State Groundwater Quality Monitoring Program in Wyoming

National Ground Water Association, Groundwater Summit, Nashville, TN Dec 3-7, 2017
Water Quality Division/Groundwater Section Programs

• Underground Injection Control Program (Class I and V)
• Groundwater Pollution Control Program
• Federal Facilities Program
  • Superfund and Formerly Used Defense Sites
• Ambient Groundwater Monitoring Program
• Special Projects
WDEQ Groundwater Section Goals

- Determining groundwater quality status and trends;
- Establishing and/or modifying groundwater standards;
- Identifying impaired groundwater;
- Identifying causes and sources of water quality problems;
- Implementing groundwater quality protection programs;
- Evaluating effectiveness of groundwater protection programs.
Groundwater Usage in Wyoming

Wyoming State Engineer Permitted Water Wells
Principal Aquifers in Wyoming
WDEQ Groundwater Monitoring Network

• Aquifer Priority Mapping
  • Cooperative between WDEQ, University of Wyoming, and the USGS

• Ambient Groundwater Monitoring Program (AGWMP)
  • Implemented through cooperative agreements with the USGS
Aquifer Prioritization

• Based on:
  • Current use of the aquifer
  • Importance of the aquifer as a drinking water source
  • Aquifers less than 500 feet deep
  • Susceptibility to pollution
  • Land use (agricultural land, urban land, mining, oil and gas fields, known contaminant sources)
  • Aquifer sensitivity (soils, vadose zone properties, land surface slope, hydrogeologic setting, aquifer recharge, depth to groundwater)
Aquifer Priority Map
Current Approach for AGWMP Site Selection

• First select all Water Wells permitted by the State Engineer’s Office, WWDC, and USGS
  • That are located in the Moderate – High and High Aquifer Priority Area’s
  • Chosen Wells are also less than 500 ft. deep
  • The aquifer priority areas are broken into town areas for sampling.
  • Then using ArcGIS software the wells are categorized into the 3 categories using a Jenk’s (Natural Breaks) Algorithm, based on well depth
  • A minimum of 20-30 wells is chosen to be sampled in each of the 33 priority areas
  • The 30 wells are split into the 3 categories based on the overall percentage of all wells, in each category for given town
    • Shallow (<100 ft), Intermediate (100-250 ft), and Deep (>250-500 ft)
  • Then wells are pseudo-randomly picked in each category by on screen selection with consideration for spatial coverage and completeness of available construction logs
AGWMP Summary

• Since its inception in 2009, groundwater samples have been collected from roughly 337 private water wells volunteered by Wyoming citizens (primarily domestic wells).

• Sampling performed by the USGS through cooperative agreements with the Wyoming-Montana Water Science Center

• Groundwater samples were analyzed for physical characteristics, major ions and dissolved solids, trace elements, nutrients and dissolved organic carbon, uranium, stable isotopes of hydrogen and oxygen, volatile organic compounds, and coliform bacteria. Selected samples also were analyzed for gross alpha radioactivity, gross beta radioactivity, radon, tritium, gasoline range organics, diesel range organics, dissolved hydrocarbon gases (methane, ethene, and ethane), and wastewater compounds.

• USGS publications summarizing the sampling results from 2009-2012
Wells Sampled in Medium-high and High Priority Areas
Wells Sampled by Principal Aquifer
How the WDEQ uses water quality data

• Groundwater classifications:
  • Made whenever there is pollution or the threat of pollution to a groundwater of the State
  
• Examples: Underground Injection Control Permits, In-situ Uranium Mining Units, Landfills
National Groundwater Monitoring Network Project

- Approximately 50 to 100 wells, selected for inclusion in the National Groundwater Monitoring Network (NGWMN), will become a part of the state groundwater monitoring network for recurrent collection of water quality and water level data by WDEQ/WQD staff.

- These wells will be selected from the pool of existing wells sampled through the Ambient Groundwater Monitoring Program.

- Selected wells will begin being sampled on a 5-year sampling rotation in 2019.
Water Quality Parameters

- Standard list defined in NGWMN framework document: Temperature, pH, Specific Conductance.

- Additional water quality parameters selected for analysis will focus on constituents with promulgated groundwater suitability standards in Chapter 8 of the Wyoming Water Quality Rules & Regulations and other constituents that can be analyzed at the Wyoming State Water Quality Lab.

- Extended sampling lists mirroring that done for the AGWMP may be conducted at select wells.
NGWMN Well Selection Process

• Compile State Engineer’s Office (SEO) well construction records for all wells sampled as part of the AGWMN

• Eliminate wells with incomplete construction information, prioritize wells with available historical sampling data

• Plot well locations in ArcGIS and create coverages for wells in each principal aquifer
NGWMN Well Selection Process

• Select a monitoring distribution and verify that selected wells are screened in the principal aquifer of interest.

• Compare water quality data for selected wells in each principal aquifer.

• Solicit and negotiate access and participation in the network from private well owners.

• Enter selected wells into the NGWMN registry and establish web services connections with the NGWMN Portal.
6. Type of construction: Dug □ Drilled □ Cardinal  □ Type of Rig

Driven □ Jet □ Other □

7. Use of Water—Domestic □ Stock □

8. Means of conveyance, distance and direction to point of use

9. Date started  Aug 1 , 19□

10. Date completed  Aug 10 , 19□ (including pump)

11. Date after completion when water was used  Aug 11 , 19□

12. WELL DESCRIPTION

Total Depth 143 ft. Depth to Water Level 40 ft.

13. TEST DATA

Yield 20.5 GPM How Tested □ Boiler □

Drawdown □ Length of Test □

14. PUMP DATA

Type Turbine □ Centrifugal □ Power Source □ Electric □ Gas □

Horsepower □ Amount of Water Being Used 14.5 GPM

15. CASING RECORD

Plain Casing

Size 5" Kind Plastics

from 0 ft. to 48 ft.

Size □ Kind □ from □ to □ ft.

Size □ Kind □ from □ to □ ft.

Size □ Kind □ from □ to □ ft.

Perforated Casing

Size 5" □ Kind □ Plastics

from 48 ft. to 143 ft.

Size □ Kind □ from □ to □ ft.

size □ Kind □ from □ to □ ft.

16. Was surface soil provided? Yes □ No □ To What Depth □

Was well gravel packed? Yes □ No □

17. FLOWING WELL (Owner is responsible for installing control device on flowing well.)

Does well flow? Yes □ No □

Flow controlled by: Valve □ Cap □ Plug □ Does well leak around casing? Yes □ No □

18. LOG OF WELL—Clearly indicate first water bearing material and principal water bearing material.

<table>
<thead>
<tr>
<th>From</th>
<th>To</th>
<th>Material Type, Texture, Color</th>
<th>REMARKS (Cutting, Sanding, Packing, etc.)</th>
<th>Indicate Water Bearing Formation</th>
<th>Indicate Perforated Casing Location</th>
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<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
<td>90 90 Borehole Depth/Location 90-905</td>
<td>90-14 Casing</td>
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</table>
Future Plans

• Complete well selection establish web service connections with the NGWMN in 2018 and begin adding new data to the network from re-current sampling in 2019.

• Complete sampling in all 33 priority aquifers as part of the AGWMP

• Continue to roll a sub-set of wells sampled through the AGWMP into the NGWMN to expand the state-wide network.
WDEQ’s databases that store data to be served to the NGWMN

• RBDMS (SQL database)
  • Contains all Class I, III, and V wells across the state
  • Includes Locations, and groundwater chemistry
  • The RBDMS GW data is a part of the Governor’s Water Strategy
  • Our plan is to make this application open to the public

• WDEQ SDE Geodatabase (SQL database)
  • Location of SEO wells, WOGCC wells, WWDC wells (these do not have the chemistry associated)
WDEQ’s Experience with Web Applications and Web Services

• Currently we host 66 rest services with a federated ArcGIS Portal/Server
• These services are used directly in an ArcGIS Flex/JS viewer environment
• They are also available through ArcGIS Online
• These services are also available to be used in the ArcGIS Desktop/Model Builder
• We are nearing the release of 2 Mobile applications
  ➢ First for Authorized RV waste dump sites
  ➢ Second for Authorized Recycling Facilities across the state
• We use a combination of AppStudio/Web AppBuilder/Qt
  ➢ To create custom web app’s or to create out of the box widget based applications
  ➢ Using to convert our Flex applications to JS
Examples of WDEQ’s Web Applications

Wyoming DEQ Informer

Wyoming DEQ Active Viewer
WDEQ’s Approach to set up Web Services for the NGWMN

• Work with the NGWMN to see if they have a file or SDE geodatabase of the current well structure
• If so, get a replica of their database as the base for our monitoring network
• Import the needed wells into Feature Classes in our ArcSDE environment
• Create map documents and symbolize accordingly
• Create Map Service (rest services) for the needed layers
• Create a web map and potential a mobile app for the data
• Add the web map and link to the rest services to the WDEQ web page
• Pass the map link and rest service links on to the NGWMN to be integrated into their environment.
Data Flow between NGWMN and WDEQ
Flow Chart of accessing the DEQ NGWMN Data