

## COVER PAGE

**AWARD NUMBER:** G16AC00359

**SPONSORING ORGANIZATION:** Utah Geological Survey

**PROJECT TITLE:** Request of Funding from the Utah Geological Survey to Provide Data to the National Groundwater Monitoring Network via the Utah Water Quality Database of Wells and Springs

**CONTACT PERSON:** Janae Wallace      **TITLE:** Senior Geologist

**ADDRESS:** 1594 West Temple, Suite 3110 Salt Lake City, UT 84116

**PHONE:** (801)537-3387      **FAX:** (801)537-3400

**EMAIL:** janaewallace@utah.gov

**CONTACT PERSON 2:** Jodi Patterson      **TITLE:** UGS Financial Manager

**ADDRESS:** 1594 West Temple, Suite 3110 Salt Lake City, UT 84116

**PHONE:** (801)537-3310      **FAX:** (801)537-3400

**EMAIL:** jpatters@utah.gov

**TERM COVERED:** July 1, 2016, to June 30, 2018

**FINAL REPORT DATE:** February 12, 2019

**MAJOR GOALS:** The primary goal of this project was to update the metadata of selected wells and springs (objective 3) and to service wells in the UGS water-quality network for the NGWMN.

**PROJECT SUMMARY:** The UGS provided the USGS quality assurance procedures for data management of 80 initial sites to the NGWMN, maintaining a database for connection to the NGWMN, and creating a continuous flow of data to the NGWMN, within a one-year time frame. We established and continue to maintain water-quality and water-level databases as part of the UGS Water-Quality Network for integration into the NGWMN web portal.

## **WORK DONE**

The Utah Geological Survey (UGS) continued to support persistent data flow from the UGS Water-Quality Network to the National Groundwater Monitoring Network (NGWMN) by filling data gaps in the UGS database (objective 3) and maintaining some of the wells in our network (objective 4). The UGS filled gaps in information at NGWMN sites (objective 3) by improving monitoring location and construction metadata, as well as adding historical data collected by the UGS. The UGS maintained NGWMN sites (objective 4) by pumping select wells in the network to ensure connection with the aquifer.

With U.S. Environmental Protection Agency (EPA) analytical and laboratory support, the UGS has established a monitoring network consisting of approximately 108 wells and springs, where water quality is regularly measured; the goal of which is to document changes in water quality over time. This project establishes a long-term goal to provide an opportunity to recognize and help protect high-quality water resources documented through a well administered and maintained database, and a short-term goal of integrating our state-level data with a national-level database.

The UGS continues to closely follow the guidelines outlined in appendix 5 of the Framework Document (Subcommittee on Ground Water, 2013) to meet the requirements of the minimum data elements, and assures that minimum data elements are provided via the Well Registry or web services.

## **Filling gaps in information at NGWMN sites**

The UGS water quality database lacked high-precision location information for its wells and springs. The Utah Division of Water Rights derived the original location coordinates using the cadastral location system, which can have errors greater than 200 meters. Projection and datum information were not provided for the monitoring locations in many cases. During each sampling event, personnel of the UGS used global positioning system (GPS) units to determine the coordinates of each monitoring location, improving the previously designated cadastral coordinate system. Nathan Payne and Paul Inkenbrandt of the UGS verified the new location information by checking the locations against aerial photographs while they entered the new data into the database.

Site visits also included verification of the well construction details, as many of the sites have questionable or potentially outdated well construction information. If the monitoring location was a well, UGS staff measured the casing stickup above ground surface, well construction materials (i.e., steel, plastic, or concrete), and casing diameter. When well openings were accessible, a depth sounder was used to measure the well depth. Nathan Payne and Paul Inkenbrandt checked these details against the information provided by the Utah Division of Water Rights (<https://www.waterrights.utah.gov/wellInfo/wellInfo.asp>) as the data were entered into the NGWMN database.

Many of the stations in the UGS water-quality network that are in the NGWMN have existing water-quality data collected for previous UGS studies. This historical water-quality data exists in Excel spreadsheets and in paper copies of UGS reports. Nathan Payne and Paul

Inkenbrandt transcribed the historical data into the UGS database from several reports (Hurlow and Burk, 2008; Wallace and others, 2010; Wallace and others, 2012; Hurlow, 2014). Those data were added to the UGS water-quality database and then delivered to the EPA Water Quality Exchange (WQX) database using CSV file format. For quality assurance, Nathan Payne and Paul Inkenbrandt conducted a charge balance of the parameters to verify the ionic charge of the dissolved chemicals (parameters) balance. The following stations have historical UGS data:

- Bar M Spring (414234112551701)
- Irrigation well Kelton 20 (414729113080001)
- 29 Seed (414305112154901)
- Irrigation well Callao S (395300113425001)
- Fish Springs SG21C (395312113244801)
- Snake Valley AG14C (390426113585101)
- Irrigation well Burbank (384818114003101)
- Juab Valley South Levan Well (393210111525301)
- Juab Valley West Nephi Well (394313111504701)
- (A-11- 1)15bcb- 1 (414143111495501)

### **Well maintenance**

For select sites that require pumping by UGS staff, Janae Wallace and Hugh Hurlow performed routine maintenance of eight wells in the NGWMN to ensure the chemistry data are of high quality. A portable submersible pump pumped at a rate of about one to five gallons per

minute for several well volumes, until field parameters (pH, temperature, and specific conductance) stabilized, indicating a connection to the aquifer. As these sites are only pumped once a year during sampling, the pumping-during-maintenance visits maintain well connection to the aquifer. In particular, the sites that require routine pumping are located in Snake Valley in western Utah, Castle Valley in southeastern Utah, and the Uinta Basin in eastern Utah. Some of the wells took considerable time to recover after they were pumped, and all of the wells are in fairly remote parts of Utah, requiring overnight stays for the maintenance trips.

### **WEB SERVICES**

Working closely with the USGS, the UGS provided data to the NGWMN via Web Feature Services (WFS) published through an ArcGIS Server. Services include lithology, casing, screen, and other well construction information. Results are manually uploaded to the EPA WQX database through CDX and accessed by the NGWMN through the WQX. From our database, the UGS provides a WFS (REST-based) connection using ESRI products to allow for direct connection to our chemical database. All of the data transmitted and services provided follow existing federal schemas, specifically the WQX schema. To upgrade to a new version of php (a server-side programming language), the UGS has changed servers and updated the associated web services. No schema changes have occurred that would disrupt services. The current UGS services can be found at the following web addresses:

- [https://webmaps.geology.utah.gov/arcgis/services/Groundwater/NGWMN\\_USGS/MapServer/WFSServer?request=GetCapabilities&service=WFS](https://webmaps.geology.utah.gov/arcgis/services/Groundwater/NGWMN_USGS/MapServer/WFSServer?request=GetCapabilities&service=WFS)

- [https://webmaps.geology.utah.gov/arcgis/rest/services/Groundwater/NGWMN\\_USGS/MpServer](https://webmaps.geology.utah.gov/arcgis/rest/services/Groundwater/NGWMN_USGS/MpServer)

## **PROBLEMS ENCOUNTERED**

No significant issues were encountered during this project. The biggest impediment the UGS deals with is the lack of dedicated funding for travel to the remote sample locations when maintaining our chemistry network. Paul Inkenbrandt experienced difficulty in compiling historical data into a format that was consumable for the WQX, as some of the report data were in PDF format, that had to be manually transcribed.

## **EXPECTED CHANGES**

Within the next year, the UGS expects to migrate from a Microsoft SQL database for its SDE to a Postgresql database. The UGS may also explore using alternative agencies to host its data, like CUAHSI, as they meet the XML delivery requirements that the USGS currently maintains.

## **REFERENCES**

- Hurlow, H., 2014, Hydrogeologic studies and groundwater monitoring in Snake Valley and adjacent hydrographic areas, west-central Utah and east-central Nevada: Utah Geological Survey 135, 304 p.
- Hurlow, H., and Burk, N., 2008, Geology and ground-water chemistry, Curlew Valley, northwestern Utah and south-central Idaho — Implications for hydrogeology: Utah

Geological Survey Special Study 126, 193 p.

Subcommittee on Ground Water, 2013, A national framework for ground water monitoring in the United States: The Subcommittee on Ground Water of The Advisory Committee on Water Information, 182 p.

Wallace, J., Inkenbrandt, P., and Lowe, M., 2012, Groundwater quality classification for the principal basin-fill aquifer, East Shore area, Davis County, Utah: Utah Geological Survey Open-file Report 592, 15 p.

Wallace, J., Thomas, K., and Lowe, M., 2010, Evaluation of sources of poor quality ground water in the Bothwell Pocket area, lower Bear River valley, eastern Box Elder County, Utah: Utah Geological Survey Special Study 135, 56 p.