Oklahoma's Water for 2060 Initiative & Produced Water Working Group

2017 Governor's Conference on the Future of Water in Kansas

November 8-9, 2017

Julie Cunningham

Executive Director

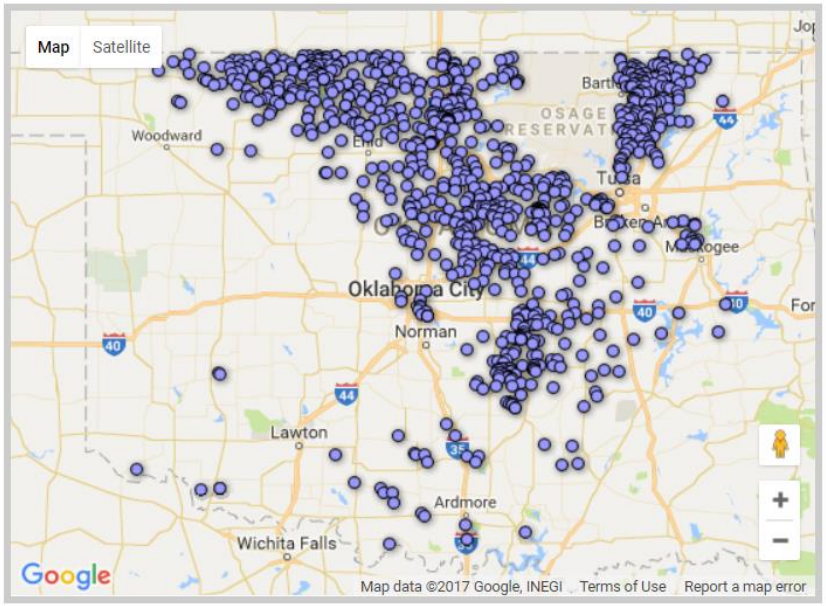
OWRB

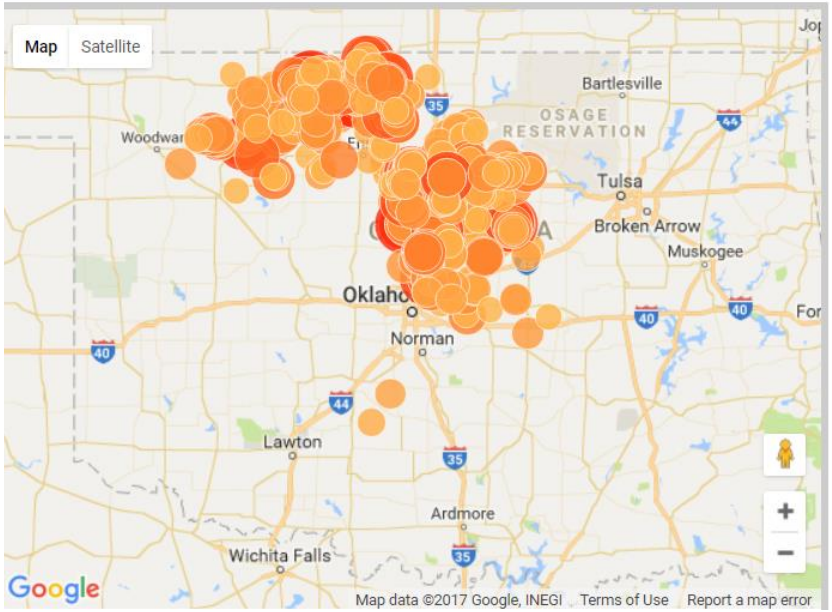
the water agency

Water for 2060 Act

- 2012 update of Ok. Comprehensive Water Plan set priority recommendation for water conservation, reuse, efficiency
- Act set goal - Consume no more fresh water in 2060 than was consumed in 2012, while continuing to grow Oklahoma's population and economy
- Achieved by – Using fresh water supplies more efficiently AND expanding use of alternatives such as treated wastewater, brackish water, and other supplies
- Established Advisory Council to make recommendations – Ag, M&I, Energy

2013 Identified Link to Wastewater Disposal and Earthquake Activity





Magnitude 3+ Earthquakes: Largest 5.8 magnitued

2013 109

2014 579

2015 903

Source: earthquakes.ok.gov

OWRB
the water agency

Water for 2060
Produced Water Working Group

- 2014 Governor Fallin establishes Coordinating Council on Seismic Activity
- 2015 WF 2060 Advisory Council recommends expanded use of MQW for energy and industry
- 2016 Gov. Fallin approved $1.4m from emergency fund to bolster efforts of earthquake regulators (OCC) and researchers (OGS)
- 2016 Gov. Fallin establishes fact-finding work group to ID regulatory, technical, and economic barriers to PW use
- Idea – Could potentially reduce quantities of PW injected, thus reducing seismic activity, AND help conserve fresh water

OWRB
the water agency

Progress Reducing Seismic Activity

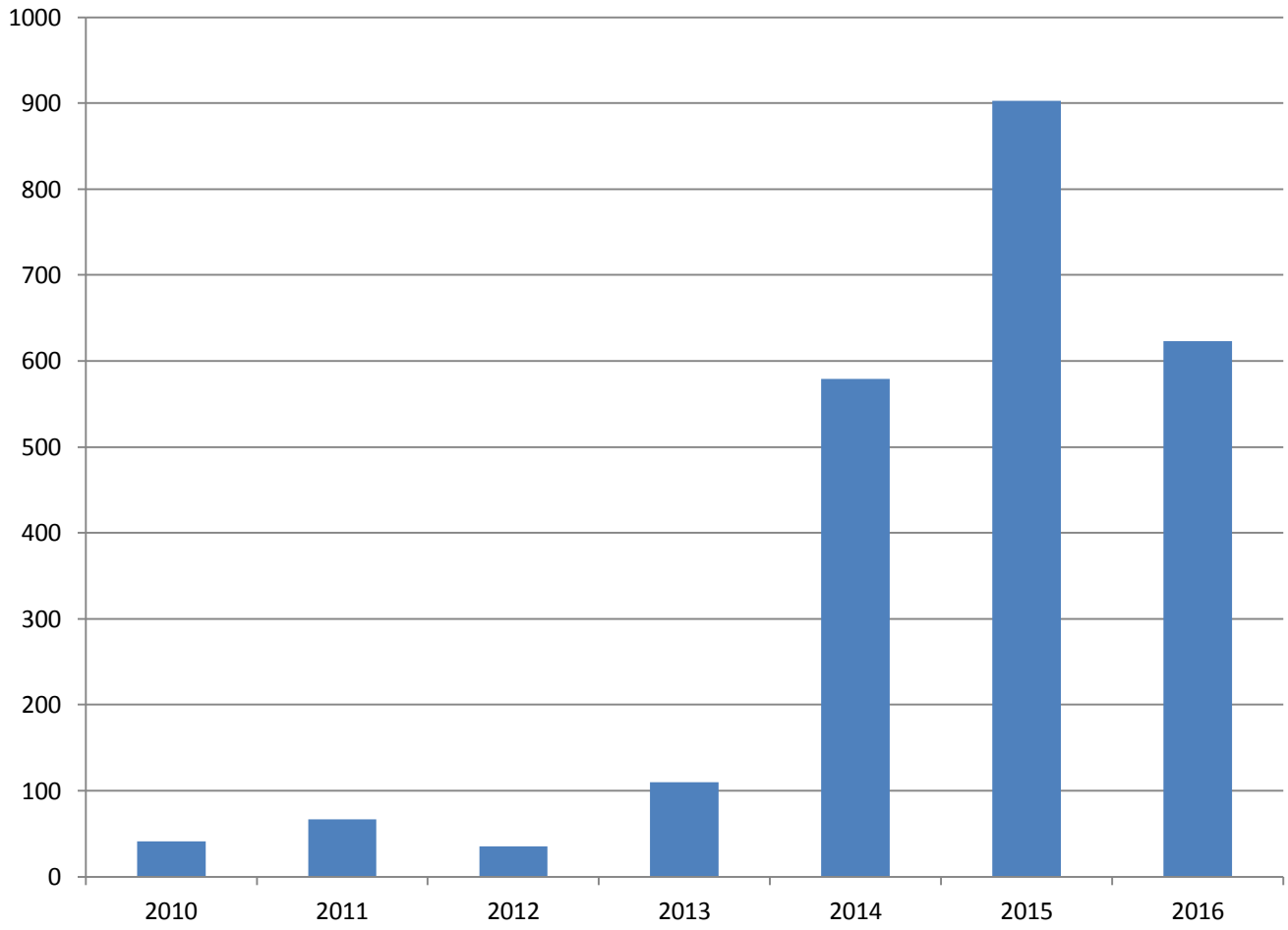
OGS Seismicity Projects and Tools:

- Enhanced seismic array and analytical tracking tools
- Characterize and model injection and fault movement
- Accelerometers across OK to see patterns and recommend actions
- OCC regulating according to real-time data

Source: earthquakes.ok.gov

OWRB the water agency

Oklahoma Earthquakes >3.0



Source: earthquakes.ok.gov

OWRB
the water agency

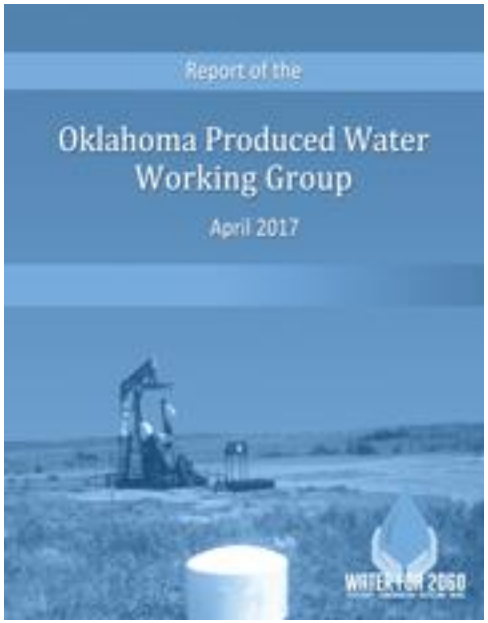
PWWG in a Nutshell

- 17 Members from Industry, Regulators, NGO's, Municipal, Academia, Users…
- 4 Subcommittees by topic
- Hi-Level Pilot Study – contract engineering firm through US Dept of Commerce grant
- Recommendations to Legislature May 2017
- 2018 – Phase 2 – US BOR WaterSmart grant- Feasibility Study on Phase 1 findings

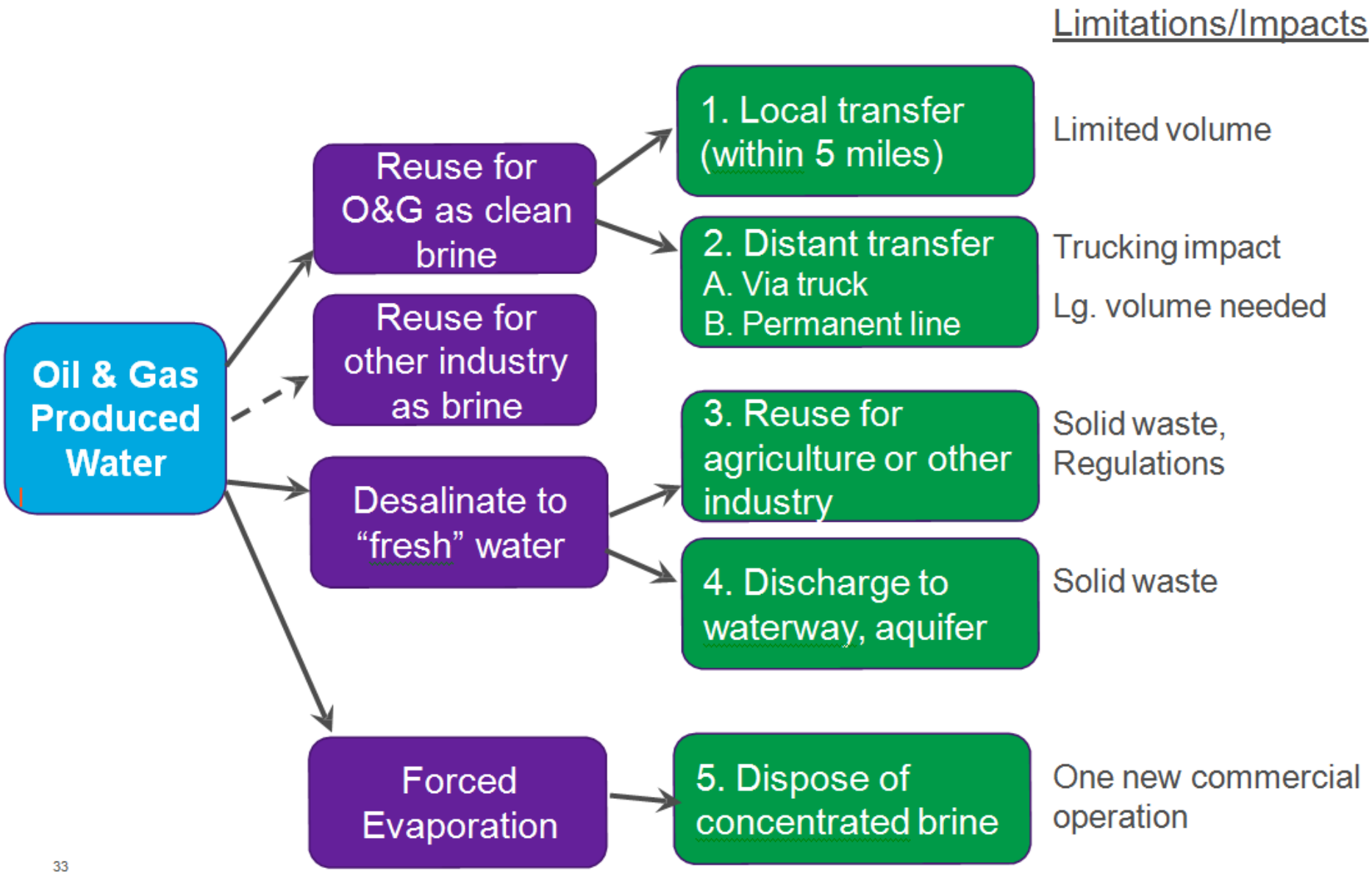
OWRB
the water agency

Pilot Study on Reuse

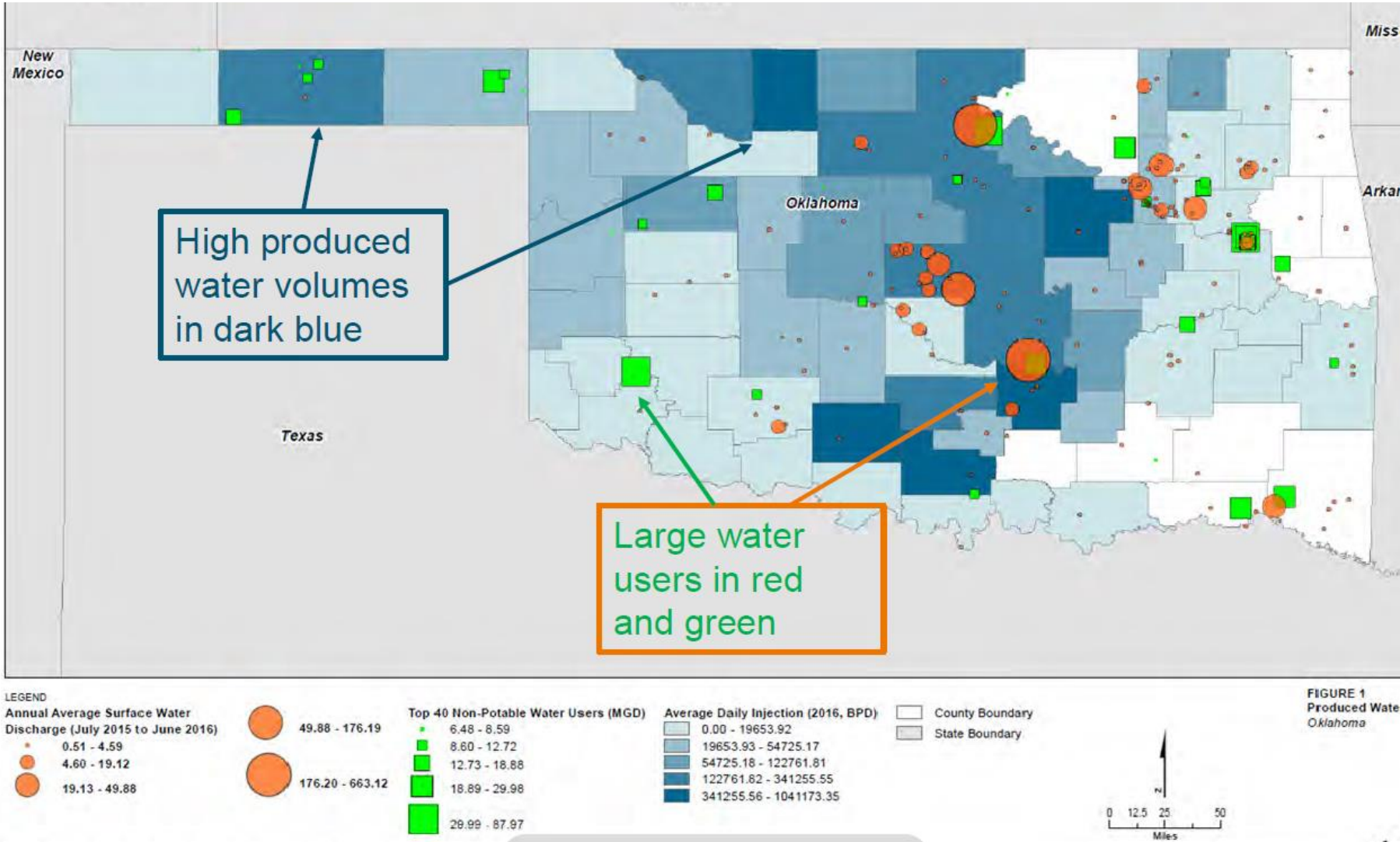
- Database of spatially proximate Supply/Demand
- Treatment cost estimates
- Challenges/Impact Assess.
- Economic scenarios
- Recommendations



Study – Preliminary Reuse Options



Desalination:
PW Supply and Industrial Demand



Subcommittees – 4 Topics

- Agriculture
- Regulatory and Legal Issues
- Oil and Gas Industry
- Industry/Municipal - Discharges

4 Subcommittees

Agriculture

- Large volume in specific widespread areas
- Seasonality an issue for treatment plant but ASR may be an option
- Chemical Spray seems like good option but only small volume of water needed
- Land use (hay) may compliment some scenarios

4 Subcommittees

Regulatory and Legal Issues

- Commercial treatment facility designation requires higher bonding cost
- NPDES discharge – challenges to obtaining, including timing
- PW ownership – value vs. liability to operator/landowner
- Right-of-way negotiations and cost of shared infrastructure

4 Subcommittees

Water Users and Discharge

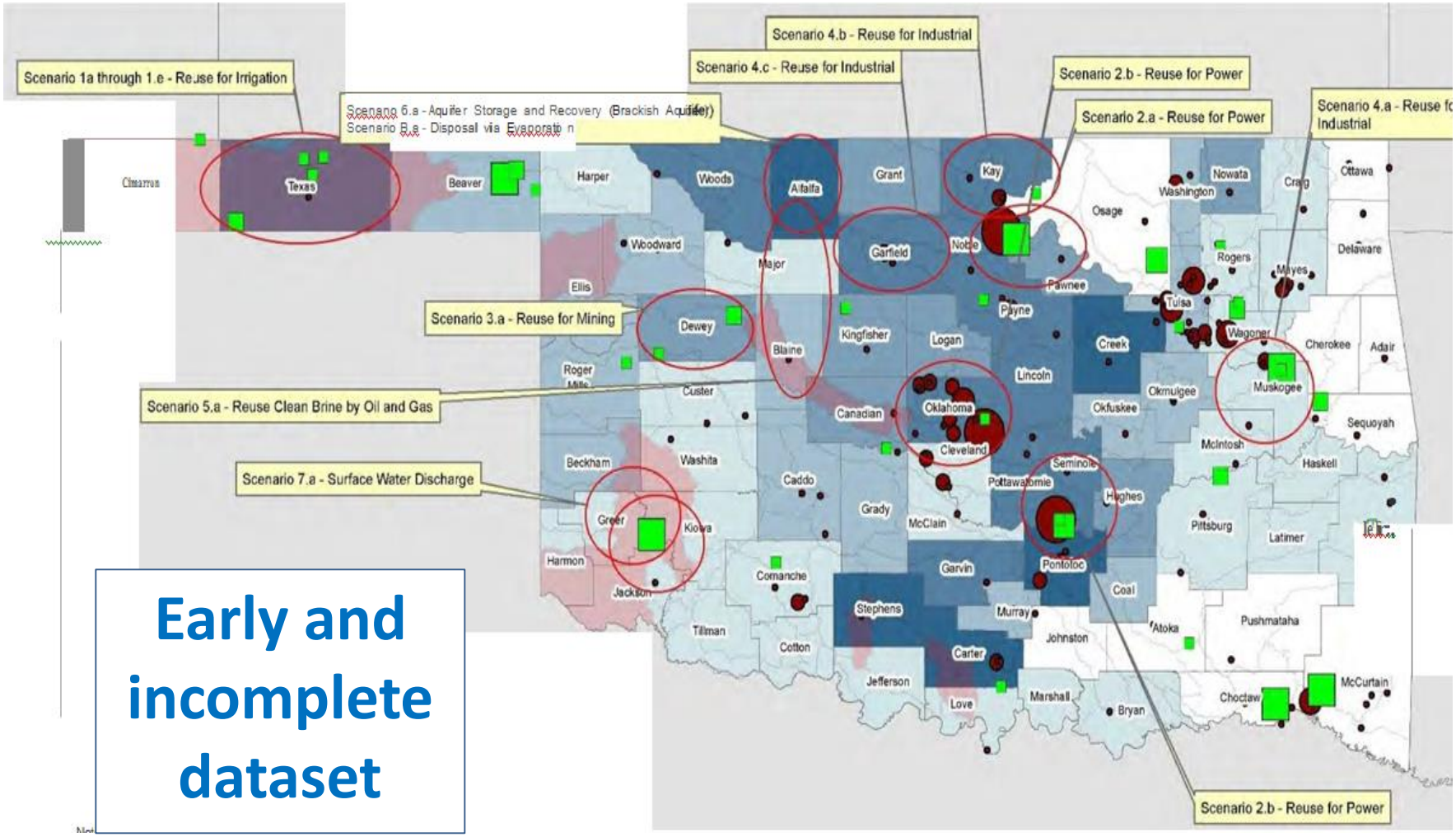
- Cooling water for power or chemical plant
- Municipal use – likely not a consideration
- Direct discharge to a stream – timing – EPA approval
- Aquifer Storage and Recovery – identify existing aquifers with marginal quality–State regulatory process is ongoing

4 Subcommittees

Oil and Gas

- Re-use requires minimal treatment and is best option, however cost and changing supply/demand are drivers
- Moving target- need valid economic comparison of scenarios; however very difficult
- Incentives needed?

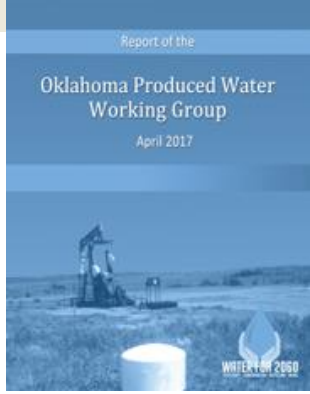
Preliminary Matches and Scenarios



Early and incomplete dataset

OWRB
the water agency

Pilot Study on Reuse



Scenarios Compared to Source Water and Disposal

- Clean brine (O&G) transfer and treatment
- Evaporation
- Desalination

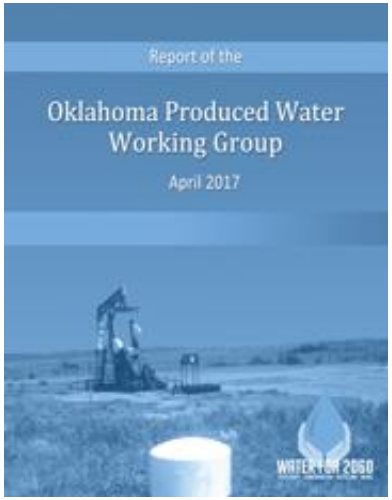
New Case	Case Description	Total Capital ($Millions)	Capacity BWPD	County	Assumed Wtr TDS (mg/L)	Normalized $/BW
1	Typical Source and Dispose - STACK & SCOOP	NA	NA	Central OK	NA	1.09
2	**Oil and gas re-use (treatment cost only)**	**NA**	**NA**	**State-wide**	**NA**	**0.57**
3	Clean Brine Transfer & treatment	208	200,000	Alfalfa	213,000	1.03
4	Evaporation - low TDS (SCOOP & STACK)	NA	20,000+	Blaine	17,000	1.66
5	Evaporation - high TDS (Miss. Lime)	NA	20,000+	Alfalfa	213,000	1.79
6	Desalination for Surface Discharge	22	15,000	Beckham	9,000	3.58
7	Desalination for Power Use	88	130,000	Pawnee	125,000	4.37
8	Desalination for Power Use	95	230,000	Seminole	180,000	4.43
9	Desalination for Industrial Use	35	30,000	Grant	227,000	7.41
10	Desalination for Surface Discharge	38	30,000	Grant	227,000	7.49

Pilot Study on Reuse

1. Transportation Costs not included in Cases 1 & 2
2. Re-use Costs less than sourcing and disposing!
3. New transfer lines could make O&G re-use grow.
4. Are there existing lines in certain locations?

New Case	Case Description	Total Capital ($Millions)	Capacity BWPD	County	Assumed Wtr TDS (mg/L)	Normalized $/BW
1	Typical Source and Dispose - STACK & SCOOP	NA	NA	Central OK	NA	1.09
2	**Oil and gas re-use (treatment cost only)**	**NA**	**NA**	**State-wide**	**NA**	**0.57**
3	Clean Brine Transfer & treatment	208	200,000	Alfalfa	213,000	1.03
4	Evaporation - low TDS (SCOOP & STACK)	NA	20,000+	Blaine	17,000	1.66
5	Evaporation - high TDS (Miss. Lime)	NA	20,000+	Alfalfa	213,000	1.79
6	Desalination for Surface Discharge	22	15,000	Beckham	9,000	3.58
7	Desalination for Power Use	88	130,000	Pawnee	125,000	4.37
8	Desalination for Power Use	95	230,000	Seminole	180,000	4.43
9	Desalination for Industrial Use	35	30,000	Grant	227,000	7.41
10	Desalination for Surface Discharge	38	30,000	Grant	227,000	7.49

Re-use Recommendations



- Reduce challenges through targeted Legislation
- Further investigate best options identified in preliminary study
- Identify research needs- water quality, existing distribution lines, etc.

Industry Re-use in Oklahoma

- Continental Resources: Re-use up to 4.2 MGD in SCOOP & STACK
- Newfield Exploration: Re-use of 100% (1.4 MGD) in STACK play at Barton WRF
- Devon Energy: Network of Re-use pipelines under construction; deal with OKC for treated wastewater substitute for fresh water
- Chesapeake & White Star – Pipe networks

Oklahoma Initiatives

- Reduced Water Disposal: strategic well management by OCC
- Seismicity WG meets monthly to improve effectiveness and seismic monitoring net
- PWWG : Multiple sector cooperative synergy on Technology and Regulations
- Feasibility Study: Phase 2 - Re-use Scenarios

PWWG Feasibility Study

Further investigate:

- Water transfer of Miss. Lime to STACK
- Evaporation technologies
- Environmental and Stakeholder impacts

Partners: OWRB, GW Protection Council, Environmental Defense Fund, Univ. of Texas Bureau of Econoic Geology, US BOR (WaterSmart)

Questions?

Julie Cunningham

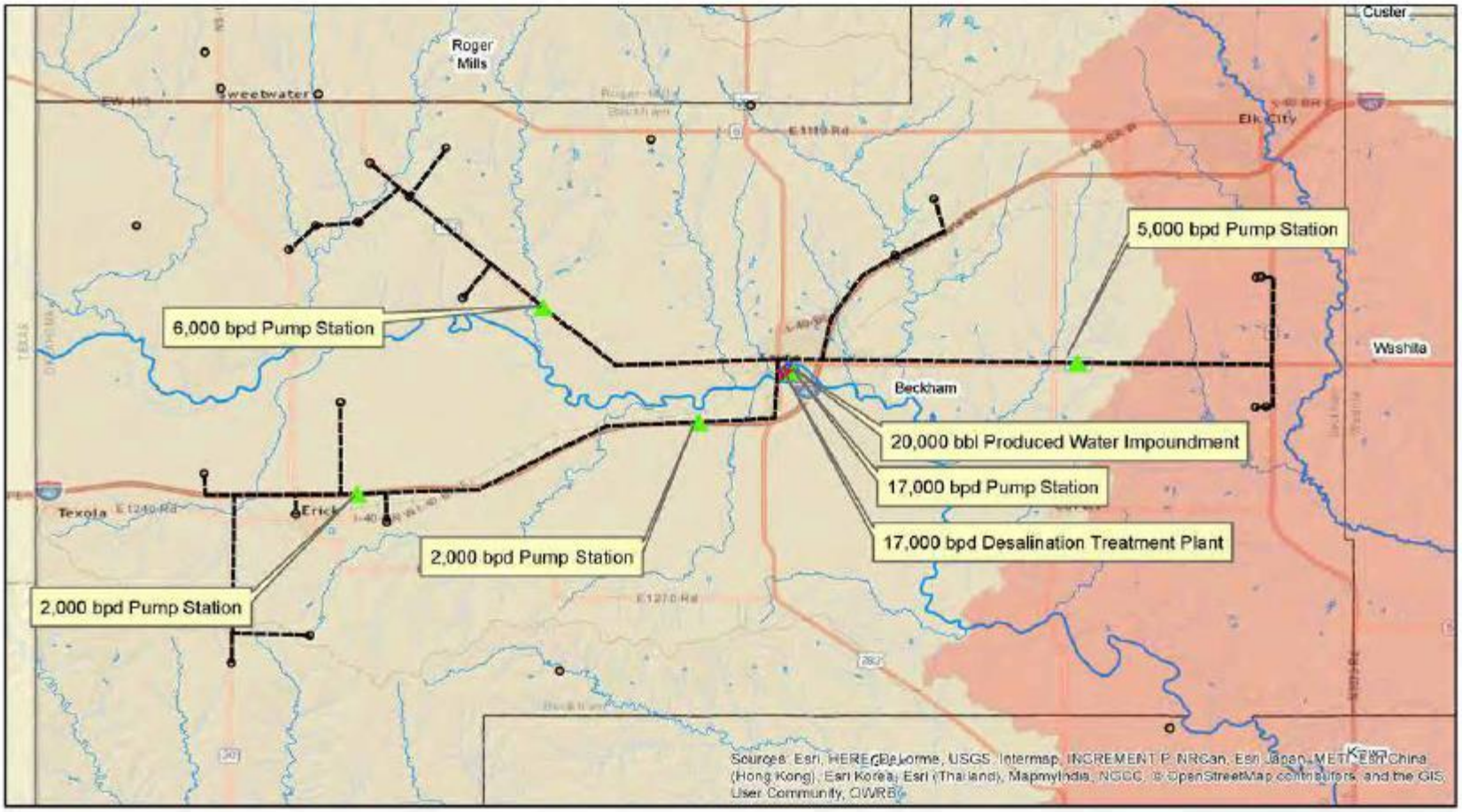
Executive Director

Julie.Cunningham@owrb.ok.gov

Oklahoma Water Resources Board
3800 North Classen Boulevard
Oklahoma City, OK 73118
Ph: 405.530.8800 • Fx: 405.530.8900
www.owrb.ok.gov • @OKWaterBoard

OWRB
the water agency

Clean Brine Transfer



Legend

- SurfaceWaterDischarge_Treatment
- SurfaceWaterDischarge_PumpStation
- SurfaceWaterDischarge_Storage
- SurfaceWaterDischarge_Pipeline

Top 40 Water Users (BPD)

- 425 - 20,000
- 20,001 - 100,000
- 100,001 - 300,000
- 300,001 - 700,000
- 700,001 - 2,094,503

OCWP Water Plan Basins

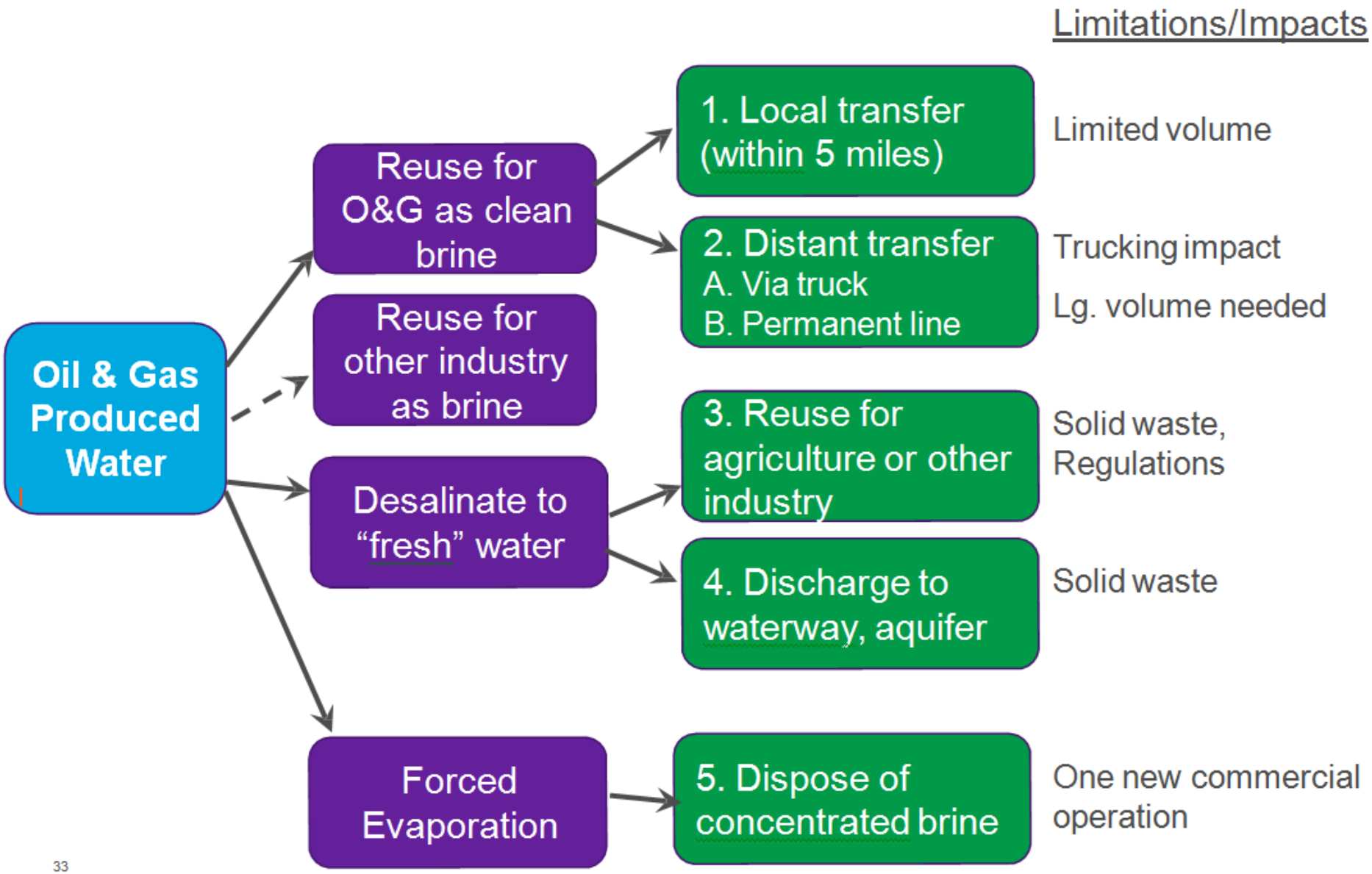
- OCWP Basins
- OCWP Hot Spot Basins
- County Boundary

N

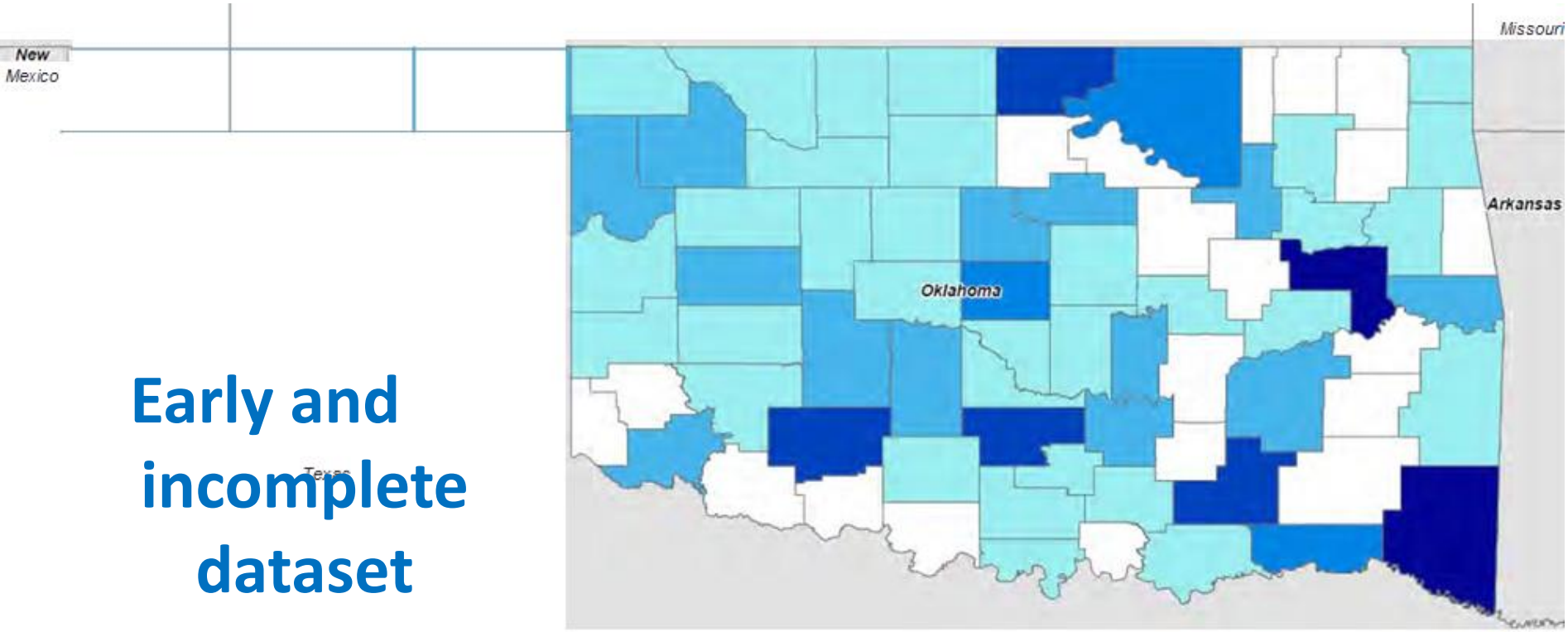
0 2 4 Miles

Evaporation

Study – Options for Reuse

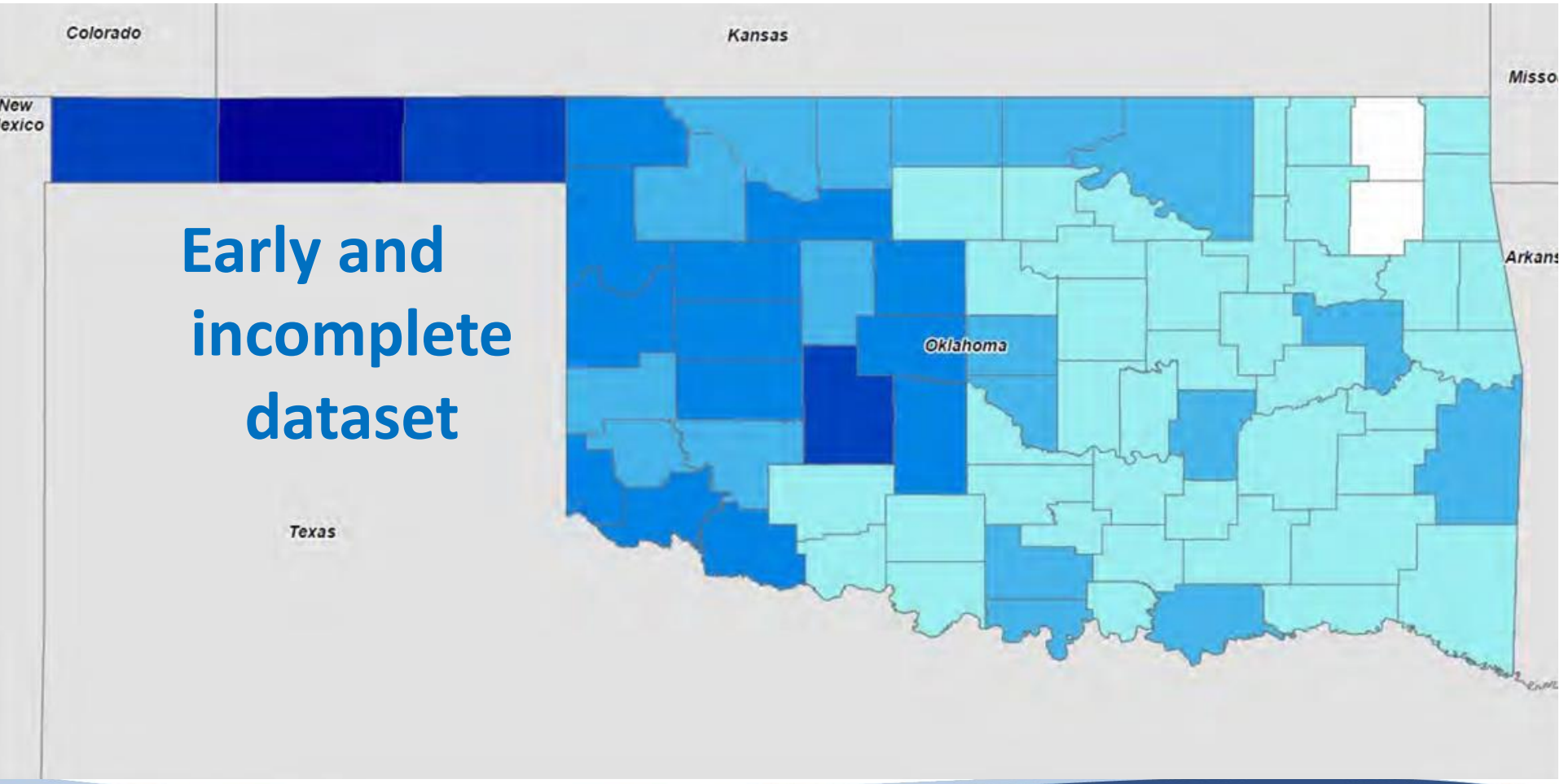


Industrial Water Use by County



Early and incomplete dataset

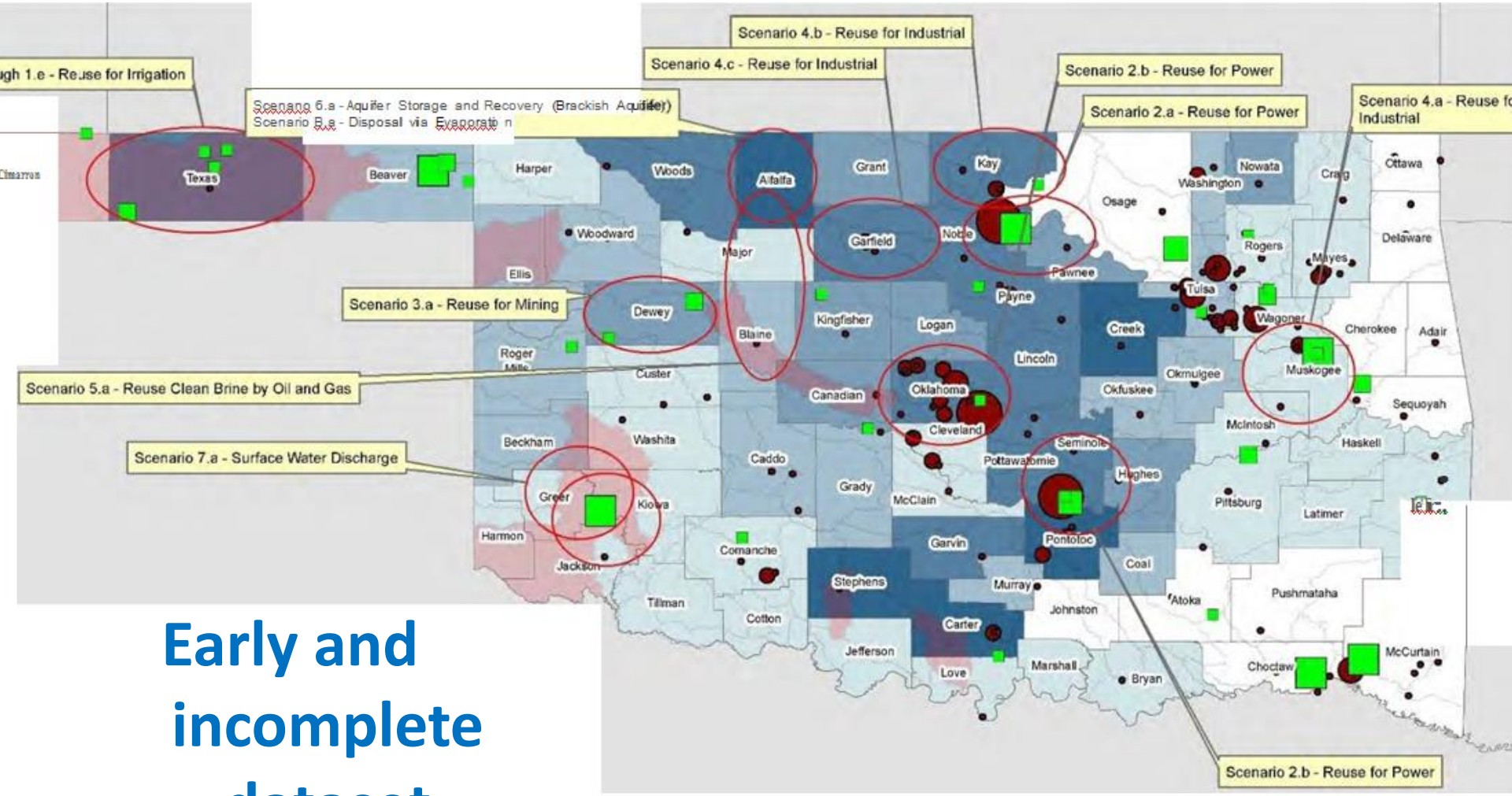
Irrigation Water Use by County



Early and incomplete dataset

OWRB
the water agency

Preliminary Matches and Scenarios



Early and incomplete dataset

OWRB
the water agency

Economic Proposition

Disposal Costs Savings

+

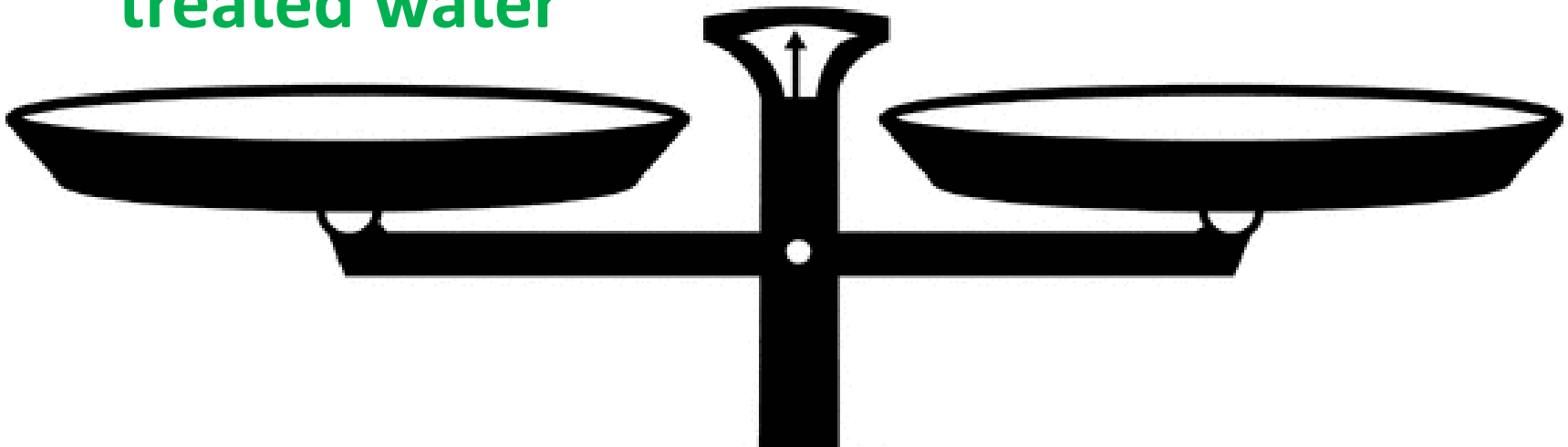
Value of treated water

Offset?

PW Transport

+

Treatment /Disposal



Produced Water Working Group

- Members of multiple sectors – industry, NGO, regulatory
- Pilot PW Study -
  - Matches PW volumes with potential end users
  - Defines economically viable technologies
  - Determines transportation network challenges
  - Identifies needs for regulatory changes
  - Recommendations moving forward
- Legislation
  - for state delegation to permit PW discharges
  - ownership issues? Who gets revenue for water, et al?

Produced Water Working Group

Findings and Next Steps for Feasibility:

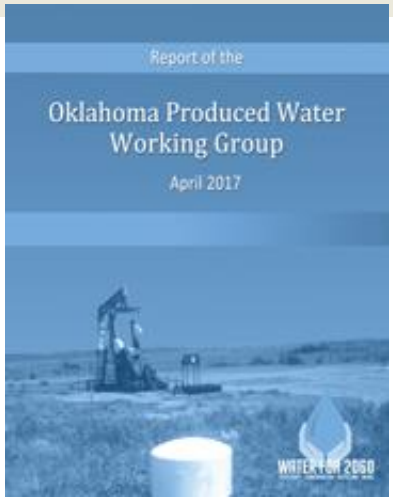
- Economic Recycling feasibility within the industry
  (STACK Play: 15,000 wells * 67 AF/ well = >1,000,000 AF)
  - Piping it to new jobs
  - Clean Brine for use
  - Regulatory needs

- Evaporation Technologies
  - Safety/environmental concerns
  - Economically feasible

Next Steps and Timing

- Data -Water Quality
- Data -Water Treatment costs
- Develop cost estimates for economic scenarios including infrastructure
- PWWG Recommendations for statutes, rulemaking, permit delegations, etc.

Pilot Study Scenarios



Scenarios Compared to Source Water and Disposal

- Clean brine transfer and treatment (O&G)
- Evaporation
- Desalination

What OK Is Doing About It?

OGS Seismicity Projects and Tools:

- **Enhanced seismic array and analytical tools to track**
- **Characterize and Model injection and fault movement**
- **Accelerometers across OK to see patterns and recommend actions**

Source: earthquakes.ok.gov

OWRB
the water agency

What OK Is Doing About It?

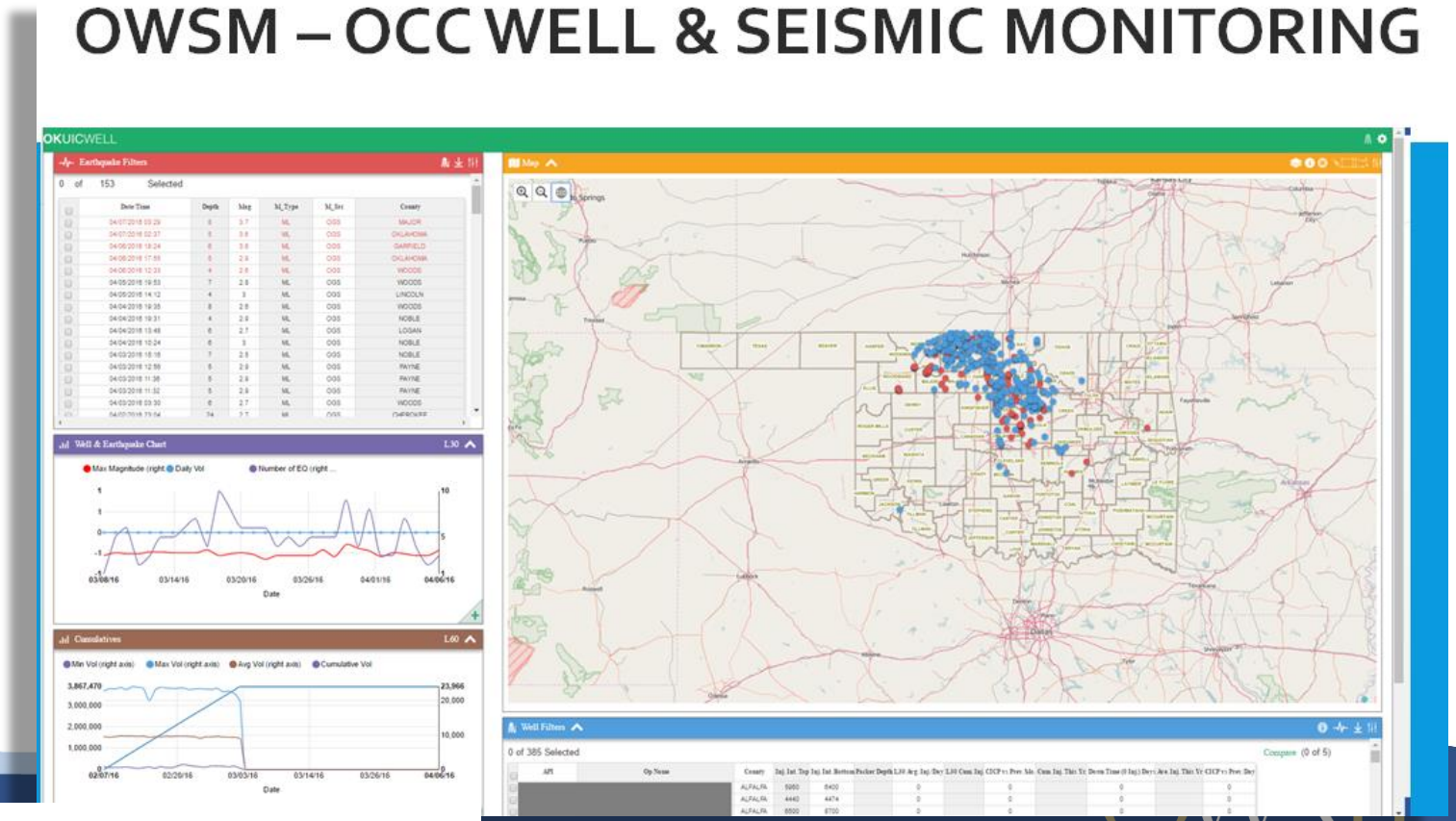
OCC revised permitting of Disposal Well Operators

- 15,000 sq mi Area Of Interest (AOI) NW Ok
- Red/Yellow/Green light system for estimated AOI stress level
- >4.0 prompts review of every well less than 6 miles of epicenter and 2 miles of faults
- Network of seismic data quickly assists OCC officials to determine what SWD Wells (if any) to shut down

OWRB
the water agency

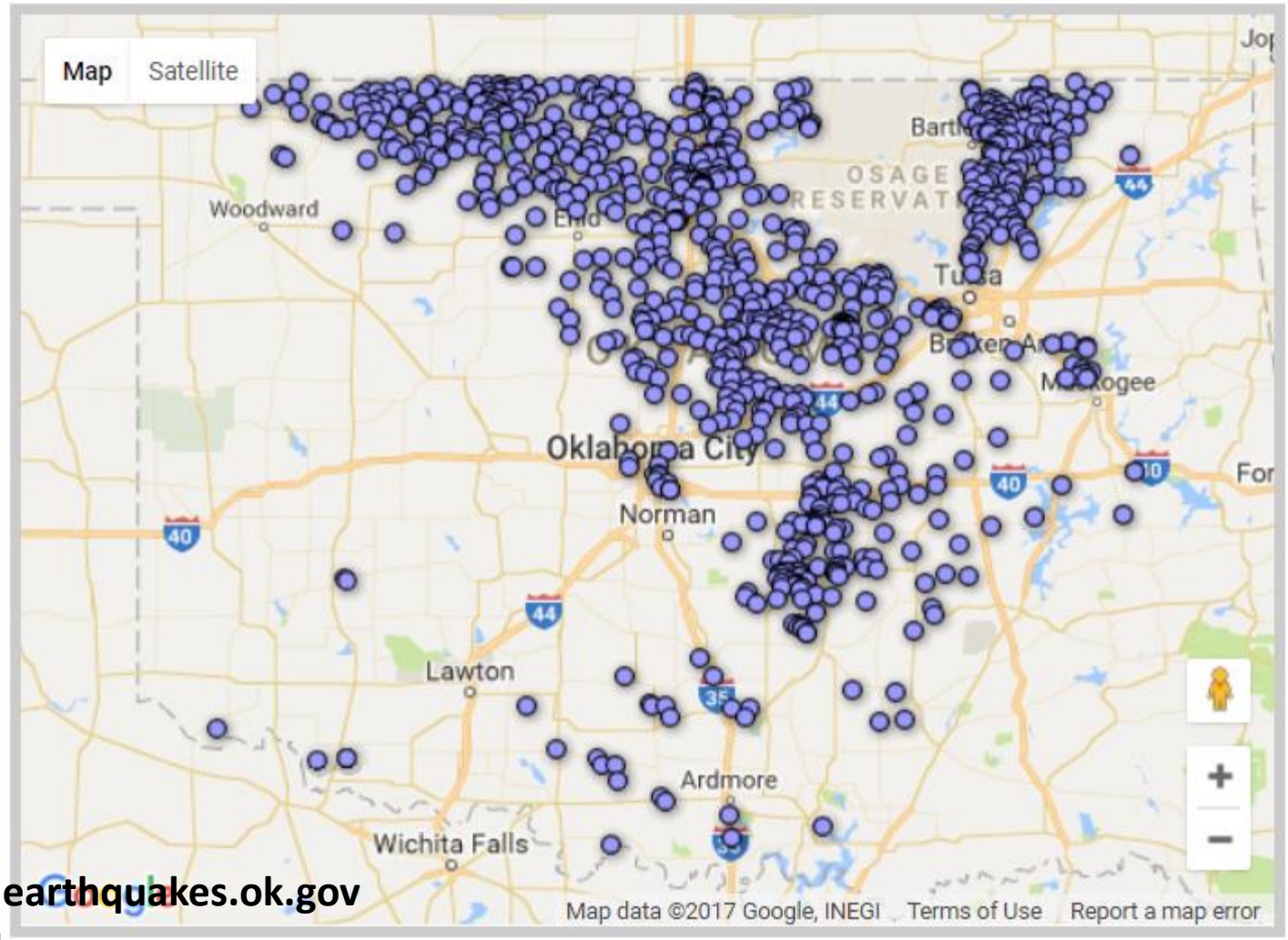
What OK Is Doing About It?

FracFocus: App for real-time OCC Well & Seismic Monitoring



Source: Groundwater Protection Council

Earthquake Map – SWD Wells

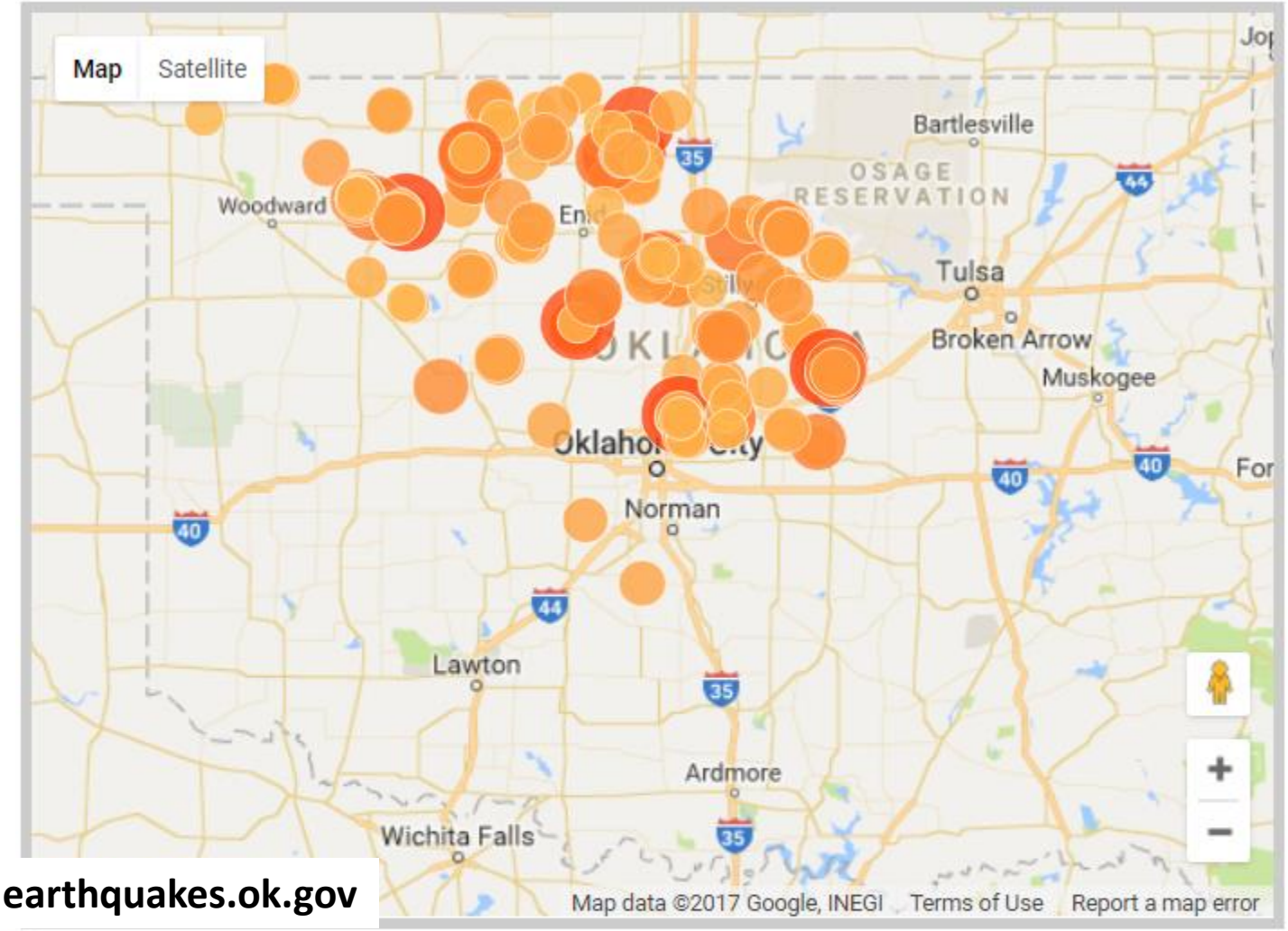


Source: earthquakes.ok.gov

Note: Only Earthquakes with a magnitude of 3.0 and higher are displayed.

☐ Earthquakes - Past 7 days ☐ Earthquakes - 2012 ☑ Arbuckle Waste Water Disposal Wells

Earthquake Map – 2017 (YTD)

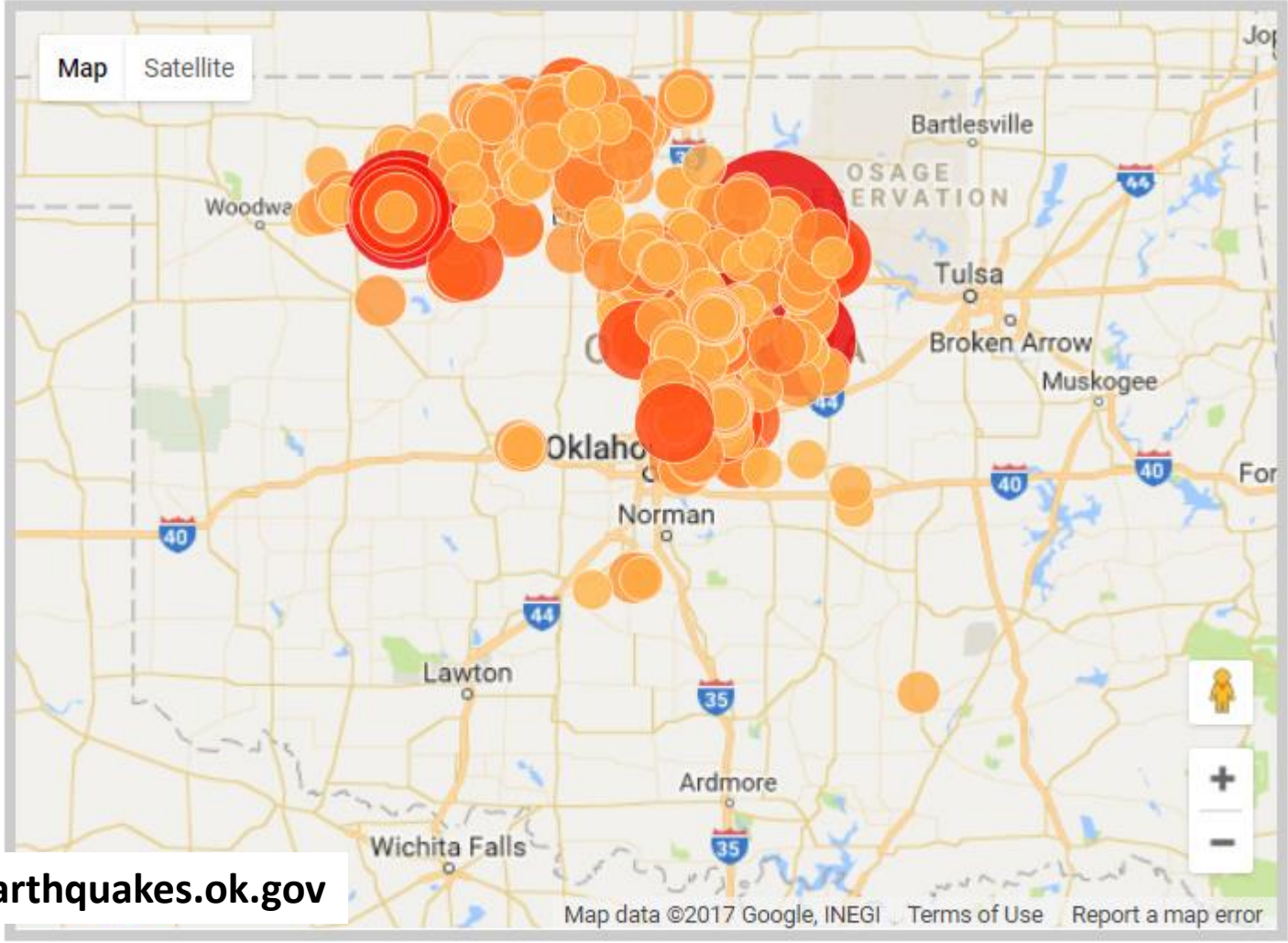


Source: earthquakes.ok.gov

Note: Only Earthquakes with a magnitude of 3.0 and higher are displayed.

- [ ] Earthquakes - Past 7 days
- [x] Earthquakes - 2017 (YTD)
- [ ] Earthquakes - 2012
- [ ] Earthquakes - 2011
- [ ] Arbuckle Waste Water Disposal Wells

Earthquake Map – 2016

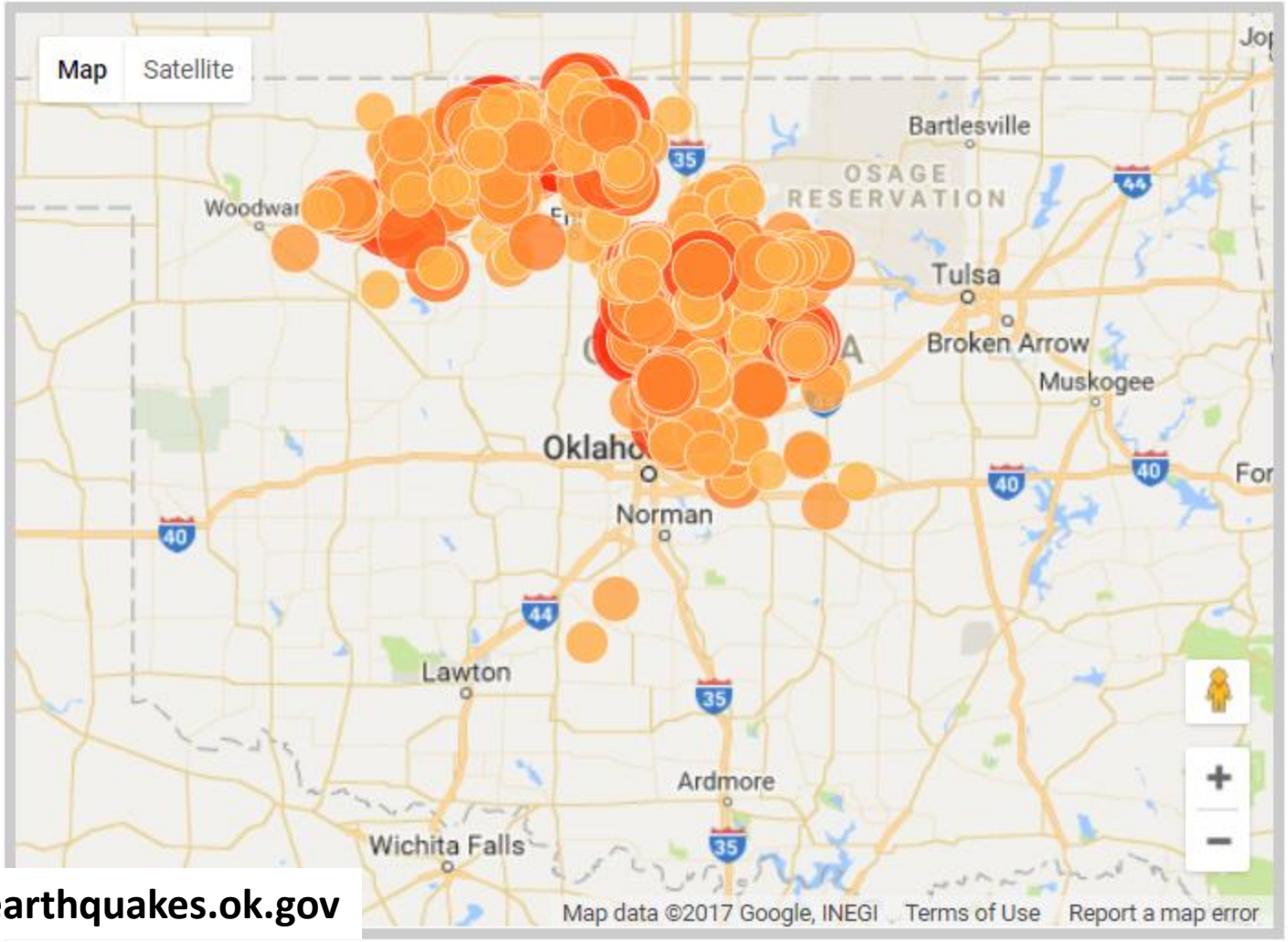


Source: earthquakes.ok.gov

Note: Only Earthquakes with a magnitude of 3.0 and higher are displayed.

- [ ] Earthquakes - Past 7 days
- [ ] Earthquakes - 2012
- [ ] Arbuckle Waste Water Disposal Wells

Earthquake Map – 2015

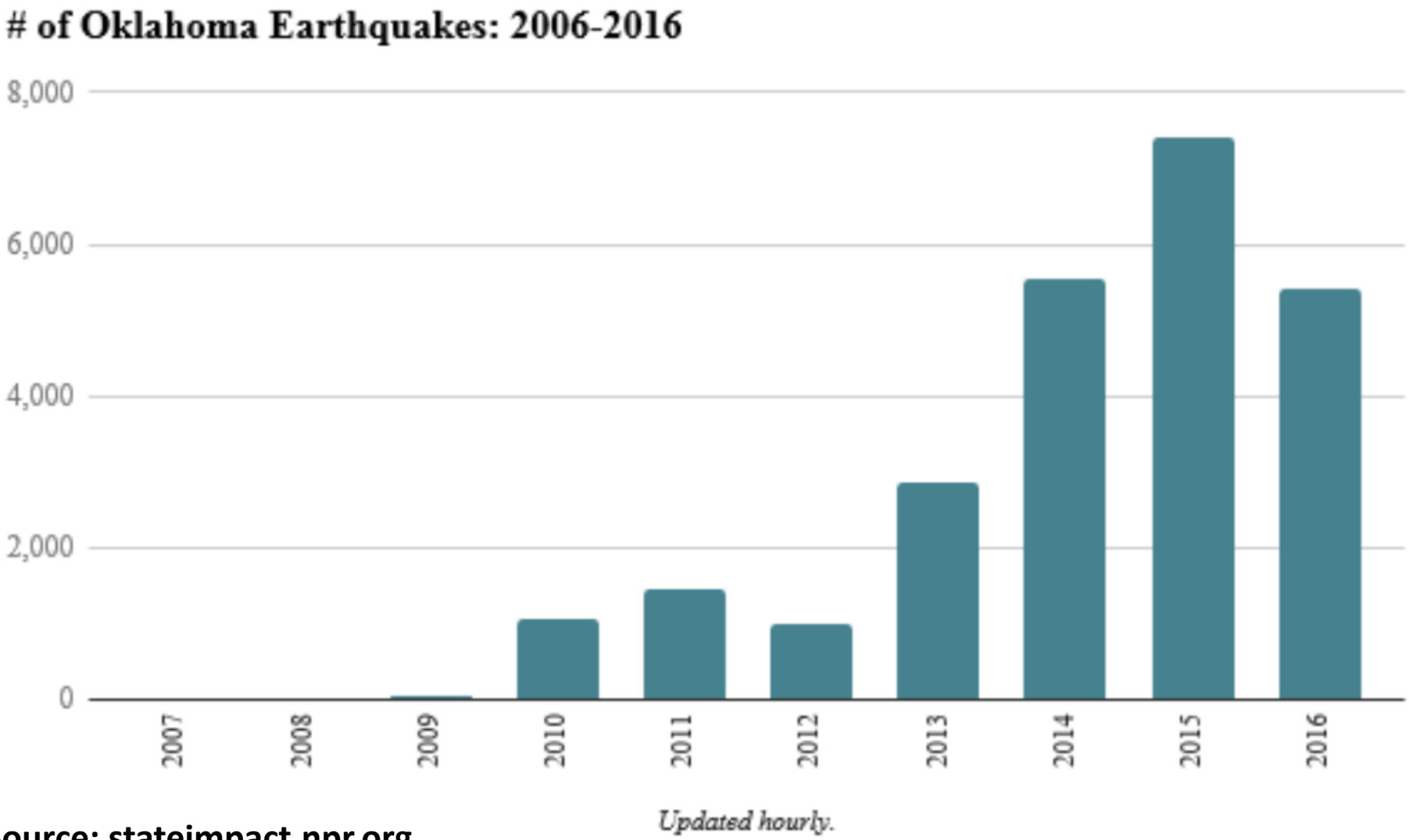


Source: earthquakes.ok.gov

Note: Only Earthquakes with a magnitude of 3.0 and higher are displayed.

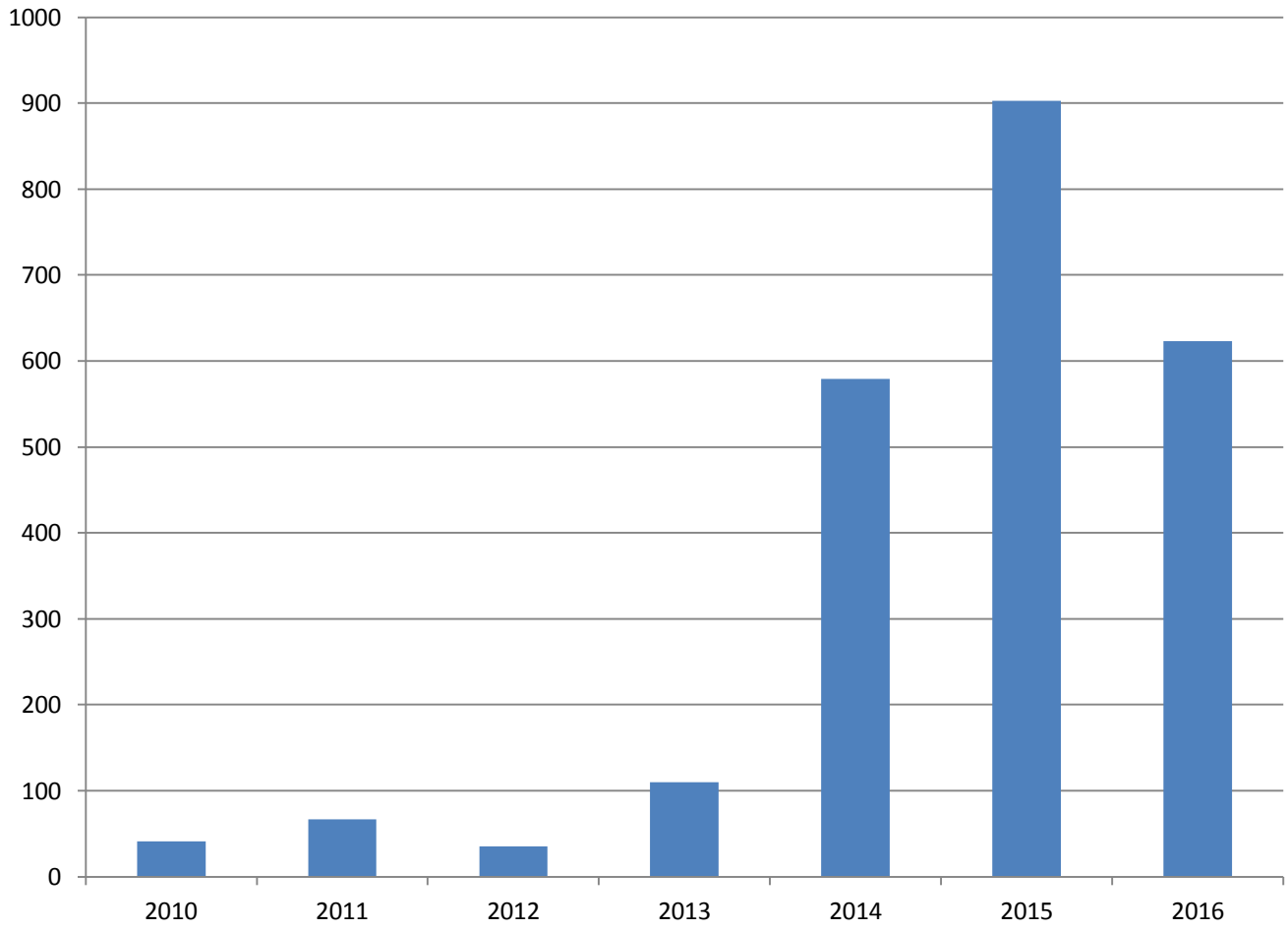
- [ ] Earthquakes - Past 7 days
- [ ] Earthquakes - 2012
- [ ] Arbuckle Waste Water Disposal Wells

Total Oklahoma Earthquakes



Source: stateimpact.npr.org

Oklahoma Earthquakes >3.0



Source: earthquakes.ok.gov

OWRB
the water agency