Kansas Geological Survey

Dynamic Online Access to the High Plains Aquifer Section-Level Database

By

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Introduction

The main activities conducted as a part of the Ogallala Aquifer Support Study by the Kansas Geological Survey (KGS) in Fiscal Year 2003 have consisted of providing improved access to and easier processing of water-level and associated data for use in assessing objectives of the Kansas Water Plan and helping the three western groundwater management districts identify aquifer subunits. This report describes and provides a guideline for use of the dynamic online access that was developed for interactively retrieving and evaluating section-level data for the High Plains aquifer.

The Database

The KGS High Plains Aquifer Section-Level Database contains datasets derived and updated from the map products of the Atlas of the Kansas High Plains Aquifer (http://www.kgs.ukans.edu/HighPlains/atlas/), and related environmental information obtained from specific projects and contracts related to the High Plains aquifer. The database has evolved to include information on aquifer characteristics, estimated recharge rates, projections on the useable lifetime of the aquifer, land cover, water rights and more. A complete listing of the variables is included in the Appendix.

Most of the data come from point measurements at a specific place and time. These point values were used to interpolate continuous surfaces across the Kansas High Plains aquifer region. Values from the surfaces are assigned to the centers of legal sections (approximately one square mile) within the saturated extent of the aquifer, as illustrated in Figure 1. The section-level database is stored and administered in an Oracle Relational Database Management System (RDBMS) and can be accessed via the internet at http://hercules.kgs.ukans.edu/geohydro/section_data/hp_step1.cfm.

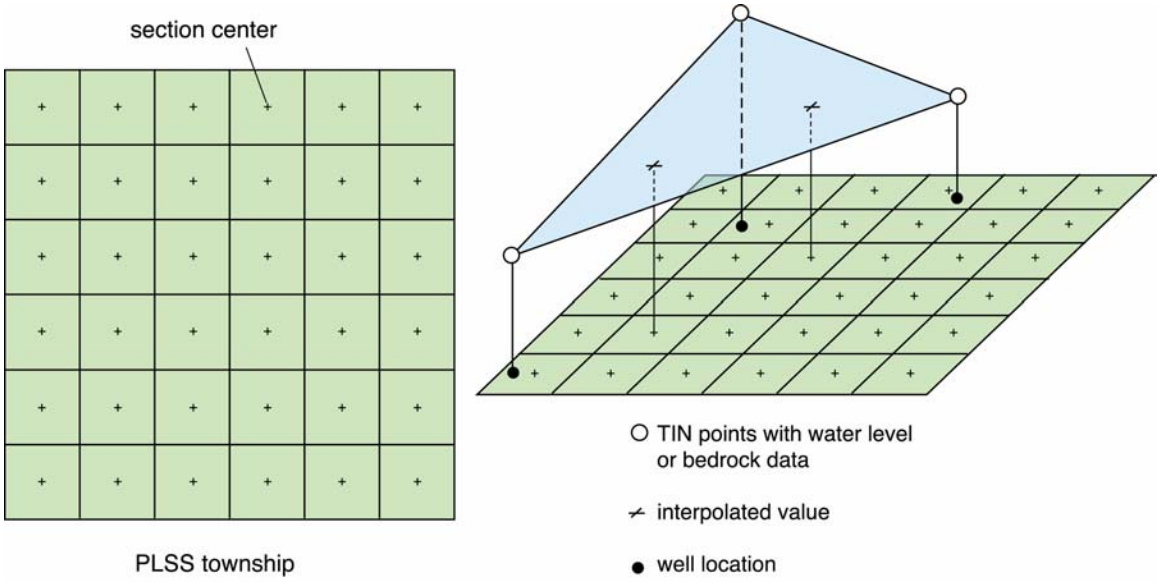


Figure 1. Process of assigning section-center values from an interpolated continuous surface.

The section-center assigned values are approximations intended to be interpreted at larger scales, and may not be appropriate for use in local, detailed, or highly quantitative analyses. The information does not have official or regulatory status, and should not be used in place of maps or information that have been subject to technical review and/or official adoption.

Dynamic Online Access

The web interface enables users to access and download section-level data directly and dynamically from the Oracle database. As data are added to the Oracle database, the data automatically become available through the web site. Neither the database nor the web site are static, but will continue to evolve as more data are added and user feedback is addressed. Special features include basic statistics, histograms, correlation matrix, calculator, data download, and an option to download an ArcView shape file of the Public Land Survey System (PLSS) sections. What follows is the procedure for accessing and using the data.

Step 1

Access to the database begins at the following url: http://hercules.kgs.ukans.edu/geohydro/section_data/hp_step1.cfm (see Figure 2). This page can also be accessed through the KGS High Plains/Ogallala Aquifer Information pages at http://www.kgs.ku.edu/HighPlains/index.htm. In Step 1 the user selects the geographic extent from which they will retrieve section-level data. The following categories are currently available: Groundwater Management District (GMD), Public Land Survey System (PLSS; Township and Range), County Name, or a Latitude/Longitude box. The default is the entire database. In Figure 2, Western Kansas GMD #1 is selected.

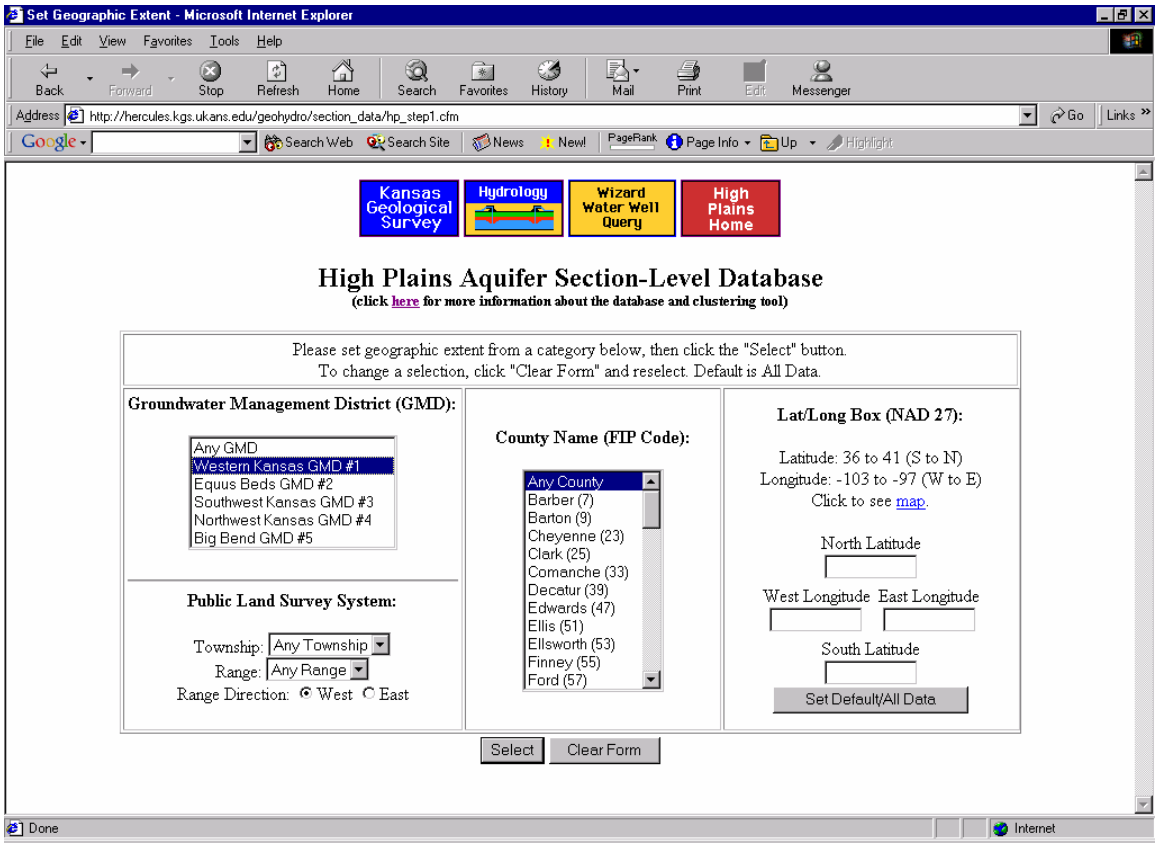


Figure 2. Step 1: Set Geographic Extent.

Step 2

Once the area of interest has been selected, the user is given the option to select specific variables from the database. Variables are grouped into the following categories: Geographic; Hydrology and Aquifer Characteristics; Water Budget Variables; Groundwater Dynamics - Changes and Trends; Administrative, Planning and Management Variables; GMD3-specific variables (developed under contract with GMD3); and Land Use and Land Cover (as of early 1990s). Figure 3 shows a partial listing of the variables; see the Appendix for a complete listing. A brief description and the actual database field name (Column Name) are given for each variable. The Scale item lists the recommended scale of use for the variable. In the example shown in Figure 3, the user has selected Longitude and Latitude of the section center, Bedrock Elevation, and Hydraulic Conductivity for the Western Kansas GMD #1 area, as identified in Step 1.

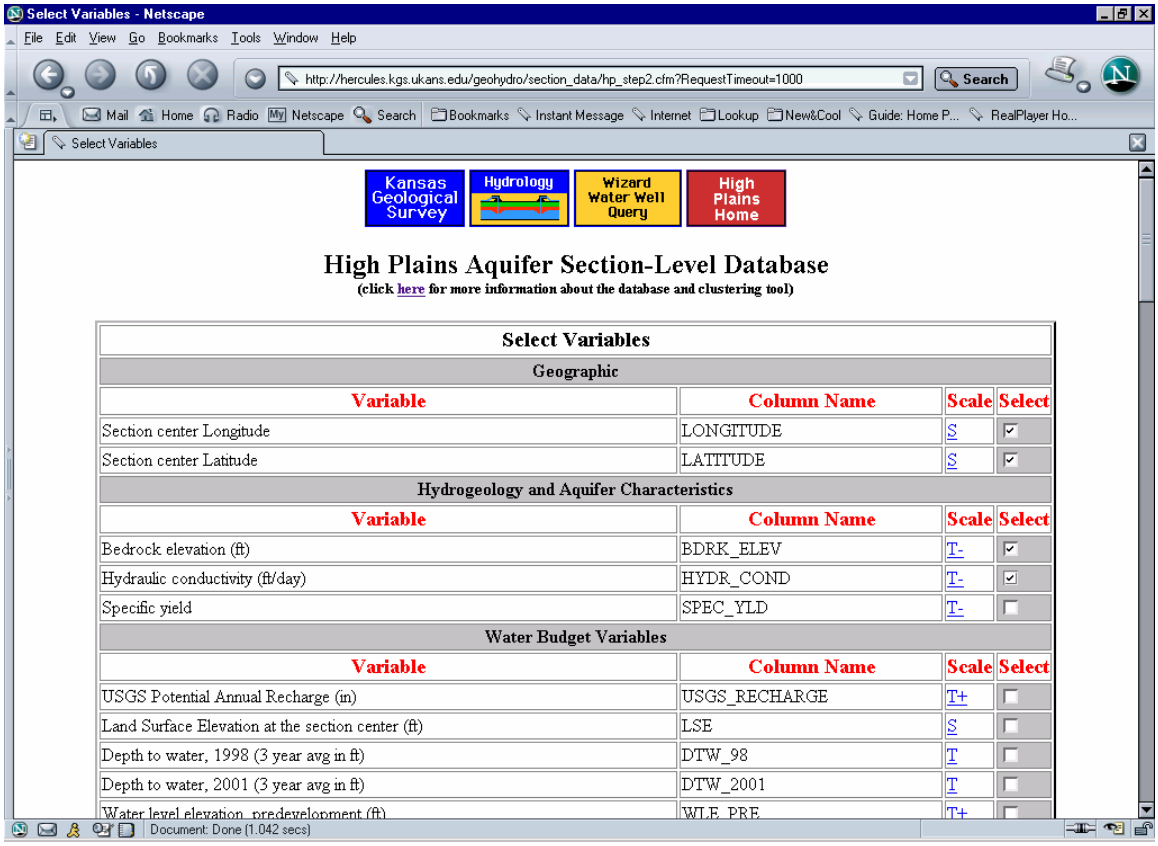


Figure 3. Step 2: Select Variables.

Step 3

The next page generated (example shown in Figure 4) lists the geographic extent and variables selected. At this point the user may generate a dataset by clicking on the Generate Dataset button, review and display general statistics for each variable, or further filter and modify the selected variable values using the available tools.

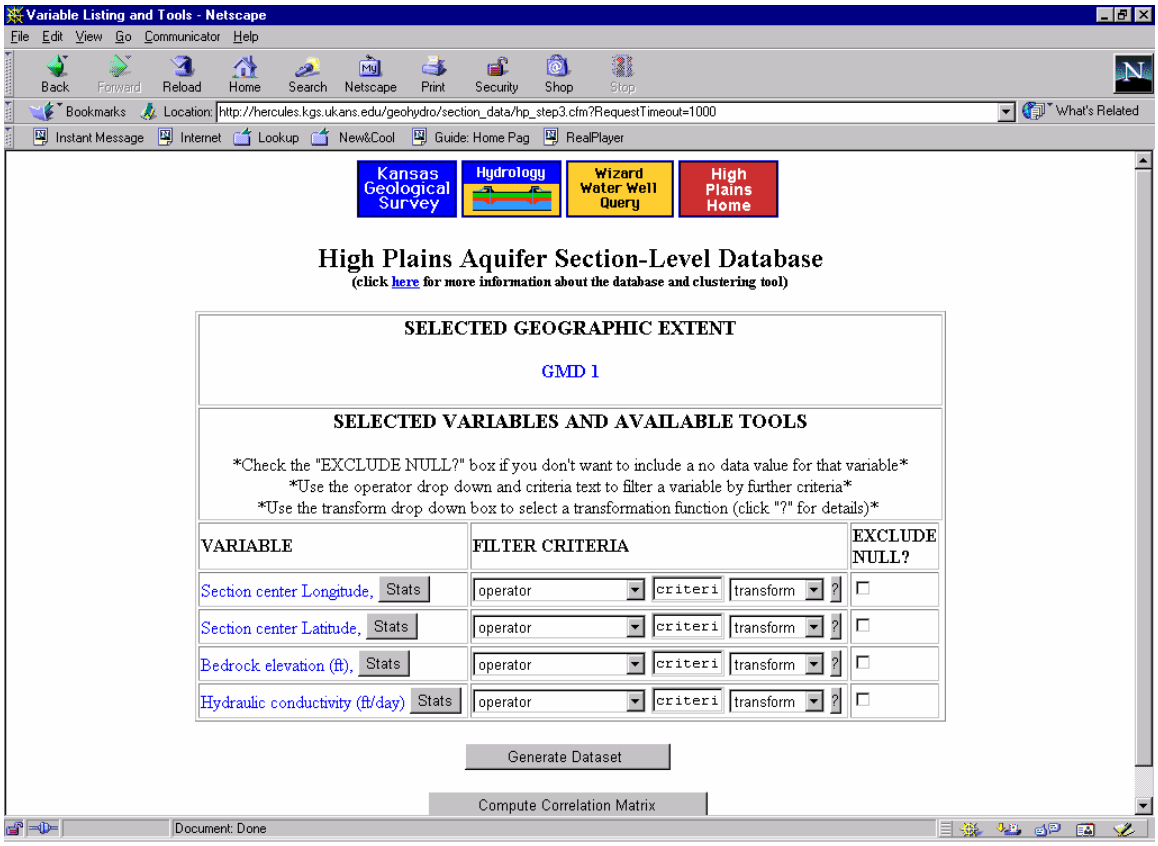
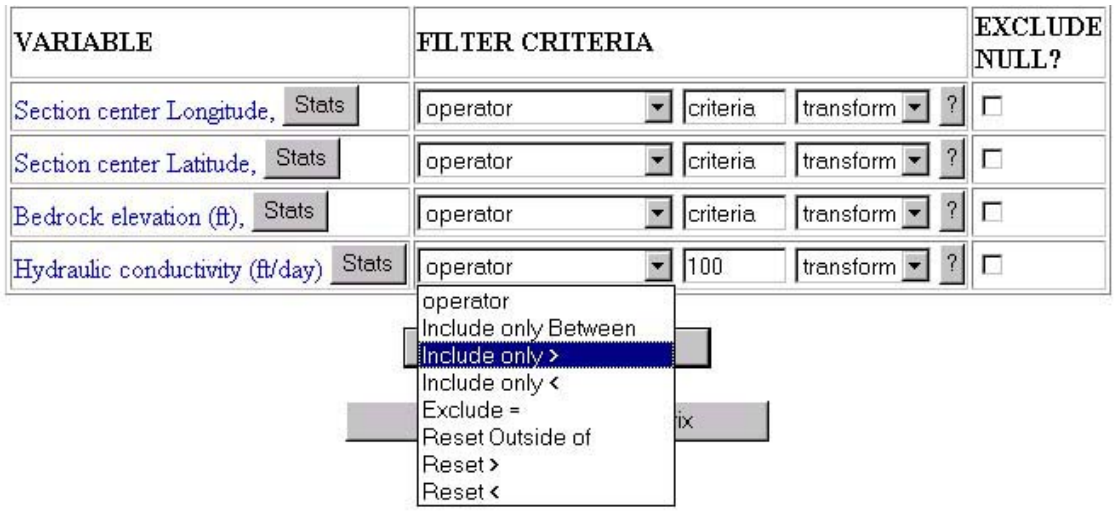
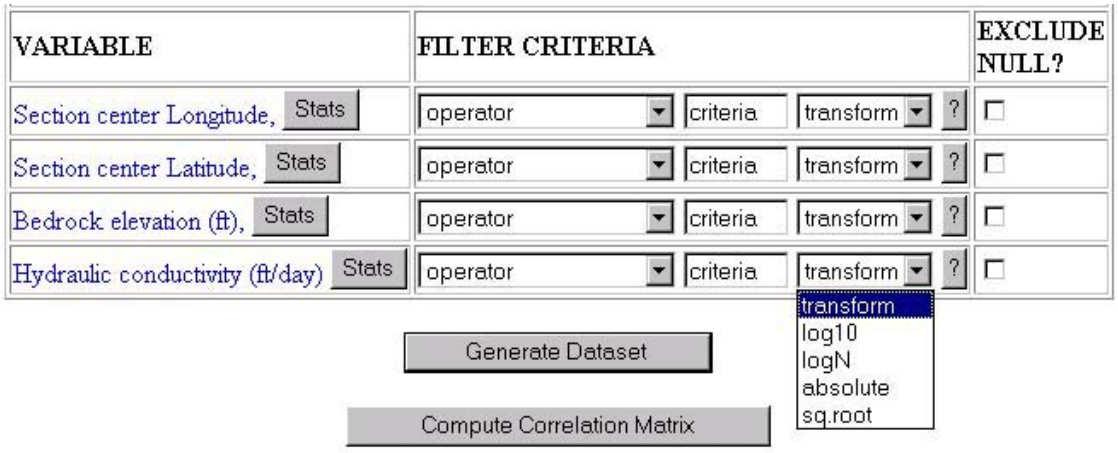


Figure 4. Step 3: Variable Listing and Tools.

Figure 5 shows the dropdown menus containing the filter and transform options. The Filter Criteria (the operator) in Step 3 allows the user to include or exclude certain data, such as select only hydraulic conductivity values greater than a specified value. Transform allows data conversions such as $\log_{10}$ and natural log. Transformations may be desirable when, for example, the data are not normally distributed. Also the user may exclude null (no data) cells from the generated dataset.



(a)



(b)

Figure 5. Dropdown menus for data filtering and transforms: (a) filter options - the user is filtering Hydraulic Conductivity to include only values greater than 100 ft/day; (b) data transform options.

The Stats button in Step 3 (Figure 4) generates a new pop up window containing basic statistics on the variable (for the geographic extent selected in Step 1), complete with a histogram (a graph showing frequency distribution) as shown in Figure 6. The histogram is customizable with respect to the number of classes and the range of values, and data transformations are possible.

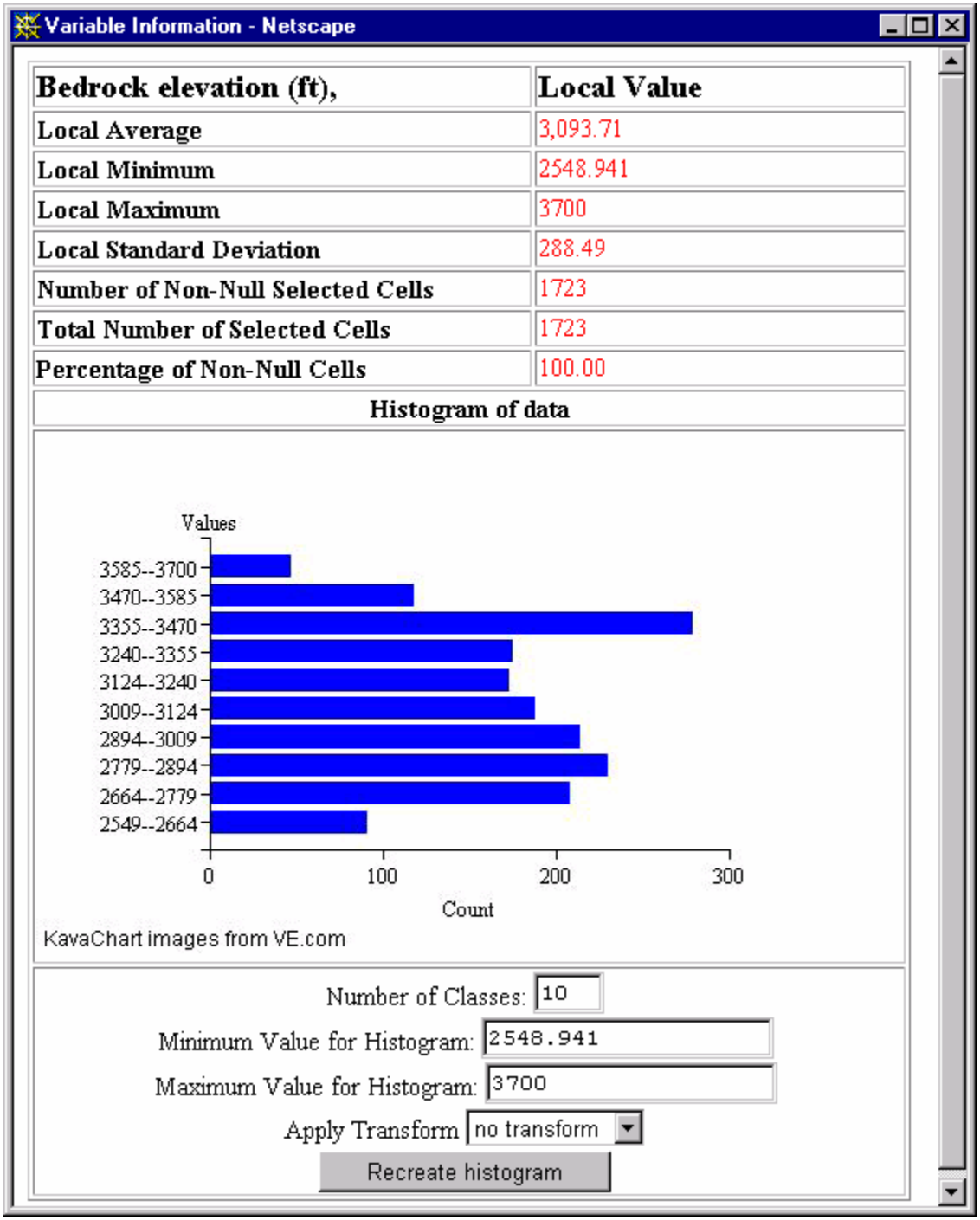
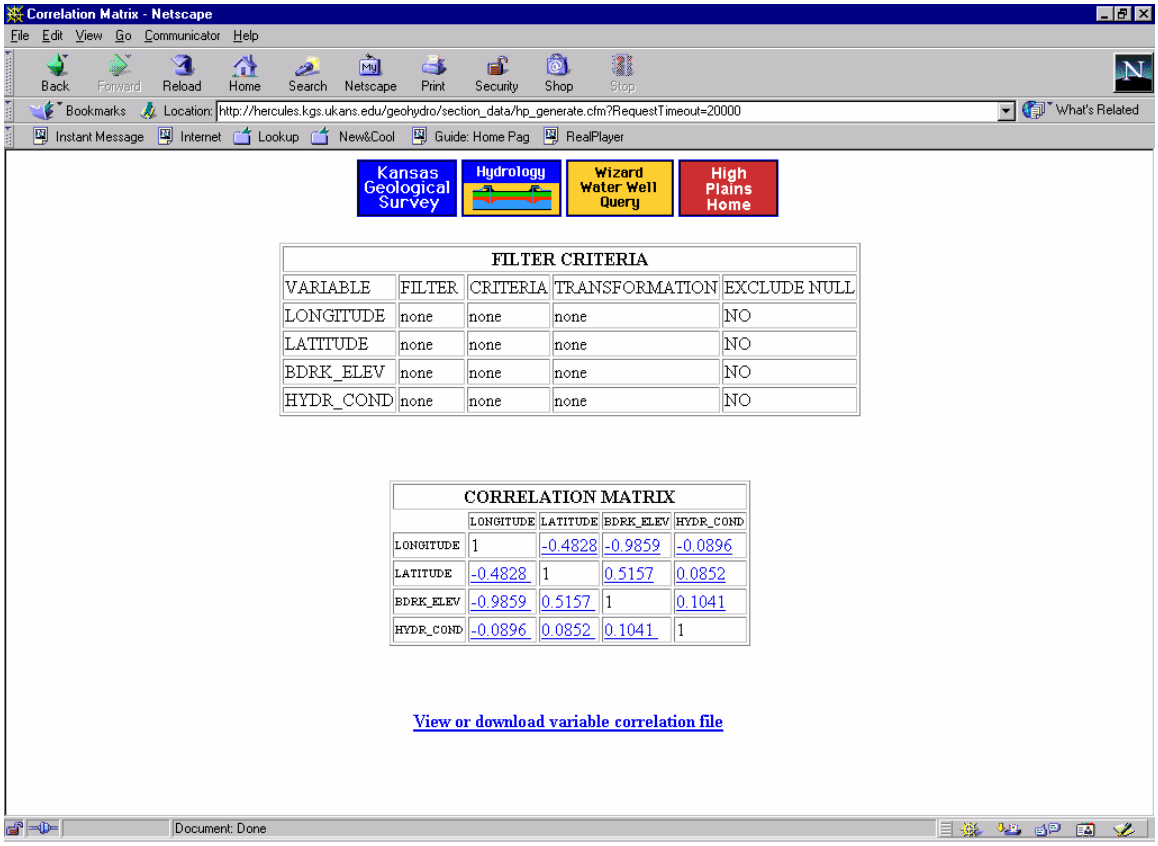


Figure 6. Basic Statistics.

Clicking on the Compute Correlation Matrix button in Step 3 (Figure 4) generates a page such as that shown in Figure 7. This tool computes a matrix of correlation coefficients (r values) for each pair of variables.



FILTER CRITERIA

VARIABLE	FILTER	CRITERIA	TRANSFORMATION	EXCLUDE NULL
LONGITUDE	none	none	none	NO
LATITUDE	none	none	none	NO
BDRK_ELEV	none	none	none	NO
HYDR_COND	none	none	none	NO

CORRELATION MATRIX

	LONGITUDE	LATITUDE	BDRK_ELEV	HYDR_COND
LONGITUDE	1	-0.4828	-0.9859	-0.0896
LATITUDE	-0.4828	1	0.5157	0.0852
BDRK_ELEV	-0.9859	0.5157	1	0.1041
HYDR_COND	-0.0896	0.0852	0.1041	1

View or download variable correlation file

Figure 7. Correlation Matrix.

Clicking on one of the correlation values in the matrix (Figure 7) generates a new pop up window with a scatterplot (x-y plot) showing the relationship between the variables. For example clicking on the BDRK_ELEV vs. LONGITUDE coefficient generates the plot shown in Figure 8.

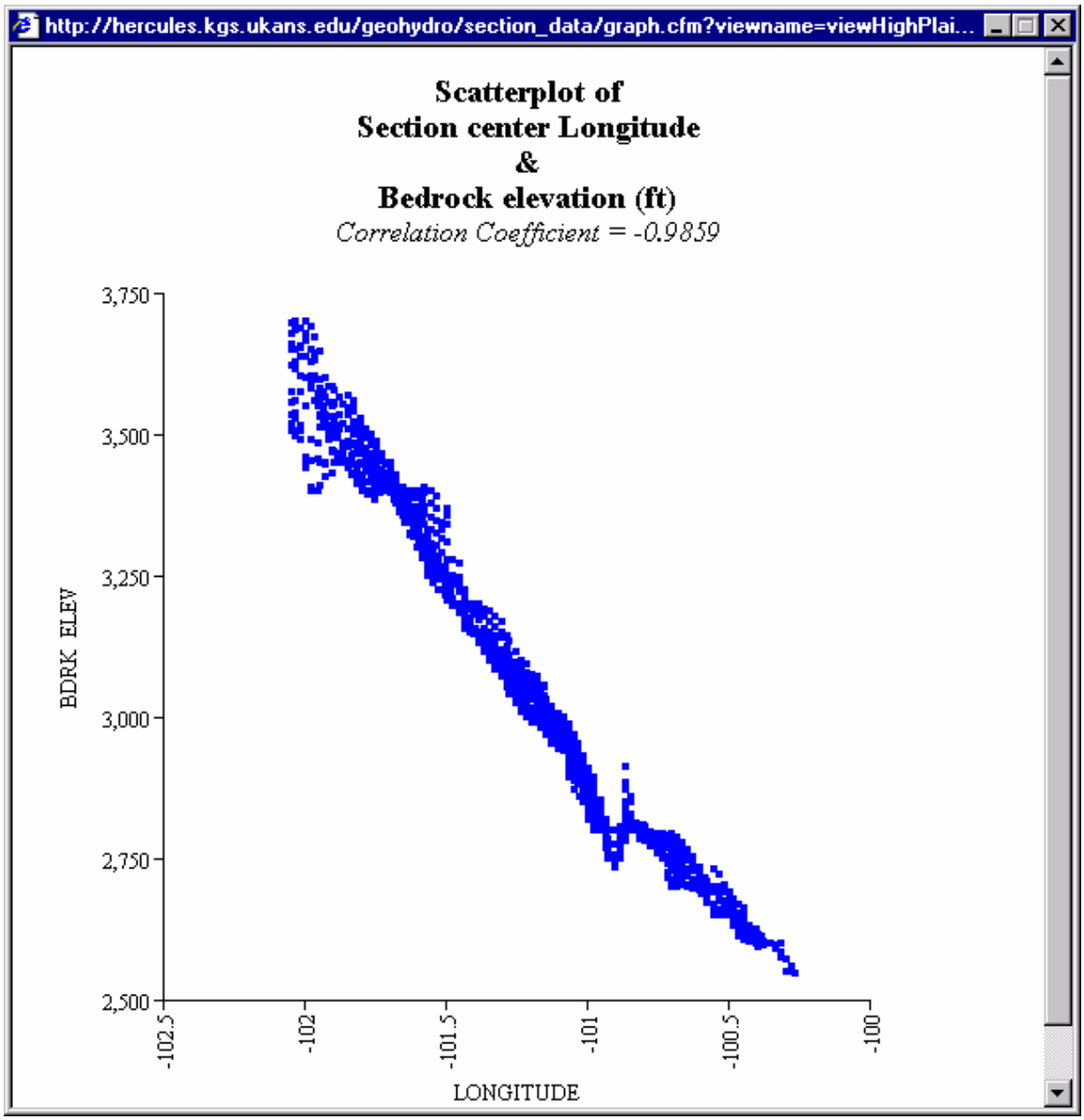


Figure 8. Scatterplot.

Finally, when the user clicks on Generate Dataset in Step 3 (Figure 4), the database is queried and a dataset is dynamically generated using the criteria selected by the user. The page generated (Figure 9) shows filter criteria selected, if any, and allows the user to view or download a variable selection report file. This page allows the user to view or download the generated dataset, a comma-delimited text file that can be imported into a spreadsheet or database. Latitude and longitude (x,y) coordinates of section centers are automatically included for use in GIS and other spatial applications. Legal locations (township, range and section) are also included for reference and as a link to a downloadable ESRI shape file of the sections.

Also available on this page are options to create additional variables using the Calculate tool or to conduct more advanced statistical clustering analysis on the variables. The Calculate tool provides the ability to conduct mathematical equations on or between variables. The result is a new variable that is part of the dataset. The database output can be passed to the LoiczView geospatial clustering package (http://www.palantir.swarthmore.edu/loicz/help/), which uses a K-mean clustering routine to spatially identify areas that share common data characteristics.

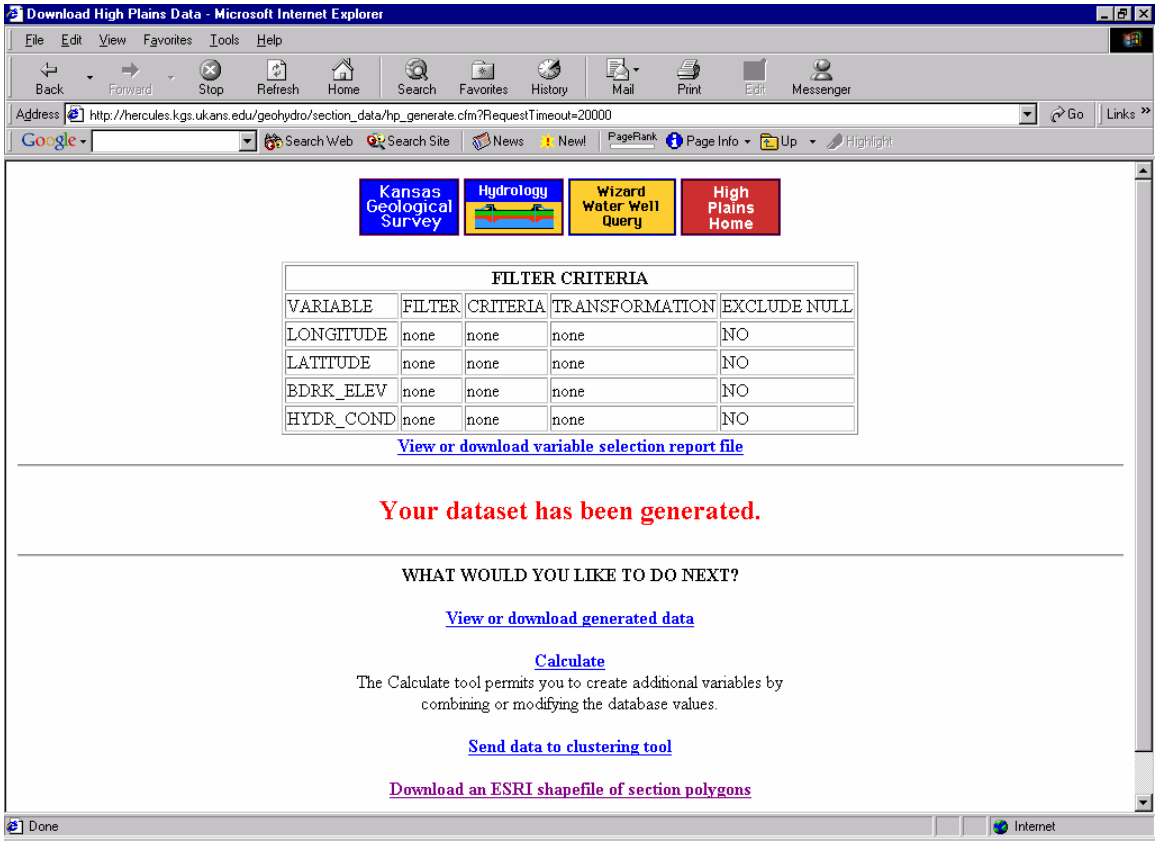


Figure 9. Download High Plains Data.

Acknowledgment

This work was funded in part with State Water Plan Funds targeted towards the Ogallala-High Plains aquifer. Melany Miller assisted in the preparation of this report.

Appendix. Variables included in the High Plains Aquifer Section-Level Database (June 2003).

COLUMN_NAME	COLUMN_DESCRIPTION	DATA_CLASS
SHAPE	SectionID number	
X_COORD	Section center X - coordinate location	
Y_COORD	Section center Y - coordinate location	
SPEC_YLD	Specific yield	Hydrogeology and Aquifer Characteristics
HYDR_COND	Hydraulic conductivity (ft/day)	Hydrogeology and Aquifer Characteristics
DWR_RECHARGE	Potential Annual Recharge, DWR Administrative (in)	Administrative, Planning and Management variables
USGS_RECHARGE	USGS Potential Annual Recharge (in)	Water Budget Variables
BDRK_ELEV	Bedrock elevation (ft)	Hydrogeology and Aquifer Characteristics
DTW_98	Depth to water, 1998 (3 year avg in ft)	Water Budget Variables
WLE_PRE	Water level elevation, predevelopment (ft)	Water Budget Variables
WLE_98	Water level elevation, 1998 (3 year avg in ft)	Water Budget Variables
ST_PRE	Saturated thickness, predevelopment (ft)	Water Budget Variables
ST_98	Saturated thickness, 1998 (3 year avg in ft)	Water Budget Variables
ST_CHG_FT	Saturated thickness change (ft), predev-1998	Groundwater Dynamics - changes and trends
ST_CHG_PCT	Saturated thickness change (%), predev-1998	Groundwater Dynamics - changes and trends
AVAIL	Availability index	Administrative, Planning and Management variables
ACCESSIB	Accessibility index	Administrative, Planning and Management variables
OPEN_WATER	Percent section classed Open Water in USGS KS LULC	Land Use and Land Cover (as of early 1990s)
LOW_INTENS_RES	Percent section classed Low Intesity Residential in USGS KS LULC	Land Use and Land Cover (as of early 1990s)
HIGH_INTENS_RES	Percent section classed High Intesity Residential in USGS KS LULC	Land Use and Land Cover (as of early 1990s)
COMMERCIAL_INDUST_TRANS	Percent section classed Commerical/Industrial/Transportation in USGS KS LULC	Land Use and Land Cover (as of early 1990s)
BARE_ROCK_SAND_CLAY	Percent section classed Bare Rock/Sand/Clay in USGS KS LULC	Land Use and Land Cover (as of early 1990s)
QUARRIES_STRIP_GRAVEL	Percent section classed Quarries/Strip Mines/Gravel Pits in USGS KS LULC	Land Use and Land Cover (as of early 1990s)
TRANSITIONAL	Percent section classed Transitional in USGS KS LULC	Land Use and Land Cover (as of early 1990s)
DECID_FOREST	Percent section classed Deciduous Forest in USGS KS LULC	Land Use and Land Cover (as of early 1990s)
EVERGREEN_FOR	Percent section classed Evergreen Forest in USGS KS LULC	Land Use and Land Cover (as of early 1990s)
MIXED_FOREST	Percent section classed Mixed Forest in USGS KS LULC	Land Use and Land Cover (as of early 1990s)
SHRUBLAND	Percent section classed Shrubland in USGS KS LULC	Land Use and Land Cover (as of early 1990s)
GRASSLANDS_HERBAC	Percent section classed Grasslands/Herbaceous in USGS KS LULC	Land Use and Land Cover (as of early 1990s)
PASTURE_HAY	Percent section classed Pasture/Hay in USGS KS LULC	Land Use and Land Cover (as of early 1990s)
ROW_CROPS	Percent section classed Row Crops in USGS KS LULC	Land Use and Land Cover (as of early 1990s)

SMALL_GRAINS	Percent section classed Small Grains in USGS KS LULC	Land Use and Land Cover (as of early 1990s)
FALLOW	Percent section classed Fallow in USGS KS LULC	Land Use and Land Cover (as of early 1990s)
URBAN_REC_GRASSES	Percent section classed Urban/Recreational Grasses in USGS KS LULC	Land Use and Land Cover (as of early 1990s)
WOODY_WETLANDS	Percent section classed Woody Wetlands in USGS KS LULC	Land Use and Land Cover (as of early 1990s)
EMERG_HERBAC_WETLND	Percent section classed Emergent Herbaceous Wetlands in USGS KS LULC	Land Use and Land Cover (as of early 1990s)
TOTALAREA	Total area of section in square meters	Geographic
TOTAL_PRECIP_MM	Total Annual Precipitation (mm)	Water Budget Variables
TOTAL_PRECIP_IN	Total Annual Precipitation (in)	Water Budget Variables
LONGITUDE	Section center Longitude	Geographic
LATITUDE	Section center Latitude	Geographic
PRECIP_NRM	Normal annual precipitation in inches, 1961 - 1990 (in/yr)	Water Budget Variables
PRECIP_SNL	Normal seasonal precipitation, March - October from 1961 - 1990 (in/yr)	Water Budget Variables
AUTH_QTY	Water authorized to be pumped annually, June 25, 2001 (af)	Administrative, Planning and Management variables
G_AUTH_QTY	Ground water authorized to be pumped annually, June 15, 2001 (af)	Administrative, Planning and Management variables
S_AUTH_QTY	Surface water authorized to be pumped annually, June 25, 2001 (af)	Administrative, Planning and Management variables
WUSE_AVG90	Average water reported diverted from 1990 to 1999 (af)	Water Budget Variables
G_WUSE_AVG	Average ground water reported diverted from 1990 to 1999 (af)	Water Budget Variables
S_WUSE_AVG	Average surface water reported diverted from 1990 to 1999 (af)	Water Budget Variables
VNUM	Number of vested water rights, June 15, 2001	Administrative, Planning and Management variables
G_VNUM	Number of vested ground water rights, June 25, 2001	Administrative, Planning and Management variables
S_VNUM	Number of vested surface water rights, June 25, 2001	Administrative, Planning and Management variables
TWP	The township the section is located in	
RNG	The Range the section is located in	
RDIR	The range direction of the range number the section is located in	
SECT	The section number	
TRS	A concatonation of the township, range, rdir, and section	
BASIN_NAME	The name of the KWO planning basin for the center of the section	
CNTY_NAME	The name of the Kansas County of the section	
GMD	The GMD number of the section	
LSE	Land Surface Elevation at the section center (ft)	Water Budget Variables
DTW_2001	Depth to water, 2001 (3 year avg in ft)	Water Budget Variables
WLE_2001	Water level elevation, 2001 (3 year avg in ft)	Water Budget Variables
ST_2001	Saturated Thickness, 2001 (3 year avg in ft)	Water Budget Variables
WL_CHG_78_88	Water level change 1978-1988 (ft)	Groundwater Dynamics - changes and trends

WL_CHG_88_98	Water level change 1988-1998 (ft)	Groundwater Dynamics - changes and trends
WL_CHG_91_01	Water level change 1991-2001 (ft)	Groundwater Dynamics - changes and trends
WL_CHG_91_96	Water level change 1991-1996 (ft)	Groundwater Dynamics - changes and trends
WL_CHG_96_01	Water level change 1996-2001 (ft)	Groundwater Dynamics - changes and trends
YRS_DEPL_78_88	Estimated Usable Lifetime, based on water level change 1978-1988 (yrs)	Administrative, Planning and Management variables
YRS_DEPL_88_98	Estimated Usable Lifetime, based on water level change 1988-1998 (yrs)	Administrative, Planning and Management variables
YRS_DEPL_91_01	Estimated Usable Lifetime, based on water level change 1991-2001 (yrs)	Administrative, Planning and Management variables
YRS_DEPL_91_96	Estimated Usable Lifetime, based on water level change 1991-1996 (yrs)	Administrative, Planning and Management variables
YRS_DEPL_96_01	Estimated Usable Lifetime, based on water level change 1996-2001 (yrs)	Administrative, Planning and Management variables
MINST_YIELD50	Minimum saturated thickness to support 50 gpm yields, KGS OFR 2002-25C (ft)	Administrative, Planning and Management variables
MINST_YIELD400	Minimum saturated thickness to support 400 gpm yields, KGS OFR 2002-25C (ft)	Administrative, Planning and Management variables
MINST_YIELD1000	Minimum saturated thickness to support 1000 gpm yields, KGS OFR 2002-25C (ft)	Administrative, Planning and Management variables
YRS_DEPL_91_01_Y50	Estimated Usable Lifetime, MIN ST for 50 gpm and wl change 1991-2001 (yrs)	Administrative, Planning and Management variables
YRS_DEPL_91_01_Y400	Estimated Usable Lifetime, MIN ST for 400 gpm and wl change 1991-2001 (yrs)	Administrative, Planning and Management variables
YRS_DEPL_91_01_Y1000	Estimated Usable Lifetime, MIN ST for 1000 gpm and wl change 1991-2001 (yrs)	Administrative, Planning and Management variables
WLE_1996_G4	Water level elevation, 1996 (3 year avg in ft- g4 selection)	Water Budget Variables
WLE_2002_G4	Water level elevation, 2002 (3 year avg in ft- g4 selection)	Water Budget Variables
ST_1996_G4	Saturated Thickness, 1996 (3 year avg in ft- g4 selection)	Water Budget Variables
ST_2002_G4	Saturated Thickness, 2002 (3 year avg in ft- g4 selection)	Water Budget Variables
WL_CHG_96_02_G4	Water level change in feet 1996-2002 (ft- g4 selection)	Groundwater Dynamics - changes and trends
PCT_CHNG_96_02_G4	Water level change in percent 1996-2002 (ft- g4 selection)	Groundwater Dynamics - changes and trends
WUSE_DENSITY_2MILE	Average Density of Water Use - 1990 to 2000, 2 mile radius (af/sq.mi)	Water Budget Variables
WUSE_DENSITY_5MILE	Average Density of Water Use - 1990 to 2000, 5 mile radius (af/sq.mi)	Water Budget Variables
WUSE_DENSITY_10MILE	Average Density of Water Use - 1990 to 2000, 10 mile radius (af/sq.mi)	Water Budget Variables
ST_PRE_G3	Predevelopment saturated thickness (ft)	OFR 2001-45 and 2002-26- GMD 3 Only
ST_2000_G3	Saturated thickness, 2000 (ft)	OFR 2001-45 and 2002-26- GMD 3 Only
STCHNG_9800_G3	Water level change 1997-2000 (ft)	OFR 2001-45 and 2002-26- GMD 3 Only
DTW2000_G3	Depth to water, 2000 (3 year avg in ft)	OFR 2001-45 and 2002-26- GMD 3 Only
ST_2010_G3	Projected saturated thickness, 2010 (ft)	OFR 2001-45 and 2002-26- GMD 3 Only
ST_2025_G3	Projected saturated thickness, 2025 (ft)	OFR 2001-45 and 2002-26- GMD 3 Only
ST_2100_G3	Projected saturated thickness, 2100 (ft)	OFR 2001-45 and 2002-26- GMD 3 Only
STCHNG_PRE00_G3	Actual change in saturated thickness, predevelopment to 2000 (ft)	OFR 2001-45 and 2002-26- GMD 3 Only
STPCT_PRE00_G3	Percent change in saturated thickness, predevelopment to 2000	OFR 2001-45 and 2002-26- GMD 3 Only
BDRCK_ELEV_G3	Bedrock elevation (ft)	OFR 2001-45 and 2002-26- GMD 3 Only