Preliminary Geologic Map of the Dayton Quadrangle, Eddy County, New Mexico

By

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June 2011

New Mexico Bureau of Geology and Mineral Resources
Open-file Digital Geologic Map OF-GM 160

Scale 1:24,000

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OVERVIEW

The Dayton 7.5-minute quadrangle lies in southeast New Mexico approximately half way between the cities of Artesia and Carlsbad. The area covered by the quadrangle, which extends from 32°37'30"N to 32°45'N and 104°122' 30"W to 104° 30'W, is approximately 158 km^2 (61 mi^2). Elevations range from approximately 1004 m (3,295 ft) in the southeast corner to the highest point of 1,095 m (3,592 ft)on the western edge in T. 18 N., R. 25 W. Sec 32, 2.8 km south of the Rio Peñasco. Physiographically, the majority of the quadrangle is comprised by distal parts of both the Rio Peñasco and North Seven Rivers alluvial piedmont complexes, which grade to Pecos Valley terraces just east of the quadrangle.

The major drainages are the Rio Peñasco , Fourmile Draw, and the northernmost channels of Seven Rivers (North Seven Rivers), which all flow eastward into the Pecos River. The Rio Peñasco heads high in the Sacramento Mountains in Permian San Andres and Yeso formation rocks, thus its piedmont gravels are dominated by limestone, but also contain dolomite, chert, yellowish brown sandstone, conglomerate, and quartzite. The headwaters of North Seven Rivers lies to the southwest on the flanks of the northern Guadelupe Mountains and drains Permian marine and non-marine limestones, redbeds and evaporates. Its' piedmont gravels are almost entirely comprised of limestone. Fourmile Draw drains the intervening lower areas between the two piedmont complexes and is used in this mapping as the divide between complexes.

The surficial piedmont deposits are up to 140 m thick and thin updip to <3 m in the oldest Pliocene to late Miocene (?) sediments. These rocks presumably grade east to a river system comprising the Gatuña formation. All piedmont deposits are underlain by Permian evaporates of the Artesia Group and unsurprisingly, karstic depressions and sinkholes are common.

COMMENTS TO MAP USERS

This quadrangle map has been Open-filed in order to make it available to the public. The map has not been reviewed according to New Mexico Bureau of Geology and Mineral Resources standards, and due to the ongoing nature of work in the area, revision of this map is likely. As such, dates of revision are listed in the upper right corner of the map and on the accompanying report. ***The contents of the report and map should not be considered final and complete until published by the New Mexico Bureau of Geology and Mineral Resources.***

A geologic map graphically displays information on the distribution, nature, orientation, and age relationships of rock and surficial units and the occurrence of structural features such as faults and folds. Geologic contacts are irregular surfaces that form boundaries between different types or ages of units. Data depicted on this geologic map are based on 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. Significant portions of the study area may have been mapped at scales smaller than the final map; therefore, the user should be aware of potentially significant variations in map detail. Site-specific conditions should be verified by detailed surface mapping or subsurface exploration. Topographic and cultural changes associated with recent development may not be shown everywhere.

The cross section is constructed based on exposed geology, and where available, subsurface and geophysical data. Cross sections are interpretive and should be used as an aid to understand the geologic framework and not used as the sole source of data in locating or designing wells, buildings, roads, or other structures. Finally, the views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of either the State of New Mexico or the U.S. Government.

STRATIGRAPHY

As alluded to above, surficial depositional units are Quaternary and late Neogene in age and are almost entirely made up of piedmont sediments. The Pecos Valley Orchard Park terrace occupies the northeast corner of the quad and is inset by the lowest of the Lakewood terraces. These deposits are underlain by middle Permian Artesia Group (Guadalupian) evaporates, redbeds, and interbedded dolomites. The majority of these rocks are comprised of the Queen and Grayburg formations (*Pgq*); the younger Seven Rivers formation outcrops in two low areas of the map. A predominant dolomite caps the Seven Rivers (*Psd*), which is either the Azotea tongue of Kelley (1971) or equivalent to it, while the remainder is made up of mixed gypsiferous facies (*Psg*).

Pecos Valley alluvial terrace complexes

Alluvial terraces of the Pecos River and its tributaries were first described in the classic study of Fiedler and Nye (1933). They recognized 3 terraces: (from lowest to highest) the Lakewood, the Orchard Park, and the Blackdom. On the Dayton quad, much of the higher Rio Peñasco and North Seven Rivers piedmont alluvial complexes are erroneously mapped by Fiedler and Nye (1933) as Blackdom terrace. These materials, however, are all derived from these western tributaries, not the Pecos River. The most extensive of these terraces is the Orchard Park (*Qot*), which rises about 3 m above the Lakewood terrace and 6 - 10.5 m above the Pecos floodplain. The Lakewood terrace, with an elevation of <1 to 3 m above the floodplain, flanked the inset Pecos floodplain and extended up many of its western tributaries. McCraw, *et al.* (2007) further differentiated three distinct, low-lying (upper to middle(?) Pleistocene) "Lakewood terraces." The highest and oldest of which (Qlt_1) would be Fiedler and Nye's original. Surface tread elevations above the floodplain for these three are: <1 - 1.2 m, 1.2 - 2 m, and 2 - 3 m, respectively.

Kelley (1971) mapped the entire piedmont alluvial complex in the Dayton quadrangle area as "Quaternary tributary alluvium." He apparently ignored the high, upland remnants that are found here. These old, Plio- (Mio-?)-Pleistocene deposits have been problematic. As summarized in Hawley (1993), these old, often high alluvial deposits have been mapped as “quartzose conglomerate” (Meinzer, *et al.,* 1923), as well as Ogallala and Gatuña by other workers (see Figure 7). Pedogenic carbonate varies within these deposits from stage IV to VI, indicating antiquity, a ground-water system supersaturated with respect to $CaCO_3$, or both. We suggest that they form the oldest deposits of the piedmont and most likely grade to the river system that formed the Gatuña formation.

Permian bedrock

Artesia Group rocks are backreef equivalents of the Capitan Reef formation, which is exposed along the southeast escarpment of the Guadalupe Mountains southwest of Carlsbad. The Artesia Group strata are most notable for their dramatic and sometimes abrupt variations in lithofacies north of the Capitan Reef complex (Kelley, 1971). The Group consists primarily of well-bedded dolomite in the near-backreef area of the Guadalupe Mountains. Farther to the north, lithology of the Artesia Group becomes increasingly evaporitic, consisting of interbedded gypsum, reddish-brown mudstone and siltstone, and thin interbeds of dolomite, typical of deposition in a far-backreef intertidal-supratidal-sabkha environment.

Defining formation contacts within evaporitic facies of the Artesia Group is often challenging. Some previous workers (e.g., Motts and Cushman, 1964) have chosen to designate these predominantly gypsum strata as the Artesia *Formation* where the individual units of the Artesia Group are not distinguishable. For consistency with previous geologic mapping in this area (Kelley, 1971; Delher, *et al.,* 2005; McCraw and Land 2008), we have chosen to break out individual formations that underlie and crop out on the Dayton quad, with formation contacts dashed where the precise location of the contact is ambiguous. These belong to the combined Queen and Grayburg formations, and the Seven Rivers formation.

The transition to evaporitic facies within the Seven Rivers formation is almost complete in the vicinity of Dayton. The unit consists of white to brick-red gypsum, reddish-brown mudstone and siltstone, and thin interbeds of gray lithographic dolomite (*Psg*). The formation is capped by dolomites, presumably those of the Azotea Tongue (*Psd*), which form a prominent east-dipping cuesta expressed by the McMillan Escarpment across the Pecos Valley east of Dayton. Described by Kelley (1971), the Azotea dolomite serves as a useful marker bed for locating the contact between the Seven Rivers formation and gypsum of the overlying Yates formation.

STRUCTURE

Structural geology of the Lake McMillan North quad is not complex. Regionally, Artesia Group strata dip gently to the east at approximately 1° (~100 ft/mile). However, the dip of these strata is enhanced on Dayton to approximately 12° east, due to the proximity of the Artesia-Vacuum Arch. In the subsurface, this arch extends east-northeast beneath the Pecos Valley. The arch is almost completely covered by post-Permian beds, although Kelley (1971) reports that the plunging south limb is expressed by Yates and Tansill strata near Chalk Bluff Draw, east of the floodplain east of Dayton. The effects of the arch are clearly seen in the cross section accompanying this map. The Artesia-Vacuum Arch controls production from Permian and Pennsylvanian reservoirs in the Empire Abo field and other oil and gas reservoirs over a distance of almost 75 miles into Lea County. Measureable surface manifestations of the arch are practically non-existent, apart from Kelley's (1971) observations of dipping strata in Chalk Bluff Draw.

DESCRIPTION OF MAP UNITS

QUATERNARY and NEOGENE

Alluvium, lacustrine, and anthropogenic deposits

daf **Disturbed land and/or artificial fill** — Dumped fill and areas affected by human disturbances, mapped where deposits or extractions are areally extensive. Especially notable are the numerous constructed oil and gas well pads. Also includes the U.S. Bureau of Reclamation's Kaiser Channel of the Pecos River, as well as other straightened reaches.

Qa **Quaternary alluvium, undifferentiated (Historic to uppermost Pleistocene)** — Brown (7.5YR4/2) to light brown (7.5YR6/3), unconsolidated, moderately sorted, pebbly sand, silt, and clay. Contains primarily carbonate gravels and pebbles. Varies considerably in thickness from <1 to 3 m in tributaries and up to 10-12 m in the floodplain.

Qbs **Pecos River floodplain alluvial backswamp deposits (upper Pleistocene to Historic)** — Light reddish-brown (5YR6/4) to very dark gray (7.5YR3/1), unconsolidated, well-sorted, silty sand, sandy clay, and clay in low-lying, poorly drained areas. These areas commonly received only fine-grained, slack-water flood deposition, prior to channelization. Thicknesses range from 3-15 (?) m.

Qp **Quaternary playa deposits (upper Pleistocene to Holocene)** — Pinkish white (7.5YR8/2), unconsolidated, well-sorted, fine-grained sand, silt, and clay Thickness unknown (≥ 1m).

Fourmile Draw depression

Fourmile Draw formed in the low area between the Rio Peñasco and North Seven Rivers piedmont alluvial complexes, and is utilized in this mapping to differentiate these complex deposits. It is shallowly underlain by Permian Artesia Group sediments that are riddled with collapse depressions and sinkholes. Just west of U.S. Highway 285, it flows into a very large depression, roughly 1-1.5 km wide and 4 km long. This depression likely formed in the uppermost Pleistocene and/or early Holocene. Upon encountering the depression, Fourmile Draw has built 4 fluviodeltaic complexes containing distributary channels and levee deposits (Htc_{1-4} and Htd_{1-4}, respectively), distinctly mappable from aerial photography. These migrate with time from the western margin to the center of the depression, where the modern Htd_4 complex is located.

Htd_4 **Youngest Fourmile Draw distributary deposits (Holocene)** — Thickness <1 to 1+ m.

Htc_4 **Youngest Fourmile Draw distributary channel deposits (Holocene)** — Thickness <1 to 1+ m.

Htd_3 **Younger Fourmile Draw distributary deposits (Holocene)** — Thickness <1 to 2 m.

Htc_3 **Younger Fourmile Draw distributary channel deposits (Holocene)** — Thickness <1 to 2 m.

Htc_2 **Older Fourmile Draw distributary deposits (Holocene)** — Thickness <1 to 2 m.

Htc_2 **Older Fourmile Draw distributary channel deposits (Holocene)** — Thickness <1 to 2 m.

Htc_1 **Oldest Fourmile Draw distributary deposits (Holocene)** — Thickness <1 to 2 m.

Htc_1 **Oldest Fourmile Draw distributary channel deposits (Holocene)** — Thickness <1 to 2 m.

Pecos Valley alluvial terrace complex

Alluvial terraces of the Pecos River and its tributaries were first described in the classic study of Fiedler and Nye (1933). They recognized 3 terraces: (from lowest to highest) the Lakewood, the Orchard Park, and the Blackdom. On the Dayton quad, much of the higher North Seven Rivers and Rio Peñasco piedmont alluvial complexes are erroneously mapped by Fiedler and Nye (1933) as Blackdom terrace. These materials, however, are all derived from these western tributaries, not the Pecos River.

Lakewood terrace alluvial deposits (upper to middle Pleistocene) — Following McCraw, *et al.* (2007) and McCraw and Land (2008), three distinct, low-lying (upper to uppermost middle(?) Pleistocene) "Lakewood terraces" are recognized. Only the lowest and youngest deposit, Qlt_3, <1-2 m above the floodplain, is found on the Dayton quad, extending up the Rio Peñasco. These deposits are comprised of occasional gravels and pebbles, brown (10YR5/3) to dark yellowish brown (10YR3/4), unconsolidated, moderately sorted, coarse- to fine- grained sand, silty sand, silt and sandy clay. Stage I pedogenic carbonate, mostly non-gypsiferous.

Qlt_3 **Youngest Lakewood terrace alluvial deposits (upper Pleistocene)** — Thickness <1 to 2 m.

Qot **Orchard Park terrace alluvial deposits (upper Pliocene (?) to upper Pleistocene**) — According to Fiedler and Nye (1933), the Orchard Park terrace rises 1-3 m above the Lakewood terrace and 10.5-20 m above the Pecos floodplain. It is comprised of gravels and pebbles of dolomite, limestone, sandstone, chert, and quartzite in a very pale brown (10YR7/4) to reddish brown (5YR4/4), unconsolidated, moderately sorted, coarse- to fine- grained sand, silty sand, silt, and sandy clay. Pedogenic carbonate is a strong stage III. Thickness ranges from 5 to 45 m.

Rio Peñasco alluvial piedmont complex

Rio Peñasco alluvial piedmont deposits (Upper Pleistocene to Late Miocene(?)) — The headwaters of the Rio Peñasco are located high in the Sacramento Mountains in predominantly carbonate rocks of the San Andres formation (*Psa*) and clastic sediments of the Yeso formation (*Pye*). Where it leaves the Permian highlands, it has built a large piedmont alluvial complex, which coalesces with Eagle Creek to the north and the Seven Rivers to the south. These piedmont deposits grade to and onto the Pecos Valley alluvial terraces on the easternmost edge of the Dayton quad. Oldest, highest remnant surfaces (Tpp_1 and $QTpp_2$) are Pliocene or older, and likely graded to a river system which forms Gatuña formation deposits today. Middle to upper Pleistocene piedmont deposits (Qpp_{3-4}) are inset into these and grade to *Qot*. The youngest, Qpp_5, grades to Qlt_3. Several channels (e.g., Tumbleweed Draw) on this piedmont surface were likely former Rio Peñasco channels.

Lithologically, the Rio Peñasco piedmont deposits are distinctly different from those of Eagle Creek to the north and Seven Rivers to the south. While gravels are dominated by limestone clasts, dolomite, chert, yellow-brown sandstone, conglomerate, and quartzite are common. The matrix consists of dark yellowish brown (10YR3/4) to light brown (7.5YR6/3), unconsolidated, moderately sorted, coarse- to fine-grained sand, silty sand, silt, and sandy clay. Stage V-VI pedogenic carbonate can be found in the oldest deposits, while middle to upper Pleistocene deposits range from stage IV to III. Degree of pedogenic carbonate development can be the main distinguishing characteristic between the youngest deposits.

Qpp_5 **Youngest Quaternary piedmont alluvium (Holocene to upper Pleistocene)** — Thickness 1 to 3 m.

Qpp_4 **Younger Quaternary piedmont alluvium (Upper Pleistocene)** — Thickness 2 to 4 m.

Qpp_3 **Old Quaternary piedmont alluvium (Upper to middle Pleistocene)** — Most extensive deposit. Thickness 2 to 4 m.

$QTpp_2$ **Older piedmont alluvium (Middle Pleistocene to late Pliocene)** — Thickness 2 to 6 m.

Tpp_1 **Oldest piedmont alluvium (Late Pliocene to late Miocene(?))** — Thickness 2 to 6 m.

Rio Peñasco piedmont channel deposits (Historic to upper Pleistocene) — Numerous, thin alluvial channels, swales, and occasional coalescing depression fill deposits drain the piedmont alluvial complex. They usually consist of light brown (7.5YR6/4) to pinkish gray (7.5YR6/2), unconsolidated, poorly sorted, fine-grained sand, silt, and clay sediments. They were often mapped primarily by soil moisture increases in lower areas relative to adjacent piedmont deposits noted on photography. Eolian input often mantles the "v-shaped" contours associated with stream channels and in some areas sand sheets and dunes can fill these channels (*Qpce*). On the Rio Peñasco, older channels ($Qppc_1$) are mapped on Qpp_4 surfaces, similar and stratigraphically equivalent to those on North Seven Rivers Qps_4 deposits.

$Qppc_2$ **Young Quaternary piedmont channels (Holocene to upper Pleistocene)** — Thickness <1 to 2 m.

$Qppc_1$ **Older Quaternary piedmont channels (Upper Pleistocene)** — Thickness <1 to 2 m.

Qpce **Youngest Quaternary piedmont channels filled with eolian sands, occasionally forming dunes (Holocene to upper Pleistocene)** — Thickness ≤ 1 m.

North Seven Rivers alluvial piedmont complex

North Seven Rivers alluvial piedmont deposits (Upper to middle Pleistocene) — North Seven Rivers, like the other Seven River channels head to the southwest out of the northern Guadelupe Mountains in both San Andres formation (*Psa*) carbonate rocks and Artesia Group (Queen-Grayburg formations) marine and non-marine redbeds and evaporites. To the south and west of the quad it flows out onto a piedmont alluvial complex, which coalesces with the Rio Peñasco to the north. Oldest, highest remnant surfaces and deposits are correlative to lower Pleistocene to late Miocene (?) piedmont deposits of the Rio Peñasco (Tpp_1 and $QTpp_2$). Like Eagle Creek to the north, gravels are almost exclusively limestone, derived from *Psa*, supported in a matrix of reddish brown (2.5YR4/6) to light brown (7.5YR6/3), unconsolidated, moderately sorted, coarse- to fine-grained sand, silty sand, silt (largely calcareous), and sandy clay. Topographic expression between the youngest deposits are often subtle to practically non-existent. Distinction is often based upon a stronger developed pedogenic carbonate (Qps_4= stage III – II+; Qps_5 = stage II). Qpe_5 grades to Qlt_3.

Qps_5 **Youngest Quaternary piedmont alluvium (Holocene to upper Pleistocene)** — Thickness 1 to 3 m.

Qps_4 **Younger Quaternary piedmont alluvium (Upper Pleistocene)** — Thickness 2 to 4 m.

Qps_3 **Old Quaternary piedmont alluvium (Upper to middle Pleistocene)** — Most extensive deposit. Thickness 2 to 4 m.

$QTps_2$ **Older piedmont alluvium (Middle Pleistocene to late Pliocene)** — Thickness 2 to 6 m.

Tps_1 **Oldest piedmont alluvium (Late Pliocene to late Miocene(?))** — Thickness 2 to 6 m.

North Seven Rivers piedmont channel deposits (Historic to upper Pleistocene) — Numerous, thin alluvial channels, swales, and occasional coalescing depression fill deposits drain the piedmont alluvial complex. They usually consist of light brown (7.5YR6/4) to light reddish-brown (5YR6/4), unconsolidated, poorly sorted, fine-grained sand, silt, and clay sediments. They were often mapped primarily by soil moisture increases in lower areas relative to adjacent piedmont deposits noted on photography. Eolian input often mantles the "v-shaped" contours associated with stream channels and in some areas sand sheets and dunes can fill these channels (*Qsce*). On the North Seven Rivers, older channels ($Qpsc_1$) are mapped on Qps_4 surfaces, similar and stratigraphically equivalent to those on Rio Peñasco (Qpp_4) deposits.

$Qpsc_2$ **Young Quaternary piedmont channels (Holocene to upper Pleistocene)** — Thickness <1 to 2 m.

$Qpsc_1$ **Older Quaternary piedmont channels (Upper Pleistocene)** — Thickness <1 to 2 m.

Qsce **Youngest Quaternary piedmont channels filled with eolian sands, occasionally forming dunes (Holocene to upper Pleistocene)** — Thickness ≤ 1 m.

Quaternary depression fill and sinkhole deposits

Qd **Quaternary depression fill, undifferentiated (middle Pleistocene to Holocene)** — Unconsolidated, well-sorted, fine-grained (fine sands to clay) complexes of alluvial, colluvial, eolian, and occasional lacustrine deposits within closed depressions. Colors variable. Depressions are created by either gradual subsidence or sudden collapse followed by gradual subsidence of underlying gypsiferous carbonate terrane. These complexes are often significantly modified by stream erosion and deposition, playa deposition, deflation, and mass wasting. Depression fills have been active since the middle

Pleistocene and are usually 1-3 m thick but can reach thicknesses in excess of 30 m.

Qds **Quaternary sinkhole deposits, primarily caused by collapse (Historic to middle Pleistocene)** — Complexes of unconsolidated, well- to poorly-sorted, coarse- to fine-grained sands to clay, alluvial, colluvial, eolian, and occasional lacustrine deposits within closed depressions. Colors variable. Thickness <1 to 3 m.

PALEOZOIC

Permian Artesia Group

Psr **Seven Rivers formation, undifferentiated** — Cross section only.

Pgq **Queen and Grayburg formations (Guadelupian)** — Cross section only.

Lower Permian Formations

Psa **San Andres formation** — Cross section only.

Pg **Glorieta sandstone tongue** — Cross section only.

Pye **Yeso formation, undifferentiated** — Cross section only.

Pa **Abo formation, undifferentiated** — Cross section only.

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