**Nuclear Development**
244 Chestnut Street, Salem, NJ 08079

PSEG
*Power LLC*

ND-2012-0007
January 25, 2012

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Subject: **PSEG Early Site Permit Application**
**Docket No. 52-043**
**Response to Request for Additional Information, RAI No. 44, Surface Faulting**

References: 1) PSEG Power, LLC letter to USNRC, Application for Early Site Permit for the PSEG Site, dated May 25, 2010

2) RAI No. 44, SRP Section: 02.05.03 – Surface Faulting, dated December 12, 2011 (eRAI 6164)

3) PSEG Power, LLC Letter No. ND-2012-0003 to USNRC, Response to Request for Additional Information, RAI No. 44, Surface Faulting, dated January 11, 2012

The purpose of this letter is to respond to the request for additional information (RAI) identified in Reference 2 above. This RAI addresses Surface Faulting, as described in Subsection 2.5.3 of the Site Safety Analysis Report (SSAR), as submitted in Part 2 of the PSEG Site Early Site Permit Application, Revision 0.

Enclosure 1 provides our response for RAI No. 44, Question Nos. 02.05.03-1 through 02.05.03-4. The response to RAI No. 44, Question Nos. 02.05.03-7, 02.05.03-9, 02.05.03-10, and 02.05.03-13 will be provided by February 10, 2012. The response to RAI No. 44, Question No. 02.05.03-8, originally scheduled as part of the 45-day response, will be provided by February 10, 2012. The responses to the remaining RAI No. 44 questions were provided in Reference 3.

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Enclosure 2 includes the revisions to SSAR Subsection 2.5.3 resulting from our response to RAI No. 44, Question No. 02.05.03-1. Enclosure 3 includes the new regulatory commitments established in this submittal.

If any additional information is needed, please contact David Robillard, PSEG Nuclear Development Licensing Engineer, at (856) 339-7914.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 25th day of January, 2012.

Sincerely,

James Mallon
Early Site Permit Manager
Nuclear Development
PSEG Power, LLC

Enclosure 1: Response to NRC Request for Additional Information, RAI No. 44, Question Nos. 02.05.03-1 through 02.05.03-4, SRP Section: 02.05.03 – Surface Faulting
Enclosure 2: Proposed Revisions, Part 2 – Site Safety Analysis Report (SSAR), Subsection 2.5.3 - Surface Faulting
Enclosure 3: Summary of Regulatory Commitments

cc: USNRC Project Manager, Division of New Reactor Licensing, PSEG Site (w/enclosures)
USNRC, Environmental Project Manager, Division of Site and Environmental Reviews (w/enclosures)
USNRC Region I, Regional Administrator (w/enclosures)

**PSEG Letter ND-2012-0007, dated January 25, 2012**

**ENCLOSURE 1**

**RESPONSE to RAI No. 44**

**QUESTION Nos.**
**02.05.03-1**
**02.05.03-2**
**02.05.03-3**
**02.05.03-4**

**Response to RAI No. 44, Question 02.05.03-1:**

In Reference 2, the NRC staff asked PSEG for information regarding Surface Faulting, as described in Subsection 2.5.3 of the Site Safety Analysis Report. The specific request for Question 02.05.03-1 was:

> *SSAR Subsection 2.5.3.1.2, "Regional Geologic Studies," discusses a subsurface fault located in the site vicinity about 20 miles north-northwest of the site (shown in Figure 2.5.3-1). This subsurface fault is defined by Benson (2006) to affect the Lower Cretaceous (145.5-99.6 Ma) Potomac Formation. The applicant indicated that this feature is the only buried potential fault discovered by the regional geologic studies. The applicant states that this structure does not deform overlying Quaternary units, but it is not clear whether this conclusion is drawn from Benson (2006) or from siting investigations performed for the PSEG site since there is no reference provided to support the statement.*
>
> *In order for the staff to adequately evaluate the potential for faulting near the PSEG site, and in compliance with 10 CFR 100.23 and in conformance to NUREG 0800, Section 2.5.3, "Surface Faulting," please clarify what type of published information or field investigation results were used to make the conclusion that the fault proposed by Benson (2006) does not affect stratigrahic units of Quaternary age in the PSEG site vicinity.*

**PSEG Response to NRC RAI:**

The conclusion that the fault shown on SSAR Figure 2.5.3-1 and cited from Benson (2006) (SSAR Reference 2.5.3-2) does not affect the Quaternary units is from the reference cited on the figure. SSAR Reference 2.5.3-2 shows, in cross section H-H', that the queried fault offsets the basement and portions of the Cretaceous Potomac strata, while the base of the Quaternary deposits is unfaulted. No field investigation was conducted as part of the PSEG Site investigation near that structure.

A reference to Benson (2006, SSAR Reference 2.5.3-2) will be added to the last sentence in the first paragraph of SSAR Subsection 2.5.3.1.2.

**Associated PSEG Site ESP Application Revisions:**

SSAR Subsection 2.5.3.1.2 will be updated as specified in Enclosure 2 of this document.

**Response to RAI No. 44, Question 02.05.03-2:**

In Reference 2, the specific request for Question 02.05.03-2 was:

> *SSAR Subsection 2.5.3.1.2 discusses subsurface faults postulated by Spoljaric (1972,1973, 1974, 1979) to occur in the PSEG site vicinity, including the New Castle County faults that were identified by Crone and Wheeler (2005) and Wheeler (2005) as potential Quaternary structures (i.e., Class C structures = lacking proven evidence of Quaternary displacement). These faults are shown in SSAR Figure 2.5.3-1. The applicant stated that no published geologic studies reviewed for the PSEG site indicate the presence of Quaternary structures capable of producing surface deformation in the site vicinity. However, it is not clear to the staff if the applicant relied solely on studies by Spoljaric and the compilations of Crone and Wheeler to make this conclusion.*
>
> *In order for the staff to adequately evaluate the potential for faulting in the PSEG site vicinity, and in compliance with 10 CFR 100.23 and in conformance to NUREG 0800, Section 2.5.3, "Surface Faulting," please clarify what published information was reviewed to conclude that no published geologic studies reviewed indicate the presence of Quaternary structures capable of producing surface deformation in the site vicinity. Also, please summarize the data that was reviewed to support this conclusion.*

**PSEG Response to NRC RAI:**

In addition to publications by Spoljaric (1972, 1973, 1974, 1979; SSAR References 2.5.3-24, 26, 27, and 25) and Crone and Wheeler (2000; SSAR Reference 2.5.3-4), several other relevant publications and geologic maps were reviewed for reports of Quaternary structures and continuity of Quaternary strata including:

- Benson (SSAR Reference 2.5.3-2),
- McLaughlin et al. (SSAR Reference 2.5.3-13),
- Newell et al. (SSAR Reference 2.5.3-14),
- Picket and Spoljaric (SSAR Reference 2.5.3-17),
- Prowell (SSAR Reference 2.5.1-173),
- Ramsey, K. W. (SSAR Reference 2.5.3-20),
- Ramsey, K. W. (SSAR Reference 2.5.1-180),
- Sanford (SSAR Reference 2.5.3-29),
- Sugarman, P. J., Monteverde, D. H. (SSAR Reference 2.5.1-215),
- Wheeler (SSAR Reference 2.5.3-34),
- Woodruff and Thompson (SSAR Reference 2.5.3-36), and
- Salem & Hope Creek UFSARs (SSAR References 2.5.1-175 and 176)

In addition, the following references not listed in the SSAR were consulted while preparing the response to the RAI question:

RAI 44-2-1 Stanford, S. D., Surficial Geology of the Woodbury Quadrangle, Gloucester County, New Jersey; New Jersey Geological Survey, Open File Map OFM 58, 2004.

RAI 44-2-2 Stanford, S. D., Surficial Geology of the Penns Grove and Wilmington South Quadrangles, Salem & Gloucester Counties, New Jersey. GMS-06-5, 2006.

RAI 44-2-3 Pickett, T. E., Geology of the Chesapeake and Delaware Canal Area, Delaware Scale 1:24,000 Delaware Geological Survey, Geologic Map Series No. 1, 1970.

RAI 44-2-4 Benson, R. N., and Pickett, T. E., Geology of South Central Kent County, Delaware; Delaware Geological Survey Geologic Map Series No. 7, 1986.

RAI 44-2-5 Woodruff, K. D., Thompson, A. M., Geology of the Newark Area, Delaware, Delaware Geological Survey, Geologic Map Series No. 3, 1972.

Our review of the data contained in these documents indicated no Quaternary surface deformation features due to faulting or folding in the site vicinity or nearby area. Most of these references are geologic and surficial maps depicting portions of the PSEG site vicinity and they indicate that the Quaternary strata are unfaulted. Similarly, boring and other subsurface data depict a smoothly varying, unfaulted base of the Quaternary section and are consistent with this conclusion.

**Associated PSEG Site ESP Application Revisions:**

None.

**Response to RAI No. 44, Question 02.05.03-3:**

In Reference 2, the specific request for Question 02.05.03-3 was:

> *SSAR Subsection 2.5.3.1.4, "Previous Site Investigations," cites the UFSARs for Hope Creek and Salem operating plants, and states that studies performed for these sites did not reveal surficial folding or faulting in the site area and did not reveal any evidence for prior earthquakes in surficial materials in the site area. The SSAR also states that these previous investigations concluded that near-surface stratigraphic units beneath the site are planar and undisrupted by folding and faulting. However, SSAR Subsection 2.5.3.1.4 does not summarize the pertinent information from the two UFSARs that support these statements. In particular, the SSAR does not provide details regarding the search for earthquake-induced liquefaction features with respect to the statement concluding a lack of evidence for prior earthquakes in the site area.*
>
> *In order for the staff to adequately evaluate the potential for faulting at the PSEG site, and in compliance with 10 CFR 100.23 and in conformance to NUREG 0800, Section 2.5.3, "Surface Faulting," please summarize the pertinent information from the two UFSARs leading to the three conclusion statements provided in SSAR Subsection 2.5.3.1.4.*

**PSEG Response to NRC RAI:**

SSAR Subsection 2.5.3.1.4 states that previous site investigations concluded that:

- No surficial folding or faulting exists within the site area.
- No evidence of prior earthquakes was found in the surficial materials in the site area.
- The near-surface geologic units are planar and undisrupted by folding or faulting beneath the site.

Pertinent information from the Updated Final Safety Analysis Reports (UFSARs) for the Hope Creek Generating Station (HCGS), (SSAR Reference 2.5.3-19) and Salem Generating Station (SGS), (SSAR Reference 2.5.3-18) for each of the above conclusions is summarized below.

*No surficial folding or faulting exists within the site area.*

The HCGS site investigation included literature review, a set of approximately 100 subsurface borings, seismic refraction surveys, and examination and mapping of site excavations. SSAR Reference 2.5.3-19 states that, "The detailed mapping of the aforementioned stratigraphic contacts preclude the presence of faults, shear zones or folds within the Tertiary and Quaternary sediments exposed in the site excavations". The HCGS UFSAR also states "there is no indication of faulting or folding in the site area..." (SSAR Reference 2.5.3-19).

The site investigation for the SGS included geologic reconnaissance of the site and surrounding area, 35 borings, collection of geophysical data, and literature review. The SGS UFSAR states that "no faulting or folding was observed at the site in a detailed review of all boring data" (SSAR Reference 2.5.3-18).

*No evidence of prior earthquakes was found in the surficial materials in the site area.*

With respect to determining the potential for prior earthquakes unidentified in the historic record, the HCGS UFSAR (SSAR Reference 2.5.3-19) states that, "... examination of excavation walls and samples from boreholes revealed no evidence which indicated adverse effects on the foundation soils from prior earthquakes." Similarly, the SGS UFSAR (SSAR Reference 2.5.3-18) states, "No major earthquake activity has affected the site area and no record of deleterious behavior of onsite soils (even the poorest surficial materials) is known". Although no detailed discussion of the evidence that led to these conclusion statements is provided in the UFSARs (SSAR References 2.5.3-18 and 2.5.3-19), it is expected that field reconnaissance, inspection of boring samples, and review of the literature cited in the UFSARs contributed to the conclusions quoted above.

*The near-surface geologic units are planar and undisrupted by folding or faulting beneath the site.*

In the HCGS UFSAR (SSAR Reference 2.5.3-19), boring investigation data, seismic reflection data and geologic mapping of the plant excavation were summarized to indicate that several contacts below the site were planar and lacked abrupt changes in elevations. These contacts include those between a Quaternary clay unit and the underlying Kirkwood formation, the contact between the Kirkwood and the underlying Vincentown formation, and the contact between the Mount Laurel formation and the overlying Navesink. The boring data from the SGS investigation indicate that the base of Quaternary sediments occurred uniformly across the site at a depth of approximately 35 feet (SSAR Reference 2.5.3-18). Similarly, Cretaceous strata are planar and dip gently to the southeast beneath the site. (SSAR Reference 2.5.3-18)

**Associated PSEG Site ESP Application Revisions:**

None.

**Response to RAI No. 44, Question 02.05.03-4:**

In Reference 2, the specific request for Question 02.05.03-4 was:

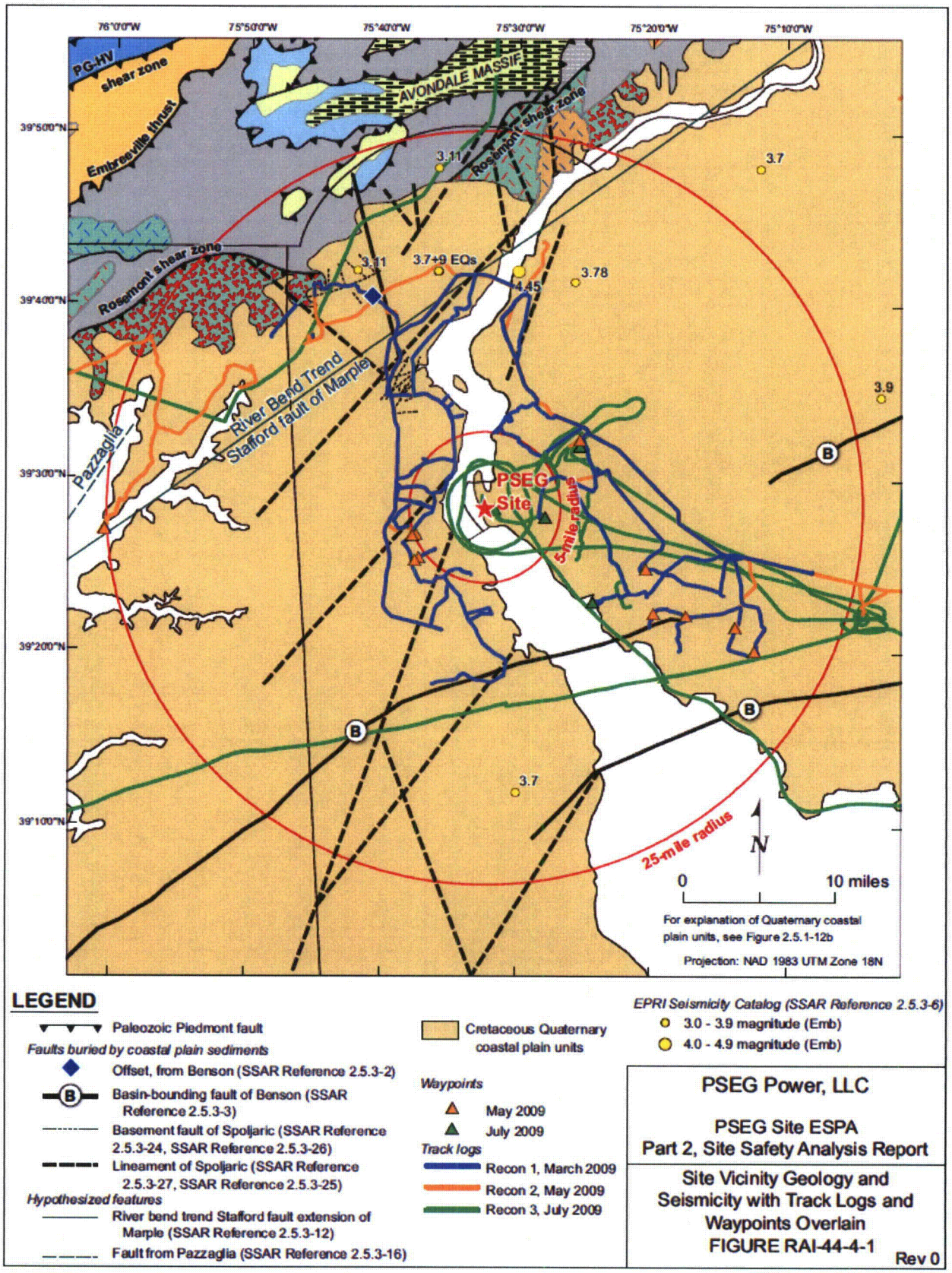
> *SSAR Subsection 2.5.3.1.5, "Aerial Imagery Analysis," discusses lineaments trending into the site vicinity based on historical (1930s) and modern (2007 and 2008) imagery, two of which also extend into the site area. The SSAR concludes that none of the "identified and accessible" lineaments investigated showed tectonic or geologic features indicative of surface faulting. Upon reviewing SSAR Subsection 2.5.3.1.5 and SSAR Figure 2.5.3-1, it is not clear to the staff which lineaments were physically investigated in the field and which lineaments were considered inaccessible.*
>
> *In order for the staff to adequately evaluate the potential for faulting within the PSEG site vicinity and at the PSEG site, and in compliance with 10 CFR 100.23 and in conformance to NUREG 0800, Section 2.5.3, "Surface Faulting," please clarify the process used to document the conclusion that none of the lineaments in the site vicinity or site area showed tectonic or geologic features indicative of surface faulting, Please identify which lineaments were evaluated in the field and which features were determined to be inaccessible. In addition, please describe what approach was applied to evaluate those features that were determined to be inaccessible in the field.*

**PSEG Response to NRC RAI:**

Ground reconnaissance in the site vicinity and site area was performed in March, May and July, 2009. An aerial reconnaissance was performed in conjunction with the July, 2009 ground reconnaissance. Figures RAI-44-4-1 and RAI-44-4-2 show locations of lineaments in the site vicinity and the site area, respectively, along with the track log for ground and aerial reconnaissance. In addition, waypoints are indicated on the figures that mark locations at which stops were made to examine specific features on foot. This ground and aerial reconnaissance evaluated lineaments in relation to their possible origins such as alignment of vegetation or possible association with surface deformation. Typical views at ground level for some of these features are shown in Figures RAI-44-4-3 through RAI-44-4-7. In all cases, as examined from the air and ground, no association with surface deformation was found. Almost all of these lineaments are completely or partially located in salt marsh or private land that is not accessible from the ground (i.e., "in the field"). Therefore, the only access for observation was by air.

**Associated PSEG Site ESP Application Revisions:**

None.



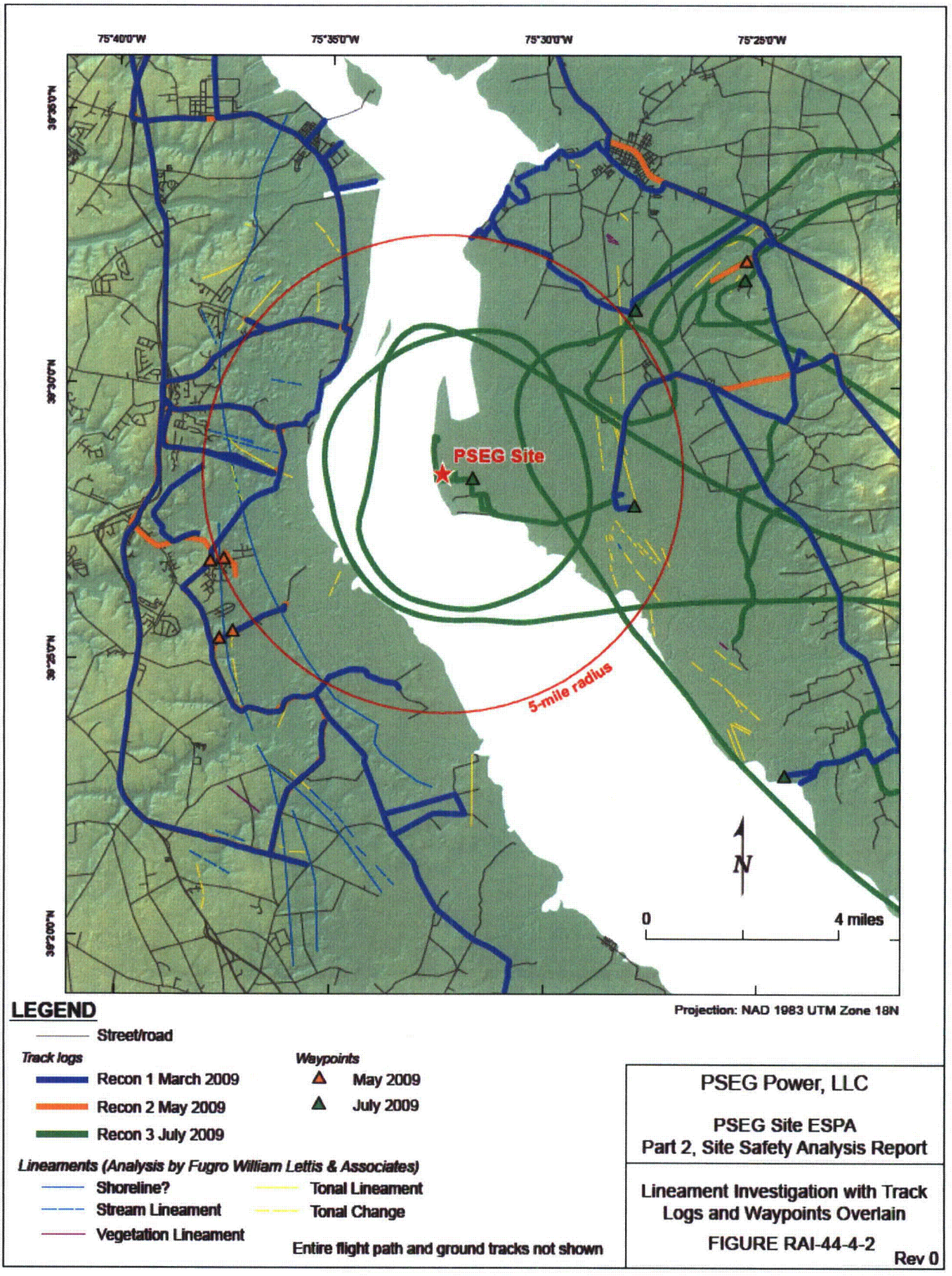

**LEGEND**

- Paleozoic Piedmont fault
- *Faults buried by coastal plain sediments*
- Offset, from Benson (SSAR Reference 2.5.3-2)
- Basin-bounding fault of Benson (SSAR Reference 2.5.3-3)
- Basement fault of Spoljaric (SSAR Reference 2.5.3-24, SSAR Reference 2.5.3-26)
- Lineament of Spoljaric (SSAR Reference 2.5.3-27, SSAR Reference 2.5.3-25)
- *Hypothesized features*
- River bend trend Stafford fault extension of Marple (SSAR Reference 2.5.3-12)
- Fault from Pazzaglia (SSAR Reference 2.5.3-16)
- Cretaceous Quaternary coastal plain units
- *Waypoints*
- May 2009
- July 2009
- *Track logs*
- Recon 1, March 2009
- Recon 2, May 2009
- Recon 3, July 2009
- *EPRI Seismicity Catalog (SSAR Reference 2.5.3-6)*
- 3.0 - 3.9 magnitude (Emb)
- 4.0 - 4.9 magnitude (Emb)

**PSEG Power, LLC**

**PSEG Site ESPA**
**Part 2, Site Safety Analysis Report**

**Site Vicinity Geology and Seismicity with Track Logs and Waypoints Overlain**
**FIGURE RAI-44-4-1**
**Rev 0**




PSEG Power, LLC

PSEG Site ESPA
Part 2, Site Safety Analysis Report

Lineament Investigation with Track Logs and Waypoints Overlain

FIGURE RAI-44-4-2

Rev 0

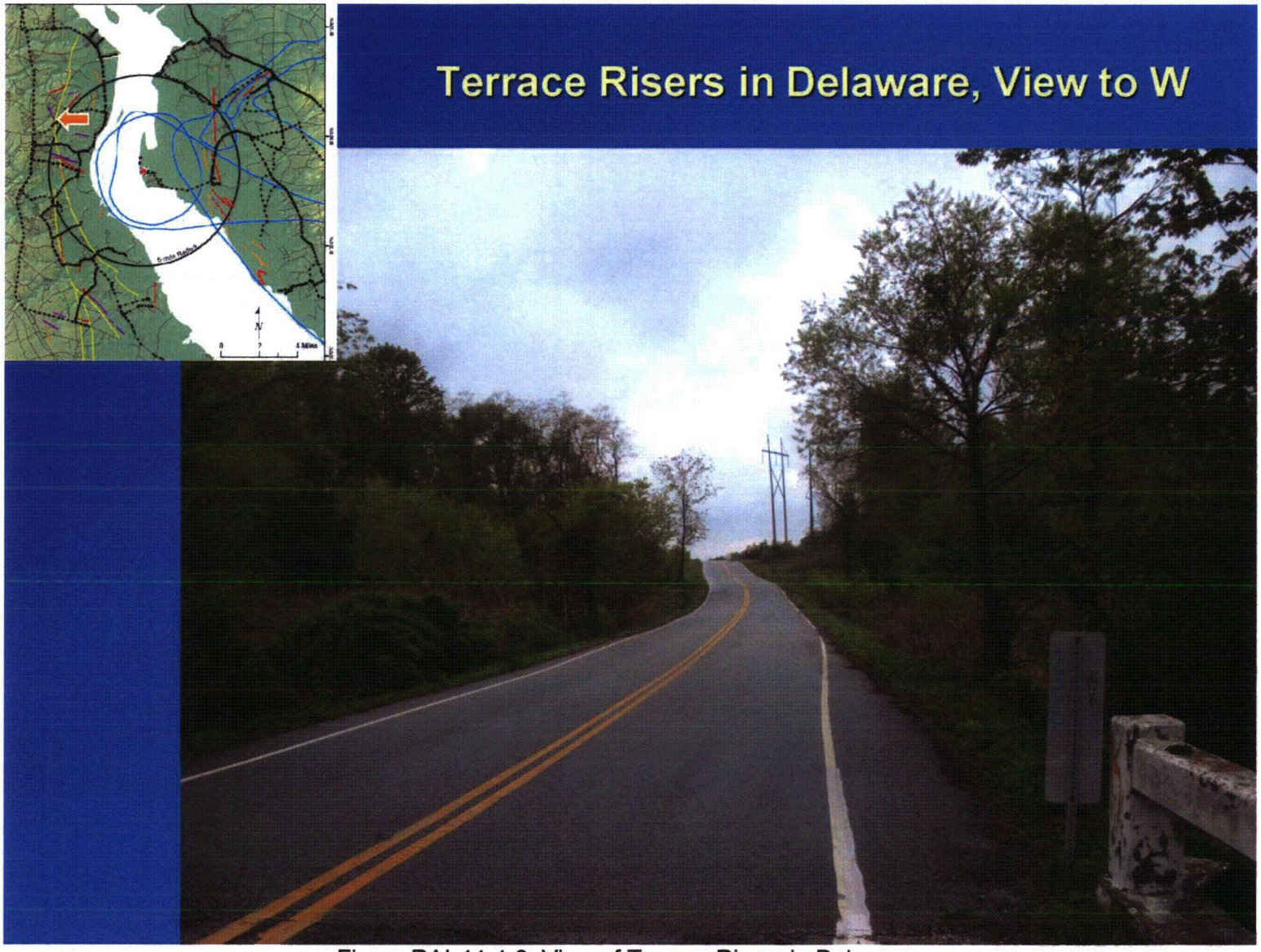



Figure RAI-44-4-3. View of Terrace Risers in Delaware.

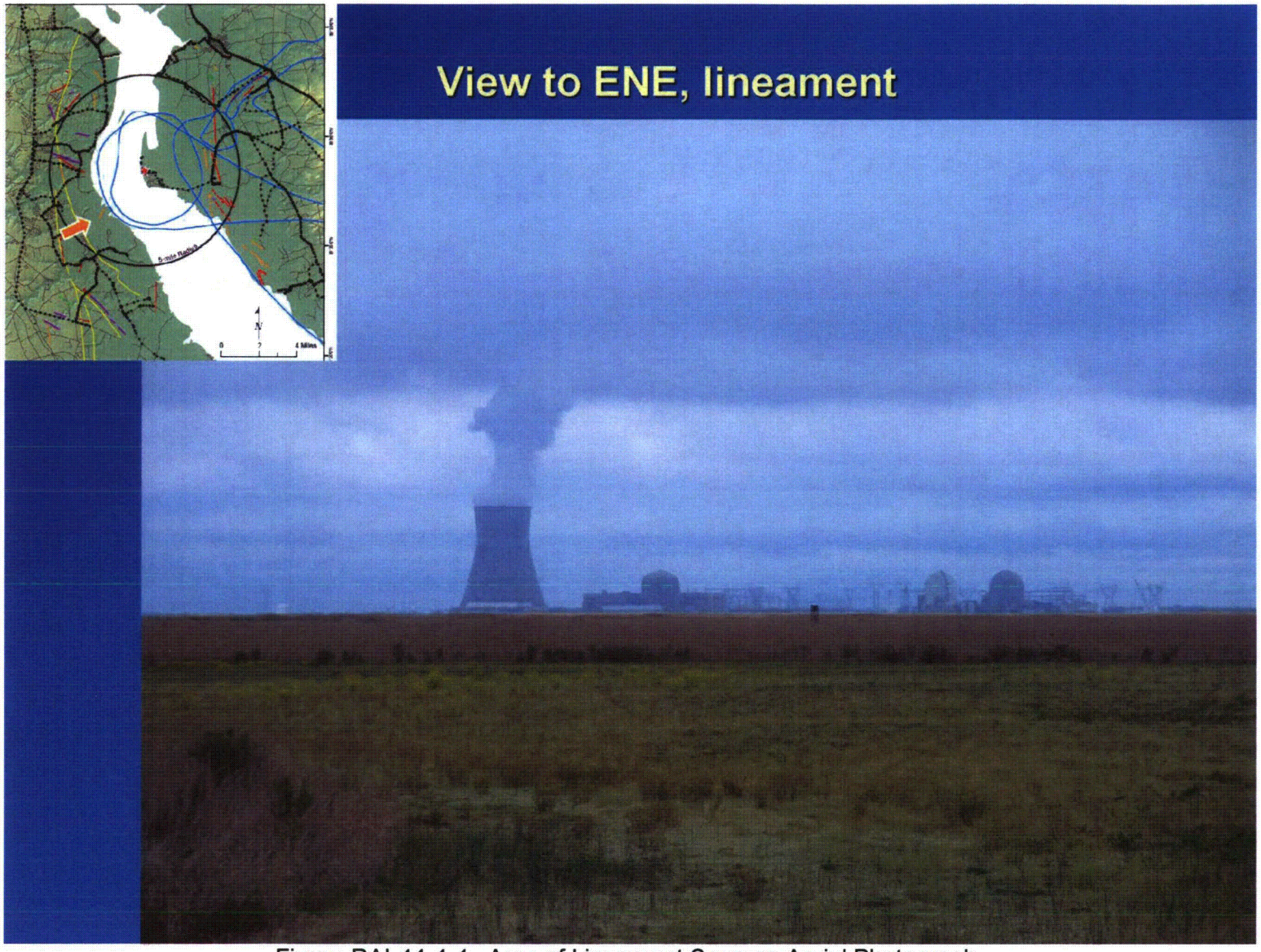



Figure RAI-44-4-4. Area of Lineament Seen on Aerial Photograph.

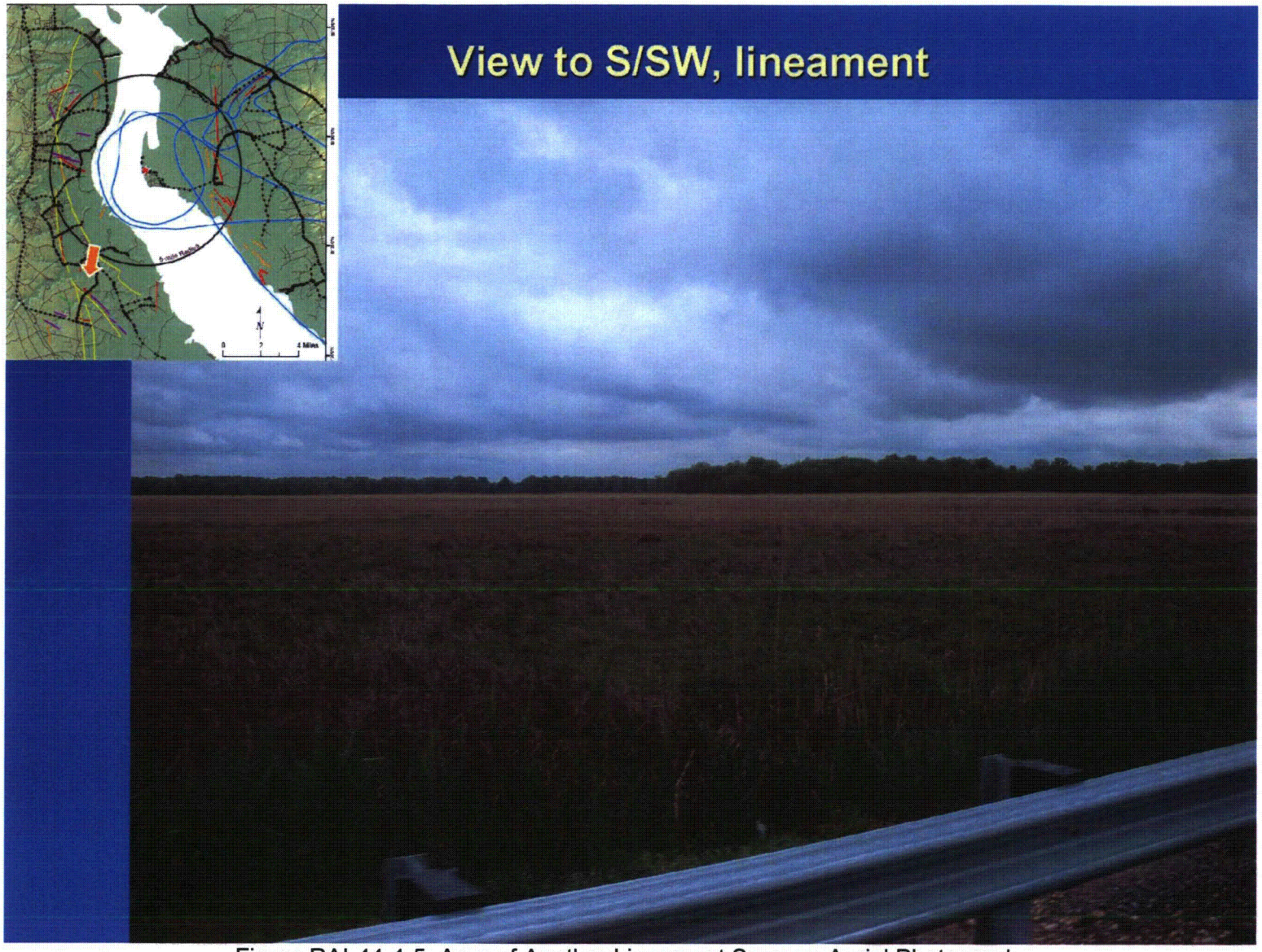



Figure RAI-44-4-5. Area of Another Lineament Seen on Aerial Photograph.

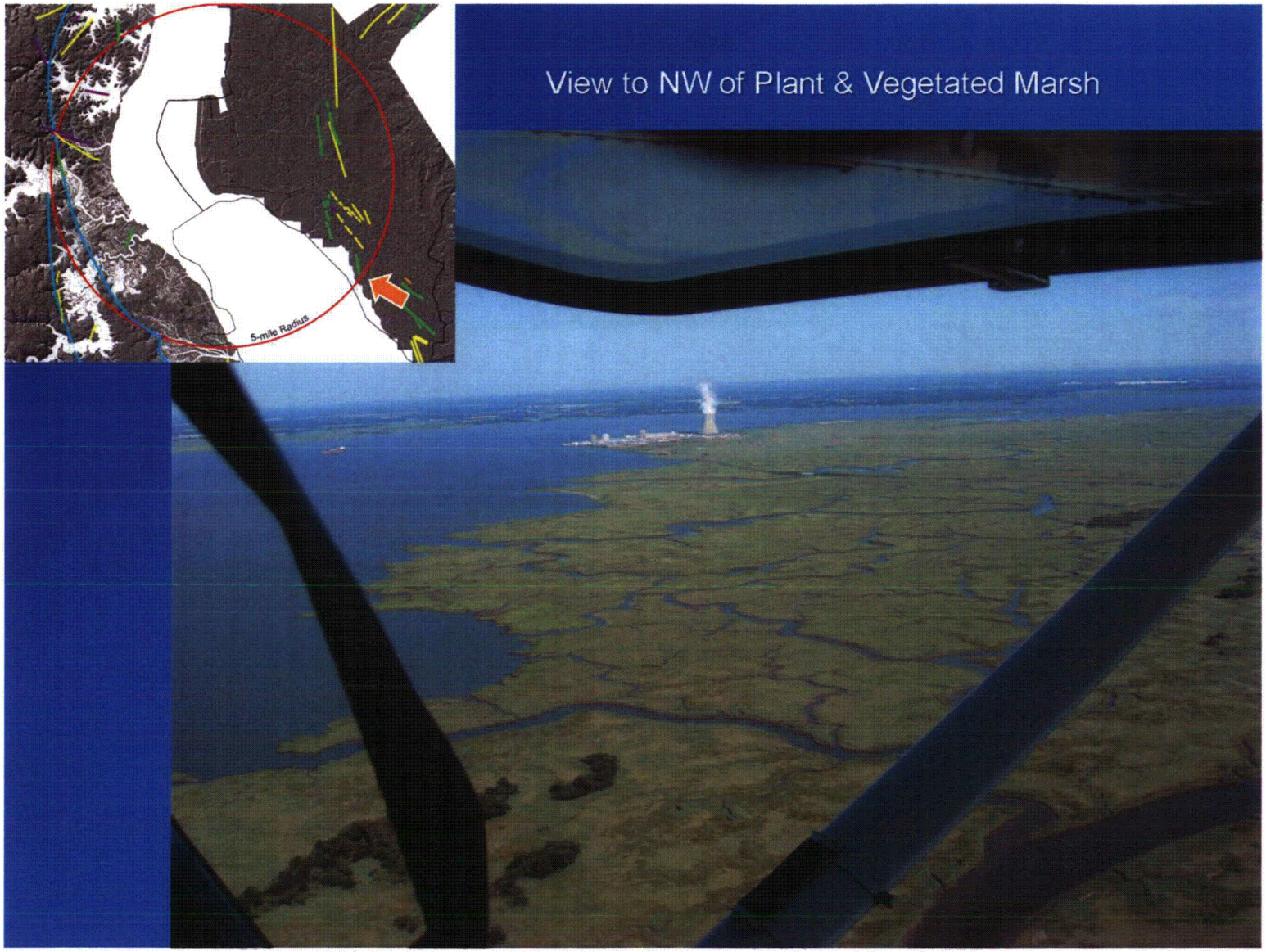



Figure RAI-44-4-6. Aerial View Showing Inaccessible Salt Marsh Setting.

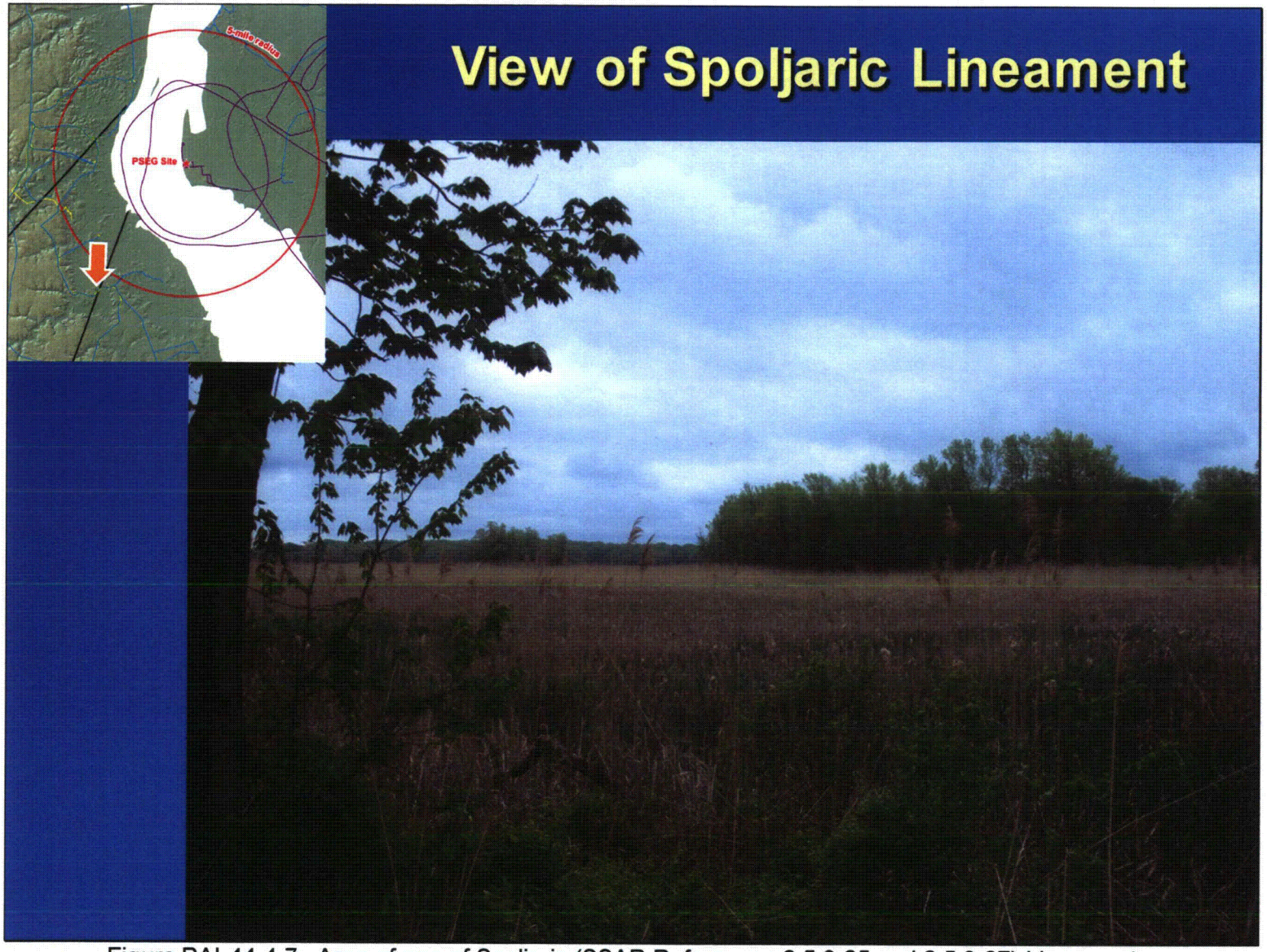



Figure RAI-44-4-7. Area of one of Spoljaric (SSAR References 2.5.3-25 and 2.5.3-27) Lineaments.

**PSEG Letter ND-2012-0007, dated January 25, 2012**

**ENCLOSURE 2**

**Proposed Revisions**
**Part 2 – Site Safety Analysis Report (SSAR)**

**Section 2.5.3 – Surface Faulting**

**Marked Up Pages**

**2.5-190**

guidebooks were reviewed with emphasis on reports published since the HCGS UFSAR (Reference 2.5.3-19) and EPRI studies (Reference 2.5.3-6).

- Review of seismicity data – A comprehensive review was completed of instrumental and historical seismicity data from published journal articles, EPRI Seismic Hazard Methodology for the Central and Eastern United States (Reference 2.5.3-6), and the updated seismicity catalog (Subsection 2.5.2).
- Previous site investigations performed for the Hope Creek (Reference 2.5.3-19) and Salem plants (Reference 2.5.3-18).

In addition to reviewing this existing information, the following investigations were performed to assess the potential for tectonic and non-tectonic deformation within the site area:

- Interpretation of aerial photography and remote sensing imagery
- Field and aerial reconnaissance
- Subsurface boring investigations

The following subsections discuss the results of these investigations.

2.5.3.1.1 Published Geologic Mapping

Review of geologic mapping in the area indicates no Quaternary faults within the site vicinity (Figures 2.5.1-12a and 2.5.1-28). All of Delaware within the site vicinity has been mapped at a scale of 1:24,000 (Reference 2.5.3-17); Maryland has been mapped at scales of 1:62,500 (Reference 2.5.3-10). Northern portions of the site vicinity within New Jersey (including the portion for the site vicinity) have been mapped at a scale of 1:24,000. The remainder of New Jersey portion of the site vicinity is available at 1:100,000 (References 2.5.3-14 and 2.5.3-15). None of these maps indicates the presence of Quaternary faults within the site vicinity.

2.5.3.1.2 Regional Geological Studies

A number of regional studies provide useful data for evaluating the possibility of near-surface faults or deformation. Extensive groundwater investigations have provided subsurface stratigraphic data in the region (References 2.5.3-2 and 2.5.3-30). These studies include boreholes surrounding the PSEG Site and report no faulting, except one buried potential offset in the Cretaceous Potomac strata northwest of the site (Reference 2.5.3-2 and Figure 2.5.3-1). This offset is located approximately 20 mi. north of the PSEG Site and does not deform the overlying Quaternary units.

The USGS has compiled information related to all known and postulated Quaternary faults, liquefaction features, and other tectonic features in the Central and Eastern United States (CEUS) (References 2.5.3-4 and 2.5.3-34). These compilations identify the New Castle County faults in Delaware (References 2.5.3-24, 2.5.3-26, 2.5.3-27, and 2.5.3-25) as potential Quaternary tectonic features within the site vicinity (Subsection 2.5.1.1.4.2.5) (Figure 2.5.1-17). These are concluded to be Class C features without proven evidence of Quaternary faulting (Reference 2.5.3-34) (Table 2.5.1-2). Review of published geological studies indicates that no Quaternary structures capable of producing surficial deformation exist within the site vicinity.

ADD "(Reference 2.5.3-2)" per Question 02.05.03-1.

**PSEG Letter ND-2012-0007, dated January 25, 2012**

# ENCLOSURE 3

## Summary of Regulatory Commitments

## ENCLOSURE 3

## SUMMARY OF REGULATORY COMMITMENTS

The following table identifies commitments made in this document. (Any other actions discussed in the submittal represent intended or planned actions. They are described to the NRC for the NRC's information and are not regulatory commitments.)

| COMMITMENT | COMMITTED DATE | COMMITMENT TYPE | |
|---|---|---|---|
| | | ONE-TIME ACTION (Yes/No) | Programmatic (Yes/No) |
| PSEG will revise SSAR Subsection 2.5.3 to incorporate the changes in Enclosure 2 in response to NRC RAI No. 44, Question No. 02.05.03-1. | This revision will be included in a future update of the PSEG ESP application. | Yes | No |