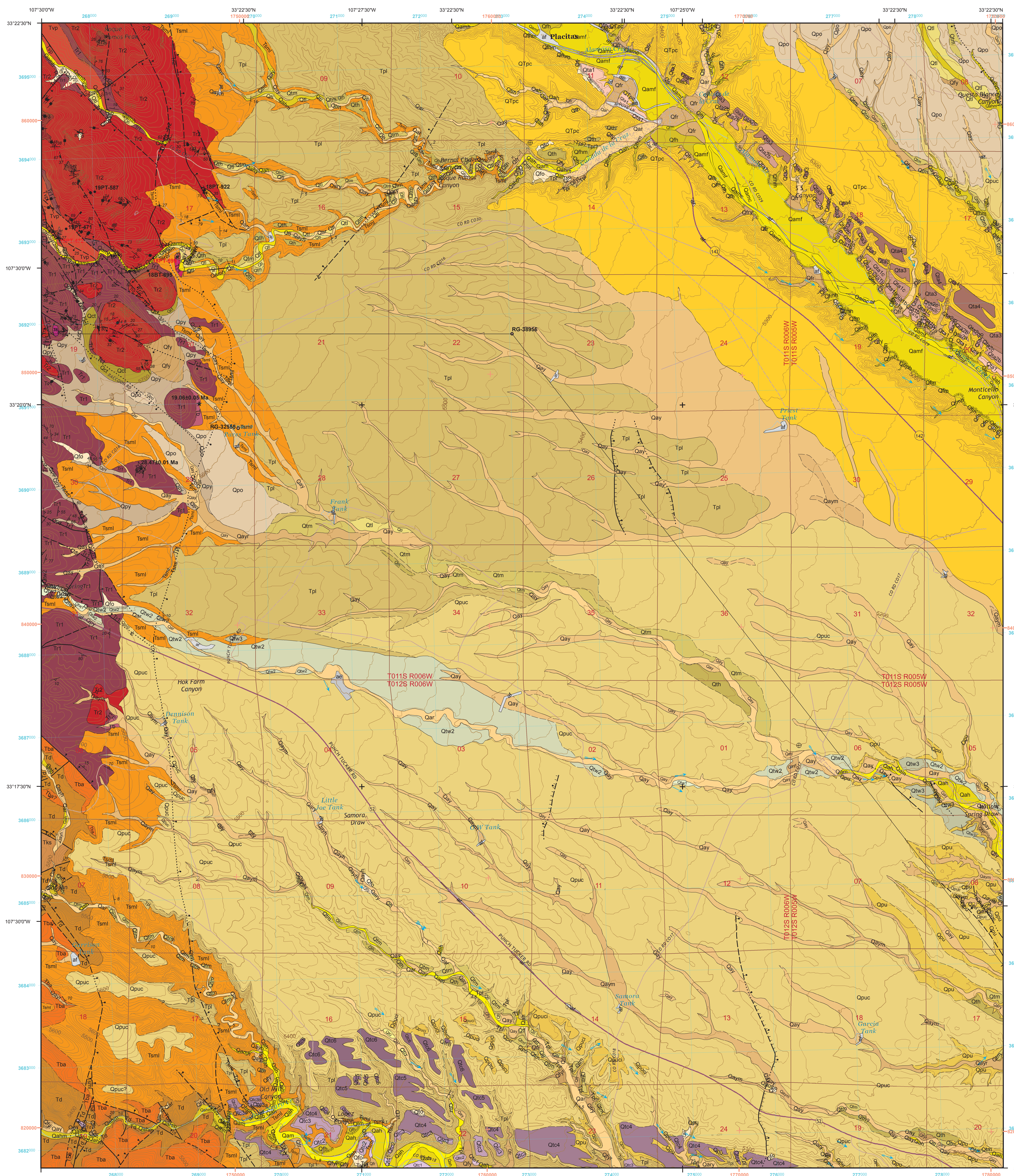
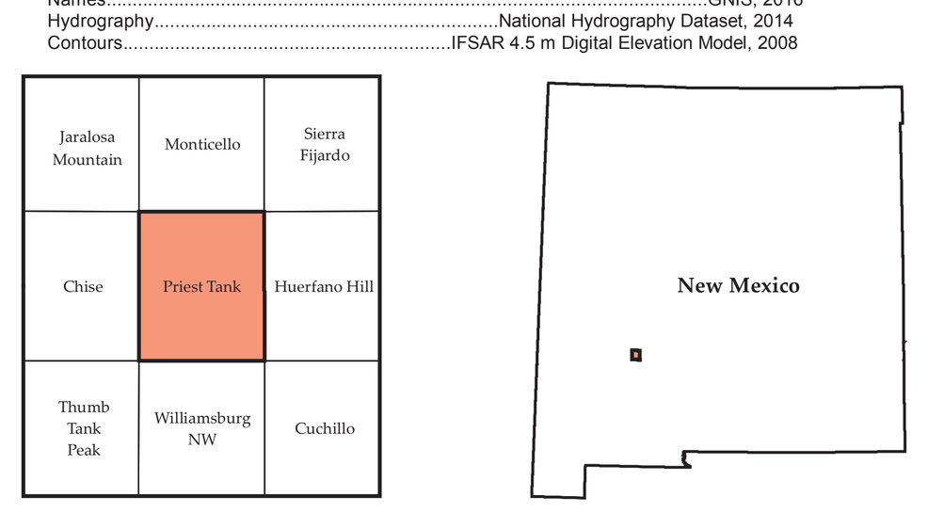
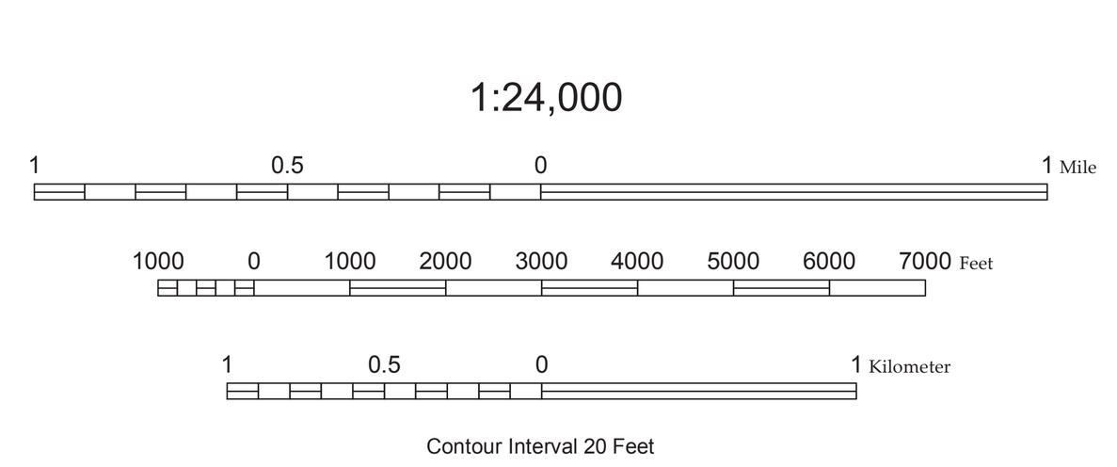


Base map from U.S. Geological Survey 2017.
North American Datum of 1983 (NAD83) World Geodetic System of 1984 (WGS84).
Projection and 1,000-meter grid: Universal Transverse Mercator, Zone 13S, shown in blue.
10,000-foot ticks: New Mexico Coordinate System of 1983 (west zone), shown in red.

Roads....U.S. Census Bureau, 2015-2016
Names....GNIS, 2016
Hydrography....National Hydrography Dataset, 2014
Contours....IFSAR 4.5 m Digital Elevation Model, 2008



Quadrangle Location



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This and other STATEMAP quadrangles are available for free download in both PDF and ArcGIS formats at:

http://geoinfo.nmt.edu

Digital layout and cartography by the NMBGMR Map Production Group:
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New Mexico Bureau of Geology and Mineral Resources
Open-File Geologic Map 275

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Geologic Map of the Priest Tank 7.5-Minute Quadrangle, Sierra County, New Mexico

June, 2019

by
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Comments to Map Users

A geologic map displays information on the distribution, nature, orientation, and age relationships of rock and deposits and the occurrence of structural features. Geologic and fault contacts are irregular surfaces that form boundaries between different types or ages of units. Data depicted on this geologic quadrangle map may be based on any of the following: reconnaissance field geologic mapping, compilation of published and unpublished work, and photogeologic interpretation. Locations of contacts are not surveyed, but are plotted by interpretation of the position of a given contact onto a topographic base map; therefore, the accuracy of contact locations depends on the scale of mapping and the interpretation of the geologist(s). Any enlargement of this map could cause misunderstanding in the detail of mapping and may result in erroneous interpretations. Site-specific conditions should be verified by detailed surface mapping or subsurface exploration. Topographic and cultural changes may not be shown due to recent development.

Cross sections are constructed based upon the interpretations of the author made from geologic mapping, and available geophysical, and subsurface (drillhole) data. Cross sections should be used as an aid to understanding the general geologic framework of the map area, and not be the sole source of information for use in locating or designing wells, buildings, roads, or other man-made structures.

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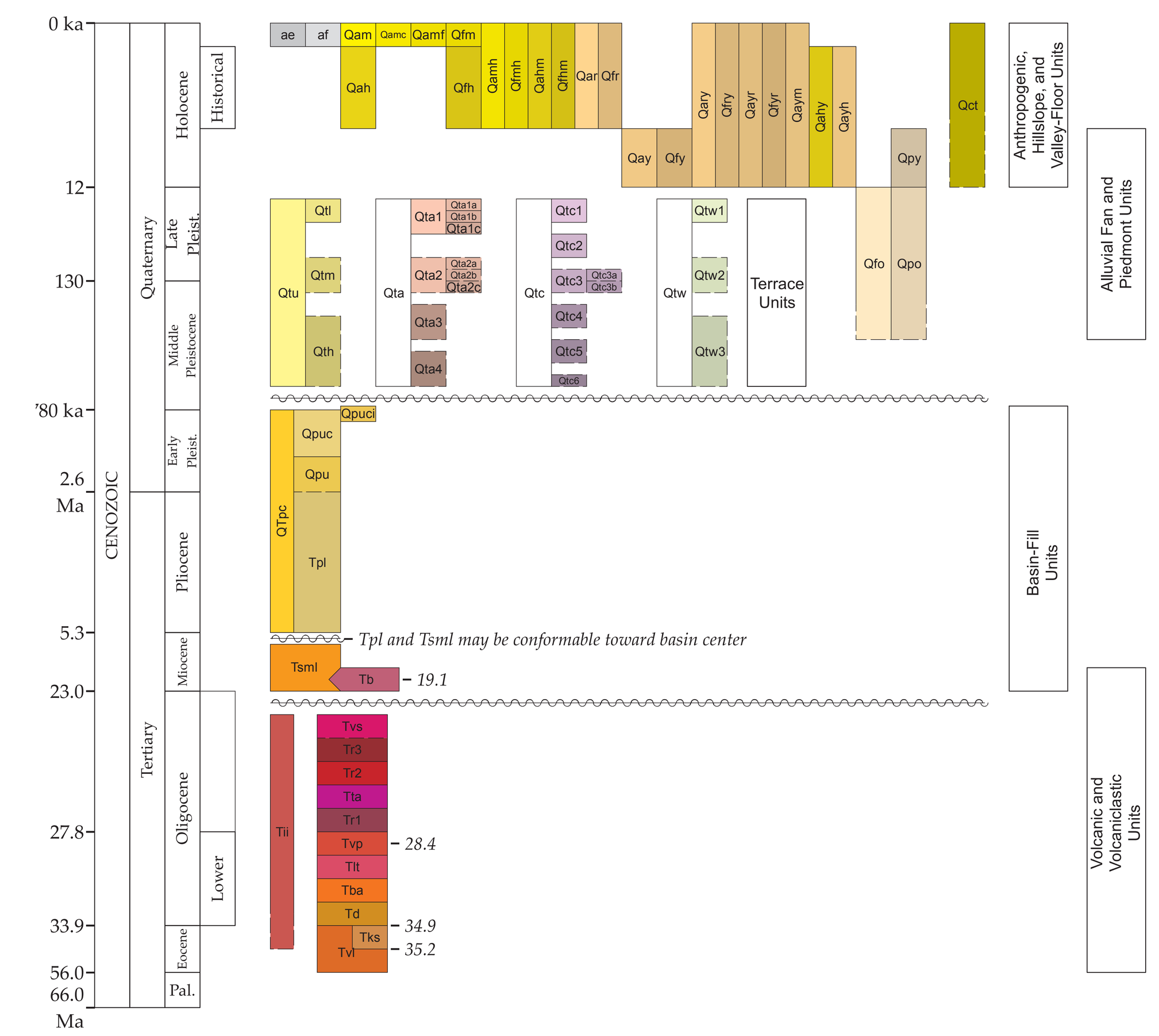


2.1.1 Fault (generic; vertical, subvertical, or high-angle; or unknown or unspecified

2.1.3 Fault (generic; vertical, subvertical, or high-angle; or unknown or unspecified

2.1.4 Fault (generic; vertical, subvertical, or high-angle; or unknown or unspecified

2.1.7 Fault (generic; vertical, subvertical, or high-angle; or unknown or unspecified

2.1.8 Fault (generic; vertical, subvertical, or high-angle; or unknown or unspecified

4.3.4 Minor inclined (dip direction to right) joint, for multiple observations at one

4.3.5 Minor inclined (dip direction to left) joint, for multiple observations at one

8.2.3 Inclined flow banding, lamination, layering, or foliation in extrusive volcanic

8.2.4 Vertical flow banding, lamination, layering, or foliation in extrusive volcanic

01-01-00-00-00—Heading3—AnthropogenicHillslope—Anthropogenic, Hillslope, and

01-01-01-00-00—Unit—af—Anthropogenic Artificial Fill—Thick accumulations of sediment used as road fill along New Mexico Highway 52 as well as levees or berms.

01-01-02-00-00—Unit—ae—Anthropogenic Excavated Ground—Disturbed and

01-01-03-00-01—Unit—Qct—Colluvium and Talus, undivided—Loose, poorly sorted, angular to subrounded cobble-boulder gravel forming aprons or mantles at the

01-02-01-00-00—Unit—Qam—Modern Alluvium—Loose, sandy gravel or pebbly sand forming bars and underlying modern channels in ephemeral drainages. Gravel are commonly imbricated, poorly to moderately sorted, subangular to well-rounded, and consist of mostly volcanic lithologies. In longitudinal bars and at channel margins are sandy pebble–cobble and pebble–cobble–boulder gravel deposits; estimated clast proportions are 65–90% pebbles, 10–35% cobbles, and 0–15% boulders. Sand is dark grayish-brown to brown or grayish-brown (10YR 4/2-3; 5/2) and consists of mL-vcU grains composed of 65–70% lithics (volcanics, ferromagnesian minerals), 15–20% feldspar, and 10–15% quartz with no clay. At channel margins, sand or gravel may underlie thin deposits of light yellowish-brown (10YR 6/4) silt to vfU sand. In places, these deposits are several 10s of cm thick and exhibit thin horizontal-planar laminations. No topsoil present. Bar-and-swale topography and occasional steep-walled channels characterize the surface, exhibiting up to 0.6 m of relief. Thickness is 1–3 m. In Monticello Canyon, this deposit is subdivided into fine and coarse facies

01-02-02-00-00—Unit—Qamc—Coarse-Grained Modern Alluvium in Monticello Canyon—Gravelly deposits in channelized (single-thread) portions of Monticello Canyon. Gravels are also occasionally found in breaches across natural or artificial

01-02-03-00-00—Unit—Qamf—Fine-Grained Modern Alluvium in Monticello Canyon—Clayey to sandy deposits capping the modern floodplain of Monticello Canyon, deposited during large flood events. Color is typically brownish (10YR) and

01-02-04-00-00—Unit—Qamh—Modern and Historical Alluvium, undivided—Modern alluvium (Qam) and subordinate historical alluvium (Qah). See

01-02-05-00-00—Unit—Qar—Recent (Historical + Modern) Alluvium—Historical alluvium (Qah) and modern alluvium (Qam) in approximately equal proportions. See

01-02-06-00-00—Unit—Qary—Recent (Historical + Modern) and Younger Alluvium, undivided—Recent alluvium (Qah + Qam) and subordinate younger alluvium

01-02-07-00-00—Unit—Qah—Historical Alluvium—Loose, pebbly silt-sand and sandy gravel in thin to thick (7–40 cm), tabular to lenticular beds underlying low terraces along valley floors. Very weakly to moderately calcareous and massive to moderately well-imbricated or trough cross-stratified. Gravel consist of mostly clast-supported, poorly sorted, subangular to rounded pebbles (typically >85–90%) with up to 30% cobbles and 0–10% small boulders in places. Clast lithologies are mostly volcanics with 10–20% Paleozoic sedimentary lithologies observed in Cuchillo Negro Creek. Matrix consists of dark grayish-brown to brown (10YR 4/2-3), very poorly to poorly sorted, subangular to rounded, fU-vcL sand composed of 70–80% lithics (volcanics>ferromagnesian minerals), 15–20% feldspar, and 10–15% quartz with no clay. Deposit is occasionally capped by 0.3–0.4 m of brown to yellowish-brown (10YR 5/3-4), massive to horizontal-planar laminated, pebbly (10–20%) silt to fU sand. This deposit is particularly dominant in Questa Blanca Canyon. No topsoil observed. Bar-and-swale surface relief up to 0.35 m is observed. Tread height is 0.7–0.9 m above

01-02-08-00-00—Unit—Qahm—Modern and Historical Alluvium, undivided—Historical alluvium (Qah) and subordinate modern alluvium (Qam). See

01-02-09-00-00—Unit—Qahy—Historical and Younger Alluvium, undivided—Historical alluvium (Qah) and subordinate younger alluvium (Qay). See

01-02-10-00-00—Unit—Qay—Younger Alluvium—Loose silt-sand and gravel in non-stratified or thin to thick (8–60 cm), tabular to lenticular beds. Weakly calcareous and internally massive to well-imbricated or trough cross-stratified. Gravel consist of mostly clast-supported, very poorly to poorly sorted, subangular to well-rounded pebbles (60–100%), cobbles (0–30%), and boulders (0–15%) of mostly volcanic lithologies. Matrix consists of dark brown to brown (10YR 3/3-4), very poorly sorted, subangular to rounded, fL-vcU sand composed of 85–90% lithics (volcanic) and 10–15% quartz + feldspar with 5–10% dark brownish clay films. Deposit is capped by a 0.2-m-thick A horizon formed in brown (10YR 4/3), pebbly (20-25%, subrounded to rounded, fine to coarse), silt to cL sand of similar composition to gravel matrix but lacking clay. This silty sand is more common in downstream locations across the quadrangle. Rare thin lenses of pebbly, fine to coarse sand are also observed. Calcic soils with stage I carbonate accumulation are rare. Weak varnishing on up to 5% of surface clasts. Commonly bioturbated by fine to very coarse roots and burrows. Tread height is 1–3 m above modern grade. Thickness is 1.0–10.5 m (thicker downstream

01-02-11-00-00—Unit—Qaym—Younger and Modern Alluvium, undivided—Younger alluvium (Qay) and subordinate modern alluvium (Qam). See detailed descriptions of

01-02-12-00-00—Unit—Qayh—Younger and Historical Alluvium, undivided—Younger alluvium (Qay) and subordinate historical alluvium (Qah). See

01-02-13-00-00—Unit—Qayr—Younger and Recent (Historical + Modern) Alluvium, undivided—Younger alluvium (Qay) and subordinate recent alluvium (Qah + Qam).

01-03-01-00-00—Unit—Qtu—Terrace Gravels, undivided—Loose to weakly consolidated gravel and minor sand in medium to very thick (12 to >120 cm), tabular to lenticular beds underlying terraces along higher order stream courses. Deposit is clast- or matrix-supported and internally massive to well-imbricated or, less commonly, planar cross-stratified (foresets 20–30 cm tall). Clasts consist of very poorly to poorly sorted, subangular to well-rounded pebbles (40–90%), cobbles (10–60%), and boulders (<5 to 45%) of mostly volcanic lithologies. Matrix consists of non- to moderately calcareous, reddish-brown to dark brown, brown, or strong brown (5YR 4/3-4; 7.5YR 3-4/3-6), poorly to moderately sorted, fU-vcL sand composed of 75–85% lithics (volcanic), 10–15% feldspar, and 10–15% quartz with <30% (dark) reddish-brown clay bridges, films, and chips. Occasional (15–20%) thin, massive to horizontal-planar laminated sand lenses similar to gravel matrix are observed. Soils and surface characteristics generally vary with age; moderate to strong calcic horizons (stage II-III carbonate accumulation), illuviated clay (Bt, Btk horizons where not eroded), and various degrees of desert pavement development and clast varnishing may be observed at the surface. Deposit lacks bar-and-swale topography and buried soils. Terrace treads tend to diverge in a downstream direction and are not necessarily correlative between drainages. Thickness is 2–7 m. Subdivided into three

01-03-01-01-00—Subunit—Qtl—Lower Terrace Gravel—Tread lies 2–6 m above valley

01-03-01-02-00—Subunit—Qtm—Middle Terrace Gravel—Tread lies 4–18 m above

01-03-01-03-00—Subunit—Qth—Higher Terrace Gravel—Tread lies 8–42 m above

01-03-02-00-00—Unit—Qta—Terrace Gravels of Alamosa Creek, undivided—Loose to moderately consolidated gravel in medium to very thick (20–90 cm), lenticular beds. Deposit is clast-supported and well-imbricated to trough or planar cross-stratified (foresets up to 20 cm tall). Clasts consist of very poorly to poorly sorted, subangular to well-rounded pebbles (50–95%), cobbles (5–45%), and boulders (0–10%) of mostly felsic volcanic lithologies with minor intermediate volcanics and trace jasperoid. Matrix consists of non- to strongly calcareous, brown to strong brown (7.5YR 4/4-6), very poorly to poorly sorted, vfU-cU sand composed of 75–80% lithics (volcanic), 10–20% feldspar, and 10–15% quartz with <15–25% reddish clay bridges, films, and chips. Soils and surface characteristics generally vary with age; moderate to strong calcic horizons (stage II-III carbonate accumulation), illuviated clay (Bt, Btk horizons where not eroded), and various degrees of desert pavement development and clast varnishing may be observed at the surface. Deposit lacks bar-and-swale topography and buried soils. Thickness is 1–12 m. Subdivided into four to eight allostratigraphic

01-03-02-01-00—Subunit—Qta1—Lower Terrace Gravel of Alamosa Creek—Tread lies 8–15 m above modern grade. Three subunits, Qta1a, Qta1b, and Qta1c, can be

01-03-02-01-01—sub-subunit—Qta1a—Lower Terrace Gravel of Alamosa

01-03-02-01-02—sub-subunit—Qta1b—Lower Terrace Gravel of Alamosa

01-03-02-01-03—sub-subunit—Qta1c—Lower Terrace Gravel of Alamosa

01-03-02-02-00—Subunit—Qta2—Lower-Middle Terrace Gravel of Alamosa Creek—Tread lies 30–42 m above modern grade. Three subunits, Qta2a, Qta2b, and Qta2c, can be differentiated that differ 2–5 m in geomorphic height. Thickness is 2–12

01-03-02-02-01—sub-subunit—Qta2a—Lower-Middle Terrace Gravel of Alamosa

01-03-02-02-02—sub-subunit—Qta2b—Lower-Middle Terrace Gravel of Alamosa

01-03-02-02-03—sub-subunit—Qta2c—Lower-Middle Terrace Gravel of Alamosa

01-03-02-03-00—Subunit—Qta3—Upper-Middle Terrace Gravel of Alamosa Creek—Deposit commonly features matrix-supported pebble gravel in upper 1.5 m, where it is overprinted by a stage III calcic soil. Moderate to strong varnish observed on 35–45% of clasts at surface. Tread lies 45–56 m above modern grade. Maximum

01-03-02-04-00—Subunit—Qta4—Upper Terrace Gravel of Alamosa Creek—Deposit commonly features strong calcic soil development in upper 2 m, including stage III soil in upper 1.5 m. Weak to moderate varnish observed on 10–25% clasts at surface (obscured by carbonate coats/rinds). Tread lies 52–70 m above modern grade.

01-03-03-00-00—Unit—Qtc—Terrace Gravels of Cuchillo Negro Creek, undivided—Loose to weakly consolidated gravel in medium to thick (20–100 cm), tabular to lenticular beds. Deposit is clast-supported with rare open-framework texture and well-imbricated or, less commonly, trough or planar cross-stratified (foresets 25–40 cm tall). Clasts consist of very poorly to poorly sorted, subangular to well-rounded pebbles (40–95%), cobbles (5–45%), and boulders (<5 to 20%) of mostly volcanic lithologies with minor proportions of chert, carbonate, and Abo Formation. Matrix consists of calcareous, reddish-brown to brown or yellowish-brown (5YR 5/4; 7.5YR 4-5/3-4; 10YR 5/4), poorly to moderately sorted, subangular to well-rounded, vfU-cU sand composed of 80–85% lithics (volcanic), 10–15% quartz, and 5–10% feldspar with 5–20% reddish-brown clay bridges, films, and chips. Soils and surface characteristics generally vary with age; moderate to strong calcic horizons (stage I-III carbonate accumulation), illuviated clay (Bt, Btk horizons where not eroded), and various degrees of desert pavement development and clast varnishing may be observed at the surface. Deposit lacks bar-and-swale topography and buried soils. Thickness is 2–11 m. Subdivided into six to seven allostratigraphic subunits

01-03-03-01-00—Subunit—Qtc1—Lowest Terrace Gravel of Cuchillo Negro Creek—Deposit commonly features stage I calcic soil in upper part. Weak varnish observed on 10–15% clasts at surface. Tread lies 4–11 m above modern grade. Thickness is 2–4

01-03-03-02-00—Subunit—Qtc2—Lower Terrace Gravel of Cuchillo Negro Creek—Deposit commonly features stage I+ calcic soil in upper 50 cm. Weak varnish observed on up to 55% clasts at surface. Tread lies 8–24 m above modern grade.

01-03-03-03-00—Subunit—Qtc3—Lower-Middle Terrace Gravel of Cuchillo Negro Creek—Topsoil commonly eroded. Weak to moderate varnish observed on 40–45% clasts at surface. Tread lies 28–46 m above modern grade. Two subunits, Qtc3a and Qtc3b, can be differentiated that differ several m in geomorphic height. Thickness is

01-03-03-03-01—sub-subunit—Qtc3a—Lower-Middle Terrace Gravel of Cuchillo

01-03-03-03-02—sub-subunit—Qtc3b—Lower-Middle Terrace Gravel of Cuchillo

01-03-03-04-00—Subunit—Qtc4—Upper-Middle Terrace Gravel of Cuchillo Negro Creek—Deposit occasionally features stage III calcic soil in upper part. Weak to moderate varnish observed on >40% clasts at surface. Tread lies 51–67 m above

01-03-03-05-00—Subunit—Qtc5—Upper Terrace Gravel of Cuchillo Negro

01-03-03-06-00—Subunit—Qtc6—Uppermost Terrace Gravel of Cuchillo Negro

01-03-04-00-00—Unit—Qtw—Terrace Gravels of Willow Spring Draw, undivided—Loose to weakly consolidated gravel and silt-sand in medium to very thick (20–130 cm), mostly lenticular beds. Deposit is clast-supported and moderately well-imbricated or, less commonly, trough cross-stratified. High-angle lateral accretion sets are rarely observed. Clasts consist of very poorly sorted, subrounded to well-rounded pebbles (50–90%), cobbles (10–50%), and boulders (<2%) of mostly volcanic lithologies with minor proportions of chert, carbonate, and Abo Formation. Matrix consists of weakly calcareous, yellowish-red (e.g., 5YR 4/6), poorly sorted, subangular to rounded, mL-vcL sand composed of 55–60% lithics (volcanic) and 35–45% quartz + feldspar with >20% reddish clay bridges, films, and chips. Up to 5% of deposit may consist of light brown (7.5YR 6/4), very calcareous, massive silt to vfU sand. Deposit also contains up to 5–10% lenses of planar to trough cross-stratified, pebbly sand similar to gravel matrix. Soils and surface characteristics generally vary with age; moderate to strong calcic horizons (stage I to II or III carbonate accumulation), illuviated clay (Bt, Btk horizons where not eroded), and various degrees of desert pavement development and clast varnishing may be observed at the surface. Deposit lacks bar-and-swale topography and buried soils. Thickness is 2–5 m. Subdivided into three allostratigraphic subunits distinguished by tread height above

01-03-04-01-00—Subunit—Qtw1—Lower Terrace Gravel of Willow Spring Draw—Weak varnish observed on 10–20% clasts at surface. Tread lies 1–4 m above

01-03-04-02-00—Subunit—Qtw2—Middle Terrace Gravel of Willow Spring Draw—Most extensive Willow Spring Draw terrace deposit in quadrangle. Weak to moderate varnish observed on 15–20% clasts at surface. Tread lies 6–11 m above

01-03-04-03-00—Subunit—Qtw3—Upper Terrace Gravel of Willow Spring Draw—Deposit commonly features stage II calcic soil (occasionally eroded) in upper part. Weak to moderate varnish observed on 10–45% clasts at surface. Tread lies 8–12

01-04-00-00-00—Heading3—FanPiedmont—Alluvial Fan and Piedmont

01-04-01-00-00—Unit—Qfm—Modern Fan Alluvium—Loose, sandy gravel underlying fan channels, bars, and levees. Gravel are open-framework on most recent deposits. Matrix sand is yellowish- or grayish-brown (7.5-10YR) and contains very little clay. Bar-and-swale topography characterizes the surface, exhibiting up to 0.5 m

01-04-02-00-00—Unit—Qfmh—Modern and Historical Fan Alluvium, undivided—Modern (Qfm) and subordinate historical fan alluvium (Qfh). See

01-04-03-00-00—Unit—Qfr—Recent (Historical + Modern) Fan Alluvium—Historical (Qfh) and modern fan alluvium (Qfm) in approximately equal proportions. See

01-04-04-00-00—Unit—Qfry—Recent (Historical + Modern) and Younger Fan Alluvium, undivided—Recent (Qfh + Qfm) and subordinate younger fan alluvium

01-04-05-00-00—Unit—Qfh—Historical Fan Alluvium—Loose, sandy gravel and silty sand in medium to thick (10–60 cm), tabular to lenticular beds. Moderately well-imbricated (gravel) or internally massive (silty sand). Gravel consist of clast-supported, very poorly to poorly sorted, subangular to rounded pebbles (55–95%) and cobbles (5–45%) of mostly volcanic lithologies. Matrix consists of dark brown (e.g., 7.5YR 3/4), weakly calcareous, poorly sorted, angular to rounded, fL-cL sand composed of 70–80% lithics (volcanics, ferromagnesian minerals), 15–20% quartz, and 10–15% quartz with trace clay. Silty sand beds consists of brown (e.g., 7.5YR 4/4), moderately sorted, subrounded, vfU-mL grains of similar composition to gravel matrix. No topsoil observed. Bar-and-swale surface relief up to 0.35 m is observed. Tread height is 0.75–1.0 m above modern grade. Thickness is <3–5 m in most places.

01-04-06-00-00—Unit—Qfhm—Historical and Modern Fan Alluvium, undivided—Historical (Qfh) and subordinate modern fan alluvium (Qfm). See

01-04-07-00-00—Unit—Qfy—Younger Fan Alluvium—Loose, sandy gravel in non-stratified to thick (>40–50 cm), tabular to wedge-shaped beds. Internally massive to weakly imbricated with slope-parallel fabric. Gravel consist of mostly matrix-supported, very poorly to poorly sorted, angular to subrounded pebbles (60–55%) and cobbles (15–40%) of mostly volcanic lithologies. Matrix consists of dark brown to yellowish brown (10YR 3/3-4), strongly calcareous, very poorly sorted, angular to rounded, vfL-vcL sand composed of 80–85% lithics (volcanic), 10–15% feldspar, and 5–10% quartz with up to 5% dark brownish clay films. Soil development varies from A and weak cambic (Bw) horizons in upper 0.4 m to occasional stage I calcic horizons. Bar-and-swale surface relief is mostly obliterated. Tread height is 1.5–2.5 m above

01-04-08-00-00—Unit—Qfyr—Younger and Recent (Historical + Modern) Fan Alluvium, undivided—Younger (Qfy) and subordinate recent (Qfh + Qfm) fan

01-04-09-00-00—Unit—Qfo—Older Fan Alluvium—Loose pebble-cobble-boulder or cobble-boulder gravel in non-stratified to thick or very thick (>60 cm), tabular to wedge-shaped beds. Internally massive to imbricated. Clasts consist of clast- to matrix-supported, very poorly to poorly sorted, angular to subrounded pebbles (35–60%), cobbles (40–60%), and boulders (5–25%) of mostly volcanic lithologies. Matrix consists of dark brown to brown (7.5YR 3-5/3-4), strongly calcareous, very poorly sorted, angular to rounded, fL-vcL sand composed of 75–80% lithics (volcanic), 15–20% quartz, and 5–10% feldspar with 5–10% pinkish free-grain argillans. Stage I-I+ calcic horizons are observed in the upper 0.75 m of the deposit. Weak to moderate varnish is observed on 10–50% of clasts at the surface. Minimum thickness is 2.5–3.0

01-04-10-00-00—Unit—Qpy—Younger Piedmont Alluvium—Loose to weakly consolidated silt-sand in non-stratified to vaguely thick or very thick (>60 cm), tabular beds. Silt-sand consists of strong brown to dark yellowish-brown (7.5YR 4/6 to 10YR 3/6), very weakly calcareous, internally massive, moderately to moderately well sorted, silt to vfL sand with ~10% subangular to rounded, fL-vcL sand grains that are >90–95% lithics (volcanic). Up to 10–15% clay is present in this sediment in addition to <7% rhyolite pebbles and cobbles (angular to subrounded). Subordinate deposits include weakly consolidated, thick-bedded (>40 cm), tabular, internally massive or weakly imbricated, pebble-cobble gravel. Clasts consist of clast- to matrix-supported, very poorly to poorly sorted, angular to rounded pebbles (40–70%) and cobbles (30–60%) of mostly or entirely felsic volcanic lithologies. Gravel matrix is very weakly calcareous and texturally similar to silt-sand except with up to 20% fine to very coarse sand grains. An A horizon is observed in the upper 20–30 cm of the deposit; no calcic horizons are found. Loose to weakly consolidated silt-sand in non-stratified to vaguely thick or very thick (>60 cm), tabular beds. Silt-sand consists of strong brown to dark yellowish-brown (7.5YR 4/6 to 10YR 3/6), very weakly calcareous, internally massive, moderately to moderately well sorted, silt to vfL sand with ~10% subangular to rounded, fL-vcL sand grains that are >90–95% lithics (volcanic). Up to 10–15% clay is present in this sediment in addition to <7% rhyolite pebbles and cobbles (angular to subrounded). Subordinate deposits include weakly consolidated, thick-bedded (>40 cm), tabular, internally massive or weakly imbricated, pebble-cobble gravel. Clasts consist of clast- to matrix-supported, very poorly to poorly sorted, angular to rounded pebbles (40–70%) and cobbles (30–60%) of mostly or entirely felsic volcanic lithologies. Gravel matrix is very weakly calcareous and texturally similar to silt-sand except with up to 20% fine to very coarse sand grains. An A horizon is observed in the upper 20–30 cm of the deposit; no calcic horizons are found. Weak to moderate varnish is observed on no more than 10% of surface clasts that may be recycled from older deposits. Faint bar-and-swale surface relief up to 0.1–0.2 m may be observed.

01-04-11-00-00—Unit—Qpo—Older Piedmont Alluvium—Loose to very weakly consolidated silt-sand and sandy gravel in non-stratified to vaguely thin to medium (4–20 cm; silt-sand) or thick to very thick (>60 cm; gravel), tabular to lenticular beds. Silt-sand consists of yellowish-brown (10YR 5/4), weakly to moderately calcareous, internally massive, well-sorted, silt and vfL-fL sand with 5–10% granules to medium pebbles (angular to subrounded) of mostly volcanic lithologies. Gravel deposits are moderately well-imbricated. Clasts consist of clast-supported, poorly sorted, angular to rounded pebbles (70–95%) and cobbles (5–30%). In the northeastern part of the quadrangle, clast lithologies consist of local Paleogene volcanic or sedimentary lithologies, including Uvas basaltic andesite, Vicks Peak and Luna Park tuffs, and Seferino Hill conglomerate. Gravel matrix consists of dark yellowish-brown (10YR 3/4-6), very poorly sorted, angular to subrounded, vfU-cL sand (10–15% very coarse sand to granules) composed of 85–90% lithics (volcanic) and 10–15% quartz + feldspar with up to 5% light brownish clay chips. Channel-fill gravels may be up to 2.2 m thick but are more typically 0.6–0.8 m thick. In the upper 2.5 m of the deposit, silty beds feature stage II-III calcic soils 0.2–0.3 m thick. Deposit is commonly capped by a 1.5-m-thick stage III soil, typically developed in gravel. Maximum thickness is 20–25 m.

02-01-01-00-00—Unit—QTpc—Coarse Piedmont Facies of the Palomas Formation, undivided—A thick package of loose to somewhat consolidated, stacked gravels and minor sand in medium to thick (20–70 cm), mostly tabular (occasionally lenticular) beds exposed on either side of Monticello Canyon. Gravel are clast-supported and well-imbricated to planar cross-stratified (foresets up to 40 cm tall). Clasts consist of very poorly to poorly sorted, subangular to well-rounded pebbles (55–100%) and cobbles (0–45%) of approximately two-thirds felsic volcanics, one-third intermediate volcanics, and trace to 2% jasperoid and basalt (visual estimate). Matrix consists of reddish brown (5YR 5/3-4), non- to weakly calcareous, very poorly sorted, subangular to rounded, fL-vcL sand (15–20% vcU sand to granules) of mostly volcanic grains with 20–30% reddish clay bridges and films. Less common (<5–10%) are beds of reddish brown (5YR 5/4), loose to weakly consolidated, non-calcareous, massive to tabular, medium- to thick-bedded (25+ cm), internally massive, poorly to moderately sorted, subrounded to rounded, vfU-mU sand (5–10% coarse to very coarse sand), composed of 70–80% lithics (volcanic), 15–20% feldspar, and 10–15% quartz with abundant clay occurring as films on coarser grains. These deposits contain 3–7% floating pebbles (fine to coarse) and become browner (7.5YR 5/4) in the upper 20 cm. Illuviated clay (Bt) horizons may be observed in places and are 30–35 cm thick. Well data indicates

02-01-02-00-00—Unit—Qpuc—Upper Coarse Piedmont Facies of the Palomas Formation—Loose to weakly consolidated, sandy channel-fill gravel intercalated with minor silt-sand and sand in thick (50–80 cm), broadly lenticular beds. Deposits are internally massive (silt-sand) or well-imbricated (gravel) and may exhibit lateral accretion sets dipping 25–30° in places, as well as normal grading within beds. Clasts consist of clast-supported, very poorly to poorly sorted, subrounded to rounded pebbles (40–80%), cobbles (20–60%), and boulders (trace to 3%) up to 45 cm across. Clast lithologies include mostly volcanics with up to 35% Paleozoic sedimentary lithologies and 10% monzonite porphyry in the southern part of the quadrangle. Matrix consists of reddish brown (5YR 4/4), moderately to strongly calcareous, very poorly sorted, subangular to rounded, mL-vcL sand (5% vcU sand to granules) composed of 80–85% lithics (volcanic), ~10% feldspar, and 5–10% quartz. Minor deposits include: (A) <10% beds of light brown (7.5YR 6/3), slightly bioturbated (massive), well-sorted silt to very fine sand; and (B) <5% beds of sand similar to gravel matrix but grayish (10YR?) and with horizontal-planar laminations or planar crossbeds (foresets up to 20 cm tall). Commonly scours underlying units (e.g., Qpu) by up to 0.8 m. Unit may feature a stage IV K horizon at its top that is up to 0.6 m thick. At its base, an illuviated clay (Bt) horizon is sometimes observed where little scour has occurred. This unit is distinguished from QTpc by greater variety in and

02-01-02-01-00—Subunit—Qpuci—Upper Coarse Piedmont Facies of the Palomas Formation, inset subunit —Gravel bed(s) as in Qpuc but underlying a mostly erosional surface inset into local aggradational surfaces by 2–7 m in the southern part of the quadrangle. Moderate to very strong varnish observed on up to 65% of clasts at

02-01-03-00-00—Unit—Qpu—Upper Piedmont Facies of the Palomas Formation—Weakly to moderately consolidated, sandy mud interbedded with subordinate silt and sandy channel-fill gravel in medium to very thick (20–110 cm), tabular to lenticular beds. Internally massive (silt and mud) to moderately well-imbricated or trough cross-stratified with possible lateral accretion sets (gravel). Mud constitutes up to 60% of unit by volume and is yellowish-red (5YR 5/6), weakly calcareous, and rarely low-angle cross-laminated. Contains <5% subrounded to rounded, vfL-mU sand grains that are mostly volcanic lithics. Rare stringers or lags of vaguely imbricated, subrounded to rounded, fine to very coarse pebbles. Muddy beds feature common cambic (Bw) soil development with occasional stage II carbonate accumulation as nodules (Btk or Bk horizons). Gravel constitutes 20–35% of unit by volume and consists of non- to very weakly calcareous, mostly clast-supported, poorly sorted, subrounded to well-rounded pebbles (75–90%) and cobbles (10–25%). Clast lithologies include subequal proportions of felsic and intermediate volcanics with minor amounts of feldspar porphyry, Paleozoic sedimentary lithologies, and carbonate nodules (<5% each). Gravel matrix consists of reddish brown (5YR 4/3-4), poorly sorted, subangular to rounded, vfU-mU (10% cL-vcL) sand composed of 80–90% lithics (volcanic), 10–15% quartz, and 5–10% feldspar with up to 30% reddish clay bridges and films. Silt-sand constitutes 15–20% of unit by volume and is brown (7.5YR 5/4), strongly calcareous, internally massive, and moderately well-sorted. Contains 25–40% subangular to rounded, vfL-cU sand grains composed of 85–90% lithics (volcanic) and 10–15% quartz + feldspar with 0% to trace reddish clay chips. Silt-sand also contains trace to 3% floating subangular to rounded, fine to medium pebbles and cobbles of volcanic lithologies. Common clay-lined, fine to medium root

02-01-04-00-00—Unit—Tpl—Lower Piedmont Facies of the Palomas Formation—Weakly to moderately consolidated, sandy gravel and minor sand in thin to thick (5–65 cm), tabular to lenticular beds. Gravel are commonly carbonate-cemented and moderately to well-imbricated or low-angle planar cross-stratified (foresets <20 cm tall) to trough cross-stratified or internally massive. Clasts consist of mostly clast-supported, very poorly to poorly sorted, subrounded to rounded pebbles (60–100%), cobbles (0–40%), and small boulders (0–3%) of mostly volcanic lithologies with <10% Paleozoic carbonates and minor proportions of tuffs and monzonite. Matrix consists of brown to dark brown (7.5YR 4/3-4 to 3/3) or occasionally reddish brown (5YR 4/4), weakly to strongly calcareous, very poorly to poorly sorted, subrounded to rounded, fU-vcL sand composed of 70–90% lithics (volcanic), <20% quartz, and 5–15% feldspar with 5–20% brownish clay films and bridges. Unit contains rare to occasional (<10–15%) lenses of brown (7.5YR 5/3), weakly to moderately calcareous (not cemented), trough cross-stratified, moderately sorted, subrounded to rounded, mU-vcU sand composed of similar lithologies as gravel matrix. Also present are rare (<5–7%) beds of medium- to thick-bedded (20–85 cm), tabular, internally massive, pebbly silt to fine sand (5–10% floating fine to very coarse pebbles). Soils are very rare and most carbonate is groundwater-related with sharp

02-01-05-00-00—Unit—Tsml—Lower and Middle Santa Fe Group, Piedmont Facies—Conglomerate and subordinate sandstone in thin to thick (4–85 cm), tabular beds (minor lenticular or trough-shaped beds). Conglomerate is moderately to strongly indurated, calcite-cemented, and internally massive to moderately imbricated or vaguely trough cross-stratified; it may be either normal- or reverse-graded. Clasts consist of mostly clast-supported, very poorly to poorly sorted, subangular to rounded pebbles (55–100%), cobbles (0–45%), and boulders (<1 to 20%) of volcanic lithologies; intermediate volcanics dominate along Cuchillo Negro Creek whereas felsic clasts are most common near Roque Ramos Canyon. Conglomerate matrix consists of light reddish-brown to pink (5YR 6-7/3) or pinkish-gray to light-brown (7.5YR 6-7/2, 6/3), moderately calcareous, very poorly to poorly sorted, subangular to rounded, mL-cU (~5% vcL-vcU) sand composed of 55–80% lithic (volcanic) and 15–45% quartz + feldspar grains. Occasional conglomerate beds feature up to ~30% pinkish clay cement; beds in the northwestern part of the quadrangle typically lack clay. Sandstone beds constitute up to ~20% of unit by volume and are pink or pinkish gray to light-brown (7.5YR 6-7/2-3; 6/4) or, less commonly light reddish-brown to reddish-yellow (5YR 6/4-6), weakly to moderately consolidated, calcareous, and internally massive to thickly horizontal-planar laminated. Sand is very poorly to poorly sorted, angular to rounded, silty, and consists of vfL-cU grains composed of 35–50% quartz, 15–45% lithics (volcanic), and 5–45% feldspar with <5–8% pinkish red clay bridges. Strongly oxidized layers of sand up to 5 cm thick are observed in places. Sandstones may contain 7–10% floating fine to coarse pebbles (subangular to subrounded) of felsic volcanic lithologies in the northern part of the quadrangle. Rarely, unit contains sandstone beds similar to conglomerate matrix but more pebbly and thin- to medium-bedded (7–30 cm) with abundant pinkish to

03-01-00-00-00—Heading3—Volcanic—Volcanic and Volcaniclastic Units—Volcanic

03-01-01-00-00—Unit—Tb—Basalt—Poorly exposed, vesicular olivine basalt flows and small intrusive plugs and dikes feeding flows. Corresponds to olivine basalt (unit QTb) of Heyl et al. (1983). 40Ar/39Ar-dated at 19.06 ± 0.05 Ma by McLemore et al.

03-01-02-00-00—Unit—Tvs—Volcaniclastic Sediment—Weakly consolidated conglomerate in non-stratified to thick (>60 cm) beds. Clasts consist of matrix-supported, subrounded to rounded pebbles (70–90%) and cobbles (10–30%) of mostly quartz-rich pumice with subordinate light grayish rhyolite containing 4–5% medium to coarse quartz and trace plagioclase phenocrysts. Rare clasts of reddish-brown to purplish, aphanitic andesite <3 cm in diameter may also be present. Tuffaceous matrix consists of very poorly sorted, subangular to rounded, silt to cU-sized particles of >70% lithics (mostly pumice and rhyolite), ~20% quartz, and ~10% feldspar (mostly sanidine). This unit grades upward into a buff-colored, clast-supported, pebble-cobble conglomerate with <65% cobbles of mostly quartz-phyric rhyolite. At its top, the unit is a yellowish-tan, pebbly, medium- to very coarse-grained sandstone with a more heterogeneous clast assemblage. Unit is exposed only in Roque Ramos Canyon near the western quadrangle boundary where it underlies Tsml with angular unconformity. Total thickness unknown but probably <15–25 m.

03-01-03-00-00—Unit—Tii—Intrusive Intermediate Rocks—Slope-forming, very dark-gray or black, weathering dark-gray to reddish-brown, non-vesicular, massive, porphyritic, intrusive rocks of intermediate composition. Phenocrysts include 3–5% medium quartz (1–3 mm; anhedral), 1–4% medium feldspar (1–3 mm; anhedral to subhedral), and 1–2% fine to medium biotite (0.5–2 mm; subhedral). Occasional cumulophyric texture. Nearly all phenocrysts are strongly altered, featuring halos of whitish, dusty appearance. Feldspars are commonly sericitized and this alteration complicates their exact identification. Whole-rock geochemistry indicates that this rock is similar in composition to trachyandesite (57.99 wt% SiO2, 6.97 wt% Na2O + K2O). Forms a small stock or plug in Roque Ramos Canyon. Corresponds to unit Td2

03-01-04-00-00—Unit—Tr3—Upper Rhyolite—Rubbly weathering rhyolite that is petrographically similar to older rhyolite flows but nearly always massive. Contains 15–20% phenocrysts of quartz and sanidine in a light-gray groundmass. Unit exhibits

03-01-05-00-00—Unit—Tr2—Middle Rhyolite—Slope- to ledge-forming, purplish to light-gray, weathering (dark) reddish-brown, well-foliated, porphyritic rhyolite flows and domes. May contain numerous, fist-sized vugs in places; these commonly interrupt foliation. Phenocrysts include 20–25% total quartz + sanidine, with lesser amounts of biotite and plagioclase up to 3.5 mm across. Quartz phenocrysts are more common than sanidine higher in the section, where the latter may be kaolinitized. In a fault block north of Roque Ramos Canyon, the rhyolite weathers light tannish-gray and is non-vesicular and massive. There, the flow contains phenocrysts that include 5–20% medium quartz + sanidine (1–4 mm; anhedral to euhedral), 2–3% very fine to medium pyroxene (<0.5–3.5 mm; subhedral to euhedral; prismatic), 1–3% medium plagioclase (1–2 mm; subhedral; striated), and trace to 1% fine biotite (<1 mm; anhedral to subhedral). Groundmass has strongly frothy appearance. Outcrop faces are manganese-stained in a few locations. The base of this unit contains cobble- to small-boulder-sized rip-ups of andesite (Ta) south of Roque Ramos Canyon. Correlative with the Rhyolite of HOK Ranch of Harrison et al. (1993). Maximum

03-01-06-00-00—Unit—Tta—Trachyandesite—Very dark-gray or black, weathering grayish-green, massive, dense, aphanitic trachyandesite flow. Commonly columnar-jointed. Flow commonly exhibits scoriaceous texture in upper 0.5 m. Forms a distinct marker bed between lower (Tr1) and middle (Tr2) rhyolite packages. Thickness is 2–3

03-01-07-00-00—Unit—Tr1—Lower Rhyolite—Slope-forming, light-gray, weathering very pale-brown to buff, blocky to spheroidally weathering, well-foliated, porphyritic rhyolite flows. Phenocrysts include 10–15% medium to coarse sanidine (subhedral to euhedral; glassy to chatoyant; commonly shattered), 3–7% medium to coarse quartz (anhedral; clear to smoky), and 1–2% fine to medium biotite (subhedral to euhedral; commonly altered to reddish brown, earthy/dull mineral). Contains trace dark-gray, lapilli-sized lithic fragments. Southeast of Roque Ramos Peak, the unit contains a thin (<10–20 m) interval of white to pinkish gray (7.5YR 8/1 to 5YR 7/2), moderately consolidated, non-calcareous, matrix-supported, thin- to medium-bedded (2–25 cm), tabular, internally massive, poorly to moderately sorted, angular to rounded, volcaniclastic pebble conglomerate. Clast lithologies are bimodal, consisting of dark purplish brown, plagioclase-phyric andesite, and light gray, aphyric rhyolite. Matrix consists of moderately to well-sorted, ashy material with 10–15% outsized cL sand grains to granules of lithics similar to pebble clasts. Matrix also contains fine to medium, intact phenocrysts of quartz and sanidine. Rare beds consisting entirely of ashy material are 2–4 cm thick. Unit is correlative to coarse moonstone porphyritic rhyolite tuff (unit Tcrt) of Heyl et al. (1983), Rhyolite of Willow Springs of Harrison et al. (1993), and units Tr, Trr, and Trv of the rhyolite-trachyte sequence of Jahns et al.

03-01-08-00-00—Unit—Tvp—Vicks Peak Tuff—Bench-forming, whitish to very light-gray or very light tan-gray, weathering buff, non-vesicular, massive, aphanitic, rhyolitic ash-flow tuff. Poorly to strongly welded. Phenocrysts include trace to 1% very fine to fine quartz (up to 0.5 mm across; anhedral), trace to 1% fine sanidine (0.5–1 mm; subhedral to euhedral; tabular), and trace fine biotite (0.75–1 mm; subhedral; highly altered). Groundmass is highly devitrified. Contains up to 1% miarolitic cavities lined by drusy quartz and/or sericitized feldspar. Likely an outflow facies of the Vicks Peak tuff (rhyolite) of Furlow (1965) and Farkas (1969). 40Ar/39Ar

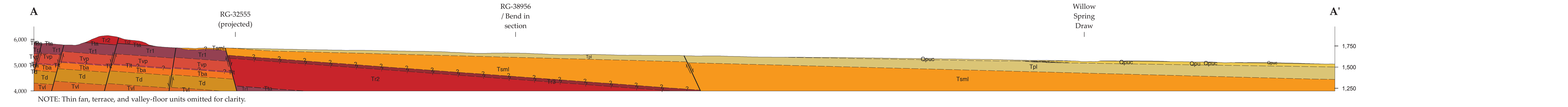
03-01-09-00-00—Unit—Tlt—Lapilli Tuff—Ledge-forming, light purplish-gray, weathering very light-gray or purplish-gray, non-vesicular, porphyritic, rhyolitic ash-flow tuff. Moderately welded and eutaxitic. Fiamme length:width ratios vary from 15:2 to 25:1. Phenocrysts include 3–5% fine to medium biotite (0.5–1.5 mm; anhedral to subhedral; commonly altered), 2–3% medium sanidine (1–2 mm; subhedral to euhedral; tabular; occasionally chatoyant), trace to 2% medium quartz (1–2 mm; euhedral; bipyramidal), and trace to 1% medium plagioclase (1–2 mm; subhedral; striated). Quartz phenocrysts usually occur in lapilli-sized pumice constituting 20–30% of rock and are up to 3 cm across. Devitrified groundmass. Thickness is

03-01-10-00-00—Unit—Tba—Basaltic Andesite—Rubbly slope- to ledge-forming, very dark-gray to gray or black, weathering brown to grayish-brown, dense to vesicular, thinly foliated, aphanitic basaltic andesite. Phenocrysts include trace to 4% fine to medium pyroxene (anhedral), trace to 2% fine olivine (anhedral), and trace plagioclase. Unit contains up to 5% amygdules filled by calcite or silica. Groundmass may contain trace glass and/or disseminated magnetite. Correlates to units Tb and Tyaf of Heyl et al. (1983), basaltic andesite of Poverty Creek of Harrison et al. (1993), and unit Ta of Jahns et al. (2006). Maximum thickness is estimated at 130 m [modified

03-01-11-00-00—Unit—Td—Dacite Flows and Tuffs—Fine-grained, in part porphyritic dacite flows and. Locally shows good flow banding; elsewhere it is still welded or partly welded tuff that grades into quartz dacite in places and has columnar jointing. Corresponds to unit Tdt of Heyl et al. (1983) and unit Ta of Jahns et al. (2006).

03-01-12-00-00—Unit—Tks—Kneeling Nun and Sugarlump Tuffs, undivided—Kneeling Nun and Sugarlump Tuffs mapped by air photo interpretation due to land access restrictions. The Kneeling Nun Tuff contains 15–35% phenocrysts of quartz, sanidine, and biotite. Lithic-rich Sugarlump Tuff contains 3–10% phenocrysts (mostly biotite). 40Ar/39Ar ages of 34.9 and 35.2 Ma (McIntosh et al., 1991; Chapin et al., 2004).

03-01-13-00-00—Unit—Tvl—Lower Volcanic Strata—Andesitic to rhyolitic tuffs and lavas with intercalated volcaniclastic facies. The upper part is correlative to the Kneeling Nun and Sugarlump Tuffs (Tks). The lower part is partly or entirely correlative to the Rubio Peak Formation and unit Tla of Jahns et al. (2006). Total



NOTE: Thin fan, terrace, and valley-floor units omitted for clarity.