



October 15, 2018

Tennessee Valley Authority
1101 Market Street
Chattanooga, TN 37402

**Engineer's Certification of Fault Area Demonstration
Gypsum Disposal Area, Gypsum Disposal Area Stilling Pond 1, and Gypsum Disposal Area
Stilling Pond 2
EPA Final CCR Rule
TVA Paradise Fossil Plant
Drakesboro, Kentucky**

1.0 PURPOSE

The purpose of this document is to certify that the Fault Area Demonstration for the TVA Paradise Fossil Plant (PAF) Gypsum Disposal Area, Gypsum Disposal Area Stilling Pond 1, and Gypsum Disposal Area Stilling Pond 2 (collectively the Gypsum Disposal Area) are in compliance with the Fault Area location requirements specified in the EPA Final CCR Rule at 40 CFR §257.62.

2.0 BACKGROUND

In accordance with 40 CFR §257.62(a), all new and existing CCR impoundments, new CCR landfills, and lateral expansions must not be located within 60 meters (200 feet) of the outermost damage zone created by faults active during the Holocene Period unless the unit meets certain requirements. The Holocene Period is defined by any geologic event occurring within the past 11,700 years, the time span indicating that a fault is potentially active.

3.0 SUMMARY OF FINDINGS

PAF is located between two subparallel, east-northeast trending fault systems: the Pennyrite Fault System located about 3 miles southeast of the plant site, and the Rough Creek Fault System, situated approximately 17 miles northwest of the site. Based on a review of the United States Geologic Survey (USGS) website which contains information on faults and associated folds in the United States that are believed to be sources of M>6 earthquakes during the Quaternary Period (the past 1,600,000 years, including Holocene Epoch), there are no known faults of the Holocene age located within the vicinity of PAF.

Based upon a review of the documented sources as presented above, fault lines in relation to the Gypsum Disposal Area have not been active during the Holocene Period and are not within the specified 200 foot fault damage zone. Through the references listed below and the attached figures, AECOM has determined that the Gypsum Disposal Area, Gypsum Disposal Area Stilling Pond 1, and Gypsum Disposal Area Stilling Pond 2 at the TVA Paradise Fossil Plant meet the fault area requirements of the EPA Final CCR Rule 40 CFR § 257.62. AECOM has determined that there are no reasonable expectations that faults will disrupt the integrity of the Gypsum Disposal Area due to fault movement.

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4.0 CERTIFICATION

I, Nicholas Golden, being a Professional Engineer in good standing in the State of Kentucky, do hereby certify, to the best of my knowledge, information, and belief that the information contained in this certification has been prepared in accordance with generally accepted engineering practices; that the information contained herein is accurate as of the date of my signature below; and that Gypsum Disposal Area, Gypsum Disposal Area Stilling Pond 1, and Gypsum Disposal Area Stilling Pond 2 meet the fault area requirements of the EPA Final CCR Rule 40 CFR § 257.62.

SIGNATURE 

DATE 10/15/18

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ATTACHMENTS: Engineer's Certification of Fault Area Demonstration (40 CFR § 257.62) for Coal Combustion Residuals (CCR) Existing Surface Impoundments for Gypsum Disposal Area, Gypsum Disposal Area Stilling Pond 1, and Gypsum Disposal Area Stilling Pond 2



COAL COMBUSTION PRODUCT DISPOSAL PROGRAM

TENNESSEE VALLEY AUTHORITY – PARADISE FOSSIL PLANT
GYPSUM DISPOSAL AREA, GYPSUM DISPOSAL AREA STILLING POND 1, AND
GYPSUM DISPOSAL AREA STILLING POND 2
DRAKESBORO, KENTUCKY

ENGINEER'S CERTIFICATION OF FAULT AREA DEMONSTRATION (40 CFR § 257.62) FOR COAL COMBUSTION RESIDUALS (CCR) EXISTING SURFACE IMPOUNDMENTS

Prepared for



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1101 Market Street
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October 15, 2018 – Rev 0

Prepared by





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1.0 INTRODUCTION

1.1 OBJECTIVE

The purpose of this demonstration is to evaluate compliance with 40 CFR § 257.62 of the Environmental Protection Agency Final Coal Combustion Residuals Rule (EPA Final CCR Rule). This Fault Area Demonstration is based on existing published documentation from various sources, as listed in Section 5. Documentation includes construction drawings, record drawings, and other pertinent data and/or investigations to support historical conditions and operations at the Gypsum Disposal Area, Gypsum Disposal Area Stilling Pond 1 and Gypsum Disposal Area Stilling Pond 2 (collectively referred to as the Gypsum Disposal Area) at the Tennessee Valley Authority (TVA) Paradise Fossil Plant (PAF).

1.2 RULE REQUIREMENTS

40 CFR § 257.62(a) *Any new CCR landfills, existing and new CCR surface impoundments, and all lateral expansions of CCR units must not be located within 60 meters (200 feet) of the outermost damage zone of a fault that has had displacement in Holocene Period unless the owner or operator demonstrates by October 17, 2018, that an alternative setback distance of less than 60 meters (200 feet) will prevent damage to the structural integrity of the CCR unit.*

40 CFR § 257.62(b) *The owner or operator must obtain a certification from a qualified professional engineer stating that the demonstration meets the requirements of paragraph (a) of 40 CFR § 257.62.*

40 CFR § 257.62(c) *The owner or operator of an existing surface impoundment must complete the demonstration required by paragraph 40 CFR § 257.62(a) by October 17, 2018.*

1.3 BACKGROUND

In accordance with 40 CFR § 257.62(a), all new and existing CCR impoundments, newlandfills, and vertical expansions must not be located within 60 meters (200 feet) of the outermost damage zone created by faults active during the Holocene Period. The Holocene Period is defined by any geologic event occurring within the past 11,700 years, the time span indicating that a fault is potentially active. During active fault movement, earth displacement where the ground may be bent or warped typically occurs within a zone spanning 200 feet from the fault line.

Providing an adequate setback distance as required by 40 CFR § 257.62(a), is an attempt to reduce the risk of CCR unit failures. Potential failures include surface breakage, cracks, and fissures between fill and confining slopes, slope failure via landslides, liquefaction induced lateral spreading and settlement of the pile, disruption of surface water and drainage control systems, liner system, and rupture of leachate collection systems. In the case that an existing



CCR facility is within 60 meters (200 feet) of an active fault, the operator or owner of the facility must provide a demonstration recognizing that acceptable engineering practices have been incorporated into the design of the CCR unit so that the structural integrity of the CCR unit will not be disrupted.

1.4 SITE DESCRIPTION

PAF is located in Drakesboro, Kentucky along the west bank of the Green River and State Route 176. The plant sits inside the eastern border of Muhlenberg County as depicted below in **Figure 1**. The plant features three units, constructed between 1963 and 1970, and three large natural-draft cooling towers. Units 1 and 2 were retired in 2017.

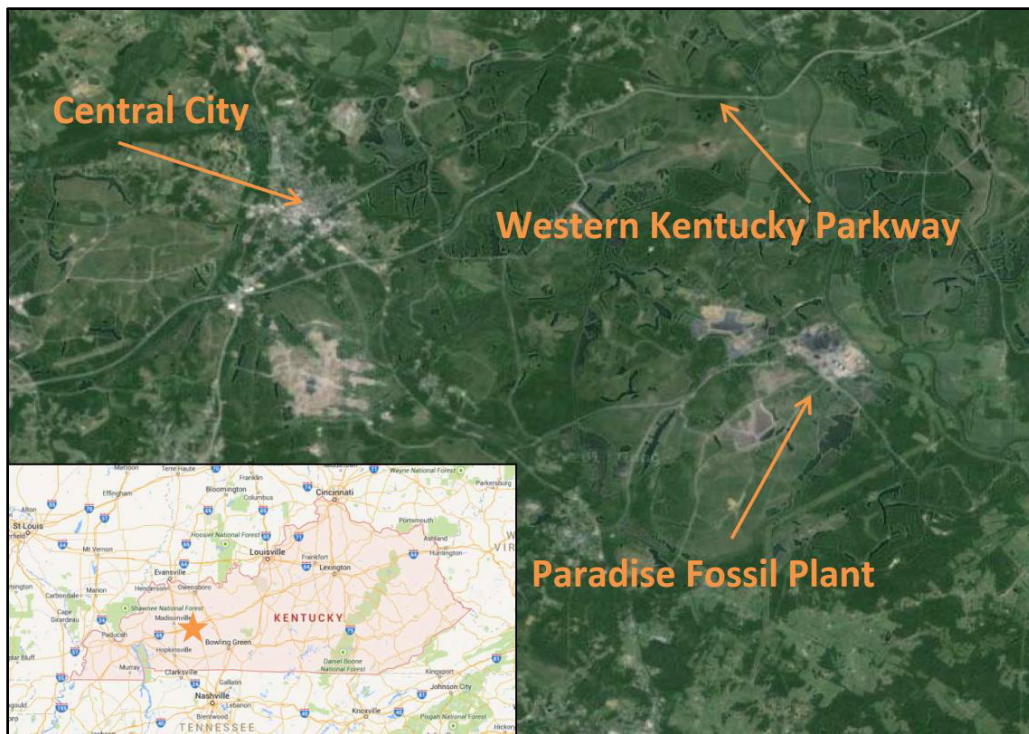


Figure 1: TVA PAF Site Location

The Gypsum Disposal Area is located in the southwest corner of the Paradise Facility. This area is located west of the PAF plant. It is bordered by hilly and grassy areas on all four sides (See **Figure 2**). Gypsum Disposal Area Stilling Ponds 1 & 2 are located at the southeast end of the Gypsum Disposal Area. The Gypsum Disposal Area manages process water flows and CCR waste during power generation. Stilling Ponds 1 and 2 receive process water and stormwater drainage from the Gypsum Disposal Area and the surrounding drainage area. Stilling Pond 1

drains to Stilling Pond 2, which discharges to a surface water channel that eventually leads to the Peabody Ash Pond, which is located on the southeast side of the site.

The Gypsum Disposal Area collectively is approximately 225 acres in area and partially enclosed by a 1.4 mile long dike with a maximum height of approximately 62 feet. The Gypsum Disposal Area currently serves as a disposal facility for gypsum and fly ash.



Figure 2: Site Overview

2.0 REGIONAL GEOLOGY

PAF is located within the Shawnee Hills Section of the Interior Low Plateaus Physiographic Province in Northwestern Kentucky. Major geologic units in the area from the ground surface downward include Quaternary Age Alluvium and Residuum, the Upper Pennsylvanian Age Sturgis Formation and the Middle Pennsylvanian Age Carbondale Formation. The Sturgis Formation is made up of the former Lisman and Henshaw formations. Unmined areas, particularly in the flood plain of the Green River, consist of Quaternary Alluvial Sands, silts, and clays. Upland areas may consist of up to 25 feet of residual material derived from the weathering of shale and sandstone bedrock materials. **Figure 3** shows the regional geologic formations surrounding PAF.

The Sturgis Formation (containing the former Lisman Formation) consists of interbedded sandstone, siltstone, shale, limestone, and coal. The contact between the Sturgis and Carbondale formation is the top of the number 11 coal seam. The Carbondale Formation underlies the Sturgis and consists of alternating sandstone, siltstone, coal, silty shale, and limestone in some areas. It is the major coal producing formation in the Western Kentucky Coal Field and includes Coal Seam Numbers 6 through 11. PAF is unique in that approximately half



of the site is covered by strip mining spoils and underground coal mines. Extensive underground and strip mining operations across the area occurred from the 1960s through the 1980s, which significantly altered the topography and geology of the site and its vicinity. Much of the mining targeted Kentucky Coal Seam Number 9 of the Carbondale Formation, but almost all of the area was strip mined to at least one of the shallower coal beds. The site and surrounding area are underlain by mine spoil deposits from previous mining operations. These spoils consist of up to 100-feet of sandy silty and gravelly clay mixed with coal and occasional sandstone boulders and gravel layers.

3.0 SITE GEOLOGY/FAULTING

The collective Gypsum Disposal Area is located within an area that was previously strip mined leaving approximately 100 feet of minespoil material between the CCR facility and the remaining bedrock. The collective Gypsum Disposal Area was constructed with a partial perimeter dike built from compacted clayey mine spoil material.

3.1 SITE FAULTING

In accordance with 40 CFR § 257.62(a), AECOM identified historic fault systems within 3 to 17 miles to the site. PAF is located between two subparallel, east-northeast trending fault systems: the Pennyrile Fault System located about 3 miles southeast of the plant site, and the Rough Creek Fault System, situated approximately 17 miles northwest of the site. Based on a review of the United States Geologic Survey (USGS) website which contains information on faults and associated folds in the United States that are believed to be sources of M>6 earthquakes during the Quaternary Period (the past 1,600,000 years including Holocene Epoch), there are no known faults of the Holocene Period are located within the vicinity of PAF. Despite the presence of major fault systems in the region, Pennyrile and Rough Creek respectively, no evidence of significant faulting has been observed at the plant site (TVA 2003).

The USGS information and geologic studies carried out by TVA indicate that the site and surrounding area may be subject to events affecting the central portion of western Kentucky, (and thus the plant site), primarily emanating from two Holocene fault zones– the New Madrid Seismic Zone of the central Mississippi Valley and the Wabash Valley Seismic Zone located along the border between Illinois and southwestern Indiana (See **Figure 4**). Site specific analyses have been performed by AECOM and have determined the site meets the ASCE Standard “Minimum Design Loads for Buildings and Other Structures”. Furthermore, both fault zones are located outside of the 200 foot offset. The New Madrid Seismic Zone is located approximately 150 miles from PAF, and the Wabash Valley Seismic Zone is approximately 250 miles from the site.



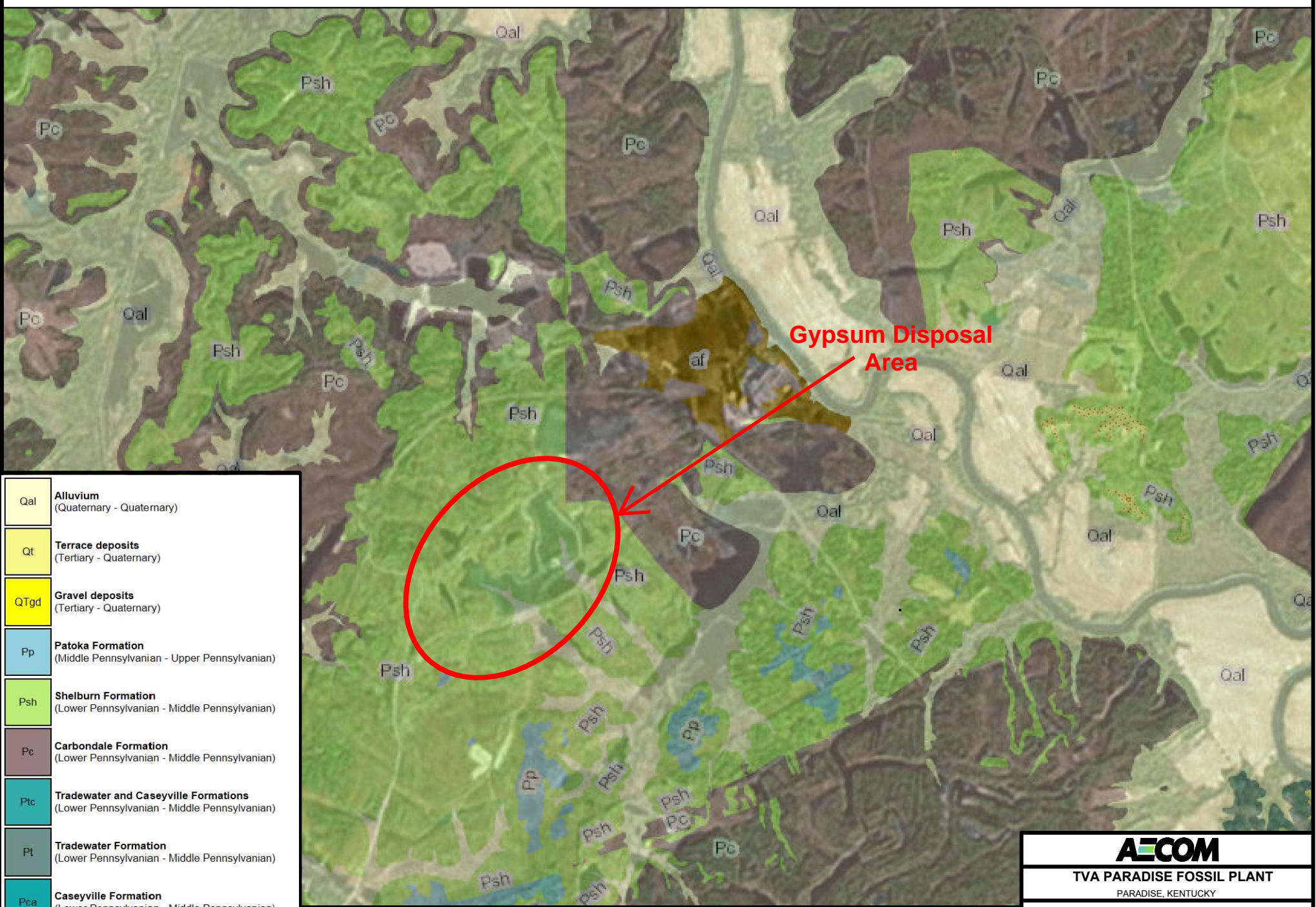
4.0 CONCLUSIONS

Based upon a review of the documented sources as presented above, fault lines in relation to the collective Gypsum Disposal Area have not been active during the Holocene Period and/or are not located within the specified 60 meter (200 foot) fault damage zone. Through the references listed below and the attached figures, AECOM has determined that the Gypsum Disposal Area at PAF meets the fault area requirements of the EPA Final CCR Rule 40 CFR § 257.62. Furthermore, AECOM has determined that there are no reasonable expectations that faults will disrupt the integrity of Gypsum Disposal Area, Gypsum Disposal Area Stilling Pond 1 and Gypsum Disposal Area Stilling Pond 2 due to fault movement.


5.0 REFERENCES

- 40 CFR § 257.73(d) Initial Structural Stability Assessment, AECOM, 2016
- Final Environmental Assessment, Installation of Flue Gas Desulfurization System on Paradise Fossil Plant Unit 3, Muhlenberg County, Kentucky, TVA 2003, <http://www.tva.gov/environment/reports/paradise/index.htm>.
- Kentucky Geological Survey, The University of Kentucky, July 6, 2016. Online Kentucky Geologic Map Information Service Map, <http://kgs.uky.edu/kgsmmap/kgsgeserver/viewer.asp>
- Online Fault Map, Quaternary Faults and Folds, United States Geological Survey, July 6, 2016. <http://earthquake.usgs.gov/hazards/qfaults/map/#qfaults>
- Starn, J. Jeffrey., Robert W. Forbes, Charles J. Taylor, and Martin F. Rose, 1993, U.S. Dept. of the Interior, U.S. Geological Survey Water-Resources Investigations Report 93-4077. Geohydrology of Parts of Muhlenberg, Ohio, Butler, McLean, Todd, and Logan Counties, Kentucky.
- USEPA 2016b. Coal Combustion Residuals Impoundment Assessment Reports. <https://www.epa.gov/coalash/coal-combustion-residuals-impoundmentassessment-reports>.

FIGURES



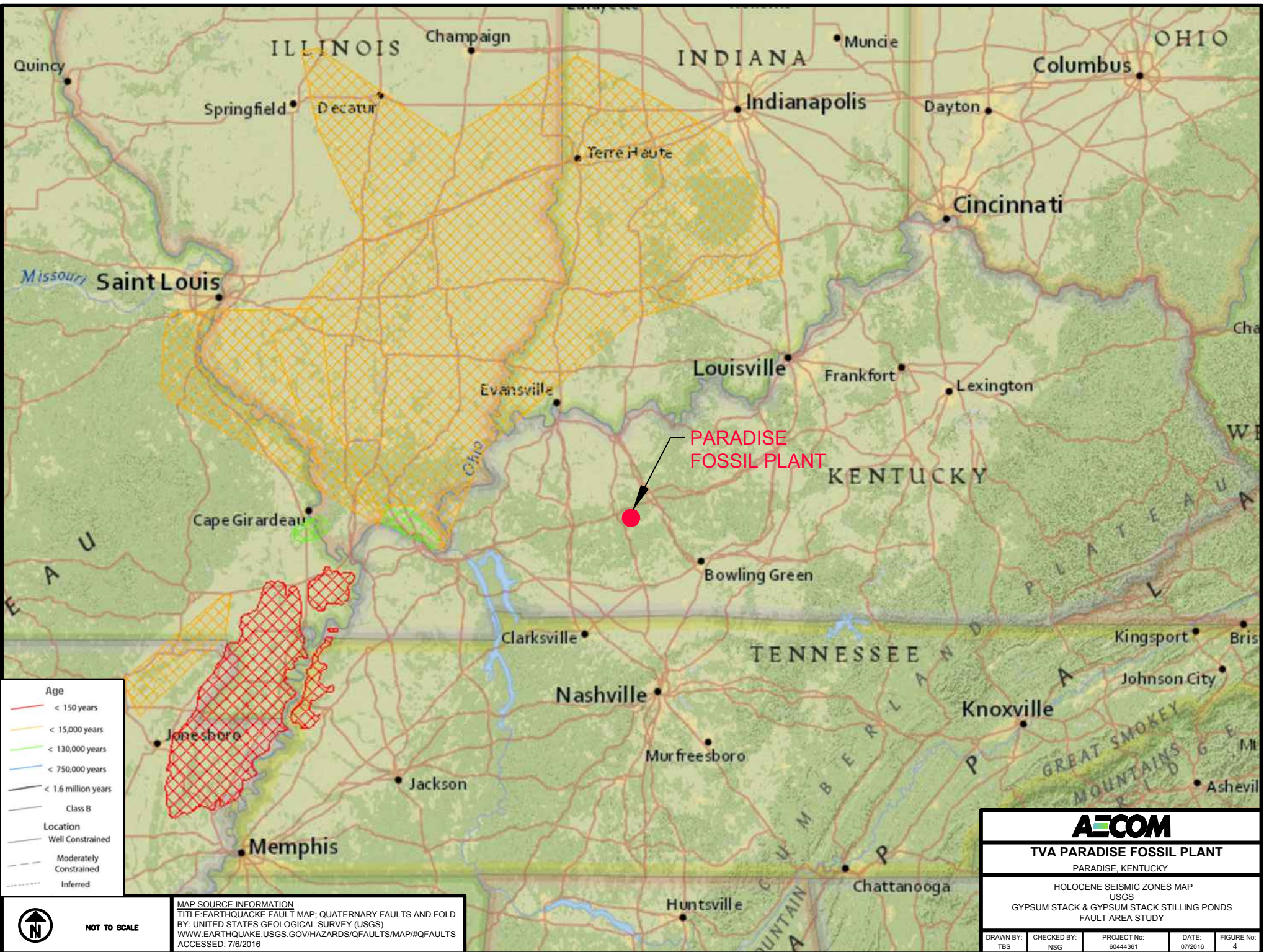
Qal	Alluvium (Quaternary - Quaternary)
Qt	Terrace deposits (Tertiary - Quaternary)
QTgd	Gravel deposits (Tertiary - Quaternary)
Pp	Patoka Formation (Middle Pennsylvanian - Upper Pennsylvanian)
Psh	Shelburn Formation (Lower Pennsylvanian - Middle Pennsylvanian)
Pc	Carbondale Formation (Lower Pennsylvanian - Middle Pennsylvanian)
Ptc	Tradewater and Caseyville Formations (Lower Pennsylvanian - Middle Pennsylvanian)
Pt	Tradewater Formation (Lower Pennsylvanian - Middle Pennsylvanian)
Pca	Caseyville Formation (Lower Pennsylvanian - Middle Pennsylvanian)
Mcl	Cloze Limestone (Upper Mississippian - Upper Mississippian)


NOT TO SCALE

MAP SOURCE INFORMATION
 TITLE: KENTUCKY GEOLOGIC MAP INFORMATION SERVICE
 BY: UNIVERSITY OF KENTUCKY & KENTUCKY GEOLOGICAL SURVEY
 WWW.KGS.UKY.EDU/KGSMAP/KGSGEOSERVER/VIEWER.ASP
 ACCESSED: 7/6/2016

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AECOM				
TVA PARADISE FOSSIL PLANT				
PARADISE, KENTUCKY				
REGIONAL GEOLOGICAL FORMATIONS KENTUCKY GEOLOGICAL SURVEY GYPSUM STACK & GYPSUM STACK STILLING PONDS FAULT AREA STUDY				
DRAWN BY: TBS	CHECKED BY: NSG	PROJECT No: 60444361	DATE: 07/2016	FIGURE No: 3



- Age**
- < 150 years
 - < 15,000 years
 - < 130,000 years
 - < 750,000 years
 - < 1.6 million years
- Location**
- Class B
 - Well Constrained
 - Moderately Constrained
 - Inferred

 **NOT TO SCALE**

MAP SOURCE INFORMATION
 TITLE: EARTHQUAKE FAULT MAP; QUATERNARY FAULTS AND FOLD
 BY: UNITED STATES GEOLOGICAL SURVEY (USGS)
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 ACCESSED: 7/6/2016

AECOM				
TVA PARADISE FOSSIL PLANT				
PARADISE, KENTUCKY				
HOLOCENE SEISMIC ZONES MAP USGS				
GYPSUM STACK & GYPSUM STACK STILLING PONDS FAULT AREA STUDY				
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