Ameren MISSOURI

July 8, 2013

By Electronic Mail and Regular Mail

Mr. Joe Feldmannn, P.E., L.S.
County Engineer
Franklin County Highway Department
400 East Locust
Room 003A
Union, MO 63084

Re: IRPE Comments

Dear Mr. Feldman,

Ameren Missouri has completed its detailed review of the June 6, 2013 comments of Andrews Engineering, the County's Independent Registered Professional Engineer ("IRPE"), under the County's new Landfill Ordinance 2011-307 (the "Ordinance"), together with the IRPE's revised draft of that review received on June 27, 2013, as well as their comments on the Groundwater Monitoring System dated April 22, 2013. This will confirm that these three sets of IRPE comments on the Application are complete for purposes of the Application and Ordinance.

Enclosed are our responses to those comments, subject to the following.

As you probably know, the Missouri Department of Natural Resources ("MDNR") has already reviewed the same Ameren Missouri Construction Permit Application that is the subject of our application to the County, by its letter dated May 7, 2013, a copy of which you have already received, so that we have the benefit of knowing exactly where MDNR stands. MDNR's letter is conclusive as to what the MDNR statute and regulations require as to the Application with the County, and therefore covers and pre-empts the great majority of the IRPE's comments.

The Ordinance does not (and cannot, legally) authorize the IRPE to state what MDNR regulations and statutes require in contradiction to what MDNR has interpreted them to mean, or to make new regulatory or environmental policy for either MDNR or the County. In addition, the Ordinance also does not (and cannot, legally) authorize the IRPE to read MDNR regulations to require items or orders of magnitude of construction of agreed upon items that MDNR does not require (e.g., the sheer number of monitoring wells).

The Ordinance does, subject to Ameren Missouri's rights under the pending zoning jurisdiction litigation now in the Missouri Court of Appeals, authorize the IRPE or the County's other officials to "verify" compliance with the MDNR regulations and enforce the specific, technical provisions of the Ordinance, which, as noted above, has been mooted as to the MDNR component, to the extent of the MDNR May 7, 2013 comment letter.

As we have discussed, Ameren Missouri does agree to comply with specific stated objective requirements of the Ordinance, for example the 500 year flood level requirement in Section 238C(3)(d)(i) on page 11 and the concrete material berm provision, and we agree that the Ordinance, in its objective, technical requirements can be "more strict" than the MDNR Regulations (again, subject to and without waiving all of our legal arguments raised in the pending lawsuit by LEO and others).

Notwithstanding the foregoing, as noted in the attached comments from our engineering team, there are a number of comments from the IPRE, outside of its authority of the Ordinance, which Ameren Missouri does present a response to, in the spirit of cooperation and simply to expedite the MDNR application, but subject, in all cases, to the IRPE and the County being overruled by MDNR.

Our legal counsel has corresponded with the County's counsel on other jurisdictional aspects of the Ordinance, and we understand that the County is in agreement with us on those issues.

Please call me at any time to discuss and we assure the County that we give you these points in a spirit of cooperation.

Sincerely,

Craig J. Giesmann, P.E., P.M.P.
Union Electric Company, d/b/a Ameren Missouri

Labadie Energy Center – Utility Waste Landfill

Construction Permit Application

Response to Franklin County IRPE Review Comments

July 8, 2013

Prepared For:

Ameren MISSOURI

Prepared by:

Reitz & Jens, Inc.
Consulting Engineers
50 Years

and

GREDELL Engineering Resources, Inc.
Environmental Engineering Land-Air-Water

The following responds to the comments made by Franklin County's Independent Registered Professional Engineer (IRPE) concerning their review of the Construction Permit Application (CPA) for Ameren Missouri's proposed Utility Waste Landfill (UWL) at the Labadie Energy Center. The CPA was submitted to Franklin County on January 29, 2013. The IRPE's review comments were transmitted to Franklin County under cover of a letter dated June 6, 2013. A copy of the IPE's cover letter and comments are attached.

Certain of the IRPE's comments refer to items which the IRPE concludes are required by Franklin County's new Landfill Ordinance 2011-307, and Missouri Solid Waste Management Rules 10 CSR 80-2 and 10 CSR 80-11 for UWL permitting, design and operation of UWLs administered by the Missouri Department of Natural Resources-Solid Waste Management Program (MDNR-SWMP). The landfill design and operating procedures have been prepared by the undersigned in accordance with the UWL requirements of the Missouri Solid Waste Management Law and Rules and Franklin County ordinances, and accepted engineering practice.

The following technical responses address those review comments that relate to the additional UWL design requirements we understand to be required by the Franklin County ordinance. Many of the IRPE's review comments relate to UWL design requirements that are MDNR-SWMP's review responsibility in accordance with 10 CSR 80-2 and 10 CSR 80-11. MDNR-SWMP provided their CPA review comments in a May 7, 2013 letter, a copy of which was sent to Franklin County. We defer to the MDNR-SWMP's review letter for interpretation of the regulatory requirements for UWL design in the State of Missouri which we believe pre-empts many of the IRPE's comments as to what the MDNR-SWMP statutes and regulations require. As a result, the following responses acknowledge, but may not directly respond to certain IRPE comments that we understand to be under MDNR-SWMP's review.

Where the IRPE's comments identified clerical corrections that need to be made to the CPA, such as typographical errors, we will revise the CPA appropriately. We are revising the Construction Permit Application and preparing a separate response to MDNR-SWMP as required by their May 7, 2013 review letter. We will also address other minor, but non-clerical comments, but only in the interest of expediting the review process, and in the event that MDNR-SWMP decides otherwise, we reserve the right to comply with MDNR-SWMP comments.

A copy of the revised Construction Permit Application and response to MDNR-SWMP will also be sent to Franklin County.

COMMENT RESPONSES:

Liner & Cover

The UWL liner system will include a composite bottom liner consisting of 24-inches of compacted clay with a permeability not exceeding 1 x 10^{-7} cm/sec overlain by a 60-mil thick HDPE geomembrane installed before placement of CCPs, and a final cover consisting of 40-mil

HDPE liner overlain by 24-inches of soil cover to support a hardy stand of vegetation once all CCPs are placed. The design, construction, and operation of the liner and cover meet or exceed the design requirements of 10 CSR 80-11.010(10) and 10 CSR 80-11.010(14).

IRPE 1 This comment will also be addressed in response to MDNR-SWMP's review comment 27. Historical flood data on the Missouri River and available historical groundwater level data were analyzed to establish the Natural Water Table at the Labadie UWL site at elevation 464. This analysis was presented in our April 9, 2012 "Design Basis for Groundwater Level". A separate November 2012 "Demonstration: Base of Utility Waste Liner in Intermittent Contact with Groundwater" showed that intermittent contact with the water table does not impact the liner performance. Both of these documents, included in Appendix Z of the CPA, were conceptually approved by the IRPE in their January 7, 2013, letter to Ameren. The bottom liner grades were designed in anticipation of the predicted settlement so that the bottom of the soil component remains at least 2 feet above the Natural Water Table, except at the sumps. The sumps will be filled with clean gravel to a minimum elevation of 468 resulting in all CCPs disposed of in the UWL being at least four (4) feet above the Natural Water Table.

IRPE 2 The requested information will be added to Sheets 22 and 23 of the revised CPA.

IRPE 5 The top crown of the HDPE will be revised to be consistent on the plan sheets and CQA Plan.

Section 238 Article 10(C)(3)c of Franklin County's Landfill Ordinance 2011-307 requires that the composite liner system meet the standards established by applicable portions of MDNR regulations. The IPRE's comments 3, 4, 6 and 7 regarding the liner and cover's compliance with 10 CSR 80-11.010 were addressed by MDNR-SWMP in their review of the CPA. These comments are noted, however no additional response or revision will be provided.

Leachate Collection

The UWL will use a conventional area disposal method for dry landfill disposal of CCPs. The CCPs will be dewatered or conditioned as necessary to pass the paint filter test prior to being transported to the UWL for disposal. In addition to intermediate and final cover, the UWL will include a leachate collection system constructed immediately on top of the composite liner. Leachate (water that has infiltrated into the CCPs) will be collected by the leachate collection system that covers the entire bottom and side slopes of each disposal cell that drains to leachate collection sumps. Each leachate collection sump will be equipped with a submersible pump automated to control and maintain less than 12 inches of leachate on the bottom composite liner during all phases of UWL operation. The design, construction, and operation of the leachate collection system meets or exceeds the requirements of 10 CSR 80-11.010(9).

Section 238 Article 10(C)(3)e of Franklin County's Landfill Ordinance 2011-307 requires that the leachate collection system be designed and constructed as required by MDNR-SWMP. The

IPRE's comments 8 through 11 regarding the leachate collection system's compliance with 10 CSR 80-11.010 were addressed by MDNR-SWMP in their review of the CPA. These comments are noted, however no additional response or revision will be provided.

Leachate Storage and Conveyance

Section 238 Article 10(C)(3)e of Franklin County's Landfill Ordinance 2011-307 requires that the leachate collection system be designed and constructed as required by MDNR-SWMP. The design, construction, and operation of the leachate storage and conveyance system meet or exceed the requirements of 10 CSR 80-11.010(9). The IPRE's comments 12 through 15 regarding the leachate collection system's storage and conveyance were addressed by MDNR-SWMP in their review of the CPA. These comments are noted, however no additional response or revision will be provided.

Stormwater

The UWL's stormwater management system is designed to manage the 25-year, 24-hour storm event without discharge to Waters of the State during the active operations. The system will temporarily retain and reuse leachate and contaminated stormwater to the extent practical on-site for dust control, to condition CCPs prior to placement, and/or as makeup water for future scrubber operations at the plant. Excess water will be managed through the plant's NPDES permit. The design, construction, and operation of the stormwater management system meet or exceed the requirements of 10 CSR 80-11.010(8)(B)1.F. The IPRE's comments 16 through 23 regarding the stormwater management system's compliance with 10 CSR 80-11.010 were addressed by MDNR-SWMP in their review of the CPA. These comments are noted, however no additional response or revision will be provided.

Berms

Each UWL cell will be fully enclosed with a perimeter berm prior to beginning active disposal operations. The perimeter berm will include both permanent exterior and temporary interior berms constructed to elevation 488, at least 0.4 feet above the highest 500-year flood elevation at the site and more than 3 feet above the regulatory 100-year flood elevation. The exterior berm will remain throughout the life of the UWL while the temporary interior berm will be enclosed as future cells are developed. The core of the exterior berms will be compacted earthen material and the core of the interior berms will be compacted CCPs, both of which will be covered on the exterior slope by fabric-formed concrete mats (FCM). The interior slope of each berm will be lined with a composite liner and leachate drainage layer. The design, construction, and operation of the berms meet or exceed the requirements of 10 CSR 80-11.010(4)(B)1, as well as Section 238 Article 10(C)(3)(d)i and ii of Franklin County's Landfill Ordinance 2011-307.

IRPE 24 The IPRE's comment regarding this aspect of the berm sequencing was addressed by MDNR-SWMP in their review of the CPA. This comment is noted, however no additional response or revision will be provided.

IRPE 25 This comment has also been addressed in response to MDNR-SWMP's review comment 9 and 28. The engineering report and the applicable plan sheets have been revised to include fabric-formed concrete mat on both the interior and exterior berms.

IRPE 26 It is our opinion that a design modification is not required to prevent 'backed-up' leachate from seeping through the exterior slope. The elevation difference between the top of the leachate sumps and the edge of the interior berms is more than 4 feet, while the maximum allowable leachate ponding depth on the bottom liner is 12-inches, making the back-up of leachate to the liner elevation in the interior berm highly unlikely. Furthermore, if the leachate elevation did reach the edge of the liner at this location, the current design in the CPA will prevent leachate from seeping past the berm toe. This comment is noted, however no additional response or revision will be provided.

IRPE 27 This comment has also been addressed in response to MDNR-SWMP's review comment 5. Appendix K will be revised to state the correct thickness of the concrete Fabric-Formed mat, 2.2 inches, as indicated in Section 3.3.2.3. Sheet 19 of the plans will be revised to identify the mat thickness at 2.2 inches.

Operations

The UWL will use a conventional area disposal method for dry landfill disposal of CCPs in accordance with 10 CSR 80-11.010(10) and 10 CSR 80-11.010(14) , as well as Section 238 Article 10(C) 7 of Franklin County's Landfill Ordinance 2011-307.

IRPE 28 The IPRE's comment regarding this operational aspect was addressed by MDNR-SWMP in their review of the CPA. This comment is noted, however no additional response or revision will be provided.

IRPE 29 A flood mitigation plan is provided in Section 3.3.2.2 of the engineering report. A provision of this plan is to flood a phase with non-potable water by pumping floodwaters from the outside the exterior berm over the berm into the cell to counterbalance uplift pressure due to flooding. Appendix Y contains calculations of the pumping rates needed to flood the largest cell.

IRPE 30 The requested revision will be added to Section 4.4 of the revised CPA.

IRPE 31 Section 4.6.1 of the engineering report will be modified to specify that dust control and mitigation will be employed during all phases of UWL construction and operation, including mining activities. Section 4.6.1 currently states that future mining of CCPs will not occur without MDNR-SWMP approval of a specific operating plan for this activity.

IRPE 32 The requested revision will be added to Section 4.8.3 of the revised CPA.

IRPE 50 The perimeter berms will be constructed to a minimum elevation of 488. As part of ongoing UWL operation and maintenance, both during operation and post closure, the top of berm elevation will be periodically determined by level survey. If the top elevation of the exterior berms settles below the 500-year elevation of 487.6, suitable fill will be added to the perimeter roads on the top of the berm to raise the minimum berm elevation to 488. Section 2.8.3 will be revised to reflect this operational procedure to maintain the perimeter berms to the 500-year flood elevations.

IRPE 56 The corrected formula yields a τ_{DES} of 1.29 PSF, and a resulting maximum allowable V_{DES} of 11.4 feet/second, which is still an order of magnitude greater than the maximum anticipated floodwater velocity of 1.4 feet/second. This correction will be included in the revised CPA but does not require any change to the design of the fabric-formed concrete erosion protection mat.

Appendix O

IRPE 57 This IPRE general comment was addressed by MDNR-SWMP in their review of the CPA. This comment is noted, however no additional response or revision will be provided.

Appendix P

The Construction Quality Assurance Plan included in Appendix P will be followed to assure that UWL construction is in accordance with the approved design and the requirements of 10 CSR 80-11.010. The IPRE's comments 58 through 61 regarding the Construction Quality Assurance Plan's compliance with 10 CSR 80-11.010 were addressed by MDNR-SWMP in their review of the CPA. These comments are noted, however no additional response or revision will be provided.

Appendix V

IRPE 62 This IPRE request was not required by MDNR-SWMP to complete their review of the CPA. This comment is noted, however no additional response or revision will be provided.

Appendix Y

IRPE 63 The miscellaneous calculations included in Appendix Y of the CPA will be revised to clarify items requested in MDNR-SWMP comments and Franklin County comments 64 and 67. The remaining IPRE comments regarding these calculations were addressed by MDNR-SWMP in their review of the CPA. These comments are noted, however no additional response or revision will be provided.

Liner & Cover

1. 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.)

2. On Sheets 22 and 23, show the bottom of the clay liner on the cross section drawings. (Article 10, Section 238 C.3.c., Article 10, Section 238 C.3. 10 CSR 80-11.010(4)(B)6.)

3. 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.)

4. No demonstration was made to not use one foot (1') of $1x10^{-5}$ cm/sec soil in the final cover directly under the geomembrane. A demonstration is required and must be approved for the use of an alternate final cover. 10 CSR 80-11.010(14)(C)3. "As each phase of the utility waste landfill is completed, a final cover system shall be installed consisting of one foot (1') of compacted clay with a coefficient of permeability of 1 X 10^{-5} cm/sec or less and overlaid with one foot (1') of soil capable of sustaining vegetative growth." 10 CSR 80-11.010(14)(C)5. "The department may approve the use of an alternative final cover system provided that the owner/operator can demonstrate to the department that the alternative design will be at least equivalent to the final cover system described in paragraph (14)(C)3. of this rule." The proposed final cover in the permit application consists of "a textured 40-mil HDPE geomembrane liner placed directly on the CCRs, overlain by a 16-oz/yd^2 non-woven, needle-punched geotextile, and covered with two (2) feet of nominally compacted vegetative soil capable of supporting the final vegetation cover." The proposed final cover does not include all the minimum requirements, specifically the 1-foot low-permeability compacted clay layer, nor is it demonstrated that the proposed final cover would be equivalent to those requirements. (Article 10, Section 238 C.3. & 10 CSR 80-11.010(14)(C)3.)

5. The plan sheets don't match the CQA Plan for the top crown HDPE. Please revise and provide the appropriate calculations as necessary. (Article 10, Section 238 C.3. & 10 CSR 80-11.010(14)(B)8.)

6. Sheet 19 shows one anchor trench containing the liner geomembrane, the geocomposite drain, and the final cover geomembrane. A second anchor trench for the cover system is necessary to prevent damage to the previously installed geosynthetic components. (General Engineering Comment)

7. 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.)

Leachate Collection

8. 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.)

9. 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)

10. 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.)

11. H.E.L.P. models include only fly ash layers. Section 3.1.4 of the report states that waste are predicted to include "approximately 70% fly ash and 30% bottom ash". This report also discusses the acceptance of Flue Gas Desulfurization (FGD) byproducts. Neither bottom ash nor FGD byproducts were included in any of the H.E.L.P. models. The H.E.L.P. models used default values for fly ash when some values, such as hydraulic conductivity, were tested for in Appendix J. Use the anticipated waste composition for modeling purposes. (Article 10, Section 238 C.3.; Article 10, Section 238 C.3.e. & 10 CSR 80-11.010(9)(B)1.E.)

Leachate Storage and Conveyance

12. 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.)

13. Leachate storage tank appears misplaced on Sheet 6. (General Engineering Comment)

14. 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.)

15. 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.)

Stormwater

16. 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.)

17. The 25-year, 24-hour rainfall event is greater than 5.6 inches based upon the NOAA Atlas 14 Volume 8, Version 2 Point Precipitation Frequency Estimates. Increase the 25-year, 24-hour rainfall event to the recently revised amount. (Article 10, Section 238 C.3.; 10 CSR 80-11.010(8)(B)1.F.(III) & 10 CSR 80-11.010(9)(B)3.)

18. 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. (General Engineering Comment)

19. In 4.2.1 UWL Disposal Operational Description section, the perimeter ditches around each phase must not provide storage of stormwater but must be designed to rapidly convey stormwater to the stormwater ponds for storage. (Article 10, Section 238 C.3. & 10 CSR 80-11.010(8)(B)1.F.(IV))

20. The perimeter ditches are designed with flat slopes. This may lead to standing water retained in these ditches which does not minimize infiltration. This design also may not empty expeditiously after storms. Additionally, this doesn't take into account the anticipated differential settlement. 10 CSR 80-11.010(8)(B)1.F.: "Provisions for surface water runoff control to minimize infiltration and erosion of cover. All Water Pollution Control Program permits and approvals necessary to comply with requirements of the Missouri Clean Water Law and corresponding rules shall be obtained from the department." 10 CSR 80-11.010(8)(B)1.F.(IV): "On-site drainage and channels shall be designed to empty expeditiously after storms to maintain the design capacity of the system." (Article 10, Section 238 C.3.; 10 CSR 80-11.010(8)(B)1.F. & 10 CSR 80-11.010(8)(B)1.F.(IV))

21. Since the perimeter ditches are designed with flat slopes, it would be difficult to estimate the amount of watershed area that would collect into the two separate ponds that serve Cells 3 and 4. The notes for Tables N-2 to N-5 state that "flows are split generally at half the distance between the entrances to the pond along the perimeter ditch." While this would seem like a reasonable assumption in theory, actual field conditions, subject to settlement and weathering, will probably not result in a perfectly flat ditch slope. Additionally, no consideration is given to the differences in times of concentration that would be present along the perimeter ditches due to the varying flow lengths down the final cover slopes. (General Engineering Comment)

22. On Sheets 5 and 7, show how the stormwater from Cell 2 will flow into the Stormwater Pond 1. (General Engineering Comment)

23. 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)

Berms

24. 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.)

25. The design of the landfill has the interior berms exposed the same as the exterior berms during the filling of Cells 1 and 3, thus it is required to have the same protection as the exterior berms since they would be considered exterior berms during the filling of cells 1 and 3, prior to the construction of cells 2 and 4. (Article 10, Section 238 C.3.d.)

26. In the interior berms, the geomembrane needs to wrap back over the leachate collection and protection layers at the point of future tie in to prevent backed-up leachate from seeping through the exterior slope. (Article 10, Section 238 C.3.; Article 10, Section 238 C.3.e. & 10 CSR 80-11.010(9)(C)2.)

27. Section 3.3.2.3 Franklin County Requirement – Erosion Protection in the Landfill Design discusses 2.2-inch thick fabric-formed concrete mats and Appendix K states that the exterior berm slopes will be lined with a 6-inch thick, fabric-formed articulated concrete mat. Section 9.0 Erosion Protection From Levee Overtopping of Failure in Appendix J provides a 56mm (2.2-inches) thick fabric-formed concrete mat such as Hydrotex FP220. The drawings include no dimensions. Revise all section and have the same dimensions listed for each. Additionally, add details to the drawings for the fabric-formed concrete mats. (Article 10, Section 238 C.3.d.)

Operations

28. The procedure for the placement of the first lift of CCR to prevent damage to the underlying layers needs to be developed and included in the operations section. (Article 10, Section 238 C.3. & 10 CSR 80-11.010(2)(C)1.)

29. Flooding of the phase due to not having adequate CCR in place would need a contingency plan developed and included in the construction permit application. The inundation of the phase area would need to be equalized to prevent significant differential head on the liner. Additionally, the pumping down would need to occur relative to the floodwaters surrounding the phase as they recede to prevent a high differential head. (Article 10, Section 238 C.3.; Article 10, Section 238 C.3.e. & 10 CSR 80-11.010(9)(B)1.E.)

30. The Solid Waste Excluded lists Major Appliances and Whole Waste Tires. Modify these to list as Any Appliances and Waste Tires. (Article 10, Section 238 C.3 & 10 CSR 80-11.010(3)(A))

31. Dust suppression must be employed to prevent the migration of CCR offsite during all phases of construction, including mining activities, if and when allowed. (Article 10, Section 238 C.3; 10 CSR 80-11.010(12)(A) & 10 CSR 80-11.010(13)(C)1.)

32. Backup equipment or additional equipment is necessary more quickly than within 3 days due to the volume of waste generated. If a piece of equipment goes down, backup or replacement equipment should be in use within 24 hours. (Article 10, Section 238 C.3 & 10 CSR 80-11.010(15)(B)1.)

33. 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))

General Comments

34. 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 complied 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 CSR 80-2.015 Appendix I)

35. 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.)

36. Sheet 8 appears to be missing leaders and detailed descriptions. Please update for further review. (General Engineering Comment)

Appendix D

37. Appendix D should be renamed "Violation History Disclosure Form" rather than the older language which has a negative connotation. (Article 10, Section 238 C.3 & 10 CSR 80-2.020(2)(A)2.I.)

Appendix H

38. The only document contained in Appendix H Floodplain Documentation is a review letter for the "Floodplain Analysis of the Missouri River for the Ameren Missouri Labadie Energy Center" by the Independent Registered Professional Engineer (IRPE). Please provide the additional documentation that was submitted to receive this letter from the IRPE. (Article 10, Section 238 C.3; 10 CSR 80-11.010(4)(B)1.)

Appendix J

39. The Table of Contents for Appendix J lists the Files on Enclosed CD. AEI was not provided the CD which includes the Files of the Printed Outputs from Computer Runs to review. We will need a copy of the computer runs of the revised report based upon the comment letters. (Article 10, Section 238 C.3 & 10 CSR 80-2.020(2)(A)2.B.)

40. 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)

41. Friction angles in the stability analyses don't correspond to the testing on the CH clay liner material from the offsite borrow. Triaxial shear testing (CU) on the CH clay resulted in phi of 14.6 effective stress shear angle with cohesion near 0.21 tons per square foot. The effective friction angle used in the stability analysis for the compacted clay liner was listed as 25 degrees. Verify each input providing references for their values. (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)

42. 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)

43. 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)

44. 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)

45. 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)

46. The draft technical guidance document from MDNR-SWMP and Stark wasn't intended for designing landfills within a very young geologic age and active floodplain. Stability analysis for varying phases of filling is necessary due to the proposed location of the landfill. (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)

47. Protective/drainage layers are missing from the stability analysis. Both designs need analyzed in the stability models if both are considered for permitting and construction. (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)

48. The boring B-100 is no longer centralized or even under a cell of the landfill. Other soil profiles should be analyzed to provide the critical Shake analysis. This will require additional borings to bedrock within the footprint of the landfill. (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)

49. 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 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)

50. 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)

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50. 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)

51. The Table of Contents for Appendix C Seismic Analyses appears to have C-18 & C-19 swapped with C-20 & C-21. Please revise and verify the information. (General Engineering Comment)

52. 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))

53. 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)

54. 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)

55. The protection of liner from hydrostatic uplift discusses the flooding with the gravel drainage layer and sand protective layer. The alternate design with the geocomposite drain and protective sand layer must also be discussed in the flooding scenarios. (General Engineering Comment)

56. In Appendix G – Design of Fabric-Formed Concrete Mat (FCM), the factor of safety calculation has a missing value, t (= 0.183 ft) in the numerator after substitution:

$$F.S. = \left[\frac{\mu(t)(\gamma_c - \gamma_w)\cos\theta\cos\propto - \tau_{DES}}{\sqrt{[t(\gamma_c - \gamma_w)\sin\theta]^2 + \tau_{DES}{}^2}}\right]$$

$$F.S. = \left[\frac{0.637(130\,PCF - 62.4\,PCF)\cos(18.435°)\cos(0°) - \tau_{DES}}{\sqrt{[(0.183')(130 - 62.4)\sin 18.435]^2 + \tau_{DES}{}^2}}\right]$$

This reduces the value of the maximum design velocity significantly. Update the calculations with the thickness of the fabric-formed concrete included. (General Engineering Comment)

Appendix O

57. The filter design basis in the Memo from Bruce Dawson, PE to Gredell Engineering Resources, Inc, included in Appendix O-1, requires a tighter gradation for the sand protective layer based upon the R15 provided. The D15 for the sand should range from 0.24 mm to 0.8

mm based upon the D15 of the Fly Ash and the R15 provided from the Peck Hanson Thornburn filter criteria. (Article 10, Section 238 C.3 & 10 CSR 80-11.010(9)(B)1.D.)

Appendix P

58. 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.)

59. Appendix P Construction Quality Assurance Plan section 3.2 Test Pad references the Demolition Landfill regulations. Please revise to reference the appropriate regulations. (Article 10, Section 238 C.3 & 10 CSR 80-11.010(10)(C)1.)

60. In section 3.5 Quality Assurance Monitoring and Testing, the following statement must be omitted since there is no justification of the reduced testing frequency. "If liner quality soils are stockpiled on site prior to the beginning of placement, a reduced frequency of verification testing will be requested." (Article 10, Section 238 C.3 & 10 CSR 80-11.010(6)(C)1.)

61. A log of soils should be maintained for soils brought in from offsite. The log should provide the testing performed and the intended use on site. This will assist in construction planning for each cell construction. (General Engineering Comment)

Appendix V

62. Need a full size Survey Plat for review of Appendix V. (General Engineering Comment)

Appendix Y

63. 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.)

64. In Appendix Y(a) Pipe Capacities, the flow capacity calculation in this section was miscalculated by a factor of 10:

$$Q = \frac{1.49}{.009} \times 0.156 \times 0.111^{2/3} \times 0.005^{1/2} \neq 4.2\ cfs$$
$$= 0.42\ cfs$$

(Article 10, Section 238 C.3.; Article 10, Section 238 C.3.e. & 10 CSR 80-11.010(9)(B))

65. 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.)

66. In Appendix Y(c) – Water Management Calculations, the second paragraph of the concluding statements reads "Backup leachate management will be at an offsite POTW." The permit should specify which POTW will manage the leachate as backup and a signed agreement pertaining to this management should be included. (Article 10, Section 238 C.3.; Article 10, Section 238 C.3.e. & 10 CSR 80-11.010(9)(B)4.)

67. In Appendix Y(d) – Flood Mitigation Calculations, Pumping Rates for Flood Water Protection – Cell 3, the concluding statement reads, "A pumping rate of 13,194 gpm, pumping 24 hours per day, is required to fill Cell 3 in 10 days for 100-year flood protection." The source and location of the required water supply, as well as the necessary equipment for pumping should be specified. (General Engineering Comment)

68. Included in Appendix Y(e), the clay/geomembrane interface for the side slope cover material stability calculates with a factor of safety of 1.46, below the 1.5 as stated. The interface friction angles used for the clay and geomembrane are stated to be taken from Table 5.6 and Table 5.7. Analysis and Design of Veneer Cover Soils is included in Appendix J with an interface friction angle of 15 degrees. In hand written calculations provided in Appendix Y(e), the factor of safety for CCR to geomembrane is calculated as 1.2 in static conditions. Provide a detailed narrative with additional calculations to support the provided calculations and how they relate to each other. If the fly ash were to be utilized as being in intimate contact with the geomembrane with moistures approximately five percent over optimum, this interface would need laboratory testing as part of the demonstration for an alternative final cover system and included in the stability analysis. (Article 10, Section 238 C.3 & 10 CSR 80-11.010(5)(A)4.D.)

69. In Appendix Y(e), the attached printout for the 60 mil Geomembrane has 23.00 kN/m provided as the Allowable Force in Geosynthetic, TDESIGN. The valve for the Strength at Yield in the GSE Product Data Sheets has 22 N/mm. Update the value in the printout. (General Engineering Comment)

Ameren Missouri
Labadie Energy Center
Response to April 22, 2013
Franklin County IRPE Comments

July 8, 2013

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1.0 INTRODUCTION

This report has been prepared in response to comments developed by the County's Independent Registered Professional Engineer (IRPE) in a report entitled, "*Groundwater Monitoring Application Review, April 2013*". The IPRE report constituted a review and critique of the basis for the detection groundwater monitoring system as presented in a document entitled, "*Documentation of Groundwater Monitoring System Design*". That document, written by GREDELL Engineering Resources, Inc. (Gredell Engineering), is included as Appendix X to the Construction Permit Application (CPA) for the Ameren Missouri Labadie Energy Center Proposed Utility Waste Landfill, which is under review by the County as of the date of this report. Appendix X along with supporting information contained elsewhere in the CPA (Appendix Q - Groundwater Sampling and Analysis Plan and Appendix W – Groundwater Hydraulic Data) was part of a January 3, 2013 submittal to both the Missouri Department of Natural Resources Solid Waste Management Program (MDNR-SWMP) and the County that predated submittal of the entire CPA document on January 29, 2013. The information included in Appendix X was presented at a level of detail sufficient to allow review and evaluation by MDNR personnel, including elements of the SWMP, Geological Survey Program (GSP), and Water Protection Program (WPP). Appendix X and the proposed detection groundwater monitoring system were approved by MDNR on March 7, 2013. Subsequently, the detection groundwater monitoring system was installed as approved around the perimeter of the proposed UWL facility from mid-March through mid-April 2013.

Comments made in the IRPE report suggest both a technical and philosophical disagreement with several elements of the detection groundwater monitoring system accepted by MDNR. Some of the technical concerns appear to be the result of what the IRPE considered incomplete documentation of the modeling approach used to develop the groundwater system design as presented in Appendix X, which limited their ability to conduct a comprehensive evaluation of the data presented. Other technical aspects are more fundamental and derive from what is best characterized as professional differences of opinion concerning the choice of basic model parameters used in the development of the current system. Philosophically, differences in opinion also exist concerning the adequacy of the site-specific investigative process (i.e. Detailed Site Investigation, or DSI) on which the system was based, the intent of the system as designed (a Detection Monitoring System), and the consideration of existing ash impoundments, which are outside the regulatory requirements of the current UWL solid waste permit process.

The responses presented below are intended to address key points raised in the IRPE report. Philosophical comments are addressed in the following subsections. Relevant technical comments are addressed in the remainder of this document.

1.1 Basis for Groundwater Monitoring Design

A fundamental difference of opinion exists concerning the adequacy of the site-specific geologic and hydrologic data on which the current detection monitoring system is based. The IRPE identifies apparent deficiencies in the data collected as contrary to regulations cited under 10 CSR 80-11.010(11) and makes the representation that such omissions result in non compliance with MDNR's regulatory process as described under Missouri Solid Waste Management Law and Rules and as implemented by MDNR-SWMP and MDNR-GSP .

The groundwater monitoring system developed for the Labadie UWL is a direct outgrowth of the geologic and hydrologic data gathered during the Detailed Site Investigation (DSI) conducted at the site in 2009-2010. The requirements for completing the DSI process are described in 10 CSR 80-2.015(1)(B), (C), and (D). This process is generally as follows:

1. Initially, a work plan development meeting must be held with the MDNR-GSP. MDNR-SWMP representatives also are in attendance. Discussion must focus on the geology and hydrology of the proposed site, specific elements to be included in the DSI work plan, time frames for completion of the work, and review of the regulatory process.

2. Following that meeting, a detailed work plan is developed for review and approval by the MDNR-GSP with input from MDNR-SWMP. It must be based on the requirements 10 CSR 80-2.015 Appendix 1, "*Guidance for Conducting and Reporting Detailed Geologic and Hydrologic Investigations at a Proposed Solid-Waste Disposal Area*" (commonly referred to simply as the "Guidance").

3. After the work plan is approved, a field investigation must be completed in accordance with the approved work plan, applicable rules, and department guidance. The "Guidance" document also details the specific elements to be included in the DSI report, which is then submitted to the MDNR-GSP and MDNR-SWMP for review and approval.

Approval of a DSI report by both the MDNR-GSP and MDNR-SWMP indicates that a site is found to have suitable geologic and hydrologic characteristics for the development of an environmentally sound solid waste disposal area. Approval also indicates that the DSI report adequately addresses geologic or hydrologic conditions that can be overcome by engineering pursuant to 10 CSR 80-11.010(5)(A)3 for the development of an environmentally sound solid waste disposal area. This is a rigorous and thorough regulatory process and is accompanied by two separate public participation events as required by Solid Waste Management Law.

The Ameren Missouri Labadie Energy Center Proposed Utility Waste Landfill was subject to the DSI process described above. All elements of the DSI work plan, field investigation, final report, and public participation requirements were conducted and completed to the satisfaction of both the MDNR-GSP and MDNR-SWMP, as evidenced by their approval of the final DSI report on April 8, 2011. To suggest that relevant parts of this process were overlooked or ignored without due consideration of their applicability is simply not an accurate portrayal of the regulatory process.

1.2 Detection versus Compliance Monitoring Systems

A second recurrent theme in the IRPE report is a reliance on various water quality standards and waste-specific chemical parameters and concentrations to make representations concerning the effectiveness of the current system at a point of compliance (e.g. property line). Understanding the intent of the required detection monitoring system as described in 10 CSR 80-11.010(11)(C)4. and as presented in Appendix X is essential to understanding the groundwater monitoring system developed at the Labadie UWL. The approved system at Labadie is not a compliance-based system. Rather, as described in 10 CSR 80-11.010(11)(B)4.B., the number, locations, and depths of the groundwater wells were designed to, "*...ensure that they detect any significant amounts of fluids generated by the UWL that migrate from the UWL to the groundwater*". Detection of "*any significant amounts of fluids*" is accomplished through statistical comparisons of groundwater analytical data to determine if statistically significant increases (SSIs) through time are occurring for any of the 32 required monitoring parameters listed in 10 CSR 80-11.010 Appendix I.

Compliance monitoring systems assume a specific standard (e.g. Federal MCL's, State Groundwater Protection Standards) must be met, generally at a property boundary. Detection monitoring is a precursor to compliance monitoring because it examines SSIs in water chemistry through time irrespective of absolute chemical concentration or compliance with specific standards. If statistical evaluations reveal an increasing concentration over time for one or more of the required analytical parameters, then a demonstration must be made to MDNR in accordance with 10 CSR 80-11.010(11)(C)6 that a source other than the UWL caused the SSI or that the SSI is the result of an error in sampling, analysis, statistical evaluation, or natural geospatial variation.

If a demonstration cannot be made that the statistical increase is not due to the UWL, then Assessment Monitoring is required by regulation. Assessment monitoring includes the installation of additional wells, an increased frequency in sample collection and analysis, and an evaluation of the rate and extent of migration of the contaminant plume, including documentation of contaminant concentrations. It is during the assessment monitoring process that comparisons to groundwater protection standards are required and in that sense the additional wells installed essentially create a compliance-based system. Most of the comments presented in the IRPE report would be addressed during the assessment phase, which is a separate and distinct process from the development and implementation of the detection groundwater monitoring system required by MDNR regulation.

The detection monitoring system presented in Appendix X of the CPA is better understood by reference to Figure 1 of this report. This figure was not included in Appendix X. It visually illustrates the derivation and selection of the spacing criteria for the down gradient wells, as described on pages 5 and 6 of Appendix X, by showing the dispersion plumes in relationship to one another and to solid waste disposal boundaries. The dimensions of the dispersion plumes, which are the same as those presented in Attachment 3 of Appendix X, are based on a 44-year (528 months) time period. These plumes demonstrate a high degree of probability for detecting contaminant plumes along the eastern and northern (i.e. down gradient) perimeters of the proposed UWL using the baseline model parameters described in Appendix X.

1.3 Existing Ash Impoundments

The third philosophical difference is related to the compliance aspects mentioned above and is the consideration of regulatory issues outside the requirements of 10 CSR 80-11. Specifically, the IRPE has included comments specific to the existing ash impoundments at the Labadie Energy Center and the impact of the impoundments on current groundwater quality based on an assumption of leakage since 1992 (e.g. refer to comments 11 and 12 of IRPE's Attachment 1). These comments also appear to form the primary basis for the IRPE's conclusion that deeper monitoring wells are required at the UWL facility that has not yet been constructed. These IRPE comments apply to a regulatory process subject to Missouri Clean Water Commission jurisdiction and consequently are not a matter specific to the solid waste permit process involving the proposed UWL. Existing groundwater quality in the recently installed detection monitoring well system has and will continue to be documented throughout the background monitoring period (eight rounds of quarterly data). Possible impacts on up gradient groundwater quality, if any, that could be attributable to other existing sources, will be evaluated at the end of the background monitoring period, which is scheduled for completion in early 2015.

Ameren has noted that they are currently in the process of renewing their NPDES permit for the Labadie Energy Center. This regulatory process will require the installation of ground water monitoring wells to evaluate the existing impoundments.

2.0 SOURCE WIDTH

Section 2.1 of the IRPE report describes the use of a 100-foot source width as representative of a catastrophic failure in the liner system and further suggests that a failure of this magnitude is unlikely. The IRPE considered that minor "tears" in the liner system of five feet or less were more likely to occur. Data is presented showing the effect a smaller source width has on dispersion plume dimensions. The data presented by the IRPE indicate that for a smaller source width (i.e. 5-ft, 10-ft, and 20-ft "tears") both the length and width of the dispersion plume is less than that for a 100-foot "tear". The width of the plume generated using a five-foot "tear" is noted as 41 percent narrower than the width of the plume generated using a 100-foot "tear" (using a 180-ft measure of dimension that presumably reflects the distance between the proposed well placements north of Cell 2 and the assumed edge of the waste placement boundary).

We have re-evaluated the dispersion plumes using the original model parameters presented in Appendix X of the CPA except for source width. Source widths (initial liner "tears") of five feet and 25 feet were assumed. PLUME model outputs showing the resultant dimensions for each modeling scenario, including the original 100-foot source width, are presented as Figures 2 through 7. The PLUME model outputs shown in Figures 2, 3, and 4 pertain to Cell 1 and 2. The PLUME Model outputs shown in Figures 5, 6, and 7 pertain to Cell 3 and 4. The dimensions for each modeling scenario are summarized in Table 1. Resultant plume widths are based on the average distance between proposed wells and the edge of waste, which is defined as the inside toe of the containment berm around the waste disposal cells.

The results of this re-evaluation also concluded that a smaller initial source width results in a slightly shorter dispersion plume and a more pronounced narrowing of the dispersion plume width. For comparison, the difference in plume length between the 100-foot and five-foot "tears" is between 5 and 6 percent. The difference in plume width is between 38 and 39 percent.

The effect a narrower plume from a five-foot "tear" has on the MDNR-approved groundwater monitoring system is graphically illustrated on Figure 8. For each well location, the dispersion plumes generated for the five-foot "tears" (Figures 4 and 7) have been superimposed (in green) on the dispersion plumes for the 100-foot "tears". Lines drawn tangentially from the widest part of each "five-foot" dispersion plume are shown extending into the solid waste area until they either intersect or the inside toe of slope is reached. These triangular shapes provide an estimate of the area where a failure in the liner system could escape detection by the approved and installed groundwater monitoring system. The sum of these areas is approximately ten percent of the total proposed disposal area of 166.5 acres.

3.0 LONGITUDINAL & TRANSVERSE DISPERSIVITY

The groundwater model approach used to determine longitudinal and transverse dispersivity values was developed in response to the data obtained during the 12-month DSI time period (December 2009 to November 2010). During that period, groundwater flow direction fluctuated widely in response to changes in Missouri River elevation. Groundwater movement generally was north-northwestward toward the Missouri River during periods of low river stage and generally shifted eastward away from the river during periods of high river stage. These changes in flow direction commonly occurred from month-to-month during the DSI time period with a 90 degree shift in groundwater flow documented over the span of one week in May 2010. The overall effect imposed by the Missouri River on groundwater movement is not unlike the ebb and flow of water in the tidal zone of an ocean beach. This "swash" effect is not uncommon in alluvial aquifers and conventional modeling literature emphasizes the need to acquire as much site-specific data as possible because of the "profound influence" such variations can have on contaminant transport (Wiedemeier et al., 1998). However, conventional modeling techniques do not account for the degree of variation observed during the 12-month DSI time period and for that reason the method of analysis used a multidirectional aspect of groundwater flow to develop an overall detection groundwater monitoring system.

An expanded discussion of the approach used to derive longitudinal and transverse dispersivity values is provided in Appendix 1. It is based on the concepts and techniques cited in Freeze and Cherry (1979), Gelahar et al., (1992), Wang and Anderson (1982), and Wilson et al., (1992).

4.0 OTHER MODEL CONSIDERATIONS

As stated in Section 1.0 of this response, the IRPE report references several concepts or opinions having relatively minor impact on the final model results or the IRPE makes recommendations that are not well supported by detailed calculations or documentation. Section 2.0, Source Width, and Section 3.0, Longitudinal & Transverse Dispersivity, address two topics described in the IRPE report that have a minor impact on the final model results. This section addresses other specific topics or recommendations made by IRPE that do not warrant individual detailed response.

4.1 Source Concentrations

We recognize the need for reasonable, site-specific source concentrations in modeling the impact from a known, contaminated site (e.g. a leaking underground petroleum storage tank) to forecast the potential time of travel, concentration, and impact of contaminant plumes on adjacent properties and/or existing groundwater uses. However, the intent of the PLUME model used for the Labadie UWL is to develop hypothetical plume shapes and sizes for the purpose of designing and evaluating a DETECTION GROUNDWATER MONITORING SYSTEM. The IRPE acknowledged that the PLUME model does not require or allow the entry of a source concentration – therefore the choice of an initial source concentration does not impact the PLUME model and does not impact the overall shape, length, or width of the resultant plume developed by the model.

The IRPE agreed with the use of the PLUME model, which develops a plume shape represented by "concentration contours" that are a percentage of the initial source concentration. In this case, "concentration contours" of one-tenth (0.1), one-one hundredth (0.01) and one-one thousandth (0.001) of an initial source concentration were modeled. Primarily for illustrative purposes, we chose to use an initial source concentration of 3,000 mg/l for the contaminant, Chloride, in the original model. Chloride was chosen as a contaminant that can be expected to be present in the UWL at some concentration, is recognized by the scientific community as mobile in groundwater flow regimes, and is commonly used as a conservative "tracer" contaminant. The following excerpt supports the use of Chloride (Wiedemeier et al, 1998):

> *Chloride (Cl-) forms ion pairs or complex ions with some of the cations present in natural waters, but these complexes are not strong enough to be of significance in the chemistry of fresh water. Chloride ions generally do not enter into oxidation-reduction reactions, form no important solute complexes with other ions unless the chloride concentration is extremely high, do not form salts of low solubility, are not significantly adsorbed on mineral surfaces, and play few biochemical roles. Thus, physical processes control the migration of chloride ions in the subsurface. Because of the neutral chemical behavior of chloride, it can be used as a conservative tracer to estimate biodegradation rates (in chlorinated solvents).*

The plume shape defined by the outermost 0.001 concentration contour was used as the basis for the number and location of groundwater monitoring wells that would result in a highly efficient detection monitoring system. The initial source concentration (in this case, 3,000 mg/l Chloride) was used to provide a numerical value for the 0.001 concentration contour (3 mg/l) that generally approximates the Practical Quantitation Limit (PQL) of Chloride.

Modeling is a hypothetical exercise, albeit a scientific one. Modeling using scientific parameters is the best available predictor of future performance of landfills. However, an actual source concentration from a POTENTIAL FUTURE LEAK from a UWL with a composite liner and leachate collection system cannot be predicted. The "leak" may be very small (the HELP model uses 2 centimeter diameter holes in the geomembrane liner, not a 5-foot tear) or it may be very minor volumes (the HELP model predicts that the maximum head on the Labadie UWL composite liner will be less than 1 inch). Therefore, despite the actual contaminant concentrations in the "leak", the contaminant will be diluted once it reaches the large volumes of groundwater within the alluvial aquifer of the Missouri River valley. As a result, an estimated source concentration was used for illustrative purposes that may represent a "worst case" scenario, while the source concentration of an actual event could be higher or lower than the concentration modeled.

It is our professional opinion that initial source concentration is a minor factor in the design of a DETECTION GROUNDWATER MONITORING SYSTEM and its value is primarily used to model only one of many possible scenarios. Regardless of the source concentration, the PLUME model predicts the size and shape of a future contaminant plume as defined by the 0.001 concentration contour. Depending on the source concentration and analytical limitations, a specific contaminant may not be detected at one-one thousandth of the initial concentration. Under the current Missouri regulatory framework for detection monitoring of landfills, the use of "indicator" or "tracer" parameters and the regular statistical evaluation of groundwater data for SSIs seeks to identify potential containment system failures at small quantities and concentrations as soon as they can be practically detected, but before they exceed a compliance concentration (typically at the property boundary).

4.2 Deep Wells

The IRPE report recommendation to install five "deep" wells (i.e. to the top of bedrock) is unsupported by the data presented. As previously noted, this recommendation appears to come from concerns with potential contamination from existing ash impoundments at Labadie. However, the recommendation also appears to be based on the potential for vertical migration of a contaminant plume emanating from the proposed UWL prior to detection by the groundwater monitoring system approved by MDNR. Vertical migration of contaminants is a concept most often associated with immiscible organic chemical compounds, some with specific gravities greater than water ("sinkers") and some with specific gravities less than water ("floaters"). The chemical constituents of CCPs are primarily metals and inorganic chemical compounds that naturally occur in the coal used in the combustion process. The list of detection monitoring parameters required by MDNR (10 CSR 80-11.010, Appendix I) focus on these inorganic parameters, which generally are in a dissolved phase and do not sink through the water column.

The groundwater transport model presented in Appendix X of the CPA considered the vertical component of dispersion insignificant "*because contaminant concentrations are assumed to be preferentially moving parallel with groundwater flow direction*" (p. 5). This assumption is confirmed by previous studies, particularly the work by Gelhar et al. (1992), who after review of multiple field studies determined that, "*In all of these cases, vertical transverse dispersivity is 1-2 orders of magnitude smaller than the horizontal transverse dispersivity*".

The data presented by Gelhar for what was considered high reliability field studies show vertical-to-horizontal dispersivity ratios greater than two orders of magnitude (see Gelhar's Table 1, data for the Garabedian et al. (1988) and Rajaram & Gelhar (1991) field studies). These data suggest that for every foot of vertical movement, the horizontal movement is in excess of 100 feet and possibly in excess of 600 feet. Thus, modeling a maximum width for the Labadie UWL of approximately 3,000 feet (Cell 3 as measured southeast to northwest) and an alluvial aquifer thickness of approximately 100 feet, the horizontal movement of groundwater will transport potential contaminants toward the approved detection monitoring system well in advance of contaminant conveyance and detection in deep wells. If assessment monitoring is needed at the site in the future, the concept of deep wells should be considered.

On these bases, we believe the recommendation for deep wells is without justification and do not agree that they are needed as part of the detection groundwater monitoring system.

4.3 Effective Porosity

The IRPE report demonstrates that use of a lower effective porosity value (0.265) results in a slight increase in plume length and virtually no change in plume width with respect to the effective porosity value (0.35) used in Appendix X. The same holds true when comparing the results for the five-foot source width shown in the two tables on page 3 of the IRPE report. We concur with IRPE's conclusion that effective porosity values have a minor impact on plume width, but that source width considerations have a much greater impact on the dispersion plume width. The range of effective porosity values presented in Table 1 of Appendix X (0.30, 0.35, and 0.40) are the same values as used in Table 8 of the DSI Report and are based on the data of Peck (1953) for mixed-grain sands. Our model uses the middle value. The grain sizes, and therefore the geometry of the pore apertures and the degree of interconnectivity of pore throats that define effective porosity found in an alluvial aquifer can vary considerably across the site. For purposes of designing a detection monitoring system, there is little apparent benefit to further refining the effective porosity value.

4.4 Contaminant Breakthrough Time

The IRPE estimated the time it would take contaminants to migrate through a compacted clay liner should a rupture occur in the overlying flexible membrane liner system. Their calculations suggest a contaminant breakthrough time of between 47 and 848 days assuming an effective porosity value of 0.06 for the compacted clay. Given that the IRPE agrees with the use of a 44-year time period (16,060 days) in the PLUME model, the breakthrough times are comparatively insignificant and were not considered in our model approach.

4.5 Southeastern Shallow Wells

The IRPE recommends the installation of three wells (P7, P8 and P9) near the southeast corner of Cell 3 without detailed explanation. Based on the information presented in their report, we conclude this recommendation is primarily based on the IRPE's misconception that the 813-acre permit boundary is also Ameren Missouri's property boundary (see Figure 3 of the IRPE report). This coupled with the IRPE's opinion that the groundwater monitoring system should be a compliance system, instead of a detection system has led to their recommendation for additional wells at the southeast corner of the UWL. In reality, the actual property boundary is over 1,200 feet east of the easternmost edge of Cell 3.

Furthermore, the locations of proposed wells P7 and P8 appear to "shadow" the current locations of MW-15 and MW-16 for the resultant predicted northeasterly direction of flow. Using a more northerly direction of flow as preferred by the IRPE (reference Section 5.0 of this report), the additional wells provide no apparent improvement to the current detection monitoring system.

The location of proposed well P9 appears to fill a perceived "gap" between MW-16 and MW-17 using the resultant predicted northeasterly direction of flow and is located very close to the permit boundary. Again, using the northerly direction of flow preferred by the IRPE, the addition of P9 provides no apparent improvement to the current detection monitoring system.

For these reasons, it is our professional opinion that adding P7, P8, and P9 does not improve the performance of the groundwater detection system at the Labadie UWL and consequently they do not need to be added.

5.0 EVALUATION OF ALTERNATIVE FLOW DIRECTION

Subsection 2.4 of the IRPE report summarizes the sensitivity analyses described in subsections 2.1, 2.2, and 2.3. These analyses are summarized at the top of page 7. This data suggests that using a 5-ft source width in combination with alternative values for effective porosity and longitudinal/transverse dispersivity, a plume length of 2,125 feet is generated over the proposed 44-year (528 months) time period. This result is graphically illustrated in Figure 1 of the IRPE report. Although not specifically stated by IRPE, a plume length of this magnitude appears to be based on an assumption that groundwater flow direction is constant throughout the 44-year time period. Plume length is also magnified by use of an average contaminant velocity of 3.060, more than triple the value (1.013) used in our model (see Figures 2, 3, and 4). Assuming the plume generated by IRPE is based on a higher velocity and a continuous direction of flow for 44 years, the result is not an accurate representation of the behavior of the alluvial aquifer and its response to changes in Missouri River elevation. Our dispersion plumes are modeled based on the back-and-forth motion of groundwater as determined during the 12-month DSI time period, which has been viewed by IRPE as "atypical" and not representative of normal site conditions (e.g. refer to comments 9 and 10 of IRPE's Attachment 1). The IRPE's opinion is not supported by review of historical Missouri River elevations for the past 13 years.

Our modeling approach presented in Appendix X of the CPA was based on the results of the 12-month DSI time period. Those data show that groundwater exhibits considerable variation in flow direction in response to changes in Missouri River elevation. During periods of low river stage, groundwater generally flows north-northwest toward the river. During periods of high river stage, groundwater flow shifts eastward away from the river. This "swash" effect on groundwater movement and resultant velocities was accounted for in our modeling approach (reference Section 3.0). This explains why plume lengths are considerably shorter than the plume lengths predicted on the summary table presented on page 7 of the IRPE report. This also explains why plumes are wider than the plume widths predicted on the IRPE's summary table.

The representativeness of Missouri River levels and their consequent impacts on groundwater flow behavior during the 12-month DSI time period in relationship to the preceding ten-year time period (2000-2009) is described on page 40 of the DSI report. The DSI recognized that Missouri River levels generally were higher during the DSI than in preceding years and is the reason why one of the conclusions stated in the DSI report (p. 52) was, "*…"unwatering" of the local water table toward the Missouri River may be more prevalent than what is suggested by the current data*". Thus, the DSI acknowledged that the 12-month DSI timeframe (2009-2010) on which our modeling effort was based coincided with a period of unseasonably high river levels and consequently, the DSI data do not positively predict groundwater behavior under "normal" river stage conditions. However, the DSI data does provide a basis for understanding how groundwater movement behaves under more seasonal river stage conditions.

In the absence of piezometric data during periods of "normal" river stage conditions, it is not possible to accurately model or predict the resultant impacts on groundwater movement. However, general conclusions can be made by extrapolating piezometric readings during the 12-month DSI investigation to the historical river elevation readings as recorded at the Labadie Power Plant gauging station.

Figure 9 is a hydrograph depicting the daily Missouri River elevations as obtained from Ameren personnel for the Labadie gauging station. The figure is identical to the hydrograph presented as Figure 32 of the DSI report except for the addition of data from 2011-2013. As noted on page 40 of the DSI report, a reversal in groundwater flow direction appears to occur when Missouri River levels attain a more or less sustained elevation of between 461 and 463 feet. Groundwater flow direction generally is toward the river below this range in elevation and generally moves away from the river above this range in elevation. As can be seen from the hydrograph, using a midpoint elevation of 462 feet, groundwater movement toward the river is predicted to occur more frequently in the timeframes both before and after the 12-month DSI time period. The hydrograph also indicates that the longest sustained period of time river elevations remained below 462 feet is approximately 678 days. Conversely, the hydrograph indicates that the longest sustained period of time river elevations remain above 462 feet is approximately 166 days. This suggests that groundwater movement typically has a more northerly component than evidenced by the data acquired during the DSI timeframe and that the maximum length of time before a shift from this northerly flow occurs is slightly less than two years. Sustained periods of high river flow are of shorter duration (<6 months), which supports the modeled impact the "swash" effect has on groundwater velocity values.

An evaluation of what constitutes more typical river flow conditions can be approximated by considering the average or mean value of the daily river elevations as measured over the 2000-2013 period at Labadie. This is shown in the frequency histogram presented as Figure 10 that indicates the mean river elevation over the 13-year (4,817 days) time period is 454.9 feet. This is approximately seven feet lower than the estimated elevation (462 feet) at which groundwater begins moving toward the Missouri River and is further evidence that a northerly flow component is more frequent than shown by the data acquired during the DSI. The longest time period the river remains below this typical flow condition is approximately 309 days (Figure 9).

A similar analysis of the Labadie gauging station data was made in Appendix Z of the CPA. However, the purpose of that analysis was to determine a "natural water table" elevation for the liner design and the focus was on the relationship between elevated groundwater levels and gauge data rather than an assessment of typical river flow conditions.

Based on a more northerly component of groundwater flow (toward the Missouri River) as suggested by the 13-year historical time period of river stage analysis, we graphically re-evaluated the northern tier of wells in the approved detection monitoring system, located immediately north of Cell 2. The results of this re-evaluation are presented in Figure 11. For the purposes of demonstration, a northerly orientation perpendicular to the solid waste boundary was selected for the axis of the dispersion plumes (a plume axis perpendicular to the solid waste boundary requires the narrowest well spacing). The dispersion plumes used are based on the five-foot source width as shown in Figures 4 and 8. All other model parameters were unchanged. Proposed well locations depicted in Figure 3 of the IRPE report are also superimposed for reference.

As diagramed in Figure 11, as many as seven well locations would be required to achieve full efficiency of the detection monitoring system using the noted plume dimensions for this more northerly flow direction. However, existing wells MW-1, MW-2, and MW-3 are within the boundaries of three of the dispersion plumes. Using the more northerly direction of groundwater flow, our evaluation is in general agreement with adding the western four of six wells suggested by the IRPE report (except the IRPE wells are further away from the edge of waste).

The remaining down gradient wells in the approved detection monitoring system (MW-5 through MW-22) were not graphically re-evaluated using a more northerly direction of groundwater flow. The northwest to southeast orientation of MW-5 through MW-15 along the eastern boundary of Cell 3 predetermines that they will provide a high efficiency detection monitoring system for a more northerly groundwater flow direction because of the relatively close well spacing in the east-west direction. Wells MW-16 through MW-22 are east or south of the solid waste boundary of Cells 3 and 4. Therefore, during a more northerly direction of groundwater flow, these wells will either be "up gradient" of the solid waste disposal area or east of a potential contaminant plume.

6.0 SUMMARY AND CONCLUSIONS

The groundwater model design presented in Appendix X of the CPA for the Labadie Energy Center Proposed Utility Waste Landfill is based on the results of the DSI investigation conducted for the facility in 2009-2010. The DSI included an evaluation of groundwater flow based on measurements taken from 100 piezometers over a period of 12 consecutive months (December 2009 to November 2010). These site-specific data are considered appropriate for the development of a rational, scientifically based groundwater well design intended specifically as a detection monitoring system as required by Missouri State Solid Waste Management Law and Rules. The detection monitoring system has been approved by MDNR-SWMP, in conjunction with joint review by MDNR-GSP and MDNR-WPP.

Modeling is a subjective process and is used as a tool to evaluate the potential efficiency of a detection groundwater monitoring system. Model parameters can be adjusted based on various assumptions and the desired degree of conservatism, with the end result being a monitoring system design that is not expected nor required to be 100 percent efficient. Rather, the intent of the modeling process is to support the development of a detection monitoring system that is considered "highly efficient" (no regulatory definition for "highly efficient" exists in Missouri State Solid Waste Management Law and Rules).

In response to the IRPE review report, Gredell Engineering and Reitz & Jens recommend the following:

1. No additional field exploration to further identify and define aquifer parameters used in the PLUME model is recommended at this time. This is supported by MDNR's review and approval of the DSI and current detection groundwater monitoring system.

2. Based on the past 13 years of historical Missouri River elevations, groundwater movement trends more northerly than what was indicated by the 12-month DSI investigative time period. In combination with the narrower plume widths generated assuming a five-foot "tear" width in the liner system, additional wells in the area north of Cell 2 warrant consideration. Recommended locations for as many as seven (7) new wells are depicted on Figure 11 of this response. Wells installed in this area should be of the same approximate depth as the existing wells and integrated into the current detection groundwater monitoring system. Alternatively, the four (4) existing wells in this location (MW-1 through MW-4) could be supplemented with four (4) additional wells.

3. The two easternmost wells proposed by the IRPE north of Cell 2 (P5 and P6) are unnecessary because they provide no additional benefit and do not increase the effectiveness of the current detection monitoring system.

4. Additional shallow wells for the purposes of detection groundwater monitoring are unnecessary southeast of the Cell 3 area of the proposed UWL, as they provide no additional benefit and do not increase the effectiveness of the current detection monitoring system.

5. The IRPE did not provide a compelling basis for the installation of deeper wells as it relates to detection groundwater monitoring for the proposed UWL. Literature sources confirm that the horizontal component of contaminant migration is much greater than the vertical component of contaminant migration. MDNR's review and approval of the DSI and their acceptance of the current detection groundwater monitoring system confirm this position.

6. No additional evaluation of PLUME model input parameters or additional iterations of model scenarios is recommended at this time.

Our interpretation of MDNR's current approach to groundwater detection monitoring at landfills is that groundwater monitoring is a dynamic process, subject to ongoing re-evaluation and conclusion based on data from each background or semi-annual sampling event. As such, future data collected during routine detection monitoring events will provide additional information that will be evaluated by Ameren Missouri, MDNR and/or Franklin County in order to consider the need for modifications to the currently approved groundwater monitoring system. Until such time, the current detection groundwater monitoring system meets the requirements and intent of 10 CSR 80-11.010. However, the addition of wells north of Cell 2 could enhance the current detection groundwater monitoring system during periods of a more northerly direction of groundwater flow.

7.0 REFERENCES

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