

# Maintain and Expand Existing Kansas-Based Data Services to the National Groundwater Monitoring Network

September 11, 2023

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Funded by the  
U.S. Geological Survey-Grant G21AC10419  
07/15/2021 to 07/15/2023



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**Kansas Geological Survey Open-File Report 2023-60**

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The University of Kansas

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## Introduction

The National Groundwater Monitoring Network (NGWMN) is an effort led by the U.S. Geological Survey (USGS) to establish a network of selected monitoring wells across the country to facilitate the planning and management of groundwater resources. The NGWMN serves as a single data portal that retrieves, in real time, construction, lithology, depth-to-water measurements, and water-quality data that are maintained and served to the portal from a variety of participating local, state, and federal sources. The NGWMN can be accessed at the following URL: <http://cida.usgs.gov/ngwmn/>.

In 2016 (federal fiscal year 2016), the USGS provided funding support through Cooperative Agreement G16AC00017 to the Kansas Geological Survey (KGS) to become a data provider to the NGWMN (Wilson, 2016). The project period started January 1, 2016, and ended December 31, 2016. Under this agreement, the KGS evaluated monitoring sites for inclusion in the NGWMN, worked with USGS staff to populate the data portal with monitoring well sites that met a set of minimum data standards, and then developed a series of web services that allowed the NGWMN real-time data access to the state's well construction, lithology, and depth-to-water measurements records.

In 2017 (FY2016), the USGS provided funding support to the KGS through Cooperative Agreement G16AC00363 to maintain persistent data services to the NGWMN (Wilson, 2017). This included preserving existing web services and applying routine updates to existing network sites, which included removing well sites that were no longer viable and uploading replacement and new well site locations. The project period started October 10, 2016, and ended September 30, 2017.

In 2018 (FY2017), the KGS was awarded funding from the USGS under Cooperative Agreement G17AC00170 to update the Kansas portion of the well registry, maintain the persistent data services to the NGWMN, and install a network of trend wells in the Kansas River alluvial aquifer, which underlies a river valley in Kansas with major population growth and economic activity but without an active water-level observation network at the state level (Wilson, 2019). This two-year project started July 1, 2017, and was completed June 4, 2019.

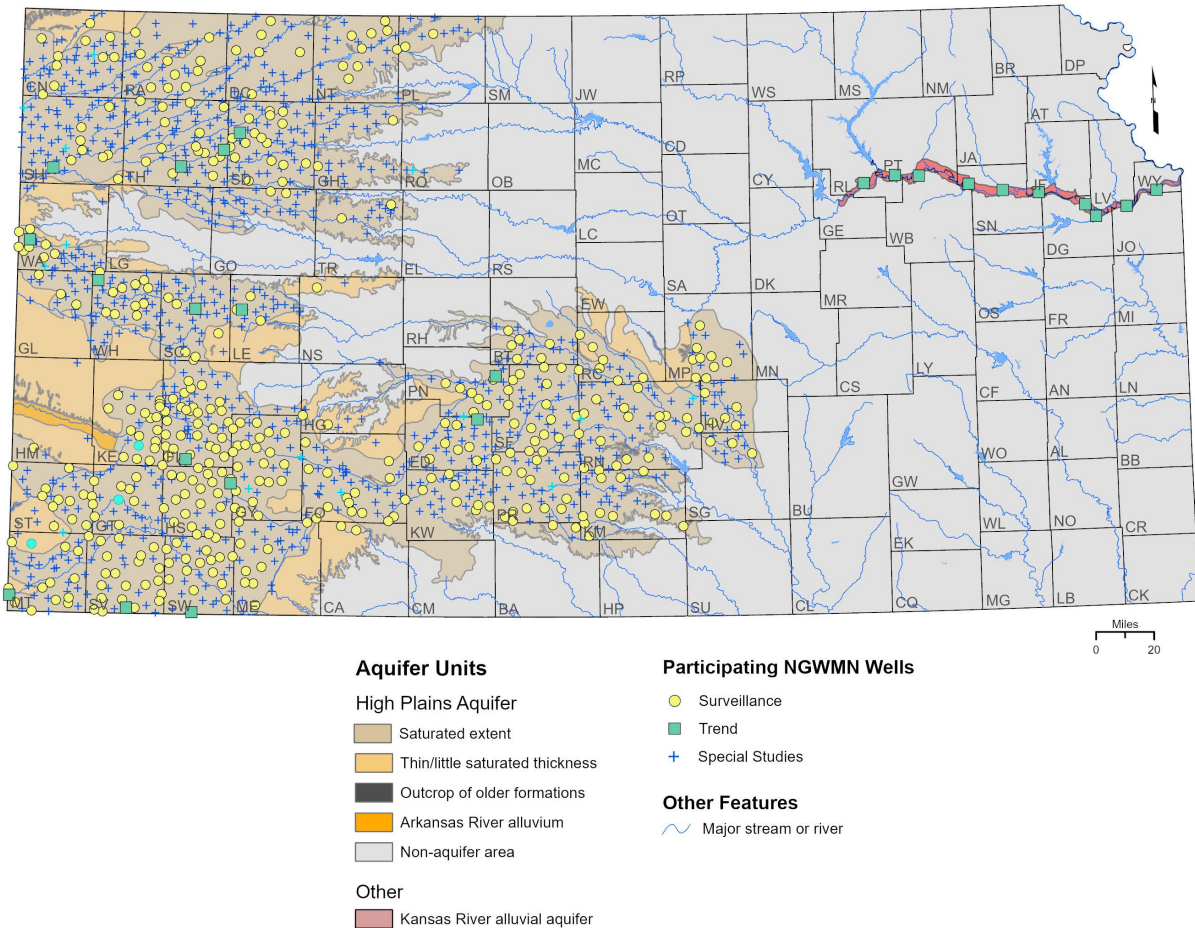
In the summer of 2019 (FY2019), USGS Cooperative Agreement G19AC00191 was awarded to the KGS to continue updates and maintenance of the Kansas portion of the well registry and persistent data services but also to expand the number of wells participating in the NGWMN by including all the annually measured wells from the Kansas Cooperative Water-Level Network. Additionally, the project calls for well maintenance on four selected trend wells by redeveloping the sites to ensure a continued good hydraulic connection with the High Plains aquifer (HPA). This two-year project started on July 15, 2019, and was delayed by travel restrictions related to the COVID-19 pandemic. After receiving a no-cost extension, the project was completed on December 23, 2021 (Wilson et al., 2022).

In 2021 (FY2022), the KGS was awarded funding from the NGWMN program under Cooperative Agreement G21AC10419 to update the Kansas portion of the well registry, maintain the persistent data services to the NGWMN, and install two trend well nests in southwest Kansas where the HPA and the unconfined Dakota aquifer are in hydraulic contact with each other. Each well nest consists of two well casings—one drilled and screened in the HPA and a second drilled and

screened in the Dakota. These four new water-level observation sites would serve to fill in the trend well coverage for the HPA in Kansas and help understand the interactions between the HPA and underlying Dakota aquifer system.

### Existing Kansas NGWMN Well Sites

The NGWMN started serving Kansas-based groundwater data in September 2016 from 133 surveillance wells — those that are measured annually during the winter months — and 4 trend wells, which are true observation wells that record water levels in real time throughout the year (Wilson, 2016). Through each subsequent NGWMN contract, the registry was updated by removing wells that were no longer measurable and adding new well sites that met the NGWMN data requirements or fit into a special studies classification related to the HPA. At the start of this project (summer 2021), there were 1,327 Kansas wells in the NGWMN network (fig. 1).



**Figure 1.** Participating 2021 NGWMN sites in the Kansas High Plains aquifer and the Kansas River alluvial aquifer.

All well sites in the HPA are part of the larger Kansas Cooperative Water-Level Network, a collection of approximately 1,400 wells measured annually by the KGS in cooperation with the Kansas Department of Agriculture, Division of Water Resources (Miller et al., 1998). The vast majority of measurements take place in the month of January, typically from irrigation wells, using steel or electric tapes, which have precisions down to hundredths of a foot. Customized software developed by the KGS combined with global positioning systems are used to ensure the same wells are measured each year and to conduct on-site data validations of depth-to-water measurements. The KGS further randomly selects 7% of the wells each year to be re-measured by a second person within 24 hours of the initial visit. Referred to as “QA” wells, these extra measurements serve to provide quality assurance of the collected data. Additional statistical and GIS reviews are conducted later on the entire data set to identify abnormal or anomalous measurements. If necessary, well sites are re-measured the same day to within a month, depending on the circumstances.

The Kansas Cooperative Water-Level Network also consists of a growing collection of continuously monitored wells. Referred to as “index wells,” these sites are equipped with pressure transducers that record water levels every hour and, with telemetry systems, provide real-time access to water-level data throughout the year (Butler et al., 2023). The index program was expanded into the Kansas River alluvial aquifer to better understand the dynamics of the aquifer and its interactions with the river (Butler et al., 2022; Wilson, 2019). Index wells are also manually measured throughout the calendar year, typically every three to four months.

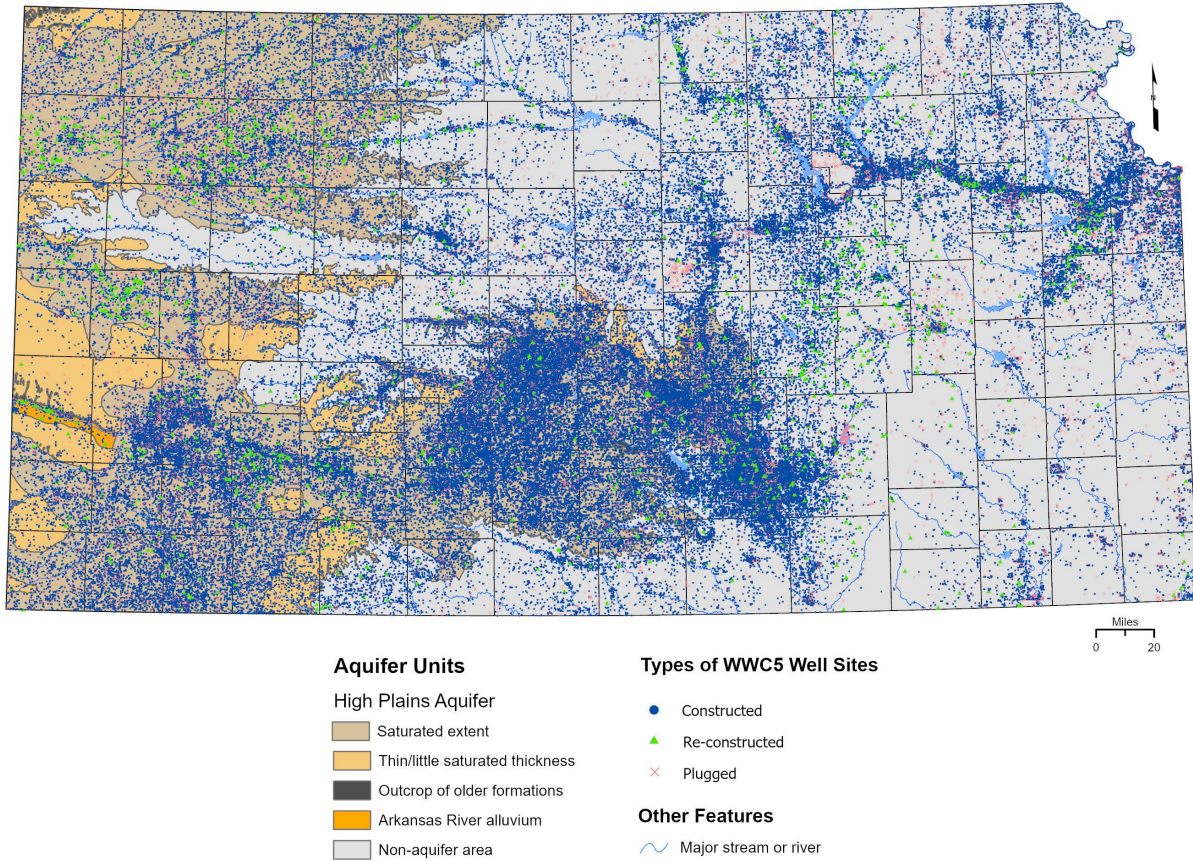
Depth-to-water measurements, both manually and electronically recorded, are stored in an Oracle-based enterprise-level relational database (RDMS) called the Water Information Storage and Retrieval Database (WIZARD). WIZARD evolved from the U.S. Geological Survey’s Ground Water Site Inventory in the mid-1990s (Hausberger et al., 1998) and today represents the largest repository of depth-to-water measurements in Kansas. Measured well sites are used to track temporal changes in water-table elevations and estimates of water availability. WIZARD currently consists of more than 57,000 well sites with more than 660,000 water-level measurements. Data can be accessed at the following URL:

<http://www.kgs.ku.edu/Magellan/WaterLevels/index.html>



A key feature of the NGWMN data framework is that participating wells must have associated construction and lithology descriptions. In Kansas, this information can be obtained from the Water Well Completion Records Database (WWC5). Since the mid-1970s, water well drilling companies have been required to provide location, type, use, casing, lithology, and other information to the Kansas Department of Health and Environment any time a well is constructed, reconstructed, or plugged. The KGS stores more than 298,000 WWC5 records (fig. 2) in an Oracle RDMS and serves these data to the public through the following URL:

<http://www.kgs.ku.edu/Magellan/WaterWell/index.html>



**Figure 2.** WWC5 well sites.



## Existing Kansas NGWMN Data Streams

Data are streamed to the NGWMN through a series of web services, standardized protocols by which data are transmitted and shared across the internet. The Kansas web services were developed as a single Adobe ColdFusion component, stored on a Linux web server running Apache software. The ColdFusion component has four methods (one representing each service [i.e., water levels, lithology, screens, and casings]), supports REST protocol, and returns XML-formatted web documents.

Each of the four methods provided under the Kansas web service is called using a URL-based variable along with a list of one or more site IDs for NGWMN wells. A list of the methods for an example well/site number is shown below.

- **Water Levels Method**
  - <http://maps.kgs.ku.edu/geohydro/wizard/services/data.cfc?method=WaterLevels&sites=371237100455301>
- **Lithology Method**
  - <http://maps.kgs.ku.edu/geohydro/wizard/services/data.cfc?method=Lithology&sites=371237100455301>
- **Casing Method**
  - <http://maps.kgs.ku.edu/geohydro/wizard/services/data.cfc?method=Casing&sites=371237100455301>
- **Screens Method**
  - <http://maps.kgs.ku.edu/geohydro/wizard/services/data.cfc?method=Screens&sites=371237100455301>

A more detailed description of each process can be found in the report “Establishing Kansas as a Data Provider to the National Groundwater Monitoring Network” (Wilson, 2016).

## Kansas 2022 and 2023 Updates to the NGWMN

At the conclusion of the 2022 and 2023 water-level collection campaigns and subsequent data review and follow-up, the KGS assessed the participating NGWMN wells to make sure the sites were still measurable and to determine whether the annual changes in the water table were representative of aquifer conditions for given areas. Table 1 lists wells that were dropped from the NGWMN data portal and the reason for removal.

<b>Table 1</b>		
<b>2022 and 2023 Kansas Wells Removed from the NGWMN Data Portal</b>		
<b>Site Number</b>	<b>Legal Description</b>	<b>Reason for Removal</b>
394651101360001	03S 38W 21BCB 01	Tape is starting to "grab" at depth.
393039099493101	06S 22W 19CCC 01	Well destroyed.
393330101420901	06S 39W 05CBD 01	No longer have landowner permission.
393020102022701	06S 42W 30ADA 01	Well reconstructed with smaller casing, measuring point now blocked.
392848100351301	07S 29W 05BBB 01	Well plugged.
391836101454401	08S 40W 35CCB 01	Well is dry.
391353099315301	09S 20W 34AAD 01	Well is dry.
391401101531801	09S 41W 34BAB 01	Pump pulled and old pipe collapsed downhole.
385707100473001	13S 31W 05CAB 01	Well broken off at land surface. Replaced by 385710100473001.
384952101442601	14S 40W 14CCC 01	Measuring point blocked.
384310101521901	15S 41W 27CBC 01	Well is dry.
381108099005302	21S 15W 31BAD 02	Well plugged.
381242100514201	21S 32W 20CBD 01	Measuring point blocked.
380509097450202	23S 04W 03BAB 02	Measuring point blocked.
380005099121102	23S 17W 33CCA 02	Well plugged. Replaced by 380013099120201.
375926098275201	24S 10W 06DBB 01	Unsure of landowner permission.
375520098373701	24S 12W 34ABC 01	Well plugged. Replaced by 372459100301501.
375342097280201	25S 01W 07ABD 01	Measuring point blocked.
374933098025301	25S 07W 36CCC 01	Diaphragm installed, no downhole access.
375059099034201	25S 16W 27AAC 01	Well had water levels merged from two different sites. The well site was split and water levels assigned to appropriate locations. Added well 375059099034202.
375004101145301	25S 36W 35CBB 01	Downhole access blocked at 45 ft. Replaced by 375004101145302.
374833098280001	26S 11W 01DDB 01	Well plugged.
374403098372301	26S 12W 34CDC 01	Well destroyed.
374404100064401	26S 26W 36DCC 01	Well is dry.
374746100132901	26S 27W 12CDD 01	Well is dry. Replaced by 374732100134101.
373907098383801	27S 12W 33CBA 01	Unsure of landowner permission.
374126098411501	27S 13W 13DDC 01	Measuring point blocked.

374103100582801	27S 33W 19CAB 01	Stockwater well that pumps almost 24/7.
373334099243001	28S 19W 33CBD 01	Well plugged.
373652099575901	28S 24W 08DCC 01	Diaphragm installed, no downhole access.
373752100330002	28S 30W 12ACB 01	Three years of very spotty cuts, well not included in the annual network.
373352100411301	28S 31W 35CCB 01	Abandoned well with non-representative measurements.
373346101215801	28S 37W 33DDC 01	Measuring point blocked.
372904101152101	29S 36W 33ADB 01	Difficult well to measure with questionable values since 2017.
372455100301701	30S 29W 28BBB 01	Well plugged.
372734101390602	30S 40W 12BBB 02	Downhole access blocked at 355 ft.
372326101422301	30S 40W 33CCB 01	Well is dry.
372240100572101	31S 33W 06CBD 01	Well is dry.
371945101541201	31S 42W 29AAB 01	Downhole access blocked at 122 ft.
371621101082601	32S 35W 08DDD 01	Well had water levels merged from two different sites. The well site was split and water levels assigned to appropriate locations. Added well 371621101082602.
370804101182801	33S 37W 35ACD 01	Downhole access blocked at 176 ft.
370128101004001	35S 34W 10BBB 01	Tape coming up covered in grit.
370218101103301	35S 36W 01AAA 01	Well plugged. Replaced by 374404100064402.

Two well sites, 395619101375202 and 375847101081801, were changed from special studies to surveillance sites when their well completion forms became available. The additional listing of construction information, screens, and lithology information allowed for the wells to meet minimum data standards and their change of NGWMN well types. The display option within the NGWMN data portal for surveillance well 383405101363901 was turned back on once its measuring point was cleared and the well was again measurable.

Table 2 lists 30 new well sites added to the NGWMN portal in 2022 and 2023. The majority of these are measured wells from the Kansas Cooperative Water Level Network in the HPA region along with two new trend wells in the Kansas River alluvial aquifer. Four of the new well sites meet the minimum data requirements to be included as surveillance sites, six have been equipped with telemetry units allowing them to be included as trend wells, with the remaining twenty sites being classified as HPA special study wells.

<b>Table 2</b>				
<b>Wells Added in 2022 and 2023 to the NGWMN Data Portal</b>				
<b>Site Number</b>	<b>Legal Description</b>	<b>Well Depth</b>	<b>Local Aquifer</b>	<b>Well Type</b>
395008100432201	02S 30W 31ADD 01	240	Ogallala Formation	Special
393127100490701	06S 31W 19ABA 01	172	Ogallala Formation	Special
393330101420901	06S 39W 05CBD 01	328	Ogallala Formation	Special
390955096053102	10S 12E 20ADD 01	80	Quaternary Alluvium	Trend
390311095231001	11S 18E 35BCD 01	60	Quaternary Alluvium	Trend
385710100473001	13S 31W 05CAB 02	78	Ogallala Formation	Special

381108099005303	21S 15W 31BAD 03	100	Quaternary System	Special
380835100393801	22S 30W 18BCA 01	125	Ogallala Formation	Special
380036098355801	23S 12W 36BBC 01	77	Quaternary System	Special
380013099120201	23S 17W 33CDB 01	100	Quaternary System	Special
375520098373702	24S 12W 34ABC 02	67	Quaternary System	Surveillance
375059099034202	25S 16W 27AAC 02	85	Quaternary System	Surveillance
375004101145302	25S 36W 35CBB 02	520	Ogallala Formation	Special
374404100064402	26S 26W 36DCC 02	140	Ogallala Formation	Special
374732100134101	26S 27W 13BAC 01	165	Ogallala Formation	Special
374233100263201	27S 29W 12DCC 01	260	Ogallala Formation	Special
374125100930001	27S 33W 21ACD 01	670	Ogallala-Dakota Formation	Special
373955101532201	27S 42W 34AAA 01	710	Ogallala-Dakota Formation	Special
373334099243002	28S 19W 33CAC 01	169	Quaternary System	Special
373605101120001	28S 36W 24ADA 01	512	Ogallala-Dakota Formation	Surveillance
373759101274201	28S 38W 10ABB 01	600	Ogallala-Dakota Formation	Special
373528101281901	28S 38W 21DDD 01	420	Ogallala Formation	Trend
373528101281902	28S 38W 21DDD 02	580	Dakota Formation	Trend
372831101023601	29S 34W 33DCC 01	525	Ogallala Formation	Trend
372831101023602	29S 34W 33DCC 02	620	Dakota Formation	Trend
372459100301501	30S 29W 28BBA 01	532	Ogallala Formation	Special
372249100555901	31S 33W 05CAA 01	560	Ogallala-Dakota Formation	Special
371621101082602	32S 35W 08DDD 02	600	Ogallala Formation	Surveillance
371223101114801	33S 36W 02DAB 01	522	Ogallala Formation	Special
370221101102301	35S 35W 06BBA 01	669	Ogallala Formation	Special

In late December of 2021, the KGS was notified by the University of Kansas that the FTP server used to harvest water-level data submitted via telemetry units from 16 trend wells had a major security vulnerability and was shut down. While new and enhanced transfer protocols were being tested and developed, the display option in the NGWMN data registry for the affected trend wells was turned off. The trend wells were visited and re-programmed on site in the winter months of 2022. By March of 2022, all the trend well sites were turned back on and submitting data to the NGWMN.

In February of 2022, the KGS was again notified by the University of Kansas that its primary server used to provide REST services to the NGWMN had a major security breach and was shut down. All NGWMN web services were transferred to a new web server running an updated version of ColdFusion software. Shortly thereafter, USGS staff notified the KGS of issues with the lithology web service. Code for the lithology web services was updated to properly deal with how the new server environment handled returned null values associated with Oracle-based queries.

As of the date of this report, a total of 1,316 wells are being served from the KGS to the NGWMN system; of those, 420 are surveillance wells, 19 are trend wells, and 865 are special study wells in the Kansas Cooperative Water Level Network; the remaining 12 are trend wells in the Kansas River alluvial aquifer (fig. 3).

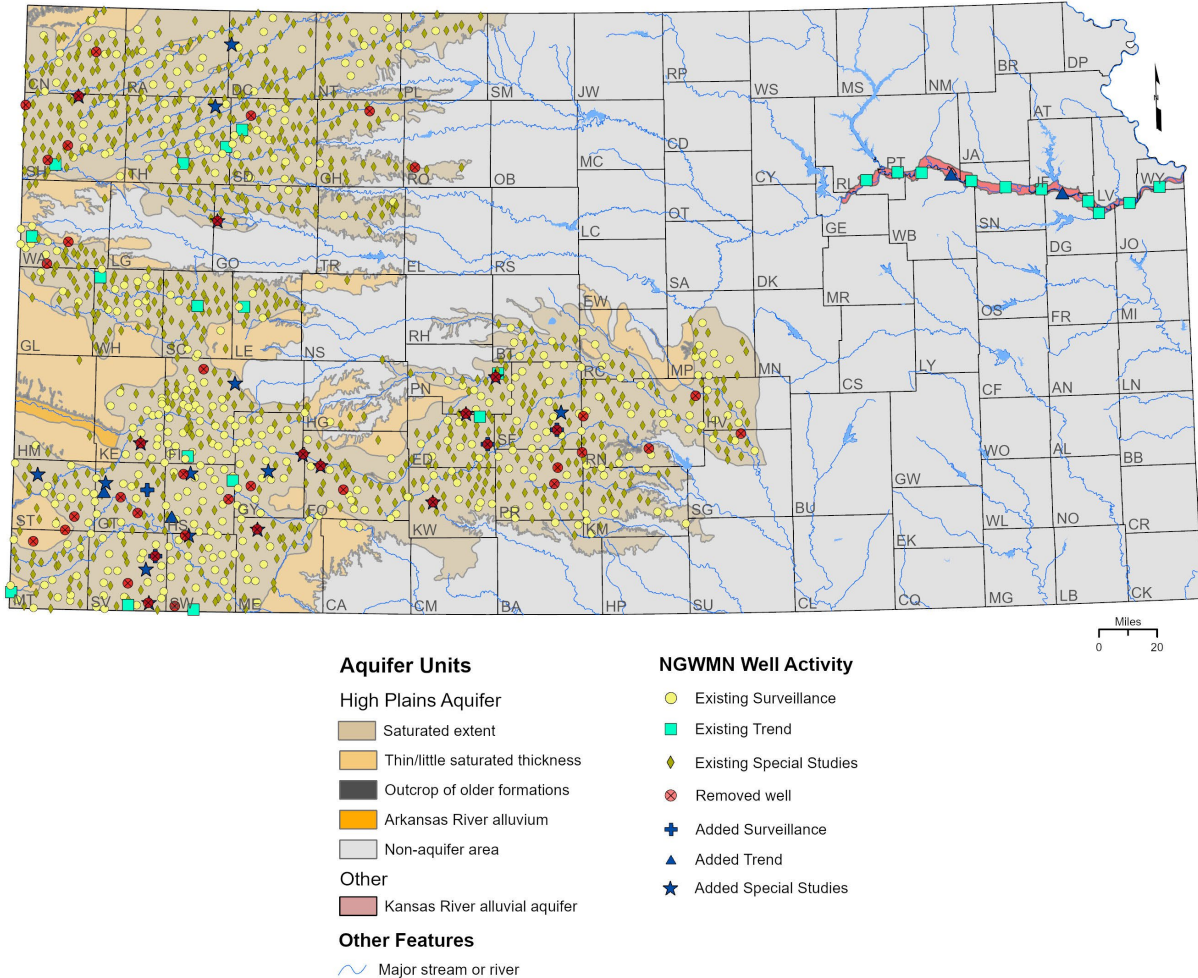
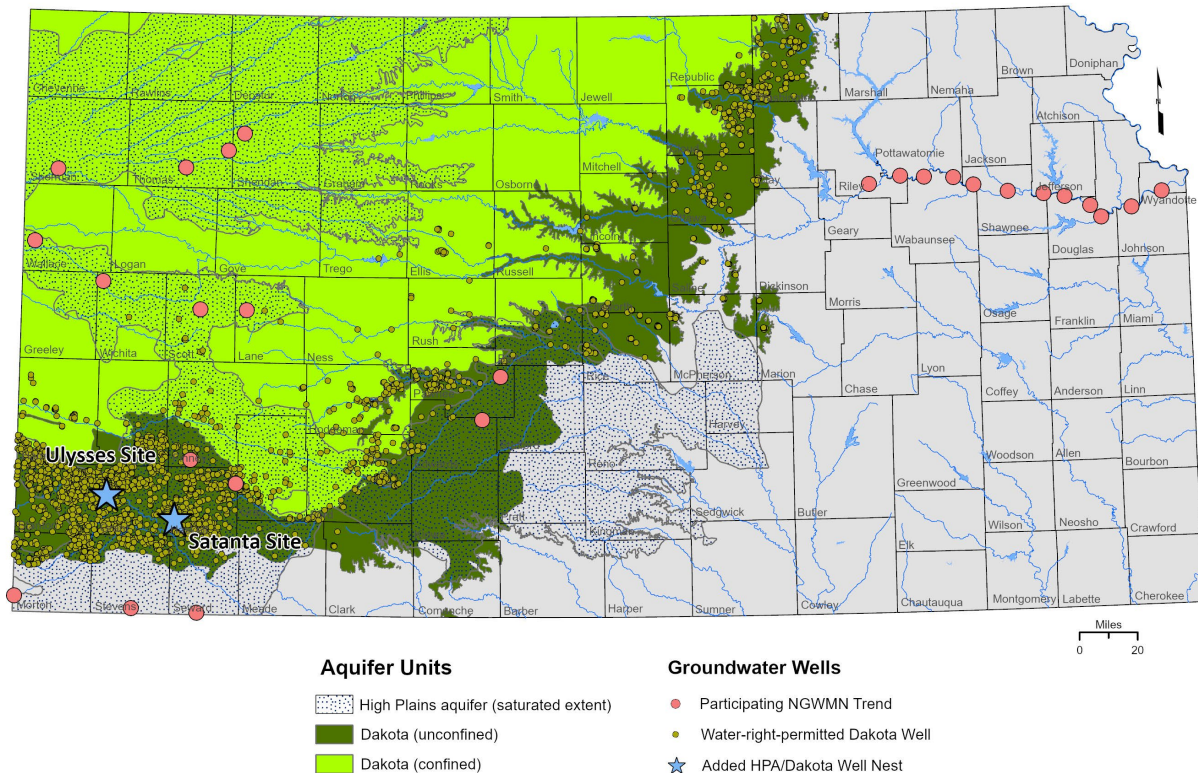


Figure 3. Status and 2022–2023 update activities of KGS-based NGWMN wells.

## Ogallala/Dakota Well Nest Installation

The second objective of the contract's first year was to start the installation process for two new well nests. Each nest consists of two individual trend wells—one drilled and screened in the Ogallala portion of the HPA and a second well drilled and screened in the underlying Dakota aquifer. Both nest locations are in southwest Kansas where the HPA and unconfined Dakota are in hydraulic contact and are administratively considered to be the same source of supply under the Kansas Water Appropriation Act (fig. 4). The selected locations have usable thickness in the HPA for water supply, typically 100 ft or more, and groundwater is pumped from both aquifer units.



**Figure 4.** Installed HPA/Dakota trend well nest locations, aquifer extents, the distribution of water-right-permitted wells screened into the Dakota aquifer, and Kansas NGWMN trend wells.

Given the recent inflationary trends across the country, the overall costs of material, mobilization, and contract services bid by drilling companies to install the first and deepest nest site near Satanta, Kansas, equaled the project's entire budgeted amount for all the well installations. In response, the KGS reallocated funds from other sources to complete the second nest sites but had to modify the original plan for how the wells would be constructed and spaced relative to each other. Instead of drilling two separate boreholes, each with their own cased wells, a short distance from each other, a single, larger borehole containing both casings was used. Within this single borehole, one well casing was completed to the base of the HPA and the other completed to the base of the Dakota; however, the two were separated from each other using a bentonite seal. This single borehole with two cased but hydraulically isolated wells greatly reduced the overall



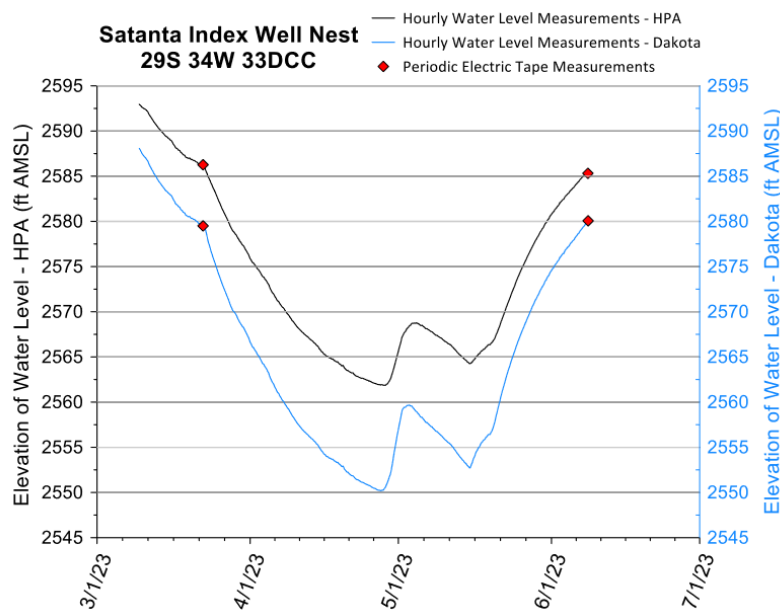
drilling costs. The submitted drillers' logs for both well nests are provided in Appendix A of this report.

Slug tests were completed at the Ulysses site on June 7, 2023, and the Satanta site on June 8, 2023. The tests were conducted using solid slugs following the Kansas Geological Survey slug-test guidelines (Butler et al., 1996; Butler, 2019). The tests were analyzed using the guidelines described in chapter 12 of Butler (2019). The final parameter estimates were obtained with the Cooper et al., model (Butler, 2019). In all cases, the resulting hydraulic conductivity estimates should be considered as lower bounds on the actual hydraulic conductivity of the formation (Butler, 2019).

### Satanta Well Nest—Haskell County, Kansas

The first HPA/Dakota trend well site was completed on September 9, 2022, in sec. 33, T. 29 S., R. 34 W. just northwest of Satanta, Kansas, in southwest Haskell County (fig. 4). The 12.25-inch borehole is 620 feet deep and contains two well casings: a 2.5-inch casing, 500 feet to the base of the HPA (520 ft), and a 2-inch diameter casing, 600 feet to the base of the Dakota (620 ft). A 20 ft bentonite seal was placed at 530 to 550 ft, just below the HPA/Dakota contact.

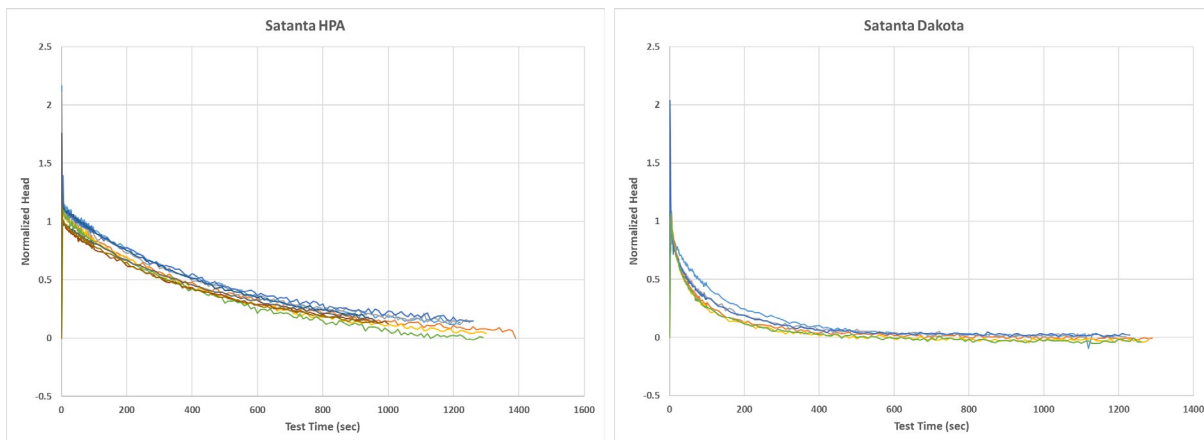
Hydrographs of the two wells show they are virtually parallel to one another (fig. 5) and indications are the bentonite seal has isolated the screened intervals of the two wells. Water quality samples from the two wells are clearly different from each other. Water samples taken at two pumping times from the HPA well on September 14, 2022, were fresh with total dissolved solids (TDS) of 691 mg/L (both times), chloride concentration of 104 to 109 mg/L, and sulfate concentration of 203 mg/L (both times). Samples taken from the Dakota well on the same day were slightly saline with TDS of 1,442–1,572 mg/L, chloride concentrations of 530–640 mg/L, and sulfate concentrations of 207–216 mg/L.



**Figure 5.** Hydrographs from the Satanta site (Butler et al., 2023).



A series of slug tests using 2 ft and 4 ft solid slugs were completed at the Satanta site on June 8, 2023. The slug test results indicated that the two wells have good hydraulic connections with the relatively low permeability sediments of their respective aquifer units. Water levels in the HPA recovered within 15 minutes, whereas water levels in the Dakota recovered within 6 minutes (fig. 6). The estimated hydraulic conductivity was 0.9 ft/day for the HPA well and 0.5 ft/day for the Dakota. The wells have no indications of incomplete development (i.e. low permeability well skins formed during well installation). Test data were collected at an acquisition rate of 0.25 s. Prior to analysis, the data were smoothed (five-pt moving average) and then resampled at 1-second intervals for the first 100 seconds and 10-second intervals thereafter.

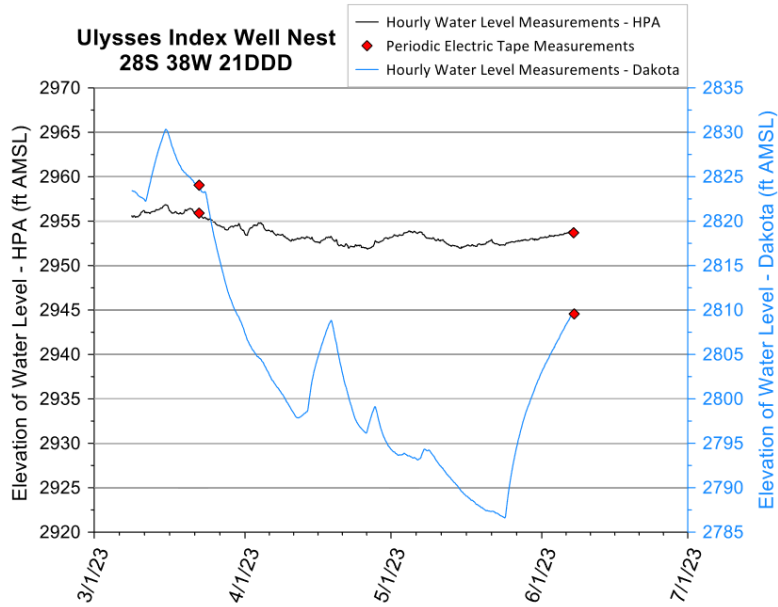


**Figure 6.** Normalized head ( $H(t)/H_0$ ) versus time since test initiation plots for a series of slug tests performed at the Satanta well nest on June 8, 2023;  $H_0$  is the initial water-level change at the start of the slug test,  $H(t)$  is the deviation from static at time  $t$ . Slug tests were performed in both falling-head or slug-in mode (solid slug introduced into the water column) and rising-head or slug-out mode (solid slug removed from the water column) modes.

#### Ulysses Well Nest—Grant County, Kansas

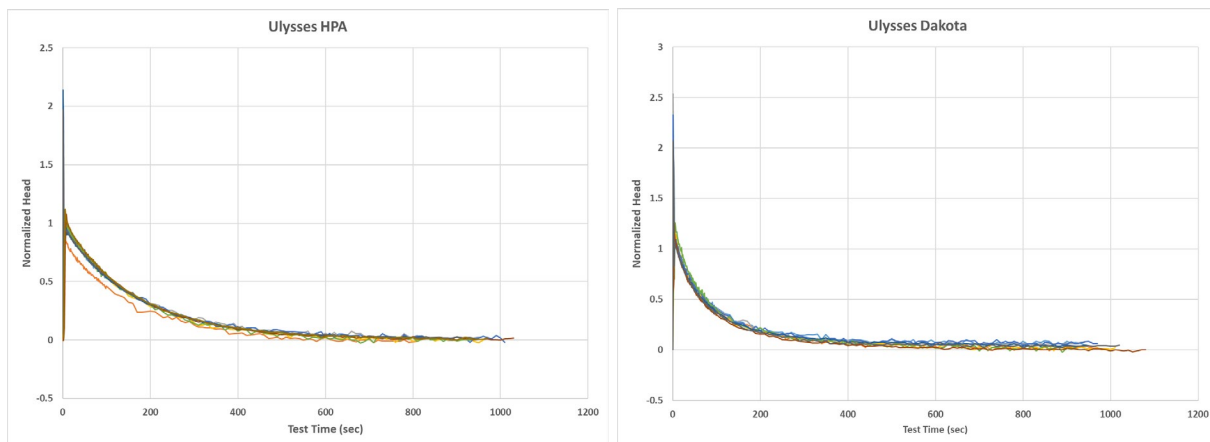
The second HPA/Dakota trend well site was completed on November 11, 2022, in sec. 21, T. 28 S., R. 38 W. just west of Ulysses, Kansas, in Grant County (fig. 4). The 12.25-inch borehole is 580 feet deep and contains two well casings: a 2-inch casing, 420 feet to the base of the HPA (440 ft), and a 2.5-inch casing, 560 feet to the base of the Dakota (580 ft). A 20 ft bentonite seal was placed at 460 to 480 ft, just below the HPA/Dakota contact.

Hydrographs of the two wells show little similarities between the wells (fig. 7) indicating the bentonite seal has likely isolated the screened intervals of the two wells. The Dakota well shows a much greater response to nearby pumping relative to the HPA. Water quality samples from the two wells are different from each other. Water samples taken at three pumping times from the HPA well on November 12, 2022, were fresh (but nearly slightly saline) with TDS of 861–1,009 mg/L, chloride concentration of 412–525 mg/L, and sulfate concentration of 253–277 mg/L. Samples taken from the Dakota well on the same day were slightly saline with TDS of 1,289–1,892 mg/L, chloride concentration of 794–1,249 mg/L, and sulfate concentrations of 182–206 mg/L. Concentrations decreased in consecutive samples from the Dakota well, indicating fresher water might have been drawn downward.



**Figure 7.** Hydrographs from the Ulysses site (Butler et al., 2023).

A series of slug tests using 2 ft and 4 ft sloid slugs were completed at the Ulysses site on June 7, 2023. The slug test results indicated that the two wells have reasonable hydraulic connections with the relatively permeable sediments of their respective aquifer units. Water levels in the HPA recovered within 10 minutes, whereas water levels in the Dakota recovered within 7 to 8 minutes (fig. 8). The estimated hydraulic conductivity was 1 to 2 ft/day for the HPA well and 0.9 ft/day for the Dakota. Unlike the Dakota well, the HPA well in the nest shows a clear indication of incomplete development. Test data were collected at an acquisition rate of 0.25 s. Prior to analysis, the data were smoothed (five-pt moving average) and then resampled at 1-second intervals for the first 100 seconds and 10-second intervals thereafter.



**Figure 8.** Normalized head ( $H(t)/H_0$ ) versus time initiation plots for a series of slug tests performed at the Ulysses well nest on June 7, 2023;  $H_0$  is the initial water-level change at the start of the slug test,  $H(t)$  is the deviation from static at time  $t$ . Slug tests were performed in both falling-head or slug-in mode (solid slug introduced into the water column) and rising-head or slug-out mode (solid slug removed from the water column) modes.

## **Future Developments**

The KGS has entered into a sixth grant and cooperative agreement with the USGS. This two-year project, which started July 25, 2023, will work to continue to maintain the Kansas-based web services to the NGWMN and make any needed changes and well additions after the Kansas Cooperative Water-Level Network measurements are acquired in the winters of 2024 and 2025. In addition, this new project will install two trend wells, one in southwest and a second in northwest Kansas. These nests will help to expand the trend/index well network across the HPA in Kansas.

## **Acknowledgments**

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# Appendix A—Water Well Completion Records for HPA/Dakota Well Nests

## Satanta Site

KOLAR Document ID: 1668540

### WATER WELL RECORD (WWC-5)

Constructed

KOLAR DOC ID 1668540 WELL ID NGWMN Nest

× Original Record Correction Change in Well Use

#### LOCATION OF WATER WELL

Latitude	37.475716	Longitude	-101.043231	Section	33	Township	29	Range	34	$\frac{E}{xW}$ Fraction	SW $\frac{1}{4}$	SW $\frac{1}{4}$	SE $\frac{1}{4}$
Datum	NAD83	Elevation	2979	County	Haskell								

#### WATER WELL OWNER

Name	
Business	Kansas Geological Survey
Address	1930 Constant Ave Lawrence KS 66048
Well location at owner's address	Approx 3 miles North West on Minneola Kansas

#### WELL WATER USE

ObservationWell

#### COMPLETION

Depth of completed well: 620 ft.  
 Depth(s) groundwater encountered:  
 (1) \_\_\_\_\_ ft.; (2) \_\_\_\_\_ ft.;  
 (3) \_\_\_\_\_ ft.; (4) dry well

Static water level in well: 417 ft.  
 × measured below land surface on (mm/dd/yy): 09/16/2022  
 measured above land surface on (mm/dd/yy): \_\_\_\_\_

Estimated yield: \_\_\_\_\_ gpm  
 Water level was: \_\_\_\_\_ ft. after \_\_\_\_\_ hours  
 pumping \_\_\_\_\_ gpm

Pump installed? Yes × No

Water well disinfected? Yes No  
 Date disinfected (mm/dd/yy): \_\_\_\_\_

Aquifer, if known: Dakota

#### NEAREST SOURCE OF POTENTIAL CONTAMINATION

Source: \_\_\_\_\_  
 Distance from well: \_\_\_\_\_ Direction from well: \_\_\_\_\_  
 Source description: \_\_\_\_\_

Source: \_\_\_\_\_  
 Distance from well: \_\_\_\_\_ Direction from well: \_\_\_\_\_  
 Source description: \_\_\_\_\_

× No potential source of contamination within 100 feet.

#### CONSTRUCTION

Borehole interval: from 0 to 620 ft. Borehole diameter: 12.25 in.  
 from \_\_\_\_\_ to \_\_\_\_\_ ft. \_\_\_\_\_ in.

Casing height above land surface: 12 in.  
 If casing height is less than 12 in. has a variance been approved?\* Yes × No  
 \*variance not required for monitoring or environmental remediation wells

Casing type: ThermalPlastic

Blank casing interval: 0 ft. to 600 ft.  
 Blank casing diameter: 2 in.  
 Casing joints: Threaded  
 Weight: \_\_\_\_\_ lbs/ft.  
 Wall thickness or gauge no.: .25

Blank casing interval: 0 ft. to 500 ft.  
 Blank casing diameter: 2.5 in.  
 Casing joints: Threaded  
 Weight: \_\_\_\_\_ lbs/ft.  
 Wall thickness or gauge no.: .25

Grout interval: 0 ft. to 20 ft.  
 Grout material: Bentonite

Grout interval: 530 ft. to 550 ft.  
 Grout material: Bentonite

Screen / perforation material: PVC  
 Screen / perforation openings: Saw cut

Screen / perforation intervals:  
 From 500 ft. to 520 ft.  
 Slot size .032 unit inches  
 From 600 ft. to 620 ft.  
 Slot size .032 unit inches

Gravel pack intervals:  
 Gravel pack not used: Gravel size \_\_\_\_\_ in  
 From 20 ft. to 530 ft.  
 Gravel pack not used: Gravel size \_\_\_\_\_ in  
 From 550 ft. to 620 ft.

#### PERMIT & ID NUMBERS (AS REQUIRED)

DWR Application No.: \_\_\_\_\_  
 KDHE / EPA Project Code: \_\_\_\_\_  
 Site Name: \_\_\_\_\_  
 KDHE UIC Class V Form Completed: Yes No  
 County Permit: Yes No Permit ID: \_\_\_\_\_  
 Lease Name & Well #: \_\_\_\_\_  
 # of boreholes: \_\_\_\_\_ # of dewatering wells: \_\_\_\_\_

#### LITHOLOGIC LOG

FROM	TO	LITHOLOGY INTERVALS
Attach	Attach	Attached

#### COMMENTS

This is a Nest Well, there are two separate strings of casing in it. One in the high plains and one in the dakota.

#### CONTRACTOR'S OR LANDOWNERS CERTIFICATION

This water well was constructed × reconstructed pursuant to the stated water well contractor's license and was completed on 09/14/2022. I certify that this record is true to the best of my knowledge and belief. This water well record was completed on 12/06/2022 under the business name of Hydro Resources Mid Continent, Inc. #145, Kansas Water Well Contractor's License No. 145 under the authority of the designated person as defined in K.A.R. 28-30-2(j) and signed and certified by the electronic signature of the designated person at its submittal: Tony Wedel.

Send one copy to WATER WELL OWNER and retain one for your records. Fee of \$5.00 for each constructed well.

KANSAS DEPARTMENT OF HEALTH AND ENVIRONMENT  
 Bureau of Water, Geology Section, 1000 SW Jackson St., Suite 420, Topeka KS 66612-1367  
 (785) 296-3565 | K.S.A. 82a-1212 | v2022c

Satanta Site (continued)

Form	WWC5.2 - Water Well Record
Doc ID	1668540
Well Owner	Kansas Geological Survey
Contractor	Hydro Resources Mid Continent, Inc. #145

Lithology

From	To	Lithology Intervals
0	2	topsoil
2	46	clay,brown
46	73	sand,fine
73	80	clay,brown
80	113	clay,fine,sandy,brown
113	179	sand,fine to medium,clayey
179	195	clay,brown
195	214	sand & gravel,fine to medium,loose
214	233	clay,yellowish,brown
233	260	clay,blueish,brown
260	295	clay,blueish
295	337	sand & gravel,fine to medium
337	341	clay,brown
341	380	sand & gravel,fine to medium
380	393	clay,sandy,brown
393	428	sand,fine to medium,gravelly
428	505	clay,sandy,brown
505	628	clay,yellowish
628	633	caliche,unweathered
633	635	shale,unweathered,Red Bed





Ulysses Site (continued)

Form	WWC5.2 - Water Well Record
Doc ID	1691814
Well Owner	Kansas Geological Survey
Contractor	Hydro Resources Mid Continent, Inc. #145

Lithology

From	To	Lithology Intervals
0	2	topsoil
2	111	clay,brown
111	201	sand,fine
201	215	sand,fine to medium
215	230	clay,gray
230	250	sand,fine,clayey,brown
250	280	sand,fine to medium
280	320	clay,sandy
320	335	sand,fine
335	370	clay,sandy
370	380	sand,fine to medium
380	420	clay,sandy
420	440	sand,fine to medium
440	465	sandstone,moderately weathered,clayey,yellowish
465	480	shale,slightly weathered,black
480	500	sandstone,unweathered,clayey
500	576	sandstone,unweathered
576	580	shale,slightly weathered,dark,red