

# Water and Energy Data, Science, and Policy in New Mexico-a Balancing Act on the Edge of Drought

**Dr. Jeri Sullivan Graham**

**Los Alamos National Laboratory &  
NM Energy, Minerals, and Natural Resources Department  
(EMNRD)**

**Sustainable Water Resources Roundtable**

**July 19, 2016**

**Denver, Colorado**



# Elephant Butte Reservoir NASA Earth Observatory Landsat 8 images

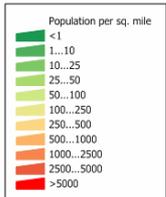
Acquired June 2, 1994  
89% of maximum  
(2.2 Maf)



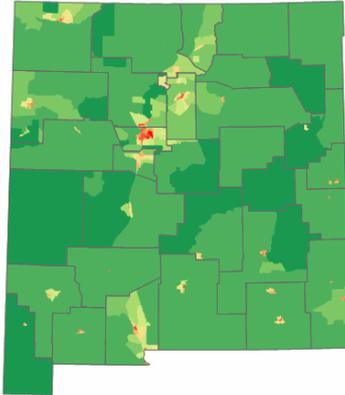
Acquired July 8, 2013  
3% of maximum



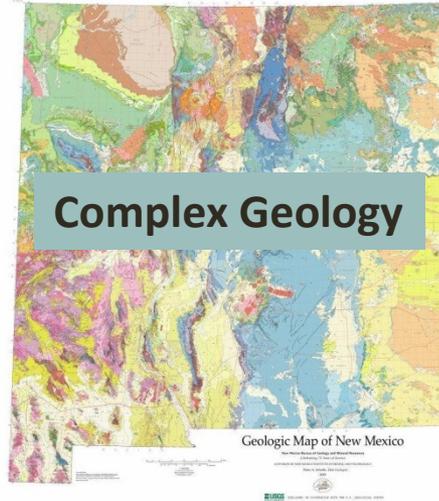
# New Mexico Profile



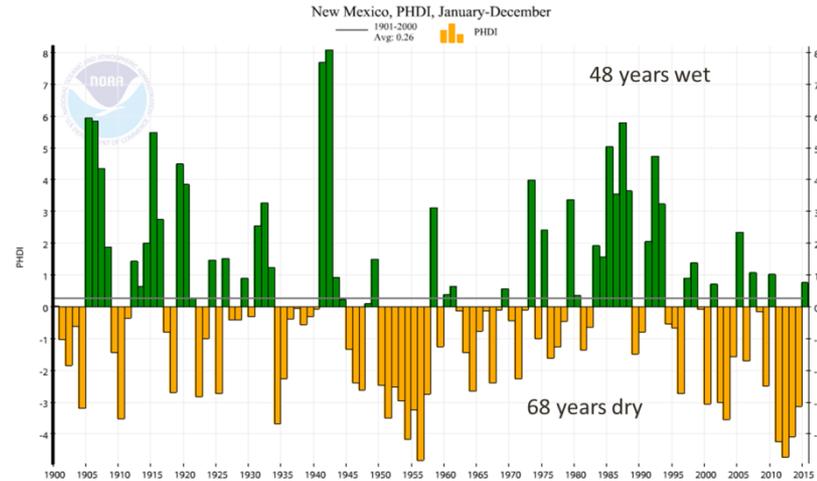
Source: U. S. Census Bureau  
Census 2000 Summary File 1  
population by census tract.



Population ~2M

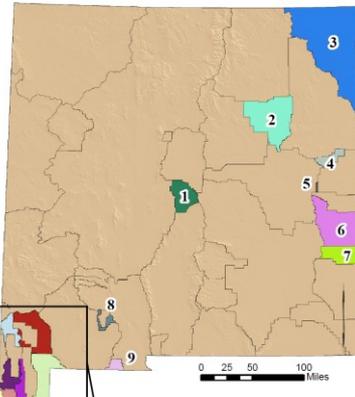


## Palmer Hydrological Drought Index for New Mexico, 1900-2016

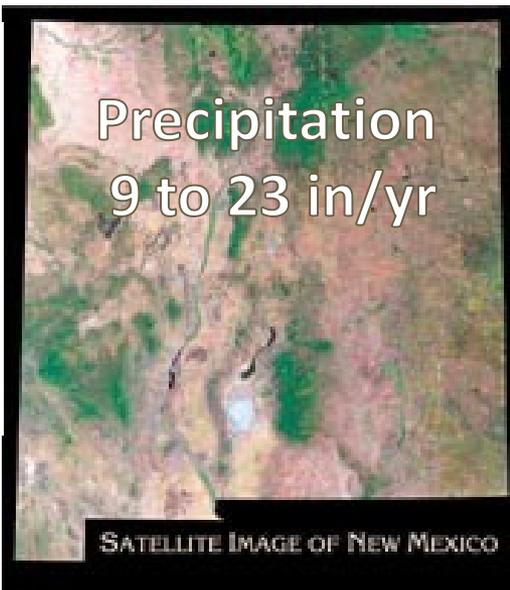


### Extended/Declared Basins

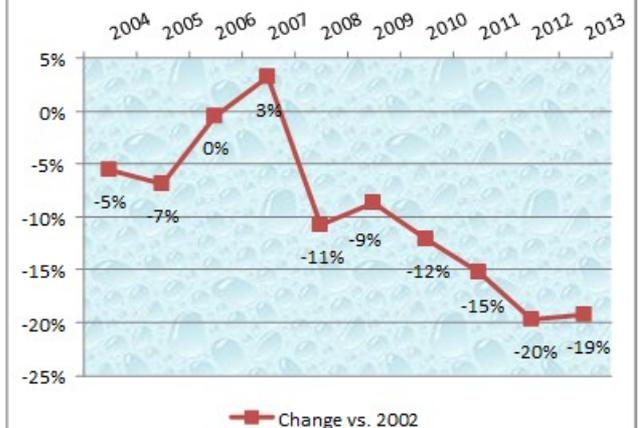
- 1 Tularosa
- 2 Canadian River
- 3 Clayton
- 4 Curry County
- 5 Fort Sumner
- 6 Causey Lingo
- 7 Lea County
- 8 Nutt-Hockett
- 9 Mount Riley
- 10 Cloverdale
- 11 Yaqui
- 12 Animas (Upper)
- 13 Animas (Lower)
- 14 Hatchita
- 15 Lordsburg
- 16 Playas Valley



16 Water Planning Regions



### Percent Change in Gallons/MWh since 2002



# New Mexico Recoverable Water Initiative

## New Mexico Drought Task Force

Chair, State Engineer Tom Blaine

### Recoverable Water Initiative

Chair, Secretary EMNRD, David Martin

Brackish Water  
Subcommittee

Work Group

Produced Water  
Subcommittee

Work Group

Dr. Jeri Sullivan Graham, Work Group Coordinator

# Critical issues for Water and Energy in New Mexico

- Our water is fully allocated and so future generation and production must adapt
- Options to explore: alternative water resources for oil and gas and improved use/reuse of fresh water for power generation.
- Balance multiple outside issues and regulatory pressures to keep the sales price of electricity low and still use less water; keep the cost of oil and gas production low and better manage water
- Incorporating the cost of infrastructure adaptation into the price of electricity and into oil and gas production is an ongoing process.
- The effects of extreme events and watershed damage are a current challenge and expected to increase in significance

*Research, tools, and public outreach to help manage and explain the interlinkage of natural systems, water, and energy production will be important in the future for NM.*

# Science to Assist EWN Policy

## a National Lab and State Partnership

- *New water resources-Brackish, Produced, Wastewaters*
  - Regulatory “square peg” problem
  - Inform with a “neutral science” perspective
  - Result: new produced water regulations for reuse/recycling
- *Coordinate research and inform research dollars to be spent*
  - Point out why funding resource is appropriate for unusual case
  - Result: NMED awards EPA funds to NMWRRRI team for produced water reuse research (research completed June 30, 2016)
- *Coalesce groups around science-informed concepts*
  - Build a Brackish water working group
  - Informing multiple agencies-NMOSE, EMNRD, NMED
  - Result: budget request for research dollars in NM FY16 budget and agency refocusing to include brackish water as a resource

Current Study:

## **The Feasibility of Utilizing Produced Water to Improve Drinking Water Supply in Southeastern New Mexico**

- Collaboration between Water Resources Research Institute (NMSU), Petroleum Recovery Research Center (NMT), EMNRD, & Los Alamos National Laboratory
- Funded by USEPA/New Mexico Environment Department-Source Water Protection grant funding
- Inventory of produced water locations, quantities, and quality
- Mapping products for analysis
- Regulatory analysis for uses within and outside of oil and gas industry
- Update and reissue of the PRRC Produced Water database
- Treatment methods and cost analyses

- Agricultural points are from a reduced version of the 2014 Cropland Data Layer
- Mining points are from EMNRD's database of active mines as of January 2016
- Injection wells are from OCD's database as of January 2016
- Inverse Distance Weighting was used to create the interpolated surface that represents the general trends in TDS

Potential uses:

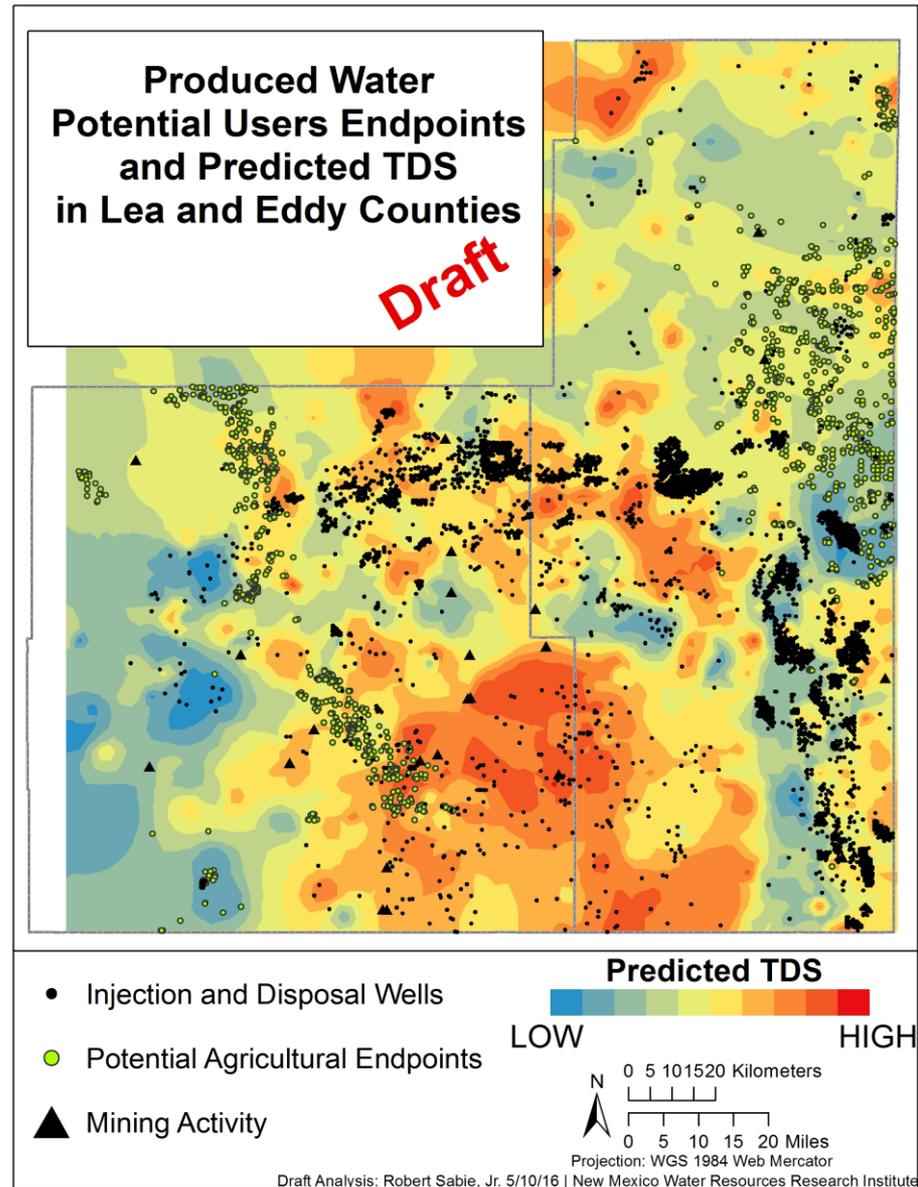
<http://nmsu.maps.arcgis.com/apps/webappviewer/index.html?id=42dfa2ddfd654181a9bed356635401b3>

Volume:

<http://nmsu.maps.arcgis.com/apps/webappviewer/index.html?id=050bd5274cfc480d9cbf3299900de92f>

Quality:

<http://nmsu.maps.arcgis.com/apps/webappviewer/index.html?id=45934ea0330a451ca0dce66024217a96>



Main Project Page: [http://nmwrri.nmsu.edu/?page\\_id=4864](http://nmwrri.nmsu.edu/?page_id=4864)

# Produced Water Quality Mapping

File Edit View History Bookmarks Tools Help

Produced Water Final Report x +

https://nmsu.adobeconnect.com/\_a769301336/r3nx8z5oig7/?launcher=false

Meeting [Speaker Icon] [Microphone Icon] [Help]

Attendee List (2)

- Active Speakers
- Hosts (1)
  - Jesslyn Ratliff
- Presenters (0)
- Participants (1)
  - Jeri Sullivan Graham

Chat (Everyone)

Note

Share - Jesslyn Ratliff

Chrome x My Home Page x Maps - New Mexico Wat... x Produced Water Potential... x Produced Water Volume... x Produced Water Quality - x

nmsu.maps.arcgis.com/apps/webappviewer/index.html?id=45934ea0330a451ca0dce66024217a96

### Produced Water Quality - New Mexico

NM WRRI Home Page Produced Water Project Page

World

Layer List

- Operational Layers
  - TDS\_by\_Well
  - Sulfate\_by\_Well
  - Sodium\_by\_Well
  - pH\_by\_Well\_Sample
  - Magnesium\_by\_Well
  - Chloride\_by\_Well
  - Calcium\_by\_Well
  - Bicarbonate\_by\_Well
  - Produced\_Water\_Quality\_by\_Township
  - Produced\_Water\_Quality\_Predictive\_Surfaces
  - Base\_Layers

Esri, HERE, DeLorme, NGA, USGS, NPS | Marthas Cather, New

32.223 -104.542 Degrees

Incident  Bicarbonate (mg/L)  Calcium (mg/L)  Chloride (mg/L)  Magnesium (mg/L)  Sodium (mg/L)  pH (mg/L)  Sulfate (mg/L)  TDS (mg/L)

DOWNLOAD CSV

Number of Samples	Avg. Sulfate	Min. Sulfate	Max. Sulfate
387	1,128	13	11,110

Windows Taskbar: 9:29 AM 7/18/2016

# Produced Water Locations and Uses

The screenshot displays a web application interface for "Produced Water Potential Uses - Lea and Eddy Counties". The main map area shows a geographical view with various colored regions (green, orange, grey) and numerous small black triangles representing data points. A red dot with an orange circle highlights a specific location on the map. The interface includes a search bar at the top left of the map area, navigation tools, and a status bar at the bottom. The browser tabs show "Produced Water Potential", "Produced Water Volume", and "Produced Water Quality". The taskbar at the bottom indicates the system time as 9:44 AM on 7/18/2016.

Meeting controls: Meeting, Help

Attendee List (2): Jesslyn Ratliff, Jeri Sullivan Graham

Active Speakers: Jesslyn Ratliff

Hosts (1): Jesslyn Ratliff

Presenters (0)

Participants (1): Jeri Sullivan Graham

Chat (Everyone)

Note

Share - Jesslyn Ratliff

Chrome tabs: My Home Page, Maps - New Mexico, Produced Water Potential, Produced Water Volume, Produced Water Quality

URL: nmsu.maps.arcgis.com/apps/webappviewer/index.html?id=42dfa2ddf654181a9bed356635401b3

Page Title: Produced Water Potential Uses - Lea and Eddy Counties

Map Search: Find address or place

Map Labels: Carlisbad, Hobbs

Status Bar: 32.150 -102.971 Degrees, HERE, DeLorme, NGA, USGS, NPS | Robert Sabie, Jr. | New Mexico Water Resources Research Institute, esri

System Tray: 9:44 AM, 7/18/2016

# New Mexico Produced Water Regulatory Framework for Reuse

J = OCD  
 O = Producer\*  
 L = Treatment Co.  
 P = Yes  
 RE = Yes



J = OCD  
 O = Producer  
 L = Producer  
 P = No  
 RE = Yes

J = OCD  
 O = Producer  
 L = Transport Co.  
 P = Yes  
 RE = No



J = OCD  
 O = Producer\*  
 L = Treatment Co.  
 P = Yes  
 RE = Yes

J = NMED/EPA  
 O = User/Public Entity  
 L = User/Public Entity  
 P = yes (NPDES)  
 RE = yes (NMED)  
**PR = No**

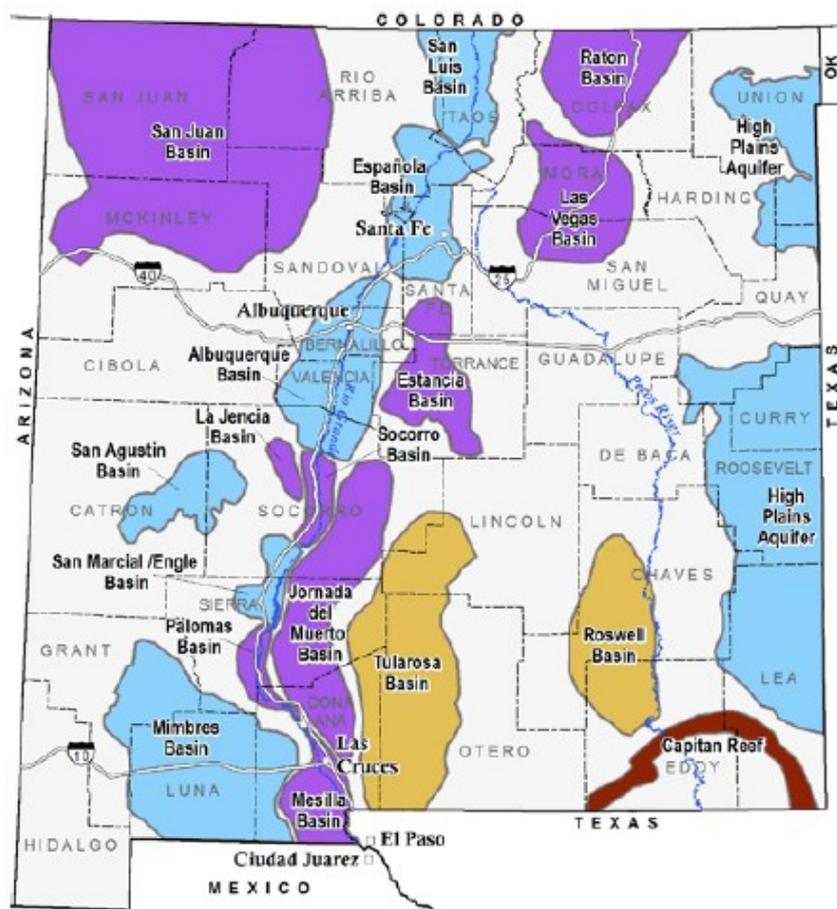
Key:  
 Jurisdiction= J  
 Ownership = O  
 Legal Liability = L  
 Permit = P  
 Reporting = RE  
 Permit+Right = PR (OSE only)  
 \* Unless sold/transferred by contract

- Hypothetical Case for Reuse outside of Oil and Gas Industry
- Partial or no consumption of clean water product
- Intentional discharge to Waters of the State/Navigable Waters (agriculture or surface water makeup)

# Overview of Fresh and Brackish Water Quality in New Mexico

Lewis Land

Open-file Report 583  
June 2016



New Report coming out soon!

From the New Mexico Bureau  
of Geology and Mineral  
Resources

For more information please  
contact:

Lewis Land, [lland@nckri.org](mailto:lland@nckri.org)

Or,

Stacy Timmons,

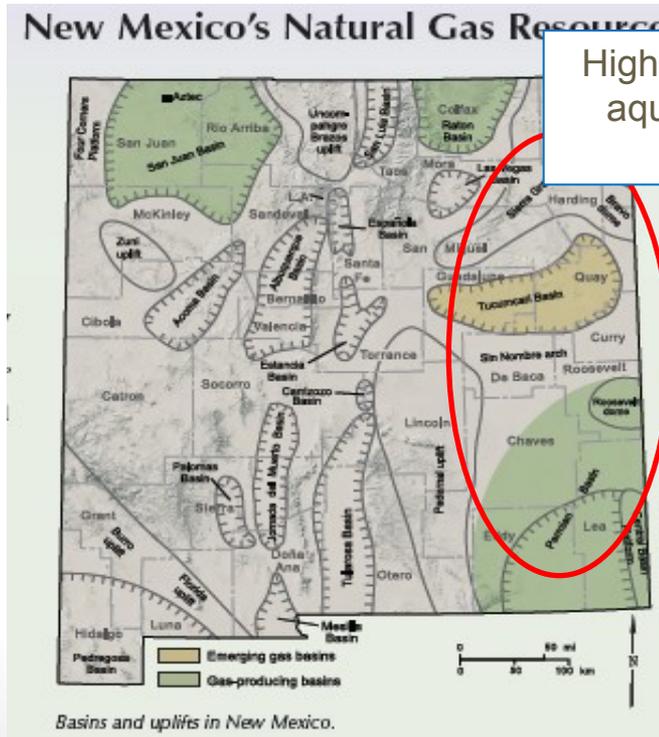
[stacy@nmbg.nmt.edu](mailto:stacy@nmbg.nmt.edu)

# Contact for more information-

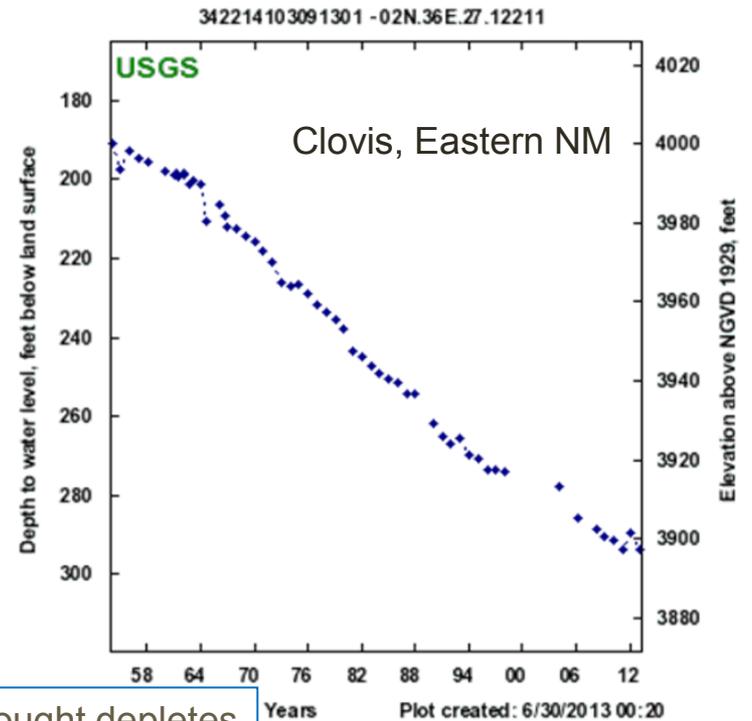
*Jeri Sullivan Graham, Ph.D*  
*Los Alamos National Laboratory*  
*[ejs@lanl.gov](mailto:ejs@lanl.gov); 505-695-4875 c*  
*New Mexico Energy, Minerals and Natural Resources Department*  
*[Jeri.sullivangraham@state.nm.us](mailto:Jeri.sullivangraham@state.nm.us)*

# Water for Oil and Gas Production in New Mexico

- Ground-water depletion in the Southwest has reached record proportions
- Increased electricity demand (brackish treatment, transport) and reduced oil and gas production (drilling and frac fluid limits) may result.
- Brackish ground water and produced water could be used for drilling and completions.



High Plains/Ogallala aquifer overlaps oil and gas basins



Cumulative drought depletes fresh ground water

# How do we do this? Infrastructure...

- Contiguous leases or ownership allow for long-term infrastructure investment; mobile investments also improve access



- Lay-flat hoses replace permanent pipelines



- New tank designs support gravity flow, conserve energy



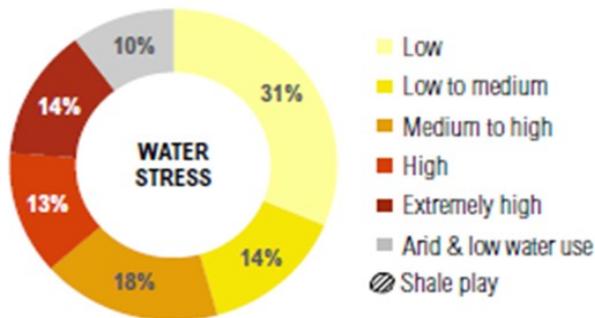
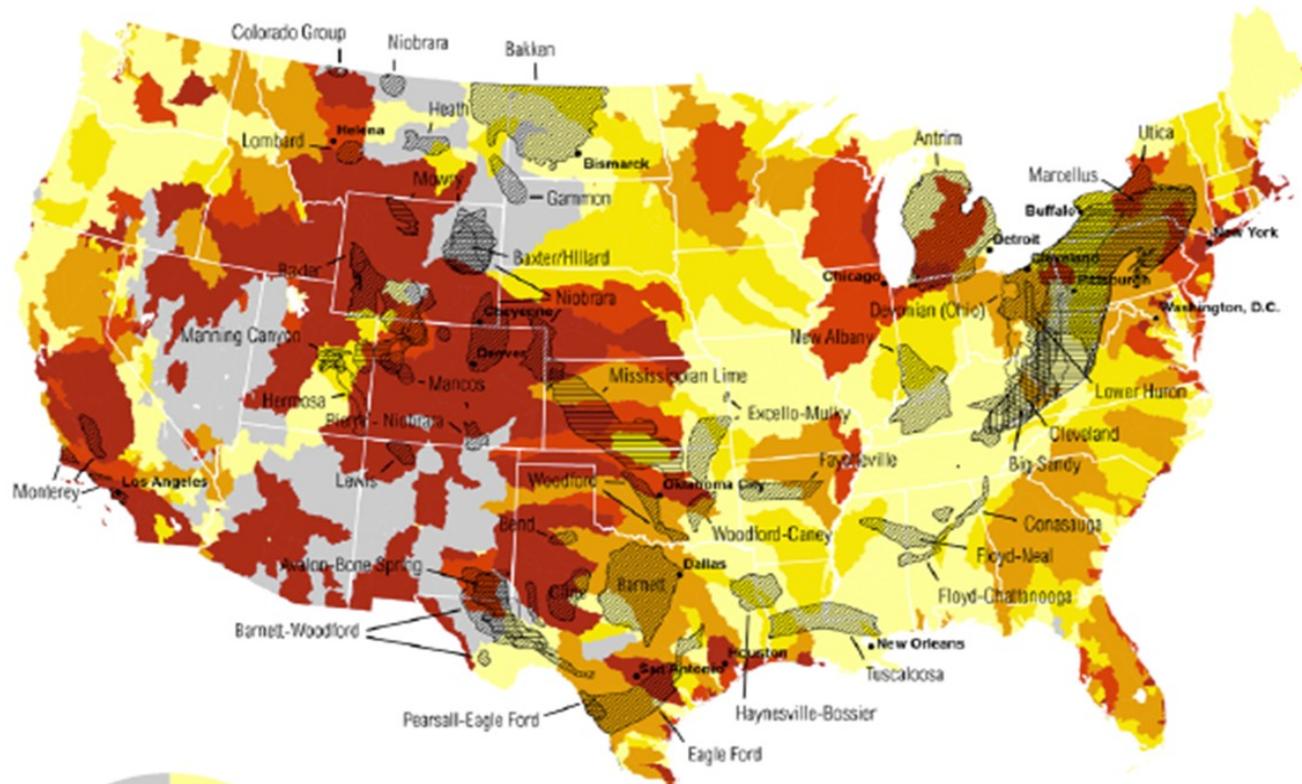
- Modular facilities are flexible

# How do we do this? Treatment...

- Oil-water separation
- pH balancing (acids, bases)
- Coagulants, lime softening
- Slant-fin gravity settling
- Filter press
- Filtration
- Microbicides
- Landfill disposal
- Reinjection
- Limited storage times
- **NO SALT REMOVAL!**



# Why reuse?



Source: [http://www.wri.org/sites/default/files/wri14\\_report\\_shalegas.pdf](http://www.wri.org/sites/default/files/wri14_report_shalegas.pdf)  
 Accessed April 19, 2016

# Brackish Water Rules in NM

- Less than 1,000 mg/L  
*or*
- Above 2,500 feet  
below ground surface
- Greater than 1,000  
mg/L,  
*and*
- Below 2,500 feet bgs

Then normal water permit applications and jurisdiction apply. Water rights are assigned for beneficial use.

Then a permit is required, but no beneficial use assignment is needed.

*Additionally, no impairment of fresh water may occur by extraction of the BW*

# Policy status, adaptation

- Oil Conservation Division
  - Open to all uses within jurisdiction (Oil and Gas industry)
  - Permitting and handling covered
  - Better data collection has begun
  - Ownership less clear in regulations but can be covered contractually
- Office of the State Engineer
  - Open to all uses
  - Produced water is not a “Water of the State”-it is privately owned
  - Brackish water rules apply (>2,500 ft deep, >1,000 mg/L TDS, no permit or right)
- New Mexico Environment Department
  - Quality impairment regulations are clearly stated
  - Applications to soils, agricultural land, surface and ground waters likely to need a discharge permit