

Ozark Plateau Aquifer in Kansas

Association of Western States Engineers

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Today's Meeting Topics

- Why Decision was Needed
- U.S.G.S. MODFLOW Model Results
- Review of Safe Yield
- “25/100” Management
- DWR Model Runs and Results
- Kansas Total Quantity
- Local Considerations
- Steps Taken to Date



Kansas Concerns

- Quantity
 - Declines in groundwater levels
 - Sustainability of aquifer system
 - Concerns related to protecting current appropriations
- Quality
 - Brines in south-central Kansas migrating eastward
 - Potential for upconing of saline water

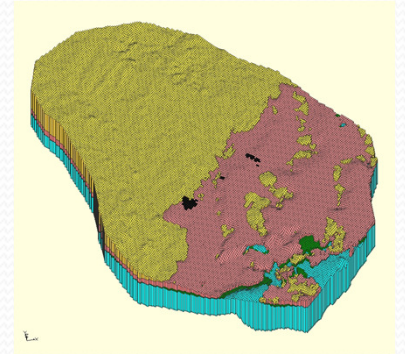


Ozark Moratorium

- Moratorium on new appropriations put in effect in 2004
- Moratorium term permits allowed to be filed as long as a backup supply was demonstrated
- December 31, 2010 deadline for completion of modeling study and evaluation of moratorium term permits

USGS Groundwater Flow Model

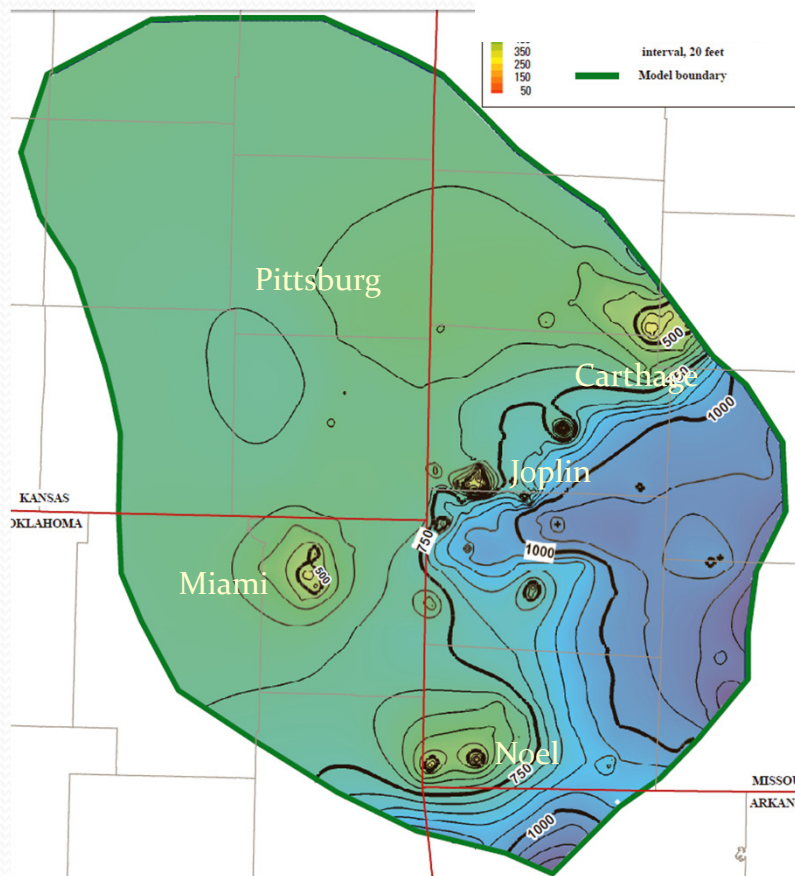
Modflow 2000



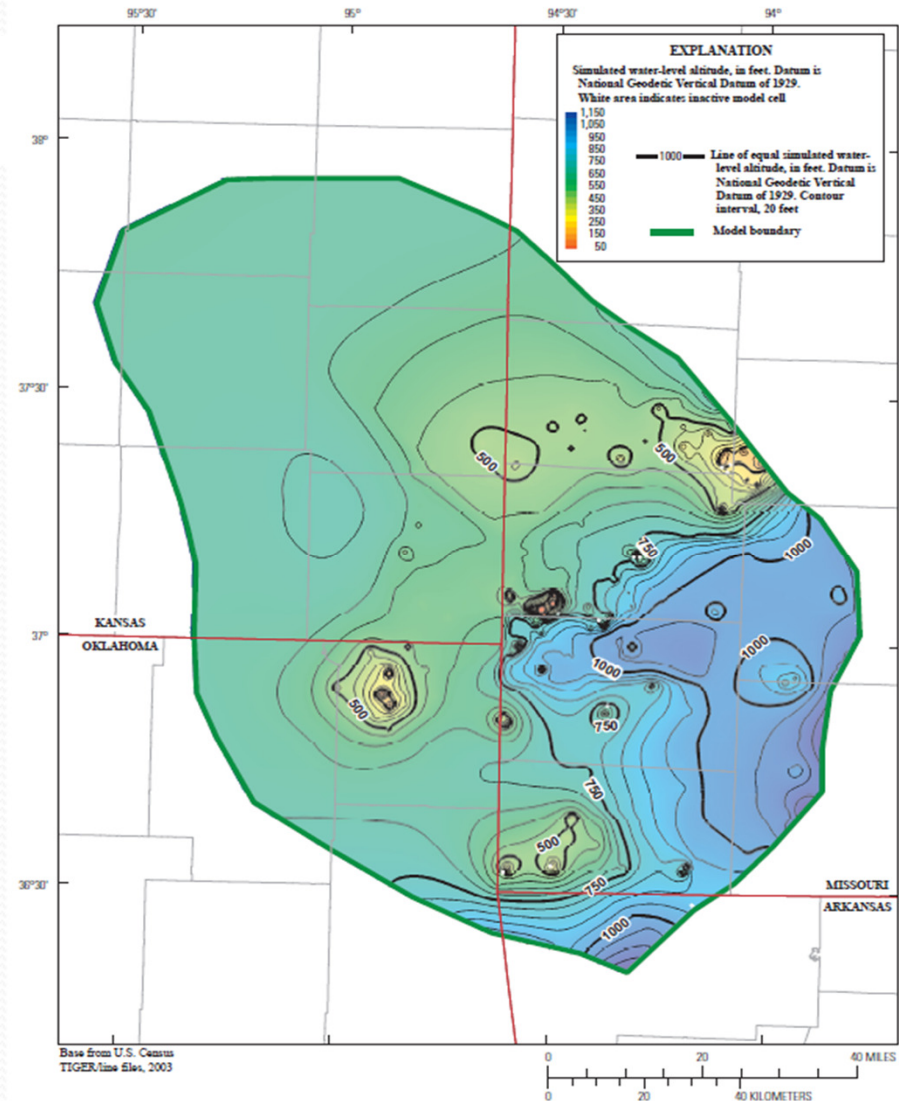
- Input Data Includes:
 - 1. Hydraulic Properties - Hydraulic Conductivity, Storage Coefficient, Layer Elevations, etc.
 - 2. Boundary Conditions - Initial Heads, Lateral Recharge, etc.
 - 3. Additional Data - Precipitation, Stream Flow, Pumping, etc.
- Hydraulic head is calculated at the center of each model cell and flux is calculated into or out of each cell
- Model is calibrated to simulate observed declines in water level elevations
- Calibration provides confidence in using the Model to run scenarios to evaluate future conditions

Water levels in 2057

Scenario 1: 2006 pumping rate



Scenario 4: Increase by 2% per year





USGS Model Summary

- Groundwater flow model provides a management tool for a 7,340 mi² area of Ozark Plateaus aquifer system
- Ozark aquifer pumping in 2006: Missouri: 87%; Kansas: 7%; Oklahoma: 6%
- Pumping significantly beyond historic values can be maintained in Kansas at least until 2057, although some areas will experience water-level declines
- Bottom line: additional water is available;
DWR's Challenge: to determine how much



Safe Yield

K.A.R. 5-1-1:

- Long-term sustainable yield of the source of supply, including hydraulically connected surface water or groundwater.

K.A.R. 5-3-10:

- Approval of any regular new application shall not cause the safe yield of the source of water supply to be exceeded.
- If the total quantity of water authorized and requested exceeds the limit determined by the chief engineer pursuant to this subsection, applications shall be denied or considered only for the quantity available.
- Allows the chief engineer to adopt specific safe yield rules and regulations in areas where detailed studies have been completed.



Safe Yield for Confined Aquifers

K.A.R. 5-3-14:

- Each application to appropriate water from a confined aquifer shall be processed on a case by case basis so that the safe yield of the source of water supply is not exceeded.
- Until a specific regulation is adopted by the chief engineer for the confined source of water supply, the analysis shall be made using the best information reasonably available to the chief engineer.



25/100 Management

- Management scheme that allows for no more than 25% depletion of water in storage in 100 years
- Allows for limited new development of water resources to occur that can be maintained over the long term.
- Protects source of supply under “Safe Yield” guidance
- Used for both overall aquifer limit and local test



KDA-DWR Model Runs

- DWR took USGS Model and ran alternative future scenarios to determine overall “Safe Yield” of the aquifer system
- DWR modeled multiples of Kansas total appropriated water as opposed to average pumping
- DWR made refinements:
 - Extended Model Run to 100 year future
 - Ozark Aquifer vs. Springfield Aquifer pumping distribution based on transmissivity

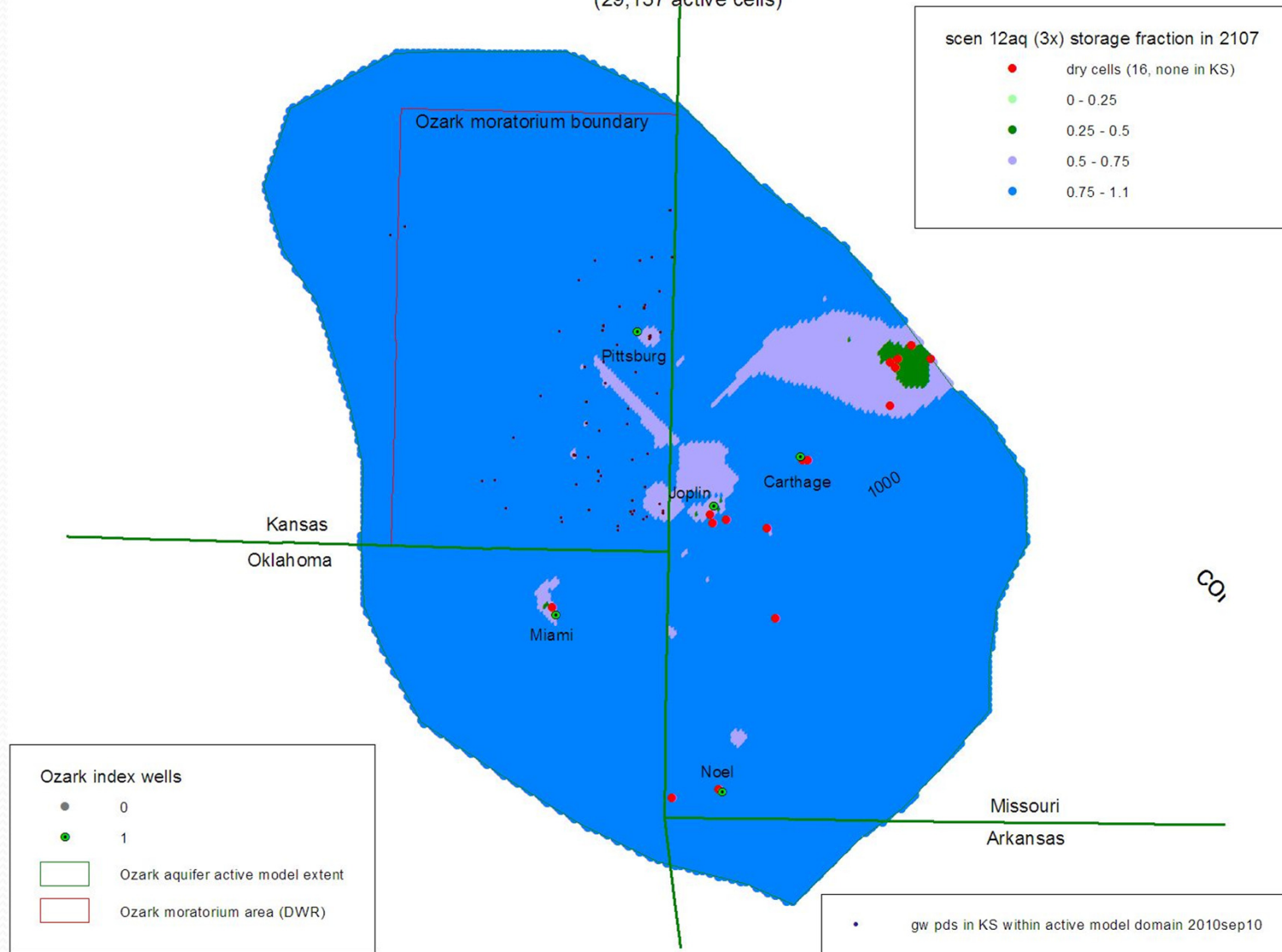


KDA-DWR Model Runs

- Ran scenarios that increase Kansas appropriations in a step by step fashion while doubling MO and OK pumping
- Evaluated results for level of pumping that breaks “25/100” management rule
- Total appropriation set at highest level that does not break “25/100” rule for a substantial portion of area of pumping area

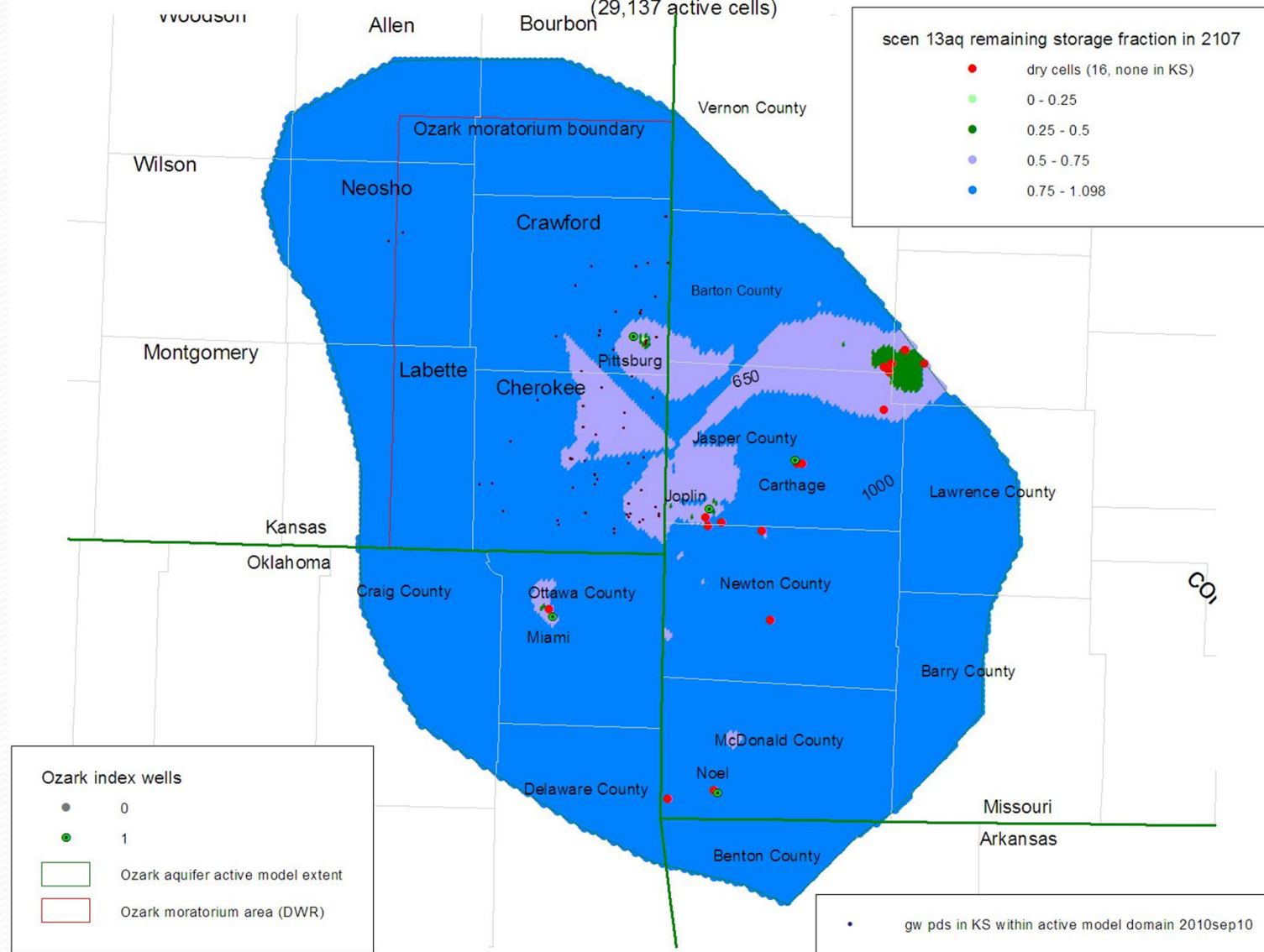
Model Results – 3 times current authorized

Scenario 12aq (3x KS auth. quant., 2x OK-MO): Storage in Ozark aquifer at end of 2107 as fraction of current storage (29,137 active cells)



Model Results – 4 times current authorized

Scenario 13aq (4x KS auth. quant., 2x OK-MO): Storage in Ozark aquifer at end of 2107 as fraction of current storage
(29,137 active cells)





Total Kansas Quantity

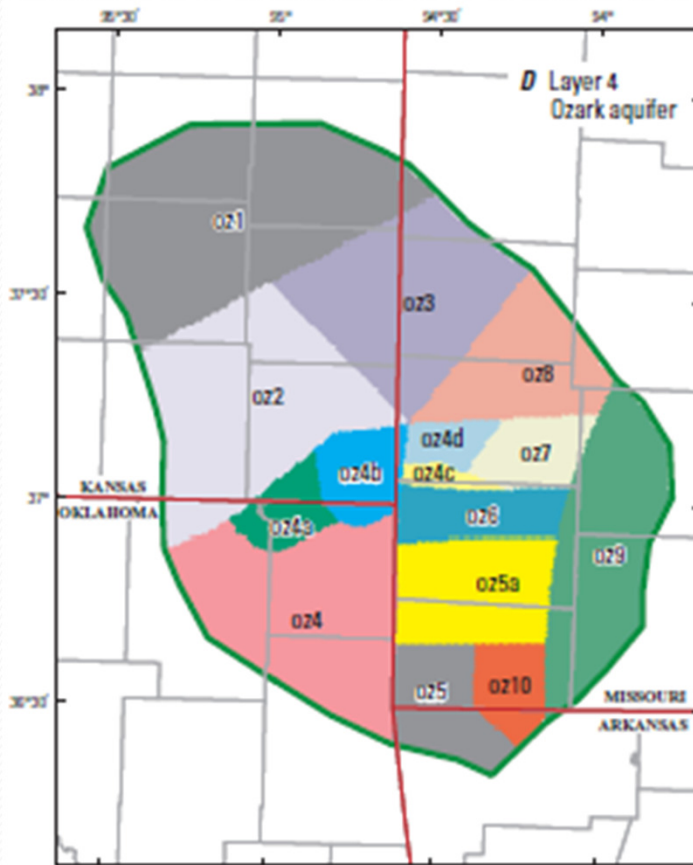
- Total allowable Kansas appropriations from Ozark Plateau Aquifer System will be at least 36,000 AF
- With 10,451 AF currently appropriated, and 1,307 AF in term permits that will be converted to appropriated rights, approximately 24,000 AF are available for future appropriation
- Total could be higher, dependent on where water resource development occurs



Local Test

- As in other aquifers, a local test will be implemented
- Total appropriations also must not break “25/100” in a 2 mile circle
- Local test provides room for growth but establishes a reasonable upper bound
- Hydraulic properties are important to these calculations and will be taken from the Model

Hydrologic Property Zones



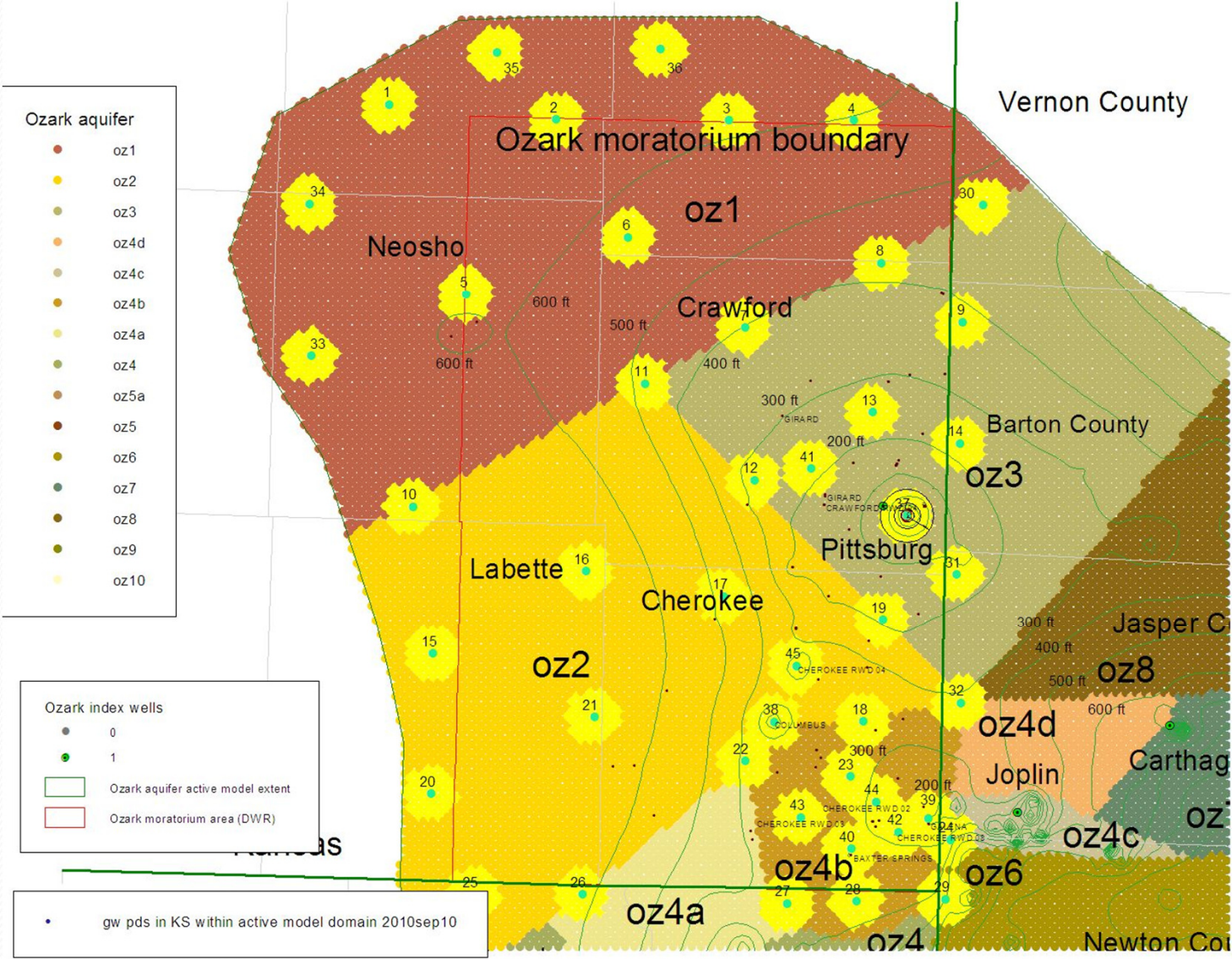
Zone Name (as shown on figures 13A-D)	Layer	Hydro- geologic unit	Hydraulic conductivity, feet per day		Specific storage, 1/foot	Specific yield, dimensionless
			Horizontal	Vertical		
oz1	4	OA	1.8083E+00	1.8083E+00	1.2200E-05	0.014591
oz2	4	OA	4.0035E-01	4.0035E-01	1.2400E-05	0.014591
oz3	4	OA	5.0000E+00	5.0000E-01	1.9200E-07	0.014591
oz4d	4	OA	1.5197E+00	1.0000E-01	2.6200E-05	0.02
oz4c	4	OA	1.0145E-01	1.0000E-02	4.0000E-06	0.01
oz4b	4	OA	2.3456E+00	3.7003E-01	2.2000E-06	0.014591
oz4a	4	OA	3.7003E-01	3.7003E-01	2.2000E-06	0.014591
oz4	4	OA	3.4826E-01	1.0000E-01	1.0000E-07	0.014591
oz5a	4	OA	6.1192E-01	1.0000E-01	1.4900E-06	0.014591
oz5	4	OA	5.1559E-01	4.9230E-01	2.4500E-07	0.000356
oz6	4	OA	1.0538E-01	1.0000E-01	3.9700E-05	0.074995
oz7	4	OA	2.5777E-01	1.0000E-01	2.6200E-05	0.02
oz8	4	OA	9.8124E-01	9.8124E-01	1.1400E-05	0.014591
oz9	4	OA	1.5897E+00	1.4000E-01	3.1800E-06	0.014591
oz10	4	OA	1.0702E-01	5.0000E-03	2.2300E-07	0.000356

Table 6. Hydrologic property values specified in the calibrated model.

Figure 13. Hydrologic property zones for (A) layer 1 (Western Interior Plains confining unit), (B) layer 2 (Springfield Plateau aquifer), (C) layer 3 (Ozark confining unit), and (D) layer 4 (Ozark aquifer). White areas within the model boundary represent active cells in the layer. Colors are used to designate the continuity of individual hydrologic-property zones. Values of hydrologic properties are listed in table 6.

On-going work to define local test

Ozark aquifer (Layer 4) property zones and pumping response grid (points labeled 1-45)





Steps Taken to Date:

- Report on safe yield determination documented in a report
- Fact sheet and press release to inform public of decision
- Moratorium term permits processed and/or approved
- Regulation process to adopt overall safe yield and required 2 mile circle analysis



Final Points

- Discussion
- Questions?