California Regional Water Quality Control Board
Central Coast Region

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Arnold Schwarzenegge
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MEMORANDUM

TO: Frank DeMarco, PE

FROM: Linda Stone, RG (#6022), CHg (#420)

DATE: March 26, 2004

SUBJECT: Chicago Grade Landfill, Geologic Substrate at Modules 3, 4 and 5

Field Observation, March 19, 2004

On March 19, 2004, Frank DeMarco and Linda Stone conducted a physical inspection of the cut-slope that will form the eastern side of planned modules 3, 4, and 5 for the proposed expansion of the Chicago Grade Landfill (Landfill). The purpose of the inspection was to perform a visual check of the site's stratigraphy in the expansion area, and determine if this stratigraphy supports the Discharger's proposal that the in-situ permeability of the cut slope was more than adequate to meet State and Federal prescriptive and performance standards. This memorandum documents the inspection observations and provides a response to the proposal that the permeability of in-situ geology at the proposed expansion area adequately meets the prescriptive requirements of the landfill regulations.

Based on visual inspection, the cut slope consists primarily of siltstone with interbeds of poorly sorted (i.e., well graded) gravel conglomerate. The siltstone beds appear fairly homogenous, but some more indurated exposures contain several fracture sets. Interbeds and lenses of conglomerate are present throughout the exposed cut. The conglomerate beds are poorly to moderately indurated and are generally lighter colored than the siltstone. The cementation of the conglomerate appears minimal since, at a saturated outcrop, the conglomerate disaggregated when we attempted to obtain a sample. It is difficult to estimate the maximum thickness of the conglomerate beds because large areas of the cut face are covered by clasts that have been transported down slope by mass wasting. The prevalence of mass wasting is also indicative of the poor induration of the conglomerate. Conglomerate beds at least 10 feet thick were observed at several locations and the thicker beds appear to be laterally extensive. The predominate clast lithology is a light colored, low density siltstone. The siltstone clasts were probably derived from the Monterey Formation. We also noted the occurrence of dark, subangular chert clasts, which were also probably derived from the Monterey Formation.

Response To The Discharger's Comment On Finding 31 of the Proposed Order

In his comment on Finding 31 of the Proposed Order, the Discharger states that "all properly sampled and tested soils that underlie the current waste disposal area and the future expansion area have been found to have a permeability of 10^{-7} to 10^{-9} cm/sec" and he concludes that there is no reliable data to support Finding 31. The Discharger refers to Table 2 of the Report of Waste Discharge (Hoover 2003) as providing the supporting geotechnical data for that statement and conclusion. There are several problems with the use of the data to support these assertions about the underlying permeability in the expansion area.

Firstly, and most importantly, sedimentary rocks, such as the Paso Robles Formation are typically heterogeneous. An early geology report on the Landfill (Central Coast Laboratories 1975), describes the Paso Robles Formation at the Landfill as primarily a massive conglomerate. The report states that the area east of the active cell (i.e., general vicinity of the proposed expansion) is predominately a clayey siltstone with beds of sandstones and lenses of conglomerate. These descriptions are consistent with our site observations, with the exception that we observed thick beds of conglomerate in the area of the proposed expansion. They are also consistent with the geologic descriptions contained in the Report of Waste Discharge (Hoover 2003), the Water Quality Solid Waste Assessment Test, Unsaturated Zone Monitoring Program (Staal, Gardner & Dunne, Inc. 1991), Water Quality Monitoring Program 1(Staal, Gardner & Dunne, Inc. 1986), and lithologic logs for boring and monitoring wells, all of which are included in the facility's reports previously submitted to the Regional Board. Liquids and gases follow the path of least resistance; hence, liquids and gases will migrate along preferential pathways. Even though siltstone appears to be the predominant lithology underlying the proposed expansion area, the more permeable interbeds of sand and gravel will control the movement of water, leachate, and landfill gas. The permeability of the coarse-grained units is probably much higher than the cited values of 10^{-7} to 10^{-9} cm/sec.

Secondly, in my review of the cited permeability values (Table 2 of Report of Waste Discharge, Hoover 2003), I found that only four permeability values are reported for the area of the proposed expansion. These values were derived from permeability tests performed in conjunction with recent geotechnical testing of the proposed expansion area (Richardson 2003). Three of the tested samples were collected from the cut face and the fourth was from a stockpile of excavated material. The samples are described as silts and clays. No results are reported for the coarser grained units, therefore, the cited permeability values represent the least permeable units at the expansion area. The laboratory report for the tests on the fine-grained units states that samples were remolded and tested under conditions of relative compaction ranging from 90 to 95 percent and moisture contents ranging from 2 percent above optimum to 4 percent above optimum. The permeability values derived from these samples represent the permeabilities that can be achieved with the fine-grained units after remolding and compaction and under specific moisture content. Remolding and compaction destroys primary and secondary features (e.g., bedding planes, sand stringers, and fractures) that can act as preferential pathways with much higher permeability than the remolded sample.

In our review of geologic information on this facility, we noted that a 1975 geology report included boring logs that contained permeability values. The report does not state how the testing was conducted, but their inclusion on boring logs implies that they represent down-hole testing of in-situ material, rather than laboratory testing of remolded material. The permeability values reported for depths greater than 10 feet range from 10^{-3} to 10^{-6} cm/s. These values may be more representative of the range of values of in-situ material (at least on a small scale, see discussion below) than the laboratory values reported by the Discharger.

Additionally, permeability testing on sample-size material tends to underestimate the permeability of geologic units because of the relationship between scale and permeability, i.e. the larger the area tested, the higher the permeability estimate. This relationship is a result of the heterogeneity of geologic units. Liquids and gases can migrate via preferential pathways that include large features such as gravel beds, and relatively thin and/or widely spaced features such as bedding planes, fractures, and sand stringers. Thin and widely spaced features are not likely to be represented in a test of a small sample. Plate 4 of the Report of Waste Discharge shows a fault that crosses the center of the proposed expansion in a north-south direction. Faults can also influence the movement of water, acting as conduits at some locations and barriers at others.

Summary

The conglomerates observed in the cut slope and described in Landfill reports and boring logs will provide significant preferential pathways for the migration of leachate, groundwater, and landfill gas. In addition to these coarse-grained units, other features such as bedding planes within the siltstone, sand stringers, fractures and faults may also act as conduits for liquid and gas migration. The in-situ permeability of the geologic units is probably much higher (i.e., more permeable) than the values reported by the Discharger because his reported values are based on laboratory testing of remolded and consolidated samples from the fine-grained units.