Ameren Missouri
Labadie Energy Center

Construction Permit Application for a Proposed Utility Waste Landfill
Franklin County, Missouri

Ameren Missouri

Power Operation Services
3700 South Lindbergh Blvd.
St. Louis, Missouri 63127

January 2013, Revised August 2013, Revised November 2013

STATE OF MISSOURI
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NUMBER E-22353
12/11/13
REGISTERED PROFESSIONAL ENGINEER

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Ameren Missouri Labadie Energy Center
Construction Permit Application (CPA)
for
Proposed Utility Waste Landfill (UWL)
Solid Waste Disposal Area
Franklin County, Missouri

January 2013, Revised August 2013, Revised November 2013

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1.0 INTRODUCTION

Union Electric doing business as (dba) Ameren Missouri (hereafter referred to as Ameren Missouri) is requesting a State of Missouri Solid Waste Disposal Area Construction Permit for a Utility Waste Landfill (UWL) to be located in northeastern Franklin County. The proposed UWL name will be "Ameren Missouri Labadie Utility Waste Landfill".

With this report, Ameren Missouri proposes to construct a UWL for disposal of coal combustion products (CCPs) from the Labadie Energy Center that pass the paint filter test (having no free liquids). This engineering report describes the facility and procedures that Ameren Missouri will use to dispose of all current and future CCPs produced by the Labadie Energy Center. This report describes the design, construction and operating techniques required to dispose of CCPs at the Labadie UWL.

The landfill design and operating procedures have been prepared in accordance with the UWL requirements of the Missouri Solid Waste Management Law and Rules and Franklin County ordinances. In addition, the design and operation of the proposed UWL have been developed in accordance with accepted engineering practice. This construction permit application, engineering design, operating manual and supporting appendices and reports are organized in a format consistent with the Missouri Solid Waste Management Rules 10 CSR 80-2 and 10 CSR 80-11 for UWL permitting, design and operation. As a reference guide, a correlation of the applicable Missouri Solid Waste regulatory references to the table of contents of this report is provided in Table 1A and Table 1B at the end of this report. Table 1A is sorted in the order of this report's table of contents. Table 1B is sorted in order of the Missouri regulatory references.

Reitz & Jens, Inc. (Reitz & Jens) and GREDELL Engineering Resources, Inc. (Gredell Engineering) are the team of design professionals retained by Ameren Missouri to develop the UWL design and Construction Permit Application (CPA). Reitz & Jens' scope of services as lead engineer included overall project management, UWL layout and design, characterizing the geotechnical engineering properties of the site, analyzing the site for global stability, settlement, flood protection, and identifying applicable criteria. Gredell Engineering's scope of services, as a subconsultant to Reitz & Jens, included completing the Detailed Site Investigation, UWL layout and design, as well as preparing the engineering reports and plans necessary to complete the solid waste permitting documents for the Missouri Department of Natural Resources (MDNR).

Ameren Missouri acknowledges that one concept proposed for the UWL construction described in this report utilizes an alternative design concept that does not adhere strictly to MDNR's historic interpretation of 10 CSR 80-11.010 for the design of the UWL. Specifically, the site conditions will result in intermittent contact of a small percentage of the constructed bottom liner (primarily at the sumps) with the alluvial groundwater. As allowed by 10 CSR 80-11.010(1), Sections 3.0 and 4.0 of this report, in conjunction with the details provided in the drawings and the appendices to this report, demonstrate that the design concepts proposed for the UWL

design meet or exceed the minimum requirements of 10 CSR 80-11.010.

The CCP disposal plan for the UWL will be implemented in four (4) phases (reference Sheet 3). The total acreage of the four (4) disposal phases is approximately 166.5 acres. The proposed phases are designed for disposal of all CCPs generated by the Labadie Energy Center. Currently, these CCPs consist primarily of fly ash (70%) and bottom ash (30%), but Flue Gas Desulfurization (FGD) byproducts will be generated when plant FGD scrubbers become operable. As proposed, each phase will consist of one disposal cell.

The UWL design has been developed in accordance with the requirements of 10 CSR 80-11.010. The UWL design will include a composite liner system, which exceeds these requirements. The composite liner system will consist of a 24-inch thick compacted clay component with a permeability not to exceed 1×10^{-7} cm/sec and a 60-mil thick HDPE geomembrane component, plus a leachate collection and drainage system to maintain less than 12 inches of hydraulic head on the liner system at any time during the life of the facility.

The approximate 166.5-acre CCP disposal area is designated for development and closure in phases with appropriate closure cost estimates and financial assurance instruments (FAIs) proposed for each phase. The phased development, operation and closure of the UWL are discussed in more detail in subsequent sections of this report.

1.1 Site Background

Ameren Missouri operates a coal-fired power plant known as the Ameren Missouri Labadie Energy Center. The Labadie Energy Center is located north of Interstate Highway 44 and northeast of the town of Labadie, Missouri on the south side of the Missouri River. The Labadie Energy Center was constructed from 1967 to 1970 and power generation began in 1970. The plant has a total generating capacity of 2,405 megawatts (MW). The current estimated annual production of CCPs (fly ash and bottom ash) is approximately 550,000 dry tons.

The proposed UWL site is immediately east of the power plant's existing CCP ash ponds. Currently, CCPs from the plant are wetted and placed in the ash ponds (NPDES permitted wastewater treatment devices) located on the south side of the power plant. A new flue gas desulfurization (FGD) system is scheduled to be built at the plant in the future. The FGD will generate an estimated maximum of 280,000 additional dry tons of CCPs per year. The UWL design includes the capacity to manage the FGD byproduct, as well as the other CCPs (e.g., fly ash and bottom ash) currently being produced by the plant.

This CPA details the design, construction and operational techniques for the proposed UWL at the Labadie Energy Center. Additional descriptions of the physical characteristics of the utility wastes to be managed at the UWL are described in Section 4.3.

The site lies in part of sections 8 and 17 and part of U.S. Survey 98 in Township 44 North, Range 2 East if the Fifth Principal Meridian in Franklin County, Missouri.

Reference to the Center for Applied Research and Environmental Systems (CARES) or similar mapping programs shows that the approximate midpoint of the proposed UWL is Latitude 38.5621 and Longitude –90.8168. The proposed UWL site is located approximately two and three-quarters (2.75) miles northeast of the town of Labadie, and two and three-quarters (2.75) miles northwest of the town of St. Albans (Figure 1).

The proposed UWL disposal area is located within a tract of land entirely owned by Ameren Missouri totaling over 1,000 acres, of which approximately 166.5 acres is planned for active disposal. The area method of waste disposal is proposed for use throughout the 166.5-acre waste boundary. Three (3) stormwater management ponds (a 5.7-acre pond for Phases 1 and 2, a 4.4-acre pond for Phase 3, and a 3.4-acre pond for Phase 4) are also located within the approximate 813-acre UWL permit boundary. Other areas within the UWL permit boundary will be used for soil stockpiles, access roads, perimeter fencing, flood protection berms, and buffer areas.

This CPA, drawings and associated reports and supporting documentation address the substantive requirements of the State of Missouri construction permit application, as well as applicable Franklin County ordinances, for the construction and operation of a UWL.

1.2 Proposed Facility

The proposed UWL covers a waste boundary area of approximately 166.5 acres of the 813-acre landfill permit boundary within the Ameren Missouri Labadie Energy Center Property. Sheet 2 shows the existing site conditions. An access road from the existing power plant to the UWL will be constructed near the northwest corner of Phase 1 across Labadie Bottom Road. Labadie Bottom Road divides Phases 1 and 2 of the proposed UWL site in the east-west direction and will be relocated as a part of the development of Phase 2. An underground pipeline owned by Explorer Pipeline runs generally north-south through the site in between Phases 1 and 2 (west of the pipeline) and Phases 3 and 4 (east of the pipeline). Two elevated access roads will be constructed across the pipeline as part of the Phase 3 development.

The DSI determined that insufficient clay is available on-site for constructing the clay soil liner component of the composite liner system. Therefore, an off-site borrow source of liner quality clay at Ameren Missouri's Callaway Energy Center in Callaway County, Missouri has been located, explored and identified through geotechnical exploration and testing and is proposed as the liner quality clay source for the Labadie Energy Center UWL. Approximately 1.75 feet of vegetative soil will be stripped from the 225-acre footprint of the proposed UWL for use as the vegetative soil cover on the final cap. For general discussion in this report, the size of the UWL will be referred to as the 813-acre UWL permit boundary and a 166.5-acre waste boundary.

The entire 813-acre UWL permit boundary is zoned by Franklin County as Agricultural Non-Urban (ANU) (refer to Sheet 4). Improvements within the UWL permit boundary include the 166.5-acre waste disposal area, stormwater management ponds, soil stockpile areas, flood

protection berms, perimeter stormwater control structures, site access roads, perimeter security fencing, buffer zones, and groundwater monitoring. These items are discussed in more detail in Section 3.0, Landfill Design. Sheet 3 provides an overview of the proposed UWL project and Sheet 4 shows the waste boundary and the UWL permit boundary.

1.3 Landfill Owner and Operator

Union Electric Company d.b.a. Ameren Missouri is the owner and operator, as defined by 10 CSR 80-2.010(67) and 10 CSR 80-2.010(68), of the land within the UWL permit boundary. A copy of the property deeds for this tract is found in Appendix A.

Union Electric Company is a registered Missouri corporation in good standing with the Secretary of State's office. Appendix B provides a copy of Union Electric Company's Certificate of Amendment to Articles of Organization from the Missouri Secretary of State's Office. A Registration of Fictitious Name for Ameren Missouri is also provided in Appendix B. A copy of a current Certificate of Corporate Good Standing is found in Appendix C.

1.4 Applicant Violation History

Ameren Missouri, a subsidiary of Ameren, is the sole interest in the application for construction permit. Ameren Missouri has maintained and submitted an annual update of the Violation History Disclosure Statement since the issuance of the Missouri Solid Waste Disposal Area Construction Permit No. 0918301 for the Sioux Power Energy Center UWL on March 28, 2008, as required. MDNR has accepted Ameren Missouri's violation history information submitted for the Sioux Power Energy Center UWL. The March 25, 2013 letter transmitting Ameren Missouri's most recent, completed MDNR Violation History Disclosure Statement is found in Appendix D.

1.5 Request for Recommendation from East Central Solid Waste Management District, Region I

As required by 260.205.7 Missouri Revised Statues (RSMo), Ameren Missouri requested a recommendation in support of this application for a UWL from the executive board of East Central Solid Waste Management District, Region I, on June 13, 2012. A copy of this letter is included in Appendix E. Region I does not currently have an approved solid waste management plan. Ameren Missouri will work with Region I to ensure that future revisions to their solid waste management plan include the Ameren Missouri Labadie UWL.

2.0 SITE SELECTION

Based on the findings of the Preliminary Site Investigation (PSI) and Detailed Site Investigation (DSI), the proposed Labadie UWL site is suitable for development of a modern, state-of-the-art and environmentally sound solid waste disposal area. The surrounding drainage patterns, topography and natural geologic and hydrologic conditions allow for the design and operation of a UWL that can provide necessary capacity, while maintaining the aesthetic and environmental quality of the surrounding area. The geologic suitability of the site as a UWL is supported by the Missouri Department of Natural Resources, Division of Geology and Land Survey's (MDNR-DGLS) February 2, 2009 letter approving the PSI for the UWL site, and MDNR-DGLS' April 8, 2011 letter approving the DSI for the Labadie UWL site

Both the State of Missouri Solid Waste Management Law and Rules and applicable Franklin County ordinances will regulate the Labadie UWL as a solid waste disposal area (e.g., landfill). Applicable portions of the Franklin County ordinances are provided in Appendix F. The requirements of the Franklin County ordinances are substantially compatible with the Missouri Solid Waste Management Rules.

2.1 Site Location

The site is located in northeastern Franklin County, in the northwestern part of Township 44 North, Range 2 East, approximately two and three-quarters (2.75) miles northeast of the town of Labadie, and two and three-quarters (2.75) miles southwest of the town of St. Albans (Figure 1). The site is located on the Labadie, MO U.S.G.S quadrangle topographic map. The cover sheet of the plans shows the UWL location in relation to the Ameren Missouri Labadie Energy Center, County Route T, Labadie Bottom Road, and the Missouri River.

2.2 Legal Description of the Property

Kuhlmann Design Group developed legal descriptions of the 813-acre proposed UWL permit boundary and the 166.5-acre waste boundary in 2012. A survey plat and legal descriptions of the proposed UWL permit boundary and waste boundary areas are provided in Appendix V. A copy of the property deeds and the detailed legal descriptions are provided in Appendix A.

2.3 Site Access

The site is located east of the Ameren Missouri Labadie Energy Center and south of the Missouri River. Site access will be from an all-weather access road extended from the existing plant to the perimeter flood protection berm near the northwest corner of Phase 1 as shown on Sheet 5. The access road will be built to a minimum elevation of 486, which is 2 feet above the 100-year flood elevation. The location of the site and public roads within one (1) mile of the site and beyond is shown on Sheet 1.

Franklin County has sole regulatory authority for the affected roadways. Franklin County has

issued a letter dated July 24, 2013, (copy enclosed in Appendix F) accepting the conceptual roadway relocation and overpass proposed by Ameren Missouri. Prior to any roadway construction, detailed plans will be completed and the required Franklin County permits will be obtained.

All CCPs will initially be delivered to the UWL by truck from Ameren Missouri's Labadie Energy Center using the all-weather access roads. Trucks will not travel on public roads when transporting CCPs from the Labadie Energy Center to the UWL. The top of the perimeter flood protection berms are designed to carry truck traffic within the UWL permit boundary. Traffic from the plant to the UWL will typically include trucks hauling utility waste (CCPs), maintenance vehicles or equipment and passenger vehicles for landfill employees. All CCPs trucked to the UWL will be moisture conditioned for dry placement in the UWL.

A seven-foot high security fence will be installed around the entire active UWL perimeter (reference Sheet 19, detail 5/19). Locked gates will be located at all ingress and egress points to the UWL waste boundary to control access to the disposal area. Ameren Missouri Labadie Energy Center security staff is on duty 24-hours per day and will provide additional security to the UWL through routine site monitoring. Only personnel authorized by Ameren Missouri will be allowed within the UWL perimeter security fence.

2.4 Zoning and Land Use

The property is currently zoned Agricultural Non-Urban (ANU). On October 25, 2011, Franklin County, by Commission Order No. 2011-307, amended Section 15, Article 2 of their Land Use Regulations to add a definition for Utility Waste Landfill, as well as Section 238 to Article 10 "Supplementary Use Regulations". Section 238 added regulations regarding Utility Waste Landfills including allowing Utility Waste Landfills as a permitted use in the ANU zoning district. A copy of the Commission Order regarding Utility Waste Landfill regulations, the definition of Utility Waste Landfill, and Section 238 are found in Appendix F. In addition, Appendix F contains the following correspondence from the County relative to this project:

- a letter dated August 21, 2012, from the County stating that the proposed site is in compliance with all existing Franklin County ordinances;
- a letter dated January 7, 2013, from the County Independent Registered Professional Engineer stating that they agree with the conceptual designs presented in pre-submittal meetings;
- a letter dated July 24, 2013, from the County stating that the conceptual Labadie Bottom Road proposed relocation and overpass is accepted, reserving the right to approve the final plan details before construction;
- a letter dated September 18, 2013, from the County, pursuant to Section 260.003 RSMo, certifying certain aspects and findings of the County's review specific to the

Franklin County ordinances;

- a letter dated October 10, 2013 from the County in response to MDNR's October 2, 2013 letter providing clarification of the September 18, 2013 County letter (referenced above);
- a letter dated December 4, 2013, from the County Independent Registered Professional Engineer and received by the County on December 8, 2013, stating that the Construction Permit Application and amendments meet the requirements of Commission Order No. 2011-307 (referenced above);
- a letter dated December 10, 2013, from the County to MDNR supplementing, confirming and restating their letters to MDNR dated September 18, 2013 and October 10, 2013.

Where applicable, Ameren Missouri will provide MDNR copies of future County correspondence as it is received.

2.5 Surrounding Land Use

The proposed UWL, as well as all contiguous properties surrounding the 813-acre UWL permit boundary, are located within unincorporated Franklin County.

As required by 10 CSR 11.010(4)(5)B, the location of all known residences, buildings, wells, watercourses, springs, lakes, rock outcroppings, caves, and sinkholes within one-quarter mile of the UWL waste boundary are shown on Sheet 4. The entire site and land adjacent to the site is currently zoned Agricultural Non-Urban (ANU). The nearby property on the bluffs to the south is currently zoned Community Development (CD). Adjacent land uses within these zoning designations include Ameren Missouri's Labadie Energy Center to the west, and residential use on the bluffs to the south. Current land use within one-quarter mile of the UWL waste boundary and adjacent to the UWL permit boundary is primarily agricultural and the majority of the property is owned by Ameren Missouri. One exception is the extreme southern arc of the line denoting one-quarter mile from the waste boundary that intersects a small portion of four parcels on the edge of the bluffs to the south. A list of names and addresses of all recorded owners of real property either adjoining or within 1,000 feet of the proposed UWL permit boundary is provided in Appendix G.

As required by 10 CSR 80-11.010(5) and Section 238.C.3.h of the Franklin County ordinances, a minimum 100-foot buffer zone has been maintained between the UWL waste boundary and dedicated public road right-of-ways, and a minimum 300 foot setback has been maintained between the UWL waste boundary and all property lines not under common ownership with the UWL site. All existing easements, jurisdictional wetlands and minimum buffers are shown on Sheets 2, 3 and 4. Ameren Missouri will relocate and/or vacate any public road, utility and easement within the UWL waste boundary, as necessary, prior to the construction of Phase 2 of the UWL. The UWL solid waste disposal boundary is significantly more than 300 feet from

the property lines north, east, south and west of the site.

The proposed UWL will cover approximately 166.5 acres of the 813-acre site. The maximum height of the proposed UWL is approximately 100 feet above the existing grades as shown on Sheet 10. The proposed maximum elevation of the UWL is 565. The final side slopes of the UWL will be a maximum of 3:1 (H:V). The top of the 3:1 side slopes begins at elevation 554 for Phases 1 and 2, and at elevation 556 for Phases 3 and 4. The 3:1 side slope ends at the perimeter ditch at the toe of the slope at approximate elevation 483. The top of the UWL will have a relatively flat, constant slope of no less than 2% that continues to rise to a peak elevation of 565. The side slopes of the disposal area are not expected to significantly flatten within the life of the facility as a result of internal consolidation of the dry CCP wastes.

2.6 Site Topography

The existing topography within the 813-acre permit boundary is relatively flat. Ground surface elevations range from 460 to 471 feet. The tract is mapped in the 100-year floodplain of the Missouri River and protected from regular flooding by the Labadie Bottom Levee District's agricultural levee located both north and south of Ameren Missouri's property. There is one topographic ridge, approximately five (5) feet high in the north part of site (Phase 2) and several shallow drainage features within the levee protected area south and southwest of the proposed waste boundary that drain to the southern boundary of Ameren Missouri's property. This drainage system is regularly pumped over the levee into Becker Creek where the discharge ultimately flows from west to east back to the Missouri River along the bluffs. The 813-acre site generally drains from northwest to southeast.

The Labadie Energy Center and ash pond embankments to the west, as well as levees on the north and south block river water from flowing onto the UWL site, except in the most severe floods. The topography surrounding the 813-acre tract is composed of the broad, flat floodplains of the Missouri River that is similar to the flat topography of the site. The Missouri River lies generally to the north of the UWL. The bluffs bordering the Missouri River valley are adjacent the proposed UWL permit boundary to the south, but are separated from the UWL boundary by the southern portion of the Labadie Bottom Levee District levee, an existing railroad embankment, and Becker Creek.

2.7 Utilities

Sheet 2 shows the existing site conditions, including all existing utilities. The existing utilities within the proposed UWL permit boundary include underground pipelines, underground telephone, overhead power (electric), fiber optic cable, and small drainage culverts.

Underground telephone lines are located along the Labadie Bottom Levee District levee to the south and generally parallel to the southern landfill permit boundary. The underground telephone lines are located outside the proposed construction boundaries of the UWL.

Existing overhead power lines are located west and generally parallel to the western waste boundary along Phases 1 and 2. Ameren Missouri owns and maintains these power lines. The power lines do not need to be relocated to accommodate the construction and/or operation of the UWL.

An underground pipeline, owned by Explorer Pipeline, is located southeast and east of the power plant and running north between UWL waste disposal area Phases 1/2 and Phases 3/4. The footprint of Phases 1 through 4 avoids conflicts with this existing pipeline. The development of the UWL next to the pipeline has been discussed with the Explorer Pipeline and was determined to be technically feasible. A copy of Ameren's November 15, 2012 email to Explorer Pipeline and Explorer Pipeline's January 28, 2013 letter concurring with the UWL development is provided in Appendix V.

An existing fiber optic line runs east-west along the Union Pacific Railroad right-of-way south of the UWL southern waste boundary and, therefore, is located outside the proposed construction boundaries of the UWL.

The access road from the plant to the UWL will cross over Labadie Bottom Road during the operation of all landfill Phases. An access road overpass is planned which will allow continuous operation of the UWL and segregate the UWL traffic from public traffic on Labadie Bottom Road. Future access roads will cross over the existing Explorer pipeline to provide access from Phases 1 and 2 to Phases 3 and 4. Requirements for building these access roads have been discussed with Explorer Pipeline and will be incorporated into the future access road design.

2.8 Site Selection Location Restrictions

Missouri's solid waste disposal area rules require applicants to follow a two-step site evaluation process prior to filing an official construction permit application. Step one is to apply for a Preliminary Site Investigation (PSI) to the Division of Geology & Land Survey (DGLS). Step two follows approval of the site under the PSI process and consists of conducting a Detailed Site Investigation (DSI) of the site geology and hydrology. These steps are discussed in more detail below.

On October 9, 1991, the United States Environmental Protection Agency (EPA) published 40 CFR Part 258, which contained the final rules for the federal Solid Waste Disposal Facility Criteria applicable to municipal solid waste disposal areas. The federal location restrictions do not apply to UWLs; however, the State of Missouri modeled site restrictions for UWLs after the federal requirements for municipal solid waste landfills.

Four (4) specific location restriction criteria must be evaluated when siting a utility waste landfill in Missouri. The site selection requirements and each specific location restriction criteria are discussed below as they relate to the proposed landfill.

2.8.1 Preliminary Site Investigation (PSI)

On December 3, 2008, a PSI request was submitted on behalf of Ameren Missouri in compliance with 260.205.2 and 10 CSR 80-2.015 to request consideration for development of a solid waste disposal area limited to the disposal of utility waste. This type of solid waste disposal area is defined by regulation as a UWL. By regulation, UWLs can only accept waste materials listed in 10 CSR 80-11.010 and specifically identified in this report.

This PSI request was reviewed and evaluated by the MDNR and the Division of Geology and Land Survey (DGLS). DGLS conducted a field inspection of the site and approved the PSI request on February 2, 2009.

2.8.2 Detailed Site Investigation (DSI)

A DSI work plan for the required geologic and hydrologic field site investigation work was submitted on behalf of Ameren Missouri to DGLS on May 18, 2009. DGLS reviewed the Detailed Site Investigation Work Plan and issued a written letter of approval on June 15, 2009. Fieldwork began on September 2009 and with the exception of survey work and monthly piezometric monitoring, was completed in January 2010. Groundwater level measurements, evaluation of field data, and preparation of a detailed geologic and hydrologic report continued through November 2010. A report containing the findings, conclusions and recommendations of the DSI process was submitted February 4, 2011. A revision to the DSI report was submitted to DGLS on March 30, 2011. DGLS issued final approval of the DSI report on April 8, 2011. Per 10 CSR 80-2.015(1)(D), approval indicates "…that the site has been found to have suitable geologic and hydrologic characteristics for development of an environmentally sound solid waste disposal area."

2.8.3 Floodplains

The project site is shown on FEMA's Flood Insurance Rate Maps (FIRM) 29071C0180D, 29071C0185D, 29071C0190D, and 29071C0195D for Franklin County, Missouri, that became effective on October 18, 2011. According to the FIRM, the site is located at approximate Missouri River Mile (RM) 57 with the regulatory 100-Year Flood Elevation (Base Flood Elevation, or BFE) at the UWL site of approximately 484. The current FIRM shows that project improvements will be made within Zone AE (100-year floodplain) within the regulatory floodway. Panel 2904930105B of the superseded Flood Boundary and Floodway Map (FBFM) and Flood Insurance Rate Map (FIRM) for the site had an effective date of October 16, 1984. These FEMA maps showed the BFE at the UWL site to be approximately 480 and that the project improvements would be made in Zone A10, entirely outside the regulatory floodway.

The proposed UWL site and surrounding areas are protected from regular Missouri River flooding by the Labadie Levee District agricultural levee. The flows of the river are blocked from impacting the UWL site by the agricultural levee and the fill for the Labadie Energy Center

to the west (upstream) of the UWL. The power plant is built on fill that blocks flows during all floods up to the 500-year event, creating an ineffective or low flow area downstream of the plant. The entire UWL is located within this ineffective flow area. In addition, a perimeter berm will be constructed around the entire active disposal area that will function as a flood protection dike. The top of the perimeter berm will be at elevation 488.0, approximately 4 feet higher than the current 100-year BFE at the UWL site. 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 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 488.0.

Ameren Missouri retained CDG Engineers to analyze the UWL development's impact on the regulatory Base Flood Elevations (BFE) of the Missouri River. This analysis determined that the project will create "No Rise" in the regulatory BFE of the Missouri River. This analysis was submitted to Franklin County for approval. In a letter dated January 22, 2013, Franklin County's Independent Professional Registered Engineer stated that they concur with the analysis and methodology provided by CDG Engineers, and recommended approval of the "No Rise" certificate. A copy of the referenced letter is included in Appendix H.

2.8.4 Wetlands

As required by 10 CSR 80-11.010(4)(B)2, the proposed UWL site has been evaluated for the presence of wetlands. On September 10, 2012 the United States Department of the Army, Kansas City District Corps of Engineers (USACE) issued a preliminary Jurisdictional Determination (JD) for the site that includes all property within the UWL permit boundary. This JD identified several Waters of the United States (wetlands) that are jurisdictional under Section 404 of the Clean Water Act. The UWL site and appurtenances have been designed to avoid impacts to all jurisdictional areas and as a result, no Department of the Army (404) permit is required. A copy of the USACE's preliminary Jurisdictional Determination letter is included in Appendix I.

2.8.5 Seismic Impact Zone

Missouri Solid Waste regulations promulgated under 10 CSR 80-11.010(4)(B)3 require an evaluation to determine if a proposed landfill site is located in a seismic impact zone. According to 10 CSR 80-2.010(96), seismic impact zone is defined as, "*an area with a ten percent (10%) or greater probability that the maximum horizontal acceleration in lithified earth material, expressed as a percentage of the earth's gravitational pull (g), will exceed 0.10 g in two hundred fifty (250) years".*

The current reference for the expected probability of acceleration for design stability purposes is the 2008 "Documentation for the 2008 Update of the United States National *Seismic Hazards Maps*" generated by the USGS (Petersen et al.) and available from the USGS as Open-File

Report 2008-1128. Reference to the hazard map most closely aligned with 10 CSR 80-2.010(57) is a large-scale map entitled, "*Peak Acceleration (PGA) with 2 Percent Probability of Exceedance in 50 Years*". Review of this map suggests that the proposed landfill site is located in an area where the peak acceleration exceeds 10 percent. Therefore, the site has been determined to be located within a seismic impact zone as defined under 10 CSR 80-2.010(96). A copy of the referenced hazard map can be found as Figure 7 of the DSI report and Figure C-1 in Appendix J.

Available information was reviewed during the DSI process to verify and document that the proposed UWL waste boundary is not located within 200 feet of a fault that has had displacement in Holocene time, in accordance with 10 CSR 80-11.010(4)(B). Review of site-specific geological information, including maps, cross sections, and boring logs, has provided no evidence of Holocene age fault displacement within any of the field exploration locations. In addition, review of available literature describing the regional geology of the site has not identified the presence of faults subject to Holocene age displacement near the Labadie Energy Center property.

2.8.6 Unstable Areas

The proposed UWL property has been evaluated for unstable conditions in previous and recent geotechnical field investigations (Appendix J). The data generated by those investigations was supplemented with other relevant information to determine compliance with the unstable area siting criteria as defined in 10 CSR 80-11.010(4)(B)4. This rule states:

> *Owners/operators of proposed utility waste landfills located in an unstable area shall demonstrate to the department that the utility waste landfill's design ensures that the integrity of the structural components of the utility waste landfill will not be disrupted. The owner/operator shall consider the following factors, at a minimum, when determining whether an area is unstable:*
>
> - *On-site or local rock or soil conditions that may result in failure or significant differential settling*
> - *On-site or local geologic or geomorphologic features*
> - *On-site or local human-made features or events (both surface and subsurface)*

Unstable areas are further defined in 10 CSR 80-2.010(114) as:

> *A location that is susceptible to natural or human-induced events or forces capable of impairing the integrity of some or all of the landfill structural components responsible for preventing releases from a landfill. Unstable areas can include poor foundation conditions, areas susceptible to mass movements and karst terrains.*

Poor foundation conditions are defined in 10 CSR 80-2.010(77) as:

> *Those areas where features exist which indicate that a natural or man-induced event may result in inadequate foundation support for the structural components of a landfill.*

Areas susceptible to mass movement are defined in 10 CSR 80-2.010(6) as:

> *Those areas of influence (for example, areas characterized as having an active or substantial possibility of mass movement) where the movement of the earth material at, beneath or adjacent to the sanitary landfill, because of natural or man-induced events, results in the downslope transport of soil and rock material by means of gravitational influence. Areas of mass movement include, but are not limited to, landslides, avalanches, debris slides and flows, solifluction, block sliding and rock fall.*

Karst terrains are defined in 10 CSR 80-2.010(49) as:

> *Areas where karst, with its characteristic surface and subsurface features, is developed as the result of dissolution of limestone, dolomite or other soluble rock. Characteristic physiographic features present in karst terrains include, but are not limited to, sinkholes, losing streams, caves, solution channels or conduits, springs and solution valleys.*

On-site or local soil conditions that may result in significant differential settling, including poor foundation conditions and areas susceptible to mass movement, have been addressed by the proposed UWL design. Detailed analysis of the UWL stability is presented in the Geotechnical Engineering Report included in Appendix J. The stability of the UWL slopes was analyzed using both short-term (undrained) and long-term (drained) shear strength properties, and the potential impact of liquefaction of foundation soils.

The minimum static factor of safety (FS) of the completed landfill using long-term strength properties ranged from 1.46 to 2.27, which satisfies the minimum recommended FS of 1.5 considering the conservative assumptions used in these analyses. The ”initial” configuration (with 18 feet of CCP in place) was also analyzed using long-term shear strength properties. The minimum FS ranged from 1.47 to 2.70. The minimum FS for failure surfaces along the interfaces of the composite liner was 1.76.

At the locations where the liquefaction analyses indicated a high potential for liquefaction in strata, a residual cohesive shear strength value was input for the liquefied soil stratum. The minimum FS for failure surfaces that intercept the liquefied soil stratum ranged from 1.76 to 2.09 for the initial configuration of the UWL, and from 1.46 to 1.78 for the completed UWL. All are greater than the minimum recommended FS of 1.2 to 1.3. If the assumption is made that liquefaction could occur beneath the completed UWL, then the FS ranged from 1.13 to 1.72. Other analyses demonstrate that liquefaction would not occur beneath the completed UWL. Although a FS of 1.13 is slightly less than 1.2 for this extreme assumption, it is still greater than 1.0 which is standard engineering practice for stability analyses with liquefaction or seismic loading. Therefore, the stability of the UWL is adequate for both intermediate and final configuration, and for both static conditions and when anticipated liquefaction is present.

Seismic analyses were performed in accordance with the 1998 Draft *Technical Guidance Document on Static and Seismic Slope Stability for Solid Waste Containment Facilities* produced by the MDNR Solid Waste Management Program and Timothy Stark, Ph.D., P.E. of the University of Illinois at Urbana-Champaign. The criterion for the seismic stability analyses of a landfill is based upon the estimated lateral deformation or spreading that may occur, rather than a factor of safety against failure with a pseudo-static seismic load (MDNR-SWMP and Stark, 1998). Numerous stability analyses were completed to determine the yield acceleration (K_y) for both the initial configuration and the final or full configuration of the landfill, as well as failure along the interface of the composite liner. The calculated K_y ranged from 0.13g to 0.28g. The proposed geometry of the berm and CCP fill was analyzed in SHAKE2000 for both a short-duration time-history and a long-duration time-history, to determine the estimated cumulative lateral deformation where the K_y of a section is exceeded by the estimated peak ground accelerations in the pseudo time-histories. The maximum estimated cumulative deformation is less than 0.05 inch.

Interior berms are proposed to be constructed using compacted CCP from the existing ash pond. The composite clay liner and drainage layer would extend under the interior berm, to permit extension of the liner and drainage layer for the next cell. The FS for the slope stability of the interior berm was analyzed using the drained shear strength properties of compacted fly ash. The minimum FS for a global circular slope failure and the full height of CCP is 1.91. The minimum FS for a sliding block failure along the extension of the composite clay liner and drainage layer beneath the interior berm is 1.59. The K_y is 0.06g for a sliding block failure along the bottom liner. The calculated cumulative lateral deformation is about 1 inch.

The Missouri regulations for a utility waste landfill (10 CSR 80-11.010) do not specify the maximum allowed deformation. The regulations for a sanitary landfill (10 CSR 80-3.010) stipulate that the cumulative lateral deformation must be less than 6 inches. Therefore, the design of the proposed landfill, both the permanent perimeter slopes and berms and the temporary interior slope and berm, satisfy this requirement.

There are no known springs, caves or sinkholes within one-quarter mile of the landfill site. Rock outcrops are present in the Missouri River bluffs more than one-quarter mile to the south of the UWL. No other potentially significant geologic or geomorphologic features have been identified at this UWL site. No significant on-site or local human-made features or events, either surface or subsurface, are in evidence at the site within the proposed footprint of the UWL.

2.9 Geotechnical Investigations

Reitz & Jens has performed two separate geotechnical investigations at the site. The first investigation was in 2007 prior to the PSI (Appendix 4 of the DSI Work Plan). Eight (8) geotechnical borings were drilled around the anticipated perimeter of the proposed disposal area during this investigation. These exploratory borings ranged in depth from 20 to 104.5 feet. Three (3) piezometers, P-1, P-2, and P-3 were installed and remained in place, and were

utilized in, the DSI process.

The second geotechnical investigation was completed as a part of the DSI field investigation between September 2009 and January 2010. This investigation obtained shallow soil samples and groundwater level information from 97 additional borings that were converted to piezometers, 22 “temporary” geotechnical borings, and 93 Cone Penetrometer Tests within the UWL footprint. A copy of the Geotechnical Engineering Report for the UWL characterizing the on-site soils and surficial materials above bedrock, and evaluating their impact on the UWL design is provided in Appendix J.

Following the DSI field investigation at the UWL site, Reitz & Jens conducted a geotechnical investigation at off-site Ameren Missouri property near the Callaway Energy Center in Callaway County, Missouri. This investigation located and evaluated an off-site source of clay soils in sufficient quantity and quality to construct the soil liner component of the UWL composite bottom liner. Twelve (12) soil borings were completed in the off-site borrow area in Callaway County. A report documenting the findings of sufficient quantities and quality of clay soil materials is included in the geotechnical report provided in Appendix J.

A summary description of the bedrock, soils and groundwater conditions that were identified during the geotechnical investigations are provided below.

2.9.1 Soils

The UWL site is located in the floodplain of the Missouri River. Deposition of soils in a floodplain is dependent on the velocity of the water. As the flood waters slow the larger size particles are deposited first, and then the finer particles. The velocities of the water vary over the floodplain and with each flood as the topography changes. Therefore, soil deposits in a floodplain ("alluvial" deposits) vary both with depth and in horizontal extent. The borings and CPT soundings at the site revealed a typical alluvial stratigraphy.

The surface soils are generally clays and silty clays with scattered seams and layers of low plastic silt, underlain by silts. The thicknesses of these fine-grain deposits ranged from 2 to 13 feet. There is not an overall pattern to the stratification of the upper fine-grain soils, except for the presence of clayey sandy silt at the surface near the southern end. Sandy silts, silty fine sands, and fine sands, generally to depths of 22 to 36 feet, underlie the upper fine-grain soils. These upper sandy soils are generally loose to medium-dense. The upper sandy soils are underlain by fine to coarse, poorly-graded sands (SP), with some silty sands (SM) and gravelly sands at greater depths. These lower sands generally ranged from medium dense to very dense, increasing in density with increasing depth.

The results of the geotechnical investigations and laboratory testing revealed an inconsistent deposition of clay soils and a limited quantity of on-site soils that meet the requirements for clay liner (permeability of $1x10^{-7}$ cm/sec or less). The relatively high groundwater levels and the poor quality of on-site soil materials relative to clay content will require off-site clay borrow

sources to construct the UWL composite liner system. Approximately 1.75 feet of vegetative cover soils will be stripped from the UWL waste boundary footprint and stockpiled for use in the final cap cover. All other soil materials for construction of the UWL, including the perimeter flood protection berms, will come from off-site borrow sources. Off-site borrow sources will be identified and qualified prior to construction of each UWL phase.

The investigation of the 182-acre off-site clay soil borrow site at the Ameren Missouri's Callaway Energy Center included twelve (12) borings ranging in depth from 14 to 31 feet, with some borings terminating at bedrock refusal. Samples of subsurface soils were obtained at about 2.5-foot intervals in the top 10 feet, and at 5-foot intervals below 10 feet. Generally, the recovered soil samples were classified as CH and CL clay materials with some traces of sand, silt and gravel. The range of liquid limits in the recovered soil samples was 28% to101%, with an average of 60%. Plastic Indices ranged from 16 to 33. All of the samples had 40% or more passing the #200 sieve. The quantity of available clay soil borrow was estimated for clay soils with a liquid limit greater than 40 that did not have a significant amount of sand and gravel. For purposes of estimating clay soil quantities, the 182-acre off-site borrow site was broken down into five (5) individual borrow areas with a total estimated quantity of suitable liner quality clay soils in all five borrow areas of roughly 4.4 million CY. A 149-acre portion of this off-site borrow site, which can produce an estimated 2.6 million CY of liner quality clay, has been permanently deed restricted to provide the liner quality clay soils for the Labadie UWL.

2.9.2 Bedrock

Because of the thickness of alluvial deposits and depth to solid bedrock, consolidated sediments or bedrock materials beneath the site were not sampled. Three (3) deep borings drilled during the geotechnical investigations indicate that there are strata of sands containing chert, limestone fragments and gravel, with the amount of the gravel-size fragments increasing with depth. The three (3) deep borings hit refusal on limestone boulders or bedrock at depths of 91.5 feet to 107.6 feet. Recent geologic mapping of the Labadie area by DGLS (Starbuck, 2010) indicate that this bedrock unit is most likely the Jefferson City-Cotter limestone formation (reference Figure 3 of the DSI Report).

2.9.3 Groundwater Occurrence

Hydrogeologic investigation of the proposed landfill site has shown that groundwater is present in the sandy soils underlying the site. The sandy soils of the Missouri River floodplains are capable of yielding sufficient quantities of groundwater for the purposes of monitoring and sampling, consistent with the current definition of an aquifer as promulgated under 10 CSR 80-2.010(5).

Piezometric monitoring at the proposed landfill site indicates that the static water level is influenced by stages of the Missouri River. As documented in the DSI, monthly measurements made over the 12-consecutive month time period reveal that the water table elevations ranged

from a maximum of 464.66 feet in P-20 (June 2010) to a minimum of 456.43 feet in P-9 (December 2009) during routine monthly measurements, but supplemental measurements made in select piezometers during the months of April, May, and June 2010 showed a maximum recorded elevation of 468.87 feet in P-9 on May 18, 2010. When topographic differences across the site are considered, actual water depth below ground surface (bgs) typically ranged from two to 13 feet during a given month, but in some instances groundwater rose up to, and in some cases, slightly exceeded ground surface elevation (June 8, 2010 data for P-102, P-155, P-165, P-167, and P-177).

Groundwater levels were relatively uniform across the site during a given monitoring event. The maximum variability recorded was during the month of December 2009 (3.94 feet) and the minimum variability recorded was during the month of May 2010 (0.95 feet). From month-to-month, variability within a given piezometer was greatest in those located in the northwestern part of the site, closest to the Missouri River. It was least variable in those piezometers clustered in the southeastern part of the site, farthest from the Missouri River. Fluctuations in the elevation of the water table are controlled by localized or seasonal variations in the Missouri River stage. Franklin County Land Use ordinances include a definition of the “Natural Water Table” as “The level at which water stands in a fully saturated unconfined aquifer as measured by shallow piezometers or wells. The natural water table is under static hydrologic conditions and uninfluenced by groundwater pumping or other engineered activities”. Because the Missouri River is an “open river,” the level of the Missouri River and the natural water table at the site is never under truly “static hydrologic conditions.” Based on the groundwater elevation monitoring at the site and almost 11 years of daily Missouri River level readings at the Labadie Energy Center, a periodic high “Natural Water Table” at the site was determined to be el. 464 NAVD88 (reference Appendix Z). Overall, when river elevations are relatively high, groundwater movement is generally toward the east and southeast. Conversely, when river elevations are relatively low, groundwater movement is generally to the north and northwest. (refer to the Figures 18 through 29 in the DSI Report for the range of observed groundwater flow gradients). On-site infiltration of precipitation does not appear to have a significant effect on the water table elevation.

Despite the seasonal variability in flow, piezometers and/or groundwater monitoring wells along the western and southern perimeter of the proposed UWL are generally considered hydraulically “upgradient” of waste disposal boundaries. Piezometers along the eastern perimeter of the proposed UWL are generally considered hydraulically “downgradient”. Piezometers along the northwest and southeast corners of the proposed UWL perimeter are considered transitional with respect to upgradient/downgradient designations due to the influence by the Missouri River stages. Appendix W(a) provides a summary of hydraulic and hydrologic information relating to groundwater monitoring from December 2009 through November 2010, including groundwater gradients and their fluctuations across the site, and groundwater gradient response to a May 2010 rise in the Missouri River.

2.10 Survey Control

Horizontal and vertical control must be maintained within the permitted boundary of the UWL in order to construct it according to plan. The Missouri State Plane coordinate system (North American Datum 1983, or NAD83) will be used throughout construction for horizontal control. Vertical control has been established for six permanent benchmarks located at the landfill site using North American Vertical Datum 1988, or NAVD88. All references in this report to horizontal coordinates (northings and eastings) are based on NAD83. All references in this report to vertical elevation are based on NAVD88. The general location, northing, easting, and elevation of these control points are shown on the drawings.

Horizontal and vertical control during the construction of new portions of the disposal area will be achieved using a site-based geodetic system that will be referenced to the permanent site benchmarks. Earthmoving equipment will have geodetic monitors to provide continuous horizontal and vertical construction control. Grades and detail features will be checked with hand-held geodetic instruments. However, as required by the current rules and as necessary, temporary alignment stakes and benchmarks consisting of wooden hubs and lath may be placed periodically throughout the landfill during construction. Alignment stakes may be used to visually identify and locate the landfill boundary, drainage channels, roadways, etc. Upon approval of the proposed landfill, the boundaries of the UWL will be marked with steel fence posts or other durable, visible markers at all corners.

The horizontal and vertical survey control established for the project was utilized to design the necessary buffer zones along the property boundaries, the on-site utilities, and Labadie Bottom Road, and to provide future survey control for construction. In addition, field data points utilized in the hydrogeologic investigation were surveyed to provide accurate documentation and interpretation of the results.

2.10.1 Boundary Survey

The survey plats and easement legal descriptions for the Utility Waste Landfill Permit Boundary and Utility Waste Boundary are found in Appendix V. Included in this information are all existing known easements, benchmarks and survey control points. Control point information is included on the drawings.

2.10.2 Permanent Survey Control Points

Six (6) permanent horizontal and vertical survey control points have been established around the perimeter of the UWL waste boundary by a registered Professional Land Surveyor, and are shown on the survey plat provided in Appendix V. The locations and elevations of each of the control points are shown on the accompanying drawings.

3.0 LANDFILL DESIGN

This section outlines the design and construction details for the UWL that are required by the State regulations and applicable Franklin County ordinances. The set of 23 drawings, provided as a separate document, provides further graphical detail and support for the design and construction narrative details provided in this section.

In the spring of 2009, Ameren Missouri requested a PSI for a proposed UWL site east of the Labadie Energy Center on an Ameren Missouri owned tract of land of 1,000 plus acres with a proposed UWL footprint of about 400 acres. Following the approved PSI, Ameren Missouri proceeded in accordance with state law, rules and guidance to conduct a DSI site investigation of the proposed UWL site with a footprint of about 350 acres. The DSI was conducted from September 2009 through December 2010 and results approved by the state Geological Survey Program in April 2011. This engineering report and supporting permit design plans and associated documentation make up the formal UWL Construction Permit Application (CPA) for a 166.5-acre waste utility waste disposal area within an 813-acre UWL permit boundary.

The proposed utility waste disposal area will use a conventional UWL area disposal method for dry landfill disposal of CCPs consisting of fly ash and bottom ash produced by the Labadie Energy Center and stored in the existing ash holding ponds, and disposal of byproducts from the plant's future FGD systems. The fly ash, bottom ash, and FGD byproducts will all be dewatered as necessary to pass the paint filter test prior to being transported to the UWL for conventional dry disposal.

Initially, Ameren Missouri anticipates using the permitted UWL for the dry landfill disposal of dewatered fly ash and bottom ash from the plant's existing plant ash ponds and fly ash and bottom ash produced in the future. Additionally, Ameren Missouri will include the disposal of the plant's FGD byproduct waste. The waste CCPs will initially be transported from the power plant by truck to the permitted UWL for disposal.

In addition to the required state permits and approvals for the UWL, Ameren Missouri has obtained or is currently pursuing all applicable Franklin County approvals.

3.1 Description of Landfill Design

The design, construction and operation of the UWL are predicated on the concepts required to implement the conventional dry UWL landfill disposal process for CCPs as defined in the current state rules. The 166.5-acre waste boundary has been divided into Phases 1, 2, 3 and 4 to manage fly ash, bottom ash and FGD byproducts, along with the disposal of other CCPs and solid wastes allowed by regulation.

The UWL design, construction and operation described in this report will primarily utilize those techniques outlined in 10 CSR 80-11.010 for the design and/or operation of the UWL.

However, the site conditions require a design that will result in intermittent contact of a small percentage of the constructed bottom liner (primarily at the sumps) with the alluvial groundwater. As allowed by 10 CSR 80-11.010 (1), detailed discussion provided in Appendix Z, portions of the text of Sections 3.0 and 4.0, and details provided in the drawings, provide a demonstration that the design and operational techniques for UWL are based on sound engineering judgment and will meet or exceed the minimum requirements of 10 CSR 80-11.010.

Phase 1 has been designed to provide CCP disposal capacity for slightly over five (5) years at the currently projected generation rates, with the estimated startup of FGD systems generating additional CCP wastes in 2021. Subsequent Phases 2, 3 and 4 have been designed to provide additional disposal capacity in minimum five-year increments. The actual size of the constructed disposal areas for Phases 2, 3 and 4 will depend on future CCP generation rates, but it is anticipated that these phases will also be developed in minimum five-year increments until the entire permitted area is developed and filled to capacity.

The major design components of the proposed UWL are summarized as:

1. A composite liner system proposed for all Phases will include a compacted clay liner (24-inch minimum thickness) with maximum permeability of 1×10^{-7} cm/sec overlain by a 60mil thick HDPE geomembrane liner.

2. The final cover system for the UWL will include a 40 mil thick HDPE geomembrane overlain by a 24-inch soil cover to support a hardy stand of vegetation, except at the perimeter ditch that includes a 40 mil thick HDPE geomembrane overlain by a 12-inch soil cover.

3. A leachate collection system designed to minimize the hydraulic head on the bottom composite liner to less than 12 inches will be included in all Phases.

4. The final cover on the UWL will have a minimum slope of 1%, but will more generally be a minimum of approximately 2%.

5. The stormwater management system is designed to prevent the discharge the 25-year, 24-hour storm event from the UWL to waters of the state during the active operations. The system allows for re-use of all leachate and contaminated stormwater to the extent practical on-site for dust control, conditioning CCPs prior to placement and makeup water for future scrubber operation. Excess water will be pumped to the power plant and managed through the plant's NPDES permit. If necessary, off-site transport and wastewater treatment may be considered.

6. The groundwater monitoring system for the UWL consists of multiple upgradient and downgradient monitoring wells that will provide representative samples of the groundwater for detection monitoring of the UWL during the active operations and

following UWL closure.

3.1.1 Project Background Summary

Ameren Missouri retained Reitz & Jens, Inc. (RJ) to assist with the preparation of the UWL CPA after completion of the PSI and DSI. RJ retained GREDELL Engineering Resources, Inc. (GER) to assist with the design and permitting of the UWL in accordance with state agency requirements.

The requirements of 10 CSR 80-11.010 are based on the dry tomb concept of landfill design and operation. The proposed UWL design and operation have been developed in accordance with conventional UWL requirements and general engineering practice.

3.1.2 Technical Background Summary

The UWL is proposed for the long-term management of all utility wastes produced by Ameren Missouri's Labadie Energy Center, including bottom ash, fly ash and FGD byproducts. Currently, Ameren Missouri manages bottom ash and fly ash from the Labadie Energy Center in on-site ash ponds permitted under an NPDES discharge permit issued by the Water Pollution Control Program of MDNR. Off-site beneficial use of the CCPs is encouraged whenever possible.

Traditionally, UWLs have been used in Missouri for the management of fly ash, boiler slag and bottom ash, with much information being published about these traditional coal combustion products or CCPs. Generally, the chemical constituents in these CCPs originate from the fuel source, or coal, and are primarily inorganic compounds following the combustion process.

When installed, the future FGD system at the Labadie Energy Center will operate "downstream of", or following, the fly ash and slag removal processes.

3.1.3 Environmental Protection

The majority of the subsections of 10 CSR 80-11.010 are intended to prevent the construction and operation of a utility waste disposal area that negatively impacts the quality of the surface water, groundwater or air within a certain zone of impact surrounding the disposal area. All federal and state environmental regulatory programs allow small, regulated releases to the environment (e.g., groundwater, surface water or air).

Routine wastewaters generated from the leachate collection system and direct precipitation on the UWL area will be managed as a closed loop system. Precipitation on the UWL will be collected and routed to stormwater ponds. The ponds will collect stormwater runoff from the perimeter ditches around the UWL and, combined with the leachate collection system, will form a water management system that will contain, temporarily store and process all waters within the active UWL for reuse or proper management. Leachate and stormwater will either be used

for dust control within the UWL area, conditioning to achieve appropriate moisture content for CCP materials prior to placement, and/or makeup water for future scrubber additions to the plant. To the extent wastewater quantities exceed these management options, discharges from the leachate and stormwater system will be managed through the Ameren Missouri Labadie Energy Center NPDES permit or may be disposed off-site. EPA currently plans to issue revisions to the Steam Electric Effluent Guidelines in May of 2014. These regulatory revisions may influence how leachate and stormwater are managed at the site. Future regulatory revisions are anticipated throughout the 24-year projected life of the UWL which will require ongoing adaptive management of the leachate and stormwater management system based on data obtained during the UWL operation.

The requirements of 10 CSR 80-11.010(12), as they pertain to air quality protection, relate primarily to minimizing fugitive dust emissions from the utility waste disposal area. By nature of the UWL disposal process moisture conditioning of the CCPs minimizes fugitive dust emissions during the transportation, placement and compaction of the CCP solids.

3.1.4 Compliance with 10 CSR 80-11.010

Prior to the addition of the FGD, the primary CCPs produced by the Labadie Energy Center will be approximately 70% fly ash and 30% bottom ash. As defined in 10 CSR 80-2.010(118), utility waste includes "…fly ash waste, bottom ash waste, slag waste and flue gas emission control waste generated primarily from the combustion of coal or other fossil fuels." A permit modification will be submitted if any future utility wastes other than those in the current definition will be disposed of in the UWL. In accordance with 10 CSR 80-11.010(2)A, "clean fill", as defined by 10 CSR 80-2.010(11), may also be accepted for disposal in a permitted UWL. The disposal area method of UWL construction and operation will be followed to allow for the disposal of utility waste as defined in 10 CSR 80-2.010(118).

The UWL will be constructed in phases as shown in Sheet 5 of the plans. In general, the development and construction of the phases will proceed in numerical order. Phases 3 and 4 will follow the completion of Phases 1 and 2. Phase 2 will require the relocation and/or vacation of Labadie Bottom Road. Phases 3 and 4 will require the construction of access roads across the Explorer pipeline, as shown on Sheet 10.

The UWL disposal areas are designed in accordance with the minimum requirements of 10 CSR 80-11.010 and include a composite liner system and leachate collection system to allow leachate to freely drain by gravity from the in-place CCPs. All leachate generated by the UWL will be managed as described in Section 3.1.3. The CCPs managed in the UWL will be moisture conditioned to minimize dust during handling, hauling, unloading, spreading and compaction operations. The CCPs will be delivered to the UWL by vehicles that will access the UWL from the plant access road. The surface of the UWL access and internal haul roads will be stabilized to further minimize dust. Additional details are provided in subsequent sections of this

engineering report to describe and demonstrate how the landfill is designed and will be operated to meet current environmental protection requirements.

The area method of landfill operation will be used in the UWL disposal process with one exception. The use of intermediate cover will be in accordance with 10 CSR 80-11.010(14)(C)1, which states, "Cover shall be applied at a total thickness of at least one foot (1') of compacted soil on filled areas of the utility waste landfill which are idle for more than sixty (60) days, and on all final side slopes at the end of each filling sequence." Instead of burying intermediate cover under landfilled CCPs, the intermediate cover will be removed and reused in other areas of the UWL when operations restart in an idle area where intermediate cover has been applied. Intermediate soil cover shall be applied and nominally compacted to a total thickness of at least one (1) foot. Temporary vegetation will be established for erosion control until final cover is installed on all final side slopes at the end of each filling sequence. The largest area anticipated to require intermediate cover at any one time is 57 acres, which is the size of the largest cell (Cell 3). The estimated volumes for intermediate soil cover for the soil balance (reference Appendix K) are based on a maximum of 57 acres requiring intermediate cover at any one time and the reuse of intermediate soil cover.

CCPs generated at the Labadie Energy Center will be transported to the UWL on an all-weather access road constructed to a minimum elevation of 486 and designated as the CCP haul route. The access road will include an overpass for crossing over the existing Labadie Bottom Road. The method of transportation is by truck. The proposed access road from the plant to the western boundary of the UWL is shown on Sheet 5 of the plans. CCPs will be loaded on haul trucks at the plant or excavated from dewatered portions of the existing ash ponds south of the plant and hauled to the active phase of the UWL without leaving Ameren Missouri property, or traveling on public right-of-ways.

The fly ash and bottom ash will be moisture conditioned (either dried or moistened) to optimize the handling characteristics during placement in the UWL. The fly ash and bottom ash will be moisture conditioned on the plant site as a part of the Labadie Energy Center operations. As required, CCPs may be further moisture conditioned in the UWL by adding leachate and/or stormwater at the active disposal area. Other methods of conveying CCPs from the plant to the UWL may be implemented in the future.

The access road will allow trucks all-weather access from the plant to the active UWL areas. Once inside the active disposal area, temporary access roads will be constructed on the previously disposed CCPs in appropriate locations to allow truck access to the active working face. Once inside the solid waste disposal area, the trucks will unload the CCPs at the active working face of the UWL.

Access of loaded trucks to the UWL will be tightly controlled. Since the utility waste accepted for disposal will only be from the Labadie Energy Center, the likelihood of unacceptable wastes

being disposed in the UWL is minimal. A landfill equipment operator will be on-site when necessary to receive, spread and compact the CCPs at the active working face. As trucks approach the active working face and prepare to unload, the equipment operator will visually inspect and screen the material for unacceptable waste materials. Trucks containing unacceptable waste will not be allowed to unload at the UWL. Unacceptable waste discovered at the working face will be sorted, temporarily stockpiled, and loaded onto trucks for return to the plant where they will be managed in accordance with current plant solid waste disposal practices.

The UWL disposal areas have leachate and stormwater collection and management systems to manage and remove accumulations of leachate and stormwater in a timely manner to maintain a dry operation. Utility wastes will not be unloaded or placed in standing water inside the disposal area.

3.2 Volume of the Proposed Landfill

The total volume of landfill airspace is estimated to be 16.5 million CY (cubic yards) based on the top of liner and final grade plans shown on Sheets 5 and 10, respectively. The 2-foot thick final cover is estimated to require approximately 537,200 CY of this airspace. The 1-foot thick leachate drainage layer and the 1-foot thick protective cover volume are estimated to occupy a total of 505,100 CY of airspace. This leaves a total net estimated 15.5 million CY of airspace available for CCP disposal. Appendix L includes supporting details regarding landfill volume calculations.

3.2.1 Landfill Life Expectancy

CCP generation and disposal requirements at the Labadie Energy Center will vary based primarily on the amount of power generated, type of coal burned, and amount of CCPs that can be beneficially reused. Ameren Missouri has estimated the maximum quantities of CCPs that will need to be disposed of in the UWL every five years. Due to the projected start-up of FGD scrubbers, the 5-year disposal rates are estimated to increase slightly every five years for the first 10 years and then remain steady for the foreseeable future. Using the estimated 5-year CCP disposal rates, the calculated life expectancy of the landfill is approximately 24 years. Appendix L includes details further supporting the estimated landfill life calculations.

3.2.2 Soil Material Volume

A sufficient quantity and type of soil materials for landfill construction and operation are not available within the landfill footprint or in adjacent non-jurisdictional areas within the 813-acre UWL permit boundary. Instead, $1x10^{-7}$ clay soils for the UWL liner will be obtained from the off-site borrow area at the Callaway Energy Center site. A March 2011 geotechnical investigation of the Callaway Energy Center site determined that this borrow source contained at least 2.6 million CY of $1x10^{-7}$ clay soil. The amount of clay needed is approximately 537,200 CY for the

UWL composite bottom liner and approximately 101,800 CY for the stormwater pond composite liner (total = 639,000 CY).

Since there is not sufficient soil to build the landfill bottom, the perimeter berms and intermediate cover within the UWL permit boundary, Ameren Missouri will provide these soils from off-site borrow sites through construction contracts as each disposal cell is built. (Reference Appendix K for quantity estimates of the various soil materials required). The off-site soil borrow areas will be reclaimed in accordance with 10 CSR 80-11.010(14)(C)9, with final slopes no steeper than 3:1 (H:V) and revegetated surfaces unless they are developed as ponds or lakes. The soil balance calculations estimate that 639,000 CY of $1x10^{-7}$-clay and 2.6 million CY of heterogeneous fill soils are needed to construct the bottom, perimeter berms and intermediate cover for all four (4) phases of the UWL.

Up to 1.75 feet of vegetative soil will be removed from the footprint of the landfill and the stormwater ponds as part of the site clearing and grubbing. This material will be stockpiled for use as vegetative soil cover in the final cap and perimeter berms. Seasonal groundwater levels at the site vary with the Missouri River level, but the natural water table, as demonstrated in Reitz & Jens' design basis memorandum dated April 9, 2012 (reference Appendix Z), is defined as elevation 464, which was used for design purposes. This elevation is within a few feet of the existing ground surface within the footprint of the landfill, which limits the amount of excavation that is proposed for construction of the UWL. Therefore, off-site borrow soil for engineered fill is needed to raise the UWL footprint to the design bottom subgrade prior to construction of clay component of the composite bottom liner system.

After issuance of the construction permit, an easement and access agreement to the UWL permit boundary will executed between the Ameren Missouri and MDNR-SWMP. A draft of the easement is included in Appendix R, Closure and Post Closure Plan.

3.3 Construction Sequence

Throughout the life of the UWL, there will be intermittent periods of construction for the UWL disposal areas. CCP disposal will be conducted in distinct and separate areas until the last few years of the operational life of the UWL, at which time the disposal may occur on parts of two phases to achieve the final grades shown on Sheet 10. CCP disposal will occur in four (4) Phases (1, 2, 3 and 4). The disposal process will concentrate on first filling each phase with CCPs to approximate elevation 478.5 and then proceed in a controlled manner to minimize the size of the working area and manage stormwater runoff within the disposal area until grades reach those shown on the plans. The UWL design utilizing multiple sumps and drainage areas within each Phase allows for the independent construction of each Phase or portions thereof as needed for CCPs disposal. CCP disposal in Phase 1 will generally start in the northwest corner and proceed from west to east then north to south. CCP disposal in Phase 2 will generally occur from west to east. CCP disposal in Phase 3 will generally occur from northwest to

southeast. CCP disposal in Phase 4 will generally start on the north edge of this phase and proceed to the south.

3.3.1 UWL Construction Sequence

The initial Phase 1 (31.4 acres with a 5.7-acre stormwater pond) disposal area is sized and designed to provide approximately 5 years of disposal capacity minimum at current projected CCP generation rates. Phases 2 (35.2 acres), 3 (57.1 acres, with a 4.4-acre stormwater pond) and 4 (42.8 acres, with a 3.4-acre stormwater pond) are designed to allow the development of disposal cells that will provide approximately 5 years of CCP waste disposal capacity. A perimeter berm will be built around the constructed portion of each Phase or disposal cell to provide flood protection from Missouri River. The perimeter berms, composite liner, and leachate collection system for Phases 1, 2, 3 and 4 will each be built as individual disposal cells. However, the size of each future disposal cell will be further evaluated during the operation of the UWL prior to construction using refined estimates of future CCP disposal rates. Additional discussion of design, construction and operation of the disposal phases is provided in subsequent sections of this report.

3.3.2 UWL Disposal Area Construction Sequence

Phase 1 will be the first UWL disposal area constructed and will be constructed as one disposal cell. The construction sequence for additional phases and individual disposal cells, as well as the overall sequence for Phases 1 through 4, is described in Section 3.3.2.1. The method used to mitigate the potential uplift pressure impacts on the bottom liner in the unlikely event of a significant flood is described in Section 3.3.2.2. Section 3.3.2.3 describes the use of Fabric-Formed Concrete Mat (FCM) to address Franklin County's requirement for perimeter berm construction.

3.3.2.1 Phase Construction Sequence

Each lined portion of the disposal area will be enclosed by both permanent exterior perimeter berms and temporary interior perimeter berms constructed to elevation 488 to provide protection from the 100-year flood event with at least 3 feet of freeboard. The core of the permanent exterior berms will be constructed with engineered soil fill and the exterior slope will be covered with FCM. The interior slope is integral to the UWL disposal area and will be lined with a composite liner and leachate drainage layer.

The lined disposal cell of an active phase will be separated from future, contiguous unlined disposal cells by the temporary interior berm constructed to elevation 488. Interior berms will be installed between Phases 1 and 2 and Phases 3 and 4 that will ultimately be covered with CCPs. The interior berm divides and fully encloses the lined disposal cell from the unlined, future disposal cells and provides flood protection during the operation of the active disposal cell. The interior berm also protects the shared edge of the active disposal cell's composite liner

and leachate drainage layer until the next disposal cell (including exterior and interior berms, composite liner and leachate collection system) is constructed. The interior berms will be constructed using compacted, moisture conditioned CCPs as the core, with the UWL composite liner and leachate drainage layer extending beneath the CCPs. The exterior slope of interior berms will be covered with FCM. The interior slope of the interior berm will be uncovered to promote internal drainage within the disposal cell. Each disposal cell will be fully enclosed with perimeter berms prior to initial active disposal operations. When the disposal cell is filled with additional CCPs during operations, the CCPs used for the interior berm core will be indistinguishable from the moisture conditioned CCPs placed in the active disposal cell. No CCPs or stormwater run-off that has come in contact with CCPs will be managed in the unlined portion of the UWL.

When the active disposal area is filled to approximately 70% of its capacity, the next disposal cell will be constructed, including the interior and exterior berms, composite liner system and leachate collection system, allowing the next disposal cell (as identified by numerical order) to be fully enclosed with perimeter berms prior to operation.

As Phase 2 and 4 are developed, the exterior berms will be extended to enclose the new disposal cells. The interior berm segments between Phases 1 and 2 and Phases 3 and 4 are designed to be left in place, and the composite liner and leachate collection system will be extended under the interior berms in each new disposal cell to provide a continuous bottom liner and leachate collection system. Other than construction of the interior and exterior berms, the construction sequence of the disposal areas is typical of the area method of landfill operation.

3.3.2.2 Flood and Liquefaction Impact Mitigation Plans

The UWL's location in the floodplain of the Missouri River requires construction of berms to elevation 488.0 to protect the active CCP disposal operations from potential flood events. The current Flood Insurance Rate Map (FIRM) for this area shows the regulatory 100-year flood elevation at the site (Approximate River Mile 57) to be about 484. The land surrounding the UWL is currently protected from Missouri River floods first by the Labadie Bottom Levee District's agricultural levee and the mass fills for the Labadie Energy Center to the west. The plant and ash pond fills are higher than the 500-year flood elevation, effectively protecting the UWL from Missouri River flood flows from the west (upstream). The agricultural levee along the Missouri River north of the UWL also protects farmland from regular flooding up to approximately elevation 480. The interior and exterior perimeter berms, with a top elevation of 488, are a second protective measure against flooding and effectively protect the UWL from Missouri River flood events greater than a 100-year return frequency. (Reference Section 2.8.3 for additional information on floodplains and flood elevations.)

During construction and initial operation of each Phase (or portion thereof), the lowest elevation

of the top of bottom liner is no more than 20 feet below the 100-year flood elevation (approximate elevation 484). In the unlikely event that floodwaters surrounding the perimeter berms exceed the bottom liner elevation, the elevation differential creates potential uplift pressure on the bottom liner. Unmitigated, this pressure could damage the composite liner. However, 'ballast' placed on top of the composite liner will effectively counterbalance and mitigate the potential uplift pressures during a flood event.

To protect the composite liner from potential uplift damage, no more than 5.5 feet of differential hydrostatic uplift pressure can be allowed between the inside and outside of the berms (reference Appendix J). In-place CCPs will effectively provide the required ballast and are denser than water (estimated in-place CCP density is 93 pounds per cubic foot). Therefore, when in-place waste reaches a minimum elevation of approximately 478.5 the weight of the CCPs will sufficiently counter balance and mitigate the uplift pressures that may result from the 100-year flood at elevation 484.

The Missouri River floodwater is expected to rise at a rate of no more than 5 feet (elevation) per 24 hours. Therefore, the majority of the CCP ballast must be in place before the pressure difference reaches the maximum 5.5-foot differential. Cell 3 is the largest disposal cell at 57.1-acres, but is approximately 51.3 acres at el. 480. Upon completion of construction, it is conservatively estimated to require 578,000 CY to fill the cell to elevation 478.5. At a CCP placement rate of 10,000 CY per day, it will take approximately 58 days to fill Cell 3 to elevation 478.5.

The most practical and effective way to ensure the required CCP ballast is in place prior to the unlikely event of a major flood is to fill each disposal area to elevation 478.5 as soon as practical following the issuance of the operating permit. Flood events at this location on the Missouri River are generally predicted several weeks in advance which allows the placement of CCP ballast to begin as soon as major flooding is predicted. In the event of an extreme emergency, the disposal area will be flooded with non-potable water to prevent uplift damage to the liner.

Appendix Y provides calculations and tables that estimate the amount of time it will take to fill all of the disposal cells to elevation 478.5 to prevent uplift of the constructed liner during a 100-year Missouri River flood. These calculations indicate an alternative operating procedure could be required if the Missouri River is predicted to flood during the initial operation of a newly constructed disposal cell. As stated in Appendix Y, the calculations have been completed using a maximum, average CCP disposal rate of 10,000 CY per day. With an adequate stockpile of CCPs in the Labadie Energy Center ash ponds or in previous UWL phases, five (5) pieces of equipment pulling two, 20 CY pan scrapers each working a double shift, are capable of moving more than 10,000 CY of CCP per day to provide this required liner uplift protection.

This approach will be used for each disposal cell development during periods of predicted

flooding up to the 100-year event until sufficient CCPs are placed within the constructed UWL area to counterbalance floodwater uplift. As soon as composite liner has been installed in a new phase or disposal cell and the new area has approved for CCP disposal, stockpiled CCPs will be moved from an adjacent phase or cell into the newly approved area at a rate necessary to achieve a minimum elevation of 478.5 prior to the next predicted flood event. Implementation of these flood mitigation practices is most critical during the initial operation of Cell 1 due to the lack of stockpiled CCPs in an adjacent disposal cells. Implementing these flood mitigation practices during the initial operation of Cells 2, 3 and 4 will be less critical due to the anticipated availability of large quantities of CCPs in adjacent phases of the UWL. Once the in-place waste reaches a minimum elevation of 478.5, the CCP disposal rate will be determined by the CCP generation rate and storage capacities at the plant.

A procedure to mitigate the potential impact of a future flood on the composite liner in the stormwater ponds is also required. The water levels within the stormwater ponds will routinely fluctuate over the operational life of the UWL based on storm events, the water demands of the UWL and Labadie Energy Center. The bottom elevation of the stormwater ponds is el. 468 and the operating level of the stormwater ponds will fluctuate between a minimum el. 471 and a maximum el. 482. To protect the composite liner from potential uplift, no more than 3.3 feet of differential hydrostatic uplift pressure will be allowed between the inside and outside of the berms (reference Appendix J). During a 100-year flood event (el. 484), the water level in the stormwater ponds must be maintained at el. 480.7 or higher to mitigate potential impacts to the composite pond liner.

To address the potential situation where the water level in the ponds is less than the required el. 480.7, water will need to be rapidly provided to the ponds to prevent damage to the composite pond liner. This will be accomplished by installing one, 24-inch culvert pipe at approximate el. 472 through the perimeter berm of each pond to allow flood water to rapidly flow into the ponds. Each pipe will have a gate and check valve to prevent discharges from the pond during normal operating conditions. During a predicted significant flood event and once the elevation of the flood water against the exterior of the pond berm exceeds el. 473 the gate valves will be opened allowing the water inside the pond to equalize with the flood elevation on the perimeter berm exterior. Appendix Y provides additional descriptions and calculations supporting the design of this stormwater pond flood impact mitigation system.

Flood events along the lower Missouri are typically seasonal and predictable weeks in advance. The exact timing and time frame for moving CCPs into the newly constructed areas is dependent on many factors that will be monitored and evaluated whenever a new area is built. The need and schedule for placing ballast fill (CCPs) in an area will be different, depending on the timing of the area's completion and the predicted timing or potential for floods during the initial month of disposal area operation. Missouri river flood forecasts are readily available on the internet via the US Army Corp of Engineer's website and other sources. River level gauging stations are located above and below the Labadie Energy Center. The landfill operator and

Labadie Energy Center Operations personnel will monitor the stage on the river on an ongoing basis. This will include monitoring short-term and long-term flood stage forecasts to manage UWL disposal area development and CCP disposal rates to effectively counterbalance and mitigate the potential uplift pressures on the landfill liner systems throughout the operating life of the UWL.

As determined in Section 2.8.5, the UWL site is located within a seismic impact zone. Before sufficient fill has been placed to eliminate the risk of liquefaction, there is a slight risk of damage to the partially completed berms and composite liner that could result from the lateral spreading, settlement or formation of sand boils. The minimum threshold ground acceleration for this potential situation is 0.10g. Therefore, if a seismic event would occur with a ground acceleration greater than 0.10 g before sufficient berm or CCP fill had been placed, then an investigation will be completed to determine whether the composite liner has been damaged. This condition is discussed in more detail in Section 6.1.3 of Appendix J.

This investigation will be completed in stages. The initial stage will consist of an topographic survey of the perimeter berms in those areas indicated in Figure D-3 of Appendix J, as being potential areas of liquefaction. The survey will determine whether settlement or lateral movement has occurred. Also, the area outside of the perimeter berms will be visually examined for evidence of settlement, lateral movement and/or sand boils. If there is evidence of liquefaction from the initial investigation, then the bottom composite liner will be surveyed in the adjacent storm water pond, to compare with the final survey of the completed liner.

Under these circumstances, the composite liner in the adjacent storm water pond will also be examined for damage. If there is evidence of heave (due to sand boils), differential settlement or damage to the liner, then the final stage will be to remove CCP in the affected area of the cell to examine the composite liner for similar evidence of damage. Any damaged area of the composite liner will be removed and replaced.

3.3.2.3 Franklin County Requirement - Erosion Protection

Franklin County's Unified Land Use Regulations were amended on October 25, 2011 to include a requirement that all UWL cells be protected by an exterior berm meeting the following criteria:

- The top of the berm at the minimum shall be equal to the five hundred (500) year flood level in the area of the proposed Utility Waste Landfill; and
- All berms shall be constructed of concrete or cement-based material sufficiently thick for the purpose intended and approved by the Independent Registered Professional Engineer.

Reitz & Jens' design basis memorandum dated April 10, 2012 defined the purpose intended of the berms to be providing erosion protection for exterior berms that will potentially be exposed

to future flood events. This design basis memorandum is included in Appendix Z. The Franklin County requirement will be met by installing fabric-formed concrete mats (FCM) on the outside slope of the exterior berm using manufactured fabric forms and cast-in-place concrete. FCMs will be installed on the exterior slopes of disposal cells and the exterior slopes of the stormwater ponds. Calculations included in Appendix G of Appendix J demonstrate that a nominally thick (2.2-inch) FCM will provide adequate protection against the maximum anticipated flood water velocities. Sheet 19 provides typical details for the use of FCM on the exterior berms.

3.3.3 Phased Development

10 CSR 80-2.010(74) defines `phased development' as "...the division of the construction and operations of a solid waste disposal area permit into two or more distinct phases in order to facilitate more orderly construction, operation, closure and/or post-closure care of the solid waste disposal area...". The proposed UWL has been designed in four (4) cells, requiring four (4) phases of development for the following reasons:

1. Phased development minimizes the initial site development and construction costs.
2. Phased development allows the landfill operator to evaluate the effectiveness of the ongoing landfill design and operation, provides intermediate stopping points, and allows alternative disposal options to be evaluated.
3. Phased development allows the owner/operator to minimize the total amount of the financial assurance instrument for closure and post-closure costs.

The initial phase (Phase 1) is 31.4 acres and will be constructed in the west portion of the project area. It will include a 5.7-acre stormwater pond. The remaining Phases or portions thereof will be built only when needed to provide for additional disposal capacity. For the general purpose of permitting the development of the UWL, construction of each succeeding Phase is expected to begin when the active disposal area is approaching 70% capacity. The transition of the composite liner system between disposal Phases is shown in typical details on the plans accompanying this engineering report. The exterior toe of the interior berm that separates the leachate collection system in the lined disposal area from unlined areas will be removed to allow tie in to the clay and geomembrane components of the liner system being constructed for the subsequent cell. The clay and geomembrane composite liner at the existing termination point will be carefully exposed to allow the subsequent disposal area's composite liner components to be constructed and welded together to form a continuous liner system within and between UWL Phases 1 and 2 and Phases 3 and 4. CQA verification testing and documentation will be completed along the sub-area liner and leachate collection system tie-in using the same procedures required for the composite liner components and leachate collection system within each disposal area. This method will create a continuous liner under all contiguous phases of the UWL.

The stormwater holding ponds will be permitted through the SWMP. The exact timing of the construction of the second and third proposed stormwater ponds will be evaluated throughout the operating life of the UWL. Generally, Pond 1 will be constructed with Phase 1, Pond 2 will be constructed with Phase 3, and Pond 3 will be constructed with Phase 4. As needed, the three stormwater holding ponds will be available for use during site closure and post-closure care. Although not required, the ponds have been designed with a composite liner system equivalent to the liner system of the UWL. All water collected in the stormwater ponds will be used as described in Section 3.1.3.

Phased closure will be utilized for the development, closure and post-closure to reduce the amount of the Financial Assurance Instrument (FAI) to the size of the constructed landfill footprint at any point in time. Four distinct phases of landfill development are proposed. No more than two of the four phases are expected to be active simultaneously to minimize closure cost financial assurance. Estimated closure and post-closure costs have been calculated for each distinct phase and for the landfill as a whole. Closure and post-closure activities for the landfill will begin as each phase of the landfill approaches the maximum proposed grades shown on Sheets 10, 11, 12, 13 and 14.

3.3.4 Excavation to Proposed Subgrade

Initial site development will include clearing and grubbing topsoil and vegetation remaining from previous agricultural activities. Approximately 1.75 feet of soil will be removed below existing ground surface and stockpiled within the UWL footprint, outside of all jurisdictional areas, for final cover. This stockpiled final cover closure material will be dedicated for use only as final cover closure material and dedicated for use by the department for that purpose. The final bottom-grading plan to the finished top of the composite liner for the UWL is shown on Sheet 5. Subgrade for the base of clay liner construction will be two (2) feet below the elevations shown on the drawings. The clearing and grubbing will extend beneath the perimeter berms to maximize the available on-site vegetative soil borrow and provide an adequate subgrade for construction of the berm and UWL. Approved soil materials will be used to bring the UWL subgrade to two feet below the top of liner elevations shown on Sheet 5.

The cross sections shown on Sheets 22 and 23 generally depict the vertical depth of excavation and fill. An average of approximately five (5) feet of fill will be needed above the existing ground surface to grade the site to subgrade for the construction of the composite liner system.

3.3.5 Miscellaneous Construction

Construction of stormwater ponds, pump stations, discharge pipes and stormwater channels will be required at different stages of the landfill development to assure the environmental integrity of the UWL.

The perimeter access roads and entrances for the UWL will be constructed of crushed

limestone aggregate. The surface of the UWL access and haul roads will be stabilized to control dust.

3.4 Final Contours

The final contours and grading plan are shown on Sheet 10 at a scale of 1" = 300' and five (5) foot contour intervals. Intermediate final grading contours for Phases 1, 2, 3, and 4 are shown on Sheets 11, 12, 13, and 14, respectively, at a scale of 1" = 100' and five (5) foot contour intervals. The horizontal and vertical extents of the proposed landfill are designed to maximize the use of the proposed site within the area bounded by Labadie Bottom Road on the west and Davis Road on the east, and to avoid impacts to the Missouri River floodplain to the north and jurisdictional wetlands. The site will be filled to a maximum elevation of 565 feet (top of final cover). The solid waste boundary (e.g., horizontal limit of solid waste disposal) will be a minimum of 100 feet from all existing property boundaries and any adjoining road right-of-way, with the exception of Labadie Bottom Road, which will be relocated prior to the construction of Phase 2.

The height and final slopes of the landfill were designed to maximize runoff and stability while minimizing erosion of the final cover (see Erosion Calculations in Appendix M). A maximum slope of 33% (3:1; horizontal: vertical) is used on the UWL side slopes. The top of the UWL will be crowned with an approximate 2% top slope, which exceeds the minimum slope of 1% required by regulation.

Surface water diversion berms and letdowns are designed to control runoff and minimize erosion. Temporary riprap lined letdown structures will be located around the perimeter slopes of the active phase of the UWL to convey runoff to the perimeter ditch at the base of the UWL slope. Ultimately, these structures will be replaced with permanent riprap lined letdown structures for use as stormwater letdowns to manage uncontaminated runoff from the closed UWL.

The perimeter ditch will be constructed at elevation 483 inside the top of the perimeter berm and within the UWL disposal boundary. The perimeter ditch and the bench at approximate elevation 520 are part of the overall stormwater management plan for the UWL.

3.5 Solid Waste Accepted

The UWL will accept allowable CCPs as defined in 10 CSR 2.010(118). By this definition, CCPs (utility waste) includes fly ash waste, bottom ash waste, slag waste and flue gas emission control waste generated primarily from the combustion of coal or other fossil fuels. This definition includes utility wastes such as moisture conditioned (dewatered and passing the paint filter test) dry FGD byproducts, fly ash, bottom ash, slag and other CCP wastes. As provided in 10 CSR 80-11.010(2)A., clean fill may also be accepted. Fly ash and bottom ash from the Labadie Energy Center are currently managed in NPDES permitted ash ponds. The UWL will

be utilized for the permanent dry disposal of the some of the fly ash and bottom ash currently stored in the ash ponds, as well as future fly ash and bottom ash generated during the remaining life of the Labadie Energy Center.

Ameren Missouri is planning to install air emissions controls on the coal-fired boilers at the Labadie Energy Center in the future consisting of FGD systems to reduce sulfur dioxide emissions. FGD systems will produce byproducts that may require disposal in the UWL. The FGD byproducts are anticipated to consist primarily of silt-sized particles that will, if necessary, be conditioned at the power plant prior to transport to the UWL for disposal.

Projected CCP waste volumes are tabulated in Appendix L. The average 5-year waste generation rate projected for the UWL varies through the first 15 years of life due to the planned start-up of FGD scrubbers. Based on projected CCP generation rates, the estimated life of the UWL is approximately 24 years.

3.6 Solid Waste Excluded

All other solid wastes not specifically listed in Section 3.5 above will be excluded from the UWL. A specific list of waste excluded is provided in Section 4.4 of the operations section of this report. The landfill manager/operator will be trained on how to identify unacceptable wastes so that unacceptable wastes may be rejected or removed if inadvertently delivered to the UWL's active disposal areas. Since the primary acceptable wastes are CCPs from the Labadie Energy Center, the exclusion of unacceptable waste is more easily managed and verified by the landfill manager/operator. The CCPs will be delivered to the UWL by truck and will exclusively come from the Ameren Missouri Labadie Energy Center. The likelihood of unacceptable waste being trucked to the UWL is minimal. However, the UWL equipment operator will visually screen incoming haul trucks preparing to unload at the active working face for unacceptable waste materials in their load.

Trucks hauling unacceptable waste will not be allowed to unload and will be directed to return to the plant to manage the waste in accordance with the plant waste management procedures. Unacceptable wastes inadvertently unloaded at the UWL's active working face will be reloaded into empty trucks and returned to the plant to be managed in the plant waste management system, as appropriate.

3.7 Stormwater Management System

Stormwater management requirements will change throughout the operating life and closure of UWL Phases 1, 2, 3 and 4. Ameren Missouri's objective to contain and reuse as much stormwater falling within the footprint of the UWL as possible is the primary factor in the design of the stormwater controls that will result in 'no discharge' from the UWL. Other factors that add or subtract significant water quantities from the UWL include: infiltration of direct precipitation; evaporation and evapotranspiration; and water re-used on-site for CCP moisture

conditioning and dust control. Excess water will be managed as described in Section 3.1.3. Direct precipitation falling within the disposal area is considered in the stormwater runoff design calculations.

10 CSR 80-11.010(8)(B)1.F.(III) states, in part, "On-site drainage structures and channels shall be designed to collect and control at least the water volume resulting from a twenty-four (24)-hour, twenty-five (25)-year storm." The published rainfall for the 25-year, 24-hour rainfall event is approximately 5.6 inches in a 24 hour period. The drainage structures included in the UWL are designed to meet or exceed this requirement.

3.7.1 Stormwater Runoff Controls

Stormwater in active disposal area will be controlled by a system of perimeter berms, let down channels, side slope bench drainage ways and perimeter ditches, all ultimately conveying runoff to the on-site stormwater holding ponds. Some of the stormwater falling into active disposal areas that infiltrates into the CCPs will ultimately drain to the leachate sumps in the bottom of each cell where it will be removed by pumping to above ground tanks for temporary storage. The number and location of leachate storage tanks will require ongoing evaluation as a part of the UWL operations. The leachate level in the storage tanks will be regularly monitored, and the tanks emptied when required. Leachate removed from the tanks will be utilized as described in Section 3.1.3. Landfill operations will strive to maintain slopes on active landfill areas to minimize ponding.

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

Small perimeter berms on top of the UWL near the slope break line will be maintained to direct stormwater runoff from the top of the UWL to designated letdown structures located around the UWL top perimeter. The letdown structures will convey the runoff in a controlled manner from the top of the UWL to the perimeter ditch or surrounding ground surface. Letdown structures have been sized to minimize the number of drainage channels that must be constructed and maintained around the perimeter of the UWL.

Side slope benches and letdown structures are designed to carry stormwater from the upper portion of the UWL slopes to the perimeter ditch and ultimately to the surrounding ground surface around the completed UWL.

During operations, the active disposal areas may have both closed areas and active areas. Temporary structures consisting of ditches or berms are used to control flows during the on-going landfill operations. All stormwater that comes in contact with CCPs in the active areas will be managed within the active disposal area as described above and conveyed to the on-site stormwater holding ponds. Stormwater in the unlined areas of future disposal areas will be separated from leachate and contact stormwater by the interior berms at the interface of the lined and unlined areas. Stormwater from the closed sections of the UWL will be temporarily stored in adjacent ponds. This collected stormwater will be used at the UWL for dust suppression, routed to the on-site stormwater holding ponds for re-use in the UWL, or pumped to the Labadie Energy Center for management. Stormwater managed through the Labadie Energy Center's stormwater management system will comply with current NPDES operating permit requirements. In the NPDES operating permit renewal application dated December 22, 2011, Ameren anticipated excess stormwater flows from the UWL will be routed through the plant's stormwater management system and ultimately discharged through Outfall 002. Prior to beginning construction, Ameren will file appropriate NPDES permit modifications to assure timely receipt of the required authorizations. Copies of all future NPDES permit correspondence related to the UWL will be submitted to the Solid Waste Management Program.

Management of surface water runoff after closure is addressed by dividing the closed UWL into distinct drainage areas to control runoff quantities and velocities from the final UWL surface. Stormwater falling on closed UWL sections will be conveyed to the outside toe of the perimeter berm where it will be discharged. The side slope benches and letdown structures define the individual drainage areas for the final contours of the landfill. These surface water structures are designed to manage flow rates, quantities and velocities resulting from the 25-year, 24-hour rainfall event referenced by the 10 CSR 80-11.010(8)(B)1, or greater. Appendix N, Figure 1 shows the overall stormwater management for the closed landfill and the location of stormwater control structures.

Runoff volumes were calculated using the Rational Method, which is applicable to the small drainage areas involved. Stormwater diversion structures, capacities and velocities were calculated using Manning's Equation for open channel flow. The perimeter ditch used to convey stormwater to the pump stations or stormwater holding ponds is modeled using both Bernoulli's Equation and Manning's Equation.

The side slope benches are designed as 1.5-foot deep, 19.5-foot wide, "V" bottom ditches. These benches are located around the perimeter of the UWL on the finished slope at approximately elevation 520. This elevation was chosen as it is approximately halfway up the side slope of the UWL. The side slope benches will be graded into the exterior surface of the

UWL as it reaches elevation 520 to 525.

The permanent side slope letdowns have been designed as flat-bottom trapezoidal ditches with a bottom width of eight (8) feet. This will allow the drainage structures to be easily cleaned and maintained. The height of the channel side slope may vary depending on the final channel slope and required flow capacity for the individual letdown. The permanent letdowns will be lined with riprap or commercially available erosion mats to dissipate energy and prevent erosion of the final slope and final cover.

The perimeter ditch at the toe of the exterior side slope is designed as a flat bottom trapezoidal ditch with a six (6) foot wide bottom, 3:1 (H:V) side slopes and a maximum depth of five (5) feet below the top of the perimeter berm (see Sheet 19). A brief description of each drainage way, associated design parameters, and calculations are shown in Appendix M.

As the exterior side slopes of the landfill are completed and the side slope benches are constructed, letdown structures will be constructed and maintained. The side slope benches are placed approximately 37 vertical feet up the side slopes, resulting in a maximum 111-foot long slope length for sheet flow. The side slope benches will be constructed approximately midway between the top and bottom of the UWL side slope, resulting in a bench being stepped into the side slope. As noted in Section 3.4, the final grading plan will utilize a maximum slope of 3:1 (H:V). Reducing the drainage slope length by incorporating side slope benches significantly reduces the potential for long term slope erosion. (Reference calculations provided in Appendix M).

The spacing of the letdown structures is designed to minimize the distance that concentrated runoff must travel to a letdown structure and, to the extent practical, equally distribute the amount of stormwater that any single letdown structure will carry. All letdown structures are designed for a 25-year, 24-hour rainfall intensity or greater. Calculations for the design of the letdown structures are found in Appendix N. Sheet 21 contains typical construction details for the side slope benches, letdown channels and perimeter ditches.

Erosion of the final cover, side slope benches, stormwater letdown structures, and perimeter ditches were evaluated using North American Green's Version 4.31 Erosion Control Materials Design software. The software uses the Revised Universal Soil Loss Equation to conservatively evaluate the amount of erosion that will occur on a slope. Variables include the rainfall/runoff factor, erosion potential of soils, slope length and gradient, and vegetation or mechanical protection. The software conservatively evaluates channel erosion using the maximum shear strength method outlined in the Federal Highway Administration's HEC #15 and the United States Agricultural Department's (USDA's) Ag Handbook #667. All drainage structures will be protected from erosion using one of several possible materials: an erosion control mat, limestone riprap, or other manufactured erosion control product. The results of the erosion evaluation are provided in Appendix M. Appendix M also identifies the minimum type of

erosion protection required for each section of the drainage ways.

Stormwater from the side slopes and top of the closed UWL will discharge directly into the perimeter ditch. The total volume of runoff from completed Phases 1 through 4 (approximately 166.5 acres) during the 25-year, 24-hour design storm is estimated to be 31.2 acre-feet. These maximum runoff volumes are supported by calculations found in Appendix N.

3.7.2 Water Quality Permits

The stormwater retention ponds, within the UWL footprint will be permitted by the SWMP. Consequently, construction permits through the Water Protection Program (WPP) are not required. The need for modifications to the existing Labadie Energy Center NPDES permit for management of excess water will be discussed and acted on with the MDNR WPP. This will occur during the solid waste disposal area construction permit application review period. MDNR SWMP will receive a copy of all correspondence relating to an NPDES permit modification.

Land disturbance permits will be obtained from Franklin County and MDNR for construction of each landfill phase. The applications for state and county stormwater permits will be submitted in a timely fashion, under separate submittals from the solid waste permit application with copies of the cover and/or transmittals letters submitted to MDNR SWMP. A separate stormwater permit is not anticipated for precipitation falling outside the perimeter berms once the perimeter berms are constructed and the exterior slopes are stabilized under the land disturbance permit.

3.8 Landfill Liner

The proposed UWL will utilize a bottom composite liner system consisting of two feet of compacted clay soil and a flexible geomembrane liner. The compacted clay will be a minimum of two feet thick with a hydraulic conductivity of 1×10^{-7} cm/sec or less. This hydraulic conductivity significantly exceeds the minimum standard of 1×10^{-5} cm/sec allowed by 10 CSR 80-11.010(10) for a composite liner system. The upper component of the composite liner will be a minimum thirty (30) mil thick geomembrane, unless the geomembrane is high density polyethylene (HDPE). HDPE geomembrane liners will be at least sixty (60) mils thick. The UWL is currently designed with a 60-mil HDPE geomembrane liner. Ameren Missouri retains the option to consider other geomembrane liners during the life of UWL with proper design and regulatory approval. The proposed composite liner design exceeds the current state requirements for UWLs.

3.8.1 Grading Plan

The overall UWL bottom grading plan is shown on Sheet 5. The grading plan shows the top of the constructed landfill bottom liner. The actual subgrade of the disposal area prior to liner

construction will be approximately two (2) feet below the elevations shown. The UWL bottom elevations were determined based on several factors: the site-specific geotechnical information; the seasonal high groundwater elevation; the bottom slope requirements for maintaining less than 12-inches of leachate on the UWL bottom; the ultimate settlement of the natural soils underlying the UWL; and the minimum regulatory bottom grade slopes for a UWL.

The bottom liner grading plan for the UWL is based on perimeter berm interior side slopes of 3:1 (H:V), a minimum bottom slope of 1.0% in the direction of leachate flow (perpendicular to the bottom contours) and a minimum slope of approximately 0.5% along leachate collection pipes, forming a “herringbone” bottom grading plan.

An inflection point approximately 198 feet from the inside toe of the perimeter berm has been designed into the leachate collection pipe slope to accommodate anticipated long-term settlement that will flatten the resulting slope of the pipe. At this inflection point the leachate drainage pipe and trench slope increase to 1.0% to the leachate sump. Over the life of the landfill and during the post closure period, settlement along the leachate collection pipe is estimated to flatten the pipe slope to approximately 0.5%. A detail graphically illustrating the typical settlement cross section along the leachate collection pipe is provided on detail 1/18 (reference Sheet 18). Additional calculations are provided in Appendix Y that supports the use of this design for the leachate collection pipe trench.

Due to the construction of interior berms in the UWL, each disposal area’s leachate collection drainage pattern is independent, draining to more than one perimeter, interior leachate collection sump. In Phase 1, the leachate collection system drains to two (2) leachate collection sumps along the southwest perimeter berm. In Phase 2, the leachate collection system drains to three (3) leachate collection sumps along the north perimeter berm. In Phase 3, the leachate collection system drains to six (6) leachate collection sumps located on the northeast perimeter berm. In Phase 4, the leachate collection system drains to four (4) perimeter leachate collection sumps on the west perimeter berm. All leachate collection sumps are located at the inside toe of exterior berms and include a side slope riser for access to the leachate sump.

3.8.2 Materials and Construction

The proposed composite liner will consist of a two-foot thick compacted clay soil liner, immediately overlain by a 60-mil HDPE smooth or double-textured liner. Alternative geomembrane liner materials may be considered during the operation of UWL depending on costs and future developments in industry standards. The soils beneath the UWL footprint are a mixture of clays, silts, and sands. The sands and silty sands grade from fine to coarse with depth.

Laboratory tests on the landfill foundation soils indicate that differential settlement and subsidence of the insitu unconsolidated soils will not impact the structural integrity of the liner or leachate collection drainage systems in the UWL (reference Appendix J). Design calculations

for landfill slope stability and settlement, as well as characterization of in-situ materials, are included in the geotechnical report in Appendix J. The settlement evaluation of unconsolidated soils under the final UWL (100 feet +/- of CCPs) indicated a generally uniform settlement of up to 26 inches under the full depth of waste with lesser settlement near the outside slopes. Due to this anticipated differential settlement, the leachate collect pipe grades were steepened near the outside perimeter of the UWL to maintain positive gravity drainage to the sumps.

3.8.2.1 Soil Component

Exploratory drilling and testing during the DSI determined an insufficient quantity of soil materials exist within the proposed UWL 166.5-acre waste footprint and adjacent 813-acre UWL permit boundary to construct and operate the proposed landfill (refer to Appendix K).

Appendix J provides a summary of the soil classification and laboratory test results for the samples collected during the DSI field investigation. The laboratory testing demonstrates that insufficient quantities of suitable soils within the proposed UWL site are available to construct a soil liner with a permeability less than 1×10^{-7} cm/sec.

The clay soils planned for construction of the bottom clay liner will come from off-site. Reitz & Jens completed a geotechnical investigation at the proposed off-site borrow area at the Ameren Missouri Callaway Energy Center property in Callaway County. Twelve (12) borings were drilled at the site and soil samples collected for geotechnical testing. The results of this investigation determined that the off-site borrow area at the Callaway Energy Center Site had at least 2.6 million CY of available clay liner quality soil. The amount of soil required for the UWL bottom composite clay liner and clay cap on the side slopes will be approximately 639,000 CY.

Liner quality clay will be brought to the UWL site, segregated and stockpiled in advance of construction of the liner. The stockpile will be tested for homogeneity and compaction criteria will be developed to determine the range of dry unit weights and moisture contents that will achieve the required maximum permeability of 1×10^{-7} cm/sec, and the other minimum engineering properties that were assumed in design. The bottom soil liner will be placed in thin lifts (six (6) to eight (8) inch layers), compacted with a pads foot roller, or equivalent compactor, and density/moisture quality control testing performed on each layer. Compaction will be performed in accordance with the criteria developed for the stockpiled liner material. Additional lifts will be constructed after quality control testing has been conducted, verifying the proper construction of the previous lift, until the minimum compacted clay liner thickness has been obtained. After verification of proper construction of a lift, the surface will be lightly scarified, as needed to assure cohesion between the two lifts and minimize horizontal permeability in the soil portion of the composite liner. Minimum soil liner placement and testing criteria are provided in the Construction Quality Assurance Plan (CQA) in Appendix P.

Prior to the start of the UWL construction, areas beneath the UWL footprint will be stripped of the existing ‘top soil’ and the perimeter flood protection berm will be constructed. A qualified

soils technician under the supervision of a geotechnical engineer will observe and evaluate all earthwork and grading conducted as part of this site development work. The soils will be sorted by suitability for use as intermediate cover, final cover, final vegetative layer, clay liner soils and/or general soil fill and stockpiled on-site within the UWL permit boundary.

The stockpile of off-site clay for liner construction will be sampled, tested and used to construct a test pad to determine proper placement criteria to achieve the required permeability standard for the clay liner component of the composite liner system design. Prior to the start of the installation of the clay liner component of the composite liner system, a clay liner test pad will be constructed to establish specific placement procedures, specifications, and quality control and assurance testing. The verification testing will demonstrate the clay liner will meet or exceed the permeability standard of 1×10^{-7} cm/sec. The same construction procedures and clay liner selection, placement, compaction and construction quality assurance testing and verification as used on the test pad will be followed for all UWL Phases.

3.8.2.2 Geomembrane Component

A 60-mil HDPE geomembrane liner will be used for the top layer of the composite landfill liner. Both smooth and double-sided, textured HDPE geomembrane liner will be used in accordance with the design. The liner material will be placed immediately on top of the two foot compacted clay soil liner. The textured geomembrane will be utilized in the construction on the interior 3:1 (H:V) side slopes of the perimeter berm and will transition to the flat bottom liner areas as needed. Stability calculations for the textured geomembrane on side slopes are found in Appendices J and Y. All geomembrane liner materials will be anchored at the top of the slope in accordance with the manufacturer's recommendations and the anchor trench details shown on Sheets 16 and 17.

Minimum liner manufacturing quality assurance (MQA) and construction quality assurance (CQA) are provided in the CQA Plan (Appendix P). Actual liner materials and construction will be bid to meet specifications developed during the construction design for all Phases, or the equivalent, to allow for competitive bidding and changing technological issues.

3.9 Leachate Management System

All phases of the UWL are designed for disposal of utility waste CCPs. In the disposal process, leachate (e.g., water that has infiltrated into the CCPs) will be collected by the leachate collection system constructed immediately on top of the composite liner within each disposal cell. A blanket leachate collection system will cover the bottom and side slopes of each disposal cell. The leachate collection system for each bottom drainage area will be installed over the composite liner system and will drain to a leachate collection sump. Each disposal cell will utilize multiple leachate collection sumps. Each leachate collection sump will be equipped with a submersible pump with access to the sump via a minimum 18-inch diameter side slope riser pipe. The submersible pump will have automatic controls to remove leachate at preset

water levels to maintain the leachate level at less than 12-inches at any point on the bottom of the UWL.

3.9.1 Leachate Generation Rate

The HELP model has been used to estimate the quantities of leachate generation under two (2) operating and one (1) closed condition. The results of the HELP model are presented in Appendix O. Table O-1 in Appendix O provides a summary of the HELP model results, including the Peak Daily Leachate Volume and the Average Annual Leachate Volume. The data in this table was used to predict leachate generation rates for pumping, transport and storage. Ameren's active 'dry cell' CCP landfills in Illinois consistently generate significantly less leachate from the leachate sumps compared to the volumes predicted by the HELP model. Therefore, the leachate quantities predicted by the HELP model are considered to represent conservatively high, or 'worst case' scenarios.

3.9.1.1 Pre-Closure Generation Rate

The first operating condition modeled is during initial operations when CCPs have been placed over the entire liner and leachate collection system in an approximate 7-foot lift. The second operating condition modeled is when CCPs have been placed to the approximate height of the perimeter berm (average depth of 20 feet). The peak daily quantity of leachate flow estimated by the HELP model for the landfill operations in the first constructed portion, Phase 1, ranged from 812 to 2,571 cubic feet/day (4.2 to 13.4 gpm). The peak daily quantity of leachate accumulating in Phase 1 will be split between the two sumps, which are approximately equal in the size of their drainage area. This results in estimated peak daily flows per sump ranging from 406 to 1,285 cubic feet/day (2.1 to 6.7 gpm). The drainage areas per sump in the other three Phases are all smaller than for Phase 1, and as a result the estimated peak daily flow per sump is less than for Phase 1.

3.9.1.2 Post-Closure Generation Rate

The post-closure generation rate assumes that the landfill is properly closed; limiting precipitation to direct rainfall and minimizing infiltration into the landfill through the final cover system. Separate cases were modeled for two closed conditions: the flatter top slope with a geomembrane/clay composite cap; and the steeper side slopes with a clay-only cap. For final closed condition with final cap installed, the HELP model results of the two closed condition cases were combined to determine the post-closure peak daily quantity of leachate flow of approximately 557 cubic feet/day (2.9 gpm) for Phase 1.

3.9.2 Water Storage and Disposal

The UWL is designed as a no-discharge facility for rainfall events up to and including the 25-year, 24-hour design storm. Any leachate that is generated within the in place CCPs during

operation will be collected in the leachate collection sumps and transferred to on-site storage tanks. The temporary storage tanks will be strategically located within the lined, permitted UWL protected from 100-year flood events. Plan sheets 6, 7, 8 and 9 show the general location of a single leachate storage tank for each cell, although there is sufficient room for several tanks at each location. If necessary, additional area for setting temporary leachate tanks can be developed within the active disposal cell on top of the CCPs, which are routinely used beneficially as a construction fill material.

The number and location of tanks will require ongoing evaluation as a part of the UWL operations. Leachate and stormwater management options include: use to moisture condition CCPs prior to disposal in the UWL; use on haul roads or active CCP disposal areas within the permitted disposal boundary for dust control; or use as makeup water for future scrubber systems. The water management calculations found in Appendix Y(c) conservatively estimate that reusing the on-site stormwater and leachate for moisture conditioning and dust control on interior haul roads can annually consume approximately 1.5 times the quantity of stormwater and leachate that is predicted to be generated by the UWL under the worst case scenarios modeled in Appendix O. Excess leachate will be managed through the Labadie Energy Center NPDES permit, or transported off-site for disposal.

Appendix Y(c) also assumes that prefabricated 10,000 gallon storage tanks, which are readily available in the market place, will be used to temporarily store the leachate on-site until it can be beneficially reused within the UWL, or transported to an off-site location for disposal. Preliminary analysis using the average annual leachate generation rates indicate that 5 to 7 10,000-gallon tanks (a total of 50,000 to 70,000 gallons of temporary storage capacity) will provide a minimum of 1 week storage during the initial operations of Cell 1. These tanks will be interconnected and located in a “tank farm” at the approximate location shown on Plan Sheet 6. The two leachate pumps required for Cell 1 will connect to a force main that conveys the leachate to this tank farm. Using the leachate generation history from the operation of Cell 1, the number of tanks required to manage leachate generated from Cells 2, 3 and 4 can be more accurately predicted using actual peak and annual data. However, the long-term leachate storage requirements will depend on the actual amount of leachate generated and amount reused within the UWL, which will require ongoing adaptive management based on historical data during the UWL operation.

Additional temporary leachate storage capacity is available in Pond 1 for Phase 1 during start-up operations, and subsequently, Pond 2 during the start-up operations of Phase 3. The ultimate purpose of these ponds is to manage stormwater runoff from the active disposal cell; however during initial cell disposal operations, stormwater runoff will be contained within the cell until the cell has been sufficiently filled with CCPs to allow gravity flow of excess stormwater into Pond 1. Until that time, the entire capacity of Pond 1 (and subsequently, Pond 2) is available for temporary leachate storage. One worst case scenario that does not require the HELP model to evaluate involves a large (e.g., 25-year, 24-hour) rainfall event that occurs

during the initial filling of a new disposal cell before the leachate collection system is covered with a lift of CCPs. As a practical matter, this water is characteristically 'contact storm water' and not 'leachate', although the regulatory definition of 'leachate' includes water that has come in contact with solid waste. Such an event, if it occurs, will generate a large quantity of water that must be removed from the disposal cell and stored in the stormwater ponds until it can be reused or disposed off-site. The design capacity of the stormwater ponds are adequate to store and manage this water until it can be reused or disposed off-site.

After closure of the UWL, leachate collected in the UWL will be managed through the Labadie Energy Center's NPDES discharge permit, or transported off-site for disposal. Following closure, stormwater that has not come in contact with CCPs will be discharged outside of the perimeter berm as uncontaminated stormwater. This future activity may require that a separate NPDES permit be obtained for the UWL after the proper closure of the facility. The need for a separate permit and the need for continued use of the constructed stormwater ponds will be determined based upon current federal, state and county regulations at the time of UWL closure.

3.10 Groundwater Monitoring

The proposed UWL is designed to protect the quality of local and regional surface water and groundwater. This is accomplished with the composite bottom liner system, stormwater management system, leachate management system, and the final cover system. Groundwater quality will be routinely monitored and the data evaluated to track the ongoing performance of the landfill design and operation with regard to groundwater protection.

3.10.1 Groundwater Quality

Groundwater in the alluvial aquifer at the UWL site has not been sampled for background chemical constituents. Groundwater quality is presumed to be consistent with local alluvial groundwater quality in the area. Groundwater quality will be determined after the installation of a groundwater monitoring network and the collection and analytical testing of the minimum number of representative samples from the monitoring network required for statistical analysis prior to the start of the UWL operation.

Water samples will be collected in accordance with the site sampling and analysis plan (SAP) included as Appendix Q and then laboratory tested for chloride, fluoride, sulfate, chemical oxygen demand, total dissolved solids, total organic carbon, total organic halides, iron, and metals. Field tests of the samples will include pH and conductivity. The test results, along with chain of custody records, will be compiled in a Groundwater Monitoring Report and will become part of the UWL facility operating record to be used to establish background groundwater quality.

3.10.2 Groundwater Monitoring System

A permanent groundwater monitoring system has been developed based on the results of the DSI. The groundwater monitoring system will monitor the uppermost continuous aquifer beneath the proposed UWL site, which consists of alluvial sand deposits. This hydrologic unit is generally described as representing channel, channel margin, crevasse splay, and natural levee deposits in Section 5.1 of the DSI Report.

The UWL site is located in the floodplain of the Missouri River. The uppermost aquifer is an unconfined aquifer system within the alluvium that is recharged by, and influenced by, the water flowing within the river. Groundwater elevations beneath the site fluctuate with, and are influenced by, the respective Missouri River stages. During and subsequent to the DSI, multiple rounds of groundwater level measurements were observed, recorded and evaluated in relation to river stage levels to determine the influence of the Missouri River on groundwater elevations, gradient and direction of flow. Summary results of the hydrogeologic information are provided in Appendix W(a).

This analysis concluded that the Missouri River stage directly impacts the groundwater gradient and flow direction of the uppermost aquifer. Since the Missouri River stage fluctuates seasonally, the uppermost aquifer has a variable direction of flow. Overall, when river elevations are relatively high, groundwater movement is generally toward the east and southeast. Conversely, when river elevations are relatively low, groundwater movement is generally to the north and northwest. The analysis also determined that temporary, seasonal fluctuations of the Missouri River stage are too brief to significantly interfere with the proposed groundwater monitoring program relative to upgradient and downgradient trends.

During periods of high river level, groundwater flow generally is to the east-southeast, with the result that groundwater monitoring wells in the northwestern part of the site are generally hydraulically upgradient and groundwater monitoring wells in the southeastern part of the site are generally hydraulically downgradient. During periods of low river level, groundwater generally flows to the north-northwest, with the result that groundwater monitoring wells in the northwestern part of the site are generally hydraulically downgradient and groundwater monitoring wells in the southeastern part of the site are generally hydraulically upgradient. Groundwater monitoring wells along the western and southern boundaries of the UWL generally remain upgradient regardless of river stage and groundwater monitoring wells along the eastern boundary generally remain downgradient regardless of river stage.

An existing agricultural irrigation well northeast of Cell 3 will remain operational during operation of the UWL, and when used, will operate at a reported estimated maximum rate of 1,200 gpm. This well will only operate periodically during periods of dry weather, typically for durations of up to four days. The periodic operation of this well will have unmeasurable impacts on the groundwater levels in the adjacent groundwater monitoring wells. Refer to Appendix W(b) for

the detailed analysis of the agricultural well impact.

Appendix X(a) and X(b) provides a summary of the methodology and rationale used to establish the proposed groundwater detection monitoring system. The proposed detection monitoring system consists of thirty-two (32) permanent shallow groundwater monitoring wells and one temporary well to be installed after approval of the proposed groundwater monitoring system design. In addition, the proposed detection monitoring system will include three (3) deep groundwater monitoring wells to develop water quality data for the lower portion of the unconfined aquifer. The minimum number of representative samples from the monitoring network required for statistical analysis will be collected and analyzed prior to the start of CCP disposal.

Each of the thirty-two (32) shallow detection monitoring wells is designed to monitor groundwater within the uppermost alluvial sand deposits underlying the UWL to an approximate depth of up to 25 feet. The permanent shallow detection monitoring system includes seven (7) wells that are generally hydraulically upgradient and twenty-five (25) wells that are generally hydraulically downgradient. The permanent shallow detection wells are designated MW-1 through MW-32 with the proposed well locations shown on Sheets 3, 5 and 10. MW-1 through MW-21 and MW-29 through MW-32 are generally downgradient well locations, while MW-22 through MW-28 are generally upgradient well locations. Temporary well TMW-1 is generally downgradient of Cell 1. TMW-1 will be abandoned during the construction of Cell 3.

The three (3) deep detection monitoring wells are designed to monitor groundwater within the lower alluvial deposits underlying the UWL at an estimated depth of 85 feet or less. The deep detection monitoring system includes one (1) well that is hydraulically upgradient and two (2) wells that are hydraulically downgradient. The deep wells are designated MW-33(D), MW-34(D), and MW-35(D) with the proposed well locations shown on Sheets 3, 5 and 10.

The proposed design for each well is described in Appendix Q. A typical groundwater monitoring well detail is shown on Sheet 18. The proposed design for each well includes: northing and easting coordinates; total depth of well; the length of the well screen; approximate elevation range for monitored interval (bottom of drill hole to top of primary filter pack); top of primary filter pack; well slot size; filter pack gradation; surface seal; and surface completion. The "monitored interval" will include the length of the primary filter pack, and not simply the length of the well screen. In addition, the backfill from the top of the filter pack to the ground surface will be a bentonite grout.

During installation, all monitoring wells will be located in the field such that reasonable access can be gained for the purpose of monitoring, maintenance, and repair. Each well will be installed to facilitate surface drainage in the vicinity of the well to the extent practical. Wells will not be placed in areas where standing water accumulates during significant precipitation events. Wells will also be placed a safe distance away from overhead utilities or known

underground utilities or hydraulic conduits.

3.10.3 Corrective Action

As per 10 CSR 80-11.010(11)(C)6, an assessment of corrective measures will be initiated within ninety (90) days of a reported Statistically Significant Increase (SSI) that exceeds the applicable groundwater protection standards. In response to a statistical analysis which results in an SSI, Ameren Missouri will submit the required information to MDNR. If the SSI is determined to have resulted from the landfill, Ameren Missouri will, within ninety (90) days of the last sampling event, obtain additional groundwater samples from the wells that exhibited SSI(s), split the samples in two (2) equal aliquots and separately obtain analyses of both aliquots at independent laboratories to determine whether the SSI(s) was the result of laboratory error.

After obtaining the results from initial or subsequent sampling events that detect SSI(s), Ameren Missouri will notify MDNR within fourteen (14) days and place a notice in the operating record of the detection. Ameren Missouri will, within ninety (90) days and on a quarterly basis after that, resample all wells, analyze the samples for all Appendix 1 parameters and notify MDNR of the constituent concentrations. Based on the results of the continued sampling, Ameren Missouri may be required to conduct an assessment of corrective measures and propose a remedy to the department. Based on the results of the corrective measures assessment, a report describing the proposed remedy will be submitted to MDNR.

The report will be placed in the operating record and will include a schedule for implementing the corrective action remedy. Ameren Missouri will implement the corrective action remedy measures according to the schedule to be protective of human health and the environment around the facility.

3.11 Cover Material

Due to the nature of the CCPs, intermediate cover (i.e., one (1') foot of compacted soil cover applied to any areas idle for more than 60 days) on inactive areas is generally not necessary to prevent wind or water erosion of the deposited CCP. However, intermediate cover will be provided as per the regulatory requirements of 10 CSR 80-11.010(14)(C)1.

The majority of inactive acreage in the UWL will be on the side slopes of the UWL. These areas will be undisturbed, dried solids that are not susceptible to wind or water erosion. In addition, the UWL has been designed and will be operated as a no-discharge facility for all stormwater. Stormwater discharges from these areas will be limited to controlled discharges from the top of the UWL into the perimeter ditch and subsequently to the on-site stormwater ponds. Accumulated stormwater will be reused within the disposal area or pumped back to the Labadie Energy Center to maintain no discharge at the UWL.

CCPs are relatively inert, relatively impermeable and will be moisture conditioned when placed to promote compaction and minimize dust. Per 10 CSR 80-11.010(14)(C)1, intermediate cover will be applied to a total thickness of at least one foot (1') of compacted soil on areas of the UWL in which waste has been placed and which are idle for more than sixty (60) days, as well as on final side slopes at the end of each fill sequence. Intermediate cover will be reused to the extent practical. As idle areas become operational again and final side slopes receive final cover, the intermediate cover will be removed and stockpiled for re-use. For purposes of estimating the volume of intermediate cover required, no more than 57 acres of fill area on final side slopes and idle areas will be open for more than 60 days at one time.

To improve aesthetics and minimize the potential for erosion, the intermediate cover on the exterior side slopes above the perimeter flood protection berm of the UWL will be vegetated at least once for every ten (10) vertical feet of elevation as final cover subgrade is reached. The intermediate cover on the final side slopes will be applied to a total thickness of at least one foot (1') of compacted soil and vegetated with a mixture of rapidly germinating grass species. The filling sequence of each active waste disposal phase will be continuous up to the approximate interim elevation of 520 feet.

3.11.1 Soil Cover Sources

Vegetative soil cover material will be obtained from the on-site stockpile created when the UWL footprint is cleared and grubbed, or off-site borrow areas, as necessary during the life of the UWL. In general, the quantity of materials excavated during clearing and grubbing of the UWL site are suitable and sufficient for use as landfill final vegetative cover. During excavation of soils on the UWL site, and when off site soil borrow materials are brought to the UWL site to be stockpiled for future construction, Ameren Missouri will have a qualified soil technician available to evaluate and sample the soil materials, as necessary. Testing will be conducted, as necessary, to classify the soils and determine their suitability for various required uses, whether they are used immediately or stockpiled. The volume of soil required to cover the exterior side slopes of the UWL has been accounted for in the volume of soil needed for final cover (Appendix K).

3.12 Landfill Final Cover

The proposed final cover design will utilize a composite final cover system on the top and side slopes as shown on Sheet 15. The final cover on the uppermost "flat" area (approximately 2% slope, but a minimum 1% slope) will consist of a single-sided textured 40-mil HDPE geomembrane liner placed directly on the CCPs, overlain by a 16 oz/yd^2 non-woven, needle-punched geotextile, and covered with two (2) feet of nominally compacted vegetative soil. The upper layer of the soil will be capable of supporting the final vegetative cover.

The final cover on the landfill's exterior side slopes (33% slope) will consist of a textured 40-mil HDPE geomembrane liner placed directly on the CCPs, 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 vegetative cover. The final cover designs meet or exceed the current state solid waste rules, as described in 10 CSR 80-11.010(14).

The final cover systems will minimize infiltration of rainfall into the landfill during the post-closure period and improve aesthetics. The two (2) foot of vegetative soil (e.g., the vegetative soil portion of composite final cover system on top of the UWL) will provide a sub-base and root zone for the permanent vegetation on the landfill final cover. The side slope final cover will be vegetated with a process similar to the "vegetation layer" on top of the UWL to provide long-term protection of the soil layer. The organic components of the surface floodplain soils found at the site make these soils suitable for vegetative growth. The final vegetation will provide soil stability and erosion control to the final cover, as well as consume the majority of the rainfall that infiltrates the soil through evapotranspiration.

3.12.1 Materials and Construction

Final cover construction will be completed in increments of approximately forty (40) acres and will be scheduled to take advantage of anticipated earthmoving and vegetation growing seasons. Final cover will include a single-sided textured 40-mil geomembrane liner, overlain by a 16 oz/yd2 non-woven, needle-punched geotextile, covered with two (2) feet of nominally compacted vegetative soil available from initial soil stripping (1.75') within the UWL footprint.

3.12.1.1 Soil Component

The approximate top 1.75 feet of soil will be excavated and stockpiled during initial disposal cell construction prior to placement of fill materials or clay liner. These soils will provide the two-foot vegetative layer soils for the final cover.

The first twelve (12) inches of the vegetative layer will be constructed by spreading sixteen (16) inches of soil over the non-woven geotextile cushion and the HDPE geomembrane liner in a single pass with a Caterpillar D-7 bulldozer, or equivalent. The final twelve (12) inches of soil will be constructed by placing the soil material in loose lifts prior to spreading and compacting. Compaction will be provided by the traffic of pan scrapers used to haul the soil to the active work area. The lifts will be smoothed and compacted prior to seed installation.

3.12.2 Vegetation

Following construction of the final cover system, the surface will be graded and prepared for seeding. Seeding will be completed in a timeframe that will take advantage of the fall or spring growing seasons, which is mid February to mid May and late August to late October. Fertilizer, lime and seeding rates may be determined through soil plant nutrient testing. A seed mixture compliant with the MDNR "Landfill Closure Guidance" Technical Bulletin, dated June 2006, will be used for vegetation on the final cover system. As indicated in the closure plan, this seed mix

will consist of a hardy grass or legume mixture, such as fescue (75 lb/acre) and clover (Appendix R). Alternatively, Ameren Missouri retains the option to consider native seed mixes during the closure of UWL, following proper design and regulatory approval.

3.13 Air Quality

The landfill is located in the northeastern portion of Franklin County near the towns of Labadie and St. Albans. The regulatory agency for air quality at the site is MDNR's Air Pollution Control Program. The landfill will comply with any future air quality standards for UWLs. No Air Pollution Control Program operating or construction permits are anticipated for the proposed landfill operations. The landfill will comply with the fugitive dust limitation required by the Labadie Energy Center's existing air operating permit for the facility. The surface of the primary truck haul route from the plant to the UWL and interior UWL haul routes will be stabilized and maintained to minimize fugitive dust from UWL operations.

3.14 General Maintenance of Landfill Systems

In addition to routine daily landfill operations, landfill equipment maintenance, and periodic containment systems construction, the landfill operator will monitor and maintain the following landfill systems and associated equipment:

- Stormwater pumps, drainage channels, ponds, sumps, outfalls and inlets.
- Leachate sumps, pumps, tanks and appurtenances in the CCP disposal phases constructed.

Ameren Missouri will continue the general maintenance and operations of these systems and the associated equipment during the life of the landfill and the post-closure period.

3.15 Closure and Post-Closure

Per 10 CSR 80-2.030(4)(B)2.D, post-closure financial assurance is not required for UWLs. However, Ameren Missouri has voluntarily agreed to provide a 20-year post-closure FAI for continued groundwater monitoring and evaluation during the post-closure period.

The state regulations were used for the development of the Closure Plan, and Post-Closure Plan and associated closure and post-closure cost estimates. The current state guidance document for the development of Closure and Post-Closure Plans for UWLs requests that the plan be developed as a separate document, but reference the appropriate design and construction documents, as necessary. The required Closure and Post-Closure Plan is included in Appendix R.

The Closure and Post-Closure Plan addresses the requirement for Ameren Missouri to grant access to the Missouri Department of Natural Resources, its agents, or its contractors by

executing an easement to the site, on-site soil stockpiles and off-site soil borrow area after issuance of the Construction Permit, at the time of application for an Operating Permit. The most current MDNR easement forms will be used to execute the easements and access agreements to the proposed UWL, on-site soil stockpiles and soil borrow areas.

4.0 LANDFILL OPERATION

The operational standards of the State (MDNR) and Franklin County, where applicable, are incorporated into an operating manual described in this section. In addition, other routine operational procedures will be developed and implemented by Ameren Missouri to provide for operations that protect the public health and the environment.

This section, Landfill Operation, can be removed and used as a separate document from the remainder of the report, providing an independent operational manual for use by the UWL operator/manager.

4.1 Construction and Development

The long-term environmental integrity of the landfill is a direct result of the quality of construction and operations. Landfill excavation, grading, composite liner installation, leachate collection system installation, filling operations, compaction, grading, and construction of stormwater diversion and control structures are among the construction and operation activities that must be properly completed prior to closure. Constructing the landfill to the approved final grade, construction of the final cover systems, and construction of the final stormwater control structures are among the construction activities to be completed during ongoing operations, as the landfill progresses from the bottom to final grades, and during closure activities. Maintenance of these features during the post-closure care period will also require construction activities.

4.1.1 Phased Development

The proposed footprint for disposal of utility waste covers approximately 166.5 acres. The proposed landfill design provides an estimated disposal capacity of 15.5 million CY of total air space. Based on the assumptions and calculations provided in Appendix L, the proposed UWL has an estimated operating life of approximately 24 years.

All large construction projects completed over a lengthy time period are broken down into phases to divide the project into economical and manageable portions. Ameren Missouri's Labadie Energy Center UWL is divided into four (4) distinct phases for the development, construction and operation; Phase 1 (31.4 acres with a 5.7 acre stormwater pond); Phase 2 (35.2 acres, using the 5.7 acre stormwater pond constructed during Phase 1); Phase 3 (57.1 acres, plus a 4.4 acre stormwater pond); and Phase 4 (42.8 acres, plus a 3.4 acre stormwater pond). These phases encompass the overall UWL waste disposal footprint. The four (4) phases allow intermediate stages of completion and evaluation and incorporation of economic or operational changes that can affect the remaining life of the landfill. Each of the phases requires the completion of multiple sump drainage areas. Sheet 5 identifies and describes the boundaries and sequence of completion for the landfill phases that make up the four (4)

operational phases, plus the three (3) stormwater ponds.

A new site access road will be constructed from the Labadie Energy Center to the northwest corner of Phase 1, with an overpass for the existing Labadie Bottom Road. Phase 1 filling will generally progress in a west-to-east and north-to-south pattern, beginning at the western boundary of Phase 1. Phases 2, 3 and 4 will be constructed in sequence after Phase 1. Disposal of CCPs in Phase 2 will generally progress from west to east and south to north. Disposal of CCPs in Phase 3 will generally progress from northwest to southeast and north to south. Disposal of CCPs in Phase 4 will generally progress from north to south.

4.1.2 Sequence of Phase Construction

As described above, the landfill operations are divided into four (4) phases of development (Phases 1 through Phase 4). The following discussion generally describes the sequencing of construction and operation of Phase 1, Phase 2, Phase 3 and Phase 4 with respect to the key elements that provide the primary environmental protection of the proposed UWL.

The transition of the composite liner system between phases and disposal cell areas is shown in typical details in the accompanying plans. The interior berms between Phases 1 and 2 and Phases 3 and 4 will remain in place. During construction of an adjacent disposal cell, the composite liner system components will be exposed at critical tie in locations to allow the compacted clay liner and the geomembrane components to be properly tied and integrated into the existing composite liner to create a continuous liner system that will allow for a continuous leachate collection and removal from the UWL. CQA verification testing and documentation will be the same as the other portions of the composite liner and leachate collection and removal systems. This method will be used to join the composite liner between Phases 1 and 2, and 3 and 4 to create a continuous liner system and leachate collection and removal system under the entire UWL.

The transition details of the leachate collection system between disposal cells and phases are shown in typical details on the plans. The toe of the interior berm that seals the liner and leachate collection system from stormwater in the adjacent, undeveloped disposal area will be removed to provide a continuous liner surface and leachate collection drainage layer as an additional UWL disposal cell is added. CQA verification testing and documentation will be completed along the composite liner and leachate collection system tie in using the same procedures completed on the composite liner components and leachate collection system components for each disposal cell.

Phase 1 Construction Sequence

Phase 1 includes the construction and operation of a disposal area totaling approximately 31.4 acres having two (2) distinct bottom drainage areas and two leachate removal side slope riser sumps. Phase 1 is planned as a single sequence of construction and operation. The following

sequence of activities generally describes the construction and operation of Phase 1:

- Base construction (includes perimeter berms, composite liner, leachate collection and removal system and a 12-inch thick protective layer)
- Construct a 5.7-acre stormwater pond located at the southern boundary of Phase 1.
- To mitigate potential uplift concerns for 100-year flood event, fill disposal area with CCPs to elevation 478.5 as soon as possible after receiving authorization to operate.
- Establish perimeter ditch at elevation 483 with discharge to the 5.7-acre stormwater pond in the southern boundary of Phase 1.
- Reference Phase 1 Pre-closure and Closure for final stages of Phase 1 operations. Install permanent letdowns where indicated on plans and temporary letdowns were needed to manage stormwater and side slope erosion.

Phase 2 Construction Sequence

Phase 2 includes the construction and operation of a disposal area totaling approximately 35.2 acres having three (3) distinct bottom drainage areas and three leachate removal side slope riser sumps. Phase 2 is planned as a single sequence of construction and operation. The following sequence of activities generally describes the construction and operation of Phase 2:

- Reroute the existing Labadie Bottom Road between Phases 1 and 2.
- Base construction (includes perimeter berms, composite liner, leachate collection and removal system and 12-inch thick protective layer)
- Reconfigure the perimeter ditch between Phase 1 and 2 to allow stormwater to flow by gravity from Phase 2 to the 5.7-acre stormwater pond constructed in Phase 1.
- To mitigate potential uplift concerns for 100-year flood event, fill disposal area with CCPs to elevation 478.5 as soon as possible after receiving authorization to operate.
- Establish perimeter ditch at elevation 483 with pumped discharge of stormwater to the 5.7-acre stormwater pond at the southern boundary of Phase 1.
- Set up permanent and temporary letdowns around the perimeter slope as Phase 2 rises to elevation 520 and beyond.
- Reference Phase 2 Pre-closure and Closure for final stages of operations. Install Phase 2 final cover system or intermediate cover as appropriate on respective Phase 2 slopes.

Phase 3 Construction Sequence

Phase 3 includes the construction and operation of a disposal area totaling approximately 57.1 acres and having six (6) distinct bottom drainage areas and six leachate removal side slope riser sumps. Dependent on future CCP generation rates, Phase 3 may be built as two distinct sequences of construction and operation. The following sequence of activities generally describes the construction and operation of Phase 3, assuming that it is built in two construction sequences:

- Base construction of the northwestern portion of the 57.1-acre Phase 3 area (includes perimeter berms, composite liner, leachate collection and removal system and 12-inch thick protective layer)
- Construct a 4.4-acre stormwater pond located at the northern boundary of Cell 3.
- To mitigate potential uplift concerns for 100-year flood event, fill disposal area with CCPs to elevation 478.5 as soon as possible after receiving authorization to operate.
- Establish perimeter ditch at elevation 483 with pumped discharge of stormwater to the adjacent 4.4-acre stormwater pond.
- Set up permanent and temporary letdowns around the perimeter slope as Phase 3 rises to elevation 520 and beyond.
- Reference Phase 3 Pre-closure and Closure for final stages of operations. Install Phase 3 final cover system or intermediate cover as appropriate on respective Phase 3 slopes.
- Repeat above sequence of activities for the remaining southeastern portion of the 57.1-acre Phase 3 area.

Phase 4 Construction Sequence

Phase 4 includes the construction and operation of an area totaling approximately 42.8 acres having four (4) distinct bottom drainage areas and four leachate removal side slope riser sumps. Phase 4 is currently planned as a single sequence of construction and operation; however, this will be re-evaluated later in the operating life of the UWL. The following sequence of activities generally describes the construction and operation of Phase 4:

- Base construction of the 42.8-acre Phase 4 area (includes perimeter berms, composite liner, leachate collection and removal system and 12-inch thick protective layer)
- Construct the 3.4-acre stormwater pond located at the southwest corner of Phase 4.
- To mitigate potential uplift concerns for 100-year flood event, fill disposal area with CCPs to elevation 478.5 as soon as possible after receiving authorization to operate.
- Establish perimeter ditch at elevation 483 with pumped discharge of stormwater to the stormwater pond at the southwest corner of Phase 4.
- Set up permanent and temporary let downs around the perimeter slope as Phase 4 rises to elevation 520 and beyond.
- Reference Phase 4 Pre-closure and Closure for final stages of operations. Install Phase 4 final cover system on respective Phase 4 final slopes.

Phases 1, 2, 3 and 4 Aesthetic Cover

Aesthetic soil cover on inactive side slopes may include:

- Grading CCP surface to two (2) feet below approved final grade.
- Establishing a temporary one-foot thick nominally compacted soil directly on the graded surface of the CCPs. The temporary cover will be placed at least once per

every ten (10) vertical feet of height completed in the active disposal areas in each Phase.

- Seed to establish vegetation on the intermediate side slope cover annually.
- Periodically review and maintain vegetation to provide adequate erosion protection in accordance with Section 3.11.

Phase 1, 2, 3 and 4 Pre-Closure and Closure

The following sequence of activities generally describes the final stages of operation and construction of each Phase:

- Each Phase area will be operated until the elevation of CCPs at the top of the 3:1 side slope boundary is at maximum elevation of approximately 552 (Phases 1 and 2) or 554 (Phases 3 and 4), which is approximately 2-feet below the proposed final grade.
- Final closure includes placing the geomembrane and soil final cover on the UWL top and side slopes.
- Stormwater drains and permanent let downs shall be installed on the top perimeter, side slopes, and across the perimeter ditch at the base of the 3:1 side slopes per the drawings to manage stormwater during the post closure period.
- Side slope benches and let downs will be graded and constructed, as necessary.
- Final cover will be constructed on the all side slopes in each Phase.

4.1.3 Construction Quality Assurance (CQA)

A CQA Plan will be used during construction of critical landfill design and environmental protection features to assure that construction is completed in accordance with the approved design. The CQA Plan for the landfill is provided in Appendix P. During construction and development of all portions of the UWL, Ameren Missouri will assure that the contractor follows the CQA plan by retaining a qualified third party CQA consultant.

4.1.4 Survey Control

Survey control will be utilized during construction and operation of the landfill to assure that the operation is conducted within the horizontal waste boundaries of the permitted utility waste disposal area and the fill height limitations approved by MDNR. Property boundaries and permanent horizontal and vertical survey control points have been established within the immediate vicinity of the UWL permit boundary for this purpose. A survey plat showing the UWL permit and waste boundaries, as well as legal descriptions of each of these boundaries is included in Appendix V.

The tract of land totaling 813 acres is the proposed UWL permit boundary. The proposed waste boundary totals approximately 166.5 acres. The waste boundary will be identified in the field at the time of construction of each Phase. The waste boundary is located at the inside top

of the perimeter berm. The Labadie UWL is constructed almost entirely above surrounding grades with disposal Phases defined by the perimeter berms. Additional identification of permitted waste boundary using steel "guard posts" is neither practical nor necessary in the configuration used for this UWL.

Elevation control for the landfill operation will be implemented in accordance with the survey control provisions specified in Section 2.10. Elevation controls will be utilized to monitor all construction, including: the initial site preparation; composite liners; leachate collection systems; intermediate landfill operations, grading and temporary cover; and final cover system.

After receiving authorization to operate a newly constructed disposal area, the inside top of the exterior perimeter berms containing the outside edge of the composite liner system anchor will designate the permitted waste boundaries. Construction stakes, consisting of wooden hubs and lath, will be used to control ongoing construction of the landfill where needed. Landfill staff will conduct elevation checks at a minimum of once every six months to keep the ongoing construction of the landfill within permitted horizontal and vertical boundaries. The project coordinate system shown on all pertinent drawings has been developed to assist in this effort. Landfill staff will have the equipment and information necessary to check construction progress as necessary. If they require assistance, they will contract with a registered land surveyor.

Both during operation and post-closure, the top of berm elevation will be periodically determined by level survey. If the elevation of the exterior berms settles below the 500-year elevation of 487.6, suitable fill will be added to the perimeter roads on the top of the berm to raise the minimum berm elevation to 488.0. Ameren Missouri will estimate the remaining permitted volume of the landfill every two years, as required. This estimate will be made by comparing photogrammetric surveys of the active portion of the site or by other means approved by the MDNR.

4.2 Operational Description

Landfill personnel must be familiar with the area method of landfill disposal concepts and daily operational requirements for the UWL in order to meet regulatory requirements on an on-going basis. This section provides a general overview of the area method of landfill disposal area operating procedures that will be followed by the landfill personnel.

4.2.1 UWL Disposal Operational Description

Utility waste CCPs from the Labadie Energy Center will initially be hauled by truck from the plant or the fly ash and bottom ash ponds to the active Phase of the UWL. Transportation will be on a new plant access road constructed to minimum elevation 486 to provide all weather access. Internal temporary roads will be constructed on the CCPs as needed in the active Phase to deliver the CCPs to the active working face. A bulldozer, tracked loader or other suitable earth moving equipment will be used to spread and compact the CCPs on the working

face.

The slope of the working face should not be steeper than 33% and the CCPs should be compacted in layers no greater than 2 feet in thickness. Generally, the disposal areas will be filled in vertical lifts 8 to 10 feet in height, with the waste confined to the smallest practicable area and compacted to the smallest practicable volume. The final landfill exterior side slopes will not exceed 33% slope (3:1, H:V). The vertical lifts will be staggered to promote stormwater runoff with minimal erosion and to provide easy truck access and traffic flow while maintaining an orderly sequence of fill within the active portion of the lined disposal area. The CCPs will be moisture conditioned to promote compaction and to provide dust control. The operator will add moisture to the CCPs deposited at the active working face by spraying water directly onto the waste as needed. If necessary, moisture content will be lowered by aerating the CCPs by disking or grading the CCPs on the working face.

The stormwater ponds as well as the perimeter ditch around each phase will provide storage for stormwater runoff management from closed and active disposal areas. Stormwater that has been in contact with CCPs in the disposal area will be collected and conveyed to the closest stormwater pond. Runoff will be utilized as described in Section 3.1.3.

4.2.2 Flood and Liquefaction Impact Mitigation Plans

The UWL is located in the floodplain of the Missouri river and will be protected first by an existing agricultural levee and second by perimeter flood protection berms. In the unlikely event that floodwaters exceed the agricultural levee and submerge the exterior of the perimeter berm surrounding active Phase of the UWL, the differential between the exterior flood water elevation and the interior CCP elevation creates potential uplift pressure on the bottom liner. Unmitigated, this pressure could damage the composite liner integrity. As described in detail in Section 3.3.2.2, CCP ‘ballast’ placed on top of the composite liner will effectively counterbalance and mitigate the potential uplift pressures during a flood event.

The ballast will be provided by in-place CCPs. The CCP ballast should be maintained no lower than 5.5 feet below the floodwater elevation outside the perimeter flood protection berm to counterbalance this uplift pressure.

For each Phase of development of the UWL, the operation plan is to accelerate the rate that CCPs are disposed in a newly constructed disposal area until the area is filled to elevation 478.5, 5.5 feet below the Base Flood Elevation. At an average daily disposal rate of 10,000 CY per day, the largest sub-area can be filled to elevation 478.5 in approximately 58 working days, or approximately 2 months. If a 100-year flood event is predicted early in the operational life of a newly constructed disposal area, the daily disposal rate will be increased to the extent required until the area is filled to elevation 478.5. In the event of an extreme emergency, the disposal area will be flooded with non-potable water to elevation 478.5 or higher to prevent uplift damage to the liner.

To protect the composite liner in the stormwater ponds from potential uplift, no more than 3.3 feet of differential hydrostatic uplift pressure will be allowed between the inside and outside of the berms (reference Appendix J). During a 100-year flood event (el. 484), the operating water level in the stormwater ponds will be maintained at el. 480.7. The maximum differential uplift pressure will be controlled by one 24-inch culvert pipe at approximate el. 472 through the perimeter berm of each pond to allow flood water to rapidly flow into the ponds. Each pipe will have a gate and check valve to prevent discharges from the pond during normal operating conditions. During a predicted significant flood event and once the level of the flood water on the exterior berm exceeds el. 473 the gate valves will be opened allowing the water inside the pond to equalize with the flood elevation on the perimeter berm exterior. When the water in the pond is high enough to mitigate the uplift pressure from an anticipated flood event, the gate valves will be closed to prevent discharge from the ponds.

As determined in Section 2.8.5, the UWL site is located within a seismic impact zone. Before sufficient fill has been placed to eliminate the risk of liquefaction, there is a slight risk of damage to the partially completed berms and composite liner that could result from the lateral spreading, settlement or formation of sand boils. The minimum threshold ground acceleration for this potential situation is 0.10g. Therefore, if a seismic event would occur with a ground acceleration greater than 0.10 g before sufficient berm or CCP fill had been placed, then an investigation will be completed to determine whether the composite liner has been damaged. This condition is discussed in more detail in Section 6.1.3 of Appendix J.

This investigation will be completed in stages. The initial stage will consist of an topographic survey of the perimeter berms in those areas indicated in Figure D-3 of Appendix J, as being potential areas of liquefaction. The survey will determine whether settlement or lateral movement has occurred. Also, the area outside of the perimeter berms will be visually examined for evidence of settlement, lateral movement and/or sand boils. If there is evidence of liquefaction from the initial investigation, then the bottom composite liner will be surveyed in the adjacent storm water pond, to compare with the final survey of the completed liner.

Under these circumstances, the composite liner in the adjacent storm water pond will also be examined for damage. If there is evidence of heave (due to sand boils), differential settlement or damage to the liner, then the final stage will be to remove CCP in the affected area of the cell to examine the composite liner for similar evidence of damage. Any damaged area of the composite liner will be removed and replaced.

4.3 Solid Waste Accepted

Solid wastes accepted and excluded at the UWL are regulated under 10 CSR 80-11.010(2) and (3) enforced by the MDNR's Solid Waste Management Program. Utility waste accepted at the landfill will meet both the state and county requirements for UWLs.

Utility waste will be accepted in accordance with the approved design and operational plan, with

no need for additional evaluation or consideration. By State regulation, UWLs may only accept: fly ash, bottom ash, boiler slag or other slag waste and flue gas emission control waste generated primarily from the combustion of coal or other fossil fuels. Clean fill may also be accepted. The byproduct materials produced by the FGD scrubber process are included in this list of acceptable wastes under the State regulations.

Access to the solid waste operation will be controlled by perimeter fencing with one (1) gated, primary access point near the northwest corner of Phase 1, as generally depicted on the drawings. There will be a minimum of two additional gated access points around the UWL that allow operation and maintenance personnel access to the UWL disposal areas. The final location and configuration of the all-weather access road into the Phase 1 disposal area will be determined by Ameren Missouri. In compliance with the state Solid Waste Management Regulations, a sign will be displayed at the entrance to the landfill containing the following information in letters at least two and one half (2.5) inches high and one-half (1/2) inches wide:

"LABADIE ENERGY CENTER

UTILITY WASTE LANDFILL

THE UTILITY WASTE LANDFILL WILL BE AVAILABLE FOR THE DISPOSAL OF ACCEPTABLE WASTES DURING HOURS OF ENERGY CENTER OPERATION.

EMERGENCY CONTACT: CALL THE OPERATING SUPERVISOR AT 314-992-8233.

THE UTILITY WASTE LANFILL IS OPERATED UNDER MISSOURI SOLID WASTE DISPOSAL AREA OPERATING PERMIT: NO. _____ ISSUED BY THE MISSOURI DEPARTMENT OF NATURAL RESOURCES.

THE UTILITY WASTE LANDFILL WILL ACCEPT WASTES GENERATED BY THE LABADIE ENERGY CENTER AND ALLOWED UNDER 10 CSR 80-11.010(2)(A), INCLUDING, BUT NOT LIMITED TO: FLY ASH, BOTTOM ASH, FLUE GAS SCRUBBER BYPRODUCTS, AND CLEAN FILL."

The normal hours of operation and emergency telephone numbers will also be posted. Normal operating hours are 24 hours per day, seven days a week, throughout the entire year Figure 3 provides a suitable entrance sign detail for the UWL delivery entrance at the northwest corner of Phase 1.

Operations personnel will control unauthorized access to the UWL. A record of all incidences of unauthorized access will be maintained in the UWL operating records. At the conclusion of each operating day, the UWL staff will lock the entrance gate to prohibit vehicle access when staff is not present.

4.4 Solid Waste Excluded

Phases 1 through 4 of the UWL are designed to accept only CCPs directly from the Labadie Energy Center. CCPs include fly ash, bottom ash, slag, FGD byproducts and clean fill generated by the Labadie Energy Center. The following materials will not be knowingly accepted for disposal at the landfill under any circumstances:

- Hazardous Waste, including PCB Waste
- Infectious Waste
- Municipal Solid Waste, including putrescible waste
- Yard Waste
- Any Appliances
- Lead-Acid Batteries
- Waste Oil
- Waste Tires
- Liquids or Semisolids
- Explosive, Flammable or Volatile Wastes
- Raw Animal Manure, Sewage Sludge or Septic Tank Pumpings
- Dead Animals

Any waste identified as unacceptable or as a special waste not previously approved in accordance with MDNR procedures will be not be accepted. In the UWL disposal operating areas, utility waste will be delivered by truck from the Ameren Missouri Labadie Energy Center. The likelihood of unacceptable waste being trucked to the disposal area is minimal. However, the disposal area equipment operator will visually screen incoming haul trucks as they unload at the active working face for unacceptable waste materials in their load. Trucks hauling unacceptable waste will not be allowed to unload and will be directed to return to the plant to manage the waste in accordance with the plant waste management practices. Unacceptable wastes inadvertently unloaded at the UWL active working face will be reloaded into empty trucks for return to the plant to be managed in the plant waste management system as appropriate.

4.5 Water Quality

The UWL will be managed to protect surface water and groundwater quality. The UWL has been designed as a no-discharge water management system for rainfall events below the 25-year, 24-hour storm event.

Surface stormwater runoff from the UWL will be collected and routed via the perimeter ditch to on-site stormwater ponds (discussed previously in Section 3.7). Stormwater will be managed to minimize erosion of all Phases of the active and closed UWL. During active operations, stormwater accumulated in the on-site stormwater ponds that cannot be reused on the UWL site for dust control or CCP moisture conditioning will be conveyed back to the Labadie Energy

Center for management through the NPDES permit. In the NPDES operating permit renewal application dated December 22, 2011, Ameren anticipated excess stormwater flows from the UWL will be routed through the plant and ultimately discharged through Outfall 002. Prior to beginning construction, Ameren will file appropriate NPDES permit modifications to assure timely receipt of the required authorizations. Copies of all future NPDES permit correspondence related to the UWL will be submitted to the Solid Waste Management Program.

Leachate collected in the leachate collection system (discussed previously in Section 3.9) will be temporarily stored in tanks located within the solid waste disposal boundary. Plan Sheets 6, 7, 8 and 9 show the general location of a single leachate storage tank for each cell, although there is sufficient room for several tanks at each location. Leachate will also be reused for ash conditioning, as a dust suppressant within the permitted boundary of the active disposal areas, or conveyed to the Labadie Energy Center for management.

Groundwater monitoring (discussed previously in Section 3.10) will be implemented throughout the operational life of the UWL, and following closure, to assure that environmental control systems related to water quality are functioning as designed, and that the groundwater is protected.

4.5.1 Stormwater Management

During the facility's operating life, stormwater will be collected in the perimeter ditch and routed to on-site stormwater ponds. The collected stormwater will be utilized as described in Section 3.1.3.

Stormwater controls were described in Section 3.7 and Appendix N. Temporary berms will be constructed to minimize erosion. Diligence in construction of temporary berms and ditches during active construction and operation of the landfill will assure that stormwater run-on will not contact the utility waste.

Stormwater runoff at the site is also controlled by the orderly and sequential operation of the landfill. The proposed final grading plan and stormwater structures will maintain site perimeter drainage patterns similar to the operating conditions, while dividing the completed landfill drainage patterns into smaller, manageable drainage areas. Side slope benches with slopes of approximately 1% constructed at approximate elevation 520 will convey stormwater from the upper portion of the 3:1 (H:V) side slopes to letdown structures.

Stormwater collected on top of the closed landfill will drain to strategically located perimeter letdown structures that convey it to the base of the landfill in a controlled manner. The stormwater runoff on the side slopes will be intercepted mid-slope by diversion benches and directed to permanent let down structures. The permanent let down structures will either flow into the perimeter ditch or over the top of the perimeter berm for release at the base of the

UWL.

Erosion control measures will be implemented during all periods of construction. A stormwater pollution prevention plan (SWPPP) will be developed and implemented as required by the site development land disturbance codes. A hardy vegetative cover will prevent erosion of final grades that are less than 33%. A hardy vegetative cover will also prevent erosion on final stormwater channels with slopes less than 2%. For stormwater channels with steeper grades and/or higher water velocities, riprap or commercially available erosion control products will be used to prevent erosion in the drainage ways. The completed portions of the landfill will be closed by phase within 180 days of reaching final elevation. Following landfill closure, uncontaminated stormwater runoff from the top and side slopes of the UWL will be discharged through a series of stormwater let down structures. The stormwater runoff will be directed over the perimeter ditch and perimeter berm and discharged at the exterior base of perimeter berm. Following proper closure, all uncontaminated stormwater runoff will be controlled and monitored to assure that state and county water quality standards are met.

4.5.2 Leachate Management in the UWL

A continuous leachate collection drainage layer will be installed on top of the composite liner system at the bottom of the waste disposal area in each Phase of the UWL. The leachate collection drainage layer will collect and convey leachate generated to a sump in each internal drainage area. Each sump will be accessed by a side slope riser discharge pipe placed on the interior slope of the perimeter berm and accessed at the top of berm. Each sump will be equipped with an automated submersible pump. Leachate removed from the active disposal area will be temporarily stored on-site in tanks and utilized as described in Section 3.1.3 and Section 3.9.2. The average annual quantities anticipated were estimated using the HELP model (reference Appendix O) and are summarized in Section 3.9.

4.5.3 Groundwater Sampling and Analysis Plan

The current state requirements for groundwater monitoring are contained in 10 CSR 80-11.010(11). A Groundwater Sampling and Analysis Plan is included as Appendix Q. The Groundwater Sampling and Analysis Plan can be removed and used as a separate document. Ameren Missouri will conduct routine groundwater sampling and analysis in accordance with the most current approved Groundwater Sampling and Analysis Plan for the UWL.

As previously described in Section 3.10.2, an existing agricultural irrigation well northeast of Cell 3 will remain operational during operation of the UWL, and when used, will operate at a reported estimated maximum rate of 1,200 gpm. This well will only operate periodically during periods of dry weather, typically for durations of up to four days. The periodic operation of this well will have unmeasurable impacts on the groundwater levels in the adjacent groundwater monitoring wells. It is recommended that groundwater sampling occur a minimum of 24 hours after the agricultural irrigation well was last operated to mitigate any potential impacts on the

adjacent groundwater monitoring wells. Refer to Appendix W(b) for the detailed analysis of the agricultural irrigation well impact.

4.6 Air Quality

Ameren Missouri does not anticipate that any additional air permits are required for the proposed utility waste disposal area. No open burning of waste is anticipated on the property, but appropriate permits and/or approvals will be obtained if it is determined that open burning will be required. The UWL operator will monitor the landfill site conditions to control unacceptable air emissions and take appropriate action when necessary to apply control measures such as adding moisture to work areas for dust control.

4.6.1 Dust Control

Dust control requirements for UWL operation will be minimal. By its nature, the moisture conditioned CCPs will not generate significant fugitive dust emissions during transportation, placement or compaction. The CCPs tend to solidify as they dry out, limiting susceptibility to wind erosion, and, when exposed to precipitation, forms a crust which aides in limiting wind erosion. The primary source of CCP dust will be disturbance from vehicular traffic on interior access roads. When necessary, the internal access roads will be watered and/or stabilized to minimize fugitive dust emissions.

The site access road will be used exclusively to provide access to the landfill and affiliated operations. Perimeter roads at the top and toe of the perimeter flood protection berms will be surfaced with limestone gravel. CCPs transported to the disposal area by truck will be moist to prevent dusting from excessive dryness. The surface of access roads from the plant to the active disposal will be stabilized and maintained as necessary to limit the amount of fugitive dust that can become airborne during hauling operations. Stormwater and leachate will be available for moisture conditioning of UWL, on-site roads, traffic areas and work areas inside the utility waste boundary limits to control dusting during all phases of construction and operation, including mining activities, if and when allowed.

4.7 Aesthetics

The aesthetic condition of the landfill does not impact its ability to protect the environment or the public health. However, the aesthetics do impact the public perception of the landfill. Ameren Missouri will be attentive to site conditions that may become aesthetically unpleasing and will implement actions to mitigate the conditions.

4.7.1 General Aesthetics

The landfill is located in a rural area. It is bordered by agricultural and limited residential areas to the east, and south, and the Ameren Missouri Labadie Energy Center to the west. The overall appearance of the landfill will not detract from the agricultural activities of adjacent

property owners, and care will be taken to maintain the existing aesthetics of the area. Vegetative growth will be established on the UWL as discussed in Section 3.12.

4.7.2 Mining for Beneficial Reuse

Any future mining operations for the purpose of removing CCP materials from the UWL for beneficial reuse will be conducted so as not to impact the integrity of the UWL containment system or detract from the general aesthetic of the landfill. Dust control and suppression measures will be implemented as needed during mining activities. Future mining activities of any in-place CCPs will not commence without the written notification and consent of MDNR.

4.8 Equipment and Staffing

The proper implementation of the landfill design and operation requires appropriate equipment and staffing. The equipment and staffing requirements will vary based in part on the volume of CCPs generated by Ameren Missouri. Design features requiring significant construction, such as Phase development, composite liner and leachate collection systems installation and final cover construction, are planned in increments that facilitate utilizing outside contractors to minimize full time equipment and staffing needs.

4.8.1 Primary Equipment

Staffing levels will be adjusted based on the actual volume of waste received. Additional equipment will be leased or purchased, as necessary, should the actual waste volumes received significantly exceed the projected waste volumes.

Equipment supports two main activities: daily landfill operations and closure of sections of the landfill that have reached final grade. In addition, various support activities require heavy equipment. Preparation and construction of the liner and leachate collection system will require additional heavy equipment for the grading, transport, placement, and compaction of construction soil materials. Closure activities require movement, spreading and compacting of soil materials. Agricultural equipment will be needed periodically for preparation of the seedbed for establishing vegetation.

The type and amount of equipment owned by Ameren Missouri will be dependent upon the amount of soil-moving activities contracted through third parties. Equipment for daily landfill operations will be either owned or leased. The management of the Labadie Energy Center will be responsible for the ongoing operation and maintenance of the UWL. It is anticipated that third party contracting will be utilized for initial excavation, liner and leachate collection system construction, final cover placement, grading and seeding.

The following types of equipment may be used on-site for daily operations:

- CAT D-7 Bulldozers, or equivalent

- CAT 953 Tracked Loaders, or equivalent
- Water Trucks (up to 3,000 gallons)
- Four Wheel Drive Pick-Up Trucks
- Pull Behind Pan Scrapers, or equivalent

Each piece of equipment shall be equipped with a fire extinguisher.

This equipment is capable of meeting the daily operation needs for the anticipated volume and operating conditions. As capacities increase, additional soil moving capabilities can be leased or subcontracted, as needed.

Initial site preparation and excavation, liner construction and closure activities may increase the equipment needs of the landfill. Site preparation, liner construction and closure activities will require soil excavation, movement and compaction equipment. Excavation of materials from borrow areas may require track-type dozers and self-propelled scrapers. Final cover construction for closure will require additional equipment such as pads foot rollers or wheeled compactors, a mobile water tank, and an industrial disc or scarifier. Establishment of vegetation will require standard farm equipment, such as tractors, discs and seeders.

The equipment selected for daily operation allows the landfill the flexibility to perform at least some of the closure activities with existing equipment and labor. The landfill will add additional equipment and labor or utilize outside contractors to complete the area preparation and closure. The option selected will depend on factors including economics, quality control, time, and availability of labor and equipment.

If Ameren Missouri decides to perform the individual closure activities internally, the previously mentioned equipment will be added as necessary to supplement the landfill equipment required for daily operation. If all or parts of the closure activities are performed by the landfill, it will have the necessary personnel and equipment. If a contractor is utilized, the contractor will be required to have the necessary experience, personnel and equipment.

4.8.2 Equipment Maintenance

Ameren Missouri staff will perform routine equipment maintenance work and the majority of the repair work. The recommended maintenance programs of the equipment manufacturers will be followed to minimize equipment downtime. Portable service trucks will maintain equipment through fueling, engine oil changes, hydraulic oil changes and lubrication.

A preventative maintenance program will be implemented for the landfill equipment to minimize equipment failure and maximize equipment life. The preventative maintenance program will only be applicable to equipment owned by Ameren Missouri. Leased equipment will be maintained under a service contract with the owner. Maintenance of all equipment belonging to an off-site contractor will be the responsibility of the contractor.

The recommended preventative maintenance program consists of a three-part program including procedures for following the equipment manufacturer's maintenance recommendations, development of a maintenance and repair log for each piece of equipment, and performing scheduled evaluations of the equipment by company maintenance personnel and an equipment dealer.

Landfill equipment maintenance personnel will log equipment hours to implement scheduled maintenance activities. The scheduled maintenance activities will be in accordance with the equipment manufacturer's recommendations. The logs will be checked at the beginning of each week and the appropriate maintenance activities scheduled.

A log will be maintained for each item of equipment. The log will include dates of repairs and maintenance, equipment hours, and descriptions of repairs and maintenance activities. Specific notes of interest concerning the equipment will be included in the log. The history developed in the log will help in scheduling major maintenance and repair.

An evaluation of each item of equipment will be performed on a scheduled basis. At a minimum, the evaluations of each item of equipment will consist of the following:

1) **Daily**
   The equipment operator will:
   - Check for leaks, broken parts, or excessively worn parts;
   - Perform minor maintenance such as fueling, lubrication and cleaning of undercarriage; and
   - Observe overall condition of equipment.
2) **Weekly**
   - Landfill equipment maintenance personnel will perform a more thorough overall evaluation of equipment for needed repairs and maintenance.
3) **Semi-Annual**
   - Landfill equipment maintenance personnel will perform a detailed evaluation of the equipment for minor and major repairs and/or maintenance. This evaluation will be part of a scheduled maintenance activity.
4) **Annual**
   - An equipment dealer or competent mechanic will perform a detailed evaluation of the equipment. An evaluation of necessary major repairs will be made at this time. Major repairs will be scheduled and timely performed.

4.8.3 Back-Up Equipment

Backup equipment is needed at the UWL for grading the utility waste and movement and placement of soil cover during periods when a piece of primary equipment is out of service. The service agreements for leased equipment typically provide for replacement equipment if repairs take more than three (3) days to complete.

It is not necessary to have an active agreement with an equipment dealer to provide equivalent substitute equipment in case of emergency for two (2) reasons. First, the Labadie Energy Center has redundant pieces of equipment for use in most emergency situations. Second, the landfill's proximity to the St. Louis metropolitan area assures an adequate supply of equipment dealers and contractors who are willing and able to supply equipment to the landfill on short notice. Substitute equipment from local suppliers can typically be available within twenty-four (24) hours to provide uninterrupted service at the landfill.

4.8.4 Staffing

Based on the anticipated volumes of waste received during the first year or more of operations, the anticipated staffing level includes:

- Landfill Manager/Operator
- Two (2) Landfill Equipment Operators
- One (1) General Equipment Operator

At a minimum, one heavy equipment operator will be required for the UWL landfill area method of disposal, and one operator is needed for traffic control and truck spotting at the open working face, and dust control and general site maintenance and upkeep. Part-time, general laborers and contractors will be utilized, as needed, to meet additional operational needs of the landfill. General Job titles and duties of landfill personnel are summarized as follows:

- Landfill Manager; responsible for daily operations of the landfill, overall responsibility for operation and maintenance of heavy equipment and overall landfill compliance. The person in this position shall be a Certified Solid Waste Technician and trained in the identification of unacceptable wastes.

- Landfill equipment operator/spotter; a landfill excavator operator/spotter responsible for grading utility waste and identifying and removing unacceptable waste. These positions will be managed by the Landfill Manager. Although not required, it is recommended that persons in this position be a Certified Solid Waste Technician trained in the identification of unacceptable wastes. Staff in these positions can serve in the role of landfill Manager during the manager's temporary absence.

- General equipment operator; a general equipment operator is responsible for operation and maintenance of various types of equipment and other duties under the direction of the Landfill Manager. This person also acts as a substitute equipment operator. Although not required, it is recommended that persons in this position be a Certified Solid Waste Technician trained in the identification of unacceptable wastes.

- General laborer; a laborer will be available for duties as assigned to assure the landfill operates in compliance with state and county requirements.

The landfill manager and at least one other employee of the landfill will be Certified Solid Waste Technicians. The second Certified Solid Waste Technician will be qualified to serve the role of landfill manager during the manager's absence. At a minimum, the landfill manager, excavator operator and other staff working on the active landfill will be trained in the identification of unacceptable wastes.

The anticipated staffing levels, combined with equipment specified for the projected maximum CCP disposal, provide the basis for a complete and efficient operation. If it is determined to permanently or temporarily add heavy equipment at the site due to increased waste volume or landfill area preparation or closure activities, additional equipment operators may be necessary.

4.9 Final Cover Material

Final cover material will be obtained from stockpiles of vegetative soil initially stripped from within the UWL footprint. The quantity and quality of available final cover material is addressed in Section 3.11. The soils required for final cover are generally characterized as a vegetative soil. Soil stockpiles will never be located on top of any constructed final cover, and will always be situated so that they do not impede stormwater drainage. If the stockpiles will be idle for more than thirty (30) days, they will be seeded with a temporary vegetative cover to minimize sediment discharge with stormwater runoff. Additional Best Management Practices will be implemented for soil stockpiles, as required to control erosion and sedimentation. All on-site and off-site areas used for soil borrow will be regraded, seeded, fertilized, and mulched for reclamation when they are no longer in use.

Construction of the final cover system is detailed in Section 3.12. The final cover on areas with slopes less than 5 percent will consist of a single-sided textured 40-mil geomembrane liner, overlain by a 16 oz/yd2 non-woven, needle-punched geotextile, covered with two (2) feet of nominally compacted soil. On the exterior side slopes of the UWL, the final cover design will consist of a textured, 40-mil geomembrane liner, overlain by a 16 oz/yd2 non-woven, needle-punched geotextile, covered with two (2) feet of nominally compacted soil capable of supporting the final vegetative cover. The top 24 inches of soil material for the top and side slopes of the UWL will be nominally compacted to enhance its ability to support vegetation on the final cover.

Completion of the final cover will require proper weather conditions. In general, when approximately forty (40) acres are filled to within two (2) feet of the final elevation, construction of that section of final cover will be scheduled as soon as practical. Whenever possible, construction will be timed to coincide with a time of year conducive to establishing vegetation. Liming, fertilizing, seeding and mulching will be completed as soon as practical after construction of a portion of the final cover. A minimum seeding rate of seventy-five (75) lbs/acre of the specified seed mixture will be applied. In any case, vegetation will be established within 180 days of reaching final elevations.

Silt fence, straw bales or other acceptable Best Management Practices will be used during the

initial establishment of vegetation. Any areas that have settled, are severely eroded, or on which previously planted vegetation did not survive will be recovered, regraded or reseeded, as necessary, to maintain cover slope and integrity.

All of the proposed landfill slopes are designed to be no steeper than 3:1 (H:V) to accommodate slope maintenance (e.g., erosion repair, reseeding and mowing).

The erosion evaluation of the final grading plan indicates that only one stormwater diversion bench is required on the exterior side slopes of the landfill to provide managed and controlled removal of precipitation runoff from the completed landfill while controlling erosion. The spacing of the diversion bench is designed to provide a stable 3:1 slope for easy maintenance of the final cover. None of the final side slopes are designed to exceed 3:1 maximum. The diversion bench is designed to carry stormwater off the landfill while minimizing erosion of the drainage channels (Appendix N). The design details for the final stormwater drainage plan are discussed in Section 3.7.

If establishing vegetation and stabilizing the slopes is difficult to maintain after closure, small, temporary diversion berms will be constructed with mulch or other suitable materials in the problem area perpendicular to the flow of water. These temporary diversion berms can be constructed to drain at an approximate 1% slope to the nearest stormwater let down structure. The construction of the small, temporary diversion berms will further reduce the length of the side slopes of the landfill, further decreasing erosion of the final cover.

Small quantities of the soil materials to be used for final cover will be stockpiled in temporary locations strategically located out of the way of ongoing operations and final cover.

After the facility is closed, the final cover will be inspected quarterly for stressed vegetation, poor vegetative coverage and erosion of final cover. The vegetative cover shall be routinely maintained to promote a healthy vegetative cover and to prevent the growth of trees. As necessary and indicated by the quarterly inspections, the soil will be tested to determine if fertilizer or other nutrients are recommended to improve the vegetative cover. Areas that have become eroded or lack hardy vegetative cover will be repaired with additional soil, fertilizer and/or seed.

4.10 Compaction

The UWL disposal area will require a minimum of one dozer to spread and compact the CCPs as received by truck haul on a daily basis. Spreading the waste in a layer not more than two (2) feet thick on a 3:1 slope and making two to three passes with the dozer should provide sufficient compaction of the CCPs to form a stable lift of waste eight (8) to ten (10) feet thick (vertically). Moisture conditioning will be used as needed to optimize spreading and compaction and to prevent dusting.

4.11 Safety

Routine vehicular access to the landfill for delivery of CCPs will be limited to one gated access point. The primary gate for the disposal process is located at the northwest corner of Phase 1, as shown on the drawings. Visitors and CCP haul trucks will use this access point. The primary access gate will be locked when the landfill is not open. Two additional secondary gated access points are planned. The secondary access points will be limited to landfill staff and Ameren Missouri personnel. These access gates will be locked whenever not in use.

Fire extinguishers will be located on all landfill equipment. Communication equipment used at the landfill will consist of two-way radios. Two-way radios will be assigned to personnel, not equipment. This ensures all staff has communication equipment on their person at all times and provides direct access to the Ameren Missouri Labadie Energy Center office. Appendix S contains a list of agencies, individuals and telephone numbers for emergency contact.

4.12 Records

The landfill will maintain the documents and records required by state and county regulation. Records will be maintained on-site at the plant offices for a minimum of five (5) years. After records are over five (5) years old, they may be retained at an alternate site, but will be made available to MDNR representatives upon request.

At a minimum, the following records will be kept as per 10 CSR 80-11.010(17):

- Major operational problems, complaints, or difficulties
- Groundwater monitoring results
- Any demonstrations, certifications, finding, monitoring, testing or analytical data required under 10 CSR 80-11.010(9)
- Dust control efforts
- Quantitative measurements of the waste handled and an estimate of the air space remaining in the landfill. These measurements are to be submitted by January 31 in even-numbered years.
- Closure plans and other information, as required under 10 CSR 80-2.030(4)(A)
- Closure cost estimates and financial assurance documentation, as required under 10 CSR 80-2.030(4)(B) and (C)
- Inspection records, training procedures and documentation of training, as required under 10 CSR 80-2.060 and 10 CSR 80-11.010(3)(B)
- Records associated with any future corrective measures, as required by 10 CSR 80-11.010(11)

Logbooks, ledgers and reporting forms will be utilized at the landfill site to record daily events. Example recordkeeping and reporting forms for use by the landfill are provided in Appendix T.

The landfill will conduct a photogrammetric topographic survey at least once every two years to

accurately determine the volume of waste disposal. Within 60 days of the anniversary date of the permit and following the topographic survey, two copies of a topographic map prepared under the direction of a registered land surveyor will be submitted to MDNR. The topographic contour maps shall conform to the specifications outlined in 10 CSR 80-11.010(17)(C)1.D.