

# Produced Water Recycling & Reuse *Addressing the Knowledge Gaps*


**Dan Mueller, P.E.**

The Produced Water Society Seminar – 2017

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# Who is EDF?

- Non-profit environmental advocacy
  - Comprised of technical and legal expertise
  - Sound science informs sound policy
  - EDF is active in catalyzing science to identify and fill knowledge gaps
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# Managing Produced Water

- 20+ billion bbls (800+ billion gallons) of produced water generated each year
- Surface operations critical to managing environmental risks
- What to do with this water?
  - Disposal wells
  - Reuse for subsequent well completions
  - Robust treatment for other purposes

# The Problem

## Produced Water Management

- Drivers to do something with this water other than dispose downhole

## An Option

### Robust Treatment

- Discharge to surface
- Agriculture/Livestock
- Other?

What are appropriate treatment goals?


# Treatment for Discharge

- Indirect vs direct discharge
- Indirect discharge
  - Publically owned treatment works (POTW)
  - Centralized wastewater treatment facilities (CWTs)
- Direct discharge (following treatment)
  - East/west of the 98<sup>th</sup> meridian makes a difference from a NPDES permitting perspective

# Beneficial Reuse

- Use for fracturing subsequent wells
  - Beneficial – reduces demand on other water sources
- Agriculture
  - Non-food chain and food chain crops
  - Impacts on soil
  - Impacts to groundwater and surface waters
- Livestock
- Other

# The Challenge

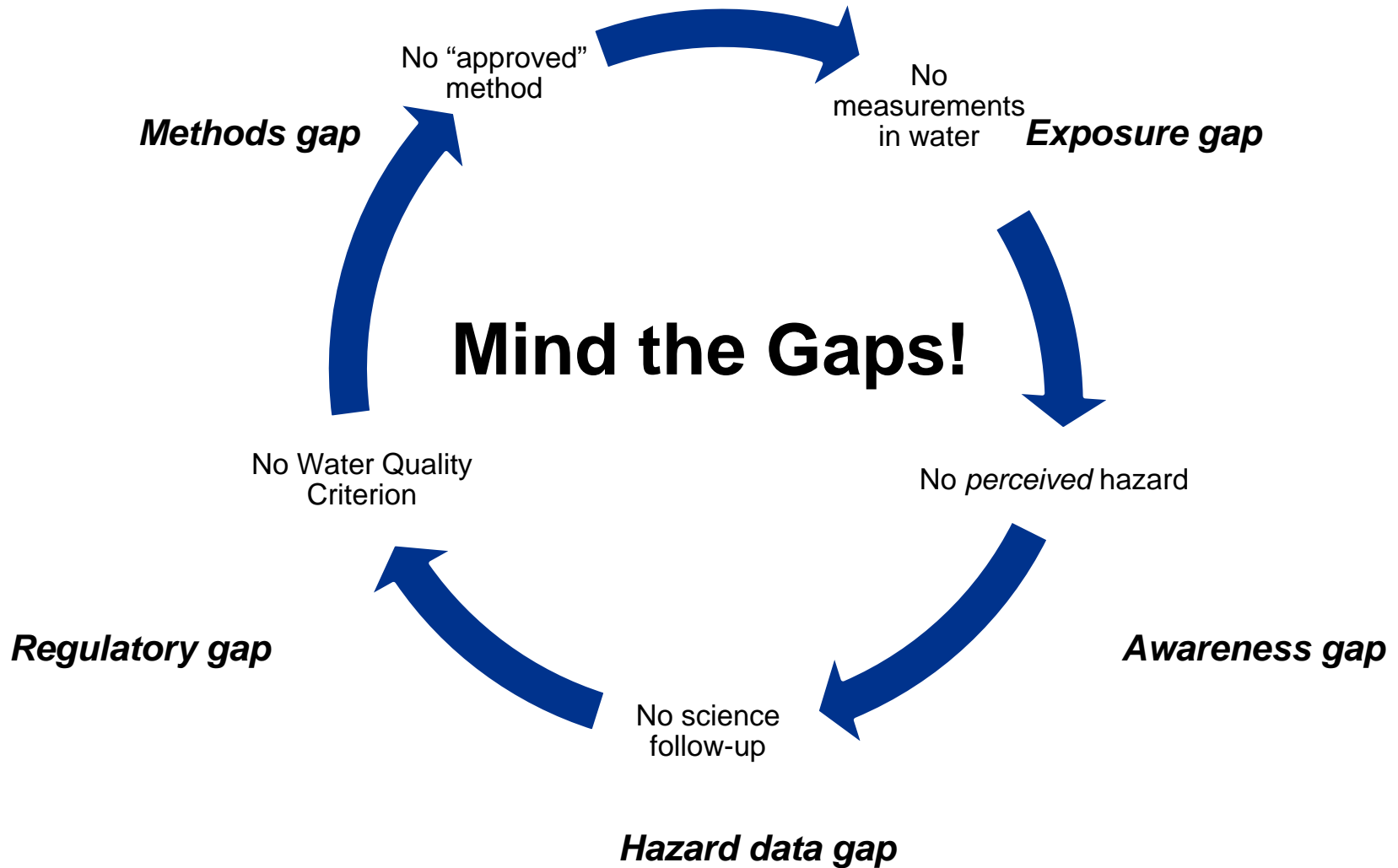
- What is in produced water?
  - What are the constituents of concern?
  - What treatment processes are required?
  - What is an appropriate monitoring program?
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# Constituents of Concern in Produced Water

- Produced water a combination of flowback and formation water
- Fracturing chemicals return with the flowback
- Formation water contain more than just total dissolved solids
  - Studies show 60 priority pollutants identified in produced water
- Transformational products
  - High heat + high pressure = chemical reactions



# Produced Water Knowledge Gaps



# Analytical Methods Gap

Approximately **500**  
unique chemicals  
reported to the  
FracFocus database  
between 2013 and early  
2015



Fewer than **half** of  
these constituents  
have “approved”  
EPA analytical  
methods

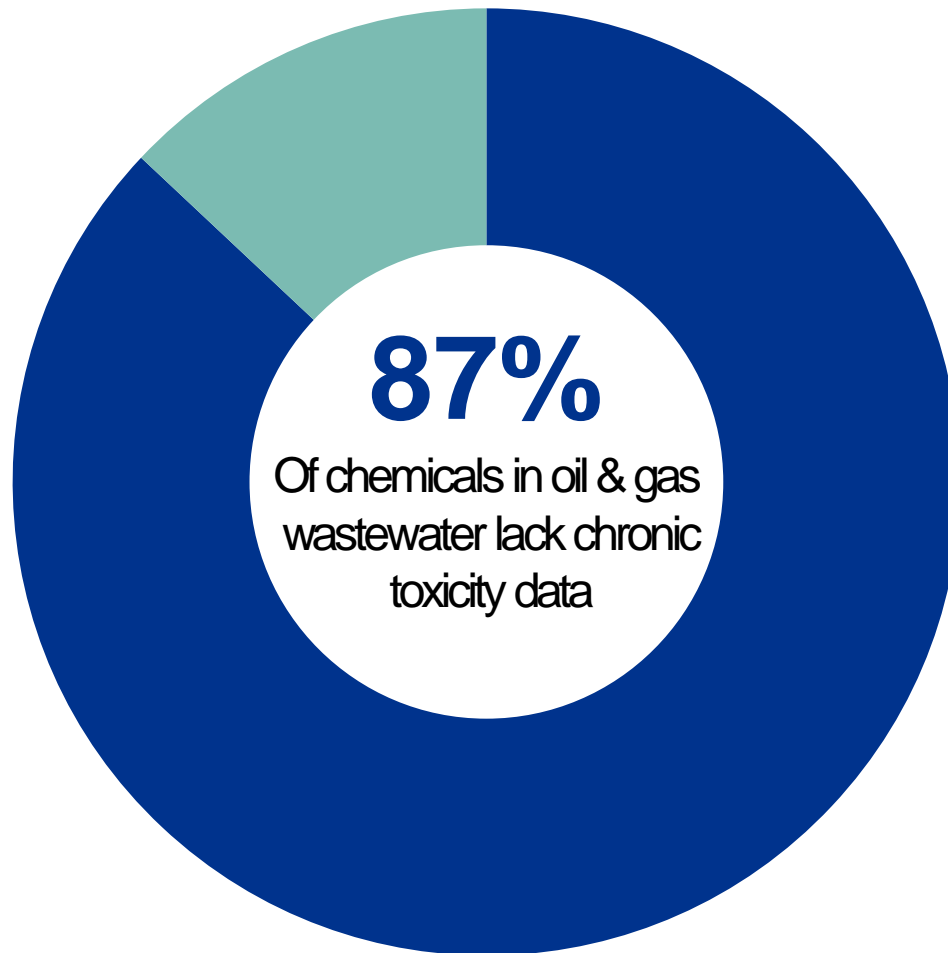
# Exposure Gap

- *Not going to find what you are not looking for*

# Awareness Gap

- *Difference between perceived threat and actual risks*
- *Unknown unknowns*

# HAZARD DATA GAP

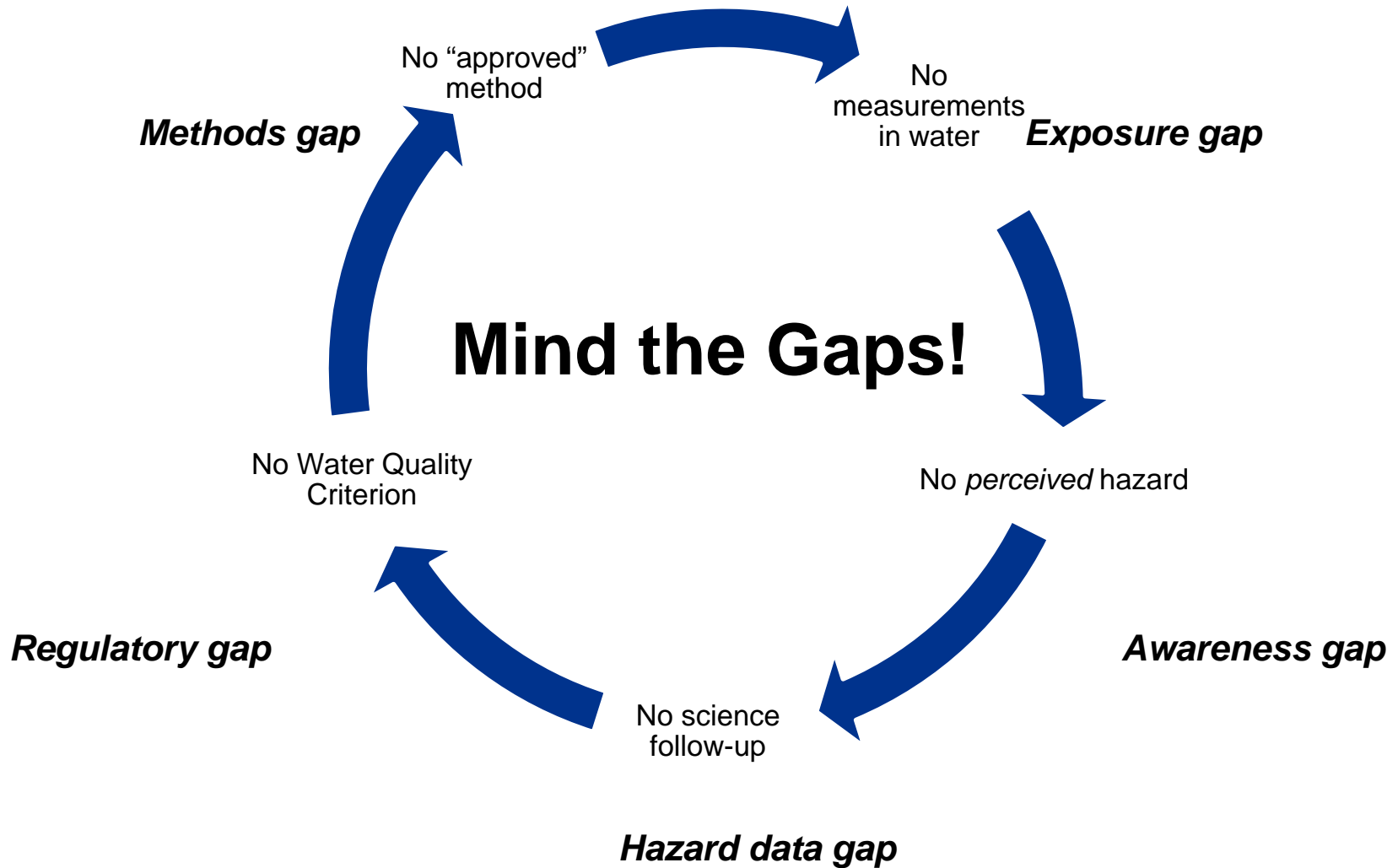


**EPA Assessment of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources (2015)**

# Regulatory Gap

- Regulations in response to a determined need to regulate
- Example - NPDES Permitting
  - “Expected to be present”
  - “Treatability”
  - “Benefit outweighs cost”

# Produced Water Knowledge Gaps



# Science to fill the gaps – EDF Activities

- Analytical Methods
  - Method gap analysis
  - Method enhancement/development
  - Standard Reference Materials
- Treatment technologies
  - Biological in high salinity environment
- Toxicity
  - Individual constituents
  - Toxicity indicators (like WET test)

# EDF's Wastewater Science



## PRODUCED WATER CHARACTERIZATION

Improve analytical methods so we can know what's in the wastewater

## TREATMENT TECHNOLOGIES

Understand how we can efficiently and economically remove toxic constituents before novel uses or discharge

## TOXICITY

Understand potential toxic impacts of beneficial reuse options on land, crops, animals, and humans

## EDF EFFORTS

### Key Takeaways from 2015 Emerging Issues Workshop:

- Methods gaps
- Unknown organics
- Need for chemical reference materials

### Current Projects:

- Analytical Advancements – Organics
- Methods Gap Report
- Peer-reviewed articles in 2017

### Future Projects:

- Further method development
- Research materials
- Reference materials



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## TOXICITY

Understand potential toxic impacts of beneficial reuse options on land, crops, animals, and humans

## EDF EFFORTS

### Key Takeaways from 2015 Emerging Issues Workshop:

- Fit for purpose treatment
- Expense, Emissions, Efficiency
- Residual Wastes

### Current Projects:

- Specialized Biological Treatment
- Peer-reviewed articles in 2017

# EDF's Wastewater Science

## PRODUCED WATER CHARACTERIZATION

Improve analytical methods so we can know what's in the wastewater

## TREATMENT TECHNOLOGIES

Understand how we can efficiently and economically remove toxic constituents before novel uses or discharge



## TOXICITY

Determine what dose is toxic and understand toxic impacts of beneficial reuse options on land, crops, animals, and humans.

## EDF EFFORTS

### Fall 2016 Emerging Issues Workshop

#### Goal:

- Managing toxicity risks without toxicity data

#### Preliminary Focus:

- High-throughput toxicity testing; Whole effluent assessment; effects-directed analysis

#### Current Projects:

- Multiple proof-of-concept projects

#### Future Projects:

- Longer-term projects building on proof-of-concept projects

# A case study in cleaner water



Setting the Standard

- **Standard One:**  
***wastewater discharge standard***
  - Industry/environmentalists collaborate on best practices
  - First-of-it's kind standard to address oil/gas wastewater treatment
  - Consensus: minimal technology for water treatment doesn't cut it.
- **Best available technology requires:**
  - Distillation
  - Biological Treatment
  - Reverse Osmosis (in some cases)
- **Initial and ongoing testing and monitoring of over 200 constituents + Whole Effluent Toxicity testing**
- **Zero direct or indirect discharges**  
(except through Centralized Wastewater Treatment Facilities)

**CAUTION**

**OPEN DOOR  
SLOWLY**



**Dan Mueller**  
dmueller@edf.org  
512-691-3453