PRELIMINARY INVESTIGATION OF THE GEOLOGY AND HYDROLOGY OF THE LASKA SIDING AREA, HUDSPETH COUNTY, TEXAS

by

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CONTENTS

Figures

Plate (in pocket)

INTRODUCTION

The Bureau of Economic Geology, The University of Texas at Austin, at the request of the Texas Low-Level Radioactive Waste Disposal Authority, conducted a preliminary investigation of the geology and hydrology of the Laska Siding area in Hudspeth County, Texas. This area is being evaluated as a potential site for a low-level radioactive waste repository to be built on State-owned lands in Trans-Pecos Texas.

The Laska Siding site lies about 9 mi (14.5 km) west of the town of Sierra Blanca (fig. 1). The site was selected for this study because of the presence of previously mapped low-permeability sediments of the Hueco Bolson, its relatively low-relief topography, and the probable great thickness of the unsaturated zone in the vicinity. The site is also attractive for a repository because of its proximity and access to a major highway and a railroad.

This investigation consisted of a brief study of the geology and hydrology of the site and surrounding area. The study included a reconnaissance field evaluation of the Bolson sediments, mapped faults, and geomorphology, a review of water-level and chemistry data from Texas Water Commission (TWC) Central Records for local water wells, static water level measurement of water wells in the immediate vicinity of the site, and drilling of one test hole on the proposed site.

PREVIOUS WORK

The most comprehensive study of the region is by Albritton and Smith (1965). Berge (1981) mapped the geology of the Malone Mountains, west of the site, and

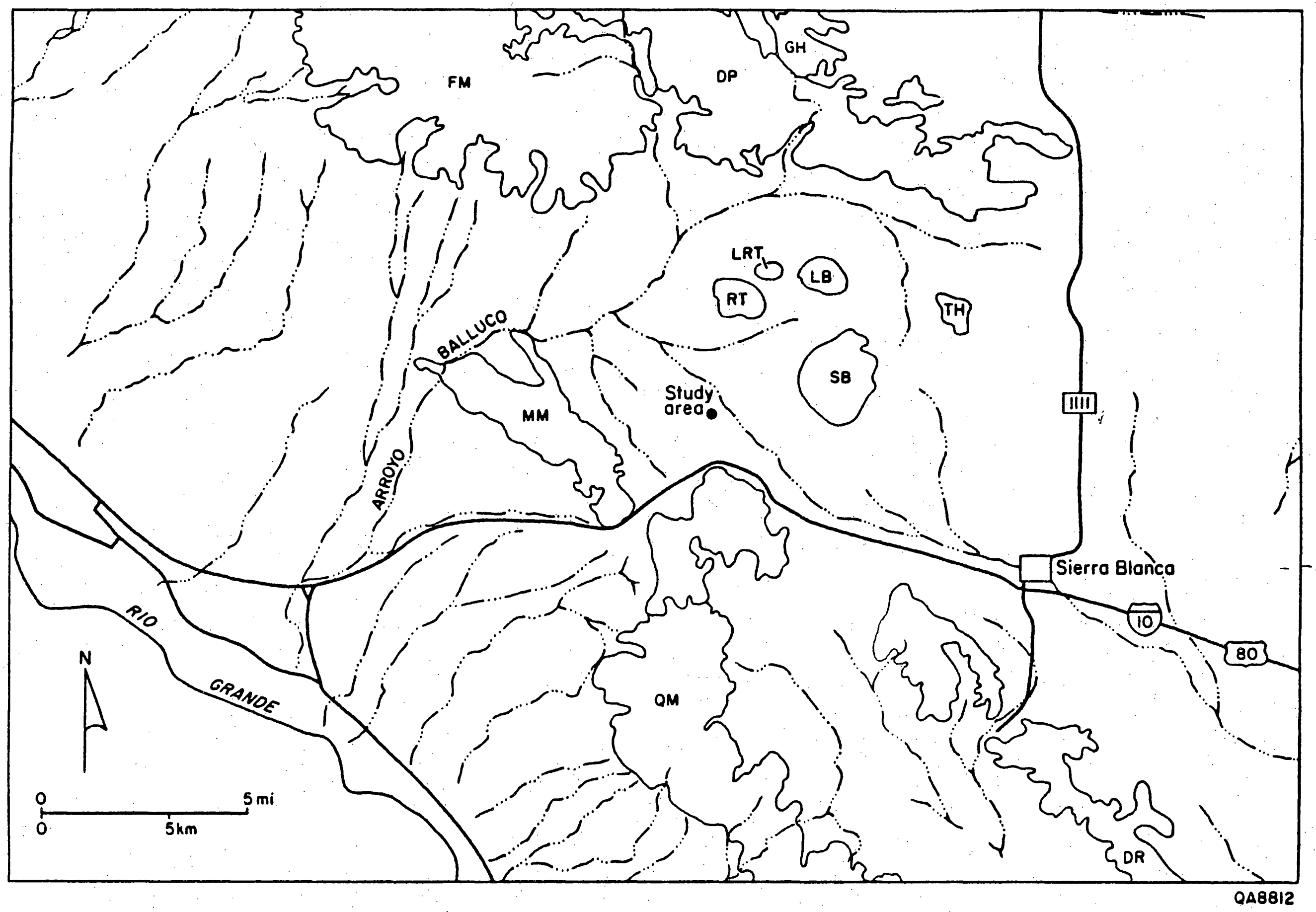

Figure 1. Physiographic setting of the Laska Siding study area. MM-Malone Mountains. QM-Quitman Mountains. RT-Round Top. LRT-Little Round Top. LB-Little Blanca. SB-Sierra Blanca. FM-Finlay Mountains. DP-Diablo Plateau. TH-Triple Hill.

Kreitler and others (1987) investigated a similar site approximately 19 mi (30.6 km) to the northwest near Fort Hancock (site S-34). Data on water wells in the vicinity of Laska Siding, in addition to data from the TWC, are from Gates and others (1980) and White and others (1980). Several other studies containing information pertinent to the understanding of the geology and hydrology of the study area include Scalapino (1950), Strain (1966, 1970, 1980), Young (1976), Henry and Price (1985), U.S. Department of Housing and Urban Development (1985), and Henry and others (1986).

DRILLING AT THE SITE

The presence or absence of impermeable bolson clays in the subsurface and their total thickness were important questions in evaluating the suitability of the Laska Siding site. One test hole (L. S. #1) was drilled (and cored where conditions permitted) to characterize the subsurface lithologies. The location of L. S. #1 is shown in figure 1. The test hole was initiated on July 12, 1987, and completed at a total depth of 240 ft (73.1 m) on July 21, 1987.

The lithologies encountered while drilling L. S. #1 are discussed in the Unsaturated Zone section of this report and illustrated in figure 2. Original plans for the test hole specified drilling through the alluvial cover (predicted to be 40 to 60 ft [12.2 to 18.3 m]), installing a temporary string of surface casing, and coring to bedrock (either Tertiary or Cretaceous). The design of the drilling program was based on mapped lithologies, observations of outcrops, and previous investigations at the S-34 site. Continuous coring was determined to be inappropriate due to a marked increase at depth in gravels and a decrease in bolson clays in the section drilled. As a result, a majority of L. S. #1 was drilled with a rock bit, and lithologic descriptions are based on cuttings and drilling characteristics.

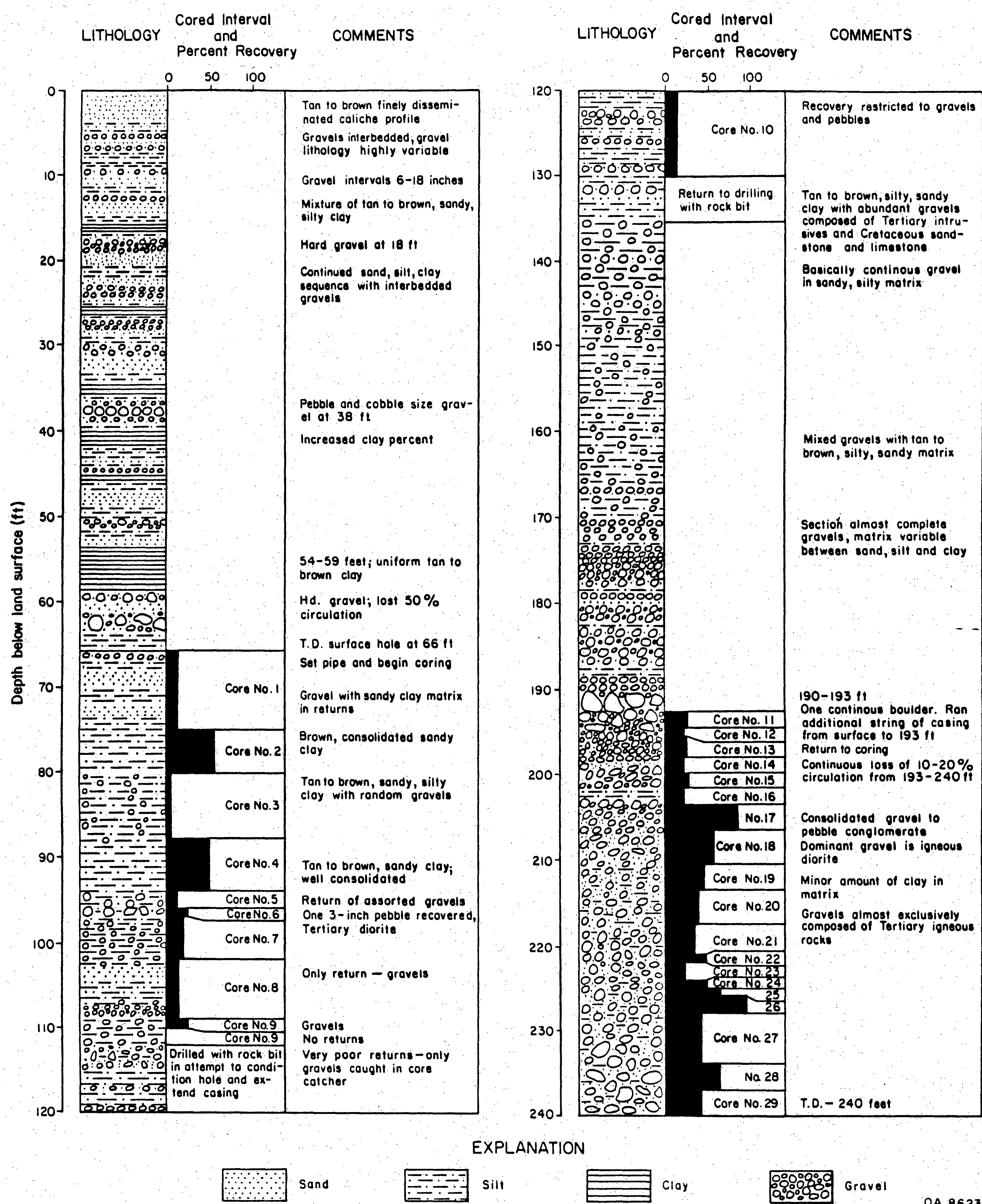

Figure 2. Lithologic log for bolson section drilled and cored at the Laska Siding site to a total depth of 240 ft (73.1 m).

GEOLOGIC SETTING

Geomorphology

The Laska Siding site is located on the low-relief surface of an alluvial fan that lies at the north end of the Quitman Mountains (figs. 1 and 3). The sands and gravels of the fan, the Balluco Gravel of Albritton and Smith (1965), have been partly dissected by intermittent desert streams. The intermittent streams drain to the northwest into Arroyo Balluco.

The Laska Siding site lies on the largest undissected remnant of the surface of the fan. This remnant has been preserved from erosion by drainages from the Quitman Mountains that divert surface waters to the northwest and southeast sides of the fan. Numerous draws are present, especially to the west of the site, that incise the surface of the fan to depths of a few meters.

Bedrock crops out in several masses that protrude through the surface of the fan, as in the Malone Hills, for example. The surfaces of these bedrock outcrops plunge steeply beneath the alluvial and bolson sediments, suggesting that the contact between the bedrock and overlying Tertiary or Quaternary sediments is irregular.

Many of the draws on the upper reaches of the fan, near the now-abandoned railroad grade, appear to be aggrading, having little evidence of recently active erosion. Although the railroad grade has been abandoned for 40 to 50 years, erosion has been minor where draws cross the railroad bed. As the drainages approach Arroyo Balluco they become more deeply incised, and tributary draws show more evidence of headward and lateral erosion. The erosive power of the intermittent streams is apparent by the recent erosion along a draw that crosses the main access road downfan from the Laska Siding site. A concrete apron was laid downstream from culverts placed beneath the road. Water flow was channeled and confined such that

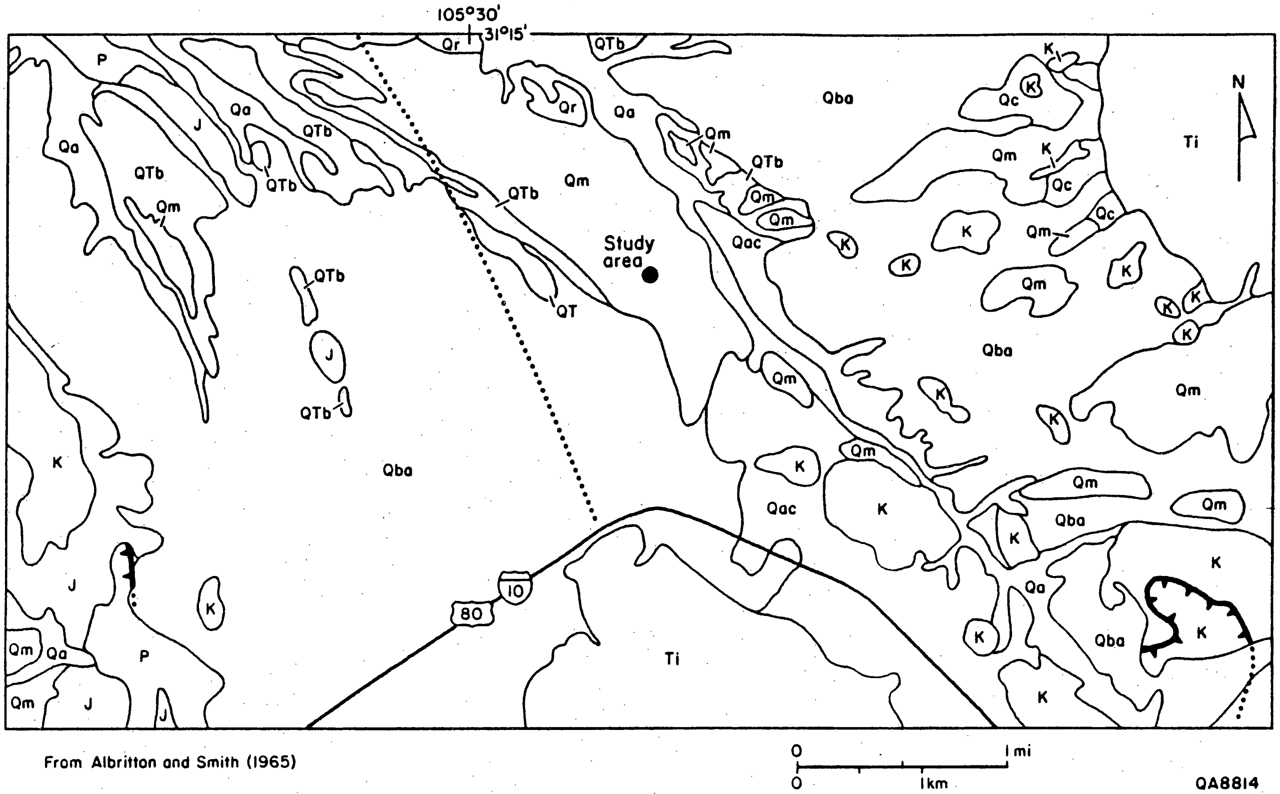

Figure 3. Geologic map of the Laska Siding study area. Qa-alluvium, Qba-Balluco Gravel, Qr-Ramey Gravel, Qm-Madden Gravel, QTb-bolson deposits, Ti-Tertiary intrusive rocks, K-Cretaceous rocks, J-Jurassic rocks, P-Permian rocks.

for more than 330 ft (100 m) the channel of the draw has been downcut by several meters. If the site is to be studied further, the rates of erosion and the potential for flooding and erosion of the site itself should be investigated in more detail.

Quaternary and Tertiary Sediments

The Laska Siding site lies in an area of extensive Tertiary and Quaternary sediments previously described by Albritton and Smith (1965) (fig. 3). Surficial deposits of Quaternary gravels (Balluco, Madden, and Ramsey Gravels) range in thickness from thin veneers at the erosional edges of the surface of the fan to as much as 40 to 50 ft (12.2 to 15.2 m) in the well-preserved central fan. The gravels are interpreted to have once formed a continuous alluvial-fan deposit with the sediments derived from nearby bedrock exposures such as those in the Sierra Blanca peaks, Quitman Mountains, Malone Mountains, and Malone Hills.

Underlying the Quaternary gravels are Quaternary to Tertiary deposits of the Hueco Bolson. The Hueco Bolson is interpreted to have been a closed basin that existed in the area of the present Rio Grande prior to its development as the major throughgoing river system of the region (Strain, 1966, 1970, 1980). The sediments deposited in the Hueco Bolson range from thick deposits of clays and silts to coarse sands and gravels. They are interpreted to have been deposited in lacustrine (playa) environments having intermittent influxes of fluvial and eolian deposits. Coarser sediments, including the alluvial-fan gravels, are most common near the margins of the basin and appear to have been locally derived. Much of the sand-size and finer sediments have been derived from source areas in New Mexico or Colorado (Strain, 1966, 1970, 1980) and may be exotic to the region.

Bolson deposits in the vicinity of the Laska Siding site are exposed in the banks of draws and in railroad cuts. In the upfan area, near the abandoned railroad grade, only about 3 ft (1 m) of bolson sediments crops out. These materials appear to be silt rich to locally clay rich and have a coarser-size fraction (fine sand to small pebbles) as a major component. Further downfan 33 to 50 ft (10 to 15 m) of Bolson sediments are exposed. The percentage of silt- and clay-rich strata tends to increase downfan from the site, but all well-exposed sections contain lenses of sand and gravel. Lenses of gravel were encountered throughout the bolson deposits penetrated by the test hole, which is in contrast to the generally gravel-free character of the bolson deposits at the S-34 site (Kreitler and others, 1987). Some of the gravel lenses present in cuts along the railroad near Arroyo Balluco are cemented (probable carbonate cement) and may have been water bearing in the past.

The coarsening of the bolson sediments near the margin of the Hueco Bolson suggests the presence of more-permeable beds. The degree to which these beds and lenses of gravel are interconnected is unknown. It appears that the deposits nearer the basin center are, in general, more clay rich and less permeable. No significant intervals of dominantly clay-rich strata were documented in this study.

The uppermost bolson sediments (basin margin) in the Laska Siding/Quitman Mountain region appear to be more than 330 ft (100 m) higher than similar bolson deposits in the basin interior near the present Rio Grande. This difference in elevations is too great to be attributed to depositional slope alone. A study of the regional area is needed to determine if this difference in elevations is primarily due to erosion related to deposition of the overlying gravels or is the result of downfaulting of the bolson sediments along unrecognized faults. Such a study would also contribute to our ability to predict the continuity of individual units within the bolson sediments.

Bedrock Units

Bedrock units present in the vicinity of the Laska Siding site range in age from Permian to Tertiary (fig. 3). The Paleozoic and Mesozoic strata are a sequence of shallow-marine carbonates and clastics exposed principally in the Malone Mountains and Malone Hills. The Tertiary rocks consist primarily of a series of igneous silicic volcanics and intrusives that have been dated at about 30 to 35 mya (Henry and others, 1986). The Tertiary rocks crop out at the north end of the Quitman Mountains and in the conical Sierra Blanca peaks north and east of the site, such as Sierra Blanca and Round Top. The intrusives are believed to be older than the basal bolson sediments. The rhyolitic rocks are known to be locally highly anomalous in thorium and uranium, and erosion and ground waters may have dispersed this radioactivity over a large area. A base-line study of the natural radioactivity, especially within the bolson sediments near any proposed site, is suggested if further work is to be done.

Structural Geology and Tectonics

The Laska Siding site lies very near the junction between the mobile belt, the Chihuahuan Trough, to the southwest, and the more stable platform, the Diablo Plateau, to the northeast. This is the classic locale of the Texas Lineament. The compressional, or perhaps transpressional, deformation of the region is related to Laramide-age tectonic events. The Laramide deformation probably ended about 40 mya, prior to the initiation of igneous activity in the region. Thrust faults and folds, indicating northeastward-directed compression and possibly left-lateral displacement related to the Texas Lineament, are well displayed in the Malone Mountains (Berge, 1981).

Basin and Range extensional deformation began about 23 mya (Henry and Price, 1986) and is believed to have initiated the formation of the Hueco Bolson. West-northwest-trending normal faults are present throughout the region and are mapped on the southwest flank of the Malone Mountains. Elsewhere in the region they are known to cut bolson sediments (Albritton and Smith, 1965; Kreitler and others, 1987), and fault scarps are present near Campo Grande Mountain to the northwest of the Laska Siding site (Kreitler and others, 1987). No faults were observed during the current investigation that displace Quaternary or Tertiary sediments. Some of the bedrock knobs near the site may be controlled by normal faults, but there is no direct field evidence to support this contention.

The trace of a major thrust fault was mapped by Albritton and Smith (1965) as passing almost directly beneath the study area. The thrust is interpreted as being the major bounding fault between the highly deformed rocks to the southwest and the little disturbed rocks to the northeast. The thrust should be of Laramide age and should not offset the Tertiary intrusives or younger sedimentary strata. The trace of the fault is not well constrained by outcrops but is shown as being cut off by the Quitman pluton (Albritton and Smith, 1965).

A traverse was made across the north flank of the Quitman pluton to evaluate the presence or absence of structural reactivation of the buried thrust since emplacement of the pluton. A series of measurements was made on joints present in the Quitman pluton in the area of the projected trace of the thrust fault. Most joints dip at moderate to very high angles, with the most common set striking nearly north-south and east-west and dipping nearly 90 degrees (fig. 4). The north-south joints appear to be related to emplacement of the pluton because they locally parallel dikes and seams of apparent feldspar alteration or textural changes in the pluton and rarely appear to control small vugs lined with quartz crystals that may have formed during late-stage cooling of the pluton. The joints have no evidence of displacement

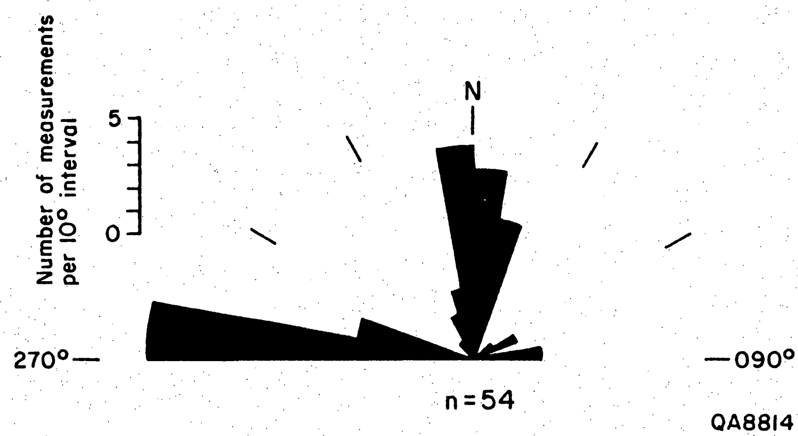

Figure 4. Rose diagram showing orientations of nearly vertical joints in the Quitman pluton quartz monzonite. n=number of measurements.

or brecciation, and no faults were observed. If the trace of the thrust is correctly mapped, there is no indication of reactivation of the structure in the Quitman pluton.

HYDROLOGIC SETTING

Surface Flow

All surface streams in this area, with the exception of the Rio Grande to the south, are ephemeral (fig. 1). The drainage is initially to the northwest but changes to the south and southwest after passing the north end of the Malone Mountains. Discharge occurs at the Rio Grande. Arroyo Balluco is the major drainage in the area of the Laska Siding site, having a drainage length from the site to final discharge in the Rio Grande of approximately 15 mi (24 km). Arroyo Balluco does not intersect any populated areas during its traverse to the Rio Grande.

The National Flood Insurance Rate Maps (FIRM) (Community-panel numbers 480361 0825 B and 480361 0950 B) designate the area at Laska Siding site as Zone C--areas of minimal flooding (fig. 5). Minor drainages to the east, west, and north of the site, however, are identified as Zone A--areas of 100-year floods; base flood elevations and flood hazard factors have not been determined. Current access from Interstate Highway 10 to the site does not cross any of the areas mapped as Zone A.

Unsaturated Zone

The thickness of the unsaturated zone in the Laska Siding region ranges from 74.7 ft (22.8 m) in well #48-44-902, 3.8 mi (6.1 km) northwest of the site, to

Figure 5. National Flood Insurance Rate Map for the Laska Siding site. Panels included in figure are #480361 0825 B and #480361 0950 B.

479.0 ft (146 m) in well #48-53-101, 1.1 mi (1.8 km) southeast of the site. Assuming no anomalies in the potentiometric surface under the Laska Siding site, the projected thickness of the unsaturated zone at the site would be about 400 to 450 ft (122 to 137 m). The unsaturated zone over the regional study area is composed of Cenozoic alluvium, colluvium, and bolson lacustrine sediments, fractured Tertiary intrusives, and Cretaceous sandstones and limestones.

No quantitative data were available concerning vertical or horizontal permeabilities of the unsaturated zone in the immediate study area. Some inferences can be made, however, as a result of previous studies in the Hueco Bolson and from observations made while drilling the test hole at the Laska Siding site. One in situ hydraulic conductivity test was conducted on the surficial Cenozoic alluvial gravels at the S-34 site. This site is also located within the Hueco Bolson. Procedures and interpretations for determination of hydraulic conductivity in the soil zone above the water table follow those described by Boersma (1965). The measured hydraulic conductivity rate for the upper 43 ft (13.1 m) at the S-34 site was 0.026 cm/hr (7.56 ft/yr [2.3 m/yr]). These rates are consistent with the expected rates for unconsolidated gravels having silts and clays as the dominant matrix, such as in the gravels present in the Laska Siding site area.

Grain sizes of the matrix throughout the entire section drilled at the Laska Siding site were observed to be significantly coarser than those at the S-34 site. While drilling a gravel section from 59 to 60 ft (16.0 to 16.2 m) at the Laska Siding site, more than 50 percent of the drilling fluids was lost to the coarse-grained formation. A similar loss in drilling fluids occurred constantly while drilling from 193 ft (58.8 m) to 240 ft (73.1 m). This inferred coarse grain size of the matrix within gravel sequences is consistent with lithologies observed in outcrop in the study area.

Bolson clays encountered at the S-34 site were thick, relatively continuous, with clay content ranging from 26 to 95 percent (based on 12 core samples selected for grain-size analysis, mean = 4.5 percent, population standard deviation = 22.1 percent). Although no grain-size analysis was performed on core recovered from L. S. #1, a distinct difference in clay content and clay interval thickness between the S-34 and L. S. #1 sections was observed. Two thin clay intervals were encountered in L. S. #1. The first clay zone was drilled from 54 to 59 ft (16.4 to 18.0 m), and the second was cored from 88 to 94 ft (26.8 to 28.6 m). These were the only clay sequences similar to those present at the S-34 site. The extent of these thin clay intervals could not be determined from available outcrops.

Saturated Zone

Primary aquifers in the study area are present within the Bluff Mesa (equivalent unit on the Diablo Plateau is the Campagrande limestone), Finlay limestones, and Cox sandstones, all of Cretaceous age. Secondary aquifers of a much more local nature include fractured Permian rocks to the northeast and water-bearing Bolson sediments randomly encountered throughout the bolson (Young, 1976; Gates and others, 1980).

Data pertaining to aquifer lithologies in the study area are limited. However, solution enhancement of fractures in carbonate units appears to enhance production capabilities when encountered. No data are available concerning the thickness of the saturated zone in the study area.

Water-bearing Characteristics

Information on the occurrence, quantity, and quality of ground water in the study area to date is limited. Regionally, the depth to water is usually greater than 500 ft

(152 m) and the water is of substandard quality for human consumption without extensive treatment. In areas where higher production rates have been encountered, solution-enhanced fractures of carbonate aquifers appear to be the controlling factor. Most wells in the area yield less than 100 gallons per minute (gpm) (378 liters per minute [lpm]). The average production rate for 21 wells reported to be producing from Cretaceous rocks is 63.7 gpm (241 lpm) with a standard deviation of 110.6 gpm (418.6 lpm). TWC records indicate that one well (#48-54-503), drilled approximately 2 mi (3.2 km) east of Sierra Blanca, produces 200 gpm (757 lpm) from the Cox sandstone, and one well (#48-45-603), drilled 9 mi (14.4 km) north of Sierra Blanca, yields 500 gpm (1,892 lpm) from the Campagrande Formation.

No pumping tests were attempted as part of this study. TWC records contain limited information concerning wells in the Sierra Blanca area. Well #48-53-803 recorded a hydraulic conductivity of 120 gallons per day per foot (gpd/ft) (454 liters per day per meter [lpd/m]) of drawdown, whereas the specific capacity of two wells, #48-45-602 and #48-45-603, was measured at 15 gallons per minute per foot (gpm/ft) (186.2 liters per minute per meter [lpm/m]) of drawdown while being produced at 210 and 500 gallons (795 and 1,892 liters), respectively.

Production capacities for wells producing from bolson or alluvial sediments are clearly controlled by grain sizes and degree of compaction within the water-bearing unit. As stated above, however, the dominant control on production capacities in water-bearing units of Cretaceous or older rocks in this area is the presence or absence of fracture and solution permeabilities. Water well #48-61-501, drilled in 1942 and located southwest of Sierra Blanca and 11.4 mi (18.3 km) south of the Laska Siding site, encountered an open cavern at a depth of approximately 400 ft (122 m). The open cavern had a vertical dimension of 20 to 25 ft (6.1 to 7.6 m). Air reportedly blew out of the borehole when the bit first penetrated the cavern. The well has produced a constant 10 to 12 gpm (37.8 to 45.4 lpm) with no reported drawdown over extended periods of production. The lithology hosting this cavern is the Finlay limestone, according to TWC records.

Potentiometric Surface

The potentiometric surface map (plate 1) is a version of Kreitler and others' (1987) figure 31 expanded to encompass a larger study area, including the Laska Siding and Sierra Blanca areas. Water-level data for water wells in the study area are presented in appendix 1. Initial observations indicate that the controls influencing the potentiometric surface in the Laska Siding - Sierra Blanca area are more complex than those observed in previous studies (Kreitler and others, 1987). Although the surface drainage in the area of Laska Siding has a final point of discharge to the south-southwest at the Rio Grande, water-level data indicate that initial ground-water flow in the vicinity of Laska Siding may not mimic topography.

As currently mapped, three scenarios exist for possible ground-water flow paths originating in the Laska Siding area: (1) Ground-water flow may be to the northeast down an extremely low-grade hydraulic gradient, with the salt flats east of the Diablo Plateau serving as the final discharge point. (2) A shorter route with basically the same direction of flow may exist, with discharge occurring in a hydraulically closed depression mapped to the east-northeast of the study area. Discharge in this area would be through water-well production because no springs are known to be present in this area. The first and second scenarios require flow through the Sierra Blanca peaks. These intrusives are fractured (C. D. Henry, personal communication, 1987), so the intrusives may not act as a hydrologic barrier. (3) Ground-water flow from the Laska Siding area is possibly toward the north-northeast until it reaches the 3,700-ft (1,128-m) potentiometric surface level. At this level, some flow may bend to the west, especially if the Sierra Blanca intrusives act as a hydrologic barrier. The flow would continue to the west around the mapped potentiometric nose approximately coincident with the northern extent of the Malone Mountains and then flow south-southwest to final discharge at the Rio Grande. Additional data would be required to determine which of the three flow directions is most probable.

As mapped in plate 1, the potentiometric surface for the Laska Siding study area is considered to be one continuous surface with the exception of the previously mapped discontinuity to the north of the site. Another possible interpretation is that two or three separate perched aquifers exist within the mapped area. Hydraulic connection between these potential shallow aquifers and the deeper regional aquifers has not been documented.

Ground-Water Geochemistry

Chemical analyses of 23 ground-water samples from the Laska Siding - Sierra Blanca area were obtained from TWC Central Records and are presented in appendix 2. No water wells were sampled for chemical or isotopic analysis as part of this study.

Ground water in the study area is fresh to brackish: total dissolved solids (TDS) range from 452 mg/L to 5,870 mg/L (fig. 6; app. 2). Within the Laska Siding study area, low TDS waters characteristically are HCO_3 waters. Water facies in the immediate vicinity of Laska Siding vary from $CaHCO_3$ to $NaHCO_3$ (figs. 7 and 8). This pattern of Ca to $NaHCO_3$ waters in an area of elevated topography as observed in the Sierra Blanca peaks, Quitman Mountains, and Malone Mountains, is an example of locally recharged waters entering the saturated zone. The dominance of HCO_3 facies may indicate a short residence time (locally recharged) for the waters

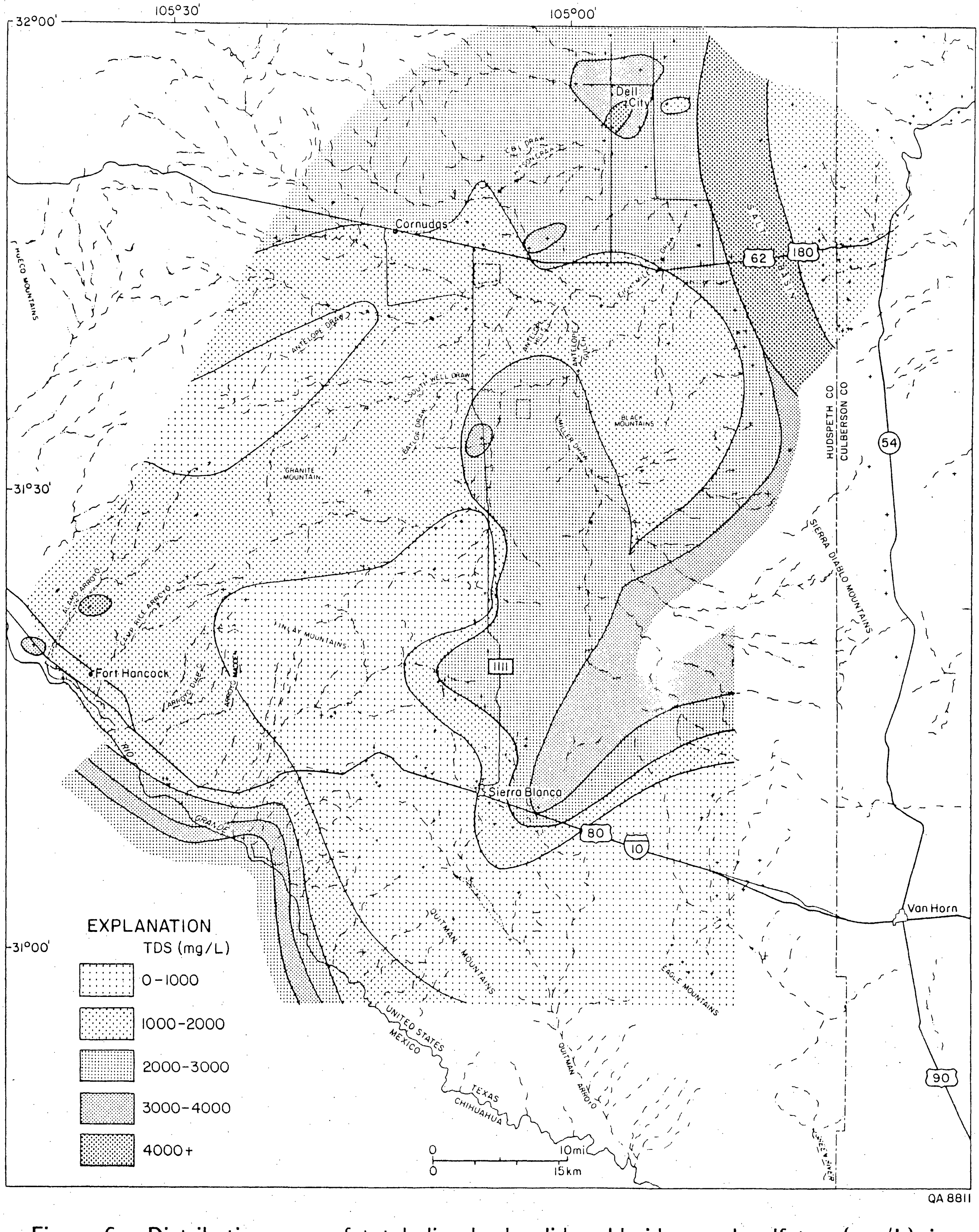

Figure 6. Distribution map of total dissolved solids, chlorides, and sulfates (mg/L) in the regional study area. Ground water in the study area is fresh to brackish.

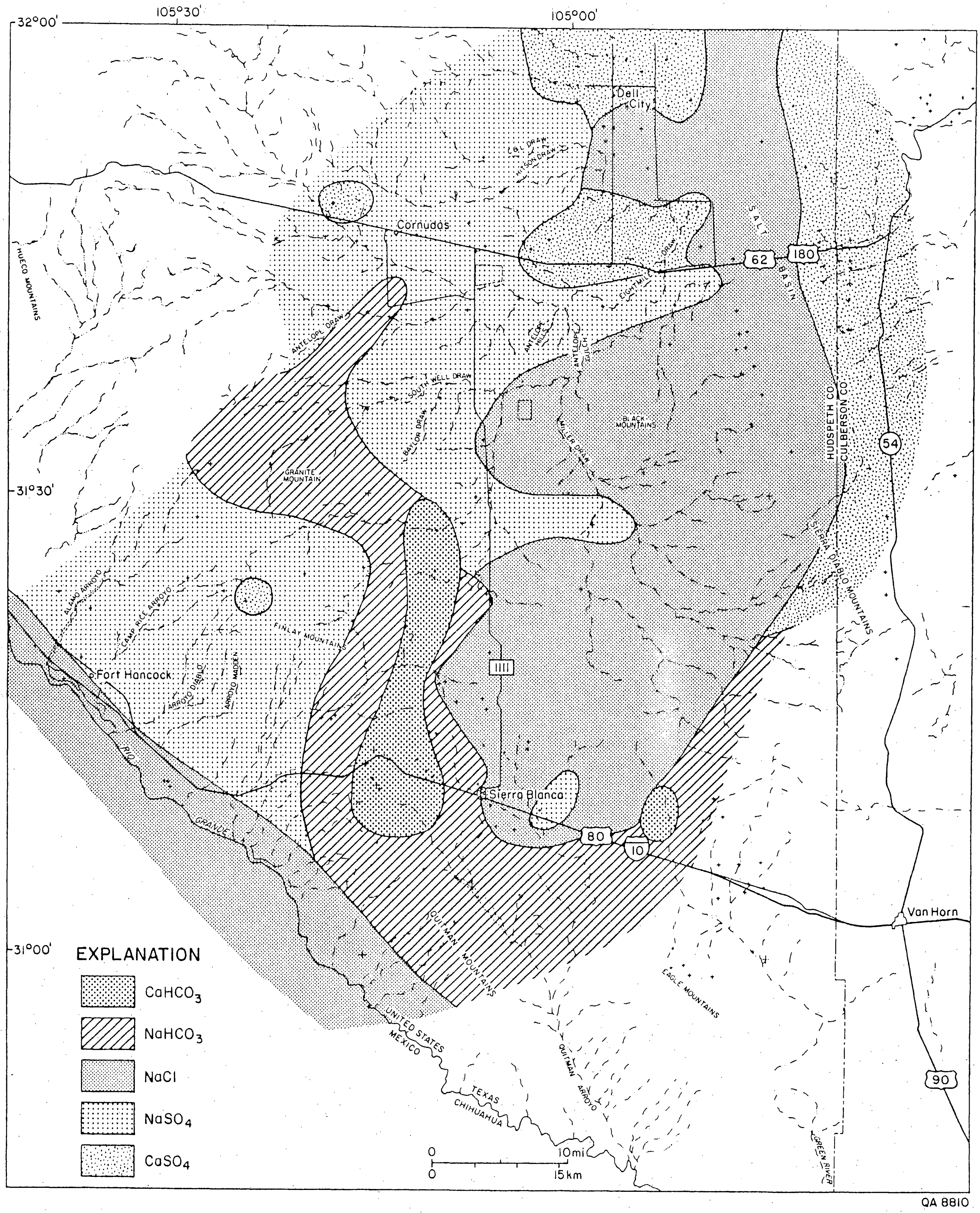

Figure 7. Chemical facies map for the regional study area. Dominant facies in the recharge areas are Ca-Na HCO_3 and in the discharge areas are NaCl.

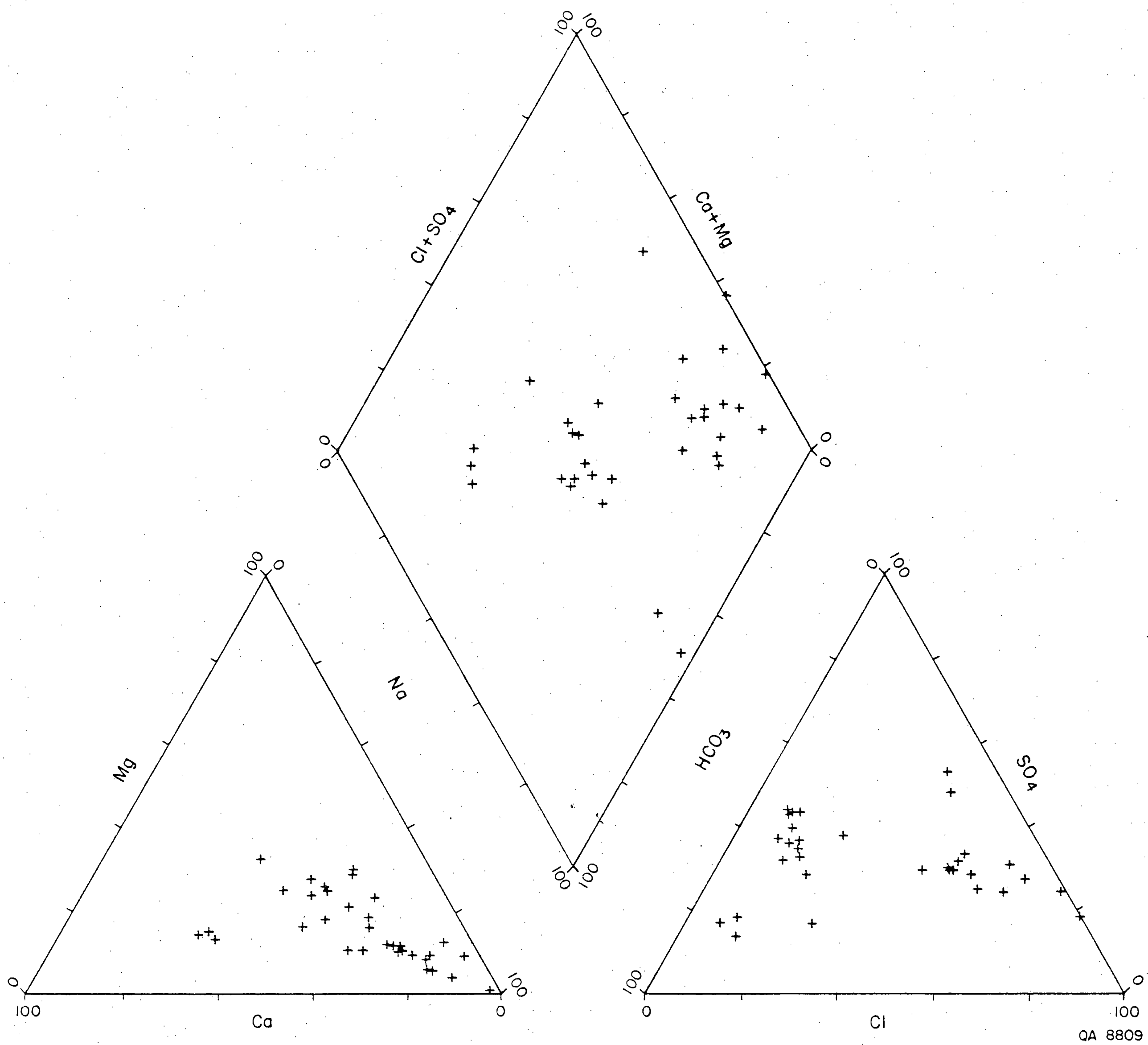

Figure 8. Piper diagram of water samples from the Laska Siding - Sierra Blanca study area.

sampled. Tritium and ^{14}C analyses of several wells in the study area are needed to define the presence and geographic extent of recharge zones.

In addition to the dominant water types described above, NaCl and $NaSO_4$ waters also were present within the general study area. Well LL263 is the only water well of the 23 wells sampled in the Laska Siding - Sierra Blanca area found to contain a $NaSO_4$ water. Several wells located on the Diablo Plateau produce $NaSO_4$ waters (Kreitler and others, 1987). The presence of $NaSO_4$ waters was attributed in Kreitler and others' (1987) study to aquifer lithologies composed of SO_4-rich and Cl-rich evaporites commonly occurring within the Permian strata.

NaCl waters were recorded in two main regions of the study area. The dominant location for NaCl type ground water both in this study and in previous investigations (Gates and others, 1980; Kreitler and others, 1987) is along the Rio Grande. One other local occurrence of NaCl waters is in the immediate vicinity of the town of Sierra Blanca. The highest TDS values recorded in this study were also found to represent NaCl type waters.

Two factors probably control both chemical facies type and TDS concentration of waters in the study area. Of the two, the more dominant would appear to be the length of residence time of the water in the saturated zone. This is evidenced by the observation that TDS concentrations and degree of chemical evolution increase as the waters move down the hydraulic gradient away from areas of ground-water recharge. The aquifer lithology also influences the chemical makeup, as occurs when waters move through highly soluble carbonate and evaporite sequences.

SUMMARY

The following hydrologic and geologic conclusions can be made about the Laska Siding site:

(1) The site is an erosional remnant of an alluvial fan that originated in the Quitman Mountains. Surface flooding would not be expected because surface flow would be contained within drainages that define the boundaries of the site.

(2) The depth to ground water beneath the site is greater than 240 ft (73.1 m), the total depth of L. S. #1. On the basis of regional investigations, depth to water at the site should be from 400 to 450 ft (122 to 137 m).

(3) Bolson deposits beneath the alluvial-fan deposits at the site are not as fine-grained as those observed at the S-34 site. The Laska Siding site may be more proximal to a sediment source than the S-34 site and therefore contain coarser gravel sediments. Clay and silt as well as sand and gravel were encountered during drilling.

(4) Regional ground-water flow may be toward the northeast or toward the west-southwest. This depends in part on whether the Sierra Blanca peaks do or do not function as a hydrologic barrier.

(5) No fault scarps were observed at the site.

(6) Although there may be a major thrust fault beneath the Laska Siding region, there does not appear to have been any fault movement after emplacement of the Tertiary pluton in the north end of the Quitman Mountains.

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Appendix 1. Records of wells and springs in Culberson and Hudspeth sites (ft).

BEG ID	Well name	TWC[1] ID	Coordinates		Ground-level elevation	Water-level depth	Water-level elevation	Total depth
CULBERSON COUNTY								
Wells: S-15 Area								
LL100	Kohen Windmill		31°40'12"	104°10'50"	3331	75	3256	80
LL101	Smilin Jack Windmill		31°40'23"	104°12'22"	3480	70	3410	140
LL104	Monument Windmill		31°38'13"	104°10'52"	3455	150	3305	200
LL119	S-15 W. Windmill		31°39'10"	104°19'02"	3712			
LL120	Philips Windmill		31°40'06"	104°14'41"	3575			
LL121	S-15 N. Windmill		31°43'55"	104°14'59"	3560			
LL001	S-15 Scott Windmill		31°41'44"	104°09'48"	3348	115	3233	200
LL002	S-15 South Windmill		31°40'04"	104°08'09"	3310	58	3252	110
Wells: S-46 Area								
LL123	S-46 Seven L. Windmill		31°44'53"	104°28'18"	4055	20	4035	
LL124	S-46 High L. Windmill		31°42'46"	104°27'46"	4265			
LL125	S-46 Cave Well		31°40'03"	104°26'23"	4108	30	4078	
Springs: S-15 area								
LL102	Rustler Spring		31°38'42"	104°13'33"	3493		3493	
LL117	S-15 W. Sp		31°41'13"	104°17'33"	3780		3780	
LL118	S-15 S. Sp		31°38'43"	104°17'25"	3680		3680	
LL122	S-15 N. WM Sp		31°44'57"	104°15'19"	3572		3572	
LL400	Spring		31°50'43"	104°14'54"	3525		3525	
LL401	Toy Springs		31°49'16"	104°09'25"	3280		3280	
LL402	Springs		31°49'10"	104°10'37"	3355		3355	
LL403	Cotton Wood Sp		31°48'26"	104°11'50"	3445		3445	
LL404	Spring		31°45'48"	104°12'37"	3460		3460	
LL405	Springs		31°44'55"	104°12'38"	3485		3485	
LL406	Springs Well		31°44'42"	104°13'07"	3485		3485	
LL407	Horseshoe Spring		31°44'20"	104°09'52"	3275		3275	
LL408	Spring		31°46'30"	104°16'10"	3600		3600	
LL409	Spring		31°45'10"	104°18'23"	3700		3700	
LL413	Springs		31°39'33"	104°12'46"	3415		3415	
Springs: S-46 Area								
LL412	Burro Spring		31°46'41"	104°28'37"	4006		4006	
LL414	Spring		31°41'20"	104°26'06"	4130		4130	
LL415	Spring		31°39'26"	104°20'38"	3720		3720	

BEG ID	Well name	TWC[1] ID	Coordinates		Ground-level elevation	Water-level depth	Water-level elevation	Total depth
HUDSPETH COUNTY								
LL106	Thaxton Spring				4,500		4,500	
LL107		48-42-1	31°22'12"	105°50'52"	3,855	335	3,550	450
LL108		48-42-404	31°18'56"	105°51'27"	3,610	90	3,520	267
LL109		48-41-618	31°17'31"	105°52'45"	3,523	10	3,513	305
LL110	Miller Feedlot	48-41-2	31°19'37"	105°54'55"	3,545	8	3,536	160
LL111		48-33-9	31°23'18"	105°53'18"	3,882	327	3,555	367
LL112	Head of Canyon Wm		31°31'42"	105°42'05"	5,059	380	4,679	720
LL113	Wilkey Well No. 1		31°23'23"	105°40'48"	4,307	600	3,707	730
LL114	Wilkey Well No. 2		31°22'48"	105°39'07"	4,346	76	4,270	200
LL115	Gunsight Well 2		31°25'03"	105°30'20"	4,780	405	4,375	480
LL116	Owen Well		31°22'31"	105°45'50"	4,014	120	3,894	300
LL126	Low Level Well		31°24'14"	105°43'32"	4,179	478	3,699	530
LL127	Gunsight Well 1		31°24'43"	105°34'45"	5,154	627	4,527	690
LL128	Temple Well	48-24-1	31°44'40"	105°05'25"	3,726	107	3,619	
LL129	Guillen E on Well	48-23-201	31°44'48"	105°17'06"	4,007	429	3,578	
LL130	Desert Inn Well	48-14-7	31°45'56"	105°21'22"	4,135			
LL131	Cornudas Cafe Well	48-13-7	31°46'45"	105°28'09"	4,304			
LL132	Williams Ranch House Well	48-20-6	31°41'31"	105°30'09"	4,334	709	3,625	—
LL133	Puett Well	48-13-8	31°46'38"	105°26'53"	4,341			
LL134	Hobo Well-Deep	48-20-5	31°41'44"	105°33'07"	4,416			
LL135	Jardin Well	48-30-4	31°33'27"	105°21'25"	4,282	528	3,754	
LL136	Sparks Windmill	48-14-9	31°46'18"	105°16'45"	4,053	446	3,607	
LL137	Sparks House Pump Well	48-14-8	31°45'39"	105°18'04"	4,032	510	3,522	
LL138	Williams #4 Well	48-12-8	31°46'21"	105°33'09"	4,409	790	3,619	
LL139	Stewart #2 Well	48-12-5	31°48'30"	105°32'52"	4,447			
LL140	Adobe House Tank Well	48-21-5	31°41'10"	105°25'18"	4,200			
LL141	Bravo Well	48-29-3	31°36'14"	105°24'27"	4,278	628	3,650	
LL142	Three Sisters Well	48-29-1	31°36'10"	105°28'18"	4,362	48	4,314	
LL143	Sumrall Well	48-16-7	31°45'57"	105°05'20"	3,668	100	3,568	
LL144	Foster House Well	48-14-1	31°51'44"	105°21'44"	4,186			
LL145	Foster South Well	48-13-9	31°47'15"	105°22'47"	4,182			
LL146	Stewart #1 Well	48-12-5	31°48'29"	105°32'56"	4,445			
LL147	Beard #1 Well	48-12-7	31°46'07"	105°37'02"	4,523			
LL148	Red Well	48-23-7	31°37'47"	105°14'20"	4,075	463	3,612	
LL149	Sampson Well	48-23-1	31°42'04"	105°12'45"	3,886	262	3,625	
LL150	South Well	48-28-3	31°35'29"	105°30'08"	4,430	63	4,367	
LL151	Moon Well	48-38-1	31°29'45"	105°21'59"	4,336	160	4,176	
LL152	Gibbs Well	48-14-4	31°49'17"	105°20'17"	4,081			
LL153	Hartnutt Well	48-31°9	31°31'20"	105°09'33"	4,509			
LL154	Flattop Well- Figure 2 Ranch	48-24-9	31°37'49"	105°02'10"	3,745	294	3,451	
LL155	Frederick Well	48-39-1	31°28'16"	105°13'16"	4,368	742	3,626	
LL156	Baylor-New Well	48-37-3	31°28'05"	105°22'59"	4,408	210	4,198	
LL157	Baylor-Old Well	48-37-3	31°27'38"	105°24'51"	4,449	72	4,377	

BEG ID	Well name	TWC[1] ID	Coordinates		Ground-level elevation	Water-level depth	Water-level elevation	Total depth
HUDSPETH COUNTY								
LL158	Desert Inn Abnd. Well	48-14-7	31°45'38"	105°22'05"	4,170	549	3,622	
LL159	Abnd. Adobe House Tank	48-21-5	31°41'06"	105°25'15"	4,201	583	3,618	
LL160	Hobo Well-Shallow	48-20-5	31°41'48"	105°33'08"	4,415	18	4,397	
LL161	Geothermal Well (UTEP)	48-21-6	31°41'47"	105°22'40"	4,224	74	4,150	
LL162	Williams Pump Jack #1	48-21-4	31°41'18"	105°28'50"	4,303	677	3,626	
LL163	Cavender Well	48-24-4	31°42'15"	105°07'19"	3,832	310	3,522	
LL164	Graham Well	48-24-2	31°43'34"	105°03'40"	3,668	100	3,568	
LL165	Bill Crane Well	48-24-5	31°41'54"	105°02'38"	3,658	140	3,518	
LL166	Morrison Well	48-24-6	31°40'34"	105°01'48"	3,629	40	3,589	
LL167	Wesley West Well	48-24-9	31°38'20"	105°01'11"	3,659	80	3,579	
LL168	Black Mountain Well	48-23-9	31°39'39"	105°07'34"	3,993	460	3,533	
LL169	Babbs Well	48-32-6	31°34'38"	105°01'22"	3,718	123	3,595	
LL170		48-07-101	31°58'08"	105°14'39"	3,804	205	3,599	700
LL171		48-07-102	31°57'33"	105°14'40"	3,795	218	3,577	962
LL172		48-07-206	31°59'25"	105°12'02"	3,709	129	3,580	215
LL173		48-07-207	31°58'10"	105°12'01"	3,707	122	3,585	712
LL174		48-07-210	31°58'15"	105°12'27"	3,721	145	3,576	240
LL175		48-07-214	31°57'56"	105°10'57"	3,678	93	3,585	500
LL176		48-07-304	31°58'00"	105°07'55"	3,644	60	3,584	
LL177		48-07-405	31°56'17"	105°13'27"	3,755	175	3,580	230
LL178		48-07-414	31°55'13"	105°14'39"	3,795	212	3,583	680
LL179		48-07-418	31°56'17"	105°14'39"	3,805	216	3,590	886
LL180		48-07-501	31°55'37"	105°11'51"	3,688	106	3,582	
LL181		48-07-504	31°56'11"	105°12'00"	3,696	72	3,624	175
LL182		48-07-516	31°56'37"	105°12'02"	3,705	119	3,586	300
LL183		48-07-606	31°57'10"	105°09'51"	3,651	67	3,583	
LL184		48-07-607	31°55'23"	105°08'51"	3,641	59	3,582	
LL185		48-07-706	31°53'34"	105°12'38"	3,712	131	3,581	835
LL186		48-07-708	31°52'37"	105°12'32"	3,722	138	3,584	1,583
LL187		48-07-801	31°54'53"	105°10'56"	3,658	80	3,578	200
LL188		48-07-803	31°53'31"	105°12'00"	3,693	100	3,593	278
LL189		48-07-901	31°54'56"	105°07'49"	3,637	53	3,584	300
LL190		48-07-904	31°53'27"	105°09'51"	3,660	62	3,598	780
LL191		48-08-102	31°59'03"	105°07'17"	3,642	56	3,586	392
LL192		48-06-201	31°59'59"	105°17'54"	3,940	303	3,637	1,100
LL193		48-06-601	31°56'20"	105°16'15"	3,874	310	3,564	1,505
LL194		48-15-203	31°51'43"	105°11'55"	3,715	138	3,599	325
LL195		48-15-301	31°50'53"	105°09'19"	3,652	60	3,593	320
LL196		48-16-402	31°48'26"	105°05'31"	3,652	61	3,591	140
LL197	(Eclipse Well)	47-01-7	31°54'57"	104°58'24"	3,671	50	3,621	
LL198		48-08-9	31°52'37"	105°00'45"	3,635	22	3,613	
LL199		48-08-4	31°55'23"	105°06'05"	3,616	3	3,613	
LL200		48-16-8	31°45'11"	105°02'50"	3,622	23	3,599	
LL201		47-09-1	31°50'58"	104°57'21"	3,697	91	3,606	
LL202		47-09-803	31°45'19"	104°55'01"	3,790	191	3,599	

BEG ID	Well name	TWC[1] ID	Coordinates		Ground-level elevation	Water-level depth	Water-level elevation	Total depth
HUDSPETH COUNTY								
LL203		47-09-805	31°46'51"	104°56'17"	3,696	97	3,591	515
LL204		47-09-8	31°46'10"	104°56'16"	3,722	130	3,592	
LL205	(Black John Well)	47-17-3A	31°44'27"	104°53'57"	3,805	202	3,603	
LL206		47-17-6A	31°40'51"	104°53'50"	3,722	135	3,587	
LL207		47-17-6B	31°40'39"	104°54'06"	3,708	141	3,567	
LL208		47-17-6C	31°40'51"	104°54'59"	3,639	29	3,610	
LL209	(Hardluck Well)	47-17-3B	31°42'20"	104°54'06"	3,697	97	3,600	
LL210		47-17-3C	31°43'31"	104°54'02"	3,755	159	3,596	
LL211		47-17-2A	31°44'33"	104°56'00"	3,717	112	3,605	
LL212		47-17-2B	31°43'38"	104°56'03"	3,688	84	3,604	
LL213		47-18-4A	31°37'37"	104°52'25"	3,762	163	3,599	
LL214		48-32-3	31°36'30"	105°00'39"	3,636	39	3,597	
LL215	(Curton Well?)	47-25-4	31°32'45"	104°58'24"	3,650	48	3,602	
LL216		47-26-7	31°31'44"	104°52'30"	3,674	88	3,586	
LL217		47-26-9	31°31'18"	104°46'02"	3,786	202	3,584	
LL218	Abandoned Well	48-12-9	31°46'13"	105°30'51"	4,325	675	3,650	
LL219	Love Well	48-39-701	31°24'17"	105°13'50"	4,517	889	3,628	
LL220	Maupin Well	48-38-703	31°23'14"	105°20'37"	4,515	888	3,627	
LL221		Not used				--		
LL222		48-37-901	31°24'44"	105°24'48"	4,578	278	4,300	
LL223		48-38-703	31°23'15"	105°20'34"	4,515	890	3,625	947
LL224		48-44-201	31°22'11"	105°32'38"	4,790	--	--	
LL225		48-44-801	31°15'57"	105°33'44"	4,067	125	3,942	
LL226	Old Wall Bridge	48-44-901	31°16'26"	105°31'30"	4,190	241	3,949	600
LL227		48-44-902	31°16'03"	105°32'17"	4,136	75	4,044	146
LL228		48-45-602	31°18'17"	105°24'22"	4,582	943	3,639	
LL229		48-45-603	31°17'56"	105°23'50'	4,582	961	3,621.5	
LL230		48-45-604	31°17'44"	105°24'22"	4,605	--	--	
LL231	Old Ward Ranch	48-45-901	31°16'41"	105°23'20"	4,740	1,111	3,629	1,126
LL232		48-46-101	31°21'51"	105°21'40"	4,590	980	3,610	
LL233		48-46-301	31°20'12"	105°17'09"	4,800	--	--	
LL234		48-46-401	31°19'17"	105°20'42"	4,678	1,040	3,638	1,093
LL235		48-46-701	31°15'55"	105°20'38"	4,600	1,120	3,480	1,137
LL236		48-46-702	31°16'58"	105°20'57"	4,650	1,120	3,530	
LL237		48-51-403	31°11'09"	105°44'29"	3,492	7	3,485	
LL238		48-51-405	31°10'59"	105°44'29"	3,492	8	3,484	
LL239		48-51-406	31°11'11"	105°44'37"	3,492	8	3,484	
LL240		48-51-706	31°09'13"	105°43'02"	3,490	13	3,477	90
LL241		48-53-101	31°13'05"	105°29'06"	4,545	479	4,066	906
LL242		48-53-104	31°12'15"	105°29'55"	4,600	223	4,377	339
LL243		48-53-301	31°14'52"	105°24'30"	4,993	1,130	3,863	1,341
LL244		48-53-401	31°11'38"	105°29'35"	4,737	148	4,589	175
LL245		48-53-402	31°11'09"	105°29'31"	4,790	52	4,738.5	90
LL246		48-53-403	31°11'09"	105°29'31"	4,785	80	4,705	200
LL247		48-53-501	31°11'29"	105°25'33"	4,656	370	4,286	1,110
LL248		48-53-502	31°11'31"	105°25'19"	4,650	345	4,305	

BEG ID	Well name	TWC[1] ID	Coordinates		Ground-level elevation	Water-level depth	Water-level elevation	Total depth
HUDSPETH COUNTY								
LL249		48-53-503	31°12'17"	105°26'12"	4,698	370	4,328	
LL250		48-53-504	31°11'38"	105°25'31"	4,643	468	4,175	490
LL251		48-53-901	31°08'37"	105°24'40"	4,655	215	4,439	
LL252		48-53-902	31°08'37"	105°24'40"	4,654	215	4,439	263
LL253		48-54-201	31°14'56"	105°18'50"	4,517	877	3,640	947
LL254		48-54-202	31°14'13"	105°18'40"	4,498	902	3,596	
LL255	Old Town Well	48-54-401	31°11'15"	105°21'10"	4,595	965	3,630	1,102
LL256		48-54-402	31°11'03"	105°21'31"	4,540	920	3,620	950
LL257		48-54-404	31°10'13"	105°20'42"	4,478	810	3,668	1,000
LL258		48-54-405	31°10'14"	105°20'42"	4,478	810	3,668	957
LL259		48-54-501	31°10'02"	105°19'35"	4,446	--	--	
LL260		48-54-503	31°10'02"	105°19'35"	4,446	--	--	
LL261		48-54-701	31°08'09"	105°20'06"	4,488	905	3,583	920
LL262	Faskin Well	48-54-801	31°08'15"	105°18'41"	4,406	920	3,486	945
LL263		48-54-901	31°09'08"	105°16'16"	4,380	789	3,591	1,150
LL264		48-55-901	31°09'42"	105°07'39"	4,649	208	4,441	397
LL265	Camel Draw Well	48-55-902	31°09'59"	105°07'37"	4,638	153	4,485	190
LL266		48-55-903	31°09'49"	105°07'38"	4,640	190	4,450	
LL267		48-60-101	31°05'26"	105°36'39"	3,455	17	3,438	72
LL268		48-61-101	31°07'25"	105°28'57"	5,020	269	4,751	
LL269		48-61-201	31°05'41"	105°25'28"	4,372	538	3,834	690
LL270		48-61-301	31°05'36"	105°23'25"	4,300	--	--	
LL271		48-61-501	31°04'29"	105°25'31"	4,495	--	--	420
LL272		48-61-901	31°02'14"	105°22'58"	4,383	--	--	
LL273		48-62-501	31°03'50"	105°18'29"	4,376	499	3,877	
LL274		48-62-701	31°02'19"	105°20'33"	4,110	448	3,662	525
LL275		48-62-805	31°00'43"	105°18'01"	4,007	--	--	
LL276		48-62-806	31°00'48"	105°18'51"	4,035	387	3,648	433
LL277		48-62-807	31°02'29"	105°19'57"	4,095	438	3,657	497
LL278	Winter Well	48-63-302	31°06'57"	105°08'10"	4,506	354	4,152	602
LL279		48-63-701	31°02'05"	105°13'23"	4,218	--	--	
LL280		48-63-802	31°00'11"	105°11'30"	4,314	122	4,192	
LL281		48-63-803	31°00'02"	105°10'01"	4,532	25	4,507	
LL282	Witch Well	48-63-902	31°00'43"	105°08'02"	4,757	228	4,529	238
LL283		48-38-704	31°23'12"	105°20'30"			--	1,169
LL284		48-54-410			4,530	871	3,659	1,226
LL285		48-62-802			4,010	365	3,645	
LL286		48-53-803			4,681	166	4,515	357
LL287		48-51-705	31°09'36"	105°43'59"	3,488	10	3,478	71
LL288		48-51-713			3,490		--	
LL289		48-51-901			3,476	3	3,473	68
LL290	Unnamed spring		31°58'43"	104°50'39"	6,635		6,635	
LL291	Unnamed spring		31°59'29"	104°47'52"	6,710		6,710	
LL292	Bone Spring		31°53'04"	104°52'24"	5,520		5,520	
LL293		48-16-402	31°48'37"	105°05'32"	3,752	39	3,913	
LL294		48-16-702	31°46'27"	105°05'29"	3,670	60	3,610	168

BEG ID	Well name	TWC[1] ID	Coordinates		Ground-level elevation	Water-level depth	Water-level elevation	Total depth
HUDSPETH COUNTY								
LL295		48-32-301	31°36'27"	105°00'38"	3,638	39	3,599	241
LL296		48-32-601	31°34'50"	105°00'26"	3,638	33	3,605	73
LL297		48-32-602	31°34'38"	105°01'23"	3,718	140	3,578	210
LL298		48-56-501	31°09'58"	105°03'50"	4,770	68	4,702	
LL299		48-56-802	31°08'31"	105°04'17"	4,655	67	4,588	186
LL300		48-56-803	31°09'17"	105°03'08"	4,757	74	4,683	130
LL301		48-64-201	31°06'01"	105°03'17"	4,504	145	4,359	226
LL302		48-64-301	31°06'26"	105°00'17"	4,676	157	4,519	200
LL303		48-64-302	31°06'13"	105°02'13"	4,560	158	4,402	193
LL304		48-64-501	31°03'59"	105°03'20"	4,388	233	4,155	477
LL305		48-64-601	31°04'51"	105°01'11"	4,511	174	4,337	177
LL306		48-64-603	31°04'35"	105°01'12"	4,492	168	4,324	196
LL307		48-64-605	31°04'46"	105°00'08"	4,556	173	4,583	236
LL308		48-64-901	31°00'31"	105°01'02"	4,271	610	3,661	1,001
LL309		50-8-101	30°58'57"	105°05'19"	4,941	80	4,861	171
LL310		50-8-102	30°59'29	105°05'42"	4,761	5	4,756	6
LL311		50-8-103	30°59'25"	105°06'52"	5,105	65	5,040	112
LL312		50-8-201	30°58'45"	105°03'45"	4,762	38	4,724	90
LL313		50-8-901	30°54'47"	105°01'07"	4,919	--	--	320
LL314		47-9-901	31°46'17"	104°54'25"	3,805	208	3,597	
LL315		47-9-904	31°46'22"	104°54'17"	3,855	272	3,583	
LL316		47-17-301	31°44'27"	104°53'59"	3,795	154	3,641	
LL317		47-17-304	31°44'34"	104°54'05"	3,810	197	3,613	450
LL318		47-17-317	31°44'36"	104°54'56"	3,762	163	3,599	
LL319		47-17-601	31°40'51"	104°53'51"	3,800	122	3,600	
LL320		47-2-801	31°54'52"	104°48'00"	5,685	266	5,419	748
LL321		47-10-501	31°49'16"	104°49'20"	4,565	800	3,765	
LL322	Black John Well	47-34-102	31°28'49"	104°51'06"	3,633	40	3,593	
LL323	Snake Well	47-34-401	31°25'26"	104°51'20"	3,681	104	3,577	
LL324	Five Mile Well	47-34-701	31°23'41"	104°51'10"	3,716	146	3,570	
LL325		47-42-401	31°19'32"	104°50'26"	3,700	129	3,571	
LL326		47-58-302	31°05'13"	104°46'45"	3,894	356	3,538	
LL327		47-58-303	31°05'43"	104°46'46'	3,880	341	3,539	
LL328		47-58-304	31°06'10"	104°46'47"	3,870	329	3,541	
LL329		47-58-601	31°04'44"	104°46'42"	3,905	365	3,540	726
LL330		47-58-901	31°01'56"	104°46'20"	3,875	141	3,734	
LL331		47-58-902	31°01'34"	104°46'41"	3,882	357	3,525	
LL332		47-43-202	31°20'06"	104°40'44"	3,784	243	3,541	
LL333		47-43-502	31°18'16"	104°41'15"	3,720	155	3,565	
LL334		47-43-701	31°15'23"	104°43'19"	3,687	145	3,542	190
LL335		47-43-801	31°16'07"	104°40'50"	3,698	142	3,556	
LL336		47-43-802	31°16'32"	104°41'10"	3,689	143	3,546	
LL337		47-51-501	31°10'30"	104°41'32"	3,702	170	3,532	
LL338		47-51-701	31°08'56"	104°43'11"	3,734	203	3,531	955
LL339		47-51-705	31°07'45"	104°42'35"	3,749	242	3,507	525
LL340		47-51-710	31°09'49"	104°44'09"	3,751	217	3,534	1,096

BEG ID	Well name	TWC[1] ID	Coordinates		Ground-level elevation	Water-level depth	Water-level elevation	Total depth
HUDSPETH COUNTY								
LL341		47-51-802	31°09'30"	104°41'18"	3,722	195	3,527	
LL342		47-51-806	31°08'29"	104°42'03"	3,737	221	3,516	
LL343		47-51-902	31°08'36"	104°39'08"	3,744	226	3,518	
LL344		47-59-104	31°06'27"	104°43'32"	3,773	253	3,520	
LL345		47-59-201	31°05'41"	104°41'37"	3,775	237	3,538	552
LL346		47-59-203	31°05'05"	104°41'19"	3,776	242	3,534	
LL347		47-59-306	31°06'26"	104°38'34"	3,789	257	3,532	
LL348	Guadalupe Spring		31°52'37"	104°50'46"	5,840		5,840	
LL349	Smith Spring		31°55'07"	104°47'39"	5,940		5,940	
LL350	Juniper Spring		31°55'03"	104°47'35"	5,630		5,630	
LL351	Manzanita Spring		31°54'38"	104°47'50	5,535		5,535	
LL352	Choza Spring		31°54'23"	104°47'06"	5,295		5,295	
LL353	Upper Pine Spring		31°54'12"	104°48'59"	5,955		5,955	
LL354	Pine Spring		31°53'56"	104°49'15"	5,765		5,765	
LL355	Bell Spring		31°56'18"	104°45'23"	5,070		5,070	
LL356	Unnamed Spring		31°55'30"	104°45'42"	5,170		5,170	
LL357	Soldier Spring		31°54'50"	104°45'46"	5,055		5,055	
LL358	Unnamed spring		31°55'15'	104°46'16"	5,060		5,060	
LL359	Unnamed Spring		31°55'03"	104°34'42"	4,090		4,090	
LL360		47-04-101	31°59'07"	104°35'13"	4,182	75	4,107	103
LL361		47-04-201	31°58'43"	104°33'50"	4,092	77	4,016	180
LL362		47-04-301	31°59'05"	104°31'27"	3,824	115	3,709	137
LL363		47-04-302	31°57'58"	104°30'27"	3,890	17	3,873	60
LL364		47-04-501	31°57'21"	104°34'18"	4,086	103	3,983	200
LL365		47-04-601	31°55'47"	104°31'31"	3,855	40	3,815	165
LL366		47-44-701	31°15'22"	104°35'01"	3,887	352	3,535	468
LL367		47-44-702	31°17'27"	104°35'28"	3,955	525	3,430	
LL368		47-52-101	31°14'08"	104°36'13"	3,815	287	3528	
LL369		47-52-401	31°10'51"	104°35'02"	3,767	240	3,531	
LL370		47-52-801	31°09'06"	104°33'50"	3,873	342	3,531	
LL371		47-60-408	31°03'17"	104°36'30"	3,865	340	3,525	
LL372		47-60-701	31°02'10"	104°35'31"	3,898	368	3,530	660
LL373	Unnamed spring		31°54'19"	104°23'55"	3,510		3,510	
LL374		47-05-401	31°55'37"	104°29'30"	3,793	42	3,751	80
LL375		47-05-403	31°56'44"	104°28'09"	3,697	370	3,695	
LL376		47-05-501	31°55'19"	104°25'20"	3,665	20	3,645	
LL377	Cedar Spring		31°49'26"	104°25'58"	3,852		3,852	
LL378	Burro Spring		31°46'41"	104°28'37"	4,006		4,006	
LL379	The Seep		31°47'06"	104°23'03"	3,815		3,815	
LL380		47-13-102	31°52'03"	104°28'39"	3,706	12	3,694	
LL381	Brooks Well North	47-37-802	31°22'43"	104°25'46"	4,310	41	4,269	60
LL382		47-45-101	31°20'24"	104°28'20"	4,445	54	4,391	69
LL383	McReynolds Well	47-45-201	31°21'43"	104°27'38"	4,545	16	4,529	40
LL384	Mutt Windmill	47-45-501	31°19'19"	104°26'06"	4,270	10	4,260	14
LL385	Deep Well	47-53-401	31°11'31"	104°28'00"	5,060	1,570	3,490	
LL386	Jose Windmill	47-53-701	31°08'43"	104°28'50"	4,430	906	3,524	915

BEG ID	Well name	TWC[1] ID	Coordinates		Ground-level elevation	Water-level depth	Water-level elevation	Total depth
HUDSPETH COUNTY								
LL387		47-61-401	31°04'08"	104°29'55"	4,091	494	3,597	577
LL388	Stewart Well	47-61-403	31°03'00"	104°28'11"	4,218	691	3,527	740
LL389	Joe's Spring		31°55'20"	104°24'15"	4,610		4,610	
LL390	Fence Line Spring		31°58'54"	104°21'35"	3,670		3,670	
LL391	Outlaw Spring		31°59'55"	104°18'59"	3,460		3,460	
LL392	Box Springs		31°58'52"	104°17'35"	3,415		3,415	
LL393	Willow Spring		31°53'39"	104°18'34"	3,410		3,410	
LL394	Unnamed spring		31°54'24"	104°15'24"	3,350		3,350	
LL395		47-06-601	31°55'59"	104°15'59"	3,374	72	3,302	
LL396		47-06-701	31°54'13"	104°19'58"	3,464	21	3,443	
LL397	Unnamed spring		31°45'09"	104°18'24"	3,695		3,695	
LL398	Unnamed spring		31°46'31"	104°16'10"	3,575		3,575	
LL399	Unnamed spring		31°41'11"	104°17'36"	3,785		3,785	
LL400	Unnamed spring		31°38'48"	104°17'30"	3,675		3,675	
LL401	Unnamed spring		31°32'39"	104°17'36"	3,770		3,770	
LL402	South Windmill	47-46-401	31°18'02"	104°22'41"	4,172	40	4,132	63
LL403		47 46-602	31°19'21"	104°15'33"	3,747	317	3,430	320
LL404	Jackson Windmill	47-46-802	Not used		--	--	--	
LL405	South House Well	47-54-202	31°13'18"	104°18'12"	3,790	99	3,691	150
LL406		47-54-302	31°13'38"	104°16'10"	3,717	163	3,554	280
LL407	Dagger Windmill	47-54-603	31°10'44"	104°16'03"	3,931	510	3,[illegible]21	550
LL408	Horse Camp Spring		31°00'10"	104°18'52"	4,632		4,632	
LL409	Unnamed spring		30°58'16"	104°19'04"	5,289		5,289	
LL410	Unnamed spring		30°57'03"	104°18'26"	5,113		5,113	
LL411	Herds Pass Spring		30°57'46"	104°17'26"	5,012		5,012	
LL412	Horse Camp Well	51-06-204	30°59'36"	104°18'40"	4,897	202	4,695	600
LL413	Toy Springs		31°49'15"	104°09'30"	3,280		3,280	
LL414	Cottonwood Springs		31°48'27"	104°11'57"	3,410		3,410	
LL415	Unnamed springs		31°49'14"	104°10'39"	3,330		3,330	
LL416	Unnamed springs		31°45'46"	104°12'37"	3,450		3,450	
LL417	Horseshoe springs		31°44'21"	104°09'51"	3,280		3,280	
LL418	Rustler Spring		31°38'37"	104°13'43"	3,493		3,493	
LL419	Unnamed springs		31°39'32"	104°12'42"	3,410		3,410	
LL420	Unnamed spring		31°33'26"	104°13'59"	3,715		3,715	
LL421	Big Tank Well	47-47-401	31°19'04"	104°14'19"	3,673	240	3,433	320
LL422	Bennit Well	47-47-402	31°18'25"	104°12'47"	3,607	177	3,[illegible]3[illegible]	
LL423	Mateo Well	47-47-403	31°17'51"	104°14'54"	3,718	300	3,418	330
LL424		47-47-701	31°16'08"	104°13'41"	3,790	205	3,585	230
LL425	Tinnin Well	47-47-801	31°17'05"	104°12'07"	3,595	166	3,429	180
LL426	Bluff Well	47-47-902	31°15'22"	104°09'54"	3,498	139	3,585	187
LL427	North Pasture Windmill	47-55-401	31°12'11"	104°12'53"	3,664	160	3,504	
LL428	Red Hills Well	47-55-604	31°11'58"	104°09'12"	3,717	271	3,446	
LL429		47 55 802	31°07'49"	104°10'40"	3,898	366	3,532	
LL430	Sulfur Windmill	47-55-901	31°07'49"	104°08'40"	3,927	174	3,753	
LL431		47-63-101	31°07'10"	104°12'30"	3,918	408	3,510	670
LL432		47-63-401	31°01'13"	104°13'36"	4,460	920	3,540	1,004

BEG ID	Well name	TWC[1] ID	Coordinates		Ground-level elevation	Water-level depth	Water-level elevation	Total depth
HUDSPETH COUNTY								
LL433	Ash Spring		30°58'31"	104°13'03"	4,741		4,741	
LL434	Hawthicket Spring		30°56'53"	104°07'52"	4,965		4,965	
LL435	Screw Bean Spring		31°48'09"	104°05'56"	3,121		3,121	
LL436	Salt Spring		31°42'50"	104°07'02"	3,155		3,155	
LL437	Unnamed spring		31°42'10"	104°04'53"	3,125		3,125	
LL438	San Martine Spring		31°06'18"	104°06'08"	3,940		3,940	
LL439	Lower Hidden Spring		31°01'51"	104°05'18"	5,000		5,000	
LL440	Cold Spring		31°01'57"	104°04'06"	5,320		5,320	
LL441	Indian Spring		31°01'20"	104°06'00"	4,775		4,775	
LL442	Walnut Spring		31°00'42"	104°06'17"	4,700		4,700	
LL443	House Spring		31°00'38"	104°02'08"	4,700		4,700	
LL444	Stratton Well	47-64-401	31°04'42"	104°05'47"	4,173	636	3,537	973
LL445	Oak Spring		30°59'51"	104°05'44"	4,974		4,974	
LL446	Dipping Vat Spring		30°59'19"	104°02'45"	4,807		4,807	
LL447	Unnamed spring		30°58'25"	104°01'57"	4,483		4,483	
LL448	Willow Spring		30°57'15"	104°01'06"	4,231		4,231	
LL449	Orchard Spring		30°56'20"	104°01'15"	4,344		4,344	
LL450	Shelbarger Spring		30°55'23"	104°01'42"	4,465		4,465	
LL451	Mud Spring		30°53'48"	104°03'32"	5,696		5,696	
LL452	Bear Wallow Spring		30°53'44"	104°00'07"	4,517		4,517	
LL453	Onion Spring		30°59'27"	104°06'26"	4,840		4,840	

[1]TWC well identification system has 3 sets of numbers; preliminary wells have 1 number in the last set, permitted wells have 3.

Appendix 2. Chemical and isotopic composition of ground-water samples.
Major ions (mg/L) and temperatures (°C).

BEG ID	Well Name	Coordinates		Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	HCO_3^-	SO_4^{2-}	Cl^-	NO_3^-	TDS	Temp.
LL100	Kohen Windmill	31°40'12"	104°10'50"	517	229.0	367.0	16.2	223	2310	283	36.1	3993.9	17.6
LL101	Smilin Jack Windmill	31°40'23"	104°12'22"	587	83.3	38.0	7.3	121	1650	50	79.7	2627.7	19.0
LL102	Rustler Spring	31°38'42"	104°13'33"	595	49.8	68.7	6.7	133	1580	70	22.1	2534.2	14.9
LL103	Division Windmill	31°37'16"	104°13'03"	527	220.0	74.0	5.3	187	1960	91	0.4	3085	
LL104	Monument Windmill	31°38'13"	104°10'52"	277	115.0	45.0	3.2	258	900	40	10.3	1655.8	21.0
LL105	Rio Grande Water	31°16'23"	105°51'14"	86.9	18.5	186	7.8	214	234	185	6.6	941.9	11.0
LL106	Thaxton Sp	31°28'11"	105°42'57"	26.8	22.9	475	4.6	501	520	148	11.3	1718.3	9.0
LL107	48-42-1 Windmill	31°22'12"	105°50'52"	169.0	35.3	1250	7.7	161	2270	520	1.3	4421.6	24.5
LL108	48-42-404 Well	31°18'56"	105°51'27"	34.7	11.9	410	4.5	263	395	259	5.1	1388.1	22.5
LL109	48-41-618 Well	31°17'31"	105°52'45"	23.8	23.9	486	14.6	96	315	555	<0.5	1517.5	
LL110	48-41-2 Well	31°19'37"	105°54'55"	387.0	91.7	881	12.8	495	770	1450	<0.5	3604.1	19.0
LL111	48-33-9 Windmill	31°23'18"	105°53'18"	26.8	10.5	327	4.2	242	360	168	11.4	1154.4	21.0
LL112	Head of Canyon WM	31°31'42"	105°42'05"	61.6	19.3	177	5.4	282	168	116	26.5	861.7	14.0
LL113	Wilkey Well no. 1	31°23'23"	105°40'48"	77.1	43.1	237	3.4	336	438	88	11.8	1241.5	20.0
LL114	Wilkey Well no. 2	31°22'48"	105°39'07"	131.0	24.6	55	1.5	284	275	10	11.3	801.4	11.0
LL115	Gunsight Windmill no. 1	31°25'03"	105°30'20"	37.3	22.1	454	7.4	411	570	137	<0.5	1649.2	19.0
LL116	Owens Well	31°22'31"	105°45'50"	48.4	15.3	362	3.5	278	525	128	<0.5	1369.4	14.0
LL117	S-15 W. Sp	31°41'13"	104°17'33"	634	25.6	34.0	5.3	151	1500	34	26.5	2419.2	11.0
LL118	S-15 S. Sp	31°38'43"	104°17'25"	714	12.3	11.5	16.6	448	1490	13	<0.5	1203.0	14.0
LL119	S-15 W. Windmill	31°39'10"	104°19'02"	577	120.0	227.0	21.0	114	2040	190	22.6	3322.7	18.0
LL120	Phillips Windmill	31°40'06"	104°14'41"	614	34.0	47.9	4.6	84	1590	31	60.0	2476.0	19.0
LL121	S-15 N. Windmill	31°43'55"	104°14'59"	600	107.0	218.0	4.5	160	1900	221	35.5	3256.8	20.0
LL122	S-15 N. Windmill Sp	31°44'57"	104°15'19"	620	50.6	163.0	7.4	126	1730	127	44.6	2879.7	13.0
LL123	S-46 Seven L. Windmill	31°44'53"	104°28'18"	618	72.2	70.4	7.3	190	1680	73	<0.5	2724.4	17.0
LL124	S-46 High L. Windmill	31°42'46"	104°27'46"	634	25.8	68.4	10.2	201	1480	74	39.6	2539.9	18.0
LL125	S-46 Cave Well	31°40'03"	104°26'23"	676	55.9	73.2	13.0	320	1540	104	104.0	2898.9	
LL126	Low Level Well	31°24'14"	105°43'32"	70.7	6.9	549	4.4	60	710	416	18.3	1850.	17.0
LL128	Temple Well	31°44'40"	105°05'25"	320	116	278	11.3	236	820	530	40	2363	22
LL129	Guillen Exxon Well	31°44'48"	105°12'06"	193	79.7	113	5.2	178	680	117	24	1404	25
LL130	Desert Inn Well	31°45'56"	105°21'22"	178	73.5	269	7.0	345	553	305	2.7	1745	24

Appendix 2. (cont.)

Major ions (mg/L) and temperatures (°C).

BEG ID	Well Name	Coordinates		Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	HCO_3^-	SO_4^{2-}	Cl^-	NO_3^-	TDS	Temp.
LL131	Cornudas Cafe Well	31°46'45"	105°28'09"	146	63.7	325	10.0	293	580	312	3.8	1744	24
LL132	Williams Ranch House Well	31°41'31"	105°30'09"	95.1	37.1	100	2.7	299	170	78	92	884	25
LL133	Puett Well	31°46'38"	105°26'53"	199	86.6	462	12.7	332	950	405	<1.0	2462	23
LL134	Hobo Well-Deep	31°41'44"	105°33'07"	157	73.2	308	5.8	352	710	202	<1.0	1827	22
LL135	Jardin Well	31°33'27"	105°21'25"	169	60.9	964	40.5	412	580	1300	<1.0	3552	23
LL136	Sparks Windmill	31°46'18"	105°16'45"	605	193	259	11.7	243	2210	245	<1.0	3803	22
LL137	Sparks House Pump Well	31°45'39"	105°18'04"	497	121	310	9.2	263	1470	401	<1.0	3095	20
LL138	Williams #4 Well	31°46'21"	105°33'09"	176	80.5	238	5.9	283	740	172	<1.0	1722	22
LL139	Stewart #2 Well	31°48'30"	105°32'52"	358	133	303	5.8	430	1490	122	2.4	2859	21
LL140	Adobe House Tank Well	31°41'10"	105°25'18"	111	48.6	249	7.9	328	510	147	26	1445	22
LL141	Bravo Well	31°36'14"	105°24'27"	95.2	69.8	381	5.9	177	690	275	76	1787	25
LL142	Three Sisters Well	31°36'10"	105°28'18"	118	60.1	290	3.7	251	570	209	99	1616	22
LL143	Sumrall Well	31°45'57"	105°05'20"	252	95.2	303	9.1	290	660	500	10	2126	23
LL144	Foster House Well	31°51'44"	105°21'44"	213	86.8	340	8.4	300	730	410	1.3	2103	26
LL145	Foster South Well	31°47'15"	105°22'47"	141	59.4	182	4.3	340	530	110	7.0	1384	21
LL146	Stewart #1 Well	31°48'29"	105°32'56"	258	102	225	4.9	400	1040	91	<1.0	2145	19
LL147	Beard #1 Well	31°46'07"	105°37'02"	166	87.6	408	7.1	400	840	340	6.0	2267	22
LL148	Red Well	31°37'47"	105°14'20"	153	60.4	416	18.3	320	540	490	10	2021	20
LL149	Sampson Well	31°42'04"	105°12'45"	216	86.2	267	9.0	280	590	410	30	1898	22
LL150	South Well	31°35'29"	105°30'08"	97	50.7	247	4.3	240	470	140	63	1322	20
LL151	Dyer #1 Ranch House	31°29'45"	105°21'59"	89.3	58	519	6.7	400	830	230	105	2247	21
LL152	Gibbs Well	31°49'17"	105°20'17"	203	82.9	328	10.3	310	700	380	1.0	2027	21
LL153	Dyer #2 Black Mountain South Well	31°31'20"	105°09'33"	113	52.8	324	14.6	370	290	400	9	1581	22
LL154	Flattop Well-Figure 2 Ranch	31°37'49"	105°02'10"	218	80.4	265	9.7	290	550	420	16	1857	24
LL155	Dyer #3 Well	31°28'16"	105°13'16"	150	77	400	14.5	370	700	340	13	2077	19
LL156	Baylor - New Well	31°28'05"	105°22'59"	66.3	36.6	164	3.3	200	230	130	99	936	22
LL157	Baylor - Old Well	31°27'38"	105°24'51"	85.2	22.4	87.3	3.3	240	110	61	100	715	20

Appendix 2. (cont.)

Major ions (mg/L) and temperatures (°C).

Chemical composition (mg/L) of ground water from selected wells (Texas Water Development Board [TWDB], 1985).

BEG ID	TWDB ID	Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	HCO_3^-	SO_4^{2-}	Cl^-	F^-	NO_3^-	TDS
LL170	48-07-101	324	139	168	-	193	1,300	145	-	31.0	2,220
LL171	48-07-102	598	164	250	-	214	2,142	267	2.0	8.7	3,555
LL172	48-07-206	459	225	640	-	172	2,230	594	3.1	286.0	4,563
LL173	48-07-207	364	136	119	-	227	1,220	156	1.8	14.1	2,140
LL174	48-07-210	326	158	267	-	240	1,180	405	1.8	51.0	2,520
LL176	48-07-304	332	124	175	-	248	860	408	1.8	7.0	2,045
LL177	48-07-405	435	219	471	-	195	1,630	800	2.4	110.0	3,779
LL178	48-07-414	324	134	481	-	260	1,120	750	1.9	29.5	2,983
LL180	48-07-501	358	264	510	-	138	1,670	890	2.1	39.0	3,817
LL183	48-07-606	368	220	338	-	259	1,230	670	2.1	42.0	3,011
LL184	48-07-607	350	137	121	-	238	910	415	1.5	3.5	2,070
LL185	48-07-706	264	82	392	1.2	294	703	667	1.1	4.87	2,276
LL187	48-07-801	538	306	952	-	231	2,117	1,512	1.8	44.20	5,603
LL188	48-07-803	500	199	820	-	123	2,110	1,120	2.6	42.0	4,869
LL189	48-07-901	215	87	160	-	95	700	320	1.4	3.50	1,548
LL190	48-07-904	522	248	773	-	255	1,646	1,400	1.6	22.60	4,757
LL192	48-06-201	560	166	40	-	229	1,910	20	2.7	0.40	2,831
LL193	48-06-601	520	178	58	-	201	1,900	27	2.7	0.40	2,804
LL194	48-15-203	266	77	378	1.1	293	681	615	1.1	5.01	2,184
LL195	48-15-301	280	81	326	-	293	720	550	1.6	7.00	2,125
LL202	47-09-803	222	99	156	-	279	660	256	-	3.50	1,549
LL203	47-09-805	171	70	82	-	283	439	126	1.0	0.10	1,044
LL226	48-44-901	5	251	1	-	326	176	46	-	-	805
LL228	48-45-602	110	590	48	-	512	428	469	-	-	2,157
LL229	48-45-603	107	575	42	-	390	509	597	-	-	2,220
LL244	48-53-401	93	55	14	-	359	72	31	-	-	624
LL246	48-53-403	91	59	15	-	356	53	34	-	-	608
LL257	48-54-404	60	489	17	-	342	363	450	-	-	1,721

Appendix 2. (cont.)

Major ions (mg/L) and temperatures (°C).

Chemical composition (mg/L) of ground water from selected wells (Texas Water Development Board [TWDB], 1985).

BEG ID	TWDB ID	Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	HCO_3^-	SO_4^{2-}	Cl^-	F^-	NO_3^-	TDS
LL258	48-54-405	68	496	19	-	340	373	468	-	-	1,764
LL260	48-54-503	99	611	39	-	282	398	773	-	-	2,202
LL263	48-54-901	128	1,103	65	-	380	1,498	775	-	-	3,949
LL266	48-55-903	54	59	30	-	349	61	20	-	-	573
LL267	48-60-101	351	1,540	136	-	403	1,240	2,200	-	-	5,870
LL269	48-61-201	61	118	30	-	315	216	35	-	-	775
LL274	48-62-701	50	110	19	-	292	157	31	-	-	659
LL278	48-63-302	41	154	44	-	410	185	58	-	-	892
LL283	48-38-704	113	560	40	-	383	415	700	-	-	2,211
LL284	48-54-410	19	219	5	-	339	144	75	-	-	801
LL285	48-62-802	35	132	20	-	276	147	48	-	-	658
LL286	48-53-803	115	81	17	-	332	164	62	-	-	771
LL287	48-51-705	38	119	10	-	95	6	184	-	-	452
LL288	48-51-713	217	570	49	-	412	640	720	-	-	2,608
LL289	48-51-901	32	910	48	-	226	660	970	-	-	2,846

1) $\delta^{18}O$ and $\delta^{2}H$ are defined relative to SMOW. $\delta^{34}S$ is given as deviation from the Canyon Diablo Meteorite standard. $\delta^{13}C$ is defined relative to Pee Dee Belemnite carbonate.
2) PMC is percent of modern carbon.
3) ^{14}C age was corrected by using $\delta^{13}C$ values (Kreitler and others, 1986b), except for sample LL126.

Appendix 2. (cont.)

Trace ions (mg/L) and isotope composition[1] in ground-water samples.

BEG ID	Well Name	Coordinates		As^{3+}	Cd^{2+}	Li^{+}	Fe^{2+}	Sr^{2+}	Ba^{2+}	Br^{-}	F^{-}	$\delta^{18}O$	$\delta^{2}H$	Tritium	$\delta^{34}S$	$\delta^{13}C$	PMC[2]	^{14}C Age[3]
LL100	Kohen Windmill	31°40'12"	104°10'50"	<0.010	<0.03	0.10	0.02	9.79	0.01	1.17	1.50	-7.1	-47	13.7	+9.3			
LL101	Smilin Jack Windmill	31°40'23"	104°12'22"	<0.010	<0.03	0.05	0.24	9.78	0.01	0.18	1.05	-6.1	-42	12.0	+9.9			
LL102	Rustler Sp	31°38'42"	104°13'33"	<0.010	<0.03	0.04	0.03	11.20	0.01	0.22	1.45	-6.6	-48	6.7	+9.9			
LL103	Division Windmill	31°37'16"	104°13'03"	<0.010	<0.03	0.06	0.34	8.55	0.01	0.65	2.82	-7.3	-50	<0.8	+3.6			
LL104	Monument Windmill	31°38'13"	104°10'52"	<0.010	<0.03	0.04	0.07	4.65	0.02	0.22	2.37	-6.7	-43	6.3	+5.8			
LL105	Rio Gr. Water	31°16'23"	105°51'14"	<0.010	<0.03	0.11	0.69	1.36	0.06	0.22	0.66	-9.1	-69	24.4	+1.1			
LL106	Thaxton Sp	31°28'11"	105°42'57"	<0.010	<0.03	0.13	0.02	1.63	0.02	1.34	5.57	-7.5	-58	<0.8	-1.8			
LL107	48-42-1 Windmill	31°22'12"	105°50'52"	0.012	<0.03	0.26	0.04	3.20	0.02	2.66	1.05	-8.0	-59	<0.8	+1.0	-16.8	16.6	14,748
LL108	48-42-404 Well	31°18'56"	105°51'27"	0.017	<0.03	0.10	0.05	1.01	0.04	1.25	2.37	-6.9	-48	<0.8	+3.8	-9.6	61	Modern
LL109	48-41-618 Well	31°17'31"	105°52'45"	<0.010	<0.03	0.21	0.02	1.43	0.01	0.59	0.39	-7.4	-71	27.2	+16.9			
LL110	48-41-2 Well	31°19'37"	105°54'55"	<0.010	<0.03	0.26	1.35	6.69	0.06	2.27	0.61	-8.8	-74	21.8	+4.7	-12.0	116	Modern
LL111	48-33-9 Windmill	31°23'18"	105°53'18"	<0.010	<0.03	0.10	0.49	0.81	0.02	1.01	2.03	-7.3	-51	<0.8	+7.2	-10.1	21.8	8,288
LL112	Head of Canyon Windmill	31°31'42"	105°42'05"	<0.010	<0.03	0.06	0.10	1.72	0.02	1.14	2.79	-7.1	-50	11.8	+5.8	-8.0	43	833
LL113	Wilkey Well no. 1	31°23'23"	105°40'48"	<0.010	<0.03	0.05	0.71	3.90	0.03	0.77	1.60	-7.7	-58	3.74	+5.2	-9.4	36	3,529
LL114	Wilkey Well no. 2	31°22'48"	105°39'07"	<0.010	<0.03	0.03	<0.02	7.50	0.03	0.44	0.90	-7.5	-54	20.67	+10.9	-11.3	60	868
LL115	Gunsight Windmill no. 1	31°25'03"	105°30'20"	<0.010	<0.03	0.12	2.15	3.32	0.03	1.15	3.10	-10.7	-83	0.5	-0.5	-7.9	9.6	13,071
LL116	Owens Well	31°22'31"	105°45'50"	<0.010	<0.03	0.07	0.20	2.87	0.12	1.10	4.30	-8.0	-62	1.52	+7.0	-7.8	8.9	13,520
LL117	S-15 W. Sp	31°41'13"	104°17'33"	<0.010	<0.03	0.09	<0.02	7.62	0.02	0.23	0.70	-6.9	-51	15.76	+9.9			
LL118	S-15 S. Sp	31°38'43"	104°17'25"	<0.010	<0.03	0.03	0.07	4.16	0.07	0.19	0.30	-6.3	-48	13.16	+17.2			
LL119	S-15 W. Windmill	31°39'10"	104°19'02"	<0.010	<0.03	0.07	0.02	9.15	0.02	0.72	1.10	-6.7	-51	9.84	+9.4	-14.4	82	314
LL120	Phillips Windmill	31°40'06"	104°14'41"	<0.010	<0.03	0.03	0.04	9.35	0.01	0.24	0.80	-6.7	-51	8.67	+9.6	-17.0		
LL122	S-15 N. Windmill Sp	31°44'57"	104°15'19"	<0.010	<0.03	0.04	0.02	9.22	0.01	0.74	1.10	-6.7	-56	16.33	+9.9			
LL121	S-15 N. Windmill	31°43'55"	104°14'59"	<0.010	<0.03	0.06	0.07	8.27	0.01	1.10	1.30	-7.2	-54	13.46	+9.8	-18.0	90	1358
LL123	S-46 Seven L. WM	31°44'53"	104°28'18"	<0.010	<0.03	0.04	1.09	9.90	0.03	0.53	1.40	-7.4	-53	28.04	+11.5	-19.5	56	5906
LL124	S-46 High L. WM	31°42'46"	104°27'46"	<0.010	<0.03	0.03	0.04	5.86	0.03	0.33	0.60	-5.8	-40	11.35	+10.5	-12.0		Modern
LL125	S-46 Cave W.	31°40'03"	104°26'23"	<0.010	<0.03	0.05	0.07	11.00	0.03	0.66	0.90	-6.5	-50	21.78	+11.3	-18.8	110	Modern
LL126	Low Level well	31°24'14"	105°43'32"	<0.050	<0.03	0.10	0.13	8.30	0.19	2.10	4.30	-8.3	-61	no data[4]	+4.1	-18.1	3.3	27,400

Appendix 2. (cont.)

Trace ions (mg/L) and isotope composition[1] in ground-water samples.

BEG ID	Well name	TWC[1] ID	As	Cd^{2+}	Li^{+}	Fe^{2+}	Sr^{2+}	Ba^{2+}	Br^{-}	F^{-}	$\delta^{18}O$**	δD**	Tritium	$\delta^{34}S$**	$\delta^{13}C$**	PMC†	^{14}C Age††
LL128	Temple Well	48-24-1	<0.05	<0.03	0.07	*0.02	8.04	0.06	0.5	3.0	-9.18	-68.8	4.1	16.11	-5.77	13.47	7,639
LL129	Guillen Exxon Well	48-23-201	<0.05	<0.03	*0.05	0.08	8.25	0.06	0.5	5.2	-9.19	-72.7	2.7	12.11	-5.78	9.56	10,488
LL130	Desert Inn Well	48-14-7	<0.05	<0.03	0.08	0.04	6.14	0.03	0.7	5.1	-9.17	-70.3	3.8	5.56	-8.49	6.74	16,556
LL131	Cornudas Cafe Well	48-13-7	<0.05	<0.03	0.10	<0.02	4.49	0.05	0.7	5.0	-9.18	-69.8	3.5	4.53	-6.07	10.54	10,084
LL132	Williams Ranch House Well	48-20-6	<0.05	<0.03	*0.04	0.03	3.77	0.61	0.6	5.0	-6.90	-50.9	13.7	8.61	-8.00	21.02	6,660
LL133	Puett Well	48-13-8	<0.05	<0.03	0.16	1.62	5.58	0.03	1.0	5.0	-10.21	-81.1	2.3	5.71	-6.36	5.36	16,061
LL134	Hobo Well-Deep	48-20-5	<0.05	<0.03	0.09	1.42	0.09	0.02	0.8	7.2	-8.01	-64.2	2.3	7.70	-8.92	18.46	8,635
LL135	Jardin Well	48-30-4	<0.05	<0.03	0.45	6.97	0.45	0.08	1.4	9.0	-9.15	-67.4	2.8	15.72	-6.79	5.08	17,046
LL136	Sparks Windmill	48-14-9	<0.05	<0.03	0.14	16.3	0.14	0.03	0.7	6.6	-10.53	-81.5	3.3	11.29	-3.64	5.99	10,529
LL137	Sparks House Pump Well	48-14-8	<0.05	<0.03	0.14	2.24	0.14	*0.01	0.7	6.2	-9.53	-71.3	3.2	10.37	-4.67	11.32	7,328
LL138	Williams #4 Well	48-12-8	<0.05	<0.03	0.09	11.8	0.09	0.08	0.8	6.3	-7.91	-65.1	6.8	10.12	-9.65	13.98	11,583
LL139	Stewart #2 Well	48-12-5	<0.05	<0.03	0.10	0.25	0.10	0.03	0.8	5.7	-10.44	-79.6	<0.8	-1.24	-10.35	4.34	21,832
LL140	Adobe House Tank Well	48-21-5	<0.05	<0.03	0.11	5.24	0.11	0.04	0.9	8.5	-9.73	-76.0	8.2	7.05	-5.67	13.02	7,775
LL141	Bravo Well	48-29-3	<0.05	<0.03	0.15	<0.02	0.15	0.02	1.9	9.0	-2.72	-35.3	3.4	5.84	-7.99	46.52	84
LL142	Three Sisters Well	48-29-1	<0.05	<0.03	0.11	0.17	0.11	0.12	1.9	7.7	-8.16	-66.5	<0.8	7.23	-6.27	23.50	3,725
LL143	Sumrall Well	48-16-7	<0.05	<0.03	0.09	<0.02	0.09	0.04	0.39	1.3	-9.26	-64.8	<0.8	11.13	-6.80	19.64	5,880
LL144	Foster House Well	48-14-1	<0.05	<0.03	0.12	0.10	0.12	0.10	0.75	2.7	-9.47	-69.1	2.2	7.81	-7.54	49.5	modern
LL145	Foster South Well	48-13-9	<0.05	<0.03	0.08	0.07	0.08	0.02	0.81	3.0	-9.82	-75.4	4.5	4.26	-7.59	9.71	12,610
LL146	Stewart #1 Well	48-12-5	<0.05	<0.03	0.08	13.0	0.08	0.04	0.93	3.0	-9.79	-73.2	1.9	-0.72	-10.04	4.84	20,678
LL147	Beard #1 Well	48-12-7	<0.05	<0.03	0.13	0.11	0.13	0.09	0.92	3.0	-8.36	-63.8	3.0	6.58	-8.01	6.31	16,618
LL148	Red Well	48-23-7	<0.05	<0.03	0.22	3.10	0.22	0.06	0.96	3.3	-9.71	-75.0	4.5	5.91	-7.46	13.13	9,974
LL149	Sampson Well	48-23-1	<0.05	<0.03	0.11	0.05	0.11	0.03	0.63	2.3	-8.99	-68.6	1.4	9.28	-6.38	16.70	6,691
LL150	South Well	48-28-3	<0.05	<0.03	0.10	0.06	0.10	0.16	1.74	3.7	-8.27	-63.0	0.9	6.87	-5.40	35.77	modern
LL151	Dyer #1 Ranch House	48-38-1	<0.05	<0.03	0.14	0.03	0.14	0.02	2.06	3.7	-8.19	-64.7	<0.8	6.34	-5.65	11.82	8,544
LL152	Gibbs Well	48-14-4	<0.05	<0.03	0.13	0.03	0.13	0.11	0.69	2.7	-9.69	-72.9	1.2	6.74	-7.58	7.60	14,628
LL153	Dyer #2 Black Mountain South Well	48-31-9	<0.05	*0.03	0.16	0.07	0.16	0.04	0.82	2.7	-8.42	-61.8	<0.8	5.58	-7.09	10.96	11,047

Appendix 2. (cont.)

Trace ions (mg/L) and isotope composition[1] in ground-water samples.

BEG ID	Well name	TWC[1] ID	As	Cd^{2+}	Li^{+}	Fe^{2+}	Sr^{2+}	Ba^{2+}	Br^{-}	F^{-}	$\delta^{18}O$**	δD**	Tritium	$\delta^{34}S$**	$\delta^{13}C$**	PMC†	^{14}C Age††
LL154	Flattop Well - Figure 2 Ranch	48-24-9	<0.05	<0.03	0.09	0.35	0.09	0.12	0.50	1.5	-8.90	-61.8	8.1	11.04	-7.40	25.54	4,406
LL155	Dyer #3 Well	48-39-1	<0.05	<0.03	0.19	0.65	0.19	0.07	1.46	3.0	-7.31	-54.8	21.4	2.91	-6.76	9.08	12,210
LL156	Baylor-New Well	48-37-3	<0.05	<0.03	0.07	<0.02	0.07	0.04	1.31	3.0	-7.38	-57.4	9.5	6.65	-4.73	39.43	modern
LL157	Baylor-Old Well	48-37-3	<0.05	<0.03	0.06	0.19	0.06	0.14	0.60	3.0	-7.04	-46.4	32.0	9.00	-4.75	90.77	modern

+ see fig. 7 for distribution
< less than indicated value
* reported value near detection limit
** $\delta^{18}O$ and $\delta^{2}H$ are defined relative to SMOW. $\delta^{34}S$ is given as deviation from the Canyon Diablo Meteorite standard. $\delta^{13}C$ is defined relative to Pee Dee Belemnite carbonate.
† PMC is percent of modern carbon.
†† ^{14}C age was corrected by using $\delta^{13}C$ values (Kreitler and others, 1986b; their Appendix 5).

[1] TWC's well identification system has 3 sets of numbers; preliminary wells have only one number in the last set, permitted wells have 3.

1) $\delta^{18}O$ and $\delta^{2}H$ defined relative to SMOW. $\delta^{34}S$ is given as deviation from the Canyon Diablo Meteorite standard. $\delta^{13}C$ defined relative to Pee Dee Belemnite carbonate.
2) PMC is percent of modern carbon.
3) ^{14}C age was corrected by using $\delta^{13}C$ values (app. 5) except for sample LL126.
4) Tritium data for the Low Level well were not available by the time this report was submitted. Data will be provided in an addendum.