Appendix K

Soil Material Volume and
Balance Calculations
Revised August 2013

Ameren Missouri Labadie Energy Center
Construction Permit Application for a
Proposed Utility Waste Landfill
Franklin County, Missouri

December 2012, Revised August 2013

Appendix K
Soil Material Volume and Balance Calculations

Appendix K contains calculations of soil needed (required) for construction of the Ameren Missouri Labadie Energy Center Utility Waste Landfill (UWL), and the soil available on-site for the construction. Soil is required for construction of the four general components of the UWL: perimeter berms; liner system; intermediate cover; and final cover system. Operational cover (intermediate) is proposed based on the characteristics of the coal combustion products (CCPs) that will be placed in the UWL.

The perimeter berms are designed with 3:1 side slopes, with a typical berm height of 23 feet, and a 12-foot wide access road on top of the berm. The exterior perimeter berm slopes will be lined with a 2.2-in thick, fabric-formed articulated concrete mat. A 2-feet thick compacted clay liner will be placed on the inside slope of the berm to tie-in with the landfill liner in each phase.

The UWL's final cover system will be two (2) feet of nominally compacted soil capable of sustaining vegetation, underlain by a geotextile cushion, which is underlain by a geomembrane liner.

Three general soil types will be used for construction of the UWL components: Liner-quality, non liner-quality, and vegetative soil. Liner-quality soil describes clayey soils that would meet the requirements of 10 CSR 11.010(10)(B)1 for the landfill liner. Non liner-quality soil describes low plastic clayey soil, silty soils, or sandy soils present at the site. Non liner-quality soils would not be suitable for the landfill liner, but would be used for the construction of the core of the perimeter berms. Vegetative soil describes soils that are capable of sustaining vegetation for the UWL final cover or the outside slopes of the perimeter berms.

The following table summarizes the pertinent acreages and berm volumes for each utility waste landfill component. The acreages and berm volumes were determined from the AutoCAD drawings that depict the three storm water ponds and the layout of the four disposal phases.

UWL Component	Design Parameters	Notes/Comments
Phase 1	Cell 1: 31.4 acres	Stormwater Pond 1: 5.7 acres
Phase 2	Cell 2: 35.2 acres	

Phase 3	Cell 3: 57.1 acres	Stormwater Pond 2: 4.4 acres
Phase 4	Cell 4: 42.8 acres	Stormwater Pond 3: 3.4 acres
Total Permitted Disposal Area	**166.5 acres**	**Includes Cells 1 through 4, excludes the Stormwater Ponds.**
Stormwater Pond 1	5.7 acres	Area at 488' contour
Stormwater Pond 2	4.4 acres	Area at 488' contour
Stormwater Pond 3	3.4 acres	Area at 488' contour
Total Area for Excavation	**180.0 acres**	**Includes Phases 1 through 4 and the Stormwater Ponds.**

Final "Top of Landfill" Area	73.7 acres	Final "flat" top of UWL at closure.
Final "Exterior Side Slopes" Area	92.8 acres	Final slopes at closure.
Total Final Area for Closure	**166.5 acres**	**Total Acreage Requiring Final Cap**

All calculated volumes of soil, both needed and available, are rounded up to the nearest 1,000 yd^3.

The total soil balance for Phases 1 through 4 and the three stormwater ponds, for clay liner, final cap (top and side slopes), and all perimeter berms, reveals a total soil shortage of 2,750,000 CY of on-site soils within the foot print of Phases 1 through 4 and the three stormwater ponds.

Soils available: 1,260,000 CY

Soils needed: (perimeter berms, liner, intermediate and final cover): 4,010,000 CY

Net soil balance for the landfill: -2,750,000CY

An estimated 2,600,000 CY of liner-quality soil is available from a borrow area in Callaway County on property owned by Ameren Missouri. This is greater than the 639,000 CY of liner-quality soil needed. A contractor will supply additional soil for berm core fill and vegetative cover.

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Note: All calculated volumes are rounded to the nearest 1,000 CY.
Stripping depth of 1.63 ft is the required minimum for volume of final cover.
Soil balance calculations utilized the minimum stripping depth required.
Stripping depth of 1.75 ft is recommended.

Lifetime Construction: Phases 1 through 4 and Stormwater Ponds

ESTIMATE OF TOTAL SOIL NEEDED

ESTIMATE OF NOMINALLY COMPACTED FINAL COVER SOIL NEEDED

SOIL TYPE REQUIRED: Vegetative

Volume (CY) = Area (AC) x 43,560 SF/AC x 2 ft x 1.1 [shrinkage factor] / 27 CF/CY

Total Area	166.5 AC		
Total Volume of 2 ft Nominally Compacted Final Cover	166.5 AC=	**591,000 CY**	

ESTIMATE OF UWL LINER SOIL REQUIRED

SOIL TYPE REQUIRED: Liner Quality

Volume (CY) = Area (AC) x 43,560 SF/AC x 2 ft x 1.1 [shrinkage factor] / 27 CF/CY

Disposal Areas	166.5 AC=	**591,000 CY**	
Pond Areas	13.5 AC=	**48,000 CY**	
Total Area	180.0 AC		
Total Volume of 2 ft Liner for Disposal Area and Ponds	180.0 AC=	**639,000 CY**	

ESTIMATE OF GENERAL FILL NEEDED UNDER UWL

SOIL TYPE REQUIRED: Non-Liner Quality

From CADD cut/fill volumes - design grade to existing grade.

Volume of General Site Fill Under UWL & Pond Floors **780,000 CY**

ESTIMATE OF PERIMETER BERM CORE FILL SOIL NEEDED

SOIL TYPE REQUIRED: Non-Liner Quality

From CADD cut/fill volumes - design grade to existing grade, less 2-ft clay liner on slope.

Phase 1	204,115 CY
Phase 2	165,531 CY
Phase 3	393,858 CY
Phase 4	293,945 CY
Pond 1	99,269 CY
Pond 2	93,713 CY
Pond 3	65,730 CY
Total Perimeter Berm Volumes	**1,316,162 CY**

ESTIMATE OF GENERAL FILL NEEDED TO REPLACE 1.63' STRIPPING UNDER UWL

SOIL TYPE REQUIRED: Non-Liner Quality

Volume (CY) = Area (225 AC) x Depth (1.63 ft) x 43,560 SF/AC / 27 CF/CY

Volume of Fill to Replace 1.63-ft Stripping in Construction Footprint **592,000 CY**

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ESTIMATE OF INTERMEDIATE COVER (IC) NEEDED

SOIL TYPE REQUIRED: Non-Liner

Assumes reuse of IC and maxium area requiring IC < 57 AC
Volume (CY) = Area (57 AC) x Depth (1 ft) x 43,560 SF/AC / 27 CF/CY

Volume of Intermediate Cover	**92,000 CY**

ESTIMATE OF TOTAL SOIL NEEDED

Intermediate Cover	
Volume of Intermediate Cover Soil Needed	**92,000 CY**
Liner and Cover Systems	
Volume of Final Cover Soil Needed	591,000 CY
Volume of Liner Soil Needed	639,000 CY
Total Needed for Liner and Final Cover Systems	**1,230,000 CY**
General Fill and Perimeter Berm Soil Needs	
Volume of General Site Fill Under UWL & Pond Floors	780,000 CY
Volume of Perimeter Berm Core Fill Soil Needed	1,316,000 CY
Volume of 1.63-ft. Stripping Replacement	592,000 CY
Total Needed for General Fill and Perimeter Berm	**2,688,000 CY**
Estimated Total Volume of Soil Needed	**4,010,000 CY**

ESTIMATE OF SOIL-SPECIFIC REQUIRMENTS

Volume of Liner Quality Soil Needed	639,000 CY
Volume of Vegetative Quality Soil Needed	683,000 CY
Volume of Non-Liner Quality Soil Needed	2,688,000 CY
Estimated Total Volume of Soil Needed	**4,010,000 CY**

ESTIMATE OF TOTAL SOIL AVAILABLE

Assumes 1.63 ft of vegetative soil will be excavated from the 225 AC area, 5% swell.

Liner Quality Soil to be Excavated from the Construction Footprint	0 CY
Vegetative Soil to be Excavated from the Construction Footprint	621,000 CY
Non-Liner Quality Soil to be Excavated from the Construction Footprint	0 CY
Total Soil to be Excavated from the Construction Footprint	**621,000 CY**
Liner Quality Soil to be Excavated from the Borrow Area	639,000 CY
Made to equal liner soil needed. No surplus from borrow inclued	
Vegetative Soil to be Excavated from the Borrow Area	0 CY
Non-Liner Quality Soil to be Excavated from the Borrow Area	0 CY
Total Soil to be Excavated from the Borrow Area	**639,000 CY**
Volume of Liner Quality Soil Available	639,000 CY
Volume of Vegetative Soil Available	621,000 CY
Volume of Non-Liner Quality Soil Available	0 CY
Total Soil Available	**1,260,000 CY**

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SOIL BALANCE FOR PHASES 1 THROUGH 4 AND THE STORMWATER PONDS

TOTAL SOIL BALANCE		
Estimated Volume of Soil Needed	4,010,000	CY
Estimated Volume of Soil Avaiable	1,260,000	CY
Soil Balance	**-2,750,000**	**CY**
SOIL SPECIFIC BALANCE		
Estimated Volume of Liner Quality Soil Needed	639,000	CY
Estimated Volume of Liner Quality Soil Available	639,000	CY
Liner Quality Soil Balance	**0**	**CY**
Estimated Volume of Vegetative Soil Needed	683,000	CY
Estimated Volume of Vegetative Soil Available	621,000	CY
Vegetative Quality Soil Balance	**-62,000**	**CY**
Estimated Volume of Non-Liner Quality Soil Needed	2,688,000	CY
Estimated Volume of Non-Liner Quality Soil Available	0	CY
Non-Liner Quality Soil Balance	**-2,688,000**	**CY**
LANDFILL SYSTEMS BALANCE		
Estimated Liner Quality Soil for Liner Needed	639,000	CY
Estimated Liner Quality Soil for Liner Available	639,000	CY
Liner and Cover System Liner Quality Soil Balance	**0**	**CY**
Estimated Volume of Vegetative Soil for Cover Systems Needed	683,000	CY
Estimated Volume of Vegetative Soil for Cover Systems Available	621,000	CY
Cover Sytem Vegetative Soil Balance	**-62,000**	**CY**
GENERAL FILL AND PERIMETER BERM BALANCE		
Estimated Volume of General Fill and Permieter Berm Core Fill Needed	2,688,000	CY
Estimated Volume of General Fill and Permieter Berm Core Fill Available	0	CY
General Fill and Perimeter Berm Core Fill Balance	**-2,688,000**	**CY**