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REPORT ON

PERIODIC STRUCTURAL STABILITY ASSESSMENT
POND 001 – CELL 002
THOMAS HILL ENERGY CENTER
CLIFTON HILL, MISSOURI

by Haley & Aldrich, Inc.
Cleveland, Ohio

for Associated Electric Cooperative, Inc.
Clifton Hill, Missouri

File No. 128064-003
October 2016

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17 October 2016
File No. 128064-003

Associated Electric Cooperative, Inc.
Thomas Hill Energy Center
5693 Highway F
Clifton Hill, Missouri 65244

Attention: Ms. Kim Dickerson
Senior Environmental Analyst

Subject: Initial Periodic Structural Stability Assessment
Pond 001 - Cell 002
Thomas Hill Energy Center
Clifton Hill, Missouri

Ms. Dickerson:

Enclosed please find our report on the Initial Periodic Structural Stability Assessment for the Associated Electric Cooperative, Inc. (AECI) Pond 001 - Cell 002 (Cell 002) coal combustion residuals (CCR) surface impoundment located at the Thomas Hill Energy Center (THEC) in Clifton Hill, Missouri.

This work was performed by Haley & Aldrich, Inc. (Haley & Aldrich) on behalf of AECI utilizing the standards from the US Environmental Protection Agency's (EPA's) Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities, 40 CFR Part 257, specifically §257.73(d). This regulation was used as a standard by which to assess this impoundment, but the regulatory status of the impoundment at the time of this assessment does not necessitate completion of this assessment under the regulation.

The scope of our work consisted of the following: 1) obtain and review readily available reports, investigations, plans and data pertaining to the Cell 002 surface impoundment; 2) visit the site to observe Cell 002; 3) evaluate whether the design, construction, operation, and maintenance of Cell 002 are consistent with recognized and generally accepted good engineering practices; and 4) prepare and submit this report presenting the results of our assessment including recommendations.

Thank you for inviting us to complete this assessment and please feel free to contact us if you wish to discuss the contents of the report.

Sincerely yours,
HALEY & ALDRICH, INC.

Steven F. Putrich, P.E.
Project Principal

Enclosures

Cc: Mark Brownstein-Haley & Aldrich

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by Haley & Aldrich, Inc.
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List of Figures

1. General

1.1 AUTHORITY

Haley & Aldrich, Inc. (Haley & Aldrich) has been contracted by Associated Electric Cooperative, Inc. (AECI) to perform this Periodic Structural Stability Assessment (Assessment) for the AECI Pond 001 – Cell 002 (Cell 002) coal combustion residuals (CCR) surface impoundment located at Thomas Hill Energy Center (THEC) in Clifton Hill, Missouri. This work was performed by Haley & Aldrich, Inc. (Haley & Aldrich) on behalf of AECI utilizing the standards from the US Environmental Protection Agency's (EPA's) Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities, 40 CFR Part 257 (CCR Rule), specifically §257.73(d). This regulation was used as a standard by which to assess this impoundment, but the regulatory status of the impoundment at the time of this Assessment does not necessitate completion of this Assessment under the regulation.

In 2015, AECI constructed a separator berm which splits Cell 002 into east and west portions. The eastern portion (Cell 002 East) had CCRs removed prior to October 2015 and is considered closed. The western portion (Cell 002 West) is considered inactive under the CCR Rule as of October 2015. Cell 002 East and Cell 002 West share the same southern berm evaluated under this Assessment, therefore this assessment covers overall Cell 002.

1.2 PURPOSE OF STRUCTURAL STABILITY ASSESSMENT

The purpose of this Periodic Structural Stability Assessment was to document whether the design, construction, operation, and maintenance of Cell 002 are consistent with recognized and generally accepted good engineering practices.

The scope of our work consisted of the following: 1) obtain and review readily available reports, investigations, plans and data pertaining to the Cell 002 surface impoundment; 2) visit the site to observe Cell 002; 3) evaluate whether the design, construction, operation, and maintenance of Cell 002 are consistent with recognized and generally accepted good engineering practices; and 4) prepare and submit this report presenting the results of our evaluation, including recommendations.

2. Description and Operation of Cell 002

2.1 DESCRIPTION OF CELL 002

Cell 002 is a CCR surface impoundment located to the south of the Thomas Hill power plant. Cell 002 was originally designed by Burns & McDonnell in 1978-1979 and constructed shortly thereafter. It is understood that Cell 002 was modified in the 1980's when Cell 001 was constructed along with additional internal modifications made in 2015.

Cell 002 is incised on the east and west sides. On the north side, Cell 002 abuts the 3H:1V downward slope from the Cell 001 processing pad/containment berm which is up to 30 ft higher in elevation than Cell 002. The remaining portion of the northern side is incised as well.

On the south side, an 18-ft wide embankment separates Cell 002 and Cell 003. The embankment is constructed from clay fill obtained from an on-site borrow source. The embankment is underlain by naturally deposited medium stiff to very stiff clay and silty clay. The south interior slope of Cell 002 is typically 3H:1V, while the south exterior slope varies from about 3H:1V to 2H:1V.

Cell 002 was originally used for settling of CCR sluiced from the power plant. In recent years, the north central portion of Cell 002 was used for temporary storage and processing of bottom ash and boiler slag removed from Cell 001, while the southern portion of the impoundment received free liquid draining from the stockpiled CCR removed from Cell 001 and placed in the processing area. The previous temporary storage area was removed in 2015.

In 2015, a separation berm was constructed to divide Cell 002 into separate and distinct eastern and western basins with the following functions:

- Cell 002 East – The eastern basin had CCR removed prior to 2015 and now functions as an unlined surface impoundment, serving as a non-CCR stormwater detention basin. Discharge from the eastern basin is via the concrete drop inlet decant structure built during the original construction of Cell 002. When the water level in the basin reaches the level of the poured concrete weir in the decant structure, water enters the structure and flows to Cell 003 through a discharge pipe that runs through the common Cell 002/003 embankment.

- Cell 002 West – The western basin is currently an unlined, inactive CCR surface impoundment that contains legacy CCR. The basin is currently being pumped to maintain a dry condition to facilitate the ongoing removal of CCR. Discharge from the western basin is via a 15-in. diameter corrugated metal pipe (CMP) which penetrates the Cell 002/003 embankment and discharges into Cell 003. This outlet pipe has not been activated since its installation in 2015.

The 400-ft long separation berm was constructed from compacted clay fill obtained from an on-site borrow source. The separation berm includes a compacted clay seepage cutoff trench keyed into the underlying natural clays, and an aggregate surfaced access roadway on top of the berm at El. 720.

2.2 OPERATION, MAINTENANCE AND INSPECTION

Cell 002 and the other cells within the Pond 001 system are operated and managed by AECI personnel in accordance with AECI's "Operating and Management Plan" dated December 14, 2012 (Reference 1).

Although not required at the time of this Assessment, AECI personnel are conducting 7-day and annual inspections of the Cell 002 impoundment in accordance with the standards of EPA's Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities, 40 CFR Part 257.83. No instrumentation exists in the dike for the 30-day inspection. In addition, the impoundment is inspected following heavy rain events.

Maintenance of the impoundment includes regular mowing of grass, seeding of thinly vegetated areas, control of woody growth, repair of erosion as needed, and inspection of the drain mechanisms.

Operation of the Cell 002 eastern basin includes monitoring and regulating water levels in the impoundment.

Current operation of the Cell 002 western basin includes pumping accumulated water to maintain a dry condition, excavating and cleaning drainage channels to facilitate drainage to the pump, and removal of CCR from the impoundment.

3. Structural Stability Assessment

3.1 REVIEW OF EXISTING INFORMATION

For this assessment, Haley & Aldrich reviewed multiple sources of information including:

- Report on the Initial Annual Inspection performed by AECI completed using the standards of 40 CFR §257.83, dated January 19, 2016
- Previous inspection reports of the adjacent impoundments and shared embankments by GEI (on behalf of EPA) and Geotechnology, Inc.
- Operating and Management Plan
- Topographic plans and aerial photos
- Design/construction drawings
- Subsurface information
- Geotechnical laboratory test results
- Slope stability evaluations
- Construction records
- Correspondence
- Variety of other information in addition to verbal information provided by AECI during our assessment.

Our review included, but was not limited to the references listed in Appendix A.

3.2 SITE VISIT AND FIELD OBSERVATIONS

On 30 August 2016, Haley & Aldrich visited Thomas Hill Energy Center to observe conditions at Cell 002, and to meet with AECI personnel to discuss operations and maintenance of the impoundment. Prior to the site visit, we reviewed previous inspection reports including the above-referenced Initial Annual Inspection Report by AECI, and previous inspection reports referenced above and listed in Appendix A. At the time of our site visit, Cell 002 East was at normal pool level and Cell 002 West was drained and undergoing maintenance of the drainage channels to facilitate drainage to the pump located in the southeastern corner of the impoundment.

3.3 STRUCTURAL STABILITY ASSESSMENT

In accordance with the standards of 40 CFR §257.73(d), a CCR surface impoundment is evaluated to determine whether the design, construction, operation, and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering practices.

Haley & Aldrich reviewed the information provided to us and visited the site to observe Cell 002. Based on our review of available information and observations during our 30 August 2016 site visit, we have concluded the following in accordance with the standards of 40 CFR §257.73(d):

1. *§257.73(d)(1)(i): Stable foundations and abutments.*

   Based on our review of available subsurface information, construction records, design reports, impoundment inspection reports, geotechnical laboratory test results, slope stability analyses, and observations during our 30 August 2016 site visit, Cell 002 was judged to have stable foundations.

The Cell 002 embankments have not exhibited signs of excessive settlement, instability or other signs of inadequate foundation support.

2. *§257.73(d)(1)(ii): Adequate slope protection to protect against surface erosion, wave action, and adverse effects of sudden drawdown.*

   Cell 002 East - The Cell 002 East interior slopes are vegetated for the full height of the slopes. Based on observations during our 30 August 2016 site visit, the slope protection on the interior slopes was in good condition and was judged to provide adequate slope protection against surface erosion, wave action and adverse effects from sudden drawdown. The exterior slopes of the Cell 002 eastern basin are vegetated for the full height of the slopes and were judged to have adequate slope protection.

   Cell 002 West - The Cell 002 West interior slopes are vegetated for the full height of the slopes, with the exception of the west slope. Based on observations during our 30 August 2016 site visit, the vegetative slope protection on the interior slopes was judged to provide adequate slope protection against surface erosion, wave action and adverse effects from sudden drawdown.

   The west interior slope was mostly bare ground as a result of the ongoing removal of CCR from the impoundment. As noted above, Cell 002 West is currently inactive and is being pumped to maintain a dry condition to facilitate the ongoing removal of CCR.

   The exterior slopes of the Cell 002 West are limited to the separation berm and south embankment which divides Cell 002 and Cell 003. These slopes are vegetated for the full height and were judged to have adequate slope protection.

3. *§257.73(d)(1)(iii): Dikes mechanically compacted to a density sufficient to withstand the range of loading conditions in the CCR unit.*

   Constructed dikes around Cell 002 include the Cell 002 separation berm and new slope from the Cell 001 processing and containment pad, in addition to the south embankment which separates Cell 002 from Cell 003.

   The separation berm and new slope from the processing pad were both constructed in 2015. The contract documents included specifications for compaction of the embankment fill. In addition, the construction records include results of field compaction testing of the embankment fill.

   Construction records are not available for the south embankment. However, in 2010, Geotechnology, Inc. performed one test boring and one cone penetrometer sounding through the south embankment fill and into the underlying natural soils. The subsurface explorations indicate the embankment fill consists of stiff clay with trace silt and sand.

   During our 30 August 2016 site visit, we observed no evidence of slope instability or other signs of inadequate compaction of the embankment fill. In addition, based on the information reviewed for this Assessment, there has been no historic evidence of slope instability or other signs of inadequate embankment compaction.

Based on our review of construction records, subsurface exploration logs, and other available information on the Cell 002 embankments, as well as our observations during the 30 August 2016 site visit, we have concluded the fill soils used to construct the Cell 002 embankments were mechanically compacted.

4. §257.73(d)(1)(iv): *Vegetated slopes of dikes and surrounding areas not to exceed a height of six inches above the slope of the dike, except for slopes which have an alternate form or forms of slope protection.*

   The vegetation on the interior and exterior slopes of Cell 002 East was typically 6 to 12 inches in height at the time of our 30 August 2016 site visit.

   In the inactive Cell 002 West, the vegetation was generally 6 to 12 inches in height. At the time of our site visit, a strip of vegetation existed along the toe of the south and west interior slopes that was up to approximately 2 ft in height. However, while we were on site, AECI was mowing with a recently purchased specialized mower that attaches to the boom of a Cat 330 long-reach excavator. The excavator has a 60-ft reach, enabling the equipment to mow areas that were previously inaccessible, which included the strip of taller vegetation at the toe of the slope. It is understood from discussions with AECI that this area was mowed shortly after our site visit.

5. §257.73(d)(1)(v)(A): *Spillway Erosion Protection – All spillways must be either: (1) Of non-erodible construction and designed to carry sustained flows; or (2) Earth- of grass-lined and designed to carry short-term, infrequent flows at non-erosive velocities where sustained flows are not expected.*

   The spillway in Cell 002 East consists of a concrete decant structure located in the southeast corner of the impoundment. The concrete construction is non-erodible and designed to carry sustained flows.

   The spillway in Cell 002 West consists of a 15-in. diameter corrugated metal pipe that penetrates the common Cell 002/003 embankment. Since its installation in 2015, the western basin has been maintained in a dry condition and the spillway pipe has not been activated. The metal construction of the pipe is non-erodible and designed to carry sustained flows.

6. §257.73(d)(1)(v)(B): *Spillway Capacity – The combined capacity of all spillways must adequately manage flow during and following the peak discharge from a: (1) Probable maximum flood (PMF) for a high hazard potential CCR surface impoundment; or (2) 1000-year flood for a significant hazard potential CCR surface impoundment; or (3) 100-year flood for a low hazard potential CCR surface impoundment.*

   The spillway capacity will be modeled in the future as part of future capacity requirements similar to those required under §257.82 Hydrologic and Hydraulic Capacity Requirements for CCR surface impoundments. The CCR Rule discussed that as the understood analysis within the CCR Rule Preamble reference to the same section.

7. *§257.73(d)(1)(vi): Hydraulic structures underlying the base of the CCR unit or passing through the dike of the CCR unit that maintain structural integrity and are free of significant deterioration, deformation, distortion, bedding deficiencies, sedimentation, and debris which may negatively affect the operation of the hydraulic structure.*

   Cell 002 East hydraulic structures include the rectangular concrete decant structure and outlet pipe. Flow entering the decant structure is conveyed through the Cell 002 south embankment and discharges underwater into Cell 003. The decant structure has some surface pitting on the concrete but was judged to be in good condition overall.

   The discharge pipe is buried within the south embankment and is not visible. There are no signs of ground settlement above or around the pipe. No sediment or debris was observed at either end of the outlet pipe.

   The only hydraulic structure in Cell 002 West is the 15-in. diameter corrugated metal pipe that penetrates the south embankment. The pipe was installed in 2015 and has not carried any flow since it was installed.

8. *§257.73(d)(1)(vii): For CCR units with downstream slopes which can be inundated by the pool of an adjacent water body, such as a river, stream or lake, downstream slopes that maintain structural stability during low pool of the adjacent water body or sudden drawdown of the adjacent water body.*

   There are no natural water bodies in the vicinity of Cell 002. Cell 003 exists immediately to the south of Cell 002 and shares the south dike of Cell 002. The water level in Cell 003 is controlled by AECI using stop logs in the Cell 003 decant structure. Cell 003 has been drained on multiple occasions in the past and never resulted in instability of the Cell 002 south embankment. In addition, slope stability analyses performed by Geotechnology, Inc. (Reference 4) confirm the embankment's stability. AECI may want to consider updated analysis of a rapid drawdown of Cell 003 as part of any future stability analyses performed form the unit.

9. *§257.73(d)(2): Identify any structural stability deficiencies associated with the CCR unit in addition to recommending corrective measures.*

   Our Structural Stability Assessment identified no structural stability deficiencies at Cell 002. However, we recommend the following maintenance actions:

   a. Maintain height of vegetation in accordance with §257.73(d)(1)(iv).

   b. Update the Operating and Management Plan to reflect recent modifications to Cell 002 including the separator berm and new spillway pipe in the western basin, as well as the current functions of the Cell 002 eastern and western basins.

   c. Complete updated rapid drawdown of downstream Cell 003 as part of any future structural analyses performed for the Cell 002 dike.

4. Conclusions/Certification

Based on our review of the information provided to us and observations during our 29 August 2016 site visit, it is our opinion that the design, construction, operation, and maintenance of Pond 001 - Cell 002 at Thomas Hill Energy Center is consistent with recognized and generally accepted good engineering practices for the maximum volume of CCR and CCR wastewater which can be impounded in Cell 002.

I certify that this Periodic Structural Stability Assessment for AECI's Pond 001 – Cell 002 at the Thomas Hill Energy Center was conducted in accordance with the standards of §257.73(d) of the USEPA's CCR Rule.

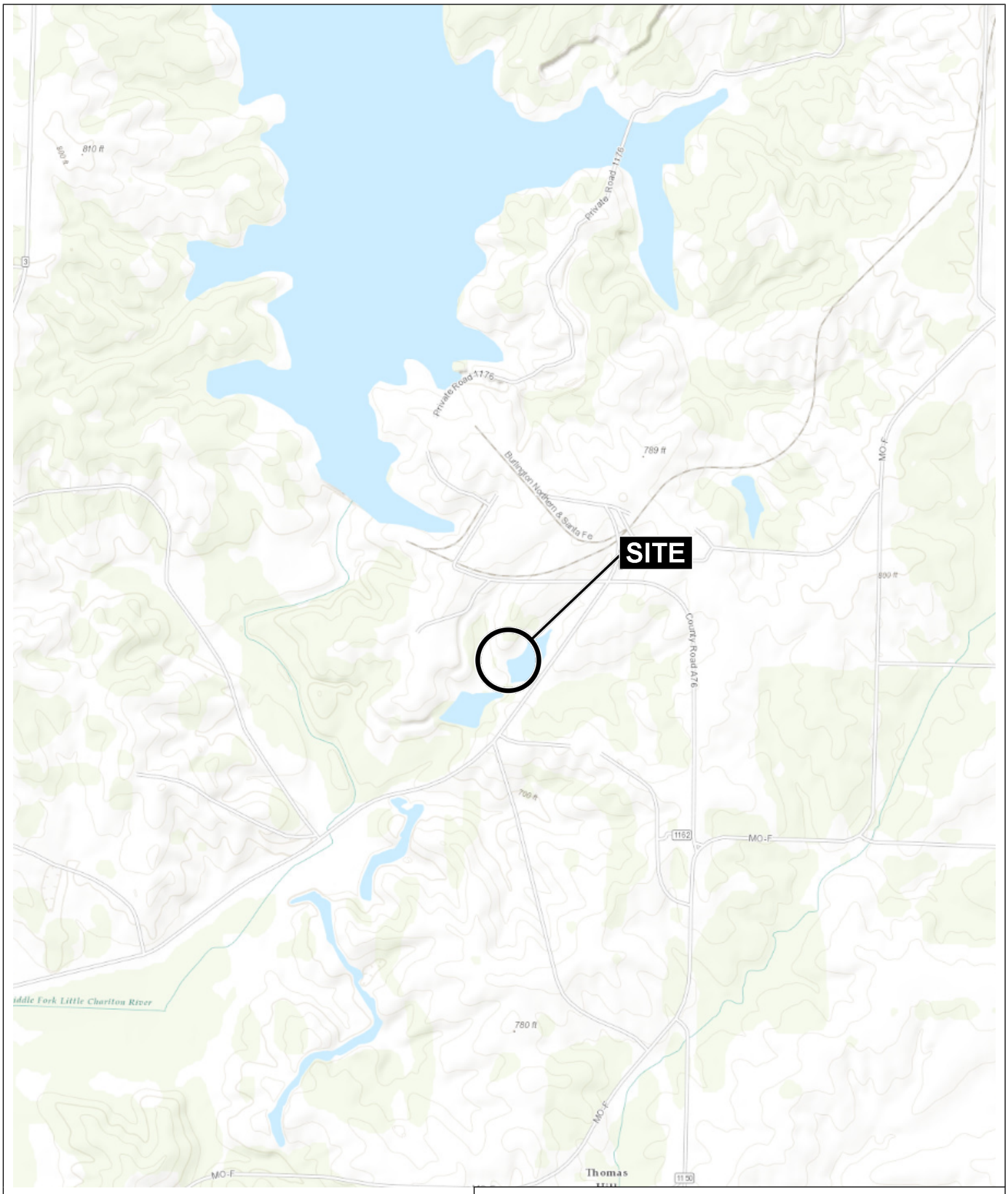
Signed:_____

Certifying Engineer

Print Name: Steven F. Putrich
Missouri License No.: 2014035813
Title: Project Principal
Company: Haley & Aldrich, Inc.

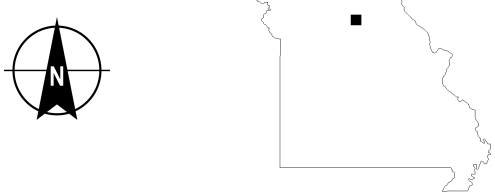
Professional Engineer's Seal:

HALEY ALDRICH



MAP SOURCE: ESRI

SITE COORDINATES: 39°32'51"N, 92°38'10"W



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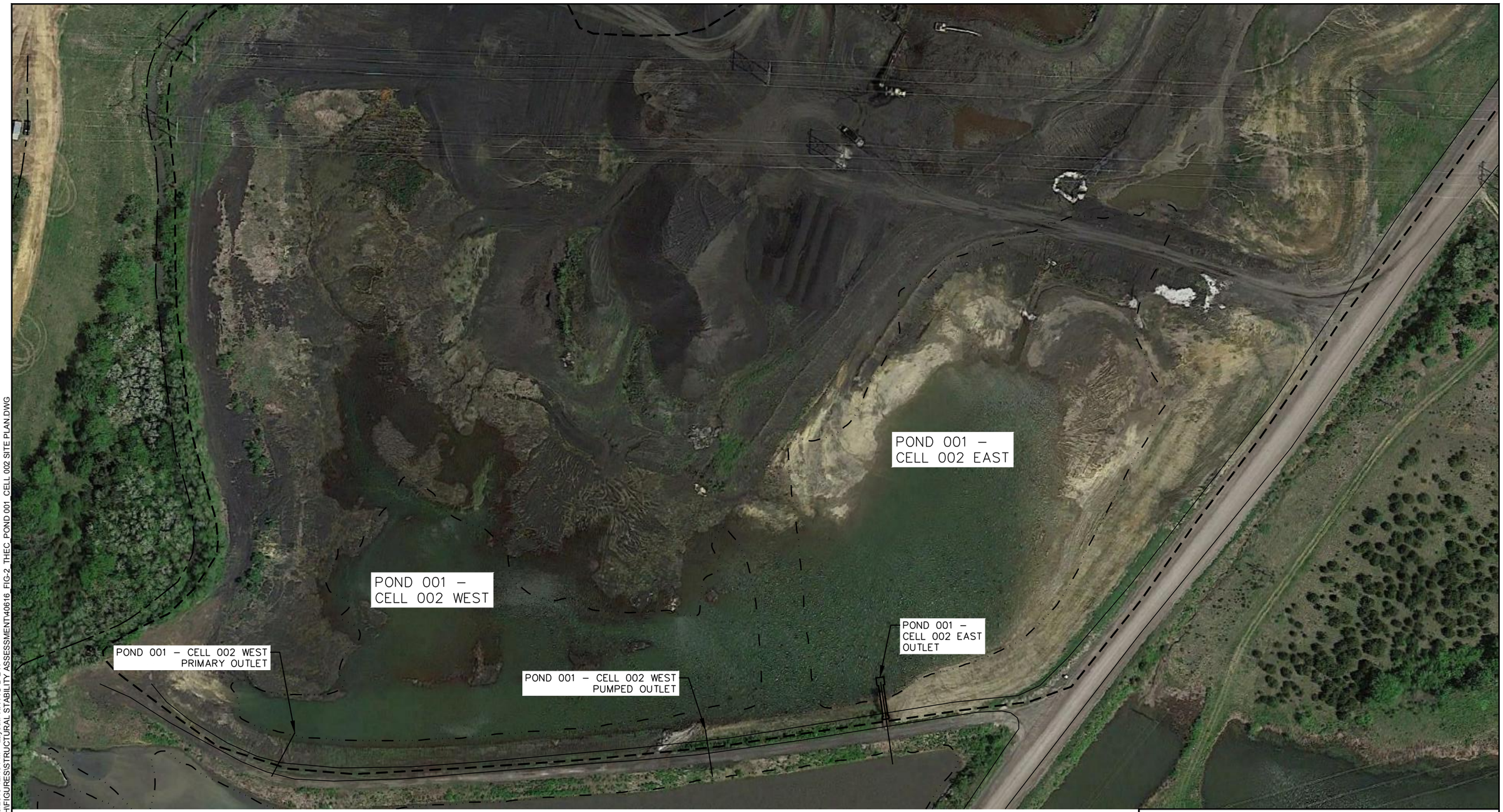
ASSOCIATED ELECTRIC COOPERATIVE, INC.
THOMAS HILL ENERGY CENTER
CLIFTON HILL, MISSOURI

POND 001 - CELL 002
PROJECT LOCUS

APPROXIMATE SCALE: 1 IN = 2000 FT
OCTOBER 2016

FIGURE 1

128064_1_LOCUS.PDF



LEGEND

- APPROXIMATE IMPOUNDMENT BOUNDARY
- WATER
- PIPE
- DITCH
- ROAD

NOTES

1. AERIAL IMAGERY PROVIDED BY GOOGLE EARTH PRO. PHOTO TAKEN ON 11 MAY 2015.

N

0 120 240

SCALE IN FEET

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ASSOCIATED ELECTRIC COOPERATIVE, INC.
THOMAS HILL ENERGY CENTER
CLIFTON HILL, MISSOURI

POND 001 - CELL 002 SITE PLAN

SCALE: AS SHOWN
OCTOBER 2016

FIGURE 2

LUCAS, ANDY Printed: 10/16/2016 12:49 PM Layout: HA-FIG-B-L-H
C:\USERS\ALUCAS\DESKTOP\CAD-TH\FIGURES\STRUCTURAL STABILITY ASSESSMENT\40616_FIG-2_THEC_POND 001_CELL 002_SITE PLAN.DWG

APPENDIX A

References

References

1. AECI, “Pond #001, the Ash Pond Series Operating and Management Plan,” revised December 14, 2012.

2. AECI, “Report: Initial Annual CCR Surface Impoundment PE Inspection, Ash Pond 001 – Cell 001, Cell 002, Cell 003, Cell 004,” dated January 19, 2016.

3. Burns & McDonnell, Various Construction Drawings, dated 1979 and 1984.

4. GEI Consultants, “Specific Site Assessment for Coal Combustion Waste Impoundments at Thomas Hill Energy Center,” dated June 2011.

5. Geotechnology, Inc., “Global Stability Evaluation, Mine Waste and Ash Pond Embankments, AECI Facilities, Bee Veer and Thomas Hill, Missouri,” dated April 22, 2010.

6. Geotechnology, Inc., “Slope Stability and Seepage Analysis, Slag Dewatering Basin, Thomas Hill Energy Center,” dated February 3, 2012.

7. Gredell Engineering Resources, Inc., “CCR Separation Berm - Pond 001 Cell 2 – 2015, Project Description and Specifications,” dated October 1, 2015.

8. Gredell Engineering Resources, Inc., “Pond 001 Cell 2 Separation Berm” Design and Construction Summary Report, dated November 2015.

9. Gredell Engineering Resources, Inc., “Ash Pond 001 Cell 2 Separation Berm” Construction Drawings, dated October 2015.