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Prepared in cooperation with
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Data Series 768

Introduction

The geologic framework and hydrologic characteristics of aquifers are important components for studying the nation's subsurface heterogeneity and predicting its hydraulic budgets. Detailed study of an aquifer's subsurface hydrostratigraphy is needed to understand both its geologic and hydrologic frameworks. Surface hydrostratigraphic mapping can also help characterize the spatial distribution and hydraulic connectivity of an aquifer's permeable zones. Advances in three-dimensional (3-D) mapping and modeling have also enabled geoscientists to visualize the spatial relations between the saturated and unsaturated lithologies.

This detailed study of two borehole cores, collected in 2001 on the Camp Stanley Storage Activity (CSSA) area (fig. 1), provided the foundation for revising a number of hydrostratigraphic units (HSUs) representing the middle zone of the Trinity aquifer (fig. 2). The CSSA area is a restricted military facility that encompasses approximately 4,000 acres and is located in Boerne, Texas, northwest of the city of San Antonio (fig. 1). Studying both the surface (fig. 3) and subsurface geology of the CSSA area are integral parts of a U.S. Geological Survey (USGS) project funded through the National Cooperative Geologic Mapping Program (NCGMP). This modification of hydrostratigraphic units is being applied to all subsurface data used to construct a proposed 3-D EarthVision (EV) model of the CSSA area and areas to the south and west (fig. 4).

There are multiple, and sometimes contrasting, meanings for HSUs. A HSU may imply a part of an aquifer, a select part of a groundwater or assessment model, or a geologic unit with distinct hydraulic properties. One of the reasons for this ambiguity is that a hydrostratigraphic unit is a term that never gained formal status within the stratigraphic community. The usage of hydrostratigraphic terminology is also inconsistent within the geologic community and its meanings can be divergent depending on whether surficial or bedrock geology is involved. Hydrostratigraphic unit boundaries can also be indistinct because they are not true stratigraphic contacts and may reflect lateral facies changes. For this report, a HSU is defined as a body of rock with distinct hydrologic properties (such as porosity) that is mappable (traceable) over considerable distance.

Two well sites, MW9-CC and MW5-LGR, were cored by the CSSA and logged by the USGS to depths of more than 470 and 450 feet, respectively (figs. 5 and 6). Close examination of the geophysical log for MW9-CC (designated the study's type log, fig. 5), and detailed descriptions of the core (table 1) has helped refine the hydrostratigraphy developed for the middle Trinity aquifer by Parsons Corporation, Austin, Texas. Parsons´ original designations for all HSU units are labeled in black on both geophysical logs (figs. 5 and 6), and modifications to Parsons´ hydrostratigraphic boundaries are shown in red on the MW9-CC log (fig. 5). Both in this report and in Parsons´ designations, the lower member of the Glen Rose Limestone is divided into six HSUs, designated units "A" through "F." Although Parsons divided the Bexar Shale and the Cow Creek Limestone Members of the Pearsall Formation into two HSUs, designated "A" and "B" (figs. 5 and 6), the authors saw little or no change in lithology throughout each member, and therefore, we treat the Bexar Shale and Cow Creek Limestone Members as single, undivided hydrostratigraphic units.

The core from site MW9-CC (fig. 5) contains hydrostratigraphic units assignable to the lower part of the Glen Rose Limestone (from about 15 to 326 feet). The core also includes the Bexar Shale and Cow Creek Limestone Members of the Pearsall Formation as well as the uppermost part of the Hammett Shale Member of the Pearsall Formation (fig. 2). Core from MW9-CC was slabbed, photographed, and described in detail (see table 1), and more than 100 thin-section samples were collected throughout its length. The core from site MW5-LGR contains HSUs assignable to the lower member of the Glen Rose as well as the uppermost part of the Bexar Shale (fig. 6).

In addition to identifying hydrostratigraphic units for the lower member of the Glen Rose in well MW5-LGR, 52 one-by-two-inch core plugs were collected throughout its core and sent to Weatherford Laboratories (Golden, Colorado) for helium-gas-injection porosity analyses (fig. 6 and table 2). Porosity values for the lower Glen Rose range from as low as 6.0 percent to as high as 30.2 percent with a mean porosity value of 17.8 percent. The helium-injection porosity values and porosity estimates from neutron geophysical logs (table 3) can be used to construct a future 3-D EV property model for the area encompassed by figure 4.

References Cited

Barker, R.A., and Ardis, A.F.,1996, Hydrogeologic framework of the Edwards-Trinity aquifer system, west-central Texas: U.S. Geological Survey Professional Paper 1421–B, 61 p.

Clark, A.R., Blome, C.D., and Faith, J.R., 2009, Map showing the geology and hydrostratigraphy of the Edwards aquifer catchment area, northern Bexar County, south-central Texas: U.S. Geological Survey Open-File Report 2009–1008, 24 p., 1 pl.

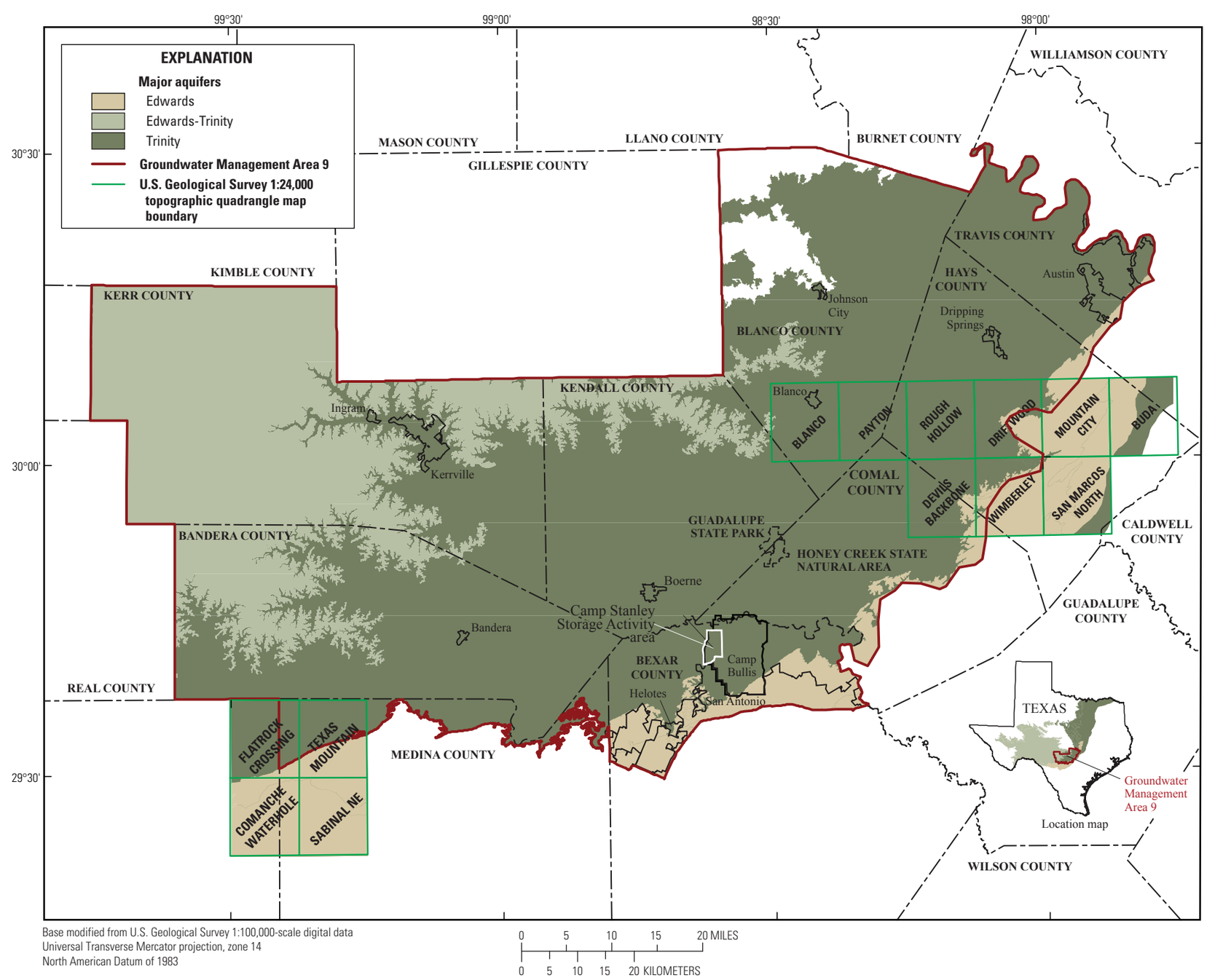


Figure 1. Map of the various study areas encompassed by the USGS National Cooperative Geologic Mapping Program's project entitled "Framework Geology of Mid-Continent Carbonate Aquifers." The quadrangles outlined in the eastern and southern parts of the figure are proposed to be mapped over the life of the project.

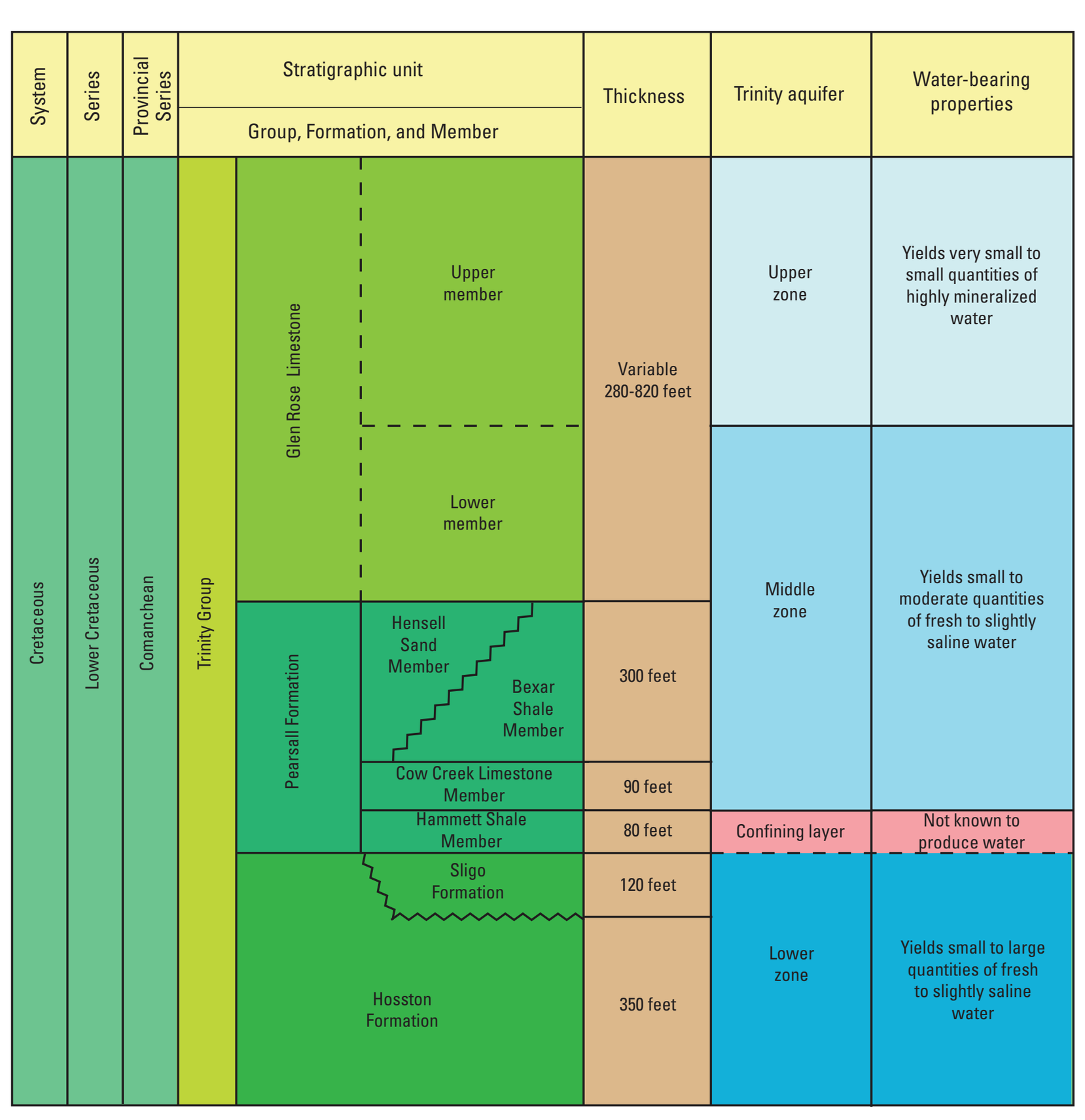


Figure 2. Lithostratigraphy of the Trinity aquifer in northern Bexar County, Texas (modified from Barker and Ardis, 1996).

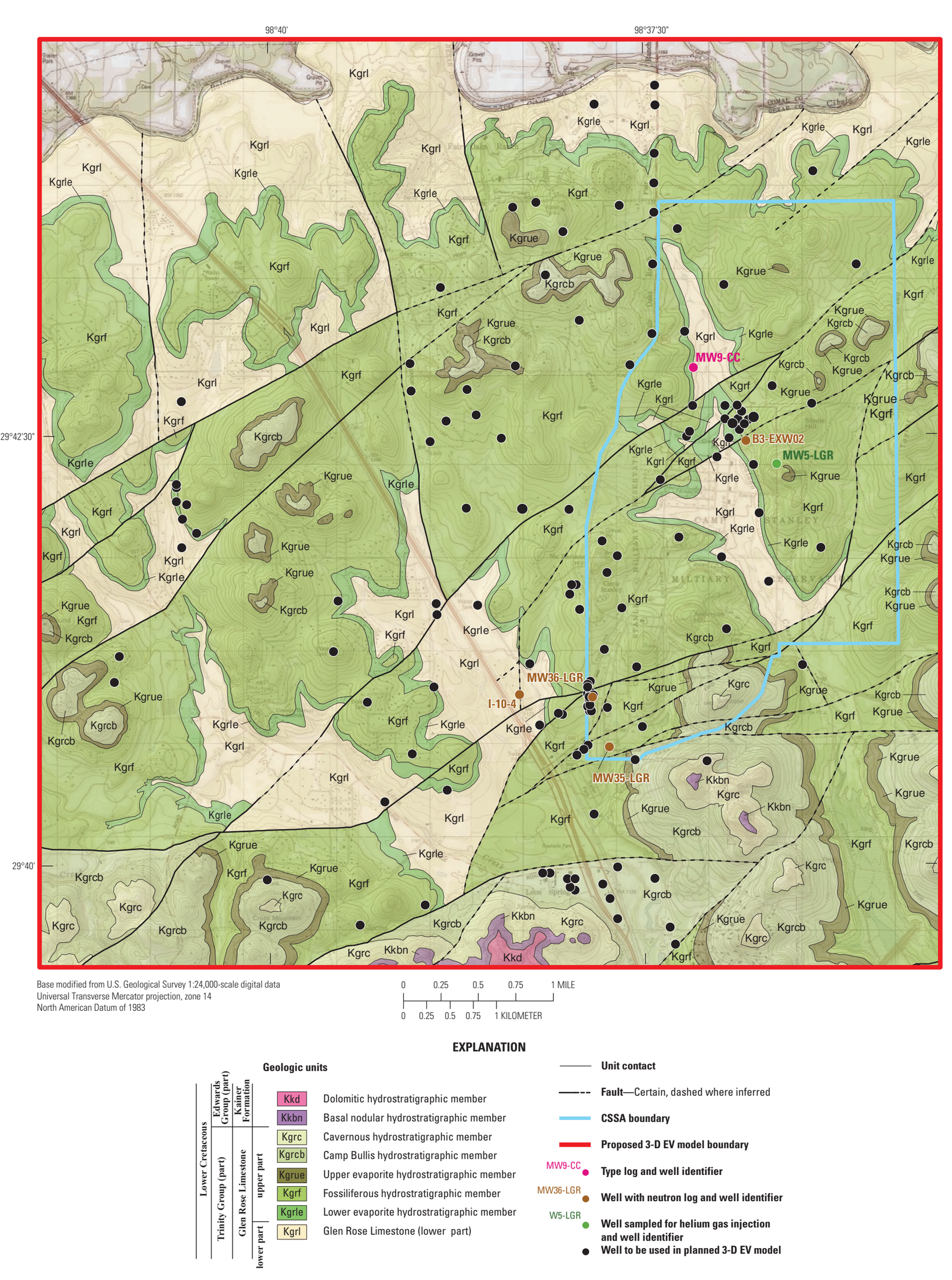
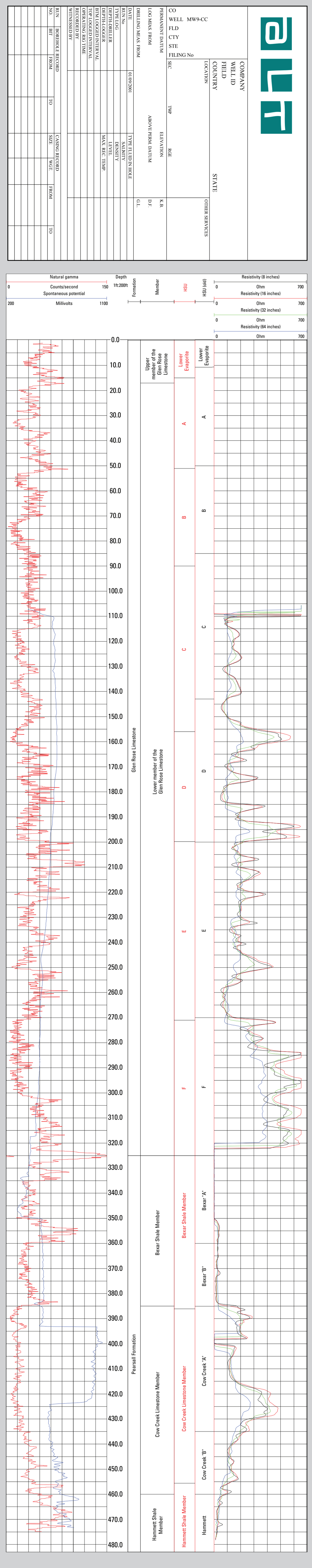


Figure 3. Map showing lithostratigraphic and hydrostratigraphic units of the Camp Stanley Storage Activity (CSSA) area and areas south and west (modified from Clark and others, 2009). Red outline represents the proposed area encompassed by an ongoing three-dimensional (3-D) EarthVision (EV) model.

Figure 5. Geophysical log for well MW9-CC. HSU, hydrostratigraphic unit.



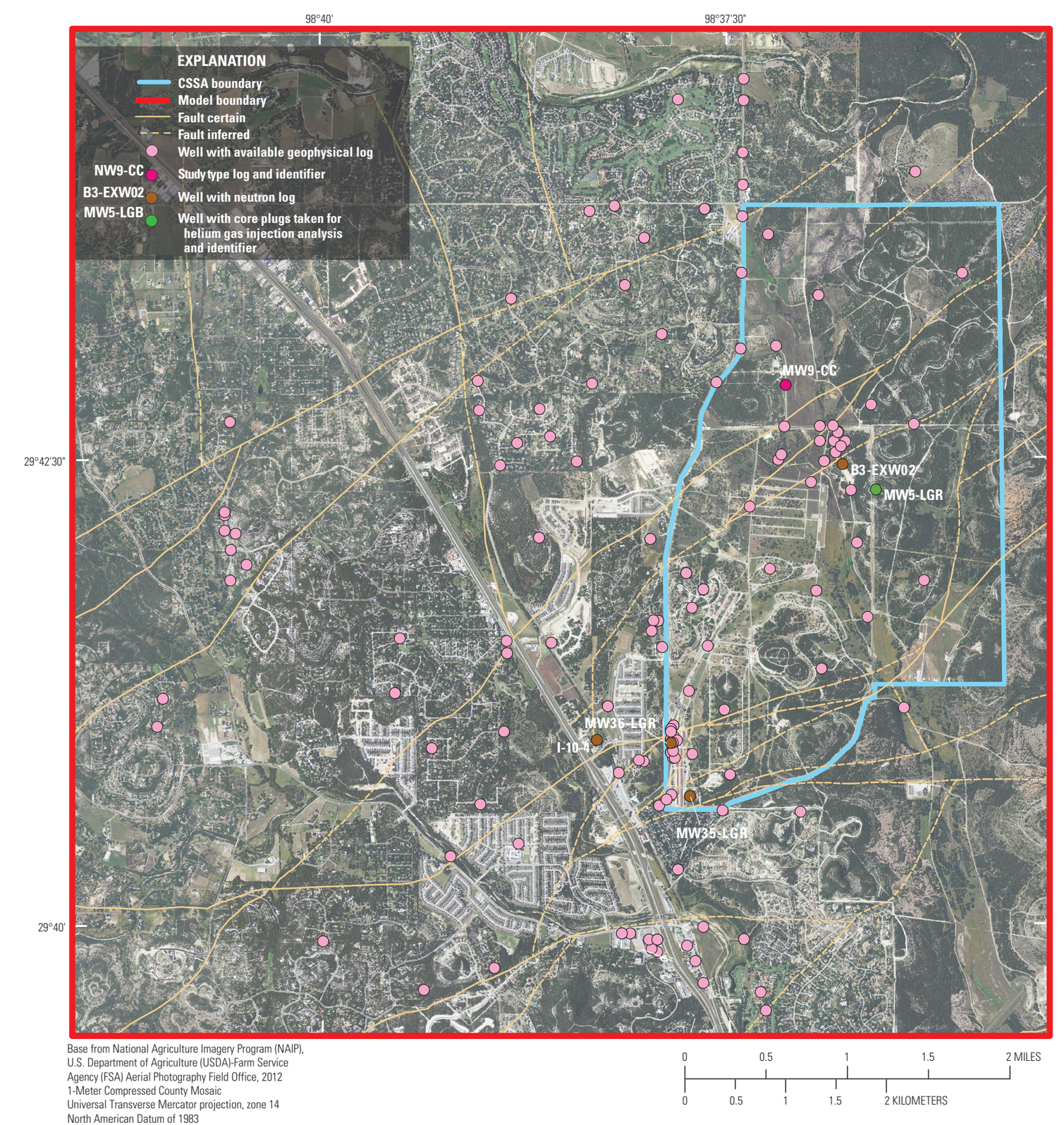
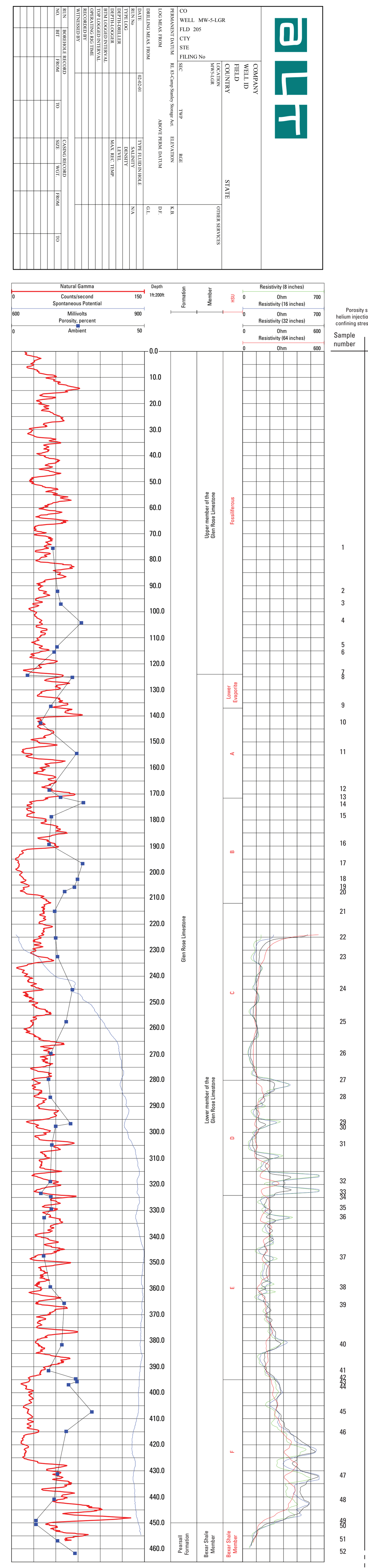


Figure 4. Map showing the downhole wells and planned area encompassed by an ongoing three-dimensional EarthVision model of the Camp Stanley Storage Activity area and areas south and west.

Table 1. Detailed description of core from well MW9-CC.

	Feet	
upper mbr., Glen Rose Ls.	0–4.0	Some organics, silty loam; small, fragile roots
	4.0–15.0	Missing section
	15.0	Contact between the upper and lower Glen Rose Limestone, possibly *Corbula* sp. found
HSU A	15.0–15.3	Some shale, mostly micritic; *Orbitalina* sp., possible *Corbula* sp.; limestone; microporosity
	15.3–17.8	Shale with occasional fossil fragments, *Orbitalina texana*; grades uphole; becoming more micritic with poorly sorted lithic fragments; some highly angular
	17.8–18.0	Vug porosity; evaporite layer; thin-section taken
	18.0–24.3	Loss of shale; yellowish-tan color to light-tan micrite; dolomitic; changing to microvug porosity at 24.3 feet to moldic porosity with abundant large vugs
	24.3	*Salenia* Zone, echinoid rich
	24.5–28.6	Biomicrite, yellowish-tan color, abundant laminae at base; highly calcareous, increasing to pure micrite. Shale increasing up-section to the point of no shell fragments
	28.6–30.15	Shale, dark gray, soft, no shell fragments at base, increasing fragments to 30.15 feet
	30.15–32.1	Some color change; less mud; lighter in color; not much change in lithology
	32.1–35.4	Beginning of microvug porosity; rip-up clasts more angular; water dries off of surface quicker; microporosity increases downhole to extremely porous, does not hold water
	35.4–36.0	Micrite; some fossil fragments, larger oyster fragments; laminae poorly developed; no porosity; rip-up clasts small, containing different color micrite
	36.0–36.4	Missing section
	36.4–37.0	Increasing rip-up clasts, small in size, minor with alternating grain size in shell fragments, weak laminae, calcareous
	37.0–38.8	Shale content increasing; appearance of laminae; alternating laminae with finer/coarser grains; some laminae spar-filled
	38.8–39.0	Approximately 0.2-ft transition to gray micrite with little porosity and skeletal elements
	39.0–41.8	Micrite with sparse fossil fragments; very few microvugs; mottled appearance
	41.8–43.3	Moldic porosity; micro-vug porosity; abundant shell debris; biomicrite, calcareous, many of the vugs filled with spar
	43.3	Biomicrite, beginning of fossil debris, abundant fossils
	43.3–44.0	Mostly clay with increasing micrite downhole; yellow wisps, tan color
	44.0–45.7	Gray clay with lots of spar and calcite
	45.7–46.3	Missing section
	46.3–51.1	Medium-gray micrite; shaley, with stringers; sporadic fossils; very calcareous
	51.1	Contact between HSU A and B; gradational contact of about 0.2 inch between the lighter biomicrite and the gray shale
HSU B	51.1–54.0	Similar lithology with increasing clay content as you near the contact between HSU A and B at 51.1 feet; light gray with darker gray burrow structures
	54.0–56.0	Similar lithology; some fossils and vug porosity; small molds with spar; yellow near top of section
	56.0–57.0	Pure tan micrite; no porosity; no fossils; chalky; highly calcareous
	57.0–59.4	Light tan, calcareous micrite; abundant shell fragments; vug or intercrystalline porosity; some stylolites
	59.4–60.0	Micrite with shale; fossil fragments; no porosity; compaction features; styolitic laminae; fracturing
	60.0–61.9	Good moldic porosity; micrite; fossil fragments; orange spots between 61.9-64.5 feet; light-gray to light-tan biomicrite; abundant fossil fragments; small vug porosity
	61.9–62.8	Boring-fill with fenestrella-type bryozoans
	63.0	Lense with bryozoans and the bivalve *Corbula* sp.(?); light gray with blue tinge, biomicritic, limestone
	64.5–65.2	Gray micrite with shale, occasional shale fragments; mottled appearance; sporadic fossils
	65.2	Moldic porosity stops
	65.2–66.3	Gray micrite with little to no shale
	66.3–69.4	Shale break; yellowish micrite becomes gray; shale rip-up clasts; no porosity; shell fragments scarce
	69.4–72.5	Yellowish micrite; minor moldic porosity; shaley from 70.5-71.5 feet
	72.5–74.0	Yellowish-tan, mottled, micritic limestone; small vug and intercrystalline porosity; whole oyster shells
	74.0–75.9	Yellowish-tan, mottled micrite; occasional fossil fragments; sparse intercrystalline porosity
	75.9–78.0	Yellowish-tan micrite; large shell fragments; moldic porosity; oyster shells; vug/intercrystalline porosity; some molds contain spar crystals
	78.0–78.9	Yellowish-tan micrite; orange stringers running horizontally through core; few shell fragments; no apparent porosity
	78.9–80.0	Same as above with shaley stringers
	80.0–85.0	Light-tan biomicrite; original shell material; some moldic porosity; high density of vug/intercrystalline porosity; spar in-fills in some of the fossil molds
	85.0–86.2	Light-tan biomicrite; small vug porosity; some moldic porosity; shell fragments; some molds appear to be filled with oolitic limestone
	86.2–90.0	Light-tan micrite, few fossils, very little vug porosity; shale increasing with depth; subsurface contact between the upper and lower members of the Glen Rose Limestone
	90.0	Contact between HSU B and C
HSU C	90.0–114.9	Light-tan micrite; few fossils; very little vug porosity; shale increasing with depth
	114.9–123.0	Light-tan micrite; few fossils; very little vug porosity
	123–132	Tan-micritic limestone; appears chalky; few fossils; little vug porosity
	132–143.3	Tan micrite; no porosity; few fossil fragments; shale increasing downhole; increase in shale from 132 to 133.5 feet
	143.3–156	Light-gray biomicrite, mottled at base around 151 feet; shaley wisps; abundant shale throughout the section from 148 to 150 feet; more shale from 143.3 to 144 feet; shell fragments; no porosity
	156	Contact between HSU C and D based on geophysical logs
HSU D	156–160	Same lithology as above; moldic porosity increases from 156.4 to157 feet; moldic porosity interconnected
	160–160.4	White; moldic porosity; large amount of vug porosity; many of the molds are in-filled with rounded carbonate clasts; shell fragments; spar totally recrystallized
	160.4–163.2	Yellowish-tan; biomicritic; limestone mottled; burrowed with larger clasts in burrows; oyster fragments; small amount of vug porosity; occasional moldic porosity
	163.2–163.9	Shell fragments increase in size up from 163.2 to 163.9 feet; whole oyster shells; vug porosity increases uphole from 163.9 feet; light-gray micrite; small moldic porosity Because some deeper parts of the core are missing, some of the descriptions cited below are from specific depths.
	163.9	Light-gray micritic limestone; small vug porosity; shell fragments; minor moldic porosity
	164.0	Light-gray micrite; shell fragments; no porosity
	166.0	Same lithology as 166 to 168 feet; with shale stringers; shell fragments less abundant; no porosity
	166.0–168.0	Light-tan biomicritic limestone; few rip-up clasts; small vug porosity; few clasts with large grains; shell fragments (not original material) and a few whole shells
	168.5	Light-gray to white biomicritic limestone; angular shell fragments; large rip-up clasts; rip-ups are composed of fine-grained micrite
	168.9	Same lithology as below with shaley wisps
	174.0	Light-gray biomicritic limestone; shell fragments (wackestone); no porosity
	174.5	Same lithology as below; some moldic porosity
	175.0	Small vugs in core, increasing in size uphole; burrows filled with grainstone (shell fragments); matrix micritic; horizontally trending burrows; burrows light gray; vugs increasing downhole
	177.7	Laminations; medium gray, shaley; some shell fragments; limestone with zone of laminations 1.3 feet thick
	180.0	Biomicritic limestone, light gray
	182.0	Darker gray limestone; contains shale (shaley partings); amorphous; no shell fragments; shaley area approximately 2 feet thick
	193.0	White; small vugs beginning and increasing downhole; angular shell fragments; biomicritic limestone
	193.5	White; small vug porosity; angular shell fragments; biomicritic limestone
	196.5	White; small vug/intercyrstalline porosity; angular shell fragments; grainstone in areas
	197.0	Same lithology as below; white biomicritic limestone; moldic porosity; some small vug porosity; limestone; shell fragments with original shell material
	199.0–199.8	White biomicritic limestone; looks like grainstone in areas; moldic porosity; original shell material; oyster shells and molds; small vugs, some open, some filled with calcite; molds interconnected in some areas
	199.8	Contact between HSU D and E
HSU E	200–262.6	This entire section is fairly consistent with white to light-gray limestone; micritic to biomicritic; some mottled areas; some soft-sediment deformation; no apparent porosity; shell fragments vary from none to abundant in areas; overall, very consistent lithologically
	262.6	Color change to lighter gray, micritic limestone (calcareous); small shell fragments abundant and angular in outline
	263.0	Micrite; dolomitic; orange wispy; light gray
	264.3	Clay bed 0.3 foot thick
	265.3–265.4	Clay bed, light to dark; tan color
	267.0–271	Mostly pure micritic limestone with dolomitic areas, light-gray to orange wisps; no areas with porosity observed
	271.0	Contact between HSU E and F
HSU F	271.0–280.0	Finer grained micritic limestone; orange wisps and dark flecks of dolomitic limestone; no areas with porosity observed
	281.0	White biomicritic limestone; corals at this level
	299.0	Biomicritic limestone, some areas with grain support; moldic porosity; gastropods abundant; white limestone; some molds filled with spar; some shell fragments; areas with sporadic grainstone; some grains appear to be fossils or ooids(?)
	302.1–324.8	White, biomicritic limestone; heavy moldic porosity; large vugs; well-developed molds; abundant gastropods; areas of grain support
	324.8–325.0	Biomicritic limestone; moldic porosity not connected; white, finely disseminated shell fragments; spar-filled shell fragments
	325.0	Lower Glen Rose Limestone and Bexar Shale Member of the Pearsall Formation contact; micritic limestone; rip-up clasts; vugs filled with spar; shell molds filled with spar; minor moldic porosity; vug-filled with clay; probably an erosional surface; vug-filling highly calcareous
Bexar Shale Member	325.0–326.5	Light-gray microspar matrix with large grains of spar; some vug-filled spar; oyster fragments increasing in size downhole; minor intercrystalline porosity
	327.9	Light-gray micritic matrix; large spar grains touching in areas; minor intercrystalline porosity; spar in-filling; some fractures; shell fragments
	329.0	Gray micritic limestone with areas of microspar; very abundant spar grains in many areas appear to be grain supported; minor moldic porosity not connected; no intercrystalline porosity; shell fragments; light-gray to white mottled
	330.0	Gray to light-gray, micritic limestone with interspersed microspar; shell fragments replaced with spar; abundant rip-up clasts; small amount of nonconnected moldic porosity
	330.3	Gray, microspar-rich limestone; oyster and other shell fragments; most fragments replaced with spar; some rip-up clasts of micrite; most molds filled with spar; some open molds; clast size and abundance increase upward; clasts mostly spar grains
	331.0	Gray-mottled, microspar-rich limestone; areas of spotty dolomitic limestone; grading into limestone at 330.3 feet; shell fragment abundance increases from 331–330.3 feet; particle size increases between 330.3 to 331.0 feet; intercrystalline porosity
	332.0	Gray mottled microspar-dolomite; small shell fragments; intercrystalline porosity; isolated larger spar grains; some moldic and small-vug porosity
	332.8	Gray mottled dolomitic clasts; microspar dolomitic limestone; soft-sediment deformation; intercrystalline porosity; particle size increases with larger grains of spar; shell fragments increase to whole shells uphole at 332.6 feet; moldic porosity to 343.2 feet
	343.2	Gray dolomite; microspar; intercrystalline porosity at this level
	343.2–343.7	Gray dolomite, microspar-rich; occasional molds; mottled with soft-sediment deformation; shell fragments
	343.7–347.0	Gray dolomite, microspar-rich; moldic porosity absent; intercrystalline porosity also decreases; mottled with soft-sediment deformation
	347.5	Moldic porosity interconnected; some oyster shell fragments
	347.5–350.0	Gray, microspar-rich dolomitic limestone; soft-sediment deformation; moldic and intercrystalline porosity; moldic porosity increases uphole; at 347.5 feet, moldic porosity is interconnected; some oyster fragments
	350.0–352.8	Gray microspar-rich, mostly dolomitic limestone; nonconnected, intercrystalline porosity; moldic porosity decreases uphole and becomes very sporadic, with some soft-sediment deformation
	354.0–354.2	Gray, microspar-rich limestone; oyster shell fragments; soft-sediment compaction and deformation; limestone grades downhole to a dolomitic limestone, with moldic porosity
	354.2–356.0	Well-developed biomicritic limestone, smaller shell fragments
	356.0–360.2	Well-developed biomicrite; smaller shell fragments
	360.2–365.5	Gray, biomicritic limestone; mostly oyster debris; poorly sorted; large shell oysters; no porosity
	365.5–374.0	Dark-gray micrite with shell debris and abundant laminae
	374.0–374.3	Petroliferous black shale; abundant shell debris; grainstone texture; same dark color
	386.1	Contact of the Cow Creek and Bexar Shale Members of the Pearsall Formation; contact contains fossil fragments with spar; intermixed with micropyrite; increasing laminations downhole; alternates with mottled, micritic areas and shale laminae to 474.3 feet. Just above the contact, Bexar Shale is petroliferous, black shale; dark gray
Cow Creek Limestone Member	386.1–395.5	Change to microporosity; minor spar, generally fine-grained microspar with minor shell debris; few styolites; porosity increases uphole to the contact of Cow Creek and Bexar Shale Members at 386.1 feet; porosity increases because of an increase in moldic porosity, which correlates with an increase in spar and intercrystalline porosity
	400.6	Lithologic change to micritic limestone; no apparent porosity; same light-buff color
	407.2	Light, buff-colored limestone; microspar-rich; inter-crystalline porosity; friable carbonate-rich sands in pockets
	409.1	Tan, microspar-rich limestone; friable; sporadic moldic and intercrystalline porosity; no fossils
	409.5	Tan, microspar-rich limestone; little to no moldic porosity; intercrystalline porosity becomes smaller and nonconnected downhole
	415.5	Microspar-rich limestone, intercrystalline porosity; few moldic pores; small voids; microporosity and moldic porosity probably the result of the interconnection of voids; limestone increases uphole to 409.5 feet
	416.0	Beginning of small-void microporosity; abundant small voids tied to the dissolution of small fossil fragments; sorted fragments all sparry
	416.0–422.2	Increasing moldic porosity; same lithology; not interconnected
	422.2–428.1	Buff-white, highly calcareous sparry limestone; oyster shells; whole original shell material; moldic porosity; intercrystalline porosity; molds filled with larger spar; smaller shell fragments
	428.1–437.6	Dolomitic limestone; moldic porosity; larger voids; appearance of megaspar; fossil fragments
	442.5	Dolomitic limestone; little to no acid fizz; recrystallized, abundant microspar; beginning of minor voids; microporosity from recrystallization of carbonate to spar; the outside of the core contains spar fragments in center of small voids.
	443.5–451.5	Light-gray, micritic limestone; occasional shell fragments; calcareous
	451.5–453.5	Oyster-rich, light-gray, micritic limestone; grading to shell hash
	453.5–455.6	Increasingly finer grained micrite, increasing shale, darker in color
	455.6	Contact between Cow Creek Limestone and Hammett Shale
Hammett Shale Member	455.6–464.6	Lighter gray, micritic limestone; shell fragments; mostly original shell material with rare spar; pelecypod and oyster fragments
	464.6–466.2	Beginning of shale partings; fine shaley mudstone, slightly calcareous
	466.2–467.2	Abrupt change to slightly petroliferous, soft mudtone; slightly calcareous; dark gray
	467.2–470.0	Transition to limestone with alternating coarse- and fine-micritic laminae
	470.0–471.7	Micritic limestone; abundant fossil fragments; occasional pyrite; classified as wackestone to grainstone
	480.0	Organic-rich, silty shale; sporadic (rare) shell fragments; grading uphole to micrite around 474.2 feet; all fragments recrystalized to spar; no voids; little to no porosity; calcareous

Figure 6. Geophysical log for well MW5-LGR. HSU, hydrostratigraphic unit; psi, pounds per square inch.



Location	Well identifier	Actual well completion	Actual well depth (ft bgs)	Logged casing depth (ft bgs)	Well diameter (inches)	Caliper	Gamma	Spontaneous potential	Normal resistivity	Fluid resistivity	Temperature	EM induction	Optical televiewer	Video	EM flowmeter	Sonic	Neutron	Gamma-gamma density
Off-post	I10-4	Cased open borehole	361	44	6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Off-post	LS-5	Cased open borehole	472	300	6	✓	✓	✓	✓	✓	✓	✓						
Off-post	LS-4	Cased open borehole	481	204	6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
On-post	MW27	PVC monitoring well	17	7	4		✓				✓	✓						
On-post	MW32	PVC monitoring well	56	26	4		✓				✓	✓						
On-post	B3-EXW02	Cased open borehole	358	65	8	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
On-post	CS-11	Cased open borehole	553	378	12.5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
On-post	MW-35-LGR	Cased open borehole	440	2	8	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
On-post	MW-36-LGR	Cased open borehole	385	2	8	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Off-post	JW-15	Cased open borehole	34	350	6	✓	✓	✓	✓	✓	✓	✓	✓					

Table 3. Recent wells drilled at the Camp Stanley Storage Activity area, including those logged with a neutron geophysical tool. On-post, within the Camp Stanley Storage Activity (CSSA); off-post, outside the area designated as the CSSA; ft bgs, feet below ground surface; EM, electromagnetic.

Weatherford LABORATORIES

SUMMARY OF ROUTINE CORE ANALYSES RESULTS
Vacuum Oven Dried at 180° F Net Confining Stress: 400 psi

USGS
MW5-LGR Well
Undisclosed Field

Undisclosed Location
File No.: CO-53459
Date: 9/9/2011

Sample Number	Sample Depth, feet	Permeability, millidarcys		Porosity, percent		Grain Density, gm/cc
		to Air	Klinkenberg	Ambient	NCS	
1	75.55	0.049	0.029	15.5	15.4	2.69
2	92.15	0.091	0.060	17.3	17.2	2.69
3	96.95	0.121	0.083	18.5	18.5	2.69
4	104.20	406.	378.	26.2	26.1	2.82
5	113.35	0.103	0.069	17.1	17.0	2.78
6	115.40	0.022	0.012	16.0	15.9	2.67
7	124.35	0.0043	0.0016	6.0	6.0	2.70
8	125.15	0.083	0.054	22.8	22.7	2.73
9	136.20	0.070	0.044	14.7	14.7	2.68
10	142.65	0.137	0.095	10.9	10.8	2.78
11	154.35	0.446	0.348	24.5	24.4	2.67
12	168.50	0.017	0.0083	14.2	14.1	2.67
13	171.20	0.095	0.062	18.4	18.4	2.72
14	173.30	1.36	1.07	27.0	26.9	2.69
15	178.70	0.082	0.053	15.0	14.9	2.69
16	189.25	0.013	0.0064	14.1	14.0	2.71
17	196.65	+		26.7		2.72
18	202.70	56.8	49.5	24.8	24.7	2.70
19	205.70	+		23.6		2.71
20	207.40	0.385	0.294	20.0	20.0	2.71
21	215.00	0.432	0.333	16.2	16.2	2.68
22	225.25	0.049	0.029	16.6	16.5	2.68
23	232.40	0.046	0.027	17.3	17.2	2.67
24	245.10	0.485	0.381	22.9	22.9	2.70
25	257.50	0.195	0.139	20.5	20.4	2.69
26	269.55	0.020	0.010	14.8	14.7	2.68
27	279.55	+		13.9		2.69
28	286.40	1.15	0.878	14.6	14.6	2.70
29	296.55	8.12	6.57	22.2	22.1	2.71
30	297.60	1.62	1.28	16.6	16.5	2.70
31	304.65	0.0091	0.0040	15.1	15.0	2.67
32	318.80	+		14.6		2.70
33	323.40	+		11.0		2.71
34	324.70	0.965	0.754	14.8	14.7	2.69
35	329.30	0.277	0.205	15.0	14.9	2.70
36	332.75	+		12.2		2.71
37	347.40	0.070	0.044	12.1	12.1	2.70
38	359.30	0.230	0.167	14.6	14.5	2.70
39	365.60	0.938	0.759	19.8	19.8	2.70
40	381.50	3.75	3.02	18.9	18.8	2.71
41	391.50	0.132	0.091	13.9	13.8	2.73
42	394.60	4.14	3.31	24.1	24.1	2.70
43	395.70	2.38	1.88	24.6	24.6	2.73
44	396.90	3.15	2.51	21.4	21.3	2.72
45	407.30	91.6	81.3	30.2	30.1	2.71
46	414.80	+		20.5		2.71
47	431.20	+		17.2		2.71
48	440.90	+		16.0		2.71
49	449.00	+		9.2		2.71
50	450.50	+		9.9		2.73
51	456.80	0.801	0.632	17.2	17.1	2.83
52	461.60	14.4	11.8	23.8	23.7	2.83
	Average values:	14.7	13.3	17.8	18.2	2.71

+ Indicates the sample is unsuitable for this type of measurement

Table 2. Helium injection porosity analyses from well MW5-LGR, Weatherford Labs, Golden, Colorado. psi, pounds per square inch; NCS, Net Confined Stress; gm/cc, grams per cubic centimeter.

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Key Subsurface Data Help to Refine Trinity Aquifer Hydrostratigraphic Units, South-Central Texas

By
Charles D. Blome and Allan K. Clark
2014