Development of Water Use Estimates and Projections in the Texas Mining and Oil and Gas Industries (FY2020)

Dec. 2020 – Aug. 2021

Bridget Scanlon, JP Nicot, Robert Reedy, and Qian Yang

Bureau of Economic Geology, Jackson School of Geosciences

University of Texas at Austin

Yun Cho and Katie Dahlberg: Project Managers, TWDB

Water Use Estimates Texas Mining and Oil and Gas

Oil and Gas

- Task 1. Quantify current and historical water use for **hydraulic fracturing and produced water** volumes
- Task 2. Identify the **sources of water** for hydraulic fracturing
- Task 3. Develop **projections** of future water demand for hydraulic fracturing for oil & gas (2030–2080)

Coal, Lignite, and Aggregates

- Task 4. Identify locations of operations and quantify current and projected future water use for **coal and lignite** mining
- Task 5. Identify locations of operations and quantify current and projected future water use for **aggregates**

Coordination:

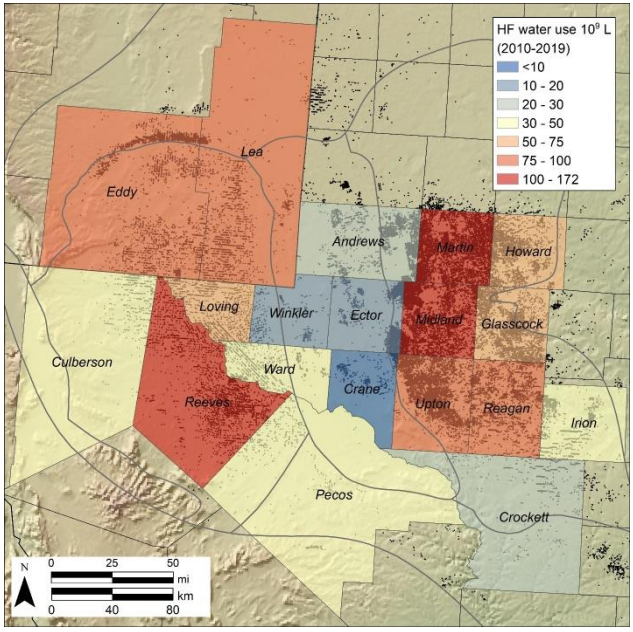
- Task 6. Collaborate with **USGS personnel** on water use for the mining category

Task 1. Quantify current and historical water use for hydraulic fracturing and produced water volumes

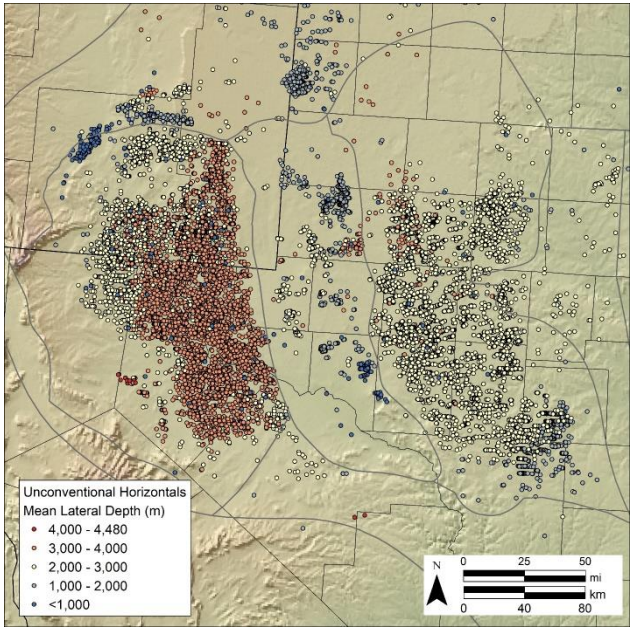
Hydraulic Fracturing

- Data sources for HF water use: FracFocus and IHS
- Time period: 2009 – 2020
- Permian, Eagle Ford, Barnett, and Haynesville
- Surveys to estimate water reuse

- **Produced water volumes**
  - Data sources: IHS database
  - Time period: 2009 – 2019
  - Focus on wells in unconventional reservoirs



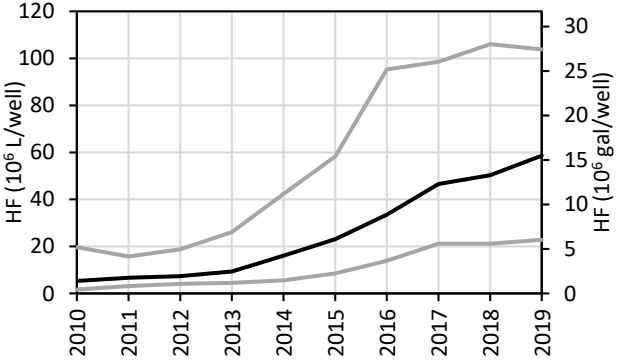
Hydraulic Fracturing Water Use (2010 through 2019)



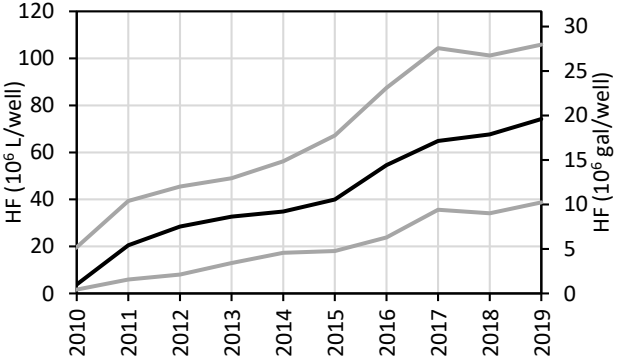
Horizontal Well Depths (2010 – 2019)

Hydraulic Fracturing Water Use per Well

Delaware Basin

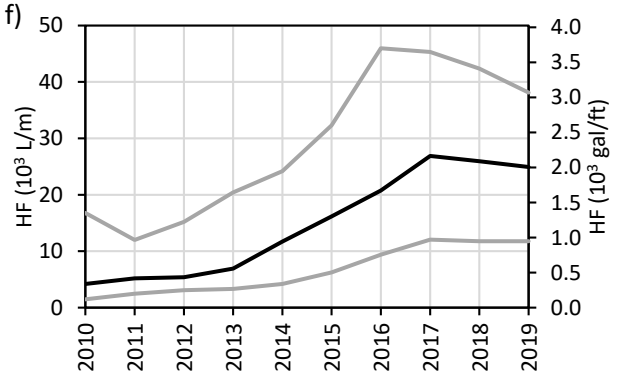


Midland Basin

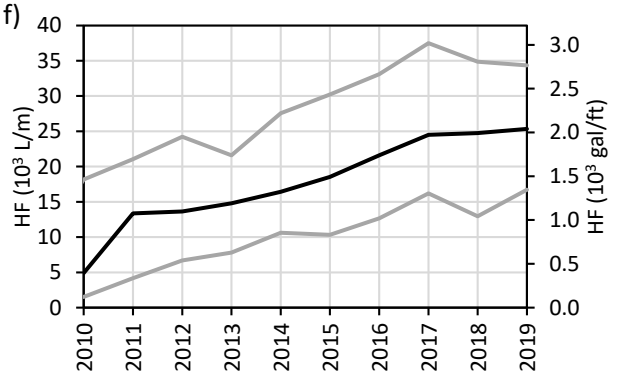


Hydraulic Fracturing Water Intensity per Foot of Lateral

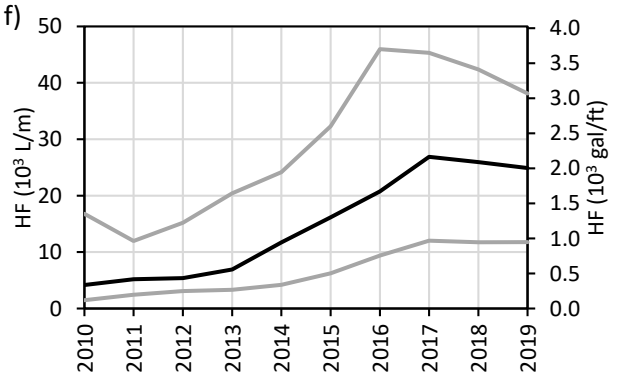
Delaware Basin

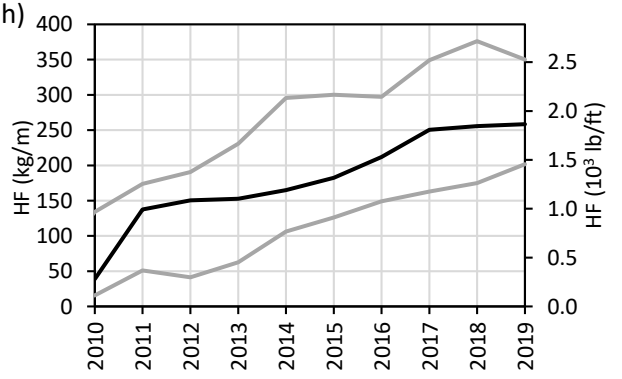


Midland Basin



Proppant Loading per Foot of Well Lateral

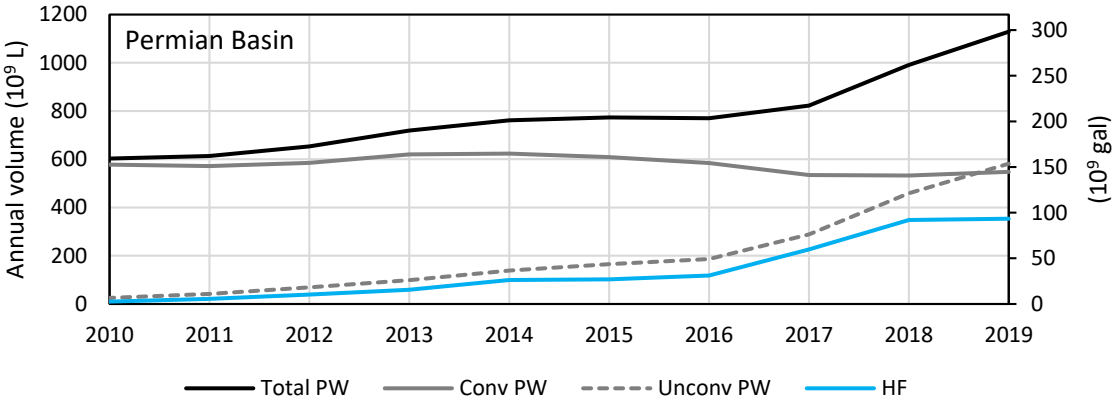




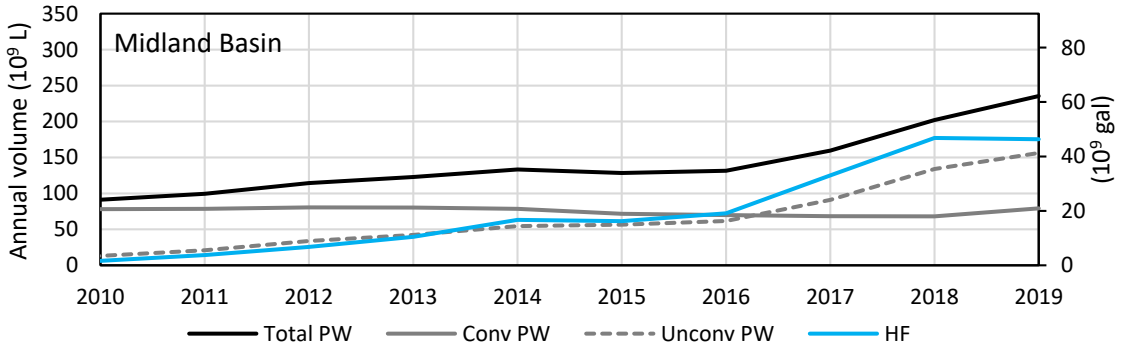
Comparison of water volumes for HF from TWDB FracFocus and BEG IHS (2019)

TWDB Play	TWDB FF mgal	BEG mgal	Counties
Anadarko	316	354	26
Barnett	253	366	26
Bossier	103	94	6
Eagle Ford	29,565	27,866	33
Haynesville	3,652	3,166	14
Misc	30	30	42
Olmos	0.1	0.3	2
Permian	46,508	48,454	56
Permian-Far West	23,156	22,904	5
None	0	0	44
Total	103,583	103,235	254

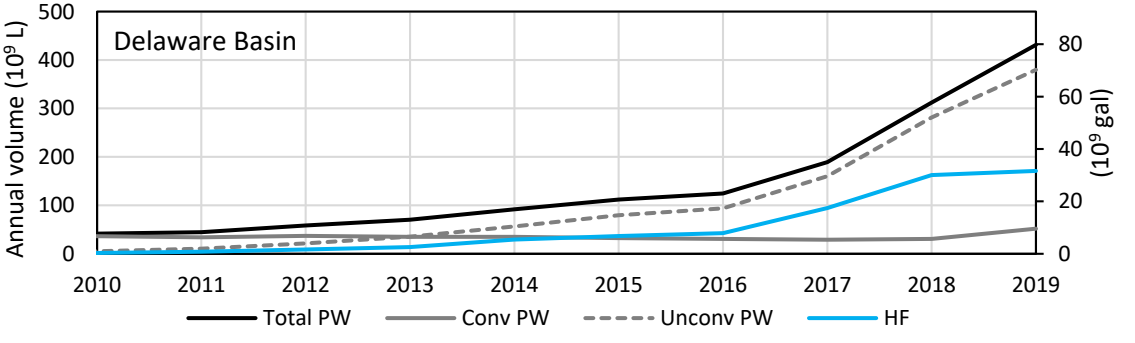
Produced Water Volumes in the Permian Basin (Conventional vs Unconventional Reservoirs)



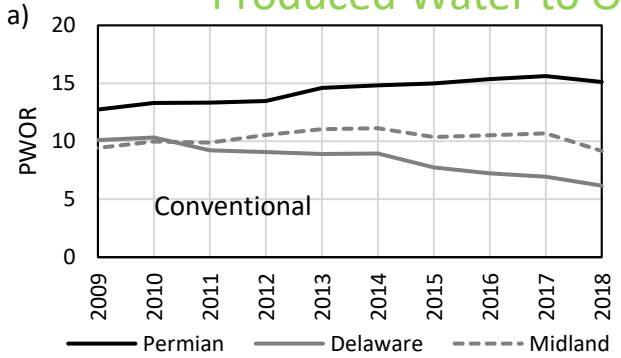
b)

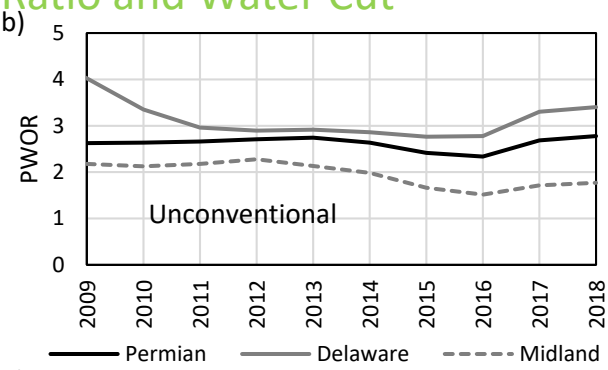

Midland Basin
Annual volume (10^9 L)
(10^9 gal)
350
300
250
200
150
100
50
0
80
60
40
20
0
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
Total PW
Conv PW
Unconv PW
HF

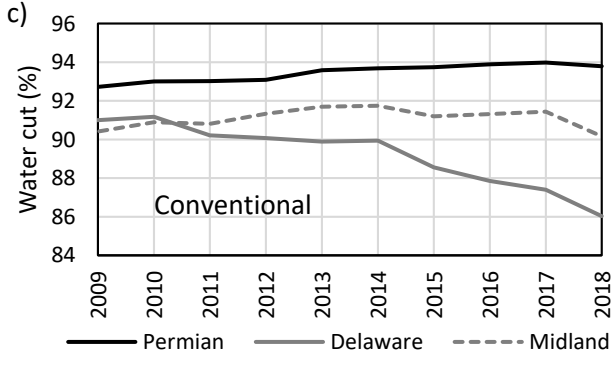
c)

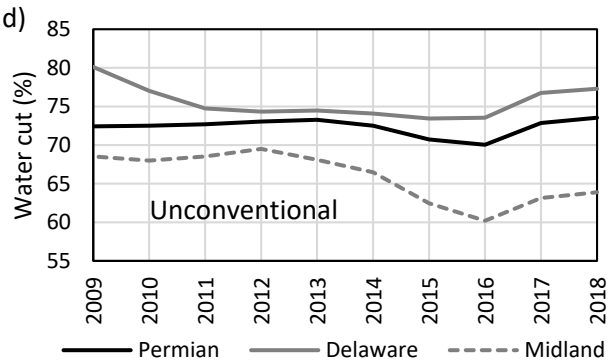

Delaware Basin
Annual volume (10^9 L)
(10^9 gal)
500
400
300
200
100
0
80
60
40
20
0
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
Total PW
Conv PW
Unconv PW
HF

Produced Water to Oil Ratio and Water Cut

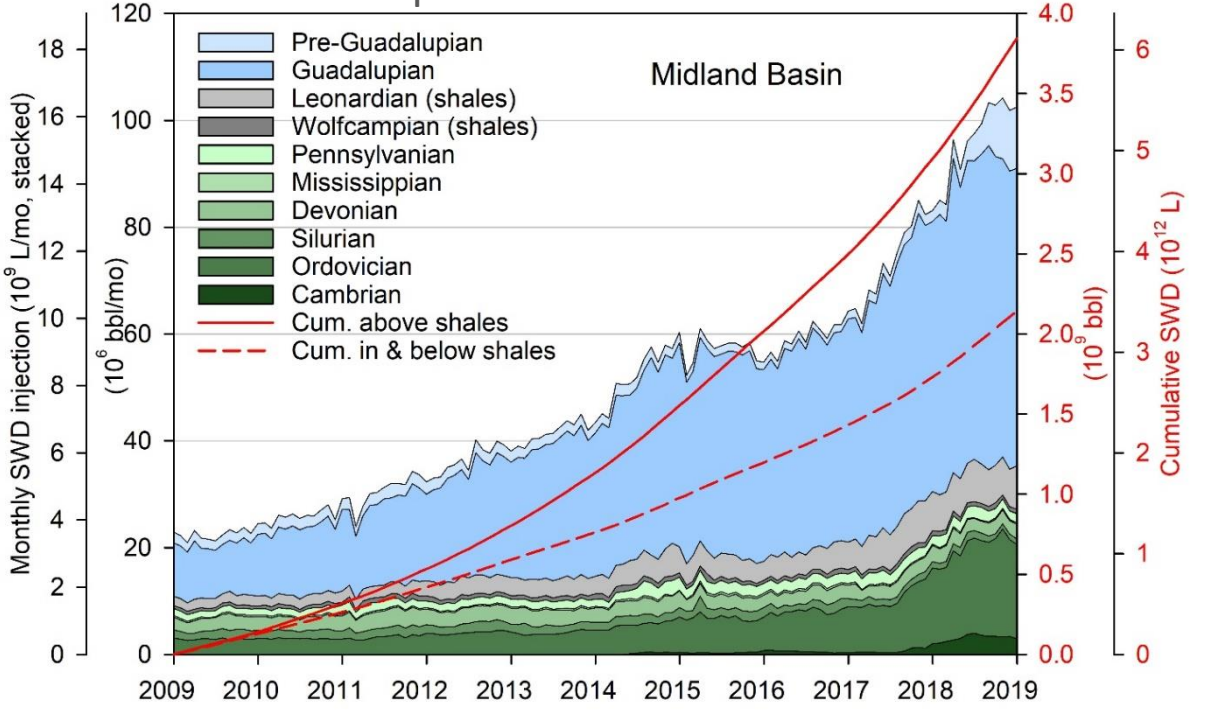




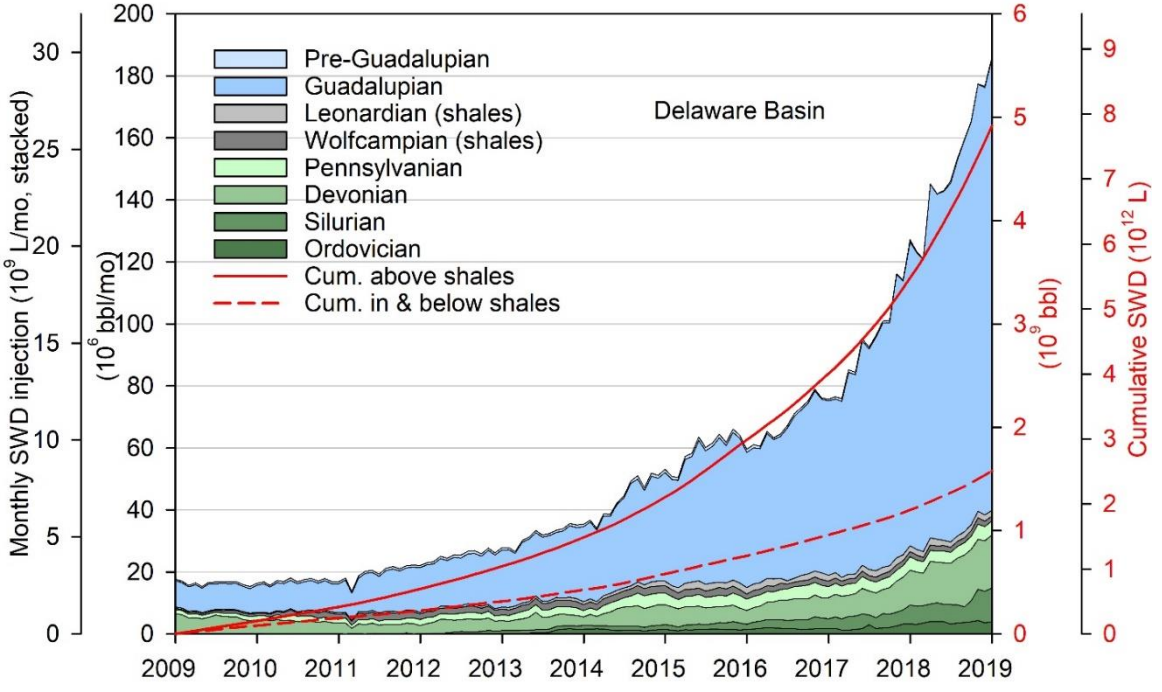




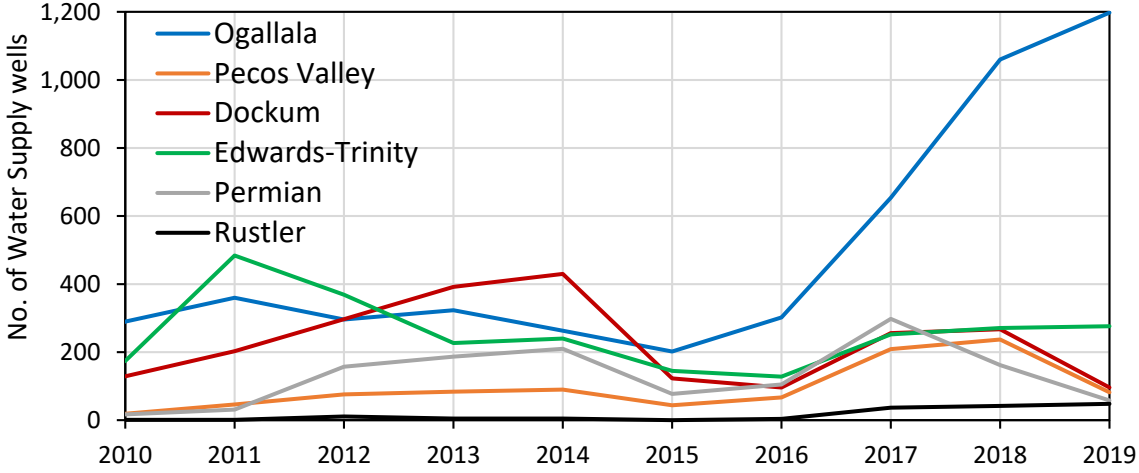
Salt Water Disposal Volumes in Midland Basin

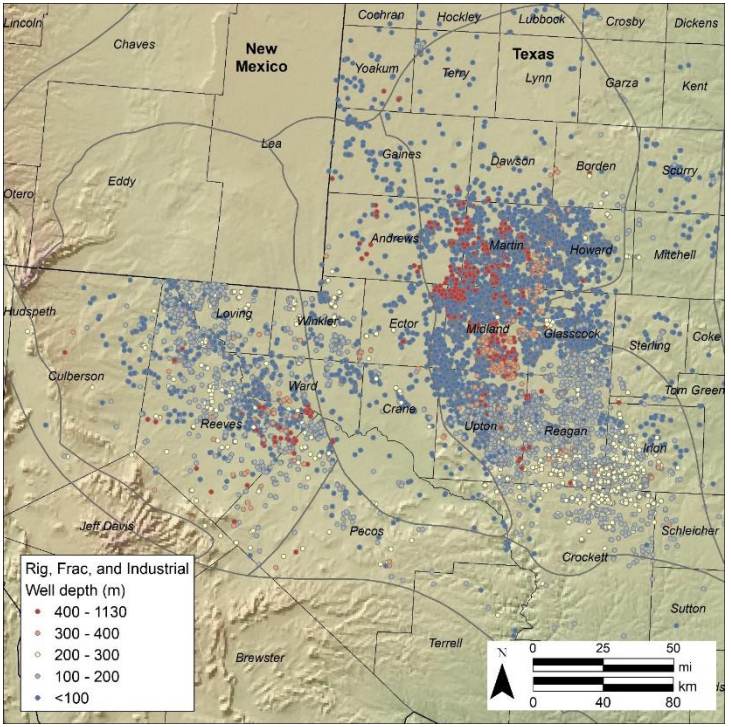


Salt Water Disposal Volumes in Midland Basin

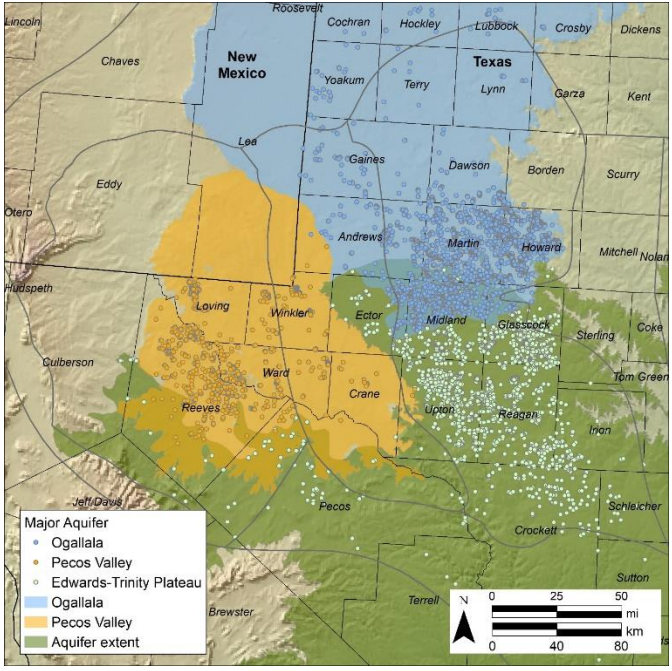


Task 2: Source Wells to Supply Water for Hydraulic Fracturing



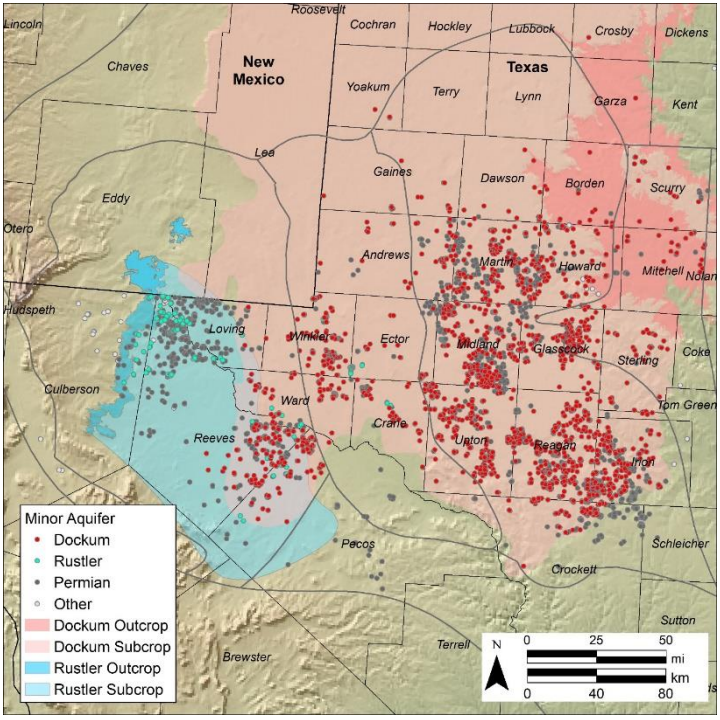


Depth of Rig, Frac, and Industrial Wells (2010 – 2019)



Rig, Frac, and Industrial Wells in Major Aquifers

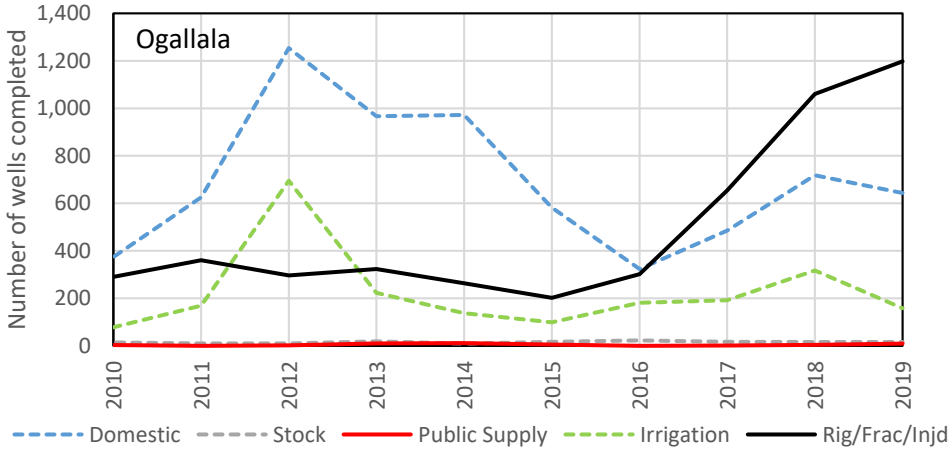
2010 - 2019



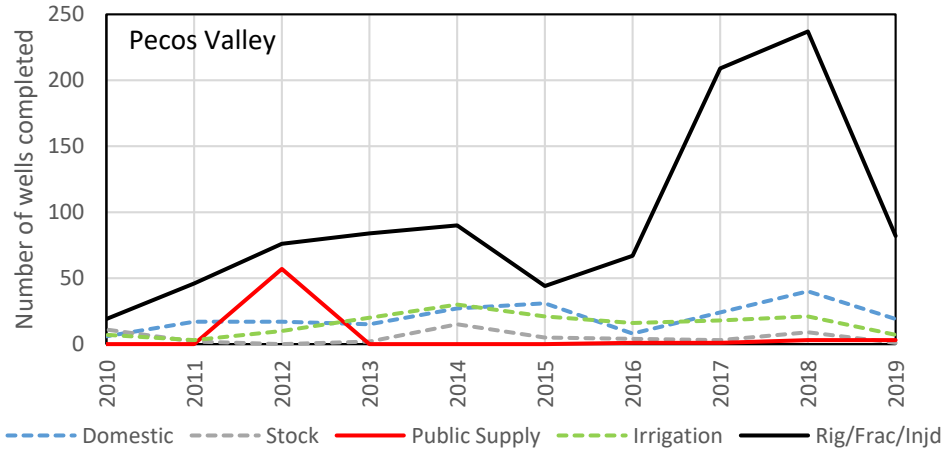
Rig, Frac, and Industrial Wells in Minor Aquifers

2010 - 2019

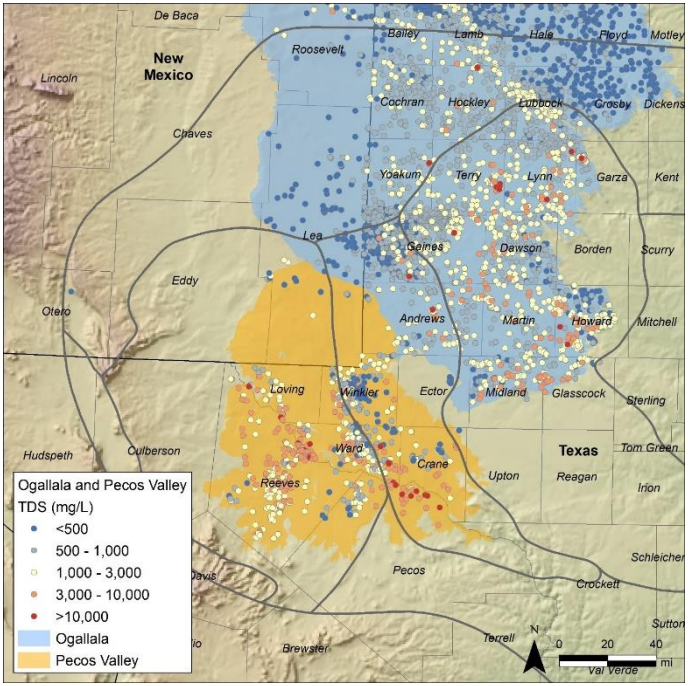
Comparison of Well Drilling for Rig/Frac/Industrial Supply relative to Other Sectors



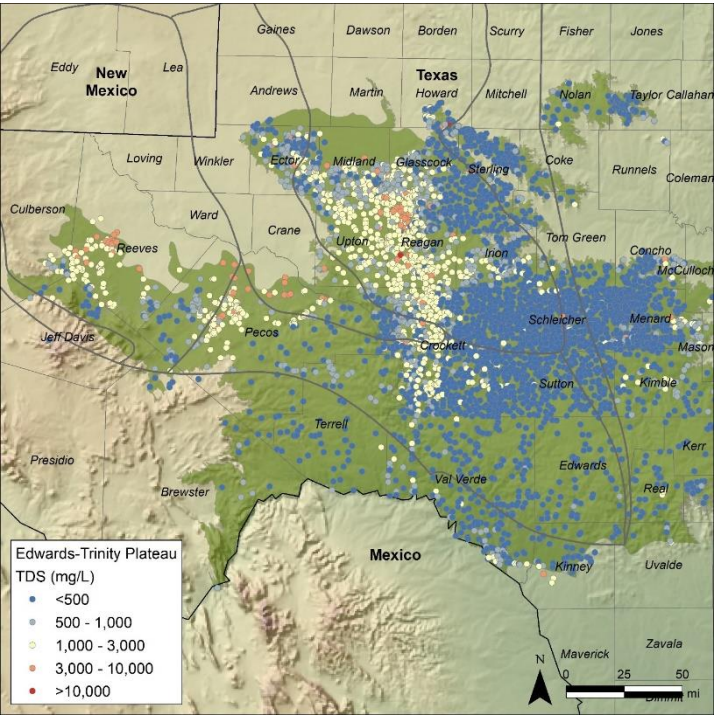
Comparison of Well Drilling for Rig/Frac/Industrial Supply relative to Other Sectors



Water Quality in the Ogallala and Pecos Valley Aquifers



Water Quality in the Edwards Trinity Plateau Aquifer



Task 3. Develop projections of future water demand for hydraulic fracturing for oil & gas (2030–2080)

- **Projected well inventory** for unconventional reservoirs
- Technically Recoverable Resource estimate (**TRR,** assuming all potential wells will be drilled)
- Consider recent well spacing and vertical stacking to develop projections
- Spatial resolution (well inventory/mi^2)
- Expand on previous projections for water demand for hydraulic fracturing for the Permian Basin, Barnett, Eagle Ford, and Haynesville plays

- Texas Oil and Gas Association: workgroup to provide input

ENVIRONMENTAL Science & Technology

Article

pubs.acs.org/est

Maximize reuse of PW for HF

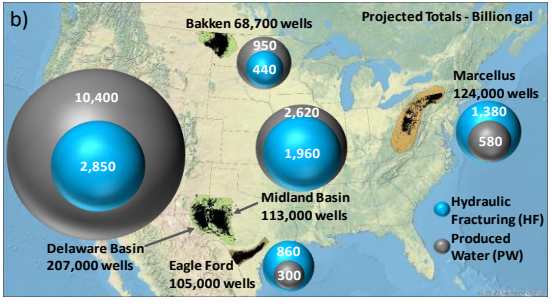
Will Water Issues Constrain Oil and Gas Production in the U.S.?

Bridget R. Scanlon*, Svetlana Ikonnikova, Qian Yang, and Robert C. Reedy

Bureau of Economic Geology, Jackson School of Geosciences, University of Texas at Austin, Austin, Texas

- Oil plays in semiarid W U.S.; gas plays in humid east
- PW from oil reservoirs >> than that from gas reservoirs

  Permian PW = 50× Marcellus PW
- **Partially mitigate water sourcing and disposal issues by reusing PW for HF**
- Projected PW volumes = ~ 4× HF water demand in the Delaware



Scanlon, B. R., Ikonnikova, S., Yang, Q. & Reedy, R. C. , Will water issues constrain oil and gas production in the U.S.? *Env. Sci. & Technol.*
https://pubs.acs.org/doi/10.1021/acs.est.9b06390

Science of the Total Environment 717 (2020) 137085

Contents lists available at ScienceDirect

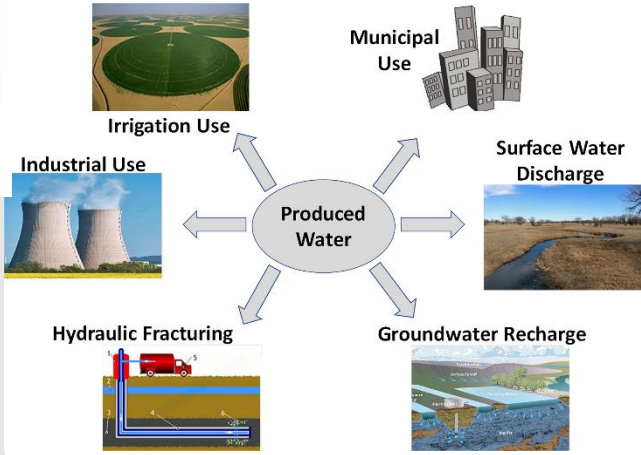
Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

Can we beneficially reuse produced water from oil and gas extraction in the U.S.?

Highlights

- Irrigation demand exceeds produced water (PW) volumes and could accommodate treated PW.
- Treated PW could also be used to recharge depleted aquifers if there was confidence in the treatment process



Scanlon, B. R. *et al.* Can we beneficially reuse produced water from oil and gas extraction in the U.S.? *Science of the Total Environment* https://www.sciencedirect.com/science/article/pii/S0048969720305957

Future Work

- Analysis of reuse of produced water for hydraulic fracturing
- Comparison of water use data for oil and gas from USGS with results from this study
- Impact of water use for hydraulic fracturing on water resources (focus on Permian Basin hydrographs)
- Projections of future water demand for hydraulic fracturing based on technically recoverable resources

Water Use Estimates Texas Mining and Oil and Gas

Oil and Gas

- Task 1. Quantify current and historical water use for **hydraulic fracturing and produced water** volumes
- Task 2. Identify the **sources of water** for hydraulic fracturing
- Task 3. Develop **projections** of future water demand for hydraulic fracturing for oil & gas (2030–2080)

Coal, Lignite, and Aggregates

- Task 4. Identify locations of operations and quantify current and projected future water use for **coal and lignite** mining
- Task 5. Identify locations of operations and quantify current and projected future water use for **aggregates**

Coordination:

- Task 6. Collaborate with **USGS personnel** on water use for the mining category