

RECLAMATION

Managing Water in the West

Geologic Site Assessment for LA-854 Mesilla, New Mexico

Prepared by:

Tamara Massong
Environment Division
Albuquerque Area Office



Department of the Interior
Bureau of Reclamation
Albuquerque Area Office

January 2006

INTRODUCTION

The purpose of this assessment is to both describe the geologic province of the area surrounding the LA-854 site, and to discuss ongoing surface erosion processes that are degrading the site. The LA-854 site is located on a geologically controlled terrace near Mesilla, NM which is southwest of Las Cruces, NM. The site is located west of Mesilla diversion dam on the southwest side of the Rio Grande (Figure 1).

The terrace is composed of loosely consolidated sediments which appear easily eroded as the terrace is highly dissected by drainage features (i.e., arroyos and gullies) and off road vehicle trails/roads (Figure 2). As a result, the terrace surface contains a variety of surface elevations and steep slopes separating the hill tops and arroyo valleys. (do we have a photograph of the site that shows the hills?)

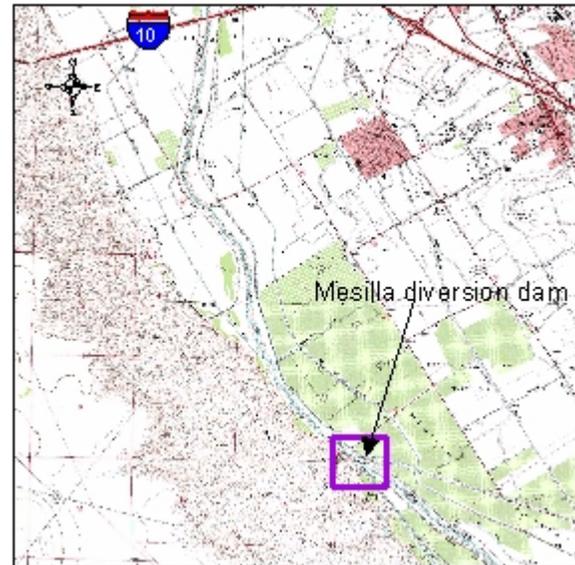


Figure 1: Site map locating the Mesilla diversion dam in relation to US Interstate 10 just west of Las Cruces, NM.

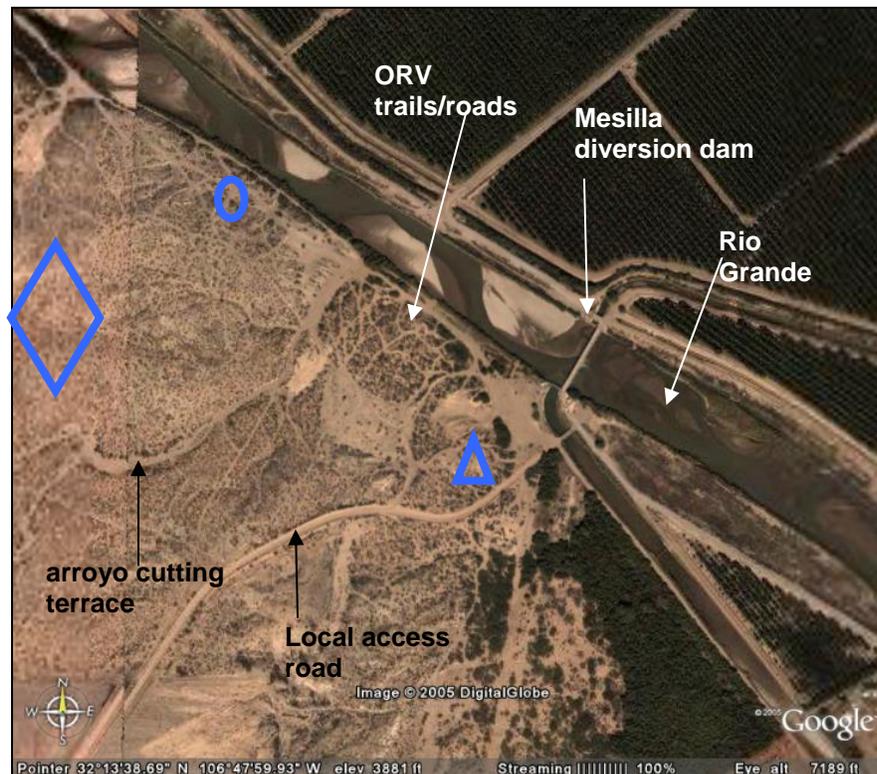
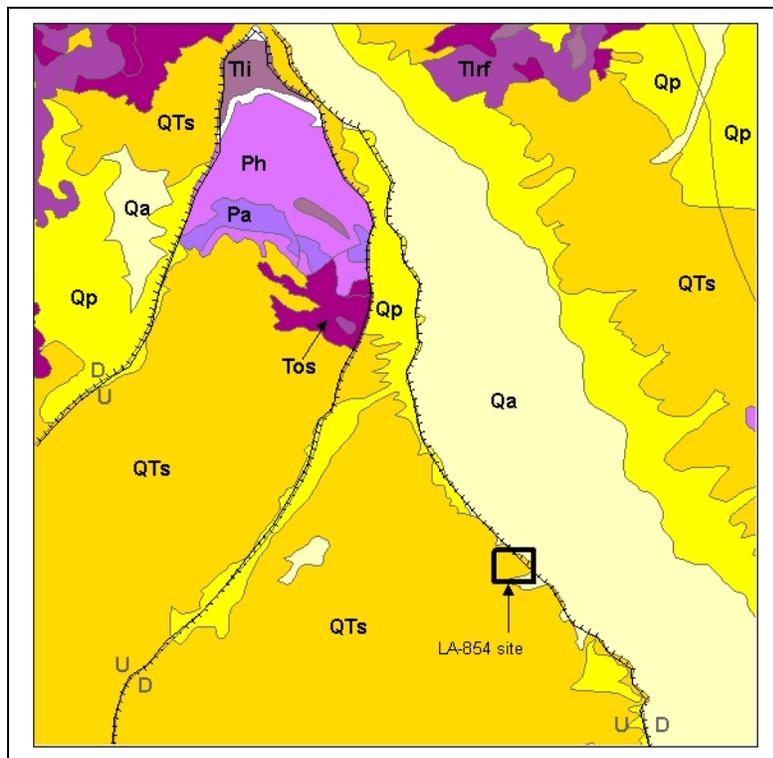


Figure 2: Satellite image of the LA-854 site/Mesilla diversion dam: triangle marks historic foundations; circle marks soil stains and lithic fragments; and the large diamond marks Locus 4 with large deposit of lithic fragments.

GEOLOGY

The LA-854 site is located in the Mesilla basin on an uplifted geologic terrace (Mack and Leeder 1998). The terrace material is composed of the sedimentary Santa Fe Formation (Figure 3) composed of poorly consolidated, rounded, cobbles, gravel and sand sized particles. Composition of these sediments includes all major rocks (sedimentary, volcanic and metamorphic). The Santa Fe Formation is of middle Pleistocene to upper Miocene age

(2.5-7 million years ago). Recently mapped faults north of the study site cut the Camp Rice Formation (part of the Santa Fe Formation), which indicates tectonic movement in late Quaternary time (Mack and Seager 1990) (probably 100,000 - 300,000 years ago). These data suggest that the terrace at the LA-854 site was also uplifted relative to the Rio Grande valley in the late Quaternary time period.



Qa=Alluvium; upper and middle Quaternary.
Qp=Piedmont alluvial deposits; upper and middle Quaternary; includes deposits of higher gradient tributaries bordering major stream valleys, alluvial veneers of the piedmont slope, and alluvial fans.
QTs=Upper Santa Fe Group, includes Camp Rice, Fort Hancock, Palomas, Sierra Ladrones, Ancha, Puye, and Alamosa Formations; middle Pleistocene to upper Miocene.
Tos=Mostly Oligocene and upper Eocene sedimentary and volcaniclastic sedimentary rocks with local andesitic to intermediate volcanics; includes Espinoso, Spears, Bell Top, and Palm Park Formations.
Tlrf=Upper Oligocene silicic (or felsic) flows and masses and associated pyroclastic rocks; includes Taylor Cree, Fanney and Rocky Canyon Rhyolites.
Tli=Quartz monzonites (Eocene) in the Silver City and Los Pino Range, intermediate intrusives of the Cook's Range (Oligocene) and other intermediate to felsic dikes and plugs of Oligocene and Eocene age.
Pa=Abo Formation; red beds, arkosic at base, finer and more mature above; In Robledo Mountains the Abo may be considered a member of the Hueco Formation.

Figure 3: Geologic information around the site: background geologic map from Anderson et al. 1997, fault locations and direction of movement estimated from data presented in Mack and Leeder 1998.

The larger geologic province, the Mesilla basin, is a half graben, tilted west-ward (Leeder et al, 1996 and Mack and Seager 1990) (Figure 4); which means that the east side is relatively tectonically stable while the west side is faulting as the surface extends. This half graben shows two phase faulting on the west side, as the main footwall block

(subsidence fault line) is the Rebledo Mountains and a secondary and later fault line/footwall block forming within the Santa Fe Formation (the terrace at LA-854). This second fault line lies between the terrace deposits (QTs) and the Rio Grande valley (Qa) in Figure 3. This two phase subsidence

indicates that the 'pull-apart'/extensional

process is ongoing and episodic in nature.

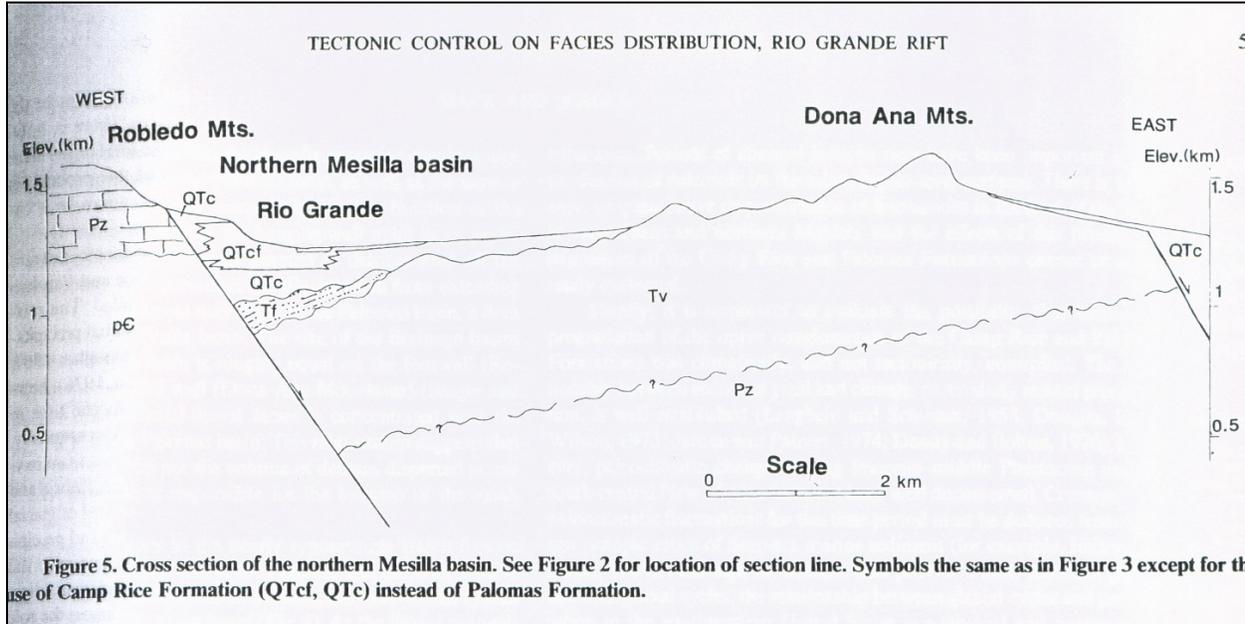


Figure 4: Copy of Figure 5 from Mack and Seager 1990, showing a cross section of the northern Mesilla basin half graben. Location of the cross section is just upstream of the study site.

SEDIMENTS

Three types of sediments are found at the LA-854 site (Figure 5): 1-mix of coarse and fine grained terrace material derived directly from the Santa Fe Formation; 2-coarse grained deposits in and around the arroyo channel, presumably arroyo-reworked Santa Fe Formation sediments; and 3-fine grained deposits in and around the arroyo which are also re-worked Santa Fe Formation sediments.

The Santa Fe Formation sediments at this site are a matrix supported coarse grained deposit. The sediments are loosely packed, rounded, and are easily disturbed. The matrix material is sand sized sediments that appear poorly sorted with a mixed composition. The coarse grains range in size from cobbles through fine gravel. The

composition of these materials is broad; observations at the site found sediments consisting of: sandstone, conglomerate, limestone, quartz, quartzite, chert, flint, jasper, welded tuff, andesite, rhyolite, granite-like rocks, and basalt. A full lithic survey was not completed though. On the relatively undisturbed hillslopes and hilltops, the coarser grains are forming a non-cohesive 'armour' layer. Selective transport of the finer grains through sheet-flow from thunderstorm runoff and eolian transport has concentrated the coarse grains on the terrace surface. In theory, the 'armour' layer decreases surface erosion, however, any process that disturbs this layer (i.e., SUV traffic, or animals walking over the surface) negates the protection of the layer.

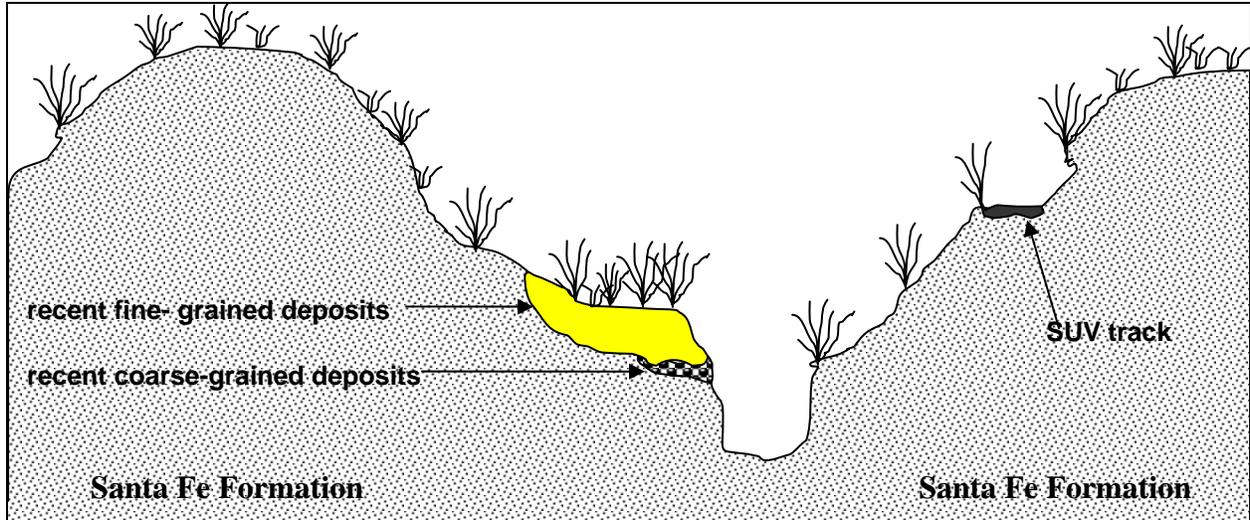


Figure 5: Schematic of the three main sediments found at the LA-854 site near Mesilla, NM.

Within the arroyo valleys, small patches of well sorted coarse grains were observed in the arroyo channel banks. These sediments appeared to consist of re-worked Santa Fe Formation sediments, as the sediment composition and particle size was identical to that found on the adjacent hillslopes. The distinctive difference with these sediments is that the smaller grains (i.e., sand and fine gravels) were absent and that the deposit was clast supported. The deposit outline was typically a half circle shape which is consistent with a small runoff channel or stream. These deposits sit on top of the Santa Fe Formation and are obviously younger in age; likely recently deposited by the arroyo.

Adjacent and/or on top of the coarse grained arroyo deposits are fine grained

deposits. These deposits are composed of mostly sand and silt sized-grains with only a few coarser grains present. The coarser grains consisted mostly of fine to medium gravels. Cross bedding was not observed. These sediments were also likely deposited by arroyos, as they are found in proximity to the arroyos and are coincident with the coarser grained deposits described earlier. As the sediment is fine grained, eolian processes could also have transported the grains in concert with the arroyo deposition. These deposits are relatively more cohesive than the Santa Fe Formation sediments, however, they could still be easily disturbed by the ongoing activities at the site.

DISCUSSION

As evident of the late Quaternary faulting found in the Camp Rice Formation, tectonic processes are ongoing in this area. However, surficial movement/expression is complicated due to the half-graben geology. A graben is an extensional feature, so the

best description is that the basin sediments are falling away from the footwalls (Rebledo Mountains and the terrace). Since this is only a half-graben, the subsiding blocks tilt westward during the event, but depending on the exact location of the fracture, which could easily occur in the Rio Grande valley,

no disturbance may even occur at the LA-854 site. Although future faulting is likely on the geologic time scale, quantifying a subsidence rate is not appropriate at this site as the surface movement is complicated.

All of the sediments found at the site are easily eroded regardless of origin. In fact, the Santa Fe Formation (the parent material for the other 2 sediments) is likely the least cohesive and most easily eroded, as

it is a loosely packed with a sand matrix. Although water erosion through arroyo channel incision and surface erosion (i.e., sheetwash) are significant historical erosion agents at the site, SUV traffic will overwhelm that erosion quickly. With continued SUV traffic, this site will continue to erode rapidly.

LITERATURE SITED

- Anderson, O.J., G.E. Jones, and G.N. Green, 1997, Geologic Map of New Mexico, USGS Open-File Report OF-97-52, digital data.
- Leeder, M.R., G.H. Mack, and S.L. Salyards, 1996, Axial-transverse fluvial interaction in half-graben: Plio-Pleistocene Palomas Basin, Southern Rio Grande Rift, New Mexico, USA, *Basin Research*, v. 12, p. 225-241.
- Mack, G.H. and M.R. Leeder, 1998, Channel shifting of the Rio Grande, southern Rio Grande rift: implications for alluvial stratigraphic models, *Sedimentary Geology*, v. 117, p. 207-219.
- Mack, G.H. and W.R. Seager, 1990, Tectonic control on facies distribution of the Cam Rice and Palomas Formations (Pliocene-Pleistocene) in the southern Rio Grande rift, *Geological Society of America Bulletin*, v. 102, p. 45-53.