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Subject: Lower Dockum Permeability Testing

Steve,

The results of permeability testing on the lower Dockum are presented in Section 3 of the permit application pages 3-9 to 3-10 (see attached). I am working with Jim Bonner to get the original laboratory data.

Regards,

Patrick Corser

Cc: Dave Ellerbroek

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Triassic

Drilling at the site has delineated 1,175 feet of Dockum sediments. Two distinct units can be identified in these sediments: the Upper Dockum (475 feet thick) and the Lower Dockum (700 feet thick). Within the proposed Facility boundary the thickness of the Upper Dockum unit never exceeds 100 feet. Upper Dockum sediments are in contact with the overlying Quaternary alluvium throughout the project area.

Upper Dockum—This unit consists of variegated (red-brown-green) mudstones interbedded with reddish gray siltstones and reddish-gray-green sandy siltstones. The siltstones are micaceous (predominantly muscovite), indicating they were part of a relatively active fluvial system capable of transporting material into the basin from distant source rocks.

From examination of lithology and down-hole electric logs, it is estimated that 30 percent of the unit is comprised of mudstones. Lithologies of the remainder of the unit are evenly divided between siltstones and sandy siltstones. However, as the geotechnical properties of these two lithologies are very similar, this geologic discussion will simply refer to them both as siltstone. Mudstones were found to have an average permeability of 2.45×10^{-7} cm/s, and the siltstones average 1.22×10^{-5} cm/s.

These sediments were deposited in a fluvial environment. Mudstone and siltstone bodies are very lenticular and are found to pinch out abruptly. Accordingly, individual lithologies are not correlatable over significant distances (thousands of feet).

Cross-sections prepared from the close-spaced drilling within the proposed Facility boundary establish an understanding of the fluvial nature of this unit (see Appendix G in Volume II). Figure 3-11 shows the locations of drill holes for the close-spaced drilling pattern and provides an index of cross-sections that illustrate the character of the Upper Dockum Unit. Also shown on Figure 3-11 is the location of the "most favorable" area for the construction of the proposed landfill. As shown in the cross-section on Figure 3-12, the lithology of this area (centered on drill hole PB-4) is predominantly mudstone, with thin beds of siltstones. The lenticular nature of the mudstone and siltstone bodies is also shown in these cross-sections. Cross-sections 3-1 and 3-2, in Appendix G (Volume II), show the facies relationships of the "most favorable" area.

The fluvial nature of the Upper Dockum Unit has led to the scouring of channels into the underlying Lower Dockum Unit. This scouring and the pinching-out of fluvial sediments have resulted in the local development of an undulatory surface on top of the Lower Dockum Unit. This phenomenon is well illustrated in Cross-sections 3-3, 3-4, and 3-5, in Appendix G (Volume II).

Lower Dockum—The Lower Dockum Unit, described in Section 3.4.1.1, has a completely different character from the upper unit. The lower unit represents a time of relatively quiet lacustrine deposition, which resulted in the accumulation of thick sequences of predominantly mudstones interbedded with thin siltstones. These sediments are very homogeneous, in contrast with the abrupt facies changes present in the more active Upper Dockum depositional system.

Most of the close-spaced drilling within the proposed Facility boundary "bottomed" in Lower Dockum mudstones. These mudstones were consistently a moderate reddish brown color, which according to McGowen (1979), is associated with low stand lacustrine and mud flat deposition.

The 1995 confirmation drilling provided some important data on this unit. As illustrated in Figure 3-13, all three holes penetrated the clays of the Lower Dockum unit. PB-36 encountered 64 feet of this unit, PB-37 encountered 55 feet, and PB-38 encountered 18 feet. Ten feet of core of Lower Dockum were collected from PB-36 at a depth of 138 to 148 feet and 7 feet of Lower Dockum were collected from PB-37 at a depth of 148 to 155 feet. Four representative samples of this core were sent to AGRA Earth & Environmental laboratories for permeability analyses. The results of these analyses

confirm the Lower Dockum to be a very impermeable unit (average permeability of 5.7×10^{-8} cm/s), capable of performing as a geologic barrier to downward migration from the proposed landfill. Following are the results of the core analyses:

Core Interval	Permeability (cm/sec)
PB-36 (144'-145')	5.2×10^{-8}
PB-36 (147'-148')	6.8×10^{-8}
PB-37 (150'-151')	5.8×10^{-8}
PB-37 (154'-155')	4.9×10^{-8}

Not provided in Vol. II, Appx E

3.4.2.2 Site Structure

There are no identified faults within the project area. As previously discussed, the proposed site is located in a geologically stable area. There are no mapped faults on or adjacent to the project area. Color air photos of the area were examined for surface lineations, which can reflect faulting in the subsurface. All surface lineations observed on these photos were attributed to man-made features (i.e., fences, roads, etc.).

Subsurface drilling did not encounter displacement or repeating of geologic sequences that would be indicative of faulting. In the Upper Dockum Unit, there are abrupt changes in lithologies, but these are attributed to depositional processes associated with an active fluvial system.

3.4.3 Site Investigation Activities

Triassic sediments in eastern Chaves County were initially identified as excellent host rocks for proposed hazardous waste disposal because they (1) contain thick sequences of low permeability clays; (2) occur in remote, unpopulated areas; and (3) produce virtually no groundwater. This section describes the series of exploration activities undertaken to verify and document the suitability of the site for hazardous waste disposal.

As part of this permit application, a total of 41 drill holes were completed. The lithologies of these holes were recorded and a geophysical log was run on each drill hole. Thirty-one of these drill holes were completed within the project boundary (Figure 3-14).

3.4.3.1 Preliminary Evaluation Activities

The first phase in determining an appropriate disposal site was to identify potential sites with exposed or near-surface Triassic sediments. To identify such sites, color aerial photos were obtained of areas underlain by Triassic sediments in eastern Chaves County (Figure 3-15). The areas exhibiting the characteristic coloration associated with the Triassic sediments on the photos were then plotted on topographic maps. The locations with desirable geology were screened for additional factors, including accessibility and land ownership. From this process, a prioritization of sites was developed and a shallow drilling program designed.

In July and September 1993, two shallow drilling programs were conducted to examine Triassic sediments underlying the Quaternary alluvium. Average depth of these holes was 40 to 60 feet, and the drilling was conducted on a spacing of approximately 1,000 feet between holes. As shown in Figure 3-16, three areas encompassing seven sections were examined. The objective of this drilling was to identify an area where the Triassic sediments were unsaturated, were situated close to the surface, and contained low permeability clays. An Ingersol Rand 1500 air rotary drill was used to perform this work. This air rotary technique was used because of the high quality of drill cuttings it produces and because the presence of any subsurface water can be easily detected.