

Maximum Annual Yield Process

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May 21st, 2019

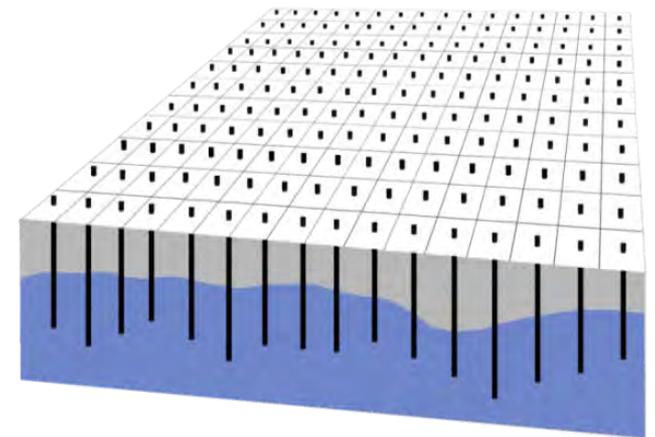
1973 Oklahoma Groundwater Law

*It is declared to be the public policy of the State of Oklahoma, in the interest of the agricultural stability, domestic, municipal, industrial and other beneficial uses, general economy, and health and welfare of the State and its citizens, to utilize the **groundwater resources** of the State, and for that purpose to provide **reasonable regulations** for the allocation for reasonable use based on **hydrologic surveys** of fresh groundwater basins or subbasins to **determine a restriction on the production** based upon the acres overlying the groundwater basin or subbasin.*

- Groundwater is considered private property that belongs to the overlying surface owner, although it is subject to reasonable regulation by the OWRB.
- Considered a “mining” law, some depletion of the aquifer is allowed

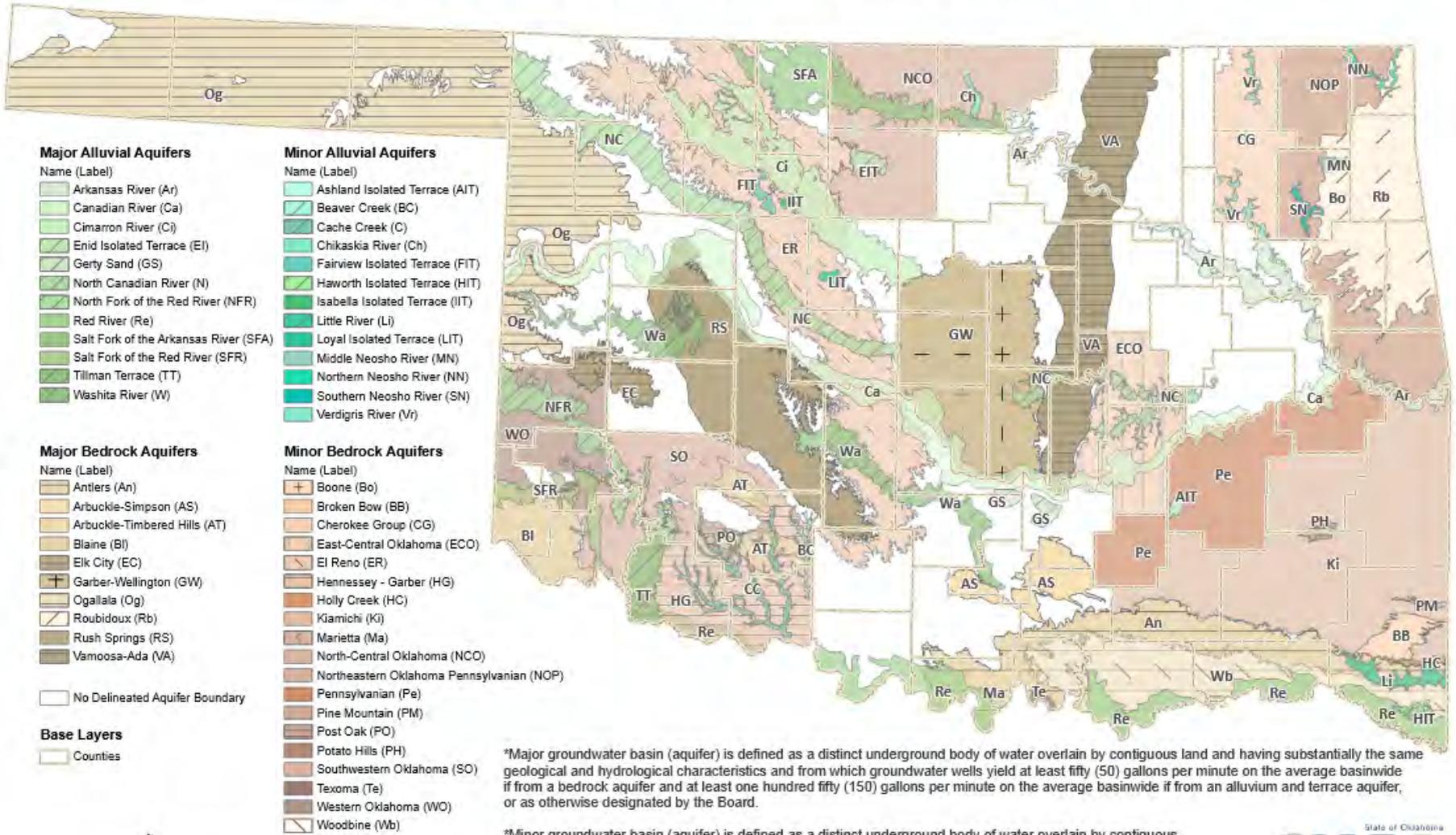
Maximum Annual Yield/Equal Proportionate Share

- Maximum Annual Yield (MAY)
 - The total amount of fresh groundwater that can be withdrawn while allowing a minimum 20-year life of the basin.
- Equal Proportionate Share (EPS)
 - Once the maximum annual yield has been established, the amount of water allocated to each permit applicant will be proportionate to the amount of land owned or leased by that applicant.
 - Each groundwater user is entitled to withdraw an equal share of water proportional to the amount of land owned.
 - Default value of 2.0 acre-feet per acre until hydrologic study is completed



Oklahoma Groundwater Resources

Major and Minor Aquifers of Oklahoma



Major Alluvial Aquifers

- Name (Label)
- Arkansas River (Ar)
 - Canadian River (Ca)
 - Cimarron River (Ci)
 - Enid Isolated Terrace (EI)
 - Gerty Sand (GS)
 - North Canadian River (N)
 - North Fork of the Red River (NFR)
 - Red River (Re)
 - Salt Fork of the Arkansas River (SFA)
 - Salt Fork of the Red River (SFR)
 - Tillman Terrace (TT)
 - Washita River (W)

Minor Alluvial Aquifers

- Name (Label)
- Ashland Isolated Terrace (AIT)
 - Beaver Creek (BC)
 - Cache Creek (C)
 - Chikaskia River (Ch)
 - Fairview Isolated Terrace (FIT)
 - Haworth Isolated Terrace (HIT)
 - Isabella Isolated Terrace (IIT)
 - Little River (Li)
 - Loyal Isolated Terrace (LIT)
 - Middle Neosho River (MN)
 - Northern Neosho River (NN)
 - Southern Neosho River (SN)
 - Verdigris River (Vr)

Major Bedrock Aquifers

- Name (Label)
- Antlers (An)
 - Arbuckle-Simpson (AS)
 - Arbuckle-Timbered Hills (AT)
 - Blaine (Bl)
 - Elk City (EC)
 - Garber-Wellington (GW)
 - Ogallala (Og)
 - Roubidoux (Rb)
 - Rush Springs (RS)
 - Vamoosa-Ada (VA)

Minor Bedrock Aquifers

- Name (Label)
- Boone (Bo)
 - Broken Bow (BB)
 - Cherokee Group (CG)
 - East-Central Oklahoma (ECO)
 - El Reno (ER)
 - Hennessey - Garber (HG)
 - Holly Creek (HC)
 - Kiamichi (Ki)
 - Marietta (Ma)
 - North-Central Oklahoma (NCO)
 - Northeastern Oklahoma Pennsylvanian (NOP)
 - Pennsylvanian (Pe)
 - Pine Mountain (PM)
 - Post Oak (PO)
 - Potato Hills (PH)
 - Southwestern Oklahoma (SO)
 - Texoma (Te)
 - Western Oklahoma (WO)
 - Woodbine (Wb)

Base Layers

- Counties

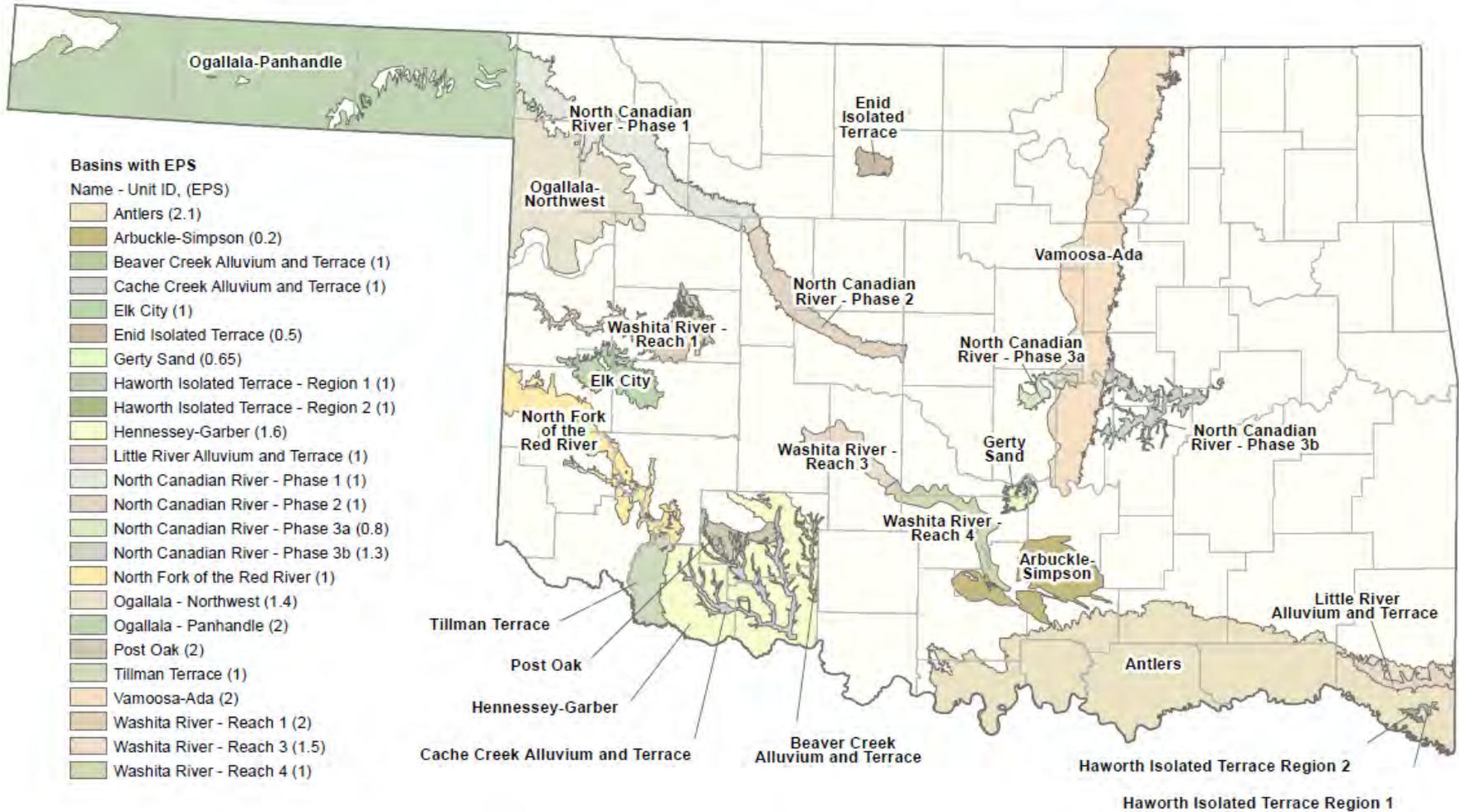
*Major groundwater basin (aquifer) is defined as a distinct underground body of water overlain by contiguous land and having substantially the same geological and hydrological characteristics and from which groundwater wells yield at least fifty (50) gallons per minute on the average basinwide if from a bedrock aquifer and at least one hundred fifty (150) gallons per minute on the average basinwide if from an alluvium and terrace aquifer, or as otherwise designated by the Board.

*Minor groundwater basin (aquifer) is defined as a distinct underground body of water overlain by contiguous land and having substantially the same geological and hydrological characteristics and which is not a major groundwater basin.

For more information please visit the OWRB's web site at: (<http://www.owrb.ok.gov>)

Oklahoma Groundwater Resources

Groundwater Basins with Final Maximum Annual Yield Determination



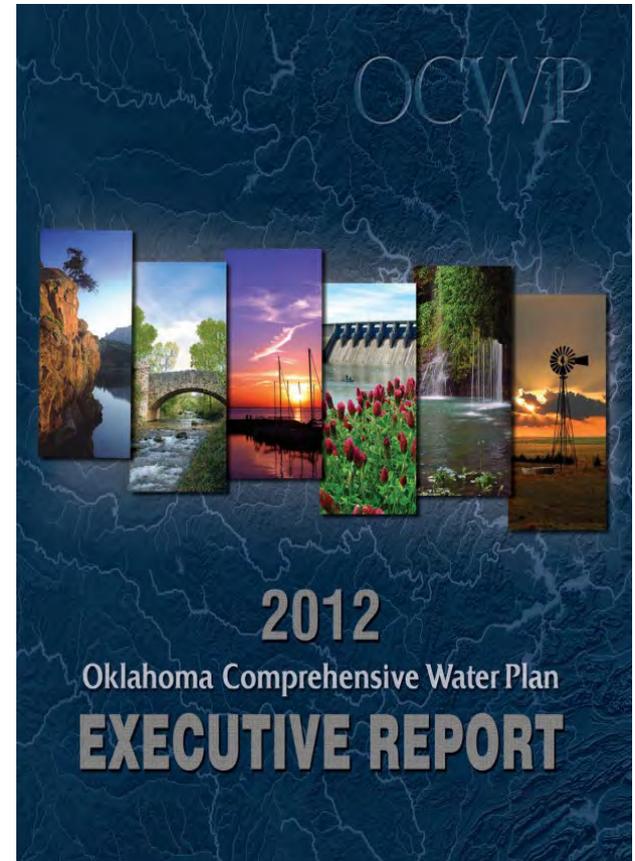
This map represents groundwater basins that have a final maximum annual yield determination by the Oklahoma Water Resources Board. TITLE 785. OKLAHOMA WATER RESOURCES BOARD, CHAPTER 30. TAKING AND USE OF GROUNDWATER, SUBCHAPTER 9. MAXIMUM ANNUAL YIELD DETERMINATIONS. <http://www.owrb.ok.gov> 10/18/2017



2012 Oklahoma Comprehensive Water Plan

- **Priority Recommendation #7**

Address...the growing backlog of statutorily-required maximum annual yield studies and overdue 20-year updates on groundwater basins within the state...to accurately determine water available for use.



MAY/EPS Requirements

Oklahoma water law states that certain factors be considered in the determination of the maximum annual yield of a major groundwater basin:

- total land area overlying the basin
- amount of water in storage in the basin
- rate of recharge to the basin
- total discharge from the basin
- transmissivity of the basin
- the possibility of pollution from natural sources

Additional requirements for sensitive sole source groundwater basins

- maximum annual yield ensures the natural flow of water from springs or streams will not be reduced

Process

Maximum Annual Yield Determination Process

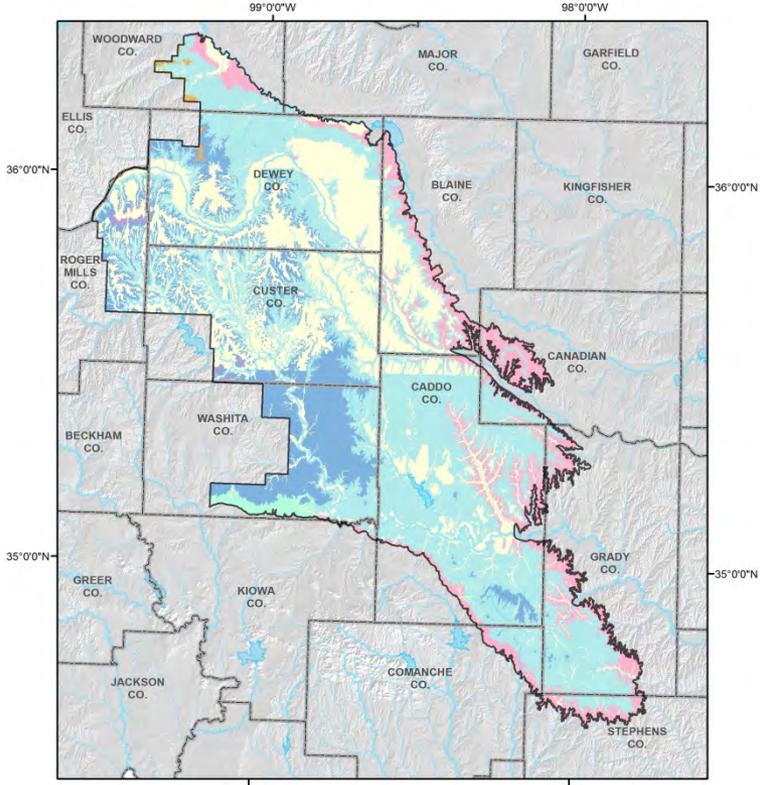


Hydrologic Studies

- The first step in determining the maximum annual yield is to conduct a hydrologic investigation or survey
- Multi-year projects performed by the OWRB or an outside expert agency or institution such as the U.S. Geological Survey
- More complex aquifers may utilize digital groundwater flow models (adding time to a project)



Define Geologic Boundaries



EXPLANATION

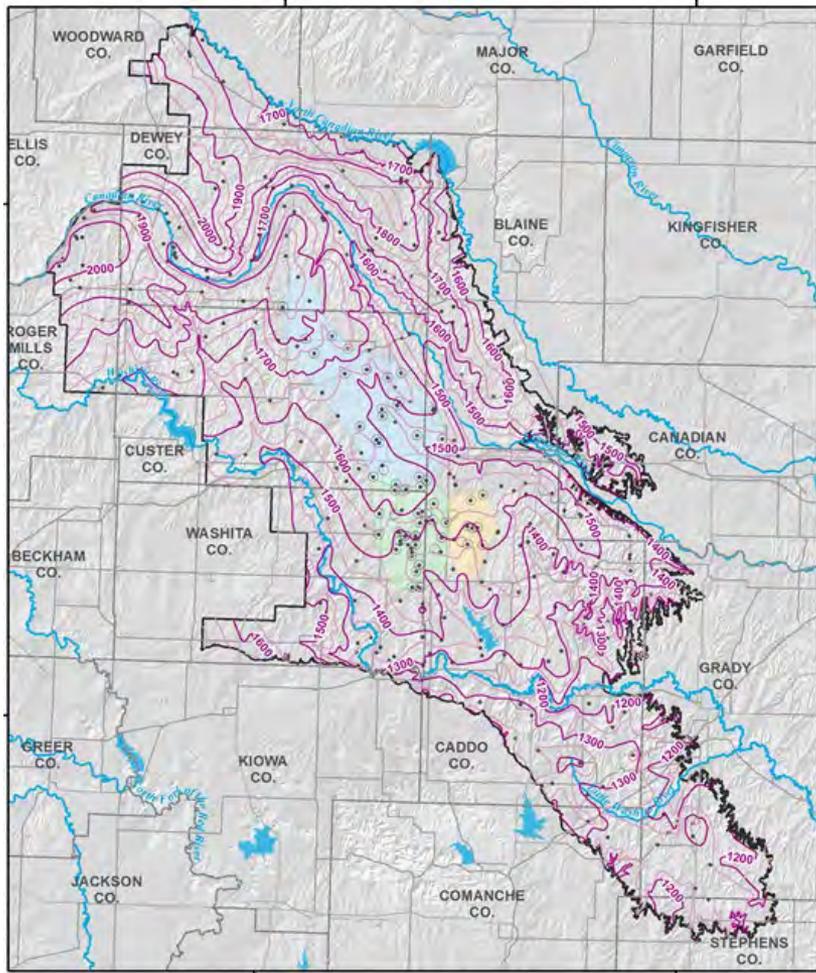
- Extent of modified Rush Springs boundary (study area)
- Quaternary Units
- Ogallala Formation
- Doxey Formation
- Cloud Chief Formation
- Whitehorse Group
- Rush Springs Formation
- Marlow Formation
- Dog Creek Shale
- Dakota Formation

Geology modified from Chang and Stanley, 2010; Fay, 2010A; Fay, 2010B; Johnson et al., 2003; Stanley, 2002; Stanley and Miller, 2004; Stanley and Miller, 2005; Stanley et al., 2002
 Albers Equal Area Conic Projection
 North American Datum of 1983

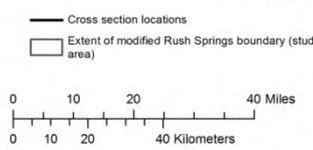
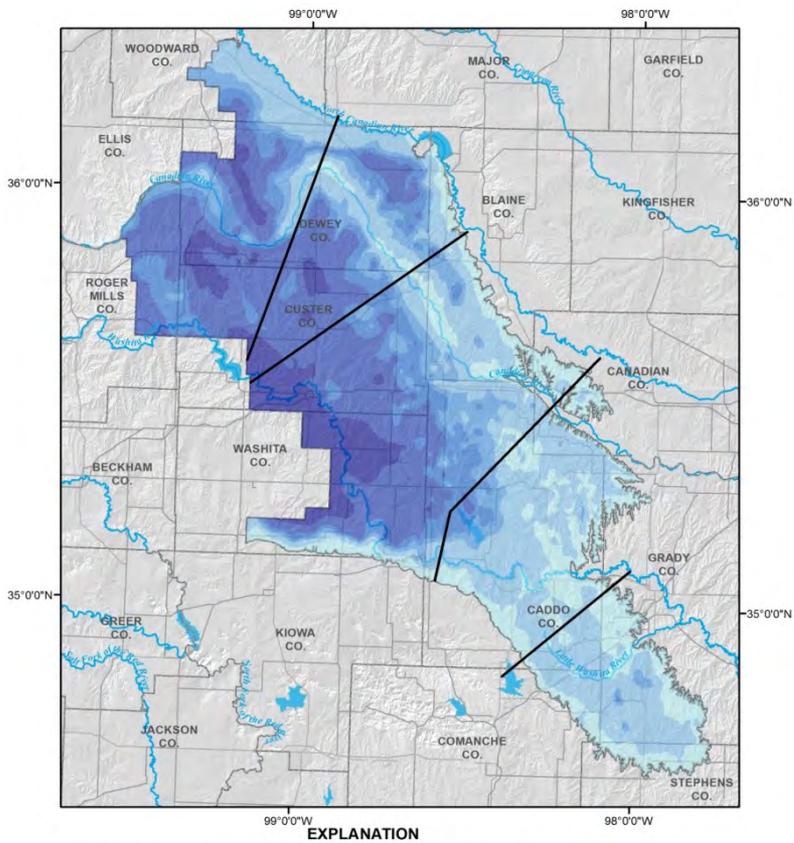
0 10 20 40 Miles
 0 10 20 40 Kilometers



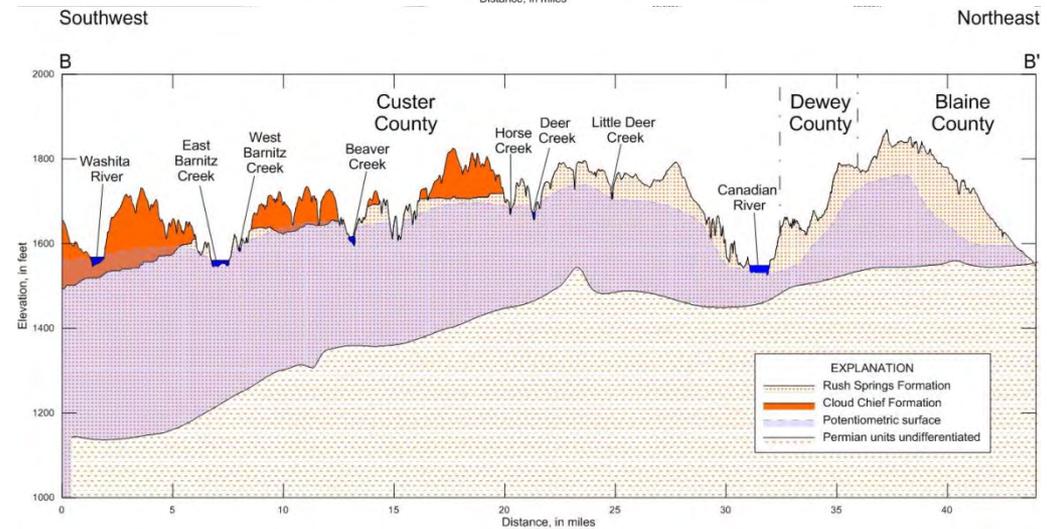
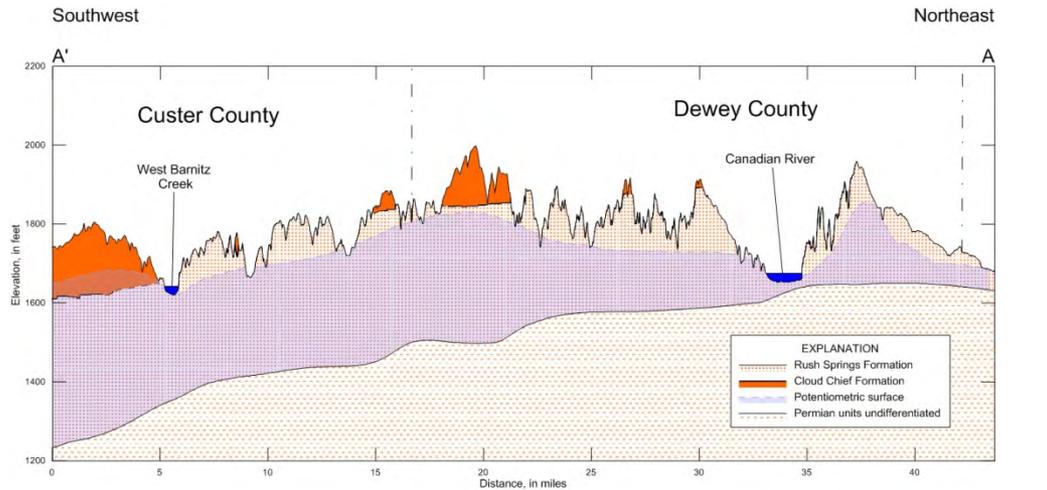
Find and Measure Wells



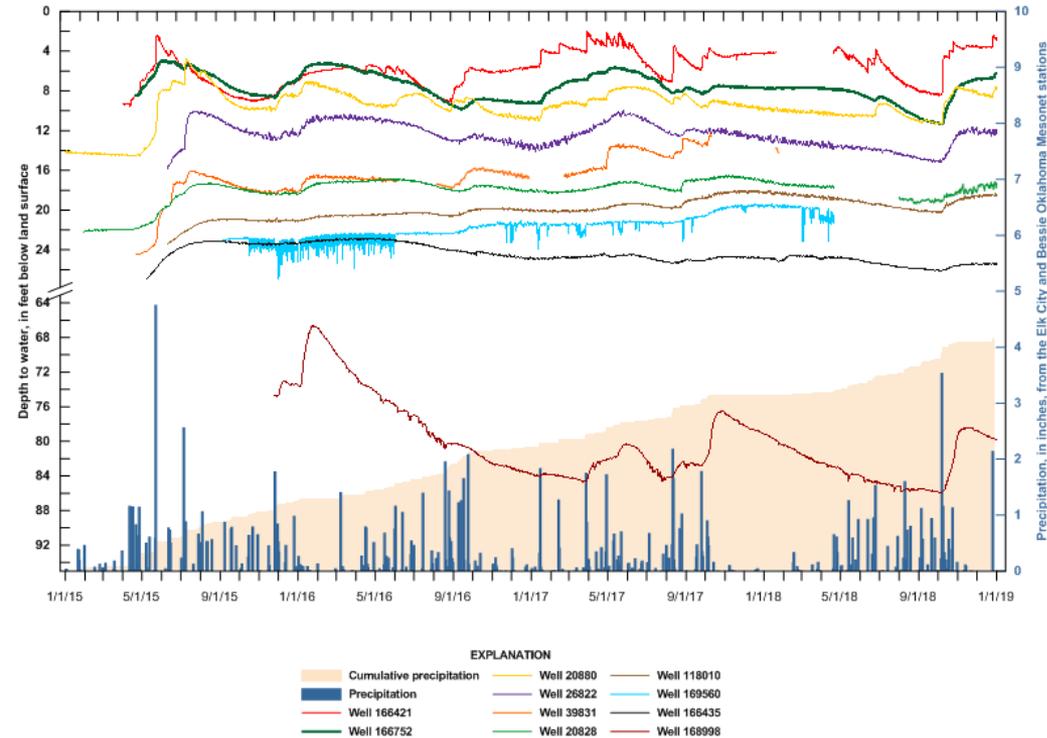
Saturated Thickness



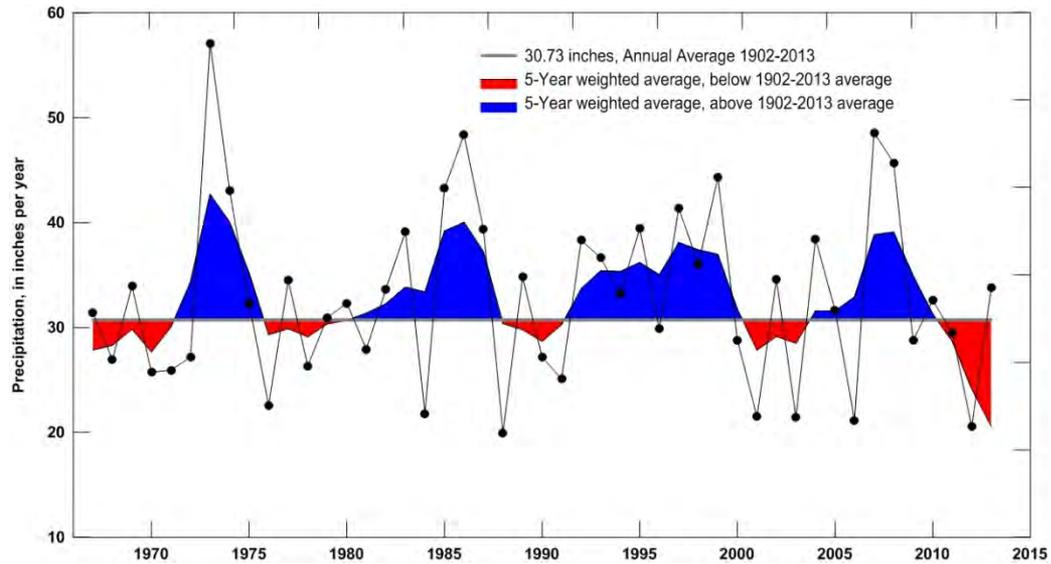
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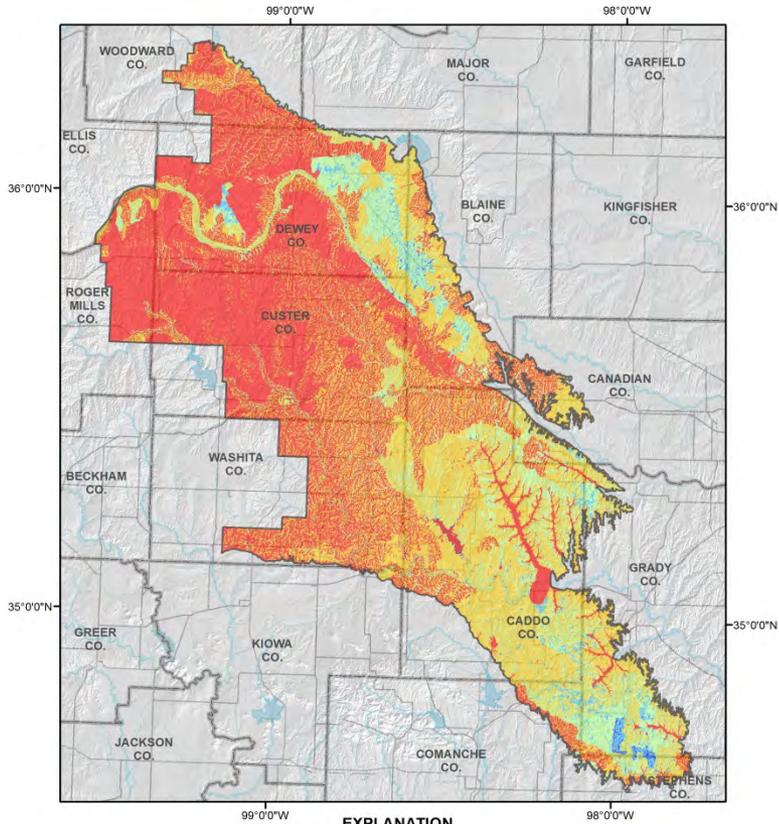
Water-Level Fluctuations



Climate Trends



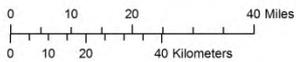
Recharge



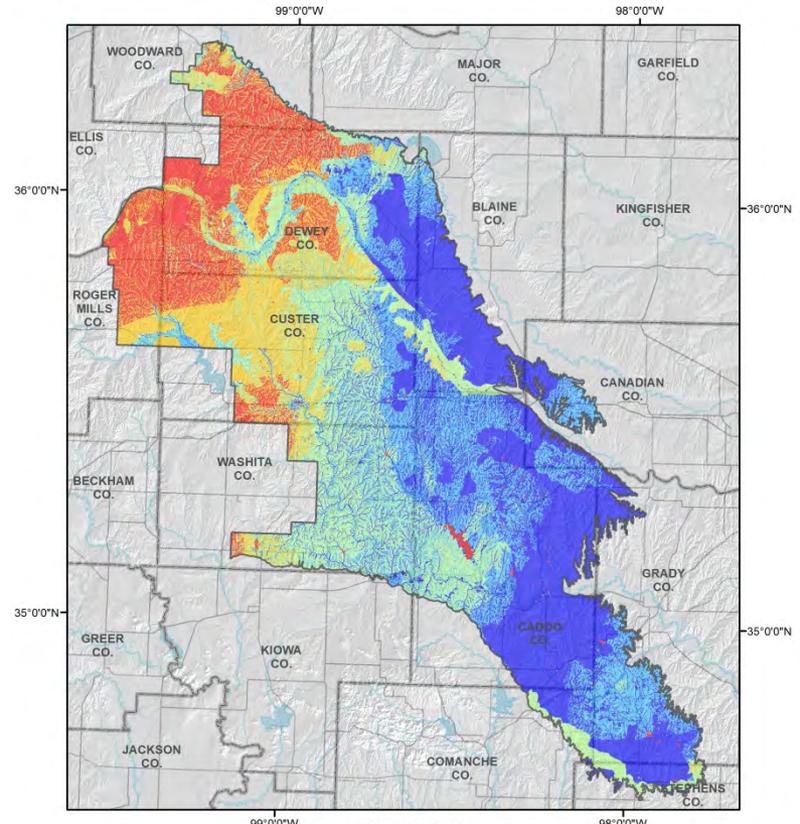
EXPLANATION

□ Extent of modified Rush Springs boundary (study area)

Average recharge 1950-2015, in inches



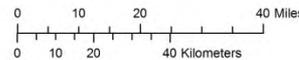
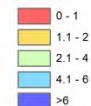
Albers Equal Area Conic Projection
North American Datum of 1983



EXPLANATION

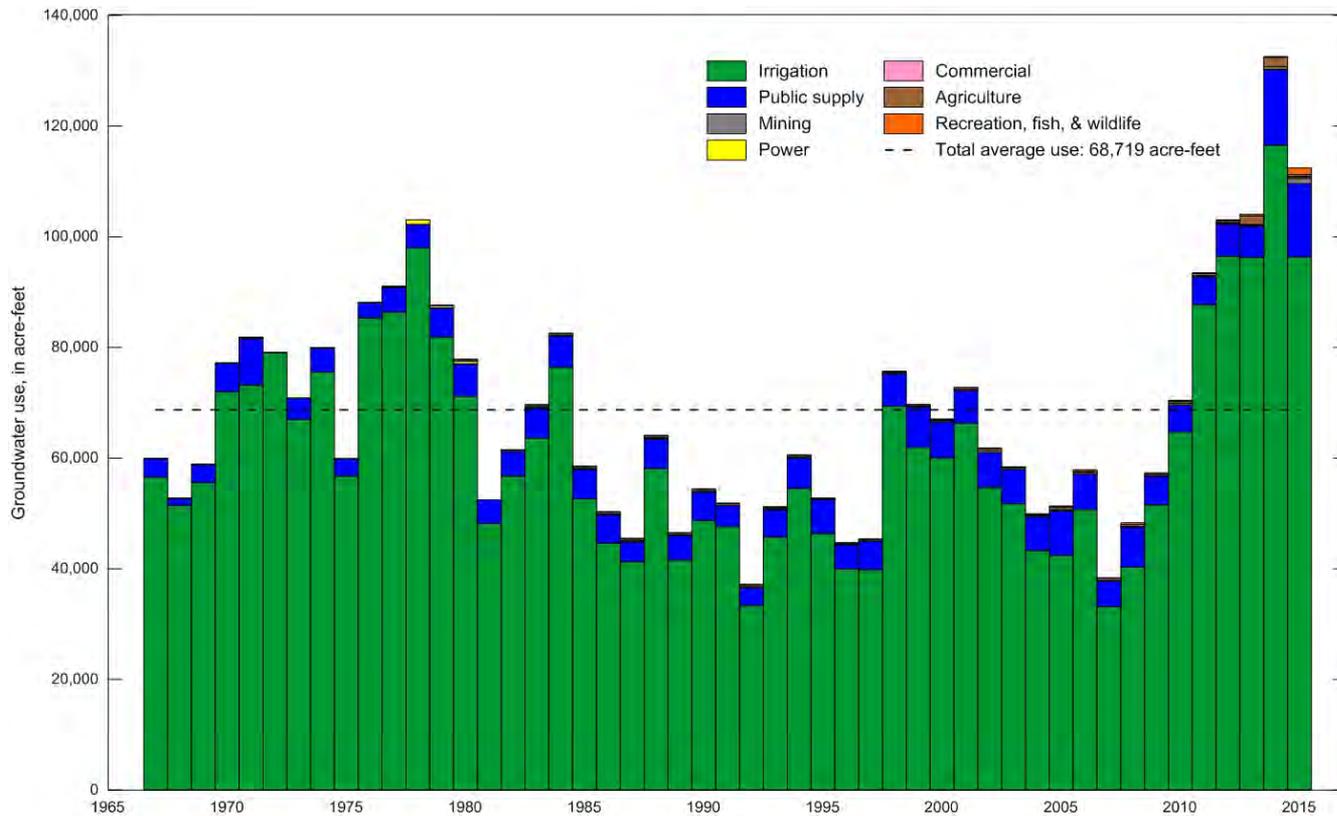
□ Extent of modified Rush Springs boundary (study area)

Average recharge 2007, in inches

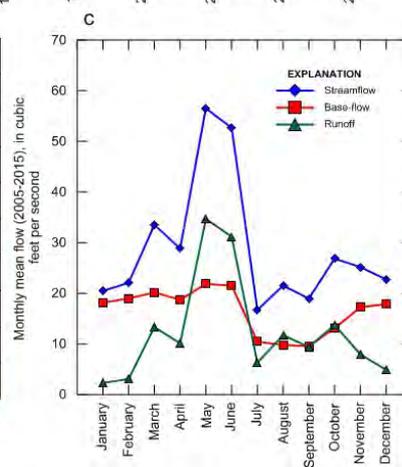
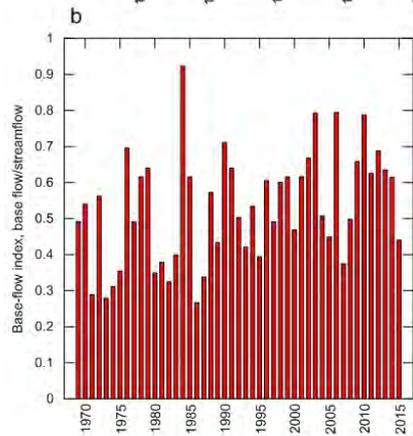
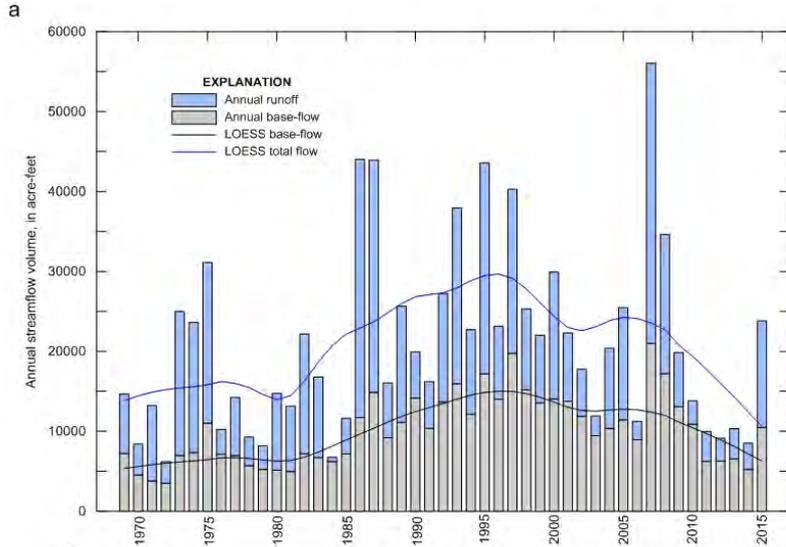


Albers Equal Area Conic Projection
North American Datum of 1983

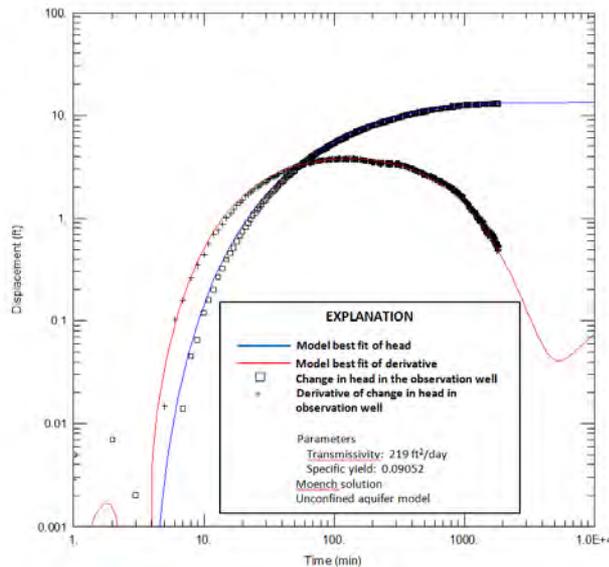
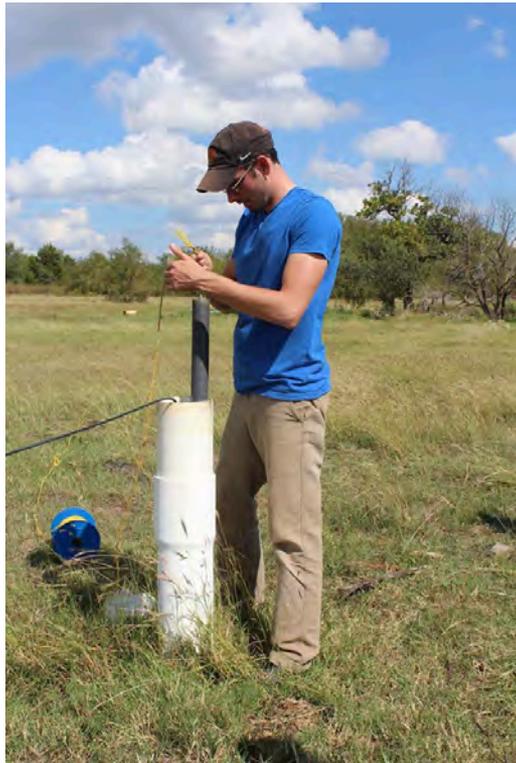
Water Use



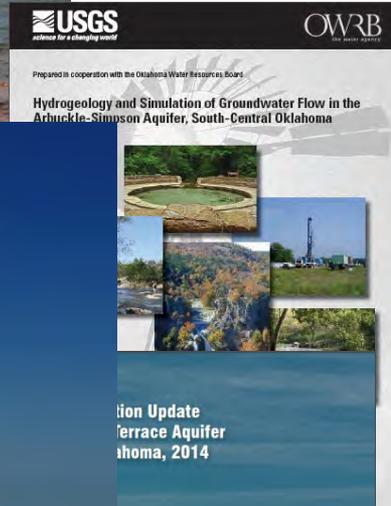
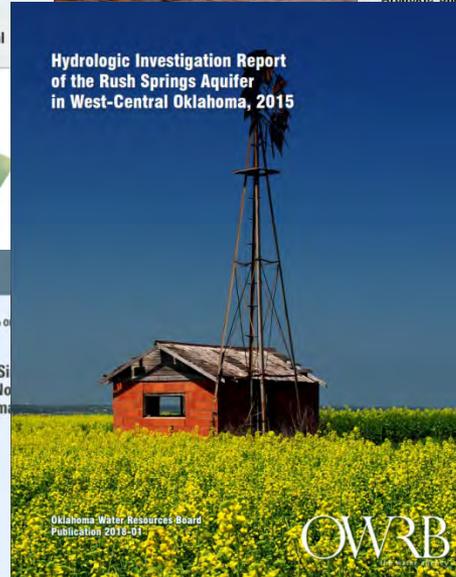
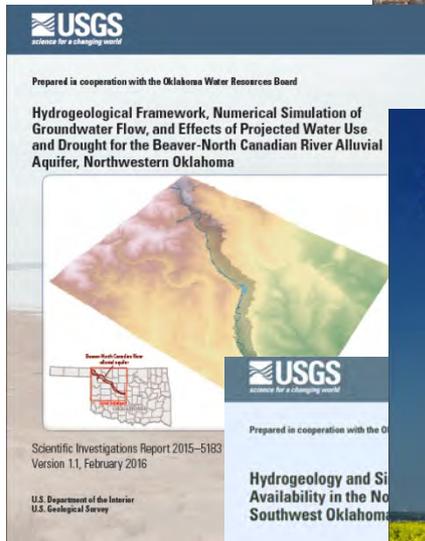
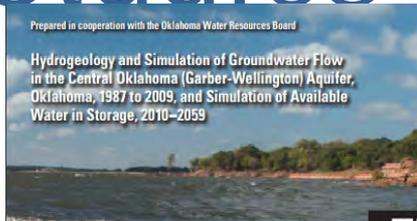
Streamflow/Springs



Estimate Aquifer Properties



Hydrologic Studies



Maximum Annual Yield Determination Process



Tentative Determination

- After a hydrologic investigation is complete, the OWRB makes a tentative determination of the maximum annual yield of the basin

BEFORE THE OKLAHOMA WATER RESOURCES BOARD STATE OF OKLAHOMA

IN THE MATTER of Determining the Maximum)
Annual Yield for the Arbuckle-Simpson)
Groundwater Basin underlying parts of Murray,)
Pontotoc, Johnston, Garvin, Coal and Carter)
Counties

TENTATIVE DETERMINATION OF MAXIMUM ANNUAL YIELD OF GROUNDWATER FROM THE ARBUCKLE-SIMPSON GROUNDWATER BASIN

On this 13th day of March, 2012, there came for consideration a proposed order to establish the tentative determination of the maximum annual yield of groundwater to be produced from the Arbuckle-Simpson Groundwater Basin. Based on the hydrologic surveys and investigations made, the Board makes and enters the following tentative findings, tentative conclusions, order and directives.

TENTATIVE FINDINGS

1. **HYDROLOGIC STUDIES AND REPORTS** - The Board has made or caused to be made hydrologic surveys and investigations of the Arbuckle-Simpson aquifer which is located under parts of the following counties: Murray, Pontotoc, Johnston, Garvin, Coal and Carter Counties in south-central Oklahoma. The hydrologic surveys and investigations reviewed for this order include the United State Geological Survey (USGS) in September 2011 entitled Hydrogeology and simulation of groundwater flow in the Arbuckle-Simpson aquifer, south-central Oklahoma, scientific Investigations Report 2011-5029, herein USGS Arbuckle-Simpson Report. The USGS Arbuckle-Simpson Report, other USGS reports, in-stream flow assessment reports, a tree ring analysis report to compare recent hydrological cycles with area hydrology over the previous 300 years, and other reports prepared as part of the Arbuckle-Simpson study can be reviewed and downloaded from the Reports & Updates section of the Oklahoma Water Resources Board Arbuckle-Simpson study webpage http://www.owrb.ok.gov/studies/groundwater/arbuckle_simpson/arbuckle_study.php.

2. **AQUIFER CHARACTERISTICS** - The Arbuckle-Simpson aquifer characteristics can be summarized as follows:

- a. The Arbuckle-Simpson aquifer is contained within three major rock units of Upper Cambrian to Middle Ordovician age, including the (1) Timbered Hills Group, (2) Arbuckle Group, and (3) Simpson Group. A discussion of the hydrogeologic settings, rock unit characteristics and time and rock stratigraphic descriptions is found within the USGS Arbuckle-Simpson Report.
- b. The Arbuckle-Simpson aquifer is considered a bedrock aquifer, as distinguished from an alluvium or alluvium and terrace aquifer. The bedrock is highly fractured,

Public Hearing

- Copies of the results of the investigation are made available for public review and one or more hearings are scheduled so that citizens can present evidence supporting or contradicting the evidence behind the tentative determination.



Maximum Annual Yield Determination Process



Final Order

- Following the hearings, the OWRB evaluates all the evidence and ascertains the factors stated by the law in the process of making the final maximum annual yield determination within one year of the tentative order

BEFORE THE OKLAHOMA WATER RESOURCES BOARD
STATE OF OKLAHOMA

IN THE MATTER of Determining the Maximum
Annual Yield for the Arbuckle-Simpson
Groundwater Basin underlying parts of Murray,
Pontotoc, Johnston, Garvin, Coal and Carter
Counties

FINDINGS OF FACT, CONCLUSIONS OF LAW, AND BOARD ORDER

Background

This proceeding took place pursuant to the Oklahoma Groundwater Law, 82 O.S. § 1020.1 et seq., which authorizes the Oklahoma Water Resources Board (OWRB or "the Agency" or "the Board") to complete an administrative proceeding to determine the maximum annual yield (MAY) of fresh groundwater that may be used from, and allocated to each acre of land over, a groundwater basin. The Groundwater Law further provides that, once the Agency has set a tentative MAY determination it shall call, give notice of, and hold a public hearing at a centrally located place within the area of the basin.

On March 13, 2012, the Agency issued a tentative determination of the MAY of fresh groundwater that may be used from the Arbuckle-Simpson Groundwater Basin ("Arbuckle-Simpson" or "A-S Aquifer") underlying portions of Murray, Pontotoc, Johnston, Garvin, Coal and Carter Counties. Thereafter, the Hearing Examiner, Emily Hammond Meazell, held a pre-hearing conference on May 9, 2012 in Ada, Oklahoma, at which numerous individuals and entities appeared as parties in opposition to, in support of, and interested in the Tentative MAY. The Hearing Examiner conducted a full hearing on May 15-16, 2012, in Sulphur, Oklahoma, during which all parties had the opportunity to present evidence and comments.

The hearing was divided into two phases. In the first phase, the Hearing Examiner took evidence for purposes of compiling a record on the Tentative MAY; in the second phase, those present had the opportunity to provide comments and other information associated with various MAY-related rulemaking matters that the Board expects to pursue at a later date.¹ Appearing at the hearing for both phases were numerous individuals as well as various groups and entities who took part in the evidentiary portion of the hearing. The latter include: (1) the OWRB;² (2) Protestants Oklahoma Farm Bureau Legal Foundation, Pontotoc County Farm Bureau, Oklahoma Independent Petroleum Association, Environmental Federation of Oklahoma,

¹ These include a potential phase-in period and well-spacing rules. This Proposed Order relates only to the MAY. However, all other materials and comments may be considered by the OWRB in connection with future rulemakings.

² OWRB exhibits are labeled "OWRB Exh. ___."

ORDER AND DIRECTIVES

IT IS THEREFORE ORDERED by the Oklahoma Water Resources Board that:

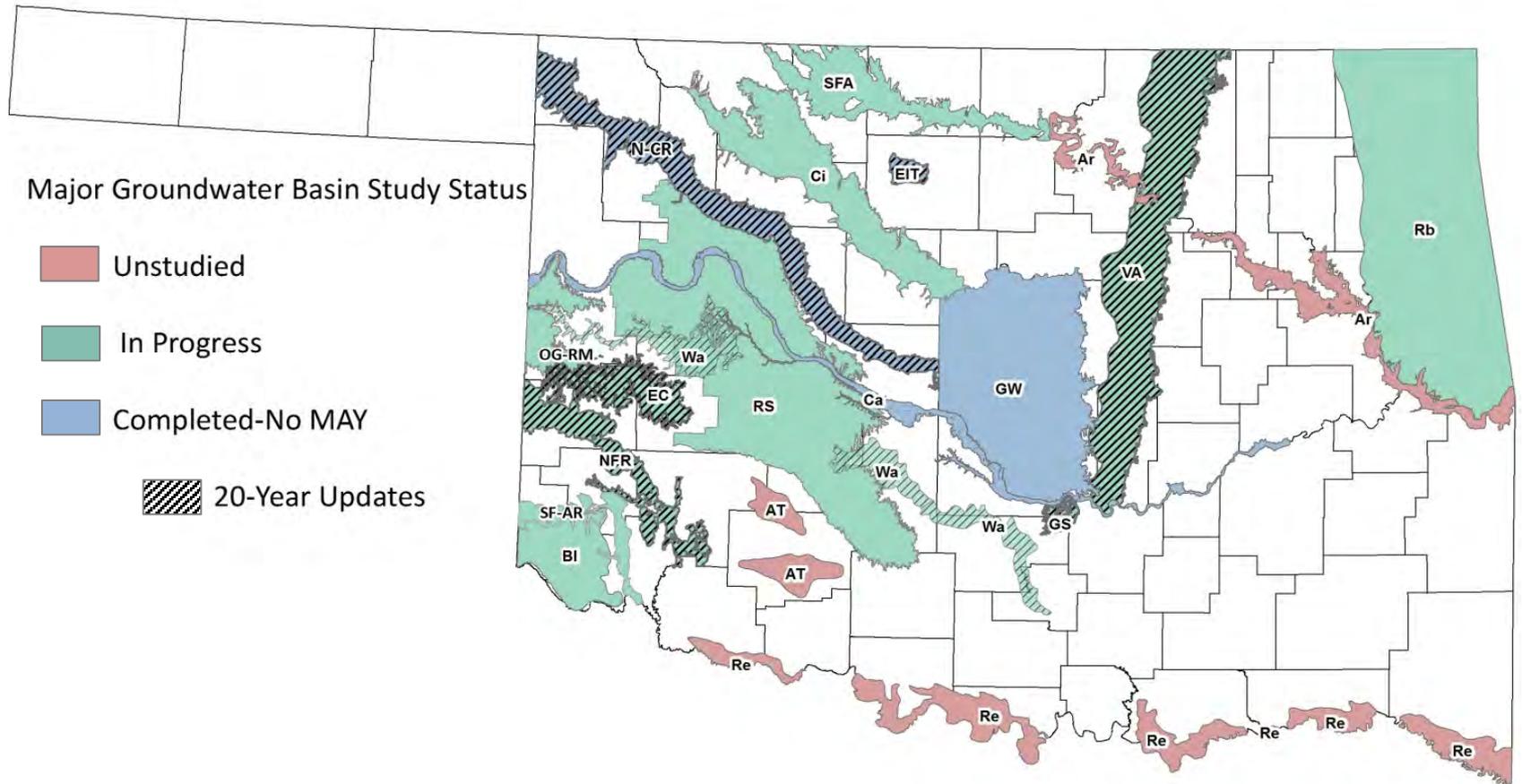
1. The Arbuckle-Simpson aquifer underlying areas in Murray, Pontotoc, Johnston, Garvin, Coal and Carter Counties in the south central part of the state shall be and the same is hereby designated the Arbuckle-Simpson Groundwater Basin, with outcrop and subcrop boundaries generally depicted on the map set forth as Appendix 1;
2. The basin is hereby declared to be a major groundwater basin under the provisions of the Oklahoma Groundwater Law;
3. The basin is also declared to be a sensitive sole source groundwater basin under the provisions of the Oklahoma Groundwater Law as amended by Senate Bill 288 enacted in 2003;
4. The determination of the maximum annual yield of the basin is 78,404 acre-feet;
5. The equal proportionate part of the yield to be allocated to each acre of land overlying the basin, based on the maximum annual yield and total overlying land area, is determined to be 0.20 acre-foot per acre per year (equivalent to two-and-four-tenths inches (2.4") per acre per year); and

Final Order

- The final determination is issued in a “final order”
- Regular permits are issued
 - Also converting temporary permits
- SB 1294 allows for phased implementation under certain circumstances



OWRB Hydrologic Investigations



COMPLETED STUDIES

- Garber-Wellington
- *North Canadian River A&T Reaches I&II*
- Canadian River A&T Reaches I,II, &, III
- *Enid Isolated Terrace*
- North Fork of the Red River A&T
- Rush Springs



Questions?

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