REPORT

CLOSURE PLAN ADDENDUM NO. 1

Martin Lake Steam Electric Station - A1 Area Landfill
Panola County, Texas

Submitted to:

Luminant Generation Company LLC

Submitted by:

WSP GOLDER

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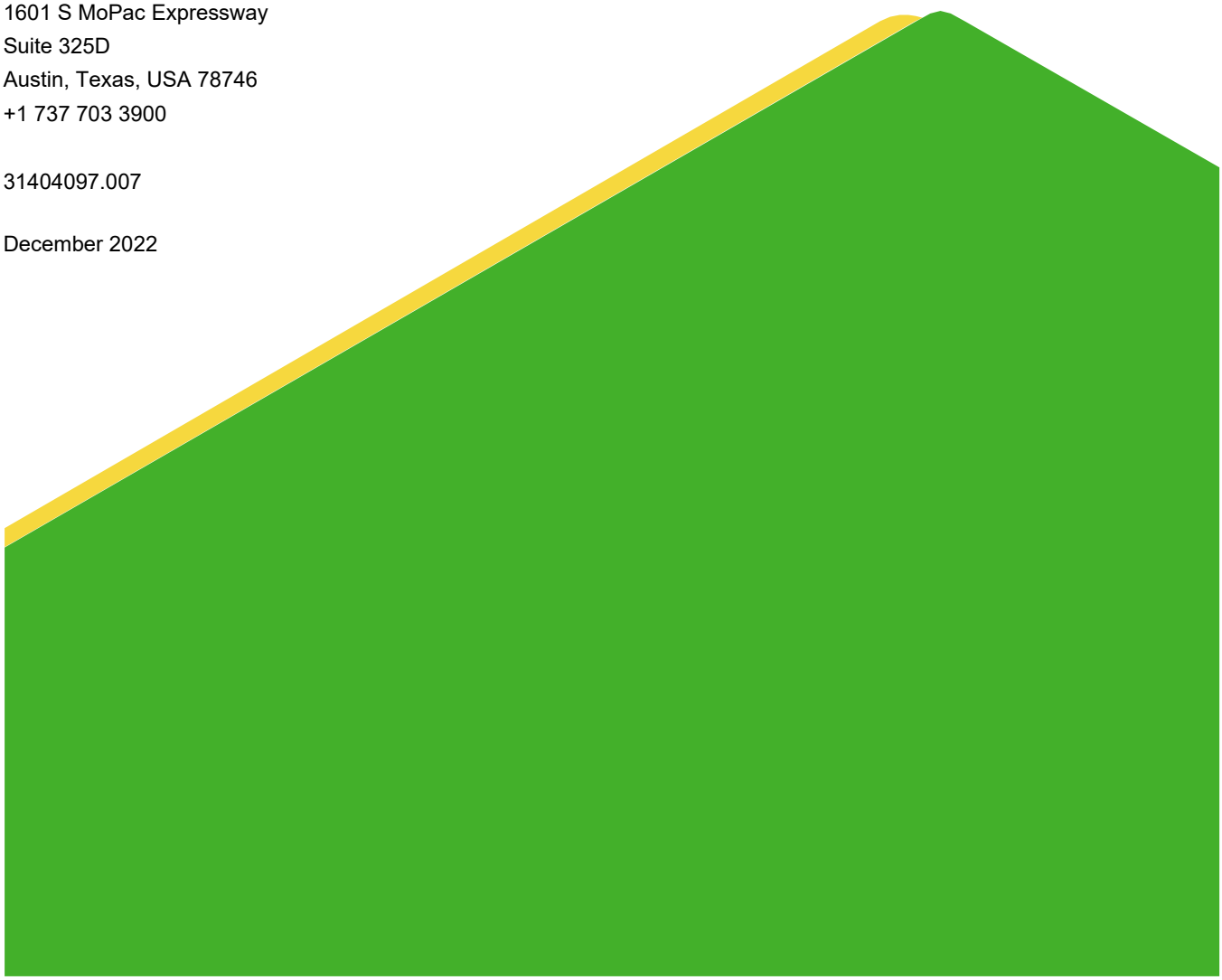
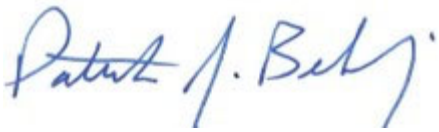
31404097.007

December 2022



PROFESSIONAL CERTIFICATION

This document and all attachments were prepared by WSP Golder under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I hereby certify that Addendum No.1 to the Closure Plan for the A1 Area Landfill at the Martin Lake Steam Electric Station has been prepared in accordance with the requirements of 40 C.F.R. §257.102(b).



Patrick J. Behling, P.E.
Principal Engineer
WSP Golder
Texas Firm Registration No. 22771

Table of Contents

APPENDICES

DOCUMENT REVISION RECORD

Issue No.	Date	Details of Revisions
Revision 0	October 2016	Original Document
Addendum 1	December 2022	Revised configuration of final cap/cover system for A1 Area Landfill, added cap settlement evaluation, added confirmation that cap slope stability will be modeled using site-specific geotechnical data during final closure design, removal of HELP Modeling from Closure Plan, revised closure schedule to state closure will be completed within six months and add estimated completion year, added section addressing the initiation of closure, and added section to address notification citations.

1.0 INTRODUCTION

On behalf of Luminant Generation Company LLC (Luminant), WSP Golder (Golder) has prepared this Addendum No. 1 to the Closure Plan for the A1 Area Landfill (A1 LF) located at the Martin Lake Steam Electric Station (MLSES) in Panola County, Texas (hereafter, the "Site"). Coal Combustion Residuals (CCR) including fly ash, bottom ash, and gypsum generated as part of MLSES operation are disposed in the A1 LF. The A1 LF is regulated as an Existing CCR Landfill under 40 C.F.R. § 257, Subpart D (the "CCR Rule").

The original Closure Plan for the A1 LF was prepared in October 2016 in accordance with 40 C.F.R. §257.102(b) and placed in the MLSES operating record in accordance with 40 C.F.R. §257.105(h)(10) (PBW, 2016). This Addendum No. 1 updates the Closure Plan to reflect the following:

- Revisions to the configuration of the A1 LF cap/cover system to be consistent with recent Texas Commission on Environmental Quality (TCEQ) approved cap modifications;
- Addition of cap settlement evaluation;
- Confirmation that the slope stability of the A1 LF cap/cover system will be modeled using site-specific geotechnical data during design of the final closure of the landfill;
- removal of HELP Modeling from Closure Plan;
- Revisions to the A1 LF closure schedule to state closure will be completed within six months and add estimated completion year;
- Addition of section addressing the initiation of A1 LF closure; and
- Addition of section to address notification citations.

2.0 A1 AREA LANDFILL FINAL CAP/COVER SYSTEM

The A1 LF is the primary disposal facility for CCR generated at the MLSES and is located within a reclaimed section of the nearby Luminant Beckville Mine. The A1 LF is an above grade landfill surrounded by earthen embankments constructed of mine spoil that extend approximately 10 to 20 feet or more above surrounding grade. The bottom of the A1 LF is lined with a 1-foot thick compacted bottom liner consisting of clay-rich mine spoil scarified and re-compacted to achieve an in-place permeability of 1 x 10^{-7} cm/sec or less. The interior faces of the earthen embankments are constructed with a 3-foot thick compacted mine spoil liner designed to achieve an in-place permeability of 1x10^{-7} cm/sec or less.

The A1 LF has been in operation since 1980 and progressive capping/closure of the A1 LF has been performed as placement of CCR in the landfill reached design elevations. Through 2019, capped/closed areas of the landfill have been covered with a 3-foot thick compacted mine spoil cap (in-place permeability of 1x10^{-7} cm/sec or less) covered with a 2-foot thick vegetative cover layer. This cap configuration was included in the 2016 A1 LF Closure Plan (PBW, 2016).

In 2019, Luminant proposed a modification of the A1 LF cap/cover configuration to close future landfill areas to TCEQ (Golder, 2019). The proposed cap modification consisted of the following (from bottom to top):

- a 2-foot thick compacted mine spoil liner layer (in-place permeability of 1x10^{-7} cm/sec or less); and
- a 1.5-foot thick vegetative soil cover layer.

TCEQ approved the proposed cap modification in 2020 and a copy of the TCEQ approval letter is reproduced in Appendix A.

The Closure Plan for the A1 LF is hereby modified to reflect that future landfill areas will be closed using the following final cap/cover system (from bottom to top):

- a 2-foot thick compacted mine spoil liner layer (in-place permeability of 1x10^{-7} cm/sec or less); and
- a 1.5-foot thick vegetative soil cover layer.

The proposed final cap/cover system for the A1 LF must comply with the final cover system requirements of 40 C.F.R. §257.102(d)(3)(i)(A) through (D):

> (A) The permeability of the final cover system must be less than or equal to the permeability of any bottom liner system or natural subsoils present, or a permeability no greater than 1 X 10^{-5} cm/sec, whichever is less.
>
> (B) The infiltration of liquids through the closed CCR unit must be minimized by the use of an infiltration layer that contains a minimum of 18 inches of earthen material.
>
> (C) The erosion of the final cover system must be minimized by the use of an erosion layer that contains a minimum of 6 inches of earthen material that is capable of sustaining native plant growth.
>
> (D) The disruption of the integrity of the final cover system must be minimized through a design that accommodates settling and subsidence.

2.1 Equivalent Infiltration Reduction – A1 Area Landfill Cap/Cover System

The final cap/cover system for the A1 LF must include an infiltration layer that achieves an equivalent reduction in infiltration as the infiltration layer specified in paragraphs 40 C.F.R. §257.102(d)(3)(i)(A) and (B):

(A) The permeability of the final cover system must be less than or equal to the permeability of any bottom liner system or natural subsoils present, or a permeability no greater than 1×10^{-5} cm/sec, whichever is less.

(B) The infiltration of liquids through the closed CCR unit must be minimized by the use of an infiltration layer that contains a minimum of 18 inches of earthen material.

2.1.1 Permeability Comparison Between Landfill Cap and Liner

Compliance of the final cap/cover system to the requirements of 40 C.F.R. §257.102(d)(3)(i)(A) was determined by comparing the estimated liquid flow rate through the A1 LF cap to the estimated liquid flow rate through the A1 LF liner system (The permeability of the clay component of the A1 LF cap is less than $1 \text{ X } 10^{-5}$ cm/sec, so this criterion is not applicable). The results of the comparison are presented below.

- Estimated Liquid Flow Through A1 LF Final Cap/Cover System

  The A1 LF will be capped with a 2-feet thick compacted clay layer with a maximum hydraulic conductivity of $1x10^{-7}$ cm/sec. Flow rate through the A1 LF cap/cover system (per acre of cap area) was estimated using Darcy's Law for gravity flow through porous media as follows:

  - Darcy Equation: $Q=A \text{ X } k \text{ X } (h/t+1)$

    Where:

    Q = flow rate through the clay layer (m^3/s)

    A = cap area perpendicular to the flow (m^2)

    h = head above cap clay layer (m)

    t = thickness of cap clay layer (m)

    k = hydraulic conductivity of cap clay layer (m/s)

  - Assumptions:

    1) The 2-feet thick cap clay layer is assumed to have a maximum hydraulic conductivity of $1x10^{-7}$ cm/sec.

    2) The hydraulic head above the CCL was assumed to be 12 inches (30.48 cm). This is a conservative assumption for the cap, since the final cap/cover system will be sloped to divert water that infiltrates through the overlying erosion soil layer away from the cap.

    3) A unit cap area of 1 acre was assumed for the evaluation.

  - Flow Rate Through 2-feet Thick Compacted Clay Layer

    A = 1 acre (4046.86 m^2)

    k = $1x10^{-7}$ cm/sec ($1 \text{ X } 10^{-9}$ m/sec)

    h = 1 foot x 30.48 cm/ft = 30.48 cm (0.3048 m)

t = 2 feet X 30.48 cm/ft = 60.96 cm (0.6096 m)

Q = (4046.86 m^2) x (1x10^{-9} m/sec) x ((0.3048 m / 0.6096 m) + 1)

= 6.07x10^{-6} m^3/s per acre of cap or 138 gallons per day per acre of cap

- Estimated Liquid Flow Through A1 LF Liner

  The bottom of the A1 LF is lined with a 1-foot thick compacted bottom liner consisting of clay-rich mine spoil scarified and re-compacted to a maximum hydraulic conductivity of 1x10^{-7} cm/sec. Flow rate through the A1 LF liner (per acre of liner area) was also estimated using Darcy's Law for gravity flow through porous media as follows:

  - Assumptions:

    1) The 1-foot compacted liner is assumed to have a maximum hydraulic conductivity of 1x10^{-7} cm/sec.
    2) The hydraulic head above the liner was assumed to be 12 inches (30.48 cm).
    3) A unit liner area of 1 acre was assumed for the evaluation.

  - Flow Rate Through A1 LF Liner

    A = 1 acre (4046.86 m^2)

    k = 1x10^{-7} cm/sec (1 X 10^{-9} m/sec)

    h = 1 foot x 30.48 cm/ft = 30.48 cm (0.3048 m)

    t = 1 foot X 30.48 cm/ft = 30.48 cm (0.3048 m)

    Q = (4046.86 m^2) x (1x10^{-9} m/sec) x ((0.3048 m / 0.3048 m) + 1)

    = 8.1x10^{-6} m^3/s per acre of liner or 184 gallons per day per acre of liner

The final cap/cover system for the A1 LF complies with the requirements of 40 C.F.R. §257.102(d)(3)(i)(A), since the estimated liquid flow rate through the final cap/cover system (138 gallons per acre per day) is less than the estimated liquid flow rate through the A1 LF liner (184 gallons per acre per day).

2.2.2 Infiltration Comparison of Landfill Cap to 18-Inch Earth Infiltration Layer

The A1 LF cap/cover system includes an infiltration layer consisting of a 2-foot thick compacted mine spoil liner layer with an in-place permeability of 1x10^{-7} cm/sec or less which exceeds the 18 inch minimum specified in 40 C.F.R. §257.102(d)(3)(i)(B).

2.2 Equivalent Erosion Protection – A1 Area Landfill Cap/Cover System

The final cap/cover system for the A1 Landfill includes an 18-inch erosion layer consisting of 12 inches of general fill overlain with 6 inches of soil capable of supporting native vegetation. This complies with the requirements of 40 C.F.R. §257.102(d)(3)(ii)(B), which states that the final cover system must use of an erosion layer that contains a minimum of six inches of earthen material that is capable of sustaining native plant growth.

2.3 Settling and Subsidence – A1 Area Landfill System

40 C.F.R. §257.102(d)(3)(i)(D) states that the disruption of the integrity of the final cover system must be minimized through a design that accommodates settling and subsidence. An evaluation of potential settlement for the final cap/cover systems for the A1 LF is attached as Appendix B to this Addendum. The A1 LF Closure Plan will be updated to include a cap/cover system settlement evaluation using site-specific data during design of the final cap/closure systems for the landfill.

2.4 Slope Stability – A1 Area Landfill Cap/Cover System

The A1 LF Closure Plan will be updated to include cap/cover system slope stability modeling using site-specific geotechnical data during design of the final cap/closure systems for the landfill.

2.5 HELP Modeling in 2016 Closure Plan

The 2016 Closure Plan for the A1 LF included Hydrologic Evaluation of Landfill Performance (HELP) model evaluations to compare the permeability of the then-proposed cap to the landfill liner (PBW, 2016). The HELP model evaluations in the 2016 Closure Plan have been replaced by the infiltration evaluations presented above for the new cap/cover system and have been deleted from this amended Closure Plan.

2.6 Conclusions

The final cap/cover system for the A1 LF described above complies with the final cover system requirements of 40 C.F.R. §257.102(d)(3)(i)(A) through (D).

3.0 A1 AREA LANDFILL CLOSURE SCHEDULE AND NOTIFICATION UPDATES

The closure schedule for the A1 Landfill is described in Section 2.7 and Appendix E of the 2016 Closure Plan (PBW, 2016). The 2016 A1 LF Closure Schedule is updated as follows:

- Initiation of A1 LF Closure. For the purposes of the A1 LF Closure Schedule, Luminant estimates that the MLSES will cease operations in approximately 2045. However, CCR and related waste will continue to be generated after plant operation has terminated as part of facility decommissioning and demolition and the CCR and related waste may be managed in the A1 LF. In accordance with 40 C.F.R. §257.102(e)(2)(i), the A1 LF will commence closure within two years of the date of final receipt of either CCR or non-CCR waste; however, in accordance with 40 C.F.R. §257.102(e)(2)(ii) an additional two years may be required to initiate closure provided Luminant provides written documentation that the A1 LF will continue to accept wastes beyond the original two-year period. For the purposes of the A1 LF Closure Schedule, Luminant estimates that A1 LF Closure will be initiated in approximately 2047.
- Completion of A1 LF Closure. In accordance with 40 C.F.R. §257.102(f)(1)(i), Luminant estimates that final closure of the A1 LF will be completed within 6 months of start of closure or in approximately 2048. It should be noted; however, that 40 CFR §257.102(f)(2) of the CCR Rule allow for extension of the closure schedule in the event that it is not feasible to complete closure of the A1 LF within the required timeframes due to factors beyond the facility's control.

Luminant will provide the following notifications related to closure of the A1 LF:

- In accordance with 40 C.F.R. §257.102(g), Luminant will prepare a notification of intent to close the A1 LF. The notice will be prepared no later than the date of closure initiation, will be sealed by a qualified professional engineer, and will be placed in the MLSES operating record as required by 40 C.F.R. §257.105(i)(7).
- In accordance with 40 C.F.R. §257.102(h), Luminant will prepare a notification of closure of the A1 LF within 30 days of completion of closure. The notice will be sealed by a qualified professional engineer and will be placed in the MLSES operating record as required by 40 C.F.R. §257.105(i)(8).
- In accordance with 40 C.F.R. §257.102(h) Luminant will provide deed notification for the A1 LF Closure.

4.0 REFERENCES

Golder Associates (Golder), 2019. TCEQ Registration Update – A1 Area Landfill, Martin Lake Steam Electric Station. December.

Pastor, Behling & Wheeler, LLC (PBW), 2016. CCR Closure Plan – A1 Area Landfill, Martin Lake Steam Electric Station. October.

APPENDIX A

TCEQ Approval Letter – A1 Area Landfill Cap Modification

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

January 23, 2020

Ms. Kimberly D. Mireles
Sr. Director, Environmental Services
Luminant Generation Company LLC
6555 Sierra Drive
Irving, TX 75039-2479

Re: Title 30 Texas Administrative Code Section (§) 335.6 Notification
Luminant Generation Company LLC - Irving, Rusk County
Hazardous Waste Permit No. None
Industrial Solid Waste Registration No. 31277
EPA Identification No. TXD000821306
Tracking No. 24891671; RN102583093/CN603256413

Dear Ms. Mireles:

The Industrial and Hazardous Waste Permits Section of the Texas Commission on Environmental Quality hereby acknowledges receipt of your notification letter dated December 20, 2019 which was received on December 23, 2019. The notification was submitted in accordance with Title 30 Texas Administrative Code (TAC) §335.6. Your letter provides an update for the A1 Area Landfill at the Luminant Martin Lake Steam Electric Station (MLSES) in Rusk County, Texas. Luminant Generation Company LLC (Luminant) is proposing to modify the cap configuration for future capped/closed areas of the A1 Area Landfill (NOR Unit No. 002).

Progressive capping/closure for 428 acres of the landfill, when the landfill reached design elevations, included covering the landfill with 3-foot compacted mine spoil cap (in-place permeability ≤ 1x10-7 cm/sec) covered with 2-foot thick vegetative cover layer. Luminant is proposing to modify the cap configuration for future capped/closed areas of the landfill to consist of a 2-foot thick compacted mine spoil layer (in-place permeability ≤ 1x10-7 cm/sec) covered with a 1.5-foot thick vegetative cover layer.

The A1 Area Landfill is an existing landfill where Coal Combustion Residuals (CCR) wastes are disposed. CCR wastes were regulated under 30 TAC 335 until CCR rule became effective on October 19, 2015. Closure of existing CCR landfills must comply with the requirements of 40 CFR 257.102 until State of Texas CCR regulations are promulgated and become effective. The final cover requirements for the CCR landfill are provided under 40 CFR 257.102(d)(3)(i). Based on the information provided in your notification, it appears that the proposed cap configuration for future capped/closed areas of the landfill to consist of a 2-foot thick compacted mine spoil layer (in-place permeability ≤ 1x10-7 cm/sec) covered with a 1.5-foot thick vegetative cover layer will meet the final cover requirements under 40 CFR 257.102(d)(3)(i)(A) -(D). You may begin your proposed waste management activities at your earliest convenience.

Please be aware that your facility may be subject to requirements other than 40 CFR 257 (i.e., requirements of Texas Water Code and Clean Air Act) which may be applicable to your proposed activities.

Please also be aware that it is the continuing obligation of persons associated with a site to ensure that municipal hazardous waste and industrial solid waste are managed in a manner which does not cause the discharge or imminent threat of discharge of waste into or adjacent to waters in the state, a nuisance, or the endangerment of the public health and welfare as required by 30 TAC §335.4. If the waste management activities fail to comply with these requirements, the burden remains upon Luminant Generation Company LLC to take any necessary and authorized action to correct such conditions.

If you have any questions or comments, please contact Mr. Rama S. Yadav, P.E., P.G. at (512) 239-6784. When responding by letter, please include mail code MC-130 in the address.

Sincerely,

Gulay Aki, Team Leader
Industrial & Hazardous Waste Permits Section
Waste Permits Division
Texas Commission on Environmental Quality

RSY/GA/gg

APPENDIX B

Evaluation of Potential Cap/Cover System Settlement

Bullock, Bennett & Associates, LLC

www.bbaengineering.com

165 N. Lampasas St. • Bertram, Texas 78605 • (512) 355-9198

December 2, 2022

Mr. Pat Behling
WSP Golder
1601 S MoPac Expressway
Suite 325D
Austin, Texas, USA 78746

Re: Evaluation of Potential for Landfill Cap Settlement, A-1 Landfill – Martin Lake Steam Electric Station, Rusk County, Texas

Dear Mr. Behling:

As requested by WSP Golder, Bullock, Bennett & Associates, LLC (BBA) has evaluated the proposed cap system at the A-1 Landfill (A-1 LF) at the Martin Lake Steam Electric Station (MLSES) located in Rusk County, Texas – specifically in regard to the suitability of the proposed cap system to accommodate anticipated settlement. This evaluation is based on the most recent design drawings dated September 2016, provided to BBA by WSP Golder. No site-specific geotechnical data for the coal combustion residuals (CCR) fill material was provided to BBA for this analysis, and no site-specific consolidation or settlement data for on-site soils were provided; therefore, general assumptions regarding typical soil and CCR properties are made in this evaluation. It is BBA's understanding that site-specific soils and CCRs will be tested for engineering properties and that a detailed engineering settlement analysis using the on-site data and final design criteria will be completed prior to final cap construction activities.

The original Closure Plan for A-1 LF was prepared in October 2016 (PBW, 2016). The 2016 Closure Plan included use of a 3-foot-thick compacted clay liner system. To date, portions of the A-1 LF have been progressively capped using the 3-foot-thick clay system overlain by a 2-foot-thick vegetative soil cover. WSP Golder submitted a TCEQ Registration Update on December 20, 2019 that modified the proposed cap system to be constructed during future capping, to consist of a 2-foot-thick clay cap with an 18-inch-thick vegetative soil cover. This Registration Update was approved by TCEQ in a letter dated January 23, 2020:

The grades, slopes, etc. for the revised A-1 LF final cap/cover system will remain as presented in the 2016 A-1 LF Closure Plan.

The landfill cap will tie into the perimeter earth embankment system constructed of clay-rich mine spoil, which ranges from approximately 10- to 20- feet or more above the surrounding natural grades. The perimeter earth embankment was constructed in thin lifts of compacted embankment fill meeting engineering specifications.

<u>Engineering Properties of CCR Fill Material Underlying the Proposed Cap System</u>:

CCR fill materials for A-1 LF include mostly bottom ash and some flue gas desulfurization material (FGD, or gypsum). These CCRs are non-plastic and moderately to highly permeable (typically drain better than clays and silts) and are well suited as fill materials[1,2,3]. The coefficient of consolidation of bottom ash when compared to typical soils is typically low and decreases with incremental loading and time. This indicates the bottom ash possesses load taking ability and that structures, or in this case a landfill cap, lying above the ash will undergo gradual settling and not suffer large deformation - making ash well suited as a fill material.[1] According to the American Coal Ash Association approximately 3.63. million metric tons (4.0 million tons) of bottom ash were used in structural fill applications in 2006 (ACAA 2007). Structural fill and embankment material is the largest use of bottom ash in the US.[2] FGD material has engineering properties that also make it suitable for use as embankment fill.[3] BBA has experience in capping multiple impoundments and landfills in Texas containing bottom ash and gypsum and has performed annual engineering inspections for years following final capping activities at these facilities and has observed very little cap settlement.

Based upon review of the A-1 LF bottom and proposed cap elevations, it appears there will be a layer of dry-placed CCRs approximately 50 to 100-feet thick under the proposed cap system.

Subsurface Conditions:

The bottom of the A-1 LF is lined with a 1-foot thick layer of clay-rich mine spoil scarified and re-compacted to achieve an in-place permeability of 1×10^{-7} cm/sec or less. Subsurface conditions below the compacted bottom liner consist of up to 150 feet or more of low permeability, clay-rich mine spoil material that has been in place for approximately 40 years.

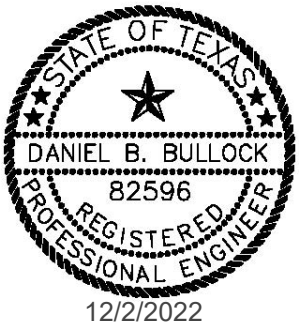
Based on review of the proposed cap system and technical specifications for materials and placement, evaluation of typical CCR engineering properties, the perimeter embankment system, and the site underlying subsurface conditions, it appears the cap design for A-1 LF is designed appropriately to accommodate settling and subsidence and will minimize the disruption of the integrity of the final capping system. Final cap grade designs include a 3% slope that will promote storm water drainage off the cap system, and these slopes appear sufficient to accommodate anticipated settlement while continuing to maintain positive surface water drainage. In addition, MLSES will conduct regularly scheduled cap inspections during post-closure care, and any settlement identified will be addressed to maintain cap design functions.

Please feel free to contact me at (512) 355-9198 if you have any questions about this submittal, or if I can be of any further assistance.

Sincerely,

Bullock, Bennett & Associates, LLC

Dan Bullock, PE (TX 82596)
Principal Engineer
Texas Professional Engineering Firm No. F-8542



12/2/2022

(1) One-Dimensional Consolidation of Sedimented Stowed Pond Ash, Devi Presad Mishra and Samir Kumar Das Document: Geotech Geol Eng (2012) 30:685-695 DOI 10.1007/s10706-011-9486-x
(2) User Guideline for Coal Bottom Ash and Boiler Slag in Green Infrastructure construction, Craig H. Benson and Sabrina Bradshaw. December 2011. Recycled Materials Resource Center, University of Wisconsin-Madison.
(3) User Guideline for Flue Gas Desulfurization Material in Green Infrastructure construction, Craig H. Benson and Sabrina Bradshaw. December 2011. Recycled Materials Resource Center, University of Wisconsin-Madison