Kentucky Interagency Groundwater Monitoring Network: Expanded Monitoring Programs

Jessica Moore and Robert J. Blair
Kentucky Division of Water
&
Bart Davidson
Kentucky Geological Survey

Groundwater Protection Council Annual Forum
Seattle, Washington
October 5-8, 2014
Interagency Groundwater Quality Monitoring Program Design

- Interagency Technical Advisory Committee (ITAC) on Groundwater

- Goals: 1) Baseline data on ambient groundwater conditions  
  2) Characterize groundwater resources  
  3) Disseminate info collected

- Represent all aquifer types (karst, fracture flow and granular) and Physiographic Regions of KY, consider Ohio River alluvium as unique region/aquifer

- Ideal Design: 640 active sites  
  120 rotating “one-time” sites

- Kentucky Revised Statute 151 (1998) – Mandated groundwater monitoring, established ITAC and set KGS as KY groundwater repository
Actual (Reasonable) Design:

- Ambient Groundwater Quality Monitoring Network:
  - 59 active sites (~10% of “Ideal”)
    - 29 wells and 30 springs
  - Sampled 4 times per year (some less frequent)
  - Priority given to Public Water Suppliers using groundwater (18 wells, 5 springs)

- Approximate total of 200 samples per year
  - Roughly 120 from GW Quality Network
  - Remainder from NPS studies, technical assistance, complaint investigations and one-time sites
Parameters Summarized

- **Bulk Parameters** – pH, Temp, Specific Conductance, TSS & TDS
- **Nutrients** – NO$_3$-N, NO$_2$-N, NH$_3$-N, TKN, TOC, Total-P & Ortho-P
- **Major Inorganic Ions** – Cl$^-$, F$^-$ & SO$_4$$^{2-}$
- **Metals (Dissolved and Total)** – Ca, Fe, Mg, K, Na, Al, As, Ba, Cd, Cr, Cu, Pb, Mn, Ni, Se, Ag & Zn
- **Organics** – N/P and Chlorinated Pesticides, Herbicides & PCBs
- **Volatile Organics** – BTEX & MTBE (numerous others)
- **Caffeine** – recent addition, surrogate for potential anthropogenic impacts
Funding Groundwater Quality Monitoring in Kentucky

• General operating funds

• Water Well Drillers Certification Fees (agency receipts)

• Federal Insecticide Fungicide, and Rodenticide Act (FIFRA) – KY Dept. of Agriculture

• Clean Water Act §319(h) assessment projects
Groundwater Sensitivity Regions of Kentucky
Division of Water, 1994

Sensitivity Ranking

- 5 - Highest
- 4
- 3 - Moderate
- 2
- 1 - Lowest

Basin Management Unit Boundaries
Water Well Distribution
Kentucky Division of Water
2014

Water Wells per County

- 4 - 10
- 11 - 100
- 101 - 500
- 501 - 1000
- 1001 - 2000
- > 2000

Basin Management Unit (BMU) Boundary

0 50 100 200 Miles

[Map of Kentucky with color-coded water well distribution by county for 2014.]
KY Ambient Groundwater Quality Monitoring Network:
Initial Monitoring Sites 1995 - 2000

Physiographic Regions
- Bluegrass
- Knobs
- E. Coal Field
- Mississippian Plateau
- W. Coal Field
- Jackson Purchase

Monitoring Sites
- Active (Spring): •
- Episodic (Well): ▲

Basin Management Unit Boundaries

Map of Kentucky showing the physiographic regions and monitoring sites.
Expanded Monitoring Sites: Basin Management Unit Cycles

Basin Management Unit (BMU)

1 - Kentucky River
2 - Salt and Licking Rivers
3 - Four Rivers and Upper & Lower Cumberland River
4 - Green and Tradewater Rivers
5 - Big & Little Sandy Rivers and Tygart's Creek
Large Springs in Green River: Major issues were Nutrients and Bacteria (9 of 10 springs failed to meet PCR)

<table>
<thead>
<tr>
<th>Spring Name</th>
<th>% Urban/Residential</th>
<th>% Agriculture</th>
<th>% Forest</th>
<th>Total Groundwater Basin Area (mi²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gorin Mill Spring</td>
<td>7.5</td>
<td>71.1</td>
<td>21.4</td>
<td>152.4</td>
</tr>
<tr>
<td>Graham Spring</td>
<td>8.4</td>
<td>74.9</td>
<td>16.7</td>
<td>122.0</td>
</tr>
<tr>
<td>McCoy Bluehole</td>
<td>3.4</td>
<td>14.3</td>
<td>82.3</td>
<td>34.1</td>
</tr>
<tr>
<td>Lost River Rise</td>
<td>25.3</td>
<td>67.1</td>
<td>7.5</td>
<td>58.8</td>
</tr>
<tr>
<td>Skees KW #1</td>
<td>5.3</td>
<td>75.5</td>
<td>19.2</td>
<td>27.5</td>
</tr>
<tr>
<td>Nolynn Spring</td>
<td>6.1</td>
<td>61.5</td>
<td>32.4</td>
<td>56.4</td>
</tr>
<tr>
<td>Goodmann Springs</td>
<td>3.3</td>
<td>53.2</td>
<td>43.8</td>
<td>14.7</td>
</tr>
<tr>
<td>Mill Spring</td>
<td>2.5</td>
<td>18.5</td>
<td>79.1</td>
<td>7.1</td>
</tr>
<tr>
<td>Head of Rough River</td>
<td>3.3</td>
<td>63.2</td>
<td>33.5</td>
<td>17.7</td>
</tr>
<tr>
<td>Mahurin Spring</td>
<td>3.9</td>
<td>31.8</td>
<td>64.3</td>
<td>25.3</td>
</tr>
</tbody>
</table>
Fill Data Gaps with:
Technical Assistance and Complaint Samples

- Technical Assistance requests from PWSs and private citizens using groundwater as drinking water source

1) Some fairly simple – groundwater quality info lacking, but necessary for new well or bringing old well back online

2) Some Complaint driven – groundwater quality or quantity has been degraded
   - Water well maintenance issues
   - Resource extraction (mining, oil & gas)
   - Construction and development
   - Leaking sewer and/or failing septic systems
   - Naturally occurring
   - Spill or leak of hazardous material
   - Source of problem(s) completely unknown

- Collect other parameters as needed (pathogens, dissolved gas...)
Fill Data Gaps with:
Technical Assistance and Complaint Samples

• Technical Assistance also includes water well and spring inspections
  - Wellhead and down hole camera inspections
  - Review construction records and groundwater data from surrounding area

• One-Time Samples generally for public relations
  - Already on site for other matter and someone requests that we collect samples from their water well or spring
  - Must be drinking water source
All Groundwater Sites Sampled Through December 2013

Predominant Aquifer Type:
- Karst
- Shallow Fracture Flow & Deep Granular - Consolidated
- Granular - Unconsolidated
- Granular (Ohio River Alluvium)
- Limited Availability (Localized Fractures & Minor Karst)

Sites Sampled:
- Spring
- Well
Success

• Collected considerable amount of groundwater quality data
  - Roughly 19,000 sample results from ~6300 groundwater sources

• Baseline geochemistry in all physiographic regions and aquifers

• Determined problematic issues: Nutrients, Pesticides, Pathogens and education/outreach about water well maintenance

• Provide groundwater data to support other agencies/programs

• KGS developed web-interfaces to Groundwater Repository
Challenges

• Data gaps spatially and temporally
  1) Need to expand geographically/number of sites
  2) Need increased frequency in karst areas

• Only minor changes in nearly 20 years
  1) Added, dropped and changed sampling frequency
  2) Time to review and evaluate goals and design
  3) Review, evaluate and report on all available data

• Personnel and resource constraints
  1) Sample smarter not harder?
Acknowledgements

• Interagency Technical Advisory Committee on Groundwater
  - Past and present representatives

• Commonwealth of Kentucky Legislature and Department of Agriculture

• US Environmental Protection Agency

• DOW and KGS field staff – field activities, data management &
  analysis and reporting

Questions/Comments: Rob Blair, KDOE – robert.blair@ky.gov
(502)564-3410

Bart Davidson, KGS – bdavidson@uky.edu
(859)323-0524