Evaluating Scenarios of Potential Impact of Water Acquisition


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EPA Hydraulic Fracturing Study – research questions

- Water Acquisition
  - How much water is used in hydraulic fracturing operations, and what are the sources of this water?
  - How might water withdrawals affect short- and long-term water availability in an area with hydraulic fracturing activity?
  - What are the possible impacts of water withdrawals from ground and surface waters on drinking water resources?

- Chemical Mixing

- Well Injection

- Produced Water

- Waste and Wastewater

Activity – Stressor/Pathway – Impact

SOURCE WATER
(non-recycled, non-saline)

Groundwater
- self supplied
- public
- private

Surface Water
- self supplied
- municipal
- private

Consumptive Use

Groundwater Storage
Lowering water table

Reservoir Storage
Lowering stage

Stream Flow
Increase pollutant concentrations

Drinking Water Quality

- well goes dry
- change geologic strata providing source water to the well
- increased treatment costs

- reservoir goes dry
- stream withdrawal restrictions
- decreased stream waste assimilative capacity
Water Availability Modeling

OBJECTIVE:

to evaluate possible impacts of large-volume consumptive water withdrawals supporting hydraulic fracturing in comparison to water availability in representative basins under hypothetical yet possible future scenarios.

APPROACH:

1. Select representative watersheds.
2. Establish baseline hydrological conditions.
3. Modify baselines to include recent water withdrawals including hydraulic fracturing.
4. Design future scenarios.
5. Run the simulations.
6. Investigate impact.
Watershed Selection ...

Source: US Energy Information Administration based on data from various published studies
Updated: May 9, 2011
Watershed Models: spatial structure/segmentation

EPA HSPF
(hydrological simulation program fortran)

USDA SWAT
(soil water assessment tool)

Legend

USGS Gages
Hydrography
Interstate
Water (Nat. Atlas Dataset)
US Census Populated Places
Municipalities (pop ≥ 50,000)
County Boundaries
Initial Calibration Watershed
Model Subbasins

Initial Calibration Watershed
Model Subbasins

Upper Colorado (17,800 sq. mi.)

Basin, Sub-basins
Hydrological Response Units
(unique combination of land use, soil, slope)

Susquehanna (27,000 sq mi)

River segments
Model Structures – *fill and spill*

Note: SWAT is similar in structure

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*Note: After Clark et al., 2008*
## Future Scenarios: Model Assumptions

<table>
<thead>
<tr>
<th>MODEL ASSUMPTIONS</th>
<th>FUTURE SCENARIOS</th>
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<tbody>
<tr>
<td></td>
<td>Business as Usual</td>
</tr>
<tr>
<td>Projected number of wells (peak yr)</td>
<td>Average projected*</td>
</tr>
<tr>
<td>Projected water use per well</td>
<td>Average observed</td>
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* Based on US Energy Information Administration and US Geological Survey projections
Several panelists suggested broadening the scale of the assessments and increasing granularity. Specifically:

– hierarchical spatial scales - zero order (ephemeral), 1st order (perennial), 2nd order, 3rd order streams, etc. and the associated catchments

– temporal scale - annual, seasonal, monthly, daily water balances
Session 2  Presentations

• EPA Scenario Modeling Water Availability  
  Steve Kraemer, US EPA

• Mapping Water Availability and Cost in the Western United States  
  Vincent Tidwell, Sandia National Laboratory

• Integrated, Collaborative Water Research in Western Canada  
  Ben Kerr, Foundry Spatial Ltd

• Water Need and Availability for Hydraulic Fracturing in the Bakken Formation, Eastern Montana  
  Mitch Plummer, Idaho National Laboratory
Session 2
Discussion Questions

- What would a more generalized, conceptual model look like for assessing hydraulic fracturing impacts in different areas of the US and at different scales?

- What factors should be included in a generalized model?