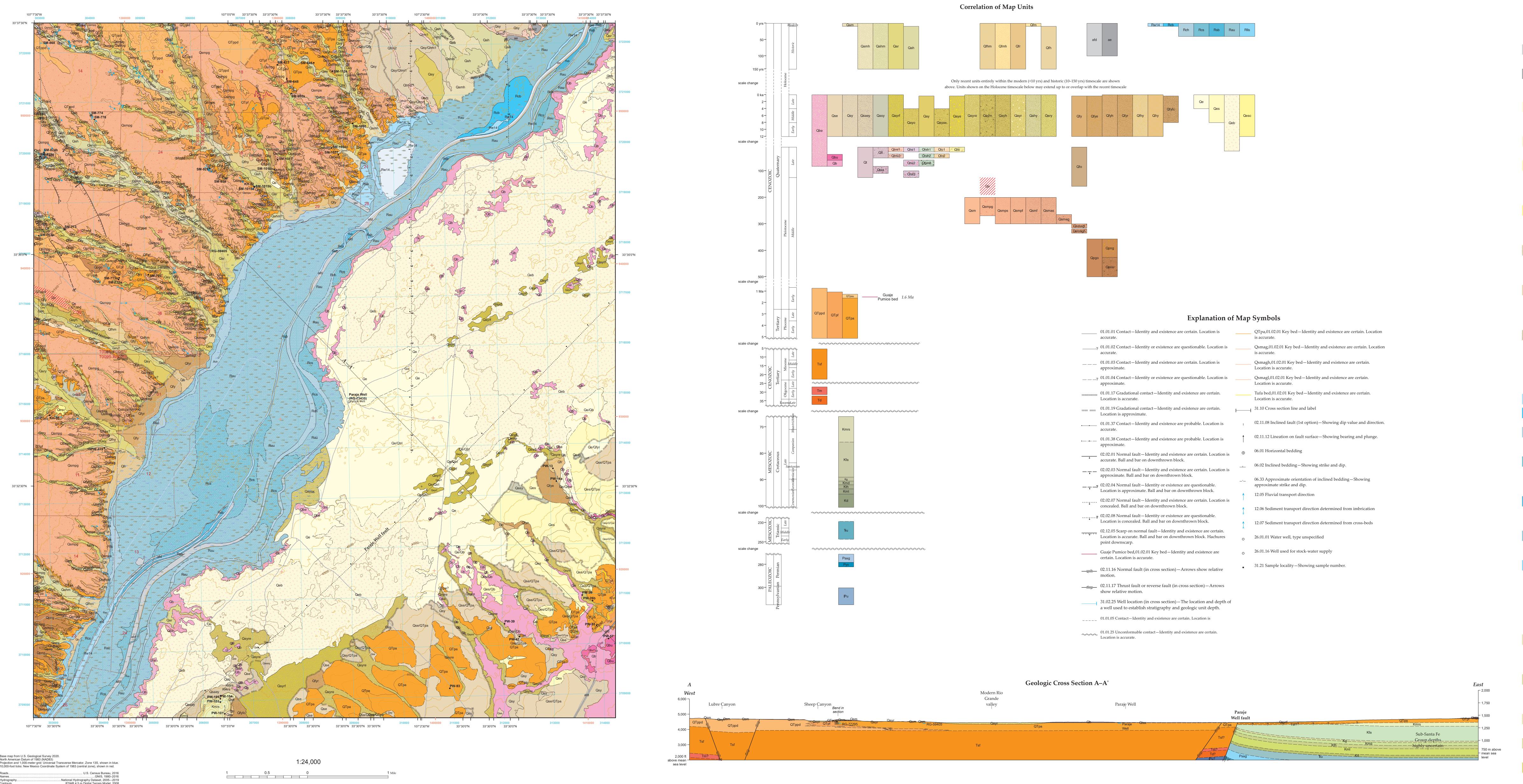
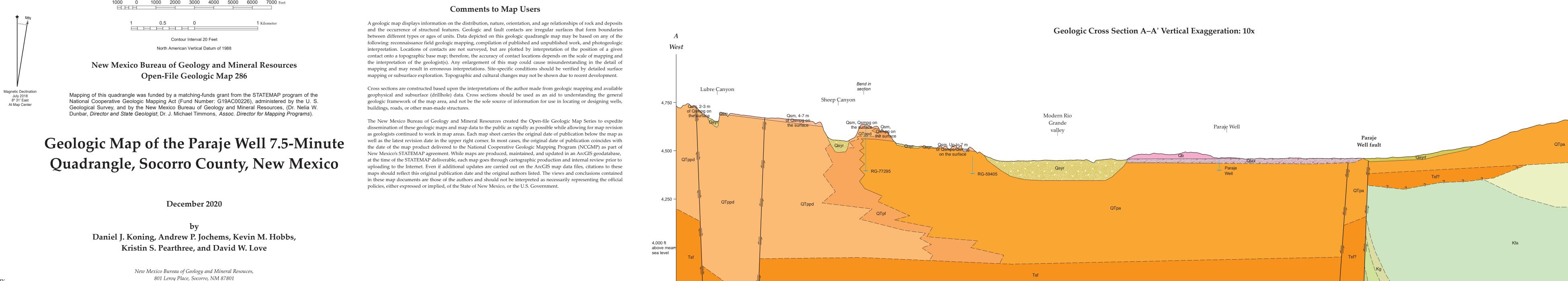
NMBGMR Open-File Geologic Map 286 NEW MEXICO BUREAU OF GEOLOGY AND MINERAL RESOURCES A RESEARCH DIVISION OF NEW MEXICO INSTITUTE OF MINING AND Last Modified December 2020





New Mexico

New Mexico Bureau of Geology and Mineral Resources

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New Mexico Tech

about 5–7% silt that coarsens upwards. Poorly sorted in the lower half of sediment that coarsens-upwards from a pebbly sand to a clast-supported sandy gravel with 30% cobbles that overlies the axial sand of QTpa. The bed, where cU-vcU sand is mixed with very fine to coarse pebbles. Cobbles and fine boulders are found in the upper half. The bed is ≈30 cm thick. gravel is in thin to thick beds. The sand is fine- to very coarse-grained, subrounded to subangular, poorly sorted, and composed of volcanic-02-01-01-04—unit—QTpa—Axial-fluvial facies—Light-brownish-gray to dominated sand with 10–15% clay fragments. The clay imparts a strongwhite sand with <25% pebbly beds. The sand is typically well-laminated brown to yellowish-red color (7.5–5YR 4/6). The tread is ≈9 m above Qah. (cross-stratified to horizontal-planar) and composed of quartz, minor The deposit is 2–3 m thick. vitreous feldspar, 10–25% orangish grains (potassium feldspar, granite, and 01-07-05-00-00—heading03—Silver—Terrace Deposits of Silver chert), 15–25% dark lithics, and <0.5% clay in the matrix. Pebbles contain up Canyon – Terrace Deposits of Silver Canyon to 20% exotic clasts such as quartzite and chert. Locally well-cemented but generally loosely consolidated. The deposit is >30 m thick. 01-07-05-01-00—unit—Qts—Undivided terrace deposits—Weakly 02-01-01-01-05—unit—QTpau—Upper tongue of the axial-fluvial consolidated pebble to cobble gravel and brownish (7.5YR) sand. The gravel is commonly imbricated with occasional lenses of massive to cross-stratified facies – Axial sand, as described in unit QTpa, that contains in its gravel silt to sand. The strongest soil development observed is Stage I(+) calcic soil assemblage either Rabbit Mountain obsidian (1.47 Ma) or pumice inferred to in the upper 30 cm of deposit. There is a weak to moderate varnish on 5–30% north-central New Mexico). The unit projects to or above the Guaje Pumice of surface clasts. The tread lies approximately 2 m above valley floors. The bed mapped north of Simon Canyon. 1.2–1.6 Ma in age. The deposit is 2–4 m deposit is 6–7 m thick. modern fan alluvium (Qfm). Qfhm is similar to unit Qahm but it forms an 01-08-00-00-heading02—PiedTer—Geomorphically High-level Piedmont and Terrace Deposits—Geomorphically High-level Piedmont and Terrace 02-01-01-02-00—heading04—LowSantaFe—Lower Santa Fe Group—Lower 01-08-01-00-00—heading03—SanMarcFm—San Marcial formation—We 02-01-01-02-01—unit—Tsf—Undifferentiated Santa Fe Group underlying the Palomas Formation—Cross section only. Clastic, basin-fill sediment apply the informal, newly proposed name of San Marcial formation to a consisting of well-consolidated and variably cemented sand, silt, and clay. laterally extensive, several meter thick, sand and gravel deposit that underlies most of the area west of the Rio Grande and is inset into older Possible conglomeratic tongues may be present to the west. The sand and conglomerates consist of volcanic detritus from the San Mateo Mountains. A Santa Fe Group deposits. A prominent, widespread geomorphic surface 500–700 m thickness has been inferred for the cross section but this is highly developed on top of the deposit primarily represents the culmination of this uncertain; a thinner wedge of <50(?) m may be present immediately east of noteworthy Middle Pleistocene aggradational event, although postsubordinate younger fan alluvium (Qfy). Ofhy is similar to unit Qahy but it the Paraje Well fault. aggradation erosion has locally resulted in fill-cut geomorphic surfaces. A forms an alluvial fan at the mouths of tributary drainages. See descriptions useful clast to recognize the San Marcial formation, in addition to younger of units Qah and Qay. The unit is weakly consolidated and 1-4 m thick. 02-02-00-00-heading02—Tvolcanic—Tertiary Volcanic Units—Tertiary inset terrace gravels, is a speckled, slightly greenish porphyry that contains 01-05-07-00-00—unit—Qfry—Recent (historic + modern) and younger fan 15–20% phenocrysts of 0.3–1 mm-long, relatively equant mafics (pyroxene?) alluvium, undivided — The unit is composed of recent fan alluvium (Qfr) and trace amounts of 0.5–1.5 mm long quartz phenocrysts. In the following 02-02-01-00-00—unit—Tm—Mogollon Group—Cross section only. descriptions, we call this the "speckled-rhyolite porphyry marker clast." Thi and subordinate younger fan alluvium (Qfy). Qfry is similar to unit Qary but mimbrites likely interbedded with minor volcaniclastic sandstone, muddy it forms an alluvial fan at the mouths of tributary drainages. See descriptions formation is subdivided according to provenance (piedmont vs. axial) and sandstone, and conglomerate. The ignimbrites include the Vicks Peak Tuff: a of Qah, Qam, and Qay. The unit is weakly consolidated and 1–4(?) m thick. texture (gravel vs. sand and pebbly sand vs. clay, silt, and fine sand). gray to light-gray, welded, crystal-poor tuff observed 6 km to west. Inferred to correlate with the Tortugas sand near Las Cruces, which is Phenocrysts contain trace to 3% sanidine, trace to 1% mafic grains, and trace capped by a ≈200 ka basalt (age from Leavy, 1987), and so the San Marcial quartz (Jochems and Koning, 2019). The underlying La Jencia Tuff may also 01-05-08-00-00—unit—Qfy—Younger fan alluvium—Weakly consolidated formation is probably ≈200–300 ka (John Hawley, written communication, be present. The unit is 50–100(?) m thick. 01-08-01-01-00—unit—Qsm—San Marcial formation, undivided—Cross 2-02-02-00-00—unit—Td—Datil Group—Cross section only. Ignimbrites, section only. Sandy gravel that grades laterally eastward into pebbly sand ermediate lavas, and likely volcaniclastic sandstone, muddy sandstone, and then into floodplain and axial sand deposits. The unit coarsens-upwards and conglomerate. The ignimbrites include the Tuff of Rocque Ramos and the facies prograded eastward with time. The lower strata fill the Canyon, which has 15–40% phenocrysts composed of sanidine, subordinate paleotopography. See detailed descriptions of units Qsmag, Qsmas, Qsmf, plagioclase and ≤7% biotite. The lowest unit to the west is a trachyandesite Qsmps, Qsmpg. The deposit is up to 13 m thick. lava with 3% phenocrysts dominated by plagioclase and pyroxene (Jochems and Koning, 2019). The unit is 100–150(?) m thick. tightly parallel, arcuate shapes formed by migration of the river channel. The Grande—Fan deposits in the eastern part of the quadrangle. The sand and 01-08-01-01-01—subunit—Qsmagl—Lower allostratigraphic unit minor pebbles are reworked from the axial-fluvial facies of the Palomas lithologically similar to Qsmag —The unit is located ≈6 m below Qsmag and 03-00-00-00-heading 01-Cretaceous-Cretaceous-Cretaceousis 1–3 m thick. Stratigraphic relations are ambiguous, and it is possible that this is a much younger, Late Pleistocene terrace deposit. 01-05-10-00-00—unit—Qfyh—Younger and historic fan alluvium, 03-01-00-00-unit - Kmrs - Sandstone of the McRae Group - Well-

> strata are subordinate. The nomenclature is from Lucas et al. (2019). The unit 03-03-00-00-unit-Kg-Gallup Sandstone-Cross section only. White to yellow, quartz-rich, fine- to medium-grained sandstone intercalated with subordinate grayish mudstone. The sandstones are cross-stratified, horizontal-planar, or massive. The unit was mostly deposited in a nearshore marine environment where one or more shallowing-upward cycles are apparent (e.g., Koning et al., 2011; Seager and Mack, 2003). The unit is ≈30 m thick in the Victorio wells to the southeast (Lucas et al., 2019). 04-00-00-unit – Kmd – D-Cross Tongue of the Mancos Shale – Cross ection only. Noncalcareous, gray to greenish-gray clay shale (lower part) coarsening upwards to a silty shale interbedded with thin siltstones and very

unit typically overlies unit Qsmag and grades laterally westward into unit Qsmps. The deposit is 2–10 m thick. 01-08-01-05-00—unit—Qsmps—Piedmont sediment dominated by sand and pebbly sand—Weakly to moderately consolidated, brownish (7.5YR), very fine- to medium-grained sand and silty fine-grained sand inset into the Santa

with 1–35% sandy gravel to pebbly sand. Near the western buttress this unit contains abundant reworked sand from QTpa. The unit is non-cemented and more calcareous than units QTpf or QTppd. The deposit is 3–13 m thick. 01-08-01-06-00—unit—Qsmpf—Piedmont and fine-grained sediment, undivided—Coarsening-upward package consisting of (from bottom to top):

Qsmpaf, Qsmps, and Qsmpg. See descriptions of those individual units. The deposit is 5–7 m thick. 01-08-01-07-00—unit—Qsmpg—Piedmont sediment dominated by sandy gravel—Well-consolidated, sandy gravel, subordinate pebbly sand, and

1–20% sand that is reddish-brown, and contains sparse calcic paleosols. The strata form very thin to medium, lenticular to tabular beds and 5–20% Ushaped channel-fills. The gravel is composed of pebbles, 1–40% cobbles, and 1–3% boulders. The sand is mostly medium- to very coarse-grained and contains 0.5–5% clay. The deposit is 2–11 m thick, thinning eastward to 1–4 m

Piedmont Deposits

01-07-01-00-00—heading03—Milligan—Terrace Deposits of Milligan Gulch—Terrace Deposits along Milligan Gulch 61-07-01-01-00—unit—Qtmi1—Lowest terrace deposits —Sandy gravel in medium, lenticular to tabular beds. The gravel consists of pebbles with 30–40% cobbles and ≤7% boulders. The sandy gravel matrix is fine- to very coarse-grained. The topsoil has a 30–50 cm thick, calcic horizon with Stage I(+) to II carbonate morphology, however, locally, a Stage III calcic horizon is

preserved beneath 1 m of the capping unit (Qsy). The tread height is 3–4 m and the strath height is 2–3 m. The deposit is mostly 1–3 m thick. 201-07-01-02-00—unit—Qtmi2—Lower-middle terrace deposits —Sandy

gravel in thin to medium, tabular to lenticular beds. The gravel is sand- to clast-supported and composed of pebbles, 40% cobbles and 2–3% boulders. The matrix sand is brownish and medium- to very coarse-grained. There is a weak desert pavement. The topsoil has a Stage I(+) to II carbonate morphology. The tread height is 4–8 m and the strath height is 3–5 m, both increasing to the west. The deposit is ≈4 m thick. 01-07-02-00-00—heading03—Simon—Terrace Deposits of Simon

01-05-12-00-00—unit—Qfyfc—Younger fan alluvium derived from the nortl

end of the Fra Cristobal Mountains—Sand and minor gravel derived from

granite found south of the quadrangle. The sand is brown (7.5YR 5/4), poorly

pebbles are very fine to very coarse and composed of angular to subangular

to moderately sorted, angular to subangular, and very fine- to very coarse-

grained. The coarser sand is composed wholly of granite fragments. The

granite. The fan surface generally lacks bar-and-swale topography. The

01-05-13-00-00—unit—Qfo—Older fan deposits—Loosely consolidated

gravel in thick to very thick, tabular to wedge-shaped beds. Clast- to matrix-

supported and internally massive to imbricated. The matrix is brown to

horizon is observed and there is a weak varnish on 25–40% of surface clasts.

01-06-00-00-00—heading02—Erosional—Erosional Surfaces—Erosional

// 01-06-01-00-00—unit—Qx—High-level erosional surface—An erosional

Canyons – Terrace Deposits that Flank Modern Canyons

surface locally developed on top of the San Marcial formation (unit Qsmpg).

01-07-00-00-00 heading 02 — Terrace — Terrace Deposits that Flank Modern

01-07-00-01-00—unit—Qt—Terrace Deposits, undivided—Loosely to

moderately consolidated, sandy gravel, and gravelly sand in very thin to

01-07-00-02-00—unit—Qtl—Lower terrace deposits in low-order

01-07-00-03-00—unit—Qtax—Terrace underlain by axial sand of Rio

Grande—Loosely consolidated medium- to coarse-grained sand

above valley floors. The deposit is 0.3–1 m thick.

minor. The deposit is up to 11–12 m thick.

canyons—Sandy gravel with 15–40% cobbles and 1–10% boulders. The

deposit commonly features illuviated clay (Bt) horizon in topsoil. There is a

weak varnish on 20–30% of surface clasts. The tread generally lies 1.5–3 m

immediately east of the Rio Grande. The deposit is overlain by 2–3 m of

volcanic rocks, quartzite, and chert; other compositions are present but

vesicular basalt (Qb). The gravel comprises 1–10% of the strata and consists

of subrounded to rounded, moderately to poorly sorted pebbles with 5–10%

cobbles. The gravel is composed mainly of felsic volcanic rocks, intermediate

mostly medium- to very coarse-grained. Stage II–III(+) calcic horizons, desert

pavement, and clast varnishing are observed at the surface. The deposit is 0.3

The tread height is 2.1–3.2 m above modern grade. The deposit is <3–4 m

strong-brown (7.5YR), fine to coarse sand with no clay. A Stage I calcic

deposit is several m thick.

Canyon – Terrace Deposits of Simon Canyon 01-07-02-01-00—unit—Qtsi1—Lower terrace deposits—Sandy gravel with abundant cobbles (25–50%) and 1% boulders. The tread lies 3–5 m above modern grade and 2 m above the tread of Qay. There is a weak desert

pavement. The geomorphic surface lacks bar-and-swale topography. Topsoi development is not observed. There is a high chance of miscorrelation with unit Qayo, but it was distinguished from the latter based on the presence of

01-04-13-00-00—unit—Qayo—Older subunit of the younger alluvium west 01-07-02-02-00—unit—Qtsi2—Middle terrace deposits—Weakly of Rio Grande—Brownish sand, gravel, and pebbly sand with likely consolidated sandy gravel with subordinate pebbly sand and sand. The gravel is composed of pebbles with 5–25% cobbles and 1–2% boulders; matrix sand is fine to very coarse. The pebbly sand and sand are horizontalplanar-laminated. The sand is brownish and mostly very fine- to mediumgrained. The topsoil manifests a Stage II to II(+) carbonate morphology. The tread is ≈7 m above modern grade. The deposit is 1–4 m thick.

01-09-03-00-00—unit—Qbe—Basalt outcrops surrounded by subordinate eolian sand—Mapped where subordinate proportions of eolian sand bury 01-07-02-03-00—unit—Qtsi3—Upper terrace deposits—Sandy gravel Grande—Brownish, massive sand with 5–15% scattered pebbles and 0.5–10% composed predominately of volcanics. The tread lies ≈15 m above the valley descriptions for units Qb and Qe. floor and 10 m below the tread of Qsmpg. The deposit is 1–2 m thick. 01-07-03-00-00—heading03—Sheep—Terrace Deposits of Sheep

> 02-01-00-00-heading02—BasinFill—Basin-fill Units—Basin-fill units collectively belong to the Santa Fe Group. The upper Santa Fe Group is called the Palomas Formation, consistent with nomenclature used in the Engle and Palomas Basins to the south. To the south and west of the quadrangle, STATEMAP work is using the age-equivalent term Sierra Ladrones Formation for these strata. The Palomas Formation is relatively non-cemented and little deformed (tilted <3°). Underlying Santa Fe Group

01-07-03-02-00—unit—Qtsh2—Middle(?) terrace deposits—Poorly exposed sandy gravel at 13S 304875mE 3719580mN and 305745mE 3718910mN NAD83. The terrace tread lies 8–11 m above modern grade and 17–20 m below the tread of Qsmpg. The unit may correlate with Qtsh3 if the tread has a steeper gradient than the tread of Qsmpg. The deposit is likely a few meters thick.

01-07-03-03-00—unit—Qtsh3—Upper terrace deposits—Reddish sandy 01-04-17-00-00—unit—Qasy—Younger alluvium and sheetflood deposits, gravel with 20% pebbly sand. The strata are in thin to medium, tabular to undivided—Sandy deposits that consist of interfingering or gradational relationships between younger alluvium (Qay) and sheetflood deposits (Qsy). The unit is commonly strong-brown, reddish-yellow, or light-brown; massive; pedogenically modified; and typically has Stage I carbonate morphology. See detailed descriptions of each unit.

01-05-00-00—heading02—AlvFan—Alluvial Fan Units—Many of the alluvial fan map units reflect combinations of deposits, such as combined younger alluvium and historic alluvium (Qfyh). In these combined units, th unit with the largest exposed area is shown first, followed by the unit with the lesser area of exposure. Where modern and historic deposits are subequal (±20%), then the resulting map unit is called recent and abbreviated as Qfr.

interbeds of sand and clayey to silty fine sand. Similar to unit Qay; however,

topsoil has a Stage I(+) calcic horizon (Bk) locally overlain by illuviated clay

it appears to contain slightly more gravel. The sediment appears less cobbly

than the lowest terrace deposits (e.g., Qtl, Qtsi1). Tread heights are 2.5–4 m.

01-04-14-00-00—unit—Qaye—Younger alluvium east of the Rio

very thin to thin, lenticular beds of pebbles eroded from QTpa. Sand is

mostly medium-grained and has 0–10% clay to silt content with 3–12%

scattered very coarse grains. Common pedogenesis characterized by ped

development, very weak to no illuviated clay, and Stage I to II calcic

01-04-15-00-00—unit—Qayre—Younger and recent (historic + modern)

alluvium east of the Rio Grande, undivided—The unit is composed of

younger alluvium (Qay) and very minor recent alluvium (Qah + Qam) east

01-04-16-00-00—unit—Qayrf—Fine-grained, younger and recent (historic +

silty fine sand, and clay to silt deposited on very low gradients or closed

of ephemeral streams by dunes). The sediment is brown to light-brown,

massive (may be laminated in upper 1–2 cm), and weakly to moderately

consolidated with an overall estimate of 1–25% fines. The deposit is likely

topographic depressions east of the Rio Grande (commonly due to blockage

modern) alluvium, undivided – Very fine- to fine-grained sand, clayey to

horizon (Bt). The deposit is 2–4(?) m thick.

horizons. The deposit likely averages 2–3 m thick.

of the Rio Grande. See detailed descriptions of each unit.

01-05-01-00-00—unit—Qfm—Modern fan alluvium—Loosely consolidated 01-02-04-00-00—unit—Qsy—Younger sheetflood deposits—Massive, very sand and gravel that underlie fan channels, bars, and levees. The sand is fine- to medium-grained sand and clayey to silty sand with minor, scattered coarser sand and 1–15% pebbles; clay to silt content is <20%. Very thin to brown to yellowish-brown (10YR 5/3–4) and consists of fine to very coarse thin, lenticular beds (0.5–3%) of sandy pebbles. Buried soils are common grains composed of volcanics, minor quartz, and minor feldspar with no clay. Bar-and-swale topography characterizes the surface and exhibits up to (Stage I calcic horizons and local clay illuviation). Locally overlain by 1–20 0.4–0.5 m of relief. The deposit is <2–3 m thick in most places. cm of well-stratified sand and pebbly sand with no topsoil development. The 01-05-02-00-00—unit—Qfh—Historic fan alluvium—Weakly consolidated, 01-02-05-00-00—unit—Qse—Sheetflood deposits with minor eolian well-bedded sandy pebbles and pebbly sand; the unit lacks a notable topsoil and has 3–30 cm tall bar-and-swale topography. Strata are in very thin- to sand—Moderately consolidated sheetflood deposits with reworked eolian sand; the unit is mapped east of the Rio Grande and includes surficial eolian thin-bedded (minor medium), tabular to lenticular to wedge-shaped beds. The gravel consists of pebbles with 1–30% cobbles. The sand is dark-brown sand sheets. Sheetflood deposits consist of pink (7.5YR 7/3-4) to strong- or

to brown (7.5YR), fine- to very coarse-grained, and lacks clay (very locally up light-brown (7.5YR 4–5/6, 6/4), massive, very fine- to medium-grained sand to 7%). The deposit is 0.1–3 m thick. and clayey to silty sand (up to 15% clay to silt) that may be pedogenically modified with Stage I carbonate morphology. The deposit likely averages 2 01-05-03-00-00—unit—Qfmh—Modern and historic alluvium, undivided —The unit is composed of modern fan alluvium (Qfm) and subordinate historic fan alluvium (Qfh). Qfmh is similar to unit Qamh but it forms an reworking eolian sand, undivided—Similar to unit Qasy and composed alluvial fan at the mouths of tributary drainages. See descriptions of Qam and Qah. The unit is weakly consolidated and 1–3 m thick. 01-05-04-00-00—unit—Qfhm—Historic and modern alluvium, undivided —The unit is composed of historic fan alluvium (Qfh) and subordinate

01-03-00-00-00—heading02—RioVlyFlr—Rio Grande Valley-floor Units—The alluvial fan at the mouths of tributary drainages. See descriptions of units Qah and Qam. The unit is weakly consolidated and 1–3 m thick. following units were mapped primarily using 2014 aerial imagery from the National Agriculture Imagery Program (NAIP). Features likely postdate 01-05-05-00-00—unit—Qfr—Recent (historic + modern) fan alluvium—Th ≈1990, when Elephant Butte Reservoir was last filled to capacity. All units are unit is similar to unit Qar but it forms an alluvial fan at the mouths of tributary drainages. See description of units Qah and Qam. The unit is 01-03-01-00-00—unit—Rw14—Water—Flowing or standing water apparent weakly consolidated and 1–3 m thick. 01-05-06-00-00—unit—Qfhy—Younger alluvial fans and slope wash deposits undivided – The unit is similar to historic fan alluvium (Qfh) and 01-03-02-00-00—unit—Rcb—Rio Grande bar deposits—Unvegetated,

digital aerial imagery. 01-03-03-00-00—unit—Rch—Rio Grande channel deposits — Areas of the Ri Grande floodplain with banded surface textures (such as vegetation trends) that are apparent in 2014 digital aerial imagery. These textures mostly parallel the axis of the modern floodplain. The unit is laterally gradational with unit Rcs (modified from Cikoski [2018]).

01-03-04-00-00—unit—Rcs—Rio Grande channel-splay deposits—Areas of

the floodplain with fanning/distributary surface textures (such as vegetatior

longitudinal bars of sand and perhaps minor gravel that is apparent in 2014

01-00-00-00-heading01—Quaternary—Quaternary—Quaternary

01-01-00-00-heading 02 — Anthropogenic Units — Anthropogenic

01-01-01-00-00—unit—afd—Disturbed land and anthropogenic fill—The unit

represents altered ground and thick accumulations of sediment (primarily

01-01-02-00-00—unit—ae—Excavated ground—The unit represents

excavations associated with stock tank impoundments and borrow pits.

sand, minor gravel, clay, and silt) used as fill for levees and berms. The

01-02-00-00-heading02-EolSheet-Eolian and Sheetflood Units Outside

of Valley Floors – Locally, underlying map units are noted using a backslash

01-02-01-00-00—unit—Qe—Eolian sand—Loosely consolidated, light-brown

(7.5YR 6/4) sand that forms 0.3–2 m tall dunes, sheets, or ramps (the latter

along the margins of basalt flows). The dunes are mostly internally massive

and include coppice, irregular, or longitudinal forms. The sand consists of

well-sorted, mostly subrounded, and is fine- to medium-grained. Surface

clast coverage is typically no more than 5%. The deposit is 0.3–2 m thick.

01-02-01-01-00—unit—Qeb—Eolian sand with subordinate outcrops of

01-02-02-00-00—unit—Qes—Eolian sand and minor sheetflood

basalt—Mapped where small (not mappable at 1:24,000) basalt outcrops

occur within predominately eolian sand sheets or dunes. See individual

deposits—Loosely consolidated sand that underlies eolian sheets, coppice

dunes, irregular dune forms, and small blowouts. The sand is fine- to

medium-grained and is grayish-brown to brown (10YR 5/2-3) in the west

to common (3–30%) pebbles at surface. The topsoil development is weak to

non-existent, but in the eastern quadrangle, deeper sand is pedogenically

undivided — Loosely consolidated sand with subordinate pebble or pebble to

cobble gravel found on the lee sides of ridges or terraces. The sand is similar

in color and texture to unit Qes and massive to cross-stratified or laminated.

The gravel is poorly sorted and mostly subangular to subrounded. The

deposit is commonly vegetated with little or no soil development. The

01-02-06-00-00—unit—Qsaey—Younger sheetflood and alluvial deposits

mainly of fine- to coarse-grained sand. The sand is interpreted to be

predominately reworked eolian sand via sheetflooding and alluvial

underlain by historic/younger alluvium (Qah/Qay).

in 2014 digital aerial imagery.

processes. The eolian sand was sourced from the inner Rio Grande valley

See description for unit Qasy. The deposit is possibly up to 5–7 m thick.

01-02-03-00-00—unit—Qesc—Eolian sand, sheetflood, and colluvium,

and light- to strong-brown (7.5YR 5-6/4, 5/6) in the east. There are occasional

Units—Anthropogenic Units

deposit is 1–6 m thick.

(i.e., Qes/underlying unit).

descriptions for units Qe and Qb.

altered. The deposit is <2–2.5 m thick.

deposit is 3–4 m thick, maximum.

deposit is 1–3 m thick.

trends) that are apparent in 2014 digital aerial imagery. Commonly, distributary textures can be traced back to current or former locations of the pebble to cobble gravel in thin to thick, tabular to lenticular to wedge-shaped beds. The gravel is clast- to sand-supported. The matrix is brown (7.5YR), Rio Grande channel, including one splay that breached a conveyance fine- to very coarse-grained sand. The topsoil has a Stage I calcic horizon. channel after 1978. The unit is laterally gradational with unit Rch (modified The surface has a weak varnish on <10% of surface clasts and bar-and-swale from Cikoski [2018]). topographic relief is up to 0.2 m. The tread height is 1–2.5 m above modern 01-03-05-00-00—unit—Rsb—Rio Grande scroll-bar deposits—Areas of the floodplain with scrolled surface textures (such as vegetation trends) that are 01-05-09-00-00—unit—Qfye—Younger fan alluvium east of the Rio apparent in 2014 digital aerial imagery. These textures are composed of

unit mostly predates units Rch and Rcs, although a few scrolls have formed Formation (QTpa). The deposit is 1–3 m thick. between 2005 and 2014. 01-03-06-00-00—unit—Rau—Rio Grande undifferentiated depsoits, primarily floodplain alluvium—Areas of the floodplain with non-distinct surface textures. This includes areas of the floodplain that have been

to moderately consolidated and 1–4(?) m thick. artificially disturbed by land management or former agricultural activities such that primary surface textures are unrecognizable (modified from 01-05-11-00-00—unit—Qfyr—Younger and recent (historic + modern) fan alluvium, undivided—The unit is similar to unit Qary but it forms an 01-03-07-00-00—unit—Rlls—Lakeshore deposits—Loosely consolidated gravelly sand associated with the highstands of Elephant Butte Reservoir. alluvial fan at the mouths of tributary drainages. See descriptions of Qay, The sediments are principally reworked from the underlying deposits and Qah, and Qam. The unit is weakly to moderately consolidated and 1–4(?) m tributary alluvium. The unit is only mapped where it is particularly thick or

extensive or where it masks underlying geologic relationships. The deposit is <4 m thick (modified from Cikoski [2018]). 01-04-00-00-heading02-VlyFlr-Valley-floor Units-Many of the valley-floor map units reflect combinations of deposits, such as combined younger alluvium and modern alluvium (Qaym). In these combined units, the unit with the largest exposed area is shown first, followed by the unit

with the lesser area of exposure. Where modern and historic deposits are subequal (±20%) the resulting map unit is called recent and abbreviated as 01-04-01-00-00—unit—Qam—Modern alluvium—Loosely consolidated

gravelly sand and gravel that underlie active channels in ephemeral drainages, very likely <10 years old. The gravel consists of pebbles, minor cobbles, and 1–10% boulders. The sand is brown to grayish-brown (7.5–10YR) with most grain sizes in the mU–vcU range. Bar-and-swale topography and steep-walled channels characterize the surface, exhibiting up to 0.1–0.6 m of relief. The deposit is 1–4(?) m thick. 01-04-02-00-00—unit—Qah—Historic alluvium—Well-stratified sandy gravel, pebbly sand, and sand that underlies low terraces (1–1.5 m tread

height) in valley bottoms. Very thin- to medium-bedded, tabular to lenticula

beds (internally massive to horizontal-planar-laminated; very minor ripple marks). The unit lacks notable topsoil development and bar-and-swale topography is evident in gravelly sediment; it often overlies Qay across a sharp contact. The deposit is 0.1–2 m thick. 01-04-03-00-00—unit—Qamh—Modern and historic alluvium, undivided —The unit is composed of modern alluvium (Qam) and subordinate historic thick, tabular to lenticular beds underlying terraces in modern canyons. The

deposit is 0.5–2 m thick. 01-04-04-00-00—unit—Qahm—Historic and modern alluvium, undivided -The unit is composed of historic alluvium (Qah) and subordinate modern alluvium (Qam). See detailed descriptions of each respective unit. The deposit is 0.5–2 m thick.

01-04-05-00-00—unit—Qar—Recent (historic + modern) alluvium—The unit is composed of historic alluvium (Qah) and modern alluvium (Qam) in subequal (±20%) proportions. See descriptions of units Qam and Qah. It is weakly consolidated and 0.5–3 m thick. 01-04-06-00-00—unit—Qary—Recent (historic + modern) and younger alluvium, undivided—The unit is composed of recent alluvium (Qar) and

subordinate younger alluvium (Qay). See detailed descriptions of Qam, Qah

and Qay. The deposit is 0.5–4 m thick.

2–6(?) m thick.

01-04-07-00-00—unit—Qahy—Historic and younger alluvium, undivided—The unit is composed of historic alluvium (Qah) and subordinate younger alluvium (Qay). See detailed descriptions of each respective unit. The deposit is 0.5–4 m thick. 01-04-08-00-00—unit—Qay—Younger alluvium west of the Rio Grande—Brownish sand, pebbly sand, slightly clayey to silty fine sand, and

sandy gravel underlying valley-bottom terraces whose treads are 0.5–2.5 m above modern grade; weakly developed, buried soils with Stage I carbonate morphologies. The surface has a very weak desert pavement, is relatively smooth with local subtle relief by cobbly bars, and has Stage I to I(+) calcic horizons. The deposit is 1–5(?) m thick.

01-04-09-00-00—unit—Qaym—Younger and modern alluvium west of the Rio Grande, undivided—The unit is composed of younger alluvium (Qay) and subordinate modern alluvium (Qam). See detailed descriptions of each unit. The deposit is 1–4 m thick. 01-04-10-00-00—unit—Qayh—Younger and historic alluvium west of the Rio

Grande, undivided—The unit is composed of younger alluvium (Qay) and subordinate historic alluvium (Qah). See detailed descriptions of each unit. 01-04-11-00-00—unit—Qayr—Younger and recent (historic + modern) alluvium west of Rio Grande, undivided—The unit is composed of younger alluvium (Qay) and subordinate recent alluvium (Qar). See detailed descriptions of each unit. The deposit is 1–4 m thick. 01-04-12-00-00—unit—Qayax—Younger alluvium deposited by the axial

river (Rio Grande) – Former terrace deposit consisting of axial sand and ver minor pebbles. Similar to unit Qtax; however, it contains less gravel. Tread was 5-6 m above the floodplain before creation of Elephant Butte Reservoir weak clast varnish and cobble-rich texture. The deposit is ≈1 m thick. (U.S. Bureau of Reclamation topographic map dated 1908; map no. 24-PT-503-14). Now, the tread is about the same elevation as the modern Rio Grande floodplain. Qayax possibly correlates with unit Qayo. The deposit is

The geomorphic surface is very weakly varnished and relatively smooth. The

basalt exposures in the eastern half of the quadrangle. See individual $02\text{-}00\text{-}00\text{-}00\text{-}00-\text{heading}01 - QuatTert - Quaternary - Tertiary - Quaternary...}$ Canyon—Terrace Deposits of Sheep Canyon

01-09-02-00-00—unit—Qbu—Basalt, upper flow lobe—Black (N2.5\),

groundmass is relatively fine-grained, but plagioclase microlaths are

observed that are mostly 0.1–0.4 mm (1–5% of plagioclase are up to 1 mm

02-01-01-00-00—heading03—SantaFeGrp—Santa Fe Group—Santa Fe Group

02-01-01-01-00—heading04—PalomasFm—Palomas Formation—Palomas

orange to tan, very fine to fine sand and clayey to silty fine sand; minor

sandy clay to silt and 1–15% gravelly bodies. The finer strata are mostly in

thick, tabular beds (internally massive, locally laminated); gravelly bodies

porphyry clasts. Paleosols (1–7%) have very rare calcic horizons. Very weak

02-01-01-01-02—unit—QTpf—Fine-grained, basin-floor margin facies —Very

interpreted mainly as floodplain deposits with ≤1% pebble beds. Minor beds

of fine- to medium-grained sand with 1–25% coarser sand and <10% volcanic

fine- to fine-grained sand, clayey to silty fine sand, silt, and clay that are

pebbles. The Strata is in very thin to very thick, tabular beds (internally

massive, minor horizontal-planar-laminated). The unit contains local tufa beds, mapped as a key bed, and paleosols. The deposit is 3–20 m, or more,

02-01-01-03—unit—Guaje Pumice bed—Guaje Pumice bed—Pumice

gravel in a matrix of coarse to very coarse pumice sand grains mixed with

cemented sandstone with minor pebbly and fine-grained beds (the latter is

nferred in non-exposed intervals) mapped near the southern edge of the

quadrangle at the north end of the Fra Cristobal Mountains. The sandstone

bodies are 1–4 m thick and broadly lenticular to tabular, cross-stratified in a

given story, and fine- to coarse-grained. The pebbles are composed of

03-02-00-00-00—unit—Kfa—Ash Canyon and Fence Lake Formations,

limestone, and trace quartzite. The unit is >40 m thick.

silicified argillite (probably intra-formational), trace to 20% granite, trace

undivided—Cross section only. Coarsening-upward sequence deposited in a

Eluvial (minor swamp) environment. The lower part is a gray- to olive-

sandstone with minor yellowish, coarser sandstone channel-fills and <3%

coals. In the upper part of the unit, the sandstone strata dominate and finer

-05-00-00-unit—Kth—Tres Hermanos Formation—Cross section only.

ontains these ascending members: the Atarque Sandstone (planar- to cross-

bedded, coarsening-upward, very fine- to fine-grained sandstone), the

Carthage Member (mudstone and siltstone with minor sandstone), and the

4-01-00-00-00—unit—^u—Triassic strata, undivided—Cross section only.

conglomerate and limestone. The sandstones are mostly fine- to medium-

grained and occur in broad, tabular or channel-form beds that exhibit cross-

bedding and horizontal stratification (from Cather, in prep). The unit is 220

m thick near Socorro but it is inferred to thin down to 130-140 m (possibly

05-00-00-00-heading01—PermPen—Permian—Pennsylvanian—Although

the typical Permian to Pennsylvanian sequence is expected to underlie the

quadrangle (e.g., Red House Formation through the San Andres Formation),

the particular units that would be present at the depths in the cross section

are highly speculative due to the uncertainty of buried structures and their

5-01-00-00-00—unit—Psag—San Andres Formation and Glorieta Sandstone

Tongue — The San Andres Formation overlies the Glorieta Sandstone. The

San Andres consists of thick, tabular beds of limestone. The limestone is

Sandstone contains thick, tabular beds of white to yellowish-tan sandstone

that may intertongue with minor limestone. The sand is very fine- to fine-

light-gray, weathering to light-brownish gray. The underlying Glorieta

<50–100 m) on this quadrangle.

respective displacements.

grained, well-sorted, and quartzose.

lish-brown to grayish-brown to red sandstone, mudstone, and minor

Fite Ranch Sandstone (planar- to cross-bedded, very fine- to fine-grained sandstone and minor intercalated shale). The unit is 63 m thick (Lucas et al.,

2019; Hook, et al., 1983; nomenclature from Hook et al., 1983).

colored package of mudstone, siltstone, and very fine- to fine-grained

are lenticular to tabular and up to 5 m thick. Trace to no speckled-rhyolite

to no HCl effervescence. The deposit is 50–100(?) m thick.

02-01-01-01-01-unit—QTppd—Distal piedmont facies —Well-consolidated,

long). Locally overlies unit Qb along the eastern quadrangle boundary,

vesicular basalt with 0.5% olivine phenocrysts 1–2 mm long. The

where it exhibits steep margins that are 8 m thick.

than the Palomas Formation.

01-07-03-01-00—unit—Qtsh1—Lower terrace deposits—Weakly-moderately consolidated sandy gravel with 10–20% pebbly sand. The beds are thin to medium and tabular to lenticular with local cross-stratification. The gravel is composed of pebbles with 5–50% cobbles and 1% boulders. The sand is fine to very coarse. The topsoil is characterized by a 30 cm-thick illuviated clay (Bt) soil horizon underlain by a 30–50 cm thick Stage II calcic horizon. The tread height is 3–5 m. The deposit is 3–5 m thick. strata are not exposed on this quadrangle, but based on other exposures in the Rio Grande rift, these strata exhibit more cementation and deformation

lenticular beds. Very thin, lenticular beds are also present (especially for pebbly sand) with 1–3% cross-stratification. The gravel is composed of pebbles with 25–50% cobbles and 1% boulders. The terrace tread is 8–10 m above the valley floor and 8–10 m below the tread of Qsmpg. The strath lies 3–6(?) m above the valley floor. The deposit is 3–5 m thick. 01-07-04-00-00—heading03—Crawford—Terrace Deposits of Crawford Hollow – Terrace Deposits of Crawford Hollow

01-07-04-01-00—unit—Qtc1—Lower terrace deposits—Sandy gravel in vague, thin to thick, tabular to lenticular beds. The gravel consists of clastsupported pebbles with minor cobbles. The tread lies 2–7 m above the valley floor. The unit may locally be subdivided into two subunits (not mapped) whose treads differ about 1 m in height. It is not known if these represent separate depositional events or if the lower is a fill-cut terrace. The deposit is 01-07-04-02-00—unit—Qtc2—Lower-middle terrace deposits—Terrace

undivided — The unit is composed of younger (Qfy) and subordinate historic 01-08-01-01-02 — subunit — Qsmagh — Higher allostratigraphic unit (Qfh) fan alluvium. See detailed descriptions of each unit. The unit is weakly lithologically similar to Qsmag — The unit is located 3–6 m above Qsmag and is 1–3 m thick. Local outcrops indicate this unit is a distinctive

allostratigraphic unit representing an older paleo-terrace deposit; younger

Qsmag and Qsmps were inset into this paleo-terrace. This unit may be part

of the post-Qsmag aggradational package (generally correlative to unit Qsmps) in other places. 01-08-01-02-00—unit—Qsmag—Axial sediment dominated by sandy gravel and gravelly sand —Loose to weakly consolidated sandy gravel and gravelly sand in very thin to thin, lenticular to tabular beds. The unit immediately underlies Qsmas and is inset into QTpa. The gravel consists of pebbles with trace to 10% fine cobbles, which are subrounded to rounded, and have a more diverse composition than QTpa pebbles. The sand is light-brownish-

gray to pale-brown to light-gray (10YR) and fine- to coarse-grained. The deposit is 1–3 m thick. 01-08-01-03-00—unit—Qsmas—Axial sediment dominated by sand—Loose 🧂 to weakly consolidated, fining-upward sand that conformably overlies units Qsmag and underlies Qsmaf. The lower sand is mostly medium- to coarsegrained (with local pebbles); the uppermost sand is mostly fine- to very finegrained. Massive or horizontal- to low-angle cross-laminated. The sand is light-gray to pale-brown (10YR 7/1–6/3). The lack of cementation and vaguer

bedding distinguishes this unit from QTpa sand. The deposit is 1–6 m thick. 01-08-01-04-00—unit—Qsmf—Fine-grained strata—Fine-grained sediment that coarsens upwards to sand. The lower part consists of interbedded clay, silt, and very fine- to fine-grained sand in thin to thick, tabular beds. The fine sandstones in its upper part. Local septarian concretions are up to 1 m upper part is light-brown to strong-brown, poorly sorted, fine- to coarseacross. Minor calcarenite beds are present near the base. Conformably grained sand overprinted by calcic and weakly illuviated clay horizons. The underlies the Gallup Sandstone. The unit is 58 m thick in the Victorio wells to the southeast (Lucas et al., 2019; Hook et al., in prep).

03-06-00-00-unit—Kmt—Tokay Tongue of the Mancos Shale—Cross ection only. Gray to black shale with a several-meter-thick interval of imestone beds in its lower-middle part (the Bridge Creek Limestone). Deepwater calcareous shales are found immediately above and below these limestones but pass outwards into noncalcareous shales (Hook and Cobban, 2015). Thin, tabular beds of sandstone are present near the base. The unit is 130 m thick in the Victorio wells to the southeast (Lucas et al., 2019). 07-00-00-unit—Kd—Dakota Sandstone—Cross section only. Cross-

stratified, well-cemented, quartzose sandstone and pebbly sandstones that are white (fresh) and weather to pink, magenta, orange, or dark-brown to blackish. The uppermost strata consists of a fining-upwards, marine, very fine- to fine-grained sandstone, but the underlying strata consists of a medium- to coarse-grained, fluvial sandstone. The unit is 48 m thick in the Victorio wells to the southeast (Lucas et al., 2019). 01-08-02-00-00—heading03—OldPied—Older Piedmont Deposits—Older 04-00-00-00—heading01—Triassic—Triassic—Triassic

01-08-02-01-00—unit—Qpgo—Older piedmont gravels—Orangish sandy gravel and subordinate pebbly sand whose tread and strath are 2–3 meters above those of adjoining unit Qsmpg. The sandy gravel form mostly very thin to medium, tabular to lenticular beds. Locally, there are thick, internally massive beds of sand with 1–10% pebbles. Weakly cemented by clays and weak to no HCl effervescence. The topsoil consists of a 0.5-1 m thick, Stage III to III(+) calcic horizon. The deposit is 1–7 m thick.

1-08-02-02-00—unit—Qpng—Gravelly piedmont sediment —Sandy gravel, pebbly sand, and sparse sand in thin to thick, tabular to broadly lenticular beds; locally trough cross stratified. The gravel is composed of pebbles with 5–45% cobbles and <5% boulders. The clasts are composed of felsic volcanics with trace to 3% each of feldspar porphyry and/or intermediate volcanics. The matrix sand is reddish-brown to strong-brown. The topsoil has Stage II to IV calcic horizons. The deposit is 2–7 m thick.

01-08-02-03-00—unit—Qpns—Sandy piedmont sediment—Gravelly sand with subordinate sandy gravel that grades eastward to a coarsening-upward package consisting of: fine- to very coarse-grained sand and pebbly sand overlying 2–4 m of muddy sand that, in turn, overlies 1–2 m of light-brown to reddish-brown clay to silt. To the north, there is a locally a 1.2 m-thick, argillic paleosol. The basal contact exhibits 6 m of paleotopographic relief. The deposit is 5–12 m thick.

01-09-00-00-heading02—QVolcanic—Quaternary Volcanic Units—Quaternary Volcanic Units

Zimmerer, pers. comm., 2019). The deposit is 1–8 m thick.

2-00-00-00—unit—Pyv—Los Vallos Formation—Intertonguing reddish own mudstone to siltstone to very fine-grained sandstone, light-gray gypsum, white to yellow siltstone to fine-grained sandstone, and light-gray to light-brownish-gray limestone to dolomite. Individual tongues are 1–10 m 01-09-01-00-00—unit—Qb—Basalt—Black to very dark-gray (N2.5/ to 3/), thick. The clastic sediment is well-sorted, quartzose, and internally highly vesicular basalt with trace to 1% olivine phenocrysts 0.5–3 mm long horizontal-planar-laminated to massive. The carbonates are thin to thick and (mostly 1–2 mm long). The groundmass is relatively fine-grained but has tabular-bedded. The unit is ≈200–230 m thick. plagioclase laths up to 1 mm long and locally exhibiting trachytic texture. The Late Pleistocene age is based on unpublished 40Ar/39Ar data (M. 05-03-00-00-00—unit—*u—Pennsylvanian strata, undivided—Limestone

interbedded with clastic sediment. The limestone is a medium- to dark-gray, generally fossiliferous micrite, wackestone, and packstone. The unit includes subequal to subordinate clastic tongues composed of shale, siltstone, and very fine to fine sandstones (1–25 m thick). The unit mostly consists of the Bar B and underlying Gray Mesa Formations. 460–470 m thick (from Lucas et al., 2017a, b; Koning et al., 2020).

