

The Equus Beds Aquifer: Opportunities and Challenges



Equus Beds Groundwater Management District

Equus Beds Groundwater Management District

313 Spruce Street

Halstead, Kansas 67056-1925

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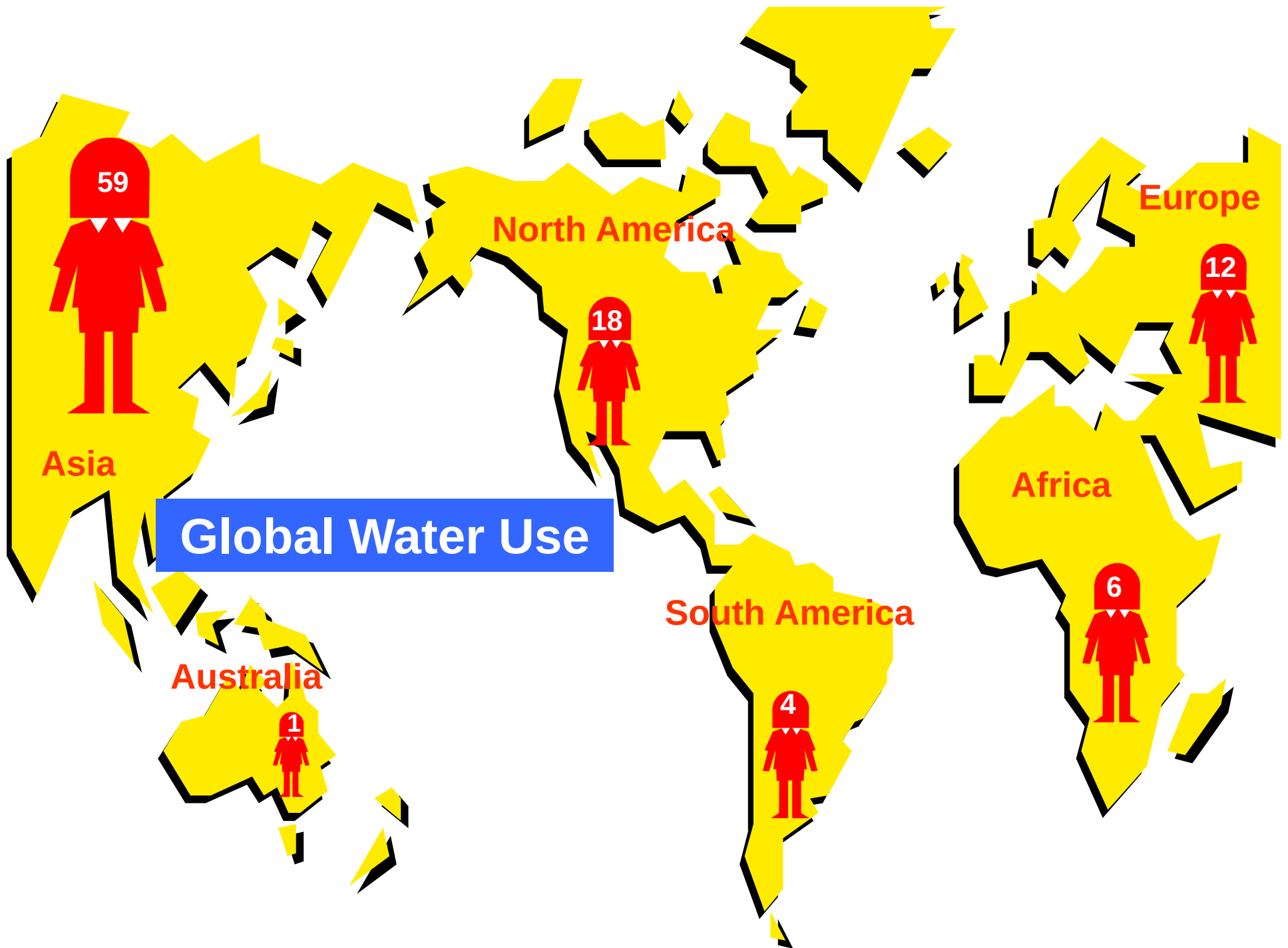
Discussion Topics

- **Global Water Perspective**
- **State Water Perspective**
- **The Equus Beds Aquifer**
- **Water Protection Activities**
- **Water Protection Issues**
- **Closing Thoughts**



Global Water Supply

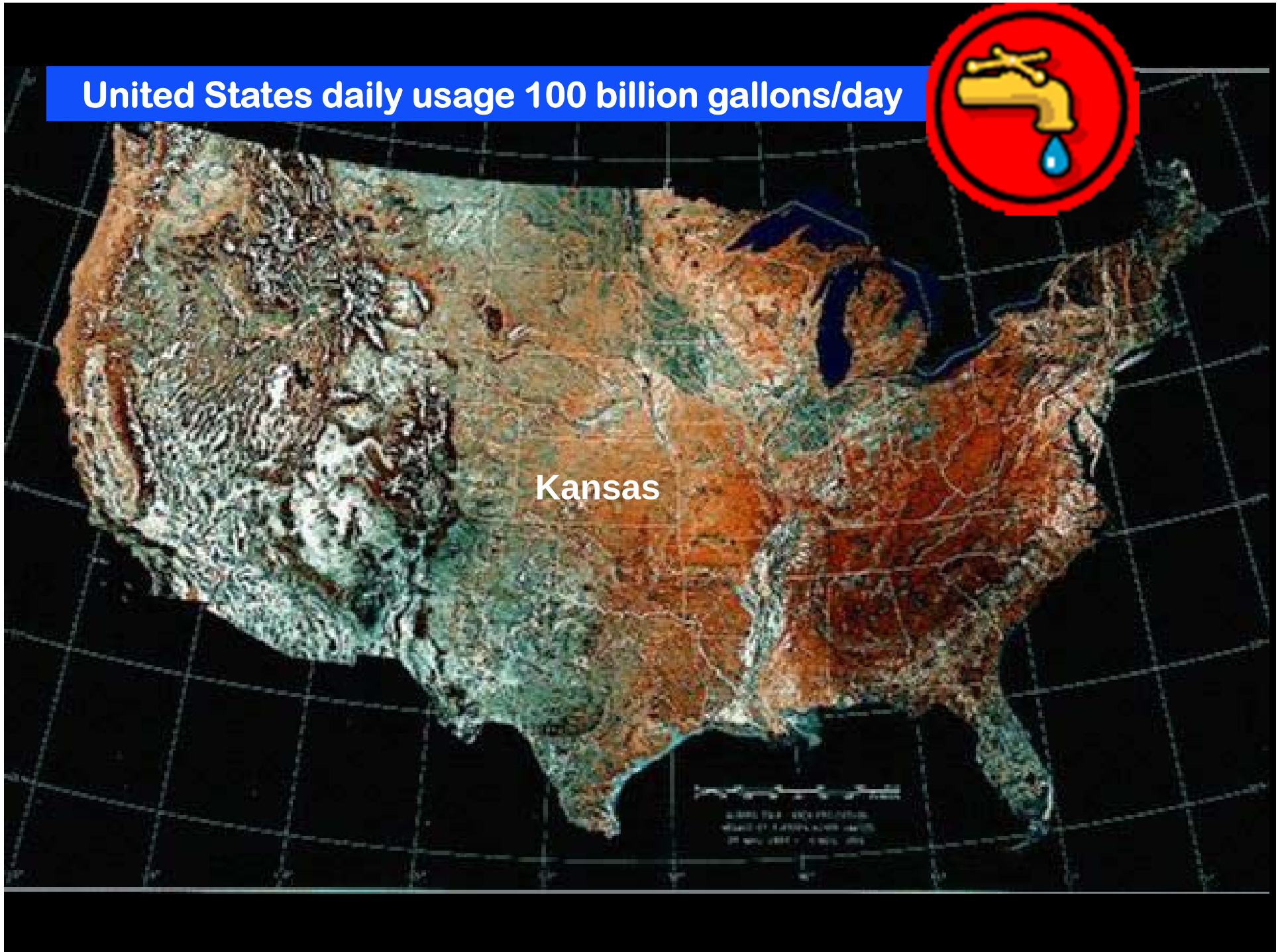
- World Oceans - 317,000,000 Mi³ ~ 97.2 %
- Lakes , Inland seas, Rivers, Soil, Groundwater, Ice caps and Glaciers - 9,100,000 Mi³ ~ 2.8 %
- Groundwater 2,000,000 Mi³ ~ 0.61%
- **Water consumers - 6.7 billion people and growing**
- **One in six do not have daily access to clean drinking water , causing over 500,000 (mostly children) to die annually.**



United States daily usage 100 billion gallons/day

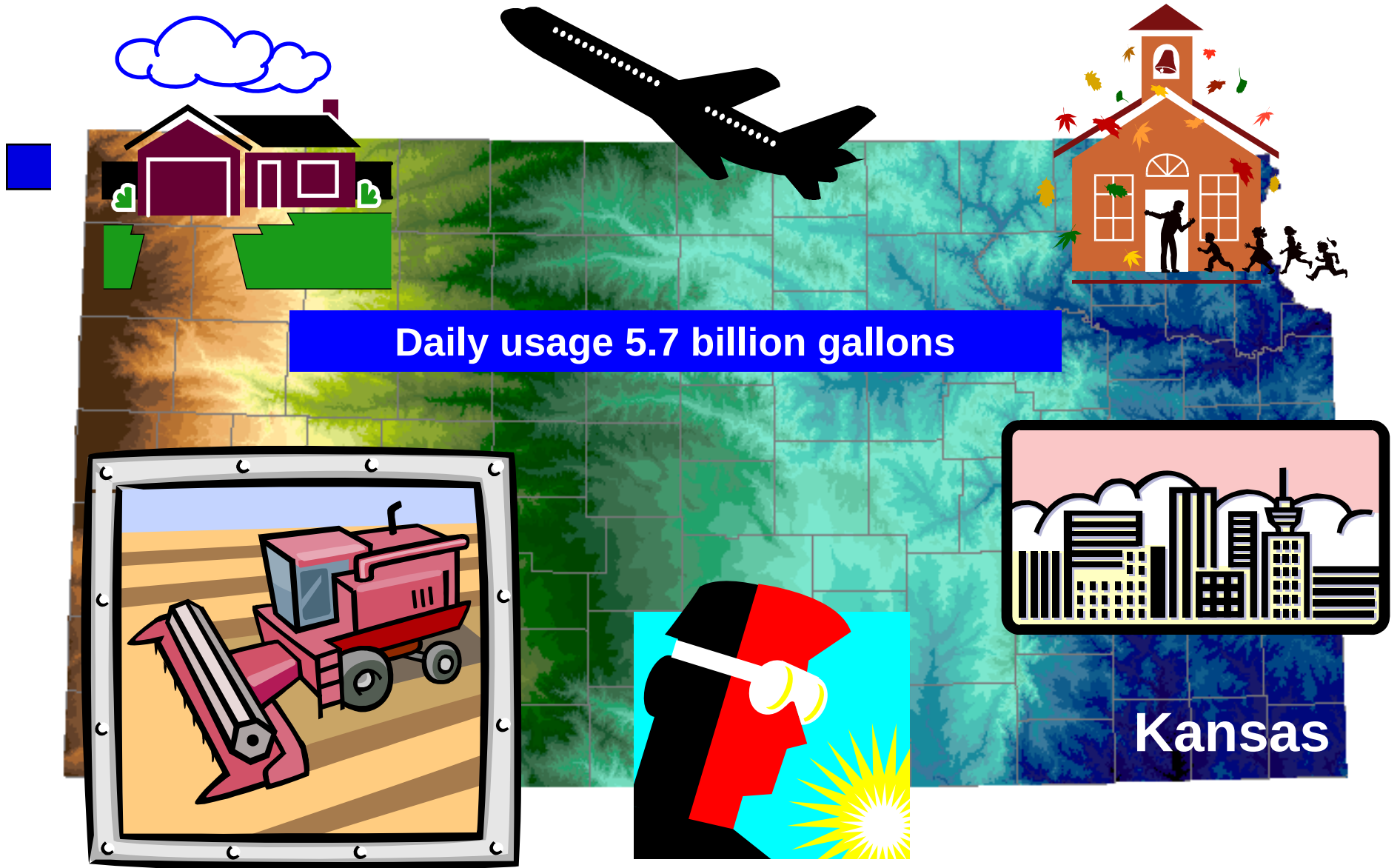


Kansas

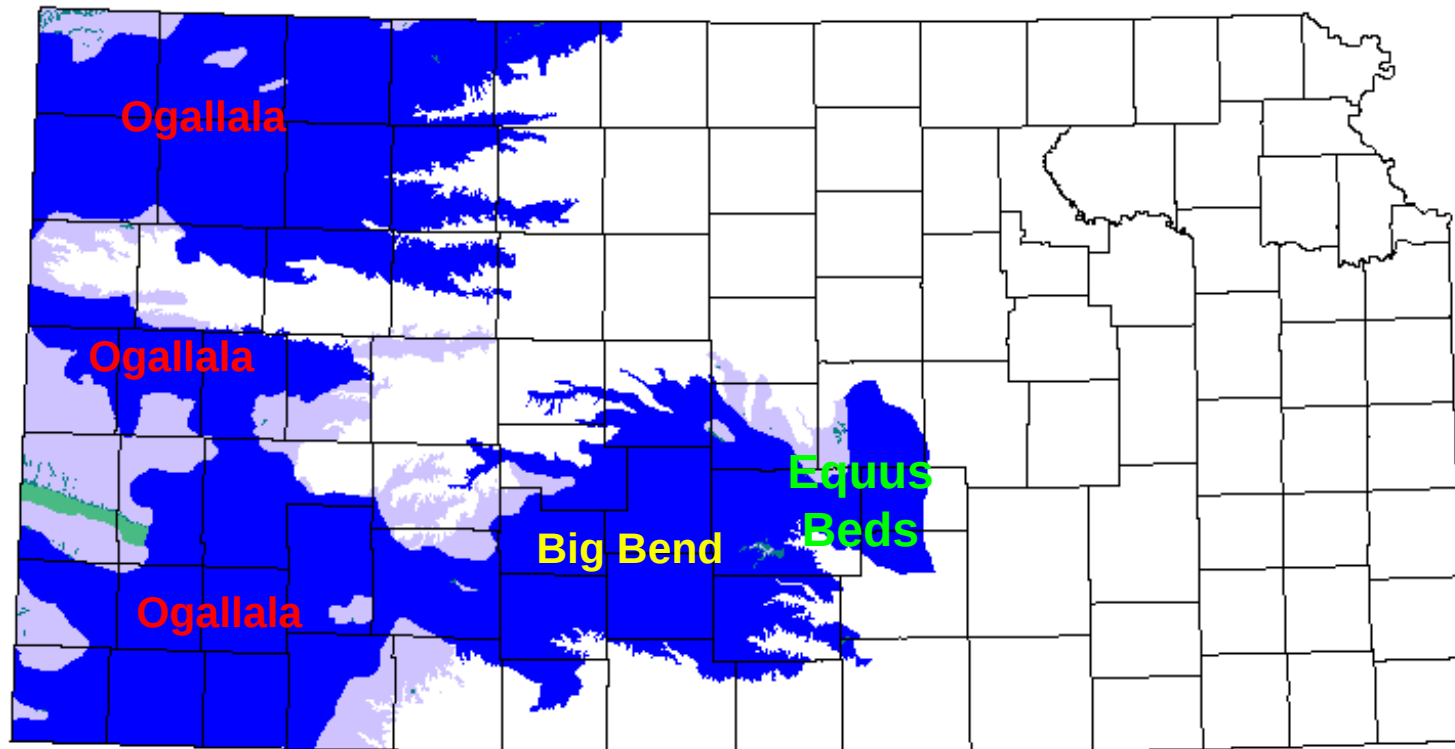


Discussion Topics

- **Global Water Perspective**
- **State Water Perspective**

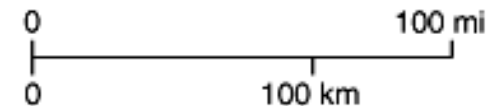
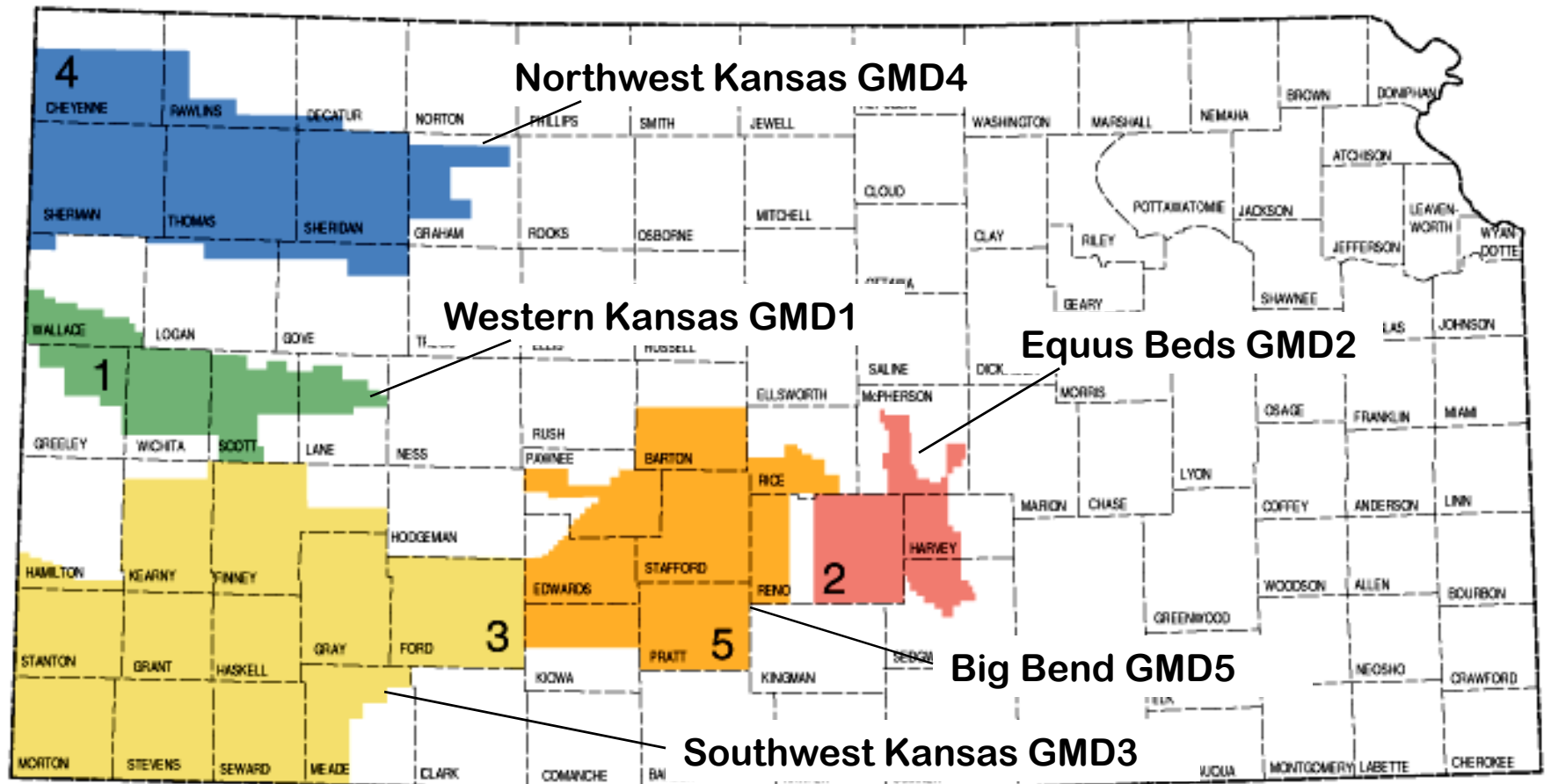


Extent of High Plains Aquifer in Kansas



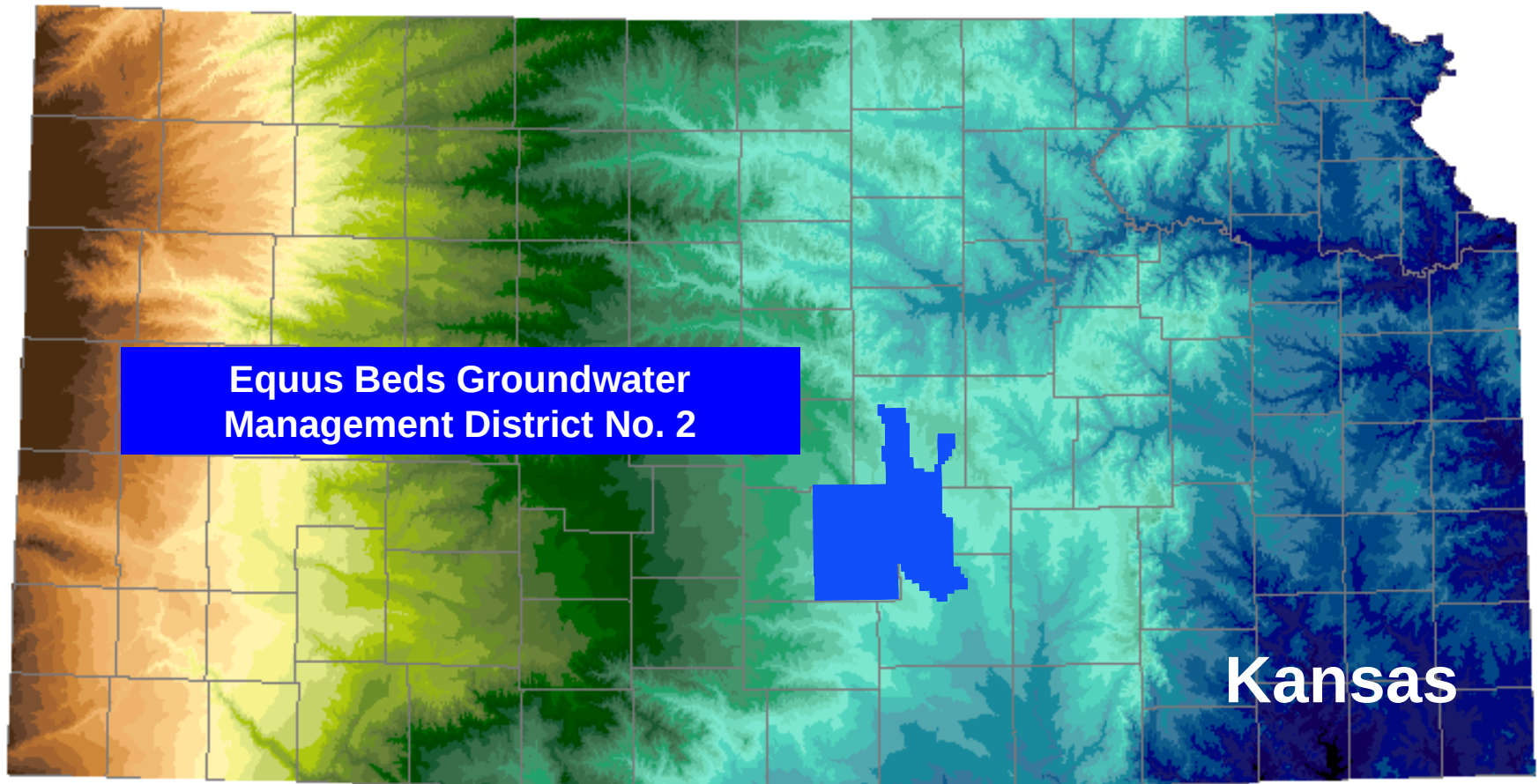
- Little or no saturated thickness
- Missing aquifer due to outcrop of older rocks
- Some saturated thickness
- Arkansas River alluvium

Kansas Groundwater Management Districts



Discussion Topics

- **Global Water Perspective**
- **State Water Perspective**
- **The Equus Beds Aquifer**



Daily usage 160 - 180 million gallons

Geology and Hydrology of the Equus Beds Aquifer



Equus Beds Average Annual Use

Baseflow - 6,500,000,000 gallons

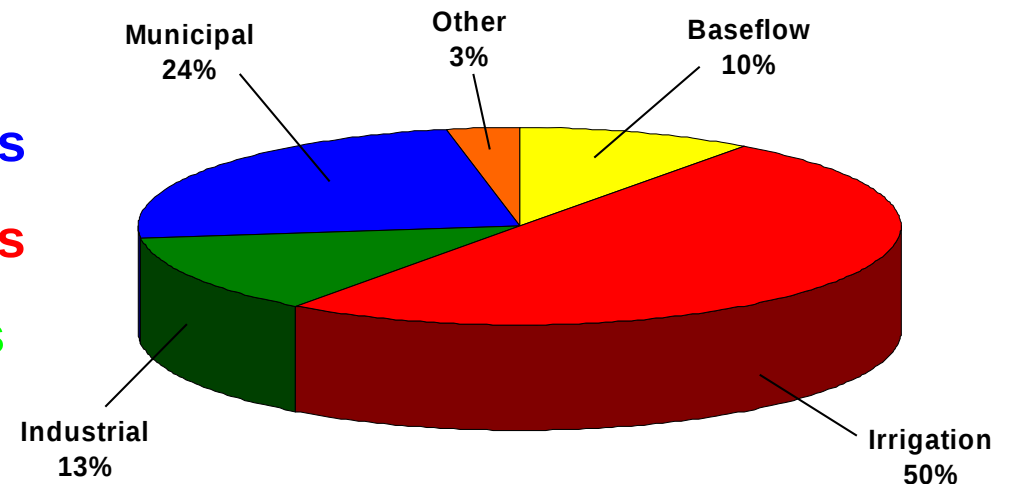
Municipal - 15,270,322,830 gallons

Irrigation - 31,834,189,142 gallons

Industrial - 8,579,871,892 gallons

Other - 1,541,842,211 gallons

Average annual use - 63,726,622,075 gallons

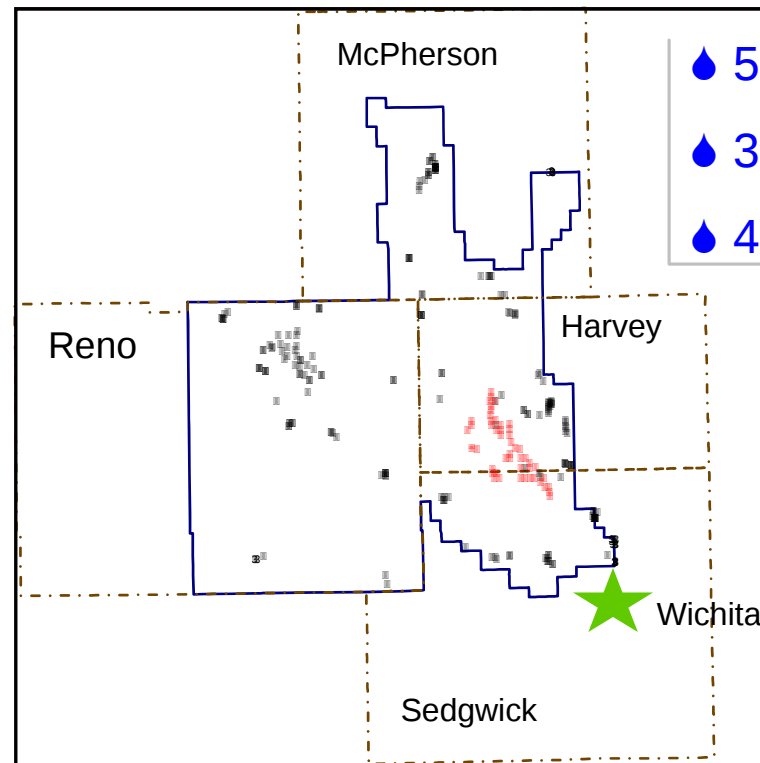


Geology and Hydrology of the Equus Beds Aquifer



◆ **Wichita water
supply well**

◆ **Other
municipal
water supply
well**



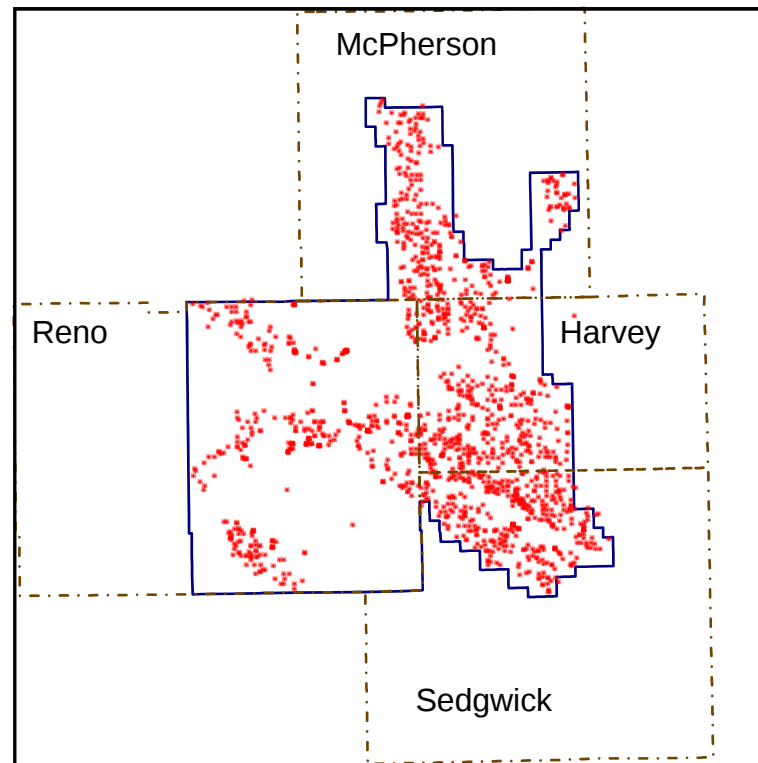
◆ 55 wells

◆ 36 million gallons/day

◆ 40,000 acre-feet/year

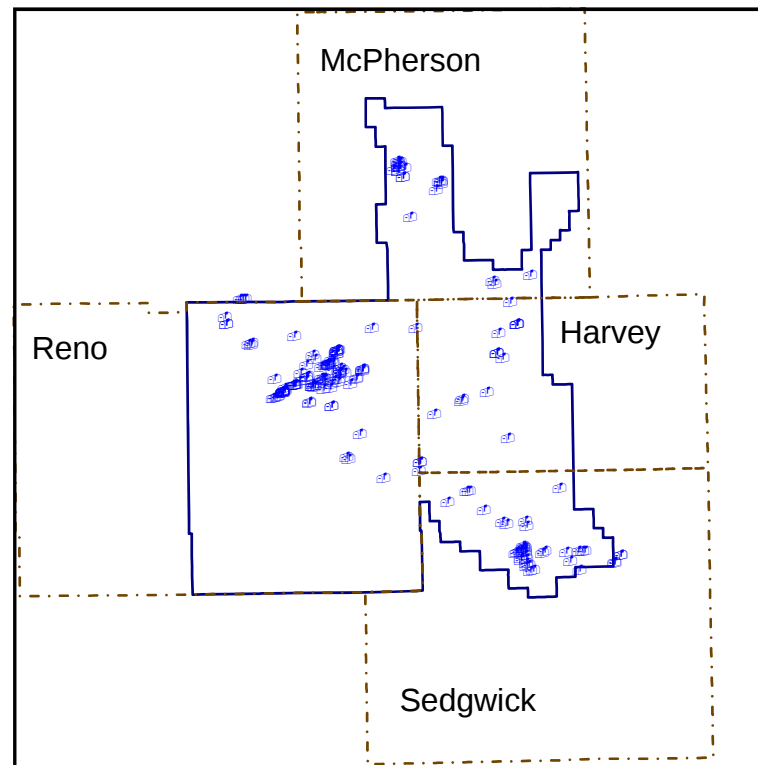
Location Map of Municipal Water Supply Wells
Total Number of Wells ~ 200

Geology and Hydrology of the Equus Beds Aquifer



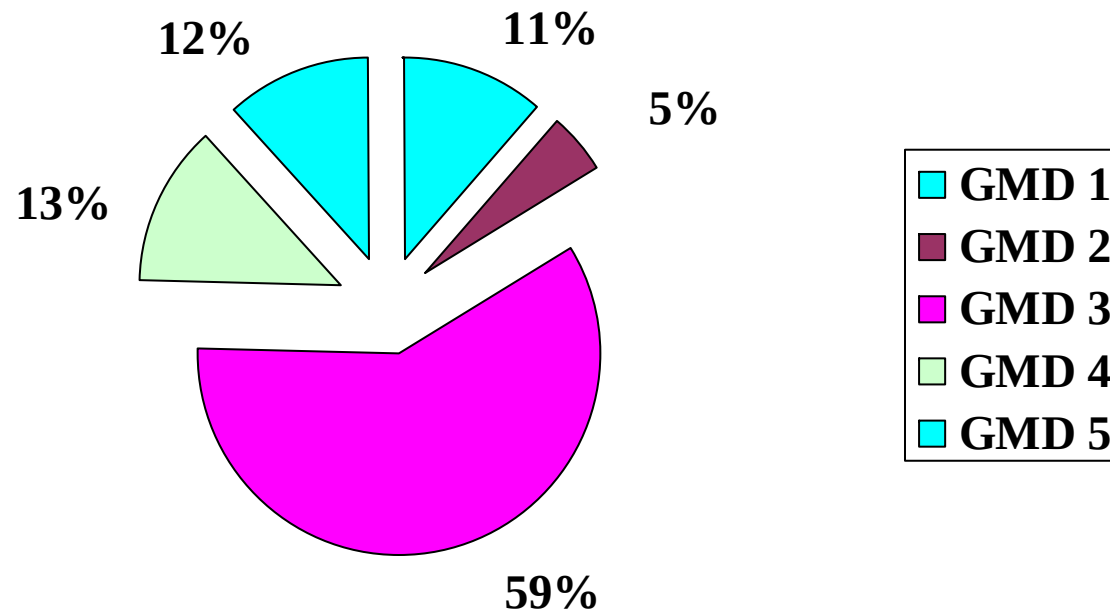
Location Map of Irrigation Wells Total Number of Wells ~ 1,600

Geology and Hydrology of the Equus Beds Aquifer



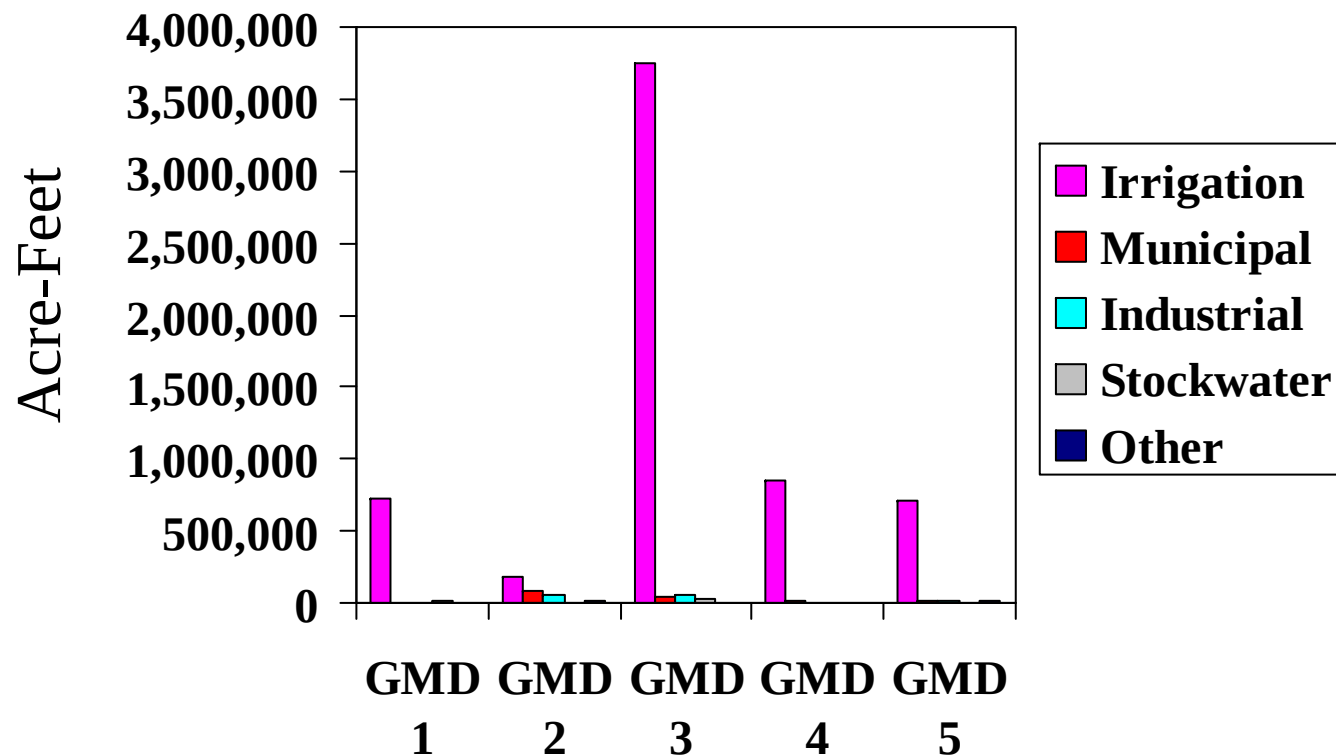
Location Map of Industrial Wells Total Number of Wells ~ 165

Summary of Groundwater Use Appropriations by Kansas Groundwater Management Districts



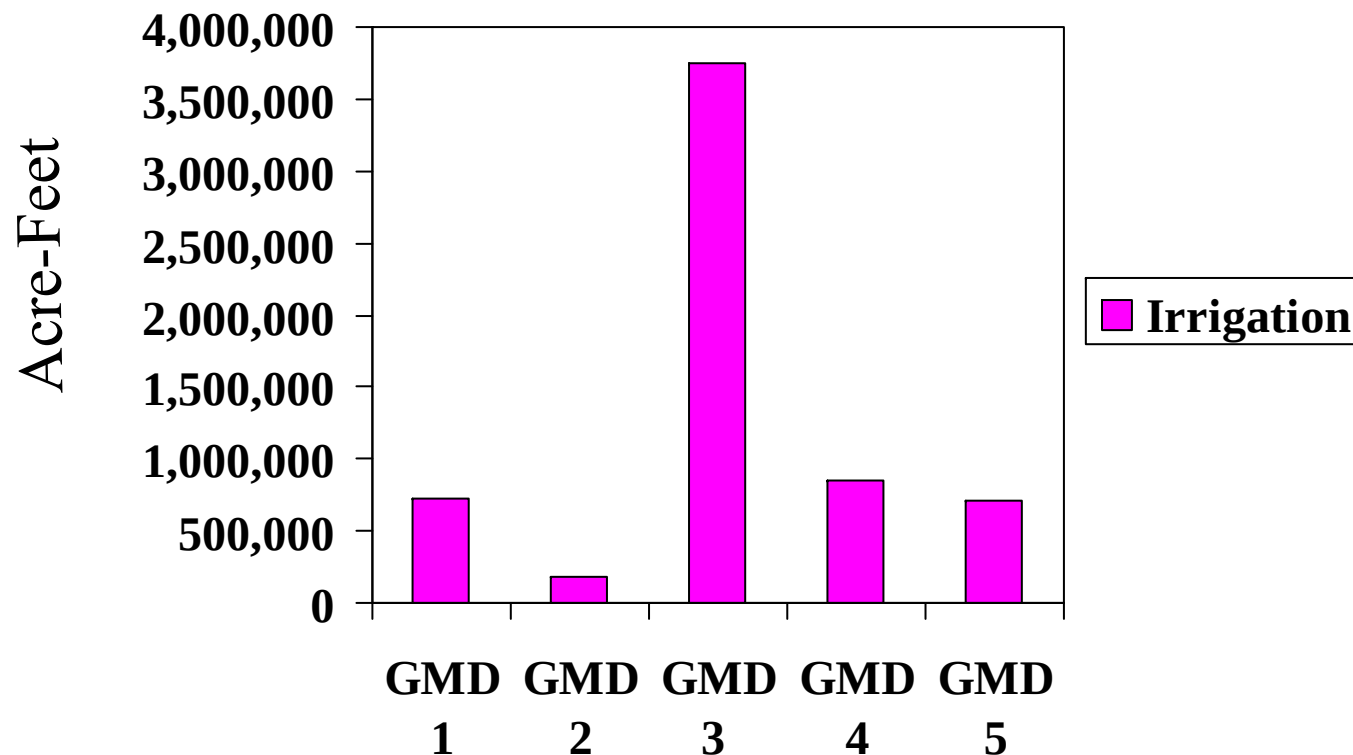
Prepared by: Regional Economic Area Partnership
Data Source: Division of Water Resources
Date: November 1, 2000

Comparison of Groundwater Appropriations among Kansas Groundwater Management Districts



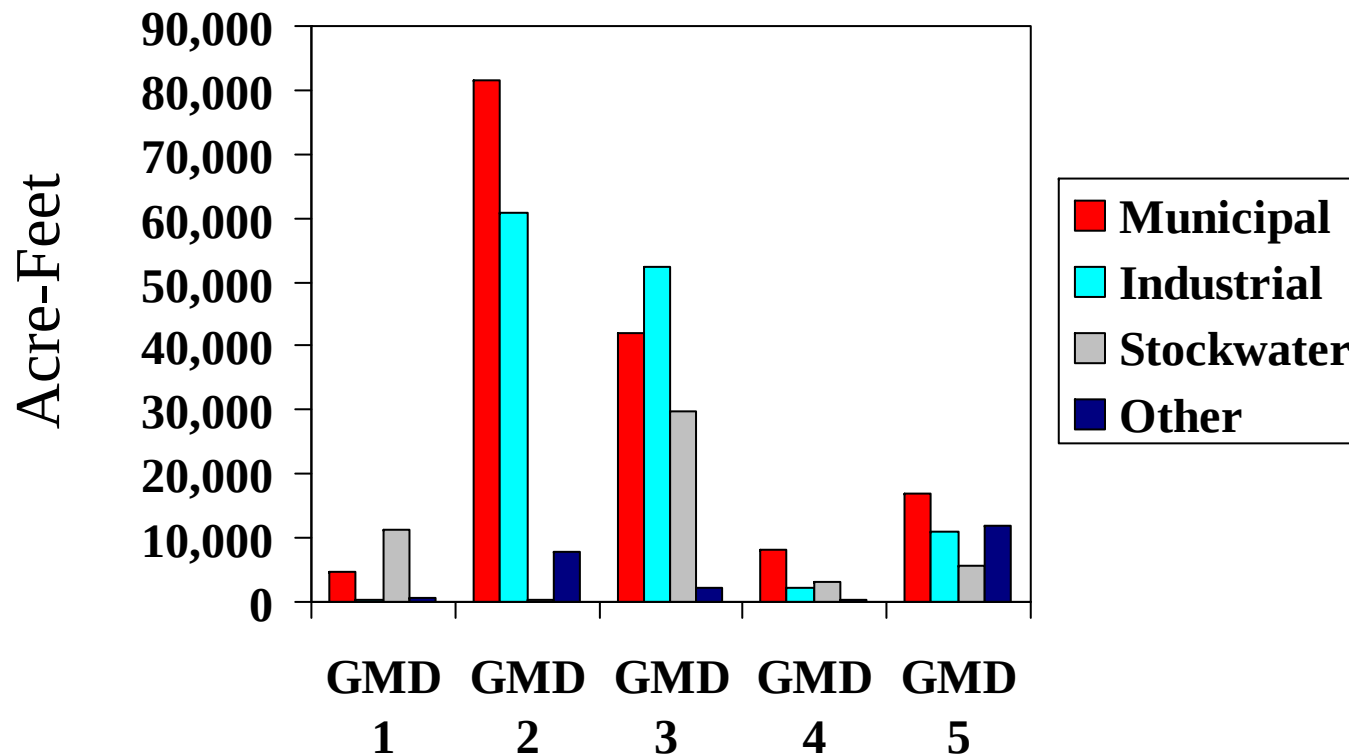
Prepared by: Regional Economic Area Partnership
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Comparison of Irrigation Appropriations Among Kansas Groundwater Management Districts



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Comparison of Water Use Appropriations by Kansas Groundwater Management Districts

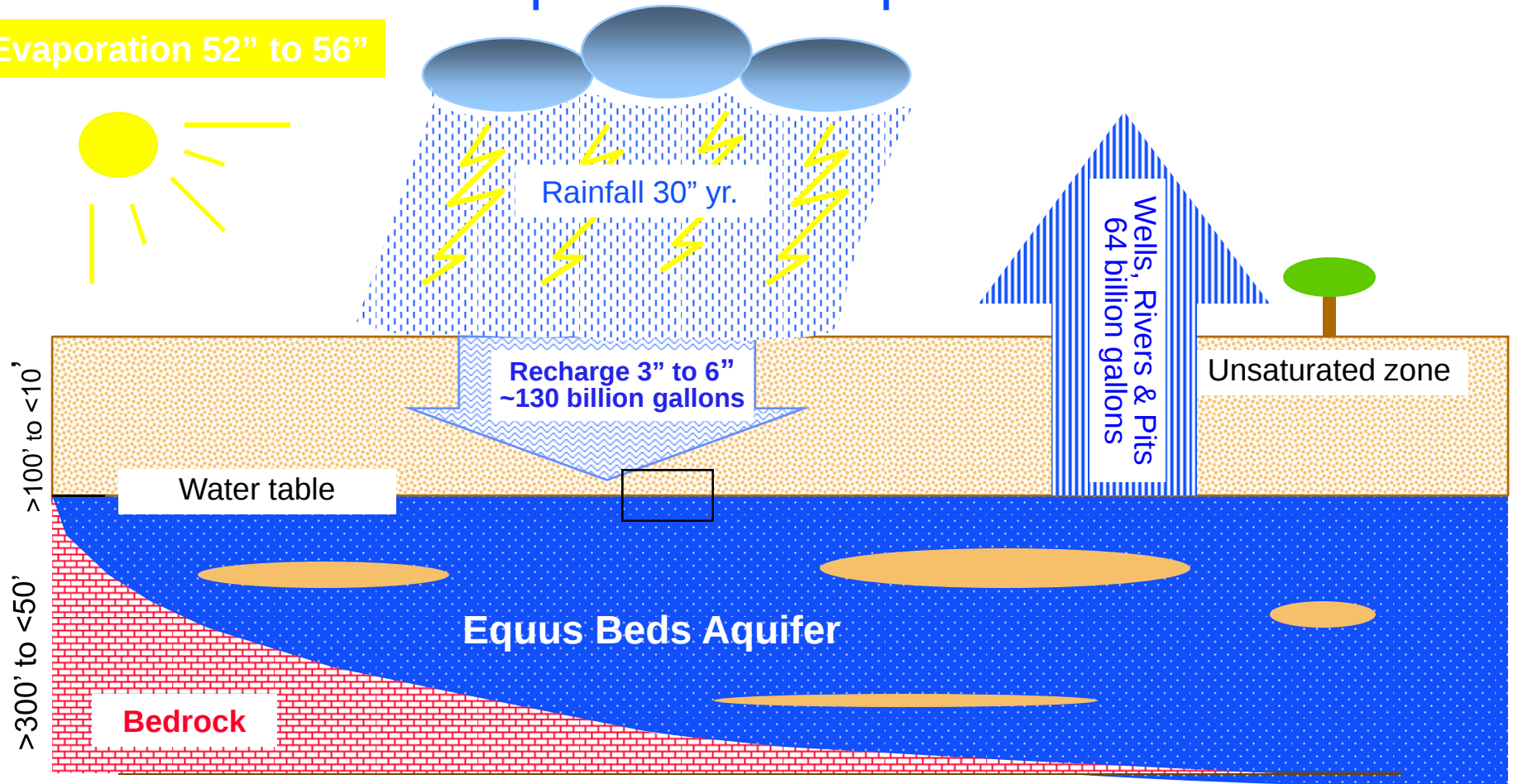


Prepared by: Regional Economic Area Partnership
Data Source: Division of Water Resources
Date: November 1, 2000

Groundwater Overview

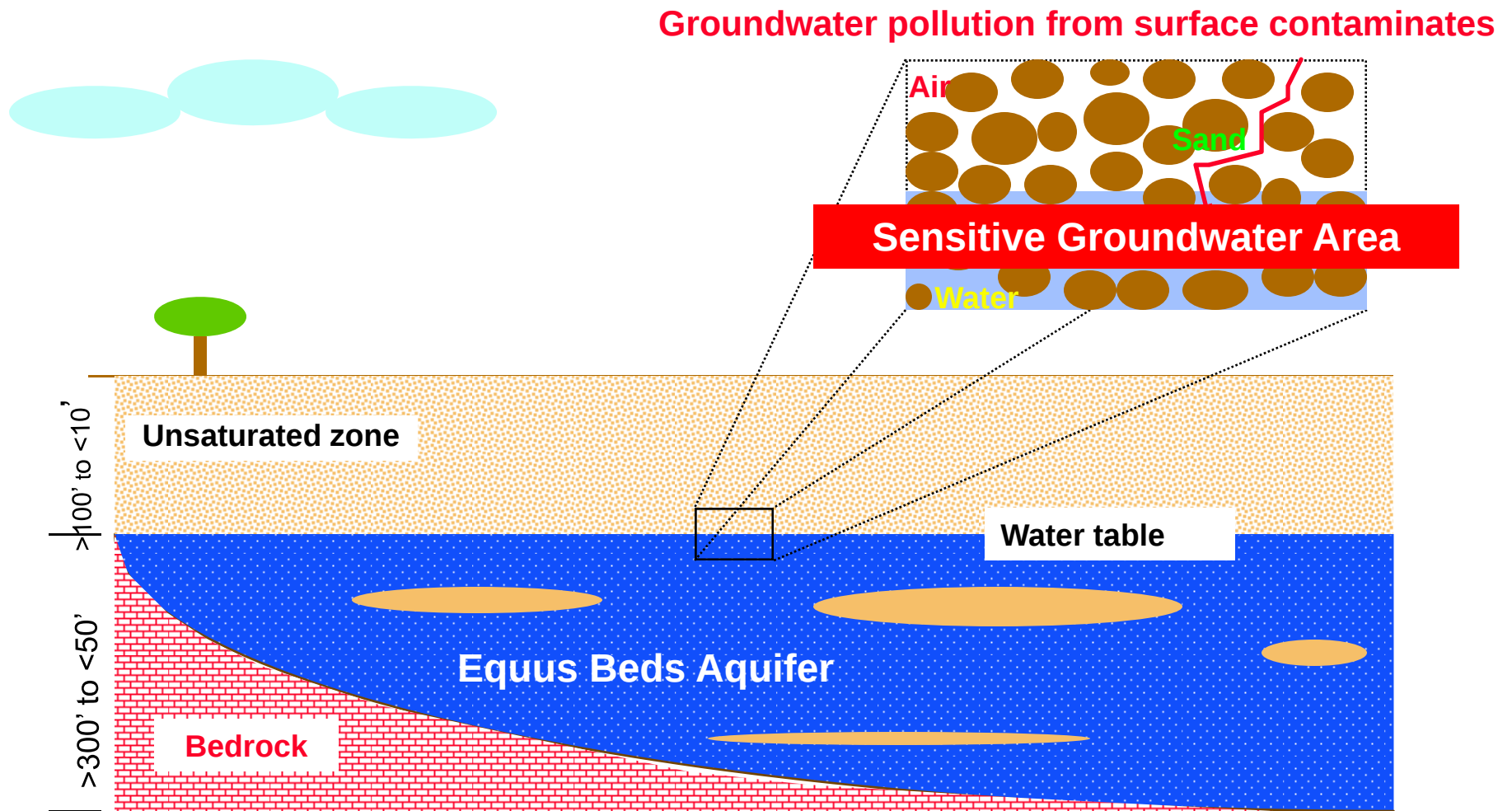
Geology and Hydrology of the Equus Beds Aquifer

Evaporation 52" to 56"



Generalized Illustration of the Hydrologic Cycle and the Equus Beds Aquifer

Geology and Hydrology of the Equus Beds Aquifer



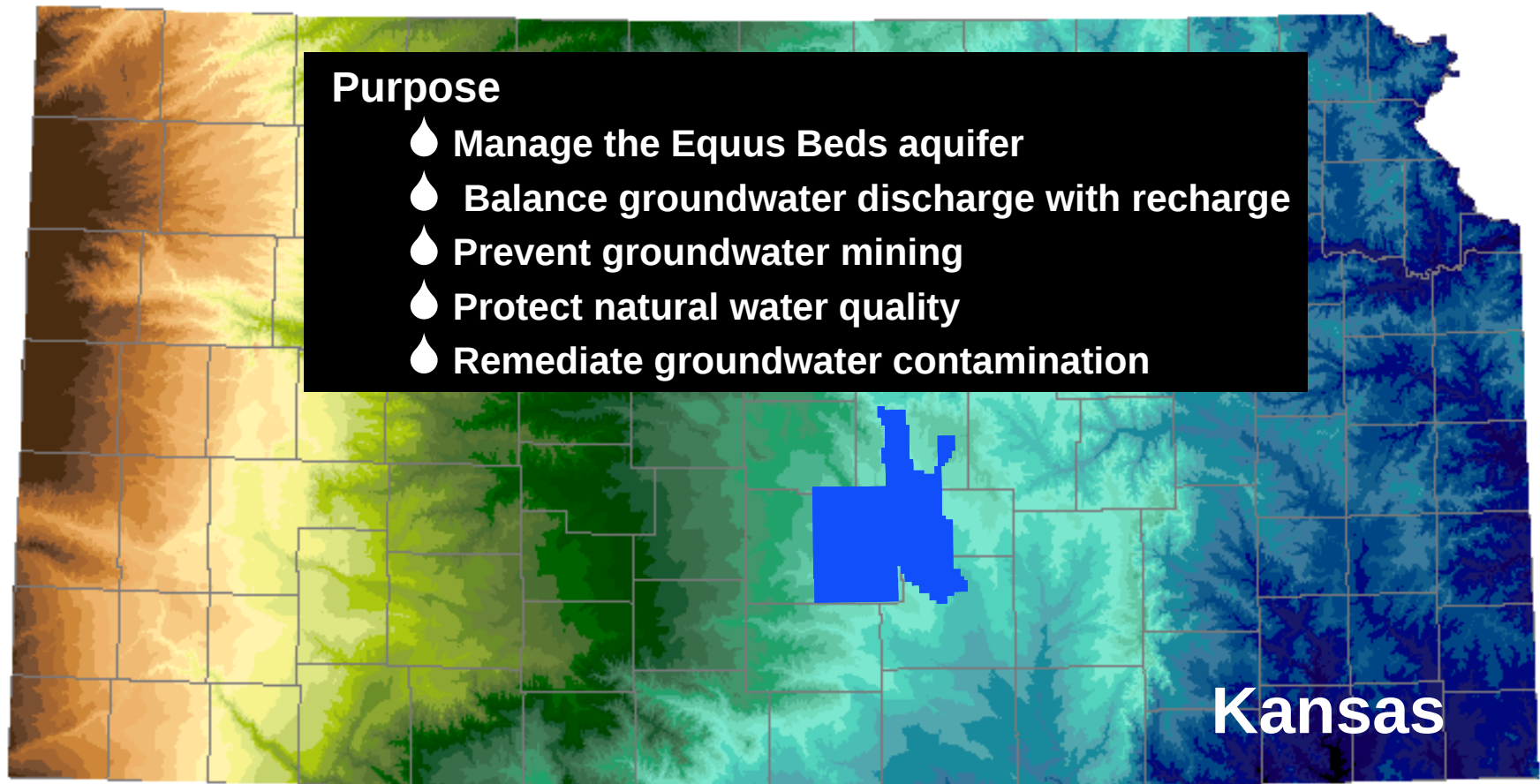
Generalized Cross-section of the Equus Beds Aquifer

Discussion Topics

- **Global Water Perspective**
- **State Water Perspective**
- **The Equus Beds Aquifer**
- **Water Protection Activities**

Equus Beds Groundwater Management District

Established 1975



Size - 1,406 square miles

Location - South-central Kansas (Reno, Harvey, McPherson & Sedgwick Counties)

Population - 550,000

Groundwater Management Districts

Local Management of Water Issues

State and Federal Water Agencies

Division of Water Resources	Kansas Water Office	Kansas Geological Survey	Kansas Corporation Commission	Kansas Dept Health & Environment	Bureau of Reclamation	US Geological Survey
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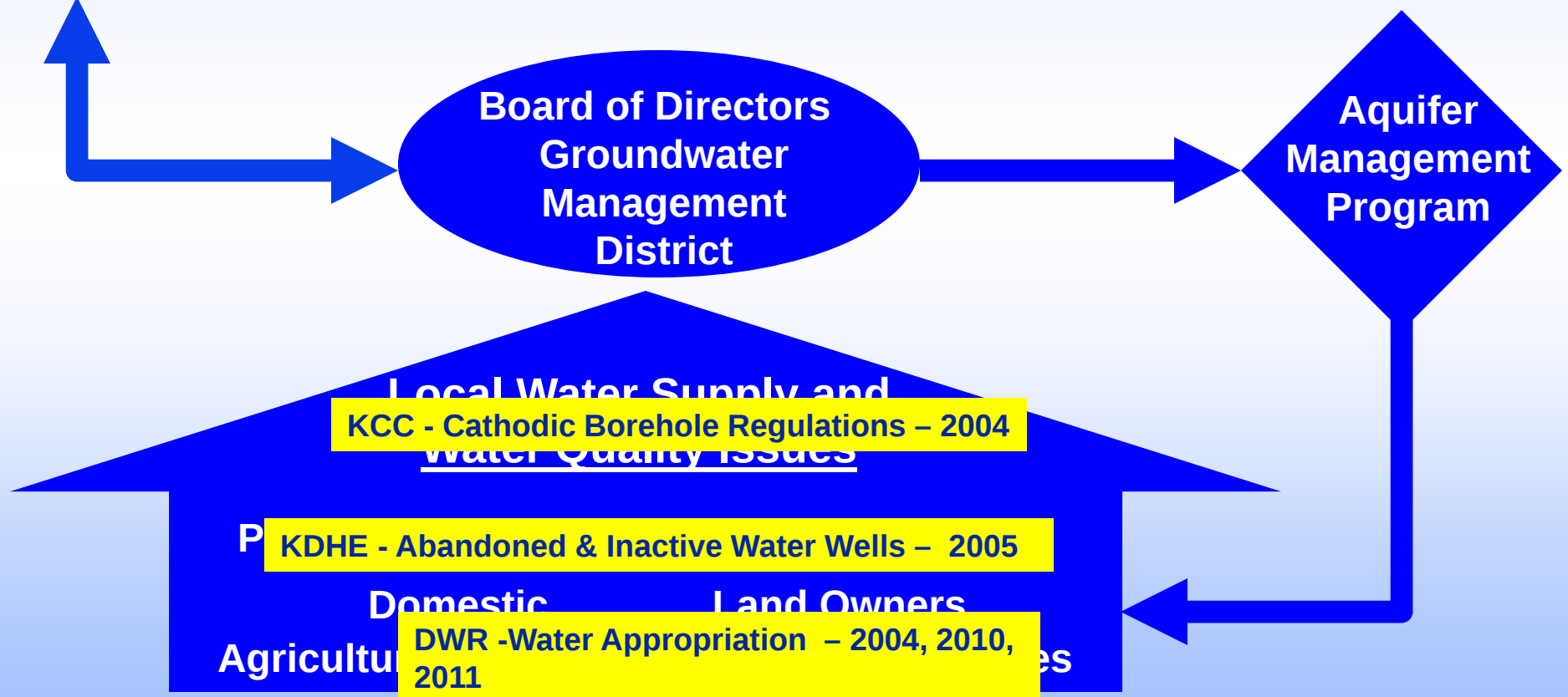
Board of Directors
Groundwater
Management
District

Aquifer
Management
Program

Local Water Supply and
KCC - Cathodic Borehole Regulations – 2004
Water Quality Issues

P KDHE - Abandoned & Inactive Water Wells – 2005

Domestic Land Owners
Agriculture DWR - Water Appropriation – 2004, 2010, 2011

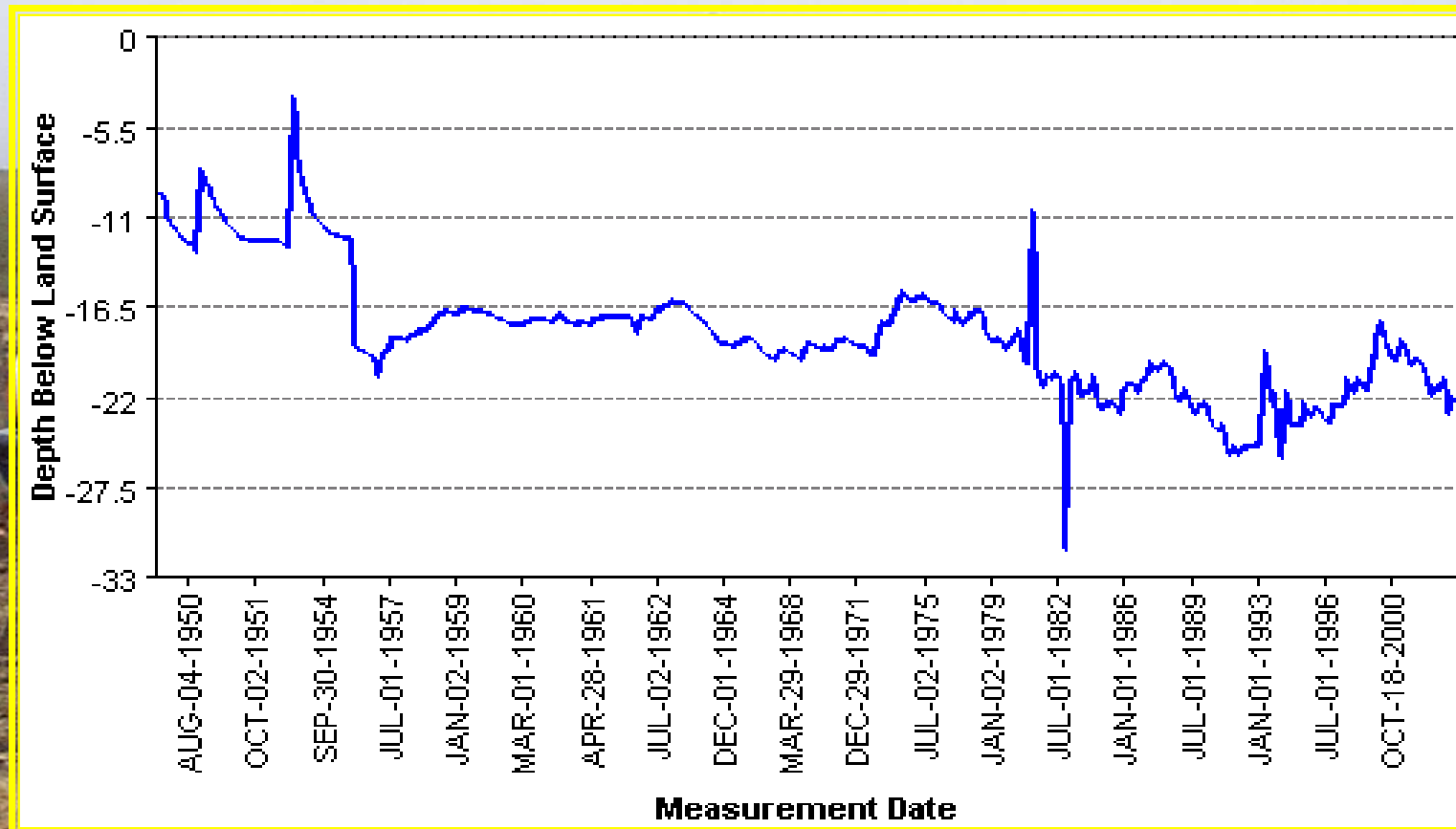


Groundwater Management Activities

Data Collection

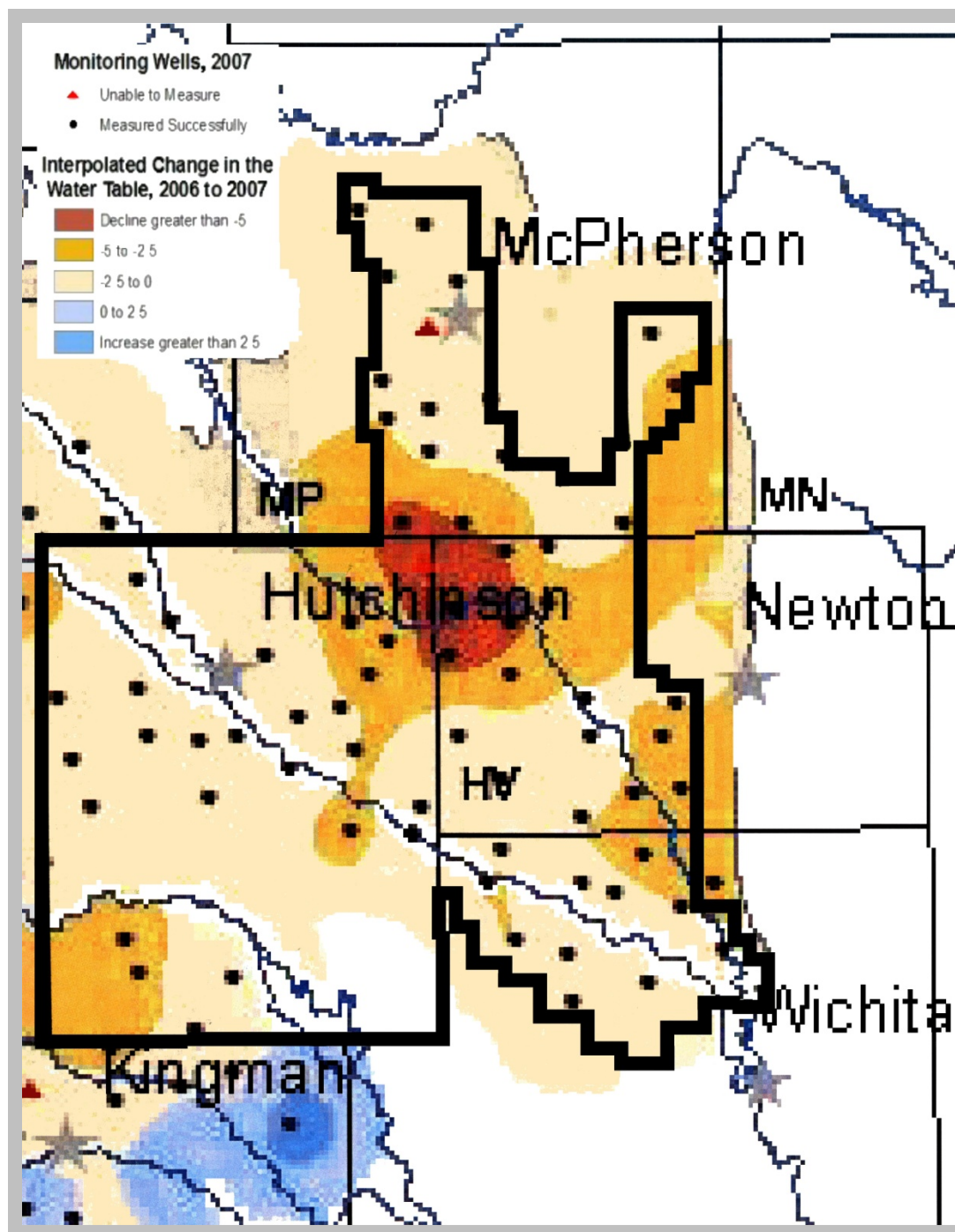
Kansas Geological Survey - WIZARD

<http://magellan.kgs.ku.edu/WaterLevels/index.html>

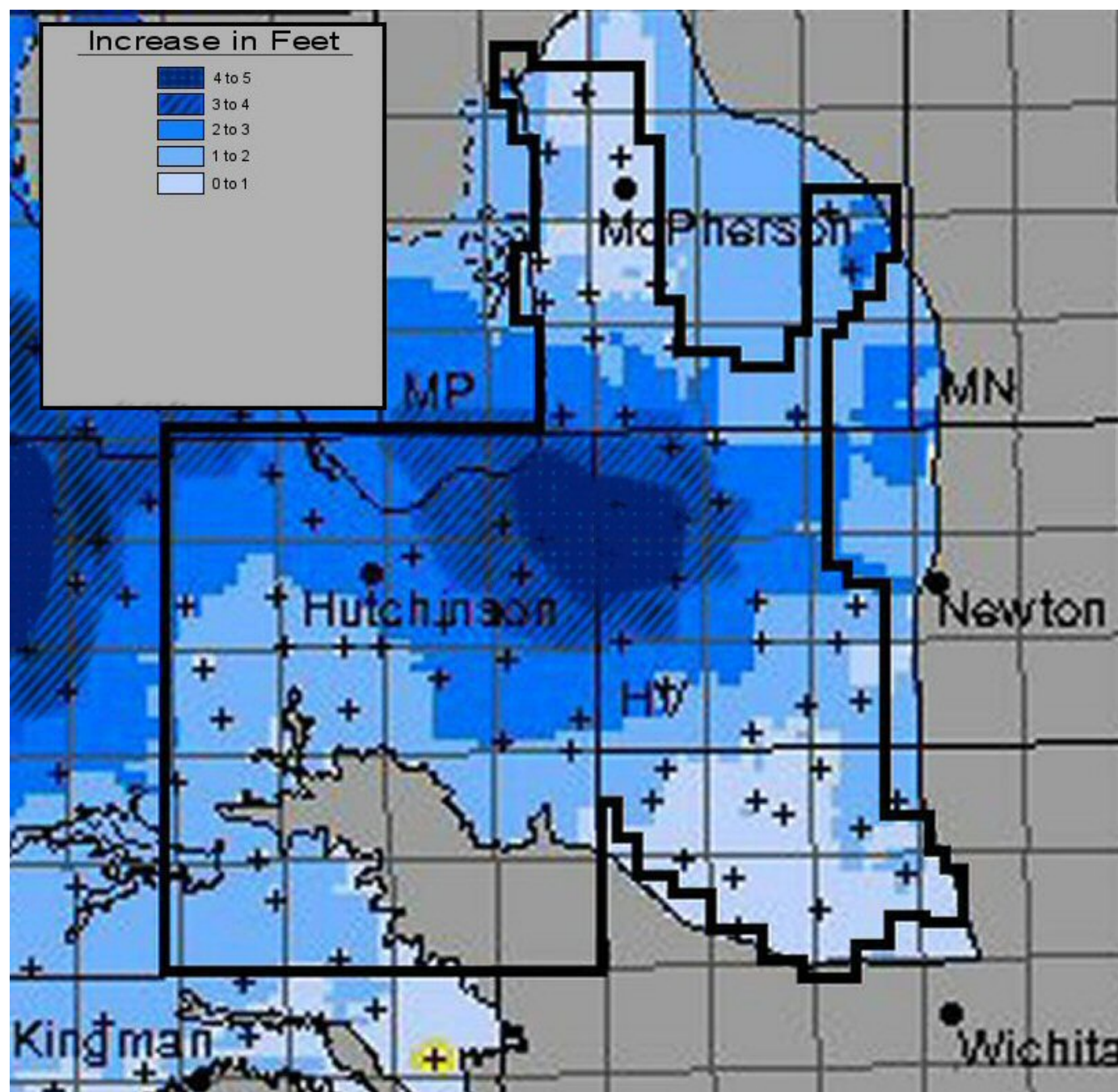


- Maintains nearly 550 water level monitoring wells
- Collects 2,000 to 3,000 measurements annually
- Maintains historical water level records to 1975
- Available to local, state and federal agencies & public

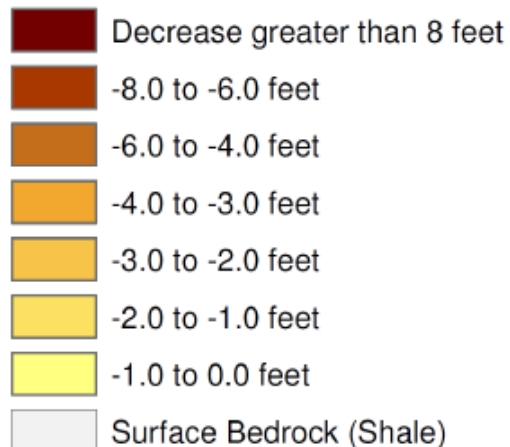
Groundwater Level Changes in the Equus Beds Aquifer January 2006-2007



**Preliminary
Groundwater
Level
Changes
in the
Equis Beds
Aquifer
January
2007-2008**

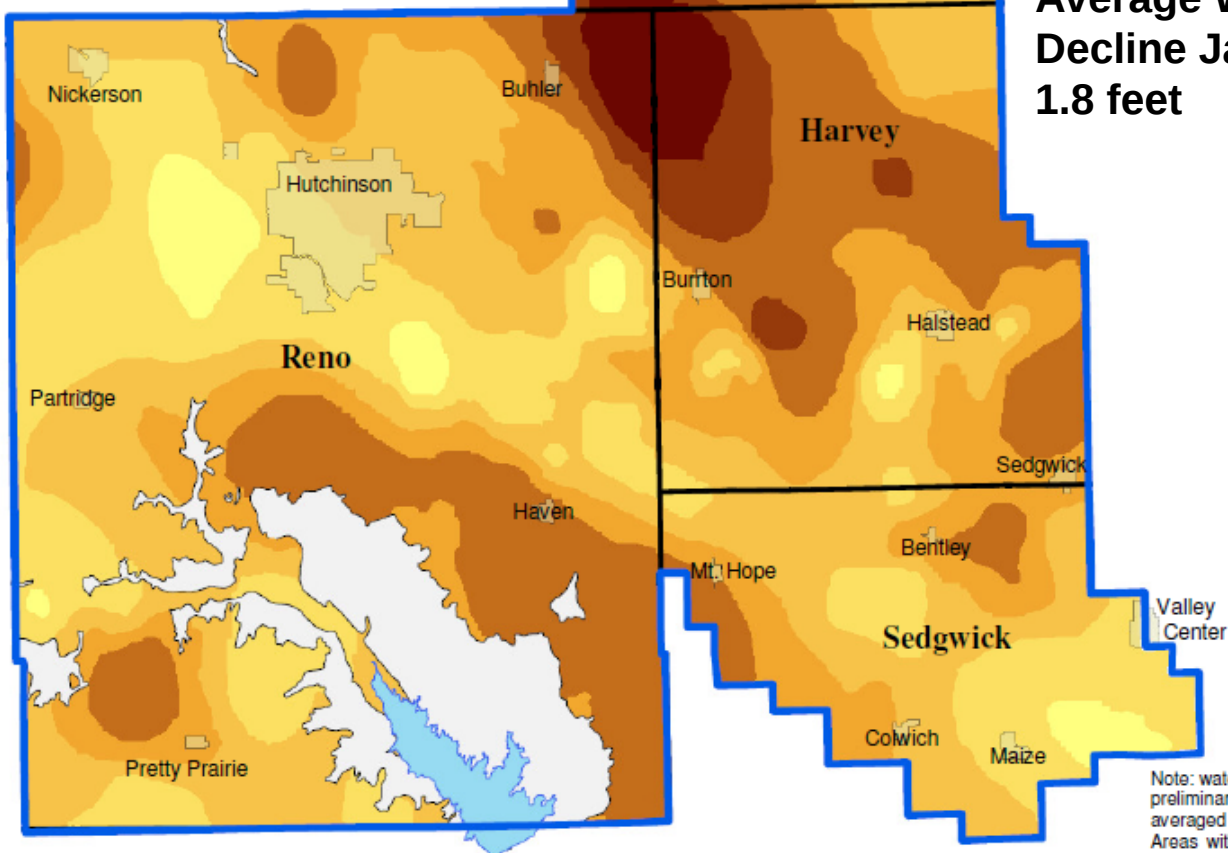


Interpolated Water Level Changes January 2011 to January 2012



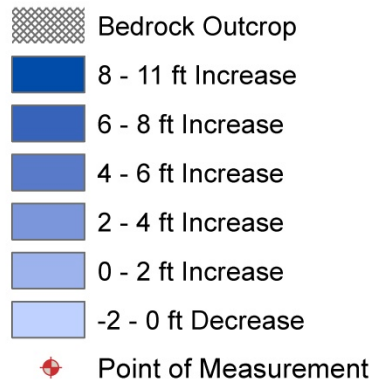
**Average Water-Level
Decline Jan 2011-Jan 2012 :
3.2 feet**

**Average Water-Level
Decline Jan 2012-Jan 2013 :
1.8 feet**



Note: water level changes are considered preliminary and are based primarily on averaged lower level aquifer zone measurements. Areas with semi-confined conditions may exaggerate perceived water level declines.

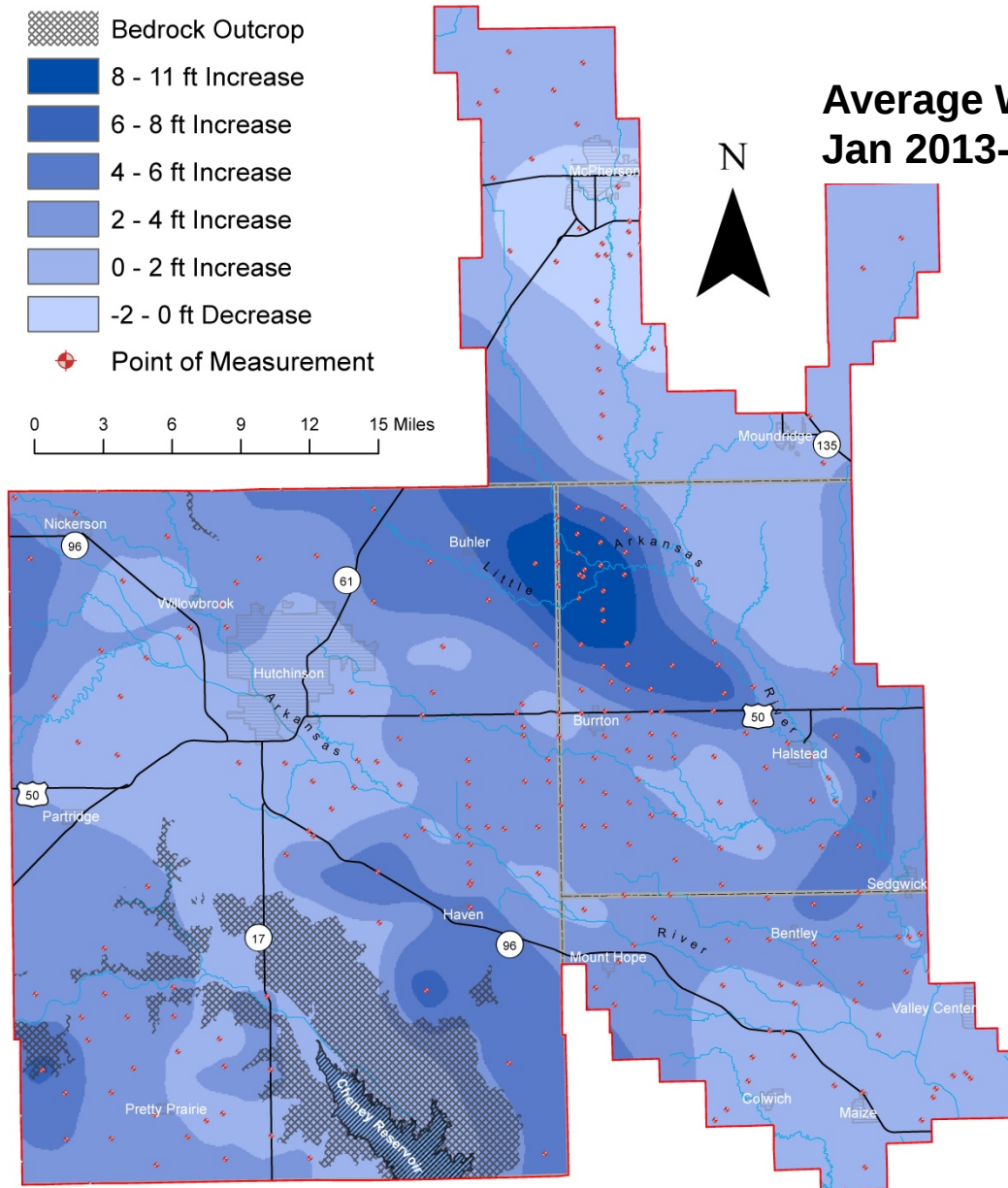
Jan 2013 to Jan 2014 Depth to Groundwater Change Map



0 3 6 9 12 15 Miles



**Average Water-Level Increase
Jan 2013-Jan 2014 : 2.5 feet**

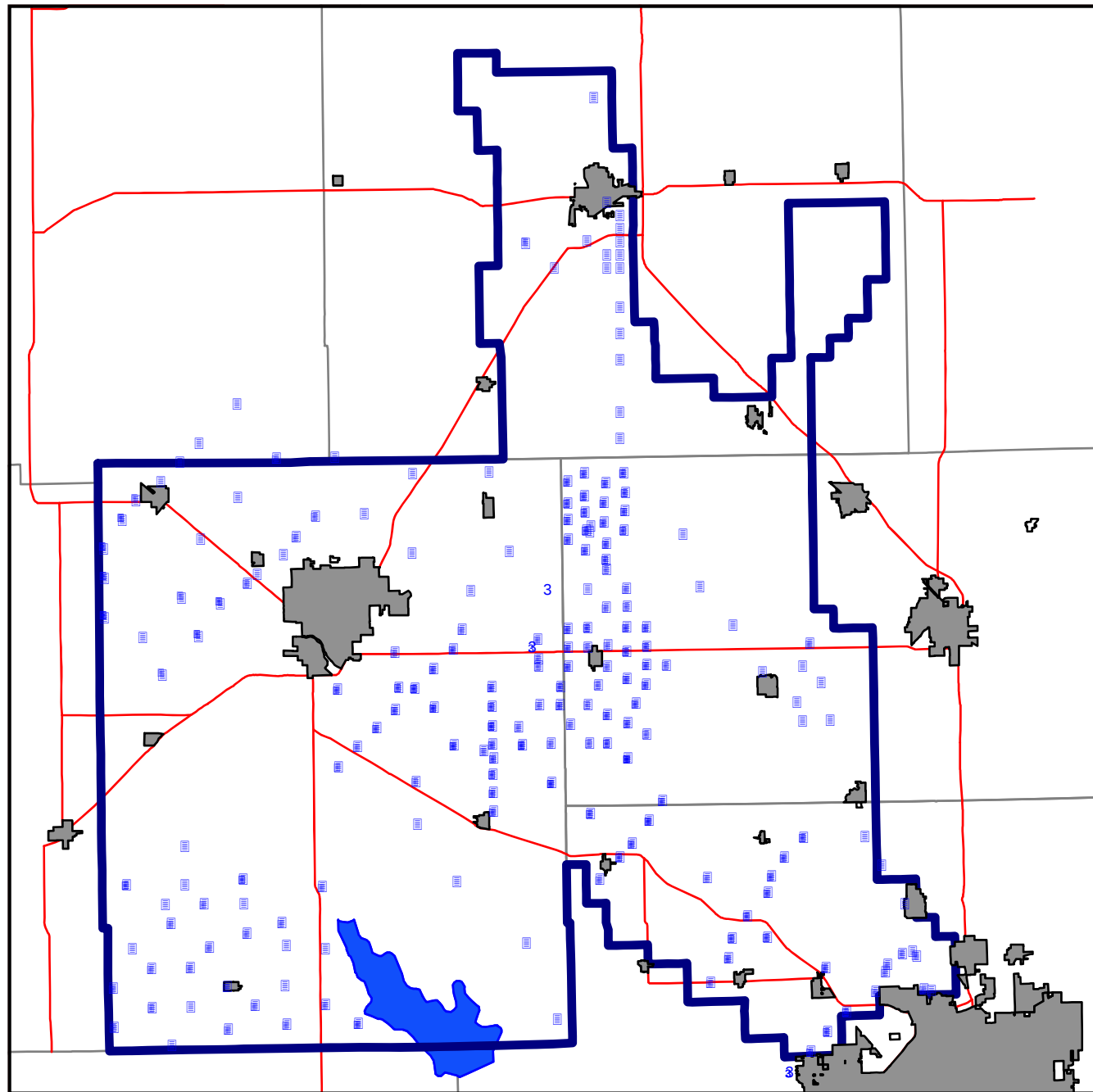


300 to 500 WATER SAMPLES COLLECTED ANNUALLY

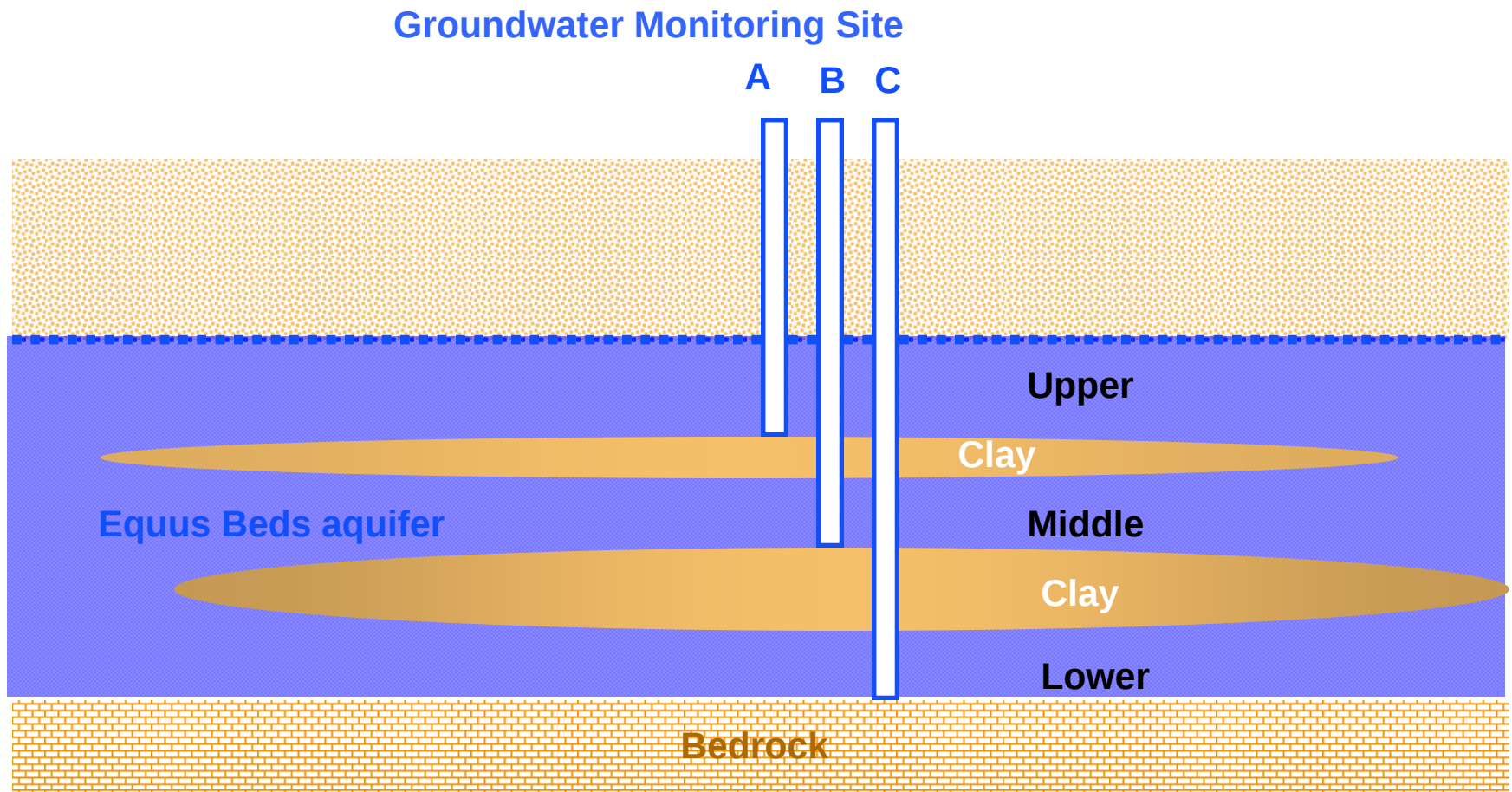


Equus Beds Groundwater Management District No. 2 Groundwater Monitoring Site Map

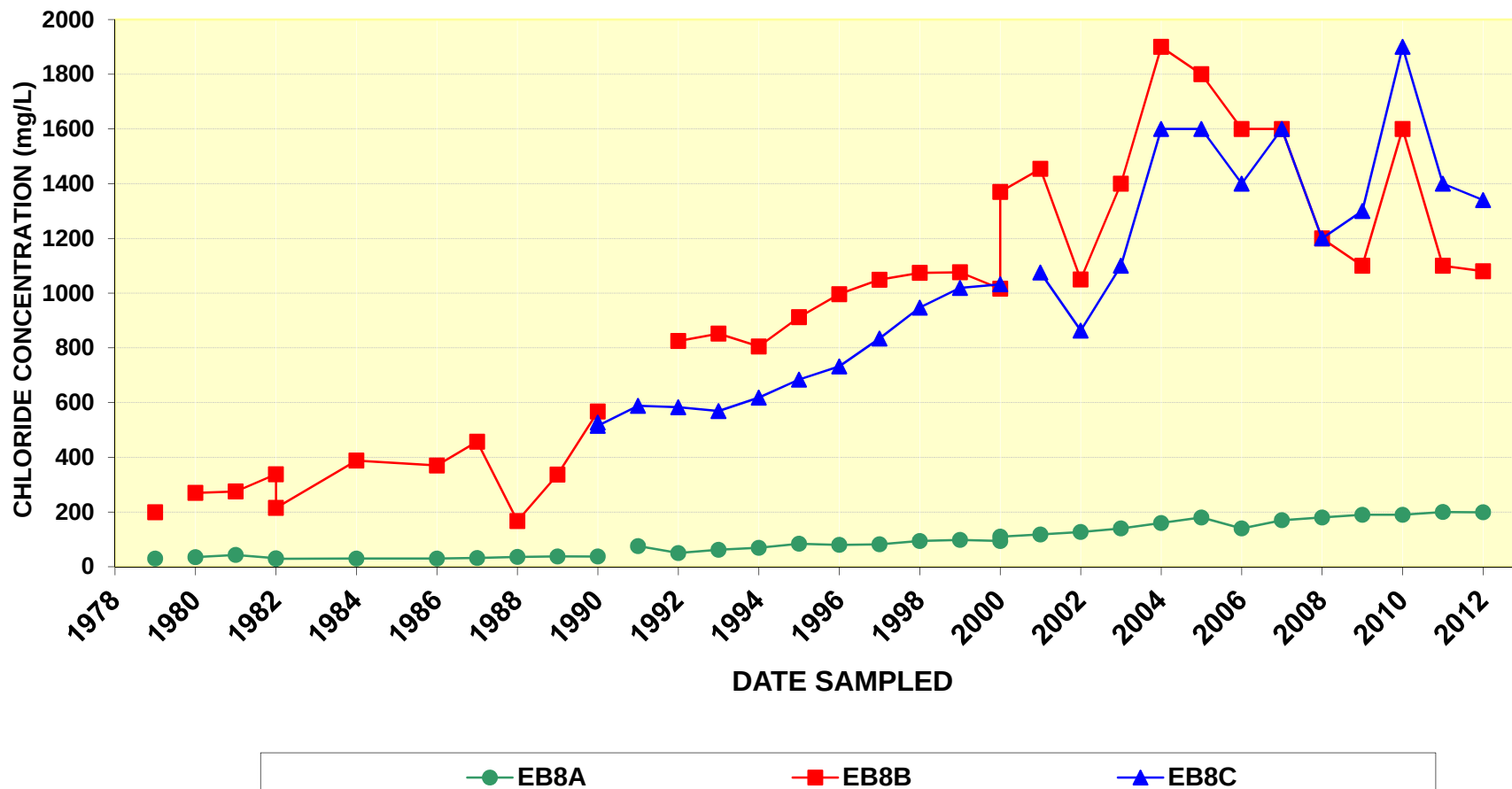
■ Groundwater
Monitoring Site



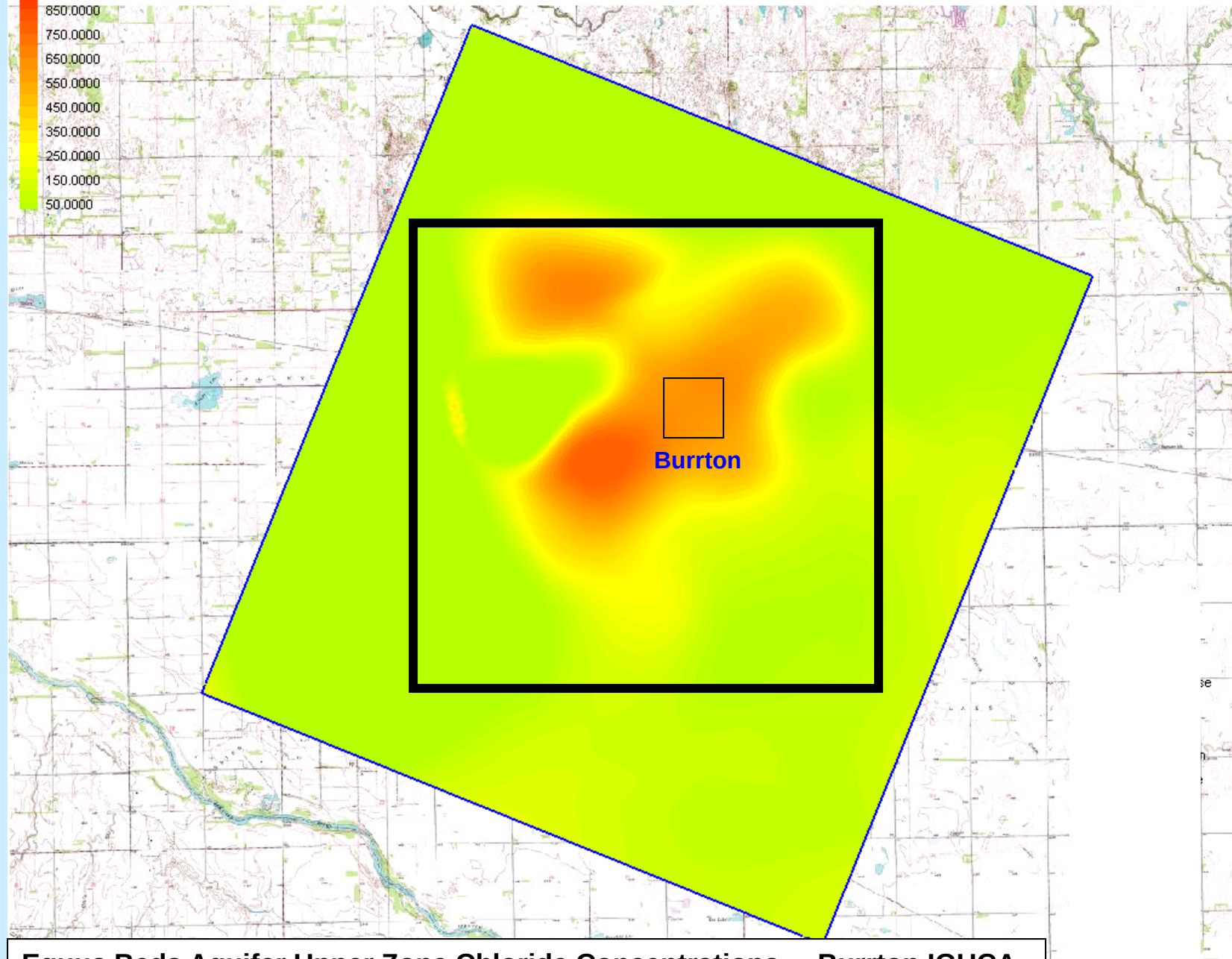
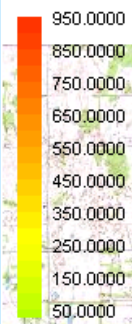
Equus Beds Groundwater Management District Groundwater Quality Monitoring Network



Equus Beds Groundwater Management District No. 2 Chloride Concentrations - Groundwater Monitoring Site EB 8

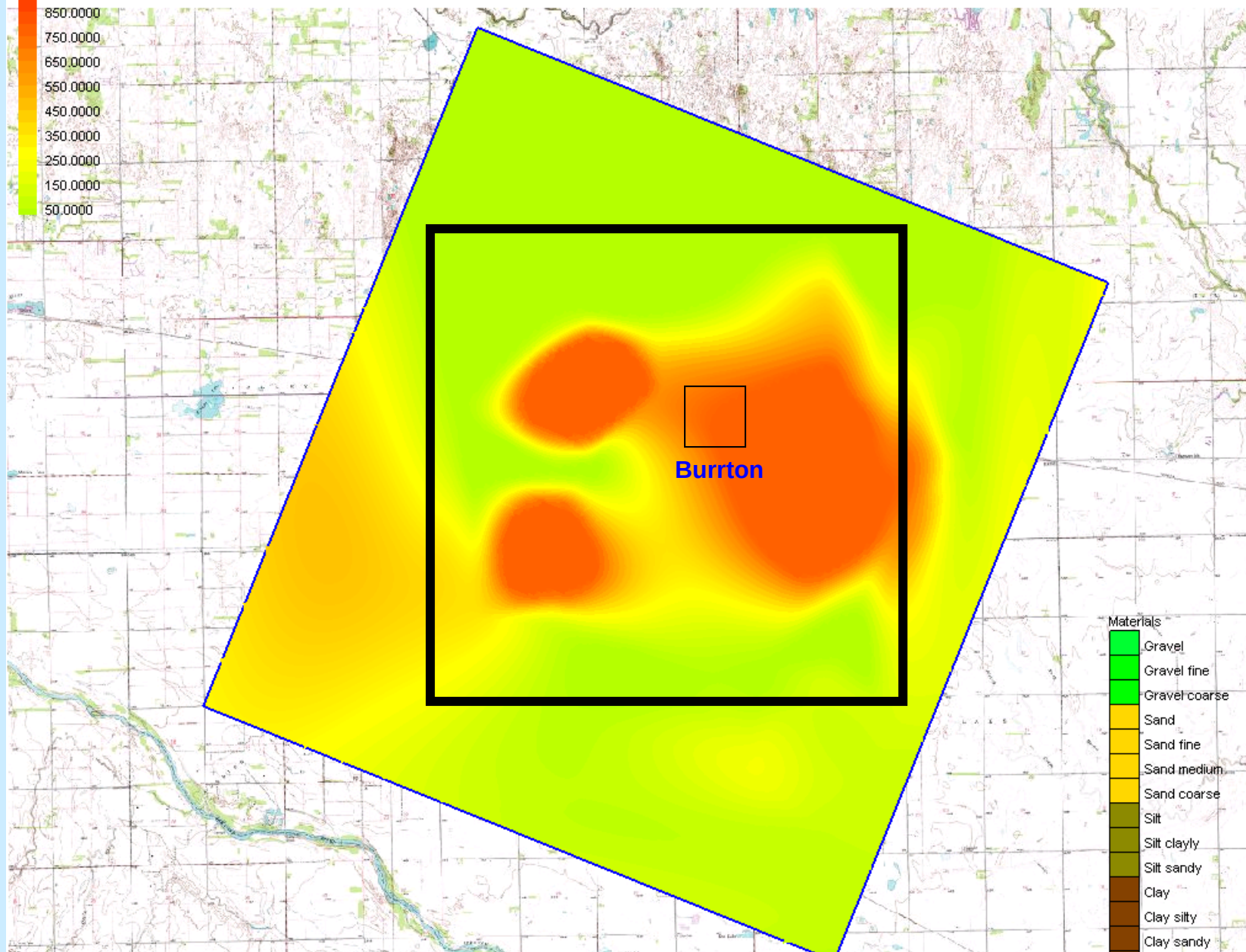
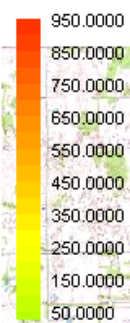


SCALAR

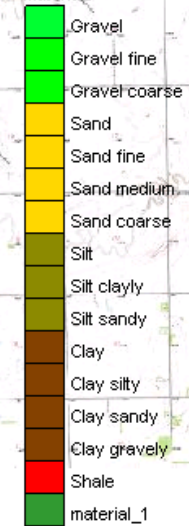


Equus Beds Aquifer Upper Zone Chloride Concentrations – Burton IGUCA

SCALAR

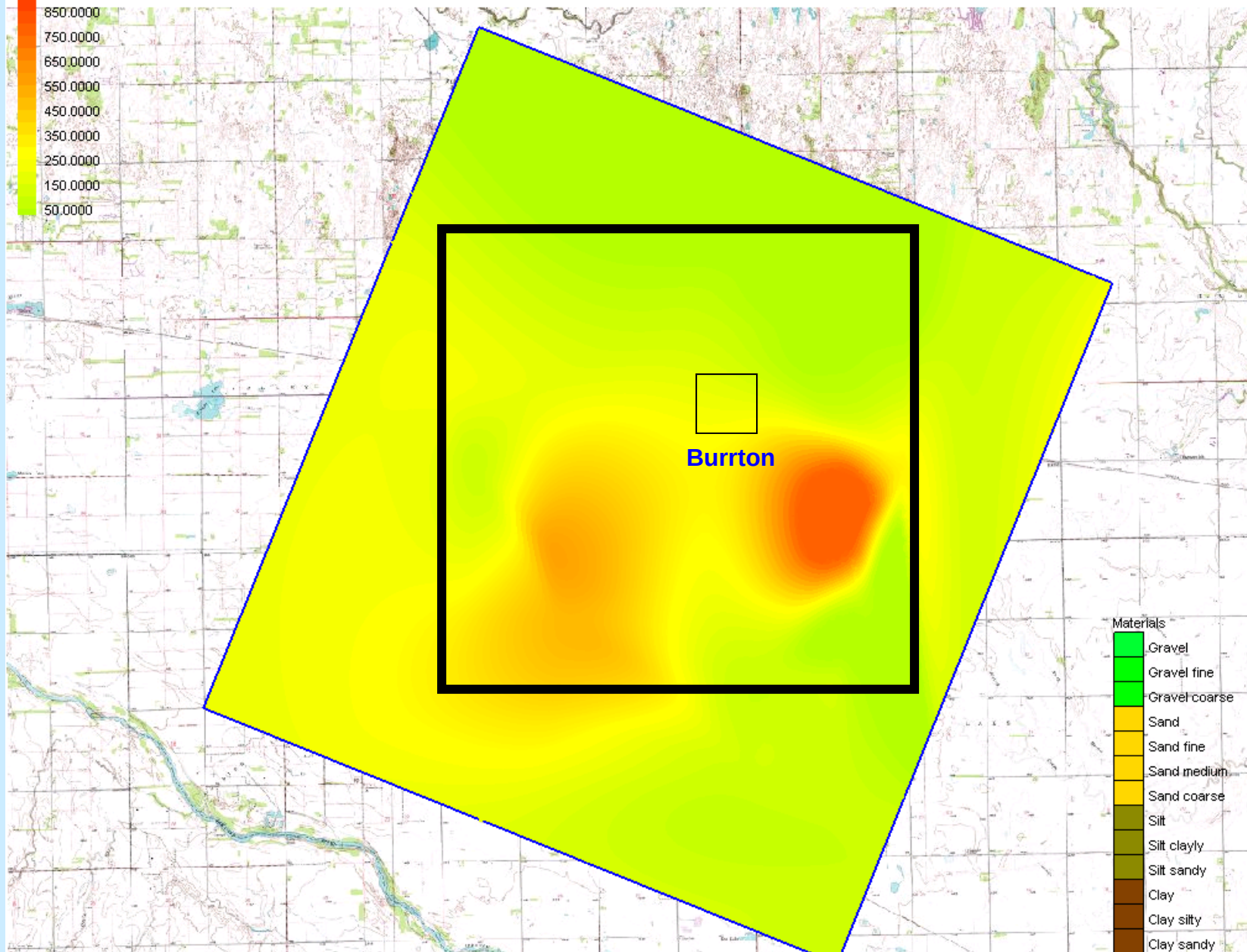
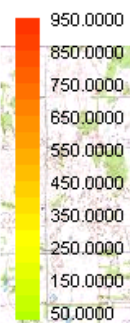


Materials

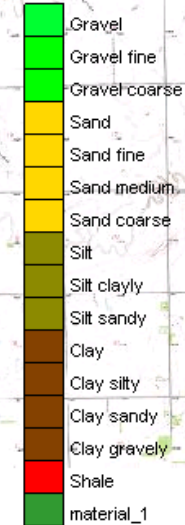


Equus Beds Aquifer Middle Zone Chloride Concentrations – Burrton IGUCA

SCALAR



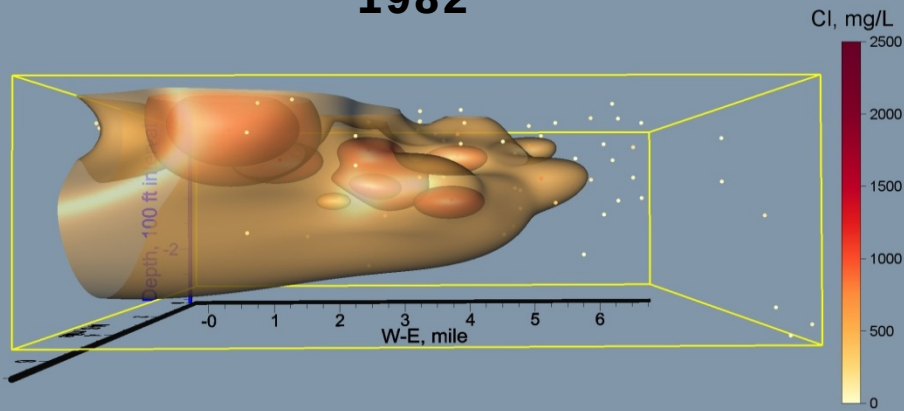
Materials



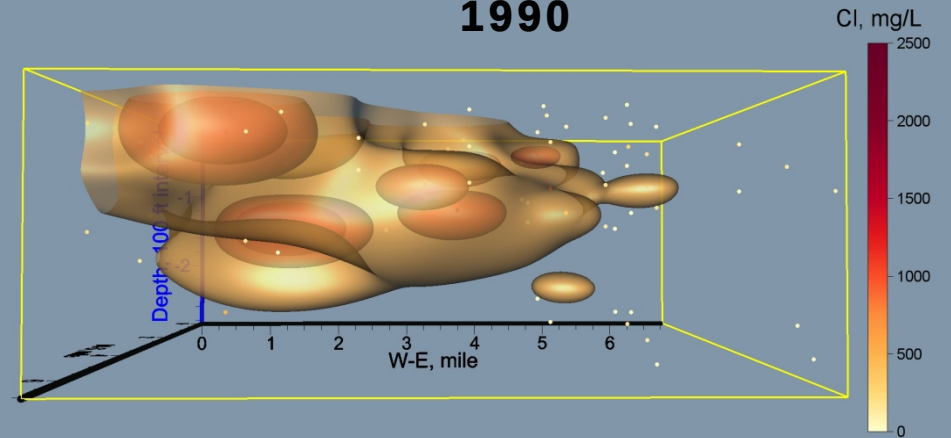
Equus Beds Aquifer Lower Zone Chloride Concentrations – Burrton IGUCA

Burrton Chloride Plume

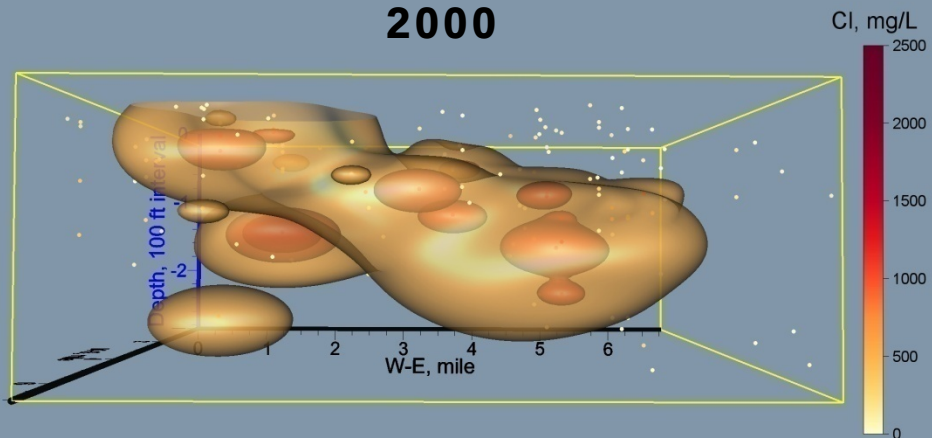
1982



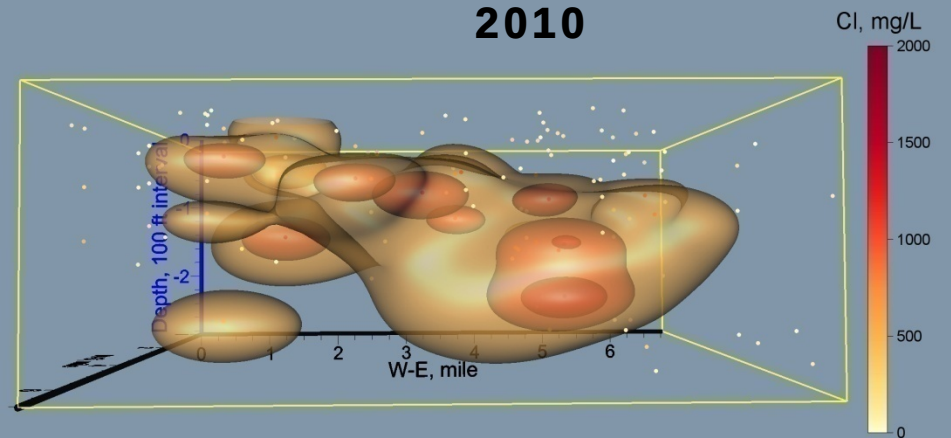
1990



2000

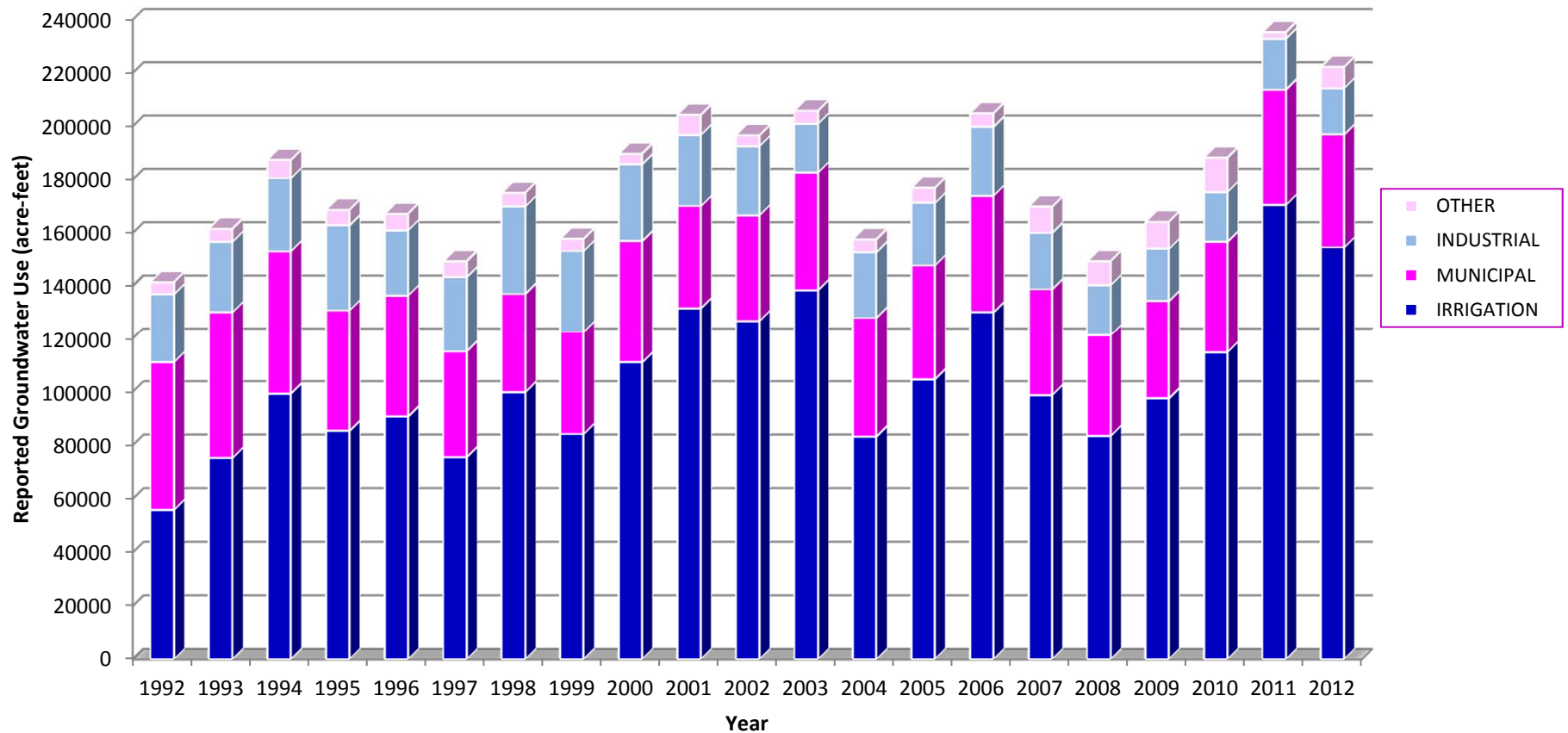


2010



EQUUS BEDS GROUNDWATER MANAGEMENT DISTRICT NO. 2

Total Reported Groundwater Use, 1992-2012



Drought Impacts



Cheney Reservoir



ARKANSAS RIVER – AUGUST 2012



LITTLE ARKANSAS RIVER – AUGUST 2012



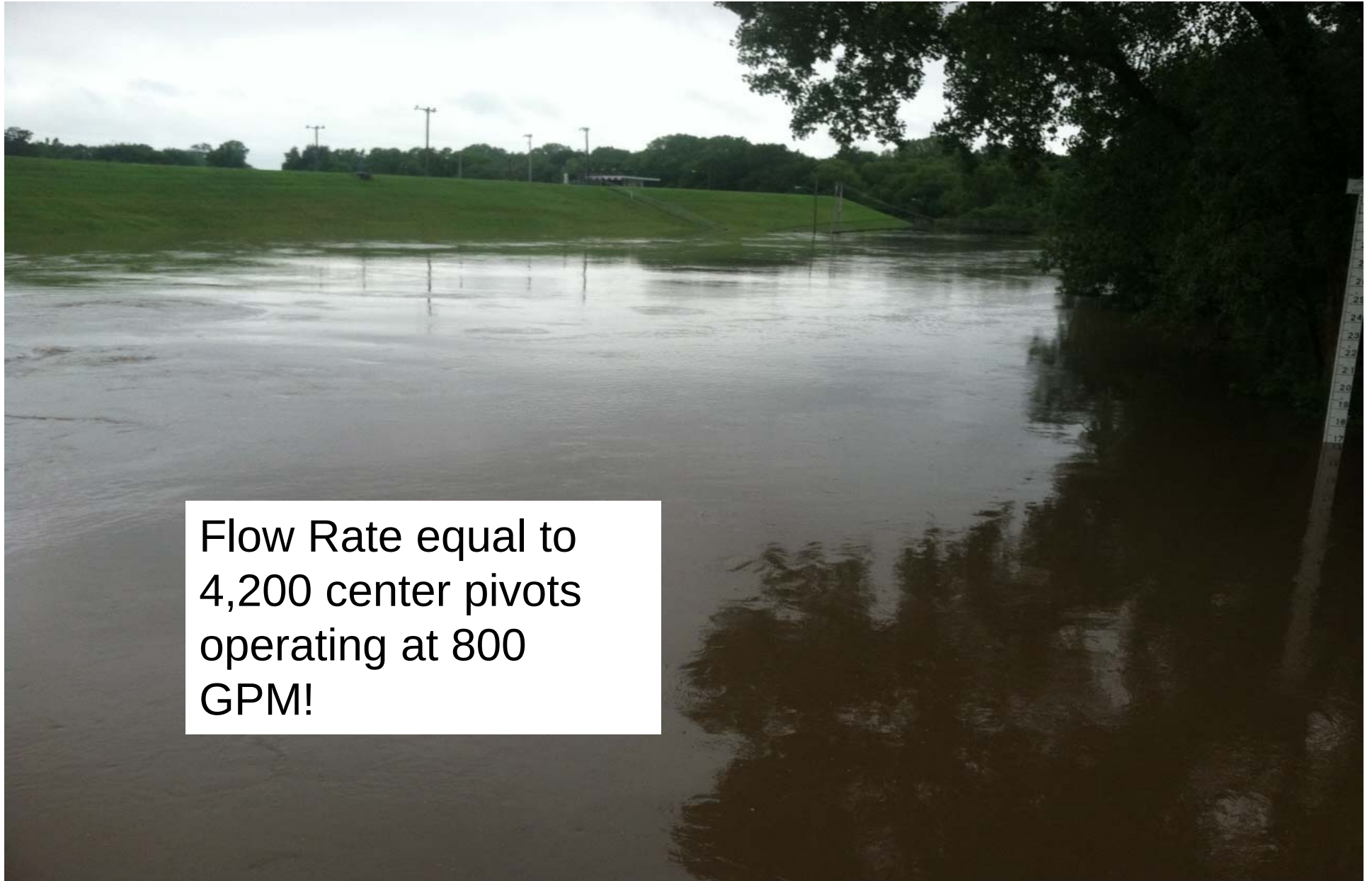
LITTLE ARKANSAS RIVER – JULY 30, 2013

~7,500 CFS



LITTLE ARKANSAS RIVER – JULY 30, 2013

~7,500 CFS



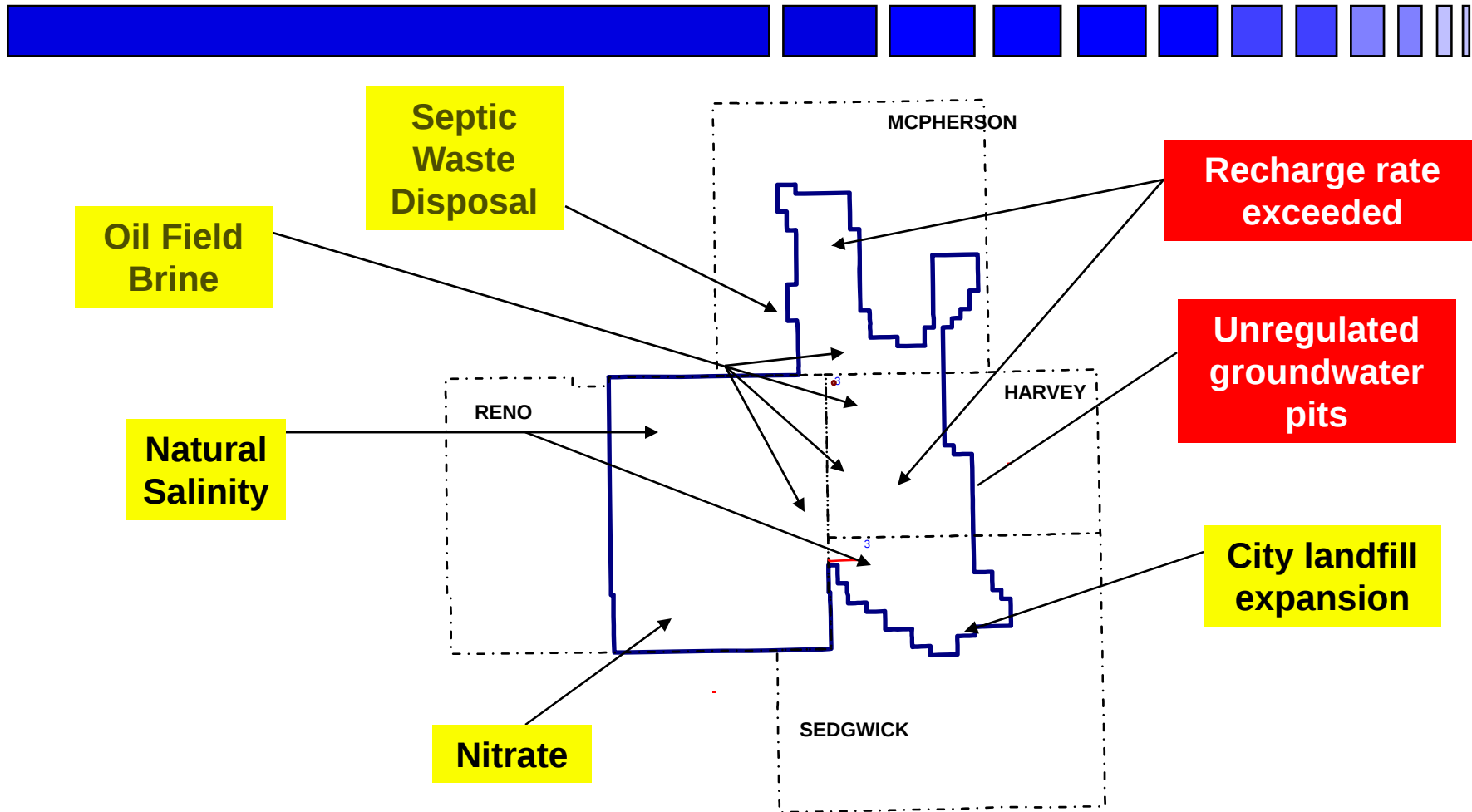
Flow Rate equal to
4,200 center pivots
operating at 800
GPM!

Discussion Topics

- **State Water Perspective**
- **The Equus Beds Aquifer**
- **Water Protection Activities**
- **Water Protection Issues**

Equus Beds Groundwater Management District No. 2

Groundwater Management Issues



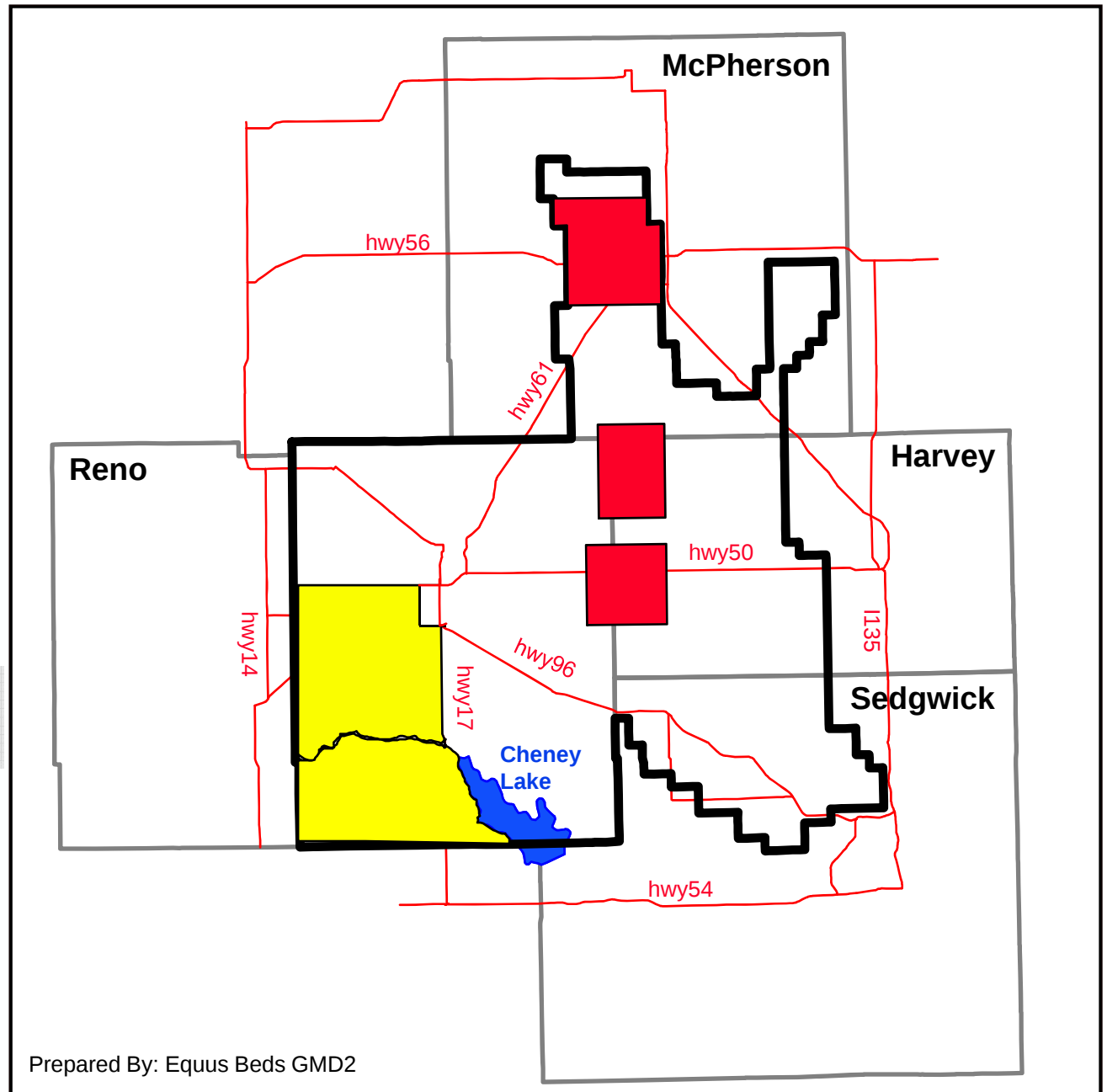
Equus Beds Groundwater Management District No. 2 Special Management Areas

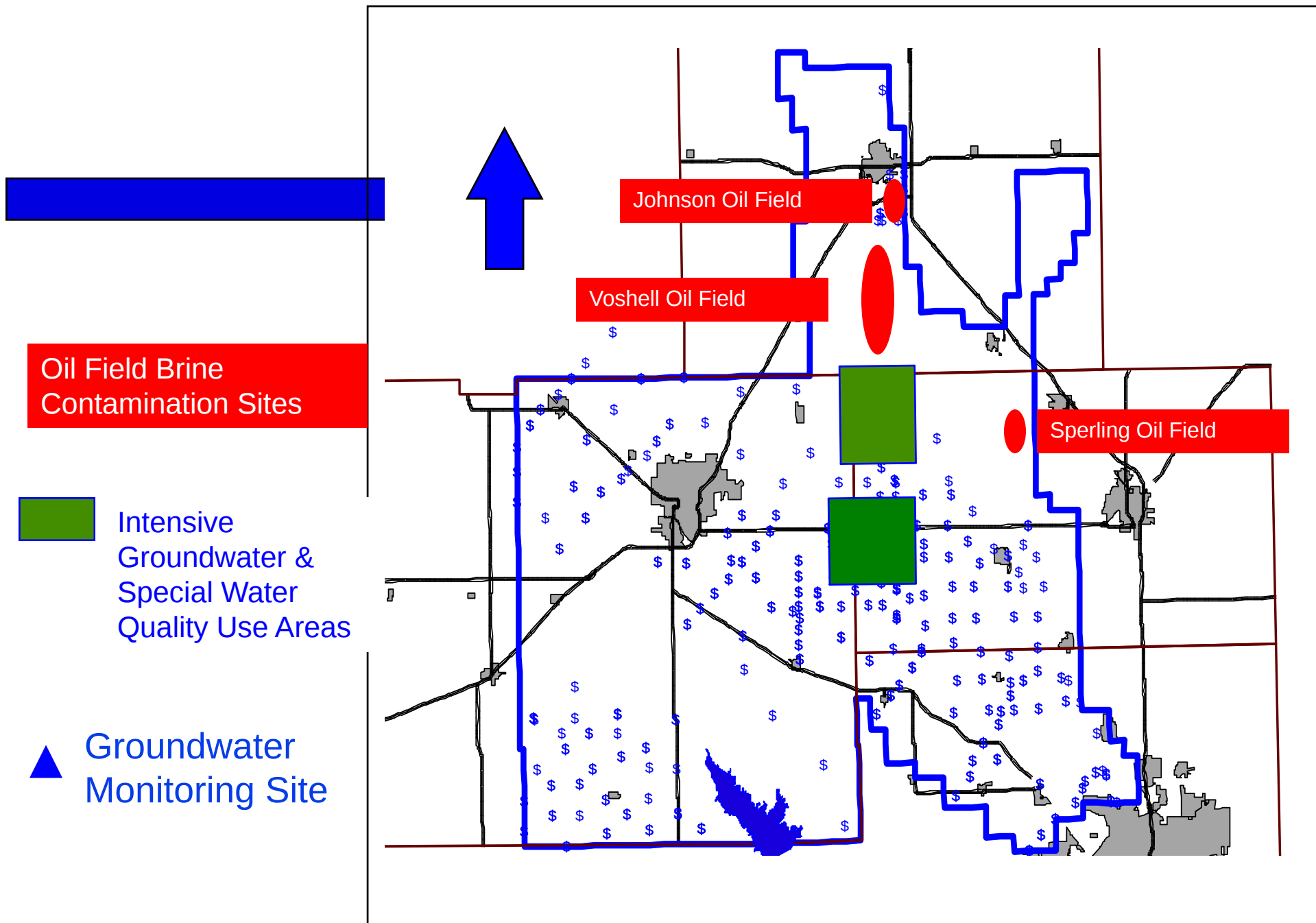


Intensive
Groundwater
Use & Special
Water Quality
Areas



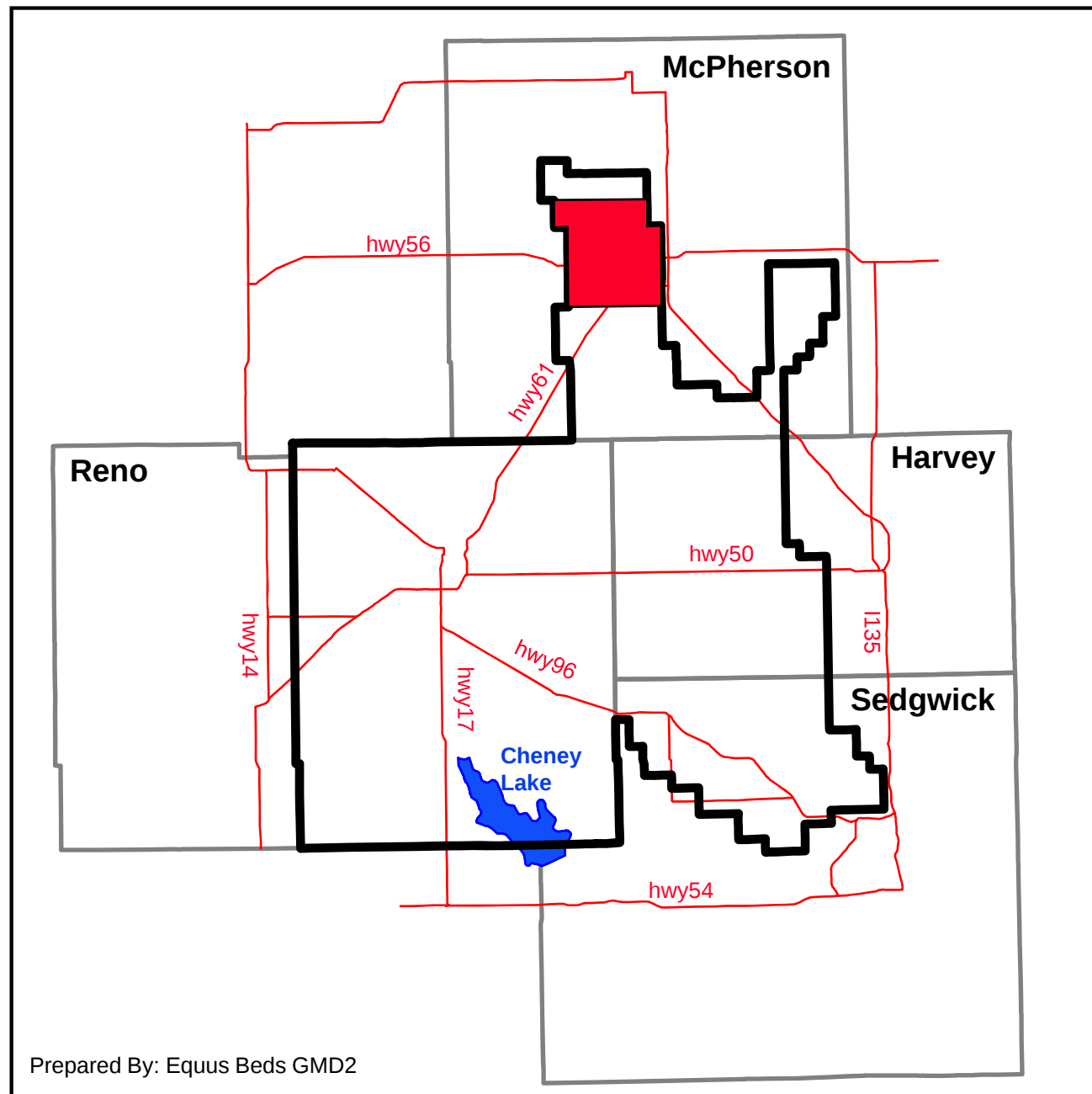
Enhanced Well
Spacing Area





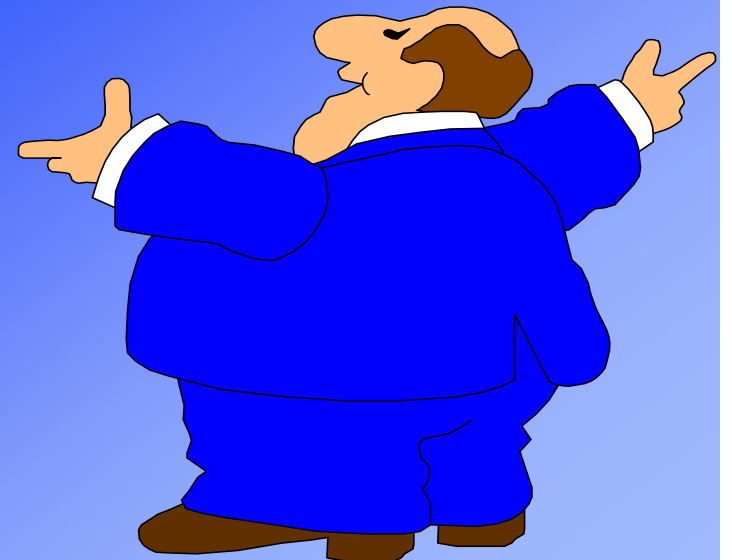
**Equus Beds
Groundwater
Management
District No. 2
Special
Management Area**

 **Intensive
Groundwater
Use Control Area**

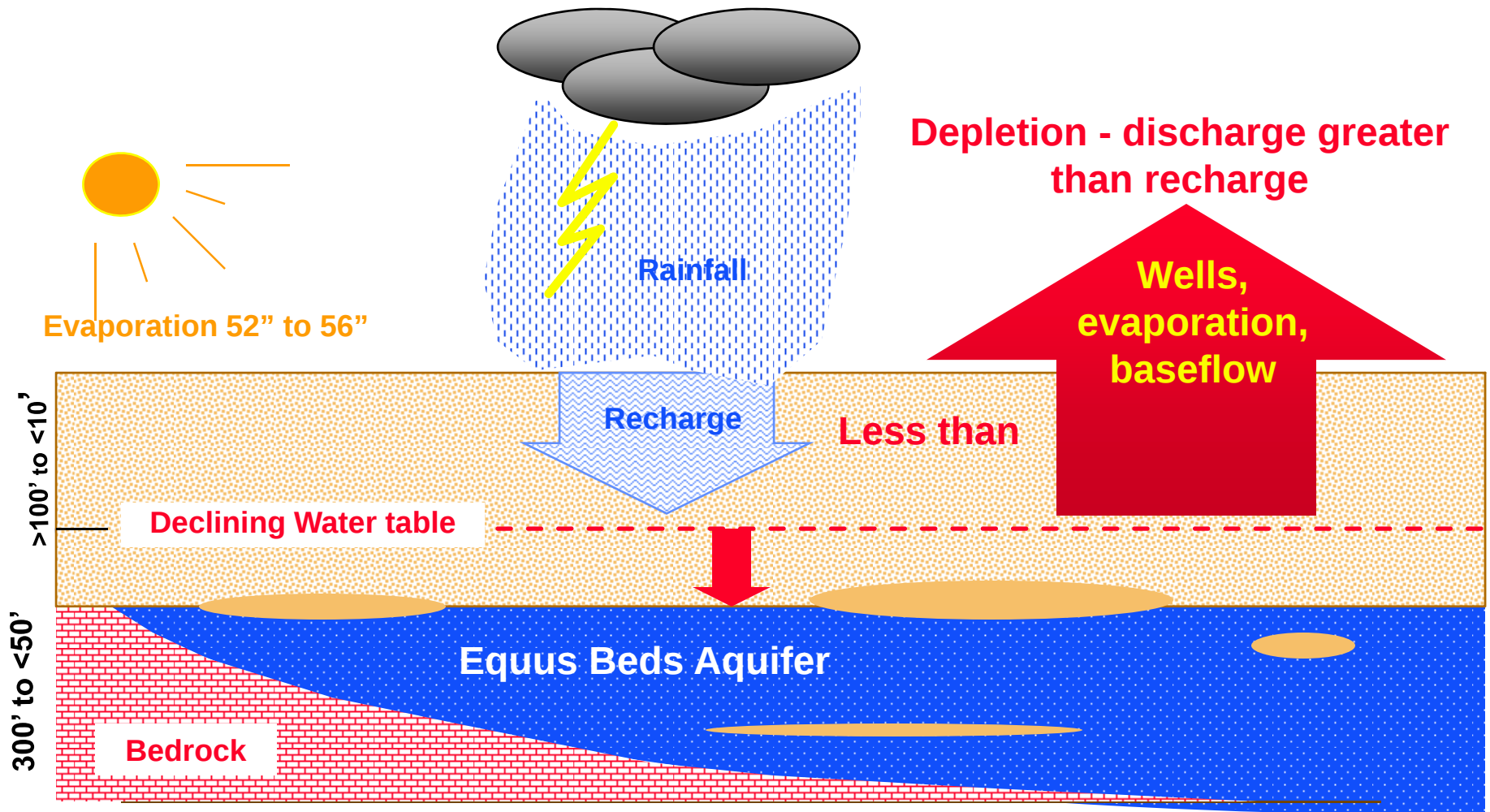


Groundwater Management Issues

Water Budget:
Safe-yield
vs.
Depletion

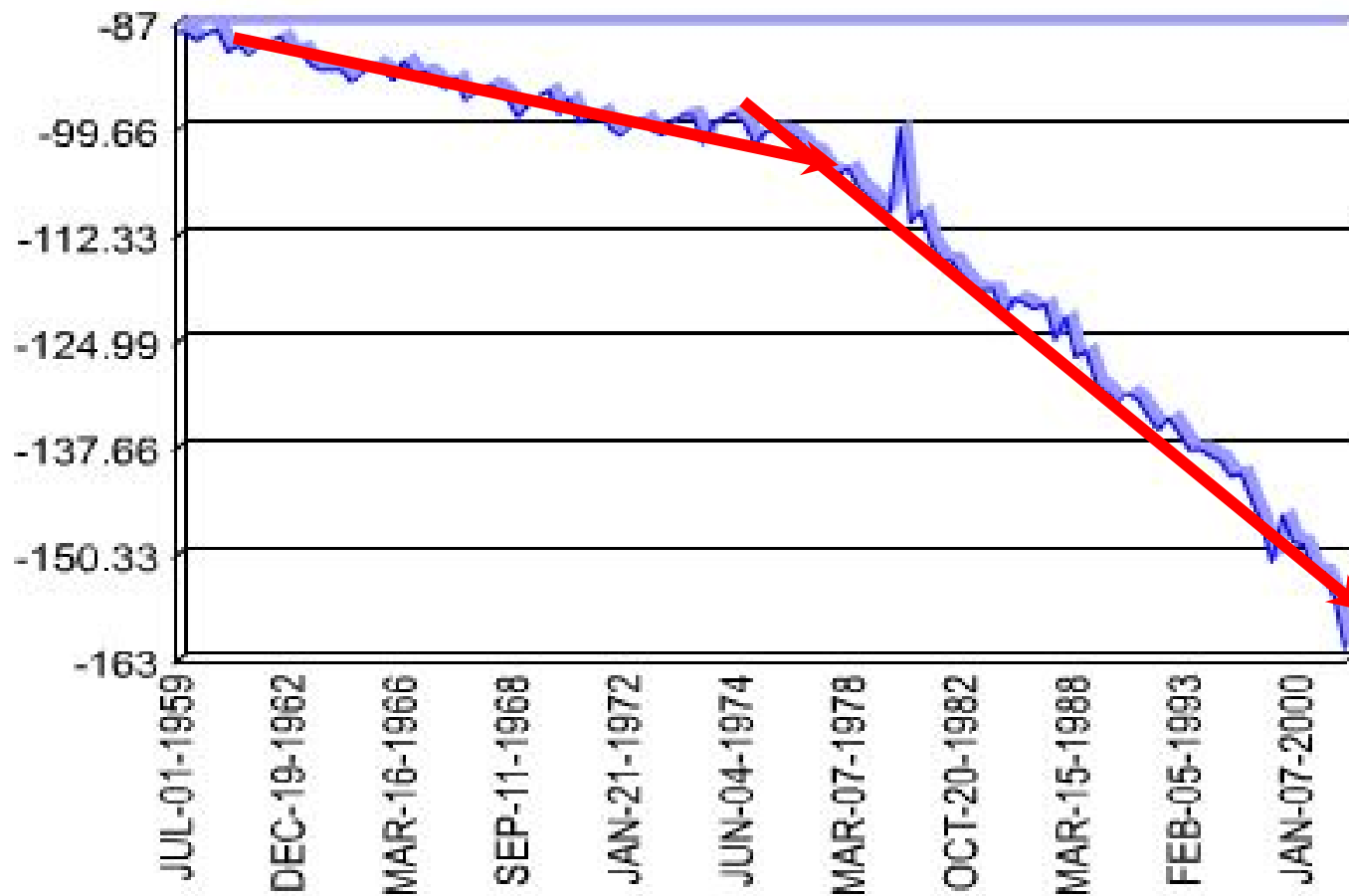


Water Budget



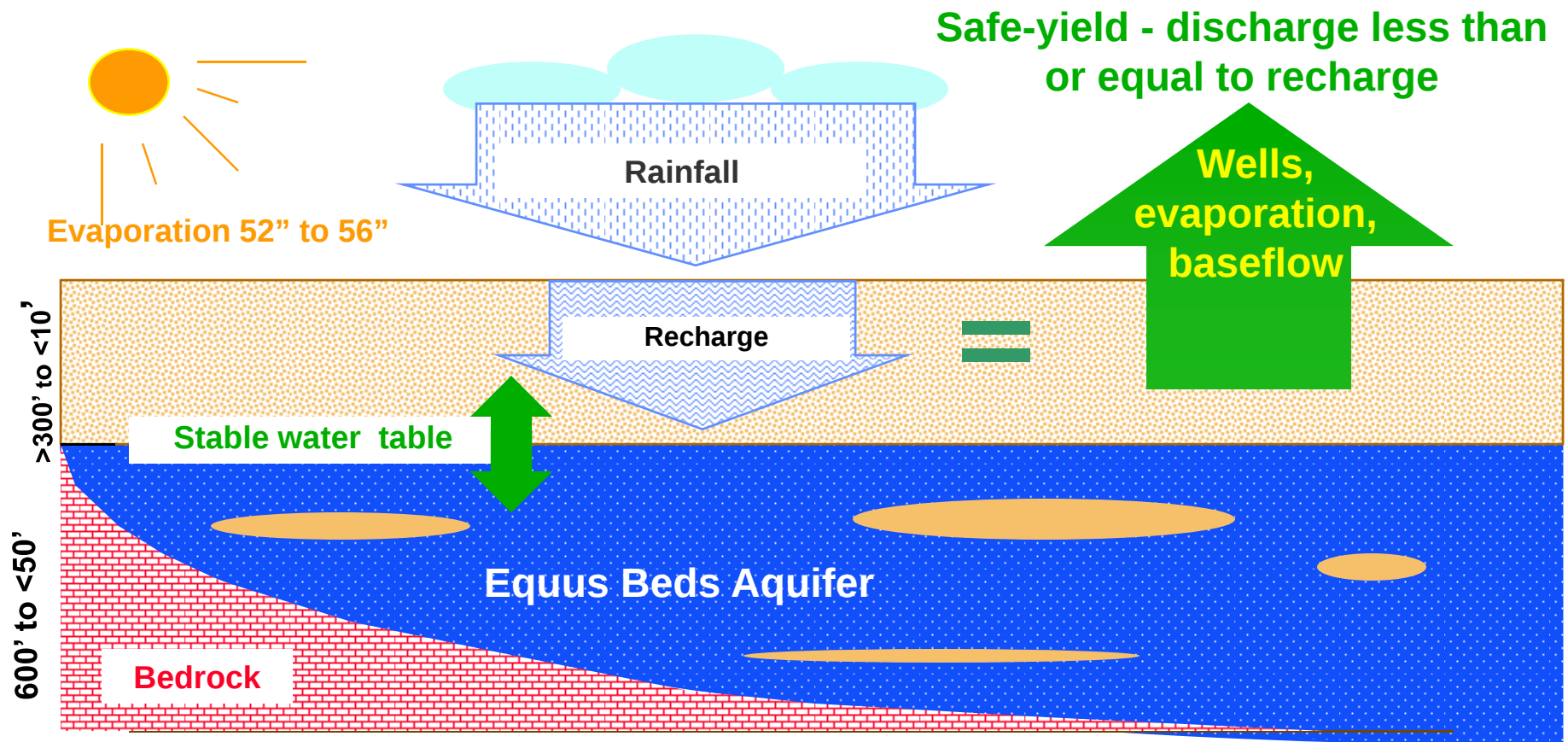
Water Budget

Hydrograph- Depth to Water Below Land Surface



Ogallala aquifer Southwest Kansas

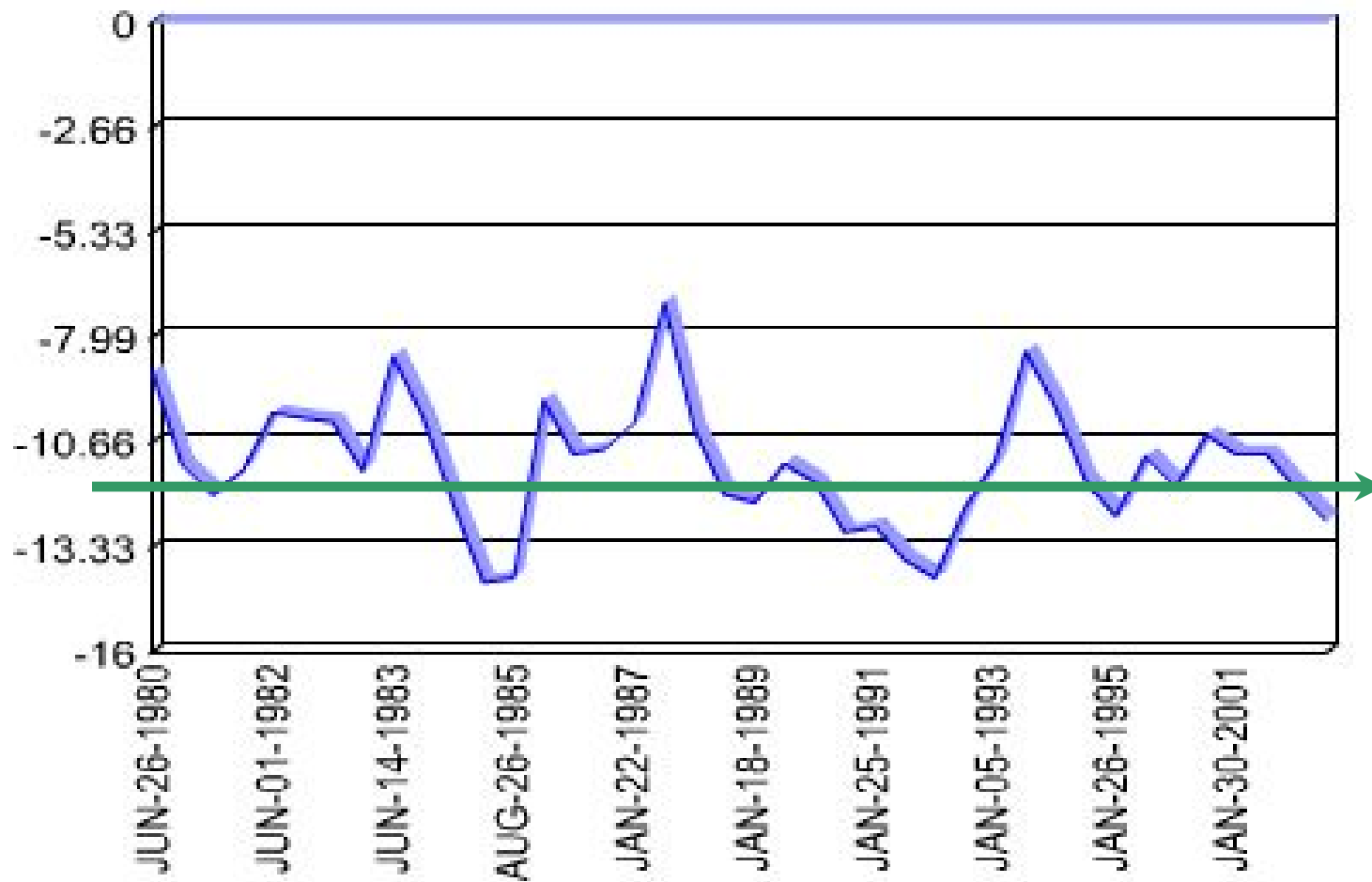
Water Budget



Generalized Illustration of the Hydrologic Cycle and the Equus Beds Aquifer

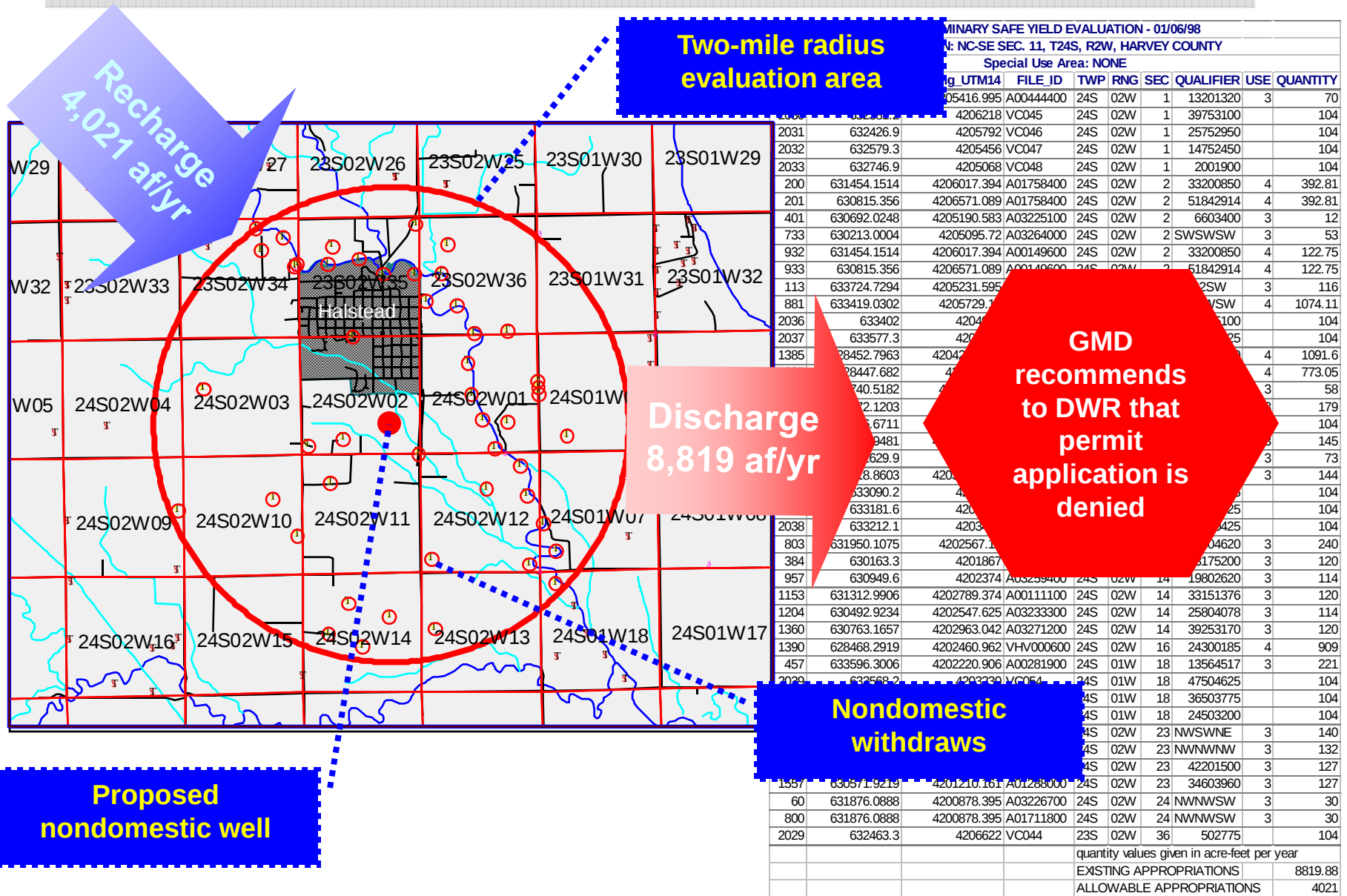
Water Budget

Hydrograph- Depth to Water Below Land Surface



Equus Beds aquifer South-central Kansas

Safe Yield Regulation - Effective 1980



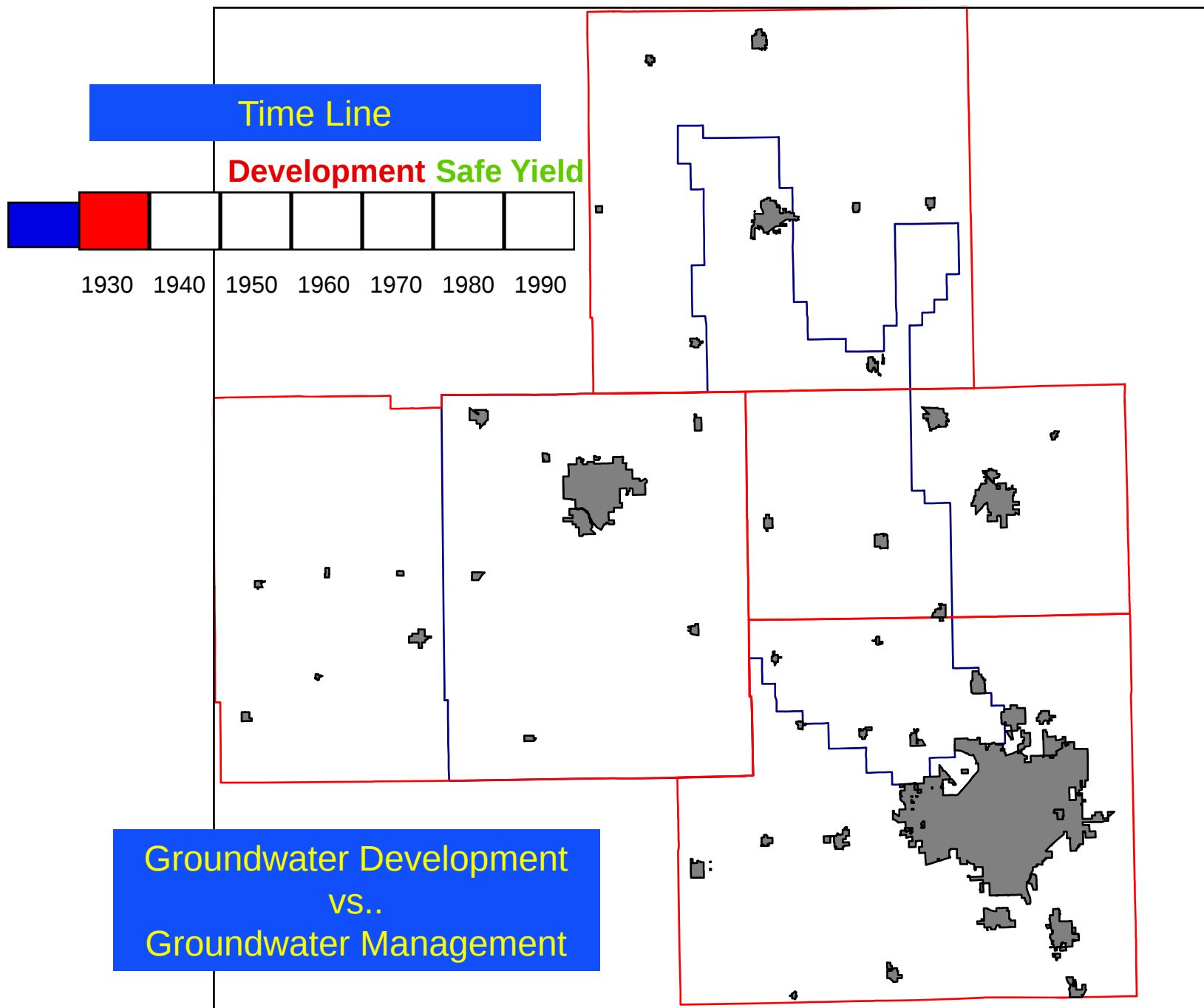
MINIARY SAFE YIELD EVALUATION - 01/06/98							
N: NC-SE SEC. 11, T24S, R2W, HARVEY COUNTY							
Special Use Area: NONE							
UTM14	FILE ID	TWP	RNG	SEC	QUALIFIER	USE	QUANTITY
405416.995	A00444400	24S	02W	1	13201320	3	70
4206218	VC045	24S	02W	1	39753100		104
4205792	VC046	24S	02W	1	25752950		104
4205456	VC047	24S	02W	1	14752450		104
4205068	VC048	24S	02W	1	2001900		104
4206017.394	A01758400	24S	02W	2	33200850	4	392.81
4206571.089	A01758400	24S	02W	2	51842914	4	392.81
4205190.583	A03225100	24S	02W	2	6603400	3	12
4205095.72	A03264000	24S	02W	2	SWSWSW	3	53
4206017.394	A00149600	24S	02W	2	33200850	4	122.75
4206571.089	A00149600	24S	02W	2	51842914	4	122.75
4205231.595					2SW	3	116
4205729.1					WSW	4	1074.11
4204					100		104
420					25		104
4204						4	1091.6
4						4	773.05
						3	58
							179
							104
							145
						3	73
420						3	144
4							104
420						25	104
4203						425	104
4202567.1						04620	240
4201867						175200	120
4202374	A03259400	24S	02W	14	19802620	3	114
4202789.374	A00111100	24S	02W	14	33151376	3	120
4202547.625	A03233300	24S	02W	14	25804078	3	114
4202963.042	A03271200	24S	02W	14	39253170	3	120
4202460.962	VHV000600	24S	02W	16	24300185	4	909
4202220.906	A00281900	24S	01W	18	13564517	3	221
4203339	VC054	24S	01W	18	47504625		104
		24S	01W	18	36503775		104
		24S	01W	18	24503200		104
		24S	02W	23	NWSWNE	3	140
		24S	02W	23	NWNWNW	3	132
		24S	02W	23	42201500	3	127
4201210.161	A01288000	24S	02W	23	34603960	3	127
4200878.395	A03226700	24S	02W	24	NWNWSW	3	30
4200878.395	A01711800	24S	02W	24	NWNWSW	3	30
4206622	VC044	23S	02W	36	502775		104

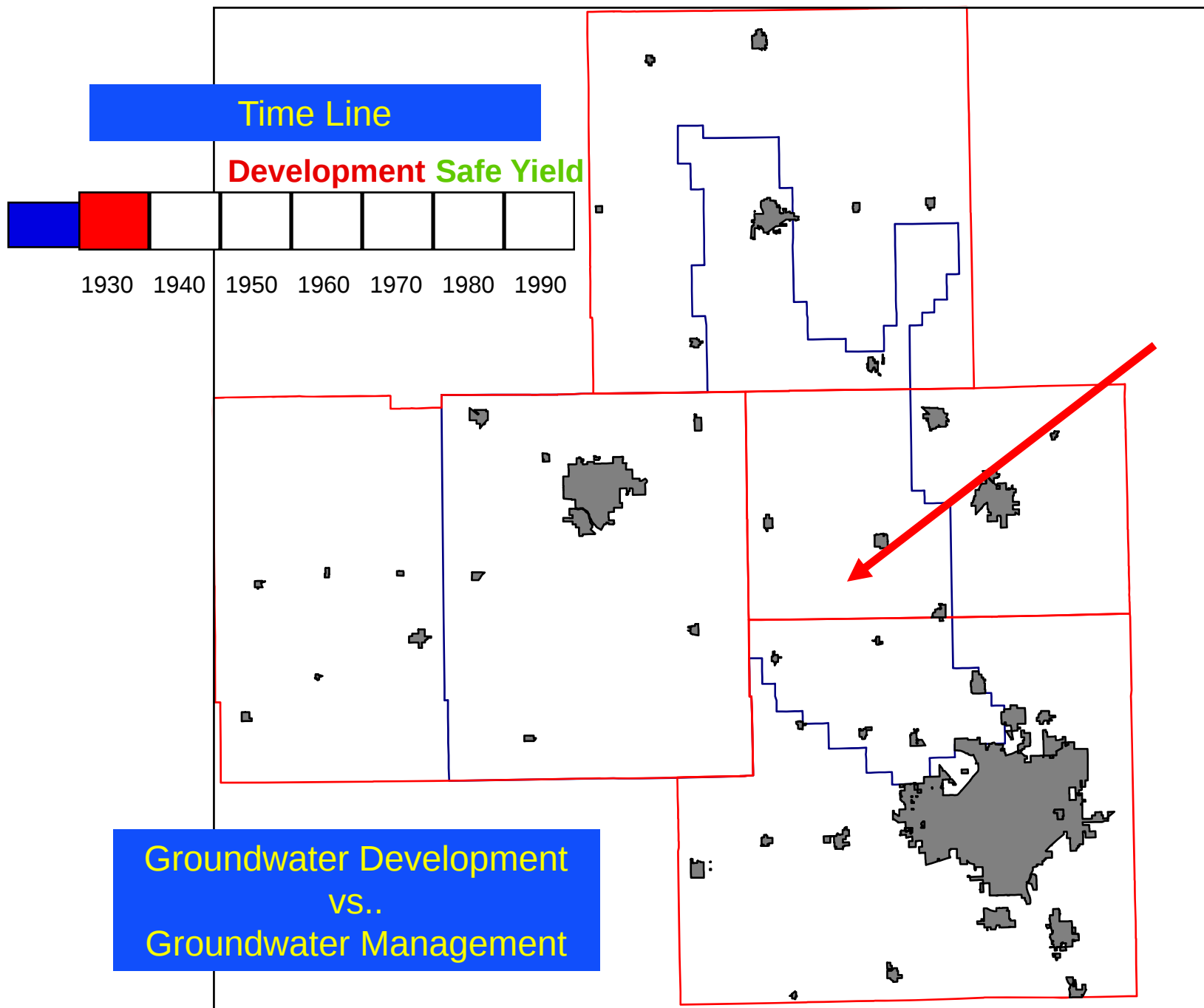
GMD recommends to DWR that permit application is denied

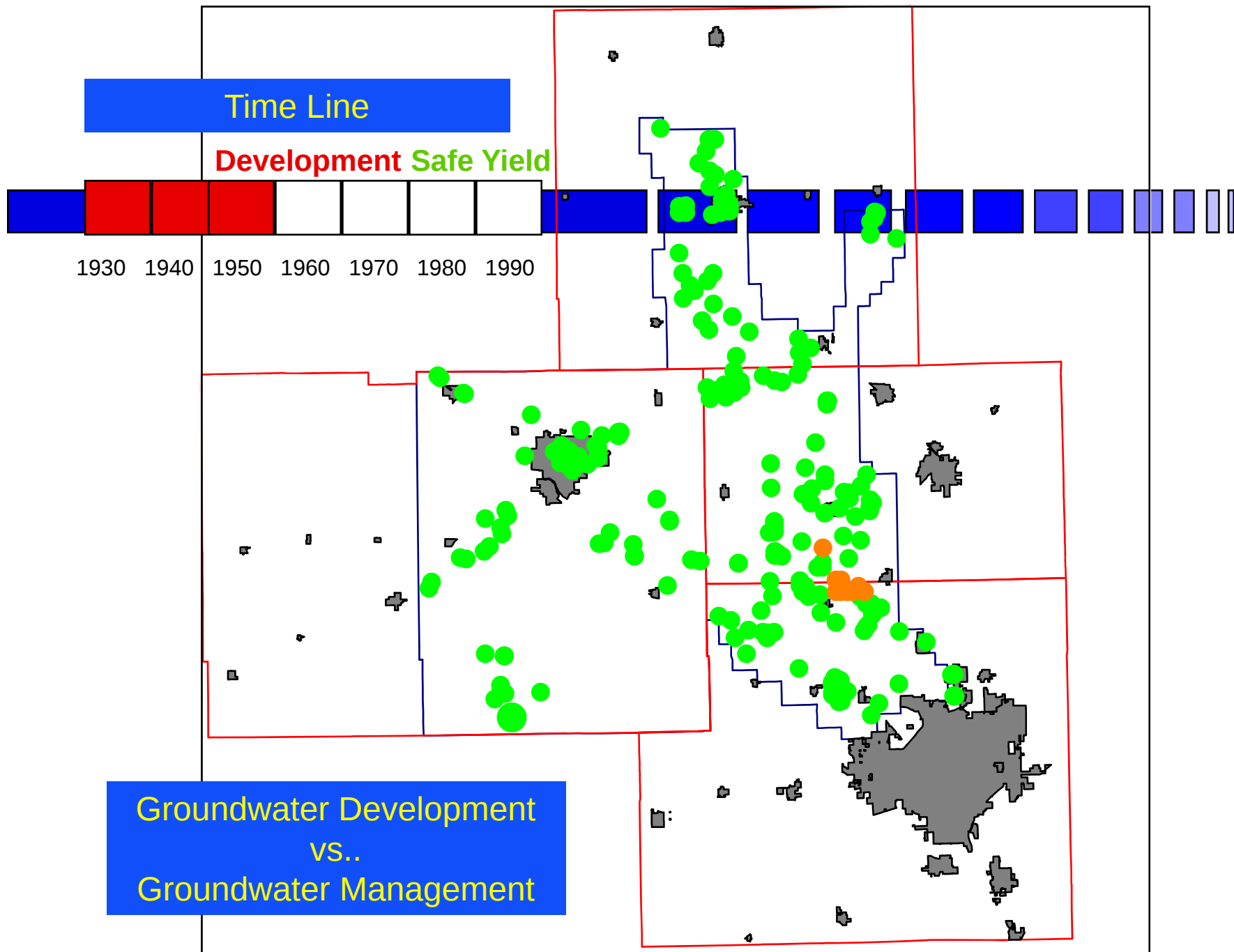
domestic draws

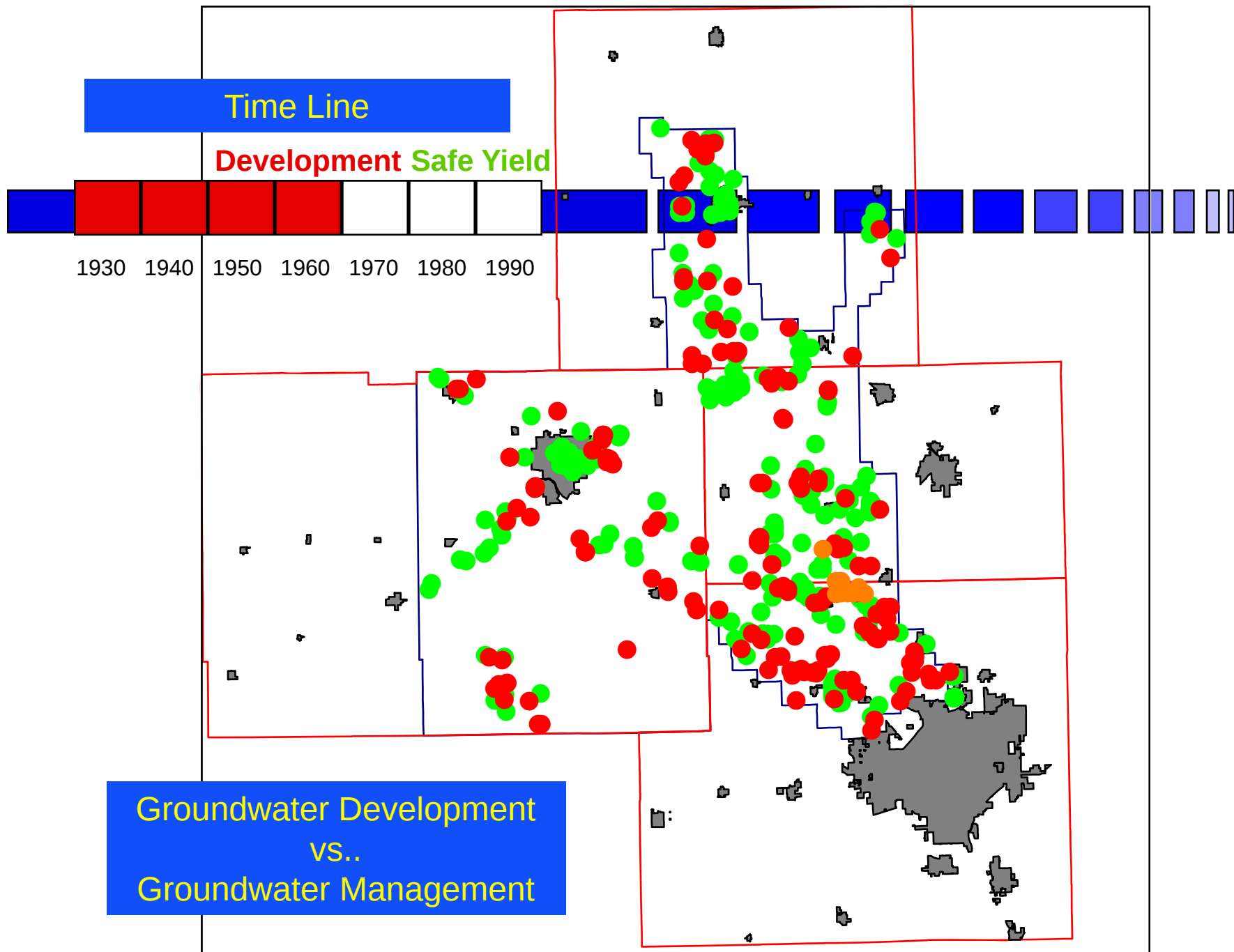
quantity values given in acre-feet per year

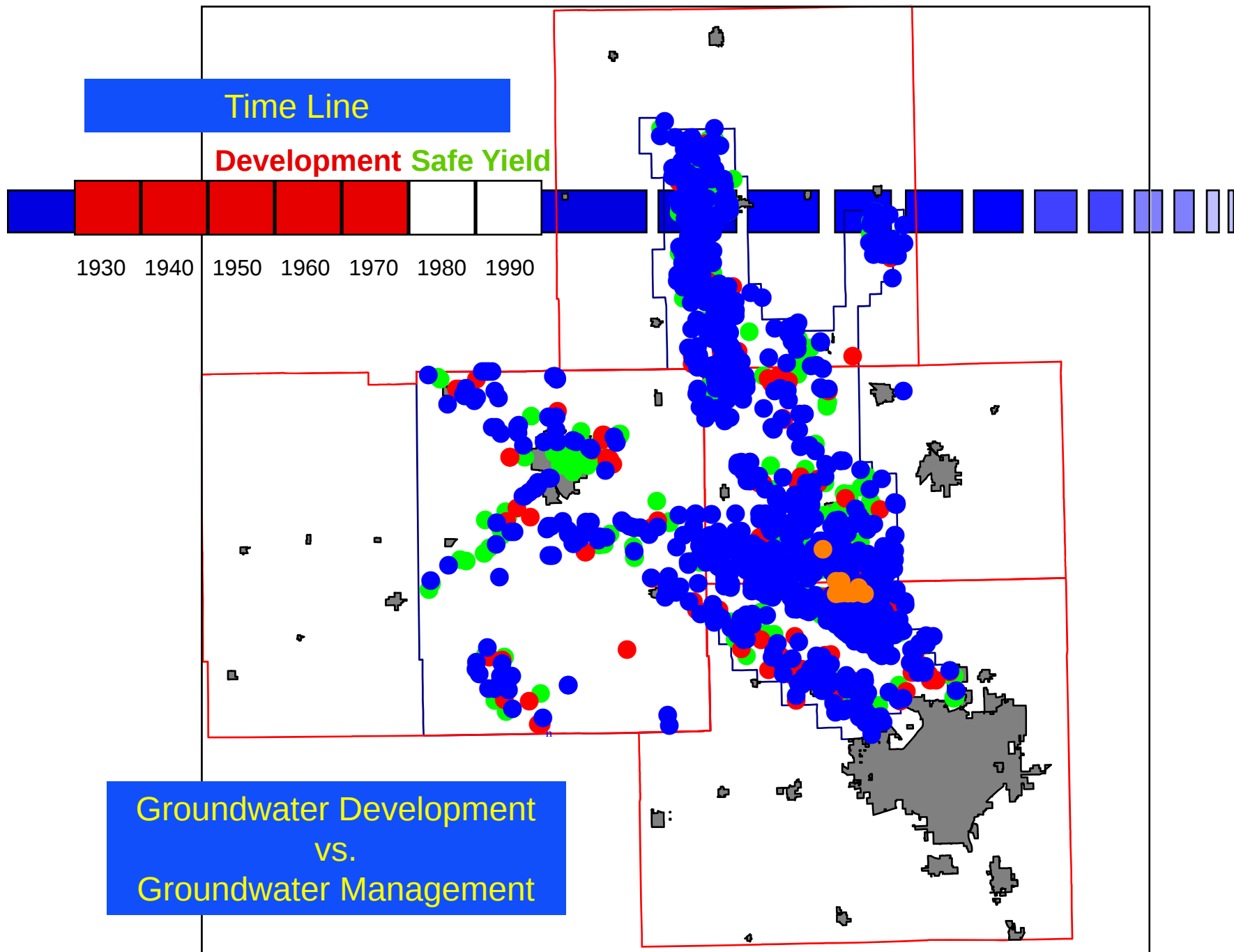
EXISTING APPROPRIATIONS	8819.88
ALLOWABLE APPROPRIATIONS	4021

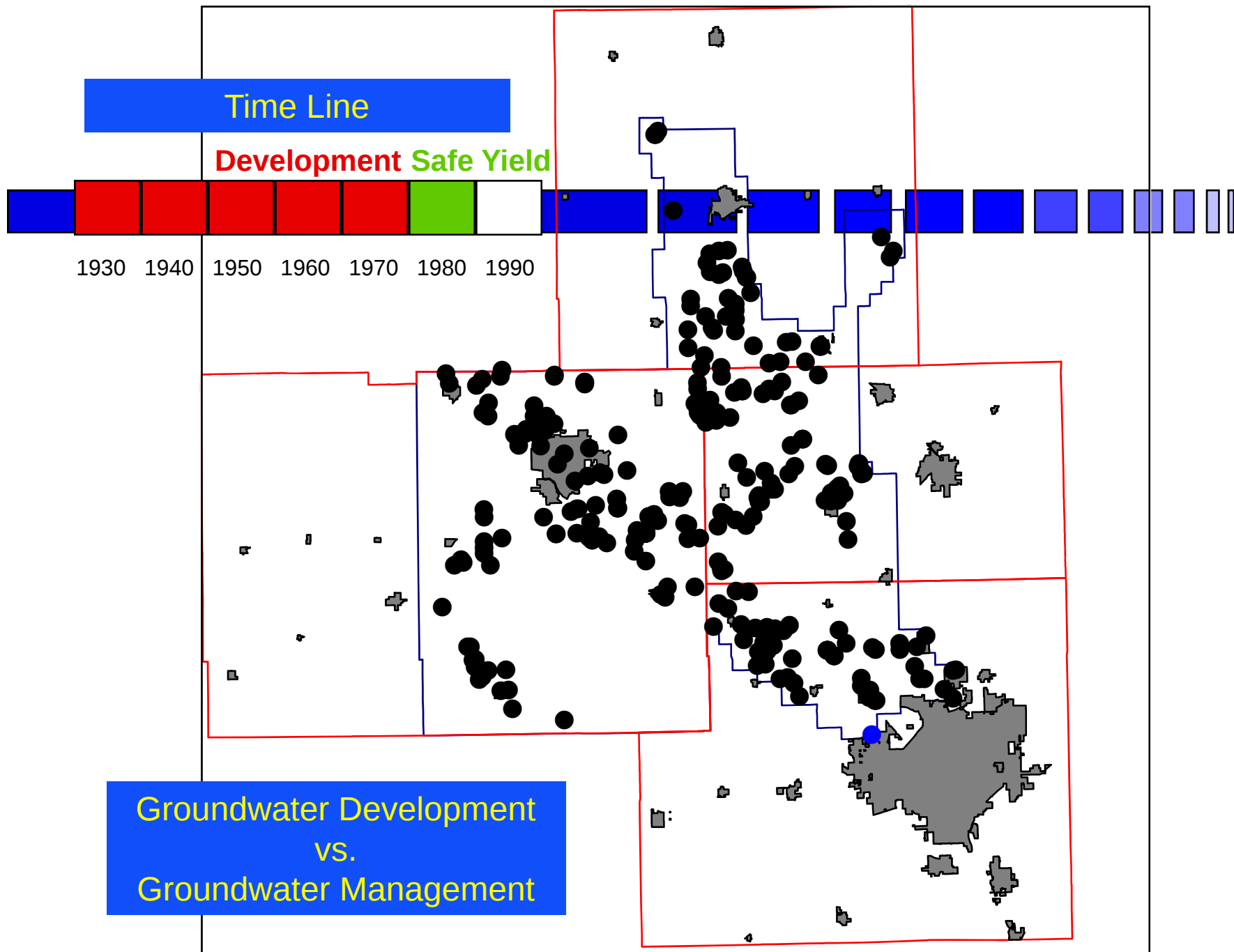


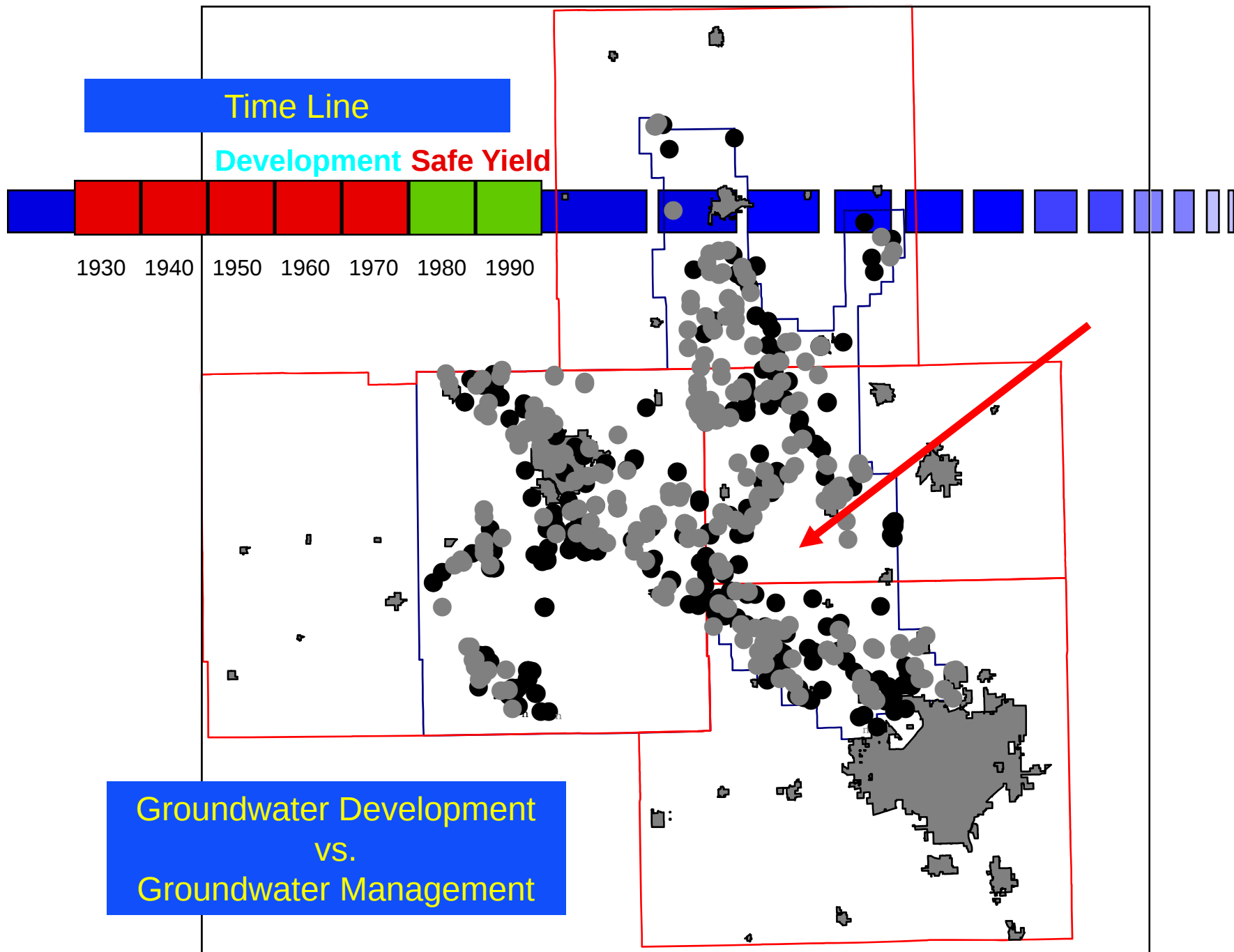




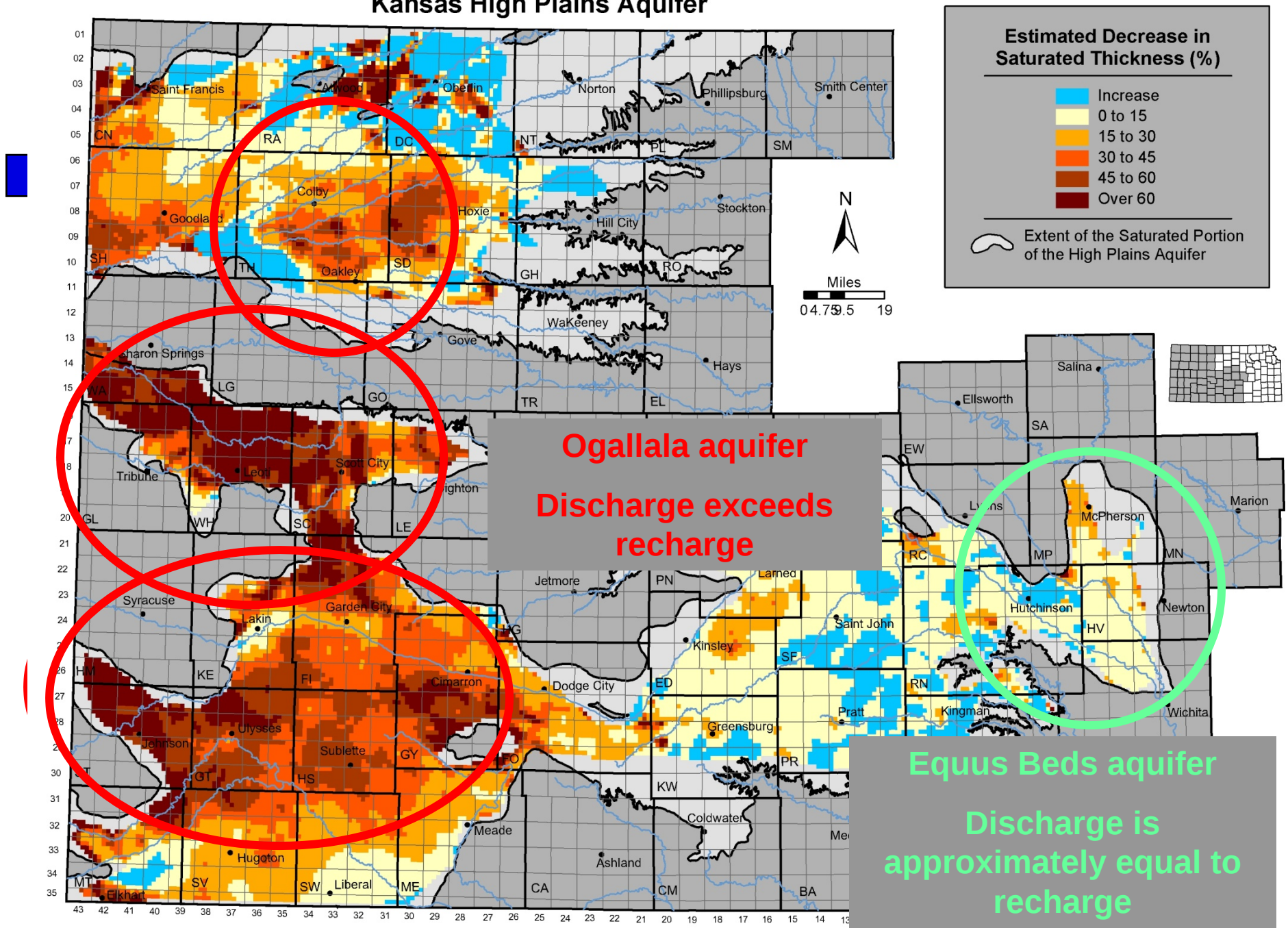




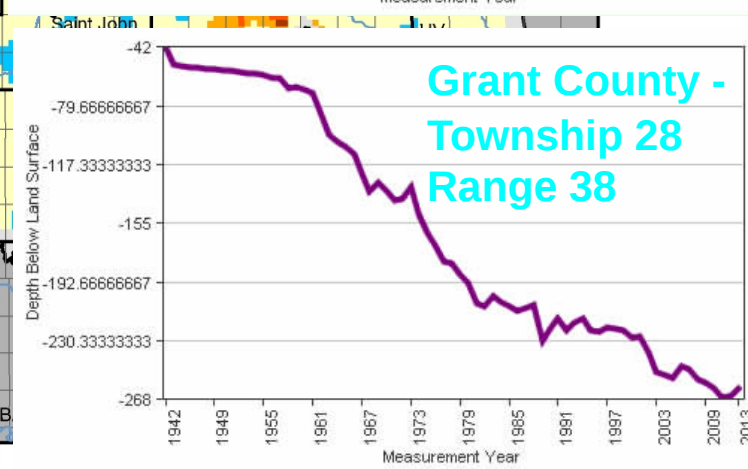
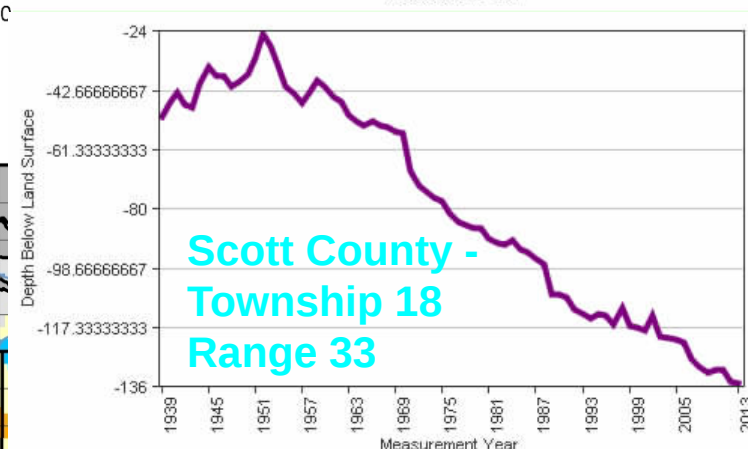
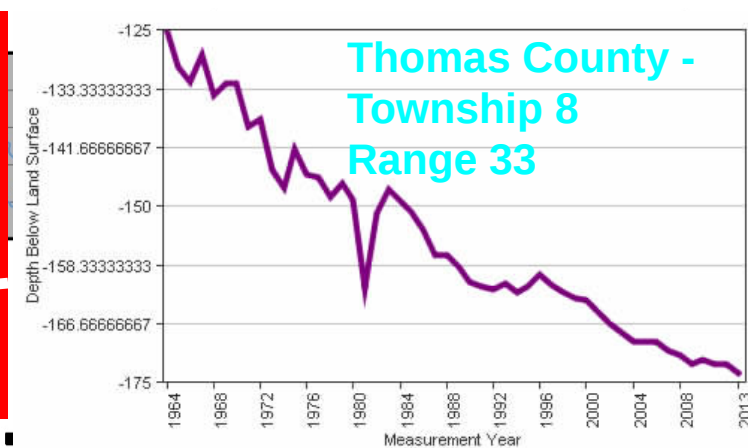
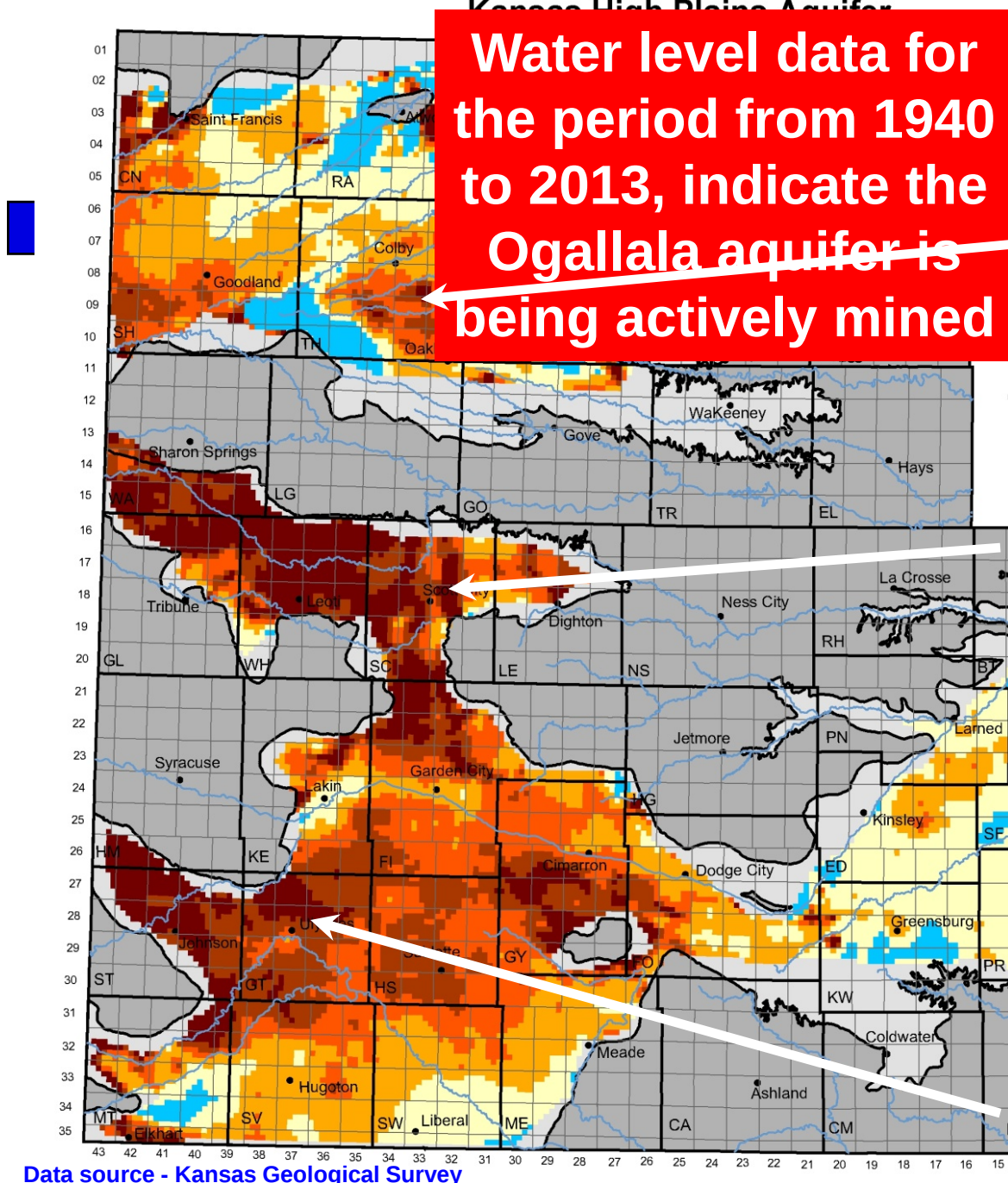


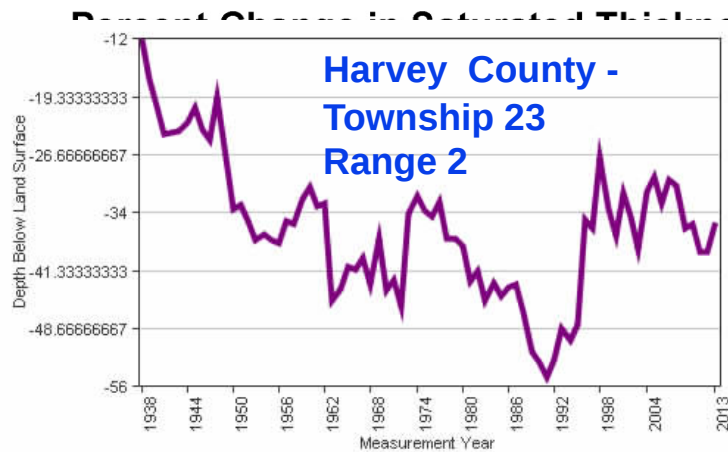


Percent Change in Saturated Thickness, Predevelopment to Average 2010 - 2012, Kansas High Plains Aquifer



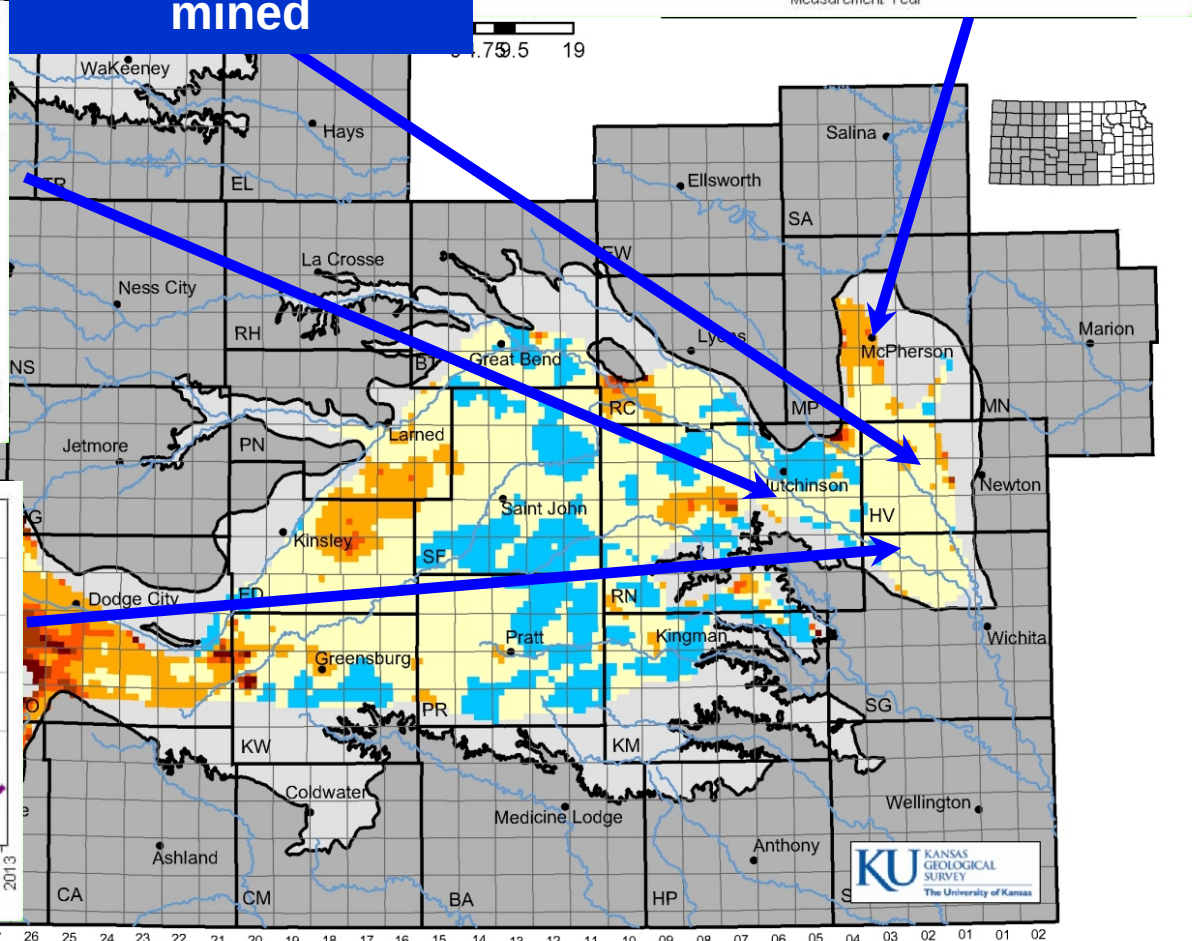
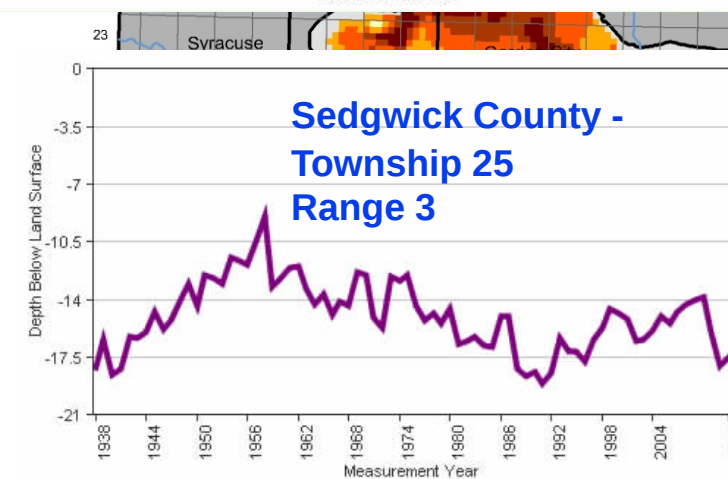
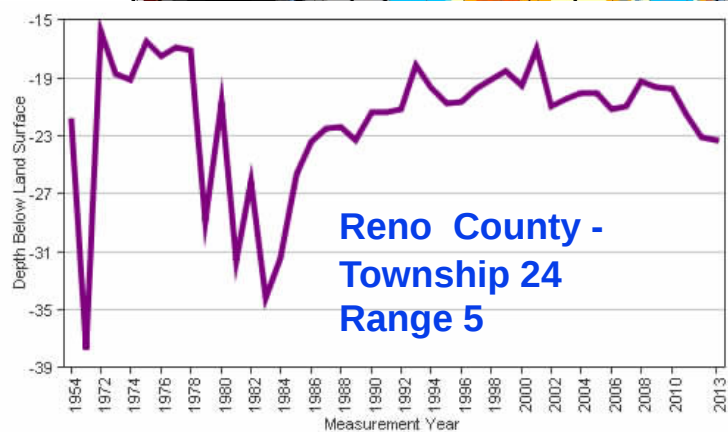
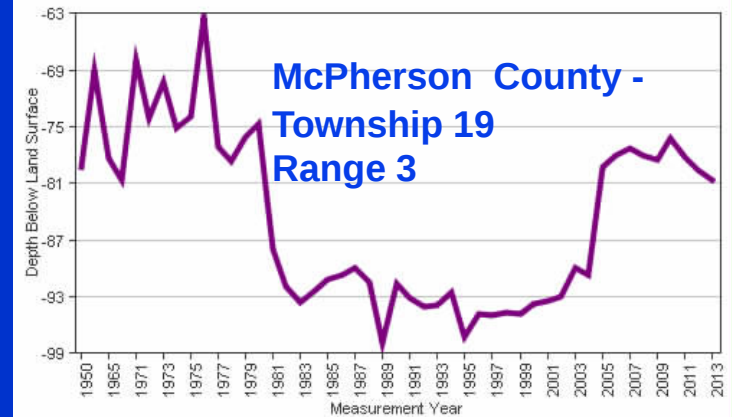
Percent Change in Saturated Thickness, Predevelopment to Average 2010 - 2012, Kansas High Plains Aquifer





ss. Predevelopment to Average 2010 - 2012,

**Water level data
for the period
from 1939 to 2013,
indicate the
Equis Beds
aquifer is not
being actively
mined**



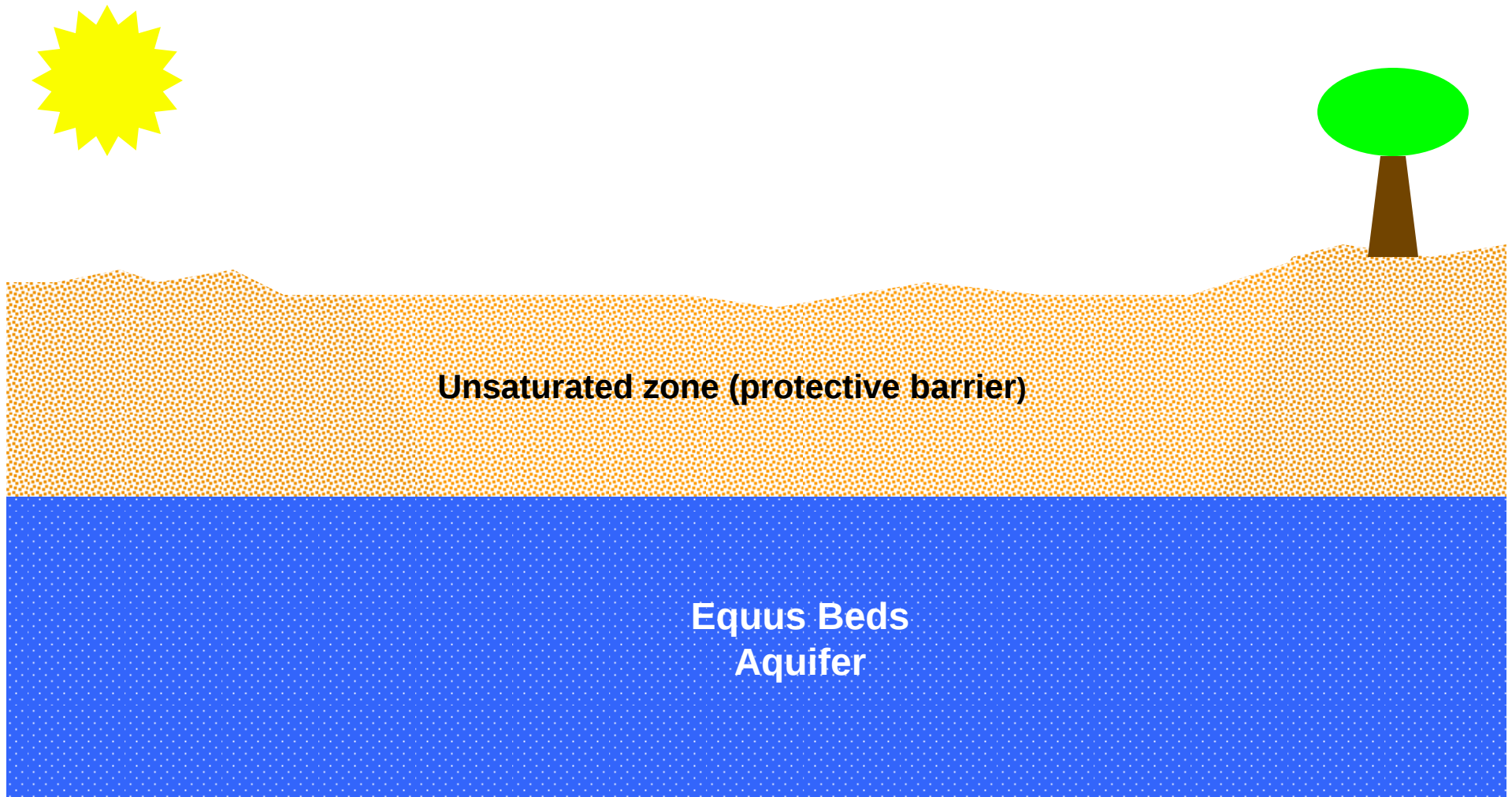
Data source - Kansas Geological Survey

Groundwater Management Issues

Groundwater Pits

Groundwater Management Issues

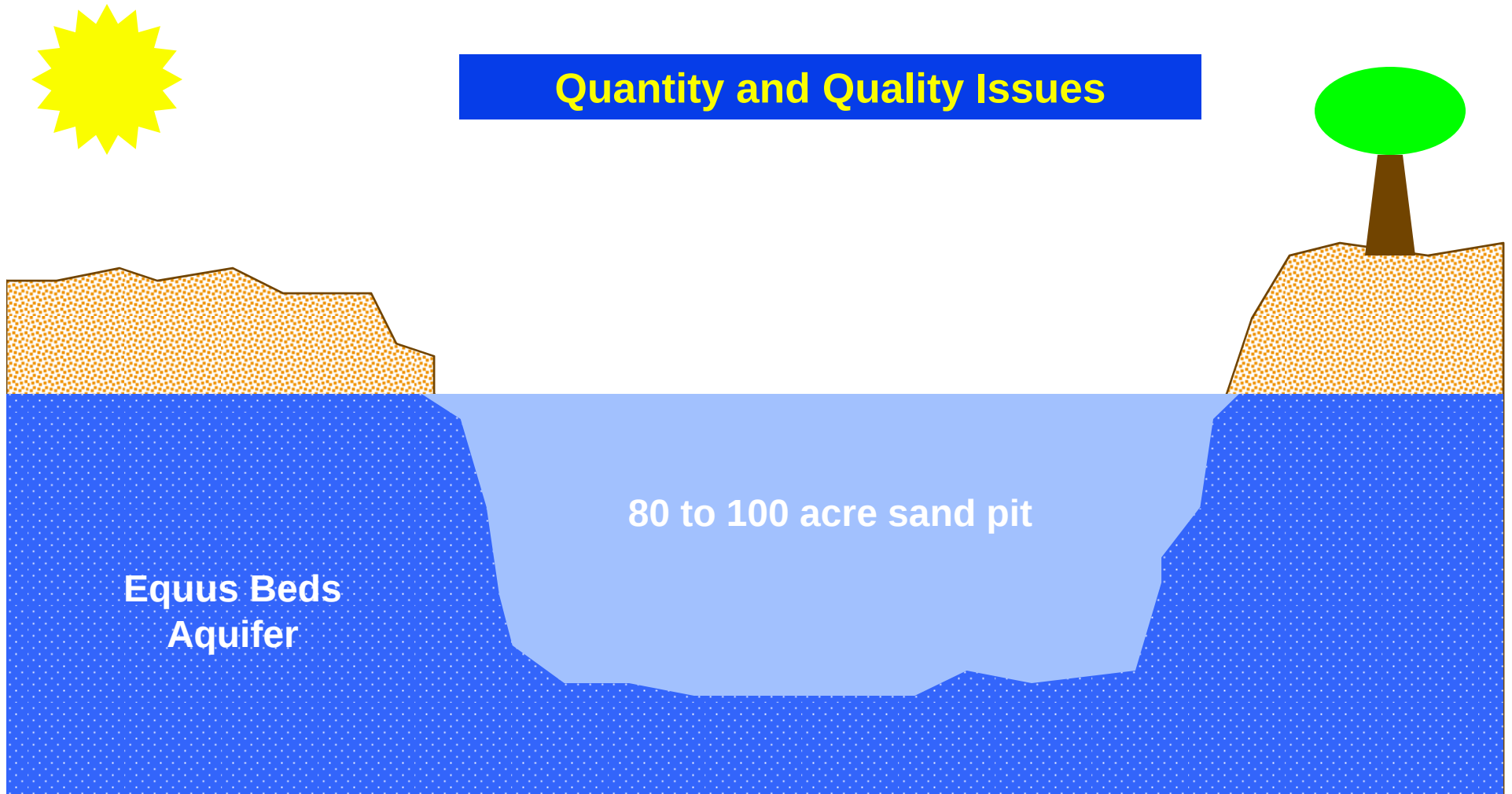
Groundwater Pits



Groundwater Management Issues

Groundwater Pits

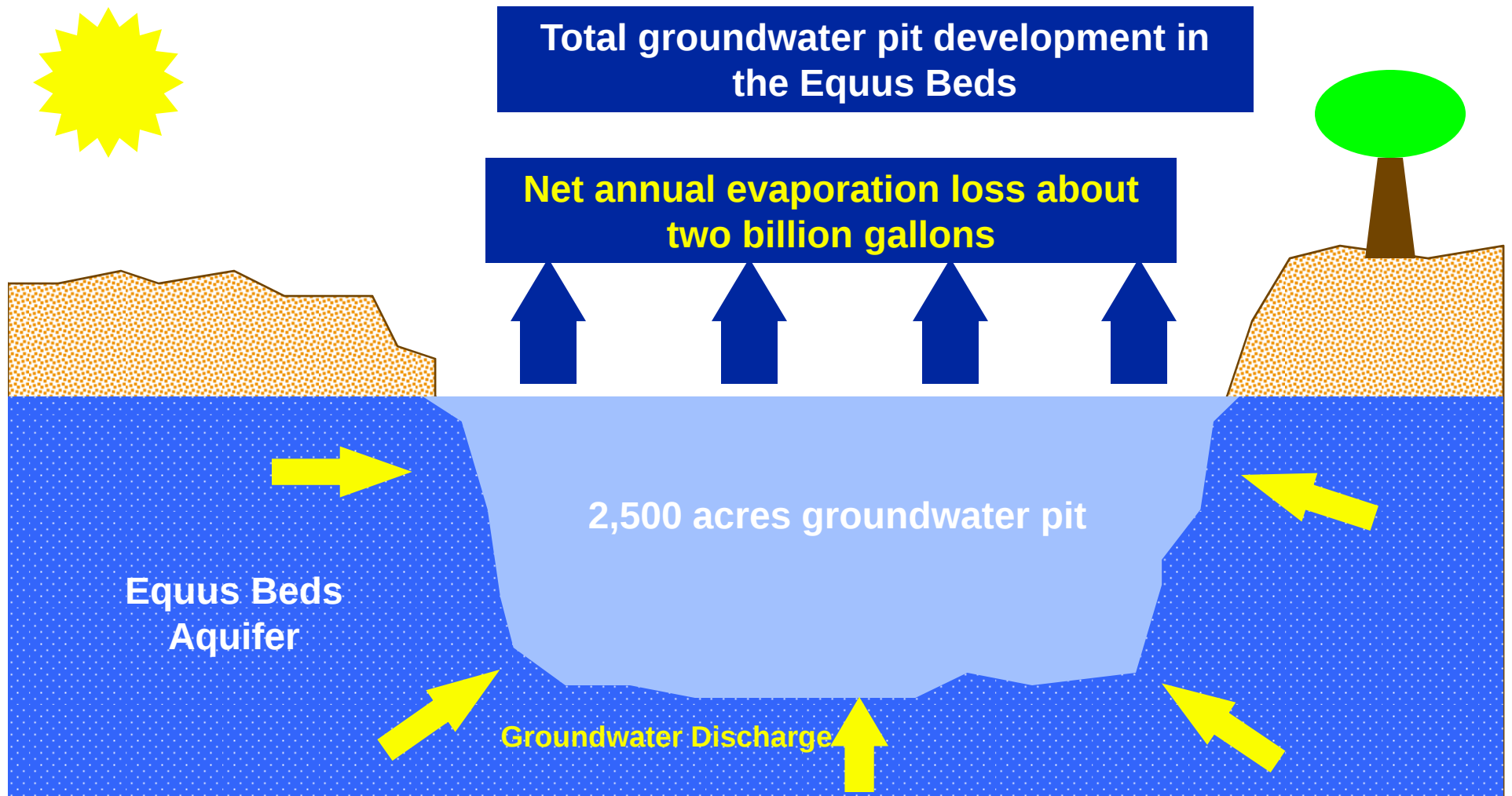
Quantity and Quality Issues



Groundwater Management Issues

Groundwater Pits

Quantity Issue



Groundwater Management Issues

Groundwater Pits

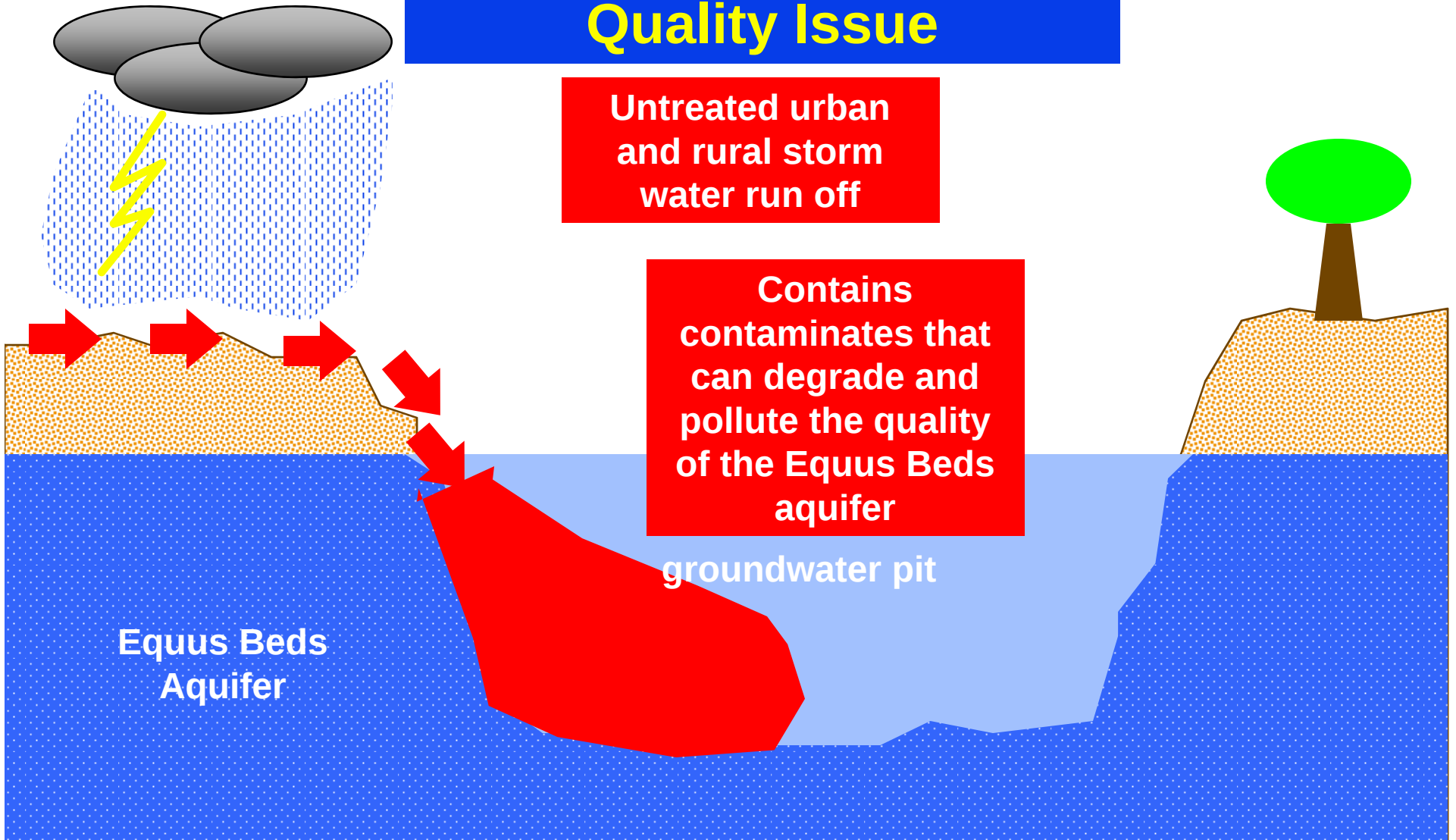
Quality Issue

Untreated urban
and rural storm
water run off

Contains
contaminates that
can degrade and
pollute the quality
of the Equus Beds
aquifer

groundwater pit

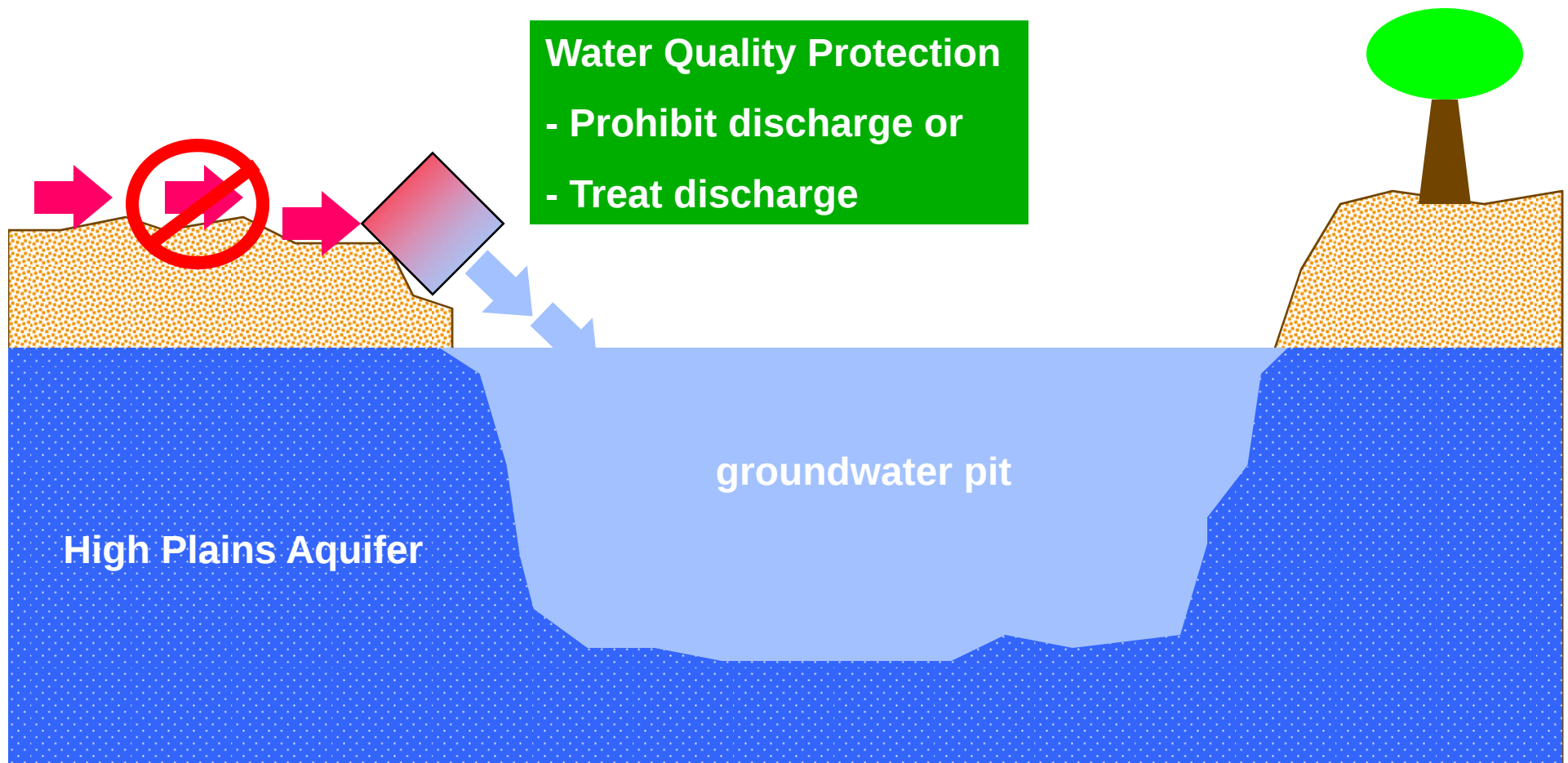
Equus Beds
Aquifer



Groundwater Management Issues

Groundwater Pits

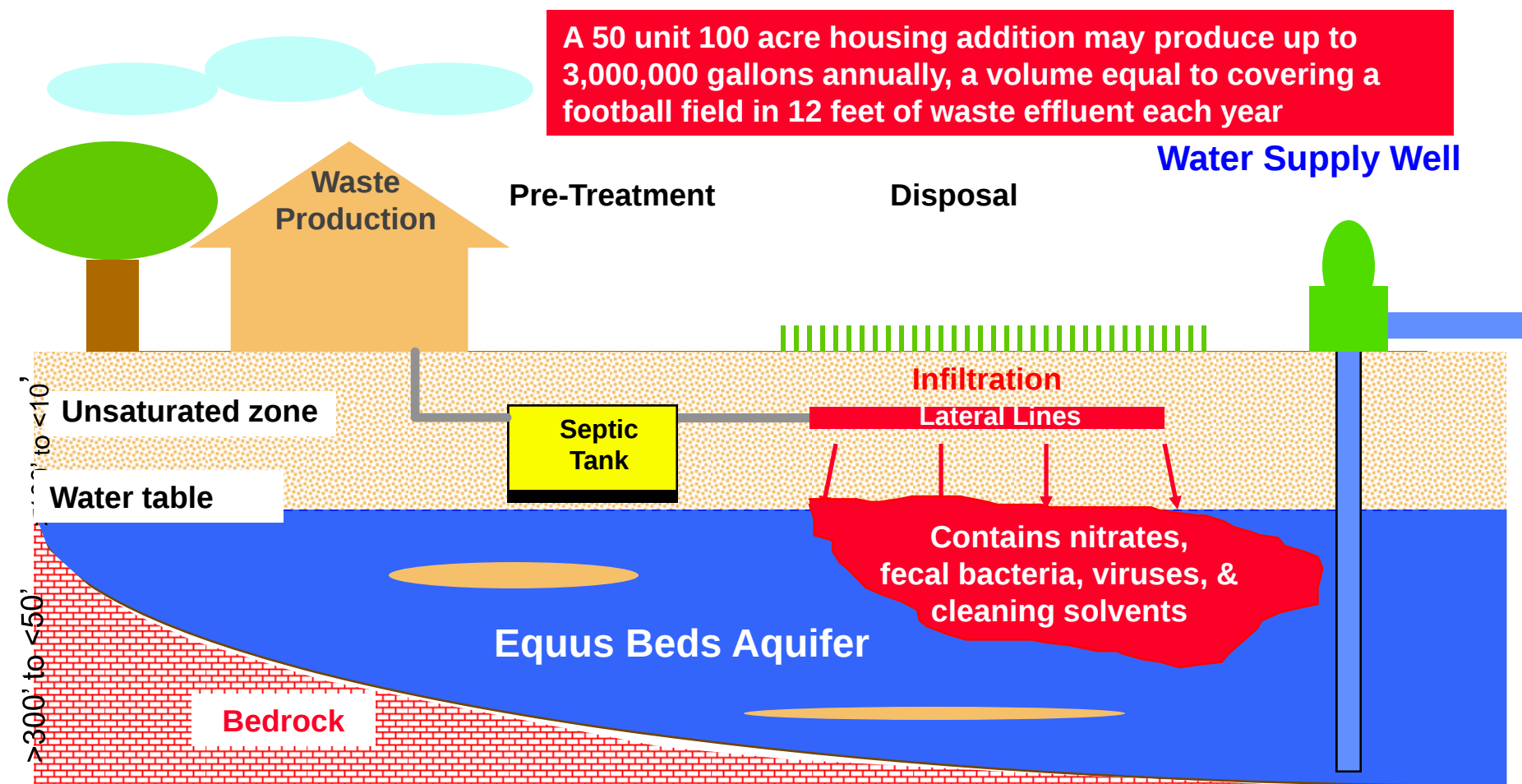
Legislators Mandated Groundwater Pit Study - 2004



Groundwater Management Issues

Septic Waste Disposal

Septic Waste Disposal and Groundwater Protection

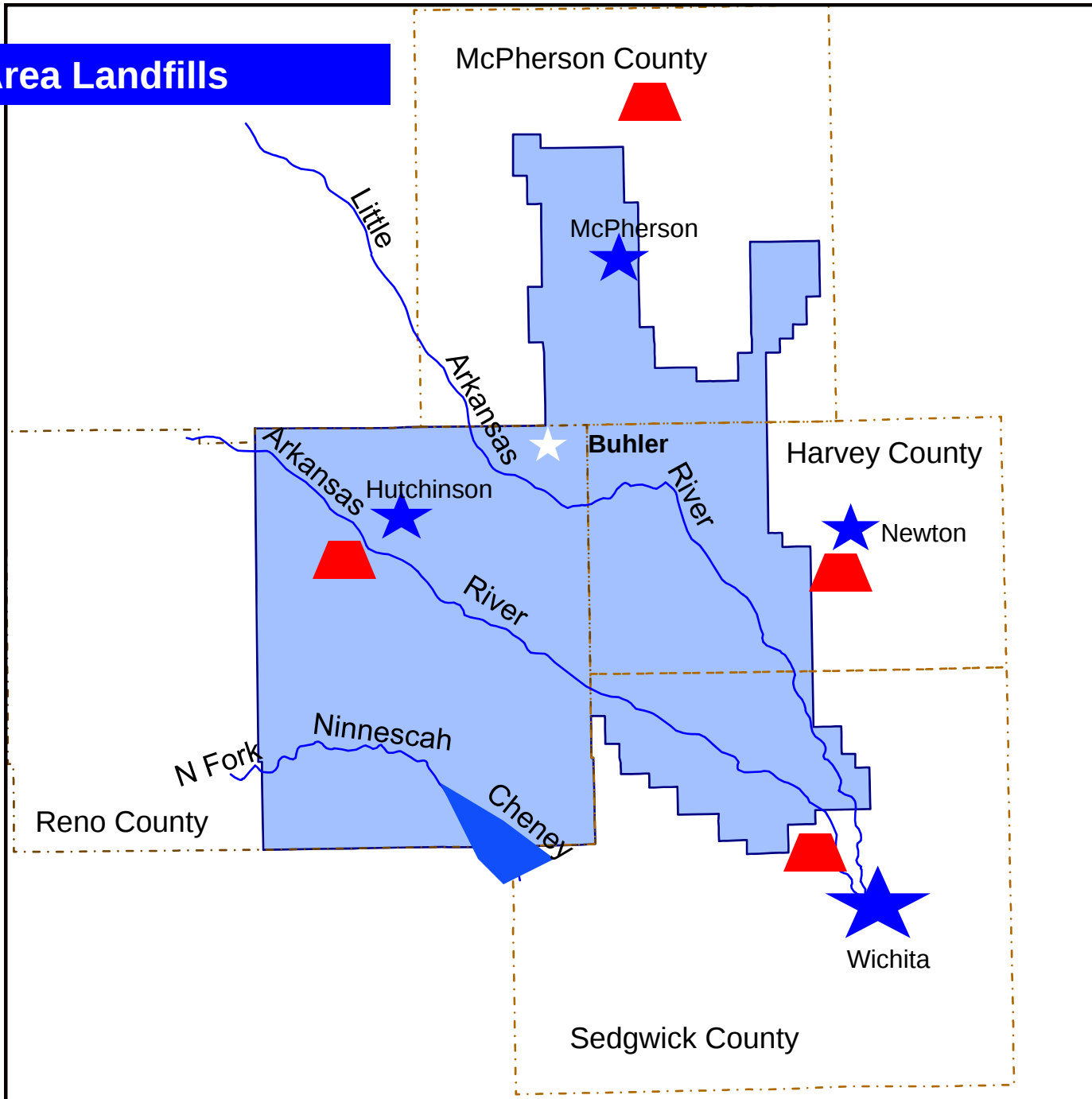


Generalized Cross-section of the Equus Beds Aquifer

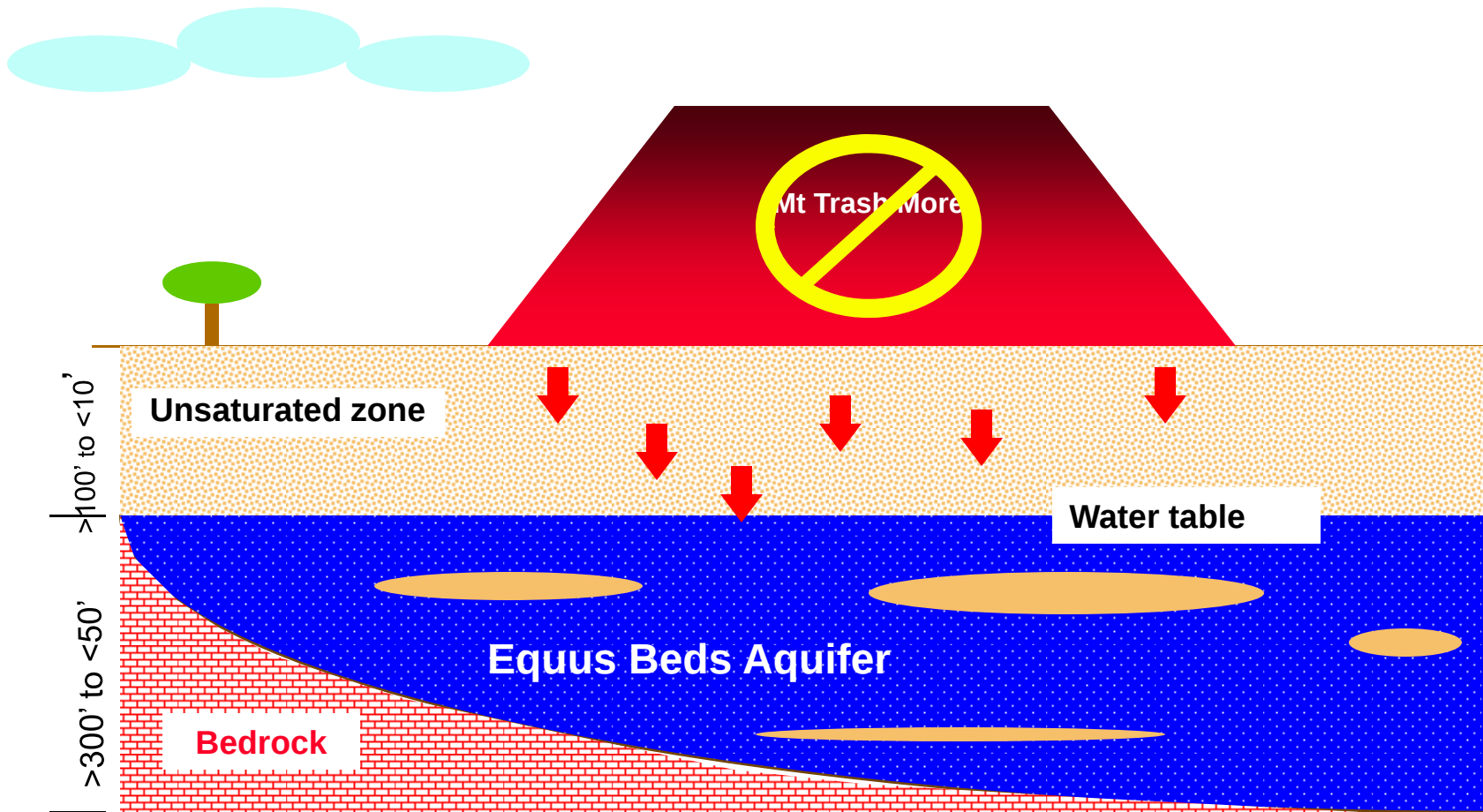
Groundwater Management Issues

Landfills

Area Landfills



Landfills and Groundwater Protection

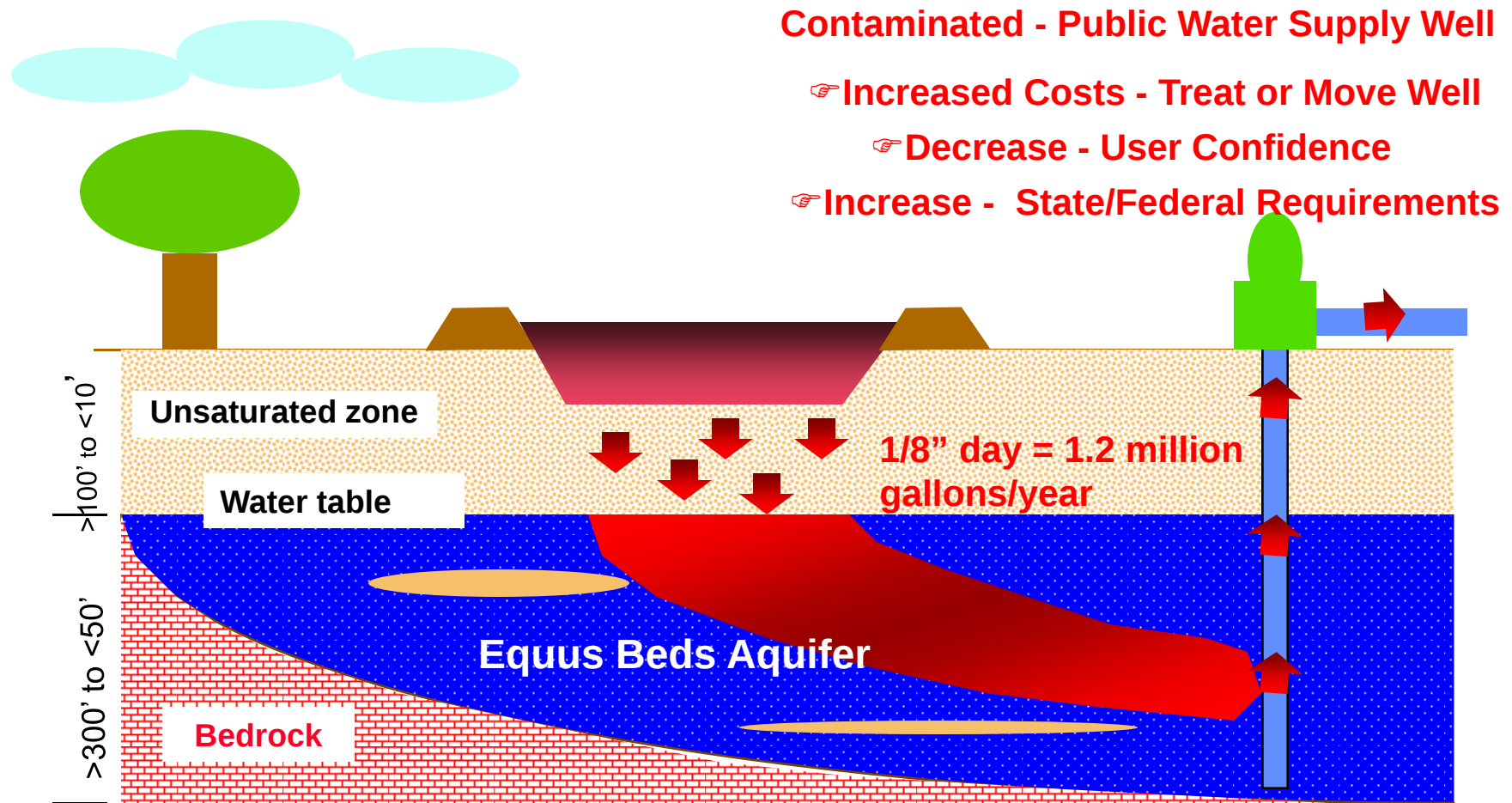


Generalized Cross-section of the Equus Beds Aquifer

Groundwater Management Issues

Waste Lagoons

Waste Lagoons and Groundwater Protection

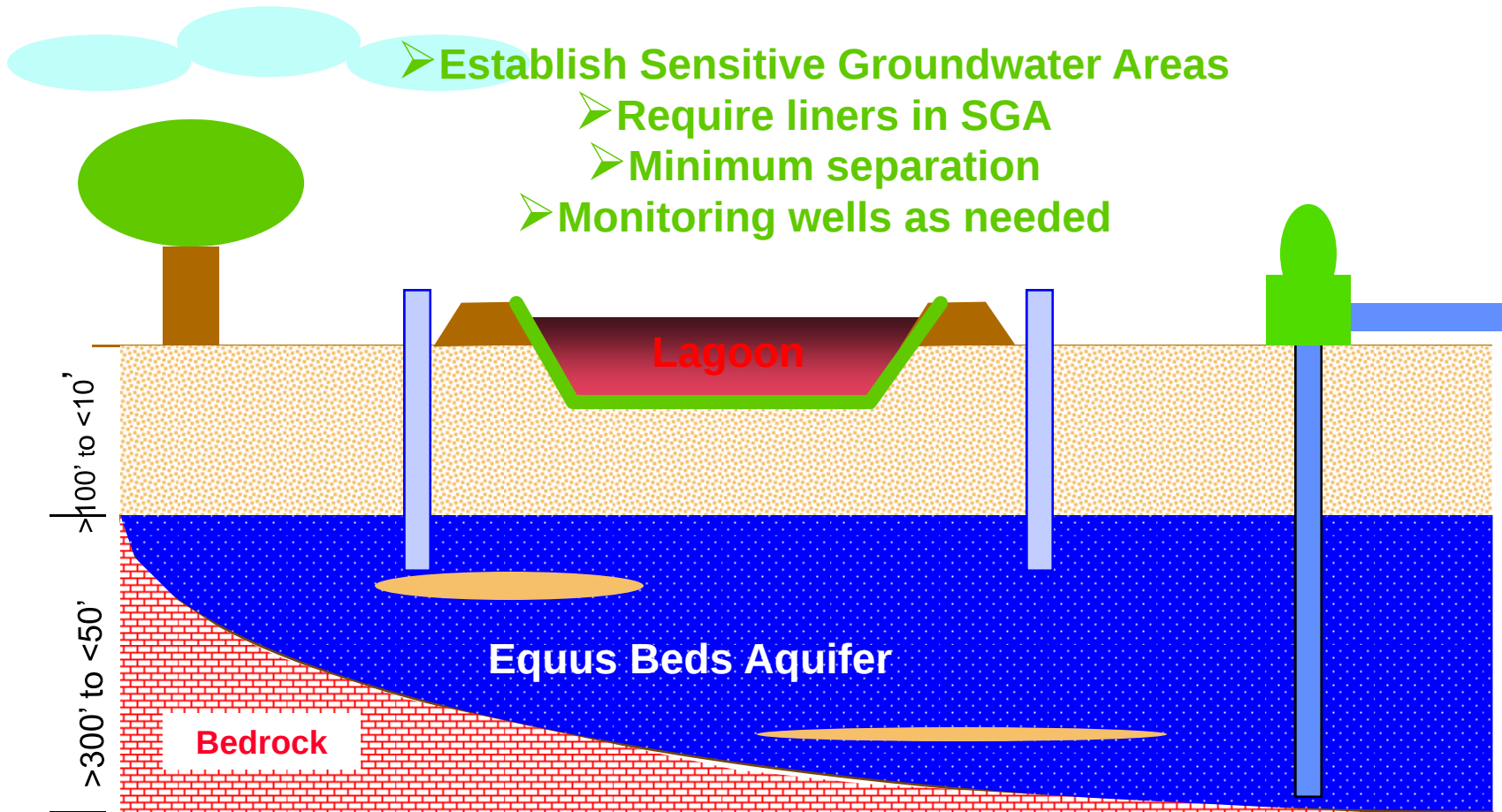


Generalized Cross-section of the Equus Beds Aquifer

Waste Lagoons and Groundwater Protection

Groundwater Protection Practices

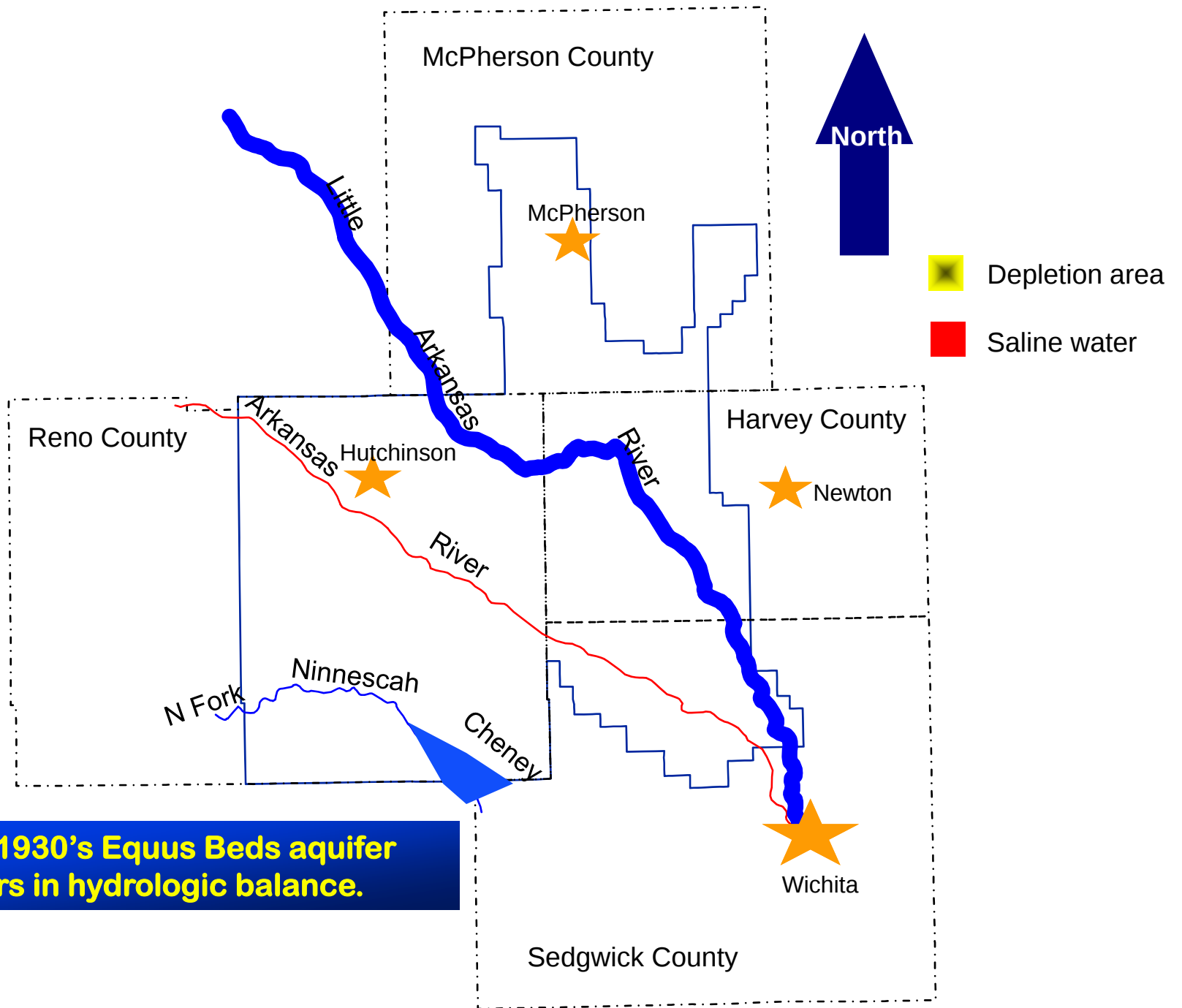
- Establish Sensitive Groundwater Areas
- Require liners in SGA
- Minimum separation
- Monitoring wells as needed

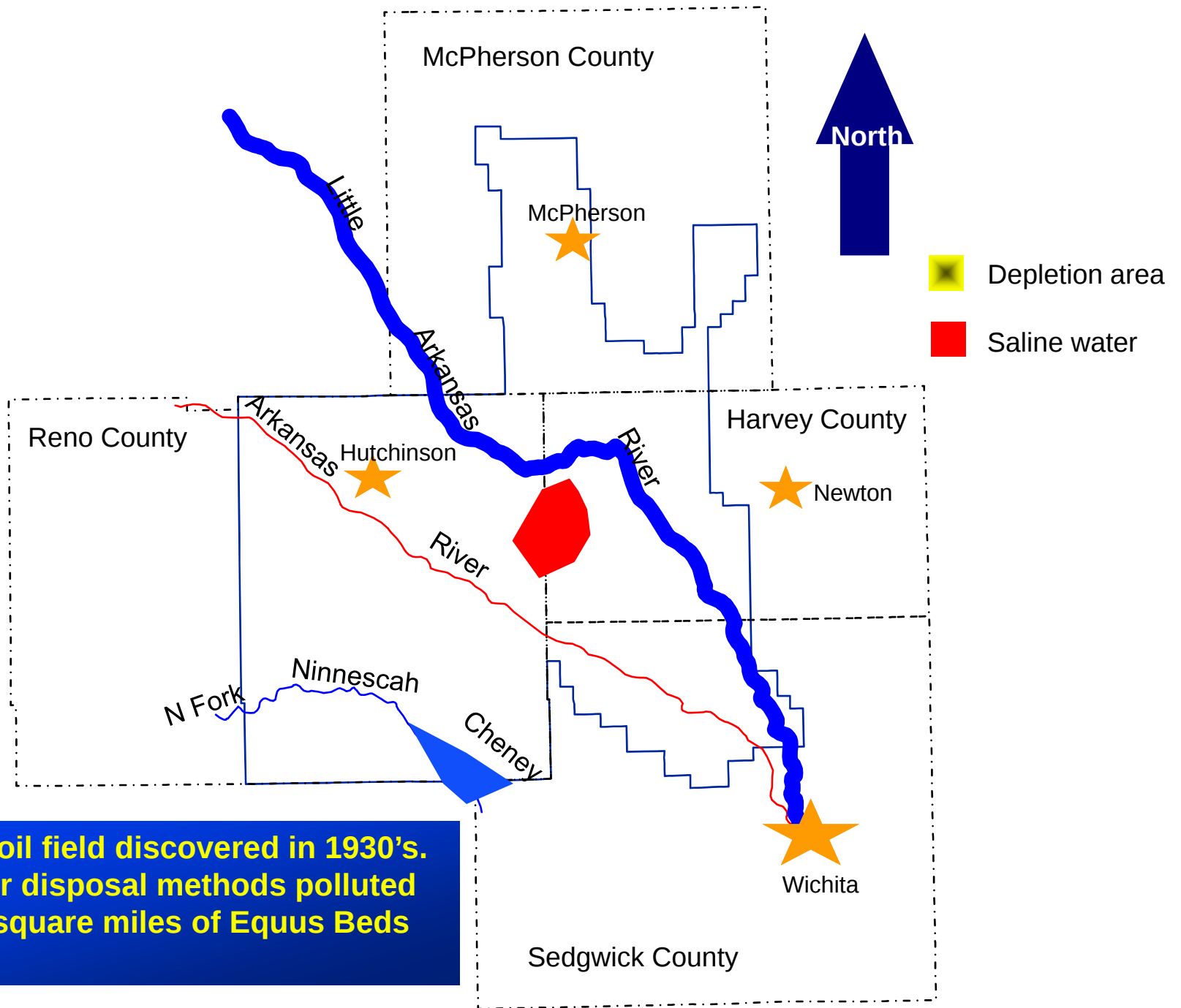


Generalized Cross-section of the Equus Beds Aquifer

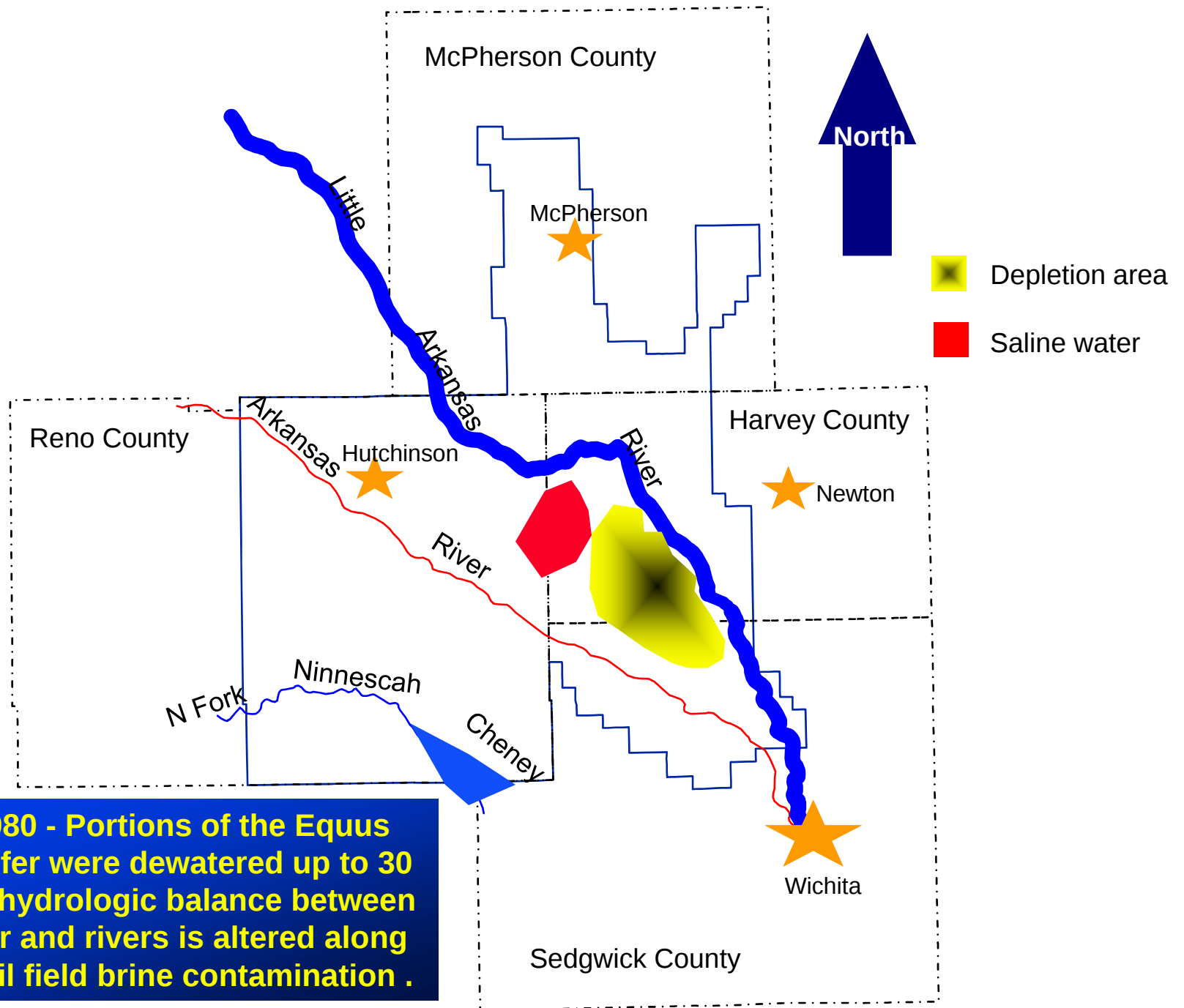
Groundwater Management Issues

Aquifer Storage and Recovery
(groundwater recharge)

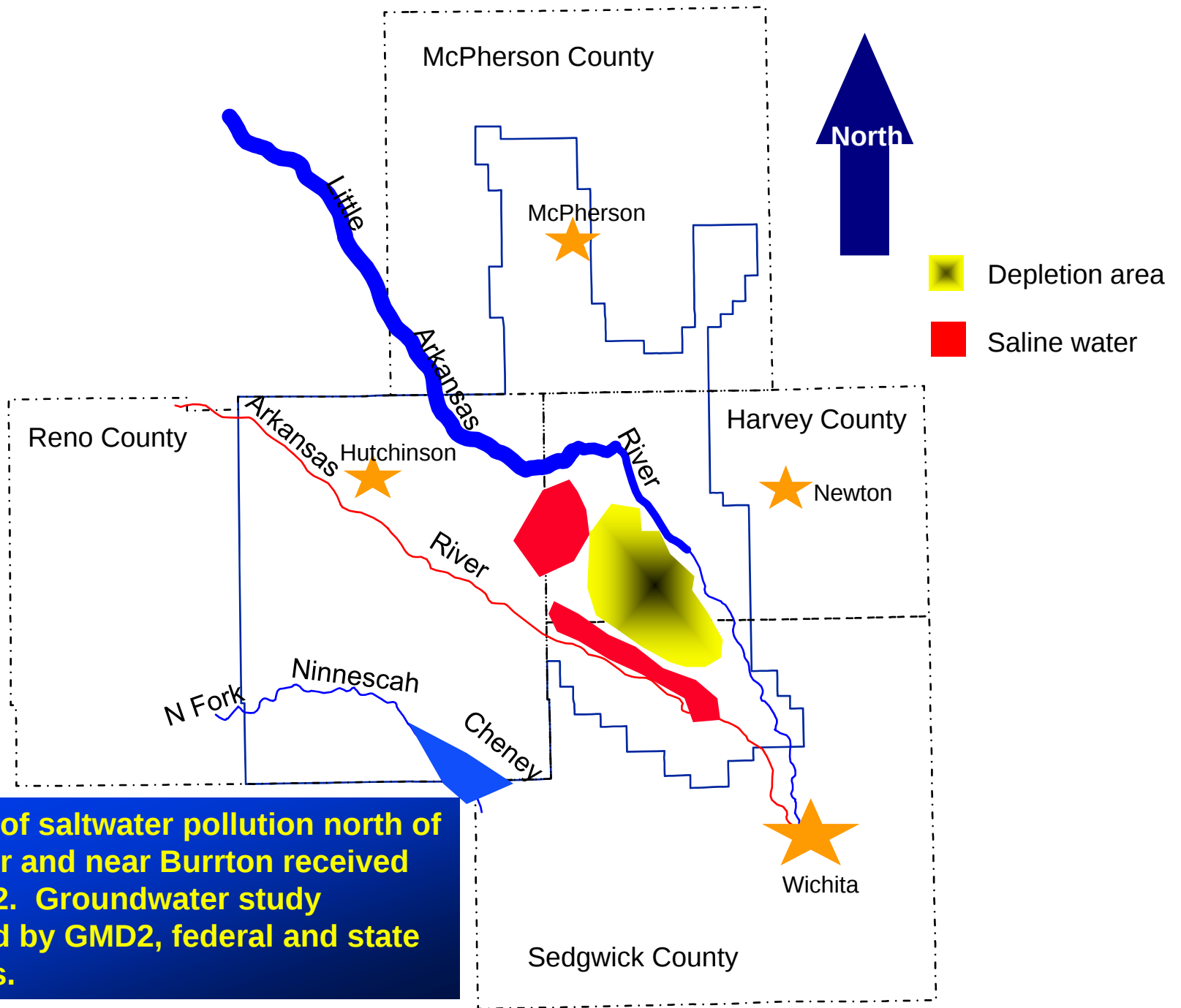




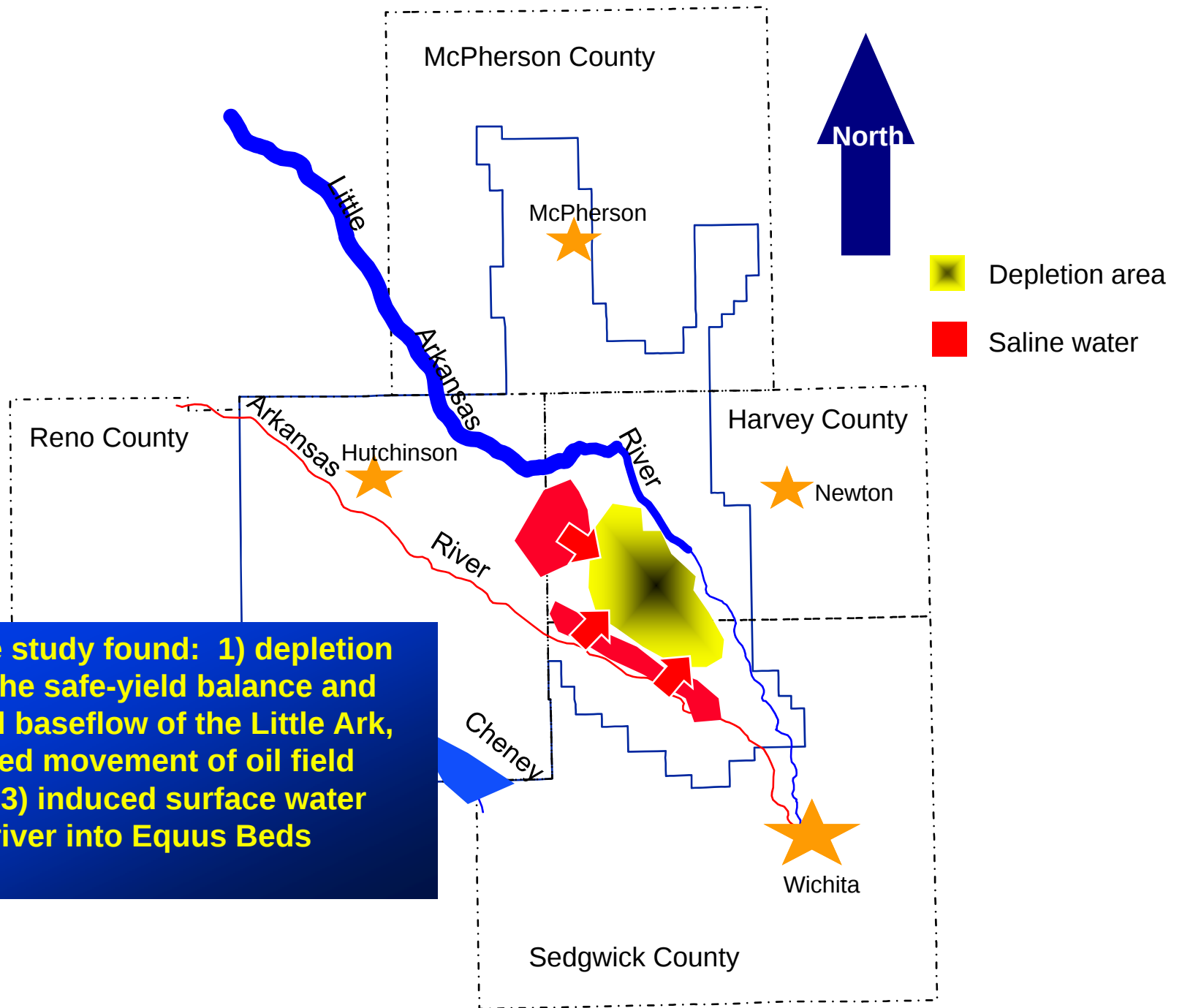
Burrton oil field discovered in 1930's. Saltwater disposal methods polluted over 35 square miles of Equus Beds aquifer.



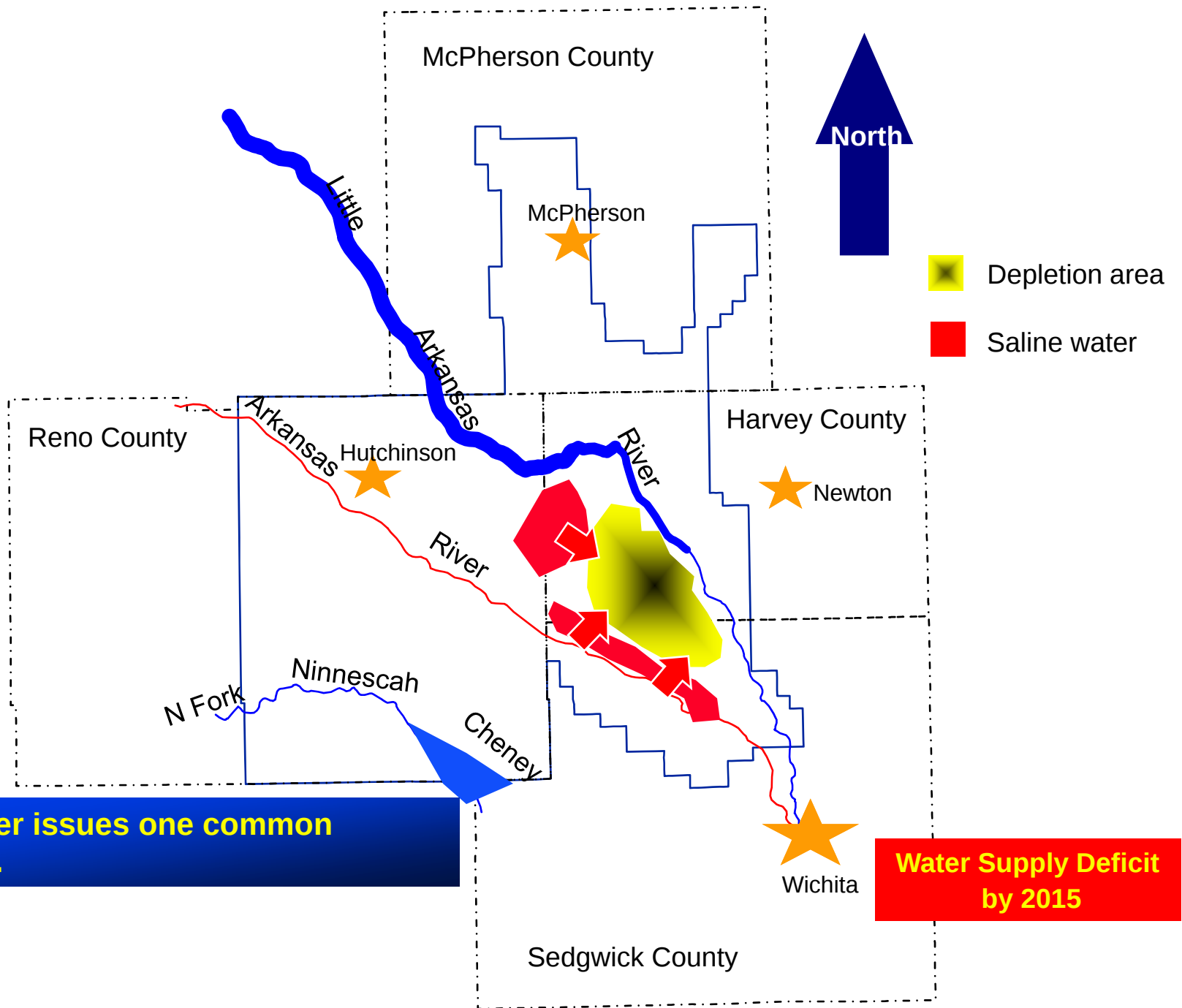
1940 to 1980 - Portions of the Equus Beds aquifer were dewatered up to 30 feet. The hydrologic balance between the aquifer and rivers is altered along with the oil field brine contamination .



Reports of saltwater pollution north of Ark River and near Burrton received by GMD2. Groundwater study launched by GMD2, federal and state agencies.

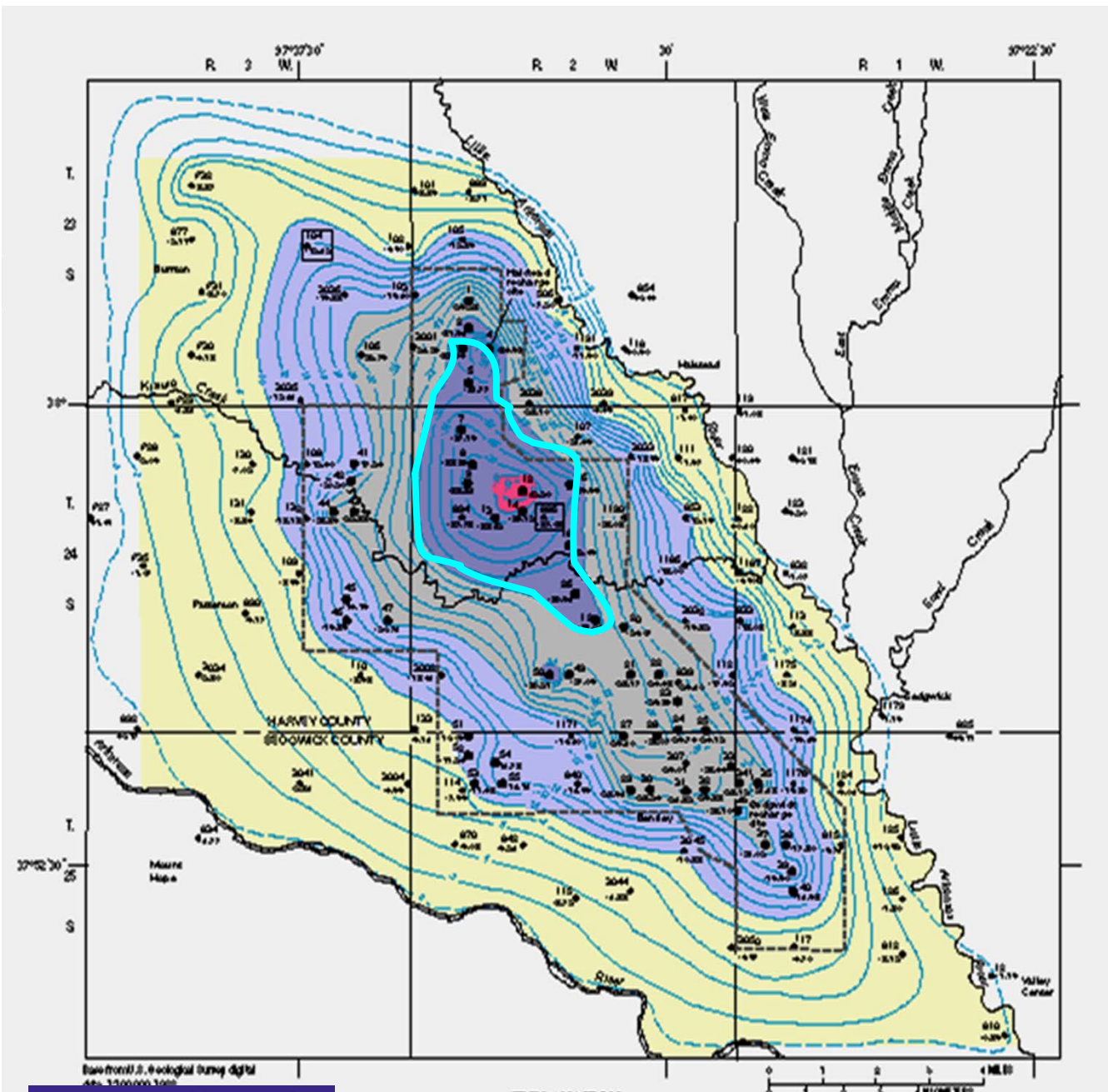


In part the study found: 1) depletion changed the safe-yield balance and decreased baseflow of the Little Ark, 2) increased movement of oil field brine and 3) induced surface water from Ark river into Equus Beds aquifer.

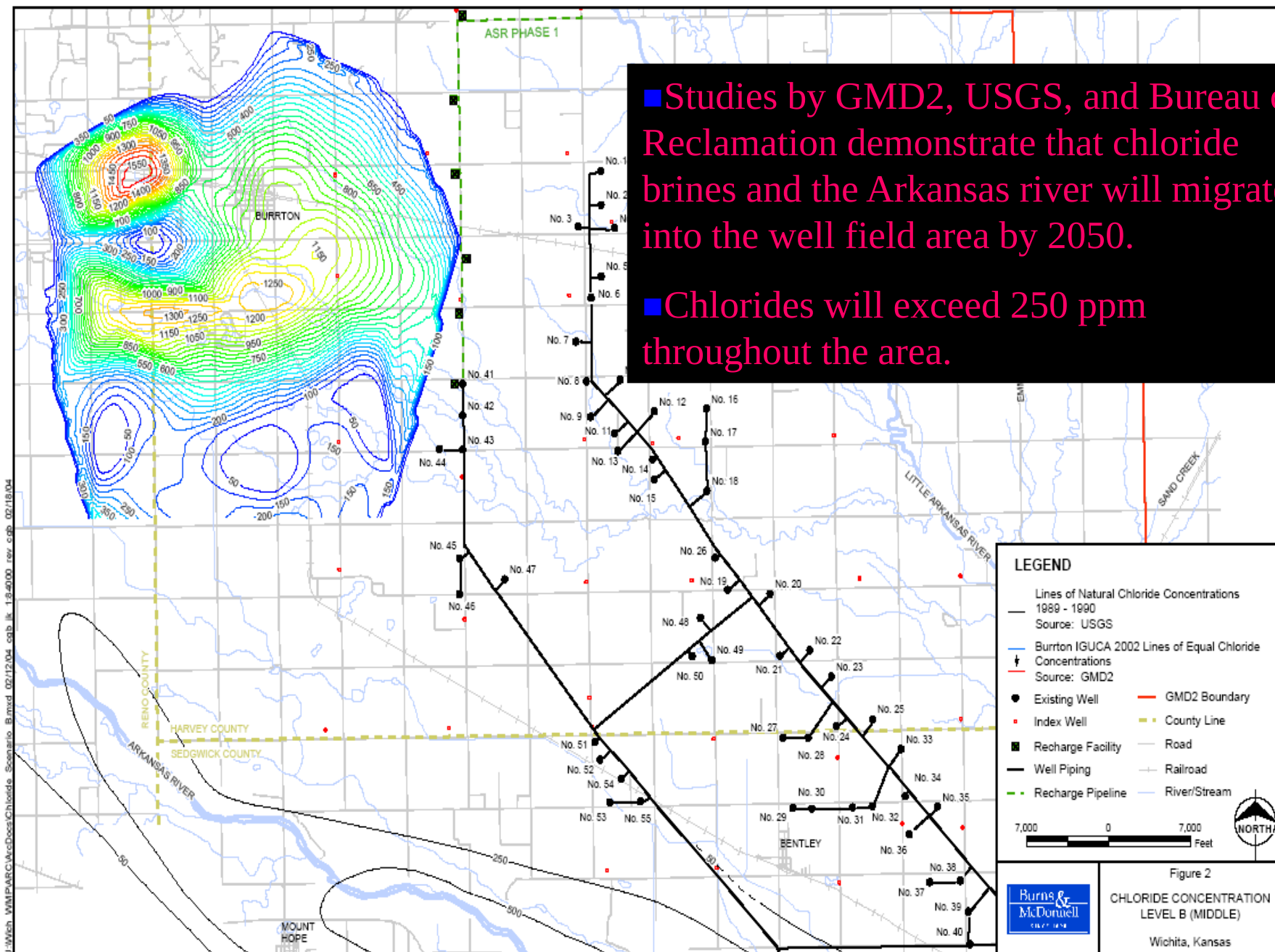


Two water issues one common solution.

Water Supply Deficit by 2015

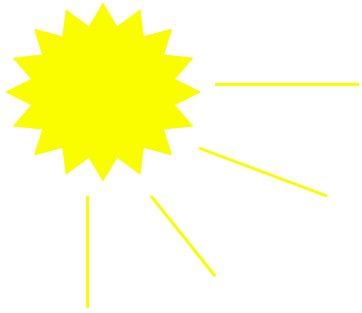


65 billion gallons
are available for
storage to return to
1940 water levels.

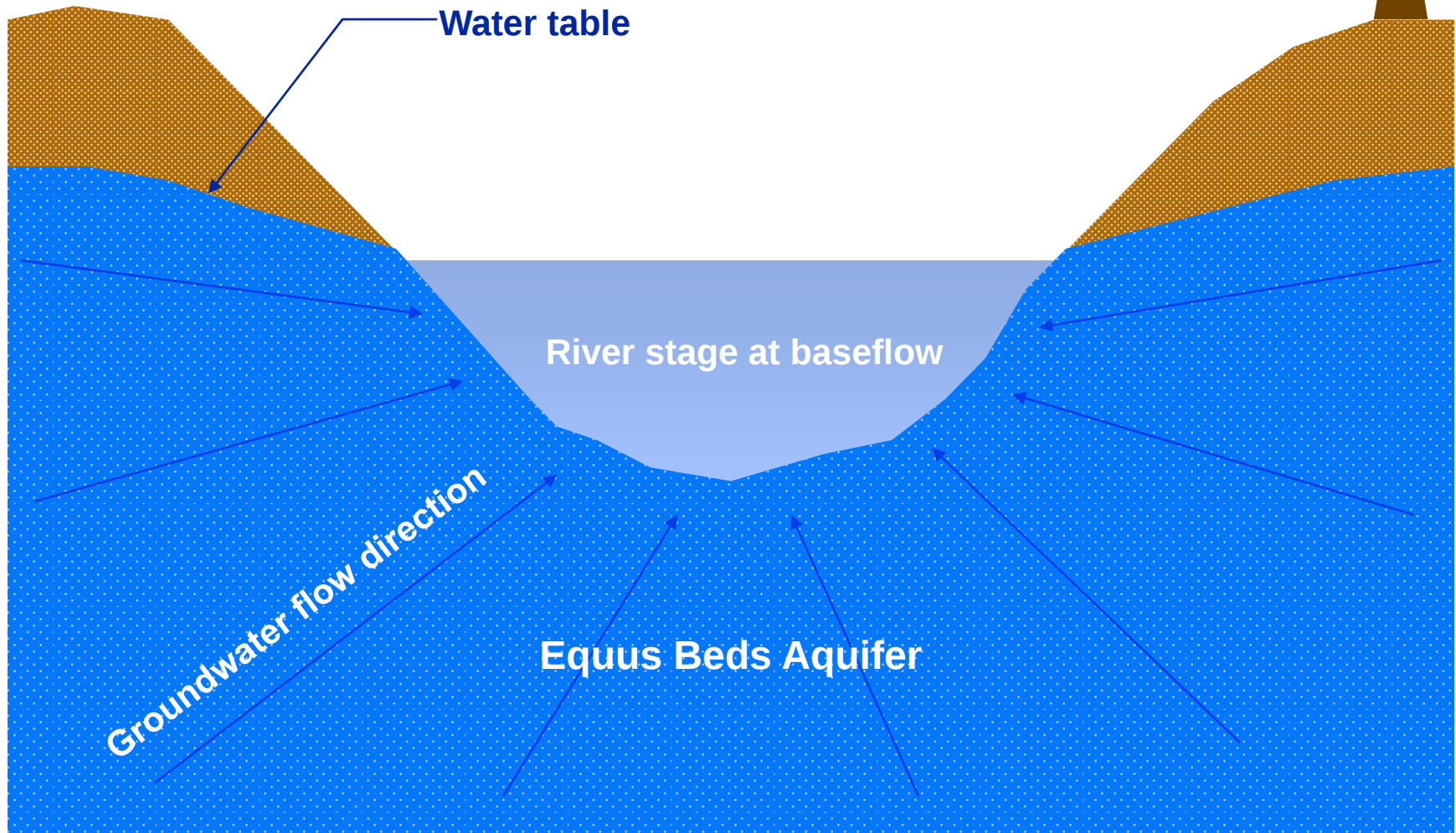
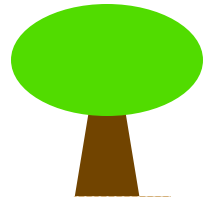


■ Studies by GMD2, USGS, and Bureau of Reclamation demonstrate that chloride brines and the Arkansas river will migrate into the well field area by 2050.

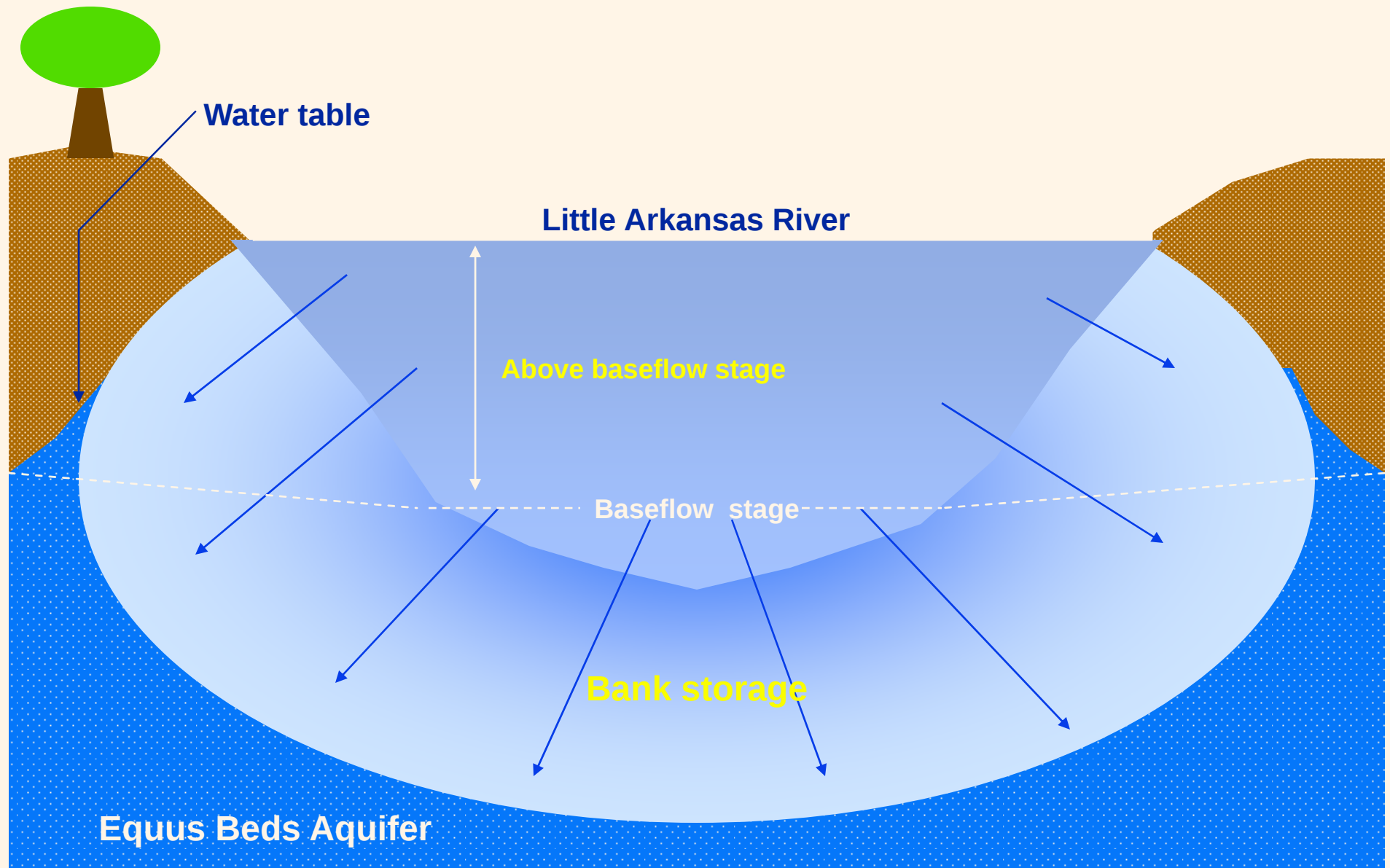
■ Chlorides will exceed 250 ppm throughout the area.



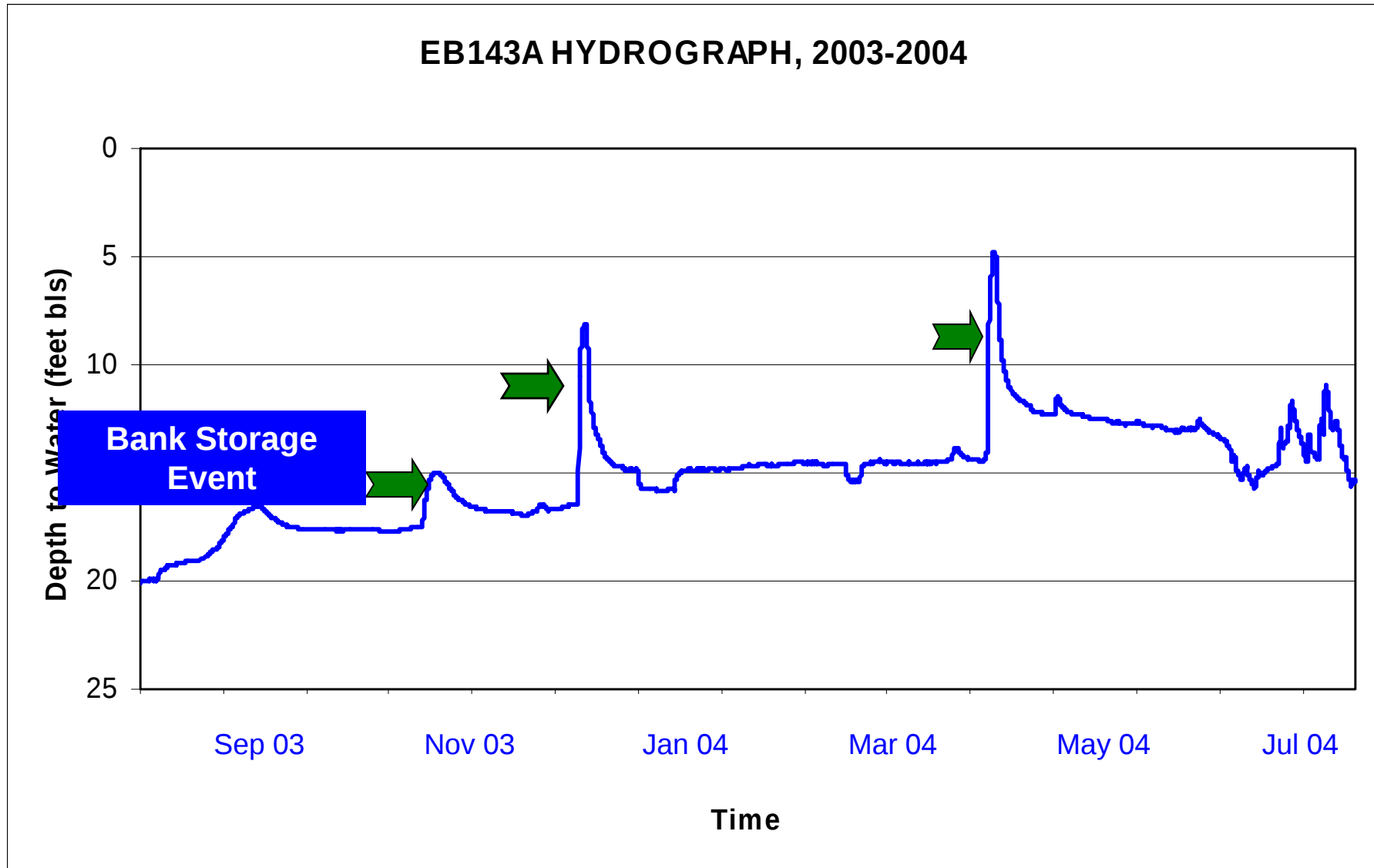
Generalized cross section of the Equus Beds aquifer discharging (baseflow) to the rivers. Annual baseflow is approximately 6.5 billion gallons.



Aquifer Storage and Recovery Project - ASR

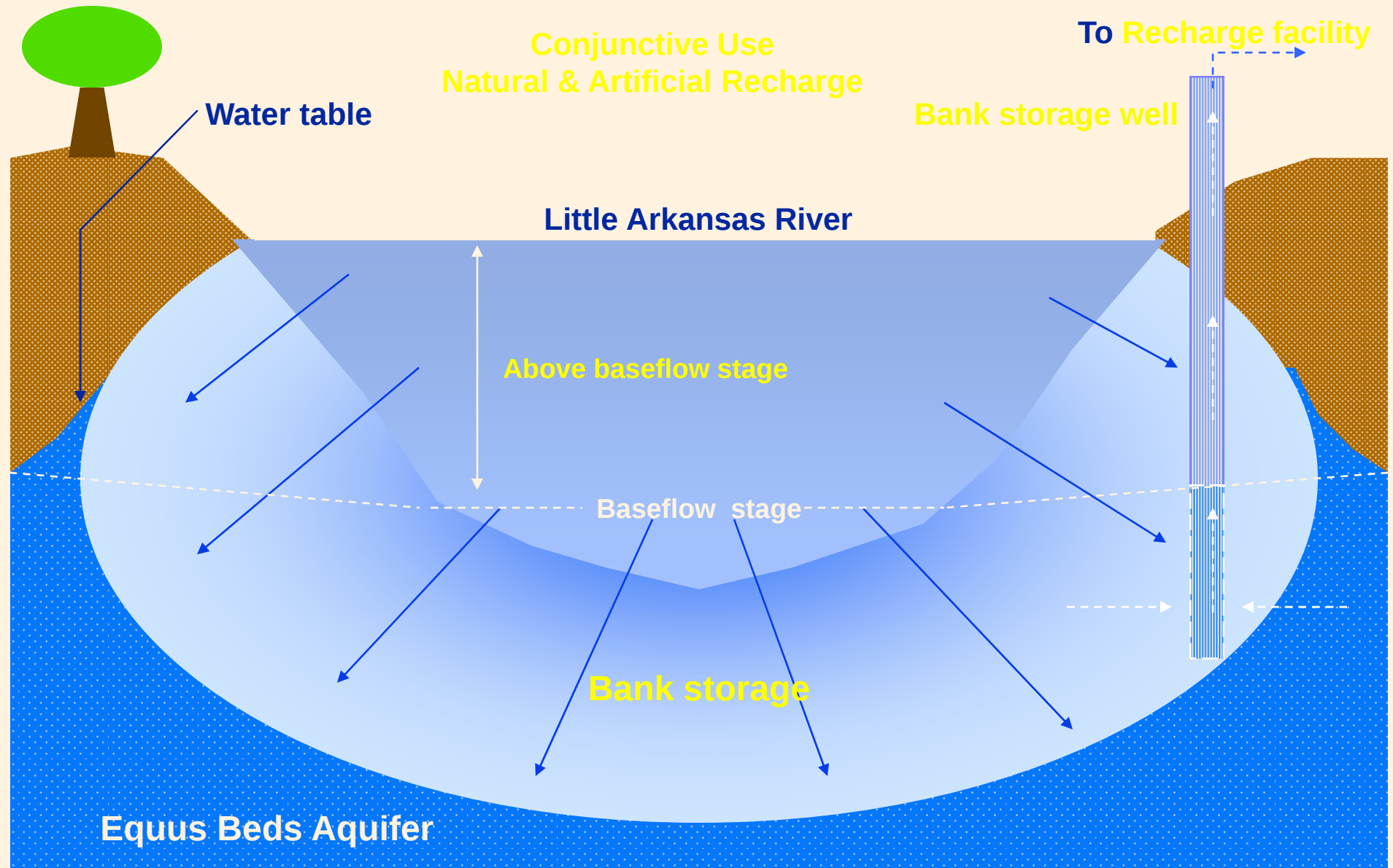


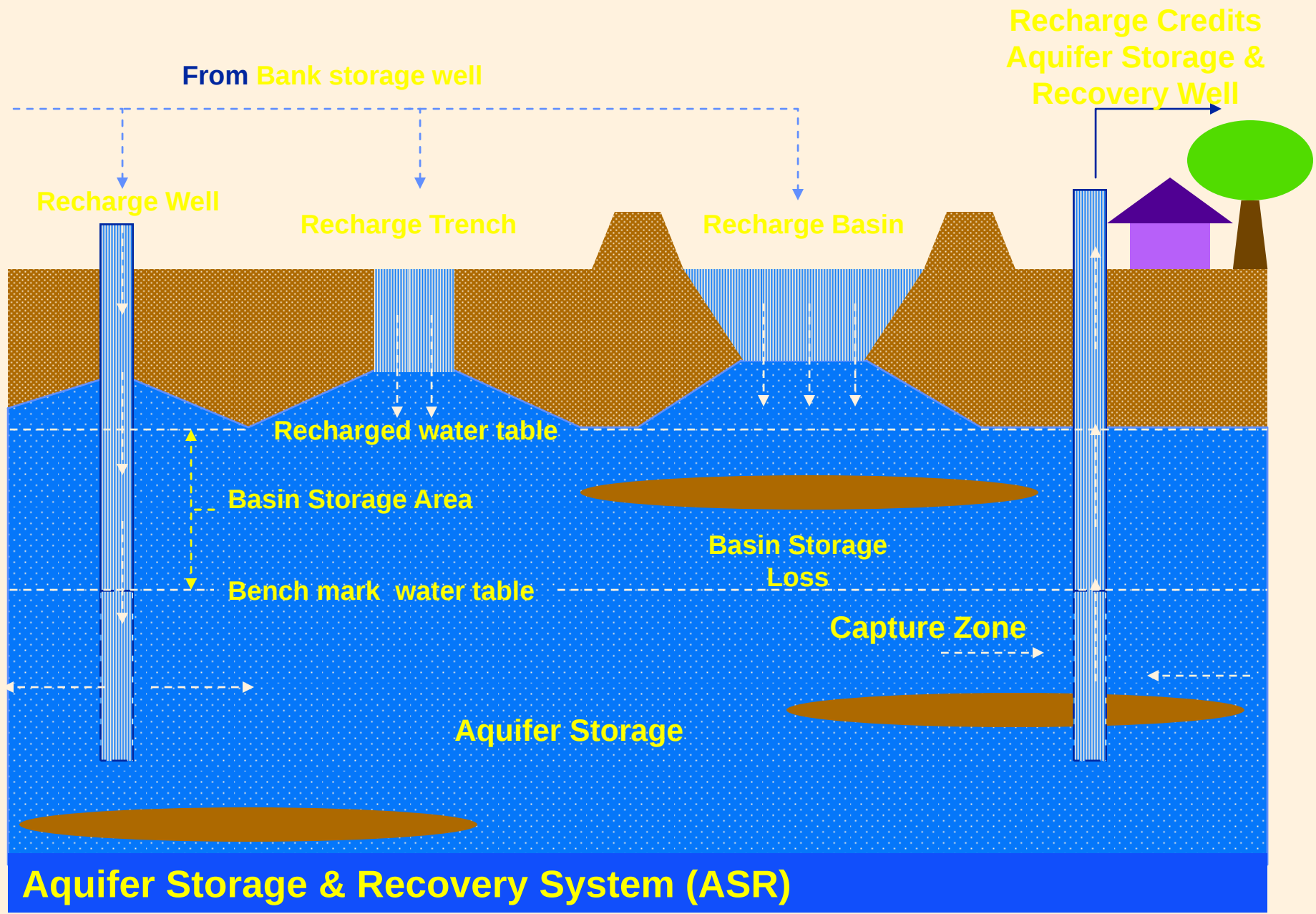
Groundwater Monitoring Site - EB143 Hydrograph, August 2003-July 2004



EB143A Depth – 59 feet

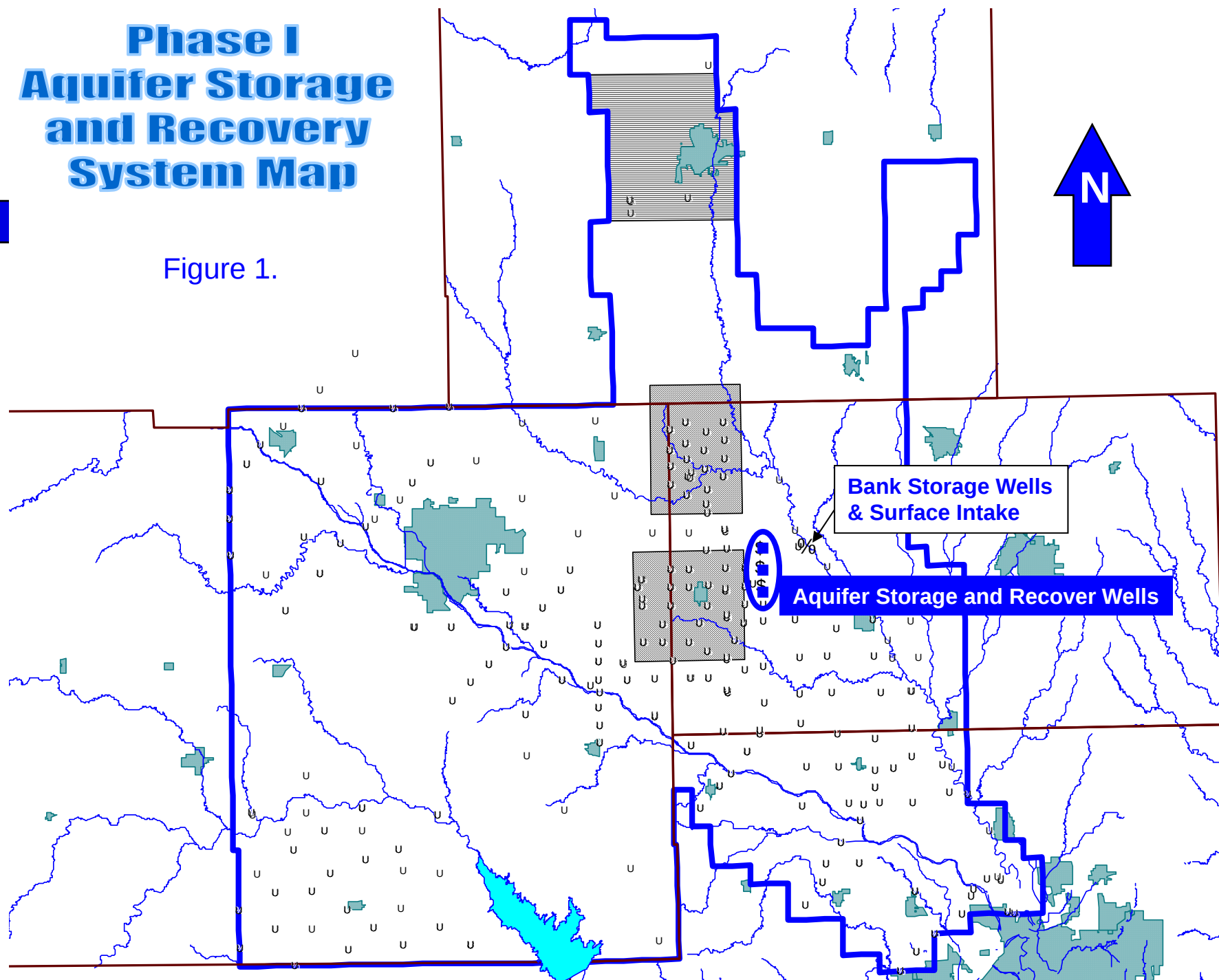
Aquifer Storage and Recovery Project - ASR

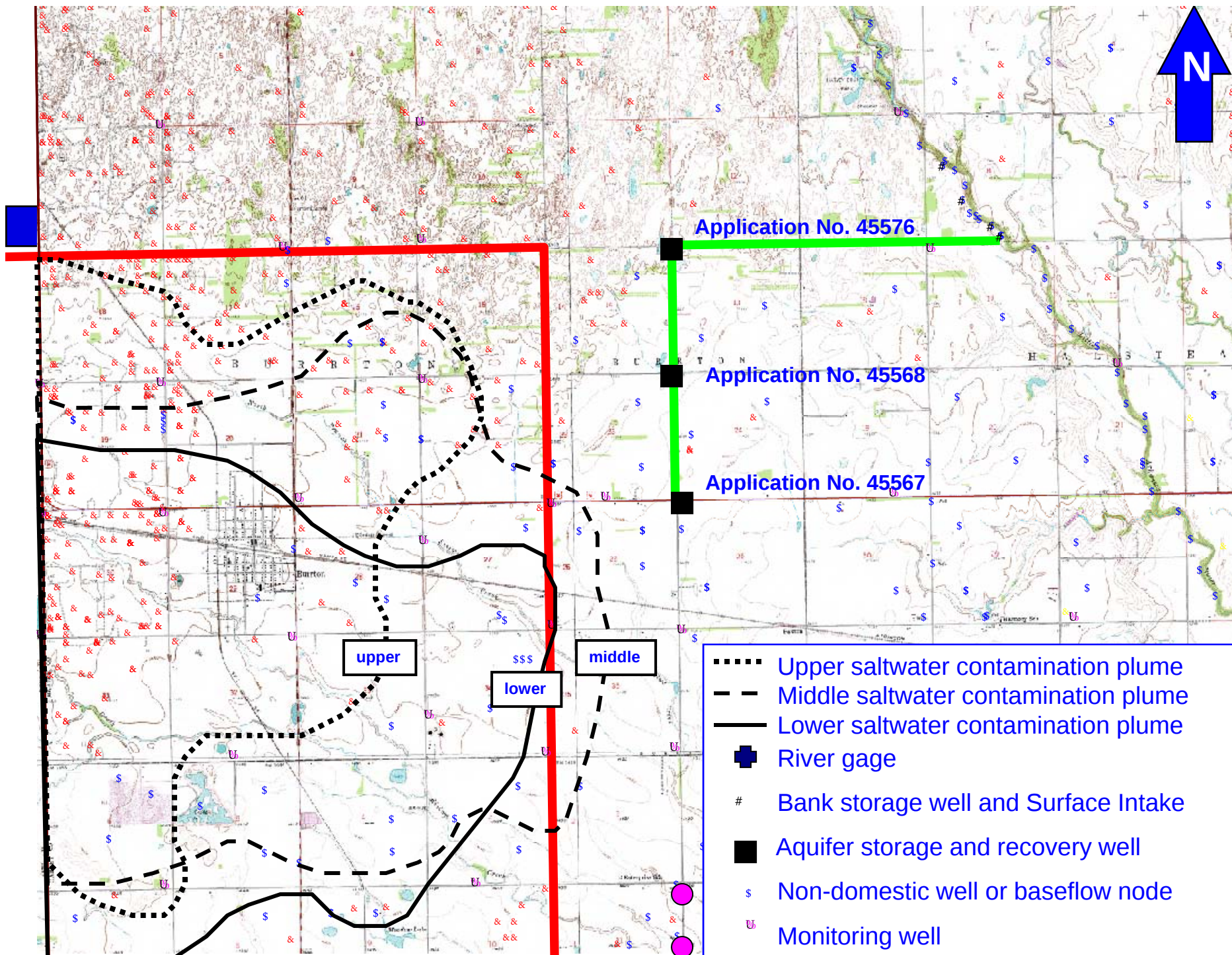


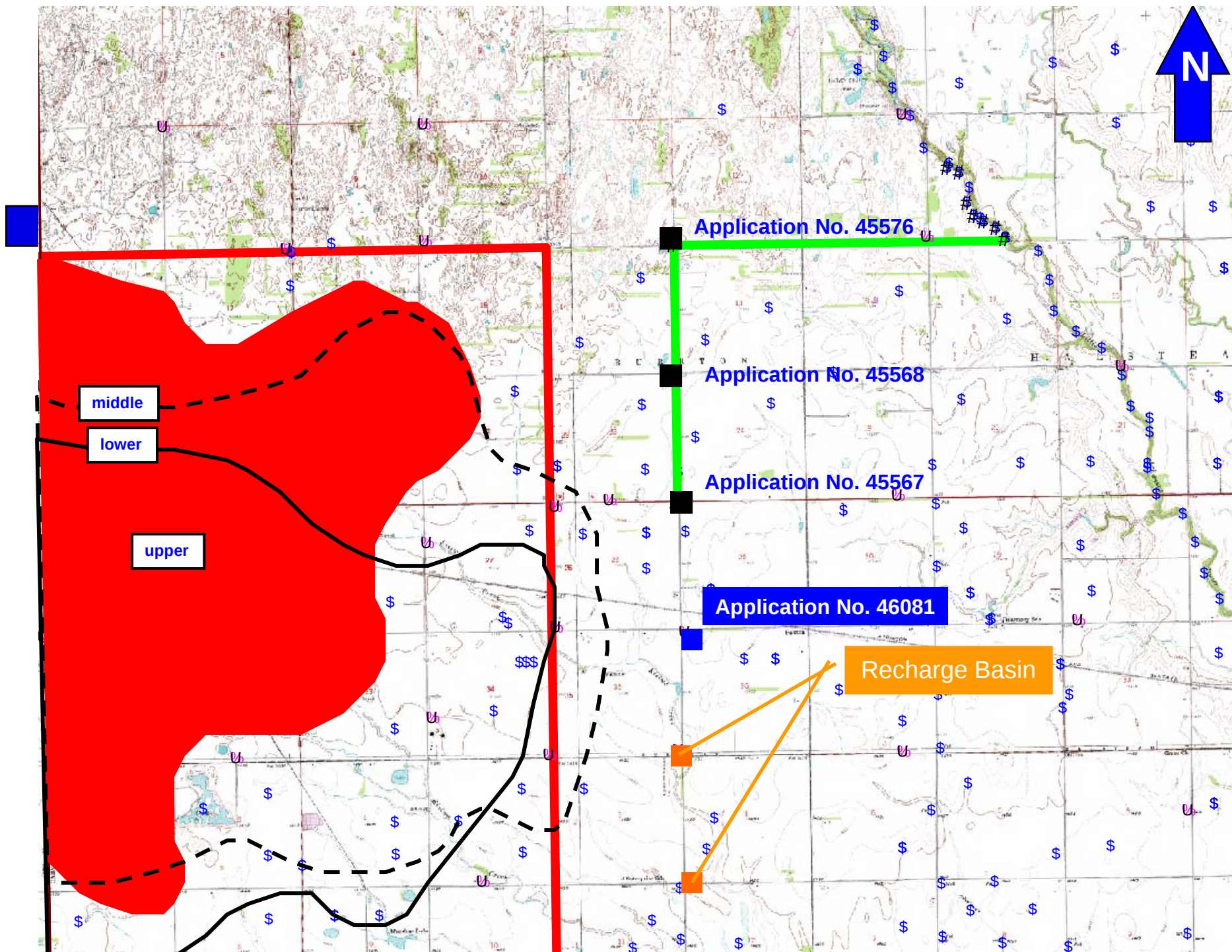


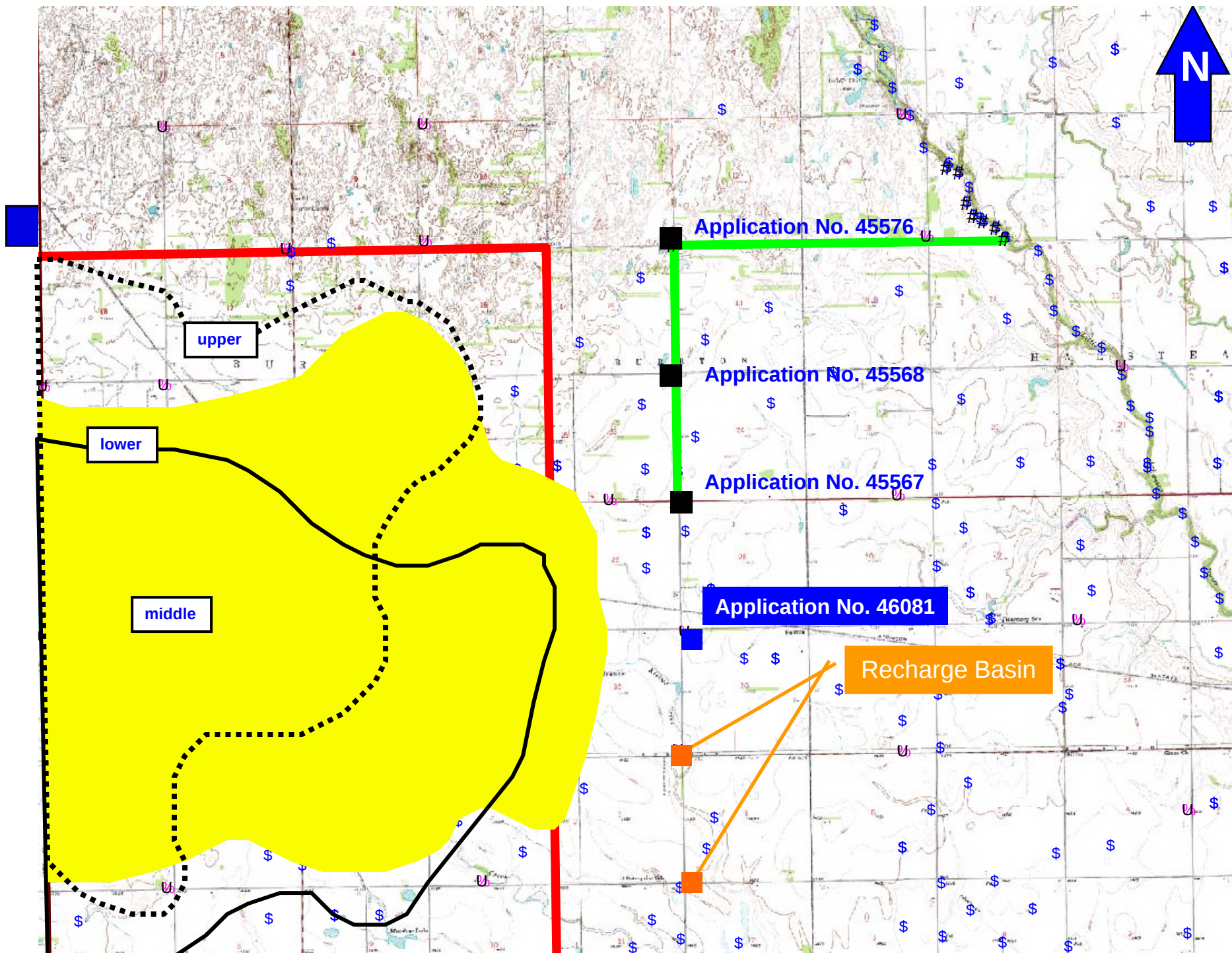
Phase I Aquifer Storage and Recovery System Map

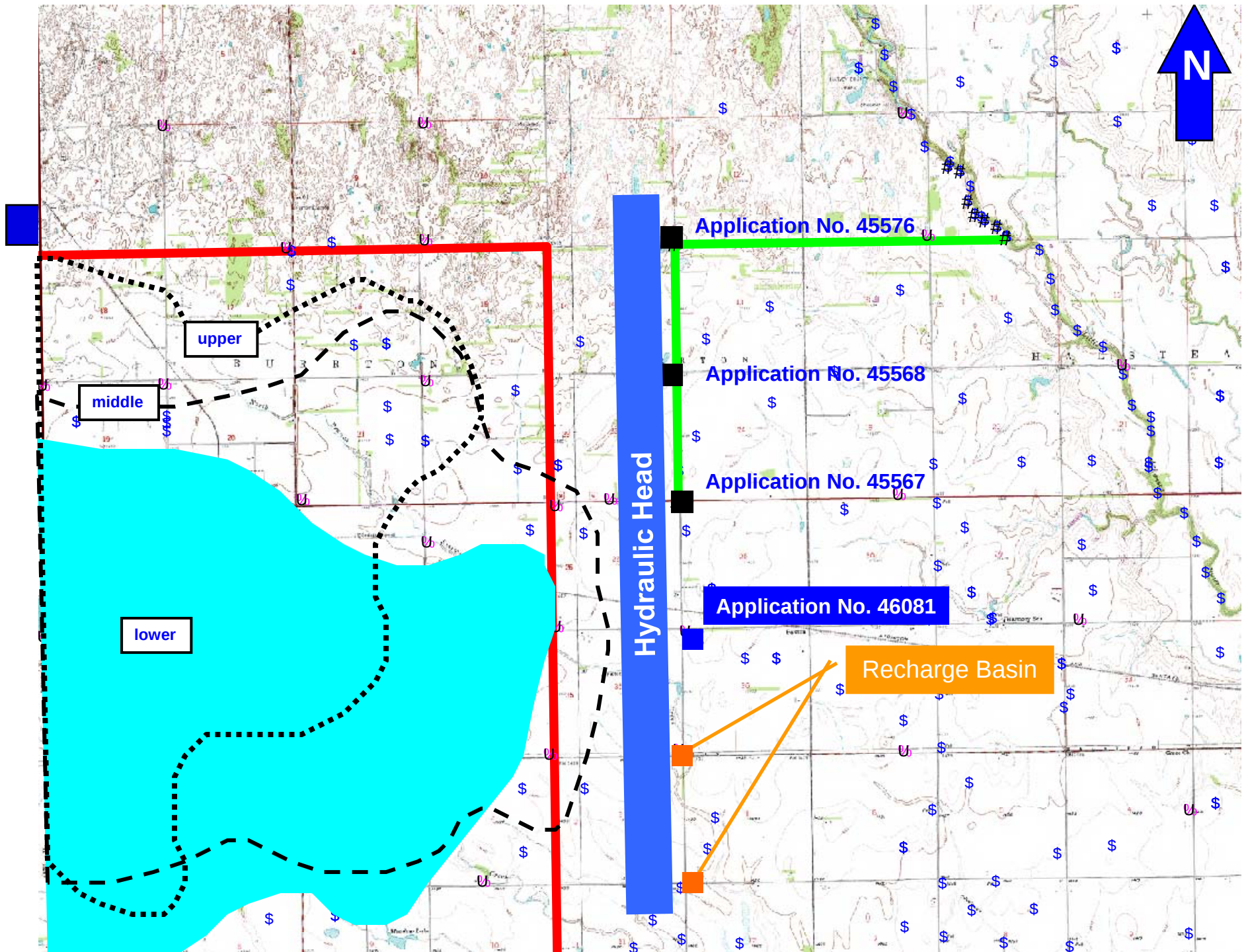
Figure 1.







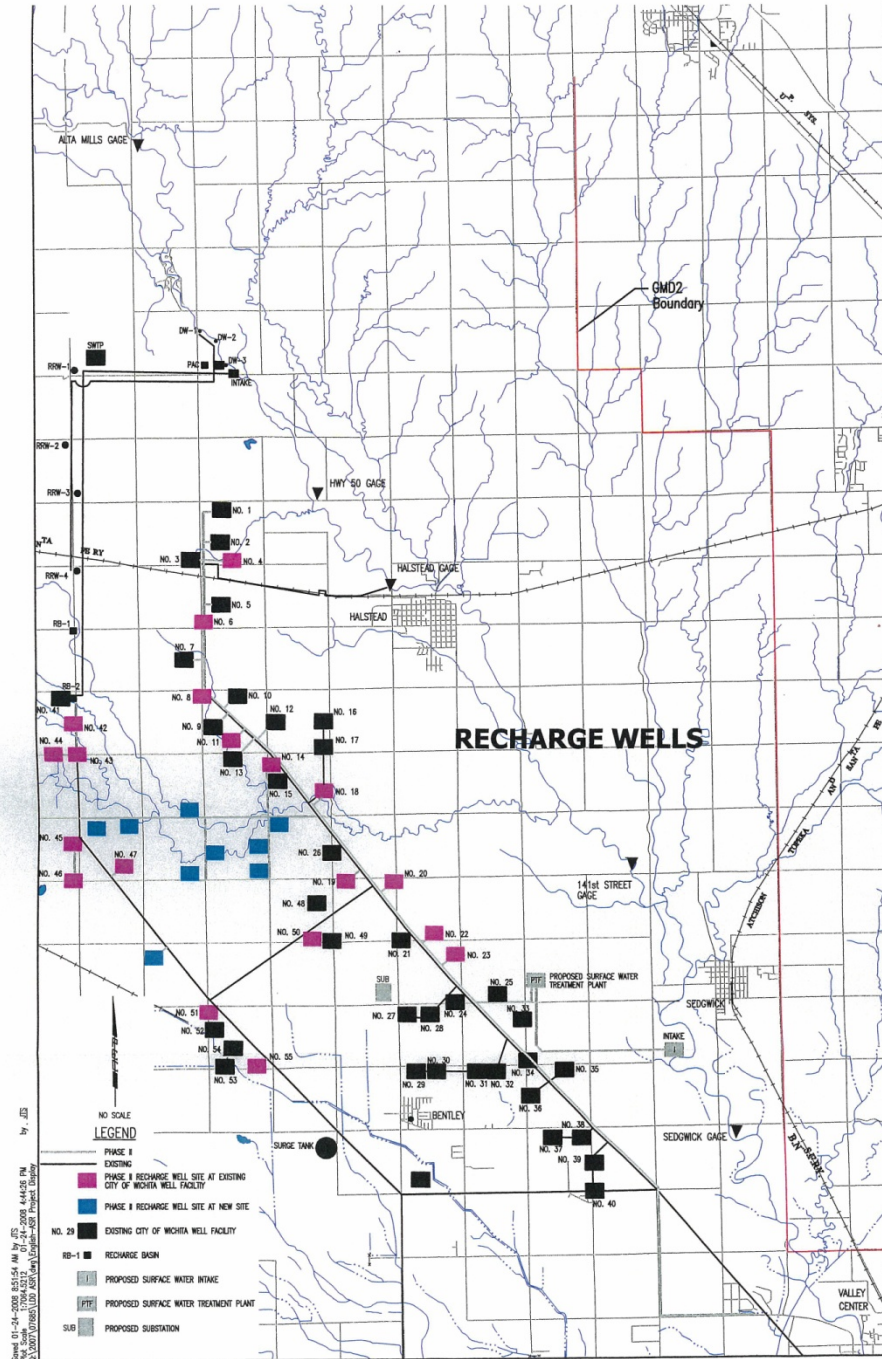




Phase II



- Can capture and recharge up to 30 MGD.
- Only uses surface water.
- Treatment plant that will treat the water adequately to go directly into 31 recharge wells.
- Included replacement of approximately 17 miles of existing raw water pipeline.
- Through 2012 – 2961 AF Recharged for Phase I & II; 1691 AF recharge credits



Sheet 01-24-2008 8:51:54 AM by JY 07-24-2008 4:44:35 PM
 Project: 01-24-2008 8:51:54 AM
 Project: 01-24-2008 8:51:54 AM
 Project: 01-24-2008 8:51:54 AM

Discussion Topics

- Global Water Perspective
- State Water Perspective
- The Equus Beds Aquifer
- Water Protection Activities
- Water Protection Issues
- Closing thoughts.



Groundwater Protection Golden Rule

**Prevention of groundwater
contamination and water quality
protection costs more than doing
nothing, but much less than
groundwater cleanup.**



**LASTLY:
PRAY FOR RAIN....JUST NOT TOO MUCH!**







GMD2.ORG

A composite image showing a large portion of the Earth on the left, with visible continents and swirling cloud patterns, and the Moon on the right, showing its cratered surface. The background is the blackness of space. The text "Questions and Answers" is overlaid in the center in a bold, yellow font.

Questions and Answers