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Analysis, Design and Implementation of a Pilot Relational Database for Groundwater in the State of Arkansas

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ANALYSIS, DESIGN AND IMPLEMENTATION OF A PILOT RELATIONAL DATABASE FOR GROUNDWATER IN THE STATE OF ARKANSAS

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ABSTRACT

ANALYSIS, DESIGN AND IMPLEMENTATION
OF A PILOT RELATIONAL DATABASE FOR GROUNDWATER
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There are several agencies within the state of Arkansas dealing with underground water. Each agency has its own database that acts as an isolated depository of data. Practically, the communication among these databases is zero, not because there is no need for it, but because the communication is very difficult if not impossible. Data redundancy, inconsistency, and lack of integrity is overwhelming.

In this study we have addressed the problem of lack of unity among the databases belonging to different agencies. Also, as an alternative we have developed a relational database. In this database the data was normalized to 4NF. This pilot program uses the ORACLE Database Management System. It deals with data for 38 water wells. For each well more than 300 data attributes have been collected where available.

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Keywords -- Data/Groundwater/System Analysis

TABLE OF CONTENTS

Page

Abstract i

Introduction 1

A. Purpose and Objectives 1

B. Related Research and Activities 1

Methods and Procedures 1

A. Data Analysis 1

B. Database Design 8

C. Implementation Notes. 9

Principal Findings and Significance 12

Conclusions 18

Literature Cited 19

Appendix I 21

Appendix II 50

INTRODUCTION

A. Purpose and Objectives

A high volume of data - over 1/2 billion bytes - has been gathered for over 100,000 water wells across the state of Arkansas. This high volume of data encompasses a broad range of attributes in which the physical characteristics of the wells are at one end of the spectrum, and pollutants in the wells' water are at the other end. This data has been collected by many State and United States government agencies, and each agency has its own data storage system.

The nature of this research was to determine what data is gathered by different departments, define the enterprise rules (determination of associations among operational data), design a relational database normalized to 4NF by determining the functional dependencies and from them designing the conceptual model (logical database), and implement a pilot database by loading the relational database in the computer and by manipulating the database using the data language. This pilot database included data from thirty (30) wells and included at least 300 data attributes.

B. Related Research and Activities

Based on our best knowledge and reports from Dr. Leslie Mack of the Arkansas Water Resources Research Center, there has been virtually no attempt in the state of Arkansas, or nationwide for that matter, to organize all the data from all the agencies effectively.

METHODS AND PROCEDURES

A. Data Analysis

Interviews were conducted with authorities in various branches of government who deal with ground water, including Ken Acklin at the Arkansas Water Well Construction Commission (AWWCC), Jon Sweeny, and Todd Fugitt of the Arkansas Soil and Water Conservation Commission (ASWCC), Mr. Baber at the Arkansas Geological Commission (AGC), A.H. (Gus) Ludwig, and Keith Stafford at the United States Geological Survey (USGS). Information was also gathered from Department of Pollution Control and Ecology (DPCE) and the Arkansas Department of Health. The results of these studies follow.

1. The United States Geological Survey, the USGS, Water Resource Division, collects data about ground water for internal use and for several other agencies. These data is kept in several files. All data were once kept centrally on a computer in Reston, VA. Access was by a tree-structured database, WATSTORE [1]. All the data for all fifty states plus the territories was stored there. Everything was loosely tied together under the header file, but one could not perform a join with two subsidiary files [2]. This system is still in place, but data is now first entered on disk at each state and copies are sent to Reston monthly. WATSTORE is less used now because of the data being slightly out-of-date. Instead, data access is through four (4) database systems besides WATSTORE. In a few years, there will be a WATST0RE II Distributed

Information System (DIS), which will supersede the systems described here [3].

At the USGS, water wells are identified by latitude-longitude (Site ID or SID) in all files except the NEWSWUDS (water use) file, and the USGS is working on providing latitude-longitudes for the NEWSWUDS file. Once this ID number is established, it is not changed even if the latitude-longitude data is found to be in error, although the data values for latitude and longitude are corrected. However, there are a few wells to which operators in the past have accidentally assigned more than one ID number. Wells could also be identified by landnet (township, range, etc.), but this does not work for all wells because several wells near each other could have the same landnet. If wells have the same landnet they are also assigned a sequence number and this makes up the Station Name. In the field this is used to locate the well because it is difficult to obtain a latitude-longitude field measurement accurate enough to find the well.

The Quality of Water (QW) file contains data about water quality testing [4]. Access is by the Interim Water Quality Data Processing System. The Water-Quality file is a keyed indexed file managed by a PR1ME software system called MIDAS (Multiple Indexed Data Access System). In addition to the Water-Quality file, the system includes a Station Header file used to select QW records by location, and additional files used for checking the validity of parameter codes, aquifer codes, and so forth. There are plans to replace this system.

Each QW test has a parameter code and value, and information about when and under what conditions the water was sampled. There are over a thousand parameter codes for various parameters that can be measured in water, such as temperature, specific conductivity, and various chemical elements and compounds. These parameter codes are standardized among the government agencies which collect water data. The STORET [5] database maintained by DPCE is similar to the QW file and uses the same parameter codes but they have collected different data sets. The QW data is also made available through STORET. The STORET database is available online at the USGS, but there is some problem with water well identification not being comparable to the USGS water well identification system.

QW data for four parameter codes, and also some one-time measurements, are kept in the GWSI file described later. Yet another physical layer is added which in turn contributes more to the confusion.

The Daily Values file contains information about water wells which have water level recorders attached. Measurements of water levels are made at regular intervals by recorders attached to the wells. Most commonly, water level readings are taken hourly but the water level can be measured anywhere between every five minutes and once a day. The raw data goes into the Unit Values file. Then the daily average is calculated, and this data goes into the Daily Values file. The ADR System Menu is used for data maintenance [6].

The Water Use (NEWSWUDS) file is maintained by the USGS for the ASWCC. It contains information about water used under permits issued by the ASWCC. It contains water-user data; measurement point data about where water is obtained, used, conveyed, or returned; amount used and returned yearly and monthly; and extended data about irrigated crops, public water supply and power generation [7]. Each water-user is assigned an identifier, plus he has a permit number assigned by the ASWCC. Also, each water source or destination has an ID, because one water user may use water from several wells or streams and discharge the water in yet another location. These data are accessible by water-user ID, by water-use category, by geographical location using FIPS codes, or by user-defined region. The monthly water usage may be retrieved by year for each site. No other fields may be used for retrieval. Some of the data are accessible only through the Water User identifier; whereas other data are accessible by the Source/Destination identifier [8]. This is a total disaster for data retrieval. At present, there is no latitude-longitude identification for this file as is now used throughout the other of the USGS databases, but the USGS is working at providing it.

The Ground Water Site Inventory (GWSI) file contains ground water site data and water level data [9]. Each field or attribute of a water well in the GWSI file has been assigned an alphanumeric code ranging from C001 to C813, although all numbers between have not been used. This code can be used instead of field name in retrieving data. All wells

are primarily identified by latitude-longitude, and landnets are also available.

The GWSI files include geographic data, geologic data, water quality data, water and site use data, data about the pump(s), power source(s), construction of the well, physical characteristics of the well hole, casing, and openings, geohydrologic and aquifer data, hydraulics data, discharge data, owner, minor site repairs, remarks, visits, other ID's, logs, multiple well groups, cooperator data, data for collection wells, water levels, and measuring point data.

The Ground Water (GW) file retrieval system can be invoked under GWSI to obtain water level tables, or the same data can be obtained under the GWSI data retrieval system, which is a System 2000 derivative. Instead of creating views within one database retrieval system with one data language, two retrieval programs are available.

There are other problems with the USGS data storage system. One main problem is that there are five (5) data retrieval systems to learn - QW, Daily Values, Water Use, GWSI, and WATSTORE at Reston. Data cannot be obtained from several files with one query.

The Water Use file has measuring point data which contains the same data attributes as the GWSI file, but there is no way to combine the two until better identification is supplied.

2. The Arkansas Water Well Construction Commission (AWWCC). Whenever a commercial-type water well producing over 50,000 gallons of water a day is drilled, copies of the Water Well Construction form are

received at the AWWCC. A duplicate of this form is filed at the AGC. These data are not kept in a computerized database. It is filed by the AGC by county, by year and by contractor. They recently adopted a new form. The old form had no latitude-longitude [10]. It is optional on the new form, but they do have landnet [11]. Most, but not all, of the data attributes are the same as those collected by the USGS on their GWSI wells, but have different names.

3. Arkansas Soil and Water Conservation Commission (ASWCC). ASWCC uses data from the USGS, the DPCE, the Soil Conservation Service (SCS) and AWWCC to define critical areas where the water supply is developing problems. They also register ground water and surface water use, especially for irrigation. This is contracted to the USGS, as discussed under the USGS NEWSWUDS file section.

4. The Arkansas Geologic Commission (AGC). The AGC does some studies cooperatively with the USGS, gathers some data independently, especially in northwest Arkansas, and keeps some data in books.

5. The Department of Pollution Control and Ecology (DPCE). The DPCE tests ground water for pollutants. Their data is stored in STORET, accessible to the USGS also. The wells in each county have a number. They do not necessarily have complete latitude-longitude (Site ID) or Township-Range (Station Name), which leads to identification problems when trying to use their QW data along with the USGS QW data, but the data is reciprocally available.

6. Arkansas State Department of Health. This department takes water samples from public water supplies, sent by county health units or other entities, and tests them for potability. The wells have a number assigned. This data sometimes includes the water user name, but identification of the wells by latitude-longitude or landnet would be a problem.

B. Database Design

The first step in designing the database was to determine what data was being collected, as described above. The USGS kept the most complete list of data attributes, so it was decided to use their alphanumeric codes and attribute names where possible. When there was some data attribute which they did not collect, we assigned our own code and name. In our design each relation has two views, one which uses the attribute name and one which uses the attribute code. Retaining the old names as much as possible makes it easier for those who already are familiar with the USGS names. We ended up with around 306 attributes for each water well.

The wells are identified by latitude-longitude site IDs concatenated with the name of the source agency which provided the data. Where site ID is not available, sequence numbers could be substituted. Site ID is more useful in selecting wells geographically and in insuring that the same well isn't described under several IDs.

The next step was to determine the functional dependencies (see Appendix I). This process shows the relationships between data

attributes - which combination of attributes defines a unique value in other attributes.

These functional dependencies were used to group the attributes into relations (see Appendix II). There are forty-two (42) relations and they have been normalized to 4th Normal Form[1]. Data in different relations may be retrieved together by performing a join, usually on the Site ID.

C. Implementation Notes

The relational database which we had available at the University of Arkansas at Little Rock was the ORACLE relational database management system (Version 5) on a VAX-780 Super minicomputer star cluster with four nodes. ORACLE was also installed on a PC-compatible computer. The ground water database was initially started on PC and finally defined on the VAX, because it has less of a tendency to slow down with larger amounts of data. The relations determined above were defined in the ORACLE database using the SQL data language.

We wanted to use the Oracle Data Loader (ODL) to load data into the database wherever possible. The ODL requires fixed-length records with each field a fixed number of characters. A control file must be created which defines the name, location and length of each field in a

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[1] Normalization process removes unacceptable functional dependencies from a relation by decomposing it to a new set of relations. This process has different levels. The practical levels are first, second, third, and fourth Normal Forms (1NF, 2NF, 3NF, 4NF). The relations in 4NF, practically, do not have any unacceptable functional dependencies. Such relations are free of operational anomalies.

record, gives the length of the record and name of the file which contains the record, and assigns each field to an attribute within a relation in ORACLE.

Data from the thirty-three (33) master wells was obtained from the USGS GWSI, QW, WL, and Daily Values files. None of these wells had data in the Water Use file, so data from this file was obtained on five (5) additional wells. This data was downloaded to a micro computer and then uploaded to the VAX.

All of this data had variable length records. ODL requires fixed length records. On a larger project, it would save time to write a C-language program to read in the variable length records and write out fixed length records, but for this project it was decided to edit them to be fixed length with a text editor by padding them with blanks to a uniform length. To be usable the output from certain files required additional processing as described below.

The GWSI data was obtained in twenty-eight (28) files with records of eighty (80) characters or less. This was so that they could be prepared for ODL with the text editor. Each record had the Site ID (SID) followed by several data fields. The data was loaded into temporary load relations within ORACLE and then reorganized into the permanent relations, because all the data for the permanent relation may not be in the same load file, which gave trouble with the attributes defined as not null.

The data obtained with the WL data system turned out to be the same as the data obtained by the GWSI data system, but this was not

determined until all the data was loaded into the ORACLE database so that a query could be performed to ask for all the combined SID/dates in one data set which were not the same as the SID/dates in the other data set.

The QW data was obtained in a card format consisting of a header card describing a visit to a well (date, time, aquifer sampled, conditions at time of sampling), followed by many * cards, each of which described three tests performed on the water obtained on this visit [12]. This data was split into two files, one containing the header cards and one containing the * cards. Each * card was related to the appropriate header card by adding a sequence number to both. This data was now ready to be loaded into temporary and permanent ORACLE relations.

The Daily Values file contained the average daily water levels for those of the master wells which had recorders attached. The output for each well consisted of a header card followed by many water-level measurement cards. There were four water-level measurement cards per month, with sequence numbers one through four, and each card contained eight values except for the last one, which varied by month length. These cards were edited to include the header information (primarily Site ID) on every line. After these were edited to fixed length and loaded into a temporary table with the eight water level values named VALUE1 - VALUE8, the data was loaded into the permanent table in eight operations, one for each value field, using the sequence number to calculate the day of the month in the function: day of month = value-

number + 8 * (sequence-number - 1). For example, for VALUE1, the day of month would be 1 + 8 * (sequence number - 1).

The Water Use data was in the form of a report which was entirely unsuitable for loading using ODL, since it was not composed of repeating records. A SQL*Forms data entry form was made for this part of the data, and the data was entered by filling in the blanks.

PRINCIPAL FINDINGS AND SIGNIFICANCE

The bottlenecks to unifying all data from all the agencies are lack of a standard method of water well identification, existence of multiple data languages, nonflexibility in having direct access to some of the data fields, ignoring the creation of views, having noncontrolled data redundancy, and using data manually. Each of these bottlenecks is addressed below, and also the solution provided by our system is described.

The best candidates for an ID are latitude-longitude or landnet plus a sequence number for the wells which are geographically close together. Latitude-longitude is useful from a retrieval point of view, because by specifying a certain range of ID's one can retrieve water well information from a specific geographic area. Landnet is easier to use in locating wells in the field. Water wells are identified by latitude-longitude (Site ID or SID) plus source agency (default USGS) in all files at the USGS except the NEWSWUDS (water use) file, and the USGS is in the process of providing latitude-longitudes for the NEWSWUDS file. Landnet (station name) is also determined for all wells and can be used

for a secondary key. The STORET database at DPCE assigns a number to the wells within a county, records a landnet, and on some wells has a USGS lat-long identifier. The AWWCC construction data is filed manually by the AGC by county, by year and by contractor. This data is thus difficult to access. The old form had no latitude-longitude. It is optional on the new form, but they do have landnet. The Arkansas State Department of Health assigns a well number .

Our system attempts to solve the identifier problem by using a latitude-longitude ID wherever available. If funds were available, it would be best to assign them to all wells, but in the interim sequence numbers concatenated with source agency provides a unique ID where latitude-longitude ID's are not available.

Data cannot be obtained from several files with one query. The problem stems from the fact that in the USGS alone there are five (5) data retrieval systems to learn - QW, Daily Values, Water Use, GWSI, and WATSTORE at Reston. Our system solved this problem by using one data language and also one centralized database. Since all the data is in one database, queries which once took several hours to answer because the data was in several files could be answered in minutes.

The Water Use file (NEWSWUDS) has several problems. Only certain fields can be used for data retrieval. Some of the data is accessible only through the Water User identifier, whereas other data are accessible by the Source/Destination identifier (A major hinderance to data retrieval). Our system solved this problem by creating unified

relations and using one data language. In fact, all of the attributes (fields) of a relation could be used for retrieval. This flexibility allows more effective use of data.

The Ground Water (GW) file retrieval system can be invoked under GWSI to obtain water level tables, or the same data can be obtained under the GWSI data retrieval system. Instead of creating views within one database retrieval system with one data language, two retrieval programs are available. Our system solved this problem by enabling the user to create user views which are acting as templates over the database.

One example of data redundancy is the quality of water data. There are QW data in the QW file and the GWSI file at the USGS. Also QW data on other wells are kept at the agencies which developed the data, most notably at DPCE (STORET) and domestic wells at the Arkansas State Department of Health. Our system solved this problem in the design step. Through the process of data normalization we have eliminated all the harmful data redundancy. Therefore there are no problems with data being updated in one file and not another or having to search in several places to find the needed data.

The AWWCC data on well construction is not computerized. Most, but not all, of the data attributes are the same as are collected by the USGS on their GWSI wells, but by different names and on different wells. All attributes have been included in our database so that the data could be entered if funds become available.

A SQLFORM data entry form could be constructed which only includes the data AWWCC needs, with the names AWWCC uses, so that they would never need to know what names are used in the underlying data structure. Since the AWWCC does not keep latitude-longitude, a sequence number would be entered where the USGS keeps their Site ID. The key is composed of the Site ID plus the Source Agency, so this would give a unique ID. SQL*Forms can be set up to assign the sequence numbers automatically. This would also work for the other agencies which do not have latitude-longitudes. Of course, this is not as good as a true latitude-longitude ID because it indicates nothing about geographic region.

Many researchers utilize extra-agency data, but combining the data manually is much slower than if a combined database were used.

Our system would allow the researcher to uncover hitherto unnoticed facts derivable from the inter-related information among related datum which are now scattered in various files and agencies. More specifically, this database would unite all the QW data. It would provide easy access to the data, efficient storage of data, and preserve the integrity and reliability of the data.

This pilot database used the ORACLE relational database management system. It uses SQL, the same language used with IBM's SQL/DS and DB2, although ORACLE came out with a system using SQL first. This language can be used for retrieval, data manipulation, data definition, and data access control. It can be used interactively or

imbedded in standard programming languages. Other tools are also available, including the SQL*Forms application generator and screen formatter, a report writer, color graphics, document preparation and text merge, ODL data loader, and a data dictionary which can be queried using SQL just like any other relation in the database [13].

SQL*Forms produces fill-in-the-blank data entry forms. It is a simple and easy way to maintain a database or enter data not available in ASCII fixed length files, but when a large amount of data is to be entered from pre-existing files, ODL is faster and eliminates data entry errors. SQL*Forms can be set up to automatically assign sequence numbers, enter default values in certain fields, and validate data entered to allow just numeric or alphabetic data in a field, or to allow only values from a list to be entered, or to not allow "orphan" data to be entered without required header information [14]. We set up a relation which would contain the meanings of codes, of which there are many. It could be used to automatically give the meaning of codes when data is retrieved using SQL*FORMS.

ORACLE is available on different sizes and types of computers, including IBM PC compatible computers as well as larger computers. All versions work more or less the same.

A useful ability of the system is the ability to make views for the user. A view can present the data in the manner to which the user has been accustomed. The user could only "see" the data which he needed, organized with several relations combined, with the names he prefers.

However, there are pitfalls for the unwary in using ORACLE. If the user breaks to get out, the data is lost from the relations being accessed. Therefore, the user must be careful to back up all the data.

Retrieval time can be slow with larger amounts of data on unindexed fields. Indexing frequently-used keys will improve performance. Also some systems support clustering, in which related data from different relations is stored physically together on the disk. This is available on our PC system but not on the VAX.

When data is entered or updated in the database, the changes are not actually made permanent until they are committed. This gives the user a chance to recover if a mistake is made, but if an inexperienced user has been entering data for two hours, forgot to ever commit the data, and the system goes down, all the work is lost. This could be avoided if the SQL*Form were set up to automatically back up work, which it could be, but this creates overhead in maintaining the system.

CONCLUSION

The study of the current status of the different databases in different agencies which deal with ground water shows that they are suffering from the following:

. Data is not distributed systematically. Each agency creates its own database for its own use. In fact, they act as perfectly isolated data depositories.

. Communication among these distributed databases is practically zero. As a result, almost no agency is willing to seek data from other databases, outside of their own home-made database.

. Data redundancy and inconsistency is overwhelmingly high as a result and the integrity of the databases is questionable.

. Current systems are not able or their users are not willing to create different views of the system as it is needed. Instead they are creating new physical data- bases which in turn contributes to the data redundancy, data inconsistency and lack of integrity of the databases.

. The user of the current databases must be highly knowledgeable and well trained to use the system.

Our system is able to overcome the above shortcomings of the existing systems.

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APPENDIX I

FUNCTIONAL DEPENDENCIES

The functional dependencies are defined for the following set of groups of data: Header data, LIFT (PUMP) data, CONSTRUCTION data, Hole data, CASING data, OPENNING data, GEOHYDROLOGIC UNIT DESCRIPTIONS data, AQUIFER data, HYDRAULICS data, MEASUREMENTS MADE ON HYDRAULICS INTERVAL data, NETWORK data, DISCHARGE data, OWNER data, MISCELLANEOUS data, REMARKS data, VISITS data, DIFFERENT IDENTIFICATION data, (we refer to it as OTHER ID's data), QUALITY OF WATER - VISIT data, QUALITY OF WATER-MEASUREMENTS data, LOGS data, MULTIPLE WELL GROUPS data, COOPERATOR data, COLLECTION WEELS data, WATER-LEVEL data, MEASURING POINT data, WATER USER data, SOURCE/DESTINATION OF WATER USED data, STANDARD INDUSTRIAL CLASSIFICATION data, ANNUAL data, MONTHLY WITHDRAWALS/RETURNES data, IRRIGATION data, PUBLIC SUPPLIERS data, and POWER data. Within each group the functional dependecies have been defined.

NOTATION: If data item ID determines the NAME then this functional dependecy is shown as ID -> NAME. This notation is read as "ID determines NAME" or "NAME is functionally dependent on ID.

If data item SOCIAL_SEC determines the STUDENT_ID and the STUDENT_ID determines the SOCIAL_SEC then, this functional dependency is shown as SOCIAL_SEC <-> STUDENT_ID.

HEADER data

(This type data is found in the GWSI header file, NEWSWUDS measuring point data, and a little in the AWWCC data.)

C001 Site ID, C4 Source agency -> C002 Code for type of site.

C002 Type of site <-> type explanation.

C001 Site ID, C4 Source agency -> C005 Project number.

C004 Source agency code <-> Source agency name.

C001 Site ID, C4 Source agency -> C006 District code.

C006 District code <-> District name.

C001 Site ID, C4 Source agency -> C007 State code.

C007 State code <-> State name.

C001 Site ID, C4 Source agency -> C008 County code.

C008 County code <-> County name.

C001 Site ID, C4 Source agency -> C009 Latitude.

C001 Site ID, C4 Source agency -> C010 Longitude.

C001 Site ID, C4 Source agency -> C011 Lat-long accuracy code.

C011 Lat-long accuracy code <-> Lat-long accuracy.

C001 Site ID, C4 Source agency -> C012 Local number.

C001 Site ID, C4 Source agency -> C013 Land-net location .

C001 Site ID, C4 Source agency -> C014 Name of location map.

C014 Name of location map -> C015 Scale of location map.

C001 Site ID, C4 Source agency -> C016 Altitude of land surface (Land surface datum or LSD).

C001 Site ID, C4 Source agency -> C017 Method altitude determined (Code: A, L, M).

C017 Method altitude determined <-> Method name (altimeter, level, map).

C001 Site ID, C4 Source agency -> C018 Altitude accuracy.

C001 Site ID, C4 Source agency -> C801 Drainage basin code.

C801 Drainage basin code <-> Drainage basin name.

C001 Site ID, C4 Source agency -> C019 Topographic setting (code).

C019 Topographic setting (code) <-> topography explanation.

C001 Site ID, C4 Source agency -> C805 Flags - Instruments at site (This, when expanded, yields a list of instruments).

C001 Site ID, C4 Source agency -> C806 Remarks.

C001 Site ID, C4 Source agency -> C020 Hydrologic unit code.

C020 Hydrologic unit code <-> Hydrologic unit.

C001 Site ID, C4 Source agency -> C021 Date well constructed.

C001 Site ID, C4 Source agency, Site use sequence no. -> C023 Use of site (code).

C023 Use of site (code) -> Use of site explanation.

C001 Site ID, C4 Source agency, Water use sequence no. -> C024 Use of water (code).

C024 Use of water (code) -> Water use explanation.

If use = "A" (Airconditioning), .

C001 Site ID, C004 Source agency -> Medium into which water is returned.

C001 Site ID, C4 Source agency -> C714 Primary aquifer.

(C714, C93) Aquifer codes <-> Aquifer name.

(C714, C93) Aquifer codes <-> C713 Aquifer type (code).

C713 Aquifer type <-> Aquifer type name.

C001 Site ID, C4 Source agency -> C027 Hole depth.

C001 Site ID, C4 Source agency -> C028 Depth of well.

C001 Site ID, C4 Source agency -> C029 Source of depth data (code).

C029 Source of depth data (code) <-> Source explanation.

C001 Site ID, C4 Source agency -> C030 (Inventory) Water level.

C001 Site ID, C4 Source agency -> C031 Date water level measured.

C001 Site ID, C4 Source agency -> C033 Source of water level data (code).

C033 Source of water level data code <-> Source explanation.

C001 Site ID, C4 Source agency -> C034 Method water level measured (code).

C034 Method water level measured (code) <-> Method explanation.

C001 Site ID, C4 Source agency -> C037 Site status at water-level measurement (code).

C037 Site status at water-level measurement (code) <-> status.

C001 Site ID, C4 Source agency -> C040 Date site data last updated.

C1 Site ID, C4 Source agency -> C802 Station type codes.

C802 Station type codes <-> Station types.

C1 Site ID, C4 Source agency -> C803 Agency use of site code.

C803 Agency use of site code <-> Agency use description.

C1 Site ID, C4 Source agency -> C804 Flags - Types of data collected.

C804 Flags - Types of data collected <-> Types of data explanation.

C1 Site ID, C4 Source agency -> C711 Date sit established / inventoried.

C1 Site ID, C4 Source agency -> C303 Date record created.

C1 Site ID, C4 Source agency -> C712 Other GW files.

LIFT (Pump) Data

(Found in GWSI record type LIFT).

C001 Site ID, C4 Source agency, C254 Record sequence no -> C043 Type of lift (code).

C043 Type of lift (code) -> Lift name.

C001 Site ID, C4 Source agency, C254 Record sequence no -> C038 Date lift data collected.

C001 Site ID, C4 Source agency, C254 Record sequence no -> C044 Depth to intake.

C001 Site ID, C4 Source agency, C254 Record sequence no -> C045 Type of power (code).

(C045, C056) Type of power (code) <-> Power description.

C001 Site ID, C4 Source agency, C254 Record sequence no -> C046 Horsepower rating.

C001 Site ID, C4 Source agency, C254 Record sequence no -> C048 Manufacturer of lift device.

C001 Site ID, C4 Source agency, C254 Record sequence no -> C049 Serial number of lift device.

C001 Site ID, C4 Source agency, C254 Record sequence no -> C050
Name of power company.

C001 Site ID, C4 Source agency, C254 Record sequence no -> C051
Power company account number.

C001 Site ID, C4 Source agency, C254 Record sequence no -> C052
Power-meter number.

C001 Site ID, C4 Source agency, C254 Record sequence no -> C053
Power-consumption coefficient.

C001 Site ID, C4 Source agency, C254 Record sequence no -> C054
Company that maintains lift device.

C001 Site ID, C4 Source agency, C254 Record sequence no -> C255
Additional lift (above land surface).

C001 Site ID, C4 Source agency, C254 Record sequence no -> C056
Type of standby power (code).

C001 Site ID, C4 Source agency, C254 Record sequence no -> C057
Horsepower of standby power source.

C001 Site ID, C4 Source agency, C254 Record sequence no -> C268
Rated pump capacity.

CONSTRUCTION data

(GWSI Record type CONS, AWWCC Data)

C001 Site ID, C4 Source agency, C273 Record sequence no -> C060
Date of construction.

C001 Site ID, C4 Source agency, C273 Record sequence no -> C063
Name of contractor.

C001 Site ID, C4 Source agency, C273 Record sequence no -> U1
Name of driller.

C001 Site ID, C4 Source agency, C273 Record sequence no -> C064
Source of construction data (code).

C064 Source of construction data (code) <-> Source explanation.

C001 Site ID, C4 Source agency, C273 Record sequence no -> C065
Method of construction (code).

C065 Method of construction (code) <-> Method explanation.

C001 Site ID, C4 Source agency, C273 Record sequence no -> C066
Type of finish (code). The finish is called the gravel pack on the Water Well Construction form.

C066 Type of finish (code) <-> Finish explanation.

C001 Site ID, C4 Source agency, C273 Record sequence no -> C067
Type of surface seal (code).

C067 Type of surface seal (code) <-> Seal explanation.

C001 Site ID, C4 Source agency, C273 Record sequence no -> C068
Depth to bottom of seal.

C001 Site ID, C4 Source agency, C273 Record sequence no -> C069
Method of development (code).

C069 Method of development (code) <-> Development code explanation.

C001 Site ID, C4 Source agency, C273 Record sequence no -> C070
Hours of development.

C001 Site ID, C4 Source agency, C273 Record sequence no -> C071
Special treatment during development (code).

C071 Special treatment during development (code) <-> Treatment code explanation.

C001 Site ID, C4 Source agency, C273 Record sequence no -> U2 Disinfectant.

HOLE data

(GWSI record type HOLE, AWWCC data)

The C273 Sequence number ties this record to the construction record. A well may be drilled in several intervals, each with a different diameter.

C001 Site ID, C724 Record sequence number, C273 Record sequence number (cons) -> C073 Depth to top of this interval.

C001 Site ID, C724 Record sequence number, C273 Record sequence number (cons) -> C074 Depth to bottom of this interval.

C001 Site ID, C724 Record sequence number, C273 Record sequence number (cons) -> C075 Diameter of this interval.

CASING Data

(GWSI record type CSNG, AWWCC Data)

The C273 Sequence number ties this record to the appropriate construction record. One well may have several types of casing.

C001 Site ID, C725 Record sequence number, C273 Record sequence number - cons -> C077 Depth to top of this casing string.

C001 Site ID, C725 Record sequence number, C273 Record sequence number - cons -> C078 Depth to bottom of this casing string.

C001 Site ID, C725 Record sequence number, C273 Record sequence number - cons -> C079 Diameter of this casing string.

C001 Site ID, C725 Record sequence number, C273 Record sequence number - cons -> C080 Casing material (code).

C080 Casing material (code) <-> Casing material type name.

C001 Site ID, C725 Record sequence number, C273.

Record sequence number - cons -> C081 Wall thickness of this casing.

OPENING (SCREENS) Data

(GWSI Record type OPEN, AWWCC data)

The C273 sequence number ties this record to the appropriate construction record. One well may be constructed with several openings or screens.

C001 Site ID, C726 Record sequence number, C273 Record sequence number - cons -> C083 Depth to top of this open interval.

C001 Site ID, C726 Record sequence number, C273 Record sequence number - cons -> C084 Depth to bottom of this open interval.

C001 Site ID, C726 Record sequence number, C273 Record sequence number - cons -> C085 Type of openings in this interval (code).

C085 Type of openings in this interval (code) <-> Type openings explanation.

C001 Site ID, C726 Record sequence number, C273 Record sequence number - cons -> C086 Material in this interval (code).

C086 Material in this interval (code) <-> Material explanation.

C001 Site ID, C726 Record sequence number, C273 Record sequence number - cons -> C087 Diameter of this open interval.

C001 Site ID, C726 Record sequence number, C273 Record sequence number - cons -> C088 Width of openings.

C001 Site ID, C726 Record sequence number, C273 Record sequence number - cons -> C089 Length of openings.

GEOHYDROLOGIC UNIT DESCRIPTIONS

GWSI Record type GEOH, found on the SITE SCHEDULE
and the LITHOLOGIC SCHEDULE.

C001 Site ID, C721 Record sequence No (Number for this set of logs), C4 Source agency code, C256 Parent sequence number (for this unit) -> C091 Depth to top of interval.

C001 Site ID, C721 Record sequence No (Number for this set of logs), C4 Source agency code, C256 Parent sequence number (for this unit) -> C092 Depth to bottom of interval.

C001 Site ID, C721 Record sequence No (Number for this set of logs), C4 Source agency code, C256 Parent sequence number (for this unit) -> C093 Aquifer code.

C093 Aquifer code <-> Aquifer name.

C001 Site ID, C721 Record sequence No (Number for this set of logs), C4 Source agency code, C256 Parent sequence number (for this unit) -> C096 Lithology code.

C096 Lithology code <-> Lithology explanation.

C001 Site ID, C721 Record sequence No (Number for this set of logs), C4 Source agency code, C256 Parent sequence number (for this unit) -> C304 Contributing unit (code).

C304 Contributing unit (code) <-> Contributing unit name.

C001 Site ID, C721 Record sequence No (Number for this set of logs), C4 Source agency code, C256 Parent sequence number (for this unit) -> C097 Description of material (Lithologic modifier).

AQUIFER Data

(SITE SCHEDULE record type AQFR or LITHOLOGIC SCHEDULE, Aquifer data).

C001 Site ID, C742 Record sequence no, C4 Source agency, C256 Parent Sequence no. (Ties to GEOHYDROLOGIC Layer) -> C095 Aquifer date - geo.

C001 Site ID, C742 Record sequence no, C4 Source agency, C256 Parent Sequence no. (Ties to GEOHYDROLOGIC Layer) -> C126 Aquifer static level.

C001 Site ID, C742 Record sequence no, C4 Source agency, C256 Parent Sequence no. (Ties to GEOHYDROLOGIC Layer) -> C132 Aquifer contribution.

NHYDRAULICS Data

(GWSI data entered on the HYDRAULICS DATA form)

C001 Site ID, C099 Parent sequence number - hydr (Entry no), C4 Source agency -> C100 Hydrologic unit ID (Geohydrologic unit tested).

C100 Hydrologic unit ID (Geohydrologic unit tested) <-> Hydrologic unit name.

C001 Site ID, C099 Parent sequence number - hydr (Entry no), C4 Source agency -> C101 Test interval - top.

C001 Site ID, C099 Parent sequence number - hydr (Entry no), C4 Source agency -> C102 Test interval - bottom.

C001 Site ID, C099 Parent sequence number - hydr (Entry no), C4 Source agency -> C103 Hydraulic unit type code.

C103 Hydraulic unit type code <-> Hydraulic unit type name (aquifer or confining layer).

C001 Site ID, C099 Parent sequence number - hydr (Entry no), C4 Source agency -> C104 Hydraulic remarks.

C001 Site ID, C099 Parent sequence number - hydr (Entry no), C4 Source agency -> C305 Hydraulics source agency.

Measurements made on a HYDRAULICS interval

(Data related to a hydraulics tuple with the C99 Parent sequence number Data found in the GWSI COEF record).

C001 Site ID, C099 Parent sequence number - hydr (Entry no), C106 Sequence number for COEF relation -> C107 Transmissivity.

C001 Site ID, C099 Parent sequence number - hydr (Entry no), C106 Sequence number for COEF relation -> C108 Horizontal conductivity.

C001 Site ID, C099 Parent sequence number - hydr (Entry no), C106 Sequence number for COEF relation -> C109 Vertical conductivity.

C001 Site ID, C099 Parent sequence number - hydr (Entry no), C106 Sequence number for COEF relation -> C110 Storage coefficient.

C001 Site ID, C099 Parent sequence number - hydr (Entry no), C106 Sequence number for COEF relation -> C111 Leakance.

C001 Site ID, C099 Parent sequence number - hydr (Entry no), C106 Sequence number for COEF relation -> C112 Diffusivity.

C001 Site ID, C099 Parent sequence number - hydr (Entry no), C106 Sequence number for COEF relation -> C113 Specific storage.

C001 Site ID, C099 Parent sequence number - hydr (Entry no), C106 Sequence number for COEF relation -> C271 Barometer efficiency.

C001 Site ID, C099 Parent sequence number - hydr (Entry no), C106 Sequence number for COEF relation -> C306 Porosity.

NETWORK Data

(This data would not be needed if all data were in one database. It is found in GWSI, NETW record.)

C001 Site ID, C4 Source agency, C730 Sequence number -> C706 Data type.

C001 Site ID, C4 Source agency, C730 Sequence number -> C115 Begin year.

C001 Site ID, C4 Source agency, C730 Sequence number -> C116 End year.

C001 Site ID, C4 Source agency, C730 Sequence number -> C120 General type of analyses.

C001 Site ID, C4 Source agency, C730 Sequence number -> C117 Source agency.

C001 Site ID, C4 Source agency, C730 Sequence number -> C118 Frequency of collection.

C001 Site ID, C4 Source agency, C730 Sequence number -> C133 Method of collection.

C001 Site ID, C4 Source agency, C730 Sequence number -> C307 Water quality analyzing agency.

C001 Site ID, C4 Source agency, C730 Sequence number -> C257 Network site code.

C001 Site ID, C4 Source agency, C730 Sequence number -> C708 Secondary network site code.

Network site code <-> Network site explanation.

DISCHARGE Data

(GWSI DSCH record)

C001 Site ID, C4 Source agency, C147 Record sequence no -> C148 Date discharge measured.

C001 Site ID, C4 Source agency, C147 Record sequence no -> C703 Type of discharge (Code: P or F).

C001 Site ID, C4 Source agency, C147 Record sequence no -> C703 Type of discharge (code) <-> Type of discharge name.

C001 Site ID, C4 Source agency, C147 Record sequence no -> C150 Discharge.

C001 Site ID, C4 Source agency, C147 Record sequence no -> C151 Source of discharge data (code).

C151 Source of discharge data (code) <-> Source of discharge data name.

C001 Site ID, C4 Source agency, C147 Record sequence no -> C152 Method discharge measured (code).

C152 Method discharge measured (code) <-> Method name.

C001 Site ID, C4 Source agency, C147 Record sequence no -> C153 Production level.

C001 Site ID, C4 Source agency, C147 Record sequence no -> C154 Static water level.

C001 Site ID, C4 Source agency, C147 Record sequence no -> C155 Source of water-level data (code).

C155 Source of water-level data (code) <-> Source name.

C001 Site ID, C4 Source agency, C147 Record sequence no -> C156 Method water level measured (code).

C156 Method water level measured (code) <-> Method name.

C001 Site ID, C4 Source agency, C147 Record sequence no -> C157 Duration of discharge before producing level.

C001 Site ID, C4 Source agency, C147 Record sequence no -> C272 Specific capacity.

C001 Site ID, C4 Source agency, C147 Record sequence no -> C309 Drawdown.

OWNER Data

(GWSI record type OWNR, AWWCC Data, NEWSWUDS Data)

C001 Site ID, C4 Source agency, C718 Record sequence no -> C159 Date of ownership.

C001 Site ID, C4 Source agency, C718 Record sequence no -> C161 Owner name.

C001 Site ID, C4 Source agency, C718 Record sequence no -> U3 Street.

C001 Site ID, C4 Source agency, C718 Record sequence no -> U4 City.

C001 Site ID, C4 Source agency, C718 Record sequence no -> U5 State.

C001 Site ID, C4 Source agency, C718 Record sequence no -> U6 Zip.

C001 Site ID, C4 Source agency, C718 Record sequence no -> U7 Phone.

DATA ON MINOR SITE REPAIRS

(GWSI, MISCELLANEOUS DATA Form)

C001 Site ID, C4 Source agency, C165 Sequence number for repairs tuple -> C166 Nature of repair (code).

C166 Nature of repair (code) <-> Nature of repair explanation.

C001 Site ID, C4 Source agency, C165 Sequence number for repairs tuple -> C167 Date of repairs.

C001 Site ID, C4 Source agency, C165 Sequence number for repairs tuple -> C169 Name of contractor who made repairs.

C001 Site ID, C4 Source agency, C165 Sequence number for repairs tuple -> C170 Pecent change of performance after repairs.

MISCELLANEOUS OTHER DATA

(This GWSI data tells where other data may be found. In a normalized database this would not be necessary. However, we included the relation so that we would not be in the position of discarding data.)

C1 Site ID, C4 Source agency, C31 Sequence number -> C181 Type of data.

C1 Site ID, C4 Source agency, C31 Sequence number -> C182 Location.

C1 Site ID, C4 Source agency, C31 Sequence number -> C183 Format.

REMARKS

(GWSI record type RMKS)

C001 Site ID, C4 Source agency, C311 Record sequence number -> C184 Remark data.

C001 Site ID, C4 Source agency, C311 Record sequence number -> C185 Remarks - miscellaneous.

VISITS

(GWSI record type VIST)

C001 Site ID, C774 Record sequence no, C4 Source agency -> C187 Date of visit.

C001 Site ID, C774 Record sequence no, C4 Source agency -> C188 Person who made visit.

OTHER ID'S

(GWSI record type OTID. Ideally, all wells would have only one ID, however amongst all the agencies a well may have several already.)

C001 Site ID, C4 Source agency, C736 Record sequence number -> C190 Other ID.

C001 Site ID, C4 Source agency, C736 Record sequence number -> C191 Assignor of other identifier.

QUALITY OF WATER - VISIT Data

(Data found in GWSI QUAL record, QW File, OPCE, Ark. State Department of Health)

C001 Site ID, C4 Source agency, C738 Sequence number -> U61 Medium code.

U61 Medium code <-> Medium name ('6' is Ground Water).

C001 Site ID, C4 Source agency, C738 Sequence number -> U62 Beginning year, prefix.

C001 Site ID, C4 Source agency, C738 Sequence number -> U63 Beginning year.

C001 Site ID, C4 Source agency, C738 Sequence number -> U64 Beginning month.

C001 Site ID, C4 Source agency, C738 Sequence number -> U65 Beginning day.

C001 Site ID, C4 Source agency, C738 Sequence number -> U66 Beginning time.

C001 Site ID, C4 Source agency, C738 Sequence number -> U67 End year.

C001 Site ID, C4 Source agency, C738 Sequence number -> U68 End month.

C001 Site ID, C4 Source agency, C738 Sequence number -> U69 End day.

C001 Site ID, C4 Source agency, C738 Sequence number -> U70 End time.

C001 Site ID, C4 Source agency, C738 Sequence number -> C195 Aquifer sampled.

C195 Aquifer sampled <-> Aquifer name.

C001 Site ID, C4 Source agency, C738 Sequence number -> U71 Analysis status code.

U71 Analysis status code <-> Analysis status.

C001 Site ID, C4 Source agency, C738 Sequence number -> U72 Analysis source code.

U72 Analysis source code <-> Analysis source.

C001 Site ID, C4 Source agency, C738 Sequence number -> U73 Hydrologic condition code.

U73 Hydrologic condition code <-> Hydrologic condition.

C001 Site ID, C4 Source agency, C738 Sequence number -> U74 Sample type code.

U74 Sample type code <-> Sample type.

C001 Site ID, C4 Source agency, C738 Sequence number -> U75 Hydrologic event code.

U75 Hydrologic event code <-> Hydrologic event.

C001 Site ID, C4 Source agency, C738 Sequence number -> U76 Analyzing agency.

QUALITY OF WATER - MEASUREMENTS

(The sequence number ties a parameter measurement to a QW visit.)

C001 Site ID, C738 Sequence number -> C196 Parameter code.

C001 Site ID, C738 Sequence number -> C197 Paramter value.

C001 Site ID, C738 Sequence number -> U77 Remark code.

U77 Remark code <-> Remark explanation.

C001 Site ID, C738 Sequence number -> U78 Quality assurance code.

U78 Quality assurance code <-> Quality assurance value.

C001 Site ID, C738 Sequence number -> U79 Method code.

U79 Method code <-> Method.

C001 Site ID, C738 Sequence number -> U80 Precision code.

U80 Precision code <-> Precision.

LOGS Data

(Found in the GWSI LOGS record)

C001 Site ID, C4 Source agency, C739 Record sequence no -> C199 Type of log (code).

C199 Type of log (code) <-> Type of log name.

C001 Site ID, C4 Source agency, C739 Record sequence no -> C200 Depth to top of logged interval.

C001 Site ID, C4 Source agency, C739 Record sequence no -> C201 Depth to bottom of logged interval.

C001 Site ID, C4 Source agency, C739 Record sequence no -> C202 Source of log data (code).

C202 Source of log data (code) <-> Source name.

DATA FOR MULTIPLE WELL GROUPS

(GWSI MULT record, entered on the MISCELLANEOUS DATA form)

C001 Site ID -> C204 Number of wells/laterals in a group.

C001 Site ID -> C205 Depth of deepest well in group.

C001 Site ID -> C206 Depth of shallowest well in group.

C001 Site ID -> C207 Method wells in group constructed.

C207 Method wells in group constructed <-> Method explanation.

COOPERATOR DATA

(GWSI COOP Record, MISCELLANEOUS DATA entry form)

C001 Site ID -> C213 Cooperators site id.

C001 Site ID -> C214 Contractors (Registration number).

C001 Site ID -> C215 Inspection status.

C001 Site ID -> C216 Reason unapproved.

C001 Site ID -> C217 Date inspected.

C001 Site ID -> C218 Cooperators remarks.

DATA FOR COLLECTION WELLS

(GWSI COLL Record, MISCELLANEOUS DATA entry form)

C1 Site ID -> C204 Number of laterals in group.

C001 Site ID, C220 Entry number -> C221 Depth of lateral in collector well.

C001 Site ID, C220 Entry number -> C222 Length of lateral in collector well.

C001 Site ID, C220 Entry number -> Diameter of lateral in collector well.

C001 Site ID, C220 Entry number -> C224 Mesh of screen in lateral.

WATER-LEVEL Data

(GWSI WATER-LEVEL Data Form)

C001 Site ID, C235 Water-level measurement date, C709 Water level time, C4 Source agency -> C236 Date accuracy code.

C236 Date accuracy code <-> Date accuracy explanation.

C001 Site ID, C235 Water-level measurement date, C709 Water level time, C4 Source agency -> C237 Water level.

C001 Site ID, C235 Water-level measurement date, C709 Water level time, C4 Source agency -> C238 Water-level status (code).

C238 Water-level status (code) <-> Water level status explanation.

C001 Site ID, C235 Water-level measurement date,.

C709 Water level time, C4 Source agency -> C239 Water-level method (code).

C239 Water-level method (code) <-> Water level method explanation.

C001 Site ID, C235 Water-level measurement date, C709 Water level time, C4 Source agency -> C240 Statistics code.

C240 Statistics code <-> Statistics explanation.

C001 Site ID, C235 Water-level measurement date, C709 Water level time, C4 Source agency -> C276 Water level accuracy.

MEASURING POINT Data

(Found on the GWSI MPNT Record. Data about the point at which the tape is put into the well to measure water levels.)

C001 Site ID, C728 Record sequence number, C4 Source agency -> C321 Begin date for use of this measuring point.

C001 Site ID, C728 Record sequence number, C4 Source agency -> C322 End date for use of this measuring point.

C001 Site ID, C728 Record sequence number, C4 Source agency -> C323 Height of this measuring point.

C001 Site ID, C728 Record sequence number, C4 Source agency -> C324 Description of this measuring point.

OTHER DATA AVILABLE

(GWSI OTDT Record. This relation would not be necessary if all data were in one database.)

C001 Site ID, C312 Sequence number, C4 Source agency -> C181 Type of data.

C001 Site ID, C312 Sequence number, C4 Source agency -> C812 Location.

C812 Location <-> Location explanation.

C001 Site ID, C312 Sequence number, C4 Source agency -> C261 Format.

C261 Format <-> Format explanation.

WATER USER DATA

(Data from the WATER USE FILE (NEWSWUDS), about the water user who holds a ASWCC permit)

WU1 Water user ID -> WU2 Facility name.

WU1 Water user ID -> WU2 Water use.

WU1 Water user ID -> CD4 Permit number (ASWCC).

WU1 Water user ID -> WU20 Agency that gave permit (default ASWCC).

WU1 Water user ID -> WU21 Other informatio.

NWU1 Water user ID -> U13 Phone number.

WU1 Water user ID -> U14 Manager of facility.

WU1 Water user ID -> WU4 Facility latitude (which may be different than the latitude of the well).

WU1 Water user ID -> WU5 Facility longitude.

WU1 Water user ID -> WU7 Water user street (This is how to physically locate the facility, which may differ from the mailing address.).

WU1 Water user ID -> WU8 Water user city name.

WU1 Water user ID -> WU9 FIPS City code.

WU1 Water user ID -> WU11 FIPS County code.

WU1 Water user ID -> WU10 FIPS State code.

WU1 Water user ID -> WU12 Mailing street address.

WU1 Water user ID -> WU13 Mailing City address.

WU1 Water user ID -> WU14 Mail state abbreviation.

WU1 Water user ID -> WU15 Zip.

MEASURING POINT Data (Data about the source or destination of water used)

(NEWSWUDS Data)

WU1 Water user ID, CD4 Permit, CD3 Action -> MP9 Source/destination type (Default 'GW' for ground water).

MP9 Source type <-> Source explanation.

WU1 Water user ID, CD4 Permit, CD3 Action -> WU20 Agency.

WU1 Water user ID, CD4 Permit, CD3 Action -> MP8 Aquifer.

WU1 Water user ID, CD4 Permit, CD3 Action -> MP10 Subtype.

WU1 Water user ID, CD4 Permit, CD3 Action -> MP13 Subpermit.

WU1 Water user ID, CD4 Permit, CD3 Action -> MP12 QW Organization.

WU1 Water user ID, CD4 Permit, CD3 Action -> MP2 Description.

WU1 Water user ID, CD4 Permit, CD3 Action -> MP15 Additional data.

WU1 Water user ID, CD4 Permit, CD3 Action -> MP11 Reclaimed waste? Y or N .

WU1 Water user ID, CD4 Permit, CD3 Action -> CD5 Additional source/destination type.

WU1 Water user ID, CD4 Permit, CD3 Action -> CD6 Additional source/destination identifier.

STANDARD INDUSTRIAL CLASSIFICATIONS (SIC)

(NEWSWUDS)

WU1 Water user ID, WU16 SIC -> Sequence number.

IDENTIFIERS

(NEWSWUDS related to GWSI)

WU1 Water user ID, CD4 Permit, C001 Site ID ->Sequence number.

MORE MEASURING POINT DATA

(This data could be determined by Site ID, for sites which have already been assigned an ID. The USGS is in the process of assigning latitude-longitude Site ID's to these sites, so there is no point in assigning sequence numbers for Site ID when it would have to be changed later. To preserve the data, it was loaded into this relation.)

WU1 Water user ID, CD4 Permit -> WU4 Diversion point latitude.

WU1 Water user ID, CD4 Permit -> WU5 Diversion point longitude.

WU1 Water user ID, CD4 Permit -> WU6 Diversion point hydrologic unit code.

WU6 Diversion point hydrologic unit code <-> Hydrologic unit descriptor.

WU1 Water user ID, CD4 Permit -> WU14 State.

WU1 Water user ID, CD4 Permit -> WU11 Aquifer.

ANNUAL DATA

(NEWSWUDS data collected annually about withdrawals and returns)

WU1 Water user ID, CD3 Action, CD4 Permit, CD7 Year -> AM2 Annual amount, average rate of withdrawal/return.

WU1 Water user ID, CD3 Action, CD4 Permit, CD7 Year -> AM15 Measuring method.

WU1 Water user ID, CD3 Action, CD4 Permit, CD7 Year -> AM16 Measuring entity, who measures.

WU1 Water user ID, CD3 Action, CD4 Permit, CD7 Year -> AM17 Accuracy.

WU1 Water user ID, CD3 Action, CD4 Permit, CD7 Year -> AM18 Restrictions, Y or N.

WU1 Water user ID, CD3 Action, CD4 Permit, CD7 Year -> AM19 Salinity; F, S, or U (Fresh, Saline, Undetermined).

WU1 Water user ID, CD3 Action, CD4 Permit, CD7 Year -> AM20 Treatment type.

WU1 Water user ID, CD3 Action, CD4 Permit, CD7 Year -> AM21 Other annual data.

WU1 Water user ID, CD3 Action, CD4 Permit, CD7 Year -> U11 Sequence number used to reference monthly data for this year.

MONTHLY WITHDRAWALS/RETURNS

(NEWSWUDS data)

WU1 Water user ID, U11 Sequence number, U18 Month number -> AM4 Withdrawal or return rate or amount.

EXTENDED DATA - IRRIGATION

(NEWSWUDS Data about irrigation water yearly and monthly usage)

WU1 Water user ID, ED2 Year, ED3 Crop type, SIC code -> EDIR1 Acres irrigated.

WU1 Water user ID, ED2 Year, ED3 Crop type, SIC code -> EDIR2 Annual production of this crop.

WU1 Water user ID, ED2 Year, ED3 Crop type, SIC code -> Annual amount of water applied (average).

WU1 Water user ID, ED2 Year, ED3 Crop type, SIC.

code, U19 Month number -> Monthly amount supplied.

EXTENDED DATA FOR PUBLIC SUPPLIERS

(NEWSWUDS Data about public water utilities)

WU1 Water user ID, ED2 Year, ED3 Site ID -> EDPS1 Domestic population served.

WU1 Water user ID, ED2 Year, ED3 Site ID -> EDPS2 Agricultural connections served.

WU1 Water user ID, ED2 Year, ED3 Site ID -> EDPS3 Commercial connections served.

WU1 Water user ID, ED2 Year, ED3 Site ID -> EDPS4 Domestic connections served.

WU1 Water user ID, ED2 Year, ED3 Site ID -> EDPS5 Industrial connections served.

WU1 Water user ID, ED2 Year, ED3 Site ID -> EDPS6 Irrigation connections served.

WU1 Water user ID, ED2 Year, ED3 Site ID -> EDPS7 Power connections served.

WU1 Water user ID, ED2 Year, ED3 Site ID -> EDPS8 Mining connections served.

EXTENDED DATA: POWER

(NEWSWUDS Data about water used to generate power)

WU1 Water user ID, ED2 Year, ED3 SIC -> EDPW1 Generating capacity.

WU1 Water user ID, ED2 Year, ED3 SIC -> EDPW2 Annual power produced.

WU1 Water user ID, ED2 Year, ED3 SIC, U19 Month -> EDPW3 Monthly production.

APPENDIX II

RELATIONS

For each relation, the relation name is listed, followed in parentheses by the names of the keys, which are underlined, and then the other attribute names. Each attribute has a name such as SCORAC and also an alphanumeric code such as C11. To access the data by name, use the first relation name, such as HEDR. To reference the data by code use the second relation (view) name, such as HEDR2.

Following the listing of relation components is an expanded listing of attributes with a more detailed description.

GENERAL WELL DATA

HEDR, HEDR2 (C1 SID, C4 SAGNCY, C2 SGWTYP, C5 SPRNO, C6 SDIST, C7 SSTATE, C8 SCNTY, C9 SLAT, C10 SLONG, C11 SCORAC, C12 SNAME, C13 SLNDNT, C14 SMAP, C16 SDATUM, C17 SALTMT, C18 SALTAC, C19 STOPO, C20 SHUC, C801 SBASIN, C2 SGWTYP, C805 SINST, C21 SCONDT, C27 SHDEPT, C28 SWDEPT,C29 SWDSRC, C30 SINVWL, C31 SIWLDT, C33 SIWLSC, C34 SIWLMT, C37 SIWLST, C40 SUPDAT, C802 STYPE, C803 SUSE, C804 SDATA, C711 SINVDT, C303 SCRDAT, C712 SCWFLE, C713 SAQTYP, C714 SAQUFR, C806 SREMRK)

C1 SID	CHAR(15) Site ID.
C4 SAGNCY	CHAR(5) Source agency.
C2 SGWTYP	CHAR(1) Type of site.
C5 SPRNO	CHAR(12) Project number.

C6 SDIST	CHAR(3) District code.
C7 SSTATE	CHAR(2) State code.
C8 SCNTY	CHAR(3) County code.
C9 SLAT	CHAR(7) Latitude.
C10 SLONG	CHAR(8) Longitude.
C11 SCORAC	CHAR(1) Lat-long accuracy code.
C12 SNAME	CHAR(50) Local number.
C13 SLNDNT	CHAR(23) Landnet location.
C14 SMAP	CHAR(20) Name of location map.
C16 SDATUM	CHAR(8) Land surface datum (LSD) Altitude of land surface.
C17 SALTMT	CHAR(1) Method altitude determined.
C18 SALTAC	CHAR(3) Altitude accuracy.
C19 STOPO	CHAR(1) Topographic setting.
C20 SHUC	CHAR(16) Hydrologic unit code.
C801 SBASIN	CHAR(2) Drainage basin code.
C2 SGWTYP	CHAR(1) Type of site.
C805 SINST	CHAR(30) Instrument vector.
C21 SCONDT	CHAR(8) Date well constructed.
C27 SHDEPT	CHAR(8) Hole depth.
C28 SWDEPT	CHAR(8) Well depth.
C29 SWDSRC	CHAR(1) Source of depth data.
C30 SINVWL	CHAR(7) Inventory water level.
C31 SIWLDT	CHAR(8) Date water level measured.

C33 SIWLSC CHAR(1) Source of water level data.

C34 SIWLMT CHAR(1) Method water level measured.

C37 SIWLST CHAR(1) Site status at water level measurement.

C40 SUPDAT CHAR(8) Date site data last updated.

C802 STYPE CHAR(20) Station type codes.

C803 SUSE CHAR(1) Agency use of site code.

C804 SDATA CHAR(30) Flags - type of data collected.

C711 SINVDT CHAR(8) Date site established/ inventoried.

C712 SCWFLE CHAR(20) Flags for other GW files.

C303 SCRDAT CHAR(8) Date relation created.

C713 SAQTYP CHAR(1) Aquifer type.

C714 SAQUFR CHAR(8) Primary aquifer.

C806 SREMRK CHAR(50) Remark.

USES OF WATER AND SITE

SUSE, SUSE2 (C1 SID, C4 SAGNCY, C23 SUSE)

C1 SID CHAR(15) Site ID.

C4 SAGNCY CHAR(5) Source agency.

C23 SUSE CHAR(1) Use of site.

WUSE, WUSE3 (C1 SID, C4 SAGNCY, C24 WUSE)

C1 SID CHAR(15) Site ID.

C4 SAGNCY CHAR(5) Source agency.

C24 WUSE CHAR(1) Use of water.

MAP SCALE

MAPSCALE (C14 SMAP, C15 SMSCAL)

C14 SMAP CHAR(20) Name of location map.

C15 SMSCAL CHAR(7) Scale of map.

LIFT (PUMP)

LIFT, LIFT2 (C1, SID, C4 SAGNCY, C254 SEQNO, C43 CDLTYP, C38 CDLDAT, C44 CDLINT, C45 CDLPWR, C46 CDLHPR, C48 CDLMFR, C49 CDLSER, C50 CDLPCO, C51 CDLACT, C52 CDLMTR, C53 CDLCNS, C54 CDLMNT, C255 CDLADL, C56 CDLSBY, C57 CDLSHP, C268 CDLCAP)

C1 SID CHAR(15) Site ID.

C4 SAGNCY CHAR(5) Source agency.

C254 SEQNO CHAR(3) Sequence number.

C43 CDLTYP CHAR(1) Type of lift.

C38 CDLDAT CHAR(8) Date lift data collected.

C44 CDLINT CHAR(5) Depth to intake.

C45 CDLPWR CHAR(1) Type of power.

C46 CDLHPR CHAR(7) Horsepower rating.

C48 CDLMFR CHAR(12) Manufacturer of lift device.

C49 CDLSER CHAR(12) Serial number of lift device.

C50 CDLPCO CHAR(12) Name of power company.

C51 CDLACT CHAR(10) Power company account number.

C52 CDLMTR CHAR(12) Power meter number.

C53 CDLCNS CHAR(8) Power-consumption coefficient.

C54 CDLMNT CHAR(12) Company that maintains lift device.

C255 CDLADL CHAR(3) Additional lift (above land surface).

C56 CDLSBY CHAR(1) Type of standby power source.

C57 CDLSHP CHAR(7) Horsepower of standby power source.

C268 CDLCAP CHAR(5) Rated pump capacity.

CONSTRUCTION

CONS, CONS2 (C1 SID, C4 SAGNCY, C273 SEQNO, C60 CDCODT, C63 CDCOCT, U1 CDCODLR, C64 CDCOSC, C65 CDCOME, C66 CDCOFI, C67 CDCOSL, C68 CDCOSD, C69 CDCODM, C70 CDCODV, C71 CDCOST, U2 CDCODIS)

C1 SID CHAR(15) Site ID.

C4 SAGNCY CHAR(5) Source agency.

C273 SEQNO CHAR(3) Parent sequence number (construction) used to link this relation to "child" relations.

C60 CDCODT CHAR(8) Date of construction.

C63 CDCOCT CHAR(12) Name of contractor.

U1 CDCODLR CHAR(12) Name of driller.

C64 CDCOSC CHAR(1) Source of construction data.

C65 CDCOME CHAR(1) Method of construction.

C66 CDCOFI CHAR(1) Type of finish.

C67 CDCOSL CHAR(1) Type of surface seal.

C68 CDCOSD CHAR(4) Depth to bottom of seal.

C69 CDCODM CHAR(1) Method of development.

C70 CDCODV CHAR(3) Hours of development.

C71 CDCOST CHAR(1) Special treatment during development.

U2 CDCODIS CHAR(30) Disinfectant.

HOLE

HOLE, HOLE2 (C1 SID, C4 SAGNCY, C724 SEQNO, C273 PARSEQNO, C73 CDHTOP, C74 CDHBOT, C75 CDHDIA)

C1 SID	CHAR(15) Site ID.
C4 SAGNCY	CHAR(5) Source agency.
C724 SEQNO	CHAR(3) Tuple sequence number.
C273 PARSEQNO	CHAR(3) Parent sequence number. construction inks this tuple to the construction tuple.
C73 CDHTOP	CHAR(8) Depth to top of this interval.
C74 CDHBOT	CHAR(8) Depth ot bottom of this interval.
C75 CDHDIA	CHAR(5) Diameter of this interval.

CASING

CSNG, CSNG2 (C1 SID, C4 SAGNCY, C725 SEQNO, C273 PARSEQNO, C77 CDCSTP, C78 CDCSBT, C79 CDCSDI, C80 CDCSMT, C81 CDCSTK)

C1 SID	CHAR(15) Site ID.
C4 SAGNCY	CHAR(3) Source agency.
C725 SEQNO	CHAR(3) Sequence number.
C273 PARSEQNO	CHAR(3) Parent sequence number construction.
C77 CDCSTP	CHAR(8) Depth to top of this casing string.
C78 CDCSBT	CHAR(8) Depth to bottom of this casing string.

C79 CDCSDI CHAR(5) Diameter of this casing string.

C80 CDCSMT CHAR(1) Casing material.

C81 CDCSTK CHAR(6) Wall thickness of this casing.

OPENINGS OR SCREENS

OPEN, OPEN2 (C1 SID, C4 SAGNCY, C726 SEQNO, C273 PARSEQNO, C83 CDOTOP, C84 CDOBOT, C85 CDOTYP, C86 CDOMAT, C87 CDODIA, C88 CDOWID, C89 CDOLEN)

C1 SID CHAR(15) Site ID.

C4 SAGNCY CHAR(5) Source agency.

C726 SEQNO CHAR(3) Sequence number.

C273 PARSEQNO CHAR(3) Parent sequence number. construction.

C83 CDOTOP CHAR(8) Depth to top of this opening.

C84 CDOBOT CHAR(8) Depth to bottom of this opening.

C85 CDOTYP CHAR(1) Type of openings.

C86 CDOMAT CHAR(1) Material in this opening.

C87 CDODIA CHAR(5) Diameter of this opening.

C88 CDOWID CHAR(6) Width of this open interval.

C89 CDOLEN CHAR(6) Length of this open interval.

GEOHYDROLOGIC UNIT DESCRIPTIONS

GEOH, GEOH2 (C1 SID, C4 SAGNCY, C721 LGSEQ, C256, PARSEQNO, C91 LGTOP, C92 LGBOT, C93 LGAQFR, C96 LGLITH, C304 LGCONT, C97 LGDESC)

C1 SID CHAR(15) Site ID.

C4 SAGNCY CHAR(5) Source agency.

C721 LGSEQ CHAR(3) Sequence number for this set of logs.

C256 PARSEQNO CHAR(3) Parent sequence number used to link this tuple with "child" tuples in the AQFR relation .

C91 LGTOP CHAR(8) Depth to top of interval.

C92 LGBOT CHAR(8) Depth to bottom of interval.

C93 LGAQFR CHAR(8) Code for aquifer.

C94 LGLITH CHAR(4) Code for lithology.

C304 LGCONT CHAR(1) Contributing unit.

C97 LGDESC CHAR(123) Description of material or lithologic modifier.

AQUIFER DATA

AQFR, AQFR2 (C1 SID, C4 SAGNCY, C742 SEQNO, C256 CNASEQ, C95 CNAQDT, C126 CNAQSL, C132 CNAQCN)

C1 SID CHAR(15) Site ID.

C4 SAGNCY CHAR(5) Source agency.

C742 SEQNO CHAR(3) Sequence number.

C256 CNASEQ CHAR(3) Parent sequence number ties to GEOH layer.

C95 CNAQDT CHAR(8) Date of aquifer - geologic.

C126 CNAQSL CHAR(7) Static level of aquifer.

C132 CNAQCN CHAR(3) Contribution of aquifer.

HYDRAULICS

HYDR, HYDR2 (C1 SID, C4 SAGNCY, C99 PARSEQNO, C790, SEQNO, C100 HYHYUN, C101 HYHTOP, C102 HYHBOT, C103 HYHTYP, C104 HYHRMK, C305 HYHSAG)

C1 SID	CHAR(15) Site ID.
C4 SAGNCY	CHAR(5) Source agency.
C99 PARSEQNO	CHAR(3) Sequence number ties to COEF tuples.
C100 HYHYUN	CHAR(8) ID of hydrologic unit.
C101 HYHTOP	CHAR(7) Top of test interval.
C102 HYHBOT	CHAR(7) Bottom of test interval.
C103 HYHTYP	CHAR(1) Type of hydraulic unit (code).
C104 HYHRMK	CHAR(40) Remarks about hydraulics.
C305 HYHSAG	CHAR(5) Source agency for hydraulics.

COEF, COEF2 (C1 SID, C99 PARSEQNO, C106 HYSEQ, C107 HYCTRN, C108 HYCHHY, C109 HYCVHY, C110 HYCSTR, C111 HYCLKC, C112 HYCDIF, C113 HYCSPS, C271 HYCBRE, C306 HYCPOR)

C1 SID	CHAR(15) Site ID.
C99 PARSEQNO	CHAR(3) Parent sequence number ties to HYDR tuple.
C106 HYSEQ	CHAR(3) Sequence number.
C107 HYCTRN	CHAR(7) Transmissivity.
C108 HYCHHY	CHAR(12) Horizontal conductivity.
C109 HYCVHY	CHAR(12) Vertical conductivity.

C110 HYCSTR CHAR(8) Storage coefficient.

C111 HYCLKC CHAR(9) Leakance.

C112 HYCDIF CHAR(9) Diffusivity.

C113 HYCSPS CHAR(10) Specific storage.

C271 HYCBRE CHAR(3) Barometer efficiency.

C306 HYCPOR CHAR(4) Porosity.

DISCHARGE DATA

DSCH, DSCH2 (C1 SID, C4 SAGNCY, C147 DISEQ, C148 DIDTE, C703 DITYPE, C150 DIVAL, C151 DISRC, C152 DIMET, C153 DIPROD, C154 DISTAT, C155 DILVSC, C156 DILVME, C157 DIDUR, C272 DISPCP, C309 DIDRND)

C1 SID CHAR(15) Site ID.

C4 SAGNCY CHAR(5) Source agency.

C147 DISEQ CHAR(3) Sequence number.

C148 DIDTE CHAR(8) Date of discharge measurement.

C703 DITYPE CHAR(1) Discharge type.

C150 DIVAL CHAR(10) Discharge.

C151 DISRC CHAR(1) Discharge data source.

C152 DIMET CHAR(1) Discharge measurement method.

C153 DIPROD CHAR(8) Level of production.

C154 DISTAT CHAR(8) Static water level.

C155 DILVSC CHAR(1) Water level data source.

C156 DILVME CHAR(1) Method of water level measurement.

C157 DIDUR CHAR(7) Discharge duration before producing level.

C272 DISPCP CHAR(8) Specific capacity.

C309 DIDRND CHAR(8) Drawdown.

OWNER DATA

OWNR, OWNR2 (C1 SID, C4 SAGNCY, C718 SEQNO, C159 MGDODA,

C161 MGDONM, U3 STREET, U4 CITY, U5 STATE, U6 ZIP)

C1 SID CHAR(15) Site ID.

C4 SAGNCY CHAR(5) Source agency.

C718 SEQNO CHAR(3) Sequence number of this tuple.

C159 MGDODA CHAR(8) Ownership date.

C161 MGDONM CHAR(42) Name of owner.

U3 STREET CHAR(20) Street or route.

U4 CITY CHAR(15) City.

U5 STATE CHAR(2) State.

U6 ZIP CHAR(9) Zip code.

U60 PHONE CHAR(10) Phone.

DATA ON MINOR SITE REPAIRS

REPR, REPR2 (C1 SID, C4 SAGNCY, C165 SEQNO, C166 CDRNAT,

C167 CDRDAT, C169 CDRCTR, C170 CDRCHG)

C1 SID CHAR(15) Site ID.

C4 SAGNCY CHAR(5) Source agency.

C165 SEQNO CHAR(3) Sequence number.

C166 CDRNAT CHAR(1) Repair nature.

C167 CDRDAT CHAR(8) Repair date.

C169 CDRCTR CHAR(12) Repair contractor's name.

C170 CDRDHG CHAR(3) Change in performance after repairs (percent).

REMARKS

RMKS, RMKS2 (C1 SID, C4 SAGNCY, C311 MGDSEQ, C184 MGDRDT, C185 MGDRMX)

C1 SID CHAR(15) Site ID.

C4 SAGNCY CHAR(5) Source agency.

C311 MGDSEQ CHAR(3) Sequence number.

C184 MGDRDT CHAR(8) Date of remark.

C185 MGDRMX CHAR(44 or 250) Miscellaneous remark.

VISITS

VIST, VIST2 (C1 SID, C4 SAGNCY, C774 SEQNO, C187 MGDVDT, C188 MGDVPM)

C1 SID CHAR(15) Site ID.

C4 SAGNCY CHAR(5) Source agency.

C774 SEQNO CHAR(3) Sequence number.

C187 MGDVDT CHAR(8) Visit date.

C188 MGDVPM CHAR(22) Name of person who made visit.

OTHER IDENTIFIERS

OTID, OTID2 (C1 SID, C4 SAGNCY, C736 SEQNO, C190 MGDOID, C191 MGDOIA)

C1 SID CHAR(15) Site ID.

C4 SAGNCY CHAR(5) Source agency.

C736 SEQNO CHAR(3) Sequence number.

C190 MGDOID CHAR(15) Other identifier.

C191 MGDOIA CHAR(15) Who assigned other identifier.

QUALITY OF WATER

QWVISIT, QWVISIT2 (C1 SID, C4 SAGNCY, C738 SEQ, U61 MEDIUM, U62 BEGPRE, U63 BEGYR, U64 BEGMO, U65 BEGDA, U66 BEGTIME, U67 ENDYR, U68 ENDMO, U69 ENDDA, U70 ENDTIME, U71 STAT, U72 SOURCE, U73 HYDCOND, U74 TYPE, U75 HYDEVENT, U76 AAGNCY)

C1 SID CHAR(15) Site ID

C4 SAGNCY CHAR(5) Source agency.

C738 SEQ CHAR(4) Sequence number.

U61 MEDIUM CHAR(1) Sample medium code: "6" is ground water.

U62 BEGPRE CHAR(2) Beginning year prefix.

U63 BEGYR CHAR(2) Beginning year.

U64 BEGMO CHAR(2) Beginning month.

U65 BEGDA CHAR(2) Beginning day.

U66 BEGTIME CHAR(4) Beginning time.

U67 ENDYR CHAR(4) End year.

U68 ENDMO CHAR(2) End month.

U69 ENDDA CHAR(2) End day.

U70 ENDTIME CHAR(4) End time.

C195 GEOL CHAR(8) Geologic unit code for unit sampled.

U71 STAT CHAR(1) Analysis status code.

U72 SOURCE CHAR(1) Analysis source code.

U73 HYDCOND CHAR(1) Code for hydrologic conditions.

U74 TYPE CHAR(1) Code for sample type.

U75 HYDEVENT CHAR(1) Hydrologic event code.

U76 AAGNCY CHAR(5) Agency analyzing sample.

QWMEAS, QWMEAS2 (C1 SID, C738 SEQ, C196 PARCODE, C197 PARVALUE, U77 K, U78 Q, U79 D, U80 N)

C1 SID CHAR(15) Site ID.

C738 SEQ CHAR(4) Sequence number corresponding to visit.

C196 PARCODE CHAR(5) Parameter code.

C197 PARVALUE CHAR(9) Parameter value.

U77 K CHAR(1) Remark code.

U78 Q CHAR(1) Quality assurance code.

U79 D CHAR(1) Method code.

U80 N CHAR(1) Precision code.

LOG DATA

LOGS, LOGS2 (C1 SID, C4 SAGNCY, C739 SEQNO, C199 MGDLTY, C200 MGDLTP, C201 MGDLBT, C202 MGDLSC)

C1 SID CHAR(15) Site ID.

C4 SAGNCY CHAR(5) Source agency.

C739 SEQNO CHAR(3) Sequence number.

C199 MGDLTY CHAR(1) Log type.

C200 MGDLTP CHAR(8) Depth to top of logged interval.

C201 MGDLBT CHAR(8) Depth to bottom of logged interval.

C202 MGDLSC CHAR(1) Code for source of log data.

MULTIPLE WELL GROUPS DATA

MULT, MULT2 (C1 SID, C4 SAGNCY, C729 SEQNO, C204 MGDSWN, C205 MGDSWD, C206 MGDSWS, C207 MGDSWM, C262 MGDSWZ)

C1 SID	CHAR(15) Site ID.
C4 SAGNCY	CHAR(5) Source agency.
C729 SEQNO	CHAR(3) Sequence number.
C204 MGDSWN	CHAR(3) How many wells/laterals in the group.
C205 MGDSWD	CHAR(3) Depth of deepest well in the group.
C206 MGDSWS	CHAR(3) Depth of shallowest well in the group.
C207 MGDSWM	CHAR(1) Construction method of wells in the group.
C262 MGDSWZ	CHAR(7) Well group size.

COOPERATOR DATA

COOP, COOP2 (C1 SID, C4 SAGNCY, C786 SEQNO, C213 MGDCID, C214 MGDCRN, C215 MGDCST, C216 MGDCAP, C217 MGDCIN, C218 MGDCRK)

C1 SID	CHAR(15) Site ID.
C4 SAGNCY	CHAR(5) Source agency.
C786 SEQNO	CHAR(3) Sequence number.
C213 MGDCID	CHAR(10) Cooperator's identifier.
C214 MGDCRN	CHAR(7) Registration number of contractor.
C215 MGDCST	CHAR(2) Inspection status.
C216 MGDCAP	CHAR(1) Reason unapproved.
C217 MGDCIN	CHAR(8) Inspection date.
C218 MGDCRK	CHAR(25) Remarks by cooperator.

COLLECTION WELL DATA

COLL, COLL2 (C1 SID, C4 SAGNCY, C220 SEQNO, C221 MGDSLD, C222 MGDSLL, C223 MGDSLS, C224 MGDSLM)

C1 SID	CHAR(15) Site ID.
C4 SAGNCY	CHAR(5) Source agency.
C220 SEQNO	CHAR(3) Sequence number.
C221 MGDSLD	CHAR(3) Collector well lateral depth.
C222 MGDSLL	CHAR(3) Collector well lateral length.
C223 MGDSLS	CHAR(3) Collector well lateral diameter.
C224 MGDSLM	CHAR(3) Mesh of screen in lateral.

WATER LEVEL DATA

LEVL, LEVL2 (C1 SID, C4 WLAGY, C235 WLDATE, C709, WLTIME, C236 WLDACC, C237 WLEVL, C238 WLSTAT, C239 WLMETH, C240 WLREF, C276 WLACC)

C1 SID	CHAR(15) Site ID.
C4 WLAGY	CHAR(5) Source agency.
C235 WLDATE	CHAR(8) Date of water level measurement.
C236 WLDACC	CHAR(1) Water level date accuracy code.
C709 WLTIME	CHAR(4) Time of water level measurement.
C237 WLEVL	CHAR(7) Water level.
C238 WLSTAT	CHAR(1) Water level status.
C239 WLMETH	CHAR(1) Water level method.
C240 WLREF	CHAR(1) Statistics code.
C276 WLACC	CHAR(1) Water level accuracy.

MEASURING POINT DATA

MPNT, MPNT2 (C1 SID, C4 SAGNCY, C728 SEQNO, C321 CDMPBD, C322 CDMPED, C323 CDMPHT, C324 CDMPRM)

C1 SID	CHAR(15) Site ID.
C4 SAGNCY	CHAR(5) Source agency.
C728 SEQNO	CHAR(3) Sequence number.
C321 CDMPBD	CHAR(8) Beginning date for use of this measuring point.
C322 CDMPED	CHAR(8) Ending date for use of this measuring point.
C323 CDMPHT	CHAR(6) Measuring point height.
C324 CDMPRM	CHAR(250) Measuring point description.

OTHER DATA AVAILABLE

OTDT, OTDT2 (C1 SID, C4 SAGNCY, C31 SEQNO, C181 MGDODT, C182 MGDODL, C261 MGDODF)

C1 SID	CHAR(15) Site ID.
C4 SAGNCY	CHAR(5) Source agency.
C31 SEQNO	CHAR(3) Sequence number.
C181 MGDODT	CHAR(38) Data type.
C182 MGDODL	CHAR(1) Location of data.
C261 MGDODF	CHAR(1) Format of data.

NETWORK DATA

NETW, NETW2 (C1 SID, C4 SAGNCY, C730 SEQNO, C706 MGDNDT, C115 MGDNBY, C116 MGDNEY, C120 MGDNTY, C117 MGDNSC,

C118 MGDNFQ, C133 MGDNMT, C307 MGDNAA, C257 MGDNT1, C708 MGDNT2)

C1 SID CHAR(15) Site ID.

C4 SAGNCY CHAR(5) Source agency.

C730 SEQNO CHAR(3) Sequence number.

C706 MGDNDT CHAR(3) Type of data.

C115 MGDNBY CHAR(4) Year data begins.

C116 MGDNEY CHAR(4) Year data ends.

C120 MGDNTY CHAR(2) Analysis type.

C117 MGDNSC CHAR(5) Agency source.

C118 MGDNFQ CHAR(1) Collection frequency.

C133 MGDNMT CHAR(1) Collection method.

C307 MGDNAA CHAR(5) Analyzing agency for water quality.

C257 MGDNT1 CHAR(1) Primary network site.

C708 MGDNT2 CHAR(1) Secondary network site.

WATER USER DATA

WUSER, WUSER2 (WU1 WUID, WU2 FACNAME, WU3 USE, WU19 PERMIT, WU20 ACNC, WU21 OTHER, U13 FONE, U14 MANAGER, WU4 FACLAT, WU5 FACLON, WU6 FACHUC, WU7 WUADDR, WU8 WUCITY, WU9 FIPSCITY, WU11 FIPSCOU, WU10 FIPSSTA, WU12 MAILADDR, WU13 MAILCITY, WU14 MAILST, WU15 MAILZIP)

WU1 WUID CHAR(7) Water user ID.

WU2 FACNAME CHAR(25) Name of facility with this ID.

WU3 USE	CHAR(2) NEWSWUDS use code (this is a different code system than is used in SUSE and WUSE).
WU19 PERMIT	CHAR(9) Permit number.
WU20 AGNC	CHAR(5) NAWDEX code for permitting agency - default ASWCC.
WU21 OTHER	CHAR(30) Description or other comments.
U13 FONE	CHAR(8) Phone.
U14 MANAGER	CHAR(22) Manager.
WU4 FACLAT	CHAR(6) Latitude of facility which may differ from the location of the measuring point.
WU5 FACLON	CHAR(7) Longitude of the facility.
WU7 WUADDR	CHAR(20) Route,street or highway - directions for finding facility not mailing address.
WU8 WUCITY	CHAR(15) Actual city or village.
WU9 FIPSCITY	CHAR(5) FIPS city code.
WU11 FIPSCOU	CHAR(3) FIPS county code.
WU10 FIPSSTA	CHAR(2) FIPS state code default 05 for Arkansas.
WU12 MAILADDR	CHAR(25) Street or route mailing address.
WU13 MAILCITY	CHAR(15) City mailing address.
WU14 MAILST	CHAR(2) State postal abbreviation.
WU15 MAILZIP	CHAR(9) Zip.

SICS (WU1 WUID, WU16 SIC)

WU1 WUID CHAR(7) Water user ID.

WU16 SIC CHAR(9) Standard industrial classification.

MEASPT (ED3 ACT, MP9 DTYP, WU1 WUID, MP11 RECL, MP10 SUBTYP, CD4 PERMIT, WU20 AGNC, MP12 QWORG, MP13 SUBPER, MP14 SUBAGNC, MP2 DESCR, MP15 ADDATA, CD5 ADTYP, CD6 ADID)

ED3 ACT CHAR(2) Action code indicating whether water is being withdrawn returned etc.

MP9 DTYP CHAR(2) Destination/source type.

WU1 WUID CHAR(15) Water user id.

MP11 RECL CHAR(1) Reclaimed waste Y or N.

MP10 SUBTYP CHAR(1) Source/destination subtype.

CD4 PERMIT CHAR(9) Permit number.

WU20 AGNC CHAR(5) Agency issuing permit.

MP12 QWORG CHAR(5) Organization for water quality.

MP13 SUBPER CHAR(9) Subpermit any other permit held.

MP14 SUBAGNC CHAR(5) Agency that issued subpermit.

MP2 DESCR CHAR(15) Any additional data.

MP15 ADDATA CHAR(30) Additional data description.

CD5 ADDTYP CHAR(2) Another type.

CD6 ADID CHAR(15) Another ID.

MOREMP (WU1 WUID, CD4 PERMIT, WU4 MPLAT, WU5 MPLONG, WU6 HUC, WU14 STA, WU11 COU, MP8 AQFR)

This data duplicates HEDR information. Once NEWSWUDS has Site ID, this relation can be eliminated and the information found in the HEDR relation.

WU1 WUID	HAR(7) Water user ID.
CD4 PERMIT	CHAR(15) Permit number.
WU4 MPLAT	CHAR(7) Measuring point latitude.
WU5 MPLONG	CHAR(8) Measuring point longitude.
WU6 HUC	CHAR(8) Hydrologic unit code.
WU14 STA	CHAR(2) State code.
WU11 COU	CHAR(3) County code.
MP8 AQFR	CHAR(98) Aquifer.

ANNUAL MEASUREMENT DATA

YRDATA (WU1 WUID, CD3 ACT, CD4 PERMIT, CD7 YR, AM2 YRAMT, AM15 MMTHD, AM16 ENT, AM17 ACC, AM18 RESTR, AM19 SALT, AM20 TTYP, AM21 OTHER, U11 SEQNO)

WU1 WUID	CHAR(7) Water user ID.
CD3 ACT	CHAR(2) Action.
CD4 PERMIT	CHAR(15) Permit number for source/destination.
CD7 YR	CHAR(4) Year.
AM2 YRAMT	CHAR(10) Annual amount or average rate of withdrawal.
AM15 MMTHD	CHAR(1) Measuring method.
AM16 ENT	CHAR(5) Measuring entity who measured.
AM17 ACC	CHAR(1) Accuracy of measurement.

AM18 RESTR CHAR(1) Restrictions.

AM19 SALT CHAR(1) Salinity.

AM20 TTYP CHAR(1) Treatment type.

AM21 OTHER CHAR(30) Other annual data.

U11 SEQNO CHAR(3) Record sequence number.

MONTHLY WITHDRAWALS

MOWD (WU1 WUID, U11 SEQNO, U18 MO, AM4 AMOUNT)

WU1 WUID CHAR(7) Water user ID.

U11 SEQNO CHAR(3) Sequence number of associated annual data.

U18 MO CHAR(2) Month number.

AM4 AMT CHAR(10) Withdrawal rate.

EXTENDED DATA - IRRIGATION

IRR (WU1 WUID, ED2 YR, ED3 CTYP, EDIR1 ACRE, EDIN1 YRPROD, EDIR2 AAMT)

WU1 WUID CHAR(7) Water user ID.

ED2 YR CHAR(4) Year.

ED3 CTYP CHAR(6) Crop type SIC Code.

EDIR1 ACRE CHAR(8) Irrigated acreage.

EDIN1 YRPROD CHAR(8) Crop production annually.

EDIR2 AAMT CHAR(8) Amount of water applied in the year (average).

MOREPT (WU1 WUID, ED2 YR, ED3 SIC, U19 MO, EDIR3 AMT)

WU1 WUID CHAR(7) Water user ID.

ED2 YR CHAR(4) Year.

ED3 SIC CHAR(6) Standard industrial code for whatever is being produced.

U19 MO CHAR(2) Month number.

EDIR3 AMT CHAR(8) Monthly amount applied.

PUBSUP (WU1 WUID, ED2 YR, ED3 SIC, EDPS1 DOMPOP, EDPS2 AGCONN, EDPS3 COMMCONN, EDPS4 DOMCONN, EDPS5 INDCONN, EDPS6 IRRCONN, EDPS7 PWRCONN, EDPS8 MINCONN)

WU1 WUID CHAR(7) Water user ID.

ED2 YR CHAR(4) Year.

ED3 SIC CHAR(6) Standard industrial code.

EDPS1 DOMPOP CHAR(7) Domestic population served.

EDPS2 AGCONN CHAR(7) Agricultural connections served.

EDPS3 COMMCONN CHAR(7) Commercial connections served.

EDPS4 DOMCONN CHAR(7) Domestic connections served.

EDPS5 INDCONN CHAR(7) Industrial connections served.

EDPS6 IRRCONN CHAR(7) Irrigation connections served.

EDPS7 PWRCONN CHAR(7) Power connections served.

EDPS8 MINCONN CHAR(7) Mining connections served.

EXTENDED DATA: POWER

POWR (WU1 WUID, ED2 YR, ED3 SIC, EDPW1 GENCAP, EDPW2 YRPROD)

WU1 WUID CHAR(7) Water user ID.

ED2 YR CHAR(4) Year.

ED3 SIC CHAR(6) Standard industrial code.

EDPW1 GENCAP CHAR(8) Generating capacity.

EDPW2 YRPROD CHAR(8) Annual power produced.

MOPOWR (WU1 WUID, ED2 YR, ED3 SIC, U19 MO, EDPW3, MOPROD)

WU1 WUID CHAR(7) Water user ID.

ED2 YR CHAR(4) Year.

ED3 SIC CHAR(6) Standard industrial code.

U19 MO CHAR(2) Month number.

EDPW3 MOPROD CHAR(8) Monthly production.

CODES USED IN RELATIONS and INFORMATION ABOUT DATA

CODE1 (REL, NAME1, NAME2, CODE, EXPL)

This relation "decodes" codes used in other relations, telling what the code means. The key is either REL and NAME1 or REL and NAME2.

REL CHAR(10) Name of the relation.

NAME1 CHAR(4) The alphanumeric attribute name e.g. C001.

NAME2 CHAR(10) The alphabetic attribute name e.g. SID.

CODE CHAR(2) The code used in the relation REL.

EXPL CHAR(100) Explanation of what the code means.