

**Illinois State Water Survey  
Prairie Research Institute  
University of Illinois**

**G22AC00134-00  
Final Technical Report**

**Support of Data Service and Installation of Monitoring Well Equipment for the  
National Ground-Water Monitoring Network in Illinois**

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**FY2022 Award Term  
September 30<sup>th</sup>, 2022 to September 30<sup>th</sup> 2024**

**January 2025**

## Overview

The Illinois State Water Survey (ISWS) continued its maintenance of database and web services to the current sites in the National Ground Water Monitoring Network (NGWMN) registry. We performed routine maintenance to fix bugs, updated security protocols and connections to the NGWMN portal, and administered basic tasks of maintaining backups, performance and data storage. These activities were in congruence with Objective 2a of the FY2022 request for proposals.

In addition to maintaining the existing database and water level services of NGWMN sites, we also substantially updated the list of wells in the registry under Objective 2a. Eighteen wells were dropped, 61 wells stayed in the registry, and 30 wells were added to the registry. Thus, the overall number of wells in the registry changed from 79 to 91. For all the wells currently in the registry, services were updated so that wells have a lithology and lithology description. Every well (with a few exceptions) also has complete casing, and screen information now, but we were not able to push these as new services in time for the writing of this report (we anticipate these additional services to be complete in February 2025).

Under Objective 4, we fixed a NGWMN well that had been struck by a car resulting in bent casing and the loss of monitoring equipment. Under Objective 6, the ISWS installed telemetry equipment at nine sites to collect real-time data, installed a self-logging transducer at one site, and upgraded dataloggers, modems, and batteries at six other sites, which had stopped reporting due to the change from 3G to 4G cellular coverage or had damaged equipment.

The new list of NGWMN wells and the installation of new equipment will contribute to a more robust monitoring coverage of Principal aquifers in Illinois and a better understanding of regional groundwater flow and local pumping effects within these aquifers.

The FY2022 contract award term was scheduled for September 30<sup>th</sup>, 2022 through September 30<sup>th</sup> 2024. The NGWMN award granted for FY2022 was \$114,334. Final expenditures of the award totaled \$112,449, with a remainder of \$1,885. All deliverables of the proposal were successfully completed, as described below.

## Project objectives

### **Objective 2a:** *Support Persistent Data Service from Existing Data Providers*

We substantially updated the list of wells in the NGWMN registry bringing our total number of sites to 91 (Figure 1). The registry was updated for several reasons: 1) to have a more even spatial coverage over the Principal aquifers, 2) to include more sites that already had telemetry at them, 3) to eliminate sites that are no longer visited due to ISWS budget and field staff time constraints, and 4), to include more nested sites, which track water levels in two or more aquifer units and provides a more holistic picture of groundwater conditions in the Principal aquifers.

For the 61 wells that remained in the NGWMN registry (Figure 2), the ISWS maintained its databases and web services of water levels and lithology and updated the status of several sites to reflect changes in nearby withdrawals and influence. Some wells changed from

surveillance wells to trend wells to reflect the addition of telemetry equipment. For the 30 wells that were added to the registry (Figure 2, Table 1), every existing hydrograph was reviewed and compared to nearby municipal and irrigation withdrawals to assess whether the wells have known hydrologic changes or reflect a mostly natural condition (i.e., no seasonal or long-term signals of drawdown due to pumpage). All new wells added to the registry are also trend wells, as they already had telemetry equipment on them or are measured on a quarterly to semi-yearly basis. Currently, there are 32 wells that are background wells, 40 wells that have known hydrologic impacts, and 19 wells that have suspected hydrologic impacts. We now have 79 out of 91 wells as trend wells and 12 wells that are surveillance wells. The 12 surveillance wells are measured infrequently or do not have telemetry equipment on them.

For the 30 new wells added to the registry, 29 of them are in the Sand and Gravel Principal aquifer and 1 is in the Silurian-Devonian Principal aquifer (Table 1). Most of the new wells are in the Mahomet aquifer or the overlying Glasford aquifer, but 4 are also located in the Green River lowlands (Sankoty and Tampico aquifers). Eighteen of the 30 new wells are also nested wells (9 sites total). The other 12 wells are single monitoring wells.

For all wells in the registry, lithology information was updated and verified with multiple databases and populated with new basic and detailed lithology descriptions. More casing and screened interval information (such as casing diameter, slot screen size, casing type) was also compiled for every well from ISWS databases, ISWS paper reports, and Illinois State Geological Survey databases. We did not specify in this contract that we would update these casing and screen services, but nonetheless our goal was to push these services by the end of this contract. At the time of this writing, we were not able to set up these new screen and casing services but anticipate completing this in February 2025. The new and updated services are a substantial upgrade from previous projects in which we only provided basic lithology information and the basic elements of the registry fields.

In a previous project, telemetry station data was migrated to a virtual machine environment and a centralized client-server arrangement, in part through a LoggerNet upgrade purchased separate to our NGMWN contracts. With the current arrangement and existing services, real-time data is managed on separate machines related to project-specific work, and this new arrangement exists as a redundancy that is not yet live. We are in the process of transitioning to this new arrangement pending final quality assurance and stability checks. Though all data currently receive regular backups and validations before being provided as services, centralizing management of real-time telemetry data has obvious advantages.

Work is ongoing to increase communication between the ISWS and ISGS well databases, which includes matching wells and adding missing data elements. When there is parity between the two databases, we anticipate changing lithology, screen, and casing services to be provided by the ISGS database directly instead of a secondary database maintained by the ISWS as is the current arrangement.

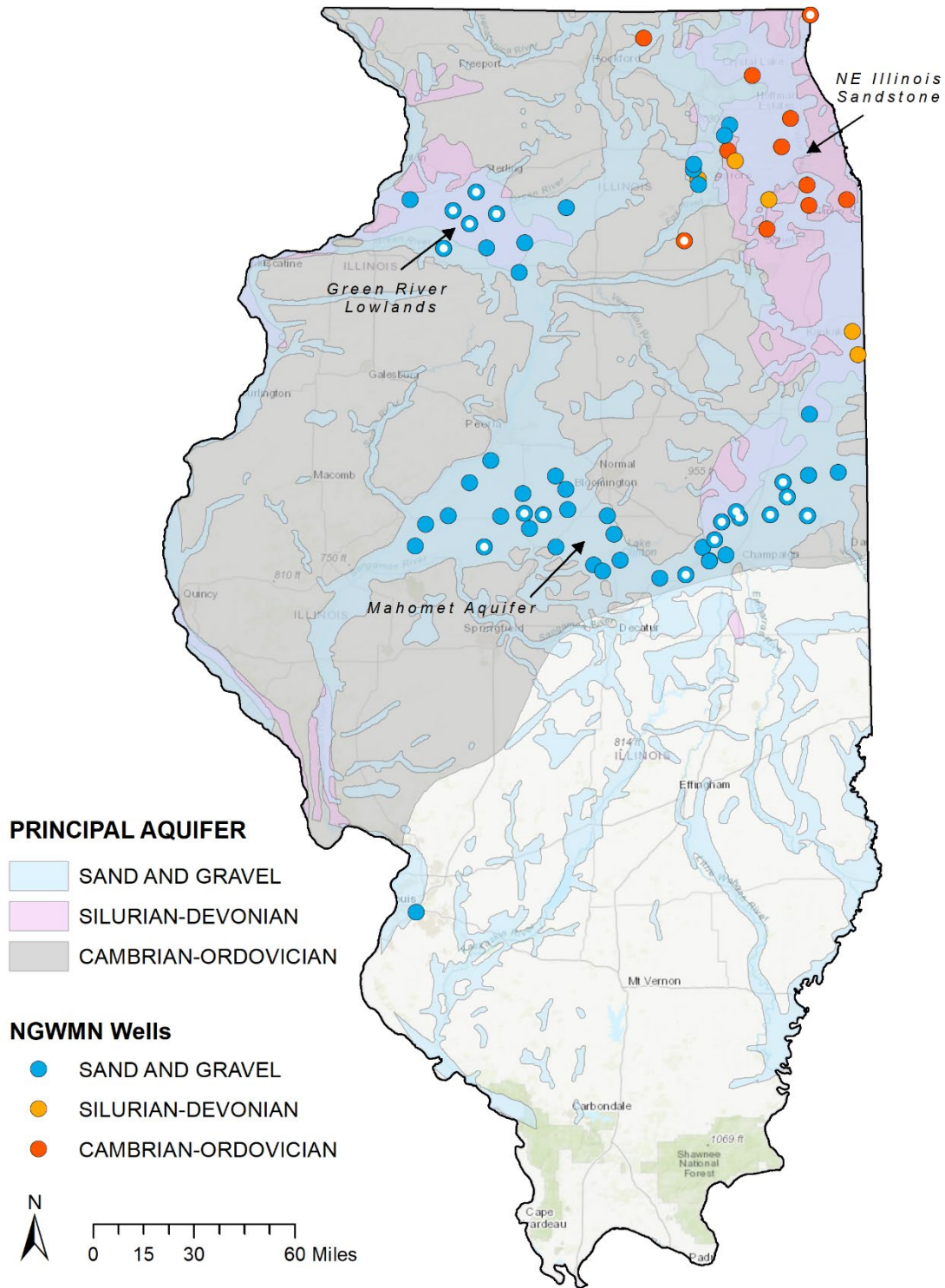


Figure 1. Map of the current distribution of the 91 NGWMN wells in Illinois. White dots indicate nested sites with 2 or more wells at the same location.



Table 1. List of the 30 wells added to the NGWMN registry during this project.

ISWS Pnumber	Site Name	National Aquifer Code	Local Aquifer Name	Well Depth (ft)	Nested Site	Well Characteristic
65886	Aurora Airport	N400SLRDVN	Silurian Dolomite	204	n	Background
236004	SWS-08	N100GLCIAL	Mahomet Aquifer	232	n	Known Changes
236009	ISWS-E	N100GLCIAL	Mahomet Aquifer	210	n	Background
286731	MTOW-13 (Talbot Tree Farm)	N100GLCIAL	Mahomet Aquifer	82	n	Known Changes
294641	MTH-15	N100GLCIAL	Mahomet Aquifer	237	n	Known Changes
294646	MTH-20	N100GLCIAL	Mahomet Aquifer	222	n	Known Changes
294648	MTH-22A	N100GLCIAL	Mahomet Aquifer	237	y	Background
360669	MTOW-3 (Wildlife Refuge)	N100GLCIAL	Mahomet Aquifer	24	n	Known Changes
360676	MTOW-10 (San Jose)	N100GLCIAL	Mahomet Aquifer	56	n	Known Changes
360677	MTOW-11 (Mason City)	N100GLCIAL	Mahomet Aquifer	63	n	Known Changes
381653	LEE-91A	N100GLCIAL	Sankoty Aquifer	129	y	Known Changes
381654	LEE-91B	N100GLCIAL	Tampico Aquifer	27	y	Suspected Changes
381666	BUR-91E	N100GLCIAL	Sankoty Aquifer	165	y	Suspected Changes
381672	BUR-92E	N100GLCIAL	Sankoty Aquifer	239	y	Suspected Changes
381690	VERM-94A (Rankin)	N100GLCIAL	Mahomet Aquifer	255	y	Background
381691	VERM-94B (Rankin)	N100GLCIAL	Glasford Aquifer	135	y	Background
381701	IRO-98C (Crescent City)	N100GLCIAL	Mahomet Aquifer	171	n	Background
444887	CHAM-08-02A (Middle Fork FP)	N100GLCIAL	Mahomet Aquifer	306	y	Background
444888	CHAM-08-02B (Middle Fork FP)	N100GLCIAL	Glasford Aquifer	75	y	Background
444896	CHAM-08-08A	N100GLCIAL	Mahomet Aquifer	254	y	Background
444897	CHAM-08-08B	N100GLCIAL	Glasford Aquifer	100.5	y	Background
444911	VERM-08-01A (Armstrong)	N100GLCIAL	Mahomet Aquifer	244	y	Known Changes
444912	VERM-08-01B (Armstrong)	N100GLCIAL	Glasford Aquifer	105	y	Suspected Changes
444917	CHAM-09-03A (Orr Farms)	N100GLCIAL	Mahomet Aquifer	308	y	Known Changes
444919	CHAM-09-03C (Orr Farms)	N100GLCIAL	Henry Aquifer	61	y	Suspected Changes
446903	MTH-22B	N100GLCIAL	Mahomet Aquifer	157	y	Background
449279	MTOW-16 (Sand Lake-04)	N100GLCIAL	Mahomet Aquifer	45	n	Known Changes
491517	MTOW-14 (Mason City)	N100GLCIAL	Mahomet Aquifer	215	n	Known Changes
495463	CHAM-12-02A (Dillsburg)	N100GLCIAL	Mahomet Aquifer	245	y	Known Changes
496467	CHAM-12-02C (Dillsburg)	N100GLCIAL	Glasford Aquifer	91	y	Known Changes

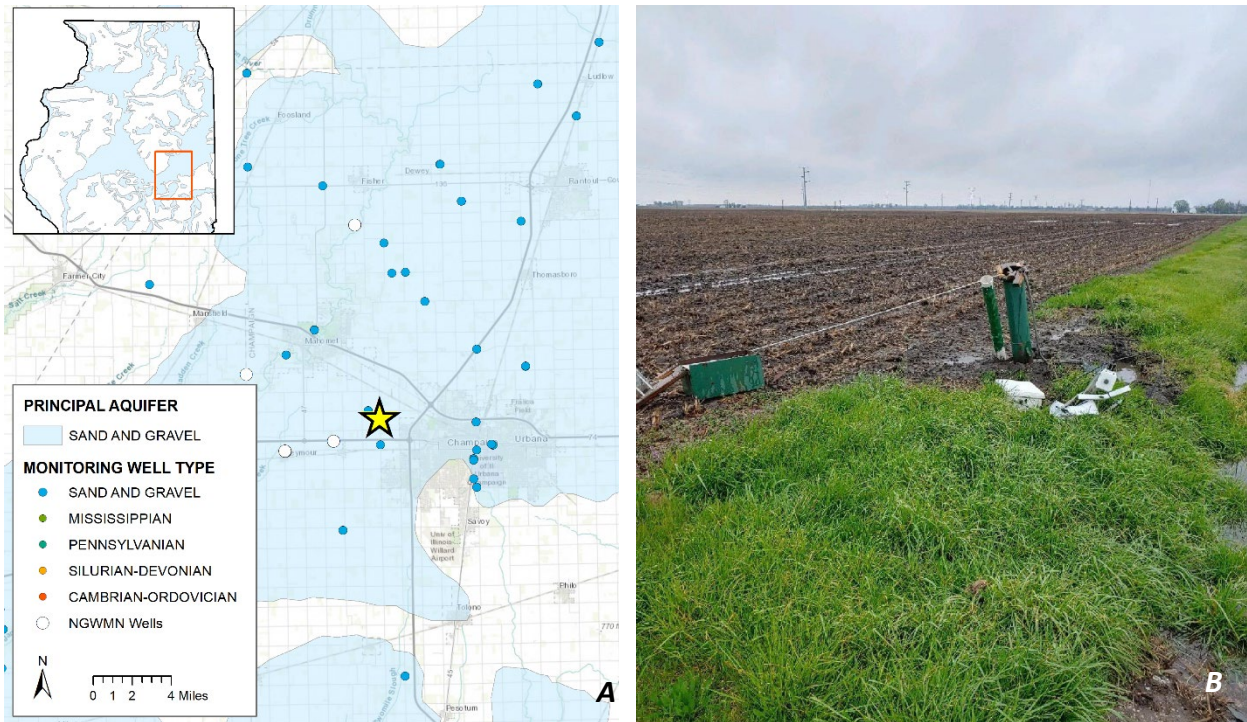
#### **Objective 4: Well Repair**

Under objective 4, we fixed one NGWMN well, the Petro North monitoring well (NGWMN Site #P434983) (Figure 3a). This well was drilled in 1952 to a depth of 235 feet and is cased into the Mahomet aquifer (Sand and Gravel Principal aquifer). It has the longest record of water levels out of all the ISWS monitoring sites in the national registry and is a key well in documenting decadal changes in the Mahomet aquifer. The Mahomet aquifer is now designated as a sole-source aquifer in central Illinois and is the primary aquifer in which many municipalities and irrigators draw water from. This well is therefore a critical monitoring well for the ISWS and is one of our best representative wells for the Mahomet aquifer within the NGWMN registry.

In April 2021, the Petro North monitoring well was struck by a car (Figure 3b). The transducer, datalogging and telemetry equipment, the equipment box, and the 8" steel casing itself were all damaged. Staff from the ISWS groundwater section and the ISGS drilling crew tried to move the casing to an upright position by attempting to tow it out but were unsuccessful.

In September of 2023, Seevers Farm Drainage Inc, a local drainage and excavation company, completed the repair. They excavated around the upper 4 feet of casing to expose the bent portion of the pipe and it was revealed that the bend went even further than that. It was decided in the field based on water table conditions to not excavate any further. The upper portion of the casing was cut off with a torch parallel to ground surface, and re-welded back on so that the casing was upright again (Figure 4). A new measuring point elevation was determined and has been updated within the registry. We installed new telemetry equipment on this well, which had already been purchased prior to this project.





**Figure 3.** (a) map showing location of Petro North monitoring well (NGWMN Site #P434983), denoted as the yellow star, and (b) photograph of damage to the well after being struck by a car in April 2021. Note the heavy steel casing was bent into an inclined position.





**Figure 4.** Photographs of the Petro North NGWMN well being repaired in September 2023.

## Objective 6: Equipment Installation

The ISWS operates over 100 telemetry stations that collect hourly water level data in near real-time. At most of these sites, the ISWS uses Campbell Scientific brand equipment boxes, dataloggers, and vented pressure transducers (Figure 5). Telemetry sites report water level data to ISWS servers via a cellular modem on the 4G network. At a few sites, only In-Situ brand self-logging vented transducer are deployed due to site constraints (e.g., monitoring well is flush mounted and installing a large equipment box is not feasible).

Under objective 6 we requested transducers, telemetry equipment, and/or dataloggers at 17 sites within the NGWMN registry. However, one site, Fermi Lab 4 (previously NGWMN site #409763) had to be dropped in the course of this project because the facility had to replace the pump and anticipate using it in the future. Thus, we installed equipment only at 16 sites (Figure 6, Table 2).

At nine sites, a full set of transducer, logging, and telemetry equipment was installed to upgrade these sites from annual/quarterly measurements to continuous logging on an hourly basis. Six out of these nine sites monitor the central portion of the Mahomet aquifer (Sand and Gravel Principal aquifer) and fill in an existing spatial data gap of continuous data needed to assess seasonal changes (Figure 6). The other three wells are nested within a 3,475 feet deep borehole drilled by the USGS at Illinois Beach State Park in 1980 (Figure 5) within the Cambrian-Ordovician Principal aquifer.

The deep borehole is documented extensively in Nicholas et al. 1987. This borehole is unique in that it is the only nested site in the state that has wells open to each of the sandstone units within the Cambrian-Ordovician Principal aquifer system: the lower Mt. Simon sandstone, the upper Mt. Simon sandstone (Elmhurst), the Ironton-Galesville sandstone, and the St. Peter sandstone. The USGS collected continuous water levels at each of these wells from 2010 to 2018 but also have frequent hand measurements going back to 1982. The USGS transferred ownership of this site to the ISWS several years ago.

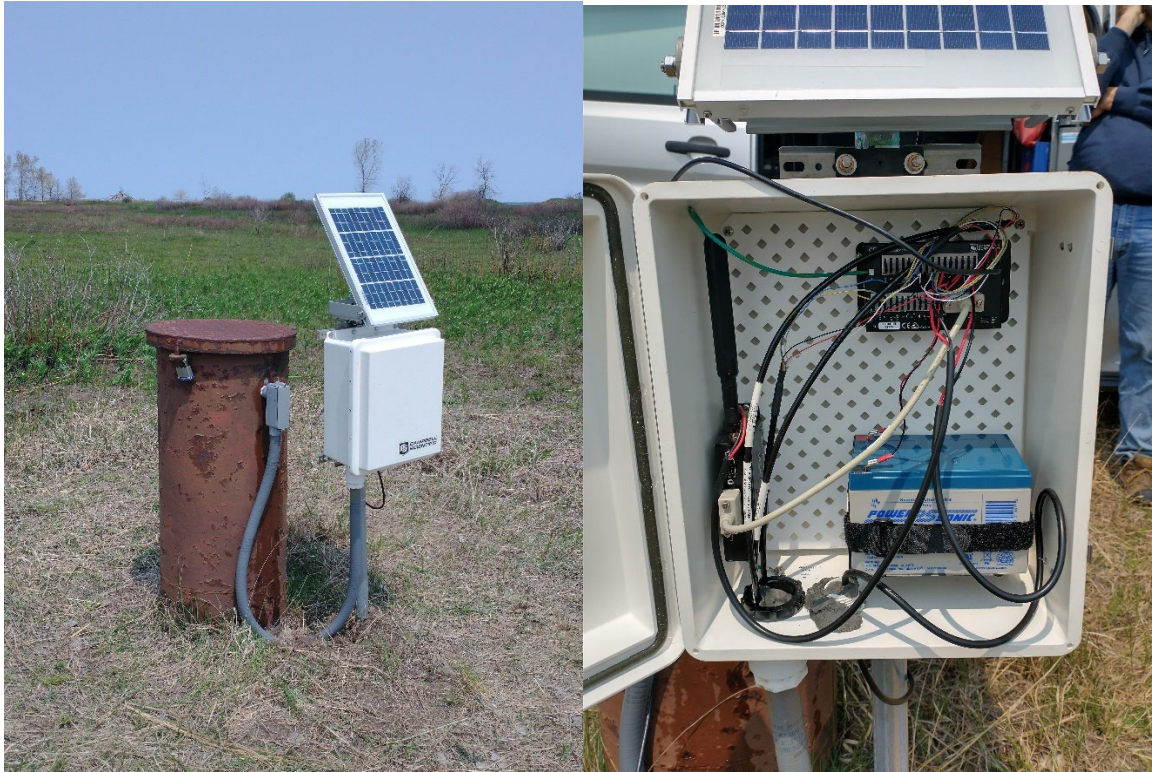
We installed transducers within three out of the four wells (the upper Mt. Simon, the Ironton-Galesville, and the St. Peter) and have them hooked up to one datalogger/telemetry system (Figure 5). We did not intend to install a transducer in the fourth well (the lower Mt. Simon) since water levels are within a foot of the upper Mt. Simon well. Adding continuous water-level measurement capability to these wells is worthwhile given the long period of record, the uniqueness of this site, and the location (fills in a large spatial data gap for the Cambrian-Ordovician in Illinois).

At an additional monitoring site (NGWMN Site #360671), we upgraded that site from quarterly measurements to continuous hourly measurements to better track how the Mahomet aquifer responds to flood events of the Illinois River. We installed a self-logging In-Situ brand transducer as opposed to a full telemetry station because this site is flush mounted and located in a homeowner's front yard.

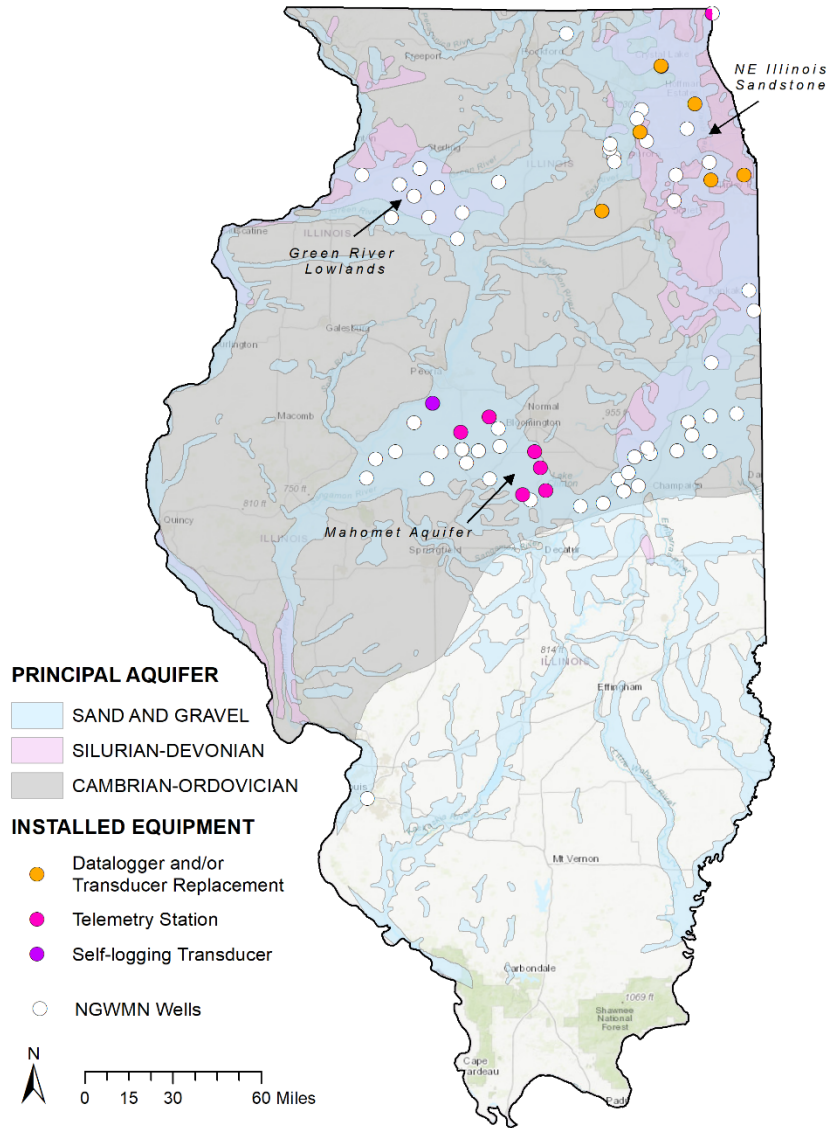
At six Cambrian-Ordovician NGWMN sites, we replaced old CR200x dataloggers (Campbell Scientific brand) with newer CR300 dataloggers (Figure 6). The CR200x's that were at these sites wells were all 5-10 years old and were due for replacement. We also used remaining funds to purchase additional equipment. At Geneva 5 (NGWMN Site #406422) we replaced the



existing transducer due to age and installed a new equipment box (the old box had bad seals). We also replaced the transducer at Orland Park 11 (NGWMN Site #410539) with a new 650 ft transducer. The old transducer stopped working in the course of this project likely due to ground lightning.



**Figure 5.** Installation of telemetry equipment at the nested sandstone well at Illinois Beach State Park (NGWMN site #'s 505005-505008). Site setup consisting of a Campbell Scientific brand datalogger, modem, weatherproof box, and pressure transducers. Site is powered by a 10-watt solar panel and battery.



**Figure 6.** Map of equipment installed under Objective 6. Refer to Table 2 for specific equipment.

**Table 2.** List of monitoring well equipment installed under Objective 6 at NGWMN sites. “CR” and “CS” models are Campbell Scientific brand equipment, “Level TROLL” is In-Situ brand equipment.

NGWMN Site #	Name	Principal Aquifer	Measurement Frequency	Measurement Category	Well Depth (ft)	Installed Equipment			
						Request Type	Datalogger Model	Transducer Model	Cable Length (ft)
P502613	KENN-20-01	Sand and Gravel	Annually	Surveillance	250.3	upgrade	CR300	CS451	150
P502612	MARO-20-01	Sand and Gravel	Annually	Surveillance	315.3	upgrade	CR300	CS451	150
P502611	CLIN-20-01	Sand and Gravel	Annually	Surveillance	320.3	upgrade	CR300	CS451	150
P502610	HWTH-19-01	Sand and Gravel	Annually	Surveillance	335.3	upgrade	CR300	CS451	150
P294634	MTH-08	Sand and Gravel	Quarterly	Trend	256	upgrade	CR300	CS451	130
P294635	MTH-09	Sand and Gravel	Quarterly	Trend	296	upgrade	CR300	CS451	140
P505005	USGS-Zion-1	Cambrian-Ord.	Annually	Surveillance	940	upgrade	CR300	CS451	250
P505007	USGS-Zion-3	Cambrian-Ord.	Annually	Surveillance	1648	upgrade	-	CS451	225
P505008	USGS-Zion-4	Cambrian-Ord.	Annually	Surveillance	1203	upgrade	-	CS451	225
P360671	MTOW-5	Sand and Gravel	Quarterly	Trend	49	upgrade	-	Level TROLL 400	50
P37395	MSD-Calumet	Cambrian-Ord.	Continuous	Trend	1684	replace	CR300	-	-
P406712	Lake-Barr-2	Cambrian-Ord.	Continuous	Trend	1305	replace	CR300	-	-
P406422	Geneva-5	Cambrian-Ord.	Continuous	Trend	1550	replace	CR300	CS451	450
P410748	DesPlaines-7	Cambrian-Ord.	Continuous	Trend	1845	replace	CR300	-	-
P487087	Kendall-1	Cambrian-Ord.	Continuous	Trend	1180	replace	CR300	-	-
P410539	Orland-Park-11	Cambrian-Ord.	Continuous	Trend	1683	replace	CR300	CS451	650

## References

Nicholas, J.R., Sherrill, M.G., Young, H.L. (1987) Hydrogeology of the Cambrian-Ordovician Aquifer System at a Test Well in Northeastern Illinois, *USGS Water Resources Investigation Open File Report*, 84-4165