Occurrence of BTEX from oil- and gas-related incidents in groundwater above the Denver-Julesburg Basin

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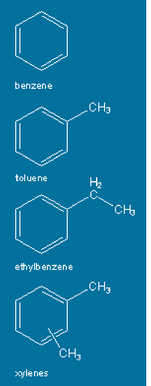
Introduction

Public concern about water quality related to oil and gas development has grown in recent years.

There is a need to better understand the exposure potential in groundwater for organic compounds associated with oil and gas development.

Various organic compounds, including BTEX, are found in hydraulic fracturing fluids, flowback/produced waters, and petroleum products.[1-5]

The most likely pathway for groundwater contamination is thought to be isolated, accidental surface spills.[1,6,7]



Drilling rig near subdivision in northern Colorado.

Objectives & Methods

1. How many spills impacted groundwater?

- The Colorado Oil and Gas Conservation Commission (COGCC) maintains incident reports in an online database.
- Oil and gas operators report incidents and indicate impacted media.
- Possible groundwater impacts were confirmed by manually reviewing reports.

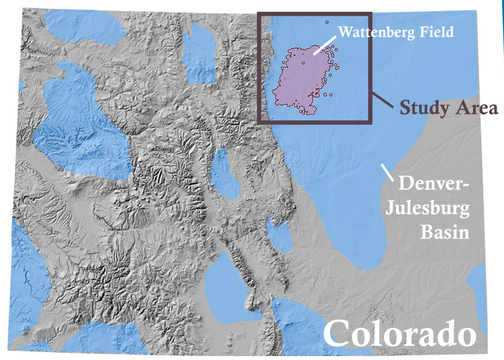
2. How frequently did spills impact groundwater?

- The number of spills was normalized to indicators of development in the study area.

3. What was the character of spills that impacted groundwater?

- Spill and remediation reports were reviewed to determine spill causes, facility types, and materials released, among other information.

Analysis was conducted for the years 2010–2012, since extensive unconventional oil and gas development began in this region in 2010.



Results

Numbers of spills

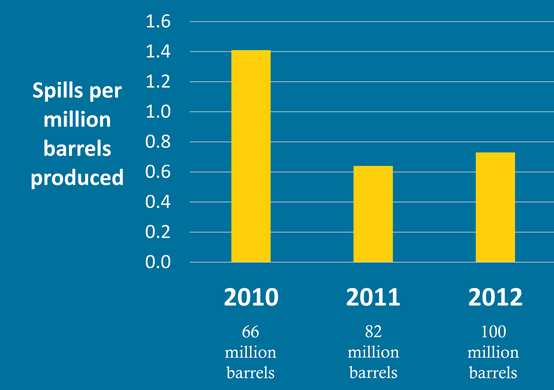
Year	All	Groundwater	Groundwater (BTEX)
2010	192	102	93
2011	183	61	52
2012	215	86	73
Total	589	249	218

Rates of spills compared to number of producing wells

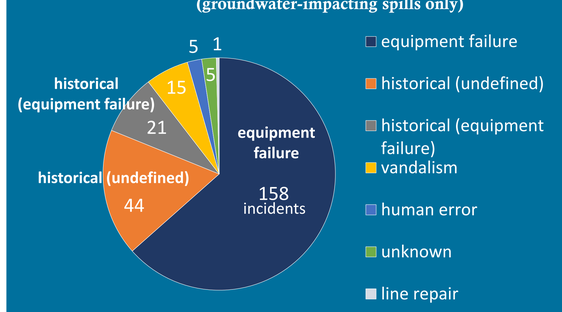
Year	Producing wells	All incidents*	Groundwater impact	Groundwater impact (BTEX)
2010	17,855	1.07%	0.57%	0.52%
2011	19,348	0.94%	0.32%	0.27%
2012	20,775	1.03%	0.41%	0.35%

*Predicted based on the expected overlap among spill and remediation files submitted to the COGCC in 2010-2012. An "overlap ratio" was developed as part of the manual review of spill and remediation files.

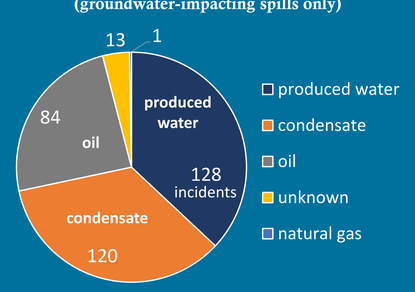
Rates of spills impacting groundwater with BTEX compared to combined volume of oil and water produced



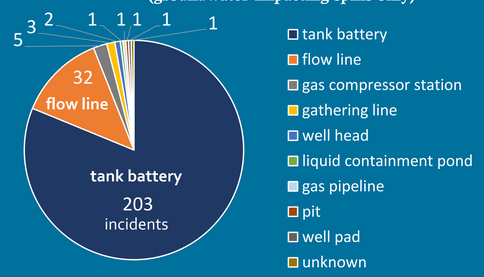
Spill causes
(groundwater-impacting spills only)



Materials released
(groundwater-impacting spills only)



Facility types
(groundwater-impacting spills only)



Conclusions

Spills impacting groundwater occurred most often at tank batteries and flow lines. These spills were most often due to equipment failure or were historical releases, and the materials released most frequently were produced water, condensate, and oil.

We estimate that the number of spills overall is **~1%** of the number of producing wells. About **40%** of spills resulted in impacts to groundwater. About **90%** of groundwater-impacting spills involved one or more of the BTEX compounds.

These occurrence rates and spill characteristics are a foundation for future exposure assessments of organic compounds of concern (including the BTEX compounds) that are associated with oil and gas development. This research could also be applied to inform improved regulations for the oil and gas industry.

Future work is planned for this project: we will evaluate spills from 2004 to 2014 in the study area in order to tell a "story" of oil and gas development in the Denver-Julesburg Basin, which experienced a boom in 2010 thanks to advances in unconventional drilling technology.

References

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Additional Information

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The **AirWaterGas Sustainability Research Network** is an NSF-funded project based at CU Boulder. Research teams from 10 different institutions are working to develop a science-based framework for understanding the environmental, economic, and social tradeoffs of oil and gas development.
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