Enclosure 5 to E-54422

SAR Changed Pages
(Public Version)

2.1 Geography and Demography of Site Selected

The WCS CISF is situated in northwest Andrews County on the southwestern edge of the Southern High Plains. The entire Waste Control Specialists site is approximately 14,000 acres with all acreage being controlled by Waste Control Specialists. The nearest population center of 25,000 or more is Hobbs, NM about 20 miles northwest of the WCS CISF.

Land uses within a few miles of the WCS CISF include agriculture, cattle ranching, drilling for and production from oil and gas wells, quarrying operations, uranium enrichment, municipal waste disposal, and the surface recovery and land farming of oil field wastes. Surface quarrying of caliche, sand and gravel is conducted in New Mexico, approximately one mile west of the WCS CISF. The oil field waste recovery facility is adjacent to this quarry. The Lea County, New Mexico municipal solid waste landfill is located adjacent to the state line to the immediate south and west of the WCS CISF. Uranium Enrichment Company (URENCO) operates a centrifuge technology, uranium enrichment facility about one mile to the southwest of the HW-50397 RCRA landfill location.

The 15-mile radius area around the WCS CISF is very low population with some industry and mostly ranch land and very little seasonal variation in population. In the Environmental Report, Appendix A, the Socioeconomic Impact Assessment includes 2010 Census data and Figure 1.1-1 in Appendix A shows cities and towns within a 30 mile radius of the WCS CISF.

Except for a historical marker and picnic area approximately 5.5 km (3.3 mi) from the WCS CISF at the intersection of New Mexico Highways 234 and 18, there are no known public recreation areas or state or federal parks within 8 km (5 mi) of the WCS CISF.

The following nonindustrial water resources are located in the proposed WCS CISF vicinity:

- A manmade pond on the adjacent quarry property owned by Permian Basin Materials (Permian, 2016[2-29]).
- Baker Spring, an intermittent surface-water feature situated about *2,500 feet west* of the WCS CISF that contains water seasonally.
- Several cattle-watering holes where groundwater is pumped by windmill and stored in aboveground tanks.
- Monument Draw, a natural shallow drainageway situated several kilometers southwest of the WCS CISF. Local residents indicated that Monument Draw only contains water for a short period of time following a significant rainstorm (LES, 2005[2-19]).

All Indicated Changes are in response to RAI NP-2.6-6

The WCS CISF Drainage Evaluation and Floodplain Analysis (Attachment B) models the 100-year flood, the 500-year flood and the PMF to evaluate the effects on the WCS CISF.

The only analysis of significance from a flooding standpoint is the water level in the playa area resulting from the PMP event. The result is that the WCS CISF storage area is above the maximum water level elevation resulting from that storm event as demonstrated in Attachment B. The area west of the WCS CISF drains freely and does not result in any ponded water to create a flood area near the WCS CISF.

As noted previously, a stormwater collection ditch and berm are to be constructed up-gradient from the WCS CISF storage area. The ditch and berm are to be constructed as a matter of operational convenience to minimize (not prevent) run-on of stormwater during precipitation events by diverting it around the operational storage area. Figure 2-26 (CJI Drawing C-1) show the location of the Collection Ditch and Berm. Figure 2-27 through Figure 2-30 (CJI Drawings C-2, C-3, C-4, and C-5) show plan and profile of the collection ditch and berm. *Berms and ditches upgradient of the storage area will be constructed of on-site available red bed compacted clay and armored with on-site available caliche in order to minimize erosion and seepage. It is unlikely that seepage through or under the berms would occur due to the materials used to construct the berms and to the routine inspection and maintenance performed on all areas upgradient of the storage pads.* The storage area is sloped to promote drainage across the area, which will result in short-term overland flow of stormwater falling directly on the storage area during some precipitation events. The overland flow across the storage area will be temporary in nature. Compromise of the ditch and berm may result in increased flow across the storage area as a result of some precipitation events, but again, it would be short term and temporary. *The maximum berm height will be 2.6 feet. The site will be graded so that stormwater runoff flows off and around the storage pads. Assuming the berm were to breach, and the peak Probable Maximum Precipitation discharge reached a storage pad, the estimated depth of the flow is approximately 3 inches (Addendum A of Attachment B).* The storage pad area is approximately three times the area from which run-on might emanate, thus the majority of the overland flow results from the stormwater that falls directly on the pad. The area upgradient of the storage area is predominately a sand dune area with little to no developed drainage paths, which has the effect of lessening the overland flow of water from that area during the storm events. In order to provide a conservative analysis of the flood effects, the flood events are modeled without including the collection ditch and berms, which provides the greatest possible area contributing runoff into the playa.

As indicated in Section 4.0 of the December 2016 revision of the March 2016 report entitled *Centralized Interim Storage Facility Drainage Evaluation and Floodplain Analysis* (Attachment B of SAR Chapter 2):

RAI NP-2.4-2

"The local PMP [probable maximum precipitation] floodplain analysis yielded the PMF elevation near the CISF site of 3488.9 ft msl. Elevations of the storage pads vary from *3490* ft msl to 3504 msl. Elevations of the foundations of the security/administration building and the Cask Handling Building are 3496 ft msl and 3493 ft msl, respectively."

The finish floor elevations of the Security and Administration building and the Cask Handling Building are 7 feet and 4 feet, respectively, above the PMF elevation and will not be impacted by the PMF. The detailed calculations for determining the water level elevations in the playa can be found in Attachment B.

2.4.2.3 Effects of Local Intense Precipitation

RAI P-2.6-4

The Flood Plain Study in Attachment B includes calculations for a PMP using a 500-year frequency storm event and the limits of the floodplain. The results from these additional storms that were modeled describe a floodplain that is still shallow and wide that is too distant from the WCS CISF to ever be any threat. *The soils in the area of the WCS CISF are classified as hydrologic group A/B, which means the soils have high infiltration and transmission rates as shown on Attachment B, Flood Plain Report, Figure No. 2.2.1-1, Soils Boundary Map of the SAR. Infiltrating rainwater is quickly redistributed and removed by evapotranspiration (Grisak, et al., 2011 [2-57]). Precipitation occasionally exceeds the infiltration capacity, with transient ponding evidenced by enhanced vegetation in the playas (WCS, 2007 [2-52]). There are no localized playas or drainageways in the proposed WCS CISF vicinity.*

2.4.3 Probable Maximum Flood on Streams and Rivers

There are no streams or rivers on or in the vicinity of the WCS CISF. Monument Draw, an ephemeral stream, is the closest main surface water drainage and is about 3 miles west of the WCS CISF in New Mexico, so the WCS CISF would be unaffected by flooding on streams of rivers. While Monument Draw is typically dry, the maximum historical flow occurred on June 10, 1972 and measured 36.2 cubic meters per second (1,280 cubic feet per second).

2.4.4 Potential Dam Failures (Seismically Induced)

RAI NP-2.6-6

There are no dams on or in the vicinity of the WCS CISF. The Waste Control Specialists RCRA and LLRW facilities currently have five (5) manmade evaporation ponds *used for sedimentation control and evaporation. In addition to the WCS ponds, there are a series of manmade ponds to the southwest in New Mexico. As indicated in Section 2.6.5, the maximum elevation of the embankment structure of any of these ponds is lower than the minimum elevation of any structure at the CISF. If a seismic event were to cause slope failure, the inherent topography would preclude any adverse effects to the CISF.*

2.6 Geology And Seismology

2.6.1 Basic *Geology*

This section discusses the regional geology *and site-specific geology. Figure 2-13 is presented to identify the geologic formations of the region. This stratigraphic column adopts the nomenclature of Lehman (1994a[2-17], 1994b[2-18]) for the Dockum Group and includes the entire stratigraphic sequence typical of the Central Basin Platform of the west Texas Permian Basin (Bebout and Meador, 1985[2-2]).* Figure 2-14 presents the Hobbs Sheet of the Geologic Atlas of Texas, 1:250,000 scale. The map shows surficial lithologic exposures, *geologic descriptions of the formations that are exposed*, topography infrastructure and governmental boundaries in the area surrounding the Waste Control Specialists permitted area.

Site Specific Geology

Two cross sections in the vicinity of the WCS CISF were created using boring logs from former site investigations. The locations of the cross sections are shown on Figure 2-15. Two cross sections in the vicinity of the WCS CISF are included as Figure 2-16 and Figure 2-17 and the associated boring logs are included in Attachment C.

The geologic formations of concern, beneath of the WCS CISF comprise, from oldest to youngest, the Triassic Dockum Group, the Late Tertiary Ogallala Formation, the Pleistocene windblown sands of the Blackwater Draw Formation, *and* Holocene windblown sands. A regional hard caliche pedisol, termed the Caprock caliche, developed on all pre-Quaternary formations before the Blackwater Draw sands were deposited. *A less indurated caliche has also formed in portions of the upper Blackwater Draw Sands. Unlike the Caprock caliche, the Blackwater Draw caliche is not regionally extensive.*

A stratigraphic column *of the WCS CISF area* for the above units is provided in *Figure 2-37. This CISF site-specific stratigraphic column was developed from data collected from site boring logs. The boring logs are presented in Attachment C.*

The WCS permitted facilities are located over a geologic feature referred to as the red bed ridge. The red bed ridge is an expression of the top of the Triassic Dockum Group. The ridge is buried beneath the late Tertiary caprock caliche, which developed on all pre-Quaternary formations on the southern High Plains. Beneath the caprock caliche is the remnant Cretaceous Antlers Formation, which is not observed in bore holes at the CISF, and the Quaternary alluvial and windblown sands of the Ogallala, Gatuña and Blackwater Draw Formations, which are in turn covered by 10 to 20 feet of recent windblown sand. WCS site investigations have followed the convention suggested by Hawley (1993) to refer to the late Tertiary to Quaternary formations south of the red bed ridge as Gatuña and those north of the ridge as Ogallala (Hawley, 1993[2-51]).

All Indicated Changes are in response to RAI NP-2.6-2

As a consequence, Gatuña is not present at the CISF site. The depth to the top of red beds at the CISF is approximately 50 to 80 feet, based on the logs of borings shown in Figure 2-15, Figure 2-16 and Figure 2-17. The northward slope gradient of the top of the red beds across the CISF ranges from approximately 0.98% (based on red bed elevations between TP-64 (3435 ft msl) and PZ-46 (3414 ft msl) and 0.84%, based on red bed elevations between TP-65 (3437 ft msl) and PZ-47 (3414 ft msl). At the CISF, the maximum apparent slope on the late Pliocene erosional surface of the red beds is 1.77%, between TP-84 (3432 ft msl) and PZ-36 (3419 ft msl).

In the immediate vicinity of the WCS facility, the axis of the red bed ridge occurs from approximately the northwest corner of the Byproduct landfill to the southeast corner of the Compact Facility, continuing southeastward beyond the WCS landfills. The axis is not located under the CISF area. The nearest location of the crest of the buried ridge to the CISF is approximately 1200 feet south along State Line Road. At this location, the depth to the crest of the red beds is about 34 ft, based on the log of boring B-1 in Figure 5-4 from WCS (Waste Control Specialists LLC, 2007 [2-43]). The elevations of the top of red beds are estimated from Figure 2-16 and Figure 2-17, with locations estimated from Figure 2-15 and Figure 2-35.

Regional Geology

The red bed ridge is the position of a drainage divide that has separated two major fluvial systems throughout late Cenozoic time (Hawley, 1993 [2-51]; Fallin, 1988 [2-53]). This area was uplifted at the start of the Laramide Orogeny when the Cretaceous seas retreated. From the late Paleocene to near the end of the Pliocene the area was subject to erosion, removing most of the Cretaceous deposits. The relatively resistant limestones over the partially silicified Cretaceous Antlers Formation on the crest of the ridge may have effectively capped the red bed ridge, maintaining the ridge as a mesa or inter-drainage high. The axis of the red bed ridge remains coincident today with a local topographic high, between Monument Draw Texas, which drains to the Colorado River, and Monument Draw New Mexico, which drains to the Pecos River. In Andrews County, the buried red bed ridge plunges to the south/southeast at about 8 to 10 feet per mile, similar to the surface topography, and the crest of the surface water drainage divide is virtually coincident with the crest of the underlying red bed ridge.

The WCS CISF is located over the north-central portion of a prominent subsurface structural feature known as the Central Basin Platform. The Central Basin Platform is a deep-seated horst-like structure that extends northwest to southeast from southeastern New Mexico to eastern Pecos County, Texas. The Central Basin Platform is flanked on three sides by regional structural depressions known as the Delaware Basin to the southwest and the Midland Basin to the northeast, and by the Val Verde Basin to the south.

Uplift from the west and southward and eastward–retreating Cretaceous seas were coincident with the Laramide Orogeny, which formed the Cordilleran Range west of the Permian Basin. The Laramide Orogeny uplifted the region to essentially its present position, supplying sediments for the nearby late Tertiary Ogallala Formation. The major episode of Laramide folding and faulting occurred in the late Paleocene. There have been no major tectonic events in North Americas since the Laramide Orogeny, except for a brief period of minor volcanism during the late Tertiary in northeastern New Mexico and in the Trans-Pecos area. Hills (1985)[2-13] suggests that slight Tertiary movement along Precambrian lines of weakness may have opened joint channels which allowed the circulation of groundwater into Permian evaporite layers. The near-surface regional structural controls may be locally modified by differential subsidence related to groundwater dissolution of Permian salt deposits (Gustavson, 1980[2-10]).

In Figure 2-3, small circular features seen on the aerial photo began as small erosional depressions on the land surface. These depressions accumulated water, which variably dissolved surficial or near-surface pedogenic calcrete and carbonate. This process enlarged the depressions and accumulated sediment as the calcrete was dissolved (Holt and Powers, 2007a, [2-54]). They are surficial and show no signs of collapse and subsidence that would indicate dissolution of the much deeper evaporite-bearing formations. Analysis of cores and geophysical logs reveal no evidence of post-depositional dissolution of evaporites that would lead to such collapse (Attachment F). There is no evidence that human activities initiated these depressions. These features are unrelated to oil and gas exploration and extraction activities in the site area. The main part of these depressions ranges from a few hundred feet to more than 1000 feet in length and none of the localized features appear to reach a depth of 10 ft. Studies of playa fill indicate these features are thousands to tens of thousands of years old and older (Holliday et al., 1996, [2-55]). There is no indication that these features will form naturally at the site of the WCS CISF in the near geological future.

The Central Basin Platform is an area of moderate, low intensity seismic activity based on data obtained from the U.S. Geological Survey (USGS) Earthquake Data Base available from the National Earthquake Information Center (http://neic.usgs.gov/). Typical of the central U.S., there is a marked absence of mapped Quaternary faults and few of the known earthquakes can be associated with a specific geologic structure. In the 2014 U.S.G.S. National Hazard Maps, the site area was characterized as one of relatively low seismic hazard.

2.6.2 Vibratory Ground Motion

The WCS CISF lies in a region with crustal properties that indicate minimum risk due to faulting and seismicity. Crustal thickness is the most reliable predictor of seismic activity and faulting in intracratonic regions. Crustal thickness in the vicinity of the WCS CISF is approximately 30 miles (50 km), one of the three thickest crustal regions in North America (Mooney and Braile, 1989[2-22]). In comparison, the crustal thickness of the Rio Grande Rift is as little as 7.5 miles (12 km) in places.

All Indicated Changes are in response to RAI NP-2.6-1

The natural moisture content of the subsurface materials ranged from 2.5 to 9 percent. Atterberg limits testing on three selected residual samples revealed liquid limits (LL) ranging from 26 to 20 percent and each sample was non-plastic. Wash 200 tests performed on eight soil samples revealed 24 to 45 percent finer than the 200 sieve.

Shear wave velocities for the upper 100 feet below ground surface (bgs) range from 820.3 ft/sec to 23,383 ft/sec. The upper 10 feet of the site is a loose fill material and shear wave velocities for 0-10 feet bgs ranged from 820.3 ft/sec to 1,107 ft/sec. For 15 to 35 feet bgs, the shear wave velocities were 1302 to 1940 feet per second for a stratigraphic unit of silty sands, gravels, and caliche referred to as the Ogallala/Antlers/Gatuna formation (OAG). The Dockum Formation (dense clay) starts at 35 to 40 feet bgs beneath the OAG and shear wave velocities ranged from 2,058 feet/s to 3,383 ft/s. The results of the shear wave studies are located in Table 4 of the Geotechnical Exploration Report (Attachment E). The plot plan of the linear array is shown in Figure 12 of Appendix E of the Geotechnical Report (Attachment E). The engineering properties of site materials by strata, based on the geophysical survey investigation, are contained in Table 8 located in Appendix C of Attachment E.

During the geotechnical investigation, no water was encountered in any of the borings. There are no water table conditions anticipated beneath the site during facility construction and operations. Several monitor wells in the area are installed in the uppermost transmissive zone, and have been dry since installation in 2005 or 2008. The site is underlain by a northerly dipping lower confining unit. Since groundwater was not encountered in any of the 18 soil test borings and given that some of the borings penetrated as deep as 45 feet below the ground surface, it can be concluded that a liquefaction hazard does not exist for the proposed CISF.

The recommended allowable bearing capacity for design of the foundations is 3,000 pounds per square foot (psf) or less. A one-third increase in the allowable bearing capacity for all load conditions that include transient loads (wind, seismic, other short term loads) is permitted. The 33% increase in allowable bearing capacity (stress) can be applied to load combinations that consider transient loads in conjunction with dead loads. Calculations can be found in Appendix G of Attachment E. Calculations indicate a higher bearing capacity is possible; however, it is recommended to use a more conservative 3,000 pounds psf to avoid long term settlement. A summary table for the site characteristics geotechnical-related parameters can be found in Table 9 in Appendix D of Attachment E. Plans and profiles showing the extent of excavations and backfill are shown in Figure 2-26, Figure 2-31, Figure 2-32, and Figure 2-33. *Structural backfill shall comply with the criteria for material, compaction, and quality control specified in Section 4.2.2 of Attachment E.*

All Indicated Changes are in response to RAI P-2.6-2

2.6.5 Slope Stability

The WCS CISF site and surrounding area is nearly flat, so there is little possibility of landslides. Settling or slumping is unlikely because the geologic strata are well consolidated and surface soils have low moisture content. The semi-arid climate helps maintain low moisture content of the soils. *Except for sedimentation and evaporation ponds, surface* water is absent except during infrequent rainstorms.

As indicated in Sections 2.1 and 2.4, there are several nonindustrial water resources near the CISF. These include ponds, basins, springs, and drainage features. The ponds and basins are depressions and do not have embankments preventing water from escaping. The spring and drainage features do not have embankments. They are ephemeral and precluded from impacting the CISF due to inherent topography.

The WCS property has five manmade ponds used for sedimentation control and evaporation. The maximum elevation of any of the WCS pond embankment overflow structures is 3,454 ft. The minimum elevation of any structure at the CISF is 3,488 ft. Because the WCS pond embankment elevations are over 30 feet lower than the ground elevation of the CISF structures, slope failure of any of the WCS pond embankments would not adversely affect the CISF.

In addition to the five manmade ponds on WCS property, there are a series of manmade ponds to the southwest in New Mexico owned by Sundance Services, Inc. used for their oil field waste disposal operation. The nearest of these ponds is approximately 4,000 feet from the western WCS CISF OCA Boundary. The maximum elevation of all of the overflow points is approximately 3,475 feet. Because the Sundance pond embankment elevations are located at a substantial distance from the CISF and are over 10 feet lower than the ground elevation of any CISF structures, slope failure of any of these pond embankments would not adversely affect the CISF.

There are two stockpile areas, one to the southwest and one to the northeast of the CISF, created during construction of existing WCS landfills. The closest stockpile area is over 2,000 feet from the WCS CISF Phase 1 PA Boundary. This distance is sufficient to preclude any lateral spread from a potential slope failure from having any impact on the CISF.

2.6.6 Volcanism

There is minimal seismic and no volcanic activity near the WCS CISF. There is no evidence of tectonic or volcanic activity near the WCS CISF in the recent past.

2.7 Summary of Site Conditions Affecting Construction and Operating Requirements

The WCS CISF site is located on the southwestern edge of the Southern High Plains, approximately 32 miles northwest of the City of Andrews. This part of Andrews County is a gently southeastward sloping plain with a natural slope of about 8 to 10 feet per mile. The finished grade of the WCS CISF is expected to be sloped gently with an anticipated elevation of 3,485 feet above msl. The WCS CISF site is currently undeveloped and the existing land surface is fairly flat with an average slope of 0.8 percent (%). The existing maximum and minimum elevations of the site are about 3520 feet and 3482 feet msl, respectively. The cover type is desert shrub. The existing Waste Control Specialists railroad is generally aligned parallel with and south of the proposed WCS CISF site boundary.

The entire WCS CISF, including the access road, is above the 100-year flood elevation. The northern most limit of the 100-year floodplain is approximately 4,000 feet southeast of the WCS CISF while the northernmost limits of the 500-year and PMP floodplains are 3965 feet and 3895 feet southeast of the WCS CISF, respectively.

A probabilistic seismic hazard analysis was performed to determine the design basis ground motion at the WCS CISF. The peak ground acceleration for a 10,000 year return period is 0.26 g.

Subsurface soils at the WCS CISF are suitable for supporting conventional foundations under both the static and dynamic loading conditions. There is no potential for liquefaction, collapse, or excessive settlement of these soils. *As described in Section 2.6.5, there* are no slopes, natural or manmade, close enough to the proposed WCS CISF facilities that their failure would adversely affect these facilities.

Storage overpacks will be used to store canisters containing spent fuel and GTCC waste. The canisters are drained of all liquid prior to being shipped to the WCS CISF. Therefore, liquid releases cannot result from operation of the WCS CISF.

The shallowest water bearing zone is about 225 feet deep at the WCS CISF. The method of storage (dry cask), the nature of the storage casks, the extremely low permeability of the red bed clay and the depth to groundwater beneath the WCS CISF preclude the possibility of groundwater contamination from the operation of the WCS CISF.

All Indicated Changes are in response to RAI NP-2.6-6

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2-51 *Hawley, J.A., 1993. The Ogallala and Gatuna Formations in the Southeastern New Mexico Region, A Progress Report: New Mexico Geological Society Guidebook, 44th Field Conference, p. 261-269.*

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2-53 *Fallin, J.A.T., 1988, Hydrogeology of Lower Cretaceous Strata under the Southern High Plains of New Mexico. New Mexico Geology, Volume 10, No. 1, February 1988, pp. 6-9.*

RAI NP-2.6-2

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RAI NP-2.6-1

2-55 *Holliday, V.T., Hovorka, S.D., and Gustavson, T.C., 1996, Lithostratigraphy and geochronology of fills in small playa basins on the Southern High Plains, United States: Bulletin Geological Society of America, v. 108, p. 953-965.*

2-56 *Dutton et. al., 2005, Play analysis and leading-edge oil-reservoir development methods in the Permian basin: Increased recovery through advanced technologies. AAPG Bulletin, V.89, No. 5 (May 2005), pp. 553-576.*

RAI P-2.6-4

2-57 *Grisak, G., N. Baker, and R. Holt, 2011. "OAG Water Levels: Empirical and Modeled Relationship between Precipitation and Infiltration," (2011).*

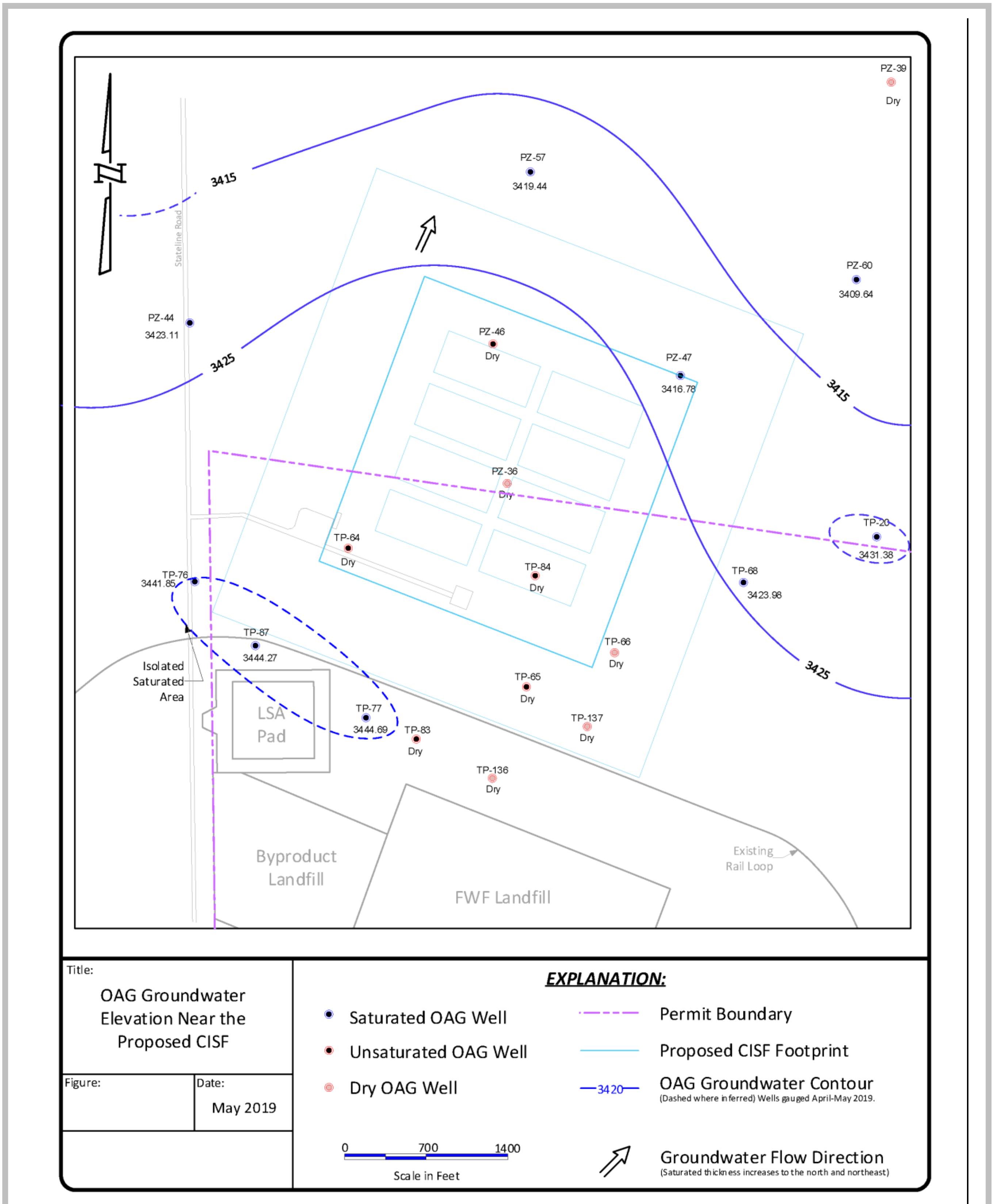

Figure 2-10
OAG Groundwater Elevation Near the Proposed WCS CISF

All Indicated Changes are in response to RAI P-2.6-4

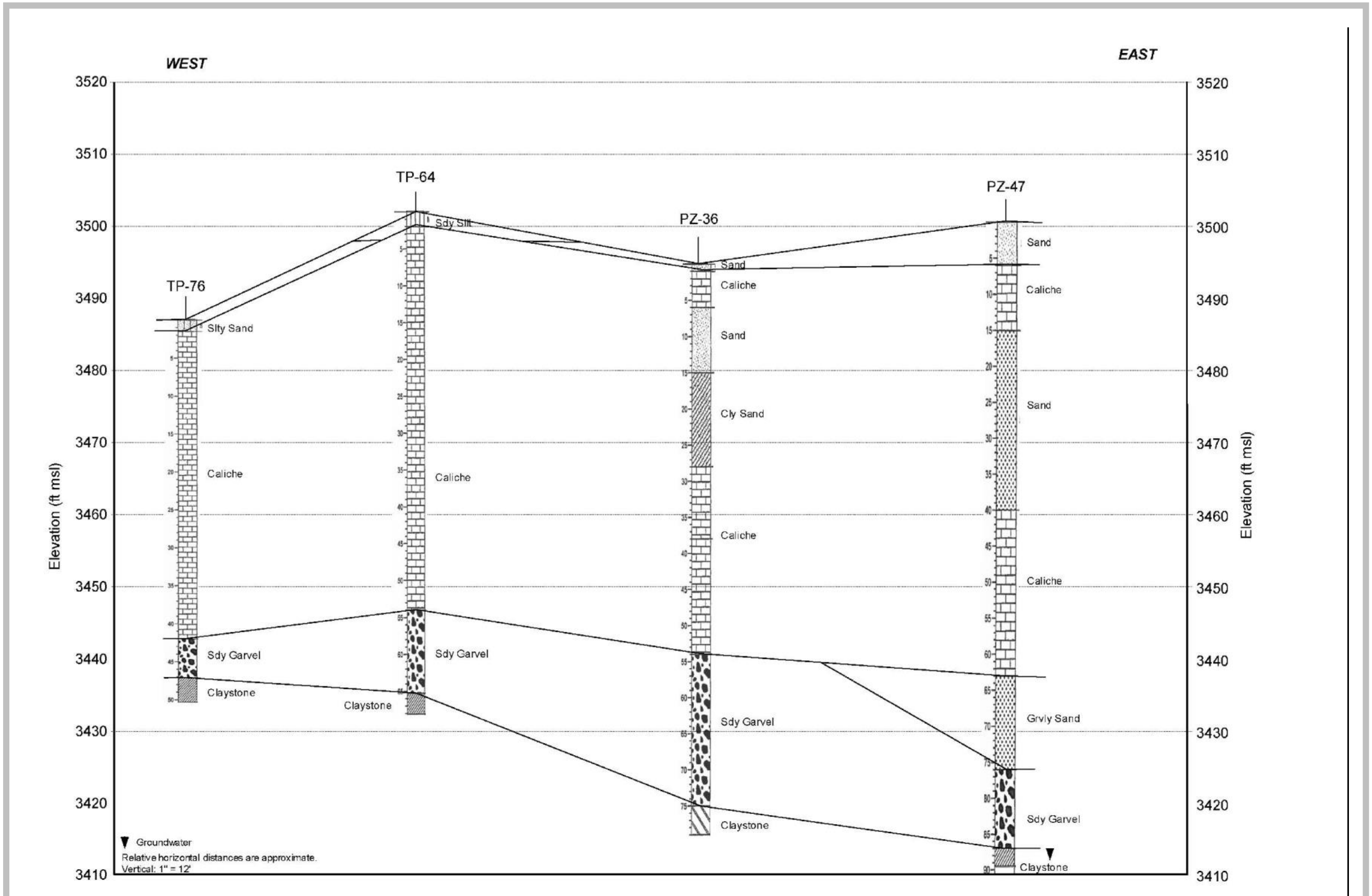

Figure 2-16
WCS CISF Cross Section West-East

All Indicated Changes are in response to RAI P-2.6-4

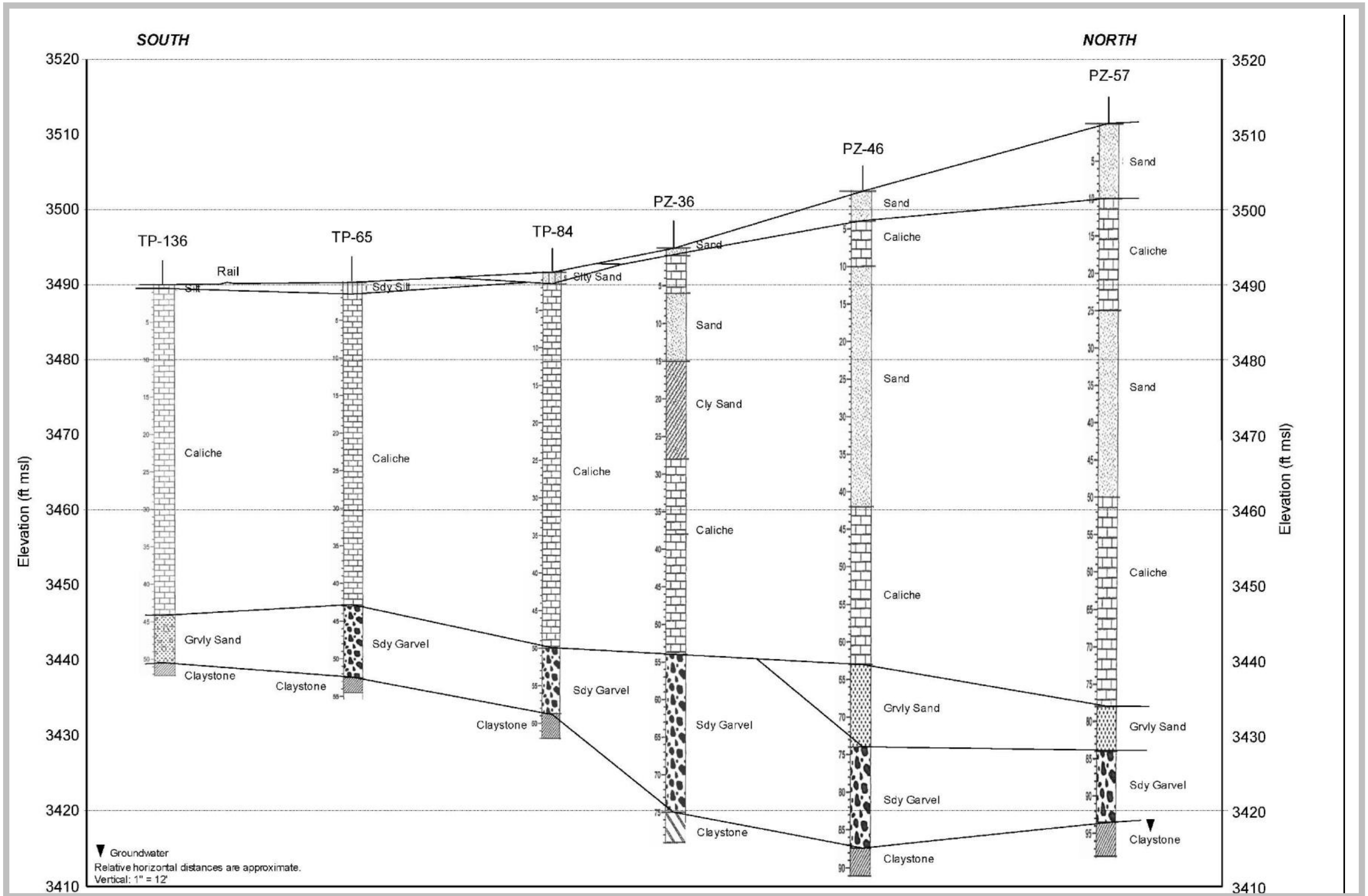

Figure 2-17
WCS CISF Cross Section South-North

All Indicated Changes are in response to RAI P-2.6-4

Years BP (millions)	ERA	PERIOD	FORMATION	THICKNESS	USCS	LITHOLOGY
	CENOZOIC	QUATERNARY	COVER SANDS	1'-10'	SP	SAND, FINE GRAINED, WELL SORTED, **UNCONSOLIDATED**, LOOSE, ORANGE TO TAN, **DRY**
0.01	CENOZOIC	QUATERNARY	CALICHE	4'-28'	NA	CALICHE WITH SAND MATRIX, **CONSOLIDATED**, FIRM TO MODERATELY HARD, WHITE TO TAN, **DRY**
	CENOZOIC	QUATERNARY	BLACKWATER DRAW	14'-38'	SP/SC/SM	SAND, W/SILT & CLAY, FINE GRAINED, WELL SORTED, **UNCONSOLIDATED**, ORANGE TO TAN, **DRY**
2.6	CENOZOIC	TERTIARY	CALICHE	19'-28'	NA	CALCAREOUS SAND, **CONSOLIDATED**-VERY HARD, LIGHT GRAY TO WHITE, **DRY**
	CENOZOIC	TERTIARY	OGALLALA	35'-51'	SW/GW	SAND WITH GRAVEL GRADING DOWNWARD TO A GRAVEL WITH SAND, UPPER SAND IS WELL GRADE, **UNCONSOLIDATED**, TAN, **DRY**, LOWER GRAVEL WITH SAND MATRIX, POORLY SORTED, WELL TO POORLY CEMENTED, SUBANGULAR TO SUB ROUNDED, **DRY** IN THE SOUTHERN PORTION OF CISF SITE, 1-5 FEET OF GROUNDWATER PRESENT IN THE NORTHERN PORTION OF THE CISF SITE
	CENOZOIC	TERTIARY	ERODED OR NOT DEPOSITED			
66	MESOZOIC	CRETACEOUS	ERODED OR NOT DEPOSITED			
145	MESOZOIC	JURASSIC	ERODED OR NOT DEPOSITED			
201	MESOZOIC	TRIASSIC	DOCKUM/ COOPER CANYON	~1400'/~500'	CL-CH	CLAY, CLAYSTONE, PLASTIC, STIFF, **CONSOLIDATED** MAROON TO RED, **DRY**

Figure 2-37
Geologic Column of the WCS CISF Area

All Indicated Changes are in response to RAI P-2.6-1

7.6.1.10 Results and Conclusions

Based on the evaluations performed, it is concluded that the licensing design of the NAC storage pad for Andrews, TX meets all of the applicable structural requirements of NUREG-1567 [7-28] with reference to NUREG-1536 [7-42] and NUREG-0800 [7-43]. Therefore, the NAC storage pad for Andrews, TX is qualified and acceptable. The WCS CISF licensing design includes consideration of four cask configurations on the pad based on systematically loading the pad with casks from one short side moving across to the other. Seismic, operational wind, and tornado wind were all considered to act on the casks. In the case of an SSE event, the VCCs do not overturn; however, the casks could slide up to 1.32 in (considering a safety factor of two). Furthermore, the concrete pad could slide up to 1.06 in (considering a safety factor of two).

Impact from cask drop or tornado-generated missiles was not considered with respect to the storage pad. The casks are already qualified for impact conditions and impact to the storage pad is an accident condition where damage is acceptable as long as there is no loss of function. The VCT was considered at several locations while fully supporting a cask. Operational wind load was applied to the VCT; however, seismic and tornado wind were not considered given that cask movements are infrequent evolutions.

7.6.2 Soil Liquefaction and VCC Storage Pad Settlement

The purpose of this evaluation is to determine the liquefaction potential and elastic settlement of the VCC storage pad located at the WCS CISF in Andrews, Texas.

The scope of work included:

- Review of Drawing NAC004-C-001, Rev. 0 showing the dimensions and general arrangement of the storage pad [7-30], and review of Drawing NAC004-C-002, Rev. 0 showing the structural concrete plan, sections, and details [7-37].
- Review of "Report of Geotechnical Exploration" performed by GEOServices, LLC [7-32].
- Liquefaction potential evaluation using the data from reference [7-32].
- Elastic settlement evaluation under static loading conditions using the data from reference [7-32].

7.6.2.1 Design Basis

All Indicated Changes are in response to RAI P-2.6-2

[ ]

7.6.2.2 Design Inputs

Soil Properties

[ ]

Relevant Concrete Pad Properties

[ ]

7.6.2.3 Analysis

Liquefaction Potential Evaluation

Liquefaction potential evaluation was based on NRC Regulatory Guide 1.198 [7-52] and widely accepted empirical methodology using Standard Penetration Test (SPT) and laboratory test data [7-53].

All Indicated Changes are in response to RAI P-2.6-2

7.6.2.4 Elastic Settlement Evaluation

7.6.2.5 Calculations

Liquefaction Potential

All Indicated Changes are in response to RAI P-2.6-2

[ ]

Soil Model Inputs:

[ ]

Time History Inputs:

[ ]

SSI Analysis Inputs:

[ ]

7.6.3.3 Calculations

The following sections detail the calculations of the inputs for the SSI analysis.

SSI Soil Model

[ ]

Proprietary Information on This Page
Withheld Pursuant to 10 CFR 2.390

7-20 Calculation 630075-2016, rev 3, Structural Evaluation of Gantry Base, NAC International.

7-21 NAC International Report 630075-R-06, Rev. 3, Appendix A, Independent Assessment of Lift Systems Hydraulic Gantry Crane System for Compliance with the Criteria of NUREG-0612 & -0554 Providing Single-Failure-Proof Handling of Spent Fuel Casks.

7-22 NAC International Report 630075-R-06, Rev. 3, Appendix B, Failure Modes and Effects Analysis.

7-23 NAC International Report 630075-R-06, Rev. 3, Appendix C, Crane Operations Descriptions.

7-24 NAC International Report 630075-R-06, Rev. 3, Appendix D, Kuosheng Hydraulic Gantry Crane NUREG-0554/ASME NOG-1 Conformance Matrix.

7-25 NAC International Report 630075-R-06, Rev. 3, Appendix E, Kuosheng Chain Hoist ASME NUM-1 Compliance Matrix.

7-26 Calculation NAC004-CALC-04, Rev. 1, "Soil Structure Interaction Analysis of Independent Spent Fuel Storage Installation (ISFSI) Concrete Pad at Andrews, TX."

7-27 Jacks, Industrial Rollers, Air Casters, and Hydraulic Gantries (ASME B30.1-2009).

7-28 NUREG-1567, "Standard Review Plan for Spent Fuel Dry Storage Facilities," Revision 0, U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, March 2000.

7-29 TN Document NUH-003, Revision 14, "Updated Final Safety Analysis Report for the Standardized NUHOMS® Horizontal Modular Storage System for Irradiated Nuclear Fuel." (Basis for NRC CoC 72-1004).

7-30 Drawing NAC004-C-001, Rev. 0, "ISFSI Pad Licensing Design General Arrangement & Geotechnical."

7-31 ACI 349-06, "Code Requirements for Nuclear Safety-Related Concrete Structures and Commentary."

7-32 Geoservices, LLC, Project No. 31-151247*.R1*, "Report of Geotechnical Exploration: Consolidated Interim Storage Facility (CISF) Andrews, Texas," *July 15, 2016*.

7-33 WCS-12-05-100-001, Rev 0, "Site-Specific Seismic Hazard Evaluation and Development of Seismic Design Ground Motions."

7-34 ASCE 7-05, "Minimum Design Loads for Buildings and Other Structures."

7-35 Reg Guide 1.76, "Design-Basis Tornado And Tornado Missiles For Nuclear Power Plants," Revision 1, March 2007.

7-36 GTSTRUDL Computer Program User Manual, Intergraph, Version 32.0.

7-37 Drawing NAC004-C-002, Rev. 0, "ISFSI Pad Licensing Design Structural Concrete Plan, Sections, and Details."

7-38 Regulatory Guide 1.61, Rev. 1, "Damping Values for Seismic Design of Nuclear Power Plants."

All Indicated Changes are in response to RAI P-2.6-2

Years BP (millions)	ERA	PERIOD	FORMATION	THICKNESS	USCS	LITHOLOGY
0.01	CENOZOIC	QUATERNARY	COVER SANDS	1'-10'	SP	SAND, FINE GRAINED, WELL SORTED, **UNCONSOLIDATED**, LOOSE, ORANGE TO TAN, **DRY**
			CALICHE	4'-28'	NA	CALICHE WITH SAND MATRIX, **CONSOLIDATED**, FIRM TO MODERATELY HARD, WHITE TO TAN, **DRY**
			BLACKWATER DRAW	14'-38'	SP/SC/SM	SAND, W/SILT & CLAY, FINE GRAINED, WELL SORTED, **UNCONSOLIDATED**, ORANGE TO TAN, **DRY**
2.6		TERTIARY	CALICHE	19'-28'	NA	CALCAREOUS SAND, **CONSOLIDATED**-VERY HARD, LIGHT GRAY TO WHITE, **DRY**
			OGALLALA	35'-51'	SW/GW	SAND WITH GRAVEL GRADING DOWNWARD TO A GRAVEL WITH SAND, UPPER SAND IS WELL GRADE, **UNCONSOLIDATED**, TAN, **DRY**, LOWER GRAVEL WITH SAND MATRIX, POORLY SORTED, WELL TO POORLY CEMENTED, SUBANGULAR TO SUB ROUNDED, **DRY** IN THE SOUTHERN PORTION OF CISF SITE, 1-5 FEET OF GROUNDWATER PRESENT IN THE NORTHERN PORTION OF THE CISF SITE
66	MESOZOIC	CRETACEOUS	ERODED OR NOT DEPOSITED			
145		JURASSIC				
201		TRIASSIC	DOCKUM/ COOPER CANYON	~1400'/~500'	CL-CH	CLAY, CLAYSTONE, PLASTIC, STIFF, **CONSOLIDATED** MAROON TO RED, **DRY**

Figure 7-30
Soil Characterization at Depth

All Indicated Changes are in response to RAI P-2.6-1