Ameren Missouri November 18, 2013 Response to Andrews Engineering's Comments Re: Labadie Landfill

Ameren Missouri's responses to comments appended to Andrews Engineering's *October 8, 2013* correspondence to Franklin County are set forth below:

Groundwater Comments

Background

On April 8, 2011, the Missouri Department of Natural Resources ("MDNR") issued its approval of the Detailed Site Investigation ("DSI") conducted by Ameren Missouri and its consultants regarding property located in Franklin County ("the County") and adjacent to the Labadie Energy Center. As regulatory pre-requisite to submitting a Construction Permit Application (CPA), an applicant must perform a Preliminary Site Investigation ("PSI") and a DSI. Those evaluations which consider a variety of hydrogeologic and geologic conditions were included along with the use of a model (from Monitoring Network Design Package ("MAP"), by Golder Associates, Inc. (1992) to define the locations of a groundwater monitoring well network associated with the proposed Labadie UWL. All such assessments (groundwater modeling, DSI, groundwater monitoring plan) have undergone extensive agency review pursuant to MDNR's Solid Waste Management Program, the Geologic Survey Program and, as appropriate, the Water Pollution Program. Such submittals were prepared in accordance with Missouri regulations and MDNR requirements. On March 7, 2013, MDNR approved the Groundwater Detection Monitoring System for a Proposed Utility Waste Landfill in Franklin County. Accordingly the site evaluation phase of the project has concluded and once MDNR approves the revised CPA, Ameren Missouri's focus is on landfill design and construction.

The County has engaged Andrew's Engineering, Inc. as its Independent Registered Professional Engineer ("IRPE") under the County's Landfill Ordinance to review the DSI and CPA. Andrews Engineering has provided written comments as a result of their reviews. Subsequent to a November 12, 2013 meeting with the County and the IRPE, Ameren Missouri agreed to install seven (7) additional groundwater monitoring wells to monitor UWL Phase 1. This includes four (4) shallow and two (2) deep wells downgradient of UWL Phase 1 and one (1) deep well immediately upgradient of UWL Phase 1.

All of the wells will be monitored in accordance with the routine groundwater monitoring requirements. The downgradient deep wells will be statistically compared to the background concentrations established by sampling the upgradient deep well. In addition the deep wells will be used to calculate the vertical gradients using data collected contemporaneously at the adjacent shallow well.

The proposed groundwater monitoring network is now comprised of a total of 35 monitoring wells all located approximately 70 to 460 feet from the landfill base (outside toe). Thirty-two (32) of the wells are finished at depths of approximately 16 to 25 feet within the shallow portion of the aquifer and three (3) wells will be screened in the deeper portion of the aquifer. Attached is a figure that depicts the landfill layout and accompanying groundwater monitoring network including the locations of the seven (7) newly proposed wells. Monitoring wells MW-29 through MW-32 are located north of Cell 2 and will monitor the shallow portion of the aquifer.

As indicated above, the deep wells will be used to determine groundwater quality a nd gradient data. In order to determine vertical gradients the deep wells need to be installed within approximately ten (10) feet of a shallow well location. Therefore the proposed locations are within approximately ten (10) feet of wells MW-30 and MW-05 for hydraulically downgradient locations and MW-25 for the upgradient location. The three deep wells will be screened over a ten (10) feet interval approximately seventy-five (75) to eighty-five (85) feet below the existing ground surface.

Ameren Missouri will collect data during the installation of the deep wells to determine the textural and geologic classification of the aquifer. Such data will consist of disturbed soil samples collected in a Standard Penetration Test (ASTM D1586) at about 5-foot intervals and continuous logging by a qualified geologist. Laboratory testing of the soil samples will consist of grain-size analyses. The grain-size analyses and the N-values from the SPT testing will be used to estimate the bulk porosity and horizontal coefficient of permeability at the depth of each sample. Following installation of the wells, Ameren Missouri will obtain water level and water quality data on a routine schedule to obtain 8 representative background data sets. These data will be evaluated to determine the apparent direction of horizontal flow and gradient. Vertical flow and gradients will be determined using similar data from the shallow groundwater monitoring wells.

Engineering Comments

1. **(Bearing Capacity of the Subgrade and Impact on Liner and Leachate Collection)**

Calculate the bearing capacity of the subgrade in varying locations throughout the footprint. Additionally, calculate the bearing capacity during a maximum credible seismic event which induces liquefaction during each phase of construction and filling of the landfill. (Article 10, Section 238 C.3 & 10 CSR 80-11.010(5)(A)4.A)

Bearing capacity analysis has been performed on static conditions. The factor of safety slightly exceeded 1.0. The model analysis had multiple error codes which are typically indicative of improper input parameters. No explanation of the error codes was provided other than the stability software's output.

RESPONSE: Missouri regulations require a settlement and bearing analysis be performed for all stages of construction on the "in place foundational material beneath the disposal area." *10 CSR 80-11-010 (5) (A) 4A.* Contrary to the comment and citation to the regulation, the regulation does not require the plan to "calculate the bearing capacity during a maximum credible seismic event which includes liquefaction during each phase of construction and filling of the landfill." Rather, the regulation states: "*Settlement and bearing capacity shall be performed on the in-place foundation material beneath the disposal area. The effect of the foundation material settlement on the liner and leachate collection system shall be evaluated." 10 CSR 80-11-010 (5) (A) 4A.* (In any event, a liquefaction stability analysis (as depicted in Figure E-2 and similar Figures) does in fact show the bearing capacity of the UWL foundation soils with liquefaction at multiple locations and for various phases of construction. Those analyses contemplate a seismic event of magnitude (Mw) 7.5 and a peak horizontal ground acceleration (PHGA) of 0.179g and assesses the impact of potential liquefaction at various locations within the UWL where liquefaction might occur. See also Response to Comment 26).

Ameren Missouri has performed the bearing capacity analysis required by *10 CSR 80-11-010 (5) (A) 4A* which confirmed that the weight of the expected landfill mass will be protective of the liner and leachate collection system. Specifically, the bearing capacity analysis included in Appendix J, Section 6.4 of the August 2013 CPA demonstrates that UWL's factor of safety against bearing capacity failure is 2.0, which conforms to generally accepted engineering practice. The error codes in the output from the SLIDE software program are not the result of input errors, but boundary conditions. Boundary conditions will be properly established in all future modeling runs to eliminate error codes where feasible. The software analyzes tens of thousands of potential failure surfaces within the parameters requested, some of which are not feasible; the error codes merely notify the user that those trial surfaces were considered.

2. **(Final Cover System)**

On Sheet 19, the Perimeter Ditch at Closure shows 12" of cover soils over the geomembrane with no clay liner beneath the geomembrane. A minimum of two feet of soil cover must be over the landfilled CCR. Additionally, erosion protection in the perimeter ditch is necessary to prevent exposure of the geomembrane. (Article 10, Section 238 C.3. & 10 CSR 80-11.010(14)(C)3.)

This has not been revised and still remains an outstanding issue. This issue can be handled in a permit condition that requires two feet soil required in the final cover and the stormwater perimeter ditches are part of the cover system due to the fact that they are directly over waste. No erosion protection exists in the design and will need to be addressed during construction.

RESPONSE: Missouri regulations permit MDNR to authorize the use of alternative landfill cover systems. Specifically, *10 CSR 80-11-010 (14)(C)5* provides "*[t]he department may approve the use of an alternative final cover system provided that the owner/operator can demonstrate that the alternative design will be at least equivalent to the final cover system described in paragraph (14)(C)3 of this rule.*" Ameren Missouri has elected to use a synthetic geomembrane system similar to that approved by MDNR at the Sioux Energy Center UWL. Ameren Missouri has proposed to MDNR an alternative final cover system comprised of geomembrane component overlain by at least 1 foot of soil to support vegetative growth. Missouri regulations require a minimum final cover to include 1 foot of compacted clay with a permeability of 1x10-5 cm/sec or less, overlain by 1 foot of soil capable of sustaining vegetative growth. The final cover in Labadie UWL perimeter ditch will include a 40-mil HDPE liner overlain with 1 feet of vegetative soil, while the final cover for the remainder of the UWL will include a 40-mil HDPE liner overlain with 2 feet of vegetative soil as indicated in Section 3.12 of the August 2013 CPA. . The adequacy of this alternative landfill cover system was demonstrated in the Modification to Construction Permit Number 0918301 for the Sioux Energy Center UWL that was approved by MDNR on February 8, 2013. Ameren will comply with future modifications to UWL regulations that may necessitate revisions to final cover system requirements.

10 CSR 80-11-010 (14)(C)3 states *"As each phase of the utility waste landfill is completed, a final cover system shall be installed of* ***one foot (1')*** *of compacted clay ... and overlaid with one foot of soil capable of sustaining vegetative growth."* 10 CSR 80-11.010(1) states *"...If techniques other than those listed as satisfactory compliance in design or operation are used, it is the obligation of the utility waste landfill owner/operator to demonstrate to the department in advance that the techniques to be employed will satisfy the requirement..."* The use of a much less permeable HDPE liner in lieu of 1 foot of compacted clay is a more conservative cover system than required by 10 CSR 80-11.010(14)(C)3 and is consistent with other landfill cover systems approved by MDNR. Nevertheless, Ameren intends to employ two feet of soil over the majority of the UWL surface area and one foot of soil in the stormwater channels (over a geomembrane) as outlined above with erosion protection within the stormwater channels where flow velocities exceed 3 ft/sec.

(3) **(Modeling to Assess Liquefaction)**

Liquefaction has been determined to occur in multiple layers. When reviewing the post-liquefied shear strengths provided in the table for the stability analysis, they don't match the shear strengths from correlation charts based upon the SPT blow counts. The chart referenced in the Reitz & Jens report was H. Bolton Seed's 1987 chart. Seed and Harder updated this chart with additional information in 1990 and this chart is available with a 3rd Order Best-Fit curve to simplify the correlation. Please provide the graphed correlations providing the residual shear strengths based upon the SPT blowcount corrected for the percentage of fines. (Article 10, Section 238 C.3; 10 CSR 80-11.010(5)(A)4. & Draft Technical Guidance Document on Static and Seismic Slope Stability for Solid Waste Containment Facilities produced by The Solid Waste Management Program/DEQ/MDNR and Timothy D. Stark, Ph.D., P.E. Associate Professor of Civil Engineering, Department of Civil Engineering, University of Illinois at Urbana-Champaign).

The model runs have been revised with some new values but the Table E-1 has not been revised so the values don't correlate between the model runs and the table. Additionally, the model runs have the revised inputs with the reduced cohesive values but resulted in higher FOS. Please explain how the model was revised to obtain a higher FOS when using reduced cohesive values.

RESPONSE: Pursuant to *10 CSR 80-11.010(5)(A)4,* the applicant must perform stability analyses for all stages of construction as follows: settlement and bearing capacity, *11.010(5)(A)4A*; stability analysis on all liner and leachate system components, *11.010(5)(A)4B*; structural strength to support maximum loads imposed by overlying materials and equipment, *11.010(5)(A)4C*; waste mass stability and intermediate and final slope grade conditions, *11.010(5)(A)4D*. Ameren Missouri has performed each of these assessments and the results can be found in Appendix J, Section 6.1.3 of the August 2013 CPA.

The Seed and Harder, 1990 empirical relationship was compared with 8 other published criteria. The criteria for estimating the shear resistance of liquefied soils used in the initial analyses are consistent with Seed and Harder (1990) for N-values up to about 10 blows per foot (for weak or loose soils). The stability analyses were rerun using the residual strengths of the liquefied soils per the recent criterion by Idriss and Boulanger (2008), corrected for fine soil content. The factors of safety (FS) decreased by 0.068 or less, which is less than the accuracy of the analyses (which MDNR-SWMP and Stark states is about $\pm 5\%$). Also, the original stability analyses were run assuming that liquefaction could occur under the completed UWL where other analyses showed that liquefaction would not occur. If the liquefiable soil strata were limited to those areas where it may still occur within the completed UWL, then the FS shown in Table E-2 increased to between 1.50 and 1.81. However, since the original liquefaction analysis was more conservative, and thus adequately protective, the original results were reported in Table E-1 and E-2. The additional modeling runs using justified appropriate values to demonstrate that the FS exceeds the minimums provided in MDNR-SWMP and Stark's Guidance Document will be included in Appendix J of the CPA.

(4) **(Ground Water Monitoring Wells)**

The waste boundary should be reduced to allow the groundwater monitoring wells to be installed in the area of the DSI. If the wells are installed outside the area of the DSI, the data from the wells must be compiled and correlated to existing DSI data and provided as an addendum to the DSI. (Article 10, Section 238 C.3; 10 CSR 80-2.015(1)(D) & 10 CSR80-2.015 Appendix I) No revisions were made pertaining to this comment. The geologic data from the new groundwater monitoring wells that were installed needs to be used to update the DSI.

RESPONSE: The subsurface information obtained during groundwater monitoring well installation was compiled and submitted to MDNR and DGLS in the "Groundwater Detection Monitoring Wells Installation Report" dated May 9, 2013. This data has been correlated with the existing DSI data to verify the consistency of the geology. The proposed landfill is located within the area defined and evaluated by the DSI and monitoring wells have been located approximately 70 to 460 feet from the base (outside toe) of the landfill. MDNR's published guidance provides that wells be "*located outside but not greater than 500 feet from the anticipated limit of the area". 10 CSR 80-2.015; Appendix I, Monitoring Wells*. The monitoring well network is intended to "evaluate the potential for migration of fluids generated by the utility waste landfill." *11 CSR 80- 011 8 (B)3.* The monitoring well network serves that purpose. Further, as noted above, at the request of the County, Ameren Missouri will install seven (7) additional monitoring wells (4 shallow and 3 deep) to augment the monitoring network.

(5) **(Construction of Stormwater Ponds)**

Section 4.1.2 Sequence of Phase Construction describes the construction sequence of each phase. The Phase 1 Construction Sequence doesn't discuss the timing of constructing the stormwater pond, but Phases 3 and 4 Construction Sequence discusses constructing the stormwater ponds after placing CCR in the phase area. The construction of each stormwater pond and the CQA report for each must be approved prior to placing CCR into the phase area associated with the stormwater pond. (40 CFR Part 122.26; 10 CSR 20-6.200)

No revisions were made. The construction of each stormwater pond and the CQA report for each must be approved prior to placing CCR into the phase area associated with the stormwater pond. A condition could be added to the construction permit to require that the stormwater ponds are constructed and permitted prior to the operating permit for each associated cell.

RESPONSE: Construction of stormwater ponds will occur in conjunction with construction of the landfill so that stormwater can be properly managed at the site. Accordingly, permits for the construction of stormwater ponds will be obtained from MDNR as appropriate prior to the operation of the pond associated with a specific phase of the landfill. In Section 4.1.2 of the CPA to be re-submitted, Ameren will clarify that Pond 1 will be constructed concurrently with Phase 1; Pond 2 will be constructed concurrently with Phase 3; and Pond 3 will be constructed concurrently with Phase 4. CQA reports will be completed for each pond and submitted concurrently with the CQA report for the applicable cell prior to issuance of the MDNR operating permit and Franklin County operating license.[1]

(6) **(Seismic Risk Analysis)**

The information provided in Section 5.3 Estimate of Yield Acceleration and Lateral Spreading for the short-duration time history appears to be incorrect and/or not the most critical based upon the provided charts. The data provided for the short-duration time history came from chart #10 (page C-9) when chart #2 (page C-10) provide a higher peak rock acceleration =0.25 and PHGA = 0.24 based upon the output provided from SHAKE2000 analysis using the same soil profile. The values provided are for the unfilled conditions. Additional model runs were completed for the filled conditions for use in the final cover but not discussed in this section. Provide a narrative with the Appendix C

[1] In this comment, the IRPE also suggests that a "condition could be added to the construction permit..." Because the County does not require or issue a UWL construction permit, we assume that this comment may suggest a condition under the County's Operating License should the County so chose.

Results of Seismic Risk Analyses to detail the assumptions and correlate the model analysis from the inputs to the generated results. Update this information and use it in your modeling. (Article 10, Section 238 C.3; 10 CSR 80-11.010(5)(A)4. & Draft Technical Guidance Document on Static and Seismic Slope Stability for Solid Waste Containment Facilities produced by The Solid Waste Management Program/DEQ/MDNR and Timothy D. Stark, Ph.D., P.E. Associate Professor of Civil Engineering, Department of Civil Engineering, University of Illinois at Urbana-Champaign)

RESPONSE: The comment notes that additional modeling runs have been performed as reflected in Sub-Appendix C of Appendix J in the August 2013 CPA and requests a narrative description of the assumptions and correlations be provided. The description was in Section 6.1.2 of Appendix J in the August 2013 CPA. The additional computer runs will be added to Sub-Appendix C of Appendix J in the CPA.

(7) **(Geomembrane Liner and Clay Interface)**

Friction angles for the geomembrane/clay interface appear to be too high. The direct shear testing performed on the interface did not adequately displace the interface and the normal loads were low. The displacement testing should be on the order of inches and the normal stresses need to meet the full capacity of the landfill design. Additionally, at lower normal stresses, the critical interface may occur between the geomembrane and geotextile or geocomposite. All of the designs need to be analyzed to have the proper inputs for stability analysis. The bottom liner illustrated as detail 3/17 Bottom Liner and Leachate Collection Detail shows a smooth geomembrane, not a textured HDPE geomembrane as was tested and provided in Appendix A-1 of Appendix J. The interface friction angle (15 degrees) utilized in the Analysis and Design of Veneer Cover Soils, Figure E-42, is a more representative value for textured HDPE geomembranes/clay interface. (Article 10, Section 238 C.3; 10 CSR 80-11.010(5)(A)4.B. & Draft Technical Guidance Document on Static and Seismic Slope Stability for Solid Waste Containment Facilities produced by The Solid Waste Management Program/DEQ/MDNR and Timothy D. Stark, Ph.D., P.E. Associate Professor of Civil Engineering, Department of Civil Engineering, University of Illinois at Urbana-Champaign)

This comment was not addressed. Direct shear analysis of the clay liner borrow material and the textured HDPE for the composite liner will need to be properly tested and analyzed during preparation of the construction specifications to verify the permanent cumulative deformation analysis.

RESPONSE: This comment addresses the level of friction between the clay and the HPDE liner. Circular sliding surfaces were used for the global stability analyses in accordance with standard practice. A plane with lower shear strength properties would be "invisible" to a circular sliding surface because only the tangent point at the interface would have the lower shear strength (see discussion by MDNR-SWMP and Stark). Therefore, the shear strength properties of the clay liner, and the gravel leachate collection layer if used, were reduced to account for the probable lower shear strength at the interface. This is conservative because it assigns a reduced shear strength to all of the increments of the trail sliding surface that are in the clay liner. Minimum shear strength properties of the interface were used for the stability analyses that assumed trial sliding surfaces consisting of multiple planes because the critical sliding surface would be along the interface. Section 10.1 in Appendix J of the August 2013 CPA states that all of the engineering properties of the clay and associated interfaces will be tested to verify that the proposed clay liner material meets or exceeds all of the design assumptions. Ameren Missouri agrees with the comment and a testing and analysis requirement using Spencer's Method will be included as part of the procurement and construction bid process. The testing and analysis will be provided to Franklin County's IRPE for review and approval.

(8) **(Air Pressure Tests of Liner)**

The Construction Quality Assurance Plan inadequately addresses the requirements in 10 CSR 80- 11.010(6)(B)1.A. "A detailed description of the QA/QC testing procedures that will be used for every major phase of construction. The description must include at a minimum, the frequency of inspections, field testing, laboratory testing, equipment to be utilized, the limits for test failure, and a description of the procedures to be used upon test failure;" Specifically, this section should include tables showing the frequency and acceptable test result values for each testing procedure. The Air Pressure Testing of seams cannot allow a drop of 4 psi during the 5 minute test. It must not drop more than 10% of the equalized pressure of at least 25 psi. (Article 10, Section 238 C.3 & 10 CSR 80-11.010(6)(B)1.A.)

RESPONSE: Ameren Missouri agrees that the liner system should be properly air tested during construction and will employ industry standard air pressure tests to assess liner seams during construction. The CQA Plan (Appendix P) will be modified in the CPA to reflect the industry standards, including that the pressure cannot drop more than 2 psi during the 5 minute test or more than 10% of the equalized pressure of at least 25 psi.

(9) **(Construction of Interior CCR Berms)**

Interior berms filled with CCR must be constructed immediately after receiving the Operating Permit or Authorization to Operate due to placing waste within the landfill footprint. Additional CQA reporting will then be required for the construction of the interior berm and requires approval prior to placing CCR material onto it. (Article 10, Section 238 C.3.d.)

RESPONSE: The interior CCP berm is an integral component of the exterior berm system required by Article 10, Section 238 C.3.d of the Franklin County regulations. With respect to timing of construction, both the interior and exterior berms must be constructed under the MDNR Construction Permit, and prior to issuance of the MDNR operating permit and Franklin County operating license. CCP material used as part of the berm construction is an authorized use by MDNR and CCP waste material cannot be placed in the UWL until MDNR issues an operating permit. This same construction sequencing of berms (interior and exterior berms constructed in conjunction but prior to placement of CCP waste) has been approved by MDNR on February 8, 2013 as part of their approval of the Modification to Construction Permit Number 0918301 for the Sioux Energy Center UWL. Upon completion of Phase 1 and Phase 3 construction of the composite lined area, including the CCP berms, a CQA Report will be submitted to Franklin County's IRPE to review the report for the internal CCP berms and areas beneath the internal berms.

(10) **(Safety Factor Analysis – Slope Stability Analysis)**

The minimum factor of safety recommended by the draft technical guidance document from MDNR-SWMP and Stark is 1.2 to 1.3, not 1.1 as listed in Table E-2 Results of Slope Stability Analyses. (Article 10, Section 238 C.3; 10 CSR 80-11.010(5)(A)4. & Draft Technical Guidance Document on Static and Seismic Slope Stability for Solid Waste Containment Facilities produced by The Solid Waste Management Program/DEQ/MDNR and Timothy D. Stark, Ph.D., P.E. Associate Professor of Civil Engineering, Department of Civil Engineering, University of Illinois at Urbana-Champaign)

Revisions to the narrative of Appendix J with regards to the minimum factor of safety have been further discussed and now agrees with the above draft technical guidance document but Table E-2 has not been updated.

RESPONSE: As described in Appendix J, Section 6.1.3 of the August 2013 CPA, to confirm the conservative nature of our assumptions, Ameren Missouri performed stability analyses of five UWL cross sections and assumed the presence of fully liquefied soil strata (loose sandy soils) *without* consideration of the impact of soil consolidation resulting from construction of the berms and CCP fill . (As soil consolidation occurs, loose, sandy soil pockets become compressed and the potential for liquefaction diminishes.) The FS_{liq} for this conservative assumption ranged from 1.13 to 1.72, slightly less than the above guidance criterion (1.2 to 1.3). As standard engineering practice, a factor of safety above 1.0 is acceptable when assessing seismic conditions. Table E-2 will be modified to show Recommended Minimum FS' of 1.2 for global circular failure with liquefaction analyses with a footnote explaining the reduced FS for the full height UWL.

(11) **(Routing of Stormwater Following Closure of the Landfill)**

After closure, all stormwater should be routed through the stormwater ponds to reduce sediment loading rather than allowing the letdown structures to discharge over the exterior berms. (General Engineering Comment)

RESPONSE: Ameren Missouri intends for the UWL to operate for approximately 30 years and it is premature at this time to delineate the precise manner in which stormwater occurring post-closure will be managed. The current UWL design that discharges stormwater from the closed landfill directly to the surrounding property via letdowns is consistent with 10 CSR 80-11.010(8)(F) and other landfill drainage systems approved by MDNR throughout the State. The letdowns have been designed to control erosion so that the stormwater discharges meet water quality requirements. Ameren Missouri will comply with all MDNR requirements and appropriate stormwater management measures developed and included within the Labadie UWL operating procedures. Upon closure of the UWL, such Plan will be updated to describe the appropriate stormwater management methods applicable at that time.

(12) **(Separation between Compacted Soils and Natural Groundwater Table)**

The separation between the compacted soil component of the composite liner shall be two feet above the Natural Water Table in the site area. Provide a potentiometric surface map for the critical monitoring events from the DSI with the post-settlement base grades provided of the landfill footprint. In any area where the potentiometer surface map illustrates that the surface is above the existing topography, use the top of the existing topography (pre-land disturbance) for those areas. (Article 10, Section 238 C.3.c.)

RESPONSE: Franklin County's Ordinance requires "the clay or composite soil component at the base of the Utility Waste Landfill shall be at least two (2) feet above the Natural Water table in the site area." The Natural Water Table at the Labadie Energy Center was defined in Appendix Z of the August 2013 CPA at elevation 464 and is the basis for design of the composite liner system. The site will be graded to a minimum subgrade elevation of 466 prior to installation of the clay liner. Drainage sumps must be located at a lower level so that gravity will allow the leachate to drain into them. The separation between the composite liner and Natural Water Table proposed in the August 2013 CPA is consistent with other landfill liner systems approved by MDNR and has been preliminarily approved by MDNR. 10 CSR 80-11.010 (4) (B) 6.

(13) **Potential for Differential Settlement in Stormwater Channels and Berm Heights**

Settlement analysis demonstrates some differential settlement which could cause ponding in the flat stormwater channels, a reduction in the overall height of the berms and settlement of the base grades of the landfill. Each of these must be discussed including how Franklin County's regulations will be satisfied during all phases of construction, filling and closure. Additionally, the settlement analysis typically has a range of settlement that may occur due to variability in the underlying subgrade and must be conservatively considered in the analysis to prevent overtopping of the exterior and interior berms due to a 500-year flood event. (Article 10, Section 238 C.3; Article 10, Section 238 C.3d.i.; 10 CSR 80-11.010(5)(A)4.A & 10 CSR 80-11.010(8)(B)1.F.(IV))

RESPONSE: In accordance with 10 CSR 80-11.010(5)A.4.A.&B., and 10 CSR 80-11.010(8)(B)1.F.(IV), Ameren Missouri has performed an analysis that contemplates the manner in which various feature of the landfill (e.g. berms, stormwater channels, etc.) may settle based upon a variety of future operating scenarios and weather conditions. As with any structure, settlement may occur over time. The integrity of the landfill will be operated, maintained, and monitored, however, so that stormwater is properly managed and that, in the event of a 500-year flood event, the exterior berms are not overtopped. Temporary ponding due to minor settlement in the perimeter ditches is not an issue since all stormwater falling within the UWL waste boundary will be managed as either leachate or stormwater in this no-discharge system. As part of the operating procedures of the Labadie UWL, stormwater management practices and procedures that will be developed and periodically updated as project and external conditions warrant. Section 2.8.3 of the CPA states "...as part of the UWL ongoing operation and maintenance, both during operation and post-closure, the top of berm elevation will be periodically determined by level survey. If the elevation of the exterior berms settles below the 500-year elevation of 487.6, suitable fill will be added to the perimeter roads on top of the berm to raise the minimum berm elevation to 488.0"

(14) **(Removal Rate of Leachate Generated during a Storm Event Occurring) during First 2 weeks Of Filling)**

Due to the size of the cells, provide calculations to show the removal rate of leachate generated from a storm event during the first couple of weeks of filling. Justify the storm event, calculate the removal rate and describe disposal method utilized. (Article 10, Section 238 C.3.; Article 10, Section 238 C.3.e. & 10 CSR 80-11.010(9)(B)1.E.)

RESPONSE: Pursuant to *10 CSR 80-11.010(9(A) and (B),* the applicant must design and construct a leachate collection system. A leachate collection system open to the atmosphere must be designed to prevent discharge during a 25 year, 24 hour storm event. In addition, ponds and/or tanks must have sufficient capacity to store and equalize flow to the disposal system. The leachate collection system has been designed with these requirements.

Section 3.9.2 of the August 2013 CPA summarizes the approach to leachate collection, storage, and disposal. Leachate will be routed to sumps and then pumped to a storage vessel adjacent to the landfill. Preliminary analysis using the average annual leachate generation rates indicate that 50,000 to 70,000 gallons of temporary storage capacity will be provided by multiple 10,000 gallon movable tanks interconnected in a "tank farm" during the initial operations of Phase 1. Additional temporary leachate storage capacity is available in Pond 1 for Phase 1 during start-up, Pond 2 for Phase 3 start-up, and Pond 3 for Phase 4 start-up. The ultimate purpose of these ponds is to manage stormwater runoff from the active disposal cell, however during initial operations stormwater runoff will be contained within the cell until the cell has been sufficiently filled with CCPs to allow gravity flow of excess stormwater into the ponds. Until that time, the entire capacity of the ponds is available for temporary leachate storage. The design capacity of the stormwater ponds are adequate to store and manage this water until it can be reused or disposed off-site. Using the leachate generation history from the operation of Phase 1, the water (leachate and stormwater) management plan will be re-evaluated and revised as the project proceeds. Due to the nature of the materials, CCP tends to consolidate quickly thereby reducing the amount of leachate generated. See also Response to Comment 23.

(15) **(Flow of Stormwater from Cell 2 into Stormwater Pond)**

On Sheets 5 and 7, show how the stormwater from Cell 2 will flow into the Stormwater

Pond 1. (General Engineering Comment)

This comment was not addressed. At some point in time, they appear to regrade the stormwater ditches to connect from Cell 2 to Cell 1 with no discussion. This is an operational issue that would need to be addresses prior to issuing the operating permit for Cell 2.

RESPONSE: Sections 3.7.1 and 4.5.1 of the August 2013 CPA describes how stormwater runoff will be routed from the UWL disposal cells (referred to as Phase 1, Phase 2, etc.) into designated stormwater ponds via properly sized perimeter ditches inside the perimeter berms and how the UWL will manage stormwater as a no discharge facility. Phase 2 is constructed adjacent to Phase 1 and the perimeter ditch around Phase 1 that conveys stormwater runoff from Phase 1 to Pond 1. The Phase 2 perimeter ditch will be connected to the Phase 1 perimeter ditch once Phase 2 is constructed and filled to a minimum elevation of 483. Ameren Missouri recognizes this operational issue and, as the various cells are constructed, stormwater will need to be conveyed away from the UWL and into a stormwater pond. As stated in Section 3.7.1 of the CPA,

> "During the initial, active operation of disposal cells, stormwater runoff may temporarily pond on the CCPs within the UWL. Temporary collection basins will be located within the active disposal cell and temporary pumps used to pump accumulated runoff to the perimeter ditch or directly to adjacent stormwater holding ponds to minimize the amount of stormwater that infiltrates into the waste. After the elevation of in place CCPs exceeds the height of the perimeter ditch, the CCPs will be graded to maintain slopes on active landfill areas to avoid ponding, except in temporary collection basins. Ultimately, the perimeter ditch will convey stormwater from the side slopes, letdown structures, and side slope benches to the on-site stormwater holding ponds."

At the point in operations when CCP fill exceeds the height of the perimeter berm, plans detailing the connection of the perimeter ditch from Phase 2 to Phase 1 will be determined and submitted to the IRPE before construction of Phase 2.

(16) **(Stormwater Management)**

The stormwater management plan for the site allows most stormwater to become contact waters and thus leachate. Based upon the stormwater management plan, no waters onsite will be allowed to discharge from the site and must be contained and treated as leachate. Additionally, a one-way valve rather than a gate valve alone would be required in the Stormwater Ponds (Leachate Ponds) to prevent leachate out of the ponds during the equalization. These ponds will additionally need to be designed with a liner system which meets the requirements of MDNR's Solid Waste Management and Water Protection Programs for storing leachate (waste waters). The use of these waters will be limited to within the composite lined landfill area or for use as makeup waters within the power plant's future scrubber systems. (Article 10, Section 238 C.3.; Article 10, Section 238 C.3.e.; 10 CSR 80-11.010(8)(B)1.F.(V); 10 CSR 80-11.010(8)(C)2. & 10 CSR 80-11.010(9)(C)2.)

In the response to MDNR Comment #7, it is stated that "Leachate and stormwater that cannot be utilized within the UWL limits for dust control or for conditioning of the ash prior to disposal in the UWL will be pumped back to ash ponds at the plant for discharge through NPDES Outfall 002." Based upon this response, it appears they intend to manage their leachate via dilution with the stormwater. No revisions made to the plan.

RESPONSE: Sections 3.7, 3.9 and 4.5 of the August 2013 CPA describe how stormwater runoff and leachate from the UWL will be managed and disposed of in accordance with applicable water quality standards and requirements. A gate valve and check (one-way) valve will be installed on the flood mitigation pipe as shown on drawing 4/16 of the CPA. A separate NPDES construction permit will be obtained from MDNR prior to construction of the ponds as in indicated in Note 1 on drawing 16. Stormwater and leachate will be managed as explained in the second of section 3.7.1 of the CPA. All on-site stormwater ponds will be fully lined and comply with MDNR permitting requirements.

(17) **(Seeding to Establish Vegetation)**

Seeding to establish vegetation on the intermediate side slope cover needs to occur within a much shorter period than annually as provided in the Phases 1, 2, 3 and 4 Aesthetic Cover section. (Article 10, Section 238 C.3 & 10 CSR 80-11.010(13)(B)) This comment has not been incorporated into the CPA. On page 4-4, Section 4.1.2 Sequence of Phase Construction; Phases 1, 2, 3 and 4 Aesthetic Cover states "Seed to establish vegetation on the intermediate side slope cover annually." This is still unacceptable.

RESPONSE: As part of its ongoing maintenance and inspection procedures, Ameren Missouri will inspect the landfill slopes and perform seeding activities at appropriate intervals so as to establish a vegetative cover. Section 3.11 states that cover will be vegetated by seeding immediately after placement. Section 4.1.2 will be updated to state that vegetation on the intermediate side slope cover will be inspected and maintained as necessary to provide adequate erosion protection as indicated in specification Section 3.11. Section 4.9 states that seeding will be completed as soon as practical after placement of cover as required by *10 CSR 80-11.010(14)(B)7.* Furthermore, all stormwater within the UWL waste boundary is captured and controlled during operations to prevent sediment discharge from the area.

(18) **(Depths of Leachate and Stormwater Piping)**

The Leachate and Stormwater Forcemains are shown in the Exterior Berm without the depths noted. The forcemains must be installed at a depth to prevent freezing during cold weather conditions. Additionally, account for these forcemains being located in a berm above grade and the landfill will not have exothermic reactions. (Article 10, Section 238 C.3.; Article 10, Section 238 C.3.e. & 10 CSR 80-11.010(9)(B)1.D.)

RESPONSE: Ameren Missouri agrees that such piping will be installed below the frost depth established by existing Franklin County building code or local practice, whichever is more conservative. Typically this depth is no more than 30-inches below finished grade.

(19) **(Test Pad – Borrow Material)**

If soils from onsite are acceptable for clay liner, prior to use for such, a test pad for these materials would be necessary since the offsite borrow soils are different. (Article 10, Section 238 C.3. & 10 CSR 80-11.010(10)(C)1.)

RESPONSE: Ameren Missouri intends to use off-site soils in constructing the compacted clay liner and will use a test pad to confirm performance and suitability for such materials prior to construction as indicated in Section 3.0 Appendix P of the August 2013 CPA.

(20) **(Slope Between Landfill Liner and Leachate Collection System)**

The landfill liner and overlying leachate collection system must have a minimum slope of 1%, pre and post settlement. Revise the landfill grades to meet this requirement during all times within the landfill footprint. Provide plan sheets with the critical cross sections which show the pre and post settlement landfill base grades. (Article 10, Section 238 C.3.; Article 10, Section 238 C.3.e. & 10 CSR 80-11.010(10)(B)4.)

RESPONSE: This comment suggests that a minimum slope of 1% between the liner and leachate collection system should be maintained at all times. However, due to the size and configuration of the UWL, the CPA includes a 1% liner and 0.5% leachate collection system slope. 10 CSR 80-11.010(1) states "...If techniques other than those listed as satisfactory compliance in design or operation are used, it is the obligation of the utility waste landfill owner/operator to demonstrate to the department in advance that the techniques to be employed will satisfy the requirement..." The effectiveness of using of a 0.5% slope for the leachate collection pipe was demonstrated in the CPA to the satisfaction of MDNR. In addition, the HELP modeling results show that the depth of leachate on the liner in this collection system will never be greater than 2 inches, much lower than the 1 foot maximum allowed by 10 CSR 80-11.010(B)1.E. This is consistent with 10 CSR 80-11.010(10)(B)4 and other landfills approved by MDNR.

(21) **(Material Specifications of Liner Cushion and Filter Fabric)**

Specify the geotextiles for the cushion fabric and the filter fabric shown in the Bottom Liner and Leachate Collection System Detail. Provide the supporting documentation and any necessary calculations. (General Engineering Comment)

RESPONSE: The detailed material specifications for the various liner elements will be determined as part of the construction procurement specification and bid process.

(22) **(Drawing Details – Slotting Pattern For Leachate Lines)**

Provide detail drawings for the pipe perforation or slotting pattern for the leachate collection lines and sump riser pipe. (Article 10, Section 238 C.3.; Article 10, Section 238 C.3.e. & 10 CSR 80-11.010(9)(B)1.C.)

RESPONSE: The detailed material specifications and configuration or the various leachate collection lines will be determined as part of the construction procurement specification and bid process. At that point, construction drawings detailing such elements will be developed.

(23) **(Detailed Drawings Leachate Storage Tanks)**

In Appendix Y(a) Leachate Pipe and Pump Calculations, the leachate storage tank is listed as a 12-ft diameter horizontal tank. The drawings provided for the site have a vertical storage tank shown without any detail drawings for the storage tanks. Provide a detailed drawing for the storage tanks and the anticipated operations of the tanks to prevent them from exceeding capacity. Provide the pump details for the pumps within the leachate storage tanks. This should be included in the leachate management plan. (Article 10, Section 238 C.3.; Article 10, Section 238 C.3.e. & 10 CSR 80-11.010(9)(B)1.A.)

RESPONSE: Section 3.9.2, of the August 2013 CPA summarizes the approach to leachate storage. The number and location of tanks will require ongoing evaluation as a part of the UWL operations. Plan sheets 6, 7, 8 and 9 show the general location of a leachate storage tank for each cell, although there is sufficient room for several tanks at each location. If necessary, additional area for setting temporary leachate tanks will be developed within the active disposal cell on top of the CCPs. Appendix O summarizes the Peak Daily Leachate Volume and the Average Annual Leachate Volume predicted by the HELP model which was used to predict leachate generation rates. Ameren's experience with utility waste active dry cell CCP landfills reflects that very little leachate is generated, particularly when compared to the volumes predicted by the HELP model.[2] Therefore, the leachate quantities predicted by the HELP model are considered to represent conservatively high, or 'worst case' scenarios. The water management calculations found in Appendix Y(c) conservatively estimate that reusing the on-site stormwater and leachate for moisture conditioning and dust control on interior haul roads can annually consume approximately 1.5 times the quantity of water that will be generated by the UWL under the worst case scenarios modeled. Appendix Y(c) also assumes that prefabricated 10,000 gallon storage tanks, which are readily available, will be used to temporarily store the leachate on-site until it can be beneficially reused within the UWL, or transported to an off-site location for disposal. These tanks will be interconnected and located in a "tank farm" at the approximate locations shown on the

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[2] For example, at landfills owned and operated by an Ameren Energy Resources, an affiliate, less than 1,000 gallons of leachate is generated annually. Ameren Missouri would anticipate less than 10,000 gallons ***annually*** of leachate generated from the Labadie UWL, far less than the 6,000 gallons ***daily*** default levels predicted by the HELP model. (Such model was developed for municipal landfills whose waste materials decay and generated significant quantities of leachate).

drawings. Using the leachate generation history from the operation of Phase 1, the number of tanks required to manage leachate generated from Phases 2, 3 and 4 can be more accurately predicted using actual peak and annual data. The long-term leachate storage requirements will depend on the actual amount of leachate generated and amount reused within the UWL, which will require ongoing adaptive management based on historical data during the UWL operation.

(24) **(Capacity Size: Leachate Storage Tanks)**

The leachate storage tanks have no capacities or sizes listed or illustrated in the drawings. The leachate storage tanks must be sized based upon the pumping rates of the sumps within the landfill, and the maintenance and inspection schedule or control systems for each. (Article 10, Section 238 C.3.; Article 10, Section 238 C.3.e. & 10 CSR 80-11.010(9)(B)1.A.)

RESPONSE: The CPA has been modified to include additional discussion regarding the leachate storage tanks as outlined in response to comments 14 and 23. The precise location of such tanks cannot be determined at this time but will be included on final construction drawings. A maintenance and inspection schedules for such tanks will also be developed as part of Ameren Missouri's internal operating plan.

(25) **(Stability Analysis and Safety Factors)**

The stability analysis failed to meet the required and recommended factor of safeties. Cross-section E-E' failed to meet the factor of safety of 1.5 for the static drained global circular failure surface both with the initial and full fill of CCP. (Article 10, Section 238 C.3; 10 CSR 80-11.010(5)(A)4. & Draft Technical Guidance Document on Static and Seismic Slope Stability for Solid Waste Containment Facilities produced by The Solid Waste Management Program/DEQ/MDNR and Timothy D. Stark, Ph.D., P.E. Associate Professor of Civil Engineering, Department of Civil Engineering, University of Illinois at Urbana-Champaign)

The CPA stated the required factor of safety as 1.5 for the static drained global circular failure. Our review concurred with this statement and further implemented it during the review.

RESPONSE: Appendix J, Section 6.1.1 of the August 2013 CPA states that the initial configuration was also analyzed using long-term (i.e. "drained") shear strength properties. The minimum FS ranged from 1.45 to 2.70, which are essentially 1.5 or greater. The actual FS in the long-term will be greater than the values depicted in Table E-2 because the "initial" configuration is temporary and the fully drained shear strength properties are greater. The global stability of the completed UWL was also analyzed using drained strength properties. The FS of the global stability of the CCP and berm varied from 1.46 to 2.27. The actual FS would be greater than these values because these analyses did not incorporate the compressive strength of the CCP due to cementation, nor the gain in shear strength of the foundation soils due to consolidation. While Missouri regulations do not specify a minimum factor of safety, guidance documents (MDNR-SWMP and Stark, 1998) recommend a minimum factor of safety of 1.5 for static stability analyses. Modeling runs using justified appropriate values to demonstrate that the FS exceeds the minimums provided in MDNR-SWMP and Stark's Guidance Document will be included in Appendix J of the CPA.

(26) **(Liquefaction Analysis – Narrative Description Pertaining to Depths below 35 Feet)**

Liquefaction analysis is typically performed in the upper 50' of unconsolidated materials. Almost every boring was stopped at 35' in depth. Due to the lack of information from the 35' to 50' interval of the unconsolidated materials, provide a narrative justifying why liquefaction would not be anticipated at depths below 35'. (Article 10, Section 238 C.3; 10 CSR 80-11.010(5)(A)4. & Draft Technical Guidance Document on Static and Seismic Slope Stability for Solid Waste Containment Facilities produced by The Solid Waste Management Program/DEQ/MDNR and Timothy D. Stark, Ph.D., P.E. Associate Professor of Civil Engineering, Department of Civil Engineering, University of Illinois at Urbana-Champaign)

RESPONSE: As part of its liquefaction analysis, in addition to 93 CPT soundings, Ameren Missouri drilled 119 borings at the UWL site at depths ranging from 19 to 108 feet. Sixty-five (65) CPT soundings were more than 35 feet deep. Twelve (12) borings and seven (7) CPT soundings in the DSI were more than 40 feet deep. As explained in Appendix J, Section 6.1.3 of the August 2013 CPA, the risk of liquefaction diminishes as CCP is placed in the UWL and the soil consolidates. The CPT data was analyzed in discrete 6-inch increments (a "location") for the full depth of each sounding where empirical analysis suggested an anomaly or potential liquefaction existed. After 20 feet of CCP has been placed, less than 13% of the 78 locations analyzed between 35 and 50 feet in the 65 CPT soundings had a factor of safety less than 1.0 against liquefaction. All of these locations were only 6 inches thick. After 80 feet of CCP has been placed, less than 4% of the locations had a factor of safety less than 1.0 against liquefaction. Such limited strata are both too deep to impact the stability of the UWL, and too thin to significantly impact settlement. Accordingly, the analyses focused on the potential for near-surface liquefiable strata which could theoretically impact the UWL in the event of a seismic event. The analyses of the risk of liquefaction for various heights of CCP are included in Appendix D of Appendix J of the CPA. Such analysis reflects that liquefaction conditions would be localized to thin sand zones exterior to the UWL (not the landfill interior) near the surface which would drain quickly. As noted in the guidance document by MDNR-SWMP and Stark and in the IRPE's comment, liquefaction does not appear to occur below depths of 50. Therefore, after 20 to 30 feet of CCP has been placed, all of these potentially liquefiable thin strata are effectively located more than 50 feet deep and it is reasonable to expect the liquefaction potential to disappear.

(27) **(Stability Analysis – Deformation of UWL Side Slopes)**

Provide the actual stability analysis for the deformation analysis and provide with a *narrative rather than a table listing the yield accelerations and deformations for the short and long- duration events. (Article 10, Section 238 C.3; 10 CSR 80-11.010(5)(A)4. & Draft Technical Guidance Document on Static and Seismic Slope Stability for Solid Waste Containment Facilities produced by The Solid Waste Management Program/DEQ/MDNR and Timothy D. Stark, Ph.D., P.E. Associate Professor of Civil Engineering, Department of Civil Engineering, University of Illinois at Urbana-Champaign)*

RESPONSE: The slope stability analyses that determined the yield acceleration for each section for initial and full conditions are in Appendix E of Appendix J of the August 2013 CPA. The SHAKE2000 deformation analyses were run for a range of yield accelerations. The minimum yield acceleration caused a maximum cumulative deformation of 0.05 inch, two orders of magnitude smaller than the allowable deformation of 6 inches. This method of analysis was thorough and complete, and there is nothing to be learned or gained from additional calculations. Section 5.3 of Appendix J currently reflects that the analyses estimated the probable horizontal deformation due to a seismic event for a range of yield accelerations (K), and that the analyses demonstrate that the estimated probable horizontal deformations of the UWL are much less than the maximum deformation of 6 inches allowed by MDNR for a sanitary landfill.

(28) **Calculations Regarding Settlement Analysis and CPT Test Data**

Provide the calculations correlating the CPT test data to the elastic modulus utilized in the Settlement Analysis. The CPT logs which were provided in the DSI don't provide enough detail to verify the elastic moduli provided in the settlement analyses. Additionally, heavily loaded conditions decrease the modulus, so these factors need to be accounted for relative to their location within the footprint of the fill. The Bowles 1997 reference appears to be dated and newer, more precise correlations are widely available which utilize the normalized cone resistance and normalized friction ration. (Article 10, Section 238 C.3 & 10 CSR 80-11.010(5)(A)4.A)

RESPONSE: The CPT test data were correlated to the elastic modulus in Appendix 2, Sub-Appendix D of the DSI. This analysis was completed using CPT-Pro, a commercially available CPT analysis software from GeoSoft. References were provided in the Appendix D of the DSI. The description of the methods used to correlate CPT test data to the elastic modulus that was included in Appendix 2, Sub-Appendix D of the DSI will be added to Appendix J of the CPA.

(29) **(Pipe Crushing and Buckling Scenarios)**

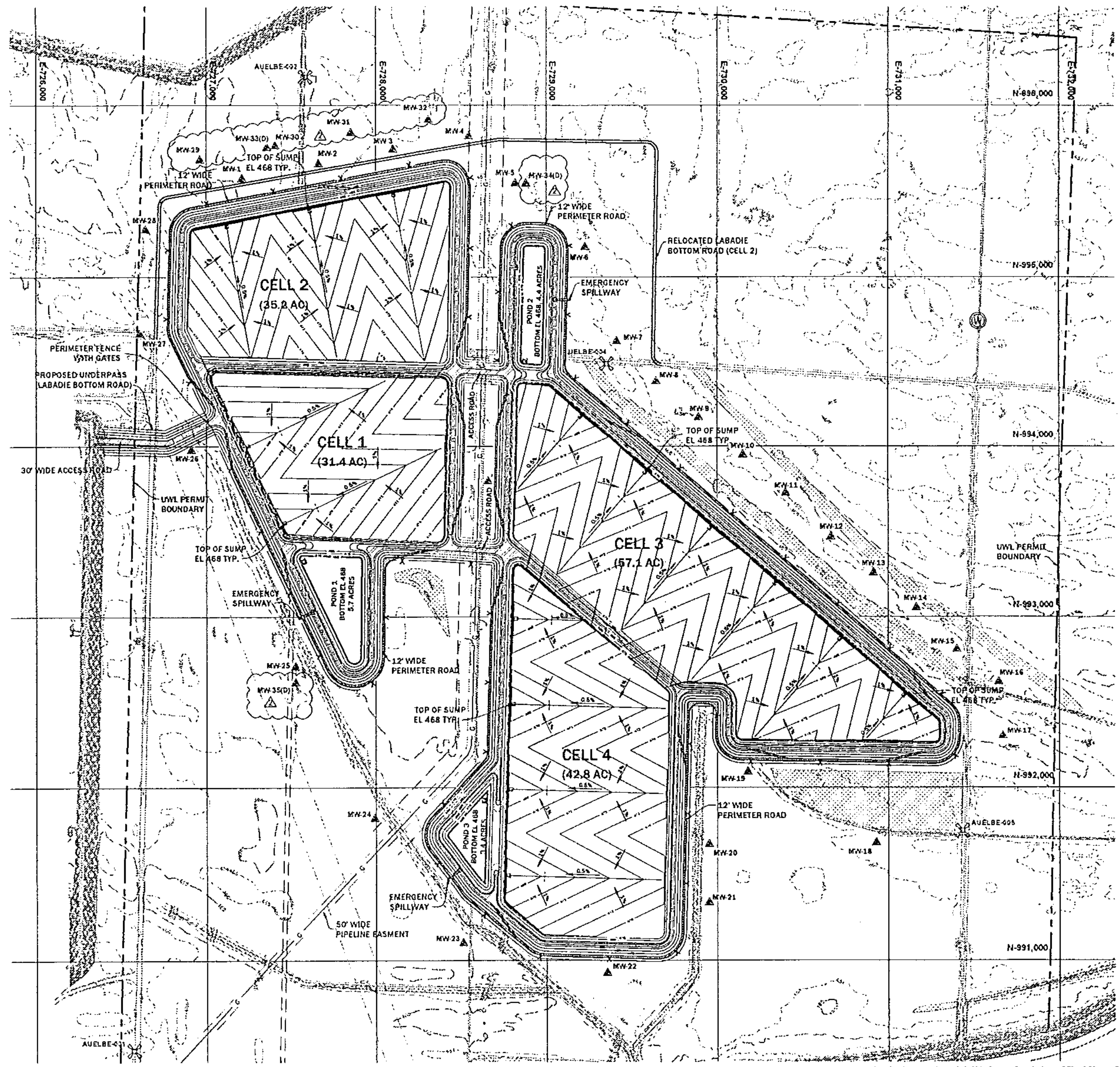
In Appendix Y(a), the Leachate Pipe Crushing and Buckling Scenarios, Scenario 1 provides an H20 truck in the analysis. This size of truck is normal for highway use but it is anticipated based upon the amount of CCR being deposited that the size of the equipment and tire loads could be greater. Scenario 3 uses a live load of a 3 ton skid steer on the sump riser trench with one foot of CCR placed over the top of the sump riser *trench. In all likelihood, this loading would occur prior to the placement of the CCR and the geotextile, and would be used to place the clean gravel. Additionally, Scenarios 1 and 3 drawings appears to be in error that CCR would be placed as the protective cover over the geocomposite drainage. Please revise these drawings and recalculate with the proper loading. It also appears that the pipe values were not reduced due to the perforations in Scenarios 1 and 2. Density of waste is listed as 75 pcf. Testing results in Appendix J report higher densities for CCPs. A density of 93 pcf is assumed in calculations in Appendix Y(d). (Article 10, Section 238 C.3.; Article 10, Section 238 C.3.e. & 10 CSR 80-11.010(9)(B)1.C.)*

RESPONSE: The pipe crushing and buckling calculations and scenarios in Appendix Y(a) and Y (d) of the August 2013 CPA depict typical worst case loadings and substantiate the pipe strength is more than adequate. Those assessments reflect that the leachate pipes can withstand wheel weights of 16,000. The scenarios evaluated are typical of those completed and accepted for compliance with 10 CSR 80-11.010(9)(B)1.C and the probability that the worst case loading would occur prior to the pipes having additional cover and protection is remote. Ameren Missouri agrees that as part of the prudent construction design and operation of the landfill, vehicles used in either the construction or operation of the landfill must be evaluated to ensure that the weight of such vehicle does not damage the underlying leachate piping system, as well as other components. A variety of standard construction practices can be employed to further protect existing underground piping or piping being installed during the ongoing construction. The specific vehicles to be used in either the construction or operation of the UWL must be evaluated and appropriate care will be taken to ensure the integrity of the leachate system is maintained.

(30) **Labadie Bottom Road Underpass**

Provide the approved design and drawings of the proposed underpass for Labadie Bottom Road and all approvals from the controlling authorities. (Article 10, Section 238 C.3 & 10 CSR 80-11.010(4)(C)1.)

RESPONSE: See attached correspondence from Franklin County.



SCALE: 1" = 300'
0 150 300 600

N

SURVEY MONUMENTS

MONUMENT ID	NORTHING	EASTING	ELEVATION
AUELBE-001	990484.82	726569.81	467.19
AUELBE-002	996166.50	727588.30	470.70
AUELBE-003	989921.39	728508.32	467.59
AUELBE-004	994487.78	729353.29	467.02
AUELBE-005	991746.97	731438.29	462.78
AUELBE-006	996729.00	731621.70	467.67

Missouri State Plane Coordinate System Datum:
Horizontal Datum NAD 1983,
Vertical Datum NAVD 1988

NOTES:

1. CELLS 1 & 3 AREAS WERE MEASURED TO INSIDE TOP OF EXTERIOR BERMS AND OUTSIDE TOE OF INTERIOR BERMS.
2. CELLS 2 & 4 AREAS WERE MEASURED TO INSIDE TOP OF EXTERIOR BERMS AND INSIDE TOE OF INTERIOR BERMS.
3. POND AREAS WERE MEASURED FROM THE INSIDE TOP OF BERM.
4. FABRIC-FORMED FILTER POINT CONCRETE MAT (FCM) ON NON-WOVEN GEOTEXTILE FILTER TO BE PLACED ON THE OUTSIDE FACE OF ALL EXTERIOR BERMS.
5. ALL LAND DISTURBANCE ACTIVITIES WILL HAVE A 25' MINIMUM SETBACK FROM JURISDICTIONAL WETLANDS WITH A STORMWATER BMP INSTALLED BETWEEN THE DISTURBANCE AND THE WETLAND DURING CONSTRUCTION. SEE DETAIL 4 ON SHEET 19

NOTES TO THE CONTRACTOR

UNDERGROUND FACILITIES, STRUCTURES, AND UTILITIES HAVE BEEN PLOTTED FROM AVAILABLE SURVEYS AND RECORDS AND THEREFORE, THEIR LOCATIONS MUST BE CONSIDERED APPROXIMATE ONLY. THERE MAY BE OTHERS, THE EXISTENCE OF WHICH IS AT PRESENT NOT KNOWN. VERIFICATION OF THE LOCATIONS OF UNDERGROUND UTILITIES, SHOWN OR NOT SHOWN, WILL BE THE RESPONSIBILITY OF THE CONSTRUCTION CONTRACTOR.

THE CONTRACTOR SHALL MAKE SUITABLE AND TIMELY REQUESTS TO ALL UTILITY OWNERS, PIPELINE OWNERS, OR OTHER PARTIES AFFECTED TO HAVE ALL NECESSARY ADJUSTMENTS OF PUBLIC OR PRIVATE UTILITIES, PIPE LINES, OR OTHER APPURTENANCES WITHIN, OR ADJACENT TO THE LIMITS OF CONSTRUCTION, AS SOON AS PRACTICAL OR POSSIBLE.

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Reitz & Jens, Inc.

GREDELL Engineering Resources, Inc.
ENVIRONMENTAL ENGINEERING

PREPARED FOR Ameren

DRAFT
11/21/13

DRAWN W.J.A (G.E.R.)
CHKD R.L.R (G.E.R.)
SUPV T.R.G (G.E.R.)
APPD T.R.G (G.E.R.)

SHEET 5
PROPOSED UTILITY WASTE LANDFILL
OVERALL BOTTOM GRADING PLAN (TOP OF LINER)

LOCATION 001009
LABADIE ENERGY CENTER
CLASS 02010

Ameren
ST. LOUIS, MISSOURI
JANUARY 2013
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