Experiences Using ArcGIS Online for Research Collaboration

Maribeth Price
South Dakota School of Mines and Technology
ESRI International User Conference, July, 2014
San Diego, CA
Talk Outline

- Background on the research project
- How we used ArcGIS Online in the research
- Was ArcGIS Online helpful?
Ongoing groundwater research

- Provide a guide on water availability and predicted drilling depths
- Identify areas sensitive and vulnerable to contamination
- Establish baseline water quality measurements
- Active project since 2001

Artesian well producing from the Madison Aquifer in west Rapid City, SD
Acknowledgements

- Project funded by the
  - West Dakota Water Development District
- Faculty research team
  - Dr. Arden Davis
  - Dr. Alvis Lisenbee
- Graduate Student research team
  - Gary Smith, Henok Tiruneh, Erik Walega
- Undergraduate research associates
  - Evan Doughty, Hans Krage
Where are we?
What are aquifers?

- **Aquifers** are rock units that are capable of containing and transmitting significant quantities of water.
  - Water is typically present in pore space or fractures.
  - Better aquifers have:
    - More pore space.
    - Good connectivity between pores.
- **Aquitards** are rocks that retard the flow of water.

[http://www.kgs.ku.edu/General/Geology/Pawnee/gifs/fig4.gif](http://www.kgs.ku.edu/General/Geology/Pawnee/gifs/fig4.gif)
Sedimentary aquifers

- Limestones, sandstones, and unconsolidated sediments (sands and gravels) typically make the best aquifers
- Shales and mudstones are aquitards
Crystalline aquifers

- Igneous or metamorphic rocks have virtually no pore space, and primarily contain water in fractures.
I-90 Development Corridor
Current Work

- Water Quality Assessment of Crystalline Aquifers in western Pennington County, SD
Research Goals

- Gather baseline data on frequency and spatial distribution of water quality issues
- Assess spatial relationships between water quality and geology/mining
- Serve community through free water testing

- Arsenic
- Iron
- Sulfate
- Magnesium
- Calcium
- Hardness
- Nitrate
- Total coliform bacteria
- Fecal coliform bacteria
Why Use ArcGIS Online (AGO)?

- Accommodate diverse GIS skills for viewing/analyzing
- Protect privacy of homeowners
- Collect location data using mobile technology
- Facilitate public outreach
Research Methods

- Found homeowner volunteers through door to door soliciting on Sundays
- Analyzed water samples using MidContinent Laboratories in Rapid City, SD
- Compiled data for public wells from published reports
- Mapped and analyzed results using actual locations
- Created map and report products for the public
WDWDD-SDSMT Report Card for Arsenic

Private Well Tests
Number of wells 91
Number of tests 95
Earliest test date 5/5/2013
Latest test date 11/17/2013
Lowest value detected **
Highest value detected (mg/L) 0.299
Number of wells above EPA limit 26
Percent wells above EPA limit 29%

Public Well Records
Number of wells 23
Number of recorded tests 59
Earliest test date 12/5/1977
Latest test date 8/15/2013
Lowest value detected **
Highest value detected (mg/L) 0.178
Number of wells above EPA limit 6
Percent wells above EPA limit 26%
** Below detection limit of 0.005 mg/L

Dissolved arsenic can occur in well water because of natural weathering of certain minerals in rocks. The maximum contaminant level for arsenic in public water supplies is 0.010 mg/L. Arsenic is regulated in public water supplies because of links to cancer. It can also cause nervous damage and other problems.

We sampled 91 private wells in 2013 and compiled published data from 23 public wells to evaluate the presence of arsenic in well water in western Pennington County, SD. In some cases the wells were tested multiple times; we took the highest test in each case. We found that 29% of private wells and 26% of public wells had tests that exceeded the EPA standard. The maximum value detected was 0.299 mg/L, nearly three times the EPA standard.

In the graphs, the blue bars represent arsenic values below the EPA standard; the orange bars represent values above the standard, and the standard is indicated by a black horizontal line at 0.01 mg/L. The graphs show that many arsenic values are much higher than the EPA standard; a
Arsenic results
Arsenic Areas of Concern

- Cannot show individual points
- Developed density maps showing areas with a higher frequency of elevated arsenic values
- Selected threshold value of 0.2 / km²
Interactive web map

http://sdmines.maps.arcgis.com/apps/PublicInformation/index.html?appid=7d90b2c4219c4e16b0d3144886939a43

Water Quality in Western Pennington County, SD

This map shows the results of a water quality study in which we tested 91 private wells in 2013 and compiled data for public wells between 1967 and 2013. Participation was voluntary for homeowners.

You can examine each constituent we tested individually or in groups by turning the map layers on and off (Click the Layers button above). You can also see how the results compare to geology and mining areas. This information is provided to help residents understand more about their well water.

Areas of Concern layers show areas where more frequent problems have been detected.
How did we use ArcGIS Online?

- Secure AGO group for data protection
- Field work planning
- Mobile data collection
- Data viewing
- Outreach
Using Groups

Members must be in organization.
Field work planning

Live feature service for sampling sites
Mobile data collection

- ArcGIS app tested
- Poor cellular service in study area
- Predated offline collecting capability
- Try Collector in future work
Analysis

- Secure environment to overlay and explore data and associated layers.
Outreach

“Public Information” web app template
Evaluating success

Accommodating skill levels

😊 Effective way to plan/present data at meetings
😊 All members used to some extent
😊 Faculty used viewing/analysis capabilities less than anticipated
😊 Sometimes tedious to republish services during work in progress
😊 Does not replace ArcMap!

Protect privacy of data

😊 Live feature service an excellent way to share data across team without violating privacy of homeowners
😊 Allowed viewing of progress cross-platform, including mobile devices
😊 Secure group was troublesome to set up; difficult to migrate accounts into the organizational subscription
Evaluating success

Mobile field collection

😎 Implementation test was easy to create
😊 Did not work without offline capability
😊 Developing offline capability for next phase using Collector

Facilitating outreach

😊 Very easy to create applications
😊 Used out-of-the-box template with no customization
😊 Not always easy to find the “right” template
😊 Customization is a difficult hurdle for a busy research team
Conclusions

- ArcGIS Online was an effective platform for collaboration.
- We will continue to use it for this and other projects.