Technical Memorandum

Date:	Tuesday, October 16, 2018
Project:	North Omaha OPPD
To:	OPPD
From:	Greg Shafer, PE
Subject:	North Omaha Ash Landfill 'Unstable Areas' Evaluation, Demonstration and Certification

Purpose

The Coal Combustion Residual (CCR) Rule, specifically CFR Title 40, Part 257, Section 257.64, states that, "An existing or new CCR landfill, existing or new CCR surface impoundment, or any lateral expansion of a CCR unit must not be located in an unstable area unless the owner or operator demonstrates by the dates specified in paragraph (d) of this section that recognized and generally accepted good engineering practices have been incorporated into the design of the CCR unit to ensure that the integrity of the structural components of the CCR unit will not be disrupted."

An unstable area is defined in Section 257.53 as a location that is susceptible to natural or human-induced events or forces capable of impairing the integrity, including structural components of some or all of the CCR unit that are responsible for preventing releases from such unit. Unstable areas can include poor foundation conditions, areas susceptible to mass movements, and karst terrains."

The purpose of this technical memorandum is to review and summarize the existing conditions and determine if the active CCR landfill also known as the North Omaha Power Station Ash Disposal Area (North Omaha Ash Landfill) is within an Unstable Area. The following factors are required to be considered in this evaluation:

1) On-site or local soil conditions that may result in significant differential settlement;
2) On-site or local geologic or geomorphologic features; and
3) On-site or local human-made features or events (both surface and subsurface).

Differential Settlement

The compressibility of soils consists of consolidation settlement and immediate settlement. Consolidation settlement is a result of a volume change in saturated soils due to the expulsion of water occupying the void spaces. Immediate settlement is due to the elastic deformation of dry soils and of moist and saturated soils without any change in the water content. (Reference 1: DAS, 2nd Edition). Materials typical of large settlement include soft and highly plastic clays which take a large amount of time to dissipate the pore water pressure that develops over time

during the loading. The soil materials below the North Omaha Ash Landfill are sandy and will dissipate water quickly, and are not susceptible to large settlements or differential settlement over time.

The materials below the North Omaha Ash Landfill consist of an unconsolidated fill material, which is a "mixture of fly ash and bottom ash (granular fill material)", overlying alluvium. Geologically, unconsolidated refers to not consolidated or cemented together such as sandstone, siltstone, shale or limestone (USGS). The alluvium is "comprised of laterally and vertically discontinuous fine-grained, cohesive clayey sands and sandy clays, and non-cohesive silts and fines sands… The fine-grained soils are generally found above elevations between approximately 970 [feet] and 980 [feet]. The soils below this range in elevations tend to be non-cohesive and coarser grained, and are comprised primarily of medium to coarse sand with minor gravel." Reference: Hydrogeologic Investigations Report, SCS Engineers, SCS June 29, 1995. The soils profiles are also described in previous subsurface investigations summarized in the June 29th report. The top of bedrock was encountered approximately 35 to 60 feet below existing grades.

An evaluation of maximum total settlement of the landfill was conducted by Black and Veatch in the original Nebraska Department of Environmental Quality (NDEQ) Permit Application. Reference: Landfill Settlement calculations, March 23, 1995. The maximum total settlement was estimated to be 2.2 feet. Preliminary estimates of the settlement range from less than an inch along the outside perimeter (west side) to approximately 2.2 feet in the center, approximately 325 feet away. The resulting differential settlement deflection ratio (maximum differential movement in the span length – EM 1110-1-1904 (USACE Engineer Manual) is approximately 1/150 and is not considered excessive for earthen structures. Typically, a deflection ratio of 1/100 or greater is considered excessive with embankments (Reference: Bureau of Reclamation, Design Standards No. 13 Embankment Dams, Chapter 5, pg. 5-17). Based on these existing conditions and future capping system grades, anticipated differential settlement is not excessive and will not cause the area to be unstable.

Geologic or Geomorphologic Features

The general geologic features of the site are described in the Hydrogeologic Investigations Report, SCS Engineers June 29, 1995. The materials at the surface and below are described in the prior section of this memo.

There was no indication of encountering karst deposits, which is a distinctive topography that indicates dissolution (also called chemical solution) of underlying soluble rocks by surface water or ground water..

Alluvial soil deposits are not known to have mass movements. They can be susceptible to erosion and possibly subject to scour if not vegetated for stabilization. But, since the site is planned to be vegetated as part of the operations plan as well as the closure plan, there is no concern for mass movements or slope instability.

The borings included split spoon sampling which provides an indicator of consistency based on the number of hammer blows (drops). The higher the blow count, the higher relative density and consistency (stiffness) of the materials sampled. The cohesive materials encountered (silts and clays) had blow counts indicating a consistency range of soft to hard. The non-cohesive materials (sands and gravels) had blow counts indicating consistency ranging from very loose to medium dense (Peck). The blow counts were not corrected for groundwater or depth. The results of the slope stability analysis (May 23, 1995, Black & Veatch) show the calculated factors of safety exceed the minimum requirements for the maximum height section. Based upon this general information and a review of the slope stability, the existing soils are capable of supporting the loads.

Seismic Considerations

Seismic impact zones are defined as an area having a 2% or greater probability that the maximum expected horizontal acceleration, expressed as a percentage of the earth's gravitational pull (g), will exceed 0.10 g in 50 years. The site location in Douglas County, in North Omaha, was located on the USGS Seismic-Hazard Maps for the Conterminous United States, 2008, Peak Horizontal Acceleration with 2 Percent Probability of Exceedance in 50 Years. See attached USGS Seismic-Hazard Map. The peak horizontal acceleration at that location is below the 0.10 g threshold and is not considered in a seismic impact zone. It is noted that the slope stability calculation within the NDEQ permit, did take into account a seismic acceleration which determined an acceptable factor of safety.

Human-made Features or Events

Currently, an ash storage building is located within the ash disposal limits. Other infrastructure items including an electric transformer, silo/auger, mobile trailers and an overhead power line support tower. These items, with the exception of the overhead power line support tower, are scheduled to be abandoned (removed) during the remaining improvements in Phase 3 (Sheet 3 of the Permit Drawings and Operational Plan). There are railroad tracks and a transmission tower adjacent to the area. Adjacent to the landfill are process water ponds, coal pile, coal pile runoff pond, Pershing drive, and USACE flood levees. None of these items impact the stability of the area.

Professional Engineer Certification

"I hereby certify that this Technical Memorandum for the CCR landfill known as the North Omaha Ash Landfill at the North Omaha Power Station, owned and operated by Omaha Public Power District (OPPD), meets the requirements of the Coal Combustion Residual Rule 40 CFR, Section 257.64. I am a duly licensed Professional Engineer under the laws of the State of Nebraska."

Print Name: Gregory M Shafer

Signature:

Date: October 16, 2018

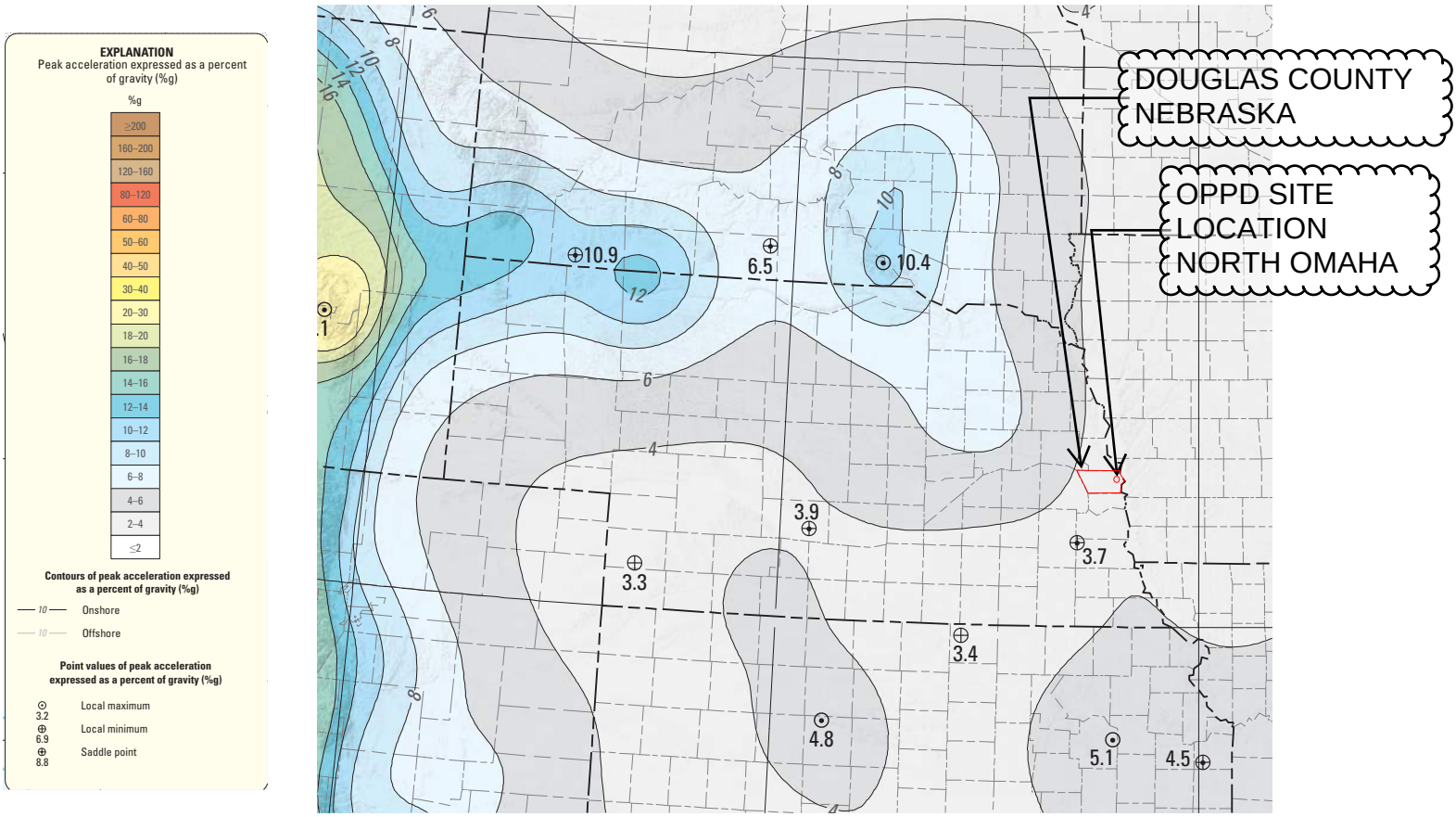
License #: E-11178

My license renewal date is December 31, 2018.

References

1. Principles of Foundation Engineering, Braja Das, 2nd Edition, pg. 156.
2. Hydrogeologic Investigations Report, SCS Engineers, June 29, 1995.
3. Bureau of Reclamation, Design Standards No. 13 Embankment Dams, Chapter 5, pg. 5-17.
4. USACE Engineer Manual – EM 1110-1-1904, Engineering and Design.
5. USGS Seismic-Hazard Map peak acceleration 2 percent probability of exceedance in 50 years; Nebraska excerpt. Attached.
6. HDR Permit Renewal Drawings, November 2014.
7. Black & Veatch Settlement and Slope Stability Calculations, May 23, 1995; current permit renewal, May 16, 2016 (original calculations 1995).

FIGURE 1: NEBRASKA EXCERPT OF 2014 PEAK HORIZONTAL ACCELERATION WITH 2 PERCENT PROBABILITY OF EXCEEDANCE IN 50 YEARS (10 PERCENT IN 250 YEARS)



Seismic-Hazard Maps for the Conterminous United States, 2014

Peak Horizontal Acceleration with 2 Percent Probability of Exceedance in 50 Years

By

Mark D. Petersen,[1] Morgan P. Moschetti,[1] Peter M. Powers,[1] Charles S. Mueller,[1] Kathleen M. Haller,[1]Arthur D. Frankel,[1] Yuehua Zeng,[1] Sanaz Rezaeian,[1] Stephen C. Harmsen,[1] Oliver S. Boyd,[1] Edward H. Field,[1] Rui Chen,[2] Nicolas Luco,[1]Russell L. Wheeler,[1] Robert A. Williams,[1] Anna H. Olsen,[1] and Kenneth S. Rukstales[1]

2015

[1]U.S. Geological Survey
[2]California Geological Survey, Sacramento, Calif.