

Comparison of Federal Water Quality Criteria, State Water Quality Standards and other Existing Information on Chemical Constituents Identified in Produced Water

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Oil and gas operations across the United States produce over a trillion gallons of wastewater, or “produced water” each year; a vast majority of this wastewater is managed through underground injection for disposal or enhanced recovery. Some western states are beginning to consider produced water management alternatives through legislation and regulation focused on converting this industrial wastewater into useable water for purposes outside of oil and gas operations. Challenges to such uses of produced water include: its high variability in quality and volume; poorly understood chemical makeup due to a lack of analytical methods coupled with various analytical challenges; and minimal research efforts to date. Furthermore, the economics of treatment at levels that would be required for release to the environment are generally far out of balance with current operating budgets and existing costs of water for other potential users, such as agriculture. Importantly, regulatory programs necessary to oversee and implement reuse practices, including land application and surface water discharge, either do not currently exist or were not designed with this industrial waste in mind.

It is EDF’s position that significant expansion of management options for produced water that include surface water discharges, land application, or other scenarios that increase potential exposure to constituents of concern from produced water should not occur until science-based regulatory programs can be put in place to ensure these practices are allowed only where risks are understood, mitigated, and monitored through enforceable regulations. However, there are instances where decision-makers have or will move forward despite these gaps. In these cases, acting on data and tools currently available will strengthen any permitting programs that do proceed even as decision-makers gather more information.

In an effort to better elucidate what is known about produced water chemicals, EDF partnered with Texas A&M University and the Endocrine Disruption Exchange (TEDX) to perform a comprehensive literature review of the subject, and to develop a framework to prioritize chemicals identified in produced water for monitoring or further research based on toxicity hazard data.¹ Of the chemicals identified in that effort, more than half of those have not been the subject of a published safety evaluation or mechanistic toxicology study, and 86% were lacking the type of substantive toxicological data or values that would be necessary to conduct a risk assessment. More recently, EDF and University of Colorado, Boulder, partnered to expand and

¹ Danforth C, Chiu WA, Rusyn I, Schultz K, Bolden A, Kwiatkowski C, Craft E. 2020. An integrative method for identification and prioritization of constituents of concern in produced water from onshore oil and gas extraction. *Environment International*. 134:105280. doi:[10.1016/j.envint.2019.105280](https://doi.org/10.1016/j.envint.2019.105280).

update the database and have found a total 179 citations, resulting in the identification of over 1350 chemicals associated with produced water.

In an effort to understand the potential applicability of this assessment, EDF is conducting an analysis of the alignment of regulatory programs with what is currently known about chemicals in produced water. This work is bringing the following information together:

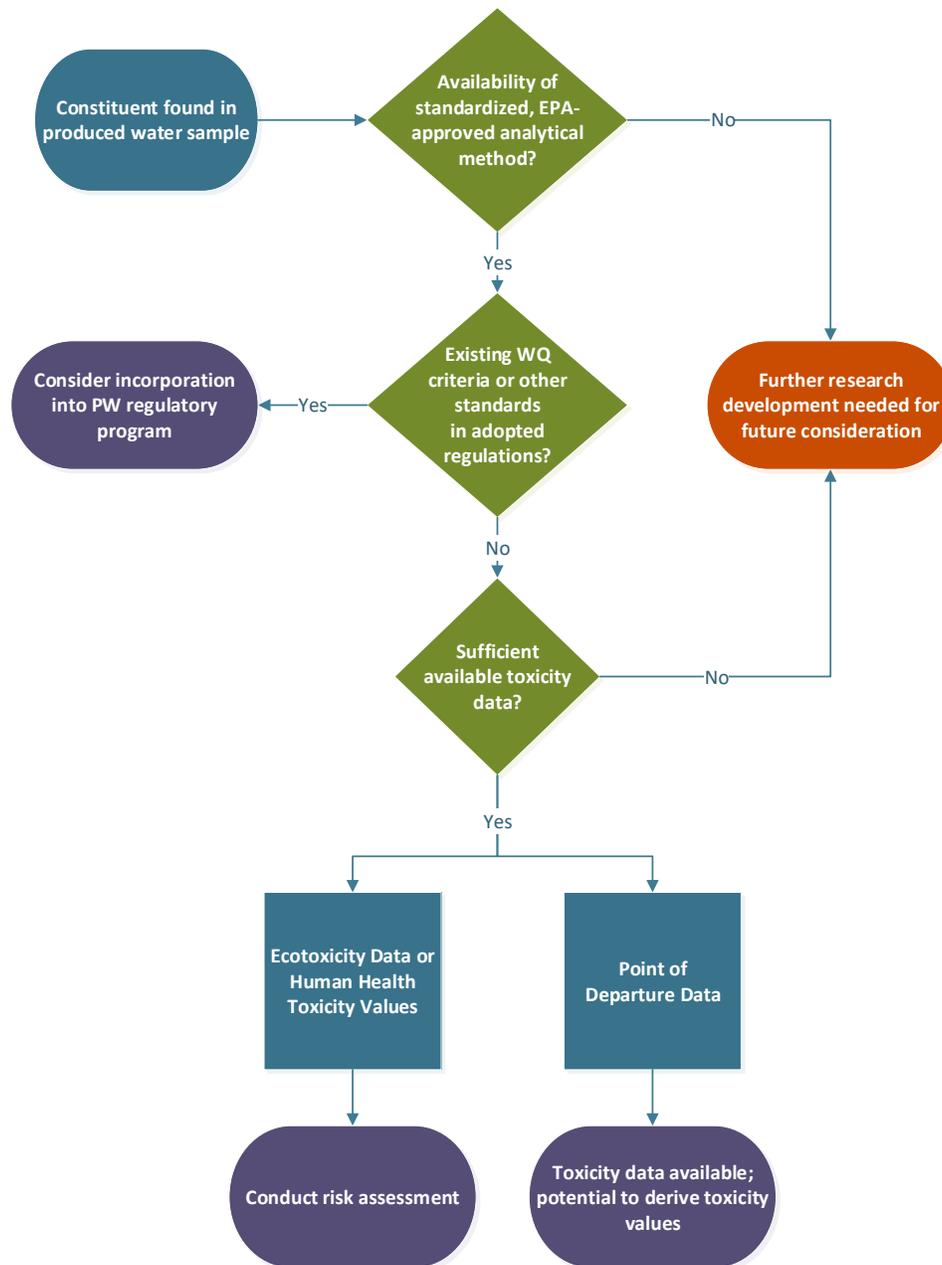
- A summary of the current status of knowledge regarding the constituents of concern potentially present in produced waters;
- An overview of existing state and federal regulatory programs that currently, or could in the future, apply to produced water reuse and discharge, focusing initially on water quality criteria and standards;
- An applied case-study crosswalk to existing federal water quality criteria and state standards with known produced water data to identify priority options for near-term and long-term action and highlight where scientific information is lacking.

For the crosswalk effort, EDF developed a framework to identify, at the federal level and on a state-by-state basis, produced water chemicals that have a standard approved analytical method available as well as toxicity data (either human toxicity values or ecotoxicity data), and if they have existing numeric criteria or water quality standards. This framework is presented in the figure included herein.

This research has shown that there are a significant number of chemicals in produced water that have existing water quality criteria or standards, or potentially have enough toxicity information to begin considering development of human health and/or aquatic life water quality criteria that could be incorporated into water quality standards. Although criteria and standards based on the existing body of knowledge would only be a first step, such work also can be used to develop permit conditions to advance protection of the health and safety of water and the environment as regulatory authorities contemplate discharges of treated produced water.

Key takeaways from these crosswalks include:

- State and federal regulatory programs and guidance offer some coverage of produced water constituents of concern, but major gaps remain, meaning research should continue to be a priority.
- Utilizing current federal criteria to define success of treatment outcomes clearly falls short of comprehensively assessing risk or safety, as, for example, "meets federal surface water quality standards" only covers about 8% of chemicals identified in produced water.
- Before moving to modify programs and expand permitting, EPA should consider what can be done with available information to help states strengthen regulatory programs.
- The chemicals identified as those with standard analytical methods and toxicity data should be considered "low-hanging fruit" for research and possible near-term action and NOT a final priority list.



Overview of framework to assess potential for regulation of constituents identified in produced water. Where a method and standard are available for a produced water chemical, the regulatory authority has the tools and data necessary to incorporate an applicable limitation or other requirement in a research, pilot, or permitting program and should strongly consider doing so in the near-term. Chemicals that are found in produced water, have an approved analytical method as well as meaningful toxicity data, but do not have an existing regulatory standard, should be prioritized for near-term study and action toward the development of improved, more protective criteria for the treatment and reuse or discharge of produced water. While these may or may not be the most toxic or most concerning constituents potentially present in produced water or treated produced water effluents, many have enough available data to make decisions in the near-term while further research is conducted to better analyze and develop data on other constituents of concern.