

Florida Department of Environmental Protection

Memorandum

TO: Susan Pelz
Professional Engineer III
Solid Waste Program Manager
DEP Southwest District Office

THROUGH: Jon Arthur, Ph.D., PG #1149 *REC for JA*
Acting Director
Florida Geological Survey

FROM: Clint Kromhout, PG #2522 *CK*
Professional Geologist I
Florida Geological Survey

RE: 2nd review for sinkhole formation probability of the proposed
Angelo's Class I landfill site, Pasco County, FL

DATE: February 11th, 2009

The Florida Geological Survey (FGS) was asked to conduct a follow-up review and provide comments regarding the probability of sinkhole formation within the boundaries of the proposed Angelo's Class I Landfill site located in eastern Pasco County. The comments herein are based solely upon the provided landfill permit application geologic and hydrogeologic data supplied by the Florida Department of Environmental Protection's (DEP) Southwest District Office's Solid Waste Program and existing data maintained by the FGS. No attempt has been made to evaluate the engineering measures proposed for use at this site, as those measures fall outside the technical expertise of the FGS. Newly provided materials reviewed in preparation for this memorandum include the March 2008 Site Evaluation Supplemental Report and August 2008 RAIs #4 and #5, both from Jones Edmunds & Associates, INC. The assessment of sinkhole formation probability is based on professional judgment in consideration of data in these materials and knowledge of regional geologic and hydrogeologic conditions.

Borings drilled prior to GPR survey:

A subsidence occurrence at boring EB-9, not previously identified in the first memorandum provided by the FGS, presents evidence of concern. This is a potential indication that other subsidence features could be induced should heavy equipment start disturbing the currently semi-stable geology. That potential also exists regarding the weight of the landfill's contents over time. A 4 foot diameter sinkhole approximately 2 feet in depth was induced while drilling. Unlike all of the other previously identified borings exhibiting potential subsurface subsidence-related conditions (voids, weight of rods, weight of hammer, and lost circulation) at depth (~>50 below land surface), EB-9 actually showed active subsidence at land surface. EB-9 was drilled on the southern side of the pond located on the western side of the proposed landfill site. This pond is part of a lineament trace identified by Jones Edmunds &

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Associates. Concerns about the identified lineaments and their potential indications can be found in the first memorandum issued by the FGS. It is important to note that this information can only be found on page 2 of 2 in the "Notes & additional data/info" section on the bottom of the *Test Boring Field Report*. That information cannot, to my knowledge, be found anywhere else in the entire permit application.

Additional investigative boreholes were drilled in close proximity to previously drilled boreholes identified in the first FGS memorandum (November 16, 2007) because they exhibit potential subsurface subsidence-related conditions (voids, weight of rods, weight of hammer, and lost circulation) and to determine their extent and nature. The additional borings found the subsurface subsidence-related anomalies to be localized. Those findings include additional investigative borings for both EB-7 and EB-9, the boreholes exhibiting the worst conditions. The findings of the additional borings suggest a local nominally dormant karst environment.

GPR survey:

Resulting from the concerns identified in the borings, a ground penetrating radar (GPR) survey was conducted to geophysically assess the site to identify any anomalous features which may indicate locally favorable conditions for sinkhole formation. The spacing of the GPR transects was set at 50 feet in the southern 30 acre portion and 100 feet in the northern 60 acre portion of the landfill site. It is unclear why the 50 foot grid pattern spacing was not used in the northern 60 acres as it is preferred for consistent site characterization. In addition to the larger grid pattern spacing (100 feet), the northeastern corner of the 60 acre portion grid spacing was increased to 200 feet due to the "anticipated presence of shallow electrically conductive soils and possible greater attenuation of the radar signal," presumable clayey soils. Although additional investigative drilling, prior to the GPR survey, suggests the void in borehole EB-7 is localized, it would seem appropriate to retain the same grid pattern of at least 100 feet (preferably 50 feet) to identify any potentially anomalous features within the vicinity of that borehole.

Borings drilled post GPR survey:

All anomalies identified by the GPR transects were drilled using the standard penetration test (SPT) method until refusal. All of those anomalies contained loose sands and soils. Out of the thirteen boreholes, six boreholes exhibited the same drilling conditions (voids, weight of rods, weight of hammer, and lost circulation) as borings drilled prior to the GPR survey. Similar to the previous borings not all boreholes terminated in clay or limestone. Eight of the boreholes terminated in sand.

Section 2.2.2, *The Closest Known Sinkhole Occurrence*, that states the DEP (FGS) maintains the most comprehensive list of reported sinkholes; this assumption is incorrect. Environmental consultants and insurance companies possess the most comprehensive lists of reported sinkholes. This section also outlines an induced subsidence feature that occurred while

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excavating a temporary stormwater retention pond approximately 5000 feet northeast of the proposed site at the Enterprise Class III landfill. The subsidence occurred in a "dormant low-density sand feature." Geologic characteristics of the feature prior to subsidence were likely similar to the anomalies identified and drilled based on GPR survey results.

The borings indicate both a locally dormant and active karst environment. A change in groundwater chemistry or rapid/extreme rise and fall of the water table resulting from weather patterns and possibly local pumping may change local groundwater flow paths and reactivate natural sinkhole formation activity. Introduction of terra-forming heavy equipment disturbing the semi-stable geology may potentially induce sinkhole activity. The additional investigations, data, and observations do present critical information that leads me to amend my original qualitative assessment. The site conditions are consistent with what one would expect regarding sinkhole potential for this region of Florida; the general probability of sinkhole formation within the proposed Class I landfill site is moderate-to-high with respect to relative potential elsewhere in the state.

\ck

Cc: J. Arthur
Acting Director
Florida Geological Survey