

UNCONVENTIONAL OIL AND GAS ENVIRONMENTAL OVERVIEW OF WATER ISSUES

Presentation to US/Mexico Border 2020 Program

September 22, 2015 – Michael Overbay



DISCLAIMER

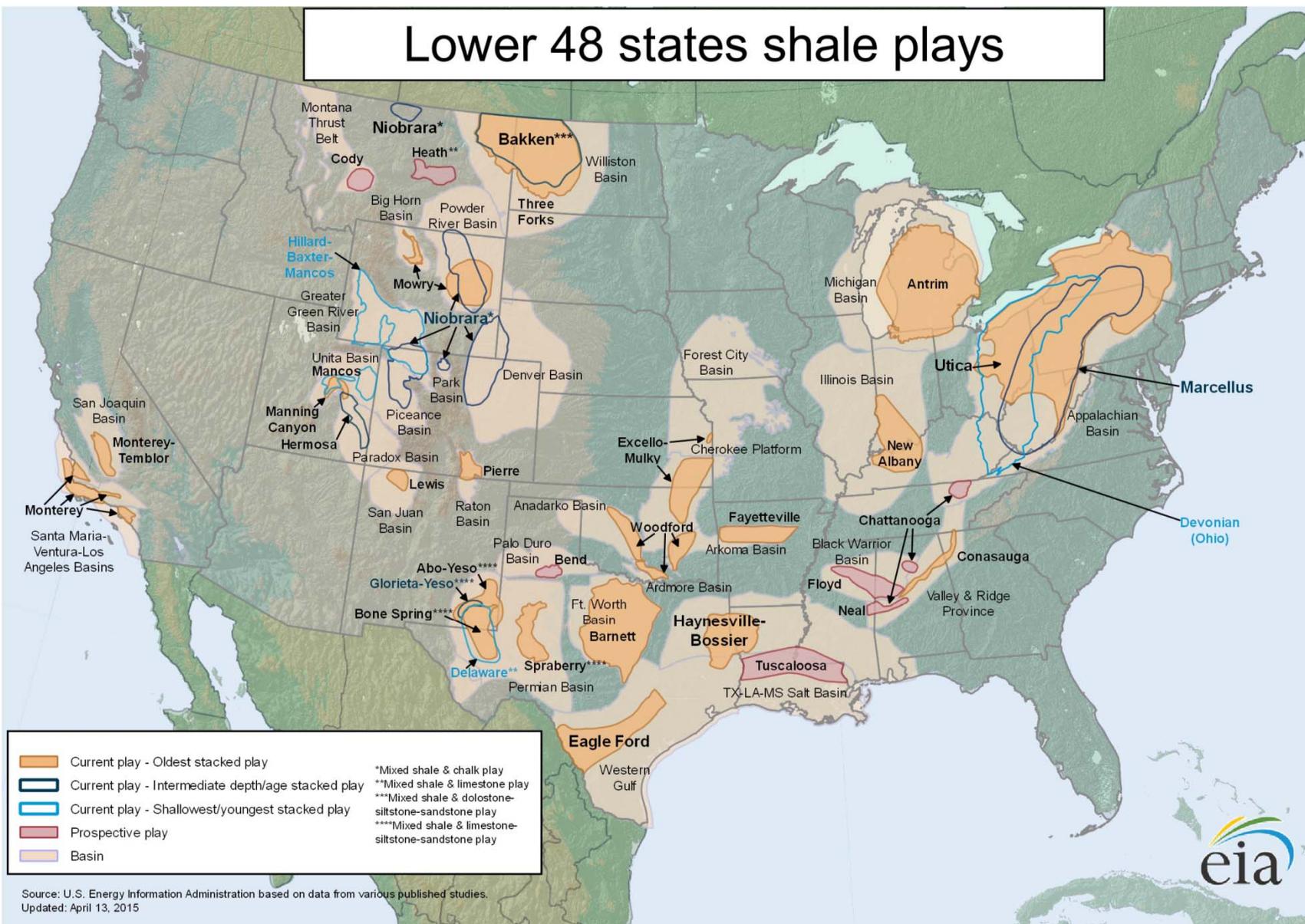
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Levels of Government in the US

- There are 3 levels of government: Federal, State, and Local
- Native American Tribes maintain an unique status and may apply to EPA for approval to implement, and enforce federal environmental laws
- Depending on the state, local governments (counties and cities) may have regulatory authorities under special use permitting or zoning requirements

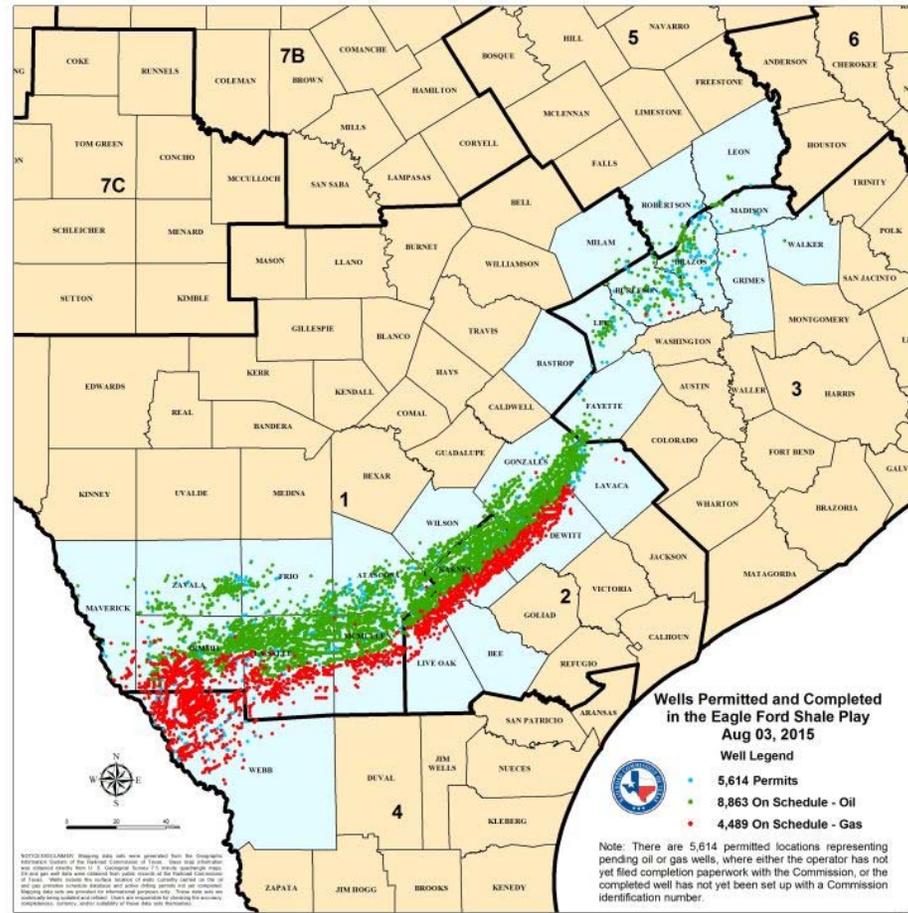


Lower 48 states shale plays



Drilling in the Eagle Ford Shale

Source: Railroad Commission of Texas website, updated 8/03/2015

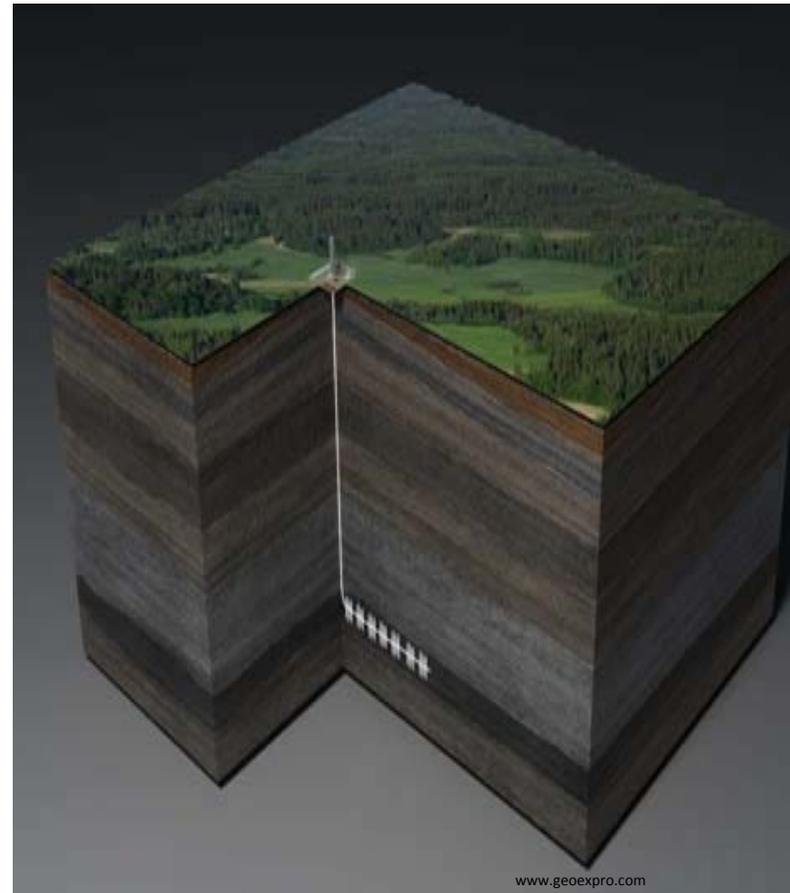
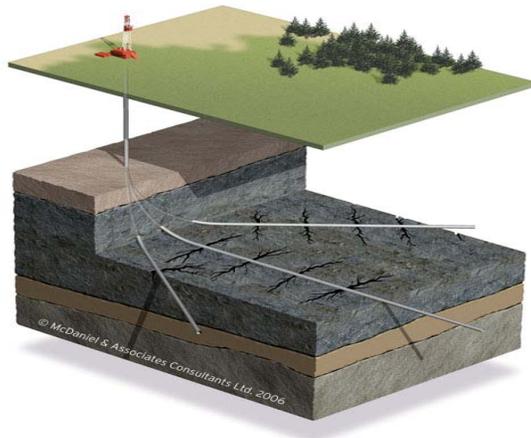
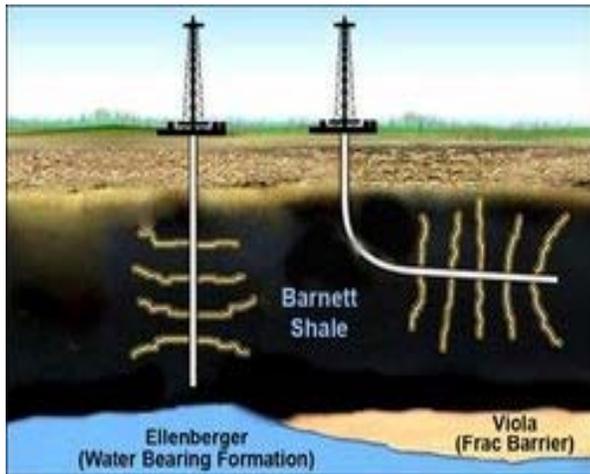


Oil and Natural Gas Production in the Eagle Ford Shale

- Over 18,000 wells have been permitted between 2008 and the end of 2014, in an area that includes part or all of 26 counties in south central Texas.
- Natural gas production exceeded 4886 million cubic feet per day (2014).
- Crude oil production exceeded 1,013,051 barrels per day (2014).
- Condensate production exceeded 271,014 barrels per day (2014).
- Source: Railroad Commission of Texas (4/20/15)

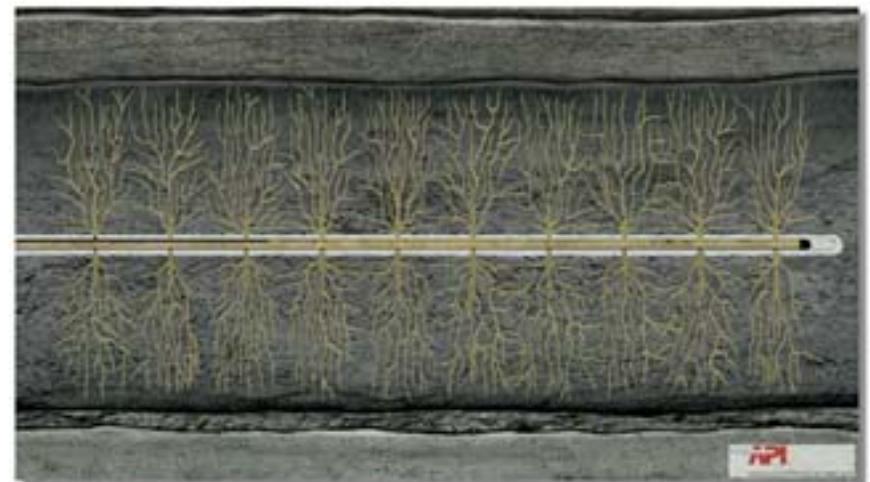
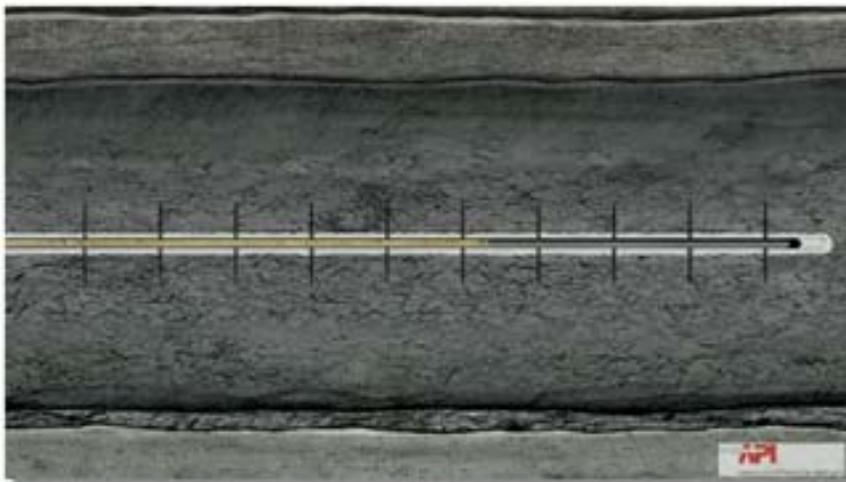
Unconventional Natural Gas Drilling

Often relies on horizontal drilling and hydraulic fracturing



Unconventional Oil and Natural Gas Drilling: Hydraulic Fracturing

- Hydraulic fracturing (HF) is commonly used in the oil and gas industry to enhance subsurface fracture systems to allow oil or natural gas to move more freely from the rock pores to production wells.
- The goal of hydraulic fracturing is to improve the flow of fluids in oil and gas wells by connecting many pre-existing fractures and flow pathways in oil and gas containing rocks.
- Hydraulic fractures are created when a fluid is pumped down production wells at high pressure for short periods of time (hours).
- The high-pressure fluid exceeds the rock strength and fractures the rock.
- A propping agent, usually sand, is pumped into the fractures to keep them from closing when the fracturing pressure is released.



Unconventional Oil and Natural Gas Production: Potential Health Concerns – Air Emissions

- **VOCs** are one of the key ingredients in forming ozone (smog).
 - The oil and gas industry is the largest industrial source of VOC emissions in the U.S., based on data reported to the 2011 National Emissions Inventory.
 - Ozone is linked to asthma attacks, hospital and emergency department visits, and increased school absences, among other serious health effects.
 - Ozone used to be considered a summertime pollutant; but recently has become a problem in winter in some areas where significant natural gas production occurs.
 - In some areas, VOCs also help form fine particle pollution (PM_{2.5}).
- **Air toxics** can cause cancer and other serious, irreversible health effects, such as neurological problems and birth defects.
- **Methane** reacts in the air to form ground-level ozone and is a major Greenhouse Gas emission.

Aerial Photos of Unconventional Oil and Natural Gas Production





Fracture Stimulation Operations

Trucks
Pumps

Water Storage Tanks at a Hydraulic Fracturing Site (source: U.S. EPA January 20, 2015. Site Visit Report Anadarko Petroleum Corporation, Marcellus Shale Gas Operations, EPA-HQ-OW-2014-0598-0537)



Disposal Operations

Exhaust

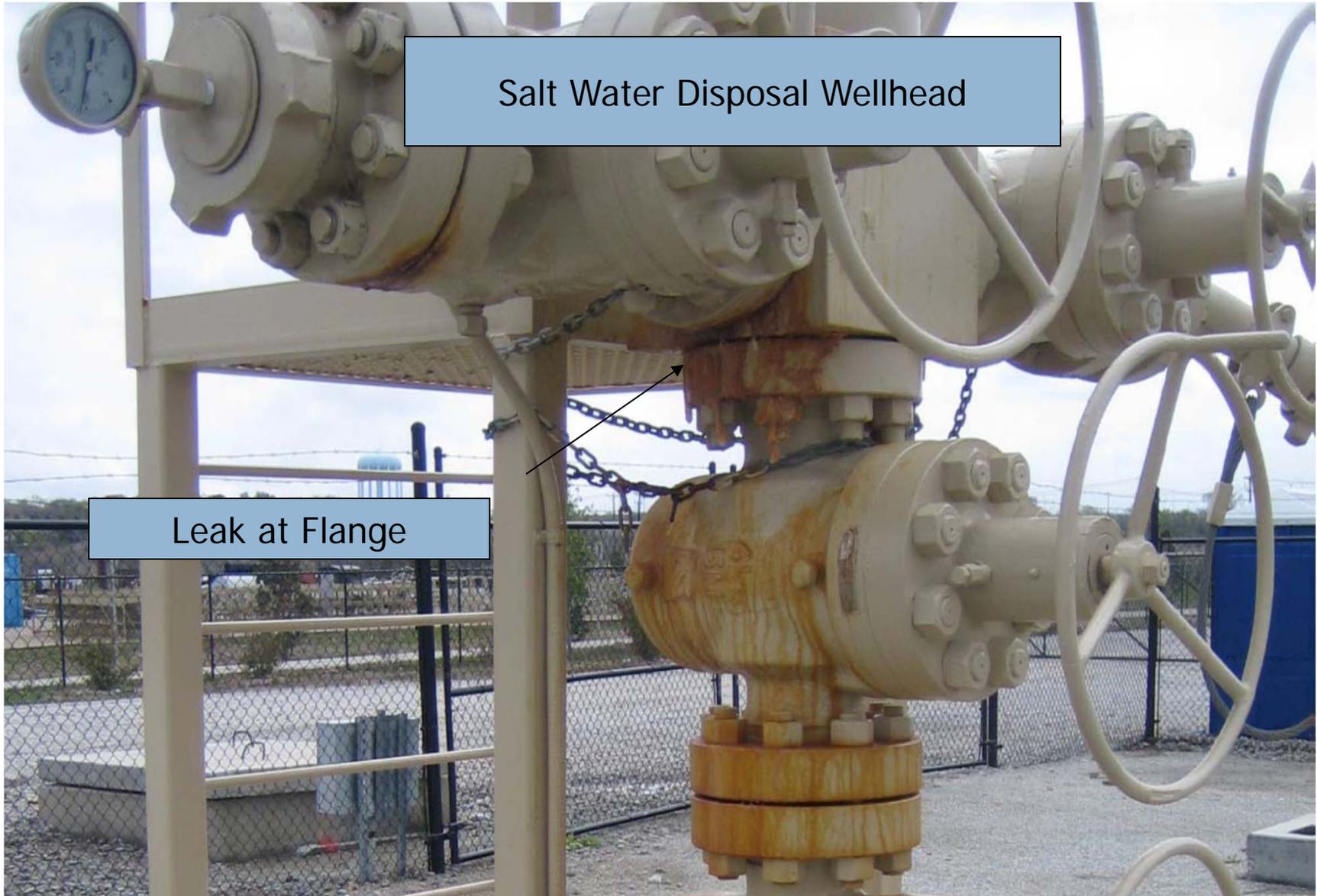
Waste Collection
Tank

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Disposal Operations





Salt Water Disposal Wellhead

Leak at Flange

Flowback Water Waste Pits



How Can Extraction of Unconventional Gas Affect Water Resources?

- Concerns about potential impact to surface waters
 - For example, shale gas wastewater contains high concentrations of total dissolved solids (salts), and may also contain various organic chemicals, inorganic chemicals, metals, and naturally occurring radioactive materials (NORM)
 - Surface disturbances from construction of well pads and pipeline corridors, including stream crossings, can lead to erosion, sedimentation, and altered hydrology
- Concerns about potential endangerment of water supplies
 - If diesel fuels are used, hydraulic fracturing fluids may contain benzene, toluene, ethylbenzene or xylene (BTEX) compounds, which are highly mobile in ground water and are regulated under the national primary drinking water regulations
- Sustainability of water resources
 - Water sources used for horizontal hydraulic fracturing often come from public water sources, or directly from ground or surface waters
 - Recycling flowback/produced water is becoming more common in areas where water availability or disposal is limited

Federal Water Authorities Applicable to Oil and Gas Extraction

Clean Water Act

- National Pollutant Discharge Elimination System Permitting and National Pretreatment Program
- Effluent Limitations Guidelines and Standards (ELGs)
- Water quality criteria and standards

Safe Drinking Water Act

- Underground Injection Control Program Class II regulations
 - Hydraulic fracturing (HF) using diesel fuels
 - Produced water/flowback injection

Unconventional Natural Gas Production Impacts

Average horizontal / hydraulically fractured well water usage and production:

- 5,000,000 gallons of water (not including proppant and/or additive volume)
- Flowback ~60% injected volume (some may be recycled and reused)
- 3,000,000 gallons of produced water to be managed
- Would need 1,000+ trucks to transport waste water to disposal well operations
- Closure of reserve pits and disposal of liners and solids



Study of the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources



Hydraulic Fracturing Study Background

- In FY2010, Congress urged EPA to study the relationship between hydraulic fracturing and drinking water.
- EPA launched this study with the purpose to:
 - Assess whether hydraulic fracturing can impact drinking water resources
 - Identify driving factors that affect the severity and frequency of any impacts
- EPA's HF study was outlined in a 2011 *Study Plan* with additional details provided in a 2012 *Progress Report*.

HF Study Progress

- EPA's HF study has produced:
 - 12 EPA technical reports – Including 9 reports being released in June 2015
 - 4 EPA authored journal publications
 - 9 journal publications from colleagues at Lawrence Berkeley National Laboratory
 - Draft Hydraulic Fracturing Drinking Water Assessment report
- All completed products available online:
 - www.epa.gov/hfstudy

Technical Reports Released in June

- Study of water acquisition in the Susquehanna and Upper Colorado river basins.
- Study of sources of selected HF-related chemicals in the Allegheny river and streams in PA.
- Studies of possible impacts to drinking water resources (five retrospective case studies):
 - Northeast, PA (Bradford County)
 - Southwest, PA (Washington County)
 - Killdeer, ND
 - Raton Basin, CO
 - Wise County, TX
- Description of well construction and design characteristics.
- Characterization of spills related to HF operations.



Draft HF Assessment Report

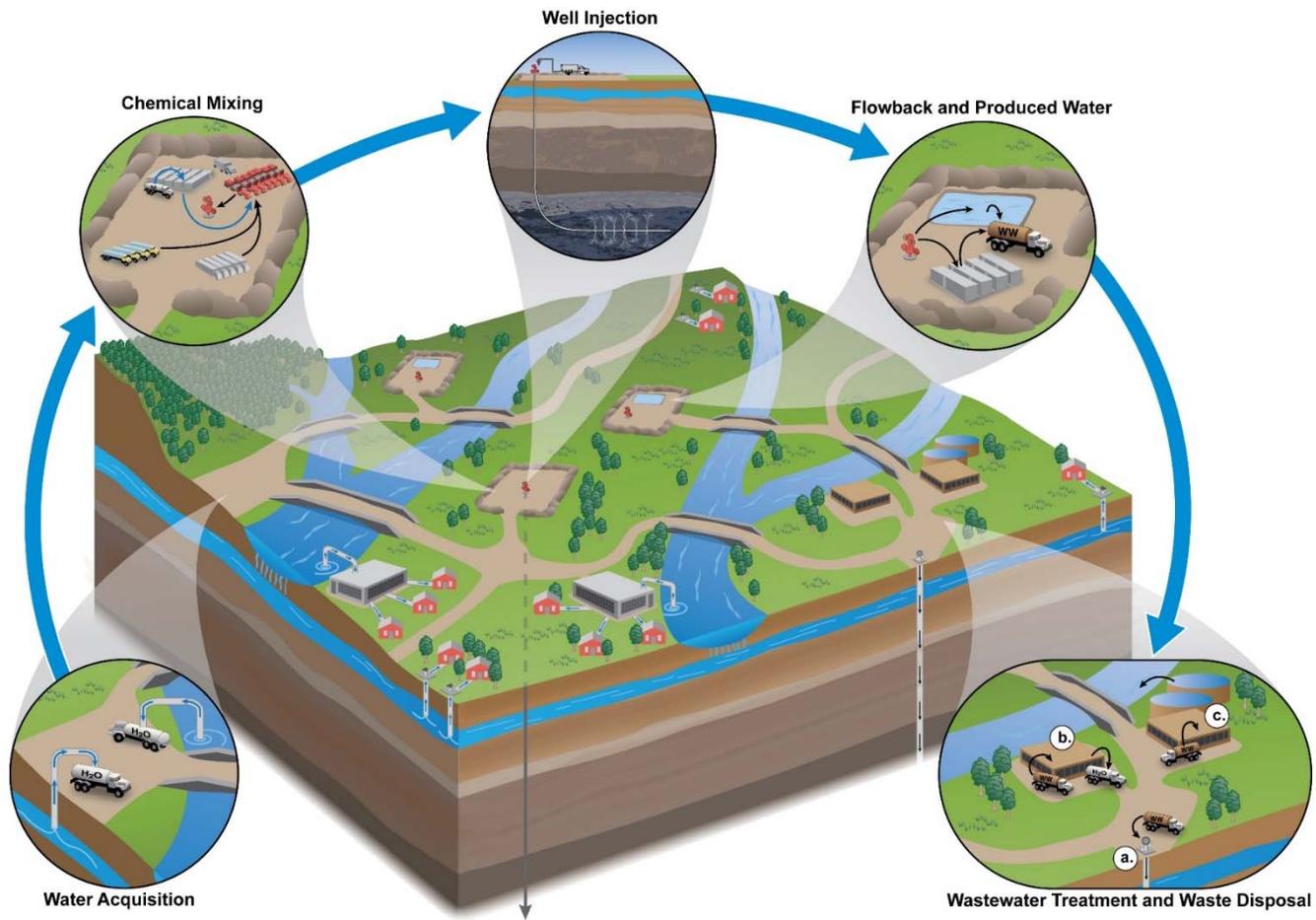
What it is

- A state-of-the-science **integration and synthesis** of information
- Based upon EPA research results, a robust literature review, and other information, including input from stakeholders
- Identifies potential vulnerabilities and addresses questions identified in the *Study Plan* and *Progress Report*

What it is not

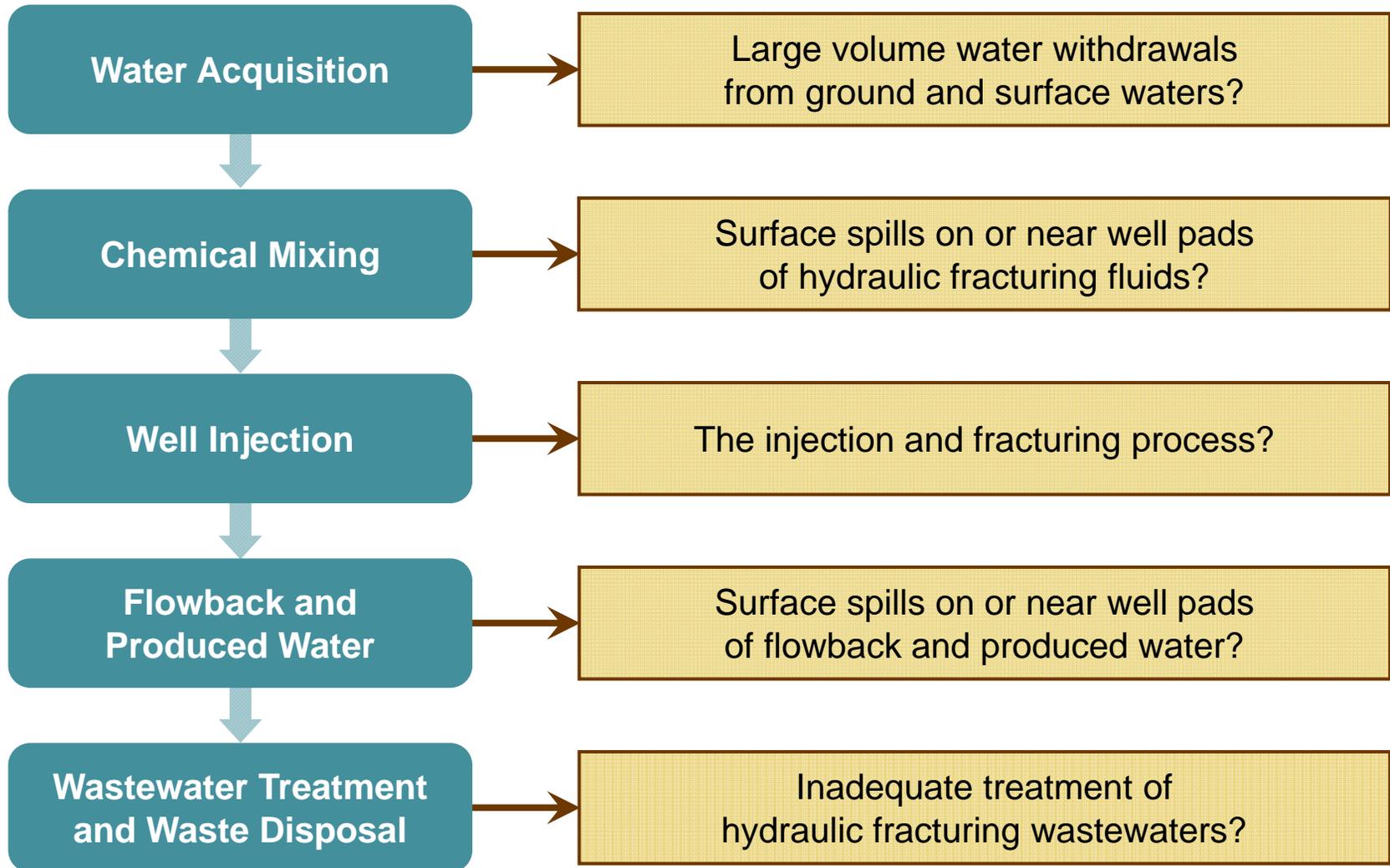
- Not a human health, exposure, or risk assessment
- Not site specific
- Does not identify or evaluate best management practices
- Not designed to inform specific policy decisions
- Does not identify or evaluate policy options

Hydraulic Fracturing – the Water Cycle



Primary Research Questions

What are the potential impacts on drinking water resources of:



Summary of Impacts to Drinking Water Resources

- Assessment identified potential vulnerabilities to drinking water resources due to hydraulic fracturing activities.
- These vulnerabilities include:
 - Water withdrawals in areas with low water availability
 - Spills of HF fluids and flowback/produced water
 - HF conducted directly into formations containing drinking water resources
 - Well integrity failures
 - Subsurface migration of gases and liquids
 - Inadequately treated wastewater
- Despite vulnerabilities, there is no evidence of widespread, systemic impacts on drinking water resources due to hydraulic fracturing activities.



HF Study: What's Next?

- Science Advisory Board (SAB) review of draft assessment:
 - Public, open process
 - Opportunity to comment on charge questions
 - Opportunity to address SAB panel concerning EPA's draft assessment
 - Opportunity to provide comments on the draft assessment
- Agency will use comments from public and SAB to revise draft assessment and release as final.

Contacts and Acknowledgement

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Drilling and production photos provided by the City of Fort Worth