COAL ASH IMPOUNDMENT SITE ASSESSMENT FINAL REPORT

SUBMITTED TO:

LAKE ROAD GENERATING STATION
KCP&L Greater Missouri Operations Company
ST. JOSEPH, MISSOURI

KLEINFELDER

October 2011

COAL ASH IMPOUNDMENT
SITE ASSESSMENT REPORT

Lake Road Generating Station
KCP&L Greater Missouri Operations Company
St. Joseph, MO

Prepared by:

KLEINFELDER
Bright People. Right Solutions.

611 Corporate Circle, Suite C
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KLEINFELDER PROJECT NUMBER 116664-2

October 12, 2011

I acknowledge that the management units referenced herein:

- Coal Combustion Byproduct (CCB) Pond System consisting of:
  - Coal Pile Run-off Pool (Northwest Ash Pool)
  - Slag Settling Pool (Northeast Ash Pool)
  - Interim Settling Basin (Southwest Settling Basin)
  - Final Settling Basin (Southeast Settling Basin)

Were assessed on March 2, 2011

STATE OF MISSOURI
JEFFREY G. HOFFMAN
NUMBER
PE-2005029616
10-12-11
PROFESSIONAL ENGINEER

Signature: ______________ Date: 10-12-11

Jeffrey G. Hoffman, P.E.
Lead Geotechnical Engineer

EXECUTIVE SUMMARY

Background information taken from the U. S. Environmental Protection Agency's (EPA's) website:

> "Following the December 22, 2008 dike failure at the TVA/Kingston, Tennessee coal combustion waste (CCW) ash pond dredging cell that resulted in a spill of over 1 billion gallons of coal ash slurry, covered more than 300 acres and impacted residences and infrastructure, the EPA is embarking on an initiative to prevent the catastrophic failure from occurring at other such facilities located at electric utilities in an effort to protect lives and property from the consequences of a impoundment or impoundment failure of the improper release of impounded slurry."

As part of the EPA's effort to protect lives and the environment from a disaster similar to that experienced in 2008, Kleinfelder was contracted to perform a site assessment at the Lake Road Generating Station that is owned and operated by KCP&L Greater Missouri Operations Company. This report summarizes the observations and findings of the site assessment that occurred on March 2, 2011.

The Response Letter to the EPA's Section 104(e) Request for information is presented in Appendix C. This letter addresses two units "Settling Pond" and "Slag Settling Pond." However, based on observations made during the site visit, it appears the CCB Ash Pond functions as one ash pond separated into four pools; therefore, Kleinfelder only considered the outer embankment of the CCB Ash Pond, disregarding the interior dike between the northeast and northwest pools and the filter dikes between the northern pools and the southeast and southwest pools. The coal combustion waste impoundments observed during the site assessment included:

Coal Combustion Byproduct (CCB) Pond System constructed in 1967 and modified in 1977.

- Coal Pile Run-off Pool (Northwest Ash Pool)
- Slag Settling Pool (Northeast Ash Pool)
- Interim Settling Basin (Southwest Settling Basin)
- Final Settling Basin (Southeast Settling Basin)

Preliminary observations made during the site assessment are documented on the Site Assessment Checklists presented in Appendix A. A copy of this checklist was transmitted to the EPA following the field walk-through. A more detailed discussion of the observations is presented in Section 4, "Site Observations."

The Ash Pond impoundment is not regulated by any state agency and therefore does not currently have a designated hazard rating. Failure at this impoundment would likely be contained on KCP&L property and the environmental and economic losses should be low. It is recommended that a Hazard Classification of “Low” be assigned to the impoundment.

Overall, the site is reasonably well maintained and operated with few areas of concern as discussed in Section 6, “Recommendations.”

On the date of this site assessment, there appeared to be no immediate threat to the safety of the impoundment embankments. No assurance can be made regarding the impoundments condition after this date. Subsequent adverse weather and other factors may affect the condition.

A brief summary of the Priority 1 and 2 Recommendations is given below. A more detailed discussion is provided in Section 6, “Recommendations.”

Priority 1 Recommendations

1. None. The impoundment appeared to be in satisfactory condition.

Priority 2 Recommendations

1. Repair erosion on landside embankment west of the Interim Settling Basin.
2. Perform an internal video inspection of the outlet conduit at least once every five years.
3. Update O&M Manual to provide maximum dredging elevation.
4. Continue to update EAP and O&M Manuals.
5. Develop an Interim Pool Elevation Monitoring Program during storm events.

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SECTION 1 – INTRODUCTION

1.1 General

This report has been prepared for the United States Environmental Protection Agency (EPA) to document findings and observations from a site assessment at the Lake Road Generating Station on March 2, 2011.

The following sections present a summary of data collection activities, site information, performance history of the facility's impoundments, a summary of site observations and recommendations resulting from the site assessment.

1.2 Project Location

The Lake Road Generating Station is located on the southeast bank of the Missouri River in Buchanan County, Missouri. The station is located on the southwest side of the Town of St Joseph, Missouri at Latitude 39^{o} 43' 23'' N and Longitude 94^{o} 52' 43'' W, as shown in Plate 1. It should be noted that the ash pond is located within the levee critical area (LCA), which is defined by the United States Corp of Engineers as the area within 300 feet and 500 feet of the levee centerline on the wet and dry sides of levee, respectively.

1.3 Site Documentation

KCP&L Greater Missouri Operations Company provided the following documents during the time of this inspection to aid in the review of the impoundments:

- KCP&L GMO Lake Road Generating Station Ponds, Available Information Checklist, Coal Combustion Waste Impoundment (CCWI) Dam, March 2, 2011.
- Request for Information under Section 104(e) of the Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C. 9604(e), July 28, 2009.
- Compaction Testing, Kansas City Testing Laboratory, November 7, 1977.
- Nuclear Gauge Results prepared for Black and Veatch by Kansas City Testing Laboratory, June 12, 1978.
- Missouri State Operating Permit # MO-0004898, June 13, 2003.

- St Joseph Light and Power Company, Structural Ash Storage Plan and Details, prepared by Black and Veatch, Drawings S1601 and S1602, October 12, 1977.

- Boring Logs, Soil Testing Services of Iowa Inc., February 5, 1975.

- KCP&L Lake Road, Emergency Response Action Plan, February 2011.

- URS, Geotechnical Evaluation Ash Pond – KCP&L Greater Missouri Operations Company, Lake Road Generating Station, dated February 2011.

- State of Missouri, Department of Natural Resources, 2008 Inspection Report, March 7, 2008.

- Google Earth, Lake Road Generating Station Aerial Property Map, 2010.

- United States Geological Survey, Lake Road Generating Station Aerial Property Map.

- Lake Road Generating Station, Coal Combustion Product Storage Ponds, Operation and Maintenance Plan, February 22, 2011.

- Lake Road CCB Pond Freeboard Checklist, February 26, 2011.

- Lake Road CCB Pond Inspection Checklist, February 23, 2011.

- Environmental Protection Agency, Steam Electric Questionnaire, Part D – Pond/Impoundment Systems and other Wastewater Treatment Operations.

All documents were provided in a compact disc (CD) titled Lake Road Generating Station Pond Assessment, dated March 2, 2011.

SECTION 2 – SITE ASSESSMENT

2.1 Attendees

The site assessment was performed on March 2, 2011 by Jeff Hoffman, P.E. and Brad Piede, E.I.T. of Kleinfelder. Other persons present during the site assessment included:

- Paul Ling, PE – KCP&L
- Mark Howell – KCP&L
- Steven Brooks – KCP&L
- Jim Parker – KCP&L
- Charlie Bruce – KCP&L

2.2 Impoundments Inspected

Impoundments and associated structures that were observed during the site assessment included:

Coal Combustion Byproduct (CCB) Ash Pond consisting of:

- Coal Pile Run-off Pool (Northwest Ash Pool)
- Slag Settling Pool (Northeast Ash Pool)
- Interim Settling Basin (Southwest Settling Basin)
- Final Settling Basin (Southeast Settling Basin)

Observations from the site assessment are documented on the Site Assessment Checklists presented in Appendix A. A summary of observations from the site assessment is presented in Section 4.

2.3 Weather During Assessment

During the assessment of the Lake Road Generating Station impoundment, the weather was mostly sunny and temperatures ranged from 30^o to 35^o F. Wind speed ranged from 10 to 20 miles per hour (mph).

SECTION 3 – SITE INFORMATION AND HISTORY

3.1 Site Information and History

3.1.1 General

The Lake Road Generating Station is a coal-fired power generating facility. The facility currently sluices slag, residual fly ash, and other materials into the CCB Ash Pond. The CCB Ash Pond is a system of four pools consisting of two ash pools (northeast and northwest) and two settling basins (southeast and southwest). The Slag Settling Pool is the northeast pool and is used to settle slag waste from slurry discharge. The Coal Pile Run-off Pool is to the northwest and is used to detain rainwater run-off from the coal fuel pile, sluiced residual fly ash, and concentrate discharge from reverse osmosis. The Interim Settling Basin, located to the southwest, is gravity fed through a stone filter separator dike from the Coal Pile Run-off Pool. The Final Settling Basin is to the southeast and is gravity fed through stone filter separator dikes from both the Slag Settling Pool and the Interim Settling Basin. The stone filter dikes are equipped with overflow CMPs to pass flow from the Ash Pools to the Settling Basins. Water decants from the Final Settling Basin to the canal south of the CCB Ash Pond and flows west. The canal flows through a culvert under a levee to Brown's Branch Canal, which flows to the Missouri River. Aerial images of the impoundment can be seen in Plates 2 and 3.

The CCB Ash Pond functions as one ash pond separated into four pools; therefore, Kleinfelder only considered the outer embankment of the CCB Ash Pond, disregarding the interior dike between the northeast and northwest pools and the filter dikes between the northern pools and southeast and southwest pools. A failure of the interior dike and filter dikes was initially considered due to the potential risk of water from a higher elevation pool spilling into a lower elevation pool, and exceeding lower elevation pool capacity. However, the stone filter dikes seep water at a high rate and does not allow a significant accumulation of hydrostatic head on one side of a dike. Kleinfelder concluded that failure of the internal dike and filter dikes appears unlikely because the minimal difference in water surface elevations between pools, and stress on the dike should remain low. Further, if a dike failure was to occur, differences in water surface elevations are small relative to available freeboard throughout the CCB Pond. It is assumed that the failure of the interior dikes could disrupt plant operations, but would not have a significant impact on the CCB Pond embankment stability.

3.1.2 Slag Settling Pool

The Slag Settling Pool is a combination incised/diked pool. A sluice pipe transports primarily slag to the northeast of the pool. Slag settles and water is filtered through a 1 ½ to 2-inch clean stone filter dike to the Final Settling Basin at the south end. During high water events a 12-inch CMP overflow pipe accelerates flow to the Final

Settling Basin. The east embankment is a designed structure and was built adjacent to the Existing Oil Tank Berm on the pond side. The embankment foundation does not have an inspection trench and has a wider crest than other sections. A typical embankment cross-section is shown below in Figure 1. The interior embankment to the west is a separator dike constructed of ash mixed with clay to add stability.

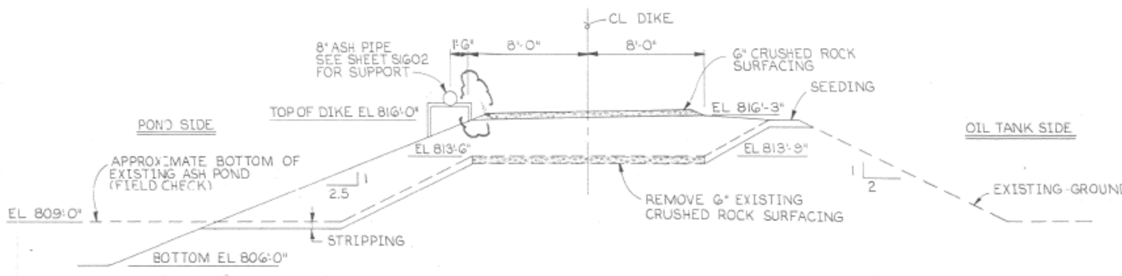

Figure 1 – Typical Embankment Cross-Section of East Embankment, (Black & Veatch, 1977)

3.1.3 Coal Pile Run-off Pool

The Coal Pile Run-off Pool is also a combination incised/diked pool. A sluice pipe transports residual fly ash, sluice water for softening, and concentrate discharge from reverse osmosis to the northeast of the pool. Coal pile run-off water enters through the west embankment. Water is filtered through a 1 ½ to 2-inch clean stone filter dike to the Interim Settling Basin at the south end. A 12-inch CMP overflow pipe accelerates flow to the Final Settling Basin during high water events. The west embankment is a designed embankment with an 8-foot wide inspection trench, a 10-foot crown, and 2.5H:1V slopes .A typical embankment cross-section is shown below in Figure 2.

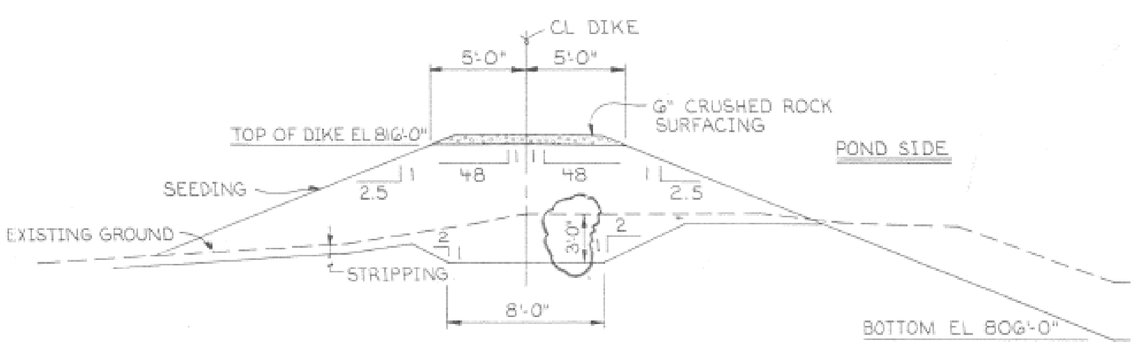

Figure 2 – Typical Embankment Cross-Section of West Embankment, (Black & Veatch, 1977)

3.1.4 Interim and Final Settling Basin Pool

The Settling Basin is a combination incised/diked pool with a stone filter separator dike between the Interim and Final Settling Basin. Water enters through the stone filter dike from the Ash Pools and exits though the Decant Outlet Works to the southeast. The Decant Outlet Works consists of a 4-foot wide concrete structure with stop-logs that adjust the intake elevation between 806 and 812 feet. The Decant Outlet works flows to a 12-inch RCP conduit which exits at the discharge canal. The landside of the south embankment is part embankment and part excavated canal, and represents the highest section of embankment. The landside of the south embankment (waterside of drainage canal) is reinforced with riprap. The discharge canal flows west and off-site. A typical embankment cross-section is shown below in Figure 3.

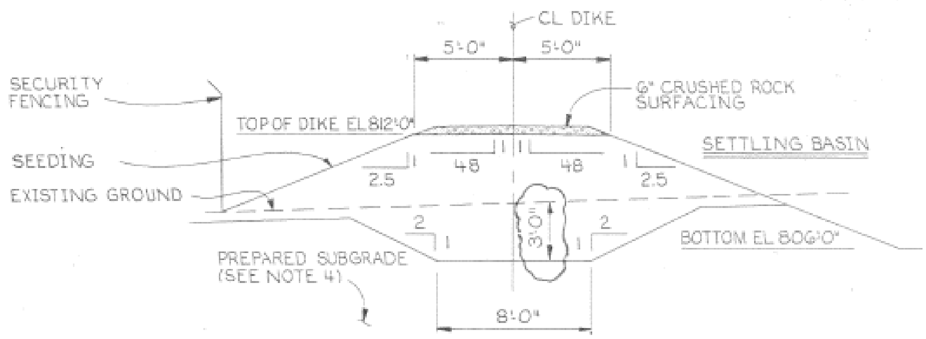

Figure 3 – Typical Embankment Cross-Section of South Embankment, (Black & Veatch, 1977)

3.2 Pertinent Data

Data listed below was primarily gathered from information provided by KCP&L at the time of the site visit. The information includes reports, construction drawings, and spreadsheet documentation. Data not provided by KCP&L was estimated as noted below.

A. GENERAL

1. Name .... Lake Road Generating Station
2. State .... Missouri
3. County .... Buchanan
4. Latitude .... 39° 43' 23'' North
5. Longitude .... 94° 52' 43'' West
6. River used for operations .... Missouri River
7. Year Constructed 1967
8. Modifications .... North Ash Pool and Settling Basin separator dike, 1977
9. Current Hazard Classification .... None
10. Size .... 640,862 cubic feet[1]

B. POND

CCB ASH POND

1. Total Pond Capacity .... 17.19 acre-feet[2]

C. IMPOUNDMENTS

SLAG ASH POOL

1. Type........ Combination Incised/Diked
2. Crest Elevation........ 815± feet[1]
3. Crest Length (north and east embankments) .... Approx. 460 feet[3]
4. Crest Width .... 10 to 16 feet[4]
5. Impoundment Height........ Approx. 9 feet[1]
6. Waterside Slope .... 2.5:1 (H:V)[4]
7. Landside Slope........ 2.5:1 (H:V)[4,5]
8. Total Solids .... 11,000 tons[1]
9. Total Volume of Pool .... 7.23 acre-feet[6]

COAL PILE RUN-OFF ASH POOL

1. Type........ Combination Incised/Diked
2. Crest Elevation........ 815± feet[1]
3. Crest Length (north and west embankments) .... Approx. 480 feet[3]
4. Crest Width .... 10 feet[4]
5. Impoundment Height........ Approx. 9 feet[1]
6. Waterside Slope .... 2.5:1 (H:V)[4]
7. Landside Slope........ 2.5:1 (H:V)[4]
8. Total Solids .... 3,700 tons[1]
9. Total Volume of Pool .... 4.61 acre-feet[6]

INTERIM SETTLING BASIN

1. Type........ Combination Incised/Diked
2. Crest Elevation........ 812± feet[1]
3. Crest Length (south and west embankments)........ Approx. 290 feet[3]
4. Crest Width .... 10 feet[4]
5. Impoundment Height........ Approx. 6 feet[1]
6. Waterside Slope .... 2.5:1 (H:V)[4]
7. Landside Slope........ 2.5:1 (H:V)[4]
8. Total Volume of Pool .... 2.24 acre-feet[6]

FINAL SETTLING BASIN

1. Type........ Combination Incised/Diked
2. Crest Elevation........ 812± feet[1]
3. Crest Length (south and east embankments) .... Approx. 200 feet[3]
4. Crest Width .... 10 feet[4]
5. Impoundment Height........ Approx. 6 feet[1]
6. Waterside Slope .... 2.5:1 (H:V)[4]
7. Landside Slope........ 2.5:1 (H:V)[4]
8. Total Volume of Pool .... 0.62 acre-feet[6]

D. DRAINAGE BASIN

1. Area of Drainage Basin .... Unknown
2. Landside Description: .... City of Atchison and the Missouri River

E. POND INLETS

SLAG ASH POOL

1. Pool Inlet .... Sluice pipes from the generating station
2. Inlet Invert Elevation .... Unknown

COAL PILE RUN-OFF POOL

1. Pool Inlet .... Sluice pipes from the generating station
2. Inlet Invert Elevation .... Unknown

F. PRIMARY SPILLWAY

1. Description .... N/A – No Spillway Present

G. OUTLET WORKS

FINAL SETTLING BASIN

1. Description .... Concrete inlet structure with adjustable stop-logs and 12" RCP outlet pipe
2. Location .... Near east side of pool
3. Decant Intake Structure .... Concrete with adjustable stop-log weir
   a. Intake Invert Elevation .... 806-812 feet[2]
4. Decant Conduit .... RCP
   a. Length .... approximately 75 feet[3]
   b. Diameter .... 12-inch[4]
5. Outlet Structure .... Uncontrolled gravity discharge
   a. Outlet Invert Elevation .... 803.5 feet[4]
   b. Energy Dissipation .... Canal bottom
6. Discharge Capacity with Water Surface at Top of Impoundment .... 9.3 cfs[2]

H. MANAGEMENT

1. Owner .... Kansas City Power & Light
2. Purpose .... Coal Fired Energy Generation

Notes:
1. Referenced from documentation provided by KCP&L.
2. Referenced from the 2011 URS Geotechnical Evaluation Report.
3. Information approximated using Google Earth and does not include interior separator dikes.
4. Referenced from the 1977 Black and Veatch Construction drawings.
5. Landside slope adjacent to the Fuel Oil Tank is 2:1 (H:V).
6. Total Volume of Pool value is the volume from documentation provided by KCP&L in Part D of EPA Questionnaire for Steam Electric Power Generating Effluent Guidelines.

3.3 Regional Geology and Seismicity

The plant site is situated in the Dissected Till Plains physiographic area, also known as the Northern Plains. The Dissected Till Plains are gentle plains composed of rock and soil particles left behind from retreating glaciers, which extended approximately as far south as the Missouri River. The area is rolling, with an abundance of streams. Since the last glaciation, the action of stream and river deepening and widening of valleys has caused the original plain to become dissected, hence the name Dissected Till Plains.

The Web Soil Survey (http://websoilsruvey.nrcs.usda.gov) developed by the United States Department of Agriculture (USDA) and Natural Resources Conservation Service (NRCS) was reviewed for the area near the plant site. The Urban land, bottomland, soil series is located in the area around the Lake Road Generating Station. This soil series is formed in alluvium located in urban areas, with the alluvium near the plant site deposited by the Missouri River. Near surface alluvial soils generally consist of fine-grained soils, including clay, silt, and sandy silts. The alluvial soils normally become coarser grained with depth, with the soil grading to silty sands to medium to coarse grained sands. Bedrock in the area is anticipated to be at depths greater than 50 feet.

United States Geological Society (USGS) has developed and mapped peak ground accelerations (PGA) having a 2% probability of exceedance in 50 years. Based on Kleinfelder's experience near the plant site and published information, we have assumed a Seismic Site Class "D" with a PGA at the plant site of 0.07 g. This value could vary depending on a site classification defined by a subsurface exploration.

The presence of existing known faults was also evaluated by reviewing posted geologic information on University of Missouri, Center for Applied Research and Environmental Systems (CARES) website (www.cares.missouri.edu). Based on the published information, no known faults were located within 25 miles of the plant site.

3.4 Hydrology and Hydraulics

URS performed a spillway analysis and breach impact analysis for KCP&L in the 2011, Geotechnical Evaluation Report. The URS spillway analysis calculated that the outlet works could not pass the flow of a 25-year, 24-hour rainfall event combined with the average or maximum daily plant flows (22.75 cfs and 25.3 cfs, respectively). However, the CCB Ash Pond "could store the 25-year 24-hour storm with 0.5 feet of freeboard if water levels in the pond are at or below elevation 814.92 feet." URS concluded that "an emergency spillway is not required as long as water levels in the ash ponds are maintained at or below this elevation." The Ash Pond water elevation was observed to be below this level for both the URS and Kleinfelder site visits. It may be necessary to develop a pool elevation monitoring program with more frequency than bi-weekly inspection in order to assure safe pool elevations.

The breach impact analysis URS performed assumed the ash pools and settling basins would release the full capacity of 17.19 acre-feet, and the drainage canal to the Missouri River was closed when breach occurred. URS calculated the elevation of the inundation area to be 810.5 feet and concluded the depth of water in the operational areas to "not exceed 1 foot." They showed water to inundate parts of Lake Road to depths of "several inches."

3.5 Geotechnical Considerations

Recent soil boring samples taken by URS in the 2011 Geotechnical evaluation show the embankment is composed of stiff, high plasticity clay. The embankment is founded on natural ground, a typically soft, low-plasticity silt or silty clay, underlain by a sand or clay layer.

URS analyzed three cross-sections of the embankment for stability using SLOPEW and UTEXAS3 software. Steady-state seepage, steady-state seepage with seismic and rapid drawdown conditions were analyzed and URS concluded the "safety factors are adequate for the current ash pond configuration." Based on interviews conducted during Kleinfelder's site visit, it is our understanding that riprap was added to the landside of the south embankment in 2010 per URS recommendations to mitigate concerns.

No historical seepage has been reported and none was observed at the time of inspection. Owner documentation shows 15.24 cm of compacted clay was used to line the pond and no toe drains or relief wells are present. URS installed two piezometers on-site in 2011 as part of their Geotechnical Evaluation Report, seepage analysis. They concluded that "infiltration through the embankments is slow and limited and that the embankments are effectively controlling seepage." KCP&L is not currently taking readings from the instrumentation. A piezometer on the south embankment is shown on Photograph 18.

3.6 Structural Considerations

The structural components within the Lake Road Generating Station impoundments include corrugated metal pipes (CMPs), reinforce concrete pipes (RCPs), and a concrete decant outlet works structure.

Flow was not seen passing through the overflow pipes between the ash pools and settling basins; however, Kleinfelder understands these pipes were installed in 2011 and appeared to be in satisfactory condition. The internal condition of the pipes could not be verified.

The outlet works was passing flow at the time of inspection and appeared to be in satisfactory condition. The internal condition of the outlet conduit was not inspected and records of internal video inspection were not available.

Documentation of the structural portions of the impoundments under seismic loading was not available for our review. The plant site is located in a zone of relatively low risk for damaging seismic activity. Evaluation of the structural components of the impoundments under applicable seismic loading conditions merits consideration at the Owner's discretion.

3.7 Performance Evaluations

There have been no previous federal or state assessments of the Lake Road Generating Station's CCB Ash Pond. Currently, KCP&L's local plant personnel perform bi-weekly assessments of available freeboard, and the condition of the impoundments and their associated structures. Based on observations by KCP&L in their bi-weekly assessments and other documents and accounts, there have been no major incidents or releases involving the CCB Ash Pond in the last ten years.

3.8 Hazard Classification

The Lake Road Generating Station's impoundment is not regulated by any state agency and therefore does not currently have a designated hazard rating. Potential environmental and economic impacts that a failure of this impoundment would present appears low because an unintended release would mostly be contained on KCP&L property. URS performed a breach impact analysis in the 2011 Geotechnical Evaluation report and estimated less than a foot of water on KCP&L property and several inches on parts of Lake Road. URS assumed the full pond capacity was released instantaneously. Significant economic loss, environmental damage, or disruption of lifeline facilities is not expected in the event of a failure. A loss of life situation is not expected without any homes, recreational facilities, businesses, or other structures immediately downstream of the impoundment. It is recommended a Hazard Classification of "Low" be assigned to the impoundment.

3.9 Site Access

We were required to seek permission from KCP&L to gain access to the plant site. After arriving at the site and meeting with representatives of KCP&L, we were escorted by facility personnel to assess the impoundments. The impoundments can be accessed by standard car or on foot during normal weather conditions via gravel-surfaced roadways on the Lake Road Generating Station property.

SECTION 4 – SITE OBSERVATIONS

The impoundment embankments, overflow conduits, and decant outlet works of the CCB Ash Pond were observed during the March 2, 2011 site assessment. General observations of these features are presented below; more specific observations of the site and facilities are documented in the Site Assessment Checklists provided in Appendix A. Site observation photographs are shown at the end of this section, and a map showing photograph locations is shown on Plate 4.

4.1 CCB Ash Pond

4.1.1 Waterside Slopes

Overall, the waterside slopes were in satisfactory condition. Photographs 8, 10, 22, and 27 show typical conditions of the waterside slopes. Specific observations include:

- The waterside slopes generally appear as designed, based on visual observations. Inspection occurred while pond was in service so the waterside embankment slopes below the water surface were not observed.
- No large diameter trees, vegetation, or animal burrows were observed in the embankment.

4.1.2 Crest

Overall, the crest of the impoundment was in satisfactory condition. Photograph 6 shows the typical condition of the crest. Specific observations include:

- Most of the crest was a gravel road.
- Almost no grasses were observed on the crest.
- No major depressions or rutting were noted on the impoundment crest.

4.1.3 Landside Slopes

Overall, the landside slopes were in fair condition. Photographs 6, 11, 21, and 23 show typical conditions of the landside slopes. Specific observations include:

- The west embankment of the Interim Settling Basin showed minor erosion.
- Mowed grass was observed along the west and east embankment of the Ash Pond.
- No large diameter trees or animal burrows were observed in the embankment.

4.1.4 Landside Toe Areas

Overall, the landside toe areas were in satisfactory condition. Photographs 6, 24, and 25 show typical conditions of the landside toe. Specific observations include:

- No large trees or hydrophilic vegetation was observed along the embankment toe.
- No ponding water was observed along the embankment toe, with the exception of a coal pile run-off ditch to the northwest and the drainage canal to the south. Both locations appeared intended to contain some water.
- Three utility poles were built near the embankment toe.

4.1.5 Overflow Pipes

The overflow pipes appeared to be in satisfactory condition with no corrosion at the inlet and outlet; however internal condition of the pipes was not verified. A picture of an overflow pipe is shown in Photograph 12.

4.1.6 Decant Outlet Works

The decant outlet works appeared to function properly and was passing water. The structure looked plumb and the concrete was in satisfactory condition; however the submerged portion of the intake structure and foundation was not visible. The RCP outlet pipe was passing flow and appeared in satisfactory condition with minor deterioration. The internal condition of the outlet conduit was not inspected. The outlet works can be seen in Photograph 14.

4.1.7 Impoundment Inlet

Inflow into the CCB Ash Pond includes metal pipes on the North and Northeast side of the impoundment, as well as coal pile run-off that is pumped into the pond from the west. The Inlet pipes can be seen in Photographs 7 and 27. Specific observations include:

- The Slag Pool Inlet stretched approximately 30 feet into the pond and did not expose the embankment to erosion. Low flow was observed at the time of inspection.
- The Coal Pile Run-off Pool fly ash inlet was riprapped and appeared to be in satisfactory condition. Low flow was observed at the time of inspection.
- The Coal Pile Run-off Pool inlet penetrated the west embankment and appeared in satisfactory condition. High flow was observed at the time of inspection.

1-Slag Sluice Pipe to Pond Looking West

2-Slag Inlet Sluice Pipe Looking Northeast

3-Waterside East Embankment of Slag Pool (East Pool) Looking South

4-Landside East Embankment of Slag Pool (East Pool) Looking South

5-Slag Pool Looking Southwest

6-Fly Ash Sluice Pipe to Coal Pile Run-off Pool on North Embankment

7-Crown and Landside of Slag Pool East Embankment Looking South

8-Stone Filter Outlet and Overflow Pipe at South End of Slag Pool

9-Stone Filter between Interim Settling Basin and Final Settling Basin Looking South

10-Piezometer on South Embankment of Interim Settling Basin

11-Stromwater Erosion Control Channel West of West Embankment Toe

12-Landside of West Embankment Looking North

13-Waterside Embankment of Coal Pile Run-off Pool (West Pool)

14-Landside Embankment of Interim Settling Basin (West Settling Basin) Looking South

15-Landside Embankment Toe of Interim Settling Basin Looking South

16-Landside Embankment of Coal Pile Run-off Pool Looking North

17-Landside Embankment of Coal Pile Run-off Pool Looking North

18-Coal Pile Run-off Inlet (foreground) and Fly Ash Inlet (background)

19-Coal Pile Run-off Pipe Landside Penetration

20-Coal Pile Run-off Pipe and Electric Boxes at Landside Toe

21-Fly Ash Inlet and North Embankment of Coal Pile Run-off Pool Looking East

22-Final Settling Basin Decant Outlet Works Intake

23-Landside of South Embankment Drainage Canal and Outlet Pipe

24-Decanter 12" Outlet Pipe

25-Landside South Embankment Drainage Canal and Inlet Culvert to Brown's Branch

26-Discharge Canal to Brown's Branch Culvert Inlet

27-Bottom Ash Silo (Hauled Off-site)

28-Bottom Ash Silo Outlet

29-Fly Ash Pneumatic Pipe

30-Fly Ash Silo

SECTION 5 – OVERALL CONDITION OF THE FACILITY IMPOUNDMENTS

5.1 Analysis and Conclusions

Our analysis is summarized in three general considerations that are presented as follows:

Safety of the Impoundments, Including Maintenance and Methods of Operation

Kleinfelder understands that the impoundments have a history of safe performance. However, the future performance of these impoundments will depend on a variety of factors that may change over time, including surface water hydrology, changes in groundwater levels, changes in embankment slope integrity, etc. In light of this situation, we have noted the following items that present some concern in this regard:

- Erosion and slope steepening was observed on the landside embankment west of Interim Settling Basin. The area is adjacent to a drainage ditch and is likely exposed to more stormwater run-off.
- No internal video inspection of the outlet conduit was available at the time of inspection.

Changes in Design or Operation of the Impoundments Following Initial Construction

The original 1967 construction documents show an Ash Pool to the north and a Settling Basin to the south. Around 1977, a separator dike was constructed to approximately bisect the North Ash Pool and South Settling Basin. The dike runs north and south and separated the North Ash Pool into the Coal Pile Run-off Pool (Northwest Pool) and the Slag Pool (Northeast Pool), and separated the Settling Basin into the Interim Settling Basin (West Settling Basin) and the Final Settling Basin (East Settling Basin). The ash pool dike was initially constructed from ash, and clay was later added to reduce seepage. The settling basin dike was constructed of mostly clayey soil. The separator dike is used for plant operations and is not critical to pond impoundment.

Riprap protection was added to the south embankment of the settling basins in December 2010 to repair and reduce erosion.

Adequacy of Program for Monitoring Performance of the Impoundments

The present monitoring program primarily involves visual inspections by plant personnel. These visual inspections seem to be adequate to address issues, such as surface erosion and general condition of the impoundments.

5.2 Summary Statement

I acknowledge that the management units referenced herein:

- Coal Combustion Byproduct (CCB) Pond System consisting of:
  - Coal Pile Run-off Pool (Northwest Ash Pool)
  - Slag Settling Pool (Northeast Ash Pool)
  - Interim Settling Basin (Southwest Settling Basin)
  - Final Settling Basin (Southeast Settling Basin)

Were personally inspected by me and found to be in the following condition:

SATISFACTORY

Signature: [signature] Date: 10-12-11

Jeffrey G. Hoffman, P.E.
Lead Geotechnical Engineer

SECTION 6 – RECOMMENDATIONS

Based on observations during the site assessment, it is recommended that the following actions be taken at the Lake Road Generating Station.

6.1 Priority 1 Recommendations

1. **None.** The impoundment appeared to be in satisfactory condition during inspection and no severe deficiencies were observed that would threaten the safety of the impoundment.

6.2 Priority 2 Recommendations

1. **Repair erosion of landside embankment west of Interim Settling Basin.** Areas where erosion and slope steepening have occurred should be filled in and re-dressed with appropriate fill to prevent erosion from cutting further into the embankments.

2. **Perform an internal video inspection of the outlet conduit a minimum of once every 5 years.** Evaluate the presence of cracks, displacement, or general deterioration of the outlet conduit that could potentially impair functionality of the outlet.

3. **Update O&M Manual to provide maximum dredging elevation.** As noted in Section 1.2, the ash pond is located within the LCA for the Missouri River levee system. As such, dredging operations should be limited to a maximum elevation equal to the original design bottom of pond elevation. If the pond is dredged to greater depths, USACE review and approval would be required.

4. **Periodic updates to O&M and EAP Manuals.** It is recommended that O&M and EAP manuals be revised to include provisions requiring yearly review of documents and updating, as appropriate, with current emergency contact information and up-to-date procedures.

5. **Develop an Interim Pool Elevation Monitoring Program during storm events.** As stated in Section 3.4, the pond could not pass the flow of a 25-year, 24-hour rainfall event combined with the average or maximum daily plant flows; however, the CCB Ash Pond could store the flow if water levels in the pond are at or below elevation 814.92 feet. A more frequent monitoring program should be developed when the water level is at or above 814 feet to assure safe pool elevations.

6.3 Definitions

Priority 1 Recommendation: Priority 1 Recommendations involve the correction of severe deficiencies where action is required to ensure the structural safety and operational integrity of a facility or that may threaten the safety of the impoundment.

Priority 2 Recommendation: Priority 2 Recommendations are where action is needed or required to prevent or reduce further damage or impaired operation of the facility and/or improve or enhance the O&M of the facility, which do not appear to threaten the safety of the impoundment.

SECTION 7 – GLOSSARY OF TERMS

For the EPA Ash Pond Assessment program, the following glossary of terms shall be used for classification unless otherwise noted.

Hazard Potential Rating

"Hazard Potential" means the possible adverse incremental consequences that result from the release of water or stored contents due to the failure of the impoundment or reservoir or the misoperation of the impoundment, reservoir, or appurtenances. The Hazard Potential Classification of an impoundment or reservoir shall not reflect in any way on the current condition of the impoundment or reservoir and its appurtenant works, including the impoundment's or reservoir's safety, structural integrity, or flood routing capacity. These classifications are as described below:

1. **Less than Low Hazard Potential**

   "Less than Low Hazard" means failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

2. **Low Hazard Potential**

   "Low Hazard" means an impoundment's or reservoir's failure will result in no probable loss of human life and low economic loss or environmental loss, or both. Economic losses are principally limited to the owner's property.

3. **Significant Hazard Potential**

   "Significant Hazard" means a impoundment's or reservoir's failure will result in no probable loss of human life but can cause major economic loss, environmental damage, disruption of lifeline facilities, or impact other concerns. Significant Hazard Potential classification impoundments or reservoirs are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

4. **High Hazard Potential**

   "High Hazard" means a impoundment's or reservoir's failure will result in probable loss of human life.

Overall Classification of Impoundment

In a system similar to the New Jersey Department of Environmental Protection Impoundment Safety Guidelines for the Inspection of Existing Impoundments

(January 2008), when the following terms are capitalized, they denote and shall be used to describe the overall classification of the impoundment as follows:

SATISFACTORY - No existing or potential impoundment safety deficiencies are recognized. Acceptable performance is expected (the term expected is to be defined as likely) under all applicable loading conditions (static, hydrologic and seismic) in accordance with the applicable criteria. Minor maintenance items may be required.

FAIR – Acceptable performance is expected (the term expected is to be defined as likely) under all required loading conditions (static, hydrologic and seismic) in accordance with the applicable safety regulatory criteria. Minor deficiencies may exist that require remedial action and/or secondary studies or investigations.

POOR - A management unit safety deficiency is recognized for any required loading condition (static, hydrologic and seismic) in accordance with the applicable impoundment safety regulatory criteria. Remedial action is necessary. POOR also applies when further critical studies or investigations are needed to identify any potential impoundment safety deficiencies.

UNSATISFACTORY – The facility is considered unsafe. An impoundment safety deficiency is recognized that requires immediate or emergency remedial action for problem resolution. Reservoir restrictions may be necessary.

Condition Rating Criteria

In a system similar to the U.S. Department of Interior, Safety Evaluation of Existing Impoundments (SEED 1995), the terms "Satisfactory," "Fair," "Poor," and "Unsatisfactory" are used in a general sense when describing the structural condition and the operational adequacy of the equipment for a impoundment or reservoir and its appurtenant works during the visual assessment. In addition, the term "Unknown" may be utilized, as applicable.

Satisfactory – Expected to fulfill intended function.

Fair – Expected to fulfill intended function, but maintenance or other actions are recommended.

Poor – May not fulfill intended function; maintenance, repairs, or other actions are necessary.

Unsatisfactory – Is not expected to fulfill intended function; repair, replacement, or modification is necessary.

Unknown – Not visible, not accessible, not inspected, or unable to determine the condition rating based on the observation taken.

Recommendation Listing

Recommendations shall be written concisely and identify the specific actions to be taken. The first word in the recommendation should be an action word (i.e. “Prepare”, “Perform”, or ”Submit”). The recommendations shall be prioritized and numbered to provide easy reference. Impoundment Safety Recommendations shall be grouped, listed or categorized similar to the U.S. Department of Interior, Reclamation Manual - Directives and Standards - Review/Examination Program for High- and Significant-Hazard Impoundments (July, 1998 FAC 01-07) as follows:

Priority 1 Recommendations: Priority 1 Recommendations involve the correction of severe deficiencies where action is required to ensure the structural safety and operational integrity of a facility or that may threaten the safety of the impoundment.

Priority 2 Recommendations: Priority 2 Recommendations are where action is needed or required to prevent or reduce further damage or impaired operation of the facility and/or improve or enhance the O&M of the facility, which do not appear to threaten the safety of the impoundment.

SECTION 8 – LIMITATIONS

The scope of this work is for a preliminary screening for the EPA and plant owner/operator of the visible performance and apparent stability of the impoundment embankments based only on the observable surface features and information provided by the owner/operator. Other features below the ground surface may exist or may be obscured by vegetation, water, debris, or other features that could not be identified and reported. This site assessment and report were performed without the benefit of any soil drilling, sampling, or testing of the subsurface materials, calculations of capacities, quantities, or stability, or any other engineering analyses. The purpose of this assessment is to provide information to the EPA and the plant owner/operator about recommended actions and/or studies that need to be performed to document the stability and safety of the impoundments.

This work was performed by qualified personnel in a manner consistent with that level of care and skill ordinarily exercised by other members of Kleinfelder's profession, practicing in the same locality, under similar conditions, and at the date the services are provided. Kleinfelder's conclusions, opinions, and recommendations are based on a limited number of observations. It is possible that conditions could vary between or beyond the observations made. Kleinfelder makes no other representation, guarantee, or warranty, express or implied, regarding the services, communication (oral or written), report, opinion, or instrument of service provided. Kleinfelder makes no warranty or guaranty of future embankment stability or safety.

This report may be used only by the client and the registered design professional in responsible charge and only for the purposes stated for this specific engagement within a reasonable time from its issuance but in no event later than one (1) year from the date of the report.

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Recommendations contained in this report are based on preliminary field observations without the benefit of subsurface explorations, laboratory tests, or detailed knowledge of the existing construction. If the scope of the proposed recommendations changes from that described in this report, the conclusions and recommendations contained in this report are not considered valid unless the changes are reviewed and the conclusions of this report are modified or approved in writing by Kleinfelder. Kleinfelder cannot be responsible for interpretation by others of this report or the conditions encountered in the field.

SECTION 9 – REFERENCES

- Google Inc. (2011). Google Earth Pro (Version 6.0.2.2074) [Software]. Available from http://www.google.com/earth/index.html.

- KCP&L Lake Road Generating Station Pond Assessment (CD), March 2, 2011.

- Missouri Center for Applied Research and Environmental Systems (CARES), Missouri Soil Survey, 2011.

- New Jersey Department of Environmental Protection, Impoundment Safety Guidelines for the Inspection of Existing Impoundments, January 2008.

- URS, Geotechnical Evaluation Ash Pond – KCP&L Greater Missouri Operations Company, Lake Road Generating Station, dated February 2011.

- US Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS), Web Soil Survey – online.

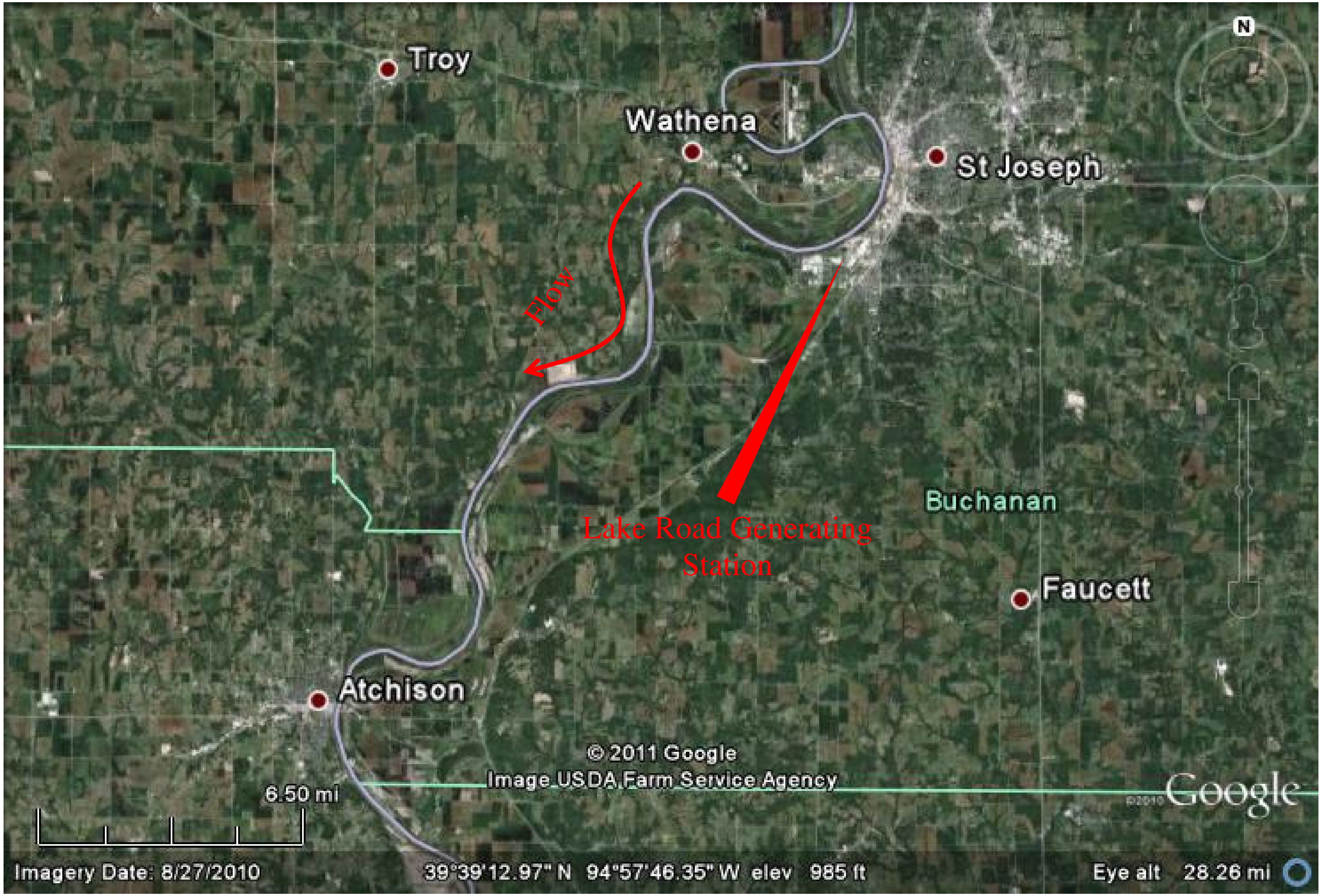
- US Department of Interior, Reclamation Manual – Directives and Standards – Review/Examination Program for High and Significant Hazard Impoundments, July 1998.

- US Department of the Interior, Safety and Evaluation of Existing Impoundments (SEED), 1995.

- US Geologic Survey (USGS) "Design Maps" Detailed Report, 2009 NEHRP Recommended Seismic Provisions, Section 11.4.1 – Mapped Acceleration Parameters and Risk Coefficients, March 15, 2011.

Plates

Plate 1	Downstream Infrastructure Map
Plate 2	Aerial Site Location Map
Plate 3	Pond Area - Site Features Map
Plate 4	Pond Area - Photograph Location Map



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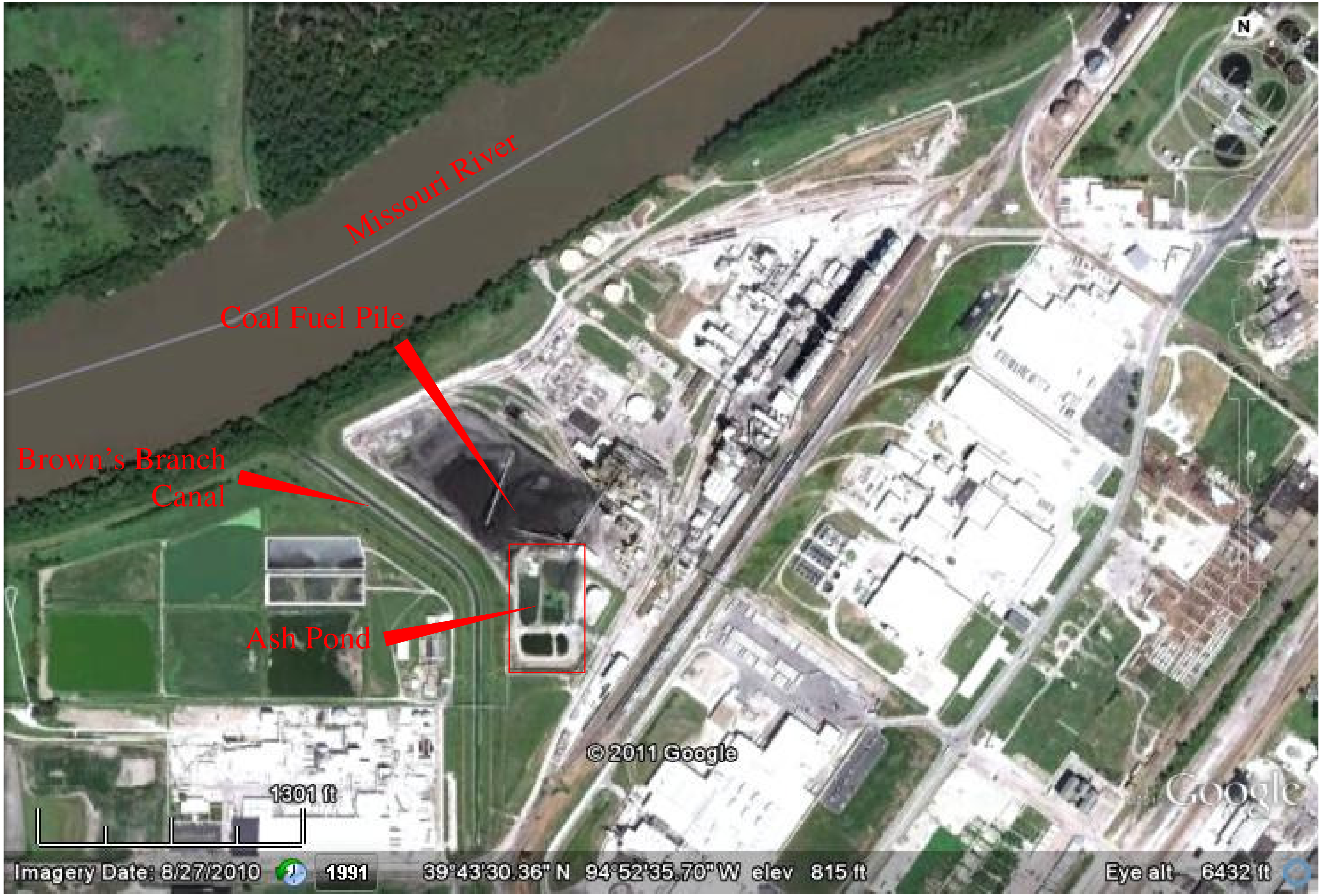
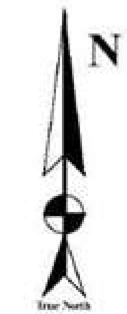
DATE:	10-3-11
DRAWN BY:	B. Piede
CHECKED BY:	J. Hoffman
FILE NAME:	Lake Road Plates

DOWNSTREAM INFRASTRUCTURE MAP

LAKE ROAD GENERATING STATON
KANSAS CITY POWER & LIGHT
ST. JOSEPH, MISSOURI

PLATE
1





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AERIAL SITE LOCATION MAP

LAKE ROAD GENERATING STATON
KANSAS CITY POWER & LIGHT
ST. JOSEPH, MISSOURI

PLATE

2

N

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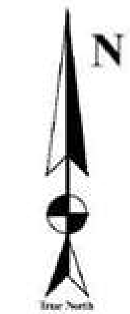
POND AREA—SITE FEATURES MAP

LAKE ROAD GENERATING STATON
KANSAS CITY POWER & LIGHT
ST. JOSEPH, MISSOURI

PLATE

3



Legend:

12 - Photo number, location, and direction

Note: Photographs 1 and 27 through 30 were taken at the power generating plant northeast of the ash pond. Locations not shown.

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PROJECT NO. 116664-2	**POND AREA—PHOTOGRAPH LOCATION MAP**	PLATE	
DATE: 10-3-11			
DRAWN BY: B. Piede		4	
CHECKED BY: J. Hoffman	LAKE ROAD GENERATING STATON KANSAS CITY POWER & LIGHT ST. JOSEPH, MISSOURI		
FILE NAME: Lake Road Plates			

Appendix A

Site Assessment Checklists

Coal Combustion Dam Inspection Checklist Form

US Environmental Protection Agency

Site Name:	Lake Road Generating Station	Date:	03/02/11
Unit Name:	Slag/Coal Pile Run-off Pond System	Operator's Name:	Kansas City Power & Light
Unit I.D.:	N/A	Hazard Potential Classification:	High Significant Low ✓
Inspector's Name:	Jeff Hoffman, Brad Piede		

Check the appropriate box below. Provide comments when appropriate. If not applicable or not available, record "N/A". Any unusual conditions or construction practices that should be noted in the comments section. For large diked embankments, separate checklists may be used for different embankment areas. If separate forms are used, identify approximate area that the form applies to in comments.

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?	Bi-Weekly		18. Sloughing or bulging on slopes?		✓
2. Pool elevation (operator records)?	812.0		19. Major erosion or slope deterioration?		✓
3. Decant inlet elevation (operator records)?			20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	N/A		Is water entering inlet, but not exiting outlet?		✓
5. Lowest dam crest elevation (operator records)?	812.0		Is water exiting outlet, but not entering inlet?		✓
6. If instrumentation is present, are readings recorded (operator records)?		✓	Is water exiting outlet flowing clear?	✓	
7. Is the embankment currently under construction?		✓	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation,stumps, topsoil in area where embankment fill will be placed)?	✓		From underdrain?		N/A
9. Trees growing on embankment? (If so, indicate largest diameter below)		✓	At isolated points on embankment slopes?		✓
10. Cracks or scarps on crest?		✓	At natural hillside in the embankment area?		✓
11. Is there significant settlement along the crest?		✓	Over widespread areas?		✓
12. Are decant trashracks clear and in place?		N/A	From downstream foundation area?		✓
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		✓	"Boils" beneath stream or ponded water?		✓
14. Clogged spillways, groin or diversion ditches?		✓	Around the outside of the decant pipe?		✓
15. Are spillway or ditch linings deteriorated?		N/A	22. Surface movements in valley bottom or on hillside?		✓
16. Are outlets of decant or underdrains blocked?		✓	23. Water against downstream toe?	✓	
17. Cracks or scarps on slopes?		✓	24. Were Photos taken during the dam inspection?	✓	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Inspection Issue # Comments

2. Operator records show approximate pool elevation between 811 - 813 feet.

5. Indicates lowest elevation at the sedimentation basins. North Ash Pond (East and West) indicate a low elevation of approx 816 feet.

12. No trashracks present.

19. Some minor erosion on landside.

23. Downstream toe of south embankments is used as a drainage ditch and usually contains flowing water.

* CCB Pond System includes: Coal Pile Run-off Pool (NW pool), Slag Settling Pool (NE pool), Interim Settling Basin (SW basin), and Final Settling Basin (SE basin).

** CCB Pond System was constructed on natural ground and was not built over wet ash, slag, or other unsuitable materials.

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW)
Impoundment Inspection

Impoundment NPDES Permit # MO-0004898 INSPECTOR Kleinfelder
Date 3/2/11

Impoundment Name Lake Road Generating Station
Impoundment Company Kansas City Power & Light
EPA Region 7
State Agency (Field Office) Addresss 500 Northeast Colbern Rd.
Lee's Summit, MO 64086
Name of Impoundment Coal Combustion By-product Ponds (coal pile run-off / slag settling / sedimentation basin)
(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New ______ Update x

	Yes	No
Is impoundment currently under construction?		x
Is water or ccw currently being pumped into the impoundment?	x	

IMPOUNDMENT FUNCTION: Boiler Slag / Coal Pile Run-off Temporary Storage

Nearest Downstream Town : Name Atchison, MO
Distance from the impoundment 23 miles
Impoundment
Location: Longitude 94 Degrees 52 Minutes 43 Seconds
Latitude 39 Degrees 43 Minutes 22 Seconds
State MO County Buchanan

Does a state agency regulate this impoundment? YES ______ NO x

If So Which State Agency? ______

HAZARD POTENTIAL (In the event the impoundment should fail, the following would occur):

______ **LESS THAN LOW HAZARD POTENTIAL:** Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

__x__ **LOW HAZARD POTENTIAL:** Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

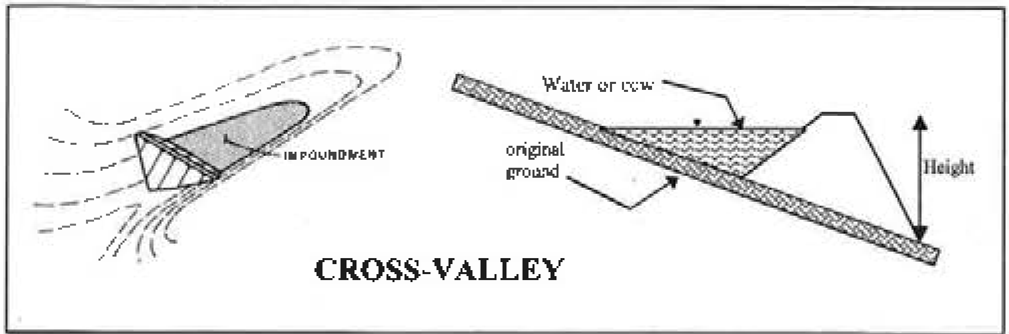
______ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

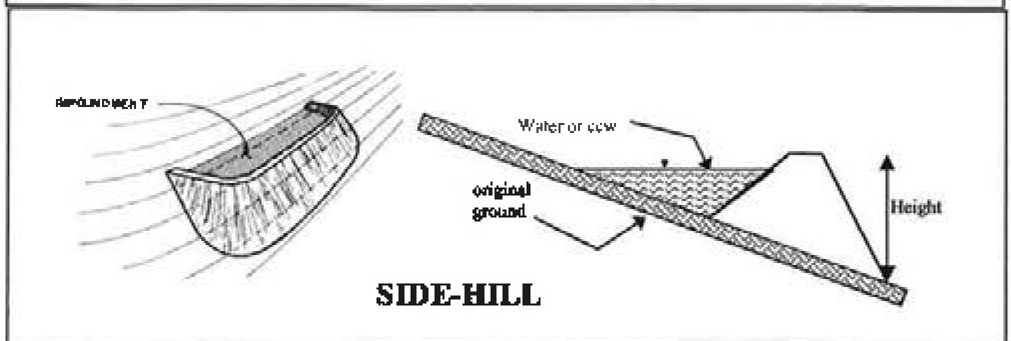
______ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

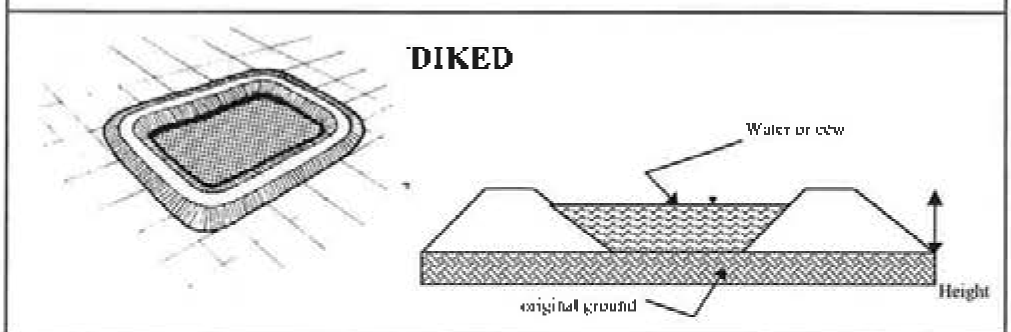
DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

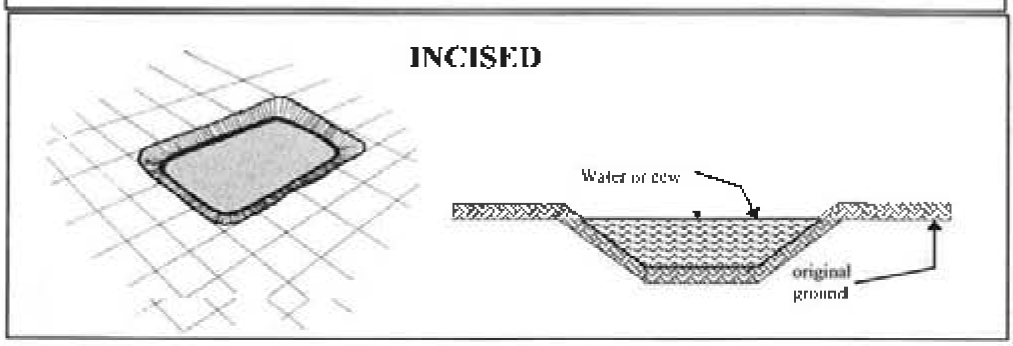
- Potential inundation area was analyzed by URS in the the February 2011 Geotechnical Evaluation Report and most of the flooded area would remain on KCP&L property, with some water reaching Lake Road. Report shows "depth of water in the operational areas of the facility will not exceed a foot."
- Loss of human life is not anticipated since inundated area is mostly on KCP&L property.
- A Slide gate at the discharge under the levee can stop contaminated flow to the canal and river.

CONFIGURATION:









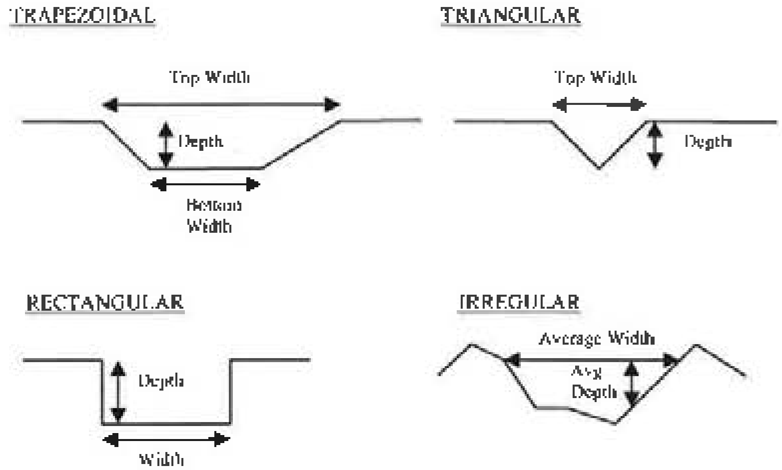
______ Cross-Valley
______ Side-Hill
______ Diked
______ Incised (form completion optional)
__X__ Combination Incised/Diked

Embankment Height 10 feet Embankment Material Earth Fill
Pool Area 1.8 acres Liner Clay
Current Freeboard 1-3 feet Liner Permeability N/A

TYPE OF OUTLET (Mark all that apply)

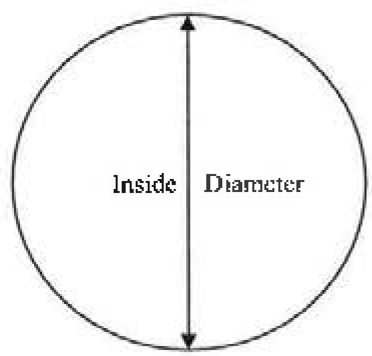
______ **Open Channel Spillway**
______ Trapezoidal
______ Triangular
______ Rectangular
______ Irregular

______ depth
______ bottom (or average) width
______ top width



______ **Outlet**

__12"__ inside diameter



Material
______ corrugated metal
______ welded steel
__x__ concrete
______ plastic (hdpe, pvc, etc.)
______ other (specify) ______________________

Is water flowing through the outlet? YES __x__ NO ______

______ **No Outlet**

______ **Other Type of Outlet** (specify) ______________________

The Impoundment was Designed By ______________________

Has there ever been a failure at this site? YES __________ NO ___x_______

If So When? ______________________________

If So Please Describe : ____

Has there ever been significant seepages at this site? YES _______ NO __x____

If So When? ______________________________

IF So Please Describe: ____

Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site? YES ________ NO __x______

If so, which method (e.g., piezometers, gw pumping,...)? ____________________

If so Please Describe : ____________________

Additional questions To Ask While conducting Coal Ash Site assessments

The purpose of the following questions is to identify each part of the equipment sequence that handles fly ash, bottom ash, boiler slag, and Flue gas desulfurization sludges from the point of generation to the CCR impoundments or into “dry” disposal.

Ask the same 4 questions for fly ash, bottom ash, boiler slag, Flue gas desulfurization sludge:

FLY ASH

1. Exactly how is it generated at the boiler? Describe equipment used to initially collect it (steel box, etc).

   Coal is burned with fly ash collected on electrostatic precipitators which then drop the ash into a steel hopper.

2. How is it moved from point of generation to storage? Describe each piece of equipment used to move it. Does this equipment have containment?

   From the hopper, the fly ash is pneumatically moved through pipes to a fly ash silo. There is no containment equipment between the hopper and silos.

3. Describe the type of equipment is used to store it. Describe the engineering characteristics of each of these storage units (silos, tanks, size, construction type (steel). Does this equipment have containment?

   The fly ash is then stored in an approximately 25 foot diameter, 50-foot tall, metal silo.

4. How is it moved from storage to final disposal? Describe each piece of equipment Does this equipment have containment?

   The fly ash is used for beneficial purposes and hauled off-site through the use of tanker trucks. The ash is transferred from the silos to the tankers through a pipe at the bottom of the silo.

Bottom Ash

5. Exactly how is it generated at the boiler? Describe equipment used to initially collect it (steel box, etc).

   Coal is burned and the ash falls into a steel hopper.

6. How is it moved from point of generation to storage? Describe each piece of equipment used to move it. Does this equipment have containment?

   The bottom ash is then pneumatically moved from the hopper to a steel silo. There is no containment between the hopper and silo.

7. Describe the type of equipment is used to store it. Describe the engineering characteristics of each of these storage units (silos, tanks, size, construction type (steel). Does this equipment have containment?

   The steel silo is approximately 25 feet in diameter and 30 feet tall. The ash is contained in the silo until hauled off-site by dump truck.

8. How is it moved from storage to final disposal? Describe each piece of equipment Does this equipment have containment?

   Covered dump trucks remove bottom ash from the silo, with the ash transferred to the dump truck using a pipe at the bottom of the silo. The bottom ash is then hauled off-site for beneficial use.

Boiler Slag

9. Exactly how is it generated at the boiler? Describe equipment used to initially collect it (steel box, etc).

   Coal burned, with slag falling from the cyclone into a metal quenching tank.

10. How is it moved from point of generation to storage? Describe each piece of equipment used to move it. Does this equipment have containment?

    The slag is then sluiced and transferred by pipe to the ash pond. There is no storage/containment between the tank and ash pond.

11. Describe the type of equipment is used to store it. Describe the engineering characteristics of each of these storage units (silos, tanks, size, construction type (steel). Does this equipment have containment?

    Once transferred to the ash pond, the slag settles out as water flows from inlet to outlet. The slag is typically dredged 1 to 2 times a month.

12. How is it moved from storage to final disposal? Describe each piece of equipment Does this equipment have containment?

    The slag is dredged and hauled off-site by covered dump truck.

Flue Gas Desulfurization Sludge – NO FGD SLUDGE

13. Exactly how is it generated at the boiler? Describe equipment used to initially collect it (steel box, etc).

N/A

14. How is it moved from point of generation to storage? Describe each piece of equipment used to move it. Does this equipment have containment?

N/A

15. Describe the type of equipment is used to store it. Describe the engineering characteristics of each of these storage units (silos, tanks, size, construction type (steel). Does this equipment have containment?

N/A

16. How is it moved from storage to final disposal? Describe each piece of equipment Does this equipment have containment?

    N/A

Appendix B

Response Letter to the EPA's Section 104(e) Request for Information

July 28, 2009

Via Express Mail

Mr. Richard Kinch
US Environmental Protection Agency
Two Potomac Yard
2733 S. Crystal Dr.
5th Floor; N-5738
Arlington, VA 22202-2733

Re: Request for Information Under Section 104(e) of the Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C. 9604(e)

Dear Mr. Kinch:

Enclosed is the response of KCP&L Greater Missouri Operations Company (KCP&L GMO) to EPA's Section 104 (e) request for information dated July 14, 2009 that was received July 23, 2009 regarding a settling pond and slag settling pond at KCP&L GMO's Lake Road Generating Station. Both ponds are currently being operated for settling and not disposal. Slag is removed from the slag settling pond and beneficially used off-site. Fly ash is removed from the settling pond and beneficially used off-site.

I certify that the information contained in this response to EPA's request for information and the accompanying documents is true, accurate, and complete. As to the identified portions of this response for which I cannot personally verify their accuracy, I certify under penalty of law that this response and all attachments were prepared in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations.

If you have any questions regarding this response, please contact me at 816-387-6407.

Sincerely,

Mark W. Howell

Mark W. Howell
Plant Manager
Lake Road Generating Station

Enclosure A

Enclosure A

KCP&L Greater Missouri Operations Company **July 28, 2009**
Lake Road Generating Station
Management Unit: Settling Pond

Please provide the information requested below for each surface impoundment or similar diked or bermed management unit(s) or management units designated as landfills which receive liquid-borne material for the storage or disposal of residuals or by-products from the combustion of coal, including, but not limited to, fly ash, bottom ash, boiler slag, or flue gas emission control residuals. This includes units that no longer receive coal combustion residues or by-products, but still contain free liquids.

1. Relative to the National Inventory of Dams criteria for High, Significant, Low, or Less-than-Low, please provide the potential hazard rating for each management unit and indicate who established the rating, what the basis of the rating is, and what federal or state agency regulates the unit(s). If the unit(s) does not have a rating, please note that fact.

The Management Unit does not have a known rating. The Missouri Department of Natural Resources - Solid Waste Management Program regulates solid waste facilities in Missouri.

2. What year was each management unit commissioned and expanded?

The Management Unit was commissioned approximately in 1967 and expanded in 1977. The pond sludge is removed from the Management Unit and beneficially used off-site.

3. What materials are temporarily or permanently contained in the unit? Use the following categories to respond to this question: (1) fly ash; (2) bottom ash: (3) boiler slag; (4) flue gas emission control residuals; (5) other. If the management unit contains more than one type of material, please identify all that apply. Also, if you identify "other," please specify the other types of materials that are temporarily or permanently contained in the unit(s).

Fly ash, soil, water treatment sludge and some coal pile runoff.

4. Was the management unit(s) designed by a Professional Engineer? Is or was the construction of the waste management unit(s) under the supervision of a Professional Engineer? Is inspection and monitoring of the safety of the waste management unit(s) under the supervision of a Professional Engineer?

The Management Unit was designed by a Professional Engineer. The construction drawings for the Management Unit were sealed by a Professional Engineer. Inspection and monitoring of the safety of the Management Unit is not completed under the supervision of a Professional Engineer.

5. When did the company last assess or evaluate the safety (i.e., structural integrity) of the management unit(s)? Briefly describe the credentials of those conducting the structural integrity

assessments/evaluations. Identify actions taken or planned by facility personnel as a result of these assessments or evaluations. If corrective actions were taken, briefly describe the credentials of those performing the corrective actions, whether they were company employees or contractors. If the company plans an assessment or evaluation in the future, when is it expected to occur?

The Management Unit is visually inspected on approximately a weekly basis by operational or security personnel. There has been no known assessment or evaluation of the safety (i.e., structural integrity) of the Management Unit beyond the visual inspection. There have been no known actions taken or planned by facility personnel as a result of the visual inspections of the Management Unit. There are no planned assessments or evaluation of this Management Unit in the future beyond the visual inspections.

6. When did a State or a Federal regulatory official last inspect or evaluate the safety (structural integrity) of the management unit(s)? If you are aware of a planned state or federal inspection or evaluation in the future, when is it expected to occur? Please identify the Federal or State regulatory agency or department which conducted or is planning the inspection or evaluation. Please provide a copy of the most recent official inspection report or evaluation.

There have been no known State or Federal regulatory official inspection or evaluation of the safety (structural integrity) the Management Unit. We are not aware of a planned state or federal inspection or evaluation in the future.

7. Have assessments or evaluations, or inspections conducted by State or Federal regulatory officials conducted within the past year uncovered a safety issue(s) with the management unit(s), and, if so, describe the actions that have been or are being taken to deal with the issue or issues. Please provide any documentation that you have for these actions.

There has been no known assessments or evaluations, or inspections conducted by State or Federal regulatory officials conducted within the past year that uncovered a safety issue(s) with the Management Unit.

8. What is the surface area (acres) and total storage capacity of each of the management units? What is the volume of material currently stored in each of the management unit(s)? Please provide the date that the volume measurement(s) was taken. Please provide the maximum height of the management units(s). The basis for determining the maximum height is explained later in this Enclosure.

The Management Unit's surface area is approximately 0.7 acres and the total storage capacity is approximately 7,400 cubic yards. The capacity measurements were made as of 2009. The volume of material currently stored in the Management Unit is estimated today to be approximately 5,140 cubic yards. The Management Unit's Dam Height, pursuant to Enclosure A, is approximately 10 feet.

9. Please provide a brief history of known spills or unpermitted releases from the unit within the last ten years, whether or not these were reported to State or federal regulatory agencies. For

purposes of this question, please include only releases to surface water or to the land (do not include releases to groundwater).

There have been no known spills or unpermitted releases from the Management Unit within the last ten years.

10. Please identify all current legal owner(s) and operator(s) at the facility.

The current legal owner of the Lake Road Generating Station is KCP&L Greater Missouri Operations Company. The current operator of Lake Road Generating Station is KCP&L Greater Missouri Operations.

Enclosure A

KCP&L Greater Missouri Operations Company **July 28, 2009**
Lake Road Generating Station
Management Unit: Slag Settling Pond

Please provide the information requested below for each surface impoundment or similar diked or bermed management unit(s) or management units designated as landfills which receive liquid-borne material for the storage or disposal of residuals or by-products from the combustion of coal, including, but not limited to, fly ash, bottom ash, boiler slag, or flue gas emission control residuals. This includes units that no longer receive coal combustion residues or by-products, but still contain free liquids.

1. Relative to the National Inventory of Dams criteria for High, Significant, Low, or Less-than-Low, please provide the potential hazard rating for each management unit and indicate who established the rating, what the basis of the rating is, and what federal or state agency regulates the unit(s). If the unit(s) does not have a rating, please note that fact.

The Management Unit does not have a known rating. The Missouri Department of Natural Resources - Solid Waste Management Program regulates solid waste facilities in Missouri.

2. What year was each management unit commissioned and expanded?

The Management Unit was commissioned approximately in 1967 and expanded in 1977. Slag is removed from the Management Unit and beneficially used off-site.

3. What materials are temporarily or permanently contained in the unit? Use the following categories to respond to this question: (1) fly ash; (2) bottom ash; (3) boiler slag; (4) flue gas emission control residuals; (5) other. If the management unit contains more than one type of material, please identify all that apply. Also, if you identify "other," please specify the other types of materials that are temporarily or permanently contained in the unit(s).

Slag.

4. Was the management unit(s) designed by a Professional Engineer? Is or was the construction of the waste management unit(s) under the supervision of a Professional Engineer? Is inspection and monitoring of the safety of the waste management unit(s) under the supervision of a Professional Engineer?

The Management Unit was designed by a Professional Engineer. The construction drawings for the Management Unit were sealed by a Professional Engineer. Inspection and monitoring of the safety of the Management Unit is not completed under the supervision of a Professional Engineer.

5. When did the company last assess or evaluate the safety (i.e., structural integrity) of the management unit(s)? Briefly describe the credentials of those conducting the structural integrity

assessments/evaluations. Identify actions taken or planned by facility personnel as a result of these assessments or evaluations. If corrective actions were taken, briefly describe the credentials of those performing the corrective actions, whether they were company employees or contractors. If the company plans an assessment or evaluation in the future, when is it expected to occur?

The Management Unit is visually inspected on approximately a weekly basis by operational or security personnel. There has been no known assessment or evaluation of the safety (i.e., structural integrity) of the Management Unit beyond the visual inspection. There have been no known actions taken or planned by facility personnel as a result of the visual inspections of the Management Unit. There are no planned assessments or evaluation of this Management Unit in the future beyond the visual inspections.

6. When did a State or a Federal regulatory official last inspect or evaluate the safety (structural integrity) of the management unit(s)? If you are aware of a planned state or federal inspection or evaluation in the future, when is it expected to occur? Please identify the Federal or State regulatory agency or department which conducted or is planning the inspection or evaluation. Please provide a copy of the most recent official inspection report or evaluation.

There have been no known State or Federal regulatory official inspection or evaluation of the safety (structural integrity) the Management Unit. We are not aware of a planned state or federal inspection or evaluation in the future.

7. Have assessments or evaluations, or inspections conducted by State or Federal regulatory officials conducted within the past year uncovered a safety issue(s) with the management unit(s), and, if so, describe the actions that have been or are being taken to deal with the issue or issues. Please provide any documentation that you have for these actions.

There has been no known assessments or evaluations, or inspections conducted by State or Federal regulatory officials conducted within the past year that uncovered a safety issue(s) with the Management Unit.

8. What is the surface area (acres) and total storage capacity of each of the management units? What is the volume of material currently stored in each of the management unit(s)? Please provide the date that the volume measurement(s) was taken. Please provide the maximum height of the management units(s). The basis for determining the maximum height is explained later in this Enclosure.

The Management Unit's surface area is approximately 1.0 acres and the total storage capacity is approximately 11,900 cubic yards. The capacity measurements were made as of 2009. The volume of material currently stored in the Management Unit is estimated today to be approximately 5,900 cubic yards. The Management Unit's Dam Height, pursuant to Enclosure A, is approximately 10 feet.

9. Please provide a brief history of known spills or unpermitted releases from the unit within the last ten years, whether or not these were reported to State or federal regulatory agencies. For

purposes of this question, please include only releases to surface water or to the land (do not include releases to groundwater).

There have been no known spills or unpermitted releases from the Management Unit within the last ten years.

10. Please identify all current legal owner(s) and operator(s) at the facility.

The current legal owner of the Lake Road Generating Station is KCP&L Greater Missouri Operations Company. The current operator of Lake Road Generating Station is KCP&L Greater Missouri Operations.

Appendix C

Technical Reports

R E P O R T

GEOTECHNICAL EVALUATION ASH POND – KCP&L GREATER MISSOURI OPERATIONS COMPANY

LAKE ROAD GENERATING STATION

Prepared for
KCP&L Greater Missouri Operations Company
1413 Lower Lake Road
P.O. Box 998
St. Joseph, Missouri 64502

February 2011

URS Corporation
8300 College Boulevard
Suite 200
Overland Park, Kansas 66210

Project No. 16530714

URS

February 21, 2011
URS Project 16530714

Mr. Charles Bruce
Kansas City Power & Light
Greater Missouri Operations Company
P.O. Box 998
St. Joseph, Missouri 64502

Re: Geotechnical Evaluation - Ash Pond
Lake Road Generating Station
St. Joseph, Missouri

Dear Mr. Bruce:

Transmitted with this letter is URS Corporation's report on our geotechnical evaluation of the ash pond at the referenced site. The scope of our evaluation included a breach impact analysis, seepage and slope stability analysis, and analysis of the pond's principal spillway.

We appreciate the opportunity to work with you on this project. If you have any questions regarding this report, please call.

Very truly yours,
URS Corporation

Greg Sanders, P.E.
Staff Engineer

Brian D. Linnan, P.E.
Project Manager

STATE OF MISSOURI
BRIAN D. LINNAN
NUMBER E-28261
REGISTERED PROFESSIONAL ENGINEER

Enclosure

URS Corporation
8300 College Boulevard
Suite 200
Overland Park, KS 66210
Tel: 913.344.1000
Fax: 913.344.1011

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Attachments

Attachment 1 Historic Ash Pond Design and Embankment Quality Control Records
Drawing 1 - 1977 Black & Veatch Drawing – Structural Ash Storage Plans and Details – Sheet S1601
Drawing 2 - 1977 Black & Veatch Drawing – Structural Ash Storage Sections and Details – Sheet S1602
Specification Section 2B – Earthwork and Trenching
Exploratory Borings Location and Logs
Embankment Quality Control Records
Attachment 2 Hydrology and Hydraulics Calculations

This report contains the results of URS Corporation's evaluation of the existing ash ponds at KCP&L Greater Missouri Operations Company's (KCP&L GMO) Lake Road Generating Station located at 1413 Lower Lake Road, St. Joseph, Missouri. The site location is shown in Figure 1. The evaluation was made to assess:

- The stability of ash pond embankments
- Seepage conditions in the embankments and their impact on stability
- Internal drainage of the ash ponds
- The impacts of a breach of ash pond embankments on the surrounding area

Our investigation included drilling exploratory borings, conducting geotechnical tests on embankment and foundation materials, installing piezometers to measure groundwater levels, reviewing design drawings and records provided by KCP&L GMO showing the details of the original ash pond design, conducting engineering analyses, and preparing this report. All of the field and laboratory data collected for this report and the drawings and records showing the original ash pond design are included in this report.

2.1 ASH POND DESIGN AND CONSTRUCTION

Records provided by KCP&L GMO show that the ash pond system is a designed and engineered facility. Design details of the original ash pond are shown on Sheets S1601 and S1602 of plans prepared by Black & Veatch dated 1977. Copies of these sheets are included in Attachment 1 to this report. The plans show that the current ash pond system was constructed over the footprint of an existing ash pond and was formed by constructing embankments. General Note 4 on Sheet S1601 states "The existing ash beneath the new dike is to be completely excavated and removed." The project specifications required that fill placed for embankment construction be placed in loose lifts not exceeding 8 inches in thickness and that the material be compacted to at least 95 percent of the maximum Standard Proctor density. The water content of the soil at the time of compaction was required to be in the range between -1 to +3 percent of the optimum water content. The earthwork specifications for the project are included in Attachment 1.

The specifications required that compaction tests be conducted on the fill at a frequency of one test per 1,000 cubic yards of material placed. Records provided by KCP&L GMO include the results of two Standard Proctor compaction test on fill materials and the results of four in-place density tests on soils placed in the embankments. The test results are included in Attachment 1 and show that the compaction criteria were met.

The plans for the ash pond system show that it originally consisted of two ponds, an ash pond on the north (the north ash pond) and a settling basin to the south. The north ash pond and settling basin are divided by an earthen separating dike. The north ash pond is shown to have a ten-foot wide top width, 2.5H:1V sideslopes, and a six-inch thick gravel surfacing. Top of embankment and bottom of pond elevations are shown as 816 and 806 feet, respectively. The top width, slopes, and top of embankment elevation of the separating dike are the same as shown for the north ash pond embankment.

Plans for the settling basin show a top of embankment elevation of 812 feet, a top width of 10 feet, 2.5H:1V sideslopes, and a bottom elevation of 806 feet. The embankment is shown to be surfaced with a six-inch thick layer of crushed rock.

Cross Section 18 on Sheet S1602 shows that water flows from the north ash pond to the settling basin through a section of the separator dike backfilled with 1½ to 2-inch clean filter stone. The filter stone extends from elevation 806, the bottom of the north ash pond and settling basin, to elevation 816, the top of the separate dike embankment.

The discharge for the pond system consists of a principal spillway located along the east embankment of the settling basin, as shown on Sheet S1062 of the 1977 Black & Veatch plans and in Figure 2. The principal spillway consists of a concrete riser equipped with stop logs that can control the water surface from the bottom of the basin to approximately elevation 812 feet. A 12-inch diameter reinforced concrete pipe (RCP) with an invert elevation of 803.5 feet conveys water from the spillway to a canal south of the settling basin. This canal flows west to a culvert beneath a levee and into another canal (Brown's Branch) that flows into the Missouri River (see Figure 2).

A gatewell structure is located at the top of the levee as shown on Figure 2. The gates to the culvert are closed at the gatewell structure during periods of high river stage to keep river water out of the ash pond area.

2.2 ASH POND MODIFICATIONS

The current configuration of the ash pond system is shown in Figure 2. The original ash pond has been divided into two ponds by a separator dike constructed in the late 1970's. We understand from KCP&L GMO that the dike was initially constructed using ash and later that clay was mixed with the ash to reduce seepage through the dike. A separator dike was also constructed in the late 1970's in the settling basin. This dike was constructed primarily from clayey soil. Riprap was placed along the south slopes of the settling basins embankment in December 2010 to repair minor erosion of the embankment and to protect the embankment surface against future erosion due to fluctuations in canal levels.

2.3 INFLOW AND DISCHARGE

Four pipes discharge into the ash ponds, three into the west pond and one into the east pond. The source and flows from the pipes are listed below:

Source	Receiving Ash Pond	Flow (MGD) Average	Flow (MGD) Maximum
River water used for transporting ash to ash pond	East	0.096	.794
	West	0.032	0.265
Coal Pile Runoff	West	.006	.157
Sluice water for softener to pond	West	0.036	0.080
Concentrate discharge from Reverse Osmosis	West	0.128	.648

The inflow pipes discharge into the north end of the ash ponds as shown in Figure 2. Water in the west ash pond flows through the gravel filter in the divider dike into the west settling basin. Water in the west settling basin flows through a gravel filter into the east settling basin, then into the principal spillway.

Water that enters the east ash pond flows into the east settling basin through a gravel filter in the dividing dike, then into the principal spillway.

3.1 SITE RECONNAISSANCE

URS Corporation conducted a visual reconnaissance of the site on November 15, 2010 to observe the ash ponds and stilling basins operations and features and to select locations for exploratory borings. The embankments were observed to be in good condition. No cracking at the top of the embankment or bulging at the toe or other signs of potential instability were observed. We did observe that the south slope of the settling basins embankment had become over-steepened through erosion and that the riprap at the principal spillway outlet was largely gone. These areas were repaired in December 2010; repairs included placing riprap at the principal spillway outlet and along the south embankment of the settling basins from the channel to the top of the slope.

3.2 EXPLORATORY BORINGS AND PIEZOMETERS

Five exploratory borings, B-101 through B-105, were drilled at the site between January 4 and 6, 2011. Boring locations are shown on Figure 2. The borings were drilled on top of the embankments using hollow stem augers or wash boring techniques. Soil samples were collected at 5-foot intervals at each boring by driving a split barrel sampler in accordance with Standard Penetration Test (ASTM D-1586) procedures. Piezometers were placed in Borings B-102 and B-104 upon completion; the other borings were backfilled with granular bentonite.

A geologist or geotechnical engineer from URS was on-site full-time during drilling to direct sample collection and prepare boring logs. Logs of the exploratory borings and completion reports for piezometer installation are included in Appendix A. The exploratory boring logs have been modified based on the results of laboratory tests conducted to classify the soils.

3.3 LABORATORY INVESTIGATION

Selected samples of soil were tested in our Overland Park, Kansas laboratory to assist in the classification of the soils encountered and to evaluate their engineering properties. The tests included water content, particle size analyses, and Atterberg limits. A summary of the laboratory test results is included in Appendix B.

4.1 SUBSURFACE MATERIALS

Generalized graphical logs showing the soil types and groundwater levels in the exploratory borings are shown on Figure A-1 in Appendix A. Fill composed primarily of stiff, high plastic clay was encountered beneath a thin gravel surfacing at each of the boring locations. Standard Penetration Test N values (N_{SPT}) in the fill ranged between 3 and 8 blows per foot; measured water contents ranged between 26.9 and 35.6. Measured liquid limits ranged between 52 and 77. The fill extends to depths ranging between 8 and 12.5 feet below ground surface at the boring locations. Bottom of fill elevations range between 800 and 806 feet.

Native low plastic silt or silty clay is present beneath the fill at each boring location. This finding is consistent with the note on the ash pond design drawings that specified that ash be removed from beneath the footprint of the pond embankment. The native silt or silty clay is typically soft, having measured N_{SPT} values ranging between 2 and 7. Measured water contents ranged between 32.3 and 32.6. One Atterberg limit test was conducted on the material; a liquid limit of 32 and a plasticity index of 8 were measured. The silt or silty clay extends to depths ranging between 16 and 26 feet below ground surface at the boing location. The bottom elevation of the silt ranges between 796 and 786 feet at the boring locations.

A 3 to 4-foot thick layer of clay is present beneath the silt or silty clay at Borings B-101, B-104, and B-105. The clay is high plastic at B-101 and B-105 and low plastic at B-104. Sand is present beneath silt or silty clay at Borings B-102 and B-103 and beneath clay at B-101, B-104, and B-105. Typically, the upper portion of the sand is silty, classifying as a SM in accordance with the Unified Soil Classification System (USCS). With depth, the fines content of the sand typically decreases, and the sand classifies as SP in accordance with the USCS. The sand encountered is typically medium dense having measured N_{SPT} values ranging between 10 and 18.

4.2 GROUNDWATER LEVELS

Groundwater entered Brings B-102 through B-105 at time of drilling at depths ranging between 13 and 19 feet below ground surface. The elevations of water entry ranged between 792 and 800 feet. The measured phreatic surface is in the native silt or silty clay soils present beneath the ash pond embankments.

The two piezometers installed for this project are screened across the silt and silty clay layer and terminate in the underlying sand. Water levels measured in the piezometers are listed below along with the Missouri River Stage recorded by the U.S. Geological Survey (see http://www.waterwatch.usgs.com) on January 26, 2011:

Piezometer No.	Water Level Elevation (feet) 01/26/2011
B-102	800
B-104	795
Missouri River Stage	795

Groundwater levels and the river stage are close to the same elevation, indicating that the water level in the sand beneath the ash pond follows the river stage.

5.1 ASH POND AND SETTLING BASIN STORAGE

The ash ponds receive water and solids from the plant activities and from precipitation; runoff from outside the area does not enter the pond. The exception is runoff from the coal pile that enters the west ash pond. The ash ponds receive flow from the plant at the northern end of the ponds. An interior dike with a north-south orientation separates the original ash pond into two approximate equal size ponds each receiving flow directly from the plant. The elevation of the dike surrounding the ash ponds is approximately 816 feet.

The stage-storage relationship for the ash pond was calculated from the original (1977) construction documents prepared by Black and Veatch. The original construction drawings did not include the interior dike mentioned above; consequently, the calculated volumes listed below represent a conservative value for the ash pond.

Water Elevation in Pond (ft)	Cumulative Storage Ash Pond (Ac-ft)
806	0.00
807	1.16
808	2.38
809	3.65
810	4.97
811	6.34
812	7.77
813	9.26
814	10.80
815	12.40
816	14.06

The settling basins receive flow from the ash ponds via rock filled gravel filters located at the south end of the ash ponds.

The stage-storage relationship for the settling basin was calculated from the 1977 construction documents prepared by Black and Veatch. The original construction drawings did not include the interior dike mentioned above and as such, the calculated volumes listed below represent a conservative value for combined lower basins.

Water Elevation in Basin (ft)	Cumulative Storage Settling Basin (Ac-ft)
806	0.00
807	0.43
808	0.90
809	1.41
810	1.95
811	2.52
812	3.13

5.2 INFLOWS

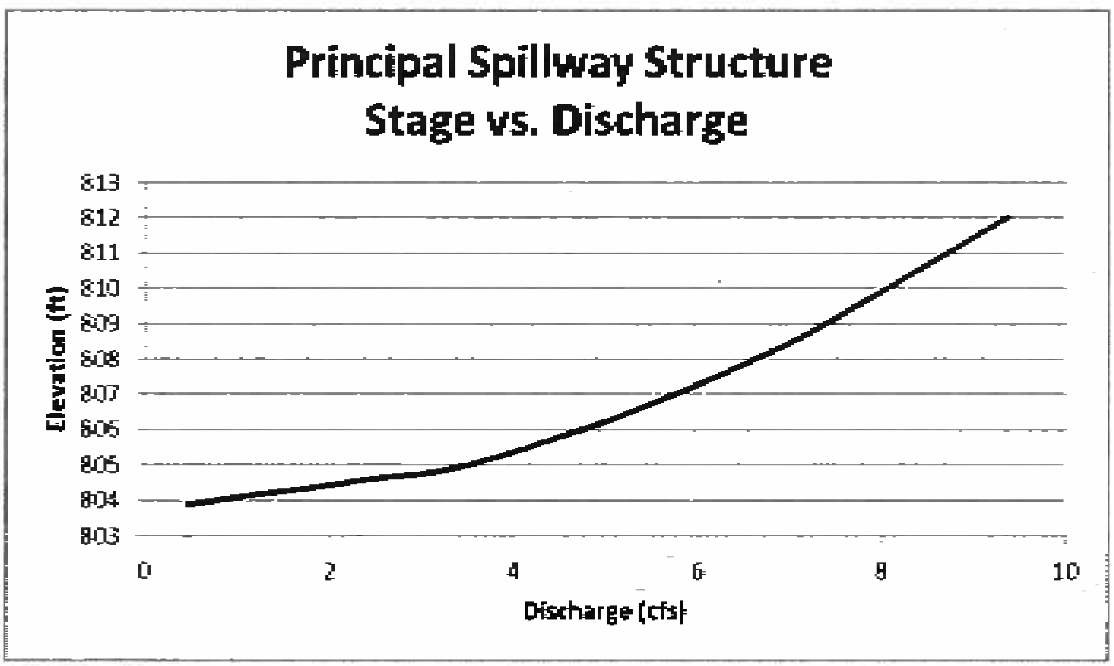
The ash ponds inflow estimated by KCP&L GMO ranges between an average of 0.298 MGD (0.46 cfs) to a maximum of 1.944 MGD (3.01 cfs); this flow includes both water and solids.

The 25-year rainfall event was selected to analyze the performance of the spillway when precipitation was added to the daily flows from the plant. The precipitation value for the 25-year, 24-hour storm event is 6 inches according to the NCRS WinTR-55 Small Watershed Hydrology software, Ver, 1.00.08.

The peak runoff rate produced by the design storm was calculated using the Rational Method (see Attachment 2 for calculations); peak flows of 16.3 cfs were calculated for the ash pond, a peak flow of 5.99 cfs was calculated for the settling basin.

5.3 DISCHARGE ANALYSIS

The principal spillway, located in the east settling basin, is a concrete structure equipped with stop logs that allow the water surface in the basin to range between 806 (the basin bottom) and 812 feet. A 12-inch diameter RCP with an invert elevation of 803.5 feet conveys water from the inlet to the discharge canal. The principal spillway was evaluated using the Federal Highway Administration's HY-8 Culvert Analysis software, version 8.7.1. The model was performed with the pipe operating under inlet control. The calculated stage-discharge curve for the principal spillway is shown below:



Average and maximum daily plant flows are 0.46 cfs and 3.01 cfs, respectively. The stage discharge curve above shows that the principal spillway will readily pass these flows.

Analyses were also made to check the ability of the principal spillway to pass the plant flows along with the 25-year, 24-hour storm event. The combined average plant flows and storm produces a flow rate of 22.75 cfs, the combined maximum plant flows and storm event produce a flow of 25.3 cfs.

Our calculations show that the principal spillway cannot pass these combined flows. Consequently, calculations were made to evaluate the required storage in the ash ponds under the assumption that the ash ponds would store the precipitation event while plant flows plus precipitation within the settling basins pass through the principal spillway. Under the stated conditions, the spillway would discharge 9.0 cfs at a water surface elevation of 811.38; therefore, a freeboard of approximately 0.52 feet would be maintained at the settling basin during the design storm.

Our calculations show that the ash ponds could store the 25-year 24-hour store with 0.5 feet of freeboard if water levels in the pond are at or below elevation 814.92 feet. We conclude that an emergency spillway is not required as long as water levels in the ash ponds are maintained at or below this elevation. At the time of our review, the ash ponds were below that level.

The SEEPW software program was used to calculate the theoretical phreatic surface that could develop within the embankments. The analyses were made assuming that the water level in the settling basins is at the current inlet elevation of the principal spillway (Elev. 812 feet). A water level differential of approximately 2.5 feet existed between settling basins and the ash ponds at the time of our investigation. Consequently, the water surface elevation in the ash ponds was assumed to be 814.5 feet.

Input and graphic output files from the SEEPW program are included in Appendix C. The analyses show a theoretical phreatic surface within the embankment. The information from the piezometers and exploratory borings drilled for this project show that current groundwater levels are below the embankment. The embankment materials consist of high plastic clays placed under water content and density control. We conclude that infiltration through the embankments is slow and limited and that the embankments are effectively controlling seepage.

7.1 SECTIONS ANALYZED

Stability analyses were made at the three section locations, A-A through C-C, shown in Figure 2, Section A-A is located at Boring B-102 and the slope is composed of high plastic and a rip rap protective cover recently added to the embankment. The section passes through the existing canal south of the ash pond. The embankment is at its maximum height along this section. Section B-B is located at Boring B-103. The area west of this boring consists of a shallow drainage ditch located between the settling basin embankment and the nearby levee. Section C-C is located at Boring B-105. The area east of this boring consists of fuel oil tank and containment area.

The ground surface elevations at all of the sections were obtained from survey data provided by Midland Surveying in January 2011.

7.2 SHEAR STRENGTH AND SEISMIC FORCE SELECTION

The ash ponds have been in service for many years and the rate of sediment loading is slow. Consequently, drained shear strengths of the embankment and foundation soils are applicable for steady state stability analysis. The exploratory borings show that the embankments consist of high plastic clay. Measured liquid limits on samples of the embankment soils tested ranged between 52 and 77. Measured plasticity indices ranged between 37 and 56. The drained friction angle of the embankment soils used for stability analyses, 26 degrees, was obtained from the correlation between friction angle and plasticity index presented in Stark et al[1]. The high plastic clay is the weakest material encountered at the boring locations. For the purpose of the stability analysis, it was assumed that this material extended horizontally at the depth shown on the borings.

Shear strengths for the silts and sands present beneath the high plastic clay were obtained from typical values for silts and sands published by the U.S. Army Corps of Engineers for levee projects[2].

Stability analyses for the rapid drawdown case were analyzed using two shear strength envelopes, the drained envelope identified above and an undrained envelope calculated using zero friction and a cohesion of 1,000 psf selected based on the N_{SPT} values in the embankment and underlying native soils.

Seismic forces for the stability analysis were obtained from the 2008 National Seismic Hazard Maps published by the United States Geological Survey (USGS), (see http://gldims.cr.usgs.gov/website/nshmp2008/viewer.htm. The acceleration listed in this publication for the site area is 0.0183g (10% probability of exceedance in 50 years) and this value was used in our analysis.

---

[1] Stark, Timothy D., Choi, Hangseok, and McCone, Sean. Drained Shear Strength Parameters for Analysis of Landslides. Journal of Geotechnical and Geoenvironmental Engineering, Vol. 131, No. 5, May 1, 2005.

[2] USACE Design Guidelines – Hurricane and Storm Damage Risk Reduction Systems, June 2008.

7.3 GROUNDWATER LEVELS

As discussed in Section 6 of this report, measured groundwater levels are below the embankment. For the purpose of slope stability analyses, however, it was assumed that the water level in the embankments was at their theoretical calculated level. Since this level is above the current water levels, the assumption is conservative and results in calculated safety factors that are lower than those that would be calculated using current groundwater levels.

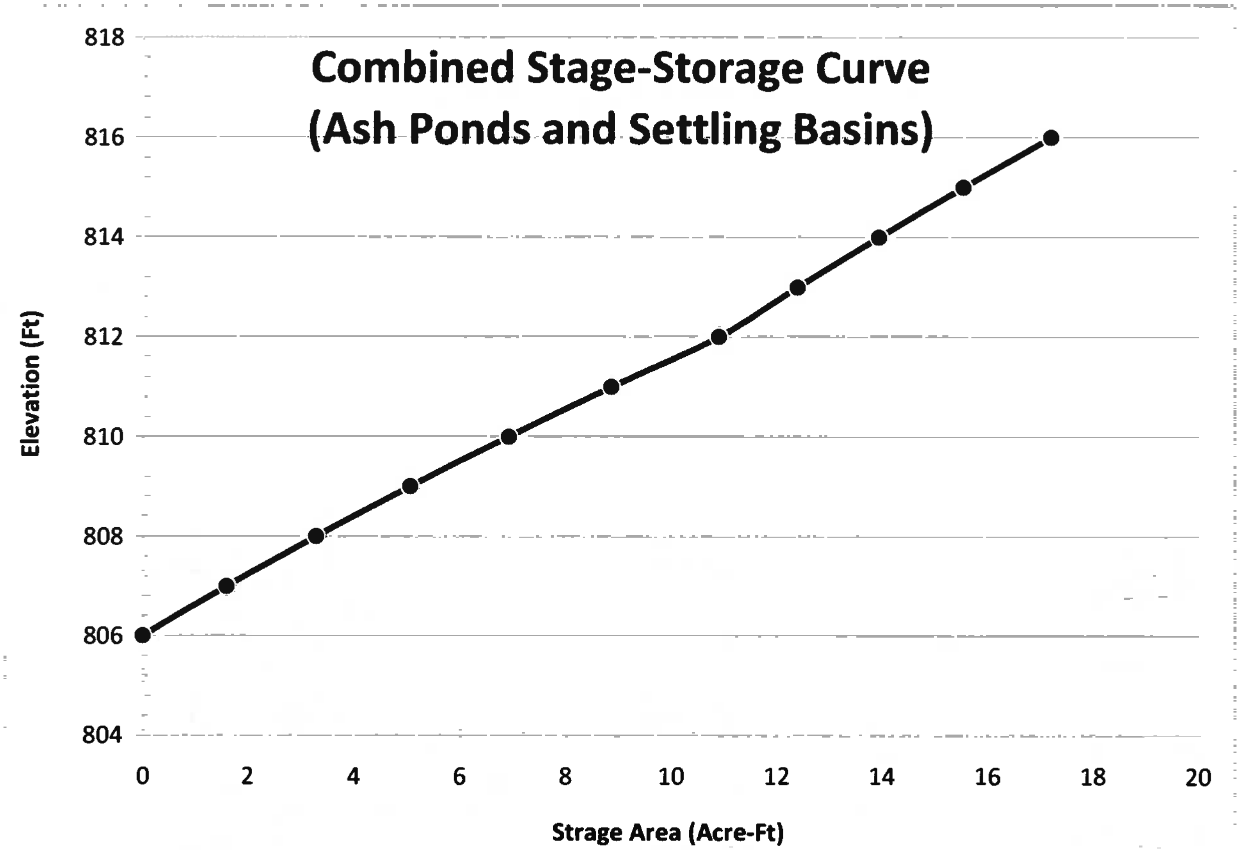
7.4 RESULTS OF STABILITY ANALYSES

Stability calculations were made using the SLOPEW computer software for three conditions: steady state with seepage, steady state seepage with seismic loading, and rapid drawdown. Selected sections were also analyzed using the UTEXAS3 software program to confirm the results. Analyses were made for circular and block (wedge) failure surfaces. Output from the slope stability analyses showing the ground surface profile, groundwater levels, soil layers and their assumed engineering properties, the location of the critical failure surface, and lowest calculated safety factor are provided in Appendix D. The results of the analyses are summarized below:

Section	Recommended Minimum Safety Factor (USACE)	Calculated Safety Factor – Steady State Seepage	
		Circular Surfaces	Wedge Surfaces
A-A	1.5	1.56	1.70
B-B	1.5	2.01	2.14
C-C	1.5	1.50	1.64
Section	**Recommended Minimum Safety Factor (FERC)**	**Calculated Safety Factor – Steady State Seepage with Seismic Forces**	
		Circular Surfaces	**Wedge Surfaces**
A-A	1.0	1.48	1.63
B-B	1.0	1.93	2.06
C-C	1.0	1.43	1.56
Section	**Recommended Minimum Safety Factor (USACE)**	**Calculated Safety Factor – Rapid Drawdown**	
		Circular Surfaces	**Wedge Surfaces**
A-A	1.1	1.53	1.69
B-B	1.1	1.55	1.74
C-C	1.1	1.19	1.31

The calculated safety factors meet the minimum safety factors recommended for dams by the United States Army Corps of Engineers (EM1110-2-1902) for the steady state seepage and rapid drawdown conditions and the minimum safety factor recommended by the Federal Energy Regulatory Commission (FERC) for the steady state seepage with seismic condition. We conclude that safety factors are adequate for the current ash pond configuration.

An analysis was made to evaluate the impact of a hypothetical breach of the embankments on the surrounding area. The amount of water released by a breach would depend on the water level in the ash ponds and settling basins at the time of the breach. A stage-storage curve was developed for the combined basin elevations as shown below:



The hypothetical analysis assumes both the ash ponds and the settling basins are at their maximum capacity, defined as the capacity at a water surface elevation equal to the top of the surrounding dike. The combined total storage capacity of the ash ponds and settling basins is 17.19 acre-feet. For the purpose of this analysis, it is assumed that the breach would release this volume of water.

The water released from the breach would flow to the south, filling the canal leading to the culvert under the levee. For the purposes of this analysis, it is assumed that the valve to the canal drainage way to the Missouri River is closed and the entire volume released would be contained on the east side of the levee. The water would accumulate in the canal, the drainage ditch on the southwest side of the settling basins, low laying area to the south of the ponds, the road ditch along the west side of Lake Road, and a portion of the facility grounds adjacent to Lake Road. Elevation of the inundation area will be approximately 810.5 feet. The depth of water in the operational areas of the facility would not exceed 1 foot. The theoretical inundation would overtop a small portion of Lake Road, but the depth of water would only be several inches. The potential inundation area is show on Figure 3.

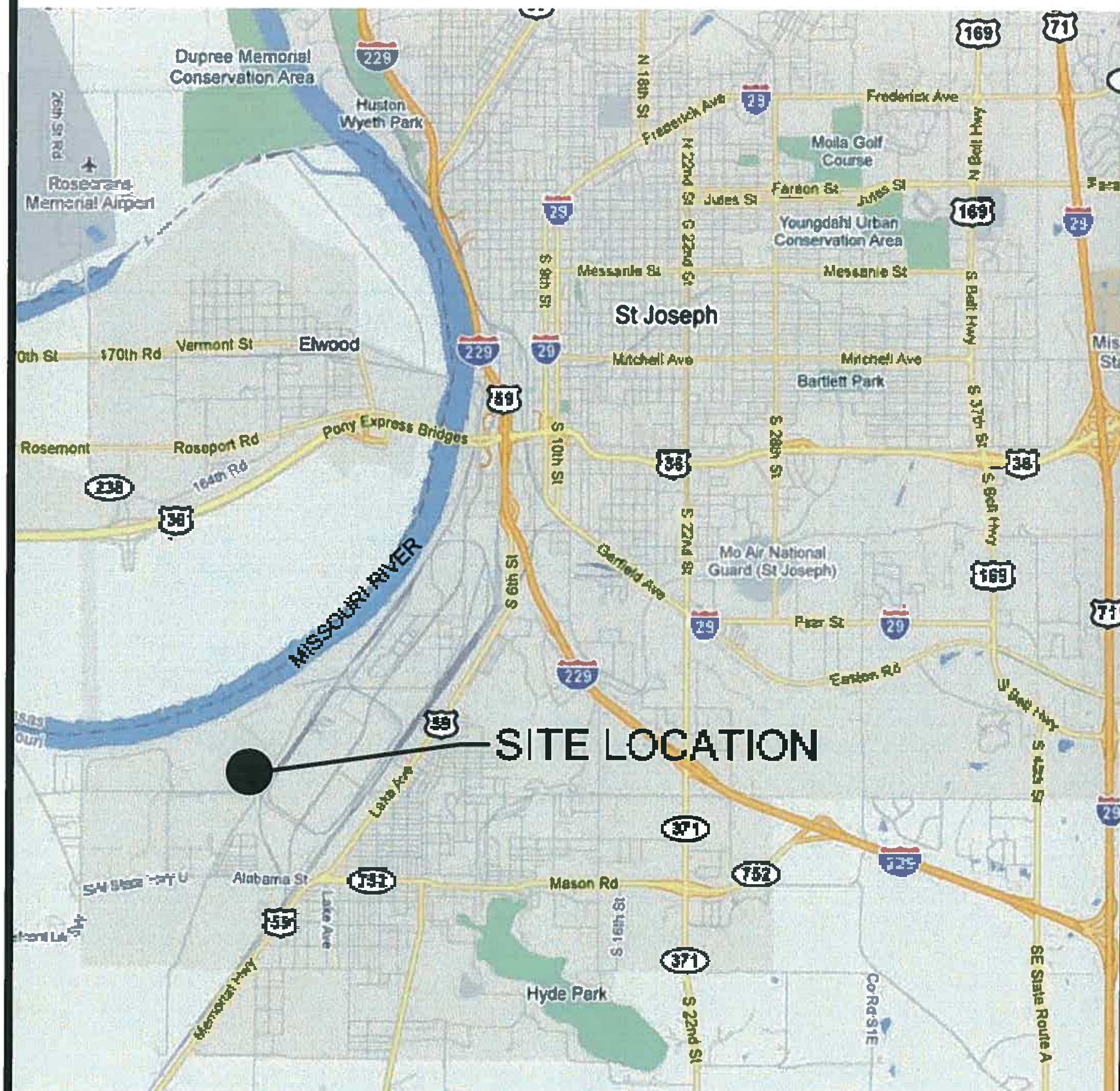
We offer the following conclusions based on our field and laboratory investigations, engineering analysis, and experience:

1. Records retained in KCP&L GMO's files and provided to URS show that the ash ponds and settling basins are designed and engineered structure and that the embankments that form the ponds and basins were constructed under water content and density control.
2. The data from the exploratory borings shows that the embankments are founded on native soils. The general subsurface profile at the boring locations consists of high plastic clay embankment materials over native soils composed of silt and silty clay. Sand is typically present beneath the silt and silty clay and extends to the bottom of the exploratory borings drilled for this project. Measured groundwater levels are in the native silt and silty clay below the embankment.
3. Piezometers installed for this project are screened across the silt and silty clay layer and extends into the underlying sand. The observed water levels in the piezometers are close to the Missouri River Stage, indicating that the water levels in the sand beneath the ash ponds and settling basins follow the Missouri River Stage.
4. A comparison between the water levels in the embankments measured in the boring logs and piezometers and the theoretical phreatic surface consistently show water levels below the theoretical phreatic surface. We conclude that infiltration through the embankments is slow and limited and that the embankments are effectively controlling seepage.
5. Analyses were made to assess the stability of the existing embankments under three conditions: steady state seepage, steady state seepage with seismic forces, and rapid drawdown. The analyses were made with the conservative assumption that the water levels were in the embankment at their calculated theoretical level. The calculated safety factors meet the minimum safety factors recommended for dams by the U.S. Army Corps of Engineers for the steady state seepage and rapid drawdown conditions and the minimum safety factor recommended by FERC for the steady state seepage with seismic forces condition. We conclude that safety factors are adequate.
6. The principal spillway for the ash ponds consists of a concrete box structure fitted with stop logs capable of holding a water surface elevation between 806 feet, the bottom of the basin, and 812 feet, the top of the embankment. Discharge from the spillway is through a 12-inch diameter RCP. Our calculations show that the principal spillway is capable of discharging the average and maximum plant flows. Our calculations also indicate that the ash ponds and settling basins will not be overtopped by a 25-year 24-hour storm provided that the water level in the ash ponds is maintained at or below elevation 814.92. Provided this can be accomplished, an emergency spillway is not necessary.
7. An analysis was conducted to assess the impacts of a hypothetical breach of the ash ponds and settling basins embankments. The analysis assumed that the entire volume contained in the ash ponds and settling basins is released instantaneously. The inundation area covers a portion of the plant with a water depth less than one foot. The theoretical inundation overtops a small portion of Lake Road, but the depth of water over the road is expected to be only several inches.

The conclusions and recommendations presented in this report are based on the assumption that significant variations in soil properties from those encountered by our investigation do not occur. Borings have been placed at planned, selected locations, but some variation in soil properties between the borings probably exists. If conditions are notably different from those described, we should be immediately notified.

The conclusions and recommendations given in this report are based on our analysis of the data collected for this project. Additive conclusions or recommendations made from these data by others are their responsibility. Our assessment is based on observations of current conditions. We note that planned, periodic visual inspections of the ash pond are important to identify any changes from present conditions that may require data maintenance.

Our services were provided in a manner consistent with the level of care and skill ordinarily exercised by other professional consultants under similar circumstances. No other representation is intended.



N

URS	8300 College Blvd., Suite 200 Overland Park, Kansas 66210	
CLIENT: KCP&L GMO		
LOCATION: LAKE ROAD GENERATING STATION, ST JOSEPH, MO.		
TITLE: SITE LOCATION MAP		
DRAWN BY CTD	CHECKED BY GWS	APPROVED BY BOL
PROJECT NO. 16530714	DATE FEB 2011	FIGURE NO. 1

February 18, 2011 2:09.22 pm (mik)
J:\KCPL Lake Road\Site Location.dwg

URS 8300 College Blvd. Suite 200
Overland Park, KS 66210

CLIENT:	KCP&L GMO
LOCATION:	LAKE ROAD GENERATING STATION ST. JOSEPH, MISSOURI
TITLE:	ASH POND FEATURES AND EXPLORATORY BORING LOCATIONS

DRAWN BY	CHECKED BY	APPROVED BY
IJP	BDL	BDL
PROJECT No.	DATE	FIGURE NO
16530714	FEBRUARY 2011	2

Legend

Cross Section for Stability Analysis

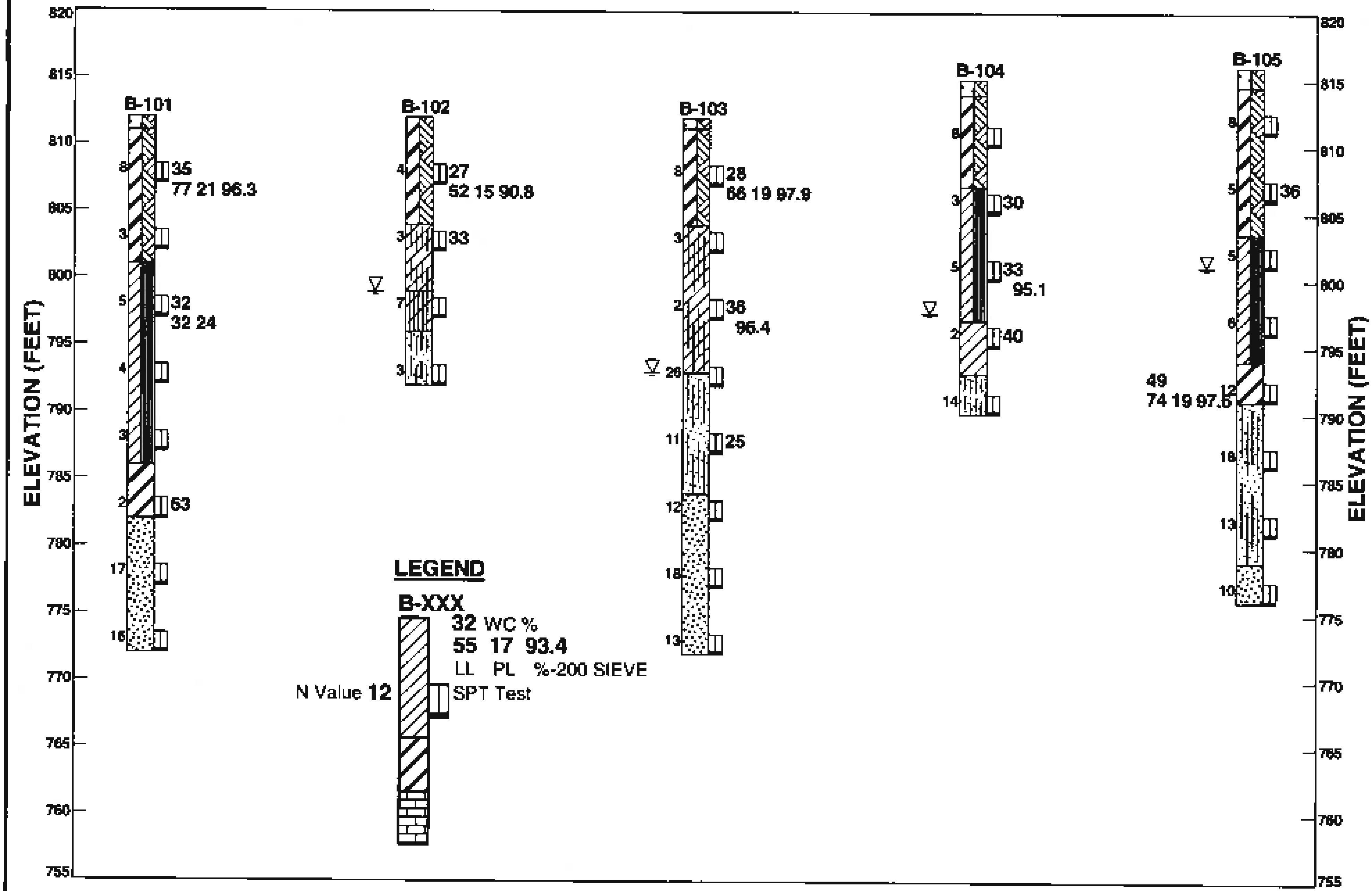
B-101
Exploratory Boring
Location and Number

N W E S

1 inch = 65 feet

0 32.5 65 130 Feet


West Inflow Pipe
East Inflow Pipe
B-104
West Ash Pond
East Ash Pond
Separator Dike
B-105
Gravel Filter
Divider Dike
Gravel Filter
Gravel Filter
B-103
West Settling Basin
East Settling Basin
Separator Dike
Principal Spillway
B-101
B-102
Principal Spillway Discharge
Drainage Ditch
Gatewell Structure
Levee Road
Levee Road
Canal
Lake Rd.
Lake Rd.
Imagery: Buchanan County GIS,
St. Joseph SID Mosaic-2008 http://www.buchanancomogis.com/
Legend
Potential Inundation Area
B-101 Exploratory Boring Location and Number
1 inch = 65 feet
0 37.5 75 150 Feet
N E S W
URS
8300 College Blvd. Suite 200
Overland Park, KS 66210
CLIENT: KCP&L GMO
LOCATION: LAKE ROAD GENERATING STATION ST. JOSEPH, MISSOURI
TITLE: POTENTIAL INNUNDATION AREA
DRAWN BY IJP
CHECKED BY BDL
APPROVED BY BDL
PROJECT No. 16530714
DATE FEBRUARY 2011
FIGURE NO 3



URS

8300 College Blvd.
Suite 200
Overland Park, Kansas 66210

KCP&L GMO Lake Road Generating Station
Ash Pond Investigation
St. Joseph, Missouri
GENERALIZED GRAPHICAL BORINGS

Project Number	Date
16530714	2/8/2011
Checked By	Figure No.
	A-1

BORING LOG NOMENCLATURE SHEET

TERM	IDENTIFICATION AND DESCRIPTION
SPT	Split-Spoon Sample (Standard Penetration Test). A 2-inch O.D., 1.5-inch I.D., split-barrel, 18 to 30-inch long sampler is driven by blows from a 140-pound hammer falling 30-inches. The number of blows required to advance the sampler three 6-inch increments are counted (See Sampling resistance below).
C	California Sample: Thick-wall sampler containing four nominal 2-inch diameter, 4-inch long brass liners. The sampler is hydraulically pushed a maximum of 12 inches.
ST	Shelby Tube sample: Hydraulically pushed, 3-inch diameter, thin-walled tube used for obtaining undisturbed soil samples.
CME	CME 3-inch diameter continuous soil sampling system.
PS	Nominal 3-inch diameter Shelby tube piston sampler
D	Disturbed sample or auger cuttings
NX	NX-size (2.155-inch diameter) rock core sample obtained using a diamond bit and recirculating water (See RQD below).
PP	Pocket Penetrometer measurement indicative of soil unconfined compressive strength (ksf).
TV	Torvane measurement of soil shear strength (tsf).
W %	As-received water content (percent)
LL, PL	Liquid Limit, Plastic Limit
PI	Plasticity Index
USC	Unified Soil Classification
Qu	Unconfined compressive strength (ksf).
RQD	Rock Quality Designation: The sum of the lengths of intact core pieces 4 or more inches (10 cm) in length, measured along the center line of the core, and expressed as a percentage of the length cored.
REC	Recovery: The length of recovered soil or rock sample expressed as a percentage of the sample length or depth cored.
▽	Point of groundwater entry
▼	Stabilized groundwater level at some time after drilling.

SAMPLING RESISTANCE

P	Sampler pushed by hydraulic system.
3 6 9	Numbers indicate the number of blows from a 140-pound hammer falling freely for 30 inches required to drive the SPT sampler 6 inches. The SPT test result, N-value, or blow count, is the number of blows required to drive the sampler the last 12 inches. The N value for this example is 15.
50/2"	The split-spoon sampler was driven 2 inches by 50 blows; the Standard Penetration Resistance, or N-value, is set at 100.

ABBREVIATIONS USED

HSA	Hollow-Stem Auger
SSA	Solid-Stem Auger
ATD	At the time of drilling
AD	After Drilling
DWL	Drill Water Loss
DWR	Drill Water Return
NAD	None After Drilling
NATD	Not at time of drilling

The relative density of coarse-grained soils (sands and gravels having less than 50 percent passing the number 200 sieve) is indicated by the uncorrected SPT test result (N-Value or blow count) in accordance with the relationships given below:

RELATIVE DENSITY	BLOW COUNT (N-VALUE)
Very Loose	0 to 4
Loose	5 to 10
Medium Dense	11 to 30
Dense	31 to 50
Very Dense	Greater than 50

The shear strengths of silts and clays (fine-grained soils having more than 50 percent passing the #200 sieve) are directly related to the torvane reading (TV) and my be taken to be equal to one half of the unconfined compressive strength (Qu) of the soil. Furthermore, the pocket penetrometer reading (PP) approximates Qu which is related to consistency and manual methods as indicated in the following table:

CONSISTENCY	UNCONFINED COMPRESSIVE STRENGTH (ksf)	BLOW COUNT (N-VALUE)
Very Soft	≤ 0.5	< 2
Soft	> 0.5 to 1	2 - 3
Medium Stiff	> 1 to 2	4 - 6
Stiff	>2 to 4	7 - 12
Very Stiff	> 4 to 8	13 - 26
Hard	> 8	26 +

Rock descriptions include weathering terms as indicated below:

	WEATHERING TERMS FOR ROCK
Fresh	No visible sign of rock material weathering
Slightly Weathered	Discoloration of rock and discontinuity surfaces; rock may be weaker than in its fresh condition.
Moderately Weathered	Up to half of the rock is decomposed to soil. Discolored or fresh rock is present as a continuous framework or as corestones.
Highly Weathered	More than half of the rock is decomposed to soil. Fresh or discolored rock is present either as a discontinuous framework or as corestones.
Completely Weathered	All rock material is decomposed to soil. The original mass structure is still largely intact.

The Graphical Key to Boring Logs shows the graphical symbols used on boring logs and generalized, geologic cross-sections of selected boring logs. The basic Unified Soil Classification System (USCS) designations are used for soils. The basic letter types are as follows: G - Gravels, S - Sands, M - Silts (M comes from the Swedish word mo for rock flour), W - Well graded, P - Poorly graded, C - Clay, H - High Plastic (fat), and L - Low Plastic (lean). Dual classification designations show the primary soil type throughout the graphic column, and the secondary soil type appears in the right half of the column. CL-CH, SP-GP, and GP-SP are examples.

TERM	MOISTURE CONDITION
Dry	Water content is less than the plastic limit
Moist	Water content is greater than the plastic limit, but the soil is relatively dry to the touch.
Wet	Soil exhibits free water or is obviously saturated.

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GRAPHICAL KEY TO BORING LOGS

SOIL TYPE	GRAPHICAL SYMBOLS				
GRAVELS	Well-Graded		Poorly-Graded		
	GW	GP-SP	GP	GM	GC
	GW-GM	GW-GC	GP-GM	GP-GC	GC-GM
SANDS	Well-Graded		Poorly-Graded		
	SW	SP-GP	SP	SM	SC
	SW-SM	SW-SC	SP-SM	SP-SC	SC-SM
SILTS and CLAYS	Silts		Clays		
	ML	MH	CL	CH	CL-ML
SPECIAL SYMBOLS	CL w/Sand	CH w/Sand	Low Plastic Till	High Plastic Till	Loess
ORGANIC SOILS	Organic Silts		Organic Clays		
	OL	OH	OL	OH	Peat
MISCEL-LANEOUS	Asphalt	Concrete	Topsoil	Fill	Void
IGNEOUS ROCKS	Granite	Breccia	Basalt	Lava	Tuff
METAMORPHIC ROCKS	Quartzite	Gneiss	Schist	Soapstone	Marble
SEDIMENTARY ROCKS	Limestone	Dolomite	Shale	Sandstone	Marl
	Coal	Conglomerate	Siltstone	Claystone	Chalk
MODIFIERS	Weathered	Calcareous	Cemented	Caliche	Chert
	These symbols may be overlaid on basic symbols to form new symbols. The fill symbol (see Miscellaneous above) may replace the right half of any primary (single-style) soil symbol to differentiate between fill types. The CL and CH symbols can be combined to represent medium plastic clays.				
DRILLING METHODS	Solid-Stem Auger	Hollow-Stem Auger	Tri-Cone/ Mud-Rotary	NX Rock Core	Rock Drilling

URS CORPORATION

URS GRAPHIC BORING LOG

B-101

PROJECT NAME:	KCP&L GMO Lake Road Generating Station	SHEET	1 OF 2
PROJECT LOCATION:	St. Joseph, Missouri	PROJECT NO:	16530714
LOGGED BY: T.L.Andrews	DRILLING CO: Geotechnology, Inc.	RIG:	Diedrich D50
SURFACE ELEVATION: 812 ft.	ELEVATION DATUM: NGVD	DATE:	1/4/2011
GROUNDWATER ENTRY: NATD	DELAYED GROUNDWATER: NAD	NORTH:	NA
OBSERVATIONS:		EAST:	NA

DEPTH (feet)	TYPE	RECOVERY	RQD LENGTH	REC/RQD (%)	RESISTANCE/N COMPONENTS	PP (KSF)	DESCRIPTION	SYMBOL	ELEVATION (feet)	FIELD NOTES
0							Fine to coarse GRAVEL (GP) with fine to coarse sand (fill)			Boring advanced with HSA
1.0							Stiff, moist, very dark grayish brown, high plastic CLAY (CH) (fill)		810	
5	SPT			83	2 3 5					
							Becoming soft, wet, gray		805	
10	SPT			61	2 1 2					
11.0							Soft, wet, grayish brown with yellowish brown, low plastic Silty CLAY (CL) to Clayey SILT (ML)		800	
15	SPT			67	1 2 3					Boring continues with mud rotary at 15'
									795	
20	SPT			17	4 3 1					
									790	
25	SPT			100	4 1 2					

URS

GRAPHIC BORING LOG

B-101

PROJECT NAME:	KCP&L GMO Lake Road Generating Station	SHEET	2 OF 2
PROJECT LOCATION:	St. Joseph, Missouri	PROJECT NO:	16530714
LOGGED BY:	T.L.Andrews	DRILLING CO:	Geotechnology, Inc.
RIG:	Diedrich D50	SURFACE ELEVATION:	812 ft.
ELEVATION DATUM:	NGVD	DATE:	1/4/2011
GROUNDWATER ENTRY:	NATD	DELAYED GROUNDWATER:	NAD
NORTH:	NA	EAST:	NA
OBSERVATIONS:			

DEPTH (feet)	TYPE	RECOVERY	RQD LENGTH	REC/RQD (%)	RESISTANCE/N COMPONENTS	PP (KSF)	DESCRIPTION	SYMBOL	ELEVATION (feet)	FIELD NOTES
25							Soft, wet, grayish brown with yellowish brown, low plastic Silty CLAY (CL) to Clayey SILT (ML) (to 26.0)			
26.0							Soft, wet, gray, high plastic CLAY (CH)		785	
28.5–30	SPT			100	1 1 1					
30.0							Grayish brown, fine to medium grained, poorly graded SAND (SP)		780	
33.5–35	SPT			56	6 8 9					
									775	
38.5–40	SPT			67	6 8 8					
40.0							BOTTOM OF BORING B-101 AT 40.0 FEET			Boring backfilled with bentonite chips
									770	
45										
									765	
50										

OVP3 W/NOTES 16530714KCPLGMOLAKE ROAD.GPJ CWF1.GDT 2/8/11

URS

GRAPHIC BORING LOG

B-102

PROJECT NAME: KCP&L GMO Lake Road Generating Station
SHEET 1 OF 1
PROJECT LOCATION: St. Joseph, Missouri
PROJECT NO: 16530714
LOGGED BY: T.L.Andrews
DRILLING CO: Geotechnology, Inc.
RIG: Diedrich D50
SURFACE ELEVATION: 812 ft.
ELEVATION DATUM: NGVD
DATE: 1/5/2011
GROUNDWATER ENTRY: 13 ft.
DELAYED GROUNDWATER: NAD
NORTH: NA
OBSERVATIONS:
EAST: NA

DEPTH (feet)	TYPE	RECOVERY	RQD LENGTH	REC/RQD (%)	RESISTANCE/N COMPONENTS	PP (KSF)	DESCRIPTION	SYMBOL	ELEVATION (feet)	FIELD NOTES
0							Stiff, moist, dark grayish brown, high plastic CLAY (CH) (fill)			Boring advanced with HSA
									810	
	SPT			56	1 2 2		Becoming grayish brown			
5							Becoming soft, wet		805	
8.0	SPT			78	2 1 2		Soft, wet, grayish brown, low plastic Silty CLAY (CL) to low plastic Clayey SILT (ML)			
10										Boring continues with mud rotary at 10'
									800	
13.0	SPT			100	3 3 4		Soft, wet, low plastic Clayey SILT (ML) with some fine sand	∇		
15										
16.0	SPT			100	2 2 1		Medium dense, moist, grayish brown with yellowish brown, fine grained, Silty SAND (SM)		795	
20							BOTTOM OF BORING B-102 AT 20.0 FEET			
									790	
25										

URS

GRAPHIC BORING LOG

B-103

PROJECT NAME: KCP&L GMO Lake Road Generating Station
SHEET 1 OF 2
PROJECT LOCATION: St. Joseph, Missouri
PROJECT NO: 16530714
LOGGED BY: T.L.Andrews
DRILLING CO: Geotechnology, Inc.
RIG: Diedrich D50
SURFACE ELEVATION: 812 ft.
ELEVATION DATUM: NGVD
DATE: 1/5/2011
GROUNDWATER ENTRY: 19 ft.
DELAYED GROUNDWATER: NAD
NORTH: NA
OBSERVATIONS:
EAST: NA

DEPTH (feet)	TYPE	RECOVERY	ROD LENGTH	REC/ROD (%)	RESISTANCE/N COMPONENTS	PP (KSF)	DESCRIPTION	SYMBOL	ELEVATION (feet)	FIELD NOTES
0							Fine to coarse GRAVEL (GP) with fine to coarse sand (fill)			Boring advanced with HSA
0.8							Medium stiff, moist, dark grayish brown, high plastic CLAY (CH) (fill)		810	
5	SPT			61	2 4 4					
8.0							Soft, wet, light grayish brown,low plastic Silty CLAY (CL) to Clayey SILT (ML)		805	
10	SPT			100	2 1 2					
15	SPT			89	1 1 1				800	
19.0	SPT			69	8 12 14		Medium dense, moist, grayish brown fine grained, Silty SAND (SM)	▽	795	
20										Boring continues with mud rotary at 20'
25	SPT			78	6 5 6				790	

OVP3 WI NOTES 16530714KCPL GMOLAKE ROAD.GPJ OVP1.GDT 2/8/11

URS | # GRAPHIC BORING LOG | **B-103**

PROJECT NAME:	KCP&L GMO Lake Road Generating Station	SHEET	2 OF 2
PROJECT LOCATION:	St. Joseph, Missouri	PROJECT NO:	16530714
LOGGED BY: T.L.Andrews	DRILLING CO: Geotechnology, Inc.	RIG:	Diedrich D50
SURFACE ELEVATION: 812 ft.	ELEVATION DATUM: NGVD	DATE:	1/5/2011
GROUNDWATER ENTRY: 19 ft.	DELAYED GROUNDWATER: NAD	NORTH:	NA
OBSERVATIONS:		EAST:	NA

DEPTH (feet)	TYPE	RECOVERY	RQD LENGTH	REC/RQD (%)	RESISTANCE/N COMPONENTS	PP (KSF)	DESCRIPTION	SYMBOL	ELEVATION (feet)	FIELD NOTES
25							Medium dense, moist, grayish brown fine grained, Silty SAND (SM)			
									785	
28.0							Medium dense, moist, grayish brown with yellowish brown, fine to coarse grained, poorly graded SAND (SP)			
	SPT			83	5 6 7					
30										
									780	
	SPT			100	5 8 10					
35										
									775	
	SPT			83	9 6 8					
40 (40.0)							**BOTTOM OF BORING B-103 AT 40.0 FEET**			Boring backfilled with bentonite chips
									770	
45										
									765	
50										

DWP3 W/ NOTES 16530714KCPLGMOLAKE ROAD.GPJ CYP1.GDT 2/8/11

URS

GRAPHIC BORING LOG

B-104

PROJECT NAME:	KCP&L GMO Lake Road Generating Station	SHEET	1 OF 1
PROJECT LOCATION:	St. Joseph, Missouri	PROJECT NO:	16530714
LOGGED BY: T.L.Andrews	DRILLING CO: Geotechnology, Inc.	RIG:	Diedrich D50
SURFACE ELEVATION: 815 ft.	ELEVATION DATUM: NGVD	DATE:	1/6/2011
GROUNDWATER ENTRY: 17.5 ft.	DELAYED GROUNDWATER: NAD	NORTH:	NA
OBSERVATIONS:		EAST:	NA

DEPTH (feet)	TYPE	RECOVERY	ROD LENGTH	REC/RQD (%)	RESISTANCE COMPONENTS	PP (KSF)	DESCRIPTION	SYMBOL	ELEVATION (feet)	FIELD NOTES
0							Fine to coarse GRAVEL (GP) with fine to coarse sand (fill)		815	Boring advanced with HSA
1.2							Stiff, moist, dark grayish brown, high plastic CLAY (CH) (fill)			
3.5–5	SPT			72	3 3 5					
5									810	
8.0							Soft, moist, grayish brown, low plastic Silty CLAY (CL) to Clayey SILT (ML)			
8.5–10	SPT			83	1 1 2					
10									805	
13.5–15	SPT			89	1 2 3		Becoming wet, very silty			
15									800	
17.5								▽		
18.0							Soft, wet, gray, low to medium plastic CLAY (CL)			
18.5–20	SPT			100	0 1 1					
20									795	
22.0							Medium dense, moist, yellowish brown, fine grained, Silty SAND (SM)			
23.5–25	SPT			56	4 6 6					
25.0									790	

BOTTOM OF BORING B-104 AT 25.0 FEET

GVP3 W/ NOTES 16530714KCPLGMOLAKEROAD.GPJ GVP1.SDT 2/8/11

URS

GRAPHIC BORING LOG

B-105

PROJECT NAME: KCP&L GMO Lake Road Generating Station
SHEET 1 OF 2

PROJECT LOCATION: St. Joseph, Missouri
PROJECT NO: 16530714

LOGGED BY: T.L.Andrews
DRILLING CO: Geotechnology, Inc.
RIG: Diedrich D50

SURFACE ELEVATION: 816 ft.
ELEVATION DATUM: NGVD
DATE: 1/6/2011

GROUNDWATER ENTRY: 15 ft.
DELAYED GROUNDWATER: NAD
NORTH: NA

OBSERVATIONS:
EAST: NA

DEPTH (feet)	TYPE	RECOVERY	ROD LENGTH	REC/ROD (%)	RESISTANCE/N COMPONENTS	PP (KSF)	DESCRIPTION	ELEVATION (feet)	FIELD NOTES
0							Fine to coarse GRAVEL (GP) (fill)	815	Boring advanced with HSA
1.5							Medium stiff, moist, light brown, high plastic CLAY (CH) (fill)		
5	SPT			89	1 4 4			810	
10	SPT			100	2 2 3			805	
12.5							Soft, wet, light grayish brown, low plastic Silty CLAY (CL) to Clayey SILT (ML)		
15	SPT			89	1 2 3		Becoming wet	800	
							Becoming very silty		
20	SPT			33	2 2 4			795	
22.0							Medium stiff, moist, gray, medium to high plastic CLAY (CH)		
25	SPT			94	1 3 9				
25.0									

DVP3 W NOTES 16530714KCPLGMOLAKE ROAD.GPJ DVP1.GDT 2/8/11

URS

GRAPHIC BORING LOG

B-105

PROJECT NAME: KCP&L GMO Lake Road Generating Station

PROJECT LOCATION: St. Joseph, Missouri

PROJECT NO: 16530714

LOGGED BY: T.L.Andrews

DRILLING CO: Geotechnology, Inc.

RIG: Diedrich D50

SURFACE ELEVATION: 816 ft.

ELEVATION DATUM: NGVD

DATE: 1/6/2011

GROUNDWATER ENTRY: 15 ft.

DELAYED GROUNDWATER: NAD

NORTH: NA

OBSERVATIONS:

EAST: NA

DEPTH (feet)	SAMPLE DATA: TYPE	RECOVERY	ROD LENGTH	REC/RQD (%)	RESISTANCE/ COMPONENTS	PP (KSF)	DESCRIPTION	SYMBOL	ELEVATION (feet)	FIELD NOTES
25							Medium dense, moist, brownish gray, fine grained, Silty SAND (SM)		790	
	SPT			72	9 9 9					
30									785	
	SPT			78	4 6 7		Becoming yellowish brown			
35									780	
37.0							Grayish brown, fine to coarse grained, poorly graded SAND (SP)			
	SPT			39	5 5 5					
40.0							**BOTTOM OF BORING B-105 AT 40.0 FEET**		775	
45									770	
50										

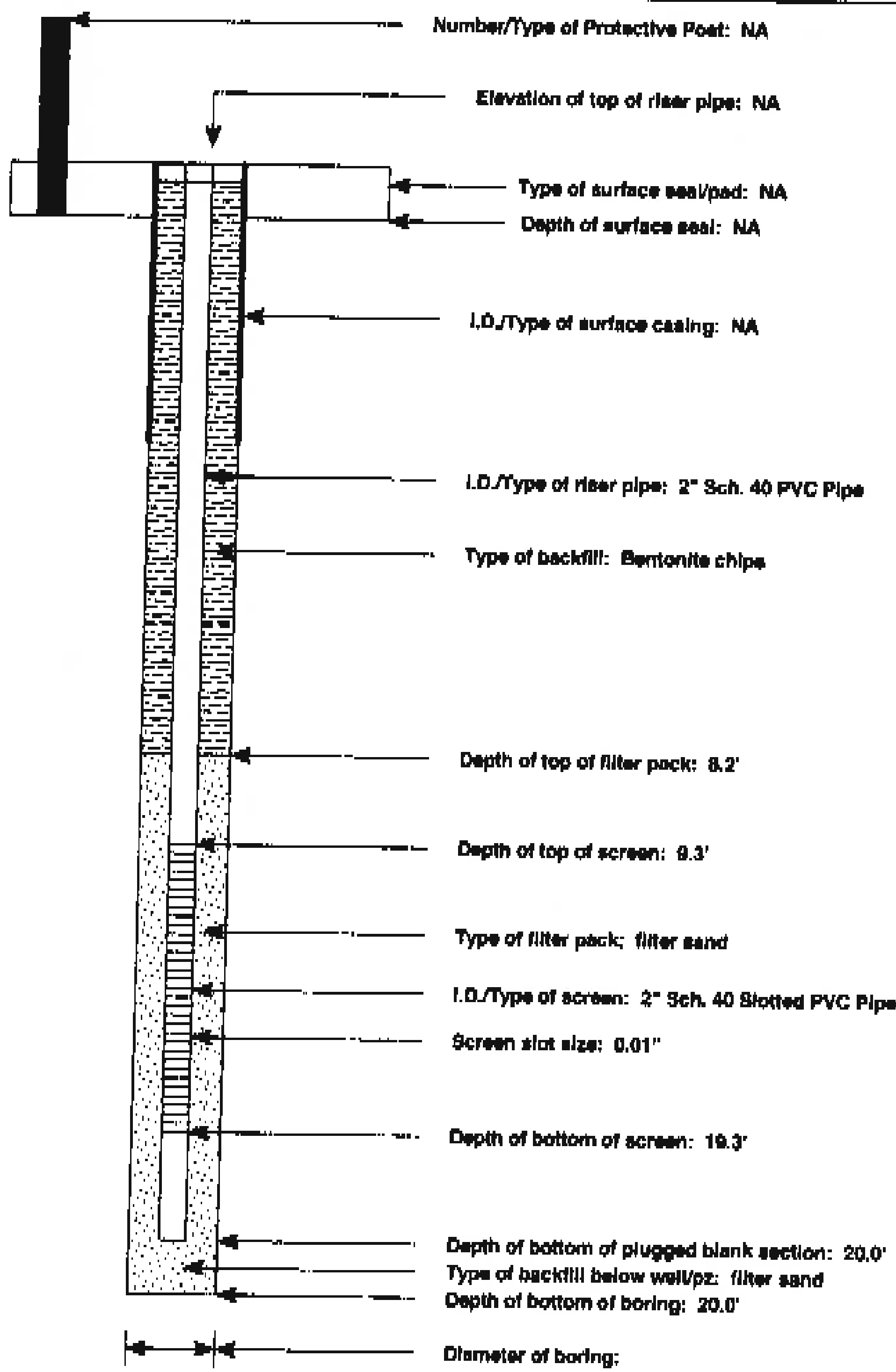
OVP3 W/ NOTES 16530714KCPLGMOLAKE ROAD.GPJ CVP1.GDT 2/8/11

GROUNDWATER MONITORING WELL/PIEZOMETER REPORT

PROJECT NAME: KCP&L GMO Lake Road Generating Station
PROJECT LOCATION: St. Joseph, Missouri
INSTALLED BY: Geotechnology, Inc.
INSPECTED BY: T.L.Andrews
METHOD OF INSTALLATION: HSA
OBSERVATIONS:

MW/PZ NO: B-102
PROJECT NO: 16530714
DATE: 1/5/2011
GRND ELEV: 812
NORTH: NA
EAST: NA

For detailed geologic descriptions see boring log: B-102



Note: Depths are in feet below grade.

MW/PZ REPORT-PM W/ NO SEAL 16530714KCPLGMOLAKE ROAD.GPJ GNPI.GDT 2/7/11

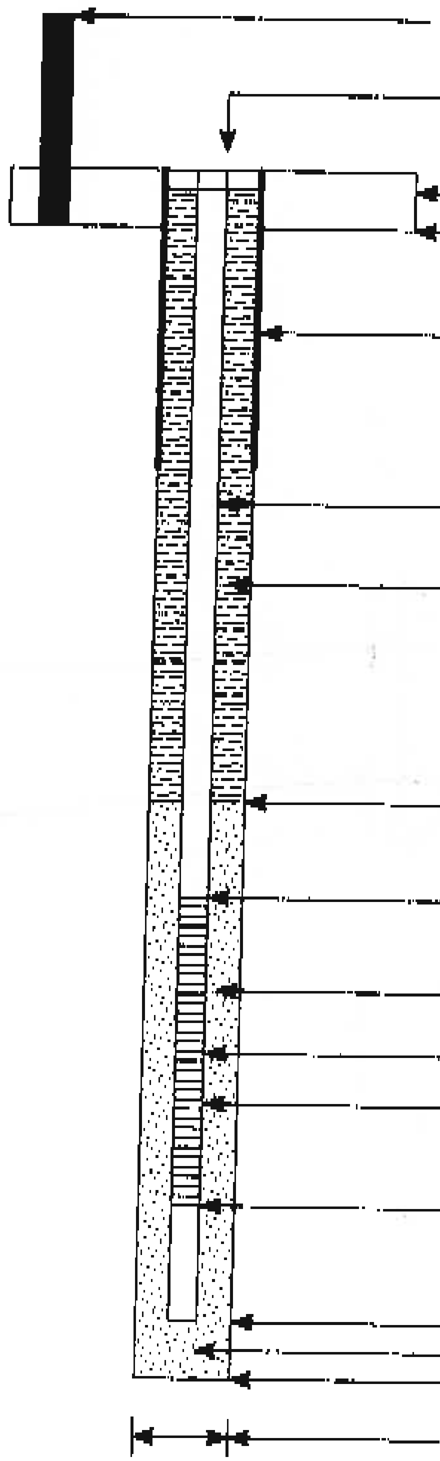
URS

GROUNDWATER MONITORING WELL/PIEZOMETER REPORT

PROJECT NAME: KCP&L GMO Lake Road Generating Station
PROJECT LOCATION: St. Joseph, Missouri
INSTALLED BY: Geotechnology, Inc.
INSPECTED BY: T.L.Andrews
METHOD OF INSTALLATION: HSA
OBSERVATIONS:

MW/PZ NO: B-104
PROJECT NO: 16530714
DATE: 1/6/2011
GRND ELEV: 815
NORTH: NA
EAST: NA

For detailed geologic descriptions see boring log: B-104



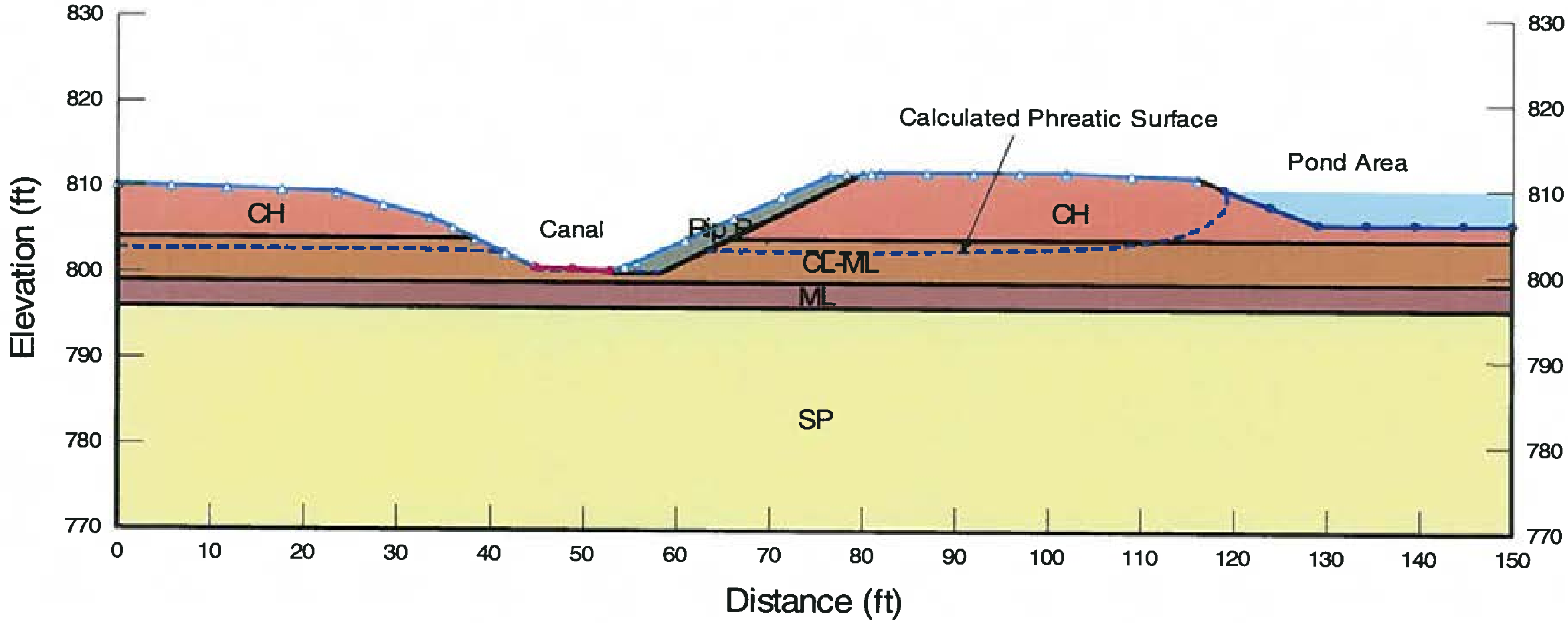
Note: Depths are in feet below grade.

URS

SUMMARY OF LABORATORY TEST DATA

KCPL GMO LAKE ROAD GENERATING STATION
ST. JOSEPH, MO.
16530714

			Classification Properties					Compaction		Permeability	Strength Properties Unconfined	
Boring/Test Pit No.	Sample Depth, ft.	Unified Soil Class.	As Received Water Cont., %	Dry Unit Wt., pcf	Liquid Limit	Plastic Limit	% Pass. No. 200 or Fig No.	Max. Dry Unit Weight, pcf	Optimum Water Content, %	cm/sec @ 20° C	Comp. Strength, ksf (Qu)	Strain @ Failure, %
B-101	3.5-5.0	CH	35.1		77	21	96.3					
	13.5-15.0	ML	32.3		32	24						
	28.5-30.0	CH	63.0									
B-102	3.5-5.0	CH	28.9		52	15	90.8					
	8.5-10.0	ML	32.6									
B-103	3.5-5.0	CH	28.4		66	19	97.9					
	13.5-15.0	ML	35.8				96.4					
	23.5-25.0	SP-SM	25.4									
B-104	8.5-10.0	CL	30.1									
	13.5-15.0	ML	32.6				95.1					
	18.5-20.0	CL	40.4									
B-105	8.5-10.0	CH	35.6									
	23.5-25.0	CH	48.6		74	18	97.6					



Name: CH Model: Saturated Only K-Sat: 3.3e-007 Volumetric Water Content: 0 Mv: 0 K-Ratio: 1 K-Direction: 0
Name: ML Model: Saturated Only K-Sat: 3.3e-005 Volumetric Water Content: 0 Mv: 0 K-Ratio: 1 K-Direction: 0
Name: SP Model: Saturated Only K-Sat: 0.033 Volumetric Water Content: 0 Mv: 0 K-Ratio: 1 K-Direction: 0
Name: CL-ML Model: Saturated Only K-Sat: 3.3e-007 Volumetric Water Content: 0 Mv: 0 K-Ratio: 1 K-Direction: 0
Name: Rip Rap Model: Saturated Only K-Sat: 0.033 Volumetric Water Content: 0 Mv: 0 K-Ratio: 1 K-Direction: 0

URS 8300 College Boulevard Suite 200 Overland Park, KS 66210	KCPL	LAKE ROAD GENERATING STATION ASH POND CALCULATED PHREATIC SURFACE AT CROSS SECTION A-A	Drawn By: DKN Date: 2-8-2011 Checked By: BDL Date: 2-8-11	Project No. 16530714 Figure No. C-1

SEEP/W Analysis

File Information

Created By: Deepak K. Neupane
Revision Number: 115
Last Edited By: Deepak K. Neupane
Date: 2/16/2011
Time: 9:28:20 AM
File Name: Section A-A.gsz
Directory: I:\16530714 KCPL-GMO Lake Road Generating Station\slope stabiltiy\
Last Solved Date: 2/16/2011
Last Solved Time: 9:28:30 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Mass(M) Units: lbs
Mass Flux Units: lbs/sec
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SEEP/W Analysis

Description: Lake Road Generating Station Section A-A
Kind: SEEP/W
Method: Steady-State
Settings
- Include Air Flow: No

Control
- Apply Runoff: Yes

Convergence
- Convergence Type: Gauss Point K
- Convergence Settings
  - Maximum Number of Iterations: 500
  - Tolerance: 0.01
  - Maximum Change in K: 0.1
  - Rate of Change in K: 1.02
  - Minimum Change in K: 0.0001
- Equation Solver: Parallel Direct
- Potential Seepage Max # of Reviews: 10

Time

Starting Time: 0 sec
Duration: 0 sec
Ending Time: 0 sec

Materials

CH

Model: Saturated Only
Hydraulic
K-Sat: 3.3e-007 ft/sec
Volumetric Water Content: 0 ft^3/ft^3
Mv: 0 /psf
K-Ratio: 1
K-Direction: 0 °

ML

Model: Saturated Only
Hydraulic
K-Sat: 3.3e-005 ft/sec
Volumetric Water Content: 0 ft^3/ft^3
Mv: 0 /psf
K-Ratio: 1
K-Direction: 0 °

SP

Model: Saturated Only
Hydraulic
K-Sat: 0.033 ft/sec
Volumetric Water Content: 0 ft^3/ft^3
Mv: 0 /psf
K-Ratio: 1
K-Direction: 0 °

CL-ML

Model: Saturated Only
Hydraulic
K-Sat: 3.3e-007 ft/sec
Volumetric Water Content: 0 ft^3/ft^3
Mv: 0 /psf
K-Ratio: 1
K-Direction: 0 °

Rip Rap

Model: Saturated Only
Hydraulic
K-Sat: 0.033 ft/sec
Volumetric Water Content: 0 ft^3/ft^3
Mv: 0 /psf
K-Ratio: 1

K-Direction: 0 °

Boundary Conditions

Potential Seepage Face

Review: true
Type: Total Flux (Q) 0

Pond Side

Type: Head (H) 810.09

Land Side

Type: Head (H) 800.19

Regions

	Material	Points	Area (ft^2)
Region 1	CH	1,2,3,25,11	182.3983
Region 2	CL-ML	11,25,4,5,22,23,24,12,14,13	675.0748
Region 3	SP	15,19,20,16	3900
Region 4	Rip Rap	5,22,23,21,7,6	48.24555
Region 5	CH	24,21,8,9,10,26,18,17,12	439.97372
Region 6	ML	13,15,16,14	450

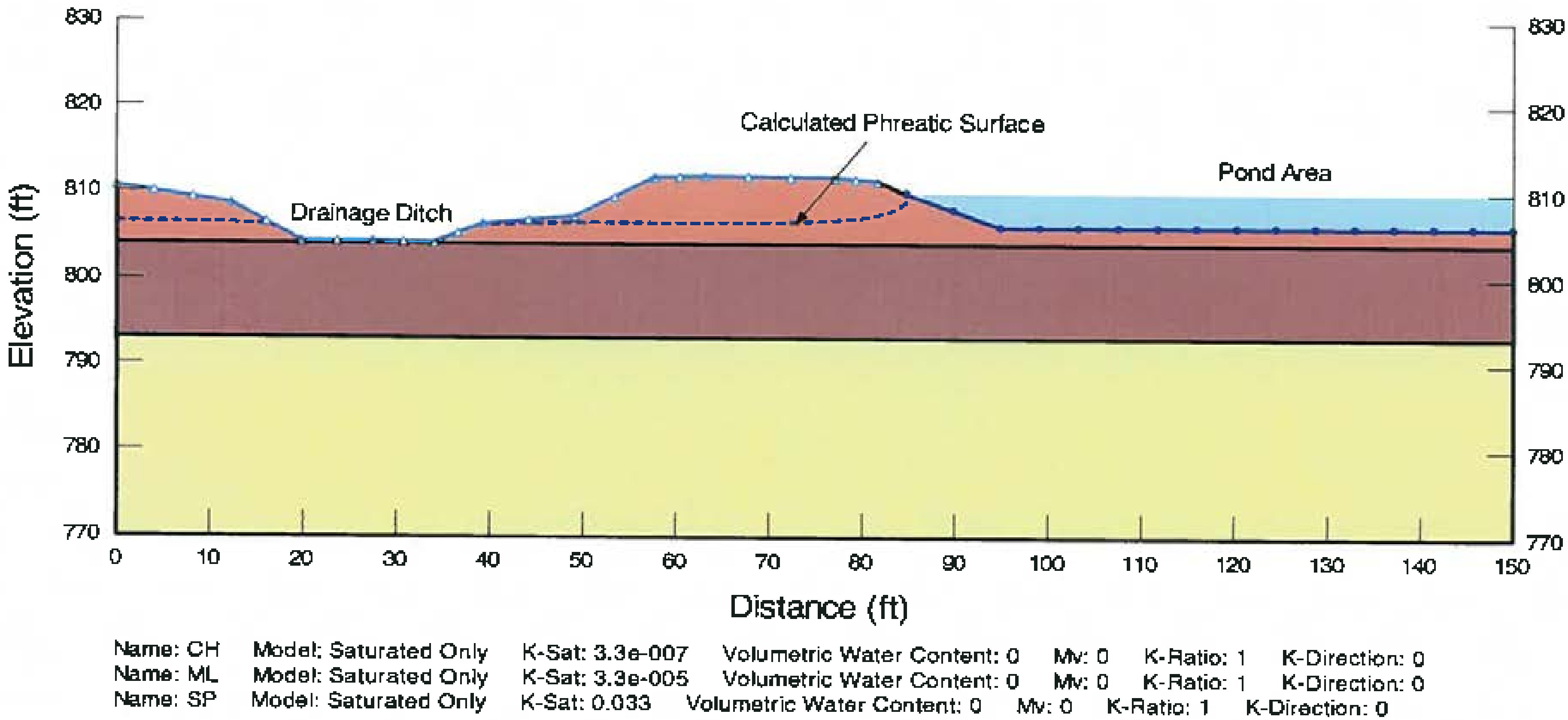
Lines

	Start Point	End Point	Hydraulic Boundary
Line 1	1	2	Potential Seepage Face
Line 2	2	3	Potential Seepage Face
Line 3	11	1	
Line 4	12	14	
Line 5	14	13	
Line 6	13	11	
Line 7	16	15	
Line 8	15	19	
Line 9	19	20	
Line 10	20	16	
Line 11	5	22	
Line 12	22	23	
Line 13	6	5	Potential Seepage Face
Line 14	23	21	
Line 15	21	7	Potential Seepage Face
Line 16	7	6	Potential Seepage Face
Line 17	21	8	Potential Seepage Face
Line 18	8	9	Potential Seepage Face

Line 19	9	10	Potential Seepage Face
Line 20	18	17	Pond Side
Line 21	17	12	
Line 22	3	25	Potential Seepage Face
Line 23	25	11	
Line 24	25	4	Potential Seepage Face
Line 25	4	5	Land Side
Line 26	24	21	
Line 27	12	24	
Line 28	23	24	
Line 29	13	15	
Line 30	16	14	
Line 31	10	26	
Line 32	26	18	Pond Side

Points

	X (ft)	Y (ft)
Point 1	0	810.21
Point 2	23.52	809.43
Point 3	33.56	806.47
Point 4	44.82	800.69
Point 5	52.96	800.19
Point 6	55.65	801.29
Point 7	76.5	811.66
Point 8	81.94	811.9
Point 9	101.9	811.98
Point 10	115.98	811.25
Point 11	0	804
Point 12	150	804
Point 13	0	799
Point 14	150	799
Point 15	0	796
Point 16	150	796
Point 17	150	806
Point 18	129.105	806
Point 19	0	770
Point 20	150	770
Point 21	80	811.8
Point 22	53	800
Point 23	58	800
Point 24	65.5	804
Point 25	38.3	804
Point 26	118.88	810.09



URS 8300 College Boulevard Suite 200 Overland Park, KS 66210	KCPL	LAKE ROAD GENERATING STATION ASH POND CALCULATED PHREATIC SURFACE AT CROSS SECTION B-B	Drawn By	DKN	Project No.
			Date	2-8-2011	16530714
			Checked By	BDL	Figure No.
			Date	2-8-11	C-2

SEEP/W Analysis

File Information

Created By: Deepak K. Neupane
Revision Number: 85
Last Edited By: Deepak K. Neupane
Date: 2/16/2011
Time: 8:19:41 AM
File Name: Section B-B.gsz
Directory: I:\16530714 KCPL-GMO Lake Road Generating Station\slope stabiltiy\
Last Solved Date: 2/16/2011
Last Solved Time: 8:19:52 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Mass(M) Units: lbs
Mass Flux Units: lbs/sec
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SEEP/W Analysis

Description: Lake Road Generating Station Section B-B
Kind: SEEP/W
Method: Steady-State
Settings
- Include Air Flow: No

Control
- Apply Runoff: Yes

Convergence
- Convergence Type: Gauss Point K
- Convergence Settings
  - Maximum Number of Iterations: 500
  - Tolerance: 0.01
  - Maximum Change in K: 0.1
  - Rate of Change in K: 1.02
  - Minimum Change in K: 0.0001
- Equation Solver: Parallel Direct
- Potential Seepage Max # of Reviews: 10

Time

Starting Time: 0 sec
Duration: 0 sec
Ending Time: 0 sec

Materials

CH

Model: Saturated Only
Hydraulic
K-Sat: 3.3e-007 ft/sec
Volumetric Water Content: 0 ft^3/ft^3
Mv: 0 /psf
K-Ratio: 1
K-Direction: 0 °

ML

Model: Saturated Only
Hydraulic
K-Sat: 3.3e-005 ft/sec
Volumetric Water Content: 0 ft^3/ft^3
Mv: 0 /psf
K-Ratio: 1
K-Direction: 0 °

SP

Model: Saturated Only
Hydraulic
K-Sat: 0.033 ft/sec
Volumetric Water Content: 0 ft^3/ft^3
Mv: 0 /psf
K-Ratio: 1
K-Direction: 0 °

Boundary Conditions

Potential Seepage Face

Review: true
Type: Total Flux (Q) 0

Pond Side

Type: Head (H) 810.03

Regions

	Material	Points	Area (ft^2)
Region 1	CH	1,2,3,4,5,6,7,8,9,10,21,22,18,17,12,11	531.45355
Region 2	ML	11,12,14,13	1650

Region 3	SP	13,15,19,20,16,14	3450

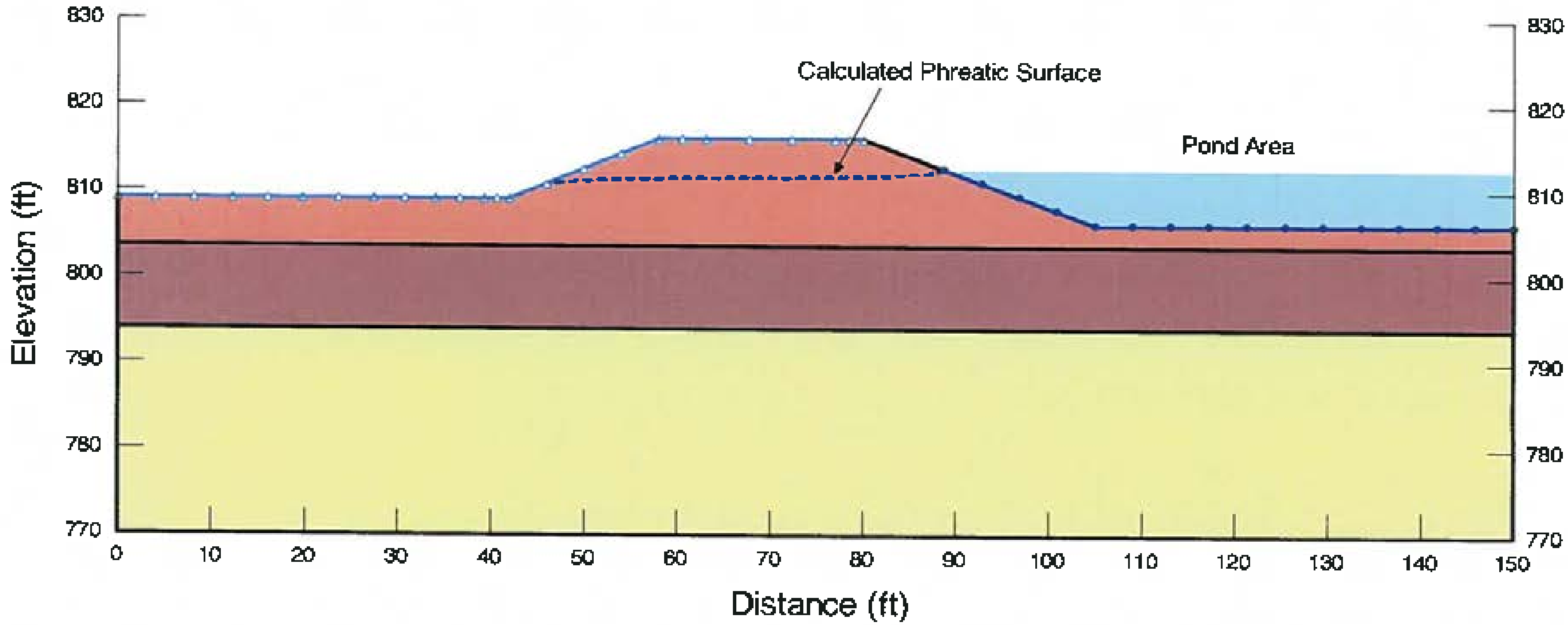
Lines

	Start Point	End Point	Hydraulic Boundary
Line 1	1	2	Potential Seepage Face
Line 2	2	3	Potential Seepage Face
Line 3	3	4	Potential Seepage Face
Line 4	4	5	Potential Seepage Face
Line 5	5	6	Potential Seepage Face
Line 6	6	7	Potential Seepage Face
Line 7	7	8	Potential Seepage Face
Line 8	8	9	Potential Seepage Face
Line 9	9	10	Potential Seepage Face
Line 10	12	11	
Line 11	11	1	
Line 12	12	14	
Line 13	14	13	
Line 14	13	11	
Line 15	18	17	Pond Side
Line 16	15	19	
Line 17	19	20	
Line 18	20	16	
Line 19	17	12	
Line 20	10	21	Potential Seepage Face
Line 21	21	22	
Line 22	22	18	Pond Side
Line 23	13	15	
Line 24	16	14	

Points

	X (ft)	Y (ft)
Point 1	0	810.68
Point 2	12.28	808.68
Point 3	19.76	804.37
Point 4	27.47	804.32
Point 5	34.03	804.15
Point 6	39.24	806.43
Point 7	49.09	807.16
Point 8	57.64	811.76
Point 9	63.07	811.91
Point 10	76.99	811.71
Point 11	0	804
Point 12	150	804

Point 13	0	793
Point 14	150	793
Point 15	0	780
Point 16	150	780
Point 17	150	806
Point 18	94.835	806
Point 19	0	770
Point 20	150	770
Point 21	81.61	811.29
Point 22	84.764	810.03



Name: CH Model: Saturated Only K-Sat: 3.3e-007 Volumetric Water Content: 0 Mv: 0 K-Ratio: 1 K-Direction: 0
Name: ML Model: Saturated Only K-Sat: 3.3e-005 Volumetric Water Content: 0 Mv: 0 K-Ratio: 1 K-Direction: 0
Name: SP Model: Saturated Only K-Sat: 0.033 Volumetric Water Content: 0 Mv: 0 K-Ratio: 1 K-Direction: 0

URS 8300 College Boulevard Suite 200 Overland Park, KS 66210	KCPL	LAKE ROAD GENERATING STATION ASH POND CALCULATED PHREATIC SURFACE AT CROSS SECTION C-C	Drawn By: DKN Date: 2-8-2011 Checked By: BDL Date: 2-8-11	Project No. 16530714	Figure No. C-3

SEEP/W Analysis

File Information

Created By: Deepak K. Neupane
Revision Number: 83
Last Edited By: Deepak K. Neupane
Date: 2/8/2011
Time: 1:48:43 PM
File Name: Section C-C.gsz
Directory: I:\16530714 KCPL-GMO Lake Road Generating Station\slope stabiltiy\
Last Solved Date: 2/8/2011
Last Solved Time: 1:48:58 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Mass(M) Units: lbs
Mass Flux Units: lbs/sec
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SEEP/W Analysis

Description: Lake Road Generating Station Section C-C
Kind: SEEP/W
Method: Steady-State
Settings
    Include Air Flow: No
Control
    Apply Runoff: Yes
Convergence
    Convergence Type: Gauss Point K
    Convergence Settings
        Maximum Number of Iterations: 500
        Tolerance: 0.01
        Maximum Change in K: 0.1
        Rate of Change in K: 1.02
        Minimum Change in K: 0.0001
    Equation Solver: Parallel Direct
    Potential Seepage Max # of Reviews: 10
Time

Starting Time: 0 sec
Duration: 0 sec
Ending Time: 0 sec

Materials

CH

Model: Saturated Only
Hydraulic
K-Sat: 3.3e-007 ft/sec
Volumetric Water Content: 0 ft^3/ft^3
Mv: 0 /psf
K-Ratio: 1
K-Direction: 0 °

ML

Model: Saturated Only
Hydraulic
K-Sat: 3.3e-005 ft/sec
Volumetric Water Content: 0 ft^3/ft^3
Mv: 0 /psf
K-Ratio: 1
K-Direction: 0 °

SP

Model: Saturated Only
Hydraulic
K-Sat: 0.033 ft/sec
Volumetric Water Content: 0 ft^3/ft^3
Mv: 0 /psf
K-Ratio: 1
K-Direction: 0 °

Boundary Conditions

Potential Seepage Face

Review: true
Type: Total Flux (Q) 0

Pond Side

Type: Head (H) 812.5

Regions

	Material	Points	Area (ft^2)
Region 1	CH	1,2,3,4,5,6,7,8,9,10,21,22,18,17,12,11	950
Region 2	ML	11,12,14,13	1425

Region 3	SP	13,15,19,20,16,14	3600

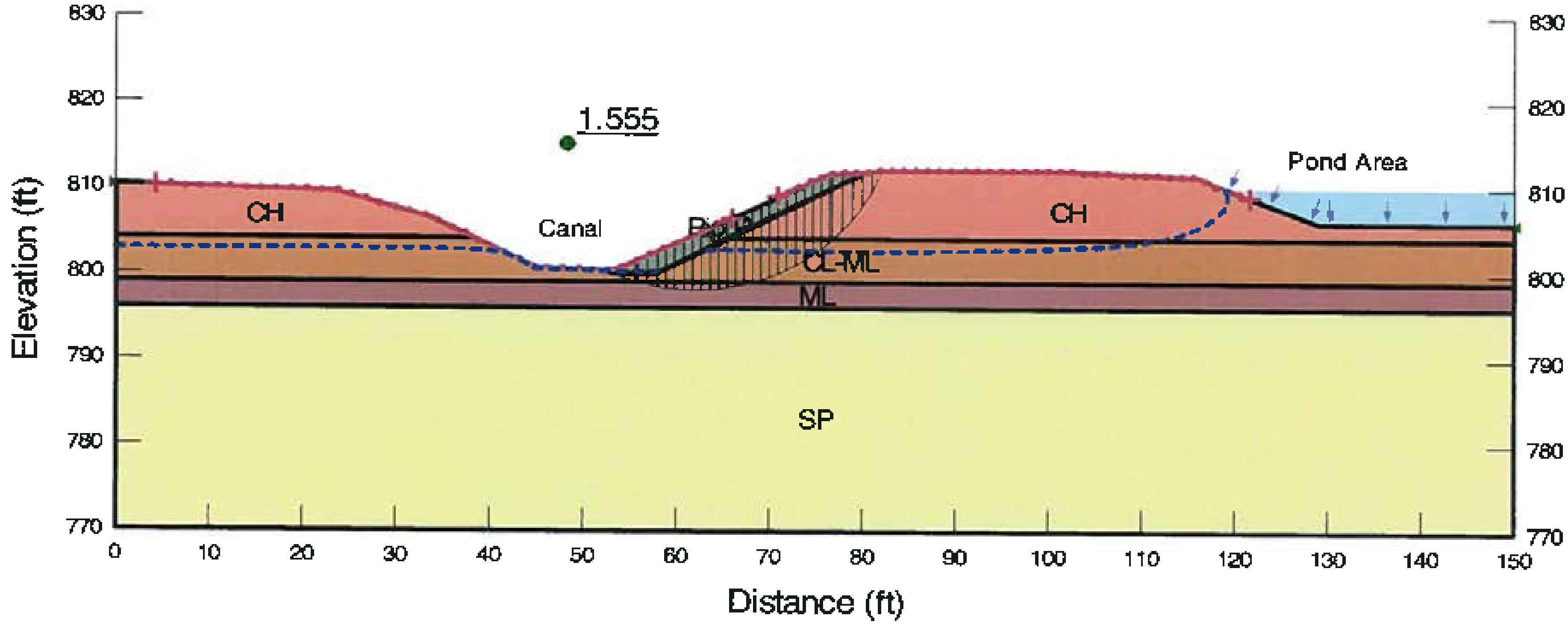
Lines

	Start Point	End Point	Hydraulic Boundary
Line 1	1	2	Potential Seepage Face
Line 2	2	3	Potential Seepage Face
Line 3	3	4	Potential Seepage Face
Line 4	4	5	Potential Seepage Face
Line 5	5	6	Potential Seepage Face
Line 6	6	7	Potential Seepage Face
Line 7	7	8	Potential Seepage Face
Line 8	8	9	Potential Seepage Face
Line 9	9	10	Potential Seepage Face
Line 10	12	11	
Line 11	11	1	
Line 12	12	14	
Line 13	14	13	
Line 14	13	11	
Line 15	18	17	Pond Side
Line 16	15	19	
Line 17	19	20	
Line 18	20	16	
Line 19	17	12	
Line 20	10	21	Potential Seepage Face
Line 21	21	22	
Line 22	22	18	Pond Side
Line 23	13	15	
Line 24	16	14	

Points

	X (ft)	Y (ft)
Point 1	0	809
Point 2	12.28	809
Point 3	19.76	809
Point 4	27.47	809
Point 5	34.03	809
Point 6	39.24	809
Point 7	42	809
Point 8	58	816
Point 9	63.07	816
Point 10	76.99	816
Point 11	0	803.5
Point 12	150	803.5

Point 13	0	794
Point 14	150	794
Point 15	0	780
Point 16	150	780
Point 17	150	806
Point 18	105	806
Point 19	0	770
Point 20	150	770
Point 21	80	816
Point 22	88.75	812.5



Name: CH Model: Mohr-Coulomb Unit Weight: 120 Cohesion: 50 Phi: 26
Name: ML Model: Mohr-Coulomb Unit Weight: 120 Cohesion: 200 Phi: 15
Name: SP Model: Mohr-Coulomb Unit Weight: 125 Cohesion: 0 Phi: 33
Name: CL-ML Model: Mohr-Coulomb Unit Weight: 120 Cohesion: 200 Phi: 15
Name: Rip Rap Model: Mohr-Coulomb Unit Weight: 120 Cohesion: 0 Phi: 34

URS 8300 College Boulevard Suite 200 Overland Park, KS 66210	KCPL	LAKE ROAD GENERATING STATION ASH POND CRITICAL CIRCULAR SLIP SURFACE STEADY STATE SEEPAGE CROSS SECTION A-A	Drawn By DKN Date 2-8-2011 Checked By BDL Date 2-8-11	Project No. 16530714 Figure No. D-1

Slope Stability (Circular Failure)

File Information

Created By: Deepak K. Neupane
Revision Number: 116
Last Edited By: Deepak K. Neupane
Date: 2/16/2011
Time: 3:10:47 PM
File Name: Section A-A.gsz
Directory: I:\16530714 KCPL-GMO Lake Road Generating Station\slope stabiltiy\
Last Solved Date: 2/16/2011
Last Solved Time: 3:11:19 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

Slope Stability (Circular Failure)

Description: Lake Road Generating Station Section A-A
Kind: SLOPE/W
Parent: SEEP/W Analysis
Method: Spencer
Settings
- PWP Conditions Source: Parent Analysis

Slip Surface
- Direction of movement: Right to Left
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No
- Tension Crack
  - Tension Crack Option: Search for Tension Crack
  - Percentage Wet: 1
  - Tension Crack Fluid Unit Weight: 62.4 pcf

FOS Distribution
  FOS Calculation Option: Constant
Advanced
  Number of Slices: 30
  Optimization Tolerance: 0.01
  Minimum Slip Surface Depth: 3 ft
  Optimization Maximum Iterations: 2000
  Optimization Convergence Tolerance: 1e-007
  Starting Optimization Points: 8
  Ending Optimization Points: 16
  Complete Passes per Insertion: 1
  Driving Side Maximum Convex Angle: 5 °
  Resisting Side Maximum Convex Angle: 1 °

Materials

CH
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 50 psf
Phi: 26 °
Phi-B: 0 °

ML
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 200 psf
Phi: 15 °
Phi-B: 0 °

SP
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

CL-ML
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 200 psf
Phi: 15 °
Phi-B: 0 °

Rip Rap
Model: Mohr-Coulomb

Unit Weight: 120 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (4.26648, 810.06851) ft
Left-Zone Right Coordinate: (66, 806.4377) ft
Left-Zone Increment: 40
Right Projection: Range
Right-Zone Left Coordinate: (71, 808.92451) ft
Right-Zone Right Coordinate: (121.64723, 808.98311) ft
Right-Zone Increment: 40
Radius Increments: 6

Slip Surface Limits

Left Coordinate: (0, 810.21) ft
Right Coordinate: (150, 806) ft

Regions

	Material	Points	Area (ft²)
Region 1	CH	1,2,3,25,11	182.3983
Region 2	CL-ML	11,25,4,5,22,23,24,12,14,13	675.0748
Region 3	SP	15,19,20,16	3900
Region 4	Rip Rap	5,22,23,21,7,6	48.24555
Region 5	CH	24,21,8,9,10,26,18,17,12	439.97372
Region 6	ML	13,15,16,14	450

Points

	X (ft)	Y (ft)
Point 1	0	810.21
Point 2	23.52	809.43
Point 3	33.56	806.47
Point 4	44.82	800.69
Point 5	52.96	800.19
Point 6	55.65	801.29

Point 7	76.5	811.66
Point 8	81.94	811.9
Point 9	101.9	811.98
Point 10	115.98	811.25
Point 11	0	804
Point 12	150	804
Point 13	0	799
Point 14	150	799
Point 15	0	796
Point 16	150	796
Point 17	150	806
Point 18	129.105	806
Point 19	0	770
Point 20	150	770
Point 21	80	811.8
Point 22	53	800
Point 23	58	800
Point 24	65.5	804
Point 25	38.3	804
Point 26	118.88	810.09

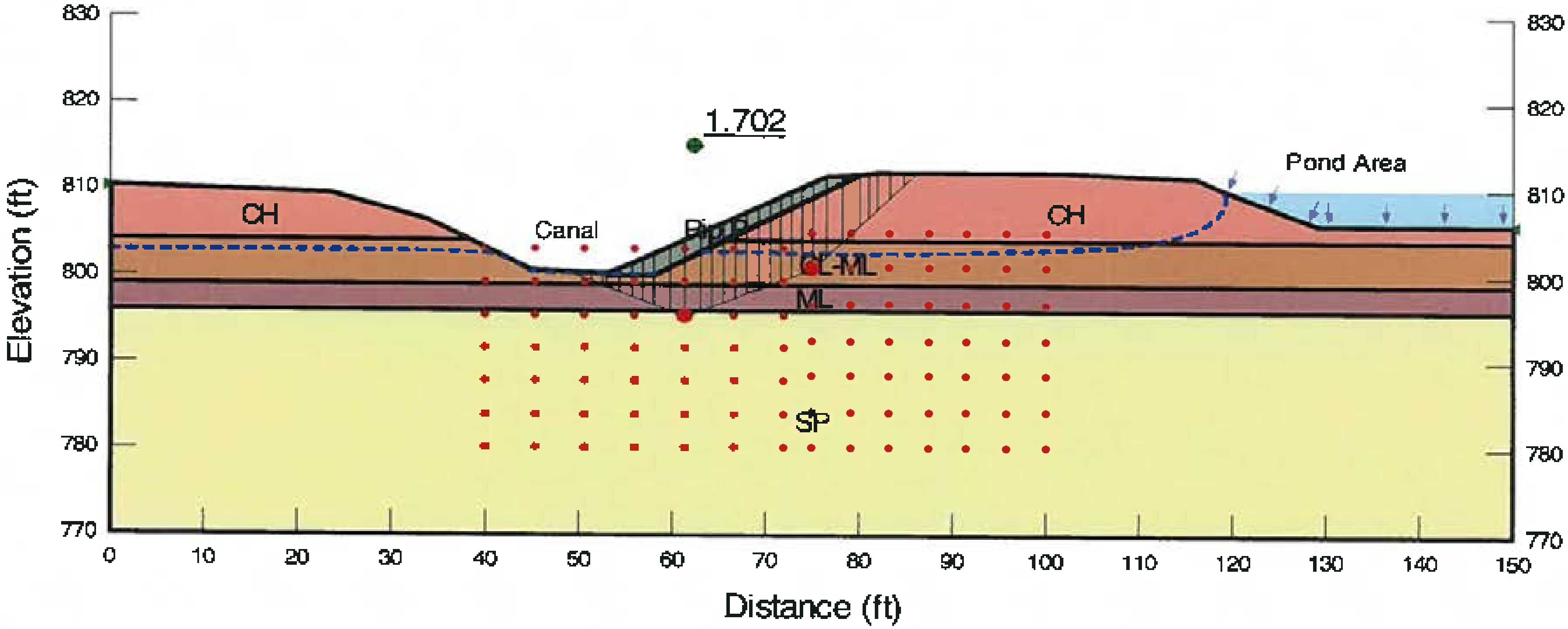
Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	8965	1.555	(62.032, 819.438)	21.339	(81.94, 811.9)	(52.7989, 800.2)

Slices of Slip Surface: 8965

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	8965	52.879435	800.16165	1.770551	142.63753	37.745194	200
2	8965	52.96778	800.11975	4.3865712	147.28761	38.290217	200
3	8965	53.101515	800.05805	8.2412343	37.638779	19.828895	0
4	8965	53.833105	799.7478	68.031416	238.87172	45.776521	200
5	8965	55.04437	799.2856	170.9491	350.36922	48.075476	200

6	8965	55.773195	799.0378	226.22977	413.19284	50.096602	200
7	8965	56.42229	798.85665	243.98701	472.97651	61.357551	200
8	8965	57.474095	798.59825	260.98918	562.42703	80.77003	200
9	8965	58.46875	798.4038	273.99424	636.43479	97.115652	200
10	8965	59.40625	798.26625	283.27976	697.24866	110.92263	200
11	8965	60.34375	798.1709	289.75475	750.36379	123.41982	200
12	8965	61.28125	798.1172	293.44995	796.21005	134.71416	200
13	8965	62.21875	798.10475	294.43142	835.13611	144.88138	200
14	8965	63.15625	798.13355	292.76624	867.43383	153.98172	200
15	8965	64.09375	798.2038	288.45726	893.28323	162.06263	200
16	8965	65.03125	798.31585	281.50748	912.83998	169.16503	200
17	8965	65.94472	798.46535	272.20856	926.22086	175.24207	200
18	8965	66.83416	798.65105	260.63054	933.79829	180.37476	200
19	8965	67.7236	798.8769	246.54215	935.79394	184.68446	200
20	8965	68.63119	799.15055	229.24911	931.98388	188.29721	200
21	8965	69.556935	799.4756	208.40483	922.01295	191.21072	200
22	8965	70.48268	799.84975	184.25707	905.68343	193.30561	200
23	8965	71.40842	800.2759	156.5755	882.75904	194.58029	200
24	8965	72.33416	800.75765	125.07756	852.94518	195.03154	200
25	8965	73.2599	801.2994	89.410613	815.84142	194.64655	200
26	8965	74.185645	801.9068	49.187881	770.93594	193.39181	200
27	8965	75.11139	802.58695	3.8448016	717.58082	191.24499	200
28	8965	76.03713	803.34915	-47.270597	658.30277	176.39169	200
29	8965	76.632135	803.87605	-82.812873	611.80359	163.93228	200
30	8965	77.30356	804.5533	-128.76067	542.00884	264.35537	50
31	8965	78.382135	805.7508	-210.72879	420.02923	204.86195	50
32	8965	79.46071	807.16055	-308.86132	291.09158	141.97485	50
33	8965	80.485	808.7646	-422.88534	162.95275	79.477369	50
34	8965	81.455	810.6785	-561.32368	35.801126	17.461376	50



Name: CH Model: Mohr-Coulomb Unit Weight: 120 Cohesion: 50 Phi: 26
Name: ML Model: Mohr-Coulomb Unit Weight: 120 Cohesion: 200 Phi: 15
Name: SP Model: Mohr-Coulomb Unit Weight: 125 Cohesion: 0 Phi: 33
Name: CL-ML Model: Mohr-Coulomb Unit Weight: 120 Cohesion: 200 Phi: 15
Name: Rip Rap Model: Mohr-Coulomb Unit Weight: 120 Cohesion: 0 Phi: 34

URS
8300 College Boulevard
Suite 200
Overland Park, KS 66210

KCPL

LAKE ROAD GENERATING STATION ASH POND
CRITICAL WEDGE SLIP SURFACE
STEADY STATE SEEPAGE
CROSS SECTION A-A

Drawn By	DKN	Project No.	
Date	2-8-2011	16530714	
Checked By	BDL	Figure No.	
Date	2-8-11	D-2	

Slope Stability (Block Failure)

File Information

Created By: Deepak K. Neupane
Revision Number: 115
Last Edited By: Deepak K. Neupane
Date: 2/16/2011
Time: 9:28:20 AM
File Name: Section A-A.gsz
Directory: I:\16530714 KCPL-GMO Lake Road Generating Station\slope stabiltiy\
Last Solved Date: 2/16/2011
Last Solved Time: 9:29:11 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

Slope Stability (Block Failure)

Description: Lake Road Generating Station Section A-A
Kind: SLOPE/W
Parent: SEEP/W Analysis
Method: Spencer
Settings
- PWP Conditions Source: Parent Analysis

Slip Surface
- Direction of movement: Right to Left
- Use Passive Mode: No
- Slip Surface Option: Block
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No
- Tension Crack
  - Tension Crack Option: Search for Tension Crack
  - Percentage Wet: 1
  - Tension Crack Fluid Unit Weight: 62.4 pcf

FOS Distribution
- FOS Calculation Option: Constant

Restrict Block Crossing: No

Advanced

Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

CH

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 50 psf
Phi: 26 °
Phi-B: 0 °

ML

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 200 psf
Phi: 15 °
Phi-B: 0 °

SP

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

CL-ML

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 200 psf
Phi: 15 °
Phi-B: 0 °

Rip Rap

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Slip Surface Limits

Left Coordinate: (0, 810.21) ft
Right Coordinate: (150, 806) ft

Slip Surface Block

Left Grid
- Upper Left: (40, 803) ft
- Lower Left: (40, 780) ft
- Lower Right: (72, 780) ft
- X Increments: 6
- Y Increments: 6
- Starting Angle: 135 °
- Ending Angle: 180 °
- Angle Increments: 2

Right Grid
- Upper Left: (75, 805) ft
- Lower Left: (75, 780) ft
- Lower Right: (100, 780) ft
- X Increments: 6
- Y Increments: 6
- Starting Angle: 45 °
- Ending Angle: 65 °
- Angle Increments: 2

Regions

	Material	Points	Area (ft^2)
Region 1	CH	1,2,3,25,11	182.3983
Region 2	CL-ML	11,25,4,5,22,23,24,12,14,13	675.0748
Region 3	SP	15,19,20,16	3900
Region 4	Rip Rap	5,22,23,21,7,6	48.24555
Region 5	CH	24,21,8,9,10,26,18,17,12	439.97372
Region 6	ML	13,15,16,14	450

Points

	X (ft)	Y (ft)
Point 1	0	810.21
Point 2	23.52	809.43
Point 3	33.56	806.47
Point 4	44.82	800.69
Point 5	52.96	800.19
Point 6	55.65	801.29
Point 7	76.5	811.66

Point 8	81.94	811.9
Point 9	101.9	811.98
Point 10	115.98	811.25
Point 11	0	804
Point 12	150	804
Point 13	0	799
Point 14	150	799
Point 15	0	796
Point 16	150	796
Point 17	150	806
Point 18	129.105	806
Point 19	0	770
Point 20	150	770
Point 21	80	811.8
Point 22	53	800
Point 23	58	800
Point 24	65.5	804
Point 25	38.3	804
Point 26	118.88	810.09

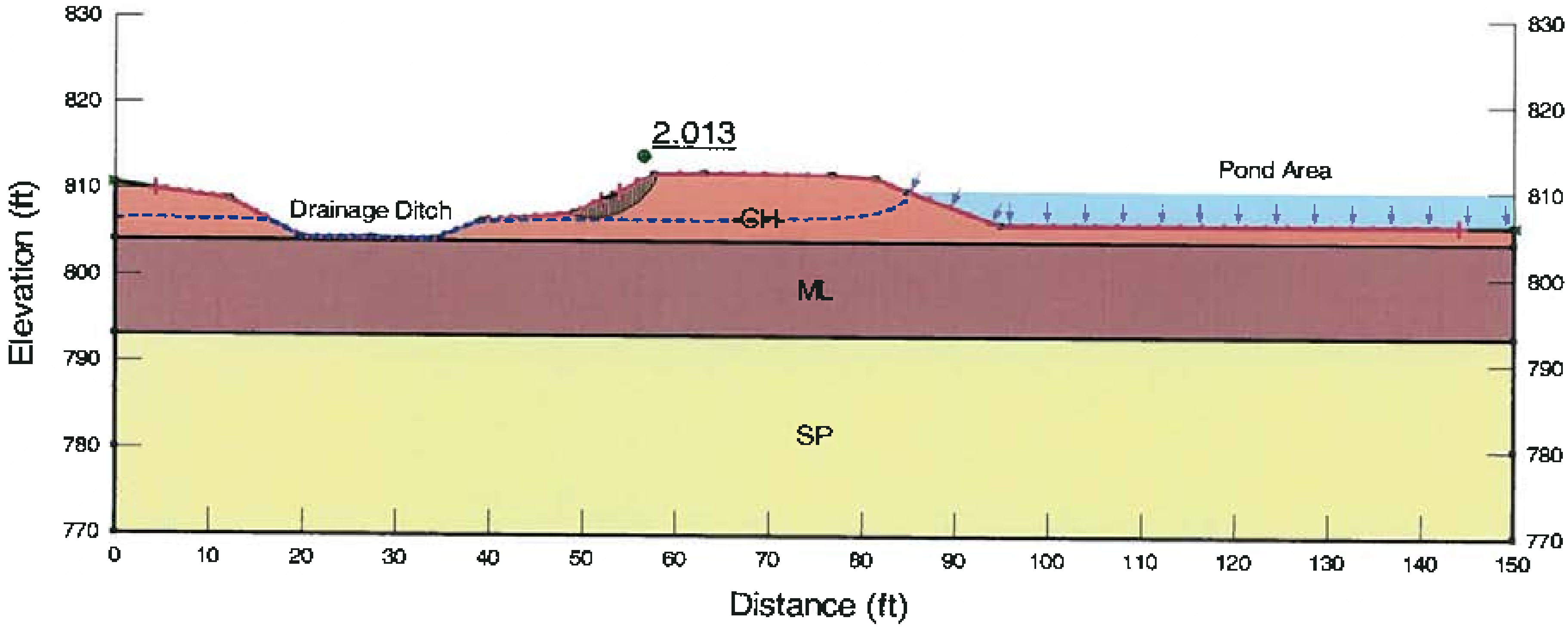
Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	14365	1.702	(64.885, 814.788)	19.95	(86.0833, 811.917)	(49.0247, 800.432)

Slices of Slip Surface: 14365

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	14365	49.60081	800.1931	23.348718	129.04421	28.321021	200
2	14365	50.75297	799.71585	103.75337	180.26737	20.501865	200
3	14365	51.905135	799.2386	189.5209	230.77688	11.054506	200
4	14365	52.72061	798.90085	241.05076	267.75699	7.1559133	200
5	14365	53.6425	798.519	265.30578	363.25057	26.244228	200
6	14365	54.9875	797.96185	300.91272	527.64317	60.752239	200
7	14365	56.2375	797.44405	334.11411	688.34913	94.916989	200
8	14365	57.4125	796.95735	365.32158	847.8461	129.79206	200
9	14365	58.86193	796.357	403.56077	1044.2202	171.66417	200
10	14365	60.528595	795.66665	446.91875	1343.9076	582.5114	0
11	14365	62.161615	795.66665	446.92218	938.29802	319.1032	0
12	14365	63.617425	796.25255	410.33476	949.46229	144.45879	200
13	14365	64.872475	796.75765	378.80182	961.06724	156.01755	200
14	14365	66.118055	797.2589	347.52393	972.94092	167.57998	200
15	14365	67.354165	797.75635	316.48348	985.02388	179.13486	200
16	14365	68.590275	798.2538	285.44304	997.10684	190.68974	200

17	14365	69.826385	798.75125	254.39508	1009.1898	202.24664	200
18	14365	71.013885	799.21915	224.11019	1020.808	213.47452	200
19	14365	72.152775	799.6875	194.38686	1031.886	224.40722	200
20	14365	73.291665	800.14585	164.38657	1043.0455	235.43594	200
21	14365	74.430555	800.60415	134.10119	1054.1235	246.51924	200
22	14365	75.75	801.5833	69.258763	787.43424	192.43454	200
23	14365	77.333335	803.16665	-36.437065	679.33151	182.02633	200
24	14365	79.083335	804.91665	-154.7291	542.86513	264.77302	50
25	14365	80.485	806.3183	-250.46162	433.82899	211.58864	50
26	14365	81.455	807.2883	-316.13509	358.88225	175.03857	50
27	14365	82.630545	808.45385	-393.42951	265.39584	129.4422	50
28	14365	84.011635	809.84495	-477.93368	153.35165	74.794597	50
29	14365	85.392725	811.22505	-557.35378	41.308486	20.147495	50



Name: CH	Model: Mohr-Coulomb	Unit Weight: 120	Cohesion: 50	Phi: 26
Name: ML	Model: Mohr-Coulomb	Unit Weight: 120	Cohesion: 200	Phi: 15
Name: SP	Model: Mohr-Coulomb	Unit Weight: 125	Cohesion: 0	Phi: 33

URS 8300 College Boulevard Suite 200 Overland Park, KS 66210	KCPL	LAKE ROAD GENERATING STATION ASH POND CRITICAL CIRCULAR SLIP SURFACE STEADY STATE SEEPAGE CROSS SECTION B-B	Drawn By: DKN	Date: 2-8-2011	Project No. 16530714
			Checked By: BDL	Date: 2-8-11	Figure No. D-3

Slope Stability (Circular Failure)

Report generated using GeoStudio 2007, version 7.17. Copyright © 1991-2010 GEO-SLOPE International Ltd.

File Information

Created By: Deepak K. Neupane
Revision Number: 86
Last Edited By: Deepak K. Neupane
Date: 2/16/2011
Time: 8:23:33 AM
File Name: Section B-B.gsz
Directory: I:\16530714 KCPL-GMO Lake Road Generating Station\slope stabiltiy\
Last Solved Date: 2/16/2011
Last Solved Time: 8:23:58 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

Slope Stability (Circular Failure)

Description: Lake Road Generating Station Section B-B
Kind: SLOPE/W
Parent: SEEP/W Analysis
Method: Spencer
Settings
- PWP Conditions Source: Parent Analysis

Slip Surface
- Direction of movement: Right to Left
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No
- Tension Crack
  - Tension Crack Option: Search for Tension Crack
  - Percentage Wet: 1
  - Tension Crack Fluid Unit Weight: 62.4 pcf

FOS Distribution
- FOS Calculation Option: Constant

Advanced

Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

CH

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 50 psf
Phi: 26 °
Phi-B: 0 °

ML

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 200 psf
Phi: 15 °
Phi-B: 0 °

SP

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (4.25325, 809.98729) ft
Left-Zone Right Coordinate: (52, 808.72561) ft
Left-Zone Increment: 40
Right Projection: Range
Right-Zone Left Coordinate: (54, 809.80164) ft
Right-Zone Right Coordinate: (144, 806) ft
Right-Zone Increment: 40
Radius Increments: 6

Slip Surface Limits

Left Coordinate: (0, 810.68) ft
Right Coordinate: (150, 806) ft

Regions

	Material	Points	Area (ft²)
Region 1	CH	1,2,3,4,5,6,7,8,9,10,21,22,18,17,12,11	531.45355
Region 2	ML	11,12,14,13	1650
Region 3	SP	13,15,19,20,16,14	3450

Points

	X (ft)	Y (ft)
Point 1	0	810.68
Point 2	12.28	808.68
Point 3	19.76	804.37
Point 4	27.47	804.32
Point 5	34.03	804.15
Point 6	39.24	806.43
Point 7	49.09	807.16
Point 8	57.64	811.76
Point 9	63.07	811.91
Point 10	76.99	811.71
Point 11	0	804
Point 12	150	804
Point 13	0	793
Point 14	150	793
Point 15	0	780
Point 16	150	780
Point 17	150	806
Point 18	94.835	806
Point 19	0	770
Point 20	150	770
Point 21	81.61	811.29
Point 22	84.764	810.03

Critical Slip Surfaces

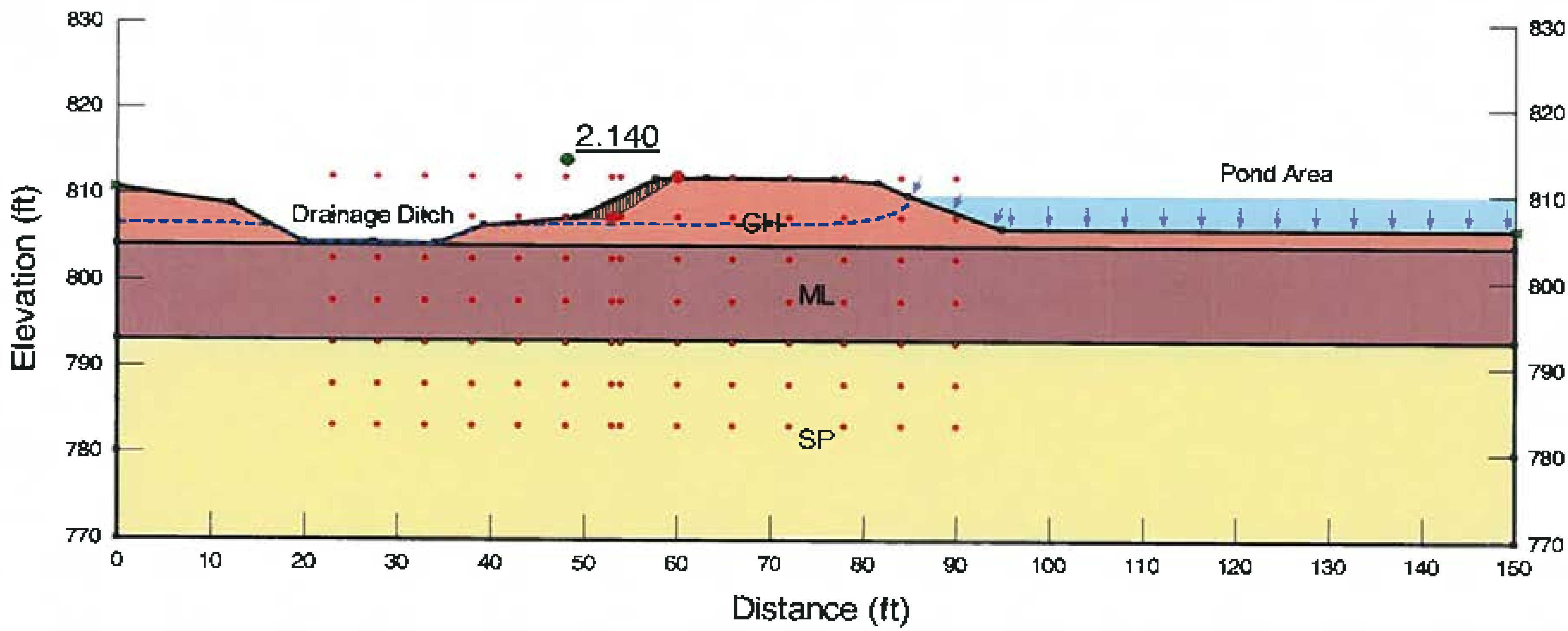
	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	10638	2.013	(50.966, 814.326)	7.561	(58.0832, 811.772)	(48.6527, 807.128)

Slices of Slip Surface: 10638

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)

1	10638	48.87133	807.0645	-37.662007	35.89128	17.505347	50
2	10638	49.248335	806.96445	-31.229213	64.19287	31.308955	50
3	10638	49.565	806.89765	-26.924229	96.545411	47.088343	50
4	10638	49.881665	806.8448	-23.500991	124.76795	60.853397	50
5	10638	50.198335	806.80565	-20.94065	149.32744	72.831859	50
6	10638	50.515	806.78005	-19.232254	170.60347	83.208873	50
7	10638	50.831665	806.76775	-18.359608	188.88471	92.125231	50
8	10638	51.148335	806.7687	-18.316799	204.41447	99.699598	50
9	10638	51.465	806.783	-19.103989	217.3887	106.02755	50
10	10638	51.781665	806.81065	-20.732471	227.95421	111.1807	50
11	10638	52.098335	806.8518	-23.209234	236.24498	115.22438	50
12	10638	52.415	806.9067	-26.545175	242.35835	118.20606	50
13	10638	52.731665	806.97565	-30.761106	246.37134	120.16333	50
14	10638	53.048335	807.05905	-35.876677	248.34687	121.12686	50
15	10638	53.365	807.15735	-41.925858	248.32386	121.11564	50
16	10638	53.681665	807.27125	-48.949007	246.33354	120.1449	50
17	10638	53.998335	807.40155	-56.989971	242.38601	118.21955	50
18	10638	54.315	807.54915	-66.112595	236.47597	115.33703	50
19	10638	54.631665	807.71515	-76.386223	228.58974	111.49066	50
20	10638	54.948335	807.90105	-87.901823	218.69162	106.66303	50
21	10638	55.265	808.10865	-100.76531	206.72564	100.82683	50
22	10638	55.581665	808.3402	-115.1236	192.62208	93.948064	50
23	10638	55.898335	808.59865	-131.15744	176.28125	85.97811	50
24	10638	56.215	808.8878	-149.10373	157.5746	76.854269	50
25	10638	56.531665	809.21295	-169.29359	136.33605	66.495533	50
				-			

26	10638	56.848335	809.5816	192.19266	112.34881	54.796178	50
27	10638	57.165	810.005	-218.5113	85.327761	41.61713	50
28	10638	57.481665	810.50185	-249.39956	54.88165	26.767569	50
29	10638	57.861595	811.2719	-297.32474	5.6009043	2.7317435	50



Name: CH	Model: Mohr-Coulomb	Unit Weight: 120	Cohesion: 50	Phi: 26
Name: ML	Model: Mohr-Coulomb	Unit Weight: 120	Cohesion: 200	Phi: 15
Name: SP	Model: Mohr-Coulomb	Unit Weight: 125	Cohesion: 0	Phi: 33

URS
8300 College Boulevard
Suite 200
Overland Park, KS 66210

KCPL

LAKE ROAD GENERATING STATION ASH POND
CRITICAL WEDGE SLIP SURFACE
STEADY STATE SEEPAGE
CROSS SECTION B-B

Drawn By	DKN	Project No.
Date	2-8-2011	16530714
Checked By	BDL	Figure No.
Date	2-8-11	D-4

Slope Stability (Block Failure)

File Information

Created By: Deepak K. Neupane
Revision Number: 87
Last Edited By: Deepak K. Neupane
Date: 2/16/2011
Time: 8:38:23 AM
File Name: Section B-B.gsz
Directory: I:\16530714 KCPL-GMO Lake Road Generating Station\slope stabiltiy\
Last Solved Date: 2/16/2011
Last Solved Time: 8:38:58 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

Slope Stability (Block Failure)

Description: Lake Road Generating Station Section B-B
Kind: SLOPE/W
Parent: SEEP/W Analysis
Method: Spencer
Settings
  PWP Conditions Source: Parent Analysis
Slip Surface
  Direction of movement: Right to Left
  Use Passive Mode: No
  Slip Surface Option: Block
  Critical slip surfaces saved: 1
  Optimize Critical Slip Surface Location: No
  Tension Crack
    Tension Crack Option: Search for Tension Crack
    Percentage Wet: 1
    Tension Crack Fluid Unit Weight: 62.4 pcf
FOS Distribution
  FOS Calculation Option: Constant
Restrict Block Crossing: No

Advanced

Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

CH

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 50 psf
Phi: 26 °
Phi-B: 0 °

ML

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 200 psf
Phi: 15 °
Phi-B: 0 °

SP

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

Slip Surface Limits

Left Coordinate: (0, 810.68) ft
Right Coordinate: (150, 806) ft

Slip Surface Block

Left Grid

Upper Left: (23, 812) ft
Lower Left: (23, 783) ft
Lower Right: (53, 783) ft
X Increments: 6
Y Increments: 6

Starting Angle: 135 °
Ending Angle: 180 °
Angle Increments: 2

Right Grid

Upper Left: (54, 812) ft
Lower Left: (54, 783) ft
Lower Right: (90, 783) ft
X Increments: 6
Y Increments: 6
Starting Angle: 45 °
Ending Angle: 65 °
Angle Increments: 2

Regions

	Material	Points	Area (ft^2)
Region 1	CH	1,2,3,4,5,6,7,8,9,10,21,22,18,17,12,11	531.45355
Region 2	ML	11,12,14,13	1650
Region 3	SP	13,15,19,20,16,14	3450

Points

	X (ft)	Y (ft)
Point 1	0	810.68
Point 2	12.28	808.68
Point 3	19.76	804.37
Point 4	27.47	804.32
Point 5	34.03	804.15
Point 6	39.24	806.43
Point 7	49.09	807.16
Point 8	57.64	811.76
Point 9	63.07	811.91
Point 10	76.99	811.71
Point 11	0	804
Point 12	150	804
Point 13	0	793
Point 14	150	793
Point 15	0	780
Point 16	150	780
Point 17	150	806
Point 18	94.835	806
Point 19	0	770
Point 20	150	770
Point 21	81.61	811.29
Point 22	84.764	810.03

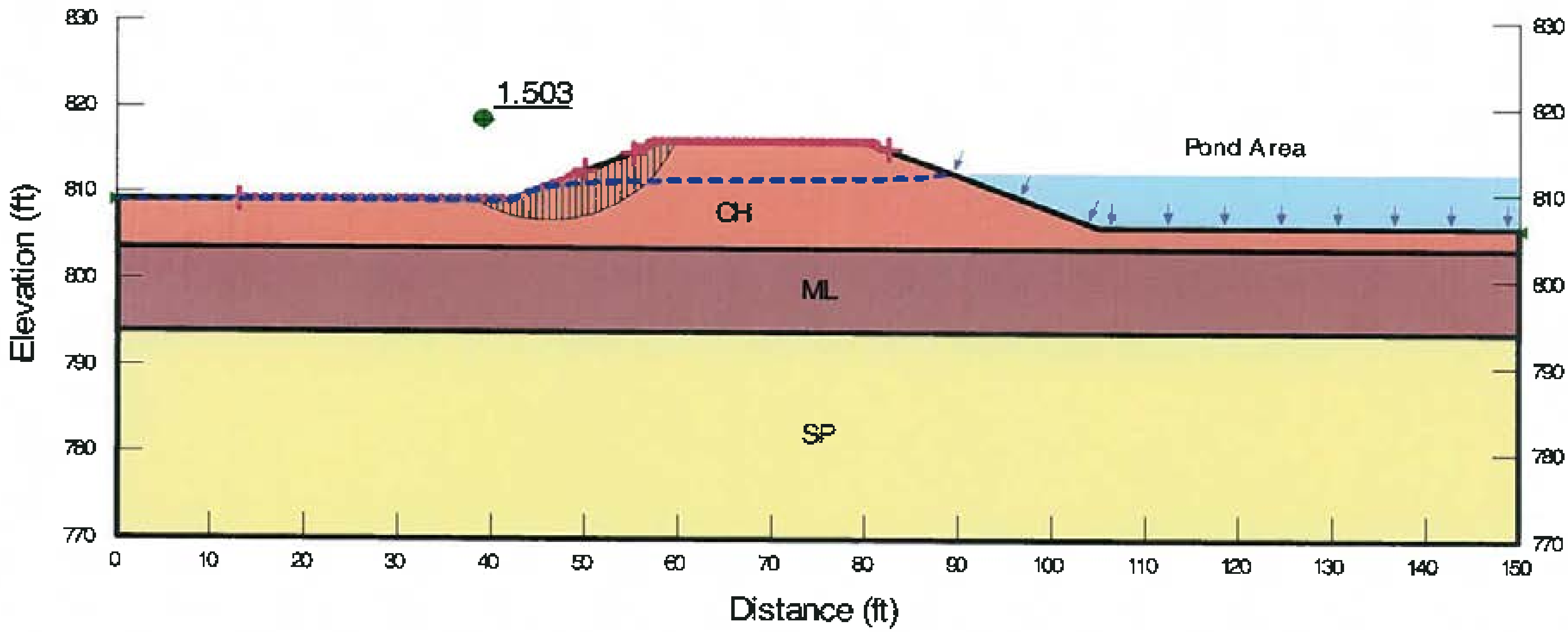
Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	18505	2.140	(52.894, 812.981)	6.279	(59.7363, 811.818)	(49.1024, 807.167)

Slices of Slip Surface: 18505

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	18505	49.279555	807.1667	-43.809678	23.047001	11.240773	50
2	18505	49.633885	807.1667	-43.645988	48.254711	23.535395	50
3	18505	49.988215	807.1667	-43.493587	73.460163	35.828915	50
4	18505	50.34254	807.1667	-43.363764	98.665615	48.122436	50
5	18505	50.696865	807.1667	-43.248052	123.87389	60.417333	50
6	18505	51.051195	807.1667	-43.137984	149.07934	72.710853	50
7	18505	51.405525	807.1667	-43.027917	174.28479	85.004374	50
8	18505	51.759855	807.1667	-42.923494	199.49307	97.299271	50
9	18505	52.11418	807.1667	-42.821893	224.69852	109.59279	50
10	18505	52.468505	807.1667	-42.728759	249.90397	121.88631	50
11	18505	52.822835	807.1667	-42.638447	275.11225	134.18121	50
12	18505	53.17846	807.2899	-50.228282	179.53856	87.566805	50
13	18505	53.535385	807.53635	-65.495503	174.68772	85.200895	50
14	18505	53.89231	807.7828	-80.767336	169.83689	82.834984	50
15	18505	54.24923	808.02925	-96.039168	164.98836	80.470198	50
16	18505	54.606155	808.2757	-111.31561	160.13752	78.104287	50
17	18505	54.96308	808.5221	-126.58975	155.28668	75.738377	50
18	18505	55.32	808.76855	-141.86619	150.43585	73.372466	50
19	18505	55.67692	809.015	-157.14264	145.58732	71.00768	50

20	18505	56.033845	809.26145	-172.42139	140.73648	68.641769	50
21	18505	56.39077	809.5079	-187.70013	135.88565	66.275859	50
22	18505	56.74769	809.75435	-202.97888	131.03481	63.909948	50
23	18505	57.104615	810.0008	-218.25994	126.18628	61.545162	50
24	18505	57.46154	810.24725	-233.55021	121.33545	59.179251	50
25	18505	57.81469	810.4911	-248.67314	108.589	52.962393	50
26	18505	58.16407	810.73235	-263.62933	87.947102	42.894668	50
27	18505	58.51345	810.9736	-278.58552	67.307561	32.828091	50
28	18505	58.86283	811.2148	-293.54171	46.665665	22.760356	50
29	18505	59.21221	811.45605	-308.49789	26.023769	12.69264	50
30	18505	59.56159	811.6973	-323.45408	5.3832859	2.625604	50



Name: CH	Model: Mohr-Coulomb	Unit Weight: 120	Cohesion: 50	Phi: 26
Name: ML	Model: Mohr-Coulomb	Unit Weight: 120	Cohesion: 200	Phi: 15
Name: SP	Model: Mohr-Coulomb	Unit Weight: 125	Cohesion: 0	Phi: 33

URS
8300 College Boulevard
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KCPL

LAKE ROAD GENERATING STATION ASH POND
CRITICAL CIRCULAR SLIP SURFACE
STEADY STATE SEEPAGE
CROSS SECTION C-C

Drawn By	DKN	Project No.
Date	2-8-2011	16530714
Checked By	BDL	Figure No.
Date	2-8-11	D-5

Slope Stability (Circular Failure)

File Information

Created By: Deepak K. Neupane
Revision Number: 88
Last Edited By: Deepak K. Neupane
Date: 2/9/2011
Time: 8:54:23 AM
File Name: Section C-C.gsz
Directory: I:\16530714 KCPL-GMO Lake Road Generating Station\slope stabiltiy\
Last Solved Date: 2/9/2011
Last Solved Time: 8:56:26 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

Slope Stability (Circular Failure)

- Description: Lake Road Generating Station Section C-C
- Kind: SLOPE/W
- Parent: SEEP/W Analysis
- Method: Spencer
- Settings
  - PWP Conditions Source: Parent Analysis
- Slip Surface
  - Direction of movement: Right to Left
  - Use Passive Mode: No
  - Slip Surface Option: Entry and Exit
  - Critical slip surfaces saved: 1
  - Optimize Critical Slip Surface Location: No
  - Tension Crack
    - Tension Crack Option: Search for Tension Crack
    - Percentage Wet: 1
    - Tension Crack Fluid Unit Weight: 62.4 pcf
- FOS Distribution
  - FOS Calculation Option: Constant
- Advanced

Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 5 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

CH

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 50 psf
Phi: 26 °
Phi-B: 0 °

ML

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 200 psf
Phi: 15 °
Phi-B: 0 °

SP

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (33, 809) ft
Left-Zone Right Coordinate: (50, 812.5) ft
Left-Zone Increment: 40
Right Projection: Range
Right-Zone Left Coordinate: (55, 814.6875) ft
Right-Zone Right Coordinate: (82.5, 815) ft
Right-Zone Increment: 40
Radius Increments: 6

Slip Surface Limits

Left Coordinate: (0, 809) ft
Right Coordinate: (150, 806) ft

Regions

	Material	Points	Area (ft²)
Region 1	CH	1,2,3,4,5,6,7,8,9,10,21,22,18,17,12,11	950
Region 2	ML	11,12,14,13	1425
Region 3	SP	13,15,19,20,16,14	3600

Points

	X (ft)	Y (ft)
Point 1	0	809
Point 2	12.28	809
Point 3	19.76	809
Point 4	27.47	809
Point 5	34.03	809
Point 6	39.24	809
Point 7	42	809
Point 8	58	816
Point 9	63.07	816
Point 10	76.99	816
Point 11	0	803.5
Point 12	150	803.5
Point 13	0	794
Point 14	150	794
Point 15	0	780
Point 16	150	780
Point 17	150	806
Point 18	105	806
Point 19	0	770
Point 20	150	770
Point 21	80	816
Point 22	88.75	812.5

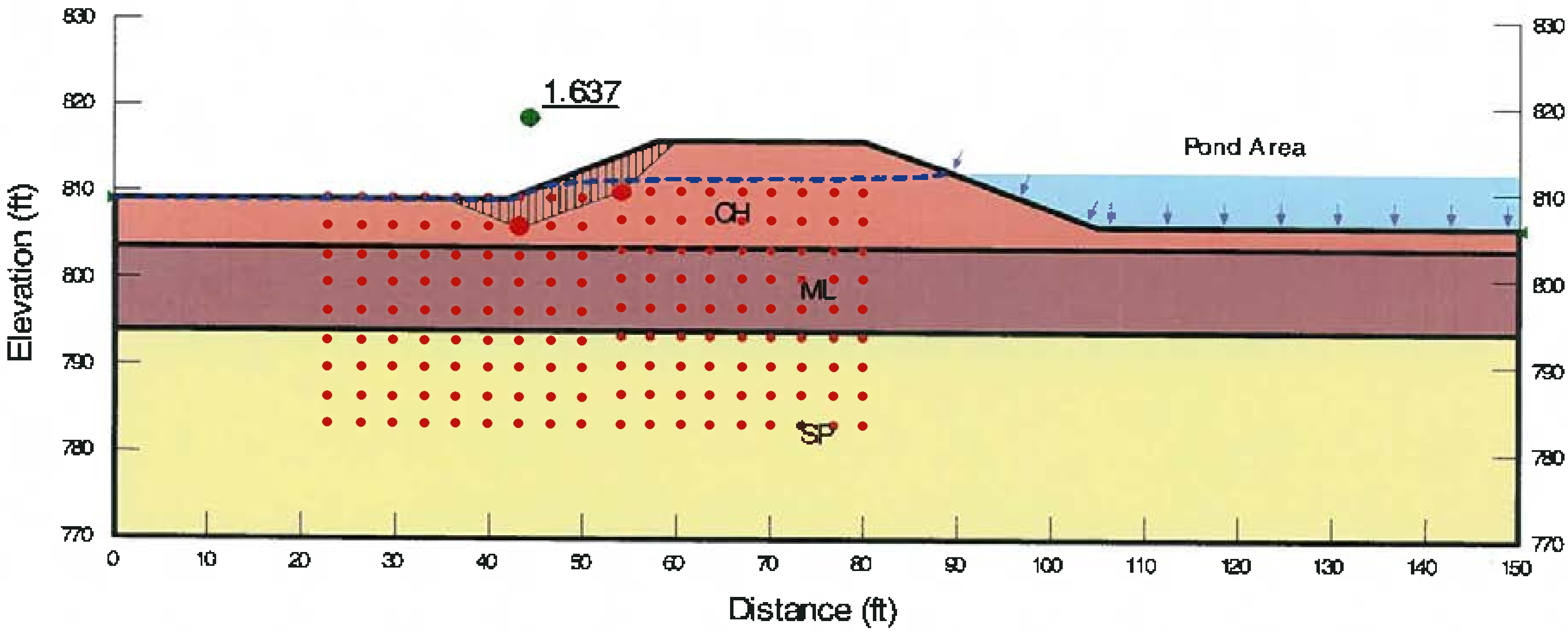
Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	7803	1.503	(46.139, 821.278)	14.477	(59.6197, 816)	(38.4692, 809)

Slices of Slip Surface: 7803

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)

1	7803	38.85459	808.77545	20.658994	84.355503	31.066863	50
2	7803	39.585	808.37565	57.955663	137.44329	38.768706	50
3	7803	40.275	808.0475	89.737232	176.92258	42.523136	50
4	7803	40.965	807.7625	118.76967	208.22015	43.627913	50
5	7803	41.655	807.518	147.00014	232.19904	41.55428	50
6	7803	42.347825	807.31115	172.6769	274.5184	49.671418	50
7	7803	43.043475	807.14055	196.26921	332.95695	66.667065	50
8	7803	43.73913	807.0059	215.0919	383.98434	82.374344	50
9	7803	44.434785	806.90615	231.39729	427.94937	95.864855	50
10	7803	45.130435	806.8406	243.89541	465.63546	108.14985	50
11	7803	45.826085	806.8088	252.63899	497.44544	119.40008	50
12	7803	46.52174	806.8105	258.32909	523.62762	129.39474	50
13	7803	47.217395	806.84565	260.8693	544.431	138.30228	50
14	7803	47.913045	806.91455	260.46567	560.02188	146.10332	50
15	7803	48.608695	807.01775	257.2783	570.53348	152.78476	50
16	7803	49.304345	807.15595	251.336	576.03328	158.36544	50
17	7803	50	807.3302	242.65382	576.55046	162.85227	50
18	7803	50.695655	807.54185	231.25149	572.07763	166.23202	50
19	7803	51.391305	807.7927	217.2128	562.54847	168.43146	50
20	7803	52.086955	808.085	200.42565	547.87465	169.4622	50
21	7803	52.782605	808.4215	180.48983	527.86859	169.42794	50
22	7803	53.47826	808.8059	157.579	502.29777	168.13058	50
23	7803	54.173915	809.2428	131.29683	470.83697	165.60479	50
24	7803	54.869565	809.73815	101.18357	433.02971	161.85218	50
25	7803	55.565215	810.29995	66.899039	388.31305	156.76409	50
26	7803	56.26087	810.9391	27.762495	335.8474	150.26305	50
27	7803	56.956525	811.67125	-17.215458	277.60463	135.39683	50
28	7803	57.652175	812.5201	-69.524539	216.85132	105.76546	50
29	7803	58.404925	813.6264	-137.84346	129.92878	63.370501	50
30	7803	59.214775	815.13775	-231.43135	18.982913	9.2585855	50



Name: CH	Model: Mohr-Coulomb	Unit Weight: 120	Cohesion: 50	Phi: 26
Name: ML	Model: Mohr-Coulomb	Unit Weight: 120	Cohesion: 200	Phi: 15
Name: SP	Model: Mohr-Coulomb	Unit Weight: 125	Cohesion: 0	Phi: 33

URS 8300 College Boulevard Suite 200 Overland Park, KS 66210	KCPL	LAKE ROAD GENERATING STATION ASH POND CRITICAL WEDGE SLIP SURFACE STEADY STATE SEEPAGE CROSS SECTION C-C	Drawn By: DKN Date: 2-8-2011 Checked By: BDL Date: 2-8-11	Project No.: 16530714 Figure No.: D-6

Slope Stability (Block Failure)

File Information

Created By: Deepak K. Neupane
Revision Number: 87
Last Edited By: Deepak K. Neupane
Date: 2/9/2011
Time: 8:48:14 AM
File Name: Section C-C.gsz
Directory: I:\16530714 KCPL-GMO Lake Road Generating Station\slope stabiltiy\
Last Solved Date: 2/9/2011
Last Solved Time: 8:49:53 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

Slope Stability (Block Failure)

Description: Lake Road Generating Station Section C-C
Kind: SLOPE/W
Parent: SEEP/W Analysis
Method: Spencer
Settings
- PWP Conditions Source: Parent Analysis

Slip Surface
- Direction of movement: Right to Left
- Use Passive Mode: No
- Slip Surface Option: Block
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No
- Tension Crack
  - Tension Crack Option: Search for Tension Crack
  - Percentage Wet: 1
  - Tension Crack Fluid Unit Weight: 62.4 pcf

FOS Distribution
- FOS Calculation Option: Constant

Restrict Block Crossing: No

Advanced

Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

CH

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 50 psf
Phi: 26 °
Phi-B: 0 °

ML

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 200 psf
Phi: 15 °
Phi-B: 0 °

SP

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

Slip Surface Limits

Left Coordinate: (0, 809) ft
Right Coordinate: (150, 806) ft

Slip Surface Block

Left Grid

Upper Left: (23, 809) ft
Lower Left: (23, 783) ft
Lower Right: (50, 783) ft
X Increments: 8
Y Increments: 8

Starting Angle: 135 °
Ending Angle: 180 °
Angle Increments: 2

Right Grid

Upper Left: (54, 810) ft
Lower Left: (54, 783) ft
Lower Right: (80, 783) ft
X Increments: 8
Y Increments: 8
Starting Angle: 45 °
Ending Angle: 65 °
Angle Increments: 2

Regions

	Material	Points	Area (ft^2)
Region 1	CH	1,2,3,4,5,6,7,8,9,10,21,22,18,17,12,11	950
Region 2	ML	11,12,14,13	1425
Region 3	SP	13,15,19,20,16,14	3600

Points

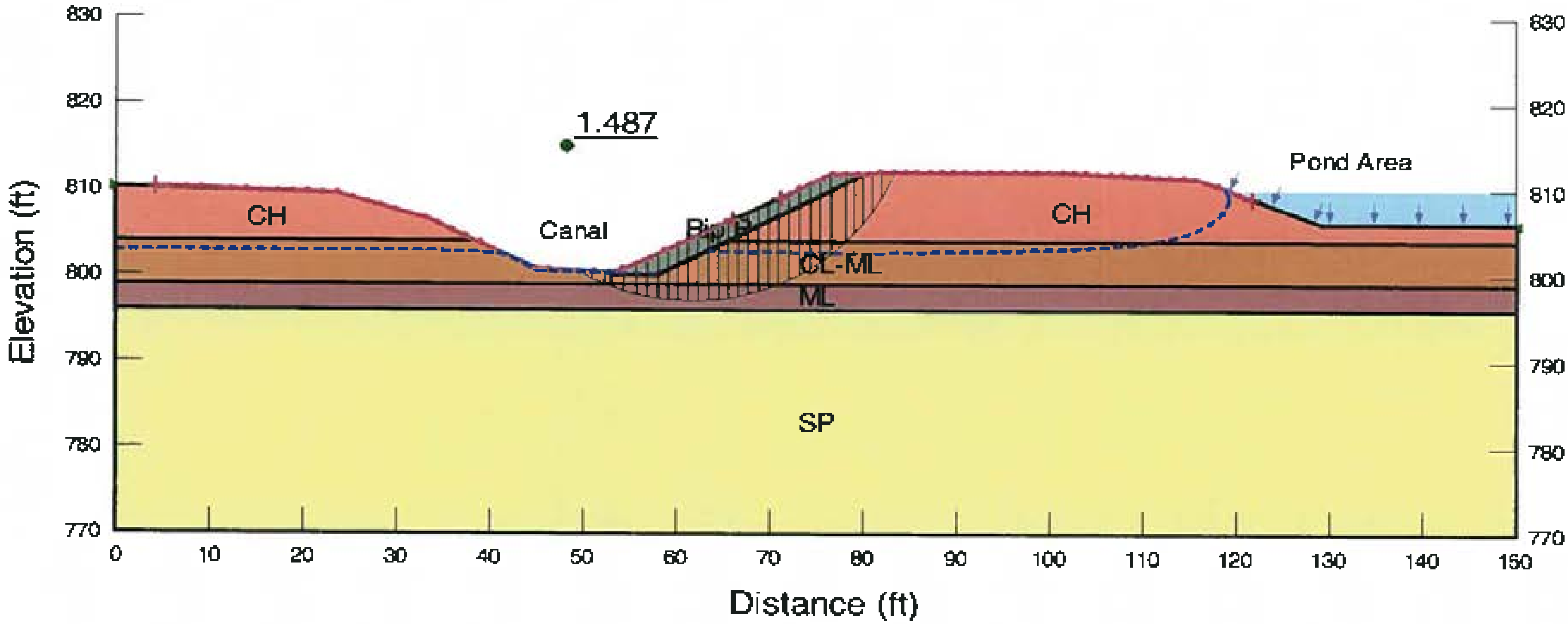
	X (ft)	Y (ft)
Point 1	0	809
Point 2	12.28	809
Point 3	19.76	809
Point 4	27.47	809
Point 5	34.03	809
Point 6	39.24	809
Point 7	42	809
Point 8	58	816
Point 9	63.07	816
Point 10	76.99	816
Point 11	0	803.5
Point 12	150	803.5
Point 13	0	794
Point 14	150	794
Point 15	0	780
Point 16	150	780
Point 17	150	806
Point 18	105	806
Point 19	0	770
Point 20	150	770
Point 21	80	816
Point 22	88.75	812.5

Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	50761	1.637	(46.208, 817.75)	12.681	(60, 816)	(35.4038, 809)

Slices of Slip Surface: 50761

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	50761	35.787425	808.8411	14.419836	50.384531	17.541154	50
2	50761	36.55466	808.5233	43.329348	96.081261	25.728827	50
3	50761	37.3219	808.2055	72.38336	141.74187	33.828404	50
4	50761	38.08914	807.8877	101.69747	187.33142	41.76647	50
5	50761	38.85638	807.5699	131.4222	232.81261	49.451407	50
6	50761	39.7	807.22045	164.80204	282.62681	57.46698	50
7	50761	40.62	806.83935	202.75139	336.54321	65.25463	50
8	50761	41.54	806.4583	241.9259	390.12823	72.283107	50
9	50761	42.3125	806.13835	274.93178	458.08166	89.378168	50
10	50761	42.9375	805.87945	301.06648	540.60998	116.83317	50
11	50761	43.66346	805.91345	303.58674	410.09795	51.948987	50
12	50761	44.490385	806.24035	284.17609	412.92071	62.792947	50
13	50761	45.31731	806.5673	265.87878	415.79969	73.121312	50
14	50761	46.14423	806.89425	249.31337	418.74615	82.637888	50
15	50761	46.971155	807.22115	233.01787	421.70386	92.028308	50
16	50761	47.79808	807.54805	216.37373	424.65032	101.58328	50
17	50761	48.625	807.875	199.95452	427.59678	111.02855	50
18	50761	49.45192	808.20195	183.04048	430.532	120.70968	50
19	50761	50.278845	808.52885	165.58663	433.44472	130.64312	50
20	50761	51.10577	808.85575	147.84039	436.3462	140.71368	50
21	50761	51.93269	809.1827	129.74552	439.22518	150.94332	50
22	50761	52.759615	809.50965	111.24916	442.09292	161.36328	50
23	50761	53.58654	809.83655	97.48965	444.93817	171.90063	50
24	50761	54.4	810.4	58.663339	323.94325	129.38566	50
25	50761	55.2	811.2	9.8172925	279.26295	131.41743	50
26	50761	56	812	-39.028754	240.72563	117.40974	50
27	50761	56.8	812.8	-87.946394	203.73511	99.368255	50
28	50761	57.6	813.6	-136.98424	166.7446	81.326773	50
29	50761	58.5	814.5	-192.23399	107.14786	52.259502	50
30	50761	59.5	815.5	-253.8159	24.952376	12.170087	50



Name: CH	Model: Mohr-Coulomb	Unit Weight: 120	Cohesion: 50	Phi: 26
Name: ML	Model: Mohr-Coulomb	Unit Weight: 120	Cohesion: 200	Phi: 15
Name: SP	Model: Mohr-Coulomb	Unit Weight: 125	Cohesion: 0	Phi: 33
Name: CL-ML	Model: Mohr-Coulomb	Unit Weight: 120	Cohesion: 200	Phi: 15
Name: Rip Rap	Model: Mohr-Coulomb	Unit Weight: 120	Cohesion: 0	Phi: 34

URS 8300 College Boulevard Suite 200 Overland Park, KS 66210	KCPL	LAKE ROAD GENERATING STATION ASH POND CRITICAL CIRCULAR SLIP SURFACE - STEADY STATE SEEPAGE WITH SEISMIC FORCES CROSS SECTION A-A	Drawn By	DKN	Project No.
			Date	2-16-11	16530714
			Checked By	BDL	Figure No.
			Date	2-16-11	D-7

Slope Stability (Circular Failure)

File Information

Created By: Deepak K. Neupane
Revision Number: 129
Last Edited By: Deepak K. Neupane
Date: 2/18/2011
Time: 9:59:29 AM
File Name: Section A-A_Seismic.gsz
Directory: I:\16530714 KCPL-GMO Lake Road Generating Station\slope stabiltiy\
Last Solved Date: 2/18/2011
Last Solved Time: 9:59:58 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

Slope Stability (Circular Failure)

Description: Lake Road Generating Station Section A-A
Kind: SLOPE/W
Parent: SEEP/W Analysis
Method: Spencer
Settings
- PWP Conditions Source: Parent Analysis

Slip Surface
- Direction of movement: Right to Left
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No
- Tension Crack
  - Tension Crack Option: Search for Tension Crack
  - Percentage Wet: 1
  - Tension Crack Fluid Unit Weight: 62.4 pcf

FOS Distribution
- FOS Calculation Option: Constant

Advanced

Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 3 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

CH

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 50 psf
Phi: 26 °
Phi-B: 0 °

ML

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 200 psf
Phi: 15 °
Phi-B: 0 °

SP

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

CL-ML

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 200 psf
Phi: 15 °
Phi-B: 0 °

Rip Rap

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (4.26648, 810.06851) ft
Left-Zone Right Coordinate: (66, 806.4377) ft
Left-Zone Increment: 40
Right Projection: Range
Right-Zone Left Coordinate: (71, 808.92451) ft
Right-Zone Right Coordinate: (121.64723, 808.98311) ft
Right-Zone Increment: 40
Radius Increments: 6

Slip Surface Limits

Left Coordinate: (0, 810.21) ft
Right Coordinate: (150, 806) ft

Seismic Loads

Horz Seismic Load: 0.0183
Vert Seismic Load: 0
Ignore seismic load in strength: No

Regions

	Material	Points	Area (ft^2)
Region 1	CH	1,2,3,25,11	182.3983
Region 2	CL-ML	11,25,4,5,22,23,24,12,14,13	675.0748
Region 3	SP	15,19,20,16	3900
Region 4	Rip Rap	5,22,23,21,7,6	48.24555
Region 5	CH	24,21,8,9,10,26,18,17,12	439.97372
Region 6	ML	13,15,16,14	450

Points

	X (ft)	Y (ft)
Point 1	0	810.21
Point 2	23.52	809.43
Point 3	33.56	806.47
Point 4	44.82	800.69
Point 5	52.96	800.19
Point 6	55.65	801.29
Point 7	76.5	811.66
Point 8	81.94	811.9
Point 9	101.9	811.98

Point 10	115.98	811.25
Point 11	0	804
Point 12	150	804
Point 13	0	799
Point 14	150	799
Point 15	0	796
Point 16	150	796
Point 17	150	806
Point 18	129.105	806
Point 19	0	770
Point 20	150	770
Point 21	80	811.8
Point 22	53	800
Point 23	58	800
Point 24	65.5	804
Point 25	38.3	804
Point 26	118.88	810.09

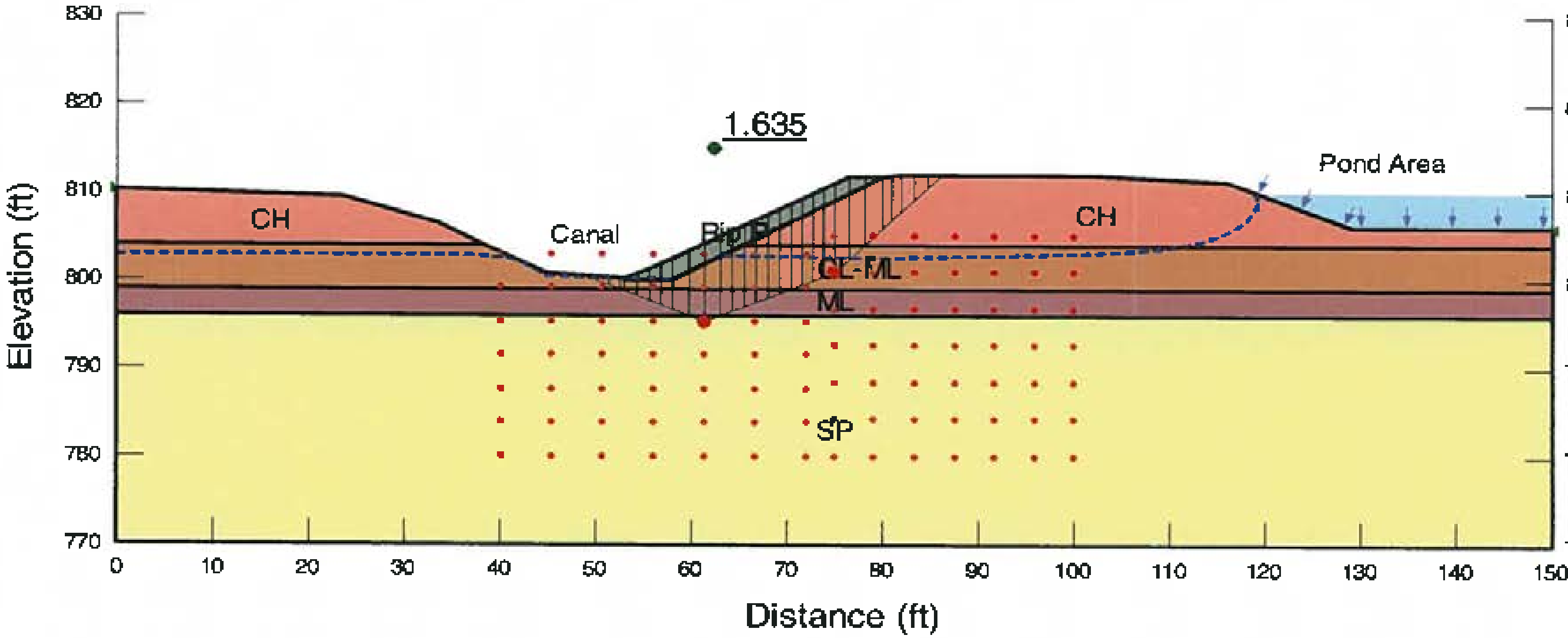
Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	8398	1.487	(61.575, 820.364)	23.304	(83.2896, 811.905)	(49.5545, 800.399)

Slices of Slip Surface: 8398

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	8398	50.232325	800.0213	50.536055	208.67481	42.373152	200
2	8398	51.587935	799.3217	174.42457	261.26032	23.26757	200
3	8398	52.61287	798.85535	243.96847	296.27496	14.015484	200
4	8398	53.6425	798.46355	268.85113	375.87221	28.676213	200
5	8398	54.9875	798.02105	297.12998	496.41591	53.398505	200
6	8398	56.2375	797.68745	318.59724	599.44296	75.252386	200
7	8398	57.4125	797.4425	334.49644	690.35423	95.351808	200
8	8398	58.535715	797.26535	346.07523	765.94788	112.50454	200
9	8398	59.607145	797.1495	353.69721	828.23849	127.15295	200
10	8398	60.678575	797.08345	358.08816	881.87894	140.34932	200
11	8398	61.75	797.06685	359.29513	927.30566	152.19796	200
12	8398	62.821425	797.0996	357.3459	964.80224	162.76744	200
13	8398	63.892855	797.1819	352.27513	994.7324	172.14591	200
14	8398	64.964285	797.31425	344.05065	1017.1282	180.35058	200
15	8398	66.038355	797.4981	332.58769	1032.4201	187.51954	200
16	8398	67.115065	797.735	317.81343	1040.5841	193.66583	200
17	8398	68.191775	798.0263	299.64611	1041.3568	198.74079	200
18	8398	69.26849	798.37415	277.93217	1034.4435	202.70659	200

19	8398	70.345205	798.78123	252.52664	1019.6917	205.56126	200
20	8398	71.445205	799.1527	221.91723	996.28901	207.49229	200
21	8398	72.56849	799.82603	185.33199	963.43121	208.49106	200
22	8398	73.691775	800.46875	143.23111	920.68457	208.31803	200
23	8398	74.815065	801.1968	95.028474	867.51753	206.98782	200
24	8398	75.938355	802.02675	39.992739	802.81233	204.39689	200
25	8398	77.333415	803.23335	-40.871014	672.33072	180.13047	200
26	8398	78.625125	804.4923	-125.94957	537.33851	261.97995	50
27	8398	79.54171	805.54005	-197.19064	433.63785	111.49931	50
28	8398	80.485	806.77015	-281.61335	322.48281	157.28538	50
29	8398	81.455	808.24005	-382.76184	203.45579	99.232019	50
30	8398	82.61482	810.47035	-531.5684	49.2061	23.999419	50



Name: CH Model: Mohr-Coulomb Unit Weight: 120 Cohesion: 50 Phi: 26
Name: ML Model: Mohr-Coulomb Unit Weight: 120 Cohesion: 200 Phi: 15
Name: SP Model: Mohr-Coulomb Unit Weight: 125 Cohesion: 0 Phi: 33
Name: CL-ML Model: Mohr-Coulomb Unit Weight: 120 Cohesion: 200 Phi: 15
Name: Rip Rap Model: Mohr-Coulomb Unit Weight: 120 Cohesion: 0 Phi: 34

URS 8300 College Boulevard Suite 200 Overland Park, KS 66210	KCPL	LAKE ROAD GENERATING STATION ASH POND CRITICAL WEDGE SLIP SURFACE - STEADY STATE SEEPAGE WITH SEISMIC FORCES CROSS SECTION A-A	Drawn By: DKN Date: 2-16-11 Checked By: BDL Date: 2-16-11	Project No. 16530714 Figure No. D-8

Slope Stability (Block Failure)

File Information

Created By: Deepak K. Neupane
Revision Number: 127
Last Edited By: Deepak K. Neupane
Date: 2/18/2011
Time: 9:46:41 AM
File Name: Section A-A_Seismic.gsz
Directory: I:\16530714 KCPL-GMO Lake Road Generating Station\slope stabiltiy\
Last Solved Date: 2/18/2011
Last Solved Time: 9:47:24 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

Slope Stability (Block Failure)

Description: Lake Road Generating Station Section A-A
Kind: SLOPE/W
Parent: SEEP/W Analysis
Method: Spencer
Settings
- PWP Conditions Source: Parent Analysis

Slip Surface
- Direction of movement: Right to Left
- Use Passive Mode: No
- Slip Surface Option: Block
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No
- Tension Crack
  - Tension Crack Option: Search for Tension Crack
  - Percentage Wet: 1
  - Tension Crack Fluid Unit Weight: 62.4 pcf

FOS Distribution
FOS Calculation Option: Constant
Restrict Block Crossing: No
Advanced
Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

CH
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 50 psf
Phi: 26 °
Phi-B: 0 °

ML
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 200 psf
Phi: 15 °
Phi-B: 0 °

SP
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

CL-ML
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 200 psf
Phi: 15 °
Phi-B: 0 °

Rip Rap

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °

Slip Surface Limits

Left Coordinate: (0, 810.21) ft
Right Coordinate: (150, 806) ft

Slip Surface Block

Left Grid
- Upper Left: (40, 803) ft
- Lower Left: (40, 780) ft
- Lower Right: (72, 780) ft
- X Increments: 6
- Y Increments: 6
- Starting Angle: 135 °
- Ending Angle: 180 °
- Angle Increments: 2

Right Grid
- Upper Left: (75, 805) ft
- Lower Left: (75, 780) ft
- Lower Right: (100, 780) ft
- X Increments: 6
- Y Increments: 6
- Starting Angle: 45 °
- Ending Angle: 65 °
- Angle Increments: 2

Seismic Loads

Horz Seismic Load: 0.0183
Vert Seismic Load: 0
Ignore seismic load in strength: No

Regions

	Material	Points	Area (ft^2)
Region 1	CH	1,2,3,25,11	182.3983
Region 2	CL-ML	11,25,4,5,22,23,24,12,14,13	675.0748

Region 3	SP	15,19,20,16	3900
Region 4	Rip Rap	5,22,23,21,7,6	48.24555
Region 5	CH	24,21,8,9,10,26,18,17,12	439.97372
Region 6	ML	13,15,16,14	450

Points

	X (ft)	Y (ft)
Point 1	0	810.21
Point 2	23.52	809.43
Point 3	33.56	806.47
Point 4	44.82	800.69
Point 5	52.96	800.19
Point 6	55.65	801.29
Point 7	76.5	811.66
Point 8	81.94	811.9
Point 9	101.9	811.98
Point 10	115.98	811.25
Point 11	0	804
Point 12	150	804
Point 13	0	799
Point 14	150	799
Point 15	0	796
Point 16	150	796
Point 17	150	806
Point 18	129.105	806
Point 19	0	770
Point 20	150	770
Point 21	80	811.8
Point 22	53	800
Point 23	58	800
Point 24	65.5	804
Point 25	38.3	804
Point 26	118.88	810.09

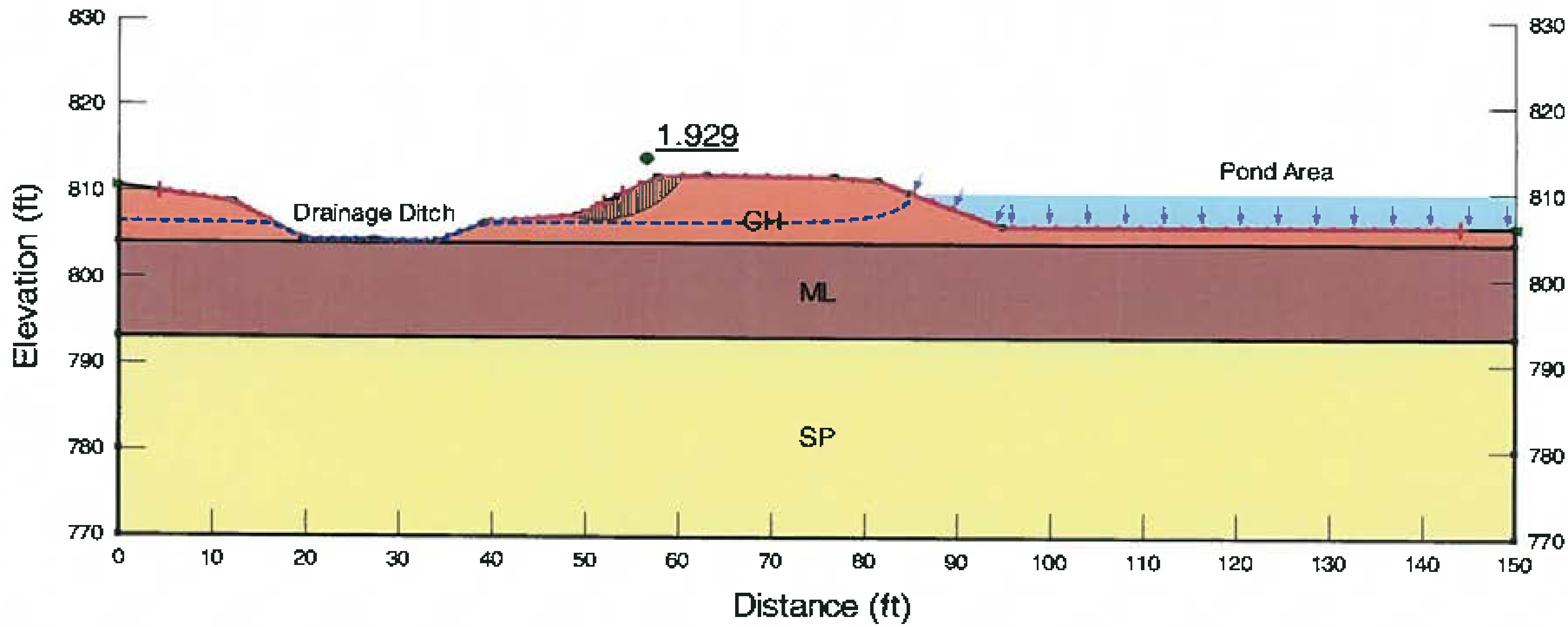
Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	14365	1.635	(64.885, 814.788)	19.95	(86.0833, 811.917)	(49.0247, 800.432)

Slices of Slip Surface: 14365

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	14365	49.60081	800.1931	23.348718	138.20953	30.776862	200
2	14365	50.75297	799.71585	103.75337	189.32845	22.929774	200
3	14365	51.905135	799.2386	189.5209	239.66155	13.435146	200
4	14365	52.72061	798.90085	241.05076	276.63334	9.5343238	200
5	14365	53.6425	798.519	265.30578	373.20004	28.910181	200
6	14365	54.9875	797.96185	300.91272	539.51066	63.932124	200
7	14365	56.2375	797.44405	334.11411	702.10904	98.603944	200
8	14365	57.4125	796.95735	365.32158	863.49308	133.48465	200
9	14365	58.86193	796.357	403.56077	1062.1741	176.47491	200
10	14365	60.528595	795.66665	446.91875	1378.3491	604.87798	0
11	14365	62.161615	795.66665	446.92218	929.89785	313.64807	0
12	14365	63.617425	796.25255	410.33476	940.81402	142.14149	200
13	14365	64.872475	796.75765	378.80182	952.41897	153.70025	200
14	14365	66.118055	797.2589	347.52393	964.23519	165.24728	200
15	14365	67.354165	797.75635	316.48348	976.2431	176.78206	200
16	14365	68.590275	798.2538	285.44304	988.25101	188.31683	200
17	14365	69.826385	798.75125	254.39508	1000.2589	199.85361	200
18	14365	71.013885	799.22915	224.11019	1011.8478	211.07365	200
19	14365	72.152775	799.6875	194.38686	1022.8444	221.98452	200
20	14365	73.291665	800.14585	164.38657	1033.9224	232.99142	200
21	14365	74.430555	800.60415	134.10119	1045.0004	244.07471	200
22	14365	75.75	801.5833	69.258763	771.26506	188.10202	200
23	14365	77.333335	803.16665	-36.437065	665.07624	178.20664	200
24	14365	79.083335	804.91665	-154.7291	532.14282	259.5434	50
25	14365	80.485	806.3183	-250.46162	425.18992	207.37898	50
26	14365	81.455	807.2883	-316.13509	351.69454	171.53289	50

27	14365	82.630545	808.46385	-393.42951	259.99945	126.8102	50
28	14365	84.011635	809.84495	-477.93368	150.10562	73.211404	50
29	14365	85.392725	811.22605	-557.35378	40.211289	19.612356	50



Name: CH	Model: Mohr-Coulomb	Unit Weight: 120	Cohesion: 50	Phi: 26
Name: ML	Model: Mohr-Coulomb	Unit Weight: 120	Cohesion: 200	Phi: 15
Name: SP	Model: Mohr-Coulomb	Unit Weight: 125	Cohesion: 0	Phi: 33

URS 8300 College Boulevard Suite 200 Overland Park, KS 66210	KCPL	LAKE ROAD GENERATING STATION ASH POND CRITICAL CIRCULAR SLIP SURFACE - STEADY STATE SEEPAGE WITH SEISMIC FORCES CROSS SECTION B-B	Drawn By: DKN Date: 2-16-11 Checked By: BDL Date: 2-16-11		Project No. 16530714 Figure No. D-9

Slope Stability (Circular Failure)

File Information

Created By: Deepak K. Neupane
Revision Number: 100
Last Edited By: Deepak K. Neupane
Date: 2/18/2011
Time: 9:39:49 AM
File Name: Section B-B_Seismic.gsz
Directory: I:\16530714 KCPL-GMO Lake Road Generating Station\slope stabiltiy\
Last Solved Date: 2/18/2011
Last Solved Time: 9:40:54 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

Slope Stability (Circular Failure)

Description: Lake Road Generating Station Section B-B
Kind: SLOPE/W
Parent: SEEP/W Analysis
Method: Spencer
Settings
- PWP Conditions Source: Parent Analysis

Slip Surface
- Direction of movement: Right to Left
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No
- Tension Crack
  - Tension Crack Option: Search for Tension Crack
  - Percentage Wet: 1
  - Tension Crack Fluid Unit Weight: 62.4 pcf

FOS Distribution
    FOS Calculation Option: Constant
Advanced
    Number of Slices: 30
    Optimization Tolerance: 0.01
    Minimum Slip Surface Depth: 0.1 ft
    Optimization Maximum Iterations: 2000
    Optimization Convergence Tolerance: 1e-007
    Starting Optimization Points: 8
    Ending Optimization Points: 16
    Complete Passes per Insertion: 1
    Driving Side Maximum Convex Angle: 5 °
    Resisting Side Maximum Convex Angle: 1 °

Materials

CH

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 50 psf
Phi: 26 °
Phi-B: 0 °

ML

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 200 psf
Phi: 15 °
Phi-B: 0 °

SP

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (4.25325, 809.98729) ft
Left-Zone Right Coordinate: (52, 808.72561) ft
Left-Zone Increment: 40
Right Projection: Range
Right-Zone Left Coordinate: (54, 809.80164) ft
Right-Zone Right Coordinate: (144, 806) ft

Right-Zone Increment: 40
Radius Increments: 6

Slip Surface Limits

Left Coordinate: (0, 810.68) ft
Right Coordinate: (150, 806) ft

Seismic Loads

Horz Seismic Load: 0.0183
Vert Seismic Load: 0
Ignore seismic load in strength: No

Regions

	Material	Points	Area (ft²)
Region 1	CH	1,2,3,4,5,6,7,8,9,10,21,22,18,17,12,11	531.45355
Region 2	ML	11,12,14,13	1650
Region 3	SP	13,15,19,20,16,14	3450

Points

	X (ft)	Y (ft)
Point 1	0	810.68
Point 2	12.28	808.68
Point 3	19.76	804.37
Point 4	27.47	804.32
Point 5	34.03	804.15
Point 6	39.24	806.43
Point 7	49.09	807.16
Point 8	57.64	811.76
Point 9	63.07	811.91
Point 10	76.99	811.71
Point 11	0	804
Point 12	150	804
Point 13	0	793
Point 14	150	793
Point 15	0	780

Point 16	150	780
Point 17	150	806
Point 18	94.835	806
Point 19	0	770
Point 20	150	770
Point 21	81.61	811.29
Point 22	84.764	810.03

Critical Slip Surfaces

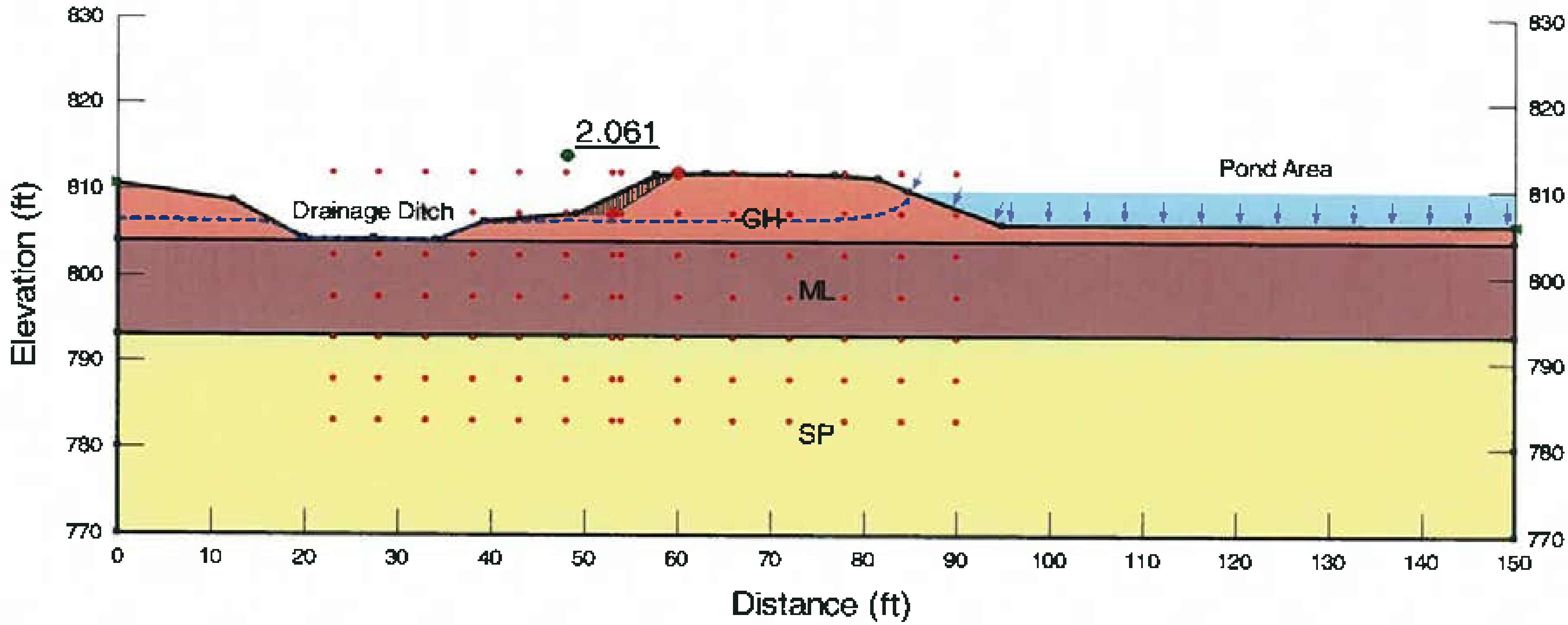
	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	10644	1.929	(51.427, 817.16)	10.409	(60.3707, 811.835)	(48.6527, 807.128)

Slices of Slip Surface: 10644

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	10644	48.87133	807.0722	- 38.141789	31.864619	15.541413	50
2	10644	49.28432	806.9759	- 31.925359	62.382741	30.426096	50
3	10644	49.672955	806.9018	- 27.135752	101.06603	49.293195	50
4	10644	50.06159	806.84285	- 23.307442	135.4633	66.069866	50
5	10644	50.45023	806.7988	- 20.423743	165.99318	80.960286	50
6	10644	50.838865	806.7695	- 18.466397	192.98749	94.126286	50
7	10644	51.2275	806.7548	- 17.421317	216.72841	105.70551	50
8	10644	51.616135	806.7546	- 17.285541	237.43982	115.80714	50
9	10644	52.00477	806.7689	- 18.069715	255.31752	124.52667	50
10	10644	52.39341	806.79785	-	270.51934	131.9411	50

				19.768484			
11	10644	52.782045	806.8415	-22.387466	283.15668	138.10474	50
12	10644	53.17068	806.90005	-25.937965	293.3717	143.08694	50
13	10644	53.55932	806.97375	-30.436099	301.21286	146.91133	50
14	10644	53.947955	807.06295	-35.904016	306.78936	149.63117	50
15	10644	54.33659	807.1681	-42.363722	310.14355	151.26712	50
16	10644	54.72523	807.2896	-49.850865	311.30251	151.83238	50
17	10644	55.113865	807.42815	-58.400719	310.30269	151.34474	50
18	10644	55.5025	807.5845	-68.057731	307.14289	149.8036	50
19	10644	55.891135	807.7595	-78.877548	301.85723	147.22561	50
20	10644	56.27977	807.9542	-90.928666	294.40056	143.58875	50
21	10644	56.66841	808.1699	-104.28746	284.74772	138.88074	50
22	10644	57.057045	808.40825	-119.05218	272.89644	133.10048	50
23	10644	57.44568	808.67105	-135.33976	258.74457	126.19816	50
24	10644	57.83505	808.96125	-153.33437	233.61678	113.94252	50
25	10644	58.22515	809.28205	-173.23096	198.32036	96.727303	50
26	10644	58.615245	809.63675	-195.23424	161.67523	78.854277	50
27	10644	59.00534	810.03045	-219.67792	123.7043	60.334617	50
28	10644	59.39544	810.47015	-246.98191	84.413917	41.171418	50
29	10644	59.78554	810.96575	-	43.882823	21.403083	50

				277.76837			
30	10644	60.17564	811.5322	- 312.99308	2.318534	1.1308246	50



Name: CH	Model: Mohr-Coulomb	Unit Weight: 120	Cohesion: 50	Phi: 26
Name: ML	Model: Mohr-Coulomb	Unit Weight: 120	Cohesion: 200	Phi: 15
Name: SP	Model: Mohr-Coulomb	Unit Weight: 125	Cohesion: 0	Phi: 33

URS
8300 College Boulevard
Suite 200
Overland Park, KS 66210

KCPL

LAKE ROAD GENERATING STATION ASH POND CRITICAL WEDGE SLIP SURFACE - STEADY STATE SEEPAGE WITH SEISMIC FORCES CROSS SECTION B-B

Drawn By	DKN	Project No.
Date	2-16-11	16530714
Checked By	BDL	Figure No.
Date	2-16-11	D-10

Slope Stability (Block Failure)

File Information

Created By: Deepak K. Neupane
Revision Number: 100
Last Edited By: Deepak K. Neupane
Date: 2/18/2011
Time: 9:39:49 AM
File Name: Section B-B_Seismic.gsz
Directory: I:\16530714 KCPL-GMO Lake Road Generating Station\slope stabiltiy\
Last Solved Date: 2/18/2011
Last Solved Time: 9:40:32 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

Slope Stability (Block Failure)

Description: Lake Road Generating Station Section B-B
Kind: SLOPE/W
Parent: SEEP/W Analysis
Method: Spencer
Settings
- PWP Conditions Source: Parent Analysis

Slip Surface
- Direction of movement: Right to Left
- Use Passive Mode: No
- Slip Surface Option: Block
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No
- Tension Crack
  - Tension Crack Option: Search for Tension Crack
  - Percentage Wet: 1
  - Tension Crack Fluid Unit Weight: 62.4 pcf

FOS Distribution
  FOS Calculation Option: Constant
Restrict Block Crossing: No
Advanced
  Number of Slices: 30
  Optimization Tolerance: 0.01
  Minimum Slip Surface Depth: 0.1 ft
  Optimization Maximum Iterations: 2000
  Optimization Convergence Tolerance: 1e-007
  Starting Optimization Points: 8
  Ending Optimization Points: 16
  Complete Passes per Insertion: 1
  Driving Side Maximum Convex Angle: 5 °
  Resisting Side Maximum Convex Angle: 1 °

Materials

CH

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 50 psf
Phi: 26 °
Phi-B: 0 °

ML

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 200 psf
Phi: 15 °
Phi-B: 0 °

SP

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

Slip Surface Limits

Left Coordinate: (0, 810.68) ft
Right Coordinate: (150, 806) ft

Slip Surface Block

Left Grid

Upper Left: (23, 812) ft
Lower Left: (23, 783) ft
Lower Right: (53, 783) ft
X Increments: 6
Y Increments: 6
Starting Angle: 135 °
Ending Angle: 180 °
Angle Increments: 2

Right Grid

Upper Left: (54, 812) ft
Lower Left: (54, 783) ft
Lower Right: (90, 783) ft
X Increments: 6
Y Increments: 6
Starting Angle: 45 °
Ending Angle: 65 °
Angle Increments: 2

Seismic Loads

Horz Seismic Load: 0.0183
Vert Seismic Load: 0
Ignore seismic load in strength: No

Regions

	Material	Points	Area (ft^2)
Region 1	CH	1,2,3,4,5,6,7,8,9,10,21,22,18,17,12,11	531.45355
Region 2	ML	11,12,14,13	1650
Region 3	SP	13,15,19,20,16,14	3450

Points

	X (ft)	Y (ft)
Point 1	0	810.68
Point 2	12.28	808.68
Point 3	19.76	804.37
Point 4	27.47	804.32
Point 5	34.03	804.15
Point 6	39.24	806.43

Point 7	49.09	807.16
Point 8	57.64	811.76
Point 9	63.07	811.91
Point 10	76.99	811.71
Point 11	0	804
Point 12	150	804
Point 13	0	793
Point 14	150	793
Point 15	0	780
Point 16	150	780
Point 17	150	806
Point 18	94.835	806
Point 19	0	770
Point 20	150	770
Point 21	81.61	811.29
Point 22	84.764	810.03

Critical Slip Surfaces

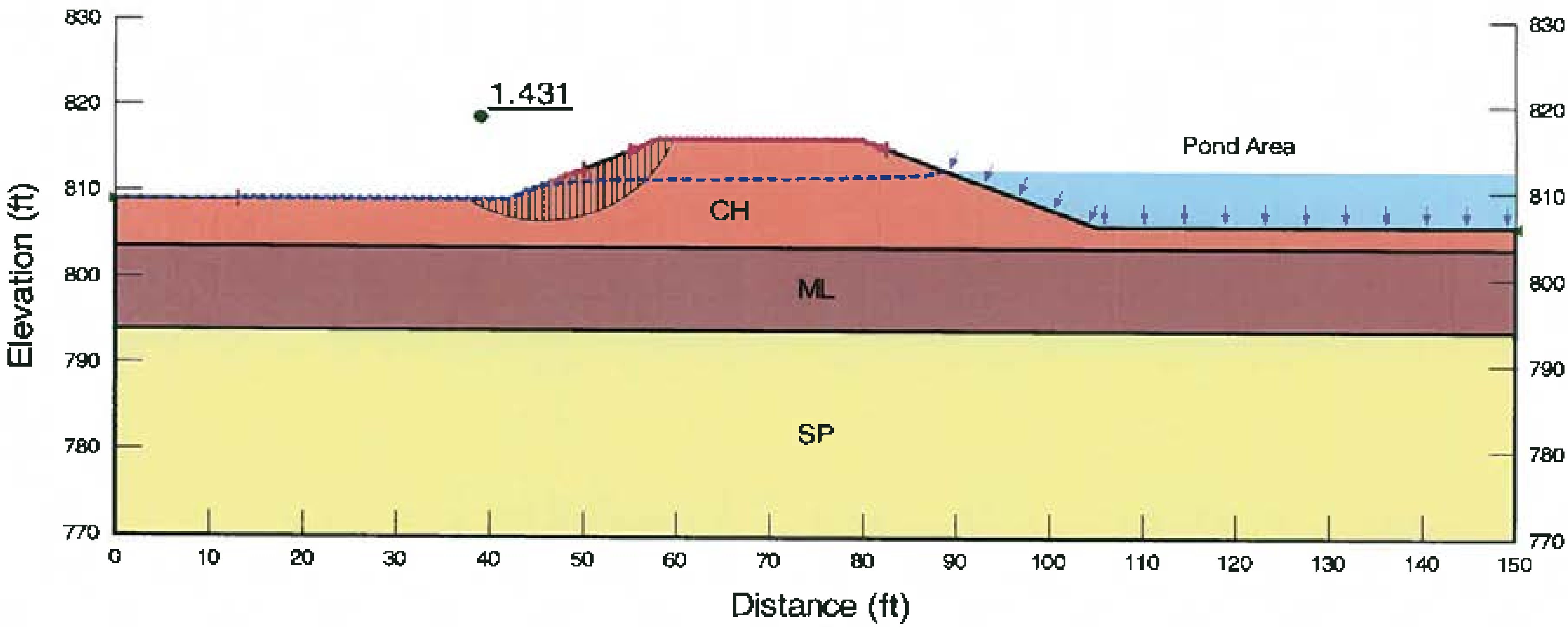
	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	18507	2.061	(52.894, 812.981)	6.279	(59.7363, 811.818)	(49.1024, 807.167)

Slices of Slip Surface: 18507

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	18507	49.279555	807.1667	-43.809678	23.779091	11.597837	50
2	18507	49.633885	807.1667	-43.645988	48.960272	23.87952	50
3	18507	49.988215	807.1667	-43.493587	74.137501	36.159275	50
4	18507	50.34254	807.1667	-43.363764	99.317553	48.440407	50
5	18507	50.696865	807.1667	-43.248052	124.49761	60.721539	50

6	18507	51.051195	807.1667	-43.137984	149.67766	73.002671	50
7	18507	51.405525	807.1667	-43.027917	174.85771	85.283803	50
8	18507	51.759855	807.1667	-42.923494	200.03776	97.564935	50
9	18507	52.11418	807.1667	-42.821893	225.21781	109.84607	50
10	18507	52.468505	807.1667	-42.728759	250.39787	122.1272	50
11	18507	52.822835	807.1667	-42.638447	275.57792	134.40833	50
12	18507	53.17846	807.2899	-50.228282	177.3898	86.518788	50
13	18507	53.535385	807.53635	-65.495503	172.5943	84.179865	50
14	18507	53.89231	807.7828	-80.767336	167.8011	81.842066	50
15	18507	54.24923	808.02925	-96.039168	163.00791	79.504268	50
16	18507	54.606155	808.2757	-111.31561	158.21471	77.166469	50
17	18507	54.96308	808.5221	-126.58975	153.42151	74.828671	50
18	18507	55.32	808.76855	-141.86619	148.62831	72.490872	50
19	18507	55.67692	809.015	-157.14264	143.83512	70.153073	50
20	18507	56.033845	809.26145	-172.42139	139.03961	67.81415	50
21	18507	56.39077	809.5079	-187.70013	134.24642	65.476352	50
22	18507	56.74769	809.75435	-202.97888	129.45322	63.138553	50
23	18507	57.104615	810.0008	-218.25994	124.66002	60.800755	50
24	18507	57.46154	810.24725	-233.55021	119.86682	58.462956	50

25	18507	57.81469	810.4911	-248.67314	107.27003	52.319088	50
26	18507	58.16407	810.73235	-263.62933	86.870727	42.369685	50
27	18507	58.51345	810.9736	-278.58552	66.469072	32.419133	50
28	18507	58.86283	811.2148	-293.54171	46.069773	22.469729	50
29	18507	59.21221	811.45605	-308.49789	25.670473	12.520326	50
30	18507	59.56159	811.6973	-323.45408	5.2702312	2.5704635	50



Name: CH	Model: Mohr-Coulomb	Unit Weight: 120	Cohesion: 50	Phi: 26
Name: ML	Model: Mohr-Coulomb	Unit Weight: 120	Cohesion: 200	Phi: 15
Name: SP	Model: Mohr-Coulomb	Unit Weight: 125	Cohesion: 0	Phi: 33

URS 8300 College Boulevard Suite 200 Overland Park, KS 66210	KCPL	LAKE ROAD GENERATING STATION ASH POND CRITICAL CIRCULAR SLIP SURFACE - STEADY STATE SEEPAGE WITH SEISMIC FORCES CROSS SECTION C-C	Drawn By: DKN Date: 2-16-11 Checked By: BDL Date: 2-16-11	Project No. 16530714 Figure No. D-11

Slope Stability (Circular Failure)

File Information

Created By: Deepak K. Neupane
Revision Number: 98
Last Edited By: Deepak K. Neupane
Date: 2/18/2011
Time: 9:49:08 AM
File Name: Section C-C_Seismic.gsz
Directory: I:\16530714 KCPL-GMO Lake Road Generating Station\slope stabiltiy\
Last Solved Date: 2/18/2011
Last Solved Time: 9:51:14 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

Slope Stability (Circular Failure)

Description: Lake Road Generating Station Section C-C
Kind: SLOPE/W
Parent: SEEP/W Analysis
Method: Spencer
Settings
    PWP Conditions Source: Parent Analysis
Slip Surface
    Direction of movement: Right to Left
    Use Passive Mode: No
    Slip Surface Option: Entry and Exit
    Critical slip surfaces saved: 1
    Optimize Critical Slip Surface Location: No
    Tension Crack
        Tension Crack Option: Search for Tension Crack
        Percentage Wet: 1
        Tension Crack Fluid Unit Weight: 62.4 pcf

FOS Distribution

FOS Calculation Option: Constant

Advanced

Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 5 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

CH

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 50 psf
Phi: 26 °
Phi-B: 0 °

ML

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 200 psf
Phi: 15 °
Phi-B: 0 °

SP

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (13, 809) ft
Left-Zone Right Coordinate: (50, 812.5) ft
Left-Zone Increment: 40
Right Projection: Range
Right-Zone Left Coordinate: (55, 814.6875) ft
Right-Zone Right Coordinate: (22.5, 915) ft

Right-Zone Increment: 40
Radius Increments: 6

Slip Surface Limits

Left Coordinate: (0, 809) ft
Right Coordinate: (150, 806) ft

Seismic Loads

Horz Seismic Load: 0.0183
Vert Seismic Load: 0
Ignore seismic load in strength: No

Regions

	Material	Points	Area (ft²)
Region 1	CH	1,2,3,4,5,6,7,8,9,10,21,22,18,17,12,11	950
Region 2	ML	11,12,14,13	1425
Region 3	SP	13,15,19,20,16,14	3600

Points

	X (ft)	Y (ft)
Point 1	0	809
Point 2	12.28	809
Point 3	19.76	809
Point 4	27.47	809
Point 5	34.03	809
Point 6	39.24	809
Point 7	42	809
Point 8	58	816
Point 9	63.07	816
Point 10	76.99	816
Point 11	0	803.5
Point 12	150	803.5
Point 13	0	794
Point 14	150	794
Point 15	0	780

Point 16	150	780
Point 17	150	806
Point 18	105	806
Point 19	0	770
Point 20	150	770
Point 21	80	816
Point 22	88.75	812.5

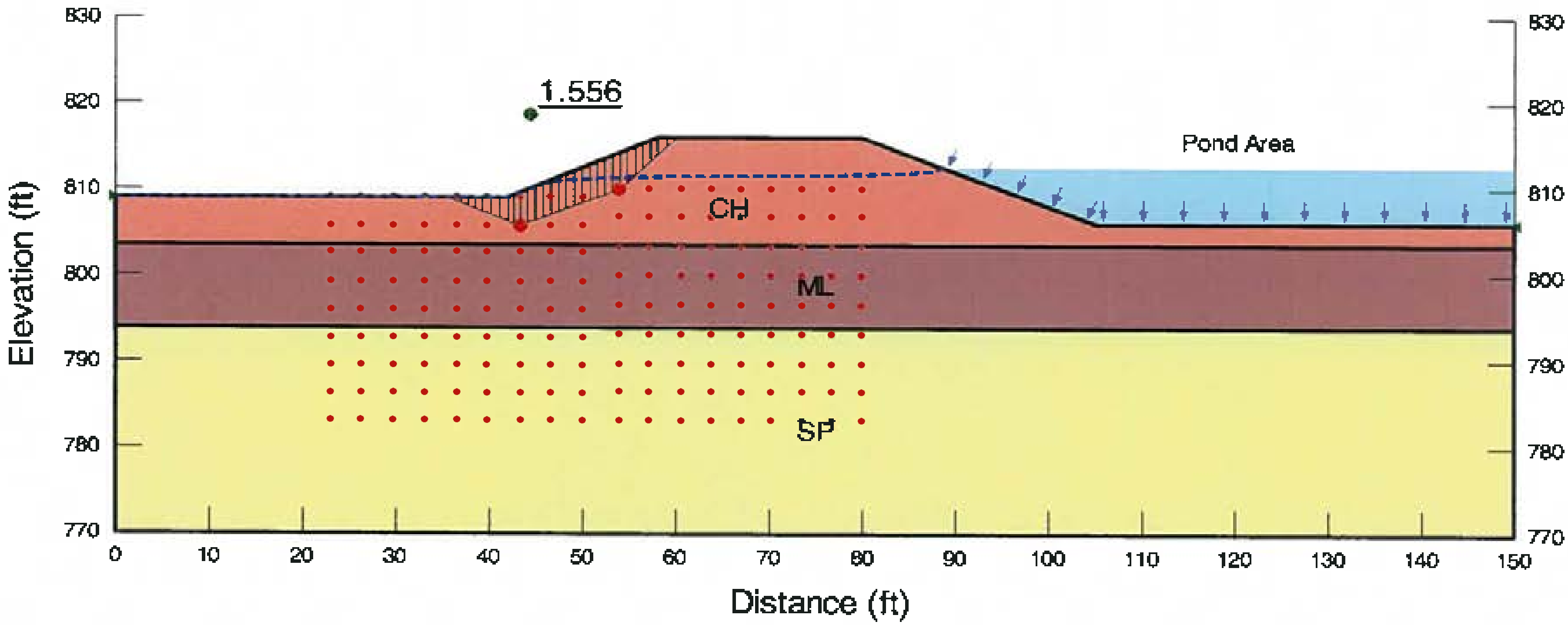
Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	7516	1.431	(45.728, 821.478)	14.932	(59.6197, 816)	(37.5259, 809)

Slices of Slip Surface: 7516

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	7516	37.95441	808.7385	23.894443	99.045756	36.653745	50
2	7516	38.81147	808.25285	68.723449	163.36681	46.160654	50
3	7516	39.585	807.8729	104.59151	208.39052	50.626156	50
4	7516	40.275	807.5817	132.96352	239.6681	52.043302	50
5	7516	40.965	807.33015	159.46457	263.98872	50.979835	50
6	7516	41.655	807.11615	184.12809	282.42455	47.942387	50
7	7516	42.363635	806.9342	206.05945	320.82419	55.974506	50
8	7516	43.09091	806.7848	226.52668	376.31742	73.057823	50
9	7516	43.818185	806.6726	243.25605	424.17756	88.241319	50
10	7516	44.545455	806.59675	256.89207	465.01549	101.50857	50
11	7516	45.272725	806.5567	266.32333	499.49712	113.72646	50
12	7516	46	806.55225	272.83734	527.84389	124.375	50
13	7516	46.727275	806.58325	275.90652	550.44112	133.89947	50
14	7516	47.454545	806.64995	275.83223	567.46649	142.23953	50
15	7516	48.181815	806.7529	273.09145	579.07323	149.23729	50
16	7516	48.90909	806.8928	267.14002	585.35705	155.20481	50
17	7516	49.636365	807.07075	258.34903	586.36791	159.98549	50
18	7516	50.363635	807.28815	246.75415	582.11186	163.56488	50

19	7516	51.09091	807.5469	232.23534	572.52979	165.97269	50
20	7516	51.818185	807.8494	214.79338	557.53381	167.16568	50
21	7516	52.545455	808.19855	194.22392	536.9231	167.14555	50
22	7516	53.272725	808.59825	170.3723	510.47624	165.87977	50
23	7516	54	809.05335	142.96537	477.85983	163.33894	50
24	7516	54.727275	809.57025	111.51797	438.59053	159.52395	50
25	7516	55.454545	810.1575	75.696257	392.07576	154.30859	50
26	7516	56.181815	810.8268	34.695604	337.44703	147.66174	50
27	7516	56.90909	811.59515	-12.508252	275.83538	134.5339	50
28	7516	57.636365	812.48825	-67.55017	212.84281	103.81037	50
29	7516	58.404925	813.62345	-137.65829	125.70497	61.310412	50
30	7516	59.214775	815.1385	-231.48	17.005525	8.2941489	50



Name: CH	Model: Mohr-Coulomb	Unit Weight: 120	Cohesion: 50	Phi: 26
Name: ML	Model: Mohr-Coulomb	Unit Weight: 120	Cohesion: 200	Phi: 15
Name: SP	Model: Mohr-Coulomb	Unit Weight: 125	Cohesion: 0	Phi: 33

URS
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Suite 200
Overland Park, KS 66210

KCPL

LAKE ROAD GENERATING STATION ASH POND
CRITICAL WEDGE SLIP SURFACE - STEADY
STATE SEEPAGE WITH SEISMIC FORCES
CROSS SECTION C-C

Drawn By	DKN	Project No.	16530714
Date	2-16-11		
Checked By	BDL	Figure No.	D-12
Date	2-16-11		

Slope Stability (Block Failure)

File Information

Created By: Deepak K. Neupane
Revision Number: 98
Last Edited By: Deepak K. Neupane
Date: 2/18/2011
Time: 9:49:08 AM
File Name: Section C-C_Seismic.gsz
Directory: I:\16530714 KCPL-GMO Lake Road Generating Station\slope stabiltiy\
Last Solved Date: 2/18/2011
Last Solved Time: 9:50:52 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

Slope Stability (Block Failure)

- Description: Lake Road Generating Station Section C-C
- Kind: SLOPE/W
- Parent: SEEP/W Analysis
- Method: Spencer
- Settings
  - PWP Conditions Source: Parent Analysis
- Slip Surface
  - Direction of movement: Right to Left
  - Use Passive Mode: No
  - Slip Surface Option: Block
  - Critical slip surfaces saved: 1
  - Optimize Critical Slip Surface Location: No
  - Tension Crack
    - Tension Crack Option: Search for Tension Crack
    - Percentage Wet: 1
    - Tension Crack Fluid Unit Weight: 62.4 pcf

FOS Distribution

FOS Calculation Option: Constant

Restrict Block Crossing: No

Advanced

Number of Slices: 30

Optimization Tolerance: 0.01

Minimum Slip Surface Depth: 0.1 ft

Optimization Maximum Iterations: 2000

Optimization Convergence Tolerance: 1e-007

Starting Optimization Points: 8

Ending Optimization Points: 16

Complete Passes per Insertion: 1

Driving Side Maximum Convex Angle: 5 °

Resisting Side Maximum Convex Angle: 1 °

Materials

CH

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion: 50 psf

Phi: 26 °

Phi-B: 0 °

ML

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion: 200 psf

Phi: 15 °

Phi-B: 0 °

SP

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion: 0 psf

Phi: 33 °

Phi-B: 0 °

Slip Surface Limits

Left Coordinate: (0, 809) ft

Right Coordinate: (150, 806) ft

Slip Surface Block

Left Grid

Upper Left: (23, 809) ft
Lower Left: (23, 783) ft
Lower Right: (50, 783) ft
X Increments: 8
Y Increments: 8
Starting Angle: 135 °
Ending Angle: 180 °
Angle Increments: 2

Right Grid

Upper Left: (54, 810) ft
Lower Left: (54, 783) ft
Lower Right: (80, 783) ft
X Increments: 8
Y Increments: 8
Starting Angle: 45 °
Ending Angle: 65 °
Angle Increments: 2

Seismic Loads

Horz Seismic Load: 0.0183
Vert Seismic Load: 0
Ignore seismic load in strength: No

Regions

	Material	Points	Area (ft^2)
Region 1	CH	1,2,3,4,5,6,7,8,9,10,21,22,18,17,12,11	950
Region 2	ML	11,12,14,13	1425
Region 3	SP	13,15,19,20,16,14	3600

Points

	X (ft)	Y (ft)
Point 1	0	809
Point 2	12.28	809
Point 3	19.76	809
Point 4	27.47	809
Point 5	34.03	809
Point 6	39.24	809

Point 7	42	809
Point 8	58	816
Point 9	63.07	816
Point 10	76.99	816
Point 11	0	803.5
Point 12	150	803.5
Point 13	0	794
Point 14	150	794
Point 15	0	780
Point 16	150	780
Point 17	150	806
Point 18	105	806
Point 19	0	770
Point 20	150	770
Point 21	80	816
Point 22	88.75	812.5

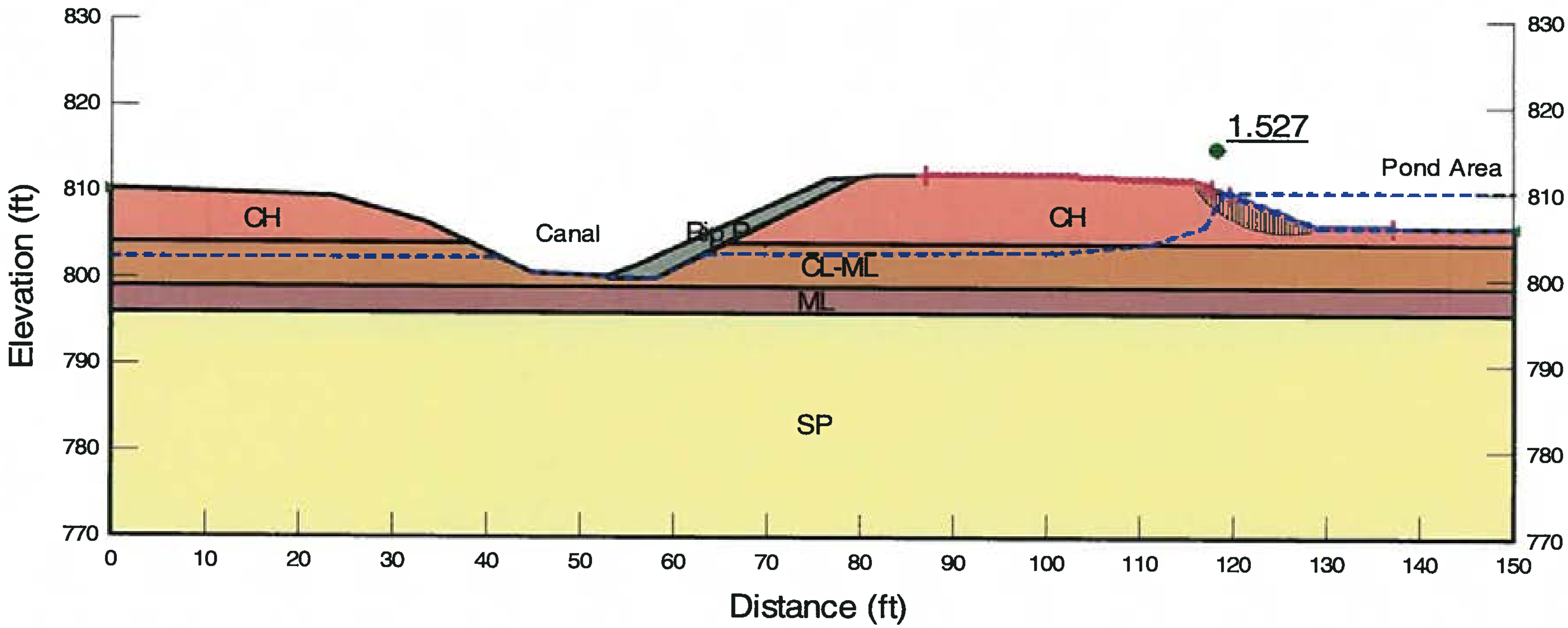
Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	50761	1.556	(46.208, 817.75)	12.681	(60, 816)	(35.4038, 809)

Slices of Slip Surface: 50761

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	50761	35.787425	808.8411	14.419836	52.739871	18.68993	50
2	50761	36.55466	808.5233	43.329348	98.613613	26.963937	50
3	50761	37.3219	808.2055	72.38336	144.43919	35.143975	50
4	50761	38.08914	807.8877	101.69747	190.19733	43.164265	50
5	50761	38.85638	807.5699	131.4222	235.83506	50.925552	50
6	50761	39.7	807.22045	164.80204	285.81017	59.019612	50
7	50761	40.62	806.83935	202.75139	339.86717	66.875833	50
8	50761	41.54	806.4583	241.9259	393.56265	73.958186	50
9	50761	42.3125	806.13835	274.93178	461.96935	91.224318	50
10	50761	42.9375	805.87945	301.06648	545.28111	119.11143	50

11	50761	43.66346	805.91345	303.58674	407.59008	50.725819	50
12	50761	44.490385	806.24035	284.17609	410.3791	61.553324	50
13	50761	45.31731	806.5673	265.87878	413.2131	71.859748	50
14	50761	46.14423	806.89425	249.31337	416.12583	81.359869	50
15	50761	46.971155	807.22115	233.01787	419.0498	90.733834	50
16	50761	47.79808	807.54805	216.37373	421.95127	100.26687	50
17	50761	48.625	807.875	199.95452	424.87524	109.70117	50
18	50761	49.45192	808.20195	183.04048	427.76547	119.36035	50
19	50761	50.278845	808.52885	165.58663	430.64446	129.27734	50
20	50761	51.10577	808.85575	147.84039	433.50095	139.32597	50
21	50761	51.93269	809.1827	129.74552	436.3462	149.53914	50
22	50761	52.759615	809.50965	111.24916	439.16895	159.93717	50
23	50761	53.58654	809.83655	92.48965	441.98046	170.45806	50
24	50761	54.4	810.4	58.663339	319.09957	127.02324	50
25	50761	55.2	811.2	9.8172925	274.67559	129.18002	50
26	50761	56	812	-39.028754	236.5979	115.39651	50
27	50761	56.8	812.8	-87.946394	200.12887	97.609372	50
28	50761	57.6	813.6	-136.98424	163.651	79.817928	50
29	50761	58.5	814.5	-192.23399	104.89219	51.159338	50
30	50761	59.5	815.5	-253.8159	23.836562	11.625868	50



Name: CH	Model: Mohr-Coulomb	Unit Weight: 120	Cohesion: 50	Phi: 26	Drawdown Total Cohesion: 1000	Drawdown Total Phi: 0
Name: ML	Model: Mohr-Coulomb	Unit Weight: 120	Cohesion: 200	Phi: 15	Drawdown Total Cohesion: 1000	Drawdown Total Phi: 0
Name: SP	Model: Mohr-Coulomb	Unit Weight: 125	Cohesion: 0	Phi: 33	Drawdown Total Cohesion: 0	Drawdown Total Phi: 33
Name: CL-ML	Model: Mohr-Coulomb	Unit Weight: 120	Cohesion: 200	Phi: 15	Drawdown Total Cohesion: 1000	Drawdown Total Phi: 0
Name: Rip Rap	Model: Mohr-Coulomb	Unit Weight: 120	Cohesion: 0	Phi: 34	Drawdown Total Cohesion: 0	Drawdown Total Phi: 34

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KCPL

LAKE ROAD GENERATING STATION ASH POND CRITICAL CIRCULAR SLIP SURFACE AND CALCULATED SAFETY FACTOR - RAPID DRAWDOWN CROSS SECTION A-A

Drawn By	DKN	Project No.	16530714
Date	2-16-2011		
Checked By	BDL	Figure No.	D-13
Date	2-16-11		

Slope Stability (Circular Failure)

File Information

Created By: Deepak K. Neupane
Revision Number: 138
Last Edited By: Deepak K. Neupane
Date: 2/16/2011
Time: 3:12:55 PM
File Name: Section A-A_RD.gsz
Directory: I:\16530714 KCPL-GMO Lake Road Generating Station\slope stabiltiy\
Last Solved Date: 2/16/2011
Last Solved Time: 3:14:28 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

Slope Stability (Circular Failure)

Description: Lake Road Generating Station Section A-A
Kind: SLOPE/W
Parent: SEEP/W Analysis
Method: Spencer
Settings
- **Apply Phreatic Correction:** No
- **PWP Conditions Source:** Piezometric Line
- **Use Staged Rapid Drawdown:** Yes

Slip Surface
- **Direction of movement:** Left to Right
- **Use Passive Mode:** No
- **Slip Surface Option:** Entry and Exit
- **Critical slip surfaces saved:** 1
- **Optimize Critical Slip Surface Location:** No
- **Tension Crack**
  - **Tension Crack Option:** Search for Tension Crack

Percentage Wet: 1
Tension Crack Fluid Unit Weight: 62.4 pcf
FOS Distribution
FOS Calculation Option: Constant
Advanced
Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

CH

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 50 psf
Phi: 26 °
Phi-B: 0 °
Drawdown Total Cohesion: 1000 psf
Drawdown Total Phi: 0 °
Pore Water Pressure
Piezometric Line: 1
Piezometric Line After Drawdown: 2

ML

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 200 psf
Phi: 15 °
Phi-B: 0 °
Drawdown Total Cohesion: 1000 psf
Drawdown Total Phi: 0 °
Pore Water Pressure
Piezometric Line: 1
Piezometric Line After Drawdown: 2

SP

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 0 psf

Phi: 33 °
Phi-B: 0 °
Drawdown Total Cohesion: 0 psf
Drawdown Total Phi: 33 °
Pore Water Pressure
Piezometric Line: 1
Piezometric Line After Drawdown: 2

CL-ML

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 200 psf
Phi: 15 °
Phi-B: 0 °
Drawdown Total Cohesion: 1000 psf
Drawdown Total Phi: 0 °
Pore Water Pressure
Piezometric Line: 1
Piezometric Line After Drawdown: 2

Rip Rap

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °
Drawdown Total Cohesion: 0 psf
Drawdown Total Phi: 34 °
Pore Water Pressure
Piezometric Line: 1
Piezometric Line After Drawdown: 2

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (87, 811.92028) ft
Left-Zone Right Coordinate: (117.65627, 810.57949) ft
Left-Zone Increment: 40
Right Projection: Range
Right-Zone Left Coordinate: (119.45543, 809.54623) ft
Right-Zone Right Coordinate: (137, 806) ft
Right-Zone Increment: 40
Radius Increments: 6

Slip Surface Limits

Left Coordinate: (0, 810.21) ft

Right Coordinate: (150, 806) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
	0	802.5
	41.25	802.5
	44.82	800.69
	52.96	800.19
	58	800
	63.58	802.96
	77	802.78
	94.23	803
	100.74	803.04
	111.24	804
	117.11	806.2
	118.88	810.09
	150	810.09

Piezometric Line 2

Coordinates

	X (ft)	Y (ft)
	0	802.5
	41.25	802.5
	44.82	800.69
	52.96	800.19
	58	800
	63.58	802.96
	77	802.78
	94.23	803
	100.74	803.04
	111.24	804

	117.11	806.2
	118.88	810.09
	129.105	806
	150	806

Regions

	Material	Points	Area (ft²)
Region 1	CH	1,2,3,25,11	182.3983
Region 2	CL-ML	11,25,4,5,22,23,24,12,14,13	675.0748
Region 3	SP	15,19,20,16	3900
Region 4	Rip Rap	5,22,23,21,7,6	48.24555
Region 5	CH	24,21,8,9,10,26,18,17,12	439.97372
Region 6	ML	13,15,16,14	450

Points

	X (ft)	Y (ft)
Point 1	0	810.21
Point 2	23.52	809.43
Point 3	33.56	806.47
Point 4	44.82	800.69
Point 5	52.96	800.19
Point 6	55.65	801.29
Point 7	76.5	811.66
Point 8	81.94	811.9
Point 9	101.9	811.98
Point 10	115.98	811.25
Point 11	0	804
Point 12	150	804
Point 13	0	799
Point 14	150	799
Point 15	0	796
Point 16	150	796
Point 17	150	806
Point 18	129.105	806

Point 19	0	770
Point 20	150	770
Point 21	80	811.8
Point 22	53	800
Point 23	58	800
Point 24	65.5	804
Point 25	38.3	804
Point 26	118.88	810.09

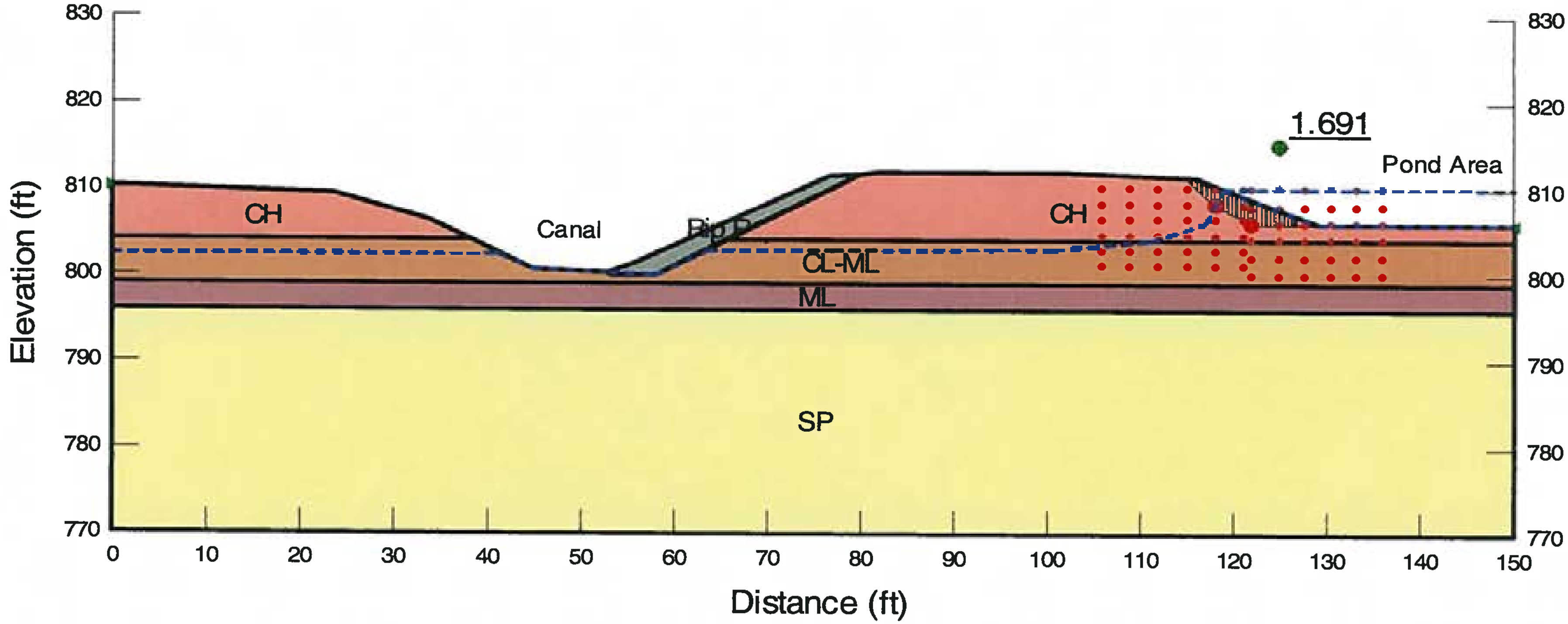
Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	10784	1.527	(125.742, 817.465)	11.987	(115.98, 811.25)	(129.243, 806)

Slices of Slip Surface: 10784

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	10784	116.16835	810.25765	-275.22192	36.939485	18.016591	50
2	10784	116.545	809.78205	-236.73137	73.1367	35.671152	50
3	10784	116.92165	809.3518	-201.0771	100.02094	48.783471	50
4	10784	117.3454	808.9158	-137.18408	127.85876	62.360884	50
5	10784	117.8162	808.477	-45.23629	156.37871	76.270995	50
6	10784	118.2587	808.10385	38.732119	185.47064	71.569157	50
7	10784	118.6729	807.787	115.30614	213.86926	48.072445	50
8	10784	119.1023	807.4878	156.82948	235.6281	38.432655	50
9	10784	119.54685	807.20565	163.34048	251.97439	43.229645	50
10	10784	119.9914	806.94985	168.20476	265.91157	47.654797	50
11	10784	120.436	806.7185	171.54464	277.48712	51.671598	50
12	10784	120.88055	806.5101	173.45144	286.79328	55.280509	50
13	10784	121.3251	806.32335	174.01118	293.87662	58.462284	50
14	10784	121.7697	806.1571	173.2849	298.74731	61.192105	50
15	10784	122.21425	806.01055	171.33366	301.45696	63.465372	50
16	10784	122.6588	805.8829	168.20364	302.01098	65.2622	50
17	10784	123.1034	805.77355	163.93043	300.38517	66.553421	50

18	10784	123.54795	805.682	158.54658	296.58831	67.327939	50
19	10784	123.9925	805.6078	152.28095	290.55646	67.539019	50
20	10784	124.43706	805.55065	144.54939	282.27446	67.173007	50
21	10784	124.8816	805.5103	135.97017	271.6756	66.187961	50
22	10784	125.3262	805.4666	126.35526	258.70377	64.550684	50
23	10784	125.77075	805.4794	115.70597	243.2257	62.195528	50
24	10784	126.2153	805.4687	104.02951	225.14555	59.072236	50
25	10784	126.6599	805.5146	91.319418	204.34225	55.12492	50
26	10784	127.10445	805.5571	77.570225	180.62175	50.261585	50
27	10784	127.549	805.6164	62.772205	153.7829	44.388881	50
28	10784	127.9936	805.69285	46.908734	123.57067	37.390525	50
29	10784	128.43815	805.7867	29.955563	89.674924	29.126542	50
30	10784	128.8827	805.89835	11.891344	51.705752	19.417614	50
31	10784	129.1741	805.97935	1.2684603	28.780185	13.406609	50



Name: CH	Model: Mohr-Coulomb	Unit Weight: 120	Cohesion: 50	Phi: 26	Drawdown Total Cohesion: 1000	Drawdown Total Phi: 0
Name: ML	Model: Mohr-Coulomb	Unit Weight: 120	Cohesion: 200	Phi: 15	Drawdown Total Cohesion: 1000	Drawdown Total Phi: 0
Name: SP	Model: Mohr-Coulomb	Unit Weight: 125	Cohesion: 0	Phi: 33	Drawdown Total Cohesion: 0	Drawdown Total Phi: 33
Name: CL-ML	Model: Mohr-Coulomb	Unit Weight: 120	Cohesion: 200	Phi: 15	Drawdown Total Cohesion: 1000	Drawdown Total Phi: 0
Name: Rip Rap	Model: Mohr-Coulomb	Unit Weight: 120	Cohesion: 0	Phi: 34	Drawdown Total Cohesion: 0	Drawdown Total Phi: 34

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KCPL

LAKE ROAD GENERATING STATION ASH POND CRITICAL WEDGE SLIP SURFACE AND CALCULATED SAFETY FACTOR - RAPID DRAWDOWN CROSS SECTION A-A

Drawn By	DKN	Project No. 16530714
Date	2-16-2011	
Checked By	BDL	Figure No. D-14
Date	2-16-11	

Slope Stability (Block Failure)

File Information

Created By: Deepak K. Neupane
Revision Number: 135
Last Edited By: Deepak K. Neupane
Date: 2/15/2011
Time: 5:15:14 PM
File Name: Section A-A_RD.gsz
Directory: I:\16530714 KCPL-GMO Lake Road Generating Station\slope stabiltiy\
Last Solved Date: 2/15/2011
Last Solved Time: 5:16:12 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

Slope Stability (Block Failure)

- Description: Lake Road Generating Station Section A-A
- Kind: SLOPE/W
- Parent: SEEP/W Analysis
- Method: Spencer
- Settings
  - Apply Phreatic Correction: No
  - PWP Conditions Source: Piezometric Line
  - Use Staged Rapid Drawdown: Yes
- Slip Surface
  - Direction of movement: Left to Right
  - Use Passive Mode: No
  - Slip Surface Option: Block
  - Critical slip surfaces saved: 1
  - Optimize Critical Slip Surface Location: No
  - Tension Crack
    - Tension Crack Option: Search for Tension Crack
    - Percentage Wet: 1
    - Tension Crack Fluid Unit Weight: 62.4 pcf
- FOS Distribution

FOS Calculation Option: Constant
Restrict Block Crossing: No
Advanced
Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

CH

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 50 psf
Phi: 26 °
Phi-B: 0 °
Drawdown Total Cohesion: 1000 psf
Drawdown Total Phi: 0 °
Pore Water Pressure
Piezometric Line: 1
Piezometric Line After Drawdown: 2

ML

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 200 psf
Phi: 15 °
Phi-B: 0 °
Drawdown Total Cohesion: 1000 psf
Drawdown Total Phi: 0 °
Pore Water Pressure
Piezometric Line: 1
Piezometric Line After Drawdown: 2

SP

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °
Drawdown Total Cohesion: 0 psf
Drawdown Total Phi: 33 °
Pore Water Pressure

Piezometric Line: 1
Piezometric Line After Drawdown: 2

CL-ML

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 200 psf
Phi: 15 °
Phi-B: 0 °
Drawdown Total Cohesion: 1000 psf
Drawdown Total Phi: 0 °
Pore Water Pressure
Piezometric Line: 1
Piezometric Line After Drawdown: 2

Rip Rap

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 0 psf
Phi: 34 °
Phi-B: 0 °
Drawdown Total Cohesion: 0 psf
Drawdown Total Phi: 34 °
Pore Water Pressure
Piezometric Line: 1
Piezometric Line After Drawdown: 2

Slip Surface Limits

Left Coordinate: (0, 810.21) ft
Right Coordinate: (150, 806) ft

Slip Surface Block

Left Grid
Upper Left: (106, 810) ft
Lower Left: (106, 801) ft
Lower Right: (121, 801) ft
X Increments: 5
Y Increments: 5
Starting Angle: 115 °
Ending Angle: 135 °
Angle Increments: 2
Right Grid
Upper Left: (122, 810) ft
Lower Left: (122, 800) ft
Lower Right: (136, 800) ft
X Increments: 5
Y Increments: 5
Starting Angle: 0 °

Ending Angle: 45 °
Angle Increments: 2

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
	0	802.5
	41.25	802.5
	44.82	800.69
	52.96	800.19
	58	800
	63.58	802.96
	77	802.78
	94.23	803
	100.74	803.04
	111.24	804
	117.11	806.2
	118.88	810.09
	150	810.09

Piezometric Line 2

Coordinates

	X (ft)	Y (ft)
	0	802.5
	41.25	802.5
	44.82	800.69
	52.96	800.19
	58	800
	63.58	802.96
	77	802.78
	94.23	803
	100.74	803.04
	111.24	804
	117.11	806.2
	118.88	810.09
	129.105	806
	150	806

Regions

	Material	Points	Area (ft²)
Region 1	CH	1,2,3,25,11	182.3983
Region 2	CL-ML	11,25,4,5,22,23,24,12,14,13	675.0748
Region 3	SP	15,19,20,16	3900
Region 4	Rip Rap	5,22,23,21,7,6	48.24555
Region 5	CH	24,21,8,9,10,26,18,17,12	439.97372
Region 6	ML	13,15,16,14	450

Points

	X (ft)	Y (ft)
Point 1	0	810.21
Point 2	23.52	809.43
Point 3	33.56	806.47
Point 4	44.82	800.69
Point 5	52.96	800.19
Point 6	55.65	801.29
Point 7	76.5	811.66
Point 8	81.94	811.9
Point 9	101.9	811.98
Point 10	115.98	811.25
Point 11	0	804
Point 12	150	804
Point 13	0	799
Point 14	150	799
Point 15	0	796
Point 16	150	796
Point 17	150	806
Point 18	129.105	806
Point 19	0	770
Point 20	150	770
Point 21	80	811.8
Point 22	53	800
Point 23	58	800
Point 24	65.5	804
Point 25	38.3	804
Point 26	118.88	810.09

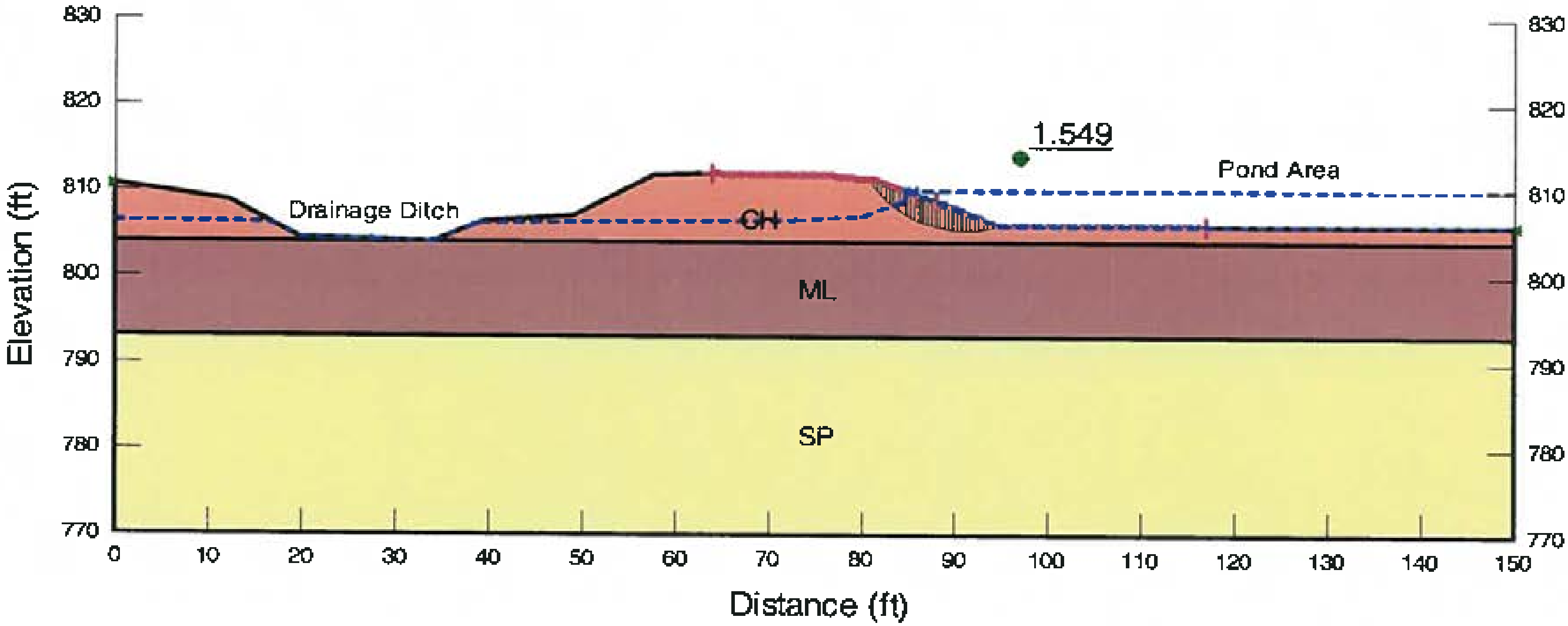
Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	9343	1.691	(123.485, 812.633)	8.032	(114.894, 811.306)	(129.105, 806)

Slices of Slip Surface: 9343

	Slip				Base Normal	Frictional	Cohesive

	Surface	X (ft)	Y (ft)	PWP (psf)	Stress (psf)	Strength (psf)	Strength (psf)
1	9343	115.16525	811.03475	-347.17372	4.8838391	0	56.303
2	9343	115.7084	810.4916	-300.56798	48.078119	23.449265	50
3	9343	116.2625	809.9375	-253.04409	82.920469	40.443015	50
4	9343	116.8275	809.3725	-204.57287	110.58148	53.934193	50
5	9343	117.3325	808.8675	-135.9393	135.30529	65.992798	50
6	9343	117.7855	808.4181	-45.770577	158.41699	77.26513	50
7	9343	118.232	808.0724	37.035061	218.38902	88.452234	50
8	9343	118.664	807.8348	111.10316	229.8693	57.926118	50
9	9343	119.10285	807.59345	150.22384	239.01035	43.304073	50
10	9343	119.54855	807.3483	154.39542	245.85157	44.606148	50
11	9343	119.99425	807.10315	158.56699	252.6928	45.908223	50
12	9343	120.44	806.858	162.73857	259.51436	47.20071	50
13	9343	120.88575	806.61285	166.91014	266.35559	48.502786	50
14	9343	121.33145	806.3677	171.08368	273.19681	49.803902	50
15	9343	121.77715	806.12255	175.25525	280.01838	51.096389	50
16	9343	122.23685	806	171.42856	350.4574	87.3182	50
17	9343	122.7105	806	159.6059	326.8543	81.572497	50
18	9343	123.18415	806	147.78324	303.25121	75.826795	50
19	9343	123.65785	806	135.96058	279.64812	70.081093	50
20	9343	124.1315	806	124.13792	256.04502	64.335391	50
21	9343	124.60515	806	112.31526	232.44193	58.589688	50
22	9343	125.07885	806	100.4926	208.82616	52.837808	50
23	9343	125.5525	806	88.669944	185.22096	47.091076	50
24	9343	126.02615	806	76.847285	161.61575	41.344344	50
25	9343	126.49985	806	65.024626	138.00844	35.596582	50
26	9343	126.9735	806	53.201967	114.40323	29.84985	50
27	9343	127.44715	806	41.379307	90.795912	24.102088	50
28	9343	127.92085	806	29.556648	67.190706	18.355356	50
29	9343	128.3945	806	17.733989	43.583389	12.607595	50
30	9343	128.86815	806	5.9113296	19.97755	6.8605539	50



Name: CH Model: Mohr-Coulomb Unit Weight: 120 Cohesion: 50 Phi: 26 Drawdown Total Cohesion: 1000 Drawdown Total Phi: 0
Name: ML Model: Mohr-Coulomb Unit Weight: 120 Cohesion: 200 Phi: 15 Drawdown Total Cohesion: 1000 Drawdown Total Phi: 0
Name: SP Model: Mohr-Coulomb Unit Weight: 125 Cohesion: 0 Phi: 33 Drawdown Total Cohesion: 0 Drawdown Total Phi: 33

URS 8300 College Boulevard Suite 200 Overland Park, KS 66210	KCPL	LAKE ROAD GENERATING STATION ASH POND CRITICAL CIRCULAR SLIP SURFACE AND CALCULATED SAFETY FACTOR - RAPID DRAWDOWN CROSS SECTION B-B	Drawn By: DKN Date: 2-16-2011 Checked By: BDL Date: 2-16-11	Project No. 16530714 Figure No. D-15

Slope Stability (Circular Failure)

File Information

Created By: Deepak K. Neupane
Revision Number: 92
Last Edited By: Deepak K. Neupane
Date: 2/16/2011
Time: 9:03:19 AM
File Name: Section B-B_RD.gsz
Directory: I:\16530714 KCPL-GMO Lake Road Generating Station\slope stabiltiy\
Last Solved Date: 2/16/2011
Last Solved Time: 9:05:26 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

Slope Stability (Circular Failure)

Description: Lake Road Generating Station Section B-B
Kind: SLOPE/W
Parent: SEEP/W Analysis
Method: Spencer
Settings
- Apply Phreatic Correction: No
- PWP Conditions Source: Piezometric Line
- Use Staged Rapid Drawdown: Yes

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No
- Tension Crack
  - Tension Crack Option: Search for Tension Crack
  - Percentage Wet: 1
  - Tension Crack Fluid Unit Weight: 62.4 pcf

FOS Distribution

FOS Calculation Option: Constant

Advanced

Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

CH

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 50 psf
Phi: 26 °
Phi-B: 0 °
Drawdown Total Cohesion: 1000 psf
Drawdown Total Phi: 0 °
Pore Water Pressure
Piezometric Line: 1
Piezometric Line After Drawdown: 2

ML

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 200 psf
Phi: 15 °
Phi-B: 0 °
Drawdown Total Cohesion: 1000 psf
Drawdown Total Phi: 0 °
Pore Water Pressure
Piezometric Line: 1
Piezometric Line After Drawdown: 2

SP

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °
Drawdown Total Cohesion: 0 psf
Drawdown Total Phi: 33 °
Pore Water Pressure
Piezometric Line: 1

Piezometric Line After Drawdown: 2

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (64, 811.89664) ft
Left-Zone Right Coordinate: (85.94622, 809.55551) ft
Left-Zone Increment: 40
Right Projection: Range
Right-Zone Left Coordinate: (88, 808.734) ft
Right-Zone Right Coordinate: (116.82677, 806) ft
Right-Zone Increment: 40
Radius Increments: 6

Slip Surface Limits

Left Coordinate: (0, 810.68) ft
Right Coordinate: (150, 806) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
	0	806.5
	16.57	806.16
	19.76	804.37
	27.47	804.32
	34.03	804.15
	38.4	806
	39.2	806.2
	72.9	806.6
	80	807
	84	808.5
	84.6	808.9
	84.76	810.03
	150	810.03

Piezometric Line 2

Coordinates

	X (ft)	Y (ft)
	0	806.5
	16.57	806.16

	19.76	804.37
	27.47	804.32
	34.03	804.15
	38.4	806
	39.2	806.2
	72.9	806.6
	80	807
	84	808.5
	84.6	808.9
	84.76	810.03
	94.835	806
	150	806

Regions

	Material	Points	Area (ft²)
Region 1	CH	1,2,3,4,5,6,7,8,9,10,21,22,18,17,12,11	531.44297
Region 2	ML	11,12,14,13	1650
Region 3	SP	13,15,19,20,16,14	3450

Points

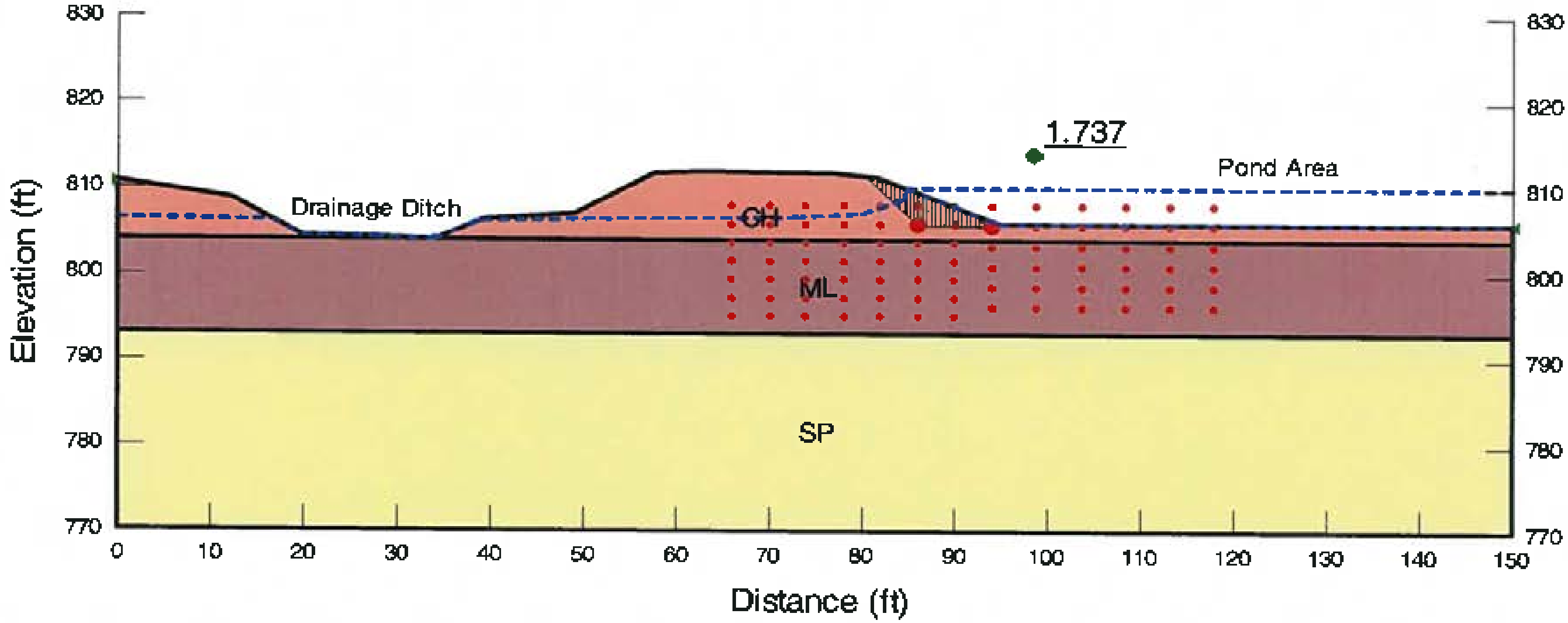
	X (ft)	Y (ft)
Point 1	0	810.68
Point 2	12.28	808.68
Point 3	19.76	804.37
Point 4	27.47	804.32
Point 5	34.03	804.15
Point 6	39.24	806.43
Point 7	49.09	807.16
Point 8	57.64	811.76
Point 9	63.07	811.91
Point 10	76.99	811.71
Point 11	0	804
Point 12	150	804
Point 13	0	793
Point 14	150	793
Point 15	0	780
Point 16	150	780
Point 17	150	806
Point 18	94.835	806
Point 19	0	770
Point 20	150	770
Point 21	81.61	811.29
Point 22	84.76	810.03

Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	8684	1.549	(91.188, 817.701)	12.242	(81.1594, 811.331)	(94.8135, 806.009)

Slices of Slip Surface: 8684

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	8684	81.3847	810.3782	-178.40035	41.396533	20.190438	50
2	8684	81.831735	809.8136	-132.70546	85.730078	41.813353	50
3	8684	82.275205	809.31495	-91.210839	117.66269	57.38793	50
4	8684	82.71868	808.86675	-52.865999	146.94947	71.672047	50
5	8684	83.162155	808.4616	-17.206216	173.69647	84.717428	50
6	8684	83.691945	808.0302	22.107713	204.75901	89.084992	50
7	8684	84.3	807.5871	69.442206	238.21036	82.313731	50
8	8684	84.68	807.3326	133.05799	259.8482	61.839716	50
9	8684	84.98849	807.1482	174.12135	273.5729	48.505763	50
10	8684	85.445465	806.8926	178.66536	287.11453	52.894195	50
11	8684	85.90244	806.6618	181.65931	298.19626	56.838866	50
12	8684	86.359415	806.45435	183.19992	306.89496	60.330101	50
13	8684	86.81639	806.2689	183.36611	313.26151	63.35422	50
14	8684	87.273365	806.1044	182.22351	317.33144	65.89654	50
15	8684	87.73034	805.96	179.82723	319.14007	67.947411	50
16	8684	88.187315	805.83495	176.22364	318.69782	69.489298	50
17	8684	88.64429	805.72865	171.45081	316.00788	70.505193	50
18	8684	89.10127	805.6406	165.53965	311.0216	70.956288	50
19	8684	89.558245	805.5704	158.5152	303.74418	70.832902	50
20	8684	90.01522	805.5177	150.39662	294.12783	70.102394	50
21	8684	90.472195	805.48235	141.19691	282.09235	68.719297	50
22	8684	90.92917	805.46415	130.92534	267.61338	66.667211	50
23	8684	91.386145	805.463	119.59022	250.54936	63.873038	50
24	8684	91.84312	805.479	107.18644	230.79655	60.288675	50
25	8684	92.300095	805.51215	93.716092	208.22651	55.85046	50
26	8684	92.75707	805.56255	79.163609	182.66639	50.481678	50
27	8684	93.214045	805.63045	63.521427	153.90685	44.083914	50
28	8684	93.67102	805.71615	46.76615	121.6927	36.544121	50
29	8684	94.128	805.82005	28.876514	85.714007	27.721498	50
30	8684	94.584975	805.9426	9.822595	45.653634	17.475965	50



Name: CH Model: Mohr-Coulomb Unit Weight: 120 Cohesion: 50 Phi: 26 Drawdown Total Cohesion: 1000 Drawdown Total Phi: 0
Name: ML Model: Mohr-Coulomb Unit Weight: 120 Cohesion: 200 Phi: 15 Drawdown Total Cohesion: 1000 Drawdown Total Phi: 0
Name: SP Model: Mohr-Coulomb Unit Weight: 125 Cohesion: 0 Phi: 33 Drawdown Total Cohesion: 0 Drawdown Total Phi: 33

URS 8300 College Boulevard Suite 200 Overland Park, KS 66210	KCPL	LAKE ROAD GENERATING STATION ASH POND CRITICAL WEDGE SLIP SURFACE AND CALCULATED SAFETY FACTOR - RAPID DRAWDOWN CROSS SECTION B-B	Drawn By: DKN Date: 2-16-2011 Checked By: BDL Date: 2-16-11	Project No. 16530714 Figure No. D-16

Slope Stability (Block Failure)

File Information

Created By: Deepak K. Neupane
Revision Number: 92
Last Edited By: Deepak K. Neupane
Date: 2/16/2011
Time: 9:03:19 AM
File Name: Section B-B_RD.gsz
Directory: I:\16530714 KCPL-GMO Lake Road Generating Station\slope stabiltiy\
Last Solved Date: 2/16/2011
Last Solved Time: 9:04:12 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

Slope Stability (Block Failure)

Description: Lake Road Generating Station Section B-B
Kind: SLOPE/W
Parent: SEEP/W Analysis
Method: Spencer
Settings
- Apply Phreatic Correction: No
- PWP Conditions Source: Piezometric Line
- Use Staged Rapid Drawdown: Yes

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Block
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No
- Tension Crack
  - Tension Crack Option: Search for Tension C ack
  - Percentage Wet: 1
  - Tension Crack Fluid Unit Weight: 62.4 pcf

FOS Distribution

FOS Calculation Option: Constant
Restrict Block Crossing: No
Advanced
Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

CH

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 50 psf
Phi: 26 °
Phi-B: 0 °
Drawdown Total Cohesion: 1000 psf
Drawdown Total Phi: 0 °
Pore Water Pressure
Piezometric Line: 1
Piezometric Line After Drawdown: 2

ML

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 200 psf
Phi: 15 °
Phi-B: 0 °
Drawdown Total Cohesion: 1000 psf
Drawdown Total Phi: 0 °
Pore Water Pressure
Piezometric Line: 1
Piezometric Line After Drawdown: 2

SP

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °
Drawdown Total Cohesion: 0 psf
Drawdown Total Phi: 33 °
Pore Water Pressure

Piezometric Line: 1
Piezometric Line After Drawdown: 2

Slip Surface Limits

Left Coordinate: (0, 810.68) ft
Right Coordinate: (150, 806) ft

Slip Surface Block

Left Grid
- Upper Left: (66, 808) ft
- Lower Left: (66, 795) ft
- Lower Right: (90, 795) ft
- X Increments: 6
- Y Increments: 6
- Starting Angle: 115 °
- Ending Angle: 135 °
- Angle Increments: 2

Right Grid
- Upper Left: (94, 808) ft
- Lower Left: (94, 796) ft
- Lower Right: (118, 796) ft
- X Increments: 5
- Y Increments: 5
- Starting Angle: 0 °
- Ending Angle: 45 °
- Angle Increments: 2

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
	0	806.5
	16.57	806.16
	19.76	804.37
	27.47	804.32
	34.03	804.15
	38.4	806
	39.2	806.2
	72.9	806.6
	80	807
	84	808.5
	84.6	808.9

	84.76	810.03
	150	810.03

Piezometric Line 2

Coordinates

	X (ft)	Y (ft)
	0	806.5
	16.57	806.16
	19.76	804.37
	27.47	804.32
	34.03	804.15
	38.4	806
	39.2	806.2
	72.9	806.6
	80	807
	84	808.5
	84.6	808.9
	84.76	810.03
	94.835	806
	150	806

Regions

	Material	Points	Area (ft²)
Region 1	CH	1,2,3,4,5,6,7,8,9,10,21,22,18,17,12,11	531.44297
Region 2	ML	11,12,14,13	1650
Region 3	SP	13,15,19,20,16,14	3450

Points

	X (ft)	Y (ft)
Point 1	0	810.68
Point 2	12.28	808.68
Point 3	19.76	804.37
Point 4	27.47	804.32
Point 5	34.03	804.15
Point 6	39.74	806.43
Point 7	49.09	807.16
Point 8	57.64	811.76
Point 9	63.07	811.91
Point 10	76.99	811.71
Point 11	0	804
Point 12	150	804
Point 13	0	793

Point 14	150	793
Point 15	0	780
Point 16	150	780
Point 17	150	806
Point 18	94.835	806
Point 19	0	770
Point 20	150	770
Point 21	81.61	811.29
Point 22	84.76	810.03

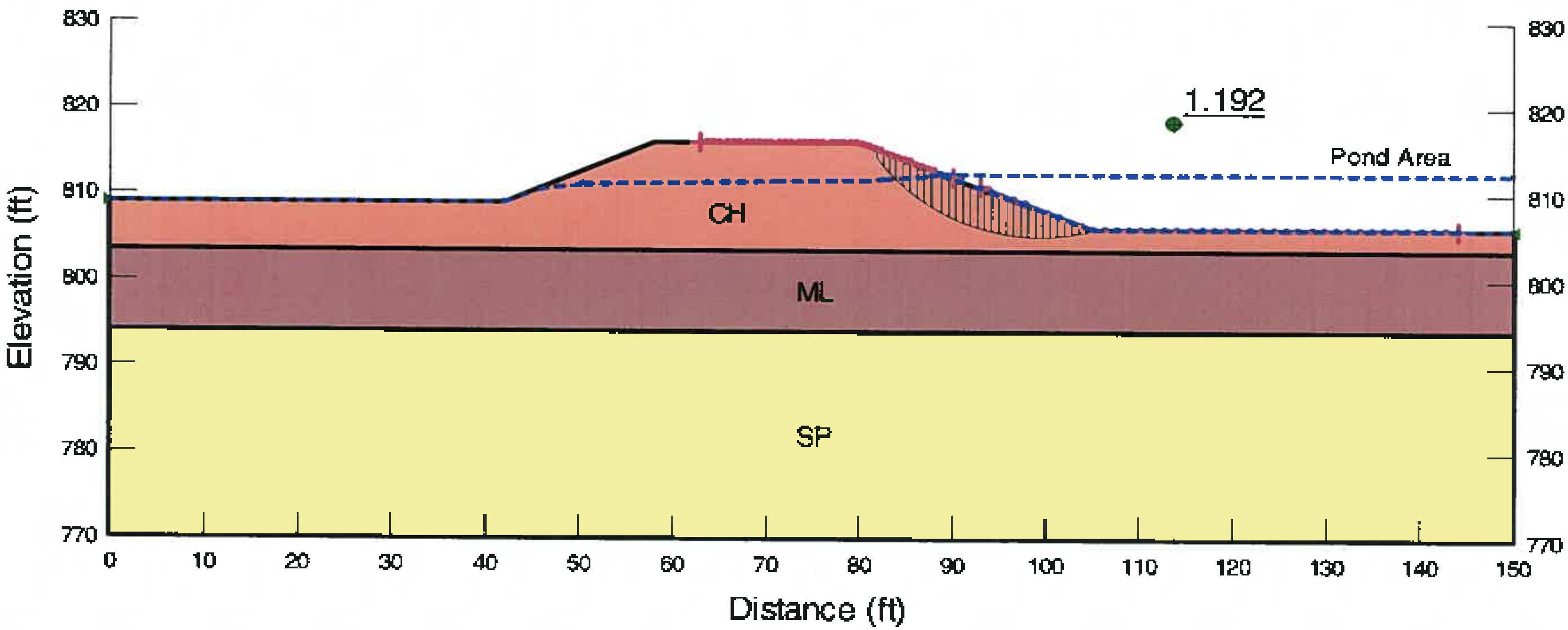
Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	13250	1.737	(89.205, 812.746)	8.258	(80.4367, 811.397)	(94.9657, 806)

Slices of Slip Surface: 13250

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	13250	80.73	811.10335	-238.9619	6.2785052	0	57.013
2	13250	81.316665	810.51665	-188.62876	50.803209	24.778381	50
3	13250	81.848145	809.98515	-143.02983	84.11266	41.024485	50
4	13250	82.374435	809.5089	-102.16416	107.35588	52.360961	50
5	13250	82.80072	809.03265	-61.298497	130.59761	63.696712	50
6	13250	83.277005	808.55635	-20.432832	153.83638	75.031015	50
7	13250	83.757575	808.07575	20.799811	180.18628	77.737973	50
8	13250	84.3	807.5333	77.800182	213.88803	68.813139	50
9	13250	84.68	807.1533	144.24976	242.37408	47.858424	50
10	13250	84.966665	806.86665	192.2361	263.04373	34.535184	50
11	13250	85.38	806.45335	207.70121	285.36891	37.881067	50
12	13250	85.793335	806.04	223.18343	307.67699	41.210262	50
13	13250	86.235295	805.82645	225.47285	452.26263	110.61277	50
14	13250	86.705885	805.81275	214.59747	430.78801	105.44317	50
15	13250	87.17647	805.79905	203.69873	409.29216	100.27461	50
16	13250	87.647055	805.7853	192.80849	387.7963	95.10191	50
17	13250	88.117645	805.77155	181.91825	366.32169	89.939567	50
18	13250	88.588235	805.75785	171.03013	344.82583	84.765827	50
19	13250	89.058825	805.74415	160.13988	323.35121	79.603484	50
20	13250	89.529415	805.7304	149.25177	301.85536	74.429744	50
21	13250	90	805.71665	138.36152	280.38074	69.2674	50
22	13250	90.470585	805.70295	127.47128	258.88488	64.094697	50

23	13250	90.941175	805.68925	116.58316	237.38903	58.920957	50
24	13250	91.411765	805.6755	105.69292	215.91441	53.758614	50
25	13250	91.882355	805.66175	94.8048	194.4228	48.586946	50
26	13250	92.352945	805.64805	83.914557	172.93544	43.418387	50
27	13250	92.82353	805.63435	73.024314	151.45021	38.250863	50
28	13250	93.294115	805.6206	62.136195	129.96285	33.081268	50
29	13250	93.764705	805.60685	51.245953	108.47548	27.912708	50
30	13250	94.20875	805.68645	35.195941	115.71399	39.271275	50
31	13250	94.62625	805.8594	13.983665	62.985355	23.899721	50
32	13250	94.900345	805.97295	1.6889014	32.42422	14.990617	50



Name: CH Model: Mohr-Coulomb Unit Weight: 120 Cohesion: 50 Phi: 26 Drawdown Total Cohesion: 1000 Drawdown Total Phi: 0
Name: ML Model: Mohr-Coulomb Unit Weight: 120 Cohesion: 200 Phi: 15 Drawdown Total Cohesion: 1000 Drawdown Total Phi: 0
Name: SP Model: Mohr-Coulomb Unit Weight: 125 Cohesion: 0 Phi: 33 Drawdown Total Cohesion: 0 Drawdown Total Phi: 33

URS 8300 College Boulevard Suite 200 Overland Park, KS 66210	KCPL	LAKE ROAD GENERATING STATION ASH POND CRITICAL CIRCULAR SLIP SURFACE AND CALCULATED SAFETY FACTOR - RAPID DRAWDOWN CROSS SECTION C-C	Drawn By	DKN	Project No.
			Date	2-16-2011	16530714
			Checked By	BDL	Figure No.
			Date	2-16-11	D-17

Slope Stability (Circular Failure)

File Information

Created By: Deepak K. Neupane
Revision Number: 94
Last Edited By: Deepak K. Neupane
Date: 2/15/2011
Time: 1:59:24 PM
File Name: Section C-C_RD.gsz
Directory: I:\16530714 KCPL-GMO Lake Road Generating Station\slope stabiltiy\
Last Solved Date: 2/15/2011
Last Solved Time: 2:00:34 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

Slope Stability (Circular Failure)

Description: Lake Road Generating Station Section C-C
Kind: SLOPE/W
Parent: SEEP/W Analysis
Method: Spencer
Settings
- Apply Phreatic Correction: No
- PWP Conditions Source: Piezometric Line
- Use Staged Rapid Drawdown: Yes

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No
- Tension Crack
  - Tension Crack Option: Search for Tension Crack
  - Percentage Wet: 1
  - Tension Crack Fluid Unit Weight: 62.4 pcf

FOS Distribution

FOS Calculation Option: Constant

Advanced

Number of Slices: 30

Optimization Tolerance: 0.01

Minimum Slip Surface Depth: 0.1 ft

Optimization Maximum Iterations: 2000

Optimization Convergence Tolerance: 1e-007

Starting Optimization Points: 8

Ending Optimization Points: 16

Complete Passes per Insertion: 1

Driving Side Maximum Convex Angle: 5 °

Resisting Side Maximum Convex Angle: 1 °

Materials

CH

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion: 50 psf

Phi: 26 °

Phi-B: 0 °

Drawdown Total Cohesion: 1000 psf

Drawdown Total Phi: 0 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

ML

Model: Mohr-Coulomb

Unit Weight: 120 pcf

Cohesion: 200 psf

Phi: 15 °

Phi-B: 0 °

Drawdown Total Cohesion: 1000 psf

Drawdown Total Phi: 0 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

SP

Model: Mohr-Coulomb

Unit Weight: 125 pcf

Cohesion: 0 psf

Phi: 33 °

Phi-B: 0 °

Drawdown Total Cohesion: 0 psf

Drawdown Total Phi: 33 °

Pore Water Pressure

Piezometric Line: 1

Piezometric Line After Drawdown: 2

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (63.03937, 816) ft
Left-Zone Right Coordinate: (90, 812) ft
Left-Zone Increment: 40
Right Projection: Range
Right-Zone Left Coordinate: (92.94733, 810.82107) ft
Right-Zone Right Coordinate: (144, 806) ft
Right-Zone Increment: 40
Radius Increments: 6

Slip Surface Limits

Left Coordinate: (0, 809) ft
Right Coordinate: (150, 806) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
	0	809
	42	809
	45.78	810.6
	50.52	811.21
	71.06	811.46
	82.6	811.75
	87.69	812.17
	88.75	812.5
	150	812.5

Piezometric Line 2

Coordinates

	X (ft)	Y (ft)
	0	809
	42	809
	45.78	810.6
	50.52	811.21
	71.06	811.46
	82.6	811.75

	87.69	812.17
	88.75	812.5
	105	806
	150	806

Regions

	Material	Points	Area (ft²)
Region 1	CH	1,2,3,4,5,6,7,8,9,10,21,22,18,17,12,11	950
Region 2	ML	11,12,14,13	1425
Region 3	SP	13,15,19,20,16,14	3600

Points

	X (ft)	Y (ft)
Point 1	0	809
Point 2	12.28	809
Point 3	19.76	809
Point 4	27.47	809
Point 5	34.03	809
Point 6	39.24	809
Point 7	42	809
Point 8	58	816
Point 9	63.07	816
Point 10	76.99	816
Point 11	0	803.5
Point 12	150	803.5
Point 13	0	794
Point 14	150	794
Point 15	0	780
Point 16	150	780
Point 17	150	806
Point 18	105	806
Point 19	0	770
Point 20	150	770
Point 21	80	816
Point 22	88.75	812.5

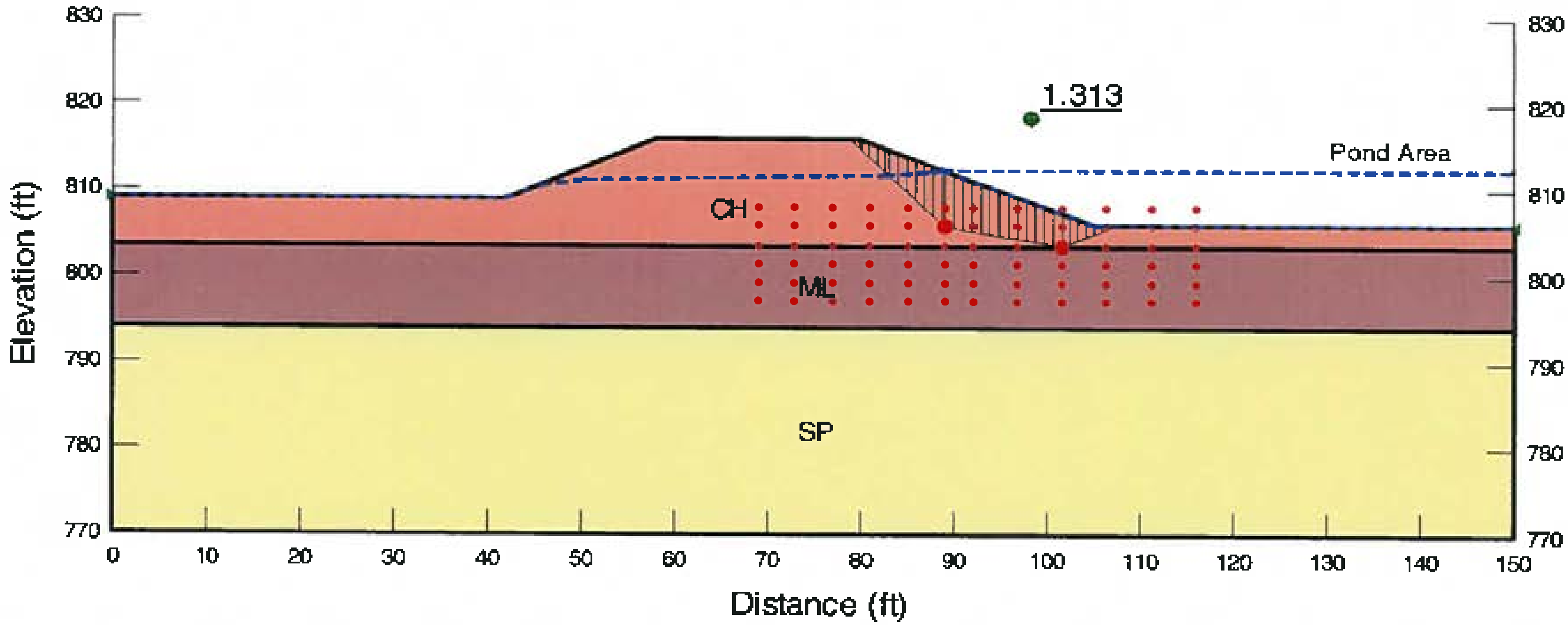
Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	7536	1.192	(99.28, 826.508)	21.295	(81.7942, 815.282)	(105.014, 806)

Slices of Slip Surface: 7536

							Cohesive

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Strength (psf)
1	7536	82.19709	813.81215	-129.31293	56.554513	27.583479	50
2	7536	82.90788	812.8996	-70.152775	112.67546	54.955494	50
3	7536	83.52364	812.1904	-22.727062	153.82187	75.023941	50
4	7536	84.217365	811.46525	26.094816	201.94935	85.769988	50
5	7536	84.98906	810.72945	75.983445	254.96537	87.295318	50
6	7536	85.76076	810.0628	121.55414	302.12856	88.07203	50
7	7536	86.532455	809.45715	163.31895	343.86652	88.058932	50
8	7536	87.30415	808.90615	201.6782	380.49297	87.21379	50
9	7536	88.22	808.3213	250.45622	417.88112	81.658576	50
10	7536	89.136905	807.78935	284.28303	448.56954	80.127883	50
11	7536	89.910715	807.3901	289.87986	467.88095	86.816932	50
12	7536	90.684525	807.02975	293.05951	483.45893	92.864002	50
13	7536	91.458335	806.7062	293.93516	495.35677	98.239883	50
14	7536	92.232145	806.41765	292.61941	503.63317	102.91829	50
15	7536	93.005955	806.1626	289.2195	508.27054	106.83833	50
16	7536	93.779765	805.93985	283.80834	509.28947	109.97449	50
17	7536	94.553575	805.7483	276.44554	506.65931	112.28276	50
18	7536	95.327385	805.5871	267.18795	500.30597	113.69926	50
19	7536	96.101195	805.4556	256.08874	490.17334	114.17069	50
20	7536	96.875	805.3532	243.15817	476.17244	113.64865	50
21	7536	97.648805	805.2795	228.43994	458.14262	112.03348	50
22	7536	98.422615	805.2342	211.96029	435.95513	109.24958	50
23	7536	99.196425	805.2171	193.71543	409.38699	105.19005	50
24	7536	99.970215	805.22815	173.71108	378.20166	99.736719	50
25	7536	100.74405	805.26735	151.95082	342.12786	92.755538	50
26	7536	101.5179	805.3349	128.41593	300.76338	84.059469	50
27	7536	102.2917	805.4311	103.09983	253.70054	73.452876	50
28	7536	103.0655	805.5563	75.973623	200.37167	60.672982	50
29	7536	103.8393	805.711	47.004059	140.11845	45.414922	50
30	7536	104.6131	805.8959	16.150547	72.077557	27.277425	50
31	7536	105.0071	805.998	0.12334273	35.180912	17.098719	50



Name: CH	Model: Mohr-Coulomb	Unit Weight: 120	Cohesion: 50	Phi: 26	Drawdown Total Cohesion: 1000	Drawdown Total Phi: 0
Name: ML	Model: Mohr-Coulomb	Unit Weight: 120	Cohesion: 200	Phi: 15	Drawdown Total Cohesion: 1000	Drawdown Total Phi: 0
Name: SP	Model: Mohr-Coulomb	Unit Weight: 125	Cohesion: 0	Phi: 33	Drawdown Total Cohesion: 0	Drawdown Total Phi: 33

URS
8300 College Boulevard
Suite 200
Overland Park, KS 66210

KCPL

LAKE ROAD GENERATING STATION ASH POND CRITICAL WEDGE SLIP SURFACE AND CALCULATED SAFETY FACTOR - RAPID DRAWDOWN CROSS SECTION C-C

Drawn By	DKN	Project No.
Date	2-16-2011	16530714
Checked By	BDL	Figure No.
Date	2-16-11	D-18

Slope Stability (Block Failure)

File Information

Created By: Deepak K. Neupane
Revision Number: 95
Last Edited By: Deepak K. Neupane
Date: 2/15/2011
Time: 2:01:15 PM
File Name: Section C-C_RD.gsz
Directory: I:\16530714 KCPL-GMO Lake Road Generating Station\slope stabiltiy\
Last Solved Date: 2/15/2011
Last Solved Time: 2:02:02 PM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

Slope Stability (Block Failure)

Description: Lake Road Generating Station Section C-C
Kind: SLOPE/W
Parent: SEEP/W Analysis
Method: Spencer
Settings
- Apply Phreatic Correction: No
- PWP Conditions Source: Piezometric Line
- Use Staged Rapid Drawdown: Yes

Slip Surface
- Direction of movement: Left to Right
- Use Passive Mode: No
- Slip Surface Option: Block
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No
- Tension Crack
  - Tension Crack Option: Search for Tension Crack
  - Percentage Wet: 1
  - Tension Crack Fluid Unit Weight: 62.4 pcf

FOS Distribution

FOS Calculation Option: Constant
Restrict Block Crossing: No
Advanced
Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1
Driving Side Maximum Convex Angle: 5 °
Resisting Side Maximum Convex Angle: 1 °

Materials

CH

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 50 psf
Phi: 26 °
Phi-B: 0 °
Drawdown Total Cohesion: 1000 psf
Drawdown Total Phi: 0 °
Pore Water Pressure
Piezometric Line: 1
Piezometric Line After Drawdown: 2

ML

Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion: 200 psf
Phi: 15 °
Phi-B: 0 °
Drawdown Total Cohesion: 1000 psf
Drawdown Total Phi: 0 °
Pore Water Pressure
Piezometric Line: 1
Piezometric Line After Drawdown: 2

SP

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 0 psf
Phi: 33 °
Phi-B: 0 °
Drawdown Total Cohesion: 0 psf
Drawdown Total Phi: 33 °
Pore Water Pressure

Piezometric Line: 1
Piezometric Line After Drawdown: 2

Slip Surface Limits

Left Coordinate: (0, 809) ft
Right Coordinate: (150, 806) ft

Slip Surface Block

Left Grid
- Upper Left: (69, 808) ft
- Lower Left: (69, 797) ft
- Lower Right: (89, 797) ft
- X Increments: 5
- Y Increments: 5
- Starting Angle: 115 °
- Ending Angle: 135 °
- Angle Increments: 2

Right Grid
- Upper Left: (92, 808) ft
- Lower Left: (92, 797) ft
- Lower Right: (116, 797) ft
- X Increments: 5
- Y Increments: 5
- Starting Angle: 0 °
- Ending Angle: 45 °
- Angle Increments: 2

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
	0	809
	42	809
	45.78	810.6
	50.52	811.21
	71.06	811.46
	82.6	811.75
	87.69	812.17
	88.75	812.5
	150	812.5

Piezometric Line 2

Coordinates

	X (ft)	Y (ft)
	0	809
	42	809
	45.78	810.6
	50.57	811.21
	71.06	811.46
	82.6	811.75
	87.69	812.17
	88.75	812.5
	105	806
	150	806

Regions

	Material	Points	Area (ft^2)
Region 1	CH	1,2,3,4,5,6,7,8,9,10,21,22,18,17,12,11	950
Region 2	ML	11,12,14,13	1425
Region 3	SP	13,15,19,20,16,14	3600

Points

	X (ft)	Y (ft)
Point 1	0	809
Point 2	12.28	809
Point 3	19.76	809
Point 4	27.47	809
Point 5	34.03	809
Point 6	39.24	809
Point 7	42	809
Point 8	58	816
Point 9	63.07	816
Point 10	76.99	816
Point 11	0	803.5
Point 12	150	803.5
Point 13	0	794
Point 14	150	794
Point 15	0	780
Point 16	150	780
Point 17	150	806
Point 18	105	806
Point 19	0	770
Point 20	150	770
Point 21	80	816

Point 22	88.75	812.5

Critical Slip Surfaces

	Slip Surface	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	9674	1.313	(95.72, 818.5)	15.961	(78.8, 816)	(107.304, 806)

Slices of Slip Surface: 9674

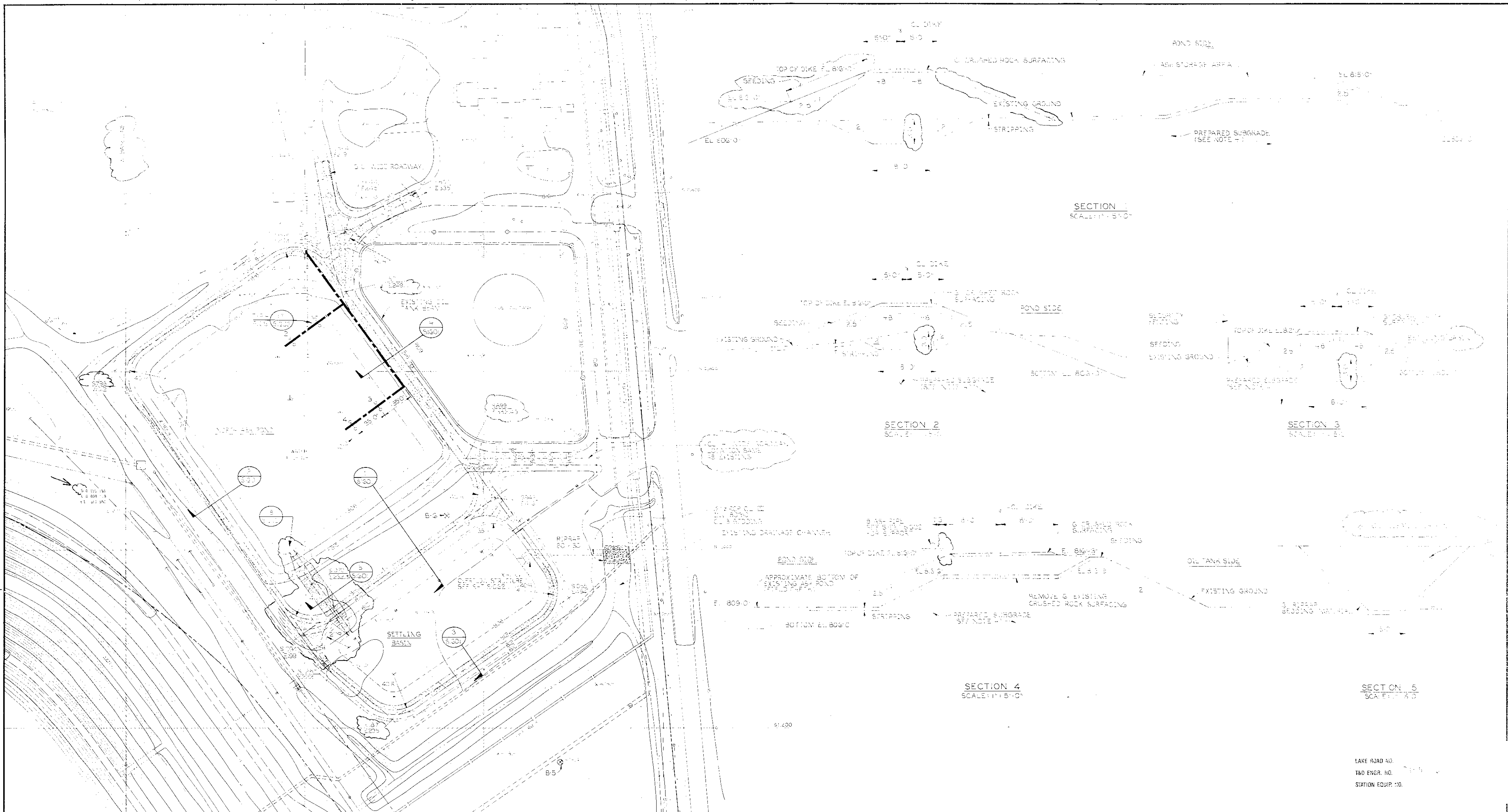
	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	9674	79.4	815.4	-232.77959	26.036265	0	69.482
2	9674	80.433335	814.36665	-166.67863	95.712323	46.682019	50
3	9674	81.3	813.5	-111.23875	136.32744	66.491335	50
4	9674	82.166665	812.63335	-55.799689	176.9344	86.296672	50
5	9674	82.80785	811.99215	-14.039948	206.97862	100.95022	50
6	9674	83.48313	811.31685	31.574202	244.26439	103.73594	50
7	9674	84.41799	810.382	94.721094	299.35133	99.804835	50
8	9674	85.35285	809.44715	157.87101	354.43827	95.872258	50
9	9674	86.28771	808.5123	221.02093	409.52521	91.93968	50
10	9674	87.22257	807.57745	284.17084	464.61214	88.007103	50
11	9674	88.22	806.58	359.11027	524.7334	80.779797	50
12	9674	88.875	805.925	407.15207	564.01664	76.50796	50
13	9674	89.484615	805.7154	405.02331	758.93338	172.61348	50
14	9674	90.453845	805.54615	391.39379	733.49365	166.85325	50
15	9674	91.423075	805.3769	377.76427	708.06408	161.09798	50
16	9674	92.392305	805.2077	364.12459	682.63451	155.34767	50
17	9674	93.361535	805.03845	350.49507	657.19478	149.58744	50
18	9674	94.330765	804.8692	336.86556	631.76521	143.83217	50
19	9674	95.3	804.7	323.23604	606.32548	138.07194	50
20	9674	96.269235	804.5308	309.59636	580.89591	132.32163	50
21	9674	97.238465	804.36155	295.96684	555.46634	126.56636	50
22	9674	98.207695	804.1923	282.33732	530.02661	120.80614	50
23	9674	99.176925	804.0231	268.70781	504.59704	115.05087	50
24	9674	100.14617	803.85385	255.06813	479.16747	109.30055	50
25	9674	101.1154	803.6846	241.43861	453.72774	103.54033	50
26	9674	102.025	803.77605	213.03574	596.08706	186.82661	50
27	9674	102.875	804.12815	169.84166	483.38462	152.92512	50
28	9674	103.725	804.4802	126.65845	370.68219	119.01834	50
29	9674	104.575	804.83225	83.473057	257.97976	85.112608	50
30	9674	105.399	805.1736	51.566056	174.71847	60.065008	50

31	9674	106.19705	805.50415	30.940405	120.8975	43.875005	50
32	9674	106.9951	805.8347	10.313391	67.070731	27.682404	50

ATTACHMENTONE

Historic Ash Pond Design and Embankment Quality Control Records

Drawing 1
1977 Black & Veatch Drawing
Structural Ash Storage Plans and Details – Sheet S1601



GENERAL NOTES

1. ASH STORAGE SPACE AND TRANSPORT SYSTEM MUST BE CONTINUOUSLY AVAILABLE THROUGHOUT THE PROJECT TO SERVICE THE PLANT.
2. THE LOCATION OF EXISTING UNDERGROUND LINES ON THESE DRAWINGS ARE APPROXIMATE AND ARE INDICATED TO THE EXTENT OF AVAILABLE INFORMATION.
3. ELEVATIONS ARE REFERENCED TO THE U.S. COAST AND GEODETIC SURVEY DATUM WHICH IS ABOUT .64' LOWER THAN THE ST. JOSEPH LIGHT AND POWER COMPANY DATUM.
4. THE EXISTING ASH BENEATH THE NEW DIKES IS TO BE COMPLETELY EXCAVATED AND REMOVED.
5. EXISTING ELEVATIONS BASED ON AERIAL SURVEY BY WESTERN AIR MAPS, INC. APRIL 1974. ELEVATIONS OF THE EXISTING OIL TANK BERM AND ADJACENT ...
6. RIPRAP PROTECTION SHALL BE ...

LEGEND

EXISTING FEATURES

	REVISED & ISSUED FOR CONSTRUCTION, SPEC 324.0000	DFW
	ISSUED FOR ADDENDUM ... SPEC 324.0000	DFW
7-5-77	ISSUED FOR BIDS SPEC 324.0000	DFW
DATE	REVISIONS AND RECORD OF ISSUE	NO. BY CK APP

DEPT HEAD VHS
DES ENGR DFW
CHECKED
DRAWN

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF

SIGNED

DATE ____ REG. NO. ____

BLACK & VEATCH
CONSULTING ENGINEERS
PROJECT 6791

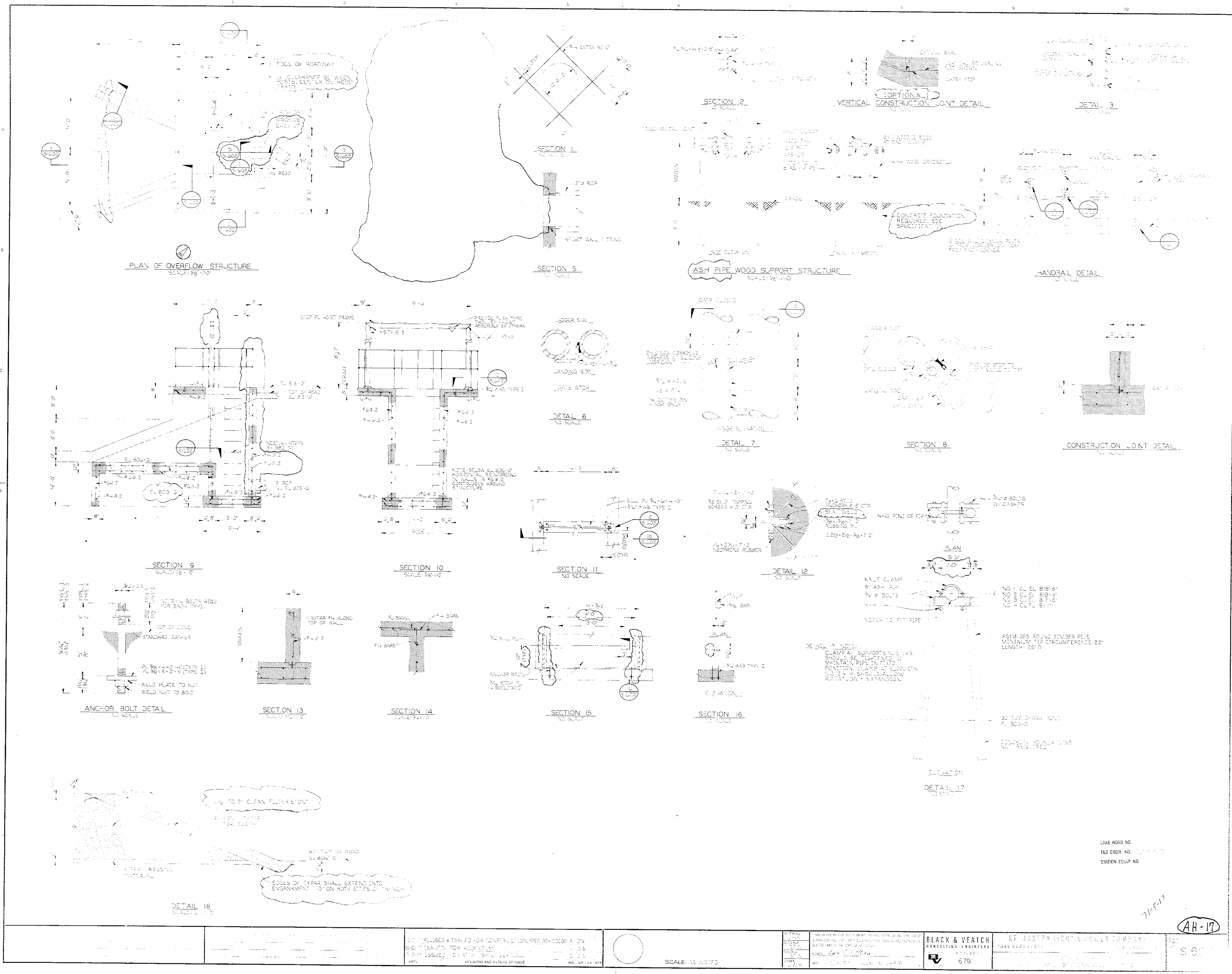
ST. JOSEPH LIGHT & POWER COMPANY
LAKE ROAD PLANT

B&V DWG NO. S160

AH-16

7-5-76

Drawing 2
1977 Black & Veatch Drawing
Structural Ash Storage Sections and Details – Sheet S1602


PLAN OF OVERFLOW STRUCTURE
SCALE: 3/8"=1'-0"
FACE OF ROADWAY
SECTION 1
SECTION 5
SECTION 2
(OPTIONAL)
VERTICAL CONSTRUCTION JOINT DETAIL
DETAIL 3
CONCRETE FOUNDATION REQUIRED, SEE SPECIFICATIONS
ASH PIPE WOOD SUPPORT STRUCTURE
HANDRAIL DETAIL
SECTION 9
SECTION 10
DETAIL 6
NO SCALE
LANDING SIDE
DETAIL 7
NO SCALE
SECTION 8
CONSTRUCTION JOINT DETAIL
SECTION 11
NO SCALE
DETAIL 12
NO SCALE
NEOPRENE RUBBER
PLAN
ANCHOR BOLT DETAIL
NO SCALE
STANDARD WASHER
WELD PLATE TO NUT
WELD NUT TO BOLT
SECTION 13
SECTION 14
SECTION 15
NO SCALE
SECTION 16
ELEVATION
HALF CLAMP
NOTCH TO FIT PIPE
ASTM D25 ROUND TIMBER PILE
MINIMUM TIP CIRCUMFERENCE 22"
DETAIL 17 NOTE:
CLAMP AT SUPPORTS SHALL BE SHOULD BE TIGHTENED TO MAINTAIN PIPE IN FIXED POSITION. CLAMP AT SUPPORTS NO. 3 & 4 SHOULD ALLOW ROTATION & EXPANSION
ELEVATION
DETAIL 17
BOTTOM OF POND
EDGES OF TYPAR SHALL EXTEND INTO EMBANKMENT 10' ON BOTH SIDES OF TRENCH
DETAIL 18
LAKE ROAD NO.
T&D ENGR. NO.
STATION EQUIP. NO.
AH-17
SCALE: AS NOTED
BLACK & VEATCH
CONSULTING ENGINEERS
6791
ST. JOSEPH LIGHT & POWER COMPANY
LAKE ROAD PLANT
S 6

* 2B.1 GENERAL. This section covers general earthwork and shall include the necessary preparation of the construction areas; removal and disposal of all debris; excavation and trenching as required; the handling, storage, transportation, and disposal of all excavated material; all necessary sheeting, shoring, and protection work; preparation of subgrades; pumping and dewatering as necessary or required; protection of adjacent construction; backfilling; pipe embedment; construction of fills and embankments; surfacing and grading; and other appurtenant work.

2B.2 SHEETING AND SHORING. The stability of previously constructed structures and facilities shall not be impaired or endangered by excavation work. Previously constructed structures and facilities include both structures and facilities existing when this construction began and structures and facilities already provided under these specifications.

Hazardous and dangerous conditions shall be prevented and the safety of personnel shall be maintained. Adequate sheeting and shoring shall be provided as required to protect and maintain the stability of previously constructed structures and facilities and the sides of excavations and trenches until they are backfilled. Sheeting, bracing, and shoring shall be designed and built to withstand all loads that might be caused by earth movement or pressure, and shall be rigid, maintaining shape and position under all circumstances.

2B.3 REMOVAL OF WATER. The Contractor shall provide and maintain adequate dewatering equipment to remove and dispose of all surface and ground water entering excavations and other parts of the work. Each excavation shall be kept dry during subgrade preparation and continually thereafter until the construction to be provided therein is completed to the extent that no damage from hydrostatic pressure, flotation, or other cause will result. Ground water level shall be maintained at least 12 inches below the bottom of each excavation.

2B.4 BLASTING. No blasting or other use of explosives for excavation will be permitted.

2B.5 CLASSIFICATION OF EARTH MATERIALS. No classification of excavated materials will be made except for identification purposes. Excavation work shall include the removal and subsequent handling of all materials excavated or otherwise removed in performance of the contract work, regardless of the type, character, composition, or condition thereof.

Soil identification shall be in accordance with Table 1 of the Unified Soil Classification System which is bound herewith at the end of this section. Identification and classification shall be based upon visual examination and simple manual tests performed by qualified personnel furnished by the Contractor.

* Refer to Item 6 of Contractor's letter dated September 23, 1977.

2B.6 FREEZING WEATHER RESTRICTIONS. Backfilling and construction of fills and embankments during freezing weather shall not be done except by permission of the Company. No earth material shall be placed on frozen surfaces, nor shall frozen materials, snow, or ice be placed in any backfill, fill, or embankment.

2B.7 MAINTENANCE OF TRAFFIC. The Contractor shall conduct his work so as to interfere as little as possible with the Company's operations. Whenever it is necessary to cross, obstruct, or close roads, driveways, parking areas, and walks, the Contractor shall provide and maintain suitable and safe bridges, detours, or other temporary expedients at his own expense. Construction adjacent to traffic areas shall be provided with adequate warning devices.

2B.8 PROTECTION OF UNDERGROUND AND ABOVE GROUND CONSTRUCTION. The Contractor shall locate, protect, shore, brace, support, and maintain all existing underground pipes, conduits, drains, and other underground and above ground construction which may be uncovered or otherwise be affected by the work.

2B.9 UNAUTHORIZED EXCAVATION. Except where otherwise authorized, indicated, or specified, all material excavated below the bottom of concrete structures which will be supported by the subgrade shall be replaced with concrete placed monolithic with the concrete above.

2B.10 STABILIZATION. Subgrades for structures and the bottom of trenches shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud and muck; and shall be sufficiently stable to remain firm and intact under the feet of the workmen.

Subgrades for structures and trench bottoms which are otherwise solid but which become mucky on top due to construction operations, shall be reinforced with one or more layers of crushed rock or gravel.

The finished elevation of stabilized structure subgrades shall not be above the subgrade elevations indicated on the drawings.

Not more than 1/2 inch depth of mud or muck shall be allowed to remain on stabilized trench bottoms when the pipe embedment material is placed thereon.

All stabilization work shall be performed by and at the expense of the Contractor.

2B.11 TESTING. All field and laboratory testing required to determine compliance with the requirements of this section shall be provided by the Contractor. All laboratory testing shall be done by an independent testing laboratory acceptable to the Engineer and retained and paid by the Contractor. Field sampling shall be done by the testing laboratory or by a qualified employee of the Contractor.

At least one field density determination will be required for each 1000 cubic yards of compacted material. Field samples shall be taken at locations selected by the Company. If additional field control tests are necessary, in the opinion of the Company, such tests shall be made.

Maximum density for cohesive compacted materials placed under this section shall be determined in accordance with ASTM D698. The terms "maximum density" and "optimum moisture content" shall be as defined in ASTM D698.

Relative density for noncohesive compacted materials placed under this section shall be determined in accordance with ASTM D2049. The term "relative density" shall be as defined in ASTM D2049.

The following tests will be required for the trenching work:

> Two gradation tests for each type of granular embedment or backfill material
>
> Two tests for laboratory density (ASTM D698 or ASTM D2049) for each type of embedment or backfill material proposed
>
> In-place field density tests at average intervals of one test per 100 feet of trench

A copy of each test result shall be promptly furnished to the Company and the Engineer.

2B.12 SITE PREPARATION. Ground surfaces within the construction areas shall be cleared of all trees, brush, debris, and surface vegetation. Stumps and roots larger than 2 inches in diameter shall be completely grubbed and removed. Matted roots shall be removed regardless of size. Surface vegetation shall be removed complete with roots to a depth of not less than 6 inches below the ground surface.

All combustible and other waste materials shall be removed from the construction areas and disposed of by and at the expense of the Contractor. Open burning is not permitted at the site.

2B.13 ROADWAY ROADBEDS. Roadway roadbed construction shall include excavation and subgrade preparation, and fills and embankments where required. Fills and embankments shall be constructed as specified hereinafter. In excavated roadbed areas, overburden shall be removed and the subgrade shall be shaped to line, grade and cross section, and compacted to a depth of at least 6 inches to 95 per cent of maximum density at optimum moisture content as determined by ASTM D698 when that test is appropriate, or to 70 per cent relative density as determined by ASTM D2049 when that test is appropriate. This operation shall include any scarifying, reshaping, and wetting required to obtain proper compaction. Soft, organic, and otherwise unsuitable material shall be removed from the subgrade and replaced with suitable material.

All material in the upper 30 inches of the subgrade in both cut and fill sections, shall be material with compaction characteristics equal to or better than inorganic clays of low to medium plasticity. This material shall be classified as Group CL or ML as indicated on the Unified Soil Classification chart bound herein at the end of this section.

The subgrade shall be compacted and finished to a true surface and no depression shall be left that will hold water or prevent proper drainage. The subgrade shall be finished to within 0.1 of a foot of the elevation indicated on the drawings. Any deviation of the subgrade surface in excess of one inch as indicated by a 16 foot straightedge, or template cut to typical section, shall be corrected by loosening, adding or removing material, reshaping, and recompacting.

Ditches and drains along the subgrade shall be maintained as required for effective drainage. Whenever ruts of 2 inches or more in depth are formed, the subgrade shall be brought to grade, reshaped, and recompacted. Storage or stockpiling of materials on the subgrade will not be permitted.

Roadway subgrades shall be maintained throughout the work under these specifications. Roadway surfacing is covered in Section 2D.

* 2B.14 FILLS, EMBANKMENTS, AND BERMS. To the maximum extent available, suitable earth materials obtained from excavation shall be used for the construction of fills, embankments, and berms. Additional material shall be obtained from borrow pits as necessary. After preparation of the fill, embankment, or berm site, the subgrade shall be scarified, leveled, and rolled so that surface materials of the subgrade will be compact and well bonded with the first layer of the fill, embankment, or berm. All material deposited in fills, embankments, and berms shall be free from rocks or stones, brush, stumps, logs, roots, debris and organic or other objectionable materials. Fills, embankments, and berms shall be constructed in horizontal layers not exceeding 8 inches in uncompacted thickness. Material deposited in piles or windrows by excavating and hauling equipment shall be spread and leveled prior to compaction.

All material in the upper 30 inches of the subgrade in both cut and fill sections, shall be material with compaction characteristics equal to or better than inorganic clays of low to medium plasticity. This material shall be classified as Group CL or ML as indicated on the Unified Soil Classification chart bound herein at the end of this section.

* Refer to Item 3 of the Basis of Contract Award.

Materials used in the construction of berms and roadways shall be classified as group CL or ML as indicated on the Unified Soil Classification chart bound herein at the end of this section.

Each layer shall be thoroughly compacted by rolling or other methods acceptable to the Engineer. The compacted density of each layer shall be at least 95 per cent of the maximum density at optimum moisture content as determined by ASTM D698 when that test is appropriate or 70 per cent of relative density as determined by ASTM D2049 when that test is appropriate. If the material fails to meet the density specified, compaction methods shall be modified as required to attain the specified density. The moisture content for ASTM D698 shall be within -1.0 to +3.0 per cent of the optimum moisture content.

2B.14.1 Borrow Areas. Material necessary to complete fills, embankments, and berms shall be excavated from borrow areas and hauled to the fill, * embankment, or berm site. Not all borrow material will be available on the Company's property; it will therefore be necessary for the Contractor to supply additional borrow material from an acceptable source.

2B.15 STRUCTURE EXCAVATION. Excavation for structures shall be done to lines and elevations indicated on the drawings and to the limits required to perform the construction work. Machine excavation shall be controlled to prevent undercutting the proper subgrade elevations and shall not be used within 5 feet of permanent structures and facilities. Only hand tools shall be used for excavation around permanent structures and facilities.

Work shall be done so that the construction areas will be as free as possible from obstructions and from interference with the transportation, storage, or handling of materials. Excavated materials free of trash, rocks, roots, and other foreign materials, and which meet the specified requirements, may be used as required for the fills, embankments, and backfills constructed under these specifications.

Vertical faces of excavations shall not be undercut to provide for extended footings.

2B.16 STRUCTURE BACKFILL. Backfill around and outside of structures shall be deposited in layers not to exceed 6 inches in uncompacted thickness and mechanically compacted, using platform type tampers, to at least 95 per cent of maximum density at optimum moisture content as determined by ASTM D698 when that test is appropriate, or to 70 per cent relative density as determined by ASTM D2049 when that test is appropriate. Compaction of structure backfill by rolling will be permitted provided the desired compaction is obtained and damage to the structure is prevented. Compaction of structure backfill by inundation with water will not be permitted.

* Refer to Item 3 of Addendum 1.

Material for structure backfill shall be composed of earth only and shall contain no wood, grass, roots, broken concrete, stones, trash, or debris of any kind.

No tamped, rolled, or otherwise mechanically compacted backfill shall be deposited or compacted in water.

All backfill material shall consist of loose earth having a moisture content such that the required density of the compacted soil will be obtained with the compaction method used. Moisture content shall be distributed uniformly and water for correction of moisture content shall be added sufficiently in advance so that proper moisture distribution and compaction will be obtained. Granular material shall be wet, not just damp, when compacted.

Particular care shall be taken to compact structure backfill which will be beneath pipes, drives, roads, or other surface construction or structures. In addition, wherever a trench will pass through structure backfill, the structure backfill shall be placed and compacted to an elevation at least 12 inches above the top of the pipe before the trench is excavated.

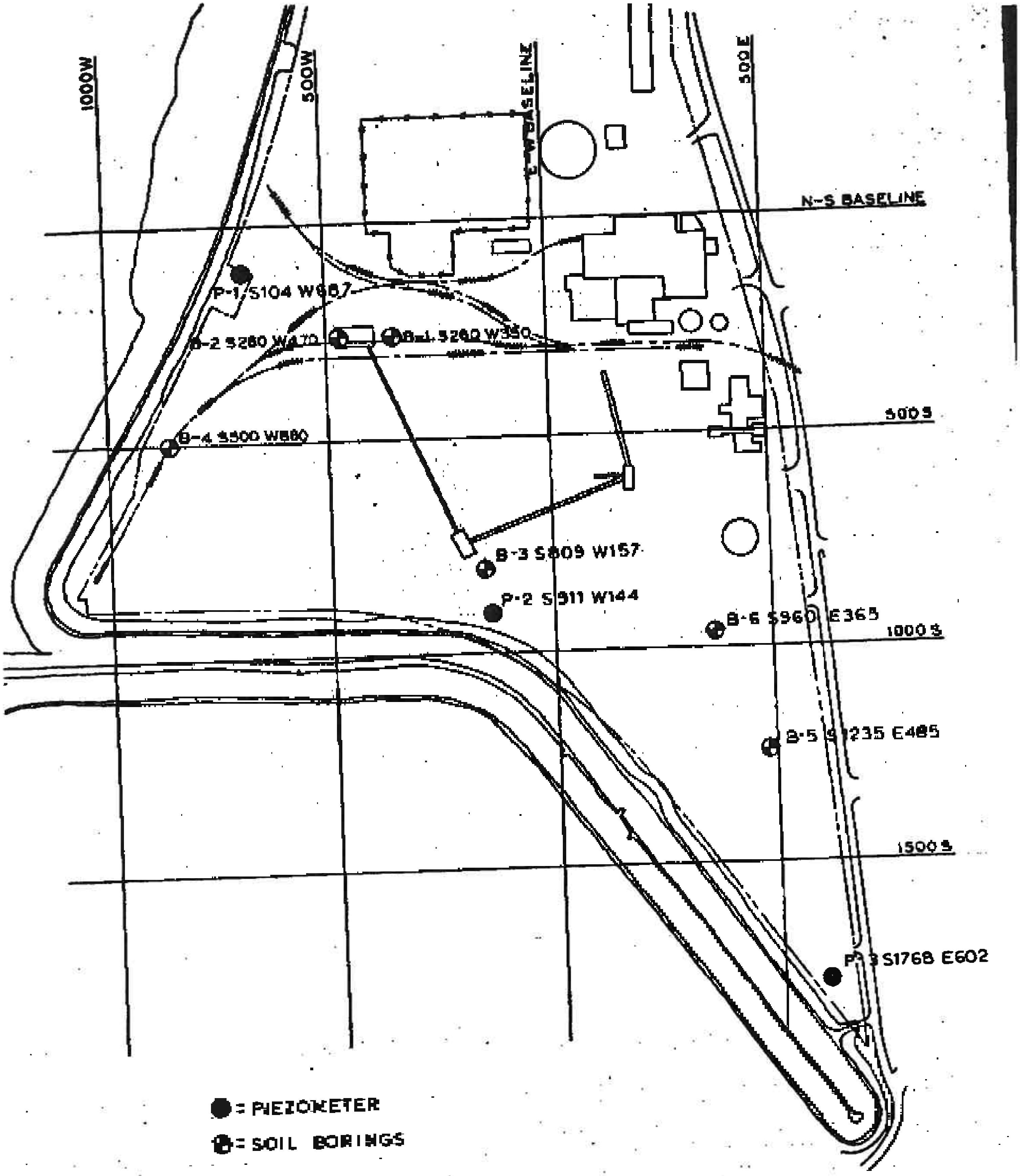
2B.17 PIPE TRENCH EXCAVATION. The Contractor shall not open more trench in advance of pipe laying than is necessary to expedite the work.

2B.17.1 Alignment and Grade. The alignment and grade or elevation of each pipeline shall be fixed and determined by means of batter boards and offset stakes unless otherwise accepted. Vertical and horizontal alignment of pipes, and the maximum joint deflection used in connection therewith, shall be in conformity with requirements of the specification section covering installation of pipe.

2B.17.2 Limiting Trench Widths. Trenches shall be excavated to a width which will provide adequate working space and pipe clearance for proper pipe installation, jointing, and embedment. However, excepting trenches for steel piping and encased piping, the width of trench below an elevation 6 inches above the top of the pipe shall not be more than 18 inches greater than the outside diameter of the pipe unless otherwise indicated on the drawings.

Where necessary to reduce earth load on trench banks to prevent sliding and caving, banks may be cut back on slopes which shall not extend lower than one foot above the top of the pipe.

2B.17.3 Unauthorized Trench Widths. Where, for any reason, the width of the lower portion of the excavated trench exceeds the maximum specified, pipe of adequate strength, special pipe embedment, or arch concrete encasement, as required by loading conditions and as determined by the Engineer, shall be furnished and installed by and at the expense of the Contractor.



SOIL BORING LOCATION DIAGRAM
ST. JOSEPH LIGHT & POWER COMPANY
ST. JOSEPH, MO.

SOIL TESTING SERVICES
OF IOWA, INC.

1=300	D.J.W.	675501	2-5-75

SOIL TESTING SERVICES OF IOWA, INC.

LABORATORY PERMEABILITY TEST DATA

Project: St. Joseph Light and Power Company STSI #675501

Boring	Sample	Depth	Description	Moisture Content	Dry Density	Permeability
5	4	6.5'-8.5'	Gray (Varved) Silty Clay	31.5%	88 pcf	6.0×10^{-8} cm/se
6	4	7.0'-8.5'	Brown-Gray Fine Sand-Trace to Some Silt	11.6%	114 pcf	7.3×10^{-2} cm/se

LOG OF BORING NO. 5

OWNER: ST. JOSEPH LIGHT & POWER COMPANY	ARCHITECT-ENGINEER: BLACK & VEATCH
SITE: LAKE ROAD PLANT, ST. JOSEPH, MO.	PROJECT NAME: COAL FACILITIES

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs/ft.^{2}	Water Content-%	Dry Density-lbs/ft.^{3}	Unified Class. Symbol
	WB							
1	SS	18	18	18	*5000			
2	3" ST	24	14		*5000			
	WB							
3	SS	18	18	11	*2400			CL
4	3" ST	24			*4000			CL
	WB							
5	SS	18	18	5	*1600			CL
6	ST	24	14		*2000			CL / SM
	WB							
7	SS	18	18	3	* 400			CL
	WB							
8	SS	18	18	2/6" 5	* 600			SM / ML
	WB							
9	ST	24						
10	SS	18	18	51				SP
	WB							

*Calibrated Penetrometer

Depth	Elevation	Description
		Surface Elevation 810.0
		6" Gray Brown Sandy Silt
		POSSIBLE FILL - SILTY CLAY - TRACE SAND AND ORGANICS WITH GLASS, Gray-Brown
5	805.0	(5.0)
		SILTY CLAY - TRACE SAND, Gray, Stiff to Tough
	797.9	(12.1)
		SILTY FINE SAND, Gray
15	794.8	(15.2)
		CLAYEY SILT, Gray, Soft
	793.8	(16.2)
		SILTY FINE SAND, Gray, Loose
20	789.5	(20.5)
		SANDY SILT - TRACE CLAY, Gray, Loose
25	784.9	(25.1)
		FINE SAND - TRACE SILT, Gray, Medium Dense to Dense
30	780.0	(30.0)

Continued on Sheet #2

WATER LEVEL OBSERVATIONS

W.L.	14.0'	W.S. OR W.D.	
W.L.		B.C.R.	A.C.R.
W.L.	12.0' A.B.		

SOIL TESTING SERVICES of IOWA, INC.

Cedar Rapids, Davenport, Iowa City, Des Moines

BORING STARTED 1/9/75	
BORING COMPLETED 1/9/75	
RIG CME #3	FOREMAN DAP
DRAWN RGG	APPROVED GBO
JOB # 675501	SHEET 1 of 2

LOG OF BORING NO. 5 (Continued)

OWNER	ARCHITECT-ENGINEER
ST. JOSEPH LIGHT & POWER COMPANY	BLACK & VEATCH
SITE	**PROJECT NAME**
LAKE ROAD PLANT, ST. JOSEPH, MO.	COAL FACILITIES

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.²	Water Content-%	Dry Density-lbs./ft.³	Unified Class. Symbol	Depth	Elevation	Description Surface Elevation 810.0
									30	780.0	(30.0) Continued from Sheet #1
11	SS	18	18	9 10 18 28				SP			FINE SAND - TRACE SILT, Gray, Medium Dense to Dense
	WB										
									35		
12	SS	18	18	[illegible] 35				SP		773.5	(36.5)
											Bottom of Boring
									40		

WATER LEVEL OBSERVATIONS			
W.L.	14.0'	W.S. OR W.D.	
W.L.	B.C.R.	A.C.R.	
W.L.	12.0' A.B.		

SOIL TESTING SERVICES of IOWA, INC.
Cedar Rapids · Davenport · Iowa City · Des Moines

BORING STARTED 1/9/75	
BORING COMPLETED 1/9/75	
RIG CME #3	FOREMAN DAP
DRAWN RGG	APPROVED GRD
JOB # 675501	SHEET 2 of 2

LOG OF BORING NO. 6

OWNER	ARCHITECT-ENGINEER
ST. JOSEPH LIGHT & POWER COMPANY	BLACK & VEATCH
SITE	**PROJECT NAME**
LAKE ROAD PLANT, ST. JOSEPH, MO.	COAL FACILITIES

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.²	Water Content-%	Dry Density-lbs./ft.³	Unified Class. Symbol	Depth	Elevation	Description
											Surface Elevation 809.8
	PA										9" Dark Brown Sandy Clayey Silt
1	SS	18	18	3 4 7	*2000			CL			
2	3" ST	24	20		*3000			CL			**SILTY CLAY - TRACE SAND,** Gray and Brown, Tough
	PA								5		
3	SS	18	18	3 3 4 7	*2000			CL		803.3	(6.5)
4	3" ST	24						SM			
	PA								10		
5	SS	18	18	2 4 4 8				SM			**SILTY FINE SAND,** Gray and Brown, Loose to Dense
	PA								15		
6	SS	18	18	7 14 18 32				SM		792.8	(17.0)
	PA								20		
7	SS	18	18	[illegible] 20 23 43				SP			**FINE TO MEDIUM SAND - TRACE SILT,** Brown, Medium Dense to Dense
	PA								25		
8	SS	18	18	[illegible] 14 14 28				SP			
	PA								30		
9	SS	18	18	12 17 19 36				SP		778.3	(31.5)
	*Calibrated Penetrometer										Bottom of Boring

WATER LEVEL OBSERVATIONS			
W.L.	9.0'	W.S. OR W.D.	
W.L.	B.C.R.	A.C.R.	
W.L.	9.0' A.B.		

SOIL TESTING SERVICES of IOWA, INC.
Cedar Rapids, Davenport, Iowa City, Des Moines

BORING STARTED	1/10/75		
BORING COMPLETED	1/10/75		
RIG	CME #3	FOREMAN	DAP
DRAWN	RGG	APPROVED	GRO
JOB #	675501	SHEET	1 of 1

From the office of

KANSAS CITY TESTING LABORATORY
1669 JEFFERSON
P. O. BOX 8586
A.C. 913-648-2303
KANSAS CITY, MISSOURI 64114

November 7, 1977

Garney Industrial and Environmental
1331 Northwest Vivion Road
Kansas City, Missouri 64118

Reference: St. Joseph Power & Light
Proctor delivered: 10-24-77
K.C.T.L. No.: 3742

REPORT OF PROCTOR DATA

DESCRIPTION: Dark gray silty clay

LOCATION: Jobsite - From Northwest corner of Ash Pond

MOISTURE DENSITY RELATIONSHIP: ASTM D-698

OPTIMUM MOISTURE: 27.1%

MAXIMUM UNIT DRY WEIGHT: 92.1 lbs./cu.ft.^{3}

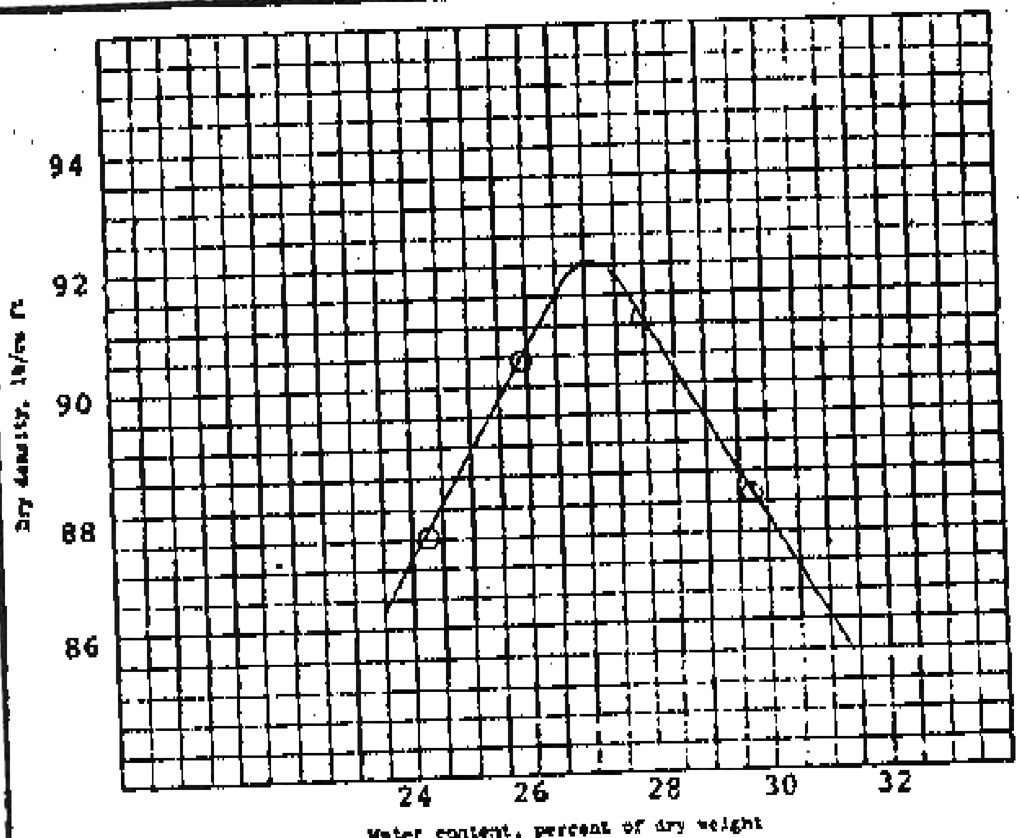
Thank you for your continued interest in Kansas City Testing Laboratory.

Respectfully submitted,
KANSAS CITY TESTING LABORATORY, INC.

Diana D. Long

DDL/bn

KANSAS CITY TESTING LABORATORY



ASTM D-698 compaction test

25 blows per each of 3 layers, with 5.5 lb rammer and

12 inch drop. 4 inch diameter mold

Sample No.	Elev or Depth	Classification	G	LL	PL	% > No. 4	% > 3/4 in.

Sample No.	3742		
Natural water content, percent	37.3		
Optimum water content, percent	27.1		
Max dry density, lb/cu ft	92.1		

Remarks DARK GRAY SILTY CLAY

Project ST. JOSEPH POWER & LIGHT
GARNEY CONSTRUCTION

Area JOBSITE

Boring No.

Date 10-24-77

COMPACTION TEST REPORT

From the office of

KANSAS CITY TESTING LABORATORY

1669 JEFFERSON
P. O. BOX 8586
A.C. 913—648-2303
KANSAS CITY, MISSOURI 64114

November 7, 1977

Garney Industrial and Environmental
1331 Northwest Vivion Road
Kansas City, Missouri 64118

Reference: St. Joseph Power & Light
Proctor delivered: 10-24-77
K.C.T.L. No.: 3743

REPORT OF PROCTOR DATA

DESCRIPTION: Brown, very silty clay

LOCATION: Jobsite - From borrow pit east of King Hill Road & Russell Street

MOISTURE DENSITY RELATIONSHIP: ASTM D-698

OPTIMUM MOISTURE: 15.7%

MAXIMUM UNIT DRY WEIGHT: 106.8 lbs./cu.ft.[3]

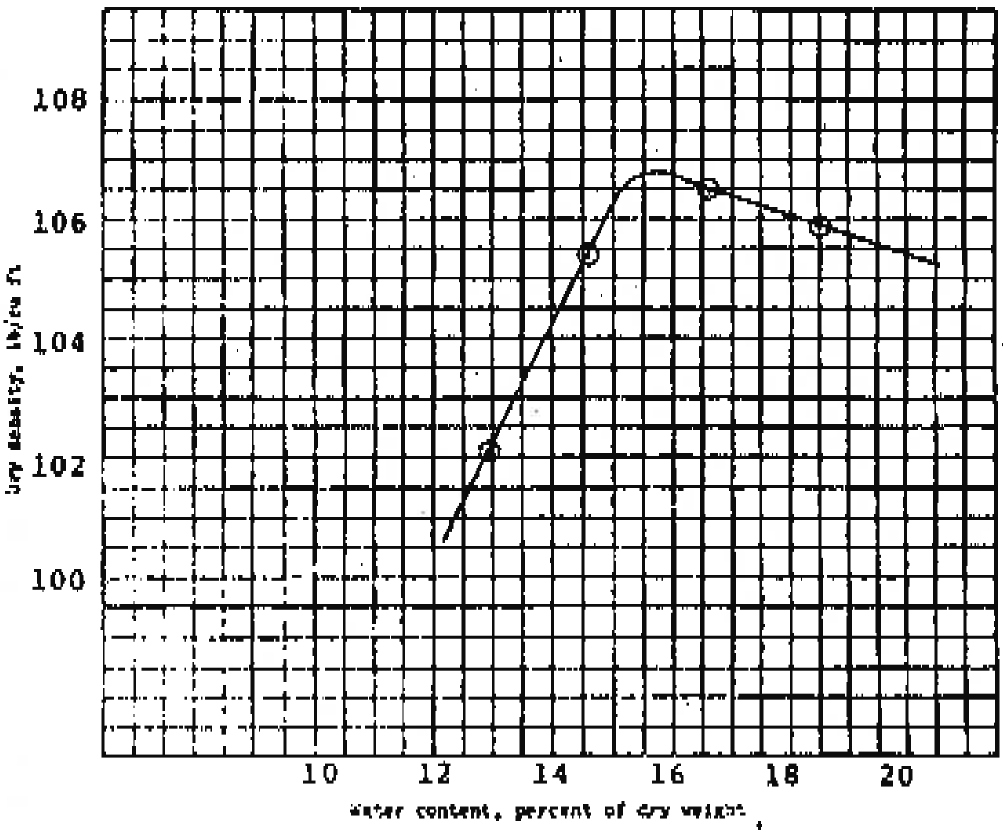
Thank you for your continued interest in Kansas City Testing Laboratory.

Respectfully submitted,
KANSAS CITY TESTING LABORATORY, INC.

Diana D. Long

DDL/bh

KANSAS CITY TESTING LABORATORY



ASTM D-698 compaction test

25 blows per each of 3 layers, with 5.5 lb rammer and

12 inch drop. 4 inch diameter mold

Sample No.	Elev or Depth	Classification	G	LL	PL	% > No. 4	% > 3/4 in.

Sample No.	3743			
Natural water content, percent	25.5			
Optimum water content, percent	15.7			
Max dry density, lb/cu ft	106.8			

Remarks BROWN, VERY SILTY CLAY

Project ST. JOSEPH POWER & LIGHT
GARNEY CONSTRUCTION

Area JOBSITE

Boring No. Date 10-24-77

COMPACTION TEST REPORT

BLACK & VEATCH

CONSULTING ENGINEERS

TEL (913) 967-2000
TELEX 42-6263

1500 MEADOW LAKE PARKWAY
MAILING ADDRESS: P.O. BOX NO. 8405
KANSAS CITY, MISSOURI 64114

Client: St. Joseph Light & Power Company
Project: Ash Storage General Construction
Spec No: 324.00000
Mfg Ref:

Date: June 29, 1978
B&V Proj No: 6791
B&V File No: 32.00030.46

To: Garcey Industrial Environmental
1331 N. W. Vivion Road
Kansas City, Missouri 64118

Attention: Mr. Phil Sutton

(1) each of the following submittals forwarded with your transmittal dated June 12, 1978 are enclosed. We have indicated the action required.

VENDOR DWG. NO.	REV.	B&V DWG. NO.	TITLE OR DESCRIPTION	ACTION	COPIES
1491	-	6791 324.00000-17	Nuclear Density Results	RD	0

Please forward the indicated number of revised or additional copies by ---------. If copies cannot be forwarded by this date please advise when we may expect receipt.

Enclosure
cc: (2) Mr. R. A. Sullwold, w/3 prints

Very truly yours,

BLACK & VEATCH

By Dale F. Woltman by RLW

Dale F. Woltman

imm

ACTION CODE
NE - No Exceptions Noted
EN - Exceptions Noted
RD - Received for Distribution
RC - Returned for Correction

P-GN-043-B

B&V 6791 324.00000-12

From the office of

KANSAS CITY TESTING LABORATORY

1650 JEFFERSON
P. O. BOX 8595
A.C. 913—648-2303
KANSAS CITY, MISSOURI 64114

June 7, 1978

Garney Companies
1331 Northwest Vivion Road
Kansas City, Missouri 64118

Attention: Mr. Glen Masterson

Reference: St Joseph Light & Power

REPORT OF TEST RESULTS

Nuclear Density Results
Date Sampled: 6-5-78
KCTL No.: 1491

KCTL NO.	LOCATION	FIELD DRY WT.	FIELD MOISTURE	% DENSITY
1491-A	East Burme	95.0	22.2	103.6
B	West Burme	92.8	25.0	100.6
C	North Burme	97.3	19.0	107.0
D	South Burme	95.3	22.6	103.2

Maximum Density: 92.1
Optimum Moisture: 27.1

Thank you for your continued interest in Kansas City Testing Laboratory.

Respectfully submitted
KANSAS CITY TESTING LABORATORY, INC.

Donald C. Sesso, P.E.

DCS/st

cc: Black & Veatch
Richard Sulbuold

RECEIVED FOR DISTRIBUTION
JUN 29 1978
BLACK & VEATCH

Phil S.

25-year, 24-hour storm calculations

Volume Calculations
25-year, 24-hour rainfall data obtained using NCRS's TR-55, "Small Watershed Hydrology" Ver. 1.00.08.

The 25-year, 24-hour rainfall amount for Buchanan County, Missouri is 6.0 inches.

Rain fall volumes were with the conservative run off coefficient of 0.9

Ash Pond
Rainfall Volume = 0.90 x 0.5 feet x 2.12 acres = 0.95 acre-feet

Settling Basin
Rainfall Volume = 0.90 x 0.5 feet x 0.78 acres = 0.35 acre-feet

Flow Rate Calculations
25-year, 24-hour rainfall intensity data obtained American Public Works (APWA) Kansas City Metro Standards and Specifications, Section 5600 – Storm Drainage and Facilities

The Rainfall Intensity Equation for the 25-year storm with a time of concentration greater than or equal to 5 minutes and less than or equal to 15 minutes is:

$$i = \frac{203}{T_c + 18.8}$$

where: i = rainfall intensity (inches /hour)
T_c = time of concentration (minutes)

The time of concentration used in these calculations is 5 minutes.

i = (203/(5+18.8)) = 8.53 inches / hour

The Rational Formula was used to calculate the maximum peak flow.

Q=CiA

where: Q = flow rate (cfs)
C= runoff coefficient (unitless)
i = rainfall intensity (inches per hour)
A = drainage area (acres)

Ash Pond
Rainfall Volume = 0.90 x 8.53 in/hr x 2.12 acres = 16.3 cfs

Settling Basin
Rainfall Volume = 0.90 x 8.53 in/hr x 0.78 acres = 5.99 cfs

Development of Ash Pond and Stilling Basin Storage Areas

Ash Pond Stage-Storage Table					
Elevation (ft)	Area (ft²)	Ave. Area (ft²)	Σ Vol. (ft³)	Σ Vol. (Ac-ft)	Notes
806	49,569	0	0	0.00	
807	51,790	50,680	50,680	1.16	
807.96	53,965	52,877	101,593	2.33	Maximum plant + 25-year storage
808	54,049	54,007	103,599	2.38	
808.72	55,698	54,874	142,957	3.28	Maximum plant storage
809	56,348	56,023	158,798	3.65	
810	58,686	57,517	216,315	4.97	
811	61,063	59,875	276,189	6.34	
811.35	61,920	61,492	297,987	6.84	Average plant flow + 25-year storm storage
812	63,480	62,700	338,461	7.77	
812.02	63,525	63,502	339,624	7.80	Average plant flow storage
813	65,936	64,730	403,169	9.26	
814	68,431	67,183	470,352	10.80	
814.92	70,768	69,599	534,529	12.27	25-year storm storage
815	70,965	70,867	540,050	12.40	
815.50	72,252	71,609	575,855	13.22	0.5 feet freeboard - Max. operating level
816	73,539	72,896	612,303	14.06	Top of dike

Stilling Basin Stage-Storage Table					
Elevation (ft)	Area (ft²)	Ave. Area (ft²)	Σ Vol. (ft³)	Σ Vol. (Ac-ft)	Notes
806	18,203	0	0	0.00	
807	19,660	18,932	18,932	0.43	
808	21,156	20,408	39,340	0.90	
809	22,691	21,924	61,263	1.41	
810	24,266	23,479	84,742	1.95	
811	25,880	25,073	109,815	2.52	
811.50	26,707	26,293	122,962	2.82	0.5 feet freeboard - Max. operating level
812	27,533	27,120	136,522	3.13	Top of dike

Hydrology and Hydraulic Calculations
Project: Geotechnical Evaluation
Ash Pond – GMO Lake Road Generating Station
Development of Flood Inundation Area Elevation

Calculations By: T. Bond Date: 2/8/11
Checked By: AP Date: 2-8-11

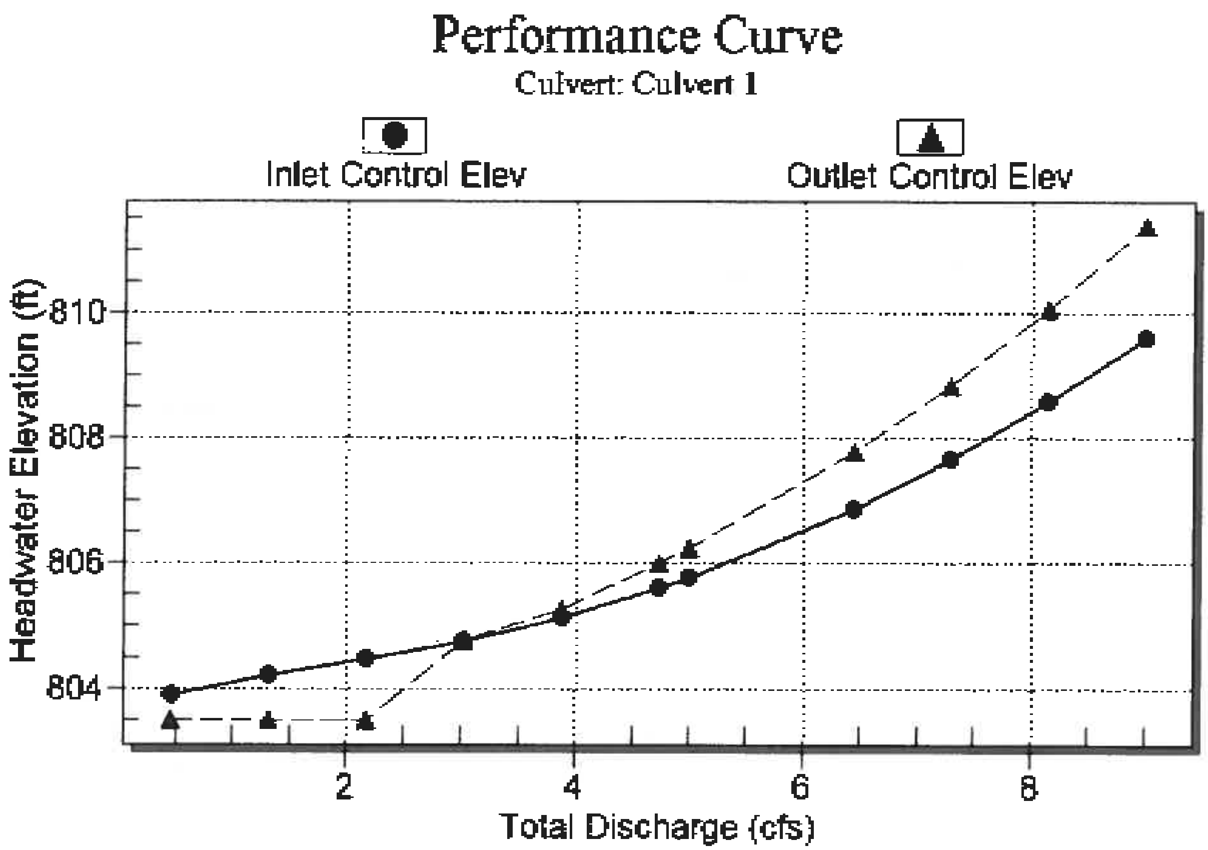
Combined Basin and Overland Flood Area Stage-Storage Table							
Elevation	Ash Pond (ft^3)	Stilling Basin (ft^3)	Overflow Area (ft^3)	Combined (ft^3)	∑ Vol. (ft^3)	∑ Vol. (Ac-ft)	Notes
801	-	-	-	-	-	0.00	
802	-	-	141	141	141	0.00	
803	-	-	607	607	748	0.02	
804	-	-	5,521	5,521	6,269	0.14	
805	-	-	11,537	11,537	17,805	0.41	
806	-	-	14,937	14,937	32,742	0.75	
807	50,680	18,932	18,663	88,274	121,016	2.78	
808	52,919	20,408	25,109	98,436	219,453	5.04	
809	55,199	21,924	41,794	118,916	338,368	7.77	
810	57,517	23,479	134,970	215,965	554,334	12.73	
810.52	58,739	24,305	215,457	298,501	748,796	17.19	Calculated inundation area elevation
811	59,875	25,073	290,271	375,218	929,552	21.34	
812	62,272	26,707		88,978	1,018,530	23.38	
813	64,708	-		64,708	1,083,238	24.87	
814	67,183	-		67,183	1,150,421	26.41	
815	69,698	-		69,698	1,220,119	28.01	
816	72,252	-		72,252	1,292,372	29.67	

HY-8 Analysis Results

Culvert Summary Table - Culvert 1

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth(ft)	Outlet Control Depth(ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.46	0.46	803.88	0.38	0.00	1-S2n	0.26	0.28	0.26	0.05	2.80	0.94
1.31	1.31	804.21	0.71	0.00	1-S2n	0.46	0.48	0.46	0.09	3.74	1.41
2.17	2.17	804.47	0.97	0.00	1-S2n	0.62	0.63	0.62	0.12	4.21	1.71
3.02	3.02	804.77	1.26	1.27	2-M2c	0.81	0.74	0.74	0.15	4.82	1.94
3.88	3.88	805.28	1.63	1.78	7-M2c	1.00	0.83	0.83	0.18	5.54	2.13
4.73	4.73	806.00	2.10	2.50	7-M2c	1.00	0.90	0.90	0.20	6.34	2.30
5.00	5.00	806.24	2.27	2.74	7-M2c	1.00	0.92	0.92	0.20	6.56	2.35
6.44	6.44	807.78	3.36	4.28	6-FFc	1.00	1.00	1.00	0.24	8.20	2.59
7.29	7.29	808.85	4.17	5.35	6-FFc	1.00	1.00	1.00	0.26	9.28	2.71
8.15	8.15	810.05	5.08	6.55	6-FFc	1.00	1.00	1.00	0.27	10.37	2.83
9.00	9.00	811.38	6.09	7.88	6-FFc	1.00	1.00	1.00	0.29	11.46	2.94

Culvert Crossing: 802.5


Performance Curve
Culvert: Culvert 1
Inlet Control Elev
Outlet Control Elev
Headwater Elevation (ft)
810
808
806
804
2
4
6
8
Total Discharge (cfs)