



OWRB Produced Water Working Group
November 2, 2016

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Agenda

1. Produced Water Quality Request
 - A. Where to return data?
 - B. Timing
2. Summary of Subcommittee Meetings and Conference Calls
3. Water treatment status
4. Produced Water and Potential User Data in Map Form
5. Economic Case Development
6. Timing for draft report
7. Next Steps

Julie Cunningham

PWWG Subcommittee Overviews

1. Agriculture

- A. Big water use in specific areas
- B. Seasonality for irrigation – does not match with plant output
- C. Chemical spraying volumes are small relative to PW plant
- D. Land use (hay) may compliment some scenarios

2. Water Users and Water Discharge

- A. Power, chemical plants, other
- B. Municipal – probably not a consideration
- C. Discharge to stream – permit timing – talked to EPA
- D. Aquifer Storage & Recovery – no treatment before drinking – State regulatory process is ongoing
 - Inject to marginal quality aquifer
- E. Evaporation – potential to rid water at lower cost



PWWG Subcommittee Overview

1. Oil and Gas

- A. Re-use requires minimal treatment
- B. Industry is working on re-use now
- C. Is there a way to compare to other economic scenarios?
- D. Incentives needed?



2. Regulatory and Challenges

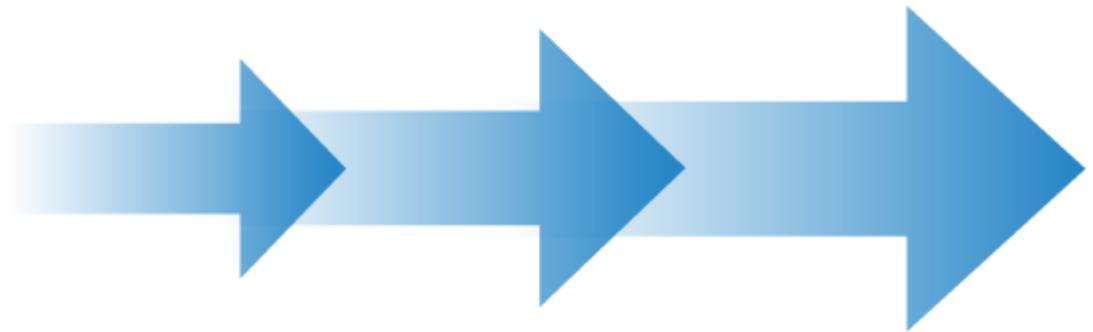
- A. Commercial treatment facility designation - higher bonding
- B. NPDES permits -challenge to obtain, including the timing requirements.
- C. Produced water ownership – Value and liabilities
- D. Right-of-Way (ROW) and landowner negotiations
- E. Costs to re-use vs. disposal
- 5 F. Legal custody of water as it relates to potential spills

Water Treatment Update

1. Six producing companies suggested treatment companies that had delivered in prior projects
2. Plan to send Request For Information (RFI) to 12 treatment companies for cost estimates for a number of treatment scenarios
3. Variables for treatment scenarios
 - A. 20,000 Barrels of Water Per Day (BWPD) and 100,000 BWPD
 - B. Varying TDS levels: 10,000, 30,000, 150,000 mg/l
 - C. Contract term assumption: 2 years and 10 years
 - D. Quality needed: “Clean brine” and TDS removal (desalination)

Summary of Data Analysis Completed to Date

1. Quantified/classified water use by county.
2. Evaluated produced water supply versus demands based on data provided by the PWWG.
3. Identified 16 matches which could be potential economic scenarios.
4. Developed screening matrix to shortlist the 16 potential scenarios down to 7 for further evaluation based on produced water quality data and treatment requirements



Commercial Water use by County

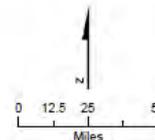
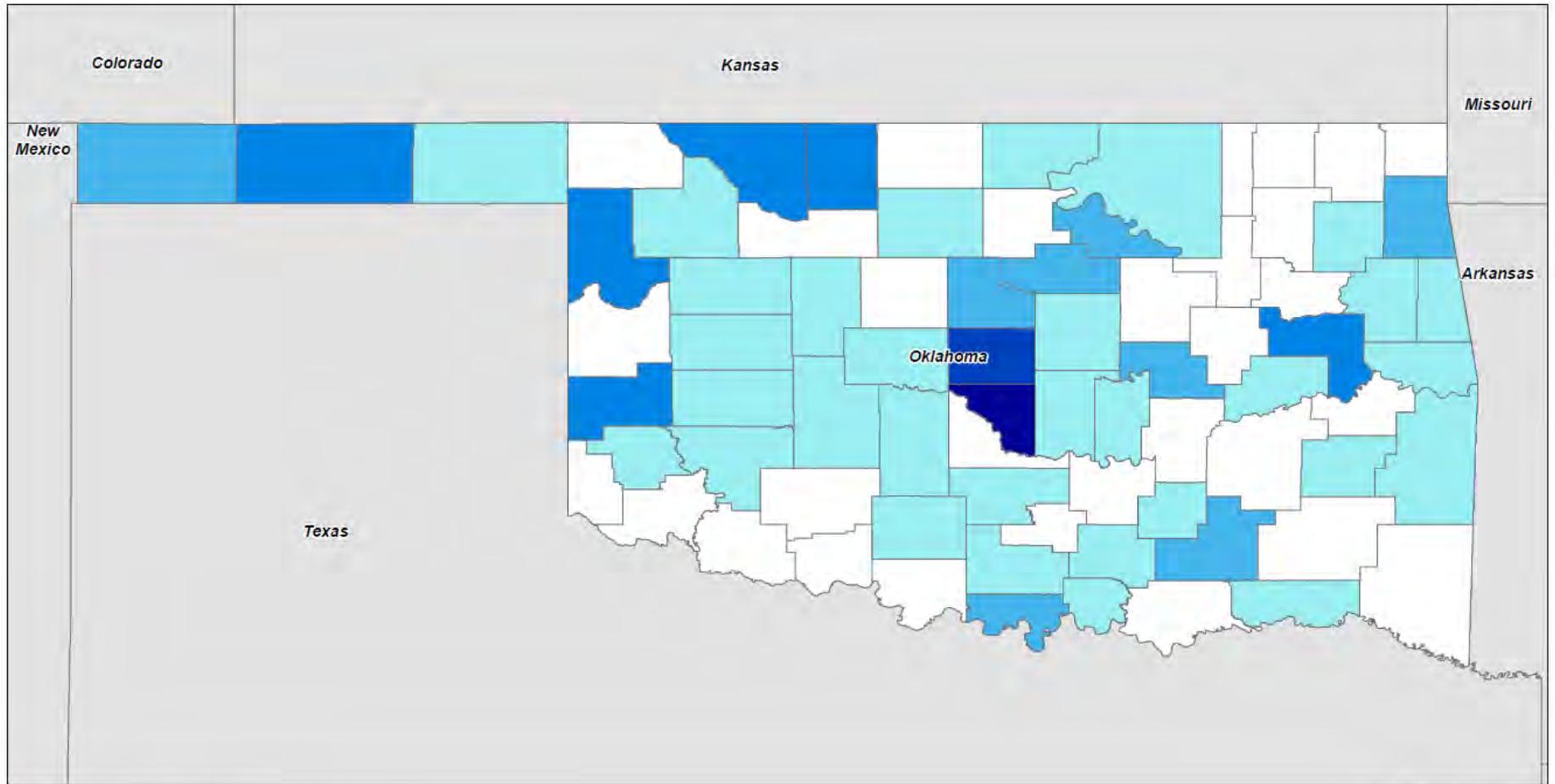
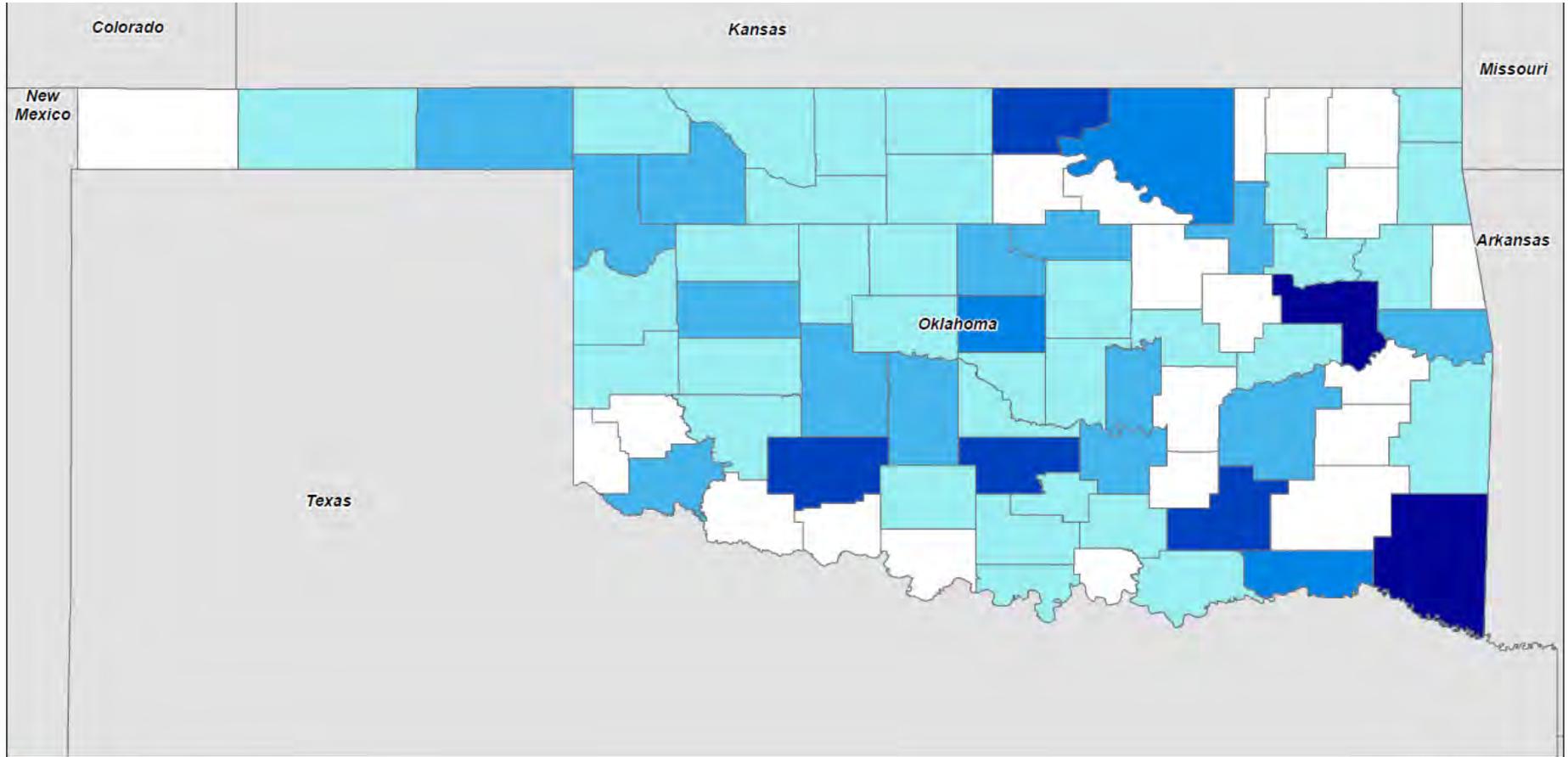


FIGURE X
Commercial Use by County
Produced Water Study
Oklahoma

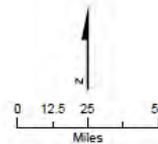
Industrial Water use by County



LEGEND
Industrial Primary Use (MGD)
 0.01 - 0.51
 0.52 - 1.49
 1.50 - 3.02
 3.03 - 11.03
 11.04 - 34.16

County Boundary
 State Boundary

FIGURE X
 Industrial Use by County
 Produced Water Study
 Oklahoma



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Irrigation Water use by County

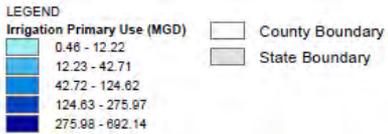
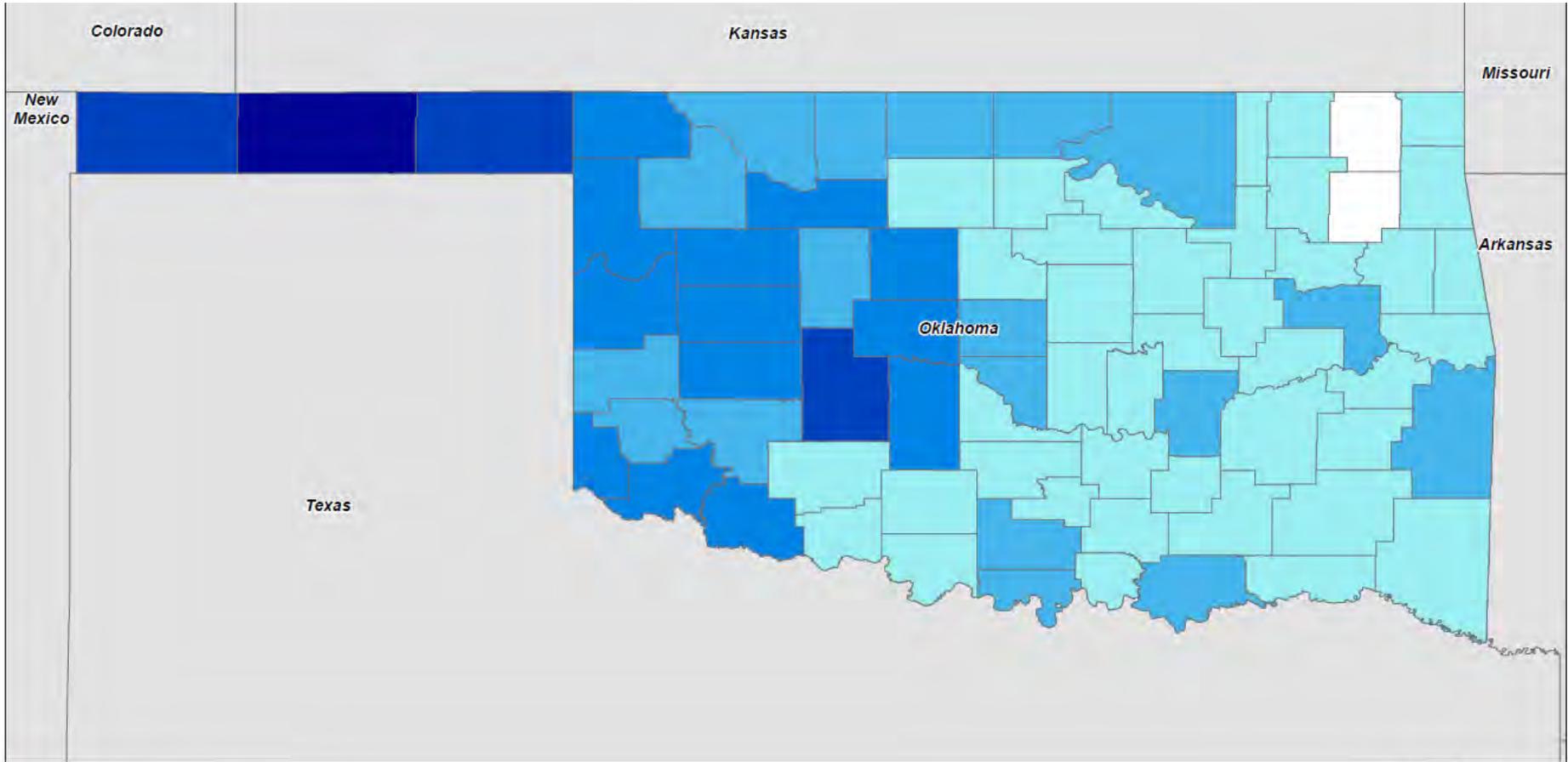
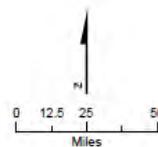


FIGURE X
Irrigation Use by County
Produced Water Study
Oklahoma



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Power Industry's Water use by County

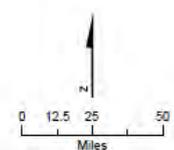
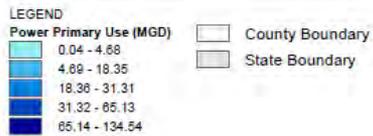
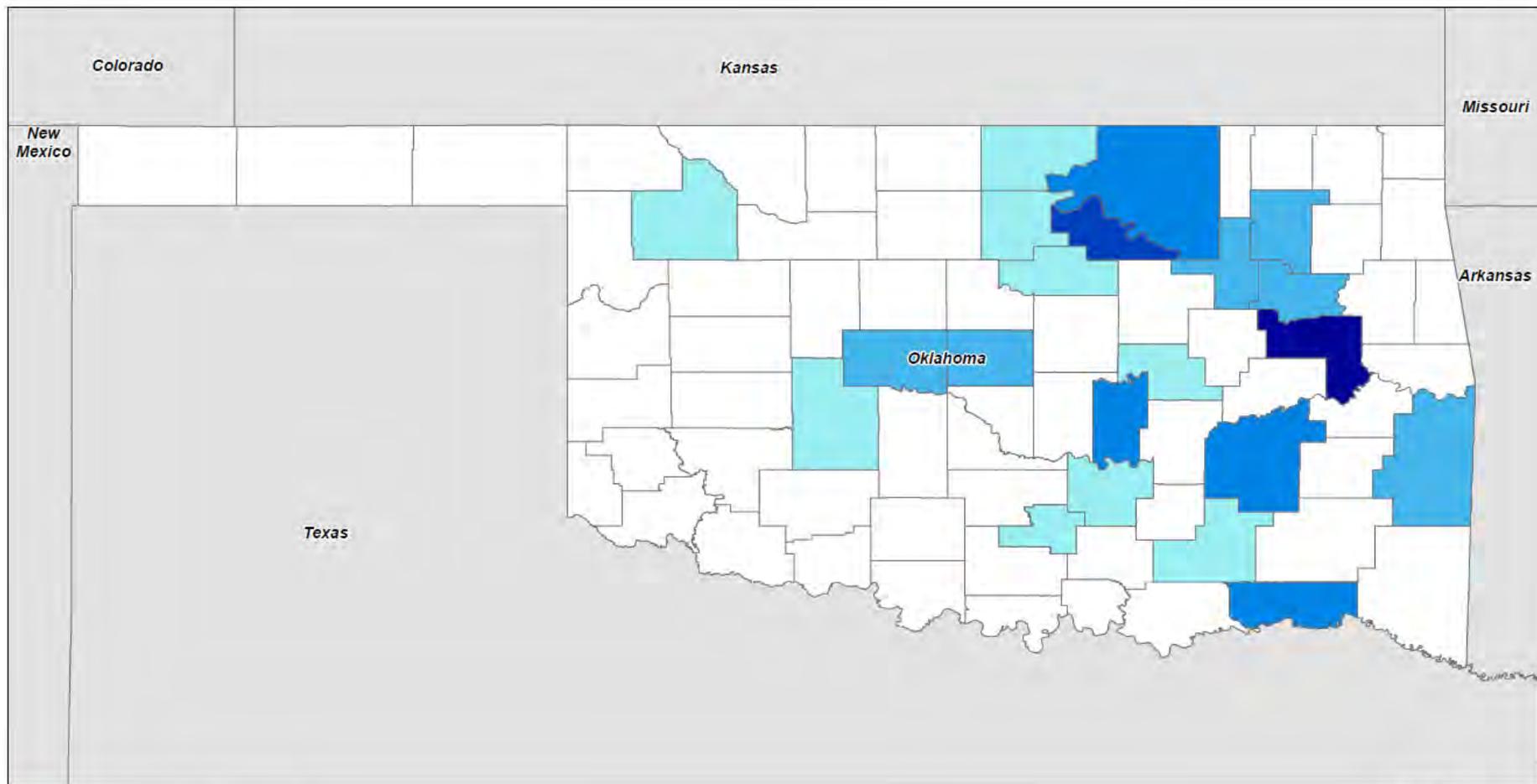


FIGURE X
Power Use by County
Produced Water Study
Oklahoma

Recreation, Fish & Wildlife - Water use by County

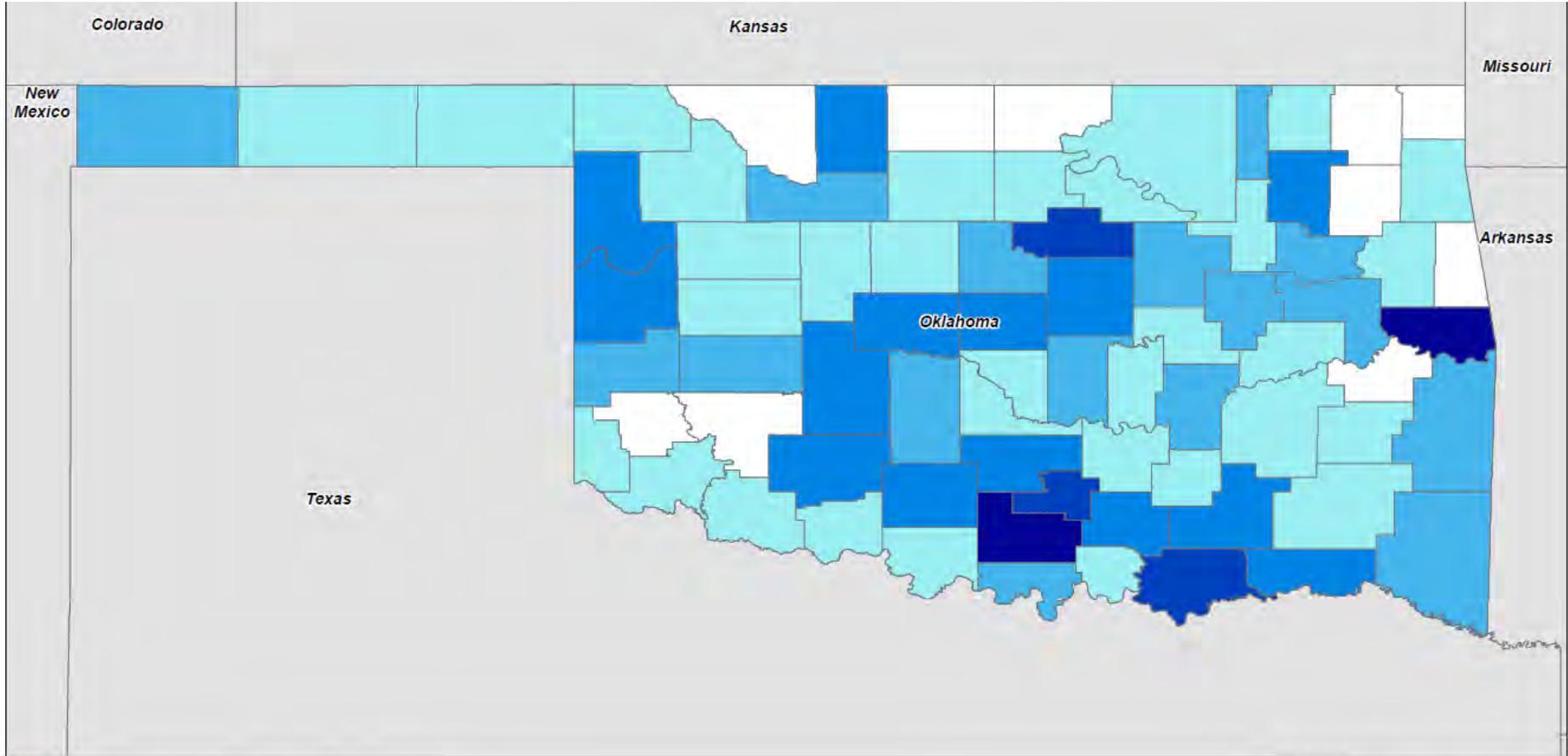
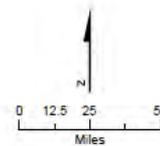


FIGURE X
 Recreation, Fish and Wildlife Use by County
 Produced Water Study
 Oklahoma



Produced Water Disposal & Water Users

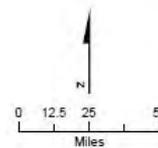
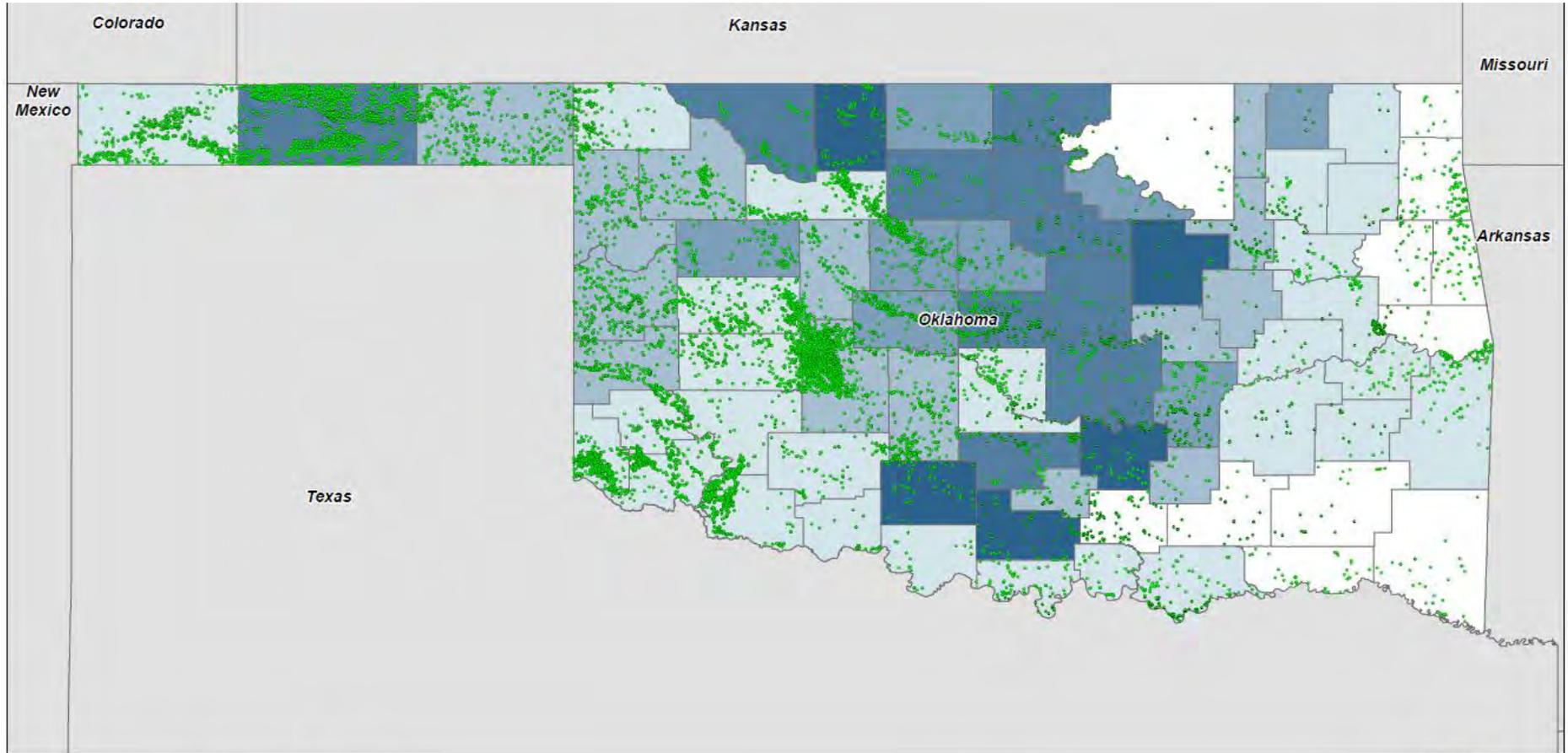
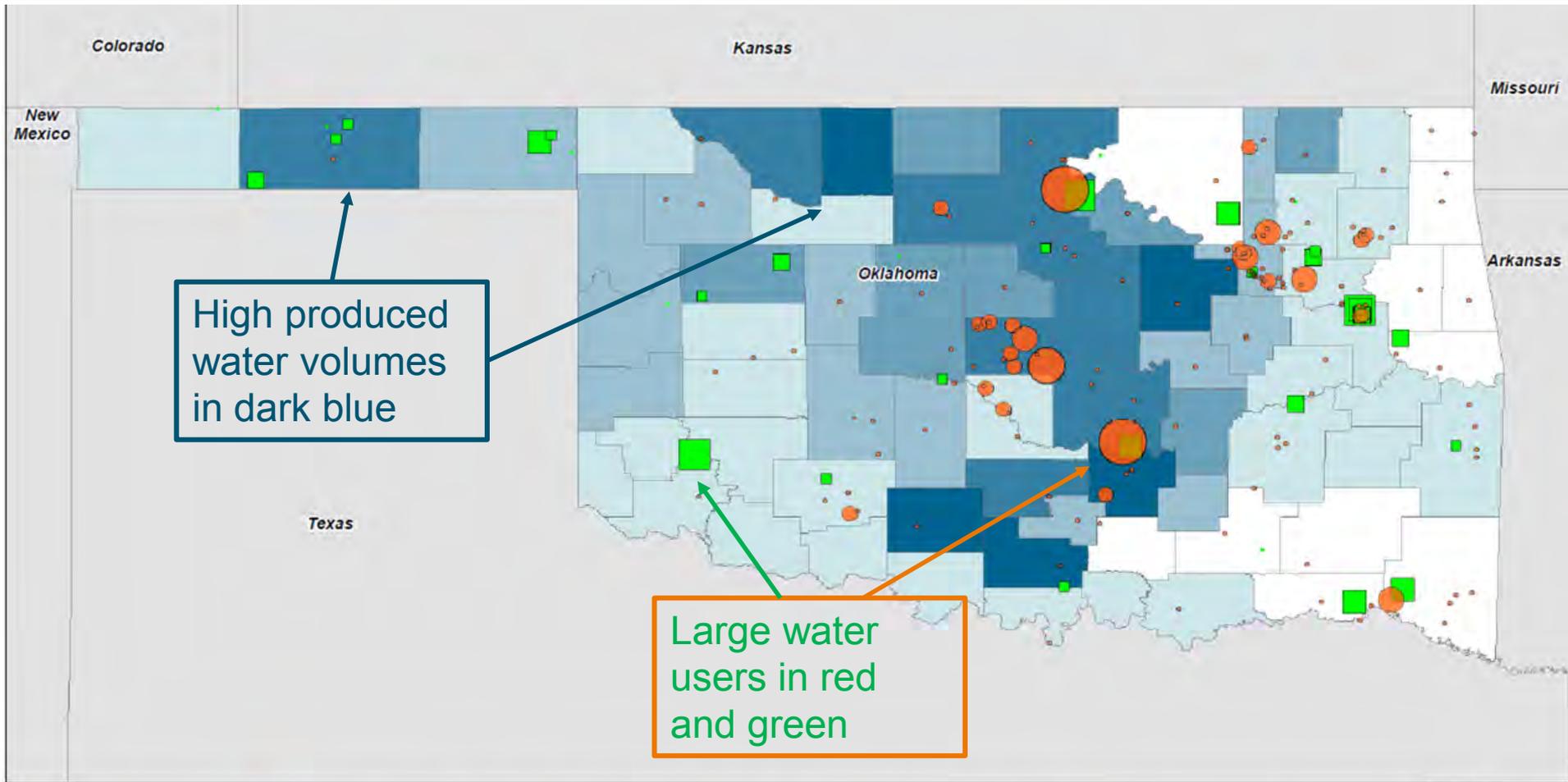


FIGURE X
Water Users
Produced Water Study
Oklahoma

Preliminary Matches of PW & Water Users



High produced water volumes in dark blue

Large water users in red and green

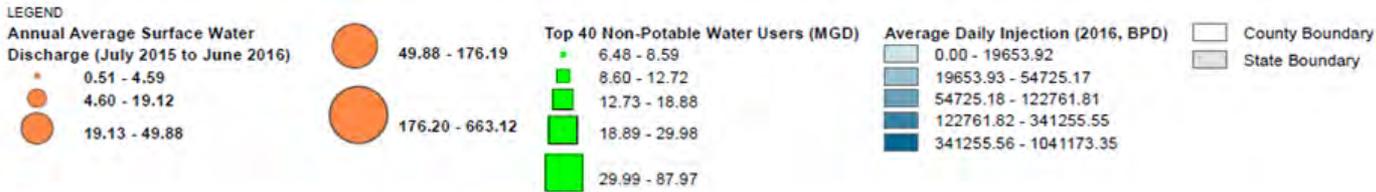
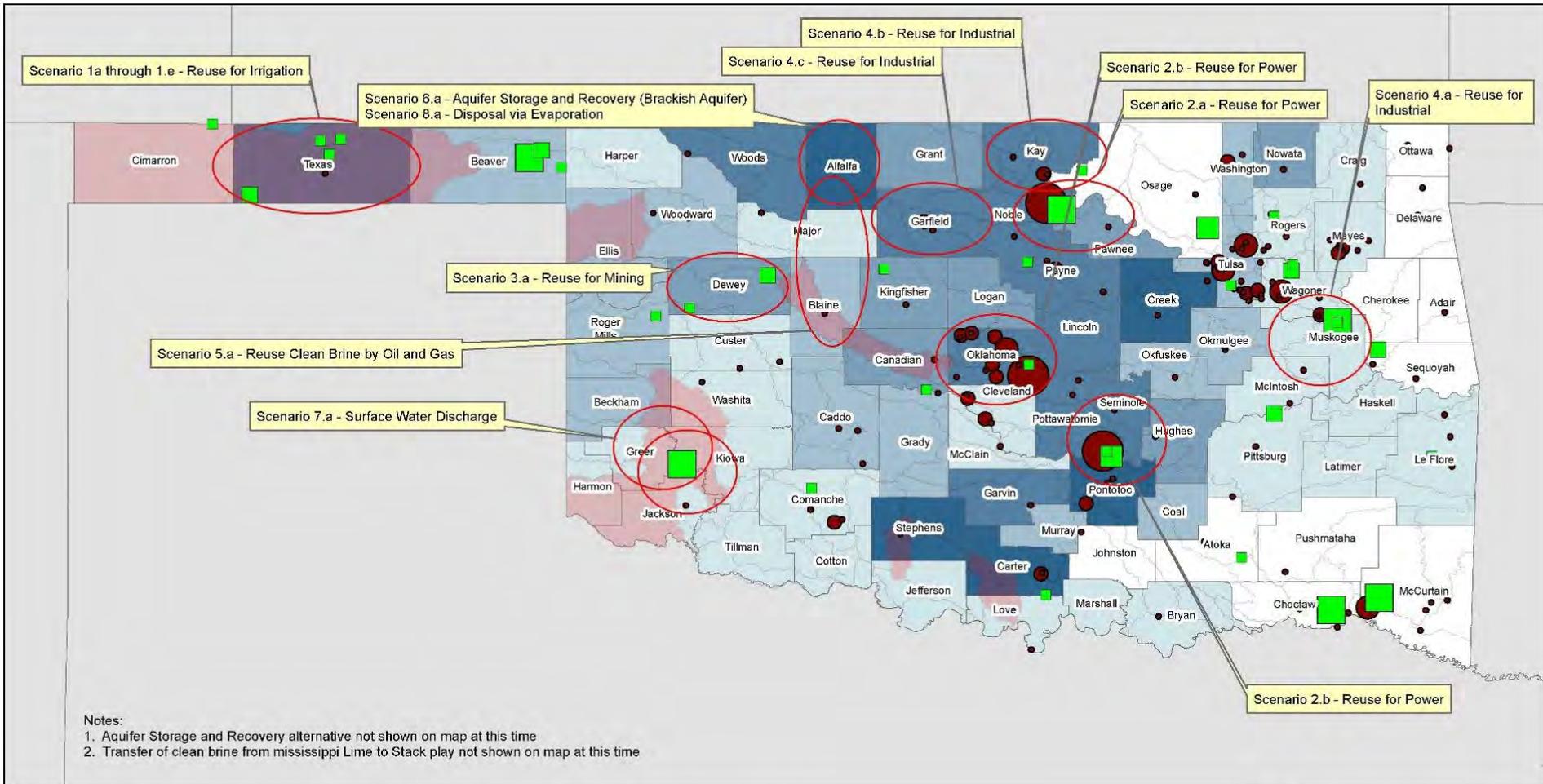


FIGURE 1
Produced Water Study
Oklahoma

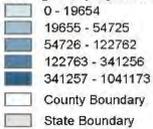


Preliminary Matches of PW & Water Users



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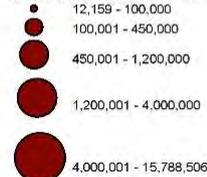
Average Daily Injection (2016, BPD)



Top 40 Water Users (BPD)



Annual Average Surface Water Discharge (BPD) June 2015 to July 2016



OCWP Water Plan Basins

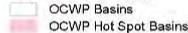
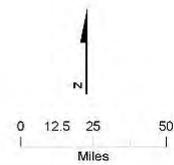


FIGURE 1
Overview - Produced Water versus Water Users
Produced Water Study
Oklahoma



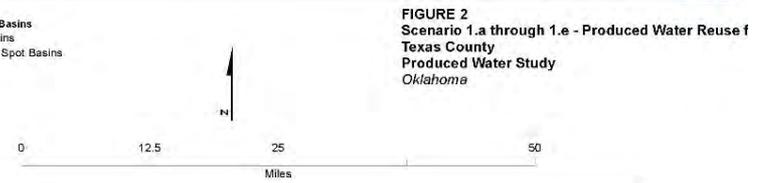
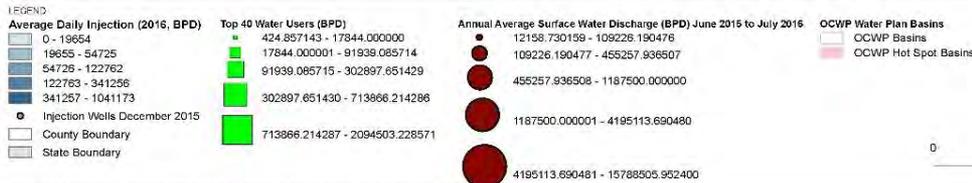
Screening Matrix

Scenario	Water Use	County	Potential User(s)	Volume Needed (BPD)	Volume Produced in County (BPD)	Match Supply and Demand	Located in OCWP Hot Spot Basin	Year Around User	Treatment Required	Regulatory Challenges
1.a	Irrigation	Texas	Heimsoth Partners	217,739	149,403	X	X		X	X
1.b		Texas	Russell Family Partnership	449,499	149,403	X	X		X	X
1.c		Texas	Fischer Family Farms LP	227,681	149,403	X	X		X	X
1.d		Texas	Stephens Land & Cattle Co Inc	195,477	149,403	X	X		X	X
1.e		Texas	Chemical Spray for Agriculture/Irrigation	<10,000 ²	149,403			X		X
2.a	Power	Pawnee	Oklahoma Gas and Electric Company	1,550,729	93,787			X	X	X
2.b		Oklahoma	Oklahoma Gas and Electric Company	203,617	191,323	X		X	X	X
2.c		Seminole	Oklahoma Gas and Electric Company	743,499	329,065	X		X	X	X
3.a	Mining	Dewey	Kauk Mike and LaDena	223,199	122,762	X		TBD	X	X
4.a	Industrial	Muskogee	Georgia-Pacific Consumer Products	752,741	4,108			X	X	X
4.b		Kay	Phillips Refinery	131,748	173,719	X		X	X	X
4.c		Garfield	Koch (Chemical Manufacturing) ³	10,000,000	146,793			X	X	X
5.a	Oil and Gas	Alfalfa to Blaine	Transfer Produced Water	250,000	600,560	X	X	X	X	X
6.a	Oil and Gas or Other?	Alfalfa	Aquifer Storage and Recovery - in Saline Aquifer	TBD	600,560	X		X	X	X
7.a	Surface Water Discharge	Beckham	Irrigation - Lugert-Altus Irrigation District	1,819,025	22,323		X	X	X	X
8.a	Evaporation	Alfalfa	None	NA	600,560	X		X		

*Uses highlighted have been shortlisted for further evaluation; assume one from "Power" and one from "Industrial" will be selected based on water quality.

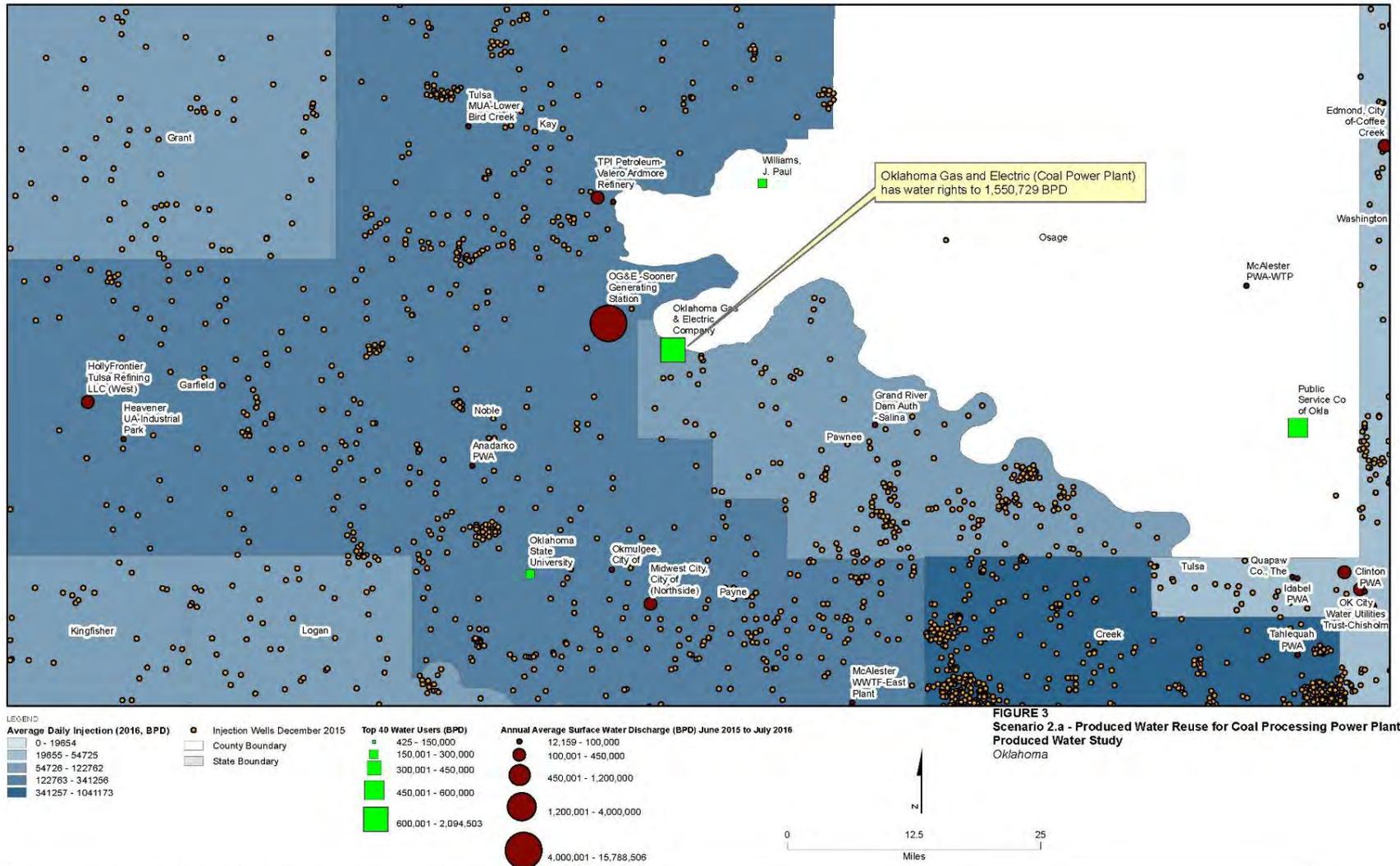
Scenario 1: Irrigation and Chemical Spray

- Not feasible due to seasonal demands for irrigation and small volume of water required for chemical spraying.



Scenario 2.a: Power (Coal Power Plant)

- One alternative match between power plant water demands and an area of high produced water.



Scenario 3.a: Mining

- Further evaluation is required to determine seasonality of water demands, water quality requirements, etc.

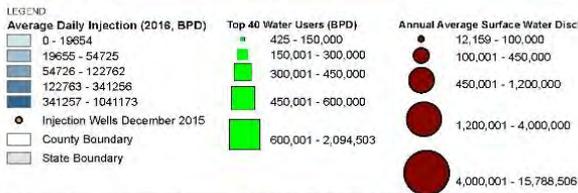
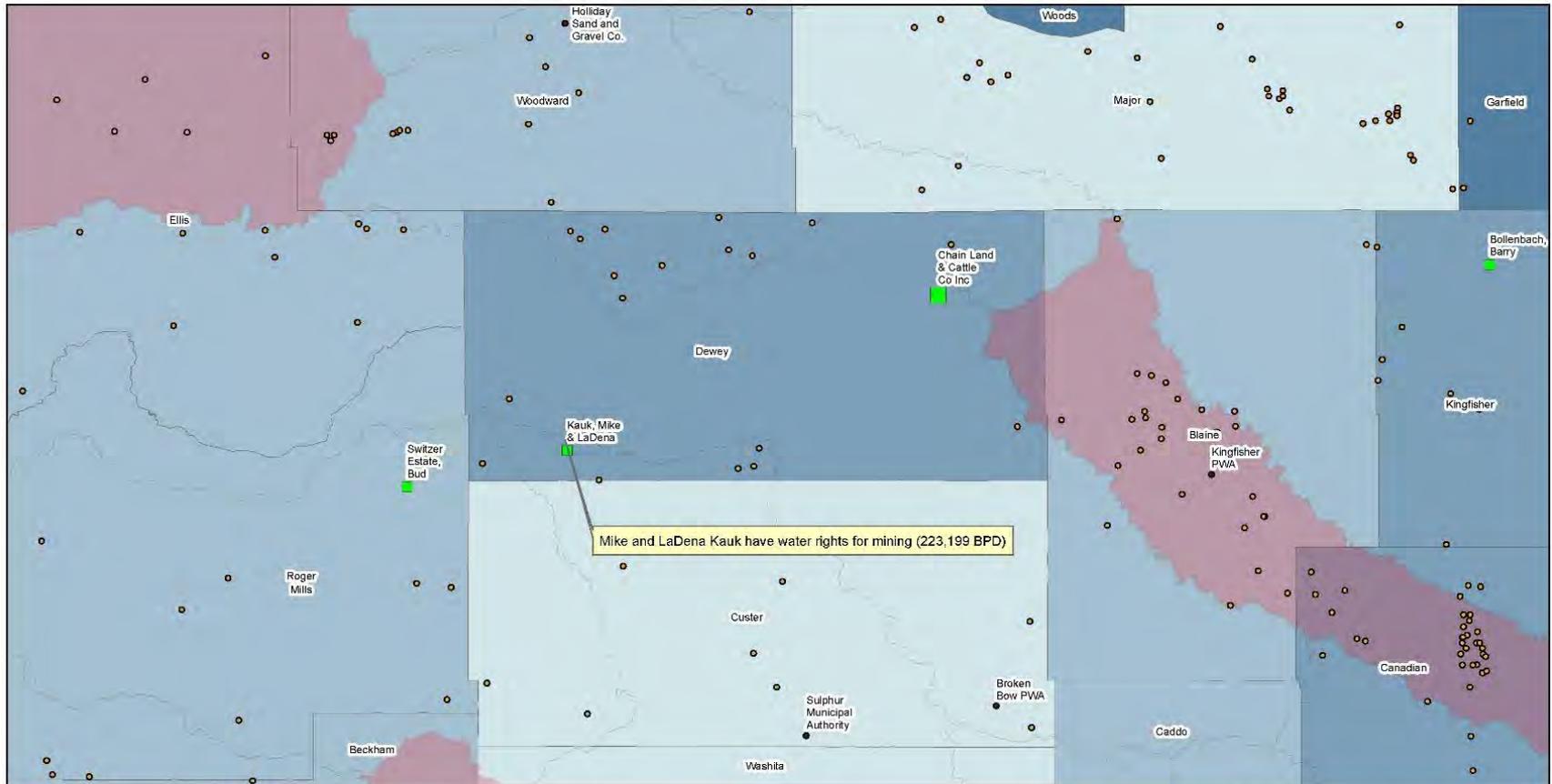
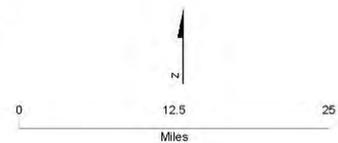


FIGURE 6
Scenario 3.a - Produced Water Reuse for Mining
Dewey County
Produced Water Study
Oklahoma



Scenario 5.a: Transfer Clean Brine for O/G

- Transfer clean brine from Mississippi Lime to Stack play for oil and gas use.

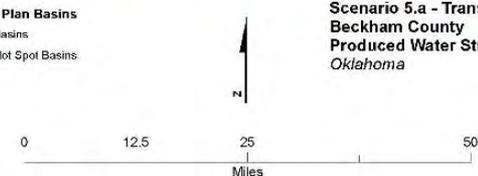
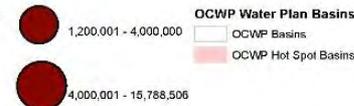
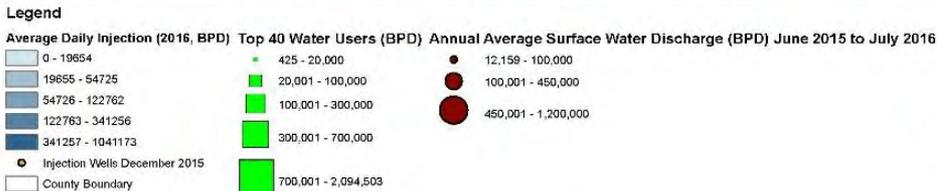
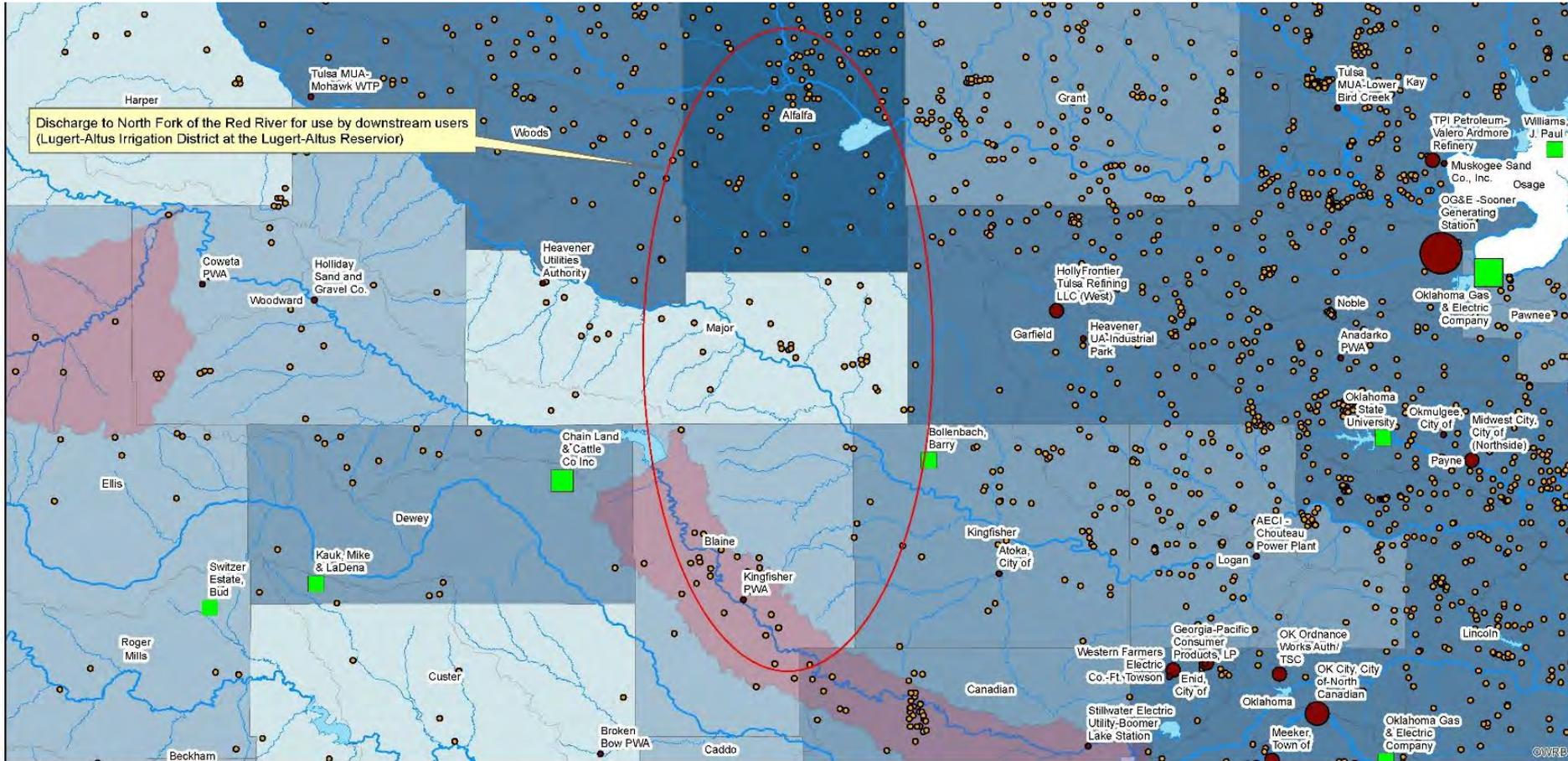


FIGURE 9
Scenario 5.a - Transfer Clean Brine for O/G
Beckham County
Produced Water Study
Oklahoma

Scenario 6.a: Aquifer Storage and Recovery

- Aquifer storage and recovery into a brackish aquifer.
- Higher chloride concentrations around Great Salt Plains Reservoir.
- May be a potential to improve native water quality and provide incentive for ASR.
- Target shallow depth to brackish water.

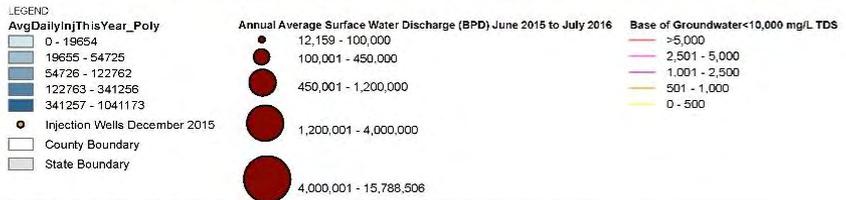
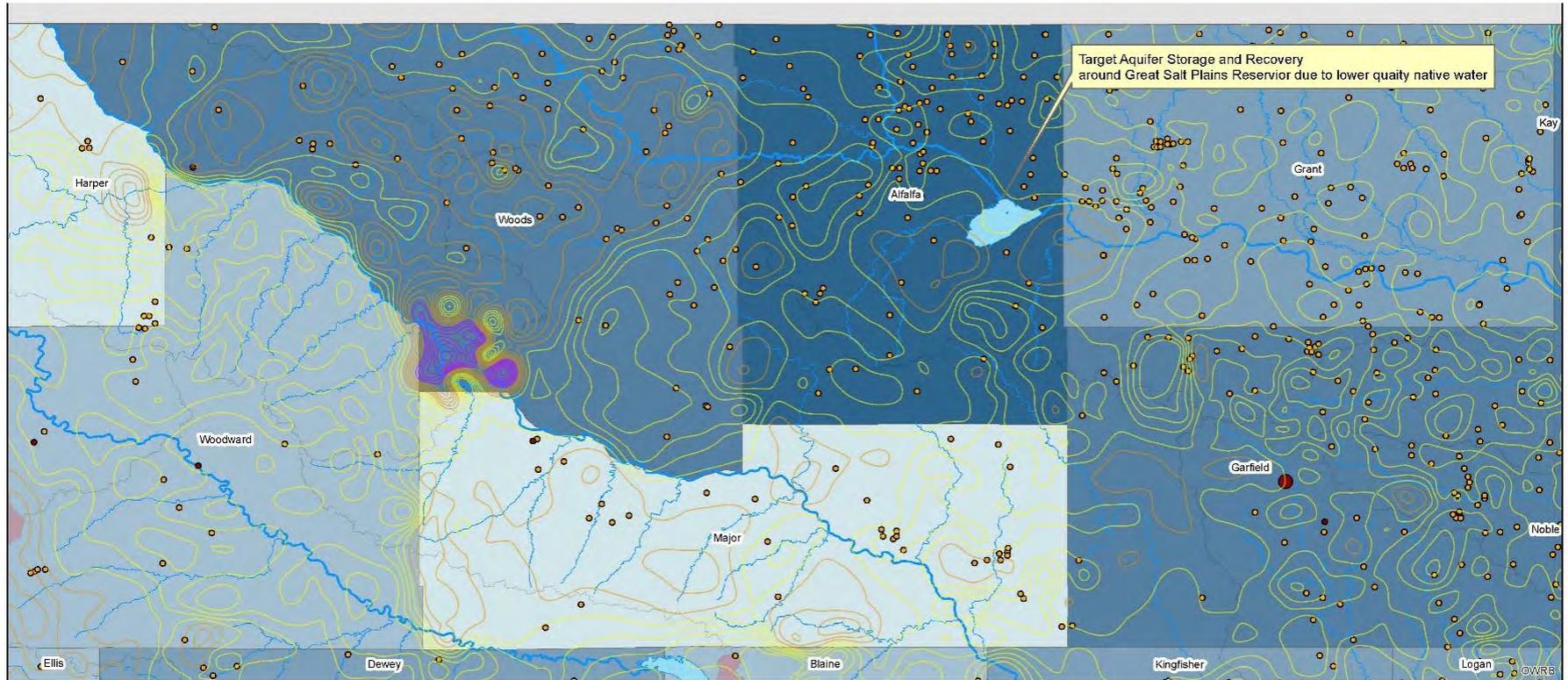
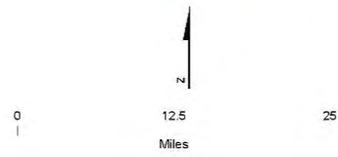


FIGURE 10
Scenario 6.a - Produced Water Reuse for
Aquifer Storage and Recovery into Brackish Groundwater
Alfalfa County
Produced Water Study
Oklahoma



Scenario 7.a: Surface Water Discharge

- Target hot spot basin.
- Discharge into North Fork of the Red River in Beckham County due to higher produced water volumes.
- North Fork of the Red River supplies the Lugert-Altus Irrigation District Reservoir.

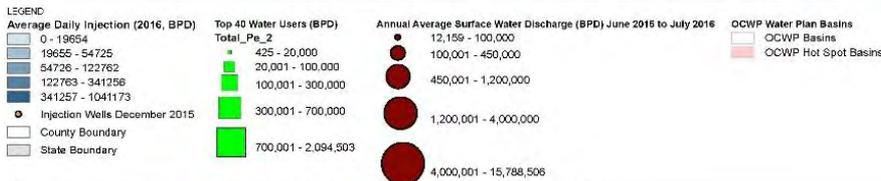
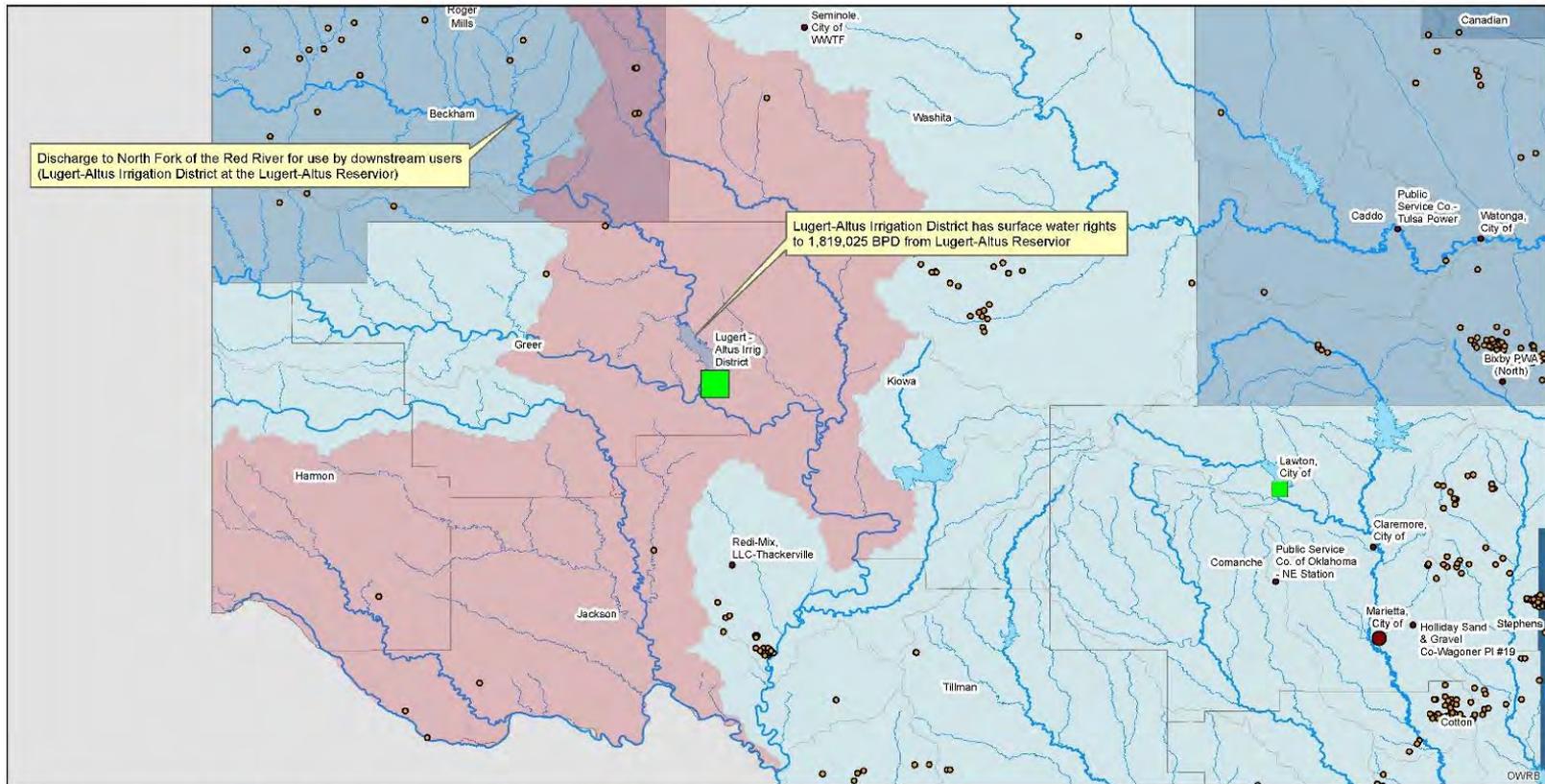
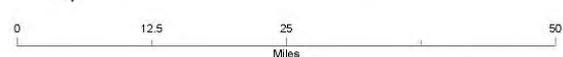


FIGURE 11
Scenario 7.a - Surface Water Discharge
Beckham County
Produced Water Study
Oklahoma



Scenario 8.a: Evaporation

- Evaporation ponds in Alfalfa County due to high volume of produced water and vicinity to oil and gas activity
- Current produced water estimates 600,560 BPD.

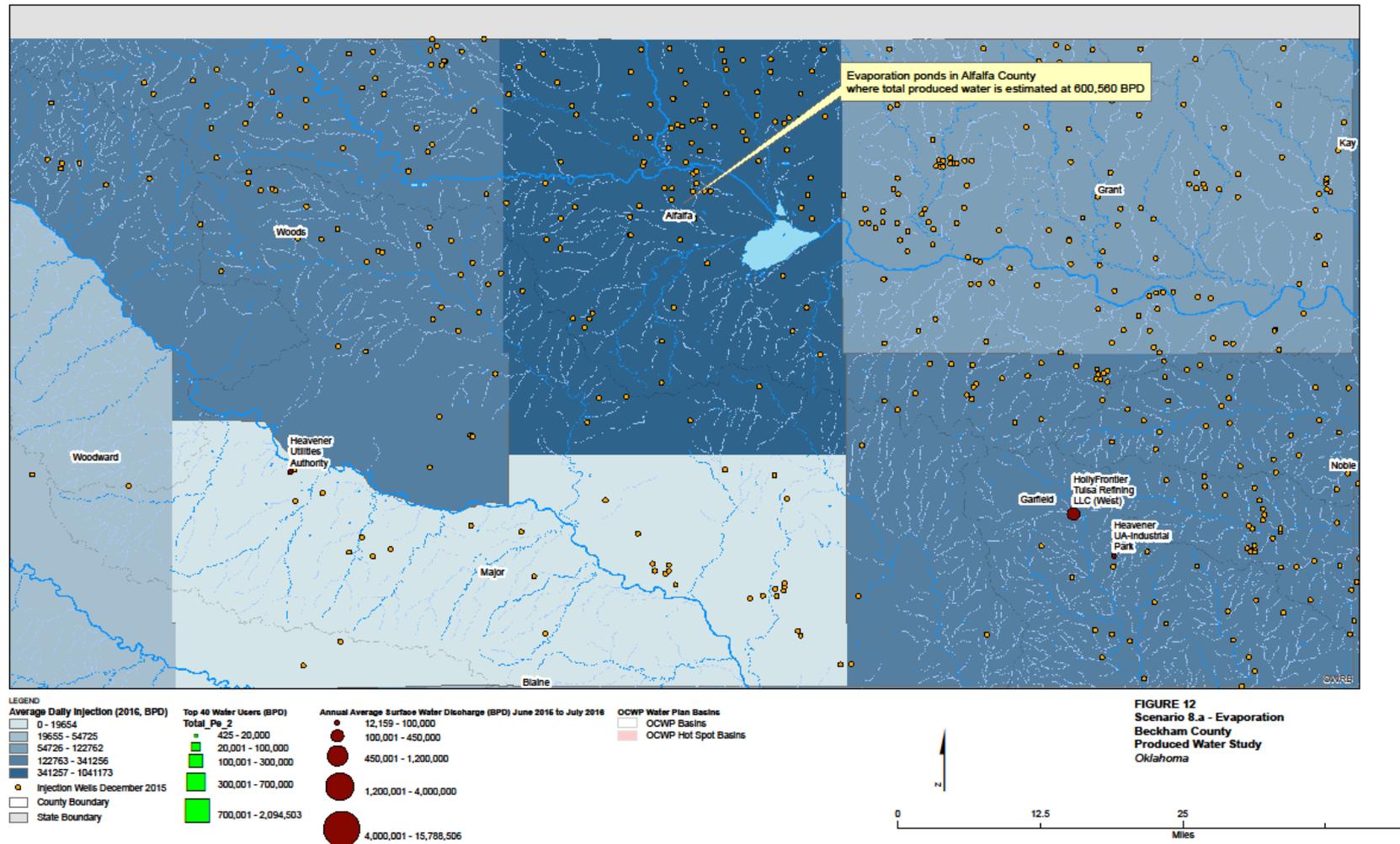


FIGURE 12
Scenario 8.a - Evaporation
Beckham County
Produced Water Study
Oklahoma

Next Steps - Timing

1. Produced water quality is crucial
2. Water treatment cost estimates
3. Cost estimates of economic scenarios
4. Review of economic conclusions
 - A. Next meeting in mid-December or January?
 - B. Phone meeting?
5. Review of draft report (February?)





Thank You

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