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FRACKING IN CALIFORNIA
Wastewater Handling and Disposal

A reality of oil and gas production in California is that it generates large volumes of wastewater; for every gallon of oil produced, an average of 15 gallons of wastewater is pumped to the surface (DOGGR 2015). This wastewater is of varying quality and can contain chemicals and other constituents that pose a risk to humans and the environment. Wastewater from hydraulically fractured, or "fracked", wells may also contain chemical additives used during the fracking process. The potential human health and environmental impacts from fracking wastewater can be managed through proper handling and disposal. In this brief, we describe the kinds of wastewater produced during fracking, the methods for disposing of this waste, and the potential impacts of this wastewater on health and the environment.

WASTEWATER FROM OIL AND GAS PRODUCTION

Large volumes of water are brought to the surface as a byproduct of oil and gas production. This water, referred to as "produced water", is of varying salinity and quality. It contains constituents that occur in deep geological formations, including metals, trace elements, petroleum hydrocarbons, volatile organic compounds (VOCs), and radionuclides. Wells that have been fracked produce an additional waste stream called "flowback" or "recovered fluids". Flowback contains produced water as well as fracking fluids and their reaction byproducts. Because drillers recover only a small amount of this fluid before the well begins producing oil and gas, the remainder of the fracking fluid either stays underground or eventually returns to the surface mixed with produced water (CCST and LBNL 2015). In this issue brief we refer to flowback and produced water collectively as "wastewater".

Regulators and the public do not have a complete understanding of the potential health and environmental effects of the chemicals of the fracking fluid used in California (CCST and LBNL 2015). While state law requires oil companies to report the contents of fracking fluids, 38% of the substances used for fracking in the state are not known because oil companies used non-specific names or reported them as trade secrets, confidential business information, or proprietary information. Additionally, the toxicity and biodegradability of more than half the chemicals used in fracking remain uninvestigated, unmeasured, and unknown.

Photo: Sarah Craig/Faces of Fracking

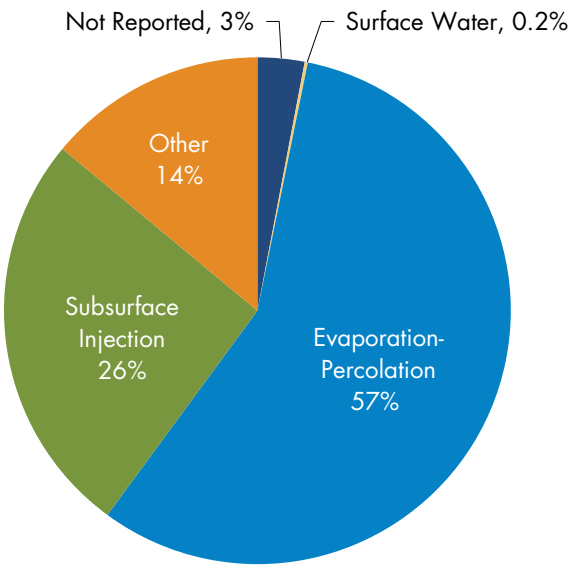
DISPOSAL METHODS IN USE IN CALIFORNIA

Wastewater from oil and gas production is disposed of using a variety of methods (Figure 1). Flowback and produced water are intermingled, and this wastewater is managed and disposed of together (DOGGR 2013). Oil companies reported that unlined percolation pits were the most common disposal method for wastewater from wells that had been stimulated.[1,2] Unlined pits are among the oldest methods for disposing of produced water, where some of the water evaporates, but the majority percolates into the ground. Between 2011 and 2014, 57% of produced water from stimulated wells was disposed of in unlined pits during the month after stimulation occurred (CCST and LBNL 2015).[3]

Underground injection is the second most commonly reported disposal method for wastewater from stimulated wells in California, accounting for 26% of the wastewater produced between 2011 and 2014 during the first full month after stimulation. Some injection wells are used for enhanced oil recovery, where water is injected into oil or gas-bearing formations to increase production. The rest of these wells are disposal wells where water is injected into zones either without hydrocarbons or where hydrocarbons have already been extracted.

Figure 1.

Produced water disposal during the first full month after stimulation.



Source: CCST and LBNL (2015)

Notes: Data for stimulated wells throughout California were evaluated for the years 2011 to 2014. Subsurface injection includes injection into Class II disposal wells as well as injection for enhanced oil recovery.

The disposal method for 17% of the wastewater from stimulated wells is not known or not reported. Very few operators discharge produced water from stimulated wells into creeks or streams, with only two wells reported to be discharging a total of 550,000 gallons (1.7 acre-feet) of wastewater produced during the first full month after stimulation. There were no reports of produced water from stimulated wells being disposed of in sewer systems.

RISKS FROM WASTEWATER DISPOSAL

These disposal methods pose a risk to the state's groundwater resources. When the water in unlined percolation pits contains fracking chemicals, these chemicals can cause pollution of the soil or groundwater that is underneath or nearby. Underground injection is considered safe when impervious "confining layers" keep the waste in place and prevent fluids from moving into drinking

1 According to CCST and LBNL (2015), these values are "reliant on official data reported to DOGGR, which shows that these and other operators sent the majority of their produced water to unlined pits for evaporation and percolation, but the reports from industry suggest that more produced water may be disposed of in injection wells and less to percolation pits now, than in the past."

2 "Stimulation" includes techniques that increase or improve the flow of oil and natural gas into the wellbore. The data and information cited from CCST and LBNL typically apply to well stimulation generally; however, fracking is the most common technique used in California.

3 The report evaluated the disposal method for the water produced during the first full month after stimulation because it was more likely that this water would contain stimulation chemicals. Some wells continue to produce or are put back into production long after stimulation has been conducted.

water aquifers (Figure 2). Nevertheless, there have been confirmed cases from across the United States in which wastes have migrated from the formation where they were injected and have contaminated soil and groundwater, threatening the environment, farms, and public health (Lustgarten 2012; GAO 1989; Gómez 2014). From 2009 to 2010, there were 21 cases of alleged contamination reported in California (Gómez 2014). Furthermore, contamination can also occur when operators make mistakes or violate rules, or where regulators allow injection or percolation in the wrong areas.

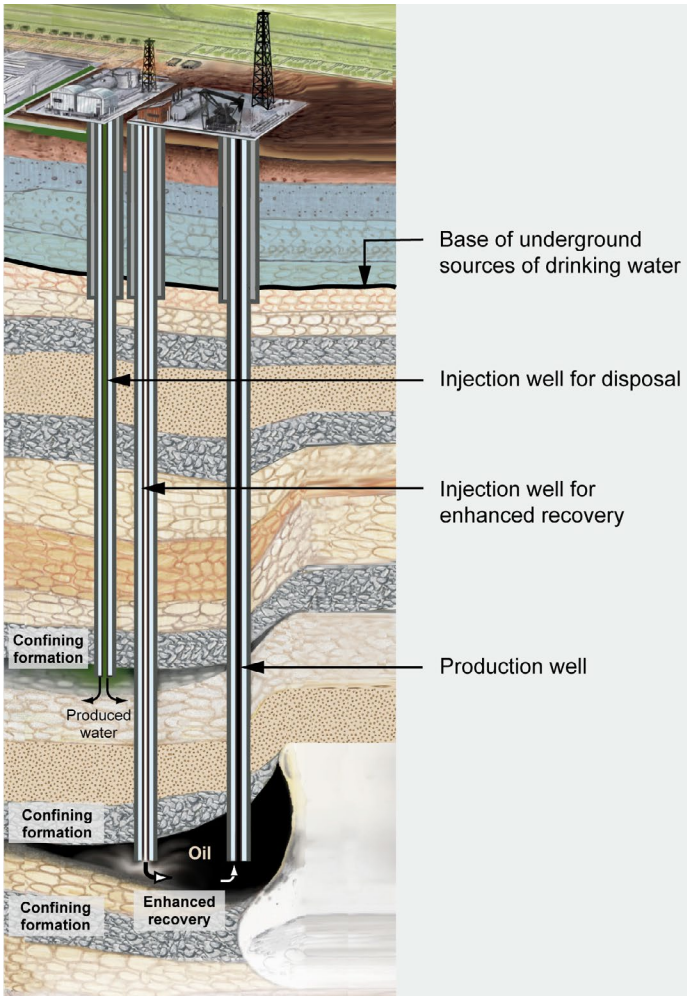
However, it is difficult to say whether this problem is widespread in California. The state does not monitor groundwater to detect contamination from injection wells, nor does it require well operators to do so. Investigations are typically conducted only in response to citizen complaints. Further, in 2011 it was revealed that California has allowed oil companies to inject wastes into waters that are considered potential water supplies (Walker 2011). Under an agreement with the U.S. EPA, California's Division of Oil, Gas, and Geothermal Resources (DOGGR) is responsible for implementing safeguards under the Safe Drinking Water Act. For the last 30 years, California has failed to enforce the federal law that restricts injection in aquifers where the concentration of total dissolved solids (TDS) is less than 10,000 milligrams per liter (mg/L) (Bohlen and Bishop 2015). As a result of lax regulation and poor record keeping, potential sources of water supply have been endangered by oil industry wastes.

THE FUTURE OF FRACKING WASTEWATER DISPOSAL IN CALIFORNIA

Proper handling and disposal of wastewater from fracked wells is necessary to protect the environment and groundwater resources. Underground injection disposal wells and percolation pits pose a particular risk when they are improperly sited or not appropriately operated or maintained. Indeed, many states (including Texas, Ohio, and New Mexico) have banned the use of percolation pits for the disposal of oil and gas wastewater due to the inherent risks from this disposal method.

Figure 2.

Schematic of underground injection wells for disposal of oil and gas wastes and for enhanced oil recovery.



Source: Reprinted from the U.S. EPA (Gómez 2014)

One of the main issues with managing wastewater disposal is that many of the chemicals that are used for oil and gas production are unknown. State and federal regulators should create stronger rules for the handling, use, and reporting of chemicals used by the oil and gas industry. Priorities include greater

disclosure of the amount and kinds of chemicals used, particularly those used for fracking. In addition, oil companies should eliminate or minimize the use of hazardous materials that could impact humans or sensitive environments. Stronger regulation of the industry and better wastewater handling and management are vital to prevent pollution and to protect human health and the environment.

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