Geologic Evaluation of the Safford Basin for Carbon Dioxide Sequestration Potential

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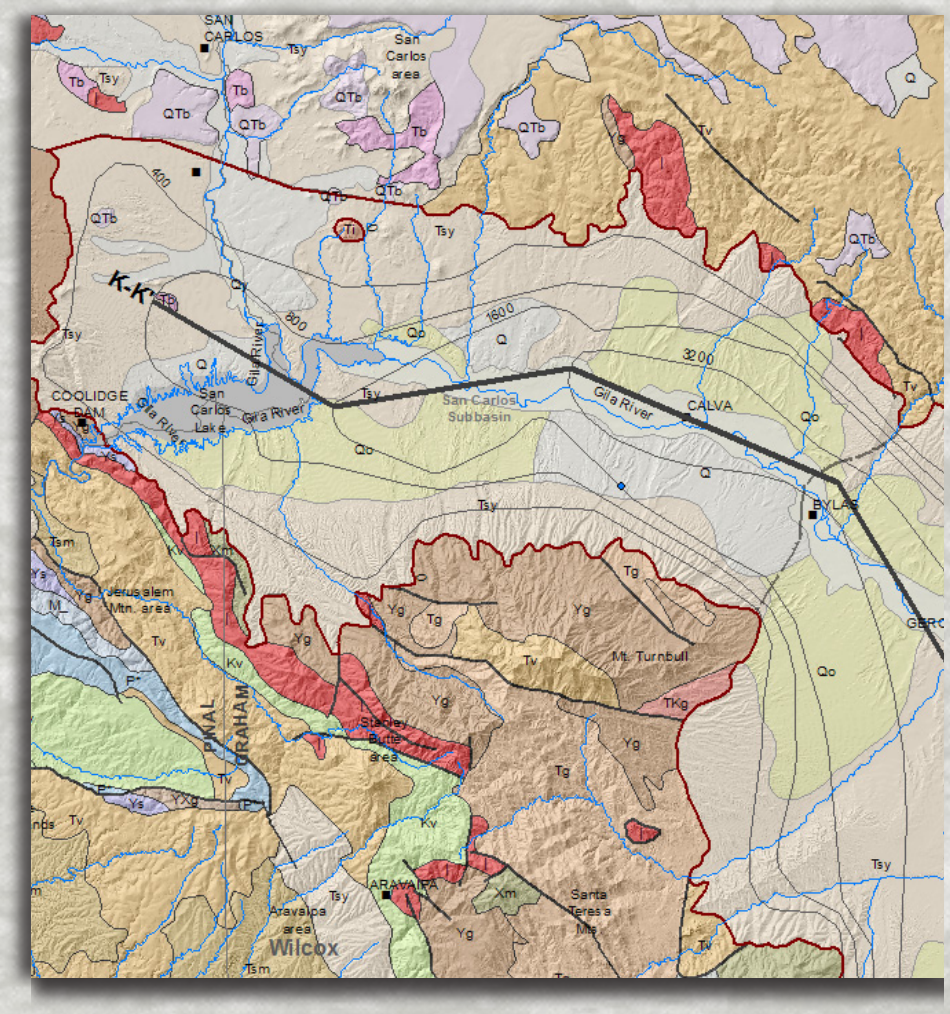

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ACRONYMS

ADEQ	Arizona Department of Environmental Quality
ADWR	Arizona Department of Water Resources
AZGS	Arizona Geological Survey
bls	below land surface
CCS	carbon dioxide capture and storage
CO2	carbon dioxide
DOE	U.S. Department of Energy
EPA	Environmental Protection Agency
ft	feet
GIS	Geographic Information System
GWSI	Groundwater Site Inventory
HGUID	hydrogeologic unit ID
km	kilometer
LBF	lower-basin fill
m	meter
mg/L	milligrams per liter
Ma	million years ago
mi	miles
NWIS	National Water Information System
OGCC	Oil and Gas Conservation Commission
STORET	STOrage and RETrieval
TD	total depth
TDS	total dissolved solids
UBF	upper basin-fill
USGS	U.S. Geological Survey
WATSTORE	Water Data Storage and Retrieval System
WESTCARB	West Coast Regional Carbon Sequestration Partnership

1.0 Introduction

The U.S. Department of Energy (DOE), through its National Energy Technology Laboratory, established a national program to evaluate the feasibility of separating carbon dioxide (CO_2) from industrial sources and pumping it underground for long-term storage or disposal. This program was established in response to concerns that CO_2 emissions from fossil-fuel combustion, and from other industrial processes such as cement production from limestone, are increasing atmospheric CO_2 concentration and solar-energy absorption, thereby causing global warming. Carbon dioxide removal from industrial sources and storage in geologic reservoirs is known as "geologic sequestration." A major aspect of the DOE program is to evaluate subsurface geology to determine the potential of underground rock formations for long-term CO_2 sequestration.

The West Coast Regional Carbon Sequestration Partnership (WESTCARB) is a consortium of seven western U.S. States and one Canadian Province that is one of seven regional North American partnerships established to evaluate technical aspects of high-volume CO_2 capture and sequestration. Collaborative WESTCARB research programs have included more than 90 public agencies, private companies, and non-profit organizations. The Arizona Geological Survey began work in 2010 on *WESTCARB Phase III – Arizona Geological Characterization*. This report represents an initial WESTCARB assessment of CO_2 storage potential in the first of ten identified Cenozoic basins in Arizona (Spencer, 2011), the Safford basin, and is part of Tasks 2 and 3 of Arizona WESTCARB Phase III (California Energy Commission Agreement Number 500-10-024).

As part of an initial assessment of each potential subsurface region with potential for CO_2 sequestration, the following goals and objectives are included in this study of the Safford basin:

1. Identify and delineate the subsurface region to be considered for CO_2 storage evaluation (Spencer, 2011).
2. Refine the depth-to-bedrock map and provide simplified subsurface structural and stratigraphic information based on available reports, borehole data, and geologic maps.
3. Compile and characterize available geologic data which shall include but not be limited to physical and chemical properties of basin units pertinent to CO_2 sequestration (ex. Lithology, depth, structure, stratigraphy, porosity, permeability, salinity, temperature, etc.).
4. Collect data similar to that of target formations on the presence or absence of impermeable seals (cap rocks).
5. If sufficient data and data types are available, analyze and estimate the geologic CO_2 storage capacity in accordance with DOE's 2008 Methodology for Development of Geologic Storage Estimates for Carbon Dioxide.
6. Determine if, and at what depth, salinities approach 10,000 milligrams per liter total dissolved solids (TDS), in the Tertiary basins and deep Paleozoic formations with potential CO_2 storage capacity. This concentration is the upper limit for an "underground source of drinking water" as defined by 40 Code of Federal Regulation Chapter 1, part 144.3.
7. Prepare and submit Geographic Information System (GIS) layers, screened for storage potential, in accordance with the National Carbon Sequestration Database and Geographic Information System guidelines.

The Safford basin is a deep, sediment-filled structural half-graben within the Basin and Range province in southeastern Arizona. The Safford basin has the largest volume of basin-filling sediments compared to all 88 Cenozoic sedimentary basins identified in Arizona, as well as the largest inferred volume of sedimentary basin fill below 800 meters (m) depth (Spencer, 2011). Four subbasins delineated by bedrock geometry are San Carlos, Bear Springs, 111 Ranch, and San Simon, collectively referred to herein as the Safford basin (Figure 23). Basin-fill sediments in the Safford basin have a total estimated volume of 5,157 cubic kilometers (km^3), of which 2,296 km^3 (45%) lies beneath the 800-m depth below land surface (bls) (Spencer, 2011). The Safford basin is approximately 250 km in length (155 miles [mi]) between Coolidge Dam near San Carlos, Arizona, on the basin's northwest margin to the border with New Mexico on its southeast margin (Figure 23). The uppermost extent of basin-fill sediments in New Mexico are considered negligible and not included in this evaluation. The Hayes, Santa Teresa, Pinaleño, and Chiricahua mountains border the southwestern margin of the Safford basin, and are composed predominantly of Precambrian to mid-Tertiary bedrock. The northeastern margin of the Safford basin is bound by predominantly mid-Tertiary volcanic rocks in the Gila, Whitlock and Peloncillo mountains. The Gila and San Simon rivers occupy the basin floors, where the Gila River is the main through-flowing drainage in the basin.

The Safford basin was initially formed by low-angle normal faulting associated with extension and uplift of metamorphic core complexes between approximately 30 and 20 million years ago (Ma) (Spencer and Reynolds, 1989; Long et al., 1995). After this time, Basin and Range high-angle normal faulting on the southwest side of the basin cut or reactivated portions of the detachment fault, deepening the basin to as much as 3,600m (12,000 feet [ft]). This allowed thick accumulations of basin-fill sediment to collect along an extensive half-graben hinge, towards a basin axis located adjacent to an active fault zone. Basin-fill sediments consist of unconsolidated to moderately consolidated alluvial fan, playa and lacustrine (lake) deposits reflecting long periods in closed-basin conditions.

At least two basin-fill units have been recognized throughout the Safford basin: an upper basin-fill (UBF) and lower-basin fill (LBF). The UBF and LBF are separated by a shift in depositional environments, possibly associated with erosion of the LBF (Houser et al., 1985). The LBF represents the greatest volume of basin-fill sediments and is also the least understood, with scarce deep-well data. The LBF is interpreted to correlate to the mid- to late Miocene Midnight Canyon conglomerate and possible the lower part of the Sanchez beds (Houser et al., 1985). Facies of the LBF thicken and grade into playa and lacustrine deposits toward basin centers (Kruger et al., 1995). The UBF consists of an upper interval of Pliocene to early Pleistocene lacustrine and alluvial deposits referred to as the 111 Ranch beds, and a lower interval of alluvial and playa-dominated deposits known as the Sanchez beds. The lower part of the UBF and upper part of the LBF are not easily discernible in well or geophysical logs; however, the contact is more apparent in seismic-reflection profiles. Incision of the Gila and San Simon rivers and their tributaries into the uppermost portions of the UBF followed integration of the Gila River between the Duncan and San Pedro valleys during the early Pleistocene (Houser et al., 1985).

Most of the ~7,300 wells in the Safford basin extract water from Holocene alluvial deposits associated with the modern Gila-San Simon Rivers and were not studied in detail. Many previous studies have been directed at determining the origin and pathways of elevated saline groundwater in the

Safford basin. Other studies have focused on geothermal groundwater, often under artesian conditions, that is present in some basin areas. However, these studies are limited to shallow-well data far above the 800 m minimum depth for CO_2 sequestration. Nonetheless, these studies have some bearing on the origin of saline groundwater as it relates to the basin-fill units.

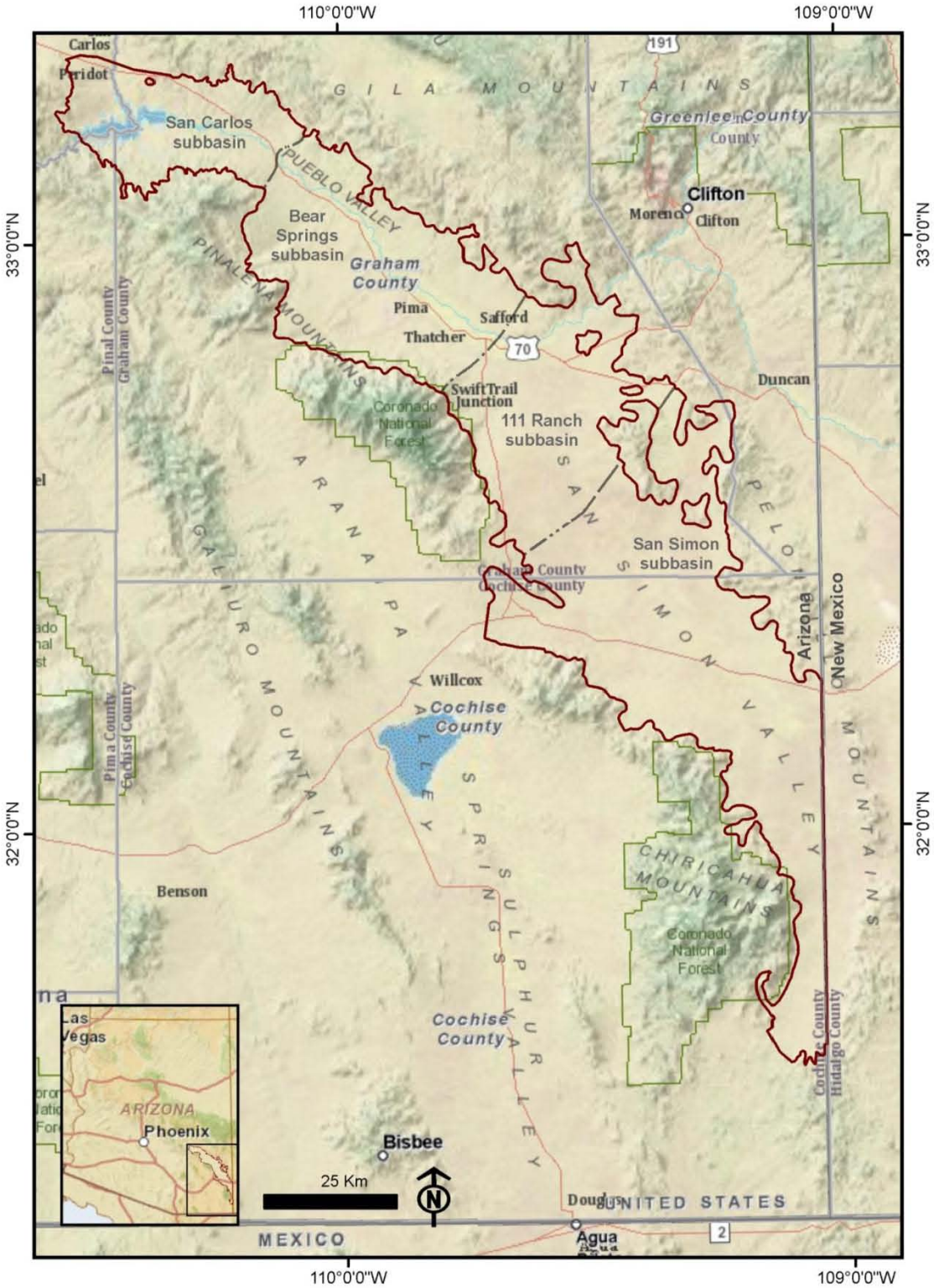

Figure 23. Regional map of the Safford basin in southeastern Arizona. State outline and major highways are shown in the index map at bottom left, with the Safford basin highlighted in blue. The Safford basin (outlined in red) includes structural subbasins San Carlos, Bear Springs, 111 Ranch, and San Simon delineated by dash-dotted lines.

2.0 Approach and Methods

The DOE National Energy Technology Laboratory and Regional Carbon Sequestration Partnerships has developed methodologies for characterizing CO_2 sequestration potential in major geological systems, in particular saline formations for which this study is focused on (DOE, 2010). The methods outlined herein are intended to collect, analyze and interpret data which meet basic criteria for characterizing a potential for carbon dioxide capture and storage (CCS) in saline aquifers. Although basalt is being considered for future opportunities in CCS, and basalt is likely present at greater depths interlayered and underlying basin fill units in the Safford basin (Wrucke et al., 2004; Kruger and others, 1994 and 1995), basalt is not part of this characterization. Furthermore no attempt was made to establish criteria based on population vicinity or infrastructure as part of this assessment.

Initial screening of Cenozoic sedimentary basins in Arizona to meet basic criteria for CCS potential was performed by Spencer (2011), which included an assessment of sufficient storage potential in sedimentary formations below a minimum depth of 800 m bls. Although depths greater than 800 m generally lack sufficient data and are thus poorly understood, the potential for saline conditions and a low-permeability caprock or seal system, such as evaporites or clay bodies, warranted further consideration for basin selection and investigation. Spencer (2011) identified ten (10) Cenozoic sedimentary basins in Arizona which possibly meet such criteria and warrant further study. Methods of basin screening and volume calculations for basin selection were unique to Arizona's extensive interconnected basin fill deposits and are outlined by Spencer (2011). The Safford basin is one of the ten largest and deepest Cenozoic basins in Arizona.

Collection, compilation and quality assurance/quality control of well-log databases and relevant water-quality data were a major effort in this assessment. In addition, numerous published and unpublished previous works were screened for applicability, acquired, scanned to PDF and in many cases georeferenced into ArcMap project files by Arizona Geological Survey (AZGS) geologists Diane S. Love and Michael Mahan. These data sets were used to modify the existing depth-to-bedrock map (Richard et al., 2007) and build two- and three-dimensional datasets for constructing new geologic cross-sections and three-dimensional geologic models. Subsurface geologic data were incorporated into multiple cross-sections, which included well data, geophysical logs, existing cross-sections and seismic profiles. The cross-sections were used to analyze the spatial relationships between the data and each other in order to identify aspects of basin stratigraphy such as caprock or seal systems and physical/chemical characteristics of basin-fill sediments at target depths below 800 m depth.

Well data are the largest portion of subsurface data in the Safford basin; however, only eleven (11) wells out of approximately 7,300 (0.15%) extend below 800 m (2,625 ft). Well statistics are briefly discussed with regards to this study in the next section. Well data were thoroughly researched from a variety of sources, including Arizona Department of Water Resources (ADWR) 35- and 55-well databases, Arizona Oil and Gas Conservation Commission (OGCC) oil and gas well files, and various published reports (referred to as the Miscellaneous M-wells in this study) which also included non-permitted wells with no known well ID (Appendix A). ADWR and USGS GWSI databases were not known to contain any subsurface lithologic data not already obtained from the previously mentioned sources.

Because most wells are drilled in relatively shallow alluvial aquifers, wells were screened for this study to include wells below an arbitrary depth of 400 feet and greater. Wells were further screened for available lithologic and geologic descriptions per depth. Wells-35 data was previously tabulated for all statewide 35-wells by ADWR and these entries, including comments, were tabulated by staff at ADWR. Wells-55 driller log data existed as scanned logs only available online through ADWR Imaged Records database; these driller logs were downloaded during this study and lithology for each depth-interval were tabulated in an Excel spreadsheet (Appendix B) by AZGS staff geologist Michael Mahan. In some cases, especially with some oil and gas wells, geologic descriptions were too numerous or detailed to list and were summarized instead.

All well identifiers, well locations, and total depths were checked for quality assurance/quality control. Elevation of well tops were compiled and where elevations were not available the locations were extracted from the NED 10m digital elevation map raster data in meters and feet above mean sea level. The types of subsurface logs (drillers log, geophysical log, etc.) were compiled from various publications. All well data in this evaluation were compiled into a generalized well location table (Appendix A) and borehole log table (Appendix B).

Depth-to-bedrock for the Safford basin was modified after Richard et al. (2007) using lithology from well data. Bedrock at the base of the LBF unit was interpreted from seismic profiles (Kruger and Johnson, 1994, 1995; Kruger et al., 2000) but was too complicated to reconcile significant differences in depth-to-bedrock modeled from gravity with that of seismic. Differences between bedrock interpreted from seismic and modeled from gravity are instead shown in the geologic cross-sections, leaving the depth-to-bedrock map for the Safford basin from Richard et al. (2007) largely unchanged, with minor changes to the 400- and 800-foot contours toward the basin margin, increasing the volume of basin-fill sediments marginally. The volume of basin-fill sediments were estimated using the same methods in ArcMap as outlined by Spencer (2011).

Geologic map data from various publications were georeferenced in ArcMap primarily for transferring to the cross-sections. Quaternary active faults and concealed faults inferred from other studies were used in addition to the geologic map and projected into the cross-sections. Post-processed seismic profile lines were also georeferenced. The location of unpublished seismic reflection survey lines from Amoco-Phillips were acquired and georeferenced but not usable and therefore not displayed.

Stratigraphic correlation between wells in the Safford basin was not practical on a basin- or even subbasin scale from available data due to the variation of driller log quality and consistency, and the apparent complexity in lateral facies changes in basin-fill sediments. As a result, correlating horizons between wells was not practical for the Safford basin. In order to characterize the extent, thickness, and relationships between and within basin-fill units, creating individual cross-sections throughout the basin was a more practical approach and method. An ESRI ArcGIS tool kit developed by ESRI and Aquaveo called Arc Hydro Groundwater – Subsurface Analyst was used to aid in construction of cross-sections towards developing a generalized three-dimensional model of the Safford basin. In order to identify the vertical and lateral extent of basin-fill units, wells with lithologic data were assigned a “hydrogeologic unit ID” (HGUID) based on the following basin-fill stratigraphy adopted by previous authors (Houser et al., 1985; Houser, 1990) (Table 3).

Basin-Fill Unit	HGUID	Generalized description
Gila River alluvium	1	Alluvial and fluvial deposits derived from the modern Gila River drainage network.
Upper Basin Fill	2	Unconsolidated coarse and fine siliciclastics, evaporites, and limestone deposited in alluvial, fluvial, and lacustrine environments interpreted to have formed in a closed basin possibly from an ancestral Gila River. Bear Springs Wash and Sanchez Formations are included in this unit, which is generally undeformed. Age is Pliocene to early Pleistocene (5 to 2.3 Ma). Regional studies indicate an unconformable relationship with the underlying basin fill unit.
Lower Basin Fill	3	Semi-indurated and semi-consolidated coarse and fine siliciclastics, evaporites, and limestone deposited in proximal and distal alluvial fans and lacustrine environments. Also referred to as the Midnight Canyon Formation (Houser et al. 1985). Basalt flows may be interbedded in the lowermost portions of this unit at the downstream and upstream termini of the Safford basin. Age is interpreted to be late Miocene to Pliocene. More deformation is apparent in this basin-fill unit and is unconformable with underlying early Miocene volcanic rocks (bedrock) equivalent to rocks exposed in the Gila Mountains along the northeast margin of the Safford basin.
Bedrock	4	Proterozoic igneous and metamorphic rocks, Paleozoic sedimentary rocks and Cenozoic igneous rocks. Portions of the Cenozoic volcanic rocks may include andesite and basalt flows underlying the lower basin fill unit.

Table 3. Generalized geologic units assigned to wells with lithologic data.

Although it was possible to differentiate lithology types (sand, gypsum, lime) into lithologic groups or environments (alluvial, playa, lacustrine) in the lithology data base, this was avoided due the fact that only 11 of the 453 wells penetrated depths below 800 m. And although the lithology database can reveal lithology composition and spatial distribution of potential sealing conditions these data were not studied in detail as many wells are still far above sealing conditions near the 800 m bls boundary criteria for CO_2 storage. Because the upper and lower basin-fill units are associated with differing depositional environments and potentially favorable conditions for storing and sealing CO_2, this study set out to differentiate these two basin fill units only.

The locations of cross-sections in this study were chosen to capture the most comprehensive distinction and assessment of the basin-fill stratigraphy done to date based on seismic data by Kruger and Jonson (1994 and 1995) and Kruger et al. (2000). No previous works successfully differentiated upper and lower basin fill in the Safford basin based on available subsurface data; however, Mock (2008) interpolated the base of the basin fill units from Kruger et al. (1995) and extended these depths

throughout the San Carlos, Bear Springs, and 111 Ranch subbasins. Mock (2008) did not describe the methods of unit-boundary interpolation, and these interpolations were not incorporated into this study.

Kruger and others processed and interpreted a total of six (6) seismic reflection lines in the Safford basin. The resulting seismographs were extremely useful in capturing major inferred lithologic boundaries. In addition, variability in wave amplitudes is interpreted to represent lithologic heterogeneity of facies in basin fill units. For this reason these seismic profiles were georeferenced and constructed into geologic cross-sections first in the area of Safford (lines 1, 6, 3A, 3B and 4) and near the town of Ashurst (line 13). Lower and upper basin-fill units were delineated based on interpretations by Kruger and others.

New cross-section locations were created sequentially starting in the northwest portion of the Safford basin (Bear Springs subbasin) and southeast, up-basin (through the 111 Ranch Beds and San Simon subbasins) towards the upper portion of the Safford basin at the border with New Mexico. Cross-sections AA' through JJ' were constructed transverse to the long dimension of the basin to capture maximum depth-to-bedrock and wells of maximum depth and log quality. The San Carlos Subbasin at the northwest end of the Safford basin was excluded from any transverse cross-sections due to the relatively shallow depth-to-bedrock above 800 m depth and lack of subsurface data. A final cross-section K-K' was constructed along the axis of the maximum depth-to-bedrock primarily to reveal the lack of well data at maximum depths as determined from gravity data, and to capture basin-fill stratigraphy and structure interpreted from previous cross-sections. The basin-fill stratigraphy in the southernmost portion of the San Simon subbasin is relatively poorly constrained, and thus the contact between the UBF and LBF was projected from previous works to extend to the end of K'.

Research of salinity data was limited to wells greater than 800 m depth with any salinity value and wells of any depth with salinity greater than 10,000 milligrams per liter (mg/L) TDS. Salinity data were queried from electronic databases with ADWR-GWSI, Arizona Department of Environmental Quality (ADEQ), Environmental Protection Agency (EPA) STORET, and U.S. Geological Survey (USGS) WATSTORE/GWSI/NWIS. These and additional salinity data from a wide range of published reports encountered during this study were compiled by AZGS geologist Michael Mahan. Springs and seeps with salinity greater than 10,000 mg/L TDS were also collected in an attempt to identify any possible relationships between saline sources, springs, faults and basin-fill stratigraphy. Research such as baseline and isotopic studies conducted by previous researchers were also researched to discuss potential sources of elevated salinity conditions and possible connections with deep saline aquifers.

Conductance is directly related to TDS and is more commonly measured in the field; therefore, these values were compiled as well and converted into TDS (mg/L). Multiplication factors to convert conductance (micro-ohms/cm2) to TDS range from 0.55 to 0.75 milligrams per liter for natural waters (Hem, 1985), and a median value of 0.65 milligrams per liter was used if TDS has not been determined. Otherwise, studies limited to the study area which developed a relationship between conductance and ion species are used otherwise (for example, a factor of 0.59 was developed by Hem (1985) for the Gila River near Bylas, Arizona). For conductance in waters with 'very' high salinity approaching brine of 50,000 mg/L TDS, conductance may not be easily related to TDS unless the chemical characteristics are

well identified and thus conductance is more reliable as an indicator of TDS than calculated TDS (Hem, 1985).

Chloride concentrations were recorded in some deep oil and gas wells throughout Arizona during drilling; however, these values are considered unreliable indicators of ground-water salinity because of unknown factors during drilling and sample collection. These data are listed but should not be considered a reliable determination of salinity of groundwater.

3.0 Previous Works

No known previous works related to the evaluation of CO_2 sequestration potential exist for the Safford basin. Evaluation of deep-formation salinity in Cenozoic basins is poorly understood in Arizona, generally limited to shallow well data. However, much research in the Safford basin has focused on mostly groundwater chemistry related to groundwater use. The focus of many other works in the Safford basin includes geothermal, economic geology, geologic mapping, geophysical, hydrologic, paleontologic, stratigraphic and tectonic aspects.

Works cited throughout this report and listed in the references cited section. Other reports considered ancillary or supplemental are listed in the extended bibliography. Mock (2008) provided a useful summary of several regional, local-primary and local-secondary groups of studies conducted in the San Carlos-Safford portion of the Safford basin. Raymond Harris provided extensive bibliographic and map references pertaining to geologic mapping, geophysics, geothermal, salinity, water quality, and groundwater (Harris, 1996, 1997a, 1997b, 1998a, 1998b, 1999a, 1999b, 1999c, 2000a, 2000b and 2004).

Most published and unpublished works relevant to the geologic characterization of formations near and below 800 m depth in basin-fill units are derived from surficial geologic maps, well logs from oil and gas exploration, and seismic reflection profiles. The most recent surficial geologic mapping efforts which have contributed to the present understanding of deep basin-fill stratigraphy are works by Richter et al. (1983), Galusha et al (1984), Lindsay et el. (1987), Houser et al. (1985 and 2004), and Houser (1990). Richard et al. (2000 and 2007) provided the current depth-to-bedrock map and surficial geologic map used in this report. In the area of the San Carlos Indian Reservation Wrucke et al. (2004) provided surficial geology useful in correlating basin-fill units with adjacent subbasins. Oil and gas well data make up the bulk of subsurface physical data in the Safford basin. Well-log data, including geophysical logs, were collected from files stored at the AZ OGCC. Cuttings and core samples associated with many of these wells are part of the AZGS core repository (Spencer and Duncan, 1993); however, these were not examined for this study. Oil and gas records were also compiled in Johnson (1959), Koester et al. (1996) and Conley et al. (2005), with minor errors noted in Conley et al. (2005). Records are updated in Appendix A (Steve Rauzi, personal communication). Kruger and Johnson (1991, 1994, and 2001) and Kruger and others (1995) processed existing Amoco-Phillips seismic line data and contributed significant findings and interpretations into the tectonic and depositional history of the Safford basin and form the basis on many of the interpretations presented here of basin-fill structure and stratigraphy below 800 m depth. Regional work pertaining to geologic setting and geologic evolution of basins in southeastern Arizona include Spencer and Reynolds (1989), Freethey et al. (1986), Pearthree (1986), Anderson (1990 and 1995), Robertson (1991), and Spencer (2011).

Deep-formation salinity data throughout Arizona is scarce, especially below 800 m depth. Electronic databases from statewide and nationwide sources (ADEQ, ADWR-GWSI, USGS-NWIS, and Witcher, 1983) were queried for specific water-quality data related to salinity. Many reports which specifically address brackish and saline groundwater throughout the state are limited to upper aquifers above 800 m, and thus general saline conditions at shallow depths (Daniel, 1981; Errol Montgomery and Associates, 2008; McGavock and Cullom, 2008; Eden et al., 2011). Works discussion salt bodies throughout Arizona were done by Koester (1971), Peirce (1969 and 1981), Pay Dirt (1984), and Rauzi (2002).

In the Safford basin several studies have addressed concerns of increased salinity in shallow aquifers, and as a result have provided an additional source of salinity data, including salinity data above 10,000 mg/L TDS and/or below 800 m depth, not found in ADEQ, NWIS and ADWR GWSI data sets (Schwennesen and Forbes, 1919; Knechtel and Lohr, 1938; Turner, 1946; Hem, 1950; Weist, 1971; Muller et al., 1973; Barnes, 1991; Black, 1991; Wallin, 1998; Harris, 1997, 1999, 2000; ADEQ, 2004 and 2009; ADWR, 2009; and Towne, 2004 and 2009).

4.0 Well data

This section briefly discusses limitations of the use of well data for a CCS study in some Cenozoic sedimentary basins in Arizona. Because of these limitations, well data are used and interpreted in conjunction with other types of data such as seismic, gravity, etc. as with any basin analysis.

A total of 7,285 wells in the Safford basin were queried for subsurface geologic data from ADWR wells, Arizona OGCC wells, and wells with no apparent permitted numbers (miscellaneous wells) found in various publications (Chart 4). Wells with lithologic log data from drillers and geologists and wells with a minimum depth of 400 feet bls were the main criteria for well selection, resulting in 453 wells with lithology data below 400 feet depth for the Safford basin (Appendix A and B). Miscellaneous wells with no apparent well ID or duplicate data with permitted wells were found amongst a comprehensive bibliography and used in this study (a small number of wells in one publication [Harris, 1997], with total depth greater than 400 feet, but too shallow for this study, are not included in the data repository).

Of the 453 wells with lithology log data in the Safford basin, relatively few wells contained deep, high-quality log data (Chart 5). The analysis of well data reported here reveals the limitations of directly sampled basin-fill material for an ideal evaluation of CO_2 potential in a deep saline sedimentary basin. The majority of the lithologic logs are derived from driller logs with a wide range in log quality, of generally poor quality for subsurface evaluation. However, less than 20 wells with driller logs were used to define depth-to-bedrock along the basin margins in this study.

A total of eleven (11) wells were drilled greater than 800 m depth, originally for oil and gas and geothermal exploration (Appendix A). Log quality of the oil and gas wells range from poor to good, and most oil and gas wells have associated geophysical-log data (Chart 5). Most oil and gas wells have a geologic record of potential target formation(s) and cap rock or seal systems. Few oil and gas wells penetrated bedrock. Only three wells in the Safford basin identified TDS greater than 10,000 mg/L, and

only one well extending below 800 m was associated with a salinity value (Chart 5), precluding any meaningful analysis of salinity distribution in the Safford basin.

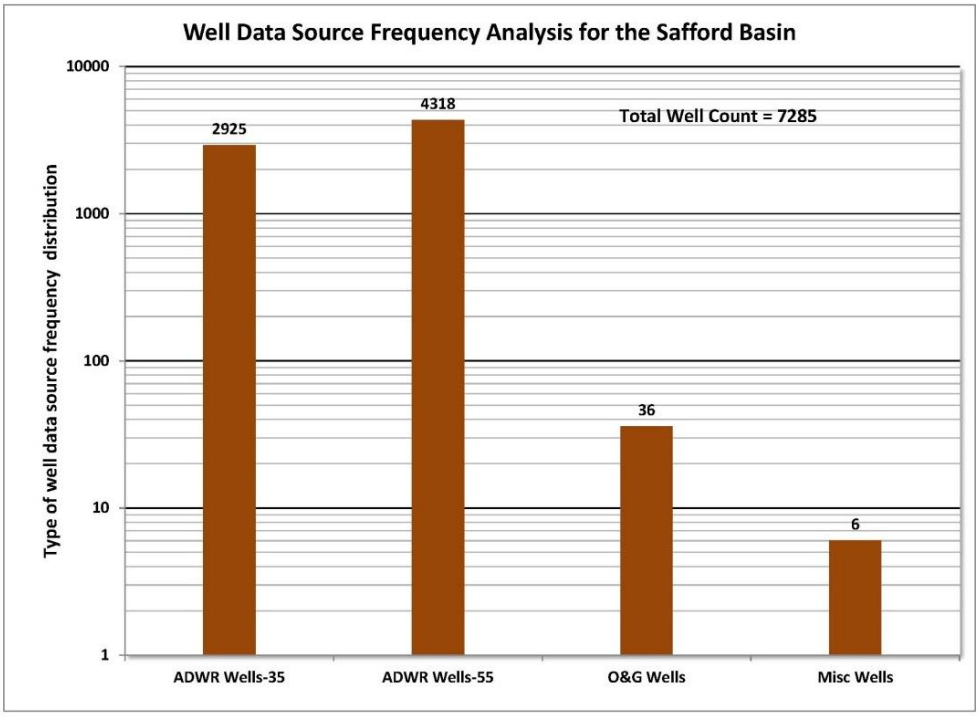

Chart 4 – Logarithmic chart of the frequency of well data sources.

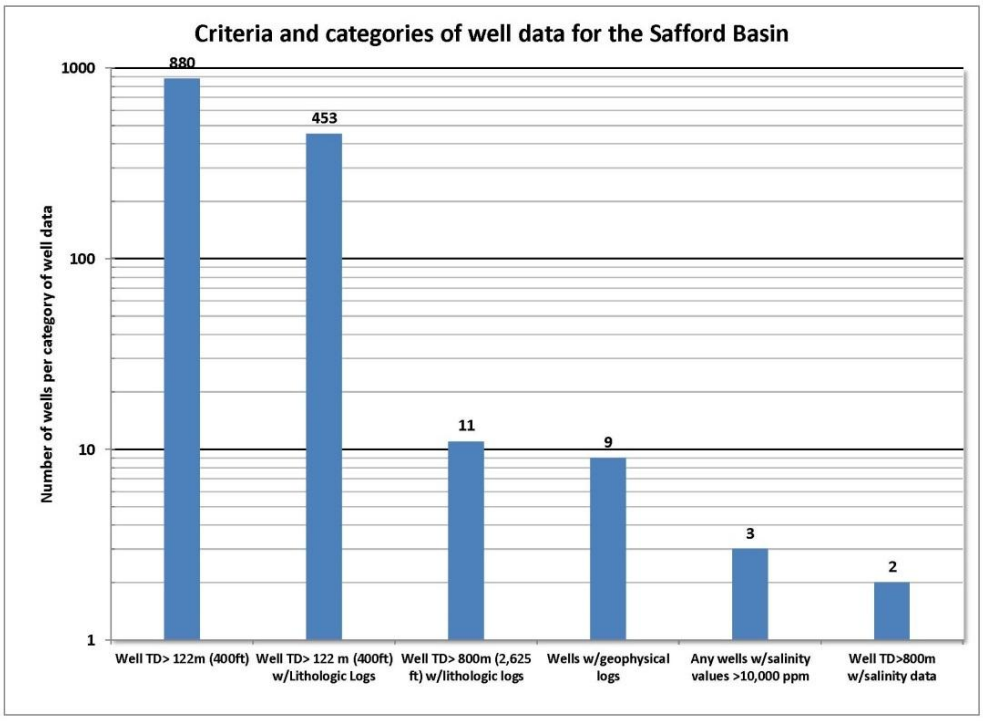

Chart 5 – Logarithmic chart of the frequency of well criteria and categories of well data.

5.0 Geologic Setting

The Safford basin is a large northwest-southeast trending sedimentary basin in southeastern Arizona within the Basin and Range Province of southwestern United States. The Safford basin is part of chain of discontinuous extensional basins over 300 km long between Globe, AZ and northern Mexico (Figure 23). Crustal extension during the mid-Tertiary led to high- to low-angle normal faulting, uplift and exposure of ranges, and tectonic subsidence of adjoining basins. Continued high-angle normal faulting on the southwest margin of the Safford basin during the Miocene and Pliocene allowed thick sequences of basin-fill sediments to accumulate in an asymmetric sedimentary half-graben. The Safford basin is approximately 250 km (155 mi) long, 25 km (15 mi) wide, with a maximum depth of basin-fill sediments reaching approximately 4,600 m (15,100 ft) (Kruger, 1991), and averaging approximately 900 m (2,900 ft) depth.

A series of discontinuous mountain ranges separated by mountain passes border the southern margin of the Safford basin, and border the Willcox and San Bernardino basins to the southwest and San Carlos, Ash Flat and Duncan basins to the northeast. Mountain ranges bordering the southern margin of the Safford basin include, from northwest to southeast, the Hayes, Mescal, Santa Teresa, Pinaleño, Dos Cabezas, and Chiricahua mountains and include a complex variety of geologic rock types, ages, and structures. The opposing mountain ranges northwest and northeast of the Safford basin include the Peridot/San Carlos volcanic field, Gila, Whitlock, and Peloncillo mountains. The Gila Mountains are composed of mostly mid-Tertiary volcanics with minor Laramide-age volcanic and intrusive rocks that are associated with a major porphyry copper deposit. The southern mountain ranges are composed of Precambrian and Laramide-age granitoid plutonic rocks, Paleozoic sedimentary rocks, and volcanic and sedimentary rocks of Mesozoic, and mid-Tertiary ages.

The Safford basin initially formed during mid-Tertiary extension associated with the development of a metamorphic core complex and low-angle normal faulting. Paleozoic, Mesozoic and early- to mid-Tertiary rocks generally form the upper plate or hanging wall of the detachment fault, and are present as faulted blocks in the Hayes, Santa Teresa, Dos Cabezas and Chiricahua mountains to the south and mid-Tertiary volcanic rocks in the Gila, Whitlock and northern Peloncillo Mountains. Granitoids in the Pinaleño and Santa Teresa mountains form the lower plate or footwall of the detachment-fault system (Spencer and Reynolds, 1989; Long et al., 1995). Subsequent faulting along a secondary breakaway fault zone superimposed along the low-angle detachment fault on the northeast flank of the Pinaleño Mountains allowed further uplift and exposure of adjacent ranges, and allowed further basin subsidence and accumulation of thick sequences of basin-fill sediment in an asymmetric half-graben. Seismic analysis of the breakaway fault suggests that the fault dips 50 degrees in the shallow subsurface and extends several kilometers and merges with a low-angle 20-degree detachment fault in the area of Safford (Kruger and Johnson, 1991, 1994, 2001; Kruger and others, 1995).

Tectonic processes associated with detachment faulting and basin formation may explain significant differences in geometry of depth-to-bedrock and basin-fill stratigraphy. Relative differences in the shape of bedrock in the Safford basin throughout its length may be the related to warping in the lower plate of the Pinaleño detachment fault system. Bedrock ridges or saddles between subbasin troughs may correspond to antiforms and synforms, respectively. Such large-scale features are

documented elsewhere in the Basin and Range such as the formation of the Tucson (Houser et al., 2004) and Butler Valley basins (Spencer and Reynolds, 1989). The relief between subbasins in the Safford basin is significant, between 600 and 1,600 meters (2,000 and 5,200 ft). If antiforms and synforms are present at the detachment fault boundary, it is not clear what effect these features had on depositional systems and sedimentary facies distribution in the basin fill.

The Safford basin is comprised of lower and upper basin-fill units, apparently separated by an unconformity. The lower and upper basin-fill units are distinguished primarily by differences in lithology and consolidation as revealed primarily by seismic reflection profiling and well logs, although little is known about the lower-basin fill unit. The lower basin fill (LBF) unit is interpreted to have formed in a closed basin setting formed from predominantly alluvial processes during the early (?) to mid-Miocene, between 17 and 11 (?) Ma (Houser et al., 1990; Houser et al., 1985; Richter et al., 1983). Degree of consolidation and deformation (fractures, faults and folds) are more abundant in the LBF than the UBF. The upper basin-fill (UBF) unit is unconsolidated to weakly consolidated, generally undeformed, and consists of alluvial to lacustrine deposits. Exposures of the LBF are discontinuous and generally absent along basin margins; whereas the upper basin-fill unit is widespread and dissected by modern tributaries of the Gila and San Simon rivers

Quaternary faults are present along the southwest and northeast basin margins (Houser et al., 2004). These faults offset upper basin fill and alluvial fan-pediment. Some of the faults on the northeast margin of the basin offset fluvial deposits associated with the ancestral Gila River, indicating the most recent activity was during the late to latest Pleistocene, prior to Holocene (Machette et al., 1986) (see Plate 1).

Deposition of the UBF ceased upon integration of a through-flowing Gila River between the Safford and San Pedro basins by approximately 2.0 +- 0.01 Ma (Wrucke et al., 2004). The Gila and San Simon drainage network are geologically recent and make up a relatively thin and shallow veneer of Quaternary sediments incised into the UBF. The arrival of the Gila River in the Safford basin has been previously interpreted to have integrated into the Safford basin through headward erosion from the area of the San Pedro basin. Alternatively, the downstream-terminus of the Safford basin may have been a ponded basin for an ancestral Gila River tributary system, and subsequently overflowed across bedrock into the San Pedro trough. This may explain the abundance of lacustrine, fluvial, and Bonita Creek fan deposits found in the upper-UBF.

6.0 Structure and stratigraphy of the Safford basin

The structural and stratigraphic framework of the Safford basin is complex and varied with at least four broad subbasins. Due to the variety of geology and availability of subsurface data along the extensive length of the Safford basin, the structure, stratigraphy and basin properties are discussed from the northwest to the southeast along the length of the basin. Although the Safford basin has been subdivided into subbasins by various authors based primarily on apparent differences in modeled depth-to-bedrock from gravity data (Houser et al., 1985, 1990, and 2004), these subbasin boundaries are not well defined laterally or vertically. As such the structure, stratigraphy, and basin-fill properties of the Safford basin are discussed per cross-sectional areas transverse to the basin axis in order to characterize relationships between the LBF and UBF units, potential seals within basin-fill units, structures, etc. for the purposes of characterizing CO_2-sequestration potential below 800 m depth.

6.1 San Carlos Subbasin

The San Carlos subbasin is a relatively shallow end-member and northern terminus of the Safford basin between the towns of Bylas and Coolidge Dam, covering an area of 752 km^2 (290 mi^2) (Plate 1 and Figure 24). The subbasin is bound by bedrock of the Santa Teresa Mountains to the south, Hayes Mountains to the west, Peridot Mesa to the north and Gila Mountains to the northeast. These ranges consist of a complex variety of rock types with significant structural complexity. Basin-fill sediments in the San Carlos subbasin are continuous with those in the Bear Springs subbasin. Between Bylas and Coolidge Dam basin-fill sediments are progressively shallower to the west. The eastern extent of the San Carlos subbasin is delineated by an abrupt increase in depth-to-bedrock to the east into the Bear Springs subbasin.

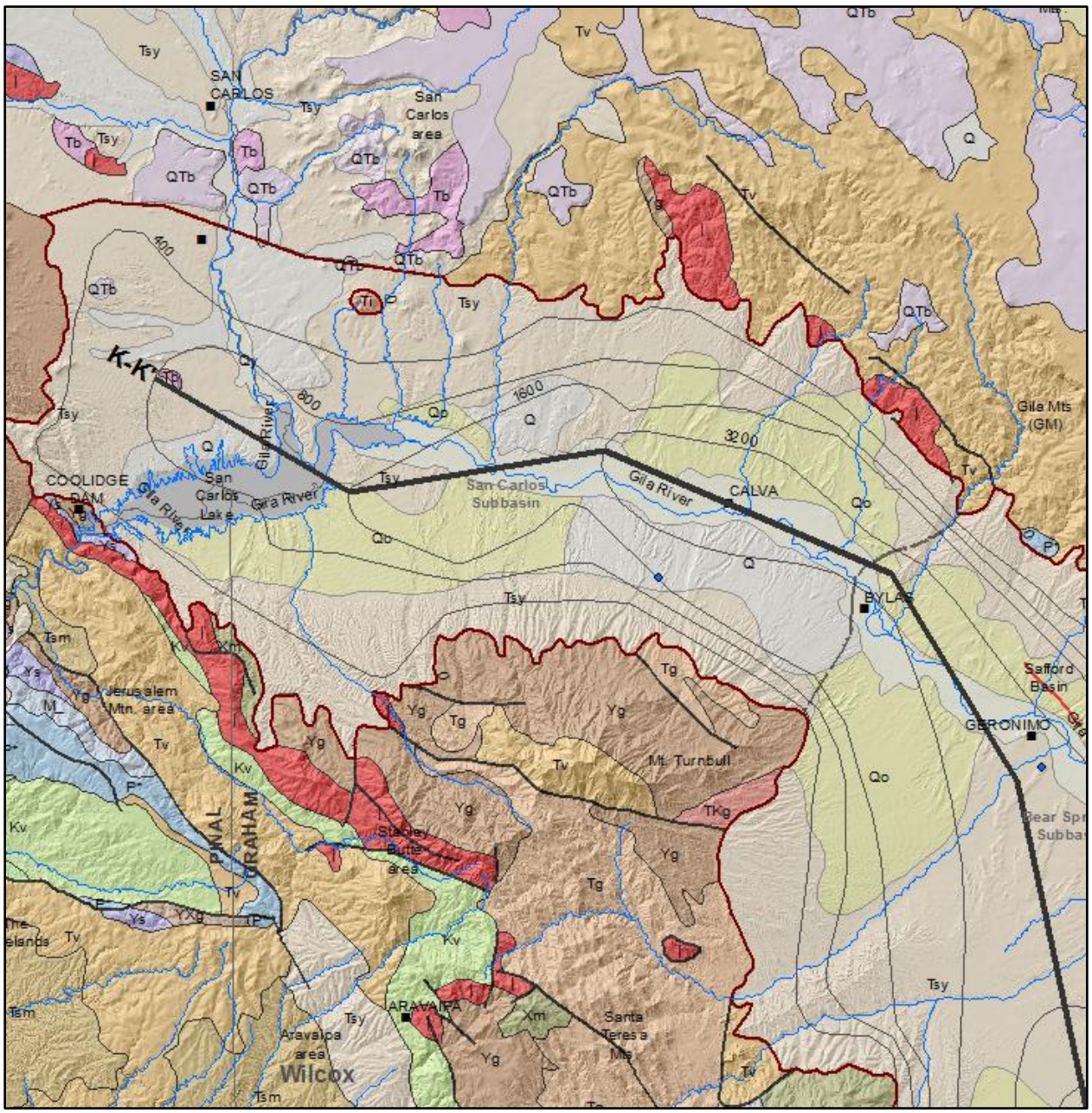

Figure 24. Geologic map and location of cross-section KK' in the San Carlos subbasin. Subbasin boundary delineated by dash-dotted line near Bylas. See Plate 1 for legend of features. North to top. Scale not shown.

Structural Geology

The depth-to-bedrock in this subbasin is modeled as a symmetrical subbasin, in contrast to the basin asymmetry near the town of Safford (Plate 1). Basin genesis and evolution in the San Carlos subbasin is not well understood but, except for greater basin symmetry as indicated by geophysical data, is not obviously dissimilar to basin evolution along the Pinaleño segment of the Safford basin.

The geometry of the San Carlos subbasin boundary and depth-to-bedrock are noticeably dissimilar to other subbasins in the Safford basin to the southeast. The Santa Teresa Mountains form a

prominent bend in the strike of the Pinaleño Mountain range. This may be due to differences in the overall geometry and history of deformation associated detachment faulting during the mid-Tertiary. During the late Miocene and Pliocene detachment faults are known to have been subsequently reactivated by a secondary breakaway normal-fault system associated with development of the Basin and Range extension (Spencer and Reynolds, 1989; Kruger et al., 1995). The San Carlos subbasin is significantly more shallow and broad than the adjacent Bear Spring subbasin for reasons unclear. Nonetheless, these differences may translate to subtle differences in depositional setting such as the location of basin axes and distribution of basin-fill facies within and between each subbasin. Younger high-angle normal faults on the margins of the San Carlos subbasin may be present, although their location and extent are unknown, inferred only by steepness in depth-to-bedrock contours.

Stratigraphy

Depositional setting and history of basin-fill deposits in the San Carlos subbasin are limited to interpretations made from mapping outcrop exposures (Wrucke et al., 2004). The basin fill deposits in the San Carlos subbasin are interpreted to be associated with UBF deposits in the Bear Springs subbasin based on an interlayered tuff in basin fill near Bylas which yielded a radiometric age of approximately 5 Ma (Wrucke et al., 2004). Exposures of the UBF deposits in the subbasin consist of weakly consolidated coarse conglomerate along basin margins grading basinward into finer grained sandstone, siltstone and mudstone interlayered with limestone, gypsum and basalt flows. Limestone deposits contain microbial mats and stromatolites and locally diatomaceous earth. Limestone deposits are interbedded with fine-grained clastic material and tuffaceous sands, extend from Coolidge Dam to Bylas, and indicate a large lacustrine environment; however, the depth of deposits associated with lacustrine depositional environments is unknown.

The San Carlos subbasin lies within the San Carlos Indian Reservation. Only one well log was found for this area and little is known about the extent and character of basin fill at depth. Basin-fill deposits in the subbasin consist of a proximal to distal alluvial fan facies terminating in shoreline, playa and lacustrine basin-center facies (Wrucke et al., 2004). Lacustrine facies in the subbasin may be equivalent to the 111 Ranch beds in the UBF unit to the southeast, although stratigraphic relationships are unclear.

Volcanism occurred during and following deposition of basin fill in the San Carlos subbasin. The youngest age of basin-fill sediments in the subbasin is constrained by early Quaternary volcanism (approximately 2.0 Ma) where several dacitic diatremes and lava flows post-date the basin fill units (Wrucke et al., 2004). The youngest age of the UBF sequence near the town of Safford is approximately 2.3 Ma (Dickson and Izett, 1981). Basin fill deposits in the subbasin are interbedded with basalt flows, and rhyolite and dacite tephra deposits dated between 2.5 and 7.8 Ma. Wrucke et al. (2004) interpreted onset of basin fill deposition to coincide with volcanism at the surface in the subbasin area, thus it is conceivable that a structural trough which allowed basin fill sediments to accumulate in the subbasin may have also allowed basalt flows to accumulate within basin down-gradient towards the Bear Springs subbasin; however, the extent of lava flows in the subsurface are unknown. The Bylas diatreme between the towns of Bylas and Geronimo in the adjacent Bear Spring subbasin is the easternmost exposure of volcanic rocks associated with basin fill deposition. It should be noted that the presence, thickness,

composition, and number of lava flows have a significant effect on measured gravity, and will result in underestimation of depth to bedrock if the higher density of volcanic rocks, especially basaltic, is not considered when modeling depth to bedrock (Lysonski et al., 1980) or base of Miocene/Pliocene basin fill.

The northwest end of cross-section K-K' is between the towns of Peridot and Coolidge Dam along the axis of the basin (Plate 1; cropped and presented in Figure 25). Here basalt is interbedded with basin fill at the surface. The basin keel plunges eastward and reaches a depth of 800 m, approximately 8 km west of Calva. East of this point the thickness of basin fill deposits range from 800 to 1,200 m (2,625 to 3,937 ft) thick, averaging approximately 1,000 m (3,280 ft) thick; however, basin fill is only 200 m to 300 m thick below the 800 m depth boundary to bedrock (if assumptions of modeled bedrock from gravity data are correct). Along this distance very few well data exist and no wells are reported to have encountered bedrock. If interlayered basin-fill and lava flows exist in this area of the Safford basin, depth-to-bedrock may be deeper than indicated by basin-depth contours, and CO_2 sequestration potential may be correspondingly greater.

Summary

The San Carlos subbasin is the shallow, northwestern terminus of the Safford basin. The subbasin is essentially lacking any subsurface well data, thus interpretations about the structure and stratigraphy of basin fill sediments are limited to surficial outcrops and geology in the adjacent Bear Springs subbasin. Basin-fill units are interpreted to extend from Bear Springs subbasin into the San Carlos subbasin, although the extent and depth of the LBF in the San Carlos subbasin is unknown. Interlayered basalt flows and tephra deposits constrain the age of basin fill in the San Carlos subbasin to UBF age at land surface. The UBF in the subbasin consists of weakly consolidated coarse conglomerate along basin margins grading basinward into finer grained sandstone, siltstone and mudstone interlayered with limestone, gypsum and basalt flows. The depositional setting is interpreted to represent alluvial fans terminating into shoreline, playa and lacustrine basin center(s) (Wrucke et al, 2005). The potential for storage of CO_2 and possibly sealing conditions may be present in the southeastern portion of the subbasin within basin-fill sediments; however, this is based primarily on depth-to-bedrock modeled from gravity. The down-gradient extent of interbedded basalt flows in this area near the Bear Springs subbasin boundary is unknown, but may significantly underestimate the modeled depth-to-bedrock from gravity, affecting volume estimates below the 800 m depth.

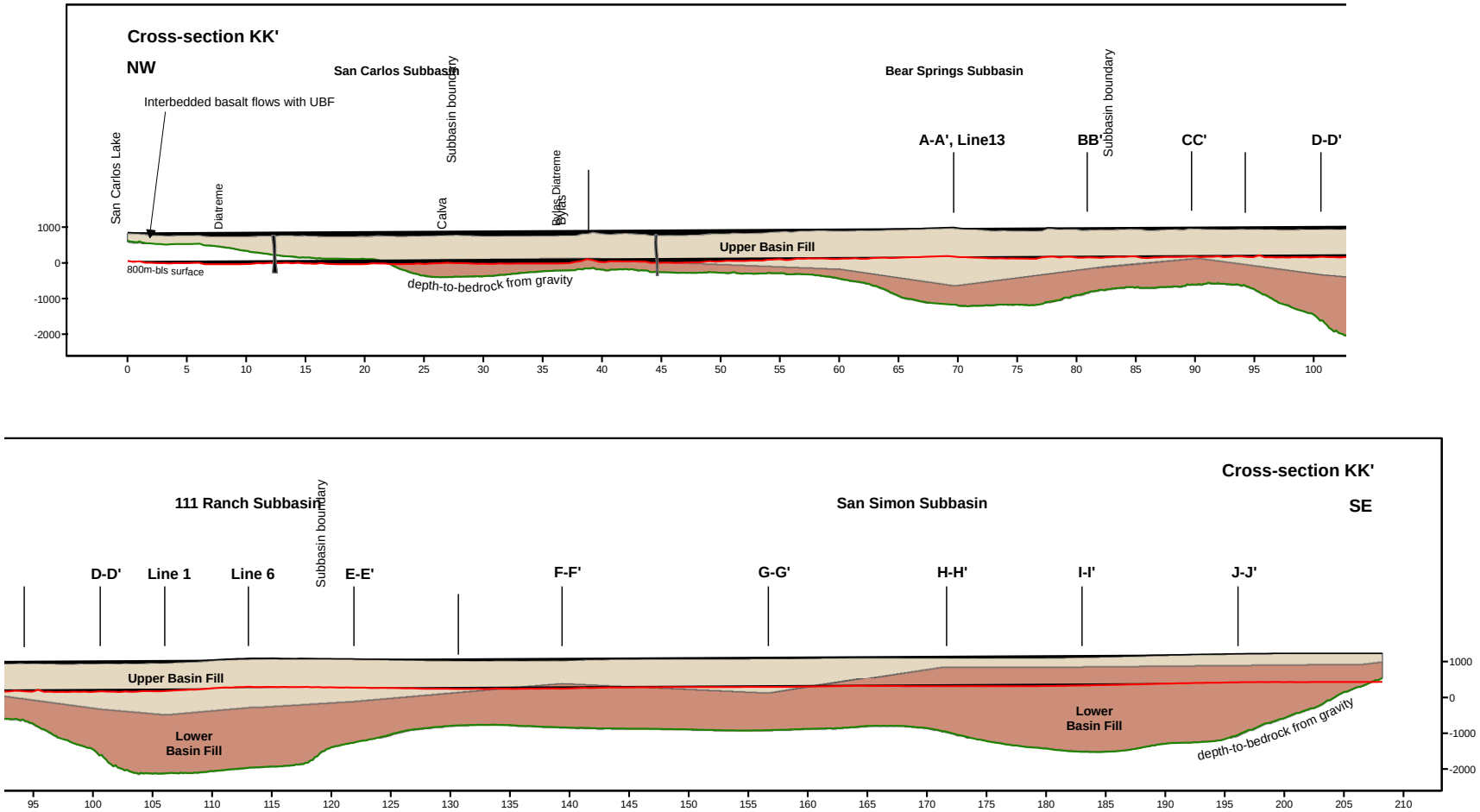

Figure 25. Geologic cross-section KK' split at the Bear Springs/111 Ranch subbasin boundary. See Plate 1 for location. Vertical scale in meters above mean sea level, vertical exaggeration 3x. Red line represent the depth to 800 m (2,625ft) below land surface. Horizontal scale in kilometers distance from beginning of KK'.

6.2 Bear Springs Subbasin

Structural Geology

The Bear Springs Subbasin is characterized by a major gravity low and depositional sink referred to as the Pima low or salt dome (Rauzi, 2002). The Bear Springs subbasin is delineated by ridges or saddles in the bedrock which separate the San Carlos subbasin to the west and 111 Ranch subbasin to the east, and encompasses an area of 1,445 km^2 (558 mi^2) (Figure 25). Granitic bedrock in the northern part of the Pinaleño mountain range and Eagle Pass are part of the lower plate below the Eagle Pass detachment fault and form the southern margin of the Bear Springs subbasin. Mid-Tertiary volcanic rocks and Laramide-age intrusions that make up the Gila Mountains are part of the upper plate and northern margin of the Bear Springs subbasin. The Laramide-age plutonic stock and ore body (Dos Pobres mine) is present in the shallow subsurface along the northeast margin near the end of cross-section CC'. The LBF and UBF units have been interpreted by Kruger and Johnson (1994) from a seismic reflection profile along "Line 13" (acquired from Amoco-Phillips). Geologic cross-section Line 13 and supplemental cross-sections AA' through CC' were constructed across the Bear Springs subbasin (Figure 26).

Much of the interpretation of basin-fill units in the Bear Springs subbasin is derived from seismic line 13 and scarce deep well data. Cross-section Line 13 (Figure 27) illustrates differences between depth-to-bedrock modeled from gravity (Lysonski et al., 1981) and bedrock defined as the base of Miocene basin fill and top of igneous bedrock as identified in the seismic reflection profile (Kruger and Johnson, 1994). Seismic data show depth to the base of the LBF between 200 and 800 m deeper than bedrock modeled from gravity. Differences between these two indirect methods of determining depth-to-bedrock are more similar than different in other portions of the Safford basin, thus the reason for the difference is unclear. The geometry of bedrock and basin fill units is asymmetric with the basin axis closer to the Pinaleño Mountains. Depth-to-bedrock along the northern margin of the subbasin slopes steeply southwestward over a distance of only 3 to 4 km in cross-sections AA' through CC' (Figure 28, Figure 29 and Figure 30), with the slope becoming much more gentle at greater depth. The steep slope in bedrock on the northeastern margin of the basin is interpreted to represent antithetic faults (Kruger et al., 1995), apparently active during deposition of the LBF. However, movement along the Pinaleño range-bounding fault dominated to produce a largely asymmetric basin-fill distribution in both the lower and upper basin fill. Quaternary (and likely Pliocene) faults on the northeast flank of the subbasin may be related to these antithetic, pre-existing faults.

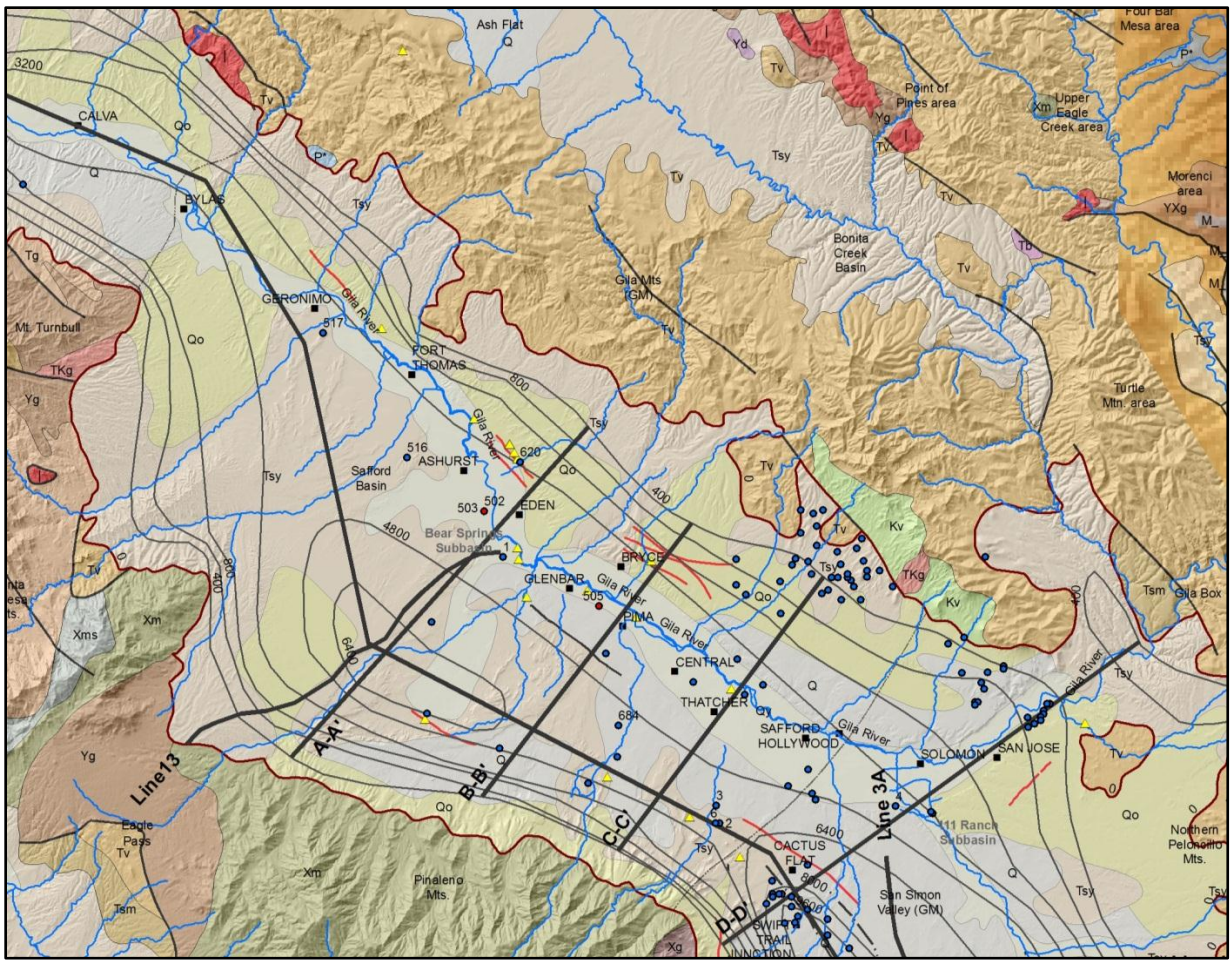

Figure 26. Geologic map and location of geologic cross-sections in the Bear Springs Subbasin. Subbasin boundaries delineated by dash-dotted line near Bylas and Safford. See Plate 1 for legend of features. North to top. Scale not shown.

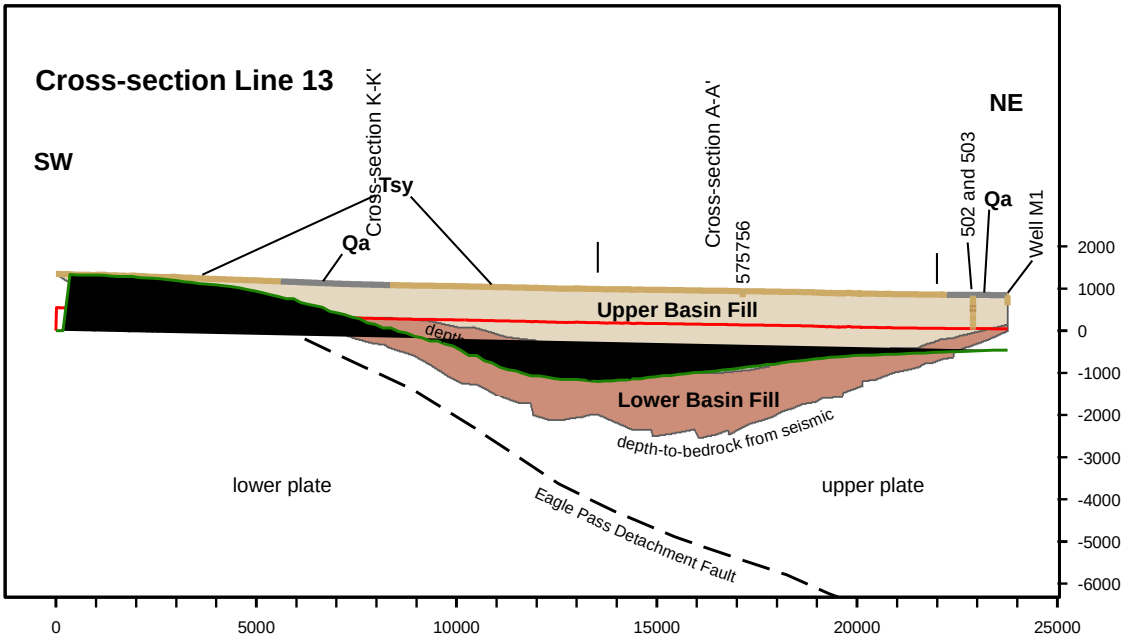

Figure 27. Geologic cross-section along seismic Line 13. Horizontal scale in meters distance from beginning of section. Vertical scale in meters above mean sea level, exaggerated 1.05X. See Plate 1 for detailed legend.

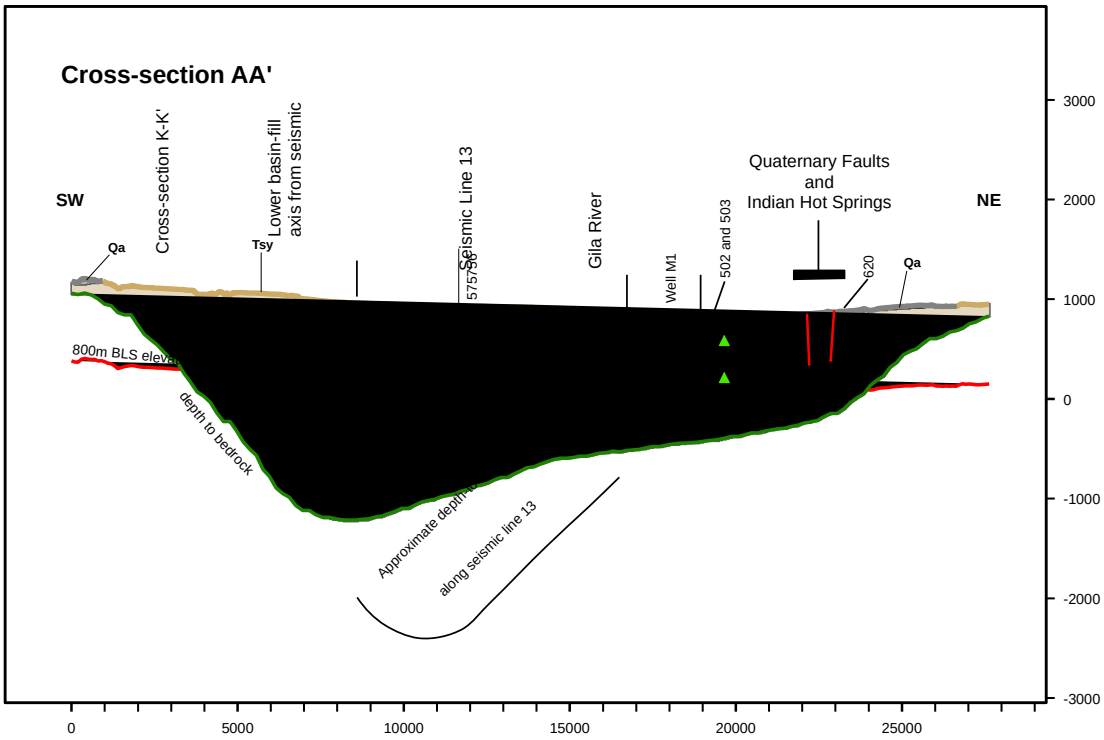

Figure 28. Geologic cross-section AA'. Horizontal scale in meters distance from beginning of section. Vertical scale in meters above mean sea level, exaggerated 3.0X. See Plate 1 for detailed legend.

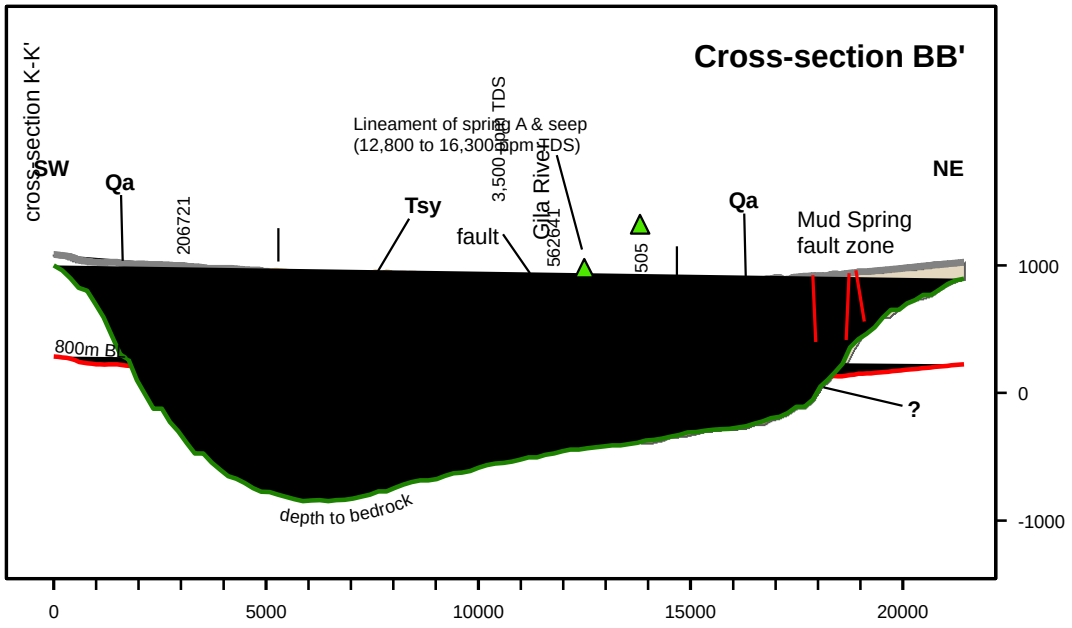

Figure 29. Geologic cross-section BB'. Horizontal scale in meters distance from beginning of section. Vertical scale in meters above mean sea level, exaggerated 3.0X. See Plate 1 for detailed legend.

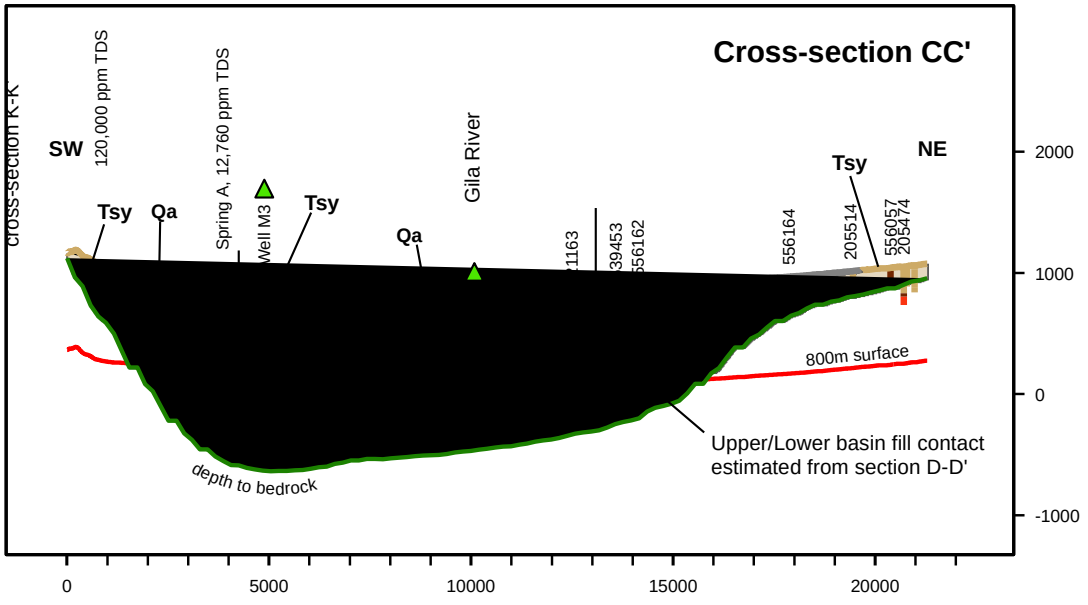

Figure 30. Geologic cross-section CC'. Horizontal scale in meters distance from beginning of section. Vertical scale in meters above mean sea level, exaggerated 3.0X. See Plate 1 for detailed legend.

Stratigraphy

The LBF unit is considered a suitable candidate for CO_2 storage in the Safford basin and is interpreted to underlie depths >800 m throughout the Bear Springs subbasin; however, only one well (505) (corresponding to OGCC well 5-05) (Plate 1) penetrates the LBF in this subbasin and no wells penetrate the 'Pima Low' (Figure 29Figure 29). Well 505 logged predominantly red sandstone and shale with minor amounts of lime and gypsum below the 800 m depth (Appendix B). Well 505 is several kilometers northeast of the basin axis along section BB' and penetrates the upper 700 m of the 970-m thick LBF. Thickness of individual lithologic intervals logged in well 505 varies from about a meter to up to 74 m (243 ft) thick. Water flow from well 505 ranged from approximately 12,000 gallons per day at 480 m (1,580 ft) depth to 50,000 gallons per day at 1,076 m (3,530 ft) depth. Salinity from well 505 measures at approximately 3,500 mg/L TDS; however, it is unclear what depth this salinity is sourced from.

An unconformable relationship is apparent between the lower and upper basin-fill units in cross-section Line 13 (Figure 27), and elsewhere in the Safford basin (Houser et al., 1985; Richter et al., 1983; Houser, 1990; Kruger et al., 1995). The erosional surface approximately coincides with the 800 m depth level where the UBF is interpreted to onlap eroded portions of the LBF and the Eagle Pass detachment fault. Implications of this unconformity with regards to sealing conditions are not clear, nor is the lateral character of the unconformity basinward at depth.

Subtle variations in reflection-seismic wave amplitude and lateral continuity in the LBF in Line 13 (Kruger and Johnson, 1994) may suggest variable lithology and lateral facies change from proximal to distal alluvial fan, and possibly lacustrine deposits as one might expect. Otherwise, lateral or vertical facies changes in the LBF within the Bear Springs subbasin could not be determined.

All other wells in the Bear Springs subbasin are drilled in the UBF. Few wells penetrate the entire thickness of the UBF in the subbasin. Wells on the northeast margin of the subbasin penetrate predominantly fine clastic alluvial sand and clay intermixed with calcareous clastic sediments. Well 516 (corresponding to OGCC well 5-16) penetrated predominantly siliciclastics from the surface to 290 m bls (951 ft) and consolidated limestone intermixed with clay and gypsum between 290 and 395 m bls total depth (TD) (951 and 1,296 ft). A gentle dip of 5-degrees was noted in core below 951 ft. Well 517 (corresponding to OGCC well 5-17), also in the northwestern portion of the subbasin, also consists of predominantly fine-grained clastic lithologies above 247 m (810 ft) (TD), although a 10-m thick (33-ft) sand layer at 120 m depth (400 ft) had artesian flow of salt water noted at the time of drilling. In the northwestern area of the Bear Springs subbasin between cross-section AA' and the San Carlos subbasin boundary, the upper part of the UBF seems to be characterized by predominantly alluvial fan and lacustrine environments, with minor amounts of evaporite deposits (although this may be grossly underestimated).

In the vicinity of cross-sections BB' and CC' (Figure 26, Figure 29 and Figure 30) the UBF is largely fine-grained clastic sand, silt and clay with relatively minor amounts of lime and gypsum. Well 505 was drilled through the UBF and consists of predominantly red, gray and rare blue shale [clay], red sand and sandstone and relatively thin and few beds of gravel and calcareous shale and calcareous gypsum. Well 21163 along cross-section CC', which like well 505 is located on the northeast flank of the Bear Springs

subbasin but below the steep basin margin, has a similar lithology of predominantly clay and sandy clay above 275 m (900 ft) depth and is interpreted to represent distal-fan and lacustrine-(?) depositional environments. At least two other wells at this 275 m interval in the UBF consist of similar clayey deposits. In well 21163 between 275 and 660 m (TD) (900 and 2,161 ft) the lithology consists of predominantly hard sand and shale with minor amounts of gravel; these deposits are interpreted to reflect medial to distal alluvial fan environment in the UBF.

Three wells located on the shallow northeastern basin margin near section CC' penetrated fractured sandstone near bedrock which may represent older portions of the basin fill, perhaps the LBF unit. Well 205514 near the margin of CC' encountered and completed the well in basalt (interpreted as bedrock) at 173 m (570 ft) depth.

Near the southeastern boundary of the Bear Springs subbasin and southwestern margin of CC' a cluster of relatively deep miscellaneous "M-wells" penetrated impermeable lithologies in the LBF approaching the 800 m depth level (Figure 26). Well M3 penetrated predominantly clay and silt, with gypsum beds and calcareous silt to 766 m depth (2,515 ft). The well log for the lower twenty feet of well M3 at 772 m (2,535 ft) depth (TD) notes "probably bedrock potash granite", and given other wells in the vicinity and the depth to bedrock, this log is most likely arkosic sand. Well M3 also has a reported TDS of 120,000 mg/L, discussed further in the section on salinity. Well M6 (not shown on CC') is only 1.1 km south of M3 and records mostly sand and clay between the surface and 136 m (446 ft) depth, pure gypsum between 136 and 367 m (446 and 1,205 ft) depth, and fine volcanic sand to 425 m (1,396 ft) depth (TD). Well M2 (also not shown on CC') is only 230 meters east of M6 and 1.1 km south of M3 and records predominantly sand with minor gravel to 457 m (1,499 ft) depth (TD).

Although the quality of the three M-well logs may be considered inadequate or unreliable for the purposes of this study, the lithologies present in the southern portion of the Bear Springs subbasin are interpreted to represent distal fan, playa and marginal lacustrine conditions in the 111 Ranch beds and possibly the upper Sanchez beds above 800 m depth (Houser, 1990; Houser et al., 1985). The volcanic sand noted in wells M2 and M6 suggest the sediment source is derived from the Gila Mountains approximately 18 km to the northeast, and is known as the Bonita Creek fan delta (Houser et al., 1985 and Houser, 1990). The age, thickness and lateral extent of the Bonita Creek fan is poorly constrained, but Houser (1990) estimated the extent of the Bonita Creek fan to be approximately 730 km^2. Exposures of the Bonita Creek fan in the UBF indicate braided streams with sustained water flow sourced from at least as far as the Bonita Creek basin (Figure 26) and may represent the ancestral arrival of the Bonita Creek or Gila River (Houser, 1990). The Bonita Creek fan may have persisted throughout deposition of the UBF during the Pliocene-(?). Kruger et al. (1995) identified a migration of the basin axis in the Safford area attributed to renewed uplift of the Pinaleño block and/or subsidence of the Safford basin during UBF time. This renewed tectonism may also coincide with the arrival of an ancestral Bonita Creek/Gila River connection to the Safford basin, providing an influx of relatively fresh water into a closed-basin setting.

Based on available well data, the stratigraphy of the UBF is poorly understood in the Bear Springs subbasin near depths of 800 m bls. The upper 300 m of the UBF is dominated by clay and silt across the width of the subbasin within a few kilometers of the basin margin, and is interpreted to be

equivalent to the upper part of the 111 Ranch beds. Along the basin margins, clastic-dominated lithologies are equivalent to the Bear Springs Wash and Sanchez formations (Houser et al., 1985; Houser, 1990) (Table 3). The remainder of the UBF below this horizon consists predominantly of fine clastic silt and sand interbedded and intermixed with gypsum. The lower portion of the UBF is equivalent to the 111 Ranch beds and the upper Sanchez beds and possibly the upper portion of the Midnight Canyon Formation (Richter et al., 1983; Kruger et al., 1995). Houser (1990) and Houser et al. (1985) estimated the maximum thickness of the 111 Ranch beds to be approximately 520 m. Seismic line 13 in the Bear Springs subbasin and line 1 in the 111 Ranch subbasin both indicate the 111 Ranch beds to be between 500-(?) and 1,000 m thick, although the true vertical extent of the 111 Ranch beds throughout the Bear Springs subbasin is not known.

Summary

Basin-fill in the Bear Springs Subbasin unconformably overlies early Miocene volcanic and Precambrian crystalline bedrock between the Pinaleño and Gila mountain blocks. Upper and lower basin-fill units were deposited in a largely asymmetric basin with significant range-bounding faults on the northeastern and southwestern basin margins active throughout deposition of basin fill. Only one well in the Bear Springs subbasin encountered the LBF; however, seismic surveys show the LBF is present on the northwestern and southeastern margins of the subbasin, and is interpreted to be continuous at depth.

Stratigraphy and structure of the LBF unit is interpreted from very scarce subsurface data given the volume of this unit. Based on surficial geologic mapping, limited borehole data and interpretations from seismic data, a significant unconformity separates the LBF and UBF; however, the extent and character of this unconformity at depth towards the basin center is unknown. Thickness of the LBF ranges from a few hundred meters along basin margins to as much as 1,000m near the basin center. Generally the LBF has a higher degree of consolidation and deformation than the UBF unit. Stratigraphy and facies characteristics of the LBF were not discernible in the Bear Springs subbasin; however, the depositional setting was in an asymmetrically closed basin with proximal to distal alluvial-fan deposits. Lithologies penetrated by well 505 in the LBF are predominantly siliciclastics with minor amounts of evaporite minerals; however, playa conditions closer to the basin center may yield significantly more evaporite deposits. Based on the well 505 which penetrated the LBF and seismic amplitude data, facies changes in the LBF appear to be abundant over relatively short distances. Given the basin geometry, depositional setting and lithologies, the LBF unit is a potential target for CO_2 storage below 800 m.

The UBF is thick, widespread and continuous across the Bear Springs subbasin. The UBF and may represent both target and sealing conditions for the storage of CO_2 below 800 m. Thickness of the UBF ranges from 1,000 to 2,000 m near basin centers where it consists of predominantly unconsolidated sand, silt and clay with relatively minor amounts of gypsum and lime salts. Lithologies in the UBF are interpreted to represent to proximal to distal alluvial fan, playa and lacustrine environments in an asymmetrically closed-basin. Thus facies changes are gradational from coarse clastic debris in basin margin settings to lacustrine clay and lime deposits near basin centers. The basin center or axis is largely asymmetric towards the northeast flank of the Pinaleño Mountains, although the basin axis has apparently migrated northeastward several times during deposition of the UBF in response to uplift of

the Pinaleño Mountains, subsidence of the basin or both (Kruger et al., 1995). A large fan-delta known as the Bonita Creek fan may represent a significant influx of relatively fresh water derived from ancestral Bonita Creek and/or Gila River headwaters throughout the upper part of the UBF, possibly throughout deposition of the UBF in the Pliocene.

Although little is known about the UBF or LBF throughout their extent and thickness in the Bear Springs subbasin, especially near the Pima low, conditions for storage of CO_2 in permeable sediments below 800 m exists. Although sealing conditions may exist locally across stratigraphic horizons in the LBF and/or UBF, an impermeable caprock unit was not identified near or below 800 m depth. Clearly more subsurface data and work are needed to evaluate these conditions.

6.3 The 111 Ranch Subbasin

Structural Geology

The 111 Ranch Subbasin lies in the center of the Safford basin between the Bear Springs subbasin to the northwest and the San Simon subbasin to the southeast, and covers an area of 1,181 km^2 (456 mi^2) (Figure 25 and Figure 31). The 111 Ranch subbasin is delineated by saddles or ridges in bedrock (Houser, 1990; Mock, 2008). The 111 Ranch subbasin is the deepest part of the Safford basin with a maximum depth of 3,185 m (10,450 ft) according to gravity data, and 3,800 m (12,500 ft) according to seismic (Kruger et al., 1995). The Pinaleño Mountains border the southwest margin of the subbasin and consist of predominantly crystalline Precambrian and mid-Tertiary granitoid plutonic rocks and Precambrian metasedimentary rocks, which are part of the lower plate of the Pinaleño detachment fault (Naruk, 1987; Long et al., 1995ref) (Figure 31). The Gila, Whitlock and northern Peloncillo mountains border the northeast margin of the subbasin and are composed of predominantly early Miocene volcanics that form part of the upper plate of the detachment fault. Basin-fill units unconformably overlie early Miocene volcanics and older consolidated rocks. Several seismic lines were shot in the subbasin (Lines 1, 3A, 3B, 4 and 6) by Amoco-Phillips Petroleum Co. and studied in depth by Kruger and others (1991, 1994, 1995 and 2001). Cross-sections DD' and EE' were constructed, and along seismic lines 1, 3B and 6 (see following figures). Cross-sections of lines 3A and 4 are shown on Plate 1 only.

The 111 Ranch subbasin is an asymmetric basin, bound on its southwest margin by a high-angle listric normal fault zone, referred to herein as the Pinaleño fault. The Pinaleño fault has been interpreted to represent a reactivated secondary-breakaway fault as part of a splay or continuation of the mid-Tertiary Pinaleño detachment fault (Spencer, 1984). The Pinaleño fault zone also coincides with the North and South Safford fault zones and Cactus Flats fault, most recently active during the late to latest Pleistocene (Houser et al., 2004). Quaternary faults may also be present in the vicinity of Solomon and San Jose (Machette et al., 1986). Several concealed faults in basin fill identified from seismic surveys lie between the Pinaleño fault and Gila and Whitlock Mountains to the northeast. These faults, interpreted to have been active during the late Miocene, are predominantly limited to the LBF unit (see Figure 33, Figure 34 and Figure 35). Subsequences M1 through M7, identified and annotated in seismic images (Kruger and Johnson, 1994, 2001; Kruger et al., 1995), correlate with the lower basin fill and parts of the Sanchez and Midnight Canyon beds (Houser, 1990; Houser et al., 1985). One notable fold was imaged in seismic line 6 (Figure 34). Well 798, the deepest well in the Safford basin, penetrated this structure. The folded strata are also associated with tilted strata up against the range-bounding Pinaleño fault. Although relationships between tectonic uplift of the Pinaleño range, subsidence of the Safford basin, and onlap sedimentation are not fully resolved, folds and tilted bedding are expressed in the Pliocene upper basin fill, and at least as much in the lower basin fill units (Kruger et al., 1995). A detailed history and discussion of these relationships are presented further in Kruger et al. (1995). Furthermore, the fold seen in section 6 (Figure 34) also coincides with exposure of the UBF unit (111 Ranch beds) at the surface (Tsy in geologic map in Figure 31). Given that this fold is localized to Line 6, not visible in Line 1, the anticlinal fold may be the northern extent of an anticline or a dome-like structure. Hypothetically, other exposures of the UBF unit at the surface (Tsy on maps and cross-sections) may be related to

structures associated with the Pinaleño fault system on the southwest margin of the basin (ex. Tsy at the 111 Ranch subbasin/Bear Springs subbasin boundary) or other structures elsewhere in the basin.

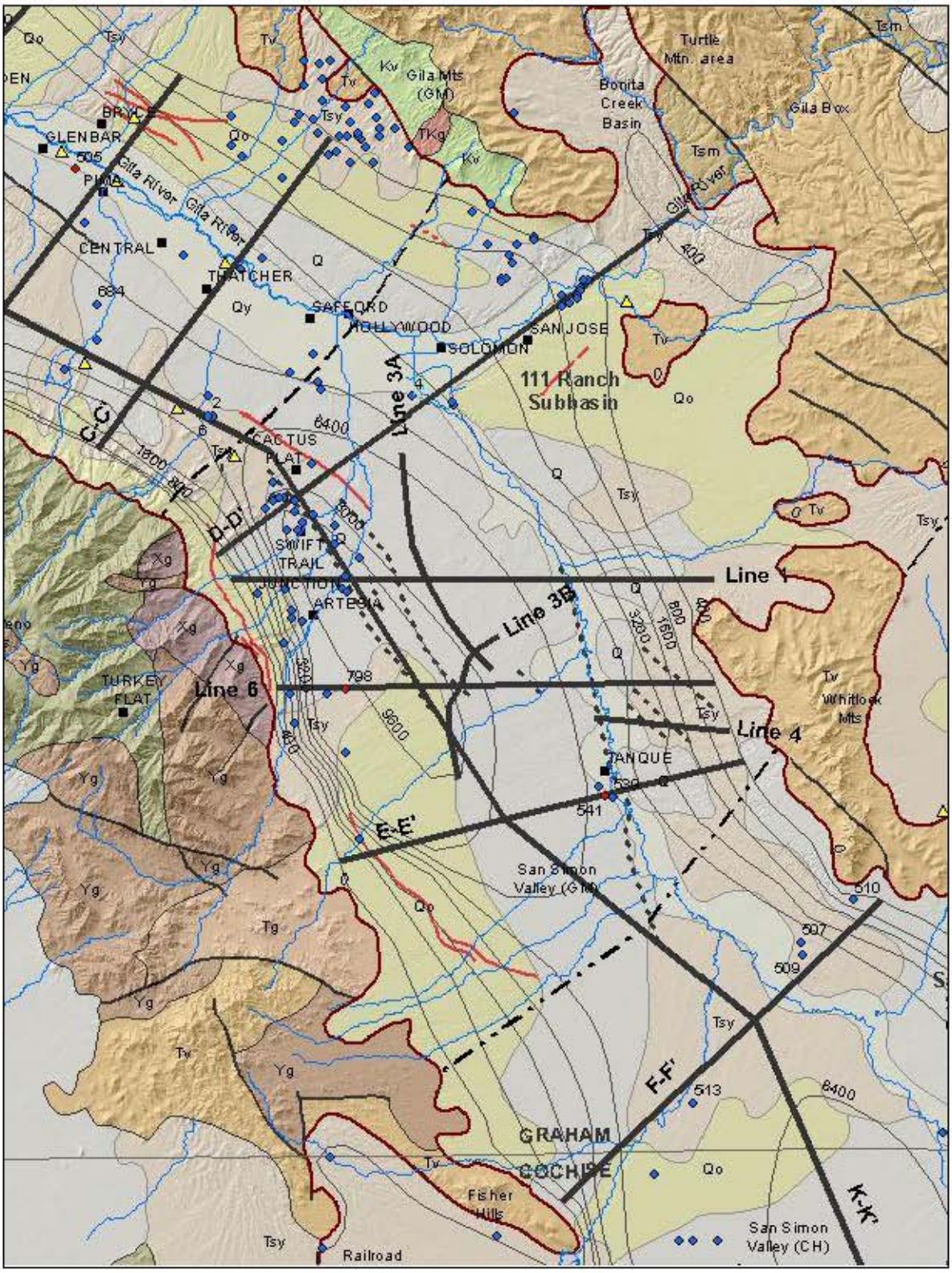

Figure 31. Geologic map and location of geologic cross-sections in the 111 Ranch subbasin. Subbasin boundary delineated by dash-dotted line. North is to top. Scale not shown. See Plate 1 for legend.

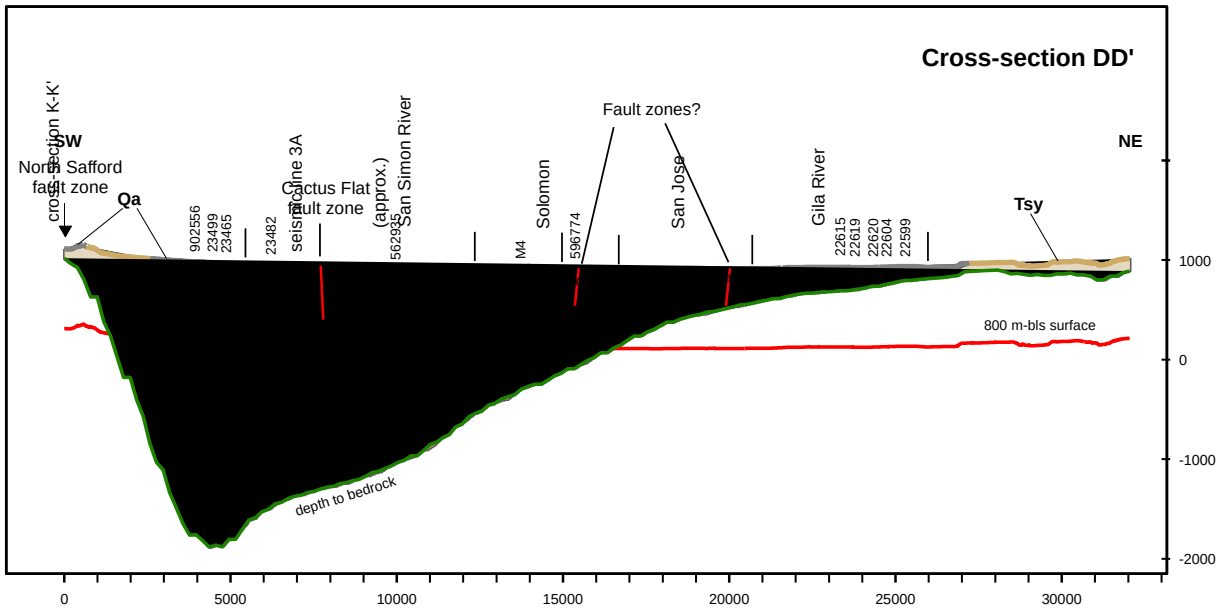

Figure 32. Geologic cross-section DD'. Horizontal scale in meters distance from beginning of section. Vertical scale in meters above mean sea level, exaggerated 3.0x. See Plate 1 for detailed legend.

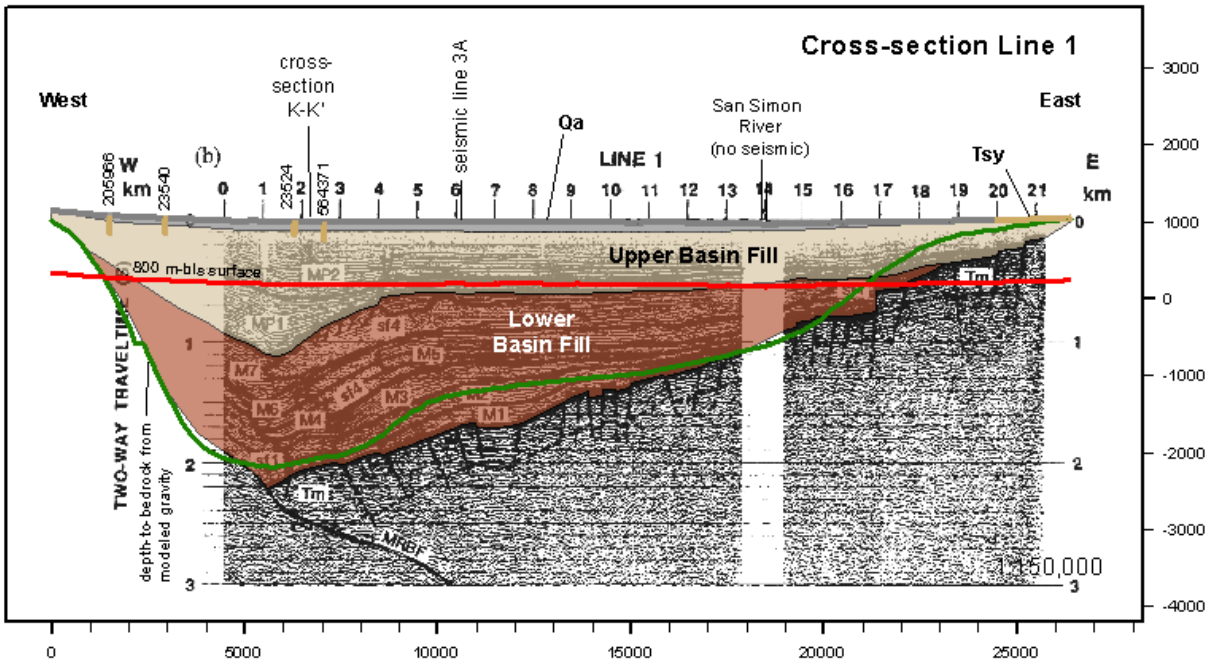

Figure 33. Geologic cross-section Line 1. Seismic profile and interpretations from Kruger and Johnson (1995) (MRBF= mountain range-bounding fault, Tm=Tertiary Miocene volcanics, M1-M7=LBF, MP1 and MP2 = Sanchez and 111-Ranch beds, respectively). Horizontal scale in meters distance from beginning of section. Vertical scale in meters above mean sea level, exaggerated 2.0x. See Plate 1 for detailed legend.

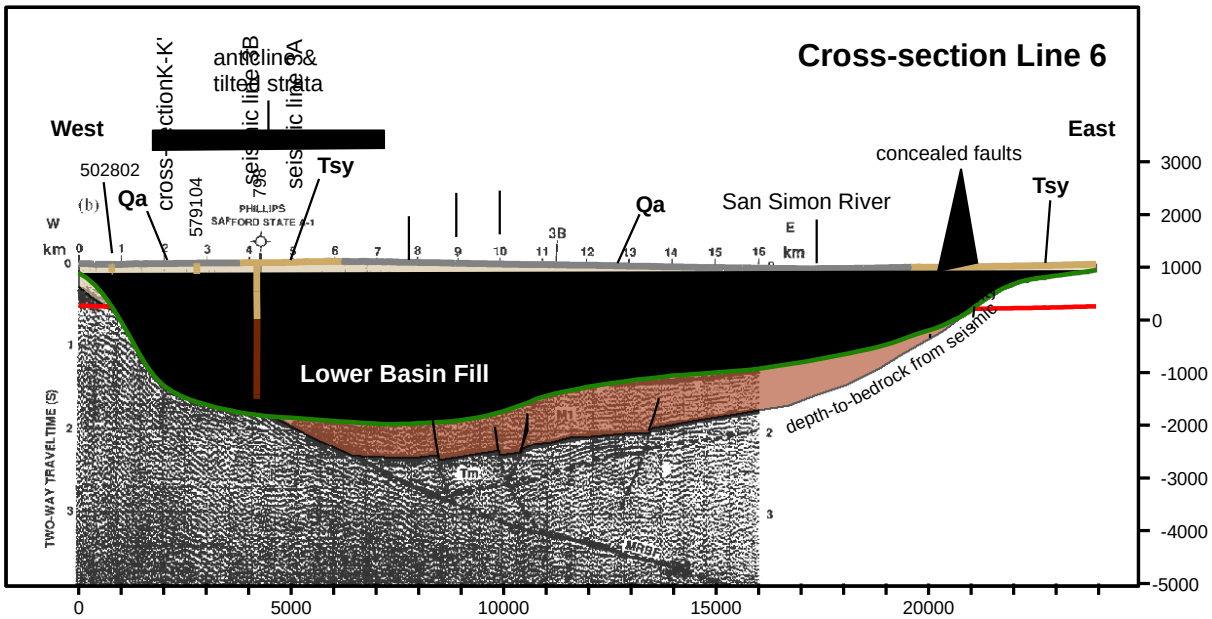

Figure 34. Geologic cross-section Line 6. Seismic profile and interpretations from Kruger and Johnson (1995). Horizontal scale in meters distance from beginning of section. Vertical scale in meters above mean sea level, exaggerated 1.24X. See Plate 1 for detailed legend.

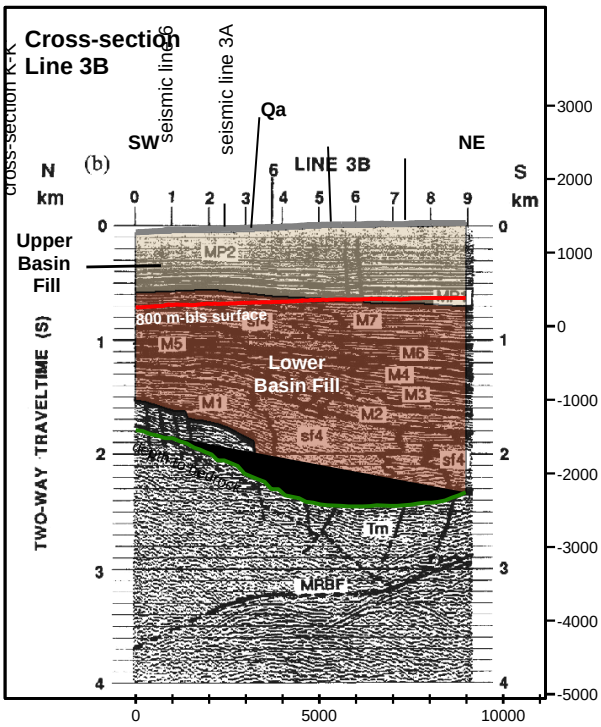

Figure 35. Geologic cross-section Line 3B. Seismic profile and interpretations from Kruger et al. (1995). Seismic units M1 to M7 correlate with beds of the Midnight Canyon Conglomerate, MP1 with the Sanchez beds, and MP2 with the 111-Ranch beds. Horizontal scale in meters distance from beginning of section. Vertical scale in meters above mean sea level, exaggerated 2.54x. See Plate 1 for detailed legend.

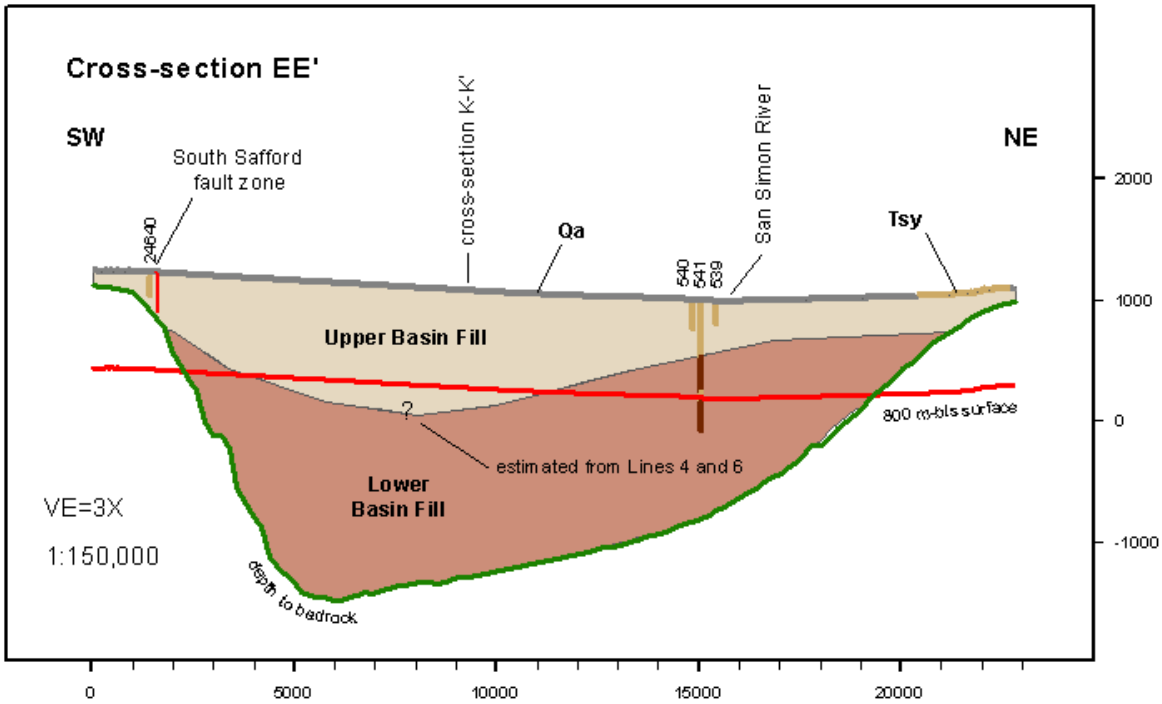

Figure 36. Geologic cross-section EE'. Horizontal scale in meters distance from beginning of section. Vertical scale in meters above mean sea level, exaggerated 3.0X. See Plate 1 for detailed legend.

Stratigraphy

Both basin-fill units are continuous throughout the 111 Ranch subbasin. Depositional setting of basin-fill sedimentation was restricted to a closed, asymmetric half-graben. Multiple depocenters throughout basin-fill deposition were controlled primarily by the Pinaleño fault. Proximal fan deposits in basin-fill units appear to be restricted to within a few kilometers from basin margins, and mid- to distal-fan, playa and lacustrine facies lie toward basin centers. The Pinaleño fault was active throughout basin-fill deposition, largely confining the location of subsiding basin centers to the southwest margin of the Safford basin. A southwest-dipping limb on the northeastern portion of the half-graben allowed the accumulation of proximal to distal alluvial fan facies to gradually thicken to the southwest in both basin-fill units. However, basin-fill facies and depocenters interpreted from seismic profiles reveal both lateral and vertical changes throughout the subbasin between basin margins. These changes are interpreted to be primarily driven by tectonism associated with the Pinaleño fault, more so than sedimentation rates, although the stratigraphy and structural history is not fully resolved (Kruger et al., 1995).

Lithologic and stratigraphic character of the LBF is poorly understood in the 111 Ranch subbasin, lacking sufficient well data. Parts of the LBF are unconformable with the overlying UBF along basin margins; however, this relationship is uncertain at depth in the subsurface. In general the LBF exhibits a higher degree of consolidation and deformation. The contact between the LBF and UBF is not clearly discernible from well data alone; therefore, interpretations from seismic by Kruger et al. (1995) were considered useful for constraining the depth of the base of the UBF across the subbasin. Based on construction of cross-sections from seismic and new geologic sections, thickness of the UBF and LBF

were determined. Thickness of the LBF ranges from only a few hundred meters along basin margins to 1,800 to 2,600 m near the basin center(s). Depth to the base of the UBF and top of the LBF ranges from 600 to 1,000 m bls along basin margins to 1,500 to 1,800 m near the basin center(s).

Well data in the LBF is limited to two oil and gas wells, 798 and 541, located along basin margins opposite of each other (Figure 31). In well 798 (Figure 34) sand, silt and clay are fairly uniform throughout the thickness of both basin-fill units (2,508 m or 8,230 ft-thick) (Harris, 1997). Grain size, composition and color were noted to be fairly uniform throughout the depth of well 798 with overall gneissic and granitic sources (Pinaleño Mountains). A density log for 798 shows an increased density at 550 m (1,800 ft) and remains fairly uniform to total depth. The 111 Ranch beds are interpreted to represent the upper 550 m, underlain by the Sanchez beds between approximately 550 and 1,100 m and Midnight Canyon beds from 1,100 to 2,285 m depth. These contacts are interpreted to be gradational and probably represent mid- and distal alluvial fan deposits of the Bear Springs Wash beds (Houser, 1990; Kruger et al., 1995). Bedding in the lower portion of the UBF (likely Sanchez beds) down to the base of the LBF (bedrock) uniformly dips 10 to 30-degrees to the west-northwest, presumably on the northwest flank of the anticline seen in cross-section Line 6 (Figure 34). Below 800 m depth in well 798 resistivity logs indicate relatively uniform fine-grained clastic sediments with prominent stringers of sand between 1 and 10 m thick. Between 1,100 and 1,370 m (3,500 and 4,500 ft) depth, resistivity is relatively uniform, increases below 1,370 m, and remains uniform from 2,500 m to the base of the LBF unit (bedrock).

Oil and gas well 541 is interpreted to penetrate the UBF and upper part of the LBF to a total depth of 1,067 m (3,500 ft). In well 541 the contact between the UBF and LBF is not easily distinguishable and appears to be gradational between lithologies in the two units; however, the contact is estimated to be between 500 and 1000 m bls from nearby seismic Line 4 (Plate 1). Lithology of the LBF in well 541 consists of predominantly anhydrite with brown and gray shale and lime with disseminated crystals of halite. Sparse salt beds are as much as 10 m (30 ft) thick. Fracturing below 940 m (3,140 ft) was noted at several intervals. Blue clay present in the upper 500 m is interpreted to represent the 111 Ranch beds; where the blue clay is lacking in the LBF. The interval between 500 and 940 m may correlate with the Sanchez beds, and lacks blue clay and fractures.

Stratigraphy of the UBF consists of the 111 Ranch beds and underlying Sanchez beds (Houser et al., 1985) in the 111 Ranch subbasin, equivalent to seismic units MP2 and MP1, respectively, of Kruger et al. (1995). The 111 Ranch beds consist of predominantly lacustrine blue and green clay with silt and sand beds; however, much of the 111 Ranch beds in the subbasin are characterized by alluvial-fan deposits of the Bonita Creek fan delta. The Bonita Creek fan delta is estimated to be approximately 730 km^2 and be Pliocene or earlier in age (Houser et al., 1985). Distal fan-toe deposits of the Bonita Creek fan indicate sustained perennial water flow, derived from the headwaters of Bonita Creek (Houser et al., 1985) and possibly the Gila River. The vertical and lateral extents of the Bonita Creek fan are poorly constrained and the Bonita Creek fan may have been a significant component in the depositional landscape throughout deposition of the UBF and possibly as early as the upper part of the LBF. The extent and possibly the thickness of the Bonita Creek fan is shown in cross-section DD’ determined from well data in this study (Figure 32).

Thickness of the UBF ranges from 1,000 to 1,500 m near the basin center on the southwestern margin of the 111 Ranch subbasin. The base of the UBF was determined from seismic profiles by Kruger et al. (1995), extended into cross-section EE' along the southeast margin of the subbasin (Figure 36). The upper part of the UBF in the subbasin is part of the 111 Ranch beds, including the Bonita Creek fan. Whereas, the lower part of the UBF may be equivalent to the Sanchez beds (Houser et al., 1985). At well M4 in cross-section DD' (Figure 32) lithology consists of thick beds of gypsum and halite with minor amounts of clastics, indicating a dry basin center (playa) in the lower part of the UBF. A nearby depocenter is also indicated in the northern part of Line 3A, 1.5 km to the southeast of well M4 (Plate 1). The evaporite deposits identified in well M4 may grade basinward into thicker evaporite and lacustrine deposits near and below the 800 m depth to the southwest (Figure 33).

Facies determinations across the 111 Ranch subbasin in basin-fill units were discernible from seismic data (Kruger et al., 1995). At least four types of subtle variations in amplitude and wave-contrasts were interpreted to represent facies packages across the subbasin (from Kruger et al., 1995, table 1). These four types are proximal coarse-grained fan facies (sf1); interbedded alluvial, fluvial and lacustrine deposits (sf2); interbedded laterally extensive lacustrine and fluvial deposits composed of evaporites and clastics (sf3); and thick, uniform accumulations of fine-grained lacustrine or alluvial plain deposits (sf4). Not all seismic facies are shown in accompanying figures. The seismic facies were useful in making interpretations about changes in depositional setting and evolution in response to tectonic uplift and/or subsidence versus sedimentation (and compaction) rates. For the purposes of this study to evaluate the potential for storage of CO_2 below 800 m in structural and sedimentary environments, the seismic facies are useful for demonstrating the location of depocenters, contrasting lithology types, thicknesses and lateral and vertical facies changes across the subbasin.

Summary

The 111 Ranch subbasin is the deepest subbasin in the Safford basin, where much of the LBF represents a significant volume of the basin-fill sediments below the 800 m depth. Both UBF and LBF units are continuous throughout the subbasin; however, subsurface data are limited to few deep wells and seismic reflection data. Both the upper and lower basin-fill units in the subbasin exhibit some deformation such as folds and tilted bedding associated with renewed uplift of the Pinaleño Mountains and subsidence of the Safford basin. In general the LBF exhibits a higher degree of consolidation, fractures, faults and folds. Anticlinal folds in the LBF and UBF along the southwest margin of the subbasin are of uncertain origin.

Information about stratigraphic relationships and depositional history in basin-fill units across the 111 Ranch subbasin is derived largely from a cluster of five seismic lines and only two deep oil and gas wells. The LBF and lower portions of the UBF lie below 800 m depth and represent a significant volume of potential storage of CO_2. Both basin-fill units appear to be continuous across the subbasin, delineated by seismic profiles; however, the UBF/LBF contact is not easily discernible in detailed geologic and geophysical logs along the southwest and southeast basin margins. Nonetheless, thickness of the basin-fill units could be determined across the subbasin. Depth to the base of the UBF and top of the LBF (thickness of the UBF) ranges from 600 to 1,000 m along basin margins to 1,500 to 1,800 m depth near the basin center. Thickness of the LBF ranges from only a few hundred meters along basin

margins to approximately 1,800 to 2,600 m near the basin center. Lithologies in the LBF consist of predominantly fine-grained clastic sand, silt and clay along the southwest margin in well 798 and grade rapidly into playa and lacustrine basin centers within 4 to 7 km northeast of the Pinaleño Mountains. On the southeast margin of the subbasin the LBF consists of evaporite deposits in a playa setting approximately 5 to 7 km from the Whitlock Mountains. No wells penetrate the LBF near or below 800 m depth in the thickest and deepest parts of the subbasin. Seismic facies in this portion of the subbasin indicate extensive and uniform accumulations of lacustrine and distal alluvial sediments (Kruger et al., 1995). Based on available well and seismic data, physical conditions and lithologies of the LBF and lower UBF units suggest conditions for storage of CO_2 are potentially favorable in the subbasin.

6.4 San-Simon Subbasin

The San-Simon Subbasin is the largest of the subbasins in the Safford basin with an area of 2,669 km^2 (1,031 mi^2). The subbasin is bound on its southwest margin by the southern Pinaleño, Dos Cabezas, and Chiricahua mountains, and the Railroad, Apache and San Bernardino mountain passes (Figure 37). Bedrock along these mountain blocks consists of Proterozoic through early Cenozoic igneous, metamorphic and sedimentary consolidated and cemented rocks with a complex range of age, lithology and structure. In contrast, relatively undeformed and widespread mid-Tertiary volcanic rocks make up the northern Peloncillo Mountains, bordering the northern margin of the Safford basin.

Of the 327 wells below 400 ft bls only seven (7) wells (all oil and gas wells) were drilled below 800 m depth. All other wells in the San Simon subbasin are less than 600 m deep. A total of five transverse cross-sections and the southern half of longitudinal cross-section K-K' were constructed for the subbasin (Figure 37). Cross-sections constructed in the area by previous researchers include Freethey et al. (1986) and Drewes et al. (1985). Basin-fill deposits in the southernmost terminus of the subbasin, south of the town of Portal, are above the 800 m depth and were not evaluated. Fifteen seismic lines are known to intersect all or part the subbasin (not shown in figures or plate); however, no published accounts or interpretations of these seismic lines were identified.

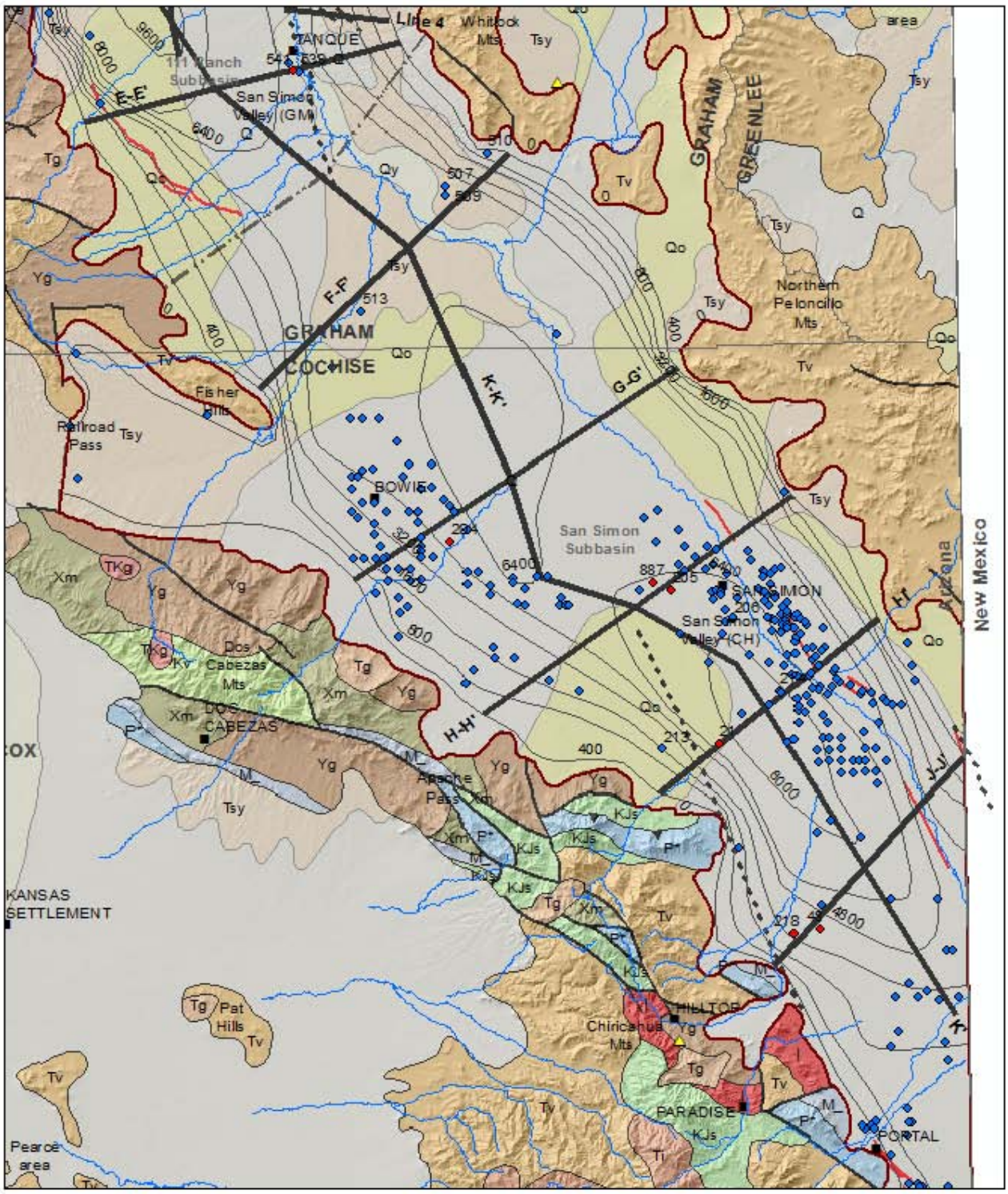

Figure 37. Geologic map and location of cross-sections in the San Simon subbasin. Northern boundary of the San Simon subbasin is a dash-dotted line; southern boundary cropped (see Figure 23). See Plate 1 for detailed legend. North to top. Scale not shown.

Structural Geology

Bedrock geometry in the San Simon subbasin appears to be symmetrical with steep bedrock margins and relatively flat basin floors (Figure 37). Near the town of San Simon, Drewes et al. (1985) inferred high-angle normal faults from aeromagnetic and gravity data on opposite margins of the basin, concealed in the subsurface. A series of Plio-Pleistocene faults and escarpments are located on the northeast margin of the subbasin and along the southernmost margin at the base of the Chiricahua Mountains (Machette et al., 1986) (Figure 37). The relatively continuous steep gradient of bedrock along the north and south basin margins implies that structural relationships are similar to those observed in the 111 Ranch subbasin and Bear Springs subbasin. Otherwise, little is known about the timing and location of geologic structures on either side of the subbasin as it relates to basin subsidence and sedimentation. The depth and structure of consolidated rocks below basin fill (and below the horizon of well data) are poorly understood. The location and extent of the detachment fault is also unclear (Swan, 1976), and faulted Paleozoic sedimentary rocks are likely present at depth (Drewes et al., 1985). The origin and structure of the wide, flat basin floor in the northern part of the San Simon subbasin is unknown, but the basic geometry suggests inward-dipping normal faults on the flanks of the basin, as in a graben. However, no faults are known on the margins of this basin that support this interpretation.

Stratigraphy

The basin-fill units are interpreted to extend from the 111 Ranch subbasin into the San Simon subbasin; however, oil and gas wells interpreted to be partly in the LBF in the 111 Ranch subbasin are 13km from the nearest well in the San Simon subbasin. Thus, stratigraphy inferred along the southeastern margin of the 111 Ranch subbasin was extended to the northeast margin of the San Simon subbasin in cross-section FF’ (Figure 38). Here, oil and gas wells 507 and 509 (corresponding to OGCC wells 5-07 and 5-09) (Plate 1), were drilled through the UBF into the upper part of the LBF. In well 507 oil and gas showings were encountered near the surface to the total depth of the well at 467 m (1,532 ft). Clay, limestone and shale grade into increasing accounts and thicknesses of gypsum and shale to 437 m (1,436 ft), interpreted to represent lacustrine deposits of the 111 Ranch beds grading into possibly the Sanchez beds. Hard conglomerate and sand was encountered at 437 m to the total depth, interpreted to be the uppermost part of the LBF. This horizon near 440 m is similar to the UBF/LBF contact 14 km to the north near seismic Line 4, with the UBF/LBF contact at ~450 m bls the same distance from the bedrock margin (Plate 1).

In section FF’, oil and gas well 509 is 700 m south of well 507 and has a nearly identical lithologic record with a TD of 560 m (1,837 ft) (Figure 38). “Salt water” was encountered at several intervals of sand and gravel between 195 and 411 m (640 and 1,350 ft) and “fresh artesian water” from a six-foot interval at 330 m (1,080 ft). Sandstone and conglomerate predominated below approximately 427 m (1,400 ft) and is interpreted to coincide with the top of the LBF unit. Oil and gas well 510 (corresponding to OGCC well 5-10) on the northeast margin of section FF’ encountered hard red conglomerate between 116 to 156 m (TD) (382 and 515 ft), possibly the LBF close to the surface. The UBF/LBF contact is down-gradient to the southwest, however, the location of any basin center(s) and stratigraphy is speculative and uncertain in this area of the San Simon subbasin. Wells on the southwestern margin of section FF’

are predominantly lacustrine clay to a maximum depth of 240 m, interpreted to be equivalent to the 111 Ranch beds.

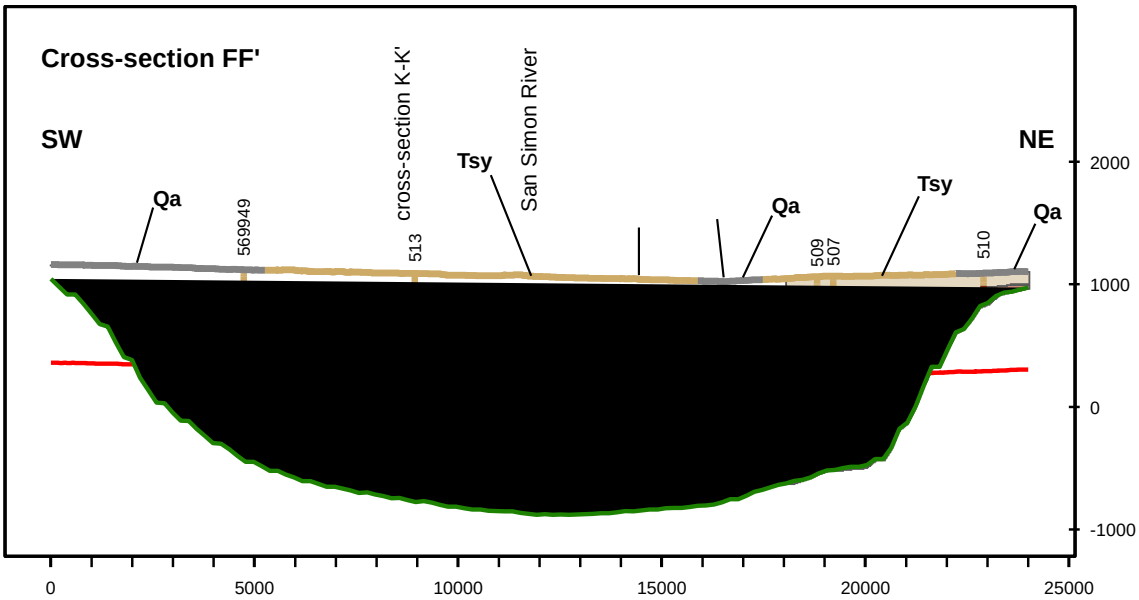

Figure 38. Geologic cross-section FF' across the San Simon subbasin. Horizontal scale in meters distance from beginning of section. Vertical scale in meters above mean sea level, exaggerated 3.0x. See Plate 1 for detailed legend.

In the vicinity of cross-section GG' near the town of Bowie, several shallow wells are drilled into the UBF (Figure 39). In this area sandy and gravelly blue clay is present between 60 and 150 m (200 to 500 ft) bls, interpreted to represent lacustrine deposits of the 111 Ranch beds. These lacustrine deposits sharply overly semi-consolidated and cemented deposits of coarse sand, gravel and conglomerate to a depth of at least 580 m (1,900 ft) (only oil and gas well 204 extends beyond this depth in this area). The extent and thickness of the 111 Ranch beds indicate the basin center in the uppermost UBF lies east of this well field, but restricted to depths greater than 150 m (500 ft) and probably less than 300 m (1,000 ft). The semi-consolidated, coarse-grained deposits below the 111 Ranch beds are interpreted to represent proximal to mid-fan deposits derived from westerly source terrain (granite and rhyolite lithologies noted in driller logs); however, correlating these deposits with the Sanchez or Midnight Canyon conglomerate is difficult. Instead, this coarse-grained facies may represent facies similar to the Bear Springs facies which span deposition of both UBF and LBF observed in the 111 Ranch subbasin along the southwest margin of the basin (Houser, 1990). It is likely that Freethey et al. (1986) picked the contact between an upper and lower basin fill based on this relatively sharp contact in the area of San Simon (Figure 40).

Oil and gas well 204 in section GG' was drilled to a TD of 1,253 m (4,110 ft) (Figure 39). The base of the 111 Ranch beds is picked at 97 m (320 ft) overlying coarse sand and gravel interpreted to represent the fan deposits previously described to a depth of 308 m (1,010 ft). Below 308 m and throughout the depth of the well the lithology consists of predominantly hard red shale, sandstone and limestone. The presence of gas, oil and sulfide odors and minerals (pyrite) were noted below 490 m

(1,600 ft) to the TD of the well (1,253 m). The contrast in lithologies at 97 and 308 m may represent portions of both basin-fill units, with the fanglomerate deposit correlative with the Sanchez beds in the UBF and the underlying sandstone, shale and limestone correlative with a marginal lacustrine facies of the Midnight Canyon conglomerate or the LBF unit (Kruger et al., 1995).

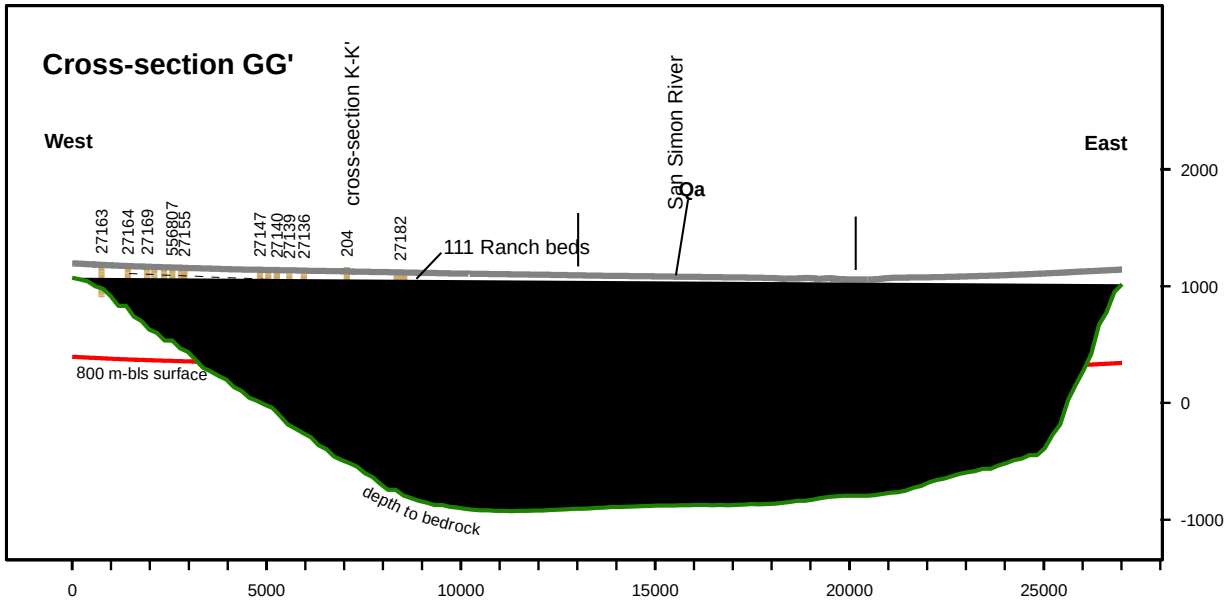

Figure 39. Geologic cross-section GG'. Horizontal scale in meters distance from beginning of section. Vertical scale in meters above mean sea level, exaggerated 3.0x. See Plate 1 for detailed legend.

In a cluster of wells near the town of San Simon, a total of 4 (four) of the 163 wells were drilled below 800 m depth. The remaining wells were drilled no deeper than 600 m. Cross-sections HH', II', JJ' and KK' were constructed through this area supplemented by the four deep oil and gas wells. Drewes et al. (1985) constructed a generalized and hypothetical cross-section through the same area. Several of the shallow wells above 600 m depth encountered artesian conditions. The depth to bedrock in this part of San Simon subbasin is modeled from gravity to be approximately 2,670 m (8,770 ft) deep; however, oil and gas well 887 located near the 6,400-feet depth-to-bedrock contour is possibly completed in basin fill sediments interbedded with volcanic flows shallower than projected bedrock. Well 206 is in an area of the basin estimated to be approximately 2,130 m (7,000 ft) deep; however, this well has interbedded lava flows in the basin-fill unit. Thus, depth-to-bedrock in this area is not fully resolved, especially if volcanic rocks interbedded with basin-fill were not modeled into the gravity data.

Oil and gas well 887 penetrates basin fill and older consolidated rocks to a TD of 2,670 m (8,770 ft), as indicated in section HH' (Figure 40). An abbreviated drillers log and suite of geophysical logs are available for this well in the AZGS archives, and are summarized in Appendix B. A distinction between upper and lower basin fill units was not possible given the high quality of available logs; however, the upper 365 m (1,200 ft) is interpreted to be equivalent to the upper basin fill and 111 Ranch beds. Between 365 and 1,756 m (1,200 and 5,760 ft) the lithology consists of predominantly loose, unconsolidated fine- and coarse-grained siliciclastics with a calcareous component throughout, with several beds of marl, limestone, chalky limestone and dolostone beds. A significant component of the

clastic material is derived from volcanic sources, with minor input from granitic sources. Electric logs in well 887 between 365 and ~900 m (1,200 and 3,000 ft) indicate relatively uniform basin fill stratigraphy with few sharp contrasts, although individual bedding thicknesses are discernible within 5-ft intervals. Gamma and porosity logs in well 887 between 884 and 1,219 m (2,900 and 4,000 ft) indicate a range of contrasting lithologies within basin fill strata, both porous and non-porous. Thickness of these variations in stratigraphy and porosity average 12 m (40 ft). Below 1,756 m depth are a mixture of loose- to well-consolidated, moderately-cemented to well-cemented (indurated and welded in some cases) sedimentary and volcanic rocks interpreted to be bedrock; however, the distinction between bedrock and basin-fill with interbedded volcanic flows may be problematic.

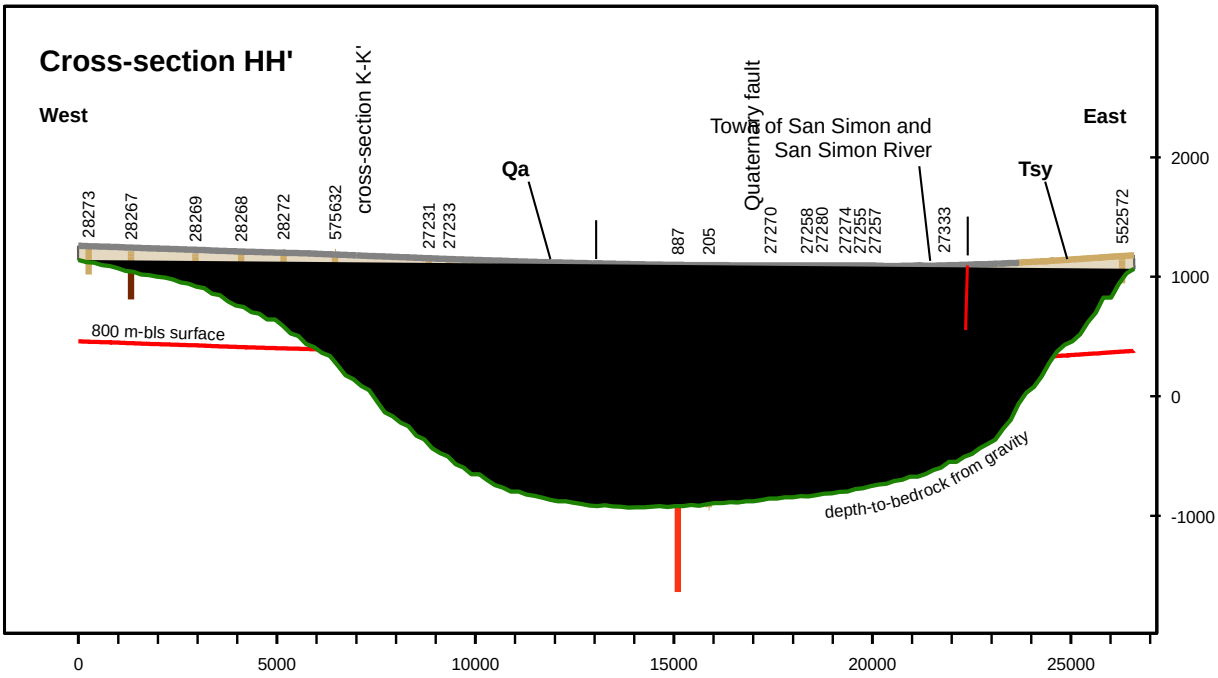

Figure 40. Geologic cross-section HH'. Horizontal scale in meters distance from beginning of section. Vertical scale in meters above mean sea level, exaggerated 3.0x. See Plate 1 for detailed legend.

One of the deep wells in the San Simon subbasin, oil and gas well 206 with a TD of 1,248 m (4,095 ft), yielded a suite of subsurface data not projected in cross-sections HH' and II' (see Figure 37 for location of well 2-06). A driller log, geologist log, logs from memory, and core fractions in the AZGS repository all make up an incomplete well record for well 206. However, some important distinctions can be made regarding lithology and stratigraphy. Lithology in well 206 consists of predominantly sand, silt and clay to 237 m (780 ft) depth (111 Ranch beds) overlying coarse sand, hard clay and conglomerate to 262 m (860 ft) (LBF-?). Between 262 and 527 m (860 and 1,728 ft) no lithologic intervals are recorded; however, Harris (1997) summed cuttings from the interval between 61 and 534 m (200 and 1,750 ft) as consisting of predominantly (>50% fraction of cuttings) poorly sorted angular sand from mostly volcanic and minor Paleozoic and granitic sources; the less than 50% fraction of cuttings is generally well-rounded sand grains under 2 mm with no apparent fines in the samples. Twenty-three (23) cored intervals of unknown depths all consist of volcanic rock (tuff, basalt and rhyolite) and sedimentary breccia. A geologist log is recorded between 527 and 1,248 m (1,728 and 4,095 ft) (TD), where the base

of the basin-fill deposits was picked at 1,142 m (3,748 ft) overlying volcanic sand and felsite. The interval between 527 and 1,248 m (1,728 and 4,095 ft) consists of consolidated conglomerate and sand (from volcanic-rich sources), with at least one “igneous rock” interbedded with basin-fill between 596 and 606 m (1,955 and 1,990 ft). Depth-to-bedrock determined from gravity is estimated to be at 2,254 m (7,395 ft), 1,112 m below bedrock picked in well 2-06, a significant discrepancy. The presence of the interbedded igneous rock raises questions about the lower 100 m of volcanic rock belonging to either mid-Miocene or older volcanic rocks or the LBF unit. The possibility that depth-to-bedrock is approximately 1,100 m higher than modeled gravity is possible but uncertain. Aeromagnetic data (Andreasen et al., 1966) indicate a locally strong, northwest-trending gradient in gamma data which strikes between well 887 and 2-06, possibly indicating a structure that allows the apparent offset in basin-fill observed between the two wells (Figure 37). Otherwise, the depth-to-bedrock and extent of the LBF remains uncertain in the area of well 2-06.

Along section II’ oil and gas well 21 provides the only deep well to penetrate basin fill (Figure 41). Unfortunately well 21 has poor and insufficient lithologic data indicating only “gravel and conglomerate” between 192 and 2,306 m (630 and 7,568 ft). Spontaneous potential and electric logs throughout the entire depth of well 21 indicate a fairly uniform stratigraphy and lithology, with minor contrasts in bedding over the depth of the well.

Oil and gas well 214 in section II’ consists of predominantly clay in the upper 244 m (800 ft), interpreted to correlate with the 111 Ranch beds. Between 244 and 530 m (800 to 1,740 ft) depth the lithology consists of predominantly sand and gravel with minor clay and limestone. Granite and limestone clasts were noted, possibly indicating southwesterly sources in the Chiricahua Mountains and a basin center to the northeast. Between 530 to 610 m (1,740 to 2,000 ft) (TD) cemented gravel, sand and clay are possibly equivalent to the LBF unit.

Heavy showings of oil and gas were noted in the westernmost part of section II’ in oil and gas well 213 at shallow depths of 120 m. Several wells in section II’ near the San Simon River drilled through predominantly blue and brown clay (111 Ranch beds) into cemented sand and gravel at depths approaching 200 to 290 m (650 to 900 ft), and under artesian conditions. The coarse material underlying the overlying clays may be equivalent to fanglomerate deposits equivalent to the lower part of the UBF or the upper part of the LBF, although this remains uncertain. The oil showings and artesian conditions on the southwestern margin of section II’ may also indicate tilted bedding, inclined to the northeast, allowing groundwater flow to migrate southwesterly.

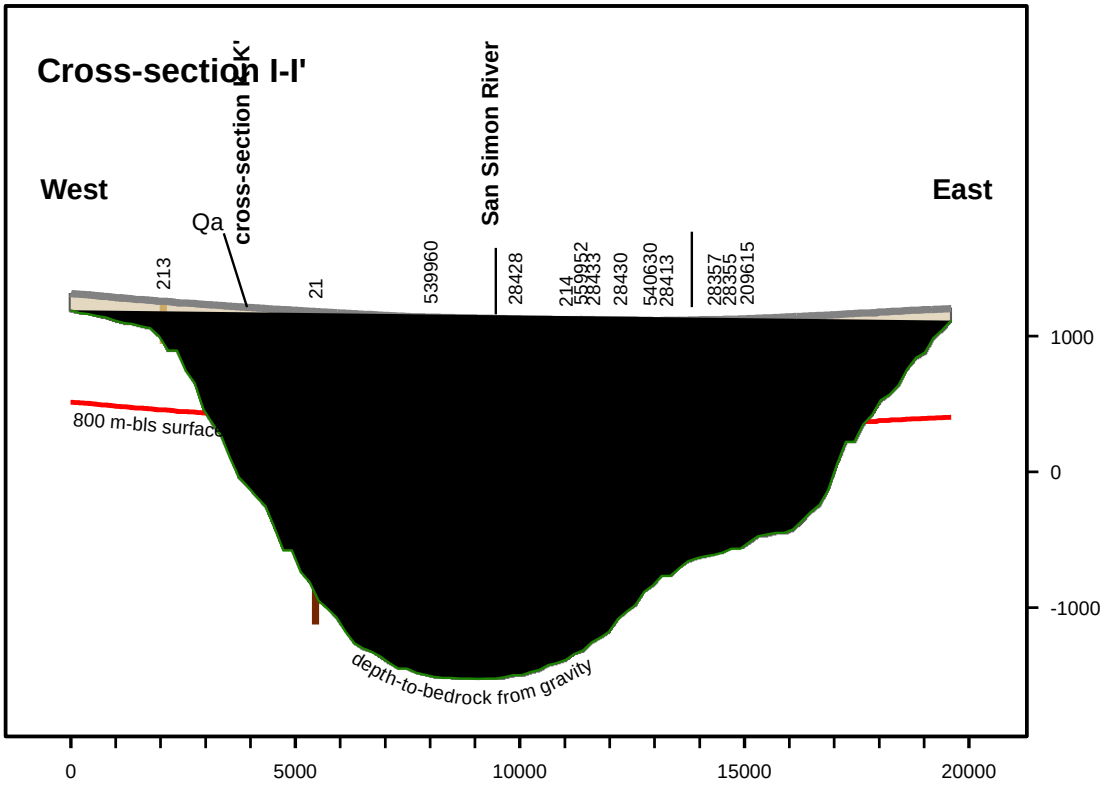

Figure 41. Geologic cross-section along II'. Horizontal scale in meters distance from beginning of section. Vertical scale in meters above mean sea level, exaggerated 3.0x. See Plate 1 for detailed legend.

Along section JJ', oil and gas well 218 drilled to a TD of 1,631 m (5,350 ft) (Figure 42). However, the interval between 853 and 981 m (2000 to 3,219 ft) has the only recorded lithology. Between 853 and 981 m in well 218 the lithology consists of predominantly lime marl and red, sandy lime. Oily colors and temperature of 120 F were noted in this 128-m (420-foot) interval. Diatomaceous clay was noted at 868 m (2,847 ft) depth. Several other intervals were indicated as being porous in a gamma-neutron log between 300 and 1,630 m (1,000 and 5,350 ft). The upper 3,219 ft is interpreted to be basin-fill sediments which correspond with depth-to-bedrock. The logged interval between 2,799 and 3,219 ft is interpreted to be equivalent to LBF given the depth and location of bedrock. Others wells in the vicinity of section JJ' were predominantly completed coarse sand, gravel and conglomerate with clay above 427 m (1,400 ft) depth. Many of these wells noted an increase in consolidation and broken conglomerate below approximately 320 m (1,000 ft) depth.

OG well 48 is completed to a TD of 1,656 m (5,434 ft) in section JJ' (Figure 42). Basin fill overlies rhyolitic and latitic rocks at 933 m (3,060 ft) depth. The upper 549 m (1,800 ft) of an otherwise high-quality geologist log is missing. The interval between 549 and 1,656 m (1,800 and 3,060 ft) consists of predominantly poorly sorted conglomerate interbedded with claystone and sandstone, interpreted to be equivalent to the LBF unit based on adjacent wells. Claystone with calcareous nodules, and tuffaceous sand and bentonite were also noted in the lower portion of well 48, indicating both permeable and impermeable conditions. Between 549 and 747 m (1,800 and 2,450 ft) the lithology is

almost entirely poorly sorted, loose conglomerate. Bed thicknesses range between 2 and 10 m and average about 5 m thick in oil and gas well 48.

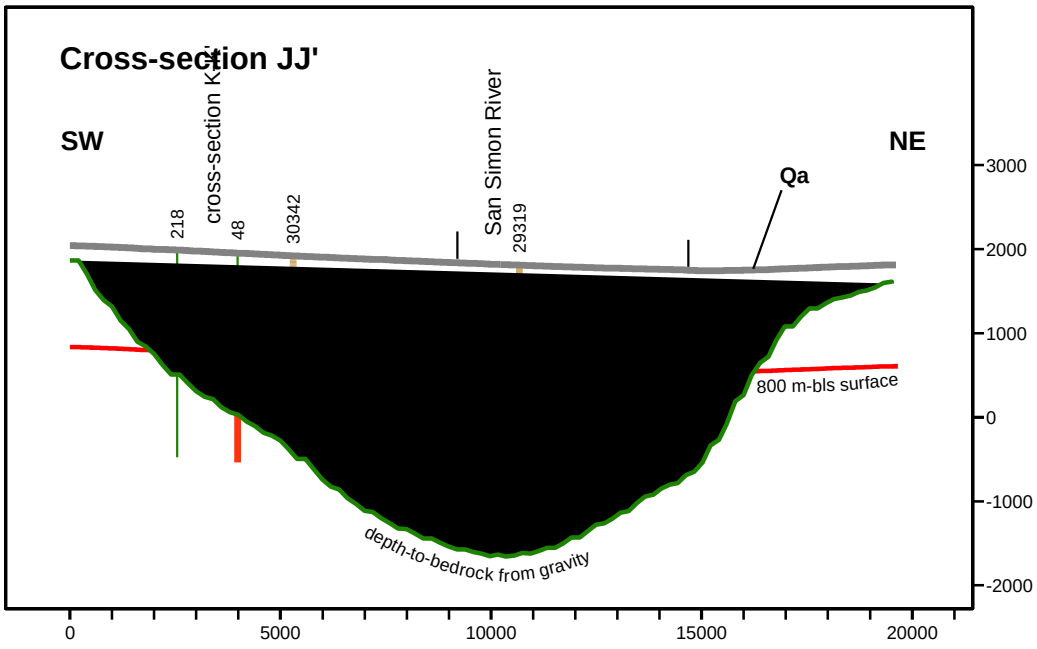

Figure 42. Geologic cross-section JJ'. Horizontal scale in meters distance from beginning of section. Vertical scale in meters above mean sea level, exaggerated 3.0x. See Plate 1 for detailed legend.

Summary

The San Simon subbasin is the largest of the subbasins in the Safford basin, representing the largest volume of basin fill sediments. Basin fill units from the 111 Ranch subbasin project into the San Simon subbasin from the northwest and appear to extend throughout the extent of the subbasin to its southern terminus with the Chiricahua and northern Peloncillo mountains. Bedrock in the subbasin appears to be a largely symmetrical basin bound by high-angle normal faults. Although fifteen seismic lines intersect the subbasin, no known accounts of seismic studies have imaged the subbasin. Deep well data near and below the 800 m depth are limited to only seven oil and gas wells in the subbasin. Thus, the basin-fill stratigraphy and structure is poorly understood in the subbasin.

Depth to bedrock in the San Simon subbasin modeled from gravity differs from bedrock picked in some OG wells, especially where lava flows are known or suspected to be interbedded with basin fill. Lava flows interbedded with basin fill could significantly underestimate the actual depth to the base of basin fill deposits in the subbasin. In the case of oil and gas well 2-06, bedrock is 1,100 m (3,600 ft) higher than modeled from gravity data. Further research and additional data are needed to resolve this data point and relationships between basin fill and interbedded lava flows in the LBF.

A large basin center northeast of the town of Bowie is devoid of wells, thus the location and presence of evaporite and lacustrine deposits in basin centers within basin fill remains unclear. In the area of Bowie a fanglomerate facies underlying the 111 Ranch beds appears to be present in the upper and possibly the lower basin fill; however, this is well above the 800 m depth. Although the presence of

the clay-rich 111 Ranch beds is fairly well defined throughout the San Simon subbasin, this unit is restricted to relatively shallow depths of approximately 300 m (1,000 ft). Confined groundwater and artesian conditions appear to be closely related to the 111 Ranch beds and underlying alluvial sand, gravel and conglomerate deposits in many areas of the San Simon subbasin. An increase in the degree of consolidation and cementation underlying the 111 Ranch beds in many but not all parts of the San Simon subbasin suggest the LBF may lie at shallow depths. However, distinctions between the UBF and LBF are unclear. Where the LBF is interpreted in cross-sections throughout the subbasin, lithology of the LBF is overall fine- to coarse-grained alluvial deposits and varies considerably from coarse-grained conglomerate and breccia to chalky limestone and marl. The lack of well data precludes resolution of vertical and lateral facies trends. The composition of clasts in most wells is derived from predominantly volcanic source terrains with minor input from granitic and Paleozoic sedimentary rocks. Portions of the LBF to depths of at least 1,800 m near the San Simon basin center consist of limestone, dolostone and marl intermixed with relatively thick alluvial deposits. These deposits indicate a closed basin setting with lacustrine and alluvial margins in a closed basin.

Potential storage of CO_2 in permeable basin fill sediments does exist in the San Simon subbasin below 800 m depth. However, no clearly defined and continuous sealing unit is apparent. The potential for sealing conditions likely exist, such as clay and evaporite deposits. Evaporite deposits such as salt and gypsum appear to be absent or insignificant in the southeastern portion of the subbasin near San Simon, possibly due to narrow basin geometry. The only account of salty water in the subbasin was reported northeast of Bowie in oil and gas well 509 and may indicate evaporite deposits associated with the basin center to the south; however, no deep wells are drilled in the basin center northeast of Bowie.

7.0 Target Formation and Seals

Based on available subsurface data in the Safford basin, the potential for storage of CO_2 exists below the 800 m depth in basin fill sediments. Portions of the upper basin fill (UBF) and lower basin fill (LBF) lie below the 800 m depth level and consist of fine-grained evaporite and clastic deposits near basin centers, gradually coarsening into fanglomerate deposits along basin margins. Extensive sheets of clastic alluvial-fan facies (proximal, mid-fan and fan-toe facies) combined with playa evaporites and lacustrine clay and limestone, create both permeable and impermeable conditions under confined and unconfined groundwater conditions. Well data from a few oil and gas wells in the Safford basin show that portions of the LBF below 800 m consist of predominantly loose to moderately consolidated, permeable sediment which may serve as a potential target for CO_2 storage. Scarce neutron and porosity logs below 800 m depth indicate porosities range from less than 5% to as much as 20% (in the San Simon subbasin). Seismic reflection studies in the Bear Springs subbasin and 111 Ranch subbasin suggest multiple facies changes vertically and laterally in relatively undeformed basin fill sediments below 800 m depth. These stratigraphic relationships are likely present throughout much of the Safford basin, although further seismic analyses are needed to confirm this. Although the LBF or portions of the LBF are potentially favorable as a CO_2 sequestration target, no clearly defined permeable formations or bodies were mappable at the subbasin scale.

Sealing sediments such as clay, evaporite and carbonates appear to be associated with the basin centers in both the UBF and LBF in portions of each subbasin except the San Carlos subbasin. The extent and thickness of these relatively impermeable deposits appear to be limited to individual beds that grade laterally over short distances into clastic facies. While sealing conditions from impermeable lithologies (clay, salt, and gypsum) are present near and below the 800 m depth, delineating potential sealing units or bodies was not discernible from the available data.

Seismic reflection studies have been effective at discerning facies distribution and extent, folds, and faults in basin fill, especially in the 111 Ranch subbasin. Where seismic and well data are relatively closely spaced, these data suggest that the potential for sealing conditions below the 800 m depth is present locally but discontinuous basinwide. Groundwater flow under confining conditions is prevalent at shallow depths in the Bear Springs subbasin, 111 Ranch subbasin and San Simon subbasin associated with the clay-rich 111 Ranch beds, especially along Plio-Pleistocene faults near basin margins. Geothermal and saline groundwater is also associated with these faults, derived from the UBF and possibly the LBF. Although isotopic and water quality studies indicate artesian leakage across relatively impermeable units in the upper basin fill exists (Harris 1999, 2000) (discussed further in section 9), it is not clear how well interconnected the upper and lower basin fill units are throughout the depth of basin.

8.0 Storage estimates

Spencer (2011) provided calculated estimates of basin-fill volume and volume below 800 m depth in the Safford basin 800 m. Although conditions favorable for storing and sealing CO_2 exists in the Safford basin, the lack of sufficient subsurface data limited the ability to calculate storage based on the criteria outlined in this evaluation (such as iso-salinity boundaries below a capping unit in a target formation). Thus, calculations of CO_2 storage volume below cap rocks were not feasible.

During this evaluation minor changes to the depth-to-bedrock contours were made from Richard et al. (2007), resulting in a slight increase in basin volumes. Thus, a brief comparison of sediment volumes below land surface and the 800 m depth level were made using ArcMap methods outlined by Spencer (2011). The storage of basin fill sediments below land surface to the newly modified depth to bedrock resulted in 5,228.7 km^3, an increase of 1.4% from the previous calculation of 5,157.6 km^3. The volume below 800 m in basin fill was recalculated at 2,318.9 km^3, a 0.9% increase from Spencer's 2,296.0 km^3.

9.0 Salinity data

The focus of this groundwater salinity study is to determine if, and at what depth, salinity values exceed 10,000 mg/L TDS in formations below 800 m depth with potential to store CO_2. Little is known about deep saline aquifers or their groundwater in basins within the Basin and Range province. Two slightly different queries were performed to acquire salinity data for the Safford basin during separate phases of this research. First, salinity data for groundwater were queried from only wells in state and federal databases used to identify regional or sub-regional relationships between salinity and depth, as discussed in Section 9.1. Second, salinity data for groundwater from both wells and springs within the Safford basin were gathered and compiled from various published and unpublished sources, as discussed further in Section 9.2. Methods and approach used to gather salinity data are discussed in Section 2.0.

9.1 Statewide Salinity

A statewide query of existing water-quality parameters from state and federal databases reveal the scarcity of deep-basin water-quality data. Salinity data for wells with total depth either above or below the 800 m depth are illustrated in Figure 43. Data used to generate Figure 21 were screened by wells completed at depths greater than 800 m with any reported salinity and wells above 800 m only with salinity greater than 5,000 mg/L.

General assumptions that project an increase in salinity with depth may not hold true within saline formations regionally or within a particular basin. In order to identify a potential relationship between salinity and depth in wells across Arizona, including within the Safford basin, data used to generate Figure 43 were plotted in Chart 6. Because screened-interval data are mostly unavailable for these select wells, salinity data are plotted against the total well depth, thus salinity values reflect a maximum depth, rather than a discrete screened interval of the well.

Excluding the Colorado Plateau, salinities in Cenozoic basins range widely in TDS concentration and depth. A trend between salinity and depth is not apparent. However, downward percolation of saline water from irrigation recharge is known to elevate salinity in agricultural basin settings in the Basin and Range province, including the Safford basin (ADWR and ADEQ, 2009). Since most irrigation wells are generally no deeper than approximately 610 m (2,000 ft), then the upper 610 m (2,000 ft)of salinity data can be ignored for the purposes of analyzing salinity within a basin or region within the Basin and Range Province. Unfortunately, the quantity of salinity data available for the Safford basin is insufficient to determine depth vs. salinity trends. Therefore, projecting iso-contours for salinity values of 10,000 mg/L were not possible for the Safford basin.

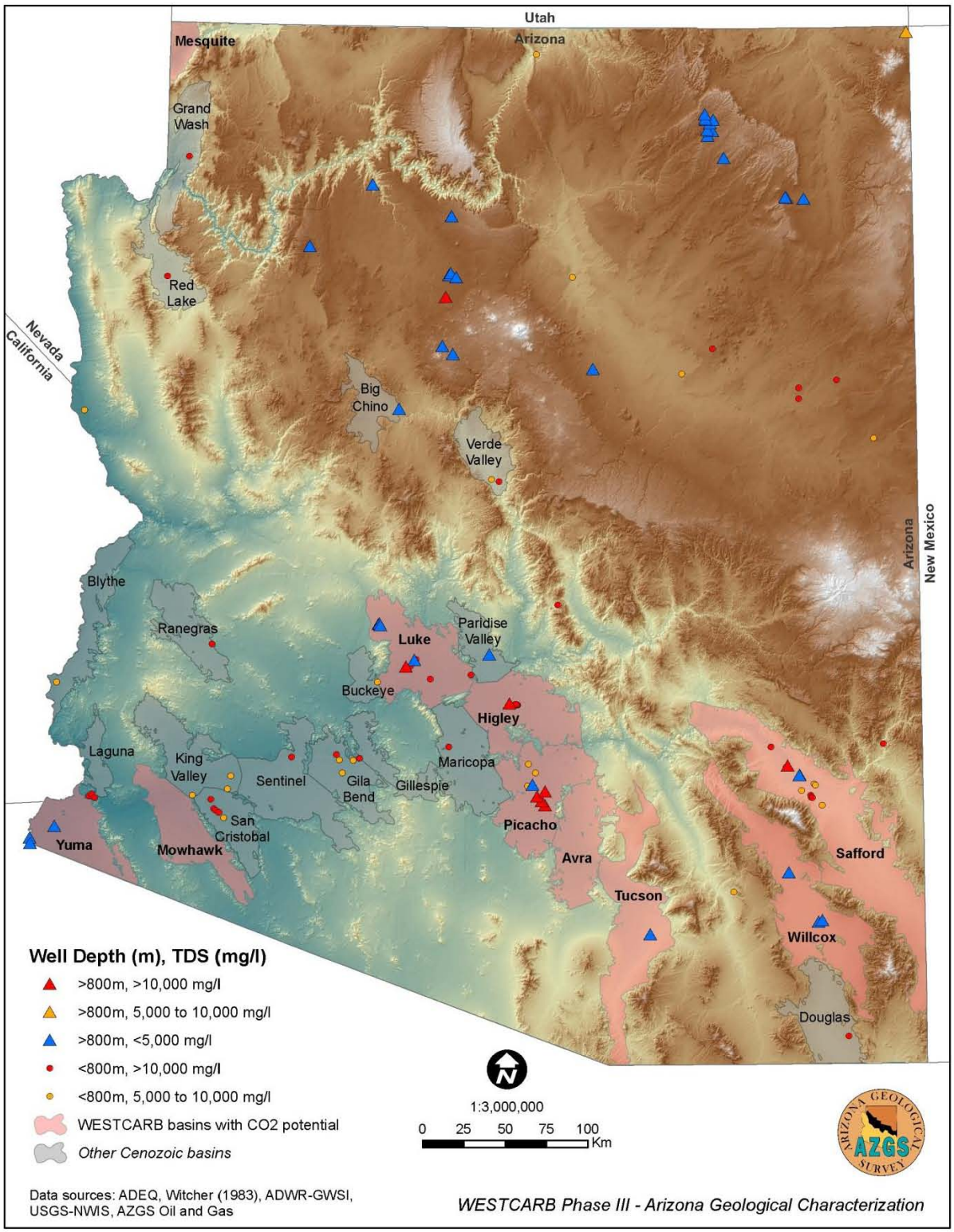

Figure 43. Saline groundwater in Arizona above and below 800 m depth.

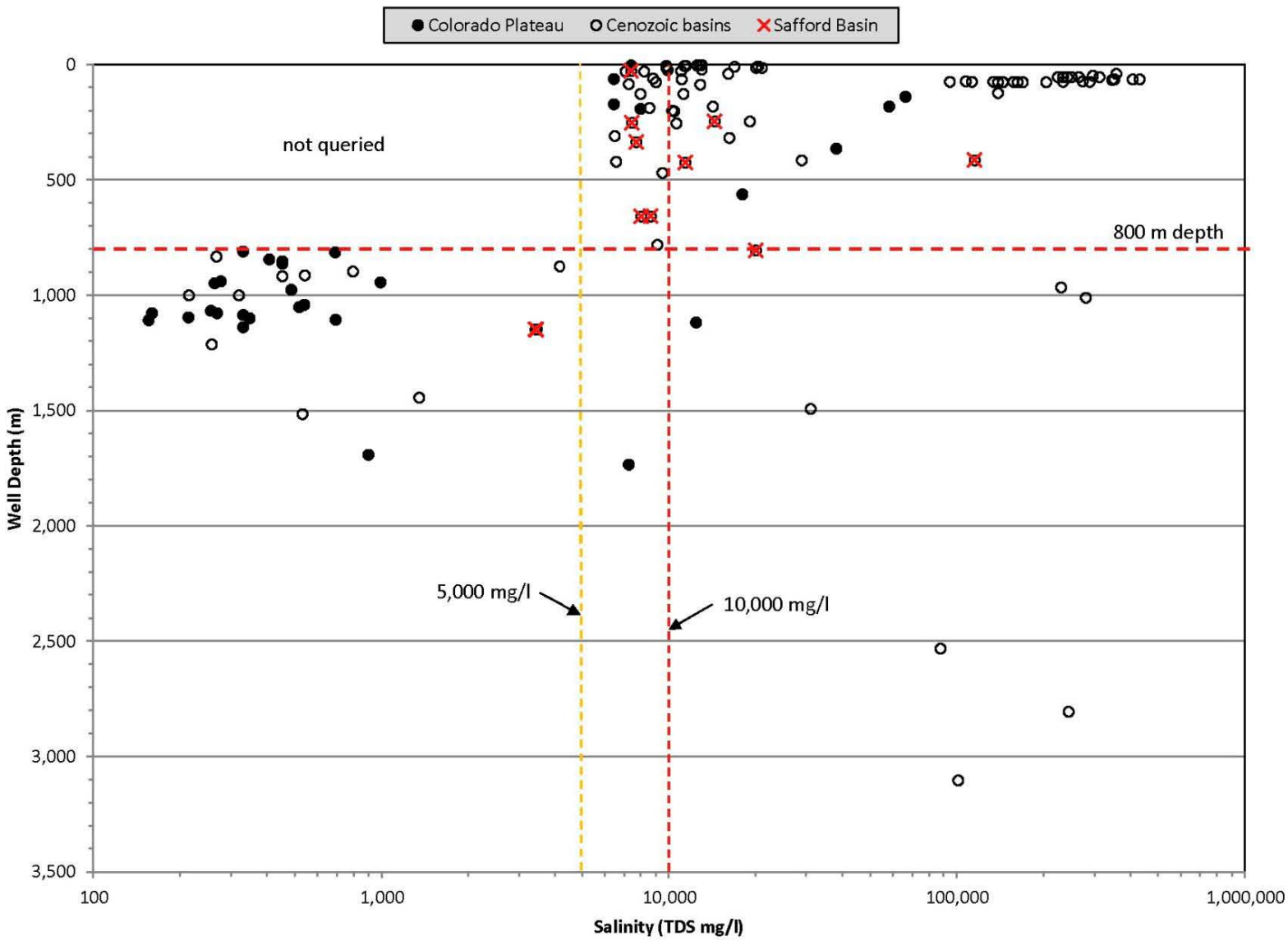

Chart 6. Well depth versus salinity in wells across Arizona and in the Safford basin plotted in Figure 43.

9.2 Results

Salinity data for groundwater within the Safford basin are scarce for wells greater than 800 m in depth (Figure 44). In addition, only a small fraction of all well and spring data compiled have TDS greater than 10,000 mg/L. Data were screened for the Safford basin and subbasins based on the aforementioned criteria; qualifying data was compiled and mapped in Figure 44 and summarized in Table 4. Complete details for these wells were formatted for submission to the National Carbon Sequestration Database and Geographic Information System Atlas III database (Appendix C).

Only five oil and gas exploration wells had salinity data from below or near the 800 m depth level, and only one well yielded water with TDS greater than 10,000 mg/L below the 800 m depth level. A total of six locations in Safford basin had TDS greater than 10,000 mg/L and all of these are in Bear Springs Subbasin, including three springs. Due to the lack of salinity data and uncertainty of salinity sources within the well (such as depth of screened intervals and aquifer), identifying a relationship between basin fill units and sources of salinity is unclear; however, it is known that groundwater with very high salinity of approximately 115,000 mg/L TDS is present in the UBF unit (Witcher, 1982). In one well completed in the UBF, higher salinity groundwater of about 20,000 mg/L TDS is present near 300 m depth, where lower salinity of about 5,500 mg/L TDS values is present near 730 m depth, interpreted to be in the UBF unit. (oil and gas well 503 in cross-section AA' in Plate 1, and Table 4).

Based on available driller log data, sources of salinity appear to be derived gypsum and salt deposits in the both the UBF and LBF. There are several notes made in driller's logs which indicate salty water at depth throughout the Safford basin. Although vague and mostly above the target depth, some references to salty water are worth mentioning. For example, the driller's log for well 205 in the San Simon subbasin reads "lime with salt water that raised 350' [feet]" between 5,250 and 5,255 feet depth (Appendix B).

Chloride concentrations were recorded during drilling below 800 m depth at multiple depths in two deep oil and gas wells in the Safford basin (wells 798 and 887); however, these chloride measurements are possibly misleading indicators of formation salinity because of unknown factors during drilling and sample collection, including contamination by drilling fluids. These data are included in this study, but should not be considered a reliable determination of groundwater salinity.

Wells and springs/seeps with high salinity values appear to be limited to the Bear Springs subbasin, although this is almost certainly an artifact of the limited spatial distribution of data. Nonetheless, a lineament of wells with well-water TDS greater than 10,000 mg/L are present between, and including, wells OG 05-17 and M3 Figure 44. No seismic lines were available, nor known, that extend to this lineament. The only deep well known to penetrate the LBF along this lineament is well OG 5-05. The only well with vertical salinity information is well OG 5-03, which has salinity recorded at two different depths, 5,500 mg/L at 2,400 feet and 20,000 mg/L TDS between 630 and 1,025 feet (Harris, 2004). Based on these salinity data, high salinity (above 10,000 mg/L) may be derived from evaporites in the UBF, downward percolation of saline irrigation water, or both. If a fault exists along this high-salinity lineament, the fault would be east of the basin fill axis in the UBF and east of a major gravity low.

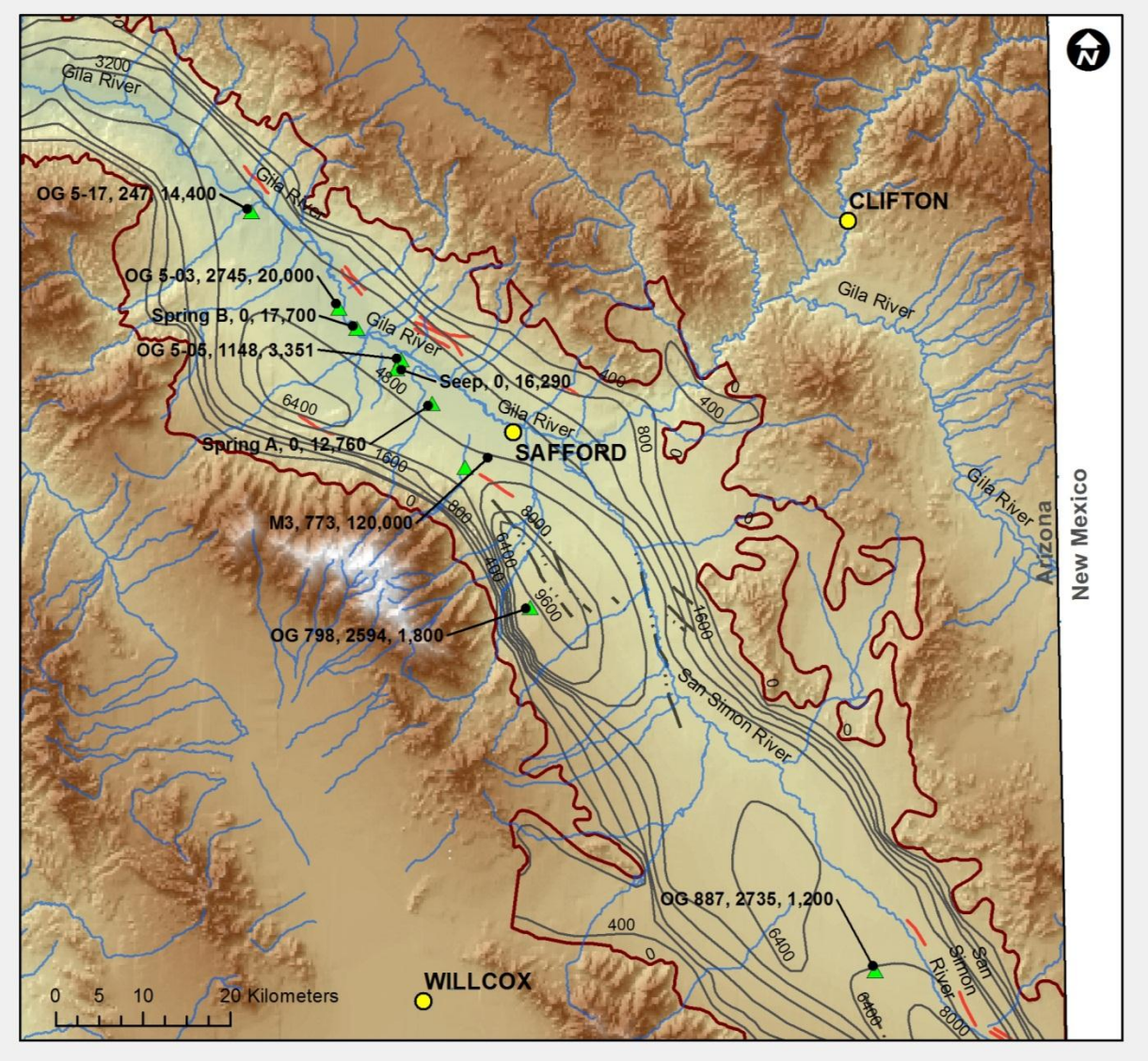

Figure 44. Map of salinity location data in the Safford basin. Salinity points are green triangle (labeled with point ID, well depth in m-bls and salinity value in mg/L TDS). Subbasins not shown. Depth-to-bedrock contours are in feet bls. Quaternary and concealed faults shown in heavy solid red and heavy dash-dotted black lines, respectively. Outline of zero-depth to bedrock of the Safford basin in dark red (from Spencer, 2011).

Salinity Point ID	UTME	UTMN	Sample Date	Land Elevation (ft)	Well Depth (m)	Well Depth (ft)	Total Dissolved Solids (mg/L)	Basin Fill Unit at Total Depth	Remarks
M3: Safford Golf Course well; Water Well #8 (Witcher, 1982, AZ-259)	614372	3629509	n/a	3,068	773 (5)	2,536	115,000 (3) to 120,000 (4)	UBF	Considerable salt encrustation from 1,465 to 1,780 feet bls. Chloride of 168,200 mg/L recorded (4).
OG 5-05: Mary Mack Well	608061	3642477	11/30/1933	2,780	1,148	3,767	3,351 (1)	LBF (?)	
			10/30/1940				3,530 (2)	LBF (?)	
			10/27/1943				3,400 (2)	LBF (?)	
			5/8/1952				3,440 (3)	LBF (?)	
OG 5-17: R.S. Knowles well	590899	3659453	11/22/1933	2,769	247	810	14,035 (1)	UBF	
			4/24/1941				14,290 (2)	UBF	
			1/6/1944				14,400 (2)	UBF	
OG 5-03: Gila Oil Syndicate #1	600906	3648398	12/15/2000	2730	806	2,645	20,000 (6)	UBF	From depth interval between 630 to 1025 ft) (6)
			12/15/2000				5,500 (6)	UBF	From depth of well, reported to be 2,400 feet depth (6)
OG 798: Phillips Petroleum A1 Safford State	622815	3614079	4/11/1982	3,562	2,594	8,509	600 to 1,800* (6)	UBF and (?) LBF	Chloride data not reliable of formation salinity
OG 887: Arzon Corporation No. 1 State	662242	3572465	7/28/1995	3,600	2,735	8,974	300 to 1,200* (6)	UBF and (?) LBF	Chloride data not reliable of formation salinity
Spring at Terrace Scarp	611564	3637447	12/1/1940	2,907	0	0	12,760 (2)	UBF and (?) LBF	From Hem (1950; sample no. 1592)
Unnamed spring (ADWR, 2009, Map Key 19)	603000	3646098	8/7/1943	2,740	0	0	17,700 (2)	UBF and (?) LBF	From Hem (1950; sample no. 1730). Location from ADWR (2009)
Seep from Terrace Gravel	607553	3641434	11/29/1940	2,845	0	0	16,290 (2)	UBF and (?) LBF	Location from Hem (1950; sample 2597) to the nearest 1/4, 1/4 of section 13, T6S, R24E

Table 4. Salinity data for wells and springs with depths greater than 800 m bls or salinity above 10,000 mg/L for the Safford basin.

Notes: n/a = not available; UBF = Upper Basin Fill; LBF = Lower Basin Fill; * = value represents chloride concentration; 1=Knechtel (1938); 2=Hem (1950); 3=Witcher (1982); 4=Rauzi (2002); 5=Conley et al. (2005); 6=Harris (2004).

9.3 Discussion

Brackish or salty groundwater conditions are ubiquitous throughout the Safford basin. Many studies have sought to identify the sources and flowpaths of salts in groundwater (ADEQ, 2004, 2009; ADWR, 2009, 2004, 1991, 1981; Towne, 2009; Harris, 1997, 2000; Hem, 1950; and Knechtel, 1938). Although many of these water-quality and isotope studies are limited to shallow wells in the UBF, the data are interpreted to support the conclusion that elevated salinity in the Safford basin, particularly along the Gila River, appears to result from saline water under artesian pressure entering the basin from upward migration along faults and abandoned wells and from downward percolation of saline irrigation water (ADWR and ADEQ, 2009). Isotopic studies by Harris (1999, 2000) reveal that elevated TDS in springs and wells result from leaching of natural evaporite deposits in the UBF unit and/or artesian leakage from the LBF. These studies recognize the need for further investigation to fully characterize and understand the extent and origin of elevated salinity in groundwater. Furthermore, these studies are only representative of the conditions at the time of sampling (Harris, 2000).

Due to scarce well and salinity data for groundwater below 800 m and the wide range of salinity values in the Safford basin, more research is clearly needed in order to characterize any saline formations at depth. While the presence of salts in groundwater may reflect laterally extensive evaporite deposits in basin-fill sediments above and below the 800 m depth, salinity at target depths for CO_2 storage is not known, nor are vertical salinity profiles in the UBF and LBF. The lack of salinity data for deep basin water precludes iso-contours for salinity below (or above) the 800 m depth contour.

10.0 Summary and Discussion

An evaluation of the structural and stratigraphic relationships of the Safford basin-fill sediments was performed as part of the *WESTCARB Phase III – Arizona Geologic Characterization* to assess the CO_2 sequestration potential in the largest of Arizona Cenozoic basins. The Safford basin has the largest volume of basin-filling sediments compared to all 88 Cenozoic sedimentary basins identified in Arizona, as well as the largest inferred volume of sedimentary basin fill below 800 m depth (Spencer, 2011). Four subbasins are delineated by bedrock geometry, including the San Carlos subbasin, Bear Springs subbasin, 111 Ranch subbasin and San Simon subbasin, collectively referred to herein as the Safford basin (Figure 23).

The Safford basin is a deep, sediment-filled basin within the Basin and Range province in southeastern Arizona. It is primarily a half-graben basin, but lack of exposures of basin-bounding faults, and lack of seismic data, precludes determination of basic basin structure in the southern (San Simon subbasin) and northern (San Carlos subbasin) subbasins. The Safford basin is approximately 245 km (155 mi) in length and ranges from 20 to 25 km (12 to 16 mi) in width. The maximum depth of the Safford basin is approximately 3,500 m (11,500 ft), averaging between 2,000 and 3,000m (6,500 and 9,800 ft) depth over the length of the deepest subbasins (Plate 1 and Figure 25). The mountains bordering the southwestern margin of the Safford basin are composed of predominantly Precambrian to mid-Tertiary plutonic, metamorphic and volcanic rock types with relatively minor Paleozoic sedimentary rocks. The northeastern margin of the Safford basin is bound by predominantly mid-Tertiary volcanic rocks. The Gila and San Simon rivers occupy the basin floors, where the Gila River is the main through-flowing drainage across the Safford basin.

The structural and stratigraphic framework of the Safford basin is complex and varied along the length of the basin and subbasins. High-angle normal faults extend along basin margins and span basin-fill sedimentation. Portions of these range-bounding faults have been active as recently as the late Pleistocene and have a significant effect on groundwater flow. Basin-fill sedimentation in response to tectonic uplift along major range-bounding faults provides the depositional framework and setting throughout the history of basin fill sedimentation (Kruger and others, 1994, 1995 and 2001).

Basin fill is delineated into the upper basin-fill (UBF) and lower-basin fill (LBF) units. This nomenclature of the basin fill is applied based on lithologic descriptions from available deep well cuttings and logs and largely follows the interpretations from previous seismic profiling. Deep well data were scarce and sparse, limited to only 11 deep wells below the 800 m depth in the Safford basin. A series of 17 cross-sections were constructed to coincide with previous cross-sections, seismic profiles and deep wells in order to define the vertical and lateral extent of the UBF and LBF. Lithologic well data alone was insufficient to distinguish upper and lower basin fill units or clearly defined stratigraphic horizons or boundaries.

Both the UBF and LBF units appear to be continuous over the length of the Safford basin, although the lateral stratigraphic extent of the LBF below 800 m depth in the subsurface was more difficult to distinguish. Basin fill sediments in both units consists of proximal-, mid- and distal-fan alluvial deposits derived from adjacent mountain blocks, grading basinward into fine-grained clastic and

evaporite deposits interpreted to represent playa and lacustrine basin centers. Lavas flows interbedded within the upper basin fill exist in the San Carlos subbasin, and possibly in the Bear Springs subbasin. In the San Carlos subbasin lava flows are interbedded with the LBF. Although particular basin-fill facies are discernible at individual wells in the basin, mapping the lateral extent was not possible from available well data. Seismic reflection surveys suggest facies changes varied considerably over relatively short distances in the basin. In addition, the location of basin centers and axes where fine-grained clastics and evaporite deposits are known or suspected, have shifted several kilometers from mountain fronts throughout deposition of basin-fill.

Much of the LBF lies below 800 m depth and within the target zone for potential CO_2 sequestration. Although portions of the UBF lie below the 800 m depth, the LBF is considered the primary target for CO_2 storage potential. The distribution of permeable gravel, sand and silt deposits and impermeable clay, gypsum and limestone in the LBF varies considerably with depth and lateral extent. Individual beds or facies were not mappable laterally between wells or within the subbasin from available well data. In general the LBF exhibits a higher degree of consolidation and cementation than the UBF, although portions of what is interpreted to be the LBF range from loose and unconsolidated to well-cemented and indurated at depths well below 800 m. The LBF exhibits a higher degree of deformation than the UBF, with fractures and tilted bedding observed in well logs, and faulted strata, folds and tilted bedding observed in seismic profiles. Tilted bedding in the LBF ranges from 2 to 20 degrees, averaging less than 10 degrees. Limited porosity logs suggest porosity in the LBF ranges from approximately 5% to as much as 20%. Secondary porosity features such as fractures are present in the LBF.

Sealing conditions are present in both basin-fill units but were not discernible as a mappable sealing body or formation in any of the Safford subbasins. Rather, the well and seismic data suggest sealing conditions are restricted to individual, discontinuous beds of salt, gypsum and clay that grade into clastic facies towards basin margins. However, more extensive impermeable strata and structural conditions favorable for sealing conditions may be present towards basin centers where well control is absent

Elevated salinity conditions characterize some groundwater within the Safford basin. Artesian and geothermal conditions prevalent in many parts of the basin are closely related to shallow clay strata of the 111 Ranch beds in the upper 300 m of the UBF, and along Quaternary faults. Isotopic and water quality studies (Harris, 1999 and 2000; ADWR and ADEQ, 2009) conclude that artesian leakage through the 111 Ranch beds is delivering elevated saline groundwater into the shallow aquifers and along faults. However, the extent of saline conditions below 800 m depth is very poorly known. Only five (5) oil and gas exploration wells had salinity data below or proximal to the 800 m depth level, and only one well yielded water with TDS greater than 10,000 mg/L below 800 m depth. A total of six locations had TDS greater than 10,000 mg/L in the Safford basin, and all of these are in Bear Springs subbasin, including three springs (Figure 44 and Table 4). While the presence of salts in groundwater may reflect laterally extensive evaporite deposits in basin-fill sediments above and below the 800 m depth, salinity at target depths for CO_2 storage are not known, nor are vertical salinity profiles in the UBF and LBF. The lack of

salinity data for deep basin water precludes iso-salinity contours below (or above) the 800 m depth contour.

11.0 Recommendations

The following recommendations are based on the evaluation of CO_2 storage potential of basin fill sediments in the Safford basin.

- Acquire and process existing seismic line-data in addition to previous works (Kruger et al. 1991, 1994, 1995, 2000). Seismic lines include those in the San Simon subbasin. At least fourteen known seismic reflection lines in the San Simon subbasin include those from Conoco-Phillips: No's 7 and 8, CX-2, CX29 to CX32, KN1 to KN4, WGC1 and WGC2, and WP34;
- Conduct additional seismic reflection lines, especially in the Bear Springs subbasin near the Pima basin center, otherwise known as the Pima low;
- Reoccupy select OG wells with open boreholes and conduct vertical salinity/conductivity measurements and grab sampling of groundwater;
- Continue to monitor existing point sources where salinity is elevated at or below the 800 m depth and/or values approaching 10,000 mg/L or greater;
- Scan existing geophysical logs and convert into digital files for the Aquaveo database; and
- Showcase a GIS-interactive database viewer of AZGS-WESTCARB data (screened data) to facilitate awareness of CO_2 evaluation, data gaps, cross-sections, CO_2 source and sink areas, etc. (similar to the National Carbon Sequestration Database and Geographic Information System but warehoused by AZGS data with more detail).

However, only a well-funded program involving both seismic reflection profiling and deep drilling will provide sufficient data to determine if the deep Safford basin is truly suitable for CO_2 sequestration.

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APPENDIX A

APPENDIX B

APPENDIX C

Well Type	Well ID	Basin	Subbasin	Elev. (m)	Elev. (ft)	UTMX NAD83	UTMY NAD83	Well Depth (ft)	Well Depth (m)	Log Type	Comments
35	21122	Safford	Bear Springs Subbasin	869	2852	613919	3637761	400	122	D	
35	21163	Safford	Bear Springs Subbasin	873	2865	617113	3636981	2161	659	D, RES, SP, S	
35	22027	Safford	Bear Springs Subbasin	952	3122	597367	3635792	550	168	D	
35	22072	Safford	Bear Springs Subbasin	965	3167	607389	3631469	400	122	D	
35	22160	Safford	Bear Springs Subbasin	925	3035	609201	3633103	1100	335	D	
35	22473	Safford	Bear Springs Subbasin	896	2940	621044	3632321	1820	555	D	
35	22599	Safford	111 Ranch Subbasin	932	3057	636103	3636394	400	122	D	
35	22601	Safford	111 Ranch Subbasin	929	3048	635901	3636391	500	152	D	
35	22604	Safford	111 Ranch Subbasin	929	3048	635705	3635985	525	160	D	
35	22605	Safford	111 Ranch Subbasin	932	3057	635708	3635784	400	122	D	
35	22611	Safford	111 Ranch Subbasin	924	3030	634708	3635571	435	133	D	
35	22615	Safford	111 Ranch Subbasin	941	3087	634719	3634968	435	133	D	
35	22619	Safford	111 Ranch Subbasin	932	3057	635116	3635173	702	214	D	
35	22620	Safford	111 Ranch Subbasin	930	3050	635510	3635580	433	132	D	measured at top of casing, approximate elevation @ 3025', well was deepened to 433' in November, 1948, by Tom Tye.
35	22621	Safford	111 Ranch Subbasin	932	3057	635513	3635379	650	198	D	
35	23388	Safford	111 Ranch Subbasin	989	3246	618452	3623976	527	161	D	
35	23401	Safford	111 Ranch Subbasin	939	3080	621007	3626400	664	202	D	
35	23419	Safford	111 Ranch Subbasin	966	3170	618828	3625381	743	226	D, S	
35	23437	Safford	111 Ranch Subbasin	964	3163	620020	3624386	545	166	D	
35	23438	Safford	111 Ranch Subbasin	964	3163	620020	3624386	668	204	D	
35	23446	Safford	111 Ranch Subbasin	975	3198	618837	3624581	412	126	D	
35	23447	Safford	111 Ranch Subbasin	976	3203	618840	3624380	454	138	D	
35	23452	Safford	111 Ranch Subbasin	964	3163	619428	3624583	1458	444	D	
35	23454	Safford	111 Ranch Subbasin	968	3176	619231	3624582	1522	464	D	
35	23455	Safford	111 Ranch Subbasin	968	3176	619231	3624582	646	197	D	
35	23465	Safford	111 Ranch Subbasin	971	3184	620026	3623789	1270	387	D	
35	23478	Safford	111 Ranch Subbasin	956	3135	621034	3623600	418	127	D	
35	23482	Safford	111 Ranch Subbasin	952	3123	622250	3623009	460	140	D	
35	23486	Safford	111 Ranch Subbasin	961	3152	622255	3622006	564	172	D	
35	23489	Safford	111 Ranch Subbasin	968	3176	620431	3623193	610	186	D	
35	23499	Safford	111 Ranch Subbasin	978	3208	620240	3622788	1525	465	D	
35	23523	Safford	111 Ranch Subbasin	986	3235	622691	3619598	421	128	D	
35	23524	Safford	111 Ranch Subbasin	987	3240	622892	3619400	465	142	D	
35	23540	Safford	111 Ranch Subbasin	1036	3399	619497	3619561	670	204	D	
35	23543	Safford	111 Ranch Subbasin	1061	3480	619907	3618360	595	181	D	
35	23544	Safford	111 Ranch Subbasin	1038	3405	619912	3617959	450	137	D	
35	24254	Safford	111 Ranch Subbasin	1032	3387	619460	3616573	400	122	D	
35	24259	Safford	111 Ranch Subbasin	996	3267	636725	3608738	765	233	D	
35	24640	Safford	111 Ranch Subbasin	1202	3942	623607	3605840	550	168	D	
35	25129	Safford	San Simon Subbasin	1413	4634	621980	3588393	550	168	D	
35	25830	Safford	San Simon Subbasin	1233	4045	631102	3584122	500	152	D	
35	25842	Safford	San Simon Subbasin	1121	3678	643130	3583865	1340	408	D	
35	25846	Safford	San Simon Subbasin	1134	3720	641127	3583863	750	229	D	
35	25847	Safford	San Simon Subbasin	1129	3703	641925	3583868	1900	579	D	
35	25858	Safford	San Simon Subbasin	1119	3671	644384	3582263	1000	305	D	
35	25859	Safford	San Simon Subbasin	1112	3649	646838	3580699	1360	415	D	
35	25861	Safford	San Simon Subbasin	1119	3672	645224	3580660	687	209	D	
35	25872	Safford	San Simon Subbasin	1138	3734	641983	3580231	550	168	D	
35	25873	Safford	San Simon Subbasin	1145	3757	641181	3579815	758	231	D	
35	25875	Safford	San Simon Subbasin	1143	3750	641585	3579819	488	149	D	
35	25876	Safford	San Simon Subbasin	1151	3776	641190	3578991	953	290	D	
35	25877	Safford	San Simon Subbasin	1125	3692	644813	3579850	640	195	D	
35	25878	Safford	San Simon Subbasin	1121	3679	646031	3579054	715	218	D	
35	25879	Safford	San Simon Subbasin	1117	3666	646848	3579065	1000	305	D	
35	27115	Safford	San Simon Subbasin	1129	3705	645255	3577438	1000	305	D	duplicated with well 25879
35	27116	Safford	San Simon Subbasin	1127	3696	645860	3577438	1010	308	D	
35	27117	Safford	San Simon Subbasin	1143	3751	642826	3578016	600	183	D	
35	27119	Safford	San Simon Subbasin	1141	3742	643643	3577421	800	244	D	
35	27120	Safford	San Simon Subbasin	1149	3769	641913	3578100	495	151	D	
35	27121	Safford	San Simon Subbasin	1149	3769	641913	3578100	768	234	D	
35	27122	Safford	San Simon Subbasin	1149	3769	641913	3578100	830	253	D	
35	27123	Safford	San Simon Subbasin	1157	3795	641214	3577387	462	141	D	
35	27130	Safford	San Simon Subbasin	1156	3792	641626	3576988	450	137	D	
35	27135	Safford	San Simon Subbasin	1150	3774	642845	3576601	1000	305	D	
35	27136	Safford	San Simon Subbasin	1132	3713	645873	3576632	504	154	D	
35	27139	Safford	San Simon Subbasin	1138	3732	646090	3575628	774	236	D	
35	27140	Safford	San Simon Subbasin	1140	3741	646099	3575024	800	244	D	
35	27143	Safford	San Simon Subbasin	1140	3741	646099	3575024	804	245	D	

Well Type	Well ID	Basin	Subbasin	Elev. (m)	Elev. (ft)	UTMX NAD83	UTMY NAD83	Well Depth (ft)	Well Depth (m)	Log Type	Comments
35	27146	Safford	San Simon Subbasin	1143	3751	646106	3574621	800	244	D	
35	27147	Safford	San Simon Subbasin	1147	3763	646112	3574217	600	183	D	
35	27150	Safford	San Simon Subbasin	1143	3750	646920	3574230	750	229	D	
35	27154	Safford	San Simon Subbasin	1156	3792	643269	3574995	1013	309	D	
35	27155	Safford	San Simon Subbasin	1156	3792	643269	3574995	1013	309	D	well deepened 01/01/1958
35	27157	Safford	San Simon Subbasin	1165	3822	642877	3574189	455	139	D	
35	27161	Safford	San Simon Subbasin	1159	3801	643687	3574195	475	145	D	
35	27163	Safford	San Simon Subbasin	1179	3869	641271	3574153	895	273	D	
35	27164	Safford	San Simon Subbasin	1172	3845	642072	3574172	671	205	D	
35	27166	Safford	San Simon Subbasin	1165	3821	643698	3573390	465	142	D	
35	27169	Safford	San Simon Subbasin	1172	3846	643709	3572585	500	152	D	
35	27170	Safford	San Simon Subbasin	1156	3793	645313	3573405	511	156	D	
35	27172	Safford	San Simon Subbasin	1159	3803	644506	3573397	1000	305	D	
35	27173	Safford	San Simon Subbasin	1163	3814	645321	3572604	530	162	D	
35	27175	Safford	San Simon Subbasin	1160	3805	646129	3572612	520	158	D	
35	27177	Safford	San Simon Subbasin	1178	3866	644532	3571370	500	152	D	
35	27179	Safford	San Simon Subbasin	1182	3879	645145	3570768	460	140	D	
35	27180	Safford	San Simon Subbasin	1191	3906	644547	3570354	478	146	D	
35	27181	Safford	San Simon Subbasin	1116	3662	647663	3578263	1000	305	D	
35	27182	Safford	San Simon Subbasin	1117	3665	648050	3577830	1275	389	D	
35	27185	Safford	San Simon Subbasin	1118	3667	648434	3577377	926	282	D	
35	27186	Safford	San Simon Subbasin	1120	3675	649299	3576130	750	229	D	
35	27193	Safford	San Simon Subbasin	1137	3731	650047	3573178	616	188	D	
35	27194	Safford	San Simon Subbasin	1141	3744	649241	3573162	576	176	D	
35	27196	Safford	San Simon Subbasin	1148	3765	649254	3572350	560	171	D	
35	27209	Safford	San Simon Subbasin	1130	3708	652479	3572807	707	215	D	
35	27210	Safford	San Simon Subbasin	1134	3720	652481	3572397	1104	337	D	
35	27220	Safford	San Simon Subbasin	1123	3683	654086	3572828	801	244	D	
35	27223	Safford	San Simon Subbasin	1120	3674	654887	3572841	870	265	D	
35	27231	Safford	San Simon Subbasin	1135	3724	655717	3570822	863	263	D	
35	27232	Safford	San Simon Subbasin	1133	3717	656131	3570832	790	241	D	
35	27233	Safford	San Simon Subbasin	1133	3716	656338	3570836	1000	305	D	
35	27234	Safford	San Simon Subbasin	1134	3721	653292	3572012	1900	579	D	
35	27237	Safford	San Simon Subbasin	1147	3764	652706	3570996	1040	317	D	
35	27239	Safford	San Simon Subbasin	1146	3761	653314	3570810	608	185	D	
35	27241	Safford	San Simon Subbasin	1141	3742	650877	3572188	660	201	D	
35	27245	Safford	San Simon Subbasin	1147	3763	650888	3571585	629	192	D	
35	27250	Safford	San Simon Subbasin	1087	3565	662630	3577564	855	261	D	
35	27252	Safford	San Simon Subbasin	1087	3568	661621	3576957	900	274	D	
35	27254	Safford	San Simon Subbasin	1090	3575	664053	3576142	800	244	D	
35	27255	Safford	San Simon Subbasin	1095	3593	666087	3574969	915	279	D	
35	27257	Safford	San Simon Subbasin	1093	3585	666694	3574771	850	259	D	
35	27258	Safford	San Simon Subbasin	1092	3583	664473	3574941	900	274	D	
35	27259	Safford	San Simon Subbasin	1094	3589	665187	3574247	930	283	D	
35	27260	Safford	San Simon Subbasin	1090	3577	662439	3575329	975	297	D	
35	27270	Safford	San Simon Subbasin	1095	3592	664495	3573327	860	262	D	
35	27272	Safford	San Simon Subbasin	1094	3589	664088	3573727	850	259	D	
35	27274	Safford	San Simon Subbasin	1096	3594	666508	3573746	750	229	D	
35	27280	Safford	San Simon Subbasin	1097	3598	666005	3573435	660	201	D	
35	27294	Safford	San Simon Subbasin	1103	3620	666435	3571812	820	250	D	
35	27297	Safford	San Simon Subbasin	1105	3625	666748	3571919	750	229	D	
35	27307	Safford	San Simon Subbasin	1104	3623	666545	3571309	740	226	D	
35	27333	Safford	San Simon Subbasin	1100	3609	668911	3574669	630	192	D	
35	27337	Safford	San Simon Subbasin	1096	3595	667430	3573063	700	213	D	
35	27347	Safford	San Simon Subbasin	1099	3607	669123	3574067	597	182	D	
35	27350	Safford	San Simon Subbasin	1102	3615	669952	3573309	660	201	D	
35	27353	Safford	San Simon Subbasin	1102	3615	670055	3573215	909	277	D	
35	27356	Safford	San Simon Subbasin	1101	3613	669957	3572907	600	183	D	
35	27358	Safford	San Simon Subbasin	1105	3624	670558	3573133	580	177	D	
35	27359	Safford	San Simon Subbasin	1109	3638	670854	3573443	1280	390	D	The 8" Casing is cemented in the Rhyolite at 915 ft. Cement plug set in the 8" casing at 500ft.
35	27361	Safford	San Simon Subbasin	1113	3651	671254	3573454	900	274	D	
35	27368	Safford	San Simon Subbasin	1105	3627	670569	3572322	600	183	D	ARTESIAN WELL Originally done for Merritt; Now owned (1951) by Cameron and leased to Fred Watts has been reemed to below 500' and is not a larger diameter well.
35	27372	Safford	San Simon Subbasin	1108	3636	670883	3571616	757	231	D	ARTESIAN WELL- "During pumping season well does not flow. For short periods it flows into an earthen reservoir."

Well Type	Well ID	Basin	Subbasin	Elev. (m)	Elev. (ft)	UTMX NAD83	UTMY NAD83	Well Depth (ft)	Well Depth (m)	Log Type	Comments
35	27373	Safford	San Simon Subbasin	1108	3636	670883	3571616	675	206	D	ARTESIAN WELL 11/1951 woned by Don Foster. Well is not abandoned but it is capped & used only for observation well.
35	27374	Safford	San Simon Subbasin	1105	3626	670276	3571597	500	152	D	8 " hole set 6"X.188 steel casing. Hole produced 75gpm at 90'. Rumor says that the upper aquifer is unfit for consumption. Sealed annulus with portland cement. Set 475' PVC well casing. Air developed 4 hours- very sandy - fine grained.
35	27379	Safford	San Simon Subbasin	1108	3636	670886	3571412	600	183	D	flowed 50gpm when drilled, 4gpm 1938. Possibly plugged at 200 ft level by a hardwood plug that could not be removed. ABANDONED AND PLUGGED. ARTESIAN WELL
35	27382	Safford	San Simon Subbasin	1101	3612	669662	3571972	800	244	D	
35	27383	Safford	San Simon Subbasin	1104	3621	670070	3571792	540	165	D	
35	27386	Safford	San Simon Subbasin	1105	3624	670075	3571178	600	183	D	ARTESIAN WELL-- "another well in SE 1/4 is old and was probably spoiled by drilling new well in NE-NE-SE
35	27391	Safford	San Simon Subbasin	1106	3628	667058	3571828	700	213	D	
35	27398	Safford	San Simon Subbasin	1102	3616	668158	3571378	750	229	D	
35	27403	Safford	San Simon Subbasin	1106	3629	667380	3570540	1190	363	D	
35	27414	Safford	San Simon Subbasin	1105	3625	667886	3570063	1190	363	D	
35	27424	Safford	San Simon Subbasin	1112	3648	671407	3570727	600	183	D	
35	27425	Safford	San Simon Subbasin	1112	3648	671407	3570727	550	168	D	
35	27426	Safford	San Simon Subbasin	1115	3657	671703	3571033	799	244	D	
35	27435	Safford	San Simon Subbasin	1104	3623	670386	3570891	600	183	D	
35	27440	Safford	San Simon Subbasin	1106	3629	670613	3569911	645	197	D	
35	27442	Safford	San Simon Subbasin	1104	3623	670306	3570000	700	213	D	Well location may be D(13-31) 33BCC, acording to one section plat diagram.
35	27445	Safford	San Simon Subbasin	1114	3654	671625	3570143	650	198	D	
35	27447	Safford	San Simon Subbasin	1115	3659	671724	3570245	662	202	D	
35	27450	Safford	San Simon Subbasin	1110	3642	671317	3570231	663	202	D	
35	27452	Safford	San Simon Subbasin	1110	3642	671228	3569735	645	197	D	
35	27453	Safford	San Simon Subbasin	1110	3642	671228	3569735	666	203	D	
35	27456	Safford	San Simon Subbasin	1113	3652	671635	3569749	650	198	D	
35	27460	Safford	San Simon Subbasin	1120	3673	672237	3569963	688	210	D	
35	27461	Safford	San Simon Subbasin	1122	3682	672332	3570261	840	256	D	
35	27463	Safford	San Simon Subbasin	1123	3685	672541	3569871	760	232	D	(note in 27464 file) "This well I am going to drill is a replacement of a well the Arizona Highway is going to take & destroy for interstate Hwy 10. The old well will be capped - pulled all of casing out & filled up with dirt" Edward Barnes.
35	27464	Safford	San Simon Subbasin	1123	3685	672541	3569871	850	259	D	(note in packet paraphrased) This well is a replacement of a well in the I-10 right of way. "The old well will be capped - pulled all of casing out & filled up wth dirt." Edward Barnes, San Simon Ariz.
35	28260	Safford	San Simon Subbasin	1206	3956	644448	3568590	650	198	D	
35	28266	Safford	San Simon Subbasin	1187	3893	651101	3567938	670	204	D	
35	28267	Safford	San Simon Subbasin	1214	3982	649705	3566333	1325	404	D	
35	28268	Safford	San Simon Subbasin	1196	3922	652511	3567179	1100	335	D	
35	28269	Safford	San Simon Subbasin	1196	3923	651111	3567164	765	233	D	
35	28272	Safford	San Simon Subbasin	1208	3962	654944	3565601	400	122	D	
35	28273	Safford	San Simon Subbasin	1232	4043	649113	3565319	700	213	D	
35	28278	Safford	San Simon Subbasin	1111	3645	664190	3568870	850	259	D	
35	28289	Safford	San Simon Subbasin	1120	3674	666151	3566803	800	244	D	
35	28295	Safford	San Simon Subbasin	1126	3694	672954	3569479	735	224	D	
35	28300	Safford	San Simon Subbasin	1117	3664	672146	3569256	805	245	D	
35	28305	Safford	San Simon Subbasin	1116	3662	672240	3568329	720	219	D	
35	28306	Safford	San Simon Subbasin	1116	3662	672240	3568329	714	218	D	
35	28317	Safford	San Simon Subbasin	1112	3648	671424	3569127	760	232	D	
35	28318	Safford	San Simon Subbasin	1112	3648	671424	3569127	715	218	D	
35	28322	Safford	San Simon Subbasin	1111	3646	671334	3569436	730	223	D	
35	28323	Safford	San Simon Subbasin	1108	3636	670608	3569087	755	230	D	
35	28324	Safford	San Simon Subbasin	1108	3636	670608	3569087	770	235	D	
35	28337	Safford	San Simon Subbasin	1106	3630	667103	3568837	720	219	D	
35	28345	Safford	San Simon Subbasin	1110	3641	669028	3567356	600	183	D	
35	28346	Safford	San Simon Subbasin	1112	3649	670450	3566795	800	244	D	
35	28348	Safford	San Simon Subbasin	1112	3650	671459	3566653	550	168	D	

Well Type	Well ID	Basin	Subbasin	Elev. (m)	Elev. (ft)	UTMX NAD83	UTMY NAD83	Well Depth (ft)	Well Depth (m)	Log Type	Comments
35	28355	Safford	San Simon Subbasin	1122	3681	673381	3567843	750	229	D	
35	28357	Safford	San Simon Subbasin	1120	3673	672968	3567832	874	266	D	
35	28358	Safford	San Simon Subbasin	1116	3661	672253	3567507	780	238	D	
35	28366	Safford	San Simon Subbasin	1121	3678	673407	3567025	552	168	D	
35	28368	Safford	San Simon Subbasin	1121	3678	673407	3567025	770	235	D	
35	28371	Safford	San Simon Subbasin	1131	3712	674201	3567867	967	295	D	
35	28372	Safford	San Simon Subbasin	1129	3702	674003	3567656	540	165	D	
35	28373	Safford	San Simon Subbasin	1123	3684	673607	3567236	518	158	D	
35	28374	Safford	San Simon Subbasin	1123	3684	673829	3566625	712	217	D	
35	28381	Safford	San Simon Subbasin	1125	3692	675292	3565432	500	152	D	
35	28387	Safford	San Simon Subbasin	1126	3695	674860	3566228	500	152	D	
35	28394	Safford	San Simon Subbasin	1118	3668	673966	3565109	600	183	D	
35	28397	Safford	San Simon Subbasin	1121	3678	673763	3564905	660	201	D	
35	28405	Safford	San Simon Subbasin	1121	3678	674790	3565121	600	183	D	
35	28407	Safford	San Simon Subbasin	1121	3678	674790	3565121	755	230	D	
35	28413	Safford	San Simon Subbasin	1116	3663	673128	3565899	650	198	D	
35	28414	Safford	San Simon Subbasin	1118	3668	673330	3566106	810	247	D	
35	28416	Safford	San Simon Subbasin	1117	3665	672304	3565876	800	244	D	
35	28419	Safford	San Simon Subbasin	1117	3665	671990	3565966	921	281	D	
35	28422	Safford	San Simon Subbasin	1122	3682	671238	3564722	2000	610	D	
35	28428	Safford	San Simon Subbasin	1128	3700	670435	3563894	711	217	D	
35	28430	Safford	San Simon Subbasin	1125	3690	672962	3564474	700	213	D	
35	28432	Safford	San Simon Subbasin	1127	3696	673266	3563968	800	244	D	
35	28433	Safford	San Simon Subbasin	1126	3694	672368	3564250	900	274	D	
35	28435	Safford	San Simon Subbasin	1130	3707	672385	3563433	665	203	D	
35	28441	Safford	San Simon Subbasin	1131	3710	674104	3563161	744	227	D	
35	28445	Safford	San Simon Subbasin	1132	3713	676719	3564653	660	201	D	
35	28454	Safford	San Simon Subbasin	1144	3753	675387	3561580	1037	316	D	
35	28464	Safford	San Simon Subbasin	1145	3755	674130	3561528	766	233	D	
35	28466	Safford	San Simon Subbasin	1144	3752	674547	3561546	740	226	D	
35	28468	Safford	San Simon Subbasin	1137	3730	672406	3562611	740	226	D	
35	28469	Safford	San Simon Subbasin	1146	3760	672144	3561466	800	244	D	
35	28475	Safford	San Simon Subbasin	1152	3779	673736	3560704	800	244	D	
35	28476	Safford	San Simon Subbasin	1159	3802	673756	3559900	900	274	D	
35	28477	Safford	San Simon Subbasin	1157	3796	674589	3559929	1000	305	D	
35	28478	Safford	San Simon Subbasin	1149	3771	675402	3560769	1300	396	D	
35	28479	Safford	San Simon Subbasin	1156	3793	675422	3559956	1476	450	D	
35	28480	Safford	San Simon Subbasin	1157	3797	676239	3559969	1150	351	D	
35	28481	Safford	San Simon Subbasin	1158	3799	676648	3559975	1004	306	D	
35	28482	Safford	San Simon Subbasin	1185	3886	680345	3566580	470	143	D	
35	28486	Safford	San Simon Subbasin	1180	3872	680571	3565568	465	142	D	
35	28487	Safford	San Simon Subbasin	1180	3872	680571	3565568	470	143	D	
35	28488	Safford	San Simon Subbasin	1138	3732	677667	3563966	700	213	D, S	
35	28490	Safford	San Simon Subbasin	1145	3757	678378	3564290	800	244	D	
35	28491	Safford	San Simon Subbasin	1138	3735	677542	3564675	750	229	D	
35	28494	Safford	San Simon Subbasin	1146	3759	678589	3564093	720	219	D	
35	28495	Safford	San Simon Subbasin	1148	3765	678998	3563899	430	131	D	
35	28496	Safford	San Simon Subbasin	1153	3783	679604	3563913	641	195	D	
35	28498	Safford	San Simon Subbasin	1135	3725	678007	3562650	470	143	D	
35	28501	Safford	San Simon Subbasin	1138	3735	677010	3562014	490	149	D	
35	28506	Safford	San Simon Subbasin	1145	3757	677847	3560813	750	229	D	
35	28508	Safford	San Simon Subbasin	1149	3769	677043	3560795	800	244	D	
35	28509	Safford	San Simon Subbasin	1157	3795	677059	3559982	1046	319	D	
35	29299	Safford	San Simon Subbasin	1165	3822	676256	3559152	943	287	D	
35	29300	Safford	San Simon Subbasin	1164	3817	675442	3559136	810	247	D	
35	29310	Safford	San Simon Subbasin	1200	3937	674693	3555860	800	244	D	
35	29314	Safford	San Simon Subbasin	1214	3983	673725	3555013	604	184	D	
35	29315	Safford	San Simon Subbasin	1263	4142	668258	3553894	400	122	D	
35	29319	Safford	San Simon Subbasin	1200	3936	676762	3554692	950	290	D	Correct location in Sec. 24 is 10 ft NE of center NE1/4, SW1/4, NE1/4, NE1/4; (D-15-31) 24 aac
35	29324	Safford	San Simon Subbasin	1159	3803	677881	3559186	1145	349	D	
35	29325	Safford	San Simon Subbasin	1163	3817	677071	3559168	1145	349	D	
35	29326	Safford	San Simon Subbasin	1165	3821	677893	3558374	915	279	D	
35	29333	Safford	San Simon Subbasin	1222	4010	678902	3550285	800	244	D	
35	29335	Safford	San Simon Subbasin	1193	3914	682174	3550353	400	122	D	
35	30342	Safford	San Simon Subbasin	1270	4165	673996	3549949	410	125	D	
35	30351	Safford	San Simon Subbasin	1212	3977	682784	3546720	490	149	D	
35	30352	Safford	San Simon Subbasin	1208	3963	683185	3546724	500	152	D	
35	30355	Safford	San Simon Subbasin	1248	4095	680204	3544435	600	183	D	
35	30356	Safford	San Simon Subbasin	1264	4147	679233	3543408	840	256	D	drilled 10/60, deepened 06/64

Well Type	Well ID	Basin	Subbasin	Elev. (m)	Elev. (ft)	UTMX NAD83	UTMY NAD83	Well Depth (ft)	Well Depth (m)	Log Type	Comments
35	30358	Safford	San Simon Subbasin	1240	4068	681423	3543854	510	155	D	
35	30361	Safford	San Simon Subbasin	1246	4087	680830	3543440	513	156	D	
35	30365	Safford	San Simon Subbasin	1222	4009	683643	3543484	522	159	D	
35	30370	Safford	San Simon Subbasin	1235	4051	682233	3543260	500	152	D	
35	30374	Safford	San Simon Subbasin	1274	4181	679447	3540979	840	256	D	
35	30379	Safford	San Simon Subbasin	1254	4114	682667	3540253	570	174	D	
35	31517	Safford	San Simon Subbasin	1264	4145	682888	3539054	700	213	D	
35	31519	Safford	San Simon Subbasin	1291	4234	678842	3539958	740	226	D	
35	31521	Safford	San Simon Subbasin	1339	4391	680344	3534655	1000	305	D	
35	31522	Safford	San Simon Subbasin	1342	4404	680143	3534652	503	153	D	
35	32892	Safford	San Simon Subbasin	1273	4177	683001	3520331	400	122	D	
35	32910	Safford	San Simon Subbasin	1272	4174	684359	3519129	500	152	D	
35	32911	Safford	San Simon Subbasin	1338	4389	679024	3515449	400	122	D	
35	32913	Safford	San Simon Subbasin	1286	4218	684288	3516280	600	183	D	
35	32914	Safford	San Simon Subbasin	1294	4244	681312	3513211	510	155	D	
35	32915	Safford	San Simon Subbasin	1293	4240	681927	3513213	535	163	D	
35	32916	Safford	San Simon Subbasin	1292	4239	682130	3513213	604	184	D	
35	32917	Safford	San Simon Subbasin	1302	4271	680905	3514654	500	152	D	
35	32920	Safford	San Simon Subbasin	1305	4283	682967	3511598	500	152	D	
35	33871	Safford	San Simon Subbasin	1336	4383	677519	3505687	750	229	D	
35	33878	Safford	San Simon Subbasin	1309	4296	680125	3509973	435	133	D	
35	33880	Safford	San Simon Subbasin	1314	4313	679728	3509161	460	140	D	
35	33882	Safford	San Simon Subbasin	1387	4551	684287	3505356	450	137	D	
35	37012	Safford	San Simon Subbasin	1105	3627	667401	3569745	850	259	D	
55	200083	Safford	San Simon Subbasin	1372	4502	682803	3505132	552	168	D	
55	201526	Safford	San Simon Subbasin	1404	4607	677075	3534207	460	140	D	
55	201604	Safford	San Simon Subbasin	1272	4172	684003	3528879	506	154	D	
55	202632	Safford	San Simon Subbasin	1405	4608	676869	3534412	510	155	D	
55	202908	Safford	San Simon Subbasin	1136	3728	674473	3562554	850	259	D	
55	204482	Safford	San Simon Subbasin	1300	4264	680649	3525370	435	133	D	
55	204779	Safford	San Simon Subbasin	1381	4532	677874	3534807	430	131	D	
55	205473	Safford	Bear Springs Subbasin	1047	3435	620066	3645041	1015	309	D	
55	205474	Safford	Bear Springs Subbasin	1047	3435	620066	3645041	505	154	D	
55	205496	Safford	Bear Springs Subbasin	1060	3479	622303	3643462	545	166	D	
55	205514	Safford	Bear Springs Subbasin	1008	3307	619326	3644024	705	215	D	
55	205966	Safford	111 Ranch Subbasin	1080	3543	618053	3619340	784	239	D	
55	206192	Safford	San Simon Subbasin	1335	4379	680068	3535652	440	134	D	
55	206343	Safford	San Simon Subbasin	1393	4571	677479	3534413	430	131	D	
55	206721	Safford	Bear Springs Subbasin	980	3215	601881	3633625	700	213	D	
55	208694	Safford	San Simon Subbasin	1129	3705	655856	3571430	1052	321	D	
55	209499	Safford	San Simon Subbasin	1114	3655	671665	3569440	1011	308	D	
55	209615	Safford	San Simon Subbasin	1129	3704	675002	3566427	1115	340	D	
55	209727	Safford	San Simon Subbasin	1130	3708	672820	3563333	900	274	D	
55	210387	Safford	San Simon Subbasin	1125	3690	675028	3565624	1154	352	D	
55	210504	Safford	Bear Springs Subbasin	1086	3563	621070	3645248	575	175	D	
55	210507	Safford	Bear Springs Subbasin	1086	3563	622493	3644270	580	177	D	
55	500093	Safford	San Simon Subbasin	1139	3736	674123	3569290	795	242	D	
55	501349	Safford	San Simon Subbasin	1306	4284	684758	3513106	415	126	D	
55	502802	Safford	111 Ranch Subbasin	1057	3469	619816	3613815	500	152	D	
55	503819	Safford	San Simon Subbasin	1292	4239	683679	3513622	425	130	D	
55	503992	Safford	San Simon Subbasin	1301	4268	679621	3513192	401	122	D	
55	504089	Safford	San Simon Subbasin	1208	3963	666204	3619653	509	155	D	
55	504228	Safford	San Simon Subbasin	1302	4272	681887	3511199	410	125	D	
55	506160	Safford	San Simon Subbasin	1347	4418	680145	3530420	555	169	D	
55	507836	Safford	San Simon Subbasin	1356	4449	679459	3523561	540	165	D	
55	507843	Safford	San Simon Subbasin	1269	4165	682716	3521333	401	122	D	
55	508418	Safford	San Simon Subbasin	1288	4226	681966	3518711	440	134	D	
55	509050	Safford	San Simon Subbasin	1324	4345	681147	3530233	500	152	D	
55	509526	Safford	San Simon Subbasin	1285	4217	683376	3529673	428	130	D	
55	510735	Safford	San Simon Subbasin	1305	4282	682906	3511593	400	122	D	
55	511868	Safford	San Simon Subbasin	1307	4287	684485	3512598	400	122	D	
55	513752	Safford	San Simon Subbasin	1328	4358	680946	3530230	500	152	D	
55	516114	Safford	San Simon Subbasin	1278	4194	681700	3522589	400	122	D	
55	516675	Safford	San Simon Subbasin	1334	4375	680741	3530427	456	139	D	
55	519388	Safford	San Simon Subbasin	1294	4246	681041	3513819	600	183	D	
55	520648	Safford	San Simon Subbasin	1122	3682	674435	3564602	650	198	D	
55	521528	Safford	111 Ranch Subbasin	913	2995	628800	3629588	500	152	D	
55	521529	Safford	Bear Springs Subbasin	907	2975	619795	3631303	500	152	D	
55	521995	Safford	San Simon Subbasin	1328	4358	680946	3530230	490	149	D	
55	523397	Safford	San Simon Subbasin	1294	4244	681096	3522412	490	149	D	

Well Type	Well ID	Basin	Subbasin	Elev. (m)	Elev. (ft)	UTMX NAD83	UTMY NAD83	Well Depth (ft)	Well Depth (m)	Log Type	Comments
55	525252	Safford	San Simon Subbasin	1267	4158	682283	3524216	520	158	D	
55	528357	Safford	San Simon Subbasin	1109	3640	671684	3567377	800	244	D	
55	529731	Safford	San Simon Subbasin	1297	4255	681349	3518706	675	206	D	
55	530926	Safford	San Simon Subbasin	1134	3721	676861	3564855	800	244	D	
55	532601	Safford	San Simon Subbasin	1275	4183	682200	3527618	520	158	D	
55	532742	Safford	111 Ranch Subbasin	913	2995	628800	3629588	406	124	D	
55	533915	Safford	San Carlos Subbasin	938	3078	572244	3668701	500	152	D	
55	533938	Safford	111 Ranch Subbasin	976	3202	622829	3620198	486	148	D	
55	536128	Safford	San Simon Subbasin	1270	4167	684289	3519738	480	146	D	
55	536445	Safford	111 Ranch Subbasin	1025	3363	632204	3638351	610	186	D	
55	536901	Safford	111 Ranch Subbasin	985	3231	631418	3636525	1215	370	D	
55	537717	Safford	111 Ranch Subbasin	985	3230	631620	3636528	1180	360	D	
55	538838	Safford	Bear Springs Subbasin	1064	3491	620262	3645436	720	219	D	
55	539448	Safford	Bear Springs Subbasin	994	3261	616576	3645389	565	172	D	
55	539449	Safford	Bear Springs Subbasin	1186	3890	624072	3646064	880	268	D	
55	539450	Safford	Bear Springs Subbasin	951	3119	616591	3643783	650	198	D	
55	539451	Safford	Bear Springs Subbasin	951	3119	617193	3643182	540	165	D	
55	539452	Safford	Bear Springs Subbasin	1101	3611	622895	3644274	800	244	D	
55	539453	Safford	Bear Springs Subbasin	878	2882	618248	3637580	1220	372	D	
55	539454	Safford	Bear Springs Subbasin	1064	3490	621284	3644459	740	226	D	
55	539960	Safford	San Simon Subbasin	1138	3733	668556	3563232	490	149	D	
55	540630	Safford	San Simon Subbasin	1121	3678	673390	3564994	440	134	D	
55	541143	Safford	San Simon Subbasin	1114	3654	671665	3569233	750	229	D	
55	542147	Safford	111 Ranch Subbasin	1033	3389	633204	3638768	1057	322	D	
55	542374	Safford	111 Ranch Subbasin	1025	3363	632013	3637339	910	277	D	
55	542375	Safford	111 Ranch Subbasin	1028	3372	633207	3638568	650	198	D	
55	542991	Safford	San Simon Subbasin	1116	3663	672287	3568632	640	195	D	
55	542993	Safford	San Simon Subbasin	1190	3905	642857	3571752	600	183	D	
55	543000	Safford	San Simon Subbasin	1108	3635	670864	3569823	700	213	D	
55	543203	Safford	San Simon Subbasin	1106	3629	667002	3571622	1035	315	D	
55	543312	Safford	111 Ranch Subbasin	1022	3354	630597	3638323	860	262	D	
55	543313	Safford	111 Ranch Subbasin	1022	3353	631808	3637738	960	293	D	
55	544044	Safford	San Simon Subbasin	1356	4449	621572	3583382	500	152	D	
55	544362	Safford	111 Ranch Subbasin	983	3226	631422	3636324	1300	396	D	
55	546369	Safford	San Simon Subbasin	1270	4167	683807	3528466	420	128	D	
55	546627	Safford	San Simon Subbasin	1280	4199	682997	3528656	420	128	D	
55	550669	Safford	San Simon Subbasin	1133	3718	676043	3565244	460	140	D	
55	550671	Safford	San Simon Subbasin	1242	4075	665976	3621452	500	152	D	
55	552431	Safford	Bear Springs Subbasin	1239	4065	621979	3648460	1580	482	D	
55	552572	Safford	San Simon Subbasin	1171	3840	671509	3578753	740	226	D	
55	552682	Safford	San Simon Subbasin	1291	4236	683675	3513831	400	122	D	
55	555790	Safford	San Simon Subbasin	1115	3658	671668	3570244	795	242	D	
55	556032	Safford	Bear Springs Subbasin	1210	3968	621380	3648253	800	244	D	
55	556038	Safford	Bear Springs Subbasin	1236	4055	624412	3646669	940	287	D	
55	556040	Safford	Bear Springs Subbasin	1148	3766	622868	3645858	580	177	D	
55	556043	Safford	Bear Springs Subbasin	1168	3830	625512	3644694	740	226	D	
55	556044	Safford	Bear Springs Subbasin	1062	3483	623115	3642863	560	171	D	
55	556046	Safford	Bear Springs Subbasin	1159	3802	621589	3647448	690	210	D	
55	556049	Safford	Bear Springs Subbasin	1125	3692	621601	3646243	1300	396	D	
55	556053	Safford	Bear Springs Subbasin	1122	3681	623083	3645071	760	232	D	
55	556056	Safford	Bear Springs Subbasin	1118	3668	623704	3644079	700	213	D	
55	556057	Safford	Bear Springs Subbasin	1043	3423	621903	3643257	500	152	D	
55	556058	Safford	Bear Springs Subbasin	1061	3482	624325	3642876	580	177	D	
55	556162	Safford	Bear Springs Subbasin	882	2894	616633	3639172	1000	305	D	
55	556164	Safford	Bear Springs Subbasin	964	3163	619346	3642016	740	226	D	
55	556589	Safford	Bear Springs Subbasin	1135	3722	626326	3643697	1210	369	D	
55	556807	Safford	San Simon Subbasin	1160	3806	643425	3574189	485	148	D	
55	557411	Safford	San Simon Subbasin	1350	4430	679262	3522750	600	183	D	
55	559952	Safford	San Simon Subbasin	1128	3701	672419	3563734	538	164	D	
55	559955	Safford	San Simon Subbasin	1155	3788	642794	3575787	1500	457	D	
55	562232	Safford	San Simon Subbasin	1126	3694	672892	3569676	800	244	D	
55	562328	Safford	San Simon Subbasin	1115	3659	671662	3570441	700	213	D	
55	562641	Safford	Bear Springs Subbasin	885	2902	608488	3639541	465	142	D	
55	562935	Safford	111 Ranch Subbasin	905	2970	621499	3630421	450	137	D	
55	563447	Safford	Bear Springs Subbasin	1121	3678	624710	3644289	2060	628	D	
55	563450	Safford	Bear Springs Subbasin	1159	3802	621589	3647448	1500	457	D	
55	563451	Safford	Bear Springs Subbasin	1120	3674	623499	3644279	1600	488	D	
55	563452	Safford	111 Ranch Subbasin	1052	3451	629760	3640125	1540	469	D	
55	563453	Safford	111 Ranch Subbasin	1087	3565	630763	3640546	1520	463	D	
55	563455	Safford	Bear Springs Subbasin	1097	3598	623911	3643678	1500	457	D	

Well Type	Well ID	Basin	Subbasin	Elev. (m)	Elev. (ft)	UTMX NAD83	UTMY NAD83	Well Depth (ft)	Well Depth (m)	Log Type	Comments
55	563456	Safford	Bear Springs Subbasin	1148	3765	624704	3644689	1740	530	D	
55	563457	Safford	Bear Springs Subbasin	1122	3680	623496	3644481	1600	488	D	
55	563458	Safford	Bear Springs Subbasin	1176	3859	624490	3645279	1700	518	D	
55	563462	Safford	Bear Springs Subbasin	1214	3982	620574	3648447	1340	408	D	
55	563922	Safford	San Simon Subbasin	1352	4437	680088	3533845	700	213	D	
55	564371	Safford	111 Ranch Subbasin	964	3164	623609	3621212	700	213	D	
55	565031	Safford	San Simon Subbasin	1196	3925	680042	3568199	500	152	D	
55	565817	Safford	San Simon Subbasin	1298	4258	622028	3579771	450	137	D	
55	566710	Safford	Bear Springs Subbasin	1121	3678	624710	3644289	2017	615	D	
55	566711	Safford	Bear Springs Subbasin	1123	3685	620588	3647038	1727	526	D	
55	569817	Safford	San Simon Subbasin	1148	3768	678619	3560009	1000	305	D	
55	569818	Safford	San Simon Subbasin	1150	3774	674513	3560732	1000	305	D	
55	569949	Safford	San Simon Subbasin	1129	3703	639806	3587487	800	244	D	
55	574705	Safford	San Simon Subbasin	1363	4473	679256	3523558	565	172	D	
55	575632	Safford	San Simon Subbasin	1207	3961	657090	3564818	570	174	D	
55	575756	Safford	Bear Springs Subbasin	928	3046	597630	3641476	430	131	D	
55	578919	Safford	San Simon Subbasin	1119	3672	672492	3568843	904	276	D	
55	579104	Safford	111 Ranch Subbasin	1083	3554	621816	3613834	700	213	D	
55	579106	Safford	111 Ranch Subbasin	1096	3595	620036	3612205	590	180	D	
55	579109	Safford	111 Ranch Subbasin	1172	3846	622867	3610626	800	244	D	
55	579207	Safford	San Simon Subbasin	1365	4479	679254	3523759	527	161	D	
55	582307	Safford	San Simon Subbasin	1046	3431	655497	3589786	875	267	D	
55	586984	Safford	San Simon Subbasin	1295	4250	682954	3530267	400	122	D	
55	587964	Safford	San Simon Subbasin	1268	4159	682610	3527217	700	213	D	
55	592204	Safford	San Simon Subbasin	1294	4245	680850	3525373	504	154	D	
55	593460	Safford	San Simon Subbasin	1110	3642	671268	3569004	600	183	D	
55	593838	Safford	111 Ranch Subbasin	1011	3317	620446	3617764	420	128	D	
55	594381	Safford	111 Ranch Subbasin	1344	4408	632081	3645545	870	265	D	
55	594618	Safford	San Simon Subbasin	1289	4227	681052	3525378	429	131	D	
55	596421	Safford	San Simon Subbasin	1393	4569	677683	3534197	465	142	D	
55	596774	Safford	111 Ranch Subbasin	911	2988	628699	3629687	500	152	D	
55	598293	Safford	San Simon Subbasin	1384	4539	678913	3532421	400	122	D	
55	599411	Safford	San Simon Subbasin	1148	3767	671688	3561249	599	183	D	
55	599432	Safford	111 Ranch Subbasin	902	2960	621293	3630817	500	152	D	
55	625841	Safford	San Simon Subbasin	1133	3717	642728	3580432	760	232	D	
55	902556	Safford	111 Ranch Subbasin	986	3236	619592	3622777	430	131	D	
M	1	Safford	Bear Springs Subbasin	847	2777	602069	3645533	800	244	D	
M	2	Safford	Bear Springs Subbasin	960	3149	615542	3628986	1499	457	D	See Witcher 1983, Appendix A, p.2
M	3	Safford	Bear Springs Subbasin	935	3068	613913	3630077	2535	773	D	Also known as WW-08. See Witcher 1983 detailed driller logs (BFG).
M	4	Safford	111 Ranch Subbasin	910	2986	626492	3630037	2262	689	D, RES, SP, GAM, S	From Witcher 1983
M	5	Safford	San Simon Subbasin	1103	3619	661323	3571940	1354	413	D	See detailed log in Harris 1997, p.40.
M	6	Safford	Bear Springs Subbasin	964	3163	615612	3628977	1396	425	D, S	See Witcher 1983, Appendix A, p.2
OG	21	Safford	San Simon Subbasin	1181	3876	666945	3561134	7579	2310	G, RES, SP, S	
OG	48	Safford	San Simon Subbasin	1299	4262	673953	3548201	5434	1656	G, RES, SP	
OG	539	Safford	111 Ranch Subbasin	992	3255	637479	3608126	630	192	D	
OG	541	Safford	111 Ranch Subbasin	997	3270	637068	3608189	3500	1067	G, S	
OG	620	Safford	Bear Springs Subbasin	856	2810	603158	3651445	700	213	D	
OG	684	Safford	Bear Springs Subbasin	907	2975	609241	3635073	1024	312	D, S	
OG	798	Safford	111 Ranch Subbasin	1086	3562	622815	3614079	8509	2594	G, DL, RES, SP, CN, CS, SS, S	
OG	887	Safford	San Simon Subbasin	1097	3600	662242	3572465	8974	2735	CS, SS, DL, GAM, G, CN	
OG	2-04	Safford	San Simon Subbasin	1165	3821	648062	3575320	4110	1253	D, S	
OG	2-05	Safford	San Simon Subbasin	1097	3600	663560	3571962	6668	2032	D	
OG	2-06	Safford	San Simon Subbasin	1103	3620	667930	3569856	4440	1353	S, G	Location inconsistent between logs, off by one section; not known which one. Location from Harris (1997) used.
OG	2-13	Safford	San Simon Subbasin	1244	4080	662903	3560757	990	302	D	From Harris 1997. Reinterpreted depths by BFG.
OG	2-14	Safford	San Simon Subbasin	1120	3675	671112	3564851	2000	610	D	
OG	2-18	Safford	San Simon Subbasin	1314	4310	672134	3547921	5353	1632	D, CN, GAM, RES, SP	
OG	5-02	Safford	Bear Springs Subbasin	832	2731	600906	3648398	1247	380	D	
OG	5-03	Safford	Bear Springs Subbasin	832	2730	600906	3648398	2645	806	D, T	
OG	5-05	Safford	Bear Springs Subbasin	847	2780	608061	3642477	3767	1148	D	
OG	5-07	Safford	San Simon Subbasin	1052	3450	647744	3600168	1555	474	D	
OG	5-09	Safford	San Simon Subbasin	1049	3440	647797	3599530	1925	587	D	
OG	5-10	Safford	San Simon Subbasin	1103	3620	650594	3602518	521	159	D	

Well Type	Well ID	Basin	Subbasin	Elev. (m)	Elev. (ft)	UTMX NAD83	UTMY NAD83	Well Depth (ft)	Well Depth (m)	Log Type	Comments
OG	5-13	Safford	San Simon Subbasin	1082	3550	641881	3591403	670	204	G, GAM, CS, RES, SP, G	
OG	5-16	Safford	Bear Springs Subbasin	850	2790	596096	3651735	1296	395	G	See detailed geologists log in Harris 1997
OG	5-17	Safford	Bear Springs Subbasin	844	2769	590889	3659485	810	247	D	

D = Drillers log
G = Geologist log
S = core or cuttings samples
DI = dual induction
RES = resistivity
SP = spontaneous potential
CS = compensated sonic
SS = synthetic seismic
CN = compensated neutron -formation density
GAM = gamma ray activity
T = temperature

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	21122	0	28	28	sandy loam	
35	21122	28	33	5	gravel	
35	21122	33	98	65	clay	
35	21122	98	103	5	gravel	
35	21122	103	250	147	clay	
35	21122	250	252	2	gravel	
35	21122	252	400	148	clay	
35	21163	0	179	179	silty clay	
35	21163	179	209	30	soft clay	
35	21163	209	292	83	sticky clay	
35	21163	292	440	148	clay	
35	21163	440	507	67	sticky clay	
35	21163	507	522	15	hard clay	
35	21163	522	570	48	sticky clay	
35	21163	570	754	184	clay with streaks of shale	
35	21163	754	770	16	soft sandy clay	
35	21163	770	881	111	hard clay	
35	21163	881	897	16	shale	
35	21163	897	911	14	clay	
35	21163	911	1012	101	clay with streaks of sand	
35	21163	1012	1044	32	sandy shale	
35	21163	1044	1106	62	shale with streaks of gravel	
35	21163	1106	1111	5	hard cemented sand	
35	21163	1111	1198	87	sandy shale	
35	21163	1198	1389	191	sandy shale	
35	21163	1389	1510	121	sand with streaks of gravel	
35	21163	1510	1561	51	hard clay & shale	
35	21163	1561	1654	93	sand, gravel & streaks of gravel	
35	21163	1654	1761	107	coarse gravel with streaks of clay	
35	21163	1761	1812	51	hard sandy shale with streaks of sand	
35	21163	1812	1835	23	hard sandy shale	
35	21163	1835	1918	83	cemented sand	
35	21163	1838	1945	107	soft break	
35	21163	1918	1922	4	soft break	
35	21163	1922	1927	5	hard sandy shale	
35	21163	1927	1935	8	soft break	
35	21163	1935	1938	3	hard sandstone	
35	21163	1945	1961	16	hard sandstone	
35	21163	1961	1985	24	sandy shale	
35	21163	1985	1996	11	loose sand & gravel	
35	21163	1996	2001	5	hard sand	
35	21163	2001	2025	24	fine sand with streaks of shale	
35	21163	2025	2037	12	hard sand & shale	
35	21163	2037	2042	5	fine sand with streaks of shale	
35	21163	2042	2048	6	hard sand & shale	
35	21163	2048	2052	4	loose gravel	
35	21163	2052	2060	8	hard sand	
35	21163	2060	2119	59	medium soft sand with some shale	
35	21163	2119	2161	42	hard, sandy shale with streaks of gravel	
35	22027	0	80	80	sandy loam (water @ 80')	
35	22027	80	123	43	clay	
35	22027	123	137	14	silt	
35	22027	137	462	325	clay	
35	22072	0	28	28	clay	
35	22072	28	32	4	water gravel	
35	22072	32	80	48	red clay	
35	22072	80	85	5	water gravel	
35	22072	85	198	113	red clay	
35	22072	198	225	27	water sand	
35	22072	225	398	173	clay	
35	22072	398	400	2	water sand	
35	22160	0	25	25	sandy loam	
35	22160	25	250	225	red & blue clay	
35	22160	250	975	725	blue & gray clay	
35	22160	975	980	5	sand & clay	
35	22160	980	1100	120	clay	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	22473	0	8	8	soil	
35	22473	8	90	82	gravel and boulders	
35	22473	90	100	10	unconformity - base of alluvium	
35	22473	100	190	90	blue clay	
35	22473	190	260	70	yellow clay	
35	22473	260	300	40	blue clay	
35	22473	300	700	400	yellow stratified clay	
35	22473	700	800	100	yellow clay with streaks of gypsum	
35	22473	800	895	95	yellow clay with strata of hard rock	
35	22473	895	1000	105	yellow and brown clay with streaks of gypsum	
35	22473	1000	1820	820	salty clay	
35	22599	0	18	18	boulders	
35	22599	18	45	27	clay	
35	22599	45	52	7	sand & water	
35	22599	52	72	20	clay	
35	22599	72	85	13	sandy clay	
35	22599	85	97	12	clay	
35	22599	97	105	8	sandy clay	
35	22599	105	117	12	clay	
35	22599	117	125	8	gravel	
35	22599	125	145	20	clay	
35	22599	145	157	12	gravel & warm water	
35	22599	157	165	8	clay	
35	22599	165	177	12	gravel & water	
35	22599	177	200	23	clay	
35	22599	200	206	6	gravel	
35	22599	206	212	6	clay	
35	22599	212	232	20	boulders & gravel	
35	22599	232	243	11	gravel	
35	22599	243	247	4	clay	
35	22599	247	348	101	gravel	
35	22599	348	357	9	clay	
35	22599	357	400	43	gravel & clay	
35	22601	0	16	16	brown sand & dirt	
35	22601	16	24	8	boulders	
35	22601	24	125	101	yellow clay	
35	22601	125	180	55	gravel	
35	22601	180	190	10	clay	
35	22601	190	330	140	gravel conglomerate	
35	22601	330	350	20	yellow clay	
35	22601	350	500	150	conglomerate	
35	22604	0	10	10	top soil	
35	22604	10	25	15	boulders	
35	22604	25	46	21	clay	
35	22604	46	52	6	gravel	
35	22604	52	78	26	clay	
35	22604	78	84	6	fine sand	
35	22604	84	104	20	clay	
35	22604	104	109	5	fine sand	
35	22604	109	117	8	clay	
35	22604	117	123	6	fine sand	
35	22604	123	129	6	clay	
35	22604	129	134	5	sand	
35	22604	134	139	5	clay	
35	22604	139	152	13	sand	
35	22604	152	156	4	clay	
35	22604	156	160	4	sand	
35	22604	160	168	8	clay & gravel	
35	22604	168	188	20	clay	
35	22604	188	194	6	sand	
35	22604	194	198	4	clay	
35	22604	198	205	7	gravel	
35	22604	205	210	5	sandy clay	
35	22604	210	216	6	clay	
35	22604	216	222	6	sand	
35	22604	222	234	12	sand, gravel & water	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	22604	234	242	8	clay	
35	22604	242	248	6	gravel	
35	22604	248	253	5	clay	
35	22604	253	262	9	gravel	
35	22604	262	266	4	clay	
35	22604	266	276	10	gravel	
35	22604	276	282	6	clay	
35	22604	282	286	4	gravel	
35	22604	286	288	2	clay	
35	22604	288	297	9	gravel	
35	22604	297	300	3	clay	
35	22604	300	309	9	sand	
35	22604	309	320	11	gravel	
35	22604	320	324	4	clay	
35	22604	324	332	8	sand & gravel	
35	22604	332	338	6	clay	
35	22604	338	345	7	gravel & clay	
35	22604	345	350	5	clay	
35	22604	350	354	4	coarse sand	
35	22604	354	366	12	boulders	
35	22604	366	387	21	boulders & clay	
35	22604	387	392	5	clay	
35	22604	392	420	28	malapai boulders	
35	22605	0	8	8	top soil	
35	22605	8	15	7	gravel	
35	22605	15	25	10	clay	
35	22605	25	38	13	sandy clay & water	
35	22605	38	45	7	clay	
35	22605	45	52	7	gravel	
35	22605	52	77	25	clay	
35	22605	77	88	11	sand & gravel	
35	22605	88	95	7	clay	
35	22605	95	110	15	gravel	
35	22605	110	118	8	clay	
35	22605	118	125	7	gravel	
35	22605	125	134	9	clay	
35	22605	134	145	11	sand & gravel	
35	22605	145	151	6	clay	
35	22605	151	171	20	gravel & sand	
35	22605	171	184	13	clay	
35	22605	184	200	16	gravel	
35	22605	200	217	17	clay	
35	22605	217	227	10	sand & gravel	
35	22605	227	239	12	clay	
35	22605	239	252	13	sand & gravel	
35	22605	252	262	10	clay	
35	22605	262	400	138	gravel & boulders	
35	22611	0	70	70	boulders	
35	22611	70	117	47	clay	
35	22611	117	124	7	sand	
35	22611	124	131	7	clay	
35	22611	131	138	7	sand	
35	22611	138	144	6	clay	
35	22611	144	149	5	gravel	
35	22611	149	158	9	clay	
35	22611	158	167	9	sand	
35	22611	167	175	8	clay	
35	22611	175	179	4	sand	
35	22611	179	186	7	clay	
35	22611	186	191	5	gravel	
35	22611	191	238	47	clay	
35	22611	238	247	9	gravel	
35	22611	247	278	31	clay	
35	22611	278	287	9	gravel	
35	22611	287	291	4	clay	
35	22611	291	297	6	sandy clay	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	22611	297	304	7	sand	
35	22611	304	323	19	clay	
35	22611	323	331	8	gravel	
35	22611	331	338	7	clay	
35	22611	338	341	3	gravel	
35	22611	341	349	8	clay	
35	22611	349	360	11	gravel	
35	22611	360	374	14	clay	
35	22611	374	387	13	gravel & clay	
35	22611	387	435	48	gravel	
35	22615	0	18	18	boulders	
35	22615	18	42	24	clay	
35	22615	42	46	4	sand & water	
35	22615	46	54	8	clay	
35	22615	54	58	4	sand	
35	22615	58	72	14	clay	
35	22615	72	75	3	sand	
35	22615	75	83	8	clay	
35	22615	83	87	4	sand	
35	22615	87	96	9	clay	
35	22615	96	100	4	sand	
35	22615	100	104	4	clay	
35	22615	104	106	2	sand	
35	22615	106	110	4	clay	
35	22615	110	112	2	gravel	
35	22615	112	117	5	clay	
35	22615	117	122	5	sand	
35	22615	122	129	7	clay	
35	22615	129	145	16	sandy clay	
35	22615	145	149	4	clay	
35	22615	149	158	9	sand	
35	22615	158	169	11	clay	
35	22615	169	177	8	sand	
35	22615	177	194	17	clay	
35	22615	194	197	3	sand	
35	22615	197	212	15	clay	
35	22615	212	217	5	sand	
35	22615	217	239	22	clay	
35	22615	239	243	4	sand	
35	22615	243	247	4	clay	
35	22615	247	258	11	sand	
35	22615	258	262	4	clay	
35	22615	262	274	12	sand	
35	22615	274	302	28	clay	
35	22615	302	339	37	sandy clay	
35	22615	339	344	5	clay	
35	22615	344	356	12	gravel & water	
35	22615	356	361	5	clay	
35	22615	361	398	37	sand & gravel	
35	22615	398	409	11	clay	
35	22615	409	416	7	sand	
35	22615	416	420	4	clay	
35	22615	420	435	15	coarse sand	
35	22619	0	10	10	surface soil	
35	22619	10	48	38	boulders	
35	22619	48	130	82	yellow clay	
35	22619	130	142	12	gravel	
35	22619	142	158	16	yellow clay	
35	22619	158	172	14	gravel	
35	22619	172	197	25	yellow clay	
35	22619	197	215	18	gravel	
35	22619	215	222	7	yellow clay	
35	22619	222	237	15	gravel	
35	22619	237	248	11	clay	
35	22619	248	255	7	gravel	
35	22619	255	260	5	clay	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	22619	260	301	41	conglomerate	
35	22619	301	307	6	yellow clay	
35	22619	307	415	108	water gravel	
35	22619	415	418	3	yellow clay	
35	22619	418	502	84	water gravel	
35	22619	502	508	6	yellow clay	
35	22619	508	535	27	water gravel	
35	22619	535	538	3	yellow clay	
35	22619	538	560	22	sand & boulders	
35	22619	560	566	6	yellow clay	
35	22619	566	700	134	water, gravel & sand	
35	22619	700	702	2	bed rock - hard granite	
35	22620	0	14	14	water & loam	
35	22620	14	35	21	gravel & rock	
35	22620	35	45	10	rock & clay	
35	22620	45	55	10	clay	
35	22620	55	75	20	clay & gravle	
35	22620	75	76	1	water gravel	
35	22620	76	130	54	clay	
35	22620	130	142	12	clay	
35	22620	142	148	6	gravel	
35	22620	148	155	7	clay	
35	22620	155	160	5	gravel	
35	22620	160	166	6	clay	
35	22620	166	169	3	gravel	
35	22620	169	180	11	clay	
35	22620	180	187	7	gravel	
35	22620	187	193	6	clay	
35	22620	193	198	5	gravel	
35	22620	198	210	12	clay	
35	22620	210	232	22	gravel	
35	22620	232	238	6	clay	
35	22620	238	257	19	gravel	
35	22620	257	268	11	clay	
35	22620	268	276	8	gravel	
35	22620	276	282	6	clay	
35	22620	282	287	5	gravel	
35	22620	287	291	4	clay	
35	22620	291	297	6	gravel	
35	22620	297	308	11	clay	
35	22620	308	315	7	gravel	
35	22620	315	322	7	clay	
35	22620	322	327	5	gravel	
35	22620	327	334	7	clay	
35	22620	334	342	8	gravel	
35	22620	342	348	6	clay	
35	22620	348	356	8	gravel & flowing water	
35	22620	356	364	8	clay	
35	22620	364	373	9	gravel	
35	22620	373	381	8	clay	
35	22620	381	393	12	gravel	
35	22620	393	433	40	gravel	
35	22621	0	15	15	native top soil	
35	22621	15	75	60	sand, gravel & water	
35	22621	75	250	175	rock & gravel	
35	23388	50	52	2	soil & clay between cavities	
35	23388	52	99	47	some sandstone	
35	23388	99	520	421	water in hony comb formation	
35	23401	0	494	494	sandstone, clay & water	
35	23419	0	113	113	sandstone & clay	
35	23419	113	200	87	white clay & sandstone	
35	23419	200	742	542	packed gravel	
35	23437	0	82	82	sandstone	
35	23437	82	217	135	clay	
35	23437	217	314	97	clay	
35	23438	0	80	80	sandstone & clay	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	23438	80	186	106	blue clay & sandstone (water @ 82')	
35	23438	186	314	128	hard pan clay (water @ 190')	
35	23438	314	385	71	clay (water @ 394')	
35	23438	385	389	4	hardpan	
35	23438	389	647	258	brown clay hardpans (water @ 394')	
35	23438	647	668	21	brown clay (water @ 660')	
35	23446	0	131	131	soil, sandstone & clay	
35	23446	131	412	281	clay	
35	23447	0	135	135	sandstone & clay	
35	23447	135	450	315	sandstone & clay	
35	23452	0	130	130	sandstone & clay	
35	23452	130	265	135	clay & sandstone streaks (water @ 130'-132')	
35	23452	265	356	91	blue clay (water @ 265'-269')	
35	23452	356	642	286	clay	
35	23452	642	760	118	clay & hardpan	
35	23452	760	1010	250	clay & hardpan (water @ 760'-764')	
35	23452	1010	1032	22	water in between hardpan	
35	23452	1032	1150	118	hardpan & clay	
35	23452	1150	1265	115	clay & water	
35	23452	1265	1310	45	water & honey comb formation	
35	23454	0	130	130	sandstone & clay	
35	23454	130	265	135	clay sandstone	
35	23454	265	356	91	water & blue clay	
35	23454	356	642	286	clay	
35	23454	642	760	118	clay & hardpan	
35	23454	760	1010	250	clay hardpan (water @ 760'-764')	
35	23454	1010	1032	22	water & hardpan	
35	23454	1032	1150	118	hardpan & clay	
35	23454	1150	1265	115	clay (water @ 1150'-1160')	
35	23454	1265	1500	235	clay & hardpan (water @ 1265'-1310')	
35	23455	0	71	71	sand rock & clay	
35	23455	132	133	1	blue clay (first water)	
35	23455	133	370	237	fine blue & black sand	
35	23455	370	645	275	fine sand	
35	23465	0	1135	1135	sandstone & clay	
35	23478	0	301	301	sandstone, clay & rock	
35	23478	301	365	64	sandstone & clay streaks (water @ 301'-303')	
35	23478	365	418	53	clays (water @ 365'-415')	
35	23482	0	60	60	surface soil	
35	23482	60	70	10	sandstone	
35	23482	70	250	180	clay	
35	23482	250	300	50	clay & sandstone	
35	23482	300	340	40	sand & sandstone (water @ 340')	
35	23482	340	460	120	clay & sandstone (water @ 460')	
35	23486	0	85	85	sand, rock & clay	
35	23486	85	112	27	clay & sandstone	
35	23486	112	535	423	sand & clay (flowing @ 410')	
35	23486	535	564	29	clay	
35	23489	0	25	25	sand & clay	
35	23489	25	27	2	gravel & water	
35	23489	27	260	233	clay	
35	23489	260	263	3	sand	
35	23489	263	270	7	clay	
35	23489	270	274	4	sand	
35	23489	274	285	11	clay	
35	23489	285	297	12	sand	
35	23489	297	460	163	clay	
35	23489	460	475	15	clay, sand & gravel	
35	23489	475	490	15	sand & gravel	
35	23489	490	520	30	hard sand & gravel	
35	23489	520	565	45	hard conglomerate	
35	23489	565	575	10	gray clay	
35	23489	575	580	5	sand & gravel	
35	23489	580	610	30	clay	
35	23499	0	1525	1525	sandstone & clay (water from 1250'-1254' & 1500'-1525')	
35	23523	0	51	51	soil & rocks	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	23523	51	390	339	clay & water (honeycombed from 365'-390')	
35	23523	390	421	31	unknown [BFG]	
35	23524	0	4	4	decomposed granite fill	
35	23524	4	12	8	fill & boulders	
35	23524	12	18	6	granite boulders & clay	
35	23524	18	22	4	sandstone	
35	23524	22	27	5	yellow clay	
35	23524	27	35	8	brown clay	
35	23524	35	51	16	red clay	
35	23524	51	64	13	sandstone & water (5gpm)	
35	23524	64	72	8	bentonite clay	
35	23524	72	76	4	red clay	
35	23524	76	81	5	river silt	
35	23524	81	84	3	blue clay	
35	23524	84	95	11	green bentonite clay	
35	23524	95	99	4	brown clay	
35	23524	99	101	2	red clay	
35	23524	101	113	12	brown clay	
35	23524	113	118	5	joint clay	
35	23524	118	124	6	brown clay	
35	23524	124	131	7	sandstone	
35	23524	131	145	14	brown clay	
35	23524	145	152	7	green bentonite clay	
35	23524	152	157	5	sandy clay	
35	23524	157	161	4	bentonite clay	
35	23524	161	165	4	sandstone	
35	23524	165	169	4	brown clay	
35	23524	169	187	18	sticky clay	
35	23524	187	201	14	gray sticky clay	
35	23524	201	205	4	green bentonite clay	
35	23524	205	260	55	green sticky clay	
35	23524	260	268	8	green bentonite	
35	23524	268	315	47	green sticky clay	
35	23524	315	325	10	clay with very fine sand	
35	23524	325	350	25	gray sticky clay	
35	23524	350	361	11	clay with fine sand	
35	23524	361	430	69	gray clay	
35	23524	430	435	5	blue sandstone	
35	23524	435	441	6	blue sand & water	
35	23540	0	30	30	granite boulders	
35	23540	30	450	420	sand with water	
35	23540	450	670	220	granite sandstone & water	
35	23543	0	85	85	top soil	
35	23543	85	90	5	sand	
35	23543	90	240	150	clay	
35	23543	240	275	35	sand & clay	
35	23543	275	290	15	good sand	
35	23543	290	325	35	sand & clay	
35	23543	325	335	10	sand	
35	23543	335	355	20	clay	
35	23543	355	365	10	sand & clay	
35	23543	365	370	5	clay	
35	23543	370	405	35	good sand	
35	23543	405	415	10	sand	
35	23543	415	445	30	sand & clay	
35	23543	445	485	40	sand	
35	23543	485	493	8	sand & clay	
35	23543	493	550	57	sand	
35	23543	550	595	45	clay	
35	23544	0	35	35	top soil	
35	23544	35	90	55	sand & clay strips	
35	23544	90	140	50	sand & clay strips (water @ 90')	
35	23544	140	250	110	red clay	
35	23544	250	257	7	sand & water	
35	23544	257	290	33	clay	
35	23544	290	293	3	sand & water	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	23544	293	404	111	clay	
35	23544	404	450	46	sand & water	
35	24254	0	4	4	soil & sand	
35	24254	4	27	23	sandy gravel & small rocks	
35	24254	27	28	1	boulder	
35	24254	28	55	27	brown sand & gravel	
35	24254	55	60	5	brown sand & water	
35	24254	60	80	20	brown clay & gravel	
35	24254	80	83	3	sand & water	
35	24254	83	110	27	clay & gravel	
35	24254	110	115	5	sand	
35	24254	115	150	35	clay & streaks of gravel	
35	24254	150	154	4	blue clay	
35	24254	154	157	3	sand & water	
35	24254	157	168	11	brown sandy clay	
35	24254	168	172	4	sand	
35	24254	172	193	21	sandy clay & gravel	
35	24254	193	201	8	sandy conglomerate	
35	24254	201	218	17	sandy clay	
35	24254	218	226	8	fine, hard sand	
35	24254	226	267	41	sand with clay streaks	
35	24254	267	283	16	hard sand	
35	24254	283	291	8	brown clay	
35	24254	291	294	3	sand	
35	24254	294	303	9	clay	
35	24254	303	307	4	sand	
35	24254	307	345	38	sandy clay	
35	24254	345	354	9	hard sand	
35	24254	354	368	14	sand	
35	24254	368	380	12	hard sand	
35	24254	380	400	20	sand	
35	24259	0	32	32	hardpan	
35	24259	32	38	6	gravel	
35	24259	38	90	52	yellow clay	
35	24259	90	124	34	sand and gravel	
35	24259	124	132	8	yellow clay	
35	24259	132	144	12	gravel	
35	24259	144	240	96	blue clay	
35	24259	240	254	14	blue clay and sand	
35	24259	254	260	6	gravel and sand	
35	24259	260	284	24	blue clay	
35	24259	284	288	4	sand	
35	24259	288	322	34	yellow clay	
35	24259	322	326	4	sand and clay	
35	24259	326	396	70	blue clay	
35	24259	396	400	4	sandstone	
35	24259	400	592	192	blue clay	
35	24259	592	735	143	gypsum and clay	
35	24259	735	765	30	gypsum	
35	24640	0	10	10	gravel	
35	24640	10	550	540	gravel and sand, little clay	
35	25129	0	3	3	top soil	
35	25129	3	20	17	boulders	
35	25129	20	550	530	conglomerate	
35	25830	1	375	374	unknown [BFG]	
35	25830	375	500	125	WATER	
35	25842	0	5	5	SOIL	
35	25842	5	10	5	CLAY	
35	25842	10	30	20	GRAVEL	
35	25842	30	125	95	SAND AND GRAVEL - WATER AT 125'	
35	25842	125	190	65	SAND, GRAVEL AND SHALE STREAKS	
35	25842	190	600	410	BLUE CLAY	
35	25842	600	655	55	RED CLAY	
35	25842	655	680	25	RED CLAY AND GRAVEL	
35	25842	680	780	100	RED CLAY AND GYPSUM	
35	25842	780	1000	220	CONGLOMERATE AND CLAY	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	25842	1000	1145	145	CONGLOMERATE AND SAND - POSSIBLE WATER AT 145	
35	25842	1145	1340	195	CONGLOMERATE	
35	25846	0	30	30	CLAY	
35	25846	30	300	270	BLUE SHALE	
35	25846	300	330	30	CLAY AND GRAVEL	
35	25846	330	400	70	GRAVEL AND SHELLS	
35	25846	400	460	60	BOULDERS	
35	25846	460	750	290	SAND AND GRAVEL WITH CEMENTED SHELLS	
35	25847	0	180	180	OVERBURDER	
35	25847	180	550	370	BLUE CLAY	
35	25847	550	1900	1350	SAND AND GRAVEL	
35	25858	0	5	5	TOPSOIL	
35	25858	5	14	9	CALICHE	
35	25858	14	70	56	CLAY	
35	25858	70	505	435	BLUE CLAY	
35	25858	505	535	30	RED CLAY	
35	25858	535	539	4	GRAVEL	
35	25858	539	560	21	CLAY AND GRAVEL	
35	25858	560	570	10	SAND AND GRAVEL	
35	25858	570	600	30	SAND AND GRAVEL WITH CLAY STRATAS	
35	25858	600	620	20	CLAY	
35	25858	620	645	25	SAND AND GRAVL WITH CLAY STRATAS	
35	25858	645	660	15	SAND AND GRAVEL	
35	25858	660	820	160	SAND AND GRAVEL WITH CLAY	
35	25858	820	826	6	CEMENTED GRAVEL	
35	25858	826	840	14	GRAVEL CEMENTED WITH CLAY	
35	25858	840	874	34	SAND AND GRAVEL WITH CLAY STRATAS	
35	25858	874	1000	126	CONGLOMERATE SAND AND GRAVEL WITH CLAY	
35	25859	0	11	11	TOPSOIL	
35	25859	11	47	36	SANDY CLAY	
35	25859	47	60	13	CLAY	
35	25859	60	90	30	SANDY CLAY	
35	25859	90	98	8	CLAY	
35	25859	98	548	450	BLUE SHALE	
35	25859	548	646	98	GREY SHALE	
35	25859	646	720	74	SILT AND CLAY	
35	25859	720	735	15	CONGLOMERATE	
35	25859	735	745	10	SILT	
35	25859	745	750	5	FINE SAND	
35	25859	750	761	11	SILT AND CLAY	
35	25859	761	795	34	SAND AND CLAY	
35	25859	795	925	130	CONGLOMERATE	
35	25859	925	1186	261	SANDY CLAY	
35	25859	1186	1348	162	CONGLOMERATE OF CLAY AND GRAVEL	
35	25859	1348	1360	12	HARD CLAY	
35	25861	0	3	3	SOIL --- HARD	
35	25861	3	46	43	CALICHE AND HARD STREAKS -- LIGHT	
35	25861	46	105	59	RED CLAY AND BOULDERS -- RED	
35	25861	105	127	22	SAND BOULDERS -- WATER? RED	
35	25861	127	146	19	BLUE CLAY WITH SAND STREAKS	
35	25861	146	160	14	YELLOW AND BLUE CLAY, SAND STREAKS -- GREY	
35	25861	160	175	15	SAND AND GRAVEL -- GREY	
35	25861	175	385	210	BLUE CLAY WITH FEW BOUDERS -- BLUE	
35	25861	385	558	173	470 WATER SAND AND GREY CLAY MIXED, SANDY WI. LT. BLUE	
35	25861	558	640	82	SAND SOME QUARTZ - LT. RED	
35	25861	640	678	38	HARD CEMENTED SAND WITH BOULDERS -- LIGHT	
35	25861	678	687	9	HARD FINE SAND --- LIGHT	
35	25872	0	9	9	TOPSOIL -- DARK COLOR	
35	25872	9	20	11	SAND AND CLAY YELLOW	
35	25872	20	148	128	SAND AND BOULDERS -- YELLOW (SOME WATER)	
35	25872	148	227	79	BLUE CLAY WITH SAND STREAKS	
35	25872	227	247	20	SAND HARD --- LIGHT	
35	25872	247	283	36	BLUE SHALE -- BLUE	
35	25872	283	304	21	SAND AND GRAVLE SOME BOULDERS -- RED AND SOME WATER	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	25872	304	338	34	CLAY -- YELLOW	
35	25872	338	345	7	SAND AND GRAVEL -- LIGHT	
35	25872	345	355	10	SAND STONE HARD GREY	
35	25872	355	358	3	GRAVEL AND SAND -- YELLOW	
35	25872	358	381	23	CLAY SOFT -- YELLOW	
35	25872	381	400	19	SAND AND BOULDERS -- YELLOW	
35	25872	400	550	150	SAND -- YELLOW	
35	25873	0	105	105	TOPSOIL	
35	25873	105	106	1	WATER SAND	
35	25873	106	155	49	BROWN CLAY	
35	25873	155	265	110	BLUE CLAY	
35	25873	265	292	27	BROWN CLAY	
35	25873	292	295	3	SAND	
35	25873	295	312	17	BROWN CLAY	
35	25873	312	315	3	CALICHE	
35	25873	315	367	52	BROWN CLAY	
35	25873	367	370	3	HARD SAND ROCK	
35	25873	370	395	25	CONGLOMERATE	
35	25873	395	405	10	BROWN CLAY	
35	25873	405	408	3	SAND	
35	25873	408	420	12	CONGLOMERATE	
35	25873	420	425	5	GRAVEL	
35	25873	425	429	4	CONGLOMERATE	
35	25873	429	433	4	SAND	
35	25873	433	448	15	BROWN CLAY	
35	25873	448	455	7	CONGLOMERATE	
35	25873	455	460	5	GRAVEL	
35	25873	460	467	7	CONGLOMERATE	
35	25873	467	470	3	GRAVEL	
35	25873	470	481	11	CONGLOMERATE	
35	25873	481	483	2	SAND	
35	25873	483	496	13	CONGLOMERATE	
35	25873	496	500	4	SAND	
35	25873	500	507	7	CONGLOMERATE	
35	25873	507	510	3	GRAVEL	
35	25873	510	512	2	CONGLOMERATE	
35	25873	512	516	4	GRAVEL	
35	25873	516	524	8	CONGLOMERATE	
35	25873	524	526	2	GRAVEL	
35	25873	526	534	8	CONGLOMERATE	
35	25873	534	565	31	CONGLOMERATE	
35	25873	565	568	3	GRAVEL	
35	25873	568	570	2	SAND	
35	25873	570	582	12	GRAVEL	
35	25873	582	625	43	CONGLOMERATE	
35	25873	625	627	2	GRAVEL	
35	25873	627	650	23	BROWN CLAY	
35	25873	650	655	5	GRAVEL	
35	25873	655	758	103	CONGLOMERATE	
35	25875	0	94	94	RED CLAY	
35	25875	94	205	111	BLUE CLAY	
35	25875	205	365	160	GRAY SANDY CLAY	
35	25875	365	375	10	SAND AND GRAVEL	
35	25875	375	380	5	RED CLAY	
35	25875	380	385	5	SAND AND GRAVEL	
35	25875	385	390	5	GREY STICKY CLAY	
35	25875	390	395	5	SAND AND BOULDERS	
35	25875	395	400	5	GREY STICKY CLAY	
35	25875	400	405	5	PACKED SAND	
35	25875	405	410	5	YELLOW STICKY CLAY	
35	25875	410	415	5	SAND AND BOULDES	
35	25875	415	420	5	YELLOW STICKY CLAY	
35	25875	420	425	5	PACKED SAND	
35	25875	425	430	5	YELLOW STICKY CLAY	
35	25875	430	445	15	PACKED SAND	
35	25875	445	460	15	SAND BOULDERS	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	25875	460	465	5	YELLOW STICKY CLAY	
35	25875	465	470	5	SAND AND BOULDERS	
35	25875	470	475	5	YELLOW STICKY CLAY	
35	25875	475	480	5	SAND AND BOULDERS	
35	25875	480	482	2	YELLOW STICKY CLAY	
35	25875	482	488	6	SAND AND BOULDERS	
35	25876	0	25	25	TOPSOIL AND RED SANDY CLAY	
35	25876	25	36	11	DRY GRAVEL BED	
35	25876	36	90	54	RED SANDY CLAY	
35	25876	90	95	5	DRY SAND	
35	25876	95	150	55	RED SANDY CLAY	
35	25876	150	153	3	WATER GRAVEL - WET	
35	25876	153	180	27	RED CLAY	
35	25876	180	280	100	BLUE CLAY	
35	25876	280	290	10	RED CLAY	
35	25876	290	292	2	FINE SAND	
35	25876	292	396	104	BROWN CLAY	
35	25876	396	490	94	BROWN CONGLOMERATE	
35	25876	490	953	463	SAND, GRAVEL AND STREAKS OF CONGLOMERATE	
35	25877	0	8	8	TOPSOIL	
35	25877	8	10	2	CLAY	
35	25877	10	50	40	SANDY CLAY	
35	25877	50	90	40	SHALE	
35	25877	90	91	1	SAND	
35	25877	91	140	49	CLAY	
35	25877	140	307	167	BLUE SHALE	
35	25877	307	310	3	WATER SAND	
35	25877	310	547	237	CLAY	
35	25877	547	551	4	SAND	
35	25877	551	587	36	CLAY	
35	25877	587	591	4	SAND	
35	25877	591	594	3	CLAY	
35	25877	594	597	3	SAND	
35	25877	597	600	3	CLAY	
35	25877	600	610	10	SAND	
35	25877	610	613	3	SAND	
35	25877	613	640	27	SAND	
35	25878	0	3	3	TOPSOIL	
35	25878	3	12	9	CALICHE - LIGHT	
35	25878	12	32	20	SAND - RED	
35	25878	32	50	18	SAND AND BOULDERS - RED	
35	25878	50	108	58	SANDY CLAY - YELLOW	
35	25878	108	135	27	SAND - RED	
35	25878	135	140	5	SAND AND GRAVEL - LIGHT	
35	25878	140	180	40	BLUE AND YELLOW CLAY - LIGHT	
35	25878	180	370	190	BLUE CLAY - BLUE	
35	25878	370	480	110	BLUE AND GREY CLAY MIXED - GREY	
35	25878	480	490	10	SANDY BLUE CLAY - GREY	
35	25878	490	515	25	SAND AND GRAVEL - SOFT - RED	
35	25878	515	522	7	CLAY AND SAND - BLUE	
35	25878	522	640	118	SAND AND GRAVEL - WATER - GREY	
35	25878	640	715	75	HARD SAND AND BOULDERS	
35	25879	0	5	5	SOIL	
35	25879	5	10	5	CALICHE	
35	25879	10	40	30	SAND	
35	25879	40	60	20	GRAVEL	
35	25879	60	95	35	SHALE GREY	
35	25879	95	120	25	SAND	
35	25879	120	155	35	RED CLAY	
35	25879	155	280	125	BLUE CLAY	
35	25879	280	325	45	CLAY AND GRAVEL	
35	25879	325	400	75	RED CLAY	
35	25879	400	475	75	GREY CLAY	
35	25879	475	540	65	BROWN CLAY AND GRAVEL	
35	25879	540	660	120	LOOSE CONGLOMERATE	
35	25879	660	690	30	SANDY CONGLOMERATE	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	25879	690	1000	310	FIRM CONGLOMERATE	
35	27115	0	5	5	soil	
35	27115	5	10	5	caliche	
35	27115	10	40	30	sand	
35	27115	40	60	20	gravel	
35	27115	60	95	35	shale, gray	
35	27115	95	120	25	sand	
35	27115	120	280	160	clay	
35	27115	280	325	45	clay & gravel	
35	27115	325	475	150	clay	
35	27115	475	540	65	brown clay & gravel	
35	27115	540	660	120	loose conglomerate	
35	27115	660	690	30	sandy conglomerate	
35	27115	690	1000	310	firm conglomerate	
35	27116	0	5	5	sandy red soil	
35	27116	5	105	100	sandy clay	
35	27116	105	107	2	sand - water	
35	27116	107	130	23	gray conglomerate	
35	27116	130	145	15	green clay	
35	27116	145	352	207	blue clay	
35	27116	352	390	38	gray conglomerate	
35	27116	390	495	105	gray conglomerate with pockets of fine sand - possible water	
35	27116	495	530	35	hard brown conglomerate - gravel	
35	27116	530	700	170	brown conglomerate	
35	27116	700	703	3	sand & gravel	
35	27116	703	800	97	brown conglomerate, some honeycomb - gravel	
35	27116	800	910	110	gray sticky clay and fine sand	
35	27116	910	940	30	hard honeycombed conglomerate - big water gravel	
35	27116	940	1010	70	gray sticky clay, traces of fine sand	
35	27117	0	105	105	red sandy clay	
35	27117	105	108	3	sand & gravel (water)	
35	27117	108	140	32	red sandy clay	
35	27117	140	310	170	blue clay	
35	27117	310	456	146	honeycomb formation, clay & small sand pockets	
35	27117	456	485	29	coarse sand & gravel	
35	27117	485	525	40	red clay	
35	27117	525	530	5	sand & gravel	
35	27117	530	575	45	red clay	
35	27117	575	585	10	sand & gravel	
35	27117	585	600	15	red clay & conglomerate	
35	27119	0	5	5	red soil	
35	27119	5	175	170	red sandy clay	
35	27119	175	180	5	fine sand (water)	
35	27119	180	210	30	red clay	
35	27119	210	475	265	blue clay	
35	27119	475	506	31	hard red conglomerate	
35	27119	506	516	10	blue clay	
35	27119	516	580	64	gray conglomerate with pockets of coarse gravel (water)	
35	27119	580	800	220	brown conglomerate honeycombed with pockets of gravel (water)	
35	27120	0	110	110	soil & clay	
35	27120	110	200	90	blue clay	
35	27120	200	260	60	water bearing gravel & clay	
35	27120	260	495	235	yellow clay with small streaks of sand 1' thick	
35	27121	0	87	87	soil & clay	
35	27121	87	390	303	yellown & blue clay (first water @ 99')	
35	27121	390	490	100	clay, water gravel mixed	
35	27121	490	523	33	conglomerate (water @ 510')	
35	27121	523	553	30	yellow clay	
35	27121	553	598	45	water gravel	
35	27121	598	675	77	conglomerate	
35	27121	675	705	30	cemented gravel	
35	27121	705	768	63	conglomerate	
35	27122	0	2	2	sand	
35	27122	2	10	8	soil	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	27122	10	15	5	clay	
35	27122	15	17	2	sand & gravel	
35	27122	17	19	2	clay	
35	27122	19	30	11	sand & gravel	
35	27122	30	38	8	clay	
35	27122	38	51	13	sand & gravel	
35	27122	51	108	57	light brown clay	
35	27122	108	110	2	sand	
35	27122	110	135	25	shale	
35	27122	135	140	5	water sand	
35	27122	140	188	48	brown & blue clay	
35	27122	188	252	64	gray shale	
35	27122	252	255	3	sandstone	
35	27122	255	274	19	shale	
35	27122	274	315	41	brown sandy shale	
35	27122	315	320	5	sand & gravel	
35	27122	320	325	5	brown shale, sand & gravel	
35	27122	325	451	126	sand & gravel	
35	27122	451	492	41	shale	
35	27122	492	542	50	sand & gravel	
35	27122	542	545	3	boulders	
35	27122	545	552	7	blue shale	
35	27122	552	608	56	sand & gravel	
35	27122	608	612	4	water sand, big flow	
35	27122	612	725	113	sand & gravel	
35	27122	725	765	40	sand & gravel, hard	
35	27122	765	815	50	water sand	
35	27122	815	830	15	blue hard shale	
35	27123	0	2	2	top soil	
35	27123	2	6	4	clay	
35	27123	6	18	12	boulders & clay	
35	27123	18	28	10	sand	
35	27123	28	60	32	clay	
35	27123	60	85	25	sand & boulders (trace of water)	
35	27123	85	121	36	sand & clay	
35	27123	121	140	19	clay, sand & boulers (little water)	
35	27123	140	247	107	clay & boulders	
35	27123	247	260	13	sand	
35	27123	260	264	4	very hard, red sand	
35	27123	264	288	24	sand & gravel, some large gravel	
35	27123	288	308	20	quartz - granite boulders - hard	
35	27123	308	362	54	sandy quartz	
35	27123	362	400	38	sandy quartzite, some hard granite	
35	27123	400	462	62	quartzite, hard granite	
35	27130	0	14	14	top soil	
35	27130	14	23	9	sand	
35	27130	23	35	12	boulders in sand	
35	27130	26	302	276	gravel & sand	
35	27130	35	45	10	sand	
35	27130	45	55	10	clay & boulders	
35	27130	55	75	20	sand & boulders	
35	27130	75	90	15	clay with a few boulders	
35	27130	90	165	75	clay	
35	27130	165	200	35	clay & small boulders	
35	27130	200	232	32	bluish clay with sand streaks	
35	27130	232	251	19	sand, some water	
35	27130	251	262	11	clay	
35	27130	302	329	27	boulders & hard quartz	
35	27130	329	346	17	soft sand & small gravel	
35	27130	346	360	14	boulders & hard quartz	
35	27130	360	376	16	hard boulders	
35	27130	376	450	74	granite with some quartz	
35	27135	0	5	5	top soil	
35	27135	5	20	15	caliche & boulders	
35	27135	20	50	30	gravel & boulders	
35	27135	50	195	145	blue clay	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	27135	195	245	50	blue clay with sand	
35	27135	245	250	5	sand & gravel	
35	27135	250	290	40	blue clay with sand	
35	27135	290	293	3	boulders, sand & gravel	
35	27135	293	325	32	clay with gravel strata's	
35	27135	325	353	28	light gravel	
35	27135	353	375	22	clay & gravel	
35	27135	375	385	10	sand & gravel with cemented shell	
35	27135	385	395	10	gravel & boulders	
35	27135	395	415	20	sand & gravel with hard shells	
35	27135	415	429	14	cemented gravel	
35	27135	429	435	6	gravel	
35	27135	435	453	18	clay with gravel embedded	
35	27135	453	457	4	gravel & boulders	
35	27135	457	1000	543	large boulders cemented with seams of loose layers of gravel	
35	27136	0	85	85	red sandy clay	
35	27136	85	100	15	water gravel	
35	27136	100	125	25	gray conglomerate	
35	27136	125	490	365	blue & brown clay	
35	27136	490	500	10	water gravel	
35	27136	500	504	4	red clay	
35	27139	9	25	16	clay	
35	27139	25	40	15	sand	
35	27139	40	90	50	clay	
35	27139	90	100	10	sand (water)	
35	27139	100	130	30	clay	
35	27139	130	140	10	sand	
35	27139	140	460	320	clay	
35	27139	460	465	5	sand	
35	27139	465	480	15	conglomerate	
35	27139	480	520	40	sand & clay	
35	27139	520	665	145	conglomerate & clay	
35	27139	665	685	20	sand	
35	27139	685	755	70	conglomerate	
35	27139	755	774	19	quartz	
35	27140	0	3	3	top soil	
35	27140	3	28	25	clay	
35	27140	28	140	112	sand & clay streaks	
35	27140	140	150	10	soft sand	
35	27140	150	275	125	blue shale	
35	27140	275	290	15	hard sand	
35	27140	290	400	110	sandy clay	
35	27140	400	420	20	sand & gravel (water)	
35	27140	420	440	20	sandy clay	
35	27140	440	470	30	hard reolite (water)	
35	27140	470	475	5	medium hard riolite (water)	
35	27140	475	568	93	hard quartz	
35	27140	568	670	102	sand & quartz cemented	
35	27140	670	715	45	fine hard sand streaks (water)	
35	27140	715	760	45	hard sand & quartz	
35	27140	760	803	43	hard conglomerate	
35	27143	0	10	10	red sandy soil	
35	27143	10	30	20	red clay	
35	27143	30	35	5	red sand & gravel	
35	27143	35	82	47	brown clay	
35	27143	82	86	4	water gravel	
35	27143	86	134	48	brown clay	
35	27143	134	137	3	bentonite	
35	27143	137	147	10	red clay	
35	27143	147	180	33	green bentonite	
35	27143	180	328	148	blue & brown clay	
35	27143	328	330	2	cemented conglomerate	
35	27143	330	353	23	brown clay	
35	27143	353	370	17	gray conglomerate	
35	27143	370	375	5	honeycombed conglomerate - possible water	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	27143	375	390	15	cemented conglomerate	
35	27143	390	400	10	honeycombed conglomerate - possible water	
35	27143	400	415	15	brown clay	
35	27143	415	436	21	honeycombed conglomerate - possible water	
35	27143	436	441	5	brown clay	
35	27143	441	461	20	honeycombed conglomerate - possible water	
35	27143	461	469	8	sticky red clay	
35	27143	469	472	3	gravel	
35	27143	472	485	13	honeycombed conglomerate - possible water	
35	27143	485	488	3	brown clay & fine sand	
35	27143	488	491	3	cemented conglomerate	
35	27143	491	500	9	brown clay & coarse gravel - possible water	
35	27143	500	508	8	cemented conglomerate	
35	27143	508	515	7	sand & gravel515	
35	27143	515	531	16	honeycombed conglomerate - possible water	
35	27143	531	545	14	hard cemented conglomerate	
35	27143	545	560	15	sand & gravel - possible water	
35	27143	560	600	40	brown clay	
35	27143	600	640	40	honeycombed conglomerate - possible water	
35	27143	640	675	35	brown clay	
35	27143	675	677	2	hard conglomerate	
35	27143	677	695	18	brown clay	
35	27143	695	703	8	gray conglomerate	
35	27143	703	707	4	hard conglomerate	
35	27143	707	717	10	clay	
35	27143	717	719	2	hard conglomerate	
35	27143	719	724	5	brown clay	
35	27143	724	765	41	brown sticky clay	
35	27143	765	780	15	honeycombed conglomerate - possible water	
35	27143	780	804	24	brown clay	
35	27146	0	10	10	red sandy top soil	
35	27146	10	35	25	red sandy clay	
35	27146	35	53	18	dry sand & gravel	
35	27146	53	130	77	red clay	
35	27146	130	145	15	water - sand & gravel	
35	27146	145	400	255	blue & brown clay	
35	27146	400	430	30	hard conglomerate	
35	27146	430	435	5	coarse water gravel	
35	27146	435	455	20	hard conglomerate	
35	27146	455	460	5	sand & gravel	
35	27146	460	475	15	hard conglomerate	
35	27146	475	483	8	gravel	
35	27146	483	545	62	hard conglomerate	
35	27146	545	550	5	gravel	
35	27146	550	680	130	hard conglomerate	
35	27146	680	690	10	water gravel	
35	27146	690	800	110	hard conglomerate	
35	27147	0	6	6	top soil	
35	27147	6	20	14	clay & gravel	
35	27147	20	30	10	gravel	
35	27147	30	150	120	streaks of gravel & clay (water)	
35	27147	150	280	130	blue clay	
35	27147	280	310	30	sandy clay	
35	27147	310	340	30	sand	
35	27147	340	380	40	clay	
35	27147	380	410	30	sandy clay	
35	27147	410	440	30	sand	
35	27147	440	490	50	gravel	
35	27147	490	600	110	gravel & clay conglomerate	
35	27150	0	5	5	top soil	
35	27150	5	50	45	gravel & clay	
35	27150	50	90	40	clay	
35	27150	90	125	35	sandy clay (some water)	
35	27150	125	340	215	clay	
35	27150	340	350	10	sand & gravel	
35	27150	350	750	400	clay & gravel ribs	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	27154	0	6	6	soil	
35	27154	6	220	214	red sandy clay	
35	27154	220	222	2	gravel	
35	27154	222	250	28	red clay	
35	27154	250	350	100	blue clay	
35	27154	350	359	9	gravel & clay	
35	27154	359	385	26	conglomerate	
35	27154	385	394	9	gravel & sand	
35	27154	394	415	21	conglomerate	
35	27154	415	420	5	gravel & sand	
35	27154	420	585	165	conglomerate	
35	27154	585	587	2	water sand	
35	27154	587	598	11	conglomerate	
35	27154	598	600	2	water gravel	
35	27154	600	608	8	conglomerate	
35	27154	608	610	2	gravel	
35	27154	610	678	68	conglomerate	
35	27154	678	680	2	gravel	
35	27154	680	697	17	conglomerate	
35	27154	697	700	3	gravel	
35	27154	700	740	40	conglomerate	
35	27154	740	746	6	gravel	
35	27154	746	769	23	conglomerate	
35	27154	769	770	1	gravel	
35	27154	770	780	10	conglomerate	
35	27154	780	782	2	gravel	
35	27154	782	805	23	conglomerate	
35	27154	805	813	8	sand	
35	27154	813	1013	200	sand rock, some breaks may carry water	
35	27155	0	179	179	red clay	
35	27155	179	185	6	gravel & sand (water)	
35	27155	185	260	75	blue clay	
35	27155	260	266	6	sand & gravel	
35	27155	266	340	74	blue clay	
35	27155	340	345	5	gravel & sand	
35	27155	345	408	63	conglomerate	
35	27155	408	417	9	gravel & sand	
35	27155	417	580	163	conglomerate	
35	27155	580	591	11	gravel & sand	
35	27155	591	763	172	conglomerate	
35	27155	763	769	6	sand & gravel	
35	27155	769	886	117	conglomerate	
35	27155	886	892	6	sand & gravel	
35	27155	892	980	88	conglomerate	
35	27155	980	1004	24	sand & gravel	
35	27155	1004	1013	9	hard sand & rock	
35	27157	0	3	3	top soil	
35	27157	3	18	15	clay	
35	27157	18	30	12	sand & gravel	
35	27157	30	45	15	yellow clay & boulders	
35	27157	45	60	15	boulders with some sand	
35	27157	60	85	25	clay, boulders	
35	27157	85	105	20	sand & boulders	
35	27157	105	167	62	sand with clay streaks	
35	27157	167	176	9	sand & gravel	
35	27157	176	183	7	clay & boulders	
35	27157	183	218	35	gray & blue shale & sand streaks	
35	27157	218	242	24	sand, quartz, clay streaks	
35	27157	242	272	30	sand, quartz, polly haylite - soft (show of water)	
35	27157	272	299	27	boulders, quartz - hard	
35	27157	299	313	14	sand, gravel & small boulders	
35	27157	313	327	14	hard cemented sand	
35	27157	327	345	18	boulders & sand - hard	
35	27157	345	363	18	sand, soft with hard streaks	
35	27157	363	372	9	cemented sand with hard boulders	
35	27157	372	384	12	red sand, small gravel	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	27157	384	397	13	soft sand (water)	
35	27157	397	409	12	hard cemented sand & boulders	
35	27157	409	425	16	sand with quartz & large gravel	
35	27157	425	455	30	sand (water)	
35	27161	0	2	2	top soil	
35	27161	2	4	2	sand	
35	27161	4	10	6	caliche	
35	27161	10	30	20	sand & boulders	
35	27161	30	80	50	clay & boulders	
35	27161	80	130	50	sand with quartz (show water)	
35	27161	130	140	10	sandy clay	
35	27161	140	180	40	yellow clay with blue streaks	
35	27161	180	195	15	gray & blue clay with sand streaks	
35	27161	195	221	26	sand & quartz (some water)	
35	27161	221	230	9	sand & quartz with clay streaks	
35	27161	230	241	11	sand & gravel	
35	27161	241	248	7	sand & gravel with polly haylite, quartz - hard, red	
35	27161	248	255	7	sand, quartz, ryolite boulders	
35	27161	255	282	27	sand with gray clay streaks	
35	27161	282	297	15	sand & granite boulders	
35	27161	297	309	12	hard cemented sand with quartz	
35	27161	309	318	9	sand, quartz, some mica	
35	27161	318	330	12	sand, quartz (show water)	
35	27161	330	350	20	hard cemented sand with ryolite boulders	
35	27161	350	360	10	sand, small gravel - soft	
35	27161	360	382	22	sand & boulders	
35	27161	382	390	8	sand & small gravel	
35	27161	390	402	12	cemented sand, quartz, boulders	
35	27161	402	425	23	sand, large gravel with lots of streaks	
35	27161	425	430	5	large hard boulders	
35	27161	430	475	45	cemented sand	
35	27163	0	8	8	soil & sand	
35	27163	8	170	162	shale & boulders	
35	27163	170	230	60	white shale	
35	27163	230	245	15	sand & gravel	
35	27163	245	425	180	sand & gravel (caving)	
35	27163	425	437	12	brown shale	
35	27163	437	475	38	sand & gravel	
35	27163	475	500	25	sand, gravel & granite boulders	
35	27163	500	510	10	granite boulders	
35	27163	510	540	30	gravel & shale	
35	27163	540	575	35	brown shale & granite boulders	
35	27163	575	825	250	shale, gravel & sand	
35	27163	825	845	20	gravel & boulders	
35	27163	845	895	50	brown shale & boulders	
35	27164	0	15	15	soil & sand	
35	27164	15	185	170	shale & boulders	
35	27164	185	210	25	white shale	
35	27164	210	400	190	sand, gravel & water	
35	27164	400	415	15	brown shale	
35	27164	415	495	80	sand, gravel & granite boulders	
35	27164	495	520	25	gravel & shale	
35	27164	520	560	40	brown shale	
35	27164	560	610	50	brown & yellow shale, sand & gravel	
35	27164	610	640	30	gray shale, quartz & gravel	
35	27164	640	671	31	brown & gray shale, sand & gravel	
35	27166	0	6	6	top soil	
35	27166	6	105	99	boulders & sand	
35	27166	105	137	32	boulders & red & blue clay	
35	27166	137	152	15	red & blue clay	
35	27166	152	210	58	quartz	
35	27166	210	292	82	sand, small gravel & boulders (water @ 230')	
35	27166	292	309	17	hard, cemented sand with quartz	
35	27166	309	410	101	sand & boulders (water)	
35	27166	410	430	20	hard cemented sand with granite boulders	
35	27166	430	465	35	granite	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	27169	0	10	10	top soil	
35	27169	10	30	20	sand, gravel & clay	
35	27169	30	160	130	gravel clay	
35	27169	160	185	25	shale	
35	27169	185	200	15	gravel water	
35	27169	200	240	40	shale & gravel	
35	27169	240	275	35	clay	
35	27169	275	285	10	lime & conglomerate	
35	27169	285	295	10	clay	
35	27169	295	305	10	rock	
35	27169	305	330	25	clay	
35	27169	330	340	10	rock	
35	27169	340	357	17	clay	
35	27169	357	370	13	rock	
35	27169	370	382	12	clay	
35	27169	382	395	13	rock	
35	27169	395	400	5	clay	
35	27169	400	431	31	rock	
35	27169	431	432	1	lime	
35	27169	432	437	5	water sand	
35	27169	437	439	2	clay	
35	27169	439	441	2	quartz	
35	27169	441	450	9	rock	
35	27169	450	456	6	shale, gravel & quicksand	
35	27169	456	475	19	shale & gravel	
35	27169	475	477	2	clay & gravel	
35	27169	477	479	2	boulders	
35	27169	479	500	21	boulders and clay	
35	27170	0	10	10	brown clay	
35	27170	10	50	40	sandy brown clay	
35	27170	50	60	10	brown clay	
35	27170	60	145	85	brown clay with gravel	
35	27170	145	147	2	water sand, fine	
35	27170	147	215	68	green clay with fine gravel	
35	27170	215	247	32	blue & green clay	
35	27170	247	252	5	white conglomerate	
35	27170	252	425	173	blue, brown, gray & green clay	
35	27170	425	432	7	conglomerate	
35	27170	432	438	6	brown clay	
35	27170	438	444	6	sand & gravel	
35	27170	444	449	5	brown clay	
35	27170	449	494	45	conglomerate water & gravel	
35	27170	494	511	17	hard brown sand	
35	27172	460	1000	540	gravel conglomerate with soft streaks (indicate water bearing)	
35	27173	0	1	1	top soil	
35	27173	1	18	17	caliche	
35	27173	18	45	27	boulders & rocks	
35	27173	45	87	42	sand	
35	27173	87	142	55	sand & boulders	
35	27173	142	173	31	sandy clay	
35	27173	173	192	19	hare quartz	
35	27173	192	227	35	blue clay boulders	
35	27173	227	251	24	quartz, sand coarse (water)	
35	27173	251	332	81	quartz boulders	
35	27173	332	367	35	hard cemented sand with ryolite streaks & water	
35	27173	367	397	30	sand, quartz	
35	27173	397	415	18	hard sand	
35	27173	415	447	32	sand, quartz with hard streaks	
35	27173	447	485	38	cemented sand, medium hard to hard	
35	27173	485	513	28	cemented sand with ryolite	
35	27173	513	530	17	large granite boulders	
35	27175	0	5	5	top soil	
35	27175	5	50	45	sandy clay	
35	27175	50	150	100	clay	
35	27175	150	200	50	streaks of sand & clay	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	27175	200	240	40	fine sand	
35	27175	240	250	10	clay	
35	27175	250	300	50	streaks of gravel & clay	
35	27175	300	350	50	clay	
35	27175	350	450	100	streaks of gravel & clay	
35	27175	450	480	30	gravel	
35	27175	480	520	40	gravel & clay conglomerate	
35	27177	0	40	40	sand & rock with streaks of clay	
35	27177	40	440	400	clay with sandy clay	
35	27177	440	460	20	small boulders, coarse sand & fine sand mixed	
35	27177	460	480	20	sandy clay	
35	27177	480	490	10	water sand	
35	27177	490	500	10	sandy hard clay	
35	27179	0	40	40	red sandy clay	
35	27179	40	45	5	sand rock	
35	27179	45	60	15	dry sand & gravel	
35	27179	60	235	175	red clay	
35	27179	235	300	65	red sandy clay	
35	27179	300	350	50	gray blue clay	
35	27179	350	405	55	red clay with streaks of cemented conglomerate	
35	27179	405	455	50	water sand & gravel with streaks of conglomerate	
35	27179	455	460	5	hard conglomerate	
35	27180	0	65	65	dry sand & gravel beds	
35	27180	65	403	338	red sandy clay with dry sand beds	
35	27180	403	478	75	water sand & gravel	
35	27181	0	5	5	red sandy soil	
35	27181	5	41	36	red sandy clay	
35	27181	41	92	51	fine sugar sand - possible water	
35	27181	92	95	3	fine sand - water	
35	27181	95	125	30	gray conglomerate	
35	27181	125	350	225	green & blue clay	
35	27181	350	370	20	gray conglomerate	
35	27181	370	400	30	blue clay	
35	27181	400	410	10	gray conglomerate	
35	27181	410	451	41	gray conglomerate & fine sand	
35	27181	455	490	35	gray conglomerate & fine sand	
35	27181	490	515	25	hard brown conglomerate	
35	27181	515	520	5	fine water sand	
35	27181	520	605	85	brown conglomerate & fine sand	
35	27181	605	610	5	fine water sand	
35	27181	610	682	72	brown honeycomb formation with pockets of sand	
35	27181	682	685	3	sand & small gravel - water	
35	27181	685	695	10	hard brown conglomerate	
35	27181	695	795	100	brown conglomerate honeycombed with sand pockets & water	
35	27181	795	855	60	sticky brown clay & fine sand	
35	27181	855	895	40	hard honeycombed conglomerate, possible water	
35	27181	895	970	75	sticky brown clay & fine sand	
35	27181	970	1000	30	hard honeycombed conglomerate - possible water	
35	27182	0	165	165	clay fill	
35	27182	165	285	120	blue shale	
35	27182	285	468	183	clay	
35	27182	468	482	14	sand & water (raised to 100')	
35	27182	482	492	10	blue clay	
35	27182	492	498	6	sand & some water	
35	27182	498	505	7	clay & gravel	
35	27182	505	512	7	sand & water	
35	27182	512	518	6	sand & clay	
35	27182	518	526	8	sand & water	
35	27182	526	530	4	sand & clay	
35	27182	530	537	7	sand	
35	27182	537	545	8	sandstone	
35	27182	545	551	6	gravel & water	
35	27182	551	568	17	sand, gravel & clay	
35	27182	568	578	10	clay	
35	27182	578	592	14	sand, gravel & clay	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	27182	592	628	36	sandy clay, water raised to 11' of top	
35	27182	628	705	77	hard sandstone & clay	
35	27182	705	760	55	hard sandstone & clay & some water	
35	27182	760	800	40	sand, gravel, clay & some water	
35	27182	800	974	174	sand	
35	27182	974	1011	37	sand rock	
35	27182	1011	1020	9	conglomerate of red & black shale & gray sand	
35	27182	1020	1029	9	gray shale & sand	
35	27182	1029	1051	22	red sand with some gray shale	
35	27182	1051	1198	147	hard sand with streaks of quartz	
35	27182	1198	1225	27	very hard sandstone	
35	27182	1225	1275	50	soft sand (some water)	
35	27185	0	5	5	red sandy soil	
35	27185	5	80	75	red clay	
35	27185	80	82	2	water sand	
35	27185	82	115	33	gray conglomerate	
35	27185	115	140	25	green clay	
35	27185	140	170	30	gray conglomerate	
35	27185	170	340	170	blue clay	
35	27185	340	365	25	gray conglomerate	
35	27185	365	390	25	blue clay	
35	27185	390	451	61	gray conglomerate with pockets of fine sand & possible water	
35	27185	451	455	4	blue clay	
35	27185	455	490	35	gray conglomerate with pockets of fine sand & possible water	
35	27185	490	520	30	hard brown conglomerate	
35	27185	520	680	160	brown conglomerate wit pockets of sand & water	
35	27185	680	684	4	sand - water	
35	27185	684	695	11	hard brown conglomerate	
35	27185	695	770	75	brown conglomerate honeycombed with sand pockets, water	
35	27185	770	870	100	gray sticky clay with fine sand	
35	27185	870	900	30	brown conglomerate with sand pockets, water	
35	27185	900	926	26	gray sticky clay and fine sand	
35	27186	0	90	90	soil & dirt	
35	27186	90	460	370	clay & conglomerate	
35	27186	460	685	225	hard lime sediment	
35	27186	685	750	65	sand & gravel with hard cemented streaks	
35	27193	0	4	4	top soil	
35	27193	4	20	16	clay & gravel	
35	27193	20	55	35	sandy, clay, boulders	
35	27193	55	80	25	sand clay streaks, large boulders	
35	27193	80	174	94	hard cemented sand boulders, quartz	
35	27193	174	198	24	sand & boulders	
35	27193	198	280	82	blue clay & boulders	
35	27193	280	350	70	sand, blue clay & light clay streaks	
35	27193	350	536	186	sand, gravel, small boulders, water	
35	27193	536	616	80	conglomerate, granite boulders, hard sand streaks	
35	27194	0	10	10	brown clay	
35	27194	10	45	35	brown sandy clay	
35	27194	45	55	10	sand & gravel	
35	27194	55	145	90	brown clay	
35	27194	145	146	1	water sand	
35	27194	146	212	66	green clay	
35	27194	212	245	33	blue & green clay	
35	27194	245	250	5	caliche	
35	27194	250	420	170	blue & green clay	
35	27194	420	425	5	sand & gravel	
35	27194	425	490	65	conglomerate	
35	27194	490	495	5	brown clay	
35	27194	495	498	3	conglomerate	
35	27194	498	504	6	sand & gravel	
35	27194	504	540	36	conglomerate with pockets of gravel	
35	27194	540	545	5	sand & gravel	
35	27194	545	557	12	conglomerate	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	27194	557	564	7	sand & gravel	
35	27194	564	566	2	conglomerate	
35	27194	566	570	4	sand & gravel	
35	27194	570	576	6	conglomerate	
35	27196	0	2	2	top soil	
35	27196	2	15	13	sand & gravel	
35	27196	15	26	11	sandy clay	
35	27196	26	56	30	boulders in clay	
35	27196	56	168	112	hard cemented sand & boulders, quartz	
35	27196	168	197	29	ryolite boulders & clay, some sand, quartzite	
35	27196	197	244	47	blue clay & boulders, sandy	
35	27196	244	255	11	sand & small gravel with hard streaks	
35	27196	255	342	87	boulders with sand & bluish clay	
35	27196	342	376	34	sand, small gravel, thin yellow clay streaks	
35	27196	376	397	21	conglomerate of sand, quartz, boulders & soft streaks	
35	27196	397	462	65	sand, quartz, soft & hard streaks	
35	27196	462	520	58	hard ryolite boulders & quartzite	
35	27196	520	560	40	granite with some boulders	
35	27209	0	145	145	red sandy clay	
35	27209	145	160	15	water sand & caving	
35	27209	160	180	20	gray conglomerate	
35	27209	180	385	205	blue clay	
35	27209	385	465	80	brown conglomerate	
35	27209	465	473	8	water gravel	
35	27209	473	515	42	brown conglomerate	
35	27209	515	525	10	water gravel	
35	27209	525	655	130	brown conglomerate	
35	27209	655	667	12	water gravel	
35	27209	667	679	12	brown conglomerate	
35	27209	679	690	11	water gravel	
35	27209	690	707	17	red sticky clay	
35	27210	0	35	35	red sandy soil	
35	27210	35	85	50	red sandy clay	
35	27210	45	470	425	sand	
35	27210	85	164	79	conglomerate	
35	27210	164	166	2	water sand	
35	27210	166	185	19	conglomerate	
35	27210	185	380	195	blue clay	
35	27210	380	465	85	conglomerate	
35	27210	470	520	50	conglomerate	
35	27210	520	530	10	gravel	
35	27210	530	655	125	conglomerate	
35	27210	655	664	9	gravel	
35	27210	664	850	186	conglomerate & clay	
35	27210	850	852	2	gravel	
35	27210	852	1050	198	conglomerate & red clay	
35	27210	1050	1053	3	gravel	
35	27210	1053	1077	24	conglomerate	
35	27210	1077	1084	7	gravel	
35	27210	1084	1104	20	conglomerate & red clay	
35	27220	0	95	95	red sandy clay	
35	27220	95	100	5	dry gravel	
35	27220	100	165	65	red sandy clay	
35	27220	165	178	13	water sand & gravel	
35	27220	178	465	287	blue clay	
35	27220	465	495	30	brown clay	
35	27220	495	530	35	gray conglomerate	
35	27220	530	600	70	brown clay	
35	27220	600	604	4	coarse gravel	
35	27220	604	620	16	brown conglomerate	
35	27220	620	625	5	coarse gravel	
35	27220	625	645	20	brown conglomerate with pockets of sand	
35	27220	645	652	7	gravel	
35	27220	652	670	18	brown conglomerate with pockets of sand	
35	27220	670	680	10	coarse gravel	
35	27220	680	801	121	brown conglomerate with pockets of sand	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	27223	0	3	3	top soil	
35	27223	3	10	7	caliche	
35	27223	10	30	20	clay & boulders	
35	27223	30	55	25	sand & boulders	
35	27223	55	171	116	hard sand boulders & quartzite	
35	27223	171	202	31	gray & blue shale	
35	27223	202	583	381	blue shale	
35	27223	583	641	58	coarse sand & water	
35	27223	641	654	13	sand, quartzite, hard shale streaks	
35	27223	654	684	30	sand, hard lime streaks	
35	27223	684	818	134	hard ryolite, quartzite, brown shale	
35	27223	818	830	12	sand, ryolite boulders, quartzite	
35	27223	830	870	40	very hard	
35	27231	0	32	32	brown clay	
35	27231	32	183	151	brown sandy clay	
35	27231	183	190	7	gray clay (water @ 183')	
35	27231	190	543	353	blue clay	
35	27231	543	555	12	water gravel	
35	27231	555	580	25	brown clay	
35	27231	580	590	10	sand & gravel	
35	27231	590	675	85	brown sandy clay	
35	27231	675	755	80	brown clay	
35	27231	755	810	55	gray conglomerate	
35	27231	810	820	10	gray conglomerate, some gravel @ 820'	
35	27231	820	863	43	hard gray conglomerate	
35	27232	0	28	28	top soil	
35	27232	28	175	147	brown sandy clay	
35	27232	175	177	2	water sand	
35	27232	177	590	413	blue clay	
35	27232	590	595	5	water gravel	
35	27232	595	630	35	conglomerate	
35	27232	630	637	7	gravel & sand	
35	27232	637	645	8	conglomerate	
35	27232	645	650	5	gravel & sand	
35	27232	650	670	20	conglomerate	
35	27232	670	678	8	sand & gravel	
35	27232	678	712	34	conglomerate	
35	27232	712	717	5	gravel & sand	
35	27232	717	725	8	conglomerate	
35	27232	725	732	7	gravel & sand	
35	27232	732	760	28	conglomerate	
35	27232	760	762	2	gravel & sand	
35	27232	762	768	6	conglomerate	
35	27232	768	775	7	gravel & sand	
35	27232	775	795	20	conglomerate	
35	27233	0	50	50	dry sand & red sandy clay	
35	27233	50	120	70	red sandy clay	
35	27233	120	125	5	rock ledge	
35	27233	125	169	44	red clay	
35	27233	169	171	2	rock ledge	
35	27233	171	173	2	water sand	
35	27233	173	180	7	red sandy clay	
35	27233	180	200	20	caliche	
35	27233	200	470	270	blue clay	
35	27233	470	590	120	blue/gray clay	
35	27233	590	596	6	hard conglomerate	
35	27233	596	600	4	gravel 4'	
35	27233	600	642	42	brown clay	
35	27233	642	657	15	gravel	
35	27233	657	680	23	brown conglomerate	
35	27233	680	684	4	sand 4'	
35	27233	684	725	41	gravel 41'	
35	27233	725	728	3	hard sand rock	
35	27233	728	735	7	brown conglomerate	
35	27233	735	743	8	gravel 12'	
35	27233	743	751	8	hard conglomerate	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	27233	751	754	3	sand 3'	
35	27233	754	756	2	rock (double hard)	
35	27233	756	830	74	conglomerate	
35	27233	830	835	5	gravel	
35	27233	835	850	15	sandy brown clay	
35	27233	850	857	7	hard conglomerate	
35	27233	857	933	76	conglomerate	
35	27233	933	938	5	gravel	
35	27233	938	967	29	conglomerate	
35	27233	967	970	3	gravel	
35	27233	970	1000	30	conglomerate	
35	27234	0	8	8	top soil	
35	27234	8	130	122	sticky clay & gravel	
35	27234	130	350	220	blue clay	
35	27234	350	450	100	sand & clay	
35	27234	450	1000	550	boulders in gravel & clay	
35	27234	1000	1500	500	boulders	
35	27234	1500	1900	400	rock	
35	27237	0	4	4	top soil	
35	27237	4	90	86	sandy clay	
35	27237	90	480	390	combination of sand, rocks & blue clay	
35	27237	480	611	131	gravel with shale streaks	
35	27237	611	840	229	clay	
35	27237	840	856	16	small gravel	
35	27237	856	910	54	clay & shale	
35	27237	910	1040	130	small gravel	
35	27239	0	4	4	top soil	
35	27239	4	40	36	red clay & boulders	
35	27239	40	60	20	sandy clay & boulders	
35	27239	60	132	72	sand & boulders (water)	
35	27239	132	155	23	sand & a few hard boulders (water)	
35	27239	155	187	32	sandy (light) clay streaks, boulders	
35	27239	187	265	78	blue shale a few boulders	
35	27239	265	338	73	blue & gray shale	
35	27239	338	408	70	gray shale with lots of boulders	
35	27239	408	412	4	hard cemented sand	
35	27239	412	448	36	sand, small gravel with boulders (water)	
35	27239	448	570	122	sand, small gravel, quartzite hard streaks	
35	27239	570	608	38	ryolite, quartzite, hard sand	
35	27241	0	3	3	sandy loam	
35	27241	3	184	181	red clay	
35	27241	184	210	26	blue shale	
35	27241	210	211	1	fine sand	
35	27241	211	260	49	blue clay	
35	27241	260	280	20	coarse sand & gravel (water)	
35	27241	280	367	87	sandy brown clay	
35	27241	367	380	13	coarse sand & gravel (water)	
35	27241	380	405	25	sandy brown clay	
35	27241	405	407	2	hard sandrock	
35	27241	407	425	18	sandy brown clay	
35	27241	425	426	1	hard sandrock	
35	27241	426	480	54	red sandy clay	
35	27241	480	530	50	conglomerate, rock & blue clay	
35	27241	530	547	17	blue granite rock	
35	27241	547	555	8	blue clay	
35	27241	555	570	15	blue granite rock	
35	27241	570	573	3	coarse water gravel	
35	27241	573	612	39	hard conglomerate, rock & blue clay	
35	27241	612	615	3	coarse water gravel	
35	27241	615	655	40	hard conglomerate, rock & blue clay	
35	27241	655	660	5	blue granite rock	
35	27245	0	4	4	top soil	
35	27245	4	31	27	soil, sand, some small gravel	
35	27245	31	84	53	clay, small boulders	
35	27245	84	92	8	sand	
35	27245	92	101	9	boulders, sand & clay	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	27245	101	161	60	sand & hard boulders	
35	27245	161	174	13	soft sand	
35	27245	174	189	15	sand & boulders, rough clay streaks	
35	27245	189	293	104	blue shale & a few boulders	
35	27245	293	313	20	blue shale with brown sandy clay steaks & small boulders	
35	27245	313	319	6	sand, quartz with blue shale streaks	
35	27245	319	335	16	sand, small gravel with large boulders	
35	27245	335	345	10	sand, hard with soft streaks, layers of brown & blue shale	
35	27245	345	356	11	sand, small grave, hard streaks & boulders	
35	27245	356	363	7	blue & gray shale, sandy	
35	27245	363	368	5	hard cemented sand with large boulders	
35	27245	368	396	28	sand, soft with hard streaks some quartz (water)	
35	27245	396	402	6	sand, hard with soft streaks, thin layer of blue shale	
35	27245	402	435	33	hard cemented sand with ryolite boulders	
35	27245	435	473	38	hard sand with soft streaks, some boulders	
35	27245	473	506	33	hard ryolite boulders	
35	27245	506	517	11	sand, granite wash, some meduim soft quartz	
35	27245	517	530	13	cemented sand with granite	
35	27245	530	607	77	conglomerate of decomposed granite & ryolite	
35	27245	607	615	8	cemented hard sand with granite	
35	27245	615	629	14	ryolite & granite, very hard	
35	27250	0	85	85	gravel & soil	
35	27250	85	115	30	sand & gravel	
35	27250	115	600	485	blue clay	
35	27250	600	810	210	caliche & hardpan	
35	27250	810	855	45	sand, gravel & boulders	
35	27252	0	90	90	soil & gravel	
35	27252	90	125	35	sand & gravel	
35	27252	125	640	515	blue clay	
35	27252	640	860	220	caliche, hard streaks	
35	27252	860	900	40	sand, gravel & boulders	
35	27254	0	80	80	soil & gravel	
35	27254	80	110	30	sand & gravel	
35	27254	110	600	490	blue clay	
35	27254	600	770	170	caliche & hardpan	
35	27254	770	800	30	sand, gravel & boulders	
35	27255	0	90	90	soil, some gravel	
35	27255	90	120	30	sand & gravel (water)	
35	27255	120	640	520	blue clay	
35	27255	640	820	180	caliche, hard streaks	
35	27255	820	885	65	sand, gravel & boulders	
35	27255	885	915	30	clay	
35	27257	0	5	5	soil	
35	27257	5	100	95	clay & gypsum	
35	27257	100	150	50	water gravel	
35	27257	150	650	500	blue clay	
35	27257	650	815	165	caliche	
35	27257	815	850	35	sand & gravel	
35	27258	0	90	90	soil, some gravel	
35	27258	90	120	30	sand, gravel & water	
35	27258	120	645	525	blue clay	
35	27258	645	850	205	caliche, hard streaks	
35	27258	850	900	50	sand, gravel & boulders	
35	27259	0	8	8	soil	
35	27259	8	100	92	caliche	
35	27259	100	120	20	sand & gravel	
35	27259	120	700	580	blue clay	
35	27259	700	890	190	caliche & hardpan	
35	27259	890	930	40	sand, gravel & boulders	
35	27260	0	90	90	soil, some gravel	
35	27260	90	125	35	sand, gravel & water	
35	27260	125	640	515	blue clay	
35	27260	640	920	280	caliche, hard streaks	
35	27260	920	975	55	sand, gravel & boulders	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	27270	0	80	80	soil & gravel	
35	27270	80	110	30	sand & gravel	
35	27270	110	600	490	blue clay	
35	27270	600	820	220	caliche, hardpan	
35	27270	820	860	40	sand, gravel & boulders	
35	27272	0	5	5	soil	
35	27272	5	100	95	clay & gypsum	
35	27272	100	150	50	water gravel	
35	27272	150	650	500	blue clay	
35	27272	650	820	170	caliche	
35	27272	820	850	30	sand & gravel	
35	27274	0	5	5	soil	
35	27274	5	100	95	clay & gypsum	
35	27274	100	130	30	water gravel	
35	27274	130	630	500	blue clay	
35	27274	630	730	100	caliche	
35	27274	730	750	20	sand & gravel	
35	27280	0	2	2	top soil	
35	27280	2	12	10	clay	
35	27280	12	19	7	sand	
35	27280	19	24	5	clay	
35	27280	24	32	8	sand & gravel	
35	27280	32	59	27	clay	
35	27280	59	72	13	gravel, sand & water	
35	27280	72	84	12	clay	
35	27280	84	96	12	gravel, sand & water	
35	27280	96	134	38	clay	
35	27280	134	135	1	gravel	
35	27280	135	270	135	blue clay	
35	27280	270	276	6	gravel, sand & water	
35	27280	276	436	160	blue clay	
35	27280	436	458	22	gravel, sand & water	
35	27280	458	480	22	blue clay	
35	27280	480	520	40	conglomerate & water	
35	27280	520	580	60	clay	
35	27280	578	612	34	clay	
35	27280	580	578	-2	gravel, sand & water	
35	27280	612	632	20	gravel, sand & water	
35	27280	632	645	13	clay	
35	27280	645	660	15	gravel, sand & wqter	
35	27280	660	660	0	clay	
35	27294	0	75	75	soil & gravel	
35	27294	75	100	25	sand & gravel	
35	27294	100	600	500	blue clay	
35	27294	600	790	190	caliche & hardpan	
35	27294	790	820	30	sand, gravel & boulders	
35	27297	0	3	3	soil	
35	27297	3	100	97	clay & gypsum	
35	27297	100	130	30	water gravel	
35	27297	130	620	490	blue clay	
35	27297	620	720	100	caliche	
35	27297	720	750	30	sand & gravel	
35	27307	0	2	2	soil	
35	27307	2	95	93	clay & gypsum	
35	27307	95	130	35	blue clay	
35	27307	130	145	15	sand & gravel	
35	27307	145	600	455	blue clay	
35	27307	600	700	100	caliche	
35	27307	700	740	40	sand & gravel	
35	27333	0	60	60	dirt, some gravel	
35	27333	60	100	40	sand & gravel	
35	27333	100	485	385	blue clay	
35	27333	485	580	95	caliche with hard streaks	
35	27333	580	630	50	sand, gravel & boulders	
35	27337	0	5	5	soil	
35	27337	5	75	70	clay & caliche	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	27337	75	300	225	brown joint clay	
35	27337	300	500	200	blue clay	
35	27337	500	660	160	conglomerate	
35	27337	660	700	40	sand & gravel	
35	27347	0	55	55	dirt	
35	27347	55	100	45	water, sand & gravel	
35	27347	100	480	380	blue clay	
35	27347	480	560	80	caliche, hard streaks	
35	27347	560	597	37	sand, gravel & boulders	
35	27350	0	60	60	sand & caliche	
35	27350	60	180	120	gray clay	
35	27350	180	500	320	blue clay	
35	27350	500	640	140	conglomerate	
35	27350	640	660	20	sand & gravel	
35	27353	0	5	5	soil	
35	27353	5	100	95	tan sandy clay (water @ 75')	
35	27353	100	405	305	blue clay	
35	27353	405	420	15	fine brown clay	
35	27353	420	425	5	white boxite	
35	27353	425	500	75	brown & blue clay	
35	27353	500	520	20	gray mud	
35	27353	520	865	345	brown mud, small rock in mud	
35	27353	865	885	20	rock - gravel after pumping test	
35	27353	885	909	24	brown rock	
35	27356	0	60	60	sand & caliche	
35	27356	60	180	120	gray clay	
35	27356	180	480	300	blue clay	
35	27356	480	560	80	conglomerate	
35	27356	560	600	40	sand & gravel	
35	27358	0	50	50	Dirt	
35	27358	50	280	230	Brown Clay	
35	27358	280	455	175	Blue Clay	
35	27358	455	550	95	Conglomerate	
35	27358	550	580	30	Sand and Gravel	
35	27359	0	55	55	Red Valley Fill	
35	27359	55	70	15	Sandy Shale	
35	27359	70	85	15	Sticky Shale	
35	27359	85	97	12	Sandy, a little water about 5 G.P.M. Water level 90'	
35	27359	97	135	38	Gray soapy gumbo shale	
35	27359	135	150	15	Green gumbo after green	
35	27359	150	235	85	Gray gumbo shale caved bad from 97'	
35	27359	235	243	8	Water sand and water	
35	27359	243	260	17	Blue sandy shale	
35	27359	260	320	60	Blue gumbo shale	
35	27359	320	330	10	Red shale with fine sand	
35	27359	330	355	25	White gumbo shale or bentonite	
35	27359	355	370	15	Red sandy shale	
35	27359	370	373	3	Light gray shale	
35	27359	373	420	47	Light red conglomerate gravel - some sand	
35	27359	420	440	20	Conglomerate, water level 26' 3"	
35	27359	440	460	20	Conglomerate gravel sand with clay binding	
35	27359	906	1280	374	Rhyolite	
35	27361	0	148	148	Red Clay	
35	27361	148	375	227	Blue Clay	
35	27361	375	425	50	Red Clay	
35	27361	425	900	475	Conglomerate	
35	27368	0	60	60	dirt	
35	27368	60	290	230	brown clay	
35	27368	290	460	170	blue clay	
35	27368	460	560	100	conglomerate	
35	27368	560	600	40	sand and gravel	
35	27372	0	30	30	adobe	
35	27372	30	55	25	sandy clay	
35	27372	55	68	13	dry sand	
35	27372	68	82	14	sticky mud	
35	27372	82	90	8	sand some gravel, small show water	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	27372	90	102	12	mud sticky	
35	27372	102	270	168	mud, blue in color	
35	27372	270	281	11	sand little water	
35	27372	281	451	170	mud, blue	
35	27372	451	457	6	sand little more water	
35	27372	457	468	11	clay, light in color	
35	27372	468	472	4	shale grey in color	
35	27372	472	532	60	clay light in color	
35	27372	532	598	66	conglomerate sand, rock, clay	
35	27372	598	604	6	sand, hard	
35	27372	604	735	131	conglomerate, sand,rock,blue mud	
35	27372	735	745	10	sandy clay, large granules	
35	27372	745	757	12	conglomerate, sand rock, red in color	
35	27373	0	50	50	soil	
35	27373	50	450	400	grey clay	
35	27373	450	598	148	blue clay	
35	27373	598	675	77	gravel, sand with hard streaks of cemented material	
35	27374	0	20	20	red clay	
35	27374	20	50	30	red clay	
35	27374	50	90	40	sand & gravel hole produceing 75 gpm at 90'	
35	27374	90	140	50	blue clay	
35	27374	140	305	165	blue grey shales and soft clays	
35	27374	305	500	195	reddish brown sediments- very sandy	
35	27379	0	50	50	Soil	
35	27379	50	400	350	grey clay	
35	27379	400	565	165	blue clay	
35	27379	565	600	35	sand, gravel, cemented streaks	
35	27382	0	90	90	gravel sand and caliche	
35	27382	90	200	110	gray clay	
35	27382	200	580	380	blue clay	
35	27382	580	800	220	sand, gravel, boulders. "hard all the way down"	
35	27383	0	14	14	soil and red clay	
35	27383	14	30	16	sand and gravel , no water	
35	27383	30	67	37	brown shale	
35	27383	67	70	3	water gravel some water not tested	
35	27383	71	90	19	sandy fill	
35	27383	90	93	3	gravel	
35	27383	93	98	5	gravel and shale	
35	27383	98	225	127	blue shale	
35	27383	225	255	30	blue shale and hard gravel streaks	
35	27383	255	300	45	light grey shale	
35	27383	300	310	10	light grey shale with black streaks	
35	27383	310	345	35	grey sandy shale	
35	27383	345	350	5	fine grey sand	
35	27383	350	402	52	grey gumbo with brown streaks	
35	27383	402	404	2	brown sticky shale	
35	27383	404	406	2	gravel	
35	27383	406	410	4	brown shale with sand streaks	
35	27383	410	419	9	light grey shale	
35	27383	419	434	15	water sand & gravel	this is the first water that rose above the level of the surface strata. Water rose to within 20 ft of the top.
35	27383	434	437	3	brown shale	
35	27383	437	478	41	brown shale with sand streaks	
35	27383	476	487	11	fine sand some gravel	
35	27383	487	502	15	red clay with sand & gravel streaks	
35	27383	502	518	16	water sand	
35	27383	518	525	7	gravel with clay binding	
35	27383	525	535	10	sand	
35	27383	535	540	5	gravel with clay binding.	Casing drove to 416 open hole from there to bottom.
35	27386	0	65	65	dirt and gravel	
35	27386	65	230	165	grey clay	
35	27386	230	545	315	blue clay	
35	27386	545	600	55	sand and gravel	
35	27391	0	2	2	top soil	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	27391	2	10	8	caliche	
35	27391	10	70	60	red clay	
35	27391	70	75	5	sand & water	
35	27391	75	165	90	clay	
35	27391	165	170	5	sand	
35	27391	170	185	15	clay	
35	27398	0	3	3	soil	ARTESIAN WELL discharge not available
35	27398	3	85	82	clay and gypsum	ARTESIAN WELL discharge not available
35	27398	85	140	55	water gravel	ARTESIAN WELL discharge not available
35	27398	140	610	470	blue clay	ARTESIAN WELL discharge not available
35	27398	610	715	105	caliche	ARTESIAN WELL discharge not available
35	27398	715	750	35	sand and gravel	ARTESIAN WELL discharge not available
35	27403	0	75	75	CLAY	ARTESIAN WELL
35	27403	75	80	5	sand	ARTESIAN WELL
35	27403	80	90	10	clay	ARTESIAN WELL
35	27403	90	140	50	sand and gravel	ARTESIAN WELL
35	27403	140	565	425	dark blue clay	ARTESIAN WELL
35	27403	565	575	10	fine sand	ARTESIAN WELL
35	27403	575	660	85	grey joint clay	ARTESIAN WELL
35	27403	660	665	5	fine sand	ARTESIAN WELL
35	27403	665	710	45	caliche and clay	ARTESIAN WELL
35	27403	710	715	5	coarse sand	ARTESIAN WELL
35	27403	715	800	85	caliche, pebbles, clay	ARTESIAN WELL
35	27403	800	805	5	coarse sand	ARTESIAN WELL
35	27403	805	1190	385	hard clay	ARTESIAN WELL
35	27414	0	65	65	soil and clay	
35	27414	65	145	80	clay, sand, gravel, water	
35	27414	145	575	430	blue clay and shale	
35	27414	575	576	1	fine sand, small flow to surface	
35	27414	576	660	84	joint gray clay	
35	27414	660	662	2	fine sand, small flow water	
35	27414	662	700	38	yellow clay with caliche, pebbles	
35	27414	700	705	5	coarse sand, small flow water	
35	27414	705	770	65	caliche and clay	
35	27414	770	778	8	coarse sand, no water	
35	27414	778	845	67	hard clay, conglomerate	
35	27414	845	860	15	coarse sand, good flow of water	
35	27414	860	1190	330	conglomerate and clay	
35	27424	0	70	70	surface formation	Artesian well
35	27424	70	420	350	brown joint clay	Artesian well
35	27424	420	560	140	blue clay	Artesian well
35	27424	560	600	40	sand and gravel with hard cemented streaks	Artesian well
35	27425	0	50	50	soil	Artesian well
35	27425	50	400	350	grey clay	Artesian well
35	27425	400	515	115	blue clay	Artesian well
35	27425	515	550	35	sand, gravel, cemented streaks	Artesian well
35	27426	0	90	90	light sandy soil and clay	
35	27426	90	92	2	water sand	
35	27426	92	100	8	red clay	
35	27426	100	115	15	sand - water	
35	27426	115	423	308	blue clay	
35	27426	423	525	102	conglomerate	
35	27426	525	540	15	gravel and sand	
35	27426	540	565	25	conglomerate with gravel breaks	
35	27426	565	620	55	conglomerate	
35	27426	620	627	7	sand and gravel	
35	27426	627	665	38	conglomerate	
35	27426	665	672	7	gravel	
35	27426	672	735	63	conglomerate	
35	27426	735	738	3	gravel	
35	27426	738	770	32	conglomerate	
35	27426	770	773	3	gravel	
35	27426	773	799	26	conglomerate	
35	27435	0	65	65	dirt, some sand	
35	27435	65	230	165	gray clay	
35	27435	230	545	315	blue clay	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	27435	545	600	55	sand and gravel	
35	27440	0	60	60	clay and caliche	ARTESIAN WELL
35	27440	60	285	225	brown joint clay	ARTESIAN WELL
35	27440	285	450	165	blue clay	ARTESIAN WELL
35	27440	450	600	150	conglomerate	ARTESIAN WELL
35	27440	600	645	45	sand and gravel with hard cemented streaks	ARTESIAN WELL
35	27442	0	53	53	topsoil and sandy conglomerate	
35	27442	53	75	22	sand	
35	27442	75	80	5	sandy brown clay	
35	27442	80	110	30	fine sand and water	
35	27442	110	380	270	green and blue clay	
35	27442	380	458	78	conglomerate	
35	27442	458	466	8	blue shale	
35	27442	466	473	7	brown shale, honeycomed	
35	27442	473	590	117	sand	
35	27442	590	597	7	brown sandy conglomerate	
35	27442	597	612	15	caliche	
35	27442	612	614	2	sand	
35	27442	614	622	8	gravel	
35	27442	622	663	41	brown sandy clay	
35	27442	663	674	11	sand	
35	27442	674	700	26	conglomerate	
35	27445	0	40	40	dirt	ARTESIAN WELL
35	27445	40	390	350	grey clay	ARTESIAN WELL
35	27445	390	610	220	bue clay	ARTESIAN WELL
35	27445	610	650	40	sand and gravel	ARTESIAN WELL
35	27447	0	40	40	dirt	ARTESIAN WELL
35	27447	40	390	350	gray clay	ARTESIAN WELL
35	27447	390	622	232	blue clay	ARTESIAN WELL
35	27447	622	662	40	sand and gravel	ARTESIAN WELL
35	27450	0	70	70	clay and caliche	ARTESIAN WELL
35	27450	70	290	220	brown joint clay	ARTESIAN WELL
35	27450	290	460	170	blue clay	ARTESIAN WELL
35	27450	460	600	140	conglomerate	ARTESIAN WELL
35	27450	600	663	63	sand and gravel with hard cemented streaks	ARTESIAN WELL
35	27452	0	70	70	clay and caliche	ARTESIAN WELL - discharge not available
35	27452	70	290	220	brown joint clay	ARTESIAN WELL - discharge not available
35	27452	290	600	310	conglomerate	ARTESIAN WELL - discharge not available
35	27452	600	645	45	sand and gravel	ARTESIAN WELL - discharge not available
35	27453	0	70	70	Clay caliche	ARTESIAN WELL
35	27453	70	300	230	brown joint clay	ARTESIAN WELL
35	27453	300	470	170	blue clay	ARTESIAN WELL
35	27453	470	610	140	conglomerate	ARTESIAN WELL
35	27453	610	666	56	sand and gravel with hard cemented streaks	ARTESIAN WELL
35	27456	0	70	70	Clay and caliche	ARTESIAN WELL
35	27456	70	290	220	brown joint clay	ARTESIAN WELL
35	27456	290	460	170	blue clay	ARTESIAN WELL
35	27456	460	600	140	conglomerate	ARTESIAN WELL
35	27456	600	650	50	sand and gravel	ARTESIAN WELL
35	27460	0	45	45	DIRT SAND GRAVEL	ARTESIAN WELL
35	27460	45	395	350	grey clay	ARTESIAN WELL
35	27460	395	645	250	blue clay	ARTESIAN WELL
35	27460	645	688	43	sand and gravel	ARTESIAN WELL
35	27461	0	120	120	unknown (BFG)	
35	27461	120	405	285	blue clay	
35	27461	405	460	55	brown clay	
35	27461	460	580	120	sand and gravel and clay	
35	27461	580	840	260	conglomerate	
35	27463	1	15	14	topsoil	
35	27463	15	90	75	blue clay	
35	27463	90	120	30	fine water sand did not vise in well	
35	27463	120	389	269	blue and brown clay	
35	27463	390	530	140	water gravel. Fine gravel mixed with volcanic rock	
35	27463	530	545	15	blue clay	
35	27463	545	760	215	water gravel - as above. Stopped drilling in water gravel.	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	27464	0	77	77	red sandy clay	
35	27464	77	125	48	fine sand - water	
35	27464	125	145	20	red clay	
35	27464	145	395	250	blue clay	
35	27464	395	585	190	conglomerate	
35	27464	585	590	5	gravel - water	
35	27464	590	635	45	conglomerate	
35	27464	635	642	7	sand and gravel	
35	27464	642	670	28	conglomerate	
35	27464	670	675	5	gravel	
35	27464	675	755	80	conglomerate	
35	27464	755	770	15	sand and gravel	
35	27464	770	815	45	conglomerate	
35	27464	815	819	4	sand and gravel	
35	27464	819	850	31	conglomerate	
35	28260	0	500	500	Conglomerate; water @ 485'	
35	28260	500	650	150	Sand and gravel	
35	28266	0	15	15	soil	
35	28266	15	365	350	streaks of clay and boulders with gravel	
35	28266	365	390	25	gravel and boulders	
35	28266	390	420	30	clay	
35	28266	420	670	250	boulders streaks of clay and gravel	
35	28267	0	10	10	soil	
35	28267	10	65	55	gravel and boulders	
35	28267	65	150	85	sand and gravel	
35	28267	150	390	240	grey conglomerate	
35	28267	390	460	70	gravel and boulders	
35	28267	460	1325	865	hard conglomerate	
35	28268	0	14	14	soil and gravel	
35	28268	14	80	66	sandy clay and gravel	
35	28268	80	260	180	streaks of clay and gravel	
35	28268	260	370	110	small boulders and clay and gravel	
35	28268	370	388	18	gravel and boulders some sandy clay	
35	28268	388	428	40	boulders and water bearing gravel	
35	28268	428	670	242	boulders conglomerate with streaks of gravel	
35	28268	670	800	130	hard boulders	
35	28268	800	1100	300	boulders and gravel	
35	28269	0	15	15	topsoil	
35	28269	15	30	15	clay and gravel	
35	28269	30	90	60	clay and boulders	
35	28269	90	385	295	clay and mixed gravel with boulders	
35	28269	385	405	20	gravel	
35	28269	405	765	360	boulders gravel and clay streaks	
35	28272	0	3	3	soil	
35	28272	3	290	287	clay and boulders	
35	28272	290	310	20	sand and gravel	
35	28272	310	400	90	boulders	
35	28273	0	700	700	boulders and shale	
35	28278	0	4	4	soil	ATRESIAN WELL
35	28278	4	120	116	brown clay	ATRESIAN WELL
35	28278	120	360	240	blue clay	ATRESIAN WELL
35	28278	360	400	40	sand and gravel	ATRESIAN WELL
35	28278	400	630	230	blue clay	ATRESIAN WELL
35	28278	630	650	20	sand and gravel	ATRESIAN WELL
35	28278	650	810	160	brown clay	ATRESIAN WELL
35	28278	810	850	40	sand and gravel	ATRESIAN WELL
35	28289	0	4	4	topsoil	
35	28289	4	653	649	clay	
35	28289	653	659	6	clay W/L sand	
35	28289	659	679	20	clay sticky	
35	28289	679	683	4	clay W/L sand	
35	28289	683	694	11	joint clay	
35	28289	694	791	97	clay sticky	
35	28289	791	794	3	gravel	
35	28289	794	800	6	clay sticky	
35	28295	0	80	80	soil, clay and gravel	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	28295	80	160	80	sand, gravel and clay layers	
35	28295	160	400	240	blue brown and green clay	
35	28295	400	735	335	sand gravel and clay layers	
35	28300	0	80	80	red sandy clay	
35	28300	80	95	15	fine sand	
35	28300	95	115	20	red clay	
35	28300	115	135	20	sand	
35	28300	135	320	185	blue clay	
35	28300	320	400	80	grey clay	
35	28300	400	500	100	conglomerate	
35	28300	500	503	3	water gravel	
35	28300	503	552	49	conglomerate	
35	28300	552	555	3	gravel	
35	28300	555	700	145	conglomerate	
35	28300	700	705	5	gravel	
35	28300	705	745	40	conglomerate	
35	28300	745	753	8	gravel	
35	28300	753	805	52	conglomerate	
35	28305	0	70	70	clay water	Artesian Well
35	28305	70	340	270	joint blue clay	Artesian Well
35	28305	340	530	190	yellow clay	Artesian Well
35	28305	530	720	190	cemented sand, gravel, alternating	Artesian Well
35	28306	0	400	400	sedementary brown joint clay	
35	28306	400	550	150	blue clay	
35	28306	550	670	120	conglomerate	
35	28306	670	714	44	sand and gravel with hard streaks cemented	
35	28317	0	3	3	soil	ARTESIAN WELL
35	28317	3	70	67	caliche	ARTESIAN WELL
35	28317	70	120	50	gray clay	ARTESIAN WELL
35	28317	120	560	440	blue clay	ARTESIAN WELL
35	28317	560	730	170	conglomerate, sand, boulders	ARTESIAN WELL
35	28317	730	760	30	sand and gravel	ARTESIAN WELL
35	28318	0	75	75	clay, water	ARTESIAN WELL
35	28318	75	345	270	joint blue clay	ARTESIAN WELL
35	28318	345	530	185	yellow joint clay	ARTESIAN WELL
35	28318	530	715	185	cemented sand, gravel, clay, alternating	ARTESIAN WELL
35	28322	0	3	3	soil	ARTESIAN WELL
35	28322	3	70	67	caliche	ARTESIAN WELL
35	28322	70	120	50	gray clay	ARTESIAN WELL
35	28322	120	550	430	blue clay	ARTESIAN WELL
35	28322	550	700	150	congomerate, sand, boulders	ARTESIAN WELL
35	28322	700	730	30	sand, fine gravel	ARTESIAN WELL
35	28323	0	70	70	gray clay	ARTESIAN WELL
35	28323	70	350	280	blue clay	ARTESIAN WELL
35	28323	350	545	195	yellow clay	ARTESIAN WELL
35	28323	545	755	210	cemented sand, gravel, clay, alternating	ARTESIAN WELL
35	28324	0	180	180	soil, new formation	ARTESIAN WELL -- good flow, could not measure
35	28324	180	300	120	gray clay	ARTESIAN WELL -- good flow, could not measure
35	28324	300	320	20	hardpan	ARTESIAN WELL -- good flow, could not measure
35	28324	320	730	410	blue clay	ARTESIAN WELL -- good flow, could not measure
35	28324	730	770	40	sand and gravel	ARTESIAN WELL -- good flow, could not measure
35	28337	0	2	2	topsoil	
35	28337	2	73	71	caliche	
35	28337	73	74	1	water sand (checked 12-14gpm) hard water	
35	28337	74	140	66	caliche	
35	28337	140	153	13	conglomerate	
35	28337	153	370	217	blue clay	
35	28337	370	373	3	light blue shale	
35	28337	373	380	7	blue clay	
35	28337	380	385	5	grey clay	
35	28337	385	445	60	blue clay	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	28337	445	455	10	grey clay	
35	28337	455	475	20	blue clay	
35	28337	475	518	43	brown clay	
35	28337	518	528	10	blue clay	
35	28337	528	550	22	brown clay	
35	28337	550	578	28	blue clay	
35	28337	578	605	27	brown clay	
35	28337	605	635	30	red clay	
35	28337	635	638	3	water sand (first deep water) 3'	
35	28337	638	655	17	brown clay	
35	28337	655	663	8	water sand (second deep water) 8'	
35	28337	663	678	15	brown clay	
35	28337	678	695	17	water sand (third deep water sand 17')	
35	28337	695	719	24	brown clay	
35	28337	719	720	1	hard caliche	
35	28345	0	3	3	soil	
35	28345	3	65	62	caliche	
35	28345	65	200	135	grey clay	
35	28345	200	560	360	blue clay	
35	28345	560	600	40	sand and gravel	
35	28346	0	3	3	soil	
35	28346	3	70	67	caliche	
35	28346	70	120	50	grey clay	
35	28346	120	550	430	blue clay	
35	28346	550	775	225	conglomerate some boulders	
35	28346	775	800	25	sand and gravel	
35	28348	0	5	5	soil	Artesian Well
35	28348	5	65	60	caliche	Artesian Well
35	28348	65	120	55	grey clay	Artesian Well
35	28348	120	510	390	blue clay	Artesian Well
35	28348	510	550	40	sand and gravel	Artesian Well
35	28355	0	2	2	topsoil red sandy loam	
35	28355	2	100	98	red clay	
35	28355	100	102	2	sand and water	
35	28355	102	535	433	blue clay	
35	28355	535	544	9	gravel and sand	
35	28355	544	615	71	conglomerate	
35	28355	615	621	6	gravel and sand	
35	28355	621	672	51	conglomerate	
35	28355	672	730	58	clay and conglomerate	
35	28355	730	735	5	gravel and sand	
35	28355	735	750	15	conglomerate	
35	28357	0	10	10	soil	
35	28357	10	15	5	dry sand	
35	28357	15	30	15	brown clay	
35	28357	30	55	25	dry gravel	
35	28357	55	80	25	brown clay	
35	28357	80	96	16	sand and gravel	
35	28357	96	115	19	brown clay	
35	28357	115	370	255	blue clay	
35	28357	370	455	85	brown clay	
35	28357	455	463	8	sand	
35	28357	463	470	7	conglomerate	
35	28357	470	493	23	brown clay	
35	28357	493	496	3	gravel	
35	28357	496	523	27	brown clay	
35	28357	523	530	7	sand	
35	28357	530	543	13	brown clay	
35	28357	543	548	5	gravel	
35	28357	548	574	26	conglomerate	
35	28357	574	578	4	sand and gravel	
35	28357	578	585	7	conglomerate	
35	28357	585	588	3	gravel	
35	28357	588	595	7	conglomerate	
35	28357	595	597	2	sand	
35	28357	597	630	33	conglomerate	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	28357	630	638	8	gravel	
35	28357	638	717	79	conglomerate	
35	28357	717	725	8	hard shale	
35	28357	725	743	18	gravel	
35	28357	743	750	7	conglomerate	
35	28357	750	753	3	gravel	
35	28357	753	774	21	conglomerate	
35	28357	774	775	1	gravel	
35	28357	775	820	45	conglomerate	
35	28357	820	822	2	gravel	
35	28357	822	835	13	conglomerate	
35	28357	835	840	5	gravel	
35	28357	840	874	34	conglomerate	
35	28358	0	4	4	soil	
35	28358	4	120	116	brown clay	
35	28358	120	330	210	blue clay	
35	28358	330	375	45	sand and gravel	
35	28358	375	600	225	blue clay	
35	28358	600	612	12	sand and gravel	
35	28358	612	735	123	brown clay	
35	28358	735	780	45	sand and gravel	
35	28366	0	15	15	soil	
35	28366	15	45	30	dry gravel	
35	28366	45	70	25	soil	
35	28366	70	93	23	water gravel and sand	
35	28366	93	110	17	red clay	
35	28366	110	240	130	blue clay	
35	28366	240	265	25	red clay	
35	28366	265	281	16	water gravel and sand	
35	28366	281	340	59	red clay	
35	28366	340	347	7	yellow clay	
35	28366	347	365	18	red clay	
35	28366	365	367	2	gravel	
35	28366	367	415	48	red clay	
35	28366	415	416	1	gravel	
35	28366	416	431	15	red clay	
35	28366	431	437	6	yellow clay	
35	28366	437	448	11	water gravel and sand	
35	28366	448	550	102	red clay	
35	28366	550	552	2	water gravel	
35	28368	0	4	4	soil	
35	28368	4	125	121	light brown clay	
35	28368	125	335	210	light blue clay	
35	28368	335	380	45	sand and gravel	
35	28368	380	600	220	blue clay	
35	28368	600	610	10	sand and gravel	
35	28368	610	730	120	brown clay	
35	28368	730	770	40	sand and gravel	
35	28371	0	3	3	soil	
35	28371	3	32	29	brown clay	
35	28371	32	38	6	gravel dry	
35	28371	38	45	7	brown clay	
35	28371	45	50	5	gravel dry	
35	28371	50	65	15	red clay	
35	28371	65	75	10	gravel dry	
35	28371	75	136	61	red clay	
35	28371	136	138	2	gravel water	
35	28371	138	181	43	brown clay	
35	28371	181	182	1	gravel	
35	28371	182	325	143	blue clay	
35	28371	325	460	135	brown clay	
35	28371	460	462	2	gravel	
35	28371	462	469	7	brown clay	
35	28371	469	475	6	gravel	
35	28371	475	532	57	red clay	
35	28371	532	537	5	gravel	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	28371	537	554	17	red clay	
35	28371	554	576	22	gravel	
35	28371	576	617	41	red clay	
35	28371	617	618	1	gravel	
35	28371	618	665	47	conglomerate	
35	28371	665	672	7	gravel	
35	28371	672	807	135	conglomerate	
35	28371	807	808	1	gravel	
35	28371	808	859	51	conglomerate	
35	28371	859	861	2	gravel	
35	28371	861	888	27	conglomerate	
35	28371	888	893	5	gravel	
35	28371	893	900	7	conglomerate	
35	28371	900	901	1	gravel	
35	28371	901	938	37	conglomerate	
35	28371	938	941	3	gravel	
35	28371	941	948	7	conglomerate	
35	28371	948	952	4	gravel	
35	28371	952	967	15	conglomerate	
35	28372	0	66	66	topsoil and conglomerate	
35	28372	66	71	5	water sand	
35	28372	71	298	227	conglomerate	
35	28372	298	470	172	brown clay and conglomerate	
35	28372	470	475	5	gravel	
35	28372	475	490	15	clay	
35	28372	490	510	20	gravel	
35	28372	510	540	30	clay	
35	28373	0	7	7	sandy loam	
35	28373	7	50	43	red sandy clay	
35	28373	50	93	43	sand and gravel water	
35	28373	93	140	47	green clay	
35	28373	140	300	160	blue clay	
35	28373	300	315	15	brown clay	
35	28373	315	350	35	blue clay	
35	28373	350	360	10	red clay	
35	28373	360	425	65	brown clay	
35	28373	425	427	2	sand and gravel	
35	28373	427	430	3	brown clay	
35	28373	430	440	10	brown conglomerate	
35	28373	440	445	5	sand and gravel water	
35	28373	445	477	32	brown conglomerate	
35	28373	477	500	23	green bentonite	
35	28373	500	518	18	red clay	
35	28374	0	71	71	top fill	depth to water 12' on 8/28/1948, ground level 3681'
35	28374	71	96	25	boulders and sand- some water	
35	28374	96	101	5	clay	
35	28374	101	271	170	shale	
35	28374	271	276	5	water and gravel	
35	28374	276	413	137	blue shale	
35	28374	413	414	1	sand and gravel	
35	28374	414	432	18	shale	
35	28374	432	438	6	sand, gravel and water	
35	28374	438	462	24	sandy shale	
35	28374	462	482	20	sand shale	
35	28374	482	501	19	yellow clay	
35	28374	501	515	14	clay and gravel	
35	28374	515	517	2	sand and gravel	
35	28374	517	538	21	boulders	
35	28374	538	543	5	yellow clay	
35	28374	543	551	8	sand, gravel and water	
35	28374	551	552	1	water sand	
35	28374	552	558	6	gravel	
35	28374	558	563	5	sandy shale	
35	28374	563	571	8	clay and gravel	
35	28374	571	574	3	sand, clay and boulders	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	28374	574	581	7	clay and gravel	
35	28374	581	585	4	sand and gravel	
35	28374	585	592	7	clay	
35	28374	592	597	5	sand and gravel	
35	28374	597	599	2	shale	
35	28374	599	606	7	clay and gravel	
35	28374	606	615	9	sandy clay	
35	28374	615	618	3	water sand	
35	28374	618	630	12	blue shale	
35	28374	630	637	7	clay and gravel	
35	28374	637	640	3	sand and gravel	
35	28374	640	663	23	blue shale	
35	28374	663	665	2	water sand	
35	28374	665	672	7	clay and gravel	
35	28374	672	674	2	clay	
35	28374	674	678	4	clay and gravel	
35	28374	678	682	4	gray shale	
35	28374	682	683	1	fine sand	
35	28374	683	697	14	clay and gravel	
35	28374	697	712	15	boulders, gravel, sand and water	
35	28381	0	5	5	sandy loam	
35	28381	5	60	55	red sandy clay	
35	28381	60	90	30	sand and gravel- water	
35	28381	90	260	170	blue clay	
35	28381	260	300	40	red clay	
35	28381	300	312	12	red conglomerate	
35	28381	312	330	18	brown clay	
35	28381	330	337	7	green bentonite	
35	28381	337	348	11	blue clay	
35	28381	348	360	12	brwon clay	
35	28381	360	368	8	sand and gravel- water	
35	28381	368	500	132	honeycomb conglomerate, possible water	
35	28387	0	8	8	sandy loam topsoil	
35	28387	8	25	17	red sandy clay	
35	28387	25	43	18	brown sandy clay	
35	28387	43	85	42	sand and gravel- water	
35	28387	85	105	20	green bentonite	
35	28387	105	240	135	blue clay	
35	28387	240	333	93	brown clay	
35	28387	333	350	17	green bentonite	
35	28387	350	455	105	brown clay	
35	28387	455	500	45	honeycomb conglomerate w/ pockets of gravel- water	
35	28394	0	60	60	surface formation	artesian well
35	28394	60	360	300	blue clay	artesian well
35	28394	360	560	200	conglomerate	artesian well
35	28394	560	600	40	sand and gravel, cemented, hard streaks	artesian well
35	28397	0	3	3	soil	
35	28397	3	70	67	caliche	
35	28397	70	120	50	grey clay	
35	28397	120	550	430	blue clay	
35	28397	550	620	70	conglomerate	
35	28397	620	660	40	sand and gravel	
35	28405	0	60	60	surface formation	Artesian Well
35	28405	60	350	290	blue clay	Artesian Well
35	28405	350	550	200	conglomerate	Artesian Well
35	28405	550	600	50	sand and gravel, cemented hard streaks	Artesian Well
35	28407	0	60	60	red clay	
35	28407	60	500	440	blue clay	
35	28407	500	755	255	water formation sand	
35	28413	0	60	60	surface fill	
35	28413	60	400	340	brown joint clay	
35	28413	400	600	200	conglomerate	
35	28413	600	650	50	sand and gravel with cemented streaks of sand and gravel	
35	28414	0	4	4	soil	
35	28414	4	75	71	caliche	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	28414	75	140	65	grey clay	
35	28414	140	570	430	blue clay	
35	28414	570	770	200	conglomerate	
35	28414	770	810	40	sand and gravel	
35	28416	0	5	5	soil	
35	28416	5	120	115	brown clay	
35	28416	120	350	230	blue clay	
35	28416	350	380	30	sand and gravel	
35	28416	380	600	220	blue clay	
35	28416	600	620	20	sand and gravel	
35	28416	620	760	140	brown clay	
35	28416	760	800	40	sand and gravel	
35	28419	0	55	55	topsoil and conglomerate	
35	28419	55	58	3	water sand	
35	28419	58	130	72	blue clay	
35	28419	130	280	150	blue shale	
35	28419	280	350	70	blue and gray mud	
35	28419	350	398	48	gray shale	
35	28419	398	440	42	grey clay	
35	28419	440	450	10	conglomerate	
35	28419	450	570	120	brown clay	
35	28419	570	575	5	sand and gravel	
35	28419	575	605	30	conglomerate	
35	28419	605	609	4	sand and gravel	
35	28419	609	620	11	brown clay	
35	28419	620	627	7	sand and gravel	
35	28419	627	700	73	brown clay	
35	28419	700	705	5	sticky brown clay	
35	28419	705	710	5	sand and gravel	
35	28419	710	750	40	conglomerate	
35	28419	750	758	8	gravel	
35	28419	758	790	32	conglomerate	
35	28419	790	793	3	gravel	
35	28419	793	850	57	conglomerate	
35	28419	850	860	10	gravel	
35	28419	860	885	25	conglomerate	
35	28419	885	890	5	gravel	
35	28419	890	921	31	conglomerate	
35	28422	0	3	3	surface soil	
35	28422	3	120	117	light brown clay, silt, water	
35	28422	120	323	203	light blue clay	
35	28422	323	325	2	light blue shale	
35	28422	325	372	47	blue clay	
35	28422	372	375	3	fine clean water sand	
35	28422	375	571	196	blue clay	
35	28422	571	582	11	water bearing sand	
35	28422	582	682	100	brown clay	
35	28422	682	693	11	cemented sand and gravel	
35	28422	693	714	21	brown clay	
35	28422	714	716	2	sand and gravel	
35	28422	716	721	5	clay	
35	28422	721	752	31	sand, gravel partially cemented	
35	28422	752	882	130	very fine cemented sand and gravel	
35	28422	882	885	3	fine water sand, artesian stratum	
35	28422	885	928	43	fine cemented sand	
35	28422	928	1740	812	very fine sand, some clay	
35	28422	1740	1810	70	cemented sand, gravel clay	
35	28422	1810	2000	190	cemented sand and gravel	
35	28428	0	7	7	soil	
35	28428	7	20	13	caliche	
35	28428	20	25	5	clay	
35	28428	25	35	10	caliche	
35	28428	35	40	5	sandy clay	
35	28428	40	60	20	hard brown clay	
35	28428	60	95	35	red clay	
35	28428	95	120	25	calcihe	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	28428	120	125	5	red sticky clay	
35	28428	125	145	20	caliche	
35	28428	145	150	5	red clay	
35	28428	150	180	30	gray clay	
35	28428	180	305	125	blue clay	
35	28428	305	460	155	gray clay	
35	28428	460	496	36	brown clay	
35	28428	496	508	12	cemented sand	
35	28428	508	600	92	brown clay	
35	28428	600	610	10	cemented sand	
35	28428	610	625	15	red sticky clay	
35	28428	625	685	60	conglomerate	
35	28428	685	690	5	cemented sand	
35	28428	690	711	21	conglomerate with sandy streaks	
35	28430	0	75	75	sand and gravel, water	artesian well
35	28430	75	350	275	blue clay	artesian well
35	28430	350	660	310	yellow joint clay	artesian well
35	28430	660	700	40	sand and gravel with cemented streaks	artesian well
35	28432	0	3	3	soil	depth to water 48' on 3/31/1959
35	28432	3	65	62	clay	
35	28432	65	75	10	sand and gravel (water)	
35	28432	75	80	5	sandy clay	
35	28432	80	90	10	clay	
35	28432	90	125	35	yellow clay	
35	28432	125	185	60	blue clay	
35	28432	185	190	5	sand	
35	28432	190	205	15	sandy clay	
35	28432	205	315	110	blue clay	
35	28432	315	325	10	red clay	
35	28432	325	330	5	blue clay	
35	28432	330	360	30	brown clay	
35	28432	360	380	20	brown sandy clay	
35	28432	380	390	10	clay	
35	28432	390	400	10	sand and gravel	
35	28432	400	460	60	clay	
35	28432	460	470	10	sand	
35	28432	470	490	20	clay	
35	28432	490	500	10	sand	
35	28432	500	560	60	clay	
35	28432	560	572	12	sandy clay	
35	28432	572	615	43	clay	
35	28432	615	645	30	sandy clay	
35	28432	645	650	5	sand and gravel	
35	28432	650	655	5	sandy clay	
35	28432	655	660	5	sand	
35	28432	660	690	30	clay	
35	28432	690	705	15	sand and gravel	
35	28432	705	740	35	clay	
35	28432	740	750	10	sand and gravel	
35	28432	750	757	7	clay	
35	28432	757	785	28	sand and gravel	
35	28432	785	795	10	clay	
35	28432	795	800	5	sand and gravel	
35	28433	0	4	4	soil	artesian well
35	28433	4	60	56	light brown shale	artesian well
35	28433	60	200	140	brown clay	artesian well
35	28433	200	280	80	shale	artesian well
35	28433	280	630	350	blue clay	artesian well
35	28433	630	765	135	brown clay	artesian well
35	28433	765	870	105	fine cemented sand and gravel	artesian well
35	28433	870	900	30	fine sand, water	artesian well
35	28435	0	4	4	soil	artesian well
35	28435	4	66	62	dirt and gravel	artesian well
35	28435	66	280	214	gray clay	artesian well
35	28435	280	325	45	shale	artesian well
35	28435	325	630	305	blue clay	artesian well

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	28435	630	665	35	sand and gravel	artesian well
35	28441	0	6	6	soil	
35	28441	6	60	54	light green clay	
35	28441	60	62	2	water gravel	
35	28441	62	131	69	light green clay	
35	28441	131	171	40	blue clay	
35	28441	171	172	1	fine water sand, water rose to 33'	
35	28441	172	231	59	blue clay	
35	28441	231	233	2	water gravel	
35	28441	233	293	60	grey clay	
35	28441	293	340	47	red clay	
35	28441	340	344	4	sand and gravel	
35	28441	344	470	126	red clay	
35	28441	470	473	3	grey clay	
35	28441	473	518	45	red clay	
35	28441	518	521	3	water gravel	
35	28441	521	540	19	red clay	
35	28441	540	560	20	sand and gravel	
35	28441	560	601	41	red clay	
35	28441	601	622	21	sand clay and gravel	
35	28441	622	665	43	red clay	
35	28441	665	675	10	gravel water rose to 31'	
35	28441	675	699	24	red clay	
35	28441	699	734	35	sand and gravel	
35	28441	734	735	1	sand rock	
35	28441	735	744	9	sand and gravel	
35	28445	0	3	3	soil	
35	28445	3	6	3	gavel	
35	28445	6	10	4	sand	
35	28445	10	35	25	brwon clay	
35	28445	35	40	5	gravel	
35	28445	40	70	30	brown clay	
35	28445	70	85	15	gravel	
35	28445	85	105	20	water gravel	
35	28445	105	135	30	brown clay	
35	28445	135	230	95	blue green clay	
35	28445	230	235	5	gravel	
35	28445	235	285	50	blue green clay	
35	28445	285	305	20	sticky brwon clay	
35	28445	305	330	25	hard ledges and sticky brown clay	
35	28445	330	340	10	brown clay	
35	28445	340	347	7	sticky brown clay	
35	28445	347	355	8	gravel	
35	28445	355	388	33	sticky brown clay	
35	28445	388	392	4	gravel	
35	28445	392	413	21	conglomerate	
35	28445	413	416	3	gravel	
35	28445	416	433	17	conglomerate	
35	28445	433	436	3	gravel	
35	28445	436	437	1	conglomerate	
35	28445	437	440	3	gravel	
35	28445	440	455	15	conglomerate	
35	28445	455	460	5	gravel	
35	28445	460	470	10	conglomerate	
35	28445	470	475	5	gravel	
35	28445	475	500	25	conglomerate	
35	28445	500	505	5	gravel	
35	28445	505	550	45	conglomerate	
35	28445	550	555	5	gravel	
35	28445	555	581	26	conglomerate	
35	28445	581	585	4	gravel	
35	28445	585	600	15	conglomerate	
35	28445	600	605	5	gravel	
35	28445	605	660	55	conglomerate	
35	28454	0	10	10	surface soil	
35	28454	10	127	117	clay and boulders rock	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	28454	127	260	133	sandy clay	
35	28454	260	385	125	gravel and rock with clay streaks	
35	28454	385	456	71	caly imbedded gravel streaks	
35	28454	456	503	47	clay	
35	28454	503	510	7	fine gravel	
35	28454	510	667	157	clay with gravel streaks	
35	28454	667	678	11	gravel and boulders	
35	28454	678	761	83	clay with gravel streaks	
35	28454	761	896	135	boulders and sand	
35	28454	896	971	75	clay with gravel streaks	
35	28454	971	981	10	fine gravel	
35	28454	981	1031	50	boulders and gravel	
35	28454	1031	1037	6	clay	
35	28464	0	2	2	fill dirt	
35	28464	2	5	3	soil	
35	28464	5	10	5	red clay	
35	28464	10	60	50	brown clay	
35	28464	60	102	42	brown sandy clay	
35	28464	102	103	1	sand and gravel- water	
35	28464	103	135	32	brown sandy clay	
35	28464	135	180	45	green clay	
35	28464	180	200	20	blue clay	
35	28464	200	245	45	green clay	
35	28464	245	340	95	blue clay	
35	28464	340	400	60	brown clay	
35	28464	400	578	178	conglomerate	
35	28464	578	580	2	limestone shell	
35	28464	580	586	6	conglomerate	
35	28464	586	588	2	gravel	
35	28464	588	604	16	brown clay	
35	28464	604	606	2	limestone shell	
35	28464	606	610	4	gravel	
35	28464	610	612	2	limestone shell	
35	28464	612	615	3	gravel	
35	28464	615	625	10	brown clay	
35	28464	625	628	3	gravel	
35	28464	628	635	7	brown clay	
35	28464	635	639	4	gravel	
35	28464	639	660	21	brown clay	
35	28464	660	663	3	gravel	
35	28464	663	689	26	brown clay	
35	28464	689	693	4	gravel	
35	28464	693	703	10	brown clay	
35	28464	703	708	5	gravel	
35	28464	708	720	12	brown clay	
35	28464	720	724	4	sand and gravel	
35	28464	724	745	21	brown sandy clay	
35	28464	745	749	4	brown clay	
35	28464	749	752	3	gravel	
35	28464	752	766	14	brown clay	
35	28466	101	104	3	rose 60'	depth to water 80' in 11/1962
35	28468	0	4	4	soil	artesian well
35	28468	4	75	71	caliche	artesian well
35	28468	75	140	65	gray clay	artesian well
35	28468	140	575	435	blue clay	artesian well
35	28468	575	700	125	conglomerate	artesian well
35	28468	700	740	40	sand and gravel	artesian well
35	28469	1	4	3	soil	
35	28469	4	95	91	caliche and clay	
35	28469	95	96	1	gravel and sand	
35	28469	96	124	28	red clay	
35	28469	124	132	8	gravel and sand	
35	28469	132	145	13	brown clay	
35	28469	145	146	1	gravel and sand	
35	28469	146	164	18	gray clay	
35	28469	164	198	34	red clay	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	28469	198	199	1	gravel and sand	
35	28469	199	398	199	blue shale	
35	28469	398	399	1	gravel and sand	
35	28469	399	402	3	white clay	
35	28469	402	418	16	red clay	
35	28469	418	419	1	gravel and sand	
35	28469	419	439	20	red clay	
35	28469	439	440	1	gravel and sand	
35	28469	440	461	21	red clay	
35	28469	461	462	1	gravel and sand	
35	28469	462	480	18	grey clay	
35	28469	480	482	2	gravel and sand	
35	28469	482	507	25	red clay	
35	28469	507	508	1	gravel and sand	
35	28469	508	537	29	red clay	
35	28469	537	538	1	gravel and sand	
35	28469	538	567	29	red clay	
35	28469	567	604	37	grey clay	
35	28469	604	607	3	gravel and sand	
35	28469	607	642	35	brown clay	
35	28469	642	645	3	gravel and sand	
35	28469	645	701	56	red clay	
35	28469	701	703	2	gravel and sand	
35	28469	703	721	18	gray clay	
35	28469	721	724	3	gravel and sand	
35	28469	724	734	10	red clay	
35	28469	734	738	4	gravel and sand	
35	28469	738	749	11	brown clay	
35	28469	749	751	2	gravel and sand	
35	28469	751	762	11	red clay	
35	28469	762	764	2	gravel and sand	
35	28469	764	778	14	brown clay	
35	28469	778	780	2	gravel and sand	
35	28469	780	792	12	red clay	
35	28469	792	794	2	gravel and sand	
35	28469	794	797	3	red clay	
35	28469	797	800	3	gravel and sand	
35	28475	0	108	108	red clay	
35	28475	108	112	4	water gravel and sand	
35	28475	112	150	38	caliche and red clay	
35	28475	150	180	30	red clay	
35	28475	180	400	220	grey and blue clay	
35	28475	400	518	118	brown bentonite	
35	28475	518	520	2	gravel	
35	28475	520	625	105	conglomerate	
35	28475	625	631	6	water gravel	
35	28475	631	678	47	conglomerate	
35	28475	678	684	6	gravel	
35	28475	684	708	24	conglomerate	
35	28475	708	712	4	gravel and sand	
35	28475	712	723	11	conglomerate	
35	28475	723	728	5	gravel and sand	
35	28475	728	745	17	conglomerate	
35	28475	745	750	5	gravel and sand	
35	28475	750	775	25	conglomerate	
35	28475	775	780	5	gravel and sand	
35	28475	780	800	20	conglomerate	
35	28476	0	6	6	soil	
35	28476	6	8	2	dry gravel	
35	28476	8	130	122	clay	
35	28476	130	132	2	water sand	
35	28476	132	340	208	clay	
35	28476	340	343	3	gravel	
35	28476	343	490	147	clay	
35	28476	490	500	10	sand	
35	28476	500	510	10	conglomerate	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	28476	510	515	5	gravel	
35	28476	515	520	5	clay	
35	28476	520	523	3	gravel	
35	28476	523	530	7	clay	
35	28476	530	535	5	gravel	
35	28476	535	545	10	clay	
35	28476	545	548	3	gravel	
35	28476	548	564	16	conglomerate	
35	28476	564	578	14	gravel	
35	28476	578	700	122	conglomerate	
35	28476	700	703	3	gravel	
35	28476	703	770	67	conglomerate	
35	28476	770	778	8	gravel	
35	28476	778	807	29	conglomerate	
35	28476	807	811	4	gravel	
35	28476	811	860	49	conglomerate	
35	28476	860	870	10	gravel	
35	28476	870	900	30	conglomerate	
35	28477	0	5	5	red sandy soil	
35	28477	5	128	123	red clay	
35	28477	128	130	2	water sand	
35	28477	130	180	50	red clay	
35	28477	180	295	115	blue clay	
35	28477	295	460	165	conglomerate	
35	28477	460	470	10	gravel	
35	28477	470	535	65	conglomerate	
35	28477	535	550	15	gravel	
35	28477	550	585	35	conglomerate	
35	28477	585	620	35	gravel	
35	28477	620	675	55	conglomerate	
35	28477	675	690	15	gravel	
35	28477	690	715	25	conglomerate	
35	28477	715	740	25	gravel	
35	28477	740	770	30	conglomerate	
35	28477	770	840	70	conglomerate with gravel breaks	
35	28477	840	855	15	gravel	
35	28477	855	895	40	conglomerate with gravel breaks	
35	28477	895	910	15	conglomerate	
35	28477	910	940	30	gravel	
35	28477	940	1000	60	conglomerate	
35	28478	0	5	5	topsoil	
35	28478	5	135	130	clay, caliche	
35	28478	135	180	45	sand, gravel	
35	28478	180	350	170	clay and few rocks	
35	28478	350	545	195	sand gravel with clay streaks	
35	28478	545	650	105	clay, rocks, possible few sand streaks	
35	28478	650	900	250	sand, grave, clay streaks	
35	28478	900	998	98	clay, rocks	
35	28478	998	1274	276	sand and gravel	
35	28478	1274	1300	26	clay few rocks	
35	28479	0	4	4	topsoil	
35	28479	4	125	121	caliche clay	
35	28479	125	239	114	sand gravel	
35	28479	239	550	311	clay with few rocks and gravel	
35	28479	550	850	300	sand and gravel few streaks of clay	
35	28479	850	998	148	clay, few intermittent sand streaks	
35	28479	998	1300	302	sand and gravel	
35	28479	1300	1450	150	clay, few small stratas gravel and rocks	
35	28479	1450	1473	23	sand and gravel	
35	28479	1473	1476	3	clay and rock	
35	28480	0	5	5	topsoil	
35	28480	5	135	130	clay mixed with gravel	
35	28480	135	160	25	sand and gravel	
35	28480	160	235	75	clay	
35	28480	235	245	10	sand and gravel	
35	28480	245	350	105	clay	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	28480	350	406	56	sand and gravel	
35	28480	406	465	59	clay and rock	
35	28480	465	670	205	sand and gravel few streaks of clay	
35	28480	670	802	132	clay few possible sand streaks	
35	28480	802	960	158	sand and gravel	
35	28480	960	1050	90	clay	
35	28480	1050	1150	100	sand gravel	
35	28481	0	5	5	topsoil	
35	28481	5	130	125	clay and caliche	
35	28481	130	150	20	sand and gravel	
35	28481	150	320	170	clay, some rock	
35	28481	320	365	45	sand and gravel	
35	28481	365	560	195	broken clay and sand streaks	
35	28481	560	720	160	boulders, sand and gravel some clay streaks	
35	28481	720	900	180	clay and shale	
35	28481	900	1002	102	sand and gravel	
35	28481	1002	1004	2	rock (sandstone)	
35	28482	0	290	290	broken rock gravel and clay	
35	28482	290	470	180	red andesite	
35	28486	0	4	4	fill	Drilled with spudder rig.
35	28486	4	25	21	sandy clay	Drilled with spudder rig.
35	28486	25	28	3	gravel	Drilled with spudder rig.
35	28486	28	92	64	gravel	Drilled with spudder rig.
35	28486	92	106	14	white sand	Drilled with spudder rig.
35	28486	106	111	5	sand rock	Drilled with spudder rig.
35	28486	111	144	33	sand with some clay	Drilled with spudder rig.
35	28486	144	149	5	gravel	Drilled with spudder rig.
35	28486	149	201	52	sand with some clay	Drilled with spudder rig.
35	28486	201	208	7	sand and gravel (water)	Drilled with spudder rig.
35	28486	208	230	22	hard, packed sand (some water)	Drilled with spudder rig.
35	28486	230	317	87	sand and gravel (water)	Drilled with spudder rig.
35	28486	317	328	11	sand, gravel and clay	Drilled with spudder rig.
35	28486	328	335	7	hard, packed sand (some water)	Drilled with spudder rig.
35	28486	335	412	77	sand and gravel (water)	Drilled with spudder rig.
35	28486	412	420	8	clay and gravel	Drilled with spudder rig.
35	28486	420	460	40	sand and gravel (water)	Drilled with spudder rig.
35	28486	460	465	5	Rhyolite	Drilled with spudder rig.
35	28487	0	34	34	surface	
35	28487	34	38	4	sand, gravel and clay	
35	28487	38	63	25	clay	
35	28487	63	72	9	sand, gravel and clay	
35	28487	72	95	23	sand and gravel	
35	28487	95	109	14	sand, gravel and clay	
35	28487	109	114	5	gravel, sand, clay, some lime	
35	28487	114	146	32	lime rock	
35	28487	146	175	29	sandy clay, ribs of conglomerate limestone	
35	28487	175	190	15	cemented gravel and sandy clay with embedded thin layers of conglomerate	
35	28487	190	250	60	sandy clay and gravel	
35	28487	250	255	5	sand, clay and gravel	
35	28487	255	404	149	sand and gravel	
35	28487	404	421	17	conglomerate	
35	28487	421	450	29	conglomerate and granite	
35	28487	450	468	18	conglomerate	
35	28487	468	470	2	sandstone	
35	28487	470	470	0	hard rock	
35	28488	0	60	60	sand and caliche	Artesian well.
35	28488	60	180	120	grey clay	Artesian well.
35	28488	180	500	320	blue clay, water, good flow	Artesian well.
35	28488	500	640	140	conglomerate	Artesian well.
35	28488	640	700	60	sand and gravel	Artesian well.
35	28490	0	4	4	topsoil	
35	28490	4	270	266	conglomerate, sand, gravel and clay	
35	28490	270	305	35	conglomerate and clay	
35	28490	305	308	3	gravel	
35	28490	308	320	12	conglomerate, blue shale and brown clay	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	28490	320	330	10	sand and gravel	
35	28490	330	340	10	brown clay	
35	28490	340	350	10	conglomerate, sand and gravel	
35	28490	350	355	5	brown clay and conglomerate	
35	28490	355	365	10	conglomerate, sand and gravel	
35	28490	365	370	5	blue shale	
35	28490	370	410	40	sand and gravel, some blue shale	
35	28490	410	415	5	clay	
35	28490	415	442	27	sand and gravel with clay brakes	
35	28490	442	447	5	clay and blue shale	
35	28490	447	484	37	sand and gravel with clay brakes	
35	28490	484	487	3	clay	
35	28490	487	500	13	sand and gravel	
35	28490	500	525	25	conglomerate, shale and clay	
35	28490	525	532	7	sand and gravel (substantial water increase)	
35	28490	532	560	28	conglomerate and clay	
35	28490	560	570	10	hard sand with brakes of water gravel	
35	28490	570	590	20	conglomerate and clay	
35	28490	590	655	65	clay and shale with gravel brakes	
35	28490	655	662	7	sand and gravel	
35	28490	662	680	18	clay and shale	
35	28490	680	683	3	gravel	
35	28490	683	694	11	sandy clay	
35	28490	694	730	36	sand and gravel with clay brakes	
35	28490	730	741	11	sand and gravel	
35	28490	741	785	44	sandy conglomerate	
35	28490	785	800	15	clay	
35	28491	0	4	4	soil	
35	28491	4	80	76	red clay	
35	28491	80	100	20	Bentonite	
35	28491	100	110	10	fine sand	
35	28491	110	240	130	Bentonite	
35	28491	240	280	40	fine clay	
35	28491	280	290	10	Bentonite	
35	28491	290	310	20	blue clay	
35	28491	310	321	11	sand and gravel	
35	28491	321	360	39	brown clay	
35	28491	360	380	20	sand and gravel	
35	28491	380	405	25	red clay	
35	28491	405	425	20	gravel	
35	28491	425	430	5	clay (red)	
35	28491	430	455	25	sand and gravel	
35	28491	455	462	7	red clay	
35	28491	462	480	18	gravel	
35	28491	480	483	3	clay	
35	28491	483	492	9	gravel	
35	28491	492	495	3	clay	
35	28491	495	510	15	sand and gravel	
35	28491	510	550	40	clay	
35	28491	550	660	110	conglomerate	
35	28491	660	675	15	sand and gravel	
35	28491	675	710	35	clay	
35	28491	710	713	3	gravel	
35	28491	713	750	37	red clay	From 715' to 750' was all tight clay and seemed useless to put casing beyong 717'.
35	28494	0	81	81	(alluvium) gravel	
35	28494	81	111	30	clay and sand	
35	28494	111	293	182	light grey clay and fine sand	
35	28494	293	350	57	conglomerate and clay	
35	28494	350	470	120	boulders and conglomerate	
35	28494	470	608	138	conglomerate and clay	
35	28494	608	614	6	boulders	
35	28494	614	713	99	conglomerate and clay	
35	28494	713	715	2	boulders	
35	28494	715	720	5	volcanics	
35	28495	0	6	6	sandy soil	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	28495	6	160	154	red sandy clay	
35	28495	160	350	190	red clay	
35	28495	350	430	80	honey comb formation with conglomerate and water gravel pockets	
35	28496	0	3	3	red sandy soil	
35	28496	3	150	147	red clay	
35	28496	150	151	1	fine sand	
35	28496	151	220	69	red clay	
35	28496	220	222	2	gravel	
35	28496	222	230	8	red clay	
35	28496	230	234	4	gravel	
35	28496	234	260	26	conglomerate	
35	28496	260	265	5	gravel	
35	28496	265	280	15	conglomerate	
35	28496	280	283	3	gravel	
35	28496	283	340	57	conglomerate	
35	28496	340	350	10	gravel	
35	28496	350	355	5	conglomerate	
35	28496	355	360	5	gravel	
35	28496	360	380	20	conglomerate	
35	28496	380	384	4	gravel	
35	28496	384	420	36	conglomerate	
35	28496	420	422	2	gravel	
35	28496	422	472	50	conglomerate	
35	28496	472	475	3	gravel	
35	28496	475	520	45	conglomerate	
35	28496	520	531	11	gravel	
35	28496	531	612	81	conglomerate	
35	28496	612	641	29	blue granite	
35	28498	0	58	58	unknown (BFG)	
35	28498	58	62	4	water sand	
35	28498	105	110	5	water sand	
35	28498	325	330	5	water sand	
35	28498	330	430	100	water sand	
35	28501	0	50	50	made soil	The water came to surface of the ground but did not flow. Mr. Wantz said it would make a good pumping well. No other artesian wells south fo here in the San Simon valley.
35	28501	50	85	35	coarse gravel	
35	28501	85	295	210	grey clay	
35	28501	295	330	35	red clay	
35	28501	330	335	5	cemented sand and boulders	
35	28501	335	475	140	blue clay	
35	28501	475	490	15	quicksand	
35	28506	0	100	100	soil and conglomerate	
35	28506	100	175	75	conglomerate and sand	
35	28506	175	300	125	conglomerate and sand	
35	28506	300	500	200	layers of sand and gravel and clay	
35	28506	500	750	250	hard layers of conglomerate and clay and sand and gravel	
35	28508	0	4	4	red sandy soil	
35	28508	4	75	71	red sandy clay	
35	28508	75	80	5	water sand and gravel	
35	28508	80	185	105	red sandy clay	
35	28508	185	220	35	green, shale looks like bentonite	
35	28508	220	250	30	red clay	
35	28508	250	317	67	grey shale or clay	
35	28508	317	455	138	blue clay	
35	28508	455	478	23	sand and gravel	
35	28508	478	496	18	hard conglomerate	
35	28508	496	503	7	coarse gravel	
35	28508	503	650	147	honeycomb formation conglomerate and pockets of sand	
35	28508	650	665	15	coarse gravel	
35	28508	665	677	12	cong	
35	28508	677	682	5	gravel	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	28508	682	705	23	cong	
35	28508	705	720	15	gravel	
35	28508	720	800	80	honeycomb formation with cong and pockets of sand, belive this formation makes water	
35	28509	0	5	5	top soil	
35	28509	5	80	75	caliche- clay	
35	28509	80	110	30	sand and gravel	
35	28509	110	233	123	clay- some gravel	
35	28509	233	266	33	sand gravel- clean	
35	28509	266	430	164	clay- brown	
35	28509	430	465	35	gravel	
35	28509	465	585	120	clay imbedded with gravel	
35	28509	585	710	125	clay some rock, few sand stratas	
35	28509	710	767	57	clay some gravel	
35	28509	767	770	3	sandstone- some sand	
35	28509	770	1046	276	gravel, boulders, few clay streaks	
35	29299	0	5	5	red sandy soil	
35	29299	5	130	125	red clay	
35	29299	130	132	2	water sand	
35	29299	132	390	258	gray conglomerate	
35	29299	390	490	100	brown conglomerate	
35	29299	490	495	5	gravel	
35	29299	495	525	30	brown conglomerate	
35	29299	525	535	10	gravel	
35	29299	535	555	20	brown conglomerate	
35	29299	555	560	5	gravel	
35	29299	560	585	25	conglomerate	
35	29299	585	610	25	gravel	
35	29299	610	630	20	conglomerate	
35	29299	630	645	15	gravel	
35	29299	645	715	70	conglomerate with gravel breaks	
35	29299	715	733	18	gravel	
35	29299	733	770	37	conglomerate	
35	29299	770	780	10	gravel	
35	29299	780	830	50	conglomerate with gravel breaks	
35	29299	830	845	15	gravel	
35	29299	845	930	85	conglomerate with gravel breaks	
35	29299	930	935	5	gravel	
35	29299	935	943	8	conglomerate	
35	29300	0	10	10	red sandy soil	
35	29300	10	145	135	red clay	
35	29300	145	148	3	sand, water	
35	29300	148	485	337	brown clay and conglomerate	
35	29300	485	498	13	water gravel	
35	29300	498	510	12	conglomerate	
35	29300	510	520	10	gravel	
35	29300	520	565	45	conglomerate	
35	29300	565	570	5	gravel	
35	29300	570	580	10	conglomerate	
35	29300	580	585	5	gravel	
35	29300	585	595	10	conglomerate	
35	29300	595	599	4	gravel	
35	29300	599	635	36	conglomerate	
35	29300	635	639	4	gravel	
35	29300	639	670	31	conglomerate	
35	29300	670	675	5	gravel	
35	29300	675	690	15	conglomerate	
35	29300	690	694	4	gravel	
35	29300	694	745	51	conglomerate	
35	29300	745	750	5	gravel	
35	29300	750	770	20	conglomerate	
35	29300	770	773	3	gravel	
35	29300	773	810	37	conglomerate	
35	29310	0	70	70	clay	
35	29310	70	73	3	sand - no water	
35	29310	73	120	47	clay	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	29310	120	127	7	sand - no water	
35	29310	127	220	93	clay	
35	29310	220	245	25	sand and gravel	
35	29310	245	380	135	clay and conglomerate	
35	29310	380	445	65	gravel and clay streaks	
35	29310	445	525	80	conglomerate	
35	29310	525	530	5	gravel	
35	29310	530	585	55	conglomerate and gravel	
35	29310	585	765	180	conglomerate and narrow streaks of gravel	
35	29310	765	800	35	conglomerate	
35	29314	0	217	217	alluvail fill	
35	29314	217	244	27	sand gravel	
35	29314	244	322	78	shale	
35	29314	322	340	18	gravel	
35	29314	340	372	32	shale	
35	29314	372	421	49	gravel	
35	29314	421	441	20	shale	
35	29314	441	461	20	gravel	
35	29314	461	490	29	shale	
35	29314	490	560	70	gravel	
35	29314	560	590	30	shale	
35	29314	590	601	11	gravel	
35	29314	601	604	3	shale	
35	29315	0	380	380	boulders	
35	29315	380	387	7	sand	
35	29315	387	400	13	rock and gravel	
35	29319	0	10	10	sand, gravel and boulders	
35	29319	10	70	60	boulders	
35	29319	70	380	310	gravel embedded in clay	
35	29319	380	950	570	conglomerate with sporadic streaks of caly	
35	29324	0	6	6	topsoil	
35	29324	6	12	6	caliche	
35	29324	12	76	64	gravel and rock	
35	29324	76	97	21	caliche and clay	
35	29324	97	119	22	rock	
35	29324	119	201	82	clay	
35	29324	201	278	77	gravel and clay streaks	
35	29324	278	598	320	clay few sand and gravel streaks	
35	29324	598	751	153	gravel and rock and little clay	
35	29324	751	914	163	hard rock little gravel and clay streaks	
35	29324	914	990	76	sand and conglomerate rock	
35	29324	990	1083	93	conglomerate rock and gravel	
35	29324	1083	1145	62	broken conglomerate rock	
35	29325	0	6	6	topsoil	
35	29325	6	15	9	clay and caliche	
35	29325	15	80	65	rock and clay	
35	29325	80	101	21	sand	
35	29325	101	119	18	rock	
35	29325	119	216	97	clay	
35	29325	216	301	85	clay with few gravel streaks	
35	29325	301	396	95	rock and gravel	
35	29325	396	447	51	gravel, sand and clay streaks	
35	29325	447	536	89	rock and clay	
35	29325	536	631	95	clay	
35	29325	631	727	96	rock and clay streaks	
35	29325	727	756	29	clay	
35	29325	756	830	74	conglomerate and rock and gravel	
35	29325	830	846	16	sand	
35	29325	846	965	119	conglomerate rock	
35	29325	965	976	11	sand and gravel	
35	29325	976	1028	52	conglomerate and rock	
35	29325	1028	1037	9	sand and rock	
35	29325	1037	1084	47	conglomerate	
35	29325	1084	1145	61	broken rock, some sand streaks	
35	29326	0	2	2	topsoil	
35	29326	2	120	118	red sandy clay	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	29326	120	140	20	sand water	
35	29326	140	205	65	clay	
35	29326	205	220	15	sand	
35	29326	220	370	150	clay	
35	29326	370	390	20	gravel	
35	29326	390	435	45	clay	
35	29326	435	450	15	gravel	
35	29326	450	460	10	clay	
35	29326	460	470	10	gravel	
35	29326	470	520	50	clay	
35	29326	520	530	10	gravel	
35	29326	530	560	30	clay	
35	29326	560	575	15	gravel	
35	29326	575	585	10	clay	
35	29326	585	610	25	gravel	
35	29326	610	620	10	clay	
35	29326	620	635	15	gravel	
35	29326	635	640	5	clay	
35	29326	640	660	20	gravel	
35	29326	660	675	15	conglomerate	
35	29326	675	735	60	gravel	
35	29326	735	738	3	conglomerate	
35	29326	738	742	4	gravel	
35	29326	742	750	8	conglomerate	
35	29326	750	765	15	gravel	
35	29326	765	775	10	conglomerate	
35	29326	775	785	10	gravel	
35	29326	785	815	30	conglomerate	
35	29326	815	835	20	gravel	
35	29326	835	840	5	conglomerate	
35	29326	840	855	15	gravel	
35	29326	855	915	60	conglomerate	
35	29333	0	170	170	sand and clay	
35	29333	170	256	86	conglomerate	
35	29333	256	275	19	sand and clay	
35	29333	275	310	35	conglomerate	
35	29333	310	317	7	sand and gravel	
35	29333	317	370	53	conglomerate	
35	29333	370	385	15	gravel	
35	29333	385	418	33	conglomerate	
35	29333	418	420	2	gravel and sand	
35	29333	420	423	3	conglomerate	
35	29333	423	430	7	sand and gravel	
35	29333	430	466	36	conglomerate	
35	29333	466	470	4	sand and gravel	
35	29333	470	495	25	conglomerate	
35	29333	495	501	6	sand and gravel	
35	29333	501	505	4	conglomerate	
35	29333	505	512	7	sand and gravel	
35	29333	512	595	83	conglomerate	
35	29333	595	598	3	sand and gravel	
35	29333	598	632	34	conglomerate	
35	29333	632	635	3	gravel	
35	29333	635	700	65	conglomerate	
35	29333	700	703	3	sand and gravel	
35	29333	703	740	37	conglomerate	
35	29333	740	743	3	gravel	
35	29333	743	800	57	conglomerate	
35	29335	0	10	10	clay	
35	29335	10	25	15	gravel and boulders (brown)	
35	29335	25	60	35	gravel and sand (brown)	
35	29335	60	140	80	sandy clay (brown) little water at 80 ft.	
35	29335	140	180	40	boulders - sand - gravel; tan increase water at 175'	
35	29335	180	200	20	conglomerate - all colors	
35	29335	200	210	10	boulders, tan	
35	29335	210	365	155	conglomerate, tan, hard	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	29335	365	370	5	gravel, tan loose water possible	
35	29335	370	375	5	conglomerate, tan - nit very hard, pipe would drive no further	
35	29335	375	400	25	rock ? Red very hard	
35	30342	0	10	10	red clay	
35	30342	10	20	10	sand and boulders	
35	30342	20	60	40	conglomerate	
35	30342	60	70	10	sandy clay	
35	30342	70	90	20	conglomerate	
35	30342	90	100	10	brown sand	
35	30342	100	170	70	conglomerate	
35	30342	170	190	20	hard conglomerate	
35	30342	190	210	20	sandy clay	
35	30342	210	230	20	hard conglomerate	
35	30342	230	240	10	sandy clay	
35	30342	240	260	20	conglomerate	
35	30342	260	280	20	sandy clay	
35	30342	280	320	40	conglomerate	
35	30342	320	390	70	sandy clay	
35	30342	390	395	5	water gravel	
35	30342	395	410	15	water sand and gravel	
35	30351	0	2	2	soil	
35	30351	2	75	73	clay	
35	30351	75	80	5	sand and gravel	
35	30351	80	235	155	clay	
35	30351	235	480	245	conglomerate	
35	30352	0	15	15	sandy clay	
35	30352	15	30	15	gravel	
35	30352	30	85	55	sandy clay	
35	30352	85	105	20	sand and gravel (water)	
35	30352	105	125	20	white clay	
35	30352	125	140	15	red clay	
35	30352	140	155	15	pink clay	
35	30352	155	172	17	sandy clay	
35	30352	172	180	8	course sand (water)	
35	30352	180	198	18	white clay	
35	30352	198	265	67	sand and gravel (water)	
35	30352	265	300	35	sand and gravel (course)	
35	30352	300	355	55	sand and gravel	
35	30352	355	400	45	sand and gravel (course)	
35	30352	400	420	20	clay	
35	30352	420	470	50	sandy clay	
35	30352	470	500	30	sand and gravel (course)	
35	30355	0	164	164	surface soil and shale	
35	30355	164	176	12	heavy water gravel and sand	
35	30355	176	198	22	red shale	
35	30355	198	220	22	water gravel and sand	
35	30355	220	270	50	grey shale	
35	30355	270	285	15	water gravel and sand	
35	30355	285	340	55	red shale	
35	30355	340	380	40	wager gravel boulders and sand	
35	30355	380	405	25	red shale	
35	30355	405	440	35	water gravel and boulders	
35	30355	440	480	40	yellow shale	
35	30355	480	520	40	gravel boulders and sand	
35	30355	520	580	60	red shale	
35	30355	580	595	15	heavy water gravel and boulders	
35	30355	595	600	5	red shale	
35	30356	0	4	4	surface soil	
35	30356	4	9	5	gravel dry	
35	30356	9	30	21	sandy clay	
35	30356	30	38	8	gravel dri	
35	30356	38	197	159	yellow clay	
35	30356	197	223	26	sandy clay	
35	30356	223	228	5	sand and gravel	
35	30356	228	280	52	clay	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	30356	280	282	2	conglomerate	
35	30356	282	305	23	clay	
35	30356	305	309	4	conglomerate	
35	30356	309	312	3	clay	
35	30356	312	317	5	pea gravel	
35	30356	317	350	33	clay	
35	30356	350	357	7	pea gravel	
35	30356	357	370	13	clay	
35	30356	370	375	5	gravel	
35	30356	375	390	15	conglomerate	
35	30356	390	394	4	gravel	
35	30356	394	402	8	conglomerate	
35	30356	402	425	23	clay	
35	30356	425	445	20	conglomerate	
35	30356	445	455	10	sand and gravel	
35	30356	455	458	3	conglomerate	
35	30356	458	470	12	gravel	
35	30356	470	480	10	conglomerate	
35	30356	480	485	5	clay	
35	30356	485	540	55	conglomerate	
35	30356	540	553	13	gravel	
35	30356	553	600	47	conglomerate	
35	30356	600	610	10	brown clay	
35	30356	610	613	3	gravel	
35	30356	613	676	63	brown clay	
35	30356	676	680	4	gravel	
35	30356	680	785	105	brown clay	
35	30356	785	788	3	sand and gravel	
35	30356	788	798	10	brown clay	
35	30356	798	800	2	gravel	
35	30356	800	840	40	brown clay	
35	30358	0	135	135	unknown (BFG)	
35	30358	135	146	11	gravel (water at 135)	
35	30358	146	154	8	clay	
35	30358	154	220	66	conglomerate	
35	30358	220	247	27	gravel	
35	30358	247	256	9	clay	
35	30358	256	510	254	conglomerate	
35	30361	0	162	162	water	
35	30361	162	163	1	sand	
35	30361	163	200	37	clay	
35	30361	200	220	20	sand and gravel	
35	30361	220	235	15	clay	
35	30361	235	240	5	clay and gravel	
35	30361	240	255	15	clay	
35	30361	255	260	5	clay and gravel	
35	30361	260	290	30	clay	
35	30361	290	310	20	sand and gravel	
35	30361	310	513	203	gravel and conglomerate	
35	30365	0	10	10	top soil	
35	30365	10	35	25	clay	
35	30365	35	45	10	sand and gravel	
35	30365	45	85	40	clay	
35	30365	85	95	10	sand (water)	
35	30365	95	135	40	clay	
35	30365	135	140	5	sand and gravel	
35	30365	140	285	145	sandy clay	
35	30365	285	290	5	gravel	
35	30365	290	522	232	conglomrerate	
35	30370	0	4	4	soil	
35	30370	4	12	8	sand and gravel	
35	30370	12	40	28	clay	
35	30370	40	50	10	sand and gravel	
35	30370	50	80	30	clay	
35	30370	80	85	5	sand and gravel	
35	30370	85	115	30	sandy clay	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	30370	115	140	25	sand and gravel (water)	
35	30370	140	195	55	clay	
35	30370	195	215	20	sand and gravel	
35	30370	215	250	35	sandy clay	
35	30370	250	260	10	sand and gravel	
35	30370	260	300	40	sandy clay	
35	30370	300	350	50	sandy clay	
35	30370	350	370	20	sand and gravel (muddy)	
35	30370	370	400	30	sandy clay	
35	30370	400	410	10	sand and gravel (muddy)	
35	30370	410	440	30	sandy clay	
35	30370	440	460	20	sand and gravel (muddy)	
35	30370	460	500	40	sandy clay	
35	30374	0	5	5	soil	
35	30374	5	17	12	clay and gravel	
35	30374	17	33	16	gravel and boulders	
35	30374	33	40	7	red clay	
35	30374	40	145	105	conglomerate rock and gravel	
35	30374	145	173	28	hard brown sand rock	
35	30374	173	185	12	sandy clay	
35	30374	185	210	25	rock, boulders and gravel	
35	30374	210	225	15	red clay	
35	30374	225	270	45	rock, gravel and sand (water from 265 - 270)	
35	30374	270	275	5	clay	
35	30374	275	405	130	rock, conglomerate, sand and gravel (water 370 - 380)	
35	30374	405	412	7	clay	
35	30374	412	415	3	gravel (water)	
35	30374	415	425	10	rock, sand and clay	
35	30374	425	428	3	sand (water)	
35	30374	428	531	103	conglomeratte, rock, sand and gravel (possible water)	
35	30374	531	535	4	clay	
35	30374	535	545	10	gravel (possible water)	
35	30374	545	555	10	conglomerate, clay and boulders	
35	30374	555	568	13	sand and gravel (water)	
35	30374	568	597	29	conglomerate, rock and clay	
35	30374	597	640	43	conglomerate, sand and gravel	
35	30374	640	670	30	conglomerate and clay	
35	30374	670	685	15	sand and gravel (good water)	
35	30374	685	755	70	conglomerate and sandy clay	
35	30374	755	785	30	red clay	
35	30374	785	790	5	rock	
35	30374	790	822	32	conglomerate and clay	
35	30374	822	827	5	sand and gravel	
35	30374	827	829	2	gravel and clay	
35	30374	829	835	6	sand and gravel	
35	30374	835	840	5	clay	
35	30379	0	5	5	top soil	
35	30379	5	90	85	boulders and clay	
35	30379	90	197	107	clay and gravel	
35	30379	197	302	105	sandy clay	
35	30379	302	320	18	gravel	
35	30379	320	550	230	streaks of gravel and clay	
35	30379	550	570	20	clay	
35	31517	0	6	6	soil	
35	31517	6	20	14	sand & gravel	
35	31517	20	100	80	sandy clay	
35	31517	100	115	15	sand & gravel	
35	31517	115	140	25	clay	
35	31517	140	165	25	sandy clay	
35	31517	165	220	55	sand, gravel & water (water @ 200')	
35	31517	220	280	60	sandy clay	
35	31517	280	300	20	sand & gravel	
35	31517	300	335	35	clay	
35	31517	335	350	15	sand & gravel	
35	31517	350	400	50	sandy clay	
35	31517	400	415	15	clay	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	31517	415	500	85	sandy conglomerate	
35	31517	500	645	145	conglomerate	
35	31517	645	700	55	medium hard conglomerate	
35	31519	0	2	2	top soil	
35	31519	2	13	11	caliche	
35	31519	13	33	20	gravel	
35	31519	33	52	19	conglomerate	
35	31519	52	73	21	clay & gravel	
35	31519	73	98	25	conglomerate	
35	31519	98	114	16	clay & gravel	
35	31519	114	127	13	conglomerate	
35	31519	127	157	30	clay & gravel	
35	31519	157	186	29	conglomerate	
35	31519	186	195	9	clay & gravel	
35	31519	195	258	63	hard conglomerate	
35	31519	258	277	19	sandy clay	
35	31519	277	294	17	conglomerate	
35	31519	294	302	8	sandy clay	
35	31519	302	352	50	conglomerate (first water @ 320')	
35	31519	352	372	20	clay & gravel	
35	31519	372	383	11	gravel	
35	31519	383	451	68	clay & gravel	
35	31519	451	567	116	conglomerate	
35	31519	567	575	8	hard conglomerate	
35	31519	575	612	37	conglomerate	
35	31519	612	673	61	clay & gravel	
35	31519	673	740	67	hard conglomerate	
35	31521	0	55	55	red conglomerate	
35	31521	55	85	30	brown rocky formation	
35	31521	85	155	70	brown clay, gravel & rock	
35	31521	155	165	10	water, sand & gravel	
35	31521	165	190	25	red clay & rocks	
35	31521	190	235	45	gravel & red clay	
35	31521	235	243	8	red sandy gravel	
35	31521	243	270	27	sand & gravel	
35	31521	270	325	55	hard sand rock	
35	31521	325	360	35	sand formation	
35	31521	360	390	30	conglomerate	
35	31521	390	410	20	conglomerate & gravel	
35	31521	410	425	15	gravel	
35	31521	425	690	265	conglomerate	
35	31521	690	695	5	gravel	
35	31521	695	1000	305	conglomerate, mostly gravel	
35	31522	0	40	40	reddish soil, rock & gravel	
35	31522	40	60	20	gravel bed	
35	31522	60	145	85	red clay conglomerate - mostly rock	
35	31522	145	160	15	water, gravel & sand	
35	31522	160	235	75	red clay & rocks	
35	31522	235	246	11	gravel & sand	
35	31522	246	278	32	red sandy clay	
35	31522	278	318	40	sand, gravel & clay	
35	31522	318	355	37	sand rock	
35	31522	355	384	29	sandy clay	
35	31522	384	400	16	conglomerate	
35	31522	400	410	10	gravel & sandy clay	
35	31522	410	503	93	conglomerate of rock & gravel	
35	32892	0	4	4	topsoil	
35	32892	4	10	6	shale	
35	32892	10	18	8	caliche	
35	32892	18	25	7	boulders	
35	32892	25	50	25	shale	
35	32892	50	60	10	clay	
35	32892	60	100	40	shale	
35	32892	100	110	10	clay	
35	32892	110	120	10	sand gravel	
35	32892	120	145	25	shale and clay	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	32892	145	155	10	sand and gravel	
35	32892	155	180	25	shale and clay	
35	32892	180	185	5	clay	
35	32892	185	195	10	gravel	
35	32892	195	225	30	shale	
35	32892	225	245	20	shale and clay	
35	32892	245	255	10	sand and gravel	
35	32892	255	270	15	clay	
35	32892	270	290	20	sand and shale	
35	32892	290	300	10	sand and gravel	
35	32892	300	315	15	clay	
35	32892	315	320	5	gravel	
35	32892	320	330	10	clay	
35	32892	330	335	5	gravel	
35	32892	335	340	5	clay	
35	32892	340	345	5	sand and gravel	
35	32892	345	350	5	clay	
35	32892	350	360	10	gravel	
35	32892	360	365	5	clay	
35	32892	365	370	5	gravel	
35	32892	370	380	10	clay	
35	32892	380	400	20	gravel	
35	32910	0	155	155	red clay	
35	32910	155	160	5	coarse sand	
35	32910	160	180	20	red clay	
35	32910	180	187	7	sand	
35	32910	187	224	37	red clay	
35	32910	224	230	6	coarse sand	
35	32910	230	270	40	red clay	
35	32910	270	280	10	sand	
35	32910	280	322	42	red clay	
35	32910	322	326	4	sand and gravel	
35	32910	326	355	29	red clay	
35	32910	355	370	15	gravel	
35	32910	370	380	10	red clay	
35	32910	380	386	6	sand	
35	32910	386	395	9	white clay	
35	32910	395	405	10	gravel	
35	32910	405	422	17	clay	
35	32910	422	435	13	gravel	
35	32910	435	455	20	white clay	
35	32910	455	462	7	sand and gravel	
35	32910	462	485	23	white clay	
35	32910	485	495	10	sand	
35	32910	495	500	5	clay	
35	32911	0	400	400	sand and conglomerate (water at 360)	
35	32913	0	160	160	clay - red	
35	32913	160	165	5	gravel	
35	32913	165	250	85	clay - red	
35	32913	250	260	10	gravel	
35	32913	260	310	50	clay - red	
35	32913	310	315	5	gravel	
35	32913	315	382	67	red clay	
35	32913	382	390	8	gravel and sand	
35	32913	390	411	21	clay	
35	32913	411	445	34	sand and gravel	
35	32913	445	450	5	clay and gravel	
35	32913	450	460	10	clay	
35	32913	460	465	5	sand and gravel	
35	32913	465	480	15	clay	
35	32913	480	485	5	gravel	
35	32913	485	523	38	clay	
35	32913	523	526	3	sandy clay	
35	32913	526	545	19	clay	
35	32913	545	549	4	gravel	
35	32913	549	552	3	red rock	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	32913	552	600	48	sandy clay	
35	32914	0	4	4	topsoil	
35	32914	4	14	10	caliche	
35	32914	14	22	8	dry gravel	
35	32914	22	62	40	clay	
35	32914	62	104	42	sandy clay	
35	32914	104	136	32	clay and gravel	
35	32914	136	173	37	clay	
35	32914	173	177	4	coarse sand	
35	32914	177	261	84	clay and imbedded gravel	
35	32914	261	273	12	clay	
35	32914	273	277	4	coarse sand	
35	32914	277	297	20	clay	
35	32914	297	301	4	gravel	
35	32914	301	330	29	sandy clay	
35	32914	330	333	3	gravel	
35	32914	333	361	28	clay and imbedded gravel	
35	32914	361	371	10	clay	
35	32914	371	378	7	gravel	
35	32914	378	410	32	clay and imbedded gravel	
35	32914	410	412	2	fine sand	
35	32914	412	423	11	clay	
35	32914	423	448	25	large gravel	
35	32914	448	468	20	sandy clay	
35	32914	468	482	14	gravel	
35	32914	482	510	28	hard clay	
35	32915	0	170	170	clay	
35	32915	170	210	40	gravel	
35	32915	210	297	87	clay	
35	32915	297	311	14	gravel	
35	32915	311	330	19	clay	
35	32915	330	343	13	gravel	
35	32915	343	371	28	clay	
35	32915	371	388	17	gravel	
35	32915	388	410	22	clay	
35	32915	410	412	2	sand	
35	32915	412	433	21	clay	
35	32915	433	458	25	sand and gravel	
35	32915	458	479	21	clay	
35	32915	479	493	14	gravel	
35	32915	492	535	43	clay	
35	32916	0	6	6	sandy soil	
35	32916	6	45	39	clay and gravel	
35	32916	45	70	25	red clay	
35	32916	70	172	102	clay and gravel	
35	32916	172	175	3	sand	
35	32916	175	220	45	clay	
35	32916	220	235	15	coarse sand	
35	32916	235	280	45	red clay	
35	32916	280	300	20	coarse sand and gravel	
35	32916	300	328	28	clay	
35	32916	328	352	24	coarse sadn and gravel	
35	32916	352	360	8	hard red clay	
35	32916	360	380	20	coarse sand and gravel	
35	32916	380	390	10	coarse sand and gravel	
35	32916	390	395	5	red clay	
35	32916	395	432	37	coarse sand and gravel	
35	32916	432	455	23	red clay	
35	32916	455	465	10	coarse sand	
35	32916	465	493	28	red clay	
35	32916	493	502	9	coarse sand	
35	32916	502	505	3	clay	
35	32916	505	510	5	sand	
35	32916	510	516	6	red clay	
35	32916	516	528	12	sand	
35	32916	528	544	16	clay	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	32916	544	554	10	sand	
35	32916	554	558	4	clay	
35	32916	558	564	6	coarse sand	
35	32916	564	568	4	clay	
35	32916	568	580	12	sand	
35	32916	580	584	4	clay	
35	32916	584	592	8	sand	
35	32916	592	598	6	clay	
35	32916	598	604	6	sand	
35	32917	0	20	20	clay with rock, sand, gravel	
35	32917	20	30	10	loose gravel and clay	
35	32917	30	52	22	rocky clay	
35	32917	52	67	15	soft sandy clay	
35	32917	67	255	188	rocky clay	
35	32917	255	260	5	gravelly sand and clay - first water	
35	32917	260	280	20	rocky clay	
35	32917	280	290	10	sandy clay	
35	32917	290	440	150	rocky clay	
35	32917	440	500	60	sandy clay	
35	32920	0	400	400	conglomerate	
35	32920	400	460	60	clay	
35	32920	460	500	40	sandy clay	
35	33871	0	10	10	topsoil	
35	33871	10	300	290	boulders & clay	
35	33871	300	350	50	gravel & boulders (water @ 340')	
35	33871	350	750	400	round Malapai	
35	33878	0	16	16	fill top soil	
35	33878	16	85	69	clay & gravel	
35	33878	85	100	15	clay	
35	33878	100	140	40	clay & gravel	
35	33878	140	158	18	sandy clay	
35	33878	158	170	12	clay & gravel	
35	33878	170	180	10	clay	
35	33878	180	190	10	sandy clay	
35	33878	190	199	9	clay	
35	33878	199	210	11	gravel (first water)	
35	33878	210	237	27	clay & gravel	
35	33878	237	306	69	clay	
35	33878	306	312	6	gravel with clay streaks	
35	33878	312	315	3	gravel, sand & water	
35	33878	315	317	2	clay & gravel	
35	33878	317	326	9	clay	
35	33878	326	330	4	clay & gravel	
35	33878	330	340	10	coarse sand & water	
35	33878	340	350	10	clay	
35	33878	350	385	35	clay & gravel	
35	33878	385	397	12	gravel	
35	33878	397	401	4	rock	
35	33878	401	435	34	clay	
35	33880	0	15	15	soil	
35	33880	15	180	165	clay & gravel	
35	33880	180	185	5	sand, gravel & water	
35	33880	185	225	40	clay	
35	33880	225	246	21	sand, gravel & water	
35	33880	246	270	24	red clay & gravel	
35	33880	270	275	5	sand, gravel & water	
35	33880	275	292	17	red clay & gravel	
35	33880	292	305	13	sand, gravel & water	
35	33880	305	322	17	red clay	
35	33880	322	328	6	sand, gravel & water	
35	33880	328	388	60	red clay & gravel	
35	33880	388	398	10	sand, gravel & water	
35	33880	398	435	37	red clay	
35	33880	435	449	14	boulder bed	
35	33880	449	460	11	solid rock with clay below	
35	33882	0	8	8	soil	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
35	33882	8	385	377	clay & gravel	
35	33882	385	450	65	water bearing sand	
35	37012	0	78	78	clay	
35	37012	78	82	4	sand	
35	37012	82	86	4	clay	
35	37012	86	143	57	sand and gravel	
35	37012	143	565	422	dense dark blue clay, with foul odor	
35	37012	565	571	6	fine sand	
35	37012	571	657	86	gray, joint clay	
35	37012	657	662	5	fine sand	
35	37012	662	705	43	caliche and clay	
35	37012	705	710	5	coarse sand	
35	37012	710	796	86	caliche, pebbles, clay	
35	37012	796	800	4	coarse sand	
35	37012	800	850	50	hard clay	
55	200083	0	3	3	top soil	
55	200083	3	45	42	clay with rocks	
55	200083	45	60	15	sand and gravel	
55	200083	60	320	260	clay with rocks	
55	200083	320	340	20	fractured rock	
55	200083	340	385	45	clay	
55	200083	385	490	105	conglomerate	
55	200083	490	552	62	sand and gravel with thin layers of clay	
55	201526	0	2	2	top soil	
55	201526	2	8	6	caliche conglomerate	
55	201526	8	30	22	clay - rocks	
55	201526	30	55	25	rocks, san, gravel	
55	201526	55	360	305	rocks, clay	
55	201526	360	380	20	rocks	
55	201526	380	418	38	layer of clay with sand, gravel, rocks	
55	201526	418	460	42	rocks, sand gravel	
55	201604	0	3	3	top soil	
55	201604	3	20	17	rocks, clay	
55	201604	20	65	45	sand, gravel rocks, clay	
55	201604	65	150	85	clay, rocks	
55	201604	150	230	80	conglomerate	
55	201604	230	257	27	gravel, rocks	
55	201604	257	305	48	clay, rocks	
55	201604	305	380	75	hard ryolite	
55	201604	380	408	28	clay, rocks	
55	201604	408	445	37	clay, rocks	
55	201604	445	504	59	sand, gravel, rocks	
55	202632	0	2	2	top soil rocks	
55	202632	2	4	2	clay, rocks	
55	202632	4	10	6	cemented conglomerate	
55	202632	10	20	10	clay, rocks	
55	202632	20	45	25	rocks, clay	
55	202632	45	250	205	clay, rocks, boulders	
55	202632	250	320	70	fractured rock	
55	202632	320	345	25	clay	
55	202632	345	395	50	clay with layers os sand and gravel	
55	202632	395	450	55	fractured rock	
55	202632	450	510	60	sand and gravel with layers of clay	
55	202908	0	95	95	top soil	
55	202908	95	140	45	clay	
55	202908	140	142	2	gravel	
55	202908	142	160	18	clay	
55	202908	160	255	95	blue clay	
55	202908	255	270	15	yellow lime clay	
55	202908	270	280	10	gravel	
55	202908	280	420	140	brown clay with gravel streaks	
55	202908	420	590	170	boulders and conglomerate	
55	202908	590	672	82	conglomerate- mostly clay	
55	202908	672	680	8	gravel and clay	
55	202908	680	683	3	boulders and gravel	
55	202908	683	714	31	conglomerate	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
55	202908	714	726	12	gravel and boulders	
55	202908	726	745	19	conglomerate	
55	202908	745	765	20	clay	
55	202908	765	770	5	boulders and gravel	
55	202908	770	775	5	conglomerate	
55	202908	775	800	25	gravel and boulders	
55	202908	800	820	20	clay	
55	202908	820	830	10	gravel and boulders	
55	202908	830	850	20	gravel, conglomerate, and clay	
55	204482	0	3	3	top soil	
55	204482	3	40	37	clay, rocks, sand gravel	
55	204482	40	192	152	multi-coulored rock, clay	
55	204482	192	258	66	clay with rocks	
55	204482	258	306	48	fractured rock	
55	204482	306	325	19	rock	
55	204482	325	382	57	clay with rocks	
55	204482	382	435	53	sand and gravel	
55	204779	0	2	2	top soil	
55	204779	2	22	20	clay, rocks	
55	204779	22	35	13	sand, gravel, rocks	
55	204779	35	220	185	clay, rocks	
55	204779	220	290	70	clay, sand gravel	
55	204779	290	310	20	sand, gravel	
55	204779	310	385	75	clay, rocks	
55	204779	385	430	45	sand, gravel, rocks	
55	205473	0	710	710	unconsolidated basin fill - gravels and sands	
55	205473	710	800	90	conglomerate, small to large gravels with course to fine sand	
55	205473	800	1025	225	weathered volcanics	
55	205474	0	505	505	Basin fill, unconsolidated sands and gravels w/some clay	
55	205496	0	15	15	alluvium silts and small gravels	
55	205496	15	565	550	unconsolidated sands, clays, and gravels -basin fill	
55	205514	0	570	570	basin fill, sands, clays, and gravels	
55	205514	570	710	140	basalt	
55	205966	0	20	20	sand, gravel, and boulders	
55	205966	20	100	80	sand, gravel, and boulders	
55	205966	100	140	40	sand, gravel, and clay	
55	205966	140	160	20	brown clay	
55	205966	160	180	20	tan clay	
55	205966	180	220	40	tan clay with sand	
55	205966	220	275	55	sand and clay	
55	205966	275	300	25	sand with few boulders	
55	205966	300	370	70	sand	
55	205966	370	380	10	pea gravel	
55	205966	380	390	10	pea gravel	
55	205966	390	400	10	pea gravel	
55	205966	400	410	10	course sand	
55	205966	410	420	10	sand	
55	205966	420	460	40	sand	
55	205966	460	470	10	clay and sand	
55	205966	470	500	30	clay and course sand	
55	205966	500	530	30	clay and sand	
55	205966	530	540	10	rocks and sand	
55	205966	540	560	20	clay, sand and rocks	
55	205966	560	780	220	clay conglomerate	
55	206192	0	3	3	boulders, topsoil	
55	206192	3	20	17	boulders, sand and gravel	
55	206192	20	65	45	rocks, boulders	
55	206192	65	90	25	rocks, sand, and gravel	
55	206192	90	130	40	rocks, clay	
55	206192	130	270	140	rocks, boulders, sand, and gravel	
55	206192	270	280	10	rocks, clay	
55	206192	280	325	45	sand, gravel, rocks	
55	206192	325	370	45	rocks, clay	
55	206192	370	440	70	gravel, sand, rocks	
55	206343	0	3	3	top soil	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
55	206343	3	6	3	caliche	
55	206343	6	55	49	rocks with clay	
55	206343	55	160	105	rocks with sand gravel, gravel and clay	
55	206343	160	280	120	sand and gravel with clay and rocks	
55	206343	280	360	80	rock with clay	
55	206343	360	430	70	sand and gravel	
55	206721	0	30	30	sand and gravel	
55	206721	30	40	10	silty sand	
55	206721	40	60	20	sandy clay	
55	206721	60	140	80	clayey sand	
55	206721	140	160	20	fine sand	
55	206721	160	190	30	sandy clay	
55	206721	190	210	20	fine sand	
55	206721	210	230	20	sandy clay	
55	206721	230	240	10	clay	
55	206721	240	250	10	fine sand	
55	206721	250	260	10	clayey sand	
55	206721	260	280	20	fine sand	
55	206721	280	290	10	clayey sand	
55	206721	290	300	10	sandy clay	
55	206721	300	310	10	fine sand	
55	206721	310	330	20	clayey sand	
55	206721	330	340	10	clay	
55	206721	340	350	10	sandy clay	
55	206721	350	360	10	clay	
55	206721	360	370	10	clayey sand	
55	206721	370	380	10	sandy clay	
55	206721	380	480	100	fine sand	
55	206721	480	490	10	clayey sand	
55	206721	490	520	30	fine sand	
55	206721	520	530	10	clayey sand	
55	206721	530	700	170	fine sand	
55	208694	0	10	10	top soil	
55	208694	10	110	100	clay	
55	208694	110	175	65	clay and gravel streaks	
55	208694	175	690	515	blue clay	
55	208694	690	765	75	conglomerate	
55	208694	765	1052	287	conglomerate (hard)	
55	209499	0	30	30	top soil	
55	209499	30	90	60	gravel	
55	209499	90	130	40	conglomerate	
55	209499	130	360	230	blue clay	
55	209499	360	485	125	brown clay	
55	209499	485	615	130	conglomerate with little brown clay	
55	209499	615	850	235	conglomerate with some hard streaks	
55	209499	850	1011	161	conglomerate with some gravel	
55	209615	0	100	100	conglomerate with brown clay	
55	209615	100	130	30	conglomerate with green clay	
55	209615	130	375	245	blue clay	
55	209615	375	480	105	conglomerate with brown clay	
55	209615	480	900	420	conglomerate (coarse)	
55	209615	900	1100	200	conglomerate (hard, being ground-up fine))	
55	209615	1100	1115	15	rock	
55	209727	0	25	25	top soil - clay and sand	
55	209727	25	35	10	gravel	
55	209727	35	130	95	brown clay and sand	
55	209727	130	300	170	blue clay	
55	209727	300	475	175	brown clay, sand, and conglomerate	
55	209727	475	780	305	conglomerate and clay streaks	
55	209727	780	850	70	harder conglomerate with fewer clay streaks	
55	209727	850	900	50	very hard conglomerate	
55	210387	0	25	25	top soil, clay and sand	
55	210387	25	75	50	gravel	
55	210387	75	100	25	clay, sand, and gravel	
55	210387	100	300	200	blue clay	
55	210387	300	400	100	brown clay and sand	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
55	210387	400	450	50	clay, sand, and conglomerate	
55	210387	450	490	40	conglomerate with a little clay	
55	210387	490	620	130	harder conglomerate	
55	210387	620	720	100	conglomerate with gravel	
55	210387	720	1000	280	conglomerate	
55	210387	1000	1154	154	very hard conglomerate with a lot of broken formation	
55	210504	0	160	160	alluvium	
55	210504	160	585	425	bed rock green	
55	210507	0	160	160	alluvium	
55	210507	160	580	420	bed rock green	
55	500093	0	5	5	red sandy loam	
55	500093	5	25	20	red clay	
55	500093	25	135	110	red sandy clay	
55	500093	135	138	3	green clay	
55	500093	138	145	7	sand (water)	
55	500093	145	305	160	blue clay	
55	500093	305	350	45	brown sandy clay	
55	500093	350	361	11	coarse gravel (water)	
55	500093	361	695	334	honeycomb cemented conglomerate with pockets of gravel (water)	
55	500093	695	715	20	hard sandstone ledge	
55	500093	715	725	10	course gravel (water)	
55	500093	725	795	70	honeycomb cemented conglomerate with pockets of gravel (water)	
55	501349	0	8	8	clay	
55	501349	8	16	8	clay and gravel	
55	501349	16	32	16	clay	
55	501349	32	65	33	clay and sand	
55	501349	65	75	10	clay	
55	501349	75	94	19	clay and sand	
55	501349	94	123	29	clay	
55	501349	123	133	10	sand	
55	501349	133	142	9	clay and sand	
55	501349	142	150	8	sand	
55	501349	150	155	5	clay and sand	
55	501349	155	163	8	clay	
55	501349	163	188	25	clay and sand	
55	501349	188	191	3	clay	
55	501349	191	200	9	clay and sand	
55	501349	200	217	17	clay	
55	501349	217	265	48	clay and sand	
55	501349	265	285	20	sand	
55	501349	285	345	60	clay and sand	
55	501349	345	354	9	clay	
55	501349	354	415	61	clay and sand	
55	502802	0	30	30	sandy loam	
55	502802	30	70	40	sand loose	
55	502802	70	130	60	hard sandy formation	
55	502802	130	155	25	hard pan, hard sand trickle of water	
55	502802	155	156	1	hard pan water bearing sand	
55	502802	156	170	14	sand and clay mixture extra hard	
55	502802	170	185	15	sand streaks hard	
55	502802	185	205	20	extra hard formation, clay sand mix	
55	502802	205	210	5	hard pan layers sand	
55	502802	210	235	25	hard clay	
55	502802	235	240	5	hard pan streaks sand and gravel	
55	502802	240	244	4	few large rocks, gravel sand	
55	502802	244	260	16	few sandy streaks extra hard	
55	502802	260	286	26	hard sand clay mixture	
55	502802	286	290	4	sand gravel hard pan	
55	502802	290	420	130	hard clay very little sand	
55	502802	420	426	6	sandy streaks	
55	502802	426	430	4	hard sandy hardpan formation	
55	502802	430	444	14	sandy streaks	
55	502802	444	500	56	hard clay	
55	503819	0	30	30	red clay	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
55	503819	30	45	15	sand and clay	
55	503819	45	64	19	clay	
55	503819	64	80	16	clay and sand	
55	503819	80	175	95	sand and clay	
55	503819	175	195	20	clay and sand	
55	503819	195	228	33	clay	
55	503819	228	252	24	sand	
55	503819	252	264	12	clay	
55	503819	264	270	6	gravel	
55	503819	270	300	30	clay	
55	503992	0	30	30	sandy red clay	
55	503992	30	150	120	very sandy red clay	
55	503992	150	180	30	very sandy red clay with cobbles, first water @ 160' bgs	
55	503992	180	185	5	sand	
55	503992	185	220	35	sand in alternate clay beds	
55	503992	220	375	155	sandy soft clay	
55	503992	375	401	26	tight red clay, some sand	
55	504089	0	17	17	loose rock and dirt	
55	504089	17	45	28	large rocks and conglomerate	
55	504089	45	80	35	hard conglomerate	
55	504089	80	243	163	small layershard conglomerate and red clay	
55	504089	243	355	112	red cong.	
55	504089	355	432	77	grey cong.	
55	504089	432	485	53	hard red rock (water @ 472)	
55	504089	485	498	13	hard rock and sand (more water @ 485)	
55	504089	498	509	11	white clay	
55	504228	0	35	35	clay and gravel	
55	504228	35	82	47	gravel and sand	
55	504228	82	86	4	rock	
55	504228	86	110	24	clay	
55	504228	110	118	8	clay with sand	
55	504228	118	125	7	clay	
55	504228	125	155	30	clay and sand	
55	504228	155	166	11	clay	
55	504228	166	190	24	clay and sand	
55	504228	190	204	14	clay	
55	504228	204	209	5	rocks	
55	504228	209	229	20	clay	
55	504228	229	236	7	rock	
55	504228	236	240	4	clay	
55	504228	240	250	10	rock	
55	504228	250	273	23	clay	
55	504228	273	285	12	rock	
55	504228	285	309	24	clay and sand	
55	504228	309	315	6	sand (first encountered waterhere, rose to 290' bgs)	
55	504228	315	324	9	clay	
55	504228	324	330	6	rock	
55	504228	330	344	14	clay and sand	
55	504228	344	346	2	rock	
55	504228	346	350	4	clay	
55	504228	350	352	2	rock	
55	504228	352	370	18	clay and sand	
55	504228	370	383	13	rock	
55	504228	383	387	4	clay	
55	504228	387	410	23	rock	
55	506160	0	18	18	rhyolite boulders	
55	506160	18	45	27	sand and gravel	
55	506160	45	50	5	boulders	
55	506160	50	62	12	gravel and sand	
55	506160	62	70	8	boulders	
55	506160	70	80	10	sand and gravel	
55	506160	80	93	13	boulders	
55	506160	93	108	15	gravel	
55	506160	108	127	19	clay	
55	506160	127	140	13	gravel and clay	
55	506160	140	233	93	clay and gravel	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
55	506160	233	240	7	rock or big rhyolite boulder	
55	506160	240	245	5	conglomerate	
55	506160	245	252	7	clay	
55	506160	252	275	23	rock	
55	506160	275	310	35	conglomerate	
55	506160	310	410	100	gravel	
55	506160	410	490	80	gravel and clay	
55	506160	490	555	65	gravel	
55	507836	0	315	315	boulders and clay	
55	507836	315	355	40	sand and boulders	
55	507836	355	465	110	boulders and sand	
55	507836	465	540	75	conglomerate	
55	507843	0	17	17	red clay	
55	507843	17	35	18	red clay and gravel	
55	507843	35	132	97	sandy clay	
55	507843	132	135	3	clay and gravel	
55	507843	135	155	20	clay	
55	507843	155	220	65	sandy clay	
55	507843	220	225	5	sandy gravel	
55	507843	225	322	97	sand - clays - gravel	
55	507843	322	401	79	sandy clay	
55	508418	0	20	20	boulders	
55	508418	20	200	180	boulders and sand	
55	508418	200	300	100	boulders with streaks of sand and clay	
55	508418	300	380	80	clay streaks of sand - very tight	
55	508418	380	440	60	clay with streaks of sand, (well made approx. 6-8 gpm)	
55	509050	0	1	1	sandy soil mixed with sand and gravel	
55	509050	1	19	18	boulders	
55	509050	19	45	26	cemented conglomerate	
55	509050	45	370	325	boulders	
55	509050	370	380	10	cemented conglomerate, with small pockets sand, first water	
55	509050	380	465	85	boulders	
55	509050	465	500	35	black malapi	
55	509526	0	305	305	unknown (BFG)	
55	509526	305	307	2	gravel	
55	509526	307	327	20	clay and gravel	
55	509526	327	335	8	gravel	
55	509526	335	350	15	clay and gravel	
55	509526	350	360	10	clay	
55	509526	360	415	55	clay and gravel	
55	509526	415	420	5	gravel	
55	509526	420	428	8	clay and gravel	
55	510735	0	400	400	Brown Conglomerate, hit water @ 260', SWL=250'	
55	511868	0	17	17	sand and clay	
55	511868	17	82	65	gravel and sand	
55	511868	82	90	8	clay	
55	511868	90	105	15	sand and gravel	
55	511868	105	113	8	clay	
55	511868	113	135	22	sand and clay	
55	511868	135	147	12	gravel	
55	511868	147	158	11	clay and sand	
55	511868	158	174	16	gravel	
55	511868	174	185	11	clay sand	
55	511868	185	275	90	sand and gravel	
55	511868	275	400	125	sand	
55	513752	0	90	90	loose boulders and gravel	
55	513752	90	120	30	loose clay and gravel	
55	513752	120	185	65	sandy clay with gravel and boulders	
55	513752	185	195	10	sandy clay	
55	513752	195	329	134	sandy clay with gravel and boulders (water)	
55	513752	329	332	3	sand and gravel (water)	
55	513752	332	392	60	sandy clay with boulders	
55	513752	392	500	108	sandy clay with boulders	
55	516114	0	16	16	grey clay	
55	516114	16	180	164	grey clay gravel, layer and small stones, sands	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
55	516114	180	280	100	grey clay	
55	516114	280	350	70	grey clay and fine sands	
55	516114	350	375	25	grey clay and good sands and gravel	
55	516114	375	400	25	grey clay and very fine sands	
55	516675	0	38	38	boulders	
55	516675	38	78	40	clay - sand	
55	516675	78	456	378	boulders sand	
55	519388	0	20	20	boulders	
55	519388	20	55	35	clay sand	
55	519388	55	70	15	gravel	
55	519388	70	105	35	clay	
55	519388	105	238	133	gravel sand	
55	519388	238	250	12	clay	
55	519388	250	320	70	clay sand	
55	519388	320	458	138	clay	
55	519388	458	463	5	sand	
55	519388	463	495	32	clay	
55	519388	495	510	15	sand	
55	519388	510	550	40	clay sand	
55	519388	550	590	40	sand clay	
55	519388	590	600	10	clay	
55	520648	0	85	85	unknown (BFG)	
55	520648	85	86	1	sand (water)	
55	520648	86	94	8	sandy clay	
55	520648	94	260	166	blue clay	
55	520648	260	398	138	sandy grey clay	
55	520648	398	400	2	sand and gravel (water)	
55	520648	400	578	178	gray sandy clay	
55	520648	578	580	2	sand (water)	
55	520648	580	598	18	brown sticky clay	
55	520648	598	600	2	sand (water)	
55	520648	600	610	10	brown sticky clay	
55	520648	610	612	2	sand (water)	
55	520648	612	629	17	brown sticky clay	
55	520648	629	630	1	sand (water)	
55	520648	630	650	20	sticky clay	
55	521528	0	70	70	sand and gravel	
55	521528	70	75	5	blue clay	
55	521528	75	85	10	hard red rock (water @ 472)	
55	521528	85	285	200	blue clay	
55	521528	285	310	25	brown shale	
55	521528	310	460	150	blue clay	
55	521528	460	500	40	brown shale	
55	521529	0	45	45	sand	
55	521529	45	65	20	sand and gravel	
55	521529	65	80	15	gravel and rock	
55	521529	80	145	65	sandy brown clay	
55	521529	145	280	135	grey clay	
55	521529	280	310	30	brown clay	
55	521529	310	395	85	gery clay	
55	521529	395	410	15	brown clay	
55	521529	410	500	90	gery clay	
55	521995	0	40	40	boulders	
55	521995	40	60	20	gravel	
55	521995	60	490	430	boulders gravel	
55	523397	0	320	320	open hole	
55	523397	320	365	45	clean out sand	
55	523397	365	405	40	sand	
55	523397	405	440	35	clay	
55	523397	440	480	40	sand clay	
55	523397	480	490	10	gravel	
55	525252	0	105	105	gravel sand	
55	525252	105	115	10	clay	
55	525252	115	170	55	sand clay	
55	525252	170	429	259	clay	
55	525252	429	460	31	sand gravel clay	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
55	525252	460	510	50	clay	
55	525252	510	520	10	gravel	
55	528357	0	2	2	top soil	
55	528357	2	28	26	clay	
55	528357	28	35	7	sand	
55	528357	35	73	38	sand and gravel	
55	528357	73	107	34	sandy clay	
55	528357	107	292	185	blue clay	
55	528357	292	515	223	tan clay with streaks of sticky clay	
55	528357	515	535	20	brown clay with some gravel	
55	528357	535	539	4	sand	
55	528357	539	560	21	brown clay with some gravel	
55	528357	560	585	25	comglomerate	
55	528357	585	630	45	sandy clay with streaks of conglomerate	
55	528357	630	703	73	conglomerate	
55	528357	703	708	5	sand	
55	528357	708	715	7	sticky clay	
55	528357	715	738	23	conglomerate	
55	528357	738	750	12	sand and some gravel	
55	528357	750	800	50	hard conglomerate	
55	529731	0	55	55	gravel sand	
55	529731	55	75	20	clay	
55	529731	75	105	30	gravel	
55	529731	105	111	6	clay	
55	529731	111	118	7	gravel	
55	529731	118	128	10	clay	
55	529731	128	157	29	gravel	
55	529731	157	170	13	clay	
55	529731	170	177	7	clay gravel	
55	529731	177	194	17	sand	
55	529731	194	204	10	clay	
55	529731	204	215	11	sand	
55	529731	215	222	7	clay sand	
55	529731	222	245	23	clay	
55	529731	245	250	5	sand gravel	
55	529731	250	345	95	clay	
55	529731	345	390	45	clay sand	
55	529731	390	410	20	sand	
55	529731	410	416	6	sand clay	
55	529731	416	470	54	clay sand	
55	529731	470	484	14	sand clay	
55	529731	484	486	2	sand	
55	529731	486	572	86	clay	
55	529731	572	575	3	sand	
55	529731	575	612	37	clay	
55	529731	612	622	10	sandstone	
55	529731	622	635	13	clay	
55	529731	635	648	13	sandstone	
55	529731	648	658	10	clay	
55	529731	658	663	5	sandstone	
55	529731	663	675	12	clay	
55	530926	0	3	3	top soil	
55	530926	3	15	12	sand	
55	530926	15	18	3	clay	
55	530926	18	55	37	sand and gravel	
55	530926	55	90	35	sandy clay	
55	530926	90	94	4	sand and gravel (first water)	
55	530926	94	150	56	sandy clay with streaks of sand	
55	530926	150	182	32	clay	
55	530926	182	308	126	sandy clay with streaks of conglomerate	
55	530926	308	343	35	clay	
55	530926	343	390	47	sandy clay	
55	530926	390	453	63	conglomerate	
55	530926	453	462	9	sand and gravel	
55	530926	462	566	104	conglomerate	
55	530926	566	577	11	sand	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
55	530926	577	582	5	conglomerate	
55	530926	582	667	85	sandy clay	
55	530926	667	672	5	sand and gravel	
55	530926	672	712	40	conglomerate	
55	530926	712	717	5	sand	
55	530926	717	736	19	conglomerate	
55	530926	736	745	9	sand	
55	530926	745	800	55	sandy clay	
55	532601	0	135	135	clay gravel	
55	532601	135	475	340	clay sand	
55	532601	475	483	8	sand clay	
55	532601	483	493	10	rock	
55	532601	493	520	27	sand gravel	
55	532742	0	18	18	top soil	
55	532742	18	65	47	sand and gravel	
55	532742	65	406	341	blue/gray clay	
55	533915	0	15	15	top soil	
55	533915	15	35	20	sand	
55	533915	35	55	20	gravel	
55	533915	55	500	445	sandy clay	
55	533938	0	2	2	top soil	
55	533938	2	6	4	hard pan	
55	533938	6	12	6	sand	
55	533938	12	22	10	boulders	
55	533938	22	26	4	sand (first water)	
55	533938	26	109	83	clay with streaks of sand rock	
55	533938	109	113	4	sand rock	
55	533938	113	230	117	clay with streaks of sand rock	
55	533938	230	313	83	sand rock	
55	533938	313	330	17	blue clay	
55	533938	330	356	26	tan clay	
55	533938	356	427	71	blue clay	
55	533938	427	438	11	sand	
55	533938	438	451	13	blue clay	
55	533938	451	454	3	sand	
55	533938	454	490	36	blue clay	
55	536128	0	15	15	sand	
55	536128	15	20	5	gravel	
55	536128	20	125	105	clay	
55	536128	125	138	13	sand	
55	536128	138	400	262	clay	
55	536128	400	430	30	clay	
55	536128	430	433	3	bentonite	
55	536128	433	437	4	clay sand	
55	536128	437	460	23	clay	
55	536128	460	470	10	sand clay	
55	536128	470	480	10	clay	
55	536445	0	40	40	sand / boulders	
55	536445	40	545	505	sand / clay/ possible water .5 to 5 gpm	
55	536445	545	610	65	sand/ clay/ rock	
55	536901	0	55	55	gravel	
55	536901	55	115	60	clay	
55	536901	115	120	5	sand, gravel	
55	536901	120	245	125	clay	
55	536901	245	275	30	clay, sand (encountered 5' zone of water)	
55	536901	275	455	180	clay	
55	536901	455	465	10	sand, clay (water increases)	
55	536901	465	550	85	clay	
55	536901	550	580	30	sand clay (water)	
55	536901	580	1045	465	sand, clay, gravel	
55	536901	1045	1215	170	volcanic, clay (water) rose to 270'	
55	537717	0	26	26	reddish clay some rock	
55	537717	26	45	19	loose rock some clay	
55	537717	45	58	13	sand and gravel - some clay	
55	537717	58	67	9	red sandy clay	
55	537717	67	84	17	tan sandy clay	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
55	537717	84	245	161	red sandy clay	
55	537717	245	270	25	tan sandstone (water @ 245')	
55	537717	270	460	190	grey sticky clay (small layers green, red, brown clay)	
55	537717	435	803	368	red sandy clay	
55	537717	460	465	5	sticky brown clay	
55	537717	465	499	34	brown clay	
55	537717	499	550	51	small layers brown, green, red clay	
55	537717	550	595	45	sandy brown clay	
55	537717	595	627	32	redish sandy clay	
55	537717	627	634	7	redish brown sandstone	
55	537717	634	719	85	redish brown sandy clay	
55	537717	719	435	-284	brown and white clay	
55	537717	803	813	10	hard layers brown, red, green clay	
55	537717	813	845	32	brown silt	
55	537717	845	871	26	red sticky clay	
55	537717	871	879	8	red sand and gravel	
55	537717	879	915	36	red conglomerate	
55	537717	915	975	60	layers grey rock/ red clay	
55	537717	975	990	15	Gila conglomerate (cemented)	
55	537717	990	1045	55	layers grey rock/ red clay	
55	537717	1045	1065	20	grey rock	
55	537717	1065	1076	11	red stickey conglomerate	
55	537717	1076	1088	12	bright red clay	
55	537717	1088	1091	3	yellowish sandy clay	
55	537717	1091	1122	31	red rock- white filler	
55	537717	1122	1141	19	redish yellow conglomerate	
55	537717	1141	1148	7	redish yellow rock	
55	537717	1148	1165	17	soft red rock	
55	537717	1165	1178	13	hard brown rock	
55	537717	1178	1179	1	hard yellowish - red rock	
55	537717	1179	1183	4	hard brown rock	
55	538838	0	20	20	alluvium-sand gravel	
55	538838	20	80	60	caliche	
55	538838	80	360	280	conglomerate with snady stringers	
55	538838	360	480	120	red shale with sandy stringers	
55	538838	480	720	240	grey bedrock with yellowish sand	
55	539448	0	220	220	caliche with hard rock stringers	
55	539448	220	565	345	red shale, yellow sandstone with hard rock stringers	
55	539449	0	200	200	boulders-gravel	
55	539449	200	420	220	yellow sandstone	
55	539449	420	500	80	red shale	
55	539449	500	650	150	yellow sandstone-red shale	
55	539449	650	800	150	volcanic rock-sandstone (fractured)	
55	539450	0	140	140	boulders - gravel	
55	539450	140	200	60	red clay	
55	539450	200	400	200	sandstone	
55	539450	400	520	120	red sand	
55	539450	520	650	130	sandstone (fractured)	
55	539451	0	20	20	boulders	
55	539451	20	320	300	red shale-sandy clay	
55	539451	320	490	170	and red shale	
55	539451	490	540	50	fractured sandstone	
55	539452	0	120	120	hard rock sandstone	
55	539452	120	400	280	red shale	
55	539452	400	800	400	red shale - sandstone fractured	
55	539453	0	300	300	caliche-sand and gravel, soft formation	
55	539453	300	740	440	grey bedrock with sand stringers	Not likely bedrock given location in basin and proximity of other well data (BFG)
55	539453	740	1220	480	red shale with strings of yellow sandstone	as above (BFG)
55	539454	0	120	120	gravel-sand alluvium	
55	539454	120	600	480	red sandy shale	
55	539454	600	740	140	fractured sandstone	uncertain Tcmc or Tcs or Tvu (BFG)
55	539960	0	200	200	brown mud and caliche	
55	539960	200	410	210	blue clay	
55	539960	410	480	70	sandy with blue clay	
55	539960	480	490	10	red bed	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
55	540630	0	440	440	brown mud and blue clay	
55	541143	0	2	2	top soil	
55	541143	2	5	3	hard pan	
55	541143	5	18	13	clay	
55	541143	18	28	10	sand	
55	541143	28	65	37	sandy clay	
55	541143	65	66	1	fine sand (seep water)	
55	541143	66	75	9	sandy clay	
55	541143	75	95	20	fine sand (seep water)	
55	541143	95	104	9	clay	
55	541143	104	265	161	blue clay	
55	541143	265	445	180	gray clay	
55	541143	445	460	15	sandy clay	
55	541143	460	475	15	gray clay	
55	541143	475	490	15	gray clay with streaks of conglomerate	
55	541143	490	555	65	sandy clay	
55	541143	555	585	30	conglomerate	
55	541143	585	600	15	sand and gravel	
55	541143	600	750	150	conglomerate	
55	542147	0	21	21	loose sand gravels, cobbles	
55	542147	21	80	59	sandy clay	
55	542147	80	460	380	clay with occasional sand or gravel stringers	
55	542147	460	535	75	conglomerate- loose, caving, prob. Saturated	
55	542147	535	1057	522	very hard andesite- no alteration, fracturing, No water encountered below intermediate casing; wells abandoned.	
55	542374	0	43	43	sand, gravel	
55	542374	43	735	692	clay with sandstone stringers- usually only a few inches thick	
55	542374	735	760	25	conglomerate	
55	542374	760	785	25	clays- green to brown	
55	542374	785	810	25	alt. layers of siltstone, clay	
55	542374	810	864	54	conglomerate, well cemented	
55	542374	864	880	16	conglomerate , very soft altered	
55	542374	880	910	30	hard andesite	
55	542375	0	58	58	gravels, cobbles - unstable	
55	542375	58	363	305	clay	
55	542375	363	650	287	V. hard andesite	
55	542991	0	1	1	top soil	
55	542991	1	8	7	hard pan	
55	542991	8	32	24	sandy clay	
55	542991	32	40	8	sand	
55	542991	40	72	32	clay	
55	542991	72	90	18	sand (1st water)	
55	542991	90	112	22	sand and gravel	
55	542991	112	140	28	tan clay	
55	542991	140	280	140	blue clay	
55	542991	280	285	5	sand	
55	542991	285	502	217	tan clay	
55	542991	502	505	3	sand	
55	542991	505	570	65	sandy clay	
55	542991	570	595	25	tan clay	
55	542991	595	640	45	conglomerate	
55	542993	0	15	15	sand	
55	542993	15	32	17	sand and gravel	
55	542993	32	75	43	boulders sand and gravel	
55	542993	75	220	145	sandy clay	
55	542993	220	385	165	sand gravel and clay	
55	542993	385	425	40	sand gravel and boulders	
55	542993	425	495	70	boulders	
55	542993	495	498	3	rock and sand (1st water)	
55	542993	498	510	12	sand and boulders	
55	542993	510	600	90	sand gravel and boulders	
55	543000	0	20	20	clay	
55	543000	20	60	40	clay with gravel	
55	543000	60	70	10	fine sand (1st water)	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
55	543000	70	110	40	fine sand and clay	
55	543000	110	140	30	brown clay	
55	543000	140	300	160	blue clay	
55	543000	300	385	85	gray clay	
55	543000	385	445	60	gray sticky clay	
55	543000	445	453	8	fine sand and clay	
55	543000	453	490	37	sticky clay	
55	543000	490	555	65	sandy clay	
55	543000	555	565	10	conglomerate with streaks of sticky clay	
55	543000	565	580	15	sticky clay	
55	543000	580	670	90	sticky clay with streaks of conglomerate	
55	543000	670	675	5	sand	
55	543000	675	700	25	sticky clay with streaks of conglomerate	
55	543203	0	75	75	caliche	
55	543203	75	77	2	gravel	
55	543203	77	79	2	caliche	
55	543203	79	109	30	gravel	
55	543203	109	135	26	caliche	
55	543203	135	140	5	gravel	
55	543203	140	148	8	caliche	
55	543203	148	350	202	blue clay	
55	543203	350	580	230	blue and brown clay	
55	543203	580	785	205	brown clay	
55	543203	785	955	170	brown clay with sand streaks	
55	543203	955	1000	45	course sand	
55	543203	1000	1010	10	brown clay	
55	543203	1010	1035	25	course sand SWL @ 119'	
55	543312	0	21	21	clayey sand with gravels	
55	543312	21	633	612	clay with occasional sandstone layer	
55	543312	633	848	215	soft andesite	
55	543312	848	860	12	red clay or volcanic ash, very soft	
55	543313	0	18	18	sandy clay with large gravels	
55	543313	18	220	202	sandy clay	
55	543313	220	280	60	clay sticky	
55	543313	280	380	100	sandy brown clay	
55	543313	380	420	40	green clay	
55	543313	420	630	210	sandy lite brown clay	
55	543313	630	655	25	sand gravels - hole stability prob.- producing 60+ gpm	
55	543313	655	753	98	alternating layers of clay, sand, gravels	
55	543313	753	835	82	conglomerate	
55	543313	835	960	125	alt. layers of andesite, siltstone	
55	544044	0	10	10	sandy clay	
55	544044	10	55	45	gravel	
55	544044	55	105	50	cementer gravel with clay bits	
55	544044	105	500	395	conglomerate rock with small clay bits	
55	544362	0	55	55	clayey sand with gravel, cobbles	
55	544362	55	415	360	lite brown clay	
55	544362	415	440	25	pale green clay	
55	544362	440	855	415	brown to yellow clays	
55	544362	855	865	10	conglomerate? Poorly cemented, high fraction of volcanics	
55	544362	865	870	5	sandy clay	
55	544362	870	900	30	conglomerate- (Gila?) weak poorly cemented	
55	544362	900	980	80	andesite, soft soft with lots of clays interbedded?	
55	544362	980	1070	90	andesite, harder, some fracturing? Bit chatter	
55	544362	1070	1180	110	softer mostly clays with pebbles or a weak conglomerate	
55	544362	1180	1300	120	soft volcanics	
55	546369	0	8	8	clay - rocks	
55	546369	8	25	17	clay-red	
55	546369	25	30	5	gravel-sand alluvium	
55	546369	30	35	5	clay-sand	
55	546369	35	60	25	clay-sand-rocks	
55	546369	60	65	5	rocks	
55	546369	65	91	26	clay rocks	
55	546369	91	100	9	hard clay-gravel	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
55	546369	100	120	20	clay-sand-gravel	
55	546369	120	175	55	clay-rock	
55	546369	175	182	7	boulders in clay	
55	546369	182	190	8	rock-sand-gravel	
55	546369	190	360	170	clay- sand - rocks	
55	546369	360	420	60	rocks - sand - clay	
55	546627	0	15	15	clay - rocks	
55	546627	15	20	5	clay - sand	
55	546627	20	60	40	clay - sand, and rocks	
55	546627	60	92	32	clay- sand- gravel	
55	546627	92	340	248	clay - rocks - sand	
55	546627	340	398	58	rocks- gravel- clay layers	
55	546627	398	400	2	clay- gravel - sand	
55	550669	0	25	25	clay	
55	550669	25	110	85	loose gravel sand, small amount of clay	
55	550669	110	460	350	clay	
55	550671	0	14	14	clay	
55	550671	14	60	46	gravel	
55	550671	60	320	260	grey clay	
55	550671	320	465	145	hard brown clay	
55	550671	465	500	35	soft clay	
55	552431	0	225	225	tertiary basin fill; subangular to subrounded chips of assorted volcanics and metavolcanics. Water @ 935'	
55	552431	225	1580	1355	tertiary volcanics; subangular to subrounded chips of reddish to dark gray volcanics	
55	552572	0	2	2	top soil	
55	552572	2	5	3	hard pan	
55	552572	5	18	13	clay	
55	552572	18	32	14	sand	
55	552572	32	40	8	sandy clay	
55	552572	40	48	8	sand	
55	552572	48	65	17	sandy clay	
55	552572	65	102	37	fine sand (1st water)	
55	552572	102	126	24	gray clay	
55	552572	126	270	144	blue clay	
55	552572	270	447	177	gray clay	
55	552572	447	460	13	sandy clay	
55	552572	460	495	35	gray clay	
55	552572	495	530	35	sandy clay	
55	552572	530	560	30	gray clay	
55	552572	560	585	25	conglomerate	
55	552572	585	600	15	sand and gravel	
55	552572	600	740	140	conglomerate	
55	552682	0	10	10	clay	
55	552682	10	115	105	clay- sand- gravel	
55	552682	115	250	135	clay	
55	552682	250	270	20	sand	
55	552682	270	280	10	clay	
55	552682	280	350	70	clay- sand	
55	552682	350	400	50	sand- gravel	
55	555790	0	20	20	dirt and clay	
55	555790	20	520	500	clay	
55	555790	520	795	275	conglomerate first water @ 550 ft	
55	556032	0	220	220	Gila Conglomerate	
55	556032	220	800	580	teriary vesicular basalts, highly jointed, water @ 800 bgs, rose to 718' in 3 hours.	
55	556038	0	270	270	Gila Conglomerates	
55	556038	270	690	420	tertiary Gila volcanics	
55	556038	690	940	250	tertiary Safford meta-volcanics	
55	556040	0	140	140	Gila Conglomerate	
55	556040	140	297	157	tertiary Safford meta-volcanics	
55	556040	297	580	283	early tertiary Baboon metavolcanics	
55	556043	0	80	80	alluvium	
55	556043	80	670	590	TV Tertiary aged basalt	Bonita Creek Tb (BFG)
55	556043	670	740	70	TVB Tertiary basal conglomerate	Likely Bonita Creek conglomerate (BFG)
55	556044	0	560	560	Gila Conglomerate, water @ 540, rose to 446' bgs	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
55	556046	0	22	22	Quaternary Gila conglomerate	
55	556046	22	100	78	faulted zone and valley fault	Fault zone
55	556046	22	690	668	Tertiary Baboon meta-volcanics	
55	556049	0	160	160	Quaternary Gila conglomerate	
55	556049	160	1300	1140	Tertiary Baboon meta-volcanics with epidate and chlorite	
55	556053	0	205	205	conglomerate. Alluvium and gravel, well-graded sand and gravel	
55	556053	205	610	405	red, gray and brown basalts, andesite and rhyolites	
55	556053	610	635	25	conglomerate, poorly sorted tuffaceous conglomerate	
55	556053	635	760	125	greenish-grey, andesite, edidote and chlorites; WL@ 630'	
55	556056	0	85	85	conglomerate-alluvium and gravel	
55	556056	85	700	615	greenish grey andesite	
55	556057	0	500	500	Quaternary Gila conglomerate	
55	556058	0	350	350	conglomerate	Tgs (BFG)
55	556058	350	560	210	andesites, basalts, and rhyolites	
55	556058	560	580	20	basal conglomerate	
55	556162	0	25	25	gravels	
55	556162	25	1000	975	clay	
55	556164	0	95	95	gravel	
55	556164	95	740	645	clay	
55	556589	0	1210	1210	Conglomerate, Gila formation	Likely not Gila Conglomerate and some older bedrock-related clastic/volcaniclastic/volcanic deposits (BFG)
55	556807	0	15	15	red clay	
55	556807	15	55	40	red clay and rock	
55	556807	55	160	105	red clay/sandy	
55	556807	160	480	320	gray clay/sandy	
55	556807	480	485	5	hard rock	
55	557411	0	20	20	dirt and boulders	
55	557411	20	75	55	boulders	
55	557411	75	360	285	clay conglomerate	
55	557411	360	460	100	conglomerate	
55	557411	460	600	140	sand and gravel; first water @ 460 ft	
55	559952	0	2	2	top soil	
55	559952	2	10	8	sandy loam and clay	
55	559952	10	20	10	weak caliche	
55	559952	20	60	40	clay	
55	559952	60	72	12	hard brown clay	
55	559952	72	80	8	clay and sand first water @ 72'	
55	559952	80	90	10	very hard brown clay	
55	559952	90	206	116	brown clay less hard	
55	559952	206	210	4	sandy clay, 2nd water, caving	
55	559952	210	220	10	very hard brown clay	
55	559952	220	230	10	begin blue clay, mixed with brown clay	
55	559952	230	320	90	blue clay, no granules, brilliant color	
55	559952	320	433	113	brown clay	
55	559952	433	480	47	conglomerate, clayey	
55	559952	480	500	20	sand and gravel	
55	559952	500	530	30	sticky brown clay	
55	559952	530	538	8	hard brown fanglomerate	
55	559955	1	10	9	top soil	
55	559955	10	135	125	clay with streaks of gravel	
55	559955	135	430	295	blue clay	
55	559955	430	523	93	fine sand and gravel	
55	559955	523	1501	978	conglomerate of granite boulders, cemented	
55	562232	0	3	3	top soil	
55	562232	3	67	64	sand gravel and clay	
55	562232	67	73	6	sand (1st water)	
55	562232	73	145	72	sand gravel and clay	
55	562232	145	195	50	tan clay	
55	562232	195	285	90	blue clay	
55	562232	285	455	170	gray clay	
55	562232	455	470	15	fine sand	
55	562232	470	665	195	conglomerate	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
55	562232	665	675	10	sand	
55	562232	675	690	15	conglomerate and sticky clay	
55	562232	690	800	110	conglomerate	
55	562328	0	24	24	clay	
55	562328	24	42	18	sand and gravel	
55	562328	42	560	518	clay, a few gravel seams	
55	562328	560	700	140	conglomerate	
55	562641	0	15	15	sand	
55	562641	15	65	50	boulders	
55	562641	65	465	400	red clay	
55	562935	0	50	50	boulders	
55	562935	50	70	20	brown clay	
55	562935	70	210	140	blue clay	
55	562935	210	450	240	red and blue clay	
55	563447	0	20	20	unconsolodated to consolidated polylithic conglomerate	
55	563447	20	2060	2040	pre-mineral volcanics, altered fragmental andesites	
55	563450	0	30	30	alluvium	
55	563450	30	1500	1470	pre-mineral volcanics, altered fragmental andesites	
55	563451	0	180	180	unconsolodated to consolidated polylithic conglomerate	
55	563451	180	1600	1420	pre-mineral volcanics, altered fragmental andesites	
55	563452	0	30	30	alluvium	
55	563452	30	490	460	unconsolodated to consolidated polylithic conglomerate	
55	563452	490	1540	1050	pre-mineral volcanics, altered fragmental andesites	
55	563453	0	310	310	unconsolodated to consolidated polylithic conglomerate	
55	563453	310	1520	1210	pre-mineral volcanics, altered fragmental andesites	
55	563455	0	20	20	unconsolodated to consolidated polylithic conglomerate	
55	563455	20	1500	1480	pre-mineral volcanics, altered fragmental andesites	
55	563456	0	20	20	unconsolodated to consolidated polylithic conglomerate	
55	563456	20	310	290	post-mineral volcanics, various flows of andesite, rhyolite, tuffs and basalts	
55	563456	310	1740	1430	pro-mineral volcanics, altered fragmental andesites.	
55	563457	0	20	20	unconsolodated to consolidated polylithic conglomerate	
55	563457	20	130	110	post-mineral volcanics, various flows of andesite, rhyolite, tuffs and basalts	
55	563457	130	190	60	Tertiary paleosol	
55	563457	190	1600	1410	pre-mineral volcanics, altered fragmental andesites	
55	563458	0	20	20	unconsolodated to consolidated polylithic conglomerate	
55	563458	20	560	540	post-mineral volcanics, various flows of andesite	
55	563458	560	1700	1140	pre-mineral volcanics, altered fragmental andesites	
55	563462	0	110	110	unconsolodated to consolidated polylithic conglomerate	
55	563462	110	1340	1230	post-mineral volcanics, various flows of andesite, rhyolite, tuffs and basalts	
55	563922	0	20	20	clay conglomerate	
55	563922	20	80	60	clay	
55	563922	80	700	620	conglomerate first water @ 620'	
55	564371	0	6	6	top soil	
55	564371	6	27	21	sandy clay	
55	564371	27	28	1	sand (seep water)	
55	564371	28	60	32	sandy clay	
55	564371	60	110	50	clay	
55	564371	110	112	2	sand	
55	564371	112	125	13	clay	
55	564371	125	165	40	sandy clay with streaks of sand	
55	564371	165	168	3	sandstone	
55	564371	168	305	137	sandy clay and clay	
55	564371	305	700	395	clay	
55	565031	0	250	250	gravelly clayey sand (older alluvial fan deposits)	
55	565031	250	500	250	andesite volcanic rock, red-brown; well may yield < 1 gpm	
55	565817	0	150	150	sandstone and brown clay (1st water @ 150 approx 10 gpm)	
55	565817	150	450	300	black shale with quartz stringers	
55	566710	0	20	20	alluvium	
55	566710	20	35	15	talus	
55	566710	35	1100	1065	andesite	
55	566710	1100	1700	600	altered andesite	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
55	566710	1700	1800	100	premineralized volcanics	
55	566710	1800	2017	217	altered porphyrtic andesite	
55	566711	0	50	50	basin fill	
55	566711	50	1727	1677	andesite	
55	569817	0	400	400	sandy clay	
55	569817	400	550	150	clay	
55	569817	550	800	250	conglomerate	
55	569817	800	1000	200	hard conglomerate	
55	569818	0	400	400	sandy clay	
55	569818	400	500	100	clay	
55	569818	500	850	350	conglomerate	
55	569818	850	1000	150	hard conglomerate first water @ 66'	
55	569949	0	20	20	bolders sand and gravel	
55	569949	20	30	10	sandy clay	
55	569949	30	70	40	sandy clay with streaks of boulders	
55	569949	70	145	75	sandy clay	
55	569949	145	170	25	fine sand (1st water)	
55	569949	170	220	50	clay	
55	569949	220	222	2	sand	
55	569949	222	675	453	clay	
55	569949	675	685	10	sand	
55	569949	685	700	15	sandy clay	
55	569949	700	720	20	sticky clay	
55	569949	720	785	65	sandy clay	
55	569949	785	800	15	sticky clay	
55	574705	0	18	18	top soil, small gravel-brown colored	
55	574705	18	265	247	small gravel, snady-brown-red	
55	574705	265	460	195	sandy gravel, small cobbles	
55	574705	460	565	105	heavy sandy gravel, small cobbles (wet)	
55	575632	0	3	3	top soil	
55	575632	3	410	407	clay with rocks	
55	575632	410	525	115	fractured rock - limestone	
55	575632	525	570	45	sand, gravel -rocks	
55	575756	0	20	20	dirt and clay conglomerate	
55	575756	20	90	70	clay conglomerate	
55	575756	90	430	340	rock, first water @ 340 ft	
55	578919	0	2	2	top soil	
55	578919	2	10	8	hard pan	
55	578919	10	18	8	clay	
55	578919	18	31	13	sand	
55	578919	31	40	9	sandy clay	
55	578919	40	72	32	sandy clay with streaks of sand	
55	578919	72	115	43	sand	
55	578919	115	140	25	tan clay	
55	578919	140	275	135	blue clay	
55	578919	275	402	127	tan clay	
55	578919	402	410	8	sand	
55	578919	410	425	15	tan clay	
55	578919	425	535	110	clay with streaks of sand	
55	578919	535	555	20	sand	
55	578919	555	560	5	clay with streaks of sand	
55	578919	560	670	110	conglomerate	
55	578919	670	700	30	sand and gravel	merged two logs here (well deepened) (BFG)
55	578919	700	904	204	conglomerate (reddish) streaks of sand and gravel	
55	579104	0	20	20	silty clay	
55	579104	20	370	350	gravelly sands	
55	579104	370	520	150	sand	
55	579104	520	540	20	clay	
55	579104	540	600	60	sand and silt	
55	579104	600	700	100	sand, silt, and clay	
55	579106	0	285	285	sand and gravel	
55	579106	285	440	155	sand course to medium	
55	579106	440	580	140	silty sand with clay stringers	
55	579109	0	310	310	gravelly sand	
55	579109	310	660	350	sand course to medium	
55	579109	660	800	140	sand silt and clay	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
55	579207	0	15	15	top soil, large cobbles - brown	
55	579207	15	306	291	large gravel, little sandy-brown-red	
55	579207	306	455	149	small gravel, small cobbles	
55	579207	455	517	62	gravel with cobbles, small, brown/red (wet)	
55	579207	517	527	10	hard red rylite, rock	
55	582307	0	180	180	clay	
55	582307	181	187	6	hard strick (sp) possible water	
55	582307	188	240	52	clay	
55	582307	241	244	3	conglomerate possible water	
55	582307	245	285	40	clay	
55	582307	286	291	5	conglomerate possible water	
55	582307	292	307	15	clay	
55	582307	308	750	442	clay	
55	582307	751	875	124	conglomerate warm water	
55	586984	0	5	5	top soil rocks	
55	586984	5	60	55	rocks and boulders	
55	586984	60	80	20	rocks -sand and gravel	
55	586984	80	100	20	rocks	
55	586984	100	180	80	clay and rocks	
55	586984	180	210	30	rocks	
55	586984	210	265	55	solid rock -hard	
55	586984	265	300	35	rocks with clay layers	
55	586984	300	350	50	rocks	
55	586984	350	400	50	rocks sand and gravel	
55	587964	0	20	20	dirt and clay	
55	587964	20	240	220	sandy clay	
55	587964	240	360	120	clay conglomerate	
55	587964	360	480	120	red clay	
55	587964	480	700	220	conglomerate layer of sand and gravel	
55	592204	0	3	3	dirt- rocks	
55	592204	3	20	17	rocks and boulders	
55	592204	20	78	58	rock	
55	592204	78	211	133	rock and clay	
55	592204	211	249	38	rock sand and gravel	
55	592204	249	401	152	rock and clay	
55	592204	401	458	57	conglomerate	
55	592204	458	504	46	sand and gravel	
55	593460	0	2	2	top soil	
55	593460	2	12	10	hard pan	
55	593460	12	40	28	sand and clay	
55	593460	40	80	40	clay with streaks of sand and gravel	
55	593460	80	140	60	sand and gravel	
55	593460	140	260	120	blue clay	
55	593460	260	405	145	blue gray clay	
55	593460	405	505	100	tan clay	
55	593460	505	590	85	sandy clay with streaks of conglomerate	
55	593460	590	600	10	sticky clay	
55	593838	0	60	60	sandy clay	
55	593838	60	120	60	sand and gravel	
55	593838	120	420	300	sand and gravel	
55	594381	0	170	170	unconsolidated Tertiary volcanics (Qtg)	
55	594381	170	520	350	Tertiary volcanics (Tv)	
55	594381	520	880	360	Premineral (Ka)	
55	594618	0	21	21	top soil dirt rocks	
55	594618	21	263	242	rocks, clay	
55	594618	263	306	43	rocks	
55	594618	306	344	38	clay	
55	594618	344	363	19	rocks, clay	
55	594618	363	386	23	clay	
55	594618	386	429	43	rocks, sand and gravel	
55	596421	0	3	3	top soil	
55	596421	3	190	187	rocks, clay	
55	596421	190	210	20	clay, rocks	
55	596421	210	235	25	clay with layers of sand and gravel	
55	596421	235	249	14	clay	
55	596421	249	363	114	clay, rocks	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
55	596421	363	418	55	rocks, clay	
55	596421	418	463	45	rocks, sand and gravel	
55	596774	0	25	25	brown soil	
55	596774	25	95	70	large gravel and sand	
55	596774	95	285	190	sticky blue clay	
55	596774	285	430	145	sticky blue clay and shale	
55	596774	430	500	70	sticky blue and brown clay	
55	598293	0	3	3	top soil - boulders	
55	598293	3	30	27	boulders -sand and gravel	
55	598293	30	340	310	conglomerate (clay and rocks)	
55	598293	340	350	10	sand and gravel	
55	598293	350	400	50	clay and rocks	
55	599411	0	280	280	brown clay	
55	599411	280	425	145	blue clay	
55	599411	425	500	75	brown clay	
55	599411	500	505	5	sandy gravel	
55	599411	505	599	94	sandy brown clay	
55	599432	0	15	15	top soil	
55	599432	15	60	45	boulders	
55	599432	60	125	65	sand and gravel	
55	599432	125	500	375	blue clay	
55	625841	0	700	700	unknown (BFG)	
55	625841	700	760	60	sand	0 to 700 feet no log
55	902556	0	20	20	boulders and loose sand	
55	902556	20	220	200	tan sand rock	
55	902556	220	230	10	sand and gravel	
55	902556	230	240	10	brown clay	
55	902556	240	340	100	brown sand rock	
55	902556	340	400	60	brown clay	
55	902556	400	430	30	tan sand rock	
55	902556	430	450	20	red dense clay	
M	1	0	15	15	sand	
M	1	15	35	20	soft red clay	from Knechtel p.201, unknown well id. Location based on one 1/4 section in 6S24E sec. 5, NE 1/4
M	1	35	40	5	coarse sand	
M	1	40	45	5	red clay	
M	1	45	50	5	coarse sand	
M	1	50	60	10	red clay	
M	1	60	62	2	sand	
M	1	62	80	18	hard red clay	
M	1	80	82	2	gravel	
M	1	82	800	718	clay with beds of limestone and tuff	
M	2	0	45	45	sand, few gravels, some gypsum (blue-grey)	See Witcher 1983, App. A, p.2
M	2	45	119	74	Sand, few gravels, no gypsum (blue -grey)	
M	2	119	397	278	Fine to coarse sand	
M	2	397	668	271	Sand, few gravel	
M	2	668	1499	831	Grey sand, rare gravel	
M	3	0	2535	2535	See Witcher 83 (BFG)	Also known as WW-08. See Witcher 83, Appendix A, p.2 (BFG)
M	4	0	250	250	no samples	Description of cuttins in Harris 1999, Ap. B, p.74
M	4	250	260	10	sand to fine gravel (granitic/gneisses)	
M	4	260	500	240	no samples	
M	4	500	510	10	sand, fine to coarse (granitic/gneisses)	
M	4	510	1035	525	no samples	
M	4	1035	1080	45	sand, silt-clay; poor sample return	
M	4	1080	1110	30	sand, clay-silt with clear and white gypsum; poor sample return	
M	4	1110	1570	460	gypsum (selenite common); minor clay, silt, sand.	
M	4	1570	2240	670	clay-silt; strong fizz; mod consolidated; brown-gray; gypsiferous; very salty. Salt crusts and disseminated salt crystals in clay 1895, 1925, 1970 ,2015, 2060 feet. Pure salt or clayey salt at 2075,2090,2105,2120-2150,2195-2225 ft.	
M	5	0	1354	1354	predominantly coarse siliciclastics with 200ft of gypsum in the upper 240 feet of hole (BFG)	see detailed log in Harris 1997, p.40.

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
M	6	0	130	130	unknown	See Witcher 1983, Ap. A, p.2
M	6	130	230	100	grey vol. sand, gravel, few pebbles	
M	6	230	310	80	sticky brown clay, vol. sand and gravel; few granite fragments	
M	6	310	446	136	very fine to coarse sand with gypsum fragments	
M	6	446	1205	759	gypsum	
M	6	1205	1396	191	very fine to coarse volcanic sand	
OG	21	0	155	155	gravel	
OG	21	155	630	475	shale and Gravel	
OG	21	630	7568	6938	gravel and conglomerate	
OG	48	0	1800	1800	unknown	
OG	48	1800	3060	1260	predominantly conglomerate (BFG)	See AMSL for details. (BFG)
OG	48	3060	5434	2374	Rhyolite complex	
OG	204	0	719	719	clay and shale	samles suggest clastics at 3800', probably valley fill top to bottom.
OG	204	719	1619	900	brown sand - 38 ft. showing oil	
OG	204	1619	2107	488	limestone and shale	log missing; inserted from 02-04SAMP logs 1 and 2 [BFG]
OG	204	2107	2237	130	sand - 130 ft showing oil	
OG	204	2237	2283	46	red lime sandy shale	log missing; inserted from 02-04SAMP logs 1 and 2 [BFG]
OG	204	2283	2434	151	sand - 151 ft showing oil. The formations outside of the sand were some clay, but mostly brown, red and other colors of shale and lime, toward the last.	
OG	204	2434	2847	413	mix of hard sand, shale and limestone with oil/gas showings (BFG)	log missing; inserted from 02-04SAMP logs 1 and 2 [BFG]
OG	204	2847	2895	48	gray sand carring considerable oil and dead gas	
OG	204	2895	2900	5	hard blue lime	
OG	204	2900	2918	18	blue broken lime	
OG	204	2918	2945	27	green hard serpentine	
OG	204	2945	2958	13	hard black lime	
OG	204	2958	2972	14	sand showing oil and dead gas	
OG	204	2972	2976	4	blue shale oil and gas	
OG	204	2976	2995	19	gray sand oil and gas	
OG	204	2995	3000	5	blue shale	
OG	204	3000	3018	18	coarse sand showing oil and dead gas	
OG	204	3018	3020	2	break	
OG	204	3020	3048	28	hard grey lime	
OG	204	3048	3054	6	brown sandy shale	
OG	204	3054	3065	11	fine grey chalky lime	
OG	204	3065	3097	32	sand showing oil and dead gas	
OG	204	3097	3180	83	brown lime shale	
OG	204	3180	3185	5	water sand	
OG	204	3185	3190	5	brown shale	
OG	204	3190	3210	20	sandy	
OG	204	3210	3276	66	brown hard lime	
OG	204	3276	3285	9	gray soapstone	
OG	204	3285	3292	7	gray sandy lime	
OG	204	3292	3322	30	pink lime	
OG	204	3322	3326	4	brown lime gas and oil showing	
OG	204	3326	3354	28	brown lime shale	
OG	204	3354	3370	16	brown shale showing gas and oil	
OG	204	3370	3398	28	pink sandy lime	
OG	204	3398	3410	12	fine gray mixed sand	
OG	204	3410	3440	30	pink sandy lime	
OG	204	3440	3444	4	pink shaleshowing showing oil and gas	
OG	204	3444	3460	16	gray mixed sand	
OG	204	3460	3470	10	pink, blue, brown shale	
OG	204	3470	3480	10	gray hard mixed sand	
OG	204	3480	3495	15	pink lime shale showing oil and gas	
OG	204	3495	3500	5	pink lime shale	
OG	204	3500	3504	4	blue and pink shale	
OG	204	3504	3510	6	hard sand	
OG	204	3510	3520	10	blue and gray sandy shale	
OG	204	3520	3530	10	blue sticky shale	
OG	204	3530	3542	12	pink mixed sandy lime showing gas and oil	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
OG	204	3542	3544	2	tough hard drilling lime	
OG	204	3544	3580	36	sandy lime different colors	
OG	204	3580	3600	20	brown shale	
OG	204	3600	3620	20	gray sandy lime showing more gas and oil	
OG	204	3620	3623	3	gray lime shale	
OG	204	3623	3625	2	brown lime shale	
OG	204	3625	3682	57	brown sandy lime shale	
OG	204	3682	3705	23	brown sandy lime shale	
OG	204	3705	3710	5	shale	
OG	204	3710	3713	3	hard gray lime	
OG	204	3713	3740	27	sandy lime shale	
OG	204	3740	3746	6	blue and gray soapstone shale	
OG	204	3746	3750	4	hard gray lime shale	
OG	204	3750	3765	15	blue and gray	
OG	204	3765	3777	12	blue soapstone shale	
OG	204	3777	3790	13	gray sandy lime	
OG	204	3790	3792	2	shale	
OG	204	3792	3812	20	sandy shale - all colors	
OG	204	3812	3820	8	brown shale	
OG	204	3820	3835	15	lime shell mixed	
OG	204	3835	3845	10	green lime shell	
OG	204	3845	3852	7	green lime shell	
OG	204	3852	3857	5	green sand- heavily sat. w/gas and oil	
OG	204	3858	3861	3	green sand porus showing heavy heavy oil and gas	
OG	204	3861	3872	11	green sand porus showing heavy heavy oil and gas	
OG	204	3872	3877	5	green sans and little shale	
OG	204	3877	3879	2	green sand and shale	
OG	204	3879	3884	5	green sand	
OG	204	3884	3944	60	green sand and lime	
OG	204	3944	3946	2	green sand	
OG	204	3946	4100	154	green sandy lime	
OG	205	0	95	95	clay and gypsum	
OG	205	95	125	30	water and gravel	
OG	205	125	175	50	clay and gypsum	
OG	205	175	180	5	water and gravel	
OG	205	180	394	214	blue clay and shale	
OG	205	394	400	6	yellow clay	
OG	205	400	630	230	blue shale and soapstone	
OG	205	630	695	65	brown shale, possibly little water	
OG	205	695	700	5	water and break	
OG	205	700	710	10	water sand	
OG	205	710	735	25	light brown shale	
OG	205	735	742	7	water sand, water filled hole	
OG	205	742	767	25	brown shale	
OG	205	767	837	70	blue soapstone shale	
OG	205	837	895	58	brown shale	
OG	205	895	905	10	light brown shale	
OG	205	905	1015	110	brown shale caved badly	
OG	205	1015	1065	50	water sand artesian flow	
OG	205	1065	1105	40	strictly red shale	
OG	205	1105	1128	23	water sand	
OG	205	1128	1200	72	sticky red shale	
OG	205	1200	1260	60	red sand shale with traces of oil	
OG	205	1260	1290	30	water sand artesian flow, 14,000 B. day	
OG	205	1290	1305	15	red clay	
OG	205	1305	1320	15	water sand artesian	
OG	205	1320	1340	20	red sandy shale	
OG	205	1340	1355	15	red sticky shale	
OG	205	1355	1395	40	red sandy shale	
OG	205	1395	1415	20	red clay	
OG	205	1415	1460	45	red sandy shale	
OG	205	1460	1511	51	red sticky clay	
OG	205	1511	1517	6	sandy shale	
OG	205	1517	1525	8	brown sandy shale	
OG	205	1525	1550	25	brown shale	
OG	205	1550	1598	48	red shale	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
OG	205	1598	1618	20	water sandy, artesian	
OG	205	1618	1675	57	red sandy shale, showing oil	
OG	205	1675	1678	3	water sand	
OG	205	1678	1723	45	red shale	
OG	205	1723	1747	24	red sand , considerable oil and gas	
OG	205	1747	1830	83	brown shale mixed	
OG	205	1830	1865	35	red shale caved badly	
OG	205	1865	1980	115	red shale mixed gravel	
OG	205	1980	1996	16	sand carrying some water	
OG	205	1996	2010	14	red sand oil colors	
OG	205	2010	2014	4	sand	
OG	205	2014	2020	6	red shale	
OG	205	2020	2030	10	red sand heavy oil sand at bottom	
OG	205	2030	2033	3	gravel seemed to carry some water	
OG	205	2033	2040	7	red sandy shale carrying black oil	
OG	205	2040	2044	4	small gravel	
OG	205	2044	2052	8	red shale mixed gravel	
OG	205	2052	2068	16	sand last 11ft carrying much black oil	
OG	205	2068	2103	35	tough hard brown and pink shale oil and gas	
OG	205	2103	2130	27	red shale, some gravel showing some oil and gas	
OG	205	2130	2140	10	red soapstone shale	
OG	205	2140	2181	41	red sandy shale	
OG	205	2181	2187	6	conglomerate shale	
OG	205	2187	2232	45	red sandy shale	
OG	205	2232	2244	12	red sandstone some shale	
OG	205	2244	2284	40	red shale	
OG	205	2284	2285	1	red sand more oil and gas smell	
OG	205	2285	2297	12	red hard sand, little water traces of oil	
OG	205	2297	2310	13	brown shale oil trace	
OG	205	2310	2333	23	red sticky sandy shale, oil and gas trace	
OG	205	2333	2353	20	red sticky shale, slight water, oil trace	
OG	205	2353	2367	14	red shale sand conglomerate	
OG	205	2367	2370	3	blue soapstome shale	
OG	205	2370	2407	37	red sand, more oil showing, gas smell	
OG	205	2407	2414	7	brownish red shale, oil and gas trace	
OG	205	2414	2424	10	red oil sand	
OG	205	2424	2430	6	sand little water	
OG	205	2430	2460	30	red sand some shale, hard oil trace	
OG	205	2460	2475	15	red sand some shale, hard oil trace	
OG	205	2475	2494	19	red sandstone and shale	
OG	205	2494	2532	38	hard red sandstone	
OG	205	2532	2550	18	red sandy shale, oil and gas showing	
OG	205	2550	2595	45	brown shale, oil and gas showing	
OG	205	2595	2650	55	hard brown sandy lime	
OG	205	2650	2664	14	red sand slight water, oil and gas showing	
OG	205	2664	2673	9	brown sandy lime, oil and gas showing	
OG	205	2673	2685	12	brown shale, oil and gas showing	
OG	205	2685	2692	7	brown lime, oil and gas showing	
OG	205	2692	2698	6	brown shale, oil and gas showing	
OG	205	2698	2704	6	brown lime, oil and gas showing	
OG	205	2704	2730	26	brown shale, oil and gas showing	
OG	205	2730	2754	24	brown sandstone, oil and gas showing	
OG	205	2754	2766	12	brown shale, oil and gas showing	
OG	205	2766	2784	18	brown shale	
OG	205	2784	2798	14	brown shale, sandy lime, oil and gas showing	
OG	205	2798	2805	7	lime	
OG	205	2805	2812	7	brown shale	
OG	205	2812	2849	37	brown lime some shale, oil and gas showing	
OG	205	2849	2851	2	hard shell, oil and gas showing	
OG	205	2851	2857	6	brown sandy lime, oil and gas showing	
OG	205	2857	3061	204	red sandstone red lime, shale more oil and gas	
OG	205	3061	3065	4	brown lime showing oil and gas	
OG	205	3065	3075	10	hard red sandy shale, oil and gas showing	
OG	205	3075	3077	2	hard red sandy lime, oil and gas	
OG	205	3077	3082	5	hard brown lime oil and gas	
OG	205	3082	3090	8	hard red sandy lime, oil and gas	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
OG	205	3090	3098	8	hard brown lime oil and gas	
OG	205	3098	3100	2	hard brown sandy lime, oil and gas	
OG	205	3100	3104	4	red sandy lime shaowing oil and gas	
OG	205	3104	3115	11	red sandy lime more oil and gas	
OG	205	3115	3120	5	red sandy lime more oil and gas	
OG	205	3120	3125	5	red sandy shale,more oil and gas	
OG	205	3125	3127	2	red sandy shale,more oil and gas	
OG	205	3127	3145	18	red sandy shale,more oil and gas	
OG	205	3145	3158	13	brown sandy lime	
OG	205	3158	3165	7	hard red sandstone, oil and gas	
OG	205	3165	3195	30	hard red sandstone, oil and gas	
OG	205	3195	3215	20	hard red sandstone, oil and gas	
OG	205	3215	3220	5	hard red sandy lime, oil and gas	
OG	205	3220	3224	4	brown lime showing oil and gas, hard	
OG	205	3224	3227	3	hard light sandy brown lime showing oil and gas	
OG	205	3227	3232	5	hard light sandy brown lime showing oil and gas	
OG	205	3232	3236	4	hard brown lime showing oil and gas	
OG	205	3236	3240	4	pink soapstone shale, showing oil and gas	
OG	205	3240	3265	25	pink sandy shale, showing oil and gas	
OG	205	3265	3285	20	brown lime shale, showing oil and gas	
OG	205	3285	3310	25	mixed brown and blue shale, showing oil and gas	
OG	205	3310	3370	60	red sandy shale, showing oil and gas	
OG	205	3370	3392	22	brown sandy shale, showing oil and gas	
OG	205	3392	3438	46	hard geay lime, showing oil and gas	
OG	205	3438	3448	10	red sandstone, showing oil and gas	
OG	205	3448	3460	12	brown gray shale, showing oil and gas	
OG	205	3460	3471	11	hard gray sandy lime heavily sat.	
OG	205	3471	3477	6	red sandstone softer	
OG	205	3477	3488	11	red sandy lime heavily sat.	
OG	205	3488	3507	19	hard red sandy lime heavily sat.	
OG	205	3507	3547	40	hard red sandstone, heavily sat.	
OG	205	3547	3572	25	very tough rubbery brown shale	
OG	205	3572	3586	14	very tough rubbery brown shale	
OG	205	3586	3815	229	report mislayed, formation brown shale lime	
OG	205	3815	3865	50	reddish brown shale	
OG	205	3865	3872	7	hard brown lime	
OG	205	3872	3879	7	red sandstone little water break	
OG	205	3879	3990	111	red shale	
OG	205	3990	4050	60	red sandy shale	
OG	205	4050	4060	10	"red water s and break"	
OG	205	4060	4102	42	hard brown grayish sandy lime	
OG	205	4102	4106	4	brown shale	
OG	205	4106	4109	3	red sandstone	
OG	205	4109	4130	21	light brown sandy shale	
OG	205	4130	4152	22	brown sandstone	
OG	205	4152	4160	8	red sandstone some water	
OG	205	4160	4170	10	red sandy shale	
OG	205	4170	4195	25	hard brownish gray sandstone showing oil	
OG	205	4195	4207	12	brown shale	
OG	205	4207	4210	3	hard brown sandstone	
OG	205	4210	4325	115	broken sandstone	
OG	205	4325	4500	175	brown sand at 4400 lots black grease; might be water (from 02-05SAMP.tif - BFG)	
OG	205	4500	4570	70	light brown sandstone	
OG	205	4570	4692	122	light broken sandstone	
OG	205	4692	4700	8	gray broken sandstone, showing more oil, gas	
OG	205	4700	4727	27	brown broken sandstone	
OG	205	4727	4743	16	brown sandstone	
OG	205	4743	4765	22	broken brown sandstone, gas burns	
OG	205	4765	4798	33	red sandy shale, more oil and gas	
OG	205	4798	4820	22	brown sandstone more oil and gas	
OG	205	4820	4855	35	hard brown sandy lime, gas burns	
OG	205	4855	4890	35	reddish brown sandstone, gas burns	
OG	205	4890	4922	32	red broken sanstone, gas burns	
OG	205	4922	4950	28	brown mixed shale, caves badly	
OG	205	4950	4960	10	gray sandy lime	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
OG	205	4960	4986	26	blue and gray mixed shale gas burns more	
OG	205	4986	4990	4	gray sandy lime broken, some shale, gas burns	
OG	205	4990	5016	26	broken lime shale, mixed.	
OG	205	5016	5030	14	shale and cong	
OG	205	5030	5080	50	light brown lime	
OG	205	5080	5093	13	brown shale	
OG	205	5093	5096	3	hard shell	
OG	205	5096	5110	14	brown and grey sandy lime	
OG	205	5110	5126	16	hard gray sandy lime heavily sat.	
OG	205	5126	5210	84	sandy light brown shale	
OG	205	5210	5214	4	sand	
OG	205	5214	5250	36	sand and shale	
OG	205	5250	5255	5	lime with salt water that raised 350'	
OG	205	5255	5374	119	broken lime shale, mixed.	
OG	205	5374	5400	26	sandy lime some oil and gas	
OG	205	5400	5410	10	brown shale	
OG	205	5410	5418	8	brown shale	
OG	205	5418	5432	14	sandy lime some oil and gas	
OG	205	5432	5464	32	brown shale	
OG	205	5464	5480	16	gray broken lime	
OG	205	5480	5608	128	gray broken lime	
OG	205	5608	5662	54	gray broken hard lime	
OG	205	5662	5667	5	hard gray lime	
OG	205	5667	5669	2	reddish gray sand	
OG	205	5669	5680	11	gray broken lime shale	
OG	205	5680	5695	15	brown lime and shale	
OG	205	5695	5738	43	gray lime broken a little	
OG	205	5738	5780	42	gray reddish sand mixed	
OG	205	5780	5795	15	hard gray sandy lime	
OG	205	5795	5830	35	broken sandy lime shale	
OG	205	5830	5832	2	light brown sandy lime	
OG	205	5832	5905	73	hard sandy lime	
OG	205	5905	5908	3	gray water sand w/gas and good oil showing	
OG	205	5908	5996	88	hard sandy lime	
OG	205	5996	6000	4	broken streak of shale	
OG	205	6000	6012	12	hard sandy lime	
OG	205	6012	6014	2	broken streak, soft streak of shale	
OG	205	6014	6040	26	hard brown sandy lime	
OG	205	6040	6042	2	hard brown sandy lime, softer	
OG	205	6042	6050	8	hard sandy lime	
OG	205	6050	6052	2	hard sandy lime	
OG	205	6052	6100	48	hard sandy lime	
OG	205	6100	6135	35	hard sandy lime	
OG	205	6135	6147	12	broken formation, shale	
OG	205	6147	6184	37	hard sandy lime and conglomerate	
OG	205	6184	6186	2	hard gray sandy lime	
OG	205	6186	6197	11	hard sandy lime and conglomerate	
OG	205	6197	6200	3	brown shale	
OG	205	6200	6212	12	hard sandy lime and conglomerate	
OG	205	6212	6214	2	hard sandy lime	
OG	205	6214	6650	436	hard gray sandy lime some conglomerate, just into white fossilized lime with gas increasing	
OG	205	6650	6651	1	porous sandy formation carrying salty water very hard fossilized lime capping carrying little gas and oil.	
OG	206	0	65	65	soil and clay	
OG	206	65	70	5	clay	
OG	206	70	145	75	sand and gravel; water raising to within 65 feet of surface	
OG	206	145	575	430	blue clay and ahale foul water	
OG	206	575	576	1	fine sand small flow of water to surface	
OG	206	576	660	84	joint clay, grey	
OG	206	660	662	2	fine sand small flow of water to surface	
OG	206	662	700	38	yellow clay with caliche pebbles	
OG	206	700	705	5	coarse sand	
OG	206	705	770	65	caliche and clay	
OG	206	770	778	8	coarse sand, no water	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
OG	206	778	845	67	hard clay and conglomerate	
OG	206	845	860	15	coarse sand flowing 125 gpm	
OG	206	860	1728	868	unknown. Basin fill (BFG).	See Harris (1997) p.47. for details.
OG	206	1728	1955	227	conglomerate composed of volcanic, ch [?] pebble fragments, earthy and san, fine to med., sub-[round to round], and some coarse; traces igneous rocks.	Well log in AZGS files recoverd log below 1728 feet. Geologists logs unabbreviated partially by BFG. Remaining abbreviations unknown.
OG	206	1955	1990	35	Igneous rock.	
OG	206	1990	2060	70	Ch conglomerate w/some ss & cons[olidated] igneous rock	
OG	206	2060	2065	5	Sand as above with some ch	
OG	206	2065	2280	215	Volcanic ch with consolidated igneous material	
OG	206	2280	2290	10	Mostly sand	
OG	206	2290	2515	225	Conglomerate of mostly ch, vcl, and cons sd	
OG	206	2515	2558	43	Mostly sand	
OG	206	2558	2750	192	Vcl ch and igneous rock, some sand	
OG	206	2750	3748	998	igneous rock and minerals. Top of cement plug at 3700.	"Northrup (NMBM) B/Val Fill 3748'" noted.
OG	206	3748	4095	347	Consolidated, fine grained ignous rock. Some very fine to fine sand and porous igneous rock noted. Consolidated white quartz noted.	Descriptions here correlate with Harris (1997) regarding depth of core at 4,100ft (felsite).
OG	0213	0	404	404	valley fill.	from Harris 1997. Reinterpreted depths by BFG.
OG	0213	404	460	56	Drilling in hard sand	
OG	0213	460	520	60	"heavy showings of oil and gas". From 360' encountered 23 gas pockets.	
OG	0213	520	650	130	drilling for 6.25 casing	
OG	0213	650	700	50	passed from thick bed of conglomerate into sandy limestone. Gas and "cats eyes showings" encountered.	
OG	0213	700	850	150	In conglomerate, bottom of conglomerate encountered below above ls.	
OG	0213	850	930	80	In sandy hard limestone with stratas of hard shale.	
OG	0213	930	990	60	In lime conglomerate.	
OG	214	0	61	61	grey clay	
OG	214	61	68	7	light brown clay, some pebbles	
OG	214	68	78	10	light brown clay, some pebbles	
OG	214	78	88	10	brown clay some gravel	
OG	214	88	98	10	gravel showingcaliche	
OG	214	98	102	4	caliche	
OG	214	102	110	8	grey clay	
OG	214	110	323	213	blue clay	
OG	214	323	372	49	grey clay	
OG	214	372	375	3	sand and some water	
OG	214	375	384	9	blue clay	
OG	214	384	394	10	grey clay	
OG	214	394	420	26	brown clay	
OG	214	420	571	151	yellow clay showing some gravel	
OG	214	571	574	3	sand, second flow to the top; guage about 4 lbs test. Buckey test 10 gpm.	
OG	214	574	584	10	first showing of oil in brown sand	
OG	214	584	591	7	yellow clay	
OG	214	591	640	49	yellow clay	
OG	214	640	650	10	yellow clay showing some sand	
OG	214	650	657	7	yellow sticky clay	
OG	214	657	667	10	yellow sticky clay	
OG	214	667	668	1	sand showing some black shale, light flow to the surface	
OG	214	668	683	15	yellow clay	
OG	214	683	693	10	water sand, small flow	
OG	214	693	698	5	yellow clay	
OG	214	698	706	8	grey clay	
OG	214	706	714	8	grey clay	
OG	214	714	716	2	dry water sand	
OG	214	716	721	5	yellow sticky clay	
OG	214	721	726	5	sand, small flow	
OG	214	726	731	5	medium hard grey clay	
OG	214	731	747	16	yellow sticky clay	
OG	214	747	752	5	small flow	
OG	214	752	775	23	yellow clay	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
OG	214	775	779	4	dry water sand	
OG	214	779	796	17	yellow clay	
OG	214	796	816	20	yellow clay showing brown sand (oil showing)	
OG	214	816	818	2	some sand showing gravel	
OG	214	818	833	15	yellow clay	
OG	214	833	845	12	dry sand very hard, no water	
OG	214	845	852	7	yellow sticky clay	
OG	214	852	857	5	yellow clay and sand, no water	
OG	214	857	882	25	yellow sticky clay	
OG	214	882	885	3	flow to the surface, 8 gpm	
OG	214	885	908	23	sand no water	
OG	214	908	923	15	sand	
OG	214	923	928	5	sand and gravel	
OG	214	928	1007	79	sand	
OG	214	1007	1012	5	sand, gravel, some red clay and sand	
OG	214	1012	1020	8	some sand showing blue clay	
OG	214	1020	1034	14	granite sand	
OG	214	1034	1091	57	sand	
OG	214	1091	1212	121	red clay some gravel	
OG	214	1212	1243	31	dry sand	
OG	214	1243	1253	10	blue clay and some sand	
OG	214	1253	1293	40	yellow sticky clay	
OG	214	1293	1307	14	very fine running sand	
OG	214	1307	1402	95	very fine running sand	
OG	214	1402	1405	3	grey clay	
OG	214	1405	1406	1	white lime	
OG	214	1406	1410	4	very sticky clay	
OG	214	1410	1425	15	caliche or white lime	
OG	214	1425	1460	35	fine running sand	
OG	214	1460	1468	8	sticky clay	
OG	214	1468	1550	82	fine sand	
OG	214	1550	1566	16	yellow clay	
OG	214	1566	1610	44	sand and clay showing granite and lime pebbles	
OG	214	1610	1645	35	clay and sand	
OG	214	1645	1740	95	very fine sand, some clay and fine gravel cemented together in places and sand heaved up in casing when casing was moved.	
OG	214	1740	1765	25	cemented sand and gravel up to 3 or 4 inches, coasre materal encountered	See logs for further details as logs were spliced together (BFG)
OG	214	1765	1775	10	cemented sand and clay	
OG	214	1775	1780	5	cemented gravel up to 2 inches	
OG	214	1780	1805	25	cemented sand and clay	
OG	214	1805	1810	5	cemented sand, clay and gravel up to 3/4 "	
OG	214	1810	1830	20	cemented sand, clay slightly darker than before, and more of a brown color	
OG	214	1830	1835	5	cemented sand and gravel, not much clay, gravel up to 2"	
OG	214	1835	2000	165	fine sand and clay cemented together.	
OG	218	0	2000	2000	Quaternary alluvium	unknown, have Electric Log to analyze (BFG)
OG	218	2000	2799	799	unknown	unknown, have Electric Log to analyze (BFG)
OG	218	2799	2809	10	lime	
OG	218	2809	2816	7	lime sand	
OG	218	2816	2823	7	lime	
OG	218	2823	2835	12	sandy lime (white)	
OG	218	2835	2841	6	lime	
OG	218	2841	2847	6	diatomaceous clay- mud temp = 120°	
OG	218	2847	2868	21	sandy lime	
OG	218	2868	2876	8	lime shale (white)	
OG	218	2876	2893	17	lime	
OG	218	2893	2900	7	white lime sand, hard - mud temp = 112°	
OG	218	2900	2906	6	lime	
OG	218	2906	2912	6	lime- shale	
OG	218	2912	2918	6	hard lime, white -mud temp = 120°	
OG	218	2918	2923	5	lime	
OG	218	2923	2928	5	sandy lime	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
OG	218	2928	2938	10	white lime - hard - mud temp = 120°	
OG	218	2938	2953	15	lime - mud temp = 120°	
OG	218	2953	2962	9	shale and lime (red shale at 2962, soft and sticky)	
OG	218	2962	2968	6	shale - lime	
OG	218	2968	2979	11	lime and shale- mud temp = 120°	
OG	218	2979	2983	4	lime - sand. Cuttings settle rapidly	
OG	218	2983	2996	13	lime - mud temp = 120o	
OG	218	2996	3005	9	lime and shale. Hole caving badly at 2996'	
OG	218	3005	3010	5	sandy lime	
OG	218	3010	3050	40	red sandy lime (3050, light shale)	
OG	218	3050	3059	9	red shale	
OG	218	3059	3070	11	8 -5/8 " casing - underreaming	
OG	218	3070	3075	5	red sandy shale	
OG	218	3075	3082	7	red shale	
OG	218	3082	3090	8	shale - shells	
OG	218	3090	3103	13	sandy shale - slight rainbow, 3102'.	
OG	218	3103	3109	6	brown lime hard	
OG	218	3109	3141	32	sandy lime	
OG	218	3141	3147	6	sand	
OG	218	3147	3152	5	sandy lime - hard and sharp	
OG	218	3152	3157	5	sand	
OG	218	3157	3159	2	shale	
OG	218	3159	3170	11	sand	
OG	218	3170	3180	10	brown sand	
OG	218	3180	3185	5	sandy lime	
OG	218	3185	3191	6	sand	
OG	218	3191	3219	28	red sand	
OG	218	3219	5350	2131	unknown	See gamma-neutron log for details of this interval in AZGS files.
OG	502	0	20	20	brown clay	
OG	502	20	50	30	gravel, water	
OG	502	50	450	400	brown clay	
OG	502	450	465	15	red sand, water	
OG	502	465	510	45	white lime	
OG	502	510	540	30	lime and shale	
OG	502	540	620	80	light grey sand , water (10,000 bbls/day)	
OG	502	620	667	47	lime and shale	
OG	502	667	717	50	shale	
OG	502	717	757	40	gray gravel	
OG	502	757	1197	440	gray gravel	
OG	502	1197	1247	50	brown shale	
OG	503	0	50	50	allluvium	
OG	503	50	430	380	clay	
OG	503	430	445	15	sand	
OG	503	445	590	145	white limestone	
OG	503	590	620	30	limy shale	
OG	503	620	700	80	gray sand	
OG	503	700	750	50	limy shale	
OG	503	750	805	55	blue shale	
OG	503	805	835	30	gravel	
OG	503	835	1035	200	gray shale	
OG	503	1035	1115	80	brown shale	
OG	503	1115	1135	20	blue shale	
OG	503	1135	1150	15	brown shale	
OG	503	1150	1165	15	blue shale	
OG	503	1165	1200	35	brown shale	
OG	503	1200	1235	35	sandy shale	
OG	503	1235	1255	20	blue shale	
OG	503	1255	1335	80	brown shale	
OG	503	1335	1395	60	red shale	
OG	503	1395	1435	40	sandy shale	
OG	503	1435	1515	80	brown shale	
OG	503	1515	1995	480	brown sandstone	
OG	503	1995	2005	10	gravel	
OG	503	2005	2075	70	dark brown shale	
OG	503	2075	2085	10	black sandstone	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
OG	503	2085	2210	125	brown shale	
OG	503	2210	2280	70	dark brown sandstone	
OG	503	2280	2295	15	gray shale	
OG	503	2295	2405	110	red shale	
OG	503	2405	2485	80	dark brown sandstone	
OG	503	2485	2565	80	limestone	
OG	503	2565	2595	30	sandy limestone	
OG	503	2595	2645	50	blue shale	
OG	505	0	3	3	sandy loam and clay	
OG	505	3	20	17	sand	
OG	505	20	180	160	gravel; water (18- -300, unconformity, base of alluvium; hole full of water)	
OG	505	180	300	120	red sandstone	
OG	505	300	460	160	gray shale	
OG	505	460	500	40	brown shale	
OG	505	500	510	10	balck shale	
OG	505	510	560	50	brown shale	
OG	505	560	656	96	gray shale	
OG	505	656	684	28	red sandstone	
OG	505	684	740	56	brown shale	
OG	505	740	835	95	gray shale	
OG	505	835	852	17	gypsum and shale	
OG	505	852	870	18	blue shale	
OG	505	870	950	80	hard shale	
OG	505	950	960	10	gray shale	
OG	505	960	1020	60	blue shale	
OG	505	1020	1270	250	brown shale	
OG	505	1270	1300	30	gravel	
OG	505	1300	1390	90	brown shale	
OG	505	1390	1392	2	limy shale	
OG	505	1392	1450	58	red shale	
OG	505	1450	1451	1	sand	
OG	505	1451	1470	19	gravel	
OG	505	1470	1522	52	red shale	
OG	505	1522	1542	20	red sandstone	
OG	505	1542	1580	38	red shale	
OG	505	1580	1625	45	red sand; well flowing 12,280 barrels water per day	
OG	505	1625	1630	5	gravel	
OG	505	1630	1645	15	red sand	
OG	505	1645	1720	75	sand ; water; flow of water increased	
OG	505	1720	1730	10	gravel	
OG	505	1730	1748	18	red sand	
OG	505	1748	1788	40	sandy shale	
OG	505	1788	1803	15	gravel	
OG	505	1803	1820	17	red shale	
OG	505	1820	1830	10	red gravel	
OG	505	1830	1880	50	red sand	
OG	505	1880	1885	5	red shale	
OG	505	1885	1897	12	gravel	
OG	505	1897	1947	50	hard red sand	
OG	505	1947	1952	5	limy shale	
OG	505	1952	2143	191	red sand	
OG	505	2143	2220	77	sand; water	
OG	505	2220	2250	30	red sand	
OG	505	2250	2305	55	red shale	
OG	505	2305	2318	13	sand; water	
OG	505	2318	2399	81	red sand	
OG	505	2399	2475	76	red shale	
OG	505	2475	2480	5	gravel	
OG	505	2480	2498	18	limy shale	
OG	505	2498	2520	22	gravel	
OG	505	2520	2575	55	red shale	
OG	505	2575	2660	85	red sand	
OG	505	2660	2690	30	red shale	
OG	505	2690	2702	12	broken sand	
OG	505	2702	2707	5	hard lime	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
OG	505	2707	2770	63	sandy shale	
OG	505	2770	2800	30	red sandstone	
OG	505	2800	2840	40	red shale	
OG	505	2840	2850	10	pink shale	
OG	505	2850	3005	155	red sandstone	
OG	505	3005	3094	89	red shale	see AMP log; different from written log. 2/3 pick made at 2,950 FT-BLS based on AMP log (BFG) in AQUAVEO log only.
OG	505	3094	3101	7	hard lime	
OG	505	3101	3140	39	sand	
OG	505	3140	3210	70	red sand; water	
OG	505	3210	3212	2	gray lime	
OG	505	3212	3247	35	red sand	
OG	505	3247	3250	3	gray lime	
OG	505	3250	3254	4	gray sand	
OG	505	3254	3258	4	gray lime	
OG	505	3258	3273	15	gray sand	
OG	505	3273	3287	14	sandy lime	
OG	505	3287	3530	243	red sandstone	
OG	505	3530	3540	10	red sand; flow of water increasedto 50,000 barrles per day	
OG	505	3540	3720	180	red sandstone	
OG	505	3720	3734	14	red sandy shale	
OG	505	3734	3738	4	gypsum	
OG	505	3738	3767	29	red sandstone	
OG	507	0	14	14	drift sand	
OG	507	14	49	35	adobe	
OG	507	49	53.5	4.5	hard, black sand	
OG	507	53.5	88.5	35	water sand; little water	
OG	507	88.5	241.5	153	gumbo and green clay	
OG	507	241.5	245.5	4	black water sand; water	
OG	507	245.5	280.5	35	grey clay, squeezes	
OG	507	280.5	343.5	63	soft sandstone	
OG	507	343.5	357.5	14	lime, blue	
OG	507	357.5	402.2	44.7	hard sand; gas and oil colours	
OG	507	402.2	432.5	30.3	green shale	
OG	507	432.5	433	0.5	lime	
OG	507	433	468	35	quicksand	
OG	507	468	468.5	0.5	lime	
OG	507	468.5	506.5	38	peat and quicksand; oil and gas showings	
OG	507	506.5	510.5	4	sandstone	
OG	507	510.5	513.5	3	black shale and selenite	
OG	507	513.5	564.5	51	green shale	
OG	507	564.5	614.5	50	blue and white shale	
OG	507	614.5	619.5	5	shale and selenite	
OG	507	619.5	638	18.5	green and brown shale	
OG	507	638	678	40	light-colored shale and selenite	
OG	507	678	705	27	green and brown shale	
OG	507	705	715	10	green and brown shale	
OG	507	715	720	5	crystalized lime; gypsum	
OG	507	720	735	15	brown and green shale	
OG	507	735	800	65	green shale	
OG	507	800	905	105	brown shale with streaks of gypsum	
OG	507	905	930	25	yellow shale; not sandy	
OG	507	930	1008	78	yellow and brown shale	
OG	507	1008	1030	22	alternate layers of dark and light brown, and yellow shale	
OG	507	1030	1035	5	brown shale; oil showings	
OG	507	1035	1042	7	lime or gypsum	
OG	507	1042	1069	27	water gravel; some water	
OG	507	1069	1084	15	brown shale and sandstone; oil showings	
OG	507	1084	1241	157	alternate layers of brown shaleand gypsum.	
OG	507	1241	1326	85	alternate layers of brown shaleand gypsum.	
OG	507	1326	1436	110	Brown sandy shale	
OG	507	1436	1444	8	hard conglomerate	
OG	507	1444	1476	32	hard rock	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
OG	507	1476	1500	24	hard conglomerate	
OG	507	1500	1503	3	coarse sand	
OG	507	1503	1516	13	conglomerate	
OG	507	1516	1519	3	fine sand	
OG	507	1519	1521	2	black sandstone	
OG	507	1521	1530	9	black sandstone	
OG	507	1530	1532	2	light sand; @ 1532- dark brown sand showing heavy in oil, and some gas	
OG	509	0	40	40	sand	
OG	509	40	120	80	sand and shale	
OG	509	120	135	15	sand shale and water	
OG	509	135	155	20	brown and blue shale	
OG	509	155	165	10	blue shale	
OG	509	165	180	15	sand and water (hole full)	
OG	509	180	205	25	brown and blue shale	
OG	509	205	215	10	water sand (hole full)	
OG	509	215	230	15	brown and blue shale	
OG	509	230	240	10	water sand (hole full)	
OG	509	240	416	176	grey shale	
OG	509	416	640	224	brown and light shale	
OG	509	640	650	10	sandy shale (salt water)	
OG	509	650	740	90	brown shale	
OG	509	740	1015	275	blue shale	
OG	509	1015	1022	7	water sand (salt water)	
OG	509	1022	1045	23	brown shale	
OG	509	1045	1078	33	brown sandy shale	
OG	509	1078	1094	16	slight sandy shale	
OG	509	1094	1096	2	shells gypsum (selenite)	
OG	509	1096	1104	8	brown shale	
OG	509	1104	1115	11	light gypsum shale	
OG	509	1115	1125	10	sand (water)	
OG	509	1125	1165	40	brown shale	
OG	509	1165	1185	20	sand (water)	
OG	509	1185	1197	12	brown shale	
OG	509	1197	1208	11	water sand (salt water)	
OG	509	1208	1212	4	blue shale	
OG	509	1212	1260	48	sand and gravel (salt water)	
OG	509	1260	1274	14	brown and green shale	
OG	509	1274	1284	10	water sand (salt water)	
OG	509	1284	1323	39	brown sandy shale	
OG	509	1323	1328	5	red clay (hot)	
OG	509	1328	1350	22	brown sandy shale	
OG	509	1350	1352	2	water sand (salt water)	
OG	509	1352	1363	11	brown shale	
OG	509	1363	1364	1	coarse water gravel (fresh artesian water at 1080')	
OG	509	1364	1369	5	fine sand (fresh artesian water at 1080')	
OG	509	1369	1405	36	coarse water sand	
OG	509	1405	1411	6	conglomerate	
OG	509	1411	1422	11	fine sand	
OG	509	1422	1477	55	sand and gravel	
OG	509	1477	1614	137	red sandstone	
OG	509	1614	1627	13	hard shells	
OG	509	1627	1647	20	brown sandstone	
OG	509	1647	1657	10	hard sand	
OG	509	1657	1675	18	hard sand	
OG	509	1675	1695	20	hard sand, coarse	
OG	509	1695	1750	55	conglomerate	
OG	509	1750	1780	30	hard rock mixed with lime	
OG	509	1780	1801	21	brown sand rock	
OG	509	1801	1806	5	very hard conglomerate	
OG	509	1806	1813	7	conglomerate	
OG	509	1813	1814	1	sandstone	
OG	509	1814	1837	23	sandstone, 6' congl. 18'	
OG	510	0	12	12	cemented gravel	
OG	510	12	42	30	quicksand	
OG	510	42	48	6	brown clay	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
OG	510	48	93	45	brown sand	
OG	510	93	103	10	sand with sandstone shells	
OG	510	103	115	12	brown sand	
OG	510	115	130	15	brown clay	
OG	510	130	136	6	hard conglomerates	
OG	510	136	155	19	fine brown sand	
OG	510	155	173	18	brown clay and boulders	
OG	510	173	193	20	cemented gravel and boulders	
OG	510	193	198	5	sandstone	
OG	510	198	206	8	gravel	
OG	510	206	253	47	sandy shale and shells	
OG	510	253	282	29	sandy shale and shells	
OG	510	282	285	3	blue shale	
OG	510	285	296	11	blue and brown shale	
OG	510	296	325	29	blue and brown shale with shells	
OG	510	325	353	28	soft shale	
OG	510	353	373	20	blue shale	
OG	510	373	382	9	hard lime shells	
OG	510	382	513	131	hard red rock; conglomerate	
OG	513	0	215	215	blue clay	
OG	513	215	265	50	coarse gravel	
OG	513	265	300	35	blue clay	
OG	513	300	350	50	blue cemented gravel	
OG	513	350	400	50	blue clay	
OG	513	400	450	50	gray-coloured clay	
OG	513	450	480	30	sandy blue clay	
OG	513	480	522	42	brown clay	
OG	513	522	565	43	gray-coloured clay	
OG	513	565	597	32	blue shale	
OG	513	597	610	13	gravel	
OG	513	610	640	30	brown shale	
OG	513	640	660	20	blue shale	
OG	513	660	670	10	brown shale	
OG	516	0	951	951	sand, silt and clay, brown overall (BFG). Some shales and silts were tuffaceous, noted later by R.M.B. (BFG)	see detailed geologists log in Harris 1997
OG	516	951	1296	345	consolidated and hard limestone with intermixed shale, sand, gypsum, calcareous, micaceous, gray to dark gray to white with traces of brown and green colors, with secondary vugular porosity. Gentle dips of 5 degrees noted in core. (BFG)	see detailed geologists log in Harris 1997
OG	517	0	28	28	clay	
OG	517	28	45	17	sand and clay	
OG	517	45	88	43	hard clay	fresh water at several horizons
OG	517	88	90	2	gravel	a little water
OG	517	90	495	405	hard clay and lime	
OG	517	495	525	30	sand	artesian flow of salt water
OG	517	525	795	270	shale, lime and clay	
OG	517	795	810	15	gravel	no water struck below 495
OG	539	0	5	5	sand soil	
OG	539	5	73	68	sandy clay	
OG	539	73	395	322	sand black with blue streaks of clay	
OG	539	395	630	235	Blue sticky clay	
OG	541	0	5	5	sandy soil	
OG	541	5	120	115	sand and clay	
OG	541	120	240	120	sand	
OG	541	240	360	120	conglomerate	
OG	541	360	400	40	brown clay and sand	
OG	541	400	1200	800	blue clay	
OG	541	1200	1300	100	blue clay and anhy - small amount salt water at 1240 ft	
OG	541	1300	1410	110	anhy and blue clay	
OG	541	1410	1525	115	anhy	
OG	541	1525	1635	110	brown shale and anhy	
OG	541	1635	1660	25	anhy	
OG	541	1660	1825	165	brown shale and anhy	
OG	541	1825	1895	70	brown sticky clay	
OG	541	1895	2140	245	grey shale and anhy	

Well Type	Well ID	From Depth (ft-bls)	To Depth (ft-bls)	Thick-ness (ft)	Material	Comments
OG	541	2140	2475	335	anhy and salt	
OG	541	2475	2685	210	anhy	
OG	541	2685	2750	65	anhy and shale	
OG	541	2750	2795	45	lime	
OG	541	2795	3150	355	lime anhy and shale	
OG	541	3150	3200	50	anhy	
OG	541	3200	3500	300	anhy and brown shale	
OG	620	0	550	550	solid rock	
OG	620	550	700	150	numerous cavities of 5' to 15' depth, some solid rock intervals	
OG	684	0	13	13	sandy fill; (0 - 1024' valley fill, Pliocene?)	
OG	684	13	16	3	sand and gravel	
OG	684	16	25	9	sand	
OG	684	25	35	10	brown clay	
OG	684	35	36	1	red clay	
OG	684	36	44	8	sand and gravel	
OG	684	44	55	11	brown clay	
OG	684	55	80	25	blueish brown clay	
OG	684	80	82	2	brown clay	
OG	684	82	96	14	blueish brown clay	
OG	684	96	105	9	brown clay	
OG	684	105	111	6	blueish brown clay	
OG	684	111	1024	913	red clay; note: ("there was also found layers of blue clay in the red clay at various places, but they were so small that they were unable to be logged.)	
OG	798	0	1800	1800	sand, siltstone, clay valley fill [111 Ranch Beds] (BFG). From Ray Harris (1997) 45-8380 cuttings: sand to fine gravel; granitic/gneissic; remarkably uniform grain size, color, and composition throughout. (samples have been washed, so no fines are present?)	Basin fill unit interpreted by BFG
OG	798	1800	4000	2200	[Sanchez] (BFG)	Basin fill unit interpreted by BFG
OG	798	4510	8230	3720	[Midnight Canyon] (BFG)	Basin fill unit interpreted by BFG
OG	798	8230	8509	279	conglomerate granite wash= Tertiary conglomerate	
OG	887	0	1200	1200	loose clay and minor gypsum deposits	Summarized by BFG
OG	887	1200	2550	1350	loose and unconsolidated sand and silty sand	Summarized by BFG

OBJECTID	SITEID	OTHERID	SITENAME	OTHERNAME	BASIN_NAME	LABEL	SOURCE	FEATURETYPE	DATE
1	3		Safford Golf Cours Well	WW#8	Safford_San_Simon	M3	Rauzi 2002	Misc Well	ND
2	505		Mary Mack	1-Mack	Safford_San_Simon	OG 5-05	Knechtel_1938	OG Well	11/30/1933
3	505		Mary Mack	1-Mack	Safford_San_Simon	OG 5-05	Hem_1950	OG Well	10/30/1940
4	505		Mary Mack	1-Mack	Safford_San_Simon	OG 5-05	Hem_1950	OG Well	10/27/1943
5	505		Mary Mack	1-Mack	Safford_San_Simon	OG 5-05	Hem_1950	OG Well	1/5/1944
6	505		Mary Mack	GA-11	Safford_San_Simon	OG 5-05	Witcher_1982	OG Well	5/8/1952
7	517		R.S.Knowles	1-Geronimo	Safford_San_Simon	OG 5-17	Knechtel_1938	OG Well	11/22/1933
8	517		R.S.Knowles	1-Geronimo	Safford_San_Simon	OG 5-17	Hem_1950	OG Well	4/24/1941
9	517		R.S.Knowles	1-Geronimo	Safford_San_Simon	OG 5-17	Hem_1950	OG Well	1/6/1944
10	798		Phillips Petroleum A1		Safford_San_Simon	OG 798	O&G Well File	OG Well	4/11/1982
11	887		Arzon Corporation 1 State		Safford_San_Simon	OG 887	O&G Well File	OG Well	7/28/1995
12	100		Spring at Terrace Scarp		Safford_San_Simon	Spring A	Hem_1950	Spring	12/1/1940
13	101		Unnamed Spring)	ADWR 2009 Map Key 19	Safford_San_Simon	Spring B	Hem_1950	Spring	8/7/1943
14	102		Seep from Terrace gravel		Safford_San_Simon	Seep	Hem_1950	Spring	11/29/1940
15	503		Gila Oil Syndicate		Safford_San_Simon	OG 5-03	Harris_2004	OG Well	12/15/2000
16	503		Gila Oil Syndicate		Safford_San_Simon	OG 5-03	Harris_2004	OG Well	12/15/2000

SITEID	WELLDEPTH_FT	LANDELEV_FT	WELLDEPTH_M	TOPSCREEN_M	BOTTOMSCREEN_M	TDS_MGL	PH	STRATIGRAPHIC_UNIT
3	2536	3068	773	ND	ND	120000	ND	UBF
505	3767	2780	1148	ND	ND	3351	ND	Unknown
505	3767	2780	1148	ND	ND	3530	ND	Unknown
505	3767	2780	1148	ND	ND	3400	ND	Unknown
505	3767	2780	1148	ND	ND	ND	ND	Unknown
505	3767	2780	1148	ND	ND	3440	7.7	Unknown
517	810	2710	247	ND	ND	14035	ND	UBF
517	810	2710	247	ND	ND	14290	ND	UBF
517	810	2710	247	ND	ND	14400	ND	UBF
798	8509	3562	2594	ND	ND	1200	ND	UBF/LBF/bedrock
887	8974	3600	2735	923	1209	2100	ND	Unknown
100	NA	2907	0	NA	NA	12760	ND	Unknown
101	NA	2740	0	NA	NA	17700	ND	Unknown
102	NA	2845	0	NA	NA	16290	ND	Unknown
503	2645	2745	806	ND	ND	5500	7.4	UBF
503	2645	2745	806	ND	ND	20000	ND	UBF

SITEID	CONDUCTIVITY	TEMP_F	TEMP_C	UTM_E	UTM_N	UTM_DATUM	REMARKS
3	ND	ND	ND	614372	3629509	Z12 NAD-83	Chloride concentration of 168,200 mg/L. No TDS. Considerable salt encrustation from 1465 to 1780 ft bls
505	ND	138	59	608061	3642477	Z12 NAD-83	
505	5920	138	59	608061	3642477	Z12 NAD-83	
505	5820	ND	ND	608061	3642477	Z12 NAD-83	
505	5830	ND	ND	608061	3642477	Z12 NAD-83	
505	5850	138	59	608061	3642477	Z12 NAD-83	
517	ND	82	28	590899	3659453	Z12 NAD-83	
517	ND	ND	ND	590899	3659453	Z12 NAD-83	
517	ND	ND	ND	590899	3659453	Z12 NAD-83	
798	ND	ND	ND	622815	3614079	Z12 NAD-83	The TDS values represent reporded Cl concentration from the mud-Log, Well File states no porosity
887	ND	ND	ND	662242	3572465	Z12 NAD-83	
100	18700	ND	ND	611564	3637447	Z12 NAD-83	Reported sample date flow = 2gpm
101	26400	ND	ND	603000	3646098	Z12 NAD-83	ADWR 2009, Map Key 19
102	23000	ND	ND	607553	3641434	Z12 NAD-83	Reported sample date flow = 1gpm
503	31000	154	67.8	600906	3648398	Z12 NAD-83	Discrete sample depths
503	ND	105	40.6	600906	3648398	Z12 NAD-83	Discrete sample depths 650 to 1025 ft depth