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2.5.3 SURFACE FAULTING

PTN COL 2.5-4 This subsection evaluates the potential for tectonic and non-tectonic surface deformation within a 25-mile radius (site vicinity) of Units 6 & 7. Information contained in Subsection 2.5.3 was developed in accordance with RGs 1.165 and 1.208 in order to demonstrate compliance with 10 CFR 100.23(c). RG 1.208 contains guidance on characterizing seismic sources, and it defines a “capable tectonic source” as a tectonic structure that can generate both vibratory ground motion and tectonic surface deformation, such as faulting or folding at or near the earth's surface, in the present seismotectonic regime.

This section contains evaluations of:

- Potential surface deformation associated with capable tectonic sources.
- Potential surface deformation associated with non-tectonic processes, such as collapse structures (karst collapse), subsurface salt migration (salt domes), volcanism, and human-induced deformation (e.g., mining collapse and subsidence due to fluid withdrawal).

The conclusions developed in this subsection as well as Subsections 2.5.1 and 2.5.2 regarding the potential for surface deformation are summarized as follows:

- There are no capable tectonic fault sources or bedrock faults and there is no potential for tectonic fault rupture within the site, site area, or site vicinity.
- There is no evidence of Quaternary tectonic surface faulting or tectonic deformation within the site, site area, or site vicinity.
- There are non-tectonic surface deformation features within the site area and the site. Investigations show that these features are related to surficial dissolution of carbonate strata in the site area.

The following subsections contain the data, observations, evaluations, and references that form the bases for these conclusions.

2.5.3.1 Geological, Seismological, and Geophysical Investigations

Geological, seismological, and geophysical investigations have been performed at the site to characterize the local Quaternary tectonics, structural geology, stratigraphy, paleoseismology, and geologic history. The results of these investigations, including site and regional geologic maps and profiles that illustrate lithology, stratigraphy, topography, and structure, are presented in Subsections 2.5.1 and 2.5.4. Evaluation of geological, seismological, and geophysical data obtained during investigation for the potential of surface faulting are presented in this subsection.

Information regarding the potential for surface faulting for the site is summarized below from the following investigations and sources:

- Compilation and Review of Existing Data and Literature: The UFSAR for Turkey Point Units 3 & 4 provides information about the stratigraphy and structure within the site area (Reference 209). Consequently, emphasis has been placed on published maps and literature pertaining to the structure, tectonics, and stratigraphy of the region published since the UFSAR (Reference 209). Materials include geologic mapping published by the Florida Geologic Survey and articles published in refereed journals and field trip guidebooks.

- Interpretation of Aerial Photography: Aerial photographs taken pre- and post-construction of Turkey Point Units 3 & 4 were obtained from the U. S. Geological Survey and Florida Department of Environmental Protection. Coverage includes black and white, color infrared, and true color photographs and stereo-pairs. The photographs cover the entire onshore portion of the site area and beyond and were examined specifically for evidence of tectonic or non-tectonic (e.g., karst or dissolution feature) surface deformation. This analysis included mapping and identifying lineaments, or linear features, in the site vicinity. No lineaments were identified within the site area.

- Review of Seismicity Data: A comprehensive catalog of instrumental and historical earthquakes was compiled and analyzed (Subsection 2.5.2.1). Based on the catalog, no earthquakes with estimated body wave magnitude (Emb) $\geq$ 3.0 have occurred within the Turkey Point site vicinity.

- Field and Aerial Reconnaissance: Geologic field reconnaissance was conducted as part of the Units 6 & 7 characterization activities. Field reconnaissance included visiting type localities for geologic units, performing detailed geologic mapping of the site, and visiting geomorphic features and outcrops of interest in the region. Aerial reconnaissance was focused on features closest to the site area but included assessment of lineations identified from the aerial photography study as well as two potential geomorphic features described in the literature. No evidence of faulting or seismic activity (such as paleoliquefaction features) was found.

- Geologic reconnaissance and aerial photo analysis: Numerous ellipsoidal or circular features with a higher concentration of vegetation as well as water-filled areas that are generally less than 1 foot lower in elevation than the surrounding areas within the site and site area were identified; however, these surficial depressions observed on pre-construction photographs were both small and confined to the near-surface. Many surficial depressions have been removed by construction of the Turkey Point Units 3 & 4 cooling canals.

- Integrated Multi-method Geophysical Survey: An integrated, multi-method geophysical investigation program was conducted on and around the area of Units 6 & 7. The geophysical investigation program was focused on identifying the potential for subsurface dissolution features. Geophysical techniques deployed consisted of high-resolution microgravimetric, seismic refraction, and multichannel analysis of surface waves techniques obtained in collocated lines. The results of this survey found no evidence of cover-subsidence or cover-collapse hazards in the site area (Subsection 2.5.4.4.5).

2.5.3.1.1 Previous Site Investigations

The results of previous geologic and seismologic investigations are presented in the UFSAR for Turkey Point Units 3 & 4 (Reference 209) and in a more detailed study of the 5-mile radius site area (Reference 215). Both studies conclude that no tectonic or non-tectonic surface deformation hazards exist at the site. In addition, the UFSAR states that “local depressions, some of which attain depths as great as 16 feet, are occasionally encountered in the surface of the limestone bedrock at the site. Such depressions are not sinkholes associated with collapse above an underground solution channel, but rather potholes, which are surficial erosion or solution features” (Reference 209). The UFSAR further explains that the Miami Limestone and Fort Thompson Formation have been susceptible to solution activity from groundwater during periods of low sea level (Pleistocene glacial advances), but that the “bedrock beneath the site is competent with respect to foundation conditions and is capable of supporting heavy loads” (Reference 209) (Subsection 2.5.4.4.5).

2.5.3.1.2 Regional and Local Geological Studies

Regional and local geologic mapping by the Florida Geologic Survey and other researchers does not indicate any faults at the surface on the Florida peninsula within the 200-mile radius site region (References 213, 214, 226, 212, and 234) (Figures 2.5.1-201 and 2.5.1-331). Mapping indicates that the Miami Limestone, a Pleistocene unit approximately 20 feet thick, is exposed over an area greater than 50 miles wide in southern Florida (Reference 226). The outcrop pattern indicates that less than 20 feet of offset or differential erosion has occurred over a wide area and is evidence for the lack of geologic deformation in the region. Well data along a greater than 30-mile east-west transect indicate a maximum relief on the base of the Miami Limestone of 10 feet (References 213 and 214) and this variability is due to sedimentary variations in unit thickness. All geologic contacts within the site area and site are sedimentary in nature (Figures 2.5.1-335, 2.5.1-334, and 2.5.1-337).

In addition to the geologic mapping described above, the U.S. Geological Survey has published a compilation of all known or suggested Quaternary faults, liquefaction features, and possible tectonic features in the Central and Eastern United States (References 203 and 235) (Figure 2.5.3-201). These compilations do not identify any Quaternary tectonic faults or tectonic features within the site region or site area. However, one potential Quaternary feature, Grossman's Hammock, is located approximately 20 miles northwest of the site, but a ground-penetrating radar study provides evidence that the feature has no tectonic offset (Reference 217); Subsection 2.5.3.2 describes this feature in detail. The U.S. Geological Survey studies (References 203 and 235) classify Grossman's Hammock as a non-tectonic feature (Figure 2.5.3-201).

The United States Army Corps of Engineers (USACE) used Landsat satellite data, supplemented locally with digital orthophoto quadrangles, to identify possible linear features across central and southern Florida (Reference 232) (Figure 2.5.3-204). This study identifies more than 500 lineaments, or linear patterns, in sinkholes and solution depressions, ponds or lakes, streams, and tonal changes. The features have dominantly a northwest trend (~305°) with a secondary northeast (~40°) trend. While the USACE notes that the northwest trend is similar to the trend of previously hypothesized basement structures, e.g., the Bahamas fracture zone, no offsets along any of these lineaments are reported, nor are any designated as faults (Reference 232). The northwest and northeast orientations exhibited by the mapped lineaments are typical for all of Florida, and are recognized as reflecting joint or fracture patterns in the limestone, which are enhanced by karstic dissolution (e.g., Reference 221). The density of mapped lineaments appears to be directly proportional to karst density (Figure 2.5.1-222).

2.5.3.1.3 Seismicity Data

The Florida peninsula is an area of low seismic activity. The original EPRI earthquake catalog (Reference 205) does not contain any earthquakes within the Turkey Point site vicinity. Only three earthquakes in the original EPRI catalog (Reference 205) occur within the 200-mile radius site region. However, the original EPRI catalog did not cover Cuba and large parts of the Gulf of Mexico (Subsection 2.5.2.1.2).

As described in Subsection 2.5.2.1.2, the EPRI earthquake catalog for this COL investigation was updated to include earthquakes that have occurred after the publication of the EPRI catalog. Moreover, this updated earthquake catalog extends south of the original EPRI catalog to include the entire site region and beyond to a latitude of 15° N.

The updated earthquake catalog for the Phase 1 seismicity investigation region (22° to 35° N, 100° to 65° W) contains a total of about 700 earthquakes with Rmb ≥ 3.0 or intensity I_0 ≥ IV for all years through mid-February 2008 (Figure 2.5.3-201). Approximately 66 out of about 700 earthquakes are located within the 200-mile radius site region. Most of these earthquakes are concentrated in a zone of seismicity in and near Cuba, which is greater than about 160 miles south of the Units 6 &7 site. Figure 2.5.3-203 shows that there are no earthquakes from the updated Phase 1 earthquake catalog inside the 25-mile radius site vicinity.

2.5.3.1.4 Current Field and Aerial Reconnaissance

Aerial photography, satellite imagery, and topographic maps of varying scales and vintages reveal no evidence of geomorphic features indicative of the potential for tectonic surface deformation (e.g., faulting or folding) within the site area. Imagery reviewed as part of this COL investigation includes:

- 1:40,000-scale, black and white, stereo aerial photographs acquired in 1940 by the U.S. Geological Survey covering the entire site area (pre-construction).
- 1:40,000-scale, color infrared photographs acquired in 1999 by the Florida Department of Environmental Protection covering the entire site area and much of southern Florida.
- 1:40,000-scale, true color photographs acquired in 2004 by the Florida Department of Environmental Protection covering the entire site area and much of southern Florida.

- 1:20,000-scale, black and white photographs (1944) near Ft. Myers, Florida from the archives of the University of Florida.

- 1:40,000-scale, color infrared photographs acquired in 2004 by the U.S. Geological Survey near the Shark River in Everglades National Park.

Southern Florida is characterized by extremely subdued topography. In general, the only features on topographic maps with elevations greater than 5 feet within the site and site area are man-made roads or levees. To the north, the Atlantic Coastal Ridge (Subsection 2.5.1.1.1.1.1.1) trends north-northeast to south-southwest; it is up to 50 feet high and extends into the site vicinity (Reference 236). No topographic features within the site vicinity indicate the presence of surface faulting.

Based on an analysis of aerial imagery, three north-south-trending vegetation lineaments were identified more than 5 miles west of the site. These lineaments were investigated during aerial and field reconnaissance; no evidence for surface rupture or geomorphic features indicative of active faulting was found. The lineaments were identified as linear swaths where vegetation had been cleared. Review of published literature in southern Florida identified four other features that were further investigated during fieldwork:

- Grossman's Hammock, a rock reef in Everglades National Park, approximately 20 miles northwest of the site (Reference 231).

- Tree lineaments reported near the intersection of Flamingo Road and Ingram Highway in Everglades National Park, located 18 miles west of the site (Reference 236).

- A linear segment of the Shark River channel in Everglades National Park, approximately 34 miles west of the site (Reference 236), beyond the site vicinity.

- Faults postulated from borehole data in the McGregor Isles area near Ft. Myers, 120 miles northwest of the site (Reference 230), beyond the site vicinity.

Subsection 2.5.3.2 provides additional description of these four features. Based on the geologic field reconnaissance, no geomorphic or other evidence for faulting or surface deformation is associated with any of these features. In addition, field and aerial reconnaissance did not identify any evidence for surface rupture, warping, or offset of geomorphic features indicative of active faulting within the site or site area. Field and aerial reconnaissance did identify several vegetated and some water-filled depressions (Figures 2.5.1-333 and 2.5.3-202) within the site and site area, which are interpreted to be related to a process of surficial dissolution (Subsection 2.5.4.4.5). Analysis of 1:40,000 scale aerial photos that were taken in the 1940s prior to construction at the Turkey Point site indicates that many of these surficial depressions have been obliterated by the construction of Turkey Point Units 3 & 4 cooling canals.

2.5.3.2 Geological Evidence, or Absence of Evidence, for Surface Deformation

Field reconnaissance, review and interpretation of aerial photography, and review of published literature did not reveal any evidence for tectonic deformation within the site vicinity or site area. No faults or geomorphic features indicative of faulting have been mapped (Figures 2.5.1-334, 2.5.1-336, 2.5.1-337, 2.5.1-338, 2.5.1-339, 2.5.1-340, 2.5.1-341, and 2.5.1-342) in the site vicinity, site area, or the site. In addition, no seismic activity has been reported within the site vicinity (Subsection 2.5.2), and bedding is horizontal and undisturbed (Subsection 2.5.1.2.3). No salt domes, Quaternary volcanic features, or glacial sources of deformation occur in the site vicinity (Figures 2.5.1-201 and 2.5.1-237) (Subsections 2.5.3.8.2.1, 2.5.1.1.2.1.1, 2.5.1.1.1.2.1.1, 2.5.1.2.4, and 2.5.1.2.3). Non-tectonic deformation features in the site area are interpreted to be “potholes” caused by surficial dissolution (Subsections 2.5.1.2.4 and 2.5.4.4.5).

The site vicinity is located on the Florida carbonate platform, a tectonically stable region (Reference 219) that is characterized by extremely low rates of seismicity. The updated earthquake catalog includes no seismicity within the site vicinity (Subsection 2.5.2.1). Historical and late Holocene sea level data collected in central and southern Florida show tectonic quiescence during this period (Reference 211). Published geologic mapping at a range of scales show no bedrock faults mapped within the site vicinity (References 211, 213, 214, and 226). Regional high-resolution bathymetry and seismic data give no indication of faulting in shallow sediments offshore along the Florida Keys (References 237 and 238) or onshore in Dade county (Reference 239).

Within the site vicinity, Grossman's Hammock is the only geomorphic feature that has been speculated to be related to faulting (Figure 2.5.3-201). Grossman's Hammock (sometimes referred to as “rock reef”) is 8 miles long and is similar to eight other ridges in southern Florida that have widths of approximately 300 feet and vertical relief of 1-5 feet. Steinen et al. (Reference 231) interpret a fault to account for the apparent offset of a buried Quaternary erosion surface identified in a limited number of boreholes beneath Grossman's Hammock. However, more recent work, including a ground-penetrating radar study showing no offset on the underlying Quaternary surface, documents that there is no faulting associated with this feature (Reference 217). Consequently, Crone and Wheeler (Reference 203) classify Grossman's Hammock as a Class D feature; that is, geologic evidence demonstrates that the feature is not a tectonic fault or structure (Figure 2.5.3-201). Other postulated explanations for Grossman's Hammock include fracture-related preferential cementation, and preservation of paleoshorelines or paleo-mud banks. While its origin is unresolved, tectonic faulting has been effectively ruled out as a hazard associated with this feature (Reference 235).

Also within the site vicinity, White (Reference 236) indicates that trees in the Everglades National Park form a local alignment near the intersection of the Main Park Road (previously called Flamingo Road) and Ingram Highway. Although a geologic cause for such an alignment is improbable, this feature was investigated as part of geologic field reconnaissance. Ground-based observations as well as satellite imagery and aerial reconnaissance photographs did not reveal the presence of an alignment of trees nor any linear features that would be subject to further examination.

No geomorphic features or lineaments associated with faulting within the site area were identified during analysis of aerial imagery. The lineament analysis did identify numerous linear and ellipsoidal/circular features associated with changes in vegetation within 5 and 0.6 miles of Units 6 & 7 (Figures 2.5.1-333 and 2.5.3-202). These ellipsoidal or circular features are loci of more highly concentrated vegetation. These features are interpreted to be the result of the surficial dissolution of the limestone bedrock and are described in detail in Subsection 2.5.3.8.2. The linear features associated with these vegetated patches within the site area generally are characterized by an alignment of two to three vegetated patches connected by short, narrow drainage features. These features are oriented perpendicular to the coastline (oriented roughly east-west to northeast-southwest). The linear channels between the vegetated patches are interpreted to be tidally influenced (Reference 236). Fieldwork following the aerial imagery analysis indicated that the three north-south trending vegetation lineaments located 5-6 miles west of the site are simply areas where the vegetation has been cut down in wide swaths. There is no geomorphic expression of these features or other evidence that would indicate tectonic faulting associated with these vegetation lineaments.

Two features beyond the site vicinity were investigated as part of the geologic field reconnaissance. The first of these is a linear segment of the Shark River channel in Everglades National Park, approximately 34 miles west of the site. This linear segment was identified by White (Reference 236) and is within the Shark River slough, the dominant path of surface-water flow from anthropologically routed water discharge sites in central Florida to the southwest Gulf coast of Florida. The channel system in the Shark River slough is developed on limestone bedrock, with peat, organic debris, and shells forming mounds or levees that separate the channels. Based on field reconnaissance and review of aerial photography, there is no evidence to suggest that this linear segment is tectonic in origin. Instead, tides, joints in the limestone bedrock, and human-controlled water flow likely influence its linearity.

The second feature beyond the site vicinity investigated as part of geologic field reconnaissance includes possible faults identified from borehole data in the McGregor Isles area near Ft. Myers, 120 miles northwest of the site. Based on gamma-ray logs from several wells, Sproul et al. (Reference 230) interpret faulting of pre-upper Hawthorn (Miocene) strata. In spite of their interpretation that overlying upper Hawthorn and younger strata are unfaulted, Sproul et al. (Reference 230) suggest possible geomorphic indicators of faulting. However, despite the landscape being heavily modified by urban development, field reconnaissance and inspection of aerial photography reveal no evidence for faulting at the surface.

2.5.3.3 Correlation of Earthquakes with Capable Tectonic Sources

The original EPRI earthquake catalog was updated to incorporate earthquakes that occurred between 1985 and mid February 2008 (Subsection 2.5.2.1.2). The updated Phase 1 earthquake catalog contains no earthquakes within the site vicinity (Table 2.5.2-201). No seismicity or capable tectonic sources exist within the site vicinity or site area; therefore, there is no spatial correlation of earthquake epicenters or capable tectonic sources (Figure 2.5.3-203).

2.5.3.4 Ages of Most Recent Deformation

Field reconnaissance, review and interpretation of aerial photography, and review of published literature do not reveal any evidence for tectonic deformation within the site vicinity. In addition, results of the subsurface exploration program at the site indicate continuous, horizontal stratigraphy that precludes the presence of faults, folds, or structures related to tectonic deformation (Figure 2.5.1-335). Therefore, there is no correlation of geologic structures to ages of recent deformation (Figures 2.5.1-338, 2.5.1-339, 2.5.1-340, and 2.5.1-341) (Subsection 2.5.1.2.5.3).

2.5.3.5 Relationship of Tectonic Structures in the Site Area to Regional Tectonic Structures

Field reconnaissance, review and interpretation of aerial photography, and review of published literature do not reveal any evidence for tectonic deformation within the site area. In addition, results of the subsurface exploration program at the site indicate continuous, horizontal stratigraphy that precludes the presence of faults, folds, or structures related to tectonic deformation (Figures 2.5.1-338, 2.5.1-339, 2.5.1-340, 2.5.1-341). Therefore, there is no correlation of geologic structures in the site area to regional, capable tectonic structures (Subsection 2.5.1.2.5.3).

2.5.3.6 Characterization of Capable Tectonic Sources

Field reconnaissance, review and interpretation of aerial photography, and review of published literature, do not reveal any evidence for tectonic deformation within the site vicinity. In addition, results of the subsurface exploration program at the site indicate continuous, horizontal stratigraphy that precludes the presence of faults, folds, or structures related to tectonic deformation (Figure 2.5.1-335) (Subsections 2.5.1.2, 2.5.1.2.2, and 2.5.1.2.3). Based on the above data and analyses, there are no capable tectonic sources within the site vicinity or site area.

2.5.3.7 Designation of Zones of Quaternary Deformation in the Site Region

Results of the subsurface exploration program at the site indicate continuous, horizontal stratigraphy that precludes the presence of Quaternary faults, folds, or structures related to tectonic deformation at the site (Figure 2.5.1-335). There are no zones of Quaternary deformation associated with tectonic faults requiring detailed investigation within the site area (Figure 2.5.1-335). Field reconnaissance, review, and interpretation of aerial photography, and review of published literature performed, do not reveal any evidence for Quaternary tectonic deformation, including paleoliquefaction, within the site, site area, or site vicinity. Within the site region, seismicity and potential Quaternary deformation are restricted to the Cuba areal source zone, approximately 160 miles south of the site. No sand blows or paleoliquefaction features have been identified in the published literature for the site region.

2.5.3.8 Potential for Tectonic or Non-Tectonic Deformation at the Site

There are no sources for potential tectonic deformation at the site. The only evidence for non-tectonic deformation at the site are “potholes” that appear to be caused by surficial dissolution (Subsection 2.5.1.2.4).

2.5.3.8.1 Potential for Tectonic Deformation at the Site

Field reconnaissance, review and interpretation of aerial photography, and review of published literature do not reveal any evidence for tectonic deformation at the site (Subsections 2.5.1.2, 2.5.1.2.2, and 2.5.1.2.3). In addition, results of the subsurface exploration program at the site indicates continuous, horizontal stratigraphy that precludes the presence of faults, folds, or structures related to tectonic deformation (Figure 2.5.1-335). Therefore, there is no potential for tectonic surface deformation at the site, nor are there any capable tectonic faults within the site vicinity. The subsurface exploration program shows no evidence of folding or warping related to Quaternary tectonic activity (Figures 2.5.1-335 and 2.5.3-201).

Quaternary volcanic activity has not been mapped in the site region (Figure 2.5.1-201). The field reconnaissance and review of published literature indicate no sand blows or paleoliquefaction features are identified in the site area.

2.5.3.8.2 Potential for Non-Tectonic Deformation

No salt domes, Quaternary volcanic features, or glacial sources of deformation occur in the site vicinity (Figures 2.5.1-201 and 2.5.1-237). No human activities occurring in the site area pose a hazard for surface deformation. The only evidence for non-tectonic deformation at the site is “potholes” caused by surficial dissolution (Subsection 2.5.4.4.5).

2.5.3.8.2.1 Potential Sources of Non-Tectonic, Geologic Deformation

There is no evidence of non-tectonic deformation within the site in the form of glacially induced faulting or salt migration. Pleistocene continental glaciers did not extend as far south as the site region, and there are no documented examples of glacially induced faulting in the site region. No piercement-type salt domes are located within the site vicinity. The nearest salt dome is approximately 220 miles southeast of Units 6 & 7 along Cuba's northern coast. The Florida coastal plain is part of a stable continental region, and no Tertiary or Quaternary volcanic activity is found within the site vicinity. The nearest Cenozoic volcanic activity is recorded in early Tertiary tuffs located 400 miles southeast of Units 6 & 7 in southeastern

Cuba (Reference 218). The subdued topography indicates that no slopes are steep enough within the site area to pose a slope-stability hazard. However, deformation related to karst is noted in southern Florida (Reference 223), and limestone dissolution is evident in stratigraphic units, such as the Miami and Key Largo Limestones, which underlie the site (References 222 and 225). These are not expected to pose a significant surface deformation hazard at the Units 6 & 7 site.

Quaternary limestones in the region, including the Key Largo Limestone, the Miami Limestone, and portions of the Fort Thompson Formation, are documented as exhibiting vugs and high permeability related to soluble, karstic limestone (References 204, 215, 209, and 216) (Subsections 2.5.1.2.4, 2.5.1.1.1.2.1.1, and 2.5.4.1.2.1). In addition, an offshore U.S. Geological Survey study just southeast of the site vicinity has documented the presence of a 600-meter-diameter sinkhole southeast of Key Largo (Reference 228). Furthermore, the UFSAR indicates that “local depressions, some of which attain depths as great as 16 feet, are occasionally encountered in the surface of the limestone bedrock at the site” (Reference 209). However, the UFSAR concludes that these features are “not sinkholes associated with collapse above an underground solution channel, but rather potholes, which are surficial erosion or solution features” (Reference 209). The conclusion has been substantiated by an integrated geophysical investigation (Subsections 2.5.4.4.5 and 2.5.1.2.4).

Geologic reconnaissance and aerial photo analysis identified numerous ellipsoidal or circular features. These features consist of vegetation and water-filled areas that are generally less than 1 foot lower in elevation than the surrounding areas within the site and site area. Many of these surficial depressions observed on pre-construction photographs have been obliterated by construction of the Turkey Point Units 3 & 4 cooling canals (Figures 2.5.1-333 and 2.5.3-202). The underlying Miami Limestone is covered by recent deposits of organic-rich mud and silt approximately 2 to 6 feet thick (Subsection 2.5.1.2.2). In these vegetated areas, field and geotechnical work investigations have confirmed that the deposits of mud and silt reach thicknesses exceeding 6 feet and appear to be wetter than the surrounding areas. These karst features were formed after the deposition of the Pleistocene Miami Limestone, but their exact timing is not known. The Florida Geological Survey generally assesses a low hazard to karst features that form when limestone is exposed at the surface or beneath a thin veneer of permeable sediment, as is the case within the site area (Reference 229) (Figure 2.5.1-222). In these cases, such solution potholes are generally expected to be shallow and broad, and to develop gradually, rather than in a single, sudden collapse event.

Additionally, these solution potholes are not expected to form large voids beneath the surface that would pose a hazard to the site (Reference 229). Based on information developed in this subsection and in Subsection 2.5.1.2.5.2, the possibility of dissolution features similar to the one reported southeast of Key Largo (Reference 228) existing at depth beneath this site area is unlikely (Subsection 2.5.4.4.5). No collapse or settlement problems associated with karst-type dissolution of underlying limestones have been associated with Turkey Point Units 3 & 4 (Reference 209). An integrated geophysical survey focused on the Units 6 & 7 power block area and several of the surficial depressions identified within the site was conducted as part of this application and is discussed in Subsection 2.5.4.4.5. Based upon available data, there is minimal hazard posed by sinkholes and no evidence for potential surface collapse due to the presence of large underground openings.

2.5.3.8.2.2 Potential Sources of Non-Tectonic, Human-Related Deformation

There is no human-related, permanent ground deformation hazard at the site. There are no underground mining activities within the site area that may produce man-induced surface collapse. The closest quarrying activities are located 8 miles from the site and include localized blasting and excavation. This surficial excavation is not expected to impact the site area. No oil or gas production-related activities occur within the site or site area. Some oil and gas exploration has been performed in southern Florida, and approximately six dry holes were drilled within the site vicinity (Reference 208). No ground-shaking or subsidence hazard is expected from these activities (Subsection 2.5.1.2.5.4).

2.5.3.8.3 Summary of Potential Deformation at the Site

There is no evidence of potential tectonic faulting or tectonic deformation at the site. The only potential non-tectonic, geologic hazard at the site is surficial limestone dissolution. No indicators of collapse or settlement problems exist at the site, and the geotechnical investigation found no evidence for subsurface dissolution features that would cause such problems. This conclusion is confirmed by the results of an integrated geophysical investigation focused on identification of subsurface dissolution features at the site (Subsection 2.5.4.4.5). No human-related deformation hazard exists at the site.

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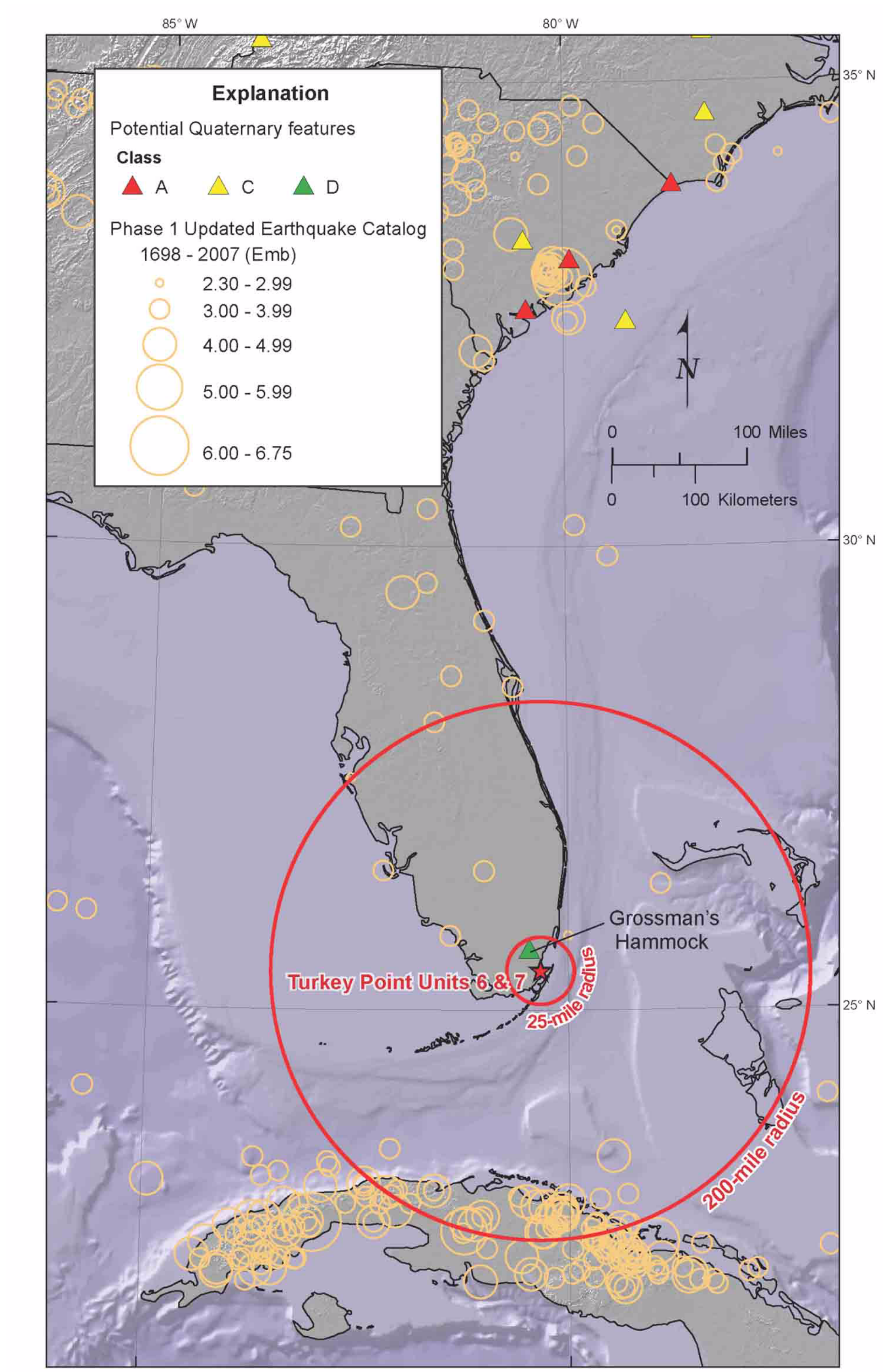
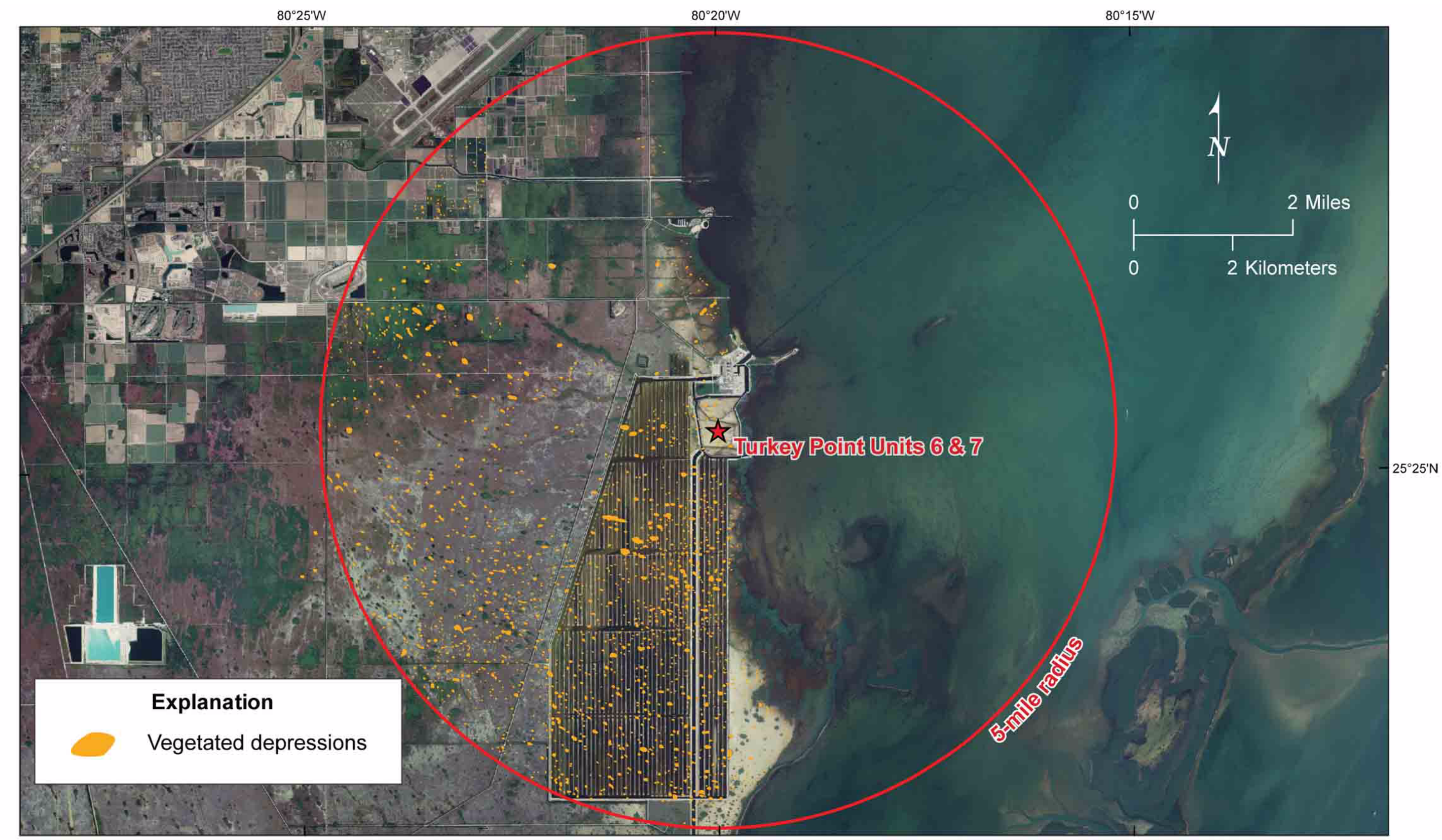
Figure 2.5.3-201 Potential Quaternary Features and Seismicity



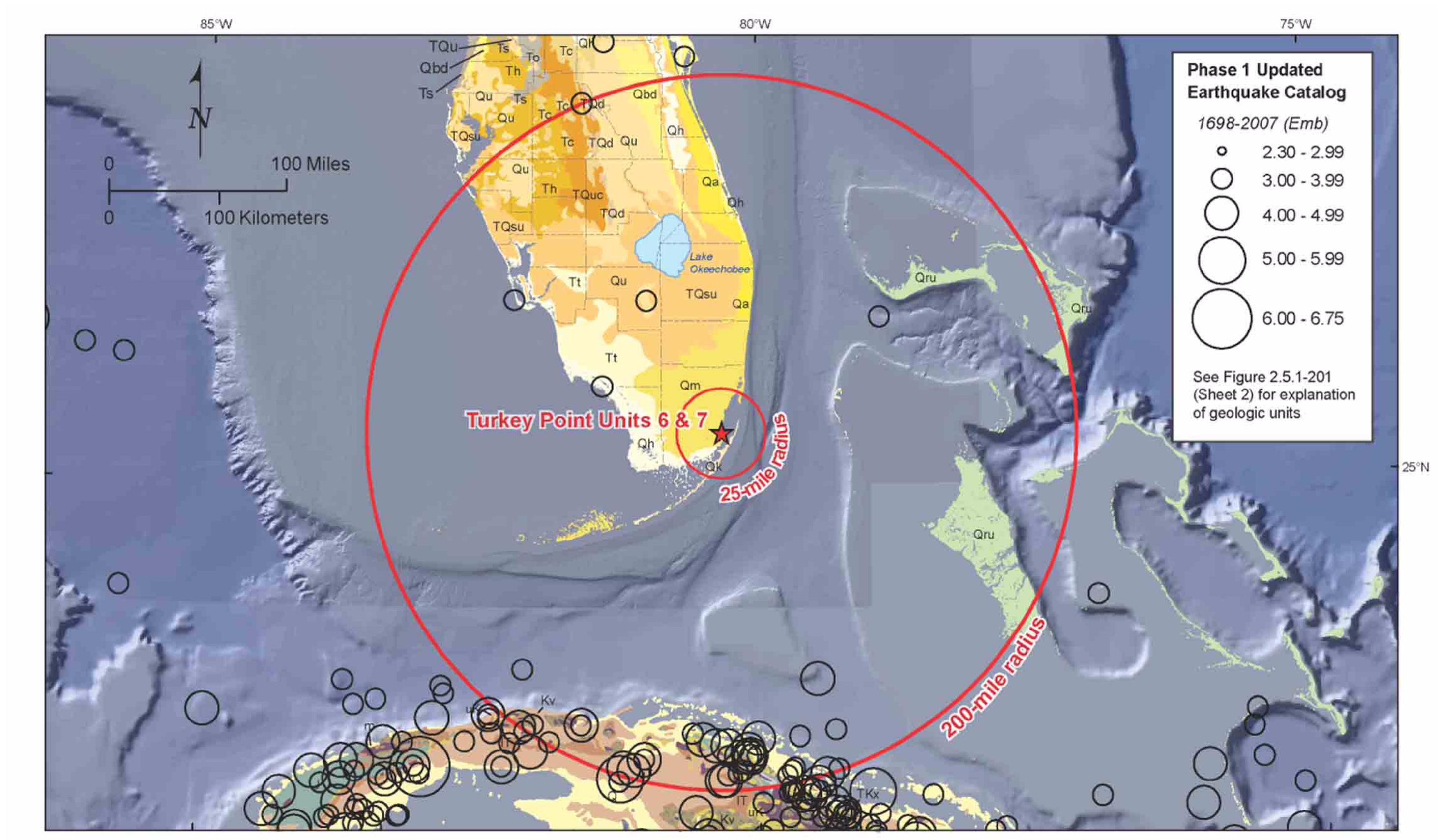
Base source: Reference 201
Source of Quaternary features: Reference 203

Figure 2.5.3-202 Vegetated Depressions Identified Within Site Area from Photographs Taken Before Construction of the Cooling Canals



Note: Reconnaissance mapping performed using 1940s 1:40,000 scale panchromatic stereo aerial photography (Reference 233), but shown on 2004 imagery (Reference 207) of the Units 6 & 7 Site for reference.

Figure 2.5.3-203 Site Region Seismicity



Base sources: References 201 and 220
Geologic information sources: References 210, 202, and 227

Figure 2.5.3-204 Lineament Analysis of South Florida for ASR Regional Study

Source: Reference 232