

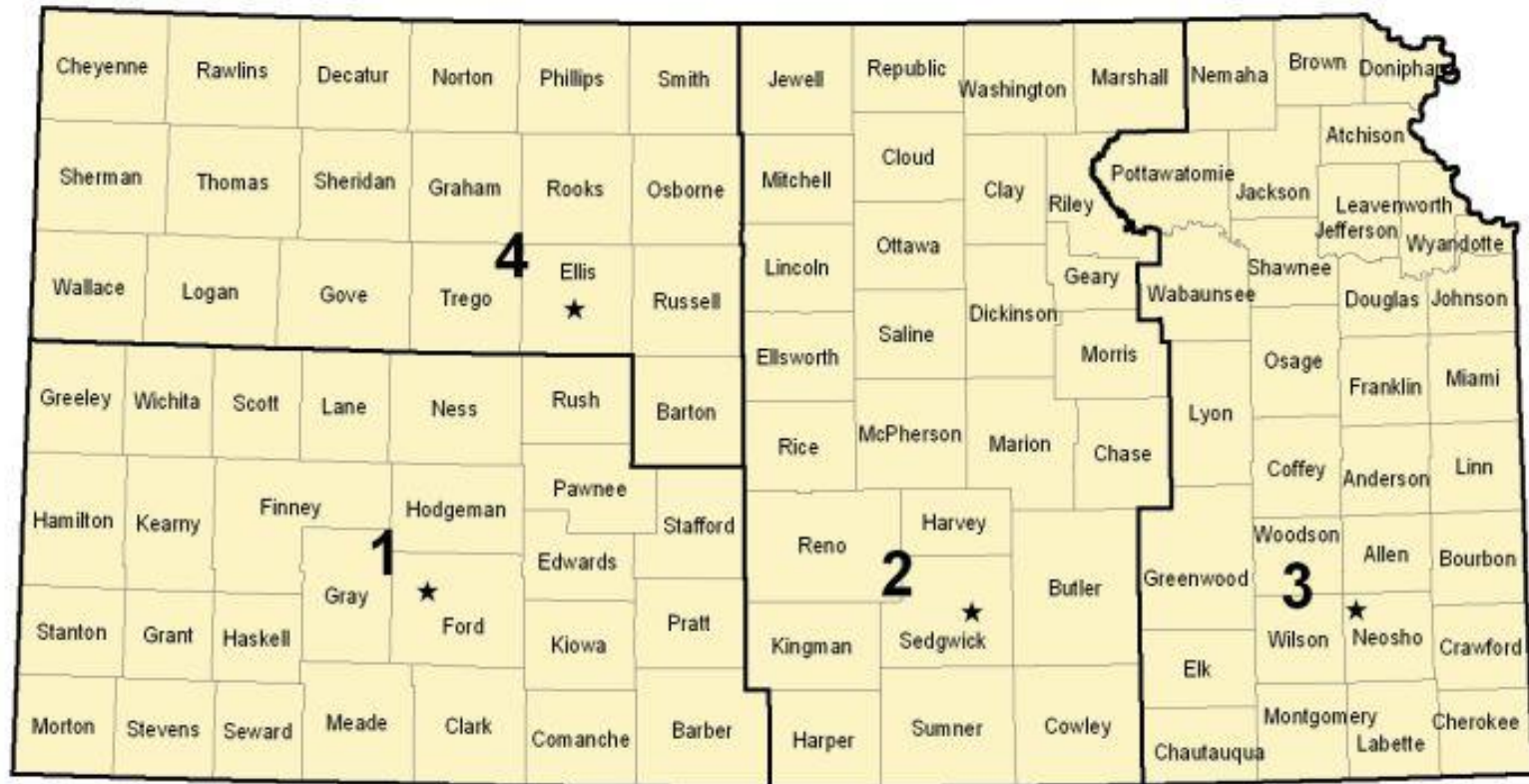
Informational Update on Induced Seismicity in Kansas

House Standing Committee on Energy and Environment January 20, 2016

Ryan A. Hoffman, Director, Conservation Division



Update on Induced Seismicity



The Conservation Division is responsible for regulating oil and gas activities statewide. The central office is located in Wichita and the four district offices are located in Dodge City, Wichita, Chanute, and Hays.

Update Induced Seismicity

- The Underground Injection Control (UIC) department is the section of the Conservation Division responsible for administration of injection wells in Kansas.
 - The KCC has primacy of the Class II UIC program from the EPA under the Safe Drinking Water Act of 1974.
 - Kansas has the third largest Class II program in the nation with more than 16,000 active injection wells.

Update on Induced Seismicity

- There are two types of Class II injection wells:
 - Enhanced Oil Recovery (EOR) – approximately 11,000 total.
 - Produced water is separated from the oil and injected back into the productive formation to improve or maintain oil production.
 - Saltwater Disposal (SWD) – approximately 5,000 total.
 - Produced water is separated from the oil and disposed of into a formation generally below the productive zone.

Update on Induced Seismicity

Saltwater Disposal				
Year	Harper County		Sumner County	
	Injection Wells	Injected Volume (Barrels)	Injection Wells	Injected Volume (Barrels)
2009	44	11,326,728	55	5,707,277
2010	44	9,671,655	53	9,763,265
2011	50	12,022,921	59	6,715,897
2012	64	31,284,057	61	8,676,329
2013	71	51,827,349	79	10,722,360
2014	106	109,341,648	164	27,034,938
2015	109	*	161	*

*K.A.R. 82-3-409 requires annual injection reports be filed by March 1, 2016 for the calendar year 2015.

Update on Induced Seismicity

- Harper County all wells drilled by year:
 - 2010: 70
 - 2011: 41
 - 2012: 109
 - 2013: 105
 - 2014: 121
 - 2015: 39
- Harper County horizontal wells by year:
 - 2010: 0
 - 2011: 9
 - 2012: 62
 - 2013: 85
 - 2014: 108
 - 2015: 39

Update on Induced Seismicity

- Sumner County all wells drilled by year:
 - 2010: 18
 - 2011: 21
 - 2012: 24
 - 2013: 43
 - 2014: 50
 - 2015: 6
- Sumner County horizontal wells by year:
 - 2010: 0
 - 2011: 2
 - 2012: 5
 - 2013: 18
 - 2014: 27
 - 2015: 0

Update on Induced Seismicity

- Harper County Oil Production by year in barrels:
 - 2010: 361,448 (NR)
 - 2011: 506,877 (NR)
 - 2012: 873,056 (NR)
 - 2013: 1,733,075 (8)
 - 2014: 2,935,249 (2)
 - 2015: 2,678,966*
- Harper County Gas Production by year in mcf:
 - 2010: 4,985,638 (NR)
 - 2011: 5,140,093 (NR)
 - 2012: 7,355,776 (NR)
 - 2013: 13,499,300 (8)
 - 2014: 24,363,439 (5)
 - 2015: 24,255,820*

*Production data is current through September 2015.
() – County rank among Kansas counties.

Update on Induced Seismicity

- Sumner County Oil Production by year (bbls):
 - 2010: 414,853
 - 2011: 391,203
 - 2012: 393,703
 - 2013: 494,679
 - 2014: 754,297
 - 2015: 422,496
- Sumner County Gas Production by year (mcf):
 - 2010: 710,031
 - 2011: 690,351
 - 2012: 678,749
 - 2013: 727,222
 - 2014: 1,252,038
 - 2015: 988,720

*Production data is current through September 2015.

Update on Induced Seismicity

March 19, 2015

- The Kansas Corporation Commission issued an Order Reducing Saltwater Injection Rates in Docket No. 15-CONS-770-CMSC (“Order”).

What's New

- Kansas Corporation Commission partners with K-State Engineering Extension
- Interest Rate on Customer Deposits for 2016
- Order 15-WSEE-365-MIS Concerning Transmission Line Request
- Order 15-CONS-770-CMSC Concerning Class II Injection Wells in Harper and Sumner Counties
- Induced Seismicity State Task Force
- Injection Wells Frequently Asked Questions
- Kansas Geological Survey Resources
- KCC Comments on EPA's Clean Power Plan
- Kansas Corporation Commission Approves Order Extending Wastewater Injection Limits



Update on Induced Seismicity

- The Commission found the increasing seismic activity and saltwater disposal to be an immediate threat to public health and safety in the Order (§1).
- **K.S.A. 77-536. Emergency proceedings; use, when; procedure.** (a) A state agency may use emergency proceedings: (1) In a situation involving an immediate danger to the public health, safety or welfare requiring immediate state agency action or (2) as otherwise provided by law.
 - See also K.S.A. 55-162.

Update on Induced Seismicity

- April 17, 2015
 - Motion to Intervene and Request for Hearing filed by SandRidge Exploration and Production LLC.
 - Owner and operator of injection wells modified by the Order.
 - Request for hearing was necessary to preserve legal right; however, SandRidge was not certain a hearing would be requested at the time of filing.

Update on Induced Seismicity

Order Requirements

- All existing and new Arbuckle disposal wells are limited to a rate of 25,000 barrels per day and a maximum pressure of 250 psi.
- All Arbuckle disposal wells disposing of more than 5,000* barrels per day are required to track daily volumes and pressures and report them on a monthly basis to the KCC.
- No large volume Arbuckle disposal wells will be permitted within $\frac{1}{4}$ mile of other large volume Arbuckle disposal wells.
 - Approximately 74 wells are subject to the limitations listed above.

**Defined as large volume injection well in Paragraph 11 of the Order.*

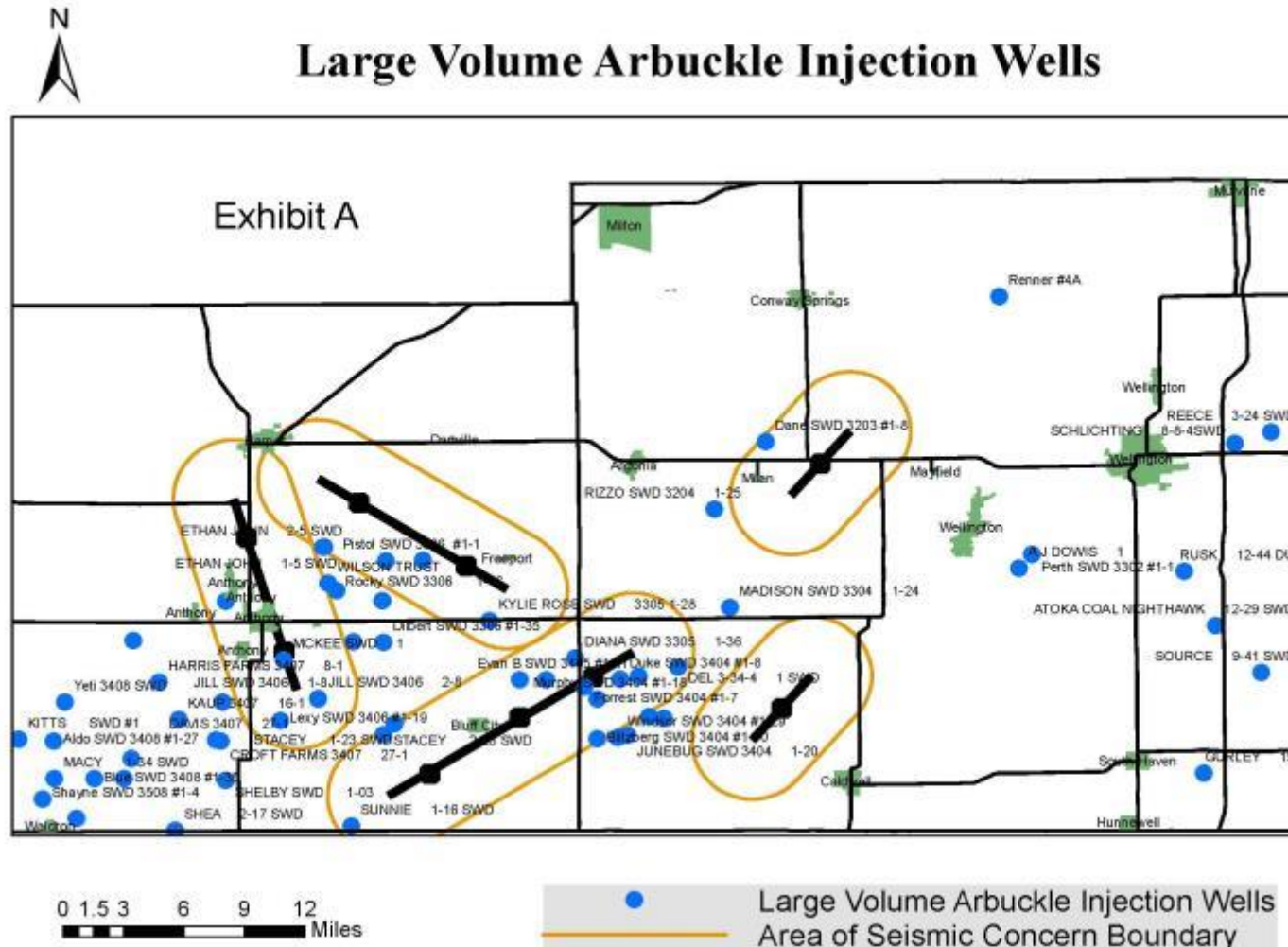
Update on Induced Seismicity

Order Requirements

- The Order identifies five areas of seismic concern as established by KCC staff and Kansas Geological Survey (KGS) staff based on the clustering of earthquakes triggering the Seismic Action Score from the State Task Force response plan.

$$\text{SAS} = \text{Magnitude}^2 + \text{Score}_{\text{felt}} + \text{Score}_{\text{structure}} + (2 \times \text{Score}_{\text{number}}^3) + \text{Score}_{\text{local recursion}}^3 \\ + \text{Score}_{\text{recursion regional}} + \text{Score}_{\text{recursion time}}$$

Update on Induced Seismicity



Update on Induced Seismicity

Order Requirements

- 23 of the 74 wells subject to the Order are within these five areas of concern and are also subject to the following conditions:
 - Verification of true vertical depth:
 - KCC staff reviewed available log data submitted with completion reports and requested outstanding logs to verify how deep the wells actually were within 30 days of the Order.
 - KCC staff witnessed bottom “tagging” of wells whose logs indicated they were deeper than the Arbuckle.
 - Nine wells within the areas of seismic concern penetrated deeper than the Arbuckle and all have since been plugged back to limit disposal to the Arbuckle formation and prevent communication with unknown basement faults.

Update on Induced Seismicity

Order Requirements

- 23 of the 74 wells subject to the Order are within these five areas of concern and are also subject to the following volume reductions:
 - March 19, 2015 – Order issued.
 - March 29, 2015 (10 days) – Maximum allowed daily volume 16,000 barrels per day.
 - May 13, 2015 (55 days) – Maximum allowed daily volume 12,000 barrels per day.
 - June 27, 2015 (100 days) – Maximum allowed daily volume 8,000 barrels per day.
 - June 27, 2015 – September 15, 2015 (day 100 through day 180) – Wells remain at 8,000 barrels per day while monitoring continues.

Update on Induced Seismicity

Order Requirements

- Paragraph 14 states:

“The period between 101 and 180 days following issuance of this Order, and for so long thereafter as may be needed, shall constitute a monitoring period during which the KGS and Commission Staff will review the available data and make recommendations regarding any further action by the Commission. The Commission shall not be restricted from making any changes to this order at any time for any reason, regardless of whether the full monitoring period has elapsed.”

Update on Induced Seismicity

- On September 14, 2015, KCC staff filed a Motion to Extend the Monitoring Period citing encouraging but inconclusive results.
- KCC Staff requested another 180-day monitoring period to continue analyzing the impact of reduced disposal volumes and wellbore plugbacks.
- The Commission issued the Order extending the monitoring period and reductions on October 29, 2015.

Update on Induced Seismicity

- The provisions of the Order provided for a 180-day monitoring period from September 15, 2015 until March 13, 2016.
 - The Order clearly provides these restrictions do not end on that date.
- Staff is directed by the Order to provide its next recommendation in advance of March 13, 2016. The Commission expressed preference during passage of the Order to have the recommendation completed near the middle of February 2016 to provide adequate time for responses and deliberation.

Update on Induced Seismicity

Disposal Within the Areas of Seismic Concern:

- 4/01/14 – 12/31/14 = 39,445,130 bbls
- 4/01/15 – 12/31/15 (after the Order) = 20,763,953 bbls
 - 18,681,177 bbls reduction

Disposal Outside of the Areas of Concern:

- 4/01/14 – 12/31/14 = 54,466,694 bbls
- 4/01/15 – 12/31/15 (after the Order) = 61,422,575
 - 6,955,881 bbls increase

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