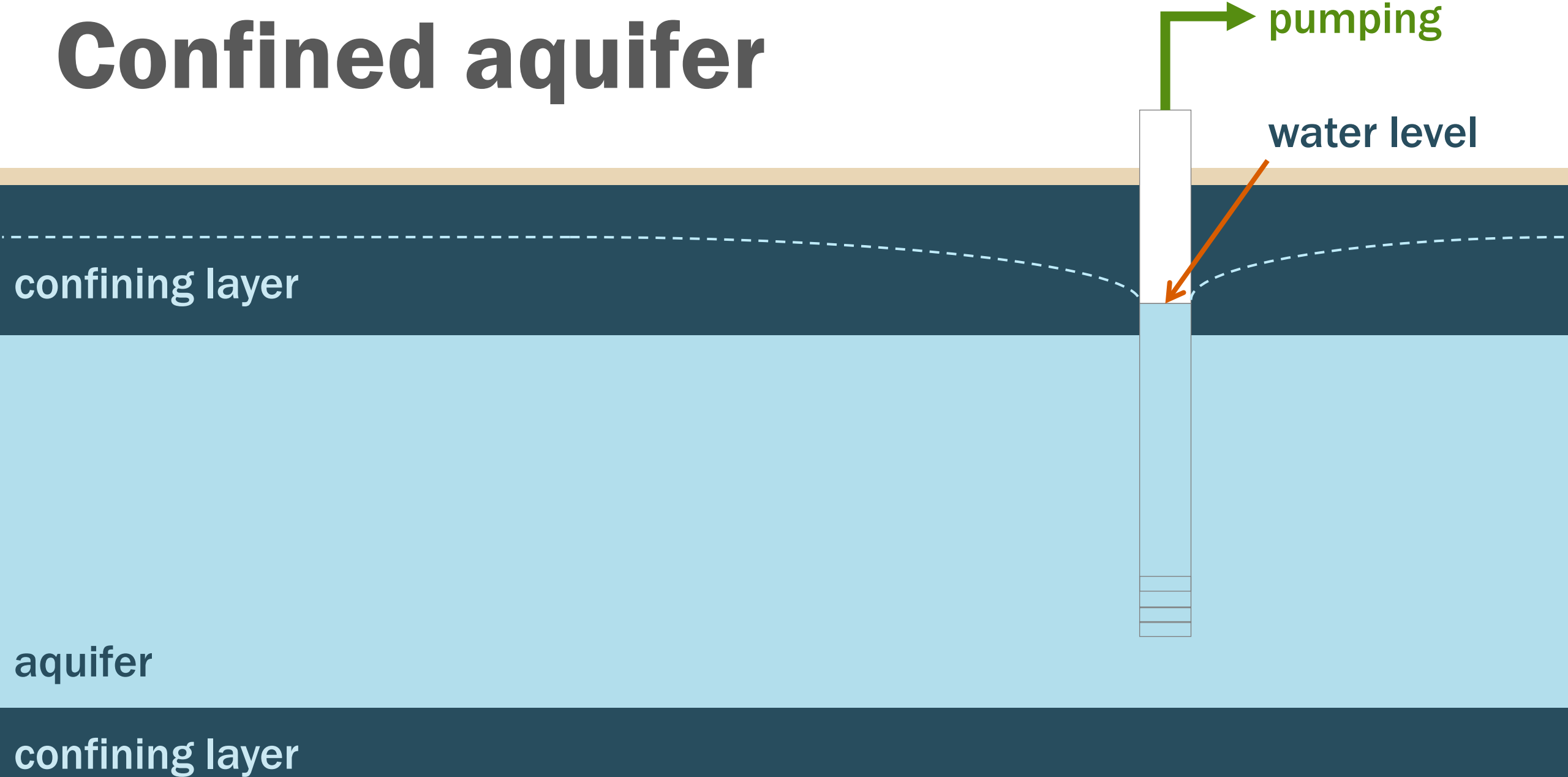
Unconfined aquifer



Confined aquifer



Confined aquifer



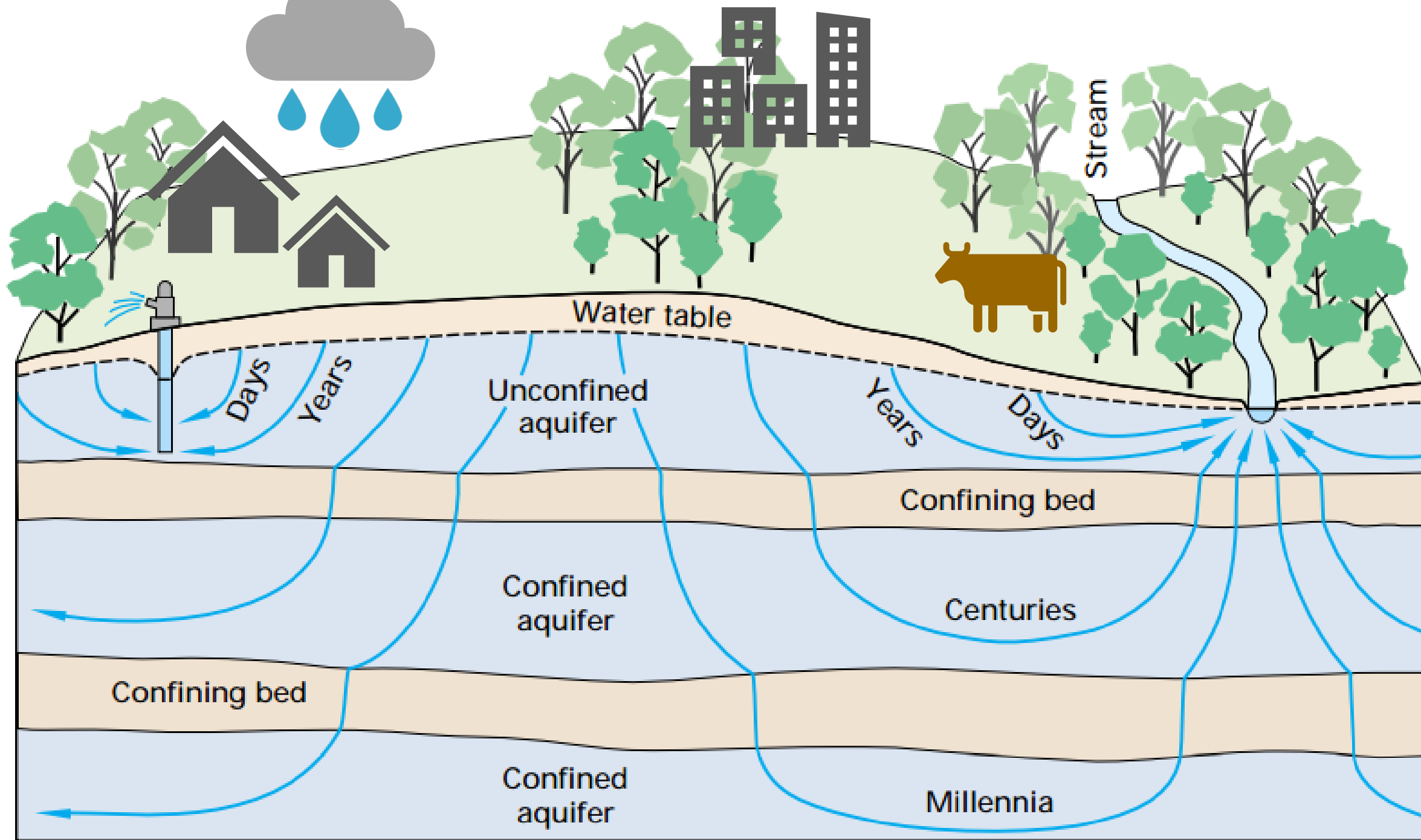
pumping

water level

confining layer

aquifer

confining layer



Water budgets



Inflows
like income



Aquifer storage
like a bank account



Outflows
like spending

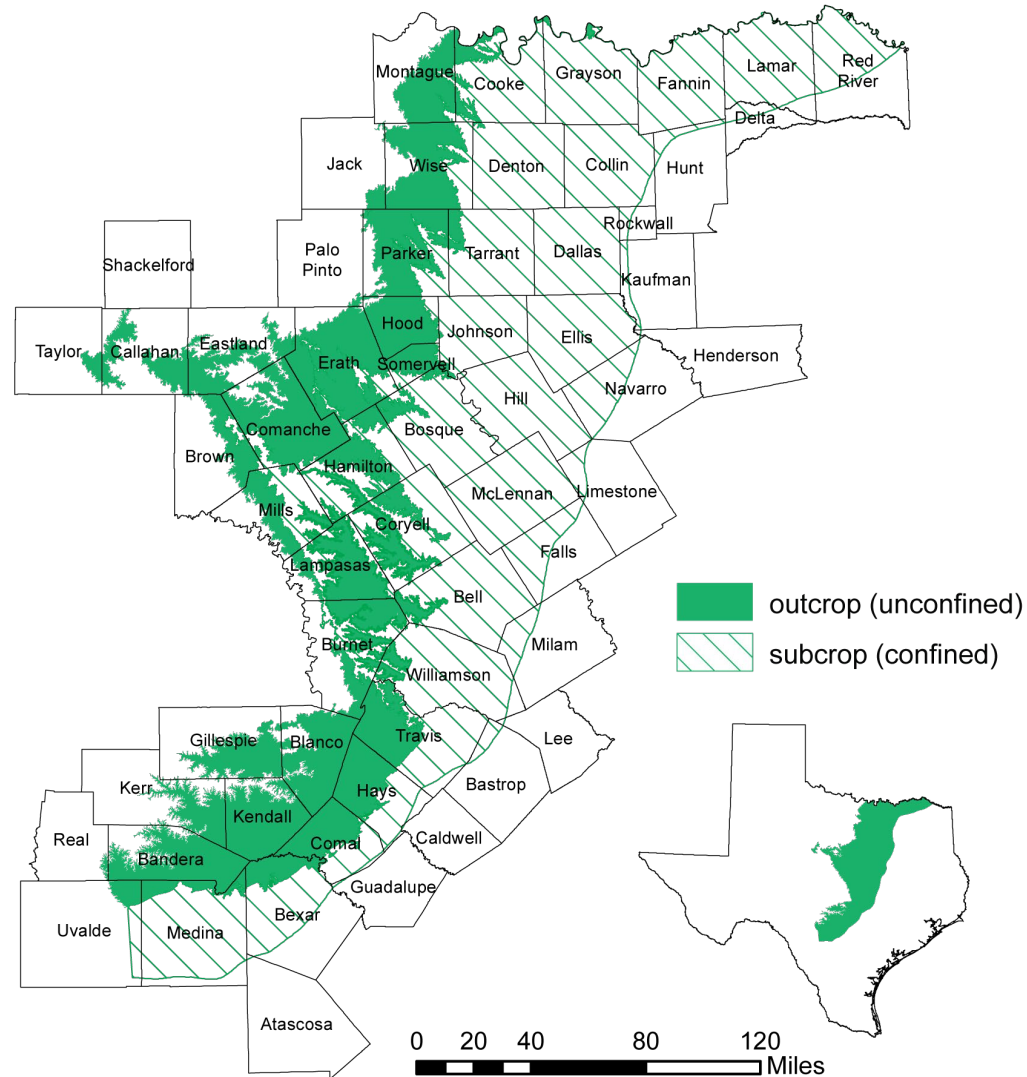


Bandera County

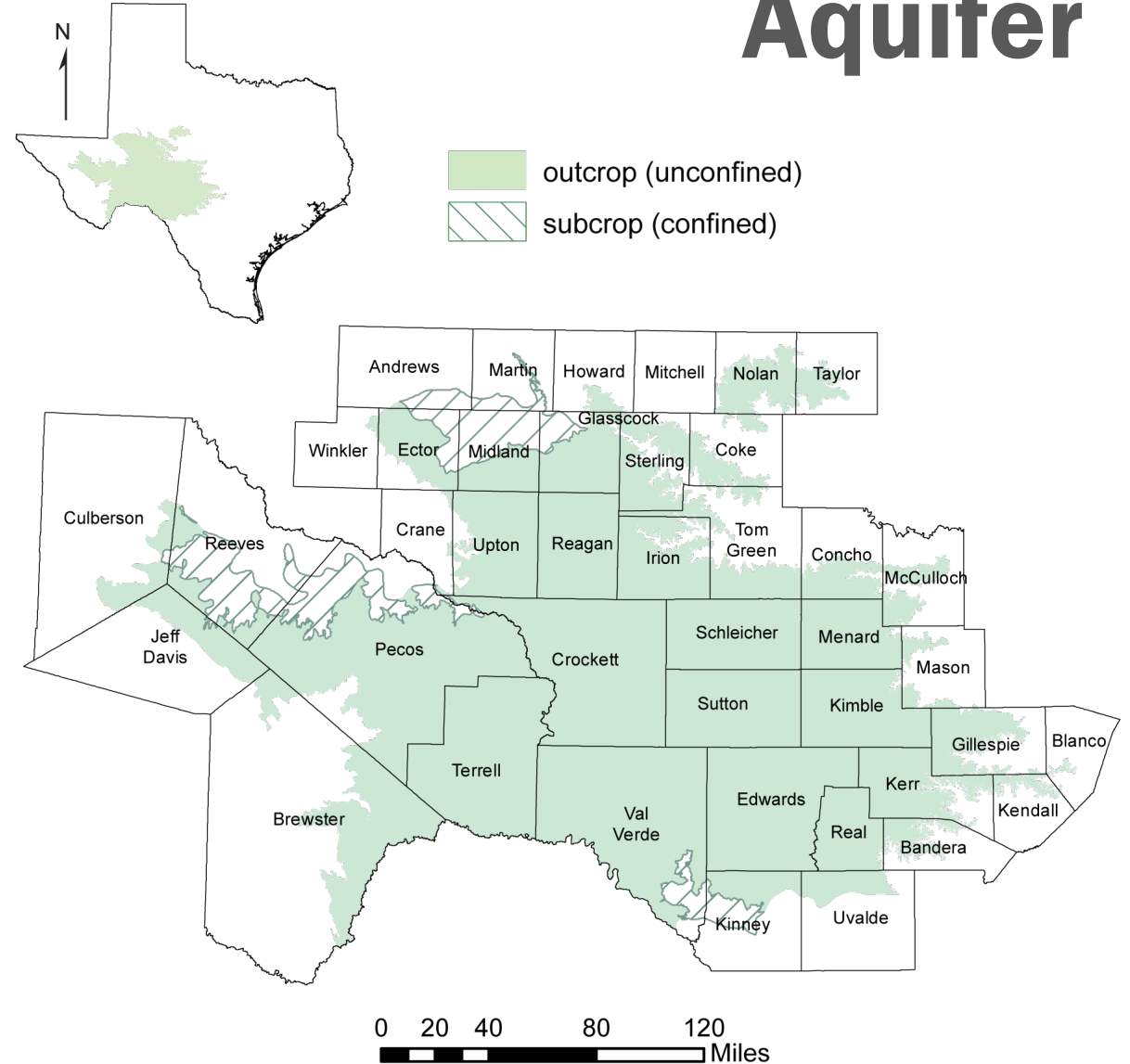
Aquifers



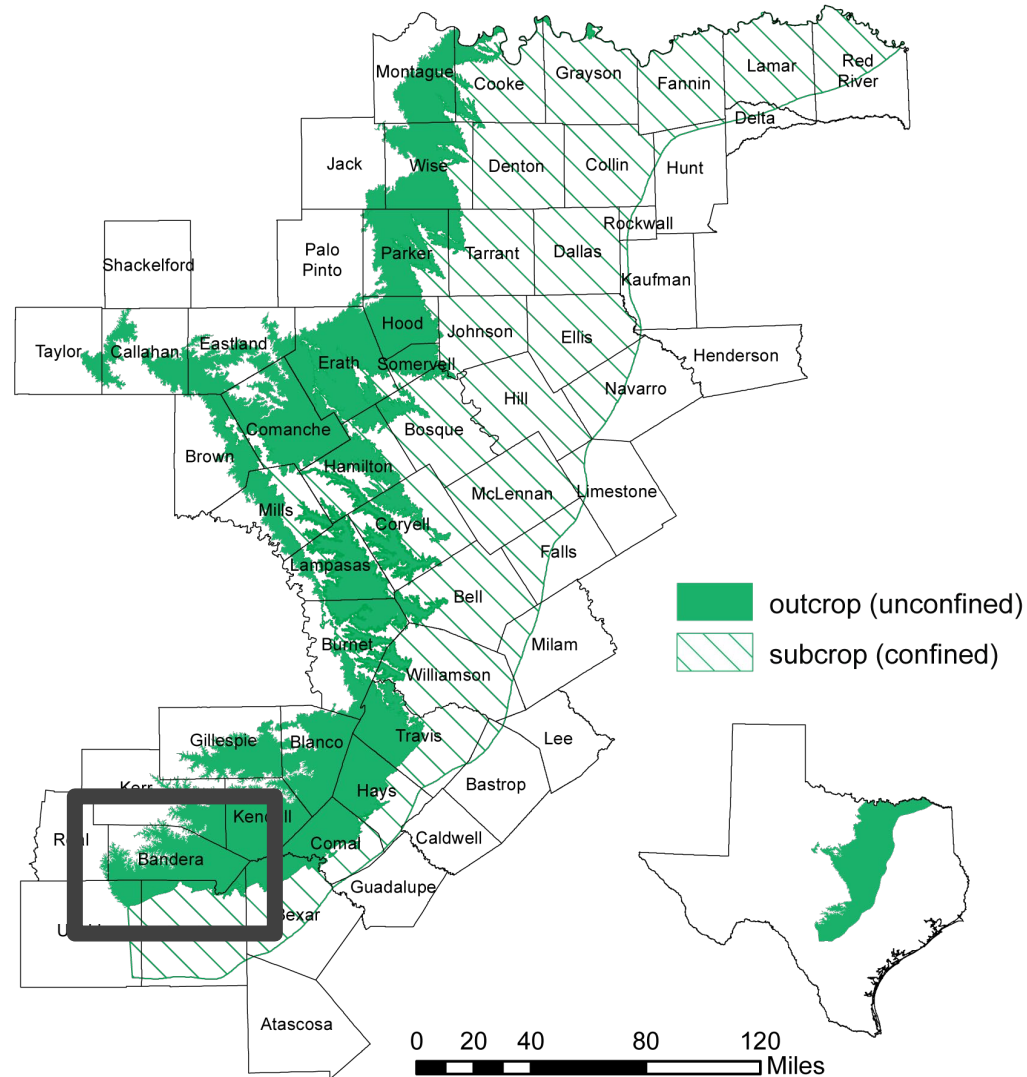
Trinity Aquifer



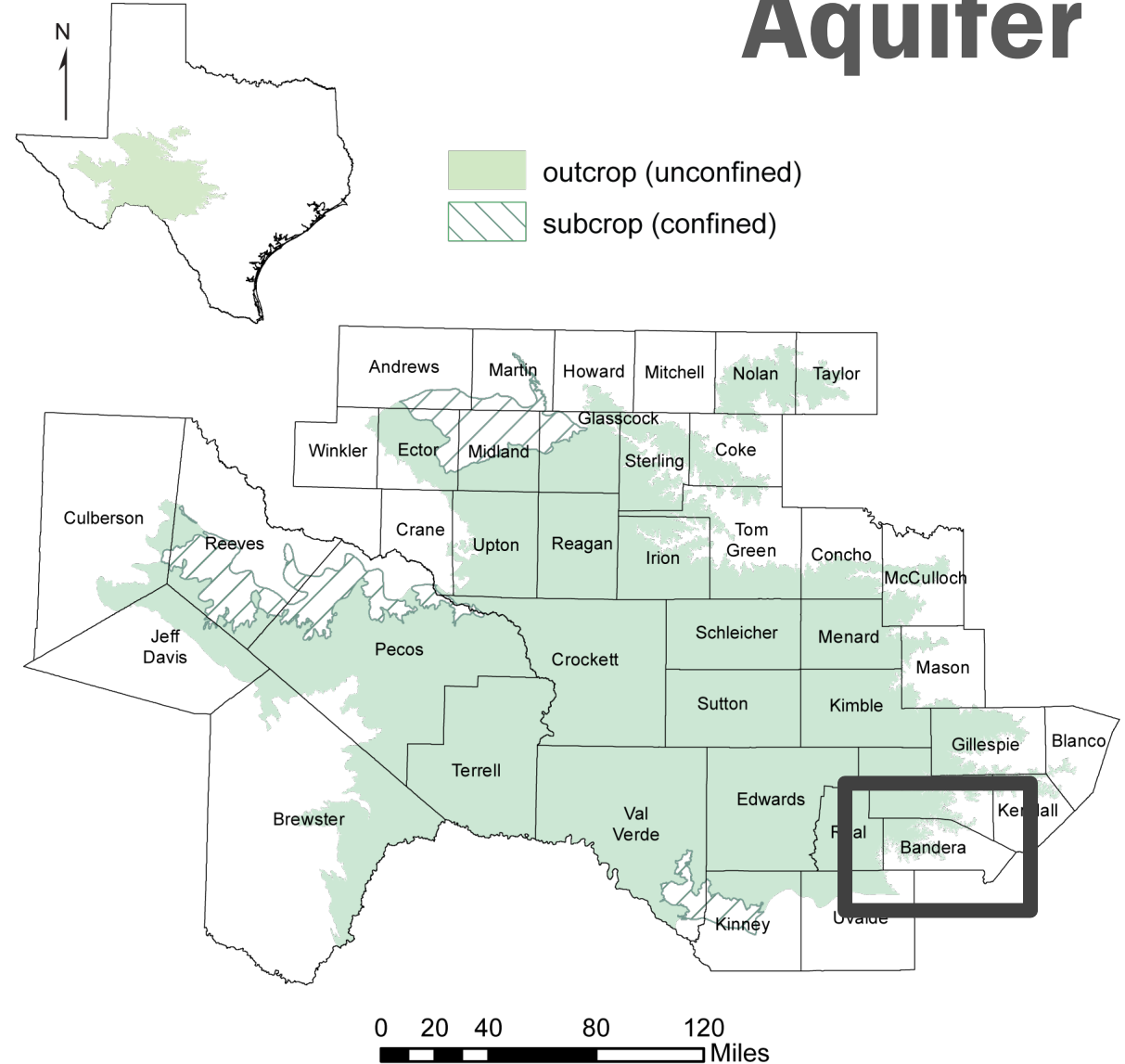
Edwards-Trinity (Plateau) Aquifer

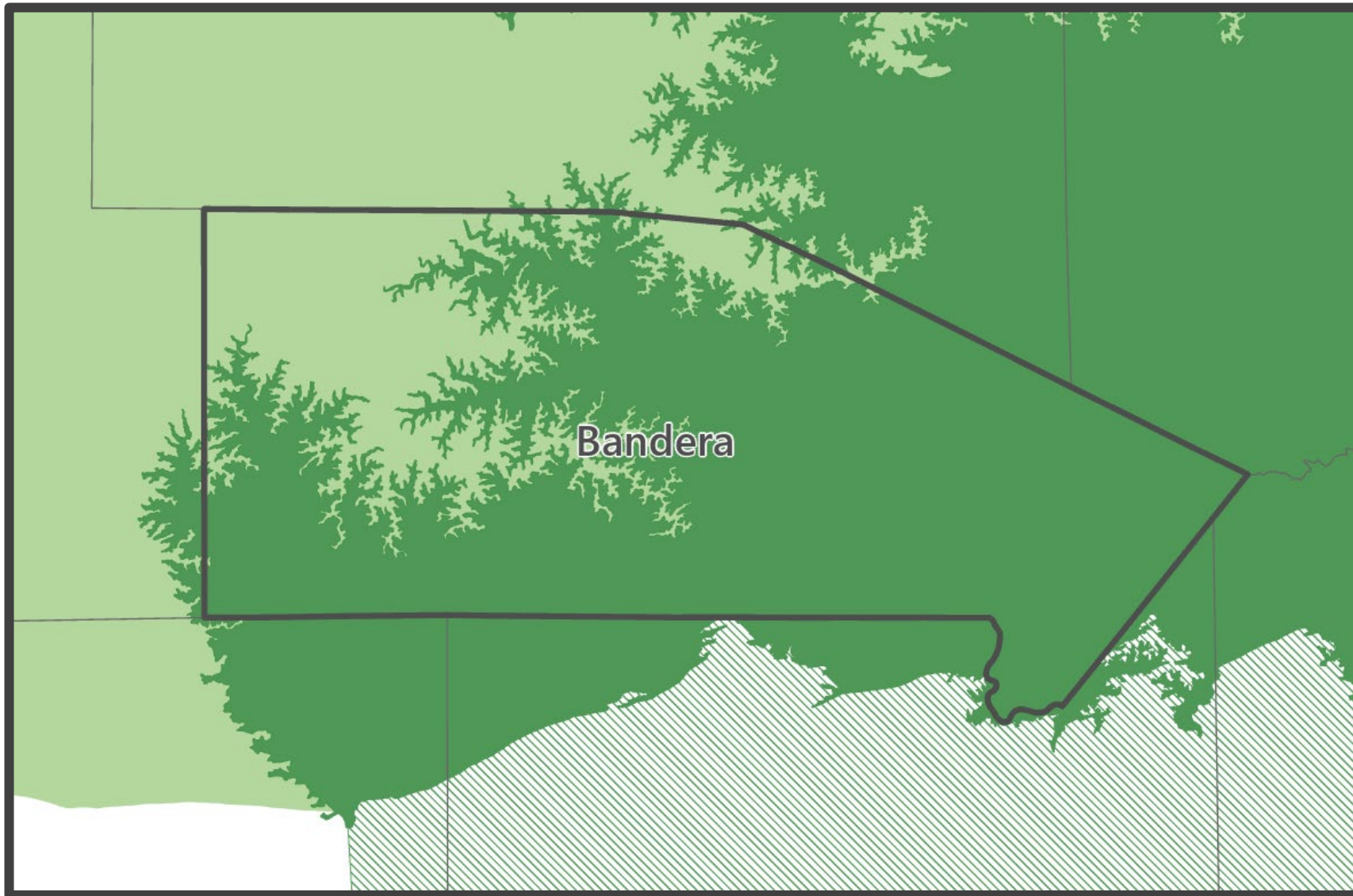


Trinity Aquifer



Edwards-Trinity (Plateau) Aquifer



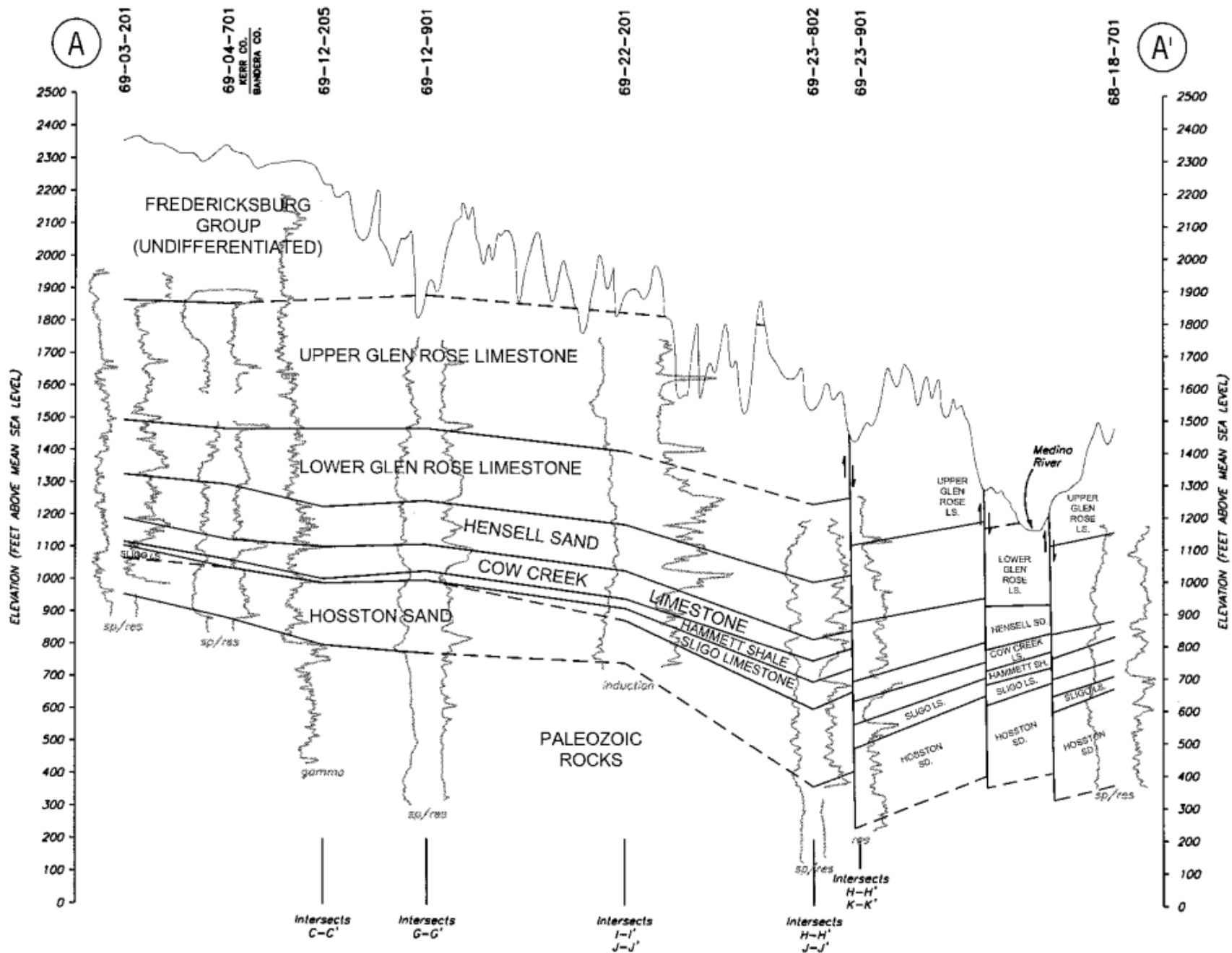


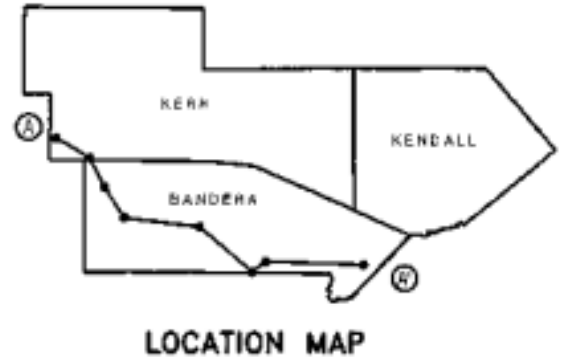
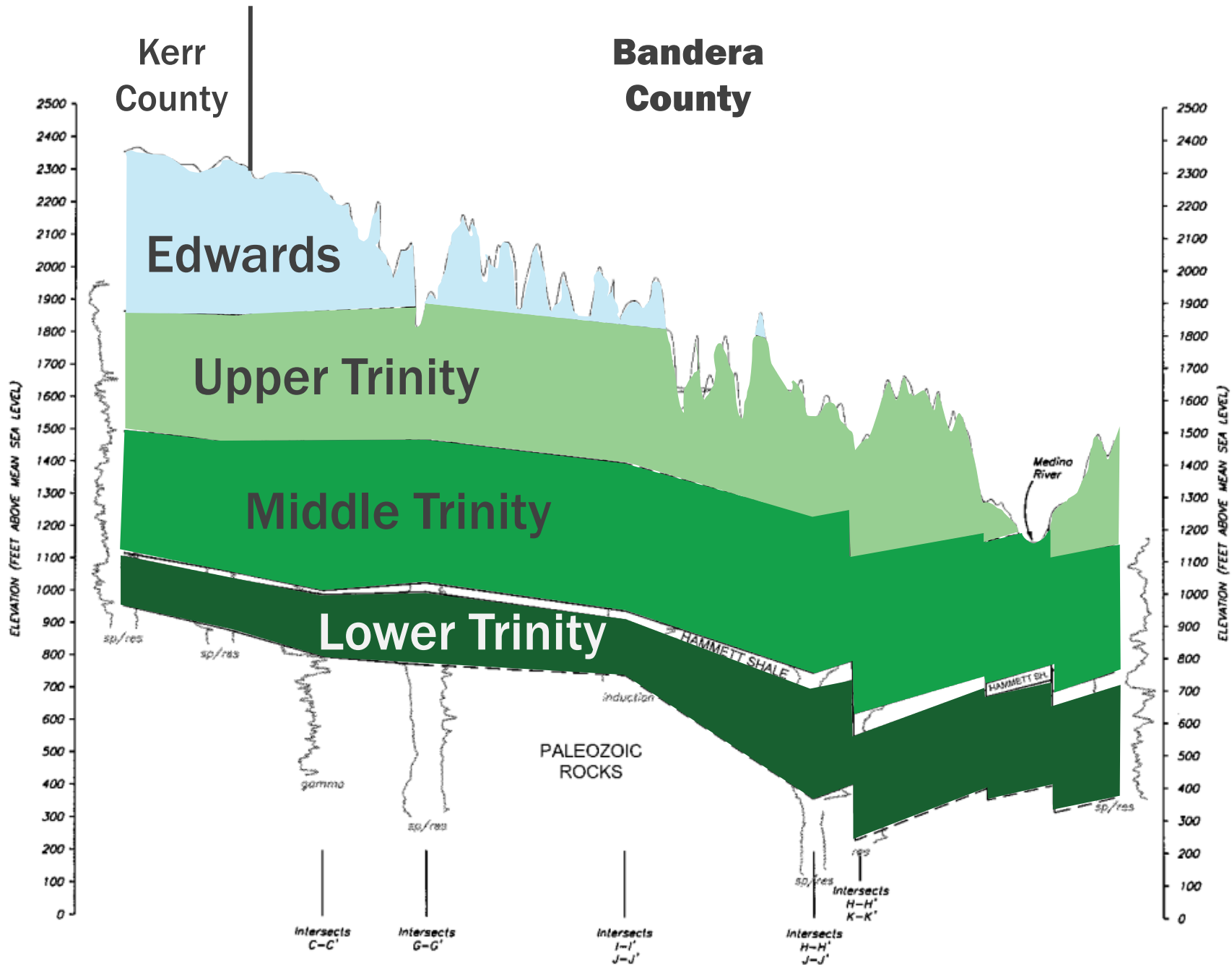
-  Edwards-Trinity (Plateau) Aquifer (outcrop/unconfined)
-  Trinity Aquifer (outcrop/unconfined)
-  Trinity Aquifer (downdip/confined)

↑
younger

↓
older

ERA	SYSTEM	GROUP	STRATIGRAPHIC UNIT		HYDROLOGIC UNIT		
Cenozoic	Quaternary		Alluvium		Alluvium		
Mesozoic	Cretaceous	Edwards	Segovia Formation		Edwards Group		
			Fort Terrett Formation				
		Trinity	Glen Rose Limestone	Upper Member		Trinity Aquifer System	Upper Trinity
				Lower Member			Middle Trinity
			Hensell Sand/Bexar Shale				
			Cow Creek Limestone				
			Hammett Shale		confining unit		
Sligo Formation		Lower Trinity					
Sycamore Sand/Hosston Formation							
Paleozoic			Undifferentiated Pre-Cretaceous rock				







Search Google Maps



Ranch Rd 337

Vanderpool, Texas



Google Street View

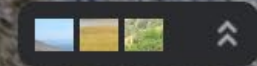
Dec 2022

[See more dates](#)

Edwards-Trinity (Plateau) Aquifer Fort Terrett Formation



Google





Search Google Maps



Ranch Rd 337

Vanderpool, Texas



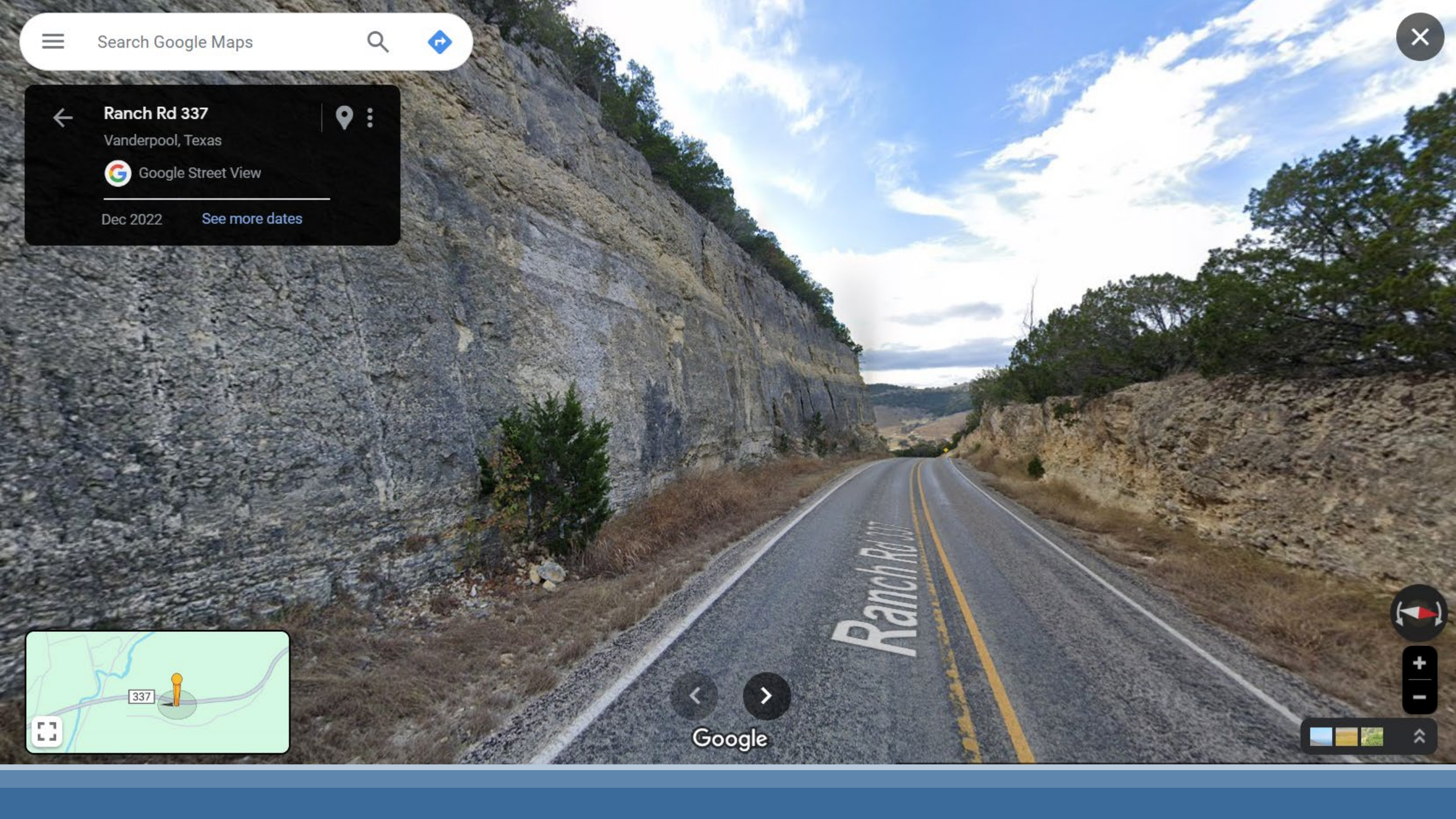
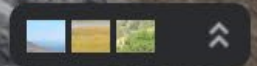
Google Street View

Dec 2022

[See more dates](#)



Google





Search Google Maps



Ranch Rd 337

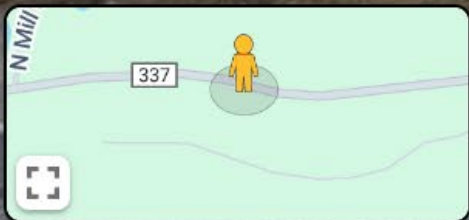
Vanderpool, Texas



Google Street View

Dec 2022

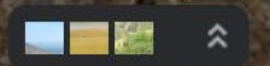
See more dates



Upper Trinity aquifer
Upper Glen Rose Limestone



Google





Search Google Maps



Ranch Rd 337

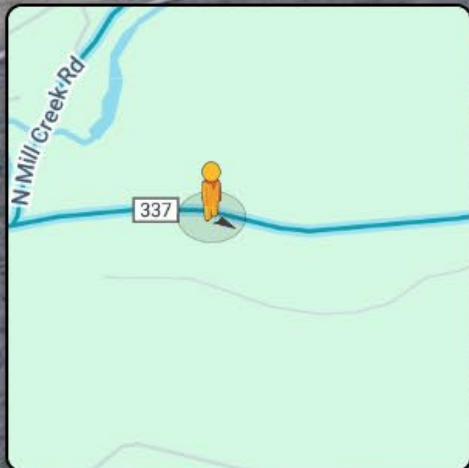
Vanderpool, Texas



Google Street View

Dec 2022

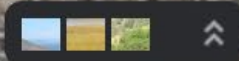
[See more dates](#)



Ranch Rd 337



Google





FM306

Spring Branch, Texas

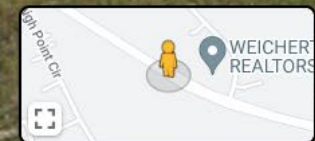


Google Street View

May 2023

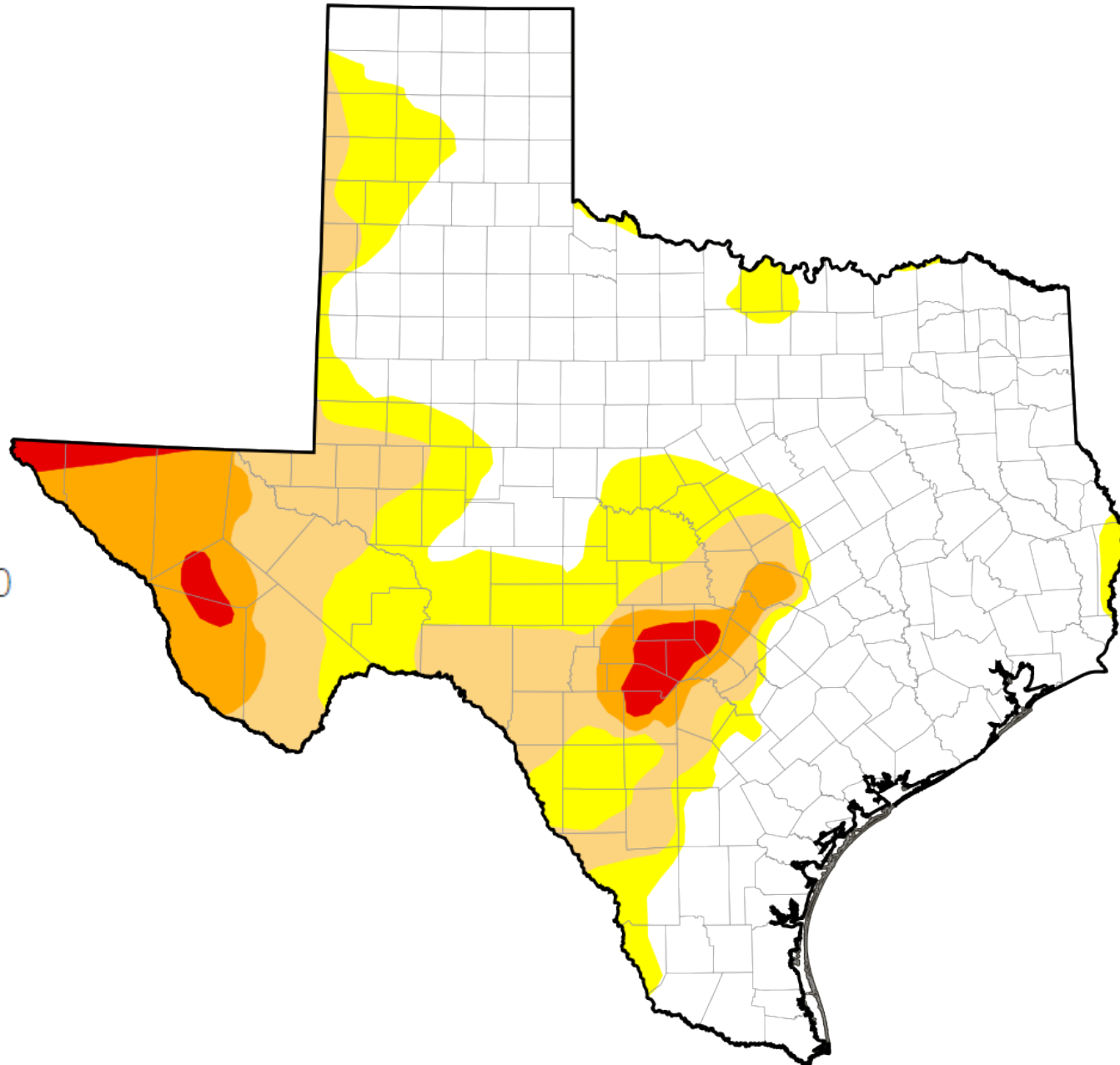
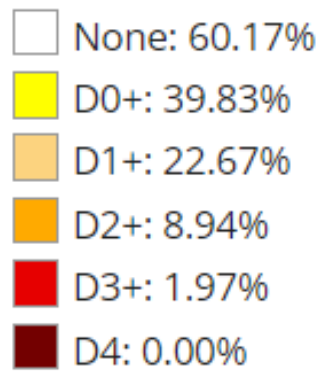
See more dates

Middle Trinity aquifer Lower Glen Rose Limestone



Map Date: 2024-02-20

Texas



Groundwater and drought

Increased pumping → water level declines

Water levels and springflow – change on variable timescales

Differences in aquifer sensitivity

Tools to track GW response

Average water level changes

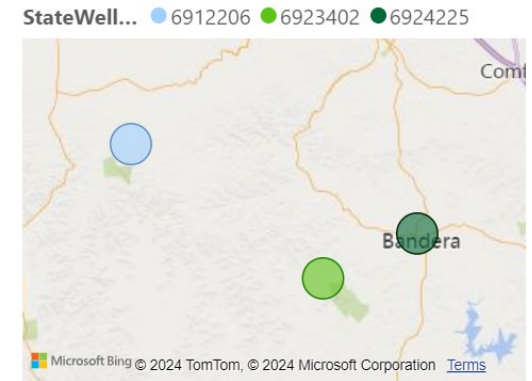
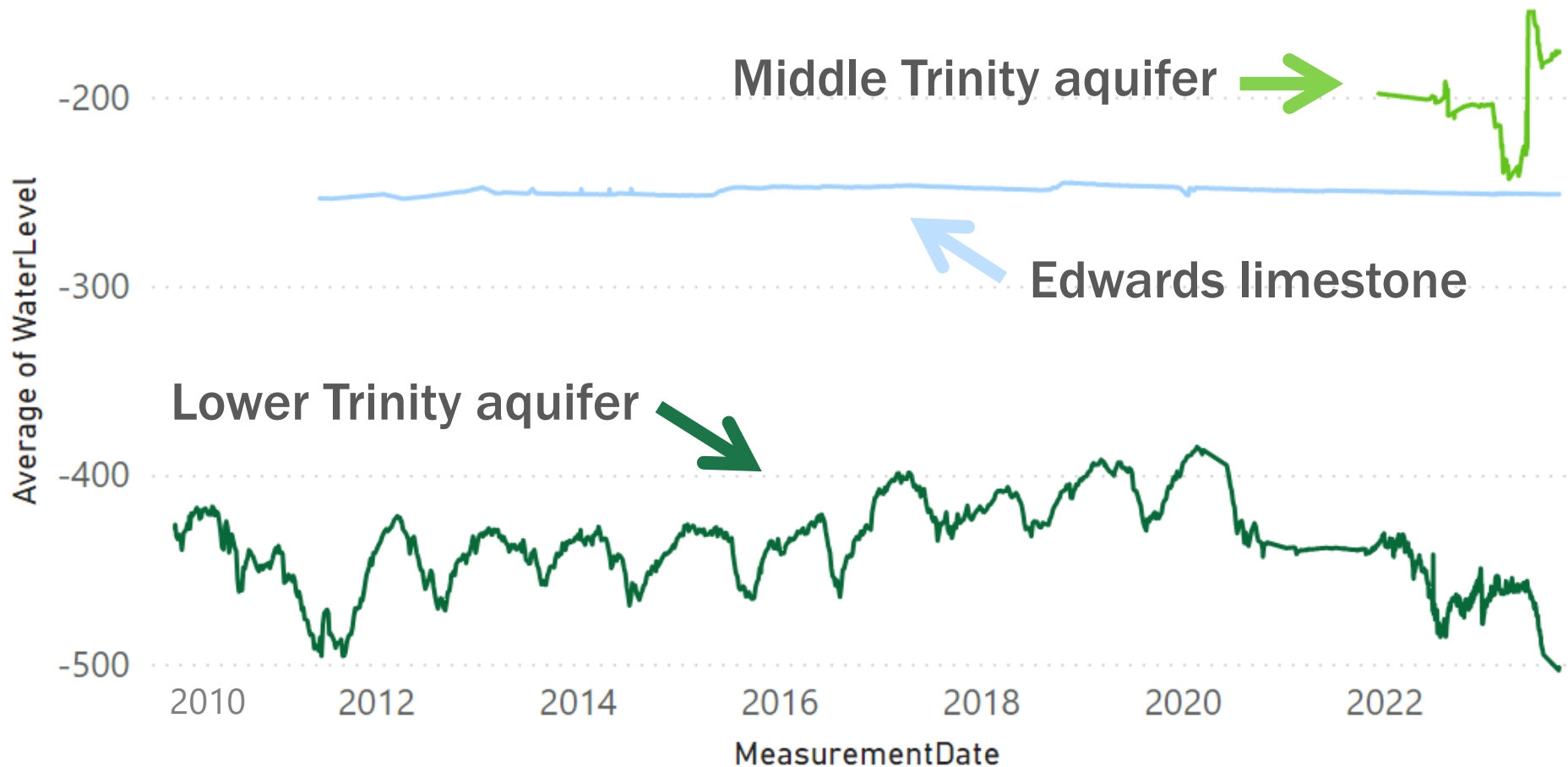
Hydrographs

Drought indicator wells and springs

Automated Recorder Wells in Bandera County

Water level trends since 2010

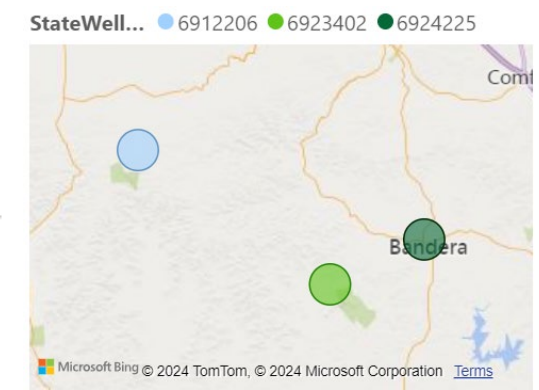
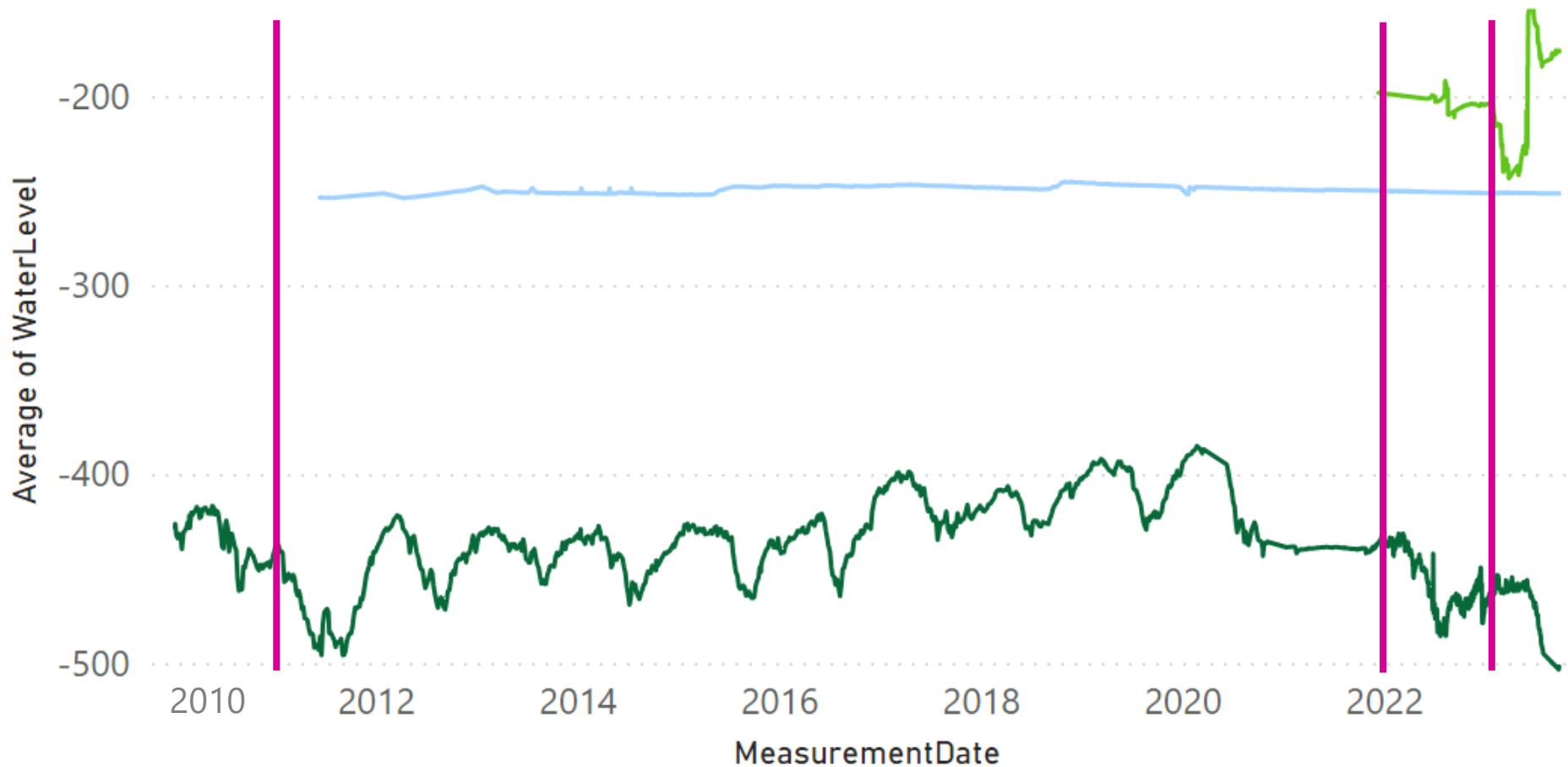
StateWellNumber ● 6912206 ● 6923402 ● 6924225



Automated Recorder Wells in Bandera County

Water level trends since 2010

StateWellNumber ● 6912206 ● 6923402 ● 6924225





Bandera County

River Authority & Groundwater District

Protecting & Preserving our Natural Resources



About ▾ Groundwater ▾ Surface Water ▾ Medina Lake Environmental Services ▾ Flood Management ▾ Education ▾ Transparency



440 FM 3240
Bandera, Texas 78003
(830) 796-7260
Fax (830) 816-2607
www.bcragd.org

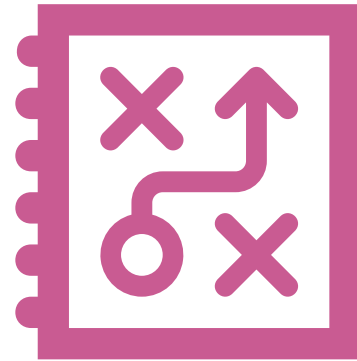
FILED
AT 11:00 O'CLOCK A.M. ON
FEB 22 2024
TANDIE MANSFIELD, COUNTY CLERK
BANDERA COUNTY, TEXAS
BY [Signature] DEPUTY

NOTICE TO ALL RESIDENTS OF BANDERA COUNTY EXTREME DROUGHT RESTRICTIONS IN EFFECT

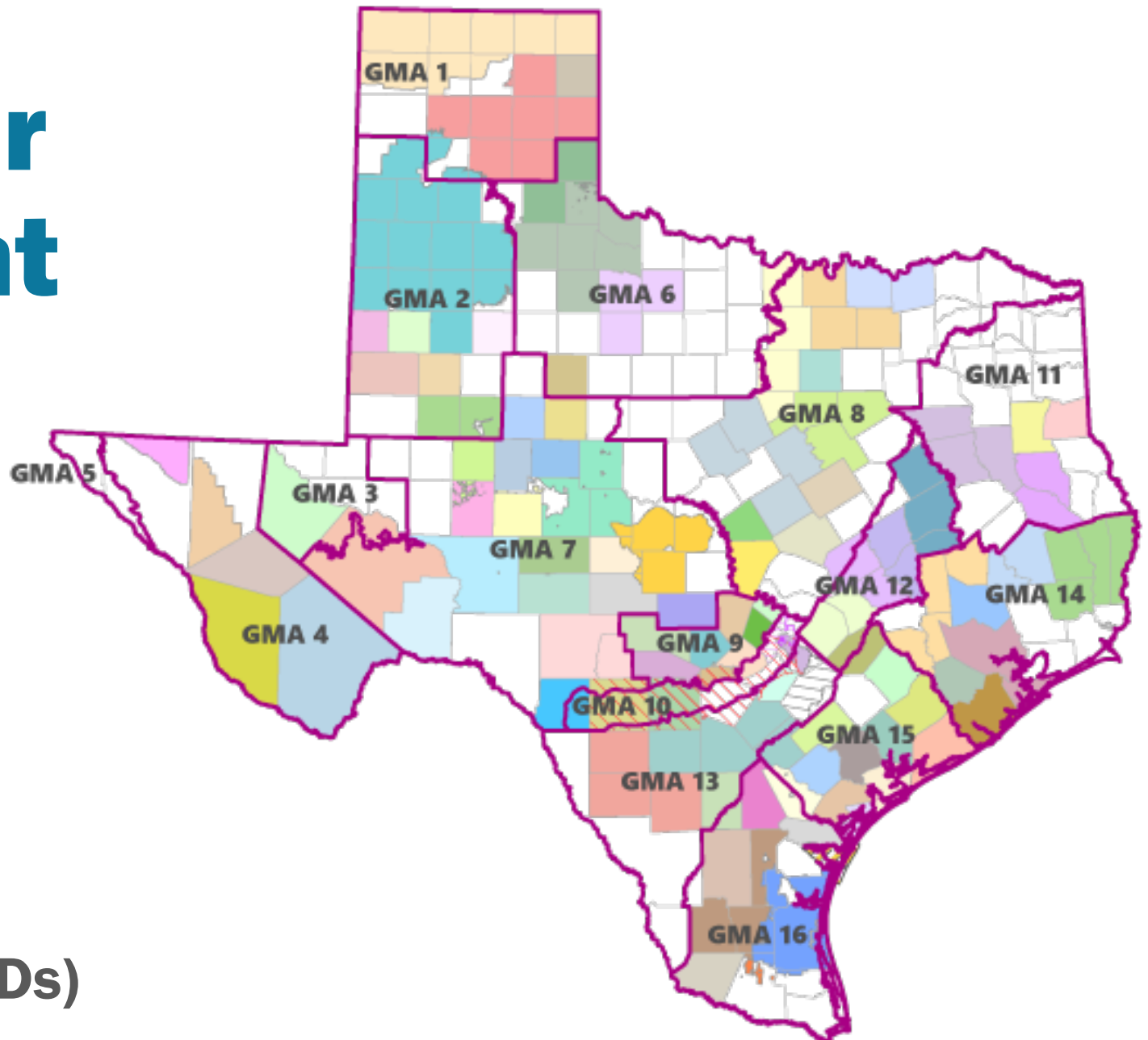
The Bandera County River Authority And Groundwater District have moved to Extreme Drought Restrictions. The District uses the U.S. Drought Monitor as one component to gauge the drought; it also considers flow conditions in its river basins, local aquifer conditions, and long-term atmospheric data (such as annual precipitation and temperatures).

<https://www.bcragd.org/drought-management/>

Joint Groundwater Planning



Groundwater management areas (GMAs)



Groups of groundwater conservation district (GCDs)

GMAs, GAMs, MAGs...OMG!

GCD Groundwater conservation district

GMA Groundwater management area

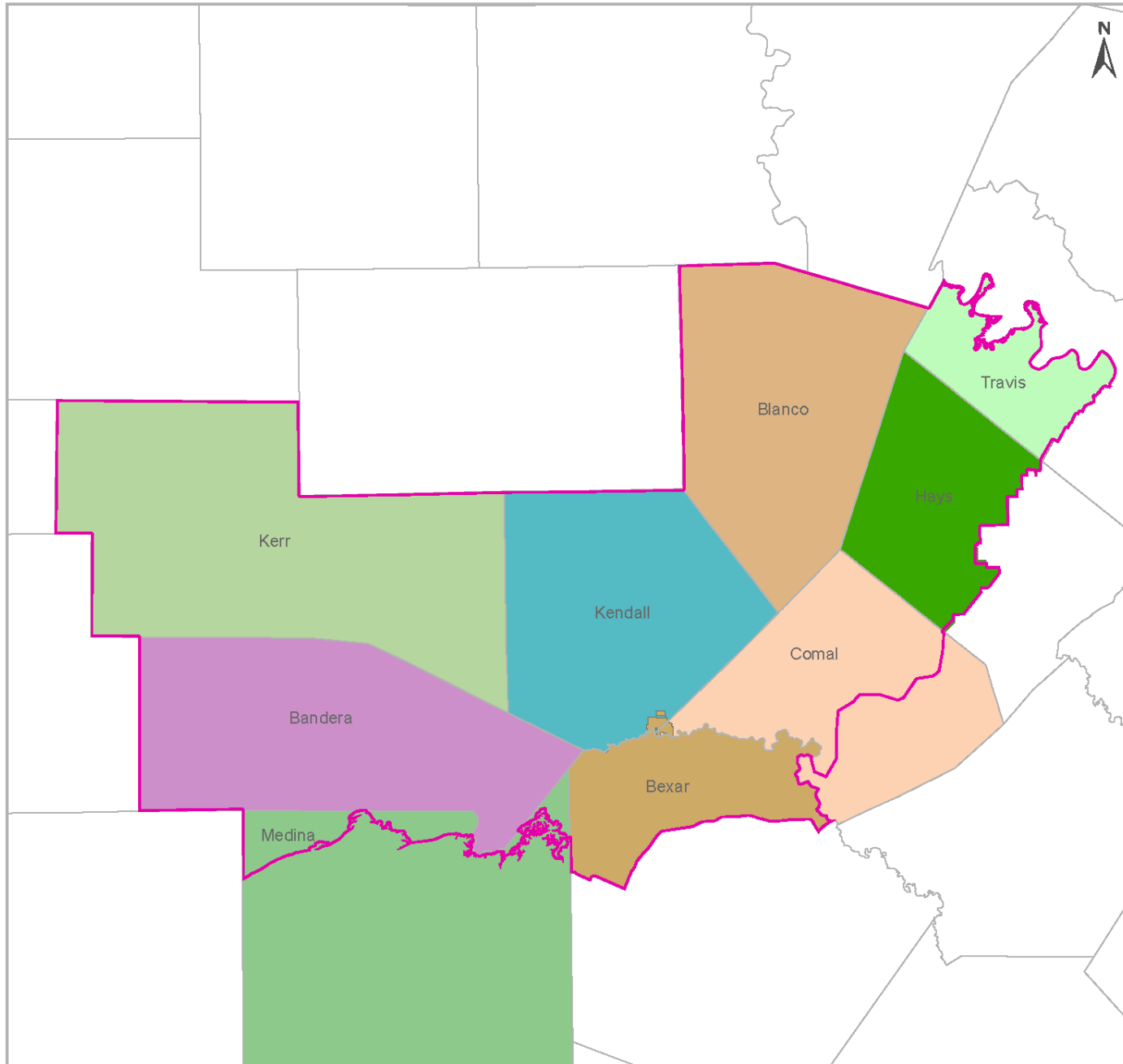
DFC Desired future condition

TWDB Texas Water Development Board

GAM Groundwater availability model

MAG Modeled available groundwater

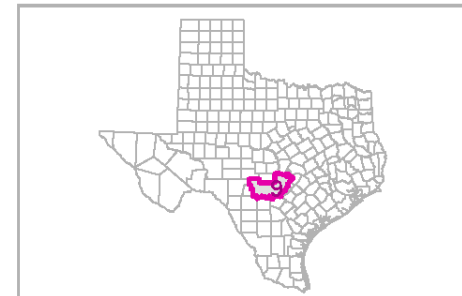
Groundwater Management Area 9



- Groundwater Management Areas
- Counties
- Groundwater Conservation Districts**
 - Bandera County River Authority & Ground Water District
 - Blanco-Pedernales GCD
 - Comal Trinity GCD
 - Cow Creek GCD
 - Hays Trinity GCD
 - Headwaters UWCD
 - Medina County GCD
 - Southwestern Travis County GCD
 - Trinity Glen Rose GCD

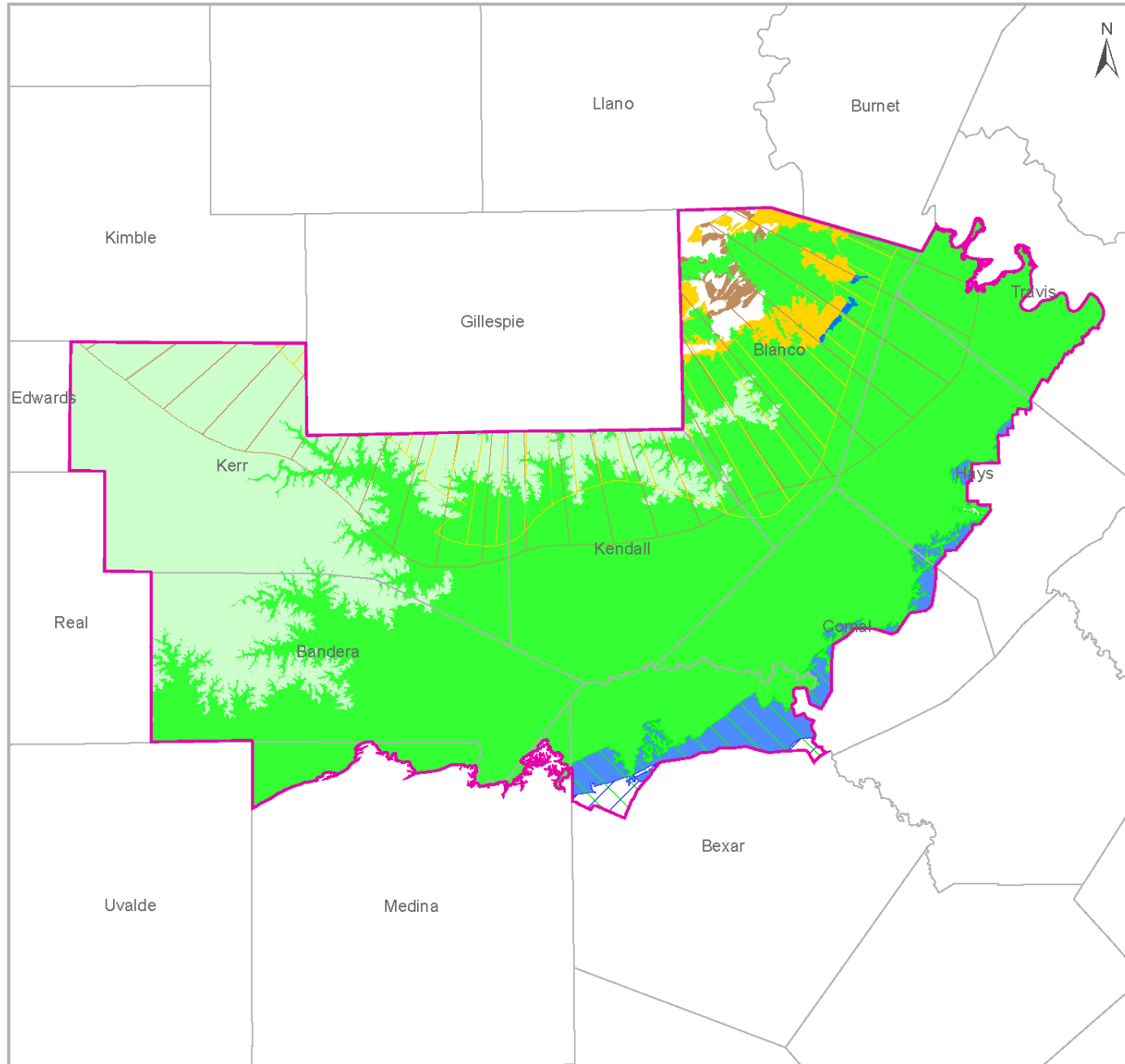
DISCLAIMER
This map was generated by the Texas Water Development Board. No claims are made to the accuracy or completeness of the information shown herein nor to its suitability for a particular use. The scale and location of all mapped data are approximate. Boundaries for groundwater conservation districts are approximate and may not accurately depict legal descriptions.

Updated 5/20/2021



1 inch = 505 miles

Groundwater Management Area 9



Groundwater Management Areas

Counties

Major Aquifers

Edwards - Trinity Plateau (outcrop)

Edwards BFZ (outcrop)

Edwards BFZ (subcrop)

Trinity (outcrop)

Trinity (subcrop)

Minor Aquifers

Marble Falls

Ellenburger - San Saba (outcrop)

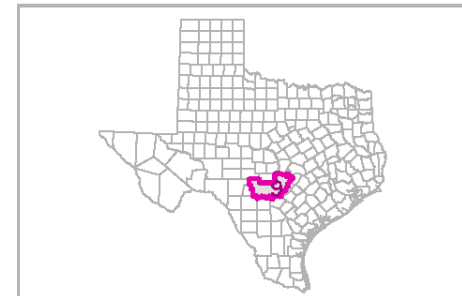
Ellenburger - San Saba (subcrop)

Hickory (outcrop)

Hickory (subcrop)

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Updated 4/11/2022

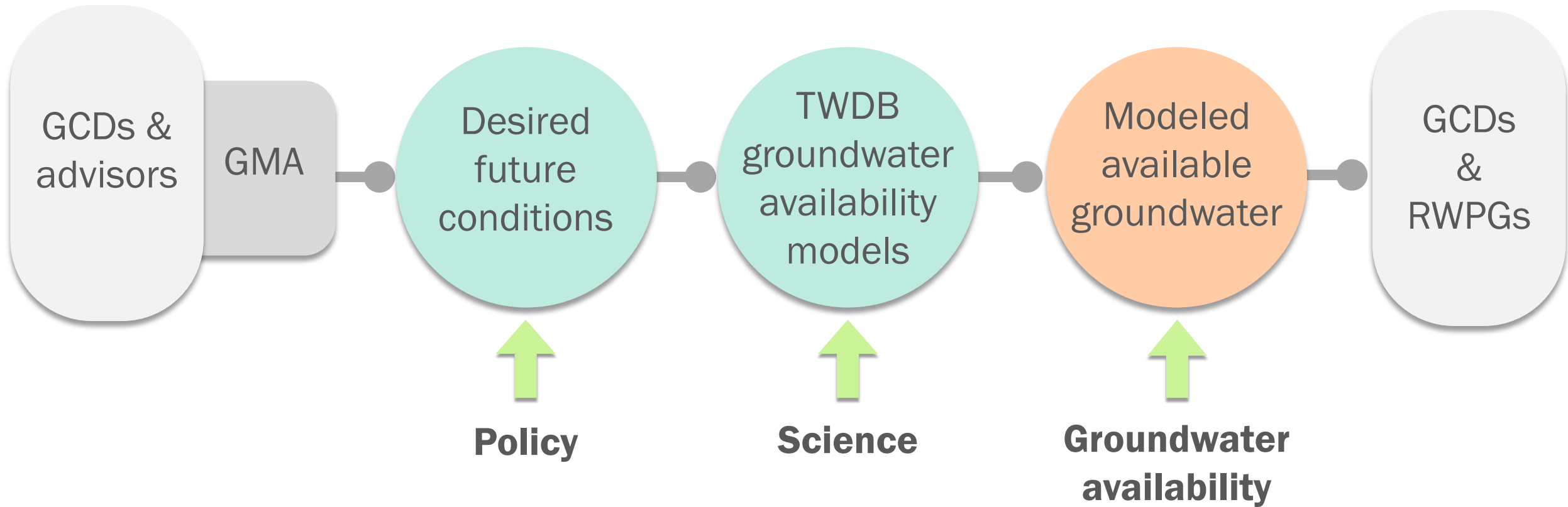


1 inch = 505 miles

What is joint planning?

- ★ District representatives in a GMA meet at least annually to:
 - conduct joint planning
 - propose to adopt new or amended desired future conditions
 - review management plans and GMA accomplishments

Joint groundwater planning



Desired future conditions

DFCs

Broad policy goal

Quantitative description

Updated at least every 5 years

Used to determine future groundwater availability

Drawdown, springflow, storage volume, etc.

May be established for:

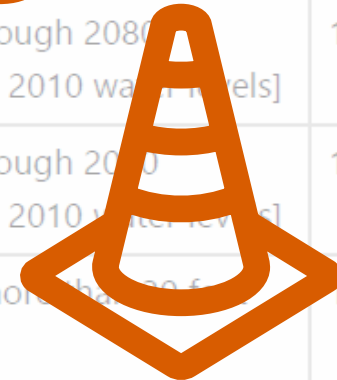
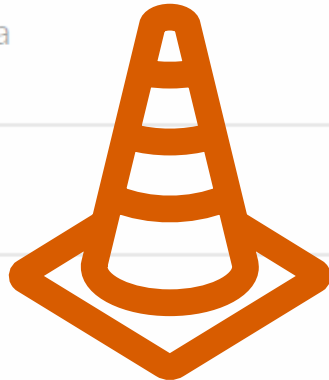
- aquifer
- aquifer subdivision
- geologic strata
- geographic area

GMA 9 DFCs

Aquifer	Desired Future Condition (DFC)	Date DFC Adopted
Edwards Group of the Edwards-Trinity (Plateau)	No net increase in average drawdown in Kendall and Bandera counties through 2080 [no average water level decline in 2080, as compared to 1997 water levels]	11/15/2021
Ellenburger-San Saba	Increase in average drawdown of no more than 7 feet in Kendall County through 2080 [average water level decline of no more than 7 feet in 2080, as compared to 2010 water levels]	11/15/2021
Hickory	Increase in average drawdown of no more than 7 feet in Kendall County through 2080 [average water level decline of no more than 7 feet in 2080, as compared to 2010 water levels]	11/15/2021
Trinity	Increase in average drawdown of approximately 30 feet through 2060 [no more than 30 feet of average water level decline in 2060, as compared to 2008 water levels]	11/15/2021

GMA 9 DFCs

**New DFCs coming
in 2026**



Aquifer	Desired Future Condition (DFC)	Date DFC Adopted
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Trinity	Increase in average drawdown of approximately 30 feet through 2060 [no more than 30 feet of average water level decline in 2060, as compared to 2008 water levels]	11/15/2021

Why DFCs matter

Districts must manage production to achieve desired future conditions

A criteria for GCD planning and rule making

Results in modeled available groundwater that can be used to evaluate permit applications

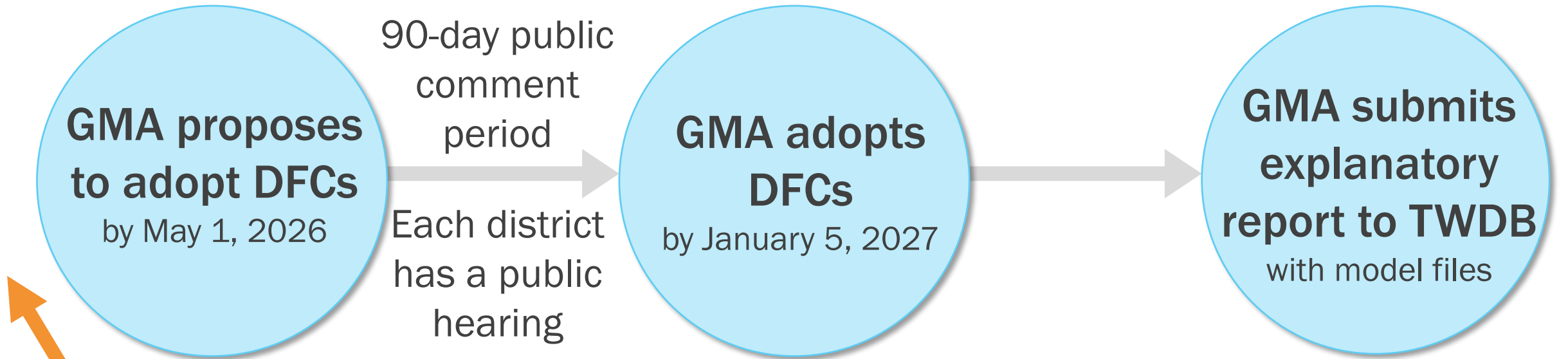
Why DFCs matter

MAGs = water availability components that feed into regional water plans and state water plan

Influence policy and resource management decisions that affect water that Texans use

What is the DFC Process?





Joint planning meetings leading up to DFC proposal

★ Good time for stakeholder involvement is now, at the beginning of joint planning round, far before any DFC proposals happen

**GMA proposes
to adopt DFCs**
by May 1, 2026

9 factors

Aquifer uses and conditions	Environmental impacts	Property rights
State water plan	Land subsidence	Feasibility
Hydrologic conditions	Socioeconomics	Any other information

**GMA proposes
to adopt DFCs**
by May 1, 2026

A balancing act

**Highest practicable level of
groundwater production**

**Conservation, preservation,
protection, recharging,
prevention of waste of
groundwater, and control of
subsidence**

**GMA proposes
to adopt DFCs**
by May 1, 2026

Assessing DFC scenarios

GMA often hire consultants to use groundwater availability models to assess various DFC scenarios

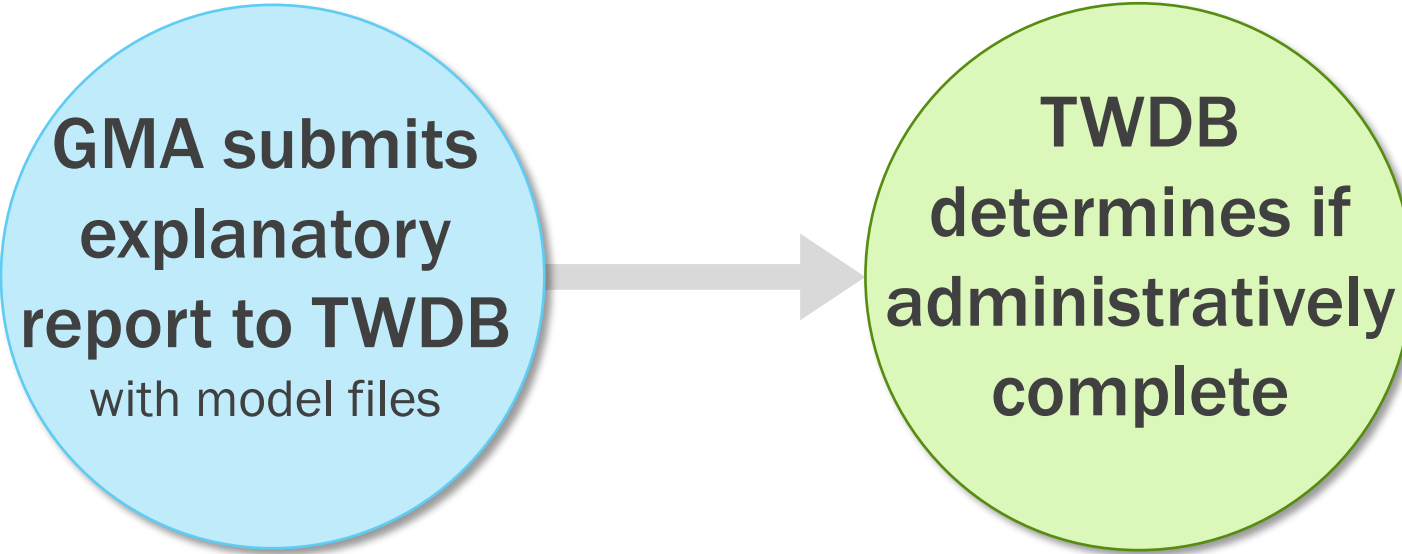
★ Active participation in the process could get a scenario you want to see on the decision table.

DFC Explanatory Report

GMA submits
explanatory
report to TWDB
with model files

Needs to include

- Each desired future condition
- Policy and technical justification
- Consideration of 9 factors
- Other desired future conditions considered
- Public comments
- Non-relevant aquifer documentation



**GMA submits
explanatory
report to TWDB**
with model files

**TWDB
determines if
administratively
complete**

**TWDB
determines if
administratively
complete**



MAGs

Modeled available groundwater MAG

Amount of water that may be produced on an average annual basis to achieve a desired future condition

Calculated by the TWDB using GAMs

Provided to regional water planning areas as groundwater availability

**TWDB
determines if
administratively
complete**

**★
GCD hearings for management
plans and rulemaking**

GMA notified

MAGs

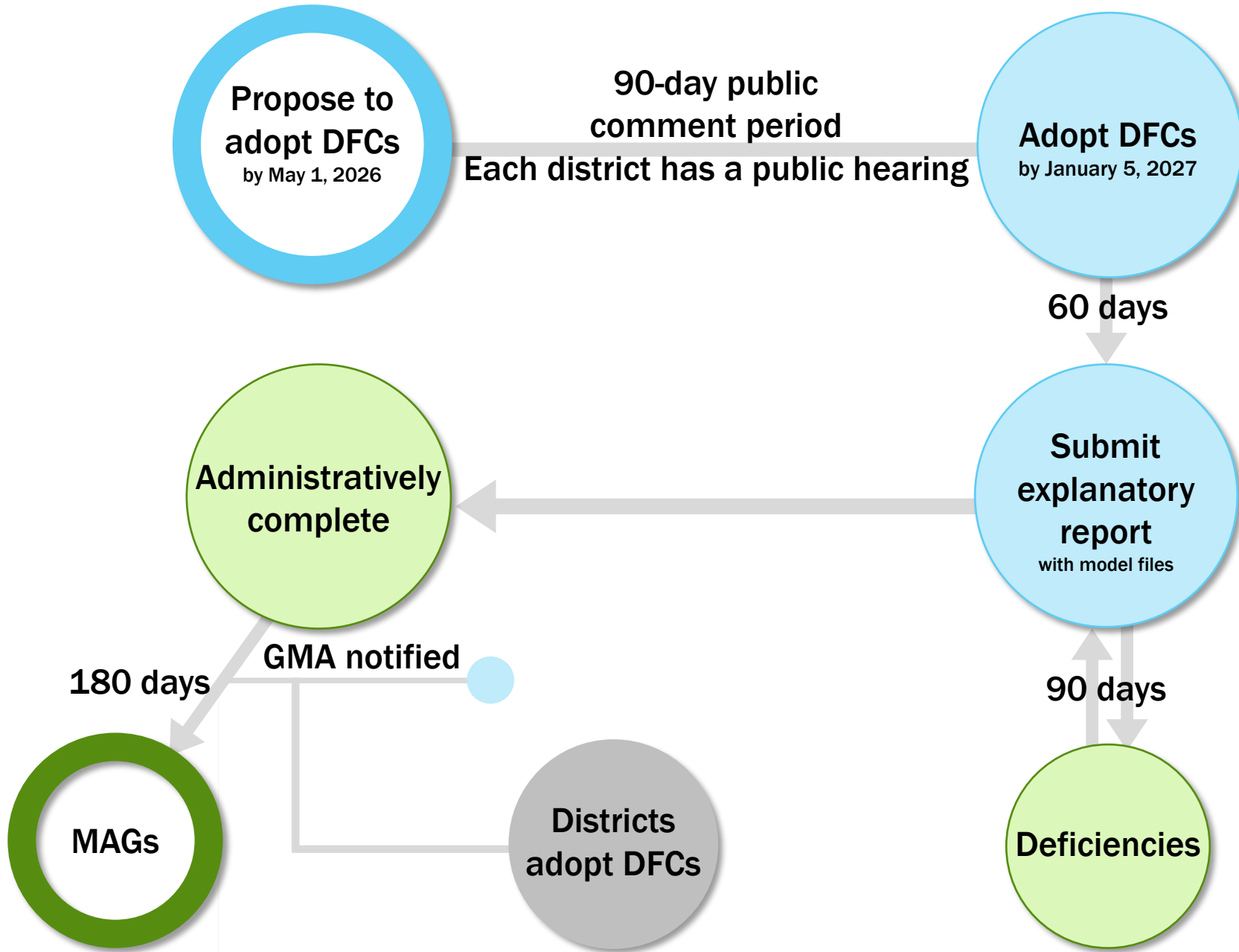
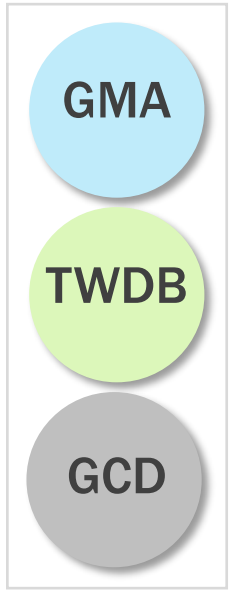
**Districts
adopt DFCs**

2 years

**★
Districts
update
management
plans**

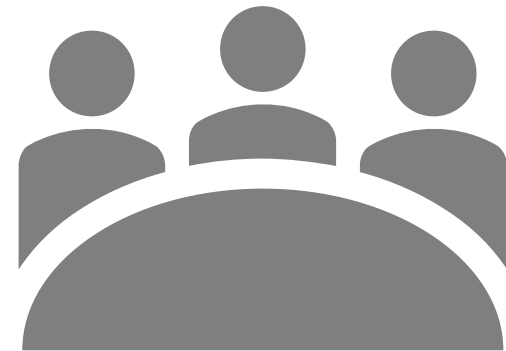
1 year

**★
Districts
update
rules**



Groundwater Management

Who does what?



 hill country alliance

Tools for Managing Groundwater in the Texas Hill Country

What Groundwater Conservation Districts, Counties, Cities
and Residents Can Do To Protect Groundwater in the Region

hillcountryalliance.org/wp-content/uploads/2023_HCA_ManagingGroundwater_Paper.pdf

Groundwater conservation districts GCDs

Sec. 36.0015. PURPOSE. (a) In this section, "best available science" means conclusions that are logically and reasonably derived using statistical or quantitative data, techniques, analyses, and studies that are publicly available to reviewing scientists and can be employed to address a specific scientific question.

(b) In order to provide for the conservation, preservation, protection, recharging, and prevention of waste of groundwater, and of groundwater reservoirs or their subdivisions, and to control subsidence caused by withdrawal of water from those groundwater reservoirs or their subdivisions, consistent with the objectives of Section 59, Article XVI, Texas Constitution, groundwater conservation districts may be created as provided by this chapter. Groundwater conservation districts created as provided by this chapter are the state's preferred method of groundwater management in order to protect property rights, balance the conservation and development of groundwater to meet the needs of this state, and use the best available science in the conservation and development of groundwater through rules developed, adopted, and promulgated by a district in accordance with the provisions of this chapter.

SUBCHAPTER D. POWERS AND DUTIES

Sec. 36.101. RULEMAKING POWER. (a) A district may make and enforce rules, including rules limiting groundwater production based on tract size or the spacing of wells, to provide for conserving, preserving, protecting, and recharging of the groundwater or of a groundwater reservoir or its subdivisions in order to control subsidence, prevent degradation of water quality, or prevent waste of groundwater and to carry out the powers and duties provided by this chapter. In adopting a rule under this chapter, a district shall:

- (1) consider all groundwater uses and needs;
- (2) develop rules that are fair and impartial;
- (3) consider the groundwater ownership and rights described by Section 36.002;
- (4) consider the public interest in conservation, preservation, protection, recharging, and prevention of waste of groundwater, and of groundwater reservoirs or their subdivisions, and in controlling subsidence caused by withdrawal of groundwater from those groundwater reservoirs or their subdivisions, consistent with the objectives of Section 59, Article XVI, Texas Constitution;
- (5) consider the goals developed as part of the district's management plan under Section 36.1071; and
- (6) not discriminate between land that is irrigated for production and land that was irrigated for production and enrolled or participating in a federal conservation program.

(f) The district shall adopt rules necessary to implement the management plan. Prior to the development of the management plan and its approval under Section 36.1072, the district may not adopt rules other than rules pertaining to the registration and interim permitting of new and existing wells and rules governing spacing and procedure before the district's board; however, the district may not adopt any rules limiting the production of wells, except rules requiring that groundwater produced from a well be put to a nonwasteful, beneficial use. The district may accept applications for permits under Section 36.113, provided the district does not act on any such application until the district's management plan is approved as provided in Section 36.1072.

(g) The district shall adopt amendments to the management plan as necessary. Amendments to the management plan shall be adopted after

Fundamental mandate

**Balance protection of property rights,
conservation, and development of
groundwater using best-available science**

GROUNDWATER MANAGEMENT PLAN
FOR
BANDERA COUNTY RIVER AUTHORITY AND
GROUNDWATER DISTRICT

PO BOX 177
440 FM 3240
BANDERA, TX 78003
(830) 796-7260

ADOPTED APRIL 8, 2010

AMENDED APRIL 11, 2013

AMENDED FEBRUARY 8, 2018

AMENDED JULY 14, 2022

GCD tools

Well spacing and pumping limits

Water use reports

Drought contingency plans

Production curtailments to achieve desired future conditions

Develop science to inform decision making

Management zones for local conditions

Education and outreach

How you can get involved

Get to know your GCD and support the science

Engage with your elected officials

Practice groundwater stewardship

Share concerns at public meetings

- rainwater harvesting, supporting reuse, native plants, etc.

Resources

[Educational groundwater videos](#)

[Bandera County River Authority and Groundwater District](#)

[Groundwater Management Area 9](#)

[Water Data for Texas](#) and [Groundwater Data Viewer](#)

[Hill Country Alliance](#)

[Texas Alliance of Groundwater Districts GCD Index](#)

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Bandera County

Water Talk

Managing our groundwater resources

