



New Produced Water Initiative to Promote Beneficial Use

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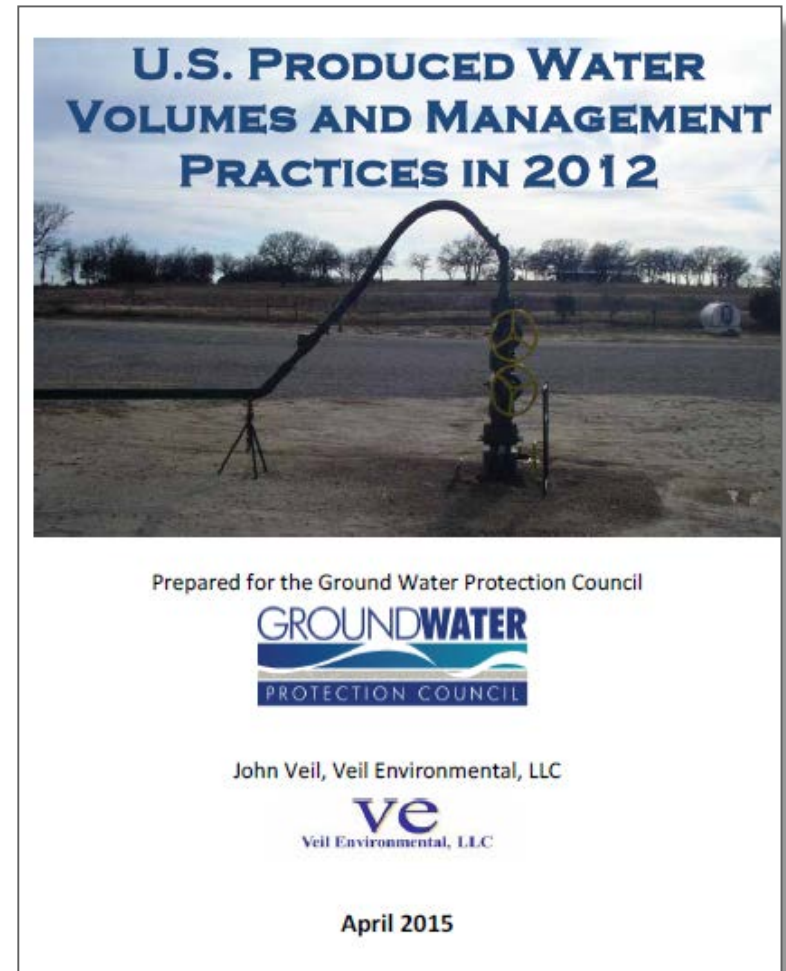
Topics for Discussion

- Produced water
 - How much?
 - How is it managed?
 - Growing interest in beneficial use
- The Ground Water Protection Council
- Why is GWPC interested?
- GWPC's initiative
 - Purpose
 - The project team
 - Layout of report
 - Schedule



Most Current Detailed Produced Water Inventory for the U.S.

- Previous study done in 2009 looked at 2007 year
- The Ground Water Protection Council (GWPC) contracted with Veil Environmental to update a 2009 report using 2012 as the baseline year.
- Data were collected during the second half of 2014
- Report was published in April 2015

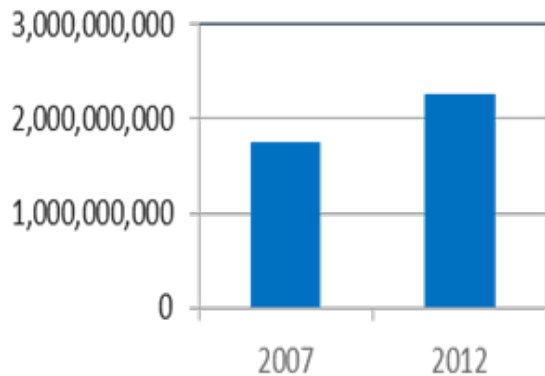


http://www.veilenvironmental.com/publications/pw/prod_water_volume_2012.pdf

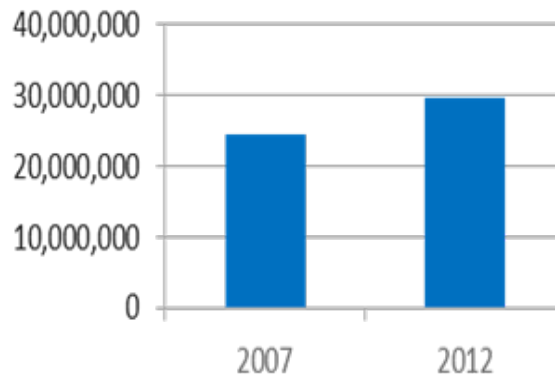
Five Year Changes in Fluid Production

- Between 2007 and 2012
 - U.S. oil production increased by 29%
 - U.S. gas production increased by 22%
 - U.S. water production increased by <1%
 - 21.2 billion bbl vs. 21 billion bbl

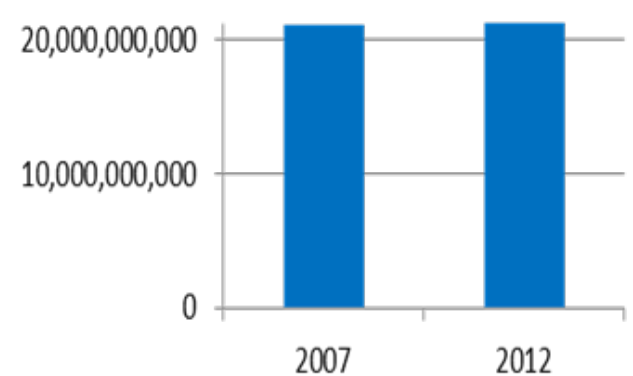
Oil Volume (bbl)



Gas Volume (Mmcf)



Water Volume (bbl)



Putting Produced Water Volume into Perspective

21.2 billion bbl/yr = 2.44 billion gal/day

1. U.S. population = 323 million people
 - 7.5 gals produced water/person/day
2. Niagara Falls average flow = 150,000 gal/sec
 - More than twice the amount of water that typically flows over the Niagara Falls each day is generated as produced water
3. Number of cans of beer or Coke at 12 oz/can
 - If all produced water were placed into cans, it would yield 26 billion cans/day
4. Cubic volume
 - The Empire State Building has a volume of 37 million ft³
 - The U.S. produced water would fill that volume nearly 9 times each day



Top Ten States in 2012 Water Production

Ranking	State	2012 Water (bbl/yr)	% of Total Water
1	Texas	7,435,659,000	35
2	California	3,074,585,000	15
3	Oklahoma	2,325,153,000	11
4	Wyoming	2,178,065,000	10
5	Kansas	1,061,019,000	5
6	Louisiana	927,635,000	4
7	New Mexico	769,153,000	4
8	Alaska	624,762,000	3
9	Federal Offshore	358,389,000	2
10	Colorado	320,191,000	2

2012 Produced Water Management Practices

<i>Management Option</i>	<i>Volume (bbl/yr)</i>	<i>%</i>
Injection for Enhanced Recovery	9,287,855,000	45.1
Injection for disposal	8,010,364,000	38.9
Surface discharge	1,121,045,000	5.4
Evaporation	691,142,000	3.4
Offsite Commercial Disposal	1,373,131,000	6.7
Beneficial Reuse	125,737,000	0.6
Total Produced Water Managed	20,609,274,000	100

- Injection for disposal should also include nearly all offsite commercial disposal
- $38.9\% + 6.7\% = 45.6\%$ (almost equal to injection for recovery)

The Ground Water Protection Council (GWPC)

- GWPC is a not-for-profit organization representing state oil and gas, underground injection control, drinking water, public health, and water quality agencies
- GWPC has a long-standing relationship with federal agencies including the EPA and the U.S. Department of Energy (DOE), the oil and gas industry, and other non-governmental organizations
- Through its membership and strategic relationships GWPC is in a unique position to explore the current and future beneficial uses of produced water



GWPC's Interest and Involvement with Produced Water

- Much of GWPC's focus is on ground water issues
 - The majority of produced water originates as natural ground water
- GWPC places a strong emphasis on energy and water interactions
 - Produced water is a direct byproduct of oil and gas production, and a large percentage of produced water is reinjected to help produce more oil
- Regulation of underground injection of fluids (the Safe Drinking Water Act's Underground Injection Control or UIC program) is one of GWPC's major programmatic concerns
 - Over 90% of the produced water brought to the surface is reinjected back into the ground to aid in future oil and gas production or for disposal

GWPC Activities Relating to Produced Water or Other Oil and Gas Water Issues

- Created the highly-acclaimed Risk Based Data Management (RBDMS) that is used by more than 24 state agencies to track oil and gas data
- Developed and implemented the FracFocus system with its unique chemical disclosure registry
- Conducted several national conferences on energy/water interactions
- Published a groundbreaking Shale Gas Primer in 2009, including water issues
- Organized the first-of-its-kind national conference on stray gas issues in 2012
- Initiated discussions on induced seismicity related to hydraulic fracturing and disposal wells at several events in 2013. This effort led to formation of an induced seismicity work group and a 2015 primer on Technical and Regulatory Considerations Informing Risk Management and Mitigation
- Sponsored a 2015 report that estimates the total volume of produced water for the year 2012 and describes how that water is managed

New Produced Water Initiative

- GWPC decided to undertake a new initiative that focused on ways in which produced water could be beneficially used
- The driving force for this initiative considered two major water concerns
 1. Fresh water supplies are diminishing in many part of the country while demand for fresh water is growing
 2. Management/disposal of produced water can represent a significant cost to industry
- Throughout 2016, GWPC discussed strategies for moving ahead
- In early 2017, Veil Environmental prepared a report for GWPC that identified 150 important produced water issues and determined which of those were within the scope of GWPC's interests and expertise
 - 28 of the topics were deemed to be outside of GWPC's scope of interest and expertise. That left 122 active topics on the list.

Universe of Produced Water Topics

- 122 produced water topics covering many different aspects of produced water. These are divided into 7 major themes and 21 secondary areas as shown below.

Disposal

- Injection
- Discharge
- Evaporation

Produced Water Characterization

- What Is Produced Water?
- What Is in Produced Water?
- How Much Produced Water Is Generated?

Processing, Storage, and Transportation

- Initial Processing of Produced Water
- Produced Water Storage
- Produced Water Transportation

Beneficial Use

- Uses within the Oil and Gas Industry
- Uses Outside of Oil and Gas Industry
- Barriers to Beneficial Use

Treatment

- Types of Produced Water Technologies
- Choosing Technologies
- Byproducts

Regulating Produced Water

- State and Federal Relationship
- Compilations of Regulations and Best Practices
- Other Issues

Impacts and Risks

- Types of Impacts and Risks
- Knowledge of Chemicals in Produced Water
- Risk Assessment and Analysis

Creation of the Initiative and First Steps

- In April 2017, the GWPC Board of Directors adopted a resolution that created a National Produced Water Beneficial Use Study Group and directed the group to:
 - “develop a report articulating the key challenges and scientific research requirements necessary to inform and define a path forward for produced water beneficial use”
- Two scoping meeting were held during the summer
 - July: two-day meeting in Salt Lake City
 - August: one-day meeting in Oklahoma City
- These allowed for formation of the project team and development of an outline for the final report

Setting Up the Project Team

- Throughout its existence, GWPC has promoted collaboration and communication between interested stakeholders
- For this important initiative of beneficially using produced water, GWPC wanted to involve many interested parties, but elected to have state officials in the two lead roles. They represent both oil and gas interests and water interests.
 - John Baza (Director of the Utah Division of Oil, Gas and Mining)
 - Shellie Chard-McClary (Director, Water Quality Division, Oklahoma Department of Environmental Quality)

The Rest of the Project Team

- In addition to the state leadership, the project team included representatives from various state agencies, DOE, industry, non-governmental organizations, and academia
- Several consultants have been engaged to assist in data collection and preparation of the reports
- In addition to the formal team members, GWPC sought out subject matter experts (SMEs) to provide targeted input and support to help fill in gaps
- Throughout the project, staff and management of GWPC were integrally involved in coordinating activities

Layout and Contents of Report

- The work effort was broken into three major modules with separate teams working on each:
- Module 1 – Current Frameworks for Regulation of Produced Water
 - This module reviews the water life cycle for oil and gas operations. Many aspects of the water cycle and produced water management are subject to regulation by federal, state, and local agencies.
 - The major water management laws and regulations, as well as the cooperative relationship between federal and state governments to administer those programs, are described with some comparison of requirements found in different regions of the country.
 - This module also reviews major barriers with a focus on whether beneficial use options are being blocked or inhibited by specific laws or regulations.

Layout and Contents of Report (2)

- Module 2 – Status and Opportunities for In-Field Management
 - This module focuses on how produced water is currently being used and can further be used within oil and gas operations
 - The module reviews in detail the water life cycle including produced water storage, transportation, and management
 - It examines the business practices and decision strategies used in the industry and what factors are causing them to shift over time
 - It discusses research needs and regulatory/policy initiatives that support and allow expanded beneficial uses within the industry

Layout and Contents of Report (3)

- Module 3 – Status, Opportunities, and Research for Use Outside the Oilfield
 - This module examines ways in which produced water is currently being used outside of the oil and gas industry and what additional opportunities might be available
 - To go along with broader use of produced water, additional research will be needed
 - The team will gather existing information to inform analysis and help to prioritize of research on alternatives
- In addition to the three main modules, which will be written in language that is not highly technical or laden with jargon, the report will contain various appendices that are able to dig in deeper to case examples and other areas of interest. The report contains a list of definitions and references.

Path Forward

- The module groups will continue to meet regularly by phone and begin writing draft versions of each module.
- As gaps in the desired information are identified, the module groups will seek out SMEs to help
- Review of the drafts will initially be done within the module groups
- Ultimately others will be engaged to review the draft
- The projected timeline for the project is 12-18 months (roughly by the end of 2018)
- Given the large number of project participants, most of whom are volunteering their time in addition to their regular jobs, this is a challenging goal



A relevant sentiment found on a beer can