

**Field Logs of Boreholes for Nested Piezometers,
Nancy Lopez Site, Valencia County, New Mexico**

Prepared for:

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Introduction:

This report summarizes the preliminary lithostratigraphy and hydrostratigraphy for the Nancy Lopez monitoring well site (Nancy Lopez well), just southeast of the town of Belen (Fig. 1). This well, completed in cooperation with the NM Office of the State Engineer (NMOSE), U.S. Geological Survey (Water Resources Division), and the New Mexico Bureau of Mines and Mineral Resources (NMBMMR), will be used to monitor groundwater conditions in the Belen sub-basin and to further characterize the Santa Fe Group regional aquifer in the Albuquerque Basin. Historical data for this monitoring well are summarized in Table 1. The Nancy Lopez well is about 8.3 miles (13.4 km) south of the Tome monitoring well. The U.S. Geological Survey will construct three piezometers at the Nancy Lopez well site. The well was drilled to a depth of 1200 feet during late August and September of 1998. To minimize caving of unconsolidated sediments near the surface, the well was cased to 38 feet during drilling. Lithologic samples (cuttings) were taken at 10-foot intervals at the well head. Borehole geophysical logs were run shortly after the target depth was attained. Borehole geophysical logs and cuttings were used to characterize the lithology of Santa Fe Group deposits encountered in this borehole and to provide qualitative estimates of the hydrogeologic character of the aquifer.

This lithologic log and report are submitted to the NMOSE as partial fulfillment of an intergovernmental service agreement with the NMBMMR, a division of the New Mexico Institute of Mining and Technology. The cuttings and geophysical logs used to prepare this report will be available for inspection at NMBMMR in Socorro, New Mexico. This lithologic report will be available as part of Open-File Report 444 in order to make it available as soon as possible. This report has not been reviewed according to NMBMMR standards. *The contents of this report should not be considered final and complete until it is published by the NMBMMR.*

Analytical Methods:

Lithologic descriptions were made by visual examination of mud-rotary cuttings taken from the well head at 10-foot intervals (Table 5). Drilling methods prevent a complete evaluation of the finer grained fraction (commonly fine-grained sand and silt) that tends to be held in suspension by the drilling fluids. Sieve testing was not conducted. Lithologic descriptions are based on the following criteria:

1. Major textural class;
2. Estimated grain-size distribution by major textural class:
 - a. silt-clay (<0.05 mm)
 - b. sand (0.05-2.00 mm)
 - c. gravel (>2.00 mm)
3. Grain and clast shape;
4. Sorting and approximate range of grain and clast size;
5. Clast composition and approximate relative abundance, in decreasing order of abundance;
6. Color, using Munsell (1992) notation;
7. Other characteristics and selected driller's comments.

Hydrostratigraphic subdivisions of the borehole were made using nomenclature developed for alluvial deposits in the Albuquerque Basin by Hawley and Whitworth (1996). In this system deposits are assigned to gravely and sandy fluvial (I-III), eolian (IV), piedmont (V-VIII), and fine-grained basin-floor/playa (IX-X) lithofacies. These lithofacies are used to determine hydrostratigraphic units that are subdivided into post-Santa Fe Group and Santa Fe Group deposits. Post-Santa Fe Group units include fluvial-terrace deposits (RA and TA), and piedmont deposits (PA). Santa Fe Group hydrostratigraphic units consist of fluvial and piedmont deposits that are further subdivided into upper (USF), middle (MSF), and lower (LSF) sub-units. The lack of available high-quality lithologic and geophysical log data from neighboring wells precludes definitive hydrostratigraphic classification using this system of nomenclature.

Geology of the Nancy Lopez Monitoring Well

The Nancy Lopez well was collared in Quaternary eolian sand (Qe) at an elevation of 4925±5 feet (Fig. 2). A prominent deflection in the sonic log at 122 ft indicates that the static water level in the uncased, 1200-ft deep hole was at an elevation of about 4803 feet on August 21, 1998. The elevation of the static water level is nearly identical to the elevation of the Rio Grande (about 4800±5 ft), 1.5 miles west of the site (Fig. 1).

Major lithologic units are graphically displayed in Figure 3 and described in Table 4. The Nancy Lopez well penetrated about 30 feet of fine-grained, quartz-rich eolian sand. The moderately to well sorted, fine to coarse-grained fluvial sand and silt/clay interbeds present below 30 feet are provisionally assigned to the Sierra Ladrones Formation (Machette, 1978). This formation consists of generally well sorted sand and gravel deposited by a through-going fluvial system, such as the ancestral Rio Grande or Rio Puerco fluvial systems. Clasts are predominantly rounded to subangular quartzite, granite, chert, and volcanic rocks, with trace amounts of sandstone. No limestone or schist was observed. The presence of volcanic and rounded quartzite clasts suggests that these deposits were derived from northern and north-central New Mexico, probably by an ancestral Rio Grande fluvial system. The lack of angular or subangular limestone and metamorphic clasts suggests that these deposits were not derived from the granitic, metamorphic and limestone rocks exposed in the Manzano Mountains approximately 10 miles east of the well site.

The Sierra Ladrones Formation is subdivided into informal "upper" and "lower" members. The upper member is encountered between 30 and 860 feet and is dominantly well sorted, sandy fluvial deposits containing 10-45% rounded to subrounded quartzite and volcanic-bearing gravel. The upper member contains interbeds of silty and clayey sand that are generally organized into crude upward-fining sequences that make up an overall upward coarsening trend in this sub-unit (Fig. 3). Geophysical log data indicate that coarse-grained intervals are typically more resistive ($R=21$ to 54 ohmm, $R_{\text{mean}}=33$ ohmm) than the finer grained interbeds ($R=25$ to 121 ohmm; $R_{\text{mean}}=100$ to 125 ohmm), which can also be delineated by increases in the gamma-ray log (GR) of up to 170 API units. Upward fining sequences range from 30 to 125 feet in thickness. The upper contact of the upper member is overlain by eolian sand.

The lower member extends from 860 ft to the bottom of the well at 1200 ft. The lower member is finer grained and is predominantly composed of muddy sand and clayey sand with

relatively rare gravel interbeds. The total gravel content is between 0 and 5%. Clasts are predominantly subrounded and the overall composition is similar to the gravel described in the upper member, which is interpreted as being related to deposition by a muddy fluvial system during Sierra Ladrones time. Interpretation of electrical conductivity and natural gamma-ray logs (Fig. 3) indicate a slight increase in silt and clay in the lower member. Geophysical data indicate that this unit typically is less resistive than the overlying deposits of the upper member.

lower Sierra Ladrones :

$R=2$ to 60 ohmm

$R_{mean}=7$ ohmm

$C= 16$ to 540 mmhos/m

upper Sierra Ladrones:

$R=5$ to 335 ohmm

$R_{mean} =31$ ohmm

$GR=80$ to 190 API units

$GR_{mean} =108$ API units

The upper contact of the lower member (at 860 ft deep) is marked by a 110-ft thick sticky and somewhat plastic clay with scattered coarse-grained sand that is expressed as a zone of relatively high electrical conductivity. This clayey interval may be somewhat thinner, but possibly correlative to the Atrisco member (Connell et al., 1998), a subsurface marker in the Calabacillas sub-basin, about 40 km to the north in Albuquerque. Further subsurface correlation, however, is required to correlate the Atrisco member on a regional scale.

The stratigraphic succession in the Nancy Lopez well is somewhat similar to deposits described in the Tome site well, about 8 miles to the north (Figs. 1 and 4). Deposits in both wells have been provisionally assigned to the Sierra Ladrones Formation and are subdivided into upper and lower members. The upper members in both wells contain a relatively thick succession of upward-fining sequences stacked in a generally upward-coarsening succession that culminates with the coarsest and most abundant gravel occurring near the top of the borehole section. Geophysical logs show slight increases in the electrical conductivity and porosity at the upper/lower member transition, which is marked by a somewhat plastic and sticky clay.

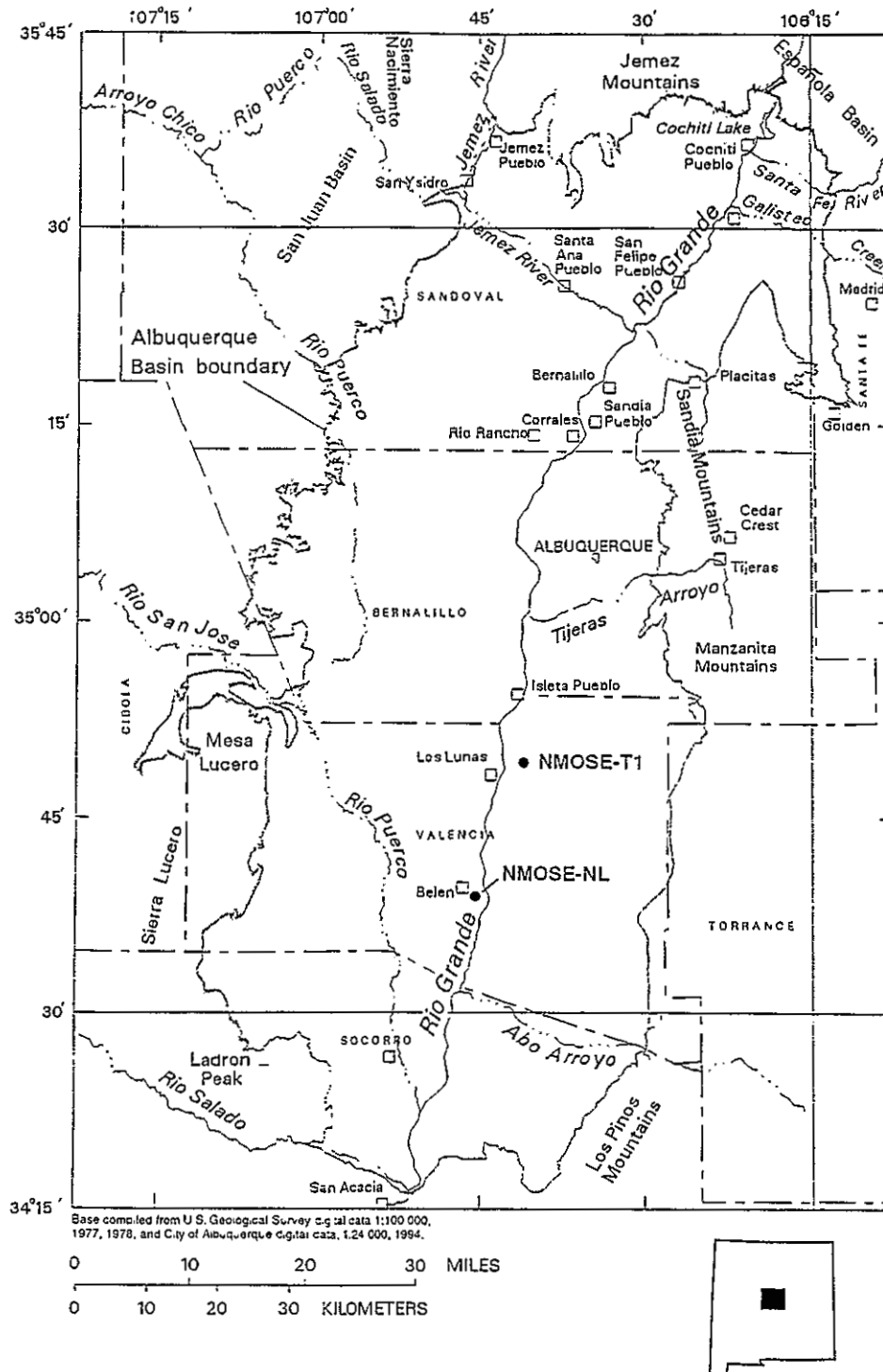


Figure 1: Index map showing the general location of the Nancy Lopez (NMOSE-NL) and Tomé (NMOSE-T1) monitoring wells. Base map modified from Bexfield (1998).

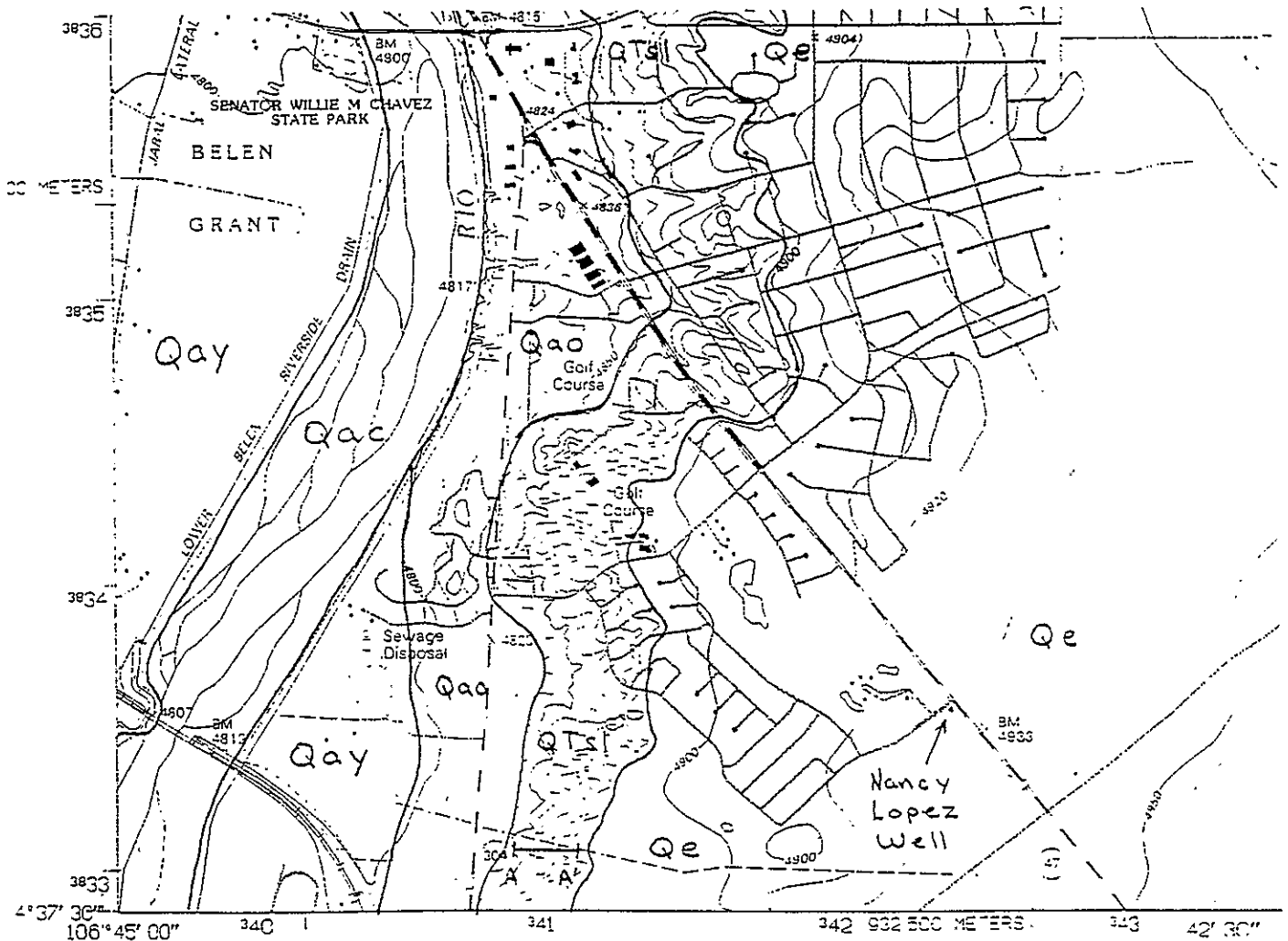
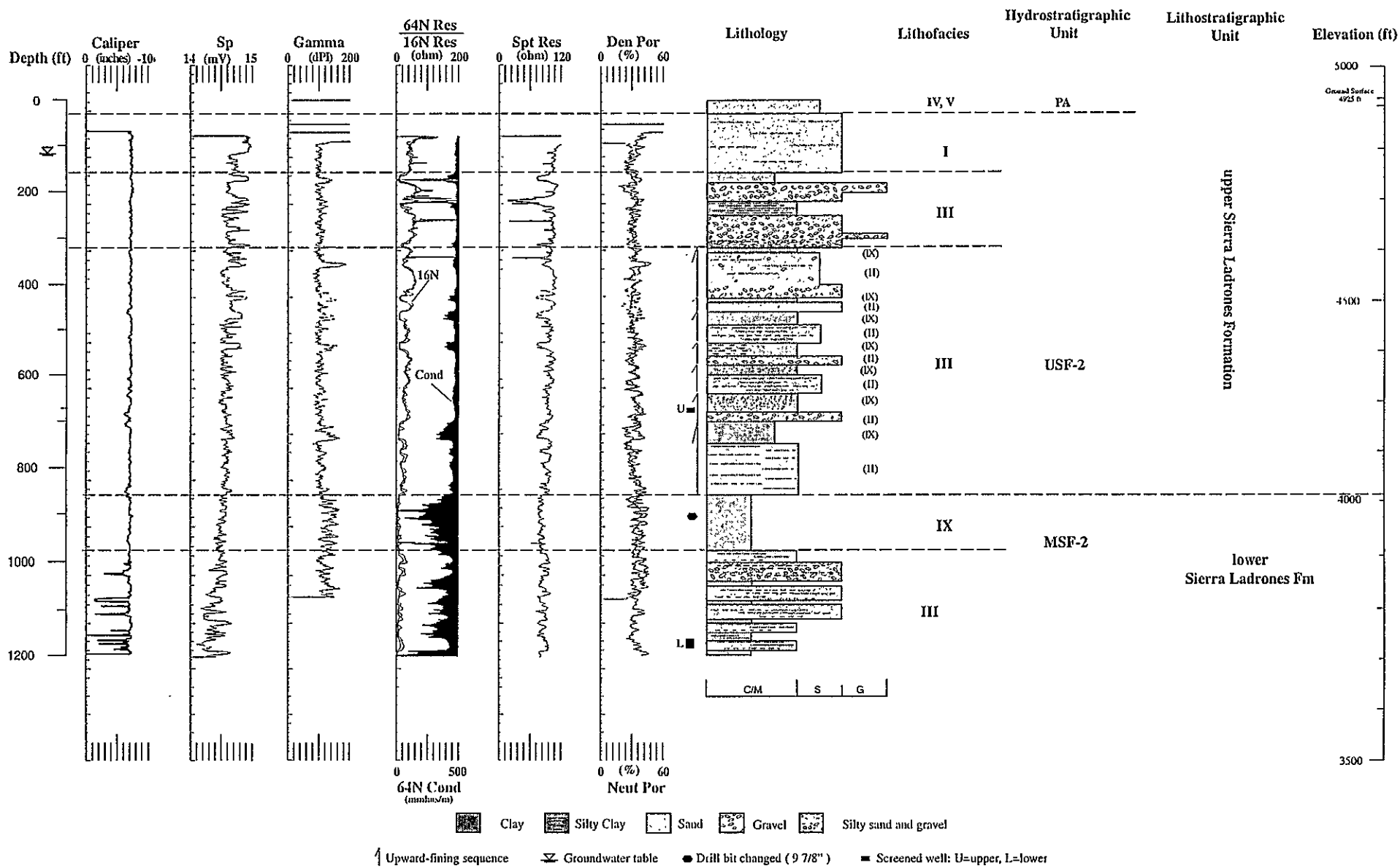


Figure 2: Reconnaissance geologic map in the vicinity of the Nancy Lopez monitoring well (NMOSE-NL), Valencia County, New Mexico (geology by R.M. Chamberlin, August 1998). Topographic base is from the southwestern part of the Tomé 7.5-minute quadrangle (scale 1:24,000). Sierra Ladrones Formation (QTsl) at reference section (A-A') consists of light gray quartzo-feldspathic sands and minor pebble gravels containing abundant clasts of quartzite with moderately abundant granitic and volcanic clasts. This unit presents well-sorted fluvial deposits of the ancestral Rio Grande. Quaternary surficial deposits include eolian sand (Qe), older alluvial deposits of the Rio Grande (Qao), younger floodplain deposits of the Rio Grande (Qay), and active channel deposits of the Rio Grande (Qac). All contacts are approximately located.

Table 2: Description and interpretation of major textural units. Color represents that of moist sediment.

<u>Depth (ft)</u>	<u>Description</u>
0-30	Fine-grained, quartz-rich eolian sand and trace amounts of silt. Yellowish brown (10YR 5/4). Peds of a strongly developed calcic soil, exhibiting stage III- to IV-carbonate morphology, were observed in an 8-ft deep mud pit near the well head. <i>Hydrostratigraphic unit PA.</i>
30-160	Fine- to coarse-grained sand with minor granules and small pebbles. Yellowish-brown (10YR 5/4). Quartzite, granite, and intermediate volcanic clasts. Interpreted to be basin-floor fluvial system deposited by the ancestral Rio Grande. <i>Hydrostratigraphic unit USF-2.</i>
160-320	Silty-clayey, medium- to coarse-grained sand and gravel, and silty-clayey, fine- to coarse-grained sand with scattered granules. Yellowish-brown to brownish yellow (10YR 5/4-6/6). Interpreted to be basin-floor fluvial system deposited by the ancestral Rio Grande. <i>Hydrostratigraphic unit USF-2.</i>
320-860	Upward-fining sequences of gravelly sand, silty medium to coarse-grained sand, silt and clay that comprise a dominantly laterally aggrading system of basin-floor fluvial deposits laid down by the ancestral Rio Grande. <i>Hydrostratigraphic unit USF-2.</i>
860-970	Clay with scattered coarse-grained sand and fine pebble gravel. Reddish-brown (5YR 5/3). Interpreted to represent a basin-floor alluvial flat and muddy ancestral Rio Grande fluvial system. <i>Hydrostratigraphic unit MSF-2.</i>
970-1200	Interbedded clayey to silty, fine- to coarse-grained sand with minor small pebble gravel and clay. Grayish brown to brown (10YR 5/2-5/4). Interpreted to represent a basin floor alluvial flat and muddy ancestral Rio Grande fluvial system. <i>Hydrostratigraphic unit MSF-2.</i>

Figure 3: Geophysical Data Logs, Stratigraphic Column, and Preliminary Hydrostratigraphic & Lithostratigraphic Interpretations



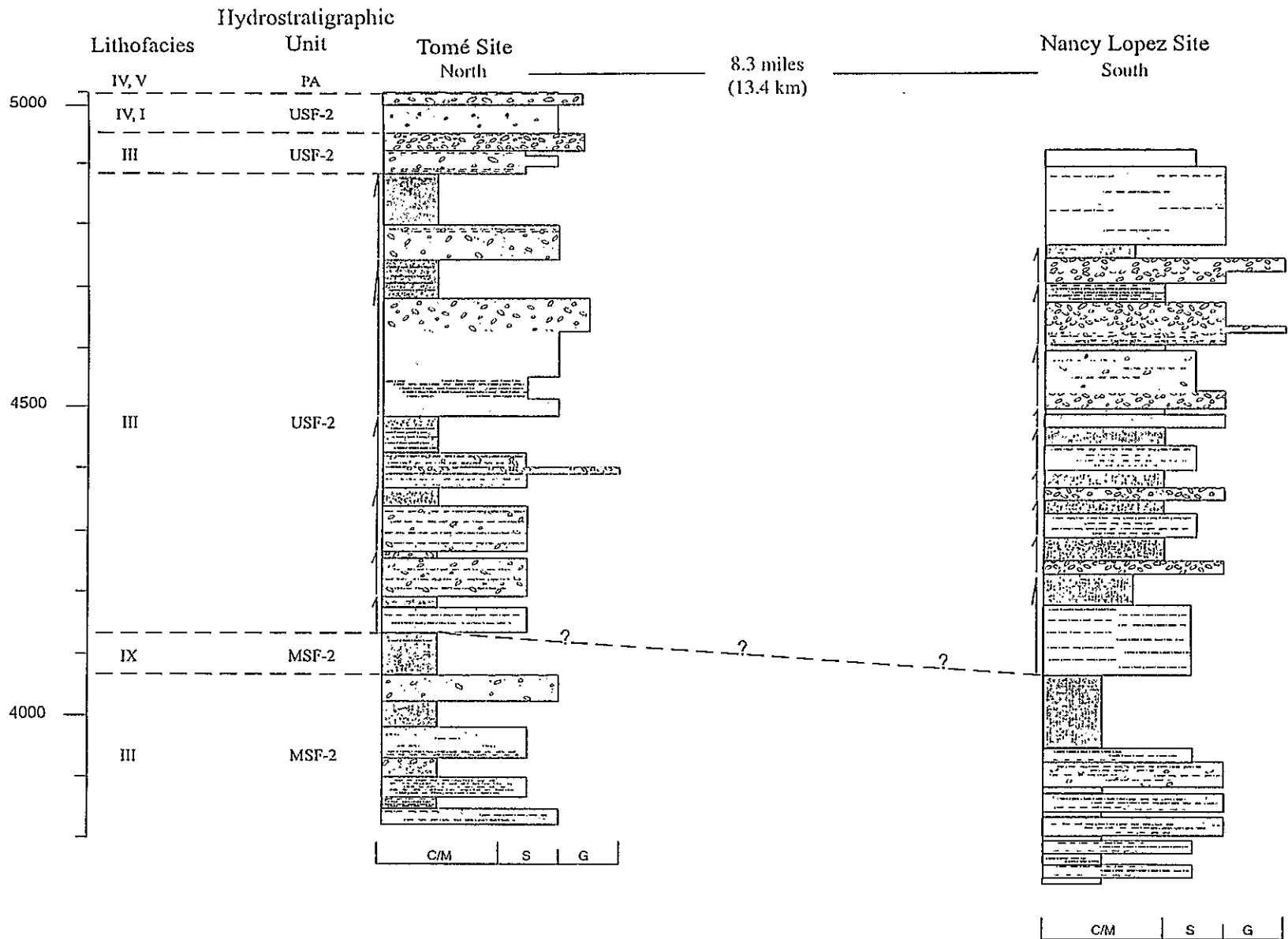


Figure 4: Correlation diagram comparing the lithologic columns of the Tomé and Nancy Lopez well sites.

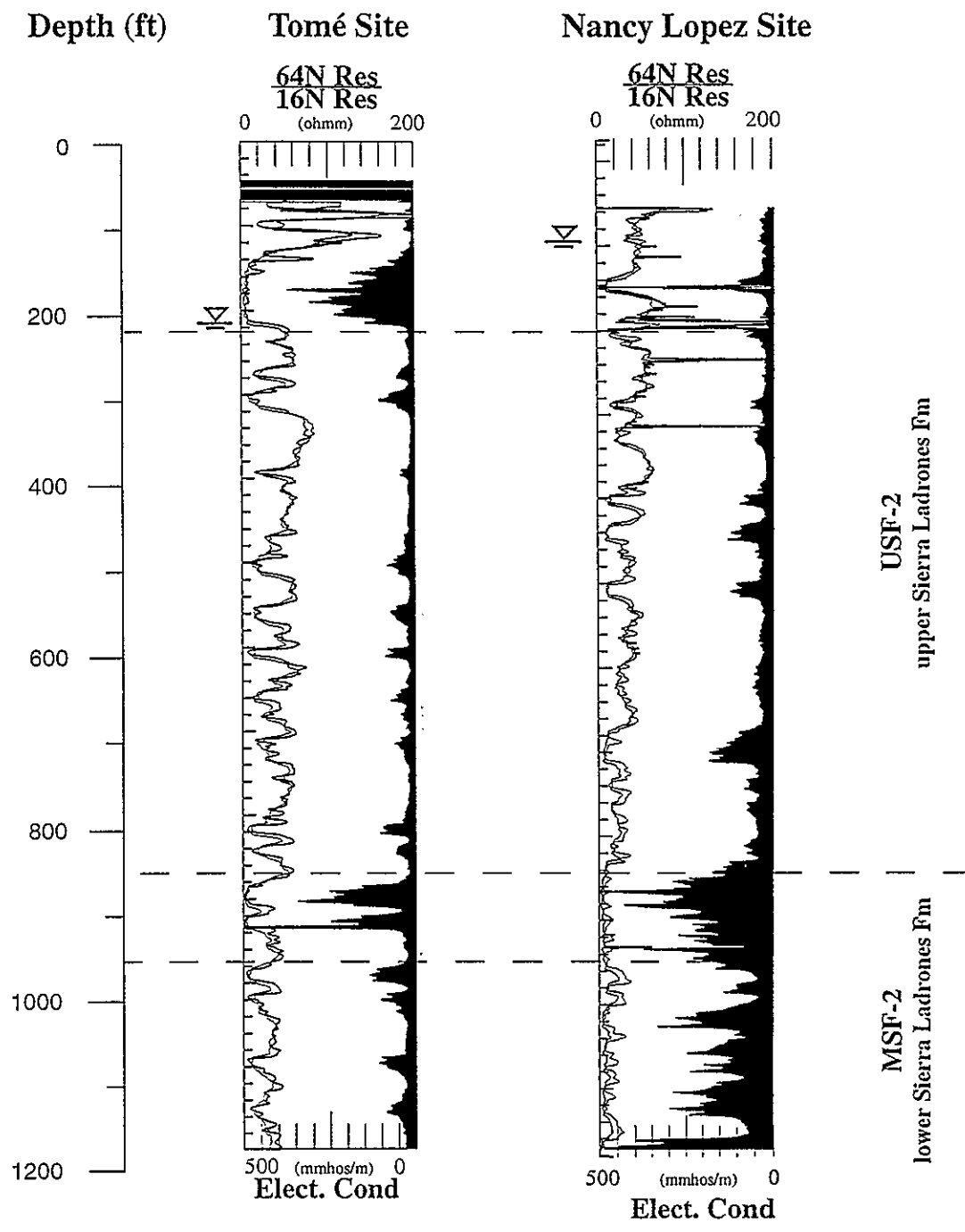


Table 3: Summary of lithofacies (modified from Hawley and Whitworth, 1996) assigned to major textural units.

Lithofacies	<u>Dominant Textural Classes</u>	<u>Dominant Deposition Setting</u>
I	Medium to very coarse-grained sand and pebble gravel mixture	Basin-floor fluvial; braid plain
II	Fine to coarse-grained sand with lenses of pebble sand and silty clay	Basin-floor fluvial; locally eolian
III	Interbedded sand and silty clay with lenses of pebbly/granular fine to coarse-grained sand	Basin-floor fluvial; locally eolian
IV	Fine-grained sand and/or sandstone with lenses of silty sand to clay	Eolian, basin-floor
V	A mixture of gravel, sand, silt, and clay	Distal to medial piedmont slope, alluvial fan
IX	Silty clay interbedded with sand, silty sand, and/or clay	Basin-floor playa-lake and alluvial flat; distal piedmont

Table 4: Summary of the hydrostratigraphic units (modified from Hawley and Whitworth, 1996) observed at the Tomé site.

<u>Hydrostratigraphic Unit</u>	<u>Description</u>
VA	Tributary-arroyo channel, fan and terrace deposits along the inter-valley borders of the Rio Grande system. These can range up to 100 feet in thickness.
USF-2	The Upper Santa Fe hydrostratigraphic unit is ancestral Rio Grande fluvial deposits that intertongue with piedmont-alluvial deposits at the basin margins. Volcanic rocks such as basalt, andesite, rhyolite and pyroclastic debris are locally present. Subunit 2 is dominated by ancestral Rio Grande and interbedded fine to coarse-grained sediments from various depositional environments.
MSF-2	The Middle Santa Fe hydrostratigraphic unit is a mixture of alluvial, eolian and playa-lake deposits and moderately indurated piedmont alluvium that intertongues basinward with basin-floor playa-lake and fluvial deposits. Basaltic to silicic volcanics are present depending on location within the basin. Basin-floor sediments of an alluvial, lacustrine, and/or eolian origin dominate MSF-2.

Table 5: Sample Descriptions of Cutting from the Nancy Lopez well site.

Sample No.	Depth Interval (ft)	Description
NL-1	0-10	Fine-grained, eolian sand (100% sand), very well sorted, subangular to subrounded grains. Yellowish brown (10YR 5/4).
NL-2	10-20	Fine-grained, eolian sand (100% sand), very well sorted, subangular to subrounded grains. Yellowish brown (10YR 5/4).
NL-3	20-30	Fine to medium-grained sand (95% sand, 5% fine pebble gravel), well sorted, subangular to subrounded grains. Yellowish brown (10YR 5/4). Quartzite, granite, and intermediate volcanics.
NL-4	30-40	Coarse-grained sand (95% sand, 5% fine pebble gravel), well sorted, subangular to subrounded grains. Yellowish brown (10YR 5/4). Quartzite, granite, and intermediate volcanics.
NL-5	40-50	Coarse-grained sand (95% sand, 5% fine pebble gravel), well sorted, subangular to subrounded grains. Yellowish brown (10YR 5/4). Granite quartzite, chert, and intermediate volcanics.
NL-6	50-60	Medium to coarse-grained sand with minor clay and trace gravel (95% sand, 5% clay, trace gravel), well sorted, subangular to subrounded grains. Yellowish brown sand (10YR 5/4) and reddish brown clay (5YR 4/4). Granite quartzite, chert, and intermediate volcanics..
NL-7	60-70	Silty/clayey fine-grained sand with minor fine pebble gravel (50% sand, 40% silt/clay, 10% gravel), moderately to well sorted, subangular to subrounded grains. Yellowish brown (10YR 5/4). Granite quartzite, chert, and intermediate volcanics.
NL-8	70-80	Coarse-grained sand (95% sand, 5% fine pebble gravel), moderately to well sorted, subangular to subrounded grains. Yellowish brown (10YR 5/4). Granite quartzite, chert, and intermediate volcanics.
NL-9	80-90	Fine pebble gravel and coarse-grained sand (65% gravel, 35% sand), moderately sorted, subangular to subrounded grains. Yellowish brown (10YR 5/4). Granite quartzite, chert, and intermediate volcanics.
NL-10	90-100	Coarse-grained sand (90% sand, 10% fine pebble gravel), moderately to well sorted, subangular to subrounded grains. Yellowish brown (10YR 5/4). Granite quartzite, chert, and intermediate volcanics.
NL-11	100-110	Medium to coarse-grained sand with minor fine pebble gravel (90% sand, 10% gravel, trace silt/clay), moderately to well sorted, subangular to subrounded grains. Yellowish brown (10YR 5/6). Granite, quartzite, chert, and intermediate volcanics.
NL-12	110-120	Medium to coarse-grained sand with minor fine pebble gravel and clay (85% sand, 10% gravel, 5% clay), moderately to well sorted, subangular to subrounded grains. Grayish brown (10YR 5/2) to yellowish brown (10YR 5/4). Granite, quartzite, chert, and intermediate volcanics.
NL-13	120-130	Pebbly gravel with coarse-grained sand (70% gravel, 25% sand, 5% clay), moderately to well sorted, subangular to subrounded grains. Yellowish brown (10YR 5/4) to grayish brown (10YR 5/2). Granite, quartzite, chert and minor rhyolitic volcanics
NL-14	130-140	Coarse-grained sand and granule-pebble gravel (50% sand, 50% gravel), moderately to well sorted, subangular to subrounded grains. Grayish brown (10YR 5/2). Granite, quartzite, chert and minor rhyolitic volcanics

Sample No.	Depth Interval (ft)	Description
NL-15	140-150	Coarse-grained sand and granule-pebble gravel (50% sand, 50% gravel), moderately to well sorted, subangular to subrounded grains. Grayish brown (10YR 5/2). Granite, quartzite, chert and minor rhyolitic volcanics
NL-16	150-160	Granular-pebbly gravel and coarse-grained sand (60% gravel, 40% sand, trace silt), moderately sorted, subangular to subrounded grains. Yellowish brown (10YR 5/4). Granite, quartzite, chert, and minor sandstone.
NL-17	160-170	Granular-pebbly gravel and silty sand (60% gravel, 30% sand, 10% silt), moderately sorted, subangular to subrounded grains. Yellowish brown sand and gravel(10YR 5/4) and reddish brown silt (5YR 3/4). Granite, quartzite, chert, and minor sandstone.
NL-18	170-180	Clay with minor silty sand and pebbly gravel (95% clay, 5% gravel and sand), moderately to well sorted, subangular to subrounded grains/clasts. Reddish brown (5YR 3/4). Granite, quartzite, chert, rhyolitic volcanics.
NL-19	180-190	Clay with pebbly gravel (60% clay, 40% gravel), moderately sorted, subangular to subrounded clasts. Reddish brown (5YR 3/4). Granite, quartzite, chert, rhyolitic volcanics. NOTE: Break between clay and gravel is closer to 190 feet.
NL-20	190-200	Granular to pebble gravel (90% gravel, 5% clay, 5% sand), moderately sorted, subangular to subrounded clasts. Reddish brown (5YR 4/3). Granite, chert, quartzite, minor volcanics and sandstone.
NL-21	200-210	Silty fine grained sand and granular to pebble gravel (50% sand, 45% gravel, 5% clay), moderately sorted, angular to subrounded clasts. Brown to yellowish brown (10YR 5/3-5/4). Granite, chert, quartzite, minor volcanics and sandstone.
NL-22	210-220	Granular to pebble gravel with silty fine-grained sand (80% gravel, 20% sand), moderately sorted, angular to subrounded clasts. Brown to yellowish brown (10YR 5/3-5/4). Granite, chert, quartzite, minor volcanics and sandstone.
NL-23	220-230	Clayey silt (70% silt, 30% clay, trace pebble gravel), well sorted, subrounded to subangular clasts. Brown (10YR 5/4). Quartzite, chert.
NL-24	230-240	Clayey silt (70% silt, 30% clay), well sorted. Brown (10YR 5/4).
NL-25	240-250	Coarse sand and granular to pebble gravel (85% sand, 10% gravel, 5% clay/silt), subangular to rounded grains, moderately sorted. Yellowish brown (10YR 5/4). Granite, quartzite, chert, minor sandstone and intermediate volcanics.
NL-26	250-260	Coarse sand and granular to pebble gravel (85% sand, 10% gravel, 5% clay/silt), subangular to rounded grains, moderately sorted. Yellowish brown (10YR 5/4). Granite, quartzite, chert, minor sandstone and intermediate volcanics.
NL-27	260-270	Coarse sand and granular to pebble gravel (85% sand, 15% gravel), subangular to rounded grains, moderately sorted. Yellowish brown (10YR 5/4). Granite, quartzite, chert, minor sandstone and intermediate volcanics.

Sample No.	Depth Interval (ft)	Description
NL-28	270-280	Coarse sand and granular to pebble gravel (80% sand, 20% gravel), subangular to rounded grains, moderately sorted. Yellowish brown (10YR 5/4). Granite, quartzite, chert, minor sandstone and intermediate volcanics.
NL-29	280-290	Coarse sand and granular to pebble gravel (70% sand, 30% gravel, trace clay/silt), subangular to rounded grains, moderately sorted. Yellowish brown (10YR 5/4). Granite, quartzite, chert, minor sandstone and intermediate volcanics.
NL-30	290-300	Granular to pebble gravel (90% gravel, 5% fine to medium-grained sand, 5% clay/silt), moderately sorted, subangular to subrounded clasts. Reddish gray to gray (5YR 5/2 to 10YR 5/1). Subequal amounts of granite, quartzite, and chert with minor sandstone and intermediate volcanics.
NL-31	300-310	Coarse-grained sand with minor gravel and clay (90% sand, 5% gravel, 5% clay), moderately sorted, subangular to rounded grains. Gray to brown (10YR 5/1 to 5/3). Granite, quartzite, chert, sandstone, trace intermediate volcanics. NOTE: Sandstone grains are the most well rounded portion of the sand component.
NL-32	310-320	Silty/clayey fine to coarse-grained sand with minor gravel (80% sand, 15% silt/clay, 5% gravel), moderately sorted, subangular to rounded grains. Gray to brown (10YR 5/1 to 5/3). Granite, quartzite, chert, sandstone, trace intermediate volcanics. NOTE: Sandstone grains are the most well rounded portion of the sand component.
NL-33	320-330	Clay and fine-grained sand with trace gravel (60% clay, 40% sand, trace pebble gravel), moderately sorted, subangular to subrounded grains. Reddish brown (5YR 5/3). Granite, quartzite, chert, sandstone, trace intermediate volcanics.
NL-34	330-340	Fine-grained sand with minor clay and trace pebble gravel (95% sand, 5% clay, trace gravel), well sorted, subrounded to rounded grains. Brown (10YR 5/3). Granite, quartzite, chert, sandstone, trace intermediate volcanics.
NL-35	340-350	Fine-grained sand with minor clay and trace pebble gravel (95% sand, 5% clay, trace gravel), well sorted, subrounded to rounded grains. Brown (10YR 5/3). Granite, quartzite, chert, sandstone, trace intermediate volcanics.
NL-36	350-360	Fine-grained sand with minor clay and trace pebble gravel (95% sand, 5% clay, trace gravel), well sorted, subrounded to rounded grains. Brown (10YR 5/3). Granite, quartzite, chert, sandstone, trace intermediate volcanics.
NL-37	360-370	Fine-grained sand with minor clay and trace pebble gravel (95% sand, 5% clay, trace gravel), well sorted, subrounded to rounded grains. Brown (10YR 5/3). Granite, quartzite, chert, sandstone, trace intermediate volcanics.
NL-38	370-380	Fine-grained sand with minor clay and trace pebble gravel (95% sand, 5% clay, trace gravel), well sorted, subrounded to rounded grains. Brown (10YR 5/3). Granite, quartzite, chert, sandstone, trace intermediate volcanics.

Sample No.	Depth Interval (ft)	Description
NL-39	380-390	Fine-grained sand with minor clay and trace pebble gravel (95% sand, 5% clay, trace gravel), well sorted, subrounded to rounded grains. Brown (10YR 5/3). Granite, quartzite, chert, sandstone, trace intermediate volcanics.
NL-40	390-400	Fine-grained sand with minor clay and trace pebble gravel (95% sand, 5% clay, trace gravel), well sorted, subrounded to rounded grains. Brown (10YR 5/3). Granite, quartzite, chert, sandstone, trace intermediate volcanics.
NL-41	400-410	Medium to coarse-grained sand with scattered pebbles (95% sand, 5% gravel, trace clay/silt), moderately to well sorted, subangular to rounded grains. Reddish gray to gray (5YR 5/2 to 10YR 5/1). Quartzite, chert, granite, sandstone, and trace intermediate volcanics.
NL-42	410-420	Medium to coarse-grained sand with scattered pebbles (85% sand, 10% gravel, 5% clay/silt), moderately to well sorted, subangular to rounded grains. Reddish gray to gray (5YR 5/2 to 10YR 5/1). Quartzite, chert, granite, sandstone, and trace intermediate volcanics.
NL-43	420-430	Medium to coarse-grained sand with scattered pebbles (85% sand, 10% gravel, 5% clay/silt), moderately to well sorted, subangular to rounded grains. Reddish gray to gray (5YR 5/2 to 10YR 5/1). Quartzite, chert, granite, sandstone, and trace intermediate volcanics.
NL-44	430-440	Clayey silt (80% silt, 10% clay, 5% fine-grained sand). Reddish brown (5YR 5/4).
NL-45	440-450	Medium-grained sand (95% sand, 5% silt/clay, trace pebbles), well sorted, subangular to rounded. Reddish gray to gray (5YR 5/2 to 10YR 5/1). Quartzite, chert, granite, sandstone, and trace intermediate volcanics.
NL-46	450-460	Medium to coarse-grained sand with scattered pebbles (95% sand, 5% gravel, trace clay/silt), moderately to well sorted, subangular to rounded grains. Reddish gray to gray (5YR 5/2 to 10YR 5/1). Quartzite, chert, granite, sandstone, and trace intermediate volcanics.
NL-47	460-470	Clay (100% clay, trace medium-grained sand), well sorted. Light reddish brown (5YR 6/3).
NL-48	470-480	Clay (100% clay), well sorted. Reddish brown (5YR 5/4).
NL-49	480-490	Clay (100% clay), well sorted. Reddish brown (5YR 5/4).
NL-50	490-500	Fine-grained sand and silt/clay (60% sand, 40% silt/clay), well sorted, subrounded to rounded. Reddish brown (5YR 5/4).
NL-51	500-510	Silty fine-grained sand (90% sand, 10% silt, trace pebble gravel), well sorted, subrounded to rounded. Pale brown (10YR 6/3). Granite, sandstone. NOTE: Sand appears whitish brown when dry.
NL-52	510-520	Silty fine-grained sand (90% sand, 10% silt, trace pebble gravel), well sorted, subrounded to rounded. Pale brown (10YR 6/3). Granite, sandstone. NOTE: Sand appears whitish brown when dry.
NL-53	520-530	Silty fine-grained sand (90% sand, 10% silt, trace pebble gravel), well sorted, subrounded to rounded. Pale brown (10YR 6/3). Granite, sandstone. NOTE: Sand appears whitish brown when dry.

Sample No.	Depth Interval (ft)	Description
NL-54	530-540	Silty clay (80% clay, 20% silt, trace pebble gravel), well sorted, angular to subangular gravel clasts. Reddish brown (10YR 5/3). Granite, sandstone, chert.
NL-55	540-550	Silty clay (80% clay, 20% silt, trace pebble gravel), well sorted, angular to subangular gravel clasts. Reddish brown (10YR 5/3). Granite, sandstone, chert.
NL-56	550-560	Silty clay (80% clay, 20% silt, trace pebble gravel), well sorted, angular to subangular gravel clasts. Reddish brown (10YR 5/3). Granite, sandstone, chert.
NL-57	560-570	Medium to coarse-grained sand with scattered pebbles (75% sand, 20% gravel, 5% silt), moderately sorted, subangular to subrounded grains. Brown (10YR 5/3). Granite, quartzite, chert, sandstone, trace intermediate volcanics.
NL-58	570-580	Medium to coarse-grained sand with scattered pebbles (75% sand, 20% gravel, 5% silt), moderately sorted, subangular to subrounded grains. Brown (10YR 5/3). Quartzite, chert, granite, sandstone, and trace intermediate volcanics.
NL-59	580-590	Clayey fine to coarse-grained sand with scattered pebbles (70% sand, 20% clay, 10% gravel), poor to moderately sorted, subangular to subrounded grains. Brown (10YR 5/3). Quartzite, chert, granite, sandstone, and trace intermediate volcanics.
NL-60	590-600	Clayey fine to coarse-grained sand with scattered pebbles (70% sand, 20% clay, 10% gravel), poor to moderately sorted, subangular to subrounded grains. Brown (10YR 5/3). Quartzite, chert, granite, sandstone, and trace intermediate volcanics.
NL-61	600-610	Silty fine to coarse-grained sand (60% sand, 40% silt, trace gravel), moderately to well sorted, subangular to subrounded. Brown (10YR 5/3). Quartzite, sandstone, granite.
NL-62	610-620	Silty fine to coarse-grained sand (65% sand, 30% silt, 5% gravel), moderately to well sorted, subangular to subrounded. Brown (10YR 5/3). Quartzite, sandstone, granite.
NL-63	620-630	Silty fine to coarse-grained sand (65% sand, 20% silt, 10% gravel), moderately to well sorted, subangular to subrounded. Brown (10YR 5/3). Quartzite, sandstone, granite, chert.
NL-64	630-640	Silty fine to coarse-grained sand (65% sand, 20% silt, 10% gravel), moderately to well sorted, subangular to subrounded. Brown (10YR 5/3). Quartzite, sandstone, granite, chert, intermediate volcanics.
NL-65	640-650	Silt and fine to coarse-grained sand (60% silt, 30% sand, 10% gravel), poor to moderately sorted, angular to subrounded. Brown (10YR 5/3). Quartzite, sandstone, granite, chert, intermediate volcanics.
NL-66	650-660	Clayey silt with some fine-grained sand (75% silt/clay, 20% sand, 5% gravel), moderately sorted, angular to subrounded grains. Pale brown to brown (10YR 6/3-5/3). Chert, sandstone, quartzite, granite.
NL-67	660-670	Clayey silt with some fine-grained sand (85% silt/clay, 15% sand, trace gravel), moderately sorted, angular to subrounded grains. Pale brown to brown (10YR 6/3-5/3). Chert, sandstone, quartzite, granite.

Sample No.	Depth Interval (ft)	Description
NL-68	670-680	Clayey silt with some fine-grained sand (80% silt/clay, 15% sand, 5% gravel), moderately sorted, angular to subrounded grains. Pale brown to brown (10YR 6/3-5/3). Chert, sandstone, quartzite, granite.
NL-69	680-690	Silty medium to coarse-grained sand (75% sand, 15% silt, 10% gravel), moderately to well sorted, subangular to subrounded. Brown (10YR 5/3). Quartzite, sandstone, granite, chert.
NL-70	690-700	Silty medium to coarse-grained sand (75% sand, 15% silt, 10% gravel), moderately to well sorted, subangular to subrounded. Brown (10YR 5/3). Quartzite, sandstone, granite, chert.
NL-71	700-710	Silt and medium to coarse-grained sand (55% sand, 45% silt, trace gravel), moderately to well sorted, subangular to subrounded. Brown (10YR 5/3). Quartzite, sandstone, granite, chert.
NL-72	710-720	Silty clay (70% clay, 30% silt), well sorted. Pale brown (10YR 6/3).
NL-73	720-730	Silty clay (70% clay, 30% silt), well sorted. Pale brown (10YR 6/3).
NL-74	730-740	Clay (100%) well sorted. Reddish brown (5YR 5/3).
NL-75	740-750	Clay (100%) well sorted. Reddish brown (5YR 5/3).
NL-76	750-760	Silt, fine-grained sand, and clay (30% clay, 30% silt, 30% sand, trace gravel), moderately sorted, angular to subrounded grains. Pale brown to pale reddish brown (10YR 6/3 to 5YR 6/3). Chert, sandstone, quartzite, granite.
NL-77	760-770	Silt, fine-grained sand, and clay (30% clay, 30% silt, 30% sand, trace gravel), moderately sorted, angular to subrounded grains. Pale brown to pale reddish brown (10YR 6/3 to 5YR 6/3). Chert, sandstone, quartzite, granite.
NL-78	770-780	Silt, fine-grained sand, and clay (30% clay, 30% silt, 30% sand, trace gravel), moderately sorted, angular to subrounded grains. Pale brown to pale reddish brown (10YR 6/3 to 5YR 6/3). Chert, sandstone, quartzite, granite.
NL-79	780-790	Silt, fine-grained sand, and clay (30% clay, 30% silt, 30% sand, trace gravel), moderately sorted, angular to subrounded grains. Pale brown to pale reddish brown (10YR 6/3 to 5YR 6/3). Chert, sandstone, quartzite, granite.
NL-80	790-800	Silt, fine-grained sand, and clay (30% clay, 30% silt, 30% sand, trace gravel), moderately sorted, angular to subrounded grains. Pale brown to pale reddish brown (10YR 6/3 to 5YR 6/3). Chert, sandstone, quartzite, granite.
NL-81	800-810	Silt, fine-grained sand, and clay (30% clay, 30% silt, 30% sand, trace gravel), moderately sorted, angular to subrounded grains. Pale brown to pale reddish brown (10YR 6/3 to 5YR 6/3). Chert, sandstone, quartzite, granite.
NL-82	810-820	Silt, fine-grained sand, and clay (30% clay, 30% silt, 30% sand, trace gravel), moderately sorted, angular to subrounded grains. Pale brown to pale reddish brown (10YR 6/3 to 5YR 6/3). Chert, sandstone, quartzite, granite.
NL-83	820-830	Silt, fine-grained sand, and clay (30% clay, 30% silt, 30% sand, trace gravel), moderately sorted, angular to subrounded grains. Pale brown to pale reddish brown (10YR 6/3 to 5YR 6/3). Chert, sandstone, quartzite, granite.

Sample No.	Depth Interval (ft)	Description
NL-84	830-840	Silt, fine-grained sand, and clay (30% clay, 30% silt, 30% sand, trace gravel), moderately sorted, angular to subrounded grains. Pale brown to pale reddish brown (10YR 6/3 to 5YR 6/3). Chert, sandstone, quartzite, granite.
NL-85	840-850	Silt, fine-grained sand, and clay (30% clay, 30% silt, 30% sand, trace gravel), moderately sorted, angular to subrounded grains. Pale brown to pale reddish brown (10YR 6/3 to 5YR 6/3). Chert, sandstone, quartzite, granite.
NL-86	850-860	Silt, fine-grained sand, and clay (30% clay, 30% silt, 30% sand, trace gravel), moderately sorted, angular to subrounded grains. Pale brown to pale reddish brown (10YR 6/3 to 5YR 6/3). Chert, sandstone, quartzite, granite.
NL-87	860-870	Clay (85% clay, 10% silt, 5% scattered coarse-grained sand and fine pebble gravel), well sorted. Reddish brown (5YR 5/3).
NL-88	870-890	Clay (85% clay, 10% silt, 5% scattered coarse-grained sand and fine pebble gravel), well sorted. Reddish brown (5YR 5/3).
NL-89	890-900	Clay (85% clay, 10% silt, 5% scattered coarse-grained sand and fine pebble gravel), well sorted. Reddish brown (5YR 5/3).
NL-90	900-910	Clay (85% clay, 10% silt, 5% scattered coarse-grained sand and fine pebble gravel), well sorted. Reddish brown (5YR 5/3).
NL-91	910-920	Clay (85% clay, 10% silt, 5% scattered coarse-grained sand and fine pebble gravel), well sorted. Reddish brown (5YR 5/3).
NL-92	920-930	Clay (85% clay, 10% silt, 5% scattered coarse-grained sand and fine pebble gravel), well sorted. Reddish brown (5YR 5/3).
NL-93	930-940	Clay (85% clay, 10% silt, 5% scattered coarse-grained sand and fine pebble gravel), well sorted. Reddish brown (5YR 5/3).
NL-94	940-950	Clay (85% clay, 10% silt, 5% scattered coarse-grained sand and fine pebble gravel), well sorted. Reddish brown (5YR 5/3).
NL-95	950-960	Clay (85% clay, 10% silt, 5% scattered coarse-grained sand and fine pebble gravel), well sorted. Reddish brown (5YR 5/3).
NL-96	960-970	Clay (85% clay, 10% silt, 5% scattered coarse-grained sand and fine pebble gravel), well sorted. Reddish brown (5YR 5/3).
NL-97	970-980	Silt, fine-grained sand, and clay (30% clay, 30% silt, 30% sand, trace gravel), moderately sorted, angular to subrounded grains. Pale brown to pale reddish brown (10YR 6/3 to 5YR 6/3). Chert, sandstone, quartzite, granite.
NL-98	980-990	Silt, fine-grained sand, and clay (30% clay, 30% silt, 30% sand, trace gravel), moderately sorted, angular to subrounded grains. Pale brown to pale reddish brown (10YR 6/3 to 5YR 6/3). Chert, sandstone, quartzite, granite.
NL-99	990-1000	Silt, fine-grained sand, and clay (30% clay, 30% silt, 30% sand, trace gravel), moderately sorted, angular to subrounded grains. Pale brown to pale reddish brown (10YR 6/3 to 5YR 6/3). Chert, sandstone, quartzite, granite.
NL-100	1000-1010	Clayey/silty coarse-grained sand and pebble gravel (65% sand, 20% gravel, 15% clay/silt), moderately sorted, subangular to subrounded grains. Brown to reddish brown (10YR 5/3 to 5YR 5/3). Chert, quartzite, granite.

Sample No.	Depth Interval (ft)	Description
NL-101	1010-1020	Clayey/silty coarse-grained sand and pebble gravel (65% sand, 20% gravel, 15% clay/silt), moderately sorted, subangular to subrounded grains. Brown to reddish brown (10YR 5/3 to 5YR 5/3). Chert, quartzite, granite.
NL-102	1020-1030	Clayey/silty coarse-grained sand and pebble gravel (65% sand, 20% gravel, 15% clay/silt), moderately sorted, subangular to subrounded grains. Brown to reddish brown (10YR 5/3 to 5YR 5/3). Chert, quartzite, granite.
NL-103	1030-1040	Clayey/silty coarse-grained sand and pebble gravel (65% sand, 20% gravel, 15% clay/silt), moderately sorted, subangular to subrounded grains. Brown to reddish brown (10YR 5/3 to 5YR 5/3). Chert, quartzite, granite.
NL-104	1040-1050	Clay (95% clay, 5% medium-grained sand), well sorted, subangular to subrounded grains. Brown (10YR 5/3).
NL-105	1050-1060	Coarse-grained sand, clay and minor pebble gravel (85% sand, 10% clay, 5% gravel), moderately sorted, subangular to subrounded. Brown (10YR 5/3). Chert, quartzite, granite.
NL-106	1060-1070	Coarse-grained sand, clay and minor pebble gravel (85% sand, 10% clay, 5% gravel), moderately sorted, subangular to subrounded. Brown (10YR 5/3). Chert, quartzite, granite.
NL-107	1070-1080	Coarse-grained sand, clay and minor pebble gravel (85% sand, 10% clay, 5% gravel), moderately sorted, subangular to subrounded. Brown (10YR 5/3). Chert, quartzite, granite.
NL-108	1080-1090	Coarse-grained sand, clay and minor pebble gravel (85% sand, 10% clay, 5% gravel), moderately sorted, subangular to subrounded. Brown (10YR 5/3). Chert, quartzite, granite.
NL-109	1090-1100	Coarse-grained sand, clay and minor pebble gravel (85% sand, 10% clay, 5% gravel), moderately sorted, subangular to subrounded. Brown (10YR 5/3). Chert, quartzite, granite.
NL-110	1100-1110	Coarse-grained sand, clay and minor pebble gravel (85% sand, 10% clay, 5% gravel), moderately sorted, subangular to subrounded. Brown (10YR 5/3). Chert, quartzite, granite.
NL-112	1110-1120	Coarse-grained sand, clay and minor pebble gravel (85% sand, 10% clay, 5% gravel), moderately sorted, subangular to subrounded. Brown (10YR 5/3). Chert, quartzite, granite.
NL-113	1120-1130	Clay (90% clay, 10% medium to coarse-grained sand), well sorted, subangular to subrounded grains. Brown (10YR 5/3).
NL-114	1130-1140	Fine-grained sand, clay/silt and minor fine pebble gravel (45% sand, 45% clay/silt, 10% gravel), moderately sorted, subangular to subrounded grains. Brown (10YR 5/3). Chert, quartzite, granite, trace volcanics.
NL-115	1140-1150	Fine-grained sand, clay/silt and minor fine pebble gravel (45% sand, 45% clay/silt, 10% gravel), moderately sorted, subangular to subrounded grains. Brown (10YR 5/3). Chert, quartzite, granite, trace volcanics.
NL-116	1150-1160	Silty clay and fine-grained sand (65% silty clay, 35% sand), well sorted, subangular to subrounded grains. Grayish brown (10YR 5/2).

Sample No.	Depth Interval (ft)	Description
NL-117	1160-1170	Silty clay and fine-grained sand (65% silty clay, 35% sand), well sorted, subangular to subrounded grains. Dark gray (10YR 4/1).
NL-118	1170-1180	Clay, fine to coarse-grained sand with minor fine pebble gravel (60% clay/silt, 35% sand, 5% gravel), moderately sorted, subangular to subrounded grains. Grayish brown to dark gray (2.5Y 5/2-4/1). Chert, quartzite, granite, trace volcanics

Sample No.	Depth Interval (ft)	Description
NL-119	1180-1190	Clay, fine to coarse-grained sand with minor fine pebble gravel (60% clay/silt, 35% sand, 5% gravel), moderately sorted, subangular to subrounded grains. Grayish brown to dark gray (2.5Y 5/2-4/1). Chert, quartzite, granite, trace volcanics
NL-120	1190-1200	Clay (95% clay, 5% medium grained sand, trace gravel), moderately to well sorted, subangular to subrounded grains. Reddish brown (5YR 5/3). Chert, quartzite, granite, sandstone.

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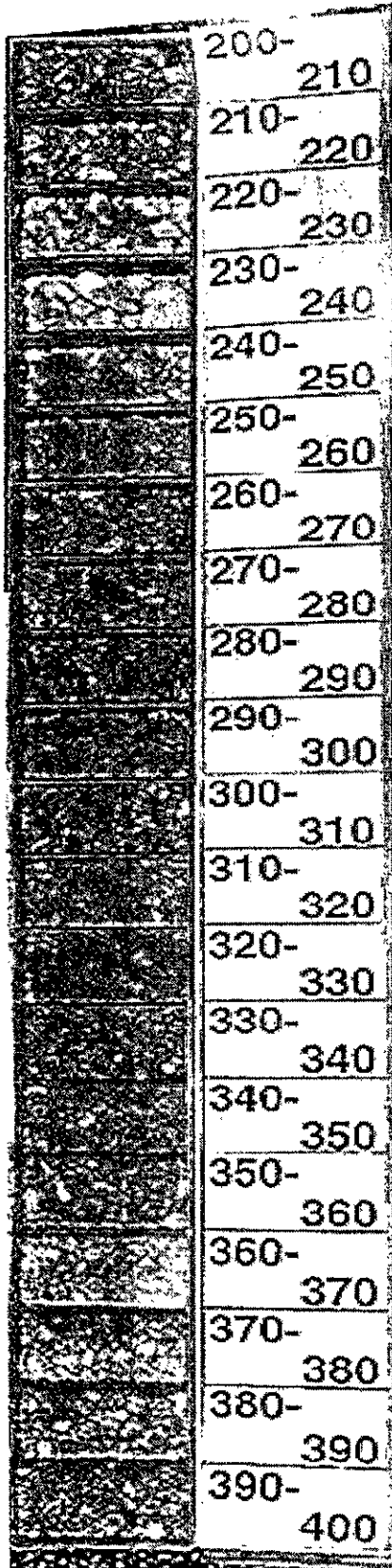
Appendix II: Photologs of cuttings samples from the Nancy Lopez monitoring site.

		Lithofacies	Hydrostratigraphic Unit	Lithologic Unit
	0-	IV, V	PA	upper Sierra Ladrones Formation
	10-			
	20-			
	30-			
	40-			
	50-			
	60-			
	70-			
	80-	I	USF-2	
	90-			
	100-			
	110-			
	120-			
	130-			
	140-			
	150-			
	160-			
	170-			
	180-	III		
	190-			
200-				

Lithofacies

Hydrostratigraphic
Unit

Lithologic
Unit



III

USF-2

(IX)

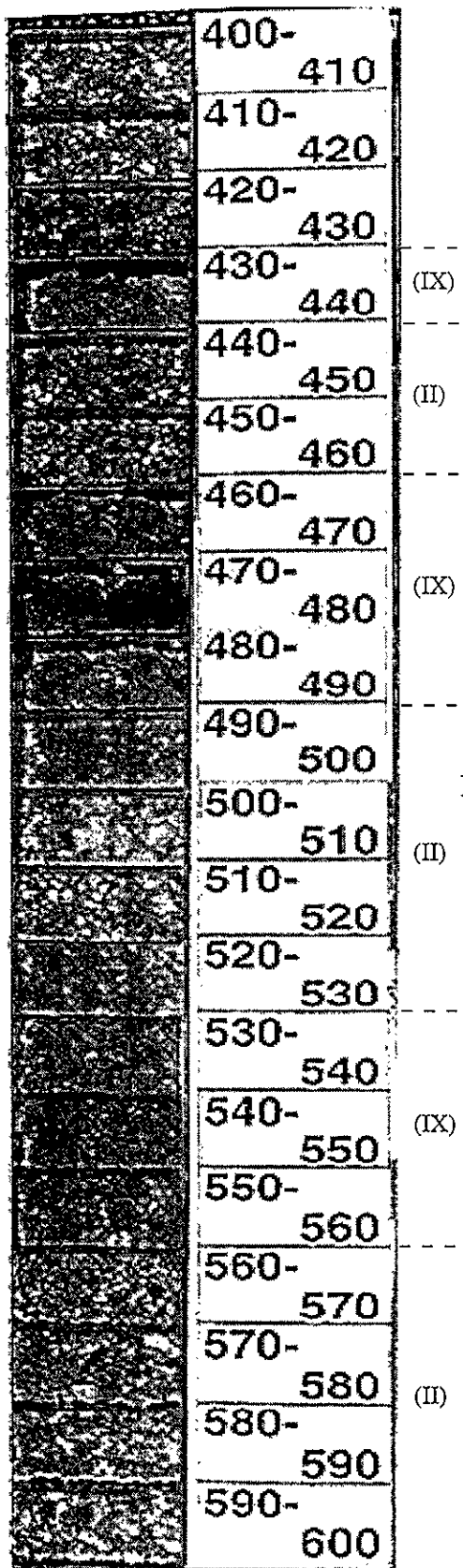
(II) III

upper Sierra Ladrones Formation

Lithofacies

Hydrostratigraphic
Unit

Lithologic
Unit





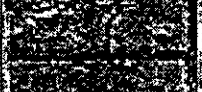


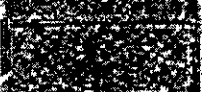














upper Sierra Ladrones Formation

Lithofacies

Hydrostratigraphic
Unit

Lithologic
Unit

	600- 610	
	610- 620	
	620- 630	(II)
	630- 640	
	640- 650	
	650- 660	
	660- 670	(IX)
	670- 680	
	680- 690	(II)
	690- 700	III
	700- 710	
	710- 720	
	720- 730	(IX)
	730- 740	
	740- 750	
	750- 760	
	760- 770	
	770- 780	(II)
	780- 790	
	790- 800	

USF-2

upper Sierra Ladrones Formation

Lithofacies

Hydrostratigraphic
Unit

Lithologic
Unit

	800- 810
	810- 820
	820- 830
	830- 840
	840- 850
	850- 860
	860- 870
	870- 880
	880- 890
	890- 900
	900- 910
	910- 920
	920- 930
	930- 940
	940- 950
	950- 960
	960- 970
	970- 980
	980- 990
	990- 1000

III
(II)

USF-2

upper Sierra Ladrone Formation

IX

MSF-2

lower Sierra Ladrone Formation

III

Lithofacies

Hydrostratigraphic
Unit

Lithologic
Unit

	1000- 1010
	1010- 1020
	1020- 1030
	1030- 1040
	1040- 1050
	1050- 1060
	1060- 1070
	1070- 1080
	1080- 1090
	1090- 1100
	1100- 1110
	1110- 1120
	1120- 1130
	1130- 1140
	1140- 1150
	1150- 1160
	1160- 1170
	1170- 1180
	1180- 1190
	1190- 1200

III

MSF-2

Lower Sierra Ladrones Formation

03R-493A



New Mexico Bureau of Mines & Mineral Resources

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July 12, 1999

Ms. Linda M. Logan
Hydrology Bureau
Office of the State Engineer
PO Box 25102
Santa Fe, NM 87504-5102

Dear Linda:

Enclosed you will find the NMBMMR report and field boring log for the Nancy Lopez Well Site, located in Valencia County, NM. The report includes a summary stratigraphic column and geophysical log, as well as lithologic descriptions and hydrogeologic interpretations. Also included are detailed cuttings descriptions in 10 foot intervals and a photo correlation of the cutting samples. This report will complete an inter-governmental service agreement between our agencies. Additionally, a revised Tomé site report has been included.

If you have any questions, please feel free to call me.

Sincerely,

Patty Jackson

Enclosure

cc: Dr. Charles Chapin, Director, NMBMMR
Condé Thorn, USGS Contractor
Dale Rankin, USGS-WRD, Albuquerque
David Sawyer, USGS, Denver
~~Lynn Femenway, GIC Coordinator, NMBMMR~~

**Field Logs of Boreholes for Nested Piezometers,
Tomé Site, Valencia County, New Mexico**

Prepared for:

New Mexico Office of the State Engineer

Patricia B. Jackson, Geological Lab Associate
Sean D. Connell, Field Geologist

New Mexico Bureau of Mines and Mineral Resources
A division of New Mexico Tech
Socorro, NM 87801

Submitted: April 30, 1999

Revised: July 13, 1999

Introduction

A borehole was drilled at the Tomé site, about 2 miles northeast of the Village of El Cerro and about 0.5 miles north of La Cañada de la Loma de Arena for the purpose of monitoring groundwater conditions in the Santa Fe Group aquifer (see Fig. 1 for location). This well, designated as the Tomé well site (C.R. Thorn, USGS), is part of a multi-agency project to characterize the regional Santa Fe Group aquifer in the Albuquerque Basin. The Tomé site is about 0.5 miles west of a west-facing fault scarp cutting the Llano de Manzano surface of Machette (1985) and was collared in Quaternary eolian sand that unconformably overlies fluvial deposits of the Sierra Ladrones Formation of the upper Santa Fe Group (Figure 2).

Historical data for this monitoring well are summarized in Table 1. Lithologic samples (cuttings) were taken at 10-foot intervals and are used to characterize the local stratigraphy. Major textural and lithologic units encountered in the Tomé site well are graphically summarized in Figure 3 and described in Table 4. Geophysical logs were run after drilling was completed and were integrated with the lithologic data to further characterize the stratigraphy beneath the site (Figure 3). The well was drilled to a depth of 1200 feet (366 m) during July and August of 1998. Three piezometers were constructed in this hole under the supervision of Conde R. Thorn (U.S. Geological Survey-Water Resources Division). The well was cased to 40 feet during drilling to minimize caving of unconsolidated sediments near the surface. The static water table in the uncased hole, determined by a prominent deflection in the sonic log, dated July 20, 1998, was 220-feet (67 m) below ground surface. With the well collared at about 5020±5 feet, this places the water table at about 4800±5 feet. The Rio Grande, 4.5 miles west of the site, is at an elevation of about 4820±5 feet (Tome 7.5-minute quadrangle, U.S. Geological Survey, 1991). These observations suggest that the water table gently slopes eastward away from the Rio Grande.

This borehole log and report is submitted to the New Mexico Office of the State Engineer (NMOSE) as partial fulfillment of an intergovernmental services agreement between NMOSE and the New Mexico Bureau of Mines and Mineral Resources (NMBMMR), a division of New Mexico Institute of Mining and Technology. The cuttings and detailed geophysical logs used to prepare this report will be available for inspection at NMBMMR in Socorro, NM. This report will also be available as NMBMMR Open-File Report 444. *The contents of this report should not be considered final and complete until it is published by the NMBMMR.*

Analytical Methods

Lithologic descriptions were made by visual analysis of mud-rotary cuttings taken from the well head at 10-foot intervals. Drilling methods prevent a complete evaluation of the finer grained fractions (commonly fine-grained sand and silt) held in suspension by the drilling fluids. No sieve testing was conducted. Lithologic descriptions are based on the following criteria:

1. Major textural class;
2. Estimated grain size distribution by major textural class:
 - a. silt and clay (<0.05 mm)
 - b. sand (0.05-2.00 mm)
 - c. gravel (>2.00 mm)
3. Sorting and range of grain and clast size;
4. Grain and clast shape;
5. Clast composition and relative abundance (listed in order of decreasing abundance);
6. Color (Munsell Company, 1992);
7. Geophysical log characteristics; and
8. Driller's comments and other characteristics.

Hydrostratigraphic subdivisions of the borehole were made using nomenclature developed for alluvial deposits in the Albuquerque Basin by Hawley and Whitworth (1996). In this system deposits are assigned to gravely and sandy fluvial (I-III), eolian (IV), piedmont (V-VIII), and fine-grained basin-floor/playa (IX-X) lithofacies. These lithofacies are used to determine hydrostratigraphic units that are subdivided into post-Santa Fe Group and Santa Fe Group deposits. Post-Santa Fe Group units include fluvial-terrace deposits (RA and TA), and piedmont deposits (PA). Santa Fe Group hydrostratigraphic units consist of fluvial and piedmont deposits that are further subdivided into upper (USF), middle (MSF), and lower (LSF) sub-units. The lack of available high-quality lithologic and geophysical log data from neighboring wells precludes definitive hydrostratigraphic classification using this system of nomenclature.

Geology of the Tomé Monitoring Well

The Tomé well penetrated 5-10 feet of fine-grained quartz-rich eolian sand. The well encountered a well-sorted fluvial sand and gravel of an unnamed fluvial member of the Sierra Ladrones Formation between 10-20 feet. We further subdivide this unnamed fluvial member into two conformable subunits, an upper (10-880 feet) dominantly sandy axial fluvial subunit containing numerous upward-fining cycles, and a lower (880-1200 feet) generally silt and clay rich unit with fine-to medium-grained sandstone interbeds. The upper member shows a general upward coarsening trend beginning at about 880 feet. Deposits of this member are generally coarse and well sorted to about 140 feet deep. Upward-fining sequences typically are 50 to 250-feet thick. Exposures of a prominent white calcic soil (Stage III+ carbonate morphology) were observed in the mud pit adjacent to the drill hole. Also, rinds of calcium carbonate on clasts found in the cuttings between 10 and 20 feet further suggest the presence of this buried, moderately to well developed calcic soil.

Clasts are predominantly quartzite, granite, and chert with trace volcanic rocks. Local presence of pumice and silicic volcanic rocks suggests derivation from northern New Mexico by the ancestral Rio Grande fluvial system. The composition of gravel near the base of the borehole is similar to that of the upper subunit, suggesting that the provenance is similar. The increase in electrical conductivity in the lower subunit suggests that this interval contains slightly greater proportions of silt and clay; however, the graphic log indicates that the section contains nearly subequal clay/sand and sand. The lack of limestone and metamorphic rocks in the lower subunit also suggests that deposits were not derived from the Manzano Mountains, about 7 miles to the east. Thus, the lower subunit is provisionally assigned to the Sierra Ladrones Formation.

The base of the upper fluvial subunit may mark a gradational top of a marker unit in the Calabacillas (northern Albuquerque) sub-basin that has been provisionally named the Atrisco member by Connell et al. (1998). The Atrisco member is 280-330 feet of reddish-brown silt/clay and fine-to medium-grained sand recognized in drill holes on Albuquerque's Westside, approximately 30 miles northwest of the Tomé site. This member locally defines a transition between overlying well-sorted sand and gravel from underlying moderately to poorly sorted silty to clayey sand. Regional correlations of the Atrisco member have not yet been made and the depth of the Tomé site well is insufficient to determine if the lower subunit is correlative to the Atrisco member. However, the top of the lower fine-gravel

subunit appears to mark the base of generally coarser-grained deposits, and thus may be correlative to the Atrisco member.

The upper subunit contains six upward fining sequences that are recorded by variations in the electrical conductivity between 25 and 125 mmhos/ m. Sandy intervals are typically resistive ($R = 185$ ohmm; $C = 25$ mmhos/ m) and finer-grained intervals are more conductive ($R = 225$ ohmm; $C = 125$ mmhos/ m). Within the 140-880 foot interval of upward fining sequences, there is a compositional change in the coarser grained materials. At approximately 240 feet the volcanic clasts decrease in relative abundance. Sandy intervals in the lower fluvial unit are typically less resistive than sand in the upper subunit. The lower fluvial subunit is slightly clayey and silty. The clayey intervals in this lower subunit have a "sticky" texture, suggesting moderate to high plasticity.

Several similar geophysical and lithological characteristics are evident between this well and the Nancy Lopez site, approximately 8.3 miles to the south (see Figure 4). Deposits in both wells have been provisionally assigned to the Sierra Ladrones Formation and are subdivided into upper and lower members. The upper members in both wells contain a relatively thick succession of upward-fining sequences stacked in a generally upward-coarsening succession that culminates with the coarsest and most abundant gravel occurring near the top of the borehole section. Geophysical logs show slight increases in the electrical conductivity and porosity at the upper/lower member transition, which is marked by a somewhat plastic and sticky clay. However, some units do not correlate from one site to the other. These units are not likely to be laterally continuous.

Table 1. Historical Data

Name:	Tomé Site (NMOSE-T1)
Location:	T38N, R3E, Tomé Land Grant Valencia County, Tomé 7.5-minute quadrangle Latitude: 34°44'31" Longitude: 106°39'34"
Elevation:	5020 feet (1,530 meters) above mean sea level
Drilling Method:	Mud Rotary
Drillers:	Steve Grant, Jeff Eman, and Brian Bretz, USGS
Drilling Start:	July 10, 1998
Drilling Completion:	August 12, 1998
Sample Interval:	10 feet
Screened Intervals:	225-265 feet; 695-705 feet; 1185-1195 feet
Drill Bits Sizes:	0-20 feet: 16 inch bit; 20-40 feet: 11 inch bit; 40-760 feet: 11 inch bit, 760-900 feet: 11 inch bit; 900-1200 feet: 11 inch bit
Total Depth:	1200 feet (366 meters)
Water Table:	220 feet (4800 feet above mean sea level) based on Sonic log
Sample Logging:	P.B. Jackson (NMBMMR)
Geophysical Logging:	July 20, 1998, Southwest Geophysical Services, Inc. Logged by Mic Peterson
Geophysical Logs:	Caliper, Spontaneous Potential (SP), Single-point resistivity (16 and 64 inch coil spacing), Natural Gamma Ray, Sonic, Neutron and Density porosity.
Log Synthesis:	P.B. Jackson & S.D. Connell (NMBMMR)

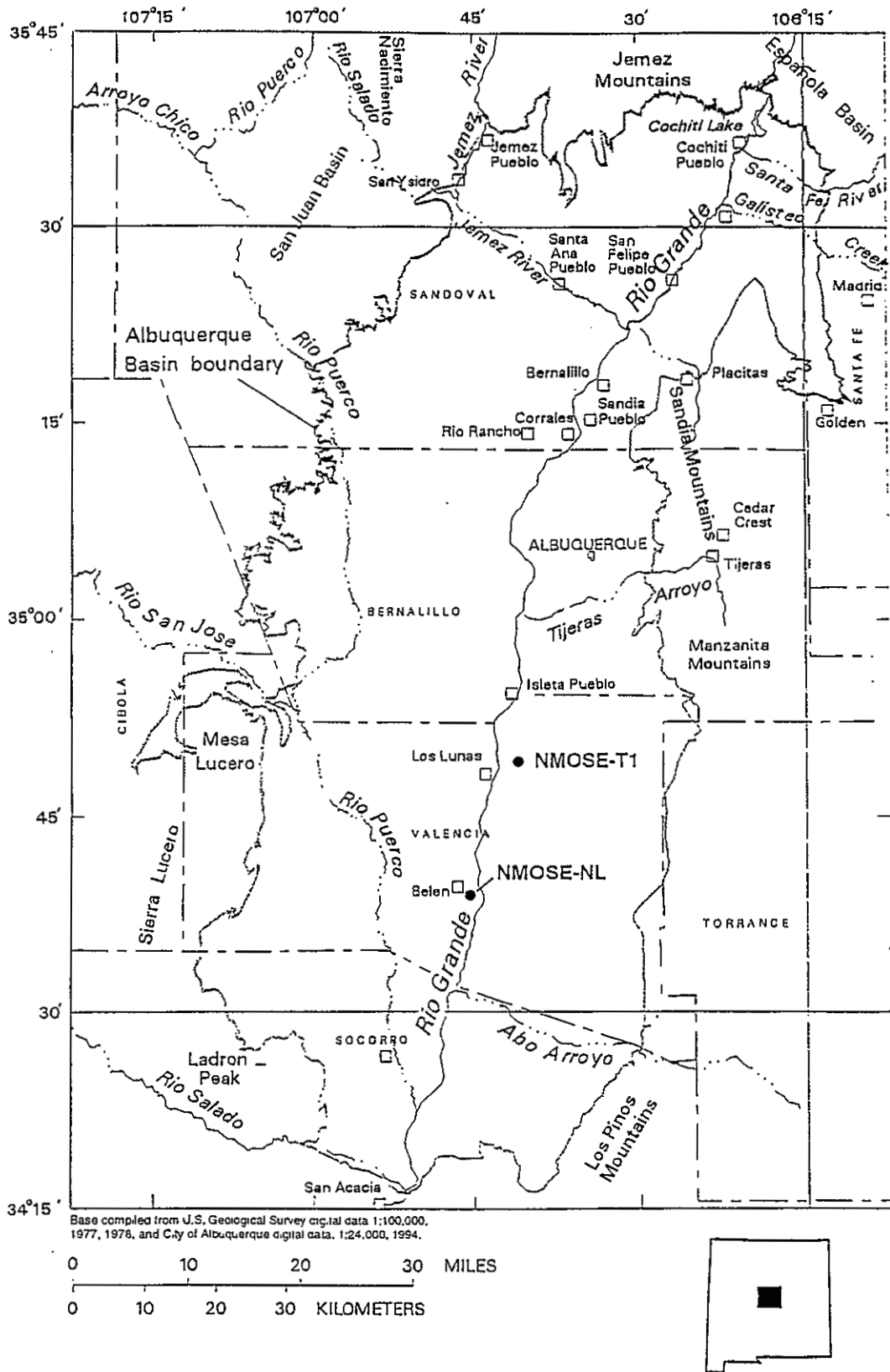


Figure 1: Index map showing the general location of the Tomé monitoring well. (NMOSE-T1)

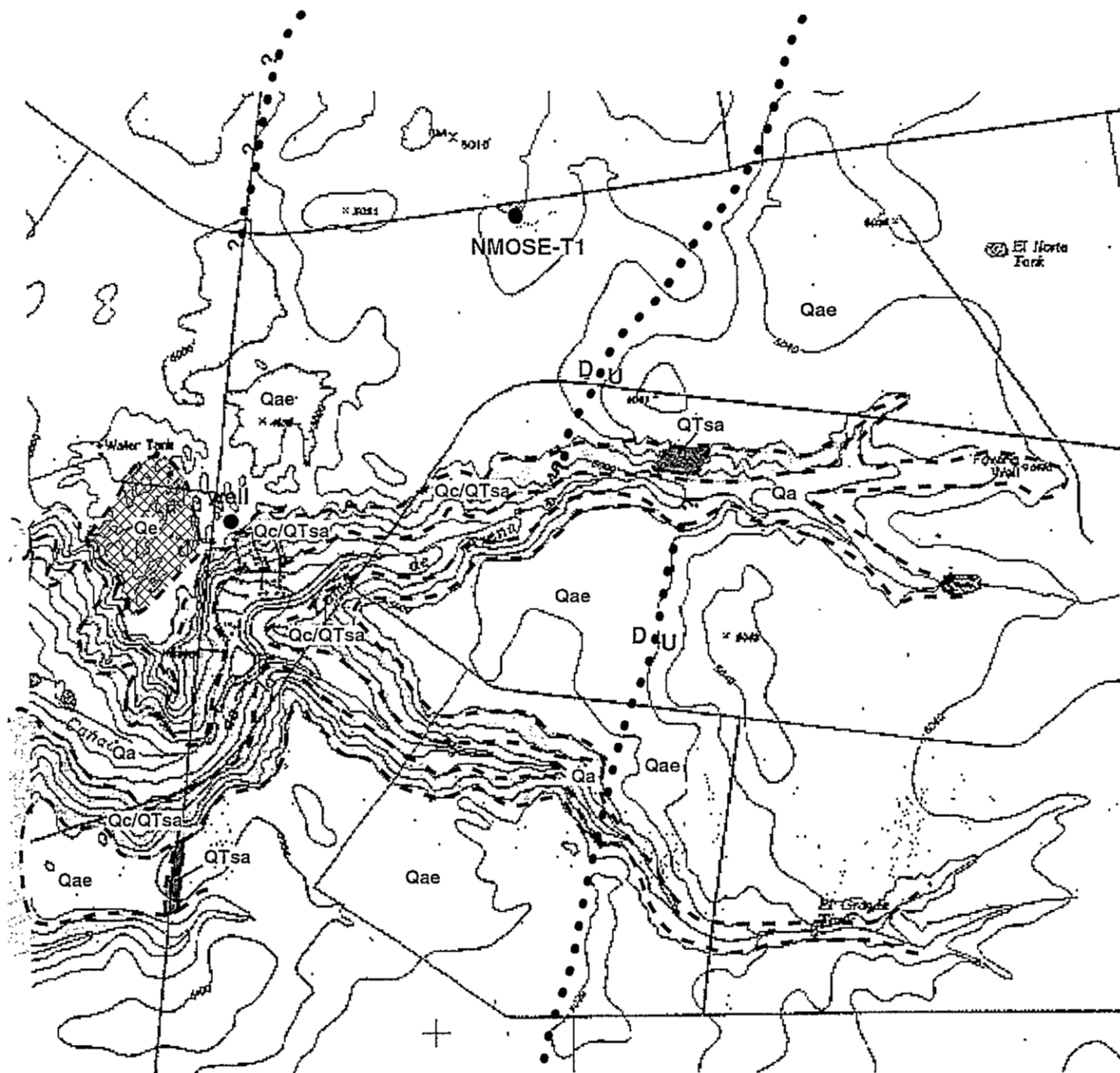
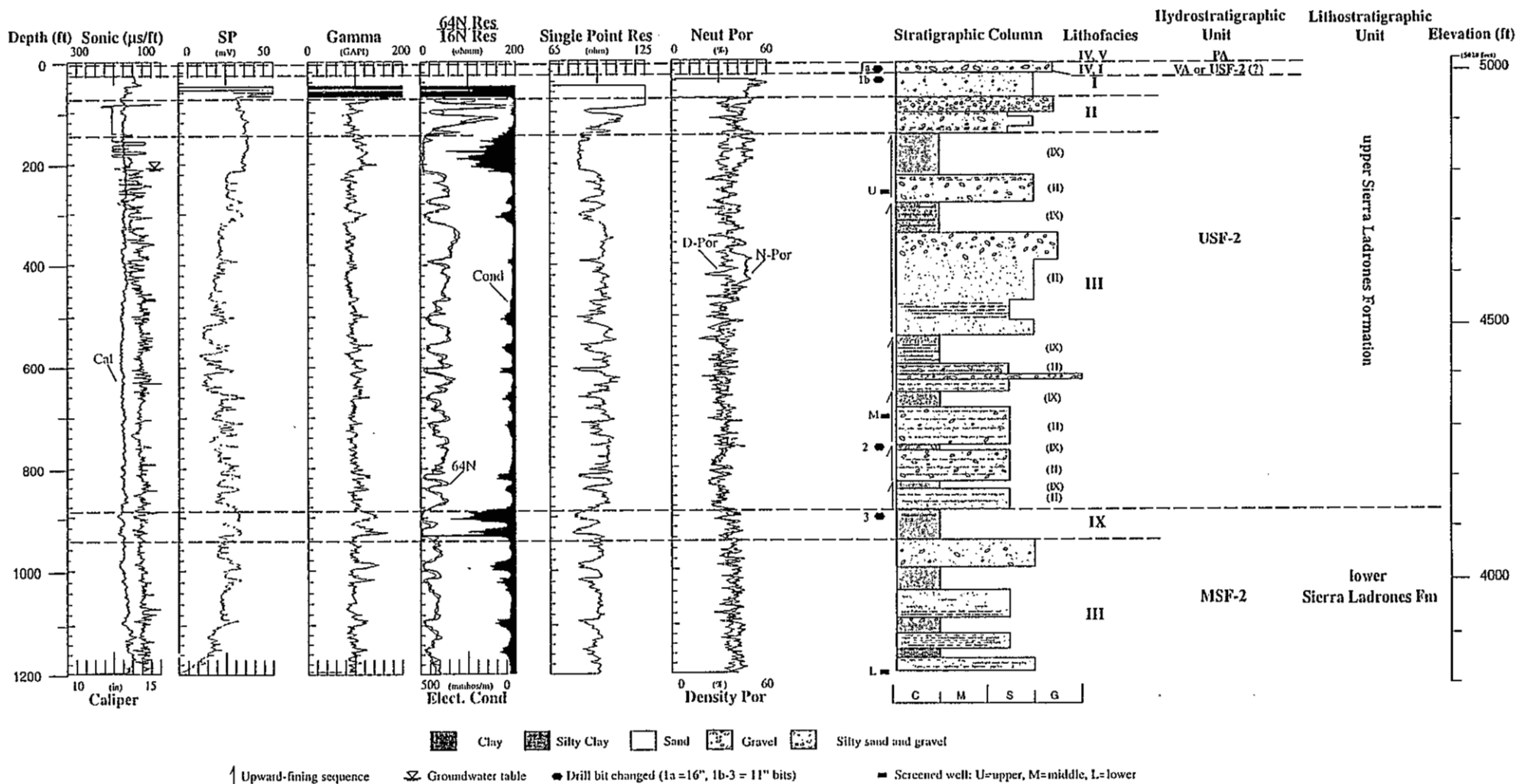


Figure 2: Reconnaissance geologic map in the vicinity of the Tomé monitoring well (NMOSE-T1), Valencia County, New Mexico (geology by S.D. Connell and P.B. Jackson, April 1999). Topographic base is from the northeastern part of the Tomé 7.5-minute quadrangle (scale 1:24,000). Quaternary deposits are as follows: eolian sand forming a small dune field near the drilling site (Qe), alluvium and eolian sands undivided (Qae), alluvium (Qa), colluvium overlying axial fluvial Santa Fe Group deposits (Qc/QTsa), axial fluvial Santa Fe group (QTsa).

Table 2: Description and interpretation of major textural units. Color represents that of moist sediment.

<u>Depth (ft)</u>	<u>Description</u>
0-5	Fine-grained quartz-rich sand with trace amounts of silt. Light yellowish-brown (10YR 6/4). (<i>Hydrostratigraphic unit PA</i>).
5-20	Fine to coarse-grained sand and cobble to pebble gravel Light yellowish-brown sand (10YR 6/4) and dark brown gravel (10YR 3/3). Quartzite, granite, and sandstone/siltstone clasts. (<i>Hydrostratigraphic unit VA or USF-2</i>).
20-70	Well sorted, medium to very coarse-grained sand with scattered granules. Volcanic clasts are the dominant lithology. Pumice in this interval may be 1.2-1.6 Ma Bandelier Tuff. Yellowish-brown to brown (10YR 5/6-4/4). (<i>Hydrostratigraphic unit USF-2</i>).
70-140	Silty/clayey medium to coarse grained sand and gravel and silty/clayey fine to coarse-grained sand with scattered granules. The abundance of volcanic clasts decreases at 240 feet. The lowest occurrence of possible Bandelier Tuff related pumice is at 340 feet. Yellowish-brown to brownish yellow. (10YR 5/4-6/6). (<i>Hydrostratigraphic unit USF-2</i>).
140-880	Upward-fining sequences of gravelly sand, silty medium to coarse-grained sand, and silty to sandy clay. (<i>Hydrostratigraphic unit USF-2</i>).
880 -960	Clay with scattered granules and lenses of increased silt and sand. Yellowish-brown (10YR 5/4). (<i>Hydrostratigraphic unit MSF-2</i>).
960-1200	A sequence of interbedded clayey/silty fine-grained sand and clay deposits. Brown to yellowish-brown (10YR 5/3-5/4). (<i>Hydrostratigraphic unit MSF-2</i>).

Figure 2: Tomé Well Site Gephysical Data Logs, Stratigraphic Column, and Preliminary Hydrostratigraphic & Lithostratigraphic Interpretations



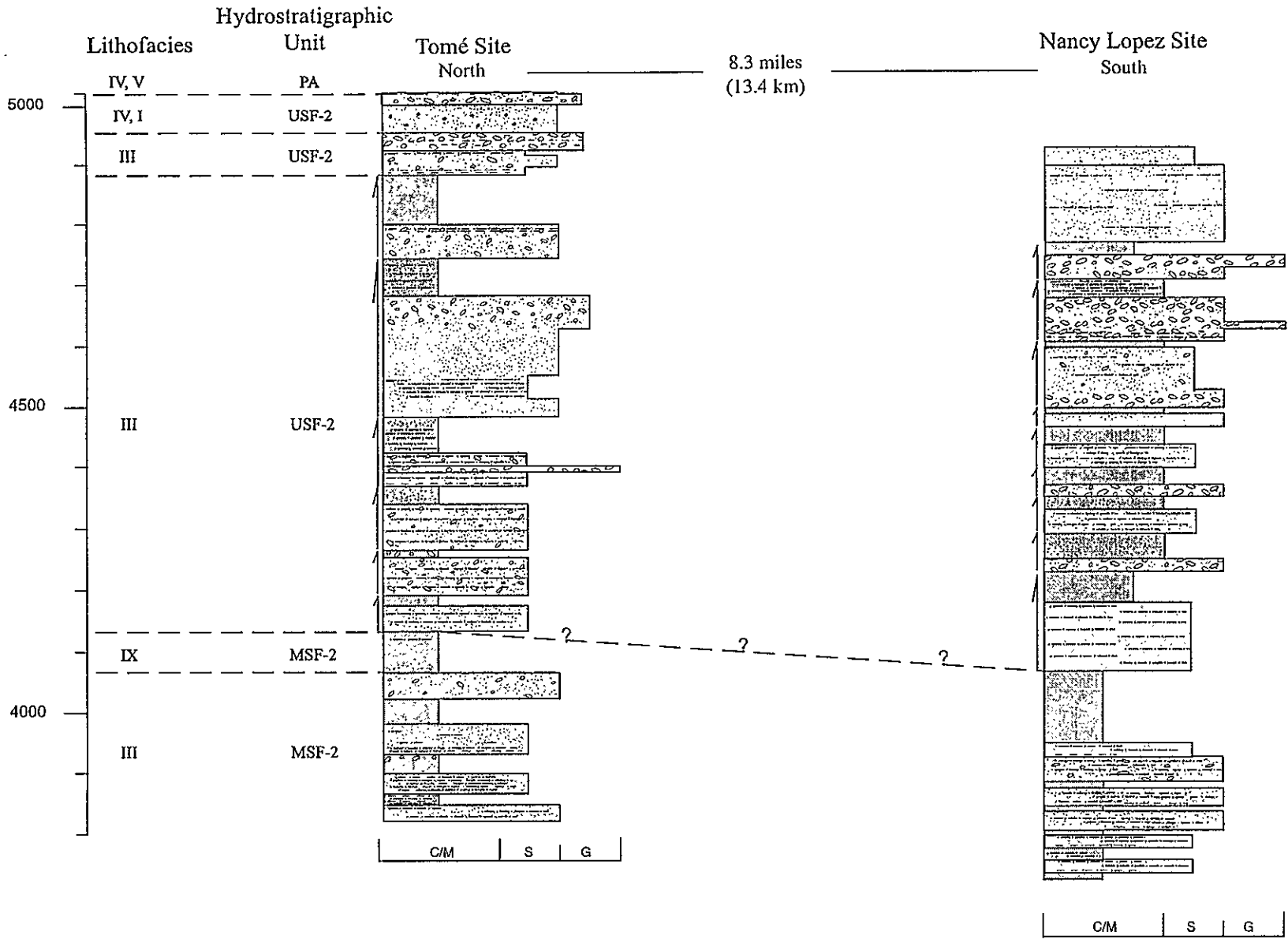


Figure 4: Correlation diagram comparing the lithologic columns of the Tomé and NancyLopez well sites.

Table 3: Summary of lithofacies (modified from Hawley and Whitworth, 1996) assigned to major textural units.

Lithofacies	<u>Dominant Textural Classes</u>	<u>Inferred Depositional Environment</u>
I	Well sorted, medium to very coarse-grained sand and pebble gravel mixture	Basin-floor fluvial; braid plain
II	Well sorted, fine to coarse-grained sand with lenses of pebble sand and silty clay	Basin-floor fluvial; locally eolian
III	Well to moderately sorted, interbedded sand and silty clay with lenses of pebbly/granular fine to coarse-grained sand	Basin-floor fluvial-deltaic and playa-lake; locally eolian
IV	Well to moderately sorted, fine-grained sand and/or sandstone with lenses of silty sand to clay	Eolian, basin-floor alluvial
V	Moderately to poorly sorted, mixture of gravel, sand, silt, and minor clay	Distal to medial piedmont slope, alluvial fan
IX	Silty clay interbedded with sand, silty sand, plus clay	Basin-floor playa-lake and alluvial flat; distal piedmont alluvial

Table 4: Summary of the hydrostratigraphic units observed at the Tomé site.

<u>Hydrostratigraphic Unit</u>	<u>Description</u>
VA	Tributary-arroyo channel, fan and terrace deposits along the inter-valley borders of the Rio Grande system. These can range up to 100 feet in thickness.
USF-2	Ancestral Rio Grande fluvial deposits that intertongue with piedmont-alluvial deposits at the basin. Volcanic rocks such as basalt, andesite, rhyolite and pyroclastic debris are locally present. Subunit 2 is dominated by ancestral Rio Grande deposits and interbedded fine to coarse-grained sediments from various depositional environments.
MSF-2	The middle Santa Fe Group is a mixture of alluvial, eolian and playa-lake deposits and moderately indurated piedmont alluvium that intertongues basinward with basin-floor playa-lake and fluvial deposits. Basaltic to silicic volcanics are present depending on location within the basin. Basin-floor sediments of an alluvial, lacustrine, and/or eolian origin dominate subunit 2.

Table 5: Sample Descriptions of Cutting from the Tomé Well Site.

Sample No.	Depth Interval (feet)	Description
1	0-10	Fine-grained sand with trace, scattered cobbles and pebbles (80% sand, 15% gravel, 5% silt), moderately sorted, subrounded to rounded sand grains, angular to subrounded gravel clasts. Light yellowish-brown sand (10YR 6/4) and white to dark-brown gravel (10Yr 8/1-3/3). Quartzite, granite, and sandstone.
2	10-20	Fine-coarse sand and cobble to pebble gravel (60% sand, 35% gravel, 5% silt), moderately sorted, subrounded to rounded sand grains, angular to subrounded gravel clasts. Light yellowish-brown sand (10YR 6/4) and dark-brown gravel (10YR 3/3). Quartzite, granite, and sandstone/siltstone clasts. Carbonate rinds around gravel clasts indicate a buried calcic soil.
3	20-30	Medium to very coarse-grained sand with granules (85% sand, 15% fine-grained gravel), well sorted, angular to subrounded grains. Yellowish-brown (10YR 5/4). Quartzite, granite, rhyo-dacite, bipryamidal quartz (possibly derived from the Bandelier Tuff), chert, and trace angular pieces of pumice.
4	30-40	Medium to very coarse-grained sand with granules (90% sand, 10% fine-grained pebble gravel), well sorted, angular to subrounded grains. Yellowish-brown (10YR 5/4). Quartzite, granite, rhyo-dacite, bipryamidal quartz (possibly derived from the Bandelier Tuff), chert, and trace angular pieces of pumice.
5	40-50	Medium to very coarse-grained sand with granules (95% sand, 5% fine-grained pebble gravel), well sorted, angular to subrounded grains. Yellowish-brown (10YR 5/4). Quartzite, granite, rhyo-dacite, bipryamidal quartz (possibly derived from the Bandelier Tuff), chert, and trace angular pieces of pumice.
6	50-60	Medium to very coarse-grained sand with granules (90% sand, 10% fine-grained pebble gravel), well sorted, angular to subrounded grains. Yellowish-brown (10YR 5/4). Quartzite, granite, rhyo-dacite, bipryamidal quartz (possibly derived from the Bandelier Tuff), chert, and trace angular pieces of pumice.
7	60-70	Medium to very coarse-grained sand with granules (90% sand, 10% fine-grained pebble gravel), well sorted, angular to subrounded grains. Yellowish-brown (10YR 5/4). Quartzite, granite, rhyo-dacite, bipryamidal quartz (possibly derived from the Bandelier Tuff), chert, and trace angular pieces of pumice.
8	70-80	Silty/clayey gravel and coarse-grained sand (40% silt/clay, 30% gravel, 30% sand), moderately sorted, angular to subrounded grains. Yellowish-brown (10YR 5/4). 30% quartzite, 25% intermediate volcanics, subequal amounts of sandstone, granite, and chert.

Sample No.	Depth Interval (feet)	Description
9	80-90	Silty/clayey medium to coarse-grained sand and gravel (50% sand, 30% gravel, 20% silt/clay), moderately sorted, subangular to subrounded grains. Yellowish-brown (10YR 5/4). 30% quartzite, 25% intermediate volcanics, subequal amounts of sandstone, granite, chert, and trace amounts of pumice.
10	90-100	Silty gravel and medium to coarse-grained sand (40% silt, 30% sand, 30% gravel), moderately sorted, subangular to subrounded grains. Brown to yellowish-brown (7.5YR 4/4-10YR 5/4). 30% quartzite, 25% intermediate volcanics, subequal amounts of sandstone, granite, and chert.
11	100-110	Silty medium to coarse-grained sand (50% sand, 40% silt, 10% gravel), moderately sorted, subangular to subrounded grains. Brown silt (7.5YR 4/4) and sand (7.5 YR 5/4). Subequal amounts of quartzite and intermediate volcanics, granite, sandstone, chert, trace pumice.
12	110-120	Medium to very coarse-grained sand with granules (85% sand, 10% gravel, 5% silt), well sorted, subangular to subrounded grains. Yellowish-brown (10YR 5/4-5/6). Subequal amounts of quartzite and intermediate volcanics, granite, sandstone, chert, trace pumice.
13	120-130	Silty/clayey fine to coarse-grained sand (65% sand, 30% silt, 5% gravel), moderately sorted, subangular to subrounded grains. Yellowish-brown to brownish-yellow (10YR 5/4-6/6).). Subequal amounts of quartzite and intermediate volcanics, granite, sandstone, chert.
14	130-140	Silty/clayey coarse-grained sand and granules (50% sand, 45% silt/clay, 5% gravel), moderately sorted, subangular to subrounded grains. Yellowish-brown to brownish-yellow (10YR 5/4-6/6).). Subequal amounts of quartzite and intermediate volcanics, granite, sandstone, chert.
15	140-150	Clay with scattered granule sized gravel (95% clay, 5% gravel), moderate to well sorted, subangular to subrounded gravel clasts. Yellowish-brown(10YR 5/4).). Subequal amounts of quartzite and intermediate volcanics, granite, sandstone, chert.
16	150-160	Clay (100% clay), very well sorted. Yellowish-brown(10YR 5/4).
17	160-170	Same as above.
18	170-180	Same as above.
19	180-190	Same as above.
20	190-200	Same as above.
21	200-210	Clay (100% clay), very well sorted. Yellowish-brown to brown (10YR 5/4 to 7.5YR 4/4).
22	210-220	Silty clay and medium to coarse-grained sand (70% silty clay, 25% sand, 5% gravel), moderately sorted, subangular to subrounded grains. Brown (7.5YR 4/4-5/4).). Subequal amounts of quartzite and intermediate volcanics, granite, sandstone, chert.

23	220-230	Silty clay and medium to coarse-grained sand (70% silty clay, 25% sand, 5% gravel), moderately sorted, subangular to subrounded grains. Brown (7.5YR 4/4-5/4).). Subequal amounts of quartzite and intermediate volcanics, granite, sandstone, chert.
24	230-240	Silty clay and pebbly medium to coarse-grained sand (40% silty clay, 40% sand, 20% gravel), moderately sorted, subangular to subrounded grains. Brown (7.5YR 4/4-5/4).). Subequal amounts of quartzite and intermediate volcanics, granite, sandstone, chert.
25	240-250	Silty/clayey medium to coarse-grained sand with scattered pebbles (65% sand, 20% silty clay, 15% gravel), moderately sorted, subangular to subrounded grains. Brown (7.5YR 4/4-5/4). Quartzite, granite, chert, and trace volcanics.
26	250-260	Medium to coarse-grained sand (80% sand, 10% silt, 10% gravel), well sorted, subangular to subrounded grains. Brown (7.5YR 4/4-5/4). Quartzite, granite, chert, and trace volcanics.
27	260-270	Pebbly medium to coarse-grained sand (80% sand, 20% gravel, 10% silt), well sorted, subangular to subrounded grains. Brown (7.5YR 4/4-5/4). Quartzite, granite, chert, and trace volcanics.
28	270-280	Pebbly medium to coarse-grained sand (70% sand, 15% gravel, 5% silt), well sorted, subangular to subrounded grains. Brown (7.5YR 4/4-5/4). Quartzite, granite, chert, and trace volcanics.
29	280-290	Silty clay and medium to coarse-grained sand (65% silty clay, 30% sand, 5% gravel), moderately sorted, subangular to subrounded grains. Yellowish-brown to brown (10YR 5/4 to 7.5YR 5/4). Quartzite, granite, chert, and trace volcanics.
30	290-300	Silty clay and medium to coarse-grained sand (55% silty clay, 40% sand, 5% gravel), moderately sorted, subangular to subrounded grains. Yellowish-brown to brown (10YR 5/4 to 7.5YR 5/4). Quartzite, granite, chert, and trace volcanics.
31	300-310	Silty clay and gravel (60% silty/clay, 30% gravel, 10% sand), moderately sorted, subangular to subrounded grains. Yellowish-brown to brown (10YR 5/4 to 7.5YR 5/4). Quartzite, granite, chert, and trace volcanics.
32	310-320	Silty clay and pebbly sand (70% silty/clay, 15% gravel, 15% sand), moderately sorted, subangular to subrounded grains. Yellowish-brown to brown (10YR 5/4 to 7.5YR 5/4). Quartzite, granite, chert, and trace volcanics.
33	320-330	Silty clay and coarse-grained sand (60% silty clay, 30% sand, 10% gravel), moderately sorted, subangular and subrounded grains. Yellowish-brown to brown (10YR 5/4 to 7.5YR 5/4). Quartzite, granite, chert, and trace volcanics.
34	330-340	Silty clay and coarse-grained sand (60% silty clay, 30% sand, 10% gravel), moderately sorted, subangular and subrounded grains. Yellowish-brown to brown (10YR 5/4 to 7.5YR 5/4). Quartzite, granite, chert, and trace volcanics.

Sample No.	Depth Interval (feet)	Description
35	340-350	Clean granular coarse-grained sand (80% sand, 20% gravel), well sorted, angular to subrounded grains (gravel tends to be the more angular component). Brown (7.5YR 5/4-5/6). Quartzite, granite, chert, pumice.
36	350-360	Medium to coarse-grained sand (85% sand, 10% gravel, 5% silt), moderately to well sorted, angular to subrounded grains. Yellowish-brown to brown (10YR 6/4 to 7.5YR 5/4-5/6). Quartzite, granite, chert, and trace volcanics.
37	360-370	Granular medium to coarse-grained sand (70% sand, 25% gravel, 5% silt), moderately to well sorted, angular to subrounded grains. Yellowish-brown to brown (10YR 6/4 to 7.5YR 5/4-5/6). Quartzite, granite, chert, and trace volcanics.
38	370-380	Pebbly medium to very coarse-grained sand (65% sand, 30% gravel, 5% silt), moderately to well sorted, angular to subrounded grains. Yellowish-brown to brown (10YR 6/4 to 7.5YR 5/4-5/6). Quartzite, granite, chert, and trace volcanics.
39	380-390	Pebbly medium to very coarse-grained sand (75% sand, 25% gravel, 5% silt), moderately to well sorted, angular to subrounded grains. Yellowish-brown to brown (10YR 6/4 to 7.5YR 5/4-5/6). Quartzite, granite, chert, and trace volcanics.
40	390-400	Granular medium to coarse-grained sand (70% sand, 20% gravel, 10% silt), moderately to well sorted, angular to subrounded grains. Yellowish-brown to brown (10YR 6/4 to 7.5YR 5/4-5/6). Quartzite, granite, chert, and trace volcanics.
41	400-410	Medium to very coarse-grained sand (90% sand, 5% gravel, 5% silt) moderately to well sorted, angular to subrounded grains. Yellowish-brown to brown (10YR 6/4 to 7.5YR 5/4-5/6). Quartzite, granite, chert, and trace volcanics.
42	410-420	Medium to very coarse-grained sand (90% sand, 5% gravel, 5% silt) moderately to well sorted, angular to subrounded grains. Yellowish-brown to brown (10YR 6/4 to 7.5YR 5/4-5/6). Quartzite, granite, chert, and trace volcanics.
43	420-430	Medium-grained sand (90% sand, 10% silt, trace gravel), moderately to well sorted, angular to subrounded grains. Yellowish-brown to brown (10YR 6/4 to 7.5YR 5/4-5/6). Quartzite, granite, chert, and trace volcanics.
44	430-440	Medium-grained sand (90% sand, 10% silt, trace gravel), moderately to well sorted, angular to subrounded grains. Yellowish-brown to brown (10YR 6/4 to 7.5YR 5/4-5/6). Quartzite, granite, chert, and trace volcanics.
45	440-450	Medium-grained sand (95% sand, 5% silt, trace gravel), moderately to well sorted, angular to subrounded grains. Yellowish-brown to brown (10YR 6/4 to 7.5YR 5/4-5/6). Quartzite, granite, chert, and trace volcanics.

Sample No.	Depth Interval (feet)	Description
46	450-460	Medium-grained sand (95% sand, 5% silt, trace gravel), moderately to well sorted, angular to subrounded grains. Yellowish-brown to brown (10YR 6/4 to 7.5YR 5/4-5/6). Quartzite, granite, chert, and trace volcanics.
47	460-470	Medium to very coarse-grained sand (90% sand, 5% gravel, 5% silt) moderately to well sorted, angular to subrounded grains. Yellowish-brown to brown (10YR 6/4 to 7.5YR 5/4-5/6). Quartzite, granite, chert, and trace volcanics.
48	470-480	Medium to very coarse-grained sand (85% sand, 5% gravel, 5% silt) moderately to well sorted, angular to subrounded grains. Yellowish-brown to brown (10YR 6/4 to 7.5YR 5/4-5/6). Quartzite, granite, chert, and trace volcanics.
49	480-490	Silty coarse to very coarse-grained sand (70% sand, 20% silt, 10% gravel), moderately sorted, subangular to subrounded grains. Yellowish-brown to brown (10YR 6/4 to 7.5YR 5/4-5/6). Quartzite, granite, chert, and trace volcanics.
50	490-500	Silty coarse to very coarse-grained sand (50% sand, 40% silt, 10% gravel), moderately sorted, subangular to subrounded grains. Yellowish-brown to brown (10YR 6/4 to 7.5YR 5/4-5/6). Quartzite, granite, chert, and trace volcanics.
51	500-510	Coarse-grained sand and silty clay (50% silt/clay, 45% sand, 5% gravel), moderately sorted, subangular to subrounded grains. Yellowish-brown to brown (10YR 6/4 to 7.5YR 5/4-5/6). Quartzite, granite, chert, and trace volcanics.
52	510-520	Silty coarse-grained sand (75% sand, 20% silt, 5% gravel), moderately sorted, subangular to subrounded grains. Yellowish-brown to brown (10YR 6/4 to 7.5YR 5/4-5/6). Quartzite, granite, chert, and trace volcanics.
53	520-530	Silty coarse-grained sand (80% sand, 15% silt, 5% gravel), moderately sorted, subangular to subrounded grains. Yellowish-brown to brown (10YR 6/4 to 7.5YR 5/4-5/6). Quartzite, granite, chert, and trace volcanics.
54	530-540	Coarse-grained sand (85% sand, 10% gravel, 5% silt), moderately to well sorted, subangular to subrounded grains. Yellowish-brown to brown (10YR 6/4 to 7.5YR 5/4-5/6). Quartzite, granite, chert, and trace volcanics.
55	540-550	Sandy clay with scattered granules (60% clay, 30% sand, 10% gravel), moderately sorted, subangular to subrounded grains. Yellowish-brown to brown (10YR 6/4 to 7.5YR 5/4-5/6). Quartzite, granite, chert, and trace volcanics.
56	550-560	Sandy clay with scattered granules (80% clay, 15% sand, 5% gravel), moderately sorted, subangular to subrounded grains. Yellowish-brown to brown (10YR 6/4 to 7.5YR 5/4-5/6). Quartzite, granite, chert, and trace volcanics.

Sample No.	Depth Interval (feet)	Description
57	560-570	Silty clay (95% silty clay, 5% gravel), moderately sorted, subangular to subrounded grains. Yellowish-brown to brown (10YR 6/4 to 7.5YR 5/4-5/6). Quartzite, granite, chert, and trace volcanics.
58	570-580	Silty clay (95% silty clay, 5% gravel), moderately sorted, subangular to subrounded grains. Yellowish-brown to brown (10YR 6/4 to 7.5YR 5/4-5/6). Quartzite, granite, chert, and trace volcanics.
59	580-590	Silty clay (95% silty clay, 5% gravel), moderately sorted, subangular to subrounded grains. Yellowish-brown to brown (10YR 6/4 to 7.5YR 5/4-5/6). Quartzite, granite, chert, and trace volcanics.
60	590-600	Silty clay (95% silty clay, 5% gravel), moderately sorted, subangular to subrounded grains. Yellowish-brown to brown (10YR 6/4 to 7.5YR 5/4-5/6). Quartzite, granite, chert, and trace volcanics.
61	600-610	Silty fine to coarse-grained sand with granules (60% sand, 20% silt/clay, 20% gravel), moderately sorted, subangular to subrounded grains. Yellowish-brown silt/clay (10YR 5/4) and gray to pinkish gray sand and gravel (7.5YR 6/1-6/2). Quartzite, granite, chert, and trace volcanics.
62	610-620	Clayey/silty fine to coarse-grained sand (50% sand, 40% clay/silt, 10% gravel), moderately sorted, subangular to subrounded grains. Yellowish-brown silt/clay (10YR 5/4) and gray to pinkish gray sand and gravel (7.5YR 6/1-6/2). Quartzite, granite, chert, and trace volcanics.
63	620-630	Pebble gravel (80% gravel, 15% sand, 5% silt), moderately to well sorted, subangular to subrounded. moderately sorted, subangular to subrounded grains. Yellowish-brown silt (10YR 5/4) and gray to pinkish gray sand and gravel (7.5YR 6/1-6/2). Quartzite, granite, chert, and trace volcanics.
64	630-640	Silty coarse to very coarse-grained sand and pebble gravel (45% sand, 45% gravel, 15% silt), moderately sorted, angular to subrounded. Yellowish-brown silt (10YR 5/4) and gray to pinkish gray sand and gravel (7.5YR 6/1-6/2). Quartzite, granite, chert, and trace volcanics.
65	640-650	Silty coarse-grained sand with scattered pebbles (60% sand, 30% silt, 10% gravel), moderately sorted, subangular to subrounded grains. Yellowish-brown silt (10YR 5/4) and gray to pinkish gray sand and gravel (7.5YR 6/1-6/2). Quartzite, granite, chert, and trace volcanics.
66	650-660	Silty coarse-grained sand with scattered pebbles (60% sand, 30% silt, 10% gravel), moderately sorted, subangular to subrounded grains. Brown silt (10YR 5/4) and gray to pinkish gray sand and gravel (7.5YR 6/1-6/2). Quartzite, granite, chert, and trace volcanics.

Sample No.	Depth Interval (feet)	Description
67	660-670	Sandy clay/silt (75% clay/silt, 20% sand, 5% gravel), moderately sorted, subangular to subrounded grains. Pale brown clay/silt (10YR 6/3) and gray to pinkish gray sand and gravel (7.5YR 6/1-6/2). Quartzite, granite, chert.
68	670-680	Sandy clay/silt (75% clay/silt, 20% sand, 5% gravel), moderately sorted, subangular to subrounded grains. Pale brown clay/silt (10YR 6/3) and gray to pinkish gray sand and gravel (7.5YR 6/1-6/2). Quartzite, granite, chert, and trace volcanics.
69	680-690	Sandy clay/silt (75% clay/silt, 20% sand, 5% gravel), moderately sorted, subangular to subrounded grains. Pale brown clay/silt (10YR 6/3) and gray to pinkish gray sand and gravel (7.5YR 6/1-6/2). Quartzite, granite, chert, and trace volcanics.
70	690-700	Silty fine to medium-grained sand with pebbles (60% sand, 30% silt, 10% gravel), moderately sorted, subangular to subrounded grains. Pale brown clay/silt (10YR 6/3) and gray to pinkish gray sand and gravel (7.5YR 6/1-6/2). Quartzite, granite, chert, and trace volcanics.
71	700-710	Silty fine to coarse-grained sand (70% sand, 25% silt with minor clay, 5% gravel), moderately sorted, subangular to subrounded grains. Yellowish-brown silt (10YR 5/4) and pinkish gray sand and gravel (7.5YR 6/2). Quartzite, granite, chert, and trace volcanics.
72	710-720	Silty fine sand with scattered granules (75% sand, 25% silt, trace gravel), moderately sorted, subangular to subrounded grains. Yellowish-brown silt (10YR 5/4) and pinkish gray sand and gravel (7.5YR 6/2). Quartzite, granite, chert, and trace volcanics.
73	720-730	Silty fine sand with scattered granules (75% sand, 25% silt, trace gravel), moderately sorted, subangular to subrounded grains. Yellowish-brown silt (10YR 5/4) and pinkish gray sand and gravel (7.5YR 6/2). Quartzite, granite, chert, and trace volcanics.
74	730-740	Silty fine sand with scattered granules (75% sand, 25% silt, trace gravel), moderately sorted, subangular to subrounded grains. Yellowish-brown silt (10YR 5/4) and pinkish gray sand and gravel (7.5YR 6/2). Quartzite, granite, and chert, and trace volcanics.
75	740-750	Silty fine sand with scattered granules (75% sand, 20% silt, ≈5% clay, trace gravel), moderately sorted, subangular to subrounded grains. Yellowish-brown silt (10YR 5/4) and pinkish gray sand and gravel (7.5YR 6/2). Quartzite, granite, and chert, and trace volcanics.

Sample No.	Depth Interval (feet)	Description
76	750-760	Silty fine sand with trace scattered granules (75% sand, 20% silt, ≈5% clay, trace gravel), moderately sorted, subangular to subrounded grains. Yellowish-brown silt (10YR 5/4) and pinkish gray sand and gravel (7.5YR 6/2). Quartzite, granite, and chert, and trace volcanics.
77	760-770	Pebbly clay (70% clay, 20% pebble gravel, 10% sand), moderately sorted, subangular to subrounded grains. Yellowish-brown silt (10YR 5/4) and pinkish gray sand and gravel (7.5YR 6/2). Quartzite, granite, and chert, and trace volcanics.
78	770-780	Clayey medium to coarse-grained pebbly sand (60% sand, 20% clay, 20% gravel), moderately sorted, subangular to subrounded grains. Yellowish-brown silt (10YR 5/4) and pinkish gray sand and gravel (7.5YR 6/2). Quartzite, granite, and chert, and trace volcanics.
79	780-790	Clayey medium to coarse-grained pebbly sand (60% sand, 20% clay, 20% gravel), moderately sorted, subangular to subrounded grains. Yellowish-brown silt (10YR 5/4) and pinkish gray sand and gravel (7.5YR 6/2). Quartzite, granite, and chert, and trace volcanics.
80	790-800	Clayey medium to coarse-grained pebbly sand (60% sand, 20% clay, 20% gravel), moderately sorted, subangular to subrounded grains. Yellowish-brown silt (10YR 5/4) and pinkish gray sand and gravel (7.5YR 6/2). Quartzite, granite, and chert, and trace volcanics.
81	800-810	Clayey coarse-grained sand (70% sand, 20% clay, 10% Fine-grained gravel), moderately sorted, subangular to rounded grains. Pink brown clay (10YR 6/3) and gray sand and gravel (7.5YR 6/1). Quartz, granite, chert, and trace volcanics.
82	810-820	Clayey coarse to very coarse-grained sand (60% sand, 20% clay, 20% Fine-grained pebble gravel), moderately sorted, subangular to rounded grains. Pink brown clay (10YR 6/3) and gray sand and gravel (7.5YR 6/1). Quartzite, granite, chert, and trace volcanics.
83	820-830	Clayey coarse-grained sand (60% sand, 30% clay, 10% Fine-grained gravel), moderately sorted, subangular to rounded grains. Pink brown clay (10YR 6/3) and gray sand and gravel (7.5YR 6/1). Quartzite, granite, chert, and trace volcanics.
84	830-840	Granular clay with scattered pebbles (60% clay, 30% coarse-grained sand, 10% pebble gravel), moderately sorted, subangular to subrounded grains. Pink brown clay (10YR 6/3) and gray sand and gravel (7.5YR 6/1). Quartzite, granite, chert, and trace volcanics.
85	840-850	Granular clay (75% clay, 20% coarse-grained sand, 5% pebble gravel), moderately sorted, subangular to subrounded grains. Pink brown clay (10YR 6/3) and gray sand and gravel (7.5YR 6/1). Quartzite, granite, chert, and trace volcanics.
86	850-860	Silty fine to medium-grained sand (70% sand, 25% silt, 5% gravel), moderately sorted, subangular to rounded grains. Grayish brown (10Yr 5/2). Quartzite, granite, chert, and trace volcanics.

Sample No.	Depth Interval (feet)	Description
87	860-870	Silty fine to medium-grained sand (70% sand, 25% silt, 5% gravel), moderately sorted, subangular to rounded grains. Grayish brown (10Yr 5/2). Quartzite, granite, chert, and trace volcanics.
88	870-880	Silty medium to coarse-grained sand (70% sand, 20% silt, 10% gravel), moderately sorted, subangular to subrounded grains. Grayish brown (10Yr 5/2). Quartzite, granite, chert, and trace volcanics.
89	880-890	Gravelly clay (60% clay, 30% gravel, 10% sand), moderately sorted, subangular to subrounded grains. Yellowish-brown (10YR 5/4). Quartzite, granite, chert, and trace volcanics.
90	890-900	Granular clay (75% clay, 20% gravel, 5% sand), well sorted, subangular to subrounded grains. Yellowish-brown (10YR 5/4). NOTE: Driller's noted that at 900 feet the bit became "clay-locked" and had to be changed.
91	900-910	Clay (95% clay, 5% sand), well sorted, subangular to subrounded grains. Yellowish-brown (10YR 5/4).
92	910-920	Silty clay (70% clay, 20% silt, 10% sand), well sorted, subangular to subrounded grains. Yellowish-brown (10YR 5/4).
93	920-930	Clay (80% clay, 10% silt, 10% sand, trace gravel), well sorted, subangular to subrounded grains. Yellowish-brown (10YR 5/4). Quartzite, granite.
94	930-940	Clay (95% clay, 5% sand), well sorted, subangular to subrounded grains. Pale brown (10YR 6/3).
95	940-950	Sandy clay, (80% clay, 20% fine to medium-grained sand), well sorted, subangular to subrounded grains. Brown (10YR 5/3).
96	950-960	Sandy clay, (65% clay, 30% fine to medium-grained sand, 5% gravel), well sorted, subangular to subrounded grains. Brown (10YR 5/3). Quartzite, chert, granite.
97	960-970	Fine-grained sand with scattered pebbles (80% sand, 10% clay, 10% gravel), moderately to well sorted, subangular to subrounded grains. Pale brown (10YR 6/3). Quartzite, granite, chert.
98	970-980	Fine-grained sand with scattered pebbles (75% sand, 15% clay, 10% gravel), moderately to well sorted, subangular to subrounded grains. Pale brown (10YR 6/3). Quartzite, granite, chert.
99	980-990	Fine to coarse-grained sand (50% fine-grained sand, 30% coarse-grained sand, 10% silt, 10% gravel). Moderately to well sorted, subangular to subrounded grains. Grayish brown (10YR 5/2). Quartzite, chert, granite.
100	990-1000	Clayey fine-grained sand (55% sand, 40% clay, 5% gravel), moderately sorted, subangular to subrounded grains. Brown (10YR 5/3). Quartzite, chert, granite.

Sample No.	Depth Interval (feet)	Description
101	1000-1010	Silty clay (90% silty clay, 10% fine-grained sand), well sorted, subangular to subrounded grains. Pale brown to brown (10YR 6/3-5/3).
102	1010-1020	Sandy silt/clay (80% silty clay, 20% fine-grained sand), well sorted, subangular to subrounded grains. Brown (10YR 5/3).
103	1020-1030	Clayey medium to coarse-grained sand (60% sand, 40% clay), moderate to well sorted, subangular to subrounded grains. Brown (10YR 5/3).
104	1030-1040	Granular clay (85% clay, 15% coarse-grained sand), well sorted, subangular to subrounded grains. Brown (10YR 5/3).
105	1040-1050	Fine-grained sand with trace scattered granules (80% fine-grained sand, 10% medium to coarse-grained sand, 10% clay, trace gravel), moderate to well sorted, subangular to subrounded grains. Yellowish-brown(10YR 5/4), quartzite, and chert. NOTE: The finer grained material is better rounded than the coarser-grained material. Quartzite, granite, intermediate volcanics.
106	1050-1060	Fine to medium-grained sand (95% sand, 5% silt, trace gravel), well sorted, subangular to subrounded grains. Yellowish-brown(10YR 5/4). Quartzite, granite, and chert.
107	1060-1070	Clayey/silty fine to medium-grained sand (85% sand, 15% clay/silt, trace gravel), moderately sorted, subangular to subrounded grains. Yellowish-brown(10YR 5/4). Quartzite, granite, and chert.
108	1070-1080	Sandy/silty clay (80% silty clay, 20% fine-grained sand), well sorted, subangular to subrounded grains. Brown (10YR 5/3),
109	1080-1090	Clayey coarse-grained sand with scattered pebbles (60% sand, 30% clay, 10% gravel), moderately sorted, subangular to subrounded grains. Yellowish-brown(10YR 5/4). Quartzite, granite, intermediate volcanics, and chert.
110	1090-1100	Clay with scattered pebbles and granules (80% clay, 10% coarse-grained sand, 10% gravel), moderately sorted, subangular to subrounded grains. Yellowish-brown(10YR 5/4). Quartzite, granite, intermediate volcanics, and chert.
111	1100-1110	Clay (>95% clay, trace gravel), well sorted, subangular to subrounded grains. Brown (10YR 5/3). Quartzite, and chert.
112	1110-1120	Clayey fine-grained sand (60% sand, 40% clay), well sorted, subangular to subrounded grains. Brown (10YR 5/3).
113	1120-1130	Clayey fine-grained sand (60% sand, 40% clay), well sorted, subangular to subrounded grains. Pale brown -brown (10YR 6/3-5/3).
114	1130-1140	Clayey fine-grained sand (60% sand, 40% clay), well sorted, subangular to subrounded grains. Pale brown -brown (10YR 6/3-5/3).
115	1140-1150	Fine to medium-grained sand (90% sand, 10% silt, trace gravel), well sorted, subangular to subrounded grains. Yellowish-brown (10YR 5/4) Quartzite, granite, and chert.

Sample No.	Depth Interval (feet)	Description
116	1150-1160	Silty clay (80% clay, 20% silt), well sorted. Brown (10YR 5/3).
117	1160-1170	Same as above.
118	1170-1180	Clayey/silty fine to medium-grained sand (85% sand, 15% clay/silt), moderate to well rounded, subangular to subrounded. Yellowish-brown (10YR 5/4).
119	1180-1190	Clayey/silty fine to medium-grained sand (90% sand, 10% clay/silt), moderate to well rounded, subangular to subrounded. Yellowish-brown (10YR 5/4).
120	1190-1200	Clayey/silty fine to medium-grained sand (90% sand, 10% clay/silt), moderate to well rounded, subangular to subrounded. Yellowish-brown (10YR 5/4).

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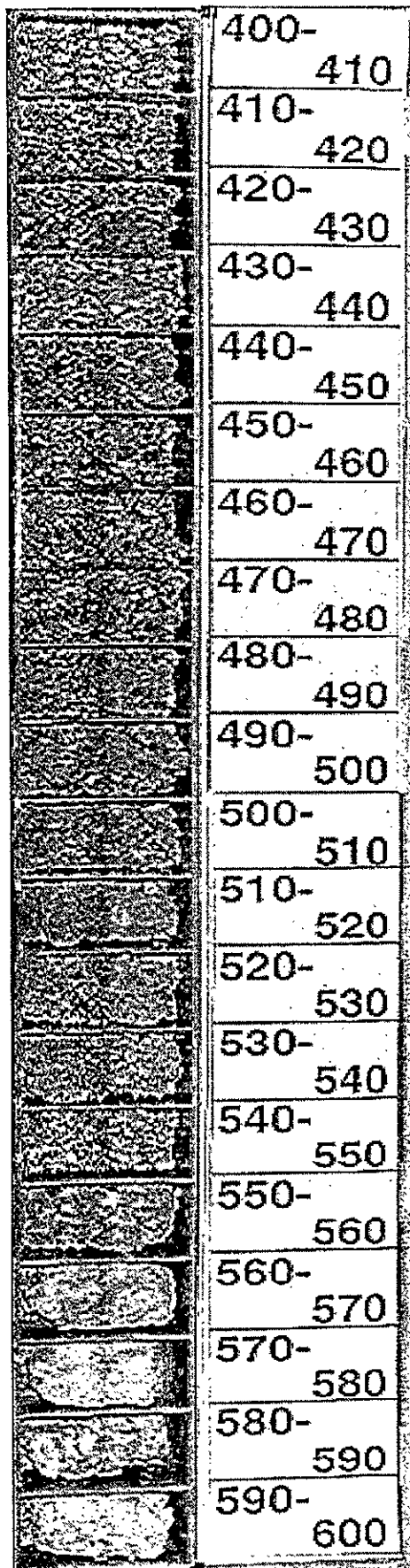
		Lithofacies	Hydrostratigraphic Unit	Lithologic Unit
	0-	IV, V	PA	upper Sierra Ladrones Formation
	10			
	10-	IV, I	VA or USF-2	
	20			
	20-	III		
	30			
	30-			
	40			
	40-			
	50			
	50-	III	USF-2	
	60			
	60-			
	70			
	70-			
	80			
	80-	III		
	90			
	90-			
	100			
100-				
110				
110-	III			
120				
120-				
130				
130-				
140				
140-	III			
150				
150-				
160				
160-				
170				
170-				
180				
180-				
190				
190-				
200				

	Lithofacies	Hydrostratigraphic Unit	Lithologic Unit	
	200-210			
	210-220	(IX)		
	220-230			
	230-240			
	240-250	(II)		
	250-260			
	260-270			
	270-280			
	280-290			
	290-300	III	USF-2	upper Sierra Ladrones Formation
	300-310	(IX)		
	310-320			
	320-330			
	330-340			
	340-350			
	350-360			
	360-370	(II)		
	370-380			
	380-390			
	390-400			

Lithofacies

Hydrostratigraphic
Unit

Lithologic
Unit



400-
410
410-
420
420-
430
430-
440
440-
450
450-
460
460-
470
470-
480
480-
490
490-
500
500-
510
510-
520
520-
530
530-
540
540-
550
550-
560
560-
570
570-
580
580-
590
590-
600

(II)

III

USF-2

(IX)

upper Sierra Ladrone Formation

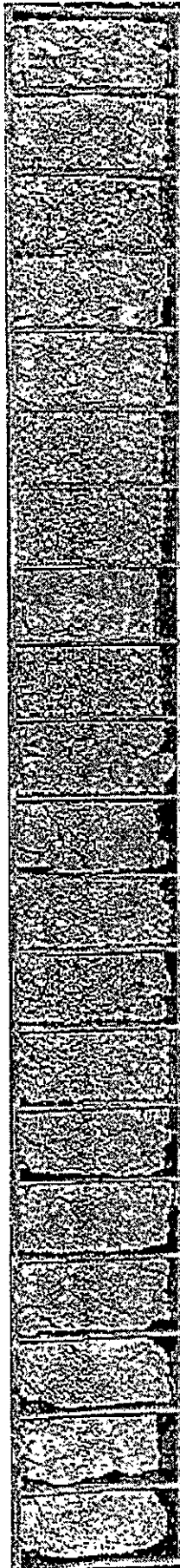
	Lithofacies	Hydrostratigraphic Unit	Lithologic Unit	
	600-610			
	610-620			
	620-630	(II)		
	630-640			
	640-650			
	650-660			
	660-670	(IX)		
	670-680			
	680-690			
	690-700			
	700-710	III	USF-2	upper Sierra Ladrones Formation
	710-720	(II)		
	720-730			
	730-740			
	740-750			
	750-760			
	760-770			
	770-780	(IX)		
	780-790			
	790-800			

	Lithofacies	Hydrostratigraphic Unit	Lithologic Unit	
	800-		upper Sierra Ladrones Formation	
	810-			
	810-			
	820-			
	820-	(IX)		USF-2
	830-	III		
	830-			
	840-			
	840-			
	840-			
850-				
850-				
860-				
860-	(II)			
870-				
870-				
880-				
880-				
890-				
890-				
900-				
900-				
910-				
910-				
920-				
920-	IX	MSF-2		
930-				
930-				
940-				
940-				
950-				
950-				
960-				
960-				
970-				
970-				
980-				
980-	III			
990-				
990-				
1000-				

Lithofacies

Hydrostratigraphic
Unit

Lithologic
Unit



1000- 1010
1010- 1020
1020- 1030
1030- 1040
1040- 1050
1050- 1060
1060- 1070
1070- 1080
1080- 1090
1090- 1100
1100- 1110
1110- 1120
1120- 1130
1130- 1140
1140- 1150
1150- 1160
1160- 1170
1170- 1180
1180- 1190
1190- 1200

III

MSF-2

Lower Sierra Ladrone Formation