

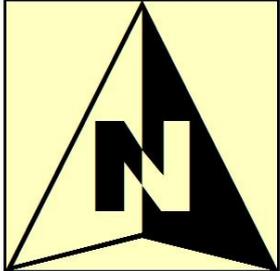
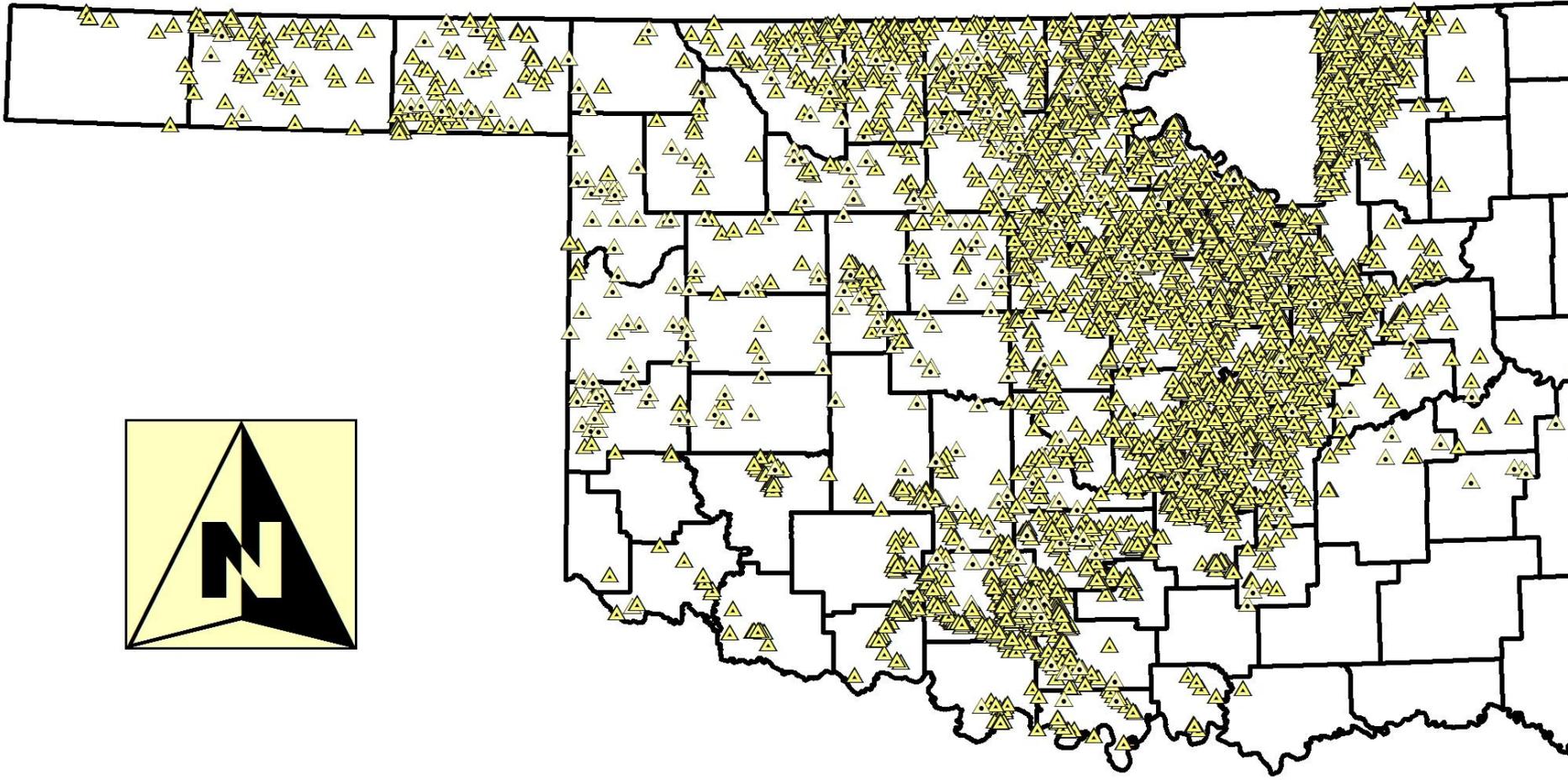


Oklahoma Corporation Commission

Oil and Gas Conservation Division

Tim Baker, Director

Disposal Wells



UIC Program

- The Underground Injection Control (UIC) program was created in 1974 by the Safe Drinking Water Act.
- All wastes injected underground are required to comply.
- OGCD received primacy to run the UIC program for oil and gas activities in 1981.
Class II wells under the UIC definition

UIC Program

- Class II wells are classified in two types
 - 2R wells are Enhance Recovery Wells (EOR).
 - EOR wells re-inject produced water back into the same producing formation to help extract the remaining oil.

UIC Program

- 2D or **Disposal wells** take waste-water and inject it into the subsurface

This water is not generally what we think of as water

- High salinity >> sea water
- Other hydro-carbon and chemical contaminants

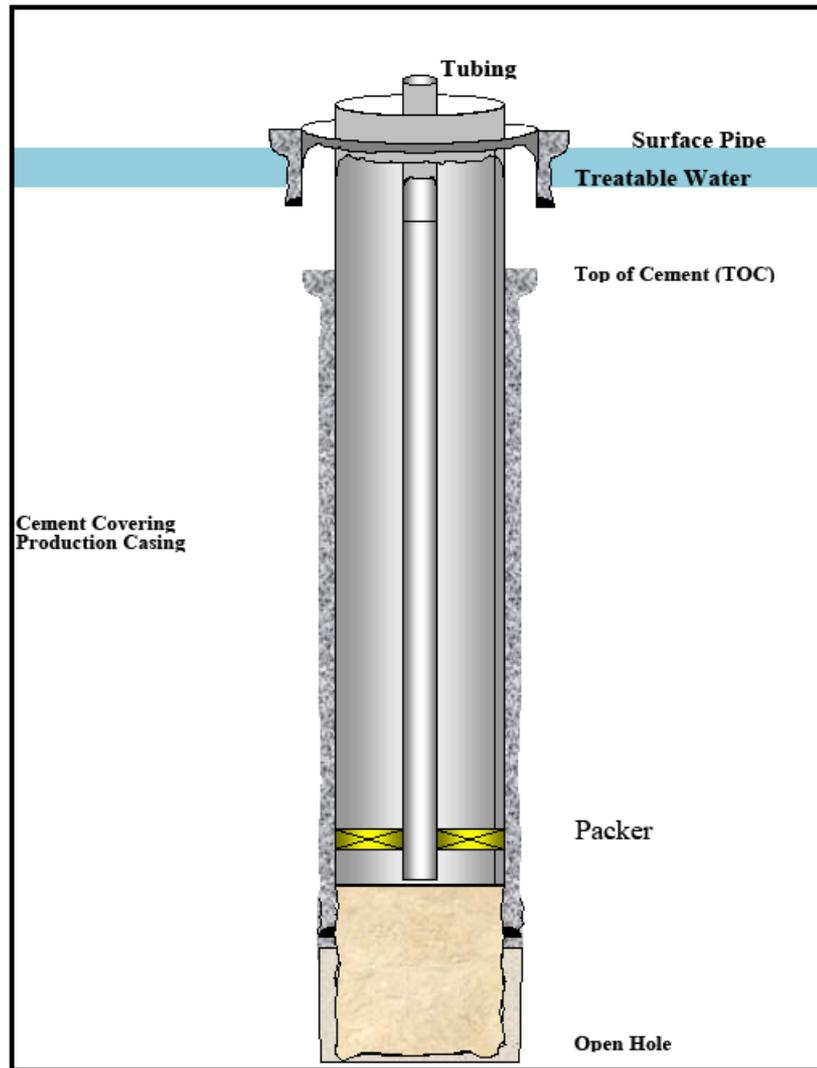
This waste-water comes from two primary sources

- Naturally occurring water that is removed with oil and gas (“Produced” Water)
- Hydraulic fracturing (“Flowback” Water) - relatively small amount of total volume

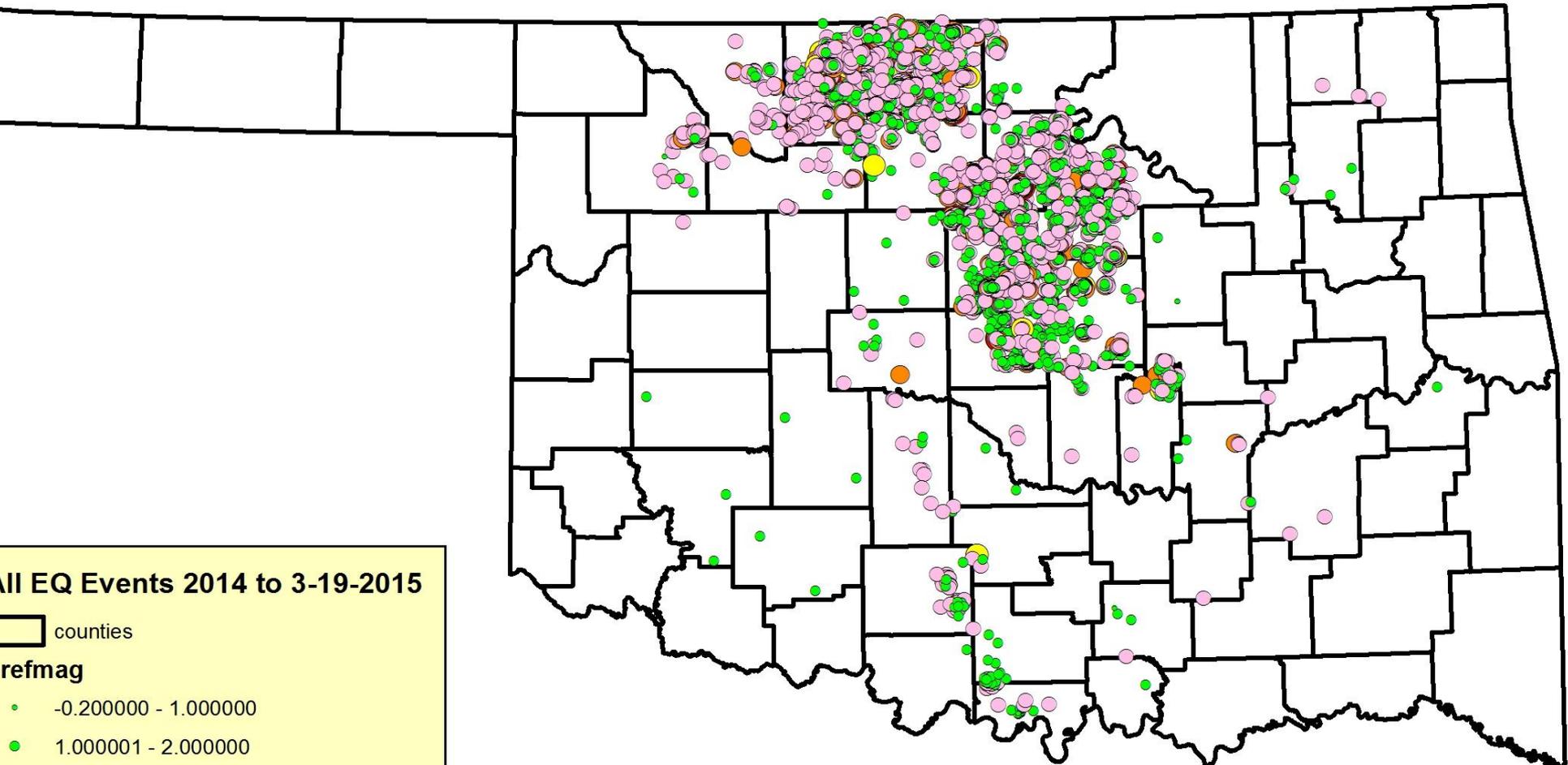
UIC Program

- In Oklahoma there are
4,626 Disposal Wells
7,037 EOR Wells

Of the 4,000 disposal wells there are 969, disposal wells that are authorized for disposal into the Arbuckle formation.



All EQ 2014 and 2015

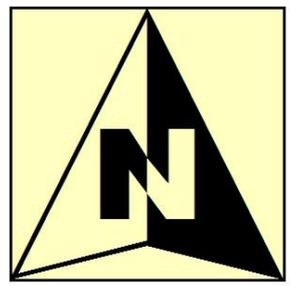


All EQ Events 2014 to 3-19-2015

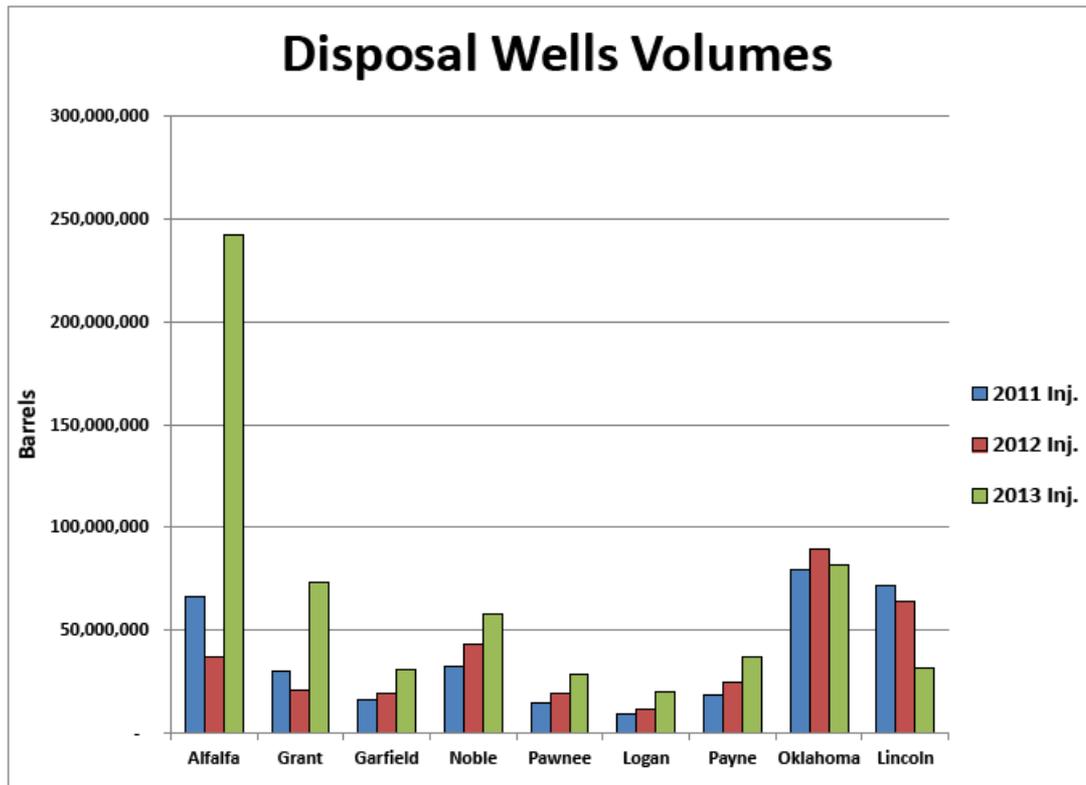
- counties
- refmag
 - 0.200000 - 1.000000
 - 1.000001 - 2.000000
 - 2.000001 - 3.000000
 - 3.000001 - 3.500000
 - 3.500001 - 3.999999
 - 4.000000 - 4.500000

Date: 3/19/2015

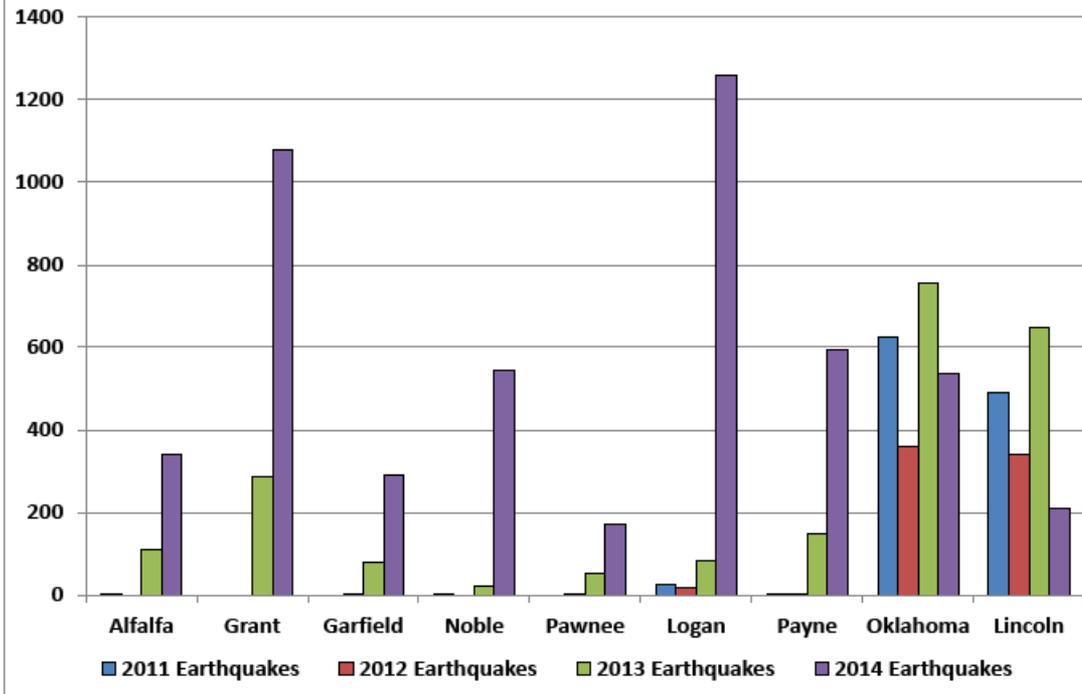
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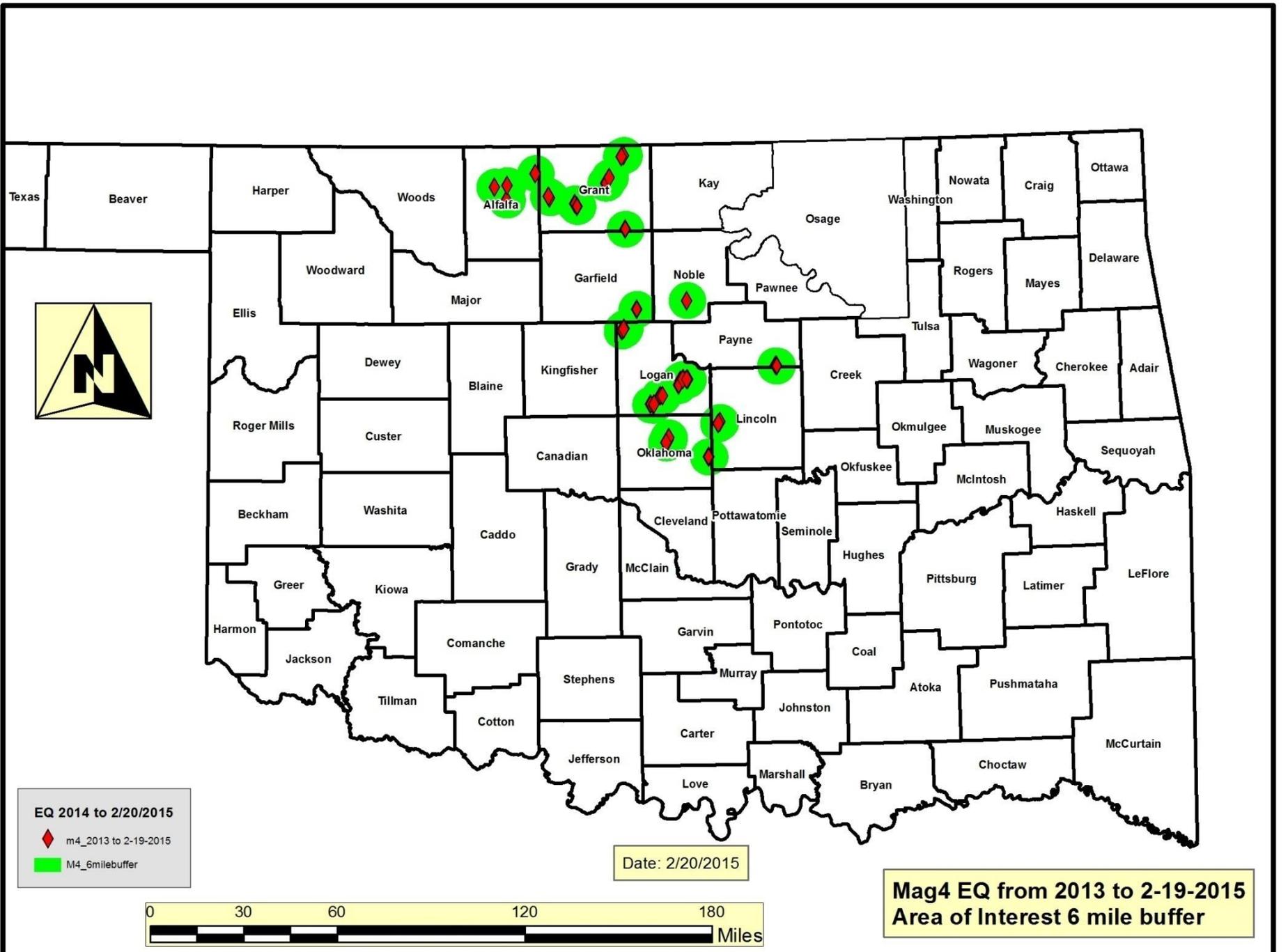


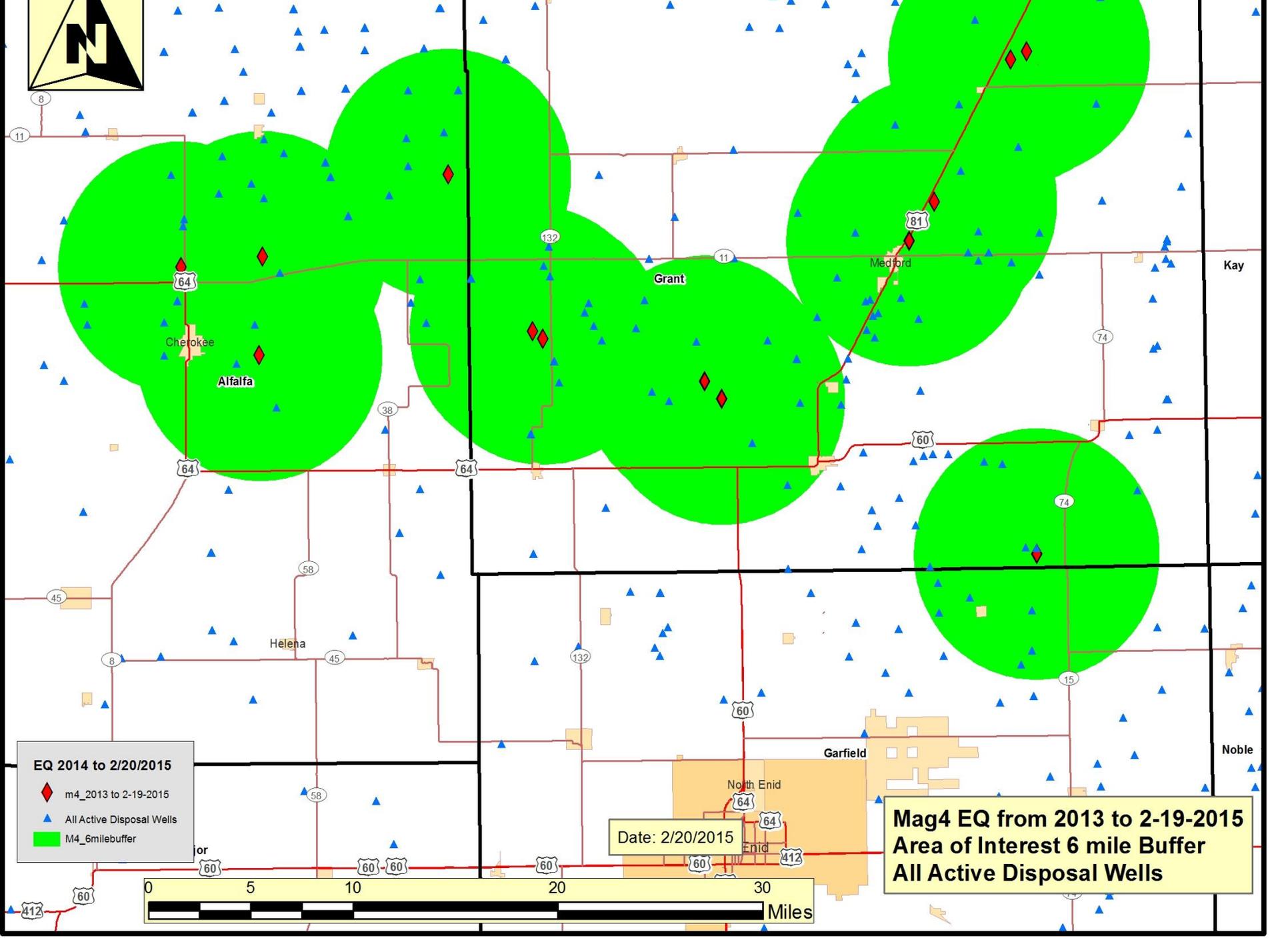
Disposal Wells Volumes



Earthquakes







EQ 2014 to 2/20/2015

- m4_2013 to 2-19-2015
- All Active Disposal Wells
- M4_6milebuffer

Date: 2/20/2015

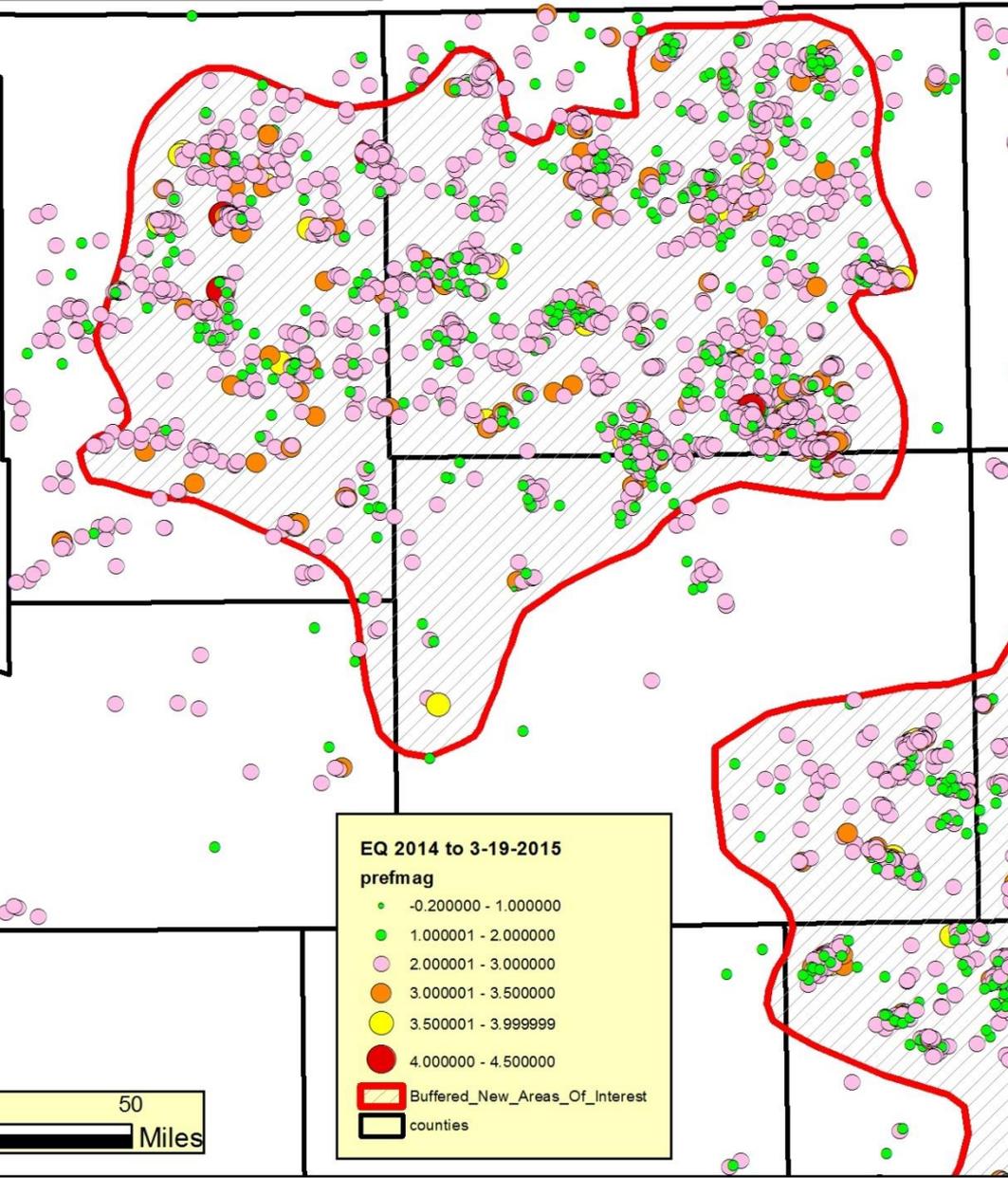
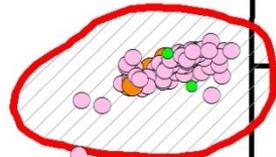
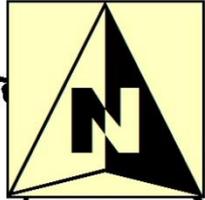
Mag4 EQ from 2013 to 2-19-2015
Area of Interest 6 mile Buffer
All Active Disposal Wells



OGCD Area of Interest

- Area Of Interest (AOI) includes seismic swarms. (New as of 3/19/15)
 1. Swarm is defined as an area consisting of at least (2) two events with epicenters within .25 mi. of each other, with at least one event with a magnitude 3.0 or greater
 2. AOI is a ten (10) km area (6 mi) with central mass of the swarm as center

New Areas Of Interest EQ 2014 to 3/19/2015



Date: 3/19/2015



EQ 2014 to 3-19-2015

prefmag

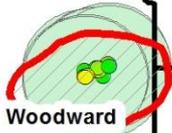
- -0.200000 - 1.000000
- 1.000001 - 2.000000
- 2.000001 - 3.000000
- 3.000001 - 3.500000
- 3.500001 - 3.999999
- 4.000000 - 4.500000

- Buffered_New_Areas_Of_Interest
- counties

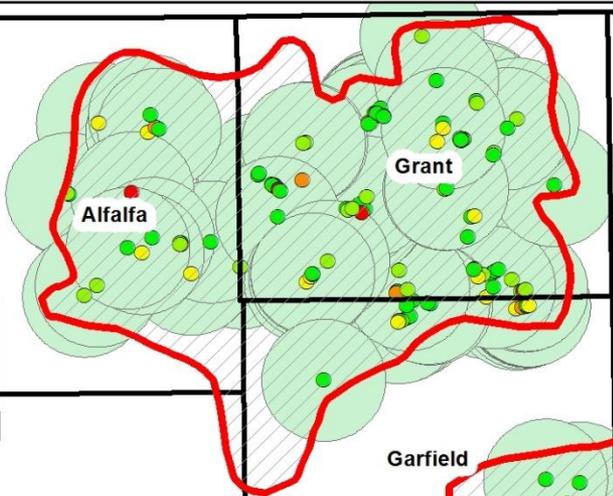


Woods

New Areas of Interest
Hypocenter Corrected M3.0+ Clusters
6 Mile Buffer



Woodward



Alfalfa

Grant

Garfield

Major

Noble

Pawnee

Osage

New Areas of Interest

-  Buffered_New_Areas_Of_Interest
-  counties
-  Hypodd6mileBuffer3.0cluster

**Hypodd3.0+Clusters
magnitude**

-  3.000000 - 3.100000
-  3.100001 - 3.300000
-  3.300001 - 3.500000
-  3.500001 - 3.800000
-  3.800001 - 4.100000

Kingfisher

Tulsa

Creek

Okmulgee

Canadian

Logan

Lincoln

Okfuskee

Caddo

Cleveland

Pottawatomie

Seminole

Hughes

Grady

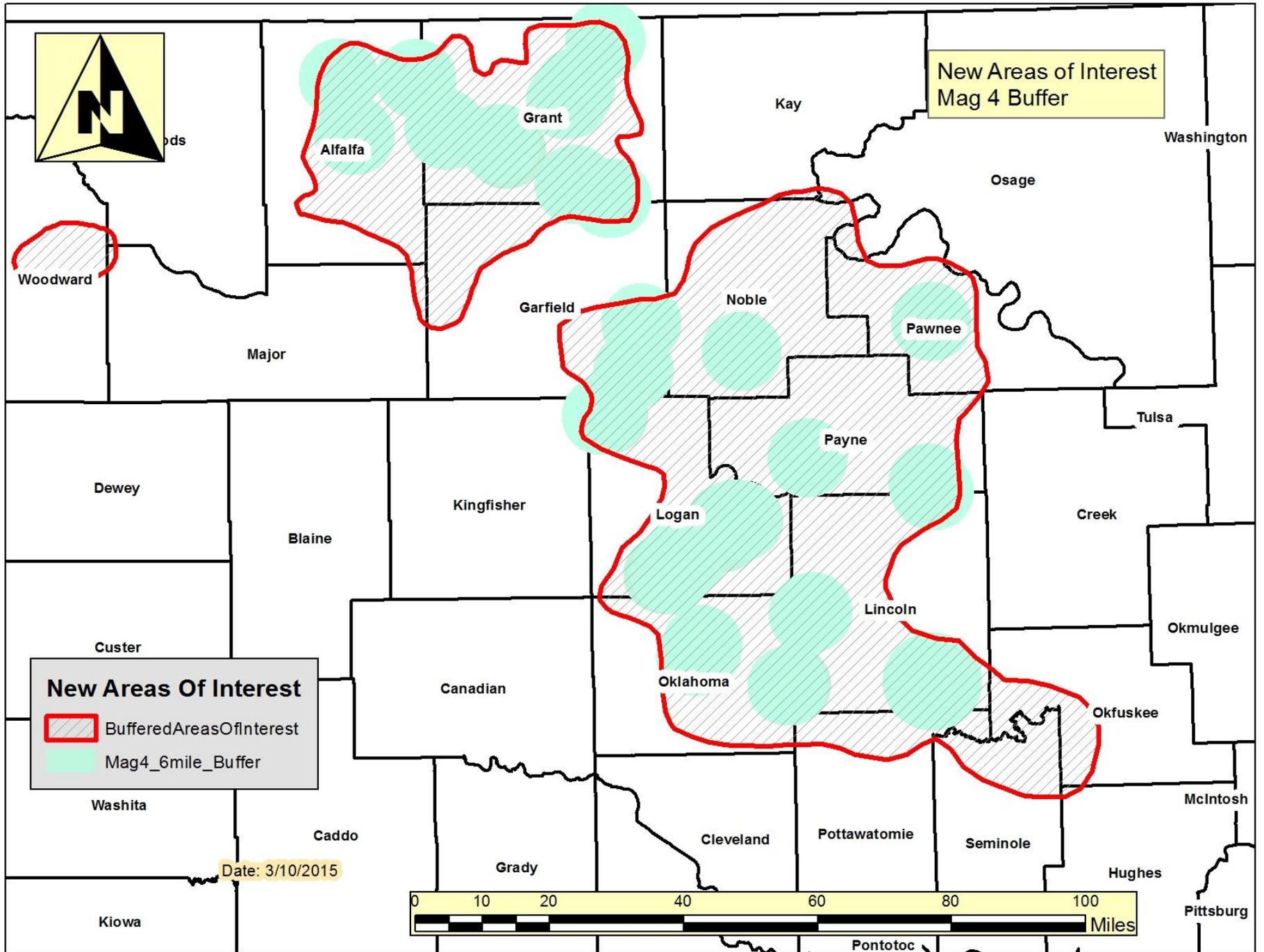
Oklahoma

Kiowa

Date: 3/19/2015



Miles



New Areas of Interest
Mag 4 Buffer

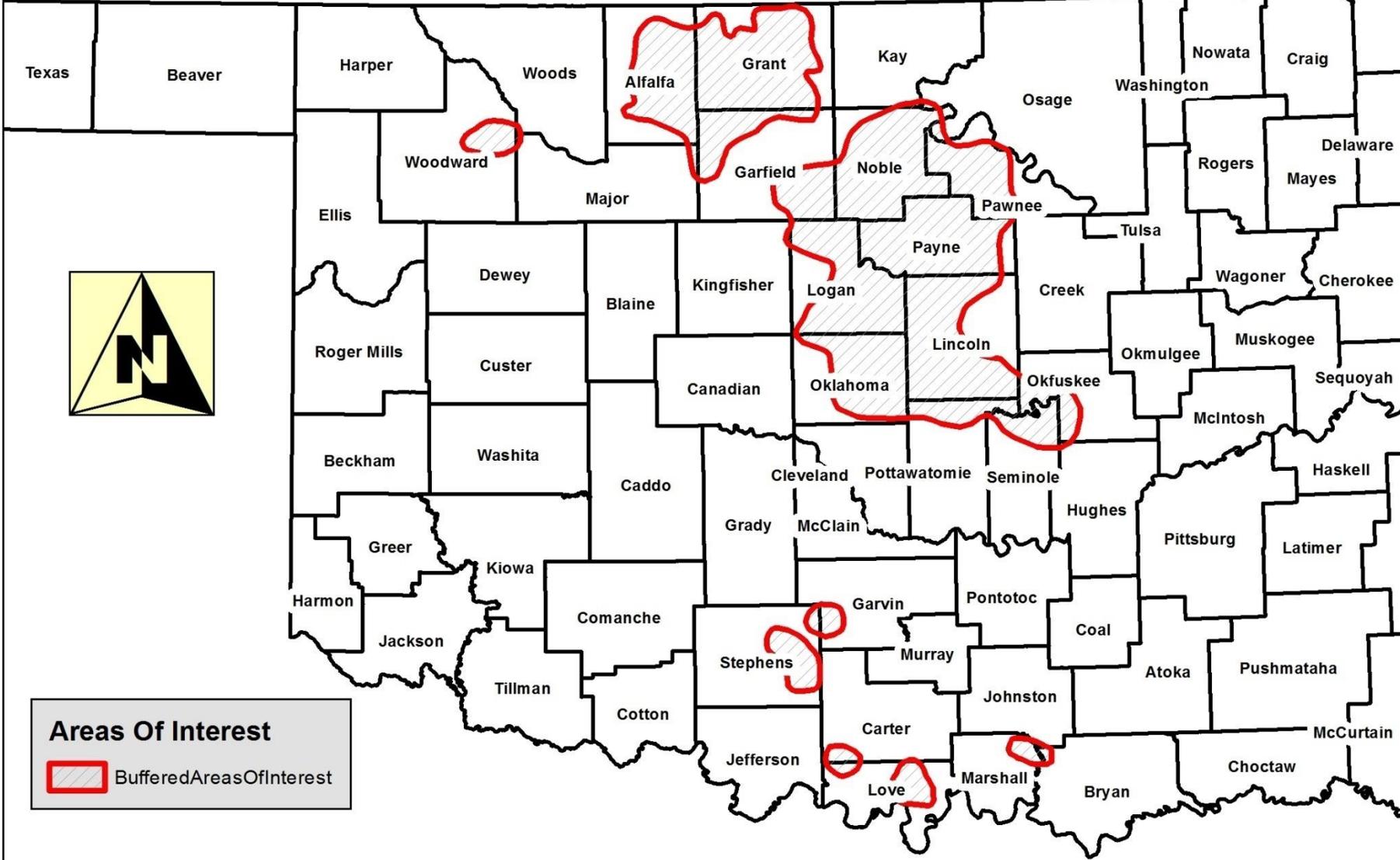
New Areas Of Interest

-  BufferedAreasOfInterest
-  Mag4_6mile_Buffer

Date: 3/10/2015



Areas of Interest

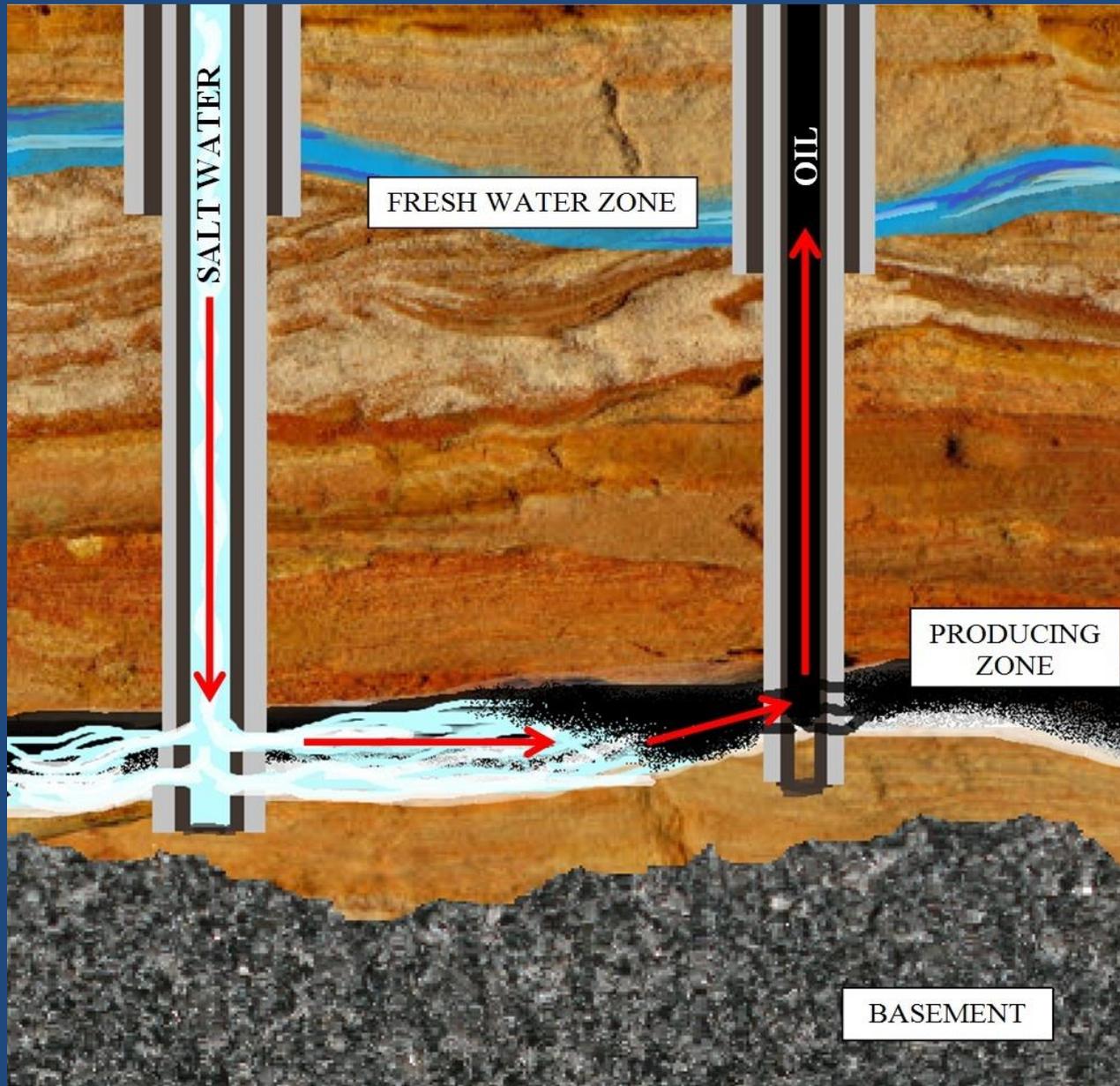


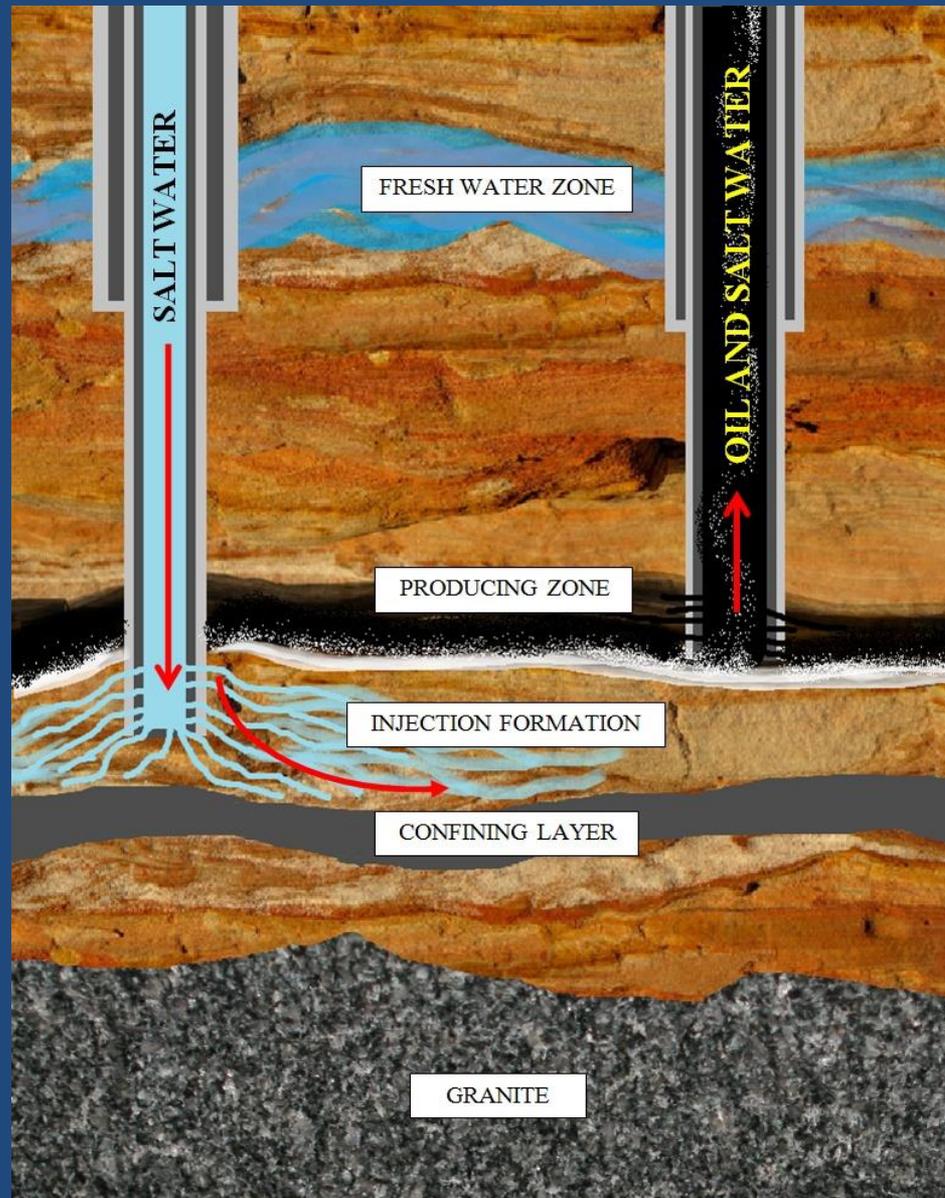
Areas Of Interest

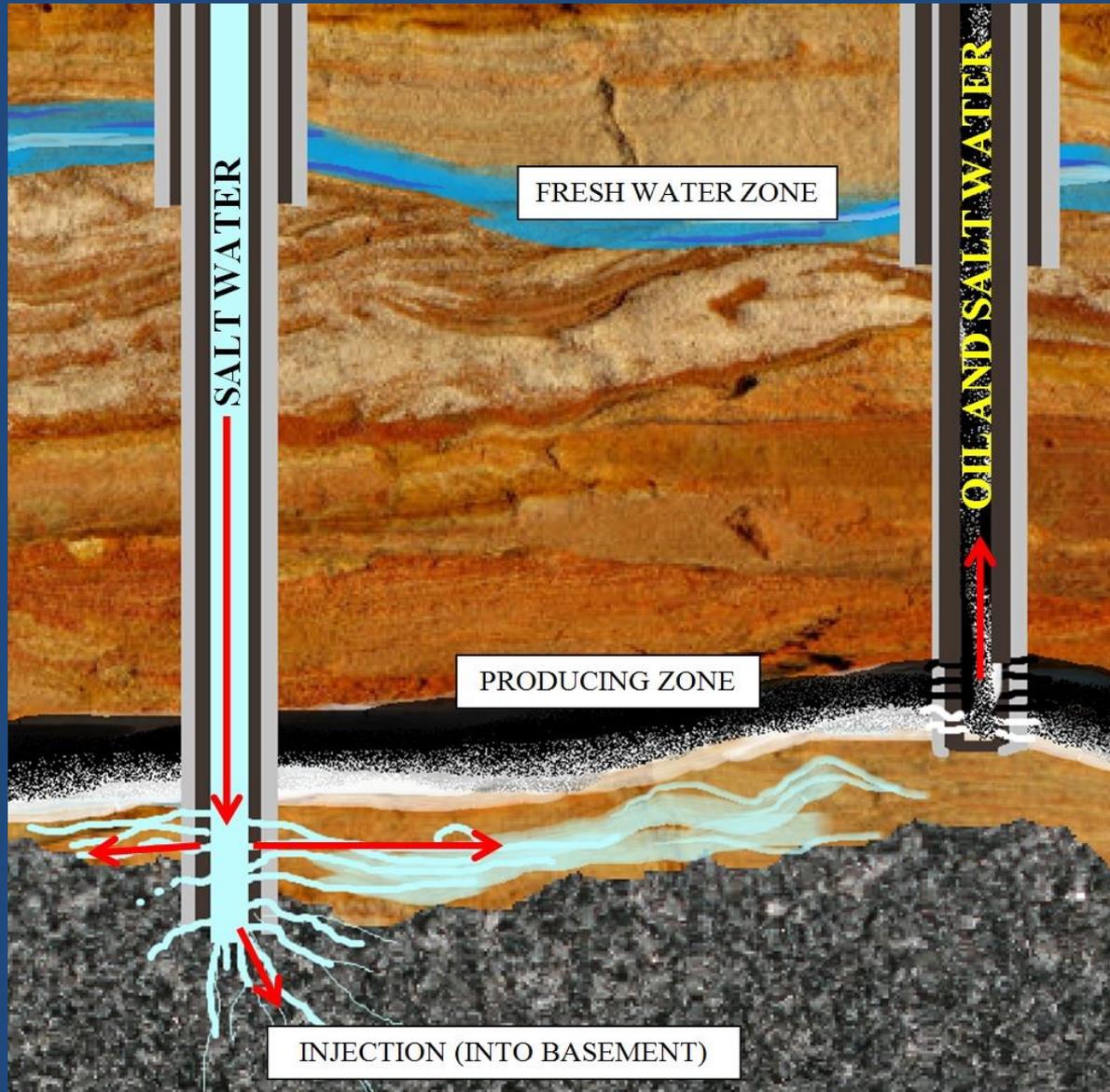
 BufferedAreasOfInterest

Date: 3/11/2015



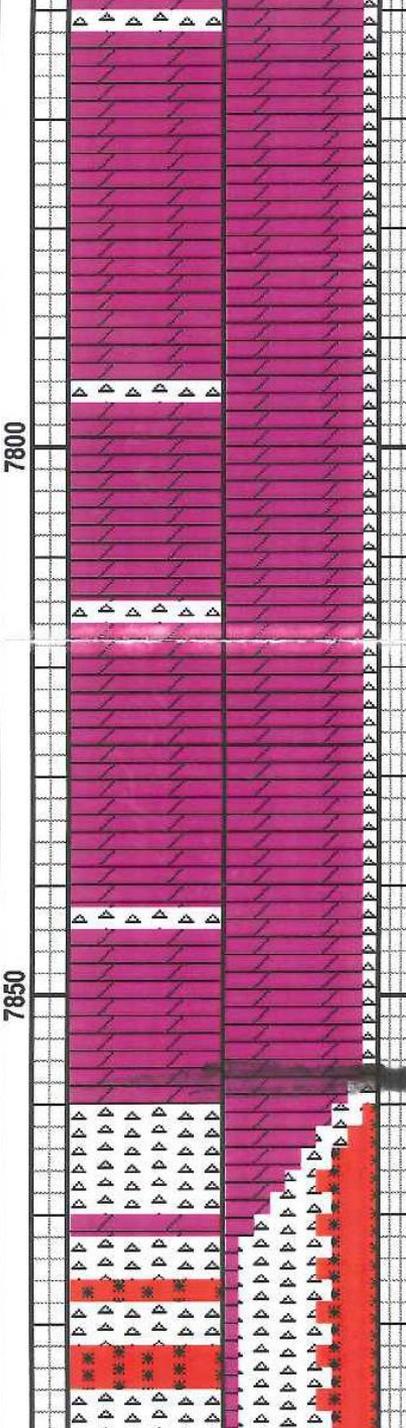
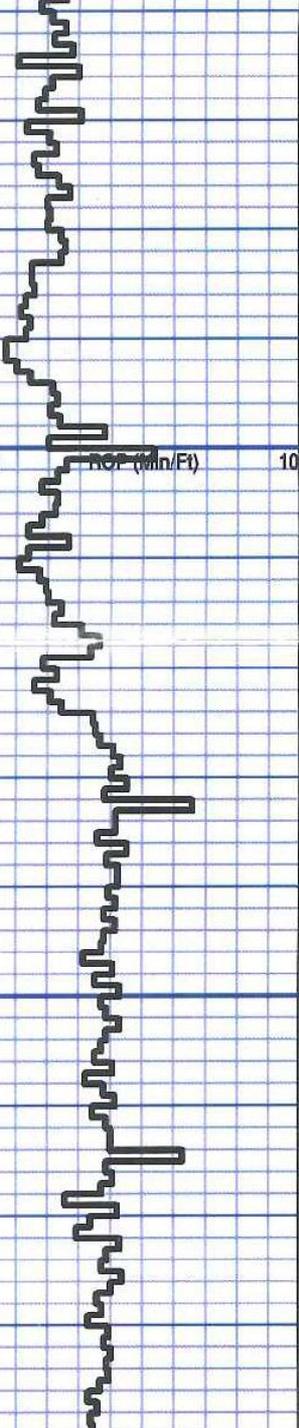






OGCD Area Of Interest

- All Arbuckle Disposal Wells must provide the following:
 1. Operators must provide information to the OGCD that their Arbuckle disposal wells within the area of interest are not in contact or communication with the crystalline basement rock.



90% DOL; OFF WH, MED TO FINE
XLN, SUCROSIC, SOFT TO
BRITTLE, YLW FLUOR, 10%
CHRT

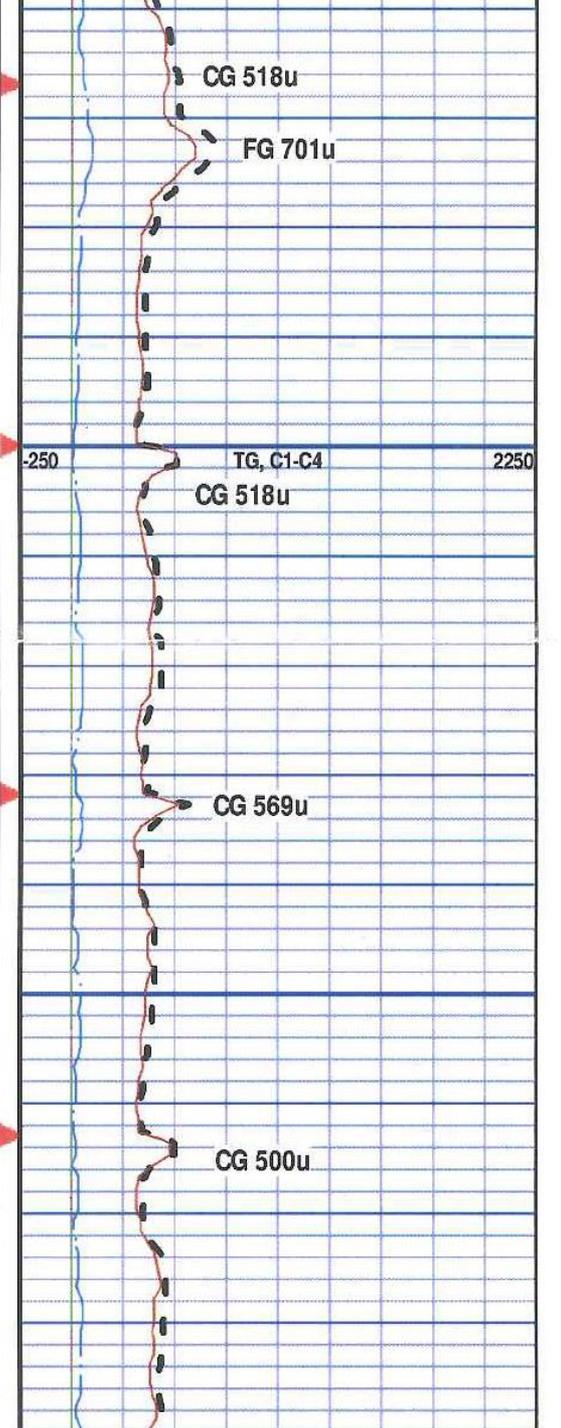
90% DOL; OFF WH, MED TO FINE
XLN, SUCROSIC, SOFT TO
BRITTLE, YLW FLUOR, 10%
CHRT

90% DOL; OFF WH, MED TO FINE
XLN, SUCROSIC, SOFT TO
BRITTLE, YLW FLUOR, 10%
CHRT

90% DOL; OFF WH, MED TO FINE
XLN, SUCROSIC, SOFT TO
BRITTLE, 10% WH CHRT

CHERT/GRANITE WASH

7,875' MD 7,875' TVD
(-6,692' SS)
55% CHRT; OFF WH TO RED



OGCD Areas Of Interest

- Wells found not to be in contact or in communication with the crystalline basement will be allowed to resume normal operations.
- Wells found to be in contact or in communication with the crystalline basement **must plug back.**

OGCD Areas Of Interest

- Directive sent out March 18th
- Operators have 7 days to begin reporting.
- Operators will have until April 18th to provide their information to the OGCD.
- Operators who do not provide this information or do not have an approved plugging schedule will be required to reduce their disposal volumes by 50% until they satisfy the directive.

OGCD Area Of Interest

- Once this project is complete OGCD will continue to look at all other Arbuckle Disposal wells in the Area.
- All data submitted will be used for a reservoir engineering studies for additional evidence.
- As new seismic data becomes available the Area Of Interest will be expanded as required.

OCC Traffic Light Protocol

- 1. Check location of proposed well with permitting map.
- 2. If well location is within 3 miles of stress fault, within 6 miles of a seismic swarm, or within an area of interest ask operator for a technical meeting.
- 3. Ask operator to demonstrate level of risk of induced seismicity.(technical data)
- 4. Require application to go to hearing.
- 5. Staff will take neutral position.



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