

Kansas Groundwater Data and How to Mine It

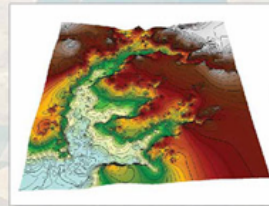
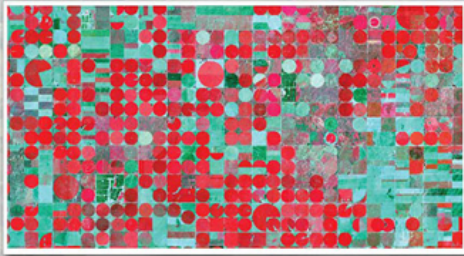
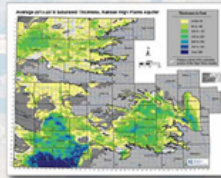
Brownie Wilson, GIS /Support Services Manager, Kansas Geological Survey

2nd Floor Commons Zone (top floor), Slawson Hall

Tuesday, April 16, 8:30 a.m.

Coffee and rolls provided

Professional Development hour available



Kansas Groundwater Data and How to Mine It

Slides and speaker notes for the Kansas Geological Survey's (KGS) Tuesday Rocks and Rolls Lecture Series

by Brownie Wilson of the Geohydrology Section, KGS.

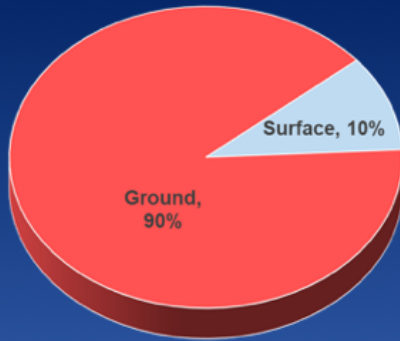
Kansas Geological Survey

Open-File Report 2019-4

May 2019

Why does Kansas care about groundwater?

Average Reported Source of Supply, Kansas, 2008 to 2017



- **Kansas is very data-rich.**
 - **Well construction and lithology**
 - **Measured depth to water**
 - **Reported Water Use**
- **Kansas does not have a single water agency**
- **Multiple agencies, each with their own database**

Over the last 10 years, 90% of the water used in Kansas each year originated from a groundwater source. Given the importance of groundwater as a resource to the state, Kansas has several freshwater databases containing data on well construction and lithology, measured depths to water, and reported water use.

Kansas is unique in relation to other states in that it does not have a single water agency that is typically found in a Department of Natural Resources. Rather, water regulation has been assigned across multiple agencies, each with its own unique goals and responsibilities and, in some cases, its own groundwater databases.

KGS Website- www.kgs.ku.edu



KGS Mission:

- Conduct geological studies and research in Kansas
- Collect, correlate, preserve, and disseminate information leading to a better understanding of the geology of Kansas
- Special emphasis on natural resources of economic value, water quality and quantity, and geologic hazards

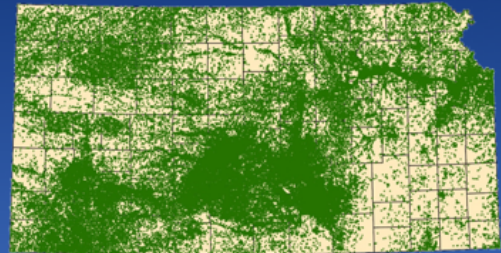
The KGS, as part of its core mission, hosts three of the state's primary freshwater groundwater databases. This presentation will address each of these data sets, all of which can be found under the "Water Section" of the KGS's website at www.kgs.ku.edu, and will show examples of how the data are being applied.

Kansas Groundwater Data
WWC5

WWC5

WWC5- Well Construction and Lithology

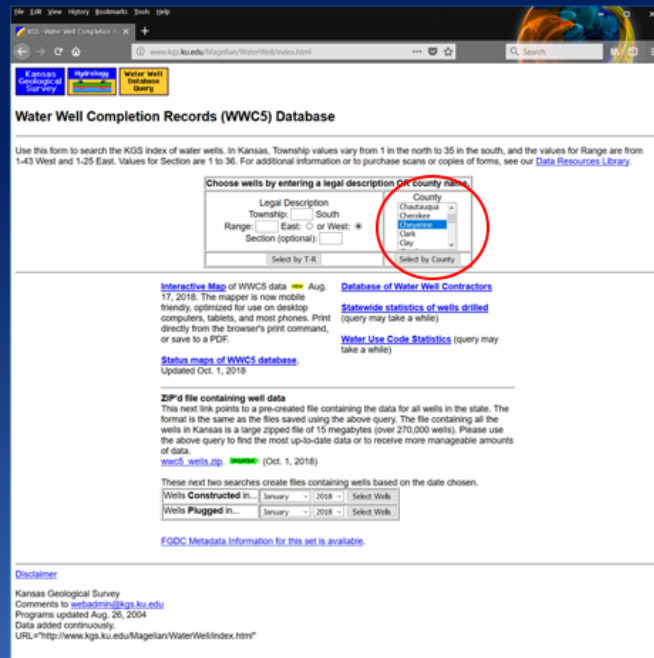
- Water Well Completion Records
- Kansas Department of Health and Environment
- KGS directed, by statute, to serve and maintain the data
- WWC5 forms are required for any constructed, reconstructed, or plugged well in Kansas since 1975
- Over 276,000 records



The Water Well Completion Records database—or as it is often referred to, WWC5—is a collection of water well construction and lithology records. The Water Well Program of the Kansas Department of Health and Environment oversees groundwater well development and provides data about potential water supplies in Kansas. Through this program, well drillers have been required to submit a WWC5 form each time a groundwater well is drilled, reconstructed, or plugged in Kansas since 1975.

The KGS is directed under state statute 2-1212 to keep these records on file and available to the public. There are more than 276,000 records on file.

WWC5- Well Construction and Lithology



The WWC5 database can be accessed at this URL:
<http://www.kgs.ku.edu/Magellan/WaterWell/index.html>. Records can be selected by a Public Land Survey System (PLSS) description or a county name. Records also can be accessed through the WWC5 map viewer (to be discussed later in the presentation) or downloaded in their entirety via a compressed zip file.

For this presentation, Cheyenne County is selected for an example query.

WWC5- Well Construction and Lithology

TR-S	Owner	Well Depth	Static Water Level	Est. Yield	Well Use	Other ID	Action Taken	Completion Date	Scanned?
11-01S-37W	Doyle, Caroline	36 ft.	18 ft.	5 gpm	Feedlot/Livestock Windmill		Constructed	25-Aug-1986	Scanned
11-01S-37W	Cubaert, James	50 ft.	37 ft.	6 gpm	Domestic, Livestock		Constructed	31-May-2015	Scanned
11-01S-37W	Doyle, Charles	140 ft.	125 ft.	10 gpm	Domestic		Constructed	13-Jan-2000	Scanned
11-01S-37W	Mears, LaVonne	36 ft.			Domestic, Lawn and Garden		Constructed	07-May-2009	FILE
11-01S-37W	Sowers, Josh	112 ft.	110 ft.	1 gpm	Domestic, Livestock		Constructed	13-Apr-2016	Scanned
11-01S-37W	Sowers, Josh	40 ft.	20 ft.	10 gpm	Domestic, Livestock		Constructed	07-May-2014	Scanned
11-01S-37W	Sowers, Josh	40 ft.	30 ft.	15 gpm	Domestic, Livestock		Constructed	07-May-2014	Scanned
11-01S-37W	Sowers, Josh	35 ft.	7 ft.	15 gpm	Domestic, Livestock		Constructed	18-Nov-2014	Scanned
11-01S-37W	Sowers, Josh	46 ft.	15 ft.	15 gpm	Domestic, Livestock		Constructed	18-Nov-2014	Scanned
11-01S-37W	Cubaert, Tharon	260 ft.	220 ft.	12 gpm	Domestic		Constructed	23-Mar-2006	FILE
11-01S-37W	Emg, Tre	37 ft.			Domestic		Constructed	23-Nov-2004	FILE
11-01S-37W	Bain, daren	35 ft.	5 ft.	15 gpm	Domestic, Livestock		Constructed	10-Nov-2014	Scanned
11-01S-37W	Ladenburger, Nikolas	34 ft.	20 ft.	10 gpm	Domestic, Livestock		Constructed	11-May-2015	Scanned
11-01S-37W	Ladenburger, Nick	38 ft.	28 ft.	10 gpm	Domestic, Livestock		Constructed	14-May-2014	FILE
11-01S-37W	Zimbelen, Reigene and Wilma	80 ft.	52 ft.	850 gpm	Irrigation		Constructed	20-May-1997	Scanned
11-01S-37W	Miller, Roy	76 ft.	47 ft.	50 gpm	Oil Field Water Supply		Constructed	05-Jul-1991	Scanned
11-01S-37W	Jones, Ronnie	90 ft.	88 ft.	0 gpm	Oil Field Water Supply	Jones 25.12	Plugged	06-Oct-2012	Scanned

Once a query is submitted, the WWC5 website returns all matching records as a sortable table. Records, shown in groups of 50 wells at a time, can be sorted by the PLSS description, owner name, well depth, static water level (at the time the well was constructed), estimated yield, intended use of water, other identification numbers, well action (constructed, reconstructed, or plugged), date of the well action, and availability of scanned WWC5 forms.

In this example, the scanned form for the WWC5 record in the SWNWNWNW of 11-01S-37W is selected.

Submitted Driller's Log

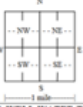
- Forms vary in layout over the years
- Location and Owner Information
- Well depth, static water level, and expected flow rate
- Casing and screening information
- Lithology

WATER WELL RECORD Form WWC-5 Division of Water Resources App. No. _____ Well ID _____

Original Record Correction Change in Well Use

1 LOCATION OF WATER WELL: County: Cherokee Fraction: _____ Section Number: 11 Township Number: 1 S Range Number: R 37 E W W
 SW1/4 NW1/4 NE1/4 NW1/4

2 WELL OWNER: Last Name: Cubwell First Name: James Street or Rural Address where well is located (if unknown, distance and direction from nearest town or intersection): If at owner's address, check here intersection of Rd DD & Rd 34
 Business Address: 1790 Rd B
 Address: _____
 City: St. Francis State: KS ZIP: 67756

3 LOCATE WELL WITH "X" IN SECTION BOX: 

4 DEPTH OF COMPLETED WELL: 50 ft. **5 Latitude:** 39.6072 (decimal degrees)
 Depth(s) (Groundwater Encountered): 37 ft. **Longitude:** 101.4480 (decimal degrees)
 1) _____ 2) _____ 3) _____ 4) _____ 5) _____ 6) _____ **Datum:** WGS 84 NAD 83 NAD 27
 WELL'S STATIC WATER LEVEL: 37 ft. **Source for Latitude/Longitude:** GPS (not under model) (WAAS enabled?) Yes No
 above land surface, measured on (no-day yr) _____ **Land Survey:** Topographic Map Online Mapper
 Pump test date: Well water was _____ gpm
 after _____ hours pumping Well water was _____ gpm
 Estimated Yield: 6 gpm
 Bore Hole Diameter: _____ in. to _____ ft. and _____ ft.

7 WELL WATER TO BE USED AS:
 1. Domestic: Household Public Water Supply: well ID _____ 10. Oil Field Water Supply: lease _____
 Lawn & Garden Aquifer Recharge: well ID _____ Canal Unused Geotechnical
 Livestock Monitoring: well ID _____ 12. Geothermal: "low-salinity brine?" _____
 2. Irrigation 9. Environmental Remediation: well ID _____ a) Closed Loop Horizontal Vertical
 Feedlot Air Sparge Soil Vapor Extraction b) Open Loop Surface Discharge Inj. of Water
 Industrial Recovery Injection 13. Other (specify): _____

Was a chemical/bacteriological sample submitted to KDHE? Yes No If yes, date sample was submitted: _____
 Water well disinfected? Yes No

8 TYPE OF CASING USED: Steel PVC Other _____ CASING JOINTS: Glibed Clamped Welded Threaded
 Casing diameter: _____ in. to _____ in. Diameter _____ in. to _____ in. **Weight:** 2.38 lb./ft. **Wall thickness or gauge No.:** 237
 Casing height above land surface: 18 in. **Weight:** _____ lb./ft. **Wall thickness or gauge No.:** _____

TYPE OF SCREEN OR PERFORATION MATERIAL: steel Stainless steel Fiberglass PVC Other (specify): _____
 Brass Galvanized steel Concrete tile Note used (open hole)

SCREEN OR PERFORATION OPENINGS ARE: Continuous Slot Mesh Slot Gauge Whipped Torch Cut Drilled Holes Other (Specify) _____
 Looped Sluiter Key Patched Wire Whipped Saw Cut Note (Open Hole)

SCREEN-PERFORATED INTERVALS: From 30 ft. to 50 ft. From _____ ft. to _____ ft. From _____ ft. to _____ ft.
GRAVEL PACK INTERVALS: From 20 ft. to 50 ft. From _____ ft. to _____ ft. From _____ ft. to _____ ft.

9 GROUT MATERIAL: Not cement Cement grout Bentonite Other _____
 Grout Interval: From _____ ft. to _____ ft. From _____ ft. to _____ ft. From _____ ft. to _____ ft.
 Nearest source of possible contamination: _____
 Septic Tank Lateral Lines Pit Pits Livestock Pens Insecticide Storage
 Sewer Lines Cess Pools Sewage Lagoons Fuel Storage Abandoned Water Well
 Watertight Sewer Lines Sepsage Pit Feedlot Fertilizer Storage Oil Well-Gas Well
 Other (Specify) _____

Distance from well? _____ ft.

18 FROM	TO	LITHOLOGIC LOG	FROM	TO	LITHO LOG (cont.) or PLUGGING INTERVALS
0	2	surface			
2	18	loess			
18	29	clay			
29	42	fine & rimed sand & small gravel w/ clay			
42	60	black shale			

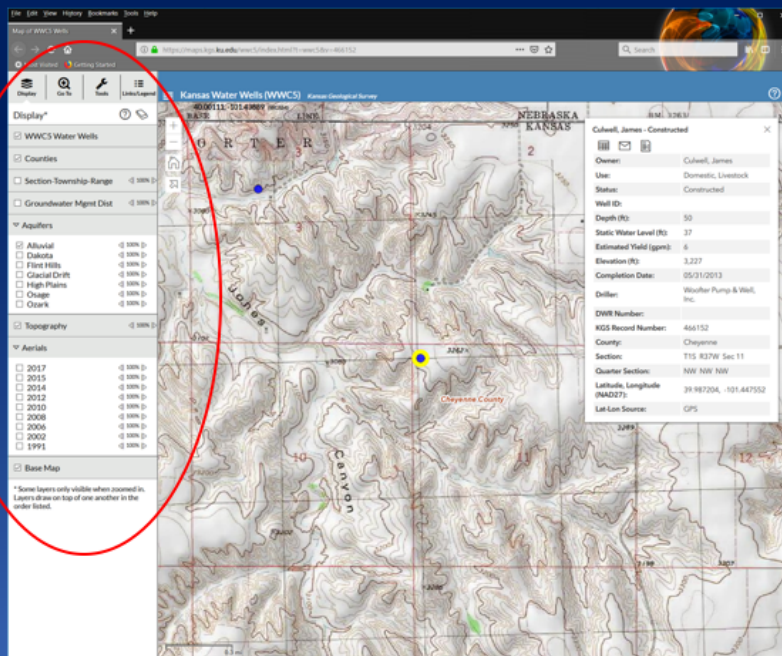
Notes: _____

11 CONTRACTOR'S OR LANDOWNER'S CERTIFICATION: This water well was constructed, reconstructed, or plugged under my production and was completed on (no-day-year) 05/21/2013, and this record is true to the best of my knowledge and belief. Kansas Water Well Contractor's License No. 256. This Water Well Record was completed on (no-day-year) 05/01/2013 under the business name of Wootter Pump & Well, Inc.
 I am the only WATER WELL OWNER and retain use for five years. Fee of \$1.00 for each constructed well.
 KS Department of Health and Environment, Bureau of Water, Geology Section, 1000 SW Jackson St., Suite 920, Topeka, Kansas 66612-1367. Telephone 785-296-3565. Visit us at <http://www.kdheks.gov/waterwell/index.html> KSA 82a-1212

Example of the selected driller's log. The traditional use of the WWC5 website has been to access these scanned images. The WWC5 forms vary over the years in terms of layout, but they all contain key data elements:

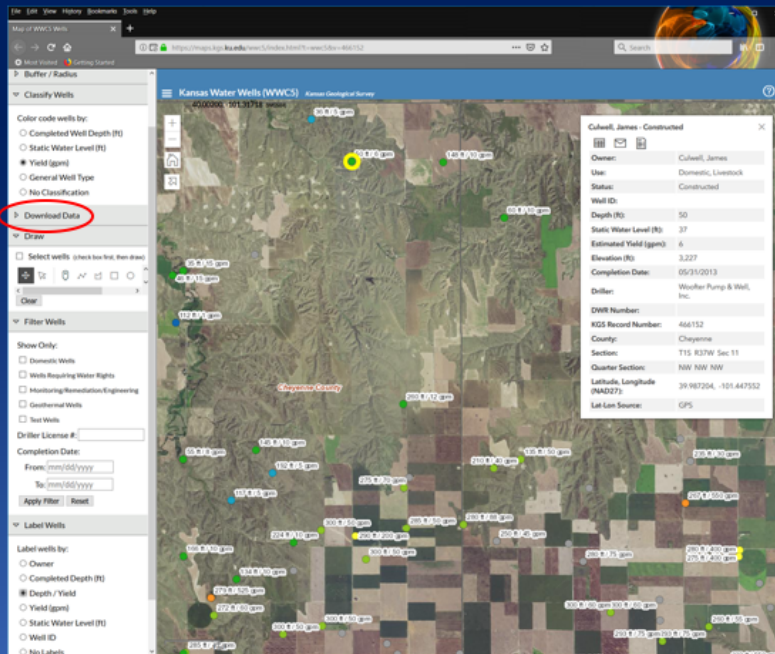
- Location and owner Information.
- Well depth, measured static water level, and expected flow rate.
- Well casing, borehole diameter, casing, screening, and gravel pack information.
- Lithologic descriptions of the subsurface material the well penetrates.

WWC5- Mapping Page



The mapping portion of the WWC5 website has recently been updated. The mapper can be accessed from an individual well listing or the initial WWC5 web page. WWC5 records can be plotted and overlain with other spatial datasets—specifically Kansas counties, PLSS sections, groundwater management district boundaries, major and minor aquifer system extents, topographic maps, and several years of aerial photos.

WWC5- Mapping Page



The WWC5 mapping page allows WWC5 records to be displayed and labeled in a variety of fashions. In this example, the WWC5 points are color-coded based on estimated flow rates—cooler colors (blues and greens) indicate lower flow rates relative to warmer colors (oranges and yellows), which represent higher rates. Each well is labeled by its well depth and estimated flow rate. The WWC5 mapping page allows users to quickly and easily explore existing groundwater well development across an area or region of the state.

The WWC5 site has options to download WWC5 data.

Data Download Option

- Well Locations
- Log Data

The screenshot shows a web browser window displaying the KGS website for County: Saline. The page title is "County: Saline" and it shows "6777 records returned". There are two main sections: "Well Locations" and "Log Data". The "Well Locations" section contains a table with columns for Well ID, Well Name, and Well Type. The "Log Data" section contains a table with columns for Well ID, Well Name, and Log Date. The page also includes a "Please Note" section and a "Please note" section.

WWC5 data can be downloaded into comma-delimited, ASCII files that are readable by spreadsheets and database software.

One file represents groundwater wells with geographic coordinates along with site-specific information, such as well depth, completion date, and owner.

The second file provides a link that generates the lithologic log data file, which describes the subsurface material the well is passing through along with the depth intervals of each category.

The two files can be related or joined via the WELL_ID field.

Not all forms/logs are created equal

Excellent

Not so Excellent



WATER WELL RECORD Form WWC5 USA 8/10/12

1. LOCATION OF WATER WELL: Co. THOMAS, 410 E. 4th St., Co. Colby, KS. 67781

2. WATER WELL OWNER: Colby Locker, DEWA #04 - easement of City of Colby

3. DEPTH OF COMPLETED WELL: 125 ft. ELEVATION: 8.3

4. WELL'S STATIC WATER LEVEL: 103.6 ft. below land surface measured on Monday

5. TYPE OF BLANK CASING USED: 1 Steel, 2 PVC, 3 RFP (RFP), 4 ABS, 5 Fiberglass, 6 Concrete tile, 7 Other (specify below)

6. TYPE OF SCREEN OR PERFORATION MATERIAL: 1 Steel, 2 Brass, 3 RFP (RFP), 4 ABS, 5 Fiberglass, 6 Concrete tile, 7 Other (specify below)

7. SCREEN PERFORATION OPENING SIZE: 1/2", 3/4", 1", 1 1/2", 2", 3", 4", 6", 8", 10", 12", 14", 16", 18", 20", 24", 30", 36", 48", 60", 72", 96", 120"

8. GROUT MATERIAL: 1 None, 2 Cement, 3 Sand, 4 Gravel, 5 Other (specify below)

9. CONTRACTORS OR LANDOWNER'S CERTIFICATION: This water well was (1) constructed, (2) reconstructed, or (3) plugged under the jurisdiction and was completed on 11-5-92.

DEPTH (ft.)	TO (ft.)	FROM (ft.)	TO (ft.)	FROM (ft.)	TO (ft.)	FROM (ft.)	TO (ft.)	FROM (ft.)	TO (ft.)
0	5	Surface	120	125	Med. Sand				
5	35	lt. Brown Clay							
20	40	lt. Brown Clay w/sand strks.							
40	45	lt. Brown Sandy clay							
45	55	lt. Brown Clay & Sand							
55	65	Red Sandy Clay							
65	74	Med. Sand							
74	89	Caliche & Clay							
89	91	Med. Sand							
91	93	Caliche							
93	94	Sand							
94	100	Clay & Cemented Strks/Caliche							
100	105	Cemented Sand							
105	112	Clay & sand Strks.							
112	120	Sand							

WATER WELL RECORD Form WWC5 USA 8/10/12

1. LOCATION OF WELL: HASSELL, 14th St. & 1st St. NW, Box 42, East Linn, MO. 64724

2. OWNER OF WELL: Frank Copeland, Kansas City, MO. 64118

3. DEPTH OF COMPLETED WELL: 14 ft. ELEVATION: 91.27

4. WELL'S STATIC WATER LEVEL: 77.27 ft. below land surface measured on Monday

5. TYPE OF BLANK CASING USED: 1 Steel, 2 PVC, 3 RFP (RFP), 4 ABS, 5 Fiberglass, 6 Concrete tile, 7 Other (specify below)

6. TYPE OF SCREEN OR PERFORATION MATERIAL: 1 Steel, 2 Brass, 3 RFP (RFP), 4 ABS, 5 Fiberglass, 6 Concrete tile, 7 Other (specify below)

7. SCREEN PERFORATION OPENING SIZE: 1/2", 3/4", 1", 1 1/2", 2", 3", 4", 6", 8", 10", 12", 14", 16", 18", 20", 24", 30", 36", 48", 60", 72", 96", 120"

8. GROUT MATERIAL: 1 None, 2 Cement, 3 Sand, 4 Gravel, 5 Other (specify below)

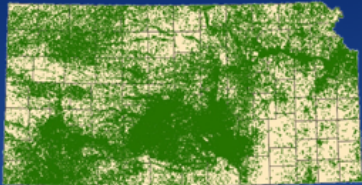
9. CONTRACTORS OR LANDOWNER'S CERTIFICATION: This well was (1) constructed, (2) reconstructed, or (3) plugged under the jurisdiction and was completed on 11-5-92.

17. Well to be completed by: Dunham Drilling Co., Copeland, Kansas

WWC5 forms provide a great wealth of information describing groundwater wells and the sources of supply the well accesses. However, the submitted information can vary in terms of quality and detail. Many WWC5 forms are excellent, both in quality and detail of the submitted information, but others are not. The Kansas Groundwater Association works to educate and assist licensed drilling companies on submitting forms; however, most of the submitted information is based on on-site observations with virtually no regulatory oversight.

WWC5- Why do people care?

- I just bought 20 acres, is there any water?
- How many private wells are drilled in town?



- What is the depth to groundwater in eastern Kansas?

Question: Why do people care whether there is a WWC5 database? WWC5 records can be used to answer a multitude of questions:

- Are there any groundwater sources available on or near a particular property? In rural environments, domestic water needs are either provided by rural water districts or private wells. WWC5 is a great source to quickly investigate water availability.
- How many private lawn/garden wells are drilled within a town? If a metropolitan area overlies a shallow, accessible aquifer system, there are often thousands of private wells drilled within the city limits. Although generally small in terms of use, together these wells can have a notable impact on the local source of supply.
- What is the depth to water for locations in eastern Kansas? The State of Kansas does not have a statewide water-level network (to be discussed in the next section of this presentation). WWC5 forms are often the only source that lists the depth to water across many areas of eastern Kansas.

WWC5- Why does the State of Kansas care?

WATER WELL RECORD Form WWC-5 Division of Water Resources App. No. 48,100
 Section Number 1 Complain No. Kansas Number

1 LOCATION OF WATER WELL: Fraction SE 1/4 SW 1/4 NE 1/4 SW 1/4
 County Saline
 Street/Road Address of Well Location, if unknown, distance & direction from nearest town or intersection. If at owner's address, check here
 1-1/2 miles North of Asaoka, Ka

2 WATER WELL OWNER: Clayton Short
 RBA, Street Address, Box # 7277 S, Ohio
 City, State, ZIP Code Asaoka, Kansas 67416

3 LOCATE WELL WITH AN "X" IN SECTION BOX: [Diagram showing a 36x36 section box with an 'X' in the center]

4 DEPTH OF COMPLETED WELL: 58
 (Depth) Groundwater Encountered (1) _____ ft. below land surface
 WELL'S STATIC WATER LEVEL: 24 _____ ft. below land surface
 Pump test date: Well water was _____ ft. after _____
 EST. YIELD: 4,000 gpm. Well water was _____ ft. after _____
 b. Show Hole Diameter: 20 in. to 58 in. and _____
WELL WATER TO BE USED AS: Public water supply
 Domestic Feedlot Oil field water supply
 Irrigation Industrial Domestic-leave & garden
 Was a chemical/bacteriological sample submitted to Department? If yes, specify by sample was submitted.
 Water well disinfected? Yes No

5 TYPE OF CASING USED: Steel PVC Other _____
CASING JOINTS: Gasket Chamfer Welded Threaded
 Casing diameter: 10 in. to 36 in. Diameter _____ in. to _____
 Casing height above land surface: 12 in. Weight: 8.875 lbs./ft. Wa _____

TYPE OF SCREEN OR PERFORATION MATERIAL:
 Steel Stainless Steel PVC Other (Specify) _____
 Screen Galvanized Steel Iron and copper tubing

SCREEN OR PERFORATION OPENINGS ARE:
 Continuous slot MS slot Coarse wrapped Trench cut Drilled holes
 Laminated slotted Key punched Wire wrapped Saw cut Other (Specify) _____

SCREEN-PERFORATED INTERVALS: From 38 ft. to 58 ft. R. Ft. _____
 From _____ ft. to _____ ft. R. Ft. _____
GRAVEL PACK INTERVALS: From 20 ft. to 58 ft. R. Ft. _____
 From _____ ft. to _____ ft. R. Ft. _____

6 GROUT MATERIAL: Neat cement Cement grout Inertible Others _____
 Grout intervals: From 0 ft. to 20 ft. R. Ft. _____

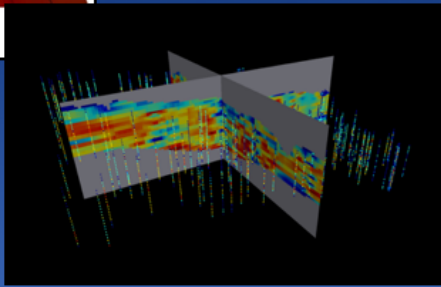
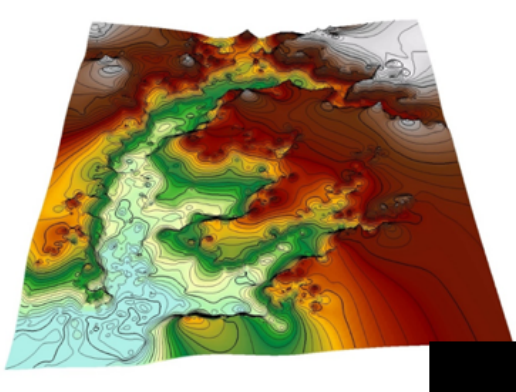
What is the nearest source of possible contamination:
 Septic tank Land fill Feeder Livestock pens _____
 Sewer lines Compost Storage lagoons Fuel storage Abandoned water well _____
 Wastewater cover lines Feedlot Fertilizer storage Oil well type well _____
 Direction from well North within 1/4 mile _____ Distance from well _____

FROM	TO	LITHOLOGIC LOG	FROM	TO	LITHO LOG (cont.) PLUGGING INTERVALS
0	1	Topsoil			
1	32	Clay, tan			
32	57	Sand and gravel			
57	58	Shale, gray			

7 CONTRACTOR'S OR LANDOWNER'S CERTIFICATION: This water well was constructed, reconstructed, or plugged under my jurisdiction and was completed on (month/year) 05/2015, and this record is true to the best of my knowledge and belief.
 Kansas Water Well Contractor's License No. 852 This Water Well Record was completed on (month/year) 05/2015 under the business name of Peterson Michael Drilling, Inc. by (signature) [Signature] 05/20/15

INTERESTS: This transaction is valid only on: PLANNED PERMITTING and PERMITTING. Please call to transfer title to the correct agency. Send one copy to Kansas Department of Health and Environment, Bureau of Water, Geology Section, 1000 SW Jackson St., Suite 420, Topeka, Kansas 66612-1007. Telephone 785-296-2324. Send one copy to WATER CONSERVATION and one to the one record. Submit fee of \$1.00 for each constructed well. Work as at <http://dhs.kansas.gov/water/well-records/>

KSA 82a-2212



The KGS uses WWC5-based records to characterize aquifer parameters and conditions.

The Smoky Hill River Valley Groundwater Model is a numerical flow model designed to help test ground and surface water management proposals in the Smoky Hill River valley between Kanopolis Reservoir and the City of Salina. WWC5 forms were used to identify shale and other non-permeable materials, which were interpolated into a continuous surface of the underlying aquifer bedrock.

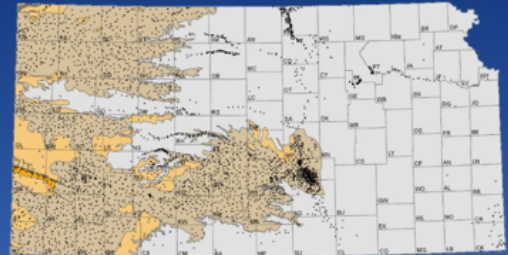
The KGS is also investigating approaches to develop quantitative aquifer models by reclassifying the tens of thousands of submitted lithologic descriptions into 71 synonymy classes. The synonymy classes are, in turn, interpolated into permeability groupings that are dynamically linked to groundwater flow models. As the simulated water levels change within each model iteration, they are intersected with a three-dimensional representation of the simplified WWC5 permeability classes, and aquifer parameters, such as the hydraulic conductivity and specific yield, are dynamically assigned to model cells.

Kansas Groundwater Data
WIZARD

WIZARD

WIZARD- Depth to water measurements

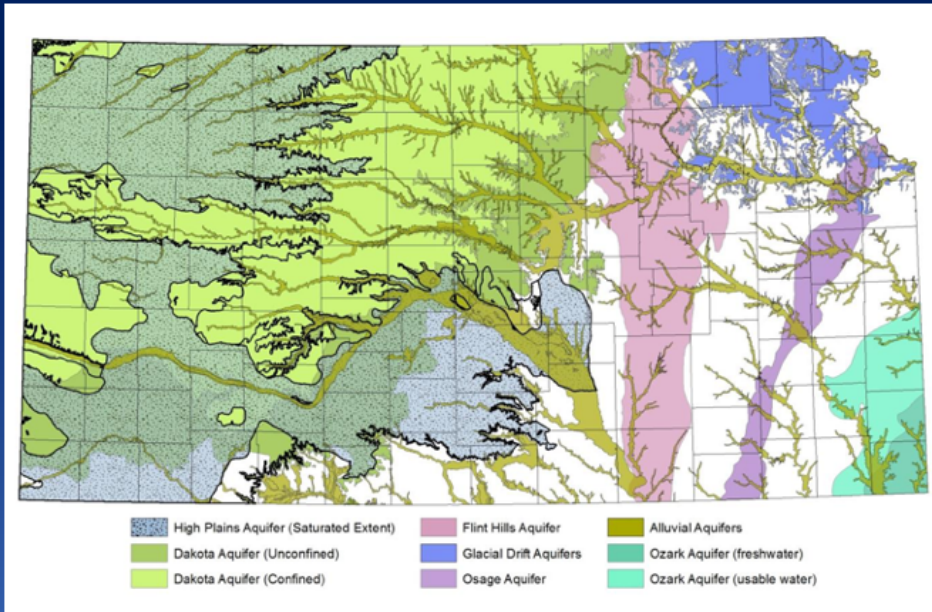
- Water Information Storage and Retrieval Database
- Kansas Geological Survey
- State's largest repository of depth-to-water measurements
- Data evolved from US Geological Survey and is populated from the KGS, KDA-DWR, local management districts and the USGS
- Over 57,000 well sites (12,617 wells and 636,693 measurements)



The KGS-administered database WIZARD is an acronym for Water Information Storage and Retrieval Database (if you say "WISARD" three time fast it sounds like "WIZARD") and represents the state's largest repository of depth-to-water measurements in Kansas. WIZARD evolved in the mid-1990s from the U.S. Geological Survey's Groundwater Site Inventory and today is used to store measured water levels from the KGS, Kansas Department of Agriculture, Division of Water Resources (KDA-DWR), local groundwater management districts, and the USGS.

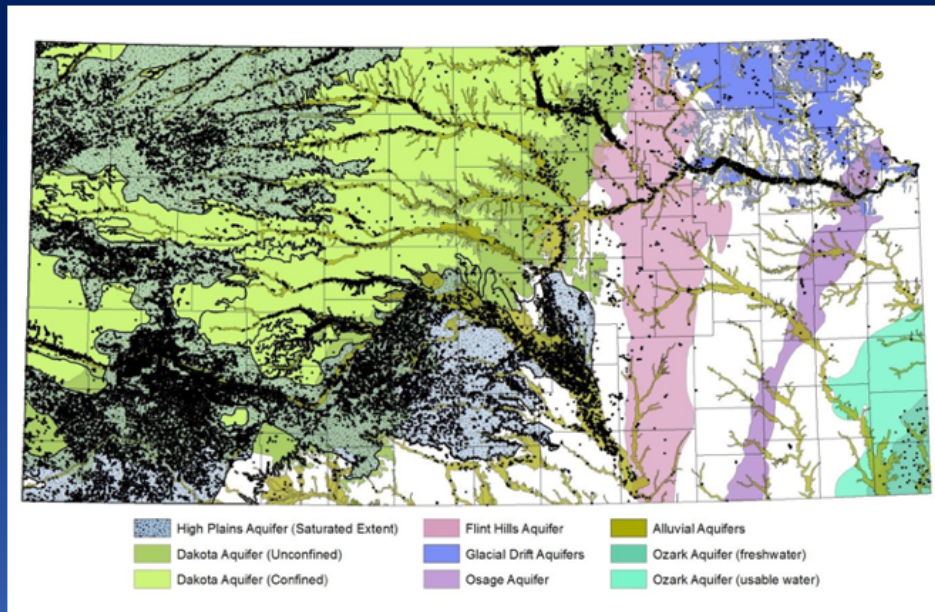
The map shows the distribution of wells with a depth-to-water measurement taken in the last 20 years. Many of the measured wells are found along major alluvial valleys, such as in the Republican River alluvium and in the High Plains aquifer (HPA) region of Kansas, shown by the tan shaded areas.

Major and Minor Aquifers in Kansas



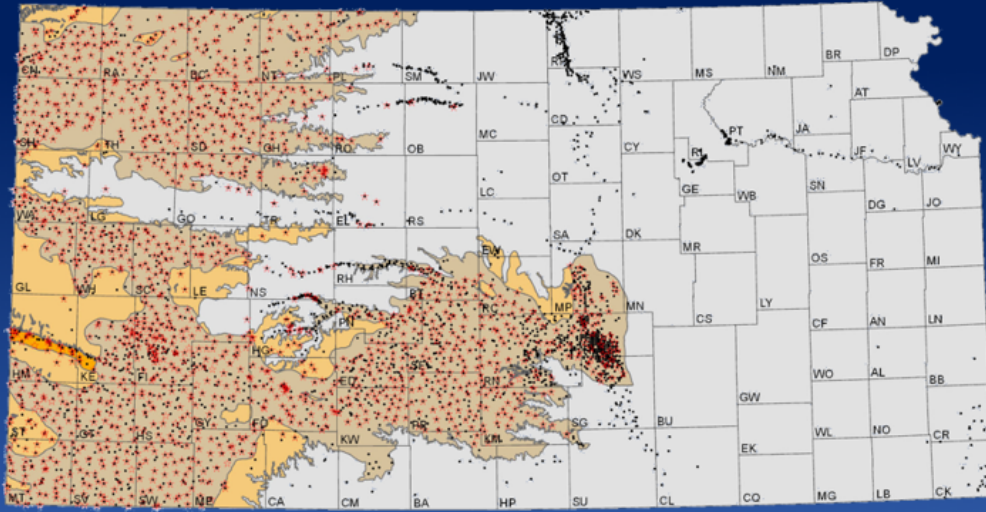
This map shows the major and minor aquifer units in the state.

Groundwater-based Water Right Wells (aka "Big Wells")



The HPA is the most-used aquifer in the state and supplies most of the groundwater used each year. This is illustrated by the distribution of groundwater-based water right wells (typically non-domestic, large capacity wells).

Kansas Cooperative Water Level Network



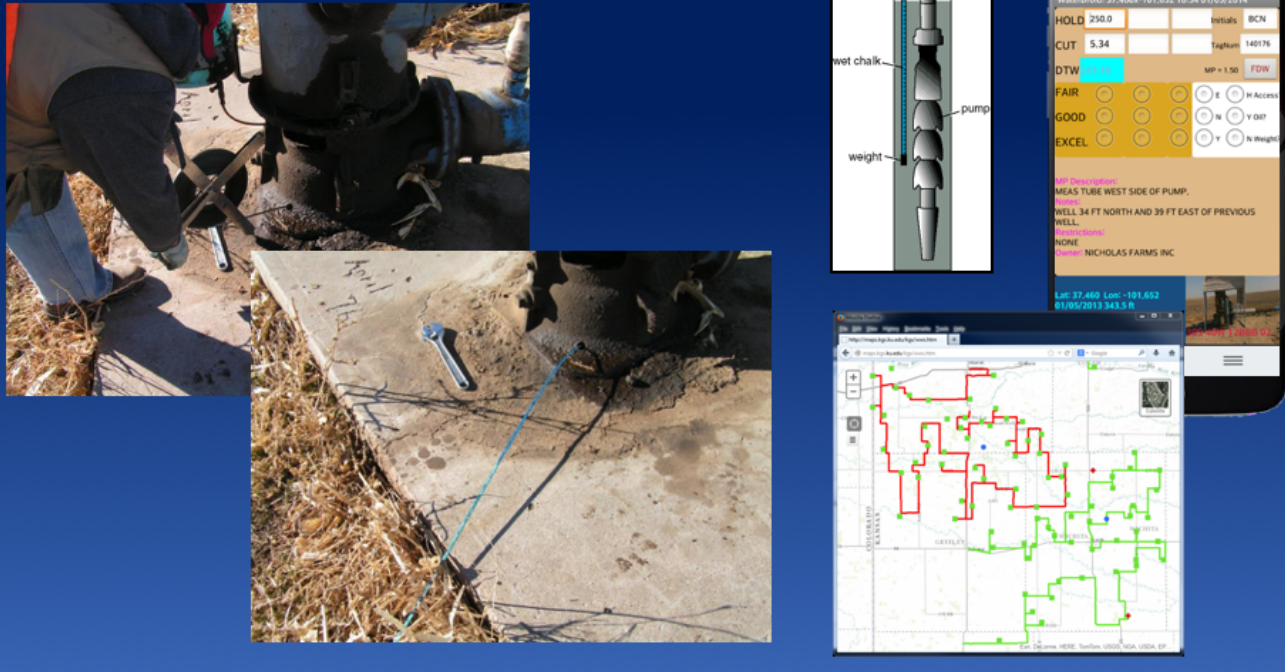
Given the importance to Kansas, each January, the KGS in cooperation with the KDA-DWR measures roughly 1,400 water wells across the HPA region, shown as red stars on the map, to provide regional characterizations of the aquifer. Collected depths to water measurements can be obtained from the WIZARD site.

Measuring Wells in Kansas



The majority of depth-to-water measurements are taken from actual production wells, usually irrigation wells. Other types of wells measured each year include windmills, abandoned wells, oil-supply wells, and observation wells constructed solely for the continuous monitoring of water levels.

Measuring a Well



The Exploration Services Section heads up the field collections effort for the KGS portion of the Cooperative Water Level Program. Steel tapes are lowered down access points between the well casing and pump column into the water column and held at specific depths, called the “hold.” The bottom 20 or 30 feet of the tape is incremented to the thousandths of a foot and covered in blue chalk, which makes a distinct “cut” mark where the tape is wet from crossing into the water table versus where it is dry. The depth to water from the measuring point is then computed by subtracting the “cut” from the “hold.”

KGS staff use internally customized software, called Water Droid, to navigate the network of groundwater wells and store collected measurements using Android-based mobile devices (e.g., phones and tablets). Water Droid provides on-site data checks and transmits the measurement back to KGS servers via cloud-based storage. Additional customized web applications then display the network wells in terms of their measurement status and any missed wells can readily be identified along with wells tagged as “UTM” (unable to measure).

UTM = Unable to Measure



Every year, a small percentage of wells are classified as UTM—unable to measure. In most cases, this happens because of simple hazards such as blocked road access or adverse field conditions caused by winter precipitation. In other situations, blockages can occur from shifts in the well casing or other down-hole obstructions, such as rodents and other critters that met unsavory ends after becoming stuck in downhole access points. The Cooperative Water Level Program is completely voluntary and landowners (or their monkeys) can opt out of the program at any time.

WIZARD- Depth to Water Measurements

Enter values for any or all parameters

Township: Any Township Range: Any Range Range Direction: E or W Section: Any Section

Public Land Survey System:

Lat/Long Box (NAD 83): North Latitude West Longitude East Longitude South Latitude

County Name: Butler Chase Chautauque Cherokee Clay

GMD Number: Western Kansas GMD #1 Shawnee Kansas GMD #2 Southeast Kansas GMD #3

Water Level Date Range: mm/dd/yyyy format or leave blank for all records

Start Date: End Date:

State: Kansas

USGS ID: Single Entry: Load From file: No file selected. Examples on Loading Files

KGS Local Well Number: Single Entry: Load From file: No file selected. Examples on Loading Files

Restrict search to wells WITH water levels?: Select Wells

The WIZARD database is a repository of information on freshwater wells drilled into aquifer in Kansas. WIZARD consolidates information formerly maintained by several local, state, and federal agencies. Most of the data stored has been taken from the U.S. Geological Survey's GWSI (Ground Water Site Inventory) and with the exception of those wells included in the Kansas monitoring well network, none of this information has been verified. About two-thirds of the annual water-level data are now submitted by local [GMDs](#) and the [Division of Water Resources](#), with the other third being updated by the KGS. WIZARD is owned and operated by the Kansas Geological Survey.

Related Links

[Water Levels Reports](#)—KGS Open-file Report and Technical Series Publications related to water-level data are available. These data were acquired by the Kansas Geological Survey, the Division of Water Resources of the Kansas Department of Agriculture, and the Groundwater Management Districts in Kansas from 1997 to present day.

[How Are Wells Measured?](#)—KGS Public Information Circular (PIC) 12 describes the Kansas water-level measurement program.

[KGS Exploration Services](#)—The Exploration Services section of the KGS has a site describing their work on the water-level measurement program. Use the "Water Well Project" link.

[EODC Metadata](#) information (data about data) is available for this database.

[Disclaimer](#)
For information on the WIZARD database, please contact Dan Suchy (dsuchy@kgs.ku.edu, 785-864-2160).
For web page or internet based comments, please contact webadmin@kgs.ku.edu
WIZARD Program updated October 2002. Data added periodically.

The WIZARD website can be accessed from this url:
<http://www.kgs.ku.edu/Magellan/WaterLevels/index.html>. It has the same look and feel as the WWC5 page but has expanded query options. In addition to PLSS and county-based queries, water levels can be selected by latitude and longitude box, local groundwater management districts, or specific ID numbers. Water levels can be filtered to limit results to a specified range of dates.

WIZARD- Depth to Water Measurements

Primary Key

USGS_ID <small>asc_desc</small>	County <small>asc_desc</small>	PLSS <small>asc_desc</small>	Records <small>asc_desc</small>	Date Range <small>Min Date Max Date</small>	Longitude <small>asc_desc</small>	Latitude <small>asc_desc</small>	Use of Site <small>asc_desc</small>	Use of Water <small>asc_desc</small>	Depth of Well <small>asc_desc</small>
3935151039401	Cheyenne	05S 42W 36CCB 01 17	17	29-JUN-1964 to 08-JAN-1981	-101.862953	39.570303	Withdrawal of Water	Irrigation	311
393629101550401	Cheyenne	05S 41W 34CBB 01 22	22	04-JAN-2001 to 03-JAN-2019	-101.919477	39.575510	Withdrawal of Water	Irrigation	280
3936441014401	Cheyenne	05S 38W 26CCA 01 29	29	09-DEC-1965 to 11-JAN-1984	-101.56	39.585452	Withdrawal of Water	Irrigation	285
393508101390801	Cheyenne	05S 39W 25CDA 01 57	57	25-JAN-1965 to 03-JAN-2019	-101.649648	39.586016	Withdrawal of Water	Irrigation	297
393547101481501	Cheyenne	05S 40W 27BBA 01 45	45	01-JUN-1966 to 03-JAN-2019	-101.802253	39.597375	Withdrawal of Water	Irrigation	327
393554101533501	Cheyenne	05S 41W 23CDD 01 1	1	29-JAN-1998 to 29-JAN-1998	-101.891176	39.597545	Withdrawal of Water	Irrigation	Unknown
393613101561301	Cheyenne	05S 41W 20DAA 01 41	41	29-JUN-1964 to 04-JAN-1994	-101.839179	39.603602	Withdrawal of Water	Irrigation	311
393625101342401	Cheyenne	05S 38W 22ACB 01 142	142	17-MAR-1964 to 03-JAN-2019	-101.572446	39.607367	Withdrawal of Water	Irrigation	270
393633101450901	Cheyenne	05S 39W 18BCC 01 10	10	25-JAN-1965 to 08-JAN-1975	-101.749597	39.609126	Withdrawal of Water	Irrigation	303
393638101345801	Cheyenne	05S 38W 22B8B 01 2	2	26-JUL-1950 to 01-JAN-1967	-101.580692	39.61102	Withdrawal of Water	Irrigation	250
393645102000401	Cheyenne	05S 42W 14DCC 01 56	56	02-SEP-1978 to 03-JAN-2019	-102.00326	39.611874	Withdrawal of Water	Irrigation	Unknown
393646101450001	Cheyenne	05S 38W 18CCC 01 13	13	09-JAN-1978 to 09-JAN-1990	-101.74952	39.612773	Withdrawal of Water	Irrigation	291
393698102003901	Cheyenne	05S 42W 14CBC 01 86	86	29-JUN-1964 to 10-JAN-1987	-102.011954	39.616159	Withdrawal of Water	Irrigation	221
393704101423301	Cheyenne	05S 37W 15CBB 01 98	98	07-JUL-1964 to 03-JAN-2019	-101.659142	39.616246	Withdrawal of Water	Irrigation	285
393704101345801	Cheyenne	05S 38W 15CBB 01 2	2	23-AUG-1950 to 01-FEB-1968	-101.58057	39.616202	Withdrawal of Water	Irrigation	168
393712101479601	Cheyenne	05S 40W 14BCD 01 95	95	01-MAR-1975 to 03-JAN-2019	-101.785452	39.615205	Withdrawal of Water	Irrigation	325
393719101474901	Cheyenne	05S 40W 15ACB 01 17	17	29-JUN-1964 to 10-JAN-1984	-101.786214	39.621867	Withdrawal of Water	Irrigation	335
393719101505501	Cheyenne	05S 40W 18ADB 01 26	26	05-JAN-2000 to 12-FEB-2019	-101.848955	39.621964	Withdrawal of Water	Irrigation	320
393724101321401	Cheyenne	05S 38W 13BAD 01 57	57	07-JUL-1964 to 03-JAN-2019	-101.538444	39.624217	Withdrawal of Water	Irrigation	220
393728101435901	Cheyenne	05S 38W 08CCC 01 21	21	20-MAR-1967 to 08-JAN-1979	-101.752933	39.627208	Destroyed	Unknown	323
393735101450901	Cheyenne	05S 39W 11CBB 01 54	54	25-JAN-1965 to 03-JAN-2019	-101.674349	39.630463	Withdrawal of Water	Irrigation	291
393804101502001	Cheyenne	05S 41W 12ADC 01 21	21	26-JUN-1964 to 10-JAN-1984	-101.866422	39.634502	Withdrawal of Water	Irrigation	315
393836102001101	Cheyenne	05S 42W 02CDA 01 2	2	22-MAR-1946 to 05-JUL-1950	-102.004595	39.643213	Withdrawal of Water	Stock	87.8
393844101492101	Cheyenne	05S 40W 04CDB 01 20	20	29-JUN-1964 to 10-JAN-1984	-101.82185	39.645426	Withdrawal of Water	Irrigation	333
393849101440101	Cheyenne	05S 39W 06DAA 01 42	42	28-AUG-1960 to 03-JAN-2019	-101.73155	39.647324	Withdrawal of Water	Irrigation	Unknown
393858101572701	Cheyenne	05S 41W 06ADD 01 2	2	10-JUN-1946 to 05-JUL-1950	-101.803778	39.648792	Withdrawal of Water	Domestic	47.5
393909101565301	Cheyenne	05S 41W 04BBD 01 11	11	08-JAN-2014 to 08-JAN-2014	-101.833255	39.651554	Withdrawal of Water	Irrigation	155
393909102015701	Cheyenne	05S 42W 04AAC 01 2	2	19-MAR-1946 to 02-DEC-1950	-102.034896	39.652185	Observation	Unused	37.2
393915102015701	Cheyenne	05S 42W 04AAB 01 87	87	29-JUN-1964 to 03-JAN-2019	-102.035925	39.653168	Withdrawal of Water	Irrigation	85
393922102014101	Cheyenne	04S 42W 34CCC 01 14	14	21-OCT-1997 to 05-OCT-2006	-102.03104	39.652502	Withdrawal of Water	Irrigation	Unknown
393928102011901	Cheyenne	04S 42W 34CDA 01 15	15	21-OCT-1997 to 05-OCT-2006	-102.023952	39.652902	Withdrawal of Water	Irrigation	Unknown
393929101562801	Cheyenne	04S 41W 32CDB 01 3	3	10-JUN-1946 to 01-MAY-1963	-101.841193	39.657953	Unused	Unused	121
393931102014301	Cheyenne	04S 42W 34CBC 01 18	18	21-OCT-1997 to 05-OCT-2006	-102.029041	39.656893	Withdrawal of Water	Irrigation	Unknown
393941102005001	Cheyenne	04S 42W 34DAB 01 2	2	12-MAR-1946 to 05-JUL-1950	-102.016132	39.661203	Withdrawal of Water	Domestic	41.3
3939411020150801	Cheyenne	04S 42W 34DBB 01 2	2	22-MAR-1946 to 18-DEC-1949	-102.020760	39.661203	Unused	Unused	14.8
393942101384801	Cheyenne	04S 38W 36DBA 01 23	23	22-AUG-1950 to 08-JAN-1975	-101.643255	39.661601	Withdrawal of Water	Domestic	180
393942101384801	Cheyenne	04S 38W 36DBA 01 23	23	22-AUG-1950 to 08-JAN-1975	-101.643255	39.661601	Withdrawal of Water	Stock	158

Once a query is submitted, the WIZARD website returns all matching records as a sortable table. Well records, shown in groups of 50 at a time, can be sorted by the USGS_ID, county designation, PLSS description, number of depth-to-water measurements, longitude, latitude, use of the well site, use made of water, and well depth.

The USGS_ID (aka the Site Number in today's federal USGS database) is still maintained as the primary key in the WIZARD schema. Each ID is hyperlinked to specific well pages.

WIZARD- Depth to Water Measurements

WIZARD Water Well Listing

General Well Site Information

USGS ID: 390429101550401 KGS Local Well ID: 055 41W 34C2B 01
 County: Cheyenne PLS Description: 55 41W 34 N4N4W5W
 MJC # Code: 10250013 GMD: Northwest Kansas GMD #4
 Longitude: -101.919477 Lat/Long Source: GPS (within 50 feet)
 Latitude: 38.573515 Lat/Long Accuracy: 9 seconds
 Surface Elevation (ft): 3730 Depth of Well (ft): 280
 Geological Unit Codes: TO USGS Map Name: ST FRANCIS 3 SW
 Use of Site: Withdrawal of Water Use of Water: Irrigation
 WWCS Links: 7525 WIMS Link: 48851

Measuring Point Information

Note that height is listed as feet above or below land surface.

Height: 0.5

Description: FLIP CAP ON SOUTHEAST CORNER-ARMY NEED HAMMER TO OPEN 2003-USE FLIP CAP ON SW CORNER-NO RESTRICTIONS

Other Well Identifiers

Well Identifier	Assignor	Date Assigned
ANNUAL	KSNET002	SEP-15-2003

Construction Data

No construction information listed for this well.

Casing Information

No casing information listed for this well.

Water Level Measurements

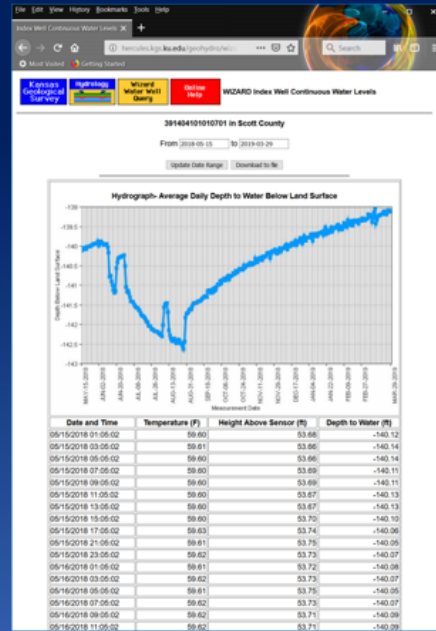
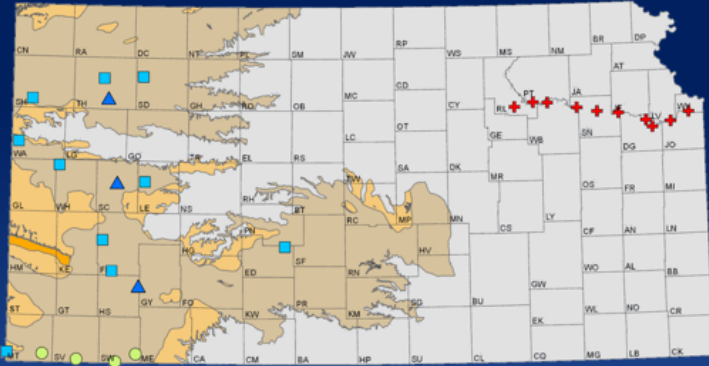
Note that depth to water is feet below land surface and all measurements for the well are included.

Hydrograph-Annual Average Depth to Water Below Land Surface

Date	Depth to Water	Status	Agency	Method	WL Source	Tape	Hold	Chk	Cut	Initials
JAN-04-2001	-202.81	-	KGS	Steel Tape	-	225	21.89			KDM
JAN-04-2002	-203.98	-	KGS	Steel Tape	-	225	15.98			KDM
JAN-07-2003	-204.96	-	KGS	Steel Tape	-	209	3.54			BBW
JAN-03-2004	-205.76	-	KGS	Steel Tape	-	207	0.74			BBW
JAN-06-2005	-206.84	-	KGS	Steel Tape	-	206	0.86			JMA
JAN-06-2006	-206.7	-	KGS	Steel Tape	-	212	4.80			KCB
FEB-23-2007	-	-	KGS	Unknown	-	-	-			BBW
APR-03-2007	-207.73	-	KGS	Steel Tape	-	209	0.77			ARW
JAN-03-2008	-	-	KGS	Unknown	-	-	-			ECR
JAN-28-2008	-	-	KGS	Unknown	-	-	-			ARW
JAN-06-2009	-208.66	-	KGS	Steel Tape	-	214	4.84			OMM
JAN-03-2010	-208.86	-	KGS	Steel Tape	-	219	9.51			JCS

Specific well pages in WIZARD are dynamically populated from WIZARD based on submitted USGS_ID values. Information is provided in three frames within a single web page that outline well-specific information, measuring point descriptions, and all recorded depth-to-water measurements, which are displayed in graph form (annual averages) and a tabular listing of each unique measurement, the date the water level was obtained, the method of collection, and which agency measured the well.

WIZARD- Kansas Index Wells



The Kansas Index Well Program is a collection of groundwater wells equipped to provide real-time and continuous water-level recordings at selected sites across Kansas. All sensor-derived and manually conducted measurements are provided through WIZARD or can be accessed from these websites:

HPA: http://www.kgs.ku.edu/HighPlains/OHP/index_program/index.shtml

KS River Valley: <http://www.kgs.ku.edu/Hydro/KansasRiver/index.html>

The web page shown on the right side of the slide shows hourly recorded water levels from mid-May 2018 to late March 2019 recorded by a pressure transducer installed at the index well north of Scott City, Kansas. Water-level responses during the pumping season occurring in the spring/summer months can readily be compared to that in the fall and winter months when water levels recover. Reviewing these types of responses in the aquifer has provided the KGS better insights into how we characterize the aquifer.

WIZARD- Data Download

WIZARD Water Well Listing

179 records currently selected. Only 50 are display at one time. Records can be sorted ascending (asc) or descending (desc) which will affect ALL the records in the selection set.

Well ID	County	PLSS	Records	Date Range	Longitude	Latitude	Use of Site	Use of Water	Depth of Well
asc_desc	asc_desc	asc_desc	asc_desc	Min Date Max Date	asc_desc	asc_desc	asc_desc	asc_desc	asc_desc
393415101593201	Cheyenne	05S 42W 36CCB 01	17	29-JUN-1964 to 08-JAN-1981	-101.862953	39.570303	Withdrawal of Water	Irrigation	311
393429101550401	Cheyenne	05S 41W 34CBB 01	23	04-JAN-2001 to 03-JAN-2019	-101.919477	39.575510	Withdrawal of Water	Irrigation	280
393507101533401	Cheyenne	05S 38W 26CCA 01	29	09-DEC-1965 to 11-JAN-1984	-101.56	39.585402	Withdrawal of Water	Irrigation	285
393508101390801	Cheyenne	05S 39W 25CDA 01	87	25-JAN-1965 to 03-JAN-2019	-101.649648	39.586016	Withdrawal of Water	Irrigation	297
393547101481501	Cheyenne	05S 40W 27BBA 01	45	01-JUN-1966 to 03-JAN-2019	-101.802253	39.597375	Withdrawal of Water	Irrigation	327
393554101533501	Cheyenne	05S 41W 23CDD 01	1	29-JAN-1998 to 29-JAN-1998	-101.891176	39.597545	Withdrawal of Water	Irrigation	Unknown
393613101561301	Cheyenne	05S 41W 20DAA 01	41	29-JUN-1964 to 04-JAN-1994	-101.839179	39.603602	Withdrawal of Water	Irrigation	311
393625101343401	Cheyenne	05S 38W 22ACB 01	142	17-MAR-1964 to 03-JAN-2019	-101.572446	39.607367	Withdrawal of Water	Irrigation	270
393633101450901	Cheyenne	05S 39W 18BCC 01	10	25-JAN-1965 to 08-JAN-1975	-101.749597	39.609126	Withdrawal of Water	Irrigation	303
393638101345801	Cheyenne	05S 38W 22B8B 01	2	26-JUL-1950 to 01-JAN-1967	-101.580602	39.61102	Withdrawal of Water	Irrigation	250
393645102000401	Cheyenne	05S 42W 14DCC 01	56	02-SEP-1967 to 03-JAN-2019	-102.00326	39.611874	Withdrawal of Water	Irrigation	Unknown
393646101450001	Cheyenne	05S 38W 18CCC 01	13	09-JAN-1978 to 09-JAN-1990	-101.74952	39.612773	Withdrawal of Water	Irrigation	291
393698102003601	Cheyenne	05S 42W 14CBC 01	86	29-JUN-1964 to 10-JAN-1987	-102.011954	39.616159	Withdrawal of Water	Irrigation	221
393704101273301	Cheyenne	05S 37W 15DBB 01	98	07-JUL-1964 to 03-JAN-2019	-101.699742	39.616246	Withdrawal of Water	Irrigation	285
393704101345801	Cheyenne	05S 38W 15CBB 01	3	23-AUG-1950 to 01-FEB-1968	-101.58057	39.616282	Withdrawal of Water	Irrigation	168
393712101478901	Cheyenne	05S 40W 14BCC 01	95	01-MAR-1975 to 03-JAN-2019	-101.785452	39.616265	Withdrawal of Water	Irrigation	325
393719101478901	Cheyenne	05S 40W 15ACB 01	17	29-JUN-1964 to 10-JAN-1984	-101.786214	39.621867	Withdrawal of Water	Irrigation	335
393719101505501	Cheyenne	05S 40W 18ADB 01	26	05-JAN-2000 to 12-FEB-2019	-101.848955	39.621964	Withdrawal of Water	Irrigation	320
393724101321401	Cheyenne	05S 38W 13BAD 01	57	07-JUL-1964 to 03-JAN-2019	-101.538444	39.624217	Withdrawal of Water	Irrigation	220
393726101435901	Cheyenne	05S 39W 08CCC 01	21	20-MAR-1967 to 08-JAN-1979	-101.752933	39.627208	Destroyed	Unknown	323
39373101450901	Cheyenne	05S 39W 11CBC 01	54	25-JAN-1965 to 03-JAN-2019	-101.674349	39.630645	Withdrawal of Water	Irrigation	291
393804101502001	Cheyenne	05S 41W 12ADC 01	21	26-JUN-1964 to 10-JAN-1984	-101.866422	39.634502	Withdrawal of Water	Irrigation	315
393836102001101	Cheyenne	05S 42W 02CDA 01	2	22-MAR-1946 to 05-JUL-1950	-102.004505	39.643213	Withdrawal of Water	Stock	87.8
393844101492101	Cheyenne	05S 40W 04CDB 01	20	29-JUN-1964 to 10-JAN-1984	-101.82185	39.645426	Withdrawal of Water	Irrigation	333
393849101440101	Cheyenne	05S 39W 06DAA 01	42	28-AUG-1960 to 03-JAN-2019	-101.73155	39.647324	Withdrawal of Water	Irrigation	Unknown
393896101572701	Cheyenne	05S 41W 06ADD 01	2	10-JUN-1946 to 05-JUL-1950	-101.80778	39.648702	Withdrawal of Water	Domestic	47.5
393909101560301	Cheyenne	05S 41W 04BBD 01	1	08-JAN-2014 to 08-JAN-2014	-101.833255	39.651564	Withdrawal of Water	Irrigation	155
393909102015701	Cheyenne	05S 42W 04AAC 01	2	19-MAR-1946 to 02-DEC-1950	-102.034896	39.652185	Observation	Unused	37.2
393915102015701	Cheyenne	05S 42W 04AAB 01	87	29-JUN-1964 to 03-JAN-2019	-102.035925	39.653168	Withdrawal of Water	Irrigation	85
393922102014101	Cheyenne	04S 42W 34CCC 01	14	21-OCT-1997 to 05-OCT-2006	-102.03104	39.652502	Withdrawal of Water	Irrigation	Unknown
393926102011901	Cheyenne	04S 42W 34CDA 01	15	21-OCT-1997 to 05-OCT-2006	-102.023952	39.658292	Withdrawal of Water	Irrigation	Unknown
393929101562801	Cheyenne	04S 41W 32CDB 01	3	10-JUN-1946 to 01-MAY-1963	-101.841193	39.657953	Unused	Unused	121
393931102014301	Cheyenne	04S 42W 34CBC 01	18	21-OCT-1997 to 05-OCT-2006	-102.030413	39.658693	Withdrawal of Water	Irrigation	Unknown
393941102005001	Cheyenne	04S 42W 34DAB 01	2	12-MAR-1946 to 05-JUL-1950	-102.016132	39.661203	Withdrawal of Water	Domestic	41.3
393941102010901	Cheyenne	04S 42W 34DBB 01	2	22-MAR-1946 to 18-DEC-1949	-102.020766	39.661203	Unused	Unused	14.8
393942101384801	Cheyenne	04S 38W 36DBA 01	23	22-AUG-1950 to 08-JAN-1975	-101.643255	39.661601	Withdrawal of Water	Domestic	180
393942101384801	Cheyenne	04S 38W 36DBA 01	23	22-AUG-1950 to 08-JAN-1975	-101.643255	39.661601	Withdrawal of Water	Stock	158

There are two methods to download or access data from WIZARD. The first is the traditional method of clicking the download button.

WIZARD- Data Download

The screenshot displays the WIZARD web application interface. At the top, there is a navigation menu with options like 'Kansas Geological Survey', 'WIZARD Water Well Listing', and 'Download'. Below the menu, a table lists records with columns: 'USGS ID', 'County', 'PLSS', 'Records', and 'Date Range'. A detailed view of a record is shown on the right, including a disclaimer and contact information for Dan Suchy.

USGS ID	County	PLSS	Records	Date Range
393415101593201	Cheyenne	05S 42W 36CCB 01 17	17	29-JUN-1964 to 08-
393429101550401	Cheyenne	05S 41W 34CBB 01 23	23	04-JAN-2001 to 03-
393507101533401	Cheyenne	05S 38W 26CCA 01 29	29	09-DEC-1965 to 11-
393508101390801	Cheyenne	05S 39W 25CDA 01 87	87	25-JAN-1965 to 03-
393547101481501	Cheyenne	05S 40W 27BBA 01 45	45	01-JUN-1966 to 03-
393554101533501	Cheyenne	05S 41W 23CDD 01 1	1	29-JAN-1996 to 29-
393613101562101	Cheyenne	05S 41W 20DAA 01 41	41	29-JUN-1964 to 04-
39362510134401	Cheyenne	05S 39W 22ACB 01 142	142	17-MAR-1964 to 03-
393633101450901	Cheyenne	05S 39W 18BCC 01 10	10	25-JAN-1965 to 08-
393638101345801	Cheyenne	05S 38W 22BBB 01 2	2	26-JUL-1950 to 01-
393645102000401	Cheyenne	05S 42W 14DCC 01 56	56	02-SEP-1967 to 03-
393646101450001	Cheyenne	05S 38W 18CCC 01 13	13	09-JAN-1976 to 09-
393658102003601	Cheyenne	05S 42W 14CBC 01 86	86	29-JUN-1964 to 10-
393704101427301	Cheyenne	05S 37W 15DBB 01 98	98	07-JUL-1964 to 03-
393724101345801	Cheyenne	05S 38W 15CBB 01 3	3	23-AUG-1950 to 01-
393732101478901	Cheyenne	05S 40W 14BCC 01 96	96	01-MAR-1975 to 03-
393739101474901	Cheyenne	05S 40W 15ACB 01 17	17	29-JUN-1964 to 10-
393739101505501	Cheyenne	05S 40W 18ADB 01 26	26	05-JAN-2000 to 12-
393741013214801	Cheyenne	05S 38W 13BAD 01 57	57	07-JUL-1964 to 03-
393738101435901	Cheyenne	05S 39W 08CCC 01 21	21	20-MAR-1967 to 09-
39373101450901	Cheyenne	05S 39W 11CBB 01 54	54	25-JAN-1965 to 03-
393804101502001	Cheyenne	05S 41W 12ADC 01 21	21	26-JUN-1964 to 10-
393836102001101	Cheyenne	05S 42W 02CDA 01 2	2	22-MAR-1946 to 05-
393844101492101	Cheyenne	05S 40W 04CDB 01 20	20	29-JUN-1964 to 10-
393849101440101	Cheyenne	05S 39W 06DAA 01 42	42	28-AUG-1960 to 03-
393856101572701	Cheyenne	05S 41W 06ADD 01 2	2	10-JUN-1946 to 05-
393909101560301	Cheyenne	05S 41W 04BBD 01 1	1	08-JAN-2014 to 08-
393909102015701	Cheyenne	05S 42W 04AAC 01 2	2	19-MAR-1946 to 02-DEC-1950 - 102 034890 39 652188 Observation Unused 37.2
393915102015701	Cheyenne	05S 42W 04AAC 01 87	87	29-JUN-1964 to 03-JAN-2019 - 102 035925 39 653168 Withdrawal of Water/Irrigation 85
393922102014101	Cheyenne	04S 42W 34CCC 01 14	14	21-OCT-1997 to 05-OCT-2006 - 102 03104 39 654252 Withdrawal of Water/Irrigation Unknown
393926102014101	Cheyenne	04S 42W 34CDA 01 15	15	21-OCT-1997 to 05-OCT-2006 - 102 023962 39 658292 Withdrawal of Water/Irrigation Unknown
393929101562801	Cheyenne	04S 41W 32DCB 01 3	3	10-JUN-1946 to 01-MAY-1963 - 101 841193 39 657953 Unused Unused 121
393931102014301	Cheyenne	04S 42W 34CDB 01 18	18	21-OCT-1997 to 05-OCT-2006 - 102 02904 39 656893 Withdrawal of Water/Irrigation Unknown
393941102005001	Cheyenne	04S 42W 34DAB 01 2	2	12-MAR-1946 to 05-JUL-1950 - 102 016132 39 661203 Withdrawal of Water/Domestic 41.3
3939411020150801	Cheyenne	04S 42W 34DBB 01 2	2	22-MAR-1946 to 18-DEC-1949 - 102 020796 39 661203 Unused Unused 14.8
393942101384801	Cheyenne	04S 39W 36DBA 01 23	23	22-AUG-1950 to 08-JAN-1975 - 101 643256 39 661601 Withdrawal of Water/Domestic 180
				309 Withdrawal of Water/Stock 158

This provides two comma-delimited, ASCII files that are readable by spreadsheets and database software.

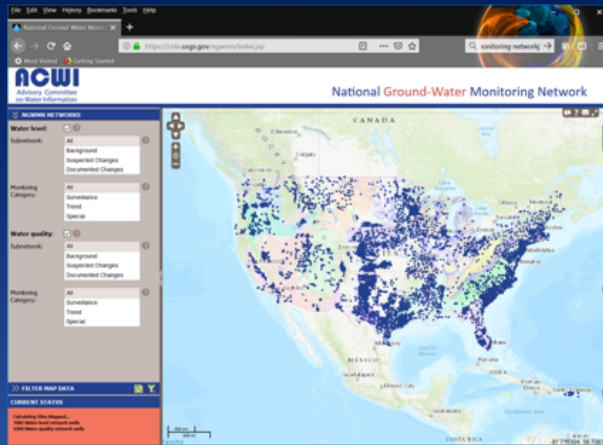
One file represents groundwater wells with geographic coordinates along with site-specific information, such as well depth, use of the site, and geologic unit codes.

The second file provides a link to the manually collected depth-to-water measurements.

The two files can be related or joined via the USGS_ID.

WIZARD- Web Service

USGS National Groundwater Monitoring Network



```
File Edit View History Bookmarks Tools Help
https://maps.usgs.gov/geohydro/wizard/
thod:WaterLevels&sites=371237100455301
Most Visited Getting Started
This XML file does not appear to have any style information associated with it. The document tree is shown below.
<WaterLevelMeasurement>
  <SiteNumber>371237100455301</SiteNumber>
  <SiteName>33S 32W 02AAC 01</SiteName>
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  <AccuracyUnit>R</AccuracyUnit>
</WaterLevelMeasurement>
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  <SiteName>33S 32W 02AAC 01</SiteName>
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  <AccuracyUnit>R</AccuracyUnit>
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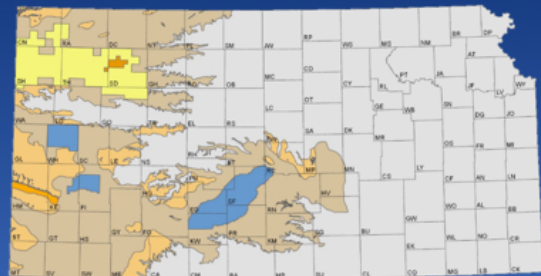
<http://maps.kgs.ku.edu/geohydro/wizard/services/data.cfc?method=WaterLevels&sites=371237100455301>

The second method to access WIZARD-based data is through a web service. Although designed specifically for the KGS involvement in the USGS National Groundwater Monitoring Network program, this web service is publicly available and returns water levels in a machine-readable, XML-formatted document. If you are a programmer/developer, this is the most exciting slide of the whole presentation (or not....).

For more information, check out KGS Open-File Report 2016-28.

WIZARD- Why do people care?

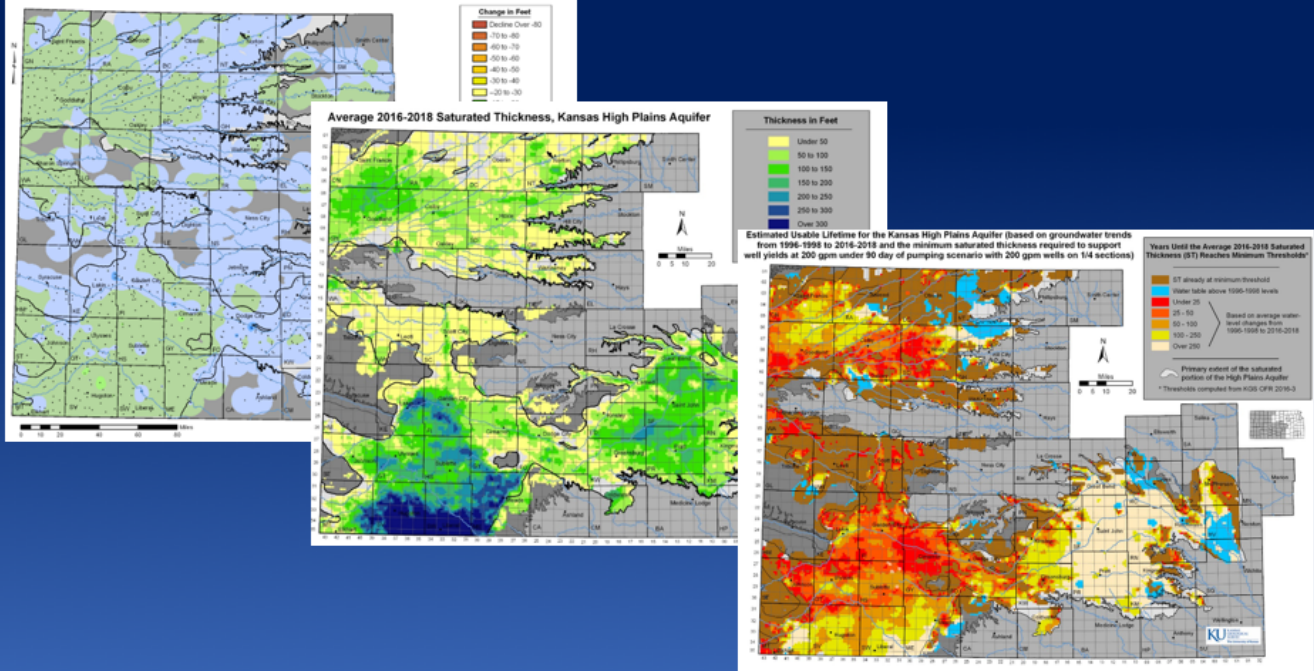
- Landowner interest
- Water conservation and management
- Land pricing and loan availability
- Tax returns



Question: Why do people care that there is a WIZARD database?

- Land- and groundwater-based water right owners often like to know the depth to water in their wells.
- Enhanced water management. The State of Kansas has several water initiatives underway that seek to reduce water use/consumption from the HPA. Some of these programs are voluntary while others are mandated through local groundwater management districts. Changes in the water table are used to both identify priority areas and trigger action items listed under the management plans.
- Banks and financial institutions are starting to use estimates of the usable lifetime of the aquifer as a consideration for loans.
- Lastly, accountants and tax professionals are often the first to inquire about the annual water-level results as tax deductions can be applied for “depleted assets” in the aquifer.

WIZARD- Why does the State of Kansas care?



The KGS uses water-level data from WIZARD to track regional changes in the water table. The animated map in the upper left shows the accumulated change in the Kansas HPA from 1996 to 2018.

Interpolated surfaces of the water table elevation can be combined with interpolated bedrock elevations (created from WWC5-based lithology data) to produce estimates of the aquifer thickness.

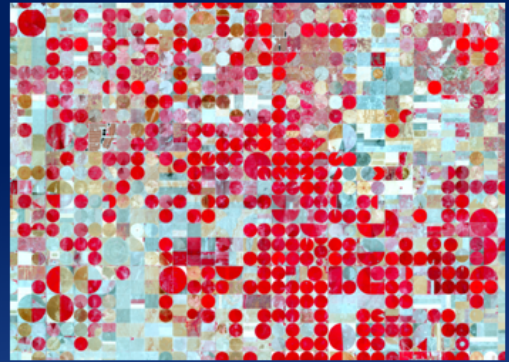
The map in the lower right shows a simple approach to estimate the usable lifetime of the Kansas HPA based on decline rates and aquifer thickness. The measured rate of water-level change is applied as an average annual change against the present-day saturated thickness and the number of years it will take before the aquifer reaches the minimum thickness needed to support 200-gpm flow rates over the summer pumping season. Red areas on the map indicate that if the annual average groundwater decline measured from 1996 to 2018 continued in the future, the aquifer would reach that 200 gpm threshold in less than 25 years.

Kansas Groundwater Data
WIMAS

WIMAS

WIMAS (WRIS)- Water Rights

- **Water Information Management and Analysis System**
- **Kansas Department of Agriculture, Division of Water Resources**
- **Water Rights Information System (WRIS)**
 - **Permits/Certificates to use water**
 - **Typically large uses (domestic excluded)**
 - **Diversions include both ground and surface water**
- **WIMAS is a set of tools using a snapshot of WRIS data**

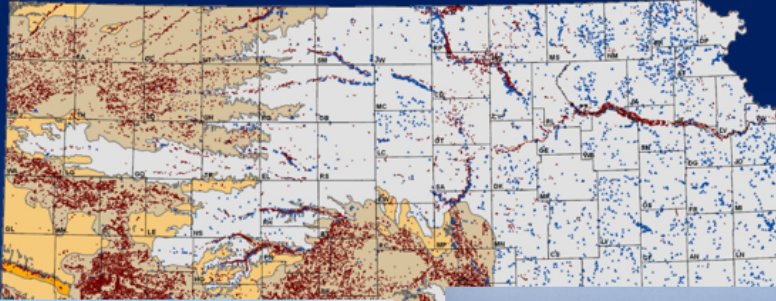


WIMAS stands for Water Information Management and Analysis System and uses water-right data maintained by the Kansas Department of Agriculture, Division of Water Resources (KDA-DWR). Water rights are required in Kansas for most non-domestic uses of water. A water right permit or certificate allows water, either from a surface or ground source, to be diverted so long as it is applied to a beneficial use. The color-infrared aerial photo above shows the development of center pivot irrigation systems between Garden City and Dodge City, all of which are permitted through a water right.

Water right information is stored internally by the KDA-DWR in a database known as the Water Rights Information System or WRIS. WIMAS is a set of tools that uses a subset of WRIS-based data to facilitate access to and analysis of Kansas water right data.

Water Rights in Kansas

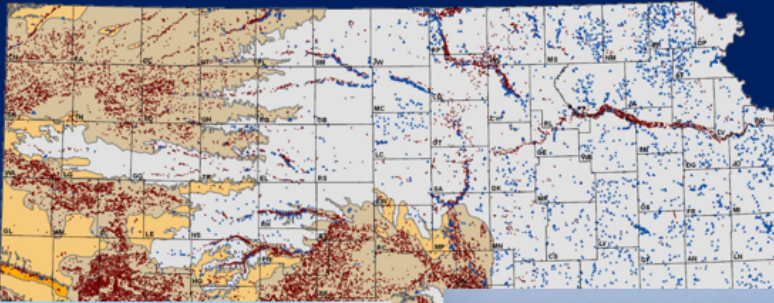
- Kansas Water Appropriation Act
 - “First in time, first in right”



Kansas Geological Survey

The KDA-DWR administers water rights through the Kansas Water Appropriation Act, which is based on the principle of “first in time, first in right” for both ground and surface water uses. Western Kansas is dominated by groundwater use (red dots on the map are water-right permitted groundwater wells) whereas eastern Kansas is primarily a surface water regime (blue dots on the map). Uses made of water in Kansas include irrigation, municipal, recreational, stockwater, and industrial. However, regardless of the use made of water, the date that water was first put to beneficial use determines which water right is “senior” to other “junior” water rights that were established later in time if a particular water supply ever becomes in short supply.

Water Rights in Kansas



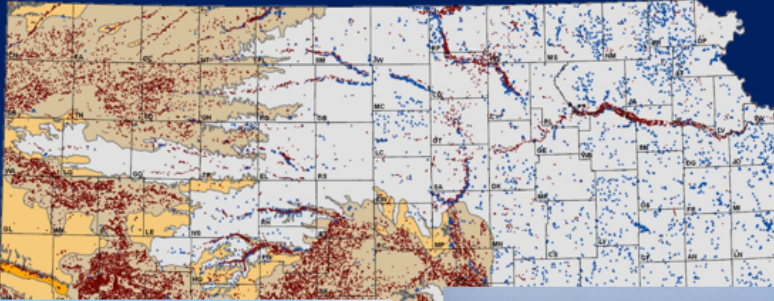
- **Kansas Water Appropriation Act**
 - "First in time, first in right"
 - **Authorized annual quantities**
 - **Reported water usage**



Kansas Geological Survey

Kansas water rights are highly regulated. Water-right permits and certificates set annual authorized levels on the amount of water that can be pumped, how fast water can be diverted, and where it can be used. Kansas is unique compared to other western states (those north, south, and west of Kansas that also follow the appropriation doctrine for water management) in that water use is required to be reported each year as a stipulation of the water-right permit or certificate. Failure to report or knowingly falsifying water-use reports is subject to regulatory consequences. Over the Kansas HPA, more than 95% of permitted groundwater wells have a totalizing flow meter installed to quantify annual water usage.

Water Rights in Kansas



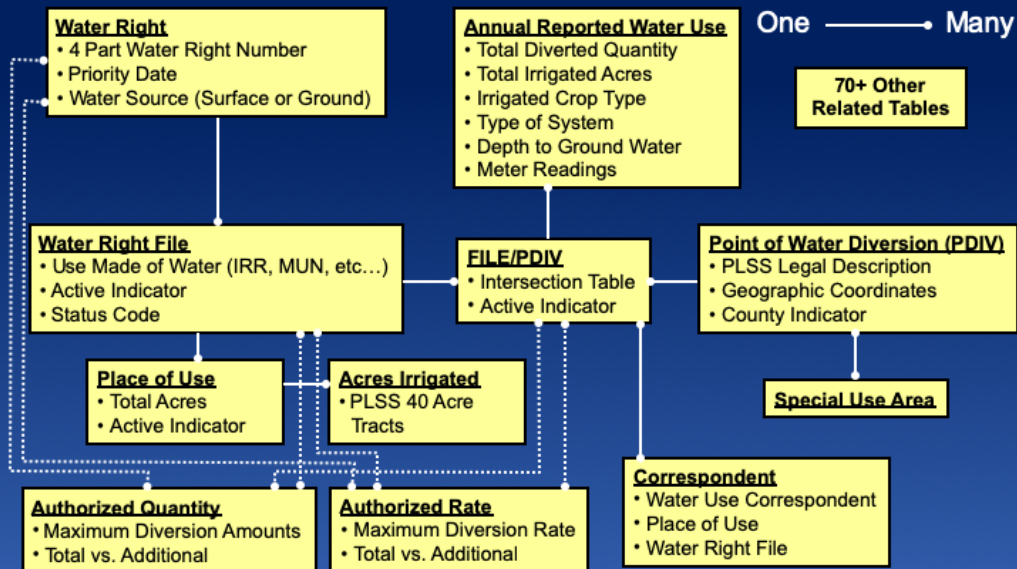
- **Kansas Water Appropriation Act**
 - "First in time, first in right"
 - Authorized annual quantities
 - Reported water usage
- **Water rights can be exceptionally complex**



Kansas Geological Survey

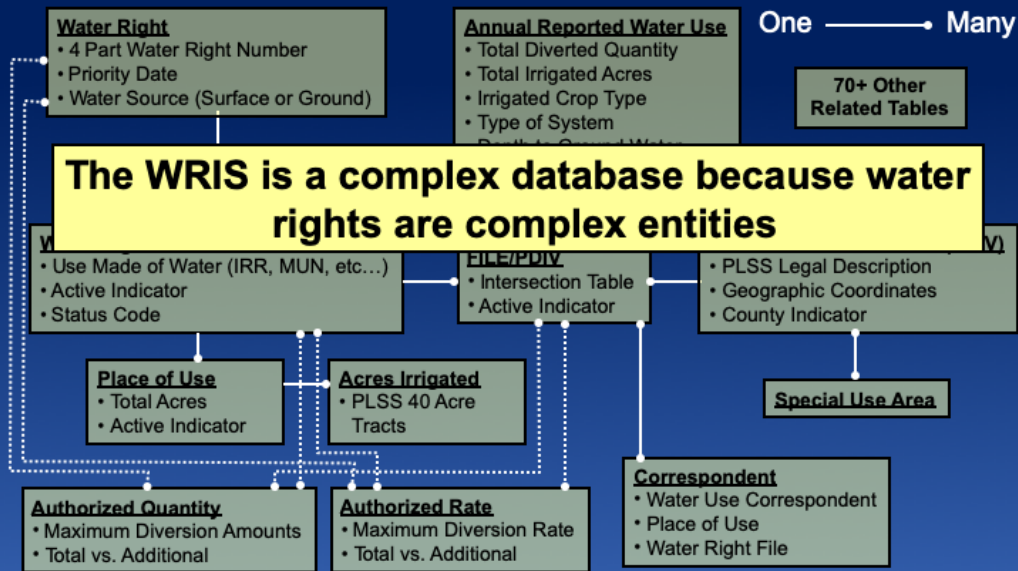
Kansas water rights can be very complex entities. A single water right may have multiple uses of water and can divert water from multiple points of diversion. In turn, individual points of diversion might be associated with more than one water rights. These relationships can make representations in database systems challenging.

Database schema (in part) for Kansas water rights



This is a diagram of a portion of the WRIS database schema. It is full of many-to-many relationships among various data tables and contains numerous status codes and indicators that determine various states of water rights. Users must have an understanding of the nuances and business rules associated with WRIS to successfully query and use the vast amount of information that it provides.

Database schema (in part) for Kansas water rights



WRIS is complex because water rights are complex entities.

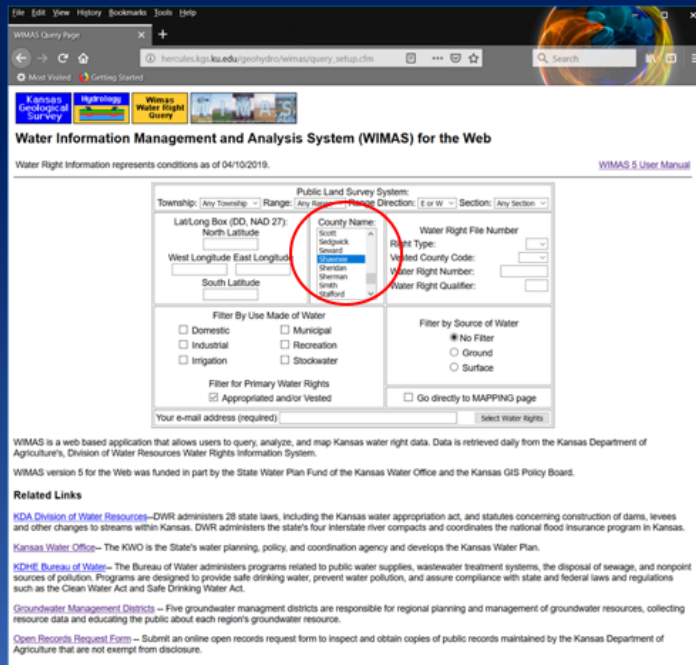


Enter WIMAS

- **WIMAS is equivalent of a data interpreter**
- **Allows querying and analysis of WRIS data without the knowledge of database structure and relationships**
- **Several version ranging from the desktop to web-based**

WIMAS acts as data interpreter for WRIS-based data as it allows users to query and analyze WRIS data without a working knowledge of the underlying database. WIMAS traditionally has been a GIS-based software package developed in 1991 by the USGS. Several versions and iterations of this software concept have been developed over the years by the KDA-DWR and KGS with the latest web-based version being hosted through the KGS website.

WIMAS- Water Rights



WIMAS can be accessed at this url: <http://hercules.kgs.ku.edu/geohydro/wimas/index.cfm>. The page allows water rights to be queried by a PLSS description, latitude and longitude box, Kansas county, or individual water-right number and then further filtered to include only certain uses of water, particular water rights, and source of supply. Unlike the other database web applications, WIMAS requires an email address to be submitted with each query to serve as a digital signature instead of a formal public records request.

WIMAS- Water Rights

Water Right Information is current as of 04/10/2019.
 You have the following filters in place:
 County(s) = 'SN'
 Appropriated and/or 'vested' Water Rights = Yes

There are 519 unique water rights and 664 unique points of diversion selected. Only 50 records are displayed at one time. Records can be sorted ascending (asc) or descending (desc) which will affect ALL the records in the selection set.

View Records: | 1-50 | 51-100 | 101-150 | 151-200 | 201-250 | 251-300 | 301-350 | 351-400 | 401-450 | 451-500 | 501-550 | 551-600 | 601-650 | 651-700 | 701-750 | 751-800 | 801-850 | 851-904 |

Wt File Number asc desc	Use of Water asc desc	Use of Water Active asc desc	Source asc desc	Priority Date asc desc	Wt Status asc desc	Pdiv Location (wp mg sect qual id) asc desc	Longitude asc desc	Latitude asc desc	County asc desc	Pdiv Active asc desc
A.1192.00	IRR	Y	G	04-FEB-1953	NK	105.13E.30.SWNENW.7	-96.01201	39.15049	SN	Y
A.1192.00	IRR	Y	G	04-FEB-1953	NK	105.13E.19.NWSEW.8	-96.00778	39.16078	SN	Y
A.1192.00	IRR	Y	G	04-FEB-1953	NK	105.13E.19.SEWSW.5	-96.00394	39.15903	SN	Y
A.1192.00	IRR	Y	G	04-FEB-1953	NK	105.13E.19.SWWSW.1	-96.00654	39.15947	SN	N
A.1192.00	IRR	Y	G	04-FEB-1953	NK	105.13E.30.NCE2NW.1	-96.01027991	39.1549291	SN	N
A.1192.00	IRR	Y	G	04-FEB-1953	NK	105.13E.30.SWNENW.6	-96.01154	39.1549291	SN	N
A.1221.00	IRR	Y	G	19-FEB-1953	NK	105.12E.24.SEWSW.1	-96.02269	39.159466	SN	Y
A.1292.00	IND	Y	G	24-MAR-1953	NK	115.15E.13.S	-95.694315	39.091334	SN	Y
A.1908.00	IRR	Y	G	13-JUL-1953	NK	115.13E.1.SWWSW.1	-95.918569	39.116237	SN	Y
A.1674.00	IRR	Y	S	30-JUL-1953	NK	135.15E.34.SWENW.1	-95.739197	39.877669	SN	Y
A.1674.00	IRR	Y	S	30-JUL-1953	NK	135.15E.34.NENENW.4	-95.734604	39.863171	SN	Y
A.1674.00	IRR	Y	S	30-JUL-1953	NK	135.15E.34.SEWENW.2	-95.734535	39.877735	SN	Y
A.1674.00	IRR	Y	S	30-JUL-1953	NK	135.15E.34.SWENW.2	-95.73687	39.877712	SN	Y
A.2073.00	IRR	Y	G	28-DEC-1953	NK	115.14E.14.NCSW.1	-95.83038	39.09029	SN	Y
A.2183.00	MUN	Y	S	04-FEB-1954	NK	115.15E.26.SWENW.1	-95.71801	39.07124	SN	Y
A.2219.00	IRR	Y	G	15-FEB-1954	NK	115.14E.13.SWENW.1	-95.81101	39.09442	SN	Y
A.2297.00	IRR	N	G	12-MAR-1954	NK	115.15E.15.SESE.1	-95.726974	39.089491	SN	Y
A.2377.00	IRR	Y	G	28-MAR-1954	NK	105.13E.30.SEWENW.3	-96.00085	39.14403	SN	Y
A.2390.00	IRR	Y	G	01-APR-1954	NK	105.13E.29.NNENW.1	-95.983414	39.15781	SN	N
A.2390.00	IRR	Y	G	01-APR-1954	NK	105.13E.29.SWENW.4	-95.98911	39.15689	SN	Y
A.2391.00	IRR	Y	G	01-APR-1954	NK	105.13E.28.NWENW.1	-95.97826	39.15132	SN	Y
A.2501.00	IRR	Y	G	23-APR-1954	NK	115.14E.15.NWENW.2	-95.84898	39.09315	SN	Y
A.2562.00	IRR	Y	G	04-MAY-1954	NK	115.14E.8.SWENW.1	-95.87964	39.10569	SN	Y
A.2639.00	IRR	Y	G	28-MAY-1954	NK	115.15E.17.SEWEN.1	-95.762965	39.095222	SN	N
A.2639.00	IRR	Y	G	28-MAY-1954	NK	115.15E.17.SEWEN.3	-95.76306	39.09556	SN	Y
A.2666.00	IRR	Y	G	15-JUN-1954	NK	115.13E.1.NWENW.2	-95.926735	39.125488	SN	N
A.2666.00	IRR	Y	G	15-JUN-1954	NK	115.13E.1.NWENW.7	-95.92741	39.12582	SN	Y

WIMAS queries return the water-right numbers associated with the permits or certificates (often referred to as the File Number), the use(s) made of water under those rights, the source of supply, an indicator of whether that use is active or inactive, the priority date of the water right, and current status code. In addition, a PLSS description of each point of diversion of each water right is listed along with lat/long coordinates, county the diversion is located in, and whether it is active or inactive. The page includes a link to a WIMAS user manual, where users can find descriptions of several of the WRIS database codes.

WIMAS- Water Rights

Water Right Information represents conditions as of 04/10/2019.

Information shown on this page depends on a water right's selected **Type(s) of Use** and point of diversion, **PD(s)**. If there are multiple uses and/or multiple points of diversion, the page will update details, quantity and rate, and reported water use depending on which entry is selected from those list boxes.

Because water rights can overlap both in points of diversion and places of use (which in turn can affect the authorized quantities and rate) AND water usage is often aggregated into a single report, you cannot determine if a water right has reported more water use than authorized from this page only.

Water Right
 Water Right: 1352-00 | 1 Type(s) of Use: [RR] | 6 PD(s): 13-105-13E-S | [Google Location Map](#)
 WWCs Links: None | **WIZARD Link:** 395936086001301

Water Right Details
 Source: [G] | Right Type: [A] | Total Acres Authorized: 306 | Net Acres Authorized: 306 | Use of Water Active: [Y]
 Water Right Status: [NK] | Place(s) of Use: 30-105-13E SW NE (Active) Total Acres: 40, Net Acres: 40
 Priority Date: 02/04/1953 | Action Trail: 02/04/1953- PENDING INITIAL REVIEW

Point of Diversion Details
 PU Active: [Y] | Feet North: 142 | Feet West: 1524 | Qualifiers: SE SW SE | County: [DRAVAGE]
 GMD Num: | Number of Wells: 1 | Subbasin: [KANSAS RIVER] | Stream Number:
 Special Use Area(s): | Comment: [EAST WELL]

Authorized Quantity & Rate
 Quantity Stored By: [Water rights] | Authorized Quantity (AF): 306 | Net Quantity (AF): 306
 Rate Stored By: [Water rights] | Authorized Rate (GPM): 1425 | Net Rate (GPM): 1425

Reported Water Use Graph Water Use History
 Water Use Year(s): 2017 | Total Water Used (AF): 4.43 | Acres Irrigated: 20
 Water Use Reported on Right Num: | Reel Number: 2 | Slip Number: 1745
 Metered Quantity: 142500 | Meter Unit: [G] | Depth to Water: | Depth of Well:
 Beginning Meter Reading: 2520600 | Ending Meter Reading: 2571100
 System Type: [4] | Hours Pumped: | Pump Rate: | Date of Measurement:
 Date Report Received: 03/02/2018 | Chemigation Indicator: | Water Use Code: [M] | Crop Code: [4]
 Current Water Use Correspondent(s): [BANDALL, JESSIE]

Print AGCE Report

Disclaimer
 For information on the WRIS/WIMAS database or water right related questions, please contact the KDA-DWR at 785-564-6640. For web page or internet based comments, please contact webadmin@kgs.ku.edu. WIMAS data updated daily.

Water-right information can be displayed as individual water rights (shown here) or as an individual point of diversion. Depending on the selected water right, the use made of water, and point of diversion, the page will update to show how much water could be diverted each year and the reported water usage. Authorized quantities and rates along with water use will change depending on the selected water right, use, and point of diversion.

WIMAS- Water Rights

WIMAS Query Results

WIMAS Quantity Summary Results

Water Right Information represents conditions as of 04/10/2019

Summaries are based on 362 unique water rights and 375 unique points of diversion that are active and non-dismissed.

	Domestic	Industrial	Irrigation	Municipal	Recreation	Stockwater	Others	Total
Surface	0.17	65,236.30	1,421.70	47,112.21	2,407.66	0.00	0.00	116,200.04
Ground	3.07	9,694.36	17,390.26	4,727.11	86.22	0.00	29,718.92	61,609.94
Total	3.24	74,942.66	18,811.96	51,839.32	2,493.88	0.00	29,718.92	177,809.98

	Surface	Ground	Total
Surface	1,949.50		
Ground		19,042.76	
Total	20,992.26		

Pdiv Location (wp mg sect qual id) asc desc	Longitude asc desc	Latitude asc desc	County asc desc	Pdiv Active asc desc
105.136.30 SWNW 7	-96.01201	39.15649	SN	Y
105.136.19 NNWSW 8	-96.00778	39.16078	SN	Y
105.136.19 SEWSW 5	-96.00394	39.15903	SN	Y
105.136.19 SWWSW 1	-96.00654	39.15947	SN	N
105.136.30 NCE2NW 1	-96.01027991	39.1549291	SN	N
105.136.30 SWNW 6	-96.011514	39.1549291	SN	N
105.136.24 SEWSW 1	-96.02269	39.159466	SN	Y
115.156.13 S	-95.694315	39.091334	SN	Y
115.136.1 SWWSW 1	-95.918569	39.116237	SN	Y
135.156.34 SEWNW 7	-95.739197	39.877669	SN	Y
135.156.34 NENENW 4	-95.734604	39.863171	SN	Y
135.156.34 SESENW 3	-95.734535	39.877735	SN	Y
135.156.34 SWSENW 2	-95.73687	39.877712	SN	Y
115.146.14 NCSW 1	-95.83038	39.09029	SN	Y
115.156.26 SWNW 1	-95.71801	39.07124	SN	Y
115.146.13 SWSENW 1	-95.81101	39.09442	SN	Y
115.156.15 SESE 1	-95.726974	39.089491	SN	Y
105.136.30 SESENW 3	-96.00085	39.14403	SN	Y
105.136.29 NNWNE 1	-95.983414	39.15781	SN	N
105.136.29 SWNW 4	-95.98911	39.15680	SN	Y
105.136.28 NNWSW 1	-95.97826	39.15132	SN	Y
115.146.15 NNWSW 2	-95.84898	39.09315	SN	Y
115.146.8 SWNW 1	-95.87964	39.10569	SN	Y
115.156.17 SESENE 1	-95.762965	39.095222	SN	N
115.156.17 SESENE 3	-95.76306	39.09556	SN	Y
115.136.1 NWSDNW 2	-95.926735	39.125488	SN	N
115.136.1 NWSDNW 7	-95.92741	39.12562	SN	Y

WIMAS allows some analysis options using the entire set of queried records. In this example, the total amount of water authorized (e.g., what could be pumped each year) in Shawnee County, Kansas, is totaled using a matrix of water source and use made of water. The total number of acres authorized by source for irrigation uses also is listed.

WIMAS- Water Rights

Water Use Trends

Water Right information represents conditions as of 04/10/2019

Currently, Kansas law (K.S.A. 82a-732, effective 1985) requires that all water right holders annually report water use information to the Chief Engineer of the Division of Water Resources (DWR). Reports are due by March 1. Since 1990, the annual water use reports are reviewed as part of the KDA-DWR and/or KWD Water Use Program, a data-quality control and assurance program. Given that each year, over 14,000 water use reports are mailed and reviewed, the data is not publicly available until late fall/early winter of that year.

The purpose of this page is to review trends in reported water use. Please note retrieval and data processing can be intensive and may take a few minutes.

Please select a starting and ending year for the water use trend. (Generate Water Use Summary Matrix by Use and Source)

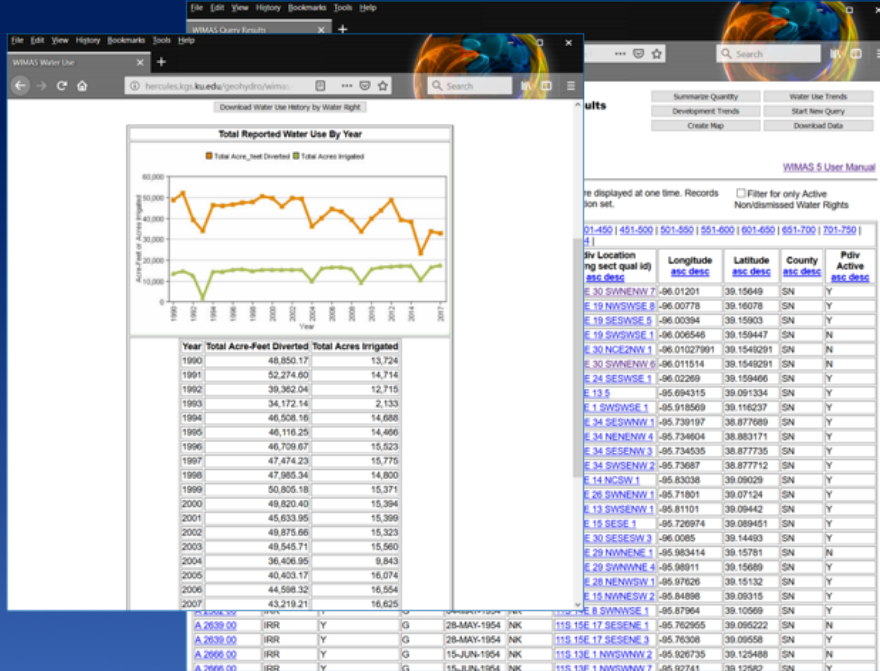
Start Year: 1958 End Year: 2017 Year: 2017

Query Results

Status	Pdiv Location (w/p mg sect qual id)	Longitude	Latitude	County	Pdiv Active
s_desc	loc_desc	asc_desc	asc_desc	asc_desc	asc_desc
105.13E.30	SWNENW.7	-96.01201	39.15649	SN	Y
105.13E.19	NWWSW.8	-96.00778	39.16078	SN	Y
105.13E.19	SEWSW.5	-96.00394	39.15903	SN	Y
105.13E.19	SWWSW.1	-96.00654	39.15947	SN	N
105.13E.30	NCE2NW.1	-96.01027991	39.1549291	SN	N
105.13E.30	SWNENW.6	-96.01154	39.1549291	SN	N
105.13E.24	SEWSW.1	-96.02269	39.15946	SN	Y
115.15E.13	S	-95.694315	39.091334	SN	Y
115.13E.1	SWWSW.1	-95.918569	39.116237	SN	Y
135.15E.34	SESWW.1	-95.739197	39.877669	SN	Y
135.15E.34	NENENW.4	-95.734604	39.863171	SN	Y
135.15E.34	SESENW.3	-95.734535	39.877735	SN	Y
135.15E.34	SWSENW.2	-95.73687	39.877712	SN	Y
115.14E.14	NC2W.1	-95.83038	39.09029	SN	Y
115.15E.26	SWNENW.1	-95.71801	39.07124	SN	Y
115.14E.13	SWSENW.1	-95.81101	39.09442	SN	Y
115.15E.15	SESE.1	-95.726974	39.089491	SN	Y
105.13E.30	SESESW.3	-96.00085	39.14403	SN	Y
105.13E.29	NNNENE.1	-95.983414	39.15781	SN	N
105.13E.29	SWNENE.4	-95.98911	39.15680	SN	Y
105.13E.28	NENWSW.1	-95.97826	39.15132	SN	Y
115.14E.15	NWWSW.2	-95.84898	39.09315	SN	Y
115.14E.8	SWNWSW.1	-95.87964	39.10569	SN	Y
115.15E.17	SESENE.1	-95.762955	39.095222	SN	N
115.15E.17	SESENE.3	-95.76306	39.09556	SN	Y
115.13E.1	NW2WNW.2	-95.926735	39.125488	SN	N
115.13E.1	NW2WNW.7	-95.92741	39.12582	SN	Y

A similar summary matrix can be generated for individual years of water use, along with options to compute simple trends in usage.

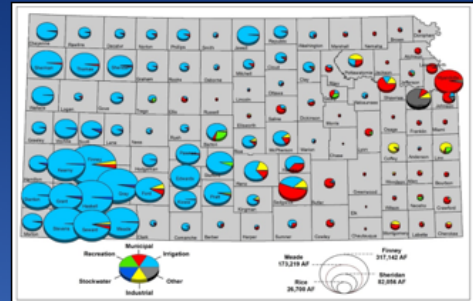
WIMAS- Water Rights



With user-specified starting and ending years, WIMAS provides the total amount of water reported used and the total number of acres reported irrigated for the queried water rights in both graph and tabular form. At this point, the individual years of water use for each water right/point of diversion can be downloaded.

WIMAS- Why do people care?

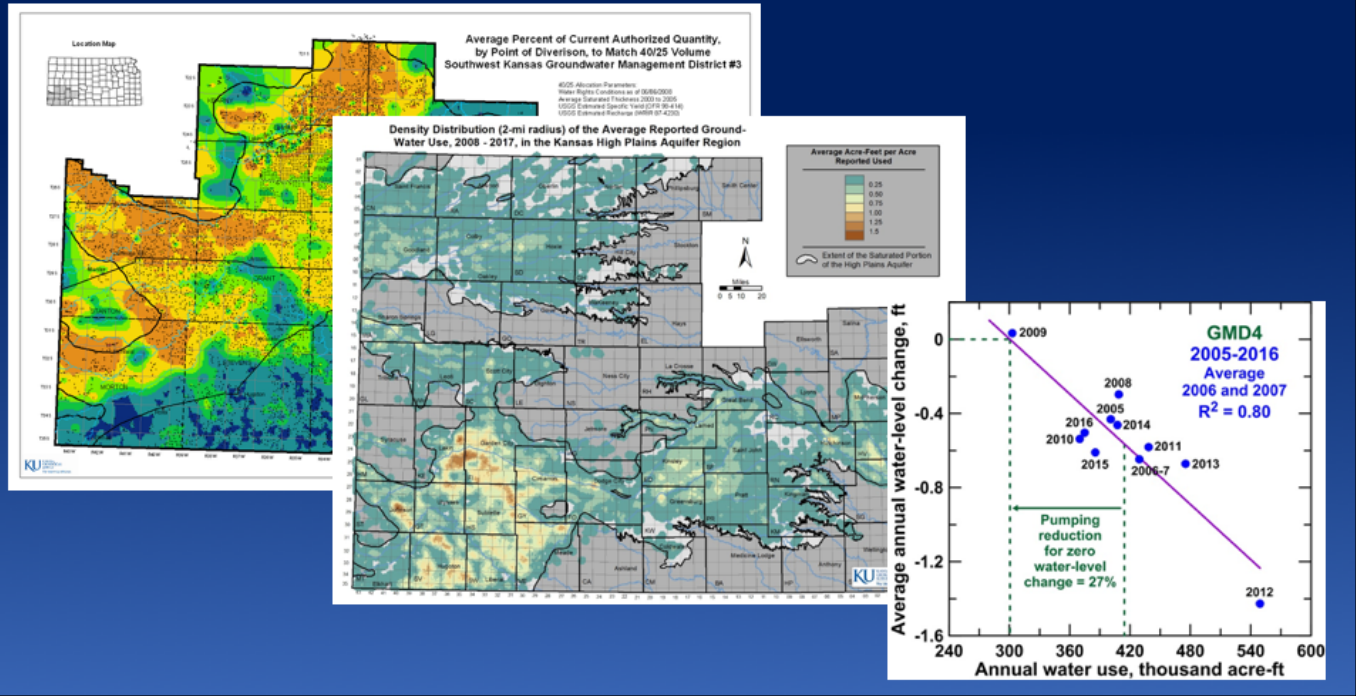
- Mark Twain, “Whiskey is for drinking, water is for fighting.”
- Water Management
- Required for larger uses of water (exclude domestic)
- Much of the state is closed to new rights



Question: Why do people care that there is a WIMAS database?

- Mark Twain’s quote that “Whiskey is for drinking, water is for fighting” is applicable to many water management situations. Water management, whether in an environment of stressed supplies or one of surplus, can be very cantankerous with conflicts that range from the local to regional and even national scale.
- Water usage in Kansas is dominated by irrigated, groundwater use in the western half of the state and primarily municipal/industrial uses in eastern Kansas, where both ground and surface water supplies are used. All are governed under the same Kansas Water Appropriation Act.
- Larger, non-domestic users of water are required to obtain a water right; however, most of the state is officially closed to new water-right development. This leads to using the marketplace to buy and sell water rights to obtain additional water allocations. WIMAS is a free public portal for that water-right-based information.

WIMAS- Why does the State of Kansas care?



The KGS uses water-right information to assist other agencies and local groundwater management districts in evaluating various management activities and proposals. The map in the upper left was developed for Southwest Kansas GMD 3, where a two-mile circle analysis was applied to every unique water right/use made of water/point of diversion combination to quantify how much of the existing annual allocations would need to be reapportioned to match the district's 40/25 policy (e.g., 40% of the amount of water in storage expressed as an annual value).

The middle map shows the density of average reported groundwater use from 2008 to 2017 over the Kansas HPA. In the Ogallala portion of the HPA (the western third of Kansas), areas of higher reported groundwater use generally correspond to areas of greater water-level decline. Reported water use in Kansas can be found for some water rights going back to 1958. However, 1990 is often used as a starting point for temporal analyses since this was the first year Kansas had a water-use quality control program in place.

Using the relationship between water use and water-level change within the context of a water balance approach, the KGS has developed a method that allows for quick evaluations of changes in groundwater usage and what rate of groundwater decline can be expected as a result. In many cases, the reduction in pumping needed to stabilize water levels in the short term (a decade or two) is much less than traditional estimates. This data-driven approach is also being used to better calibrate regional flow models.

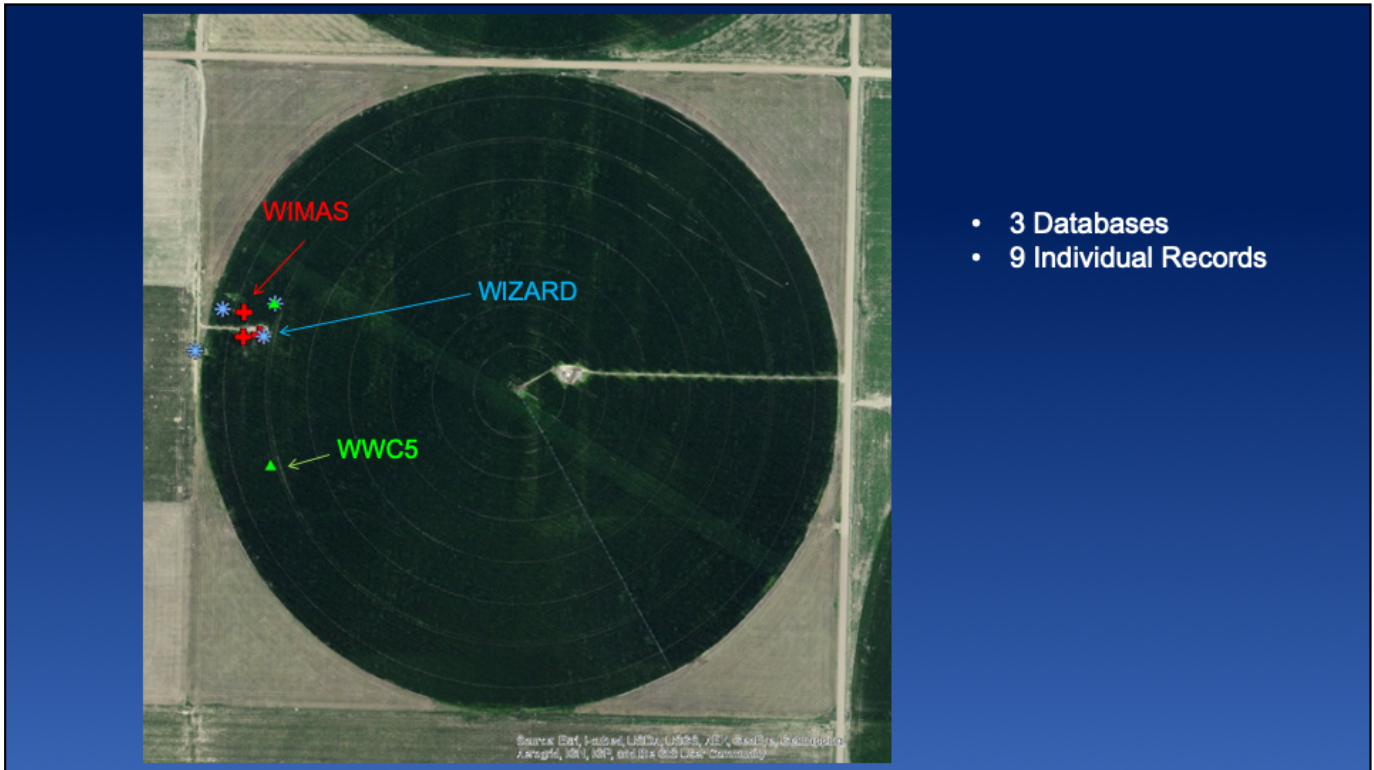
Kansas Groundwater Data
Master Well Inventory

Master Well Inventory

The Issue That Was....

- **Kansas is very data-rich.**
 - **Well construction and lithology**
 - **Measured depth to water**
 - **Reported Water Use**
- **Kansas does not have a single water agency**
- **Multiple agencies, each with their own database**

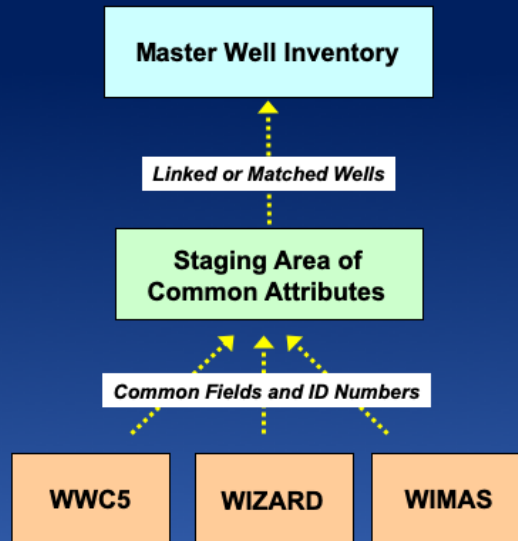
The issue that was—multiple agencies with multiple groundwater databases.



Example of a quarter section of ground somewhere in Kansas. If a person was investigating the amount of groundwater development that has taken place in this parcel of land, they would have to separately query three databases, from which nine individual database records would be returned. In this example, the records returned would be three records from WIMAS representing the known water-right activities, four from WIZARD representing measured wells (or wells historically archived in the older USGS system), and two from WWC5 for submitted driller logs.

Several of these database records reference the same groundwater well but it would be up to the user to associate any matching records.

The KGS Master Well Inventory



The Master Well Inventory was a project funded by the state water plan by which common fields and ID values from each of the source databases—in this case WWC5, WIZARD, and WIMAS—were inserted into an individual database table, which acts as a staging area to identify commonality among the database records. Matched database records and those determined to be unique well listings are then populated into another table referred to as the Master Well Inventory (MWI). The MWI represents well site locations and is composed of one or more source records. This removes duplication and allows information between the source records to be readily merged together.

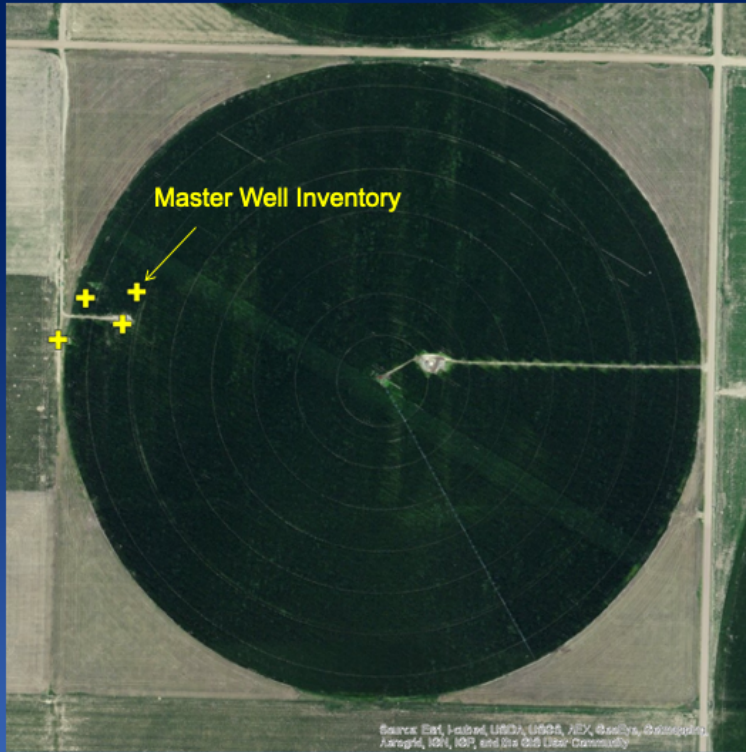
Water Well Matcher

ID	Actions	Owner	Grails	Lat. Long	Depth	Depth to Water	Constructed	Well Use	Other IDs	Children
104049360	Station, Earl		NW SW NE	37.90599 101.20296	115	140	21-JUL-1999	Constructed irrigation inactive	A 8428-00 A 4230-70	WIZARD WWS WWCS WWCS
1040450210	Aradarko Petroleum Corp		NW NW SW		3956 feet	340	10-JAN-2003	Constructed Oil Field Water Supply Injection	F 20000014-00	WWS WWCS
1044110036	LEONARD BESSIE		SW NW NE		209 feet	165	01-JAN-1960	Unplugged		WIZARD
1044110032	LEONARD, BESSIE PHIFER LYNCH, JANET SUTTON & GARY MOSTROM, GARY & VIRGINIA SHELTON BARBARA		SW NW NE		254 feet	820	15-JUL-1990	Withdrawal of water irrigation inactive	A 8428-00 A 4230-70	WIZARD WWS WWCS
1040613144	Station, Barbara		SW SW NW		583 feet	473	27-FEB-2009	Constructed irrigation Active	A 8428-00 A 4230-70	WIZARD WWS WWCS
1040312508	Stevens, Richard J		NE NE NE		236 feet	304	13-MAY-1996	Constructed Domestic		WWCS

ID	Actions	Owner	Grails	Distance	Well Depth	Well Depth	Constructed	Well Use	Other IDs	Data Src.	Map Me
1040294006	Earl Shelton 530 Washington St. Hugoton, KS 67951		NW SW	0 feet	615	765	31-JUL-1990	irrigation		WIZARD	<input type="checkbox"/>
1040125724	LEONARD, BESSIE PHIFER LYNCH, JANET SUTTON & GARY SHELTON, BARBARA		SW NW NE	142 feet	161	128	15-JUL-1990 (1995-2008)	Withdrawal of water irrigation inactive	A 8428-00 A 4230-70	WWS	<input type="checkbox"/>
1040229096	Station, Barbara		SW NW NE	209 feet	380	170	03-APR-2009	Plugged irrigation	A 8428-00	WWCS	<input type="checkbox"/>
104049360	Station, Earl		NW SW NE	583 feet	615	140	21-JUL-1999	Constructed irrigation	A 8428-00	WWCS	<input type="checkbox"/>
1040077363	Owner, Don		SE SE SW	4699 feet	190		06-MAY-2015	Plugged		WWCS	<input type="checkbox"/>
1040450209	Aradarko Petroleum Corp		NW SW SW	4378 feet	340	160	09-JAN-2003	Constructed Oil Field Water Supply	F 20000014-00	WWCS	<input type="checkbox"/>
1040507827	EARL SHELTON 530 WASHINGTON HUGOTON KS 67951		SW NW NE	254 feet	161	128	10-JAN-1989 (intermittent status)	irrigation		WIZARD	<input type="checkbox"/>
1044110060	EARL SHELTON 530 WASHINGTON ST HUGOTON KS 67951		SW NW NE	199 feet	623	370	02-FEB-2009	irrigation		WIZARD	<input type="checkbox"/>
1040294020	HOWARD DRILLING CO		NW SW SW	3020 feet			23-JAN-2003 (no use 0888)	Withdrawal of water industrial inactive	F 20000014-00	WWS	<input type="checkbox"/>
1040514278	LEONARD BESSIE		SW NW NE	213 feet	165	101	01-JAN-1960	Unplugged	A 8428-00	WIZARD	<input type="checkbox"/>
1040100201	LEONARD, BESSIE PHIFER LYNCH, JANET SUTTON & GARY MOSTROM, GARY & VIRGINIA SHELTON, BARBARA		SW NW NE	80 feet			15-JUL-1990 (1981-1985)	Withdrawal of water irrigation inactive	A 8428-00 A 4230-70	WWS	<input type="checkbox"/>
1040304210	LEONARD, BESSIE PHIFER LYNCH, JANET SUTTON & GARY SHELTON, BARBARA		SW NW NE	142 feet			15-JUL-1990 (2009-2017)	Withdrawal of water irrigation	A 8428-00 A 4230-70	WWS	<input type="checkbox"/>

This is an example of a well matching page developed at the KGS. The upper frame displays records in the MWI. Records here can exist only if they are present in the lower frame, which displays source records from WWC5, WIZARD, and WIMAS. The well matching page facilitates well matching using various color shadings based on the common database attributes.

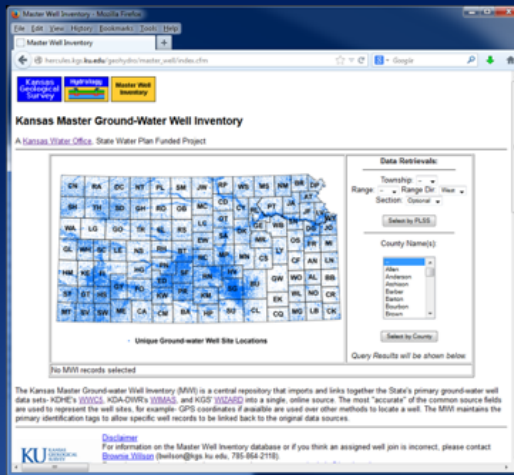
The top selected record in the MWI shows results for a single well location composed of four source database records. The MWI uses the best information available to describe a well's location. For example, if GPS coordinates are present in one of the source database records, they will be used to spatially plot the well's location.



- 3 Databases
- 9 Individual Records
- 4 Actual Wells

With the MWI in place, there are really only four actual wells in this plot of ground. They are composed based on nine records from the three source databases, but the MWI has removed the duplication and allows users to seamlessly integrate data from WWC5, WIMAS, and WIZARD.

Master Well Inventory



Map Service-

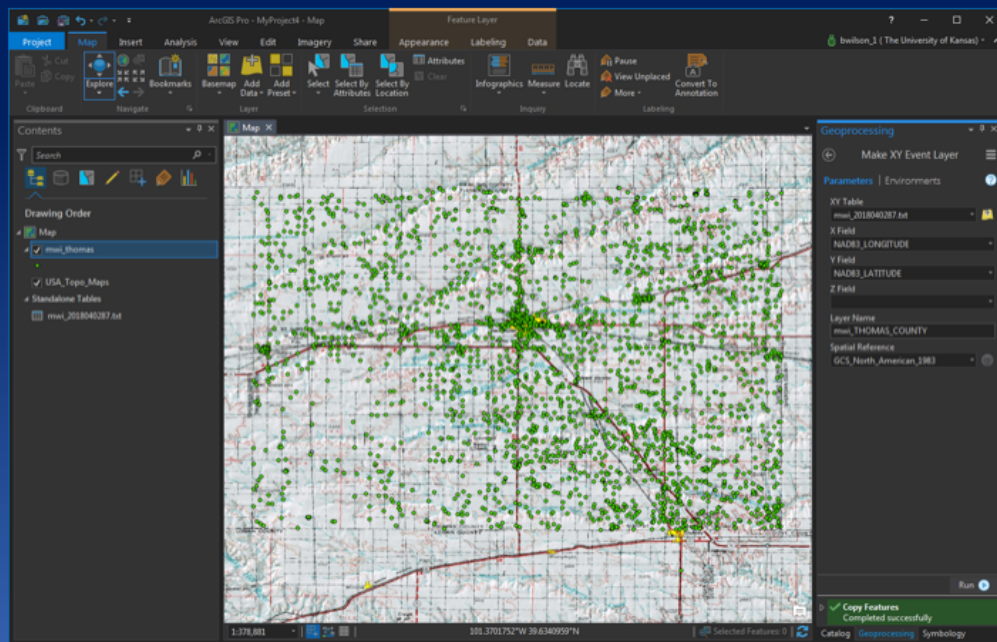
http://services.kansasgis.org/arcgis1/rest/services/water_wells/KansasWells/MapServer

Feature Service-

http://services.kansasgis.org/arcgis1/rest/services/water_wells/KansasWells/FeatureServer

The KGS plans to greatly enhance the MWI but for now, static downloads can be made based on PLSS descriptions or county designations. For ArcGIS desktop or Pro users, map and feature services are created and published nightly, allowing the MWI points to be incorporated directly into data frames.

MWI in Action



This is an example of using a comma-delimited ASCII download of wells selected in Thomas County, Kansas, from the MWI. Given the MWI has several coordinate options (geographic, UTM), the wells can readily be mapped using GIS software, in this case, ESRI's ArcPro GIS.

MWI in Action

The screenshot displays the ArcGIS Pro interface with a map of wells in Thomas County, Kansas. A data table is overlaid on the map, showing the following columns: Field, Add, Delete, Calculate, Selections, Zoom To, Switch, Clear, and Delete. The table contains the following data:

Field	Add	Delete	Calculate	Selections	Zoom To	Switch	Clear	Delete
PT_LONGITUDE	NAD83_LATITUDE	NAD83_LONGITUDE	WWC5_INPUT_SEQ	WWS_POR_ID	HAZARD_USAGE_ID	WELL_STATUS		
-101.0975	39.563019	-101.097931	-Nub-	45326	3.913411e-14	Constructed		
-101.04383	39.554161	-101.044363	88025	32593	3.913411e-14	Constructed		
-100.76142	39.562173	-100.761844	-Nub-	47870	3.913411e-14	Constructed		
-101.201998	39.55953	-101.20174	88100	45320	3.913205172201	Constructed		
-101.23528	39.558138	-101.235714	-Nub-	38154	3.913201e-14	Constructed		
-101.22598	39.558279	-101.226416	-Nub-	7291	3.913201e-14	Constructed		
-101.08479	39.55618	-101.085214	-Nub-	52114	3.913221e-14	Constructed		
-101.22106	39.555268	-101.221496	88083	13729	3.913161e-14	Constructed		
-101.19398	39.554941	-101.193537	-Nub-	8243	3.913161e-14	Constructed		

MWI downloads are populated with the common attributes from the source database, such as PLSS legal descriptions, county designations, well depth, construction date, and use(s) made of water. In addition, the primary key identifier from each of the source databases is also stored. In this example, the primary key for the WWC5 database for the selected well is 88100. This number can be used to quickly look up this specific source record from the WWC5 database directly, either through the use of hyperlinks within ArcPro or through cutting/pasting a URL into a web browser.

WWC5

http://chasm.kgs.ku.edu/apex/wwc5.wwc5d2.well_details?well_id=88100

Well T6S, R36W, Sec. 1, SW NE SW, Action: Constructed

Location Info

Owner: Brown, Wianes	Status: Constructed	
Location: T6S, R36W, Sec. 1, SW NE SW	County: Thomas	
Directions: from Brewer's 13 mi N 3 mi E		
Longitude: -101.2600954	Latitude: 39.5591176	Datum: NAD 27
Longitude: -101.2603382	Latitude: 39.5591174	Datum: NAD 83

Longitude and latitude calculated by Survey from township-range-section-quarter calls. Only good to within the quarter call accuracy.

General Info

Well Depth: 292 ft	Elevation: ft
Static Water Level: 150 ft	Est. Yield: 1000 gpm
Comp. Date: 25-Aug-1976	Well Use: Irrigation
OWR Applic. #:	Other ID:

Order Info

Order: Red Tiger Irr. Drig & Supply	License #: 125
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Scanned Form

The download files contain one or more TIFF images compressed into a ZIP archive. Your browser may be already set up to decompress these files. The TIFFs are 300 dpi archival quality scans of the WWC5 forms and can be viewed by software like Adobe Photoshop.

Material	Depth	Remarks
Reddish-brown, silty, brown	0-200	
Dark brown, fine sand, white and brown	200-250	
Dark stone, fine sand, traces sandy clay	250-265	
Dark stone, white, fine sand, brown	265-285	
Fine sand, brown	285-292	
Fine sand, brown, traces sand stone	292-295	
Fine sand, brown	295-298	
Fine sand, brown, traces Red Stone	298-299	
Fine sand, Red, gravel, brown	299-300	
Gravel, yellow, shale, sandstone	300-310	

Casing Info

Casing Type: Steel	Diam: 16 in. to 192 ft
Casing height above land surface: in	
Casing Weight: 50#	
Well thickness or gauge no.:	

Screen and Perforation Info

Screen Type: Steel	Screen Openings:
Screen-perforated intervals	from: 160 ft to 292 ft
Gravel pack intervals	from: 0 ft to 0

Example of the URL that uniquely identifies an individual WWC5 record. The URL calls data from the WWC5 database based on the listed well_id—in this case, 88100.

MWI in Action

The screenshot displays the ArcGIS Pro interface. The main map area shows a grid of green dots representing monitoring wells. A data table window titled 'mwi_thomas' is open, showing a list of well records. The selected record is highlighted in blue, with its WRS_POR_ID (45220) circled in red. The table columns are: PT_LONGITUDE, NADES_LATITUDE, NADES_LONGITUDE, WPCS_INPUT_SEQ, WRS_POR_ID, HAZARD USGS ID, and WELL_STATUS.

PT_LONGITUDE	NADES_LATITUDE	NADES_LONGITUDE	WPCS_INPUT_SEQ	WRS_POR_ID	HAZARD USGS ID	WELL_STATUS
-101.0975	39.563619	-101.097931	-Null-	45236	3.913411e-14	Constructed
-101.04383	39.554161	-101.044363	88925	32593	3.913411e-14	Constructed
-100.76142	39.562173	-100.761844	-Null-	47820	3.913411e-14	Constructed
-101.201998	39.55953	-101.201449	88190	45220	3.913411e-14	Constructed
-101.23528	39.558138	-101.235714	-Null-	36124	3.913291e-14	Constructed
-101.22598	39.558279	-101.226416	-Null-	7201	3.913221e-14	Constructed
-101.08479	39.55618	-101.085224	-Null-	52114	3.913221e-14	Constructed
-101.22106	39.555268	-101.221496	88983	11729	3.913161e-14	Constructed
-101.19398	39.554941	-101.193537	-Null-	8243	3.913161e-14	Constructed

The primary key for the WIMAS (or WRIS) database for a point of diversion is the pdiv_id, which for this selected well MWI record is 45220. This number can be used to quickly look up specific information directly from the WIMAS database, either through the use of hyperlinks within ArcPro or through cutting/pasting a URL into a web browser.

WIMAS

http://hercules.kgs.ku.edu/geohydro/wimas/pd_list_direct.cfm?pddiv_id=45220

WIMAS Point of Diversion Information Sheet

Water Right Information represents conditions as of 04/10/2019.

Information shown on this page depends on the **water right(s)** and their **Type(s) of Use** associated with a PD. If there are multiple water rights and types of use, the page will update details, quantity and rate, and reported water use depending on which entry is selected from those list boxes.

Because water rights can overlap both in points of diversion and places of use (which in turn can affect the authorized quantities and rate) AND water usage is often aggregated into a single report, **you cannot determine if a water right has reported more water use than authorized from this page only.**

By using this page directly, you agree to the responsibilities and use limitations of the WIMAS program, as specified by its [disclaimer](#).

Point of Diversion
PD: 1-65-36W-1 1 Water Right(s): 28736-00 1 Type(s) of Use: SW Google Location Map
WWCS Links: 88100 WIZARD Link: 393329101172201

Water Right Details
Source: G Right Type: A Total Acres Authorized: 260 Net Acres Authorized: 260 Use of Water Active: Y
Water Right Status: NK Place(s) of Use: 1-65-36W NE SW (active) TOTAL ACRES: 32, NET ACRES: 32
Priority Date: 03/02/1977 Action Trail: 03/02/1977- PENDING INITIAL REVIEW

Point of Diversion Details
PD Active: Y Feet North: 1340 Feet West: 2940 Qualifiers: SW NE SW County: THOMAS
GMD Num: 4 Number of Wells: 1 Subbasin: SARPA CREEK Stream Number:
Special Use Area(s): Comment: SW NE SW

Authorized Quantity & Rate
Quantity Stored By: Water Right Authorized Quantity (AF): 384 Net Quantity (AF): 384
Rate Stored By: Water Right Authorized Rate (GPM): 670 Net Rate (GPM): 670

Reported Water Use
Water Use Year(s): 2017 Total Water Used (AF): 183.00 Acres Irrigated: 245
Water Use Reported on Right Num: Reel Number: 2 Blp Number: 1337
Metered Quantity: 383 Meter Unit: 2 Depth to Water: Depth of Well:
Beginning Meter Reading: 911 Ending Meter Reading: 15
System Type: 4 Hours Pumped: Pump Rate: Date of Measurement:
Date Report Received: 03/01/2018 Chemigation Indicator: N Water Use Code: A Crop Code: 16
Current Water Use Correspondent(s): 03TH1 & NEW MAN DOWNING
Print ARCC Report

Example of the URL that uniquely identifies an individual WIMAS point of diversion record. The URL calls data from the WIMAS database based on the listed pddiv_id—in this case, 45220.

MWI in Action

The screenshot displays the ArcGIS Pro interface with a map showing green well locations. An attribute table for the 'mwi_thomas' layer is open, showing the following data:

Field	Add	Delete	Calculate	Select	Zoom To	Switch	Clear	Delete	
PT_LONGITUDE	NAD83_LATITUDE	NAD83_LONGITUDE	WPCS_INPUT_SEQ	WPCS_POR_ID	WIZARD_USGS_ID	WELL_STATUS			
-101.0975	39.563019	-101.097931	-Null-	45326	3.913411e-14	Constructed			
-101.04383	39.554161	-101.044363	88925	32593	3.913411e-14	Constructed			
-100.76142	39.562173	-100.761844	-Null-	47870	3.913411e-14	Constructed			
-101.201998	39.55953	-101.201449	88190	45326	393329101172201	Constructed			
-101.23528	39.558138	-101.235714	-Null-	38154	3.913201e-14	Constructed			
-101.22598	39.558279	-101.226416	-Null-	7201	3.913221e-14	Constructed			
-101.08479	39.55618	-101.085214	-Null-	52314	3.913221e-14	Constructed			
-101.22106	39.555268	-101.221496	88983	13729	3.913161e-14	Constructed			
-101.19398	39.554941	-101.193517	-Null-	8243	3.913161e-14	Constructed			

The primary key for the WIZARD database is the USGS_ID, which for the selected MWI well in this example is 393329101172201. This number can be used to quickly look up this record from the WIZARD database, either through the use of hyperlinks within ArcPro or through cutting/pasting a URL into a web browser.

WIZARD

http://hercules.kgs.ku.edu/geohydro/wizard/wizardwelldetail.cfm?usgs_id=393329101172201

General Well Site Information

USGS ID:	393329101172201	KGS Local Well ID:	065 36W 01CAC 01
County:	Thomas	PLS Description:	6S 36W 1 SWNE:SW
HUC 8 Code:	10250010	GMD:	Northwest Kansas GMD #4
Longitude:	-101.291449	Lat/Long Source:	GPS (within 50 feet)
Latitude:	39.55853	Lat/Long Accuracy:	5 seconds
Surface Elevation (ft):	3340	Depth of Well (ft):	292
Geological Unit Codes:	TO	USGS Map Name:	Dewey Ranch SE
Use of Site:	Withdrawal of Water	Use of Water:	Irrigation
WWC5 Links:	88100	WIMAS Link:	45220

Measuring Point Information

Note that height is listed as feet above or below land surface.

Height:	1
Description:	HOLE IN WEST SIDE PUMP BASE

Other Well Identifiers

Well Identifier	Assignor	Date Assigned
GWMD 4	GC KS	MAR-18-1996
NWHP	KSHPRASA	MAR-18-1996
028736	KSBA-DWR	MAR-18-1996
WW PRV 2-89	KGS_TIS	FEB-01-1999
ANNUAL NW	KSNET002	MAR-07-2000

Water Level Measurements

393329101172201

Note that depth to water is feet below land surface and all measurements for the well are included.

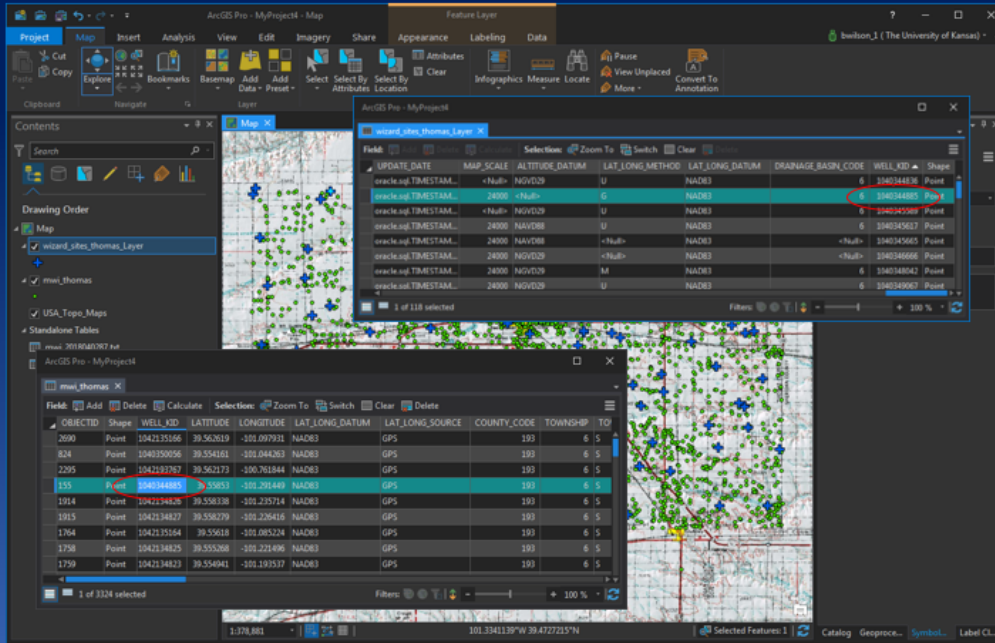
Hydrograph-Annual Average Depth to Water Below Land Surface

Date	Depth to Water	Status	Agency	Method	WL Source	Tape Hold	Chalk Cut	Initials
JAN-04-1999	-171.64	-	KGS	Steel Tape	-	190	17.36	RDM
JAN-04-2000	-172.21	-	KGS	Steel Tape	-	176	2.79	RDM
JAN-09-2001	-174.27	-	DWR	Steel Tape	-	178	0.73	CS
JAN-09-2002	-174.43	-	DWR	Steel Tape	-	178	2.87	CLS
JAN-08-2003	-175.5	-	DWR	Steel Tape	-	180	3.50	CLS
JAN-08-2004	-177.08	-	DWR	Steel Tape	-	179	0.92	CLG

Example of the URL that uniquely identifies an individual WIZARD record. The URL calls data from the WIZARD database based on the listed usgs_id.

This example from the WIZARD website shows how the MWI has been integrated within the web applications of each of the source databases. This WIZARD site/web page allows users to quickly bring up information from WWC5 and WIMAS using the provided links.

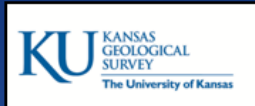
WELL_KID is the Primary Key



The primary key for the MWI is a field called WELL_KID. This number uniquely identifies well records in the MWI and is also added to downloads for WIMAS, WIZARD, and WWC5. In the example above, additional data from WIZARD for wells in Thomas County, Kansas, were downloaded and displayed within ArcPro along with the MWI wells. You can see the WELL_KID field is part of the WIZARD well's attribute table. The WELL_KID field can be used to relate or join data among all the source databases and MWI.

Questions???

Kansas Geological Survey
1930 Constant Ave
Lawrence, KS 66047
785-864-2118



Visit our site at
<http://www.kgs.ku.edu>

Thank You!