

TECHNICAL MEMORANDUM

DATE October 10, 2018

Project No. 18107517

TO Jeff Jones
Luminant Generation Company LLC

FROM Patrick J. Behling, P.E.

**LUMINANT GENERATION COMPANY LLC
CCR RULE LOCATION RESTRICTION DEMONSTRATION
BIG BROWN STEAM ELECTRIC STATION – FREESTONE COUNTY, TEXAS
BOTTOM ASH PONDS**

Luminant Generation Company LLC (Luminant) formerly operated the Big Brown Steam Electric Station (BBSES) located approximately 10 miles northeast of Fairfield, Freestone County, Texas. The BBSES consisted of two coal/lignite-fired units with a combined operating capacity of approximately 1,150 megawatts. Coal Combustion Residuals (CCR) including fly ash, bottom ash and boiler slag were generated as part of BBSES unit operation. The BBSES suspended operations in early 2018.

The U.S. Environmental Protection Agency's (EPA's) rule entitled *Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities* (CCR Rule) has established technical requirements for CCR landfills and surface impoundments (See 80 Fed. Reg. 21,302 (Apr. 17, 2015); 83 Fed. Reg. 36,435 (July 30, 2018)). The following surface impoundments at the BBSES have been identified as Existing CCR Surface Impoundments regulated under the CCR Rule:

- North Bottom Ash Pond (NBAP); and
- South Bottom Ash Pond (SBAP).

The NBAP and SBAP (collectively referred to as the "Bottom Ash Ponds" or "BAPs") are located approximately 1,500 feet northwest of the BBSES power plant (Figure 1). The NBAP and SBAP are located immediately adjacent to each other and share an interior earthen embankment. Due to their proximity to each other, the NBAP and SBAP are considered one CCR surface impoundment (identified as the "BAPs) under the CCR Rule.

Golder Associates Inc. (Golder) was retained by Luminant to evaluate the BAPs against the five (5) applicable location restriction criteria for existing CCR surface impoundments described in Sections 257.60 through 257.64 of the CCR Rule. This memorandum sets forth Luminant's location restriction demonstrations and corresponding certifications required by the CCR Rule.

LOCATION RESTRICTION DEMONSTRATION – SUMMARY OF FINDINGS/CONCLUSIONS

This location restriction demonstration concludes that the BAPs satisfy each of the five (5) CCR Rule location restriction criteria for existing CCR surface impoundments (placement above the uppermost aquifer, wetlands, fault areas, seismic impact zone and unstable areas):

- The base of the BAPs was determined to be > 5.0 feet above the upper limit of the uppermost aquifer satisfying the separation criteria defined in §257.60.
- The BAPs were determined to not be located in wetlands as per §257.61.
- Based on the available published geologic data and information reviewed, the nearest known fault to the BAPs is located approximately 8 miles northwest of the BBSES. Therefore, the BAPs satisfy the location restriction criteria presented in §257.62.
- The BAPs were determined to not be located in a Seismic Impact Zone as per §257.63.
- The BAPs were determined to not be located in an Unstable Area as per §257.64.

A professional engineering certification that covers all five location restriction evaluations is included on page 10 of this memorandum.

MEMORANDUM ORGANIZATION

The memorandum is organized as follows:

SECTION 1.0 - Location Restriction Criteria & CCR Unit Description

SECTION 2.0 - Placement Above Uppermost Aquifer

SECTION 3.0 - Wetlands

SECTION 4.0 - Fault Areas

SECTION 5.0 - Seismic Impact Zone

SECTION 6.0 - Unstable Areas

SECTION 7.0 - Limitations

SECTION 8.0 - Professional Certification

FIGURE 1 – Site Plan – Bottom Ash Ponds

SECTION 1.0 Location Restriction Criteria & CCR Unit Description

LOCATION RESTRICTION CRITERIA

Existing CCR Surface Impoundments must comply with the following five location restrictions described in Sections 257.60 through 257.64 of the CCR Rule:

- §257.60 – Placement above the Uppermost Aquifer
- §257.61 – Wetlands
- §257.62 – Fault Areas
- §257.63 – Seismic Impact Zone
- §257.64 – Unstable Areas

The CCR Rule requires that the CCR Surface Impoundment owner or operator certify that the CCR Unit meets the specified location restriction requirements by October 17, 2018 for continued operation of the CCR Unit.

CCR UNIT DESCRIPTION

The BAPs received recovered overflow from bottom ash dewatering bins and other BBSES process wastewater sources and are considered an existing CCR Surface Impoundment under the CCR Rule. The BAPs were originally constructed in the late 1960s and were relined with a 3-foot thick compacted clay liner in 1989-1990. The NBAP and the SBAP are each approximately 1,400 feet long by 250 feet wide. The BAPs are constructed partially above and partially below grade and are surrounded by engineered earthen embankments that extend approximately 14 to 21 feet above grade.

Section 2.0 Placement Above Uppermost Aquifer

Section 257.60(a) of the CCR Rule states:

- a) *New CCR landfills, existing and new CCR surface impoundments, and all lateral expansions of CCR units must be constructed with a base that is located no less than 1.52 meters (five feet) above the upper limit of the uppermost aquifer, or must demonstrate that there will not be an intermittent, recurring, or sustained hydraulic connection between any portion of the base of the CCR unit and the uppermost aquifer due to normal fluctuations in groundwater elevations (including the seasonal high water table). The owner or operator must demonstrate by the dates specified in paragraph (c) of this section that the CCR unit meets the minimum requirements for placement above the uppermost aquifer.*

Section 257.53 of the CCR Rule defines uppermost aquifer as follows:

- Aquifer: a geologic formation, group of formations, or portion of a formation capable of yielding usable quantities of groundwater to wells or springs.
- Uppermost aquifer: the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers that are hydraulically interconnected with this aquifer within the facility's property boundary.

Golder evaluated the distance between the base of the BAPs and the uppermost aquifer by comparing the documented elevation of the base of the pond liner and historical maximum groundwater elevations as measured from monitoring wells in the vicinity of the ponds. The upper limit of the uppermost aquifer in the vicinity of the BAPs was calculated to be approximately Elev. 314 feet MSL and the base of the pond liner is located at approximately Elev. 325 ft MSL. As a result, the separation between the base of the unit and the upper limit of the uppermost aquifer was confirmed to be greater than five feet, and therefore, the BAPs comply with the requirements of §257.60(a).

Section 3.0 Wetlands

Section 257.61(a) of the CCR Rule states:

- a) *New CCR landfills, existing and new CCR surface impoundments, and all lateral expansions of CCR units must not be located in wetlands, as defined in §232.2 of this chapter, unless the owner or operator demonstrates by the dates specified in paragraph (c) of this section that the CCR unit meets the requirements of paragraphs (a)(1) through (5) of this section.*

40 CFR 232.2 defines wetlands as follows:

- Wetlands: Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

The BAPs were originally constructed in the 1960s on an upland site located in a developed industrial area that is part of the BBSES power plant. To determine if the BAPs are located in wetlands, the U.S. Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) website was reviewed by Golder. Although the BAPs themselves are represented on the NWI maps as “permanently flooded freshwater basins that were excavated by humans”, wastewater discharges from the BBSES are regulated under Texas Pollution Discharge Elimination System (TPDES) permit WQ0001309000 and the BAPs are part of the BBSES wastewater management system. As a result, the BAPs were designed and constructed to meet Clean Water Act requirements and are therefore not considered federally jurisdictional wetlands in accordance with 33 CFR § 328.3(b)(1).

Based on the NWI maps and the construction characteristics of the BAPs, the BAPs are not “located in wetlands” as per §257.61(a), and the BAPs satisfy the wetlands location restriction criterion.

Section 4.0 Fault Areas

Section 257.62(a) of the CCR Rule states:

- a) *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 time unless the owner or operator demonstrates by the dates specified in paragraph (c) of this section that an alternative setback distance of less than 60 meters (200 feet) will prevent damage to the structural integrity of the CCR unit.*

Section 257.53 of the CCR Rule defines Holocene as the most recent epoch of the Quaternary period, extending from the end of the Pleistocene Epoch (11,700 years before present) to present.

Golder evaluated the potential for existence of CCR Rule-defined faults in proximity to the BAPs based on geologic maps and documents published by the United States Geological Survey (USGS). The nearest known mapped faults to the BAPs are located approximately 8 miles of the BBSES, which greatly exceeds the 200-foot distance prescribed in the CCR Rule. As a result, the BAPs comply with the requirements of §257.62(a).

LUMINANT

Section 5.0 Seismic Impact Zone

Section 257.63(a) of the CCR Rule states:

- a) *New CCR landfills, existing and new CCR surface impoundments, and all lateral expansions of CCR units must not be located in seismic impact zones unless the owner or operator demonstrates by the dates specified in paragraph (c) of this section that all structural components including liners, leachate collection and removal systems, and surface water control systems, are designed to resist the maximum horizontal acceleration in lithified earth material for the site.*

Section 257.53 of the CCR Rule defines these terms as follows:

- Seismic impact zone: an area having a 2% or greater probability that the maximum expected horizontal acceleration, expressed as a percentage of the earth's gravitational pull (g), will exceed 0.10g in 50 years.
- Lithified earth material: all rock, including all naturally occurring and naturally formed aggregates or masses of minerals or small particles of older rock that formed by crystallization of magma or by induration of loose sediments. This term does not include man-made materials, such as fill, concrete, and asphalt, or unconsolidated earth materials, soil, or regolith lying at or near the earth surface.
- Maximum horizontal acceleration in lithified earth material: the maximum expected horizontal acceleration at the ground surface as depicted on a seismic hazard map, with a 98% or greater probability that the acceleration will not be exceeded in 50 years, or the maximum expected horizontal acceleration based on a site-specific seismic risk assessment.
- Structural components: liners, leachate collection and removal systems, final covers, run-on and run-off systems, inflow design flood control systems, and any other component used in the construction and operation of the CCR unit that is necessary to ensure the integrity of the unit and that the contents of the unit are not released into the environment.

Golder evaluated the location of the BAPs relative to seismic impact zones using maps and documents published by the United States Geological Survey (USGS). The BAPs are located in an area with peak ground accelerations between 0.02g and 0.04g, which is well below the maximum acceleration of 0.10g specified in the CCR Rule to be considered a Seismic Impact Zone. As a result, the BAPs are not located in a Seismic Impact Zone as defined in the CCR Rule and therefore comply with § 257.63(a).

Section 6.0 Unstable Areas

Section 257.64(a) of the CCR Rule states:

- a) *An existing or new CCR landfill, existing or new CCR surface impoundment, or any lateral expansion of a CCR unit must not be located in an unstable area unless the owner or operator demonstrates by the dates specified in paragraph (d) of this section that recognized and generally accepted good engineering practices have been incorporated into the design of the CCR unit to ensure that the integrity of the structural components of the CCR unit will not be disrupted.*

Section 257.53 of the CCR Rule defines unstable area as follows:

- Unstable area: a location that is susceptible to natural or human-induced events or forces capable of impairing the integrity, including structural components of some or all of the CCR unit that are responsible for preventing releases from such unit. Unstable areas can include poor foundation conditions, areas susceptible to mass movements, and karst terrains.
- Poor Foundation Conditions: those areas where features exist which indicate that a natural or human-induced event may result in inadequate foundation support for the structural components of an existing or new CCR unit.
- Areas Susceptible to Mass Movement: those areas of influence (i.e., areas characterized as having an active or substantial possibility of mass movement) where, because of natural or human-induced events, the movement of earthen material at, beneath, or adjacent to the CCR unit results in the downslope transport of soil and rock material by means of gravitational influence. Areas of mass movement include, but are not limited to, landslides, avalanches, debris slides and flows, soil fluctuation, block sliding, and rock fall.
- Karst terrain: an area where karst topography, with its characteristic erosional surface and subterranean features, is developed as a result of dissolution of limestone, dolomite, or other soluble rock. Characteristic physiographic features present in karst terrain include, but are not limited to, dolines, collapse shafts (sinkholes), sinking streams, caves, seeps, large springs, and blind valleys.

Under § 257.64(b), the following factors must be considered when determining whether an area is unstable:

- on-site or local soil conditions that may result in significant differential settling;
- on-site or local geologic or geomorphic features; and
- on-site or local human-made features or events (both surface and subsurface).

Golder completed a CCR Rule Structural Stability Assessment Report for the BAPs in 2012 and updated the assessment in 2016. The Structural Stability Assessment Report concluded that the soils underlying the BAPs were stable. As a result, the BAPs are not located in an unstable area as defined in the CCR Rule.

Section 7.0 Limitations

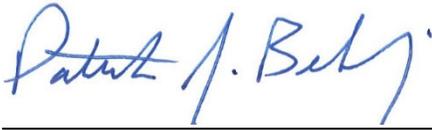
In preparing this evaluation, Golder has reviewed historic, design and investigative information and other data furnished by Luminant. Golder has relied on this information in completing the location restriction evaluations for the BAPs.

The conclusions presented in this memorandum assume that subsurface site conditions in the vicinity of the BAPs reasonably match those conditions associated with site borings, laboratory testing results, etc. The reported conclusions are also based on our understanding of current site operations, maintenance and CCR management practices at the BBSES at the current time as provided by Luminant.

LUMINANT

Section 8.0 Professional Certification

I, Patrick J. Behling, being a Registered Professional Engineer in good standing in the State of Texas, do hereby certify, to the best of my knowledge, information, and belief, that the information contained in this CCR Rule Location Restrictions Demonstration has been prepared in accordance with the accepted practice of engineering. I certify that the CCR Unit described in this report and as explained further in the CCR Rule Location Restriction Evaluation – Big Brown Steam Electric Station Bottom Ash Ponds, Golder Associates, Inc. October 10, 2018, meets the requirements of 40 CFR Sections 257.60 through 257.64.



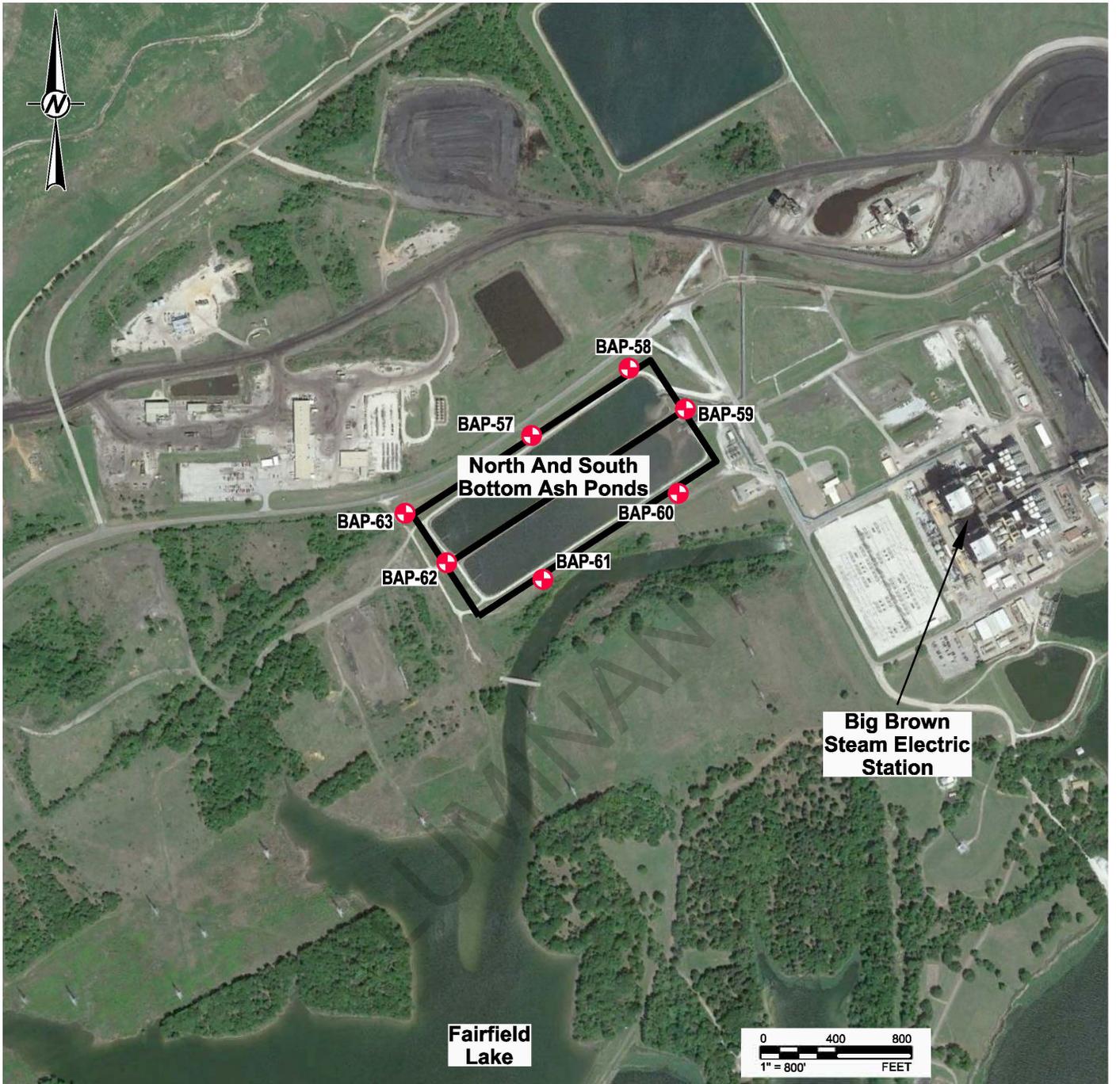
Patrick J. Behling, P.E.
Principal Engineer
Texas PE No. 79872
Golder Associates Inc.
Texas Engineering Firm No. 2578



LUMINA

LUMINANT

Figures



LEGEND



CCR MONITORING WELL LOCATION

CLIENT
LUMINANT GENERATION COMPANY LLC

PROJECT
BIG BROWN STEAM ELECTRIC STATION
BOTTOM ASH PONDS
CCR RULE LOCATION RESTRICTION DEMONSTRATION
TITLE
SITE PLAN

CONSULTANT



YYYY-MM-DD	2018-10-10
DESIGNED	AJD
PREPARED	AJD
REVIEWED	PJB
APPROVED	PJB

REFERENCE(S)
IMAGERY FROM GOOGLE EARTH DATED 3/30/2017.

PROJECT NO.
18107517

REV.
0

FIGURE
1