Brackish Resources Aquifer Characterization System Database Data Dictionary

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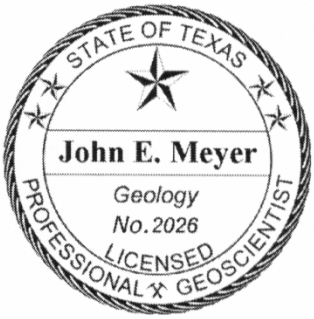

John E. Meyer

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"Palo Duro State Park, Texas"

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1. Introduction

The Brackish Resources Aquifer Characterization System (BRACS) Database was designed in the fall of 2009 to support projects characterizing brackish groundwater resources of Texas.

The database is a container designed to organize records of well and geologic information with a custom user-interface for data entry, retrieval, and specialized methods of data analysis. The Texas Water Development Board (TWDB) Groundwater Database (GWDB) was not designed to handle the information generated by the BRACS projects, and upgrades to the GWDB were not considered, because the TWDB has plans to re-design the GWDB along with other databases. The long-term goal of the TWDB is to merge the GWDB, BRACS, and the Texas Department of Licensing and Regulation's Submitted Driller Report Database into one relational database.

A primary philosophy of the TWDB is to make information readily available to the public. The BRACS Database is regularly re-compiled in a public version that can be downloaded from the TWDB website in a Microsoft® Access® format (http://www.twdb.texas.gov; navigate to Innovative Water Technologies\Bracs\Reports and Presentations). BRACS well sites are displayed on the TWDB Water Information Integration and Dissemination website (http://wiid.twdb.texas.gov/index_down.asp; navigate to the Brackish Groundwater Database application). This data dictionary is an essential reference document for users to take full advantage of the information.

The BRACS Database is maintained in Microsoft® Access®. The database is fully relational, with self-documenting object naming consistent with the Hungarian style described in Novalis (1999). The database design relies on extensive use of lookup tables. Most of the data entry uses forms and subforms with embedded data processing commands using sequential structured query language (SQL) queries and class objects written in Visual Basic for Applications® (VBA) using the ActiveX® Data Objects model. Key fields link the relational tables. The public version of the BRACS Database contains simple forms and subforms without the embedded data entry and analysis VBA code.

Figure 1-1 displays the relationships of the primary tables in the BRACS Database. This data dictionary contains separate chapters for each primary table with a discussion of data type, size, naming, lookup table references, and a brief description of each field. Custom BRACS project tables, such as aquifer determination or net sand analysis, are listed in the Appendices. The BRACS Database design will continue to evolve as more projects are completed and new methods of analysis and data sources are obtained. Consequently, this data dictionary will be updated to keep pace with new data designs and custom project tables. The user should compare this document date with the date of the public version of the BRACS Database to ensure compatibility. Older versions of this document will be maintained for users with older versions of the database.

This database was developed for use by TWDB staff in support of the BRACS program. Data change on a daily basis, and this database design may change on an as-needed basis, so users of the information should note the following disclaimer regarding the information:

Except where noted, all of the information provided is believed to be accurate and reliable; however, the Texas Water Development Board (TWDB) assumes no responsibility for any errors. Further, TWDB assumes no responsibility for the use of the information provided. ***PLEASE NOTE*** *that users of these data are responsible for checking the accuracy, completeness, currency, and/or suitability of all information themselves. TWDB makes no guarantees or warranties as to the accuracy, completeness, currency, or suitability of the information provided via the BRACS Database. TWDB specifically disclaims any and all liability for any claims or damages that may result from providing BRACS data or the information the database contains.*

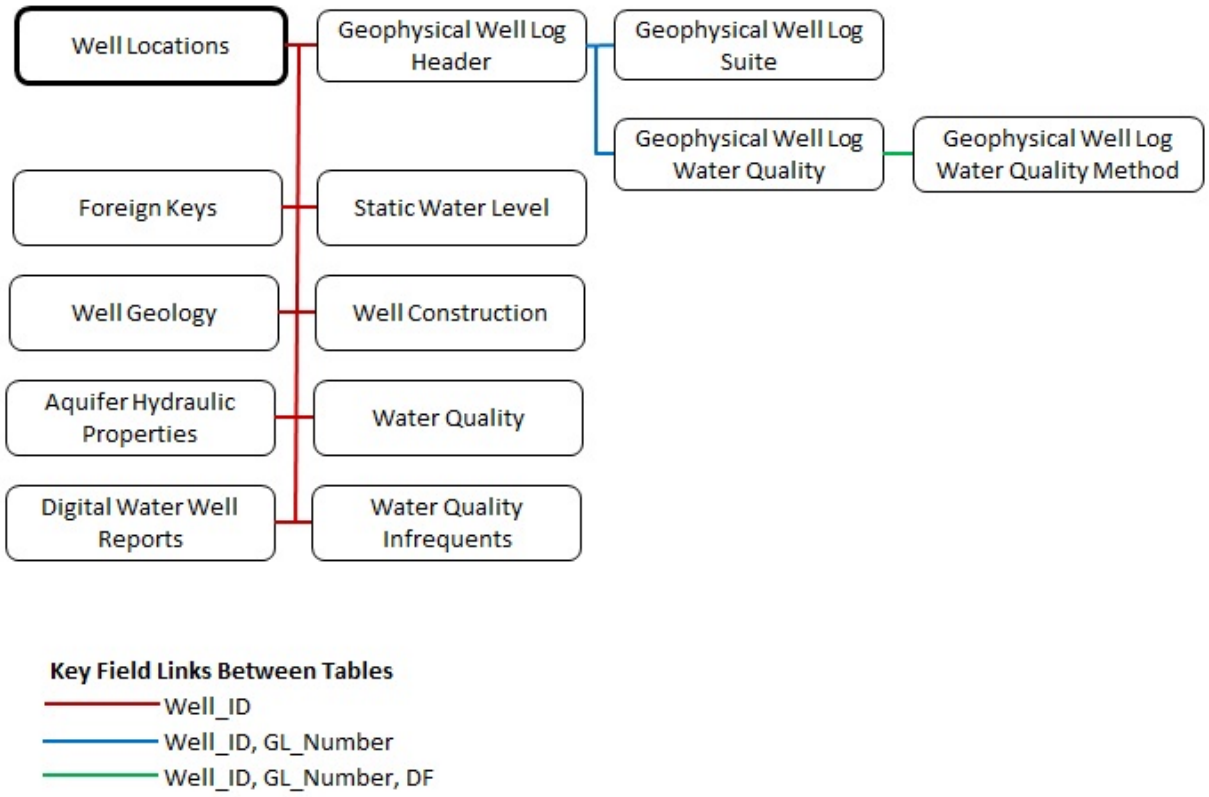

Figure 1-1. **BRACS Database table relationships. Each rectangle represents a primary table related to the other tables based on key fields, represented by colored lines. The Well Location table, in bold outline, is the primary table where the primary well record identification number, Well_ID, is assigned.**

2. Well Location Table: tblWell_Location

The well location table contains owner, location attributes, source of well information, and well depth information. When a new well record is appended into the BRACS Database, the record is first added to this table, which establishes its unique well_ID.

Table 2-1. tblWell_Location field names, data type and size, and lookup table references.

Field Name	Data Type	Size	Lookup Table
WELL_ID	Long Integer	4	
SOURCE_WELL_DATA	Text	250	tblLkSourceWellData
STATE_NAME	Text	50	tblLkState
COUNTY_NAME	Text	13	tblLkCounty
DEPTH_TOTAL	Long Integer	2	
DEPTH_WELL	Long Integer	2	
ELEVATION_BOTTOM_WELL	Long Integer	2	
ELEVATION_BOTTOM_HOLE	Long Integer	2	
DRILL_DATE	Text	10	
KELLY_BUSHING_HEIGHT	Integer	2	
OWNER	Text	100	
WELL_TYPE	Text	50	tblLkWellType
LATDD	Double	8	
LONGDD	Double	8	
HORIZONTAL_DATUM	Text	2	tblLkHorizontalDatum
LOCATION_METHOD	Text	10	tblLkLocationMethod
LOCATION_DATE	Date/Time	8	
AGENCY	Text	5	tblLkAgency
GRID_25MIN	Text	15	
ELEVATION	Long Integer	4	
VERTICAL_DATUM	Text	2	tblLkVerticalDatum
ELEVATION_METHOD	Text	1	tblLkElevationMethod
ELEVATION_AGENCY	Text	5	tblLkAgency
ELEVATION_DATE	Date/Time	8	
REMARKS	Text	250	
INITIALS	Text	3	tblLkIntial
ADDRESS	Text	100	
CITY	Text	50	
SITE_DIRECTIONS	Text	255	

Field Descriptions

WELL_ID Each record in the database is assigned a unique well ID in this table using the Microsoft® Access® autonumber data type, which is a long integer. This is the key field in the table and serves as the primary key field for every BRACS table. Records are first entered into this table, so the unique ID is assigned.

SOURCE_WELL_DATA Each well record is assigned the source of the well information. In some cases multiple sources exist; in this case, the source of the geophysical well log or water well driller report takes precedence. These field values are listed in the lookup table tblLkSourceWellData. This lookup table also contains a description of the data source, a web

address if applicable, and a published report reference if applicable. The table will continue to grow with time as new sources of information are acquired.

Table 2-2. Codes used in the source_well_data field.

SOURCE_WELL_DATA	AGENCY
BAER Yegua Jackson Study	Baer Engineering and Environmental Consulting, Inc., with Intera, Inc.
BEG Paper/Digital Geophysical Logs	Bureau of Economic Geology, University of Texas at Austin
DBSA Capitan Reef Study	Daniel B. Stephens Assoc. et al
DBSA Llano Aquifers Study	Daniel B. Stephens Assoc. et al
GLO Paper/Digital Geophysical Logs	General Land Office
Intera Gulf Coast Aquifer Study	Intera, Inc.
Intera Rustler Aquifer Study	Intera, Inc.
NM EMNRD Geophysical Logs	New Mexico Energy, Minerals and Natural Resources Department
NM OSE Aquifer Test Information	New Mexico Office of State Engineers
NM OSE Digital Water Well Reports	New Mexico Office of State Engineers
NM OSE Paper Water Well Reports	New Mexico Office of State Engineers
RRC Digital Geophysical Logs	Railroad Commission of Texas
SL Digital Geophysical Logs	Subsurface Library
TCEQ PWS Water Wells	Texas Commission on Environmental Quality
TCEQ SC Q Paper/Digital Geophysical Logs	Texas Commission on Environmental Quality
TCEQ Water Well Images	Texas Commission on Environmental Quality
TDLR Digital Water Well Reports	Texas Department of Licensing and Regulation
TDLR Paper Water Well Reports	Texas Department of Licensing and Regulation
TWDB Aquifer Test Information	Texas Water Development Board
TWDB Geophysical Logs	Texas Water Development Board
TWDB Groundwater Database	Texas Water Development Board
TWDB Published Reports	Texas Water Development Board (and all predecessor agency names)
ULUTS Digital Geophysical Logs	University Lands, University of Texas System
USGS Brazos River Alluvium Study	U.S. Geological Survey
USGS Edwards-Trinity (Plateau) Study, Pecos Co.	U.S. Geological Survey
USGS Geophysical Logs	U.S. Geological Survey

STATE_NAME The state name based on the well location. This lookup table contains state and codes for Texas and adjacent states. These field values are listed in the lookup table tblLkState.

COUNTY_NAME The county name based on the well location. This lookup table contains state and county names for Texas and adjacent states. These field values are listed in the lookup table tblLkCounty.

DEPTH_TOTAL The total depth of the hole in units of feet below ground surface. This is reported on the water well driller report or header page on a geophysical well log. A value of -99999 is used if the value is not known.

DEPTH_WELL The total depth of the well in units of feet below ground surface. This is reported on the water well driller report. A value of -99999 is used if the value is not known.

ELEVATION_BOTTOM_WELL The elevation of the bottom of the well in units of feet above mean sea level. This is a calculated field, based on the fields: [elevation] – [depth_well]. A value of -99999 is used if the value is not known.

ELEVATION_BOTTOM_HOLE The elevation of the bottom of the hole in units of feet above mean sea level. This is a calculated field, based on the fields: [elevation] – [depth_total]. A value of -99999 is used if the value is not known.

DRILL_DATE The date the well was completed in the format of MM/DD/YYYY (M = month; D = day; Y = year). If the date is incomplete, zeros (0) are entered for missing values. The field is text since many drill dates are incomplete and do not meet date standards. The drill date is referenced on the water well driller report and geophysical well log header for oil and gas wells. In the latter case, the date references when the well was logged, not completed.

KELLY_BUSHING_HEIGHT The height of the drilling rig kelly bushing used as a measuring point for all subsequent logging depths. The units are in feet above ground surface. This value is stored as an integer. The term is synonymous with rig floor, derrick floor, rotary table, drive bushing, and KB. This value is recorded on the geophysical well log header either as a unique value or a value that must be calculated from the values of elevation of the ground surface and elevation of the kelly bushing.

This value is used to correct depths recorded on well logs to true depth. The default value for this field is zero (0).

OWNER The well owner name when the well was drilled. Recorded on the water well driller report or the geophysical well log header.

WELL_TYPE The type of well when the well was drilled and completed. These terms are the same as the lookup table in the TWDB Groundwater Database (Rein and Hopkins, 2008). These field values are listed in the lookup table tblLkWellType.

LATDD Latitude of the well site in units of decimal degrees. Latitude is a positive value, referring to a site north of the earth's equator. Latitude and longitude coordinates are obtained from multiple sources. A value of zero (0) is used if the latitude is unknown.

LONGDD Longitude of the well site in units of decimal degrees. Longitude is a negative value, referring to a site west of the Prime Meridian in Greenwich, United Kingdom. Latitude and longitude coordinates are obtained from multiple sources. A value of zero (0) is used if the longitude is unknown.

HORIZONTAL_DATUM The horizontal datum of the latitude and longitude coordinates. A two-digit code is used for this value, stored in the lookup table tblLkHorizontalDatum.

Table 2-3. Codes used in the horizontal_datum field.

HORIZONTAL DATUM	HORIZONTAL DATUM DESCRIPTION
00	DATUM UNKNOWN
27	NORTH AMERICAN DATUM 1927 (NAD 27)
83	NORTH AMERICAN DATUM 1983 (NAD 83)
84	WORLD GEODETIC SYSTEM 1984 (WGS1984)

LOCATION_METHOD The method used to obtain the latitude and longitude coordinates of the well site. If coordinates are obtained from another agency and the method is known, the method is translated into one of the codes in the field lookup table. If the method is not known, a default value of unknown is used. These field values are listed in the lookup table tblLkLocationMethod.

Table 2-4. Codes used in the location_method field.

LOCATION METHOD	LOCATION METHOD DESCRIPTION
ADDMAT	ADDRESS MATCHING
GIS-M1	GIS HEADS-UP DIGITIZING; 1:24K USGS TOPO
GIS-M2	GIS HEADS-UP DIGITIZING; TXDOT COUNTY
GIS-M2A	ARCINFO CORRECTED LOCATION FOR GIS-M2
GIS-M3	GIS HEADS-UP DIGITIZING; 1:24K DOQQ
GPS-C	GPS COORDINATES - D.C. CENTROID
GPS-NC	GPS COORDINATES - NO CORRECTIONS
GPS-PP1	GPS COORDINATES - TXDOT POST PROCESS
GPS-PP2	GPS COORDINATES - TANDEM R. POST PROCESS
GPS-PP3	GPS COORDINATES - UNKNOWN POST PROCESS
GPS-PP4	GPS COORDINATES - PATHFINDER OFFICE P.P.
GPS-RT1	GPS COORDINATES - NAVSTAR D. C.
GPS-RT2	GPS COORDINATES - COMMERCIAL RADIO D. C.
GPS-RT3	GPS COORDINATES - OTHER D. C.
GPS-S	GPS COORDINATES - D.C. SUPERIMPOSED
GPS-SUR	GPS COORDINATES - SURVEY LEVEL QUALITY
GPS-UNK	GPS COORDINATES - METHOD UNKNOWN
LORAN-C	LORAN-C NAVIGATION DEVICE
MAP	MAP INTERPOLATION-DIGITAL OR MANUAL
MAP-D1	HEADS DOWN DIGITIZING SIGMA SCAN 24KTOPO
MAP-D2	HEADS DOWN DIGITIZING SIGMA SCAN TXDOT
MAP-D3	HEADS DOWN DIGITIZING ARCVIEW 24KTOPO
MAP-D4	HEADS DOWN DIGITIZING ARCVIEW 100KTOPO
MAP-D5	HEADS DOWN DIGITIZING ARCVIEW 250KTOPO
MAP-D6	HEADS DOWN DIGITIZING ARCVIEW 500KTOPO
MAP-D7	HEADS DOWN DIGITIZING ARCVIEW TXDOT
MAP-M1	MAP INTERPOLATION-MANUAL DB STICK
MAP-M2	MAP INTERPOLATION-MANUAL OVERLAY SHEET
OTHER	OTHER METHOD (SEE REMARKS)
PHOTOGM	AERIAL PHOTOGRAPHY WITH GROUND CONTROL
PHOTORAW	DIGITAL OR MANUAL RAW PHOTO EXTRACTION
RMTSEN	REMOTE SENSING
SPCSACONV	CONVERSION FROM STATE PLANE COORDINATE
SUR-C	CADASTRAL SURVEY
UNKNOWN	UNKNOWN METHOD
UTMCONV	CONVERSION FROM UTM

LOCATION_DATE The date when the latitude and longitude coordinates were obtained. The field is blank if the date is not known.

AGENCY The agency that collected the latitude and longitude coordinates of the well site. These field values are listed in the lookup table tblLkAgency.

Table 2-5. The most common codes used in the agency field. Refer to the lookup table for a complete list of codes (over 207 codes at the time of this document preparation).

AGENCY	AGENCY NAME
BAER	Baer Engineering and Environmental Consulting, Inc.
BEG	Bureau Of Economic Geology
DBSA	Daniel B. Stephens and Associates
DRILL	Water Well Driller
INT	Intera, Inc.
NMEMN	New Mexico Energy, Minerals and Natural Resources Department
NMOSE	New Mexico, Office State Engineer
RRC	Railroad Commission Of Texas
TCEQ	Texas Commission on Environmental Quality
TDLR	Texas Department of Licensing and Regulation
TWC	Texas Water Commission
TWDB	Texas Water Development Board
ULUTS	University Lands, University of Texas System
USGS	U.S. Geological Survey

GRID_25MIN The reference to the 2.5 minutes of latitude and longitude grid cell in which the well site is located. The grid cell code is based on three values: a two digit code for the degrees of latitude and longitude of a one-degree block (01 – 89); a two-digit code for the 7.5-minute topographic map (01 – 64); and a one-digit code (1 – 9) referring to the 2.5-minute region in the topographic map extent. This grid reference is used as the first 5 numbers in a state well number and used to file digital water well report images at the Texas Commission of Environmental Quality.

The grid cell is determined using spatial analysis in a geographic information system by comparing the well site with the grid cell shape file.

ELEVATION The elevation of the well site in units of feet above mean sea level. The elevation is determined using spatial analysis in a geographic information system by comparing the well site with the 30-meter digital elevation model for Texas. A value of -99999 is written to the elevation field if data are unknown.

VERTICAL_DATUM The vertical datum of the elevation value. A two-digit code is used for this value, stored in the lookup table tblLkVerticalDatum.

Table 2-6. Codes used in the vertical_datum field.

VERTICAL DATUM	VERTICAL DATUM DESCRIPTION
00	DATUM UNKNOWN
29	NORTH AMERICAN VERTICAL DATUM OF 1929
88	NORTH AMERICAN VERTICAL DATUM OF 1988

ELEVATION_METHOD The method used to obtain the elevation value. Every elevation in the BRACS Database was determined using a statewide, seamless 30-meter digital elevation model. These field values are listed in the lookup table tblLkElevationMethod.

Table 2-7. Codes used in the elevation_method field.

ELEVATION METHOD	ELEVATION METHOD DESCRIPTION
A	Altimeter
D	Digital Elevation Model -DEM
G	Global Positioning System-GPS
L	Level Or Other Surveying Meth.
M	Interpolated From Topo Map
Z	Other (see remarks)

ELEVATION_AGENCY The agency that collected the elevation value. These field values are listed in the lookup table tblLkAgency. Refer to Table 2-5 for codes.

ELEVATION_DATE The date the elevation value was obtained.

REMARKS This field contains information about a well site or its attributes that will not fit in any other field in the table.

INITIALS Initials of staff member who last edited the well site record.

ADDRESS Well site address. These data are usually from the water well driller report.

CITY Well site city. If a well is drilled in the city limits, this field may be populated.

SITE_DIRECTIONS Directions to well site in lieu of street address.

3. Foreign Key Table: tblBracs_ForeignKey

The foreign key table contains the identification names or numbers associated with a well record. The information resides in a separate table to handle the one-to-many relationship between a well record and the zero-to-many IDs it may have been assigned. This table is used to link the BRACS well records with equivalent well records in supporting databases, such as the TWDB Groundwater Database, the Railroad Commission of Texas oil and gas well database, or the Texas Department of Licensing and Regulation Submitted Driller Report Database.

Table 3-1. tblBracs_ForeignKey field names, data type and size, and lookup table references.

Field Name	Data Type	Size	Lookup Table
WELL_ID	Long Integer	4	
FOR_KEY_TXT	Text	100	
FOR_KEY_NUM	Double	8	
AGENCY	Text	5	tblLkAgency
ID_NAME	Text	50	tblLkFK_ID_Name
REMARKS_1	Text	250	

Field Descriptions

WELL_ID Each record in the database is assigned a unique well ID (which is a long integer) in this table. This is the key field in this table.

FOR_KEY_TXT The foreign key in a text format assigned to this well record. This is the second key field in this table.

FOR_KEY_NUM The foreign key in a numeric format assigned to this well record. Some foreign keys, such as the state well number, API number, or track number, are numeric in the native database, and this field retains that format for the purpose of linking these tables using structured query language.

AGENCY The agency that assigned the unique identification number/name for the well record. These field values are listed in the lookup table tblLkAgency. Refer to Table 2-5 for codes.

ID_NAME The name of the ID as assigned by the agency that created it. These field values are listed in the lookup table tblLkFK_ID_Name. This table will continue to grow with time.

Table 3-2. Codes used in the ID_name field.

ID_NAME	DESCRIPTION
ACCESSION_NUMBER	Unique ID assigned by BEG in IGOR Database (aka: sequence number in older database; M number)
API_NUMBER	Unique ID assigned to oil/gas wells by API. Consists of state code (2), county code (3), unique (5) or > 5 for some wells
BAER_YeguaJackson	Yegua Jackson Structure Well Name; assigned to all wells in project
DBSA_CapitanReef_Proj	Capitan Reef Complex ID; geodatabase [capitan_dataset].[ID]
DBSA_LlanoAquifers_Proj	Unique id assigned to each well site
INT_GulfCoast_Proj	Gulf Coast Aquifer Project ID; [sites].[master_ID]
INT_RUSTLER_PROJ	Rustler Aquifer Project ID; [Rustler_Structure_Data].[object_ID]
PLUGGING TRACK NUMBER	Assigned by TDLR for water well plugging reports
POD_NUMBER	Unique ID assigned to water well by NMOSE. Point of Diversion number.
Q_NUMBER	Q number assigned to all logs by RRC (formerly TDWR and TCEQ) in the surface casing program. Number may refer to one or more wells in a geographic area
STATE_WELL_NUMBER	Unique ID assigned by TWDB for wells in the Groundwater Database; [gwdb].[dbo_welldata].[state_well_number]
STATION_NUMBER	Unique number assigned to well sites by USGS
TRACK_NUMBER	Unique ID assigned by TDLR for water wells since about 2000
USGS_BR_Alluvium_Proj	Well Name assigned by USGS to Brazos River Alluvium Project wells
UWCD NUMBER	Assigned by an Underground Water Conservation District
WATER_SOURCE	Unique ID assigned by TCEQ for public water supply wells. G = groundwater well; next 7 = pws ID; last one or two letters unique for each well
WELL_NUMBER	Well name or number assigned by owner, company, state, or previous ID(s)

If the well record and its foreign key were obtained from a published or unpublished report, the lookup table contains this report reference as a separate field (not shown above).

REMARKS_1 General remarks associated with the foreign key.

4. Well Geology Table: tblWell_Geology

The well geology table contains records of well site lithology, simplified lithologic descriptions, stratigraphic picks, faults, and hydrogeologic units. The information resides in a separate table to handle the one-to-many relationship between a well record and the zero-to-many records describing the well site geology.

Table 4-1. tblWell_Geology field names, data type and size, and lookup table references.

Field Name	Data Type	Size	Lookup Table
WELL_ID	Long Integer	4	
RECORD_NUMBER	Long Integer	4	
GEOLOGIC_PICK	Text	15	tblLkGeologicPick
LITHOLOGIC_NAME	Text	100	
SIMPLIFIED_LITHOLOGIC_NAME	Text	100	tblLkSimplified_Lithologic_Name
STRATIGRAPHIC_NAME	Text	150	tblLkStratigraphic_Name
HYDROGEOLOGIC_NAME	Text	150	tblLkHydrogeologicName
DEPTH_TOP	Long Integer	4	
DEPTH_BOTTOM	Long Integer	4	
THICKNESS	Long Integer	4	
GT	Text	1	
ELEVATION_TOP	Long Integer	4	
ELEVATION_BOTTOM	Long Integer	4	
FAULT_TYPE	Text	50	tblLkFaultType
FAULT_DISPLACEMENT	Long Integer	4	
SOURCE_GEOLOGIC_DATA	Text	50	tblLkSourceGeologicData
INITIALS	Text	3	tblLkIntial
LAST_CHANGE	Date/Time	8	
REMARKS	Text	250	

Field Descriptions

WELL_ID Each record in the database is assigned a unique well ID (which is a long integer) in this table. This is the key field in this table.

RECORD_NUMBER This is the second key field in this table. This number is not assigned as an autonumber field, as in the usual case for a key field. The value is an integer, beginning with 1 and increasing with the addition of each record. The integer order allows the records to be displayed on a form in the order of increasing depth from the ground surface. Because several different types of information (lithology, stratigraphy, hydrogeologic units) can be appended to this table, it is important to complete the append process for a group of records at one time before appending records of a different geologic pick type. This will ensure records of different types can be ordered appropriately. If a new record must be appended and the order modified, the record number can be edited (with an autonumber data type this is impossible), although care must be taken to not duplicate an existing record number in this endeavor.

GEOLOGIC_PICK This field organizes the type of geologic records for a well. This method permits the collection of all geology records into one table. These field values are listed in the lookup table tblLkGeologicPick. This table will continue to grow with time.

Table 4-2. Codes used in the geologic_pick field.

GEOLOGIC_PICK	DESCRIPTION
FAULT	This type of pick is based on a fault identified from geophysical well log analysis. The description field should contain the fault type and amount of missing section. Fill in the top depth only
HYDROGEOLOGIC	This type of pick is based on a grouping of units that form a hydrogeologic unit
LITHOLOGIC	This type of pick is based on the individual geologic layers in the earth, such as sand, shale, or limestone. This is often recorded on well reports or interpreted from geophysical logs
STRATIGRAPHIC	This type of pick is based on a stratigraphic unit, such as a formation or member

LITHOLOGIC_NAME This field contains the lithologic description assigned to each range of depths (from depth_top to depth_bottom) as the well was drilled. The most common source for this data is the state water well report or records in published or unpublished reports. The information is copied verbatim, except in cases where obvious typographical errors have been made. The term caliche is often misspelled, and this term has been standardized when records have been appended manually.

A tremendous amount of information has come from digital water well reports from the Texas Department of Licensing and Regulation- Submitted Driller Report Database. The records in that database are appended as a memo field. These data are parsed into separate records and fields by TWDB staff before being appended into this table.

SIMPLIFIED_LITHOLOGIC_NAME This field contains a simplified version of the lithologic description so automated processing can be accomplished. For example, a unit consisting of sand may be written in over 250 different forms on water well reports.

The lookup table tblLkLithologicName_to_SimplifiedLithologicName was created to relate the two fields. A Microsoft® Access® query was written to automatically update this simplified_lithologic_name field from the lithologic_name field using values in the lookup table. The lookup table will grow with time as new records are appended to the well geology table.

Simplified lithologic names can be assigned using interpretation of geophysical well log gamma ray, SP, or resistivity tools.

STRATIGRAPHIC_NAME This field contains stratigraphic names used for mapped rock formations in Texas and adjoining states. In some cases a formation has been subdivided into units for hydrogeologic modeling purposes, and this terminology has been used to meet project needs (for example, Jackson Group Upper Unit and Jackson Group Lower Unit). In other cases, a common aquifer name consisting of multiple individual formations has been used in lieu of the formation names (for example, Pecos Valley Alluvium or Brazos River Alluvium).

The lookup table tblLkStratigraphic_Name contains the values for this field and will continue to grow with new projects in the state.

HYDROGEOLOGIC_NAME This table contains the names of hydrogeologic units in Texas and primarily consists of the major and minor aquifer names. An aquifer may be subdivided into multiple parts, necessitating the use of the term hydrogeologic name. An aquifer may be composed of part of a formation or several formations.

DEPTH_TOP This field contains the depth to the top of the unit (referred to by the geologic pick field) in the units of feet below ground surface. The value is always a positive integer. This field is not corrected for kelly bushing height (see table tblWell_Location), because future re-evaluation of records when compared with original well reports or geophysical well logs will be unnecessarily complicated by the conversion of depth numbers.

DEPTH_BOTTOM This field contains the depth to the bottom of the unit (referred to by the geologic pick field) in the units of feet below ground surface. The value is always a positive integer. This field is not corrected for kelly bushing height (see table tblWell_Location), because future re-evaluation of records when compared with original well reports or geophysical well logs will be unnecessarily complicated by the conversion of depth numbers.

THICKNESS This is a calculated field: [depth_bottom] – [depth_top]. The units are feet.

GT If a well does not fully penetrate a formation or hydrogeologic unit, the greater than symbol (>) is written to this field. This field is used with stratigraphic or hydrogeologic picks. The bottom depth for this formation cannot be entered into the record in this situation.

ELEVATION_TOP This field contains the elevation to the top of the unit (referred to by the geologic pick field) in the units of feet above mean sea level. This field is corrected for kelly bushing height (see table tblWell_Location). This is a calculated field: ([elevation] – ([depth_top] – [kelly_bushing_height])).

A value of -99999 is written to the field if no data are present for this record.

ELEVATION_BOTTOM This field contains the elevation to the bottom of the unit (referred to by the geologic pick field) in the units of feet above mean sea level. This field is corrected for kelly bushing height (see table tblWell_Location). This is a calculated field: ([elevation] – ([depth_bottom] – [kelly_bushing_height])).

A value of -99999 is written to the field if no data are present for this record.

FAULT_TYPE This field contains the type of structural fault encountered at a well site during the interpretation of a geophysical well log. These field values are listed in the lookup table tblLkFaultType.

Table 4-3. Codes used in the fault_type field.

FAULT_TYPE	FAULT_DESCRIPTION
Growth	Growth fault is a normal fault with the fault plane listric and soles into underlying shale units. Typical of Gulf of Mexico Tertiary sediments. Syndepositional.
Normal	Normal fault: the hanging wall has moved downward relative to the foot wall. Extensional.
Reverse	Reverse fault: the hanging wall has moved upward relative to the foot wall. Angle of fault plane < 45 degrees. Compressional.
Ring	Ring fault: the center portion of the ring structure has moved downward relative to the surrounding rock. May be caused by underlying solution or removal of rock with subsequent collapse of overlying rock.
Strike-slip	Strike slip fault: one side of the fault moves in either a right or left direction relative to the other side
Thrust	Thrust fault: the hanging wall has moved upward relative to the foot wall. Angle of fault plane < 45 degrees. Compressional.

FAULT_MISSING_SECTION This field contains the interpreted amount of missing geologic section at a well site determined from interpretation of a well log. Units are in feet.

A value of -99999 is written to the field if no data are present for this record.

SOURCE_GEOLOGIC_DATA The source of the geologic data appended into the table. These field values are listed in the lookup table tblLkSourceGeologicData. This table will continue to grow with time.

Table 4-4. Codes used in the source_geologic_data field.

SOURCE_GEOLOGIC_DATA	SOURCE_GEOLOGIC_DATA_DESCRIPTION
CORE	Geologist Interpretation of Core Samples
GEOPHYSICAL WELL LOG	Geologist Interpretation of Geophysical Log
MISCELLANEOUS	Geophysical logs, well reports, scout tickets, cross-sections, …
OIL / GAS WELL LOG	Geologist Interpretation of Well Cuttings (MUD Log)
PUBLISHED REPORT	Geologic description, published report, source unknown
UNKNOWN	UNKNOWN
WATER WELL LOG, DRILLER	Well Driller Interpretation of Lithology from Drill Cuttings
WATER WELL LOG, GEOLOGIST	Geologist Interpretation of Lithology from Drill Cuttings

INITIALS Initials of staff member who last edited the well site record.

LAST_CHANGE Date the record was last edited.

REMARKS General remarks associated with the well record. If the [GEOLOGIC_PICK] field indicates “FAULT,” then this field will contain a reference to the well number used for missing section evaluation and the depth range of missing section in units of feet.

5. Aquifer Test Information Table: tblBracs_AquiferTestInformation

The aquifer test table contains records of hydraulic properties. The information resides in a separate table to handle the one-to-many relationship between a well record and the zero-to-many records describing aquifer test results. The vast majority of information was obtained from a spreadsheet maintained by the TWDB that compiled results from multiple sources across Texas; GWDB remarks field; Myers, 1969; and water well reports submitted in the Texas Department of Licensing and Regulation Submitted Driller Report Database. This information was supplemented by reviewing the published report containing the data. Additional sources of information include TWDB published reports.

Table 5-1. tblBRACS_AquiferTestInformation field names, data type and size, and lookup table references.

Field Name	Data Type	Size	Lookup Table
WELL_ID	Long Integer	4	
RECORD_NUMBER	Long Integer	4	
STATE_WELL_NUMBER	Long Integer	4	
TRANSMISSIVITY	Long Integer	4	
TRANSMISSIVITY_2	Long Integer	4	
T_UNITS	Text	50	tblLkUnitsOfMeasurement
HYDRAULIC_CONDUCTIVITY	Decimal	16	
K_UNITS	Text	50	tblLkUnitsOfMeasurement
STORAGE_COEFFICIENT	Decimal	16	
SPECIFIC_YIELD	Decimal	16	
SPECIFIC_CAPACITY	Decimal	16	
SC_UNITS	Text	50	tblLkUnitsOfMeasurement
SOURCE_WELL_DATA	Text	250	tblLkSourceWellData
DATE_TEST	Text	10	
WELL_YIELD	Long Integer	4	
WELL_YIELD_METHOD	Text	25	tblLkWellYieldMethod
ARTESIAN_PSI	Decimal	16	
SCREEN_TOP	Long Integer	4	
SCREEN_BOTTOM	Long Integer	4	
DEPTH_WELL	Long Integer	4	
STATIC_WATER_LEVEL	Decimal	16	
PUMPING_WATER_LEVEL	Decimal	16	
REPORT_98_PAGE	Text	50	
REMARKS	Text	250	
ANALYSIS_REMARKS	Text	250	
TEST_LENGTH	Decimal	16	
DRAWDOWN	Decimal	16	
D_R	Text	1	

Field Descriptions

WELL_ID Each record in the database is assigned a unique well ID (which is a long integer) in this table. This is the key field in this table.

RECORD_NUMBER This is the second key field in this table. This number is not assigned as an autonumber field, as in the usual case for a key field. The value is an integer, beginning with 1 and increasing with the addition of each record for a specific well.

STATE_WELL_NUMBER This field contains the state well number if assigned to a well record. The state well number is assigned to each well in the TWDB Groundwater Database.

TRANSMISSIVITY This field contains a transmissivity value measured for the aquifer(s) at the well site. Transmissivity units are specified in the [t_units] field. The source of the information is specified in the [source_well_data] field.

If two transmissivity values are provided for a test, the larger value is written to this field and the lower of the values is written to the field [transmissivity_2]. A value of -99999 is written to the field if no data are present for this record.

TRANSMISSIVITY_2 This field contains a transmissivity value measured for the aquifer(s) at the well site. Transmissivity units are specified in the [t_units] field. The source of the information is specified in the [source_well_data] field.

If two transmissivity values are provided for a test, the lower value is written to this field and the larger of the values is written to the field [transmissivity]. A value of -99999 is written to the field if no data are present for this record.

T_UNITS The units of measurement for the values in the fields [transmissivity] and [transmissivity_2]. These field values are listed in the lookup table tblLkUnitsOfMeasurement. This table may continue to grow with time.

Table 5-2. Codes used in the t_units field.

UNITS	UNITS_DESCRIPTION
ft	feet
ft2/day	feet squared per day
gpd/ft	gallons per day per foot
gpd/ft2	gallons per day per foot squared
gpm/ft	gallons per minute per foot of drawdown

HYDRAULIC_CONDUCTIVITY This field contains a hydraulic conductivity value measured for the aquifer(s) at the well site. Hydraulic conductivity units are specified in the [k_units] field. The source of the information is specified in the [source_well_data] field. A value of -99999 is written to the field if no data are present for this record.

K_UNITS The units of measurement for the values in the field [hydraulic_conductivity]. These field values are listed in the lookup table tblLkUnitsOfMeasurement. This table may continue to grow with time.

Table 5-3. Codes used in the k_units field.

UNITS	UNITS_DESCRIPTION
ft	feet
ft2/day	feet squared per day
gpd/ft	gallons per day per foot
gpd/ft2	gallons per day per foot squared
gpm/ft	gallons per minute per foot of drawdown

STORAGE_COEFFICIENT This field contains a storage coefficient value measured for the aquifer(s) at the well site. Storage coefficient is dimensionless. The source of the information is specified in the [source_well_data] field. A value of -99999 is written to the field if no data are present for this record.

SPECIFIC_YIELD This field contains a specific yield value measured for the aquifer(s) at the well site. Specific yield is dimensionless. The source of the information is specified in the [source_well_data] field. A value of -99999 is written to the field if no data are present for this record.

SPECIFIC_CAPACITY This field contains a specific capacity value measured for the aquifer(s) at the well site. Specific capacity units are specified in the [sc_units] field. Specific capacity represents [well_yield] / [drawdown]. A value of -99999 is written to the field if no data are present for this record.

SC_UNITS The units of measurement for the values in the field [specific_capacity]. These field values are listed in the lookup table tblLkUnitsOfMeasurement. This table may continue to grow with time.

Table 5-4. Codes used in the sc_units field.

UNITS	UNITS_DESCRIPTION
ft	feet
ft2/day	feet squared per day
gpd/ft	gallons per day per foot
gpd/ft2	gallons per day per foot squared
gpm/ft	gallons per minute per foot of drawdown

SOURCE_WELL_DATA Each aquifer test record is assigned the source of the well information. In some cases multiple sources exist; see the fields [report_98_page], [remarks], or [analysis_remarks] for additional information.

DATE_TEST The date the well was tested in the format of MM/DD/YYYY (M = month; D = day; Y = year). If the date is incomplete, zeros (0) are entered for missing values. The field is text since many test dates are incomplete and do not meet date standards.

WELL_YIELD The pumping rate of the well in units of gallons per minute (gpm). In cases of variable rate pumping tests, the original data will need to be reviewed. A value of -99999 is written to the field if no data are present for this record.

WELL_YIELD_METHOD The method used to obtain the well yield. These field values are listed in the lookup table tblLkWellYieldMethod. This table may continue to grow with time.

Table 5-5. Codes used in the well_yield_method field.

WELL_YIELD_METHOD
Bailed
Flowed
Jetted
Pumped
Unknown

ARTESIAN_PSI The artesian pressure measured at the well head in units of pounds per square inch (psi). If the value is in units of feet above ground surface, the value is converted to psi using the equation (n * .434), where n represents the value units of feet and the conversion factor .434 is in units of psi/ft.

SCREEN_TOP The top of the well screen interval in units of feet below ground surface. A value of -99999 is written to the field if no data are present for this record.

SCREEN_BOTTOM The bottom of the well screen interval in units of feet below ground surface. A value of -99999 is written to the field if no data are present for this record.

DEPTH_WELL The total depth of the well in units of feet below ground surface. This is reported on the water well driller report. A value of -99999 is written to the field if no data are present for this record.

STATIC_WATER_LEVEL The static water level measured at the time of the aquifer test in units of feet below ground surface. A value of -99999 is written to the field if no data are present for this record.

PUMPING_WATER_LEVEL The pumping water level measured at the time of the aquifer test in units of feet below ground surface. A value of -99999 is written to the field if no data are present for this record.

REPORT_98_PAGE The page number within Report 98 that shows the aquifer test results (Myers, 1969).

REMARKS General remarks pertaining to the aquifer test information.

ANALYSIS_REMARKS This field contains remarks about the aquifer test information. Many references to the original report are in this field. The value of R-98 refers to the Myers, 1969 report. Additional references provide the TWDB report number and table number.

TEST_LENGTH The length of the pumping test in units of hours. A value of -99999 is written to the field if no data are present for this record.

DRAWDOWN The drawdown in water level at the end of the aquifer test in units of feet below ground surface. A value of -99999 is written to the field if no data are present for this record.

D_R This field contains a one-letter code specifying the type of aquifer test performed: D = drawdown test; R = recovery test.

6. Geophysical Well Log Header Table: tblGeophysicalLog_Header

This table contains header attributes, file names and types, and file locations for each geophysical well log in the TWDB collection. The information resides in a separate table to handle the one-to-many relationship between a well record and the one-to-many records for each geophysical well log. The top page of a geophysical well log is commonly called the header and contains the operator name, well lease and number, location, dates, depths, logging parameters, and other attributes essential in understanding the conditions under which the logging was performed.

Table 6-1. tblGeophysicalLog_Header field names, data type and size, and lookup table references.

Field Name	Data Type	Size	Lookup Table
WELL_ID	Long Integer	4	
GL_NUMBER	Long Integer	4	
GL_FILE_TYPE	Text	15	tblLkGlFileType
GL_FOLDER_NAME	Text	25	
GL_DIGITAL_FILE_NAME	Text	250	
GL_IMAGE_CUTOFF_DEPTH	Long Integer	4	
GL_HYPERLINK	Hyperlink	-	
DT	Long Integer	4	
TS	Single	4	
TBH	Single	4	
RM	Single	4	
RM_TEMP	Single	4	
RMF	Single	4	
RMF_TEMP	Single	4	
MUD_TYPE	Text	100	
GEOPHYSICAL_LOGGING_COMPANY	Text	100	tblLkGeophysicalLoggingCompany
REMARKS	Text	250	
INITIALS	Text	3	tblLkIntial

Field Descriptions

WELL_ID Each record in the database is assigned a unique well ID (which is a long integer) in this table. This is the key field in this table.

GL_NUMBER This is the second key field for this table. This value is assigned as an autonumber data type for each new record added to the table.

GL_FILE_TYPE This field contains a value for the geophysical well log file type. These field values are listed in the lookup table tblLkGlFileType. This table may continue to grow with time.

Table 6-2. Codes used in the gl_file_type field.

GL_FILE_TYPE
JPG IMAGE
LAS DIGITAL
PAPER
PDF Image
See File Name
TIF IMAGE

The majority of logs in the TWDB collection are digital TIFF file images. Paper logs are not filed with the digital logs. The value "see file name" indicates a non-standard file type.

This field is used in the concatenation of the hyperlink field.

GL_FOLDER_NAME This field contains the folder name containing the digital geophysical well logs at the TWDB. The name consists of a state code and county code in the format of 42_495. The state code is the one used by the American Petroleum Institute API number assigned to oil and gas wells in the United States. The county code is used by the Federal Information Processing System (FIPS) for counties in the United States.

This field is used in the concatenation of the hyperlink field.

GL_DIGITAL_FILE_NAME This field contains the digital geophysical well log file name without the file type extension. This field is used in the concatenation of the hyperlink field.

There are many different naming conventions used for the file names. No attempt to standardize these names was made, since the collection consists of thousands of logs from many different source agencies or projects. The only significant feature is that each file name must be unique.

For the majority of the oil and gas wells, the file name is the API number. The API number may have an extension of an underscore followed by an increasing integer or letter if more than one geophysical well log was run in the same well. Oil and gas well file names may also have extensions using some type of code reference to the type of tool(s) represented on the geophysical well log.

Geophysical well logs obtained from the Railroad Commission of Texas Groundwater Advisory Unit (formerly the Texas Commission on Environmental Quality Surface Casing Program) use a file name format consisting of QX_YYY, where X represents a unique integer for each well or collection of wells within a county and the characters YYY represent the FIPS county code where the well is located. The value Q-X is known as the Q-number, and is referenced in the foreign key table, tblBracs_ForeignKey.

Water wells with a state well number commonly use that number as the file name.

Geophysical well logs obtained from the U.S. Geological Survey have a unique identification number for every digital document. The logs are commonly run in LAS and PDF format with supporting documents (including field sheets) in various file formats.

GL_IMAGE_CUTOFF_DEPTH The total depth of the digital log image (when image does not go to total depth of the well). The units are feet below ground surface. Value of -99999 indicates image does go to total depth.

This situation arises when partial logs are imaged; in some cases, the deeper parts of the log are not available because of confidentiality. This field can be used to adjust the net sand and sand percent calculations, since it is not possible to fully evaluate a formation to total depth if part, or all, of the geophysical well log is not available for interpretation.

GL_HYPERLINK This field permits the digital geophysical well logs to be opened from a Microsoft® Access® form. The data type for this field is hyperlink, and the data format is based on the navigation path within a computer's file system, called the universal naming convention (UNC). The ability to access these digital files using this technique has saved tremendous amounts of time and ensured that the correct document was opened.

This field is created with a query that concatenates several other fields. The syntax of the Microsoft® Access® Update query is presented here so users of the database and digital geophysical well logs can modify their version of the BRACS Database and file structure to meet their needs.

```
UPDATE tblGeophysicalLog_Header SET tblGeophysicalLog_Header.GL_HYPERLINK =
"#B:\GeophysicalWellLogs\" & [GL_FOLDER_NAME] & "\" & [GL_DIGITAL_FILE_NAME] & ".tif#"
WHERE (((tblGeophysicalLog_Header.GL_FILE_TYPE)="tif image")),
```

One can substitute the pathname B:\GeophysicalWellLogs\ for any other pathname on a local computer or network drive. If the folder structure holding the digital documents is different, the query can be modified to accept this. One will need to perform several queries to account for the concatenation of different file type extensions. The query will need to be modified in the where clause (gl_file_type) and the suffix in the hyperlink.

DT This field contains the total depth of the well at the time the well was logged. The depth is in units of feet below ground surface and is not corrected for kelly bushing height. This value is written on the geophysical well log header. This value may not represent the total depth of the completed well, as recorded in the well location table (fields [depth_total] or [depth_well]), since wells may be drilled and logged in stages during the course of well development.

This field is completed only for geophysical well logs used for interpretation of total dissolved solids. The value is used in determining the local geothermal gradient, temperature at the depth of formation analysis, and resistivity of the mud filtrate at the depth of formation analysis.

TS This field contains the temperature at the ground surface at the time the well was logged. Temperature is in units of degrees Fahrenheit. This value is written on the geophysical well log header.

This field is completed only for geophysical well logs used to interpret total dissolved solids.

TBH This field contains the temperature at the bottom of the hole at the time the well was logged. Temperature is in units of degrees Fahrenheit. This value is written on the geophysical well log header.

This field is completed only for geophysical well logs used for interpretation of total dissolved solids.

RM This field contains the resistivity of the drilling mud at the ground surface at the time the well was logged. Resistivity is in units of ohm-meter. This value is written on the geophysical well log header.

This field is completed only for geophysical well logs used for interpretation of total dissolved solids.

RM_TEMP This field contains the temperature of the drilling mud at the ground surface at the time the drilling mud was tested for resistivity. Temperature is in units of degrees Fahrenheit. This value is written on the geophysical well log header.

This field is completed only for geophysical well logs used for interpretation of total dissolved solids.

RMF This field contains the resistivity of the drilling mud filtrate at the ground surface at the time the well was logged. Resistivity is in units of ohm-meter. This value is written on the geophysical well log header.

This field is completed only for geophysical well logs used for interpretation of total dissolved solids.

RMF_TEMP This field contains the temperature of the drilling mud filtrate at the ground surface at the time the drilling mud filtrate was tested for resistivity. Temperature is in units of degrees Fahrenheit. This value is written on the geophysical well log header.

This field is completed only for geophysical well logs used for interpretation of total dissolved solids.

MUD_TYPE This field contains the type of drilling mud used immediately prior to logging the well. The type of drilling mud used is extremely important when considering using the record for interpreting total dissolved solids content of the water. Drilling mud programs may change during different stages of well development.

This field is completed only for geophysical well logs used for interpretation of total dissolved solids.

GEOPHYSICAL_LOGGING_COMPANY This field contains the name of the company that created the geophysical well log.

This field is completed only for geophysical well logs used for interpretation of total dissolved solids. These field values are listed in the lookup table tblLkGeophysicalLoggingCompany.

REMARKS This field may include observations on scale changes, problems encountered during logging as noted on the log header, and quality of digital log image.

INITIALS Initials of staff member who last edited the well site record.

7. Geophysical Well Log Suite Table: tblGeophysicalLog_Suite

This table contains the list of geophysical tools represented on a geophysical well log. The information resides in a separate table to handle the one-to-many relationship between a geophysical well log and the one-to-many records describing the individual tools. This table is important in not only understanding what tools are ready for interpretation at a specific well site, but also the start and end depths of each tool. The usefulness of a particular log in understanding water resources may be precluded if the tools start below the aquifer base.

Table 7-1. tblGeophysicalLog_Suite field names, data type and size, and lookup table references.

Field Name	Data Type	Size	Lookup Table
WELL_ID	Long Integer	4	
GL_NUMBER	Long Integer	4	
GEOPHYSICAL_LOG	Text	50	tblLkGeophysicalLogs
GL_CODE	Text	25	tblLkGeophysicalLogs
DEPTH_TOP	Long Integer	4	
DEPTH_BOTTOM	Long Integer	4	
REMARKS	Text	250	

Field Descriptions

WELL_ID Each record in the database is assigned a unique well ID (which is a long integer) in this table. This is the key field in this table.

GL_NUMBER This is the second key field for this table. This value is assigned when completing data entry for a geophysical well log in the table tblGeophysicalLog_Header.

GEOPHYSICAL_LOG This is the third key field for this table. Each geophysical well log tool represents a unique record. This field is tied to the lookup table tblLkGeophysicalLogs. This ensures consistent data entry. There are a number of general and company-specific naming conventions for these tools.

GL_CODE The sole purpose of this field is to facilitate data entry by typing a simple code to load the geophysical log name. This is achieved using a data entry form. The code resides in the lookup table tblLkGeophysicalLogs and can be modified to meet the user's needs.

DEPTH_TOP The depth to the top of the interval logged by the geophysical tool (start depth) in units of feet below ground surface. This depth is not corrected for kelly bushing height. The user should attempt to determine this value to the nearest 10 feet. Logging tools start and end recording at different depths due to placement on the logging tool string.

DEPTH_BOTTOM The depth to the bottom of the interval logged by the geophysical tool (end depth) in units of feet below ground surface. This depth is not corrected for kelly bushing height. The user should determine this value to the nearest 10 feet. Logging tools start and end recording at different depths due to placement on the logging tool string.

REMARKS General remarks. This may include observations on scale changes, problems encountered during logging as noted on the log header, and so on.

8. Geophysical Well Log Water Quality: tblGeophysicalLog_WQ

This table contains the interpreted total dissolved solids content for a specific depth interval obtained from geophysical well log analysis. The table also contains parameters associated with this depth interval used for log analysis, such as temperature of formation, resistivity of the mud filtrate, and thickness of the lithologic unit that was assessed. The format of many of these field names are written as parameters since they are used in equations, coded in Microsoft® Visual Basic for Applications® (VBA), and determined by computation.

The information resides in a separate table to handle the one-to-many relationship between a geophysical well log record and the one-to-many records for each depth interval assessed for interpreted total dissolved solids.

Table 8-1. tblGeophysicalLog_WQ field names, data type and size, and lookup table references.

Field Name		Data Type	Size	Lookup Table
WELL_ID		Long Integer	4	
GL_NUMBER		Long Integer	4	
DF		Long Integer	4	
TF		Single	4	
RMF_TF		Single	4	
TDS_INTERPRETED		Single	4	
CON_TDS_METHOD		Text	150	tblLkCon_Tds_Method
ELEV_F		Long Integer	4	
LITHOLOGIC_UNIT_THICKNESS		Long Integer	4	
REMARKS		Text	250	
INITIALS		Text	3	tblLkIntial

Field Descriptions

WELL_ID Each record in the database is assigned a unique well ID (which is a long integer) in this table. This is the key field in this table.

GL_NUMBER This is the second key field for this table. This value is assigned as an autonumber data type for each new record added to the table.

DF This is the third key field for this table. This value is based on the depth of the assessed formation of interest. The depth units are feet below ground surface, and this value is not corrected for kelly bushing height.

The depth is that point on the geophysical well log where the tool values are measured. Typically the point is within a relatively thick and mineralogically uniform lithologic unit where bed boundary effects are minimal.

TF This field contains the temperature at the depth of formation of interest, field [DF]. Temperature units are degrees Fahrenheit.

This value is calculated based on the geothermal gradient at the well site.

RMF_TF This field contains the resistivity of the mud filtrate at the temperature of formation of interest, field [TF]. Resistivity is in units of ohm-meter.

This value is calculated based on the geothermal gradient at the well site.

TDS_INTERPRETED This field contains the interpreted total dissolved solids (TDS) content at the depth of formation of interest. The units of TDS are milligrams per liter.

This value is calculated based on a number of interpretation methods. Refer to field [CON_TDS_METHOD] for how this value was obtained: either through one method or the average of multiple methods.

CON_TDS_METHOD This field contains the method(s) used to determine the field [TDS_INTERPRETED]. These field values are listed in the lookup table tblLkCon_Tds_Method. This table may continue to grow with time.

Table 8-2. Codes used in the con_tds_method field.

CON_TDS_METHOD
Alger Harrison
Average of: SP, Estepp
Average of: Estepp, Mean Ro
Average of: SP, Alger, Estepp
Average of: SP, Estepp, Mean Ro
Average of: SP, Estepp, Mean Ro, Rwa, Alger
Estepp
Guyod
Mean Ro
Rwa Method
SP Method

ELEV_F This field contains the elevation of the formation of interest in units of feet above mean sea level. The value is corrected for kelly bushing height. This is a calculated field: ([elevation] – ([DF] – [kelly_bushing_height])).

LITHOLOGIC_UNIT_THICKNESS This field contains the thickness of the lithologic unit that has been evaluated, in units of feet.

REMARKS This field may include observations made during the processing of this record.

INITIALS Initials of staff member who last edited the record.

9. Geophysical Well Log Water Quality Method: tblGeophysicalLog_WQ_Method

This table contains the interpreted total dissolved solids content for a specific depth interval obtained from different methods of geophysical well log analysis. The table also contains parameters associated with this depth interval used for log analysis, including raw parameters (those from the log header or values interpreted from the tool response) and correction factors; intermediate computation parameters; and the computation results. The format of many of these field names are written as parameters since they are used in equations, coded in Microsoft® Visual Basic for Applications® (VBA), and determined by computation.

The information resides in a separate table to handle the one-to-many relationship between a specific depth interval represented on a geophysical well log record and the one-to-many records for each method used to assess interpreted total dissolved solids.

The design of this table will change in the future since the methods of analyzing total dissolved solids using geophysical well logs are still being evaluated. Until the methods are determined to be technically defensible, table and field modifications will need to evolve.

Table 9-1. tblGeophysicalLog_WQ_Method field names, data type and size, and lookup table.

Field Name	Data Type	Size	Lookup Table
WELL_ID	Long Integer	4	
GL_NUMBER	Long Integer	4	
DF	Long Integer	4	
TDS_METHOD	Text	50	tblLkTdsMethod
TDS	Single	4	
GEOPHYSICAL_LOG	Text	50	tblLkGeophysicalLogs
RXO	Single	4	
RO	Single	4	
RO_COR	Single	4	tblLkCf_Ro_MeanRoMethod
CT	Single	4	tblLkCf_ct
IZC_Method	Integer	2	tblLkCf_Rxo_Ro_InvasionZone
RXO_RO	Single	4	
RWE	Single	4	
RWE_RW_COR	Single	4	tblLkCf_RweRw_SpMethod
RW	Single	4	
RW75	Single	4	
CW	Single	4	
M	Single	4	tblLk_m
M_COR	Single	4	tblLkCf_m_EsteppMethod
SOURCE_M	Text	250	
SP	Single	4	
K	Single	4	
CHART	Text	50	
RMF_COR	Single	4	
POROSITY	Single	4	
SOURCE_POROSITY	Text	250	
REMARKS	Text	250	
INITIALS	Text	3	tblLkIntial

Space does not permit actual descriptions of these methods in this data dictionary. A separate report is planned to discuss the descriptions in detail when the evaluation is complete. In lieu of this report, the user is referred to the two reports by Estepp (1998, 2010) discussing the evaluation of groundwater quality using geophysical well logs. These table designs and VBA coding for computations are a direct result of this work.

Field Descriptions

WELL_ID Each record in the database is assigned a unique well ID (which is a long integer) in this table. This is the key field in this table.

GL_NUMBER This is the second key field for this table. This value is assigned as an autonumber data type for each new record added to the table.

DF This is the third key field for this table. This value is based on the depth of the assessed formation of interest. The depth units are feet below ground surface, and this value is not corrected for kelly bushing height.

The depth is that point on the geophysical well log where the tool values are measured. Typically the point is within a relatively thick lithologic unit with uniform mineralogy where bed boundary effects are minimal.

TDS_METHOD This is the fourth key field for this table. This lists the method used for interpreted total dissolved solids content at this depth of interest. These field values are listed in the lookup table tblLkTdsMethod. This table may continue to grow with time.

Table 9-2. Codes used in the tds_method field.

TDS_METHOD
SP Method
Alger Harrison Method
Estepp Method
Mean Ro Method
Rwa Method

TDS This field contains the interpreted total dissolved solids content in units of milligrams per liter.

GEOPHYSICAL_LOG This field contains the name of the geophysical well log tool used for interpretation.

RXO This field contains the resistivity of the invaded zone in units of ohm-meter. This value is interpreted directly from a shallow-penetration resistivity tool.

RO This field contains the resistivity of the formation, which is 100 percent saturated with water. Resistivity is in units of ohm-meter. This value is interpreted directly from a deep-penetration resistivity tool.

RO_COR This field contains a correction factor for high anion content groundwater. These field values are listed in the lookup table tblLkCf_Ro_MeanRoMethod. This table may continue to grow with time.

Table 9-3. Codes used in the ro_cor field

RO_COR	SOURCE_DATA
1	No Correction
1.75	High Bicarbonate. Standard correction due to higher resistivity of HCO3 waters

CT This field contains the ratio specific conductivity divided by total dissolved solids. This is an empirical derivation. The field value is a decimal fraction (less than one; for example, .72). This conversion factor is dimensionless. These field values are listed in the lookup table tblLkCf_ct. This table will continue to grow with time.

IZC_Method This field contains a value for invasion zone correction method used in the analysis. These field values are listed in the lookup table tblLkCf_Rxo_Ro_InvasionZone. This table may continue to grow with time.

Table 9-4. Codes used in the izc_method field

IZC_METHOD	METHOD_DESCRIPTION
0	No Correction
1	DIL SFL Rxo / Ro = (1.45 (Rxo/Ro)) - .45
2	DIL LL8 Rxo / Ro = (1.85 (Rxo/Ro)) - .85
3	Lateral Logs Rxo / Ro = Rxo / (1.67 * Ro) - (.67 * Rxo) Ro = derived from one of many curve interpretation methods
4	64" and 16" Normal Rxo / Ro = (R16)squared / (R64)squared

RXO_RO This field contains the following ratio: resistivity of the invaded zone divided by the resistivity of the formation (un-invaded zone). The value is unitless.

RWE This field contains the resistivity of water equivalent in units of ohm-meter.

RWE_RW_COR This field contains a correction factor for high cation waters. The value is unitless. These field values are listed in the lookup table tblLkCf_RweRw_SpMethod. This table may continue to grow with time.

RW This field contains the resistivity of the water as determined by geophysical well log analysis. The resistivity is in units of ohm-meter.

RW75 This field contains the resistivity of the water as determined by geophysical well log analysis corrected for 75 degrees Fahrenheit. The resistivity is in units of ohm-meter.

CW This field contains the conductivity of the water as determined by geophysical well log analysis corrected for 75 degrees Fahrenheit. The resistivity is in units of microsiemens per meter.

M This field contains the cementation method. The value is unitless. These field values are listed in the lookup table tblLk_m, which also contains the dominant lithology, texture and cement, and report references. This table may continue to grow with time.

M_COR This field contains a correction to the cementation factor for high anion content. These field values are listed in the lookup table tblLkCf_m_EsteppMethod.

SOURCE_M This field contains a reference to the source of the cementation factor value used in the analysis.

SP This field contains the spontaneous potential (SP) value in units of + or – millivolts. The value is interpreted from the spontaneous potential tool.

K This field contains a constant, K, which is dependent on temperature and is used in equations for the SP method.

CHART This field contains a reference to the chart name used for conversion.

RMF_COR This field contains the correction factor for resistivity of the mud filtrate when using the SP method of analysis.

POROSITY This field contains the formation porosity value in units of percent total volume as void. Porosity can be determined from geophysical logs or estimated from other methods.

SOURCE_POROSITY This field contains a reference to the source of the porosity value.

REMARKS This field may include observations made during the processing of this record.

INITIALS Initials of staff member who last edited the record.

10. Digital Water Well Reports: tblBracsWaterWellReports

This table contains file names and types and file locations for each digital well report that does not exist in the TWDB GWDB file collection. The majority of reports are for water wells; however. any non-geophysical well log report for oil and gas wells (such as scout tickets) is contained in this table and filing system. The majority of these documents were obtained during the BRACS projects and from work performed in fulfillment of TWDB contracted studies for aquifer information (Groundwater Availability Models (GAM) and structure/stratigraphy studies to support GAMs).

The information resides in a separate table to handle the one-to-many relationship between a well record and the one-to-many records for each digital well report.

Table 10-1. tblBracsWaterWellReports field names, data type and size, and lookup table references.

Field Name	Data Type	Size	Lookup Table
WELL_ID	Long Integer	4	
WW_NUMBER	Long Integer	4	
WW_FILE_TYPE	Text	15	tblLkGlFileType
WW_FOLDER_NAME	Text	25	
WW_DIGITAL_FILE_NAME	Text	250	
WW_HYPERLINK	Hyperlink	-	
REMARKS	Text	250	
INITIALS	Text	3	tblLkIntial

Field Descriptions

WELL_ID Each record in the database is assigned a unique well ID (which is a long integer) in this table. This is the key field in this table.

WW_NUMBER This is the second key field for this table. This value is assigned as an autonumber data type for each new record added to the table.

WW_FILE_TYPE This field contains a value for the well report file type. These field values are listed in the lookup table tblLkGlFileType. This table will continue to grow with time.

Table 10-2. Codes used in the ww_file_type field.

GL_FILE_TYPE
JPG IMAGE
LAS DIGITAL
PAPER
PDF Image
See File Name
TIF IMAGE

This field is used in the concatenation of the hyperlink fields.

WW_FOLDER_NAME This field contains the folder name containing the well reports at the TWDB. The name consists of a state code and county code in the format of 42_495. The state code is the one used by the American Petroleum Institute API number assigned to oil and gas wells in the United States. The county code is used by the Federal Information Processing System (FIPS) for counties in the United States.

This field is used in the concatenation of the hyperlink fields.

WW_DIGITAL_FILE_NAME This field contains the well report file name without the file type extension.

There are many different naming conventions used for the file names. No attempt to standardize these names was made, since the collection consists of thousands of logs from many different source agencies or projects. The only significant feature is that each file name must be unique.

Well report data from several projects submitted to the TWDB consisted of a few digital files containing multiple well reports. These documents were not subdivided into individual documents per well. The documents often contain a project-specific numbering scheme written on the well report prior to imaging. One may need to refer to the [remarks] field or the foreign key table (tlbBRACS_ForeignKey) to determine the project number prior to searching in the digital file for the correct well report.

This field is used in the concatenation of the hyperlink fields.

WW_HYPERLINK This field permits the well report to be opened from a Microsoft® Access® form. The data type for this field is hyperlink, and the data format is based on the navigation path within a computer's file system, called the universal naming convention (UNC). The ability to access these digital files using this technique has saved tremendous amounts of time and ensured that the correct document was opened.

This field is created with a query that concatenates several other fields. The syntax of the Microsoft® Access® Update query is presented here so users of the BRACS Database and digital documents can then modify their version of the database and file structure to meet their needs.

```
UPDATE tblBRACSWaterWellReports SET tblBRACSWaterWellReports.WW_HYPERLINK =
"#B:\DrillerWellLogs\" & [WW_FOLDER_NAME] & "\" & [WW_DIGITAL_FILE_NAME] & ".pdf#"
WHERE (((tblBRACSWaterWellReports.WW_FILE_TYPE)="pdf image"));
```

One can substitute the pathname B:\BRACS\DrillerWellLogs\ for any other pathname on a local computer or network drive. If the folder structure holding the digital documents is different, the query can be modified to accept this. One will need to perform several queries to account for the different file types. The query will need to be modified in the where clause (ww_file_type) and the suffix in the hyperlink.

REMARKS This field contains information about the digital well report that does not fit into any other field. The most common entry regards a digital file that holds multiple well reports.

INITIALS Initials of staff member who last edited the well site record.

11. Static Water Level Table: tblBracs_SWL

The static water level table contains records of measurements at well sites. The information resides in a separate table to handle the one-to-many relationship between a well record and the zero-to-many records describing the static water level measurements.

All of the well records within a project area are appended to this table from the TWDB Groundwater Database. This table structure is similar to that used in the Groundwater Database (Rein and Hopkins, 2008). Additional static water level measurements for wells in the project area are obtained from the Texas Department of Licensing and Regulation Submitted Driller Report Database and the Texas Commission on Environmental Quality Source Water Assessment Program Database for public water supply wells. The unique well identifications for each of these source datasets are maintained in this table.

Table 11-1. tblBracs_SWL field names, data type and size, and lookup table references.

Field Name	Data Type	Size	Lookup Table
WELL_ID	Long Integer	4	
STATE_WELL_NUMBER	Long Integer	4	
TRACK_NUMBER	Long Integer	4	
WATER_SOURCE	Text	10	
SWL	Decimal	16	
SWL_Date	Date/Time	8	
GWDB_MN	Text	2	tblLkWaterLevelMethod
mm_date	Integer	2	
dd_date	Integer	2	
yy_date	Integer	2	
AGENCY	Text	5	tblLkAgency
REMARKS	Text	200	

Field Descriptions

WELL_ID Each record in the database is assigned a unique well ID (which is a long integer) in this table. This is the key field in this table.

STATE_WELL_NUMBER This field contains the state well number assigned to each water well in the TWDB Groundwater Database.

TRACK_NUMBER This field contains the track number assigned to each well in the Texas Department of Licensing and Regulation Submitted Driller Report Database. If this field is filled in and the [agency] field indicates driller, the static water level was obtained from this data source.

WATER_SOURCE This field contains the water source code assigned to each public water supply well by the Texas Commission on Environmental Quality.

SWL This field contains the static water level in units of feet below ground surface. Negative numbers indicated the static water level is below the well site ground surface, and positive numbers indicate the static water level is above the well site ground surface (artesian conditions).

SWL_Date This field contains the date the static water level measurement was taken. If the month, day, or year values in the separate fields are incomplete (contain zeros), this field is blank.

GWDB_MN This field contains a code referring to the method used to obtain the static water level value. These field values are listed in the lookup table tblLkWaterLevelMethod.

Table 11-2. Codes used in the gwdb_mn field.

GWDB_MN	MEASURING METHOD DESCRIPTION
00	SONIC / LASER DEVICE
01	STEEL TAPE
02	CALIBRATED ELECTRIC TAPE
02	ELECTRIC TAPE
03	AIR LINE
04	ANALOG\GRAPHIC RECORDER
05	PRESSURE GAUGE
07	REPORTED - METHOD NOT KNOWN
08	OTHER - INDICATE IN REMARKS
09	RECORDER SONDE

mm_date This field contains an integer for the month the sample was collected. If the month is unknown, a zero (0) is required.

dd_date This field contains an integer for the day the sample was collected. If the day is unknown, a zero (0) is required.

yy_date This field contains an integer for the year the sample was collected. The year must have four characters. If the year is unknown, a zero (0) is required.

AGENCY This field contains a code representing the agency that collected the static water level measurement.

REMARKS General remarks about the measurement.

12. Well Construction Table: tblBracs_Casing

The well construction table contains the diameter and top and bottom depths for water well construction intervals consisting of casing, well screen, and open hole. The design of the table is exactly like the TWDB Groundwater Database (Rein and Hopkins, 2008) except the state well number field is replaced with the BRACS well_ID field. This will facilitate merging these data with the Groundwater Database in the future.

The information resides in a separate table to handle the one-to-many relationship between a well record and the one-to-many records describing the well construction.

Table 12-1. tblBracs_Casing field names, data type and size, and lookup table references.

Field Name	Data Type	Size	Lookup Table
WELL_ID	Long Integer	4	
GROUP_NUMBER	Integer	2	
C_S_O_INDICATOR	Text	1	
DIAMETER_CSG_SCN	Integer	2	
TOP_DEPTH	Integer	2	
BOTTOM_DEPTH	Integer	2	

Field Descriptions

WELL_ID Each record in the database is assigned a unique well ID (which is a long integer) in this table. This is the key field in this table.

GROUP_NUMBER This field is the second key field in the table. It consists of an integer beginning with one for the first record of a well and increases by a value of one for each new record.

C_S_O_INDICATOR This field contains a one-character code indicating the type of well construction interval: C = casing; S = screen; O = open hole. The data entry of new records follows the top to bottom construction sequence of the water well.

DIAMETER_CSG_SCN This field contains the diameter of the well construction interval in units of inches.

TOP_DEPTH The top of the casing, well screen, or open interval in units of feet below ground surface.

BOTTOM_DEPTH The bottom of the casing, well screen, or open interval in units of feet below ground surface.

13. Water Quality Table: tblBracsWaterQuality

The water quality table contains records of water chemistry data organized with one record per well per date sampled with constituents in separate fields. The design of the table is almost exactly like the TWDB Groundwater Database (Rein and Hopkins, 2008). This will facilitate merging these data with the Groundwater Database in the future.

The information resides in a separate table to handle the one-to-many relationship between a well record and the zero-to-many records describing the water chemistry.

The majority of field descriptions were obtained from the Groundwater Database Data Dictionary spreadsheet available on the TWDB website.

Table 13-1. tblBracsWaterQuality field names, data type and size, and lookup table references.

Field Name	Data Type	Size	Lookup Table
WELL_ID	Long Integer	4	
mm_date	Integer	2	
dd_date	Integer	2	
yy_date	Integer	2	
sample_number	Integer	2	
STATE_WELL_NUMBER	Long Integer	4	
SOURCE_DATA	Text	200	
sample_time	Text	4	
temp_centigrade	Text	2	
top_s_interval	Integer	2	
bottom_s_interval	Integer	2	
samp_int_aqcode	Text	8	
collection_remarks	Text	30	
reliability_rem	Text	2	
collecting_agency	Text	2	
lab_code	Text	2	
bu_wqanalysis	Text	1	
q00955_flag	Text	1	
q00955_silica_mgl	Decimal	16	
q00910_flag	Text	1	
q00910_calcium_mgl	Decimal	16	
q00920_flag	Text	1	
q00920_magnes_mgl	Decimal	16	
q00929_flag	Text	1	
q00929_sodium_mgl	Decimal	16	
q00937_flag	Text	1	
q00937_potass_mgl	Decimal	16	
q01080_flag	Text	1	
q01080_strontium	Decimal	16	
q00445_carb_mgl	Decimal	16	
q00440_bicarb_mgl	Decimal	16	
q00945_flag	Text	1	
q00945_sulfate_mgl	Decimal	16	
q00940_flag	Text	1	
q00940_chloride_mg	Decimal	16	

Field Name	Data Type	Size	Lookup Table
q00951_flag	Text	1	
q00951_fluoride_mg	Decimal	16	
q71850_flag	Text	1	
q71850_nitrate_mgl	Decimal	16	
q00403_flag	Text	1	
q00403_ph	Decimal	16	
q70300_tds	Long Integer	4	
q00415_flag	Text	1	
q00415_phen_alk	Decimal	16	
q00410_flag	Text	1	
q00410_total_alk	Decimal	16	
q00900_tot_hardnes	Long Integer	4	
q00932_percent_na	Integer	2	
q00931_sar	Decimal	16	
q71860_rsc	Decimal	16	
q00095_flag	Text	1	
q00095_spec_cond	Long Integer	4	
date_entered	Date/Time	8	
user_name	Text	8	
bu_value	Decimal	16	

Field Descriptions

WELL_ID Each record in the database is assigned a unique well ID (which is a long integer) in this table. This is the key field in this table.

mm_date This is the second key field for this table. This field contains an integer for the month the sample was collected. If the month is unknown, a zero (0) is required.

dd_date This is the third key field for this table. This field contains an integer for the day the sample was collected. If the day is unknown, a zero (0) is required.

yy_date This is the fourth key field for this table. This field contains an integer for the year the sample was collected. The year must have four characters. If the year is unknown, a zero (0) is required.

sample_number This is the fifth key field for this table. This is an integer referring to a sample number, since more than one sample may be taken on the same day. It consists of an integer beginning with one for the first record of a well and increases by a value of one for each new record.

STATE_WELL_NUMBER This field contains the state well number assigned to each water well in the TWDB Groundwater Database.

SOURCE_DATA This field contains a reference to the source of the information; for example, the report number and table or page number.

sample_time This field contains the time the sample was collected using four digits in the format of a 24-hour time period (for example, 8:45 a.m. is 0845; 4:21 p.m. is 1621).

temp_centigrade Temperature of water sample in Celsius (field measurement).

top_s_interval Top interval of formation where sample was collected in units of feet below ground surface (only for multiple completion wells).

bottom_s_interval Bottom interval of formation where sample was collected in units of feet below ground surface (only for multiple completion wells).

samp_int_aqcode Aquifer code for the sampled interval (only for multiple completion wells).

collection_remarks Remarks about the sample collected.

reliability_rem Indicates the process used to collect the sample.

collecting_agency Identifies the entity that collected the sample.

lab_code Identifies the lab used to analyze the sample.

bu_wqanalysis Indicates whether the analysis of the sample is Balanced (B) or Unbalanced (U).

q00955_flag Used to identify constituent concentrations below the lab's detection limits.

q00955_silica_mgl Silica in mg/L.

q00910_flag Used to identify constituent concentrations below the lab's detection limits.

q00910_calcium_mgl Calcium, dissolved in mg/L.

q00920_flag Used to identify constituent concentrations below the lab's detection limits.

q00920_magnes_mgl Magnesium, dissolved in mg/L.

q00929_flag Used to identify constituent concentrations below the lab's detection limits.

q00929_sodium_mgl Sodium, dissolved in mg/L.

q00937_flag Used to identify constituent concentrations below the lab's detection limits.

q00937_potass_mgl Potassium, dissolved in mg/L.

q01080_flag Used to identify constituent concentrations below the lab's detection limits.

q01080_strontium Strontium in mg/L.

q00445_carb_mgl Carbonate in mg/L.

q00440_bicarb_mgl Bicarbonate in mg/L.

q00945_flag Used to identify constituent concentrations below the lab's detection limits.

q00945_sulfate_mgl Sulfate, dissolved in mg/L.

q00940_flag Used to identify constituent concentrations below the lab's detection limits.

q00940_chloride_mg Chloride, dissolved in mg/L.

q00951_flag Used to identify constituent concentrations below the lab's detection limits.

q00951_fluoride_mg Fluoride, dissolved in mg/L.

q71850_flag Used to identify constituent concentrations below the lab's detection limits.

q71850_nitrate_mgl Nitrate nitrogen, dissolved in mg/L.

q00403_flag Used to identify constituent concentrations below the lab's detection limits.

q00403_ph pH, standard units (field measurement).

q70300_tds Solids dissolved sum of constituent.

q00415_flag Used to identify constituent concentrations below the lab's detection limits.

q00415_phen_alk Phenol alkalinity.

q00410_flag Used to identify constituent concentrations below the lab's detection limits.

q00410_total_alk Total alkalinity, dissolved (analyzed in lab).

q00900_tot_hardnes Total hardness.

q00932_percent_na Percent sodium.

q00931_sar Sodium absorption ratio.

q71860_rsc Residual sodium carbonate.

q00095_flag Used to identify constituent concentrations below the lab's detection limits.

q00095_spec_cond Specific conductance umhos/cm @ 25C (field measurement).

date_entered This field contains the date the record was last edited.

user_name This field contains the reference to the staff member who last edited the record.

bu_value Value of the balanced/unbalanced equation.

14. Water Quality, Infrequent Constituents: tblBracsInfrequentConstituents

The infrequent constituents table contains records of water chemistry data organized with one record per constituent. The design of the table is almost exactly like the TWDB Groundwater Database (Rein and Hopkins, 2008). This will facilitate merging these data with the Groundwater Database in the future.

The information resides in a separate table to handle the one-to-many relationship between a well record and the zero-to-many records describing the water chemistry.

Table 14-1. tblBracsInfrequentConstituents field names, data type and size, and lookup table references.

Field Name	Data Type	Size	Lookup Table
WELL_ID	Long Integer	4	
mm_date	Integer	2	
dd_date	Integer	2	
yy_date	Integer	2	
sample_number	Integer	2	
storet_code	Text	5	tblLkStoretCode
flag	Text	1	
const_val	Text	13	
plus_minus	Decimal	16	
STATE_WELL_NUMBER	Long Integer	4	
SOURCE_DATA	Text	200	

Field Descriptions

WELL_ID Each record in the database is assigned a unique well ID (which is a long integer) in this table. This is the key field in this table.

mm_date This is the second key field for this table. This field contains an integer for the month the sample was collected. If the month is unknown, a zero (0) is required.

dd_date This is the third key field for this table. This field contains an integer for the day the sample was collected. If the day is unknown, a zero (0) is required.

yy_date This is the fourth key field for this table. The field contains an integer for the year the sample was collected. The year must have four characters. If the year is unknown, a zero (0) is required.

sample_number This is the fifth key field in the table. It consists of an integer for a sample number, since more than one sample may be taken on the same day. It begins with an integer for the first record of a well and increases by a value of one for each new record.

storet_code This is the sixth key field for this table. This is a code referring to the constituent sampled and the unit of measure. STORET, short for STOrage and RETrieval, is a repository for water quality, biological, and physical data used by the U.S. Environmental Protection Agency, the U.S. Geological Survey, and other federal agencies (Rein and Hopkins, 2008). These field values are listed in the lookup table tblLkStoretCode.

flag This field contains symbols of greater than (>) or less than (<) as necessary.

const_val This field contains the constituent value.

plus_minus This field contains a plus sign (+) or negative sign (-), usually associated with radioactive constituents.

STATE_WELL_NUMBER This field contains the state well number assigned to each water well in the TWDB Groundwater Database.

SOURCE_DATA This field contains a reference to the source of the information; for example, the report number and table or page number.

15. References

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Kalaswad, S., 2013, Gulf Coast Aquifer, Lower Rio Grande Valley, Texas: Structure and brackish groundwater: Texas Water Development Board, Open-File Report, *in progress*

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Meyer, J.E., 2013, Wilcox and Carrizo Aquifers, Central Texas: Structure and brackish groundwater: Texas Water Development Board, Open-File Report, *in progress.*

Meyer, J.E., Wise, M.R., and Kalaswad, S., 2012, Pecos Valley Aquifer, West Texas: Structure and brackish groundwater: Texas Water Development Board, Report 382, 92p.

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Novalis, S., 1999, Access 2000 VBA Handbook: Sybex, Inc., 845 p.

Rein, H., and Hopkins, J., 2008, Explanation of the groundwater database and data entry: Texas Water Development Board, User Manual 50, 130 p.

Wise, M.R., 2013, Queen City and Sparta Aquifers, Atascosa and McMullen Counties: Structure and brackish groundwater: Texas Water Development Board, Open-File Report, *in progress.*

Young, S.C., Knox, P.R., Baker, E., Budge, T., Hamlin, S., Galloway, B., Kalbouss, R., and Deeds, N., 2010, Hydrostratigraphy of the Gulf Coast aquifer from the Brazos River to the Rio Grande: Intera, Inc., contract report to the Texas Water Development Board, 203 p.

16. Appendix A: Pecos Valley Alluvium Project

The tables in this appendix were developed for the following Texas Water Development Board BRACS project:

Meyer, J.E., Wise, M.R., and Kalaswad, S., 2012, Pecos Valley Aquifer, West Texas: Structure and brackish groundwater: Texas Water Development Board, Report 382, 92p.

16.1 Aquifer Determination Table: tblAquiferDetermination_PecosValley

This table contains information on which aquifer(s) may be used or penetrated by a well in the BRACS Pecos Valley Alluvium project. Although aquifer codes have been assigned to wells in the TWDB Groundwater Database, it was determined that a systematic assessment of every well in the project area using the 3-dimensional formation top and bottom surfaces with available well screen and well depth data would provide a more accurate and uniform aquifer assignment. Using the new aquifer codes, wells with water quality data could be compared to wells using the same aquifer.

Every well within the limits of the project area that is in the TWDB BRACS Database and the Groundwater Database was appended to a holding table. This information was imported and geo-referenced in a geographic information system (GIS). The top and bottom of each formation of interest was determined at each well location, and the values were written to the holding table. For this project, the formations include the Pecos Valley Alluvium, Dockum Group and Dewey Lake Formation, Cretaceous Undivided, Rustler Formation, and Capitan Reef Complex. The stratigraphic relationships among the formations vary across the project area, so sub-regions were mapped with similar stratigraphy and an integer value representing each sub-region was assigned to every well to support subsequent analysis.

Values for the shallowest and deepest screen depths, well depths, and total depth of hole were obtained from TWDB BRACS and Groundwater Database tables. A series of stored queries in Microsoft® Access® was used to determine if a well screen intersected a particular formation. A well may be screened in one or more aquifers. If well screen information was not available, well depth or total depth of hole was used to determine potential aquifers that were penetrated. The procedures used to process all of this information are documented in a TWDB work process document.

A value of -99999 is written to elevation and depth fields if data are unknown.

Table 16-1-1. tblAquiferDetermination_PecosValley field names, data type and size, and lookup table references.

Field Name	Data Type	Size	Lookup Table
STATE_WELL_NUMBER	Long Integer	4	
WELL_ID	Long Integer	4	
REGION	Integer	2	
AQUIFER_CODE	Text	8	tblLkAquifer
AQUIFER_NEW	Text	50	tblLkBRACS_Aquifer_AD
AQ_REASON	Text	10	
AQ_DECISION	Text	100	tblLkAq_Decision
DEPTH_WELL	Long Integer	4	
DEPTH_TOTAL	Long Integer	4	
SCREEN_TOP	Long Integer	4	
SCREEN_BOTTOM	Long Integer	4	
MULTIPLE_SCREENS	Yes/No	1	
PV_T_D	Long Integer	4	
PV_B_D	Long Integer	4	
PV_AQUIFER	Yes/No	1	
KU_T_D	Long Integer	4	
KU_B_D	Long Integer	4	
KU_AQUIFER	Yes/No	1	
DO_T_D	Long Integer	4	
DL_T_D	Long Integer	4	
DL_B_D	Long Integer	4	
DO_AQUIFER	Yes/No	1	
RU_T_D	Long Integer	4	
RU_B_D	Long Integer	4	
RU_AQUIFER	Yes/No	1	
CR_T_D	Long Integer	4	
CR_B_D	Long Integer	4	
CR_AQUIFER	Yes/No	1	
LATDD	Double	8	
LONGDD	Double	8	
ELEVATION	Long Integer	4	
OWNER	Text	100	
INITIALS	Text	3	tblLkIntial
REMARKS	Text	250	

Field Descriptions

STATE_WELL_NUMBER This field contains the state well number assigned to each water well in the TWDB Groundwater Database. A value of zero (0) is assigned if the state well number has not been assigned to this well.

WELL_ID Each record in the database is assigned a unique well ID (which is a long integer) in this table. A value of zero (0) is assigned if the well id has not been assigned to this well.

REGION This field contains an integer value representing a sub-region of the Pecos Valley Alluvium project area that has similar stratigraphic relationships. The following figure and table show the spatial distribution of regions and stratigraphy.

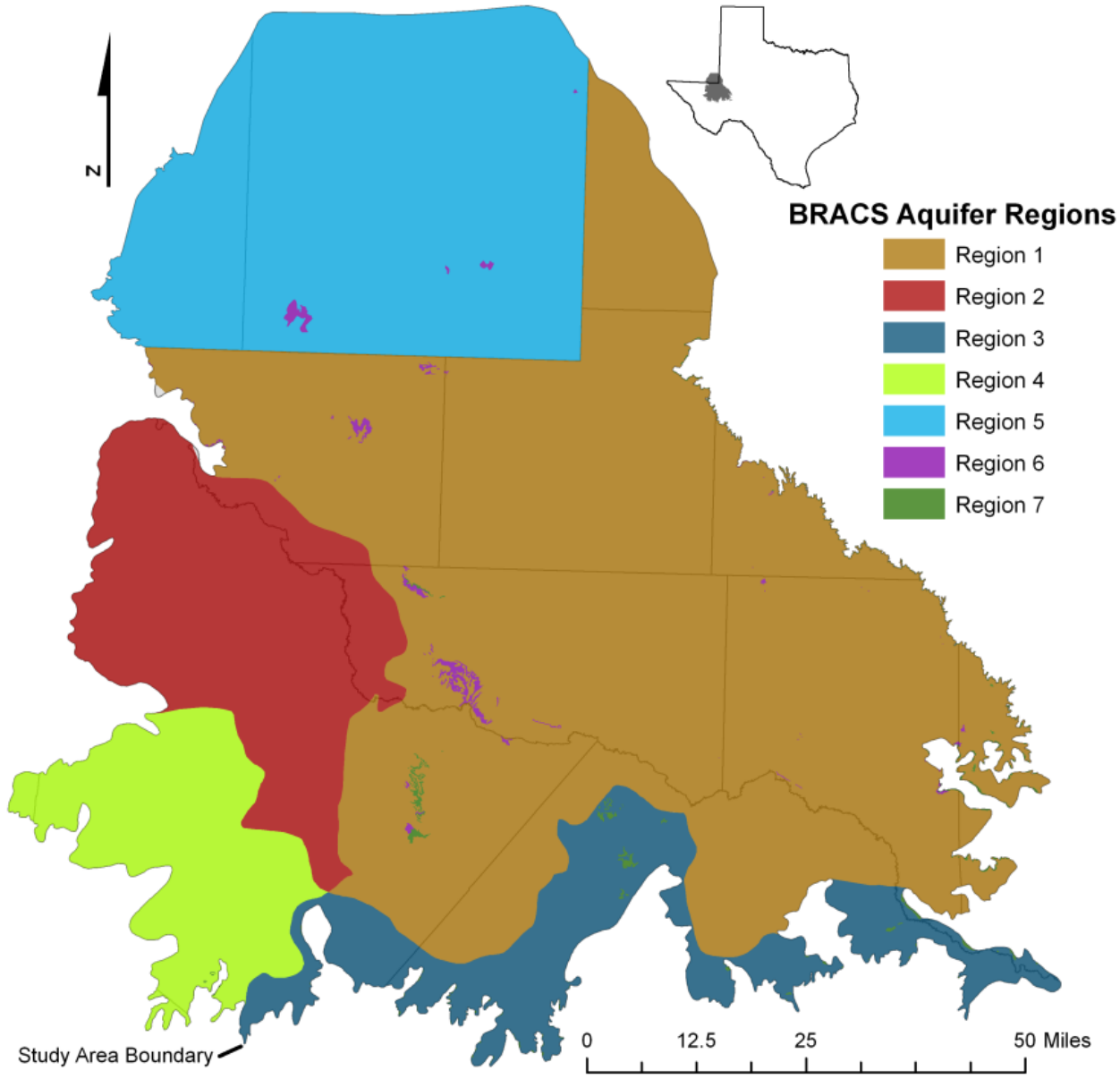

Figure 16-1-1. Regions within the Pecos Valley Alluvium Project area.

Table 16-1-2. Stratigraphic relationships within the different regions of the project area. Refer to Figure 16-1-1 for the study area regions. Shaded cells are not aquifers. The formations in this table may not occur throughout the entire region. The wavy line represents an unconformity and the solid line contact between two formations.

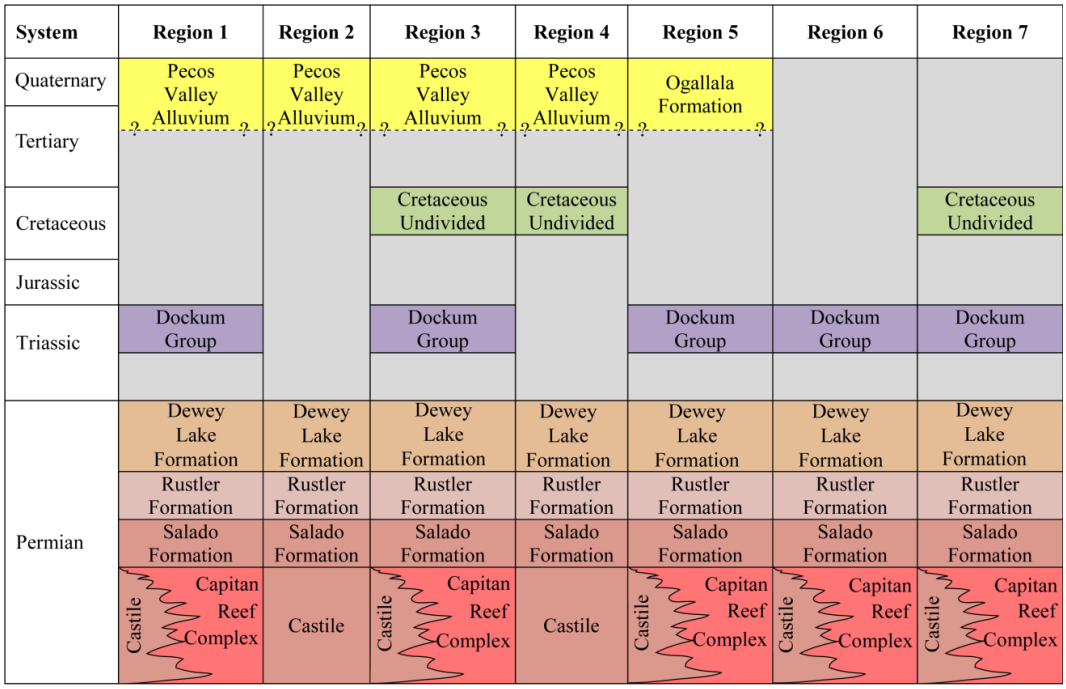

Table 16-1-3. Aquifer codes used in the BRACS Pecos Valley Alluvium Project.

AQUIFER_NEW	AQUIFER_DESCRIPTION
CR	Capitan Reef Complex
DO	Dockum Group
DO RU	Dockum Group; Rustler Formation
DO RU CR	Dockum Group; Rustler Formation; Capitan Reef Complex
KU	Cretaceous Undivided
KU DO	Cretaceous Undivided; Dockum Group
KU RU	Cretaceous Undivided; Rustler Formation
PV	Pecos Valley Alluvium
PV DO	Pecos Valley Alluvium; Dockum Group
PV DO RU	Pecos Valley Alluvium; Dockum Group; Rustler Formation
PV KU	Pecos Valley Alluvium; Cretaceous Undivided
PV KU DO	Pecos Valley Alluvium; Cretaceous Undivided; Dockum Group
PV KU DO RU	Pecos Valley Alluvium; Cretaceous Undivided; Dockum Group; Rustler Formation
PV KU RU	Pecos Valley Alluvium; Cretaceous Undivided; Rustler Formation
PV RU	Pecos Valley Alluvium; Rustler Formation
RU	Rustler Formation
X	No aquifer assigned (either because it is not applicable or it is unknown)

AQUIFER_CODE This field contains an aquifer code that has been assigned to every water well in the TWDB Groundwater Database. These field values are listed in the lookup table tblLkAquifer, derived from a similar lookup table in the Groundwater Database.

AQUIFER_NEW This field contains a code for the new aquifer assignment. These field values are listed in the lookup table tblLkBRACSAquifer_AD. This table was created because not all of these aquifer combinations are available in the Groundwater Database aquifer code table. This table will grow with time.

AQ_REASON This field contains a code based on the query used to assign a value to the [aquifer_new] field. The default value of zero (0) is used if the queries did not assign a value. This field is primarily used for internal quality control to ensure the stored queries are operating accurately.

AQ_DECISION This field contains a value of how the aquifer was determined. These field values are listed in the lookup table tblLkAq_Decision.

Table 16-1-4. Aquifer decision codes used in the BRACS Pecos Valley Alluvium Project.

AQ_DECISION
Computer analysis of Well Screen (depth) and Aquifer Surfaces (GIS)
Geologist Best Professional Judgment of available information. See remarks for more information
No Decision Made. Not enough information available

DEPTH_WELL The total depth of the well in units of feet below ground surface. This is reported on the water well driller report. A value of -99999 is used if the value is not known. This value was obtained from the BRACS Database for wells with a BRACS well ID or the TWDB Groundwater Database with a state well number.

DEPTH_TOTAL The total depth of the hole in units of feet below ground surface. This is reported on the water well driller report or header page on a geophysical well log. A value of -99999 is used if the value is not known. This value was obtained from the BRACS Database for wells with a BRACS well ID.

SCREEN_TOP This field represents the top of the screened interval in units of feet below ground surface. For multiple screen wells, it represents the shallowest depth. A value of -99999 is used if the value is not known. This value was obtained from the BRACS Database for wells with a BRACS well ID or the TWDB Groundwater Database with a state well number.

SCREEN_BOTTOM This field represents the bottom of the screened interval in units of feet below ground surface. For multiple screen wells, it represents the deepest depth. A value of -99999 is used if the value is not known. This value was obtained from the BRACS Database for wells with a BRACS well ID or the TWDB Groundwater Database with a state well number.

MULTIPLE_SCREENS This field contains a Yes or No value if a well has multiple well screens. Wells with multiple screens were manually checked for aquifer code assignment.

PV_T_D Pecos Valley Alluvium top depth in units of feet below ground surface.

PV_B_D Pecos Valley Alluvium bottom depth in units of feet below ground surface.

PV_AQUIFER This field contains a value of Yes or No based on whether this aquifer is used by the well.

KU_T_D Cretaceous Undivided top depth in units of feet below ground surface.

KU_B_D Cretaceous Undivided bottom depth in units of feet below ground surface.

KU_AQUIFER This field contains a value of Yes or No based on whether this aquifer is used by the well.

DO_T_D Dockum Group top depth in units of feet below ground surface.

DL_T_D Dewey Lake Formation top depth in units of feet below ground surface.

DL_B_D Dewey Lake Formation top depth in units of feet below ground surface.

DO_AQUIFER This field contains a value of Yes or No based on whether this aquifer is used by the well.

RU_T_D Rustler Formation top depth in units of feet below ground surface.

RU_B_D Rustler Formation bottom depth in units of feet below ground surface.

RU_AQUIFER This field contains a value of Yes or No based on whether this aquifer is used by the well.

CR_T_D Capitan Reef Complex top depth in units of feet below ground surface.

CR_B_D Capitan Reef Complex bottom depth in units of feet below ground surface.

CR_AQUIFER This field contains a value of Yes or No based on whether this aquifer is used by the well.

LATDD Latitude of the well site in units of decimal degrees. Latitude is a positive value, referring to a site north of the earth's equator. Latitude and longitude coordinates are obtained from multiple sources. Latitude is obtained based on a North American Datum of 1983. This value was obtained from the well location table.

LONGDD Longitude of the well site in units of decimal degrees. Longitude is a negative value, referring to a site west of the Prime Meridian in Greenwich, United Kingdom. Latitude and longitude coordinates are obtained from multiple sources. Longitude is based on a North American Datum of 1983. This value was obtained from the well location table.

ELEVATION The elevation of the well site in units of feet above mean sea level. The elevation is determined using spatial analysis in a geographic information system by comparing the well site with the 30-meter digital elevation model for Texas. This value was obtained from the well location table. A value of -99999 is used if the value is not known.

OWNER The name of the well owner. This value was obtained from the well location table.

INITIALS Initials of staff member who last edited the well site record.

REMARKS General remarks associated with the well record.

16.2 **Stratigraphic Table for GIS Import: gBRACS_ST**

This table is created from information, including well location, well geology, and foreign key, residing in the primary tables. Well records are appended to this table and processed using a number of stored queries in Microsoft® Access®. The purpose of this table is to take this processed information into a geographic information system (GIS) to display stratigraphic depths and elevations spatially and form the foundation for creating 3-dimensional geologic surfaces and contour maps.

Note: Formation depths have been adjusted for kelly bushing height, if known or applicable.

Formation elevations have been calculated using formation depths (adjusted for kelly bushing height, if known or applicable) and well site elevation.

A value of -99999 is written to elevation and depth fields if data are unknown.

Table 16-2-1. gBRACS_ST field names, data type and size, and lookup table references.

Field Name	Data Type	Size	Lookup Table	Source Table
WELL_ID	Long Integer	4		tblWell_Location
WELL_TYPE	Text	50	tblLkWellType	
API_NUM	Text	12		tblBracs_ForeignKey
SW_NUM	Long Integer	4		
TRACK_NUM	Long Integer	4		
WS_NUM	Text	10		
Q_NUM	Text	16		
NMOSE_POD	Text	20		
SOURCE_WELL_DATA	Text	250	tblLkSourceWellData	tblWell_Location
ELEVATION	Long Integer	4		
KELLY_BUSHING_HEIGHT	Integer	2		
DEPTH_TOTAL	Long Integer	4		
DEPTH_WELL	Long Integer	4		
LATDD	Double	8		
LONGDD	Double	8		
AGENCY	Text	5	tblLkAgency	
PV_T_D	Long Integer	4		tblWell_Geology (Note: these fields are adjusted for kelly bushing height)
PV_B_D	Long Integer	4		
PV_TK	Long Integer	4		
PV_GT	Text	1		
PV_T_E	Long Integer	4		
PV_B_E	Long Integer	4		
DO_T_D	Long Integer	4		
DO_B_D	Long Integer	4		
DO_TK	Long Integer	4		
DO_GT	Text	1		
DO_T_E	Long Integer	4		
DO_B_E	Long Integer	4		
KU_T_D	Long Integer	4		
KU_B_D	Long Integer	4		

Field Name	Data Type	Size	Lookup Table	Source Table
KU_TK	Long Integer	4		tblWell_Geology (Note: these fields are adjusted for kelly bushing height)
KU_GT	Text	1		
KU_T_E	Long Integer	4		
KU_B_E	Long Integer	4		
RU_T_D	Long Integer	4		
RU_B_D	Long Integer	4		
RU_TK	Long Integer	4		
RU_GT	Text	1		
RU_T_E	Long Integer	4		
RU_B_E	Long Integer	4		
DL_T_D	Long Integer	4		
DL_B_D	Long Integer	4		
DL_TK	Long Integer	4		
DL_GT	Text	1		
DL_T_E	Long Integer	4		
DL_B_E	Long Integer	4		
O_T_D	Long Integer	4		
O_B_D	Long Integer	4		
O_TK	Long Integer	4		
O_GT	Text	1		
O_T_E	Long Integer	4		
O_B_E	Long Integer	4		
BC_T_D	Long Integer	4		
BC_T_E	Long Integer	4		
RSC_TK	Long Integer	4		
DO_DL_TK	Long Integer	4		

Field Descriptions

WELL_ID Each record in the database is assigned a unique well ID (which is a long integer) in this table. This is the key field in this table.

WELL_TYPE The type of well and when the well was drilled and completed. These terms are the same as the lookup table in the TWDB Groundwater Database (Rein and Hopkins, 2008). These field values are listed in the lookup table tblLkWellType.

API_NUM The API number of the well, assigned to oil and gas wells.

SW_NUM The state well number of the well, assigned to wells in the TWDB Groundwater Database.

TRACK_NUM The track number of the well, assigned to wells in the Texas Department of Licensing and Regulation Submitted Driller Report Database.

WS_NUM The water source code, assigned to wells in the Texas Commission on Environmental Quality public water system program.

Q_NUM The Q number assigned to wells in the Texas Commission on Environmental Quality surface casing program.

NMOSE_POD The point of diversion number assigned to wells in the New Mexico Office of State Engineer.

SOURCE_WELL_DATA Each well record is assigned the source of the well information. In some cases multiple sources exist; in this case, the source of the geophysical well log or water well driller report takes precedence. These field values are listed in the lookup table tblLkSourceWellData.

ELEVATION The elevation of the well site in units of feet above mean sea level. The elevation is determined using spatial analysis in a geographic information system by comparing the well site with the 30-meter digital elevation model for Texas.

KELLY_BUSHING_HEIGHT The height of the drilling rig kelly bushing used as a measuring point for all subsequent logging. The units are in feet above ground surface. This value is stored as an integer. The term is synonymous with rig floor, derrick floor, rotary table, drive bushing, and KB. This value is recorded on the geophysical well log header as a unique value, or it must be calculated from the values of elevation of the ground surface and elevation of the kelly bushing.

The default value for this field is zero (0).

DEPTH_TOTAL The total depth of the hole in units of feet below ground surface. This is reported on the water well driller report or header page on a geophysical well log. A value of -99999 is used if the value is not known.

DEPTH_WELL The total depth of the well in units of feet below ground surface. This is reported on the water well driller report. A value of -99999 is used if the value is not known.

LATDD Latitude of the well site in units of decimal degrees. Latitude is a positive value, referring to a site north of the earth's equator. Latitude and longitude coordinates are obtained from multiple sources. Latitude is obtained is based on a North American Datum of 1983.

LONGDD Longitude of the well site in units of decimal degrees. Longitude is a negative value, referring to a site west of the Prime Meridian in Greenwich, United Kingdom. Latitude and longitude coordinates are obtained from multiple sources. Longitude is based on a North American Datum of 1983.

AGENCY The agency that collected the latitude and longitude coordinates of the well site. These field values are listed in the lookup table tblLkAgency.

PV_T_D Pecos Valley Alluvium top depth in units of feet below ground surface.

PV_B_D Pecos Valley Alluvium bottom depth in units of feet below ground surface.

PV_TK Pecos Valley Alluvium thickness in units of feet.

PV_GT Greater than symbol (>) represents well only partially penetrates the Pecos Valley Alluvium.

PV_T_E Pecos Valley Alluvium top elevation in units of feet above mean sea level.

PV_B_E Pecos Valley Alluvium bottom elevation in units of feet above mean sea level.

DO_T_D Dockum Group top depth in units of feet below ground surface.

DO_B_D Dockum Group bottom depth in units of feet below ground surface.

DO_TK Dockum Group thickness in units of feet.

DO_GT Greater than symbol (>) represents well only partially penetrates the Dockum Group.

DO_T_E Dockum Group top elevation in units of feet above mean sea level.

DO_B_E Dockum Group bottom elevation in units of feet above mean sea level.

KU_T_D Cretaceous Undivided top depth in units of feet below ground surface.

KU_B_D Cretaceous Undivided bottom depth in units of feet below ground surface.

KU_TK Cretaceous Undivided thickness in units of feet.

KU_GT Greater than symbol (>) represents well only partially penetrates the Cretaceous Undivided.

KU_T_E Cretaceous Undivided top elevation in units of feet above mean sea level.

KU_B_E Cretaceous Undivided bottom elevation in units of feet above mean sea level.

RU_T_D Rustler Formation top depth in units of feet below ground surface.

RU_B_D Rustler Formation bottom depth in units of feet below ground surface.

RU_TK Rustler Formation thickness in units of feet.

RU_GT Greater than symbol (>) represents well only partially penetrates the Rustler Formation.

RU_T_E Rustler Formation top elevation in units of feet above mean sea level.

RU_B_E Rustler Formation bottom elevation in units of feet above mean sea level.

DL_T_D Dewey Lake Formation top depth in units of feet below ground surface.

DL_B_D Dewey Lake Formation bottom depth in units of feet below ground surface.

DL_TK Dewey Lake Formation thickness in units of feet.

DL_GT Greater than symbol (>) represents well only partially penetrates the Dewey Lake Formation.

DL_T_E Dewey Lake Formation top elevation in units of feet above mean sea level.

DL_B_E Dewey Lake Formation bottom elevation in units of feet above mean sea level.

O_T_D Ogallala Formation top depth in units of feet below ground surface.

O_B_D Ogallala Formation bottom depth in units of feet below ground surface.

O_TK Ogallala Formation thickness in units of feet.

O_GT Greater than symbol (>) represents well only partially penetrates the Ogallala Formation.

O_T_E Ogallala Formation top elevation in units of feet above mean sea level.

O_B_E Ogallala Formation bottom elevation in units of feet above mean sea level.

BC_T_D Bell Canyon Formation top depth in units of feet below ground surface.

BC_T_E Bell Canyon Formation top elevation in units of feet above mean sea level.

RSC_TK Combined thickness of the Rustler, Salado, and Castile formations in units of feet.

DO_DL_TK Dockum Group – Dewey Lake Formation thickness in units of feet.

16.3 **Master Water Quality Table: tblBracs_PV_MasterWaterQuality**

The master water quality table contains every water quality record in the project area organized with one record per well per date sampled with constituents in separate fields. This design greatly simplifies the creation of GIS datasets, for without data residing in one table, data must be processed from 4 tables.

The majority of field descriptions were obtained from the Groundwater Database Data Dictionary spreadsheet available on the TWDB website.

Table 16-3-1. tblBracs_PV_MasterWaterQuality field names, data type and size, and lookup table references.

Field Name	Data Type	Size	Lookup Table
STATE_WELL_NUMBER	Long Integer	4	
WELL_ID	Long Integer	4	
mm_date	Integer	2	
dd_date	Integer	2	
yy_date	Integer	2	
sample_number	Integer	2	
SOURCE_DATA	Text	200	
TDS_RANGE	Text	255	
TDS_RNG_NUM	Integer	2	
sample_time	Text	4	
temp_centigrade	Decimal	16	
top_s_interval	Integer	2	
bottom_s_interval	Integer	2	
samp_int_aqcode	Text	8	
collection_remarks	Text	30	
reliability_rem	Text	2	
collecting_agency	Text	2	
lab_code	Text	2	
bu_wqanalysis	Text	1	
q00955_flag	Text	1	
q00955_silica_mgl	Decimal	16	
q00910_flag	Text	1	
q00910_calcium_mgl	Decimal	16	
q00920_flag	Text	1	
q00920_magnes_mgl	Decimal	16	
q00929_flag	Text	1	
q00929_sodium_mgl	Decimal	16	
q00937_flag	Text	1	
q00937_potass_mgl	Decimal	16	
q01080_flag	Text	1	
q01080_strontium	Decimal	16	
q00445_carb_mgl	Decimal	16	
q00440_bicarb_mgl	Decimal	16	
q00945_flag	Text	1	
q00945_sulfate_mgl	Decimal	16	
q00940_flag	Text	1	
q00940_chloride_mg	Decimal	16	

Field Name	Data Type	Size	Lookup Table
q00951_flag	Text	1	
q00951_fluoride_mg	Decimal	16	
q71850_flag	Text	1	
q71850_nitrate_mgl	Decimal	16	
q00403_flag	Text	1	
q00403_ph	Decimal	16	
q70300_tds	Long Integer	4	
q00415_flag	Text	1	
q00415_phen_alk	Decimal	16	
q00410_flag	Text	1	
q00410_total_alk	Decimal	16	
q00900_tot_hardnes	Long Integer	4	
q00932_percent_na	Integer	2	
q00931_sar	Decimal	16	
q71860_rsc	Decimal	16	
q00095_flag	Text	1	
q00095_spec_cond	Long Integer	4	
bu_value	Decimal	16	
IRON_FLAG	Text	1	
IRON	Double	8	
MANGANESE_FLAG	Text	1	
MANGANESE	Double	8	
CT	Double	8	
SULFATE_PERCENTAGE	Decimal	16	
BICARBONATE_PERCENTAGE	Decimal	16	
Na_PERCENTAGE_CATIONS	Integer	2	
date_entered	Date/Time	8	
user_name	Text	8	
REMARKS	Text	250	

Field Descriptions

STATE_WELL_NUMBER This field contains the state well number assigned to each water well in the TWDB Groundwater Database.

WELL_ID Each record in the database is assigned a unique well ID (which is a long integer) in this table. This is the key field in this table.

mm_date This is the second key field for this table. This field contains an integer for the month the sample was collected. If the month is unknown, a zero (0) is required.

dd_date This is the third key field for this table. This field contains an integer for the day the sample was collected. If the day is unknown, a zero (0) is required.

yy_date This is the fourth key field for this table. This field contains an integer for the year the sample was collected. The year must have four characters. If the year is unknown, a zero (0) is required.

sample_number This is the fifth key field for this table. This is an integer referring to a sample number, since more than one sample may be taken on the same day. It consists of an integer beginning with one for the first record of a well and increases by a value of one for each new record.

SOURCE_DATA This field contains a reference to the source of the information; for example, the report number and table or page number.

TDS_RANGE This field contains a value representing the range of total dissolved solids content to be used for GIS analysis of brackish groundwater resources in Texas. The ranges include values, in milligrams per liter, of 0 – 999; 1000 – 2999; 3000 – 9999; and > 10000.

TDS_RNG_NUM This field contains an integer value representing the range of total dissolved solids content to be used for GIS analysis of brackish groundwater resources in Texas. The ranges include values, in milligrams per liter, of 1 = 0 – 999; 2 = 1000 – 2999; 3 = 3000 – 9999; and 4 = > 10000.

sample_time This field contains the time the sample was collected using four digits in the format of a 24-hour time period (for example, 8:45 a.m. is 0845; 4:21 p.m. is 1621).

temp_centigrade Temperature of water sample in Celsius (field measurement).

top_s_interval Top interval of formation where sample was collected in units of feet below ground surface (only for multiple completion wells).

bottom_s_interval Bottom interval of formation where sample was collected in units of feet below ground surface (only for multiple completion wells).

samp_int_aqcode Aquifer code for the sampled interval (only for multiple completion wells).

collection_remarks Remarks about the sample collected.

reliability_rem Indicates the process used to collect the sample.

collecting_agency Identifies the entity that collected the sample.

lab_code Identifies the lab used to analyze the sample.

bu_wqanalysis Indicates whether the analysis of the sample is Balanced (B) or Unbalanced (U).

q00955_flag Used to identify constituent concentrations below the lab's detection limits.

q00955_silica_mgl Silica in mg/L.

q00910_flag Used to identify constituent concentrations below the lab's detection limits.

q00910_calcium_mgl Calcium, dissolved in mg/L.

q00920_flag Used to identify constituent concentrations below the lab's detection limits.

q00920_magnes_mgl Magnesium, dissolved in mg/L.

q00929_flag Used to identify constituent concentrations below the lab's detection limits.

q00929_sodium_mgl Sodium, dissolved in mg/L.

q00937_flag Used to identify constituent concentrations below the lab's detection limits.

q00937_potass_mgl Potassium, dissolved in mg/L.

q01080_flag Used to identify constituent concentrations below the lab's detection limits.

q01080_strontium Strontium in mg/L.

q00445_carb_mgl Carbonate in mg/L.

q00440_bicarb_mgl Bicarbonate in mg/L.

q00945_flag Used to identify constituent concentrations below the lab's detection limits.

q00945_sulfate_mgl Sulfate, dissolved in mg/L.

q00940_flag Used to identify constituent concentrations below the lab's detection limits.

q00940_chloride_mg Chloride, dissolved in mg/L.

q00951_flag Used to identify constituent concentrations below the lab's detection limits.

q00951_fluoride_mg Fluoride, dissolved in mg/L.

q71850_flag Used to identify constituent concentrations below the lab's detection limits.

q71850_nitrate_mgl Nitrate nitrogen, dissolved in mg/L.

q00403_flag Used to identify constituent concentrations below the lab's detection limits.

q00403_ph pH, standard units (field measurement).

q70300_tds Solids dissolved sum of constituent.

q00415_flag Used to identify constituent concentrations below the lab's detection limits.

q00415_phen_alk Phenol alkalinity.

q00410_flag Used to identify constituent concentrations below the lab's detection limits.

q00410_total_alk Total alkalinity, dissolved (analyzed in lab).

q00900_tot_hardnes Total hardness.

q00932_percent_na Percent sodium.

q00931_sar Sodium absorption ratio.

q71860_rsc Residual sodium carbonate.

q00095_flag Used to identify constituent concentrations below the lab's detection limits.

q00095_spec_cond Specific conductance umhos/cm @ 25C (field measurement).

bu_value Value of the balanced/unbalanced equation.

IRON_FLAG Used to identify constituent concentrations below the lab's detection limits.

IRON Dissolved iron in mg/L with a storet code of 01045.

MANGANESE_FLAG Used to identify constituent concentrations below the lab's detection limits.

MANGANESE Dissolved manganese in mg/L with a storet code of 01055.

CT Total Dissolved Solids / Specific Conductance. Used for resistivity analysis using geophysical well logs.

SULFATE_PERCENTAGE (sulfate / total dissolved solids) * 100. Used for resistivity analysis using geophysical well logs.

BICARBONATE_PERCENTAGE (bicarbonate / total dissolved solids) * 100. Used for resistivity analysis using geophysical well logs.

Na_PERCENTAGE_CATIONS (Sodium / (Sodium + Calcium + Magnesium + Potassium)) * 100. Used for resistivity analysis using geophysical well logs.

date_entered This field contains the date the record was last edited.

user_name This field contains the reference to the staff member who last edited the record.

REMARKS General remarks about an analysis

16.4 **Net Sand Table: tblWell_Geology_NetSand**

This table is created from information residing in the well geology, simplified lithologic name lookup, and aquifer determination tables. Well records are appended to a holding table (tblWell_Geology_ProcessingNetSand_Temp; see table description) for extensive processing using a number of stored queries in Microsoft® Access®. Once the processing is completed, the information is summarized with one record per well. The purpose of this table is to take this geologic information into a geographic information system (GIS) to display net sand and sand percent data spatially and create point and contour maps. The information can also be analyzed to determine where Pecos Valley Alluvium is in contact with sands of the underlying Dockum Group.

Table 16-4-1. tblWell_Geology_NetSand field names, data type and size, and lookup table references.

Field Name	Data Type	Size	Lookup Table
WELL_ID	Long Integer	4	
PV_PRESENT	Yes/No	1	
PV_PARTIAL_PEN	Yes/No	1	
PV_NET_SAND	Long Integer	4	
PV_NS_RANGE	Text	50	
PV_SAND_PERCENT	Long Integer	4	
PV_TK	Long Integer	4	
PV_MAX_SAND_TK	Long Integer	4	
DO_PRESENT	Yes/No	1	
DO_PARTIAL_PEN	Yes/No	1	
DO_NET_SAND	Long Integer	4	
DO_NS_RANGE	Text	50	
DO_SAND_PERCENT	Long Integer	4	
DO_TK	Long Integer	4	
DO_MAX_SAND_TK	Long Integer	4	

Field Descriptions

WELL_ID Each record in the database is assigned a unique well ID (which is a long integer) in this table. This is the key field in this table.

PV_PRESENT This field contains a value of Yes or No if the Pecos Valley Alluvium is present in this well.

PV_PARTIAL_PEN This field contains a value of Yes or No if the Pecos Valley Alluvium is only partially penetrated by this well.

PV_NET_SAND This field contains an integer representing the total thickness of sand within the Pecos Valley Alluvium, in units of feet.

PV_NS_RANGE Pecos Valley Alluvium net sand organized in terms of 100 foot increments. This field was useful in GIS mapping.

PV_SAND_PERCENT The percent of sand within the Pecos Valley Alluvium, calculated field [PV_NET_SAND] / [PV_TK] * 100.

PV_TK Pecos Valley Alluvium thickness, calculated field: [depth_bottom] – [depth_top]. The units are feet.

PV_MAX_SAND_TK This field contains the thickest sand within the Pecos Valley Alluvium, in units of feet.

DO_PRESENT This field contains a value of Yes or No if the Dockum Group is present in this well.

DO_PARTIAL_PEN This field contains a value of Yes or No if the Dockum Group is only partially penetrated by this well. Note that in the BRACS Pecos Valley Project the Dockum Group was combined with the Dewey Lake Formation as one mapped unit.

DO_NET_SAND This field contains an integer representing the total thickness of sand within the Dockum Group, in units of feet. Note that in the BRACS Pecos Valley Project the Dockum Group was combined with the Dewey Lake Formation as one mapped unit.

DO_NS_RANGE Dockum Group net sand organized in terms of 100 foot increments. This field was useful in GIS mapping.

DO_SAND_PERCENT The percent of sand within the Dockum Group, calculated field [DO_NET_SAND] / [DO_TK] * 100. Note that in the BRACS Pecos Valley Project the Dockum Group was combined with the Dewey Lake Formation as one mapped unit. The sand percent values will be lower than if the Dockum Group were mapped as one unit.

DO_TK Dockum Group thickness, calculated field: [depth_bottom] – [depth_top]. The units are feet. Note that in the BRACS Pecos Valley Project the Dockum Group was combined with the Dewey Lake Formation as one mapped unit. The thickness values will be larger than if the Dockum Group were mapped as one unit.

DO_MAX_SAND_TK This field contains the thickest sand within the Dockum Group, in units of feet.

16.5 Net Sand Analysis Table: tblWell_Geology_ProcessingNetSand_Temp

This table is created from information residing in the well geology, simplified lithologic name lookup, and aquifer determination tables. Well records are appended to this table if the lithologic description for any record associated with a well contains reference to sand or gravel. These records are then processed using a number of stored queries in Microsoft® Access® and loaded into the table tblWell_Geology_NetSand. Once the processing is completed, the information is summarized with one record per well.

The value of maintaining this table is that special sand maps can be developed; for example, maximum sand unit thickness per formation; number of sands units greater than some value (50 feet); number of and cumulative thickness of sands within a specific depth range; and so on.

Table 16-5-1. tblWell_Geology_ProcessingNetSand_Temp field names, data type and size, lookup table.

Field Name	Data Type	Size	Lookup Table
WELL_ID	Long Integer	4	
RECORD_NUMBER	Integer	2	
LITHOLOGIC_NAME	Text	100	
SIMPLIFIED_LITHOLOGIC_NAME	Text	100	tblLkSimplified_Lithologic_Name
SAND_PERCENT	Decimal	16	
DEPTH_TOP	Single	4	
DEPTH_BOTTOM	Single	4	
THICKNESS	Single	4	
PV_T_D	Integer	2	
PV_B_D	Integer	2	
DO_T_D	Integer	2	
DL_B_D	Integer	2	
PV_FM	Text	10	tblLkSandPositionCode
DO_FM	Text	10	tblLkSandPositionCode
PV_NS_TK	Integer	2	
DO_NS_TK	Integer	2	
SOURCE_GEOLOGIC_DATA	Text	50	tblLkSourceGeologicData

Field Descriptions

WELL_ID Each record in the database is assigned a unique well ID (which is a long integer) in this table. This is the key field in this table.

RECORD_NUMBER This is the second key field in this table. This number is not assigned as an autonumber field, as in the usual case for a key field. The value is an integer, beginning with 1 and increasing with the addition of each record. The integer order allows the records to be displayed in a form in the order of increasing depth from the surface. Because several different types of information (lithology, stratigraphy, hydrogeologic units) can be appended to this table, it is important to complete the append process for a group of records at one time before appending records of a different geologic pick type. This will ensure records of different types can be ordered appropriately. If a new record must be appended and the order modified, the record number can be edited (with an autonumber data type this is impossible), although care must be taken to not duplicate an existing record number in this endeavor.

SIMPLIFIED_LITHOLOGIC_NAME This field contains a simplified version of the lithologic description so additional automated processing can be accomplished. For example, a unit consisting of sand may be written in over 250 different forms on water well reports.

The lookup table tblLkLithologicName_to_SimplifiedLithologicName was created to relate the two fields. A query was written to automatically update this simplified_lithologic_name field from the lithologic_name field using values in the lookup table. The lookup table will grow with time as new records are appended to the well geology table.

SAND_PERCENT The percent sand associated with the simplified lithologic name term. This value is associated with the definition of each record in the lookup table: tblLkSimplified_Lithologic_Name.

DEPTH_TOP This field contains the depth to the top of the unit (referred to by the geologic pick field) in the units of feet below ground surface. The value is always a positive integer. This field is corrected for kelly bushing height.

DEPTH_BOTTOM This field contains the depth to the bottom of the unit (referred to by the geologic pick field) in the units of feet below ground surface. The value is always a positive integer. This field is corrected for kelly bushing.

THICKNESS This is a calculated field: [depth_bottom] – [depth_top]. The units are feet.

PV_T_D Pecos Valley Alluvium top depth in units of feet below ground surface.

PV_B_D Pecos Valley Alluvium bottom depth in units of feet below ground surface.

PV_AQUIFER This field contains a value of Yes or No based on whether this aquifer is used by the well.

DO_T_D Dockum Group top depth in units of feet below ground surface.

DL_B_D Dewey Lake Formation top depth in units of feet below ground surface.

PV_FM Relationship of the lithologic top and bottom to Pecos Valley Alluvium top and bottom. These field values are listed in the lookup table tblLkSandPositionCode.

Table 16-5-2. Codes used in the SandPositionCode field.

SAND_POSITION_CODE	CODE_DESCRIPTION
W	Sand is completely within formation
ST	Sand straddles top of formation
SB	Sand straddles bottom of formation
SS	Sand straddles top and bottom of formation
X	Sand not in formation

DO_FM Relationship of the lithologic top and bottom to Dockum Group top and bottom. These field values are listed in the lookup table tblLkSandPositionCode. Refer to Table 16-5-2 for lookup table codes.

PV_NS_TK Corrected net sand thickness of the Pecos Valley Alluvium, per individual lithologic unit, in units of feet.

DO_NS_TK Corrected net sand thickness of the Dockum Group, per individual lithologic unit, in units of feet.

SOURCE_GEOLOGIC_DATA The source of the geologic data appended into the table. These field values are listed in the lookup table tblLkSourceGeologicData. This table will continue to grow with time.

Table 16-5-3. Codes used in the source_geologic_data field.

SOURCE_GEOLOGIC_DATA	SOURCE_GEOLOGIC_DATA_DESCRIPTION
CORE	Geologist Interpretation of Core Samples
GEOPHYSICAL WELL LOG	Geologist Interpretation of Geophysical Log
MISCELLANEOUS	Geophysical logs, well reports, scout tickets, cross-sections
OIL / GAS WELL LOG	Geologist Interpretation of Well Cuttings (MUD Log)
PUBLISHED REPORT	Geologic description, published report, source unknown
UNKNOWN	UNKNOWN
WATER WELL LOG, DRILLER	Well Driller Interpretation of Lithology From Drill Cuttings
WATER WELL LOG, GEOLOGIST	Geologist Interpretation of Lithology from Drill Cuttings

17. Appendix B: Gulf Coast Aquifer Projects

The tables in this appendix were developed for the following Texas Water Development Board BRACS projects:

Meyer, J.E., 2012, Geologic characterization of and data collection in the Corpus Christi Aquifer Storage and Recovery Conservation District and surrounding counties: Texas Water Development Board, Open-File Report 12-01, 42 p.

Kalaswad, S., 2013, Gulf Coast Aquifer, Lower Rio Grande Valley, Texas: Structure and brackish groundwater: Texas Water Development Board, Open-File Report, *in progress*.

17.1 Aquifer Determination Table: tblAquiferDetermination_Gulf Coast Aquifer

This table contains information on which aquifer(s) may be used or penetrated by a well in the BRACS Gulf Coast Aquifer project. Although aquifer codes have been assigned to wells in the TWDB Groundwater Database, it was determined that a systematic assessment of every well in the project area using the 3-dimensional formation top and bottom surfaces with available well screen and well depth data would provide a more accurate and uniform aquifer assignment. Using the new aquifer codes, wells with water quality data could be compared to wells using the same aquifer.

Every well within the limits of the project area that is in the TWDB BRACS Database and the Groundwater Database was appended to a holding table. This information was imported and geo-referenced in a geographic information system (GIS). The top and bottom of each formation of interest was determined at each well location, and the values were written to the holding table. For this project, the formations within the Gulf Coast Aquifer, in descending order, include Beaumont, Lissie, Willis, Upper Goliad, Lower Goliad, Upper Lagarto, Middle Lagarto, Lower Lagarto, and the Oakville.

Values for the shallowest and deepest screen depths, well depths, and total depth of hole were obtained from TWDB BRACS and Groundwater Database tables. A series of stored queries in Microsoft® Access® was used to determine if a well screen intersected a particular formation. A well may be screened in one or more aquifers. If well screen information was not available, well depth or total depth of hole were used to determine potential aquifers that were penetrated. The procedures used to process all of this information are documented in a TWDB work process document.

A value of -99999 is written to elevation and depth fields if data are unknown.

Table 17-1-1. tblAquiferDetermination_GulfCoastAquifer field names, data type and size, and lookup table references.

Field Name	Data Type	Size	Lookup Table
STATE_WELL_NUMBER	Long Integer	4	
WELL_ID	Long Integer	4	
AQUIFER_CODE	Text	8	tblLkAquifer
AQUIFER_NEW	Text	50	tblLkBRACS_Aquifer_AD
O_G_WELL_AQ_PENETRATED	Text	50	
AQ_REASON	Text	10	

Field Name	Data Type	Size	Lookup Table
AQ_DECISION	Text	100	tblLkAq_Decision
DEPTH_WELL	Long Integer	4	
DEPTH_TOTAL	Long Integer	4	
SCREEN_TOP	Long Integer	4	
SCREEN_BOTTOM	Long Integer	4	
MULTIPLE_SCREENS	Yes/No	1	
B_T_D	Long Integer	4	
B_B_D	Long Integer	4	
L_T_D	Long Integer	4	
L_B_D	Long Integer	4	
W_T_D	Long Integer	4	
W_B_D	Long Integer	4	
Caq_T_D	Long Integer	4	
Caq_B_D	Long Integer	4	
CHICOT_AQUIFER	Yes/No	1	
UG_T_D	Long Integer	4	
UG_B_D	Long Integer	4	
LG_T_D	Long Integer	4	
LG_B_D	Long Integer	4	
UL_T_D	Long Integer	4	
UL_B_D	Long Integer	4	
Eaq_T_D	Long Integer	4	
Eaq_B_D	Long Integer	4	
EVANGELINE_AQUIFER	Yes/No	1	
ML_T_D	Long Integer	4	
ML_B_D	Long Integer	4	
BURKEVILLE_CONFINING_UNIT	Yes/No	1	
LL_T_D	Long Integer	4	
LL_B_D	Long Integer	4	
OK_T_D	Long Integer	4	
OK_B_D	Long Integer	4	
Jaq_T_D	Long Integer	4	
Jaq_B_D	Long Integer	4	
JASPER_AQUIFER	Yes/No	1	
LATDD	Double	8	
LONGDD	Double	8	
ELEVATION	Long Integer	4	
OWNER	Text	100	
INITIALS	Text	3	tblLkIntial
REMARKS	Text	250	
INS_ID	Long Integer	4	
B_B_E	Long Integer	4	
L_B_E	Long Integer	4	
W_B_E	Long Integer	4	
UG_B_E	Long Integer	4	
LG_B_E	Long Integer	4	
UL_B_E	Long Integer	4	
ML_B_E	Long Integer	4	
LL_B_E	Long Integer	4	
OK_B_E	Long Integer	4	

Field Descriptions

STATE_WELL_NUMBER This field contains the state well number assigned to each water well in the TWDB Groundwater Database. A value of zero (0) is assigned if the state well number has not been assigned to this well.

WELL_ID Each record in the database is assigned a unique well ID (which is a long integer) in this table. A value of zero (0) is assigned if the well ID has not been assigned to this well.

AQUIFER_CODE This field contains an aquifer code that has been assigned to every water well in the TWDB Groundwater Database. These field values are listed in the lookup table tblLkAquifer, derived from a similar lookup table in the Groundwater Database.

AQUIFER_NEW This field contains a code for the new aquifer assignment. These field values are listed in the lookup table tblLkBRACSAquifer_AD. This table was created because not all of these aquifer combinations are available in the Groundwater Database aquifer code table.

Table 17-1-2. Aquifer codes used in tblLkBRACSAquifer_AD.

AQUIFER_NEW	AQUIFER_DESCRIPTION
Chicot	Chicot Aquifer
Chicot - Evangeline	Chicot and Evangeline aquifers
Evangeline	Evangeline Aquifer
N/A ... Petroleum Well	Not Applicable: Petroleum Well
unknown	Unknown aquifer (not enough information)

O_G_WELL_AQ_PENETRATED Well drilled for oil or gas; lists the deepest Gulf Coast Aquifer penetrated (Chicot, Evangeline, or Jasper)

AQ_REASON This field contains a code based on the query used to assign a value to the [aquifer_new] field. The default value of zero (0) is used if the queries did not assign a value. This field is primarily used for internal quality control to ensure the stored queries are operating accurately.

AQ_DECISION This field contains a value of how the aquifer was determined. These field values are listed in the lookup table tblLkAq_Decision.

Table 17-1-3. Aquifer decision codes used in the BRACS.

AQ_DECISION
Computer analysis of Well Screen (depth) and Aquifer Surfaces (GIS)
Geologist Best Professional Judgment of available information. See remarks for more information
No Decision Made. Not enough information available

DEPTH_WELL The total depth of the well in units of feet below ground surface. This is reported on the water well driller report. A value of -99999 is used if the value is not known.

This value was obtained from the BRACS Database for wells with a BRACS well ID or the TWDB Groundwater Database with a state well number.

DEPTH_TOTAL The total depth of the hole in units of feet below ground surface. This is reported on the water well driller report or header page on a geophysical well log. A value of -99999 is used if the value is not known.

This value was obtained from the BRACS Database for wells with a BRACS well ID.

SCREEN_TOP This field represents the top of the screened interval in units of feet below ground surface. For multiple screen wells, it represents the shallowest depth. A value of -99999 is used if the value is not known.

This value was obtained from the BRACS Database for wells with a BRACS well ID or the TWDB Groundwater Database for wells with a state well number.

SCREEN_BOTTOM This field represents the bottom of the screened interval in units of feet below ground surface. For multiple screen wells, it represents the deepest depth. A value of -99999 is used if the value is not known.

This value was obtained from the BRACS Database for wells with a BRACS well ID or the TWDB Groundwater Database for wells with a state well number.

MULTIPLE_SCREENS This field contains a Yes or No value if a well has multiple well screens. Wells with multiple screens were manually checked for aquifer code assignment.

B_T_D Beaumont Formation top depth in units of feet below ground surface.

B_B_D Beaumont Formation bottom depth in units of feet below ground surface.

L_T_D Lissie Formation top depth in units of feet below ground surface.

L_B_D Lissie Formation bottom depth in units of feet below ground surface.

W_T_D Willis Formation top depth in units of feet below ground surface.

W_B_D Willis Formation bottom depth in units of feet below ground surface.

Caq_T_D Chicot Aquifer top depth in units of feet below ground surface.

Caq_B_D Chicot Aquifer bottom depth in units of feet below ground surface.

CHICOT_AQUIFER This field contains a value of Yes or No based on whether this aquifer is used by the well.

UG_T_D Upper Goliad Formation top depth in units of feet below ground surface.

UG_B_D Upper Goliad Formation bottom depth in units of feet below ground surface.

LG_T_D Lower Goliad Formation top depth in units of feet below ground surface.

LG_B_D Lower Goliad Formation bottom depth in units of feet below ground surface.

UL_T_D Upper Lagarto Formation top depth in units of feet below ground surface.

UL_B_D Upper Lagarto Formation bottom depth in units of feet below ground surface.

Eaq_T_D Evangeline Aquifer top depth in units of feet below ground surface.

Eaq_B_D Evangeline Aquifer bottom depth in units of feet below ground surface.

Evangeline_AQUIFER This field contain a value of Yes or No based on whether this aquifer is used by the well.

ML_T_D Middle Lagarto Formation top depth in units of feet below ground surface.

ML_B_D Middle Lagarto Formation bottom depth in units of feet below ground surface.

BURKEVILLE_CONFINING_UNIT This field contains a value of Yes or No based on whether this aquifer is used by the well.

LL_T_D Lower Lagarto Formation top depth in units of feet below ground surface.

LL_B_D Lower Lagarto Formation bottom depth in units of feet below ground surface.

OK_T_D Oakville Formation top depth in units of feet below ground surface.

OK_B_D Oakville Formation bottom depth in units of feet below ground surface.

Jaq_T_D Jasper Aquifer top depth in units of feet below ground surface.

Jaq_B_D Jasper Aquifer bottom depth in units of feet below ground surface.

Jasper_AQUIFER This field contains a value of Yes or No based on whether this aquifer is used by the well.

LATDD Latitude of the well site in units of decimal degrees. Latitude is a positive value, referring to a site north of the earth's equator. Latitude and longitude coordinates are obtained from multiple sources. Latitude is obtained based on a North American Datum of 1983. This value was obtained from the well location table.

LONGDD Longitude of the well site in units of decimal degrees. Longitude is a negative value, referring to a site west of the Prime Meridian in Greenwich, United Kingdom. Latitude and longitude coordinates are obtained from multiple sources. Longitude is based on a North American Datum of 1983. This value was obtained from the well location table.

ELEVATION The elevation of the well site in units of feet above mean sea level. The elevation is determined using spatial analysis in a geographic information system by comparing the well site with the 30-meter digital elevation model for Texas. This value was obtained from the well location table. A value of -99999 is used if the value is not known.

OWNER The name of the well owner. This value was obtained from the well location table.

INITIALS Initials of staff member who last edited the well site record.

REMARKS General remarks associated with the well record.

B_B_E Beaumont Formation bottom elevation in units of feet above mean sea level. This value was extracted from the GIS surfaces prepared by Young and others, 2010, at each well site in the project area. This was converted to formation top and bottom depths using an elevation value at each well site.

L_B_E Lissie Formation bottom elevation in units of feet above mean sea level. This value was extracted from the GIS surfaces prepared by Young and others, 2010, at each well site in

the project area. This was converted to formation top and bottom depths using an elevation value at each well site.

W_B_E Willis Formation bottom elevation in units of feet above mean sea level. This value was extracted from the GIS surfaces prepared by Young and others, 2010, at each well site in the project area. This was converted to formation top and bottom depths using an elevation value at each well site.

UG_B_E Upper Goliad Formation bottom elevation in units of feet above mean sea level. This value was extracted from the GIS surfaces prepared by Young and others, 2010, at each well site in the project area. This was converted to formation top and bottom depths using an elevation value at each well site.

LG_B_E Lower Goliad Formation bottom elevation in units of feet above mean sea level. This value was extracted from the GIS surfaces prepared by Young and others, 2010, at each well site in the project area. This was converted to formation top and bottom depths using an elevation value at each well site.

UL_B_E Upper Lagarto Formation bottom elevation in units of feet above mean sea level. This value was extracted from the GIS surfaces prepared by Young and others, 2010, at each well site in the project area. This was converted to formation top and bottom depths using an elevation value at each well site.

ML_B_E Middle Lagarto Formation bottom elevation in units of feet above mean sea level. This value was extracted from the GIS surfaces prepared by Young and others, 2010, at each well site in the project area. This was converted to formation top and bottom depths using an elevation value at each well site.

LL_B_E Lower Lagarto Formation bottom elevation in units of feet above mean sea level. This value was extracted from the GIS surfaces prepared by Young and others, 2010, at each well site in the project area. This was converted to formation top and bottom depths using an elevation value at each well site.

OK_B_E Oakville Formation bottom elevation in units of feet above mean sea level. This value was extracted from the GIS surfaces prepared by Young and others, 2010, at each well site in the project area. This was converted to formation top and bottom depths using an elevation value at each well site.

17.2 Stratigraphic Table for GIS Import: gBRACS_ST_GC

This table is created from information residing in the primary tables including well location, well geology, and foreign key. Well records are appended to this table and processed using a number of stored queries in Microsoft® Access®. The purpose of this table is to take this processed information into a geographic information system (GIS) to display stratigraphic depths and elevations spatially and form the foundation for creating 3-dimensional geologic surfaces and contour maps.

Note: Formation depths have been adjusted for kelly bushing height, if known or applicable.

Formation elevations have been calculated using formation depths (adjusted for kelly bushing height, if known or applicable) and well site elevation.

A value of -99999 is written to elevation and depth fields if data are unknown.

Table 17-2-1. gBRACS_ST_GC field names, data type and size, and lookup table references.

Name	Type	Size	Lookup Table	Source Table
WELL_ID	Long Integer	4		tblWell_Location
WELL_TYPE	Text	50	tblLkWellType	
API_NUMBER	Text	12		tblBracs_ForeignKey
SW_NUM	Long Integer	4		
TRACK_NUM	Long Integer	4		
Q_NUM	Text	16		
SOURCE_WELL_DATA	Text	250	tblLkSourceWellData	tblWell_Location
ELEVATION	Long Integer	4		
KELLY_BUSHING_HEIGHT	Integer	2		
DEPTH_TOTAL	Long Integer	4		
DEPTH_WELL	Long Integer	4		
LATDD	Double	8		
LONGDD	Double	8		
AGENCY	Text	5	tblLkAgency	
COUNTY_NAME	Text	13		
B_T_D	Long Integer	4		tblWell_Geology (Note: these fields are adjusted for kelly bushing height)
B_B_D	Long Integer	4		
B_TK	Long Integer	4		
B_GT	Text	1		
B_T_E	Long Integer	4		
B_B_E	Long Integer	4		
L_T_D	Long Integer	4		
L_B_D	Long Integer	4		
L_TK	Long Integer	4		
L_GT	Text	1		
L_T_E	Long Integer	4		
L_B_E	Long Integer	4		
W_T_D	Long Integer	4		
W_B_D	Long Integer	4		
W_TK	Long Integer	4		
W_GT	Text	1		
W_T_E	Long Integer	4		
W_B_E	Long Integer	4		

Name	Type	Size	Lookup Table	Source Table
UG_T_D	Long Integer	4		
UG_B_D	Long Integer	4		
UG_TK	Long Integer	4		
UG_GT	Text	1		
UG_T_E	Long Integer	4		
UG_B_E	Long Integer	4		
LG_T_D	Long Integer	4		
LG_B_D	Long Integer	4		
LG_TK	Long Integer	4		
LG_GT	Text	1		
LG_T_E	Long Integer	4		
LG_B_E	Long Integer	4		
UL_T_D	Long Integer	4		
UL_B_D	Long Integer	4		
UL_TK	Long Integer	4		
UL_GT	Text	1		tblWell_Geology (Note: these fields are adjusted for kelly bushing height)
UL_T_E	Long Integer	4		
UL_B_E	Long Integer	4		
ML_T_D	Long Integer	4		
ML_B_D	Long Integer	4		
ML_TK	Long Integer	4		
ML_GT	Text	1		
ML_T_E	Long Integer	4		
ML_B_E	Long Integer	4		
LL_T_D	Long Integer	4		
LL_B_D	Long Integer	4		
LL_TK	Long Integer	4		
LL_GT	Text	1		
LL_T_E	Long Integer	4		
LL_B_E	Long Integer	4		
OK_T_D	Long Integer	4		
OK_B_D	Long Integer	4		
OK_TK	Long Integer	4		
OK_GT	Text	1		
OK_T_E	Long Integer	4		
OK_B_E	Long Integer	4		

Field Descriptions

WELL_ID Each record in the database is assigned a unique well ID (which is a long integer) in this table. This is the key field in this table.

WELL_TYPE The type of well and when the well was drilled and completed. These terms are the same as the lookup table in the TWDB Groundwater Database (Rein and Hopkins, 2008). These field values are listed in the lookup table tblLkWellType.

API_NUM The API number of the well, assigned to oil and gas wells.

SW_NUM The state well number of the well, assigned to wells in the TWDB Groundwater Database.

TRACK_NUM The track number of the well, assigned to wells in the Texas Department of Licensing and Regulation Submitted Driller Report Database.

WS_NUM The water source code, assigned to wells in the Texas Commission on Environmental Quality public water system program.

Q_NUM The Q number assigned to wells in the Texas Commission on Environmental Quality surface casing program.

SOURCE_WELL_DATA Each well record is assigned the source of the well information. In some cases multiple sources exist; in this case, the source of the geophysical well log or water well driller report takes precedence. These field values are listed in the lookup table tblLkSourceWellData.

ELEVATION The elevation of the well site in units of feet above mean sea level. The elevation is determined using spatial analysis in a geographic information system by comparing the well site with the 30-meter digital elevation model for Texas.

KELLY_BUSHING_HEIGHT The height of the drilling rig kelly bushing used as a measuring point for all subsequent logging. The units are in feet above ground surface. This value is stored as an integer. The term is synonymous with rig floor, derrick floor, rotary table, drive bushing, and KB. This value is recorded on the geophysical well log header either as a unique value or a value that must be calculated from the values of elevation of the ground surface and elevation of the kelly bushing.

The default value for this field is zero (0).

DEPTH_TOTAL The total depth of the hole in units of feet below ground surface. This is reported on the water well driller report or header page on a geophysical well log. A value of -99999 is used if the value is not known.

DEPTH_WELL The total depth of the well in units of feet below ground surface. This is reported on the water well driller report. A value of -99999 is used if the value is not known.

LATDD Latitude of the well site in units of decimal degrees. Latitude is a positive value, referring to a site north of the earth's equator. Latitude and longitude coordinates are obtained from multiple sources. Latitude is obtained is based on a North American Datum of 1983.

LONGDD Longitude of the well site in units of decimal degrees. Longitude is a negative value, referring to a site west of the Prime Meridian in Greenwich, United Kingdom. Latitude and longitude coordinates are obtained from multiple sources. Longitude is based on a North American Datum of 1983.

AGENCY The agency that collected the latitude and longitude coordinates of the well site. These field values are listed in the lookup table tblLkAgency.

B_T_D Beaumont Formation top depth in units of feet below ground surface.

B_B_D Beaumont Formation bottom depth in units of feet below ground surface.

B_TK Beaumont Formation thickness in units of feet.

B_GT Greater than symbol (>) represents well only partially penetrates the Beaumont Formation.

B_T_E Beaumont Formation top elevation in units of feet above mean sea level.

B_B_E Beaumont Formation bottom elevation in units of feet above mean sea level.

L_T_D Lissie Formation top depth in units of feet below ground surface.

L_B_D Lissie Formation bottom depth in units of feet below ground surface.

L_TK Lissie Formation thickness in units of feet.

L_GT Greater than symbol (>) represents well only partially penetrates the Lissie Formation.

L_T_E Lissie Formation top elevation in units of feet above mean sea level.

L_B_E Lissie Formation bottom elevation in units of feet above mean sea level.

W_T_D Willis Formation top depth in units of feet below ground surface.

W_B_D Willis Formation bottom depth in units of feet below ground surface.

W_TK Willis Formation thickness in units of feet.

W_GT Greater than symbol (>) represents well only partially penetrates the Willis Formation.

W_T_E Willis Formation top elevation in units of feet above mean sea level.

W_B_E Willis Formation bottom elevation in units of feet above mean sea level.

UG_T_D Upper Goliad Formation top depth in units of feet below ground surface.

UG_B_D Upper Goliad Formation bottom depth in units of feet below ground surface.

UG_TK Upper Goliad Formation thickness in units of feet.

UG_GT Greater than symbol (>) represents well only partially penetrates the Upper Goliad Formation.

UG_T_E Upper Goliad Formation top elevation in units of feet above mean sea level.

UG_B_E Upper Goliad Formation bottom elevation in units of feet above mean sea level.

LG_T_D Lower Goliad Formation top depth in units of feet below ground surface.

LG_B_D Lower Goliad Formation bottom depth in units of feet below ground surface.

LG_TK Lower Goliad Formation thickness in units of feet.

LG_GT Greater than symbol (>) represents well only partially penetrates the Lower Goliad Formation.

LG_T_E Lower Goliad Formation top elevation in units of feet above mean sea level.

LG_B_E Lower Goliad Formation bottom elevation in units of feet above mean sea level.

UL_T_D Upper Lagarto Formation top depth in units of feet below ground surface.

UL_B_D Upper Lagarto Formation bottom depth in units of feet below ground surface.

UL_TK Upper Lagarto Formation thickness in units of feet.

UL_GT Greater than symbol (>) represents well only partially penetrates the Upper Lagarto Formation.

UL_T_E Upper Lagarto Formation top elevation in units of feet above mean sea level.

UL_B_E Upper Lagarto Formation bottom elevation in units of feet above mean sea level.

ML_T_D Middle Lagarto Formation top depth in units of feet below ground surface.

ML_B_D Middle Lagarto Formation bottom depth in units of feet below ground surface.

ML_TK Middle Lagarto Formation thickness in units of feet.

ML_GT Greater than symbol (>) represents well only partially penetrates the Middle Lagarto Formation.

ML_T_E Middle Lagarto Formation top elevation in units of feet above mean sea level.

ML_B_E Middle Lagarto Formation bottom elevation in units of feet above mean sea level.

LL_T_D Lower Lagarto Formation top depth in units of feet below ground surface.

LL_B_D Lower Lagarto Formation bottom depth in units of feet below ground surface.

LL_TK Lower Lagarto Formation thickness in units of feet.

LL_GT Greater than symbol (>) represents well only partially penetrates the Lower Lagarto Formation.

LL_T_E Lower Lagarto Formation top elevation in units of feet above mean sea level.

LL_B_E Lower Lagarto Formation bottom elevation in units of feet above mean sea level.

OK_T_D Oakville Formation top depth in units of feet below ground surface.

OK_B_D Oakville Formation bottom depth in units of feet below ground surface.

OK_TK Oakville Formation thickness in units of feet.

OK_GT Greater than symbol (>) represents well only partially penetrates the Oakville Formation.

OK_T_E Oakville Formation top elevation in units of feet above mean sea level.

OK_B_E Oakville Formation bottom elevation in units of feet above mean sea level.

17.3 Master Water Quality Table: tblBracs_GC_MasterWaterQuality

The master water quality table contains every water quality record in the project area organized with one record per well per date sampled with constituents in separate fields. This design greatly simplifies the creation of GIS datasets, for without data residing in one table, data must be processed from 4 tables.

The majority of field descriptions were obtained from the Groundwater Database Data Dictionary spreadsheet available on the TWDB website.

Table 17-3-1. tblBracs_GC_MasterWaterQuality field names, data type and size, and lookup table references.

Field Name	Data Type	Size	Lookup Table
STATE_WELL_NUMBER	Long Integer	4	
WELL_ID	Long Integer	4	
mm_date	Integer	2	
dd_date	Integer	2	
yy_date	Integer	2	
sample_number	Integer	2	
SOURCE_DATA	Text	200	
TDS_RANGE	Text	255	
TDS_RNG_NUM	Integer	2	
sample_time	Text	4	
temp_centigrade	Decimal	16	
top_s_interval	Integer	2	
bottom_s_interval	Integer	2	
samp_int_aqcode	Text	8	
collection_remarks	Text	30	
reliability_rem	Text	2	
collecting_agency	Text	2	
lab_code	Text	2	
bu_wqanalysis	Text	1	
q00955_flag	Text	1	
q00955_silica_mgl	Decimal	16	
q00910_flag	Text	1	
q00910_calcium_mgl	Decimal	16	
q00920_flag	Text	1	
q00920_magnes_mgl	Decimal	16	
q00929_flag	Text	1	
q00929_sodium_mgl	Decimal	16	
q00937_flag	Text	1	
q00937_potass_mgl	Decimal	16	
q01080_flag	Text	1	
q01080_strontium	Decimal	16	
q00445_carb_mgl	Decimal	16	
q00440_bicarb_mgl	Decimal	16	
q00945_flag	Text	1	
q00945_sulfate_mgl	Decimal	16	
q00940_flag	Text	1	
q00940_chloride_mg	Decimal	16	

Field Name	Data Type	Size	Lookup Table
q00951_flag	Text	1	
q00951_fluoride_mg	Decimal	16	
q71850_flag	Text	1	
q71850_nitrate_mgl	Decimal	16	
q00403_flag	Text	1	
q00403_ph	Decimal	16	
q70300_tds	Long Integer	4	
q00415_flag	Text	1	
q00415_phen_alk	Decimal	16	
q00410_flag	Text	1	
q00410_total_alk	Decimal	16	
q00900_tot_hardnes	Long Integer	4	
q00932_percent_na	Integer	2	
q00931_sar	Decimal	16	
q71860_rsc	Decimal	16	
q00095_flag	Text	1	
q00095_spec_cond	Long Integer	4	
bu_value	Decimal	16	
IRON_FLAG	Text	1	
IRON	Double	8	
MANGANESE_FLAG	Text	1	
MANGANESE	Double	8	
CT	Double	8	
SULFATE_PERCENTAGE	Decimal	16	
BICARBONATE_PERCENTAGE	Decimal	16	
Na_PERCENTAGE_CATIONS	Integer	2	
date_entered	Date/Time	8	
user_name	Text	8	
REMARKS	Text	250	
AQUIFER_NEW	Text	50	

Field Descriptions

STATE_WELL_NUMBER This field contains the state well number assigned to each water well in the TWDB Groundwater Database.

WELL_ID Each record in the database is assigned a unique well ID (which is a long integer) in this table. This is the key field in this table.

mm_date This is the second key field for this table. This field contains an integer for the month the sample was collected. If the month is unknown, a zero (0) is required.

dd_date This is the third key field for this table. This field contains an integer for the day the sample was collected. If the day is unknown, a zero (0) is required.

yy_date This is the fourth key field for this table. This field contains an integer for the year the sample was collected. The year must have four characters. If the year is unknown, a zero (0) is required.

sample_number This is the fifth key field for this table. This is an integer referring to a sample number, since more than one sample may be taken on the same day. It consists of an integer beginning with one for the first record of a well and increases by a value of one for each new record.

SOURCE_DATA This field contains a reference to the source of the information; for example, the report number and table or page number.

TDS_RANGE This field contains a value representing the range of total dissolved solids content to be used for GIS analysis of brackish groundwater resources in Texas. The ranges include values, in milligrams per liter, of 0 – 999; 1000 – 2999; 3000 – 9999; and > 10000.

TDS_RNG_NUM This field contains an integer value representing the range of total dissolved solids content to be used for GIS analysis of brackish groundwater resources in Texas. The ranges include values, in milligrams per liter, of 1 = 0 – 999; 2 = 1000 – 2999; 3 = 3000 – 9999; and 4 = > 10000.

sample_time This field contains the time the sample was collected using four digits in the format of a 24-hour time period (for example, 8:45 a.m. is 0845; 4:21 p.m. is 1621).

temp_centigrade Temperature of water sample in Celsius (field measurement).

top_s_interval Top interval of formation where sample was collected in units of feet below ground surface (only for multiple completion wells).

bottom_s_interval Bottom interval of formation where sample was collected in units of feet below ground surface (only for multiple completion wells).

samp_int_aqcode Aquifer code for the sampled interval (only for multiple completion wells).

collection_remarks Remarks about the sample collected.

reliability_rem Indicates the process used to collect the sample.

collecting_agency Identifies the entity that collected the sample.

lab_code Identifies the lab used to analyze the sample.

bu_wqanalysis Indicates whether the analysis of the sample is Balanced (B) or Unbalanced (U).

q00955_flag Used to identify constituent concentrations below the lab's detection limits.

q00955_silica_mgl Silica in mg/L.

q00910_flag Used to identify constituent concentrations below the lab's detection limits.

q00910_calcium_mgl Calcium, dissolved in mg/L.

q00920_flag Used to identify constituent concentrations below the lab's detection limits.

q00920_magnes_mgl Magnesium, dissolved in mg/L.

q00929_flag Used to identify constituent concentrations below the lab's detection limits.

q00929_sodium_mgl Sodium, dissolved in mg/L.

q00937_flag Used to identify constituent concentrations below the lab's detection limits.

q00937_potass_mgl Potassium, dissolved in mg/L.

q01080_flag Used to identify constituent concentrations below the lab's detection limits.

q01080_strontium Strontium in mg/L.

q00445_carb_mgl Carbonate in mg/L.

q00440_bicarb_mgl Bicarbonate in mg/L.

q00945_flag Used to identify constituent concentrations below the lab's detection limits.

q00945_sulfate_mgl Sulfate, dissolved in mg/L.

q00940_flag Used to identify constituent concentrations below the lab's detection limits.

q00940_chloride_mg Chloride, dissolved in mg/L.

q00951_flag Used to identify constituent concentrations below the lab's detection limits.

q00951_fluoride_mg Fluoride, dissolved in mg/L.

q71850_flag Used to identify constituent concentrations below the lab's detection limits.

q71850_nitrate_mgl Nitrate nitrogen, dissolved in mg/L.

q00403_flag Used to identify constituent concentrations below the lab's detection limits.

q00403_ph pH, standard units (field measurement).

q70300_tds Solids dissolved sum of constituents.

q00415_flag Used to identify constituent concentrations below the lab's detection limits.

q00415_phen_alk Phenol alkalinity.

q00410_flag Used to identify constituent concentrations below the lab's detection limits.

q00410_total_alk Total alkalinity, dissolved (analyzed in lab).

q00900_tot_hardnes Total hardness.

q00932_percent_na Percent sodium.

q00931_sar Sodium absorption ratio.

q71860_rsc Residual sodium carbonate.

q00095_flag Used to identify constituent concentrations below the lab's detection limits.

q00095_spec_cond Specific conductance umhos/cm @ 25C (field measurement).

bu_value Value of the balance/unbalanced equation.

IRON_FLAG Used to identify constituent concentrations below the lab's detection limits.

IRON Dissolved iron in mg/L with a storet code of 01045.

MANGANESE_FLAG Used to identify constituent concentrations below the lab's detection limits.

MANGANESE Dissolved manganese in mg/L with a storet code of 01055.

CT Total Dissolved Solids / Specific Conductance. Used for resistivity analysis using geophysical well logs.

SULFATE_PERCENTAGE (sulfate / total dissolved solids) * 100. Used for resistivity analysis using geophysical well logs.

BICARBONATE_PERCENTAGE (bicarbonate / total dissolved solids) * 100. Used for resistivity analysis using geophysical well logs.

Na_PERCENTAGE_CATIONS (Sodium / (Sodium + Calcium + Magnesium + Potassium)) * 100. Used for resistivity analysis using geophysical well logs.

date_entered This field contains the date the record was last edited.

user_name This field contains the reference to the staff member who last edited the record.

REMARKS General remarks about an analysis.

AQUIFER_NEW This field contains a code for the new aquifer assignment. These field values are listed in the lookup table tblLkBRACSAquifer_AD. This table was created because not all of these aquifer combinations are available in the Groundwater Database aquifer code table.

Table 17-3-2. Aquifer codes used in BRACS.

AQUIFER_NEW	AQUIFER_DESCRIPTION
Chicot	Chicot Aquifer
Chicot - Evangeline	Chicot and Evangeline aquifers
Evangeline	Evangeline Aquifer
N/A ... Petroleum Well	Not Applicable: Petroleum Well
unknown	Unknown aquifer (not enough information)

17.4 Net Sand Table: tblWell_Geology_NetSand_GulfCoast

This table is created from information residing in the well geology, simplified lithologic name lookup, and aquifer determination tables. Well records are appended to a holding table (tblWell_Geology_ProcessingNetSand_GulfCoast_Temp; see table description) for extensive processing using a number of stored queries in Microsoft® Access®. Once the processing is completed, the information is summarized with one record per well. The purpose of this table is to take this geologic information into a geographic information system (GIS) to display net sand and sand percent data spatially and create point and contour maps.

Table 17-4-1. tblWell_Geology_NetSand_GulfCoast field names, data type and size, and lookup table references.

Field Name	Data Type	Size	Lookup Table
WELL_ID	Long Integer	4	
B_PRESENT	Yes/No	1	
B_PARTIAL_PEN	Yes/No	1	
B_PARTIAL_GEODESC	Yes/No	1	
B_NET_SAND	Long Integer	4	
B_SAND_PERCENT	Long Integer	4	
B_TK	Long Integer	4	
L_PRESENT	Yes/No	1	
L_PARTIAL_PEN	Yes/No	1	
L_PARTIAL_GEODESC	Yes/No	1	
L_NET_SAND	Long Integer	4	
L_SAND_PERCENT	Long Integer	4	
L_TK	Long Integer	4	
W_PRESENT	Yes/No	1	
W_PARTIAL_PEN	Yes/No	1	
W_PARTIAL_GEODESC	Yes/No	1	
W_NET_SAND	Long Integer	4	
W_SAND_PERCENT	Long Integer	4	
W_TK	Long Integer	4	
Caq_PRESENT	Yes/No	1	
Caq_PARTIAL_PEN	Yes/No	1	
Caq_NET_SAND	Long Integer	4	
Caq_SAND_PERCENT	Long Integer	4	
Caq_TK	Long Integer	4	
UG_PRESENT	Yes/No	1	
UG_PARTIAL_PEN	Yes/No	1	

Field Name	Data Type	Size	Lookup Table
UG_PARTIAL_GEODESC	Yes/No	1	
UG_NET_SAND	Long Integer	4	
UG_SAND_PERCENT	Long Integer	4	
UG_TK	Long Integer	4	
LG_PRESENT	Yes/No	1	
LG_PARTIAL_PEN	Yes/No	1	
LG_PARTIAL_GEODESC	Yes/No	1	
LG_NET_SAND	Long Integer	4	
LG_SAND_PERCENT	Long Integer	4	
LG_TK	Long Integer	4	
UL_PRESENT	Yes/No	1	
UL_PARTIAL_PEN	Yes/No	1	
UL_PARTIAL_GEODESC	Yes/No	1	
UL_NET_SAND	Long Integer	4	
UL_SAND_PERCENT	Long Integer	4	
UL_TK	Long Integer	4	
Eaq_PRESENT	Yes/No	1	
Eaq_PARTIAL_PEN	Yes/No	1	
Eaq_NET_SAND	Long Integer	4	
Eaq_SAND_PERCENT	Long Integer	4	
Eaq_TK	Long Integer	4	
ML_PRESENT	Yes/No	1	
ML_PARTIAL_PEN	Yes/No	1	
ML_PARTIAL_GEODESC	Yes/No	1	
ML_NET_SAND	Long Integer	4	
ML_SAND_PERCENT	Long Integer	4	
ML_TK	Long Integer	4	
LL_PRESENT	Yes/No	1	
LL_PARTIAL_PEN	Yes/No	1	
LL_PARTIAL_GEODESC	Yes/No	1	
LL_NET_SAND	Long Integer	4	
LL_SAND_PERCENT	Long Integer	4	
LL_TK	Long Integer	4	
OK_PRESENT	Yes/No	1	
OK_PARTIAL_PEN	Yes/No	1	
OK_PARTIAL_GEODESC	Yes/No	1	
OK_NET_SAND	Long Integer	4	
OK_SAND_PERCENT	Long Integer	4	
OK_TK	Long Integer	4	
Jaq_PRESENT	Yes/No	1	
Jaq_PARTIAL_PEN	Yes/No	1	
Jaq_NET_SAND	Long Integer	4	
Jaq_SAND_PERCENT	Long Integer	4	
Jaq_TK	Long Integer	4	

Field Descriptions

WELL_ID Each record in the database is assigned a unique well ID (which is a long integer) in this table. This is the key field in this table.

B_PRESENT This field contains a value of Yes or No if the Beaumont Formation is present in this well.

B_PARTIAL_PEN This field contains a value of Yes or No if the Beaumont Formation is only partially penetrated by this well.

B_PARTIAL_GEODESC This field contains a value of Yes or No if the geologic description is for less than 100 percent of the Beaumont Formation. This can occur if the upper part of the formation is cased, or if the geologic log for the lower part of the formation is not available.

B_NET_SAND This field contains an integer representing the total thickness of sand within the Beaumont Formation, in units of feet.

B_SAND_PERCENT The percent of sand within the Beaumont Formation, calculated field [B_NET_SAND] / [B_TK] * 100.

B_TK Beaumont Formation thickness, calculated field: [depth_bottom] – [depth_top]. The units are feet.

L_PRESENT This field contains a value of Yes or No if the Lissie Formation is present in this well.

L_PARTIAL_PEN This field contains a value of Yes or No if the Lissie Formation is only partially penetrated by this well.

L_PARTIAL_GEODESC This field contains a value of Yes or No if the geologic description is for less than 100 percent of the Lissie Formation. This can occur if the upper part of the formation is cased, or if the geologic log for the lower part of the formation is not available.

L_NET_SAND This field contains an integer representing the total thickness of sand within the Lissie Formation, in units of feet.

L_SAND_PERCENT The percent of sand within the Lissie Formation, calculated field [L_NET_SAND] / [L_TK] * 100.

L_TK Lissie Formation thickness, calculated field: [depth_bottom] – [depth_top]. The units are feet.

W_PRESENT This field contains a value of Yes or No if the Willis Formation is present in this well.

W_PARTIAL_PEN This field contains a value of Yes or No if the Willis Formation is only partially penetrated by this well.

W_PARTIAL_GEODESC This field contains a value of Yes or No if the geologic description is for less than 100 percent of the Willis Formation. This can occur if the upper part of the formation is cased, or if the geologic log for the lower part of the formation is not available.

W_NET_SAND This field contains an integer representing the total thickness of sand within the Willis Formation, in units of feet.

W_SAND_PERCENT The percent of sand within the Willis Formation, calculated field [W_NET_SAND] / [W_TK] * 100.

W_TK Willis Formation thickness, calculated field: [depth_bottom] – [depth_top]. The units are feet.

Caq_PRESENT This field contains a value of Yes or No if the Chicot Aquifer is present in this well.

Caq _PARTIAL_PEN This field contains a value of Yes or No if the Chicot Aquifer is only partially penetrated by this well.

Caq _NET_SAND This field contains an integer representing the total thickness of sand within the Chicot Aquifer, in units of feet.

Caq _SAND_PERCENT The percent of sand within the Chicot Aquifer, calculated field [Caq_NET_SAND] / Caq_TK] * 100.

Caq _TK Chicot Aquifer thickness, calculated field: [depth_bottom] – [depth_top]. The units are feet.

UG_PRESENT This field contains a value of Yes or No if the Upper Goliad Formation is present in this well.

UG_PARTIAL_PEN This field contains a value of Yes or No if the Upper Goliad Formation is only partially penetrated by this well.

UG_PARTIAL_GEODESC This field contains a value of Yes or No if the geologic description is for less than 100 percent of the Upper Goliad Formation. This can occur if the upper part of the formation is cased, or if the geologic log for the lower part of the formation is not available.

UG_NET_SAND This field contains an integer representing the total thickness of sand within the Upper Goliad Formation, in units of feet.

UG_SAND_PERCENT The percent of sand within the Upper Goliad Formation, calculated field [UG_NET_SAND] / [UG_TK] * 100.

UG_TK Upper Goliad Formation thickness, calculated field: [depth_bottom] – [depth_top]. The units are feet.

LG_PRESENT This field contains a value of Yes or No if the Lower Goliad Formation is present in this well.

LG_PARTIAL_PEN This field contains a value of Yes or No if the Lower Goliad Formation is only partially penetrated by this well.

LG_PARTIAL_GEODESC This field contains a value of Yes or No if the geologic description is for less than 100 percent of the Lower Goliad Formation. This can occur if the upper part of the formation is cased, or if the geologic log for the lower part of the formation is not available.

LG_NET_SAND This field contains an integer representing the total thickness of sand within the Lower Goliad Formation, in units of feet.

LG_SAND_PERCENT The percent of sand within the Lower Goliad Formation, calculated field [LG_NET_SAND] / [LG_TK] * 100.

LG_TK Lower Goliad Formation thickness, calculated field: [depth_bottom] – [depth_top]. The units are feet.

UL_PRESENT This field contains a value of Yes or No if the Upper Lagarto Formation is present in this well.

UL_PARTIAL_PEN This field contains a value of Yes or No if the Upper Lagarto Formation is only partially penetrated by this well.

UL_PARTIAL_GEODESC This field contains a value of Yes or No if the geologic description is for less than 100 percent of the Upper Lagarto Formation. This can occur if the upper part of the formation is cased, or if the geologic log for the lower part of the formation is not available.

UL_NET_SAND This field contains an integer representing the total thickness of sand within the Upper Lagarto Formation, in units of feet.

UL_SAND_PERCENT The percent of sand within the Upper Lagarto Formation, calculated field [UL_NET_SAND] / [UL_TK] * 100.

UL_TK Upper Lagarto Formation thickness, calculated field: [depth_bottom] – [depth_top]. The units are feet.

Eaq_PRESENT This field contains a value of Yes or No if the Evangeline Aquifer is present in this well.

Eaq _PARTIAL_PEN This field contains a value of Yes or No if the Evangeline Aquifer is only partially penetrated by this well.

Eaq _NET_SAND This field contains an integer representing the total thickness of sand within the Evangeline Aquifer, in units of feet.

Eaq _SAND_PERCENT The percent of sand within the Evangeline Aquifer, calculated field [Eaq_NET_SAND] / [Eaq_TK] * 100.

Eaq _TK Evangeline Aquifer thickness, calculated field: [depth_bottom] – [depth_top]. The units are feet.

ML_PRESENT This field contains a value of Yes or No if the Middle Lagarto Formation is present in this well. The Middle Lagarto Formation is synonymous with the Burkeville Aquitard.

ML_PARTIAL_PEN This field contains a value of Yes or No if the Middle Lagarto Formation is only partially penetrated by this well.

ML_PARTIAL_GEODESC This field contains a value of Yes or No if the geologic description is for less than 100 percent of the Middle Lagarto Formation. This can occur if the upper part of the formation is cased, or if the geologic log for the lower part of the formation is not available.

ML_NET_SAND This field contains an integer representing the total thickness of sand within the Middle Lagarto Formation, in units of feet.

ML_SAND_PERCENT The percent of sand within the Middle Lagarto Formation, calculated field [ML_NET_SAND] / [ML_TK] * 100.

ML_TK Middle Lagarto Formation thickness, calculated field: [depth_bottom] – [depth_top]. The units are feet.

LL_PRESENT This field contains a value of Yes or No if the Lower Lagarto Formation is present in this well.

LL_PARTIAL_PEN This field contains a value of Yes or No if the Lower Lagarto Formation is only partially penetrated by this well.

LL_PARTIAL_GEODESC This field contains a value of Yes or No if the geologic description is for less than 100 percent of the Lower Lagarto Formation. This can occur if the upper part of the formation is cased, or if the geologic log for the lower part of the formation is not available.

LL_NET_SAND This field contains an integer representing the total thickness of sand within the Lower Lagarto Formation, in units of feet.

LL_SAND_PERCENT The percent of sand within the Lower Lagarto Formation, calculated field [LL_NET_SAND] / [LL_TK] * 100.

LL_TK Lower Lagarto Formation thickness, calculated field: [depth_bottom] – [depth_top]. The units are feet.

OK_PRESENT This field contains a value of Yes or No if the Oakville Formation is present in this well.

OK_PARTIAL_PEN This field contains a value of Yes or No if the Oakville Formation is only partially penetrated by this well.

OK_PARTIAL_GEODESC This field contains a value of Yes or No if the geologic description is for less than 100 percent of the Oakville Formation. This can occur if the upper part of the formation is cased, or if the geologic log for the lower part of the formation is not available.

OK_NET_SAND This field contains an integer representing the total thickness of sand within the Oakville Formation, in units of feet.

OK_SAND_PERCENT The percent of sand within the Oakville Formation, calculated field [OK_NET_SAND] / [OK_TK] * 100.

OK_TK Oakville Formation thickness, calculated field: [depth_bottom] – [depth_top]. The units are feet.

Jaq_PRESENT This field contains a value of Yes or No if the Jasper Aquifer is present in this well.

Jaq _PARTIAL_PEN This field contains a value of Yes or No if the Jasper Aquifer is only partially penetrated by this well.

Jaq _NET_SAND This field contains an integer representing the total thickness of sand within the Jasper Aquifer, in units of feet.

Jaq _SAND_PERCENT The percent of sand within the Jasper Aquifer, calculated field [Jaq_NET_SAND] / [Jaq_TK] * 100.

Jaq _TK Jasper Aquifer thickness, calculated field: [depth_bottom] – [depth_top]. The units are feet.

17.5 Net Sand Analysis Table: tblWell_Geology_NetSand_GulfCoast_Temp

This table is created from information residing in the well geology, simplified lithologic name lookup, and aquifer determination tables. Well records are appended to this table if the lithologic description for any record associated with a well contains reference to sand or gravel. These records are then processed using a number of stored queries in Microsoft® Access® and loaded into the table tblWell_Geology_NetSand. Once the processing is completed, the information is summarized with one record per well.

Table 17-5-1. tblWell_Geology_NetSand_GulfCoast_Temp field names, data type and size, and lookup table references.

Field Name	Data Type	Size	Lookup Table
WELL_ID	Long Integer	4	
RECORD_NUMBER	Integer	2	
SOURCE_GEOLOGIC_DATA	Text	50	tblLkSourceGeologicData
LITHOLOGIC_NAME	Text	100	
SIMPLIFIED_LITHOLOGIC_NAME	Text	100	tblLkSimplified_Lithologic_Name
SAND_PERCENT	Decimal	16	
DEPTH_TOP	Single	4	
DEPTH_BOTTOM	Single	4	
THICKNESS	Single	4	
B_T_D	Long Integer	4	
B_B_D	Long Integer	4	
B_FM	Text	10	tblLkSandPositionCode
B_NS_TK	Integer	2	
L_T_D	Long Integer	4	
L_B_D	Long Integer	4	
L_FM	Text	10	tblLkSandPositionCode
L_NS_TK	Integer	2	
W_T_D	Long Integer	4	
W_B_D	Long Integer	4	
W_FM	Text	10	tblLkSandPositionCode
W_NS_TK	Integer	2	
UG_T_D	Long Integer	4	
UG_B_D	Long Integer	4	
UG_FM	Text	10	tblLkSandPositionCode
UG_NS_TK	Integer	2	
LG_T_D	Long Integer	4	
LG_B_D	Long Integer	4	
LG_FM	Text	10	tblLkSandPositionCode
LG_NS_TK	Integer	2	
UL_T_D	Long Integer	4	
UL_B_D	Long Integer	4	
UL_FM	Text	10	tblLkSandPositionCode
UL_NS_TK	Integer	2	
ML_T_D	Long Integer	4	
ML_B_D	Long Integer	4	
ML_FM	Text	10	tblLkSandPositionCode
ML_NS_TK	Integer	2	
LL_T_D	Long Integer	4	

Field Name	Data Type	Size	Lookup Table
LL_B_D	Long Integer	4	
LL_FM	Text	10	tblLkSandPositionCode
LL_NS_TK	Integer	2	
OK_T_D	Long Integer	4	
OK_B_D	Long Integer	4	
OK_FM	Text	10	tblLkSandPositionCode
OK_NS_TK	Integer	2	

The value of maintaining this table is that special sand maps can be developed; for example, maximum sand per formation, number of sands greater than some value (50 feet) per formation, number of and cumulative thickness of sands within a specific depth range, and so on.

Field Descriptions

WELL_ID Each record in the database is assigned a unique well ID (which is a long integer) in this table. This is the key field in this table.

RECORD_NUMBER This is the second key field in this table. This number is not assigned as an autonumber field, as in the usual case for a key field. The value is an integer, beginning with 1 and increasing with the addition of each record. The integer order allows the records to be displayed in a form in the order of increasing depth from the surface. Because several different types of information (lithology, stratigraphy, hydrogeologic units) can be appended to this table, it is important to complete the append process for a group of records at one time before appending records of a different geologic pick type. This will ensure records of different types can be ordered appropriately. If a new record must be appended and the order modified, the record number can be edited (with an autonumber data type this is impossible), although care must be taken to not duplicate an existing record number in this endeavor.

SOURCE_GEOLOGIC_DATA The source of the geologic data appended into the table. These field values are listed in the lookup table tblLkSourceGeologicData. This table will continue to grow with time.

Table 17-5-2. Codes used in the source_geologic_data field.

SOURCE_GEOLOGIC_DATA	SOURCE_GEOLOGIC_DATA_DESCRIPTION
CORE	Geologist Interpretation of Core Samples
GEOPHYSICAL WELL LOG	Geologist Interpretation of Geophysical Log
MISCELLANEOUS	Geophysical logs, well reports, scout tickets, cross-sections, …
OIL / GAS WELL LOG	Geologist Interpretation of Well Cuttings (MUD Log)
PUBLISHED REPORT	Geologic description, published report, source unknown
UNKNOWN	UNKNOWN
WATER WELL LOG, DRILLER	Well Driller Interpretation of Lithology from Drill Cuttings
WATER WELL LOG, GEOLOGIST	Geologist Interpretation of Lithology from Drill Cuttings

LITHOLOGIC_NAME This field contains the lithologic description assigned to each range of depths (from depth_top to depth_bottom) as the well was drilled. The most common source for these data is the state water well report or records in published or unpublished reports. The information is copied verbatim, except in cases where obvious typographical errors have been made. The term caliche is often misspelled, and this term has been standardized when records have been appended manually.

A tremendous amount of information has come from digital water well reports from the Texas Department of Licensing and Regulation Submitted Driller Report Database. The records in that database are appended as a memo field. These data are parsed into separate fields by TWDB staff before being appended into this table.

SIMPLIFIED_LITHOLOGIC_NAME This field contains a simplified version of the lithologic description so additional automated processing can be accomplished. For example, a unit consisting of sand may be written in over 250 different forms on water well reports.

The lookup table tblLkLithologicName_to_SimplifiedLithologicName was created to relate the two fields. A query was written to automatically update this simplified_lithologic_name field from the lithologic_name field using values in the lookup table. The lookup table will grow with time as new records are appended to the well geology table.

SAND_PERCENT The percent sand associated with this record. This value is associated with the definition of each record in the lookup table tblLkSimplified_Lithologic_Name.

DEPTH_TOP This field contains the depth to the top of the unit (referred to by the geologic pick field) in the units of feet below ground surface. The value is always a positive integer. This field is corrected for kelly bushing height.

DEPTH_BOTTOM This field contains the depth to the bottom of the unit (referred to by the geologic pick field) in the units of feet below ground surface. The value is always a positive integer. This field is corrected for kelly bushing height.

THICKNESS This is a calculated field: [depth_bottom] – [depth_top]. The units are feet.

B_T_D Beaumont Formation top depth in units of feet below ground surface.

B_B_D Beaumont Formation bottom depth in units of feet below ground surface.

B_FM Relationship of the lithologic top and bottom to Beaumont Formation top and bottom. These field values are listed in the lookup table tblLkSandPositionCode.

Table 17-5-3. Codes used in the SandPositionCode field.

SAND_POSITION_CODE	CODE_DESCRIPTION
W	Sand is completely within formation
ST	Sand straddles top of formation
SB	Sand straddles bottom of formation
SS	Sand straddles top and bottom of formation
X	Sand not in formation

B_NS_TK Corrected net sand thickness of the Beaumont Formation, per individual lithologic unit, in feet.

L_T_D Lissie Formation top depth in units of feet below ground surface.

L_B_D Lissie Formation bottom depth in units of feet below ground surface.

L_FM Relationship of the lithologic top and bottom to Lissie Formation top and bottom. These field values are listed in the lookup table tblLkSandPositionCode. Refer to Table 17-5-3 for a list of values.

L_NS_TK Corrected net sand thickness of the Lissie Formation, individual lithologic unit, feet.

W_T_D Willis Formation top depth in units of feet below ground surface.

W_B_D Willis Formation bottom depth in units of feet below ground surface.

W_FM Relationship of the lithologic top and bottom to Willis Formation top and bottom. These field values are listed in the lookup table tblLkSandPositionCode. Refer to Table 17-5-3 for a list of values.

W_NS_TK Corrected net sand thickness of the Willis Formation, per individual lithologic unit, in units of feet.

UG_T_D Upper Goliad Formation top depth in units of feet below ground surface.

UG_B_D Upper Goliad Formation bottom depth in units of feet below ground surface.

UG_FM Relationship of the lithologic top and bottom to Upper Goliad Formation top and bottom. These field values are listed in the lookup table tblLkSandPositionCode. Refer to Table 17-5-3 for a list of values.

UG_NS_TK Corrected net sand thickness of the Upper Goliad Formation, per individual lithologic unit, in units of feet.

LG_T_D Lower Goliad Formation top depth in units of feet below ground surface.

LG_B_D Lower Goliad Formation bottom depth in units of feet below ground surface.

LG_NS_TK Corrected net sand thickness of the Lower Goliad Formation, per individual lithologic unit, in units of feet.

LG_FM Relationship of the lithologic top and bottom to Lower Goliad Formation top and bottom. These field values are listed in the lookup table tblLkSandPositionCode. Refer to Table 17-5-3 for a list of values.

UL_T_D Upper Lagarto Formation top depth in units of feet below ground surface.

UL_B_D Upper Lagarto Formation bottom depth in units of feet below ground surface.

UL_FM Relationship of the lithologic top and bottom to Upper Lagarto Formation top and bottom. These field values are listed in the lookup table tblLkSandPositionCode. Refer to Table 17-5-3 for a list of values.

UL_NS_TK Corrected net sand thickness of the Upper Lagarto Formation, per individual lithologic unit, in units of feet.

ML_T_D Middle Lagarto Formation top depth in units of feet below ground surface.

ML_B_D Middle Lagarto Formation bottom depth in units of feet below ground surface.

ML_FM Relationship of the lithologic top and bottom to Middle Lagarto Formation top and bottom. These field values are listed in the lookup table tblLkSandPositionCode. Refer to Table 17-5-3 for a list of values.

ML_NS_TK Corrected net sand thickness of the Middle Lagarto Formation, per individual lithologic unit, in units of feet.

LL_T_D Lower Lagarto Formation top depth in units of feet below ground surface.

LL_B_D Lower Lagarto Formation bottom depth in units of feet below ground surface.

LL_FM Relationship of the lithologic top and bottom to Lower Lagarto Formation top and bottom. These field values are listed in the lookup table tblLkSandPositionCode. Refer to Table 17-5-3 for a list of values.

LL_NS_TK Corrected net sand thickness of the Lower Lagarto Formation, per individual lithologic unit, in units of feet.

OK_T_D Oakville Formation top depth in units of feet below ground surface.

OK_B_D Oakville Formation bottom depth in units of feet below ground surface.

OK_FM Relationship of the lithologic top and bottom to Oakville Formation top and bottom. These field values are listed in the lookup table tblLkSandPositionCode. Refer to Table 17-5-3 for a list of values.

OK_NS_TK Corrected net sand thickness of the Oakville Formation, per individual lithologic unit, in units of feet.

18. Appendix C: Paleocene to Eocene Aquifer Projects

The tables in this appendix were developed for the following Texas Water Development Board BRACS projects:

Meyer, J.E., 2013, Wilcox and Carrizo Aquifers, Central Texas: Structure and brackish groundwater: Texas Water Development Board, Open-File Report, *in progress.*

Wise, M.R., 2013, Queen City and Sparta Aquifers, Atascosa and McMullen Counties: Structure and brackish groundwater: Texas Water Development Board, Open-File Report, *in progress.*

18.1 Aquifer Determination Table: tblAquiferDetermination_PaleoceneEocene_sTx

This table contains information on which aquifer(s) may be used or penetrated by a well in the project area. Although aquifer codes have been assigned to wells in the TWDB Groundwater Database, it was determined that a systematic assessment of every well in the project area using the 3-dimensional formation top and bottom surfaces with available well screen and well depth data would provide a more accurate and uniform aquifer assignment. Using the new aquifer codes, wells with water quality data could be compared to wells using the same aquifer.

Every well within the limits of the project area that is in the TWDB BRACS Database and the Groundwater Database was appended to a holding table. This information was imported and geo-referenced in a geographic information system (GIS). The top and bottom of each formation of interest was determined at each well location and the values were written to the holding table.

Values for the shallowest and deepest screen depths, well depths, and total depth of hole were obtained from TWDB BRACS and Groundwater Database tables. A series of stored queries in Microsoft® Access® was used to determine if a well screen intersected a particular formation. A well may be screened in one or more aquifers. If well screen information was not available, well depth or total depth of hole were used to determine potential aquifers that were penetrated. The procedures used to process all of this information are documented in a TWDB work process document.

A value of -99999 is written to elevation and depth fields if data are unknown.

Table 18-1-1. tblAquiferDetermination_ PaleoceneEocene_sTx field names, data type and size, and lookup table references.

Field Name	Data Type	Size	Lookup Table
WELL_ID	Long Integer	4	
STATE_WELL_NUMBER	Long Integer	4	
REGION	Long Integer	4	
AQUIFER_CODE	Text	8	tblLkAquifer
AQUIFER_NEW	Text	150	tblLkBRACS_Aquifer_AD
O_G_WELL_AQ_PENETRATED	Text	50	
AQ_REASON	Text	10	
AQ_DECISION	Text	100	tblLkAq_Decision
DEPTH_WELL	Long Integer	4	
DEPTH_TOTAL	Long Integer	4	
SCREEN_TOP	Long Integer	4	
SCREEN_BOTTOM	Long Integer	4	

Field Name	Data Type	Size	Lookup Table
MULTIPLE_SCREENS	Yes/No	1	
WELL_TOP	Long Integer	4	
WELL_BOT	Long Integer	4	
WELL_CD	Text	1	tblLkWell_cd
GC_AQUIFER	Yes/No	1	
F_AQUIFER	Yes/No	1	
J_T_D	Long Integer	4	
J_B_D	Long Integer	4	
J_AQUIFER	Yes/No	1	
Y_T_D	Long Integer	4	
Y_B_D	Long Integer	4	
Y_AQUIFER	Yes/No	1	
CM_T_D	Long Integer	4	
CM_B_D	Long Integer	4	
CM_AQUIFER	Yes/No	1	
SP_T_D	Long Integer	4	
SP_B_D	Long Integer	4	
SP_AQUIFER	Yes/No	1	
W_T_D	Long Integer	4	
W_B_D	Long Integer	4	
W_AQUIFER	Yes/No	1	
QC_T_D	Long Integer	4	
QC_B_D	Long Integer	4	
QC_AQUIFER	Yes/No	1	
R_T_D	Long Integer	4	
R_B_D	Long Integer	4	
R_AQUIFER	Yes/No	1	
CZ_T_D	Long Integer	4	
CZ_B_D	Long Integer	4	
CZ_AQUIFER	Yes/No	1	
WX_T_D	Long Integer	4	
WX_B_D	Long Integer	4	
WX_AQUIFER	Yes/No	1	
MD_T_D	Long Integer	4	
MD_B_D	Long Integer	4	
LATDD	Double	8	
LONGDD	Double	8	
ELEVATION	Long Integer	4	
OWNER	Text	100	
INITIALS	Text	3	tblLkIntial
REMARKS	Text	250	
INS_ID	Long Integer	4	

Field Descriptions

STATE_WELL_NUMBER This field contains the state well number assigned to each water well in the TWDB Groundwater Database. A value of zero (0) is assigned if the state well number has not been assigned to this well.

WELL_ID Each record in the database is assigned a unique well ID (which is a long integer) in this table. A value of zero (0) is assigned if the well ID has not been assigned to this well.

REGION This field contains an integer value representing a sub-region of the South Texas project area that has similar stratigraphic relationships. The regions are bounded by the outcrops of the formations. The following table shows the stratigraphy of the project area.

Table 18-1-2. Stratigraphic relationships within the different regions of the project area. Yellow cells represent aquifers, and green cells are not aquifers.

System	Region 1	Region 2	Region 3	Region 4	Region 5	Region 6
Oligocene						
Eocene						Sparta
					Weches	Weches
				Queen City	Queen City	Queen City
			Reklaw	Reklaw	Reklaw	Reklaw
		Carrizo	Carrizo	Carrizo	Carrizo	Carrizo
Paleocene	Wilcox	Wilcox	Wilcox	Wilcox	Wilcox	Wilcox
	Midway	Midway	Midway	Midway	Midway	Midway

System	Region 7	Region 8	Region 9	Region 10	Region 11
Oligocene					Gulf Coast Fms
				Frio	Frio
Eocene			Jackson	Jackson	Jackson
		Yegua	Yegua	Yegua	Yegua
	Cook Mountain	Cook Mountain	Cook Mountain	Cook Mountain	Cook Mountain
	Sparta	Sparta	Sparta	Sparta	Sparta
	Weches	Weches	Weches	Weches	Weches
	Queen City	Queen City	Queen City	Queen City	Queen City
	Reklaw	Reklaw	Reklaw	Reklaw	Reklaw
	Carrizo	Carrizo	Carrizo	Carrizo	Carrizo
Paleocene	Wilcox	Wilcox	Wilcox	Wilcox	Wilcox
	Midway	Midway	Midway	Midway	Midway

AQUIFER_CODE This field contains an aquifer code that has been assigned to every water well in the TWDB Groundwater Database. These field values are listed in the lookup table tblLkAquifer, derived from a similar lookup table in the Groundwater Database.

AQUIFER_NEW This field contains a code for the new aquifer assignment. These field values are listed in the lookup table tblLkBRACSAquifer_AD. This table was created because not all of these aquifer combinations are available in the Groundwater Database aquifer code table.

O_G_WELL_AQ_PENETRATED If well was drilled for oil or gas, list the deepest Tertiary aquifer penetrated by drilling (Jackson through Wilcox).

AQ_REASON This field contains a code based on the query used to assign a value to the [aquifer_new] field. The default value of zero (0) is used if the queries did not assign a value. This field is primarily used for internal quality control to ensure the stored queries are operating accurately.

AQ_DECISION This field contains a value of how the aquifer was determined. These field values are listed in the lookup table tblLkAq_Decision.

Table 18-1-3. Aquifer decision codes used in the BRACS.

AQ_DECISION
Computer analysis of Well Screen (depth) and Aquifer Surfaces (GIS)
Geologist Best Professional Judgment of available information. See remarks for more information
No Decision Made. Not enough information available

DEPTH_WELL The total depth of the well in units of feet below ground surface. This is reported on the water well driller report. A value of -99999 is used if the value is not known.

This value was obtained from the BRACS Database for wells with a BRACS well ID or the TWDB Groundwater Database with a state well number.

DEPTH_TOTAL The total depth of the hole in units of feet below ground surface. This is reported on the water well driller report or header page on a geophysical well log. A value of -99999 is used if the value is not known.

This value was obtained from the BRACS Database for wells with a BRACS well ID.

SCREEN_TOP This field represents the top of the screened interval in units of feet below ground surface. For multiple screen wells, it represents the shallowest depth. A value of -99999 is used if the value is not known.

This value was obtained from the BRACS Database for wells with a BRACS well ID or the TWDB Groundwater Database with a state well number.

SCREEN_BOTTOM This field represents the bottom of the screened interval in units of feet below ground surface. For multiple screen wells, it represents the deepest depth. A value of -99999 is used if the value is not known.

This value was obtained from the BRACS Database for wells with a BRACS well ID or the TWDB Groundwater Database with a state well number.

MULTIPLE_SCREENS This field contains a Yes or No value if a well has multiple well screens. Wells with multiple screens were manually checked for aquifer code assignment.

WELL_TOP Top of the open interval for the well. If well screen data are used, this is the top depth of the shallowest screen. If well depth or total depth are used, this value is 0. Units are in feet.

WELL_BOT Bottom of the open interval for the well. If well screen data are used, this is the bottom depth of the deepest screen. If well screen data are not available, then either well depth or total depth are used. Units are in feet.

WELL_CD This code is assigned to each well record based on the type of data used to compare well construction to formation top and bottom depths. These field values are listed in the lookup table tblLkWell_cd. The precedence of data used for well construction is screen top and bottom, total depth of well, and total depth of hole.

Table 18-1-4. Well codes assigned in aquifer determination analysis.

WELL_CD	WELL_CD_DESC
S	Shallowest screen top, deepest screen bottom depths used for aquifer determination analysis
T	Total hole depth used for aquifer determination analysis
W	Well depth used for aquifer determination analysis
X	Not applicable

GC_AQUIFER This field contains a value of Yes or No based on whether the Gulf Coast aquifer is used by the well.

F_AQUIFER This field contains a value of Yes or No based on whether the Frio aquifer is used by the well.

J_T_D Jackson Group top depth in units of feet below ground surface.

J_B_D Jackson Group bottom depth in units of feet below ground surface.

J_AQUIFER This field contains a value of Yes or No based on whether the Jackson Aquifer is used by the well.

Y_T_D Yegua Formation top depth in units of feet below ground surface.

Y_B_D Yegua Formation bottom depth in units of feet below ground surface.

Y_AQUIFER This field contains a value of Yes or No based on whether the Yegua Aquifer is used by the well.

CM_T_D Cook Mountain Formation top depth in units of feet below ground surface.

CM_B_D Cook Mountain Formation bottom depth in units of feet below ground surface.

CM_AQUIFER This field contains a value of Yes or No based on whether the Cook Mountain is used by the well.

SP_T_D Sparta Formation top depth in units of feet below ground surface.

SP_B_D Sparta Formation bottom depth in units of feet below ground surface.

SP_AQUIFER This field contains a value of Yes or No based on whether the Sparta Aquifer is used by the well.

W_T_D Weches Formation top depth in units of feet below ground surface.

W_B_D Weches Formation bottom depth in units of feet below ground surface.

W_AQUIFER This field contains a value of Yes or No based on whether the Weches is used by the well.

QC_T_D Queen City Formation top depth in units of feet below ground surface.

QC_B_D Queen City Formation bottom depth in units of feet below ground surface.

QC_AQUIFER This field contains a value of Yes or No based on whether the Queen City Aquifer is used by the well.

R_T_D Reklaw Formation top depth in units of feet below ground surface.

R_B_D Reklaw Formation bottom depth in units of feet below ground surface.

R_AQUIFER This field contains a value of Yes or No based on whether the Reklaw is used by the well.

CZ_T_D Carrizo Formation top depth in units of feet below ground surface.

CZ_B_D Carrizo Formation bottom depth in units of feet below ground surface.

CZ_AQUIFER This field contains a value of Yes or No based on whether the Carrizo Aquifer is used by the well.

WX_T_D Wilcox Group top depth in units of feet below ground surface.

WX_B_D Wilcox Group bottom depth in units of feet below ground surface.

WX_AQUIFER This field contains a value of Yes or No based on whether the Wilcox Aquifer is used by the well.

MD_T_D Midway Group top depth in units of feet below ground surface.

MD_B_D Midway Group bottom depth in units of feet below ground surface.

LATDD Latitude of the well site in units of decimal degrees. Latitude is a positive value, referring to a site north of the earth's equator. Latitude and longitude coordinates are obtained from multiple sources. Latitude is obtained is based on a North American Datum of 1983. This value was obtained from the well location table.

LONGDD Longitude of the well site in units of decimal degrees. Longitude is a negative value, referring to a site west of the Prime Meridian in Greenwich, United Kingdom. Latitude and longitude coordinates are obtained from multiple sources. Longitude is based on a North American Datum of 1983. This value was obtained from the well location table.

ELEVATION The elevation of the well site in units of feet above mean sea level. The elevation is determined using spatial analysis in a geographic information system by comparing the well site with the 30-meter digital elevation model for Texas. This value was obtained from the well location table. A value of -99999 is used if the value is not known.

OWNER The name of the well owner. This value was obtained from the well location table.

INITIALS Initials of staff member who last edited the well site record.

REMARKS General remarks associated with the well record.

INS_ID Unique ID assigned to each record to ensure the data from well records processed in GIS are precisely assigned to the corresponding database record.

18.2 **Stratigraphic Table for GIS Import**

This table is created from information residing in the primary tables including well location, well geology, and foreign key. Well records are appended to this table and processed using a number of stored queries in Microsoft® Access®. The purpose of this table is to take this processed information into a geographic information system (GIS) to display stratigraphic depths and elevations spatially and form the foundation for creating 3-dimensional geologic surfaces and contour maps.

Note: Formation depths have been adjusted for kelly bushing height, if known or applicable.

Formation elevations have been calculated using formation depths (adjusted for kelly bushing height, if known or applicable) and well site elevation.

A value of -99999 is written to elevation and depth fields if data are unknown.

Table 18-2-1. gBRACS_ST_SpQc field names, data type and size, and lookup table references. This table supports the project by Wise, 2013.

Name	Type	Size	Lookup Table	Source Table
Well_ID	Long Integer	4		tblWell_Location
WELL_TYPE	Text	50	tblLkWellType	
API_NUMBER	Text	12		tblBracs_ForeignKey
SW_NUM	Long Integer	4		
TRACK_NUM	Long Integer	4		
Q_NUM	Text	16		
SOURCE_WELL_DATA	Text	250	tblLkSourceWellData	tblWell_Location
ELEVATION	Long Integer	4		
KELLY_BUSHING_HEIGHT	Integer	2		
DEPTH_TOTAL	Long Integer	4		
DEPTH_WELL	Long Integer	4		
LATDD	Double	8		
LONGDD	Double	8		
AGENCY	Text	5	tblLkAgency	
COUNTY_NAME	Text	13		
CM_T_D	Long Integer	4		tblWell_Geology (Note: these fields are adjusted for kelly bushing height)
CM_B_D	Long Integer	4		
CM_TK	Long Integer	4		
CM_GT	Text	1		
CM_T_E	Long Integer	4		
CM_B_E	Long Integer	4		
SP_T_D	Long Integer	4		
SP_B_D	Long Integer	4		
SP_TK	Long Integer	4		
SP_GT	Text	1		
SP_T_E	Long Integer	4		
SP_B_E	Long Integer	4		
W_T_D	Long Integer	4		
W_B_D	Long Integer	4		
W_TK	Long Integer	4		
W_GT	Text	1		
W_T_E	Long Integer	4		
W_B_E	Long Integer	4		

Name	Type	Size	Lookup Table	Source Table
QC_T_D	Long Integer	4		tblWell_Geology (Note: these fields are adjusted for kelly bushing height)
QC_B_D	Long Integer	4		
QC_TK	Long Integer	4		
QC_GT	Text	1		
QC_T_E	Long Integer	4		
QC_B_E	Long Integer	4		
R_T_D	Long Integer	4		
R_B_D	Long Integer	4		
R_TK	Long Integer	4		
R_GT	Text	1		
R_T_E	Long Integer	4		
R_B_E	Long Integer	4		

Table 18-2-2. gBRACS_ST_PE_sTx field names, data type and size, and lookup table references. This table supports the project by Meyer, 2013.

Name	Type	Size	Lookup Table	Source Table
Well_ID	Long Integer	4		tblWell_Location
WELL_TYPE	Text	50	tblLkWellType	
API_NUMBER	Text	12		tblBracs_ForeignKey
SW_NUM	Long Integer	4		
TRACK_NUM	Long Integer	4		
Q_NUM	Text	16		
SOURCE_WELL_DATA	Text	250	tblLkSourceWellData	tblWell_Location
ELEVATION	Long Integer	4		
KELLY_BUSHING_HEIGHT	Integer	2		
DEPTH_TOTAL	Long Integer	4		
DEPTH_WELL	Long Integer	4		
LATDD	Double	8		
LONGDD	Double	8		
AGENCY	Text	5	tblLkAgency	
COUNTY_NAME	Text	13		
J_T_D	Long Integer	4		tblWell_Geology (Note: these fields are adjusted for kelly bushing height)
J_B_D	Long Integer	4		
J_TK	Long Integer	4		
J_GT	Text	1		
J_T_E	Long Integer	4		
J_B_E	Long Integer	4		
Y_T_D	Long Integer	4		
Y_B_D	Long Integer	4		
Y_TK	Long Integer	4		
Y_GT	Text	1		
Y_T_E	Long Integer	4		
Y_B_E	Long Integer	4		
CM_T_D	Long Integer	4		
CM_B_D	Long Integer	4		
CM_TK	Long Integer	4		
CM_GT	Text	1		
CM_T_E	Long Integer	4		
CM_B_E	Long Integer	4		
SP_T_D	Long Integer	4		
SP_B_D	Long Integer	4		

Name	Type	Size	Lookup Table	Source Table
SP_TK	Long Integer	4		tblWell_Geology (Note: these fields are adjusted for kelly bushing height)
SP_GT	Text	1		
SP_T_E	Long Integer	4		
SP_B_E	Long Integer	4		
W_T_D	Long Integer	4		
W_B_D	Long Integer	4		
W_TK	Long Integer	4		
W_GT	Text	1		
W_T_E	Long Integer	4		
W_B_E	Long Integer	4		
QC_T_D	Long Integer	4		
QC_B_D	Long Integer	4		
QC_TK	Long Integer	4		
QC_GT	Text	1		
QC_T_E	Long Integer	4		
QC_B_E	Long Integer	4		
R_T_D	Long Integer	4		
R_B_D	Long Integer	4		
R_TK	Long Integer	4		
R_GT	Text	1		
R_T_E	Long Integer	4		
R_B_E	Long Integer	4		
CZ_T_D	Long Integer	4		
CZ_B_D	Long Integer	4		
CZ_TK	Long Integer	4		
CZ_GT	Text	1		
CZ_T_E	Long Integer	4		
CZ_B_E	Long Integer	4		
WX_T_D	Long Integer	4		
WX_B_D	Long Integer	4		
WX_TK	Long Integer	4		
WX_GT	Text	1		
WX_T_E	Long Integer	4		
WX_B_E	Long Integer	4		

Field Descriptions

WELL_ID Each record in the database is assigned a unique well ID (which is a long integer) in this table. This is the key field in this table.

WELL_TYPE The type of well and when the well was drilled and completed. These terms are the same as the lookup table in the TWDB Groundwater Database (Rein and Hopkins, 2008). These field values are listed in the lookup table tblLkWellType.

API_NUM The API number of the well, assigned to oil and gas wells.

SW_NUM The state well number of the well, assigned to wells in the TWDB Groundwater Database.

TRACK_NUM The track number of the well, assigned to wells in the Texas Department of Licensing and Regulation Submitted Driller Report Database.

WS_NUM The water source code, assigned to wells in the Texas Commission on Environmental Quality public water system program.

Q_NUM The Q number assigned to wells in the Texas Commission on Environmental Quality surface casing program.

SOURCE_WELL_DATA Each well record is assigned the source of the well information. In some cases multiple sources exist; in this case, the source of the geophysical well log or water well driller report takes precedence. These field values are listed in the lookup table tblLkSourceWellData.

ELEVATION The elevation of the well site in units of feet above mean sea level. The elevation is determined using spatial analysis in a geographic information system by comparing the well site with the 30-meter digital elevation model for Texas.

KELLY_BUSHING_HEIGHT The height of the drilling rig kelly bushing used as a measuring point for all subsequent logging. The units are in feet above ground surface. This value is stored as an integer. The term is synonymous with rig floor, derrick floor, rotary table, drive bushing, and KB. This value is recorded on the geophysical well log header either as a unique value or a value that must be calculated from the values of elevation of the ground surface and elevation of the kelly bushing.

The default value for this field is zero (0).

DEPTH_TOTAL The total depth of the hole in units of feet below ground surface. This is reported on the water well driller report or header page on a geophysical well log. A value of -99999 is used if the value is not known.

DEPTH_WELL The total depth of the well in units of feet below ground surface. This is reported on the water well driller report. A value of -99999 is used if the value is not known.

LATDD Latitude of the well site in units of decimal degrees. Latitude is a positive value, referring to a site north of the earth's equator. Latitude and longitude coordinates are obtained from multiple sources. Latitude is obtained is based on a North American Datum of 1983.

LONGDD Longitude of the well site in units of decimal degrees. Longitude is a negative value, referring to a site west of the Prime Meridian in Greenwich, United Kingdom. Latitude and longitude coordinates are obtained from multiple sources. Longitude is based on a North American Datum of 1983.

AGENCY The agency that collected the latitude and longitude coordinates of the well site. These field values are listed in the lookup table tblLkAgency.

J_T_D Jackson Group top depth in units of feet below ground surface.

J_B_D Jackson Group bottom depth in units of feet below ground surface.

J_TK Jackson Group thickness in units of feet.

J_GT Greater than symbol (>) represents well only partially penetrates Jackson Group.

J_T_E Jackson Group top elevation in units of feet above mean sea level.

J_B_E Jackson Group bottom elevation in units of feet above mean sea level.

Y_T_D Yegua Formation top depth in units of feet below ground surface.

Y_B_D Yegua Formation bottom depth in units of feet below ground surface.

Y_TK Yegua Formation thickness in units of feet.

Y_GT Greater than symbol (>) represents well only partially penetrates Yegua Formation.

Y_T_E Yegua Formation top elevation in units of feet above mean sea level.

Y_B_E Yegua Formation bottom elevation in units of feet above mean sea level.

CM_T_D Cook Mountain Formation top depth in units of feet below ground surface.

CM_B_D Cook Mountain Formation bottom depth in units of feet below ground surface.

CM_TK Cook Mountain Formation thickness in units of feet.

CM_GT Greater than symbol (>) represents well only partially penetrates Cook Mountain Formation.

CM_T_E Cook Mountain Formation top elevation in units of feet above mean sea level.

CM_B_E Cook Mountain Formation bottom elevation in units of feet above mean sea level.

SP_T_D Sparta Formation top depth in units of feet below ground surface.

SP_B_D Sparta Formation bottom depth in units of feet below ground surface.

SP_TK Sparta Formation thickness in units of feet.

SP_GT Greater than symbol (>) represents well only partially penetrates Sparta Formation.

SP_T_E Sparta Formation top elevation in units of feet above mean sea level.

SP_B_E Sparta Formation bottom elevation in units of feet above mean sea level.

W_T_D Weches Formation top depth in units of feet below ground surface.

W_B_D Weches Formation bottom depth in units of feet below ground surface.

W_TK Weches Formation thickness in units of feet.

W_GT Greater than symbol (>) represents well only partially penetrates Weches Formation.

W_T_E Weches Formation top elevation in units of feet above mean sea level.

W_B_E Weches Formation bottom elevation in units of feet above mean sea level.

QC_T_D Queen City Formation top depth in units of feet below ground surface.

QC_B_D Queen City Formation bottom depth in units of feet below ground surface.

QC_TK Queen City Formation thickness in units of feet.

QC_GT Greater than symbol (>) represents well only partially penetrates Queen City Formation.

QC_T_E Queen City Formation top elevation in units of feet above mean sea level.

QC_B_E Queen City Formation bottom elevation in units of feet above mean sea level.

R_T_D Reklaw Formation top depth in units of feet below ground surface.

R_B_D Reklaw Formation bottom depth in units of feet below ground surface.

R_TK Reklaw Formation thickness in units of feet.

R_GT Greater than symbol (>) represents well only partially penetrates Reklaw Formation.

R_T_E Reklaw Formation top elevation in units of feet above mean sea level.

R_B_E Reklaw Formation bottom elevation in units of feet above mean sea level.

CZ_T_D Carrizo Formation top depth in units of feet below ground surface.

CZ_B_D Carrizo Formation bottom depth in units of feet below ground surface.

CZ_TK Carrizo Formation thickness in units of feet.

CZ_GT Greater than symbol (>) represents well only partially penetrates Carrizo Formation.

CZ_T_E Carrizo Formation top elevation in units of feet above mean sea level.

CZ_B_E Carrizo Formation bottom elevation in units of feet above mean sea level.

WX_T_D Wilcox Group top depth in units of feet below ground surface.

WX_B_D Wilcox Group bottom depth in units of feet below ground surface.

WX_TK Wilcox Group thickness in units of feet.

WX_GT Greater than symbol (>) represents well only partially penetrates Wilcox Group.

WX_T_E Wilcox Group top elevation in units of feet above mean sea level.

WX_B_E Wilcox Group bottom elevation in units of feet above mean sea level.

18.3 **Master Water Quality Table**

The same data design was used for two projects evaluating Paleocene to Eocene aquifers in South Texas. Table names for the two projects are

tblBracs_QcSp_MasterWaterQuality for the Sparta and Queen City aquifers

tblBracs_PE_sTx_MasterWaterQuality for the Wilcox and Carrizo aquifers

The master water quality table contains every water quality record in the project area organized with one record per well per date sampled with constituents in separate fields. This design greatly simplifies the creation of GIS datasets, for without data residing in one table, data must be processed from 4 tables.

The majority of field descriptions were obtained from the Groundwater Database Data Dictionary spreadsheet available on the TWDB website.

Table 18-3-1. tblBracs_xxx_MasterWaterQuality (where xxx = QcSp or PE_sTx) field names, data type and size, and lookup table references.

Field Name	Data Type	Size	Lookup Table
STATE_WELL_NUMBER	Long Integer	4	
WELL_ID	Long Integer	4	
mm_date	Integer	2	
dd_date	Integer	2	
yy_date	Integer	2	
sample_number	Integer	2	
SOURCE_DATA	Text	200	
TDS_RANGE	Text	255	
TDS_RNG_NUM	Integer	2	
sample_time	Text	4	
temp_centigrade	Decimal	16	
top_s_interval	Integer	2	
bottom_s_interval	Integer	2	
samp_int_aqcode	Text	8	
collection_remarks	Text	30	
reliability_rem	Text	2	
collecting_agency	Text	2	
lab_code	Text	2	
bu_wqanalysis	Text	1	
q00955_flag	Text	1	
q00955_silica_mgl	Decimal	16	
q00910_flag	Text	1	
q00910_calcium_mgl	Decimal	16	
q00920_flag	Text	1	
q00920_magnes_mgl	Decimal	16	
q00929_flag	Text	1	
q00929_sodium_mgl	Decimal	16	

Field Name	Data Type	Size	Lookup Table
q00937_flag	Text	1	
q00937_potass_mgl	Decimal	16	
q01080_flag	Text	1	
q01080_strontium	Decimal	16	
q00445_carb_mgl	Decimal	16	
q00440_bicarb_mgl	Decimal	16	
q00945_flag	Text	1	
q00945_sulfate_mgl	Decimal	16	
q00940_flag	Text	1	
q00940_chloride_mg	Decimal	16	
q00951_flag	Text	1	
q00951_fluoride_mg	Decimal	16	
q71850_flag	Text	1	
q71850_nitrate_mgl	Decimal	16	
q00403_flag	Text	1	
q00403_ph	Decimal	16	
q70300_tds	Long Integer	4	
q00415_flag	Text	1	
q00415_phen_alk	Decimal	16	
q00410_flag	Text	1	
q00410_total_alk	Decimal	16	
q00900_tot_hardnes	Long Integer	4	
q00932_percent_na	Integer	2	
q00931_sar	Decimal	16	
q71860_rsc	Decimal	16	
q00095_flag	Text	1	
q00095_spec_cond	Long Integer	4	
bu_value	Decimal	16	
IRON_FLAG	Text	1	
IRON	Double	8	
MANGANESE_FLAG	Text	1	
MANGANESE	Double	8	
CT	Double	8	
SULFATE_PERCENTAGE	Decimal	16	
BICARBONATE_PERCENTAGE	Decimal	16	
Na_PERCENTAGE_CATIONS	Integer	2	
date_entered	Date/Time	8	
user_name	Text	8	
REMARKS	Text	250	
AQUIFER_NEW	Text	50	

Field Descriptions

STATE_WELL_NUMBER This field contains the state well number assigned to each water well in the TWDB Groundwater Database.

WELL_ID Each record in the database is assigned a unique well ID (which is a long integer) in this table. This is the key field in this table.

mm_date This is the second key field for this table. This field contains an integer for the month the sample was collected. If the month is unknown, a zero (0) is required.

dd_date This is the third key field for this table. This field contains an integer for the day the sample was collected. If the day is unknown, a zero (0) is required.

yy_date Fourth key field for the table. This field contains an integer for the year the sample was collected. The year must have four characters. If the year is unknown, enter zero (0).

sample_number Fifth key field for the table. This is an integer for a sample number, since more than one sample may be taken on the same day. It consists of an integer beginning with one for the first record of a well and increases by a value of one for each new record.

SOURCE_DATA This field contains a reference to the source of the information; for example, the report number and table or page number.

TDS_RANGE This field contains a value representing the range of total dissolved solids content to be used for GIS analysis of brackish groundwater resources. The ranges include values, in milligrams per liter, of 0 – 999; 1000 – 2999; 3000 – 9999; and > 10000.

TDS_RNG_NUM This field contains an integer value representing the range of total dissolved solids content to be used for GIS analysis of brackish groundwater resources in Texas. The ranges include values, in milligrams per liter, of 1 = 0 – 999; 2 = 1000 – 2999; 3 = 3000 – 9999; and 4 = > 10000.

sample_time This field contains the time the sample was collected using four digits in the format of a 24-hour time period (for example, 8:45 a.m. is 0845; 4:21 p.m. is 1621).

temp_centigrade Temperature of water sample in Celsius (field measurement).

top_s_interval Top interval of formation where sample was collected in units of feet below ground surface (only for multiple completion wells).

bottom_s_interval Bottom interval of formation where sample was collected in units of feet below ground surface (only for multiple completion wells).

samp_int_aqcode Aquifer code for the sampled interval (only for multiple completion wells).

collection_remarks Remarks about the sample collected.

reliability_rem Indicates the process used to collect the sample.

collecting_agency Identifies the entity that collected the sample.

lab_code Identifies the lab used to analyze the sample.

bu_wqanalysis Indicates whether the analysis of the sample is Balanced (B) or Unbalanced (U).

q00955_flag Used to identify constituent concentrations below the lab's detection limits.

q00955_silica_mgl Silica in mg/L.

q00910_flag Used to identify constituent concentrations below the lab's detection limits.

q00910_calcium_mgl Calcium, dissolved in mg/L.

q00920_flag Used to identify constituent concentrations below the lab's detection limits.

q00920_magnes_mgl Magnesium, dissolved in mg/L.

q00929_flag Used to identify constituent concentrations below the lab's detection limits.

q00929_sodium_mgl Sodium, dissolved in mg/L.

q00937_flag Used to identify constituent concentrations below the lab's detection limits.

q00937_potass_mgl Potassium, dissolved in mg/L.

q01080_flag Used to identify constituent concentrations below the lab's detection limits.

q01080_strontium Strontium in mg/L.

q00445_carb_mgl Carbonate in mg/L.

q00440_bicarb_mgl Bicarbonate in mg/L.

q00945_flag Used to identify constituent concentrations below the lab's detection limits.

q00945_sulfate_mgl Sulfate, dissolved in mg/L.

q00940_flag Used to identify constituent concentrations below the lab's detection limits.

q00940_chloride_mg Chloride, dissolved in mg/L.

q00951_flag Used to identify constituent concentrations below the lab's detection limits.

q00951_fluoride_mg Fluoride, dissolved in mg/L.

q71850_flag Used to identify constituent concentrations below the lab's detection limits.

q71850_nitrate_mgl Nitrate nitrogen, dissolved in mg/L.

q00403_flag Used to identify constituent concentrations below the lab's detection limits.

q00403_ph pH, standard units (field measurement).

q70300_tds Solids dissolved sum of constituents.

q00415_flag Used to identify constituent concentrations below the lab's detection limits.

q00415_phen_alk Phenol alkalinity.

q00410_flag Used to identify constituent concentrations below the lab's detection limits.

q00410_total_alk Total alkalinity, dissolved (analyzed in lab).

q00900_tot_hardnes Total hardness.

q00932_percent_na Percent sodium.

q00931_sar Sodium absorption ratio.

q71860_rsc Residual sodium carbonate.

q00095_flag Used to identify constituent concentrations below the lab's detection limits.

q00095_spec_cond Specific conductance umhos/cm @ 25C (field measurement).

bu_value Value of the balance/unbalanced equation.

IRON_FLAG Used to identify constituent concentrations below the lab's detection limits.

IRON Dissolved iron in mg/L with a storet code of 01045.

MANGANESE_FLAG Used to identify constituent concentrations below lab detection limits.

MANGANESE Dissolved manganese in mg/L with a storet code of 01055.

CT Total Dissolved Solids / Specific Conductance. Used for resistivity analysis from geophysical well logs.

SULFATE_PERCENTAGE (sulfate / total dissolved solids) * 100. Used for resistivity analysis using geophysical well logs.

BICARBONATE_PERCENTAGE (bicarbonate / total dissolved solids) * 100. Used for resistivity analysis using geophysical well logs.

Na_PERCENTAGE_CATIONS (Sodium / (Sodium + Calcium + Magnesium + Potassium)) * 100. Used for resistivity analysis using geophysical well logs.

date_entered This field contains the date the record was last edited.

user_name This field contains the reference to the staff member who last edited the record.

REMARKS General remarks about an analysis.

AQUIFER_NEW Field containing code for the new aquifer assignment. These field values are listed in the lookup table tblLkBRACSAquifer_AD. The table was created because not all aquifer combinations are available in the Groundwater Database aquifer code table.

18.4 Net Sand Table: tblWell_Geology_NetSand_PaleoceneEocene_sTx

This table is created from information residing in the well geology, simplified lithologic name lookup, and aquifer determination tables. Well records are appended to a holding table (tblWell_Geology_ProcessingNetSand_ PaleoceneEocene_sTx_Temp; see table description) for extensive processing using a number of stored queries in Microsoft® Access®. Once the processing is completed, the information is summarized with one record per well. The purpose of this table is to take this geologic information into a geographic information system (GIS) to display net sand and sand percent data spatially and create point and contour maps.

Table 18-4-1. tblWell_Geology_NetSand_ PaleoceneEocene_sTx field names, data type and size, and lookup table references.

Field Name	Date Type	Size	Lookup Table
WELL_ID	Long Integer	4	
J_PRESENT	Yes/No	1	
J_PARTIAL_PEN	Yes/No	1	
J_PARTIAL_GEODESC	Yes/No	1	
J_NET_SAND	Long Integer	4	
J_SAND_PERCENT	Long Integer	4	
J_TK	Long Integer	4	
Y_PRESENT	Yes/No	1	
Y_PARTIAL_PEN	Yes/No	1	
Y_PARTIAL_GEODESC	Yes/No	1	
Y_NET_SAND	Long Integer	4	
Y_SAND_PERCENT	Long Integer	4	
Y_TK	Long Integer	4	
CM_PRESENT	Yes/No	1	
CM_PARTIAL_PEN	Yes/No	1	
CM_PARTIAL_GEODESC	Yes/No	1	
CM_NET_SAND	Long Integer	4	
CM_SAND_PERCENT	Long Integer	4	
CM_TK	Long Integer	4	
SP_PRESENT	Yes/No	1	
SP_PARTIAL_PEN	Yes/No	1	
SP_PARTIAL_GEODESC	Yes/No	1	
SP_NET_SAND	Long Integer	4	
SP_SAND_PERCENT	Long Integer	4	
SP_TK	Long Integer	4	
W_PRESENT	Yes/No	1	
W_PARTIAL_PEN	Yes/No	1	
W_PARTIAL_GEODESC	Yes/No	1	
W_NET_SAND	Long Integer	4	
W_SAND_PERCENT	Long Integer	4	
W_TK	Long Integer	4	
QC_PRESENT	Yes/No	1	
QC_PARTIAL_PEN	Yes/No	1	
QC_PARTIAL_GEODESC	Yes/No	1	
QC_NET_SAND	Long Integer	4	
QC_SAND_PERCENT	Long Integer	4	

Field Name	Date Type	Size	Lookup Table
QC_TK	Long Integer	4	
R_PRESENT	Yes/No	1	
R_PARTIAL_PEN	Yes/No	1	
R_PARTIAL_GEODESC	Yes/No	1	
R_NET_SAND	Long Integer	4	
R_SAND_PERCENT	Long Integer	4	
R_TK	Long Integer	4	
CZ_PRESENT	Yes/No	1	
CZ_PARTIAL_PEN	Yes/No	1	
CZ_PARTIAL_GEODESC	Yes/No	1	
CZ_NET_SAND	Long Integer	4	
CZ_SAND_PERCENT	Long Integer	4	
CZ_TK	Long Integer	4	
WX_PRESENT	Yes/No	1	
WX_PARTIAL_PEN	Yes/No	1	
WX_PARTIAL_GEODESC	Yes/No	1	
WX_NET_SAND	Long Integer	4	
WX_SAND_PERCENT	Long Integer	4	
WX_TK	Long Integer	4	

Field Descriptions

WELL_ID Each record in the database is assigned a unique well ID (which is a long integer) in this table. This is the key field in this table.

J_PRESENT This field contains a value of Yes or No if the Jackson Group is present in this well.

J_PARTIAL_PEN This field contains a value of Yes or No if the Jackson Group is only partially penetrated by this well.

J_PARTIAL_GEODESC Field containing a value of Yes or No if the geologic description is for less than 100 percent of the Jackson Group. This can occur if the upper part of the formation is cased, or if the geologic log for the lower part is not available.

J_NET_SAND This field contains an integer representing the total thickness of sand within the Jackson Group, in units of feet.

J_SAND_PERCENT The percent of sand within the Jackson Group, calculated field: [J_NET_SAND] / [J_TK] * 100.

J_TK Jackson Group thickness, calculated field: [depth_bottom] – [depth_top]. The units are feet.

Y_PRESENT Field containing a value of Yes or No if the Yegua Formation is present in the well.

Y_PARTIAL_PEN This field contains a value of Yes or No if the Yegua Formation is only partially penetrated by this well.

Y_PARTIAL_GEODESC This field contains a value of Yes or No if the geologic description is for less than 100 percent of the Yegua Formation. This can occur if the upper part of the formation is cased, or if the geologic log for the lower part of the formation is not available.

Y_NET_SAND This field contains an integer representing the total thickness of sand within the Yegua Formation, in units of feet.

Y_SAND_PERCENT The percent of sand within the Yegua Formation, calculated field [Y_NET_SAND] / [Y_TK] * 100.

Y_TK Yegua Formation thickness, calculated field: [depth_bottom] – [depth_top]. The units are feet.

CM_PRESENT This field contains a value of Yes or No if the Cook Mountain Formation is present in this well.

CM_PARTIAL_PEN This field contains a value of Yes or No if the Cook Mountain Formation is only partially penetrated by this well.

CM_PARTIAL_GEODESC This field contains a value of Yes or No if the geologic description is for less than 100 percent of the Cook Mountain Formation. This can occur if the upper part of the formation is cased, or if the geologic log for the lower part of the formation is not available.

CM_NET_SAND This field contains an integer representing the total thickness of sand within the Cook Mountain Formation, in units of feet.

CM_SAND_PERCENT The percent of sand within the Cook Mountain Formation, calculated field [CM_NET_SAND] / [CM_TK] * 100.

CM_TK Cook Mountain Formation thickness, calculated field: [depth_bottom] – [depth_top]. The units are feet.

SP_PRESENT This field contains a value of Yes or No if the Sparta Formation is present in this well.

SP_PARTIAL_PEN This field contains a value of Yes or No if the Sparta Formation is only partially penetrated by this well.

SP_PARTIAL_GEODESC This field contains a value of Yes or No if the geologic description is for less than 100 percent of the Sparta Formation. This can occur if the upper part of the formation is cased, or if the geologic log for the lower part of the formation is not available.

SP_NET_SAND This field contains an integer representing the total thickness of sand within the Sparta Formation, in units of feet.

SP_SAND_PERCENT The percent of sand within the Sparta Formation, calculated field [SP_NET_SAND] / [SP_TK] * 100.

SP_TK Sparta Formation thickness, calculated field: [depth_bottom] – [depth_top]. The units are feet.

W_PRESENT This field contains a value of Yes or No if the Weches Formation is present in this well.

W_PARTIAL_PEN This field contains a value of Yes or No if the Weches Formation is only partially penetrated by this well.

W_PARTIAL_GEODESC This field contains a value of Yes or No if the geologic description is for less than 100 percent of the Weches Formation. This can occur if the upper part of the formation is cased, or if the geologic log for the lower part of the formation is not available.

W_NET_SAND This field contains an integer representing the total thickness of sand within the Weches Formation, in units of feet.

W_SAND_PERCENT The percent of sand within the Weches Formation, calculated field [W_NET_SAND] / [W_TK] * 100.

W_TK Weches Formation thickness, calculated field: [depth_bottom] – [depth_top]. The units are feet.

QC_PRESENT This field contains a value of Yes or No if the Queen City Formation is present in this well.

QC_PARTIAL_PEN This field contains a value of Yes or No if the Queen City Formation is only partially penetrated by this well.

QC_PARTIAL_GEODESC This field contains a value of Yes or No if the geologic description is for less than 100 percent of the Queen City Formation. This can occur if the upper part of the formation is cased, or if the geologic log for the lower part of the formation is not available.

QC_NET_SAND This field contains an integer representing the total thickness of sand within the Queen City Formation, in units of feet.

QC_SAND_PERCENT The percent of sand within the Queen City Formation, calculated field [QC_NET_SAND] / [QC_TK] * 100.

QC_TK Queen City Formation thickness, calculated field: [depth_bottom] – [depth_top]. The units are feet.

R_PRESENT Field containing a value of Yes or No if Reklaw Formation is present in the well.

R_PARTIAL_PEN This field contains a value of Yes or No if the Reklaw Formation is only partially penetrated by this well.

R_PARTIAL_GEODESC This field contains a value of Yes or No if the geologic description is for less than 100 percent of the Reklaw Formation. This can occur if the upper part of the formation is cased, or if the geologic log for the lower part of the formation is not available.

R_NET_SAND This field contains an integer representing the total thickness of sand within the Reklaw Formation, in units of feet.

R_SAND_PERCENT The percent of sand within the Reklaw Formation, calculated field [R_NET_SAND] / [R_TK] * 100.

R_TK Reklaw Formation thickness, calculated field: [depth_bottom] – [depth_top]. The units are feet.

CZ_PRESENT This field contains a value of Yes or No if the Carrizo Formation is present in this well.

CZ_PARTIAL_PEN This field contains a value of Yes or No if the Carrizo Formation is only partially penetrated by this well.

CZ_PARTIAL_GEODESC This field contains a value of Yes or No if the geologic description is for less than 100 percent of the Carrizo Formation. This can occur if the upper part of the formation is cased, or if the geologic log for the lower part of the formation is not available.

CZ_NET_SAND This field contains an integer representing the total thickness of sand within the Carrizo Formation, in units of feet.

CZ_SAND_PERCENT The percent of sand within the Carrizo Formation, calculated field [CZ_NET_SAND] / [CZ_TK] * 100.

CZ_TK Carrizo Formation thickness, calculated field: [depth_bottom] – [depth_top]. The units are feet.

WX_PRESENT This field contains a value of Yes or No if the Wilcox Group is present in this well.

WX_PARTIAL_PEN This field contains a value of Yes or No if the Wilcox Group is only partially penetrated by this well.

WX_PARTIAL_GEODESC This field contains a value of Yes or No if the geologic description is for less than 100 percent of the Wilcox Group. This can occur if the upper part of the formation is cased, or if the geologic log for the lower part of the formation is not available.

WX_NET_SAND This field contains an integer representing the total thickness of sand within the Wilcox Group, in units of feet.

WX_SAND_PERCENT The percent of sand within the Wilcox Group, calculated field [WX_NET_SAND] / [WX_TK] * 100.

WX_TK Wilcox Group thickness, calculated field: [depth_bottom] – [depth_top]. The units are feet.

18.5 Net Sand Analysis Table: tblWell_Geology_NetSand_PaleoceneEocene_sTx_Temp

This table is created from information residing in the well geology, simplified lithologic name lookup, and aquifer determination tables. Well records are appended to this table if the lithologic description for any record associated with a well contains reference to sand or gravel. These records are then processed using a number of stored queries in Microsoft® Access® and loaded into the table tblWell_Geology_NetSand. Once the processing is completed, the information is summarized with one record per well.

The value of maintaining this table is that special sand maps can be developed; for example, maximum sand unit thickness per formation, number of sands units greater than some value (50 feet) per formation, number of and cumulative thickness of sands within a specific depth range, and so on.

Table 18-5-1. tblWell_Geology_NetSand_PaleoceneEocene_sTx_Temp field names, data type and size, and lookup table references.

Field Name	Data Type	Size	Lookup Table
WELL_ID	Long Integer	4	
RECORD_NUMBER	Integer	2	
SOURCE_GEOLOGIC_DATA	Text	50	tblLkSourceGeologicData
LITHOLOGIC_NAME	Text	100	
SIMPLIFIED_LITHOLOGIC_NAME	Text	100	tblLkSimplified_Lithologic_Name
SAND_PERCENT	Decimal	16	
DEPTH_TOP	Single	4	
DEPTH_BOTTOM	Single	4	
THICKNESS	Single	4	
J_T_D	Long Integer	4	
J_B_D	Long Integer	4	
J_FM	Text	10	tblLkSandPositionCode
J_NS_TK	Integer	2	
Y_T_D	Long Integer	4	
Y_B_D	Long Integer	4	
Y_FM	Text	10	tblLkSandPositionCode
Y_NS_TK	Integer	2	
CM_T_D	Long Integer	4	
CM_B_D	Long Integer	4	
CM_FM	Text	10	tblLkSandPositionCode
CM_NS_TK	Integer	2	
SP_T_D	Long Integer	4	

Field Name	Data Type	Size	Lookup Table
SP_B_D	Long Integer	4	
SP_FM	Text	10	tblLkSandPositionCode
SP_NS_TK	Integer	2	
W_T_D	Long Integer	4	
W_B_D	Long Integer	4	
W_FM	Text	10	tblLkSandPositionCode
W_NS_TK	Integer	2	
QC_T_D	Long Integer	4	
QC_B_D	Long Integer	4	
QC_FM	Text	10	tblLkSandPositionCode
QC_NS_TK	Integer	2	
R_T_D	Long Integer	4	
R_B_D	Long Integer	4	
R_FM	Text	10	tblLkSandPositionCode
R_NS_TK	Integer	2	
CZ_T_D	Long Integer	4	
CZ_B_D	Long Integer	4	
CZ_FM	Text	10	tblLkSandPositionCode
CZ_NS_TK	Integer	2	
WX_T_D	Long Integer	4	
WX_B_D	Long Integer	4	
WX_FM	Text	10	tblLkSandPositionCode
WX_NS_TK	Integer	2	

Field Descriptions

WELL_ID Each record in the database is assigned a unique well ID (which is a long integer) in this table. This is the key field in this table.

RECORD_NUMBER This is the second key field in this table. This number is not assigned as an autonumber field, as in the usual case for a key field. The value is an integer, beginning with 1 and increasing with the addition of each record. The integer order allows the records to be displayed in a form in the order of increasing depth from the surface. Because several different types of information (lithology, stratigraphy, hydrogeologic units) can be appended to this table, it is important to complete the append process for a group of records at one time before appending records of a different geologic pick type. This will ensure records of different types can be ordered appropriately. If a new record must be appended and the order modified, the record number can be edited (with an autonumber data type this is impossible), although care must be taken to not duplicate an existing record number in this endeavor.

SOURCE_GEOLOGIC_DATA The source of the geologic data appended into the table. These field values are listed in the lookup table tblLkSourceGeologicData. This table will continue to grow with time.

Table 18-5-2. Codes used in the source_geologic_data field.

SOURCE_GEOLOGIC_DATA	SOURCE_GEOLOGIC_DATA_DESCRIPTION
CORE	Geologist Interpretation of Core Samples
GEOPHYSICAL WELL LOG	Geologist Interpretation of Geophysical Log
MISCELLANEOUS	Geophysical logs, well reports, scout tickets, cross-sections, …
OIL / GAS WELL LOG	Geologist Interpretation of Well Cuttings (MUD Log)
PUBLISHED REPORT	Geologic description, published report, source unknown
UNKNOWN	UNKNOWN
WATER WELL LOG, DRILLER	Well Driller Interpretation of Lithology from Drill Cuttings
WATER WELL LOG, GEOLOGIST	Geologist Interpretation of Lithology from Drill Cuttings

LITHOLOGIC_NAME This field contains the lithologic description assigned to each range of depths (from depth_top to depth_bottom) as the well was drilled. The most common source for these data is the state water well report or records in published or unpublished reports. The information is copied verbatim, except in cases where obvious typographical errors have been made. The term caliche is often misspelled, and this term has been standardized when records have been appended manually.

A tremendous amount of information has come from digital water well reports from the Texas Department of Licensing and Regulation Submitted Driller Report Database. The records in that database are appended as a memo field. These data are parsed into separate fields by TWDB staff before being appended into this table.

SIMPLIFIED_LITHOLOGIC_NAME This field contains a simplified version of the lithologic description so additional automated processing can be accomplished. For example, a unit consisting of sand may be written in over 250 different forms on water well reports.

The lookup table tblLkLithologicName_to_SimplifiedLithologicName was created to relate the two fields. A query was written to automatically update this simplified_lithologic_name field from the lithologic_name field using values in the lookup table. The lookup table will grow with time as new records are appended to the table.

SAND_PERCENT The percent sand associated with this record. This value is associated with the definition of each record in the lookup table tblLkSimplified_Lithologic_Name.

DEPTH_TOP This field contains the depth to the top of the unit (referred to by the geologic pick field) in the units of feet below ground surface. The value is always a positive integer. This field is corrected for kelly bushing height.

DEPTH_BOTTOM This field contains the depth to the bottom of the unit (referred to by the geologic pick field) in the units of feet below ground surface. The value is always a positive integer. This field is corrected for kelly bushing height.

THICKNESS This is a calculated field: [depth_bottom] – [depth_top]. The units are feet.

J_T_D Jackson Group top depth in units of feet below ground surface.

J_B_D Jackson Group bottom depth in units of feet below ground surface.

J_FM Relationship of the lithologic top and bottom to Jackson Group top and bottom. These field values are listed in the lookup table tblLkSandPositionCode.

Table 18-5-3. Codes used in the tblLkSandPositionCode field.

SAND_POSITION_CODE	CODE_DESCRIPTION
W	Sand is completely within formation
ST	Sand straddles top of formation
SB	Sand straddles bottom of formation
SS	Sand straddles top and bottom of formation
X	Sand not in formation

J_NS_TK Corrected net sand thickness of the Jackson Group, per individual lithologic unit, in units of feet.

Y_T_D Yegua Formation top depth in units of feet below ground surface.

Y_B_D Yegua Formation bottom depth in units of feet below ground surface.

Y_FM Relationship of the lithologic top and bottom to Yegua Formation top and bottom. These field values are listed in the lookup table tblLkSandPositionCode. Refer to Table 18-5-3 for a list of values.

Y_NS_TK Corrected net sand thickness of the Yegua Formation, per individual lithologic unit, in units of feet.

CM_T_D Cook Mountain Formation top depth in units of feet below ground surface.

CM_B_D Cook Mountain Formation bottom depth in units of feet below ground surface.

CM_FM Relationship of the lithologic top and bottom to Cook Mountain Formation top and bottom. These field values are listed in the lookup table tblLkSandPositionCode. Refer to Table 18-5-3 for a list of values.

CM_NS_TK Corrected net sand thickness of the Cook Mountain Formation, per individual lithologic unit, in units of feet.

SP_T_D Sparta Formation top depth in units of feet below ground surface.

SP_B_D Sparta Formation bottom depth in units of feet below ground surface.

SP_FM Relationship of the lithologic top and bottom to Sparta Formation top and bottom. These field values are listed in the lookup table tblLkSandPositionCode. Refer to Table 18-5-3 for a list of values.

SP_NS_TK Corrected net sand thickness of the Sparta Formation, per individual lithologic unit, in units of feet.

W_T_D Willis Formation top depth in units of feet below ground surface.

W_B_D Willis Formation bottom depth in units of feet below ground surface.

W_FM Relationship of the lithologic top and bottom to Willis Formation top and bottom. These field values are listed in the lookup table tblLkSandPositionCode. Refer to Table 18-5-3 for a list of values.

W_NS_TK Corrected net sand thickness of the Willis Formation, per individual lithologic unit, in units of feet.

QC_T_D Queen City Formation top depth in units of feet below ground surface.

QC_B_D Queen City Formation bottom depth in units of feet below ground surface.

QC_FM Relationship of the lithologic top and bottom to Queen City Formation top and bottom. These field values are listed in the lookup table tblLkSandPositionCode. Refer to Table 18-5-3 for a list of values.

QC_NS_TK Corrected net sand thickness of the Queen City Formation, per individual lithologic unit, in units of feet.

R_T_D Reklaw Formation top depth in units of feet below ground surface.

R_B_D Reklaw Formation bottom depth in units of feet below ground surface.

R_FM Relationship of the lithologic top and bottom to Reklaw Formation top and bottom. These field values are listed in the lookup table tblLkSandPositionCode. Refer to Table 18-5-3 for a list of values.

R_NS_TK Corrected net sand thickness of the Reklaw Formation, per individual lithologic unit, in units of feet.

CZ_T_D Carrizo Formation top depth in units of feet below ground surface.

CZ_B_D Carrizo Formation bottom depth in units of feet below ground surface.

CZ_FM Relationship of the lithologic top and bottom to Carrizo Formation top and bottom. These field values are listed in the lookup table tblLkSandPositionCode. Refer to Table 18-5-3 for a list of values.

CZ_NS_TK Corrected net sand thickness of the Carrizo Formation, per individual lithologic unit, in units of feet.

WX_T_D Wilcox Group top depth in units of feet below ground surface.

WX_B_D Wilcox Group bottom depth in units of feet below ground surface.

WX_FM Relationship of the lithologic top and bottom to Wilcox Group top and bottom. These field values are listed in the lookup table tblLkSandPositionCode. Refer to Table 18-5-3 for a list of values.

WX_NS_TK Corrected net sand thickness of the Wilcox Group, per individual lithologic unit, in units of feet.