Volatile Organic Compounds in Ohio’s Ground Water

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Division of Drinking and Ground Waters

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Ground Water in Ohio

- ~6 million people rely on ground water (~50%)
- Over one billion gallons of ground water per day is used for people, industry and farmers.
VOC Data Sources

Public Water System Compliance Data
- ~2,000 PWSs routinely sample for regulated VOCs
- Post-1991
- Treated ground water
- n ≈ 380,000
- Sampling frequency = monthly to every 3 years

Ambient Ground Water Monitoring Data
- ~200 active wells sampled for 61 VOCs (EPA 624)
- Post-1985
- Untreated ground water
- n ≈ 84,000
- Sampling frequency = once every six to 18 months
Data Filter*

- Two confirmed results of same or related compound constitutes a VOC impact

- THMs: PWS removed, Ambient retained

*Approach identical to SWAP data censoring for Susceptibility Analyses
Public Water Systems Impacted by VOCs

144 VOC-Impacted Systems out of 1,949 Active Community and NTNC Systems
= 7.3% systems

- Community and NTNC PWSs
- VOC - Impacted PWSs
- County Boundaries

Ohio EPA
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Map By: Linda Stutteny
April 7, 2006
Ambient Ground Water Monitoring Stations Impacted by VOCs

25 VOC-Impacted Stations out of 204 Active Monitoring Stations
= 12.2% Stations

- Green stars: Ambient Stations with VOC detections
- Yellow stars: Ambient Stations with only THM detections
- Blue dots: Active Ambient GW Monitoring Stations
- White areas: County Boundaries

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OhioEPA
Sensitive Aquifers

**Geologic settings**:  
- sand and gravel deposits/aquifers  
- bedrock aquifers below thin till or thin lacustrine deposits  

(Thin < 25 ft)

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\(^1\)ODNR-Division of Water, 2000. Glacial Aquifer Map (digital format)
Sensitive Aquifers

**Community and NTNC PWSs:**
- 56% (1,107) are within sensitive aquifer settings
  - 10% (109) have VOC impacts
  - 4% in non-sensitive settings have VOC impacts

**Ambient Stations:**
- 72% (146) are within sensitive aquifer settings
  - 16% (23) have VOC impacts
  - 3% in non-sensitive settings have VOC impacts
PWSs and Ambient GW Monitoring Stations Impacted by VOCs

Within a Sensitive Aquifer Setting:
- 109 (75%) impacted PWSs
- 23 (92%) impacted stations

- VOC - Impacted PWSs
- Green Star - Ambient Stations w/VOC detections
- Yellow Star - Ambient Stations w/only THM detections
- Blue - Geologically Sensitive Aquifer Settings
- White - County Boundaries

Ohio EPA
Division of Drinking and Ground Waters
Map By: Linda Slattery
April 7, 20006
Nitrate Concentrations in VOC-impacted PWS Wells

Only 22 systems (15%) have both nitrate and VOC impacts

PWS Average Nitrate (mg/L)
- 2.0 - 5.0
- 5.0 - 7.5
- 7.5 - 10
- VOC & Nitrate Impacted PWSs
- VOC only Impacted PWSs
- Geologically Sensitive Aquifer Settings
- County Boundaries
Nitrate

Nitrate and VOC impacts:
- Average Casing Length = 51 ft
- Average Total Well Depth = 86 ft

VOC impacts only:
- Average Casing Length = 69 ft
- Average Total Well Depth = 139 ft

- Possible geochemical association
<table>
<thead>
<tr>
<th>Land Use</th>
<th>PWSs w/ No VOC Impacts</th>
<th>PWSs w/ VOC Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial</td>
<td>4%</td>
<td>10%</td>
</tr>
<tr>
<td>Industrial</td>
<td>4%</td>
<td>10%</td>
</tr>
<tr>
<td>Transportation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residential</td>
<td>12%</td>
<td>19%</td>
</tr>
<tr>
<td>Agricultural</td>
<td>61%</td>
<td>49%</td>
</tr>
</tbody>
</table>

Land use data obtained from 1994 USGS National Land Cover Dataset
Most Common VOCs found in Ohio's Ground Water

- Trichloroethylene: 2.0% Impacted - PWS, 3.4% Impacted - Ambient
- cis-1,2-Dichloroethylene: 1.4% Impacted - PWS, 3.9% Impacted - Ambient
- Tetrachloroethylene: 1.3% Impacted - PWS, 2.5% Impacted - Ambient
- 1,1,1-Trichloroethane: 1.5% Impacted - PWS, 2.5% Impacted - Ambient
- MTBE: 0.3% Impacted - PWS, 1.5% Impacted - Ambient
- Chloroform: 17.7% Impacted - Ambient

Legend:
- Yellow: % Impacted - PWS
- Orange: % Impacted - Ambient

Percent Impacted
Summary

- VOCs most likely detected in sensitive aquifers
  - Population density and urban land use directly related to VOC impacts

- Nitrate is not a good indicator of VOC occurrence
  - VOCs require a point source
  - Deeper wells more likely to exhibit reducing conditions

- Solvents most frequently detected
  - Chloroform commonly detected in untreated wells
Future Work

- Evaluate details of impacted vs. non-impacted wells to better define associations
- Evaluate point source data
- 2006 305(b) Report on GW Quality
- Ground Water Impacts database
Acknowledgements

- GIS assistance: Dave White and Bridget Simpson

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For more information...

- Web address
  [www.epa.state.oh.us/ddagw/wqcharpr.html](http://www.epa.state.oh.us/ddagw/wqcharpr.html)

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